US DEPARTMENT OF ENERGY SOLAR DECATHLON 2013

STANFORD UNIVERSITY

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AS-BUILT CONSTRUCTION DOCUMENTATION

PROJECT MANUAL

August 22, 2013

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SUMMARY OF CHANGES

- Due to manufacturer availability, Stion STN-150 Panels were changed to STN-135
- Due to change in panels, inverter was changed to SMA SB6000TL-12
- Smoke alarm added per IRC requirements
- Numerous changes made to QTO and final materials (highlighted in green in QTO)
    - Trellis and awning specified as dimensioned redwood
    - Exterior wooden doors and glass door products changed
    - Exterior plywood rolling door changed from custom fabricated metal door
    - Removed interior door between office and great room
    - Hot bituminous roof changed to PVC Sarnafil
    - Lineoleum floor added to mechanical room in place of concrete base
    - LED Light fixtures were changed
- Addenda to structural calculations were added.
- Interconnection form updated to reflect changes in Panel and Inverter schedules.
- DC Disconnect and Combiner box removed from electrical line from PV; inverter chosen to have hard DC disconnect and fuse
- Several items removed from design of house—these are denoted in red on the QTO for the most part.
    - Deck skirts and benches eliminated
    - Graywater pipe eliminated
    - Grab bar eliminated in shower
    - Living room shelving eliminated; free standing casework not built-in to be used everywhere
    - One closet removed from office space
- RFI's for Structural Engineering issues during construction included in Structural Calculations. Drawings and calculations as approved by signing engineer included.

RULES COMPLIANCE CHECKLIST

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101
Rule 4-2	Construction Equipment	Specifications for heavy machinery	01 54 19
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-101
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	S-101, Structural Calculations
Rule 4-5	Generators	Specifications for generators (including sound rating)	N/A
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	H-101, P-SERIES
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	07 62 13, 11 31 00 21 13 13, 22 11 16 22 11 23, 22 12 19 22 13 16, 22 13 29, 22 13 36, 22 33 30, 22 41 00, 22 23 00, 32 84 13,
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	S-501, Structural Calculations
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	S-401, S-501-S-502
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A-201-A212

Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	S-SERIES, Structural Calculations
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-101
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	L-001, L102, P901, P904
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	26 31 00, 48 19 00, 48 19 16
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	N/A
Rule 8-5	Village Grid	Completed interconnection application form	Page 199
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-102, E-104, E201

Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	26 31 00, 48 19 00 48 19 16
Rule 8-5	Village Grid	One-line electrical diagram	E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	Page 199
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	G-103, E201
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	H-101
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	P-101, G-601
Rule 9-2	Team-Provided Liquids	Quantity, specifications , and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	Page 196
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	P102, P904, L102
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	N/A
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	N/A
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	P-101
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	22 12 19
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-101
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	22 12 19
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G102, G-103

STANFORD UNIVERSITY

100% CONSTRUCTION DOCUMENTS

STRUCTURAL CALCULATIONS

FEBRUARY 14, 2013

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Note: All SIP panels are manufactured and produced by R-CONTROL. Wood to wood connections are designed using Simpson Strong-Tie products.

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1.0 GRAVITY TAKEOFF

1.1 ROOF TAKEOFF

CLERESTORY ROOF DEAD LOAD TAKEOFF

MATERIALS	ROOF (psf)	WALL (psf)
PV Panels (34 lbs/cell)	2.0	2.0
Roofing - Shingles	3.0	3.0
Sheathing - 3/4" Plywood	2.2	2.2
Ceiling - 1/2" Gyboard	2.2	2.2
MEP/HVAC/Lighting	3.0	3.0
8-1/4" SIP Roof	3.6	3.6
Miscellaneous	2.0	2.0
	18.0	18.0
Use:	**18**	**18**

Per California Building Code 2010:

Roof Live Load = 20 psf

DECK ROOF DEAD LOAD TAKEOFF

MATERIALS	JOIST (psf)	BEAM (psf)	POST (psf)
Sheathing - 3/4" Plywood	2.2	2.2	2.2
Lighting	1.0	1.0	1.0
2x10 Joists @ 16" O.C.	3.0	3.0	3.0
Beams	-	1.0	1.0
Post	-	-	0.5
Miscellaneous	2.0	2.0	2.0
	8.2	9.2	9.7
Use:	**9**	**10**	**10**

Per California Building Code 2010:

Roof Live Load = 20 psf

1.2 FLOOR TAKEOFF

INTERIOR FLOOR DEAD LOAD TAKEOFF

MATERIALS	FLOOR (psf)	BEAM (psf)	FOOTING (psf)
Flooring - Carpet and Pad	2.0	2.0	2.0
Sheathing - 3/4" Plywood	2.2	2.2	2.2
8-1/4" SIP Floor	3.6	3.6	3.6
Parallam Floor Beams	-	3.0	3.0
Footing	-	-	3.0
Miscellaneous	3.0	3.0	3.0
	10.8	13.8	16.8
Use:	**11**	**14**	**17**

Per Solar Decathlon Building Code 2011:

Floor Live Load = 50 psf

OUTDOOR DECK DEAD LOAD TAKEOFF

MATERIALS	DECK (psf)	JOIST (psf)	BEAM (psf)	FOOTING (psf)
1" Hardwood Deck	4.0	4.0	4.0	4.0
2x8 Joists @ 16" O.C.	-	2.2	2.2	2.2
Parallam Floor Beams	-	-	3.0	3.0
Footing	-	-	-	3.0
Miscellaneous	2.0	2.0	2.0	2.0
	6.0	8.2	11.2	14.2
Use:	**6**	**9**	**12**	**15**

Per Solar Decathlon Building Code 2011:

Floor Live Load = 100 psf

1.3 EXTERIOR WALL TAKEOFF

EXTERIOR WALL DEAD LOAD TAKEOFF

MATERIALS	**WEIGHT (psf)**
Exterior Finish	5.0
4-1/2" SIP Wall	3.2
Interior Finish - 1/2" Gypsum	2.2
Miscellaneous	2.0
	12.4
Use:	**13**

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2.0 GRAVITY SIP DESIGN

2.1 SIP ROOF DESIGN

UNIFORM AREA LOAD

Dead Load = 18 psf
Live Load = 20 psf

Total Load = 38 psf

R-CONTROL LOAD TABLE

Roof/Floor - Transverse Loads - PSF
LOAD DESIGN CHART #3
DOUBLE 2X SPLINE DETAILS SIP-102d and SIP-108

SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)							
		10	12	14	16	18	20	22	24
6-1/2"	L/360	53	40	30	24	19	15		
	L/240	79	59	45	35	28	22		
	L/180	105	79	60	47	37	30		
8-1/4"	L/360	89	65	48	37	28	22		
	L/240	109	91	72	55	42	33		
	L/180	109	91	78	68	57	44		
10-1/4"	L/360	150	111	84	65	51	41	33	27
	L/240	174	145	124	98	77	61	49	40
	L/180	174	145	124	109	97	82	66	54
12-1/4"	L/360	177	148	115	89	70	56	45	37
	L/240	177	148	127	111	99	84	68	55
	L/180	177	148	127	111	99	89	81	74

SIP ROOF SIZE

→ From Load Table

W_{ACTUAL} = 38 psf

W_{ALLOW} = 55 psf

DCR = W_{ACTUAL} / W_{ALLOW} = 0.69 < 1.0 OK

USE 8-1/4" SIP FOR ROOF

2.2 SIP WALL DESIGN

UNIFORM AREA LOAD

Dead Load = 18 psf
Live Load = 20 psf

Total Load = 38 psf

Trib. Width = 8 ft
Total Line Load = 304 plf

R-CONTROL LOAD TABLE

Wall - Uniform Axial Loads - PLF
LOAD DESIGN CHART #2B
DETAIL SIP-101c

SIP THICKNESS	SIP HEIGHT (feet)					
	8	8 WAB[1]	10	12	14	16
4-1/2"	2750	2300	2500	2000		
6-1/2"	4000	2400	3500	3000	2750	2500
8-1/4"	4000	2400	3500	3000	2750	2500
10-1/4"	4000	2400	3500	3000	2750	2500
12-1/4"	4000	2400	3500	3000	2750	2500

SIP WALL SIZE

→ From Load Table

W_{ACTUAL} = 304 plf

W_{ALLOW} = 2500 plf

DCR = W_{ACTUAL} / W_{ALLOW} = 0.12 < 1.0 OK

USE 4-1/2" SIP FOR WALL

2.3 SIP FLOOR DESIGN

UNIFORM AREA LOAD

Dead Load = 11 psf
Live Load = 50 psf

Total Load = 61 psf

R-CONTROL LOAD TABLE

Roof/Floor - Transverse Loads - PSF LOAD DESIGN CHART #3 DOUBLE 2X SPLINE DETAILS SIP-102d and SIP-108									
SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)							
		10	12	14	16	18	20	22	24
6-1/2"	L/360	53	40	30	24	19	15		
	L/240	79	59	45	35	28	22		
	L/180	105	79	60	47	37	30		
8-1/4"	L/360	89	65	48	37	28	22		
	L/240	109	91	72	55	42	33		
	L/180	109	91	78	68	57	44		
10-1/4"	L/360	150	111	84	65	51	41	33	27
	L/240	174	145	124	98	77	61	49	40
	L/180	174	145	124	109	97	82	66	54
12-1/4"	L/360	177	148	115	89	70	56	45	37
	L/240	177	148	127	111	99	84	68	55
	L/180	177	148	127	111	99	89	81	74

SIP FLOOR SIZE

→ From Load Table

W_{ACTUAL} = 61 psf

W_{ALLOW} = 72 psf

DCR = W_{ACTUAL} / W_{ALLOW} = 0.85 < 1.0 OK

USE 8-1/4" SIP FOR FLOOR

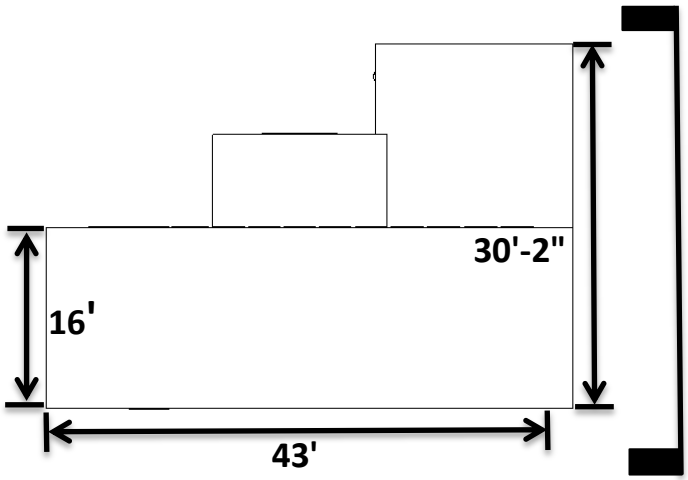
3.0 LATERAL ANALYSIS

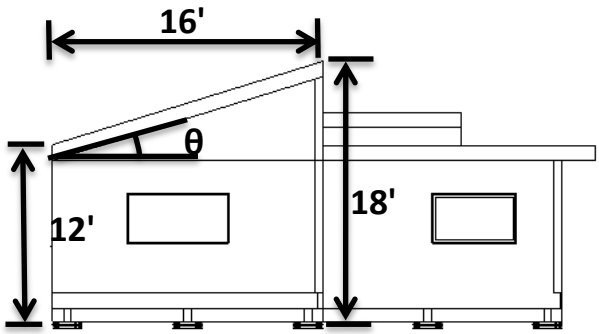
3.1 WIND ANALYSIS

GIVEN BY SOLAR DECATHLON 2012 BUILDING CODE:

Wind Speed, V = 85 mph
Exposure Category C

BUILDING DIMENSIONS:





Mean Roof Height, h = 15 ft
Roof Angle, θ = 20 °

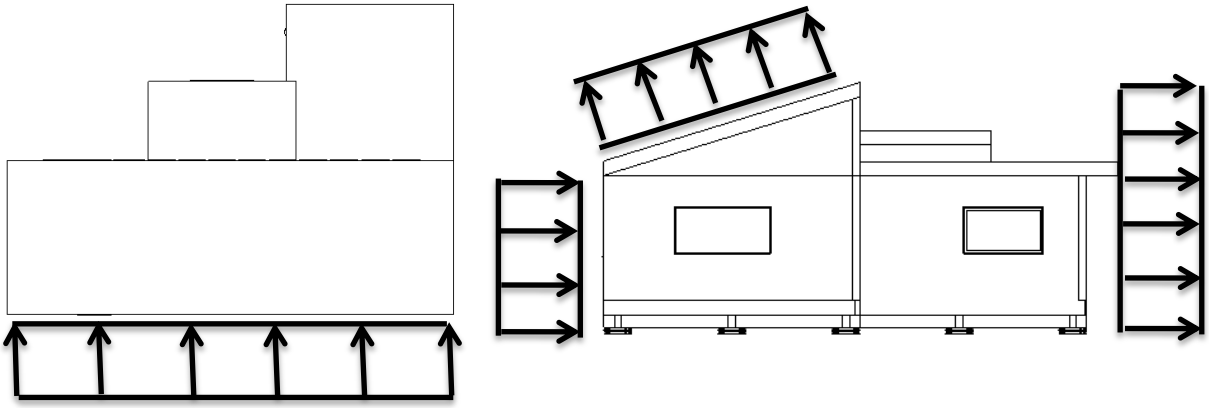
PER ASCE 7-10 DIRECTIONAL PROCEDURE:

Wind Directionality Factor, K_d =	0.85	→ *MWFRS*
Topographic Factor, K_{zt} =	1.0	→ *Flat Site*
Gust Effect Factor, G =	0.85	→ *Rigid Structure*
Internal Pressure Coefficient, GC_{pi} =	0.18	

CALCULATING VELOCITY PRESSURE:

Velocity Pressure Exposure, K_z =	0.85	→ *Height falls within 0-15 ft range*
Velocity Pressure, $q_z = 0.00256K_zK_{zt}K_dV^2$ =	13.4 psf	

MWFRS - SOUTH TO NORTH DIRECTION



→ NEGATIVE INTERNAL PRESSURE CONTROLS

WINDWARD WALL:

External Pressure Coefficient, C_p =	0.8		
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	11.5	psf	
Wall Area, A =	516	sf	
Point Load, P =	5.9	kips	

LEEWARD WALL:

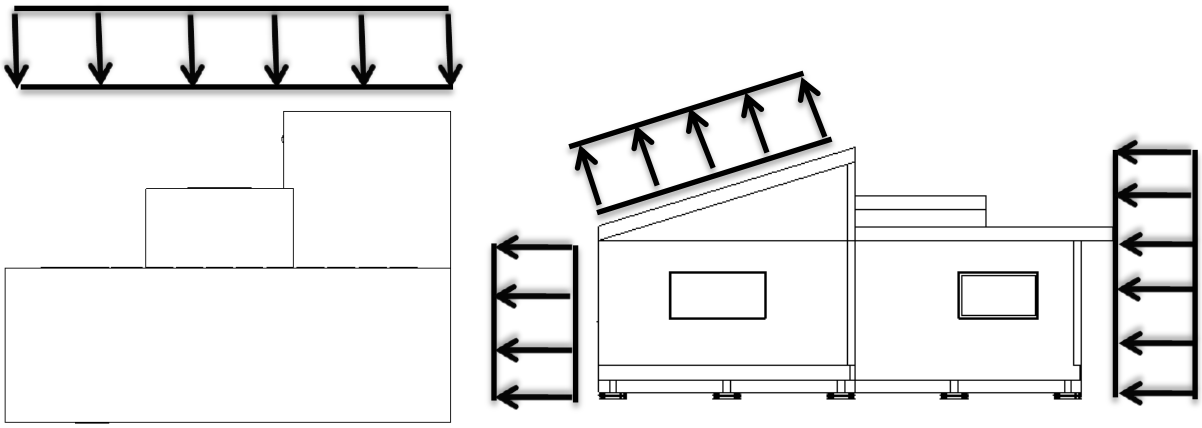
External Pressure Coefficient, C_p =	-0.5		→ *L/B = 30/43<1*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-3.3	psf	
Wall Area, A =	774	sf	
Point Load, P =	-2.5	kips	

WINDWARD ROOF:

External Pressure Coefficient, C_p =	-0.4		→ *h/L = 15/16 < 1.0 and θ = 20˚*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-0.7	psf	→ *Horizontal Direction*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-2.0	psf	→ *Vertical Direction*
Roof Area, A =	765	sf	
Point Load, P =	-0.6	kips	

SOUTH TO NORTH TOTAL FORCE, P = 7.9 kips

MWFRS - NORTH TO SOUTH DIRECTION



→ POSITIVE INTERNAL PRESSURE CONTROLS

WINDWARD WALL:

External Pressure Coefficient, C_p =	0.8	
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	6.7	psf
Wall Area, A =	774	sf
Point Load, P =	5.2	kips

LEEWARD WALL:

External Pressure Coefficient, C_p =	-0.5		→ *L/B = 30/43<1*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-8.1	psf	
Wall Area, A =	516	sf	
Point Load, P =	-4.2	kips	

WINDWARD ROOF:

External Pressure Coefficient, C_p =	-0.6		→ *h/L = 15/16 < 1.0 and θ = 20˚*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-3.2	psf	→ *Horizontal Direction*
Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ =	-8.7	psf	→ *Vertical Direction*
Roof Area, A =	765	sf	
Point Load, P =	-2.4	kips	

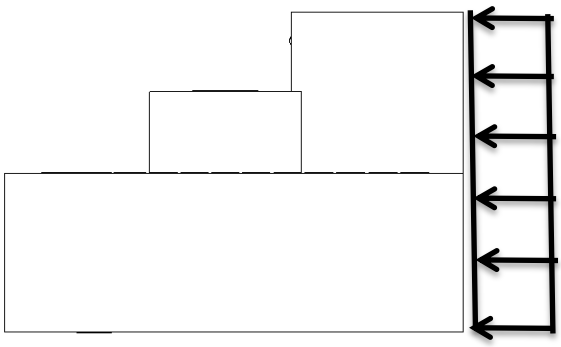
NORTH TO SOUTH TOTAL FORCE, P = 11.8 kips → *Controls North-South Direction*

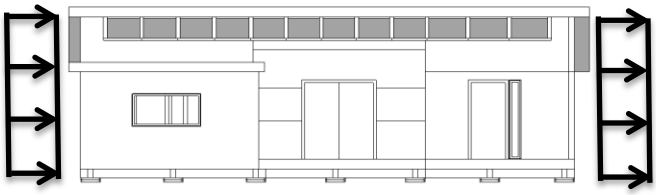
Calc: Wind Loads

By: Curtis Wong

Date: 01/22/2013

MWFRS - EAST TO WEST DIRECTIPON





→ POSITIVE INTERNAL PRESSURE CONTROLS

WINDWARD WALL:

External Pressure Coefficient, C_p = 0.8

Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ = 6.7 psf

Wall Area, A = 403 sf

Point Load, P = 2.7 kips

LEEWARD WALL:

External Pressure Coefficient, C_p = -0.4 → *L/B = 43/30 = 1.4*

Design Wind Pressure, $p=qGC_p-q_i(GC_{pi})$ = -6.9 psf

Wall Area, A = 403 sf

Point Load, P = -2.8 kips

EAST-WEST TOTAL FORCE, P = 5.5 kips

3.2 SEISMIC WEIGHT

ROOF

Clerestory Area =	765	sf	Bedroom Area =	275	sf	Core Area =	173	sf
Clerestory DL =	18	psf	Bedroom DL =	16	psf	Core DL =	16	psf
Deck Area =	507	sf						
Deck DL =	10	psf						
Total Roof Weight =	26	kips						

EXTERIOR WALLS

Wall Length =	147	ft	Average Wall Height =	11	ft
Wall Area =	1617	sf			
Wall DL =	13	psf			
Total Wall Weight =	21	kips			

FLOOR

Interior Area =	1000	sf	Deck Area =	515	sf
Floor DL =	17	psf	Deck DL =	12	psf
Total Floor Weight =	23	kips			

TOTAL

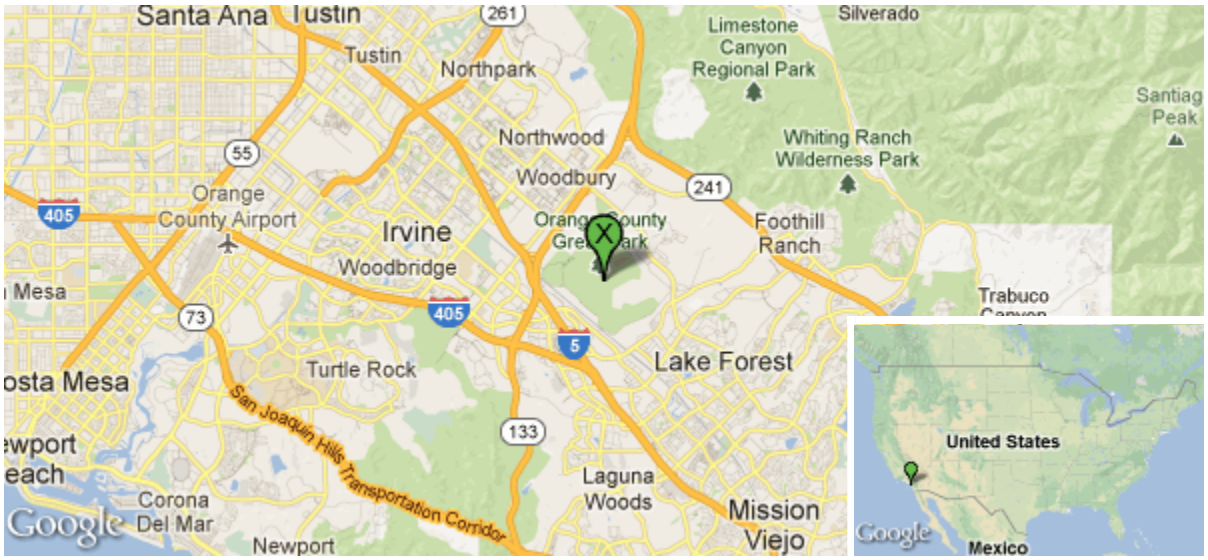
Total Weight = 70 kips → *weight bearing on foundation footings*

Seismic Weight = 37 kips → *weight of roof and half of wall*

USGS Design Maps Summary Report

User–Specified Input

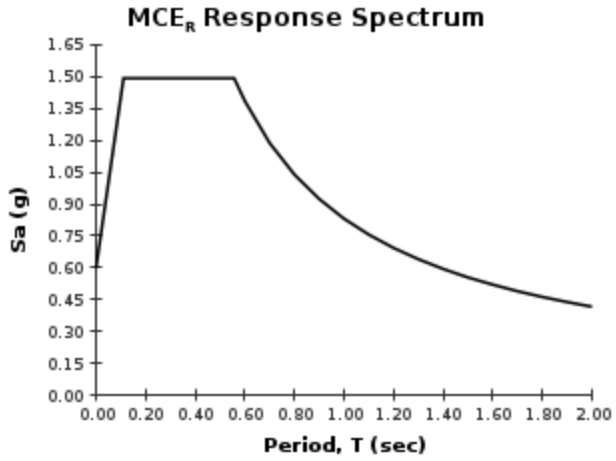
Report Title	Orange County Great Park, Irvine Tue February 5, 2013 17:14:57 UTC
Building Code Reference Document	ASCE 7-10 Standard (which makes use of 2008 USGS hazard data)
Site Coordinates	33.67°N, 117.73°W
Site Soil Classification	Site Class D – “Stiff Soil”
Risk Category	I/II/III

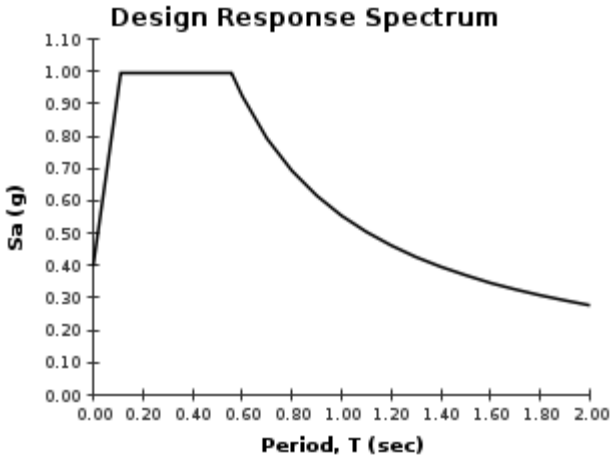


USGS–Provided Output

S_S =	1.493 g	S_{MS} =	1.493 g	S_{DS} =	0.995 g
S_1 =	0.554 g	S_{M1} =	0.831 g	S_{D1} =	0.554 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.



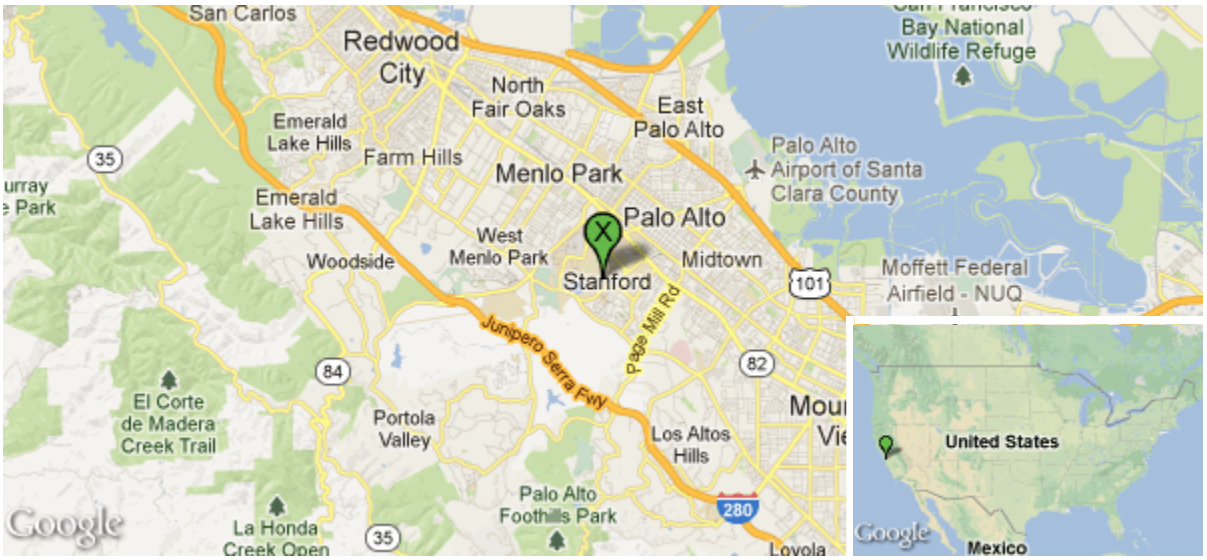


For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Summary Report

User–Specified Input

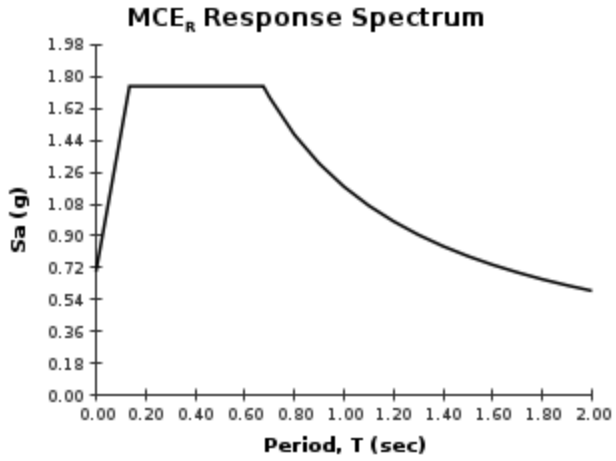
Report Title	Stanford University Wed December 19, 2012 06:00:14 UTC
Building Code Reference Document	ASCE 7-10 Standard (which makes use of 2008 USGS hazard data)
Site Coordinates	37.42494°N, 122.16719°W
Site Soil Classification	Site Class D – “Stiff Soil”
Risk Category	I/II/III

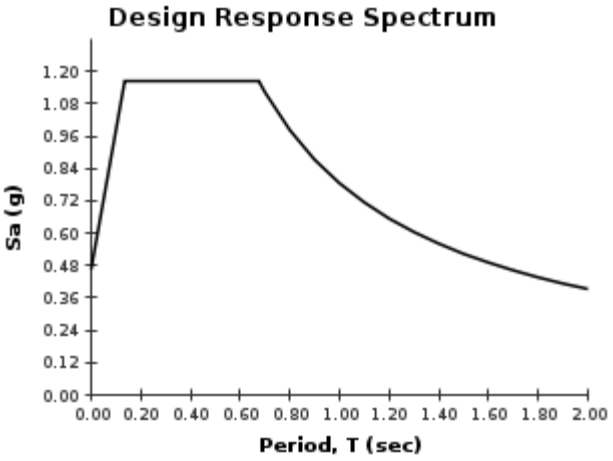


USGS–Provided Output

S_S =	1.746 g	S_{MS} =	1.746 g	S_{DS} =	1.164 g
S_1 =	0.785 g	S_{M1} =	1.178 g	S_{D1} =	0.785 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

3.3 SEISMIC BASE SHEAR

Given Parameters

Building Code = ASCE 7-10
Site Soil Classification = D *Table 20.3-1: Site Classification*
Structure Risk Category = I, II, III *Table 1.5-1*
Site Location = Stanford, CA

Note: Seismic parameters used from Stanford site since they govern over Irvine site parameters

Mapped Acceleration Parameters (Section 11.4.1)

S_s = 1.746 g *Figure 22-1*
S_1 = 0.785 g *Figure 22-2*

Site Coefficients (Section 11.4.3)

F_a = 1.0 *Table 11.4-1: Site Coefficient F_a*
F_v = 1.5 *Table 11.4-2: Site Coefficient F_v*

Table 11.4-1 Site Coefficient, F_a

	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at Short Period				
Site Class	$S_S \le 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_S.

Table 11.4-2 Site Coefficient, F_v

	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at 1-s Period				
Site Class	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_1.

MCE_R Spectral Response Acceleration Parameters (Section 11.4.3)

$S_{MS} = F_a S_S =$ 1.746 g *Equation 11.4-1*

$S_{M1} = F_v S_1 =$ 1.1775 g *Equation 11.4-2*

Design Spectral Acceleration Parameters (Section 11.4.4)

$S_{DS} = ⅔ S_{MS} =$ 1.164 g *Equation 11.4-3*

$S_{D1} = ⅔ S_{M1} =$ 0.785 g *Equation 11.4-4*

Calculation of Fundamental Period, T

Structure Type = All other structural systems

n = 1

$C_t =$ 0.02

x = 0.75

$h_n =$ 16 ft

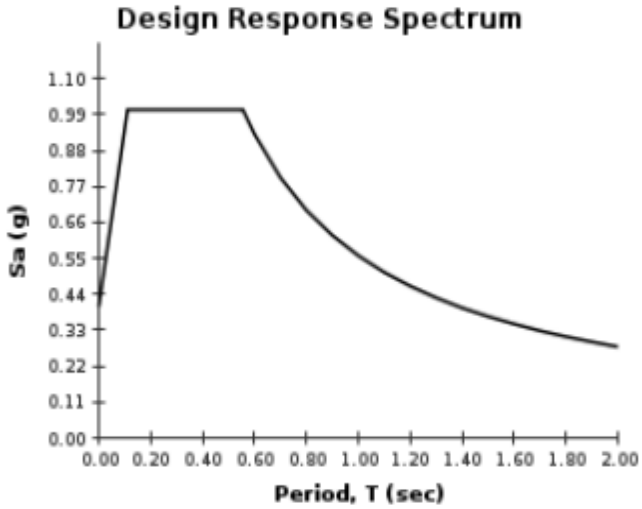
$T_a = C_t h_n^{\wedge} =$ 0.160 *Equation 12.8-7*

Table 12.8-2 Values of Approximate Period Parameters C_t and x

Structure Type	C_t	x
Moment-resisting frame systems in which the frames resist 100% of the required seismic force and are not enclosed or adjoined by components that are more rigid and will prevent the frames from deflecting where subjected to seismic forces:		
Steel moment-resisting frames	0.028 (0.0724)[a]	0.8
Concrete moment-resisting frames	0.016 (0.0466)[a]	0.9
Steel eccentrically braced frames in accordance with Table 12.2-1 lines B1 or D1	0.03 (0.0731)[a]	0.75
Steel buckling-restrained braced frames	0.03 (0.0731)[a]	0.75
All other structural systems	0.02 (0.0488)[a]	0.75

[a]Metric equivalents are shown in parentheses.

Design Response Spectrum (Section 11.4.5)



Calculation of Seismic Response Coefficient, C_s

Response Mod. Coeff., R =	6.5	*Table 12.2-1*
Seismic Importance Factor, I_e =	1.00	*Table 1.5-2*

$C_s = S_{DS}/(R/I_e)$ = 0.1791 *Equation 12.8-2*

C_s should be <u>smaller</u> than:

$C_s = S_{D1}/[T(R/I_e)]$ =	0.7548077	for $T \le T_L$	*Equation 12.8-3*
$C_s = S_{D1}T_L/[T^2(R/I_e)]$ =		for $T > T_L$	*Equation 12.8-4*

C_s should be <u>greater</u> than:

$C_s = 0.044S_{DS}I_e \ge 0.01$	0.051216	≥ 0.01, O.K.	*Equation 12.8-5*
$C_s = 0.5S_1/(R/I_e)$ =	0.0603846	for $S_1 \ge 0.6g$	*Equation 12.8-6*

C_s = 0.1791

Determine Seismic Base Shear

W =	37	kip
$V = C_sW$ =	6.6	kip

3.4 LATERAL LOAD DISTRIBUTION

DESIGN DEAD-LOAD VALUES

CLERESTORY ROOF=	18	psf	INTERIOR FLOOR=	17	psf
DECK ROOF=	10	psf	EXTERIOR FLOOR=	12	psf

DESIGN BASE SHEAR

WIND:

$V_{W\text{-}NS}$ = 11.8 kips

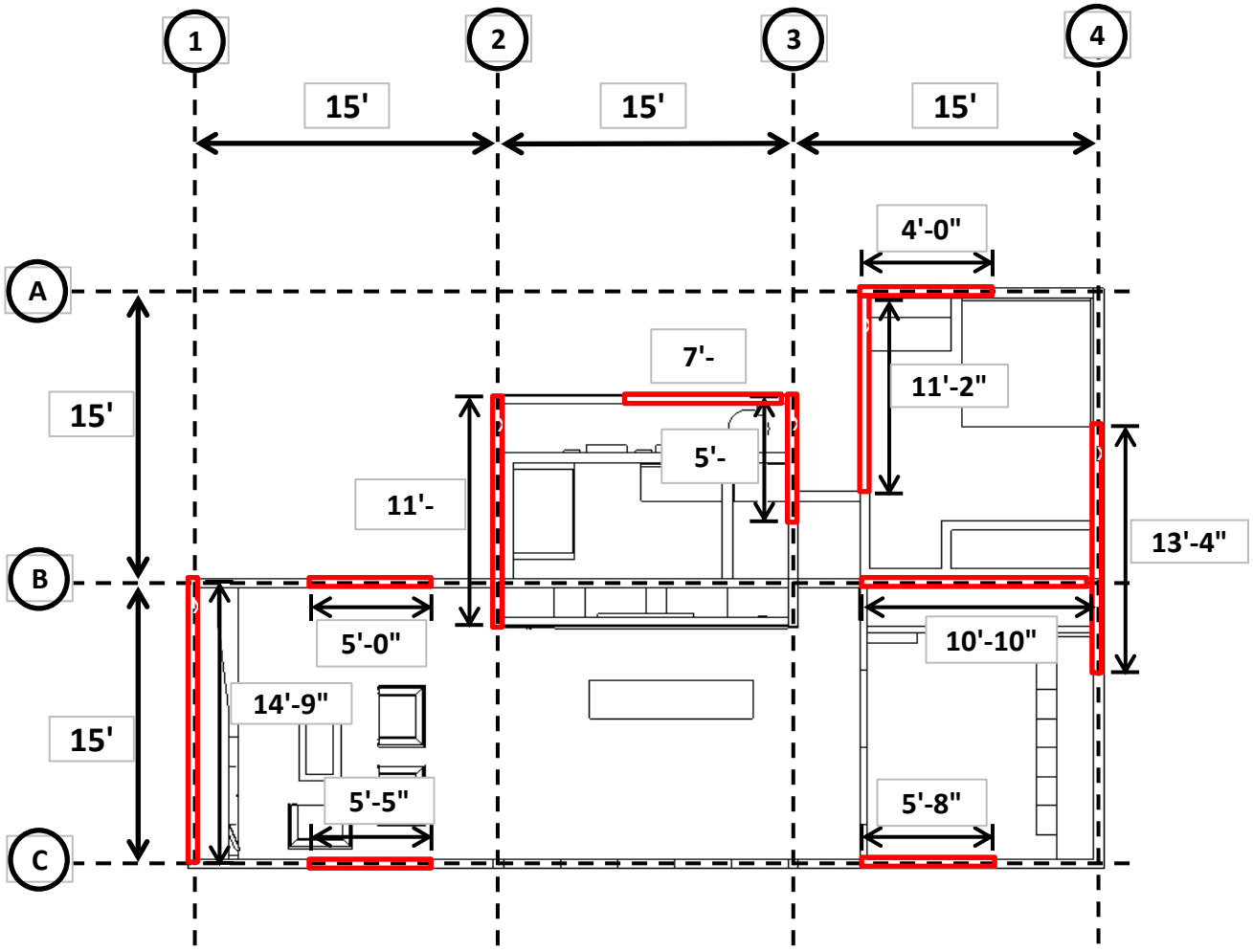
$V_{W\text{-}EW}$ = 5.5 kips

SEISMIC:

$V_{S\text{-}NS}$ = 6.623 kips

$V_{S\text{-}EW}$ = 6.623 kips

C_S = 0.1791



NOTE: GRIDLINES ARE FOR LABELING SHEARWALLS AND NOT CONSISTENT WITH CONSTRUCTION DOC'S

ASSUMPTIONS:

*FLEXIBLE DIAPHRAGM, THEREFORE LOAD DISTRIBUTION TRIBUTARY AREA BASED

*SHEAR WALLS HAVE TWO POSSIBLE IN-PLANE SHEAR CAPACITIES: q = 335 plf / q = 540 plf

**SEE R-CONTROL LOAD CHART FOR SPLINE TYPE

*OUTDOOR DECK DIMENSIONS ARE ~15' BY 45'

SEISMIC LATERAL LOAD DISTRIBUTION (EAST-WEST DIRECTION)

*DETERMINE SEISMIC LOAD DISTRIBUTED TO EACH WALL LINE

WALL LINE A

A_{TRIB} = 113 sq ft
W_{DL} = 35 psf
L_{WALL} = 4.0 ft

$V_{LINE-A} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-A} = 176 plf

WALL LINE A.5

A_{TRIB} = 75 sq ft
W_{DL} = 35 psf
L_{WALL} = 7.7 ft

$V_{LINE-A.5} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

$V_{LINE-A.5}$ = 61 plf

WALL LINE B

A_{TRIB} = 525 sq ft
W_{DL} = 35 psf
L_{WALL} = 15.83 ft

$V_{LINE-B} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-B} = 208 plf

WALL LINE C

**HOUSE AREA		**ROOF DECK AREA	
A_{TRIB} =	113 sq ft	A_{TRIB} =	338 sq ft
W_{DL} =	35 psf	W_{DL} =	10 psf

L_{WALL} = 11.08 ft

$V_{LINE-C} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-C} = 118 plf

SEISMIC LATERAL LOAD DISTRIBUTION (NORTH-SOUTH DIRECTION)

*DETERMINE SEISMIC LOAD DISTRIBUTED TO EACH WALL LINE

WALL LINE 1

**HOUSE AREA		**ROOF DECK AREA	
A_{TRIB} =	338 sq ft	A_{TRIB} =	338 sq ft
W_{DL} =	35 psf	W_{DL} =	10 psf

L_{WALL} = 14.75 ft

$V_{LINE-1} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-1} = 184 plf

WALL LINE 2

A_{TRIB} = 75 sq ft

W_{DL} = 35 psf

L_{WALL} = 11.5 ft

$V_{LINE-2} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-2} = 41 plf

WALL LINE 3

A_{TRIB} = 75 sq ft

W_{DL} = 35 psf

L_{WALL} = 5.7 ft

$V_{LINE-3} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-3} = 83 plf

WALL LINE 3.2

A_{TRIB} = 86 sq ft

W_{DL} = 35 psf

L_{WALL} = 11.2 ft

$V_{LINE-3} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-3} = 48 plf

WALL LINE 4

**HOUSE AREA

A_{TRIB} = 450 sq ft

W_{DL} = 35 psf

**ROOF DECK AREA

A_{TRIB} = 338 sq ft

W_{DL} = 10 psf

L_{WALL} = 13.33 ft

$V_{LINE-4} = C_S * W_{DL} * A_{TRIB} / L_{WALL}$

V_{LINE-4} = 257 plf

WIND LATERAL LOAD DISTRIBUTION (EAST-WEST DIRECTION)

*DETERMINE WIND LOAD DISTRIBUTED TO EACH WALL LINE

*TAKE TOTAL WIND BASE SHEAR AND APPLY AS LINE LOAD

**DISTRIBUTE WIND LOAD BASED ON TRIBUTARY WIDTH

$W_{WIND} = V_{W-EW} / L_{EW}$

W_{WIND} = 183 plf

V_{W-EW} = 5.5 kips

L_{EW} = 30 ft

WALL LINE A

L_{TRIB} = 7.5 ft

W_{WIND} = 183 plf

L_{WALL} = 4.0 ft

**NOTE: EASTERN FACE CONSIDERED AS WINDWARD SIDE

$V_{LINE-A} = W_{WIND} * L_{TRIB} / L_{WALL}$

V_{LINE-A} = 344 plf

WALL LINE A.5

L_{TRIB} = 5 ft

W_{WIND} = 183 plf

L_{WALL} = 7.7 ft

**NOTE: WESTERN FACE CONSIDERED AS WINDWARD SIDE

$V_{LINE-A.5} = W_{WIND} * L_{TRIB} / L_{WALL}$

$V_{LINE-A.5}$ = 120 plf

WALL LINE B

L_{TRIB} = 15 ft

W_{WIND} = 183 plf

L_{WALL} = 15.83 ft

**NOTE: EASTERN FACE CONSIDERED AS WINDWARD SIDE

$V_{LINE-B} = W_{WIND} * L_{TRIB} / L_{WALL}$

V_{LINE-B} = 174 plf

WALL LINE C

L_{TRIB} = 7.5 ft

W_{WIND} = 183 plf

L_{WALL} = 11.08 ft

**NOTE: EASTERN FACE CONSIDERED AS WINDWARD SIDE

$V_{LINE-C} = W_{WIND} * L_{TRIB} / L_{WALL}$

V_{LINE-C} = 124 plf

WIND LATERAL LOAD DISTRIBUTION (NORTH-SOUTH DIRECTION)

*DETERMINE WIND LOAD DISTRIBUTED TO EACH WALL LINE

*TAKE TOTAL WIND BASE SHEAR AND DISTRIBUTE BASED ON WALL FACE TRIB. AREA

$P_{WINDWARD}$ =	6.7 psf	$P_{LEEWARD}$ =	8.1 psf	P_{ROOF} :	3.2 psf	(FROM N TO S)
$P_{WINDWARD}$ =	5.9 psf	$P_{LEEWARD}$ =	-2.5 psf	P_{ROOF} :	0.7 psf	(FROM S TO N)

WALL LINE 1

WINDWARD	LEEWARD	ROOF
A_{TRIB} = 112.5 sq ft	A_{TRIB} = 258 sq ft	A_{TRIB} = 382.5 sq ft
P_{WIND} = 6.7 psf	P_{WIND} = 8.1 psf	P_{WIND} = 3.2 psf
L_{WALL} = 14.75 ft		

$V_{LINE-1} = P_{WIND} * A_{TRIB} / L_{WALL}$

V_{LINE-1} = 276 plf

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE

WALL LINE 2

A_{TRIB} = 188 sq ft

P_{WIND} = 6.7 psf

L_{WALL} = 11.5 ft

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE
CORE WALLS ONLY SUPPORT THEMSELVES

$V_{LINE-2} = P_{WIND} * A_{TRIB} / L_{WALL}$

V_{LINE-2} = 109 plf

WALL LINE 3

A_{TRIB} = 75 sq ft
P_{WIND} = 6.7 psf
L_{WALL} = 5.7 ft

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE CORE WALLS ONLY SUPPORT THEMSELVES

$V_{LINE-3} = P_{WIND} * A_{TRIB} / L_{WALL}$

V_{LINE-3} = 89 plf

WALL LINE 3.2

A_{TRIB} = 52 sq ft
P_{WIND} = 6.7 psf
L_{WALL} = 11.2 ft

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE CORE WALLS ONLY SUPPORT THEMSELVES

$V_{LINE-3} = P_{WIND} * A_{TRIB} / L_{WALL}$

V_{LINE-3} = 31 plf

WALL LINE 4

WINDWARD		LEEWARD		ROOF	
A_{TRIB} =	90 sq ft	A_{TRIB} =	258 sq ft	A_{TRIB} =	382.5 sq ft
P_{WIND} =	6.7 psf	P_{WIND} =	8.1 psf	P_{WIND} =	3.2 psf
L_{WALL} =	13.33 ft				

$V_{LINE-4} = P_{WIND} * A_{TRIB} / L_{WALL}$

V_{LINE-4} = 294 plf

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE

ASD FACTORED GOVERNING LINE LOADS

V_{LINE-A} =	344	plf =	1375	lb	(WIND)	V_{LINE-1} =	276	plf =	4068	lb	(WIND)
$V_{LINE-A.5}$ =	120	plf =	917	lb	(WIND)	V_{LINE-2} =	109	plf	1256	lb	(WIND)
V_{LINE-B} =	174	plf =	2750	lb	(WIND)	V_{LINE-3} =	89	plf	503	lb	(WIND)
V_{LINE-C} =	124	plf =	1375	lb	(WIND)	$V_{LINE-3.2}$ =	34	plf	378	lb	(WIND)
						V_{LINE-4} =	294	plf	3917	lb	(WIND)

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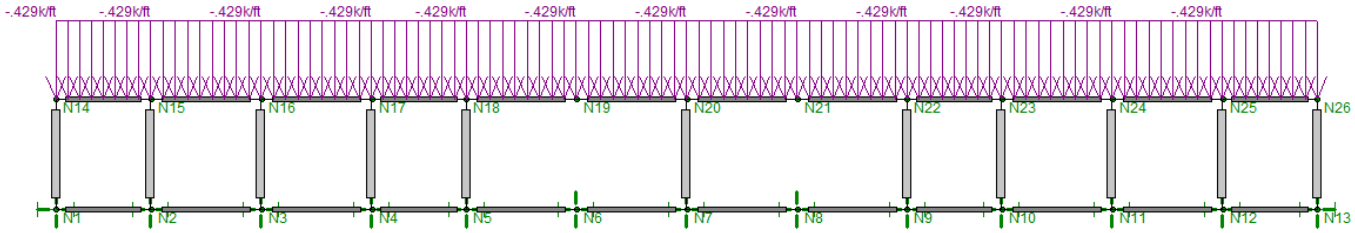
4.0 CLERESTORY DESIGN

4.0 CLERESTORY VIERENDEEL TRUSS DESIGN

CLERESTORY RISA ELEVATION



**LOAD COMBINATION SHOWN ABOVE: 1.2D + 1.6Lr

RISA 3D LOAD INPUTS

LIVE LOAD

DL= 18 psf

TRIB. WIDTH= 8 ft.

W_{DL}= 144 plf

LIVE LOAD

LL= 20 psf

TRIB. WIDTH= 8 ft.

W_{LL}= 160 plf

WIND LOAD

V_{WIND}= 5.5 kips

L_{TRUSS}= 40.0 ft.

$W_{WIND}= V_{WIND}*(L_{WALL}/L_{TRUSS})$

W_{WIND}= 0.0688 plf

SEISMIC LOAD

V_{EQ}= 6.6 kips

L_{TRUSS}= 40.0 ft.

$W_{EQ}= V_{EQ}*(L_{WALL}/L_{TRUSS})$

W_{EQ}= 0.0828 klf

TOP CHORD DESIGN CHECK

****PLEASE REFERENCE APPENDIX A.2 FOR ANALYSIS RESULTS**

ANALYSIS MODEL ANNOTATION: M19/M20
SECTION SPECIFICATION: C4 x 7.2

SECTION PROPERTIES:

I_y= 0.425 in^4.
S_y= 0.337 in^3.
Z_y= 0.695 in^3.
F_y= 36 ksi

A= 2.13 in^2.
r_y= 0.447 in.
$\bar{y}$= 0.459 in.
bf= 1.72 in.

1. GOVERNING GRAVITY COMBINATION: 1.2D + 1.6Lr

M_U = 1.836 k-ft

$\phi_b M_n = F_y Z_y$ = 25.02 k-in
$\phi_b M_n$ = 2.085 k-ft

$\phi_b M_n > M_U$ **OK**

NOTE:
SIP ROOF DIAPHRAGM PROVIDES CONTINUOUS BRACING THAT PREVENTS LATERAL-TORSIONAL BUCKLING

TOP CHORD DESIGN CHECK (CONT)

2. GOVERNING LATERAL COMBINATION: 1.2D +1.6W + 0.5Lr

M_{nt} = 1.749 k-ft
M_{lt} = 0.0 k-ft

P_U = 0.548 kips

$\phi_b M_n = F_y Z_y$ = 25.02 k-in
$\phi_b M_n$ = 2.085 k-ft

K= 1.0
L= 36.0 in.
KL/r_y = 80.5

***CONSERVATIVELY USE K=1.0 WHEN 'K' IS LESS THAN UNITY IN REALITY**

$\phi_c F_{cr}$ = 23.0 ksi
$\phi_c P_n$ = 49 kips
$P_u/\phi_c P_n$ = 0.01

***AISC MANUAL TABLE 4-22 "AVAILABLE CRITICAL STRESS"**

****THEREFORE, USE AISC EQUATION H1-1b FOR $P_u/\phi_c P_n < 0.2$**

IN THE PLANE OF BENDING: $P_{e1} = \frac{\pi^2 EI}{(K_y L)^2}$

P_{e1}= 93.86 kips

MOMENT AMPLIFICATION:

$$B_1 = \frac{C_m}{1 - (\alpha P_u / P_{e1})}$$

$C_m =$ 1.0 ***TRANSVERSLY LOADED MEMBER**

$\alpha =$ 1.0 ***LRFD**

$B_1 =$ 1.006

$B_2 =$ 0.000 ***NO MOMENT CAUSED BY SIDESWAY**

$M_U = B_1 M_{nt} + B_2 M_{lt}$

$M_U =$ 1.759 k-ft

INTERACTION EQUATION CHECK (AISC EQUATION H1-1b):

$P_u/2\phi_c P_n + M_U/\phi_b M_n =$ 0.849 **OK**

BOTTOM CHORD DESIGN CHECK

****PLEASE REFERENCE APPENDIX A.2 FOR ANALYSIS RESULTS**

ANALYSIS MODEL ANNOTATION: M30/M33

SECTION SPECIFICATION: C4 x 7.2

SECTION PROPERTIES:

$I_y =$ 0.425 in^4. $A =$ 2.13 in^2.

$S_y =$ 0.337 in^3. $r_y =$ 0.447 in.

$Z_y =$ 0.695 in^3. $\bar{y} =$ 0.459 in.

$F_y =$ 36 ksi bf= 1.72 in.

1. GOVERNING GRAVITY COMBINATION: 1.2D + 1.6Lr

$M_U =$ 0.084 k-ft

$\phi_b M_n = F_y Z_y =$ 25.02 k-in

$\phi_b M_n =$ 2.085 k-ft

$\phi_b M_n > M_U$ **OK**

NOTE:
SIP ROOF DIAPHRAGM PROVIDES CONTINUOUS BRACING THAT PREVENTS LATERAL-TORSIONAL BUCKLING

2. GOVERNING LATERAL COMBINATION: 1.2D +1.6W + 0.5Lr

M_{nt} = 1.192 k-ft
M_{lt} = 0.0 k-ft

$\phi_b M_n = F_y Z_y$ = 25.02 k-in
$\phi_b M_n$ = 2.085 k-ft

P_U = 0.000 kips

K= 1.0
L= 36.0 in.
KL/r_y = 80.5

***CONSERVATIVELY USE K=1.0 WHEN 'K' IS LESS THAN UNITY IN REALITY**

$\phi_c F_{cr}$ = 23.0 ksi
$\phi_c P_n$ = 49 kips
$P_u/\phi_c P_n$ = 0

***AISC MANUAL TABLE 4-22 "AVAILABLE CRITICAL STRESS"**

****THEREFORE, USE AISC EQUATION H1-1b FOR $P_u/\phi_c P_n < 0.2$**

IN THE PLANE OF BENDING: $P_{e1} = \dfrac{\pi^2 EI}{(K_y L)^2}$

P_{e1}= 93.86 kips

MOMENT AMPLIFICATION: $B_1 = \dfrac{C_m}{1 - (\alpha P_u / P_{e1})}$

B_1 = 1.000

B_2 = 0.000

$M_U = B_1 M_{nt} + B_2 M_{lt}$

M_U = 1.192 k-ft

α = 1.0 ***LRFD**

$C_m = 0.6 - 0.4(M_1/M_2)$

C_m = 0.202

M_1= 0.934 M_2= 0.939

***REVERSE CURVATURE, M_1/M_2 POSITIVE**

***NO MOMENT CAUSED BY SIDESWAY**

INTERACTION EQUATION CHECK (AISC EQUATION H1-1b):

$P_u/2\phi_c P_n + M_U/\phi_b M_n$ = 0.572 **OK**

WEB MEMBER DESIGN CHECK

****PLEASE REFERENCE APPENDIX A.2 FOR ANALYSIS RESULTS**

ANALYSIS MODEL ANNOTATION: M5/M9
SECTION SPECIFICATION: HSS 3x3x1/4

SECTION PROPERTIES:

I_y= 1.780 in^4. A= 1.30 in^2.
S_y= 0.799 in^3. r_y= 1.170 in.
Z_y= 0.947 in^3. $\bar{y}$= 1.500 in.
F_y= 46 ksi

1. GOVERNING GRAVITY COMBINATION: 1.2D + 1.6Lr

M_{nt} = 0.993 k-ft
M_{lt} = 0.0 k-ft

P_U = 2.248 kips

$\phi_b M_n = F_y Z_y$ = 43.56 k-in
$\phi_b M_n$ = 3.63 k-ft

K= 1.0
L= 36.0 in.
KL/r_y = 30.8

***CONSERVATIVELY USE K=1.0 WHEN 'K' IS LESS THAN UNITY IN REALITY**

$\phi_c F_{cr}$ = 25.8 ksi
$\phi_c P_n$ = 33.6 kips
$P_u/\phi_c P_n$ = 0.07

***AISC MANUAL TABLE 4-22 "AVAILABLE CRITICAL STRESS"**

****THEREFORE, USE AISC EQUATION H1-1b FOR $P_u/\phi_c P_n < 0.2$**

IN THE PLANE OF BENDING:

$$P_{e1} = \frac{\pi^2 EI}{(K_y L)^2}$$

P_{e1}= 393.11 kips

MOMENT AMPLIFICATION:

$$B_1 = \frac{C_m}{1 - (\alpha P_u / P_{e1})}$$

B_1 = 1.000

B_2 = 0.000

$M_U = B_1 M_{nt} + B_2 M_{lt}$

M_U = 0.993 k-ft

α = 1.0 ***LRFD**
$C_m = 0.6 - 0.4(M_1/M_2)$
C_m = 0.201

M_1= 0.883 M_2= 0.886
***REVERSE CURVATURE, M_1/M_2 POSITIVE**
***NO MOMENT CAUSED BY SIDESWAY**

INTERACTION EQUATION CHECK (AISC EQUATION H1-1b):

$P_u/2\phi_cP_n + M_U/\phi_bM_n =$ 0.307 **OK**

2. GOVERNING LATERAL COMBINATION: 1.2D +1.6W + 0.5Lr

$M_{nt} =$ 2.301 k-ft
$M_{lt} =$ 0.0 k-ft

$\phi_bM_n = F_yZ_y =$ 43.56 k-in
$\phi_bM_n =$ 3.63 k-ft

$P_U =$ 0.892 kips

K= 1.0
L= 36.0 in.
$KL/r_y =$ 30.8

***CONSERVATIVELY USE K=1.0 WHEN 'K' IS LESS THAN UNITY IN REALITY**

$\phi_cF_{cr} =$ 25.8 ksi
$\phi_cP_n =$ 33.6 kips
$P_u/\phi_cP_n =$ 0.03

***AISC MANUAL TABLE 4-22 "AVAILABLE CRITICAL STRESS"**

****THEREFORE, USE AISC EQUATION H1-1b FOR $P_u/\phi_cP_n < 0.2$**

IN THE PLANE OF BENDING: $P_{e1} = \dfrac{\pi^2 EI}{(K_yL)^2}$

$P_{e1} =$ 393.11 kips

MOMENT AMPLIFICATION: $B_1 = \dfrac{C_m}{1 - (\alpha P_u/P_{e1})}$

$B_1 =$ 1.000

$B_2 =$ 0.000

$M_U = B_1M_{nt} + B_2M_{lt}$

$M_U =$ 2.301 k-ft

$\alpha =$ 1.0 ***LRFD**

$C_m = 0.6 - 0.4(M_1/M_2)$
$C_m =$ 0.201

$M_1 =$ 1.169 $M_2 =$ 1.172

***REVERSE CURVATURE, M_1/M_2 POSITIVE**

***NO MOMENT CAUSED BY SIDESWAY**

INTERACTION EQUATION CHECK (AISC EQUATION H1-1b):

$P_u/2\phi_cP_n + M_U/\phi_bM_n =$ 0.647 **OK**

DESIGN WORST CASE CHORD-WEB CONNECTION

ANALYSIS MODEL ANNOTATION: M9
SECTION SPECIFICATION: HSS 3x3x1/4

SECTION PROPERTIES:

I_y=	1.780	in^4.	A=	1.30	in^2.
S_y=	0.799	in^3.	r_y=	1.170	in.
Z_y=	0.947	in^3.	$\bar{y}$=	1.500	in.
F_y=	46	ksi			

GOVERNING LOAD COMBINATION: 1.2D + 1.6Lr

MEMBER DESIGN FORCES FROM RISA MODEL: M_{TOP} = 2.301 k-ft M_{BOTTOM} = 1.742 k-ft
V_{MEM} = 1.155 kips

DETERMINE ECCENTRICITY OF LOADING

**ECCENTRICITY WILL BE THE SAME LOCATION AS POINT OF INFLECTION ON WEB MEMB.

$e_x = M_{TOP} / V_{MEM}$

e_x = 1.992 ft

CHECK L_{WELD} = 3" W/ e_x = 1.992 FT

e_x = 23.9 in.
L_W = 3.0 in.

$a = e_x / L_W$ = 7.969

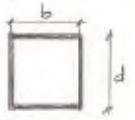
****NOTE: AISC TABLE 8-4 LISTS MAXIMUM VALUE OF a = 3.0, THEREFORE PERFORM ELASTIC METHOD BY HAND TO ANALYZE WELD CONNECTION (PER AISC MANUAL p8-12 to 8-14). ELASTIC METHOD WILL RESULT IN MORE CONSERVATIVE VALUES COMPARED TO INSTANTANEOUS CENTER OF ROTATION METHOD. SEE NEXT PAGE**

B, DONG

VIERENDEEL TRUSS WEB-CHORD CONNECTION DESIGN

① ELASTIC METHOD CONCEPT (AISC MANUAL p8-12 TO 8-14)

WELD SECTION



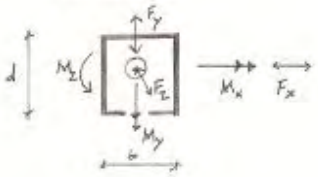
SECTION MOD (I_x/y)

$$S = \frac{d^2}{3} + bd$$

POLAR MOM. OF INERTIA

$$I_p = \frac{(b+d)^3}{6}$$

ANALYSIS



$$r_w = \left[\left(\frac{F_z}{L_{TOT}} + \frac{M_x}{S_x} + \frac{M_y}{S_y} \right)^2 + \left(\frac{F_x}{L_{TOT}} + \frac{M_z\left(\frac{d}{2}\right)}{I_p} \right)^2 + \left(\frac{F_y}{L_{TOT}} + \frac{M_z(y_z)}{I_p} \right)^2 \right]^{1/2}$$

- r_w = SHEAR PER UNIT LENGTH
- $L_{TOT} = 2d + 2b$

② CHECK WELD

PARAMETERS: $b = 3''$, $d = 3''$, $\phi = 0.75$, $F_{EXX} = 70$ ksi, $t = 3/16''$

COMPUTE S & I_p

- $S = \frac{3^2}{3} + 3(3) = 12\ in^2$
- $I_p = \frac{(3+3)^3}{6} = 36\ in^3$

COMPUTE INDUCED SHEAR STRESS

- $F_y = 1.155^k$
- $M_x = 2.301$ k-ft $= 27.6$ k-in

$$\Rightarrow r_w = \sqrt{\left(\frac{F_y}{L_{TOT}}\right)^2 + \left(\frac{M_x}{S_x}\right)^2} = \sqrt{\left(\frac{1.155}{4(3)}\right)^2 + \left(\frac{27.6}{12}\right)^2}$$

$r_w = 2.3\ ^k/_{in}$

COMPUTE WELD CAPACITY

$$\phi R_n = \phi\, 0.60 F_{EXX}\, t \left(\frac{1}{\sqrt{2}}\right) = 0.75(0.60)(70^{ksi})(3/16'')\left(\frac{1}{\sqrt{2}}\right)$$

$\phi R_n = 4.18\ ^k/_{in}$ @ $r_w = 2.3\ ^k/_{in}$ OK ✓

USE 3/16 FILLET WELD, E70 ELECTRODE, ALL AROUND CONNECTION BETWEEN HSS 3X3X1/2 AND C4X7
PLEASE REFER TO CONSTRUCTION DOCUMENTS AND DETAILING.

SHEAR TRANSFER DESIGN - FROM 2X4 TOP PLATE TO TOP STEEL CHANNEL

SIDE MEMBER THICKNESS (t_s) : 0.238 in. → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: ASTM A 653, Grade 33 (ACTUALLY GRADE 46)

SHEAR DEMAND: q= 174 plf (WIND)

TRY 8d COMMON WIRE NAIL @ 12" O.C.

Z = 132 lb → *FROM NDS TABLE 11P*

Z' = Z C_D = 211 lb

C_D = 1.6

s = 12.0 in.

d = 0.131 in.

q_{ALLOW} = Z' / s = 211.2 plf > q= 174 plf OK

MINIMUM PENETRATION: 10 x diam. = 1.31 in.

SHEAR TRANSFER DESIGN - FROM BOTTOM CHANNEL TO 2X4 SILL PLATE

****NOTE: USE NAILING FOR SHEAR TRANSFER WHERE VIERENDEEL TRUSS IS RUNNING OVER SIP WALL**

SIDE MEMBER THICKNESS (t_s) : 0.238 in. → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: ASTM A 653, Grade 33 (ACTUALLY GRADE 46)

SHEAR DEMAND: q= 174 plf (WIND)

TRY 8d COMMON WIRE NAIL @ 12" O.C.

Z = 132 lb → *FROM NDS TABLE 11P*

Z' = Z C_D = 211 lb

C_D = 1.6

s = 12.0 in.

d = 0.131 in.

q_{ALLOW} = Z' / s = 211.2 plf > q= 174 plf OK

MINIMUM PENETRATION: 10 x diam. = 1.31 in.

****NOTE: NDS TABLE 11P DESIGN VALUES ARE INTENDED FOR STEEL PLATES ATTACHING TO A WOOD MEMBER. FOR OUR CASE WE HAVE THE FLANGE OF THE VIERENDEEL CHANNEL ATTACHING TO A WOOD MEMBER. ASSUMED THAT DESIGN VALUES WOULD BE SIMILAR AND THUS USED TABLE 11P**

SHEAR TRANSFER DESIGN - FROM BOTTOM CHANNEL TO 2X4 SILL PLATE

****NOTE: USE WOOD SCREWS FOR SHEAR TRANSFER WHERE VIERENDEEL TRUSS IS RUNNING OVER MECH. CORE ROOF SIP. THIS WILL ALLOW FOR EASES OF ATTACHING AND DETACHING**

SIDE MEMBER THICKNESS (t_s) : 0.238 in. → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: ASTM A 653, Grade 33 (ACTUALLY GRADE 46)

SHEAR DEMAND: q= 174 plf (WIND)

TRY #8 WOOD SCREW @ 12" O.C.

Z = 126 lb → *FROM NDS TABLE 11M*

Z' = Z C_D = 202 lb

C_D = 1.6

s = 12.0 in.

d = 0.164 in.

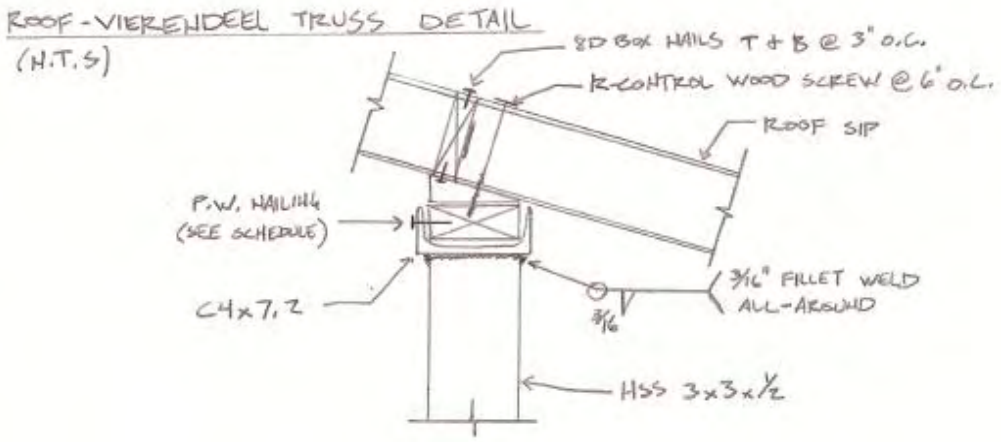
q_{ALLOW} = Z' / s = 201.6 plf > q= 174 plf OK

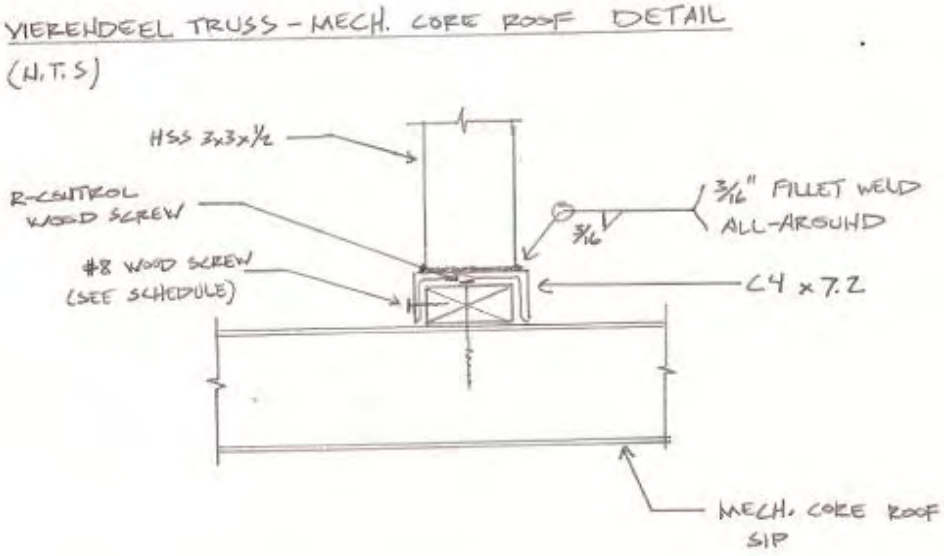
MINIMUM PENETRATION: 10 x diam. = 1.64 in.

****NOTE: NDS TABLE 11M DESIGN VALUES ARE INTENDED FOR STEEL PLATES ATTACHING TO A WOOD MEMBER. FOR OUR CASE WE HAVE THE FLANGE OF THE VIERENDEEL CHANNEL ATTACHING TO A WOOD MEMBER. ASSUMED THAT DESIGN VALUES WOULD BE SIMILAR AND THUS USED TABLE 11M**

USE 8d COMMON WIRE NAILS @ 12" o.c. W/ 1-1/2" PENETRATION INTO 2x4 WOOD PLATES
USE #8 x 2" WOOD SCREW @ 12" o.c. W/ 1-3/4" PENETRATION INTO 2x4 SILL PLATE WHERE BOTTOM CHORD OF VIERENDEEL TRUSS RUNS OVER MECH. CORE ROOF SIP.

HAND SKETCHES OF DETAILING





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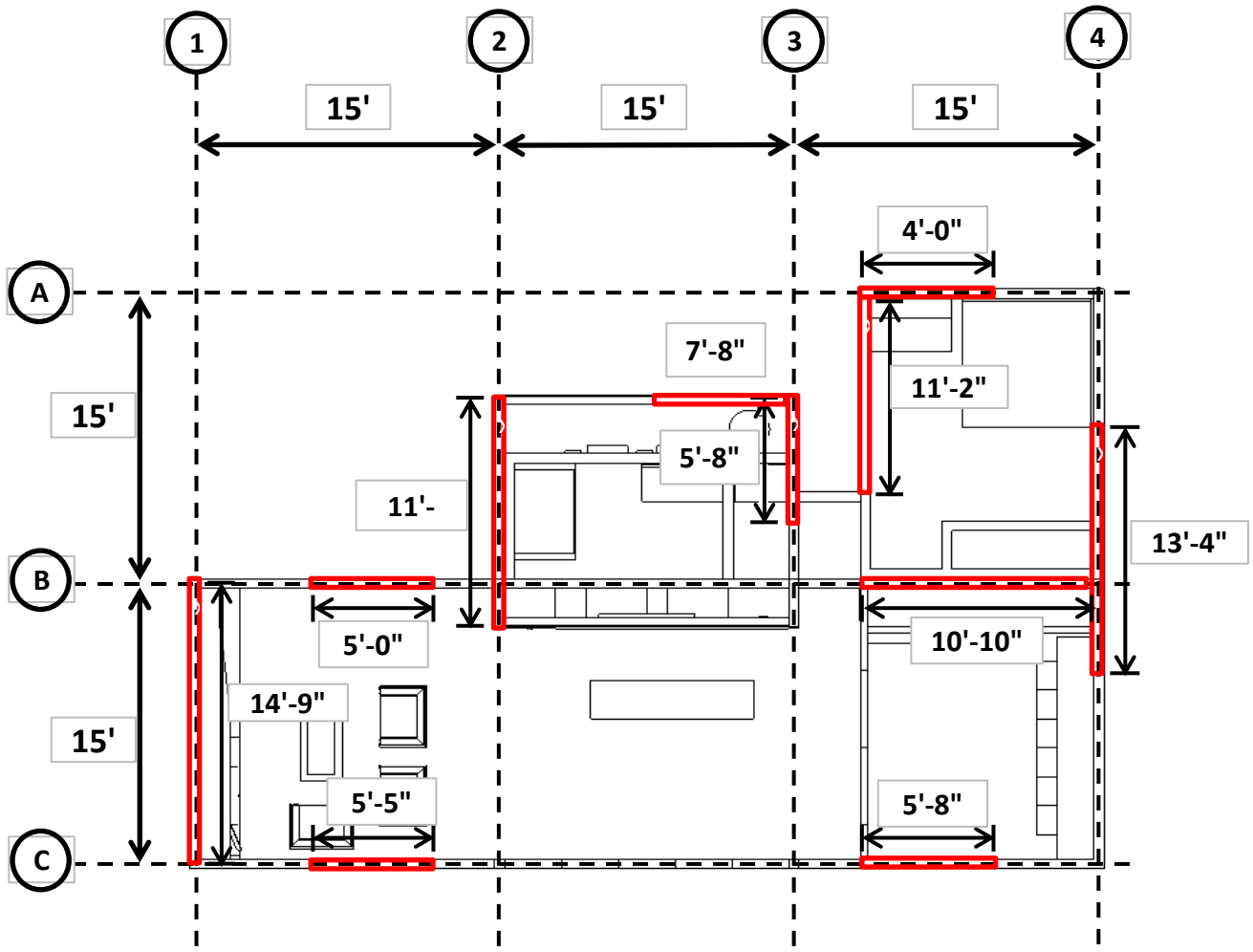
5.0 SHEARWALL DESIGN

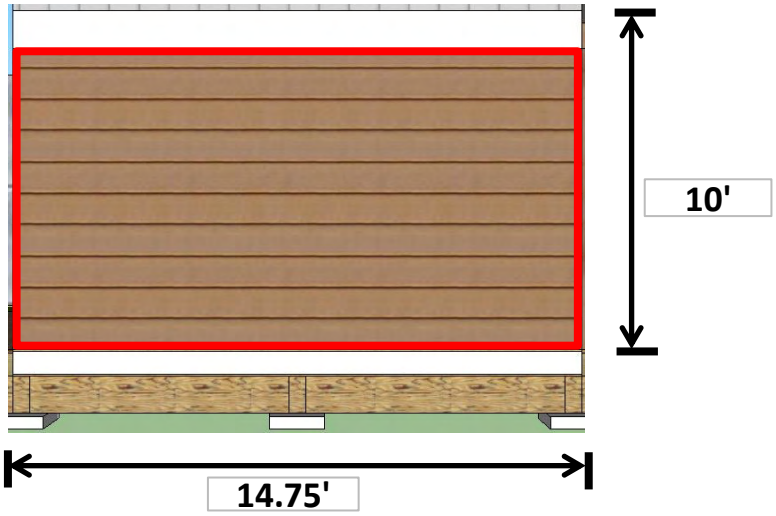
5.1 SHEARWALL LAYOUT



NOTE: GRIDLINES ARE FOR LABELING SHEARWALLS AND NOT CONSISTENT WITH CONSTRUCTION DOC'S

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-1



1. CHECK SHEAR

q = 276 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ 0.7*184 plf x 14.7' x 10 / 14.7' = 1288 (FACTORED)

WIND LOAD

$W_T = W_C =$ 276 plf x 14.7' x 10' / 14.7' = 2760 (UNFACTORED)

DEAD LOAD

DL_{ROOF} =	18	psf	DL_{WALL} =	13	psf	→ *ASSUMING ONE QUARTER OF WALL SELF-*
A_T =	26	ft^2	A_{WALL} =	40	ft^2	*WEIGHT DISTRIBUTES TO BOUNDARY POST*

$D = DL_{ROOF} * A_T + DL_{WALL} * A_{WALL}$

D = 988 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 26 ft^2

L_r = 520 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	3748	lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	3854	lb
D + 0.75W + 0.75 Lr =	3448	lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0 E) + 0.75$ Lr =	3527	lb

C= 3854 lb

TENSION:

0.6D + W =	3353	lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	2273	lb

T= 3353 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 3.4 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 3.85 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 3353 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 386 plf

q_W = 276 plf

q'= 386 plf

TRY 16d COMMON WIRE NAIL @ 6" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 6.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 451.2 plf > q'= 386 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 3.64 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 6" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 42" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

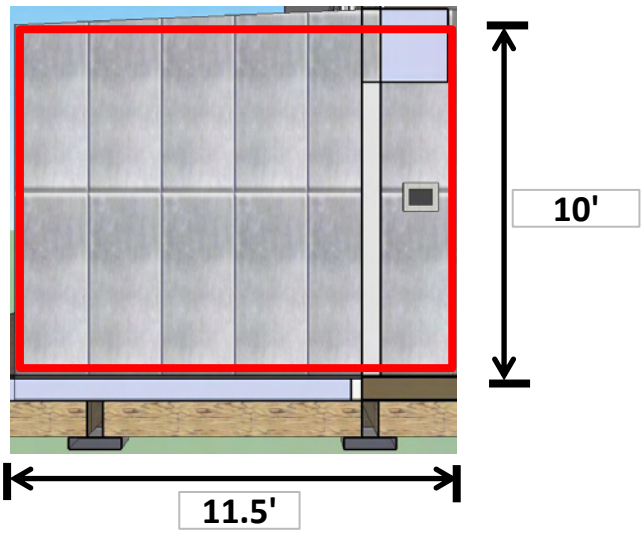
q= 276 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-2



1. CHECK SHEAR

q = 109 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C = \frac{0.7*41 \text{ plf} \times 11.5' \times 10'}{11.5'} =$ 287 (FACTORED)

WIND LOAD

$W_T = W_C = \frac{109 \text{ plf} \times 11.5' \times 10'}{11.5'} =$ 1090 (UNFACTORED)

DEAD LOAD

$DL_{ROOF} =$ 18 psf $DL_{WALL} =$ 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

$A_T =$ 14.5 ft^2 $A_{WALL} =$ 20 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 521 lbs (UNFACTORED)

ROOF LIVE LOAD

$L_r =$ 20 psf $A_T =$ 14.5 ft^2

$L_r =$ 290 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

$S_{DS} =$ 1.164 g $\Omega_0 =$ 3

COMPRESSION:

D + W =	1611	lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E =$	1209	lb
D + 0.75W + 0.75 Lr =	1556	lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	1254	lb

C= 1611 lb

TENSION:

0.6D + W =	1403	lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E =$	375	lb

T= 1403 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 1.4 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 1.61 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 1403 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 86.1 plf

q_W = 109 plf

q'= 109 plf

TRY 16d COMMON WIRE NAIL @ 12" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 12.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 225.6 plf > q'= 109 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 12.92 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 12" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 60" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

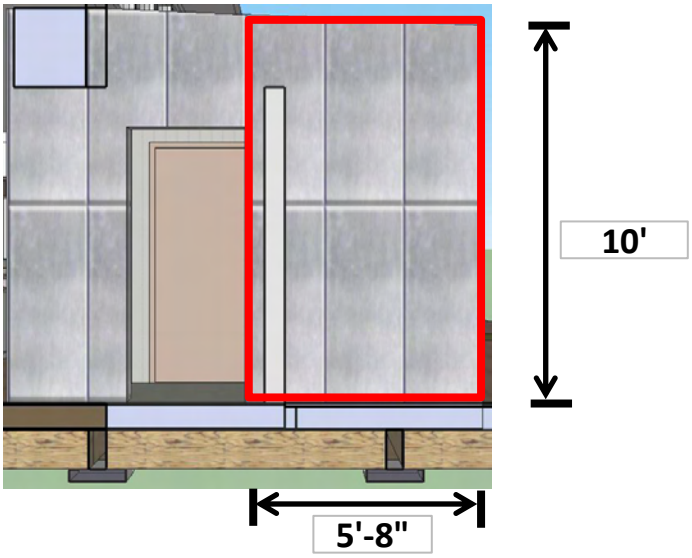
q= 109 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-3



1. CHECK SHEAR

q = 89 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*83 \text{ plf} \times 5.7' \times 10'}{5.7'}$ = 581 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{89 \text{ plf} \times 5.7' \times 10'}{5.7'}$ = 890 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 20.3 ft^2 A_{WALL} = 13.8 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 544 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 20.3 ft^2

L_r = 406 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	1433.81 lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	1853 lb
D + 0.75W + 0.75 Lr =	1516 lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	1830 lb

C= 1853 lb

TENSION:

0.6D + W =	1216 lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	982 lb

T= 1216 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 1.2 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 1.85 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 1216 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 174 plf

q_W = 89 plf

q'= 174 plf

TRY 16d COMMON WIRE NAIL @ 12" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 12.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 225.6 plf > q'= 174 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 8.08 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 12" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 36" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

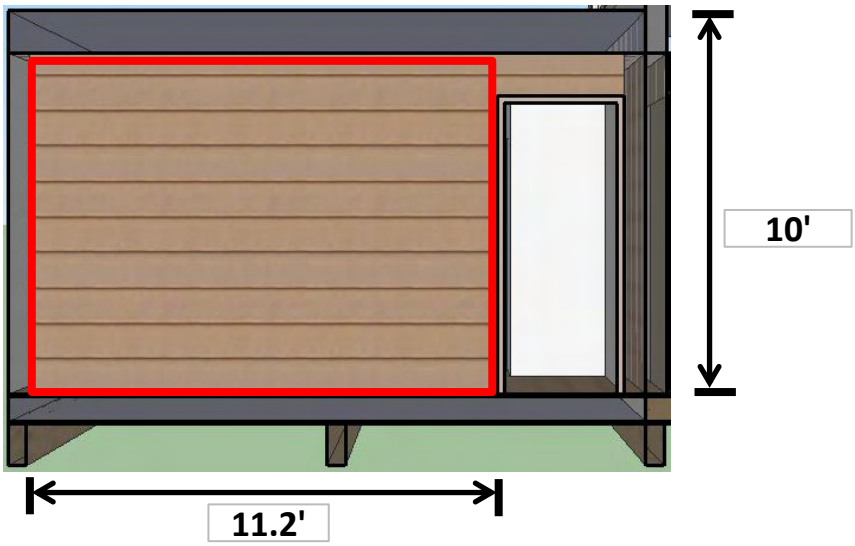
q= 89 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-3.2



1. CHECK SHEAR

q = 48 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C = \frac{0.7*48 \text{ plf} \times 11.2' \times 10'}{11.2'} = 336$ (FACTORED)

WIND LOAD

$W_T = W_C = \frac{31 \text{ plf} \times 11.2' \times 10'}{11.2'} = 310$ (UNFACTORED)

DEAD LOAD

$DL_{ROOF} =$ 18 psf $DL_{WALL} =$ 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

$A_T =$ 20.3 ft^2 $A_{WALL} =$ 13.8 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 544 lbs (UNFACTORED)

ROOF LIVE LOAD

$L_r =$ 20 psf $A_T =$ 20.3 ft^2

$L_r =$ 406 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

$S_{DS} =$ 1.164 g $\Omega_0 =$ 3

COMPRESSION:

D + W =	853.813	lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E =$	1338	lb
D + 0.75W + 0.75 Lr =	1081	lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	1444	lb

C= 1444 lb

TENSION:

0.6D + W =	636	lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E =$	468	lb

T= 636 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 0.6 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

$d =$ 3.5 in. $c =$ 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 1.44 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 636 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 101 plf

q_W = 31 plf

q'= 101 plf

TRY 16d COMMON WIRE NAIL @ 12" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 12.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 225.6 plf > q'= 101 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 13.97 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 12" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 60" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

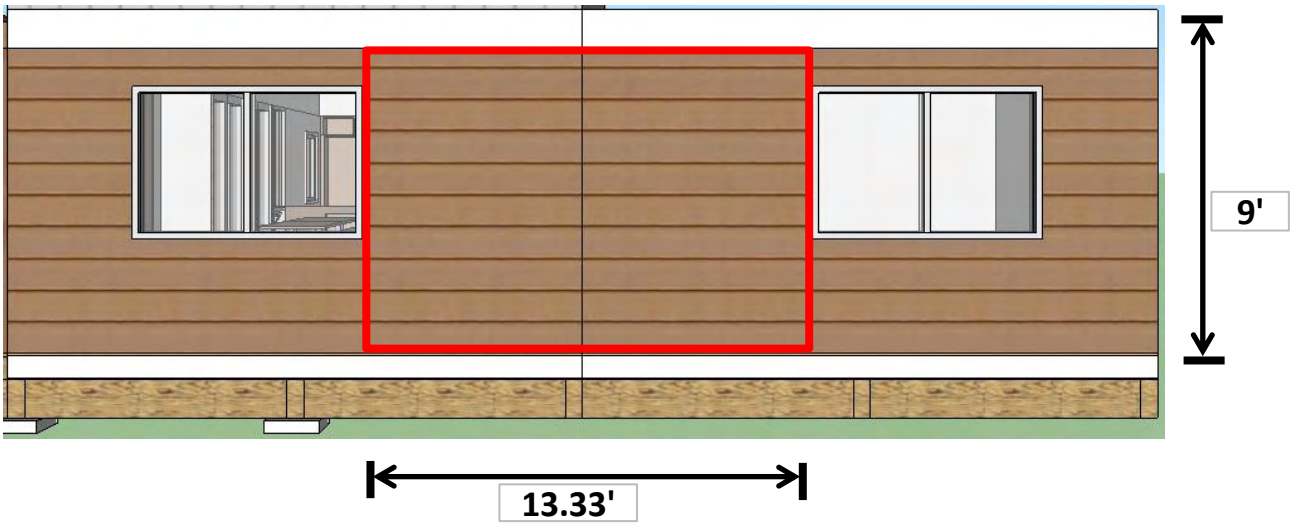
q= 48 plf

q_{ALLOW} = **500 plf OK**

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-4



1. CHECK SHEAR

q = 294 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C = \frac{0.7*257 \text{ plf} \times 13.33' \times 9'}{13.33'} = 1619$ (FACTORED)

WIND LOAD

$W_T = W_C = \frac{294 \text{ plf} \times 13.33' \times 9'}{13.33'} = 2646$ (UNFACTORED)

DEAD LOAD

$DL_{ROOF} =$ 18 psf $DL_{WALL} =$ 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

$A_T =$ 22.5 ft^2 $A_{WALL} =$ 27 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 756 lbs (UNFACTORED)

ROOF LIVE LOAD

$L_r =$ 20 psf $A_T =$ 22.5 ft^2

$L_r =$ 450 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

$S_{DS} =$ 1.164 g $\Omega_0 =$ 3

COMPRESSION:

D + W =	3402	lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E =$	4279	lb
D + 0.75W + 0.75 Lr =	3078	lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	3736	lb

C= 4279 lb

TENSION:

0.6D + W =	3100	lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E =$	3070	lb

T= 3100 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 3.1 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_P:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 4.28 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 3100 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 540 plf

q_W = 294 plf

q'= 540 plf

TRY 16d COMMON WIRE NAIL @ 4" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 4.0 in.

d = 0.192 in.

q_{ALLOW} = Z' / s = 677 plf > q'= 540 plf

MINIMUM PENETRATION: 10 x diam. = 1.92 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 2.61 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 2" PENETRATION @ 4" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 30" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

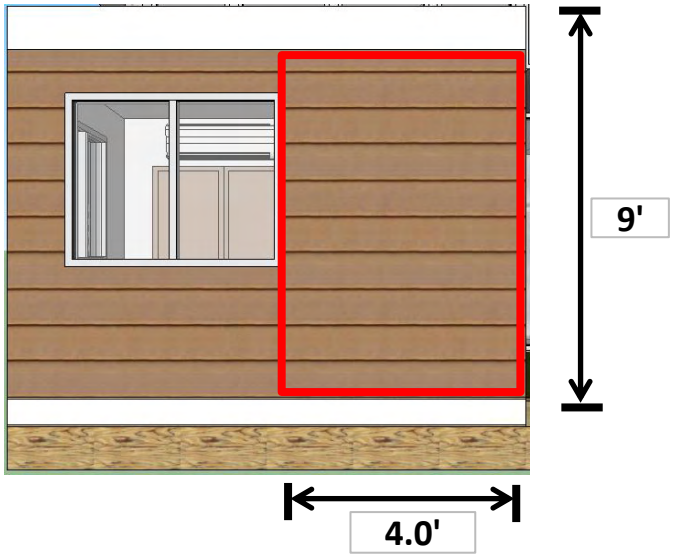
q= 294 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-A (4.5' WALL)



1. CHECK SHEAR

q = 344 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*176\ plf \times 4.0' \times 9'}{4.0'}$ = 1109 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{344\ plf \times 4.0' \times 9'}{4.0'}$ = 3096 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 7.88 ft^2 A_{WALL} = 10.1 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 273 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 7.88 ft^2

L_r = 158 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	3369.38 lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	2646 lb
D + 0.75W + 0.75 Lr =	2714 lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	2171 lb

C= 3369 lb

TENSION:

0.6D + W =	3260 lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	2209 lb

T= 3260 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 3.3 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 3.37 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 3260 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 370 plf

q_W = 344 plf

q'= 370 plf

TRY 16d COMMON WIRE NAIL @ 6" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 6.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 451.2 plf > q'= 370 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 3.81 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 6" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 24" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

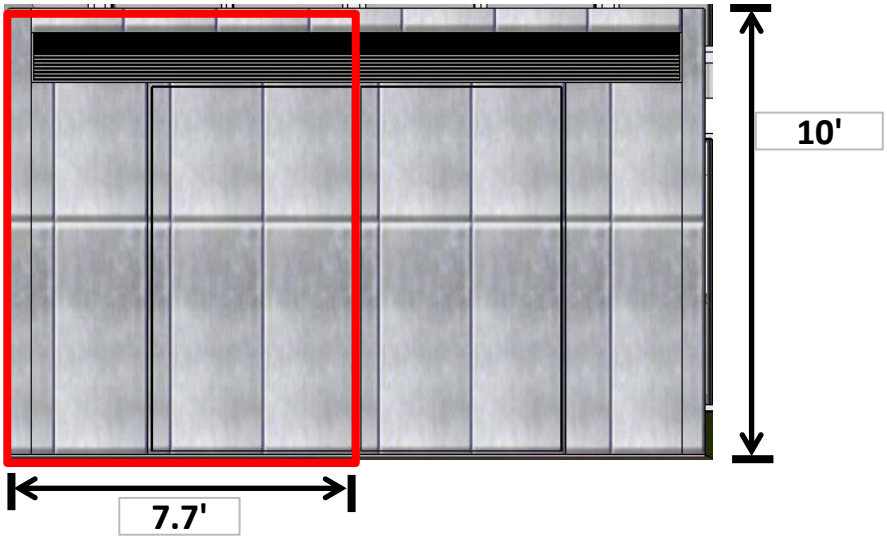
q= 344 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-A.5 (5' WALL)



1. CHECK SHEAR

q = 120 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*61 \text{ plf} \times 7.7' \times 10'}{7.7'}$ = 427 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{120 \text{ plf} \times 7.7' \times 10'}{7.7'}$ = 1200 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 5.5 ft^2 A_{WALL} = 12.5 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 262 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 5.5 ft^2

L_r = 110 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	1461.5 lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	1201 lb
D + 0.75W + 0.75 Lr =	1244 lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0E) + 0.75$ Lr =	1048 lb

C= 1462 lb

TENSION:

0.6D + W =	1357 lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	782 lb

T= 1357 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 1.4 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_p:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

d = 3.5 in. c = 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 1.46 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 1357 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 128 plf

q_W = 120 plf

q'= 128 plf

TRY 16d COMMON WIRE NAIL @ 12" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 12.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 225.6 plf > q'= 128 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 10.99 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 12" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 42" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

q= 120 plf

q_{ALLOW} = **500 plf OK**

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-B (10.8' WALL)

1. CHECK SHEAR

q = 208 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*208 \text{ plf} \times 10.8' \times 10}{10.8'}$ = 1456 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{174 \text{ plf} \times 10.83' \times 1(}{10.83'}$ = 1740 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 52.6 ft^2 A_{WALL} = 36.3 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 1417 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 52.6 ft^2

L_r = 1051 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	3157.38	lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	4706	lb
D + 0.75W + 0.75 Lr =	3511	lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0 E) + 0.75$ Lr =	4672	lb

C= 4706 lb

TENSION:

0.6D + W =	2590	lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	2438	lb

T= 2590 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 2.6 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_P:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

$d =$ 3.5 in. $c =$ 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 4.71 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 2590 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 437 plf

q_W = 174 plf

q'= 437 plf

TRY 16d COMMON WIRE NAIL @ 4" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 4.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 676.8 plf > q'= 437 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 3.22 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 4" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 36" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

q= 208 plf

q_{ALLOW} = **500 plf OK**

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-B (5.0' WALL)

1. CHECK SHEAR

q = 208 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*208\ plf \times 5.0' \times 10'}{5.0'}$ = 1456 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{174\ plf \times 5.0' \times 10'}{5.0'}$ = 1740 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 9 ft^2 A_{WALL} = 11.3 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 308 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 9 ft^2

L_r = 180 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	2048.25 lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	3416 lb
D + 0.75W + 0.75 Lr =	1748 lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0 E) + 0.75$ Lr =	2774 lb

C= 3416 lb

TENSION:

0.6D + W =	1925 lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	2923 lb

T= 2923 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 2.9 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_P:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

$d =$ 3.5 in. $c =$ 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 3.42 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 2923 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 437 plf

q_W = 174 plf

q'= 437 plf

TRY 16d COMMON WIRE NAIL @ 4" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 4.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 676.8 plf > q'= 437 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 3.22 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 4" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 36" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

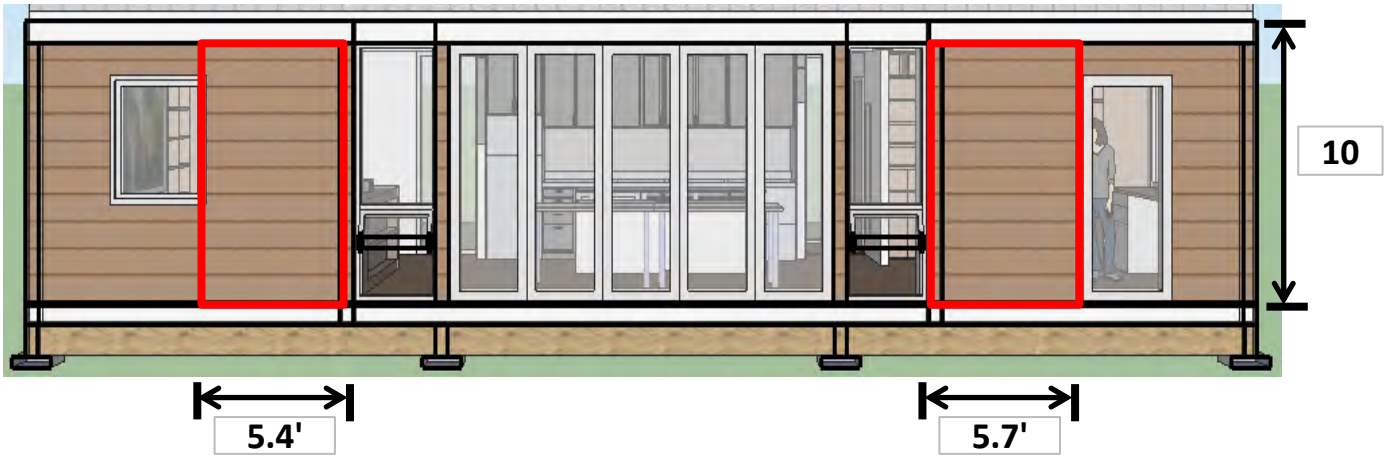
q= 208 plf

q_{ALLOW} = **500 plf OK**

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

5.2 SHEARWALL DESIGN

SHEARWALL ALONG LINE-C (5.4' WALL)



1. CHECK SHEAR

q = 124 plf → *FROM LATERAL LOAD DISTRIBUTION CALCULATIONS*

Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

USE 4X LUMBER SPLINE W/ 8d COOLER NAILS AT 4" O.C.

v = 540 plf > q (O.K.)

2. CHECK FLEXURE

SEISMIC LOAD

$E_T = E_C =$ $\frac{0.7*118\ plf \times 5.4' \times 10'}{5.4'}$ = 826 (FACTORED)

WIND LOAD

$W_T = W_C =$ $\frac{124\ plf \times 5.4' \times 10'}{5.4'}$ = 1240 (UNFACTORED)

DEAD LOAD

DL_{ROOF} = 18 psf DL_{WALL} = 13 psf → *ASSUMING ONE QUARTER OF WALL SELF-WEIGHT DISTRIBUTES TO BOUNDARY POST*

A_T = 11 ft^2 A_{WALL} = 13.8 ft^2

$D = DL_{ROOF}*A_T + DL_{WALL}*A_{WALL}$

D = 377 lbs (UNFACTORED)

ROOF LIVE LOAD

L_r = 20 psf A_T = 11 ft^2

L_r = 220 lbs (UNFACTORED)

RESULTING OVERTURNING LOADS

S_{DS} = 1.164 g Ω_0 = 3

COMPRESSION:

D + W =	1616.75 lb
$(1.0+0.14S_{DS})D + 0.7(\Omega_0)E$ =	2173 lb
D + 0.75W + 0.75 Lr =	1472 lb
$(1.0+0.105S_{DS})D + 0.75(0.7\Omega_0 E) + 0.75$ Lr =	1889 lb

C= 2173 lb

TENSION:

0.6D + W =	1466 lb
$(0.6-0.14S_{DS})D - 0.7(\Omega_0)E$ =	1570 lb

T= 1570 lb

TENSION CHORD DESIGN

$F'_t = F_t C_D C_F =$ 1620 psi

$F_t =$ 675 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$C_D =$ 1.6

$C_F =$ 1.5

$A =$ 12.3 in^2

$T_{allow} =$ 19.8 kips > T= 1.6 kips

COMPRESSION CHORD DESIGN

$F^*_c = F_c C_D C_F =$ 2760 psi → *FROM NDS TABLE 4A, USING DOUGLAS FIR LARCH NO. 1*

$F_c =$ 1500 psi

$C_D =$ 1.6

$C_F =$ 1.15

COMPUTE C_P:

$l_u =$ 108 in. $E_{min} =$ 620000 psi

$d =$ 3.5 in. $c =$ 0.8 (SAWN LUMBER)

$(l_u/d) =$ 30.9

$F_{ce} =$ 535.2 psi

$F_{ce}/F^*_c =$ 0.194

$C_P =$ 0.185

$F'_c =$ 512 psi

$A =$ 12.3 in^2

$C_{allow} =$ 6.27 kips > C= 2.17 kips

USE 4X4 DOUGLAS FIR LARCH NO. 1 FOR SHEARWALL CHORD

HOLDOWN DESIGN

T = 1570 lb

USE HTT4: $T_{ALLOW} =$ 3610 lb > T (O.K.) *[SIMPSON CATALOGUE PG. 40]*

SHEAR TRANSFER DESIGN - FROM SIP SHEARWALL TO SILL PLATE

SIDE MEMBER THICKNESS (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

SIDE MEMBER SPECIES: Douglas Fir-Larch (G=0.50)

FACTORED SHEAR DEMAND: q' = MAX(0.7* q_E * Ω, q_W)

q_E = 248 plf

q_W = 124 plf

q'= 248 plf

TRY 16d COMMON WIRE NAIL @ 9" O.C.

Z = 141 lb → *FROM NDS TABLE 11N*

Z' = Z C_D = 226 lb

C_D = 1.6

s = 9.0 in.

d = 0.162 in.

q_{ALLOW} = Z' / s = 300.8 plf > q'= 248 plf

MINIMUM PENETRATION: 10 x diam. = 1.62 in.

SHEAR TRANSFER DESIGN - FROM SILL PLATE (THROUGH FLOOR SIP) TO FOUNDATION BM

Main member thickness (t_m) : 5-1/4

Side member thickness (t_s) : 1-1/2 → *ASSUME 2x4 SILL PLATE*

Z_{II} = 880 lb → *FROM NDS TABLE 11A*

Z_{II}' = Z_{II} C_D = 1408 lb

C_D = 1.6

s = Z_{II}/q' = 5.68 ft

USE 4x4 LUMBER SPLINE W/ 2 - 8d COOLER NAILS STAGGERED @ 4" O.C. W/ HTT4 (18-10dx1-1/2 NAILS) SIMPSON HOLDOWN
USE 16d COMMON WIRE NAILING w/ 1-3/4" PENETRATION @ 9" O.C.
USE 5/8" ϕ ANCHOR BOLTS @ 36" O.C. AND 2x4 DFL NO.1 SILL PLATE

SHEAR TRANSFER DESIGN - FROM ROOF TO SIP

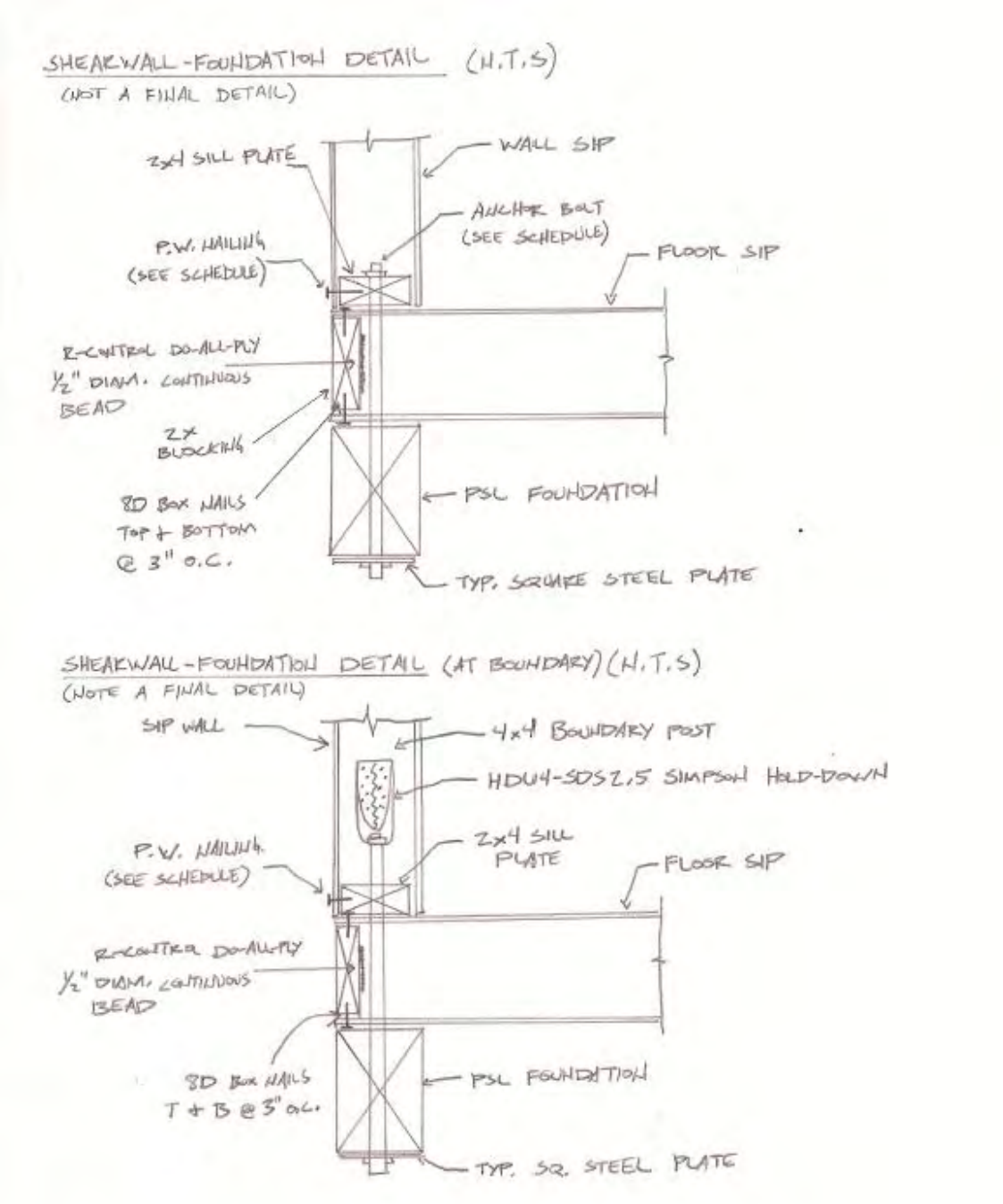
**SEE DETAIL FOR ORIENTATION AND PLACEMENT OF NAILING AND WOOD SCREWS

q= 124 plf

q_{ALLOW} = 500 plf OK

USE R-CONTROL SCREWS w/ 1-5/8" MIN. EMBED @ 6" O.C
USE 8d BOX NAILS @ 3" O.C. TOP & BOTTOM
USE 2x DFL NO.1 SOLID BLOCKING

HAND SKETCHES OF DETAILING



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6.0 DIAPHRAGM DESIGN

6.1 DIAPHRAGM FORCES-SEISMIC

SEISMIC DESIGN PARAMETERS

S_{DS} = 1.164 g

C_S = 0.179

DESIGN BASE SHEAR

WIND:

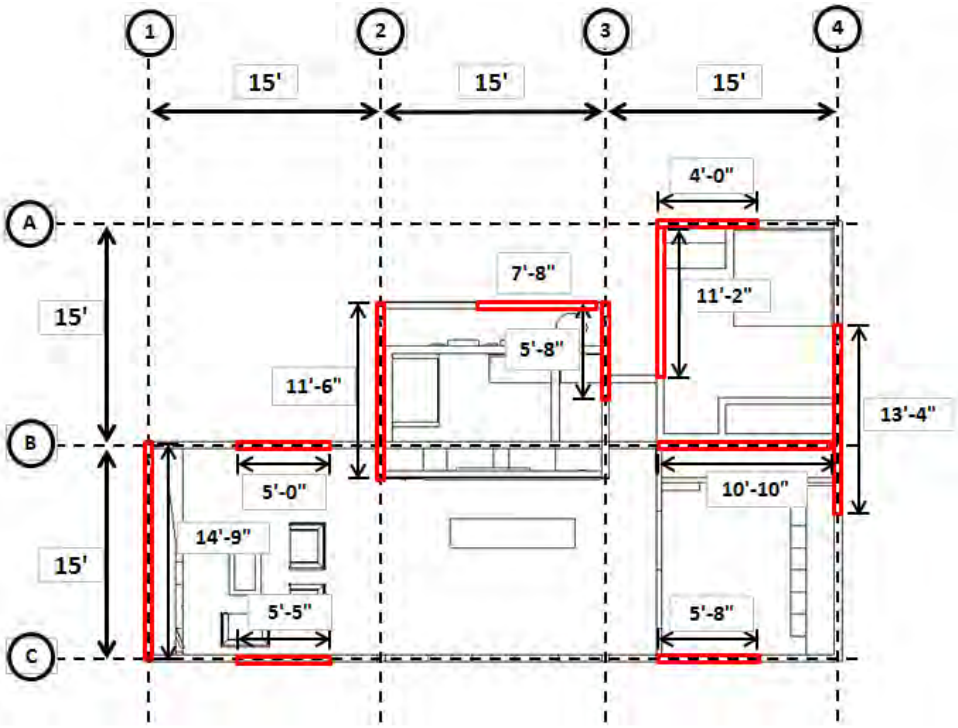
$V_{W\text{-}NS}$ = 11.8 kips

$V_{W\text{-}EW}$ = 5.5 kips

SEISMIC:

$V_{S\text{-}NS}$ = 6.62 kips

$V_{S\text{-}EW}$ = 6.62 kips



DESIGN ROOF DEAD-LOAD VALUES AND AREAS

Clerestory Area =	765	sf	Bedroom Area =	275	sf	Core Area =	173	sf
Clerestory DL =	18	psf	Bedroom DL =	16	psf	Core DL =	16	psf
Deck Area =	507	sf						
Deck DL =	10	psf						

WALL WEIGHTS TRIBUTARY TO DIAPHRAGM

DIAPHRAGM 1			DIAPHRAGM 2			DIAPHRAGM 3		
WALL LENGTH =	74.5	ft.	WALL LENGTH =	58	ft.	WALL LENGTH =	45	ft.
AVG. WALL HEIGHT =	11	ft.	AVG. WALL HEIGHT =	11	ft.	AVG. WALL HEIGHT =	11	ft.
WALL DL =	13	psf	WALL DL =	13	psf	WALL DL =	13	psf
WALL WEIGHT =	5.327	kips	WALL WEIGHT =	4.15	kips	WALL WEIGHT =	3	kips

MINIMUM DIAPHRAGM DESIGN FORCES (CONT)

PER ASCE 7-05 SECTION 12.10.1.1

$$F_{px} = \frac{\sum F_i}{\sum w_i} w_{px}$$

WHERE:

$F_{p\text{-}max} = 0.4 * S_{DS} * w_{px} = 0.466\ w_{px}$

$F_{p\text{-}min} = 0.2 * S_{DS} * w_{px} = 0.233\ w_{px}$

DIAPHRAGM 1 (NORTH-SOUTH & EAST-WEST)

NOTE: SEISMIC COEFFICIENT AND SEISMIC BASE SHEAR ARE SAME IN BOTH DIRECTIONS
FOR DIAPHRAGM 1, ROOF WEIGHT IS CONSIDERED AS TRIBUTARY WEIGHT

LEVEL	w_{px} (k)	$\sum w_i$ (k)	F_x (k)	$\sum F_i$ (k)	$\frac{\sum F_i}{\sum w_i}$	MIN / MAX	F_{px} (k)
ROOF	18.8	18.8	3.4	3.4	0.1791	0.233	4.4

DIAPHRAGM 2 (NORTH-SOUTH & EAST-WEST)

NOTE: SEISMIC COEFFICIENT AND SEISMIC BASE SHEAR ARE SAME IN BOTH DIRECTIONS

LEVEL	w_{px} (k)	$\sum w_i$ (k)	F_x (k)	$\sum F_i$ (k)	$\frac{\sum F_i}{\sum w_i}$	MIN / MAX	F_{px} (k)
ROOF	4.4	4.4	0.8	0.8	0.1791	0.233	1.0

DIAPHRAGM 3 (NORTH-SOUTH & EAST-WEST)

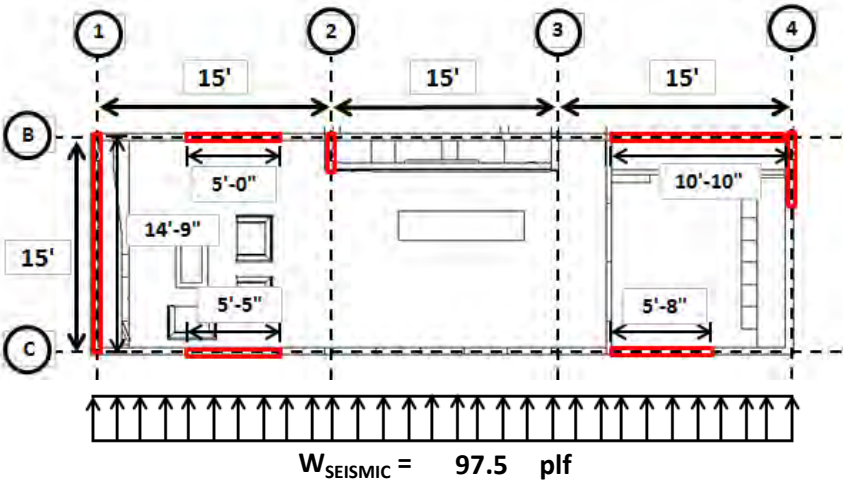
NOTE: SEISMIC COEFFICIENT AND SEISMIC BASE SHEAR ARE SAME IN BOTH DIRECTIONS

LEVEL	w_{px} (k)	$\sum w_i$ (k)	F_x (k)	$\sum F_i$ (k)	$\frac{\sum F_i}{\sum w_i}$	MIN / MAX	F_{px} (k)
ROOF	2.8	2.8	0.5	0.5	0.1791	0.233	0.6

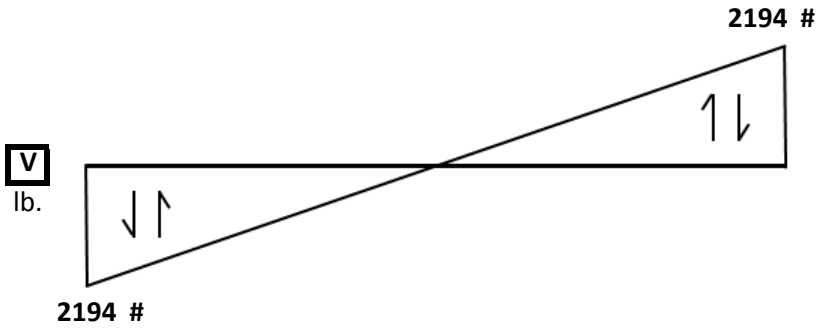
**NOTE THAT ACCELERATION VALUE FOR EACH DIAPHRAGM IS EQUIVALENT TO BASE SHEAR COEFFICIENT, C_S. THIS MAKES SENSE SINCE THERE IS ONLY ONE DIAPHRAGM LEVEL UNDER INVESTIGATION (ROOF LEVEL), SIMILAR TO SDOF STRUCTURE. THEREFORE, MINIMUM REQUIRED DIAPHRAGM FORCE GOVERNS.

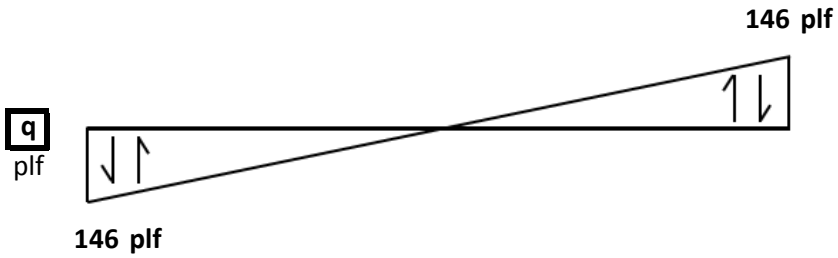
6.2 DIAPHRAGM 1 SEISMIC DESIGN (CLERESTORY ROOF)

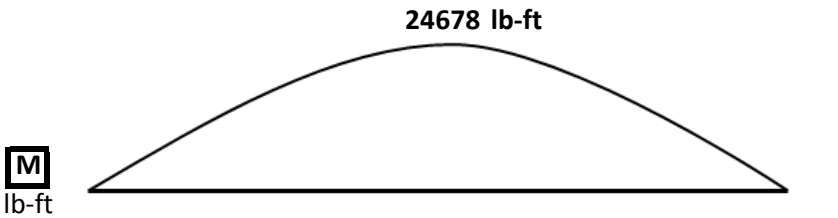
NORTH-SOUTH DIRECTION



$W_{SEISMIC}$ = 97.5 plf







FROM DIAPHRAGM DESIGN FORCES

$W_{SEISMIC} = F_{px} / L_{house}$ = 97.5 plf

1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

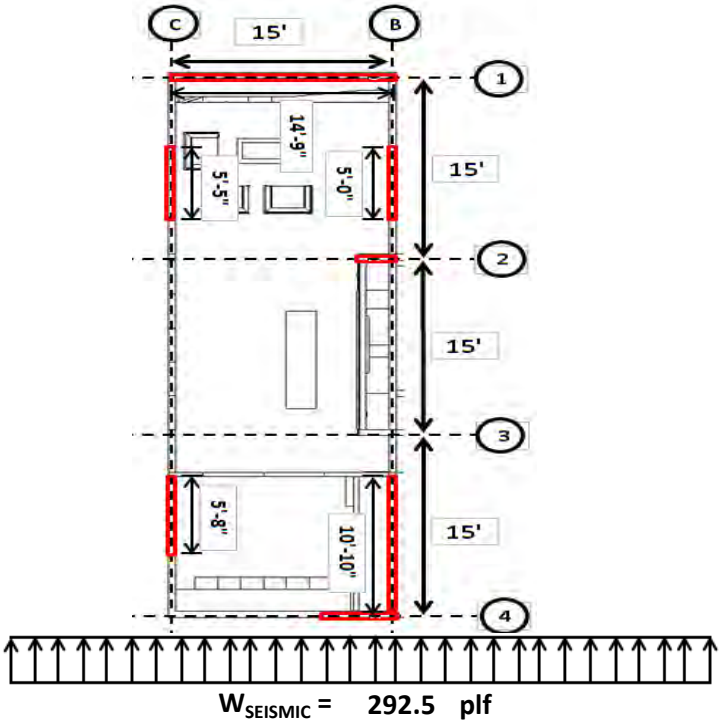
q_{allow} = 500 plf > q_U = 146 plf

2. CHORD FORCE

T = C = M / d = 1645 #

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINES 'B' AND 'C' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

EAST-WEST DIRECTION



$W_{SEISMIC}$ = **292.5 plf**

2194 #

V
lb.

2194 #

48.7 plf

q
plf

48.7 plf

8226 lb-ft

M
lb-ft

FROM DIAPHRAGM DESIGN FORCES

$W_{SEISMIC} = F_{px} / L_{house}$ = 292.5 plf

1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

q_{allow} = 500 plf > q_U = 48.7 plf

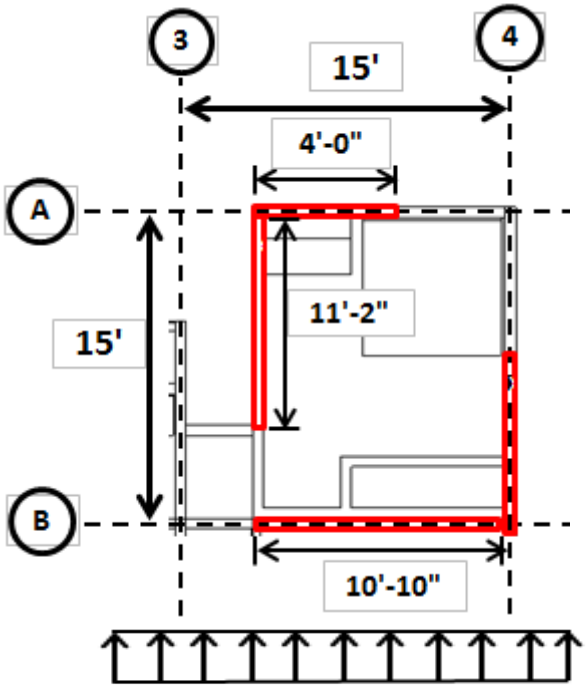
2. CHORD FORCE

T = C = M / d = 183 #

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINES 'B' AND 'C' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

6.3 DIAPHRAGM 2 SEISMIC DESIGN (BEDROOM)

NORTH-SOUTH DIRECTION



$W_{SEISMIC}$ = 93.2 plf

FROM DIAPHRAGM DESIGN FORCES

$W_{SEISMIC} = F_{px} / L_{house}$ = 93.2 plf

1. ROOF DIAPHRAGM NAILING

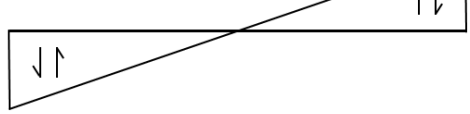
REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

q_{allow} = 500 plf > q_U = 34.2plf

513 #



V lb.

513 #

2. CHORD FORCE

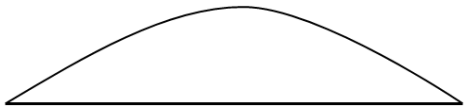
T = C = M / d = 94 #

34.2 #

q plf

34.2 #

1410 lb-ft

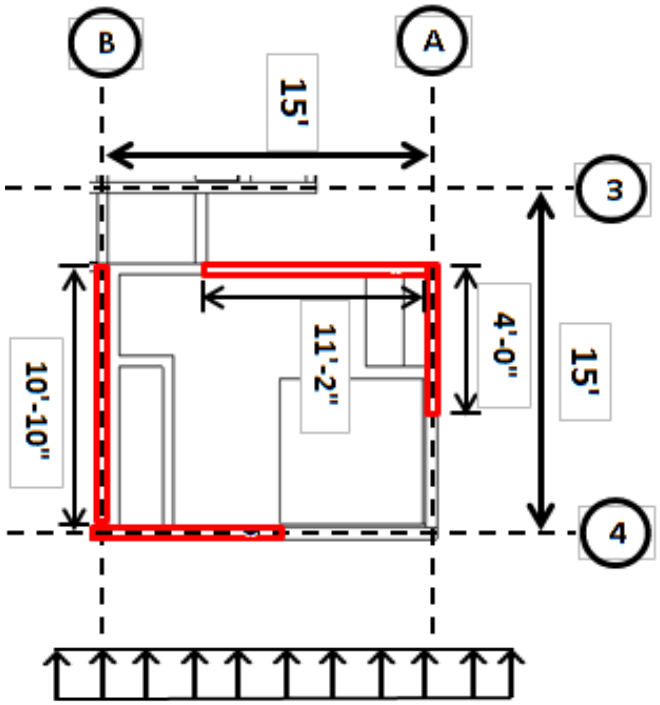


M lb-ft

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM

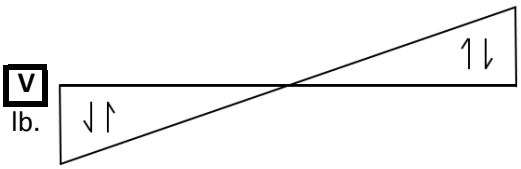
DIAPHRAGM 2 DESIGN (BEDROOM)

EAST-WEST DIRECTION



$W_{SEISMIC}$ = 68.4 plf

513 #

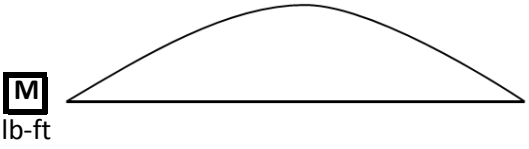


513 #

47 plf

47 plf

1922 lb-ft



FROM DIAPHRAGM DESIGN FORCES

$W_{SEISMIC} = F_{px} / L_{house}$ = 68.4 plf

1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL
DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

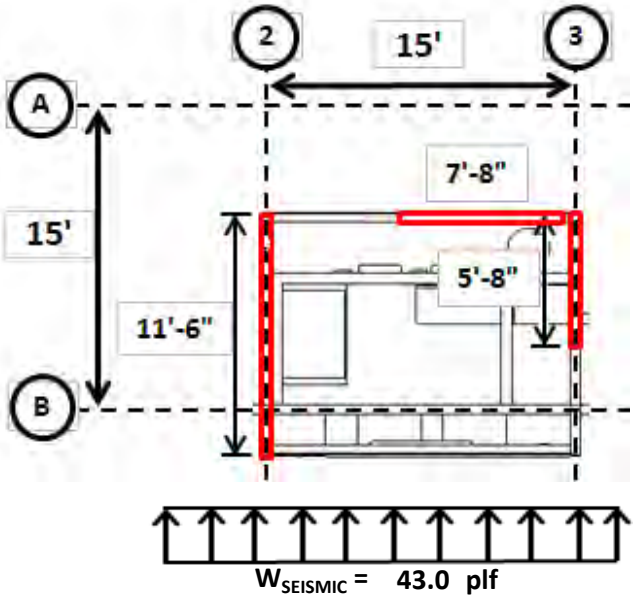
q_{allow} = 500 plf > q_U = 47 plf

2. CHORD FORCE

T = C = M / d = 175 #

6.4 DIAPHRAGM 3 SEISMIC DESIGN (MECH CORE)

NORTH-SOUTH DIRECTION



FROM DIAPHRAGM DESIGN FORCES

$W_{SEISMIC} = F_{px} / L_{house}$ = 43.0 plf

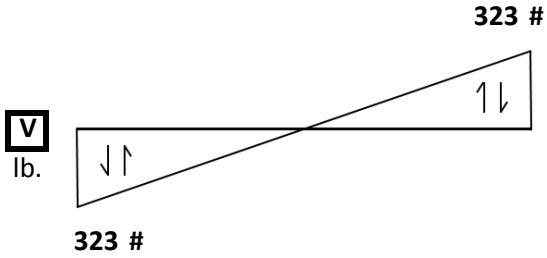
1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL
DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

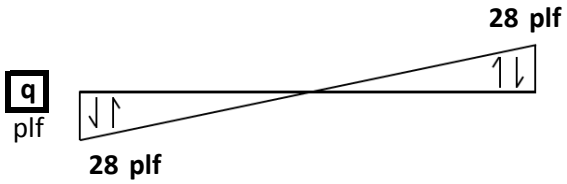
USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

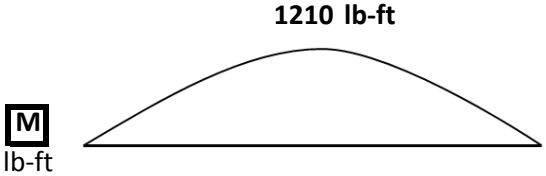
q_{allow} = 500 plf > q_U = 28plf



2. CHORD FORCE

T = C = M / d = 105 #



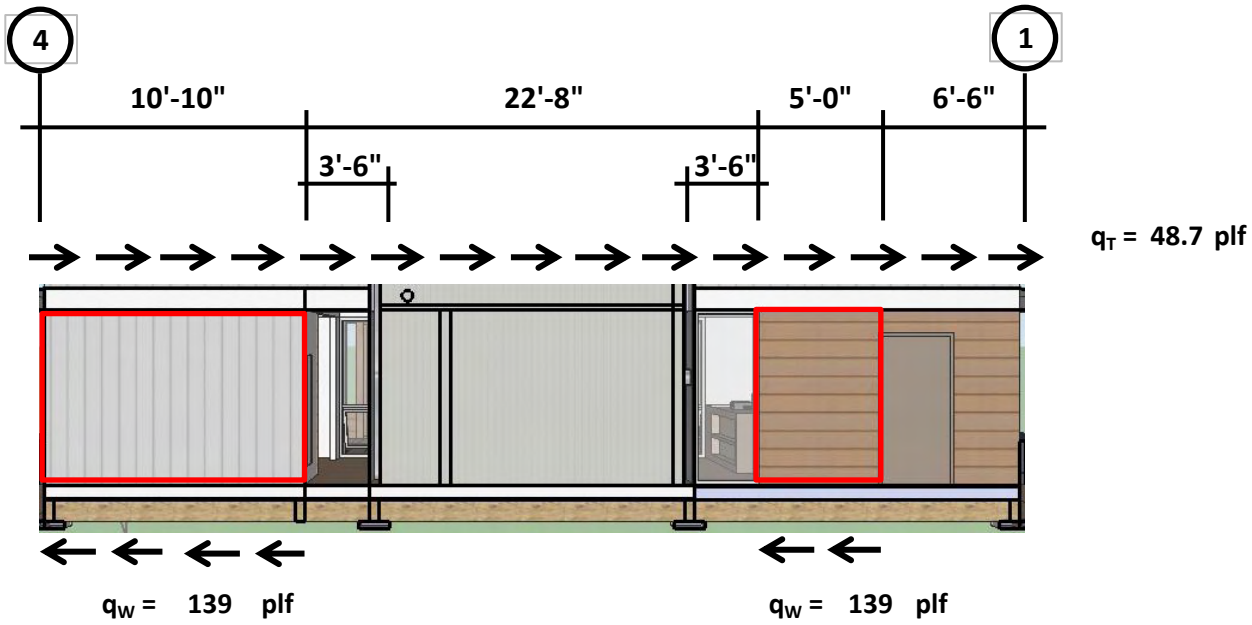


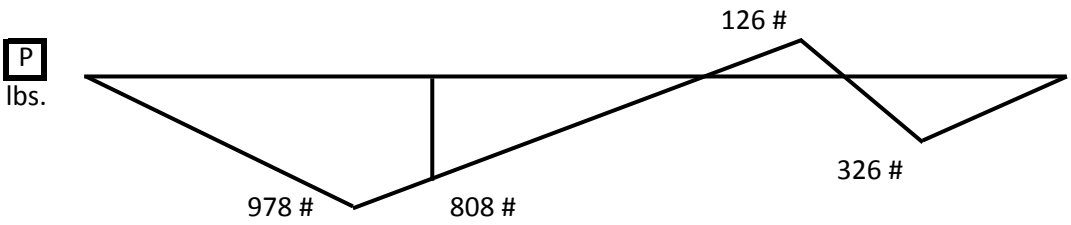
**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINE 'A' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

6.5 SEISMIC COLLECTOR SEISMIC DEMAND ANALYSIS

COLLECTER ANALYSIS AT LINE B (NORTH ELEVATION)

LINE B: q_{TOTAL} = 48.7 plf
$q_{WALL} = (1/2) * F_{PX} / L_{SHEARWALL}$: 139 plf

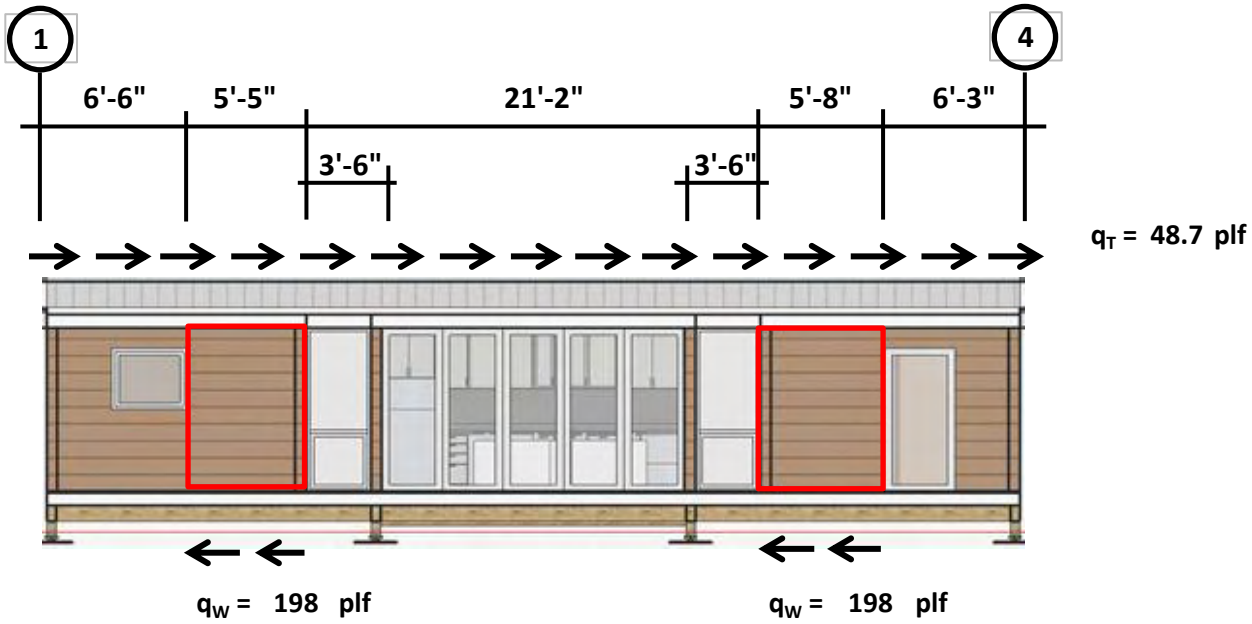


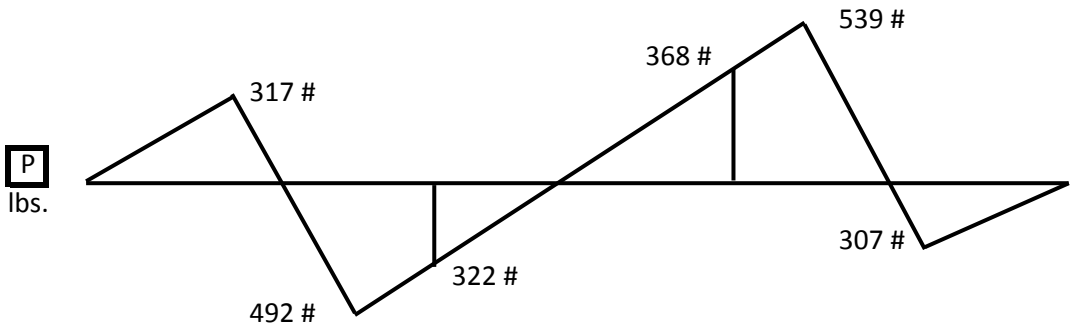


NOTES:
SIP WALLS THAT ARE CONSIDERED AS LATERAL FORCE RESISTING ARE HIGHLIGHTED IN RED
CHORD FORCES FROM NORTH-SOUTH ANALYSIS GOVERN OVER COLLECTER FORCES FROM EAST-WEST ANALYSIS

COLLECTER ANALYSIS AT LINE C (SOUTH ELEVATION)

LINE C: q_{TOTAL} = 48.7 plf
$q_{WALL} = (1/2) * F_{PX} / L_{SHEARWALL}$: 198 plf





NOTES:
SIP WALLS THAT ARE CONSIDERED AS LATERAL FORCE RESISTING ARE HIGHLIGHTED IN RED
CHORD FORCES FROM NORTH-SOUTH ANALYSIS GOVERN OVER COLLECTER FORCES FROM EAST-WEST ANALYSIS
LINES B AND C ARE ONLY DRAG/COLLECTOR LINES ANALYZED DUE TO THE FACT THAT THEY PRODUCE LOADS MUCH HIGHER RELATIVE TO LOADS OF THE OTHER DRAG/COLLECTOR LINES. WORST CASE LOADING USED TO CHECK DOUBLE TOP PLATES (2 - 2X4) THAT ARE USED FOR ENTIRE HOUSE

6.6 DIAPHRAGM FORCES-WIND

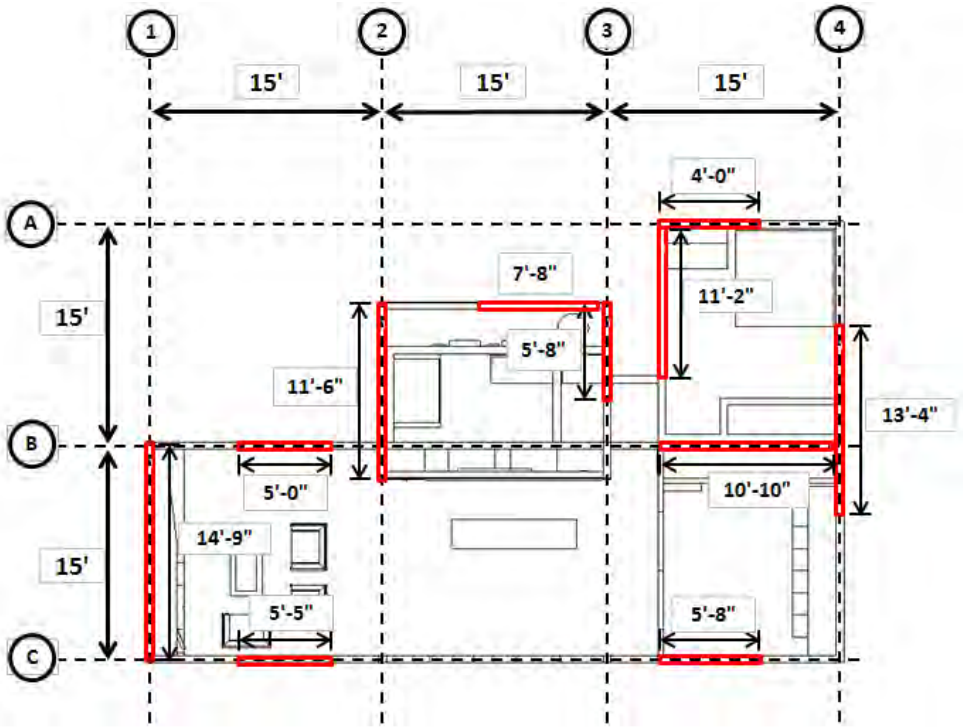
SEISMIC DESIGN PARAMETERS

S_{DS} = 1.164 g
C_S = 0.179

DESIGN BASE SHEAR

WIND:
$V_{W\text{-}NS}$ = 11.8 kips
$V_{W\text{-}EW}$ = 5.5 kips

SEISMIC:
$V_{S\text{-}NS}$ = 6.62 kips
$V_{S\text{-}EW}$ = 6.62 kips



WIND LATERAL PRESSURES (NORTH-SOUTH DIRECTION)

*DETERMINE WIND LINE LOAD APPLIED TO EACH DIAPHRAGM USING PRESSURES
*TAKE TOTAL WIND BASE SHEAR AND DISTRIBUTE BASED ON WALL FACE TRIB. AREA

$P_{WINDWARD}$ =	6.7	psf	$P_{LEEWARD}$ =	8.1	psf	P_{ROOF} =	3.2	psf (FROM N TO S)
$P_{WINDWARD}$ =	5.9	psf	$P_{LEEWARD}$ =	-2.5	psf	P_{ROOF} =	0.7	psf (FROM S TO N)

DIAPHRAGM 1

WINDWARD	LEEWARD	ROOF
A_{TRIB} = 195.0 sq ft	A_{TRIB} = 225 sq ft	A_{TRIB} = 675.0 sq ft
P_{WIND} = 6.7 psf	P_{WIND} = 8.1 psf	P_{WIND} = 3.2 psf
L_{DIAPH} = 45.0 ft		

$V_{DIAPH-1} = \Sigma(P_{WIND} * A_{TRIB}) / L_{WALL}$

$V_{DIAPH-1}$ = 118 plf

**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE

DIAPHRAGM 2

LEEWARD

A_{TRIB} = 75.0 sq ft

P_{WIND} = 8.1 psf

L_{DIAPH} = 15.0 ft

$V_{DIAPH-2} = \Sigma(P_{WIND} * A_{TRIB}) / L_{WALL}$

$V_{DIAPH-2}$ = 41 plf

**NOTE: NORTHERN FACE CONSIDERED AS LEEWARD SIDE

DIAPHRAGM 3

LEEWARD

A_{TRIB} = 55.0 sq ft

P_{WIND} = 8.1 psf

L_{DIAPH} = 11.0 ft

$V_{DIAPH-2} = \Sigma(P_{WIND} * A_{TRIB}) / L_{WALL}$

$V_{DIAPH-2}$ = 41 plf

**NOTE: NORTHERN FACE CONSIDERED AS LEEWARD SIDE

WIND LATERAL PRESSURES (EAST-WEST DIRECTION)

*DETERMINE WIND LINE LOAD APPLIED TO EACH DIAPHRAGM USING PRESSURES

*TAKE TOTAL WIND BASE SHEAR AND DISTRIBUTE BASED ON WALL FACE TRIB. AREA

$P_{WINDWARD}$ = 6.7 psf $P_{LEEWARD}$ = 6.9 psf (FROM E TO W)
(FROM W TO E)

DIAPHRAGM 1

WINDWARD	LEEWARD
A_{TRIB} = 127.5 sq ft	A_{TRIB} = 128 sq ft
P_{WIND} = 6.7 psf	P_{WIND} = 6.9 psf
L_{DIAPH} = 15.0 ft	

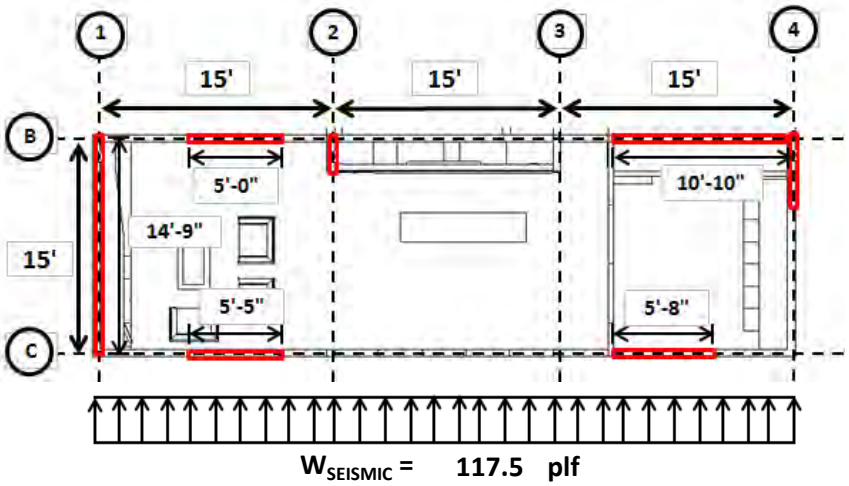
$V_{DIAPH-1} = \Sigma(P_{WIND} * A_{TRIB}) / L_{WALL}$

$V_{DIAPH-1}$ = 116 plf

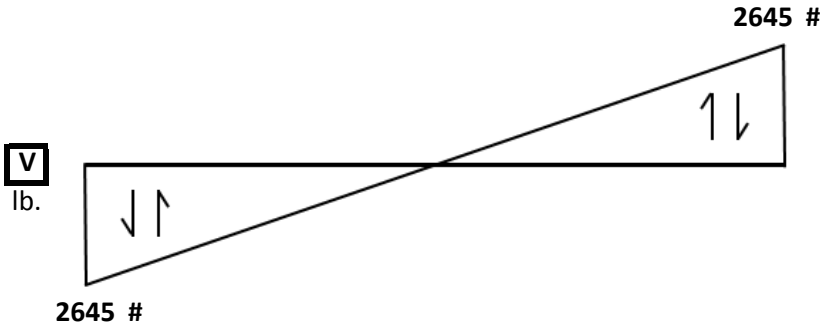
**NOTE: NORTHERN FACE CONSIDERED AS WINDWARD SIDE

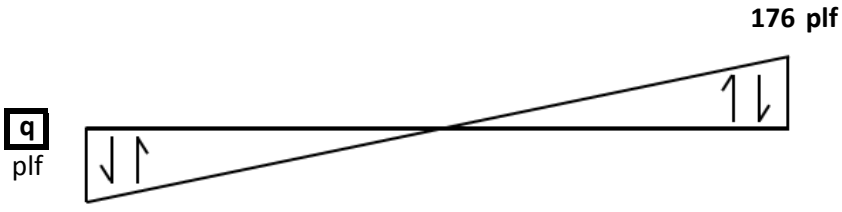
6.7 DIAPHRAGM 1 WIND DESIGN (CLERESTORY ROOF)

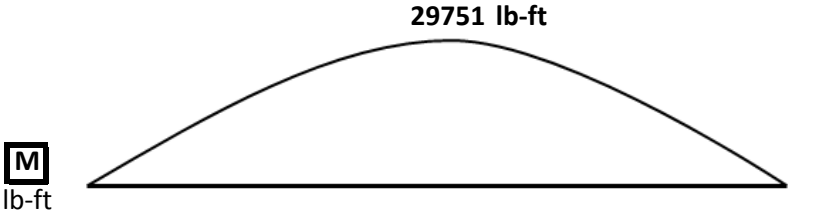
NORTH-SOUTH DIRECTION



$W_{SEISMIC}$ = 117.5 plf







FROM DIAPHRAGM DESIGN FORCES

$W_{WIND} = F_{WIND} / L_{DIAPH-1}$ = 118 plf

1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

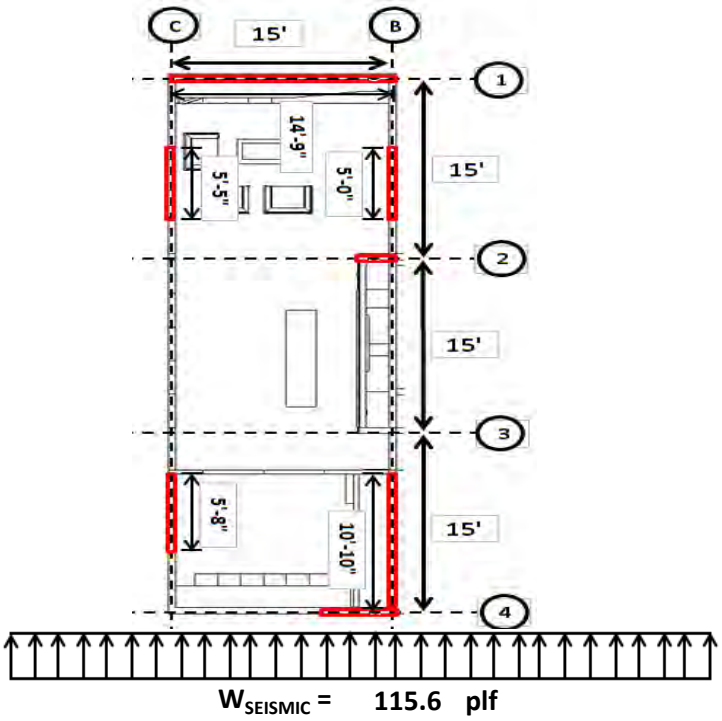
q_{allow} = 500 plf > q_U = 176 plf

2. CHORD FORCE

T = C = M / d = 1983 #

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINES 'B' AND 'C' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

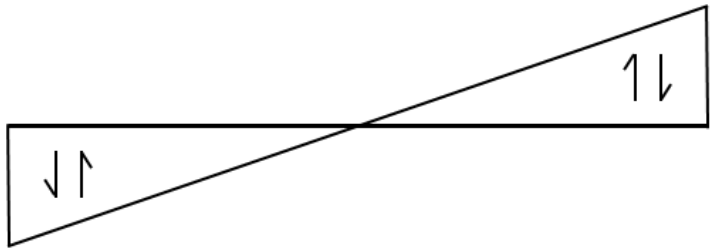
EAST-WEST DIRECTION



$W_{SEISMIC}$ = **115.6 plf**

867 #

V
lb.



867 #

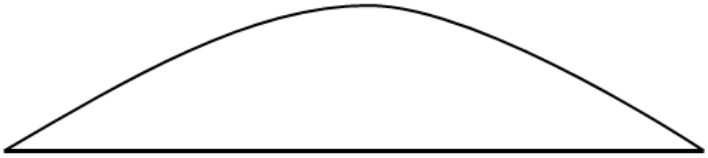
19.3 plf

q
plf

19.3 plf

3251.3 lb-ft

M
lb-ft



FROM DIAPHRAGM DESIGN FORCES

$W_{WIND} = F_{WIND} / L_{DIAPH-1}$ = 116 plf

1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

q_{allow} = 500 plf > q_U = 19.3 plf

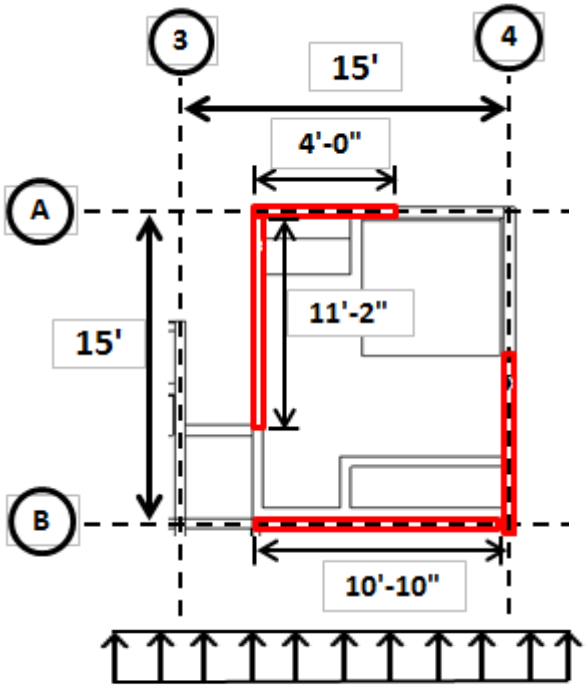
2. CHORD FORCE

T = C = M / d = 72.3 #

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINES 'B' AND 'C' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

6.8 DIAPHRAGM 2 WIND DESIGN (BEDROOM)

NORTH-SOUTH DIRECTION



$W_{SEISMIC}$ = **40.5 plf**

FROM DIAPHRAGM DESIGN FORCES

$W_{WIND} = F_{WIND} / L_{DIAPH-2}$ = 40.5 plf

1. ROOF DIAPHRAGM NAILING

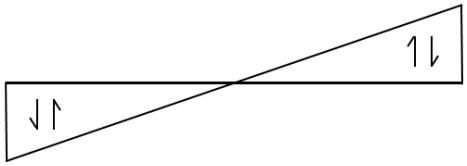
REFERENCE R-CONTROL DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

q_{allow} = 500 plf > q_U = 14.9plf

223 #



223 #

2. CHORD FORCE

T = C = M / d = 40.8 #

14.9 #

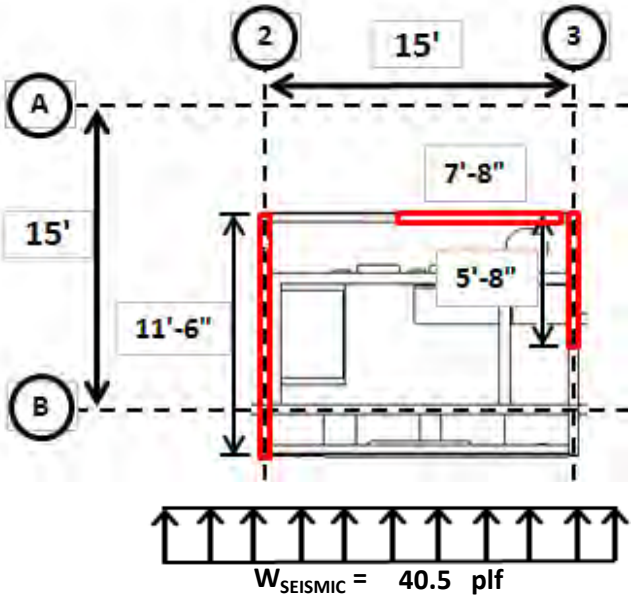
14.9 #

612.56 lb-ft

**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM

6.9 DIAPHRAGM 3 WIND DESIGN (MECH CORE)

NORTH-SOUTH DIRECTION



FROM DIAPHRAGM DESIGN FORCES

$W_{WIND} = F_{WIND} / L_{DIAPH-3}$ = 40.5 plf

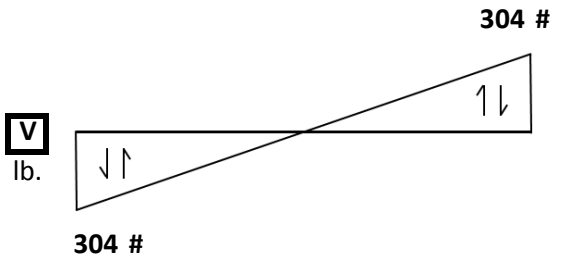
1. ROOF DIAPHRAGM NAILING

REFERENCE R-CONTROL
DIAPHRAGM DESIGN LOAD

USE R-CONTROL SCREWS @ 6" o.c. AT BOUNDARIES WHERE DIAPRAGM MEMBERS LOCATED

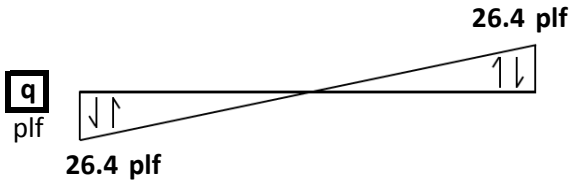
USE 8D NAILS @ 3" o.c. ALONG SPLINES ON EACH SIDE OF JOINT, STAGERRED

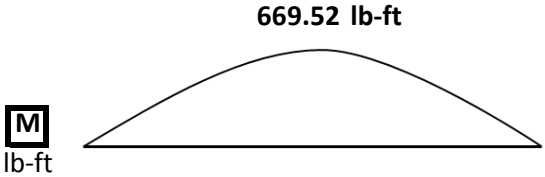
q_{allow} = 500 plf > q_U = 26.4plf



2. CHORD FORCE

T = C = M / d = 58.2 #



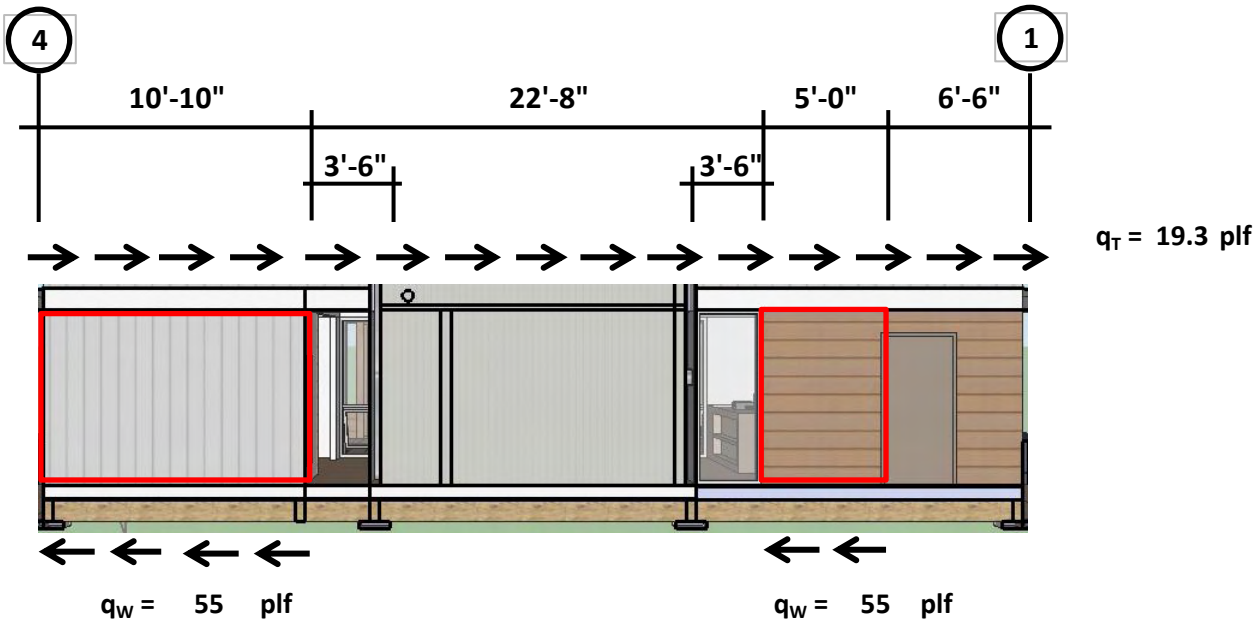


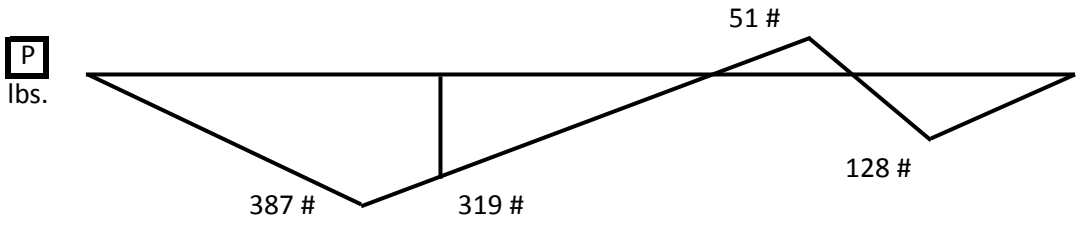
**NOTE: NORTH-SOUTH DIRECTION GOVERNS OVER EAST-WEST DIRECTION FOR DESIGN OF DIAPHRAGM. CHECK IF COLLECTOR FORCE ALONG LINE 'A' FROM EAST-WEST DIRECTION ANALYSIS GOVERN OVER CHORD FORCES FROM NORTH-SOUTH DIRECTION ANALYSIS.

6.10 COLLECTOR WIND DEMAND ANALYSIS

COLLECTER DESIGN AT LINE B (NORTH ELEVATION)

LINE B: q_{TOTAL} = 19.3 plf
$q_{WALL} = (1/2) * V_W / L_{SHEARWALL}$ = 54.8 plf



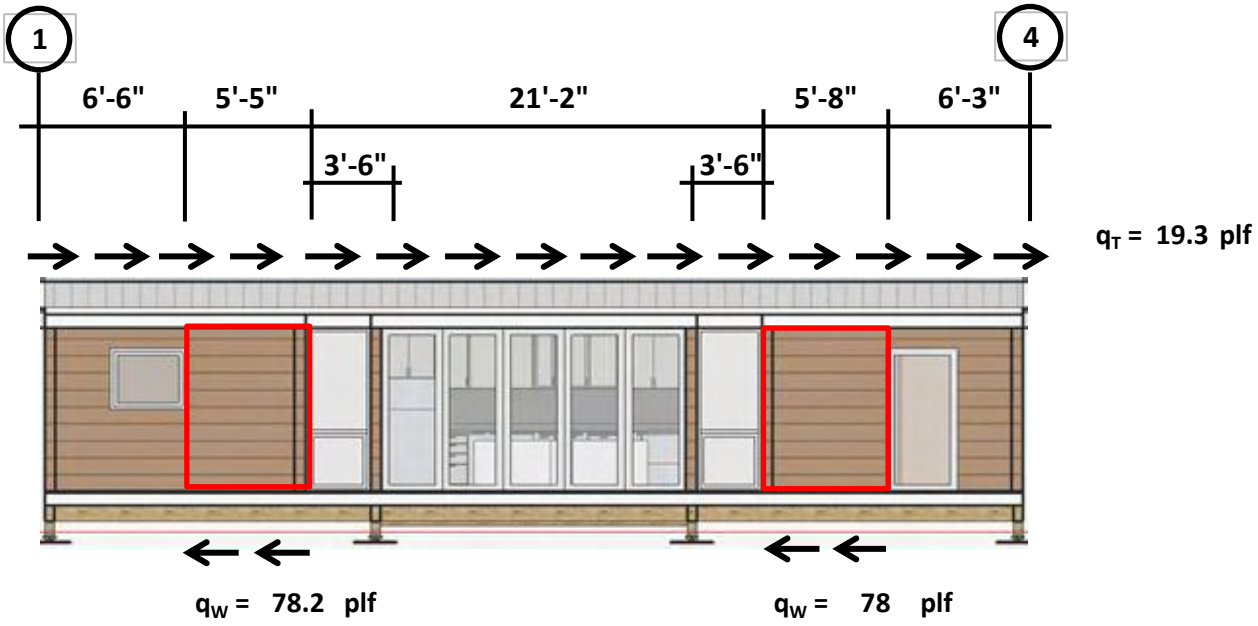


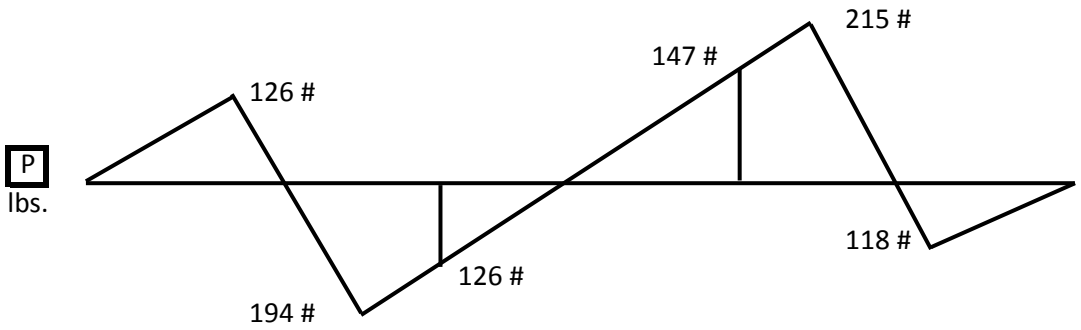
NOTES:
SIP WALLS THAT ARE CONSIDERED AS LATERAL FORCE RESISTING ARE HIGHLIGHTED IN RED
CHORD FORCES FROM NORTH-SOUTH ANALYSIS GOVERN OVER COLLECTER FORCES FROM EAST-WEST ANALYSIS

COLLECTER DESIGN AT LINE C (SOUTH ELEVATION)

LINE C: q_{TOTAL} = 19.3 plf

$q_{WALL} = (1/2) * V_W / L_{SHEARWALL}$ = 78.2 plf





NOTES:

SIP WALLS THAT ARE CONSIDERED AS LATERAL FORCE RESISTING ARE HIGHLIGHTED IN RED

CHORD FORCES FROM NORTH-SOUTH ANALYSIS GOVERN OVER COLLECTER FORCES FROM EAST-WEST ANALYSIS

LINES B AND C ARE ONLY DRAG/COLLECTOR LINES ANALYZED DUE TO THE FACT THAT THEY PRODUCE LOADS MUCH HIGHER RELATIVE TO LOADS OF THE OTHER DRAG/COLLECTOR LINES. WORST CASE LOADING USED TO CHECK DOUBLE TOP PLATES (2 - 2X4) THAT ARE USED FOR ENTIRE HOUSE

6.11 CHORD/COLLECTOR DESIGN

CHORD AND COLLECTOR DESIGN CHECK

NOTE: CHECK DOUBLE TOP PLATES (2 - 2x4) FOR WORST CASE AXIAL LOADING AND THEN APPLY THROUGHOUT ENTIRE HOUSE.

*****BY INSPECTION, DOUBLE TOP PLATES SHOULD CHECK OUT BUT CHECK ANYWAY…**

GOVERNING LOAD CRITERIA: CHORD FORCE FROM N-S WIND ANALYSIS OF DIAPHRAGM 1

DEMAND FORCES

P_U = 1983 lbs.

DEMAND STRESSES

$f_C = f_T = P_U / A$ = 378 psi

BEAM DESIGN PARAMETERS

MEMBER SIZE: 2 - 2x4 Douglas Fir Larch No. 1

A_{IND} (IN^2): 5.25

d_1 (IN)= 3.5

d_2 (IN)= 1.5

A_{TOTAL} (IN^2)= 10.5

DESIGN STRESSES

F_c (PSI)= 1500

F_t (PSI)= 675

CHECK AXIAL COMPRESSION

$F_c' = C_D C_M C_t C_F C_P F_c =$ 3600 **psi** **> f_c (OK)**

C_D =	1.6	→	*EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→	*DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→	*NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.5	→	*WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_P =	1.0	→	*CONTINUOUS LATERAL SUPPORT*	**NDS 2005, SECT 4.3.10**

CHECK AXIAL TENSION

$F_t' = C_D C_M C_t C_F F_t =$ **1620** **psi** **> f_t (OK)**

C_D =	1.6	→	*EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→	*DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→	*NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.5	→	*WIDTH OF 2" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**

DESIGN SPLICE

*IBC TABLE 2304.9.1: AT LEAST 8-16d PENNY NAILS

TRY 10-16d COMMON WIRE NAILS

Z = 141 lb → *FROM NDS TABLE 11N*

$T_{SPLICE} = Z*C_D*(\#\ NAILS) = 2256$ lb

$C_D =$ 1.6

NAILS= 10

d = 0.162 in.

T_{SPLICE} = 2256 lb > T_U = 1983 lb

USE 2x4 DOUBLE TOP PLATE W/ 10-16d (2-1/2" x 0.162") LAP SPLICE

start.home

7.0 FOUNDATION DESIGN

7.1 DECK FLOOR JOIST DESIGN

ANALYSIS

→ *FLOOR BEAMS SUPPORTING THE OUTDOOR DECK*

Tributary Width = 15 in

Beam Length = 14.5 ft

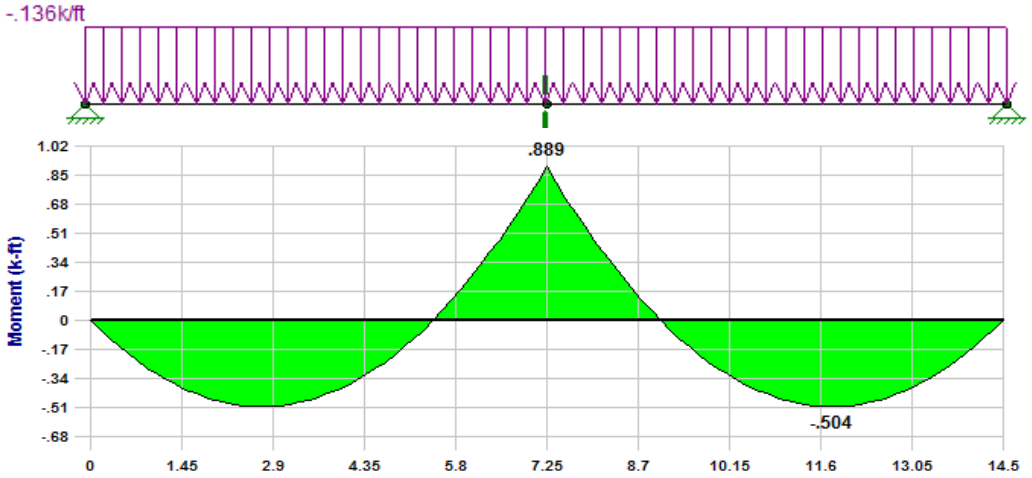
Dead Load = 9 psf

w_D = 11 plf

Live Load = 100 psf

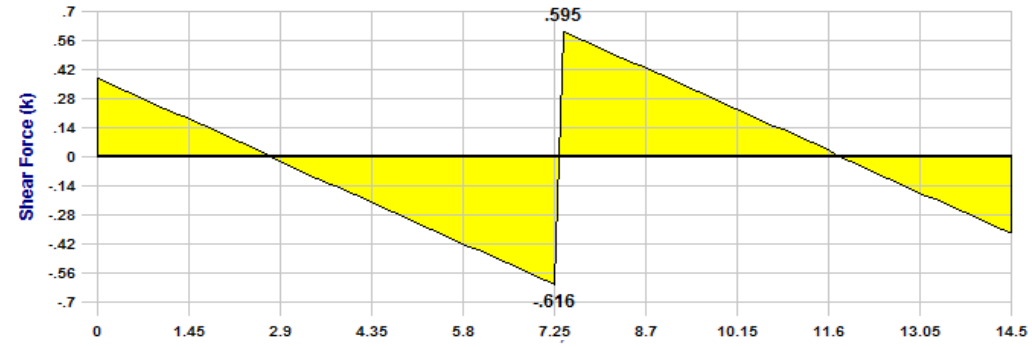
w_L = 125 plf

→ *USING ASD LOAD COMBINATION D+L IN RISA*



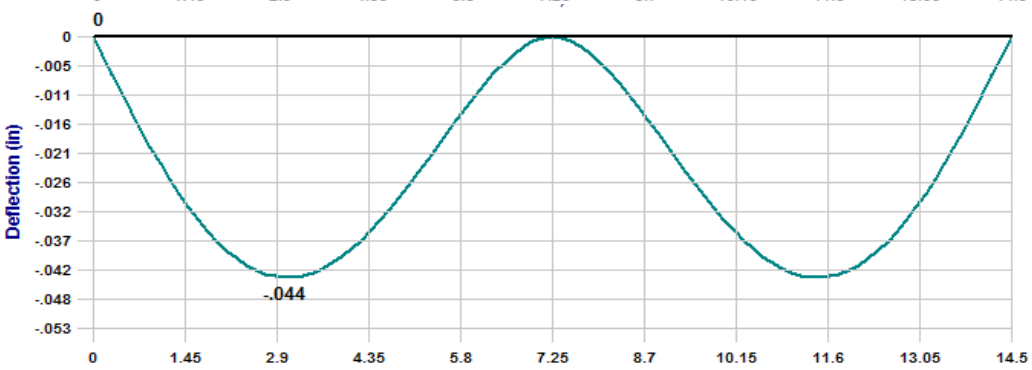
M_u = 0.889 kip-ft

= **10668 lb-in**



V_u = 0.616 kips

= **616 lb**



Δ_L = **0.040 in**

Δ_{D+L} = **0.044 in**

DESIGN

→ *USING DOUGLAS FIR-LARCH NO. 1, 2X8 SIZE JOIST*

F_b = 1000 psi A = 10.88 in2

F_v = 180 psi S_{xx} = 13.14 in3

E = #########

CHECK FLEXURE

$f_b = \frac{M}{S} =$ 812 psi

$F_b' = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r =$ 1404 psi > f_b (OK)

C_D = 0.9 → *PERMENANT LOADING*

C_M = 1.0 → *DRY-SERVICE CONDITION*

C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*

C_L = 1.0 → *LATERALLY SUPPORTED BY DECKING*

C_F = 1.5 → *FACTOR FOR 2X4 DIMENSION LUMBER*

C_{fu} = 1.0 → *FACTOR FOR 2X4 DIMENSION LUMBER*

C_i = 1.0 → *NO INCISIONS*

C_r = 1.04 → *15" SPACING OF JOISTS*

CHECK SHEAR

$f_v = \frac{1.5V}{A} =$ 85 psi

$F_v' = F_v C_D C_M C_t C_i =$ 162 psi > f_v (OK)

C_D = 0.9 → *PERMENANT LOADING*

C_M = 1.0 → *DRY-SERVICE CONDITION*

C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*

C_i = 1.0 → *NO INCISIONS*

CHECK DEFLECTION

$\Delta_{L,\,ALLOW} = \frac{L}{240} =$ 0.725 in > Δ_L (OK)

$\Delta_{D+L,\,ALLOW} = \frac{L}{360} =$ 0.483 in > Δ_{D+L} (OK)

DETERMINE JOIST HANGER FOR JOIST-BEAM CONNECTION

****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 62)**

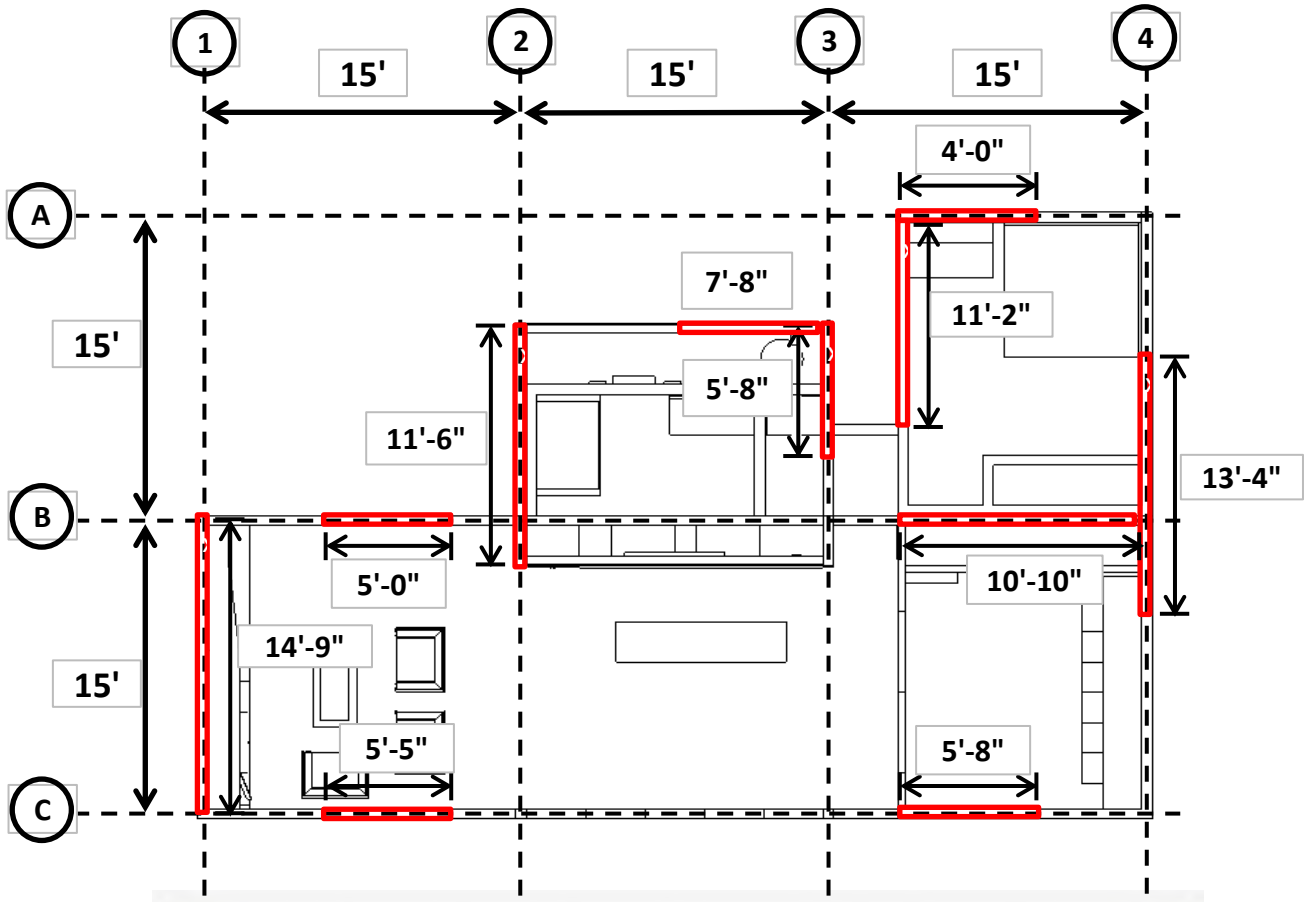
V_{allow} = 805 lbs. > V_U = 616 lbs. (OK)

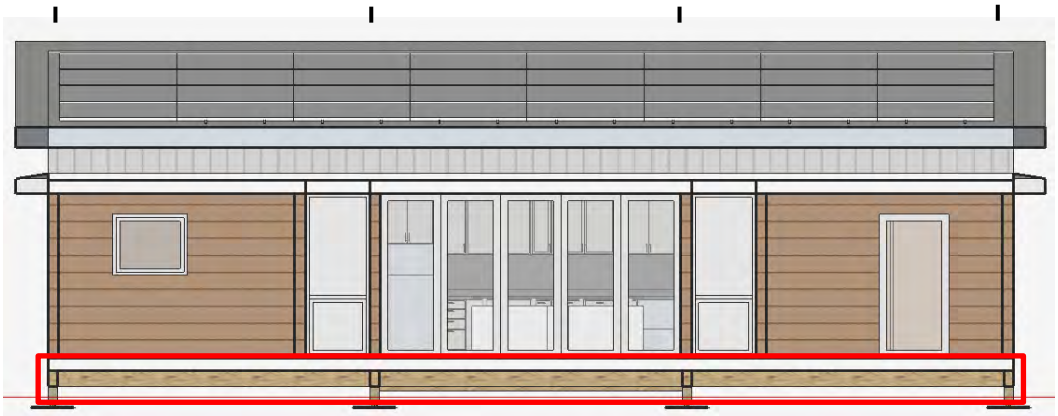
USE HU28 FACE MOUNT HANGER, WITH 6-16d NAILS

USE 2X8 DOUGLAS FIR-LARCH NO.1 JOISTS @ 15" O.C. FOR THE DECK

7.2 FOUNDATION BEAM DESIGN

→ *CONTROLLING BEAM OCCURS AT GRIDLINE C, FORCES INPUT INTO RISA INCLUDING DEAD, LIVE, AND SEISMIC*





DESIGN

→ *USING PARALLAM BEAMS SIZE 5-1/4x9-1/4*

F_b = 2900 psi A = 48.56 in2

F_v = 290 psi S_{xx} = 74.87 in3

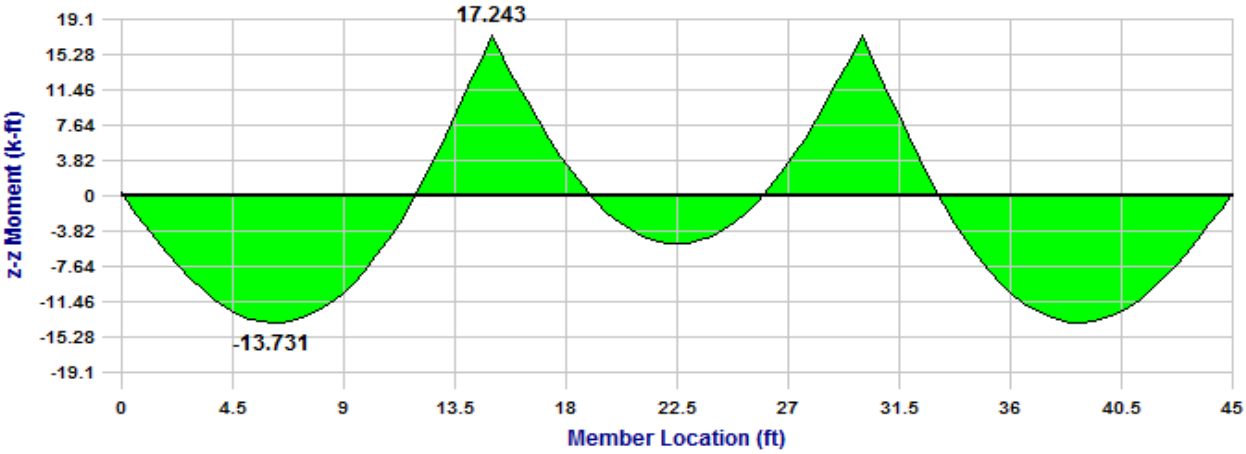
F_c = 2900 psi

LOAD COMBINATION: D+L

****MEMBER 3 (M3) GOVERNS DESIGN. PLEASE REFER TO APPENDIX A.4 FOR STRUCT. ANALYSIS RESULTS**

CHECK FLEXURE

$f_b = \frac{M}{S} = 2764$ psi

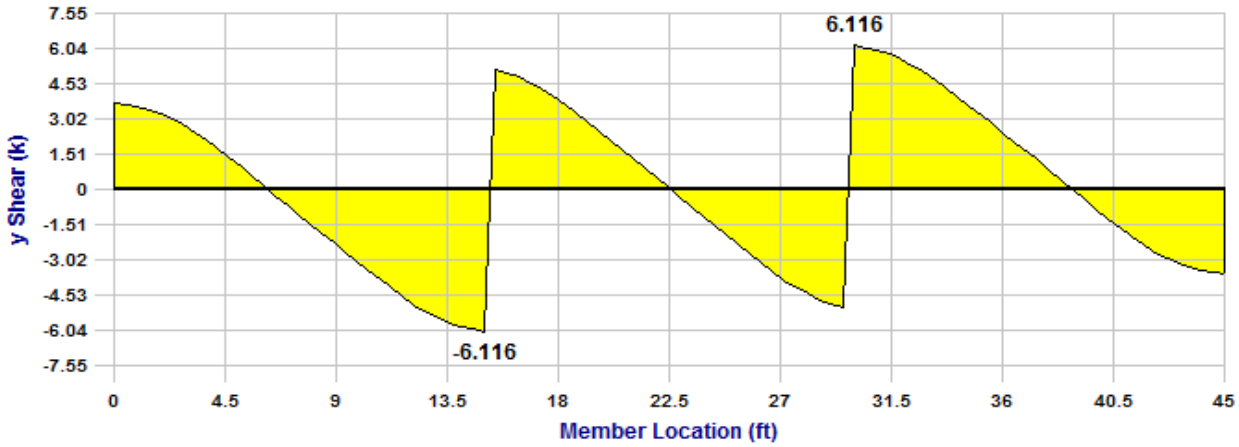


$F_b' = F_b C_D C_M C_t C_L C_V C_r =$ **2985 psi > f_b (OK)**

C_D = 1.0 → *EARTHQUAKE LOAD*
C_M = 1.0 → *DRY-SERVICE CONDITION*
C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*
C_L = 1.0 → *LATERALLY SUPPORTED BY SIP FLOOR*
C_V = 1.0 → *VOLUME FACTOR FOR PSL* $\left[\frac{12}{d}\right]^{0.111}$
C_r = 1.0 → *LARGER SPACING THAN 24 INCHES*

CHECK SHEAR SHEAR

$f_v = \frac{1.5V}{A} = 189$ lb



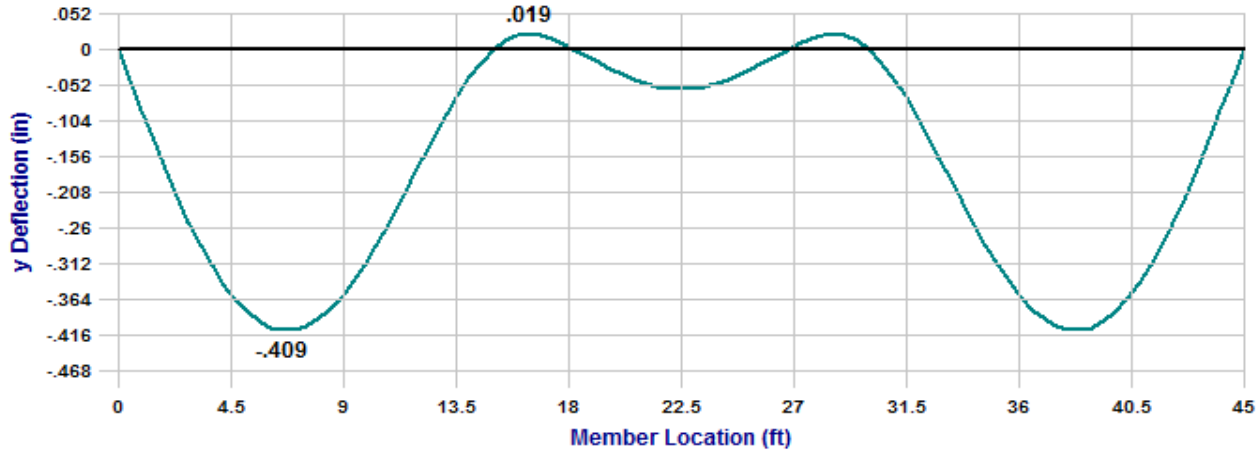
$F_v' = F_v C_D C_M C_t =$ **290 lb > f_v (OK)**

C_D = 1.0 → *PERMENANT LOADING*
C_M = 1.0 → *DRY-SERVICE CONDITION*
C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*

CHECK DEFLECTION

→ *CHECKING LIVE LOAD DEFLECTION ONLY BECAUSE IT WILL CONTROL*

Δ_L = 0.409 in



$\Delta_{L,\,ALLOW} = \frac{L}{240} =$ **0.750 in > Δ_L (OK)**

→ *LENGTH OF 15 FT USED WHICH IS DISTANCE BETWEEN FOOTINGS*

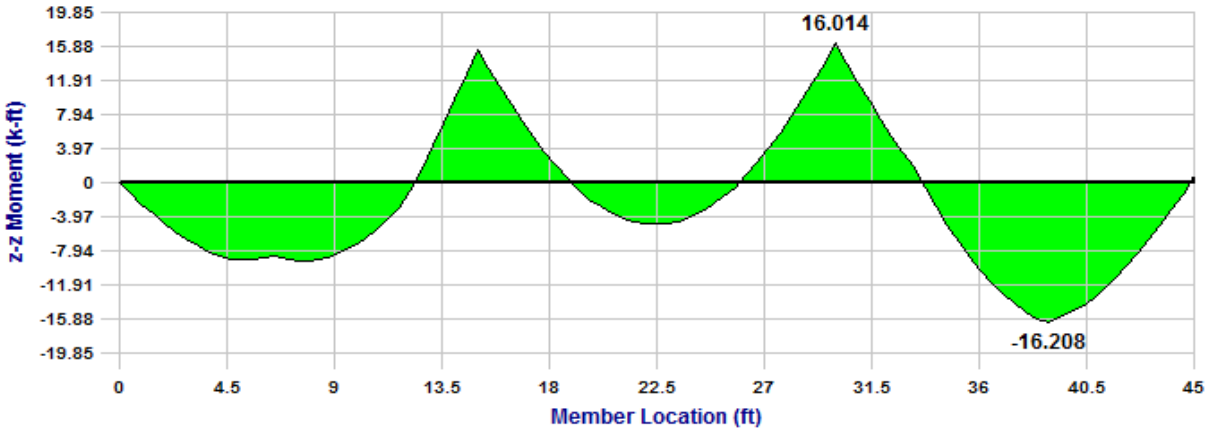
LOAD COMBINATION: D+0.75(0.7E)+0.75L+0.75Lr

****MEMBER 3 (M3) GOVERNS DESIGN. PLEASE REFER TO APPENDIX A.4 FOR STRUCT. ANALYSIS RESULTS**

→ *SEISMIC LOADS INPUT FOR SHEARWALLS INCLUDING OVERTURNING INCREASED BY OVERSTRENGTH FACTOR OF 3 IN RISA*

CHECK FLEXURE

$f_b = \frac{M}{S} =$ 2598 psi



$F_b' = F_b C_D C_M C_t C_L C_V C_r =$ **4776 psi > f_b (OK)**

C_D = 1.6 → *EARTHQUAKE LOAD*

C_M = 1.0 → *DRY-SERVICE CONDITION*

C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*

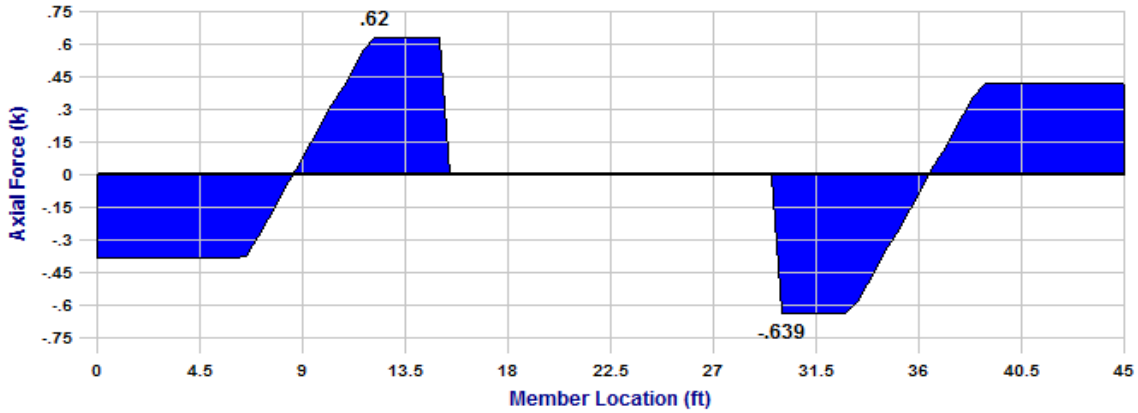
C_L = 1.0 → *LATERALLY SUPPORTED BY SIP FLOOR*

C_V = 1.0 → *VOLUME FACTOR FOR PSL* $\left[\frac{12}{d}\right]^{0.111}$

C_r = 1.0 → *LARGER SPACING THAN 24 INCHES*

CHECK AXIAL

$f_c = \frac{P}{A} =$ 13 psi



$F_c' = F_c C_D C_M C_t C_P =$ **4640 psi > f_b (OK)**

C_D = 1.6 → *EARTHQUAKE LOAD*
C_M = 1.0 → *DRY-SERVICE CONDITION*
C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*
C_P = 1.0 → *MEMBER SUPPORTED THROUGHOUT LENGTH*

COMBINED AXIAL AND COMPRESSION:

$$\left(\frac{f_c}{F'_c}\right)^2 + \left(\frac{1}{1 - {f_c}/{F_{cEx}}}\right)\frac{f_{bx}}{F'_{bx}} =$$ **0.55 < 1.0 (OK)**

f_c = 13 psi
F'_c = 4640 psi
f_{bx} = 2598 psi
F'_{bx} = 4776 psi

NOTE: BEAM IS CONTINUOUSLY SUPPORTED ABOUT BOTH AXES, PREVENTING POTENTIAL BUCKLING. THEREFORE, F_{cE1} IS INFINITELY LARGE SINCE SLENDERNESS IS BASICALLY ZERO. AS A

USE 5-1/4x9-1/4 PARALLAM STRAND LUMBER AS FLOOR BEAMS

DETERMINE JOIST HANGER FOR JOIST-BEAM CONNECTION

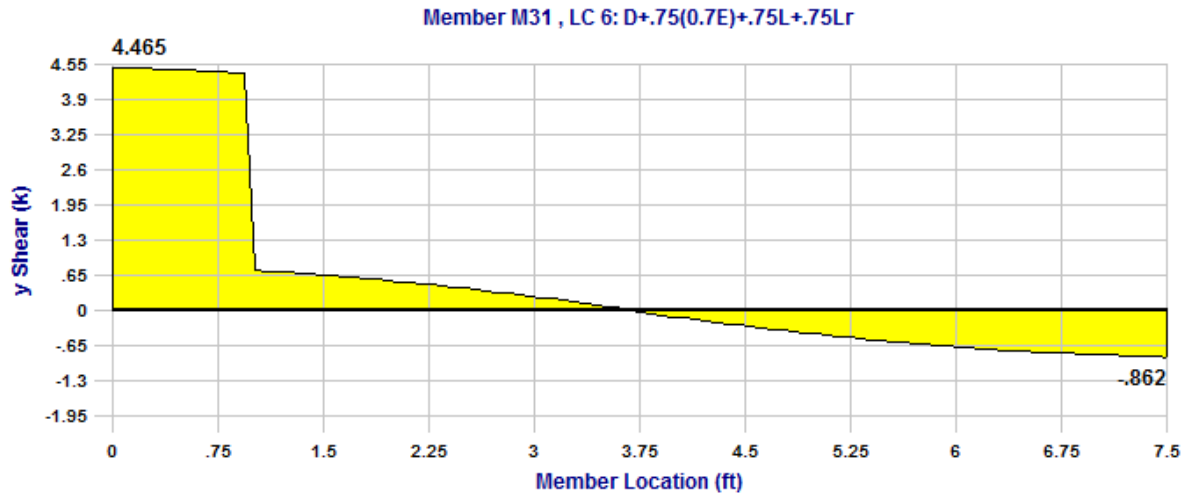
****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 88)**

V_{allow} = 8780 lbs. > V_U = 4465 lbs. (OK)
V_{uplift} = 3630 lbs. > V_U = 2365 lbs. (OK)

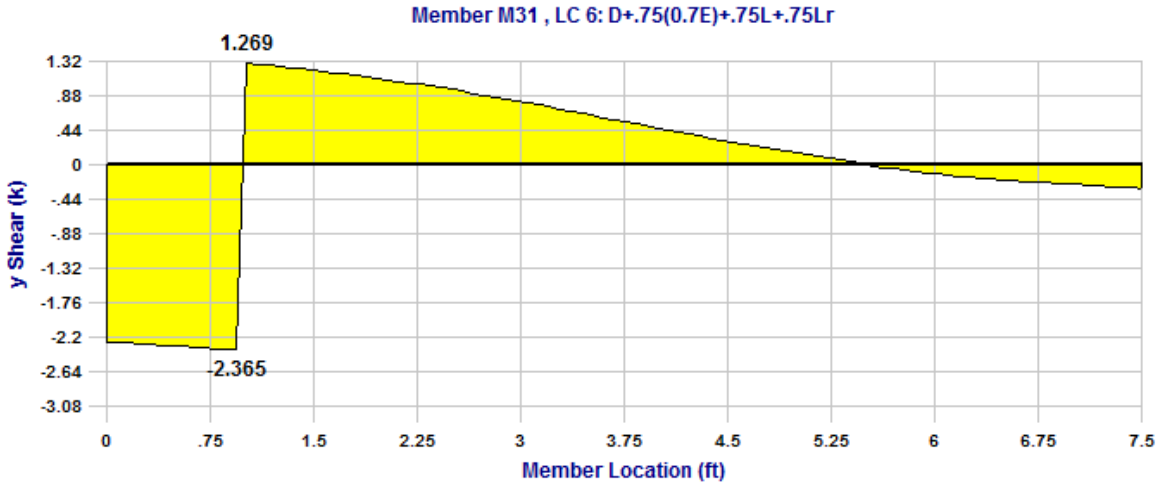
USE HGUS5.50/10 (12 Ga) FACE MOUNT HANGER, WITH 46-16d NAILS INTO FACE AND 16-16d NAILS INTO PSL BEAM

NOTE: PARALLAM STRAND LUMBER BEAM RUNNING IN THE EAST-WEST DIRECTION ARE CONTINUOUS ALONG ENTIRE LENGTH. THEREFORE, ONLY THE 7.5' PSL BEAMS WILL REQUIRE FACE MOUNT HANGERS CONNECTING TO THE EAST-WEST PSL BEAMS. GRAVITY AND UPLIFT SHEAR DEMAND LOADS ARE TAKEN FROM MEMBERS SHOWN BELOW

SHEAR DEMAND IN DOWNWARD DIRECTION



UPLIFT SHEAR DEMAND



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8.0 PERGOLA DESIGN

8.0 PERGOLA DESIGN CHECK

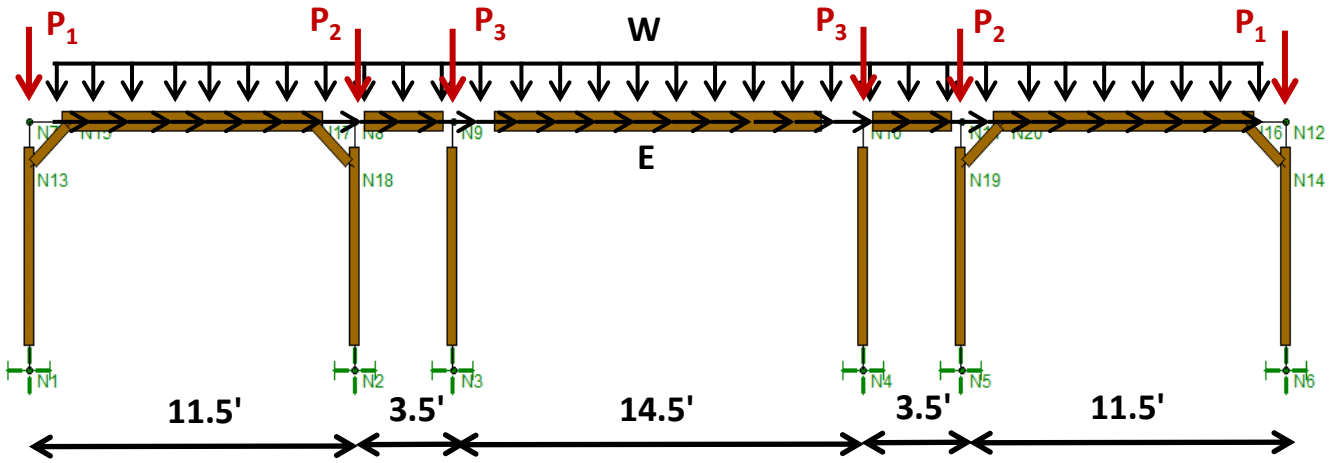
DESIGN DEAD-LOAD VALUES

DECK ROOF = 10 psf

DESIGN LIVE-LOAD VALUES

DECK ROOF = 20 psf

RISA MODEL AND ANALYSIS



DEAD LOADS

$P_{1\text{-}DL}$ = (7.5')*(11.5'/2)*10 psf = 431 lbs.

$P_{2\text{-}DL}$ = (7.5')*(11.5'+3.5')/2*10 psf 563 lbs.

$P_{3\text{-}DL}$ = (7.5')*(14.5'+3.5')/2*10 psf 675 lbs.

$W_{DL} = DL*L_{TRIB}$ = 10 psf * 2ft = 20 plf

DEAD LOADS

$P_{1\text{-}LL}$ = (7.5')*(11.5'/2)*20 psf = 863 lbs.

$P_{2\text{-}LL}$ = (7.5')*(11.5'+3.5')/2*20 psf 1125 lbs.

$P_{3\text{-}LL}$ = (7.5')*(14.5'+3.5')/2*20 psf 1350 lbs.

$W_{LL} = LL*L_{TRIB}$ = 20 psf * 2ft 40 plf

SEISMIC LOAD

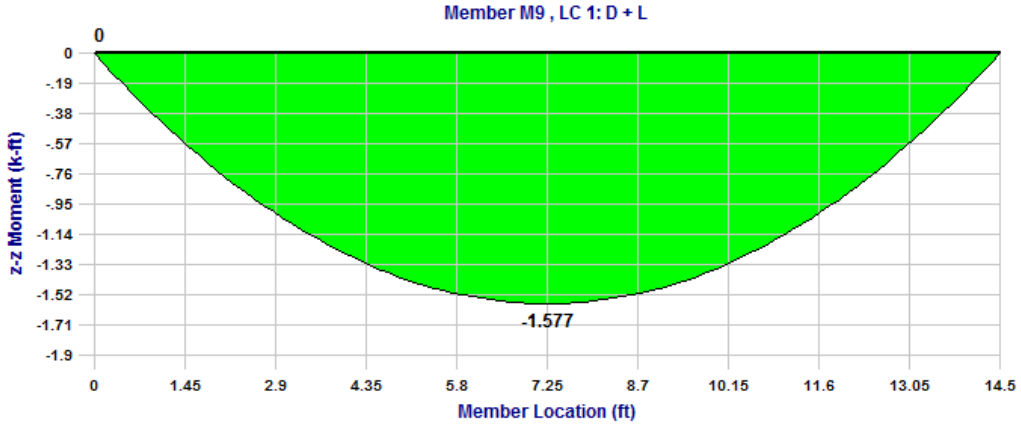
$E = W_{PERGOLA}*C_S / L_{PERGOLA}$ = (45'*7.5')*(10 psf)*(0.1791)/44.5 13.6 plf

DESIGN CHECK - 14.5' BEAM

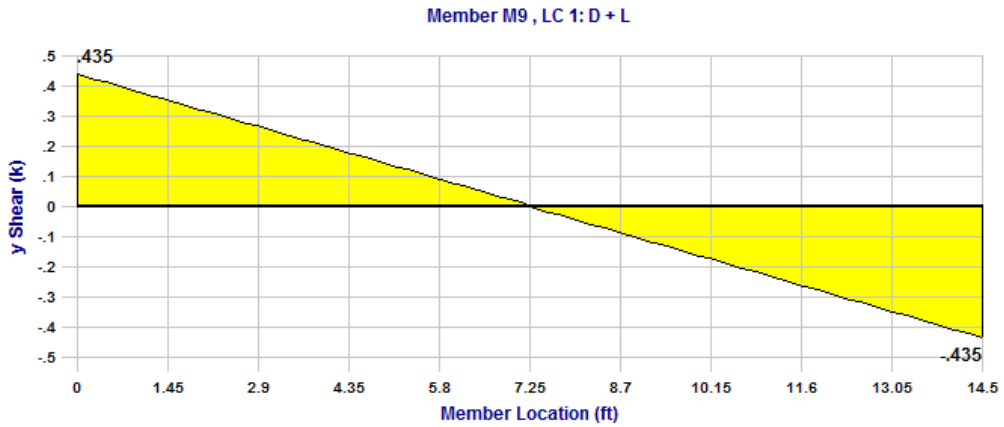
GOVERNING LOAD COMBINATION: **D + L**

****PLEASE REFERENCE APPENDIX A.5 FOR STRUCTURAL ANALYSIS RESULTS**

FLEXURAL MOMENT DIAGRAM (RISA):



SHEAR DIAGRAM (RISA):



DEMAND FORCES

M_U = 1577 lb-ft

P_U = 25 lbs.

V_U = 435 lbs.

BEAM DESIGN PARAMETERS

MEMBER SIZE: 4x8 REDWOOD No. 1

A (IN^2)=	25.4
I_x (IN^4)=	111
I_y (IN^4)=	25.9
S_x (IN^3)=	30.7
S_y (IN^3)=	14.8
d_1 (IN)=	7.25
d_2 (IN)=	3.5

DEMAND STRESSES

$f_B = M_U / S_X =$ 617 psi

$f_C = f_T = P_U / A =$ 0.99 psi

$f_V = 1.5V_U / A =$ 26 psi

DESIGN STRESSES

F_{bx} (PSI)=	975	F_t (PSI)=	575
F_{by} (PSI)=	975	E_{MIN} (PSI)=	400000
F_c (PSI)=	1200	E_X (PSI) =	1100000
F_{VX} (psi)=	160		

CHECK SHEAR

$F_v' = C_D C_M C_t F_{vx} =$ **144 psi** **> f_V (OK)**

C_D =	0.9	→ *DEAD LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**

CHECK FLEXURE

$F_b' = C_D C_M C_t C_F C_L F_{bx} =$ **1090 psi** **> f_b (OK)**

C_D =	0.9	→ *DEAD LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_L =	0.96	→ $C_L = \frac{1+(\frac{F_{bE}}{F^*_b})}{1.9} - \sqrt{[\frac{1+(\frac{F_{bE}}{F^*_b})}{1.9}]^2 - \frac{(\frac{F_{bE}}{F^*_b})}{0.95}}$	**NDS 2005, SECT 4.3.5**

→ $l_e = 2.06 l_u =$ 358 in. **TABLE 3.3.3**

→ $R_B = \sqrt{\frac{l_e d}{b^2}} =$ 14.6 **NDS 2005, EQ 3.3-5**

→ $F_{bE} = \frac{1.20 E_{min}}{{R_B}^2} =$ 2263 psi

→ $F_b^* = C_D C_M C_t C_F F_{bx} =$ 1141 psi

→ $(F_{bE}/F_b^*) =$ 1.98

CHECK AXIAL COMPRESSION

$F_c' = C_D C_M C_t C_F C_P F_c =$ **130 psi** **> f_c (OK)**

C_D =	0.9	→ *DEAD LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_P =	0.09	→ $C_P = \frac{1+(\frac{F_{cE}}{F^*_c})}{2c} - \sqrt{[\frac{1+(\frac{F_{cE}}{F^*_c})}{2c}]^2 - \frac{(\frac{F_{cE}}{F^*_c})}{c}}$	**NDS 2005, SECT 4.3.10**

→ $l_e = (K_e)l =$ 174 in. **NDS 2005, SECT 3.7.1**

→ $c = 0.8\ (sawn\ lumber) =$ 0.8

→ $F_{cE} = \frac{0.822E_{min}}{(l_e/d)^2} =$ 133 psi

→ $F_c^* = C_D C_M C_t C_F F_c =$ 1404 psi

→ $(F_{cE}/F_c^*) =$ 0.09

CHECK AXIAL TENSION

$F_t' = C_D C_M C_t C_F F_t =$ **673 psi** **> f_t (OK)**

C_D =	0.9	→ *DEAD LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**

CHECK COMBINED BENDING AND AXIAL TENSION

$$\frac{f_t}{F'_t} + \frac{f_{bx}}{F'_{bx}} = \frac{0.99}{673} + \frac{617}{1141} = \mathbf{0.57} \quad \mathbf{< 1.0\ (OK)}$$

$$\frac{f_b - f_t}{F^{**}_b} = \frac{617 - 0.99}{1141} = \mathbf{0.57} \quad \mathbf{< 1.0\ (OK)}$$

CHECK COMBINED BENDING AND AXIAL COMPRESION

$$\left(\frac{f_c}{F'_c}\right)^2 + \left(\frac{1}{1 - {f_c}/{F_{cEx}}}\right)\frac{f_{bx}}{F'_{bx}} = \mathbf{0.57} \quad \mathbf{< 1.0\ (OK)}$$

CHECK DEFLECTION

****PER IBC**

Δ_{LIMIT} = L / 240 = 0.73 in.

$$\Delta_L = \frac{5W_L L^4}{384EI} = \quad \mathbf{0.33\ in.\ (OK)}$$

DETERMINE END COLUMN CAP SIZE AND SPECIFICATION

****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 56)**

FOR 4x MAIN BEAM, 4x POST, 4x SIDE BEAM USE CCCTQ444SDS WITH FOLLOWING DIMENSIONS: H_1 = 7", H_2 = 7", W_1= 3-5/8", W_2= 3-5/8", W_3= 3-5/8". DETERMINE "L" FROM SIMPSON-STRONG TIE

MAIN BEAM:

$V_{n\text{-}uplift}$ = **4910 lbs** **> $V_{u\text{-}uplift}$: 435 lbs (OK)**

SIDE BEAM:

$V_{n\text{-}uplift}$ = **2359 lbs** **> $V_{u\text{-}uplift}$: 1890 lbs (OK)**

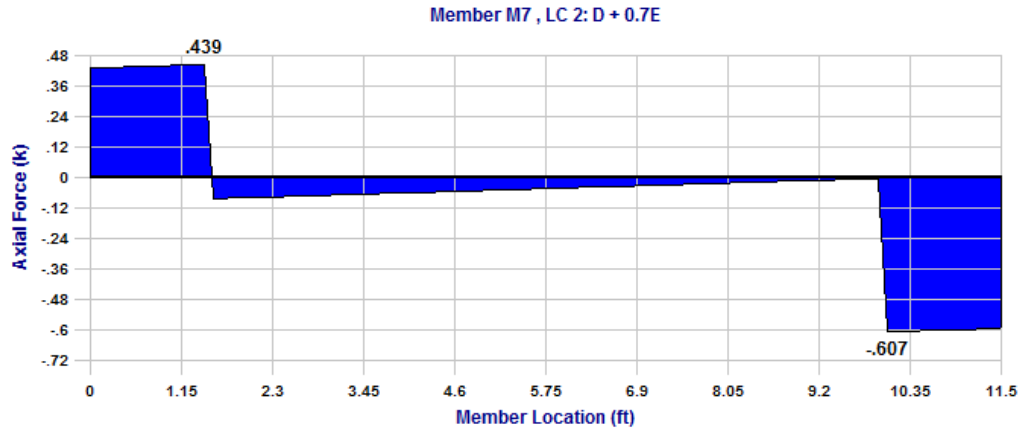
USE 4 x 8 REDWOOD BEAM No.1 (SAWN LUMBER) FOR MAIN GRAVITY SYSTEM OF PERGOLA.

DESIGN CHECK - 11.5' BEAM

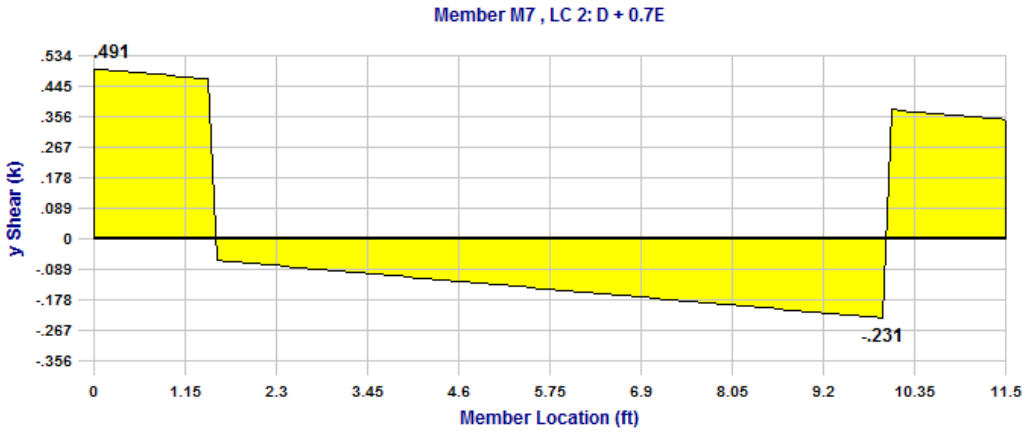
GOVERNING LOAD COMBINATION: D + 0.7E

****PLEASE REFERENCE APPENDIX A.5 FOR STRUCTURAL ANALYSIS RESULTS**

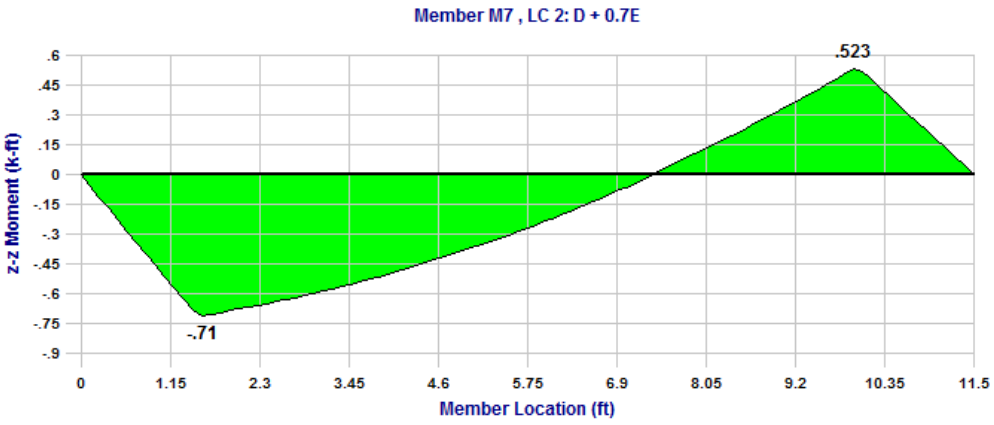
AXIAL DIAGRAM (RISA):



SHEAR DIAGRAM (RISA):



FLEXURAL MOMENT DIAGRAM (RISA):



Calc: Pergola Design Check

By: Branden Dong

Date: 1/22/2013 Page:

DEMAND FORCES

M_U = 710 lb-ft

P_U = 607 lbs.

V_U = 491 lbs.

DEMAND STRESSES

$f_B = M_U / S_X$ = 278 psi

$f_C = f_T = P_U / A$ = 23.9 psi

$f_V = 1.5V_U / A$ = 29 psi

BEAM DESIGN PARAMETERS

MEMBER SIZE: 4x8 REDWOOD No. 1

$A\ (IN^2)$= 25.4

$I_x\ (IN^4)$= 111

$I_y\ (IN^4)$= 25.9

$S_x\ (IN^3)$= 30.7

$S_y\ (IN^3)$= 14.8

d_1 (IN)= 7.25

d_2 (IN)= 3.5

DESIGN STRESSES

F_{bx} (PSI)=	975	F_t (PSI)=	575
F_{by} (PSI)=	975	E_{MIN} (PSI)=	400000
F_c (PSI)=	1200	E_X (PSI) =	1100000
F_{VX} (psi)=	160		

CHECK SHEAR

$F'_v = C_D C_M C_t F_{vx} =$ **256 psi** **> f_V (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**

CHECK FLEXURE

$F'_b = C_D C_M C_t C_F C_L F_{bx} =$ **1855 psi** **> f_b (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_L =	0.91	→ $C_L = \frac{1+(\frac{F_{bE}}{F^*_b})}{1.9} - \sqrt{[\frac{1+(\frac{F_{bE}}{F^*_b})}{1.9}]^2 - \frac{(\frac{F_{bE}}{F^*_b})}{0.95}}$	**NDS 2005, SECT 4.3.5**

→ $l_e = 2.06 l_u =$ 284 in. **TABLE 3.3.3**

→ $R_B = \sqrt{\frac{l_e d}{b^2}} =$ 13 **NDS 2005, EQ 3.3-5**

→ $F_{bE} = \frac{1.20E_{min}}{{R_B}^2} = 2853$ psi

→ $F_b^* = C_D C_M C_t C_F F_{bx} = 2028$ psi

→ $(F_{bE}/F_b^*) =$ 1.41

CHECK AXIAL COMPRESSION

$F_c' = C_D C_M C_t C_F C_P F_c =$ **208 psi** **> f_c (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_P =	0.08	→ $C_P = \frac{1+(\frac{F_{cE}}{F^*_c})}{2c} - \sqrt{[\frac{1+(\frac{F_{cE}}{F^*_c})}{2c}]^2 - \frac{(\frac{F_{cE}}{F^*_c})}{c}}$	**NDS 2005, SECT 4.3.10**

→ $l_e = (K_e)l =$ 138 in. **NDS 2005, SECT 3.7.1**

→ $c = 0.8\ (sawn\ lumber) =$ 0.8

→ $F_{cE} = \frac{0.822E_{min}}{(l_e/d)^2} =$ 211 psi

→ $F_c^* = C_D C_M C_t C_F F_c =$ 2496 psi

→ $(F_{cE}/F_c^*) =$ 0.08

CHECK AXIAL TENSION

$F_t' = C_D C_M C_t C_F F_t =$ **1196 psi** **> f_t (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.3	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**

CHECK COMBINED BENDING AND AXIAL TENSION

$$\frac{f_t}{F'_t} + \frac{f_{bx}}{F'_{bx}} = \frac{23.9}{1196} + \frac{278}{2028} = \mathbf{0.17} \quad \mathbf{< 1.0\ (OK)}$$

$$\frac{f_b - f_t}{F^{**}_b} = \frac{278 - 23.9}{2028} = \mathbf{0.14} \quad \mathbf{< 1.0\ (OK)}$$

CHECK COMBINED BENDING AND AXIAL COMPRESION

$$\left(\frac{f_c}{F'_c}\right)^2 + \left(\frac{1}{1 - {f_c}/{F_{cEx}}}\right)\frac{f_{bx}}{F'_{bx}} = \mathbf{0.18} \quad \mathbf{< 1.0\ (OK)}$$

CHECK DEFLECTION

****PER IBC**

Δ_{LIMIT} = L / 240 = 0.58 in.

$$\Delta_L = \frac{5W_L L^4}{384EI} = \quad \mathbf{0.13\ in.\ (OK)}$$

DETERMINE END COLUMN CAP SIZE

****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 56)**

FOR INTERIOR BEAM-COLUMN JOINTS:

FOR 4x MAIN BEAM, 4x POST, 4x SIDE BEAM USE CCCTQ444SDS WITH FOLLOWING DIMENSIONS: H_1 = 7", H_2 = 7", W_1= 3-5/8", W_2= 3-5/8", W_3= 3-5/8". DETERMINE "L" FROM SIMPSON-STRONG TIE

MAIN BEAM:

$V_{n\text{-}uplift}$ = **4910 lbs** **> $V_{u\text{-}uplift}$: 439 lbs (OK)**

SIDE BEAM:

$V_{n\text{-}uplift}$ = **2359 lbs** **> $V_{u\text{-}uplift}$: 1575 lbs (OK)**

FOR EXTERIOR BEAM-COLUMN JOINTS:

FOR 4x MAIN BEAM, 4x POST, 4x SIDE BEAM USE ECCLQ444SDS WITH FOLLOWING DIMENSIONS: H_1 = 7", H_2 = 7", W_1= 3-5/8", W_2= 3-5/8", W_3= 3-5/8". DETERMINE "L" FROM SIMPSON-STRONG TIE

MAIN BEAM:

$V_{n\text{-}uplift}$ = **4910 lbs** **> $V_{u\text{-}uplift}$: 439 lbs (OK)**

SIDE BEAM:

$V_{n\text{-}uplift}$ = **2359 lbs** **> $V_{u\text{-}uplift}$: 1208 lbs (OK)**

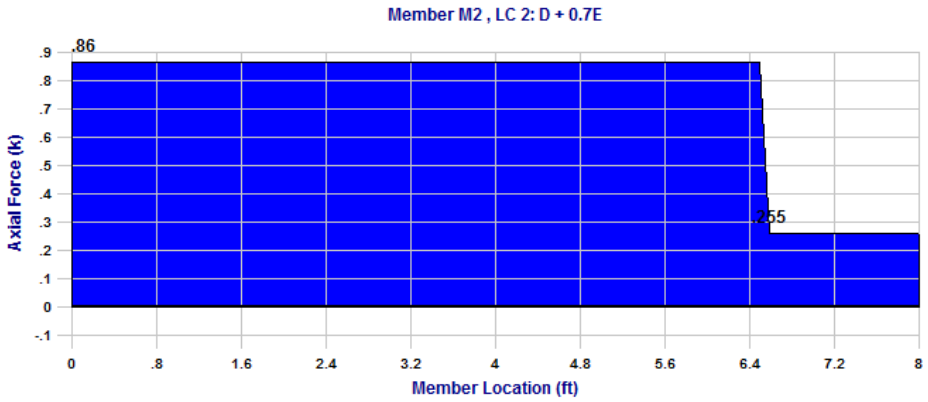
USE 4 x 8 REDWOOD No.1 BEAM (SAWN LUMBER) FOR MAIN GRAVITY SYSTEM OF PERGOLA.

DESIGN CHECK - 8' POST

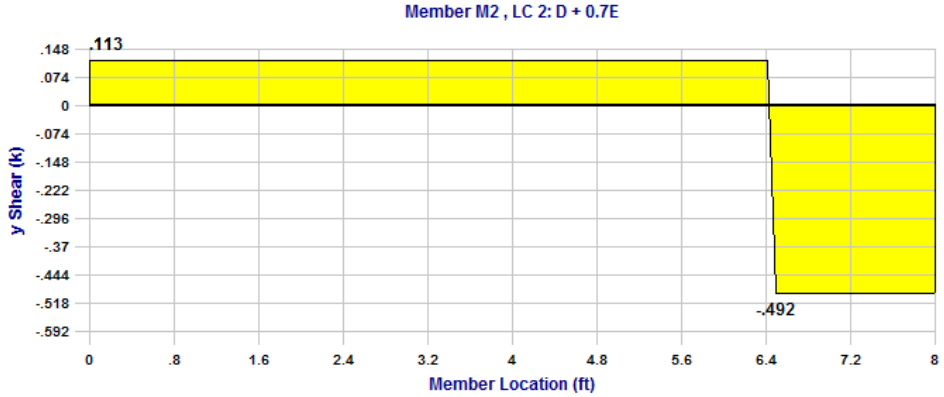
GOVERNING LOAD COMBINATION: **D + 0.7E**

****PLEASE REFERENCE APPENDIX A.5 FOR STRUCTURAL ANALYSIS RESULTS**

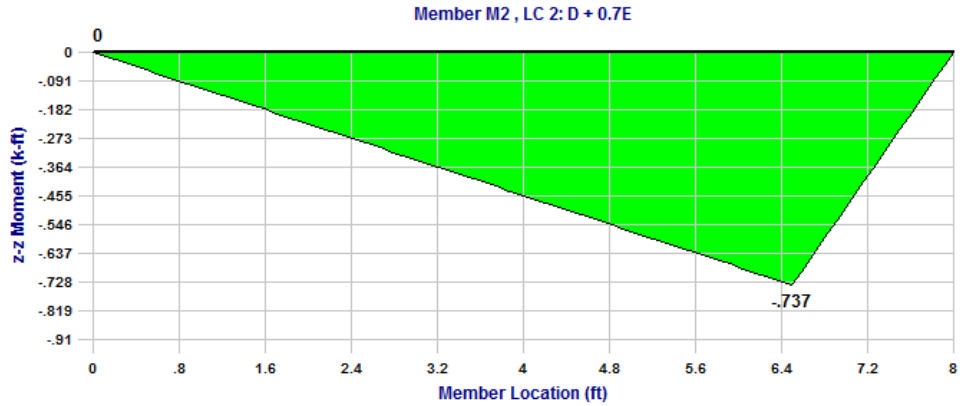
AXIAL DIAGRAM (RISA):



SHEAR DIAGRAM (RISA):



FLEXURAL MOMENT DIAGRAM (RISA):



Calc: Pergola Design Check

By: Branden Dong

Date: 1/22/2013 Page:

DEMAND FORCES

M_U = 737 lb-ft

P_U = 860 lbs.

V_U = 492 lbs.

DEMAND STRESSES

$f_B = M_U / S_X$ = 1238 psi

$f_C = f_T = P_U / A$ = 70.2 psi

$f_V = 1.5V_U / A$ = 60.2 psi

BEAM DESIGN PARAMETERS

MEMBER SIZE: 4x4 REDWOOD No. 1

A (IN^2)=	12.3
I_x (IN^4)=	12.5
I_y (IN^4)=	12.5
S_x (IN^3)=	7.15
S_y (IN^3)=	7.15
d_1 (IN)=	3.5
d_2 (IN)=	3.5

DESIGN STRESSES

F_{bx} (PSI)=	975	F_t (PSI)=	575
F_{by} (PSI)=	975	E_{MIN} (PSI)=	400000
F_c (PSI)=	1200	E_X (PSI) =	1100000
F_{VX} (psi)=	160		

CHECK SHEAR

$F'_v = C_D C_M C_t F_{vx} =$ **256 psi** **> f_V (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**

CHECK FLEXURE

$F'_b = C_D C_M C_t C_F C_L F_{bx} =$ **2297 psi** **> f_b (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.5	→ *WIDTH OF 4" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_L =	0.98	→ $C_L = \frac{1+(\frac{F_{bE}}{F^*_b})}{1.9} - \sqrt{[\frac{1+(\frac{F_{bE}}{F^*_b})}{1.9}]^2 - \frac{(\frac{F_{bE}}{F^*_b})}{0.95}}$	**NDS 2005, SECT 4.3.5**

→ $l_e = 2.06 l_u =$ 198 in. **TABLE 3.3.3**

→ $R_B = \sqrt{\frac{l_e d}{b^2}} =$ 7.52 **NDS 2005, EQ 3.3-5**

→ $F_{bE} = \frac{1.20E_{min}}{R_B{}^2} = 8495.15$ psi

→ $F_b^* = C_D C_M C_t C_F F_{bx} = 2340$ psi

→ $(F_{bE}/F_b^*) = 3.63$

CHECK AXIAL COMPRESSION

$F_c' = C_D C_M C_t C_F C_P F_c =$ **423 psi** **> f_c (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.5	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**
C_P =	0.15	→ $C_P = \frac{1+(\frac{F_{cE}}{F^*_c})}{2c} - \sqrt{[\frac{1+(\frac{F_{cE}}{F^*_c})}{2c}]^2 - \frac{(\frac{F_{cE}}{F^*_c})}{c}}$	**NDS 2005, SECT 4.3.10**

→ $l_e = (K_e)l =$ 96 in. **NDS 2005, SECT 3.7.1**

→ $c = 0.8\ (sawn\ lumber) =$ 0.8

→ $F_{cE} = \frac{0.822E_{min}}{(l_e/d)^2} =$ 437 psi

→ $F_c^* = C_D C_M C_t C_F F_c =$ 2880 psi

→ $(F_{cE}/F_c^*) =$ 0.15

CHECK AXIAL TENSION

$F_t' = C_D C_M C_t C_F F_t =$ **1380 psi** **> f_t (OK)**

C_D =	1.6	→ *EARTHQUAKE LOADING*	**NDS 2005, SECT 4.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 4.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 4.3.4**
C_F =	1.5	→ *WIDTH OF 8" AND THICKNESS OF 4"*	**NDS 2005, SECT 4.3.6**

CHECK COMBINED BENDING AND AXIAL TENSION

$$\frac{f_t}{F'_t} + \frac{f_{bx}}{F'_{bx}} = \frac{70.2}{1380} + \frac{1238}{2340} = \mathbf{0.59} \quad \mathbf{< 1.0\ (OK)}$$

$$\frac{f_b - f_t}{F^{**}_b} = \frac{1238 - 70.2}{2340} = \mathbf{0.51} \quad \mathbf{< 1.0\ (OK)}$$

CHECK COMBINED BENDING AND AXIAL COMPRESION

$$\left(\frac{f_c}{F'_c}\right)^2 + \left(\frac{1}{1 - {f_c}/{F_{cEx}}}\right)\frac{f_{bx}}{F'_{bx}} = \mathbf{0.67} \quad \mathbf{< 1.0\ (OK)}$$

DETERMINE COLUMN BASE SIZE

****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 53)**

FOR INTERIOR BEAM-COLUMN JOINTS:

FOR 4x MAIN BEAM, 4x POST, 4x SIDE BEAM USE CCCTQ444SDS WITH FOLLOWING DIMENSIONS: H_1 = 7", H_2 = 7", W_1= 3-5/8", W_2= 3-5/8", W_3= 3-5/8". DETERMINE "L" FROM SIMPSON-STRONG TIE

TOTAL UPLIFT:

$V_{n\text{-}uplift}$ = **5315 lbs** **> $V_{u\text{-}uplift}$: BASE REACTION NEVER GOES IN TENSION**

FOR EXTERIOR BEAM-COLUMN JOINTS:

FOR 4x MAIN BEAM, 4x POST, 4x SIDE BEAM USE ECCLQ444SDS WITH FOLLOWING DIMENSIONS: H_1 = 7", H_2 = 7", W_1= 3-5/8", W_2= 3-5/8", W_3= 3-5/8". DETERMINE "L" FROM SIMPSON-STRONG TIE

TOTAL UPLIFT:

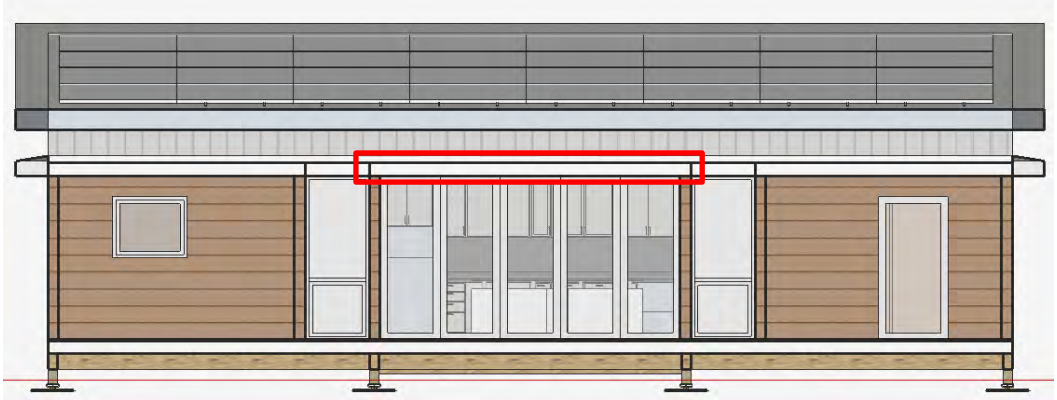
$V_{n\text{-}uplift}$ = **4910 lbs** **> $V_{u\text{-}uplift}$: BASE REACTION NEVER GOES IN TENSION**

USE 4 x 4 REDWOOD No.1(SAWN LUMBER) FOR PERGOLA POSTS. CONTACT WOOD MANUFACTURER/LUMBER YARD IN ADVANCED TO ENSURE THEY HAVE No.1 & BTR.

start.home

9.0 BI-FOLD BEAM DESIGN

9.0 BI-FOLD PATIO BEAM DESIGN CHECK



DESIGN DEAD-LOAD VALUES

CLERESTORY ROOF = 18 psf

DESIGN LIVE-LOAD VALUES

CLERESTORY ROOF = 20 psf

DESIGN CHORD FORCES (UNFACTORED)

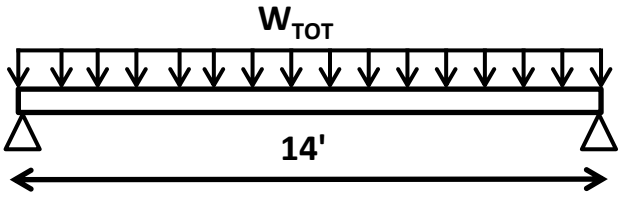
**PLEASE REFER TO DIAPHRAGM DESIGN

SEISMIC: $T_E = C_E$ = 1645 lbs
WIND: $T_W = C_W$ = 1983 lbs

DESIGN COLLECTOR FORCES (UNFACTORED)

**PLEASE REFER TO DIAPHRAGM DESIGN

SEISMIC: $T_E = C_E$ = 539 lbs
WIND: $T_W = C_W$ = 215 lbs



NANOWALL BEAM PROPERTIES

TRIB. WIDTH = 7.5 ft
L= 14 ft.

BEAM GRAVITY LOADS

$W_D = DL * L_{TRIB.}$ = 135 plf
$W_L = LL * L_{TRIB.}$ = 150 plf

GOVERNING LOAD COMBO $D + 0.75L_r + 0.75(W)$

$D + 0.75L_r + 0.75(0.7E)$

$W_{TOT} = W_D + 0.75W_L$

W_{TOT} = 248 plf

Calc:____Bi-Fold Patio Door Beam Design_____

By:____Branden Dong_____

Date:____1/22/2013_____Page:_____

DEMAND FORCES

$M_U = W_{TOT} * L^2 / 8 =$ 6064 lb-ft

$P_U = 0.75C_W =$ 1983 lbs.

$V_U = W_{TOT} * L / 2 =$ 1733 lbs.

DEMAND STRESSES

$f_B = M_U / S_X =$ 970 psi

$f_C = f_T = P_U / A =$ 52.9 psi

$f_V = 1.5V_U / A =$ 69.3 psi

BEAM DESIGN PARAMETERS

MEMBER SIZE: WESTERN SPECIES 3.125x12, 28F-2.1E SP

$A\ (IN^2) =$ 37.5
$I_x\ (IN^4) =$ 450
$I_y\ (IN^4) =$ 30.5
$S_x\ (IN^3) =$ 75
$S_y\ (IN^3) =$ 19.5
$d_1\ (IN) =$ 12
$d_2\ (IN) =$ 3.13

DESIGN STRESSES

$F_{bx}\ (PSI) =$ 2800
$F_{by}\ (PSI) =$ 1600
$F_c\ (PSI) =$ 1750
$F_{VX}\ (psi) =$ 300
$F_t\ (PSI) =$ 1250
$E_{MIN}\ (PSI) =$ 1090000
$E_X\ (PSI) =$ 2100000

CHECK SHEAR

$F_v' = C_D C_M C_t F_{vx} =$ **480 psi** **> f_V (OK)**

$C_D =$	1.6	→ *WIND LOADING*	**NDS 2005, SECT 5.3.2**
$C_M =$	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 5.3.3**
$C_t =$	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 5.3.4**

CHECK FLEXURE

$F_b' = C_D C_M C_t C_L C_V F_{bx} =$ **4480 psi** **> f_b (OK)**

$C_D =$	1.6	→ *WIND LOADING*	**NDS 2005, SECT 5.3.2**
$C_M =$	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 5.3.3**
$C_t =$	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 5.3.4**
$C_L =$	1.0	→ *CONTINUOUS LATERAL SUPPORT PROVIDED*	**NDS 2005, SECT 5.3.5**
$C_V =$	1.0	→ $C_v = \left(\frac{21}{L}\right)^{\frac{1}{x}} (\frac{12}{d})^{\frac{1}{x}} (\frac{5.125}{b})^{\frac{1}{x}} \leq 1.0$	**NDS 2005, SECT 5.3.6**

CHECK AXIAL COMPRESSION

$F_c' = C_D C_M C_t C_P F_c =$ **2800 psi** **> f_c (OK)**

C_D =	1.6	→ *WIND LOADING*	**NDS 2005, SECT 5.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 5.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 5.3.4**
C_P =	1.0	→ *MEMBER SUPPORTED THROUGHOUT ITS LENGTH ABOUT BOTH AXES*	**NDS 2005, SECT 5.3.9**

CHECK AXIAL TENSION

$F_t' = C_D C_M C_t C_P F_t =$ **2000 psi** **> f_c (OK)**

C_D =	1.6	→ *WIND LOADING*	**NDS 2005, SECT 5.3.2**
C_M =	1.0	→ *DRY-SERVICE CONDITION*	**NDS 2005, SECT 5.3.3**
C_t =	1.0	→ *NO SUSTAINED ELEVATED TEMPERATURE*	**NDS 2005, SECT 5.3.4**
C_P =	1.0	→ *MEMBER SUPPORTED THROUGHOUT ITS LENGTH ABOUT BOTH AXES*	**NDS 2005, SECT 5.3.9**

CHECK COMBINED BENDING AND AXIAL TENSION

$$\frac{f_t}{F'_t} + \frac{f_{bx}}{F'_{bx}} = \frac{52.9}{2000} + \frac{970}{4480} = \mathbf{0.24} \quad \mathbf{< 1.0\ (OK)}$$

$$\frac{f_b - f_t}{F^{**}_b} = \frac{970 - 52.9}{4480} = \mathbf{0.2} \quad \mathbf{< 1.0\ (OK)}$$

CHECK COMBINED BENDING AND AXIAL COMPRESION

$$\left(\frac{f_c}{F'_c}\right)^2 + \left(\frac{1}{1 - f_c/F_{cEx}}\right)\frac{f_{bx}}{F'_{bx}} = \mathbf{0.22} \quad \mathbf{< 1.0\ (OK)}$$

NOTE: BEAM IS CONTINUOUSLY SUPPORTED ABOUT BOTH AXES, PREVENTING POTENTIAL BUCKLING. THEREFORE, F_{cE1} IS INFINITELY LARGE SINCE SLENDERNESS IS BASICALLY ZERO. AS A RESULT, $F_c/F_{cE1} = 0$.

CHECK DEFLECTION

****PER NANAWALL WEBSITE, DEFLECTION LIMIT IS SET UNDER FULL LOADING (D+L)**

Δ_{LIMIT} = L / 720 = 0.23 in.

$$\Delta_{D+L} = \frac{5W_{D+L}L^4}{384EI} = \mathbf{0.26} \quad \mathbf{in.\ (OK)}$$

NOTE: BEAM WILL LIKELY NOT SEE FULL DEFLECTION COMPUTED TO THE LEFT. ADDITIONAL STIFFNESS DUE TO SIP THAT IS ATTACHED TO TOP OF BEAM IS NEGLECTED HERE. THEREFORE, CALCULATED DEFLECTION IS CONSERVATIVE AND AN OVER ESTIMATION.

DETERMINE END COLUMN CAP SIZE

****PLEASE REFER TO SIMPSON CONNECTORS CATALOG (PG. 53)**

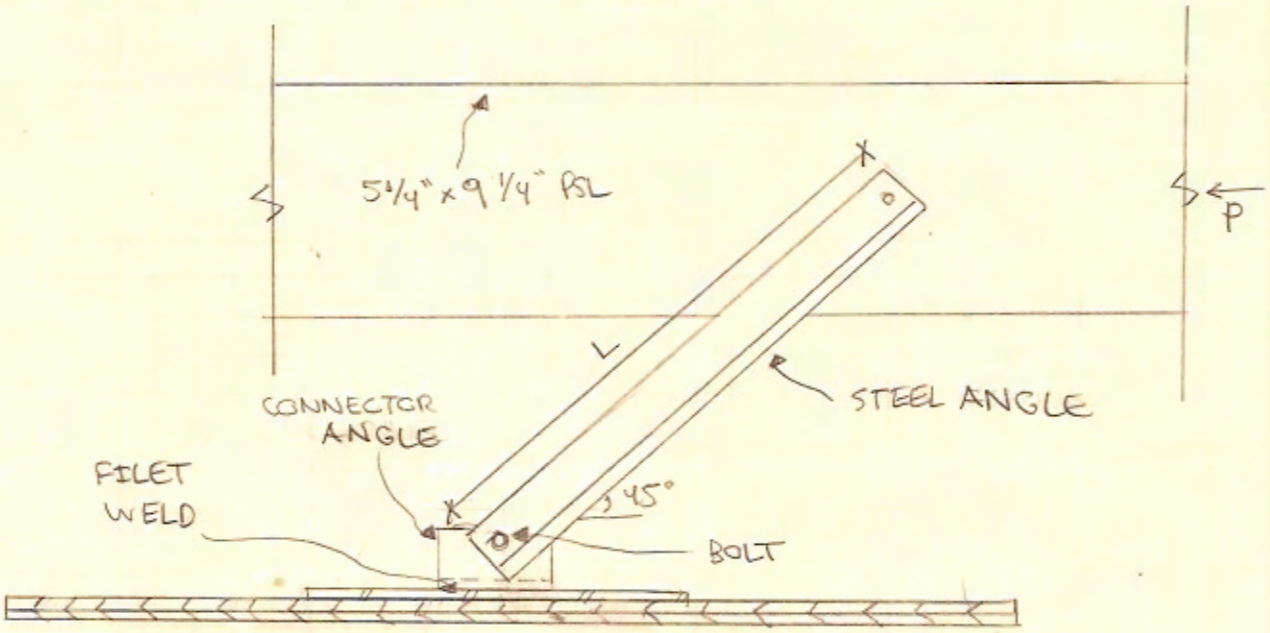
USE ECCQ44SDS2.5 COLUMN CAP FOR BEARING CONNECTION TO BEAM. USE 14-SDS SCREWS, 1/4" x 2-1/2", INTO BEAM AND 14-SDS SCREWS, 1/4" x 2-1/2", INTO POST

USE 3-1/8 x 12 WESTERN SPECIES 28F-2.1E SP GLULAM BEAM ABOVE BI-FOLD DOOR. DOUBLE CHECK AVAILABILITY OF 28F BEAM WELL IN ADVANCE OF CONSTRUCTION

start.home

10.0 CONNECTION DESIGN

10.1. FOUNDATION STRUT DESIGN



$P = 4068$ lb → FROM LATERAL LOAD DISTRIBUTION SPREADSHEET LINE ①

STEEL ANGLE DESIGN

$\frac{P}{\cos 45°} = 5753$ lb $L = 1'-9"$

⇒ FROM AISC TABLE 4-12, $kL = 2$ ft

USE L2x2x¼"

$P_n/\Omega_c = 8520$ lb > 5753 lb (OK)

BOLT SHEAR DESIGN

$V = 5753$ lb

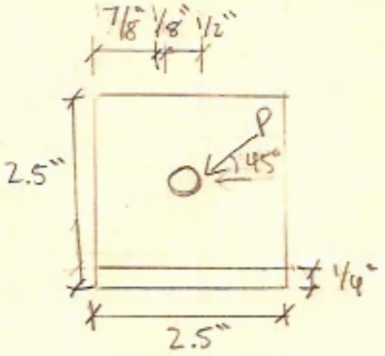
$R_n/\Omega_v = F_{nv} A_b$ $F_{nv} = 54$ ksi → AISC TABLE J3.2

$A_b = \frac{R_n/\Omega_v}{F_{nv}} = \frac{5753/2.00}{54000} = 0.053$ in²

⇒ USE ½"ϕ SLIP CRITICAL BOLT, A325

$A_b = 0.196$ in² > 0.053 in² (OK)

CONNECTOR ANGLE DESIGN



P = 5753 lb
EDGE DISTANCE = 7/8"

BEARING: $R_n = 1.2 l_c t F_u \leq 2.4 d t F_u$ (AISC EQN J3-6a)

$l_c = 7/8"$
$t = 1/4"$ → SAME AS STEEL ANGLE
$F_u = 90$ ksi → (AISC TABLE J3.2)

$R_n = 1.2(7/8)(1/4)(90) \leq 2.4(1/2)(1/4)(90)$
$= 23.7$ kips ≤ 27 kips

$R_n/\Omega = 27/2.00 = 13.5$ kips
$= 13,500$ lb > 5753 lb (OK)

EDGE DISTANCE: MIN. EDGE DISTANCE = 3/4" (AISC TABLE J3.4)

ACTUAL E.D. = 7/8" > 3/4" (OK)

ANGLE YIELDING:

$P_n = F_y A_g$

$A_g = (2.5" - 1/4")(1/4") = 0.56$ in^2
$F_y = 36$ ksi

$P_n = 0.56(36) = 20.25$ kips

$P_n/\Omega_t = 20.25/1.67 = 12,100$ lb > 5753 lb (OK)

ANGLE RUPTURE:

$P_n = F_u A_e$

$A_e = A_n U$
$= 0.406(0.6)$
$= 0.244$ in^2

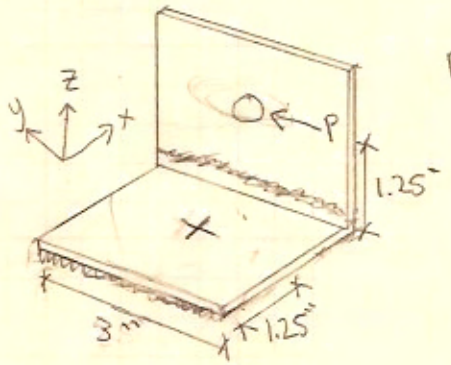
$A_n = (2.5 - 1/4 - 1/2 - 1/8)(1/4)$
$= 0.406$ in^2
$U = 0.60$

$F_u = 58$ ksi

$P_n/\Omega = \frac{58(0.244)}{2.00} = 7070$ lb > 5753 lb (OK)

=> USE L2 1/2 x 2 1/2 x 1/4 ANGLE

WELD DESIGN



$P = 5753$ lb

$I_x = 2\left[\frac{1}{12}(1)(3)^3\right] = 4.5 \text{ in}^4$

$I_y = 2\left[\frac{1}{12}(3)(1)^3 + 3(1.25)^2\right] = 9.88 \text{ in}^4$

$J = I_x + I_y = 14.4 \text{ in}^4$

SHEAR: $f_{1y} = \frac{P}{A} = \frac{5.753 \text{ k}}{6} = 0.959 \text{ ksi}$ → DIRECT SHEAR

$f_{2y} = \frac{Mx}{J} = \frac{(5.753 \times 1.25)(1.25)}{14.4} = 0.624 \text{ ksi}$ → TORSION

$f_v = f_{1y} + f_{2y} = 1.583 \text{ ksi}$
$= 1.58 \text{ kips/in}$ → ASSUME UNIT THROAT

TENSION: $f_t = \frac{Mc}{I_x} = \frac{(5.753 \times 1.25)(1.25)}{4.5} = 2.0 \text{ kips/in}$

$f_r = \sqrt{f_t^2 + f_v^2} = 2.55 \text{ kips/in}$

$f_r = 0.9279\,D$

$2.55 = 0.9279\,D \rightarrow D = 2.75$

⇒ **USE 3/16" FILLET WELD, E70XX**

$R_n = F_{nw} A_{we}$
$= 42(3/16)$
$= 7.875 \text{ kips/in}$

$F_{nw} = 0.60 F_{EXX}(1.0 + 0.50 \sin^{1.5}\theta)$
$= 0.60(70)$
$= 42 \text{ ksi}$

$A_{we} = 3/16 \text{ in}$

$R_n/\Omega = 3.94 \text{ kips/in} > 2.55 \text{ kips/in}$ (OK)

BASE METAL CHECK (ANGLE CONTROLS)

YIELDING: $R_n = 0.60 F_y A_{gv}$
$= 0.60(36)(0.75)$
$= 16.2 \text{ kips}$

$F_y = 36 \text{ ksi}$
$A_{gv} = 1/4(2.5) = 0.75 \text{ in}^2$

$R_n/\Omega = 10{,}800 \text{ lb} > 5753 \text{ lb}$ (OK)

RUPTURE: $R_n = 0.60 F_u A_{nv}$
$= 26.1 \text{ kips}$

$F_u = 58 \text{ ksi}$
$A_{nv} = 0.75 \text{ in}^2$

$R_n/\Omega = 13{,}050 \text{ lb} > 5753 \text{ lb}$ (OK)

BLOCK SHEAR: $R_n = 0.60 F_u A_{nv} + U_{bs} F_u A_{nt} \leq 0.60 F_y A_{gv} + U_{bs} F_u A_{nt}$

$= 0.60(58)(0.75) + 1(58)(1/4 \times 2.5) \leq 0.60(36)(0.75) + 1(58)(1/4 \times 2.5)$

$= 62.4 \text{ kips} \leq 52.5 \text{ kips}$

$R_n/\Omega = 26225 \text{ lb} > 5753 \text{ lb}$ (ok)

Calc: Header Design Check

By: Branden Dong

Date: 02/10/2013

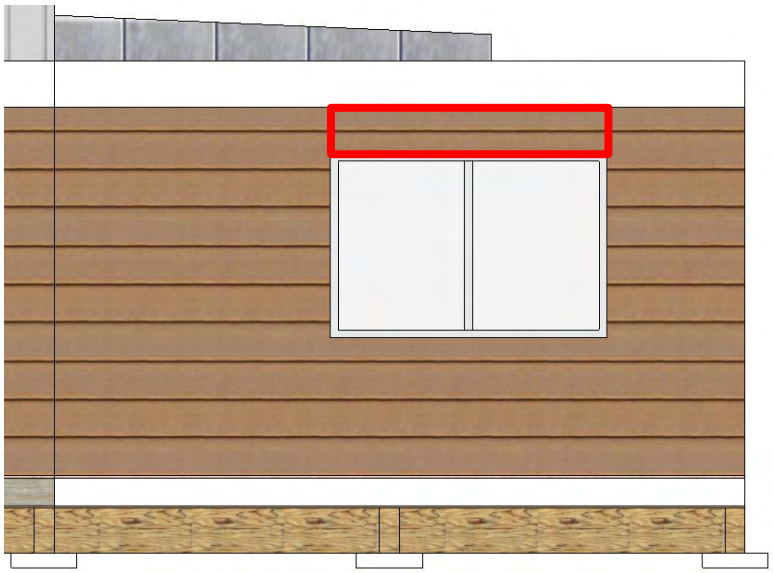
10.2 HEADER DESIGN CHECK

UNIFORM AREA LOAD

Dead Load = 18 psf
Live Load = 20 psf

Total Load = 38 psf

Trib. Width = 8 ft
Total Line Load = **304** plf



HEADER DIMENSIONS

Header Span = 6.0 ft.
Header Depth = 12 in.

R-CONTROL LOAD TABLE

Wall - Header Loads - PLF
LOAD DESIGN CHART #5
DETAILS SIP-112 through SIP-114

HEADER DEPTH	DEFLECTION LIMIT	HEADER SPAN (feet)		
		4	6	8
12"	L/480	524	319	218
	L/360	703	374	248
	L/240	708	374	248
18"	L/480	762	466	351
	L/360	773	466	351
	L/240	773	466	351
24"	L/480	837	557	455
	L/360	837	557	455
	L/240	837	557	455

SIP WALL SIZE

→ From Load Table

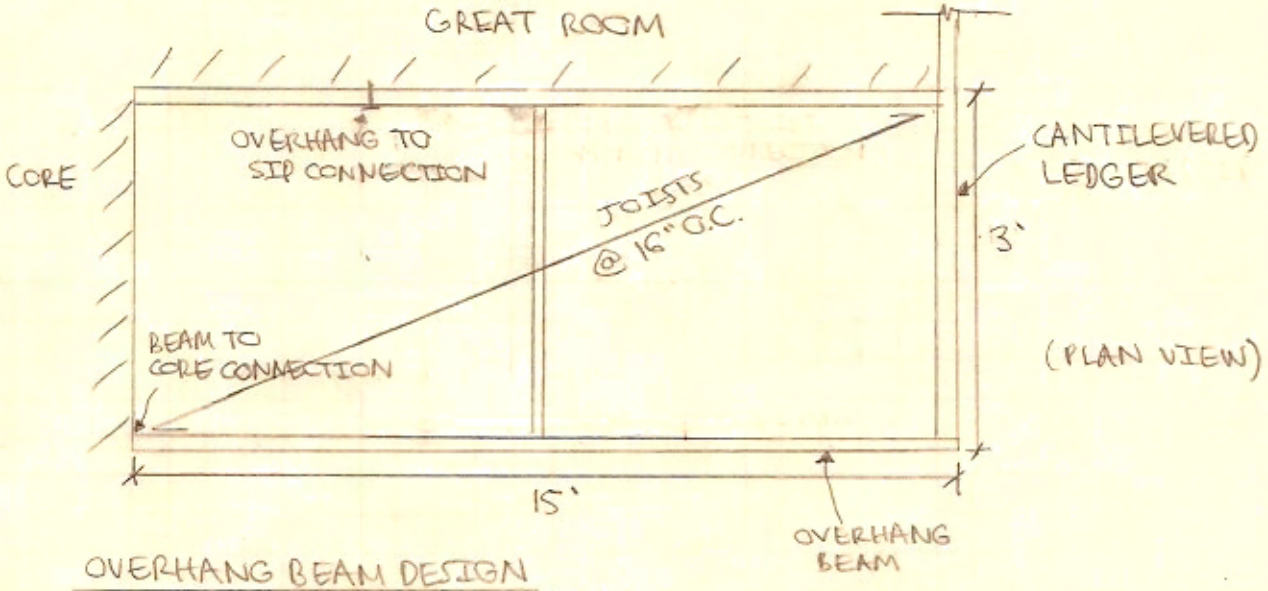
W_{ACTUAL} = 304 plf

W_{ALLOW} = 319 plf

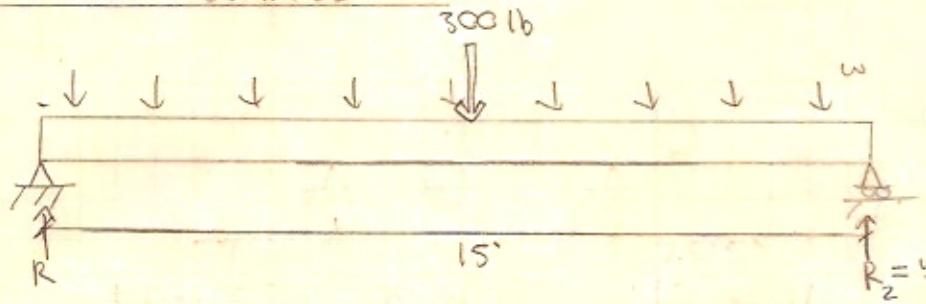
DCR = W_{ACTUAL} / W_{ALLOW} = 0.95 < 1.0 OK

USE 12" DEEP HEADER OVER ALL WINDOWS (L/480 DEFLECTION)

FRONT DOOR LOCATION



OVERHANG BEAM DESIGN



$D+L = 25$ psf $\qquad w = 25\text{ psf} \times 1.5\text{ ft} = 37.5$ lb/ft

$\Rightarrow$ CONTROLLING LOAD IS EITHER DISTRIBUTED 20 PSF OR 300 LB POINT LOAD AT MIDSPAN

$$M_{max} = \text{MAX}\begin{cases} \frac{wL^2}{8} = \frac{(37.5/12)(15\times12)^2}{8} = 12{,}656 \text{ kip in} \\ \frac{PL}{4} = \frac{300(15\times12)}{4} = 13{,}500 \text{ kip in (CONTROLS)} \end{cases}$$

FLEXURE:

$\Rightarrow$ TRY USING 2×6 DFL NO.1

$F_b = 1000$ psi $\qquad S_{xx} = 7.563$ in^3
$E = 1{,}700{,}000$ psi $\qquad I_{xx} = 20.8$ in^4

$$f_b = \frac{M}{S} = \frac{13{,}500}{7.563} = 1785 \text{ psi}$$

$F_b' = F_b C_D C_F = 1000(1.25)(1.3) = 1788$ psi > 1785 psi (OK)

$C_D = 1.25 \rightarrow$ 20 PSF CONSTRUCTION LOAD
$C_F = 1.3 \rightarrow$ FOR 2×6 MEMBER

DEFLECTION:

$\Delta_{L,ALLOW} = \frac{L}{180}$ → NOT SUPPORTING CEILING (IBC 1604.03)

$= \frac{(15\times12)}{180} = 1.0$ in

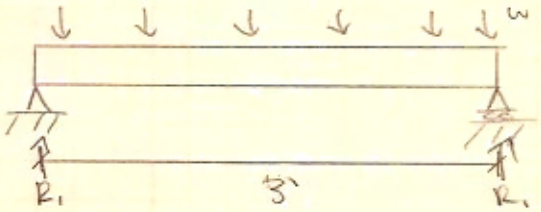
$\Delta_L = \frac{PL^3}{48EI} = \frac{300(15\times12)^3}{48(1{,}700{,}000)(20.8)} = 1.0$ in ≤ 1.0 in (OK)

$\Delta_{D+L,ALLOW} = \frac{L}{120} = \frac{(15\times12)}{120} = 1.5$ in

$\Delta_{D+L} = \frac{5wL^4}{384EI} = 1.21$ in < 1.5 in (OK)

USE 2×6 DFL NO 1 FOR OVERHANG BEAM

SIMPLY SUPPORTED JOIST DESIGN



$R_1 = \frac{wL}{2} = 50$ lb

D+L = 25 psf $\quad w = 25$ psf $\times \frac{16\text{ in}}{12\text{ ft}} = 33.33$ lb/ft

$M_{max} = \frac{wL^2}{8} = \frac{33.33/12(3\times12)^2}{8} = 450$ lb-in

FLEXURE:

⇒ TRY USING 2×8 DFL NO. 1, BUT DESIGN FOR 2×6 DUE TO TAPER

$f_b = \frac{M}{S} = \frac{450}{7.563} = 60$ psi

$F_b' = F_b C_D C_F C_r = 1000(1.25)(1.3)(1.15) = 1869$ psi > 60 psi (OK)

DEFLECTION:

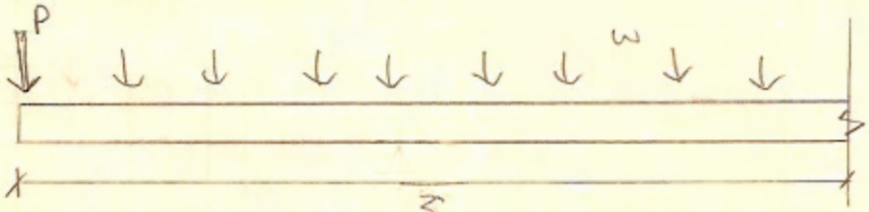
$\Delta_{L,ALLOW} = \frac{L}{180} = \frac{3\times12}{180} = 0.20$ in $\quad \Delta_{D+L,ALLOW} = \frac{L}{120} = 0.33$ in

$\Delta_L = \frac{5wL^4}{384EI} = \frac{5(27/12)(3\times12)^4}{384(1{,}700{,}000)(20.8)} = 0.0014$ in < 0.20 in (OK)

$\Delta_{D+L} = 0.0014\left(\frac{25}{20}\right) = 0.0017$ in < 0.33 in (OK)

USE 2×8 JOISTS @ 16" O.C. TAPERED DOWN TO 2×6

CANTILEVERED LEDGER DESIGN



$w = 25\ psf \times \left(\frac{18"}{2} + \frac{16}{2}"\right) \div 12' = 35\ lb/ft$

$P = 281\ lb \Rightarrow$ REACTION AT END OF OVERHANG BEAM

$M_{max} = \frac{wL^2}{2} + PL = \frac{(35/12)(3\times12)^2}{2} + 281(3\times12) = 12006\ lb\text{-}in$

FLEXURE:

$f_b = \frac{12006}{13.14} = 914\ psi \qquad F_b' > 914\ psi$ (OK)

DEFLECTION:

$\Delta_{L,ALLOW} = 0.20\ in \qquad \Delta_{D+L,ALLOW} = 0.33\ in$

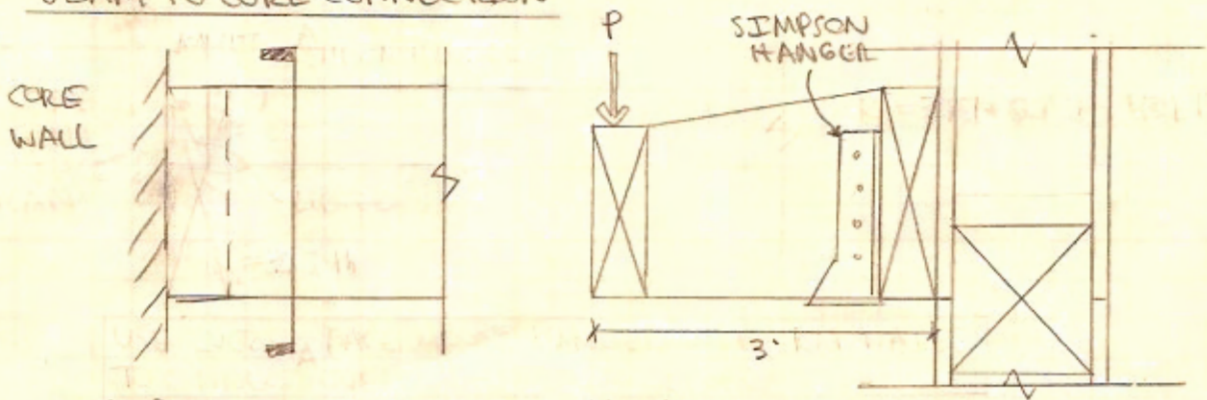
$\Delta_{D+L} = \frac{PL^3}{3EI} + \frac{wL^4}{8EI} = \frac{1}{1{,}700{,}000(47.63)}\left[\frac{281(36)^3}{3} + \frac{2.92(36)^4}{8}\right]$

$= 0.062\ in < 0.33\ in$ (OK)

$\Delta_L = 0.062\left(\frac{20}{25}\right) = 0.049\ in < 0.20\ in$ (OK)

USE 2×8 DFL NO.1 FOR CANTILEVERED LEDGER AND TAPER TO 2×6

BEAM TO CORE CONNECTION

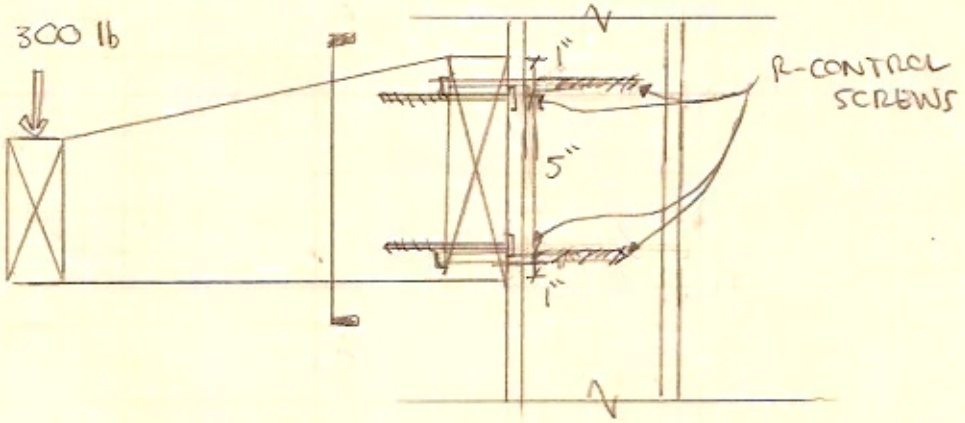


$\Rightarrow$ DESIGN FOR $P = 300\ lb$ RATHER THAN 281 lb BASED ON POINT LOAD CODE REQUIREMENT

USE LUS48 SIMPSON HANGERS AT JOIST W/ 16d NAILS

1585 lb > 300 lb (OK) $\Rightarrow$ SIMP CATALOGUE pg. 64

MOMENT CONNECTION:



$M_u = 300(3 \times 12) = 10{,}800$ lb-in

$W_u = \frac{M_u}{d} = \frac{10{,}800}{5} = 2160$ lb $\Rightarrow$ WITHDRAWAL PER SCREW

$\Rightarrow$ FROM R-CONTROL, FOR WOOD G = 0.50, W = 1067 lb/in PENETRATION

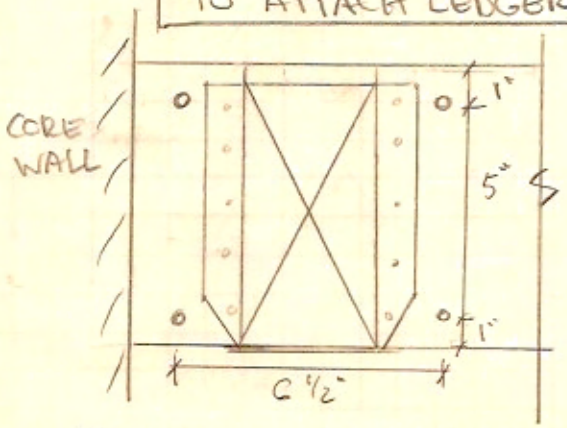
$W = \frac{1067}{1.5} = 711$ lb/in $\rightarrow$ USING SAFETY FACTOR OF 1.5

$W' = W C_D C_{eg} = 711(1.25)(0.75) = 667$ lb/in

$C_D = 1.25$ $\rightarrow$ CONSTRUCTION LOAD
$C_{eg} = 0.75$ $\rightarrow$ ATTACHED TO JOIST END

REQ. PENETRATION $= \frac{W_u}{W'} = \frac{2160}{667} = 3.24$ in

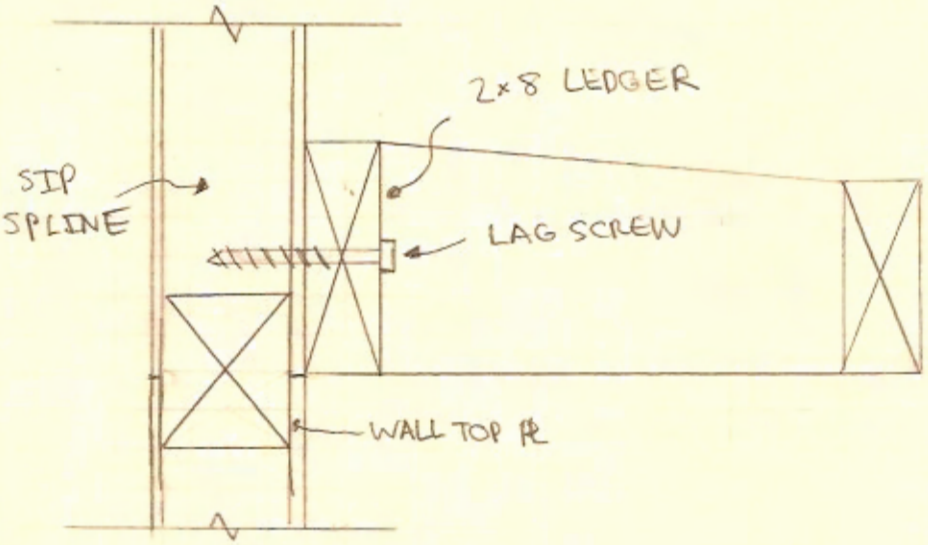
USE TWO 6" LONG R-CONTROL WOOD SCREWS WITH 4" MIN. EMBEDMENT AT 5" SPACING TO ATTACH LEDGER TO JOIST



$\Rightarrow$ SAME MOMENT CONNECTION DESIGN EXCEPT HAVE 4 SCREWS INSTEAD OF 2

USE FOUR 6" LONG R-CONTROL WOOD SCREWS WITH 3" MIN EMBEDMENT AT 5" SPACING TO ATTACH LEDGER TO WALL FACE

OVERHANG TO SIP CONNECTION



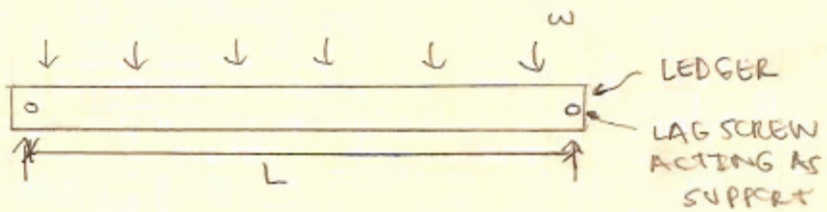
LAG SCREW SHEAR:

$$Z' = Z(C_D C_M C_t C_g C_\Delta C_{eg} C_{di} C_{tn}) = 250 \text{ lb}$$

$Z = 200$ lb → LOADED ⊥, $t_s = 1\text{-}1/2"$, $D = 1/2"$
$C_D = 1.25$

D+L = 25 psf
$w = 25 \text{ psf} \times 2 \text{ ft} = 50 \text{ lb/ft}$

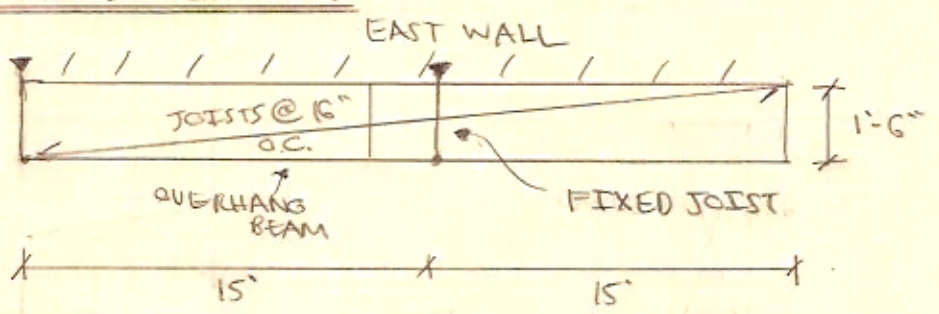
$$V = \frac{wL}{2} \rightarrow L = \frac{2V}{w} = \frac{2(250)}{50} = 10 \text{ ft}$$



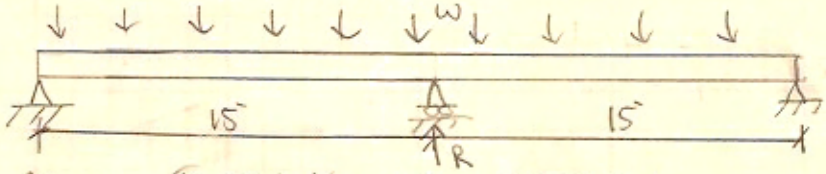
$$R = \frac{w_o L}{2} = \frac{50(10)}{2} = 250 \text{ lb} = 250 \text{ lb} = Z' \text{ (OK)}$$

USE 1/2" ϕ LAG SCREWS @ 7.5" SPACING TO CONNECT LEDGER TO SURFACES

EAST WALL LOCATION



OVERHANG BEAM DESIGN



$w = 25\ psf \times \frac{15'}{2}$

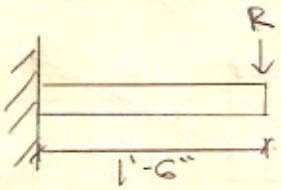
$= 18.75\ lb/ft$

$M_{max} = \frac{(18.75/12)(15\times12)^2}{8} = 6{,}328\ lb\text{-}in$

=> FROM FRONT DOOR OVERHANG BEAM CALC. ON PG. 1, 2x8 WILL WORK

USE 2x6 DFL NO. 1 FOR OVERHANG BEAM

FIXED JOIST DESIGN



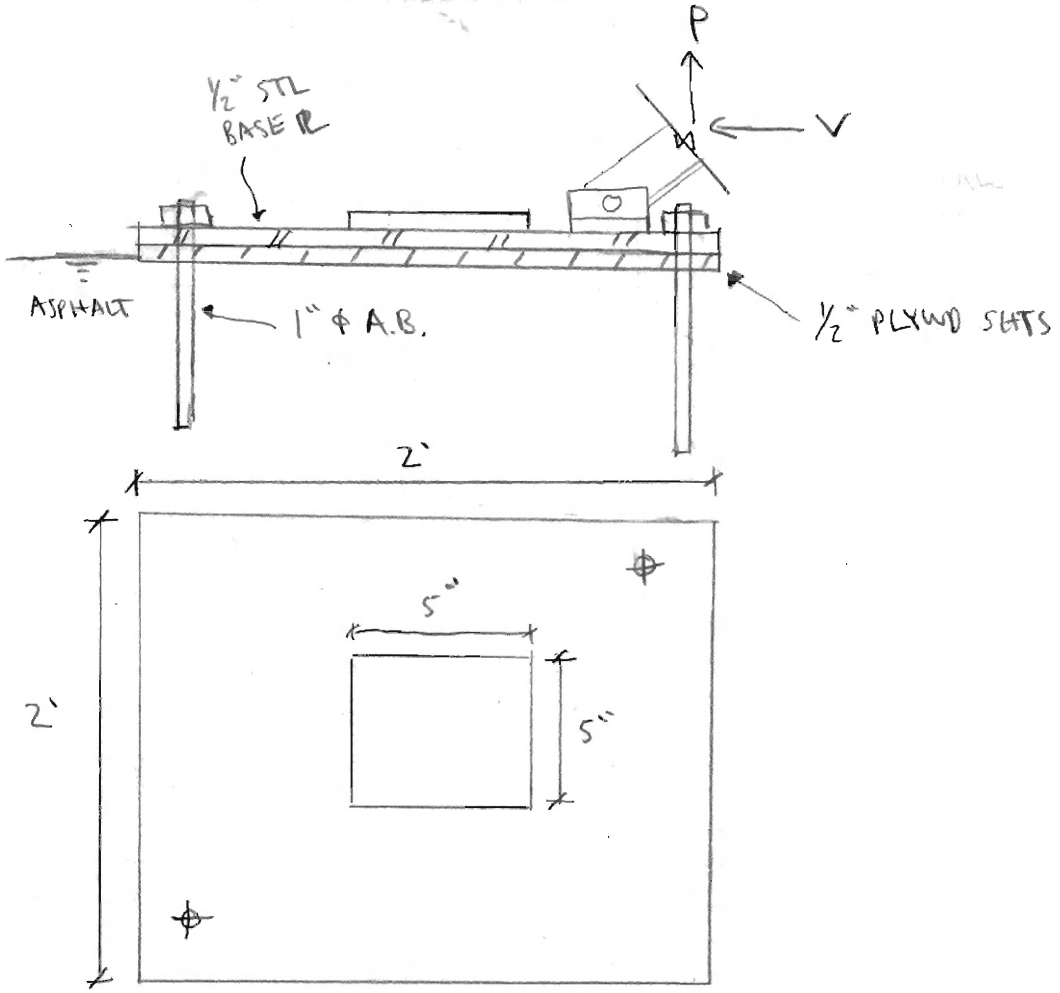
$R = \frac{5wL}{8} = \frac{5}{8}(18.75)(30) = 352\ lb$

↳ FROM REACTION AT CENTER OF OVERHANG BEAM

$M_u = 18(352) = 6328\ lb\text{-}in$

=> SAME DESIGN FOR JOIST MOMENT CONNECTION WILL WORK

10.4 ANCHORAGE DESIGN



⇒ INFORMATION GIVEN BY DOE FOR ANCHOR BOLT CAPACITY

$P_c = 1250$ lb
$V_c = 1500$ lb

$$\frac{P_r}{P_c} + \frac{V_r}{V_c} \leq 1.0$$

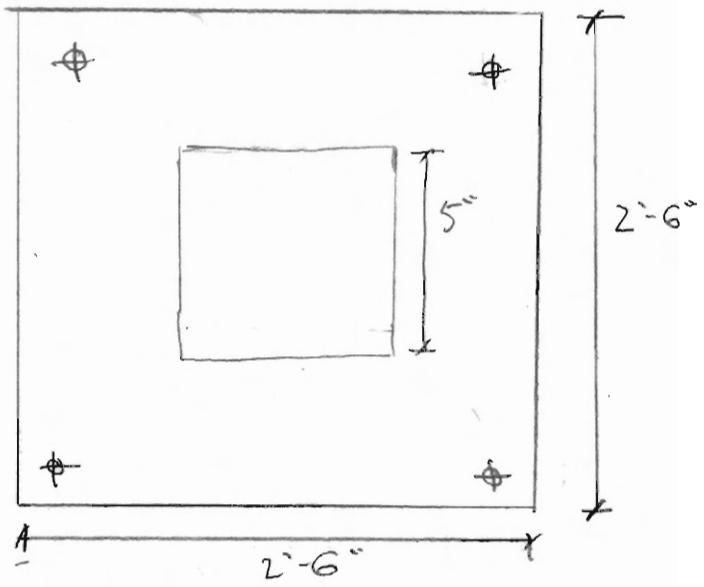
ANCHOR BOLT DESIGN

SEE APPENDIX A4 FOR REFERENCE IDENTIFICATION AND UPLIFT. SECTION 3.4 FOR SHEAR

FOOTING N9: $P_r = 2.4$ kips
$V_r = 5.5$ ft wall × 124 plf = 682 lb

$$\frac{2400}{2(1250)} + \frac{682}{2(1500)} = 1.19 \quad \text{(N.G.)}$$

⇒ NEED TO INCREASE # OF A.B.'S, DOE LIMITS A.B. SPACING TO 2 FT., SO NEED TO INCREASE BASE SIZE



$$\frac{2400}{4(1250)} + \frac{682}{4(1500)} = 0.60 \leq 1.0 \quad (OK)$$

FOOTING N13: $V = 4068\ lb \rightarrow$ SEE CALC. 10.1

$$\#\ A.B.'s = \frac{4068}{1500} = 2.712$$

$\Rightarrow$ USE 4 BOLTS

STEEL BASE PLATE DESIGN

TENSILE YIELDING: $P_n = F_y A_g$

$= 36\left(\frac{1}{2} \times 2.5 \times 12\right) = 540$ kips

$P_n/\Omega = 540$ kips > 4 kips (OK)

TENSILE RUPTURE: $P_n = F_u A_e$

$= 58\left(\frac{1}{2} \times \left[(2.5 \times 12) - (1 + \frac{1}{8})\right]\right) = 837$ kips

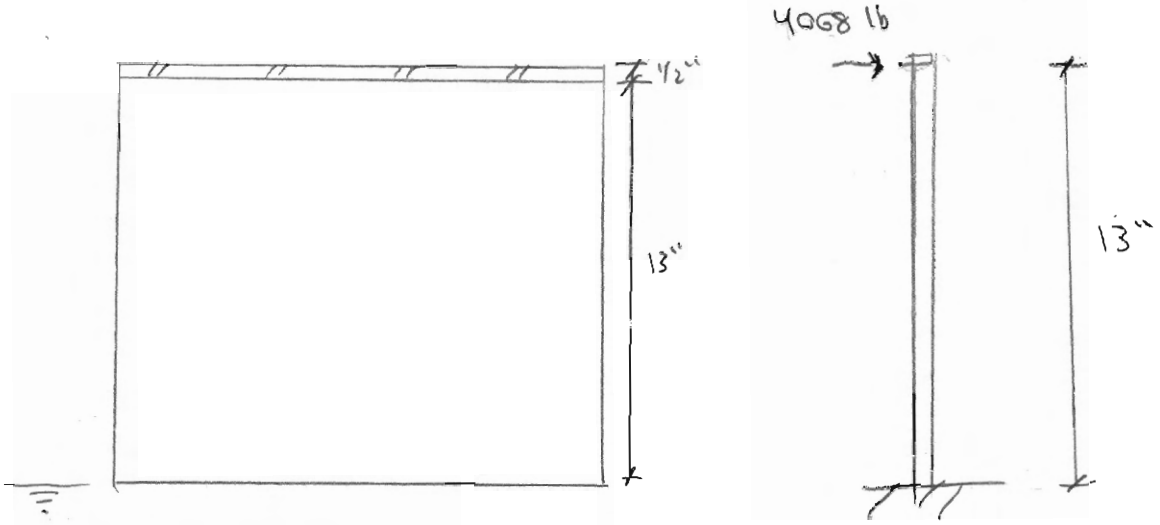
$P_n/\Omega = 419$ kips > 4 kips (OK)

CLEAR DISTANCE $= 1\frac{3}{4}$"

$\Rightarrow$ USE 2" OF CLEAR DISTANCE

FLEXURE IN ANCHOR BOLTS

=> NEED TO DESIGN FOR 18" IN ELEVATION CHANGE. WITH 5" OF VARIATION IN JACK HEIGHT NEED TO DESIGN A.B. FOR 13" OF UNSUPPORTED SPAN.



$M_r = PL = 4068(13) = 52{,}884$ lb-in

$M/\text{PER BOLT} = \frac{52{,}884}{4} = 13{,}221$ lb-in $= 13.2$ kip-in

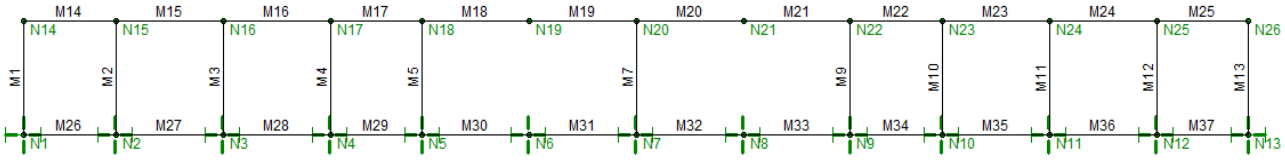
$\sigma_{BOLT} = 36$ ksi, $\quad S = \frac{\pi r^3}{4} = \frac{\pi(0.5)^3}{4} = 0.098$ in^3

$\sigma_r = \frac{M_r}{S} = \frac{13.2}{0.098} = 134$ ksi > 36 ksi (N.G.)

MAX UNSUPPORTED SPAN $= \frac{134}{36} = 3.72$"

A.1 APPENDIX

APPENDIX A.2 - VIERENDEEL TRUSS ANALYSIS



TRUSS ELEVATION WITH MEMBER AND NODE ANNOTATIONS

MEMBER DATA INPUT:

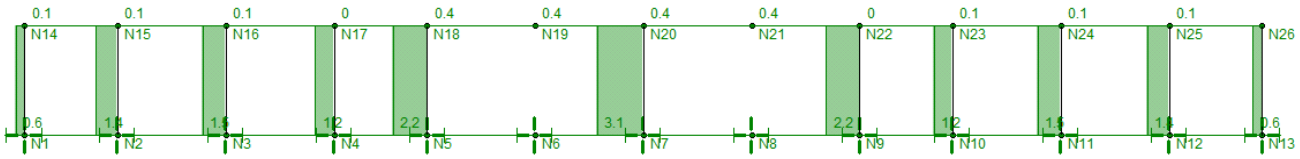
Member Primary Data

Primary | Advanced | Hot Rolled | Cold Formed | Wood | Concrete Beam | Concrete Column | Aluminum | RISAConnection | Detailing

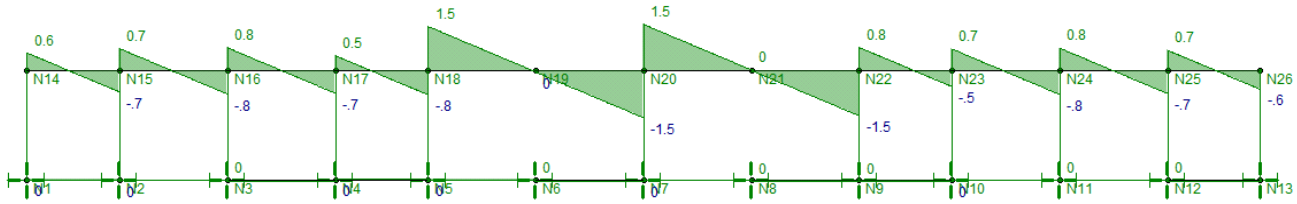
	Label	I Joint	J Joint	K Joint	Rotate...	Section/Sh...	Type	Design List	Material	Design ...
1	M1	N1	N14			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
2	M2	N2	N15			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
3	M3	N3	N16			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
4	M4	N4	N17			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
5	M5	N5	N18			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
6	M7	N7	N20			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
7	M9	N9	N22			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
8	M10	N10	N23			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
9	M11	N11	N24			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
10	M12	N12	N25			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
11	M13	N13	N26			HSS3x3x2	Beam	SquareTube	A500 Gr.46	Typical
12	M14	N14	N15		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
13	M15	N15	N16		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
14	M16	N16	N17		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
15	M17	N17	N18		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
16	M18	N18	N19		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
17	M19	N19	N20		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
18	M20	N20	N21		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
19	M21	N21	N22		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
20	M22	N22	N23		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
21	M23	N23	N24		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
22	M24	N24	N25		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
23	M25	N25	N26		270	C4x7.2	Beam	Channel	A500 Gr.46	Typical
24	M26	N1	N2		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
25	M27	N2	N3		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
26	M28	N3	N4		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
27	M29	N4	N5		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
28	M30	N5	N6		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
29	M31	N6	N7		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
30	M32	N7	N8		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
31	M33	N8	N9		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
32	M34	N9	N10		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
33	M35	N10	N11		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
34	M36	N11	N12		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical
35	M37	N12	N13		90	C4x7.2	Beam	Channel	A500 Gr.46	Typical

STRUCTURAL ANALYSIS

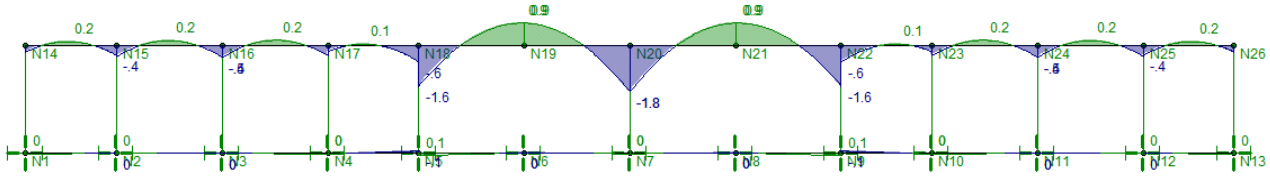
LOAD COMBINATION: 1.2D + 1.6Lr



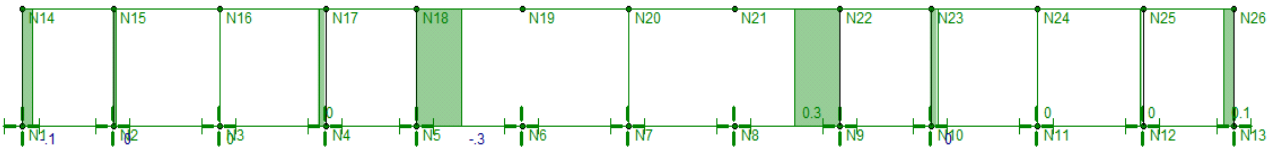
AXIAL DIAGRAM (kips)



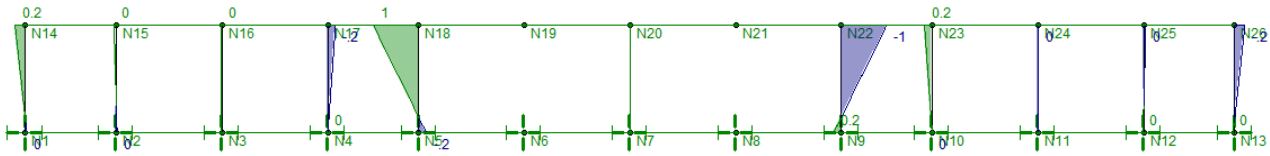
SHEAR DIAGRAM - MEMBER Z-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Y-AXIS (k-ft)



SHEAR DIAGRAM - MEMBER Y-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Z-AXIS (k-ft)

NOTE: BENDING OCCURS ABOUT BOTH MEMBER Y-AXIS AND Z-AXIS SINCE SOME MEMBERS WERE ROTATED ABOUT THEIR LOCAL X-AXIS, IN ORDER TO OBTAIN THE CORRECT ORIENTATION

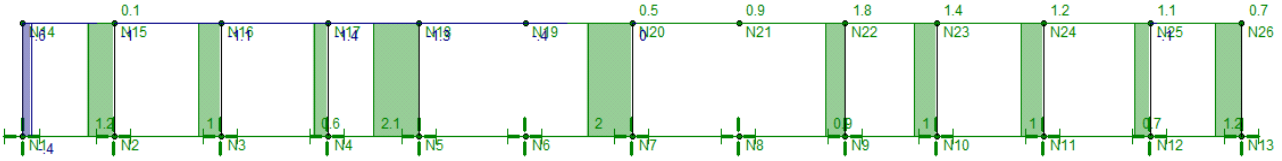
LOAD COMBINATION: 1.2D + 1.6Lr (CONTINUED)

Member Section Forces (By Combination)

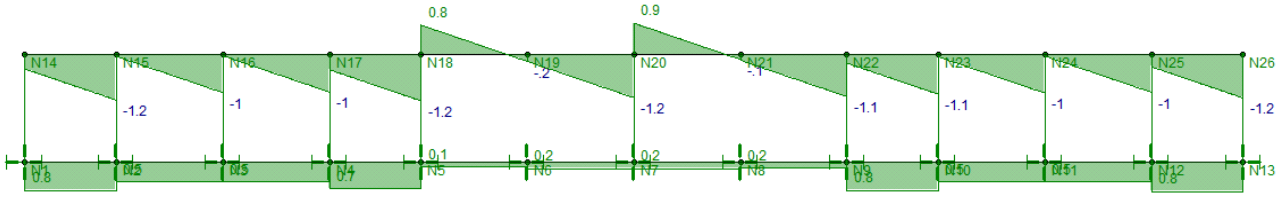
	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	1	M1	1	.596	-.075	0	0	0	-.03
2			2	.596	-.075	0	0	0	.234
3	1	M2	1	1.433	-.018	0	0	0	-.017
4			2	1.433	-.018	0	0	0	.047
5	1	M3	1	1.529	0	0	0	0	.008
6			2	1.529	0	0	0	0	.009
7	1	M4	1	1.238	.049	0	0	0	.001
8			2	1.238	.049	0	0	0	-.169
9	1	M5	1	2.248	-.335	0	0	0	-.179
10			2	2.248	-.335	0	0	0	.993
11	1	M7	1	3.064	0	0	0	0	0
12			2	3.064	0	0	0	0	0
13	1	M9	1	2.248	.335	0	0	0	.179
14			2	2.248	.335	0	0	0	-.993
15	1	M10	1	1.238	-.049	0	0	0	-.001
16			2	1.238	-.049	0	0	0	.169
17	1	M11	1	1.529	0	0	0	0	-.008
18			2	1.529	0	0	0	0	-.009
19	1	M12	1	1.433	.018	0	0	0	.017
20			2	1.433	.018	0	0	0	-.047
21	1	M13	1	.596	.075	0	0	0	.03
22			2	.596	.075	0	0	0	-.234
23	1	M14	1	.075	0	.596	0	-.234	0
24			2	.075	0	-.69	0	-.375	0
25	1	M15	1	.094	0	.743	0	-.422	0
26			2	.094	0	-.758	0	-.449	0
27	1	M16	1	.094	0	.77	0	-.458	0
28			2	.094	0	-.73	0	-.388	0
29	1	M17	1	.045	0	.508	0	-.219	0
30			2	.045	0	-.779	0	-.626	0
31	1	M18	1	.38	0	1.477	0	-1.619	0
32			2	.38	0	-.024	0	.925	0
33	1	M19	1	.38	0	-.039	0	.925	0
34			2	.38	0	-1.539	0	-1.836	0
35	1	M20	1	.38	0	1.539	0	-1.836	0
36			2	.38	0	.039	0	.925	0
37	1	M21	1	.38	0	.024	0	.925	0
38			2	.38	0	-1.477	0	-1.619	0
39	1	M22	1	.045	0	.779	0	-.626	0
40			2	.045	0	-.508	0	-.219	0
41	1	M23	1	.094	0	.73	0	-.388	0
42			2	.094	0	-.77	0	-.458	0
43	1	M24	1	.094	0	.758	0	-.449	0
44			2	.094	0	-.743	0	-.422	0
45	1	M25	1	.075	0	.69	0	-.375	0
46			2	.075	0	-.596	0	-.234	0
47	1	M26	1	0	0	-.015	0	.03	0
48			2	0	0	-.015	0	-.015	0
49	1	M27	1	0	0	-.001	0	.002	0
50			2	0	0	-.001	0	-.003	0
51	1	M28	1	0	0	.01	0	-.011	0
52			2	0	0	.01	0	.025	0
53	1	M29	1	0	0	-.04	0	.024	0
54			2	0	0	-.04	0	-.096	0
55	1	M30	1	0	0	-.031	0	.084	0
56			2	0	0	-.031	0	-.024	0
57	1	M31	1	0	0	.01	0	-.024	0

58			2	0	0	.01	0	.012	0
59	1	M32	1	0	0	-.01	0	.012	0
60			2	0	0	-.01	0	-.024	0
61	1	M33	1	0	0	.031	0	-.024	0
62			2	0	0	.031	0	.084	0
63	1	M34	1	0	0	.04	0	-.096	0
64			2	0	0	.04	0	.024	0
65	1	M35	1	0	0	-.01	0	.025	0
66			2	0	0	-.01	0	-.011	0
67	1	M36	1	0	0	.001	0	-.003	0
68			2	0	0	.001	0	.002	0
69	1	M37	1	0	0	.015	0	-.015	0
70			2	0	0	.015	0	.03	0

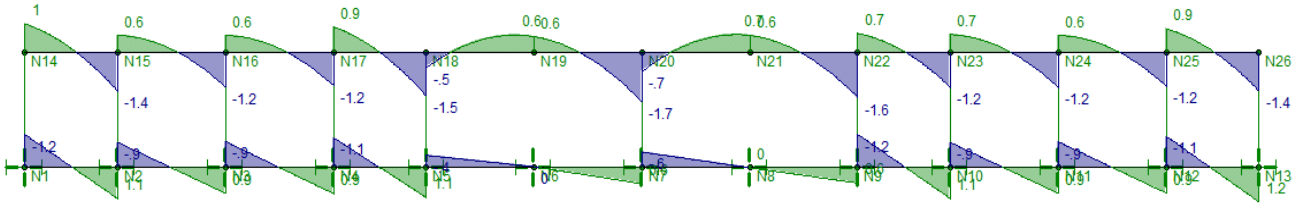
LOAD COMBINATION: 1.2D + 1.6W + 0.5Lr



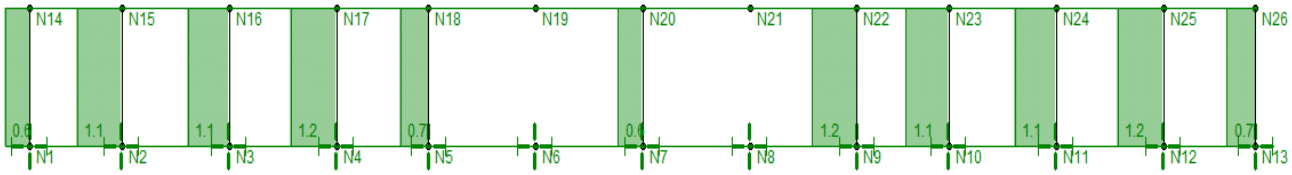
AXIAL DIAGRAM (kips)



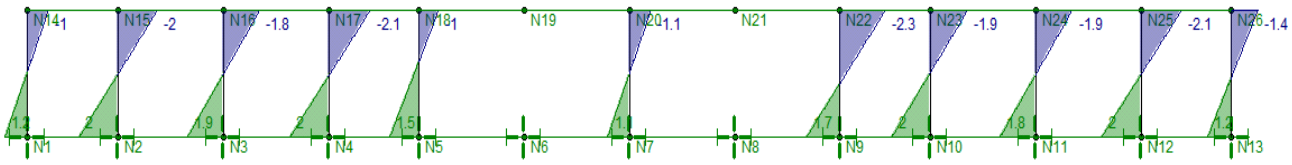
SHEAR DIAGRAM - MEMBER Z-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Y-AXIS (k-ft)



SHEAR DIAGRAM - MEMBER Y-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Z-AXIS (k-ft)

NOTE: BENDING OCCURS ABOUT BOTH MEMBER Y-AXIS AND Z-AXIS SINCE SOME MEMBERS WERE ROTATED ABOUT THEIR LOCAL X-AXIS, IN ORDER TO OBTAIN THE CORRECT ORIENTATION

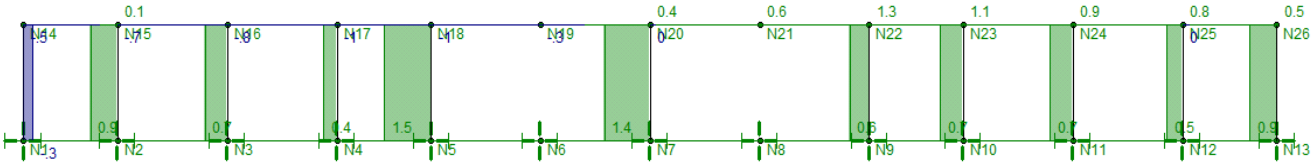
LOAD COMBINATION: 1.2D + 1.6W + 0.5Lr (CONTINUED)

Member Section Forces (By Combination)

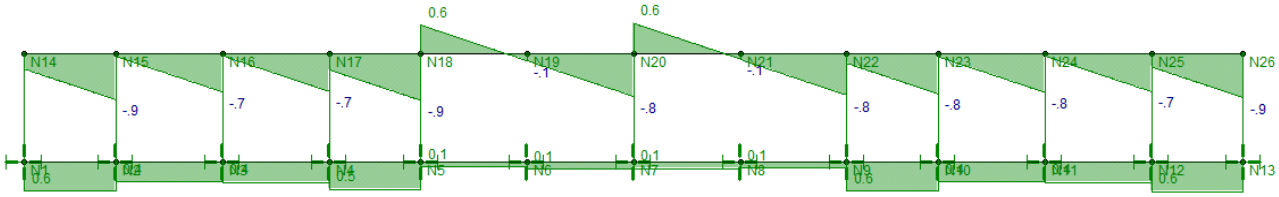
	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	3	M1	1	-.38	.635	0	0	0	1.179
2			2	-.38	.635	0	0	0	-1.043
3	3	M2	1	1.188	1.147	0	0	0	2.017
4			2	1.188	1.147	0	0	0	-1.996
5	3	M3	1	1.001	1.058	0	0	0	1.856
6			2	1.001	1.058	0	0	0	-1.847
7	3	M4	1	.608	1.175	0	0	0	2.004
8			2	.608	1.175	0	0	0	-2.11
9	3	M5	1	2.056	.714	0	0	0	1.506
10			2	2.056	.714	0	0	0	-.993
11	3	M7	1	2.018	.633	0	0	0	1.133
12			2	2.018	.633	0	0	0	-1.081
13	3	M9	1	.892	1.155	0	0	0	1.742
14			2	.892	1.155	0	0	0	-2.301
15	3	M10	1	1.018	1.111	0	0	0	2.002
16			2	1.018	1.111	0	0	0	-1.887
17	3	M11	1	1.007	1.059	0	0	0	1.846
18			2	1.007	1.059	0	0	0	-1.859
19	3	M12	1	.694	1.171	0	0	0	2.04
20			2	.694	1.171	0	0	0	-2.057
21	3	M13	1	1.163	.734	0	0	0	1.219
22			2	1.163	.734	0	0	0	-1.35
23	3	M14	1	-.635	0	-.38	0	1.043	0
24			2	.143	0	-1.224	0	-1.363	0
25	3	M15	1	-.981	0	-.037	0	.633	0
26			2	-.074	0	-1.022	0	-1.22	0
27	3	M16	1	-1.113	0	-.021	0	.627	0
28			2	-.206	0	-1.007	0	-1.172	0
29	3	M17	1	-1.369	0	-.399	0	.938	0
30			2	-.592	0	-1.243	0	-1.525	0
31	3	M18	1	-1.266	0	.812	0	-.532	0
32			2	-.359	0	-.173	0	.587	0
33	3	M19	1	-.359	0	-.174	0	.587	0
34			2	.548	0	-1.16	0	-1.749	0
35	3	M20	1	-.046	0	.864	0	-.668	0
36			2	.861	0	-.121	0	.633	0
37	3	M21	1	.861	0	-.145	0	.633	0
38			2	1.769	0	-1.13	0	-1.598	0
39	3	M22	1	.631	0	-.22	0	.703	0
40			2	1.408	0	-1.065	0	-1.226	0
41	3	M23	1	.316	0	-.047	0	.662	0
42			2	1.224	0	-1.033	0	-1.229	0
43	3	M24	1	.184	0	-.026	0	.63	0
44			2	1.091	0	-1.012	0	-1.187	0
45	3	M25	1	-.066	0	-.318	0	.87	0
46			2	.712	0	-1.163	0	-1.35	0
47	3	M26	1	0	0	.763	0	-1.179	0
48			2	0	0	.763	0	1.109	0
49	3	M27	1	0	0	.523	0	-.908	0
50			2	0	0	.523	0	.922	0
51	3	M28	1	0	0	.533	0	-.934	0
52			2	0	0	.533	0	.931	0
53	3	M29	1	0	0	.713	0	-1.073	0
54			2	0	0	.713	0	1.066	0
55	3	M30	1	0	0	.116	0	-.441	0
56			2	0	0	.116	0	-.033	0
57	3	M31	1	0	0	.174	0	-.033	0

58			2	0	0	.174	0	.574	0
59	3	M32	1	0	0	.16	0	-.559	0
60			2	0	0	.16	0	.002	0
61	3	M33	1	0	0	.157	0	.002	0
62			2	0	0	.157	0	.551	0
63	3	M34	1	0	0	.765	0	-1.192	0
64			2	0	0	.765	0	1.105	0
65	3	M35	1	0	0	.519	0	-.898	0
66			2	0	0	.519	0	.92	0
67	3	M36	1	0	0	.525	0	-.926	0
68			2	0	0	.525	0	.91	0
69	3	M37	1	0	0	.783	0	-1.129	0
70			2	0	0	.783	0	1.219	0

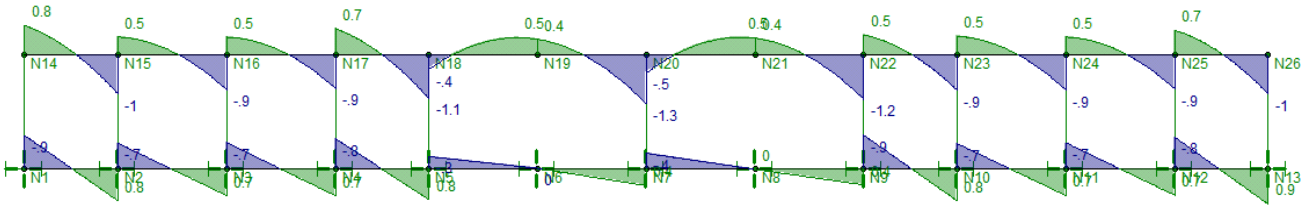
LOAD COMBINATION: (1.2+0.2Sds)D + E



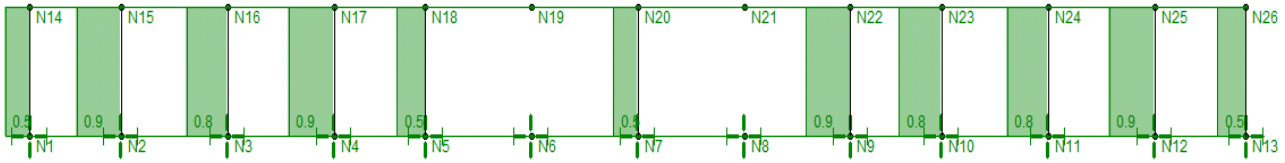
AXIAL DIAGRAM (kips)



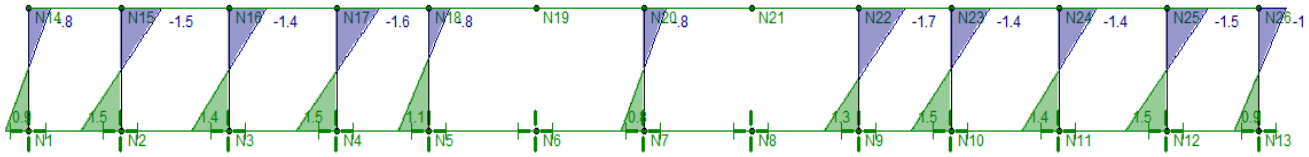
SHEAR DIAGRAM - MEMBER Z-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Y-AXIS (k-ft)



SHEAR DIAGRAM - MEMBER Y-AXIS (k-ft)



MOMENT DIAGRAM - MEMBER Z-AXIS (k-ft)

NOTE: BENDING OCCURS ABOUT BOTH MEMBER Y-AXIS AND Z-AXIS SINCE SOME MEMBERS WERE ROTATED ABOUT THEIR LOCAL X-AXIS, IN ORDER TO OBTAIN THE CORRECT ORIENTATION

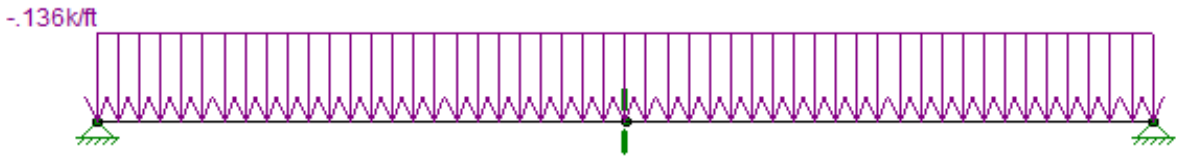
LOAD COMBINATION: (1.2+0.2Sds)D + E (CONTINUED)

Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	4	M1	1	-.294	.474	0	0	0	.878
2			2	-.294	.474	0	0	0	-.78
3	4	M2	1	.856	.853	0	0	0	1.501
4			2	.856	.853	0	0	0	-1.486
5	4	M3	1	.716	.787	0	0	0	1.381
6			2	.716	.787	0	0	0	-1.374
7	4	M4	1	.429	.873	0	0	0	1.491
8			2	.429	.873	0	0	0	-1.566
9	4	M5	1	1.486	.538	0	0	0	1.124
10			2	1.486	.538	0	0	0	-.758
11	4	M7	1	1.441	.472	0	0	0	.844
12			2	1.441	.472	0	0	0	-.808
13	4	M9	1	.622	.852	0	0	0	1.292
14			2	.622	.852	0	0	0	-1.689
15	4	M10	1	.734	.828	0	0	0	1.49
16			2	.734	.828	0	0	0	-1.408
17	4	M11	1	.72	.787	0	0	0	1.374
18			2	.72	.787	0	0	0	-1.382
19	4	M12	1	.489	.87	0	0	0	1.517
20			2	.489	.87	0	0	0	-1.53
21	4	M13	1	.853	.545	0	0	0	.906
22			2	.853	.545	0	0	0	-1
23	4	M14	1	-.474	0	-.294	0	.78	0
24			2	.108	0	-.898	0	-1.007	0
25	4	M15	1	-.733	0	-.041	0	.479	0
26			2	-.054	0	-.746	0	-.899	0
27	4	M16	1	-.831	0	-.03	0	.475	0
28			2	-.152	0	-.735	0	-.864	0
29	4	M17	1	-1.019	0	-.306	0	.702	0
30			2	-.437	0	-.91	0	-1.123	0
31	4	M18	1	-.953	0	.576	0	-.365	0
32			2	-.274	0	-.128	0	.419	0
33	4	M19	1	-.274	0	-.129	0	.419	0
34			2	.405	0	-.834	0	-1.265	0
35	4	M20	1	-.047	0	.611	0	-.458	0
36			2	.632	0	-.093	0	.449	0
37	4	M21	1	.632	0	-.106	0	.449	0
38			2	1.311	0	-.81	0	-1.154	0
39	4	M22	1	.468	0	-.179	0	.536	0
40			2	1.05	0	-.783	0	-.908	0
41	4	M23	1	.233	0	-.049	0	.5	0
42			2	.912	0	-.754	0	-.905	0
43	4	M24	1	.135	0	-.034	0	.477	0
44			2	.814	0	-.739	0	-.875	0
45	4	M25	1	-.05	0	-.25	0	.654	0
46			2	.532	0	-.853	0	-1	0
47	4	M26	1	0	0	.568	0	-.878	0
48			2	0	0	.568	0	.825	0
49	4	M27	1	0	0	.389	0	-.675	0
50			2	0	0	.389	0	.686	0
51	4	M28	1	0	0	.396	0	-.695	0
52			2	0	0	.396	0	.692	0
53	4	M29	1	0	0	.531	0	-.799	0
54			2	0	0	.531	0	.794	0
55	4	M30	1	0	0	.087	0	-.329	0
56			2	0	0	.087	0	-.024	0
57	4	M31	1	0	0	.129	0	-.024	0
58			2	0	0	.129	0	.427	0

58			2	0	0	.129	0	.427	0
59	4	M32	1	0	0	.12	0	-.416	0
60			2	0	0	.12	0	.002	0
61	4	M33	1	0	0	.116	0	.002	0
62			2	0	0	.116	0	.408	0
63	4	M34	1	0	0	.569	0	-.884	0
64			2	0	0	.569	0	.821	0
65	4	M35	1	0	0	.387	0	-.668	0
66			2	0	0	.387	0	.685	0
67	4	M36	1	0	0	.39	0	-.689	0
68			2	0	0	.39	0	.677	0
69	4	M37	1	0	0	.582	0	-.84	0
70			2	0	0	.582	0	.906	0

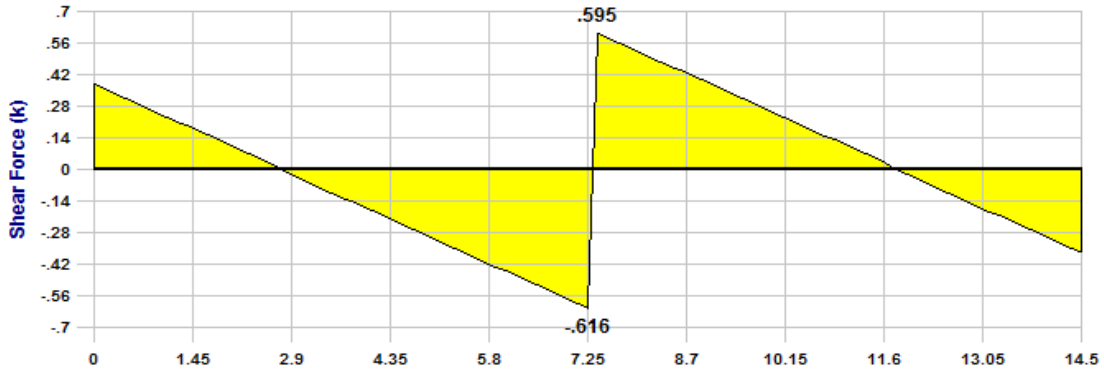
APPENDIX A.3 - DECK JOIST ANALYSIS



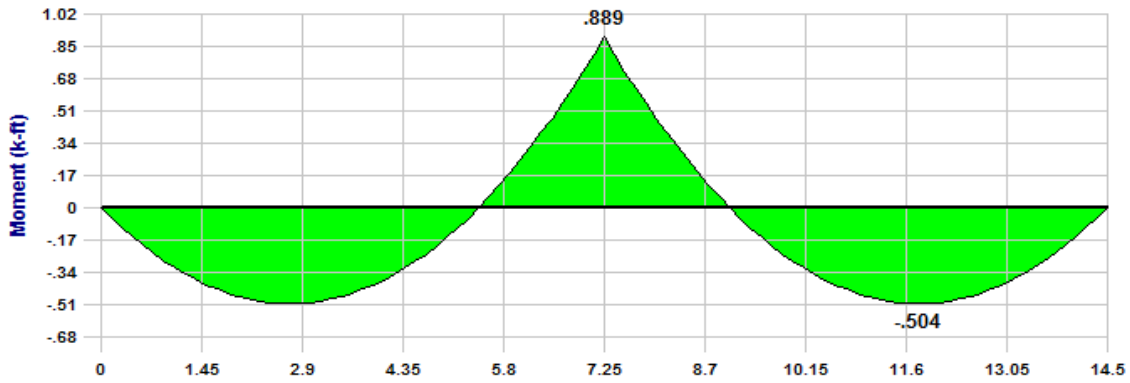
DECK JOIST LOADING DIAGRAM

STRUCTURAL ANALYSIS

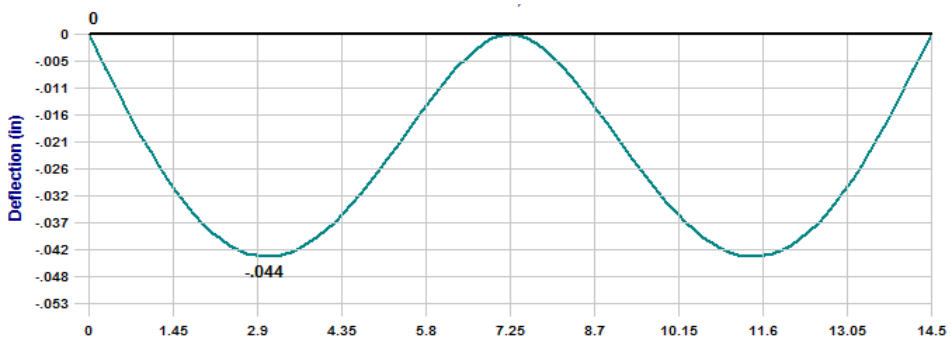
LOAD COMBINATION: 1.2D + 1.6Lr



SHEAR DIAGRAM (kips)

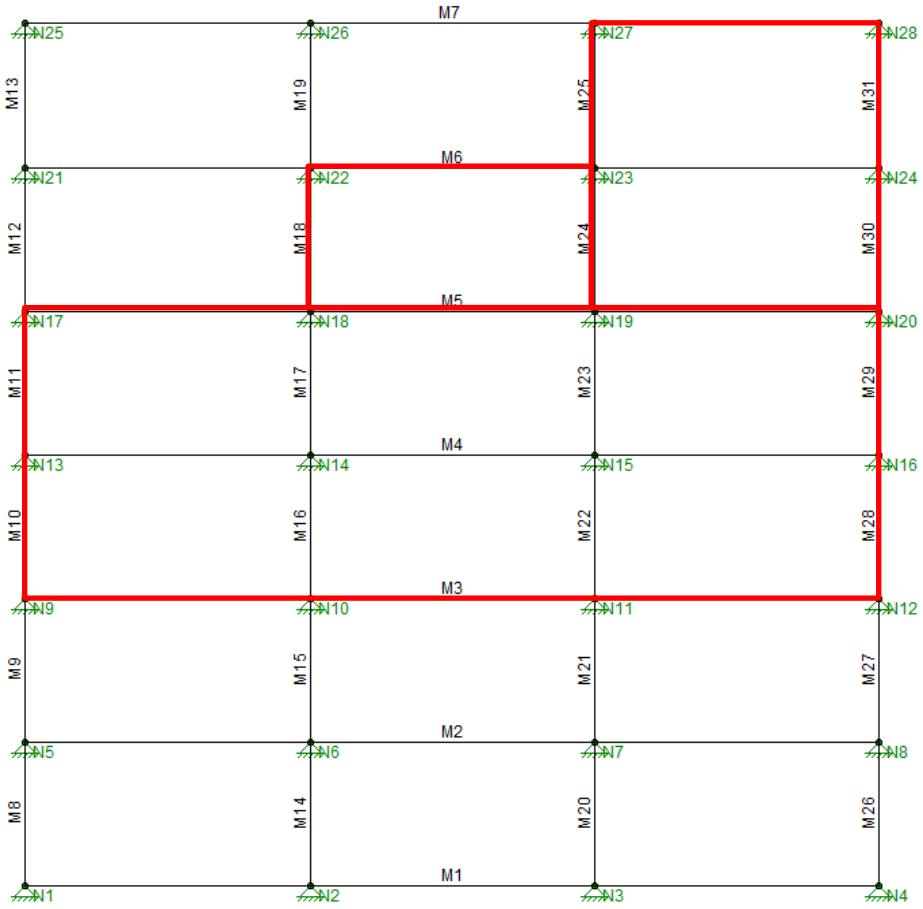


MOMENT DIAGRAM (k-ft)



DEFLECTION DIAGRAM (in.)

APPENDIX A.4 - FOUNDATION BEAM ANALYSIS



FOUNDATION BEAM SYSTEM MEMBER AND NODE ANNOTATION

NOTES:

**UNFACTORED OVERTURNING FORCES TAKEN FROM SHEARWALL DESIGN AND APPLIED TO UNDERLYING BEAMS AND THEN FACTORED BY OMEGA (Ω) SINCE DISCONTINUOUS SYSTEM EXISTS

**LINE LOADS APPLIED ALONG RED LINES TO SIMULATE WALL LOADS DUE TO ROOF DEAD AND LIVE

**FLOOR LOADS APPLIED AS MASS AREA LOADS TO TAKE INTO ACCOUNT DEAD AND LIVE

**FOR BEAM DESIGN, SEISMIC GOVERNS OVER WIND DUE TO OMEGA (Ω) FACTOR

MEMBER DATA INPUT

Member Primary Data

Primary | Advanced | Hot Rolled | Cold Formed | Wood | Concrete Beam | Concrete Column | Aluminum | RISAConnection | Detailing

	Label	I Joint	J Joint	K Joint	Rotate...	Section/Sh...	Type	Design List	Material	Design ...
1	M1	N1	N4			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
2	M2	N5	N8			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
3	M3	N9	N12			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
4	M4	N13	N16			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
5	M5	N17	N20			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
6	M6	N21	N24			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
7	M7	N25	N28			5.25X9.25FS	Beam	Rectangular	Parallam	Typical
8	M8	N1	N5			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
9	M9	N5	N9			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
10	M10	N9	N13			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
11	M11	N13	N17			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
12	M12	N17	N21			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
13	M13	N21	N25			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
14	M14	N2	N6			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
15	M15	N6	N10			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
16	M16	N10	N14			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
17	M17	N14	N18			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
18	M18	N18	N22			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
19	M19	N22	N26			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
20	M20	N3	N7			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
21	M21	N7	N11			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
22	M22	N11	N15			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
23	M23	N15	N19			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
24	M24	N19	N23			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
25	M25	N23	N27			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
26	M26	N4	N8			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
27	M27	N8	N12			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
28	M28	N12	N16			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
29	M29	N16	N20			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
30	M30	N20	N24			3.5X9.25FS	Beam	Rectangular	Parallam	Typical
31	M31	N24	N28			3.5X9.25FS	Beam	Rectangular	Parallam	Typical

SEISMIC OVERTURNING LOAD INPUT

Member Point Loads

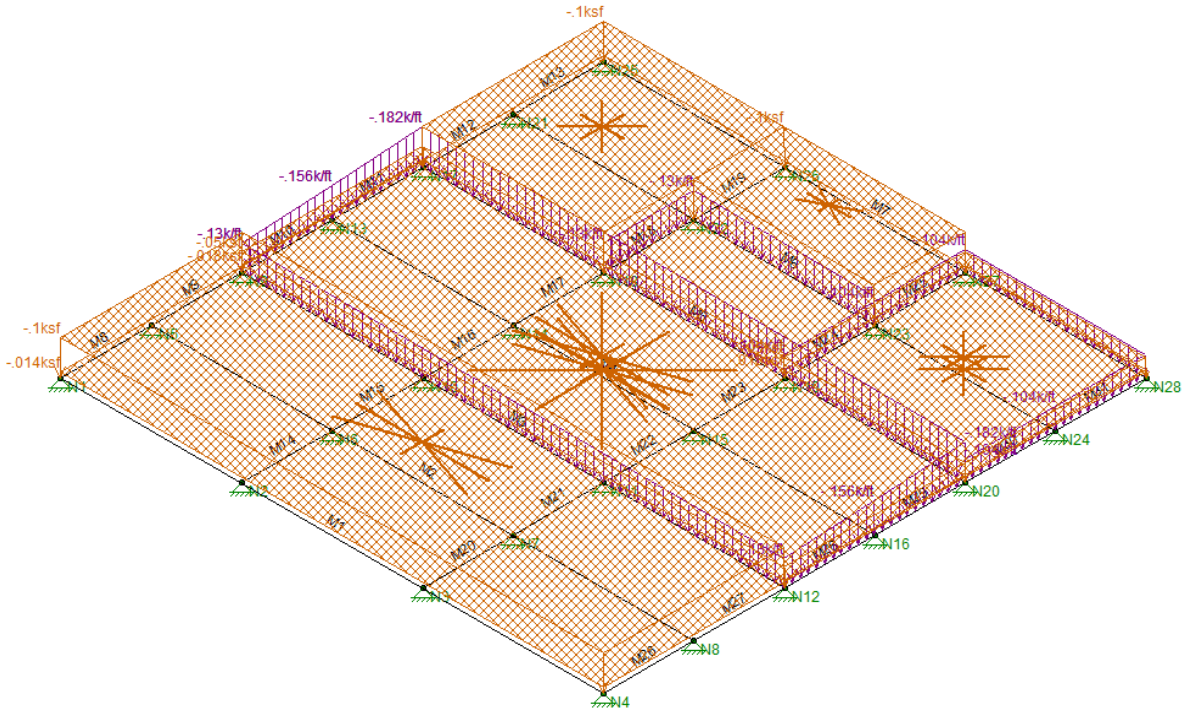
Member | Wall Panel

BLC 5:Seismic | Next BLC | Prev BLC

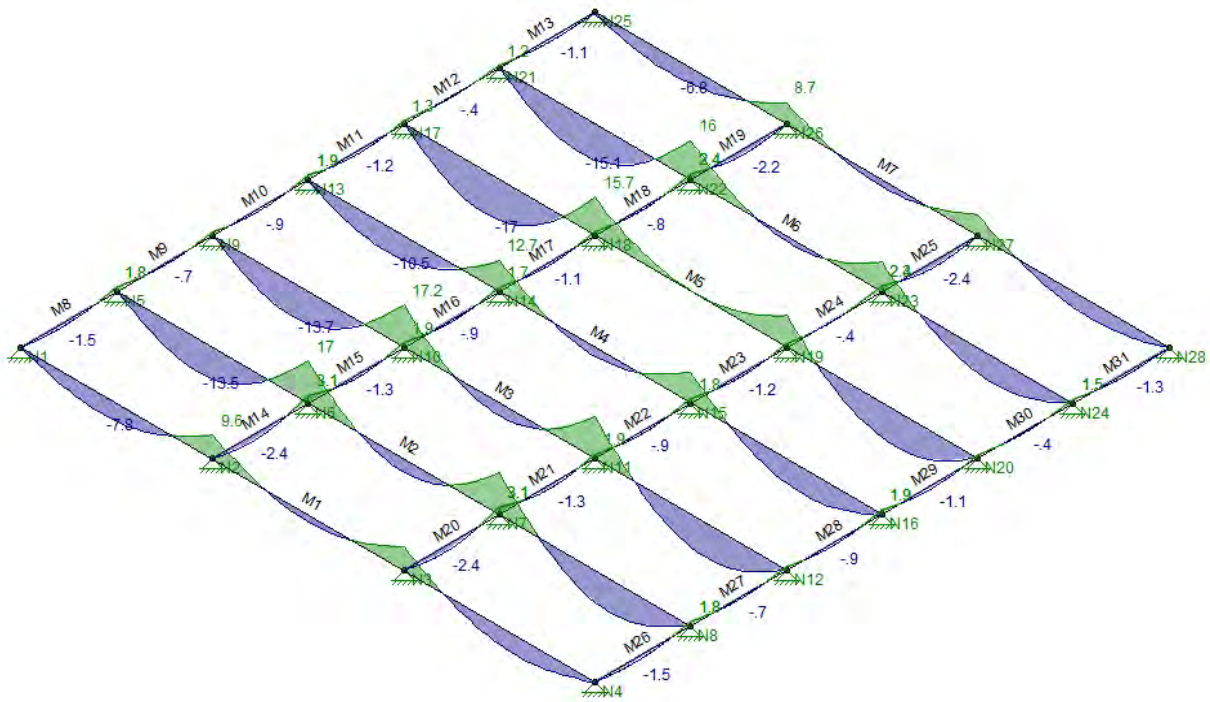
	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M3	y	-3.54	12
2	M3	y	3.54	6.5
3	M3	y	3.54	33.5
4	M3	y	-3.54	38.75
5	M5	y	6.24	6.5
6	M5	y	-6.24	11.5
7	M5	y	6.24	34
8	M5	y	-6.24	45
9	M6	y	1.83	22.3
10	M6	y	-4.752	30
11	M7	y	4.752	33
12	M7	y	-1.584	37
13	M10	y	5.52	0
14	M11	y	-5.52	7.5
15	M17	y	1.23	5.5
16	M19	y	-1.23	2.5
17	M24	y	2.49	4
18	M25	y	-2.49	7.5
19	M29	y	6.94	2.5
20	M31	y	-6.94	1

STRUCTURAL ANALYSIS

GOVERNING LOAD COMBINATIONS: D + L



LOADING DIAGRAM



MOMENT DIAGRAM (k-ft)

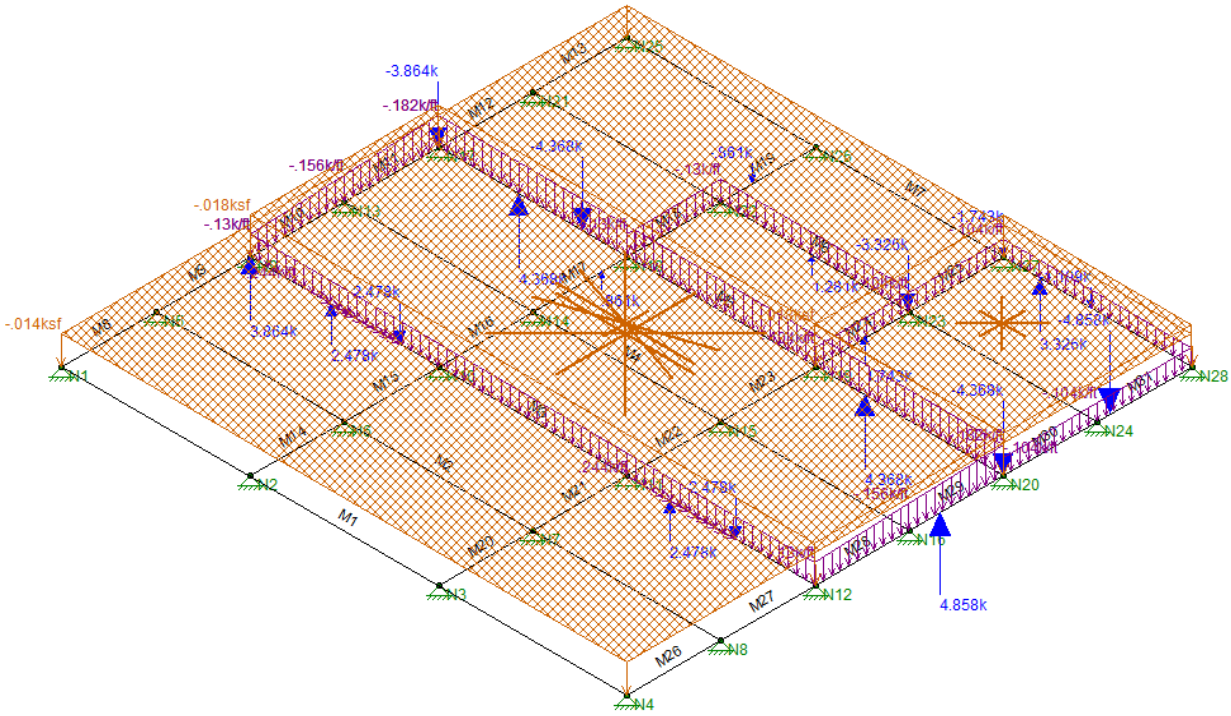
GOVERNING LOAD COMBINATIONS: D + L (CONTINUED)

Member Section Forces (By Combination)

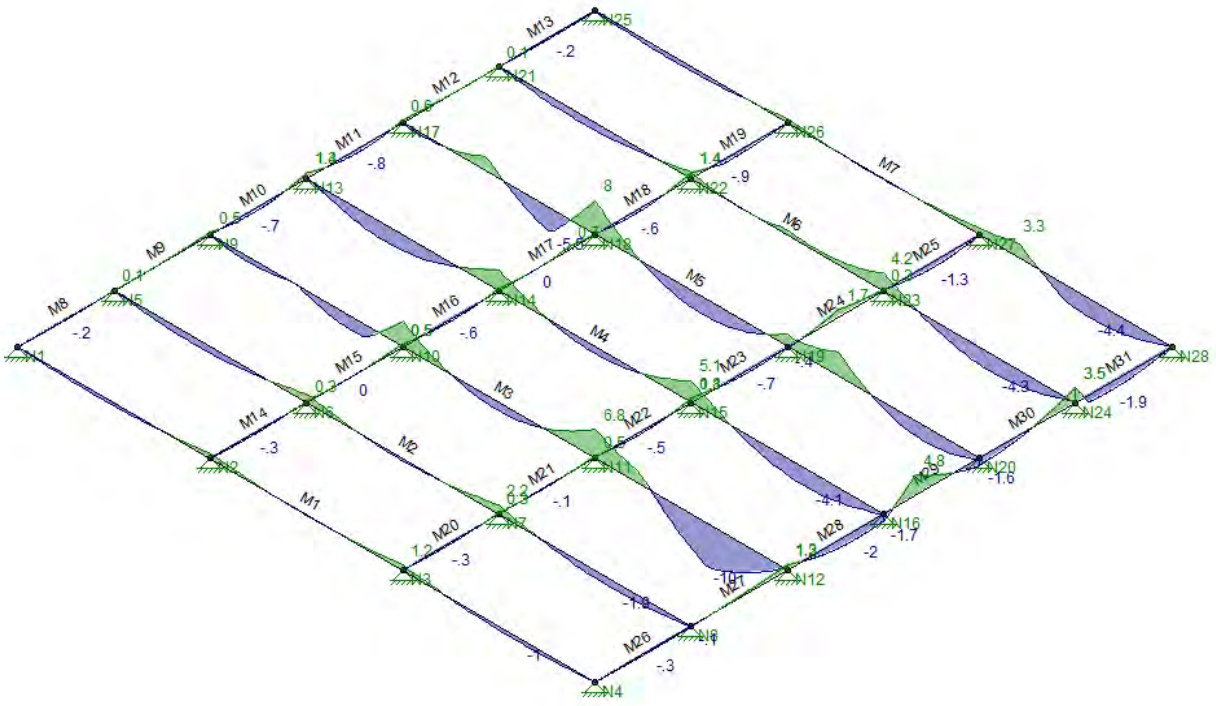
	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	2	M1	1	0	1.805	0	.057	0	-.355
2			2	0	-3.222	0	.057	0	9.551
3			3	0	3.222	0	-.057	0	9.551
4			4	0	-1.805	0	-.057	0	-.355
5	2	M2	1	0	3.338	0	-.007	0	.324
6			2	0	-5.84	0	-.007	0	16.973
7			3	0	5.839	0	.007	0	16.973
8			4	0	-3.338	0	.007	0	.325
9	2	M3	1	0	3.609	0	-.025	0	.225
10			2	0	-6.116	0	-.025	0	17.243
11			3	0	6.116	0	.026	0	17.241
12			4	0	-3.61	0	.026	0	.235
13	2	M4	1	0	2.438	0	-.002	0	-.644
14			2	0	-4.289	0	.004	0	12.736
15			3	0	4.277	0	.004	0	12.627
16			4	0	-2.451	0	-.004	0	-.483
17	2	M5	1	0	4.647	0	.02	0	.591
18			2	0	-6.772	0	.02	0	15.712
19			3	0	5.759	0	-.018	0	13.232
20			4	0	-3.971	0	.003	0	.522
21	2	M6	1	0	4.127	0	.021	0	.406
22			2	0	-6.236	0	.026	0	16.005
23			3	0	4.537	0	-.044	0	12.011
24			4	0	-2.913	0	-.044	0	.03
25	2	M7	1	0	1.803	0	-.069	0	-.548
26			2	0	-2.974	0	-.069	0	8.72
27			3	0	3.09	0	.077	0	8.668
28			4	0	-1.94	0	.077	0	-.273
29	2	M8	1	0	.708	0	-.355	0	-.057
30			2	0	.236	0	-.355	0	-1.379
31			3	0	-.726	0	-.355	0	-.77
32			4	0	-1.221	0	-.355	0	1.808
33	2	M9	1	0	1.02	0	-.031	0	1.815
34			2	0	.537	0	-.031	0	-.275
35			3	0	-.427	0	-.031	0	-.413
36			4	0	-.909	0	-.031	0	1.401
37	2	M10	1	0	1.145	0	.195	0	1.426
38			2	0	.457	0	.195	0	-.686
39			3	0	-.586	0	.195	0	-.524
40			4	0	-1.295	0	.195	0	1.926
41	2	M11	1	0	1.371	0	-.449	0	1.928
42			2	0	.64	0	-.449	0	-.694
43			3	0	-.467	0	-.449	0	-.919
44			4	0	-1.264	0	-.449	0	1.346
45	2	M12	1	0	.623	0	.141	0	1.326
46			2	0	.391	0	.141	0	-.089
47			3	0	-.354	0	.141	0	-.135
48			4	0	-.586	0	.141	0	1.188
49	2	M13	1	0	.777	0	.548	0	1.168
50			2	0	.533	0	.548	0	-.619
51			3	0	-.21	0	.548	0	-1.017
52			4	0	-.432	0	.548	0	-.069
53	2	M14	1	0	1.156	0	.105	0	.057
54			2	0	.43	0	.105	0	-2.211
55			3	0	-1.247	0	.105	0	-1.185
56			4	0	-1.949	0	.105	0	3.094
57	2	M15	1	0	1.704	0	.015	0	3.086
58			2	0	.994	0	.015	0	-.575
59			3	0	-.677	0	.015	0	-.971
60			4	0	-1.387	0	.015	0	1.898

61	2	M16	1	0	1.124	0	-.048	0	1.874
62			2	0	.624	0	-.048	0	-.515
63			3	0	-.582	0	-.048	0	-.574
64			4	0	-1.106	0	-.048	0	1.74
65	2	M17	1	0	1.148	0	.367	0	1.735
66			2	0	.625	0	.367	0	-.687
67			3	0	-.581	0	.367	0	-.736
68			4	0	-1.081	0	.367	0	1.545
69	2	M18	1	0	1.066	0	-.163	0	1.583
70			2	0	.471	0	-.163	0	-.507
71			3	0	-.698	0	-.163	0	-.223
72			4	0	-1.293	0	-.163	0	2.434
73	2	M19	1	0	1.571	0	-.301	0	2.428
74			2	0	1.081	0	-.301	0	-1.18
75			3	0	-.439	0	-.301	0	-1.988
76			4	0	-.953	0	-.301	0	.047
77	2	M20	1	0	1.156	0	-.105	0	.057
78			2	0	.43	0	-.105	0	-2.211
79			3	0	-1.247	0	-.105	0	-1.183
80			4	0	-1.95	0	-.105	0	3.097
81	2	M21	1	0	1.706	0	-.015	0	3.09
82			2	0	.996	0	-.015	0	-.577
83			3	0	-.675	0	-.015	0	-.979
84			4	0	-1.385	0	-.015	0	1.884
85	2	M22	1	0	1.114	0	.052	0	1.857
86			2	0	.614	0	.052	0	-.507
87			3	0	-.592	0	.052	0	-.54
88			4	0	-1.116	0	.052	0	1.8
89	2	M23	1	0	1.192	0	-.28	0	1.808
90			2	0	.669	0	-.28	0	-.724
91			3	0	-.537	0	-.28	0	-.883
92			4	0	-1.037	0	-.28	0	1.289
93	2	M24	1	0	.776	0	.216	0	1.268
94			2	0	.308	0	.216	0	-.214
95			3	0	-.589	0	.216	0	.138
96			4	0	-1.058	0	.216	0	2.324
97	2	M25	1	0	1.784	0	.158	0	2.394
98			2	0	1.096	0	.158	0	-1.459
99			3	0	-.478	0	.158	0	-2.238
100			4	0	-1.189	0	.158	0	.099
101	2	M26	1	0	.708	0	.355	0	-.057
102			2	0	.236	0	.355	0	-1.379
103			3	0	-.726	0	.355	0	-.771
104			4	0	-1.221	0	.355	0	1.807
105	2	M27	1	0	1.019	0	.03	0	1.814
106			2	0	.536	0	.03	0	-.274
107			3	0	-.427	0	.03	0	-.411
108			4	0	-.91	0	.03	0	1.405
109	2	M28	1	0	1.148	0	-.205	0	1.431
110			2	0	.46	0	-.205	0	-.688
111			3	0	-.583	0	-.205	0	-.534
112			4	0	-1.292	0	-.205	0	1.908
113	2	M29	1	0	1.358	0	.278	0	1.905
114			2	0	.627	0	.278	0	-.683
115			3	0	-.481	0	.278	0	-.875
116			4	0	-1.278	0	.278	0	1.424
117	2	M30	1	0	.82	0	-.243	0	1.427
118			2	0	.39	0	-.243	0	-.193
119			3	0	-.408	0	-.243	0	-.17
120			4	0	-.838	0	-.243	0	1.494
121	2	M31	1	0	1.041	0	-.273	0	1.451
122			2	0	.598	0	-.273	0	-.706
123			3	0	-.198	0	-.273	0	-1.201
124			4	0	-.617	0	-.273	0	-.077

GOVERNING LOAD COMBINATIONS: D + 0.7ΩE



LOADING DIAGRAM



MOMENT DIAGRAM (k-ft)

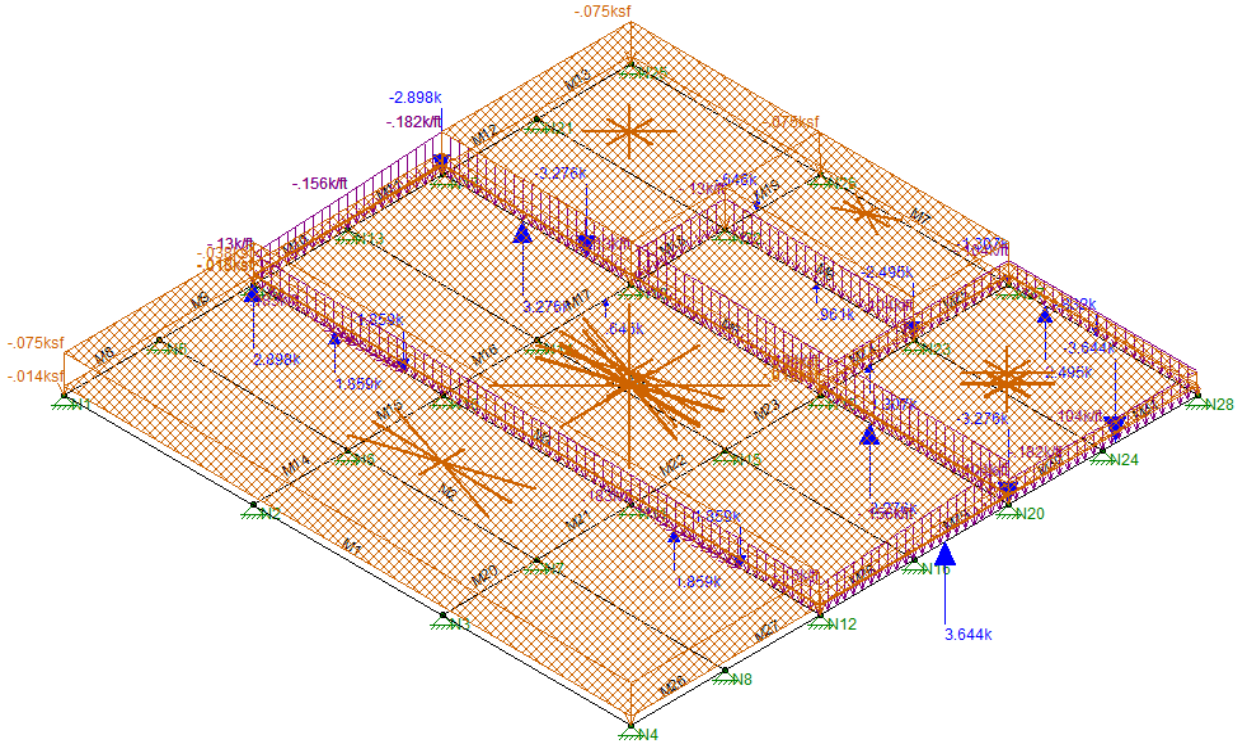
GOVERNING LOAD COMBINATIONS: D + 0.7ΩE (CONTINUED)

Member Section Forces (By Combination)

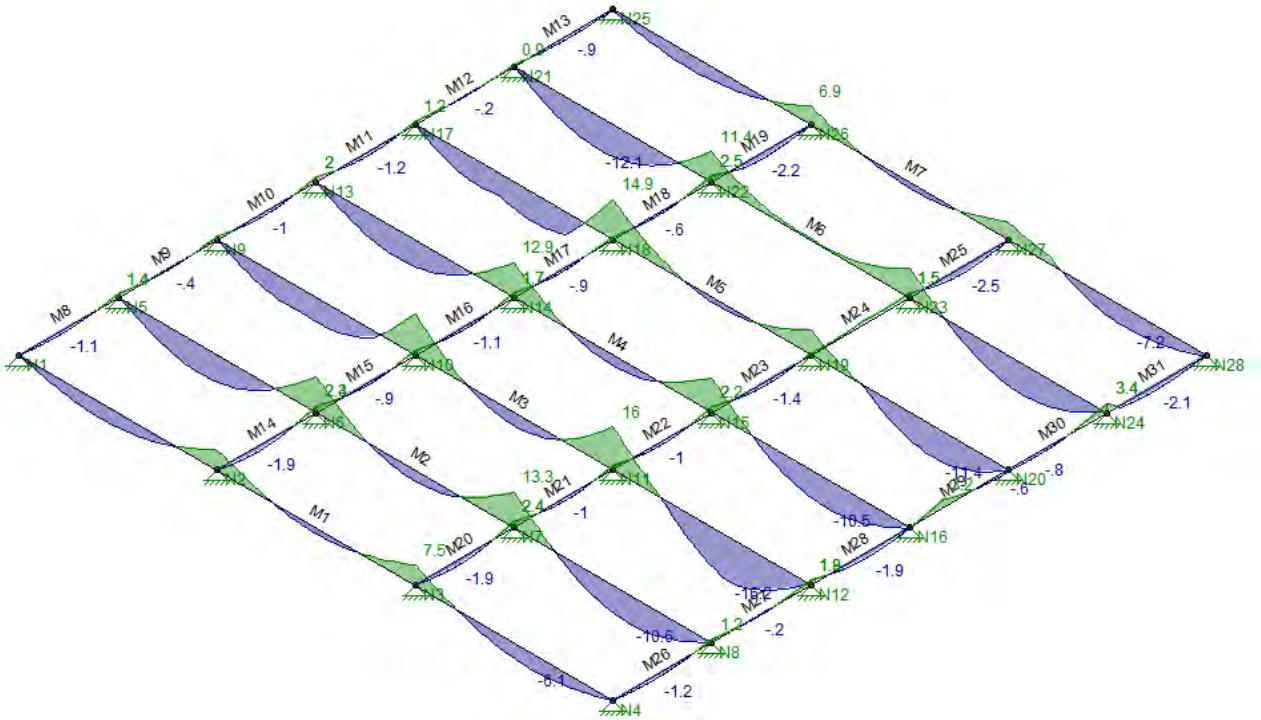
	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	4	M1	1	0	.256	0	.009	0	-.045
2			2	0	-.388	0	.009	0	1.148
3			3	0	.39	0	-.003	0	1.158
4			4	0	-.254	0	-.003	0	-.067
5	4	M2	1	0	.444	0	0	0	.038
6			2	0	-.736	0	0	0	2.025
7			3	0	.768	0	-.014	0	2.159
8			4	0	-.412	0	-.014	0	-.324
9	4	M3	1	-.514	.624	0	-.01	0	-.119
10			2	.826	-3.295	0	-.01	0	5.879
11			3	-.852	-2.057	0	.064	0	6.771
12			4	.549	-2.391	0	.064	0	.642
13	4	M4	1	0	1.063	0	-.025	0	.362
14			2	0	-1.665	0	-.025	0	4.904
15			3	0	1.712	0	-.199	0	5.12
16			4	0	-1.016	0	-.199	0	-.127
17	4	M5	1	0	.25	0	.065	0	-.343
18			2	0	-4.31	0	-.086	0	7.989
19			3	0	-1.975	0	.138	0	2.924
20			4	0	-1.362	0	.138	0	-.266
21	4	M6	1	0	.476	0	.006	0	.154
22			2	0	.762	0	.071	0	1.637
23			3	0	1.714	0	.071	0	4.187
24			4	0	-1.144	0	.035	0	.167
25	4	M7	1	0	.261	0	-.04	0	-.047
26			2	0	-.383	0	-.044	0	1.082
27			3	0	-.507	0	-.044	0	1.458
28			4	0	-1.252	0	-.039	0	-.026
29	4	M8	1	0	.068	0	-.045	0	-.009
30			2	0	.04	0	-.045	0	-.161
31			3	0	-.058	0	-.045	0	-.144
32			4	0	-.108	0	-.045	0	.083
33	4	M9	1	0	.028	0	-.007	0	.083
34			2	0	-.01	0	-.007	0	.04
35			3	0	-.109	0	-.007	0	.188
36			4	0	-.147	0	-.007	0	.529
37	4	M10	1	0	.668	0	-.126	0	.538
38			2	0	.201	0	-.126	0	-.595
39			3	0	-.409	0	-.126	0	-.334
40			4	0	-.896	0	-.126	0	1.334
41	4	M11	1	0	.949	0	.236	0	1.358
42			2	0	.44	0	.236	0	-.422
43			3	0	-.236	0	.236	0	-.687
44			4	0	-.81	0	.236	0	.658
45	4	M12	1	0	.156	0	-.107	0	.593
46			2	0	.118	0	-.107	0	.229
47			3	0	.019	0	-.107	0	.058
48			4	0	-.019	0	-.107	0	.078
49	4	M13	1	0	.111	0	.047	0	.072
50			2	0	.06	0	.047	0	-.162
51			3	0	-.037	0	.047	0	-.186
52			4	0	-.065	0	.047	0	-.04
53	4	M14	1	0	.154	0	.018	0	.009
54			2	0	.061	0	.018	0	-.296
55			3	0	-.143	0	.018	0	-.187
56			4	0	-.213	0	.018	0	.292
57	4	M15	1	0	.146	0	.037	0	.292
58			2	0	.069	0	.037	0	-.017
59			3	0	-.129	0	.037	0	.058
60			4	0	-.206	0	.037	0	.517

61	4	M16	1	0	.425	0	-.002	0	.512
62			2	0	.241	0	-.002	0	-.401
63			3	0	-.228	0	-.002	0	-.425
64			4	0	-.435	0	-.002	0	.485
65	4	M17	1	0	.256	0	-.056	0	.436
66			2	0	.05	0	-.056	0	-.027
67			3	0	-.419	0	-.056	0	.441
68			4	0	.258	0	-.056	0	.077
69	4	M18	1	0	.501	0	.044	0	.228
70			2	0	.099	0	.044	0	-.562
71			3	0	-.424	0	.044	0	-.156
72			4	0	-.826	0	.044	0	1.447
73	4	M19	1	0	.933	0	-.035	0	1.382
74			2	0	.003	0	-.035	0	-.9
75			3	0	-.201	0	-.035	0	-.659
76			4	0	-.294	0	-.035	0	-.004
77	4	M20	1	0	.152	0	-.023	0	.003
78			2	0	.059	0	-.023	0	-.297
79			3	0	-.145	0	-.023	0	-.183
80			4	0	-.215	0	-.023	0	.301
81	4	M21	1	0	.157	0	-.063	0	.316
82			2	0	.08	0	-.063	0	-.021
83			3	0	-.118	0	-.063	0	.025
84			4	0	-.194	0	-.063	0	.455
85	4	M22	1	0	.361	0	.032	0	.387
86			2	0	.177	0	.032	0	-.365
87			3	0	-.292	0	.032	0	-.228
88			4	0	-.499	0	.032	0	.842
89	4	M23	1	0	.607	0	.248	0	1.065
90			2	0	.401	0	.248	0	-.276
91			3	0	-.068	0	.248	0	-.684
92			4	0	-.252	0	.248	0	-.204
93	4	M24	1	0	-.241	0	-.313	0	-.427
94			2	0	-.613	0	-.313	0	.577
95			3	0	.556	0	-.313	0	1.084
96			4	0	.184	0	-.313	0	.222
97	4	M25	1	0	.692	0	.1	0	.258
98			2	0	.327	0	.1	0	-1.073
99			3	0	-.253	0	.1	0	-1.172
100			4	0	-.641	0	.1	0	.005
101	4	M26	1	0	.091	0	.067	0	-.003
102			2	0	.063	0	.067	0	-.213
103			3	0	-.034	0	.067	0	-.255
104			4	0	-.085	0	.067	0	-.085
105	4	M27	1	0	-.091	0	.391	0	-.1
106			2	0	-.129	0	.391	0	.156
107			3	0	-.229	0	.391	0	.603
108			4	0	-.267	0	.391	0	1.243
109	4	M28	1	0	1.151	0	-.251	0	1.307
110			2	0	.684	0	-.251	0	-1.034
111			3	0	.074	0	-.251	0	-1.981
112			4	0	-.413	0	-.251	0	-1.521
113	4	M29	1	0	-2.385	0	-.125	0	-1.72
114			2	0	1.965	0	-.125	0	4.832
115			3	0	1.289	0	-.125	0	.755
116			4	0	.715	0	-.125	0	-1.712
117	4	M30	1	0	-.103	0	.141	0	-1.574
118			2	0	-.437	0	.141	0	-.942
119			3	0	-.912	0	.141	0	.744
120			4	0	-1.245	0	.141	0	3.483
121	4	M31	1	0	5.253	0	-.026	0	3.518
122			2	0	.049	0	-.026	0	-1.939
123			3	0	-.424	0	-.026	0	-1.465
124			4	0	-.747	0	-.026	0	.039

GOVERNING LOAD COMBINATIONS: D + .75(0.7ΩE) + .75Lr



LOADING DIAGRAM



MOMENT DIAGRAM (k-ft)

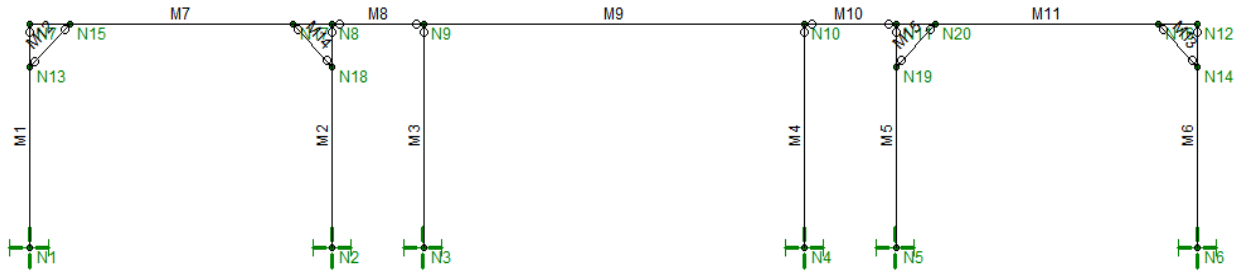
GOVERNING LOAD COMBINATIONS: D + .75(0.7ΩE) + .75Lr

Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	6	M1	1	0	1.418	0	.045	0	-.275
2			2	0	-2.513	0	.045	0	7.449
3			3	0	2.515	0	-.041	0	7.456
4			4	0	-1.417	0	-.041	0	-.292
5	6	M2	1	0	2.619	0	-.007	0	.292
6			2	0	-4.559	0	-.007	0	13.208
7			3	0	4.583	0	-.004	0	13.292
8			4	0	-2.595	0	-.004	0	.021
9	6	M3	1	-.385	2.652	0	-.016	0	-.04
10			2	.62	-6.279	0	-.016	0	15.354
11			3	-.639	4.954	0	.057	0	16.022
12			4	.411	-3.978	0	.057	0	.537
13	6	M4	1	0	2.552	0	-.015	0	-.034
14			2	0	-4.375	0	.02	0	12.895
15			3	0	4.403	0	-.154	0	12.872
16			4	0	-2.524	0	-.154	0	-.308
17	6	M5	1	0	2.979	0	.038	0	-.014
18			2	0	-7.268	0	-.071	0	14.926
19			3	0	3.239	0	.12	0	9.482
20			4	0	-3.428	0	.12	0	.003
21	6	M6	1	0	3.294	0	.035	0	.519
22			2	0	-4.774	0	.059	0	11.396
23			3	0	4.567	0	.059	0	11.006
24			4	0	-3.112	0	-.01	0	.356
25	6	M7	1	0	1.413	0	-.083	0	-.447
26			2	0	-2.331	0	-.083	0	6.922
27			3	0	-1.987	0	-.034	0	6.585
28			4	0	-2.026	0	.026	0	-.316
29	6	M8	1	0	.551	0	-.275	0	-.045
30			2	0	.19	0	-.275	0	-1.082
31			3	0	-.556	0	-.275	0	-.63
32			4	0	-.94	0	-.275	0	1.354
33	6	M9	1	0	.756	0	.017	0	1.36
34			2	0	.385	0	.017	0	-.18
35			3	0	-.363	0	.017	0	-.207
36			4	0	-.734	0	.017	0	1.277
37	6	M10	1	0	1.137	0	-.023	0	1.292
38			2	0	.437	0	-.023	0	-.787
39			3	0	-.627	0	-.023	0	-.549
40			4	0	-1.347	0	-.023	0	2.021
41	6	M11	1	0	1.418	0	-.057	0	2.035
42			2	0	.677	0	-.057	0	-.694
43			3	0	-.453	0	-.057	0	-.983
44			4	0	-1.261	0	-.057	0	1.262
45	6	M12	1	0	.518	0	-.072	0	1.224
46			2	0	.334	0	-.072	0	.043
47			3	0	-.249	0	-.072	0	-.063
48			4	0	-.433	0	-.072	0	.905
49	6	M13	1	0	.61	0	.447	0	.87
50			2	0	.414	0	.447	0	-.527
51			3	0	-.167	0	.447	0	-.831
52			4	0	-.34	0	.447	0	-.083
53	6	M14	1	0	.911	0	.084	0	.045
54			2	0	.344	0	.084	0	-1.746
55			3	0	-.965	0	.084	0	-.963
56			4	0	-1.51	0	.084	0	2.352
57	6	M15	1	0	1.286	0	.025	0	2.345
58			2	0	.734	0	.025	0	-.407
59			3	0	-.569	0	.025	0	-.613

60			4	0	-1.12	0	.025	0	1.725
61	6	M16	1	0	1.14	0	-.015	0	1.713
62			2	0	.624	0	-.015	0	-.703
63			3	0	-.618	0	-.015	0	-.716
64			4	0	-1.158	0	-.015	0	1.717
65	6	M17	1	0	1.08	0	.209	0	1.683
66			2	0	.541	0	.209	0	-.555
67			3	0	-.702	0	.209	0	-.347
68			4	0	-.572	0	.209	0	.971
69	6	M18	1	0	.858	0	-.016	0	1.081
70			2	0	.311	0	-.016	0	-.518
71			3	0	-.696	0	-.016	0	-.037
72			4	0	-1.243	0	-.016	0	2.523
73	6	M19	1	0	1.741	0	-.306	0	2.498
74			2	0	.71	0	-.306	0	-1.602
75			3	0	-.481	0	-.306	0	-1.894
76			4	0	-.889	0	-.306	0	.049
77	6	M20	1	0	.909	0	-.087	0	.041
78			2	0	.342	0	-.087	0	-1.746
79			3	0	-.967	0	-.087	0	-.959
80			4	0	-1.511	0	-.087	0	2.36
81	6	M21	1	0	1.295	0	-.044	0	2.364
82			2	0	.744	0	-.044	0	-.411
83			3	0	-.559	0	-.044	0	-.641
84			4	0	-1.111	0	-.044	0	1.673
85	6	M22	1	0	1.088	0	.04	0	1.613
86			2	0	.572	0	.04	0	-.672
87			3	0	-.671	0	.04	0	-.555
88			4	0	-1.21	0	.04	0	2.008
89	6	M23	1	0	1.36	0	-.014	0	2.182
90			2	0	.821	0	-.014	0	-.755
91			3	0	-.422	0	-.014	0	-1.248
92			4	0	-.938	0	-.014	0	.661
93	6	M24	1	0	.188	0	-.156	0	.47
94			2	0	-.286	0	-.156	0	.462
95			3	0	.108	0	-.156	0	1.011
96			4	0	-.365	0	-.156	0	1.462
97	6	M25	1	0	1.547	0	.295	0	1.532
98			2	0	.91	0	.295	0	-1.763
99			3	0	-.512	0	.295	0	-2.268
100			4	0	-1.171	0	.295	0	.06
101	6	M26	1	0	.568	0	.292	0	-.041
102			2	0	.207	0	.292	0	-1.121
103			3	0	-.539	0	.292	0	-.712
104			4	0	-.922	0	.292	0	1.227
105	6	M27	1	0	.667	0	.27	0	1.224
106			2	0	.295	0	.27	0	-.093
107			3	0	-.452	0	.27	0	.103
108			4	0	-.824	0	.27	0	1.811
109	6	M28	1	0	1.498	0	-.266	0	1.867
110			2	0	.798	0	-.266	0	-1.116
111			3	0	-.266	0	-.266	0	-1.781
112			4	0	-.986	0	-.266	0	-.115
113	6	M29	1	0	-1.078	0	.042	0	-.269
114			2	0	1.823	0	.042	0	3.244
115			3	0	.694	0	.042	0	.088
116			4	0	-.114	0	.042	0	-.533
117	6	M30	1	0	.331	0	.039	0	-.413
118			2	0	-.104	0	.039	0	-.808
119			3	0	-.918	0	.039	0	.469
120			4	0	-1.353	0	.039	0	3.417
121	6	M31	1	0	4.465	0	-.316	0	3.407
122			2	0	.375	0	-.316	0	-1.843
123			3	0	-.438	0	-.316	0	-1.759
124			4	0	-.862	0	-.316	0	-.026

APPENDIX A.5 - PERGOLA ANALYSIS



FRAME ELEVATION WITH MEMBER AND NODE ANNOTATIONS

MEMBER DATA INPUT:

Member Primary Data

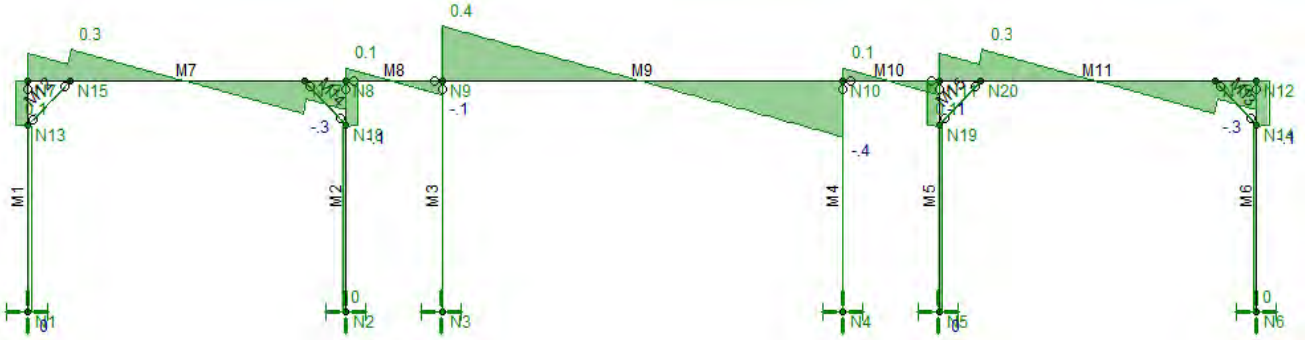
Primary | Advanced | Hot Rolled | Cold Formed | Wood | Concrete Beam | Concrete Column | Aluminum | RISAConnection | Detailing

	Label	I Joint	J Joint	K Joint	Rotate...	Section/Sh...	Type	Design List	Material	Design ...
1	M1	N1	N7			4x4	Beam	Rectangular	DF/SPine	Typical
2	M2	N2	N8			4x4	Beam	Rectangular	DF/SPine	Typical
3	M3	N3	N9			4x4	Beam	Rectangular	DF/SPine	Typical
4	M4	N4	N10			4x4	Beam	Rectangular	DF/SPine	Typical
5	M5	N5	N11			4x4	Beam	Rectangular	DF/SPine	Typical
6	M6	N6	N12			4x4	Beam	Rectangular	DF/SPine	Typical
7	M7	N7	N8			4x8	Beam	Rectangular	DF/SPine	Typical
8	M8	N8	N9			4x8	Beam	Rectangular	DF/SPine	Typical
9	M9	N9	N10			4x8	Beam	Rectangular	DF/SPine	Typical
10	M10	N10	N11			4x8	Beam	Rectangular	DF/SPine	Typical
11	M11	N11	N12			4x8	Beam	Rectangular	DF/SPine	Typical
12	M12	N13	N15			4x4	Beam	Rectangular	DF/SPine	Typical
13	M13	N14	N16			4x4	Beam	Rectangular	DF/SPine	Typical
14	M14	N18	N17			4x4	Beam	Rectangular	DF/SPine	Typical
15	M15	N19	N20			4x4	Beam	Rectangular	DF/SPine	Typical

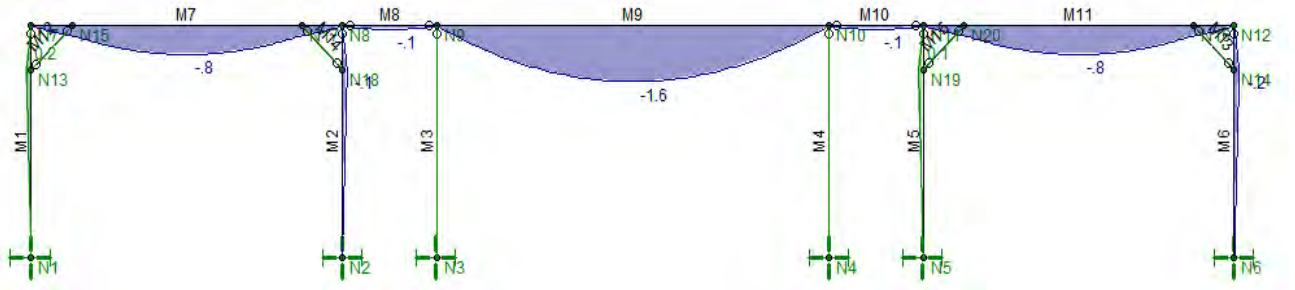
STRUCTURAL ANALYSIS

LOAD COMBINATION: D + L

AXIAL DIAGRAM (kips)



SHEAR DIAGRAM (kips)



MOMENT DIAGRAM (k-ft)

LOAD COMBINATION: D + L (CONTINUED)

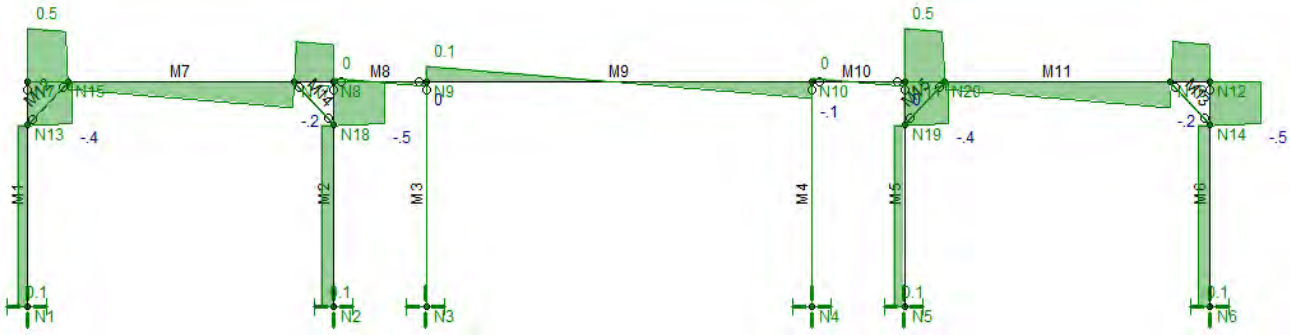
Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	1	M1	1	1.638	-.023	0	0	0	0
2			2	1.638	-.023	0	0	0	.092
3			3	1.515	.1	0	0	0	0
4	1	M2	1	2.138	.023	0	0	0	0
5			2	2.138	.023	0	0	0	-.092
6			3	2.015	-.1	0	0	0	0
7	1	M3	1	2.565	0	0	0	0	0
8			2	2.565	0	0	0	0	0
9			3	2.565	0	0	0	0	0
10	1	M4	1	2.565	0	0	0	0	0
11			2	2.565	0	0	0	0	0
12			3	2.565	0	0	0	0	0
13	1	M5	1	2.138	-.023	0	0	0	0
14			2	2.138	-.023	0	0	0	.092
15			3	2.015	.1	0	0	0	0
16	1	M6	1	1.638	.023	0	0	0	0
17			2	1.638	.023	0	0	0	-.092
18			3	1.515	-.1	0	0	0	0
19	1	M7	1	-.1	.222	0	0	0	0
20			2	.023	0	0	0	0	-.807
21			3	-.1	-.222	0	0	0	0
22	1	M8	1	0	.105	0	0	0	0
23			2	0	0	0	0	0	-.092
24			3	0	-.105	0	0	0	0
25	1	M9	1	0	.435	0	0	0	0
26			2	0	0	0	0	0	-1.577
27			3	0	-.435	0	0	0	0
28	1	M10	1	0	.105	0	0	0	0
29			2	0	0	0	0	0	-.092
30			3	0	-.105	0	0	0	0
31	1	M11	1	-.1	.222	0	0	0	0
32			2	.023	0	0	0	0	-.807
33			3	-.1	-.222	0	0	0	0
34	1	M12	1	.174	0	0	0	0	0
35			2	.174	0	0	0	0	0
36			3	.174	0	0	0	0	0
37	1	M13	1	.174	0	0	0	0	0
38			2	.174	0	0	0	0	0
39			3	.174	0	0	0	0	0
40	1	M14	1	.174	0	0	0	0	0
41			2	.174	0	0	0	0	0
42			3	.174	0	0	0	0	0
43	1	M15	1	.174	0	0	0	0	0
44			2	.174	0	0	0	0	0
45			3	.174	0	0	0	0	0

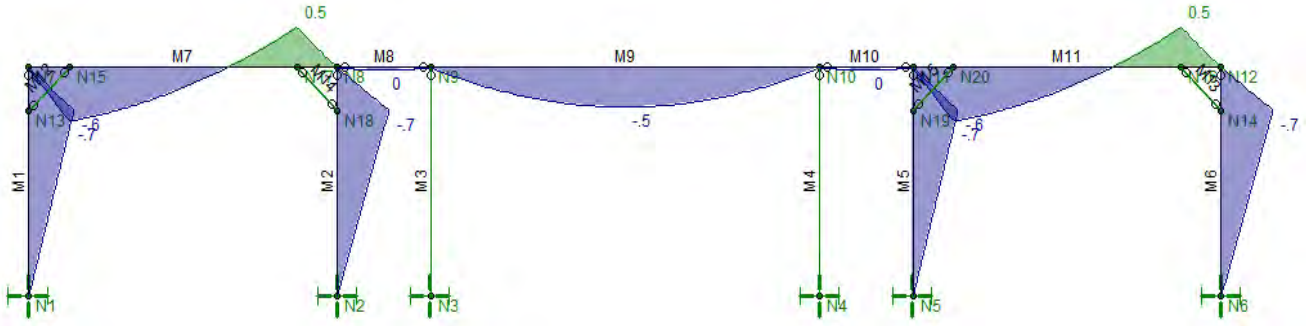
STRUCTURAL ANALYSIS

LOAD COMBINATION: D + 0.7E

AXIAL DIAGRAM (kips)



SHEAR DIAGRAM (kips)



MOMENT DIAGRAM (k-ft)

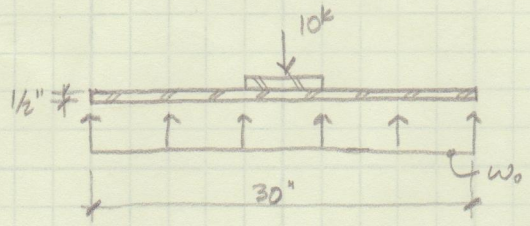
LOAD COMBINATION: D + 0.7E (CONTINUED)

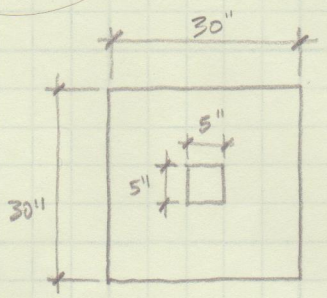
Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	2	M1	1	.399	.098	0	0	0	0
2			2	.399	.098	0	0	0	-.196
3			3	.399	.098	0	0	0	-.392
4			4	.399	.098	0	0	0	-.588
5			5	.922	-.425	0	0	0	0
6	2	M2	1	.86	.113	0	0	0	0
7			2	.86	.113	0	0	0	-.227
8			3	.86	.113	0	0	0	-.454
9			4	.86	.113	0	0	0	-.681
10			5	.255	-.492	0	0	0	0
11	2	M3	1	.855	0	0	0	0	0
12			2	.855	0	0	0	0	0
13			3	.855	0	0	0	0	0
14			4	.855	0	0	0	0	0
15			5	.855	0	0	0	0	0
16	2	M4	1	.855	0	0	0	0	0
17			2	.855	0	0	0	0	0
18			3	.855	0	0	0	0	0
19			4	.855	0	0	0	0	0
20			5	.855	0	0	0	0	0
21	2	M5	1	.566	.098	0	0	0	0
22			2	.566	.098	0	0	0	-.196
23			3	.566	.098	0	0	0	-.392
24			4	.566	.098	0	0	0	-.588
25			5	1.089	-.425	0	0	0	0
26	2	M6	1	.693	.113	0	0	0	0
27			2	.693	.113	0	0	0	-.227
28			3	.693	.113	0	0	0	-.454
29			4	.693	.113	0	0	0	-.681
30			5	.088	-.492	0	0	0	0
31	2	M7	1	.425	.491	0	0	0	0
32			2	-.071	-.09	0	0	0	-.609
33			3	-.043	-.147	0	0	0	-.269
34			4	-.016	-.205	0	0	0	.237
35			5	-.594	.343	0	0	0	0
36	2	M8	1	-.102	.035	0	0	0	0
37			2	-.094	.017	0	0	0	-.023
38			3	-.086	0	0	0	0	-.031
39			4	-.077	-.018	0	0	0	-.023
40			5	-.069	-.035	0	0	0	0
41	2	M9	1	-.069	.145	0	0	0	0
42			2	-.034	.072	0	0	0	-.394
43			3	0	0	0	0	0	-.526
44			4	.034	-.073	0	0	0	-.394
45			5	.069	-.145	0	0	0	0
46	2	M10	1	.069	.035	0	0	0	0
47			2	.077	.017	0	0	0	-.023
48			3	.086	0	0	0	0	-.031
49			4	.094	-.018	0	0	0	-.023
50			5	.102	-.035	0	0	0	0
51	2	M11	1	.527	.491	0	0	0	0
52			2	.031	-.09	0	0	0	-.609
53			3	.059	-.147	0	0	0	-.269
54			4	.086	-.205	0	0	0	.237
55			5	-.492	.343	0	0	0	0
56	2	M12	1	-.74	0	0	0	0	0
57			2	-.74	0	0	0	0	0
58			3	-.74	0	0	0	0	0
59			4	-.74	0	0	0	0	0

60			5	-.74	0	0	0	0	0
61	2	M13	1	.856	0	0	0	0	0
62			2	.856	0	0	0	0	0
63			3	.856	0	0	0	0	0
64			4	.856	0	0	0	0	0
65			5	.856	0	0	0	0	0
66	2	M14	1	.856	0	0	0	0	0
67			2	.856	0	0	0	0	0
68			3	.856	0	0	0	0	0
69			4	.856	0	0	0	0	0
70			5	.856	0	0	0	0	0
71	2	M15	1	-.74	0	0	0	0	0

// CONDITION 2 - 30" PLATE



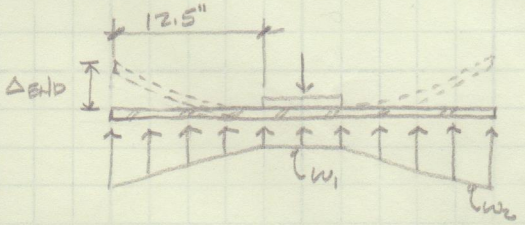


// ONE-WAY ACTION UNDER 5" PL

$w_0 = (10^k)(1/30")^2 = 11.1^{psi}$

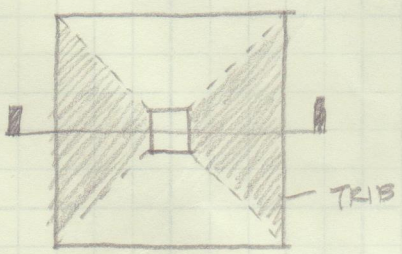
$w_1 = (11.1^{psi})(5") = 55.5^{\#/in}$

$w_2 = (11.1^{psi})(30") = 333^{\#/in}$



$$M_A = \frac{(55.5^{\#/in})(12.5")^2}{2} + \frac{(333-55.5)(12.5")^2}{3}$$

$$= 18.8^{k"}$$



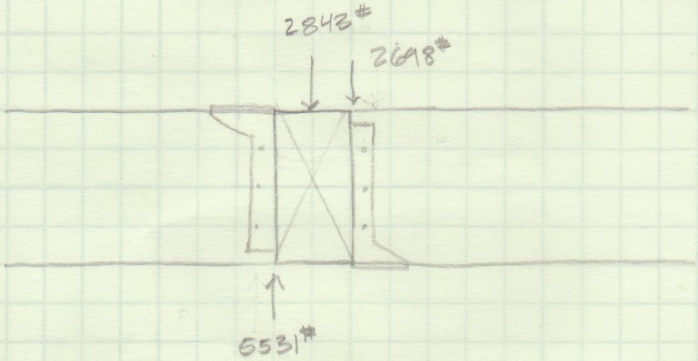
$$Z_{req} = \frac{\Omega M_A}{F_y} = \frac{(1.67)(18.8^{k"})}{36^{ksi}} = 0.872^{in^3}$$

$$h_{req} = \sqrt{\frac{4 Z_{req}}{b}} = \sqrt{\frac{4(0.872^{in^3})}{5"}} = 0.835" \rightarrow \boxed{7/8" \text{ THICK PL}}$$

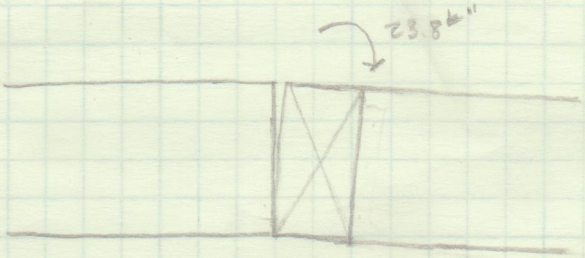
$$I_{PL} = \frac{(5")(7/8")^3}{12} = 0.279^{in^4}$$

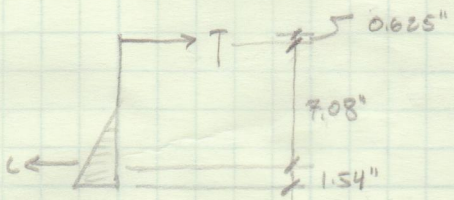
$$\Delta_{END} = 0.0836"$$

// INVERTED HANGER STRAP DESIGN



$\Sigma M_a = (5531\#)(2.625") + (2698\#)(2.625") = \underline{21.6\,k"}$

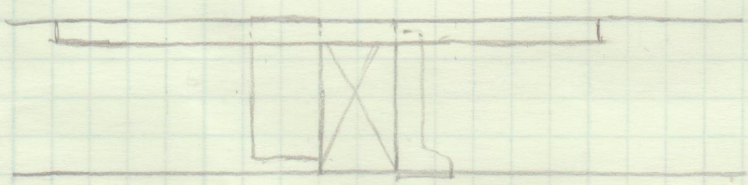




$T = \frac{21.6\,k"}{7.08"} = \boxed{3051\#}$

* USE SIMPSON CS22 - $3051\# = \frac{N}{12}(845\#) \rightarrow N = 44$ NAILS

22 NAILS / SIDE = (22" END LENGTH) x 2 + 12" CLEAR SPAN = **56" STRIPS**



SECTION

// DECKING DESIGN

* FIND MAX SPAN OF 1 1/4" x 6" RECLAIMED REDWOOD DECKING

// LOADS

DL - SELF-WEIGHT = 4.0 psf LL - 100 psf

$w = (104\ psf)(1/2') = 52\ plf$

// DESIGN VALUES (ASSUME No. 2)

$F_b = 1000\ psi$ $F'_b = F_b C_D C_M C_t C_L C_F C_{fu} C_i C_r = 1000\ psi$

$E = 1{,}100{,}000\ psi$ $E' = E\ C_M C_t C_i = 1{,}100{,}000\ psi$

// FLEXURE

$$S_y = \frac{(6")(1\,1/4")^2}{6} = 1.563\ in^3$$

$$M_{max} = \frac{wl^2}{8} = F'_b S_y \rightarrow l_{max} = \sqrt{\frac{8F'_b S_y}{w}}$$

$$l_{max} = \sqrt{\frac{8(1000\ psi)(1.56\ in^3)(1'/12")}{52\ plf}} = \boxed{4.48'}$$

// DEFLECTION

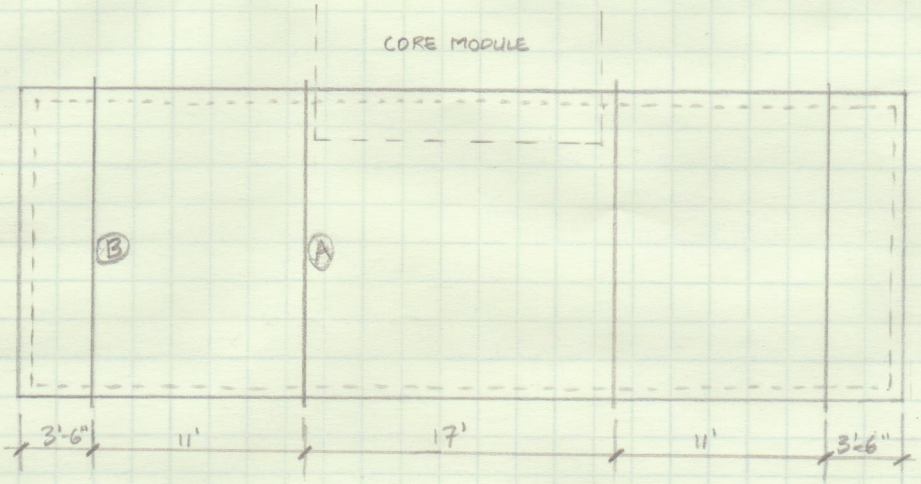
$$I_y = \frac{(6")(1\,1/4")^3}{12} = 0.977\ in^4$$

$$\Delta_L = \frac{l}{240} = \frac{5wl^4}{384EI} \rightarrow l = \sqrt[3]{\frac{384EI}{1200w}} = \sqrt[3]{\frac{384(1{,}100{,}000)(0.977)(1'/12")^2}{1200(52)}} = \boxed{3.58'}$$

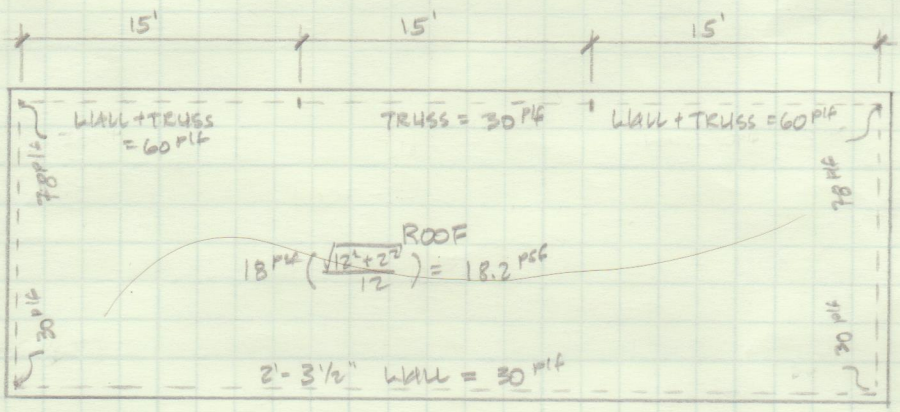
USE 16" SPACING OF JOISTS BELOW

// CLERESTORY RIGGING DESIGN

PROPOSAL: LIFT CLERESTORY ROOF AT 8 POINTS USING BEAMS SPANNING UNDER THE CLERESTORY MODULE.



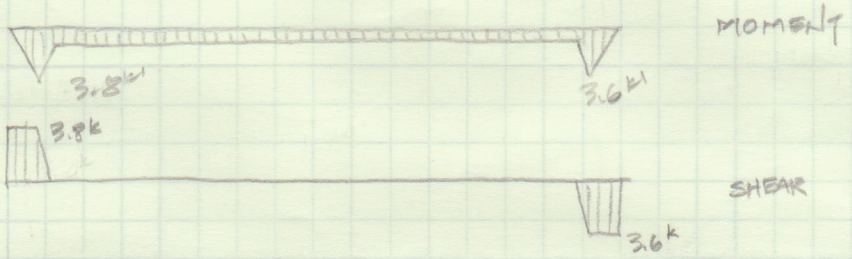
// LOADS - (DEAD LOAD ONLY)



// CLERESTORY RIGGING DESIGN

// BEAM "A"

* FROM RISA (LRFD - 1.4D)



FLEXURE

$$Z_{req} = \frac{3.8^{k'}(12")}{0.9(36^{ksi})} = 1.41\ in^3 \rightarrow \text{TRY } \underline{7 \times 12.2} \text{ ABOUT MINOR AXIS}$$

SHEAR

$$\phi V_n = \phi\, 0.6 F_y b_f t_f C_v$$

$$h/t_w = 7/.314 = 22.3 < 1.10\sqrt{k_v E/F_y} = 1.10\sqrt{1.2(29000)/36} = 34.2$$

$$C_v = \underline{1.0}$$

$$\phi V_n = (1.0)(0.6)(36^{ksi})(2)(2.19")(0.366") = \underline{34.6^k > 3.8^k}$$

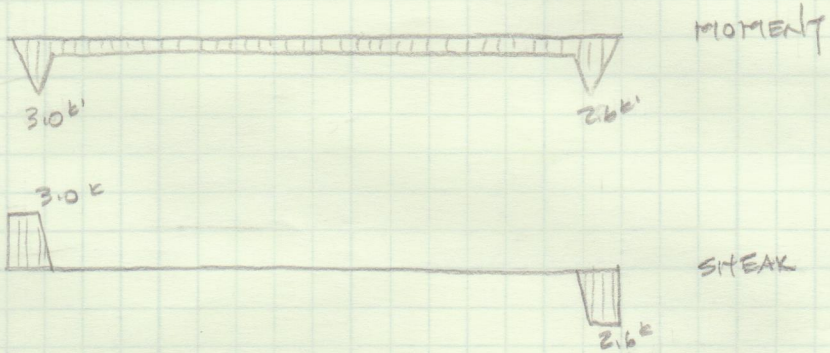
↳ okay

DEFLECTION

FROM RISA, $\Delta_{max} = 0.053" = \frac{l}{3400}$ → okay

// CLERESTORY RIGGING DESIGN

// BEAM "B"



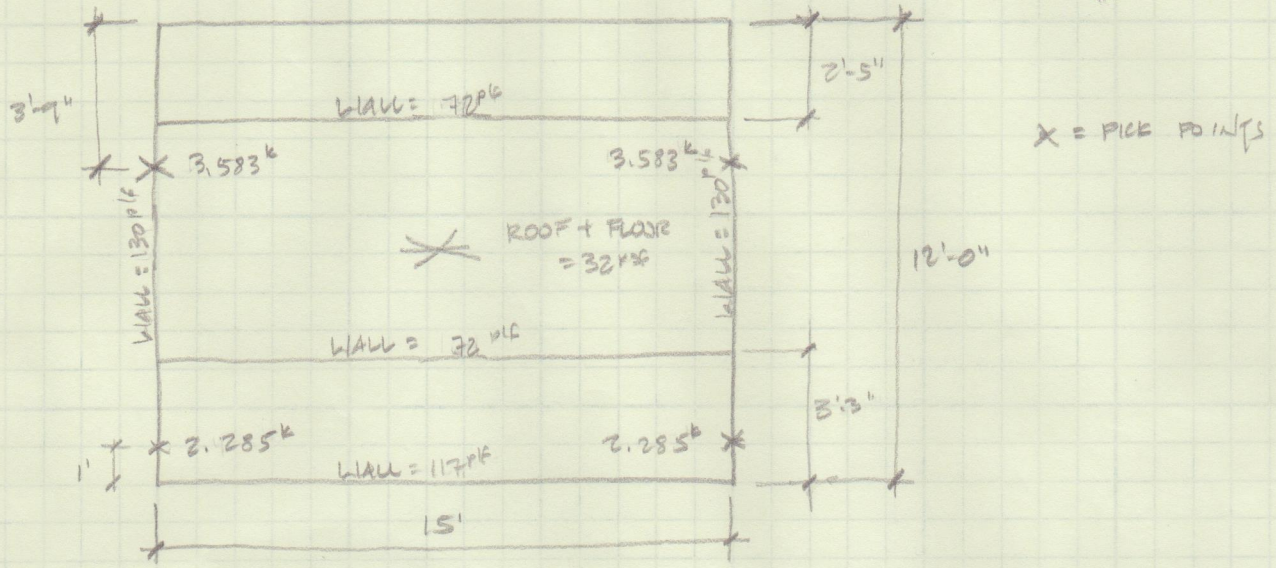
* C7x12.2 IS OKAY BY INSPECTION

USE C7x12.2 ABOUT MINOR AXIS FOR SPREADER BEAMS, MAX OUTRIGGER = 9 3/4" AWAY FROM SIP FACE

// RIGGING HARDWARE

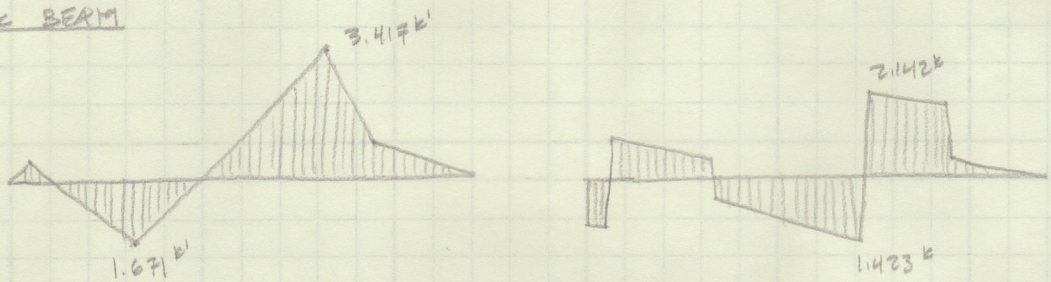
P = 3841 #

// CORE MODULE RIGGING =



X = PICK POINTS

// CHECK BEAM



MOMENT

SHEAR

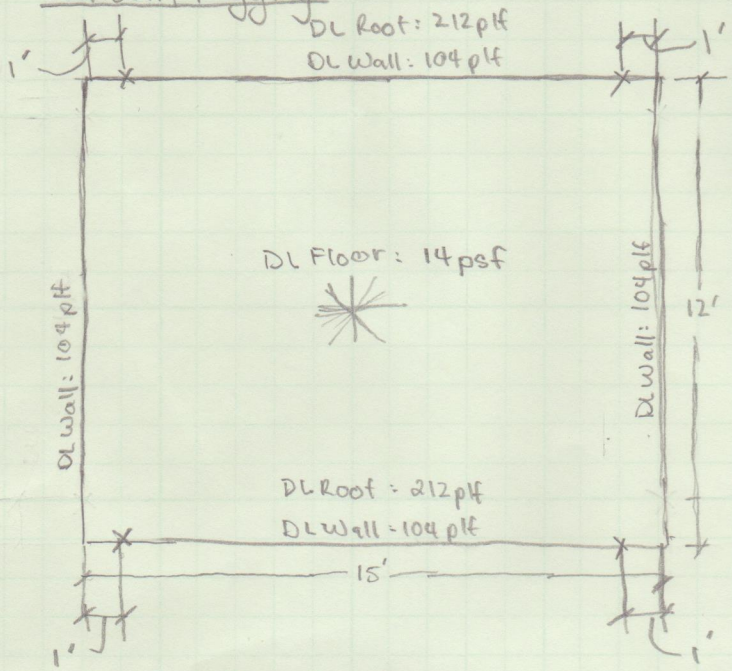
$M = 3.417^{k'} = 41^{k''}$

$f_b = \frac{M}{S} = \frac{41^{k''}}{74.87^{in^3}} = 548^{psi} < F'_b = 2985^{psi}$ — OKAY

$V = 2.142^{k}$

$f_v = \frac{1.5V}{A} = \frac{1.5(2.142^{k})}{48.56^{in^2}} = 66.2^{psi} < F'_v = 290^{psi}$ — OKAY

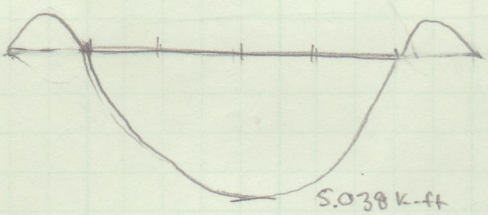
Bedroom Rigging



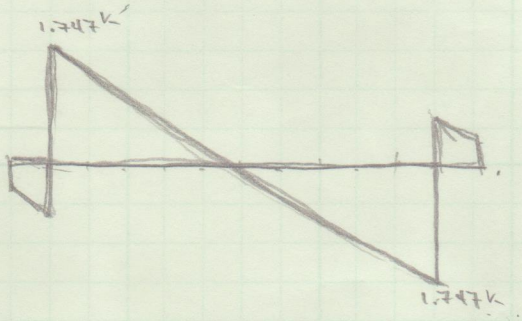
x picking location.

reaction: 2.844 k

Moment Diagram on 15' span.



Shear Diagram on 15' span



$V_{max} = 1.747 k = 1747 lb$

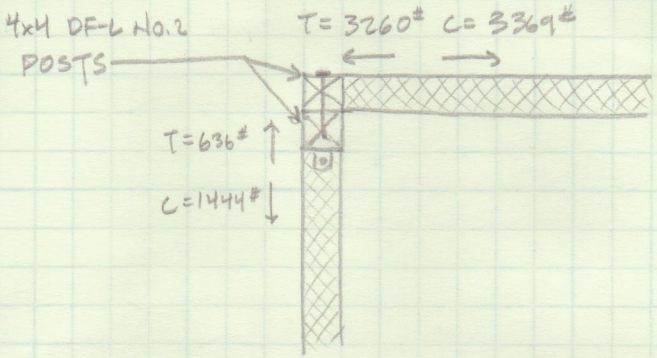
$\frac{1.5V}{A} = f_v = \frac{1.5(1747)}{48.56 in^2} = 53.96 psi < 290 psi$ [ok]

$M_{max} = 5.038 k\text{-}ft \times \frac{1000 lb}{1 k} \times \frac{12 in}{1 ft} = 60456 lb\text{-}in$

$\frac{M_{max}}{S} = \sigma = \frac{60456 lb\text{-}in}{74.87 in^3} = 807.48 psi < 2985 psi$ [ok]

// BEDROOM NE HOLDOWN POST CHECK

// FROM 100% CALCS, PP. 61-65, 71-75



	N/S	E/W	N/S + 0.3 E/W	0.3 N/S + E/W
T'	636	3260	1614	3451
C:	1444	3369	2455	3802

* CAN WE CONSIDER THE TWO POSTS AS A SINGLE MEMBER?
  - YES, IF THERE IS ADEQUATE SHEAR TRANSFER BETWEEN THEM.

6" R-CONTROL SCREWS @ 6" O.C.

FROM R-CONTROL TECHNICAL BULLETIN # 2021:

SHEAR STR. OF R-CONTROL WOOD SCREW W SIP ASSEMBLY
= 780# FOR $q = 945$ (DF-L: $q = 0.150$)

*USING A SAFETY FACTOR OF 2.0 → F_v = 390#

(16 SCREWS)(390#/SCREW) = 6240# > 3802#

* THE R-CONTROL SCREWS ARE CAPABLE OF TRANSFERRING THE SHEAR BETWEEN THE POSTS.

// BEDROOM NE HOLDOWN POST CHECK

// TENSION CHECK

$T = 3451^{\#}$

$F_t' = F_t C_D C_F = (575^{psi})(1.6)(1.5) = 1380^{psi}$

$A = 2(12.25^{in^2}) = 24.5^{in^2}$

$T_{allow} = (1380^{psi})(24.5^{in^2}) = 33.8^{k} > 3.8^{k}$ - OKAY

* IF ONLY CONSIDERING ONE POST...

$T_{allow} = (1380^{psi})(12.25^{in^2}) = 16.9^{k} > 3.8^{k}$ - OKAY

HOLDOWN

SIMPSON HTT4 W/ (18) 16d NAILS $\rightarrow T_{allow} = 4235^{\#} > 3802^{\#}$ - OKAY

// COMPRESSION CHECK

$C = 3451^{\#}$

$F_c^{*} = F_c C_D C_F = (1350^{psi})(1.6)(1.5) = 3240^{psi}$

$C_p = 0.1493$

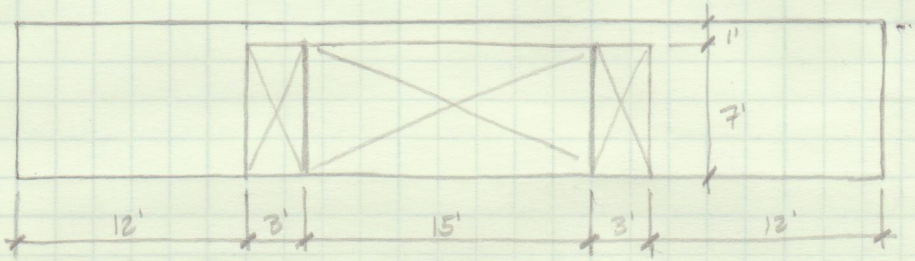
$F_c' = (3240^{psi})(0.1493) = 484^{psi}$

$C_{allow} = (484^{psi})(24.5^{in^2}) = 11.9^{k} > 3.5^{k}$ - OKAY

* IF ONLY CONSIDERING ONE POST...

$C_{allow} = (484^{psi})(12.25^{in^2}) = 5.9^{k} > 3.5^{k}$ - OKAY.

// PATIO DOOR POST BASE CHECK



WIND PRESSURE = 11.5 psf

$A_{TRIB} = (7')(1.5' + 7.5') = 63\ ft^2$

$V_{BASE} = \frac{1}{2}(63\ ft^2)(11.5\ psf) = 362\ \#$

* SIMPSON BC40 = 735# LATERAL – OKAY

// CORE WEST SHEAR WALL

// FROM 100% CALCS, PP 50-55

$C = D + W$

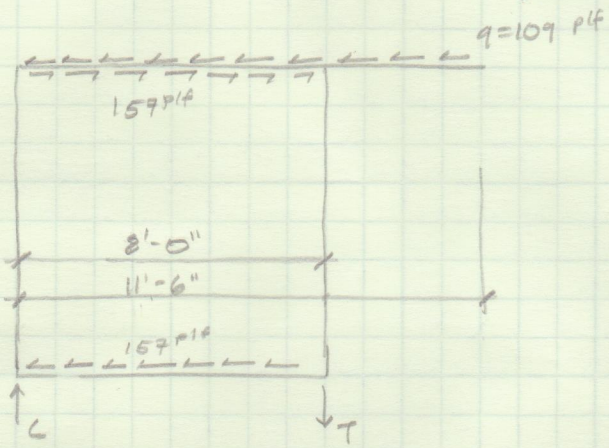
$= 521^{\#} + \frac{(109)(11.5')(10')}{8'}$

$= 2088^{\#}$

$T = 0.6D + W$

$= 313^{\#} + \frac{(109)(11.5')(10')}{8'}$

$= 1879^{\#}$



// TENSION DESIGN

$F_t' = (575^{psi})(1.6)(1.5) = 1380^{psi}$

$T_{allow} = (1380^{psi})(12.25^{in^2}) = 16.9^{k} > 1.9^{k}$ — OKAY.

HOLDOWN

SIMPSON HTT4: $T = 4235^{\#} > 1879^{\#}$ - OKAY

// COMPRESSION DESIGN

$F_c^* = (1350^{psi})(1.6)(1.5) = 3240^{psi}$

$C_p = 0.1493$

$F_c' = (3240^{psi})(0.1493) = 484^{psi}$

$C_{allow} = (484^{psi})(12.25^{in^2}) = 5.9^{k} > 2.1^{k}$ - OKAY

// CORE WEST SHEAR WALL

// COLLECTOR DESIGN

$P = (109^{plf})(3.5') = 381.5^{\#}$

2x8 DF-L No.2, FULLY BRACED IN STRONG AND WEAK AXIS

$F_t' = (575^{psi})(1.6)(1.2) = 1104^{psi}$

$T_{allow} = (10.88^{in^2})(1104^{psi}) = 12.0^{k} > 381.5^{\#}$ - OKAY

$F_c' = (1350^{psi})(1.6)(1.2)(1.0) = 2592^{psi}$

$C_{allow} = (10.88^{in^2})(2592^{psi}) = 28.2^{k} > 381.5^{\#}$ - OKAY

// PHONE BOOTH ROOF

// SHELF DESIGN

// LOAD TAKEOFF

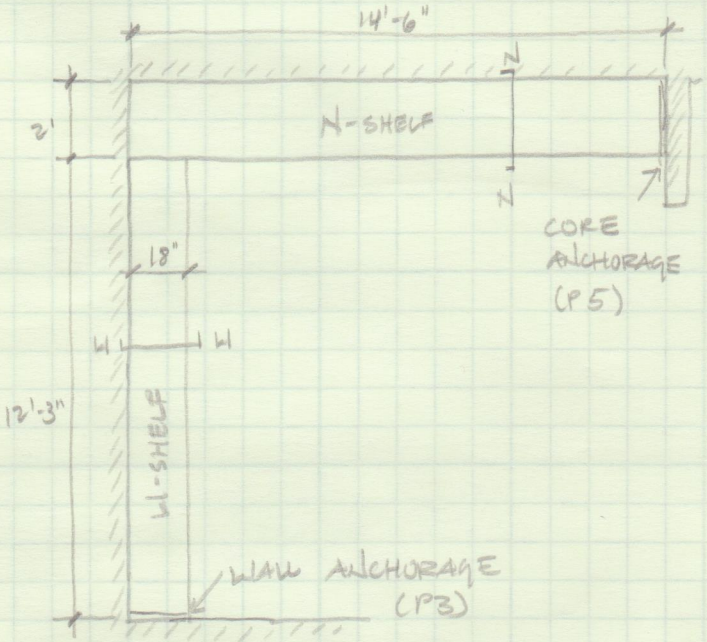
1/2" GYP. BOARD (3 FACES)	7.5 PSF
2x4 @ 16" O.C.	2 PSF
1/2" OSB (1 FACE)	2 PSF
MISC.	1 PSF
TOTAL	12.5 PSF

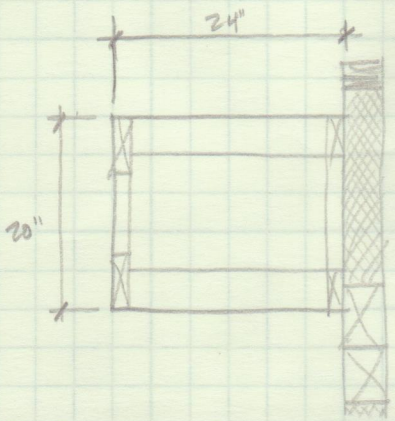
LIVE LOAD = 10 PSF (UH INHABITABLE ATTIC W/O STORAGE)

D+L = 22.5 PSF → GOVERNING LOAD CASE

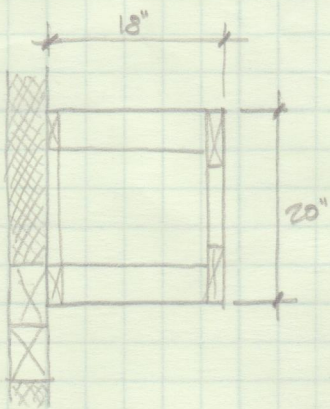
$\frac{D}{C_D} = \frac{12.5\ PSF}{0.9} = 13.9\ PSF$

// LAYOUT





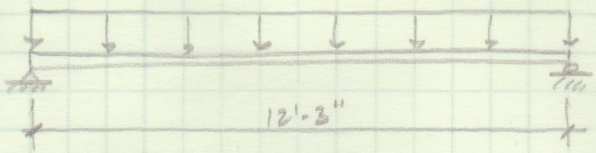
SECTION N-N



SECTION W-W

// SHELF DESIGN

// WEST SHELF BEAM



$W = (22.5^{psf})(9") = 16.9^{plf}$

$M_{max} = \frac{wl^2}{8} = \frac{(16.9^{plf})(12.25')^2}{8} = 316.5^{\#'} = \underline{3798^{\#"}}$

$V_{max} = \frac{wl}{2} = \frac{(16.9^{plf})(12.25')}{2} = \underline{103^{\#}}$

$\Delta_{D+L\,allow} = \frac{L}{240} = \frac{147"}{240} = \underline{0.61"}$

$I_{req} = \frac{5wl^4}{384EL} = \frac{5(12.15^{psf})(9"/12"/)(12.25')^4(12"/1')^3}{384(1.6\times10^6)(0.61)} = 4.87^{in^4}$

TRY 2x6 DF-L NO.2

$I = 20.8^{in^4}$ – OKAY FOR DEFLECTION

$S = 7.563^{in^3}$

$A = 8.25^{in^2}$

$f_b = \frac{M}{S} = \frac{3798^{\#"}}{7.563^{in^3}} = 502^{psi}$

$F_b = (900^{psi})C_L C_F^{1.0\ 1.3} = 1170^{psi} > 502^{psi}$ OKAY FOR BENDING

$f_v = \frac{1.5V}{A} = \frac{1.5(103^{\#})}{5.25^{in^2}} = 18.7^{psi}$

$F_v = 180^{psi}$ – OKAY BY INSPECTION

* USE 2x6 DF-L NO. 2 FOR WEST SHELF BEAMS.
USE SIMPSON HU26 FOR JOIST CONNECTION

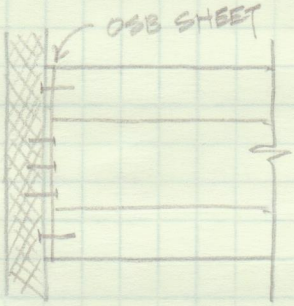
CAP = (595)(0.64) = 381# > 103# - OKAY.

↑ REDUCTION FOR FRAMING INTO A 2x HEADER

// SHELF DESIGN

// WEST SHELF WALL ANCHORAGE

PROPOSED SOLUTION:



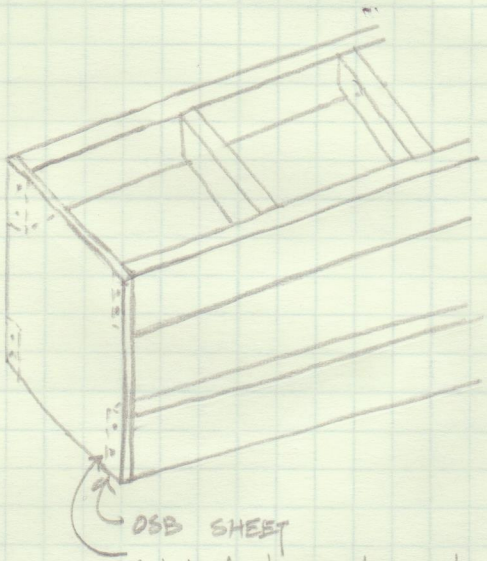
* ONE SHEET OF OSB IS ATTACHED TO THE END OF THE SHELF W/ (3) 16d NAILS (CAPACITY = 323#)

* THE SHEET OF OSB IS THEN ATTACHED TO THE WALL WITH AN ARRAY OF SCREWS.

$V_{TOTAL} = 4(103^{\#}) = 412^{\#}$

$Z = 109^{\#}$ / No. 8 W.S.

MIN. (4) No. 8 W.S.



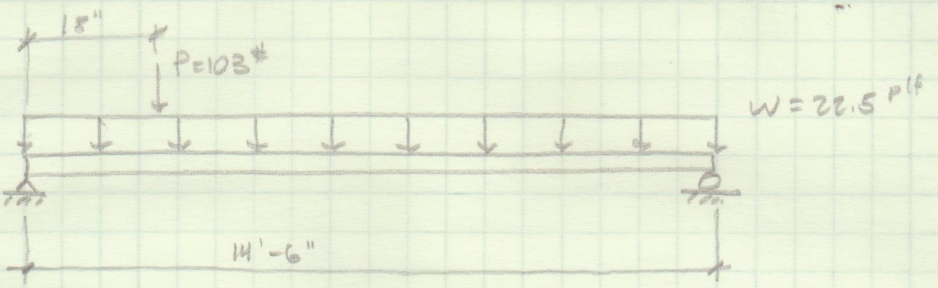
(3) 16d NAILS INTO END GRAIN

$\Sigma Z' = 3(0.69)(161^{\#}) = 323 > 103^{\#}$

OKAY

// SHELF DESIGN

// NORTH SHELF BEAM



$$M_{max} = \frac{(22.5\#)(14.5')^2}{8} + \frac{(103\#)(1.5')(13')}{4(14.5')^2}(14.5'+1.5') = 680\#' = \underline{7550\#''}$$

$$V_{max} = \frac{(22.5\#)(14.5')}{2} + \frac{(103\#)(13')}{14.5'} = \underline{255\#}$$

$$\Delta_{D\text{-}allow} = \frac{(14.5')(12''/')}{240} = \underline{0.725''}$$

$$I_{req} = \frac{5(12.5\,psf)(14.5')^4(12''/')^3}{384(1.6\times10^6\,psi)(0.725'')} = 10.72\,in^3$$

TRY 2x6 DF-L No.2

$I = 20.8\,in^3$ – OKAY FOR DEFL.

$S = 7.563\,in^3$ $\quad A = 8.25\,in^2$

$$f_b = \frac{7550\#''}{7.563\,in^3} = 998\,psi < F'_b = 1170\,psi$$ – OKAY FOR BENDING

$$f_v = \frac{1.5(255\#)}{8.25\,in^2} = 40.9\,psi < F_v = 180\,psi$$ – OKAY BY INSPECTION

* USE 2x6 DF-L No.2 FOR NORTH SHELF BEAMS.

USE SIMPSON HU26 FOR WEST WALL ANCHORAGE

(CAP = 381# > 255#)

// SHELF DESIGN

// NORTH SHELF CORE ANCHORAGE

* USING THE SAME SYSTEM AS PROPOSED FOR THE WEST SHELF WALL ANCHORAGE

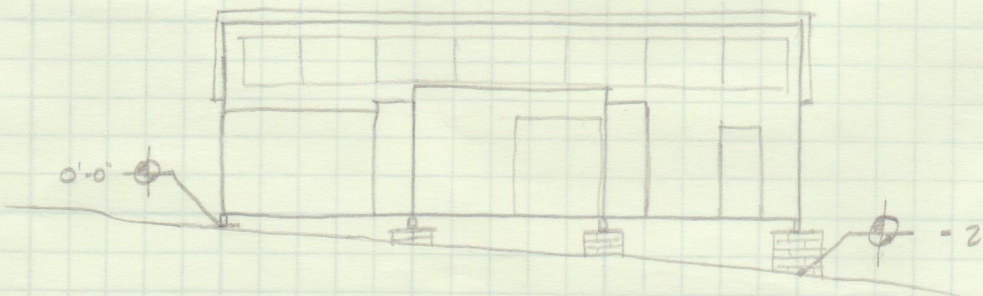
$V_{TOTAL} = 4(255^{\#}) = 1020^{\#}$

MIN. (10) No. 8 W.S. ($Z'_{TOTAL} = 1090^{\#}$)

// FOUNDATION SYSTEM

* FROM THE TOPOGRAPHIC SURVEY GIVEN BY THE DOE, WE WILL SEE A 2' DROP ALONG THE NORTH FACE OF OUR HOUSE, A 1'-6" DROP ALONG THE SOUTH FACE, AND ROUGHLY 6" DROP ON THE EAST FACE.

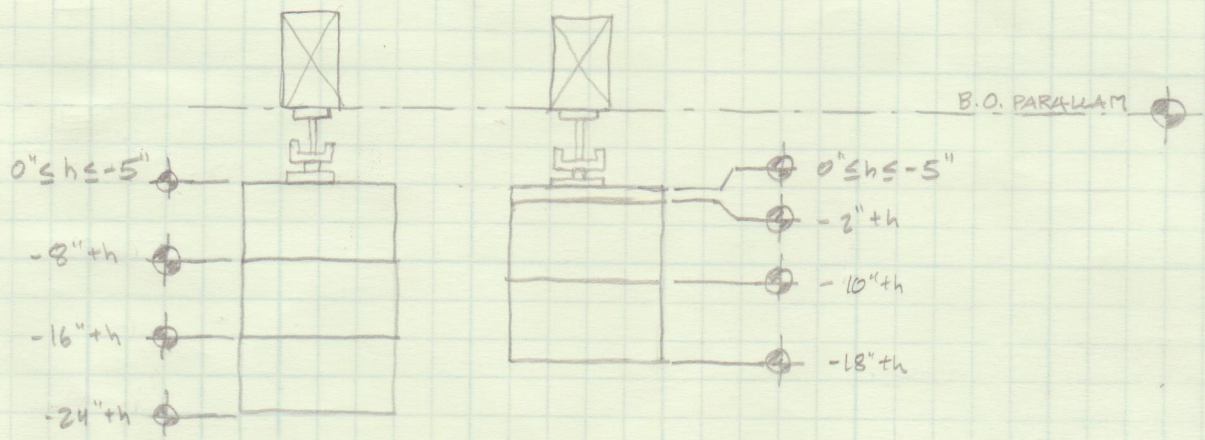
* THE MAXIMUM ELEVATION CHANGE OCCURS ON THE NORTH FACE. TO ACCOUNT FOR THE 2' DROP, A FOUNDATION SYSTEM USING CMU BLOCKS IS PROPOSED.



NORTH ELEVATION

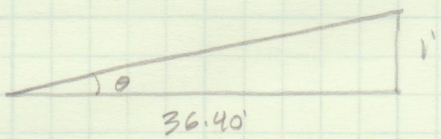
(GREATLY EXAGGERATED)

* USING 8x8x16 BLOCKS, THE FOUNDATION CAN BE BUILT UP TO WITHIN ±4" OF OUR TARGET ELEVATION. THE ELLIS JACKS HAVE AN AN ABSOLUTE RANGE OF 5" (± 2½"), WHICH LEAVES ± 1½" THAT NEEDS TO BE ACCOUNTED FOR. THIS CAN BE TAKEN UP BY 2" CMU PLATES.



// FOUNDATION SYSTEM

- FROM THE TOPO LINES, THE STEEPEST PORTION OF THE SITE IS AT THE NORTH FACE OF THE HOUSE.



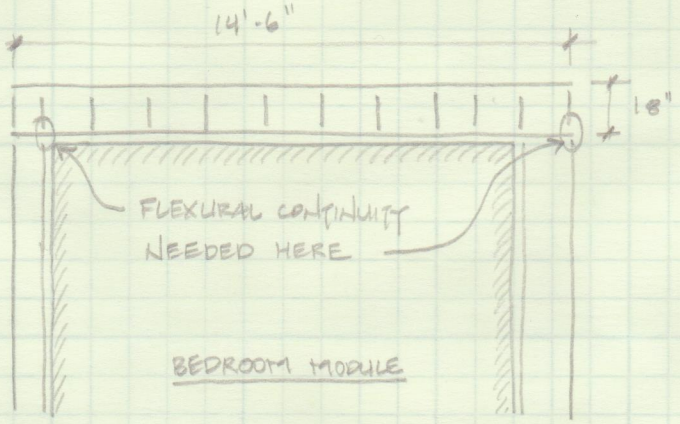
$$\theta = \tan^{-1}\left(\frac{1'}{36.40}\right) = 1.574°$$

WITH 24" x 24" FOOTINGS, THE MAX OBSERVED HEIGHT DIFFERENCE ON ANY SINGLE PAD WILL BE:

$$\frac{\Delta h}{24"} = \frac{1}{36.4} \rightarrow \Delta h = 0.66" \approx 5/8"$$

// BEDROOM OVERHANG DESIGN

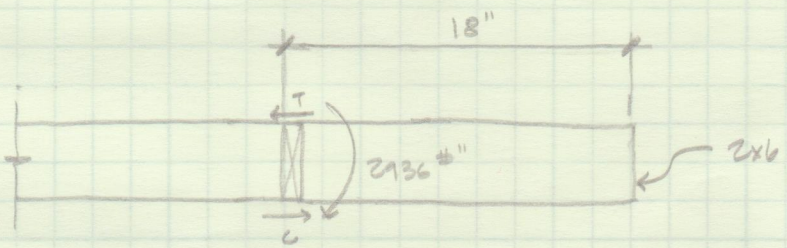
* SEE RFI S011. THE CANTILEVERED PORTIONS OF THE LEDGER AND EAVE WERE CUT. DESIGN STRAPS TO CREATE FLEXURAL CONTINUITY.



// DOWNWARD MOMENT DUE TO LIVE LOAD

DL: 2x6 @ 16" o.c.	5 psf	LL: 20 psf
5/8" OSB	2 psf	
ARCH. FINISHES	2 psf	
MISC.	1 psf	
TOTAL	10 psf	

$$M = PL = [(14.5')(30^{psf})(9/12')(1/2)](18") = 2936\ \#"$$



$$T = C = \frac{2936\ \#"}{5.5"} = 534\ \# \rightarrow \text{SIMPSON CS22} - 845\ \#\ \text{W/ (12) 8d}$$

$$\frac{12}{845} = \frac{n}{534} \rightarrow n = 7.6 \rightarrow (8)\ 8d\ \text{NAILS REQ'D TO ACHIEVE LOAD}$$

// BEDROOM OVERHANG DESIGN

// UPLIFT

* FROM 100% CALCS, $q_B = 13.4$ psf

* ASCE 7-05 FIGURE 6-11 B

$a = 0.1(\text{"LEAST HORIZONTAL DIMENSION"}) = 0.1(14.5') = 1.45'$
$0.4h = 0.4(8') = 3.2'$
$0.04(\text{"LEAST HORIZONTAL DIMENSION"}) = 0.58$
(3')

"EFFECTIVE WIND AREA" $= (3')(14.5') = 43.5\ ft^2$

$GC_p = -1.4$ (ZONE 3)
-1.6 (ZONE 2)

$p = q_h[(GC_p) - (GC_{pi})] = (13.4\ psf)[-1.4 - 0.18] = -21.2\ psf$ (ZONE 3)
$= (13.4\ psf)[-1.6 - 0.18] = -23.9\ psf$ (ZONE 2)

$M = PL = [(23.9\ psf)(14.5')(9/12')(1/2)](18") = 2339\ \#"$ < 2936 #" FROM GRAVITY.

* USE SAME STRAP DETAIL T2B.

Structural RFI’s

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

Proposed Solution:

Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

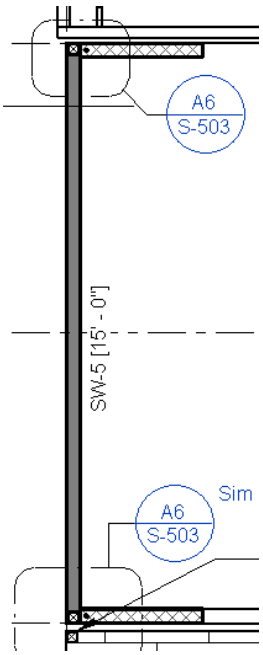
Response:

4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

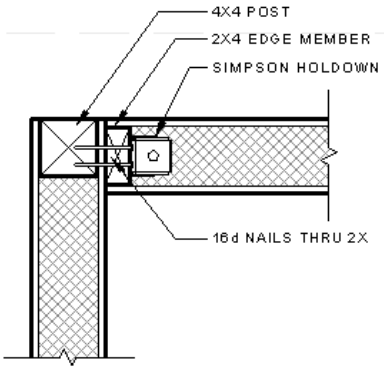
5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

Date: May 10, 2013

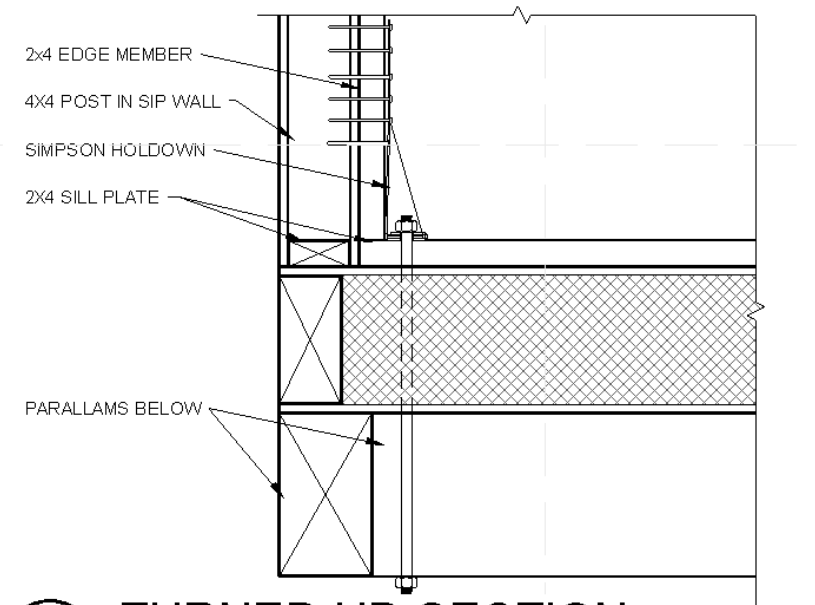


A1/S-102



A6 GREATROOM TURNED HD

1 1/2" = 1'-0"



A5 TURNED HD SECTION

1 1/2" = 1'-0"

7.2 FOUNDATION BEAM DESIGN

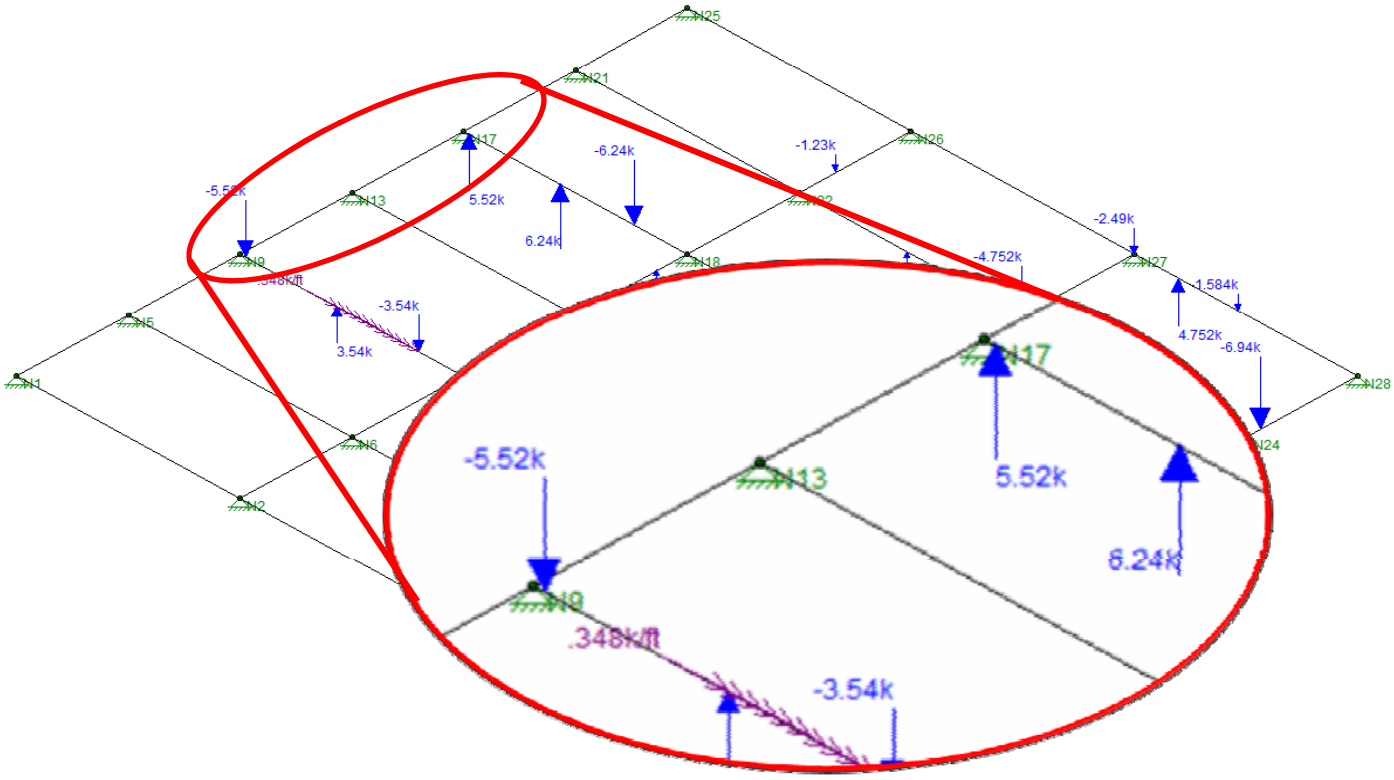
DESIGN

→ *USING PARALLAM BEAMS SIZE 5-1/4x9-1/4*

F_b = 2900 psi A = 48.56 in2

F_v = 290 psi S_{xx} = 74.87 in3

F_c = 2900 psi



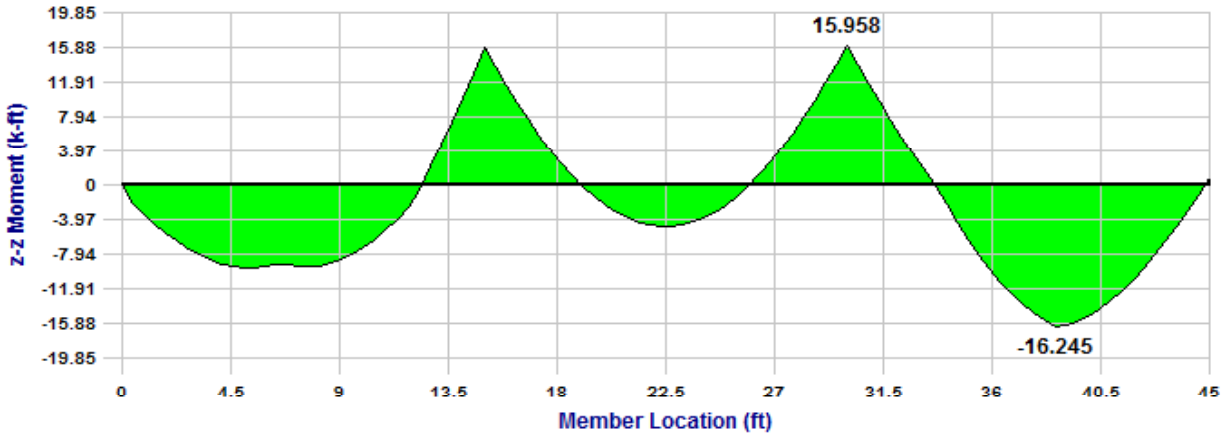
LOAD COMBINATION: D+0.75(0.7E)+0.75L+0.75Lr

****MEMBER 3 (M3) GOVERNS DESIGN. PLEASE REFER TO APPENDIX A.4 FOR STRUCT. ANALYSIS RESULTS**

→ *SEISMIC LOADS INPUT FOR SHEARWALLS INCLUDING OVERTURNING INCREASED BY OVERSTRENGTH FACTOR OF 3 IN RISA*

CHECK FLEXURE

f_b = M/S = 2605 psi (was 2598 psi with Mmax = -16.208 k-ft)



$F\_b^{\prime} = F\_b\ C\_D\ C\_M\ C\_t\ C\_L\ C\_V\ C\_r =$ **4776 psi > f_b (OK)**

C_D = 1.6 → *EARTHQUAKE LOAD*

C_M = 1.0 → *DRY-SERVICE CONDITION*

C_t = 1.0 → *NO SUSTAINED ELEVATED TEMPERATURE*

C_L = 1.0 → *LATERALLY SUPPORTED BY SIP FLOOR*

C_V = 1.03 → *VOLUME FACTOR FOR PSL* $\left[\frac{12}{d}\right]^{0.111}$

C_r = 1.0 → *LARGER SPACING THAN 24 INCHES*

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

Proposed Solution:

Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

Response:

4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

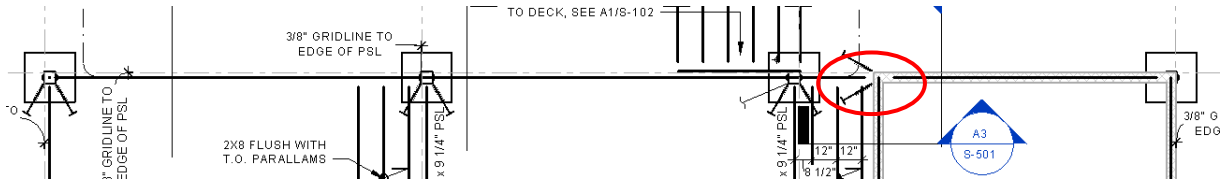
5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

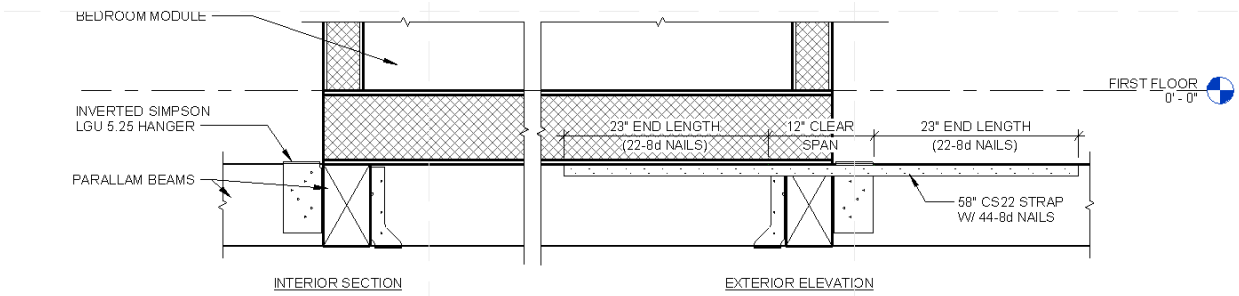
Date: May 10, 2013

start.home

RFI No: S002



A1/S-102



A2 INVERTED HANGER DETAIL

1" = 1'-0"

Calc: Bedroom Beam Verification

By: Kevin Chen

Date: 21 March 2013 Page: F1

BEDROOM BEAM VERIFICATION

Loading

Live Load Reduction

A_l = 577.5

L = 0.874 L_0

(plf)	Grid 1-1.8	Grid 1.8 - 2	Grid 2-3	Grid 3-3.2	Grid 3.2-4	Point
Trib.	3.75	3.75	2.75	3.75	3.75	22.5
Floor DL	45	281.25	33	281.3	52.5	315
Floor LL	327.8	131.1	240.4	131.1	163.9	983
Roof DL					75	450
Roof LL					52.5	315
Wall					104	780
Sum	372.8	412.4	273.4	412.4	447.9	2843.2

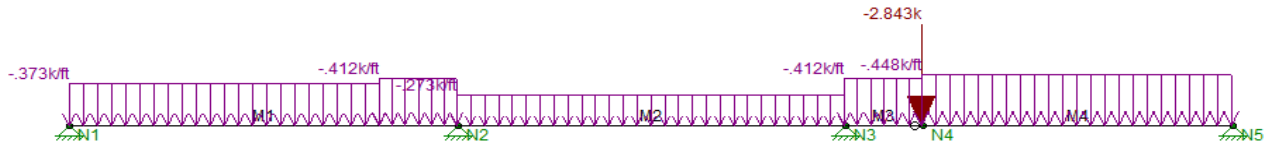
USING PARALLAM BEAMS SIZE 5-1/4x9-1/4

F'_b = 2985 psi A = 48.56 in2

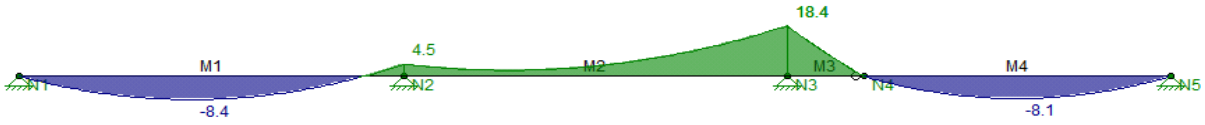
F'_v = 290 psi S_{xx} = 74.87 in3

F_c = 2900 psi

Load Diagram



Moment Check



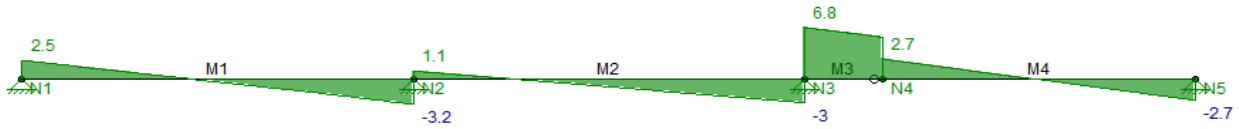
Mmax = 18.4 k-ft

f_b = M/S = 2949 psi ✗ F'_b = 2985 OKAY
✓

Calc: Bedroom Beam Verification

By: Kevin Chen

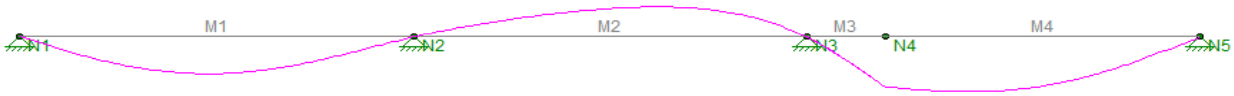
Date: 21 March 2013 Page: F1



Vmax = 6.8 k

$f_v = 1.5\ V/A$ = 210 psi < F'_v = 290 psi OKAY

Deflection Check

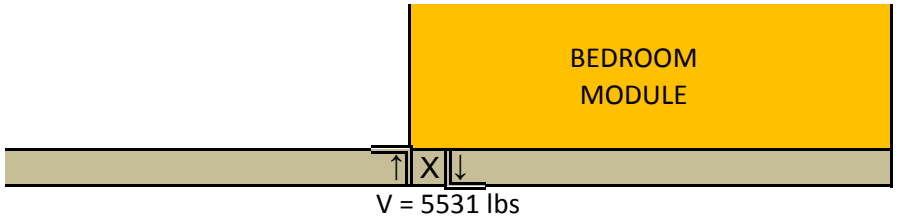


Δ_{D+L} = 0.686 in

Δ_{ALLOW} = L/180 = 1.00 in OKAY

$\Delta_{L,\ ALLOW}$ = L/240 = 0.75 in OKAY BY INSPECTION

Shear at Joint



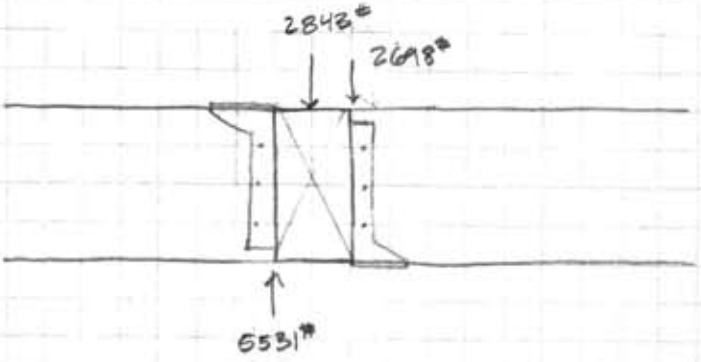
* In order to use the simpson hanger in the "Floor" condition and not "Uplift," the hanger at this joint must be inverted

Simpson LGU 5.25 with one concealed flange, inverted

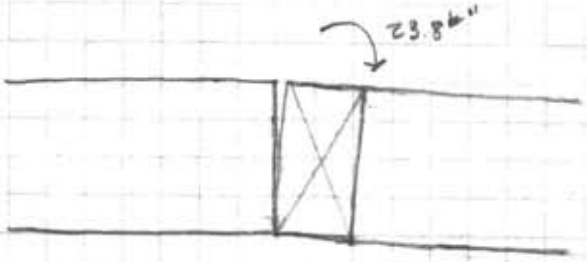
Capacity = 6720 Down

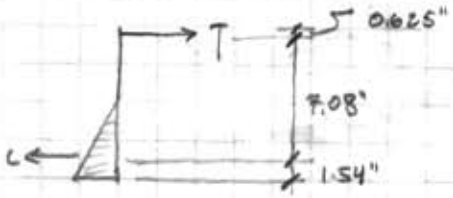
3472 Up (floor)

// INVERTED HANGER STRAP DESIGN



$\Sigma M_{@} = (5531^{\#})(2.625') + (2698^{\#})(2625") = \underline{21.6^{k"}}$

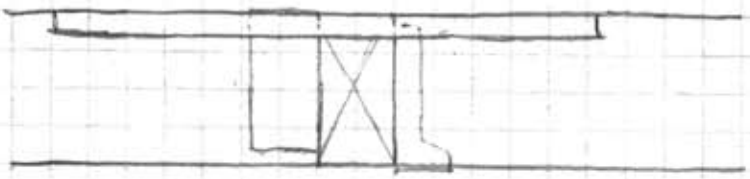




$T = \frac{21.6^{k"}}{7.08"} = \boxed{3051^{\#}}$

* USE SIMPSON C622 - $3051^{\#} = \frac{N}{12}(845^{\#}) \rightarrow N = 44$ NAILS

22 NAILS / SIDE = (22" END LENGTH) x 2 + 12" CLEAR SPAN = $\boxed{56"}$ STRIPS



SECTION

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

Proposed Solution:

Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

Response:

4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

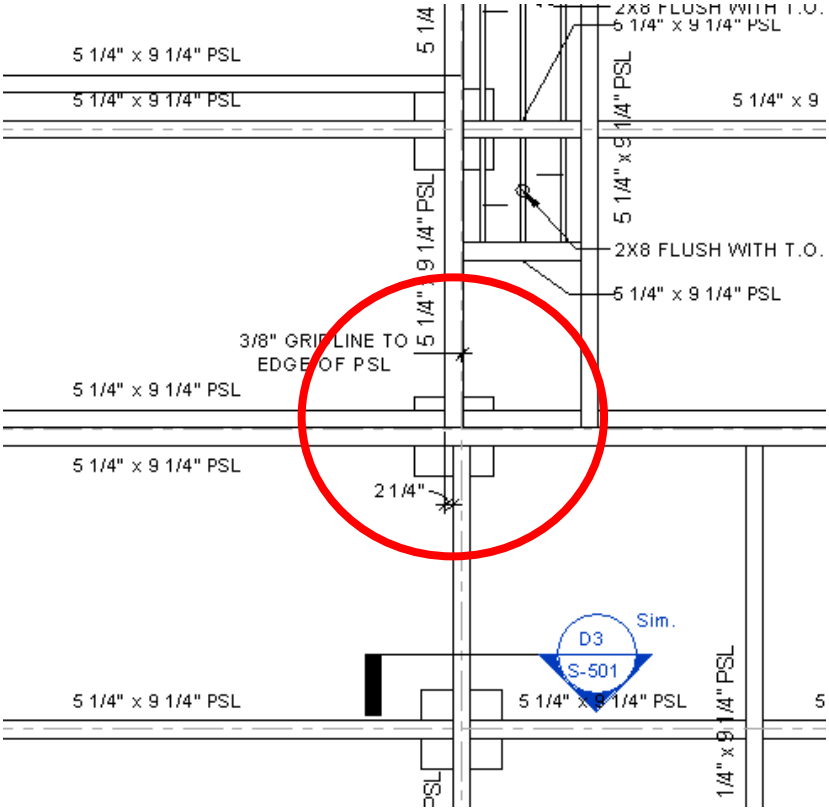
5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

Date: May 10, 2013

start.home

RFI No: S003



A1/S-101, intersection E/3

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

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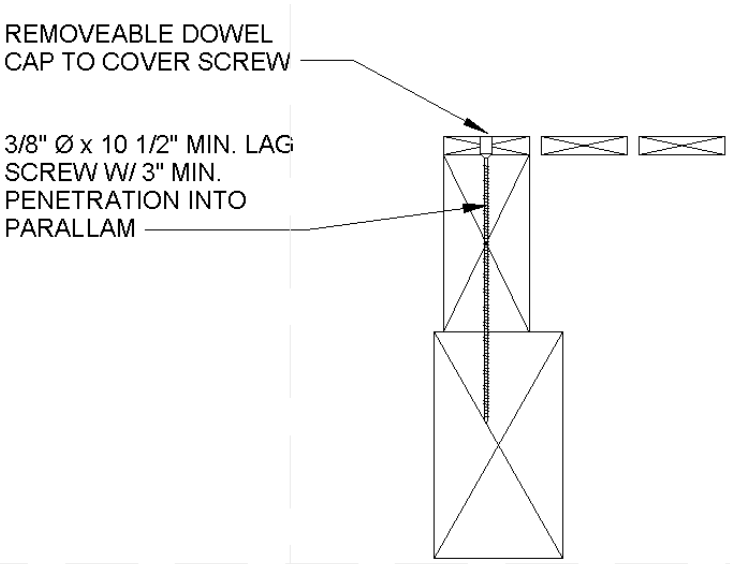
By: Erik Kneer, SE 5252

Date: May 10, 2013



D1 SCREWED DECK CONN

1 1/2" = 1'-0"

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

Proposed Solution:

Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

Response:

4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

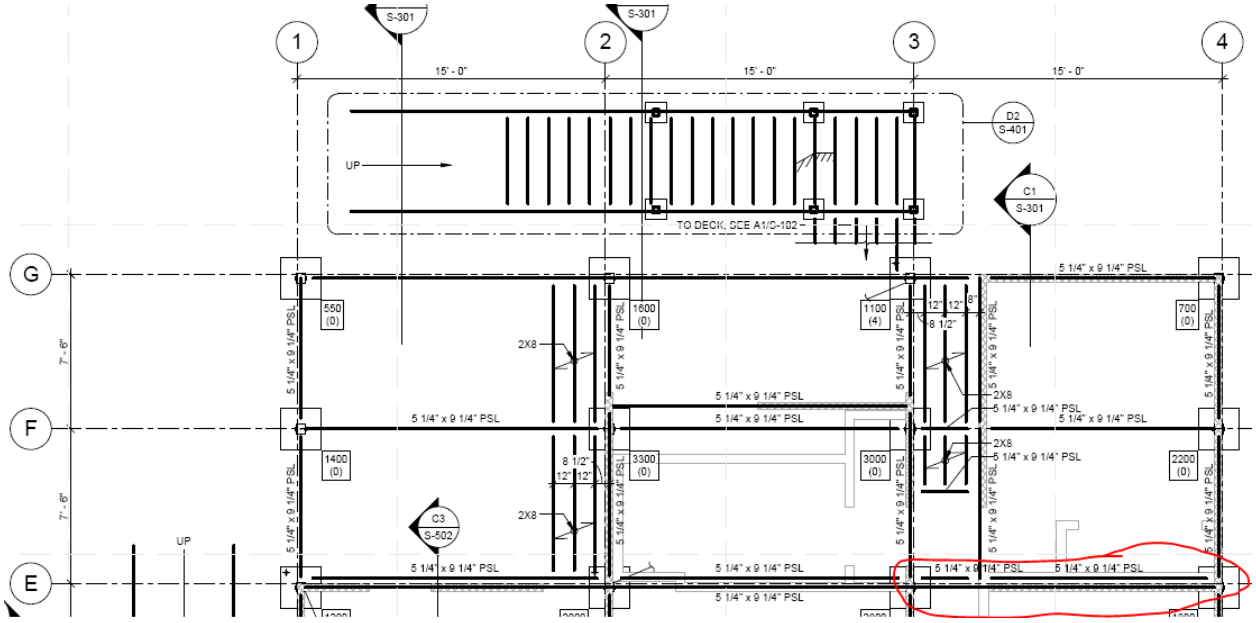
5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

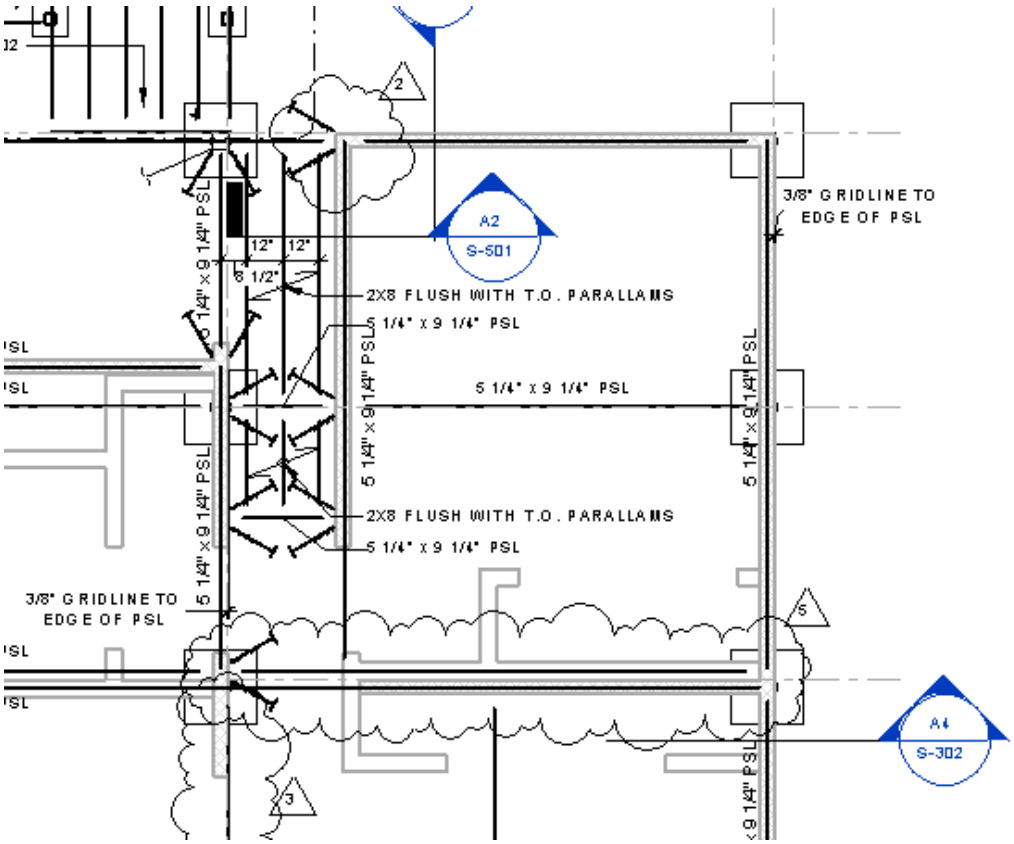
Date: May 10, 2013

start.home

RFI No: S005



A1/S-101 – Permit Set



A1/S-101 - Revised

Stanford Solar Decathlon

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

Proposed Solution:

Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

Response:

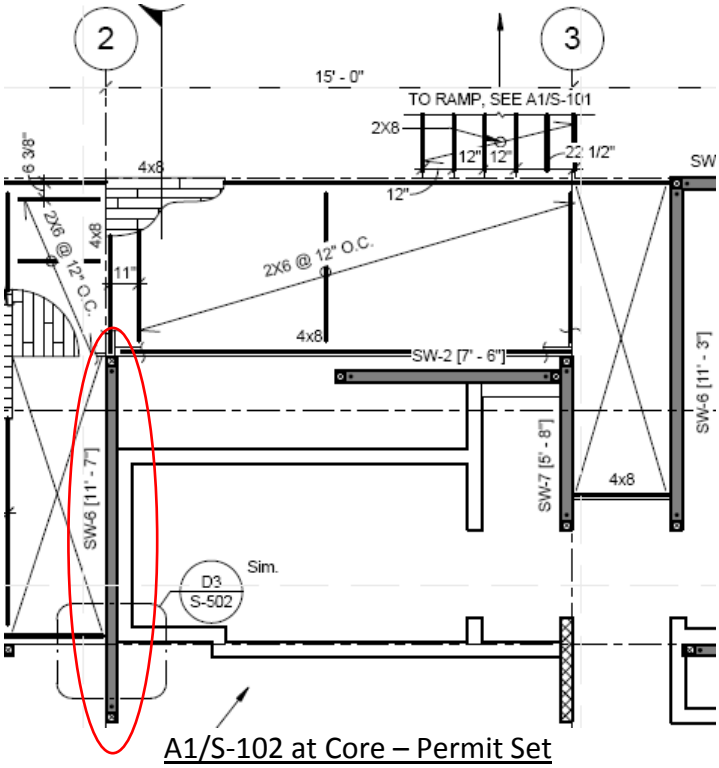
4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

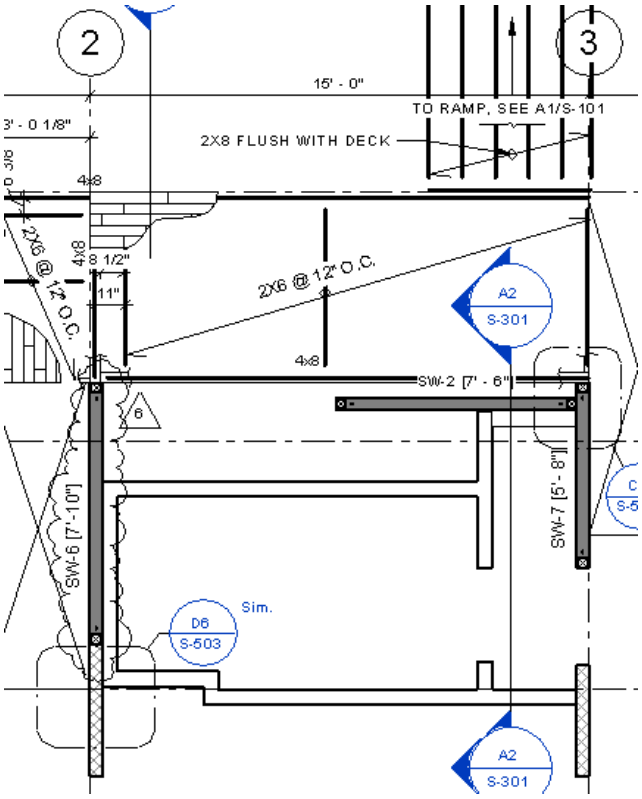
By: Erik Kneer, SE 5252

Date: May 10, 2013

RFI No: S006



A1/S-102 at Core – Permit Set



A1/S-102 at Core - Revision

// CORE WEST SHEAR WALL

// FROM 100% CALCS, PP 50-55

$C = D + W$

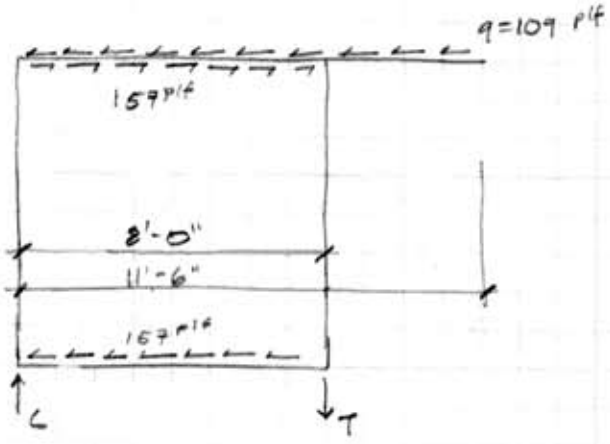
$= 521^{\#} + \frac{(109)(11.5')(10')}{8'}$

$= \underline{2088^{\#}}$

$T = 0.6D + W$

$= 313^{\#} + \frac{(109)(11.5')(10')}{8'}$

$= \underline{1879^{\#}}$



// TENSION DESIGN

$F_t' = (575^{psi})(1.6)(1.5) = 1380^{psi}$

$T_{allow} = (1380^{psi})(12.25^{in^2}) = 16.9^{k} > 1.9^{k}$ — OKAY

HOLDOWN

SIMPSON HTT4: $T = 4235^{\#} > 1879^{\#}$ - OKAY

// COMPRESSION DESIGN

$F_c^* = (1350^{psi})(1.6)(1.5) = 3240^{psi}$

$C_p = 0.1493$

$F_c' = (3240^{psi})(0.1493) = 484^{psi}$

$C_{allow} = (484^{psi})(12.25^{in^2}) = 5.9^{k} > 2.1^{k}$ - OKAY

// CORE WEST SHEAR WALL

// COLLECTOR DESIGN

$P = (108^{plf})(3.5') = 381.5^{lb}$

2x8 DF-L No.2, FULLY BRACED IN STRONG AND WEAK AXIS

$F_c' = (575^{psi})(1.6)(1.2) = 1104^{psi}$

$T_{allow} = (10.88^{in^2})(1104^{psi}) = 12.0^{k} > 381.5^{lb}$ - OKAY

$F_c' = (1350^{psi})(1.6)(1.2)(1.0) = 2592^{psi}$

$C_{allow} = (10.88^{in^2})(2592^{psi}) = 28.2^{k} > 381.5^{lb}$ - OKAY

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

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By: Kevin Chen

Response:

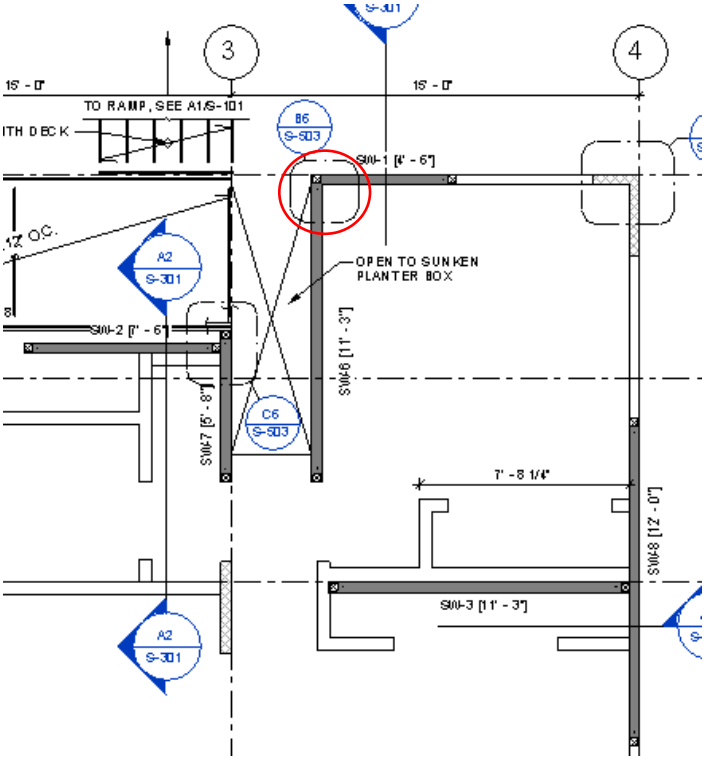
4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

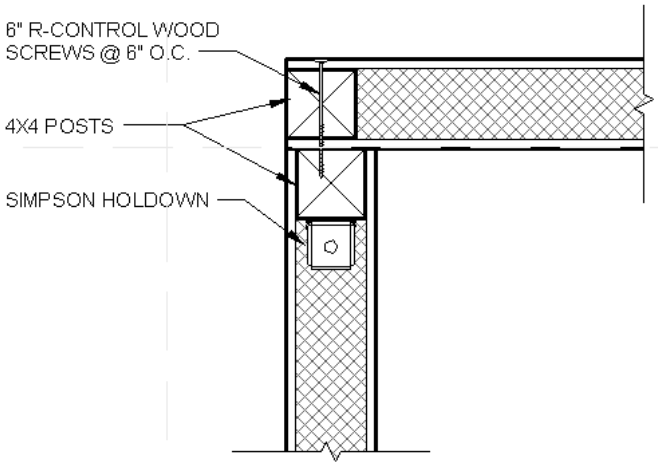
By: Erik Kneer, SE 5252

Date: May 10, 2013

RFI No:



A1/S-102

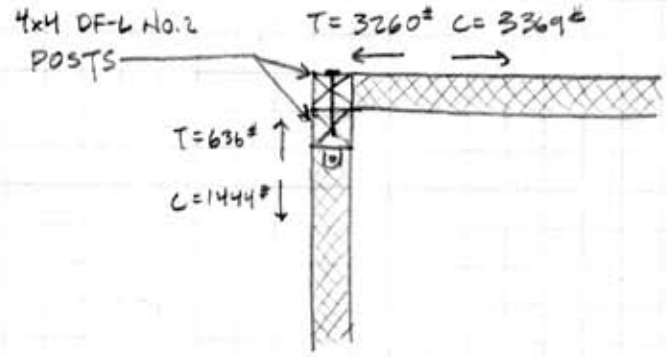


B6 BEDROOM NE HD

1 1/2" = 1'-0"

// BEDROOM NE HOLDOWN POST CHECK

// FROM 100% CALCS, PP. 61-65, 71-75



	N/S	E/W	N/S + 0.3 E/W	0.3 N/S + E/W
T'	636	3260	1614	3451
C:	1444	3369	2455	3802

* CAN WE CONSIDER THE TWO POSTS AS A SINGLE MEMBER?
  - YES, IF THERE IS ADEQUATE SHEAR TRANSFER BETWEEN THEM

6" R-CONTROL SCREWS @ 6" O.C.

FROM R-CONTROL TECHNICAL BULLETIN # 2021:

SHEAR STR. OF R-CONTROL W1000 SCREW W SIP ASSEMBLY
= 780# FOR $q = 045$ (DF-L: $q = 0.150$)

*USING A SAFETY FACTOR OF 2.0 → F_v = 390#

(16 SCREWS)(390#/SCREW) = 6240# > 3802#

* THE R-CONTROL SCREWS ARE CAPABLE OF TRANSFERRING THE SHEAR BETWEEN THE POSTS.

// BEDROOM NE HOLDOWN POST CHECK

// TENSION CHECK

$T = 3451^{\#}$

$F_c' = F_t C_D C_F = (575^{psi})(1.6)(1.5) = 1380^{psi}$

$A = 2(12.25^{in^2}) = 24.5^{in^2}$

$T_{allow} = (1380^{psi})(24.5^{in^2}) = 33.8^{k} > 3.8^{k}$ – OKAY

* IF ONLY CONSIDERING ONE POST...

$T_{allow} = (1380^{psi})(12.25^{in^2}) = 16.9^{k} > 3.8^{k}$ – OKAY

HOLDOWN

SIMPSON HTT4 W/ (18) 16d NAILS : $T_{allow} = 4235^{\#} > 3802^{\#}$ – OKAY

// COMPRESSION CHECK

$C = 3451^{\#}$

$F_c^* = F_c C_D C_F = (1350^{psi})(1.6)(1.5) = 3240^{psi}$

$C_p = 0.1493$

$F_c' = (3240^{psi})(0.1493) = 484^{psi}$

$C_{allow} = (484^{psi})(24.5^{in^2}) = 11.9^{k} > 3.5^{k}$ – OKAY

* IF ONLY CONSIDERING ONE POST...

$C_{allow} = (484^{psi})(12.25^{in^2}) = 5.9^{k} > 3.5^{k}$ – OKAY.

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

The thru-bolt for the holdowns in the NW and SW corner of the GREATROOM (serving the west shear wall) hits the parallam hanger below.

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Turn the hanger so that it is attached to the 2x4 edge post of the perpendicular wall. Nail the holdown through the 2x4 post.

By: Kevin Chen

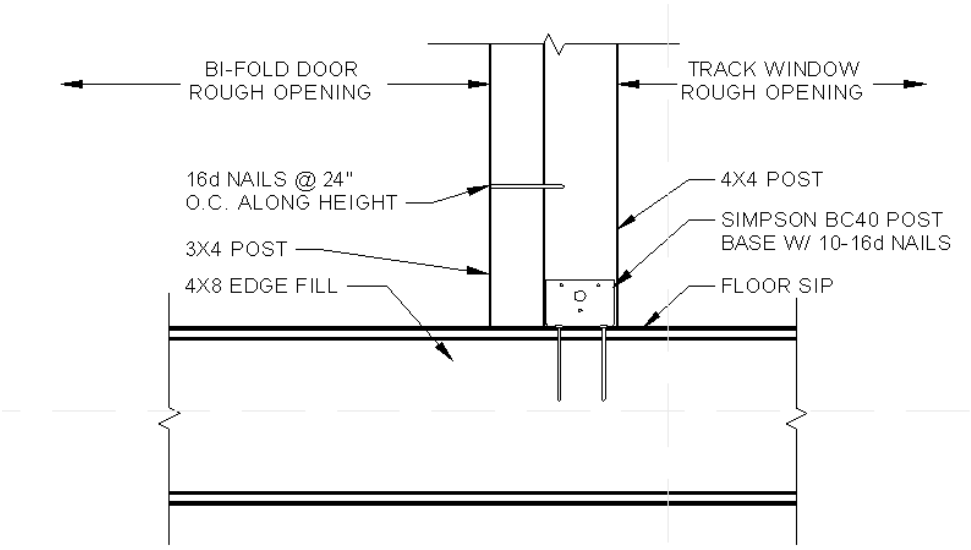
Response:

4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

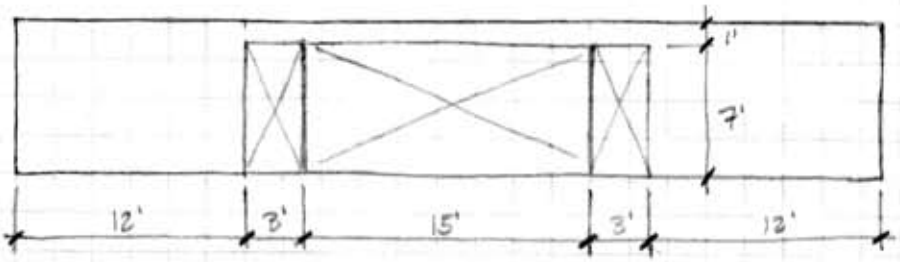
Date: May 10, 2013



C5 PATIO DOOR POST BASE

1 1/2" = 1'-0"

// PATIO DOOR POST BASE CHECK



WIND PRESSURE = 11.5 PLF

$A_{TRIB} = (7')(1.5' + 7.5') = 63\ FT^2$

$V_{BASE} = \frac{1}{2}(63\ FT^2)(11.5\ PLF) = 362\ \#$

* SIMPSON BC40 = 735# LATERAL — OKAY

start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

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By: Kevin Chen

Response:

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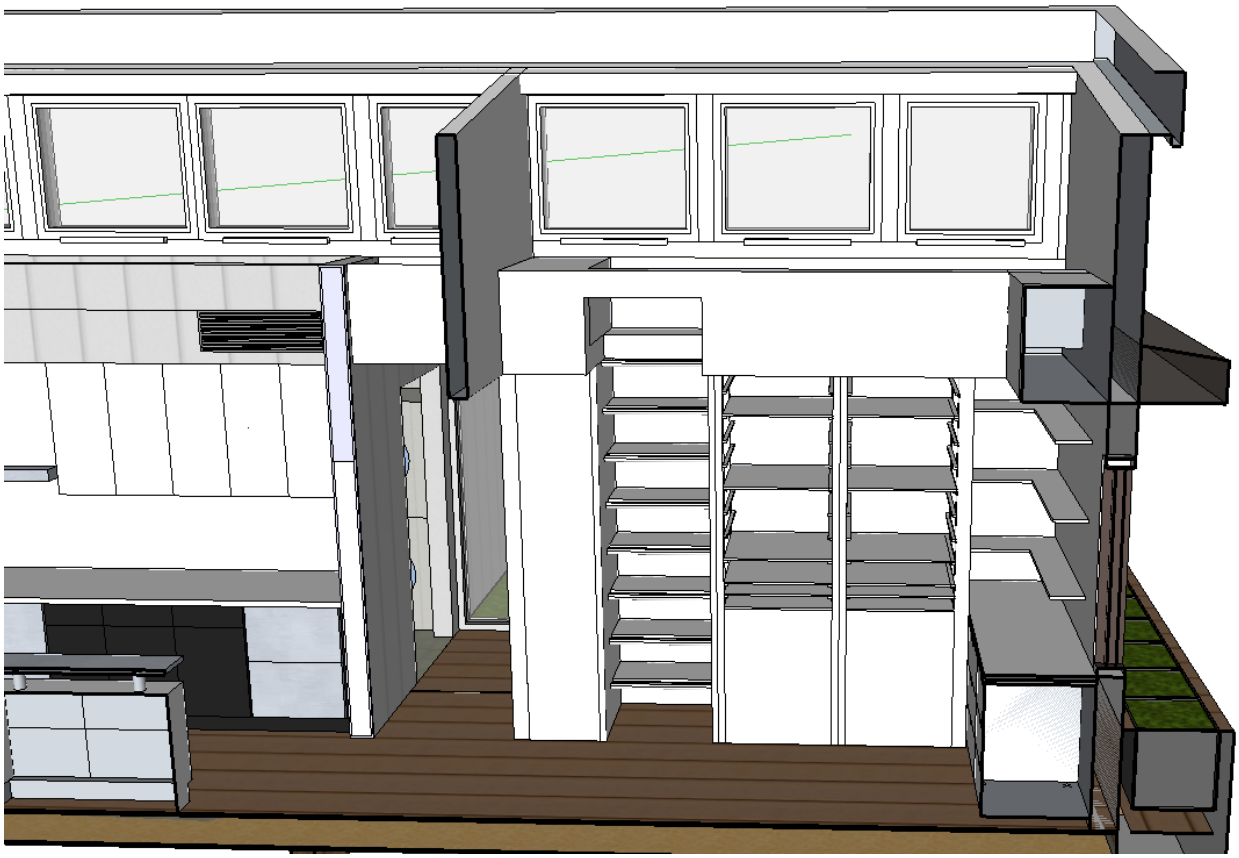
5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

Date: May 10, 2013

start.home

RFI No: S010



start.home

REQUEST FOR INFORMATION

TO: Erik Kneer

RFI No: S001.1

FROM: Kevin Chen

RFI DATE: 17 April 2013

PRIORITY: HIGH

SUBJECT: Turned holdowns in GREATROOM module

Drawings: A1/S-102

Description of Problem:

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By: Kevin Chen

Response:

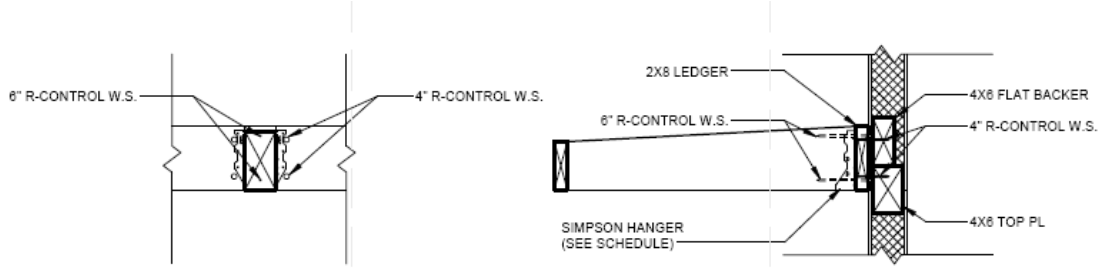
4/15/13: Please clarify framing below. What does the holdown connect into in the new configuration?

5/10/13: We take no exception to the proposed solution to locate the holdown in the perpendicular wall.

By: Erik Kneer, SE 5252

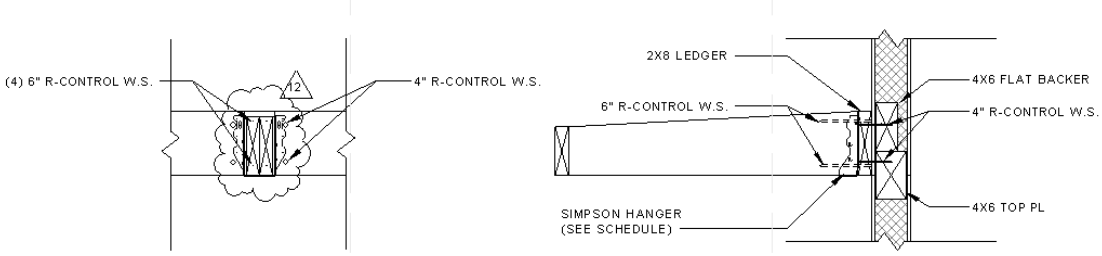
Date: May 10, 2013

RFI No: S012



E5 RIGID JOIST CONNECTION
1" = 1'-0"

Permit Set



E5 RIGID JOIST CONNECTION
1" = 1'-0"

Proposal

DETAILED WATER BUDGET

Function	Water Use (Gal)	Calculations		Notes
		Gallons	Event	
Hot Water Draws	289	17	17	One additional event was added to the 16 hot water shower draws to account for general usage in sinks and during the dinner events. Assumption: an additional gal of water is used before reaching the temperature required.
Dishwasher	20	4	5	Maximum value of gal/cycle among energy star dishwashers
Clothes Washer	112	14	8	Average value of gal/cycle taken from Energy Star washers
Vegetation	0	0	0	Water from the shower hot draws will be diverted to irrigation and the constructed wetland as graywater
Fire Protection	300	300	1	
Thermal Storage Tanks	0	0	0	
Testing	0	0	0	
Initial Systems Fill	50	50	1	50 gal HPWH
Solar Thermal Collectors	0	0	0	
Aesthetic Purpose	0	0	0	
Radiant Flooring	0	0	0	
Safety Factor	237.3			
Total	1008.3	Gallons		

SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

All electrical components installed in the Stanford Solar Decathlon home will carry an approved testing agency's listing per Section 6-7 of the SD 2013 Building Code.

SUMMARY OF RECONFIGURABLE FEATURES

There are no major features of the house which are reconfigurable. The most reconfigurable element is the kitchen island and table. We have designed here a table which slides out of the island for the purpose of dining. This will only be done during the dinner party competition, and during public tours will remain snug against the island to allow pathways on both sides of the island.

Other than this element, our house features several large operable doors and wall panels which allow us to give the house a more open feel, but not actually reconfigure any of the spaces.

These elements will be demonstrated to the architecture, market appeal, and engineering juries during their wealkthroughs.

INTERCONNECTION APPLICATION FORM

Interconnection Application Form

Team Stanford: Lot 104

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W
Stion	8 STN-135 Stion modules connected in series to central inverter	1080W

Total DC power of all arrays is 6.48 kW.

Inverters

Inverter Manufacturer	Model Number	Voltage	Rating (kW)	Quantity
SMA	SB6000TL-US-12	240V (AC)	6.0	1

Total AC power of the inverter is 6.0kW

1. One-line electric schematic E-601
2. Calculation of service/feeder net computer load and neutral load described in the chart of the following page: E-603
3. Plan view of the lot showing the house, decks, ramps, tour paths, the service point and the distribution panel or load center: E-201

ENERGY ANALYSIS RESULTS AND DISCUSSION

1. Introduction

Throughout the past year, the Stanford Solar Decathlon team has conducted a series of analyses and preliminary studies to inform critical decisions along the design process. These analyses have nurtured an iterative design process where ideas are constantly morphing as they feed off previous ones. This continuous process of creative thinking ultimately translated into our latest model of Start.Home.

A comprehensive energy analysis is crucial to the design of a Net Zero Energy House (NZEH). A complete and accurate energy analysis will provide insightful results for the design and construction phases of the NZEH. Seeking for this level of information, the Stanford Solar Decathlon team conducted a comprehensive and meticulous energy analysis. In general, the sequence and structure of our thinking process could be listed as it follows:

- Weather Data Analysis
- Design Strategies
- Potential Effectiveness of Design Strategies
- Optimal Materials Selection
- Solar Power Generation
- Sizing and Selection of Equipment

2. Design Considerations

Start.Home seeks to minimize energy consumption by first taking full advantage of passive strategies and second reducing inefficiencies in the design of the MEP systems. For passive strategies, our team integrated three different ideas in the design of Start.Home. First, we designed for optimal natural ventilation to leverage the comfortable temperatures experienced year-round in the bay area's peninsula. Second, we designed for efficient natural lighting throughout the house not to only reduce electricity consumption but also to create a sense of open and comfortable space within Start.Home. Third, we added a layer of Phase Change Material (PCM) panels to the ceiling in order to increase the thermal mass of the house and reduce the peak thermal loads of Start.Home. On the end of active systems, the Stanford Solar Decathlon team created the concept of Start.Core, a novel solution in a modular form that minimizes MEP by centralizing its components as much as possible. The main intent of Start.Core is to improve the overall energy performance of any house.

2.1 Start.Core

One of our main ideas with Start.Home is the concept of the Start.Core. We like to think of the Start.Core as the brain and muscle of the house. Most of the major components, playing a role in energy distribution and consumption, will be housed within this core in order to improve the overall performance of Start.Home. Our vision is to build the Start.Core under a controlled environment that minimizes installation inefficiencies. Once Start.Core is completely assembled, it can easily be transported in one piece to the construction site thanks to its modular characteristics. For our design, Start.Core is a 10'Hx15'Lx12'W module that fits into the middle of the living space module. However, Start.Core should not be perceived as a fixed design, but rather as a conceptual framework to maximize performance under the premise of creating an efficient and centralized MEP module.

The concept of the Start.Core sparked from the realization that in most houses, little to no thought is put into the integration and interaction of energy systems, let alone about optimization. As a result, different mechanical and electrical systems are sparse throughout the house without really thinking about the potential energy losses due to inadequate installation, distribution, and controls. Based on this observation, our team quickly recognized the necessity of minimizing inefficiencies all around the house (e.g. floor space, materials, connections, systems, etc.). Regarding mechanical and electrical systems, we decided to bring everything together into one space in order to have greater control over energy performance. Start.Core is our proposed solution to achieve maximum energy performance.

The idea of the Start.Core is to concentrate in one module the majority of the MEP systems. In this manner, Start.Core will have a compact and energy efficient distribution system that facilitates control and maintenance. Since all of the major MEP systems are part of a single module, Start.Core can be assembled by qualified professionals under a controlled environment, which will minimize risks while improving quality and performance. Once the assembly of Start.Core is finished, the module can be easily loaded onto a truck bed and shipped to its final destination. Upon arrival to its site, the integration between Start.Core and Start.Home should be a simple plug-and-play.

2.2 Natural Ventilation

Start.Home takes full advantage of natural ventilation as a passive strategy to provide cooling and outside air for better thermal comfort and indoor air quality, respectively. Building upon the concept of displacement ventilation, our design integrates low window openings on the south wall and high window openings on the north wall. Both window openings are

automated to ensure adequate control and synchronization. This configuration maximizes air movement across the south facing modules (living space and studio) due to cross ventilation and stack effect. Outdoor air enters the house through the windows placed feet high on the south walls. The outdoor air entering through these windows is at a colder temperature than the interior of the house, translating into a difference in air density that enables air displacement. Subsequently, warmer air is pushed upwards and away from the south walls towards the opposite end of the modules where the automated north clerestory windows are located. This passive cooling strategy effectively exhausts hot air from the house by taking advantage of nature. As part of good design, this strategy is also optimized by the long and narrow geometry of the south facing modules that allows efficient cross ventilation from south to north walls. Additionally, the window openings for incoming and outgoing air are not directly across from each other to ensure that the outside air mixes with indoor air before exiting the house. The total window opening for incoming air at the lower height is 12.5 ft^2. However, the opening on the south wall can be drastically increased by opening the nana walls. On the north end, the window opening available through the clerestory windows ranges from 12.5 ft^2, to match the low height window openings on the south walls, to a total of 35 ft^2 in case nana walls are opened. Figure 1 illustrates how natural ventilation should work with the design of Start.Home.

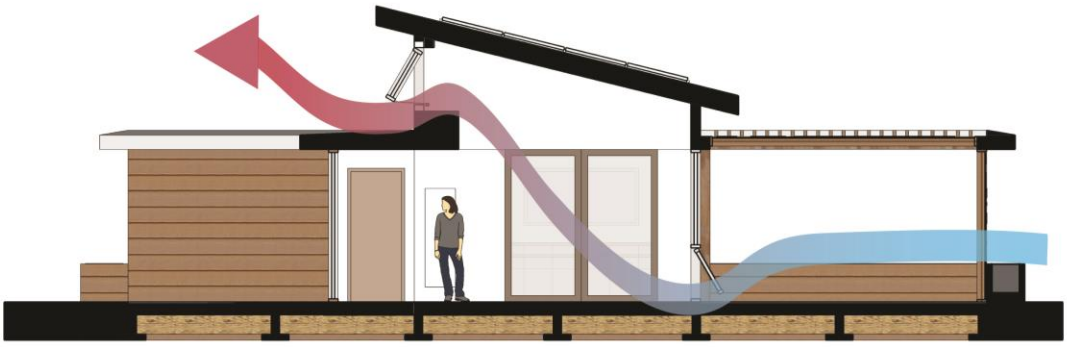


Figure 1: Natural ventilation for Start.Home.

The orientation of the house is equally important when it comes to an adequate design of natural ventilation. Since natural ventilation is a strategy for passive cooling, the house should face in the direction of the incoming summer winds. The Typical Meteorological Year 3 (TMY3) data indicates that during the time of the competition the wind in Irvine mostly comes from the southwest, as shown in Figure 2.

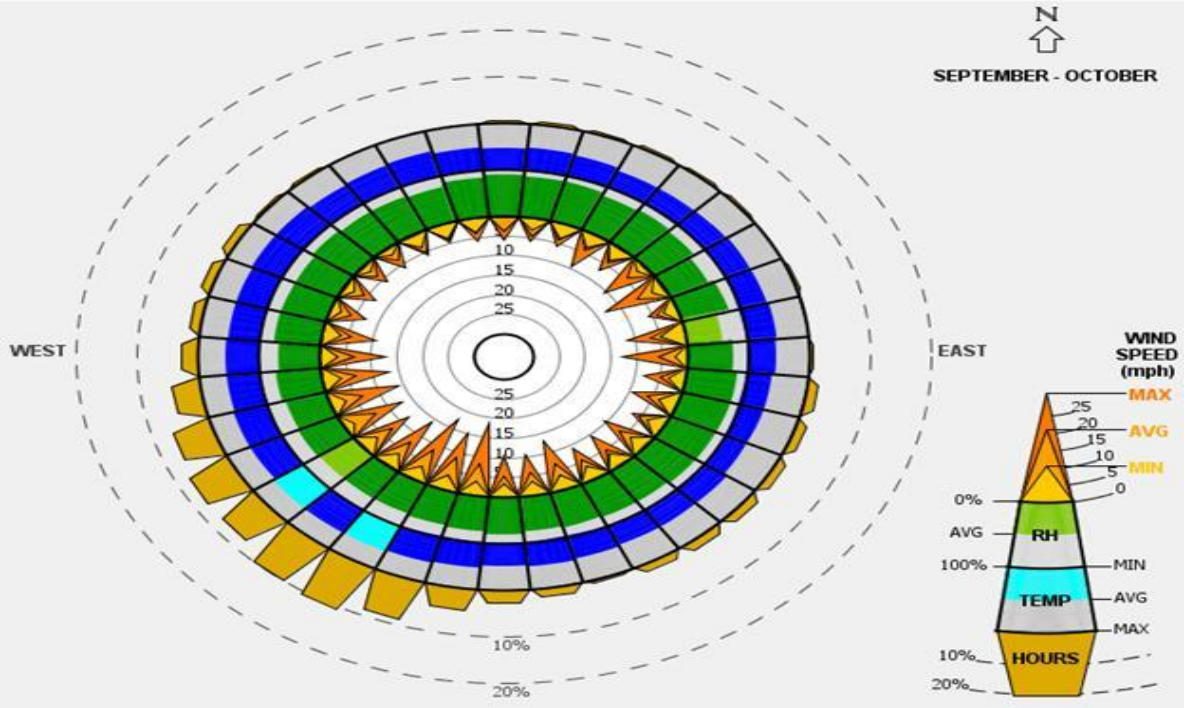


Figure 2: Wind wheel during the months of Sept. and Oct. in Irvine, CA.

Beyond the competition, our team analyzed the annual weather data from Mountain View Moffett Field NAS base and found out that natural cooling ventilation could be used for thermal comfort in a residential house and account for approximately 8% of the total thermal comfort hours in one year, as shown in Figure 3. This analysis was done using the Climate Consultant software which considers a range of thermal comfort options and accounts for natural ventilation based on the temperature and humidity in a given hour. The box in blue shows the hours that natural ventilation can be used in Mountain View, while maintaining a comfortable standard. The axes and lines denote temperature and humidity.

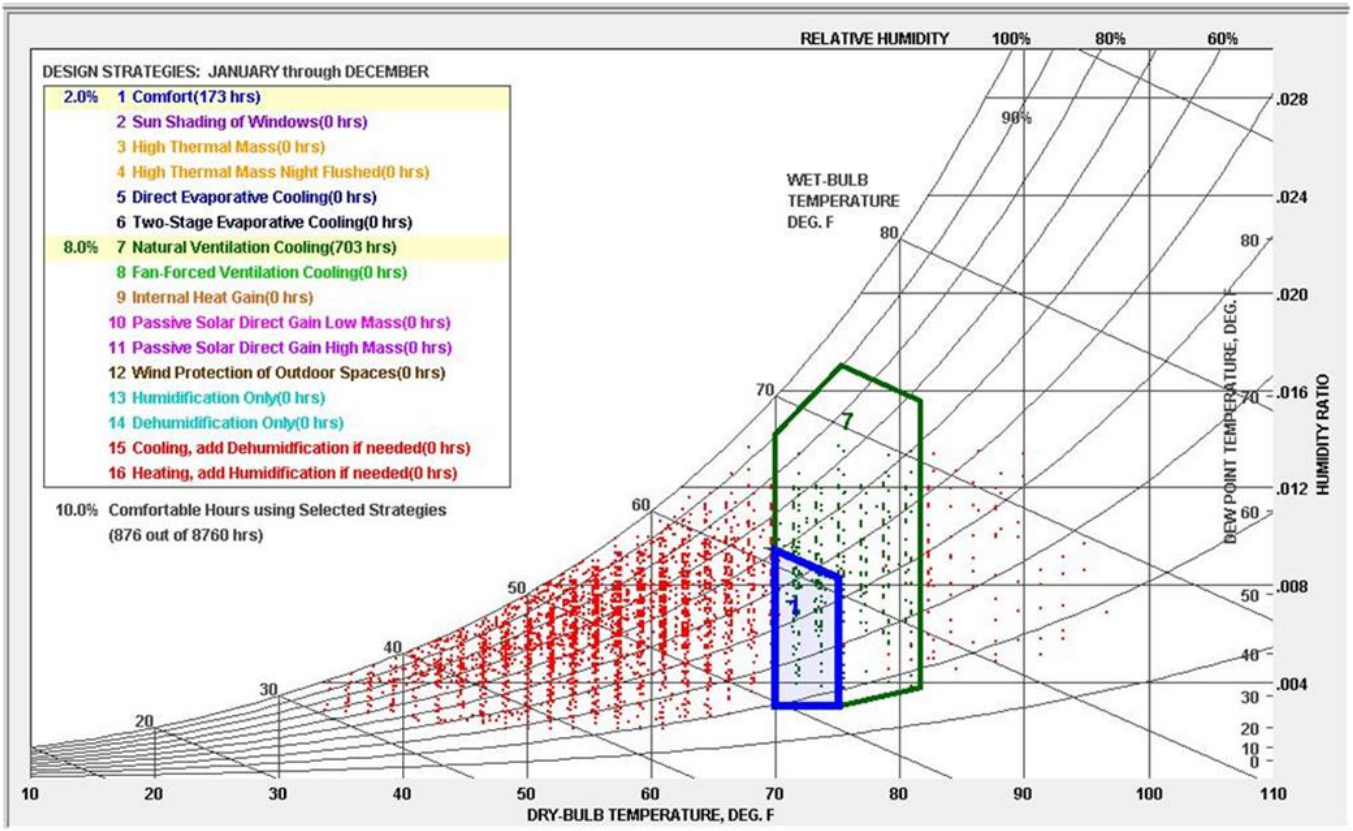


Figure 3: Natural ventilation cooling for thermal comfort in Mountain View, CA.

2.3 Natural Lighting

A simple strategy to reduce lighting loads is to increase the amount of diffuse natural light coming into the house. Diffuse light provides a more even illumination than direct light, creating the feeling of an open and welcoming space. On the other hand, direct light can produce glaring and drastic shadows. For this reason, the design team prioritized sources of diffuse natural light over direct natural light. The north clerestory windows are the main source of diffuse natural light for the majority of the living spaces. The location of the clerestory is particularly ideal because the incoming light creates that sense of brightness for the living spaces as it hits the interior of the roof first. Furthermore, the fact that the clerestory is located on the north side drastically reduces heat gains.

Since winters in Palo Alto, CA are rather mild, the need for solar heat gains is not as critical as in more extreme climates. Furthermore, our team doesn't expect high infiltration rates in the house because of the high insulation properties of SIPs. Hence, the team decided to provide a larger covered south deck rather than design overhangs for optimal solar heat

gains. The addition of a large south deck creates a comfortable outside space for the homeowner where s/he can relax and spend quality time with family and friends, a must have feature in any Californian home.

2.4 Phase Change Material (PCM)

In Start.Home, we are using PCM to create a thermal buffer within the home. These PCM panels developed by Dupont have a latent temperature range for phase change of 71°F-74°, and therefore would assist the active air conditioning system in keeping the indoor temperature within the comfort zone.

The governing idea behind the PCM panel is that the solid chemical held within the panel will absorb heat (sensible heat change) from the air at a threshold temperature, and eventually will melt into liquid, absorbing a relatively large amount of latent heat from the air.

Ideally, the panels would undergo through a day/night cycle discharge to maximize their performance. During cooling season, heat within the house is absorbed by the PCM panels, acting as a thermal mass that passively cools the house. At night, the PCM panels would release the stored heat as the air temperature drops below the comfort zone. The PCM's thermal behavior reduces the heating and cooling loads of the house and ultimately translates into savings in the homeowner's energy bills. Considering the design of our house, heat will move towards the top part of the north walls, where the clerestory windows are placed. Therefore, this is also the best area to install our PCM panels so they can be in close contact with the hotter air inside the house and also in the pathway of the displacement ventilation. Our natural ventilation design is the perfect complement for the PCM panels as air displacement will allow them to discharge through night flushing. Figure 4 shows the thermal discharge of PCM panels as night flushing happens across the house. This design strategy will be a great feature to reduce energy consumption throughout the lifetime of the house.

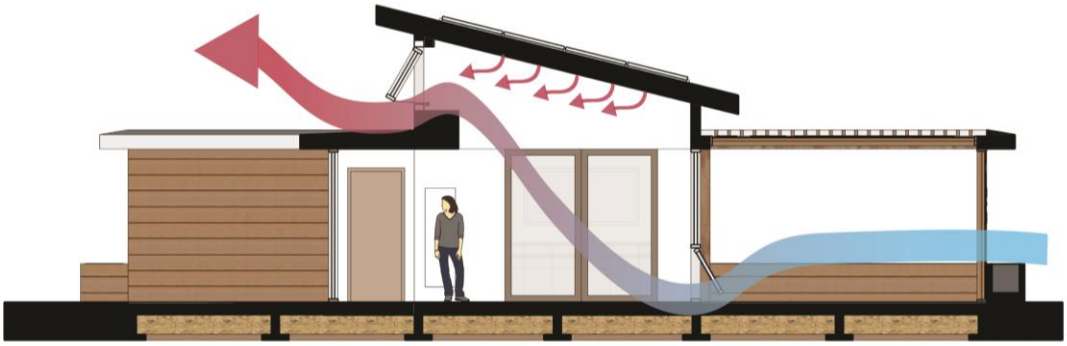


Figure 4: PCM thermal discharge and night flushing.

3. Weather Data

The design team considered climate conditions in both Irvine, where the competition will be held, and at Stanford, where Start.Home will be located afterwards. Typical Meteorological Year 3 (TMY3) weather data was extracted from the National Solar Radiation Data Base (NSRDB). This TMY3 data, produced by the National Renewable Energy Laboratory (NREL), represents a typical meteorological year from weather conditions taken between 1991 and 2005, including information for 1,020 locations. TMY3 data provides several meteorological elements necessary for energy simulations, such as dry bulb and wet bulb temperatures, relative humidity, rainfall, solar insolation, and wind speed. TMY3 data is more accurate than its predecessor TMY and TMY2 data sets as it is based on more recent weather`conditions.

The meteorological weather bases used to represent climate conditions in Irvine and Stanford, CA were 722977 Santa Ana John Wayne AP and 745090 Mountain View Moffett Fld NAS, respectively. In terms of designing for the competition, only weather data from the months of September and October were considered. On the other hand, the annual set of weather data was considered when designing for Stanford. The annual dry bulb temperature profiles for Irvine and Stanford climates are shown in Figures 5 and 6, respectively. Similarly, the annual solar radiation profiles for Irvine and Stanford are shown in Figures 7 and 8, respectively.

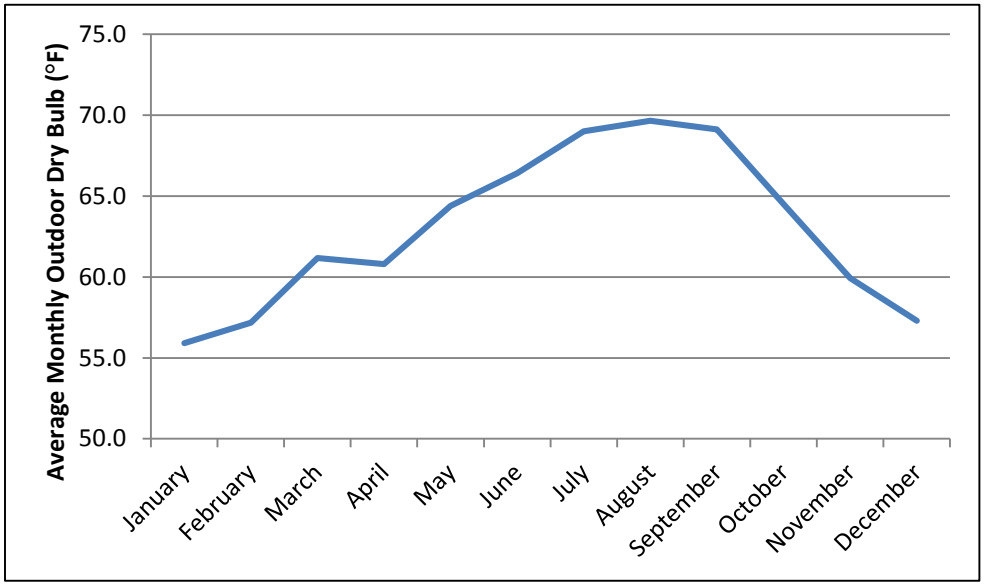


Figure 5: Average monthly outdoor dry bulb temperature in Irvine, CA

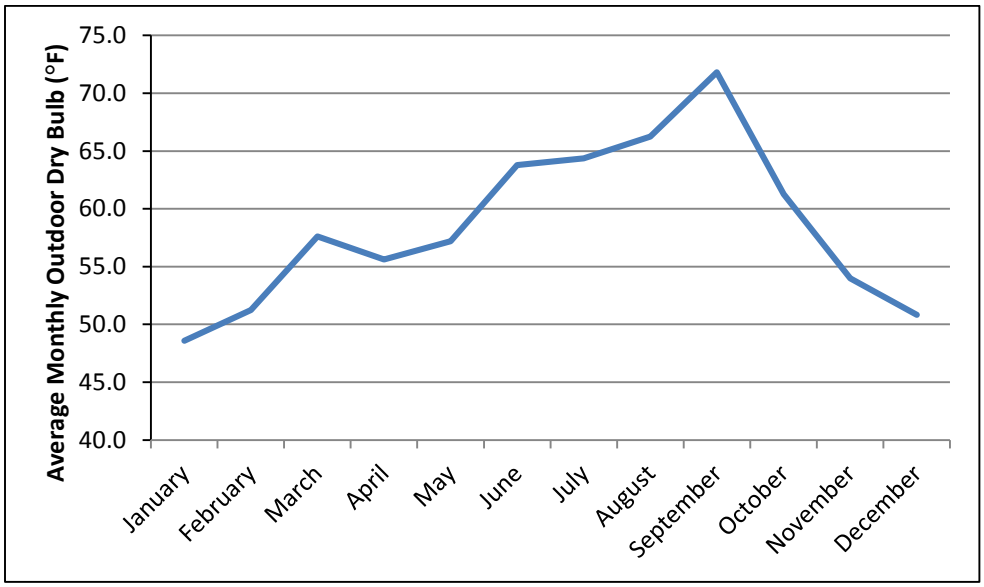


Figure 6: Average monthly outdoor dry bulb temperature in Stanford, CA

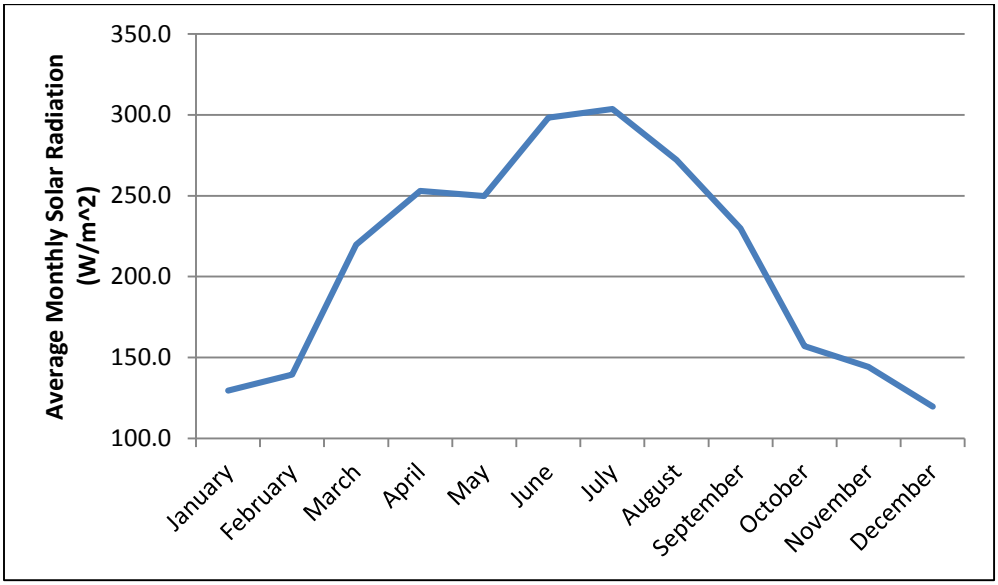


Figure 7: Average monthly solar radiation in Irvine, CA

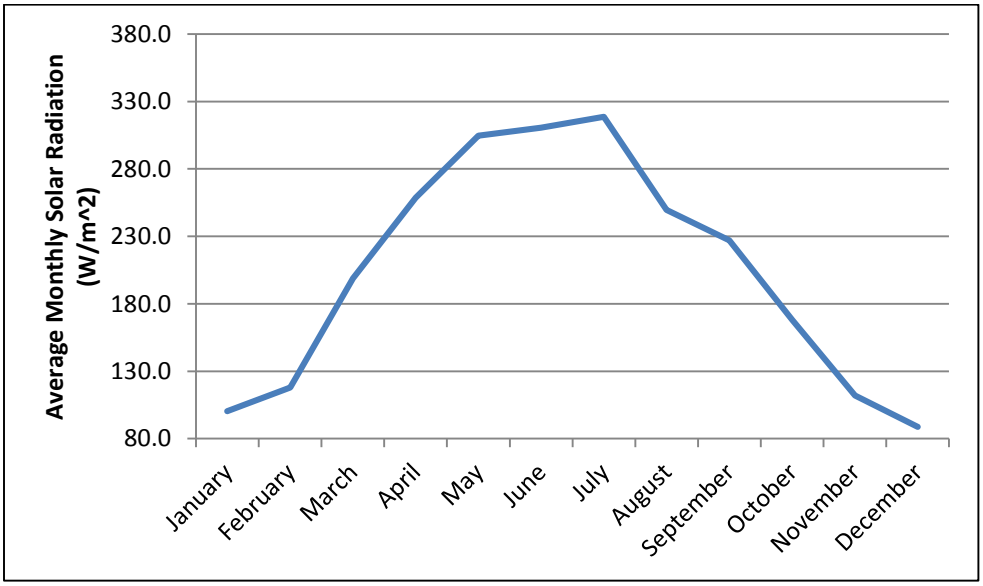


Figure 8: Average monthly solar radiation in Stanford, CA

4. Energy simulations and results

4.1 Software tools

4.1.1 Revit

Our team is constantly using Revit Architecture and Revit MEP to detail our most up to date design of Start.Home. Hence, our Revit models are the latest and most comprehensive models of the house. Architectural and structural teams use this tool only when final decisions are made.

4.1.2 Google SketchUp

Google SketchUp is our first stop modeling tool. This software let us model all kinds of ideas very easily in order to visualize and compare several options. Google SketcUp is a great tool to showcase preliminary design ideas without getting into a high level of detail.

4.1.3 Climate Consultant

This is a great tool for weather data analysis. It seamlessly links to NREL's weather data file in epw format. The software tool develops multiple graphs for analysis. Our team found the psychometric charts particularly helpful in understanding the potential strategies that could be used throughout the year in order to achieve close to 100% thermal comfort.

4.1.4 Microsoft Excel

Microsoft Excel has been used to run several energy calculations. Integrating the TMY3 data with our energy modeling has allow us to run hour-by-hour analyses for ventilation, thermal losses, internal gains, solar radiation, precipitation, wind direction, etc. Additionally, our team has been working on developing load profiles for plugloads, lighting, mechanical equipment, and domestic water. The main idea is to link all of these files into a one comprehensive master energy model file.

4.1.5 Vasari

Vasari is an energy analysis tool from AutoDesk in beta release and was used for supplemental analysis to select the type of windows. A mass model of the house was created using Vasari's own internal mass model creator. Using various techniques, a near exact copy of the current Revit model was created.

4.1.6 Autodesk Simulation CFD

This tool facilitates CFD analyses and can provide valuable information regarding the thermal performance of the house. Our team is currently working on a model to primarily study the effectiveness of our natural ventilation design. The mass of the house has been

modeled already and a couple of trial runs have been made as well. Boundary conditions and assumptions in the model need to be refined though

4.1.7 Energy Plus and Open Studio

Energy Plus and its open studio plug-in were used for energy modeling. We used Open studio to create the different thermal zones, edit the thermal properties of materials, and ultimately run an energy plus simulation. The results from energy plus served as a checking method for our existing hour-by-hour energy model and overall energy budget.

4.2 Windows Analysis

Since Vasari is still in its Beta Phase, it was used as a way of comparing how various window types would affect the heating and cooling loads of the house throughout the year. We came to the conclusion that, even though "Triple Pane Clear" provided the most support in terms of lowering heating and cooling peak loads, "Double Pane Clear – Low-e coating, Low SHGC" provides just as much support without as much cost.

Looking at the figures generated by Vasari below, we can see the impact of all of various loads on the house. Looking specifically at the "Window Solar" section, we can see how varied the loads are just by switching between the different types of windows. Figures 9 and 10 demonstrate the lower thermal performance of windows without coatings. On the contrary, we can see in Figures 11 and 12 that the triple pane and double pane windows respectively, both with low-e coating and a low SHGC value, offer a reduction in peak loads of roughly 65% and 55%, respectively, due to the amount of heat transfer given the R-value of the window and its allowable light transmittance.

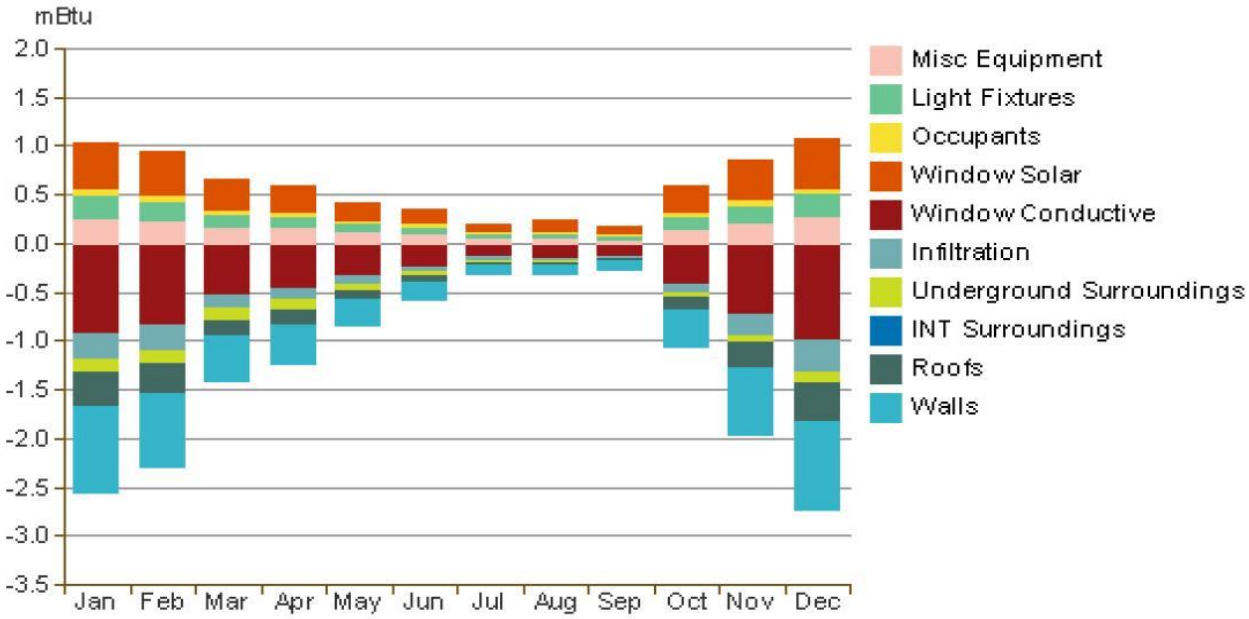


Figure 9: Monthly heating load of double pane clear no coating

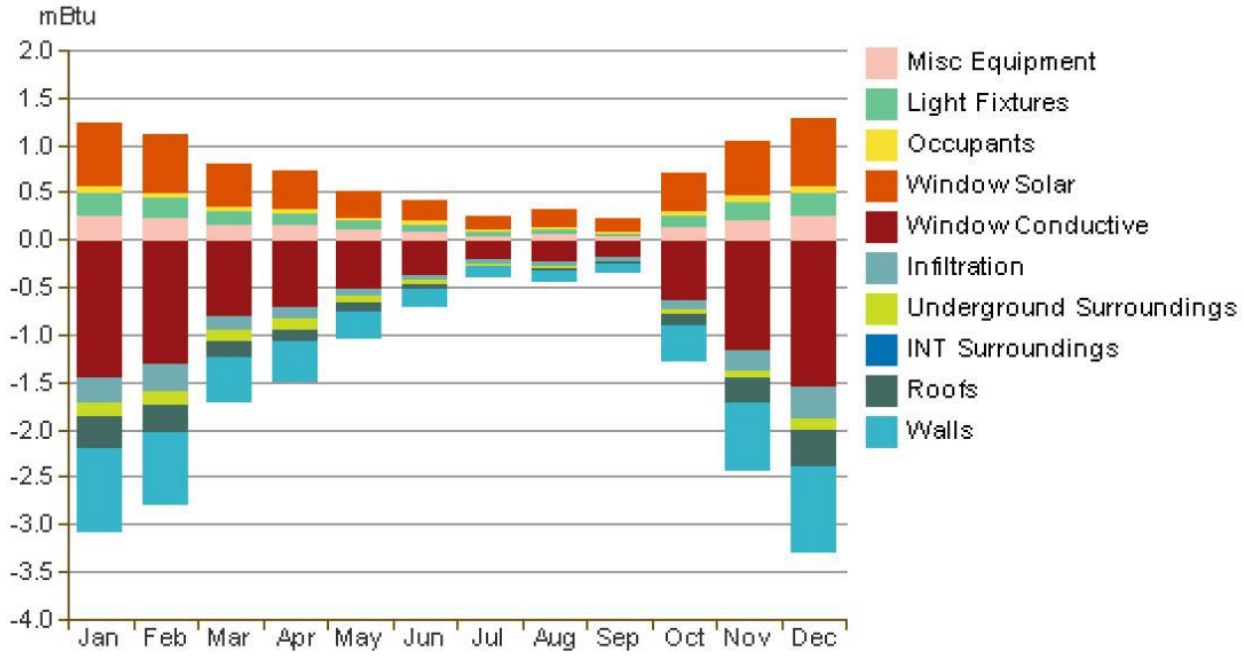


Figure 10: Monthly heating load of single pane clear no coating

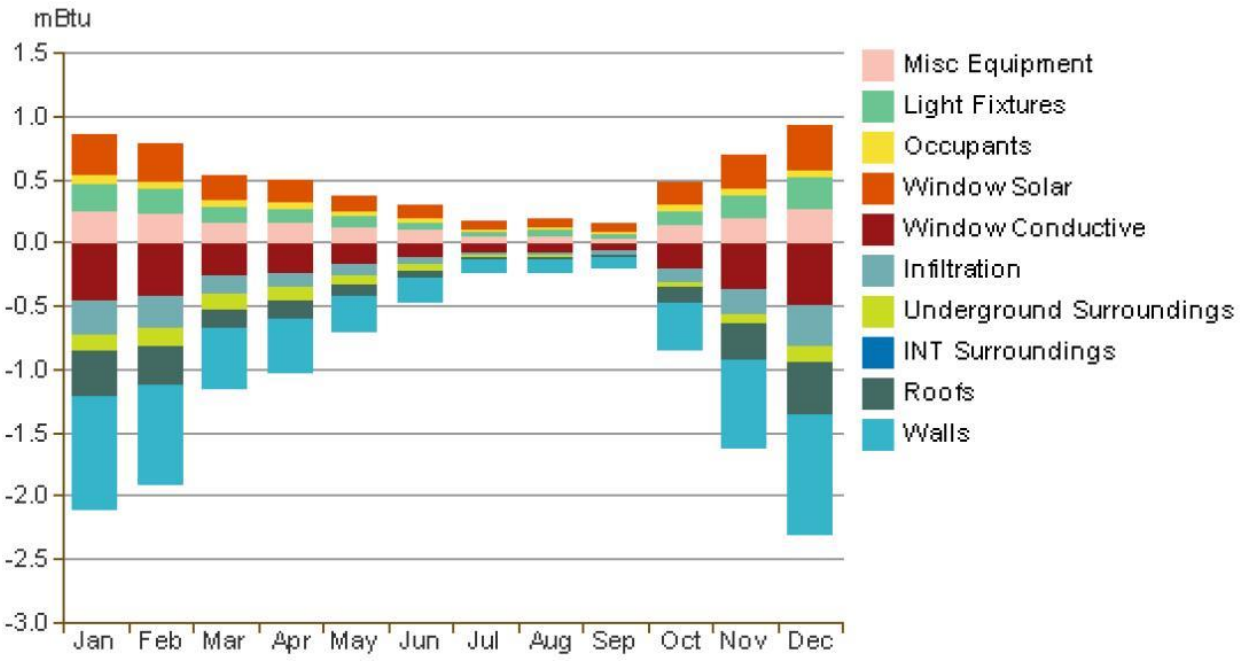


Figure 11: Monthly heating load of triple pane clear low-e hot climate, low SHGC

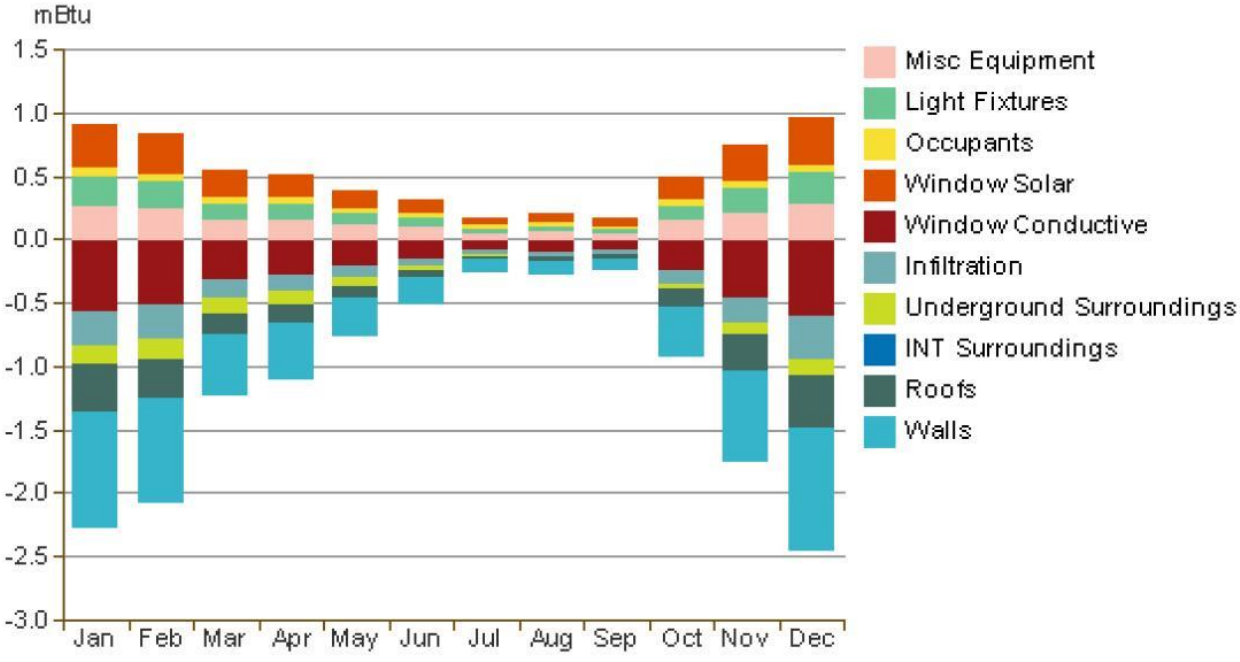


Figure 12: Monthly heating load of double pane clear low-e hot or cold climate

The results from this study allowed us to narrow down our windows' options. As we previously stated, after this point we strictly looked a double pane windows with low-e coating.

4.3 Energy Plus

The energy model was created using Energy Plus with geometry input through Google Sketch Up. Geometry input was simplified slightly for the ease of modeling. The house was treated as three thermal zones, one for the bedroom, one for the studio, and one for the living space. The mini-split system was modeled using the templates for packaged terminal heat pumps with a cooling COP of 5.1 and a heating COP of 4.2. Accurate R value parameters were input for the roof, floor, walls, and windows. Overall R value for the SIP walls was 14.13 and 2 for the windows. Argon filled, double pane low-e window was used as reference for all parameters entered into the energy model. Occupancy and lighting schedules were set based on likely occupancy schedule of a home. Lighting levels were input using a schedule for lighting intensity in the space. The household was assumed to consist of three people. On weekdays, it was assumed that the house was unoccupied from 8am-5pm, and fully occupied from 5pm-8am. On weekends, it was assumed that the house was 50% occupied from 8am-5pm, and fully occupied from 5pm-8am. The lighting levels scaled with the occupancy of the house. The maximum lighting level was 1.24W/ft^2, reported as an average for homes in a 1996 report by LBNL. Finally, the energy simulation was performed using a weather file for Santa Ana, CA airport, the closest location available to the competition site in Irvine, CA.

The peak cooling loads were calculated to be 2,910 Btu/h for the bedroom, 1,904 Btu/h for the studio, and 10,492 Btu/h for the living space. The total annual energy consumption for the house was calculated to be around 6,000 kWh.

5. Solar PV Array Size

Based on equipment characteristics, the team predicts Start.Home will consume 9,000 kWh of electricity during the course of a typical year when factoring in enough excess electricity to power an electric vehicle. NREL's SAM simulator was used to size an appropriate PV system to meet the demand.

The PV array consists of 48 Stion 135 Wp PV modules, which constitutes an array power output of 6400Wp. All 48 PV modules are fixed on the south-facing roof at an angle of

19.29° from the ground. Four PV modules connect to one TIGO Dual Maximizer. Two modules connect in parallel to each input of the Dual Maximizer. Four maximizers are connected in series and three of these parallel strings connect to an SMA SB6000TL-US central inverter. The capacity of this inverter is 6.0kW. NREL's SAM predicts the annual output of the entire system assuming installation at the competition site in El Toro, CA to be about11,000 kWh.

Given the load conditions simulated for Start.Home, an annual production of 11,000 kWh will meet the electricity demand. The size of the array provides a 20% margin to allow for weather variability and un-modeled loads or factors.

The competition will take place over a span of 10 days: October 3rd to October 13th 2013. Profiles of the hourly temperature and direct solar irradiance for the El Toro, CA site during this 10-day period can be found below in Figure 13 and Figure 14, respectively.

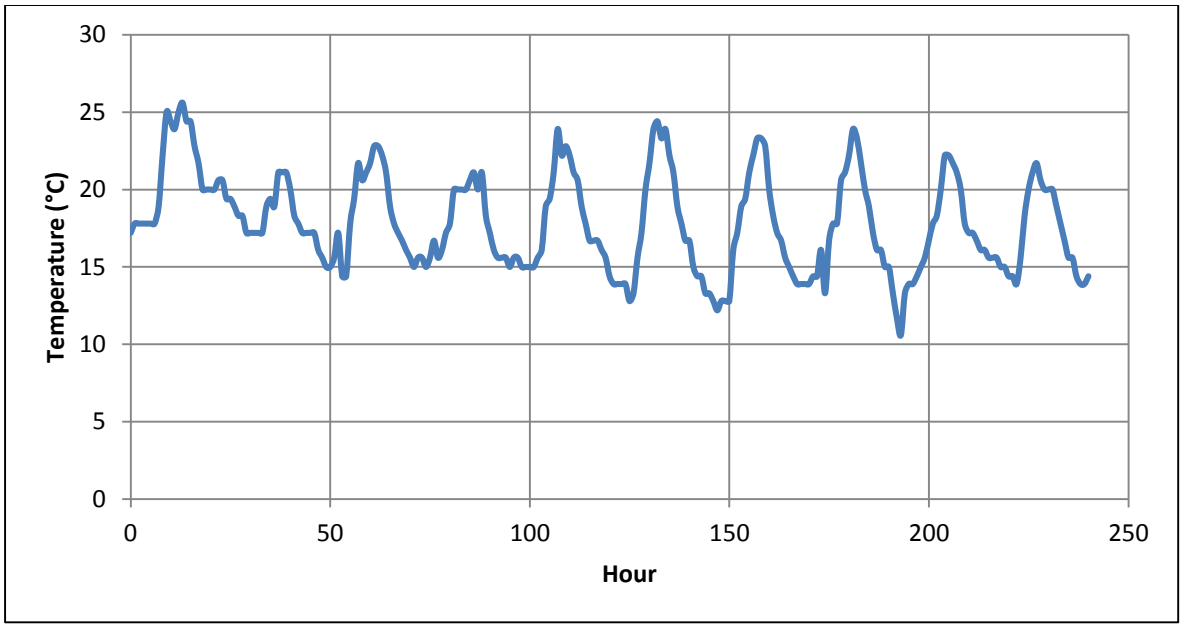


Figure 13: Hourly outdoor temperature (Oct. 3 – Oct 13)

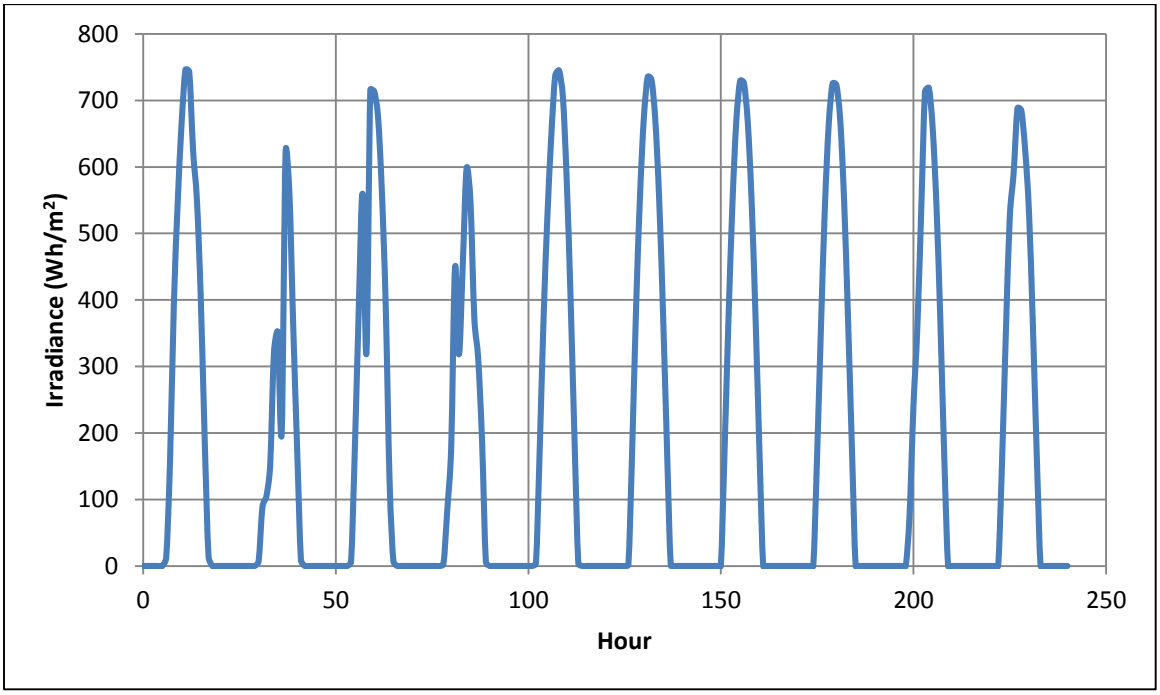


Figure 14: Hourly Direct Solar Irradiance (Oct. 3 - Oct. 13)

6. Heating and Cooling Loads

A spreadsheet energy model was specifically created by our team to determine the hour-by-hour heating and cooling loads. Creating our own energy model gives us more controllability and allows us to fully understand how performance is determined. The model divided the house into three different thermal zones: living space, studio, and bedroom. Therefore, calculations were made at a whole-house and per-zone level. Geometry values and material properties were the main input values to figure out the UA values of each zone, which also included ventilation and infiltration rates. Then TMY3 data allowed hour-by-hour calculations of thermal losses.

Equations from ASHRAE standards 62.1 and 90.2 were used to model the annual energy profiles and loads for the different thermal zones. This approach was taken because essential details affecting the energy performance of the house, such as house appliances and lighting distribution, have not been completely defined by the team yet. As decisions are made and specifications are entered into the spreadsheet, the energy model becomes more and more accurate with time.

Finally, the hour-by-hour heating and cooling load estimations were determined by combining the TMY3 data, internal gains, thermal losses, and ventilation effects. Since our team is using a reversible heat pump system for heating and cooling, the peak cooling load determined the size of the equipment in this case. The whole house peak cooling and heating loads are 15.6 kBtu/hr and 8.8 kBtu/hr, respectively. At a per zone level, the largest peak cooling load corresponds to the living space area which requires close to 9,000 kBtu/hr. For the other two zones we will use 6,000 Btu/hr units as this is the smallest size we can find in the market for a tri-zone system. However, we will choose mini-splits with variable speeds in order to work at a lower load.

7. Hot Water Heater

Domestic hot water load was also calculated for purposes of estimating the Start.Home's total energy consumption. For terms of comparing different water heating technologies we assumed that a GE GeoSpring hybrid heat pump hot water heater would be used. The water heater has an efficiency factor of 2.4 When considering technologies available for heating water we considered tankless (instant) water heaters, solar thermal preheating, and heat pumps. Our decision focused on using the most economic option while not sacrificing performance with regards to our energy balance.

In comparing the three technologies we found the tankless (instant) water heater to have low upfront cost, however, the cost to install a larger photovoltaic array in order to offset the higher electricity consumption was much greater than the savings when compared to the hot water heat pump. The GE GeoSpring provides an economical way to achieve high a COP.

Another technology taken into consideration was solar thermal panels. Similarly to the tankless water heater, the solar thermal system was deemed to not be economical in producing domestic hot water as compared to a hot water heat pump. Solar thermal did make more sense at the point when we were considering the liquid desiccant enhanced evaporative cooling system, a variation of the Devap system developed by NREL. During the summer season, this cooling system would have used the excess hot water from solar to constantly regenerate the desiccant during the cooling hours of the day and provide heat during the heating hours of the night. Since we are using a tri-zone mini-split heat pump system instead of the liquid desiccant enhanced evaporative cooling system, ultimately an electric heat pump water heater made more economical sense than solar thermal panels.

8. HVAC system

8.1 Tri-zone mini-splits

The HVAC system has been designed to balance maximum energy efficiency, user comfort, and cost effectiveness. A Mitsubishi MXZ-3B24NA tri-zone mini-split condenser with 2 tons of capacity and a variable speed compressor drives three fan coil units (MSZ-GE series). The condenser contains a reversible heat pump that can effectively provide both cooling and heating to all areas of the house throughout the year, regardless of external weather conditions.

Each fan coil unit in the system is independently controlled by the user and conditions one of the three isolated thermal zones within the house. The thermal zones separate the living area/kitchen, the office, and the bedroom. Different usage patterns for each thermal zone throughout the day encourage the homeowner to operate the HVAC system efficiently without significant difficulty or sacrifice in comfort. Refrigerant is delivered directly to each fan coil, which eliminates the use of ducts for heating and cooling and improves thermal distribution efficiency. Automated louvers and thermal sensors in each fan coil help to distribute conditioned air efficiently throughout the entire space.

8.2 Heating Recovery Ventilator

Start.Home is designed for the Bay Area, and the mild climate in this region means that homeowners will be able to open their windows and comfortably ventilate their house most seasons of the year. However, studies have shown that modern, well-sealed homes cannot rely entirely on either operable windows or infiltration to provide a healthy level of fresh air intake. A heat recovery ventilator, which exchanges heat between air intake and exhaust streams, solves this problem by providing a constant level of fresh air intake without compromising the thermal envelope of the building. The system maximizes occupancy health with minimal impact on energy consumption.

In terms of the competition, we compared the implications of having the HRV and not having it (100% outdoor air). Due to the potentially small temperature differences between outdoor and indoor temperatures, we wanted to make sure that the electricity consumption of the HRV's fan wouldn't overcome the electricity savings derived from the HRV's thermal performance. Table 1 summarizes the comparison between 100% outdoor ventilation and an HRV balance system. Based on these results and our concerns regarding indoor air quality, we decided to use the HRV in Start.Home.

Table 1: HRV energy performance compared to 100% outdoor air ventilation

	HRV in a 4hr cycle	**100% OA ventilation**

During completion period (10 days)	0.36 kWh/day	0.56 kWh/day
Through Sept.-Oct. (61 days)	0.36 kWh/day	0.55 kWh/day

8.3 Automated operable windows and displacement ventilation

Start.Home takes advantage of the mild climate and large diurnal temperature swings experience year-round in the Bay Area to maximize natural ventilation. Large, operable windows around the house and automated north clerestory windows at a ceiling level were designed as the main source for thermal comfort and ventilation. In a hot day, the hot air inside the house will first rise towards the higher points of the living modules due to a stack effect. These higher points are located in the north walls of these modules. If the south windows are opened, then cooler air will be drawn into the house and the hot air concentrated at the higher points of the north walls will exit through the clerestory windows. This strategy provides efficient cooling for the majority of the summer months and reduces the cooling demand on the mini-split condenser unit. Additionally, this passive ventilation system will allow night flushing and an effective overnight recharge cycle for the PCM panels.

QUANTITY TAKEOFF OF COMPETITION PROTOTYPE

Construction Cost Summary			
System Description	**Quantity**	**Unit**	
A10: Foundations			
A1020: Special Foundations			
Ellis TJ-4	28	ea	
2'-6" x 2'-6" x 1/2" steel plates	28	ea	
5-1/4" x 9-1/4" PSL beam	472	lf	
Subtotal			
Total - Foundations			
B10: Superstructure			
B1010: Floor Construction			
Structural Insulated Panels, 7/16" OSB both faces, EPS insulation	1008	sf	
Subtotal			
B1020: Roof Construction			
Structural Insulated Panels, 7/16" OSB both faces, EPS insulation	1113	sf	
Welded Vierendeel truss	0.75	tons	
Exterior wall structural framing for SIP's	161	lf	
Trellis/awnings structure	887	sf	NOTE: Awnings are 2x douglas fir construction totalling 167sf, trellis structure is 2x and 4x redwood framing totalling 720sf
Subtotal			
Total - Superstructure			
B20: Exterior Closure			
B2010: Exterior Walls			
Structural Insulated Panels, 7/16" OSB both faces, EPS insulation	1405	sf	
Steel siding, galvanized	350	sf	
Wood board siding, recycled red wood	1050	sf	
Weather barrier	1800	sf	
Subtotal			
B2020: Exterior Windows			
Awning window with trim 36" x	9	sf	

36"			
Casement with trim 30" x 90"	40	sf	
Casement with trim 36" x 48"	36	sf	
Double Casement with trim 72" x 48"	48	sf	
Double Casement with trim 60" x 48"	20	sf	
Clerestory Awning window with trim 42" x 36"	84	sf	
Clerestory Awning window with trim 36" x 36"	45	sf	
Subtotal			
B2030: Exterior Doors			
Exterior siding/folding door/glazed opening, 14'-0" x 7'0", Andersen	98	sf	
Exterior wooden door, 2'-10" x 6'-8"	1	ea	
Exterior glass door, 3'-3" x 7', Andersen	1	ea	
Exterior plywood rolling door, 7'-0" x 7'0", at Mech. Room	1	pr	NOTE: Door will be constructed out of plywood, 2x framing, and sliding door hardware totalling $308.23 (see 08 13 73). Exterior surface to be covered with steel siding which has already been tabulated in B2010.
Subtotal			
Total - Foundations			
B30: Roofing			
B3010: Roof Coverings			
Standing seam sheet metal roofing, pitched roof	915	sf	NOTE: Sheffield metal product on pitched roof and on metal awnings
Sarnafil roof	360	sf	
Soffit and fascia	385	sf	NOTE: Total fascia SF is 172sf, all clad with Sheffield metal. Total soffit is 213sf of 1/2" redwood ply
Gutters	46	lf	
Subtotal			
B3020: Roof Openings			
Subtotal			
Total - Foundations			
C10: Interior Construction			
C1010: Partitions			
2-sided partition	571	sf	
Subtotal			NOTE: 1-sided partition line item eliminated
C1020: Interior Doors			
Flush wood door, 2'-10" x 6'-8"	2	ea	

			NOTE: Double bi-fold door line item eliminated
			NOTE: Bi-fold closet door, 6'-0" x 7'-0" line item eliminated
Bi-fold closet door, 6'-0" x 6'-8"	1	ea	
Subtotal			
C1030: Fittings			
Countertop	16	sf	NOTE: SF calculated minus cut-outs for sink and cooktop
Lower cabinet	12	lf	
Upper cabinet	14	lf	
Island cabinet; C4/A581	8.25	lf	
Island counter; C4/A581	16	sf	
Electrically operated Roller Shades; Southern windows facing kitchen wall	140	sf	NOTE: Electrically operated roller shades used only to cover 3'x7' windows and 14'x7' Bi-fold door on south wall
			NOTE: Living room shelving line item eliminated, shelving in that location to be freestanding furniture
Bathroom Specialties			
60" bath vanity	1	ea	
Glass countertop, 1'-9" x 5"	1	ea	
Assumed Accessories			
Frameless mirror	1	ea	
Robe Hook	1	ea	
24" Towel bar	1	ea	
Toilet tissue dispenser	1	ea	
Subtotal			
Total - Interior Construction			
			NOTE: Grab bar set line item eliminated
C30: Interior Finishes			
C3010: Wall Finishes			
Painted gypsum board	1600	sf	
Ceramic tile	150	sf	NOTE: Tile up to 42" in bathroom
Mechanical: 3/8" plywood	175	sf	NOTE: Mechanical wall finish is 3/8" plywood
Subtotal			
C3020: Floor Finishes			
Wood strip and plank flooring	772	sf	
Ceramic tile	67	sf	
Base	180	lf	
Linoleum floor for mech room	27	sf	NOTE: See 09 62 19
Subtotal			
C3030: Ceiling Finishes			
Painted gypsum board	862	sf	
Mechanical: 3/8" plywood	26	sf	NOTE: Mechanical ceiling finish is 3/8" plywood
Soffit at clerestory	90	sf	NOTE: Soffit finish is wood strip and plank flooring
Subtotal			
Total - Interior Finishes			

D20: Plumbing			
D2010: Plumbing Fixtures			
Dishwasher Connection	1	ea	
Kitchen Sink/Faucet	1	ea	
Icemaker Connection	1	ea	
Washer Connection	1	ea	
Lav/Faucet	2	ea	
Water Closet	1	ea	
Shower Faucet/Drain	1	ea	
Subtotal			
D2020: Domestic Water Distribution			
Portable Water Storage Tank 300 gallon	1	ea	
Domestic Water Distribution pump	1	ea	
Domestic Water Pipe	420	lf	
Electric Water Heater	1	ea	
Subtotal			
D2030: Sanitary Waste			
Septic Tank	1	ea	
			NOTE: Wastewater Pump line item eliminated
Wastewater Pipe	150	lf	
Subtotal			
D2040: Gray Water Distribution			
Subtotal			NOTE: Gray water pipe line item eliminated
Total - Interior Finishes			
D30: Mechanical			
D3040: Distribution Systems			
Energy Recovery Unit	1	ea	
ERV duct	35	lf	
Register/boot	4	ea	
Condensing unit	1	ea	
Evaporation/Fan unit	3	ea	
Refrigeration piping	85	lf	
Range hood; GE JVE40STSS	1	ea	
Range hood exhaust duct	13	lf	
Subtotal			
D3060: Controls & Instrumentation			
Temperature controls	1	ea	
Subtotal			
D3070: System Testing & Balancing			
Test & balance	1001	sf	

Subtotal			
Total - HVAC			
D40: Fire Protection			
D4010: Sprinkers			
1" Fire Prot pipe	90	lf	
Fire Sprinker head	11	ea	
Subtotal			
Total - Fire Protection			
D50: Electrical			
D5010: Electrical Service & Distribution			
200A Pnl	1	ea	
#2/0 3C Cable 600V	15	lf	
Subtotal			
D5020: Lighting & Branch Wiring			
Devices			
20A 125V Dup Rec -	17	ea	
220V Dup Rec -	2	ea	
20A 125V Dup Rec - Fci	8	ea	
20A 120-277V 3/W Sw -	4	ea	
20A 120-277V Sw -	8	ea	
20A 125V Dup Rec Sruf Wp	2	ea	
Branch			
#14/2C Nm-B	220	lf	
#12/2C Nm-B	600	lf	
#10/3C Nm-B	200	lf	
Lighing			
Fixture 1 uplight LED cove soffit	40	lf	
Fixture 2 LED strip	110	lf	NOTE: Exterior-rated LED strip tape
Fixture 3 EXT wall sconce LED	3	ea	
Fixture 4 undercabinet LED	4	ea	
Fixture 5 exhuast hood light	1	ea	
Fixture 6 pendent LED	4	ea	
Fixture 7 down light LED	8	ea	
Fixture 8 Sun tunnel light	2	ea	
Fixture 9 mirror light	1	ea	
Fixture 10 closet light LED	2	ea	
Fixture 11 Bedroom sconce LED	4	ea	
Fixture 12 Ceiling fan	2	ea	
Mech			
3Ph Motor - #8/3C + Grd	6	ea	

Misc Mech connections & wire	1	ls	
Subtotal			
D5030: Communications & Security			
Data/Com	1	ls	
Subtotal			
D5090: Other Electrical System			
Fire Alarm	1	ls	
Subtotal			
Total - Electrical			
E10: Equipment			
E1010: Commercial Equipment			
Garbage disposal; 3/4" horsepower, Insinkerator	1	ea	
Range Hood: GE JVE40STSS	1	ea	
Oven: GE JT5000SFSS	1	ea	
Electric Cooktop; GE PP945SMSS	1	ea	
Refrigerator and Freezer: GE GTZ18GCESS	1	ea	
Dishwasher: GE CDWT280VSS	1	ea	
Washer: GE GFWH1400DWW	1	ea	
Dryer: GE GFDS140EDWW	1	ea	
Subtotal			
Total - Equipment			
F10: Special Construction			
F1010: Special Structures			
2x8 deck framing	812	sf	
2x6 ramp framing	306	sf	
Deck footings, 1/2" plywood base; 4x4 posts	12	ea	
Decking; reclaimed douglas fir (redwood)	1315	sf	
			NOTE: Deck skirt line item eliminated
			NOTE: Bench line item eliminated
Planter	733	sf	
Pipe railing	118	lf	
PV array rack	675	sf	
Subtotal			
Total - Special Construction			
G20: Site Improvement			

G2050: Landscaping			
Fill for Planter Boxes, with Tanks below	27	cy	
Small	33	ea	
Medium	15	ea	
Large	1	ea	
Extra Large	19	ea	
Sod	100	sf	
Drip Irrigation System	1	ls	
Subtotal			
Total - Site Improvment			
G40: Site Electrical Utilities			
G4010: Electrical Distribution			
200A Service	10	lf	
Solar			
3/4" Emt	65	lf	
1/2" Emt 3#12	210	lf	
#10 Thhn Black	610	lf	
Pv system & inverter	16	ea	
600V Fus Dsn Nema 1	2	ea	
Subtotal			
G4020: Site Lighting			
Site Lighting (in above)	0	ea	
Subtotal			
Total - Site Electrical Utilities			

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DIVISION 01

SECTION 01 54 19
TEMPORARY CRANES
PART 1 GENERAL

1.01. SUMMARY

A. Structural Performance: Temporary cranes will withstand structural loads and lifts incurred in lifting, placing, and handling of all modular components.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. A. Acceptable Manufacturers
      (a) Link Belt

B. Materials
   1. Model: Link Belt HTC8690 90 Ton
   2. Capacity: 90 Tons
   3. Width with Outriggers: 24’ 0”
   4. Boom Type & Length: 5-Section 38 ft to 140 ft
   5. Maximum Tip Height: 235 ft
   6. Dimensions: H: 11 ft 6.50 in, W: 7 ft 9 in, L: 45 ft 7 in
   7. Maximum Winch Line Pull: 18,880 lbs
   8. Maximum Winch Line Speed: 480 fpm
   9. Travel/Working Weight: < 90,000 lbs

PART 3 EXECUTION

3.01. INSTALLERS

A. Bragg Craning and Rigging Co.

3.02. INSTALLATION

A. Prepare ground by cleaning, removing projections, clearing obstructions, and cordoning off safe working zone, and as otherwise recommended in temporary crane manufacturer's written instructions.

B. Ground crane securely in place, per operational specifications.

C. Allow only licensed operators to operate machinery, manage lifts, and issue signals and commands.

D. Ensure placement of components complies with foundational spacing and load requirements.
E. Coordinate operations with structural requirements per specifications of structural engineer and crane operator.
F. Correct deficiencies in or remove and reinstall temporary cranes that do not comply with requirements.

3.03. ATTACHMENTS

A. Crane load chart and cut sheet.

END OF SECTION

DIVISION 05

SECTION 05 05 23
METAL FASTENINGS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Metal Fastenings
B. Related Sections: Section(s) related to this section include:
   1. Section 05 45 13 Mechanical Metal Supports
   2. Section 05 45 16 Electrical Metal Supports
C. System Description
   1. Metal Fastenings are metal connectors used for joining different structural elements. These metal fastenings are designed to resist shear and tension loads in engineered connections of combinations of cold-formed or hot-rolled steel with thicknesses ranging from 33 mils to ½ inch.

1.02. REFERENCES

A. 2009 International Building Code® (2009 IBC)
B. 2009 International Residential Code® (IRC)
C. 2006 International Building Code® (2006 IBC)
D. AISI-S100 Standard
E. ICC-ES Evaluation Report ESR-3006

1.03. QUALITY ASSURANCE

A. Metal fasteners must be approved for use on the materials being fastened.
B. Material must comply with 2009 International Building Code
C. Material must comply with 2009 International Residential Code
D. Material must comply with AISI-S100 Standard

1.04. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to Stanford build site for prefabrication.
B. Transportation to Competition: Ship installed unless otherwise noted.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers

1. Simpson Strong-Tie Company Inc. 5956 West Las Positas Boulevard Pleasanton, CA 94588

B. Materials
   1. Metal Fastening Screws: The screws must be case hardened after manufactured from carbon steel conforming to ASTM A510, Grade 1022, and must be coated with zinc coating.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that metal fasteners delivered comply with the requirements of the product to be installed.

3.02. INSTALLATION

A. Installation of the metal fasteners must be in accordance with AISI- S100, the manufacturer's published installation instructions and the ICC-ES Evaluation Report ESR-3006. The manufacturer's published installation instructions must be available at the jobsite at all times during installation.
B. The screw must be installed perpendicular to the work surface using a screw gun or drill with a maximum speed of 2,500 rpm using a $^{5}/_{16}$-inch hex driver. The screw must penetrate through the supporting steel with a minimum of three threads protruding past the backside of the supporting steel.

3.03. RELOCATION CONSIDERATIONS

A. After shipping to competition site, verify that fasteners are in adequate conditions and that none has been damaged.
B. If fasteners seem under additional or unexpected stress, proceed for a replacement.

3.04. SITE QUALITY CONTROL

A. Metal fasteners must comply with instructions specified on the installation section above.

3.05. COMMISSIONING

A. Final inspection of installed product.

END OF SECTION

SECTION 05 12 13
ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING
PART 1 GENERAL

1.01. SUMMARY

A. This section includes architecturally-exposed structural steel.

B. Related Sections:

1. Section 05 05 23: "Metal Fastenings" for steel lintels and shelf angles not attached to structural-steel frame and miscellaneous steel fabrications not defined as structural steel.
2. Section 08 44 13: “Aluminum Windows.”

1.02. REFERENCES

A. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

B. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A924 - Standard Specification General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.

D. ANSI/BHMA A156.15 - Hardware Preparation in Steel Doors and Frames.

E. AISC 303.

F. AISC 341 and AISC 341sl.

G. AISC 360.

H. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.03. QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS DI.1/DI.IM, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Preinstallation Conference: Conduct conference at Project site.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.05. WARRANTY

A. Manufacturer shall provide a warranty against manufacturing defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Custom fabrication by Albany Steel, 536 Cleveland Ave., Albany, CA 94710. Phone: (510) 525-8778.

B. Materials
   1. Channels, Angles: ASTM A 36/A 36M.
      a. Channel: C4 x 7.2.

C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
      a. Hollow Square Section: HSS 3 x 3 x ¼.

D. Welding Electrodes: Comply with AWS requirements.
   1. Weld: E70XX.

2.02. ACCESSORIES

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavyhex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbonsteel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.
D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   1. Configuration: Straight.
   2. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
   3. Plate Washers: ASTM A 36/A 36M carbon steel.
   4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   5. Finish: Plain.
E. Threaded Rods: ASTM A 36/A 36M.
   1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   3. Finish: Plain.
F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

2.03. SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS DI.1/DI.IM and the following inspection procedures, at testing agency's option:
   1. Ultrasonic Inspection: ASTM E 164.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be permitted.

PART 3 EXECUTION

3.01. INSTALLERS

A. Qualified rigging and setting crew required for placing frame. Crane shall be operated only by a certified operator.

3.02. EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03. INSTALLATION

A. Erection:
   1. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
   2. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
      a. Set plates for structural members on wedges, shims, or setting nuts as required.
      b. Weld plate washers to top of baseplate.
      c. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
      d. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
   3. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   4. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
      a. Level and plumb individual members of structure.
      b. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
   5. Splice members only where indicated.
   6. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1 M].
   7. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
B. Field Connections:
   1. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

a. Joint Type: Snug tightened.

2. Weld Connections: Comply with AWS DI.1/DI.IM for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   a. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   b. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
   2. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPCPA 1 for touching up shop-painted surfaces.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   3. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

3.05. SITE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1 M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1 M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.
D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1 M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1 M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents

END OF SECTION

SECTION 05 45 13
METAL MECHANICAL SUPPORTS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Metal hangers for HVAC ducting
   2. Metal hangers for Piping.

B. Related Sections:
   1. Section 22 11 16: Domestic Water Piping.
   2. Section 22 13 16: Sanitary Waste and Vent Piping.
   3. Section 23 23 00: Refrigerant Piping.
   4. Section 23 31 00: HVAC Ducts and Casings.

1.02. REFERENCES

A. MSS-SP-58
B. MSS-SP-69
C. ANSI/ASME B31.1
D. UL203
E. FM1551
F. MFMA-2

1.03. QUALITY ASSURANCE

A. Hangers, supports, anchors, and restraints must be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. Piping supports and equipment must be considered as a total system and appropriate balance calculations made to determine load forces at critical stress points. Loading conditions to be considered may include but are not limited to:
   1. The total load of pipe, fittings, valves, insulation, and any expected contents of the pipe
   2. Thermal expansion and contraction
   3. Stress from cycling of equipment or process
   4. Vibration transmitted to or from equipment or terminal connection.
   5. Wind, snow, or ice loading on outdoor piping.
   6. Loading due to seismic forces if required by code or specification.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Items shall be stacked neatly until used.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. AGC Incorporated, 754B Camden Ave., Campbell, CA 95008. Phone: (408) 369-6305

B. Materials:
   1. Duct strap, metal mechanical and piping support including:
      a. Hangers for refrigerant lines
      b. Refrigerant line straps
      c. Hot water heater seismic strap
      d. Duct strap
   2. Appropriate materials and protective coatings shall be used to prevent failure from environmental and galvanic corrosion.
   3. Material that comes in contact with pipe shall be compatible with piping material so that neither has a deteriorating effect on the other.

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed as approved by the Project Manager and Structural Engineer.

PART 3 EXECUTION

3.01. INSTALLERS

A. Qualified installers shall be used to erect the hangers. Qualification will be determined by demonstration of prior competence at the discretion of the Project Manager and Construction Manager.
   1. AGC Incorporated shall also serve as the installer.

3.02. INSTALLATION

A. The maximum allowable spacing for pipe hangers shall be based on structural loading limitations and the weight to be supported and the maximum recommended loads for the hangers.

3.03. RELOCATION CONSIDERATIONS

A. Hangers shall remain in place during relocation and transportation.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Fabricated metal temporary foundation screw jack supports.

1.02. REFERENCES
- A. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- B. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. AISC 303.
- D. AISC 341 and AISC 341sl.
- E. AISC 360.
- F. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.03. SUBMITTALS
- A. Sample of product shall be delivered to the Structural Engineer for testing and examination prior to the start of Work.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be kept on-site free from damage by other construction activities and protected from direct sunlight and rain until installation.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Ellis Manufacturing Co., Inc. 4803 N. Cooper Ave., Oklahoma City, OK 73118. Phone: (405) 528-4671. Fax: (405) 528-1796. Email: email@ellisok.com.
- B. Materials:
  1. Timber Jack 4x4 (TJ-4)
     a. Load Capacity: 15,000 lbs./7.5 tons.
     b. Overall Height: 9-1/8”.
     c. Base Plate: 5”.
     d. Top Plate: 5-1/2”.
     e. Acme Screw Size: 1-1/4”.
     f. Range of Adjustment: 5”.

g. Lifting Capacity: 4000 lbs./2 tons.

2.02. ACCESSORIES

A. Bolts:
   1. A325 Slip Critical Bolts.
B. Angle Bracket:
   1. L2 x 2 x ¼" A36 Steel.
C. Base Plate:
   1. ½" 30" x 30" A36 Steel.

2.03. SOURCE QUALITY CONTROL

A. Products shall be in good working order and free from defects when delivered to site.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed without the written consent of the Structural Engineer and stamped drawings of the replacement product.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by a trained, qualified installer competent in working around rigging and in confined spaces.

3.02. EXAMINATION

A. Surface shall be leveled to maximum extent possible prior to installation of product.
B. Surface shall be clean and free of debris to the extent possible.

3.03. INSTALLATION

A. Drill 1-3/8" x 6" (for TJ-4) hole using auger or self feed drill bit into center of lumber to accept 1-1/4" or 1-1/2" Acme threaded screw.
B. Position Timber Jack so the Acme screw will slide into the predrilled hole in lumber.
C. Adjust the top plate so all 4 mounting holes line up within the boundaries of the lumber.
D. Drill 4 - 5/32"x1" holes through the mounting holes in the top plate and into the lumber.
E. Insert 4 - 1/4"x1-1/2" lag screws through the mounting holes in the top plate into the predrilled holes in the lumber and tighten.
F. Attach Ellis Purlin Splicer to Beam or Joist where support is desired.
G. Slip 4x4 or 6x6 lumber attached to the Timber Jack into the square tubing of the purlin splicer and secure with nails through the holes provided.
H. Adjustment to Timber Jack can be made by turning "U" shaped handle at bottom of screw. Acme threads are greased for easy adjustment.

I. Attach base plate to a solid foundation through the 4 holes provided

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Product shall not be repaired if damaged in transportation.
B. Replacement:
   1. Replace product only with identical product.

3.05. SITE QUALITY CONTROL

A. Maintain a level surface for installed plane on top of product after installation.

3.06. ATTACHMENTS

A. Product Cut Sheet.

END OF SECTION

SECTION 05 73 16
WIRE ROPE DECORATIVE METAL RAILINGS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes
  1. Stainless steel cable and fittings for railing infill.

1.02. REFERENCES
- A. ASTM A 492 - Specification for Stainless Steel Rope Wire.

1.03. SUBMITTALS
- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation and maintenance methods.

1.04. CLOSEOUT SUBMITTALS
- A. Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment of cable tension and periodic cleaning and maintenance of all railing and infill components.

1.05. QUALITY ASSURANCE
- A. Manufacturer Qualifications: Minimum five years' experience in producing cable assemblies of the type specified.

1.06. DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to site and store in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store products in clean, dry area indoors until ready for installation. Store materials in accordance with manufacturer's instructions.
- C. Protect materials and finish from damage during handling and installation.

1.07. WARRANTY
- A. Stainless steel cables and connectors; 10 year limited warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Acceptable Manufacturer: Feeney Inc. (CableRail™), which is located at: 2603 Union St. ; Oakland, CA 94607; Toll Free Tel: 800-888-2418; Tel: 510-893-9473; Fax: 510-893-9484; Email: request info (sales@feeneyinc.com); Web: www.feeneyinc.com.

B. Materials
   1. Cables: ASTM A 492, Type 316 stainless steel as specified below, polished finish, commercial, dry grade.
      a. 1/8 inch (3.2 mm) diameter by length as required, 1x19 construction.
   2. Components:
      a. Washers and nuts: 2 flat washers and 1 washer-nut of a type and size recommended by the manufacturer for installation conditions.
      b. Finishing End Caps: 2 decorative end caps of a style selected by the Architect.
      c. Quick-Connect fitting: 1 stainless steel automatic-locking end fitting.
   3. Fittings:
      a. Swage Style: ASTM A 492, Type 316 stainless steel, vibratory/tumbled finish.
      b. Quick-Connect: Type 316 stainless steel body, mill finish.

2.02. ACCESSORIES

A. Stainless steel protector sleeves, rubber grommets, beveled washers and additional accessories as recommended by manufacturer for installation conditions.

B. Reclaimed Redwood 2x4
   1. Reclaimed redwood 2x4, sanded and rounded for hand rail, toe kick

2.03. SOURCE QUALITY CONTROL

A. Fabricate systems in accord with approved shop drawings and the manufacturer's instructions.

B. Pre-assemble items in shop to greatest extent practicable to minimize assembly at project site. Disassemble units only to extent necessary for shipping and handling limitations. Mark units for reassembly.

C. Swage hardware onto ends of cables in manufacturer's shop to the maximum extent practical. Field connections may be done using manufacturer's recommended methods.

D. Use grommets, bushings and washers as necessary for separation of dissimilar metals.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only a qualified installer shall install the product.

3.02. EXAMINATION

A. Do not begin installation until work to which cables will be anchored or will penetrate has been properly prepared.
B. Verify that post size, post spacing and cable spacing are in accordance with approved shop drawings.
C. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03. INSTALLATION

A. Install cable system in accordance with manufacturer's instructions.
B. Provide anchorage devices and fittings to secure cables to in-place construction; including threaded fittings for concrete inserts, toggle bolts and through-bolts.
C. Separate dissimilar materials with bushings, gaskets, grommets, washers or coatings where required to prevent electrolytic corrosion.
D. Use manufacturer's supplied cable and hardware.
E. Terminate and tension cables in accordance with manufacturer's instructions.
F. Ensure cables are clean, parallel to each other, and without kinks.
G. After final cable tension adjustment, apply tamper resistant locktight materials on all cable fittings. Verify that materials are a non-permanent-locking type that permits the fittings to be re-adjusted without destroying the fittings.

3.04. RELOCATION CONSIDERATIONS

A. Repair
    1. No repairs shall be allowed.
B. Replacement
    1. Damaged products shall be replaced after transportation.

3.05. SITE QUALITY CONTROL

A. Protect installed products until completion of project.
B. Repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 06

SECTION 06 05 23
WOOD, PLASTIC, AND COMPOSITE FASTENINGS
PART 1 GENERAL

1.01. SUMMARY

A. Pre-engineered metal or plastic connectors used to support a wood, plated truss, or composite wood, from a wood or composite wood supporting members.

B. Related Sections:

1. Section 06 10 00: Rough Carpentry.
2. Section 06 11 00: Wood Framing.
3. Section 06 15 00: Wood Decking.
4. Section 06 17 13: Laminated Veneer Lumber.

1.02. REFERENCES

A. ASTM A36 – Carbon Structural Steel

B. ASTM A307 – Carbon Steel Bolts and Studs

C. ASTM A449 – Hex Cap Screws, Bolts and Studs, Steel, Heat Treated

D. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

E. ASTM D7147 – Standard Specification for Testing and Establishing Allowable Loads of Joist Hangers.

F. ASTM D2395 – Standard Test Methods for Specific Gravity of Wood and Wood-Based Materials

G. ASTM F1554 – Anchor Bolts, Steel

H. ASTM F1575 – Standard Test Method for Determining Bending Yield Moment of Nails

I. ASTM F1667 – Driven Fasteners: Nails, Spikes, and Staples

J. ICC-ES AC13 – Acceptance Criteria for Joist Hangers and Similar Devices

K. ICC-ES AC116 – Acceptance Criteria for Nails and Spikes

L. ICC-ES AC118 – Acceptance Criteria for Tapping Screw Fasteners

M. ICC-ES AC120 – Acceptance Criteria for Wood Screws Used in Horizontal Diaphragms and Vertical Shear Walls

N. ICC-ES AC155 – Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members

O. ICC-ES AC261 – Acceptance Criteria for Connectors Used with Cold-Formed Steel Structural Members

P. ICC-ES AC399 Acceptance Criteria for Cast-In-Place Proprietary Bolts in Concrete for Light-Framed Construction

Q. AISI 2001 – Cold-Formed Steel Specification

1.03. QUALITY ASSURANCE

A. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Unpack and inspect connectors. Report damage immediately.
B. Store in clean, dry location with uniform temperature to prevent condensation and protect from exposure to dirt, fumes, water, corrosive substances and physical damage.

1.05. WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Simpson Strong-Tie Co., Inc.
   2. Bulk Material Manufacturer to be Specified by Local Availability.
B. Materials:
   1. Steel:
      a. Sheet: ASTM A36, ASTM A653, ASTMA1011.
      b. Fasteners: ASTM A307, ASTM F1554, ASTM F1667, SAE C1022 (SDS Screws).
   2. Stainless Steel:
      a. Sheet: ASTM A 240, ATTM A480.
      b. Fasteners: ASTM A493.
   3. Sheathing nails: 16d and 8d common nails.
   4. Frame screws: 4"
C. Products:
   1. Holddowns:
      a. HTT4.
   2. Hangers:
      a. HGUS5.50/10 (12 Ga) Face Mount Hanger.
      b. HUCQ610-SDS.
      c. HU26 Face Mount Hanger.
      d. HU28 Face Mount Hanger.
      e. HU46 Face Mount Hanger.
      f. HU48 Face Mount Hanger.

g. HUC48 Hidden Face Mount Hanger.
h. LSSU410 Slopeable/Skewable U Hanger.

3. Column Caps and Bases:
   a. CCQ-SDS2.5.
   b. ECCQ-SDS2.5.
   c. ECCLQ-SDS2.5.
   d. ECCRQ-SDS2.5.
   e. CCTQ-SDS2.5.
4. Miscellaneous:
   a. A34 Clip.
   b. LTP4 Plate.
   c. DTT2Z Deck Post Connector.
   d. LSTA9 Strap.
   e. ST6224 Strap.
   f. HGA10 Hurricane Gusset.

2.02. ACCESSORIES

A. Finishes: Gray paint.
B. Hot-dipped galvanized or electro-plated galvanized: G90, G185 (ZMAX or HDG).
C. Powder-coated paint.
D. Electro-galvanized, zinc dichromate and double barrier for SD and SDS screws.

2.03. SOURCE QUALITY CONTROL

A. Fabrication:
   1. Shop assembly to occur per the manufacturer's approved production drawings.
   2. Fabrication tolerances per manufacturer.
   3. Fabrication requiring welding shall be performed in accordance with the current American Welding Society's standards.
   4. The manufacturer's identification shall be stamped into the metal or wood part and a label may be attached to the part with adhesive.
B. Testing:
   1. Allowable loads published in manufacturer's catalog to be determined using the minimum load from static and/or cyclic analysis and one or more of the following test methods:
      a. Static load tests in wood assemblies
      b. Static load tests in steel jigs
      c. Static load tests of products embedded in concrete or masonry
   2. Testing to determine allowable loads shall be performed as per the applicable ICC-ES Acceptance Criteria or ASTM standard.

3. Allowable loads for hangers are determined by a static load test resulting in not more than a 1/8" deflection of the joist relative to the header, or either the lowest of 3 or average of 6 ultimate load divided by 3, or the fastener allowable load as determined by the NDS, whichever is lowest.
4. Manufacturer to provide code testing data on all products that have been code tested upon request.

2.04. PRODUCT SUBSTITUTIONS

A. Bulk fasteners may be substituted based on local availability.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in rough carpentry, deck installation, and framing. Competency shall be verified through mock-up construction by the site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Unless otherwise noted in the manufacturer's catalog, allowable loads are for Douglas Fir-Larch under continuously dry conditions. Allowable loads for other species or conditions must be adjusted according to the code. See manufacturer's catalog for additional notes and requirements.
B. Built up lumber (multiple members) must be fastened together to act as one unit to resist the applied load as specified by the structural engineer.
C. Verify that the dimensions of the supporting member are sufficient to receive the specified fasteners.

3.03. INSTALLATION

A. Unless otherwise noted in the manufacturer's catalog, bolts, screws and/or nails shall not be combined.
B. All nails shall be common unless otherwise noted in the manufacturer's catalog or substituted by the engineer of record with a reduction taken.
C. Unless otherwise noted in the manufacturer's catalog, bending steel in the field may cause fractures at the bend line. Fractured steel will not carry the allowable load and must be replaced. When bending is allowed or required in the catalog, the connector shall be allowed one cycle bend, one time only.
D. Galvanized connectors should not be placed in contact with treated wood unless the treated wood is adequately verified to be suitable for such contact. Some wood treatments may accelerate metal deterioration. See the manufacturer's catalog for specific recommendations.

E. A fastener that splits the wood will not carry the allowable load. Evaluate splits to determine if the connection will perform as required. Dry wood will split more easily and should be evaluated as needed. If wood tends to split, consider pre-boring holes with a diameter not exceeding 0.75 of the nail diameter, for screws in wood with a specific gravity of 0.5 or greater use: 5/32" for SDS, 5/64" for SD9 or SD10, and 1/16" for SD8 (2005 NDS 11.1.4 and 11.1.5.3).
F. Wood shrinkage will be taken into consideration when designing and installing connections.
G. Top flange hangers may cause unevenness. Possible remedies should be evaluated by a professional and include using a face mount hanger, routering the beam, or cutting the subfloor to accommodate the top flange thickness.
H. Do not overload by exceeding the manufacturer's catalog allowable load values.
I. Unless otherwise noted in the manufacturer's catalog, fill all fastener holes with fastener types as specified in the manufacturer's catalog.
J. All specified fasteners must be installed according to the instructions in the manufacturer's catalog.
K. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter (2005 NDS 11.1.2.2).
L. Install all specified fasteners before loading the connection.
M. Use proper safety equipment.
N. Nail tools with hole-location mechanisms may be used to install connectors, provided the correct quantity and type of nails are properly installed in the nail holes.
O. The joist shall bear completely on the connector seat the gap between the joist end and the header or back plate of the hanger shall not exceed 1/8".
P. Anchor bolt nuts should be finger-tight plus 1/3 to ½ turn with a wrench. Do not use an impact wrench to tighten nuts on the anchor bolts.
Q. Modifications to products or changes in installation procedures should only be made by a qualified designer. The performance of such modified products or altered installation procedure is the sole responsibility of the designer

3.04. RELOCATION CONSIDERATIONS

A. Hangers and fasteners connecting module joints or products covering or impacting module connections shall be fastened with screws or bolts to ensure easy removal and replacement during relocation.
B. Screws and bolts shall be reused only if the heads and threads are intact after removal.
C. When possible, bolts shall be used to fasten items at module connections with hex nut washers to secure connections for ease and safety of disassembly.
D. Repair:
    1. Repair of fasteners and hangers shall not be allowed.

E. Replacement:
   1. Before substituting another brand, confirm load capacity based on published testing data and calculations. The engineer/designer of record shall evaluate and give written approval for substitution prior to installation.
   2. Replacement of screws and bulk materials shall be determined by dimensions and local availability.

3.05. SITE QUALITY CONTROL

A. Determine that the proper part is being used in the correct application and has been fabricated by the approved manufacturer by observation of the stamp into the metal part and/or the adhesive label on the product denoting part and manufacturer name.

3.06. ATTACHMENTS

A. Manufacturer Code Compliance Evaluation Sheets.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Framing with timber.
   3. Framing with engineered wood products.
   4. Wood blocking and nailers.
   5. Plywood backing panels.
   6. Wood sheathing.

B. Related Sections:
   1. Section 06 05 23: Wood, Plastic, and Composite Fastenings.
   2. Section 06 11 00: Wood Framing.
   3. Section 06 15 00: Wood Decking.
   4. Section 06 20 00: Finish Carpentry.

1.02. REFERENCES

A. American Forest and Paper Association (AFPA):
   1. National Design Specification for Wood Construction NDS-05, Conventional Wood Frame Construction.

B. American Society of Mechanical Engineers (ASME):
   1. B18.2.1-96(R2005), Square and Hex Bolts and Screws.
   2. B18.2.2-87, Square and Hex Nuts.
   3. B18.6.1-97, Wood Screws.

C. American Society for Testing and Materials (ASTM):
   1. A653/A653M-10, Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
   2. C954-10, Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness.
   3. C1002-07, Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to wood Studs or Metal Studs.
   4. D1760-01, Pressure Treatment of Timber Products.
   5. F855-07, Washers, Steel, Plan (Flat) Unhardened for General Use.
   6. F1667-08, Nails, Spikes, and Staples.

D. Forest Stewardship Council (FSC)
   1. FSC STD-01-001, FSC Principles and Criteria for Forest Stewardship.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Prevent contact with damp or wet surfaces.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Wood Products, General
   1. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with above FSC standard, where available. SFI standard is allowable as a substitute.
      a. Wood-preservative-treated lumber.
      b. Dimension lumber framing.
      c. Timber.
      d. Laminated-veneer lumber.
      e. Wood sheathing.
      f. Miscellaneous lumber.
   2. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
      a. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
      b. Provide dressed lumber, S4S unless otherwise indicated.

B. Wood-Preservative-Treated Lumber:
   1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, use Category UC3b for exterior construction not in contact with the ground, and use Category UC4a for items in contact with the ground.
   2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
   3. Application: Treat items indicated on Drawings, and the following:
      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

b. Wood framing members that are less than 6 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

C. Engineered Wood Products
1. Engineered Wood Products, General: Products shall contain no urea formaldehyde.
a. Parallel Strand Lumber:
(a) Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

D. Dimension Lumber Framing:
1. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3 grade.
a. Species:
(a) Hem-fir (north); NLGA.
(b) Spruce-pine-fir; NLGA.
(c) Hem-fir; WCLIB or WWPA.
(d) Western woods; WCLIB or WWPA.
b. Load-Bearing Partitions: No.2 or better unless otherwise specified.
(a) Species:
(i) Hem-fir (north); NLGA.
(ii) Douglas fir-larch; WCLIB or WWPA.
(iii)Spruce-pine-fir; NLGA.
(iv)Hem-fir; WCLIB or WWPA.
(v) Douglas fir-larch (north); NLGA.

E. Timber Framing:
1. Provide timber framing complying with the following requirements, according to grading rules of grading agency indicated:
a. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; No. 1 grade; NLGA, WCLIB, or WWPA.
2. Miscellaneous Lumber:
a. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
(a) Blocking.
(b) Nailers.
(c) Cants.
(d) Furring.
b. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber of any species.

c. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
d. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

F. Plywood Backing Panels:
1. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than ¾-inch (19-mm) nominal thickness.
a. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.02. ACCESSORIES

A. Fasteners:
1. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
a. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Nails, Brads, and Staples: ASTM F 1667.
3. Power-Driven Fasteners: NES NER-272.
4. Wood Screws: ASME B18.6.1.
5. Lag Bolts: ASME B18.2.1 (ASMME B12.2.3.8M).
6. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.03. SOURCE QUALITY CONTROL

A. Certified Lumber:
1. Provide certification and factory mark each piece of lumber with stamp of certifying agency.

B. Lumber:
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Maximum Moisture Content of Lumber: 15 percent.

C. Wood-Preservative-Treated Lumber:
1. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Timber Framing:
   1. Maximum Moisture Content: 20 percent.

2.04. RELATED PRODUCTS
A. See section 06 11 00: Framing for works related to interior wood partition framing.
B. See section 06 12 00: Structural Insulated Panels for works related to blocking and sheathing.
C. See section 06 15 00: Wood Decking for works related to framing for decking and application of finish boards.
D. See section 07 46 23: Reclaimed Wood Siding for works related to application of siding to home.

2.05. PRODUCT SUBSTITUTIONS
A. Lumber products may be substituted based on local availability subject to verification of dimensions and grade.
B. Where unavailable, lumber compliant with FSC STD-01-001 may be replaced with lumber of identical dimensions and grade.

PART 3 EXECUTION

3.01. INSTALLERS
A. Installers shall be trained in rough carpentry prior to start of project. Training shall include tool safety and mock-ups. Demonstration of competency shall be verified by site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION
A. Lumber shall be visually inspected prior to installation to ensure that no warping or weather damage has occurred prior to installation.
B. Substrates shall be examined to determine if conditions are sufficient for installation. See specifications noted above in References and Related Products for specific substrate preparation requirements.
C. For exposed framing, provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

3.03. INSTALLATION
A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated. See additional instructions and specifications in Section 06 11 00: Wood Framing.
C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions. See additional instructions and specifications in Section 06 17 13: Laminated Veneer Lumber.
D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
    1. Should additional backing panels be required on SIPS paneling, fasteners in accordance with specifications from SIPS manufacturer shall be used. Locations shall be in accordance with manufacturer approved locations.
E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions.
F. Do not splice structural members between supports unless otherwise indicated and approved by structural engineer.
G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
H. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, with adjacent rows staggered, and use finishing nails unless otherwise indicated by the drawings.

3.04. RELOCATION CONSIDERATIONS

A. Locations requiring disassembly and reassembly shall be fastened using steel wood screws. During reassembly, locations of screws shall be reused if they are not stripped and their reuse would adversely impact continuity of the home. Exposed work shall attempt to reuse holes.
B. Repair:
    1. Repair of unexposed components shall be allowed subject to site superintendent's approval, provided that it does not adversely impact structural performance of the building.
    2. Repair of exposed carpentry shall be allowed if it maintains the desired appearance of the component.
C. Replacement:
    1. Replacement of components shall be allowed with specified materials or comparable products locally available.

3.05. SITE QUALITY CONTROL

A. Carpentry shall be checked for plumb, level, and square connections prior to covering or continuation of work dependent on said carpentry.
B. Connections and fasteners shall be inspected visually by site superintendent.

END OF SECTION

SECTION 06 11 00
WOOD FRAMING
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Framing with dimension lumber.
  2. Framing with timber.
- B. Related Sections:
  1. Section 06 10 00: Rough Carpentry.
  2. Section 06 20 00: Finish Carpentry.
  3. Section 09 29 00: Gypsum Board.

1.02. REFERENCES
- A. American Wood Council (AWC):
  1. 2012 Wood Frame Construction Manual (WFCM).
- B. American Forest and Paper Association (AFPA):
  1. National Design Specification for Wood Construction NDS-05, Conventional Wood Frame Construction.
- C. American Society of Mechanical Engineers (ASME):
  1. B18.6.1-97, Wood Screws.
- D. Forest Stewardship Council (FSC)
  1. FSC STD-01-001, FSC Principles and Criteria for Forest Stewardship.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Prevent contact with damp or wet surfaces.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Wood Products, General
  1. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with above FSC standard, where available.
     a. Wood-preservative-treated lumber.
     b. Dimension lumber framing.
     c. Timber.

2. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
    a. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
    b. Provide dressed lumber, S4S unless otherwise indicated.

B. Wood-Preservative-Treated Lumber:
1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, use Category UC3b for exterior construction not in contact with the ground, and use Category UC4a for items in contact with the ground.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
3. Application: Treat items indicated on Drawings, and the following:
    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 6 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

C. Dimension Lumber Framing:
1. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3 grade.
    a. Species:
        (a) Hem-fir (north); NLGA.
        (b) Spruce-pine-fir; NLGA.
        (c) Hem-fir; WCLIB or WWPA.
        (d) Western woods; WCLIB or WWPA.
    b. Load-Bearing Partitions: No.2.
        (a) Species:
            (i) Hem-fir (north); NLGA.
            (ii) Douglas fir-larch; WCLIB or WWPA.
            (iii) Spruce-pine-fir; NLGA.
            (iv) Hem-fir; WCLIB or WWPA.
            (v) Douglas fir-larch (north); NLGA.

D. Timber Framing:
   1. Provide timber framing complying with the following requirements, according to grading rules of grading agency indicated:
      a. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; No. 1 grade; NLGA, WCLIB, or WWPA.
   2. Miscellaneous Lumber:
      a. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
         (a) Blocking.
         (b) Nailers.
         (c) Cants.
         (d) Furring.
      b. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber of any species.
      c. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
      d. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.02. ACCESSORIES

A. Fasteners:
   1. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   2. Nails, Brads, and Staples: ASTM F 1667.
   3. Power-Driven Fasteners: NES NER-272.
   4. Wood Screws: ASME B18.6.1.
   5. Lag Bolts: ASME B18.2.1 (ASMME B12.2.3.8M).

2.03. SOURCE QUALITY CONTROL

A. Certified Lumber:
   1. Provide certification and factory mark each piece of lumber with stamp of certifying agency.
B. Lumber:
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Maximum Moisture Content of Lumber: 15 percent.
C. Wood-Preservative-Treated Lumber:
   1. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Timber Framing:
   1. Maximum Moisture Content: 20 percent.

2.04. PRODUCT SUBSTITUTIONS

A. Lumber products may be substituted based on local availability subject to verification of dimensions and grade.
B. Where unavailable, lumber compliant with FSC STD-01-001 may be replaced with lumber of identical dimensions and grade.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in framing prior to the start of the project. Training shall include tool safety and mock-ups. Demonstration of competency shall be verified by site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Lumber shall be visually inspected prior to installation to ensure that no warping or weather damage has occurred prior to installation.
B. Floor and ceiling panels or SIPS shall be inspected prior to framing activities and wiped clean before laying headers and base.
C. Exterior walls and related activities shall be completed and inspected prior to commencement of framing activities. Walls shall be plumbed prior to installation of partitions.

3.03. INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other constructions.
B. Securely attach headers, side columns, and footer to substrates, complying with specifications from fastener manufacturer and the aforementioned framing guides.
C. Secure interior studs sequentially according to spacing and locations provided in plan using wood screws.
   1. Countersink fastener heads.
D. Plumb studs and braces and check corners for square.

3.04. RELOCATION CONSIDERATIONS

A. Interior walls shall not be removed during relocation.

3.05. SITE QUALITY CONTROL

A. Superintendent shall verify plumb and square of studs and braces prior to enclosure of framed walls.

END OF SECTION

SECTION 06 12 00
STRUCTURAL INSULATED PANELS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Structural Insulated Panels (SIPS).

B. Related Sections: Section(s) related to this section include:

1. Section 06 10 00 Rough Carpentry.
2. Section 06 09 00 Wood and Plastics Fastenings.

C. System Description

1. Structural Insulated Panels (SIPs) consist of oriented strand board (OSB) laminated with structural adhesives to a termite resistant EPS insulation core, a EPA registered treatment for mold, mildew, and termites, and SIP Manufacturer supplied connecting splines, sealants, and SIP screws.

1.02. REFERENCES

A. ACSE 7 - Minimum Loads for Buildings and other Structures

B. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

C. DOC PS2 – Performance Standard for Wood-based Structural-Use Panels.

D. ICC ES AC04 – Acceptance Criteria for Sandwich Panels.

E. ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives.

F. ICC ES AC12 – Acceptance Criteria for Foam Plastic Insulation.

G. ICC ES AC239 – Acceptance Criteria for Termite-Resistant Foam Plastics.

H. AWPA E1 - Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites.

I. AWPA E12- Standard Method of Determining Corrosion of Metal in Contact with Treated Wood.

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

K. EPA - Registered products listing

1.03. SUBMITTALS

A. Product Data: Submit product data for specified products.

1. SIP Code Compliance: Provide ICC ES code report for SIP with evidence of compliance with code requirements as an alternate method of construction. Submit current compliance report number from ICC ES showing conformance to the International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC04 (Sandwich Panels) dated May 2006.

2. EPS Code Compliance: Provide ICC ES code report for EPS foam with evidence of compliance with code. Submit current compliance report numbers from ICC ES with conformance to the International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC12 (Foam Plastic) dated June 2006 and ICC ES AC239 (Termite-Resistance) dated June 2008.
3. Manufacturer's Instructions: SIP Manufacturer's Construction Manual and load design charts.

B. Calculations: Provide structural calculations by a registered architect or professional engineer qualified to perform such work.
C. Shop Drawings: Submit shop drawings for SIPs showing layout, elevations, product components and accessories.
D. Quality Assurance Submittals: Submit the following:
   1. Certificate: Product certificate showing compliance to Third Party Quality Control program of PFS Corp.
E. Fire Resistant Assemblies: PFS construction number for each fire-rated assembly
F. Warranty: Warranty documents specified herein.
G. SIPs shall be recognized for compliance with International Building Code in a current ICC ES evaluation report
H. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, SIP manufacturer installation instructions and SIP manufacturer warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

1.04. QUALITY ASSURANCE

A. Provide SIPs which have been manufactured, fabricated and installed to withstand loads as specified in design documents and ASCE guidelines for high seismic codes and to maintain performance criteria stated by SIP manufacturer without defects, damage or failure.
B. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
C. Source Limitations: Obtain all SIPs through one source. All accessories to be as furnished or recommended by the SIP manufacturer.
D. Compliance: Comply with manufacturer's ICC ES report, Load Design Charts, Construction Manual, Shop Drawings, and product data, including product technical bulletins, for installation.
E. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail and load design values shall be calculated and signed and/or sealed by a qualified architect/engineer.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials from SIP manufacturer with identification labels or markings intact.

B. Off-load SIPs from truck and handle using fork lift or other means to prevent damage to SIPs.

C. SIPs shall be fully supported in storage and prevented from contact with the ground. Stack SIPs on pallets or a minimum of three stickers for every 8 feet of SIP length.

D. SIPs shall be fully protected from weather. Protect against exposure to rain, water, dirt, mud, and other residue that may affect SIP performance. Cover stored SIPs with breathable protective wraps. SIPs shall be stored in a protected area.

1.06. WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit SIP manufacturer's standard warranty document. SIP Manufacturer warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers

1. Producer: AFM Corporation, 17645 Juniper Path, Sutie 260, Lakeville, MN 55044. Phone: (952) 892-0809.
2. Fabricator: Crowley Builders, Inc./E-Building Systems, 1201 Plumber Way, Suite 112, Roseville, CA 95678. Phone: (916) 780-7986.

B. Materials

1. SIPs consisting of the following:
   a. UL certified EPS core with Perform Guard treatment, minimum of 0.95 pcf (15.2 kg/m^3) complying with ASTM C578 Type I and having ICC ES recognition of termite resistance. Insulation manufacturer shall provide Third Party UL certificate. ICC ES report shall be provided for recognition of termite resistance in compliance with ICC AC239.
   b. OSB identified with APA or TECO performance mark with Exposure I durability rating and performance in accordance with DOC PS-2 span rating 24/16 or greater.
   c. Adhesives shall be in conformance with ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives
   d. FrameGuard treatment for mold, mildew, and termite resistance meeting the following requirements:
      (a) Registered with EPA.

(b) Mold growth: 0 rating, tested to ASTM D3273 for 8 weeks at 77 degrees F and 100 percent relative humidity.

(c) Corrosion potential for metals in contact with treated wood: Maximum 2 mils per year, tested to AWPA E12 for minimum of 60 days on aluminum 2024, carbon steel, hot-dip galvanized steel, and G90 galvanized steel

C. Fabrication
   1. Sizes: SIPs shall be fabricated in accordance with approved Shop Drawings
   2. Thermal Resistance, R-value
      a. 4 1/2" (114 mm) thick SIP with R-value of 15 at 75°F (16 at 40°F)
      b. 8 1/4" (210 mm) thick SIP with R-value of 29 at 75°F (32 at 40°F)
   3. Fire Performance Rating: TBD

2.02. ACCESSORIES

A. Splines: OSB, block splines, or I-beam for use in joining SIPs shall be supplied by SIPs manufacturer.

B. Fasteners: corrosion resistant SIP screws compatible with SIP system shall be provided by the SIPs manufacturer.
   1. Wood Screws for attachment to wood members
   2. Heavy Duty Metal Screws for attachment to metal members (16 gauge to 3/16")
   3. Light Duty Metal Screws for attachment to metal decks (18 gauge or thinner)

C. SIP Sealant: Shall be specifically designed for use with SIPs. Sealant must be compatible with all components of the SIP. Sealant shall be provided by the SIP manufacturer.

D. Dimensional Lumber: SPF, #2 or better, or engineered equivalent unless otherwise required by structural drawings.

E. Vapor Barrier SIP Tape: 40 mil thick, butyl adhesive suitable for indoor use, min. 6 inch wide for use on SIP joints as specified by designer. SIP Tape shall be supplied by the SIP manufacturer.

2.03. SOURCE QUALITY CONTROL

A. Source Quality Assurance: Each SIP component required shall be supplied by SIP manufacturer and shall be obtained from selected SIP manufacturer or its approved supplier.
   1. Each SIP shall be labeled indicating PFS Third Party certification.
   2. Provide evidence of UL Third Party inspection and labeling of all insulation used in manufacture of SIPs.
   3. SIP manufacturer shall provide Lamination, R-Value and mold/mildew/termite resistance warranty documents for building owner acceptance. Manufacturer standard forms will be submitted.

4. Provide SIPs with Foam-Control EPS with Perform Guard for termite resistance. Treatment shall be EPA registered with treatment efficacy substantiated by ICC ES report.
5. Provide SIPs with FrameGuard treatment for mold, mildew, and termite resistance. Treatment shall be EPA registered with treatment efficacy substantiated by independent research.
6. Dimensional Tolerance - shall comply with values listed in the manufacturer's Quality Control Manual.

B. Source Quality: Obtain SIPs from a single manufacturer.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions permitted without fourteen day (14) prior approval.
B. Substitutions should maintain thermal performance and dimensions provided in existing SIPs plan.

PART 3 EXECUTION

3.01. INSTALLERS

A. SIPs panels will be installed by a trained, qualified installer. A professional set crew and crane operator with proper certifications for equipment will be contracted to assist with lifting and setting panels.

3.02. EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.
   1. Verify conditions of foundation/structural system/substrate and other conditions which affect installation of SIPs. Any adverse conditions shall be reported in writing. Do not proceed with installation until adverse conditions are corrected
B. Production Verification of Conditions: Verify quality of exterior sheathing and foam core visually to ensure product is acceptable for installation. Verify that product was not damaged visibly during shipping. Inspect adhesive bond between OSB and foam layers to ensure structural continuity.

3.03. INSTALLATION

A. SIP Installation:
   1. SIP Supports: Provide level and square foundation/structural system/substrate that support wall and/or roof SIPs. For wall SIPs, hold sill plate back from edge of rim board 7/16" (11 mm) to allow full bearing of OSB skins. Provide 1 1/2" (38 mm) diameter access holes in plating to align with electrical wire chases in SIPs. Provide

adequate bracing of SIPs during erection. Remove debris from plate area prior to SIP placement.

2. SIP Fastening: Connect SIPs by nails or staples as shown on drawings. Screws of equal strength may be substituted for nails and staples as specified by engineer. SIP sealant must be used together with each fastening techniques. Where SIP Screw Fasteners are used, provide a minimum of 1" (25.4 mm) penetration into support. Join SIPs using plates and splines. Secure attachment with nails, staples, or screws, and SIP sealant. Apply SIP sealant following SIP manufacturer recommendations.
3. SIP Tape: Provide SIP Tape at joints between SIP roof panels and at intersection of SIP roof and wall.
4. Vapor Retarders: Provide vapor retarders mandated by building code or climate conditions.
5. Thermal Barriers: Interior surfaces of SIPs shall be finished with a minimum 15-minute thermal barrier, such as 1/2" (13 mm) gypsum wallboard, nominal 1" (25 mm) wood paneling, or other approved materials. Apply code approved thermal barriers according to SIP manufacturer's recommendations.
6. Restrictions: Do not install SIPs directly on concrete. Do not put plumbing in SIPs without consulting SIP manufacturer. Do not overcut skins for field-cut openings and do not cut skins for electrical chases. SIPs shall be protected from exposure to solvents and their vapors that damage the EPS foam core.
7. Remove and replace insulated wall or roof SIPs which have become excessively wet or damaged before proceeding with installation of additional SIPs or other work.
8. Protection: Protect installed product and finish surfaces from damage during construction.
    a. Roof SIPs: Protect roof SIPs from weather. Provide temporary protection at the end of the day or when rain or snow is imminent.
    b. After installation, cover SIPs to prevent contact with water on each exposed SIP edges and faces.

3.04. RELOCATION CONSIDERATIONS

A. Repair

1. Splines can be replaced with identical product should damage be incurred during dismantling and reconstruction.
2. SIPs Tape and associated fasteners to attach panels will be replaced during every deconstruction and reconstruction with identical products as specified by the manufacturer.
3. Damages to the thermal barrier shall be repaired via use of a patching sheet of thermal barrier sealed to the remainder of the thermal barrier using wood staples and SIPs tape.
4. Damage to the EPS core shall be repaired using spray can foam insulation and visually inspected for continuity and to identify potential thermal bridges.

B. Replacement
   1. Should replacement be necessary, SIPs panels from R-Control only will be used. Replacement panels should have the identical configuration.
   2. Splines may be replaced during reconstruction and relocation to ensure thermal continuity in the envelope. Replacement splines must comply with the design standards and quality standards of the remainder of the SIPS panels.

3.05. SITE QUALITY CONTROL

A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
   1. Site Visits: Site superintendent, set crew superintendent, and project manager shall review attachment of SIPs panels to foundation system for continuity and proper connection. Visual inspection of connections between panels shall be completed by the superintendent and project manager.

3.06. COMMISSIONING

A. A blower door test shall be used to test infiltration and air tightness of the envelope. Infiltration shall not exceed 0.3 ACH.

3.07. ATTACHMENTS

A. SIPS Connection Manual, Testing Summary, Load Design Chart, and ICC-ES Evaluation attached.

END OF SECTION

SECTION 06 15 00
WOOD DECKING

PART 1 GENERAL

1.01. SUMMARY

A. This section includes:
   1. Wood Decking.
   2. Attachments.

B. Related Sections:
   1. Section 06 10 00 Rough Carpentry.

1.02. REFERENCES

A. ASTM International (ASTM):
   1. A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Lumber shall be delivered to site when needed and stored in a dry, covered location sheltered from the sun and not in contact with damp surfaces.

B. Provide air circulation within and from around stacks and under temporary covering.

C. Materials shall be protected from rain, sun, and other weather damage while stored on-site.

D. Store decking in a dry, well ventilated, location protected from exposure to sun and moisture.

E. Waste material shall be diverted from landfill and disposed of at PSSI Collection Facility, Bonair Siding, Stanford, CA.

1.04. WARRANTY

A. No warranty is provided on material or fabrication.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Lumber from local saw mill.
   2. Reusable Lumber Company, P.O. Box 620327, Woodside, CA 94602. Phone: (650) 529-9122 or (650) 867-8970. Email: info@reusablelumber.com.

B. Materials:
   1. Lumber:

a. Joists: Seasoned, pressure treated No. 2 grade pine above ground MCA preservative treated yellow pine decking. Kiln dry to 15 percent maximum moisture content for 38 mm deck to 19 percent maximum content.
b. Slats: Reclaimed Redwood. Treated, Finished, and Sealed. Lumber will be sourced from one of the following locations:
   (a) Habitat for Humanity, East Bay.
   (b) Crossroads Lumber Co., North Fork, CA.
   (c) Placemakers Incorporated, Redwood City, CA.
   (d) The Reuse Network, San Leandro, CA.

2. Size: 2” x 8” DFL No. 1 pressure-treated joists; 1-1/2”” x 5” slats for finish surface in rear deck; 1-1/2” slats for finish surface in front deck.
3. Stain: To be selected by architect to complement exterior and interior finishes.

2.02. ACCESSORIES

A. Fasteners:
   1. Type: Flathead countersunk decking screws for use with pressure treated wood.
   2. Material: Hot-dip galvanized steel, ASTM A153/A153M.
   3. Length: To provide minimum ¾” penetration into framing joists.
B. Splines: Galvanized metal, as recommended by decking manufacturer.
C. Stain: As recommended by architect to match interior and exterior finishes.

2.03. PRODUCT SUBSTITUTIONS

A. Lumber from different saw mill is acceptable for joists. Slats must be sourced from Reusable Lumber Company but can be sourced from any of their providers.
B. Stain substitute shall be accepted with mock-up verifying tone and color of substitute matches original choice or is acceptable to architect.

PART 3 EXECUTION

3.01. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.02. EXAMINATION

A. Parallam beams shall be verified as level prior to installation of decking.
B. Subfloor joists shall be clean and prepared for installation prior to decking installation.

3.03. INSTALLATION

A. Frame edges of decking with 2” x 6” beams according to decking plan.

B. Lay joists between frame edges and secure with wood screws, Simpson hangers (if required) and splines.
C. Single and double spans: End joints shall be over support.
D. Cut, drill, and rout wood using carbide tipped blades and bits.
E. Cut ends square and true. Sand cut ends and edges where exposed.
F. Join butt ends with splines to ensure a tight square fit.
G. Reclaimed and re-milled redwood decking must be installed over a joist grid that is spaced a maximum of 16" on center ("OC"). 12" spacing of joist in "sub deck" will add stability to the deck surface area and reduce any flex in the wood when walking on it.
H. Deck boards should be spaced at least 1/4" apart and never less than 1/8". A 3/8"-1/2" spacing gap is optimal. Tight spacing does not allow the deck to drip dry and breathe and lends to build up of leaves and dirt. Adequate airflow around the deck keeps it dry and aired out and avoids dry rot. Rot most commonly occurs when boards are placed too close together trapping dirt and moisture. Property spacing is critical and will add years if not decades to the useful life of the deck.
I. Place each decking board to span three or more joists.
J. Fasten each finish decking board to each support with two fasteners.
K. Drive screws through pilot hole and countersink. Pre-drill screw holes located closer than ½" from edges. Two screws should be drilled per deck board per joist. Pilot holes should be set a minimum of 1" to 1.5" in from the side.
L. If necessary, sand and stain to finish. Ensure level finish across decking and between decking, metal plates at entryways, and interior finishes.

3.04. RELOCATION CONSIDERATIONS

A. Decking shall be disassembled and reassembled in panels. Boards spanning framing of two adjacent panel sections shall be removed, marked, and shipped separately.
B. Reinstallation of decking boards shall utilize the same screw holes when possible. Any new holes shall be pre-drilled and old holes filled and stained.
C. Repair:
    1. Damage to decking shall be repaired via sanding and refinishing.
D. Replacement
    1. Where necessary, deck boards may be replaced with identical or similar products from a local sawmill and stain selected to best approximation of color.

3.05. SITE QUALITY CONTROL

A. Decking shall be kept dry and free from moisture after installation.
B. Leave ample time to adequately plan each step of the project. Proper planning and correct knowledge will yield the best results possible. If you encounter an issue regarding the installation, always consult with an installation professional.

C. Installation will require either architectural plans or on-site planning to determine the actual method(s) of installation to meet local building codes. Such planning and details of all projects are the responsibility of the customer or customers' agent.
D. Finish layer shall be checked for level and shall be leveled with metal entry plates and interior finishes.
E. Boards should be tested for flexure under normal live loads.

3.06. COMMISSIONING

A. Exterior decks should be swept off regularly and at least once a month. No leaves, dirt or pine needles should be allowed to accumulate.
B. If deck is in an area that receives lots of leaves, the deck board gaps should be cleaned annually and more often in forested Areas.
C. In desert settings gap cleaning may be drastically reduced.
D. Leave the deck all-natural and allow the wood's inherent tannins and oils to protect the wood. If in full sun the deck will grey in color as it ages. If in shade, it will darken as the wood slowly oxidizes. Linseed oil, Australian tongue oil, bees wax, and other natural preservative products can be used. Oils and/or wax tend to darken the wood when applied. Oil should be re-applied bi-annually and more often in dry high solar exposure settings. Deck must be clean and free of dust, dirt or leaves when preservative or stains are applied. Do not paint the deck.

END OF SECTION

SECTION 06 17 13
LAMINATED VENEER LUMBER
PART 1 GENERAL

1.01. SUMMARY

A. This work includes the complete furnishings and installation of all Parallam® Parallel Strand Lumber (PSL) as shown on the drawings herein specified and necessary to complete the work.

B. Related Work:

1. Section 05 58 00: Formed Metal Fabrications.
2. Section 06 05 23: Wood, Plastic, and Composite Fastenings.
3. Section 06 10 00: Rough Carpentry.
4. Section 06 11 00: Wood Framing.

1.02. REFERENCES

A. These products shall be designed and manufactured to the standards set forth in the International Code Council Evaluation Service (ICC-ES) Report Number ESR-138.

B. Materials shall comply with ICC ES ESR-1387.

C. ASTM D-2559 for Adhesives.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Product shall be delivered to site when needed or ordered by project manager.

B. Parallam® PSL shall be protected from the sun and weather.

C. Storage on-site shall be facilitated in a dry location, and product shall be protected from rain and moisture during storage on-site.

D. Product shall be stored between temperatures of 40 F and 120 F.

1.04. WARRANTY

A. Warranty shall be provided by the manufacturer.

1. Weyerhaeuser 30-year limited warranty provided against manufacturing defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer:

1. Weyerhaeuser Cellulose Fibers BusinessCH 3E26P.O. Box 977733663 Weyerhaeuser Way SouthFederal Way, WA 98003, USA.

B. Materials:

1. Parallel strand lumber 5-1/4” x 9-1/4”

a. Parallam PSL is manufactured from strands of a single wood species, or species combinations that are oriented parallel to the length of the member and coated with a phenol-formaldehyde adhesive.
b. The wood species or species combinations and adhesive used in the manufacture of Parallam PSL are specified in the approved quality control manual and manufacturing standard.

2. Glulam lumber: 3-1/8" x 12"
   a. Western Species 28F-2.1 E SP.

2.02. ACCESSORIES

A. Adhesives:
   1. Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.

2.03. SOURCE QUALITY CONTROL

A. Fabrication:
   1. Parallam® PSL shall be manufactured by iLevel® Trus Joist® in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured from strands of wood fiber in a continuous process with all strands oriented to the length of the member and then fed into a press in the desired lay-up pattern. All members are to be free of finger or scarf joints or mechanical connections in full-length members.
   2. Tolerances:
      a. Finished Length (as specified): ± 1/4".
      b. Depth: ± 1/16".
      c. Width: ± 1/16".
   3. Identification:
      a. Parallam® PSL shall be identified by a stamp indicating the product type and grade and ICC-ES evaluation report number, manufacturer's name, plant number and the independent inspection agency's logo.

2.04. RELATED PRODUCTS

A. See Section 06 10 00: Rough Carpentry for additional specifications and installation instructions.

2.05. PRODUCT SUBSTITUTIONS

A. Product substitutions shall not be allowed.
B. If a substitution is required, approval of a substitute product and associated hardware must be made by the structural engineer and the construction manager.

1. Such approval will require revised structural and architectural drawings and calculations to validate use of substitute product under specified loading and conditions.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installation shall be managed only by trained installers. Union carpenters with appropriate training are allowed as is unskilled labor after receiving proper training.
B. Any equipment operation associated with moving or placing the beams on site shall be performed only by qualified operators and set crews.

3.02. EXAMINATION

A. Prior to installation of PSL beams, site grade shall be verified and level within tolerances specified in project site plan.
B. Base isolators shall be placed and their locations verified prior to installation of PSL beams on-site.
C. Beams shall be inspected for defects and for true cuts prior to installation.

3.03. INSTALLATION

A. It shall be erected and installed in accordance with the plans and any Weyerhaeuser drawings and installation suggestions. Temporary construction loads that cause stresses beyond design limits are not permitted. Safety bracing is to be provided by the installer to keep the Parallam® PSL straight and plumb as required and to ensure adequate lateral support for the individual Parallam® PSL members and the entire system until the sheathing material is applied.
B. Beams shall be measured and drilled on-site for placement in isolator frames.
C. Place beams in isolator framework as specified by structural engineering and foundation plans.
D. Beams shall be laid in Simpson® hangers welded onto isolator tops.
E. Bolts as specified by structural engineer shall be used to tie beams to isolator tops using provided holes in Simpson hangers. If necessary, drilling of beams may be performed once laid in hangers on isolators.
F. Bolts shall be tightened as specified by structural engineer.
G. Straps shall be placed on top of finished beam connections to isolators.
    1. Holes for straps shall be drilled after placing beams in isolator hangers.
    2. Wood screws as specified by structural engineer shall be used to attach straps to beams.

3.04. RELOCATION CONSIDERATIONS

A. Beams shall be remain secured to floors of modules and decking during transportation and relocation.
B. Repair:
    1. Holes may be re-drilled as needed for repair or reattachment of straps or hangers. No other repairs will be allowed.
C. Replacement:
    1. Replacement shall be deemed necessary if damage to the beams is determined by the structural engineer to adversely impact the ability of the beams to maintain the specified loads.
    2. Replacement shall be only with identical products as specified by the structural engineer and calculations from Weyerhaeuser, if requested.

3.05. SITE QUALITY CONTROL

A. Structural engineer shall verify installation of beams and placement of hangers, straps, and bolts.
B. Beams shall be checked for level after installation using standard leveling or surveying equipment.
C. Tolerances as specified by the civil engineer for grade shall be met.
D. Exposed beams after installation shall be protected from sun and weather until covered with floor construction.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY
PART 1 GENERAL

1.01. SUMMARY

A. This section includes products and installation related to exposed finish wall paneling.

B. Related Sections:

1. Section 06 05 23: Wood, Plastic, and Composite Fastenings.
2. Section 06 10 00: Rough Carpentry.

1.02. REFERENCES

A. American Society for Testing and Materials:

1. ASTM D 1037: Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
2. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM D 4442: Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
4. ASTM E 1333: Standard Test Method for Determining Formaldehyde Concentrations in Air Emission Rates from Wood Using a Large Chamber.

B. Forest Stewardship Council:

1. FSC-STD-01-001: FSC Principles and Criteria for Forest Stewardship.

1.03. QUALITY ASSURANCE

A. Wood delivered to site shall be stamped or accompanied by product certification sheet.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Wood delivered to site shall be stored in a dry location with plentiful air circulation and removed from wet or damp conditions.

B. Stacking is allowed provided that air circulation is accommodated and the products are carefully laid so as not to damage the finish surface of the product.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:

1. Wood shall be procured from local wood finish manufacturer to architect's specifications.
2. Hardwood Plywood

a. Plain sliced cut face veneer of architectural grade. Use lumber core with Type II bond.
b. 3/8" Thickness finish plywood for Mechanical Room.
c. Select veneers to provide slip match.

2.02. ACCESSORIES

A. Fasteners
1. Allowable fasteners include:
a. Exterior grade 1-1/2" screws.

2.03. SOURCE QUALITY CONTROL

A. Fabricate items rigid, plumb and square, as detailed, with tight, hairline joints. Sand work smooth, set all nails and screws.
B. Fit shelves with hardwood edging.
C. Provide 10 mm thick solid matching wood strip on plywood edges exposed in final assembly when plywood is 12 mm or thicker. Strips same width as plywood.

2.04. PRODUCT SUBSTITUTIONS

A. Substitute products from a variety of local manufacturers are allowed per architect's specifications.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in basic tool use and carpentry. Competency shall be verified by site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Substrates shall be cleaned and the installation verified prior to application of finish carpentry.

3.03. INSTALLATION

A. Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate intersecting or penetrating objects.
B. Install door and window trim in single lengths without splicing.
C. Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls.
D. Set and secure materials and components in place, rigid, plumb and square, with tight, hairline joints.
E. Form joints to conceal shrinkage.

F. Set finishing nails to receive filler. Where screws are used to secure components countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
G. Butt and cope internal joints of baseboards to make snug, tight joint. Cut right angle joints of mouldings and external corners of base with mitred joints.
H. Provide heavy duty fixture attachments for wall mounted cabinets and shelving.
I. After installation, adjust operating hardware to ensure correct operation.

3.04. RELOCATION CONSIDERATIONS

A. Some pieces of finish carpentry may require removal and replacement during disassembly, transportation, and reassembly. For these components, finish with wood screws as possible or finish nails when otherwise required.
B. Repair:
    1. Sanding and repair of finish carpentry may be effected as needed to maintain architectural surface.
C. Replacement:
    1. Replacement of finished carpentry elements is allowed with acceptable products as defined by architect.

3.05. SITE QUALITY CONTROL

A. Finish product shall be protected from damage by additional works on-site.
B. Works shall be checked for architectural surface, leveled, and plumbed as required.
C. Superintendent and architect shall verify quality of work.

END OF SECTION

SECTION 06 46 00
WOOD TRIM
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Wood trim.
  2. Corner boards.
  3. Window Sills.
  4. Fire rated trim and fascia boards.
- B. Related Sections:
  1. Section 06 05 23: Wood, Plastic, and Composite Fastenings.
  2. Section 06 10 00: Rough Carpentry.

1.02. REFERENCES
- A. ASTM International (ASTM):
  1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03. SUBMITTALS
- A. Product samples shall be provided by the manufacturer.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Protect trim from exposure to moisture and like conditions. Do not deliver trim until after concrete, masonry, plaster, ceramic tile and similar wet work is completely cured and dried.
- B. Store trim in a dry, warm, well-ventilated, weather-tight location out of the sun.
- C. It is preferable to move trim into spaces where it will be installed at least seven to ten days before installation.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Reusable Lumber Company, P.O. Box 620327, Woodside, CA 94602. Phone: (650) 529-9122 or (650) 867-8970. Email: info@reusablelumber.com.
- B. Materials:
  - a. Reclaimed, Re-milled Douglas Fir Trim. Treated, Finished, and Sealed. Lumber will be sourced from one of the following locations:
    - (a) Habitat for Humanity, East Bay.
    - (b) Crossroads Lumber Co., North Fork, CA.

(c) Placemakers Incorporated, Redwood City, CA.
(d) The Reuse Network, San Leandro, CA.

2. Reclaimed, Re-milled Redwood Plywood. Treated, Finished, and Sealed. Lumber will be sourced from one of the following locations:
   (a) Habitat for Humanity, East Bay.
   (b) Crossroads Lumber Co., North Fork, CA.
   (c) Placemakers Incorporated, Redwood City, CA.
   (d) The Reuse Network, San Leandro, CA.
3. Stain: To be selected by architect to complement exterior and interior finishes.

2.02. ACCESSORIES

A. Fasteners: 2" or 2½" finish fastening nails or equivalent finish-head #8 screws.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed. Other sources for reclaimed material shall be allowed provided that they are sourced through Reusable Lumber Company.

PART 3 EXECUTION

3.01. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.02. EXAMINATION

A. Subsurface shall be installed and verified as complete and level prior to installation of trim. Where required, flashing and weather barriers shall be installed completely prior to application of trim.

3.03. INSTALLATION

A. Do not install trim until it has adjusted to the relative humidity and temperature of the space where it is to be installed.
B. The trim should be hung with finish fastening nails 2" or 2.5" and all holes should be "pilot drilled" and then nailed up. This helps avoid cracks during installation and over the useful life of the product.
C. Surface must be flat and clear of obstructions so that trim seats properly and does not crack when nailed up.
D. Finish holes can be filled with wood putty (light in color) and touch sanded (lightly) when dry.

E. Reclaimed Douglas fir trim is very stable and should not move once installed. However it is slightly more prone to cracking or splintering. Each trim piece must be examined for cracks and splinters before and after installation as a precaution.
F. The manufacturer recommends a light linseed oil finish or natural beeswax finish. New wax and/or oil can be re-applied annually or more often in dryer climates.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Minor cracks in material may be patched with wood putty and lightly sanded to level.
B. Replacement:
   1. Components with greater damage shall be replaced. Nails shall be fully removed and the piece replaced and renailed.

3.05. SITE QUALITY CONTROL

A. Leave ample time to adequately plan each step of the project. Proper planning and correct knowledge will yield the best results possible. If you encounter an issue regarding the installation, always consult with an installation professional.
B. Installation will require either architectural plans or on-site planning to determine the actual method(s) of installation to meet local building codes. Such planning and details of all projects are the responsibility of the customer or customers' agent.
C. Trim should be clean of any dust when applying wax stains, oils, paint or varnish finishes.

END OF SECTION

DIVISION 07

SECTION 07 20 00
THERMAL PROTECTION
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Phase-Change Material (PCM) Paneling to regulate the temperature of an interior space by absorbing heat from warm convective flows on the panel face and releasing it to cold convective flows at a later time.

1.02. REFERENCES
- A. BS EN 12667-2001.
- B. ASTM D56.
- C. EN 11925-2.
- D. BS476-7.

1.03. SUBMITTALS
- A. Manufacturer should provide samples to the team to inform the design. These should be full size panels out of which mock-ups will be created.

1.04. QUALITY ASSURANCE
- A. Manufacturer Qualifications: Manufacturer with a minimum of ten years experience manufacturing products in this section shall provide all products listed.
- B. Installer Qualifications: Products listed in this section shall be installed by a single organization with at least five years experience successfully installing insulation on projects of similar type and scope as specified in this section.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  1. Finish areas designated by Architect.
  2. Do not proceed with remaining work until workmanship is approved by Architect.
  3. Refinish mock-up area as required to produce acceptable work.

1.05. DELIVERY, STORAGE, AND HANDLING
- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.

C. Handling: Handle materials to avoid damage.
D. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
1. Manufacturers:
DuPont de Nemours, Rue General Patton, L-2984 Luxembourg. Phone: 00352 3666 5885. E-mail: energain@lux.dupont.com.

B. Materials:
1. DuPont Energain Energy-Saving Thermal Mass Systems
a. The panel is a fine mixture of ethylene based polymer (40%) designed by DuPont and paraffin wax (60%) laminated on both sides with a 100 micrometer aluminum sheet. The edges are closed with a 75 micrometer aluminum tape.

2.02. SOURCE QUALITY CONTROL
A. Ensure panels are intact with no punctures or breaks in the skin layer when received.

2.03. PRODUCT SUBSTITUTIONS
A. No substitutions will be allowed for this product.

PART 3 EXECUTION

3.01. INSTALLERS
A. Qualified carpenters or other installers will be permitted to construct this material. Qualification will be at the discretion of the Construction Manager, Health and Safety Office, and/or Project Manager.

3.02. EXAMINATION
A. Substrate should be fully installed, clean, and level prior to application of the PCM Panels.

3.03. INSTALLATION
A. Install according to manufacturer specifications.

3.04. ATTACHMENTS
A. Manufacturer’s data sheet and MSDS are attached.

END OF SECTION

SECTION 07 25 00
WEATHER BARRIERS
PART 1 GENERAL

1.01. SUMMARY

A. This section includes:
   1. Fortifiber 60 Minute Building Paper.
   2. W.R. Grace Ice and Water Shield.
   3. W.R. Grace Vycor Flashing Tape.
   4. Fortifiber Sealant.
   5. Weather barrier membrane: DuPont™ Tyvek® HomeWrap®.
   6. Seam Tape: DuPont™ Tyvek® Tape.

1.02. REFERENCES

A. ASTM International:
   1. ASTM C920; Standard Specification for Elastomeric Joint Sealants.
   2. ASTM C1193; Standard Guide for Use of Joint Sealants.
   3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting.
   4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics.
   5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials.
   6. ASTM E96; Test Method for Water Vapor Transmission of Materials.
   7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls.
   8. ASTM E2178; Test Method for Air Permeance of Building Materials.

B. AATCC – American Association of Textile Chemists and Colorists:
   1. Test Method 127 Water Resistance: Hydrostatic Pressure Test.

C. TAPPI:
   1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area).
   2. Test Method T-460; Air Resistance (Gurley Hill Method).

1.03. SUBMITTALS

A. Product Data: Submit manufacturer current technical literature for each component.

B. Samples: Weather Barrier membrane, minimum 8-1/2 inches by 11 inch.

C. Quality Assurance Submittals
   1. Manufacturer Instructions: Provide manufacturer's written installation instructions.

1.04. QUALITY ASSURANCE

A. Qualifications:

1. Installer shall have experience with installation of similar weather barrier assemblies under similar conditions.
2. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
B. Store weather barrier materials as recommended by system manufacturer.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer
   1. Fortifiber Building Systems Group. 300 Industrial Drive, Fernley, NV 89408. Phone: (800) 773-4777. Email: buildingproducts@fortifiber.com
   2. W.R. Grace and Co. 6001 Broken Sound Parkway, NW, Suite 600, Boca Raton, FL 33487. Phone: (800) 974-2363.
   3. SDP Inc. 410-130 Bridgeland Ave., Toronto, Ontario, Canada. M6A 174. Phone: (866) 747-4035.
   4. DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); http://www.construction.tyvek.com.
B. Materials
   1. Vapor Permeable Weather-Resistive Barriers: Two-ply asphalt saturated kraft Grade D breather type sheathing paper.
      a. Types:
         (a) Professional: Fortifiber® / Two-Ply Super Jumbo Tex® 60 Minute
      b. Reference Standard; Federal Specification UU-B-790a, Type 1, Grade D, Style 2.
      c. Moisture Vapor Transmission: 35 grams minimum; ASTM E 96.
      d. Water Resistance: 150 minutes (professional), ASTM D 779
   2. Grace Ice and Water Shield
      a. Self-Adhered, Self-sealing underlayment membrane.
   3. Palisade Synthetic Underlayment
      a. Self-adhered, self-sealing underlayment membrane.
   4. DuPont Tyvek HomeWrap.
      a. Basis of Design: spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® HomeWrap® and related assembly components.

b. Performance Characteristics:
   (a) Air Penetration: <.004 cfm/ft^2 at 1.57 psf, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
   (b) Water Vapor Transmission: 56 perms, when tested in accordance with ASTM E96-05, Method A.
   (c) Water Penetration Resistance: 250 cm when tested in accordance with AATCC Test Method 127.
   (d) Basis Weight: 1.8 oz/yd^2, when tested in accordance with TAPPI Test Method T-410.
   (e) Air Resistance: 1200 seconds, when tested in accordance with TAPPI Test Method T-460.
   (f) Air Resistance: 1200 seconds, when tested in accordance with TAPPI Test Method T-460
   (g) Tensile Strength: 30/30 lbs/in., when tested in accordance with ASTM D882.
   (h) Tear Resistance: 8/6 lbs, when tested in accordance with ASTM D1117.
   (i) Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 15, Smoke Developed: 15.

2.02. ACCESSORIES

A. Fasteners:
   1. ½" T50 staples shall be used.
B. Sealants:
   1. Provide sealants that comply with ASTM C 920, elastomeric polymer sealant to maintain watertight conditions.
   2. Products:
C. Flashing:
   1. W.R. Grace Vycor: flexible membrane flashing materials for window openings and penetrations.
D. Seam Tape: 3 inch wide, DuPont™ Tyvek® Tape as distributed by DuPont Building Innovations.
E. Fasteners:
   1. DuPont™ Tyvek® Wrap Caps, as distributed by DuPont: #4 nails with large 1-inch plastic cap fasteners, or 1-inch plastic cap staples with leg length sufficient to achieve a minimum penetration of 5/8-inch into the wood stud.

2.03. PRODUCT SUBSTITUTIONS

A. No product substitutions shall be allowed except with the permission of the construction manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by a qualified installer.

3.02. EXAMINATION

A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.03. INSTALLATION

A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
B. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
C. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface. Maintain weather barrier plumb and level.
D. Extend bottom roll edge over sill plate interface 2" to 3" minimum.
E. Subsequent layers shall overlap lower layers a minimum of 3 inches horizontally in a shingling manner.
F. Window and Door Openings: Extend weather barrier completely over openings.
G. Weather Barrier Attachment:
    1. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, spaced 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.
H. Apply 4 inch by 7 inch piece of W.R. Grace Vycor or weather barrier manufacturer approved alternate to weather barrier membrane prior to the installation cladding anchors.
I. Seaming:
    1. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
    2. Seal any tears or cuts as recommended by weather barrier manufacturer.
J. Opening Preparation:
    1. Cut weather barrier in an "I-cut" pattern. A modified I-cut is also acceptable.
        a. Cut weather barrier horizontally along the bottom and top of the window opening.
        b. From the top center of the window opening, cut weather barrier vertically down to the sill.
        c. Fold side and bottom weather barrier flaps into window opening and fasten.

2. Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 8 inches of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

K. Flashing:
1. Cut 9-inch wide W.R. Grace Vycor a minimum of 12 inches longer than width of sill rough opening. Apply primer as recommended by the manufacturer.
2. Cover horizontal sill by aligning flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
3. Fan flashing on bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
4. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
5. Install window according to manufacturer's instructions.
6. Tape head flap in accordance with manufacturer recommendations.
7. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.04. RELOCATION CONSIDERATIONS

A. Repair
1. Apply a new layer of weather barrier over any tear or damaged area in the barrier. Overlap lower layer by 6-12 inches and flash around the seam.

3.05. SITE QUALITY CONTROL

A. Protect installed weather barrier from damage.

3.06. ATTACHMENTS

A. MSDS for Fortifiber 60 Minute Building Paper, Data Sheet for Ice and Water Shield, Data Sheet for Vycor, Data Sheet for Palisades Underlayment.

END OF SECTION

SECTION 07 41 00
PREFORMED METAL WALL AND ROOF PANELS
PART 1 GENERAL

1.01. SUMMARY

A. This section covers the pre-finished, pre-fabricated Architectural metal wall panel system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.

1.02. REFERENCES

A. Related sections:
   1. 07 92 00 Joint Sealants
   2. 06 12 00 Structural Insulated Panels

1.03. QUALITY ASSURANCE

A. Panel system installer shall be experienced with the installation of metal wall and roof systems on projects with similar scope and complexity, and acceptable to panel manufacturer.
B. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.
C. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate - .032 or .040 and Aluminum

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
B. Unload, store and erect metal wall panels in a manner to prevent bending, warping, twisting and surface damage.
C. Stack metal wall panels on platforms or pallets, covered with suitable WARRANTY

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Sheffield Metals International, 5467 Evergreen Parkway, Sheffield Village, OH 44054. Telephone: (440) 934-8500. Fax: (440) 934-8506. Web: www.coolrmetal.com.
   2. Wildcat Metals. 890 Faulstich Ct., San Jose, CA 95112. Phone: (408) 217-1595. Email: Contact@WildcatMetals.com.
B. Panel Design

1. General: Provide factory-formed metal wall panels designed for wall, soffit and fascia applications where a flush or flat appearance is desired. Around interlock leg and concealed fastening system act to improve the flush appearance while providing additional strength.
2. Panels to be produced (specifier to choose) smooth, with one pencil rib, with two pencil ribs. Specifier note: Factory standard is smooth unless specified.
3. Forming: Use continuous end rolling method. No end laps on panels. No portable rollforming machines will be permitted on this project, no installerowned or installer-rented machines will be permitted.

C. Materials
1. Preformed metal panels shall be fabricated of (specifier to choose).032", or .040" thick 3105-H14 aluminum.
2. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 2605 or 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
3. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
4. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
5. Accessories/Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates. Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the wall panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces, except at designed points of roof panel fixity
6. Underlayment
   a. On all surfaces to be covered with metal wall panels, furnish and install a 40 mil weather barrier required as outlined by metal panel manufacturer. Membrane to be a minimum of 40 mil thickness, smooth, non-granular.
7. Sealants
   a. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or

b. One part polysulfide not containing pitch or phenolic extenders or
c. Exterior grade silicone sealant recommended by roofing manufacturer or
d. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.02. ACCESSORIES

A. Fasteners
   1. Secure units to supports
   2. Place fasteners as indicated in manufacturer's standards.

PART 3 EXECUTION

3.01. INSTALLATION

A. Compliance: Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.
B. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.
C. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
D. Provide uniform, neat seams.
E. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leakproof installation.
F. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

3.02. RELOCATION CONSIDERATIONS

A. Repair or replace damaged metal panels and trim to the satisfaction of the homeowner.

END OF SECTION

SECTION 07 46 23
RECLAIMED WOOD SIDING
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Requirements for installation of reclaimed wood siding.
   2. Related Sections:
      a. Section 06 05 23: Wood, Plastic, and Composite Fastenings.
      b. Section 06 10 00: Rough Carpentry.
      c. Section 06 12 00: Structural Insulated Panels.

1.02. REFERENCES

A. American Society for Testing and Materials International, (ASTM).
   1. ASTM D5115-97, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
B. Forest Stewardship Council.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Product shall be delivered in manufacturer's packaging and with appropriate labeling to certify source and product information.
B. Material shall be stored under normal temperature and humidity conditions and protected from sun, rain, and other adverse weather conditions prior to installation.
C. Store siding in a dry, warm, well-ventilated, weather-tight location out of the sun.
D. Reclaimed redwood siding is delicate and can crack or split easily if not handled carefully.
E. Remove from site and dispose of packaging materials at appropriate recycling facilities.
F. Divert unused wood materials from landfill to PSSI Collection Site, Bonair Siding, Stanford, CA, or comparable facility in Irvine, CA.
G. Divert unused caulking material from landfill to hazardous material collections site at PSSI, Bonair Siding, Stanford, CA, or comparable facility in Irvine, CA.
H. Do not dispose of unused caulking materials into the sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

1.04. WARRANTY

A. Manufacturer shall warrant the product for a specified number of years under normal application and wear.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Reusable Lumber Company, P.O. Box 620327, Woodside, CA 94602. Phone: (650) 529-9122 or (650) 867-8970. Email: info@reusablelumber.com.

B. Materials:
   1. Reclaimed, remilled, clear heart, old growth tongue in groove redwood siding. Lumber will be sourced from one of the following locations:
      a. Habitat for Humanity, East Bay.
      b. Crossroads Lumber Co., North Fork, CA.
      c. Placemakers Incorporated, Redwood City, CA.
      d. The Reuse Network, San Leandro, CA.
   2. Size: ½" thick paneling in 6" widths and 8' lengths.
   3. Stain: To be selected by architect to complement exterior and interior finishes.

2.02. ACCESSORIES

A. Fasteners: 3" finish head screws, exterior grade.
B. Sealants: color-matched, if possible, and approved by manufacturer.
C. Paint: Touch-up stain if required as approved by manufacturer.

2.03. PRODUCT SUBSTITUTIONS

A. Substitutions of individual planks shall not be allowed. Product must be continuous in manufacture and appearance throughout project.
B. Substitutions for entire project siding shall require the approval of the architect and project manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.02. EXAMINATION

A. Substrate shall be prepared and verified that prior installations and conditions are completed before installation of siding.
B. Weatherproofing, flashing, and blocking must be installed and approved prior to installation of siding.

C. The surface that will receive the siding must be covered with a construction paper, tar paper, or vapor/ moisture barrier. The wall surface must be flat and smooth with no obstructions that might impair a proper installation.
D. Product shall be inspected prior to installation to ensure no damage has been incurred in transportation or during on-site storage.

3.03. INSTALLATION

A. The siding is milled to be fastened to the walls horizontally, with the lap hanging down over the ship. The material should be installed from the bottom tier (base of wall) up to the top of the wall.
B. All nail or screw holes should be "pilot drilled" prior to fastening to avoid cracks and splitting.
C. Siding should be fastened to the interior wall studs or equivalent. There should be two fasteners per wall stud (two per 16" spacing). Fasteners should be set to sit flush with exterior face or slightly below (no more than 1/16" depth). Fastened siding should rest flat on the wall with all boards interlocking smooth and easy. Never force the wood siding to seat, or drive it into position.
D. It is not recommended to paint redwood. Natural oils, and or non-toxic stains perform better than paint. Old growth redwood has high levels of natural tannins that give the wood longevity. Untreated the wood breathes and ages gracefully over time.
E. Once fastened to the wall the material can last hundreds of years if hung properly on a well-built structure. Old Growth redwood has inherent fire retardant, water resistant, and insect repellant qualities.
F. Install sill flashings, metal starter strips, inside corner flashings, edgings and flashings over openings.
G. Fasten recycled wood siding in straight, aligned lengths to blocking at 24 inches on-center maximum, using nails or screws at each fixing location. Siding joints to be covered with color-matched moulding and trim.
H. Butt joints on blocking and nail or screw to allow a 0.25 inch joint. Leave space between siding and window and door trim, caulk with sealant as per manufacturer’s installation instructions.
I. Begin siding at bottom of walls and proceed to top, lapping panels as specified in architectural design.

3.04. RELOCATION CONSIDERATIONS

A. Siding panels abutting or covering module connections shall be fixed in place using wood screws for easy disassembly and reassembly for transportation and reconstruction.
    1. Siding not abutting or affecting module connections shall not be removed during reinstallations.

B. Repair:
   1. Repair of damaged finishes shall involve sanding and reapplying manufacturer approved stain.
C. Replacement:
   1. Siding panels shall be replaced if necessary with a product from the same manufacturer.

3.05. SITE QUALITY CONTROL

A. Work surface shall be kept clean during installation.
B. Leave ample time to adequately plan each step of the project. Proper planning and correct knowledge will yield the best results possible. If you encounter an issue regarding the installation, always consult with an installation professional.
C. Installation will require either architectural plans or on-site planning to determine the actual method(s) of installation to meet local building codes. Such planning and details of all projects are the responsibility of the customer or customers' agent.
D. Siding shall be protected during transportation using plastic wrap or other comparable coverings.
E. Installation and finishing shall be inspected and approved by construction manager or site superintendent.
F. Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

SECTION 07 54 19
THERMOPLASTIC MEMBRANE ROOFING
PART 1 GENERAL

1.01. SUMMARY

A. This section includes complete feltback adhered Sika Sarnafil roofing system including membrane, flashings, and other components.

1.02. REFERENCES

A. The Applicator shall submit evidence that the proposed roof system meets the requirements of the local building code and has been tested and approved or listed by the following test organizations. These requirements are minimum standards and no roofing work shall commence without written documentation of the system's compliance, as required in the "Submittals" section of this specification.

B. System shall be designed to meet a minimum wind design requirements of the most recent version of ASCE 7.

C. Factory Mutual Research Corporation (FM) - Norwood, MA
   1. Class 1-60 (required for most situations)
   2. Class 1-75 (for increased wind exposure)
   3. Class 1-90 (for high wind exposure)

D. Underwriters Laboratories, Inc. - Northbrook, IL
   1. Class A assembly
   2. Class B assembly
   3. Class C assembly

1.03. QUALITY ASSURANCE

A. This roofing system shall be applied only by a Roofing Applicator authorized by Sika Sarnafil prior to bid (Sika Sarnafil "Applicator").

B. Upon completion of the installation and the delivery to Sika Sarnafil by the Applicator of certification that all work has been done in strict accordance with the contract specifications and Sika Sarnafil's requirements, a Sika Sarnafil Technical Service Representative will review the installed roof system wherever a System Warranty has been specified.

C. There shall be no deviation made from the Project Specification or the approved shop drawings without prior written approval by the Owner, the Owner's Representative and Sika Sarnafil.

D. All work pertaining to the installation of Sarnafil membrane and flashings shall only be completed by Applicator personnel trained and authorized by Sika Sarnafil in those procedures.

E. Roofing membrane manufacturer must have a demonstrated performance history of producing PVC roof membranes no less, in duration of years, than the warranty duration specified.
F. Product to be manufactured by membrane supplier and not private labeled.
G. Manufacturer to have a minimum of five years experience recycling their membranes at the end of their service life back into new membrane products. Provide a minimum of five reference projects.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Sika Sarnafil materials may be installed under certain adverse weather conditions but only after consultation with Sika Sarnafil, as installation time and system integrity may be affected.
B. Only as much of the new roofing as can be made weathertight each day, including all flashing and detail work, shall be installed. All seams shall be heat welded before leaving the job site that day.
C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.
D. All surfaces to receive new insulation, membrane or flashings shall be dry. Should surface moisture occur, the Applicator shall provide the necessary equipment to dry the surface prior to application.
E. All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof or equipment damage.
F. Uninterrupted waterstops shall be installed at the end of each day's work and shall be completely removed before proceeding with the next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with the finished roof as the installation progresses. Contaminated membrane shall be replaced at no cost to the Owner.
G. The Applicator is cautioned that certain Sarnafil membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. Such materials shall not remain in contact with Sarnafil membranes. The Applicator shall consult Sika Sarnafil regarding compatibility, precautions and recommendations.
H. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. A substantial protection layer consisting of plywood over Sarnafelt or plywood over insulation board shall be provided for all new and existing roof areas that receive rooftop traffic during construction.
I. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air or similar methods.

J. The Applicator shall follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction.
K. All roofing, insulation, flashings and metal work removed during construction shall be immediately taken off site to a legal dumping area authorized to receive such materials. Hazardous materials, such as materials containing asbestos, are to be removed and disposed of in strict accordance with applicable City, State and Federal requirements.
L. All new roofing waste material (i.e., scrap roof membrane, empty cans of adhesive) shall be immediately removed from the site by the Applicator and properly transported to a legal dumping area authorized to receive such material.
M. The Applicator shall take precautions that storage and application of materials and equipment does not overload the roof deck or building structure.
N. Installation of a Sarnafil membrane over coal tar pitch or a resaturated roof requires special consideration to protect the Sarnafil membrane from volatile fumes and materials. Consult Sika Sarnafil for precautions prior to bid.
O. Flammable adhesives and deck primers shall not be stored and not be used in the vicinity of open flames, sparks and excessive heat.
P. All rooftop contamination that is anticipated or that is occurring shall be reported to Sika Sarnafil to determine the corrective steps to be taken.
Q. The Applicator shall verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages in writing (letter copy to Sika Sarnafil) to the Owner's Representative for corrective action prior to the installation of the Sika Sarnafil roof system.
R. Applicator shall immediately stop work if any unusual or concealed condition is discovered and shall immediately notify Owner of such condition in writing for correction at the Owner's expense (letter copy to Sika Sarnafil).
S. Site cleanup, including both interior and exterior building areas that have been affected by construction, shall be completed to the Owner's satisfaction.
T. All landscaped areas damaged by construction activities shall be repaired at no cost to the Owner.
U. The Applicator shall conduct fastener pullout tests in accordance with the latest version of the SPRI/ANSI Fastener Pullout Standard to verify condition of the deck/substrate and to confirm expected pullout values.
V. The Sarnafil membrane shall not be installed under the following conditions without consulting Sika Sarnafil's Technical Dept. for precautionary steps:
    1. The roof assembly permits interior air to pressurize the membrane underside.
    2. Any exterior wall has 10 percent or more of the surface area comprised of opening doors or windows.
    3. The wall/deck intersection permits air entry into the wall flashing area.

W. Precautions shall be taken when using Sarnacol adhesives at or near rooftop vents or air intakes. Adhesive odors could enter the building. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.

X. Protective wear shall be worn when using solvents or adhesives or as required by job conditions.

Y. Sarnafil membranes are slippery when wet or covered with snow, frost, or ice. Working on surfaces under these conditions is hazardous. Appropriate safety measures must be implemented prior to working on such surfaces. Always follow OSHA and other relevant fall protection standards when working on roofs.

1.05. WARRANTY

A. Sika Sarnafil Membrane Warranty
   1. Upon successful completion of the work to Sika Sarnafil's satisfaction and receipt of final payment, the Sika Sarnafil Membrane Warranty shall be issued.

B. Sika Sarnafil System Warranty (only products purchased from Sika Sarnafil are covered under System Warranty)
   1. Upon successful completion of the work to Sika Sarnafil's satisfaction and receipt of final payment, the Sika Sarnafil System Warranty shall be issued.

C. Applicator/Roofing Contractor Warranty
   1. Applicator shall supply Owner with a separate workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator warranty term, defective or otherwise not in accordance with Contract Documents, the Applicator shall repair that defect at no cost to the Owner. Applicator's warranty obligation shall run directly to Owner, and a copy shall be sent to Sika Sarnafil.

D. Owner Responsibility
   1. Owner shall notify both Sika Sarnafil and the Applicator of any leaks as they occur during the time period when both warranties are in effect.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Sika. 6590 Dain Way, Cypress, CA 90630. Phone: (714) 898-9355.

B. Materials
   1. Sarnafil G410 thermoplastic membrane with fiberglass reinforcement, lacquer coating, and a factory applied 9 oz. felt backing.
      a. Color: EnergySmart White, initial solar reflectance of 0.83, emittance of 0.90, and solar reflective index (SRI) of 104 (ENERGY STAR listed).

2.02. ACCESSORIES

A. G410 Flashing Membrane
   1. A fiberglass reinforced membrane adhered to approved substrates using Sarnacol adhesive. G410 comes in 8" and 12" widths and is 60 mil (1.5 mm) thick. Consult Product Data Sheets for adhesive options and additional information.

B. Sarnastack Universal
   1. A 60 mil (1.5 mm) thick prefabricated stack/pipe boot injection molded. Consult Product Data Sheet for additional information.

C. Sarnacorners - Outside
   1. A 60 mil (1.5 mm) thick prefabricated outside corner injection molded. Consult Product Data Sheet for additional information.

D. DensDeck Prime
   1. Employs enhanced fiberglass mats front and back that are bonded to a high density gypsum core. DensDeck Prime is provided in 4 ft. x 4 ft. (1.2 m x 1.2 m) or 4 x 8 ft (1.2 x 2.4 m) board sizes and in thicknesses of 1/4, 1/2 and 5/8 inch (6, 13 and 16 mm). Consult Product Data Sheet for additional information.

E. Sarnacol 2170 VC Adhesive:
   1. A solvent-based, VOC compliant, reactivating adhesive used to attach the membrane to the substrate. Consult Product Data Sheets for additional information.

F. Fasteners
   1. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors shall have a minimum embedment of 1-1/4 inch (32 mm) and shall be approved for such use by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch (25 mm) and shall be approved for such use by the fastener manufacturer.

2.03. PRODUCT SUBSTITUTIONS

A. Substitution shall be made only by the Project Manager or Construction Manager and shall only be made for comparable materials.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers should be general contractors with experience installing thermoplastic roofing.

3.02. EXAMINATION

A. A dry, clean and smooth substrate shall be prepared to receive the Sarnafil Adhered roof system.
B. The Applicator shall inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.
C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.
D. All roof surfaces shall be free of water, ice and snow.
E. Sarnafil shall be applied over compatible and accepted substrates only.

3.03. INSTALLATION

A. New Construction
   1. The roof deck shall be minimum 1-1/2 inch (38 mm) thick lumber or 15/32 inch (12 mm) thick plywood. Deck shall be installed according to local code requirements. Contact Sika Sarnafil Technical for fastening patterns and methods.

B. Sarnafil
   1. The surface of the insulation or substrate shall be inspected prior to installation of the Sarnafil roof membrane. The substrate shall be clean, dry, free from debris and smooth with no surface roughness or contamination. Broken, delaminated, wet or damaged insulation boards shall be removed and replaced.
   2. Sarnacol 2170 / 2170 VC Adhesive:
   3. Over the properly installed and prepared substrate surface, adhesive shall be applied using solvent-resistant 3/4 inch (19 mm) nap paint rollers. The adhesive shall be applied to the substrate at a rate according to Sika Sarnafil requirements. No adhesive is applied to the back of the G410 feltback membrane. The adhesive shall be applied in smooth, even coats with no gaps, globs, puddles or similar inconsistencies. Only an area which can be completely covered in the same day's operations shall be coated with adhesive. The first layer of adhesive shall be allowed to dry completely prior to installing a second layer of adhesive and the membrane.
   4. The G410 feltback roof membrane is unrolled immediately into a second layer of wet adhesive. Adjacent to that first installed roll of membrane, another second layer of wet adhesive is applied and the second roll of membrane is immediately unrolled into it, overlapping the first roll by 3 inches (75 mm). This process is repeated throughout the roof area. Immediately after application into adhesive, the bonded sheet shall be pressed firmly in place with a minimum 100 lb (45 kg) steel, membrane roller, by rolling in two directions.
   5. Do not allow the second application of adhesive to dry at all!
   6. Weld G410 coverstrips at all G410 feltback seams that do not have a factory selvage edge.

7. Notes:
8. The Applicator shall count the amount of pails of adhesive used per area per day to verify conformance to the specified adhesive rate.
9. No adhesive shall be applied in seam areas. All membrane shall be applied in the same manner.

C. Sarnafil
1. Over the properly installed and prepared substrate, Sarnacol 2121 adhesive shall be poured out of the pail and spread using notched 1/4 x 1/4 x 1/4 inch (6 x 6 x 6 mm) rubber squeegees. The adhesive shall be applied at a rate according to Sika Sarnafil requirements. No adhesive is applied to the back of the G410 feltback membrane. Do not allow adhesive to skin-over or surface-dry prior to installation of G410 feltback membrane.
2. Immediately unroll G410 feltback roof membrane carefully into wet adhesive. Adjacent rolls overlap previous rolls by 3 inches (75 mm). This process is repeated throughout the roof area. The membrane is then immediately broomed into place with a medium bristle push broom to work out any air bubbles. Push the broom down the center of the sheet followed by brooming out from the center on both sides. Immediately after brooming, roll the membrane in two directions with a minimum 100 lb (45 kg), steel, membrane roller. Clean any adhesive residue on the seams while still wet and before welding. If the adhesive dries in the seam it will require a solvent to clean it.
3. Weld G410 coverstrips at all G410 feltback seams that do not have a factory selvage edge

3.04. RELOCATION CONSIDERATIONS

A. Repair
a. Some areas may be peeled back or removed for transportation. These should be replaced with the same fastener schedule. Joints shall be sealed using heat guns and sealant.

3.05. SITE QUALITY CONTROL

A. Scheduling of installation shall allow for proper curing times for adhesive.
B. Project manager and construction manager shall inspect layers of installation prior to progression to following layer.
C. Dust control measures shall be used to prevent impingement of foreign materials on coal tar and sheathing layers during installation and curing.

3.06. COMMISSIONING

A. The layers shall be visually inspected by the project manager, construction manager, and installation team for continuity and water tightness prior to placement of final layer.

3.07. ATTACHMENTS

A. Product Data Sheet and MSDS are included.

END OF SECTION

SECTION 07 61 13
STANDING SEAM SHEET METAL ROOFING
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Field-formed field-assembled concealed fastener metal roofing system.

B. Related Sections:

1. Section 06 12 00: Structural Insulated Panels.
2. Section 07 62 00: Sheet Metal Flashing and Trim.

C. Design Requirements; design roof system to withstand:

1. Live and dead loads in accordance with Building Code.
2. Minimum wind pressures in accordance with ASCE 7 tested in accordance with ASTM E1592.
3. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.
4. Performance Requirements
   a. Air Infiltration: Not more than 0.5 ft^3 per minute at a static pressure of 1.57 psf when tested in accordance with ASTM E283/ASTM E1680
   b. Water Infiltration: No water leakage when tested in accordance with ASTM E331/ASTM E646 with a water spray of 5 gal/hr ft^2 at a static pressure of 15 psf
   c. Wind Uplift:
      (a) As tested to AST E1592
      (b) Class 90, when tested in accordance with UL 580, and listed in the UL "Roofing Materials and Systems Directory"

1.02. REFERENCES

A. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International (ASTM):

1. ASTM A 755: Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
2. ASTM A 792: Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy- Coated by the Hot-Dip Process.
3. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
4. ASTM C 1311: Standard Specification for Solvent Release Sealants.
5. ASTM D 226: Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

6. ASTM D 1970: Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
7. ASTM E 1680: Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
8. ASTM E1646: Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference,
9. ASTM D 523: Standard Test Method for Specular Gloss
10. ASTM D 3363: Standard Test Method for Film Hardness by Pencil Test
11. ASTM D 4145: Standard Test Method for Coating Flexibility of pre-painted Sheet.
12. ASTM D 3359: Standard Test Methods for Measuring Adhesion by Tape Test.
13. ASTM D 2794: Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
14. ASTM D 2244: Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
15. ASTM D 4214: Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
16. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
17. ASTM D 870: Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
18. ASTM D 3361: Standard Practice for Unfiltered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
19. ASTM D 968, Method A: Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
20. ASTM D 4212: Standard Test Method for Viscosity by Dip-Type Viscosity Cups.
21. ASTM D 1475: Standard Test Method For Density of Liquid Coatings, Inks, and Related Products.
22. ASTM D 2697: Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings.
23. ASTM D 2369: Standard Test Method for Volatile Content of Coatings.
24. ASTM D 3960: Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
25. ASTM D 3278: Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus.
26. ASTM D 5402: Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs.

C. Underwriters Laboratories (UL):
1. UL 90 Wind Uplift Classification.

2. UL 580 - Tests for Uplift Resistance of Roof Assemblies.
3. UL 1897 – Uplift Tests for Roof Covering Systems.
4. UL 2218 - Impact Resistance of Prepared Roof Covering Materials.
5. Class A fire Assembly.

1.03. SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
B. Installation Details: Details shall include edge conditions, panel profiles, trim and flashings and other accessories.
C. Paint Finish Warranty: Project information sheet and warranty applications shall be completed and submitted by installer prior to delivery of the warranty.
D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.04. QUALITY ASSURANCE

A. Installer Qualifications: Installer's responsibilities shall include fabricating and installing metal roof panel assemblies and providing professional engineering services necessary to assume engineering responsibility.
B. Pre-Installation Conference: Conduct conference at Project site or at specified location with the Architect and Contractor.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06. WARRANTY

A. Paint Finish Warranty: 35 Year Limited COOLR Paint Warranty.
B. Weathertight Warranty, Standard Warranty Program: 20 year Weathertight Warranty.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Sheffield Metals International, 5467 Evergreen Parkway, Sheffield Village, OH 44054. Telephone: (440) 934-8500. Fax: (440) 934-8506. Web: www.coolrmetal.com.

B. Materials
   1. Standing Seam Metal Roof Panels:
      a. Product: SMI 1.75” SnapLock Standing Seam metal roofing system as manufactured by Sheffield Metals International or SMI Authorized MFG.
      b. Minimum Slope: 2/12
      c. Profile: SnapLock joint, 24 gauge, 0.023 min inch (0.61 mm) nominal thick.
      d. Concealed Finish: White or light-colored polyester backer finish.
      e. Panel Coverage: 18 inches (457 mm).
      f. Panel Height: 1.75 inch (44 mm).
      g. Uplift Rating: UL 580, UL 1897.
      h. Water Penetration: ASTM E 1646.
      i. Air Infiltration: ASTM E 1680
      j. Impact Resistance: UL 2218.
      k. Fire Resistance: UL Class A Fire Rating.
      l. Clip: Fixed, corrosion resistant, 18 gauge (1.214 mm) UL 90 Class approved clips designed to withstand negative-load requirements.
      m. Flashings: Provide flashings fabricated of same metal as metal roof panels.
      n. Color: Silver Metallic for Roof, Charcoal Grey for Awnings

2.02. ACCESSORIES
A. Underlayment:
   1. Self-Adhering, Polypropylene-Faced Sheet: ASTM D1970, 25 mils thick minimum, consisting of slip- top surface with release-paper backing.
      a. Palisades Roofing Underlayment.
B. Substrate Deck:
   1. 15/32” or greater plywood, wood plank, or equivalent.
C. Accessories:
   1. Paint Pen: Field touchup for minor scratches on trim and panels.

2.03. SOURCE QUALITY CONTROL
A. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in Sheffield Metals International Details or SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

2.04. PRODUCT SUBSTITUTIONS
A. No substitutions permitted without fourteen day (14) prior approval
B. Substitutions should maintain humidity, waterproofing, reflectivity, emissivity, and thermal performance and dimensions provided in existing roof plan.

PART 3 EXECUTION

3.01. INSTALLERS

A. Standing Seam Metal Roof will be installed by a trained, qualified installer as approved by the manufacturer or with requisite certification and experience in standing seam roof installation.

3.02. EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.
   1. Verify conditions of OSB surface of SIPS underlayment, seams between panels, and connection between roof panels and wall panels/finsihes and other conditions which affect installation of standing seam metal roof. Any adverse conditions shall be reported in writing. Do not proceed with installation until adverse conditions are corrected.
   2. Do not begin installation until substrates have been properly prepared.

B. Production Verification of Conditions: Verify quality of underlayment, bonding materials, and sheet metal visually to ensure product is acceptable for installation. Verify that product was not damaged visibly during shipping. Inspect for any errors or discontinuities in roof materials during bending and installation.

3.03. INSTALLATION

A. Preparation
   1. Deck Attachment:
      a. In accordance with applicable Building Code, or follow SMI Engineering Report for specifications for deck attachment.
      b. Re-roofing, where the deck is less than minimum provide additional attachment per SMI Engineering Report.
   2. Substrate: Install solid wood substrate of 15/32 inch thick minimum roof decking or sheathing on entire roof surface.
   3. Install flashings and other sheet metal to comply with requirements specified in Section "Sheet Metal Flashing and Trim."

B. Installation of Underlayment
   1. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Comply with temperature restrictions of underlayment, refer to manufacturer for installation; use primer rather than nails for

installing underlayment at low temperatures. Apply at locations indicated on Drawings, in shingle fashion to shed water, with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment past eave approximately 1-1/2 inches (38 mm) to cover substrate.

C. Installation of Roofing
   1. Provide components required for a complete metal roof panel assembly including trim, copings, fascia, corner units, flashings, sealants, gaskets, fillers and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
      a. Flashing: Provide flashing at eaves and ridges, fabricated of same metal as metal roof panels.
   2. General: Provide metal roof panels of full length from eave to ridge. Anchor metal roof panels and other components of the work securely in place, with provisions for thermal and structural movement.
      a. Field cutting of metal roof panels by torch, plasma cutter or saw blade is not permitted.
      b. Mechanically fasten ridge end of metal roof panels and allow eave end free movement due to thermal expansion and contraction.
      c. Provide metal Z closures at high-side eave, rake edges, rake walls and each side of ridge and hip caps.
      d. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
   3. Fasteners:
      a. Roof Panels: Use #10 by 1 inch (25 mm) pancake head fastener per SMI Engineering Report.
   4. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer. Fasteners used shall be Stainless Steel.
   5. Mechanical Seamed Metal Roof Panels: Fasten metal roof panels to solid substrate with concealed clips at maximum spacing o.c., two fasteners per clip, or per UL 580 specification or engineer recommendation based on project location and wind load requirements.
      a. Clip Spacing: 24 inches (406 mm).
      b. Install clips to deck with two #10 by 1 inch (25 mm) pancake head fasteners.
      c. Snap female side of panel over clip and male side interlocking panels.
   6. Metal Soffit Panel: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

a. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

D. Accessories
1. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
a. Install components required for a complete metal roof panel assembly including trim, copings, seam covers, flashings, sealants, gaskets, fillers and similar items.
b. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
c. Provide elbows at base of downspouts to direct water away from building.
d. Tie downspouts to underground drainage system indicated.

3.04. RELOCATION CONSIDERATIONS
A. Roof shall remain installed during relocation.
B. Repair
1. Repair of the roof shall be done by trained, qualified installers or members of the project team identified early and trained to repair the roof. Repairs shall be executed only when they do not compromise the integrity of the roof system with respect to humidity, thermal and solar properties, waterproofing, or other requirements as stated in these specifications.
2. The extent of repair of the underlayment and roof system shall be determined by the construction manager and project manager.
C. Replacement
1. Replacement of roof sections or the entire roof shall be performed only by trained, qualified installers in accordance with the installation procedures laid out in this manual.

3.05. SITE QUALITY CONTROL
A. Installation on-site shall be done under dry conditions with minimal impacts from dust and additional site works.
B. The project manager and construction manager shall inspect visually underlayment before installation of metal roof.
C. The sheet metal roofing shall be visually inspected before installation of final finish.

D. Seams shall be visually inspected by the project manager and construction manager for continuity.
E. Remove temporary protective coverings and strippable films if applicable, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
F. To prevent rust staining, remove any fillings caused by drilling or cutting immediately from finished surfaces.

3.06. COMMISSIONING

A. Roof shall be tested for waterproofing using 150 psi water spray test
B. Emissivity and reflectivity of roof shall be tested and performance verified by team prior to operation and handoff of the home.

3.07. ATTACHMENTS

A. Manufacturer’s Cut Sheet and UL Certifications attached.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM
PART 1 GENERAL

1.01. SUMMARY
- A. Section includes flashings and counter-flashings and other fabricated sheet metal items.
- B. Related Sections:
  1. 07 25 00: Weather Barriers
  2. 07 65 26: Self-Adhering Sheet Flashing

1.02. REFERENCES
- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot Dip Process.

1.03. SUBMITTALS
- A. Manufacturer shall provide a sample to the designer prior to installation in the home.
- B. A mock-up with the installed product shall be created prior to installation.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials causing discoloration or staining.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturer:
  1. W.A. Call Manufacturing Company. 1710 Rogers Ave., San Jose, CA 95112. Phone: (408) 436-1450.
- B. Materials
  1. Galvanized Steel: ASTM A653/A653M; structural steel sheet, G90 zinc coating; 24 gauge thick steel.

2.02. ACCESSORIES
- A. Fasteners: Same material and finish as flashing metal.
- B. Underlayment: Self-adhering modified bitumen waterproofing membrane.
- C. Slip Sheet: Rosin sized building paper.
- D. Sealant: Type sealant specified in Section 07 90 00.

E. Plastic Cement: ASTM D4586, Type I.

2.03. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed pursuant to local availability of materials.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by qualified personnel only. Qualification shall be determined by prior experience or discretion of the Project Manager and Construction Manager based on the completion of a mock-up.

3.02. EXAMINATION

A. Substrate shall be clean and dry, and SIPS and sheathing fully installed prior to installation of flashing and trim.

3.03. INSTALLATION

A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
B. Apply plastic cement compound between metal flashings and felt flashings.
C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.04. RELOCATION CONSIDERATIONS

A. Product shall remain installed during relocation.
B. Replacement
   1. Damaged product shall be replaced. Careful deconstruction of surrounding impacted areas shall occur, the affected section of product replaced, and installation to proceed.

3.05. SITE QUALITY CONTROL

A. Once installed, product shall be kept free from damage during surrounding construction.

END OF SECTION

SECTION 07 62 13
SHEET METAL GUTTERS AND DOWNSPOUTS
PART 1 GENERAL

1.01. SUMMARY

A. Rolled metal K-shape gutters and downspouts with seamless interfaces for rainwater collection and transfer.

1.02. REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A653: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed by the Hot Dip Process.
   2. ASTM A792: Standard Specification for Steel Sheet, 55 percent Aluminum Zinc Alloy Coated by the Hot Dip Process.
   3. ASTM A924: Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
   4. ASTM B370: Standard Specification for Copper Sheet and Strip for Building Construction.

B. Leadership in Energy and Environmental Design (LEED)

C. National Green Building System (NGBS)

1.03. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have a minimum of five (5) years experience in the production of sheet metal gutters and downspouts.

B. Fabricator Qualifications: Shall be approved by manufacturer for fabrication of gutters and downspouts.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Store materials on dry, level, firm, and clean surface.

1.05. WARRANTY

A. Finish Warranty:
   1. Manufacturing Defects: Standard form in which manufacturer agrees to repair or replace items that fail by blistering, checks, crazes, flakes, peels or weathers unevenly due to a defect in manufacturing within warranty period from date of original installation.
   2. Warranty Period: 20 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers

1. Sheffield Metals International, 5467 Evergreen Parkway, Sheffield Village, OH 44054. Telephone: (440) 934-8500. Fax: (440) 934-8506. Web: www.coolrmetal.com.
2. Wildcat Metals. 890 Faulstich Ct., San Jose, CA 95112. Phone: (408) 217-1595. Email: Contact@WildcatMetals.com.

B. Materials

1. Steel Coil Stock: Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792, Class AZ50 coating designation.
2. K-Style Gutter Fabrication:
   a. Gutter Size: 5 inches.
   b. Length: Continuous..
   c. Steel Thickness: 0.028 (24 gauge)
3. Gutter Corner Fabrication
   a. Provide mitered corners, welded and sealed. Corners shall extend a minimum of 12 inches from the corner in each direction. Lap joint and sealant where connecting to continuous gutter.
   b. Match material, shape and finish of gutter.
4. Rectangular downspout fabrication:
   a. Size: 2 by 3 inches.
   b. Length: Custom length.
   c. Texture: Corrugated.
   d. Material thickness:
      (a) Steel Thickness: 0.019 (28 gauge) inch.

2.02. ACCESSORIES

A. Gutters:

1. End Caps: Match material, shape and finish of gutter.
2. Outlet Tubes: Match material and shape of downspout.
3. Gutter Support:
   a. Hidden Gutter Hanger: Manufacturer's standard steel hidden hanger.

B. Downspouts:

1. Downspout Support:
   a. Exposed strap.
   b. Color: Silver, match downspout, as indicated on drawings.

2. Miscellaneous downspout components: Provide all necessary elbows, downspout offset sections, and pop rivets as required for a complete installation. All miscellaneous components shall match downspouts.

C. Fasteners:
   1. Galvanized steel fasteners of sufficient length to penetrate minimum 1 inch into substrate
D. Flashing: Provide flashing complying with Section 07 62 00 Sheet Metal Flashing and Trimat roof apron, fascia apron, and where indicated.
E. Sealants: Tripolymer, single component sealant as recommended by manufacturer at gutter joints.
F. Downspout Strainer: Steel wire-ball downspout strainer.
G. Splash Pans: Fabricate from the following. Size and shape as indicated on Drawings.
   1. Stainless Steel: 0.019 inch thick.
H. Exterior Coating:
   1. Standard Coating; Kynar 500 or Hylar 5000 applied to exposed side
   2. Color: Silver, as indicated on drawings.
I. Interior coating: Manufacturer's standard primer wash coat.
J. Exterior/Interior Finish: Galvanized steel.

2.03. PRODUCT SUBSTITUTIONS

A. Product substitution shall comply with color and shape requirements of the specifications.
B. Product substitutions shall be made no more than fourteen (14) days in advance of installation for initial installation of custom products, and three (3) days in advance of installation for off-the-shelf products.

PART 3 EXECUTION

3.01. INSTALLERS

A. Fabrication shall be done by a qualified fabrication shop.
B. Installers shall be trained in installation of sheet metal components and flashing. No specific qualifications are required, but training of installation crew is mandatory and certificate or record of completion of this training is required.

3.02. EXAMINATION

A. Verify that substrates are in place and ready for installation of gutters and downspouts.
B. Verify that product as delivered contains no material defects and that seams and lap joints between sections of gutters and downspouts are watertight and properly attached and sealed.
C. Verify that hangers are properly shaped and without defects.

D. Verify that downspout attachments are sufficiently long and without defect to attach to gutters seamlessly.

3.03. INSTALLATION

A. General: Install Work securely in place and provide for expansion and contraction of components using lapped and sealed joints
   1. Do not install damaged components.
   2. Separate dissimilar metals to prevent galvanic action through the use of bituminous coating or other permanent separation recommended by SMACNA.
   3. Space expansion joints in gutters as recommended by manufacturer.
   4. Rivet joints where required for strength, exposed rivet shall match gutter or downspout color.
   5. Torch cutting of components is not allowed.

B. Install roof edge flashings at roof edge conditions as indicated on Drawings.

C. Gutters:
   1. Install gutter supports at no more than 24 inches on center.
   2. Slope gutters evenly to downspouts; provide end caps at gutter ends and seal watertight per manufacturer's instructions.
   3. Install outlet tubes at all downspout locations, seal watertight.
   4. Apply joint sealants at gutter joints per manufacturer's installation instructions and to meet the requirements of Section 07 92 00 – Joint Sealants.

D. Downspouts:
   1. Install downspouts, provide elbows and offsets, and secure downspouts to wall construction using downspout supports spaced no more than 10 feet on center. Maximum distance of downspout support from top or bottom of downspout shall be 2 feet. Provide 45 degree elbow at bottom of downspout to direct water away from wall surface or foundation.
   2. Where downspout connects to building perimeter drainage system, lap downspout and perimeter drainage pipe a minimum of 3 inches.
   3. Install formed metal splash pans under downspouts.

3.04. RELOCATION CONSIDERATIONS

A. Repair
   1. Damaged gutter sections will be repaired via bending and reforming as possible. Re-welding and re-riveting as necessary will be applied.
   2. Repairs shall be assessed and approved by the project manager and construction manager.

B. Replacement

1. Sections of gutter and downspout shall be replaced if required with sections of the same color and cut.
2. Welding and riveting as required will be performed to attach new sections to existing sections. Touch-up painting to cover seams shall be performed as required.

3.05. SITE QUALITY CONTROL

A. Products shall be stored on-site so as not to place excessive stress on members. Storage shall take care not to cause deformation of the components.
B. Welding shall be performed, if necessary, by an experienced welder in the absence of other construction activities in the same zone so as to prevent impacts on the weld quality or safety risks.
C. Gutters and downspouts shall be covered after installation with plastic wrap to prevent dust and construction waste from entering and polluting collection system.

3.06. COMMISSIONING

A. Remove damaged, defective or improperly installed materials. Replace with new materials installed per requirements of this section.
B. Clean finished surfaces according to manufacturer's written instructions; maintain clean condition until Final Completion.

3.07. ATTACHMENTS

A. Manufacturer's data sheet attached.

END OF SECTION

SECTION 07 72 55
ROOF ACCESSORY ATTACHMENT SYSTEM
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Roof accessory attachment system for standing seam metal roofs and walls.
- B. Related Sections:
  1. Section 07 61 13: Standing Seam Sheet Metal Roofing.
  2. Section 26 31 00: Photovoltaic Collectors.

1.02. REFERENCES
- A. Aluminum Association (AA) - Aluminum Standards and Data, 2003 Edition.
- B. ASTM International (ASTM):
  1. B85-03 - Standard Specification for Aluminum-Alloy Die Castings.
  2. B221-04a - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  3. E527-83(2003) - Standard Practice for Numbering Metals and Alloys.

1.03. SUBMITTALS
- A. Submittals for Review:
  1. Shop Drawings: Show locations of clamps on roof, clamp spacing, and type of component being attached.
  2. Product Data: Include product description and installation instructions.
  3. Samples: Samples of typical clamp.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be stored in locked container prior to installation.

1.05. WARRANTY
- A. Provide manufacturer's 1 year warranty providing coverage against defects in materials and workmanship.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Metal Roof Innovations, Ltd.
- B. Materials:
  1. Standard Clamps:

a. Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
b. Clamp model: No. [S-5-U.] [S-5-E.]
c. Set screws: 300 Series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point, two per clamp. Cup-point setscrews are not permitted.
d. Attachment bolts: 300 Series stainless steel, 18-8 alloy, 10 mm diameter, with flat washers.

2.02. ACCESSORIES

A. S-5 PV Kit:
1. Friction Reducing Coated Stainless Steel Stud.
2. Integral Hex Drive.
3. Mounting Disc.

2.03. PRODUCT SUBSTITUTIONS

A. Substitutions are not allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be qualified and trained in fall protection. Qualification shall be determined by the Project Manager, Construction Manager, and/or Health and Safety Officer.

3.02. EXAMINATION

A. Prior to beginning installation, verify that:
1. Panel seaming is complete.
2. Panel attachment is sufficient to withstand loads transferred from clamps.
3. Installation will not impeded roof drainage.

3.03. INSTALLATION

A. Preparation: Clean seam areas to receive clamps; remove loose and foreign matter that could interfere with installation or performance.
B. Install clamps in accordance with manufacturer's instructions and approved Shop Drawings.
C. Place clamps in neat, straight rows, evenly spaced.
D. Place both set screws on same side of clamp.
E. Tighten set screws to manufacturer's recommended torque.
F. Randomly test set screw torque using calibrated torque wrench.

3.04. RELOCATION CONSIDERATIONS

A. Products shall remain installed during transportation unless the determination of the Construction Manager and transportation subcontractor is to remove them.
B. Repair:
    1. Products shall not be repaired.
C. Replacement:
    1. Replacement shall be with identical products.

3.05. SITE QUALITY CONTROL

A. Protect installed product from impacts from adjacent or following construction activities.

3.06. ATTACHMENTS

A. Manufacturer's Cut Sheet and Installation Instructions are attached.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Residential sealant.

1.02. REFERENCES
- A. Federal Specifications:
  1. Federal Specification TT-S-00230C, Type S, Class A.
- B. American Society for Testing and Materials (ASTM):
  1. ASTM C-920, Grade NS, Class 25.
  2. ASTM C-834 type OP, Grade-18 C.
- C. American Architectural Manufacturers Association (AAMA):
  1. AAMA 808.3.

1.03. SUBMITTALS
- A. Manufacturer shall provide data sheet prior to installation of product.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered to site in sealed containers from manufacturer.
- B. Product shall be stored between 35 F and 80 F for no more than 18 months from date printed on cartridge.

1.05. WARRANTY
- A. No warranty is provided for this item.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); http://www.construction.tyvek.com.
  2. Fortifiber Building Systems Group. 300 Industrial Drive, Fernley, NV 89408. Phone: (800) 773-4777. Email: buildingproducts@fortifiber.com.
  3. Dow Chemical. Phone: (866) 583-2583.
- B. Materials:
  1. DuPont Residential Sealant Modified Urethane Acrylic Sealant.
  2. Fortifiber Residential Sealant.

3. Great Stuff Gaps and Cracks Foam Sealant.
4. Great Stuff Window and Door Foam Sealant.

2.02. PRODUCT SUBSTITUTIONS

A. Product substitutions shall be allowed based on local availability subject to approval of the Construction Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only a qualified installer shall use this product. Qualified installers will be determined by the Project Manager, Construction Manager, or Health and Safety Officer.

3.02. EXAMINATION

A. All surfaces must be clean and dry. Remove all foreign matter and contaminants. Only apply when sealant, surface, and air temperatures remain above freezing. Do not apply on substrates or surfaces that are above 160 F. Do not apply on exterior surfaces when rain is immediately expected with 4-6 hours.

3.03. INSTALLATION

A. Cut nozzle at a 45 degree angle. Cured bead should be between 1/8" and ½". Use recommended foam backer rod or bond breaker tape for larger gaps; follow guidelines from rod and tape manufacturers for correct backer rod and tape sizes related to joint size.
B. Prior to any use, it is always recommended that the sealant be applied on the substrate surface to test adhesion.
C. Using a caulking gun, apply and tool sealant with adequate pressure to spread the sealant against the back-up material at the bottom and sides of the joint.
D. Clean up tools with soap and water.
E. Allow 4 to 6 hours curing time before applying paint.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Cracked sealant shall be stripped and reapplied.

3.05. SITE QUALITY CONTROL

A. Sealant shall be allowed to fully dry prior to painting or continuation of work adjacent to sealed area.
B. Beads shall be evenly applied and smooth after curing.

3.06. ATTACHMENTS

A. Manufacturer supplied data sheet is attached.

END OF SECTION

DIVISION 08

SECTION 08 13 73
SLIDING METAL DOORS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:

1. Horizontal sliding non-labeled door systems where shown on drawings and as specified herein.

B. Related Sections:

1. 06 12 00: Structural Insulated Panels.
2. 07 41 00: Preformed Metal Wall and Roof Panels.
3. 07 62 00: Sheet Metal Flashing and Trim.
4. 08 71 00: Door Hardware.

1.02. REFERENCES

A. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
5. ANSI/BHMA A156.15 - Hardware Preparation in Steel Doors and Frames.
6. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
7. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
8. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
9. UL 10C (1998) - Positive Pressure Fire Tests of Door Assemblies; UL 1784 (2001) - Standard for Air Leakage Tests of Door Assemblies.

1.03. SUBMITTALS

A. Provide drawings and cut sheets of product and installation manual prior to installation of product in the home.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Product shall be stored in a cool, dry location prior to installation protected from direct sunlight and wind.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Custom-Built Barn-Style Door constructed by general contractor.
B. Materials:
   1. Plain Box Rail, 600 Lb. support.
   2. Battalion Guide.
   3. Battalion Hanger for Track Door.
   4. ¾" Construction Grade Plywood.
   5. Finish: Doors shall be finished in same material as preformed sheet metal panel siding.

2.02. ACCESSORIES

A. COMPX NATIONAL Sliding Door Lock, Chrome, Key Different

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed except with written permission of the Project Manager and the product manufacturer.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by a qualified person. Qualified installers shall be determined at the discretion of the Project Manager and Construction Manager.

3.02. EXAMINATION

A. Floor shall be installed and leveled prior to installation.
B. SIPS paneling and wall finishes shall be installed with rough opening prepared prior to installation of door.

3.03. INSTALLATION

A. Preparation:

1. Prior to installation, adjust and securely frames for squareness, alignment, twist, and plumbness.
2. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
3. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

B. Installation:
1. General: Install sanitary/watertight steel work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
2. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Install door silencers in frames before grouting.
   c. Seal all areas where frames come in contact with the wall or other surrounds.
3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
4. Install doors with clearances according to NFPA 80.

3.04. RELOCATION CONSIDERATIONS

A. Door shall remained installed during transportation.
B. Repair:
1. Minor repairs shall be conducted on-site by qualified personnel.
C. Replacement:
1. Replacement shall only be conducted in cases of extreme damage at the discretion of the Project Manager.

3.05. SITE QUALITY CONTROL

A. Opening shall be kept undamaged and free of debris prior to and during installation.

3.06. ATTACHMENTS

A. Manufacturer cut sheet is attached.

END OF SECTION

SECTION 08 14 00
WOOD VENEER DOORS
PART 1 GENERAL

1.01. SUMMARY

A. Flush Wood Veneer Doors.
   1. Five-ply flush bonded doors.
B. Related Sections
   1. Section 06 10 00—Rough Carpentry.
   2. Section 06 12 00—Structural Insulated Panels.

1.02. REFERENCES

A. ANSI A208.1 – Particleboard.
B. AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 – Finishing.
C. AWI/AWMAC/WI Architectural Woodwork Standards, Section 9 – Doors.
D. NFPA 80 – Standard for Fire Doors and Other Opening Protectives.
E. UBC 7-2-1997/UL 10C – Positive Pressure Fire Tests of Door Assemblies.
F. WDMA I.S.1-A – Architectural Wood Flush Doors.
G. WDMA I.S. 10 – Industry Standard for Testing Cellulosic Composite Materials for Use in Fenestration Products.

1.03. QUALITY ASSURANCE

A. Tolerances for Warp, Telegraphing, Squareness, and Prefitting Dimensions: WDMA I.S.1-A.
B. Identifying Label: Each door shall bear identifying label indicating:
   1. Door manufacturer.
   2. Order number.
   3. Door number.
C. Environmental Responsibility: Provide doors manufactured with the following environmentally responsible components:
   1. Core:
      a. Agrifiber Core:
         (a) Rapidly renewable materials.
         (b) Pre-consumer recycled content.
         (c) No added urea formaldehyde.
   2. Composite Crossband:
      a. High-Density Fiberboard (HDF):
      b. Forest Stewardship Council (FSC) certified.
      c. Pre-consumer recycled material.

d. No added urea formaldehyde.

3. Stiles and Rails:
   a. Structural Composite Lumber (SCL): No added urea formaldehyde.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver doors to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage:
   1. Store doors in accordance with manufacturer's instructions.
   2. Store doors in clean, dry area indoors, protected from damage and direct sunlight.
   3. Store doors flat on level surface.
   4. Do not store doors directly on concrete.
   5. Keep doors completely covered. Use covering which allows air circulation and does not permit light to penetrate.
   6. Store doors between 50 and 90 degrees F (10 and 32 degrees C) and 30 to 50 percent relative humidity.

C. Handling:
   1. Handle doors in accordance with manufacturer's instructions.
   2. Protect doors and finish during handling and installation to prevent damage.
   3. Handle doors with clean hands or clean gloves.
   4. Lift and carry doors. Do not drag doors across other doors or surfaces

D. Environmental Requirements:
   1. Do not subject doors to extreme conditions or changes in temperature or relative humidity in accordance with AWS.

1.05. WARRANTY

A. Warrant solid core, interior doors for life of installation against warpage, delamination, and defects in materials and workmanship.

B. Defects noted during warranty period shall be corrected at no cost to Owner. Corrective work shall include labor and material for repair, replacement, refinishing, and rehanging as required.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer
   1. Simpson Doors, 400 Simpson Ave., McCleary, WA 98557.
   2. Impact Plus.

B. Materials

1. Simpson Entry Door #7664
   a. 2’10” x 6’8” x 1-3/4”
   b. Clear Insulated Glass Lites
2. Simpson #20 Flat Panel, stile, and rail door in Douglas Fir
   a. Two Panel Wood.
   b. 2’8” x 6,8” x 1-3/8”
   c. Door Thickness: 1-3/4 inches.
3. Impact Plus Smooth Flush Solid Core Primed MDF Interior Sliding Closet Door.
   a. Color: White
   b. 72” x 80”

2.02. ACCESSORIES

A. See Section 08 71 00, Door Hardware.
B. Pre-Hung Frames, weather stripping, trim, hinges.

2.03. SOURCE QUALITY CONTROL

A. Prefit Doors:
   1. Prefit and bevel doors at factory to fit openings.
   2. Prefit Tolerances: WDMA I.S.1-A and AWS Section 9.
B. Factory-machine doors for mortised hardware, including pilot holes for hinge screws and lock fronts required.
C. Doors shall receive factory finishing.
D. Factory Finishing: AWS System 2, precatalyzed lacquer.
   1. Sealer coat.
   2. Sanding: sand.
   3. Topcoat: 2 coats.
E. Top and Bottom Rails: Factory sealed.

2.04. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed provided the same fit and installation requirements are met.
B. The project manager and construction manager shall be notified of product substitutions with three (3) days of installation.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be qualified to hang wooden doors and shall have prior training and/or experience installing similar products.

3.02. EXAMINATION

A. Examine locations to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not begin installation until unacceptable conditions are corrected.
B. Ensure frames are solidly anchored, allowing no deflection when doors are installed.
C. Ensure frames are plumb, level, square, and within tolerance.

3.03. INSTALLATION

A. Preparation
   1. Allow doors to become acclimated to building temperature and relative humidity for a minimum of 24 hours before installation.
   2. Flashing and weather membrane around openings shall be properly installed prior to door installation.
   3. Studs and SIPS wall panels shall be installed in accordance with Section 06 12 00 and Section 06 10 00.
   4. Surfaces and substrates shall be cleaned and sanded prior to installation of door hardware and door.
B. Installation
   1. Install doors in accordance with manufacturer's instructions.
   2. Install doors at locations indicated on the Door Schedule and Architectural floorplans.
   3. Install doors plumb, level, and square.
   4. Install door hardware as specified in Section 08 71 00.
C. Adjusting
   1. Adjust doors to swing freely, without binding in frame.
   2. Adjust hardware to operate properly.
   3. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
   4. Remove and replace damaged doors that cannot be successfully repaired, as determined by Architect.

3.04. RELOCATION CONSIDERATIONS

A. Doors shall be locked or shimmed for transport to prevent free-swinging during movement.
B. Repair:
   1. Repairs of door hardware shall be undertaken by a qualified installer. Repairs shall be allowed to correct movement or drift during transportation that draw the door out of plumb, square conditions.
C. Replacement:
   1. Door hardware may be replaced if necessary by identical or comparable products as approved within this specification.

2. Door may be replaced with an identical or comparable product if damaged during relocation. Replacement may occur on short notice with approval of the architect and construction manager for the replacement product.

3.05. SITE QUALITY CONTROL

A. Protect installed doors from damage during construction.
B. Doors shall be plumbed after installation and checked to be true and square.
C. Door operation shall be verified by the architect and construction manager after installation.

3.06. COMMISSIONING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.
B. Do not use harsh cleaning materials or methods that could damage finish.

END OF SECTION

SECTION 08 35 13
FOLDING DOORS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Sliding/folding aluminum and glass door system, including aluminum frame, threshold, panels, sliding/ folding and locking hardware, weather stripping, glass and glazing; designed to provide an opening glass wall, with sizes and configurations as shown on drawings and specified herein.

1.02. REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E 283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
   2. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
   3. ASTM E 331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   4. ASTM E 547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
   5. ASTM E 2268, Standard Test Method for Water Penetration of Exterior Windows, Skylights, and Doors by Rapid Pulsed Air Pressure Difference.
   6. ASTM F 842, Standard Test Methods for Measuring the Forced Entry Resistance of Sliding Door Assemblies.

B. American National Standards Institute (ANSI):
   1. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

C. Consumer Product Safety Commission (CPSC):
   1. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials.

D. National Fenestration Rating Council (NFRC):
   1. NFRC 100, Procedure for Determining Fenestration Product Thermal Materials.
   2. NFRC 200, Procedure for Determining Solar Heat Gain Coefficient.
   3. NFRC 400, Procedure for Determining Fenestration Product Air Leakage.

1.03. QUALITY ASSURANCE

A. Manufacturer: Provide complete, precision built, engineered, pre-fitted unit by a single source manufacturer.

B. Performance Criteria: Provide from manufacturer that has independently tested typical units with the following minimum results.

1. Air infiltration: Provide system with maximum air leakage of 0.30 cfm/sq ft when tested according to ASTM E283 and NFRC 400 at a static air pressure difference of 1.57 psf and 6.24 psf.
2. Water Penetration under Static Pressure:
   a. Provide system with a raised sill (inswing or outswing) that do not evidence water penetration when tested according to ASTM E 331 and ASTM E 547 at a static air pressure difference of 12 psf.
   b. Provide system with a saddle sill with typical field installed weep holes and drainage by others (see drainage instructions from NanaWall) that do not evidence water penetration when tested according to ASTM E331 and ASTM E 547 at a static air pressure difference of 5.25 psf for an inswing unit and 6.00 psf for an outswing unit.
3. Water Penetration under Dynamic Pressure: Provide system with a raised sill that do not evidence more than allowable water entry when tested according to AAMA 520 and ASTM E 2268 at a dynamic rated air pressure difference of 6-18 psf for an inswing unit (Performance Level 2) and 5-15 psf for an outswing unit (Performance Level 1).
4. Structural Test Performance:
   a. Provide system with optional reinforced posts that when tested according to ASTM E 330 at 150% of positive and negative design pressures with panel sizes of 3’ wide and 8’ high achieved with an inswing unit with a raised sill DP rating of +70 psf / -100 psf and an outswing unit with a raised sill and inswing/outswing units with saddle sills DP ratings of +/- 70 psf.
   b. Provide standard system that when tested according to ASTM E 330 at 150% of positive and negative design pressures with panel sizes of 2’11” wide and 8’1” high achieved with an inswing unit with a raised sill DP rating of +55 psf / -90 psf, an outswing unit with a raised sill DP rating of -90 psf /+55 psf and inswing/outswing units with saddle sills DP ratings of +/- 50 psf.
5. Forced Entry Resistance: Provide system that when tested according to ASTM F 842 and AAMA 1304 there was no entry.

C. Thermal Performance U factor: Unit to be rated, certified and labeled in accordance with NFRC 100, shown in manufacturer’s latest published data for the glazing, sill, and direction of opening specified.

D. Solar Heat Gain Coefficient: Unit to be rated, certified and labeled in accordance with NFRC 200, shown in manufacturer’s latest published data for the glazing, sill, and direction of opening specified.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Product shall be delivered in protective packaging to ensure safety of material. Product shall arrive with manufacturer labeling still intact and wrapped in original packing.

B. Product shall be stored in conditions between 45 F and 105 F.
C. Product may be stacked for storage, but only five doors may be stacked at any time.
D. Glazing shall remain protected until installed with plastic or adhesive layering.

1.05. WARRANTY

A. Provide manufacturer's standard warranty against defects in materials and workmanship.
B. Warranty Period: Ten years for rollers. For all other components, one year (two years if unit is installed by manufacturer's certified trained installer) from date of delivery by manufacturer.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer
   1. Andersen Corporation, 100 Fourth Avenue North, Bayport, MN 550033-1096. Phone: (888-888-7020).
B. Materials
   1. Frame and Panels: From manufacturer's standard profiles, provide head track, side jambs, and panels with dimensions shown on drawings.
      a. Provide standard bottom rail.
      b. Aluminum Extrusion: Extrusions with nominal thickness of .078" (2.0 mm). Alloy specified as AIMgSio.5 with strength rated as 6063-T5 or F-22 (European standard). Anodized conforming to AAMA 611, powder coated conforming to AAMA 2604 or fluoropolymer kynar painted conforming to AAMA 2605.
      c. Thermally broken with ¾"-15/16" (20-24 mm) polyamide plastic reinforced with glass fibers. Polyamide plastic less than ¾" (20 mm) wide or pour and de-bridge thermal break will not be accepted.
      d. Aluminum Finish: Clear anodized.
   2. Flush single aluminum-framed door with single central lite panel.
   3. Glass:
      a. All glass to comply with safety glazing requirements of ANSI Z97.1 and CPSC 16CFR 1201. Provide manufacturer's standard glass with dry glazing with glass stops on the inside only: 15/16" (24 mm) double insulated clear safety.
      b. Provide manufacturer's standard silver gray glass spacers. Provide without capillary tubes.
   4. Locking Hardware and Handles:
      a. Main entry panel: On main entry pair of panels on models without a swing panel, provide manufacturer's standard L-shaped handles on the inside and on the outside and lock set with profile cylinder. Use stainless steel L shaped handles in a brushed satin finish.

b. On all other secondary panels and pairs of folding panels, provide manufacturer's standard handles and concealed two point locking hardware operated by 180 degree turn of handle between each pair. Face applied flush bolt locking will not be allowed. Standard handle finish: Stainless steel standard handles in a brushed satin finish.
c. Provide handle height centered at 41 3/8" from bottom of panel.
d. Aluminum locking rods with standard fiber glass reinforced polyamide end caps at top and bottom. Rods to have a stroke of 15/16" (24 mm).

5. Sliding/Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top, bottom tracks and threshold. All running carriages to be with sealed, self-lubrication, ball bearing multi-rollers. Surface mounted hinges and running carriages will not be allowed. Weight of panels to be borne by the bottom of the guide channel in the sill will not be allowed.
   a. Provide upper guide carriage and lower running carriage with four vertical stainless steel wheels and two horizontal polyamide wheels. The vertical wheels to ride on top of stainless steel guide track covers over the full length of the sill track and lie above the water runoff level. Carrying capacity of lower running carriage to be 440 lbs. (200 kgs). Wheels riding below the water runoff level and/or wheels riding on aluminum surfaces will not be allowed.
   b. Threshold: Provide thermally broken with polyamide raised sill in the same finish as panel finish. A cover plate over the sill will not be allowed.
   c. Hinges: Zinc die cast with finish closest match to finish of frame and panels. Provide stainless steel security hinge pins with set screws.
   d. Adjustment: Provide folding/sliding hardware capable of specified amount of compensation and adjustments without needing to remove panels from tracks, in width, 1/16" (1.5 mm) per hinge and in height, 1/16" (2 mm) up and down.
6. Other Components:
   a. Weather stripping: Provide manufacturer's standard double layer EPDM, Q-lon gasket or brush seals with a two layer fiber glass reinforced polyamide fin at both the inner and outer edge of door panels or on frame for sealing between panels and between panel and frame. Single layer weather stripping will not be allowed.
   b. Provide tapered pins or stainless steel screws for connecting frame components.

2.02. SOURCE QUALITY CONTROL

A. Use extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.

B. Sizes and Configurations: See drawings for selected custom dimensions within axiom frame sizes possible as indicated in manufacturer's literature. See drawings for selected number of panels and configuration. On configurations with a pair of swing panels, looking from inside, primary swing panel on the right.

2.03. PRODUCT SUBSTITUTIONS

A. No product substitutions are allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only qualified installers shall install the product. Installers shall have experience installing similar products of similar size. Installers shall be trained on placement and construction of product prior to installation.

3.02. EXAMINATION

A. Because of the large dimensions involved and the weight and movement of the panels, verify the structural integrity of the header such that the deflection with live and dead loads is limited to the lesser of L/720 of the span and ¼" (6 mm). Structural support for lateral loads (both wind load and eccentric load when the panels are stacked open) must be provided.
B. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square, with no unevenness, bowing, or bumps on the floor.
C. Installation of units constitutes acceptance of existing conditions.

3.03. INSTALLATION

A. Install frame in accordance manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
B. Installer to provide appropriate anchorage devices and to securely and rigidly fit frame in place, absolutely level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
C. If necessary, provide drain connections from lower track.
D. Install panels, handles and lock set in accordance with manufacturer's recommendations and installation instructions.
E. If necessary, adjust hardware for proper operation.
F. Accessories: Screens; install in accordance with screen manufacturer's recommendations and installation instructions

3.04. RELOCATION CONSIDERATIONS

A. Care shall be taken during relocation to protect the product. Glazing, if possible, shall be removed for transportation and the frame braced with temporary steel and wood members. If necessary, full temporary walls shall be constructed to provide shear support in the opening.
B. Glazing shall be transported separately and reinstalled on-site. Glazing shall be protected with plastic coverings during transportation and stacked and separated with foam or other soft inserts.
C. Repair:
    1. Repair to header or bottom rail shall be made only by a qualified installer.
D. Replacement:
    1. Replacement of glazing or auxiliary components shall be done by a qualified installer. Products for replacement should be sourced from Andersen Windows solely. No substitutes are allowed.

3.05. SITE QUALITY CONTROL

A. Glazing shall be protected after installation with protective plastic or adhesive layering.
B. Frame shall be squared and inspected before installation.
C. Inspection of header and railing for plumb and level finishes shall be performed prior to finishing of door opening.
D. The construction manager shall inspect the final installation for approval, check for plumb, level, and square finishes, and verify proper operation and functioning of the door. Seals may be checked with a blower door test for the entire house.

END OF SECTION

SECTION 08 53 00
PLASTIC WINDOWS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Thermal break aluminum windows with a 2-1/4 inch frame depth; fill and debridge.

B. Related Sections:
   1. Section 07 25 00: Weather Barriers.
   2. Section 07 62 00: Sheet Metal Flashing and Trim.
   3. Section 07 92 00: Joint Sealants.

1.02. REFERENCES

A. ASTM International (ASTM):
   1. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   2. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
   3. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   4. ASTM E 987 - Standard Test Methods for Deglazing Force of Fenestration Products.
   5. ASTM F 588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.

B. American Architectural Manufacturers Association (AAMA): AAMA/WDMA/CSA 101/I.S.2/A440 - Standard/Specification for Windows, Doors and Unit Skylights.

C. American Architectural Manufacturers Association (AAMA): AAMA 609 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

D. American National Standards Institute (ANSI): ANSI/AAMA 101.88 - Voluntary Specifications for Aluminum Prime Windows and Sliding Glass Doors.

E. Glass Association of North America (GANA): GANA 01-0300 - Proper Procedures for Cleaning Architectural Glass Products.

1.03. QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years experience in producing aluminum windows of the type specified.
   1. Manufacturer must be certified through the PPG Certified Window Fabricator and the Guardian Select Window Fabricator programs.

B. Performance: Comply with AAMA standards and ANSI/AAMA 101.88.

C. Mock-Up: Provide a mock-up created by selected installers for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Modify mock-up as required to produce acceptable work

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards. Protect from damage.
B. Place silicone or other spacers between glazing if windows are stacked on-site to prevent damage to glazing.
C. Place spacers between aluminum frames to ensure finishes are not damaged if product is stacked on-site.
D. Protect product from weather and damages due to dust and materials on-site.
E. Keep protective film or manufacturer packaging on windows until installation. Protect glazing with film or plastic after installation to prevent damage from continuing site works.

1.05. WARRANTY

A. Provide manufacturer's standard limited warranty for materials and workmanship.
   1. Aluminum Window Warranty Period: 1 year.
   2. Standard Insulating Glass Warranty Period: 5 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Andersen Corporation, 100 Fourth Avenue North, Bayport, MN 550033-1096. Phone: (888-888-7020).
B. Materials:
   1. Series 100 Aluminum Framed Windows
      a. Sizes:
         (a) 3’ x 4’ Casement Window.
         (b) 3’ x 8’ Combination Fixed Window with Awning.
         (c) 5’ x 3’ Fixed Window.
         (d) 3’ x 3’ Window with Awning.
         (e) 7’ x 3’ Fixed Window.
         (f) 5’ x 4’ Double Casement Window.
         (g) 6’ x 4’ Double Casement Window.
         (h) 3’6” x 3’ Window with Awning.

b. Construction:
   (a) Integral Extrusion Walls:
      (i) Wall Thickness: 0.094 inches (2.39 mm).
      (ii) Nominal Web Thickness: 1/8 inch.
   (b) Lite is retained from the exterior.
   (c) Full perimeter aluminum snap in glazing stops.
   (d) Full length pull in flat vinyl gasket.
   (e) Corners of Frame and Ventilators: Mitered and welded; muntin and intermediate bars attached to cross joints and abutting sash sections.
d. Glazing: Insulated glazed units, 1 inch (25.4 mm) overall thickness

2.02. ACCESSORIES

1. Thermal Break: Pour and debridge, two part polyurethane.
2. Weatherstripping: Two rows of santoprene, 64A durometer black bulb insert inserted in extruded slot at perimeter of vent and opening; replaceable in field.
3. Hardware for Casements and Awnings: Standard 4-bar heavy duty stainless steel hinges, die cast zing cam handles with pole ring.

B. Finishes:

1. Single Color Frames:
   a. Standard/Stock Finish: Clear Anodized Class II Finish.

2.03. PRODUCT SUBSTITUTIONS

A. Substitutions are not permitted without approval of architect and project manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in construction of windows. Competency shall be determined by site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Do not proceed with installation until substrates have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   1. Verify that openings are dimensionally correct and within allowable tolerances and substrates are plumb, level, and clean.
   2. Verify that anchoring surface is in accordance with approved shop drawings.

3.03. INSTALLATION

A. Install in accordance with manufacturer's written instructions and recommendations. Adjust for proper operation after installation.
B. Cleaning:
    1. Clean sealants, caulking, and other materials from surfaces, including adjacent work.
    2. Clean window frames, casings, and glass using materials and methods recommended by the window and glass manufacturer that do not cause defacement of work.
    3. Clean using methods which comply with AAMA 609.
    4. Clean glass using methods which comply with GANA 01-0300.

3.04. RELOCATION CONSIDERATIONS

A. Windows in clerestory and SIPS walls shall remain installed during transportation. If desired, glazing shall be removed.
B. Repair:
    1. Glazing may be replaced by qualified installer if necessary to repair damages incurred during installation and transportation.
    2. Damages in thermal break shall require replacement.
C. Replacement:
    1. Windows shall be replaced with identical product if required.

3.05. SITE QUALITY CONTROL

A. Protect glazing and window frames after installation from damage on-site.
B. Verify continuity of seals and frames with walls visually. Check frames for level, plumb, and square.

3.06. COMMISSIONING

A. Verify proper installation of windows through a blower door test for infiltration.

3.07. ATTACHMENTS

A. Product performance data sheets are included.

END OF SECTION

SECTION 08 62 50
TUBULAR DAYLIGHTING DEVICES
PART 1 GENERAL

1.01. SUMMARY

A. Engineered tubular daylighting system (VELUX SUN TUNNEL™) consisting of an exterior pitched or low profile roof flashing for installation in shingles/wooden shakes/tile roofs with an acrylic or polycarbonate dome. A self aligning pivoting device and an interior ceiling ring with dual diffuser assembly are joined by 14/21-inch nominal flexible reflective tunnel or 10/14-inch nominal rigid reflective tunnel. A ZTL electric light fixture accessory is needed to provide artificial lighting at night for all sizes. A ZTM and ZTG tile accessory kit is available for tile roofing applications.

1.02. REFERENCES

A. AAMA/WDMA/CSA 101/I.S.2/A440-08 – North American Fenestration Standard/Specification for windows, doors, and skylights (Includes all applicable reference standards).
B. AAMA/WDMA/CSA 101/I.S.2/A440-05 – Standard/Specification for windows, doors, and unit skylights (Includes all applicable reference standards).
C. ASTM D 635 – Test Method for Rate of Burning and/or Extent of Time of Burning of Self-supporting plastics in a Horizontal Position.
D. ASTM D-1929 – Standard Test Method for Ignition Properties of Plastics.
E. ASTM D 2843– Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
F. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
G. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings
H. ASTM E 283 –Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
I. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
J. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Static Air Pressure Difference.
K. ASTM E 547 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Cyclic Static Air Pressure Difference.
L. ASTM E 1886 - Standard Test Method for Performance of Exterior Window, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
M. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Windborne Debris in Hurricanes.

N. ISO 9001 – Standardized Requirements for a Quality Management System
O. ISO 14001 certified – Standardized Requirements for Environmental Management Systems

1.03. QUALITY ASSURANCE

A. Tubular daylighting device (VELUX SUN TUNNEL™) with exterior roof flashing, exterior dome, intermediate tunnel pivoting device, diffuser, reflective tunnel, adjustable elbow (TGR/TMR) and components required for a complete and weatherproof installation shall be manufactured to the highest standards of quality and craftsmanship in accordance with VELUX Manufacturing Standards and ISO 9001 and 14001.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. VELUX America Inc. product Model TMF/TMR and TGF/TGR VELUX SUN TUNNELS with exterior dome, flashing system, reflective aluminum tunnel, ceiling ring and diffuser as specified in this section and as manufactured by VELUX America Inc in the United States of America.

B. Performance Requirements
   1. Thermal Performance:
      a. Models TMF/TMR and TGF/TGR VELUX SUN TUNNELS with acrylic and polycarbonate domes tested in accordance with NFRC Procedure 100 shall have a U-factor no greater than 0.30.
      b. Models TMF/TMR and TGF/TGR VELUX SUN TUNNELS with acrylic and polycarbonate domes tested in accordance with NFRC Procedure 200 shall have a Solar Heat Gain Coefficient (SHGC) no greater than 0.30.

C. System Description
   1. Exterior Dome: 0.125-inch thick injection molded acrylic or polycarbonate
   2. Flashing System: Low profile TGF/TGR is a one piece 25 gauge, G90 galvanized sheet steel flashing that projects 4 inches above the roof deck for the 14 and 21-inch flashings. Pitched TMF/TMR is a one-piece 25 gauge, G90 galvanized sheet steel pitched flashing that projects 2.875-inches high on the backside and 10.5-inches on the front side above the roof deck for the 10 and 14-inch flashings.
   3. Pivot/Intermediate rings: Pivoting socket joint which secures upper elbow, allows for an additional 11 degrees of adjustability to help align tunnel sections, and provides a thermal break between the flashing and the dome and between the tunnel and the dome.
   4. Condensation control: Integral internal condensation collection gutter and drainage slots

5. Insect Barrier/Dome Seal – polyurethane foam between the dome and the intermediate ring.
6. Rigid tunnel: 10-inch nominal outside diameters, 2-feet in length, 24 gauge thickness, 98% specular reflective silver coated aluminum with a 20 year warranty.
7. Rigid elbows : 45 degree adjustable for 10 and 14-inch nominal outside diameters, 24 gauge thickness, 98% specular reflective silver coated aluminum with a 20 year warranty.
8. Flexible Tunnel: 14 and 21-inch nominal outside diameters with metalized polyester, fiberglass scrim and spring steel wire. 14" and 22" nominal outside diameters, 8-feet in length for the TMF/TGF 014 and 6-feet in length for the TGF 021
9. Round ceiling ring: A round diffuser assembly with a paintable acrylic trim ring and mounting ring.
10. Diffuser: Frosted(standard) or prismatic(optional) lower acrylic diffuser and a crackled clear upper acrylic diffuser. The two diffusers are secured in a santoprene gasketing system that provides an air tight seal with a 0.5-inch air space separating the upper and lower diffusers.

D. Materials
1. Exterior Dome: clear acrylic or polycarbonate (impact), includes UV absorbers to prevent UV transmittance and yellowing.
2. Flashing System: G90 galvanized sheet steel with neutral gray color
3. Pivot Ring: Black polypropylene
4. Flexible Tunnel (TGF/TMF): Metalized polyester, fiberglass scrim and spring steel wire, meeting ASTM E84 Class A requirements for smoke development index and flame spread index
5. Rigid Tunnel, Upper Rigid Elbow, Lower Rigid Elbow (TGR/TMR): Silver coated aluminum
6. Ceiling Ring: White Acrylonitrile Styrene Acrylate (ASA) plastic
7. Trim Ring: Paintable white acrylic
8. Locking Snap Ring: Steel
9. Diffuser: Dual diffuser system, upper acrylic diffuser over a lower acrylic diffuser secured by a flexible white santoprene gasketing system
10. Fasteners: Exterior dome to flashing system #8 x 0.75-inch Philips 18–8 corrosion-resistant screws; Flashing to roof sheeting 1 ½" pan head 18-8 stainless steel screws; Intermediate ring to flashing system #10 x 0.5-inch Phillips Flat head; Tunnel joint screws #6 x 0.375-inch Phillips pan head self drilling.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. An experienced and qualified installer is required.

3.02. INSTALLATION

A. Install in accordance with manufacturer's installation instructions.
B. Align tubular daylighting device free of warp or twist, maintain dimensional tolerances.
C. Apply sealant to the roof deck or bottom side of the flashing prior to Attaching the flashing system to the roof sheathing with the supplied 1 ½" pan head stainless steel screws in the locations of the pre punched holes to accommodate construction tolerances and other irregularities.
D. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in ceiling rough opening to maintain continuity of thermal barriers. In Canada secure vapor barrier to the components that penetrate the ceiling.
E. Coordinate attachment and seal of perimeter air and vapor barrier material.

3.03. RELOCATION CONSIDERATIONS

A. Check sealant for leaks. Repair or replace as necessary.

3.04. ATTACHMENTS

A. Technical test data attached.

END OF SECTION

SECTION 08 75 00
WINDOW HARDWARE
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Electromechanical actuators for residential windows.

1.02. REFERENCES
- A. CE Rated.
- B. UL Listed.

1.03. SUBMITTALS
- A. Provide architectural diagrams and sample product to architect and controls engineers prior to installation in the home. Provide information on electrical consumption and controls strategy.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Ensure that products are properly packed when received.
- B. Store product in a cool, dry location protected from sun, wind, and rain.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. UCS.
- B. Materials:
  1. UCS Vega Power Window Operator, AC.
     a. Stroke Length: 12” Opening Chain Stroke
     b. Dimensions: 1-3/4” x 1-1/4” x 17-3/4”
     c. Force: 55 lbs. in push and pull.
     d. Speed .375” per second.
     e. Minimum Sash Height: Minimum 10” height if pivoting brackets are used; minimum 35-1/2” if brackets are not used.
     f. Voltage Supply” 100-240 Vac.
     g. Watts Rating: 36 Watts at 120 V.
     h. Amp Rating: 0.3 amps at 120 V.

2.02. ACCESSORIES
- A. Optional pivoting brackets or hopper brackets are available.

2.03. PRODUCT SUBSTITUTIONS

A. Product substitutions shall be allowed for comparable products pursuant to approval of controls engineer and project manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. The product shall be constructed by only trained, qualified installers. Qualified installers shall be determined by the Project Manager and/or Construction Manager based on past performance and ability to execute electrical tasks and precision work.

3.02. EXAMINATION

A. Windows should be fully installed and walls around window finished, clean, dry, and level for installation of actuators.

3.03. INSTALLATION

A. Mount actuators to surface of window sill.
B. Use brackets to install opposite end of actuator to base of operable window.
C. Wire actuator into main control system of home.
D. Plug in the actuator.

3.04. RELOCATION CONSIDERATIONS

1. Product shall remain installed during transportation of the home.

B. Replacement:

1. Replacement shall be only with an identical product .

3.05. COMMISSIONING

A. Site Superintendent and/or Electrical Engineer shall verify the valid installation and full range of operation of the device in both manual and automatic settings.

END OF SECTION

DIVISION 09

SECTION 09 29 00
GYPSUM BOARD
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Gypsum board

B. Related Sections: Section(s) related to this section include:

1. Section 06 11 00: Wood Framing.
2. Section 06 16 00: Rough Carpentry.
3. Section 09 91 23: Interior Painting.

C. System Description

1. 7/16 inch thick gypsum core, laminated on front and back sides by 100% recycled paper, bringing total thickness to ½ in.

1.02. REFERENCES

A. ASTM C840-11: *Standard Specification for Application and Finishing of Gypsum Board*

B. ASTM C475/C475M-02 *Joint Compound and Joint Tape for Finishing Gypsum Board*

C. ASTM C1396/C1396M-11 *Standard Specification for Gypsum Board*

D. ASTM C1629/1629M-06(2011) *Standard Classification for Abuse-Resistant Standard Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels*

E. ASTM D 3273 *Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber*

F. GA-216-07 *Application and Finishing of Gypsum Panel Products*: Gypsum Association

G. GA-600-12: *Fire Resistance Design Manual*: Gypsum Association

1.03. QUALITY ASSURANCE

A. Provide gypsum board which has been manufactured, fabricated and installed to withstand loads as specified in design documents and ASCE guidelines for high seismic codes and to maintain performance criteria stated by manufacturer without defects, damage or failure.

B. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.

C. Source Limitations: Obtain all gypsum board through one source.

D. Compliance: Comply with manufacturer's ICC ES report, Load Design Charts, Construction Manual, Shop Drawings, and product data, including product technical bulletins, for installation.

E. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail and load design values shall be calculated and signed and/or sealed by a qualified architect/engineer.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials from gypsum board manufacturer with identification labels or markings intact.
B. Off-load gypsum board from truck and handle using fork lift or other means to prevent damage to board.
C. Gypsum board shall be fully supported in storage and prevented from contact with the ground. Stack gypsum board horizontally on pallets or in vertical stacks against wall.
D. Gypsum board shall be fully protected from weather. Protect against exposure to rain, water, dirt, mud that could compromise the quality or structural integrity of the gypsum board. Cover stored gypsum board with breathable protective wraps. Gypsum board shall be stored in a protected area: with 360 degree wall enclosure and roof coverage.

1.05. WARRANTY

A. Manufacturer's Warranty: Submit gypsum board manufacturer's standard warranty document certifying warranty from 15 years from date of purchase. Manufacturer warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Georgia-Pacific Corporation 133 Peachtree Street NE, Atlanta, GA 30303. Phone: (404) 652-4000.
   2. California Drywall 2290 So. 10th St., San Jose, CA 95112. Phone: (408) 292 7500
B. Materials
   1. Densglass Exterior Rated Type X Gypsum Sheathing
   2. Gypsum board for bathroom walls exposed to significant moisture levels consisting of:
      a. 100% recycled moisture and mold resistant light violet colored face paper and bronze back paper
      b. Lightweight gypsum core that complies with ASTM D 3273 test method for resistance to growth of mold
      c. Fiberglass reinforcement to resist hard impacts
   3. Gypsum board for all walls except bathroom walls consists of the following:
      a. 100% recycled paper facing on each side of the gypsum core.
      b. Lightweight gypsum core

c. Fiberglass reinforcement designed to resist hard impacts

C. Fabrication
1. Sizes: ProRoc and AirRenew gypsum board
a. 10’ (3050 mm) length
b. 4’ (1220 mm) width
c. ½” (12.7 mm) thickness
2. Fire Performance Rating: TBD, In accordance with GA-600-12: *Fire Resistance Design Manual* (Gypsum Association).

2.02. PRODUCT SUBSTITUTIONS
A. No substitutions permitted without fourteen day (14) prior approval
B. Substitutions should maintain thermal performance and dimensions provided in existing gypsum board plan.

PART 3 EXECUTION

3.01. INSTALLERS
A. Gypsum board panels will be installed by a qualified installer, trained by a drywall contractor in the proper installation process.

3.02. EXAMINATION
A. Verification of Conditions: Verify wall structures are ready for product installation in accordance with manufacturer’s instructions.
B. Production Verification of Conditions: Verify quality of paper coating of gypsum core and gypsum core visually to ensure product is acceptable for installation. Ensure that paper barrier is not broken or that product was not damaged visibly during shipping.

3.03. INSTALLATION
A. Gypsum Board Installation:
1. Gypsum Board Fastening: Apply gypsum board with selected drywall nails as indicated in drawings. Cover exposed nail heads with plaster or other sealing material to prevent compromise of paper barrier.
2. Thermal Barriers: Gypsum wallboard shall be finished with a polymer thermal barrier and nominal 1" (25 mm) interior wood paneling, or other selected materials. Apply code approved thermal barriers according to gypsum board manufacturer’s recommendations.
3. Restrictions: Do not fasten gypsum board to wall surfaces with nails other than approved drywall nails. Do not leave paper barrier compromised (seal after nailing) to prevent mold or mildew penetration to the gypsum core.

4. Remove and replace gypsum board or damaged before proceeding with installation of additional drywall.
5. Protection: Protect installed product and finish surfaces from damage during construction.

B. Before interior facing is applied, cover installed gypsum board with a plastic sheathing to prevent contamination of indoor air with drywall particulate matter.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
1. Boards with damaged paper facing will be set aside and considered for application at the end of wall sections where gypsum board will be cut to size.
2. Boards with crushed or otherwise structurally compromised gypsum cores will be set aside in a similar manner.

B. Replacement:
1. Should replacement be necessary (i.e. if the paper barrier is significantly damaged or perforated), only gypsum board from selected manufacturer will be used. Replacement boards should have the identical configuration.

3.05. SITE QUALITY CONTROL

A. Site Visits: Site superintendent, set crew superintendent, and project manager shall review attachment of gypsum board to existing wall structure to ensure quality.

3.06. COMMISSIONING

A. A blower door test shall be used to test infiltration and air tightness of the envelope. Infiltration shall not exceed 0.3 ACH. Test will be conducted after the installation of all wall structures and finishes.

END OF SECTION

SECTION 09 30 13
CERAMIC TILING
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Ceramic Tiling

B. Related Sections: Section(s) related to this section include:

1. 06 12 00 Structural Insulated Panels
2. 09 64 29 Wood Strip and Plank Flooring

1.02. REFERENCES

A. Tile Manufacturing Standard: Comply with the requirements of ANSI "American National Standard Specification for Ceramic Tile" (ANSI A137.1)

B. Installation Standards: Comply with the requirements of ANSI [ANSI A108, A118, A136, A137.1(2008)], and correlated Tile Council of America (TCA) details except where otherwise specified.

1.03. QUALITY ASSURANCE

A. Manufacturer: Procure all tile products for installation from a single manufacturer from a single production run to ensure consistent quality and aesthetic of product.

B. Certifications:

1. Provide manufacturer's Master Grade Certification for each shipment of tile

C. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.

D. Source Limitations: Obtain all tiles through one source. All accessories to be as furnished or recommended by the tile manufacturer

E. Compliance: Comply with manufacturer's instructions for installation.

F. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail shall be signed and/or sealed by a qualified architect/engineer.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver tiles in original packages with seal unbroken and original labeling intact.

B. Prevent damage to materials from water, freezing, or foreign materials. Inspect tile upon delivery to ensure that products were not significantly damaged during transport.

1.05. WARRANTY

A. Manufacturer's Warranty: Submit tile manufacturer's standard warranty document. Manufacturer warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Porcelanosa USA. 391 East Brokaw Road, San Jose, CA 95112. Phone: (408) 467-9400.

B. Materials:
   1. Porcelain Stone Wall Tiles: Jersey Mix
      a. Size 8" x 12"
   2. Porcelain Stone Wall Tiles: Jersey Nieve
      a. Size 8" x 12"
   3. Porcelain Stone Wall Tiles: Glass Acido PV
      a. Size: 12" x 35"
   4. Porcelain Stone Floor Tiles: Microcemento Gris
      a. Size: 18" x 18"

2.02. ACCESSORIES

A. Setting Materials:
   1. Portland cement mortar: complying with ANSI A 108.1, or ANSI A 108.5 in combination with ANSI A108.1
      a. Portland cement, ASTM C150, Type 1
      b. Sand, ASTM C 144
      c. Hydrated Lime: ASTM C 206 or ASTM C 207, Type S
      d. Water: clean and potable
      e. Reinforcement
   2. Floors: ¼" Hardee Backer.
   3. Waterproofing/Anti Fracture Membrane: Select per ANSI A118.10-1999 as required.
   4. Grouting Materials: Select liquid latex grout per ANSI A118.3, A118.5, A118.6, A118.7 or A118.8-1999.
   5. Provide grout in colors selected by the Architect from standard colors available from the approved manufacturers.
   6. Dry-set mortar: Complying with ANSI A 118.1, and meeting the requirements for setting the particular type of tile selected.
   7. Epoxy mortar: Complying with ANSI 118.3, chemical resistant, and water cleanable before setting

8. Epoxy adhesive: Complying with ANSI 118.3, and water cleanable before setting
9. Primer: as recommended by mortar manufacturer.

B. Grouting Materials:
1. Dry-Set Grout: Compound of portland cement and additives, factory blended for the type of tile to be grouted, and complying with ANSI A 118.6
2. Epoxy Grout: Two or three component epoxy resin and hardener, filler, blended for chemical resistance and the type of tile to be grouted and complying with ANSI A 118.3.
3. Single component, non-slumping, elastomeric rubber resistant to staining, moisture, mildew, cracking and shrinking, and complying with ANSI A 118.6

C. Waterproofing:
1. In compliance with the flooring manufacturer's recommendations, an electromeric rubber membrane, a neoprene or urethane, or 1or 2 component liquid formation.

D. Edging
1. Manufacturer provided metal band.

2.03. SOURCE QUALITY CONTROL

A. Source Quality Assurance: Each SIP component required shall be supplied by SIP manufacturer and shall be obtained from selected SIP manufacturer or its approved supplier.
1. Provide tiles with polyurethane or polysulfide sealant to prevent water damage and/or requisite mildew buildup.

B. Source Quality: Obtain tiles from a single manufacturer.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions permitted without fourteen day (14) prior approval.

PART 3 EXECUTION

3.01. INSTALLERS

A. Tiling will be installed by a trained, qualified installer. If student labor is used, it will be trained and overseen by an experienced tiler.

3.02. EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions are suitable of tile installation. Where ground is not level, a patching compound that can be troweled on and patted flat should be applied to any cracks and holes. Any protrusions can and should be removed by sanding the surface to which stile will be applied.

B. Before tiling, verify that all surfaces to be tiled are structurally sound true to plane, and fall within maximum variation of ¼" in 10'.

C. Before tiling, all surfaces must be free of curing compounds, oil, grease, wax, dirt, dust, form releases or other substances that would interfere with proper bond of setting materials. If tile is installed by the thin-set method, concrete slabs shall be steel trowel or light broom finish.

3.03. INSTALLATION

A. Install tile in accordance with ANSI A 108.1 through 108.7, as applicable for type of tile and method of installation
   1. Neutralize and seal substrate according to mortar/adhesive manufacturer's recommendations.
   2. Mix and apply grouting materials in accordance with manufacturer's instructions
   3. Protection: Protect installed product and finish surfaces from damage during construction.

B. Setting Methods:
   1. Comply with appropriate ANSI A108-1999 specification and current Tile Council of America Handbook for appropriate method of installation for each specification. For thin set adhesive mortar application use following technique: with the flat side of trowel, key mortar into substrate. Using the appropriate size trowel, comb mortar in one direction with notched side of the trowel. Set tile with a sliding motion, perpendicular to the mortar ridges. Obtain as near 100% coverage as possible of mortar to tile. Mortar coverage shall be no less than 85% and shall be sufficiently distributed to give full support under all corners and edges of the tile. Note: 95-100% coverage is mandatory for wet and exterior areas. Periodically, remove sheets or individual tiles to assure proper bond coverage consistent with industry specifications.
   2. Ensure there is a minimum 1/8" of mortar between tile and substrate after proper bedding. Installer must periodically remove sheets or individual tiles to assure proper bond coverage consistent with industry specifications. If coverage is found to be insufficient, use a larger size notch trowel.

C. Expansion Joints:
   1. Install architecturally designed expansion joints as per current TCA Detail EJ171. Prefabricated expansion joint strips can also be used when suitable.

D. Grouting Methods:
   1. Follow exactly grout manufacturer's instructions and comply with appropriate ANSI A108-1999 specification depending on type of grout selected. Grouting is not complete until all grout haze and residues are removed from the surface of the tile.

E. Cleaning and Protection:
   1. Leave finished installation free of cracked, chipped, broken, unbonded or otherwise defective tile work.
   2. Protect all floor tile installations with clean construction paper or other heavy covering during construction period to prevent staining or damage.

3. No foot or wheel traffic permitted on floor for at least 3 days after grouting.

3.04. RELOCATION CONSIDERATIONS

A. Product shall remain in place during transportation.
B. Repair:
   1. Cracked grouting can be repaired by an installer with a topcoat and proper curing time.
C. Replacement:
   1. Cracked tiles shall be removed and replaced with identical tiles. The installation shall then be regrouted.

3.05. SITE QUALITY CONTROL

A. Site superintendent shall check the level of the finish floor and verify that tiling and grouting has been completed competently.

END OF SECTION

SECTION 09 64 29
WOOD STRIP AND PLANK FLOORING
PART 1 GENERAL

1.01. SUMMARY
- A. This section includes:
  1. Reclaimed wood plank flooring.
  2. Attachments.
- B. Related Sections:
  1. Section 06 10 00 Rough Carpentry.

1.02. REFERENCES
- A. ASTM International (ASTM):
  1. A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver flooring until after concrete, masonry, plaster, ceramic tile and similar wet work is completely cured and dried.
- B. Lumber shall be delivered to site when needed and stored in a dry, covered location sheltered from the sun and not in contact with damp surfaces.
- C. Provide air circulation within and from around stacks and under temporary covering.
- D. Materials shall be protected from rain, sun, and other weather damage while stored on-site.
- E. Store decking in a dry, well ventilated, location protected from exposure to sun and moisture.
- F. Flooring is a "stable" material however it does move slightly after installation as it settles in and acclimates.
- G. Flooring should be stored in spaces where it will be installed at least 7-10 days (and preferably 3 weeks) before installation. This allows the wood to adjust to its new climate.
- H. Waste material shall be diverted from landfill and disposed of at PSSI Collection Facility, Bonair Siding, Stanford, CA.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Reusable Lumber Company, P.O. Box 620327, Woodside, CA 94602. Phone: (650) 529-9122 or (650) 867-8970. Email: info@reusablelumber.com.
- B. Materials:

4. Lumber: Reclaimed, re-milled Douglas Fir Tongue in Groove Flooring. Treated, Finished, and Sealed. Lumber will be sourced from one of the following locations:
   a. Habitat for Humanity, East Bay.
   b. Crossroads Lumber Co., North Fork, CA.
   c. Placemakers Incorporated, Redwood City, CA.
   d. The Reuse Network, San Leandro, CA.
1. Size: ¾" x 5" tongue in groove floor planks.
2. Stain: To be selected by architect to complement exterior and interior finishes.

2.02. ACCESSORIES

A. Fasteners:
   1. Minimum 2" finish flooring nails or staples, pneumatically driven.
B. Underlayment
   1. Roberts 3/32" Foam Underlayment.

2.03. SOURCE QUALITY CONTROL

A. Fabricate items rigid, plumb and square, as detailed, with tight, hairline joints. Set all nails and screws.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed. Lumber may be sourced from a different supplier as long as provided by Reusable Lumber Company.

PART 3 EXECUTION

3.01. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.02. EXAMINATION

A. SIP Subfloor must be clean and level prior to installation. Subfloor must have a vapor barrier (i.e. standardized flooring construction paper) stapled down before flooring is installed.
B. Do not install flooring until it has adjusted to the relative humidity and temperature of the space where it is to be installed.

3.03. INSTALLATION

A. Lay floorboards beginning at one end. Slide adjacent boards into the grooves of the previous track.

B. Fastening: Flooring nails or staples of 2" minimum should be used. There are many options available. Nails or staples should be spaced approximately every 2 feet into the groove above the tongue. The groove should cover the tongue entirely. The nail/staple should be invisible after next floor plank is laid into position. Floor planks should fit together so that no visible gaps exist.
C. After installation the floor should acclimate again for up to 2 weeks prior to application of any finishes.
D. After flooring is installed and acclimated/settled for a minimum of one week (preferably two weeks), finishes can be applied.
E. Prior to application of any finish, floor must be finish sanded by an experienced professional and surface must be perfectly clean and free of all dust and dirt.
F. The installer recommends floor wax, specifically bees wax based all-natural non-toxic finish. However, hard shell varathane finish is most common. Both wax and varathane take 3 coats to finish. In the case of wax, "buffing" adds to the shine and aids in wax penetration of the wood. Varathane must dry thoroughly between coats.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Minor cracks resulting in damaged flooring shall be filled with sealant and sanded to finish.
B. Replacement:
   1. Replacement of planks as required shall be performed. Remove nails and slide affected planks out of place and replace. Nail to finish.

3.05. SITE QUALITY CONTROL

A. No dust or dirt should be allowed into the area being floored. Do not walk on flooring in heavy or dirty boots until all finish coats are applied and have time to cure.

3.06. COMMISSIONING

A. Floors are routinely re-finished every ten years depending on use levels. Re-wax and buff for annual maintenance. Some floors can go years with just regular buffing. Adding a wax coat builds up a protective layer over time. Buffing or re-waxing or re-finishing is a matter of taste and varies from user to user and climate to climate (dryer climates typically require more maintenance).

END OF SECTION

SECTION 09 62 19
LAMINATE FLOORING
PART 1 GENERAL

1.01. SUMMARY
- A. This section includes:
  1. Linoleum laminated floor.
- B. Related Sections:
  1. 06 12 00 Structural Insulated Panels.

1.02. REFERENCES
- A. ASTM International (ASTM):
  1. A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Flooring shall be delivered in a roll to the project site, and pattern shall be confirmed upon delivery by the Project Manager and the Construction Manager.
- B. Material shall be stored in a covered location to prevent damage by UV radiation. Material shall be kept dry and clean prior to installation.
- C. Adhesives shall be stored in sealed containers in a well-ventilated area.
- D. Waste material shall be diverted from landfill and disposed of at PSSI Collection Facility, Bonair Siding, Stanford, CA.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Armstrong World Industries, Inc. PO Box 3001, Lancaster, PA, 17604. Phone: (800) 233-3823.
- B. Materials:
  1. Royelle Shegffley Black and White Residential Sheet Vinyl Laminate Flooring
     a. Indoor application
     b. Thickness: 0.65 in.
     c. Pattern Match Width: 4.5 in.

2.02. ACCESSORIES
- A. Fasteners:
  1. Vinyl adhesive, manufacturer recommended.

2.03. SOURCE QUALITY CONTROL

A. Fabricate items square. Ensure continuity of flooring and full coverage of adhesive on floor backing per manufacturer instructions.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed without the approval of the Project Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.02. EXAMINATION

A. SIP Subfloor must be clean and level prior to installation. Subfloor must have a vapor barrier (i.e. standardized flooring construction paper) stapled down before flooring is installed.

3.03. INSTALLATION

A. Lay vinyl beginning at one end of the space and rolling successively to the other. Overlap walls by 2-3" on all sides. Cut flooring with overlap to fit in allotted space. Ensure that layout covers all door openings and recesses and runs under any cabinetry.
B. Fastening: Apply adhesive using brush or foam brush to underside of vinyl. Begin at one end peeling back laid vinyl, applying adhesive, and replacing the flooring. Press firmly to ensure a full bond between adhesive and subfloor. If necessary, roll the laminate to ensure a full, smooth contact.
C. Trim edges of vinyl at base of wall to finish floor. Carefully remove any trimmings and allow floor to dry for 24 hours before placing any cabinetry or equipment on it.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
   1. Minor cracks resulting in damaged flooring shall be filled with sealant and sanded to finish.
B. Replacement:
   1. Replacement of floor shall be allowed if significant damage is incurred. Identical products and methods shall be used.

3.05. SITE QUALITY CONTROL

A. No dust or dirt should be allowed into the area being floored. Do not walk on flooring in heavy or dirty boots until all finish coats are applied and have time to cure.

3.06. COMMISSIONING

A. Floors are routinely re-finished every ten years depending on use levels. Re-wax and buff for annual maintenance. Some floors can go years with just regular buffing. Adding a wax coat builds up a protective layer over time. Buffing or re-waxing or re-finishing is a matter of taste and varies from user to user and climate to climate (dryer climates typically require more maintenance).

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. The Work in this Section requires the surface preparation and field application of primers, paints, stains and coatings to surfaces scheduled in the Schedule.

B. Related Sections:
   1. Section 06 20 00—Finish Carpentry.
   2. Section 09 00 00—Plaster and Gypsum Board.

1.02. REFERENCES

A. Green Seal Standard GS-11; May 20, 1993.
B. US Green Building Council, (USGBC): Green Seal standards for LEED paint credits.
C. American National Standards Institute (ANSI): Performance Standards.
D. Paint Decorating Contractors of America (PDCA): Application Standard.
E. National Paint and Coatings Association (NPCA): Gloss Standard.
F. American Society for Testing Materials (ASTM): Testing Methods.
G. Master Paint Institute (MPI): Established paint categories and standards.
H. Ozone Transmission Commission (OTC): Established levels of Volatile Organic Compounds.
I. SCAQMD 1168: South Coast Air Quality Management District Rule #1168; October 3, 2003.
J. National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

1.03. SUBMITTALS

A. Manufacturer shall provide sample materials demonstrating finishes and colors. Each sample shall be in triplicate, 5 inches x 7 inches in size, illustrating selected colors for each color and system selected with the specified coats cascaded.

1.04. MAINTENANCE MATERIAL SUBMITTALS

A. Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.05. QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: All products listed in this section are to be applied by a Painting Contractor with a minimum of five years demonstrated experience in surface preparation and field application of the same type and scope as specified.
C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Mock-up areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Approved mock-up areas will serve as the standard for remaining Work.
   4. Refinish mock-up area as required to produce acceptable Work.

1.06. DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
C. Disposal:
   1. Never pour leftover coating down any sink or drain. Use up material on the job or seal can and store safely for future use.
   2. Do not incinerate closed containers.
   3. For specific disposal or recycle guidelines, contact the local waste management agency or district. Recycle whenever possible.

1.07. WARRANTY
A. Inspection of all surfaces to be coated must be done by the manufacturer's representative to insure proper preparation prior to application. All thinners, fillers, primers and finish coatings shall be from the same manufacturer to support a product warranty. Products other than those submitted shall be accompanied by a letter stating its fitness for use and compatibility.
B. At project closeout, provide to the Owner or owner's representative an executed copy of the Manufacturer's standard form outlining the terms and conditions of and any exclusions to their Limited Warranty against Manufacturing Defect.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
A. Manufacturers:
   1. Behr Process Corporation. 3400 W. Segerstrom Ave., Santa Ana, CA 92704. Phone: (714) 545-7101.
B. Materials:
   1. Behr Premium Plus Paint+Primer All in One

a. Color: Eggshell White
b. Additional: Deep Base for Tinting

2. Volatile Organic Compound (VOC) Content:
   a. Provide coatings that comply with the most stringent requirements specified in the following:
      (a) 40 CFR 59, Subpart D-National Volatile Organic Compound Emission Standards for Architectural Coatings.
      (b) Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
3. Compatibility: Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Mixing and Tinting:
   a. Except where specifically noted in this section, all painting shall be ready-mixed and pre-tinted. Agitate all paint prior to and during application to ensure uniform color, gloss, and consistency.
   b. Thinner addition shall not exceed manufacturer's printed recommendations. Do not use kerosene or other organic solvents to thin water-based paints.
   c. Where paint is to be sprayed, thin according to manufacturer's current guidelines.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed except with written permission of the Project Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only qualified installers shall install the product. Qualified installers will be determined by the Project Manager and/or Construction Manager.

3.02. EXAMINATION

A. The Contractor shall review the product manufacturer's special instructions for surface preparation, application, temperature, re---coat times, and product limitations.
B. The Contractor shall review product health and safety precautions listed by the manufacturer.
C. The Contractor shall be responsible for enforcing on site health and safety requirements associated with the Work.
D. Do not begin installation until substrates have been properly prepared.
E. Ensure that surfaces to receive paint are dry immediately prior to application.

F. Ensure that moisture---retaining substrates to receive paint have moisture content within tolerances allowed by coating manufacturer. Where exceeding the following values, promptly notify Architect and obtain direction before beginning work.
   1. 3. Interior Wood: 15 percent.
   2. Interior Finish Detail Woodwork, Including Trim, and Casework: 10 percent.
   3. Plaster and Gypsum: 15 percent.

G. Examine surfaces to receive coatings for surface imperfections and contaminants that could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.

H. Correct conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.03. INSTALLATION

A. Preparation
   1. Clean surfaces thoroughly prior to coating application.
   2. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
   3. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.
   4. Remove Mildew, Algae, and Fungus using materials and methods recommended by coating manufacturer.
   5. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.
   6. Remove or protect adjacent hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings.
   7. Move or protect equipment and fixtures adjacent to surfaces indicated to receive coatings to allow application of coatings.
   8. Protect adjacent surfaces not indicated to receive coatings.
   9. Prepare surfaces in accordance with manufacturer's instructions for specified coatings and indicated materials, using only methods and materials recommended by coating manufacturer.

B. Surface Preparation
   1. Gypsum Board: Repair cracks, holes and other surface defects with joint compound to produce surface flush with adjacent surfaces.

2. Metals-Aluminum, Mill-Finish: Clean and etch surfaces with a phosphoric acid-water solution or water based industrial cleaner. Flush with clean water and allow to dry, before applying primer coat.
3. Metals-Galvanized Steel (not passivated): Clean with a water-based industrial strength cleaner, apply an adhesion promoter followed by a clean water rinse. Alternately, wipe down surfaces using clean, lint-free cloths saturated with xylene or lacquer thinner; followed by wiping the surface dry using clean, lint-free cloths.
4. Metals-Galvanized Steel, Passivated: Clean with water---based industrial strength cleaner. After the surface has been prepared, apply recommended primer to a small area. Allow primer to cure for 7 days, and test adhesion using the "cross-hatch adhesion tape test" method in accordance with ASTM D 3359. If the adhesion of the primer is positive, proceed with a recommended coating system for galvanized metal.
5. Metals-Stainless Steel: Clean surfaces with pressurized steam, pressurized water, or water-based industrial cleaner.
6. Plaster: Repair cracks, holes and other surface defects as required to maintain proper surface adhesion. Apply patching plaster or Joint compound and sand to produce surface flush with adjacent undamaged surface. Allow a full cure prior to coating application as recommended by the patching compound manufacturer's recommendations.
7. Wood:
   a. Seal knots, pitch streaks, and sap areas with sealer recommended by coating manufacturer; fill nail recesses and cracks with filler recommended by coating manufacturer; sand surfaces smooth.
   b. Remove mill marks and ink stamped grade marks.
   c. Apply primer coat to back of wood trim and paneling.
8. Wood Doors: Seal door tops and bottoms prior to finishing.

C. Application:
1. Application of primers, paints, stains or coatings, by the Contractor, will serve as acceptance that surfaces were properly prepared in accordance with the manufacturer's recommendation.
2. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
3. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
4. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).

5. Remove dust and other foreign materials from substrate immediately prior to applying each coat.
6. Where paint application abuts other materials or other coating color, terminate coating with a clean sharp termination line without coating overlap.
7. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.
8. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

D. Cleaning:
1. Clean excess coating materials, and coating materials deposited on surfaces not indicated to receive coatings, as construction activities of this section progress; do not allow to dry.
2. Re-install hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items that have been removed to protect from contact with coatings.
3. Reconnect equipment adjacent to surfaces indicated to receive coatings.
4. Relocate to original position equipment and fixtures that have been moved to allow application of coatings.
5. Remove protective materials.

3.04. RELOCATION CONSIDERATIONS

A. Repair:
1. Repair to Architect's acceptance coatings damaged by subsequent construction activities. Where repairs cannot be made to Architect's acceptance, re-apply finish coating to nearest adjacent change of surface plane, in both horizontal and vertical directions.

3.05. SITE QUALITY CONTROL

1. Protect completed coating applications from damage by subsequent construction activities.

END OF SECTION

DIVISION 10

SECTION 10 44 16
FIRE EXTINGUISHERS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Fire Extinguishers

B. Related Sections: Section(s) related to this section include:

1. Section 21 13 13 Wet-Pipe Sprinkler Systems

C. System Description

1. Fire extinguishers are part of the fire protection system of the house. These devices contain a chemical substance to inhibit the flames of a fire. Fire extinguisher types are determined by the kind of chemical they contain to extinguish a fire that started under certain conditions.

1.02. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to Stanford build site for test and confirm installation conditions.

B. Transportation to competition site: fire extinguishers should be protected from any kind of damage and once it arrives to final site it has to be tested to confirm that it is working properly.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers

1. Kidde Residential and Commercial Division: 1016 Corporate Park Drive, Mebane, NC 27302

B. Materials

1. Full Home Fire Extinguisher UL Rated 3-A, 40-B:C

2.02. ACCESSORIES

A. Mounting brackets: Manufacturer’s standard steel, secures fire extinguisher to wall for sizes of fire extinguishers listed. UL approved with plated or enamel finish, unless otherwise noted.

PART 3 EXECUTION

3.01. INSTALLERS

A. The personnel installing fire extinguishers in the house has to be approved by the project management and once installation is complete, a competent authority must commission it.

3.02. EXAMINATION

A. Verify that fire extinguishers are in good conditions when received and confirm it's functioning properly.

3.03. INSTALLATION

A. Installation of fire extinguishers must follow the guidelines established by the manufacturer and comply with all safety requirements determined by the competition rules.

3.04. SITE QUALITY CONTROL

A. The location of the fire extinguishers will match its location in the BIM.

3.05. COMMISSIONING

A. Final inspection of installed product.

END OF SECTION

DIVISION 11

SECTION 11 31 00
APPLIANCES
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Garbage disposal.
  2. Clothes care.
  3. Wall Oven.
  4. Dishwasher.
  5. Refrigerator.
  6. Electric Cooktop.
- B. Related Sections: Section(s) related to this section include:
  1. Section 12 35 30 Residential Casework.
  2. Section 12 36 00 Countertops.
  3. Section 22 11 16 Domestic Water Piping.

1.02. QUALITY ASSURANCE
- A. Product testing of each appliance to be undertaken on Stanford campus.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Deliver materials from package retailer or other source to Stanford build site.
- B. Transportation to Competition: Ship installed unless otherwise noted.

1.04. WARRANTY
- A. Product Warranty: Refer to Conditions of the Contract for purchase warranty provisions.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Garbage Disposals
  1. Continuous feed disposer.
     a. Basis of design: Provide disposal equal or equivalent to
        (a) Manufacturer: Insinkerator
        (b) Model: 3/4 Horsepower Continuous Feed Disposer, model no. Evolution Compact.
- B. Clothes Care
  1. Washers

a. Basis of design: Energy Star compliant front load washer equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: 4.1 cu ft. Frontload Energy Star Washer, Model no. GFWH1400DWW.

2. Dryers
a. Basis of design: Energy Star compliant electric dryer equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: 7.0 cu ft. Capacity Front Load Electric Dryer, model no. GFDS140EDWW.

C. Oven
1. Built-in Oven.
a. Basis of design: Provide built-in oven equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: 30" Built-In Single Convection Wall Oven, model no. JT5000SFSS.

D. Dishwashers
1. Built-in Dishwasher.
a. Basis of design: Provide built-in dishwasher equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: Hybrid Stainless Steel Interior Dishwasher with Hidden Controls, model no. GDT550HSDSS.

E. Refrigerator
1. Top-Freezer Refrigerators
a. Basis of design: Provide Energy Star compliant refrigerator equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: ENERGY STAR 18.1 Cu. Ft. Top-Freezer Refrigerator, model no. GTZ18GCESS.

F. Ranges
1. Electric cooktops.
a. Basis of design: Provide electric cooktop equal or equivalent to
(a) Manufacturer: General Electric
(b) Model: Profile 30" Built-In Clean Design Electric Cooktop, model no. PP945SMSS.

2.02. ACCESSORIES

A. Plumbing connections per appliance specs.
B. Electrical connections per appliance specs.
C. Mounting brackets and fasteners per casework design.

PART 3 EXECUTION

3.01. INSTALLERS

A. All appliances installed by student labor with electrical and plumbing connections installed by or under proper supervision of licensed electrician/plumber.

3.02. EXAMINATION

A. All appliance connections and project plumbing/electrical systems approved by licensed electrician/plumber before appliance testing.

3.03. INSTALLATION

A. General Conditions:
   1. Properly prepare substrates and coordinate casework rough-in work before installation
   2. Thoroughly clean and prepare surfaces in accordance to manufacturer recommendations prior to installation.

B. Installation Procedure
   1. Securely mount to substrate.
   2. Install appliances plumb and level and in proper relationship to adjacent construction.
   3. Connect appliances to building utility, supply and waste systems as applicable.
   4. Test for proper operation and drainage. Adjust until proper operation is achieved.

3.04. RELOCATION CONSIDERATIONS

A. Shipping and on-site commissioning
   1. Place protective coverings on appliances during shipping and keep appliances covered until ready for on-site commissioning

B. Repair, touch up, or replace
   1. Identify damage and assess proper course of action before Substantial Completion.

3.05. SITE QUALITY CONTROL

A. Prior to powering on:
   1. Project electrical and plumbing systems have been inspected by licensed electrician/plumber.
   2. All appliance connections and installations are to be inspected against a checklist of inspection inventory by student labor or licensed electrician or plumber per requirement.

3.06. COMMISSIONING

A. Upon proper connection and systems inspections all appliances are to have their entire use cycle tested.

3.07. ATTACHMENTS

A. All submittal sheets for appliances.

END OF SECTION

SECTION 11 34 00
RESIDENTIAL CEILING FANS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Ceiling Fan for bedroom.
- B. Related Sections:
  1. Section 09 29 00: Gypsum Board.
  2. Section 26 05 19: Low Voltage Electrical Power Conductors and Cables.

1.02. SUBMITTALS
- A. Manufacturer shall provide a CAD file of the product and product information with images to the team prior to installation of the product.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered in original manufacturer packaging and stored in box until installed.
- B. Box and product shall be kept in a locked, cool, dry location shielded from direct sunlight, wind, rain, and heat.

1.04. WARRANTY
- A. Manufacturer shall provide a standard warranty against manufacturing defects for the product.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Big Ass Fans. 2348 Innovation Drive, Lexington, KY, 40511. Phone: (877) 244-3267.
- B. Materials:
  1. Haiku ceiling hung fan.
     a. Finish: Ceramic white.
     b. Blade Span: 60”.
     c. Blade Color: White.
     d. Control: Remote Controller.

2.02. PRODUCT SUBSTITUTIONS
- A. Substitutions shall be allowed at the discretion of the Project Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in carpentry and low-voltage electrical installations.

3.02. EXAMINATION

A. The ceiling shall be clean and the drywall installed and painted prior to beginning work.
B. The product shall be free from defects and prepared for installation.

3.03. INSTALLATION

A. Install according to manufacturer's recommended instructions.

3.04. RELOCATION CONSIDERATIONS

A. Replacement:
   1. Replacement shall be with an identical or equivalent product as determined by the Architect.

3.05. SITE QUALITY CONTROL

A. Protect the installed product from being affected by adjacent or following construction work. Clean product of dirt and debris prior to operation.

3.06. ATTACHMENTS

A. Manufacturer's Cut Sheet attached.

END OF SECTION

DIVISION 12

SECTION 12 20 00
WINDOW TREATMENTS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Provide electrically operated roller shades.
      a. Include local, group and master motor control systems for shade operation with quiet, addressable, encoded motors.

B. Related Sections:
   1. Section 09 29 00: Gypsum Board.
   2. Division 26: Electrical.

1.02. SUBMITTALS

A. Manufacturer shall provide samples and product information prior to installation of project on-site including:
   1. Product Data: Manufacturer's data sheets on each product to be used, including:
      a. Preparation instructions and recommendations.
      b. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
      c. Storage and handling requirements and recommendations.
      d. Mounting details and installation methods.
      e. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
   2. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.
      a. Prepare shop drawings on AutoCAD or Microstation format using base sheets provided electronically by the Architect.
      b. Prepare control wiring diagrams based on zones, switching and operational requirements provided by the Architect in electronic format.
   3. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
   4. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.

Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

1.03. QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.
B. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
C. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.
D. ShadeCloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.05. WARRANTY

A. Motorized Roller Shade Hardware and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.
C. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
1. Hermary’s Shades. 386 El Camino Real, San Carlos, CA 94070. Phone: (650) 592-9480.
2. Materials:

a. Shade Type SOMFY LT50: Motorized interior solar roller shades in all exterior / interior windows of rooms and spaces as shown on referenced Drawings, and related motor control requirements systems.

2.02. ACCESSORIES

A. Access and Material Requirements:
   1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
   2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
   3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.

B. Motorized Shade Hardware and Shade Brackets:
   1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted.
   2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
   3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).
   4. All bands within a single motor group shall be aligned within 1/4 inch.

C. Shade Cloth
   1. Visually Transparent Single-Fabric Shadecloth.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed except with the approval of the Project Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only a qualified installer shall construct the product on the site.

3.02. EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03. INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.
B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
D. Test electrically operated shades for proper operation. Repair or replace units, which do not perform correctly.
E. Test automated tracking control system for proper operation. Repair or replace units, which do not perform correctly.
F. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.04. RELOCATION CONSIDERATIONS

A. Products shall remain in place during transportation and reconstruction.
B. Replacement:
    1. Products shall be replaced only with identical items.

3.05. COMMISSIONING

A. Operation of blinds shall be verified by the Site Superintendent and Controls Engineer after installation is complete.

3.06. ATTACHMENTS

A. Manufacturer’s Installation Sheet is attached.

END OF SECTION

SECTION 12 35 30
RESIDENTIAL CASEWORK
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes
  1. Kitchen cabinets.
  2. Bathroom cabinets.
- B. Related Sections: Section(s) related to this section include:
  1. Section 05 05 23 Metal Fastenings.
  2. Section 11 30 00 Appliances.
  3. Section 12 36 00 Countertops.
  4. Section 22 11 16 Domestic Water Piping.

1.02. QUALITY ASSURANCE
- A. Work to be verified against BIM for accuracy

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Deliver materials to Stanford build site for prefabrication.
- B. Transportation to Competition: Ship installed unless otherwise noted.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Kitchen cabinets
  1. Manufacturer: Capstone Cabinets. 119 Sunol Street, San Jose, CA 95126. Phone: (408) 998-4098. Email: info@capstonecabinets.com.
  2. Basis of Design Product: Compression Board 129” x 26” deep with standard edge detail along front only with undermount sink cutout and top mount cooktop cutout.
  3. Finish Style: Formica 2297-58 Terril (Uppers), Formica 459-58 Brite White (Lowers)
  4. Wood Type: MDF or Compression Board.
  5. Finish: Laminate.
- B. Bathroom Cabinet
  1. Manufacturer: Design Element USA, 8715 Boston Place, Rancho Cucamonga, CA 91730. Phone: (888) 487-4488.
  2. Product: Oasis Vanity Set
  3. Maple Hardwood lumber with stain
  4. Plywood Bottoms
  5. Drawer Construction: Dovetail
  6. Cabinet Finish: Crosslink conversion varnish top coat
  7. Modification: Custom fabricated 60” instead of 72”
  8. Accessories:

a. Sinks provided with Oasis vanity: Kohler Vox Round Above-Counter Bathroom Sink
b.

C. Cabinet Hardware:
1. Pulls: Hafele 126.27.306-Black Pulls for Lowers, Hafele 126.27.036-Aluminum Pulls for Uppers
2. Hinges: Blum Concealed 120 Degree European style self-closing, soft-close hinges.
3. Drawer Guides: Blum Tandem under mount Full extension with soft close feature.

PART 3 EXECUTION

3.01. INSTALLERS

A. All cabinets installed by student labor with guidance from professional carpenters and connections and fixture installation performed or supervised by licensed electrician/plumber.

3.02. EXAMINATION

A. Dimensions and final appearance checked against BIM.

3.03. INSTALLATION

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face. Coordinate connections to plumbing fixtures with MEP contractor.
B. Install cabinets without distortion so doors and drawers fit openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
C. Install cabinets and countertop level and plumb to a tolerance of 1/8 inch and 8 feet.
D. Fasten cabinets to adjacent units and to backing
1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration.
E. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.
F. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.04. RELOCATION CONSIDERATIONS

A. Shipping
1. Place protective coverings on cabinets where necessary and secure moving components to restrict motion during transport.
B. Repair, touch up, or replace
1. Identify damage and assess proper course of action before Substantial Completion.

3.05. COMMISSIONING

A. Final inspection of cabinets.

3.06. ATTACHMENTS

A. Manufacturer's Cut Sheet attached for Bathroom Vanity.

END OF SECTION

SECTION 12 36 00
COUNTERTOPS
PART 1 GENERAL

1.01. SUMMARY

A. This Section includes the following horizontal and solid surface product types:
   1. Countertops with sinks.
   2. Lavatory tops with integral bowls.

B. Related Sections include the following:
   1. Section 06 16 00 “Rough Carpentry” for Blocking.
   2. Section 22 41 00 “Residential Plumbing Fixtures.”

1.02. REFERENCES

A. NSF/ANSI Standards:
   1. Refer to www.nsf.org for the latest compliance to NSF/ANSI Standard 51 for food zone — all food types.

1.03. QUALITY ASSURANCE

A. Qualifications:
   1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.

B. Fabricator/installer qualifications:
   1. Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

C. Applicable standards:
   1. Standards of the following, as referenced herein:
      a. American National Standards Institute (ANSI)
      b. American Society for Testing and Materials (ASTM)
      c. National Electrical Manufacturers Association (NEMA)
      d. NSF International
   2. Fire test response characteristics:
      a. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
         (a) Flame Spread Index: 20.
         (b) Class A rating Smoke.
         (c) Developed Index: 110 Class A rating.

D. Coordination Drawings:

1. Shall be prepared indicating:
   a. Plumbing work.
   b. Electrical work.
   c. Miscellaneous steel for the general work.
   d. Indicate location of all walls (rated and non-rated), blocking locations and recessed wall items, etc.
2. Content:
   a. Project-specific information, drawn accurately to scale.
   b. Do not base coordination drawings on reproductions of the contract documents or standard printed data.
   c. Indicate dimensions shown on the contract drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements.
   d. Provide alternate sketches to designer for resolution of such conflicts.
      (a) Minor dimension changes and difficult installations will not be considered changes to the contract.

E. Drawings Shall:
   1. Be produced in ½-inch scale for all fabricated items.
F. Drawings must be complete and submitted to the architect within 60 days after award of contract for record only.
   1. No review or approval will be forthcoming.
   2. Coordination drawings are required for the benefit of contractor's fabricators/installers as an aid to coordination of their work so as to eliminate or reduce conflicts that may arise during the installation of their work.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver no components to project site until areas are ready for installation.
B. Store components indoors prior to installation.
C. Handle materials to prevent damage to finished surfaces.
   1. Provide protective coverings to prevent physical damage or staining following installation for duration of project

1.05. WARRANTY

A. Provide manufacturer's warranty against defects in materials.
   1. Warranty shall provide material and labor to repair or replace defective materials.
   2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

3. Warranty shall be transferable to subsequent owner for remainder of warranty period as defined as a builder/nonresident transferring to original resident occupant. No other transfers are transferable.
4. Cost limited to repair or replacement of affected countertop piece. This warranty does not include plumbing, gas, electrical, tile, wallpaper, painted surface or trim cost, incurred due to replacement of your countertop
5. Consult consumer warranty page for further information http://www.ceramiinc.com/paperstonewarranty.pdf

B. Manufacturer's Warranty Period:
1. Fifteen years from date of substantial completion.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer
1. Capstone Cabinets. 119 Sunol Street, San Jose, CA 95126. Phone: (408) 998-4098. Email: info@capstonecabinets.com Materials

B. Materials
1. 98" Long x 24" Finished edge all four sides
   a. Formica, Glacier White
2. Thickness:
   a. ½ inch.
3. Edge Treatment:
   a. Rounded corners and edges.
4. Integral Sink: Kohler
   a. Model: Undertone
   b. Specs: Under-Mount High/Low Double Squared Bowl Kitchen Sink
   c. Size: 31-1/2" x 18" x 7-5/8"
   d. Color: Brushed Stainless Steel
   e. Hardware: Simplice kitchen sink faucet with 16-5/8" pull down spout
      (a) Color: Stainless Steel
5. Backsplash:
   a. Porcelanosa Glass Acido PV
      (a) Size 12" x 35"

2.02. ACCESSORIES

A. Joint adhesive:
1. Manufacture provides recommended adhesives for each component.
   a. Seaming: G/Flex 655 Epoxy or 3M Scotch-Weld Epoxy Adhesive DP-105.
   b. Attach to Cabinet: Silicone, Polyseamseal, or Color Rite.

c. BackSplash: Silicone, Polyseamseal, or Color Rite.
d. Under-Mount Sink Silicone or Polyseamseal.
e. Waffle Mount: G/Flex 655 Epoxy or 3M Scotch-Weld Epoxy Adhesive DP-105.
f. Caulk: Polyseamseal, or Color Rite.
g. Built-p Edge: G/Flex 655 Epoxy

B. Sealant:
1. Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.

C. Sink/Lavatory Mounting Hardware:
1. Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.

D. Conductive Tape:
1. Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.

E. Insulating Felt Tape:
1. Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

2.03. SOURCE QUALITY CONTROL

A. Shop assembly
1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
a. Reinforce with strip of solid polymer material, 2" wide.
3. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
4. Rout and finish component edges with clean, sharp returns.
a. Rout cutouts, radii and contours to template.
b. Smooth edges.
c. Repair or reject defective and inaccurate work

2.04. PRODUCT SUBSTITUTIONS

A. No substitutes are allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installer shall be qualified in setting and finishing countertops and have experience installing similar products.

3.02. EXAMINATION

A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03. INSTALLATION

A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
   1. Provide product in the largest pieces available.
   2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
      a. Exposed joints/seams shall not be allowed.
   3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
   4. Cut and finish component edges with clean, sharp returns.
   5. Rout radii and contours to template.
   6. Anchor securely to base cabinets or other supports.
   7. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
   8. Carefully dress joints smooth, remove surface scratches and clean entire surface.
   9. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
B. Applied backsplashes and applied sidesplashes:
   1. Install applied sidesplashes using manufacturer's standard color-matched silicone sealant.
   2. Adhere applied backsplashes to countertops using manufacturer's standard color-matched silicone sealant.
C. Integral Sinks/Vanities:
   1. Provide solid surface materials bowls and/or lavatories sinks with overflows in locations shown on the drawings.
   2. 2. Secure sinks and lavatory bowls to tops using manufacturer's recommended sealant, adhesive and mounting hardware to maintain warranty.

3.04. RELOCATION CONSIDERATIONS

A. Keep components clean and covered during transportation, assembly, and disassembly.

B. Protect corners and edges during disassembly and reassembly.
C. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

3.05. SITE QUALITY CONTROL

A. Keep components clean during installation.
B. Remove adhesives, sealants and other stains.
C. Site superintendent and construction manager shall inspect the installation of countertops for continuity of seals, water tightness, and the quality of adhesive.

END OF SECTION

DIVISION 21

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS
PART 1 GENERAL

1.01. SUMMARY

A. Design, installation and testing shall be in accordance with NFPA 13d or IRC P2904 except for specified exceptions.

B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation for entire project

C. Related Sections

1. Section 22 11 16: Domestic Water Piping.
2. Section 22 11 23: Domestic Water Pumps.

1.02. REFERENCES

A. National Fire Protection Association (NFPA):

1. 13-2002 Installation of Sprinkler Systems
2. 101-22003 Safety to Life from Fire in Buildings and Structures (Life Safety Code)
3. 170-1999 Fire Safety Symbols

B. Underwriters Laboratories, Inc. (UL):

C. Factory Mutual Engineering Corporation (FM):

1. Approval Guide – 2001

D. Uniform Building Code – 1997

E. Foundation for Cross-Connection Control and Hydraulic Research-2005.

1.03. SUBMITTALS

A. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13. Include a site plan showing the piping to the water supply test location.

B. Manufacturers Data Sheets:

1. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
2. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.

1.04. QUALITY ASSURANCE

A. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Products should be carefully stored prior to installation.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer:
   1. The Reliable Automatic Sprinkler Co., Phone: (864) 843-5227.

B. Piping and Fittings
   1. Sprinkler systems in accordance with NFPA 13. Use nonferrous piping in MRI Scanning Rooms.
   2. Uponor PEX Tubing shall be used for Piping.

C. Sprinklers:
   1. Model G5 Concealed Sprinklers, 4.2 K-Factor.
   2. Model F156 and F1FR56 Horizontal Sidewall Sprinklers, ½" Orifice, HSW1 Deflector.

D. Valves
   1. Valves in accordance with NFPA 13.
   2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves
   3. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).
   4. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.
   5. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads

E. Fire Department Siamese Connection
   1. Brass, flush wall type, exterior fire department connection with brass escutcheon plate, and a minimum of two 65 mm (2-1/2 inch) connections threaded to match those on the

local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters "Automatic Sprinkler". Install an automatic ball drip between fire department connection and check valve with drain piping routed to the exterior of the building or a floor drain.

F. Gauges
   1. Provide gauges as required by NFPA 13.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed without the approval of the Fire Suppression designer.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installation shall be accomplished by the qualified installer. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

3.02. INSTALLATION

A. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.

B. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13.

C. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.

D. Kitchen Ventilator Hood Fire Protection: Provide piping from the building sprinkler system to the stub-out point on the ventilator control cabinet. Size piping in accordance with manufacturer specifications.

E. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

F. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material.
G. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
H. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
I. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.

3.03. RELOCATION CONSIDERATIONS

A. Upon relocation the entire system must be commissioned approved for service before occupation.

3.04. SITE QUALITY CONTROL

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.
B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.05. COMMISSIONING

A. Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COTR/Resident Engineer.

3.06. ATTACHMENTS

A. Manufacturer's Cut Sheets for Sprinklers are attached.

END OF SECTION

DIVISION 22

SECTION 22 07 00
PLUMBING INSULATION
PART 1 GENERAL

1.01. SUMMARY

A. Provide piping insulation as specified below. The purpose of the thermal pipe insulation is for condensation control, energy and water savings, noise reduction and freeze protection.

B. Related Sections:

1. Section 22 11 16: Domestic Water Piping.

1.02. QUALITY ASSURANCE

A. Material shall be delivered in nonbroken, factory furnished packaging and stored in a clean, dry indoor space that provides protection against the weather.

B. Insulation shall be applied by qualified personnel skilled in this trade.

C. Progressive testing of the systems to be insulated shall have been completed, inspected and approved by the owners' representative before the insulation is applied.

D. Insulation shall not be applied until all surfaces are clean, dry, and free of dirt, dust, grease, frost, moisture and other extraneous elements.

E. Work shall be performed at the temperatures recommended by the product manufacturer.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Material shall be stored in a cool, dry place protected from exposure to sun, wind, and rain.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:

1. Armacell Engineered Foams. Phone: (919) 304-3846. Email: info.us@armacell.com.

B. Materials:

1. Insulation material shall be a flexible, closed-cell

a. Polyolefin/polyethylene insulation in tubular form: TUBOLIT, TUBOLIT SS, TUBOLIT W, SSA 2000. This product meets the requirements as defined in ASTM C 1427, “Specification for Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form”.

b. Flexible elastomeric in tubular foam. AC/Accoflex, AP/Armaflex, AP/Armaflex SS. This product meets the requirements as defined in ASTM C 534, Grade 1, Type

I, "Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form"

2. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perminches when tested in accordance with ASTM E 96, Procedure A, latest revision.

2.02. ACCESSORIES

A. Adhesives and Finishes:
   1. Adhesive shall be the insulation manufacturer's recommended contact adhesive: Armaflex 520, Armaflex 520 BLV.
   2. Insulation finish shall be the insulation manufacturer's recommended finish: WB Armaflex Finish.
   3. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings as specified above.

2.03. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed based on local availability. Substitutes must have the same or similar specifications and purposes.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only a qualified installer should apply the foam insulation.

3.02. EXAMINATION

A. Pipe should be completely installed prior to application of insulation.

3.03. INSTALLATION

A. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLV Adhesive. A thin coat of adhesive must be applied to both surfaces, allowed to tack and join both surfaces with firm pressure. When using AP/Armaflex SS, TUBOLIT SS, SSA 2000 only the butt joints shall be adhered using Armaflex 520 or 520 BLV Adhesive.

B. The insulation must be installed in compression to allow for expansion and contraction. Install an additional 1.5 inches of insulation for every six feet of installed pipe or an additional 2 percent of measured pipe length.
C. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulationmay result in open seams and joints.
D. Tape the ends of the copper tubing before slipping the Armaflex or TUBOLIT pipe insulation over the new pipes to prevent dust from entering the pipe.
E. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives must be used.
F. On heat traced systems, the tracer shall not exceed the allowable temperature limit of the insulation material. Insulation ID may need to be oversized to accommodate heat trace tape.
G. Seams shall be staggered when applying multiple layers of insulation.

3.04. RELOCATION CONSIDERATIONS

A. Product shall remain in place during transportation.

3.05. SITE QUALITY CONTROL

A. Product shall not be protected from damage from following construction activites.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING
PART 1 GENERAL

1.01. SUMMARY

A. General: Hot and cold domestic water lines will be made from flexible Cross-linked polyethylene (PEX) tubing

B. Project Conditions: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.02. REFERENCES

A. ASTM International (ASTM):
   1. ASTM F 876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
   2. ASTM F 877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
   3. ASTM F 1281-2005 - Standard Specification for Crosslinked Polyethylene/Aluminum/ Crosslinked Polyethylene (PEX AL PEX) Pressure Pipe.
   4. ASTM F 1807 - Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
   5. ASTM F 1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
   6. ASTM F 2080 - Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe.

B. Canadian Standards Association (CSA): CAN/CSA B137.5 - Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications.

C. German Institute for Standards/Deutsches Institut fur Normung (DIN): DIN 4726 - Pipelines of Plastic Materials Used in Warm Water Floor Heating Systems; General Requirements.

D. International Code Council (ICC): PMG Listing 1053.

E. Plastics Pipe Institute (PPI):
   1. Technical Report TR-3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

F. Technical Report TR-4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds.

G. Society of the Plastics Industry (SPI).

H. IAPMO, Uniform Plumbing Code

I. BOCA, Basic Building, Mechanical Plumbing Codes

1.03. QUALITY ASSURANCE

A. Single Source Requirements: To the greatest extent possible, provide products specified in this section from a single manufacturer.
B. Installer Qualifications: Successfully engaged in installation of systems of similar size and complexity for at least 2 years.
C. Manufacturer Requirements: Appoint a representative to visit and inspection site.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers and packaging with identification labels identifying product name and manufacturer intact.
B. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards. Protect from damage.
C. Prevent dirt or foreign materials from entering tubing.
D. Do not expose tubing to direct sunlight for more than 30 days; cover tubing exposed to direct sunlight if construction delays occur.

1.05. WARRANTY

A. Warranty per contract purchase agreement.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Uponor, 5925 148th Street West, Apple Valley, MN 55124. Phone: (800) 321-4739. Fax: (952) 891-2008.
B. Tubing:
   1. Tubing Type:
      a. ½" Uponor AquaPEX White.
C. Materials: Crosslinked polyethylene (PEX) manufactured by PEX-a process.
D. Pressure Ratings: Standard Grade hydrostatic design and pressure ratings as issued by the Plastics Pipe Institute (PPI), div. of the Society of the Plastics Industry (SPI).
E. Minimum Bend Radius (Cold Bending): No less than four times the outside diameter. Use the PEX tubing manufacturer's bend supports if radius is less than stated.
F. Supply and Return Piping to the Manifolds: For above ground piping.
   1. Properly size supply and return distribution piping for the given volume and velocities required at system design.
   2. Use manufacturer approved distribution piping material (such as MrPEX Barrier PEX, type M copper) for supply fluid temperatures in systems with ferrous components.

3. Use fittings compatible with piping material. Fittings must transition from distribution piping to system manifolds.

2.02. ACCESSORIES

A. ProPEX Rings:
   1. ProPEX Ring with Stop, ½".
B. Supports:
   1. PEX Wall Support Bracket, ½" and ¾".
C. EP Multi-port Tees
   1. ¾" EP Branch Opposing-port Multi-port Tee, 3 Outlets.
D. ProPEX Valves:
   1. ProPEX EP Angle Stop Valve for ½" PEX.
E. Finishes:
   1. ProPEX LF Copper Tube Ell, ½" PEX x ½" Copper (3" x 4").
   2. ProPEX Escutcheon for ½" PEX (11/16" O.D.), white.
   3. ProPEX Ice Maker Box with Support Brackets, ½" LF Brass Valve.
   4. ProPEX Washing Machine Outlet Box, ½" LF Brass Valves.

2.03. PRODUCT SUBSTITUTIONS

A. No product substitutions

PART 3 EXECUTION

3.01. INSTALLERS

A. System Design: Shall be in accordance with standard industry practice for water distribution systems and the manufacturers' instructions. The design shall take into consideration such factors as pressure and flow requirements, friction loss, operating temperatures, support spacing, joining methods, and thermal expansion and contraction.
B. The maximum design temperature/pressure rating shall not exceed 100 psi at 180°F (400 psi at 73°F).

3.02. EXAMINATION

A. Prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions.
B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.03. INSTALLATION

A. Install products in accordance with manufacturer's instructions and recommendations.
   1. Testing: Prior to covering in wall/floor/ceiling installations perform a system pressure test and inspect for leaks; test electrical controls.
B. Installation practices such as pipe support spacing, bracing, allowance for thermal expansion/contraction, tubing bending radius and support shall be in accordance with the manufacturer's instructions and this specification.
C. Site Visits and Inspections: By manufacturer's representative to visit and inspection site; according to schedule establish in pre-installation meeting.
D. Through-Penetration Firestopping: Ensure compatibility of 1- and 2-hour rated through-penetration assemblies.

3.04. RELOCATION CONSIDERATIONS

A. Plumbing will be installed and tested on all modules during the prefabrication in Stanford.
B. Plumbing lines that cross between modules will have plumbing connection within a junction box.
   1. Pipe connections will use compression snap couplings that snap into place once the modules tare reassembled in Irvine.
   2. During transportation, all open ends of plumbing lines shall be covered to prevent contamination of the plumbing.
   3. Upon reconnection of all the plumbing junctions, the system is to be hydrostatically tested for leaks.
C. Replacement and spare parts are to be shipped with the home for onsite quality control.

3.05. SITE QUALITY CONTROL

A. Clean installed products in accordance with manufacturer's instructions.
B. Remove temporary coverings and protection of adjacent work areas.
C. Remove construction debris from project site and legally dispose of debris.
D. Touch-up, repair or replace damaged products before Substantial Completion.
E. Protect installed products and finishes from damage during construction.

3.06. ATTACHMENTS

A. Manufacturer Submittal Sheets and Code Approval sheet attached.

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS
PART 1 GENERAL

1.01. SUMMARY

A. Description
   1. Circulating pump for domestic water system.

B. Related Sections: Additional Sections of the Documents which are referenced in this Section include:
   1. Section 22 11 16: Domestic Water Piping.

1.02. REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
   1. ICS6-93 (R2006): Industrial Control and Systems Enclosures
   2. 250-08: Enclosures for Electrical Equipment (1000 Volts Maximum)

C. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code: 2010
   2. Section VIII: Pressure Vessels, Division I and II

D. Underwriters' Laboratories, Inc. (UL):
   1. 508-99 (R2008): Standards for Industrial Control Equipment

1.03. QUALITY ASSURANCE

A. Components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer.

B. Shop Test: Water booster unit and its component parts shall undergo a thorough electric and hydraulic operating test prior to shipment. Tests shall include a system operating flow test from zero to 100 percent of design flow rate under specified suction and system pressure conditions. Certified performance curves shall be furnished.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Impeller or booster pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling.

B. Mounting shall be either of the following:
   1. In-line mounted.
   2. Floor mounted set on common bed plate with drip lip.
   3. Basis of design: Energy Star compliant pump equal or equivalent to

a. Manufacturer: Grundfos.
b. Model: MQ3-45 Pressure Boosting Pump.

2.02. PRODUCT SUBSTITUTIONS

A. Replacement products with adequate capacity are acceptable

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers are to be student labor and shall be trained and their competency verified by the site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, and all control functions.
C. When any defects are detected, correct defects and repeat test.

3.03. INSTALLATION

A. Working surfaces are to cleaned and prepared per manufacturer guidelines
B. Plumbing connections are to be standard connections consistent with the plumbing system materials.
C. Before testing both plumbing and electrical systems must be inspected by licensed electrician/plumber.

3.04. ATTACHMENTS

A. Manufacturer's Product Guide is attached.

END OF SECTION

SECTION 22 12 19
FACILITY GROUND-MOUNTED POTABLE-WATER STORAGE TANKS

PART 1 GENERAL

1.01. SUMMARY

A. Facility tank specifications for:
   1. Septic
   2. Potable water

B. Go-To Custom Open Top and Enclosed Tanks.
   1. Custom designed tanks based on consumer requirements.

C. Related Sections
   1. Section 22 11 16: Domestic Water Piping.
   2. Section 22 11 23: Domestic Water Pumps.
   3. Section 22 13 16: Sanitary Waste and Vent Piping.
   4. Section 22 13 29: Sanitary Sewerage Pumps.

1.02. QUALITY ASSURANCE

A. Go-To Tanks to perform factory testing to include pressure and stress tests.

B. Single Source Requirements: To the greatest extent possible, provide products specified in this section from a single manufacturer.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Tank should be stored in factory packaging until time of installation.

B. After the tank has been removed from factory packaging, maintain apertures sealed to prevent contamination.

C. Store in a dry cool area. 50-80^{o} F and 20-70% relative humidity.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturer:
   1. Go-To Tanks. Phone: (877) 468-2657.

B. Materials:
   a. Polyethylene, polypropylene, PVC, CPVC, Teflon, or Kynar suitable for chemical storage, acides, fuel/motor oils, plating solutions, or other.
   b. Lids and hatches included with all tanks.
   c. 300 and 1,000 gallon capacity.
   d. 4” fill cap.

2.02. ACCESSORIES

A. Suitable fittings and flanges to be selected per the manufacturer's guidelines for fluid compatibility.
   1. Stainless steel, steel, or aluminum.
B. Coordinate venting requirements with manufacturer.
C. ATL Ground Cloth to be used between tank and grade.

2.03. PRODUCT SUBSTITUTIONS

A. Suitable replacements will be considered.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in installation of pipes and tanks and their competency in this specialty verified by the site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Prior to installation inspect tanks for debris, holes, and tears.

3.03. INSTALLATION

A. Prepare site on flat area free from sharp objects such as stones and sticks. An ATL Ground Cloth must be used below the tank.
B. Connect fittings and piping per manufacturer guidelines

3.04. RELOCATION CONSIDERATIONS

A. Repair: Repair "clam shell" clamps and instructions are provided for use on minor holes and tears as temporary measure until a replacement tank can be procured.

3.05. SITE QUALITY CONTROL

A. Only Use tank handles to move an empty tank. Filled or partially filled tanks must be drained before using handles.
B. Before installation check Chemical Resistance Chart shipped with tank to ensure tank compatibility.
C. Visually check cleanliness of tank.

3.06. ATTACHMENTS

A. Diagram of tank is attached.

END OF SECTION

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING
PART 1 GENERAL

1.01. SUMMARY

A. Furnish and install all sanitary, waste and vent piping from plumbing fixtures, drainage fittings and specialty items as shown on the plumbing drawings.

B. All piping shall be installed in compliance with the latest California approved Plumbing Code and as recommended by the International Association of Plumbing and Mechanical Officials (IAPMO).

C. All work specified under this section includes sanitary waste and vent system piping to a coordinated point outside the building.

1.02. REFERENCES

A. ASTM International (ASTM):

B. IAPMO, Uniform Plumbing Code

C. BOCA, Basic Building, Mechanical Plumbing Codes

1.03. QUALITY ASSURANCE

A. Single Source Requirements: To the greatest extent possible, provide products specified in this section from a single manufacturer.

B. Installer Qualifications: Successfully engaged in installation of systems of similar size and complexity for at least 2 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Sanitary Waste Pipe and Fittings - Above Ground

1. 1-1/2" thru 4": ABS Sanitary Grade Pipe and Fittings.

B. Sanitary Vent Pipe and Fittings

1. 1-1/2" thru 8": ABS Sanitary Grade Pipe and Fittings.

C. Relief Water Piping and Fittings: 3/4" thru 10": ABS Sanitary Grade Pipe and Fittings.

D. Sanitary Waste and Vent Pipe Fitting exposed in Kitchen/Dishwashing/Food Preparation Areas (1-1/4" through 8"): ABS Sanitary Grade Pipe and Fittings.

PART 3 EXECUTION

3.01. INSTALLATION

A. All horizontal waste drainage piping shall be installed with the minimum required pitch unless otherwise shown or specified.

B. All joints for bell and spigot cast iron drainage pipe, buried or inaccessible, shall be made watertight.
C. All joints for no hub systems shall use gasketed stainless steel banding mechanical fasteners.
D. All cast iron pipe buried in the ground shall have a firm bearing along the entire length of undisturbed earth or engineered bedding.
E. The bell of all horizontal pipe shall not rest upon the earth but have free area for caulking.
F. Any pipe junction shall be made with a "Y" branch or combination "Y" and 1/8 bend.
G. Cleanout fitting/adaptors shall be of the same manufacturer as the pipe manufacturer.
H. Horizontal and vertical pipe cleanouts shall be installed in accessible locations with clearances as required by the Plumbing Code. Countersunk cleanout plugs shall be installed where raised heads may cause a hazard.
I. Cleanout plugs shall be threaded cast brass type; gas and watertight without the use of gasket or packing material.
J. All openings for connections must be closed with screw plugs until used and all hand holes must be closed at once and the sewer kept clean (any earth or foreign matter that may get into the sewer must be removed by this trade).
K. Furnish all required plumbing vents from soil and waste pipes. All vents are to extend 12" above the roof line and be provided with regular roof connections to receive flashing made for this purpose.
L. Rough in piping shall be stubbed three inches from the finished building surfaces. Temporarily plug and cap piping until equipment is ready for final installation.
M. Obtain dimensioned rough-in shop drawings from the equipment suppliers.
N. Any suspended drain line serving fixtures on floors above shall be suspended from the floor as high as possible.
O. Provide on each vent pipe, a seamless lead or neoprene rubber flashing specifically manufactured for vent size penetrating roof.

3.02. RELOCATION CONSIDERATIONS

A. Piping will prefabricated in Stanford and since plumbing and vent pipes will be confined to the mechanical core, the only connections to be made on site will be to connect the sanitation piping to the external tanks.

3.03. SITE QUALITY CONTROL

A. The drainage systems shall be tested by plugging the drainage outlets and filling the systems with water which is then permitted to stand thus for one (1) hour. A hydrostatic head of ten feet of water must be attained for the entire test period.
B. Tests shall be performed before any covering or backfilling is done and before piping is built in or concealed.

C. The system shall be considered satisfactory only if there is no loss of water or leakage for the duration of the test period.

3.04. COMMISSIONING

A. Project Handyman, Mentor, and Code Expert Brian Carilli will produce a stool sample equal or equivalent in volume and consistency to twice the California Fecal Equivalence Standard. This shall be deposited in the pipe and the pipes tested for leakage. If he fails to do it right the first time, he'll do it over.

END OF SECTION

SECTION 22 13 29
SANITARY SEWERAGE PUMPS
PART 1 GENERAL

1.01. SUMMARY

A. Description
   1. Sump pump for sewerage system.

B. Related Sections: Additional Sections of the Documents which are referenced in this Section include:
   1. Section 22 13 16: Sanitary Waste and Vent Piping.

1.02. REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):
   1. ICS6-93 (R2006): Industrial Control and Systems Enclosures
   2. 250-08: Enclosures for Electrical Equipment (1000 Volts Maximum)

C. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code: 2010
   2. Section VIII: Pressure Vessels, Division I and II

D. Underwriters' Laboratories, Inc. (UL):
   1. 508-99 (R2008): Standards for Industrial Control Equipment

1.03. QUALITY ASSURANCE

A. Components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer.

B. Shop Test: Water booster unit and its component parts shall undergo a thorough electric and hydraulic operating test prior to shipment. Tests shall include a system operating flow test from zero to 100 percent of design flow rate under specified suction and system pressure conditions. Certified performance curves shall be furnished.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Submersible Utility Pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling.

B. Pump shall be installed:
   1. Floating within sewage tank.
   2. Basis of design: Energy Star compliant pump equal or equivalent to
      a. Manufacturer: Little Giant.

b. Model: 5-ASP-LL 1/6 HP, 18 GPM@5' Submersible Utility Pump.
   (a) Accessories: Piggyback Diaphragm Switch

2.02. PRODUCT SUBSTITUTIONS

A. Replacement products with adequate capacity are acceptable

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers are to be student labor and shall be trained and their competency verified by the site superintendent, construction manager, and/or project manager.

3.02. EXAMINATION

A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, and all control functions.
C. When any defects are detected, correct defects and repeat test.

3.03. INSTALLATION

A. Working surfaces are to cleaned and prepared per manufacturer guidelines
B. Plumbing connections are to be standard connections consistent with the plumbing system materials.
C. Before testing both plumbing and electrical systems must be inspected by licensed electrician/plumber.

3.04. ATTACHMENTS

A. Manufacturer's Submittal Sheet is attached.

END OF SECTION

SECTION 22 13 36
PACKAGED, WASTEWATER PUMP UNITS
PART 1 GENERAL

1.01. SUMMARY
- A. Section includes:
  1. Packaged greywater pump and storage tank.

1.02. REFERENCES
- A. National Science Foundation
  1. NSF Protocol P231.
- B. Canadian Standards Association:
  1. CSA B483.1.

1.03. SUBMITTALS
- A. Manufacturer specifications, dimensions, and product sheets shall be provided.
- B. Installation and operating instructions shall also be provided.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered in original manufacturer packaging with appropriate packaging and protective shipping materials.
- B. Product shall be stored in accordance in a cool, dry location and in accordance with manufacturer requirements.
- C. Product shall be handled carefully and only by qualified installers.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Matala Water Technology Co., Ltd., 121 Tzu Li 2 ST., Wu Chi Town, Taichung 435, Taiwan. Phone: +886(0)42630 4015. Email: info@aqua2use.com.
- B. Materials:
  1. Aqua2Use GWDD Greywater Diversion Device.

2.02. ACCESSORIES
- A. Fittings: Provide fittings in accordance with manufacturer specifications.
  1. 2” inlet DWV greywater waste pipe.
  2. 1.5” outlet DWV drain pipe.

2.03. SOURCE QUALITY CONTROL

A. Ensure product is undamaged and intact when delivered and ensure that all packaging has been appropriately secured.

2.04. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed for this product.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by qualified installers under the supervision of the Construction Manager, Project Manager, and/or Mechanical Engineering Lead. Qualified installers shall be trained in plumbing and the installation procedures of the device and approved by the appropriate supervisor to conduct such work.

3.02. EXAMINATION

A. Mounting surface shall be clean and dry and have appropriate finishes installed prior to installation of the product.
B. Tile flooring shall be fully installed and dried and be cleared of any dirt or debris.

3.03. INSTALLATION

A. Position the unit near your 50mm (2") DWV greywater waste pipe, allowing approx 360 mm (14.2") from ground level to cut in inlet and 214mm (8.4") from overflow. If the unit is not preassembled remove the filters and all of the fittings from the unit, taking note of the order of the filters. Water should flow from inlet to outlet through the Black, Green, Blue, and Grey filters.
B. Assemble and fit the drain assembly. Ensure the backing nut is tight. The fitting on the drain has a 25mm (1") thread and plug provided and the outside diameter is suitable for 40mm (1.5") DWV pipe. This should be plumbed back to your waste pipe for ease of cleaning. The plumber can fit an inline valve here for easy flushing.
C. Assemble the inlet basket. Position the threaded elbow inside the basket to the lowest point with the female thread pointing outward. Fit the bulkhead adaptor through the corresponding hole in the tank into the inlet basket. Make sure it is tight and the gaskets are in place. The elbow should be facing down. Thread the upper bulkhead adaptor into the female thread diverter valve. Make sure it is tight and the gaskets are in place.
D. Fit the overflow stand pipe to corresponding hole in the bottom of inlet basket. Make sure the pipe fits through the basket. It is possible to adjust the overflow level by moving this pipe up or down but it is advised that, the bottom end of the pipe reaches the lowest point of the basket.

E. Assemble the fittings and hose to the pump. First the 32mm (1 1/4") socket and hose barb are fitted to the top of the pump. Use multi grips to tighten the fittings on the pump. Use warm water to make the hose flexible enough to fit over the barbs. Hand tighten the hose clamp on the pump end. Now fit the outlet barb to the hose. This barb has several steps. Cut off the first section. The 32mm (1 1/4") hose fits the second step. Tighten the hose clamp on this section.
F. Carefully position the pump into the tank. Place the outlet adaptor through the upper outlet in the tank. Tighten the locking nut. Fit the level control box to the tank. The SS bracket is designed to fit between the two ribs of the tank wall. This has to be firmly in place. Make sure the probes aren't touching any part of the tank or the pump. The floats must move freely. Also inspect the floats for damage that may have occurred in transit.
G. Starting at the inlet basket end install the MATALA filter media in the tank. Starting with Black then Green. Make sure the filters slide all the way home to fit snug to the bottom of the unit.
H. Now install Green and Blue filters. Make sure the filters slide all the way home to fit snug to the bottom of the unit.
I. Install the last two MATALA filters in order, Blue then Grey. Make sure all filters are correctly installed. There should be no gaps around any part of the filter. Note: the Grey filter is the largest filter and sits higher than all the other filters.
J. Install the Stainless Steel anti distortion bracket across the middle lugs of the Aqua2use GWDD.
K. Take the electric lead out through cut out in the tank.
L. Assemble the diverting valve and insert locator to the diverting valve inlet cover. Fit this inlet cover to the lid. The locator lugs clip to this assembly to the lid.
M. Flush the unit with clean water to check the operation of the pump. Ensure that no foreign material enters the drips system.
N. Fit the Aqua2use GWDD tank cover to the tank and lock it using the two stainless steel clips provided.

3.04. RELOCATION CONSIDERATIONS

A. Unit shall remain installed during disassembly and reassembly of house.
B. Repair
    1. Unit shall not be repaired if damage is incurred during relocation. Damage to fittings or inlet and outlet pipes may be repaired with sealant by a qualified person or replacement of components may occur.
C. Replacement
    1. Unit shall be replaced with an identical product if damage is incurred.

3.05. SITE QUALITY CONTROL

A. Product and working area shall be kept clean during installation.
B. Installed product shall be protected from impact with any other components being installed in the mechanical room.

3.06. COMMISSIONING

A. Prior to use, pump performance shall be verified by flushing system with clean water.
B. Connections shall be verified through pressurizing of system and visual and tactile verification of seals.

3.07. ATTACHMENTS

A. Cut sheet, product information, and testing certificates are included.

END OF SECTION

SECTION 22 33 30
DOMESTIC WATER HEATER
PART 1 GENERAL

1.01. SUMMARY
- A. Residential appliance: Domestic water heater.

1.02. REFERENCES
- A. ANSI A117.1 - Guidelines for Accessible and Useable Buildings and Facilities.
- B. EPA - Energy Star Appliances.
- C. Public Law 101-336 - Americans with Disabilities Act.

1.03. SUBMITTALS
- A. Product Data: Manufacturer's data sheets on each product to be used, including:
- B. Model number and selected options for each appliance.
- C. Preparation instructions and recommendations.
- D. Storage and handling requirements and recommendations.
- E. Installation methods.
- F. List of maintenance parts.

1.04. QUALITY ASSURANCE
- A. Regulatory Requirements: Comply with referenced standards and the Americans with Disabilities Act as applicable for fixtures for the disabled.
- B. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.
- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.05. DELIVERY, STORAGE, AND HANDLING
- A. Packaged equipment shall be factory assembled ready to accept single source power and piping connections.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.06. WARRANTY
- A. Provide manufacturer's standard written limited one-year warranty for each type of appliance specified.
- B. Provide manufacturer's standard written limited parts warranty for each type of appliance specified.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Acceptable Manufacturer: GE Appliances, which is located at: AP4 Room 106 Appliance Park ; Louisville, KY 40225; Toll Free Tel: 800-626-2000; Tel: 502-452-3346; Email: request info (Steven.Anderson@appl.ge.com); Web: www.buildwithge.com

B. Water Heaters: Models, standard accessories/kits and custom accessories/kits as manufactured by GE Appliances.
   1. Hybrid Water Heaters: GE Series GeoSpring Hybrid Water Heaters Model GEH50DEEDSR

C. Tanks shall be complete with A.S.M.E. temperature pressure relief valve. Relief valve shall be piped to nearest drain.

D. Tank shall be of the following specifications:
   1. Capacity: 50 gallons
   2. Temperature Range: 100-140 F
   3. Required Electrical Circuit: Dedicated 30 Amp, 240 V.

2.02. SOURCE QUALITY CONTROL

A. Ensure product is packaged in manufacturer packaging with appropriate padding when delivered.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed.

PART 3 EXECUTION

3.01. EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02. INSTALLATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:

1. Securely mount to substrate.
2. Install appliances plumb and level and in proper relationship to adjacent construction.
3. Connect appliances to building utility, supply and waste systems as applicable.
4. Test for proper operation and drainage. Adjust until proper operation is achieved.

D. Set supply water temperature for {51.7 oC} [125 oF] for domestic water service.

3.03. RELOCATION CONSIDERATIONS

A. Water heater is to be pre-installed and fully tested in Stanford and shipped installed to Irvine where it will be fully tested again before going into use.

3.04. SITE QUALITY CONTROL

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion
C. Refer to the manufacturer's data sheets as attached to this Section for required features and additional requirements.

3.05. ATTACHMENTS

A. Manufacturer’s Product Manual.

END OF SECTION

SECTION 22 41 00
RESIDENTIAL PLUMBING FIXTURES
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Residential fixtures for bathroom and kitchen including sinks, toilets, shower hardware, and sink hardware.
- B. Related Sections:
  1. Section 12 35 30: Residential Casework.
  2. Section 12 36 00: Countertops.
  3. Section 22 11 16: Domestic Water Piping.
  4. Section 22 13 16: Sanitary Waste and Vent Piping.

1.02. SUBMITTALS
- A. Manufacturer shall provide cut sheets and product documentation as well as samples prior to installation.

1.03. QUALITY ASSURANCE
- A. Manufacturer shall have significant experience producing residential bathroom and kitchen plumbing hardware.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Items shall be delivered in the manufacturer's original packaging to the construction site.
- B. Products shall be stored in boxes until construction begins to prevent damaging finishes.

1.05. WARRANTY
- A. Manufacturer shall provide a limited warranty against defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Kohler. Phone: (800) 4KOHLER.
  2. Danze. Phone: (888) 328-2383.
  3. Caroma. Phone: (800) 605-4218
- B. Materials:
  1. Kitchen Sink
     a. Kohler Undertone Under-Mount Double-Bowl Kitchen Sink with 4 Faucet Holes.
     b. Dimensions: 31-1/2" x 18" x 7-5/8".

c. Finish: Brushed Stainless Steel.

2. Kitchen Faucet
   a. Kohler Simplice Three-hole kitchen sink faucet with pull-out matching color sprayhead.
   b. Dimensions: 16-5/8".
   c. Finish: Polished Chrome.
3. Bathroom Sink
   a. Kohler Vox Round Above Counter Sink
   b. Dimensions: 8" x 16-1/2" x 16-1/2"
   c. Finish: White.
4. Bathroom Faucet
   a. Danze Sirius Trim Line Widespread Lavatory Faucet
   b. Dimensions: 7.38" x 10.81" x 5.50"
   c. Finish: Polished Chrome.
5. Toilet
   a. Caroma Sydney Smart 305 Round Front Plus
   b. Dimensions: 27-3/4" x 14-1/4" x 31-7/8".
   c. Finish: White.
   d. Flush Rate: 1.28/0.8 gpf.
6. Shower Basin
   a. Sterling Ensemble 60 Series 7213 Shower Pan
   b. Dimensions: 3-7/32" x 60" x 32"
   c. Finish: White.
7. Shower Temperature Regulator
   a. Kohler DTV Prompt
   b. Dimensions: 7-3/4" x 2-11/16" x 3/4"
   c. Finish: White.
8. Shower Head
   a. Kohler Purist
   b. Dimensions: 5-1/2" x 3-15/16" 5-1/2"
   c. Finish: Polished Chrome.

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed on the basis of availability with the approval of the Project Manager and Mechanical Engineer.

PART 3 EXECUTION

3.01. INSTALLERS

A. A qualified plumber shall install the products listed herein. Qualified personnel will be determined by experience or at the discretion of the Project Manager and/or Construction Manager.

3.02. EXAMINATION

A. All substrate surfaces shall be fully installed, clean, and dry at the start of installation.

3.03. INSTALLATION

A. Install products according to manufacturer's recommended installation procedures.

3.04. RELOCATION CONSIDERATIONS

A. Fixtures shall remain in place during transportation and relocation.

3.05. SITE QUALITY CONTROL

A. Fixtures shall be protected from surrounding or following construction activities to prevent damage to the finishes.

3.06. COMMISSIONING

A. Installed fixtures shall be tested prior to operation of the home to ensure proper installation.

3.07. ATTACHMENTS

A. Manufacturer's Submittal Sheets are provided for all products listed herein.

END OF SECTION

DIVISION 23

SECTION 23 23 00
REFRIGERANT PIPING
PART 1 GENERAL

1.01. SUMMARY

A. Field refrigerant and drain condensate piping for compression and expansion HVAC systems.

B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions.

C. Related Sections:

1. Section 23 81 26: Split System Air Conditioners.

1.02. REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. ANSI/ASME B16.22-2001 (R2005), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI).
2. ANSI/ASME B31.5-2006, Refrigeration Piping and Heat Transfer Components (ANSI).

B. American Society for Testing and Materials (ASTM).

1. B88-03, Standard Specifications for Seamless Copper Water Tube.
2. B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

1.03. QUALITY ASSURANCE

A. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Material shall be sealed on site prior to installation to prevent dust and particles from entering the piping.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:

1. Select locally available materials and manufacturers meeting the criteria in this specification.

B. Materials:
1. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.
2. Water and Drain Piping: PEX water tube.

2.02. ACCESSORIES

A. Copper fittings: Wrought copper fittings, ASME B16.22.
1. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
2. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).

B. PEX Fittings: PEX barbed or quick connect fittings as required and specified by manufacturer.

2.03. PRODUCT SUBSTITUTIONS

A. Locally available products shall be substituted when available and necessary from the approved specification.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in fitting and welding copper pipings.

3.02. EXAMINATION

A. Interior partitions should be framed to provide location to route piping. Studs should be plumb and square.

B. Substrate should be clean prior to installation.

3.03. INSTALLATION

A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5

B. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
1. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.

2. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
3. Use copper tubing in protective conduit when installed below ground.
4. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

3.04. RELOCATION CONSIDERATIONS

A. Joints of piping at modules shall be made with quick connect and quick disconnect fasteners for ease of assembly and disassembly.
B. Repair:
   1. Welding repairs are allowed on-site by qualified welder.
C. Replacement:
   1. Full replacement of piping shall occur as necessary with comparable product.

3.05. SITE QUALITY CONTROL

A. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
B. Site superintendent or Mechanical Lead will visually inspect construction and approve.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS
PART 1 GENERAL

1.01. SUMMARY

A. Ductwork and accessories for HVAC including the following:
   1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.

B. Related Sections:
   1. Section 23 73 23: Packaged Air to Air Energy Recovery Units.
   2. Section: 23 81 26: Split System Air Conditioners.

1.02. REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A167-99(2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
   2. A653-09 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
   3. A1011-09aStandard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

B. Sheet Metal and Air Conditioning Contractors National Association (SMCA):
   1. 2nd Edition – 2005 HVAC Duct Construction Standards, Metal and Flexible
   2. 1st Edition - 1985 HVAC Air Duct Leakage Test Manual.

1.03. QUALITY ASSURANCE

A. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

B. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.

C. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance

1.04. DELIVERY, STORAGE, AND HANDLING

A. Keep pipes clean and sealed when possible on construction site to avoid pollution by dust and other particles.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. AGC Incorporated, 754B Camden Ave., Campbell, CA 95008. Phone: (408) 369-6305

B. Materials
   1. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
   2. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
   3. Duct Construction and Installation:
      a. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the manufacturer's pressure specification.

2.02. ACCESSORIES

A. Joint Sealings
   1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
      a. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
      b. Gaskets in Flanged Joints: Soft neoprene.
   2. Approved factory made joints may be used.

2.03. PRODUCT SUBSTITUTIONS

A. Related products meeting the same standards are allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in installation of metal ducting. Superintendents, construction manager, and/or project manager shall review the competency of all potentials.

3.02. EXAMINATION

A. HVAC units should be fairly well installed by the time duct work commences.

3.03. INSTALLATION

A. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
   1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
   2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
   3. Provide bolted construction and tie rod reinforcement in accordance with SMACNA Standards.
   4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

3.04. RELOCATION CONSIDERATIONS

A. Ductwork shall not be removed for relocation.
B. Repair:
   1. A qualified metal worker may repair the ductwork if damage is incurred on-site.
C. Replacement:
   1. Replacement can occur using similar, locally available products.

3.05. SITE QUALITY CONTROL

A. Site superintendent and mechanical manager will review the work before publicizing.
B. After installation, entrances to ductwork shall be sealed to prevent dust and particles from entering the system.

END OF SECTION

SECTION 23 33 46
FLEXIBLE DUCTS
PART 1 GENERAL

1.01. SUMMARY
- A. Flexible ductwork and accessories for HVAC.
- B. Related Sections:
  1. Section 23 73 23: Packaged Air to Air Energy Recovery Units.
  2. Section: 23 81 26: Split System Air Conditioners.

1.02. REFERENCES
- A. American Society for Testing and Materials (ASTM):
  1. ASTM Method E96, procedure A.
- B. Underwriters' Laboratory
  1. Class I Air Duct, Standard 181.
- C. NFPA
  1. Bulletin 90A.
  2. Bulletin 90B.

1.03. QUALITY ASSURANCE
- A. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- B. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- C. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Keep pipes clean and sealed when possible on construction site to avoid pollution by dust and other particles.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Thermaflex—A Division of Flexible Technologies, Inc., a Subsidiary of Smiths Group PLC. 528 Carwellyn Rd., Abbeville, SC 29620. Phone: (864) 459-5441
- B. Materials
  - a. Flex-Vent Flexible Duct.

(a) Polyolefin film, flame resistant
(b) Polyester interior film

2.02. ACCESSORIES

A. Joint Sealings

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
    a. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.

2.03. PRODUCT SUBSTITUTIONS

A. Related products meeting the same standards are allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in installation of ducting. Superintendents, construction manager, and/or project manager shall review the competency of all potentials.

3.02. EXAMINATION

A. HVAC units should be fairly well installed by the time duct work commences.

3.03. INSTALLATION

A. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
    1. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
    2. Provide bolted construction and tie rod reinforcement in accordance with SMACNA Standards.
    3. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.

3.04. RELOCATION CONSIDERATIONS

A. Ductwork shall not be removed for relocation.
B. Repair:
   1. A qualified metal worker may repair the ductwork if damage is incurred on-site.
C. Replacement:
   1. Replacement can occur using similar, locally available products.

3.05. SITE QUALITY CONTROL

A. Site superintendent and mechanical manager will review the work before publicizing.
B. After installation, entrances to ductwork shall be sealed to prevent dust and particles from entering the system.

END OF SECTION

SECTION 23 34 00
HVAC FANS
PART 1 GENERAL

1.01. SUMMARY
- A. Vent fan for residential bathroom.

1.02. REFERENCES
- A. ACAN/CSA-IEC-E60335-1: Safety of household and similar electrical appliances.
- B. CE: Product is certified to meet EU consumer safety, health or environmental requirements.
- C. ETL: Listed for US and Canada in Intertek Directory of Listed Products.
- D. NEC: National Electric Code.
- E. UL 94 5VA: Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- F. UL 507: Underwriters Laboratory Standard for Electric Fans

1.03. SUBMITTALS
- A. Product Data: Manufacturer's data sheets for each product, including but not limited to:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Power requirements and mounting recommendations.
- B. Shop Drawings:
  1. Placement Drawings: Include manufacturer's placement recommendation diagram.
  2. Wiring diagrams.
  3. Mounting details, including seismic restraint where required
- C. Manufacturer's Instructions: Provide manufacturer's "Installation & Operation Guide".

1.04. QUALITY ASSURANCE
- A. Manufacturer Qualifications: Providing sole source for design, engineering, manufacturing and warranty claims handling.

1.05. DELIVERY, STORAGE, AND HANDLING
- A. Deliver products and materials to project site in manufacturer's unopened packaging.
- B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:

1. Panasonic. Phone: (866) 292-7292. Email: ventfans@us.panasonic.com

B. Materials:
   1. WhisperRecessed Ventilation Fan
      a. Model: FV-08VRL1
      b. Volume Flow Rate: 80 cfm
      c. Outlet: 4” or 6”

2.02. PRODUCT SUBSTITUTIONS

A. Substitute products shall be allowed only with written approval from the Mechanical Engineer.

PART 3 EXECUTION

3.01. INSTALLERS

A. A qualified installer is required to construct this product on-site.

3.02. EXAMINATION

A. Do not begin installation until supporting structure and interior work have been properly completed.
B. Installation of miscellaneous support, if required, electrical wire and wiring, conduit, fuses, and disconnect switches other than those provided by fan manufacturer are specified in other sections.
C. Examine the substrate and conditions under which the fan is to be installed. Notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.03. INSTALLATION

A. Install fan according to manufacturer’s written recommendations.

3.04. RELOCATION CONSIDERATIONS

A. Fan will remain in place during transportation and relocation.

3.05. SITE QUALITY CONTROL

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

3.06. ATTACHMENTS

A. Manufacturer's Submittal Sheet

END OF SECTION

SECTION 23 37 00
AIR INLETS AND OUTLETS
PART 1 GENERAL

1.01. SUMMARY

A. This section includes grilles, diffusers, and registers for air inlets and outlets for the mechanical systems.

B. Related Sections:

1. Section 23 31 00: HVAC Ducts and Casings.
2. Section 23 73 23: Packaged Air-to-Air Energy-Recovery Units.
3. Section 23 81 26: Split-System Air-Conditioners.

1.02. REFERENCES

A. The Aluminum Association Incorporated

1. Aluminum Standards and Data
2. Specifications and Guidelines for Aluminum Structures

B. American Society of Civil Engineers

1. Minimum Design Loads for Buildings and Other Structures

C. American Society for Testing and Materials (ASTM):

1. A167-99(2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
2. A653-09 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
3. A1011-09aStandard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
4. ASTM B209
5. ASTM B211
6. ASTM B221
7. ASTM E90-90

D. Architectural Aluminum Manufacturers Association

1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA TIR Metal Curtain Wall Fasteners
4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

E. Canadian Standards Association

1. CAN3-S157-M83 Strength Design in Aluminum

2. S136 94 Cold Formed Steel Structural Members

1.03. DELIVERY, STORAGE, AND HANDLING

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

B. Storage:
   1. Material may be stored flat, on end or on its side.
   2. Material may be stored either indoors or outdoors.
   3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
   4. If stored out doors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.

C. Handling:
   1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.
   2. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.
   3. Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

1.04. WARRANTY

A. Manufacturer's warranty shall be provided against defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Titus. 605 Shiloh Rd., Plano, TX 75074. Phone: (972) 212-4800.

B. Materials:
   1. External Louver:
      a. CT-480
      b. Spacing: ¼" x 1/8" Bars
      c. Finish: Brushed Steel.
   2. Grilles:
      a. Material: Steel.
      b. Finish: White.
      c. Mounting: Flush.
   3. Grilles:
      a. Material: Steel.

b. Finish: Brushed Steel.
c. Mounting: Flush.

2.02. PRODUCT SUBSTITUTIONS

A. Grilles of the same color and size as specified on the architectural and mechanical drawings shall be deemed acceptable.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall verify that they are competent to install grilles. Knowledge of rudimentary carpentry only required.

3.02. EXAMINATION

A. Drywall and wall finish substrates must be completed and cleaned prior to installation.
B. Ductwork shall be laid to the grille prior to installation.

3.03. INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.
B. Make final locations where indicated on drawings, as much as practical. Locate units in center of panel unless otherwise indicated. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
C. Comply with manufacturer's instructions and recommendations for installation of the work.
D. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
E. Anchor louvers to the building substructure as indicated on architectural drawings.
F. Erection Tolerances:
    1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (noncumulative).
    2. Maximum offset from true alignment between two members abutting end to end, edge-to edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
G. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
H. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
I. Set units level, plumb and true to line, with uniform joints.

3.04. RELOCATION CONSIDERATIONS

A. Grilles shall not be removed during relocation.

3.05. SITE QUALITY CONTROL

A. Site superintendent shall verify that grid installation is flush and level.

3.06. ATTACHMENTS

A. CT480 Louver Specification Sheet Attached.

END OF SECTION

SECTION 23 38 00
VENTILATION HOODS

PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Residential Range Hood.
- B. Related Sections:
  1. Section 23 31 00: HVAC Ducts and Casings.
  2. Section 11 31 00: Residential Appliances.

1.02. REFERENCES
- A. HVI-2100.
- B. Underwriters' Laboratories Certified.

1.03. SUBMITTALS
- A. Provide product data and cut sheets prior to installation of product in the field. Provide installation manual and maintenance information.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered in manufacturer packaging.
- B. Store product in a cool, dark, locked environment until installation. Protect product from exposure to sun, heat, wind, and rain.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. General Electric. Phone: (800) 626-2005.
- B. Materials:
  1. 30" Energy Star Qualified Ventilation Hood
     a. Model: JVE40STSS.
     b. Voltage: 120.
     c. Fan Speed: 2-Speed

2.02. PRODUCT SUBSTITUTIONS
- A. Substitutions shall not be allowed except with the written consent of the Mechanical Engineer.

PART 3 EXECUTION

3.01. INSTALLERS

A. A qualified installer will be required to complete installation of this product. An installer will be deemed qualified by the Project Manager and/or the Construction Manager.

3.02. EXAMINATION

A. Mounting substrate should be cleanly and neatly installed and be dry and free of dust or debris.
B. The unit should be removed from its package and inspected for damage prior to installation.

3.03. INSTALLATION

A. Follow manufacturer's recommended instructions for installation.

3.04. RELOCATION CONSIDERATIONS

A. Unit will remain in place during transportation and relocation. Ensure that is properly braced and attached prior to commencing transportation.
B. Replacement
    1. Replacement shall follow the substitution guidelines stated above.

3.05. SITE QUALITY CONTROL

A. Protect the installed unit from incidental damage in subsequent construction activities.

3.06. COMMISSIONING

A. The Mechanical Engineer should test the unit and verify accurate operation.

3.07. ATTACHMENTS

A. Manufacturer's Data Sheet is attached.

END OF SECTION

SECTION 23 72 23
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01. SUMMARY

A. Section includes packaged air-to-air energy recovery installation.

B. Related Sections:

1. Section 23 33 00: HVAC Ducts and Casing.

1.02. REFERENCES

A. Underwriters' Laboratory:

1. UL 94HF.
2. UL 1812.

B. Home Ventilating Institute:

1. CSA 439.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Material shall be kept in cool, dry environment unexposed to sun and moisture.

B. Product shall be sealed prior to installation to prevent duct and particles from entering unit.

1.04. WARRANTY

A. Product shall be warranted for 5 years against manufacturing defects on core. 7 year warranty on manufacturing defects on motors.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:

1. Fantech, US, 10048 Industrial Blvd., Lenexa, KS 66215. Phone: 1 (800) 747-1762. Email: info@fantech.net.

B. Materials:

1. Fantech SH704 Heat Recovery Ventilator.
   a. Weight: 25 lbs.
   b. Case: 24 gauge galvanized steel, baked powder coated antique white paint. Cabinet fully insulated with 1" aluminum foil-face high density polystyrene foam.
   c. Motors: Two (2) balanced EBM motors with permanently lubricated sealed ball bearings.
   d. Core: Aluminum heat recovery core. 8.5" x 8.5" x 8".
   e. Filters: Two (2) washable electrostatic panel type air filters, 8.5" x 8" x 0.125".
   f. Connections: 4" steel duct connections with rubber gasket.

g. Drain: ½" OD drain spout with pan.

2.02. ACCESSORIES

A. Mounting: Appropriate hangers as specified by manufacturer shall be used to mount the product.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed without approval of the Mechanical Lead.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in mechanical installation and ductwork and shall have their competency in such installations verified by the Site Superintendent, Construction Manager, and/or Project Manager.

3.02. EXAMINATION

A. Hangers and rods shall be installed and verified prior to installation of Energy Recovery Unit.
B. Core unit shall be properly framed and covered, and substrate shall be cleaned.

3.03. INSTALLATION

A. Follow the equipment manufacturer's instructions for handling and installation, and setting up of ductwork for maximum efficiency.
B. Seal ductwork tightly to avoid air leakage.
C. Insulate ductwork to outdoor exhaust and fresh air intake.
D. Ensure spacing of at least 10' between outdoor exhaust and fresh air intake.
E. Do not locate fresh air intake within 10' of any exhaust or potential contaminant sources. Install units with adequate spacing and access for cleaning and maintenance of filters.

3.04. RELOCATION CONSIDERATIONS

A. Unit shall remain installed during disassembly and reassembly of house.

3.05. SITE QUALITY CONTROL

A. Unit shall be inspected by mechanical lead or site superintendent for proper connection of ductwork and electrical wiring to unit.
B. After installation, all ducts leading into the unit shall be sealed with plastic to ensure no dust or particles enter into the unit.

3.06. COMMISSIONING

A. Unit shall be tested under a variety of environmental conditions to verify compliance with manufacturer's data.

3.07. ATTACHMENTS

A. Manufacturer Cut Sheet is attached.

END OF SECTION

SECTION 23 81 26
SPLIT SYSTEM AIR CONDITIONERS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:
   1. Ductless HVAC system

B. Related Sections:
   1. Section 22 33 30: Residential, Electric Domestic Water Heaters.
   2. Section 23 09 13: Instrumentation and Control Devices for HVAC.
   3. Section 23 23 00: Refrigerant Piping Specialties

1.02. REFERENCES

A. ASHRAE 52.2 - Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter. Addendum B Arrestance & Dust Capacity Insertions and Appendix J MERV-A Ratings.
B. AMCA 211 - Certified Ratings Program
C. AMCA 300 - Reverberant Room Method For Sound Testing Of Fans
D. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
F. Electromagnetic Compatibility Standard EN50081-1 Emissions Interference EN61000-6-4 Immunity and EN61000-3-2 Harmonic Current Emissions.
G. NFPA 70 - `National Electrical Code.
H. NFPA 75 - Protection of Electronic Computer/Data Processing Equipment.
I. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems..
J. NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems
K. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.03. QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
E. A dry air holding charge shall be provided in the indoor section.

F. System efficiency shall meet or exceed 14.5 SEER when part of a 1:1 (indoor/outdoor) system.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.
B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

1.05. WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.
B. Manufacturer shall have over 25 years of continuous experience in the U.S. market.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers
   1. Mitsubishi.
B. Materials
   1. Mitsubishi Model Number: MSZ ACCESSORIES
      a. The heat pump air conditioning system shall be a Mitsubishi Electric MSZ-A split system series. The system shall consist of a slim silhouette, compact, wall mounted indoor fan coil section with wireless remote controller and a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven heat pump design.
      b. Indoor unit model numbers are:
         (a) MSZ-GE06NA-8, 6 ton indoor unit.
         (b) MSZ-GE09NA-8. 9 ton indoor unit.
   2. Unit Cabinet:
      a. The casing shall have a white finish – Munsell 1.0Y 9.2/0.2.
      b. Multi directional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining shall be standard.
      c. There shall be a separate, metal back-plate that secures the indoor unit firmly to the wall. The back plate shall be securely attached to the wall.

3. Fan:
   a. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
   b. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.
   c. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
      (a) Units having capacity greater than 18,000 BTU/h shall have a "Wide Vane" feature to distribute airflow over a wide – 150 degree – angle from right to left to provide comfort over a wider area.
   d. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down.
   e. The indoor fan shall operate at of three (3) selectable speeds: High, Medium and Low.
4. Filter
   a. Return air shall be filtered by means of easily removed, washable, Catechin, Antioxidant Pre-filter and an Anti-allergy enzyme filter – blue, pleated type.
5. Coil:
   a. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
   b. The tubing shall have inner groves for high efficiency heat exchange.
   c. All tube joints shall be brazed with phoscopper or silver alloy.
   d. The coils shall be pressure tested at the factory.
   e. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
6. Electrical:
   a. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
   b. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire connection plus ground.
   c. The indoor unit shall not have any supplemental electrical heat elements.
   d. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor motor control for maximum efficiency.
7. Control:
   a. General:
      (a) The unit shall have a wireless controller to perform input functions necessary to operate the system.

(b) The wireless controller shall have a Power On/Off switch, Mode Selector – Cool, Dry, Fan Modes - Temperature Setting, Timer Control, Fan Speed Select and Auto Vane selector.
(c) The indoor unit shall perform Self-diagnostic Function and Check Mode switching.
(d) Temperature changes shall be by 1ºF increments with a range of 59 - 89ºF.
(e) The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.
(f) The system shall be capable of automatically restarting and operating at the previously selected conditions when the power is restored after power interruption.
(g) Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off, System/Mode function.
(h) The indoor unit shall have the option of a field installed, multi-function, hard-wired, wall mounted remote controller. Controller shall be a PAR-21MAA Deluxe MA type remote controller.
(i) Hard-wired, wall mounted remote controller shall require a MAC-397IF-E MA Series Terminal Interface for communications. Interface will be mounted at the indoor unit.

8. Outdoor Units:
   a. Outdoor Unit:
      (a) MXZ-3B24NA
   b. Unit Cabinet:
      (a) The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.
   c. Fan:
      (a) The unit shall be furnished with a direct drive propeller type fan.
      (b) The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.
      (c) The fan motor shall be mounted for quiet operation.
      (d) The fan shall be provided with a raised guard to prevent contact with moving parts.
      (e) The outdoor unit shall have horizontal discharge airflow.
   d. Coil:
      (a) The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

(b) The coil shall be protected with an integral metal guard.
(c) Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, leaner expansion valve.

e. Compressor:
(a) The compressor motor shall be direct current (DC).
(b) The compressor shall be of a high performance hermetic; inverter driven, variable speed, rotary type.
(c) The outdoor unit shall have an accumulator.
(d) The compressor will be equipped with an internal thermal overload.
(e) The outdoor unit must have the ability to operate over the full range with a maximum height difference of 40 feet and have refrigerant tubing length of 65 feet for capacities up to 18,000 BTU/h and a maximum height difference of 50 feet and have refrigerant tubing length of 100 feet for capacities above 18,000 BTU/h between indoor and outdoor units.
(f) There shall be no need for line size changes, traps shall not be used, and no additional refrigerant oil shall be required.
(g) The compressor shall be mounted so as to avoid the transmission of vibration.

f. Electrical:
(a) The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
(b) The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
(c) The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions shall be allowed.

PART 3 EXECUTION

3.01. INSTALLERS

A. Mitsubishi Electric LES expects its Installation Partners to be fully trained and accredited to support the Mitsubishi Electric LES standards. The accepted qualifications include:
1. Safe Handling Certificate (C&G or CITB)
2. Refrigeration/Air Conditioning Qualifications
3. Refrigerant Audit System
4. Member of Refrigeration Body
5. Mitsubishi Electric LES Training

3.02. EXAMINATION

A. Indoor Unit

1. Where airflow is not blocked.
2. Where cool air spreads over the entire room.
3. Maximum refrigerant piping length between indoor unit and outdoor unit is 65 ft. and
4. the difference of height of both units is 40 ft. (for MSY, MSZ type) 35 ft. (for MS type).
5. Rigid wall without vibration.
6. Where it is not exposed to direct sunshine.
7. Where easily drained.
8. In a place as far away as possible from fluorescent and incandescent lights (so
9. the infrared remote control can operate the air conditioner normally).
10. Where the air filter can be removed and replaced easily.

B. Outdoor Unit
   1. Where it is not exposed to strong wind.
   2. Where airflow is good and dustless.
   3. Where it is not exposed to rain and direct sunshine.
   4. Where rigid wall or support is available to prevent the increase of operation sound or vibration.
   5. Where there is no risk of combustible gas leakage.
   6. Install the unit horizontally.
   7. Install it in an area not affected by snowfall or blowing snow. In areas with heavy snow, install a canopy, a pedestal and/or some baffle boards.

C. Note: It is advisable to make a piping loop near outdoor unit so as to reduce vibration transmitted from there.

3.03. INSTALLATION

A. Indoor Unit Installation:
   1. Fixing of Installation Plate
      a. Find a structural material (such as a stud) in the wall and fix installation plate horizontally.
   2. Wall Hole Drilling:
      a. Determine the wall hole position.
      b. Drill a 2-9/16 in. hole so that outside can be lower than inside.
      c. Insert the wall hole sleeve C.
   3. Indoor/Outdoor Connecting Wire Connection:
      a. Note: When the indoor unit is powered from the outdoor unit, a disconnect switch may need to be installed to power supply circuit (between indoor and outdoor unit) depending on local code.
      b. Attach the installation plate to the wall.
      c. Fix the conduit connector to conduit plate with lock nut.
      d. Fix the conduit plate to the installation plate with screws.

e. Hook the upper part of the indoor unit on the installation plate.
f. Remove the conduit cover.
g. Attach the conduit cover, front panel and corner box to the indoor unit.

4. Pipe Forming:
   a. Place the drain hose below the refrigerant piping.
   b. Make sure that the drain hose is not heaved or snaked.
   c. Do not pull the hose to apply the tape.
   d. When the drain hose passes the room, be sure to wrap insulation material around it.
   e. Wrap the felt tape around the pipe and the drain hose, then put the pipe in the back space of the indoor unit.
5. Drain Piping:
   a. If the extension drain hose has to pass through a room, be sure to wrap it with commercially sold insulation.
   b. The drain hose should point downward for easy drain flow.

B. Outdoor Unit Installation:
1. Power Supply and Indoor and Outdoor Wire Connection:
   a. Power should be taken from an exclusive branched circuit.
   b. Wiring work should be based on applicable technical standards.
   c. Wiring connections should be made following the diagram.
2. Grounding:
   a. Remove the service panel.
   b. Fix the conduit connector to conduit cover with lock nut then secure it against unit with screw.
   c. Leave some slack in wires to allow easier servicing.

3.04. RELOCATION CONSIDERATIONS

A. When relocating or disposing of the air conditioner, pump down the system following
B. the procedure below so that no refrigerant is released into the atmosphere.
C. Connect the gauge manifold valve to the service port of the stop valve on the gas pipe side of the outdoor unit.
D. Fully close the stop valve on the liquid pipe side of the outdoor unit.
E. Close the stop valve on the gas pipe side of the outdoor unit almost completely so
F. that it can be easily closed fully when the pressure gauge shows –0.101 MPa [Gauge] (0 lbf/in2).
G. Start the emergency cooling operation.
H. To start the emergency operation in cool mode, disconnect the power supply plug and/or turn off the breaker. After 15 seconds, connect the power supply plug and/or turn on the breaker, and then press the emergency operation switch once. (The emergency cooling operation can be performed continuously for up to 30 minutes.)

I. Fully close the stop valve on the gas pipe side of the outdoor unit when the pressure gauge shows 0.05 to 0 MPa [Gauge] (approx. 7.25 to 0 lbf/in.2).
J. Stop the emergency cooling operation.
K. Press the emergency operation switch twice to stop the operation.

3.05. SITE QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
C. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Remove and replace malfunctioning units and retest as specified above.
E. Prepare test and inspection reports.

3.06. COMMISSIONING

A. Units shall be tested and control units verified prior to competition.

3.07. ATTACHMENTS

A. Product submittal sheets for all three components are attached.

END OF SECTION

DIVISION 25

SECTION 25 14 00
INTEGRATED AUTOMATION OF LOCAL CONTROL UNITS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes a Custom-Designed Control Network featuring:
   1. Microprocessor Based Control Units
   2. Integrated Automation Remote Control Panels
   3. Feedback Sensors for Control

B. Related Sections:
   1. Section 22 33 30: Residential Electric Domestic Water Heaters.
   2. Section 23 81 26: Split-System Air-Conditioners.
   3. Section 26 05 19: Low Voltage Electrical Power Conductors and Cables.
   4. Section 26 27 26: Wiring Devices.
   5. Section 26 51 00: Interior Lighting.
   6. Section 26 56 00: Exterior Lighting.

1.02. SUBMITTALS

A. Designer shall submit diagrams of the network architecture and data sheets of all products to be used in the control system.

B. Documents validating performance of sensors and controls within acceptable ranges of comfort and control.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Microprocessor Boards
   1. Custom Designed Microprocessor Boards
   2. Arduino Microcontrollers

B. Integrated Automated Remote Control Panels
   1. Apple, Inc. iPad 16 GB.
   2. Custom Designed Software

C. Dell Optiplex Computer Server
   1. 4 GB RAM.
   2. Intel i3 Processor.
   3. Dedicated Video Card.

D. Sensors
   1. Thermostat
      a. From Mitsubishi Mini-Split Architecture
   2. Lighting Sensors
   3. Occupancy Sensors
   4. Temperature Probes
   5. Humidity Probes
   6. Window Open/Closed Sensors
   7. Wireless Vantage Pro2 with Standard Radiation Shield Weather Station

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall be allowed only with the approval of the Electrical Engineer or Control Systems Designer. Substitutes must be tested and approved with validation of performance.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only qualified installers shall place the control system on the site. These installers shall be competent in troubleshooting and debugging the control system architecture as well as with electrical connections and cable runs.

3.02. INSTALLATION

A. Installation shall occur in accordance with the plan laid out by the Control System Designer.

3.03. RELOCATION CONSIDERATIONS

A. Control systems will stay in place during relocation and transportation.
B. Repair:
   1. Qualified installers and the designer shall repair and troubleshoot any issues that may arise.

3.04. ATTACHMENTS

A. Weather station cut sheet.

END OF SECTION

DIVISION 26

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
PART 1 GENERAL

1.01. SUMMARY

A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.02. REFERENCES

A. American Society of Testing Material (ASTM):
   1. D2301-04 Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

B. National Fire Protection Association (NFPA):
   1. 70-08 National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):
   1. WC 70-09 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. Underwriters Laboratories, Inc. (UL):
   1. 44-05 Thermoset-Insulated Wires and Cables
   2. 83-08 Thermoplastic-Insulated Wires and Cables
   3. 467-071 Electrical Grounding and Bonding Equipment
   4. 486A-486B-03 Wire Connectors
   5. 486C-04 Splicing Wire Connectors
   6. 486D-05 Sealed Wire Connector Systems
   7. 486E-94 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
   8. 514B-04 Conduit, Tubing, and Cable Fittings
   9. 1479-03 Fire Tests of Through-Penetration Fire Stops

1.03. QUALITY ASSURANCE

A. Low voltage cables shall be thoroughly tested at the factory per NEMA WC-70 to ensure that there are no electrical defects. Factory tests shall be certified.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Cables shall be secured on-site prior to installation in a locked container.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. UL-listed manufacturers are approved.

B. Materials:
   1. 8’ Copper Grounding Rod.
   2. Conductors and cables shall be in accordance with NEMA WC-70 and as specified herein.
      a. Single Conductor:
         (a) Shall be annealed copper.
         (b) Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
         (c) Shall be minimum size No. 14 AWG, except where smaller sizes are allowed herein.
         (d) Control Wires shall be No. 18 THHN-THWN or CAT-5.
      b. Insulation:
         (a) XHHW-2 or THHN-THWN shall be in accordance with NEMA WC-70, UL 44, and UL 83.

C. Color Code:
   1. Secondary service feeder and branch circuit conductors shall be color-coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

      a. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the Electrical Lead.
   2. Use solid color insulation or solid color coating for No. 12 AWG and No. 10 AWG branch circuit phase, neutral, and ground conductors.
   3. Conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
      a. Solid color insulation or solid color coating.
      b. Stripes, bands, or hash marks of color specified above.
      c. Color as specified using 0.75 in [19 mm] wide tape. Apply tape in half-overlapping turns for a minimum of 3 in [75 mm] for terminal points, and in junction boxes, pull-boxes, troughs, and manholes. Apply the last two laps of tape with no tension

to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

2.02. ACCESSORIES

A. Splices and Joints:
   1. In accordance with UL 486A, C, D, E, and NEC.
   2. Aboveground Circuits (No. 10 AWG and smaller):
      a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F [105˚ C], with integral insulation, approved for copper and aluminum conductors.
      b. The integral insulator shall have a skirt to completely cover the stripped wires.
      c. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.
   3. Aboveground Circuits (No. 8 AWG and larger):
      a. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
      b. Field-installed compression connectors for cable sizes 250 kcmil and larger shall have not fewer than two clamping elements or compression indents per wire.
      c. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
      d. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant
   4. Control Wiring:
      a. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified for power and lighting wiring, except that the minimum size shall be not less than No. 18 AWG.
      b. Control wiring shall be large enough such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

B. Wire Lubricating Compound:
   1. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

2.03. PRODUCT SUBSTITUTIONS

A. Any UL-listed wiring shall be allowed provided that size meets requirements of electrical engineering specifications.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained in electrical installation and must be Qualified Electrical Workers as per the Solar Decathlon 2013 guidelines.

3.02. EXAMINATION

A. SIPS panels and framing must be installed and approved by the site superintendent prior to commencement of electrical works.
B. During electrical works, electrical systems shall not be connected to photovoltaic panels or a power source.

3.03. INSTALLATION

A. General
   1. Install in accordance with the NEC, and as specified.
   2. Install all wiring in raceway systems.
   3. Splice cables and wires only in outlet boxes, junction boxes, pull-boxes, manholes, or handholes.
   4. Wires of different systems (e.g., 120 V, 277 V) shall not be installed in the same conduit or junction box system.
   5. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
   6. For panel boards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
   7. Wire Pulling:
      a. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables. Use lubricants approved for the cable.
      b. Use nonmetallic ropes for pulling feeders.
      c. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Electrical Lead.
      d. All cables in a single conduit shall be pulled simultaneously.
      e. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.
   8. No more than three single-phase branch circuits shall be installed in any one conduit.
B. Splice Installation
   1. Splices and terminations shall be mechanically and electrically secure.
   2. Tighten electrical connectors and terminals according to manufacturer's published torque values.

3. Where the inspector determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices.

C. Feeder Identification
   1. In each interior pull-box and junction box, install metal tags on all circuit cables and wires to clearly designate their circuit identification and voltage. The tags shall be the embossed brass type, 1.5 in (40 mm) in diameter and 40 mils thick. Attach tags with plastic ties.

D. Control and Signal Wiring Installation
   1. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
   2. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
   3. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

E. Control and Signal System Wiring Identification
   1. Install a permanent wire marker on each wire at each termination.
   2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
   3. Wire markers shall retain their markings after cleaning.
   4. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.04. RELOCATION CONSIDERATIONS

A. Electrical connections at module interfaces shall be embedded in junction boxes and accessible through paneling on the interior or exterior of the wall. Approved connectors and terminations shall be used and wires shall be clearly labeled.

B. Power supply shall be disconnected prior to disassembly and assembly.

C. Repair:
   1. Repairs of conduit and cabling will be subject to approval by inspector and electrical lead. Repairs must comply with the references cited herein using approved electrical equipment.

D. Replacement:
   1. Cable replacement shall be done in the event of damaged cable or sheathing that is unable to be repaired due to accessibility or extent of damage.

3.05. SITE QUALITY CONTROL

A. Test all circuits for continuity prior to connection to power source using voltage and current tests.

B. Visual inspection of all connections and junction boxes shall verify the continuity of connections and labeling.
C. Inspector and/or Electrical Lead shall confirm wiring against wiring diagrams.
D. Conduits shall be kept sealed if possible to prevent infiltration of dust and particles from other works.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
PART 1 GENERAL

1.01. SUMMARY

A. This section includes:
   1. Electrical metallic tubing
   2. Flexible metal conduit
   3. Flexible nonmetallic conduit
   4. Fittings for conduit
   5. Electrical boxes
   6. Conduit supports
   7. Raceways and boxes in SIPs

B. Related sections:
   1. Section 06 12 00: Structural Insulated Panels
   2. Section 26 05 19: Low Voltage Electrical Power Conductors & Cables
   3. Section 26 24 00: Switchboards and Panel boards
   4. Section 26 27 26: Wiring Devices
   5. Section 26 28 16: Enclosed Switches and Circuit Breakers

1.02. QUALITY ASSURANCE

A. These electrical products must comply with manufacturer's instructions and installed according to the BIM.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers: Schneider Electric or equivalent.

B. Materials:
   1. Electrical Metallic Tubing (EMT): EMT shall be UL 797 and ANSI C80.3, steel tubing, hot-dip galvanized. EMT fittings shall be ANSI/NEMA FB 1, steel, insulated throat, compression type. Sizes: 3/8", 1/2", 3/4" and 1".
   2. Flexible Metal Conduit: shall be UL Type Green Field flexible metal conduit. UL1 Listed. Reduce Wall Flexible Steel Conduit, hot dipped zinc galvanized low carbon steel, corrosion resistant. Sizes: 1/2" and 3/4".
   3. Flexible Nonmetallic conduit: this type of conduit shall be UL listed. Size: 3/4".
   4. Fittings for conduits:
      a. Unions: all unions of the designated as UNF and UNY and shall be suitable for use in moist atmospheres. Unions shall be of cast ferrous alloy, electroplated with zinc.

b. Bushings: all bushings shall be steel or malleable iron threaded type electroplated with zinc or hot-dip galvanized. Bushings shall have a molded-phenolic or nylon insulating collar.
c. Liquid tight flexible metallic conduit connectors: connectors for liquid tight flexible metallic conduit shall be electroplated zinc malleable iron. An O-ring gasket and an approved grounding insert shall be part of the unit. Where applicable, 45 degree and 90 degree fittings may be used.
d. Locknuts: all locknuts used in general purpose areas shall be extra heavy steel electroplated with zinc for sizes 3⁄4" to 2". Locknuts larger than 2" shall be of malleable iron, electroplated with zinc. Locknuts used in damp and outdoor areas shall be stainless steel. Locknuts in corrosive areas shall be FRP.

5. Junction Boxes:
   a. Junction boxes, device boxes, fixture support boxes, oblong, round and rectangular conduit fittings shall be of the same material as required by the area classification for the raceway. Junction boxes for use in general purpose areas shall be steel.
   b. Cover plates shall be of similar material and finish. Full body neoprene gaskets shall be provided with all covers and shall fastened with stainless steel screws in exterior locations.
   c. NEMA 12 boxes shall be of heavy gauge sheet steel, or cast metal. All NEMA 12 boxes shall be provided with a 5 mil thick light gray thermo-epoxy finish unless otherwise noted, and designed so that moisture will drain away from the gasketed cover joint. Covers for sheet steel boxes shall have turned edges, ground smooth to form a tight seal against the gasket when the cover is closed.
6. Conduit supports:
   a. Hot-dip galvanized framing channel shall be used to support groups of conduit. Individual conduit supports shall be one-hole pipe straps. Conduit supports for PVC or epoxy coated rigid steel and PVC conduit systems shall be one hole PVC or epoxy coated clamps or PVC conduit wall hangers.
   b. Conduit supports in all exterior and corrosive areas shall be stainless steel, or as shown on the plans. All hardware shall be stainless steel.
7. Raceways and boxes in structurally insulated panels (SIPS)
   a. Conduit: 3/4" flexible type conduit will be fabricated with SIPs where indicated per electrical drawings. It has to be run both horizontally and vertically as needed in the panel layout drawings.
   b. Boxes: SIPs will include 4"x4"x2" plastic electric boxes where indicated per electrical drawing.

PART 3 EXECUTION

3.01. INSTALLERS

A. The personnel installing raceways and boxes for electrical systems in the house has to be approved by the project management and once installation is complete, a competent authority must commission it.

3.02. EXAMINATION

A. Products must be approved before installation in the house and they have to be in accordance to the BIM.

3.03. INSTALLATION

A. SIPs: All rough-in wiring should be done after wall panel installation.
B. Bends and offsets in conduit shall be avoided where possible but, where necessary, shall be made without flattening or kinking, or shall be factory preformed bends.
C. Turns shall be made with case metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.
D. Where required for pulling cable and as necessary to meet the requirements of the previous Paragraph, the Contractor shall provide junction or pull boxes. Pull boxes used for multiple conduit runs shall not combine circuits fed from different panel boards.
E. Conduit entering NEMA 1 type sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the box or cabinet and shall have an insulating grounding or bonding bushing constructed over the conduit end. Joints shall be made with standard couplings or threaded unions. Metal parts of nonmetallic boxes and plastic coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of conduit shall be cut square, reamed and threaded with straight threads.

3.04. RELOCATION CONSIDERATIONS

A. Repair: once all the components of the house have been moved, the team must verify that all connections and boxes are intact. If not, proceed to replace them.
B. Replacement: if components are not in acceptable conditions after moved to the competition site, they must be replaced.

3.05. SITE QUALITY CONTROL

A. All conduits and boxes for electrical systems must comply with instructions specified on the installation section above. At the same, the installation process must comply with the manufacturer's requirements and all safety measures.

3.06. COMMISSIONING

A. Final inspection of installed products must be performed.

END OF SECTION

SECTION 26 24 00
SWITCHBOARDS AND PANELBOARDS
PART 1 GENERAL

1.01. SUMMARY

A. This section includes:
   1. Main distribution panel
   2. PV sub panel (roof)
   3. Disconnects
   4. Breakers
   5. Meter box

B. Related sections:
   1. Section 06 12 00: Structural Insulated Panels
   2. Section 26 05 19: Low Voltage Electrical Power Conductors & Cables
   3. Section 26 05 33: Raceways and boxes for electrical systems
   4. Section 26 27 26: Wiring Devices
   5. Section 26 28 16: Enclosed Switches and Circuit Breakers

1.02. REFERENCES

A. Underwriters' Laboratories
   1. UL67—Standard for Panelboards
   2. UL 50—Enclosures for Electrical Equipment

B. Canadian Standards Association
   1. CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
   2. CSA C22.2, No. 94-Special Purpose Enclosures

C. NEMA
   1. NEMA PB 1—Panelboards

D. National Fire Protection Association
   1. NFPA 70—National Electrical Code

E. Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards

F. 2003 IBC, NFPA 5000, ASCE/SE17 Seismic Qualification

1.03. QUALITY ASSURANCE

A. These electrical products must comply with manufacturer's instructions and installed according to the BIM.

B. These electrical products must comply with NEC 2008.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers: Schneider Electric

B. Materials:

1. Distribution Panels: Schneider Electric HOM4252M200C Load Center
   a. Rating: NEMA 1.
   b. Distribution Capacity: 200A, GE THQMV200D Short Circuit Current Rating: 22kAIC. Max Single Pole Circuits: 52.
   c. Max Tandem Circuit Breakers: 26.
   d. Phase: 1.
   e. Wire Configuration: 3-Wire.
   f. Enclosure: Indoor.
   g. Wire Size: #4 to 250 AWG/kcmil (Al/Cu).
2. PV sub panels:
   a. PV sub-panel junction box: 600V, UL50 3R, NEMA 3R approved, 12A LittleFuse circuit fuses for each negative string.
   b. PV junction box: organizer access for PV monitoring: NEMA 1 approved.
3. Disconnects:
   a. PV AC disconnect: shall be provided near the utility meter as required by the standards. UL listed, 600Vdc disconnect,60A, NEMA3R enclosures, non-fused disconnect switch, L/O T/O.
   b. PV DC disconnect: Installed with PV Central inverter.
4. Breakers (general purpose & AFCI):
   a. AFCI breakers shall provide protection to circuits as required by the NEC 2008 210.12(B). These AFCI breakers shall be mounted at the main distribution panel. General purpose breakers shall be at 15A, 20A (120V), 20A, 30A, and 40A (240V).
   b. General Circuit Breakers: 1 Pole, ampere ratings: 15, 20, Voltage: 120.
   c. AFCI Circuit Breakers: 1 Pole, ampere rating: 15, Voltage: 120.
5. Ground Fault Circuit Interrupters:
   a. Compliant with UL Requirements for GFCIs.

PART 3 EXECUTION

3.01. INSTALLERS

A. The personnel installing raceways and boxes for electrical systems in the house has to be approved by the project management and once installation is complete, a competent authority must commission it.

3.02. EXAMINATION

A. Products must be approved before installation in the house and they have to be in accordance to the BIM.

3.03. INSTALLATION

A. Installation must comply with manufacturers instructions and recommendations.

3.04. RELOCATION CONSIDERATIONS

A. Repair: once all the components of the house have been moved, the team must verify that all connections and boards are intact. If not, proceed to replace them.
B. Replacement: if components are not in acceptable conditions after moved to the competition site, they must be replaced.

3.05. SITE QUALITY CONTROL

A. All conduits, boxes and boards for electrical systems must comply with instructions specified on the installation section above. At the same, the installation process must comply with the manufacturer's requirements and all safety measures.

3.06. COMMISSIONING

A. Final inspection of installed products must be performed.

3.07. ATTACHMENTS

A. Manufacturer's data sheet is attached.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes

1. Wiring devices, including the following:
    a. Straight blade receptacles.
    b. GFCI receptacles.
    c. Locking receptacles.
    d. Toggle switches.
    e. Wall-box dimmers.
    f. Occupancy/vacancy sensors.
    g. Communications outlets.
    h. Wall plates.
    i. Finishes.

1.02. REFERENCES

A. National Fire Protection Association

1. NFPA 70, Article 100: Electrical Components, Devices, and Accessories shall be listed and labeled by a testing agence acceptable to authorities having jurisdiction and marked for permissible application.

B. Comply with Federal Specifications—identified by the federal specifications marker

1. Receptacles, GFCI's, plugs and cord connectors: Federal Specification number W-C-596.
2. Snap Switches: Federal Specification Number W-S-896.

1.03. SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Selection Samples: For each device and wall plate specified, two complete sets of color chips representing manufacture's full range of available colors.

C. Verification Samples: For each finish product specified, two samples of each device and wall plate, representing actual product, color, and patterns.

1.04. QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Shall comply with standards set in References section of this document.
   2. Installer:
      a. Acceptable to the project manager and qualified in accordance with Qualified Electrical Worker Standards of Solar Decathlon 2013.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Acceptable Manufacturer: Legrand/Pass & Seymour, which is located at: P. O. Box 4822 ; Syracuse, NY 13221; Toll Free Tel: 800-776-4035 ; Email: request info (web_master@passandseymour.com); Web: www.legrand.us/PassAndSeymour.
   2. Substitutions: Permitted if meeting equivalent requirements.
   3. Custom Fabrication of Light Switches Permitted.

B. Materials:
   1. Straight Blade Receptacles
      a. Tamper-Resistant Convenience Receptacles, 125V, 15 and 20 A:
         (a) Comply with NEMA WD1, NEMA WD6 configurations 6-15P and 6-20P, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Required to be a crimped and welded terminal with right angle application connector.
         (b) Products: Legrand/Pass & Seymour, TR62 (15A duplex).
         (c) Products: Legrand/Pass & Seymour, TR63 (20A duplex).
      b. Weather-Resistant Convenience Receptacles, 125V, 15 and 20 A:
         (a) Comply with NEMA WD1, NEMA WD6 configurations 6-15P and 6-20P, UL498 and Federal Specification W-C-596.
         (b) Products: Legrand/Pass & Seymour, WR5262 (15A duplex).

(c) Products: Legrand/Pass & Seymour, WR5362 (20A duplex).
(d) Products: Legrand/Pass & Seymour, WR3802 (30A single).

2. Ground Fault Circuit Interrupt Receptacles
   a. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 15 and 20 A:
      (a) Comply with NEMA WD1, NEMA WD6 configurations 6-15P and 6-20P, UL 498 Supplement SD, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped. Products: Legrand/Pass & Seymour, 1595TR (15A duplex).
      (b) Products: Legrand/Pass & Seymour, 1595TRNA (NAFTA, 15A duplex).
3. Locking Receptacles
   a. Single Convenience Receptacles, 125 V:
      (a) Comply with NEMA WD 1, NEMA WD 6 configuration L6-15P, L6-20P and L5-30R, UL 498 and Federal Specification W-C-596.
      (b) Products: Legrand/Pass & Seymour, 4710 (15A).
      (c) Products: Legrand/Pass & Seymour, L520R (20A).
4. Toggle Switches
   a. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.
   b. Switches 120/277 V:
      (a) Products: Legrand/Pass & Seymour, PS15AC1 (15A – single pole).
      (b) Products: Legrand/Pass & Seymour, PS20AC1 (20A – single pole).
5. Wall-Box Dimmers
   a. Dimmer Switches:
      (a) Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
      (b) Function: Continuously adjustable with single-pole or three-way switching. Comply with UL 1472.
      (c) Control: Slider.
   b. Touch-Sensitive Switches:
      (a) Modular, low-voltage controlled touch-sensitive switches
      (b) Function: Continuously adjustable, programmable, and modular.
      (c) Control: Multi-touch sensing.
6. Occupancy/Vacancy Sensors
   a. Residential Vacancy Sensors (PIR):
      (a) Manual ON - Auto-OFF:
         (i) Products: Legrand/Pass & Seymour, RW500BCC4.
         (ii) Products: Legrand/Pass & Seymour, RW600BCC4 (neutral required).
      (b) Auto-ON - Auto-OFF:
         (i) Products: Legrand/Pass & Seymour, RW500UCC4.
         (ii) Products: Legrand/Pass & Seymour, RW600UCC4 (neutral required).

(c) Manual ON - Auto-ON (selectable): Legrand/Pass & Seymour, RW3U600.
(d) Manual ON - (selectable): Legrand/Pass & Seymour, RW3U603.

7. Communications Outlets
   a. Telephone Outlet:
      (a) Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.
8. Wall Plates
   a. Wall Plates:
      (a) General: Single and combination types to match corresponding wiring devices.
      (b) Plate-Securing Screws: Metal with head color to match plate finish.
      (c) Material for Finished Spaces: Steel with primer baked enamel, suitable for field painting.
      (d) Material for Finished Spaces: Smooth, high-impact thermoplastic.
      (e) Material for Finished Spaces: 0.035 inch (1 mm) thick, satin-finished stainless steel.
      (f) Material for Finished Spaces: 0.04 inch (1 mm) thick, brushed brass with factory polymer finish.
      (g) Material for Finished Spaces: 0.04 inch (1 mm) thick steel with chrome-plated finish.
      (h) Material for Finished Spaces: 0.05 inch (1.2 mm) thick anodized aluminum finish.
      (i) Material for Unfinished Spaces: Galvanized steel.
      (j) Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
      (k) Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet Locations."
      (l) Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations".
   b. Wet-Location, Weatherproof Cover Plates:
      (a) Compliance: NEMA 250, complying with type 3R weather-resistant with lockable cover.
      (b) Material: Die-cast aluminum.
      (c) Material: Thermoplastic.
9. Finishes
   a. Wiring Devices Connected to Normal Power System:
      (a) Color: Light Almond, unless otherwise indicated or required by NFPA 70 or device listing.
      (b) Color: Black, unless otherwise indicated or required by NFPA 70 or device listing.

(c) Color: Brown, unless otherwise indicated or required by NFPA 70 or device listing.
(d) Color: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
(e) Color: Ivory, unless otherwise indicated or required by NFPA 70 or device listing.
(f) Color: White, unless otherwise indicated or required by NFPA 70 or device listing.
(g) Color: Green, unless otherwise indicated or required by NFPA 70 or device listing.
(h) Color: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions allowed without approval of Electrical Lead. Product must meet Reference Standards provided in this specification.
B. Substitutions must be approved by architect for finishes.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained on installation of electrical components. Competency will be verified by Electrical Lead, Site Superintendent, and/or Project Manager.
B. Installers must be Qualified Electrical Workers per the guidelines of Solar Decathlon 2013.

3.02. EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03. INSTALLATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
D. Coordination with Other Trades:
    1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

E. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

F. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

G. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.
2. Install ground pin of vertically mounted receptacles down.
3. Install ground pin of horizontally mounted receptacles to the right.

4. Install ground pin of horizontally mounted receptacles to the left.
1. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

J. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

K. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

M. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

N. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.04. RELOCATION CONSIDERATIONS

A. Replacement:
1. Damaged products shall be replaced with identical products.

3.05. SITE QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: This Section specifies enclosed switches and circuit breakers from Schneider Electric.

1.02. REFERENCES

1. ASTM (ASTM):
   a. ASTM E 329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction."
2. Canadian Standards Association (CSA):
   a. CSA C22.2 No. 5, “Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures.”
3. Federal Specifications (FS):
   a. FS W-C-375, "Circuit Breakers, Molded Case, Branch Circuit and Service."
4. International Electrotechnical Commission (IEC):
   a. IEC 60947, “Low Voltage Switchgear and Control Gear – Part 2: Circuit Breakers.”
   b. IEC 61000-4 Series, “Electromagnetic Compatibility.”
5. Mexican Standards, Underwriters Laboratories Inc. of Mexico (NMX):
   a. NMX-J-266, “Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures.”
6. National Electrical Manufacturers Association (NEMA):
   a. NEMA AB 1, "Molded Case Circuit Breakers and Molded Case Switches."
7. National Fire Protection Association (NFPA):
   a. NFPA 70, "National Electrical Code" (copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC.
8. Underwriters Laboratories, Inc. (UL):
   a. UL 489, "Standard for Molded-Case Circuit Breakers and Circuit-Breaker Enclosures."
   b. UL 508, "Standard for Industrial Control Equipment" (copyrighted by UL, ANSI approved).
   c. UL 1053, "Standard for Ground Fault Sensing and Relaying Equipment”.

1.03. SUBMITTALS

A. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1.04. QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of molded case circuit breakers of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.
      a. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.
   2. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing molded case circuit breakers similar in type and scope to that required for this Project.
   3. Inspecting and Testing Agency Qualifications: To qualify for acceptance, the manufacturer or a qualified independent inspecting and testing agency hired by the Contractor or manufacturer to test products shall demonstrate to the Architect/Engineer's satisfaction that they are qualified according to ASTM E 329 to conduct testing indicated.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NEC, Article 100, by an inspecting and testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Environmental Requirements: Do not install molded case circuit breakers until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Square D, Schneider Electric.

B. Materials:
1. Electronic Trip Circuit Breakers:
   a. MICROLOGIC Trip System:
      (a) Basis of Design: "PowerPact H-, J-, L-, P-, and R-Frame" (15 amperes to 3000 amperes) as manufactured by Square D by Schneider Electric.
      (b) General:
         (i) Circuit breaker trip system shall be a MICROLOGIC electronic trip unit with true RMS sensing.
         (ii) Current transformers shall be used to ensure accurate measurements from low current up to high currents.
         (iii) Electronic trip unit shall be fitted with thermal imaging.
         (iv) The following monitoring functions shall be integral parts of electronic trip units:
            1. A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
            2. LED for load indication at 105 percent.
            3. LED for load indication at 90 percent of load for applications 600A and smaller
            4. LED for visual verification of protection circuit functionality for applications 600A or smaller.
            5. Optional: LED for trip indication for applications above 600A.
         (v) MICROLOGIC trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
            1. Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (In), with finer adjustments available for more precise settings to match the application.
2. Flange Mounted Disconnect Switches and Circuit Breaker Mechanisms
   a. UL 9422 Flange-Mounted Disconnect Switch.
      (a) 30-400A sizes
      (b) UL and CSA Recognized.
3. Air Conditioning Disconnect Switch.
   a. NEMA Type 3R Rainproof
   b. 240 VAC two-wire with ground.
   c. Molded case, enclosed, non-fusible.
4. General Characteristics:
   a. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.

b. Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
c. The circuit breaker handle shall reside in a tripped position between on and off to provide local trip indication. Circuit breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.
d. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
e. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
f. Circuit breakers shall be factory-sealed with a hologram quality mark and shall have date code on face of circuit breaker.

C. Accessories:
1. General:
a. Circuit breakers shall be equipped with UL-listed electrical accessories as noted on the Drawings or schedules or they may be field-installable.
b. The addition of auxiliaries shall not increase the volume of the circuit breaker.
c. The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings.
2. Electrical Auxiliaries: Electrical auxiliaries, such as voltage releases (shunt and undervoltage releases) and indication switches as follows:
a. Same field-installable auxiliary contacts for signaling different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal. Auxiliaries shall be common for the entire range,
b. Electrical auxiliaries shall be separated from power circuits,
c. Electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
d. Electrical auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
3. Handle Accessories:
a. Circuit breaker handle accessories shall provide provisions for locking handle in the on and off position.

2.02. PRODUCT SUBSTITUTIONS

A. No substitutions allowed without approval of Electrical Lead. Product must meet Reference Standards provided in this specification.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained on installation of electrical components. Competency will be verified by Electrical Lead, Site Superintendent, and/or Project Manager.

B. Installers must be Qualified Electrical Workers per the guidelines of Solar Decathlon 2013.

3.02. EXAMINATION

A. Verification of Conditions:

1. Examine areas and conditions under which the work is to be installed, and notify the superintendent of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

a. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the installer.

3.03. INSTALLATION

A. Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.

1. Install molded case circuit breakers in accordance with the NEC and applicable local codes.

B. Mold case circuit breaker pickup level and time delay settings shall be adjusted to values indicated on the Drawings or schedule, as indicated by the coordination study, and as instructed by the Architect/ Engineer

3.04. RELOCATION CONSIDERATIONS

A. Replacement:

1. Damaged breakers shall be replaced with identical products. Substitutions of individual units shall not be allowed.

3.05. SITE QUALITY CONTROL

A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the molded case circuit breakers shall be without damage at time of Substantial Completion.

3.06. ATTACHMENTS

A. Manufacturer's data sheet attached.

END OF SECTION

SECTION 26 31 00
PHOTOVOLTAIC COLLECTORS
PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: This Section specifies solar electric modules from Stion Corporation for energy generation.

B. Related Requirements:

1. Section 07 63 00: Sheet Metal Roofing Specialties.
2. Section 26 05 19: Low-Voltage Electrical Conductors and Cables.
3. Section 26 27 26: Wiring Devices.
4. Section 48 19 16: Electrical Power Generation Inverters.

1.02. REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI/UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.

B. Underwriters' Laboratories Canada:

1. ULC ORD-C1703-01 Flat Plate Photovoltaic Modules and Panels.

C. International Organization for Standardization (ISO):

1. ISO 9001 Quality Management Systems.
2. ISO 14001 Environmental Management Systems.

D. Underwriters Laboratories, Inc. (UL):

1. UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.

1.03. QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
   a. Having sufficient capacity to produce and deliver required materials without causing delay in work.
   b. Manufacturing facility certified to ISO 9001 and to ISO 14001.
2. Installer:
   a. Acceptable to the project manager and qualified in accordance with Qualified Electrical Worker Standards of Solar Decathlon 2013.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

B. Provide spacers between frames and glass of panel top faces.

C. Lock panels in a safe location while stored on site prior to installation.

D. Separate waste materials for reuse and recycling. Divert waste from landfill to appropriate receptacles at PSSI Facility, Bonair Siding, Stanford, CA.

1.05. WARRANTY

A. Warranty Term:
   1. 10 year product guarantee against manufacturing defects.
   2. 25 year performance guarantee as required by the State of California for photovoltaic panels.
      a. 90% of Maximum Power Performance after 10 years.
      b. 80% of Maximum Power Performance after 25 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Stion Corporation, 6321 San Ignacio Avenue, San Jose, CA 95119.

B. Materials:
   1. Stion Thin-Film Copper, Indium, Gallium, Selenium, and Sulfur (CIGS) Module STN-135
      a. Copper, Indium, Gallium, Selenium, and Sulfur (CIGS) surface.
      b. Module Efficiency: 12.4%.
      c. Power production: STC 135 Wp.
      d. Nominal Voltage: 30 V.
      e. Maximum System Voltage: 600 V.
      f. Size: 23.9” x 65.2” x 1.4”.
      g. Structured glass front surface.
      h. Anodized aluminum frame.
      i. Weather-resistant back sheet.

2.02. RELATED PRODUCTS

A. Attach to sheet metal panel fasteners:
   1. See Section 07 63 00: Sheet Metal Roofing Specialties.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions allowed without approval of Electrical Lead. Product must meet Reference Standards provided in this specification.

B. Substitutions must be approved by Department of Energy through resubmission of Electrical Interconnection Application.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained on installation of electrical components and fastening panels to attachments and standing seam roofing. Competency will be verified by Electrical Lead, Site Superintendent, and/or Project Manager.
B. Installers must be Qualified Electrical Workers per the guidelines of Solar Decathlon 2013.
C. Installer must have completed Ladder and Fall Protection Training if operating on roof.

3.02. EXAMINATION

A. Standing seam metal roof must be completely installed, inspected, and approved before commencement of photovoltaic installation.
B. Photovoltaic panels shall be inspected upon arrival on site to ensure no manufacturing defects or damages during transportation.

3.03. INSTALLATION

A. Place panels within clips and attach via tightening clips on frames of panels.
B. Connect panels to Tigo Maximizers as shown in electrical diagrams and in series to additional modules per chain.
C. Ensure connections are made adequately between panels.

3.04. RELOCATION CONSIDERATIONS

A. Panels shall be removed from the roof during transportation and relocation. Panels shall be packed with spacers between frames to prevent glass from scratching during transit.

3.05. SITE QUALITY CONTROL

A. Protect panels during other construction activities on roof to prevent scratching or damaging glass and panels.

3.06. COMMISSIONING

A. Output of panels shall be verified during normal operation through field measurement and comparison to manufacturer supplied specifications and data sheets.

3.07. ATTACHMENTS

A. Manufacturer supplied data sheet, installation instructions, and UL listing.

END OF SECTION

SECTION 26 33 43
BATTERY CHARGERS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. High power wall connector for charging electric vehicle.
- B. Related Sections:
  1. Section 26 05 19: Low Voltage Electrical Power Conductors and Cables.
  2. Section 26 24 00: Switchboards and Panelboards.

1.02. REFERENCES
- A. Underwriters' Laboratories.

1.03. SUBMITTALS
- A. Product data sheet, drawings, and electrical interconnection specifications and diagrams must be submitted to the Electrical Engineer prior to final design and implementation.

1.04. MAINTENANCE MATERIAL SUBMITTALS
- A. Operations manual and maintenance instructions shall be submitted with delivery of the final product.

1.05. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered direct from manufacturer in original packaging and kep securely in packaging until use.
- B. Product shall be stored on-site in a cool, dry, locked location protected from heat, rain, sun, and wind. It shall not be stacked with other elements and shall be treated as fragile.

1.06. WARRANTY
- A. Manufacturer shall provide typical warranty against defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Tesla Motors. 350 Deer Creek, Palo Alto, CA 94304. Phone: (650) 681-5000.
- B. Materials:
  1. High Power Wall Connector
     a. Purpose: Electric Vehicle Charging.
     b. Voltage Rating: 208-250 VAC, 60 Hz.

c. Breaker Rating: 50 A.
d. Cable: Insulated, 25 foot cable.
e. Weight: 20 lbs.
f. Approved for indoor or outdoor use.

2.02. SOURCE QUALITY CONTROL

A. Product shall be free from defects and have been tested in the factory prior to delivery on-site.

2.03. PRODUCT SUBSTITUTIONS

A. There shall be no substitutions for this product.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only a qualified electrical worker as defined by the Solar Decathlon Rules shall be allowed to install this product. Worker shall be trained in safe installation of medium voltage products and appliances.

3.02. EXAMINATION

A. Core SIPS and metal wall paneling shall be fully installed, flush, and free of debris and dirt prior to installation of charging panel.
B. Electrical Breaker Panel shall be installed and tested prior to installation of charging station and power should be off to the termination point of installation.

3.03. INSTALLATION

A. Install according to manufacturer's specifications.

3.04. RELOCATION CONSIDERATIONS

A. This product shall remain in place during relocation of the home.
B. Replacement:
1. No repair is allowed on this product. Should replacement be necessary, an identical product must be used.

3.05. SITE QUALITY CONTROL

A. Protect the unit from damage due to any adjacent or following construction works after installation.
B. Keep unit clean and dry after construction and clean upon completion of construction.

3.06. COMMISSIONING

A. Unit shall be tested after installation to verify proper voltage and current across the terminal. A test of charging time shall be performed to validate the ability of the charger.

3.07. ATTACHMENTS

A. Manufacturer's product data sheet is attached.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Interior lighting fixtures, lamps, and ballasts
  2. Lighting fixture supports
- B. Related Sections: Section(s) related to this section include:
  1. 26 05 19 – Low Voltage Electrical Power Conductors & Cables
  2. 26 28 16 – Enclosed Switches and Circuit Breakers
  3. 25 36 00 –Integrated Automation Control of Electrical Systems
- C. System Description

1.02. REFERENCES
- A. NFPA 70
- B. NEMA LE4
- C. ASTM A 641/A 641M
- D. ASTM A 580/A 580M

1.03. QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70

1.04. WARRANTY
- A. Warranty shall be provided by the manufacturer against manufacturing defects.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers
  1. Philips Color Kinetics, 3 Burlington Woods Drive, Burlington, MA 01803. Phone (888) 385-5742.
  2. Nora Lighting. 6505 Gayhart St., Commerce, CA 90040. Phone: (800) 686-6672.
  3. Contech Lighting. 2783 Shermer Road, Northbrook, IL 60062. Phone: (847) 559-5500.
  4. Cooper Lighting. 1121 Highway 74, South Peachtree City, GA 30269. Phone: (770) 486-4800.
  5. Progress Lighting. PO Box 6701, Greenville, South Carolina 29606. Phone: (864) 678-1000.

6. Green Matters

B. Materials
   1. Philips Vaya Cove LP.
   2. Nora Lighting NUTP8-16LED.
   3. Contech CRS8 Pendant.
   4. Halo H455TUNVD010 H4 Series Recessed Light.
   5. Progress P7232-15EB Linear Fluorescent Bath Light.
   6. Philips Lightolier LSW T8 4 Ft. and 2 Ft.
   7. Green Matters HD-3953 Link 1-Light Brushed Nickel Tube Wall Sconce.

2.02. ACCESSORIES

A. Lighting fixture support components
   1. Single-stem hangers of ½ inch steel tubing with swivel ball fittings and ceiling canopy.
   2. Twin-stem hangers of two ½ inch steel tubes with single canopy designed to mount a single fixture.
   3. Wires compliant with ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage
   4. Wires for humid spaces compliant with ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gage.
   5. Rod hangers of 3/16-inch minimum diameter cadmium-plated threaded steel rod.
   6. Hook hangers of integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

B. Doors, frames, and other internal access smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from fall accidentally during relamping and when secured in operating position.

C. Diffusers and globes of annealed crystal glass unless otherwise indicated.

2.03. SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70

PART 3 EXECUTION

3.01. INSTALLERS

A. Interior lighting components will be installed by a trained, qualified installer. A professional crew and electrician with proper certifications for equipment will be contracted to assist with electrical wiring and fixture installation.

3.02. EXAMINATION

A. Ensure that wires have been pulled to the junction boxes where lights are to be installed.

3.03. INSTALLATION

A. Lighting fixtures shall be set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. Comply with NFPA 70 for minimum fixture supports.
C. Suspended lighting fixture support:
    1. Pendants and rods braced to limit swinging where longer than 48 inches
    2. Stem-mounted, single-unit fixtures suspended with twin-stem hangers
D. Adjust aimable lighting fixtures to provide required light intensities
E. Connect wiring according to Division 26 05 19 "Low Voltage Electrical Power Conductors and Cables."

3.04. RELOCATION CONSIDERATIONS

A. Light fixtures will remain installed during relocation.

3.05. SITE QUALITY CONTROL

A. Verify proper operation of lamps in light fixtures.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.06. ATTACHMENTS

A. Tech Lighting Unilume LED Undercabinet.
B. V2 Lighting Group Core 200 Pendant.
C. WAC Lighting LEDme Step Light.
D. Philips eColor Cove EC Powercore.
E. Edge Lighting Levitate LED.
F. Philips SmartForm LED BCS 460.
G. Cree Lighting CR6 Downlight.
H. Edge Lighting Reflection Mirror Light.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Exterior lighting fixtures, lamps, and ballasts.
  2. Lighting fixture supports.
- B. Related Sections: Section(s) related to this section include:
  1. 26 05 19 – Low Voltage Electrical Power Conductors & Cables
  2. 26 28 16 – Enclosed Switches and Circuit Breakers
  3. 25 36 00 –Integrated Automation Control of Electrical Systems
- C. System Description

1.02. REFERENCES
- A. NFPA 70
- B. NEMA LE4
- C. ASTM A 641/A 641M
- D. ASTM A 580/A 580M

1.03. QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Products shall be carefully stored in a dry, locked container until installation on-site.

1.05. WARRANTY
- A. Manufacturer's shall supply warranty for all products.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Progress Lighting. PO Box 6701, Greenville, South Carolina 29606. Phone: (864) 678-1000.
  2. Malibu Lights. 4215 McEwen Road, Dallas, TX 75244. Phone: (888) 295-7348.
- B. Materials:
  1. Progress Lighting Metallic Gray 2-Light Wall Lantern

2. Malibu 9-Light Outdoor Black Tier/Flood Light Kit.

2.02. ACCESSORIES

A. Lighting fixture supports as included by manufacturer.
B. UL-Listed Wall Junction Box.

2.03. SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NFPA 70.

PART 3 EXECUTION

3.01. INSTALLERS

A. Interior lighting components will be installed by a trained, qualified installer. A professional crew and electrician with proper certifications for equipment will be contracted to assist with electrical wiring and fixture installation.
B. Installers shall meet the requirements of a Qualified Electrical Worker for Solar Decathlon 2013.

3.02. EXAMINATION

A. Ensure that wires have been pulled to the junction boxes where lights are to be installed.

3.03. INSTALLATION

A. Lighting fixtures shall be set level, plumb, and square with walls. Install lamps in each fixture.
B. Comply with NFPA 70 for minimum fixture supports.
C. Adjust aimable lighting fixtures to provide required light intensities.
D. Connect wiring according to Division 26 05 19 “Low Voltage Electrical Power Conductors and Cables.”

3.04. RELOCATION CONSIDERATIONS

A. Light fixtures will remain installed during relocation.

3.05. SITE QUALITY CONTROL

A. Verify proper operation of lamps in light fixtures.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.06. ATTACHMENTS

A. Manufacturer Product Data Sheet is attached.

END OF SECTION

DIVISION 28

SECTION 28 31 00
FIRE DETECTION AND ALARM
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Smoke Detectors and Fire Alarms.
- B. Related Sections:
  1. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables.

1.02. SUBMITTALS
- A. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Products shall be stored in a clean, dry location prior to installation.

1.04. WARRANTY
- A. Warranty shall be provided in conjunction with the manufacturer's typical installation requirements.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Kidde Fire Safety. 1016 Corporate Park Drive, Mebane, NC 27302. Phone: (919) 563-5911.
- B. Materials:
  1. Kidde Model i12060 Smoke Alarm.

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall not be allowed without consultation with the Project Manager and Fire Marshal.

PART 3 EXECUTION

3.01. INSTALLERS

A. Only qualified installers shall install and wire the smoke alarms. Installers shall have experience with such products and verify competency with the Project Manager or Construction Manager.

3.02. EXAMINATION

A. All wires shall be stripped and installed prior to fire alarm installation. All drywall shall be clean and dry. Paint shall be applied or the area masked after installation.
B. Fire alarm should be in good working order.

3.03. INSTALLATION

A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
D. Provide the service of a NICET level III, competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.
E. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.04. RELOCATION CONSIDERATIONS

A. Detector operation shall be re-verified after transportation.

3.05. SITE QUALITY CONTROL

A. Ensure that smoke detectors are covered when painting or during additional interior work after installation.
B. Ensure operation of detectors is not compromised.

3.06. ATTACHMENTS

A. Product Data Sheet

END OF SECTION

DIVISION 32

SECTION 32 71 00
CONSTRUCTED WETLANDS
PART 1 GENERAL

1.05. SUMMARY
- A. Section Includes:
  1. Sheathing.
  2. Piping and Fittings.
  3. Liner.
  4. Pebbles.
- B. Related Sections:
  1. Section 32 90 00: Planting.
  2. Section 32 94 33: Planters.

1.06. SUBMITTALS
- A. Designer shall submit layout of planter and plants prior to approval and acceptance of design.

1.07. DELIVERY, STORAGE, AND HANDLING
- A. Wood products shall be stored in a dry, well ventilated location and protected from exposure to sun, rain, and wind.
- B. Piping and fittings shall be neatly stacked and stored from time of delivery to time of installation.
- C. Liner shall be stored in a cool, dry location and protected from exposure to sun, rain, and wind.

1.08. WARRANTY
- A. No warranty shall be provided by the manufacturer.

PART 2 PRODUCTS

2.03. PRODUCT INFORMATION
- A. Manufacturers:
  1. Sheathing:
     a. General lumber yard or lumber supplier.
  2. Piping and Fittings:

a. Uponor (USA and Canada), 5925 148th Street West, Apple Valley, MN 55124. Telephone: (800) 321-4739.
b. Or Equivalent.

3. Liner:
   a. Tremco Incorporated, 3735 Green Road, Beachwood, Ohio 44122. Telephone: (800) 321-7906.
   b. Or Equivalent.
4. Pebbles:
   a. General stone supplier or home improvement store.

B. Materials:
1. Sheathing:
   a. ½" Grade C Plywood.
2. Piping and Fittings:
   a. 1 ½" and 2" PEX piping for connections as per drawings. Fittings for these connections per PEX supplier's guidelines.
   b. Corrugated black hose: 1 ½" diameter hose connecting house outlet to wetlands inlet.
   c. Slotted Pipe: 2" slotted black pipe for rainwater distribution per drawings.
3. Liner:
   a. Tremco Vulkem 116
      (a) One-part polyurethane sealant for joints.
      (b) Use over all connection points between structural trusses and sheathing.
      (c) Allow minimum 30 hours cure time.
   b. Tremco Vulkem Primer 171
      (a) Urethane sealant
      (b) Coat over entire sheathing surface.
      (c) Allow minimum 30 minutes cure time.
   c. Tremco Vulkem 350NF
      (a) Single-component polyurethane basecoat.
      (b) First coat applied in a 4" diameter around joints.
      (c) Allow minumim 4 hours cure time between first and second coat.
      (d) Second coat over entire sheathing surface has 40 mil thickness.
      (e) Allow minimum 6 hours cure time after second coat.
   d. Vulkem 951NF Topcoat
      (a) High-performance, two-part polyurethane coating.
      (b) Two coats at 12 mil each; allow minimum 6 hours cure time.
4. Pebbles:
   a. River Rocks: 1"-2" black polished pebbles.
5. Plants:

a. Woodwardia fimbriata
b. Dryopteris spp.
c. Juncus spp.

2.04. PRODUCT SUBSTITUTIONS

A. Substitutions in liner and piping shall be made only with written approval of Project Manager and Wetland Designer.
B. Substitutions in sheathing and pebbles are allowed based on local availability.

PART 3 EXECUTION

3.07. INSTALLERS

A. Only qualified installers shall construct, fill, and plumb the wetland. Qualified installers shall be determined by the Project Manager and Construction Manager.

3.08. EXAMINATION

A. Decking shall be installed, leveled, and finished without trim prior to installation of wetland. Surface shall be clear of all obstructions and debris.
B. Joists and parallam beams shall be installed, leveled, and finished prior to installation of wetland.

3.09. INSTALLATION

A. Install plywood sheathing Grade C facing up.
B. Make plumbing penetrations in locations indicated in drawings.
C. Set units level, plumb, and true to line, without warp or rack of frames. Securely in place using appropriate fastenings.
D. Connect piping to modules where indicated in drawings with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated in drawings.
E. Prepare substrate as recommended in waterproofing membrane manufacturer's specifications.
F. Apply waterproofing membrane in the following order: Tremco Vulkem 116, Tremco Vulkem Primer 171, Tremco Vulkem 350NF, Tremco Vulkem 951NF Topcoat. Apply layers to locations indicated in accordance with manufacturer's specifications allowing indicated curing times between coats.
G. Repair, refinish, or replace damaged parts during installation, as directed by Architect.
H. Place wetland plants in plant bags within the respective parts of the wetland.
I. Finish wetland by placing river rocks above bags. Bags should not be visible when installation is complete.
J. Trim wetland in reclaimed Douglas fir as indicated on drawings.

3.10. RELOCATION CONSIDERATIONS

A. Wetland shall be deconstructed and reconstructed after transportation.

3.11. SITE QUALITY CONTROL

A. Ensure that plants are kept free from activities which may negatively impact their health.

END OF SECTION

SECTION 32 84 13
DRIP IRRIGATION
PART 1 GENERAL

1.01. SUMMARY

A. General: Drip irrigation lines will be made from Low-Density Polyethylene (LDPE)

B. Project Conditions: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.02. REFERENCES

A. Plastics Pipe Institute (PPI):

1. Technical Report TR-3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

B. Technical Report TR-4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds.

C. Society of the Plastics Industry (SPI).

D. IAPMO, Uniform Plumbing Code

E. BOCA, Basic Building, Mechanical Plumbing Codes

1.03. SUBMITTALS

A. Product data, specifications, and drawings should be submitted during design and prior to the beginning of construction.

1.04. QUALITY ASSURANCE

A. Single Source Requirements: To the greatest extent possible, provide products specified in this section from a single manufacturer.

B. Installer Qualifications: Successfully engaged in installation of systems of similar size and complexity for at least 2 years.

C. Manufacturer Requirements: Appoint a representative to visit and inspection site.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers and packaging with identification labels identifying product name and manufacturer intact.

B. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards. Protect from damage.

C. Prevent dirt or foreign materials from entering tubing.

D. Do not expose tubing to direct sunlight for more than 30 days; cover tubing exposed to direct sunlight if construction delays occur.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Clean Water Components (www.cleanwatercomponents.com)

B. Materials:
   1. IrriGRAY Greywater-Rainwater Dripperline
      a. 400 micron filtration requirement
      b. Dripper flow rate: 2 GPH.
      c. Dripper spacing: 12”.
      d. Pressure Range-0.5-45 PSI
      e. Tubing Diameter: 0.540”I.D., 0.620” O.D.
      f. UV Resistant Low Density Polyethylene (LDPE)

2.02. ACCESSORIES

A. Barbed Fittings:
   1. 90 degree Elbow.
   2. Tee Joint.
   3. Barbed to ½” MPT.
   4. Barbed Back Valve.

2.03. PRODUCT SUBSTITUTIONS

A. No substitutions will be allowed without written approval of the Project Manager.

PART 3 EXECUTION

3.01. INSTALLERS

A. Product shall be installed by a qualified installer trained in drip irrigation.

3.02. EXAMINATION

A. Planters and soils shall be installed prior to the drip irrigation line being installed.
B. Line should be free of any unintentional perforations, tears, or cuts.

3.03. INSTALLATION

A. Install in accordance with manufacturer’s recommendations.

3.04. RELOCATION CONSIDERATIONS

A. Irrigation line will be removed for transportation and relocation.

3.05. ATTACHMENTS

A. Manufacturer's data sheet is attached.

END OF SECTION

SECTION 32 93 00
PLANTS
PART 1 GENERAL

1.01. SUMMARY
- A. Section includes:
  1. Plant material.
  2. Planter soils.
- B. Related Sections:
  1. Section 32 94 33: Planters.

1.02. SUBMITTALS
- A. Images and characteristics of plants shall be submitted prior to selection of final materials.

1.03. QUALITY ASSURANCE
- A. Nursery to grow plants shall be qualified in all specified plant materials and capable of storing and caring for them until October, 2013.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Plants shall be carefully transported from nursery to competition site in containers with soil. Nursery shall specify the appropriate transportation method and protection.
- B. Plants shall be transplanted once on-site and not allowed to remain on-site prior to transportation for more than 24 hours. Plants shall be stored with access to sunlight and away from other materials and activities which could damage the materials.
- C. Protect plant material from injury and desiccation. Any inspection certificates required by law to this effect shall accompany each shipment invoiced or order of stock, and shall be filed with the Project Manager.
- D. No plant material shall be planted until it is inspected and approved by the Project Manager prior to planting. All rejected material shall be immediately removed from the site and replaced with approved material at no additional cost to owner.

1.05. WARRANTY
- A. No warranty shall be provided on these materials.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers

1. Tree of Life Nursery. PO Box 635, San Juan Capistrano, CA 92693. Phone: (949) 728-0685.

B. Materials
1. Plants: The following plants shall be installed in the planters on-site:
   a. Eriogonum fasciculatum
   b. Ceanothus
   c. Dudleya brittonii
   d. Muhlenbergia rigens
   e. Nassella pulchra
   f. Leymus cond
   g. Calylophus hartwegii
   h. Salvia greggii
   i. Salvia clevelandii
   j. Juncus patens
   k. Beets
   l. Broccoli
   m. Cauliflower
   n. Lettuce
   o. Spinach
   p. Swiss Chard
   q. Raddishes
   r. Kale
   s. Lemon Balm
   t. Mint
   u. Thyme
   v. Basil
   w. Oregano
   x. Catnip
   y. Chives
   z. Parsley
   aa. Dill
   bb. Marjoram
   cc. Strawberries
   dd. Orange Trees
   ee. Lemon Trees
   ff. Lime Trees
   gg. Kumquat Trees
2. Soils:
   a. Loose sand and topsoil, mulch, and manure.

b. Well composted, stable, and weed-free organic matter, pH range of 5.5-8; moisture content 35-55 percent by weight; 100 percent passing through ¾ inch sieve; soluble salt content of 5-10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to planting. Formulated from forest products compost, sphagnum peat, perlite, a wetting agent, hydrolyzed corn starch, and plant food. Nitrogen 0.07%, phosphate 0.01%, soluble potash 0.03%.
c. Planter soils not to exceed 12 in. depth.

2.02. SOURCE QUALITY CONTROL

A. Healthy root systems shall be developed by transplanting or root pruning. Provide well shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, and defects such as sun scald, injuries, abrasions, and disfigurement.
B. All plants shall be typical of the species and variety. All plants shall have normal, well-developed branches and vigorous root systems with no signs of being root-bound. They shall be undamaged, healthy, vigorous, free from defects, disfiguring knots, abrasions of the bark, sunscald injuries, plant diseases, insect eggs, borers, and all other forms of infection.
C. Nursery grown specifications requires that the plant conform to the following:
    1. Plants collected from wild or native strands may be considered nursery grown when they have been successfully re-established in the nursery and grown under regular certifiable nursery cultural practices for a minimum or seven growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.
D. Root-Ball Depth:
    1. Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare. Root flare shall be visible before planting.

2.03. PRODUCT SUBSTITUTIONS

A. Product substitutions shall not be allowed except with the written permission of the Project Manager and relevant design advisors.

PART 3 EXECUTION

3.01. INSTALLERS

A. Plants shall be transplanted by qualified installers.

3.02. EXAMINATION

A. Planters shall be finished and liners sealed and installed prior to transplanting. Liners shall be verified to be waterproof prior to installation.

3.03. INSTALLATION

A. Place containers with plants into planters atop completed liners.
B. Set out and space ground cover and plants other than trees, shrubs, and vines in even rows with triangular spacing or as indicated on drawings.
C. Install soil around and atop planters until even with top of planter and level across top of plants; use planting soil for backfill.
D. Backfill around planters, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill.
E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.04. RELOCATION CONSIDERATIONS

A. Material shall not be included in installation until delivery at the competition. Therefore, no relocation considerations are required.

3.05. SITE QUALITY CONTROL

A. Ensure that plants are protected from damage due to landscape operations and operations of other tasks and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION

SECTION 32 94 33
PLANTERS
PART 1 GENERAL

1.01. SUMMARY
- A. Section includes:
  1. Reclaimed cedar planters and linings.
- B. Related Sections:
  1. Section 32 90 00: Planting.
  2. Section 32 84 13: Drip Irrigation.
  3. Section 06 15 00: Wood Decking.
  4. Section 06 10 00: Rough Carpentry.

1.02. REFERENCES
- A. ASTM International (ASTM):
  1. A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  2. E5199—HDPE Thickness Minimum Average.
  3. D1505—HDPE Density.
  4. D6693—HDPE Tensile Properties Each Direction.
  5. D1004—HDPE Tear Resistance.
  6. D4833—HDPE Puncture Resistance.

1.03. SUBMITTALS
- A. Samples shall be submitted to the architectural team prior to installation of the planter boxes.

1.04. DELIVERY, STORAGE, AND HANDLING
- A. Lumber shall be delivered to site when needed and stored in a dry, covered location sheltered from the sun and not in contact with damp surfaces.
- B. Provide air circulation within and from around stacks and under temporary covering.
- C. Materials shall be protected from rain, sun, and other weather damage while stored on-site.
- D. Store wood in a dry, well ventilated, location protected from exposure to sun and moisture.
- E. Store liner in a cool, dry location sheltered from direct sunlight prior to installation.
- F. Waste material shall be diverted from landfill and disposed of at PSSI Collection Facility, Bonair Siding, Stanford, CA.

1.05. WARRANTY
- A. No warranty is provided on material or fabrication.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION

A. Manufacturers:
   1. Lumber from local saw mill.
   2. Reusable Lumber Company, P.O. Box 620327, Woodside, CA 94602. Phone: (650) 529-9122 or (650) 867-8970. Email: info@reusablelumber.
   3. Global Plastic Sheeting, 1331 Specialty Drive, Vista, CA 92081. Phone: (866) 597-9298. Web: www.globalplasticsheeting.com.

B. Materials:
   1. Lumber:
      a. Structural Lumber: Construction grade pine above ground standard lumber
      b. Sides: Reclaimed Redwood PLywood. Treated, Finished, and Sealed. Lumber will be sourced from one of the following locations:
         (a) Habitat for Humanity, East Bay.
         (b) Crossroads Lumber Co., North Fork, CA.
         (c) Placemakers Incorporated, Redwood City, CA.
         (d) The Reuse Network, San Leandro, CA.
      c. Stain: To be selected by architect to complement exterior and interior finishes.
   2. Liner:
      a. High Density Polyethylene (HDPE) geomembrane.
      b. Thickness: 40 mil.

2.02. ACCESSORIES

A. Fasteners:
   1. Provide in accordance with manufacturer specifications.

2.03. PRODUCT SUBSTITUTIONS

A. Substitution of liner shall be made based on local availability.
B. Substitution of lumber slats shall not be allowed. Lumber from different sources provided by Reusable Lumber Company is allowed.
C. Substitution of structural lumber shall be allowed based on local availability.
D. Stain substitute shall be accepted with mock-up verifying tone and color of substitute matches original choice or is acceptable to architect.

PART 3 EXECUTION

3.06. INSTALLERS

A. Use an experienced installer/builder who has completed projects similar in material, design and extent indicated for the project, whose work has resulted in installations of similar products with a record of successful in-service performance.

3.07. EXAMINATION

A. Deck joists and parallams shall be installed before planters are constructed.
B. Decking shall be installed and leveled prior to installation of planters.

3.08. INSTALLATION

A. Frame edges of planters with 2” x 4” beams according to decking plan.
B. The slats should be milled to be fastened to the supports horizontally, with the lap hanging down over the ship. The material should be installed from the bottom tier (base of wall) up to the top of the planter.
C. All nail or screw holes should be "pilot drilled" prior to fastening to avoid cracks and splitting.
D. Slats should be fastened to the supports. There should be two fasteners per support (two per 16" spacing). Fasteners should be set to sit flush with exterior face or slightly below (no more than 1/16" depth). Fastened siding should rest flat on the slats with all boards interlocking smooth and easy. Never force the wood siding to seat, or drive it into position.
E. It is not recommended to paint cedar. Natural oils, and or non-toxic stains perform better than paint. Old growth redwood has high levels of natural tannins that give the wood longevity. Untreated the wood breathes and ages gracefully over time.
F. Liners shall be laid inside completed planter boxes and stapled into place.

3.09. RELOCATION CONSIDERATIONS

A. Slats and liners shall remain in place during transportation.
B. Repair
    1. Small cracks can be filled with wood putty and sanded to finish.
C. Replacement
    1. Replacement of damaged slats shall occur by qualified installers. Nails shall be fully removed, the slat replaced, and renailed.

3.10. SITE QUALITY CONTROL

A. Work surface shall be kept clean during installation.
B. Leave ample time to adequately plan each step of the project. Proper planning and correct knowledge will yield the best results possible. If you encounter an issue regarding the installation, always consult with an installation professional.

C. Installation will require either architectural plans or on-site planning to determine the actual method(s) of installation to meet local building codes. Such planning and details of all projects are the responsibility of the customer or customers' agent.
D. Slats and liners shall be protected during transportation using plastic wrap or other comparable coverings.
E. Installation and finishing shall be inspected and approved by construction manager or site superintendent.
F. Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

DIVISION 48

SECTION 48 19 10
ELECTRICAL POWER CONTROL EQUIPMENT
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Electrical Power Dual Maximizers.
- B. Related Sections:
  1. Section 26 05 19: Low Voltage Electrical Power Conductors and Cable.
  2. Section 26 31 00: Photovoltaic Collectors.

1.02. REFERENCES
1. Underwriters Laboratories (UL):
   a. UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.
   b. UL 1998: Software in Programmable Components.
   c. En 61000.
   d. NEC 2008 Compliant, MC4
   e. NEC 2008 compliant bus data.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered in original manufacturer packaging with label identifying product and specifications.
- B. Product shall be stored in locked container prior to installation.
- C. Product shall be stored in a cool, dry location and protected from exposure to sun, moisture, and extreme heat.

1.04. WARRANTY
- A. Manufacturer shall warrant product against manufacturer defects for 5 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. Tigo Energy, 420 Blossom Hill Road, Los Gatos, CA 95032.
- B. Materials:
  1. Tigo Energy Dual Maximizer-ES MM-2ES75:

(a) Maximum Power: 300 W.
(b) Maximum Input Voltage: 52 V.
(c) Vmp Range: 16-48 V.
(d) Maximum Continuous Current 9.5A.
(e) Maximum Output Power: 600 W

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall not be allowed without approval of Electrical Lead. Substitute products must meet the above power specifications and comply with the reference standards stated herein.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained and approved for electrical work by the Electrical Lead, Site Superintendent, and/or Project Manager. Installers shall be approved as Qualified Electrical Workers as designated by the Solar Decathlon 2013 guidelines.

3.02. EXAMINATION

A. Tigo modules shall be attached to panels prior to panels being secured on the metal roof. Panels should be inspected per Section 48 19 16.

3.03. INSTALLATION

A. Connect Tigo unit to panel leads.
B. Attach Tigo to the back of the panel using approved clips and fasteners.
C. Tie wires underneath panel.

3.04. RELOCATION CONSIDERATIONS

A. Tigo modules shall be removed during relocation but shall remained attached to the main solar modules.

3.05. SITE QUALITY CONTROL

A. Protect unit from damage resulting from other construction works after installation.
B. Electrical lead shall inspect and verify connections to unit.

3.06. ATTACHMENTS

A. Manufacturer’s Data Sheet is attached.

END OF SECTION

SECTION 48 19 16
ELECTRICAL POWER GENERATION INVERTERS
PART 1 GENERAL

1.01. SUMMARY
- A. Section Includes:
  1. Electrical Power Generation Inverters.
- B. Related Sections:
  1. Section 06 10 00: Rough Carpentry.
  2. Section 26 05 19: Low Voltage Electrical Power Conductors and Cable.
  3. Section 26 24 00: Switchboards and Panelboards.
  4. Section 26 31 00: Photovoltaic Collectors.

1.02. REFERENCES
- A. Institute of Electrical and Electronics Engineers (IEEE):
  1. IEEE 1547: Standard for Interconnecting Distributed Resources with Electric Power Systems.
  2. Underwriters Laboratories (UL):
     a. UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.
     b. UL 1998: Software in Programmable Components.
  3. Canadian Standards Association (CSA):
     a. C22.2 No. 107.1-01: General Use Power Supplies.

1.03. DELIVERY, STORAGE, AND HANDLING
- A. Product shall be delivered in original manufacturer packaging with label identifying product and specifications.
- B. Product shall be stored in locked container prior to installation.
- C. Product shall be stored in a cool, dry location and protected from exposure to sun, moisture, and extreme heat.

1.04. WARRANTY
- A. Manufacturer shall warrant product against manufacturer defects for 5 years.

PART 2 PRODUCTS

2.01. PRODUCT INFORMATION
- A. Manufacturers:
  1. SMA America, 6020 West Oaks Blvd., Ste. 300, Rocklin, CA 95765.
- B. Materials:

1. Sunny Boy SB-6000-TLUS-12 Inverter
   a. Max Recommended Power: 7500 Wp.
   b. MPPT-Voltage Range: 300-480 V.
   c. Nominal Input Current: 20.9 A
   d. Admissible Conductor Size (DC): NO. 14-6 AWG.
   e. Nominal Output Power: 6000 W.
   f. AC Frequency: 60 Hz.
   g. Nominal AC Output Voltage: 240 V.
   h. Maximum Efficiency: 98.7%.
   i. Dimensions: 18.4 x 24.1 x 9.5 in.
   j. Weight:
      (a) Power Stack: 78 lbs.
      (b) Wiring Compartment: 8 lbs.

2.02. PRODUCT SUBSTITUTIONS

A. Substitutions shall not be allowed without approval of Electrical Lead. Substitute products must meet the above power specifications and comply with the reference standards stated herein.

PART 3 EXECUTION

3.01. INSTALLERS

A. Installers shall be trained and approved for electrical work by the Electrical Lead, Site Superintendent, and/or Project Manager. Installers shall be approved as Qualified Electrical Workers as designated by the Solar Decathlon 2013 guidelines.

3.02. EXAMINATION

A. Verify that metal framed wall is installed, plumbed, and finished prior to installation of inverter and plywood back panel.
B. Verify that finish over studs and back panel is clean, leveled, and installed.

3.03. INSTALLATION

A. Mechanically secure inverter to back panel using approved wood screws per manufacturer's specifications.
B. Connect inverter to electrical panel and photovoltaic panels using approved wiring per manufacturer's specifications.
C. Secure and label wiring and cover all exposed leads as described in Section 26 05 19.

3.04. RELOCATION CONSIDERATIONS

A. Inverter shall remain installed during installation. Should removal be required, disconnect all wires into and out of inverter prior to removal.

3.05. SITE QUALITY CONTROL

A. Protect unit from damage resulting from other construction works after installation.
B. Electrical lead shall inspect and verify connections to unit.

3.06. ATTACHMENTS

A. Manufacturer's Data Sheet, UL Compliance, and Certification of Compliance with Tigo Maximizers.

END OF SECTION

ATTACHMENTS

HTC 8690

90-ton *(81.65 mt)* Hydraulic Truck Crane

- 90 tons *(81.65 mt)* at 8 ft *(2.44 m)* radius
- 38-140 ft *(11.6-42.7 m)* five section, full power latching boom with no charted capacity deductions for telescoping loads
- 35-58 ft *(10.7-17.7 m)* two-piece, bi-fold, on-board lattice attachment with 2°, 15°, 30°, and 45° offsets - optional
- Two 16 ft *(4.9 m)* lattice inserts provide a total attachment length of 90 ft *(27.4 m)* - optional
- 237 ft *(72.2 m)* maximum tip height
- Modular style counterweights
- 16,880 lbs *(7 656.6 kg)* maximum winch line pull
- 480 fpm *(146.3 m/min)* maximum winch line speed
- Next generation operator's cab with improved visibility and ergonomics
- 445 hp *(331.8 kW)* Detroit Diesel engine with 1,450 ft-lbs *(1966 J)* of torque
- ZF AS Tronic 12 speed automated manual transmission
- 62.3 mph *(100.3 km/hr)* travel speed
- Front and rear air ride suspension
- Anti-lock (ABS) brakes
- Four lockable storage boxes available
- "Stow 'n Go" steel pontoons

Link-Belt CRANES

HTC 8690

90-ton *(81.65 mt)* Hydraulic Truck Crane

HTT 8690

90-ton *(81.65 mt)* Truck Terrain Crane

The HTT's all-wheel steer provides outstanding on-site mobility.

- 90 tons *(81.65 mt)* at 8 ft *(2.44 m)* radius
- 38-140 ft *(11.6-42.7 m)* five section, full power latching boom with no charted capacity deductions for telescoping loads
- 35-58 ft *(10.7-17.7 m)* two-piece, bi-fold, on-board lattice attachment with 2°, 15°, 30°, and 45° offsets - optional
- Two 16 ft *(4.9 m)* lattice inserts provide a total attachment length of 90 ft *(27.4 m)* - optional
- 237 ft *(72.2 m)* maximum tip height
- Modular style counterweights
- 16,880 lbs *(7 656.6 kg)* maximum winch line pull
- 480 fpm *(146.3 m/min)* maximum winch line speed
- Next generation operator's cab with improved visibility and ergonomics
- Automated Manual Transmission
- Front and rear air ride suspension
- Anti-lock (ABS) brakes
- Four lockable storage boxes available
- "Stow 'n Go" steel pontoons

Link-Belt
CRANES

HTC 8690

90-ton *(81.65 mt)* Hydraulic Truck Crane

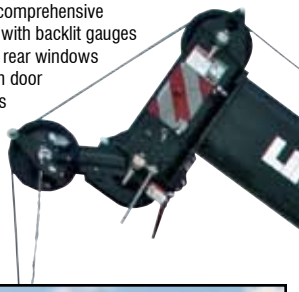
HTT 8690

90-ton *(81.65 mt)* Truck Terrain Crane

- **5-section full power latching boom with attachment flexibility**
- **Big, wide cab with outstanding visibility**
- **Winches deliver impressive numbers of line pull and line speed**
- **Counterweight flexibility, big engine and transmission power, along with air ride promise incredible mobility on the road or on the job**

Comfortable carrier :

- Dash-mounted comprehensive instrumentation with backlit gauges
- Sliding side and rear windows and roll up/down door window provides excellent ventilation
- Fully adjustable air-ride fabric seat
- Suspended pedals



35-58 ft *(10.7-17.7 m)* two-piece bi-fold lattice attachment with 2°, 15°, 30° and 45° offsets

Outstanding mobility on the road and on the job site

- Cruise control
- Three stage engine compression brake
- Ether injection system – optional
- Automated transmission (no clutch pedal) — 12 speeds forward, 2 speeds reverse with two modes of operation: fully automatic and semi-automatic
- Job site travel is permissible with all 39,500 lbs *(17 917.2 kg)* of counterweight for exceptional job site versatility:
  - HTC: 1.3 mph *(2.1 km)* job site travel
  - HTT: 1.2 mph *(1.9 km)* job site travel
- Highway speeds unmatched in the industry today:
  - HTC: up to 62.3 mph *(100.3 km/hr)*
  - HTT: up to 56.1 mph *(90.2 km/hr)*

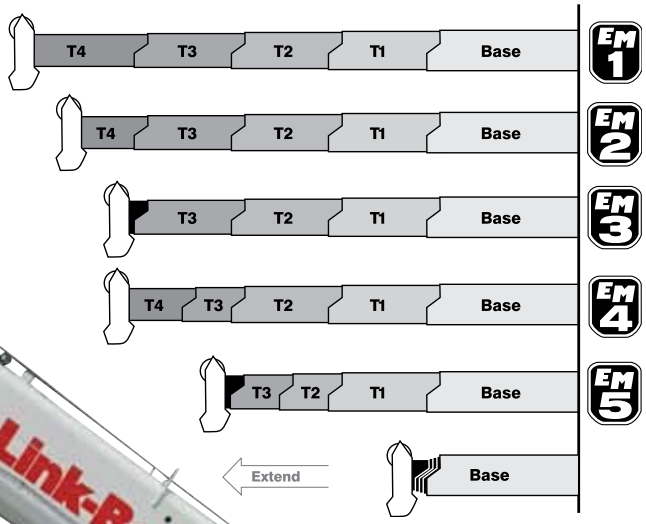
All **counterweight configurations** can be raised and lowered by hydraulic cylinders from the comfort of the operator's cab for ease of installation and removal.

Boom dolly/trailer ready when equipped with optional boom float kit and rear electrical and air connections

Optional **rear electrical and air connections**

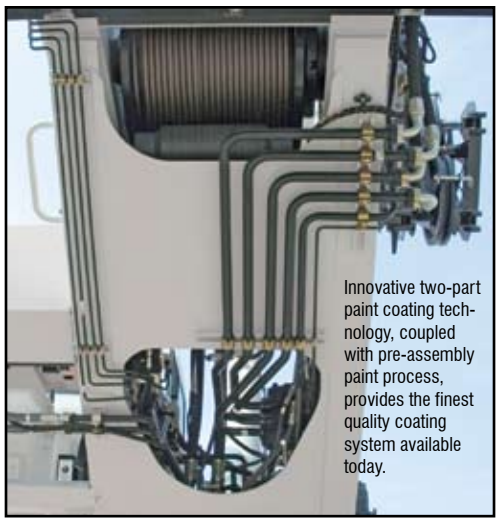
There are two standard **locking storage boxes** with options for up to four boxes.

Raydan™ air-ride suspension front and rear provides a smooth ride and precise handling. Optional air-ride lift system holds the rear suspension retracted while the crane is on outriggers.



5-section full power latching boom with attachment flexibility

- 38-140 ft *(11.6-42.7 m)* latching boom with five boom modes for superior capacities throughout the extension range
- No charted capacity reductions for telescoping loads
- Boom requires no greasing because of ingenious Teflon wear pucks impregnated in the full contact wear pads
- No minimum boom angle for extending or retracting the boom sections
- 35-58 ft *(10.7-17.7 m)* two-piece, bi-fold, on board lattice attachment with 2°, 15°, 30°, and 45° offsets
- Two 16 ft *(4.9 m)* lattice inserts provide a total attachment length of 90 ft *(27.4 m)*
- 237 ft *(72.2 m)* maximum tip height



Innovative two-part paint coating technology, coupled with pre-assembly paint process, provides the finest quality coating system available today.

Mechanical **boom angle indicator** - standard

Optional **hoist drum cable follower** and optional **third wrap indicators**

Winch viewing mirror

Optional integrated **air conditioning**

Folding **viewing mirror** for travel

Pull-out CabWalk™ slides out from secured travel position underneath operator's cab

Standard **11,500 lbs *(5 216 kg)* counterweight**

Large engine doors allow for easy access

Non-slip surface strips on carrier deck

Stow 'n Go outrigger pontoons

Carrier-mounted outrigger controls located on each side of carrier, include an engine throttle-up switch for fast outrigger deployment. For fine level adjusting of the carrier, throttle can be taken down to idle.

Optional **daytime running lights**

Self-storing fifth outrigger pontoon

Large west coast-style **rear viewing mirrors**

Integrated air conditioning (not a roof-mounted system)

Full air, S-cam anti-lock (ABS) brakes

Aluminum wheels and radial tires

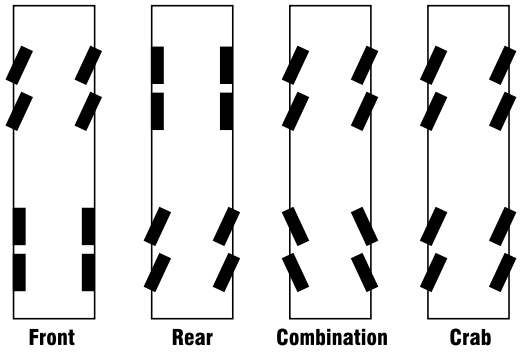
CALC — Outrigger beams have three different stages (retracted, intermediate, and fully extended) providing lifting capacities in confined areas.

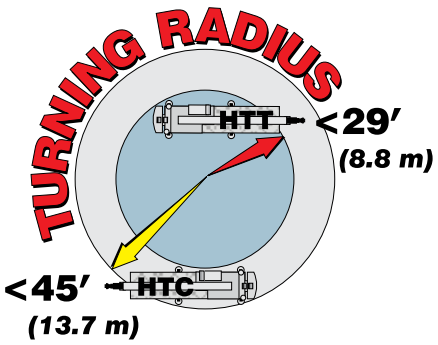
Powerful and responsive hydraulics

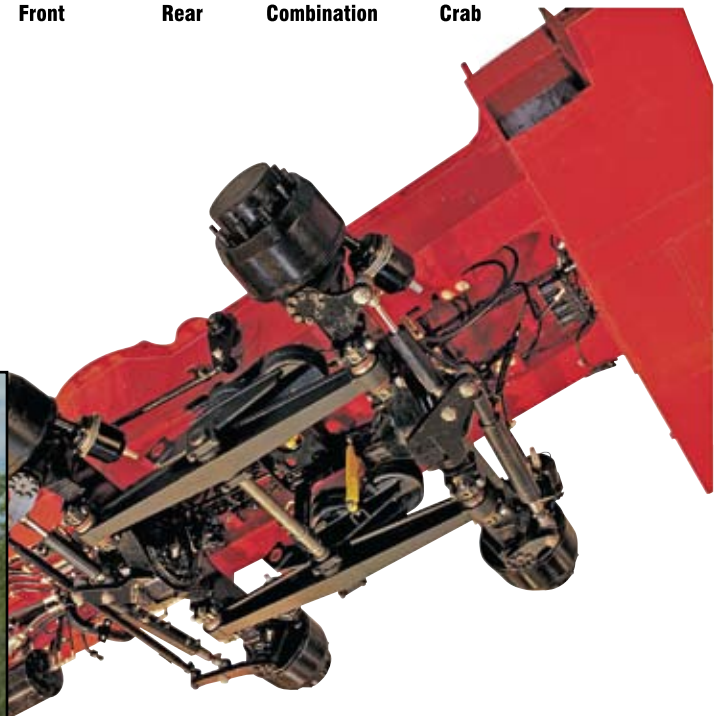
- Six pump, pressure compensated hydraulic system allows simultaneous and precise function of boom hoist, winch, and swing.
- Two-speed hydraulic piston motor hoist system delivers superior hoisting. Matched size optional front and rear winches provide equal max line pulls of 16,880 lbs *(7 657 kg)* and max line speeds of 480 fpm *(143 m/min)* on 16" *(.41 m)* root diameter grooved drums.
- Drum rotation indicators - standard.
- Bi-directional hydraulic swing motor mounted to a planetary reduction unit for 360° continuous smooth swing. Spring applied hydraulic released 360° swing park brake provides infinite swing park positions as well as free swing when control is in neutral position.

Steerable all wheel axles, in conjunction with super single tires, makes the HTT even harder to beat on the job-site. And NO changes to the on-outrigger capacity charts.

- Drive and steer capabilities for the rear axles
- Four steering modes:
  - Independent front
  - Independent rear
  - Combination
  - Crab
- Rear axles self-center and lock in the straight ahead position for high speed travel.
- Turning radius under 29 ft *(8.8 m)* at the edge of the tire
- 445/65R22.5 tires front and rear that are interchangeable
- Only one spare rim and tire combination is needed.
- Transverse (cross-axle) differential locks that greatly improve traction on unimproved job-site conditions.







Roomier and quieter operator's cab

- Extra large front window almost seamlessly merges into the roof window
- Sliding left side door, right and rear windows, and swing up top window provide excellent ventilation
- All gauges, switches, indicators, and controls are placed in the operators forward line of sight for excellent ergonomics
- All gauges and switches are backlit for excellent visibility when the cab working lights are switched to the on position
- Available — Integrated air conditioning utilizes the same ventilation outlets as the standard heating system

Integrated Microguard rated capacity limiter with color graphic display, for excellent contrast even in direct sunlight, aids the operator in safe and efficient operation by continuously monitoring a multitude of crane conditions. Optional external and internal light bars inform the operator and/or ground crew of the percentage of capacity.

Access to the engine compartments and the operator's cab is superb with strategically-located ladders and steps.

Multiple counterweight configurations give you capacities for any size job

- Standard – Total of 11,500 lbs *(5 216 kg)* of removable counterweights. Capacities for five different counterweight configurations.
- Optional – Up to 39,500 lbs *(17 917.2 kg)* of removable counterweights. Capacities for up to thirteen different counterweight configurations.
- All configurations can be raised and lowered by hydraulic cylinders from the comfort of the operator's cab for ease of installation and removal.

Your crane investment is always protected ... with your Link-Belt distributor.

When you invest in a Link-Belt crane, you invest in a legacy of outstanding customer support dating back to 1874. The ultimate value of a machine begins with state-of-the-art design and quality manufacturing, but it is the excellent Link-Belt distributor product support that determines its long term value. This philosophy has earned Link-Belt cranes the enviable position of traditionally commanding some of the highest resale prices in the industry.

"... to be recognized as a leader in customer service & satisfaction."
— The Link-Belt Vision

Link-Belt Preferred

As a member of Link-Belt Cranes user's group, you will have access to:

- Online access to a comprehensive library of all parts, service and operator manuals for YOUR crane
- Interactive, live groundbearing calculations for YOUR crane
- Plus a vast array of information on new products, services and special offerings

Link-Belt Parts Distribution Center

Link-Belt headquarters - Lexington, Kentucky

Master Technician TRAINING PROGRAM

Link-Belt's investment in the highly acclaimed Master Technician Training Program is further testimony to its commitment to highly trained, experienced service personnel.

Technical schools are specifically designed to establish proficiency in three phases: fundamentals, machine systems, and diagnostics/repair. To further support these highly trained distributor personnel, Link-Belt has dedicated, full time factory technical advisors available with comprehensive machine records, drawings and technical publications to quickly isolate and resolve service issues.

GENUINE Link-Belt Crane PARTS

No one knows your Link-Belt crane better than our trained technical specialists and coupled with the energy of our customer parts representatives, no one in the crane industry provides faster, more efficient customer service.

With state of the art computer information systems, distributors order Genuine Link-Belt Parts 24 hours a day, 7 days a week.

Our dedicated 72,000 sq. ft. *(6 689 m²)* Parts Distribution Center is an integral part of our product support commitment where we invest in an extensive and well planned parts inventory. And all parts in stock ship the same business day.

Link-Belt construction equipment company is a leader in the design, manufacture and sales of telescopic and lattice boom cranes, with headquarters in Lexington, Kentucky.

In the recent decade, a dynamic and highly focused Link-Belt has emerged as a market leader in crane design and product quality standards by focusing on continuous improvement and employee empowerment.

Link-Belt's core production base and center for worldwide operations is its 500,000 sq. ft. *(46 451.5 m²)* manufacturing facility in Lexington, Kentucky.

With major expansions over the last ten years, along with continuous improvement philosophies, this facility has emerged as the most modern crane facility in North America.

Link-Belt® CRANES

LINK-BELT CONSTRUCTION EQUIPMENT COMPANY

Lexington, Kentucky | www.linkbelt.com

We are constantly improving our products and therefore reserve the right to change designs and specifications.

Litho in U.S.A. 11/07 #4344 (supersedes #4331)

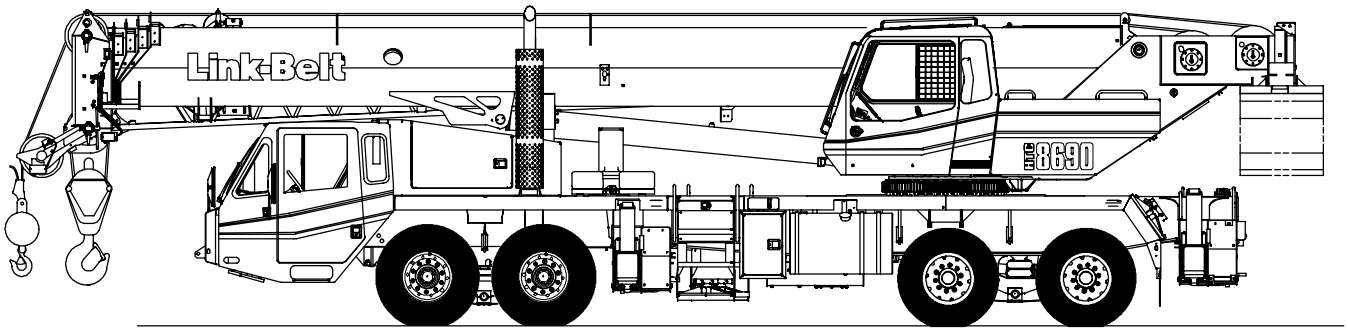
Technical Data

Specifications & Capacities

HTC 8690

Telescopic Boom Truck Crane

90 ton *(81.6 metric ton)*



CAUTION: This material is supplied for reference use only. Operator must refer to in – cab Crane Rating Manual and Operator's Manual to determine allowable crane lifting capacities and assembly and operating procedures.

Table Of Contents

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Boom, Attachments, and Upper Structure

■ Boom

Design − Five section, formed construction of extra high tensile steel consisting of one base section and four telescoping sections. The two plate design of each section has multiple longitudinal bends for superior strength. Each telescoping section extends independently by means of one double−acting, single stage hydraulic cylinder with integrated holding valves.

Boom

- 38−140 ft (*11.6−42.7m*) five section boom
- Integral boom dolly connection
- Five boom extend modes (EM1 through EM5), controlled from the operator's cab, provide superior capacities by varying the extension of the telescoping sections:
  - EM1 extends to 140.0 ft (*42.7m*)
  - EM2 extends to 127.3 ft (*38.8m*)
  - EM3 extends to 115.8 ft (*35.3m*)
  - EM4 extends to 102.0 ft (*31.1m*)
  - EM5 extends to 76.5 ft (*23.3m*)
- Mechanical boom angle indicator
- Maximum tip height for each extend mode is:
  - EM1 is 148 ft (*45.1m*)
  - EM2 is 135 ft (*41.1m*)
  - EM3 is 124 ft (*37.8m*)
  - EM4 is 110 ft (*33.5m*)
  - EM5 is 84 ft (*25.6m*)

Boom Wear Pads

- Wear pads with Teflon inserts that self−lubricate the boom sections
- Bottom wear pads are universal for all boom sections
- Top wear pads are universal for all boom sections

Boom Head

- Five 16.5 in (*41.9cm*) root diameter nylon sheaves to handle up to ten parts of line
- Easily removable wire rope guards
- Rope dead end lugs on each side of the boom head
- Boom head is designed for quick−reeve of the hook block

Boom Elevation

- One double acting hydraulic cylinder with integral holding valve
- Boom elevation: −3° to 80°

Auxiliary Lifting Sheave − Optional

- Single 16.5 in (*41.9m*) root diameter nylon sheave
- Easily removable wire rope guards
- Does not affect erection of the fly or use of the main head sheaves

Hook Blocks and Balls − Optional

- 40 ton (*36.3mt*) 4 sheave quick−reeve hook block with safety latch
- 60 ton (*54.4mt*) 4 sheave quick−reeve hook block with safety latch
- 90 ton (*81.6mt*) 6 sheave quick−reeve hook block with safety latch
- 8.5 ton (*7.7mt*) swivel and non−swivel hook balls with safety latch
- 10 ton (*9.1mt*) swivel and non−swivel hook balls with safety latch

Fly − Optional

- 35 ft (*10.7m*) one piece lattice fly, stowable, offsettable to 2°, 15°, 30°, and 45°. Maximum tip height is 182 ft (*55.5m*).
- 35 ft−58 ft (*10.7−17.7m*) two piece bi−fold lattice fly, stowable, offsettable to 2°, 15°, 30°, and 45°. Maximum tip height is 205 ft (*62.5m*).

Fly Extensions − Optional

- One 16 ft (*4.9m*) lattice extension, equipped with two 16.5 in (*41.9cm*) root diameter nylon sheaves, to be mounted between the boom head and fly options. Maximum tip height is 221 ft (*67.4m*).
- Two 16 ft (*4.9m*) lattice extensions, one equipped with two 16.5 in (*41.9cm*) root diameter nylon sheaves, to be mounted between the boom head and fly options. Maximum tip height is 237 ft (*72.2m*). Minimum of 14,500 lb (*6 577.1kg*) of counterweight required.

■ Upper Operator's Cab and Controls

Environmental Cab – Fully enclosed, one person cab of galvaneal steel structure with acoustical insulation. Equipped with:
- Tinted and tempered glass windows
- Extra–large fixed front window with windshield wiper and washer
- Swing up roof window with windshield wiper
- Sliding left side door with large fixed window
- Sliding rear and right side windows for ventilation
- Six way adjustable, cushioned seat with seat belt and storage compartment
- Engine dependent warm–water heater with air ducts for front windshield defroster and cab floor
- Defroster fan for the front window
- Bubble level
- Circulating fan
- Adjustable sun visor
- Dome light
- Cup holder
- Fire extinguisher
- Left side viewing mirror
- Pull–out cabwalk
- Two position travel swing lock

Air Conditioning – Optional – Integral with cab heating system utilizing the same ventilation outlets

Armrest Controls – Two dual axis hydraulic joystick controllers or optional single axis hydraulic controllers for:
- Swing
- Boom hoist
- Main rear winch
- Auxiliary front winch – optional
- Drum rotation indication
- Drum rotation indicator activation switch
- Winch high/low speed and disable switch(es)
- Third wrap selector switch – optional
- Counterweight handling switch
- Telescopic override switches
- Warning horn button

Outrigger Controls – Hand held control box with umbilical cord gives the operator the freedom to view operation while setting the outriggers.

Foot Controls
- Boom telescope
- Swing brake
- Engine throttle

Right Front Console – Controls and indicators for:
- Engine ignition
- Engine throttle lock
- Pump enable
- Function disable
- Swing park brake
- Front windshield wiper and washer
- Cab floodlights
- Warning horn
- Heating controls
- Console dimmer switch
- Bubble level
- 12 volt power connection
- Air conditioning – optional
- Boom floodlight – optional
- Rotating beacon/Strobe light – optional

Cab Instrumentation – Ergonomically positioned, analog instrumentation for crane operation including:
- Check and stop engine indicators
- Engine coolant temperature with warning indicator
- Hydraulic oil temperature with warning indicator
- Low air pressure warning indicator
- Fuel level with warning indicator
- Tachometer

Rated Capacity Limiter – Microguard 540 color graphic audio–visual warning system integrated into the dash with anti–two block and function limiter. Operating data available includes:
- Crane configuration
- Boom length and angle
- Boom head height
- Allowed load and % of allowed load
- Boom angle
- Radius of load
- Actual load
- Counterweight removal
- Operator settable alarms (include):
  - Maximum and minimum boom angles
  - Maximum and minimum tip height
  - Maximum boom length
  - Left/right swing positions
  - Operator defined area (imaginary plane)

Integrated Third Wrap Indicator – Optional – Microguard color display visually and audibly warns the operator when the wire rope is on the first/bottom layer and when the wire rope is down to the last three wraps.

Internal RCL Light Bar – Optional – Visually informs the operator when crane is approaching maximum load capacity with a series of green, yellow, and red lights.

External RCL Light Bar – Optional – Visually informs the ground crew when crane is approaching maximum load capacity with a series of green, yellow, and red lights.

■ Swing

Motor/Planetary – Bi–directional hydraulic swing motor mounted to a planetary reducer for 360˚ continuous smooth swing at 1.7 rpm.

Swing Park Brake – 360˚, electric over hydraulic, (spring applied/hydraulic released) multi–disc brake mounted on the speed reducer. Operated by a switch from the operator's cab.

Swing Brake – 360˚, foot operated, hydraulic applied disc brake mounted to the speed reducer.

Swing Lock – Two–position swing lock (boom over front or rear) operated from the operator's cab.

360˚ Positive Swing Lock – Optional – Meets New York City requirement.

■ Electrical

Swing Alarm – Audio warning device signals when the upper is swinging.

Lights

- Two working lights on front of the cab
- One rotating amber beacon on top of the cab – optional
- One amber strobe beacon on top of the cab – optional
- Boom floodlight – optional

■ Additional Equipment

- Left side aluminum storage box

■ Load Hoist System

Load Hoist Performance

Main (Rear) and Auxiliary (Front) Winches – 3/4 in (*19mm*) Rope										
	Maximum Line Pull		Normal Line Speed		High Line Speed		Layer		Total	
Layer	lb	*kg*	ft/min	*m/min*	ft/min	*m/min*	ft	*m*	ft	*m*
1	16,880	*7 656.6*	179	*54.6*	356	*108.5*	114	*34.7*	114	*34.7*
2	15,519	*7 039.3*	195	*59.4*	387	*118.0*	124	*37.8*	238	*72.5*
3	14,362	*6 514.5*	211	*64.3*	418	*127.4*	134	*40.8*	372	*113.4*
4	13,365	*6 062.3*	226	*68.9*	449	*136.9*	144	*43.9*	516	*157.3*
5	12,497	*5 668.5*	242	*73.8*	480	*146.3*	154	*46.9*	670	*204.2*
6	– – –	– – –	– – –	– – –	– – –	– – –	164	*50.0*	834	*254.2*

Wire Rope Application		Diameter		Type	Maximum Permissible Load	
		in	*mm*		lb	*kg*
Main (Rear) Winch	Standard	3/4	*19*	18x19 rotation resistant – right regular lay (Type RB)	12,920	*5 860.5*
	Optional	3/4	*19*	36x7 rotation resistant – right regular lay (Type ZB)	15,600	*7 076.2*
Auxiliary (Front) Winch	Standard	3/4	*19*	18x19 rotation resistant – right regular lay (Type RB)	12,920	*5 860.5*
	Optional	3/4	*19*	36x7 rotation resistant – right regular lay (Type ZB)	15,600	*7 076.2*

2M Main and Optional Auxiliary Winches

- Axial piston, full and half displacement (2–speed) motors driven through planetary reduction unit for positive control under all load conditions.
- Grooved lagging
- Power up/down mode of operation
- Hoist drum cable follower – optional
- Drum rotation indicator
- Drum diameter: 16 in (*40.6cm*)
- Rope length:
  - Main: 730 ft (*222.5m*)
  - Auxiliary: 600 ft (*182.9m*) or 730 ft (*222.5m*)
- Maximum rope storage: 834 ft (*254.2m*)
- Terminator style socket and wedge

Third wrap indicator – optional – Visually and audibly warns the operator when the wire rope is on the bottom layer and when the wire rope is down to the last three wraps.

■ Hydraulic System

All circuits of the hydraulic system are pressure compensated.

Counterbalance Valves – All hoist motors, boom extend cylinders, and boom hoist cylinders are equipped with counterbalance valves to provide load lowering and to prevent accidental load drop if hydraulic power is suddenly reduced.

Hydraulic Oil Coolers – Two carrier mounted coolers remove heat from the hydraulic oil. One is integral to the engine radiator/charge air cooler and the other is mounted in left side access ladder.

Boom Hoist Float Valves (Optional) – For transporting the boom over the rear of the crane with a boom dolly. Allows hydraulic oil within the boom hoist cylinder to flow between piston side and case side, allowing the boom to float while on the boom dolly.

Swing Brake Release – For transporting the boom over the rear of the crane with a boom dolly. Holds the 360º swing park brake in the released position allowing free rotation of the upper structure.

■ Counterweight

Standard – Total of 11,500 lb (*5 216kg*) of total counterweight consisting of three, hydraulically removable counterweights. Assembled and disassembled by hydraulic cylinders controlled from the operator's cab with capacities for:
- 0 lb (*0kg*) counterweight
- 2,500 lb (*1 134.0kg*) counterweight
- 5,500 lb (*2 494.8kg*) counterweight
- 8,500 lb (*3 855.5kg*) counterweight
- 11,500 lb (*5 216.3kg*) counterweight

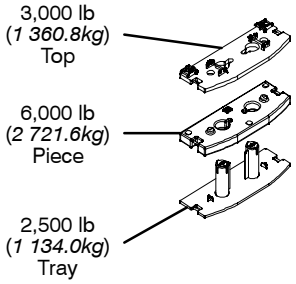
Optional – 15,000 lb (*6 803.9kg*) in addition to standard counterweight for a total of 26,500 lb (*12 020.2kg*) with additional capacities for:
- 14,500 lb (*6 577.1kg*) counterweight
- 20,500 lb (*9 298.6kg*) counterweight
- 23,500 lb (*10 659.4kg*) counterweight
- 26,500 lb (*12 020.2kg*) counterweight

Optional – 21,000 lb (*9 525.4kg*) in addition to standard counterweight for a total of 32,500 lb (*14 741.8kg*) with additional capacities for:
- 14,500 lb (*6 577.1kg*) counterweight
- 17,500 lb (*7 937.9kg*) counterweight
- 20,500 lb (*9 298.6kg*) counterweight
- 23,500 lb (*10 659.4kg*) counterweight
- 26,500 lb (*12 020.2kg*) counterweight
- 29,500 lb (*13 381.0kg*) counterweight
- 32,500 lb (*14 741.8kg*) counterweight

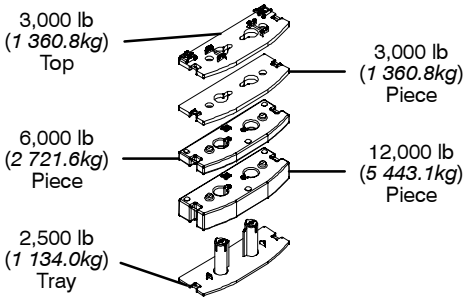
Optional – 28,000 lb (*12 700.6kg*) in addition to standard counterweight for a total of 39,500 lb (*17 916.9kg*) with additional capacities for:
- 14,500 lb (*6 577.1kg*) counterweight
- 17,500 lb (*7 937.9kg*) counterweight
- 20,500 lb (*9 298.6kg*) counterweight
- 23,500 lb (*10 659.4kg*) counterweight
- 26,500 lb (*12 020.2kg*) counterweight
- 29,500 lb (*13 381.0kg*) counterweight
- 32,500 lb (*14 741.8kg*) counterweight
- 39,500 lb (*17 916.9kg*) counterweight*

Low speed jobsite travel is offered for these optional counterweight configurations and a boom dolly or boom trailer may be required for on – highway travel.

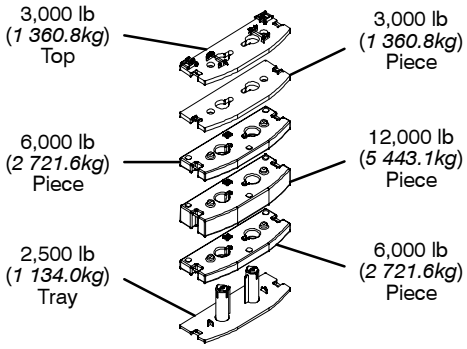
* Overall width of the crane increases to 11 ft (*3.4m*) for this counterweight configuration



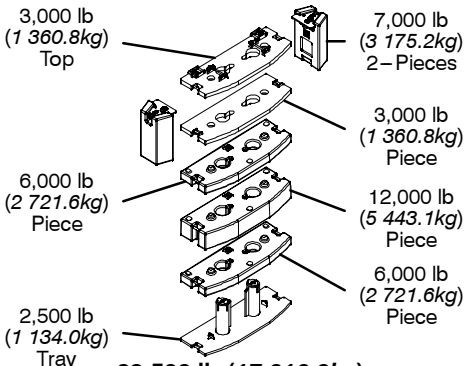
11,500 lb (*5 216.3kg*)



26,500 lb (*12 020.2kg*)



32,500 lb (*14 741.8kg*)



39,500 lb (*17 916.9kg*)

Counterweight Packages		11,500 lb (*5 216.3kg*) – Standard 26,500 (*12 020.2kg*) – Optional 32,500 (*14 741.8kg*) – Optional 39,500 (*17 916.9kg*) – Optional						
Counterweight Modules		2,500 lb (*1 134.0kg*) Tray	6,000 lb (*2 721.6kg*) Piece	3,000 lb (*1 360.8kg*) Top	3,000 lb (*1 360.8kg*) Piece	12,000 lb (*5 443.1kg*) Piece	6,000 lb (*2 721.6kg*) Piece	7,000 lb (*3 175.2kg*) 2–Pieces
Counterweight Usage Configurations	0 lb (*0kg*)							
	2,500 lb (*1 134.0kg*)	X						
	5,500 lb (*2 494.8kg*)	X		X				
	8,500 lb (*3 855.5kg*)	X	X					
	11,500 lb (*5 216.3kg*)	X	X	X				
	14,500 lb (*6 577.1kg*)	X	X	X	X			
	17,500 lb (*7 937.9kg*)	X	X	X			X	
	20,500 lb (*9 298.6kg*)	X	X	X	X		X	
	23,500 lb (*10 659.4kg*)	X	X	X		X		
	26,500 (*12 020.2kg*)	X	X	X	X	X		
	29,500 lb (*13 381.0kg*)	X	X	X		X	X	
	32,500 (*14 741.8kg*)	X	X	X	X	X	X	
	39,500 (*17 916.9kg*)	X	X	X	X	X	X	X

Carrier

General

- 8 ft 6 in (2.6 m) wide
- 23 ft 10 in (*7.26m*) wheelbase (centerline of first axle to centerline of fourth axle)
- **Frame** – Box–type, torsion resistant, welded construction made of high tensile steel. Equipped with front and rear towing and tie–down lugs, tow connections, and access ladders.

Outriggers

Boxes – Two double box, front and rear welded to the carrier frame

Beams and Jacks – Four dual stage beams with Confined Area Lifting Capacities (CALC) provide selectable outrigger extensions of full, intermediate, and retracted positions. Jacks with integral check valves, hydraulically controlled from the operator's cab and on both sides of carrier. A fifth front bumper outrigger with integral check valves is hydraulically controlled from the operator's cab and at the front bumper of carrier.

Pontoons – Four lightweight, stow'n go, 23.5" x 27.25" (*59.7 x 69.2cm*) hexagonal steel pontoons with a contact area of 485 in^2 (*3 129cm*^{2}) can be stored for road travel in either the storage racks on the carrier or under the outrigger boxes.

Main Jack Reaction – 106,000 lb (*48 080.8kg*) force and 217 psi (*1 496.2kPa*) ground bearing pressure

Steering and Axles

- Sheppard full integral master gear/slave gear steering system provides hydraulic assisted steering with mechanical link between steering wheel and wheels
- **Drive** – 8 x 4 for on/off–highway travel
- **Axle 1 & 2** – Tandem steered, non–driven
- **Axle 3 & 4** – Tandem non–steered, driven with reduction: 5.38 to 1
- **Inter–Axle Differential Lock** – Traction adding device that locks axle 3 with axle 4. Operated by a switch from the carrier cab.

Suspension

Front – Raydan Air Link walking beam air suspension

Rear – Raydan Air Link walking beam air suspension

- **Axle Lift System – Optional** – Improves rear tire ground clearance when the crane is up on outriggers. The rear tandem axles are raised and lowered with a switch in the carrier cab. The axle lift system can be controlled with a switch on both sides of the carrier.

Tires and Wheels

Front – Four (single) 445/65R22.5 tires on aluminum disc wheels

Rear – Eight (dual) 12R22.5 tires on aluminum disc wheels

- Spare tires and wheels – optional
- Tire inflation kit – optional

Brakes

Service – Full air anti–lock (ABS) brakes on all wheel ends. Dual circuit compressed air system with air dryer.

Parking/Emergency – Spring loaded type, acting on 3rd and 4th axles automatically apply when air pressure drops below 40 psi (*275.8kPa*) in both circuits.

Electrical

Battery – Three batteries provide 12 volt starting and operation

Lights

- Front lighting includes two main headlights, two high beam lights, two parking/directional indicators, and three cab marker lights.
- Side lighting includes three parking/directional indicators per side.
- Rear lighting includes two parking/directional indicators, two parking/brake lights, two reverse lights, three marker lights, and a license plate light.
- Other equipment includes hazard/warning system, cab light, instrument panel light, and signal horn.
- One amber strobe beacon on top of the cab – optional
- Daytime running lights – optional

Engine

Specification	Detroit Diesel Series 60
Numbers of cylinders	6
Cycle	4
Bore and Stroke: inch (*mm*)	5.12 x 6.30 (*130x160*)
Piston Displacement: in^3 (*L*)	778 (*12.7*)
Max. Brake Horsepower: hp (*kW*)	445 (*331.8*) @ 1,800 rpm 430 (*320.7*) @ 2,100 rpm
Peak Torque: ft lb (*J*)	1,450 (*1 966.1*) @ 1,200 rpm
Alternator: volts – amps	12 – 130
Crankcase Capacity: qt (*L*)	32 (*30.3*)

- Cruise control
- Three–stage engine compression brake
- Thermostatically controlled, hydraulically driven radiator fan
- 120 volt engine block heater
- Ether injection system – optional

Transmission

Automated – ZF AS–TRONIC (no clutch pedal) manual transmission with 12 forward gears and 2 reverse gears.

Carrier Speeds and Gradeability

ZF Astronic		Governed Speed		Gradeability (@ Peak Torque Except Creep @ Idle)
Gear	Ratio	mph	*km/h*	% Grade
12th	0.778	62.3	*100.3*	2.1
11th	1.000	48.5	*78.1*	3.1
10th	1.267	38.3	*61.6*	4.2
9th	1.629	29.8	*48.0*	5.8
8th	2.101	23.1	*37.2*	7.8
7th	2.700	18.0	*29.0*	10.2
6th	3.552	13.7	*22.0*	13.7
5th	4.565	10.6	*17.1*	17.8
4th	5.784	8.4	*13.5*	22.8
3rd	7.435	6.5	*10.5*	29.5
2nd	9.590	5.1	*8.2*	38.2
1st	12.326	3.9	*6.3*	49.3
Reverse (Low)	11.413	4.3	*6.9*	45.6
Reverse (High)	8.880	5.5	*8.9*	35.3
1st @ 700 rpm	12.326	1.3	*2.1*	20.9
Rev. (Low) @ 700 rpm	11.413	1.4	*2.3*	19.3
Rev. (High) @ 700 rpm	8.880	1.8	*2.9*	14.9
Based on a gross vehicle weight of 95,000 lb (*43 091.3kg*)				

Fuel Tank

One 95 gal (*359.6L*) capacity tank

Hydraulic System

All functions are hydraulically powered allowing positive, precise control with independent or simultaneous operation of all functions.

Main Pumps

- Three fixed displacement gear pumps with automatic disconnect for the main and auxiliary winches, swing, boom hoist, control circuit, and telescope for use when pick & carry switch is in travel mode.
- One fixed displacement gear pump for steering and the front bumper outrigger
- Two fixed displacement gear pumps for engine cooling fan and main outriggers. These pumps also provide flow to the winches and boom hoist for “pick & carry” mode. Operated by a switch in the carrier cab.
- Combined pump capacity of 188 gpm (*711.7Lpm*)

Hydraulic Reservoir – 144 gal (*545.1L*) capacity equipped with sight level gauge. Diffusers built in for deaeration.

Filtration – One 10 micron, full flow, return line filter. All oil is filtered prior to return to reservoir. Accessible for easy filter replacement.

Pump Drive

All pumps are mechanically driven by the diesel engine. Main and auxiliary winches, swing, boom hoist, control circuit, and telescope pumps are mounted to an automatic pump disconnect on the rear of the transmission to aid in cold weather starting as well as to reduce pump wear while traveling.

■ Lower Cab and Controls

Environmental Cab – Fully enclosed, one person cab of composite structure with acoustical insulation. Equipped with:
- Tinted and tempered glass windows
- Roll down left side window for ventilation
- Sliding rear and right side windows for ventilation
- Windshield wiper and washer
- Six way adjustable and air suspended driver's seat with seat belt
- Two adjustable rear view mirrors
- Engine dependent warm–water heater with air ducts for windshield defroster and cab floor
- Adjustable sun visor
- Dome light
- 12 volt connection
- Fire extinguisher

Air Conditioning – Optional – Integral with cab heating system utilizing the same ventilation outlets

Cab Instrumentation – Ergonomically positioned analog instrumentation for driving including:
- Speedometer with odometer, hourmeter, trip odometer, and clock
- Front and rear air pressure with warning indicator
- Engine coolant temperature with warning indicator
- Engine oil pressure with warning indicator
- Voltage indicator with warning indicator
- Fuel level
- Tachometer

Right Side Console – Controls and indicators for:
- Transmission gear shifting
- Transmission digital readout
- Cruise controls
- Engine compression brake controls

Dash Mounted Controls For:
- Windshield wiper and washer
- Carrier lights
- Carrier/upper throttle control
- Engine cooling fan override
- Cab heater/air conditioning
- Console dimmer switch
- Engine diagnostic switch
- Park brake
- Engine ignition
- Pick & carry switch

Dash Mounted Indicator For:
- Check and stop engine
- Turn signal indication
- Park brake
- Cruise activation
- High beam headlights
- Check anti–lock brake system

Foot Controls For:
- Carrier service brakes
- Engine throttle

■ Additional Equipment

Standard:
- Aluminum full deck fenders with mud flaps
- Left and right bubble levels
- Air hose connection ports
- Clearance flags

Optional:
- Pneumatic and electrical quick disconnect connectors mounted on the rear for trailer or boom dolly brakes and lights
- Left side aluminum storage box
- Rear mounted pintle hook

Axle Loads

Base crane with full tank of fuel and no counterweight	Gross Vehicle Weight (1)		Front Axles		Rear Axles	
	lb	*kg*	lb	*kg*	lb	*kg*
	79,206	***35 927***	**34,938**	***15 848***	**44,268**	***20 080***
Driver in carrier cab	250	*113*	315	*143*	–65	*–29*
Rear pintle hook	13	*6*	–6	*–3*	19	*8*
Pneumatic and electrical connectors for trailer or boom dolly	11	*5*	–4	*–2*	15	*7*
Carrier aluminum storage box	59	*27*	28	*13*	31	*14*
Air ride lift system – rear axles	48	*22*	0	*0*	48	*22*
Ether injection	13	*6*	12	*5*	1	*1*
Air conditioning – carrier	45	*20*	55	*25*	–10	*–4*
Hoist drum follower – main	69	*31*	–35	*–16*	104	*47*
Auxiliary winch with 600 ft (*182.9m*) of 3/4" (*19mm*) type "RB" rope	731	*332*	–239	*–108*	970	*440*
Hoist drum follower – auxiliary	69	*31*	–21	*–10*	90	*41*
Substitute 600 ft (*182.9m*) of rope with 730 ft (*222.5m*) of rope – auxiliary	163	*74*	–54	*–24*	217	*98*
Remove 730 ft (*222.5m*) of rope from rear (main) winch	–931	*–422*	373	*169*	–1,304	*–591*
Remove 600 ft (*182.9m*) of rope from front (auxiliary) winch	–768	*–348*	252	*114*	–1,020	*–463*
Upper aluminum storage box	42	*19*	–4	*–2*	46	*21*
Air conditioner – operator's cab	220	*100*	–7	*–3*	227	*103*
360° mechanical swing lock	140	*64*	21	*9*	119	*54*
2,500 lb (*1 134.0kg*) counterweight tray on upper	2,544	*1 154*	–1,255	*–569*	3,799	*1 723*
3,000 lb (*1 360.8kg*) counterweight on upper	2,981	*1 352*	–1,471	*–667*	4,452	*2 019*
6,000 lb (*2 721.6kg*) counterweight on upper	6,000	*2 722*	–2,961	*–1 343*	8,961	*4 065*
6,000 lb (*2 721.6kg*) counterweight on upper	6,000	*2 722*	–2,961	*–1 343*	8,961	*4 065*
12,000 lb (*5 443.1kg*) counterweight on upper	12,050	*5 466*	–5,947	*–2 697*	17,997	*8 163*
3,000 lb (*1 360.8kg*) top counterweight on upper	3,009	*1 365*	–1,485	*–674*	4,494	*2 038*
Floodlight to the front of boom base section	7	*3*	6	*3*	1	*1*
Fly mounting brackets to boom base section for fly options	176	*80*	136	*62*	40	*18*
35 ft (*10.7m*) offsettable, one–piece lattice fly – stowed	1,591	*722*	1,539	*698*	52	*24*
35–58 ft (*10.7–17.7m*) offsettable, two–piece (bi–fold) lattice fly – stowed	2,263	*1 026*	1,886	*855*	377	*171*
Auxiliary lifting sheave	110	*50*	200	*91*	–90	*–41*
40 ton (*36.3mt*) 4–sheave hook block at front bumper	900	*408*	1,570	*712*	–670	*–304*
60 ton (*54.4mt*) 4–sheave hook block at front bumper	1,109	*503*	1,935	*878*	–826	*–375*
90 ton (*81.6mt*) 6–sheave hook block at front bumper	1,554	*705*	2,711	*1 230*	–1,157	*–525*
8.5 ton (*7.7mt*) hook ball at front bumper	360	*163*	628	*285*	–268	*–122*
10 ton (*9.1mt*) hook ball at front bumper	580	*263*	1,012	*459*	–432	*–196*

Counterweight Load Transfer	Front Axles		Rear Axles	
	lb	*kg*	lb	*kg*
Transfer 2,500 lb (*1 134.0kg*) counterweight tray to carrier deck	3,194	*1 449*	–3,194	*–1 449*
Transfer 3,000 lb (*1 360.8kg*) counterweight to carrier deck	3,742	*1 697*	–3,742	*–1 697*
Transfer 6,000 lb (*2 721.6kg*) counterweight to carrier deck	7,532	*3 416*	–7,532	*–3 416*
Transfer 6,000 lb (*2 721.6kg*) counterweight to carrier deck	7,532	*3 416*	–7,532	*–3 416*
Transfer 12,000 lb (*5 443.1kg*) counterweight to carrier deck	15,128	*6 862*	–15,128	*–6 862*
Transfer 3,000 lb (*1 360.8kg*) top counterweight to carrier deck	3,778	*1 714*	–3,778	*–1 714*

Axle	Maximum Load @ 65 mph (*105km/h*)
Front	46,400 lb (*21 047kg*) – aluminum disc wheels with 445/65R22.5 tires
Rear	52,000 lb (*23 587kg*) – aluminum disc wheels with 12R22.5 tires

(1) Adjust gross vehicle weight and axle loading according to component weight. All weights are ±3%.

Axle Loads with 2 – Axle or 3 – Axle Boom Dolly

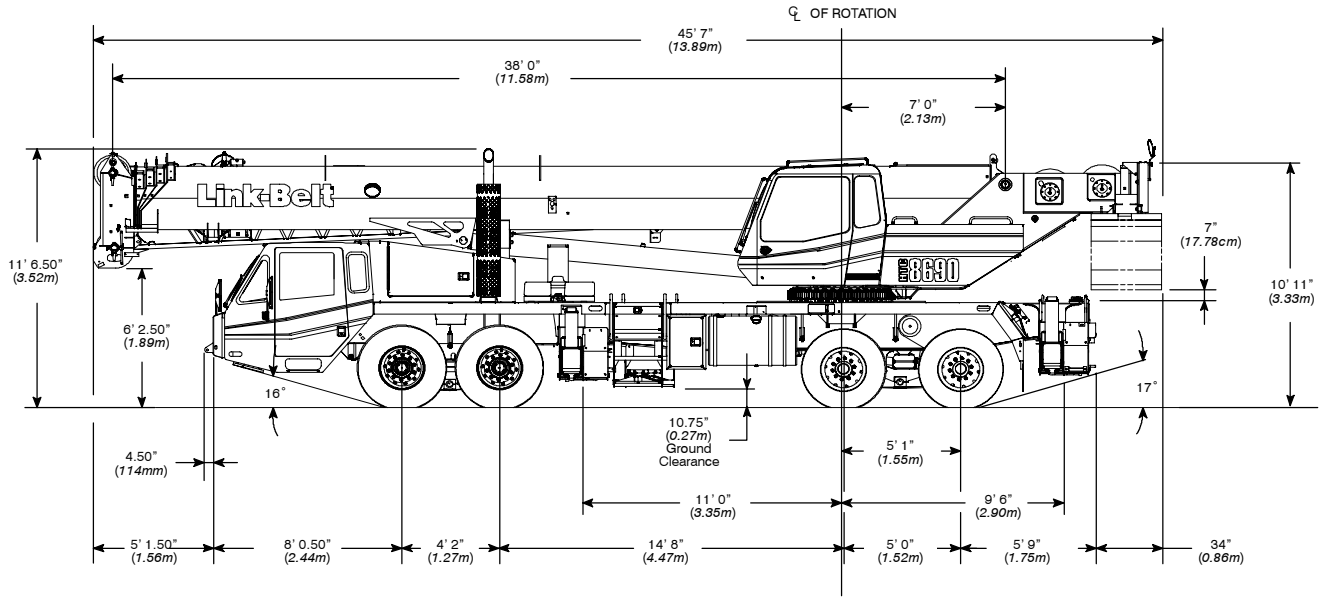
Base crane with full tank of fuel and no counterweight	Gross Vehicle Weight (1)		Front Axles		Rear Axles		Dolly Axles	
	lb	*kg*	lb	*kg*	lb	*kg*	lb	*kg*
	79,206	***35 927***	**29,457**	***13 361***	**35,680**	***16 184***	**14,069**	***6 382***
Nelson 2 – axle boom dolly	6,000	*2 722*	0	*0*	0	*0*	6,000	*2 722*
Nelson 3 – axle boom dolly	9,000	*4 082*	0	*0*	0	*0*	9,000	*4 082*
Driver in carrier cab	250	*113*	315	*143*	– 65	*– 29*	0	*0*
Rear pintle hook	13	*6*	– 6	*– 3*	19	*8*	0	*0*
Pneumatic and electrical connectors for trailer or boom dolly	11	*5*	– 4	*– 2*	15	*7*	0	*0*
Carrier aluminum storage box	59	*27*	28	*13*	31	*14*	0	*0*
Air ride lift system – rear axles	48	*22*	0	*0*	48	*22*	0	*0*
Ether injection	13	*6*	12	*5*	1	*1*	0	*0*
Air conditioning – carrier	45	*20*	55	*25*	– 10	*– 4*	0	*0*
Hoist drum follower – main	69	*31*	53	*24*	16	*7*	0	*0*
Auxiliary winch with 600 ft (*182.9m*) of 3/4" (*19mm*) type "RB" rope	731	*332*	435	*197*	296	*134*	0	*0*
Hoist drum follower – auxiliary	69	*31*	40	*18*	29	*13*	0	*0*
Substitute 600 ft (*182.9m*) of rope with 730 ft (*222.5m*) of rope – auxiliary	163	*74*	97	*44*	66	*30*	0	*0*
Remove 730 ft (*222.5m*) of rope from rear (main) winch	– 931	*– 422*	– 623	*– 282*	– 308	*– 140*	0	*0*
Remove 600 ft (*182.9m*) of rope from front (auxiliary) winch	– 768	*– 348*	– 458	*– 208*	– 310	*– 140*	0	*0*
Upper aluminum storage box	42	*19*	15	*7*	27	*12*	0	*0*
Air conditioner – operator's cab	220	*100*	66	*30*	154	*70*	0	*0*
360˚ mechanical swing lock	140	*64*	17	*8*	123	*56*	0	*0*
2,500 lb (*1 134.0kg*) counterweight tray on carrier deck	2,544	*1 154*	1,938	*879*	606	*275*	0	*0*
3,000 lb (*1 360.8kg*) counterweight on carrier deck	2,981	*1 352*	2,271	*1 030*	710	*322*	0	*0*
6,000 lb (*2 721.6kg*) counterweight on carrier deck	6,000	*2 722*	4,571	*2 074*	1,429	*648*	0	*0*
6,000 lb (*2 721.6kg*) counterweight on carrier deck	6,000	*2 722*	4,571	*2 074*	1,429	*648*	0	*0*
12,000 lb (*5 443.1kg*) counterweight on carrier deck	12,050	*5 466*	9,181	*4 164*	2,869	*1 301*	0	*0*
3,000 lb (*1 360.8kg*) top counterweight on upper	3,009	*1 365*	2,293	*1 040*	716	*325*	0	*0*
Flood light to the front of boom base section	7	*3*	1	*1*	1	*1*	5	*2*
Fly mounting brackets to boom base section for fly options	176	*80*	30	*14*	30	*14*	116	*53*
35 ft (*10.7m*) offsettable, one – piece lattice fly – stowed	1,591	*722*	168	*76*	170	*77*	1,253	*568*
35 – 58 ft (*10.7 – 17.7m*) offsettable, two – piece (bi – fold) lattice fly – stowed	2,263	*1 026*	339	*154*	342	*155*	1,583	*718*
Two 16 ft (*4.9m*) lattice inserts (stowed on 3 – axle boom dolly)	1,584	*718*	0	*0*	0	*0*	1,584	*718*
Auxiliary lifting sheave	110	*50*	– 19	*– 9*	– 19	*– 9*	149	*67*
40 ton (*36.3mt*) 4 – sheave hook block at boom head	900	*408*	– 134	*– 61*	– 135	*– 61*	1,169	*530*
60 ton (*54.4mt*) 4 – sheave hook block at boom head	1,109	*503*	– 165	*– 75*	– 167	*– 76*	1,441	*654*
90 ton (*81.6mt*) 6 – sheave hook block at boom head	1,554	*705*	– 231	*– 105*	– 233	*– 106*	2,019	*916*
8.5 ton (*7.7mt*) hook ball at boom head	360	*163*	– 54	*– 24*	– 54	*– 25*	468	*212*
10 ton (*9.1mt*) hook ball at boom head	580	*263*	– 87	*– 39*	– 87	*– 39*	754	*342*

Counterweight Load Transfer	Front Axles		Rear Axles		Dolly Axles	
	lb	*kg*	lb	*kg*	lb	*kg*
Transfer 3,000 lb (*1 360.8kg*) counterweight to the boom dolly	– 2,271	*– 1 030*	– 710	*– 322*	2,981	*1 352*
Transfer 6,000 lb (*2 721.6kg*) counterweight to the boom dolly	– 4,571	*– 2 074*	– 1,429	*– 648*	6,000	*2 722*
Transfer 6,000 lb (*2 721.6kg*) counterweight to the boom dolly	– 4,571	*– 2 074*	– 1,429	*– 648*	6,000	*2 722*
Transfer 12,000 lb (*5 443.1kg*) counterweight to the boom dolly	– 9,181	*– 4 164*	– 2,869	*– 1 301*	12,050	*5 466*
Transfer 3,000 lb (*1 360.8kg*) top counterweight to the boom dolly	– 2,293	*– 1 040*	– 716	*– 325*	3,009	*1 365*

Axle	Maximum Load @ 65 mph (*105km/h*)
Front	46,400 lb (*21 047kg*) – aluminum disc wheels with 445/65R22.5 tires
Rear	52,000 lb (*23 587kg*) – aluminum disc wheels with 12R22.5 tires

(1) Adjust gross vehicle weight and axle loading according to component weight. All weights are ±3%.

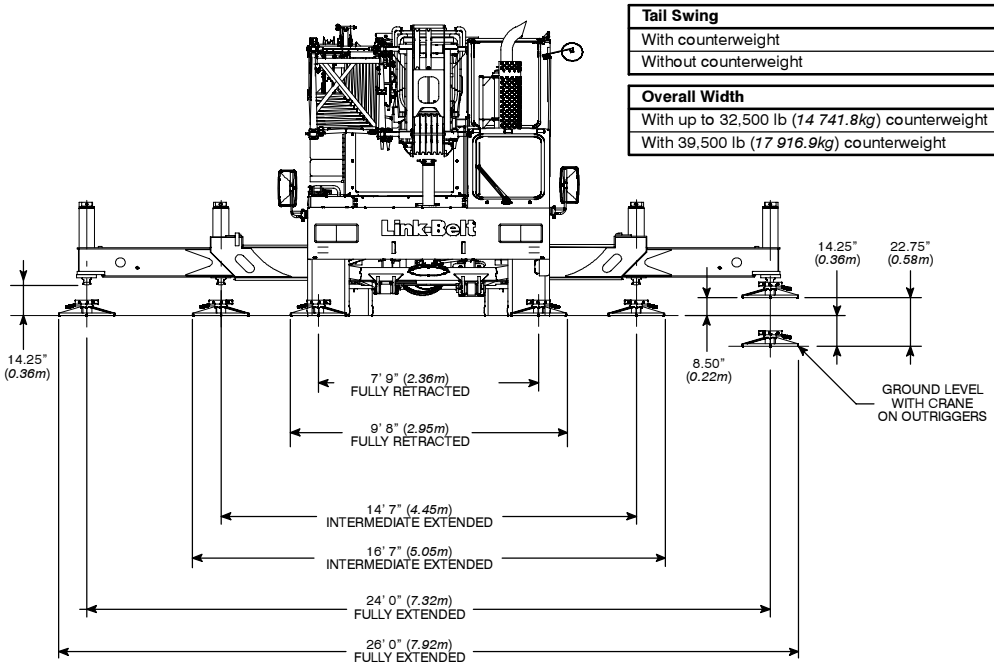
General Dimensions



Turning Radius	English	*Metric*
Wall to wall over carrier	48' 4"	*14.7m*
Wall to wall over boom	49' 2"	*15.0m*
Wall to wall over boom attachment	51' 0"	*15.5m*
Curb to curb	44' 1"	*13.4m*
Centerline of tire	43' 4"	*13.2m*

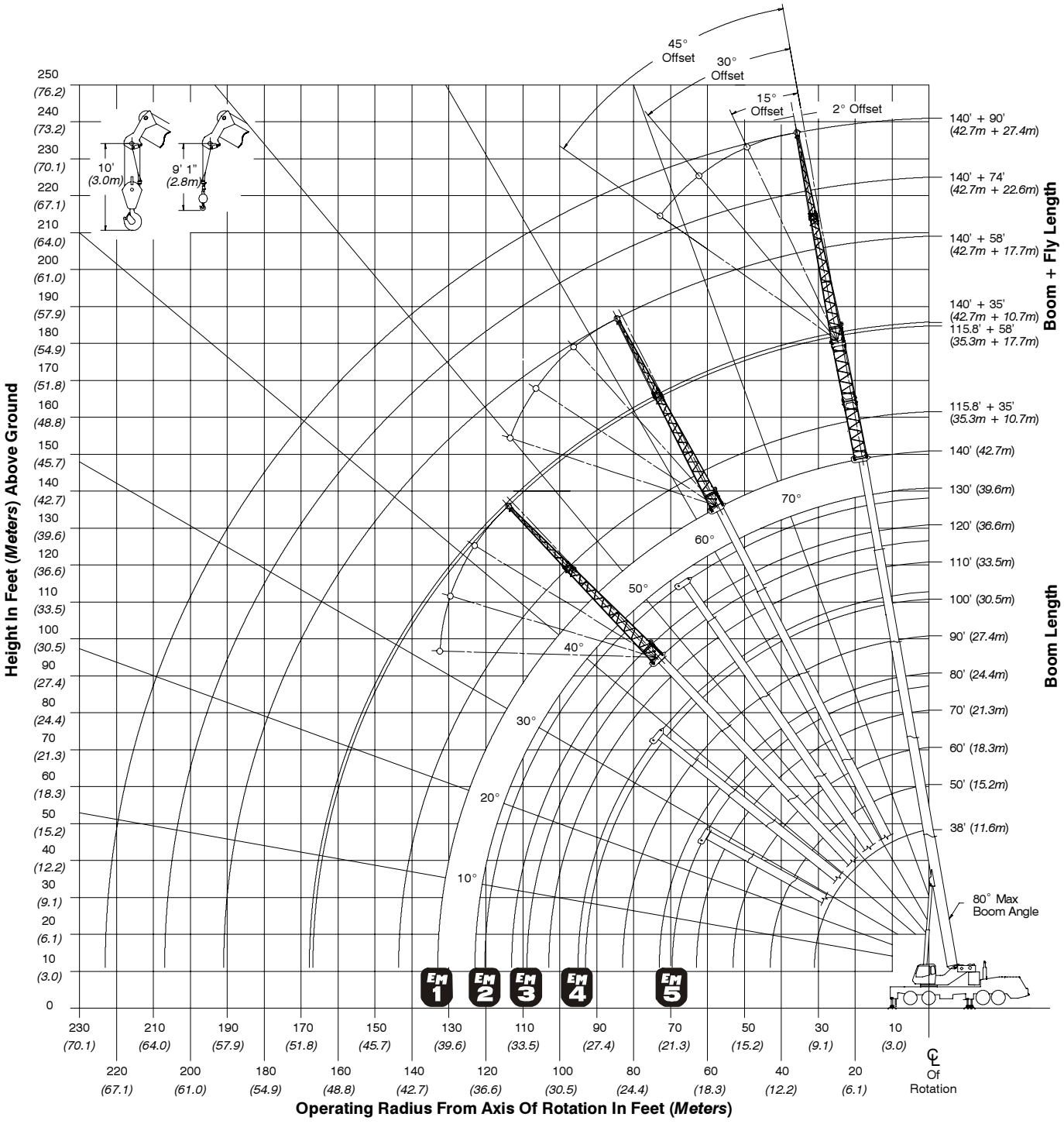
Tail Swing	English	*Metric*
With counterweight	13' 8"	*4.2m*
Without counterweight	13' 1"	*4.0m*

Overall Width	English	*Metric*
With up to 32,500 lb (*14 741.8kg*) counterweight	8' 6"	*2.6m*
With 39,500 lb (*17 916.9kg*) counterweight	11' 0"	*3.4m*



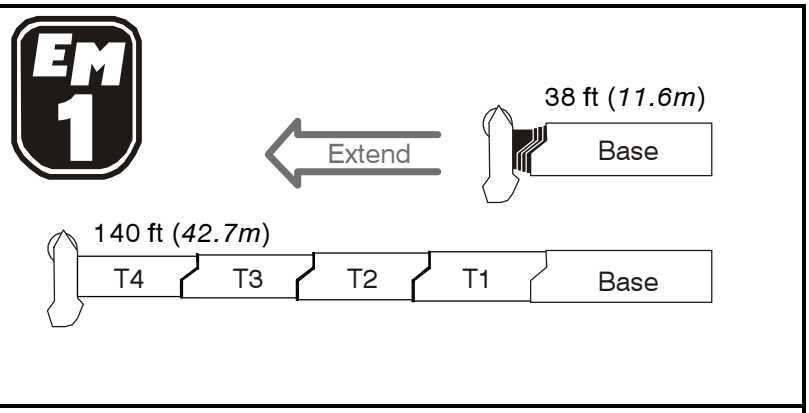
Not To Scale

Working Range Diagram

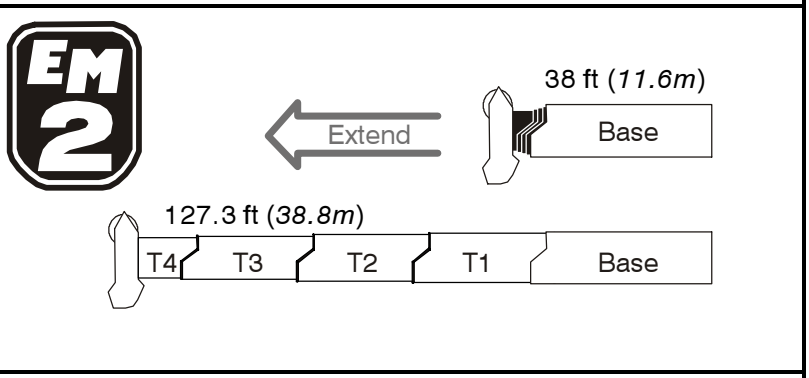


Boom Extend Modes

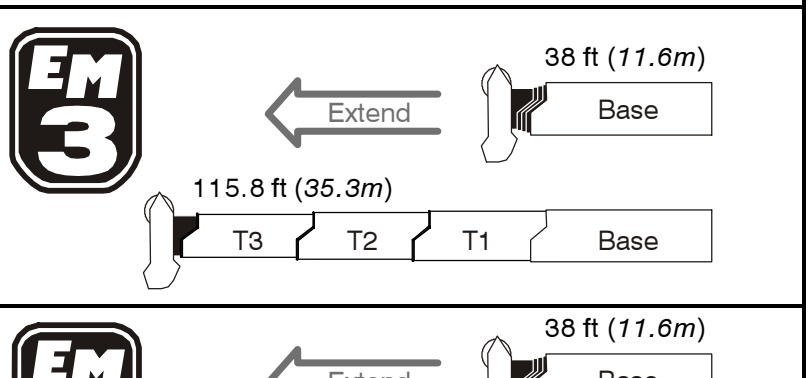
Boom Length		Section Length			
ft	*m*	T4	T3	T2	T1
50	*15.2*	50%			
60	*18.3*	91%			
70	*21.3*	100%	31%		
80	*24.4*	100%	71%		
90	*27.4*	100%	100%	11%	
100	*30.5*	100%	100%	49%	
110	*33.5*	100%	100%	88%	
120	*36.6*	100%	100%	100%	25%
130	*39.6*	100%	100%	100%	63%
140	*42.7*	100%	100%	100%	100%



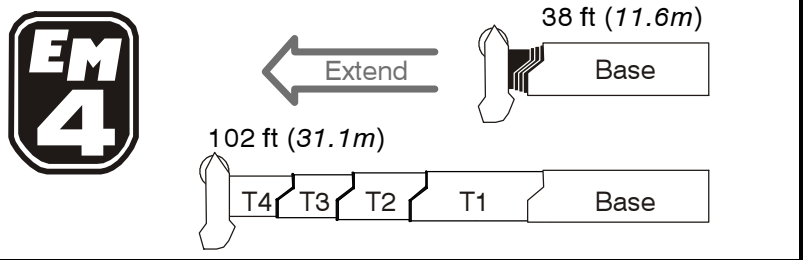
Boom Length		Section Length			
ft	*m*	T4	T3	T2	T1
50	*15.2*	48%	2%		
60	*18.3*	48%	42%		
70	*21.3*	48%	82%		
80	*24.4*	48%	100%	21%	
90	*27.4*	48%	100%	60%	
100	*30.5*	48%	100%	98%	
110	*33.5*	48%	100%	100%	35%
120	*36.6*	48%	100%	100%	73%
127.3	*38.8*	48%	100%	100%	100%



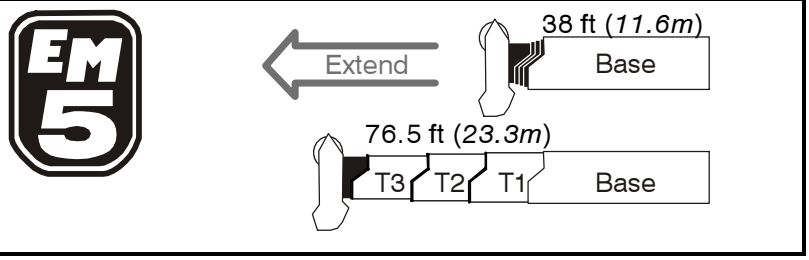
Boom Length		Section Length			
ft	*m*	T4	T3	T2	T1
50	*15.2*	0%	48%		
60	*18.3*	0%	88%		
70	*21.3*	0%	100%	27%	
80	*24.4*	0%	100%	65%	
90	*27.4*	0%	100%	100%	4%
100	*30.5*	0%	100%	100%	41%
115.8	*35.3*	0%	100%	100%	100%



Boom Length		Section Length			
ft	*m*	T4	T3	T2	T1
50	*15.2*	48%	2%		
60	*18.3*	48%	42%		
70	*21.3*	48%	51%	30%	
80	*24.4*	48%	51%	50%	18%
90	*27.4*	48%	51%	50%	55%
102	*31.1*	48%	51%	50%	100%



Boom Length		Section Length			
ft	*m*	T4	T3	T2	T1
50.7	*15.5*	0%	51%		
63.7	*19.4*	0%	51%	50%	
76.5	*23.3*	0%	51%	50%	48%



Main Boom Lift Capacity Charts – Standard

8,500 lb Counterweight – Fully Extended Outriggers – 360˚ Rotation
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)											Radius (ft)
	38	50	60	70	76.5/80	90	100	110	120	130	140	
9	164,400*											9
10	154,600*	152,100*	117,900	89,700								10
12	129,300*	131,300*	108,800	85,000	85,100**							12
15	102,500	104,600	104,900	78,800	78,400**	57,700						15
20	74,700	77,000	77,400	70,300	76,500**	56,200	49,100	42,500				20
25	54,700	57,900	59,400	60,100	59,700	55,300	45,800	42,500	33,700	29,700		25
30	39,600	43,300	44,400	44,600	44,300	43,800	43,200	38,300	31,200	29,400	24,400	30
35		33,100	34,100	34,900	34,100	35,000	33,500	34,500	30,900	29,100	24,100	35
40		26,100	27,200	27,900	28,100	28,000	28,000	27,500	28,100	26,900	24,000	40
45			22,800	23,500	23,900	23,300	24,000	23,800	23,500	23,100	22,700	45
50			18,900	19,600	20,000	20,200	20,100	19,900	19,600	19,100	18,800	50
55				16,500	16,900	17,100	16,900	16,800	16,400	16,000	15,700	55
60				14,000	14,400	14,600	14,500	14,300	14,000	13,600	13,200	60
65					12,500	12,700	12,500	12,400	12,100	11,700	11,400	65
70					10,800	11,000	10,900	10,800	10,400	10,100	9,700	70
75						9,600	9,500	9,400	9,100	8,700	8,400	75
80						8,400	8,300	8,200	7,900	7,500	7,200	80
85							7,300	7,200	6,800	6,500	6,200	85
90							6,300	6,300	6,000	5,600	5,300	90
95								5,500	5,200	4,800	4,500	95
100								4,800	4,500	4,100	3,800	100
105									3,900	3,500	3,200	105
110									3,300	3,000	2,700	110
115										2,500	2,200	115
120										2,000	1,700	120
125											1,300	125
130											900	130

* Special Conditions Or Wire Rope Required
** 76.5 EM5 mode

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

8,500 lb Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	32,200							10
12	29,000	30,400						12
15	25,000	26,500	22,300					15
20	19,700	21,400	22,300	17,700				20
25	13,100	15,700	17,100	17,700	13,600			25
30	8,800	11,400	12,700	13,300	13,600	10,800	8,900	30
35		8,400	9,600	10,200	10,600	10,800	8,900	35
40		6,100	7,400	8,000	8,400	8,600	8,500	40
45			5,600	6,200	6,600	6,800	6,800	45
50			4,300	4,900	5,200	5,400	5,400	50
55				3,800	4,100	4,300	4,300	55
60				2,900	3,200	3,400	3,400	60
65					2,400	2,600	2,600	65
70					1,800	2,000	1,900	70
75						1,400	1,400	75
80						900	900	80

8,500 lb Counterweight – On Tires – Pick & Carry (1 mph) – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	22,200							10
12	19,800	21,100						12
15	16,600	18,100	18,900					15
20	12,500	14,200	15,100	15,500				20
25	9,300	11,200	12,200	12,600	12,800			25
30	6,800	8,800	9,800	10,300	10,600	10,800	8,900	30
35		6,900	7,900	8,400	8,800	8,900	8,900	35
40		5,300	6,400	6,900	7,200	7,400	7,400	40
45			5,100	5,600	6,000	6,100	6,100	45
50			3,900	4,500	4,900	5,100	5,000	50
55				3,600	3,900	4,100	4,100	55
60				2,700	3,100	3,300	3,300	60
65					2,400	2,600	2,500	65
70					1,800	2,000	1,900	70
75						1,400	1,400	75
80						900	900	80

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

11,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)											Radius (ft)
	38	50	60	70	76.5/80	90	100	110	120	130	140	
9	165,000*											9
10	155,400*	152,100*	117,900	89,700								10
12	131,900*	133,900*	108,800	85,000	85,100**							12
15	104,600	106,700	106,500	78,800	78,400**	57,700						15
20	76,400	78,600	79,000	70,300	76,500**	56,200	49,100	42,500				20
25	57,800	61,000	61,500	63,000	62,700	55,300	45,800	42,500	33,700	29,700		25
30	42,300	46,000	47,100	47,300	47,000	46,500	45,200	38,300	31,200	29,400	24,400	30
35		35,300	36,300	36,500	36,300	36,200	35,700	35,100	30,900	29,100	24,100	35
40		27,900	29,000	29,700	29,900	29,900	29,800	29,300	28,800	28,700	24,000	40
45			23,900	24,500	25,100	24,700	24,900	25,400	25,000	24,600	23,800	45
50			20,300	21,100	21,500	21,400	21,500	21,400	21,000	20,600	20,300	50
55				17,900	18,300	18,500	18,400	18,200	17,900	17,500	17,100	55
60				15,300	15,700	15,900	15,700	15,600	15,300	14,900	14,500	60
65					13,600	13,700	13,600	13,500	13,100	12,700	12,500	65
70					11,800	12,100	11,900	11,800	11,500	11,100	10,800	70
75						10,600	10,500	10,400	10,000	9,700	9,300	75
80						9,300	9,200	9,100	8,800	8,400	8,100	80
85							8,100	8,000	7,700	7,300	7,000	85
90							7,100	7,100	6,700	6,400	6,100	90
95								6,200	5,900	5,600	5,200	95
100								5,500	5,200	4,800	4,500	100
105									4,500	4,200	3,900	105
110									3,900	3,600	3,300	110
115										3,100	2,800	115
120										2,600	2,300	120
125											1,800	125
130											1,400	130

* Special Conditions Or Wire Rope Required
** 76.5 EM5 mode

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

11,500 lb Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	31,600							10
12	28,500	29,900						12
15	24,600	26,100	21,900					15
20	19,400	21,100	21,900	18,600				20
25	14,600	17,200	18,100	18,600	14,800			25
30	10,000	12,600	13,800	14,400	14,800	11,800	9,400	30
35		9,400	10,600	11,200	11,600	11,800	9,400	35
40		7,000	8,200	8,800	9,200	9,400	9,400	40
45			6,400	7,000	7,400	7,600	7,500	45
50			5,000	5,600	5,900	6,100	6,100	50
55				4,400	4,800	4,900	4,900	55
60				3,400	3,800	4,000	3,900	60
65					3,000	3,200	3,100	65
70					2,300	2,500	2,400	70
75						1,900	1,800	75
80						1,400	1,300	80

11,500 lb Counterweight – On Tires – Pick & Carry (1 mph) – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	21,600							10
12	19,300	20,600						12
15	16,200	17,700	18,400					15
20	12,100	13,800	14,700	15,100				20
25	9,000	10,900	11,800	12,300	12,600			25
30	6,500	8,500	9,500	10,000	10,300	10,500	8,600	30
35		6,600	7,700	8,200	8,500	8,700	8,600	35
40		5,000	6,100	6,700	7,000	7,200	7,100	40
45			4,800	5,400	5,700	5,900	5,900	45
50			3,700	4,300	4,700	4,800	4,800	50
55				3,400	3,700	3,900	3,900	55
60				2,600	2,900	3,100	3,100	60
65					2,200	2,400	2,400	65
70					1,600	1,800	1,800	70
75						1,300	1,200	75
80						800	700	80

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

Main Boom Lift Capacity Charts – Optional

32,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)											Radius (ft)
	38	50	60	70	76.5/80	90	100	110	120	130	140	
8	180,000*											8
9	167,100*											9
10	158,300*	152,100*	117,900	89,700								10
12	142,700*	138,700*	108,800	85,000	85,100**							12
15	119,300	121,400	106,500	78,800	78,400**	57,700						15
20	87,600	89,800	90,200	70,300	76,500**	56,200	49,100	42,500				20
25	68,000	70,300	70,800	63,600	70,300**	55,300	45,800	42,500	33,700	29,700		25
30	54,700	57,100	57,600	58,100	58,700	54,500	45,200	38,300	31,200	29,400	24,400	30
35		47,500	49,100	49,400	49,200	48,800	42,500	35,500	30,900	29,100	24,100	35
40		40,500	41,600	41,800	41,600	41,100	38,200	33,400	30,600	28,800	24,000	40
45			34,600	34,900	34,600	34,200	33,700	30,300	29,900	28,600	23,800	45
50			29,300	29,600	29,400	28,900	28,800	27,900	27,800	26,800	23,700	50
55				25,500	25,300	26,000	24,800	24,700	25,300	24,800	23,600	55
60				22,500	22,400	22,800	21,500	22,300	22,000	21,900	22,100	60
65					20,000	20,100	20,000	19,600	19,300	20,000	19,600	65
70					17,700	17,800	17,800	17,700	18,100	17,700	17,400	70
75						15,800	16,500	16,500	16,200	15,800	15,500	75
80						14,200	14,900	14,800	14,500	14,100	13,800	80
85							13,500	13,400	13,100	12,700	12,500	85
90							12,200	12,200	11,900	11,600	11,300	90
95								11,100	10,800	10,500	10,200	95
100								10,100	9,800	9,500	9,200	100
105									8,900	8,600	8,300	105
110									8,100	7,800	7,500	110
115										7,100	6,800	115
120										6,400	6,100	120
125											5,500	125
130											5,000	130

* Special Conditions Or Wire Rope Required
** 76.5 EM5 mode

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

32,500 lb Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	28,300							10
12	25,400	26,900						12
15	21,800	23,400	24,300					15
20	16,700	18,000	19,300	20,100				20
25	13,000	14,900	15,700	16,100	16,300			25
30	10,100	12,100	13,100	13,500	13,800	13,900	13,800	30
35		9,900	10,900	11,400	11,800	11,900	11,800	35
40		8,000	9,100	9,600	10,000	10,100	10,100	40
45			7,600	8,100	8,500	8,700	8,600	45
50			6,300	6,900	7,200	7,400	7,300	50
55				5,700	6,100	6,300	6,200	55
60				4,800	5,200	5,300	5,300	60
65					4,300	4,500	4,500	65
70					3,600	3,800	3,700	70
75						3,100	3,100	75
80						2,500	2,500	80
85							1,900	85
90							1,500	90

32,500 lb Counterweight – On Tires – Pick & Carry (1 mph) – Boom Centered Over Rear
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)							Radius (ft)
	38	50	60	70	80	90	100	
10	18,200							10
12	16,000	17,500						12
15	13,200	14,800	15,600					15
20	9,500	11,300	12,200	12,700				20
25	6,700	8,600	9,600	10,000	10,400			25
30	4,400	6,500	7,500	8,000	8,300	8,500	8,500	30
35		4,700	5,800	6,300	6,700	6,900	6,800	35
40		3,300	4,400	5,000	5,300	5,500	5,500	40
45			3,300	3,900	4,200	4,400	4,400	45
50			2,300	2,800	3,200	3,400	3,300	50
55				2,000	2,400	2,600	2,500	55
60				1,300	1,700	1,900	1,800	60
65					1,100	1,200	1,200	65

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

39,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

Radius (ft)	Boom Length (ft)											Radius (ft)
	38	50	60	70	76.5/80	90	100	110	120	130	140	
8	180,000*											8
9	167,600*											9
10	158,800*	152,100*	117,900	89,700								10
12	143,600*	138,700*	108,800	85,000	85,100**							12
15	123,700	122,600	106,500	78,800	78,400**	57,700						15
20	91,300	93,500	93,800	70,300	76,500**	56,200	49,100	42,500				20
25	71,000	73,300	73,800	63,600	73,300**	55,300	45,800	42,500	33,700	29,700		25
30	57,200	59,600	60,100	58,100	61,100	54,500	45,200	38,300	31,200	29,400	24,400	30
35		49,700	50,300	51,400	51,200	50,900	42,500	35,500	30,900	29,100	24,100	35
40		42,200	43,700	44,000	43,800	43,400	38,200	33,400	30,600	28,800	24,000	40
45			37,900	38,200	38,100	37,700	34,600	30,300	29,900	28,600	23,800	45
50			32,400	32,700	32,500	32,000	31,500	27,900	27,800	26,800	23,700	50
55				28,200	28,000	27,600	27,300	25,600	25,800	24,800	23,600	55
60				24,600	24,500	24,100	24,100	23,600	24,200	23,000	22,100	60
65					21,500	22,300	21,100	21,400	21,600	21,300	20,600	65
70					19,700	19,900	18,700	19,500	19,100	19,200	19,200	70
75						17,700	17,500	17,400	17,000	17,700	17,400	75
80						16,000	16,000	15,600	15,900	15,900	15,600	80
85							14,600	14,600	14,800	14,400	14,100	85
90							13,800	13,700	13,400	13,000	12,700	90
95								12,500	12,300	11,900	11,600	95
100								11,500	11,200	10,900	10,600	100
105									10,200	9,900	9,600	105
110									9,400	9,000	8,800	110
115										8,300	8,000	115
120										7,500	7,300	120
125											6,600	125
130											6,000	130

* Special Conditions Or Wire Rope Required
** 76.5 EM5 mode

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

Fly Attachment Lift Capacity Charts – Optional

8,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 2° Fly Offset			140 ft Main Boom Length 15° Fly Offset		
Radius (ft)	Fly Length (ft)		Radius (ft)	Fly Length (ft)	
	35	58		35	58
35	12,100		35		
40	12,100		40		
45	12,100	8,500	45	11,500	
50	12,100	8,400	50	11,400	
55	12,100	8,300	55	11,200	
60	12,100	8,100	60	11,000	7,200
65	11,900	8,000	65	10,800	7,000
70	10,400	7,800	70	10,600	6,800
75	9,000	7,700	75	9,700	6,700
80	7,800	7,500	80	8,500	6,500
85	6,800	7,300	85	7,400	6,300
90	5,900	6,400	90	6,400	6,200
95	5,100	5,600	95	5,600	6,000
100	4,400	4,900	100	4,800	5,600
105	3,700	4,200	105	4,200	4,900
110	3,200	3,600	110	3,600	4,300
115	2,700	3,100	115	3,000	3,700
120	2,200	2,600	120	2,500	3,200
125	1,800	2,200	125	2,100	2,700
130	1,400	1,800	130	1,700	2,300
135	1,100	1,500	135	1,300	1,900
140			140	900	1,500
145			145		1,200

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

8,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 30° Fly Offset			140 ft Main Boom Length 45° Fly Offset		
Radius (ft)	Fly Length (ft)		Radius (ft)	Fly Length (ft)	
	35	58		35	58
35			35		
40			40		
45			45		
50			50		
55	10,000		55		
60	9,800		60		
65	9,700		65	8,800	
70	9,500		70	8,800	
75	9,400	5,700	75	8,700	
80	9,100	5,600	80	8,600	
85	8,000	5,500	85	8,400	4,900
90	7,000	5,400	90	7,400	4,900
95	6,100	5,300	95	6,400	4,800
100	5,300	5,200	100	5,600	4,800
105	4,600	5,100	105	4,800	4,700
110	3,900	4,900	110	4,200	4,700
115	3,300	4,300	115	3,500	4,700
120	2,800	3,700	120	3,000	4,100
125	2,300	3,200	125	2,500	3,600
130	1,900	2,700	130	2,000	3,100
135	1,500	2,300	135	1,500	2,600
140	1,100	1,900	140		2,100
145		1,500	145		1,700
150		1,200	150		1,300
155			155		1,000

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

11,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 2° Fly Offset				140 ft Main Boom Length 15° Fly Offset			
Radius (ft)	Fly Length (ft)			Radius (ft)	Fly Length (ft)		
	35	58	74		35	58	74
35	12,100			35			
40	12,100			40			
45	12,100	8,500		45	11,500		
50	12,100	8,400	6,600	50	11,400		
55	12,100	8,300	6,600	55	11,200		
60	12,100	8,100	6,600	60	11,000	7,200	
65	11,900	8,000	6,600	65	10,800	7,000	6,300
70	11,500	7,800	6,600	70	10,600	6,800	6,000
75	10,000	7,700	6,600	75	10,400	6,700	5,700
80	8,700	7,500	6,400	80	9,400	6,500	5,400
85	7,600	7,300	6,000	85	8,200	6,300	5,100
90	6,700	7,100	5,700	90	7,200	6,200	4,900
95	5,800	6,300	5,400	95	6,300	6,000	4,600
100	5,100	5,500	5,100	100	5,500	5,900	4,400
105	4,400	4,900	4,800	105	4,800	5,600	4,200
110	3,800	4,300	4,200	110	4,200	4,900	4,100
115	3,300	3,700	3,600	115	3,600	4,300	3,900
120	2,800	3,200	3,100	120	3,100	3,800	3,600
125	2,300	2,800	2,700	125	2,600	3,300	3,100
130	1,900	2,300	2,200	130	2,200	2,800	2,700
135	1,600	2,000	1,900	135	1,800	2,400	2,300
140	1,200	1,600	1,500	140	1,400	2,000	1,900
145	900	1,300	1,200	145	1,100	1,700	1,500
				150		1,300	1,200
				155		1,000	

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

11,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 30° Fly Offset				140 ft Main Boom Length 45° Fly Offset			
Radius (ft)	Fly Length (ft)			Radius (ft)	Fly Length (ft)		
	35	58	74		35	58	74
35				35			
40				40			
45				45			
50				50			
55	10,000			55			
60	9,800			60			
65	9,700			65	8,800		
70	9,500			70	8,800		
75	9,400	5,700	4,600	75	8,700		
80	9,200	5,600	4,400	80	8,600		
85	8,800	5,500	4,200	85	8,600	4,900	3,700
90	7,700	5,400	4,100	90	8,100	4,900	3,500
95	6,800	5,300	3,900	95	7,200	4,800	3,400
100	6,000	5,200	3,700	100	6,300	4,800	3,300
105	5,200	5,100	3,600	105	5,500	4,700	3,200
110	4,500	5,000	3,500	110	4,800	4,700	3,100
115	3,900	4,900	3,300	115	4,100	4,700	3,000
120	3,400	4,300	3,200	120	3,500	4,600	2,900
125	2,900	3,800	3,100	125	3,000	4,100	2,800
130	2,400	3,300	3,000	130	2,500	3,600	2,700
135	2,000	2,800	2,700	135	2,000	3,100	2,700
140	1,600	2,400	2,300	140		2,600	2,600
145	1,200	2,000	1,900	145		2,200	2,200
150	900	1,600	1,600	150		1,800	1,800
155		1,300	1,200	155		1,400	1,400
160		1,000	900	160		1,000	1,100
				165			800

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

32,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 2° Fly Offset					140 ft Main Boom Length 15° Fly Offset				
Radius (ft)	Fly Length (ft)				Radius (ft)	Fly Length (ft)			
	35	58	74	90		35	58	74	90
35	12,100				35				
40	12,100				40				
45	12,100	8,500			45	11,500			
50	12,100	8,400	6,600		50	11,400			
55	12,100	8,300	6,600	5,200	55	11,200			
60	12,100	8,100	6,600	5,200	60	11,000	7,200		
65	11,900	8,000	6,600	5,200	65	10,800	7,000	6,300	
70	11,700	7,800	6,600	5,200	70	10,600	6,800	6,000	4,800
75	11,500	7,700	6,600	5,100	75	10,400	6,700	5,700	4,500
80	11,300	7,500	6,400	4,800	80	10,200	6,500	5,400	4,200
85	11,000	7,300	6,000	4,500	85	10,000	6,300	5,100	4,000
90	10,500	7,100	5,700	4,200	90	9,700	6,200	4,900	3,700
95	10,100	6,900	5,400	4,000	95	9,400	6,000	4,600	3,500
100	9,700	6,700	5,100	3,700	100	9,000	5,900	4,400	3,300
105	8,800	6,500	4,900	3,500	105	8,700	5,700	4,200	3,100
110	8,000	6,300	4,700	3,300	110	8,400	5,600	4,100	3,000
115	7,300	6,000	4,500	3,200	115	7,600	5,500	3,900	2,800
120	6,600	5,800	4,300	3,000	120	6,900	5,300	3,700	2,700
125	6,000	5,600	4,100	2,800	125	6,300	5,100	3,600	2,500
130	5,500	5,300	3,900	2,700	130	5,700	4,900	3,500	2,400
135	5,000	5,200	3,800	2,500	135	5,200	4,700	3,300	2,300
140	4,500	4,900	3,600	2,400	140	4,700	4,600	3,200	2,200
145	4,100	4,400	3,500	2,300	145	4,200	4,400	3,100	2,100
150	3,700	4,000	3,400	2,200	150	3,800	4,300	3,000	2,000
155	3,300	3,700	3,200	2,100	155	3,400	4,000	2,900	1,900
160	2,900	3,300	3,100	2,000	160	3,000	3,600	2,900	1,800
165	2,500	2,900	2,700	1,900	165	2,600	3,200	2,800	1,700
170		2,600	2,400	1,800	170		2,800	2,700	1,600
175		2,300	2,100	1,800	175		2,500	2,300	1,600
180		2,000	1,800	1,700	180		2,100	2,000	1,500
185		1,700	1,500	1,400	185		1,800	1,700	1,500
190			1,200	1,200	190			1,400	1,400
195			1,000	900	195			1,100	1,100
200			800		200			800	900

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

32,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 30° Fly Offset					140 ft Main Boom Length 45° Fly Offset				
Radius (ft)	Fly Length (ft)				Radius (ft)	Fly Length (ft)			
	35	58	74	90		35	58	74	90
35					35				
40					40				
45					45				
50					50				
55	10,000				55				
60	9,800				60				
65	9,700				65	8,800			
70	9,500				70	8,800			
75	9,400	5,700	4,600		75	8,700			
80	9,200	5,600	4,400	3,600	80	8,600			
85	9,100	5,500	4,200	3,400	85	8,600	4,900	3,700	
90	9,000	5,400	4,100	3,200	90	8,500	4,900	3,500	2,900
95	8,800	5,300	3,900	3,000	95	8,400	4,800	3,400	2,700
100	8,500	5,200	3,700	2,900	100	8,200	4,800	3,300	2,600
105	8,200	5,100	3,600	2,700	105	8,000	4,700	3,200	2,400
110	8,000	5,000	3,500	2,600	110	7,800	4,700	3,100	2,300
115	7,700	4,900	3,300	2,400	115	7,600	4,700	3,000	2,200
120	7,200	4,800	3,200	2,300	120	7,400	4,600	2,900	2,100
125	6,500	4,700	3,100	2,200	125	6,700	4,500	2,800	2,000
130	5,900	4,500	3,000	2,100	130	6,000	4,400	2,700	1,900
135	5,400	4,400	2,900	2,000	135	5,400	4,300	2,700	1,800
140	4,800	4,300	2,800	1,900	140		4,200	2,600	1,800
145	4,400	4,200	2,800	1,800	145		4,100	2,600	1,700
150	3,900	4,100	2,700	1,700	150		4,000	2,500	1,600
155	3,500	4,000	2,600	1,700	155		4,000	2,500	1,600
160		3,800	2,600	1,600	160		3,900	2,500	1,500
165		3,400	2,500	1,500	165			2,500	1,500
170		3,000	2,500	1,500	170			2,500	1,400
175		2,600	2,500	1,400	175			2,500	1,400
180		2,200	2,200	1,400	180				1,400
185			1,800	1,400	185				1,400
190			1,500	1,300	190				1,400
195			1,200	1,300					
200				1,000					

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

39,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 2° Fly Offset					140 ft Main Boom Length 15° Fly Offset				
Radius (ft)	Fly Length (ft)				Radius (ft)	Fly Length (ft)			
	35	58	74	90		35	58	74	90
35	12,100				35				
40	12,100				40				
45	12,100	8,500			45	11,500			
50	12,100	8,400	6,600		50	11,400			
55	12,100	8,300	6,600	5,200	55	11,200			
60	12,100	8,100	6,600	5,200	60	11,000	7,200		
65	11,900	8,000	6,600	5,200	65	10,800	7,000	6,300	
70	11,700	7,800	6,600	5,200	70	10,600	6,800	6,000	4,800
75	11,500	7,700	6,600	5,100	75	10,400	6,700	5,700	4,500
80	11,300	7,500	6,400	4,800	80	10,200	6,500	5,400	4,200
85	11,000	7,300	6,000	4,500	85	10,000	6,300	5,100	4,000
90	10,500	7,100	5,700	4,200	90	9,700	6,200	4,900	3,700
95	10,100	6,900	5,400	4,000	95	9,400	6,000	4,600	3,500
100	9,700	6,700	5,100	3,700	100	9,000	5,900	4,400	3,300
105	9,300	6,500	4,900	3,500	105	8,700	5,700	4,200	3,100
110	8,900	6,300	4,700	3,300	110	8,400	5,600	4,100	3,000
115	8,500	6,000	4,500	3,200	115	8,100	5,500	3,900	2,800
120	7,800	5,800	4,300	3,000	120	7,900	5,300	3,700	2,700
125	7,100	5,600	4,100	2,800	125	7,400	5,100	3,600	2,500
130	6,500	5,300	3,900	2,700	130	6,800	4,900	3,500	2,400
135	6,000	5,200	3,800	2,500	135	6,200	4,700	3,300	2,300
140	5,500	5,000	3,600	2,400	140	5,700	4,600	3,200	2,200
145	5,000	4,800	3,500	2,300	145	5,200	4,400	3,100	2,100
150	4,500	4,700	3,400	2,200	150	4,700	4,300	3,000	2,000
155	4,100	4,500	3,200	2,100	155	4,300	4,200	2,900	1,900
160	3,700	4,100	3,100	2,000	160	3,800	4,100	2,900	1,800
165	3,400	3,700	3,100	1,900	165	3,400	4,000	2,800	1,700
170		3,400	3,000	1,800	170		3,600	2,700	1,600
175		3,000	2,800	1,800	175		3,200	2,700	1,600
180		2,700	2,500	1,700	180		2,900	2,600	1,500
185		2,400	2,200	1,600	185		2,500	2,400	1,500
190			1,900	1,600	190			2,100	1,400
195			1,700	1,500	195			1,800	1,400
200			1,400	1,300	200			1,500	1,400
205				1,100	205				1,300
210				900	210				1,000
					215				800

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

39,500 lb Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Pounds)

140 ft Main Boom Length 30° Fly Offset					140 ft Main Boom Length 45° Fly Offset				
Radius (ft)	Fly Length (ft)				Radius (ft)	Fly Length (ft)			
	35	58	74	90		35	58	74	90
35					35				
40					40				
45					45				
50					50				
55	10,000				55				
60	9,800				60				
65	9,700				65	8,800			
70	9,500				70	8,800			
75	9,400	5,700	4,600		75	8,700			
80	9,200	5,600	4,400	3,600	80	8,600			
85	9,100	5,500	4,200	3,400	85	8,600	4,900	3,700	
90	9,000	5,400	4,100	3,200	90	8,500	4,900	3,500	2,900
95	8,800	5,300	3,900	3,000	95	8,400	4,800	3,400	2,700
100	8,500	5,200	3,700	2,900	100	8,200	4,800	3,300	2,600
105	8,200	5,100	3,600	2,700	105	8,000	4,700	3,200	2,400
110	8,000	5,000	3,500	2,600	110	7,800	4,700	3,100	2,300
115	7,700	4,900	3,300	2,400	115	7,600	4,700	3,000	2,200
120	7,500	4,800	3,200	2,300	120	7,400	4,600	2,900	2,100
125	7,300	4,700	3,100	2,200	125	7,200	4,500	2,800	2,000
130	7,000	4,500	3,000	2,100	130	7,100	4,400	2,700	1,900
135	6,400	4,400	2,900	2,000	135	6,400	4,300	2,700	1,800
140	5,800	4,300	2,800	1,900	140		4,200	2,600	1,800
145	5,300	4,200	2,800	1,800	145		4,100	2,600	1,700
150	4,800	4,100	2,700	1,700	150		4,000	2,500	1,600
155	4,300	4,000	2,600	1,700	155		4,000	2,500	1,600
160		3,900	2,600	1,600	160		4,000	2,500	1,500
165		3,900	2,500	1,500	165		4,000	2,500	1,500
170		3,700	2,500	1,500	170			2,500	1,400
175		3,300	2,500	1,400	175			2,500	1,400
180		2,900	2,500	1,400	180				1,400
185			2,500	1,400	185				1,400
190			2,200	1,300	190				1,400
195			1,900	1,300					
200				1,300					
205				1,300					
210				1,100					

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 85% of the tipping loads and on tires do not exceed 75% of the tipping loads.

Main Boom Lift Capacity Charts – Optional (Metric)

3 856kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)											Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.67	
3	70 800*	69 550*	53 450	40 850								3
3.5	61 350*	62 250*	50 350	39 100								3.5
4	53 500	54 450	48 900	37 450	37 400							4
4.5	47 250	48 250	48 350	35 950	35 750	26 150						4.5
5	42 200	43 200	43 400	34 600	35 250	26 150						5
6	34 500	35 550	35 750	32 150	34 700	25 450	22 250	19 250				6
7	26 600	27 850	28 200	28 850	28 700	25 200	21 150	19 250				7
8	20 500	22 000	22 450	22 550	22 450	22 200	20 650	18 800	14 950	13 400		8
9	16 350	17 800	18 250	18 500	18 200	18 150	17 950	17 550	14 200	13 300	11 050	9
10		14 850	15 250	15 550	15 600	15 600	15 600	15 400	14 050	13 200	10 950	10
12		10 750	11 450	11 700	11 850	11 700	11 850	11 800	11 650	11 500	10 850	12
14			8 800	9 100	9 250	9 300	9 250	9 200	9 050	8 900	8 750	14
16			6 850	7 150	7 350	7 400	7 350	7 300	7 150	6 950	6 850	16
18				5 800	5 950	6 000	5 950	5 900	5 750	5 650	5 500	18
20					4 900	4 950	4 900	4 850	4 750	4 600	4 450	20
22					4 050	4 150	4 100	4 050	3 900	3 750	3 650	22
24						3 450	3 400	3 400	3 250	3 100	2 950	24
26							2 850	2 850	2 700	2 550	2 450	26
28							2 400	2 400	2 250	2 100	2 000	28
30								2 000	1 850	1 700	1 600	30
32								800	1 550	1 400	1 250	32
34									1 250	1 100	1 000	34
36										850	750	36
38											500	38
40											350	40

* Special Conditions Or Wire Rope Required

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

3 856kg Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	14 600							3
3.5	13 500							3.5
4	12 450	13 100						4
4.5	11 500	12 150	10 100					4.5
5	10 600	11 300	10 100					5
6	8 000	9 100	9 650	8 000				6
7	6 100	7 100	7 650	7 900				7
8	4 700	5 700	6 200	6 450	6 150			8
9	3 600	4 600	5 100	5 350	5 550	4 850	4 000	9
10		3 750	4 250	4 500	4 650	4 750	4 000	10
12		2 500	3 000	3 200	3 350	3 450	3 450	12
14			2 100	2 350	2 500	2 550	2 550	14
16			1 450	1 700	1 800	1 900	1 900	16
18				1 150	1 300	1 400	1 350	18
20					900	1 000	950	20
22					600	650	650	22
24						400	400	24

3 856kg Counterweight – On Tires – Pick & Carry (1.6 km/h) – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	10 050							3
3.5	9 250							3.5
4	8 400	9 050						4
4.5	7 650	8 350	8 550					4.5
5	6 950	7 650	8 050					5
6	5 750	6 550	6 900	7 000				6
7	4 750	5 600	6 000	6 200				7
8	3 900	4 800	5 200	5 450	5 550			8
9	3 150	4 100	4 550	4 750	4 900	4 850	4 000	9
10		3 450	3 950	4 200	4 300	4 400	4 000	10
12		2 450	2 950	3 200	3 350	3 450	3 400	12
14			2 100	2 350	2 500	2 550	2 550	14
16			1 450	1 700	1 800	1 900	1 900	16
18				1 150	1 300	1 400	1 350	18
20					900	1 000	950	20
22					600	650	650	22
24						400	400	24

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

5 216kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)											Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.67	
3	71 100*	69 550*	53 450	40 850								3
3.5	62 600*	63 450*	50 350	39 100								3.5
4	54 600	55 550	48 900	37 450	37 400							4
4.5	48 250	49 200	48 350	35 950	35 750	26 150						4.5
5	43 100	44 100	44 250	34 600	35 250	26 150						5
6	35 250	36 250	36 450	32 150	34 700	25 450	22 250	19 250				6
7	28 250	29 450	29 700	30 000	29 400	25 200	21 150	19 250				7
8	21 800	23 300	23 750	23 850	23 700	23 450	20 650	18 800	14 950	13 400		8
9	17 450	18 900	19 350	19 450	19 300	19 100	19 050	17 550	14 200	13 300	11 050	9
10		15 800	16 200	16 500	16 150	16 550	15 950	16 300	14 050	13 200	10 950	10
12		11 500	12 000	12 200	12 600	12 250	12 450	12 350	12 350	11 800	10 850	12
14			9 400	9 700	9 850	9 900	9 850	9 800	9 650	9 500	9 350	14
16			7 450	7 750	7 900	8 000	7 950	7 900	7 750	7 600	7 450	16
18				6 300	6 450	6 500	6 450	6 400	6 250	6 100	5 950	18
20					5 350	5 400	5 400	5 350	5 200	5 050	4 900	20
22					4 450	4 550	4 500	4 450	4 350	4 150	4 050	22
24						3 850	3 800	3 750	3 600	3 450	3 350	24
26							3 200	3 150	3 050	2 900	2 750	26
28							2 700	2 700	2 550	2 400	2 300	28
30								2 250	2 150	2 000	1 900	30
32								1 050	1 800	1 650	1 550	32
34									1 500	1 350	1 250	34
36										1 100	950	36
38											750	38
40											550	40

* Special Conditions Or Wire Rope Required

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

5 216kg Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	14 300							3
3.5	13 300							3.5
4	12 200	12 850						4
4.5	11 300	11 950	9 900					4.5
5	10 400	11 150	9 900					5
6	8 750	9 700	9 900	8 400				6
7	6 700	7 750	8 250	8 400				7
8	5 200	6 200	6 750	7 000	6 700			8
9	4 050	5 100	5 600	5 800	5 950	5 350	4 250	9
10		4 200	4 650	4 900	5 050	5 150	4 250	10
12		2 850	3 350	3 550	3 700	3 800	3 800	12
14			2 400	2 650	2 750	2 850	2 850	14
16			1 700	1 950	2 100	2 150	2 150	16
18				1 400	1 550	1 600	1 600	18
20					1 100	1 200	1 150	20
22					800	850	850	22
24						550	550	24

5 216kg Counterweight – On Tires – Pick & Carry (1.6 km/h) – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	9 750							3
3.5	9 000							3.5
4	8 200	8 800						4
4.5	7 450	8 100	9 300					4.5
5	6 750	7 500	7 850					5
6	5 600	6 350	6 750	6 800				6
7	4 600	5 450	5 850	6 000				7
8	3 750	4 650	5 050	5 300	5 400			8
9	3 000	3 950	4 400	4 600	4 750	4 750	3 900	9
10		3 350	3 800	4 050	4 200	4 250	3 900	10
12		2 350	2 850	3 100	3 250	3 350	3 300	12
14			2 100	2 350	2 500	2 600	2 550	14
16			1 450	1 750	1 900	2 000	1 950	16
18				1 250	1 400	1 500	1 450	18
20					950	1 050	1 050	20
22					600	700	700	22
24						400	350	24

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

14 742kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)											Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.67	
2.4	81 600*											2.4
3	72 400*	69 550*	53 450	40 850								3
3.5	66 550*	64 300*	50 350	39 100								3.5
4	61 000*	59 950*	48 900	37 450	37 400							4
4.5	55 050	55 950	48 350	35 950	35 750	26 150						4.5
5	49 250	50 200	47 000	34 600	35 250	26 150						5
6	40 450	41 400	41 600	32 150	34 700	25 450	22 250	19 250				6
7	34 000	35 050	35 250	30 000	34 700	25 200	21 150	19 250				7
8	29 150	30 200	30 400	28 150	30 200	24 950	20 650	18 800	14 950	13 400		8
9	25 150	26 300	26 500	26 550	27 000	24 700	20 500	17 550	14 200	13 300	11 050	9
10		22 100	22 800	22 900	22 750	22 550	19 750	16 450	14 050	13 200	10 950	10
12		16 650	17 100	17 200	17 050	16 900	16 700	15 200	13 850	13 050	10 850	12
14			13 400	13 500	13 400	13 450	13 200	13 000	13 350	12 750	10 750	14
16			10 850	11 150	11 250	11 200	11 000	11 050	10 900	11 050	10 700	16
18				9 250	9 350	9 350	9 300	9 350	9 450	9 300	9 150	18
20					8 150	7 900	8 200	8 150	8 000	7 850	7 700	20
22					7 000	7 000	7 050	7 000	6 850	6 700	6 600	22
24						6 150	6 100	6 100	5 950	5 800	5 750	24
26							5 350	5 350	5 250	5 100	4 950	26
28							4 700	4 700	4 600	4 450	4 350	28
30								4 150	4 050	3 900	3 800	30
32								2 800	3 550	3 400	3 300	32
34									3 150	3 000	2 900	34
36										2 650	2 550	36
38											2 200	38
40											1 950	40

* Special Conditions Or Wire Rope Required

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

14 742kg Counterweight – On Tires – Stationary – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	12 800							3
3.5	11 800							3.5
4	10 850	11 550						4
4.5	10 000	10 750	11 000					4.5
5	9 350	10 000	10 400					5
6	7 700	8 200	8 950	9 200				6
7	6 550	7 300	7 700	7 750				7
8	5 550	6 400	6 800	7 000	7 100			8
9	4 700	5 600	6 050	6 250	6 350	6 300	6 250	9
10		4 900	5 350	5 600	5 750	5 750	5 750	10
12		3 750	4 250	4 450	4 600	4 700	4 650	12
14			3 300	3 550	3 750	3 800	3 800	14
16			2 600	2 850	3 000	3 100	3 050	16
18				2 250	2 400	2 500	2 450	18
20					1 900	2 000	2 000	20
22					1 500	1 550	1 550	22
24						1 200	1 200	24
26							850	26
28							600	28

14 742kg Counterweight – On Tires – Pick & Carry (1.6 km/h) – Boom Centered Over Rear
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)							Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	
3	8 250							3
3.5	7 500							3.5
4	6 750	7 450						4
4.5	6 050	6 800	7 050					4.5
5	5 450	6 200	6 600					5
6	4 400	5 200	5 600	5 750				6
7	3 500	4 350	4 800	5 000				7
8	2 750	3 650	4 100	4 300	4 450			8
9	2 100	3 000	3 450	3 700	3 850	3 850	3 850	9
10		2 450	2 950	3 200	3 350	3 400	3 400	10
12		1 550	2 100	2 350	2 500	2 550	2 550	12
14			1 400	1 650	1 850	1 900	1 900	14
16			850	1 100	1 250	1 350	1 300	16
18				650	800	900	900	18
20					450	550	500	20

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

17 917kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

Radius (m)	Boom Length (m)											Radius (m)
	11.58	15.2	18.3	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.67	
2.4	81 600*											2.4
3	72 650*	69 550*	53 450	40 850								3
3.5	66 800*	64 300*	50 350	39 100								3.5
4	61 600*	59 950*	48 900	37 450	37 400							4
4.5	56 750	56 100	48 350	35 950	35 750	26 150						4.5
5	51 250	52 250	47 000	34 600	35 250	26 150						5
6	42 100	43 100	43 300	32 150	34 700	25 450	22 250	19 250				6
7	35 450	36 500	36 700	30 000	34 700	25 200	21 150	19 250				7
8	30 450	31 450	31 700	28 150	31 500	24 950	20 650	18 800	14 950	13 400		8
9	26 450	27 550	27 750	26 550	28 000	24 700	20 500	17 550	14 200	13 300	11 050	9
10		24 250	24 450	25 000	24 900	24 650	19 750	16 450	14 050	13 200	10 950	10
12		18 300	18 750	18 850	18 750	18 550	17 550	15 200	13 850	13 050	10 850	12
14			14 800	14 900	14 800	14 600	14 450	13 550	13 400	12 750	10 750	14
16			12 000	12 150	12 050	12 200	11 850	11 650	12 000	11 700	10 700	16
18				10 250	10 300	10 350	9 900	10 150	10 050	10 050	10 100	18
20					8 800	8 800	8 800	8 600	8 700	8 750	8 650	20
22					7 700	7 550	7 700	7 800	7 700	7 550	7 400	22
24						6 550	6 850	6 800	6 700	6 550	6 400	24
26							6 000	6 000	5 850	5 750	5 650	26
28							5 350	5 300	5 200	5 050	4 950	28
30								4 700	4 600	4 450	4 350	30
32								3 350	4 100	3 950	3 850	32
34									3 650	3 500	3 400	34
36										3 100	3 000	36
38											2 650	38
40											2 350	40

* Special Conditions Or Wire Rope Required

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

Fly Attachment Lift Capacity Charts – Optional (Metric)

3 856kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

42.67m Main Boom Length 2° Fly Offset			42.67m Main Boom Length 15° Fly Offset		
Radius (ft)	Fly Length (m)		Radius (ft)	Fly Length (m)	
	10.67	17.68		10.67	17.68
12	5 500		12		
14	5 500	3 850	14	5 200	
16	5 500	3 750	16	5 100	
18	5 500	3 700	18	5 000	3 300
20	4 750	3 600	20	4 900	3 150
22	3 900	3 500	22	4 200	3 050
24	3 250	3 400	24	3 500	2 950
26	2 650	2 900	26	2 900	2 850
28	2 200	2 400	28	2 400	2 750
30	1 800	2 000	30	2 000	2 300
32	1 500	1 650	32	1 650	1 950
34	1 200	1 350	34	1 350	1 600
36	950	1 100	36	1 050	1 350
38	700	900	38	850	1 100
40	500	700	40	600	850
42		500	42	400	650
44			44		500

42.67m Main Boom Length 30° Fly Offset			42.67m Main Boom Length 45° Fly Offset		
Radius (ft)	Fly Length (m)		Radius (ft)	Fly Length (m)	
	10.67	17.68		10.67	17.68
18	4 450		18		
20	4 350		20	3 950	
22	4 300		22	3 950	
24	3 750	2 550	24	3 900	
26	3 150	2 500	26	3 350	2 250
28	2 650	2 400	28	2 800	2 200
30	2 200	2 350	30	2 300	2 150
32	1 800	2 250	32	1 900	2 150
34	1 500	1 850	34	1 550	2 050
36	1 200	1 550	36	1 250	1 750
38	950	1 300	38	1 000	1 450
40	700	1 050	40	750	1 150
42	500	800	42		900
44		600	44		700
46		450	46		500

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

5 216kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

42.67m Main Boom Length 2° Fly Offset				42.67m Main Boom Length 15° Fly Offset			
Radius (ft)	Fly Length (m)			Radius (ft)	Fly Length (m)		
	10.67	17.68	22.56		10.67	17.68	22.56
12	5 500			12			
14	5 500	3 850		14	5 200		
16	5 500	3 750	3 000	16	5 100		
18	5 500	3 700	3 000	18	5 000	3 300	
20	5 200	3 600	3 000	20	4 900	3 150	2 850
22	4 300	3 500	3 000	22	4 600	3 050	2 650
24	3 600	3 400	2 950	24	3 850	2 950	2 450
26	3 000	3 200	2 700	26	3 250	2 850	2 300
28	2 500	2 700	2 550	28	2 750	2 750	2 150
30	2 100	2 300	2 250	30	2 300	2 600	2 050
32	1 750	1 950	1 900	32	1 900	2 200	1 900
34	1 450	1 600	1 600	34	1 600	1 850	1 800
36	1 150	1 350	1 300	36	1 300	1 550	1 500
38	950	1 100	1 050	38	1 050	1 300	1 250
40	700	900	850	40	800	1 050	1 000
42	550	700	650	42	600	850	800
44	350	500	450	44	450	650	600
46				46		500	450

42.67m Main Boom Length 30° Fly Offset				42.67m Main Boom Length 45° Fly Offset			
Radius (ft)	Fly Length (m)			Radius (ft)	Fly Length (m)		
	10.67	17.68	22.56		10.67	17.68	22.56
18	4 450			18			
20	4 350			20	3 950		
22	4 300			22	3 950		
24	4 150	2 550	2 050	24	3 900		
26	3 500	2 500	1 900	26	3 650	2 250	1 650
28	2 950	2 400	1 800	28	3 100	2 200	1 550
30	2 450	2 350	1 700	30	2 600	2 150	1 500
32	2 050	2 300	1 600	32	2 200	2 150	1 450
34	1 750	2 100	1 550	34	1 800	2 100	1 400
36	1 400	1 800	1 500	36	1 500	1 950	1 350
38	1 150	1 500	1 400	38	1 200	1 650	1 300
40	900	1 250	1 200	40	950	1 350	1 250
42	700	1 000	1 000	42		1 100	1 100
44	500	800	800	44		900	900
46		600	600	46		650	700
48		450	400	48		450	500

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

14 742kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

Radius (ft)	42.67m Main Boom Length 2° Fly Offset – Fly Length (m)				Radius (ft)	42.67m Main Boom Length 15° Fly Offset – Fly Length (m)			
	10.67	17.68	22.56	27.43		10.67	17.68	22.56	27.43
12	5 500				12				
14	5 500	3 850			14	5 200			
16	5 500	3 750	3 000		16	5 100			
18	5 500	3 700	3 000	2 350	18	5 000	3 300		
20	5 400	3 600	3 000	2 350	20	4 900	3 150	2 850	
22	5 300	3 500	3 000	2 350	22	4 750	3 050	2 650	2 100
24	5 150	3 400	2 950	2 200	24	4 650	2 950	2 450	1 950
26	5 000	3 300	2 700	2 050	26	4 550	2 850	2 300	1 800
28	4 550	3 200	2 550	1 850	28	4 350	2 750	2 150	1 650
30	4 000	3 100	2 350	1 750	30	4 150	2 700	2 050	1 550
32	3 500	2 950	2 200	1 600	32	3 650	2 600	1 900	1 400
34	3 100	2 800	2 100	1 500	34	3 250	2 550	1 800	1 300
36	2 750	2 650	1 950	1 400	36	2 850	2 400	1 700	1 250
38	2 400	2 550	1 850	1 300	38	2 500	2 300	1 650	1 150
40	2 100	2 300	1 750	1 200	40	2 200	2 200	1 550	1 050
42	1 850	2 000	1 650	1 100	42	1 950	2 100	1 500	1 000
44	1 650	1 800	1 600	1 050	44	1 700	1 950	1 400	950
46	1 450	1 550	1 500	1 000	46	1 500	1 700	1 350	900
48	1 250	1 400	1 300	900	48	1 300	1 500	1 300	850
50	1 100	1 200	1 150	850	50	1 100	1 300	1 250	800
52		1 050	1 000	800	52		1 100	1 050	750
54		900	850	800	54		950	900	700
56		750	700	700	56		800	750	700
58			550	500	58			600	600
60			400		60			450	450

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

14 742kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

42.67m Main Boom Length 30° Fly Offset					42.67m Main Boom Length 45° Fly Offset				
Radius (ft)	Fly Length (m)				Radius (ft)	Fly Length (m)			
	10.67	17.68	22.56	27.43		10.67	17.68	22.56	27.43
18	4 450				18				
20	4 350				20	3 950			
22	4 300				22	3 950			
24	4 200	2 550	2 050	1 650	24	3 900			
26	4 150	2 500	1 900	1 550	26	3 900	2 250	1 650	
28	4 050	2 400	1 800	1 400	28	3 850	2 200	1 550	1 250
30	3 900	2 350	1 700	1 300	30	3 750	2 150	1 500	1 200
32	3 700	2 300	1 600	1 250	32	3 600	2 150	1 450	1 100
34	3 350	2 250	1 550	1 150	34	3 450	2 100	1 400	1 050
36	2 950	2 200	1 500	1 050	36	3 050	2 100	1 350	950
38	2 600	2 150	1 400	1 000	38	2 650	2 050	1 300	900
40	2 300	2 050	1 350	950	40	2 350	1 950	1 250	850
42	2 000	1 950	1 300	900	42	2 050	1 900	1 200	800
44	1 750	1 900	1 250	850	44		1 850	1 150	750
46	1 500	1 800	1 200	800	46		1 800	1 150	750
48		1 600	1 200	750	48		1 600	1 150	700
50		1 400	1 150	700	50			1 100	650
52		1 200	1 150	650	52			1 100	650
54		1 000	1 000	650	54				600
56			800	600	56				600
58			650	600	58				600
60				550	60				
62				350	62				

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

17 917kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

42.67m Main Boom Length 2° Fly Offset					42.67m Main Boom Length 15° Fly Offset				
Radius (ft)	Fly Length (m)				Radius (ft)	Fly Length (m)			
	10.67	17.68	22.56	27.43		10.67	17.68	22.56	27.43
12	5 500				12				
14	5 500	3 850			14	5 200			
16	5 500	3 750	3 000		16	5 100			
18	5 500	3 700	3 000	2 350	18	5 000	3 300		
20	5 400	3 600	3 000	2 350	20	4 900	3 150	2 850	
22	5 300	3 500	3 000	2 350	22	4 750	3 050	2 650	2 100
24	5 150	3 400	2 950	2 200	24	4 650	2 950	2 450	1 950
26	5 000	3 300	2 700	2 050	26	4 550	2 850	2 300	1 800
28	4 700	3 200	2 550	1 850	28	4 350	2 750	2 150	1 650
30	4 450	3 100	2 350	1 750	30	4 150	2 700	2 050	1 550
32	4 050	2 950	2 200	1 600	32	3 950	2 600	1 900	1 400
34	3 600	2 800	2 100	1 500	34	3 750	2 550	1 800	1 300
36	3 200	2 650	1 950	1 400	36	3 300	2 400	1 700	1 250
38	2 850	2 550	1 850	1 300	38	2 950	2 300	1 650	1 150
40	2 550	2 400	1 750	1 200	40	2 650	2 200	1 550	1 050
42	2 250	2 300	1 650	1 100	42	2 350	2 100	1 500	1 000
44	2 000	2 150	1 600	1 050	44	2 100	2 000	1 400	950
46	1 800	1 950	1 500	1 000	46	1 850	1 950	1 350	900
48	1 600	1 700	1 450	900	48	1 650	1 850	1 300	850
50	1 400	1 550	1 400	850	50	1 450	1 650	1 250	800
52		1 350	1 300	800	52		1 450	1 250	750
54		1 200	1 150	800	54		1 250	1 200	700
56		1 050	1 000	750	56		1 100	1 050	700
58			850	700	58			900	650
60			700	700	60			750	650
62			550	550	62			600	600
64				400	64				450

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

17 917kg Counterweight – Fully Extended Outriggers – 360° Rotation
(All Capacities Are Listed In Kilograms)

42.67m Main Boom Length 30° Fly Offset					42.67m Main Boom Length 45° Fly Offset				
Radius (ft)	Fly Length (m)				Radius (ft)	Fly Length (m)			
	10.67	17.68	22.56	27.43		10.67	17.68	22.56	27.43
18	4 450				18				
20	4 350				20	3 950			
22	4 300				22	3 950			
24	4 200	2 550	2 050	1 650	24	3 900			
26	4 150	2 500	1 900	1 550	26	3 900	2 250	1 650	
28	4 050	2 400	1 800	1 400	28	3 850	2 200	1 550	1 250
30	3 900	2 350	1 700	1 300	30	3 750	2 150	1 500	1 200
32	3 700	2 300	1 600	1 250	32	3 600	2 150	1 450	1 100
34	3 550	2 250	1 550	1 150	34	3 500	2 100	1 400	1 050
36	3 450	2 200	1 500	1 050	36	3 400	2 100	1 350	950
38	3 050	2 150	1 400	1 000	38	3 100	2 050	1 300	900
40	2 700	2 050	1 350	950	40	2 750	1 950	1 250	850
42	2 400	1 950	1 300	900	42	2 450	1 900	1 200	800
44	2 150	1 900	1 250	850	44		1 850	1 150	750
46	1 900	1 850	1 200	800	46		1 800	1 150	750
48		1 800	1 200	750	48		1 800	1 150	700
50		1 700	1 150	700	50		1 700	1 100	650
52		1 500	1 150	650	52			1 100	650
54		1 300	1 100	650	54				600
56			1 100	600	56				600
58			950	600	58				600
60				600	60				
62				600	62				
64				450	64				

This information is not for crane operation. Operator must refer to the in–cab information for crane operation. Rated lifting capacities shown on fully extended outriggers do not exceed 75% of the tipping loads and on tires do not exceed 65% of the tipping loads.

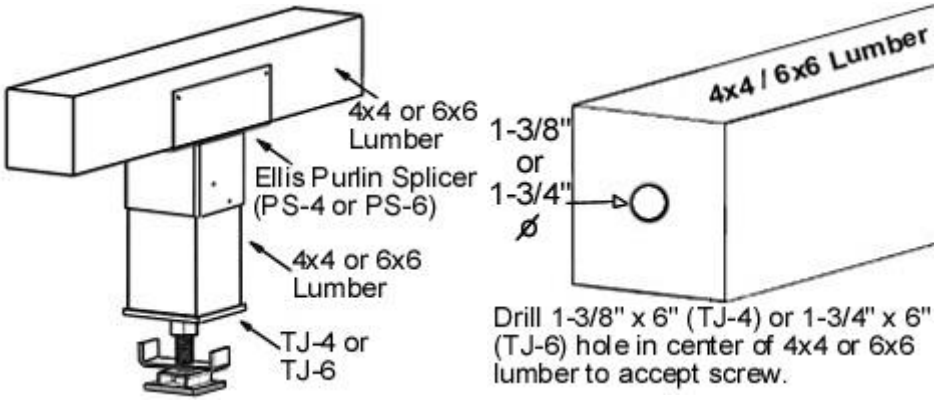
Link-Belt Construction Equipment Company Lexington, Kentucky www.linkbelt.com

Timber Jack 4x4 (TJ-4) pictured right

Load Capacity:	15,000 Lbs / 7.5 Tons
Overall Height:	9-1/8"
Base Plate	5"
Top Plate:	5-1/2"
Acme Screw Size:	1-1/4"
Range of Adustment:	5"
Lifting Capacity:	4000 Lbs. / 2 Tons

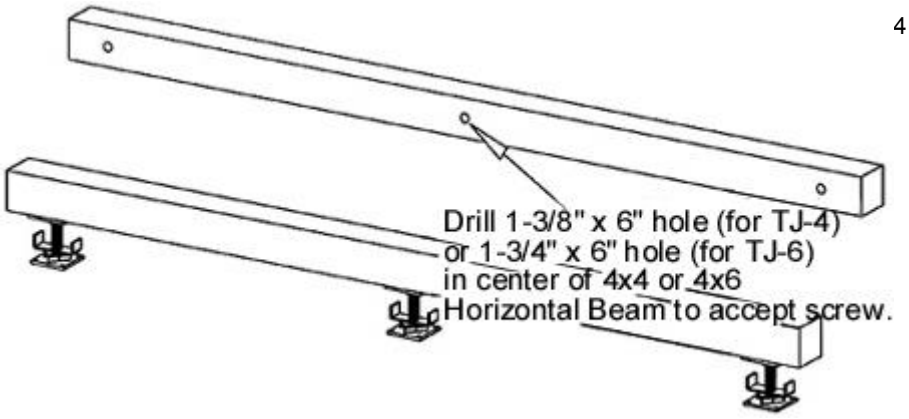
TIMBER JACK 6X6 (TJ-6)

Load Capacity:	30,000 Lbs / 15 Tons
Overall Height:	10"
Base Plate	5"
Top Plate:	5-1/2"
Acme Screw Size:	1-1/2"
Range of Adustment:	5"
Lifting Capacity:	4000 Lbs. / 2 Tons



FOR TIGHT SPACES:

Elimina 4 or 4x6 (as pictured



below).

To Assemble:

- Drill **1-3/8" x 6" (for TJ-4)** or **1-3/4" x 6" (for TJ-6)** hole using auger or self feed drill bit into center of lumber to accept 1-1/4" or 1-1/2" Acme threaded screw.
- Position Timber Jack so the Acme screw will slide into the predrilled hole in lumber.
- Adjust the top plate so all 4 mounting holes line up within the boundaries of the lumber.
- Drill 4 - 5/32"x1" holes through the mounting holes in the top plate and into the lumber.
- Insert 4 - 1/4"x1-1/2" lag screws through the mounting holes in the top plate into the predrilled holes in the lumber and tighten.
- Attach Ellis Purlin Splicer to Beam or Joist where support is desired.
- Slip 4x4 or 6x6 lumber attached to the Timber Jack into the square tubing of the purlin splicer and secure with nails through the holes provided.
- Adjustment to Timber Jack can be made by turning "U" shaped handle at bottom of screw. Acme threads are greased for easy adjustment.
- Attach base plate to a **solid foundation** through the 4 holes provided.

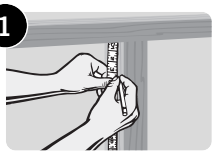
Caution. The acme screw of the Timber Jack will completely separate from the acme nut if screwed out too far. Do not extend the acme screw past the maximum adjustment of 5". This will insure that the threads of the acme nut will be used to support a heavy load.

CABLE·RAIL® by feeney Step-by-Step Installation for Wood Frames

TOOL CHECKLIST

- ☐ Safety Glasses
- ☐ Work Gloves
- ☐ Pencil
- ☐ Measuring Tape
- ☐ Electric Drill
- ☐ Drill Bits
- ☐ Hammer
- ☐ Cable Cutters or Cut-Off disk
- ☐ Vise-Grip Pliers
- ☐ 7/16" Wrench
- ☐ Electric Grinder
- ☐ Hacksaw or Electric Reciprocating Saw
- ☐ Cable Lacing Needle

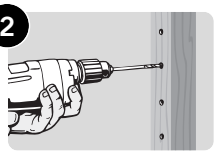
1



Mark drill hole locations on posts.

To minimize cable deflection, space cables no more than 3 inches apart and have a post or vertical spacer at least every 3 feet. Also, straight runs of cable (no turns/dips) should not exceed 70 feet. Runs with corners (2 bends at most) should not exceed 40 feet. See Frame Requirements on back page.

2

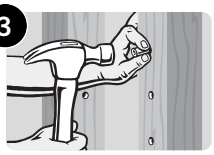


Drill holes in posts. Hole diameter depends on cable size and type of fitting. See chart below.

Cable Size	Threaded Term. Post	Intermediate Posts	Quick-Connect Post
1/8"	5/16"	1/4"	3/8"
3/16"	3/8"	1/4"	9/16"
1/4"	7/16"	5/16"	9/16"

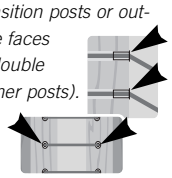
If desired, Quick-Connect®SS posts may be through drilled at 5/16" and then counter-bored with the recommended Quick-Connect®SS drill to countersink the fitting.

3



(Wood posts only) Insert Protector Sleeves at necessary locations. Tap in until flush.

Protector Sleeves prevent abrasion at angled transitions on wood posts (e.g. stair transition posts or outside faces of double corner posts).



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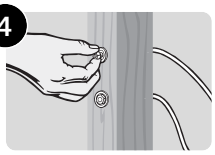
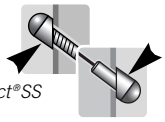


Insert the Threaded Terminal through the Terminal end post and attach a flat washer and Snug-Grip® Washer-Nut. Spin the nut 2 full turns. Strong resistance will be felt as the Snug-Grip® threads engage; so hold the Terminal shaft with pliers.

Use Beveled Washers for stair termination posts with angled holes. Available for Threaded Terminal and Quick-Connect®SS fittings.



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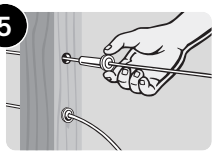


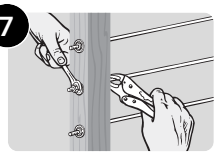
Lace the free end of the cable through the intermediate posts and Quick-Connect®SS end post. Slide-on a flat washer and Quick-Connect®SS fitting until they rest against the face of the post.

Use a Lacing Needle if snagging becomes a problem.

6

Hold the Quick-Connect®SS fitting with one hand and pull the cable tight with the other. The fitting automatically locks when you release the cable.

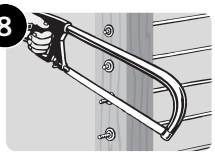
7



Tighten Snug-Grip® Washer-Nuts until you can't flex the cables more than 4 inches apart using your thumb and fingers on one hand. See diagram to the left for tensioning sequence.

Important Note: If using electric or pneumatic tools to tighten the Washer Nuts, spin the nuts very slowly otherwise they will heat-up causing the threads to seize.

8

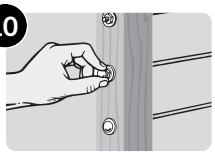


Saw off the excess threads as close to the Snug-Grip® Washer-Nut as possible. Touch-up with electric grinder. The special Snug-Grip® threads prevent the nut from loosening.

9

Use cable cutters or cut-off disk to trim the excess cable. Grind flush the exposed cable ends with an electric grinder.

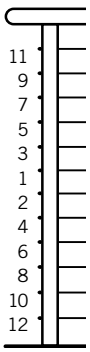
10



Snap on end caps over the exposed Quick-Connect®SS fittings and the Snug-Grip® Washer-Nuts. You're done.

Enviro-Magic® Cleaner can be applied for lasting protection of stainless steel cable and parts.

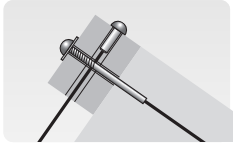
Recommended cable tensioning sequence



Cables can either terminate or run through corner posts

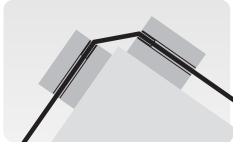
Terminating

SINGLE WOOD POST*



Continuous

DOUBLE WOOD POSTS



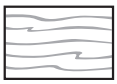
*Offset drill holes at least 1/2" if you choose to have cables terminating at a single wood post.

File 2012-520

CABLE·RAIL by feeney

Wood Frame Requirements

Railing frames need to be designed and built strong enough to support the tension of properly installed cables, which is a load in excess of 300 lbs for each cable. Here are some basic guidelines to help you properly prepare your railing frames. These guidelines apply whether you are using 1/8", 3/16" or 1/4" cable (1/4" cable not recommended for wood frames).



4X6 WOOD
3-1/2" wide, 5-1/2" thick

Minimum sizes for all corner and end posts

All other posts should be sized as required for cap rail support strength or for code

The Basic Frame Design

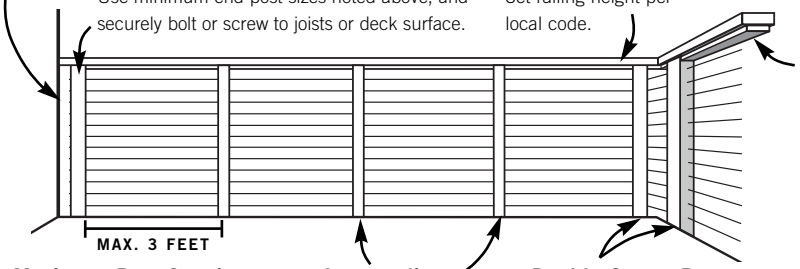
Spacing From Walls:
Set end posts 3 to 4 inches away from the house/wall face to allow access for attaching cable end fittings.

End Posts:
Use minimum end post sizes noted above, and securely bolt or screw to joists or deck surface.

Cap Rail:
Always include a strong, rigid cap rail that is securely fastened to all posts. Cap size is based on load strength needs and local code requirements. Set railing height per local code.

Cable Spacing:
Maximum 3 inches apart.

Wood Blocking (WOOD FRAMES ONLY):
Underneath the cap rail attach minimum 1"x 4" wood blocking between posts to provide additional lateral reinforcement to the posts so that they won't pull out of plumb when the cables are tensioned.



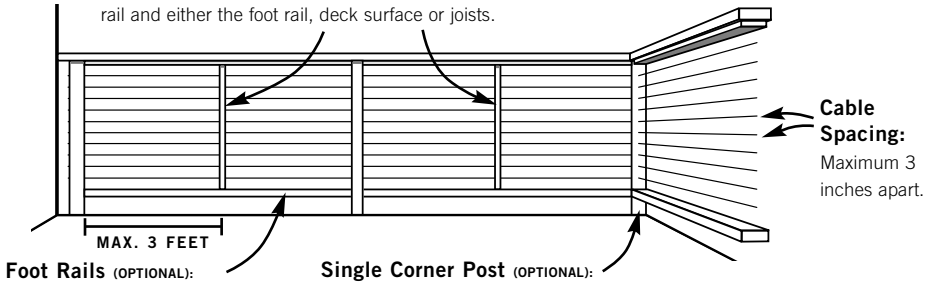
Maximum Post Spacing:
Space all posts and vertical spacers *(see below)* a maximum of 3 feet apart to minimize any deflection that may occur if the cables are ever forced apart.

Intermediate Posts:
Size all intermediate posts as required for cap rail support strength or for code.

Double Corner Posts:
If possible use double corner posts to allow the cable to run continuously through the corners without terminating *(see single corner post option below)*. Securely bolt or screw posts to joists or deck surface and use minimum corner post sizes noted above.

And Some Other Options

Vertical Spacers (OPTIONAL):
Slender spacers may be used instead of some of the larger intermediate posts to achieve a more open railing design. These are non-structural members and are only intended to maintain cable spacing and minimize deflection. Examples are 2" x 2" wood strips, 1" metal tubing or 1/4" flat bar. Attach spacers to the cap rail and either the foot rail, deck surface or joists.



Cable Spacing:
Maximum 3 inches apart.

Foot Rails (OPTIONAL):
Foot rails should be spaced no more than 4 inches above the deck surface, or as required by local code, and should be sized as needed for support strength and design appearance.

Single Corner Post (OPTIONAL):
When terminating on a single corner post, be sure to offset the drill holes at least 1/2" to allow internal clearance for the cable fittings. Use minimum end post sizes noted above and securely bolt or screw to joists or deck surface.

CONSTRUCTION CHECKLIST

- ☐ Space cables no more than 3 inches apart
- ☐ Space posts/verticals no more than 3 feet apart
- ☐ Observe minimum end/corner post sizes shown above
- ☐ Securely fasten all posts and cap rails
- ☐ Carefully plan all termination and corner posts for proper clearance, positioning, and maximum cable run lengths
- ☐ Straight runs of cable (no turns/dips) should not exceed 70 feet; runs with corner bends (2 bends at most) should not exceed 40 feet

IMPORTANT NOTE

For railings we recommend spacing the cables no more than 3 inches apart and placing posts or vertical members no more than 3 feet apart.

Please note that since building codes vary by state, county and city, our recommendations may not comply with code requirements in all areas.

Always consult with your local building department before starting your project.

EVALUATION REPORT

Report Number: 130
Originally Issued: 12/2008
Revised: 01/09/2013
Valid Through: 12/2013

DIVISION: 06—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:
SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE NAIL HOLD-DOWNS (TENSION TIES)

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes

- 2012 International Building Code® (IBC)
- 2012 International Residential Code® (IRC)
- 2009 International Building Code® (IBC)
- 2009 International Residential Code® (IRC)
- 2006 International Building Code® (IBC)
- 2006 International Residential Code® (IRC)

1.2 Evaluated in accordance with

- ICC-ES AC155, Acceptance Criteria for Hold-Downs (Tie-Downs) Attached To Wood Members, Approved June 2010

Property evaluated

- Structural

2.0 USES

Simpson Strong-Tie structural nail hold-down connectors (tension ties) are used as wood framing anchorage, such as to connect wood posts to concrete foundations or to connect an upper–story wood post to a lower-story supporting wood post, in accordance with 2012 (2009) IBC Sections 2304.9.3, 2305.1, 2308.9.3.1, 2308.9.3.2 or 2006 IBC Sections 2304.9.3, 2305.1, 2305.3.2, 2305.3.7, 2305.3.8.2.4 and 2308.9.3.1 and AF&PA SDPWS-2008 (2005) Special Design Provisions for Wind and Seismic Sections 4.3.6.4.2 and 4.3.6.1.2, and as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls as required by 2012 (2009) (2006) IBC Section 1604.8.

When regulated under the IRC, the hold-down connectors may also be used when an engineered design is submitted in accordance with 2012 (2009) (2006) IRC Section R301.1.3 or in alternate braced wall panels per 2012 IRC Sections R602.10.2.2.1, R602.10.6.1, R602.10.6.2 and R602.10.7, 2009 IRC Sections R502.2.2.3, R602.10.1.4.1(2), R602.10.3.2, R602.10.3.3, R602.10.4.4 and R602.10.5.3 or 2006 IRC Sections R602.10.6.1 and R602.10.6.2.

Hold-down connectors may be used as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls in accordance with 2012 (2009) IRC Sections R606.12.2.3 and R611.9.1 or 2006 IRC Sections R606.12.2.2 and R611.8.2.1.

3.0 DESCRIPTION

3.1 Product Information

3.1.1 LTT Nail Hold-downs: LTT Light Tension Ties are nail hold-downs consisting of a steel strap component with 90 degree angle bend at the end and a base plate component installed in the bend, which eliminates the need for a washer to transfer load. These hold-downs have pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. Bodies of the LTT19, LTT20B and LTTI31 are formed from No.16, No.12 and No.18 gage galvanized steel respectively. Base plate component for LTT's is No. 3 gage galvanized steel. See Figure 1 and Table 1 for product dimensions, required fasteners and allowable loads.

3.1.2 HTT Nail Hold-downs: HTT Heavy Tension Ties are single-piece formed nail hold-downs consisting of a steel strap with a four-ply formed seat element for an anchor bolt. The straight-strap portion has pre-punched holes for installation of fasteners used to connect the hold-down to the wood member. HTT is die-formed from No. 11 gage galvanized steel. Bearing plate BP5/8-2 is fabricated from 3/16 inch thickness steel and may be installed with HTT5 as a load transfer washer for additional capacity. See Figure 2 and Table 1 for product dimensions, required fasteners and allowable loads.

3.2 Materials

3.2.1 Steel: LTT and HTT nail hold-downs described in this report are manufactured from ASTM A 653 SS Grade 33 galvanized steel with a minimum yield strength (Fy) of 33,000 psi (227 MPa) and a minimum ultimate tensile strength (Fu) of 45,000 psi (310 MPa). Load transfer base plates of the LTT series and bearing plate BP5/8-2 are fabricated from ASTM A 1011 SS Grade 33 steel having a minimum yield strength of 33,000 psi (227 MPa) and a minimum ultimate strength of 52,000 psi (359 MPa). Base metal thicknesses for the tension ties in this report are as follows:

GAGE	BASE METAL THICKNESS (inches)
3/16 inch	0.1775
No. 3	0.2285
No. 11	0.1105
No. 12	0.0975
No. 16	0.0555
No. 18	0.0445

For SI: 1 inch = 25.4 mm

Hold-downs have a minimum G90 zinc coating specification per ASTM A 653. Some models may also be available with either a G185 zinc coating (denoted by model numbers ending in the letter Z) or with a batch hot-dipped galvanized coating with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2) total for both sides in accordance with ASTM A 123 (denoted by model numbers ending with the letters HDG). Model numbers in this report do not list the Z or HDG ending but the information shown applies.

Lumber treater or holder of this report (Simpson Strong-Tie) should be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members connected to hold-downs must be either sawn lumber or engineered lumber. Sawn lumber must have a minimum specific gravity of 0.50 and a maximum moisture content of 19 percent. Engineered lumber must have a minimum equivalent specific gravity of 0.50 and a maximum moisture content of 16 percent. Minimum thickness (depth) of the wood members in the direction of the fastener penetration is 3 inches and the required minimum width of the wood members is 3 ½ inches.

3.2.3 Fasteners

3.2.3.1 Nails: Common nails used with connectors in this report must comply with ASTM F 1667 and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inches)	FASTENER LENGTH (inches)	*Fyb* (psi)
10d x 1½	0.148	1½	90,000
10d	0.148	3	90,000
16d × 2½	0.162	2 1/2	90,000
16d	0.162	3 ½	90,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa

3.2.3.2 Bolts: Machine bolts must comply with ASME Standard B18.2.1 and with ASTM A 307. Minimum bending yield strength (F_{yb}) of the bolt must be 45,000 psi (310 MPa).

3.2.3.3 Threaded Anchor Rods: As a minimum, threaded steel anchor rods must comply with ASTM A 36 or ASTM F 1554 Grade 36.

3.2.3.4 Preservative-treated and fire-retardant-treated wood: Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must comply with 2012 (2009) (2006) IBC Section 2304.9.5 and 2012 (2009) IRC Section R317.3 or 2006 IRC Section R319.3 as applicable. Lumber treater or report holder should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design

4.1.1 Hold-Down Assembly: Allowable loads shown in Table 1 of this report are for hold-down assemblies consisting of the following components: (1) hold-down device; (2) an anchor bolt/rod attached to the seat of the device; (3) a wood member having minimum specified dimensions and properties; (4) quantity and

size of fasteners used to attach the hold-down device to the wood member; and, in some cases as noted (5) bearing plates or washers. Allowable loads shown in the product tables of this report are based on allowable stress design (ASD) and include the load duration factor (C_D) corresponding with the applicable loads in accordance with the AF&PA NDS-2012 (2005) National Design Specification for Wood Construction.

Where design load combinations include earthquake loads or effects, story drifts of the structure must be determined in accordance with Section 12.8.6 of ASCE 7 (ASCE 7-10 for 2012 IBC) (ASCE 7-05 for 2009 and 2006 IBC) except for those structures analyzed using the Simplified Design Procedure pursuant to Section 12.14.

Deflection of a shear wall restrained from overturning by hold-downs installed in accordance with this report shall be determined in accordance with 2012 IBC Section 2305.3, 2009 IBC Section 2305.1 or 2006 IBC Section 2305.3.1.

Total deflection values, Δ_{all} and $\Delta_{s,}$ at ASD-level and strength-level forces, respectively, for hold-down assemblies shown in Tables 1 of this report, include all sources of hold-down device extension and rotation and anchor rod elongation where the length of the anchor rod is a maximum of 4 ½ inches (152 mm). Contribution of the hold-down anchor rod elongation to the total elongation (deflection) of the hold-down assembly needs to be considered when the actual diameter, length or ASTM steel specification of the anchor rod differs from that described in this report.

Symbol Δ_s as used in this report refers to the symbol d_a in 2012 (2009) (2006) IBC Section 2305.3 and the symbol Δ_a in 2008 (2005) ANSI/AF&PA SDPWS Section 4.3.2.

When hold-downs are fastened to wood having a moisture content greater than 19 percent for sawn lumber or 16 percent for engineered lumber, or where wet service is expected, allowable loads shown in Tables 1 of this report must be adjusted by the wet service factor (C_m) specified in the AF&PA NDS-2012 (2005).

Tabulated allowable loads are for hold-downs connected to wood used under continuously dry interior conditions and where sustained temperatures are 100°F (37.8°C) or less.

When hold-down are fastened to wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C), allowable loads shown in Tables 1 in this report must be adjusted by the temperature factor (C_t) specified in the AF&PA NDS-2012 (2005).

Design of wood members fastened to LTT and HTT hold-down devices must consider combined stresses due to axial tension and flexural bending induced by eccentricity in the connection. Stresses shall be evaluated at the critical net section.

4.1.2 Anchorage to Concrete or Masonry: Adequate embedment length and anchorage details, including edge and end distances, must be determined in accordance with Chapters 19 or 21 of the IBC, as applicable, for design of anchorage to concrete and masonry structural members except for those structures designed in accordance with the IRC or the conventional light-frame construction provisions of Section 2308 of the IBC.

4.2 Installation: Installation of the Simpson Strong-Tie hold-down connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection

4.3.1 IBC: A statement of special inspection shall be prepared by the registered design professional in responsible charge and submitted to the building official for approval when required by 2012 IBC Section 1704.3 or 2009 (2006) IBC Section 1705. A statement of responsibility shall be submitted by each responsible contractor to the code official for approval when required by 2012 IBC Section 1704.4, 2009 IBC Section 1709 or 2006 IBC Section 1706.

4.3.2: Periodic special inspection shall be conducted when the hold-downs are components within the main wind-force-resisting system of structures constructed in areas listed in 2012 IBC Section 1705.10, 2009 IBC Section 1706.1 or 2006 IBC Section 1705.4. Special inspection requirements do not apply to structures, or portions thereof, that qualify for an exception pursuant

to 2012 IBC Sections 1704.2, 1705.3 or 1705.10.1, 2009 IBC Sections 1704.1, 1704.4, 1706.2 or 1706.3 or 2006 IBC Sections 1704.1 or 1704.4.

4.3.3: Periodic special inspection for seismic resistance shall be conducted in accordance with 2012 IBC Section 1705.11 or 2009 (2006) Section 1707 where required. Special inspection requirements for seismic resistance do not apply to structures, or portions thereof, that qualify for an exception pursuant to 2012 IBC Sections 1704.2, 1705.11, and 1705.11.2 or 2009 (2006) IBC Sections 1704.1, 1705.3, 1707.3 or 1707.4.

4.3.4: For installations under the IRC, special inspection is not normally required. However, when an engineered design is submitted or required pursuant to 2012 (2009) (2006) IRC Section 301.1.3, periodic special inspection requirements and exemptions are as stated in Sections 4.3.1, 4.3.2 and 4.3.3 of this report as applicable.

5.0 CONDITIONS OF USE

Simpson Strong-Tie nail hold-down connectors described in this report comply with, or are suitable alternatives to, what is specified in those codes listed in Section 1.0 of this report subject to the following conditions:

5.1 Hold-downs must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. Installation instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the building official. Calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of hold-down connectors with preservative-or-fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative-or-fire-retardant-treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 Anchorage to concrete or masonry structural members must be provided in accordance with Section 4.1.2 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with ICC-ES Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members (AC155), dated July 2010, inclusive of tests and calculations. Test results are from laboratories in compliance with ISO/IEC 17025.

7.0 IDENTIFICATION

Products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number and the number of the index evaluation report (ER-102) that identifies products recognized in this report.

IAPMO UES ER-130

Richard Beck, PE, CBO, MCP
Director of Uniform Evaluation Service

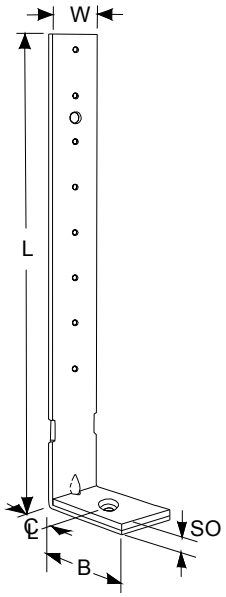
GP Russ Chaney
CEO, The IAPMO Group

TABLE 1: ALLOWABLE LOADS FOR THE LTT AND HTT NAIL HOLD-DOWNS (TENSION TIES)

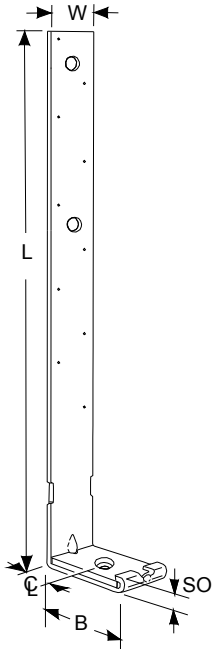
MODEL NO.	DIMENSIONS					FASTENERS		ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.6	DISPLACEMENT Δ AT MAXIMUM LOAD [6,7] (in.)	
	W	L	CL	B	SO	ANCHOR BOLT	FASTENER QUANTITY		Δ_{all}	Δ_s
LTT19	1¾	19⅛	1⅜	2¾	5/16	½, ⅝ or ¾	8-10dx1½	1310	0.180	0.248
							8-10d	1340	0.157	0.233
LTT20B	2	19¾	1½	3⅛	5/16	½, ⅝ or ¾	10-10dx1½	1355	0.195	0.250
							10-10d	1500	0.185	0.250
							2-½" Bolt[9]	1625	0.183	0.250
LTTI31	3¾	31	1⅜	2¾	¼	⅝	18-10dx1½	1350	0.193	0.250
HTT4	2½	12⅜	1⅜	2	7/16	⅝	18-10dx1½	3610	0.086	0.135
							18-16dx2½	4235	0.123	0.201
HTT5	2½	16	1⅜	2	7/16	⅝	26-10dx1½	4350	0.120	0.209
							26-10d	4670	0.116	0.234
							26-16dx2½	5090[10]	0.135	0.250

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a minimum of a 3-inch thick wood structural member, or multiple members attached together to be 3-inches or greater in thickness, with the fasteners as specified in Table 1.
2. Allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D = 1.6, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed. Reduce where other load durations govern.
3. When using the basic load combinations in accordance with 2012 (2009) (2006) IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternate basic load combinations in 2012 (2009) (2006) IBC Section 1605.3.2 that includes wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by 33⅓ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
4. Anchorage to concrete or masonry must be determined in accordance with Section 4.1.2 of this report.
5. Tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
6. Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength level forces respectively.
7. Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report or the actual unbraced length is greater than 4 ½ inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 4 ½ to 18 inches above the concrete, it is permitted to add an additional anchor rod elongation of 0.01 inches to the tabulated hold-down deflection.
8. If a ½ or ⅝ inch diameter anchor bolt is used for the LTT19 or LTT20B, add a standard cut washer to the seat. No additional washer is required for a ¾ inch diameter anchor bolt. See table for specified anchor bolt sizes.
9. Wood member bolts shall be in accordance with Section 3.2.3.2 of this report.
10. Allowable tension load for HTT5 with bearing washer BP5/8-2 is 5295 lbs. (Δ_{all} = 0.126, Δ_s = 0.179).
11. 16d common nails are permitted to substitute for 16d×2½" nails.



LTT19



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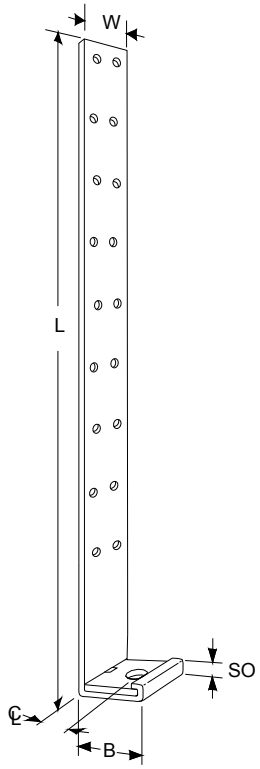
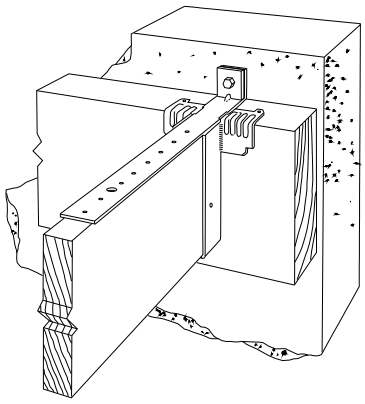
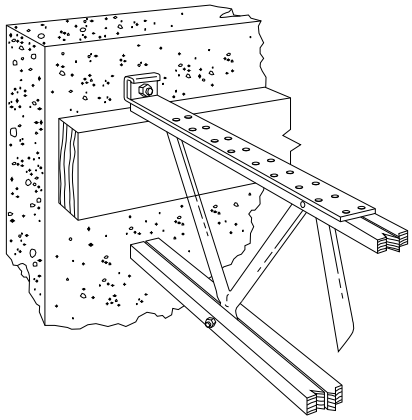


LTTI31



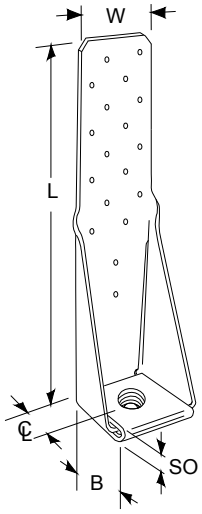
LTT19 Horizontal Installation
(LTT20B Similar)



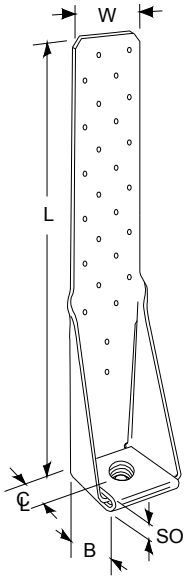
LTTI31 Horizontal Installation

Figure 1 – LTT Nail Hold-Downs

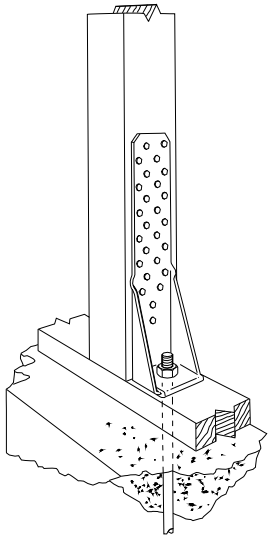
Report Number: 130
Originally Issued: 12/2008
Revised: 01/09/2013
Valid Through: 12/2013



HTT4



HTT5



HTT5 Vertical Typical Installation
(HTT4 Similar)

Figure 2 – HTT Nail Hold-Downs

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ESR-2604

Reissued January 1, 2013

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DIVISION: 06 00 00—WOOD, PLASTIC AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® COLUMN CAPS FOR WOOD CONSTRUCTION

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie® CC/ECC column caps (Table 1) and the CCQ/ECCQ column caps (Table 2) are used to connect wood beams to wood posts and timbers in engineered applications in accordance with Section 2304.9.3 of the IBC or Section R301.1.3 of the IRC. The AC/ACE post caps (Table 3), LPCZ post caps (Table 4), PC/EPC post caps (Table 5), and the BC/BCS post caps (Table 6) are used to provide a positive connection between post-and-beam construction used to support wood framing members to resist uplift forces and lateral displacement of the beam in accordance with Section 2304.9.7 of the IBC and Section R502.9 of the IRC.

3.0 DESCRIPTION

3.1 CC/ECC Column Caps:

The CC3$^1/_4$, ECC3$^1/_4$, CC4, ECC4, CC6 and ECC6 are fabricated from two No. 7 gage steel straps factory welded to a No. 7 gage steel U-shaped channel, where $^3/_{16}$-inch-thick (4.8 mm) by 2$^1/_2$-inch-long (63.5 mm) fillet welds are located on one side of each strap attached to the U-channel. All other CC/ECC column caps are fabricated from two No. 3 gage steel straps factory welded to a No. 3 gage steel U-shaped channel, where $^1/_4$-inch-thick (6.4 mm) by 2$^1/_2$-inch-long (63.5 mm) fillet welds are located on one side of each strap attached to the U-channel. Column caps with fillet welds on both sides of each strap are available. The ECC column caps are designed for use at beam ends. See Table 1 for column cap models, dimensions, required quantity and diameter of bolts, and allowable loads. See Figure 1 for a drawing of a typical CC column cap connector and the ECC44 end column connector.

3.1.1 CCQ/ECCQ Quick Drive Column Caps: The CCQ3, ECCQ3, CCQ4, ECCQ4 CCQ6, and ECCQ6 are fabricated from two No. 7 gage steel straps factory welded to a No. 7 gage steel U-shaped channel, where $^3/_{16}$-inch-thick (4.8 mm) by 2$^1/_2$-inch-long (63.5 mm) fillet welds are located on one side of each strap attached to the U-channel. The CCQ5, ECCQ5, CCQ7, and ECCQ7 column caps are fabricated from two No. 3 gage steel straps factory welded to a No. 3 gage steel U-shaped channel, where $^1/_4$-inch-thick (6.4 mm) by 2$^1/_2$-inch-long (63.5 mm) fillet welds are located on one side of each strap attached to the U-channel. Column caps with fillet welds on both sides of each strap are available. The ECCQ column caps are used to connect the end of a beam to a post. See Table 2 for column cap models, dimensions, required quantity of SDS $^1/_4$ x 2$^1/_2$ wood screws, and allowable loads. See Figure 2 for a drawing of a CCQ46-SDS2.5 column cap, a typical installation of a CCQ46-SDS2.5 column cap, and of an ECCQ46-SDS2.5 end column cap connector.

3.1.2 AC/ACE Post Caps: The AC and ACE are two-piece post caps fabricated from No. 18 gage galvanized steel. The AC post caps must be used in pairs and in locations where the supported beam is continuous over the wood post. ACE post caps are used to connect the end of a beam to a post. See Table 3 for dimensions, minimum (MIN) and maximum (MAX) fastener schedules, and allowable uplift and lateral loads corresponding to the minimum and maximum fastener schedules. See Figure 3a for a drawing of a typical AC post cap, and Figure 3b for a drawing of a typical installation of an ACE post cap showing the “left” and “right” pieces of the post cap assembly.

3.1.3 LPC Light Post Caps: The LPC6 and LPC4 post caps are two-piece post caps fabricated from No. 16 gage and No. 18 gage galvanized steel respectively. The LPC post caps must be used in pairs and in locations where the supported beam is continuous over the wood post. The LPC post caps are designed to be used with wood beams having a width less than the supporting wood post, and

can connect continuous beams or the end of beams to a post provided the required nails are installed. Both LPC post caps described in this report have a model designation ending with the letter Z, indicating they have a G185 zinc coating in accordance with ASTM A653. See Table 4 for the connector width for the supporting wood post, required fasteners, and allowable uplift and lateral loads. See Figure 4 for a drawing of a typical LPC post cap connector, and a typical installation where the supported wood beam is continuous over the wood post.

3.1.4 PC/EPC Post Caps: The PC and EPC post caps are one-piece connectors. PC44-16 (EPC44-16), PC26-16 (EPC26-16), PC48-16 (EPC48-16), PC64-16 (EPC64-16), and the PC66-16 (EPC66-16) are fabricated from No. 16 gage galvanized steel, and all of the other PC and EPC post caps are fabricated from No. 12 gage galvanized steel. The EPC post caps are used to connect the end of a beam to a post. See Table 5 for model numbers, post cap dimensions, required fasteners, and allowable uplift and lateral loads. See Figure 5 for drawings of typical PC and EPC post caps, and a drawing of a typical installation of a PC post cap.

3.1.5 BC/BCS Post Caps: The BC/BCS post caps are one-piece connectors fabricated from No. 18 gage galvanized steel. The BCS2-2/4 post cap is designed for the connection of double 2x's to a nominally 4-inch-wide post, and the BCS2-3/6 post cap is designed for the connection of triple 2x's to a nominally 6-inch-wide post. The BC/BCS post caps are designed to be used with built-up wood beams having a width less than the post width, and can connect continuous beams or the end of beams to a post provided the required nails are installed. See Table 6 for model numbers, post cap dimensions, required fasteners, and allowable uplift and lateral loads. See Figure 6 for drawings of a BC4 post cap and a BCS2-2/4 post cap, and a drawing of a typical installation of a BCS2-2/4 post cap.

3.2 Materials:

3.2.1 Steel: The galvanized connectors described in this report are manufactured from galvanized sheet steel complying with ASTM A653, SS designation, Grade 33, with a minimum specified yield strength, F_y, of 33 ksi and tensile strength, F_u, of 45 ksi. The CC/ECC and CCQ/ECCQ column cap connectors are manufactured from steel complying with ASTM A1011, SS designation, Grade 33, with minimum specified yield strength, F_y, of 52 ksi and tensile strength, F_u, of 45 ksi and a painted finish. Base-metal thicknesses for the connectors in this report are as follows:

NOMINAL THICKNESS (Gage)	MINIMUM BASE METAL THICKNESS (inches)
No. 3[1]	0.2285
No. 7[1]	0.1705
No. 12[1]	0.0955
No. 12[2]	0.0975
No. 16[2]	0.0555
No. 18[2]	0.0445

For **SI:** 1 inch = 25.4 mm.

[1]Base-metal thickness for steel conforming to ASTM A1011.
[2]Base-metal thickness for steel conforming to ASTM A653.

Some connectors (designated with a model number ending with Z) are available with a G185 zinc coating specification in accordance with ASTM A653. Some models (designated with a model number ending with HDG) are available with a hot-dip galvanization, also known as "batch" galvanization, in accordance with ASTM A123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (610 g/m^2), total for both sides. Model numbers in this report do not include the Z or HDG ending (except for Table 4), but the information shown applies. The lumber treater and the holder of this report (Simpson Strong-Tie Company) should be contacted for recommendations on the appropriate coating or material to specify for use of the steel connectors in contact with the specific proprietary preservative treated or fire retardant treated lumber.

3.2.2 Wood: Wood members with which the connectors are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber) except as noted in Section 4.1. The thickness of the supporting wood member must be equal to or greater than the length of the fasteners specified in the tables in this report, or as required by wood member design, whichever is greater. For installation in engineered wood members, minimum allowable nail spacing and end and edge distances, as specified in the applicable evaluation report for the engineered wood product, must be met.

3.2.3 Fasteners: Nails used with connectors described in this report must comply with the material requirements, physical properties, tolerances, workmanship, protective coating and finishes, certification, and packaging and package marking requirements specified in ASTM F1667. The nails must have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inches)	NAIL LENGTH (inches)	F_{yb} (psi)
10d	0.148	3	90,000
16d	0.162	$3^1/_2$	90,000

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

At a minimum, bolts must comply with ASTM A36 or A307. SDS screws must comply with ESR-2236.

Nails and bolts used in contact with preservative treated or fire retardant treated lumber must comply with Section 2304.9.5 of the IBC, Section R317.3 of the 2012 and 2009 IRC or Section R319.3 of the 2006 IRC, as applicable. SDS screws used in contact with preservative-treated or fire-retardant-treated lumber must, as a minimum, comply with ESR-2236. For use with treated lumber, the lumber treater or this report holder (Simpson Strong-Tie Company), or both, should be contacted for recommendations on the appropriate coating or material to specify for the fasteners as well as the connection capacities of fasteners used with the specific proprietary preservative treated or fire retardant treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in the product tables of this report are based on Allowable Stress Design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the National Design Specification for Wood Construction and its supplement (NDS).

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100ºF (37.8ºC) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood

products), or where wet service is expected, the allowable loads must be adjusted by the wet service factor, C_M, specified in the NDS for dowel-type fasteners. When connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100ºF (37.8ºC), the allowable loads in this report must be adjusted by the applicable temperature factor, C_t, specified in the NDS. Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie connectors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.7.2 and 3.7.3 of this report.

5.5 Use of connectors with preservative treated or fire retardant treated lumber must be in accordance with Section 3.7.1 of this report. Use of fasteners with preservative treated or fire retardant treated lumber must be in accordance with Section 3.7.3 of this report.

5.6 Welded connectors are manufactured under a quality control program with inspections by Benchmark Holdings L.L.C. (AA-660).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010 (editorially revised December 2011).

7.0 IDENTIFICATION

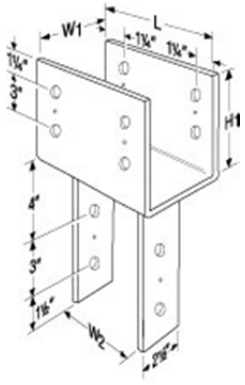
The products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report (ESR-2523) that is used as an identifier for the products recognized in this report. Additionally, the factory-welded connectors manufactured in the United States and Canada are identified with the acronym of the inspection agency (BMH)

TABLE 1—CC AND ECC SERIES COLUMN CAPS

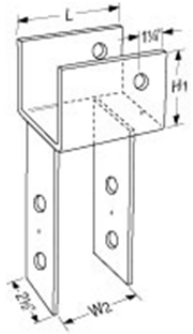
MODEL NO.	COLUMN CAP DIMENSIONS (inches)					BOLTS[1] (Quantity–Diameter)		ALLOWABLE LOADS[2,3,4] (lbs)		
								CC	CC	ECC
	Width for Beam (W_1)	Width for Post (W_2)	Bearing Length for Beam (L)		U-Channel Height for Beam (H_1)			Uplift[5,6,7]	Download[8,9,10,11]	
			CC	ECC		Beam	Post	C_D = 1.6	C_D = 1.0	
CC3 1/4-4	3 1/4	3 5/8	11	7 1/2	6 1/2	4 – 5/8	2 – 5/8	3,640	16,980	6,125
CC3 1/4-6		5 1/2	11	7 1/2	6 1/2	4 – 5/8	2 – 5/8	3,640	19,250	9,625
CC44	3 5/8	3 5/8	7	5 1/2	4	2 – 5/8	2 – 5/8	1,465	15,310	7,655
CC46		5 1/2	11	8 1/2	6 1/2	4 – 5/8	2 – 5/8	2,795	24,060	12,030
CC5 1/4-4	5 1/4	3 5/8	13	9 1/2	8	4 – 3/4	2 - 3/4	7,565	26,635	10,045
CC5 1/4-6		5 1/2	13	9 1/2	8	4 – 3/4	2 - 3/4	7,530	28,190	15,785
CC5 1/4-8		7 1/2	13	9 1/2	8	4 – 3/4	2 - 3/4	7,530	37,310	21,525
CC64	5 1/2	3 5/8	11	7 1/2	6 1/2	4 – 5/8	2 – 5/8	4,040	28,585	12,030
CC66		5 1/2	11	7 1/2	6 1/2	4 – 5/8	2 – 5/8	4,040	30,250	18,905
CC68		7 1/2	11	9 1/2	6 1/2	4 – 5/8	2 – 5/8	4,040	37,810	25,780
CC76	6 7/8	5 1/2	13	10 1/2	8	4 – 3/4	2 - 3/4	7,525	37,125	20,790
CC77		6 7/8	13	10 1/2	8	4 – 3/4	2 – 3/4	7,525	49,140	25,515
CC78		7 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,525	49,140	28,350
CC86	7 1/2	5 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,440	41,250	23,100
CC88		7 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,440	54,600	31,500
CC96	8 7/8	5 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,510	48,125	26,950
CC98		7 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,510	63,700	36,750
CC106	9 1/2	5 1/2	13	10 1/2	8	4 – 3/4	2 – 3/4	7,510	52,250	29,260

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]ECC has one-half the tabulated beam bolts. ECC9 and ECC10 have four beam bolts. Bolt holes bored into the wood beam and post must be no less than 1/32 inch greater and no more than 1/16 inch greater than the diameter of the bolt.
[2]Tabulated allowable load must be selected based on duration of load as permitted by the applicable building code.
[3]The wood post depth must be equal to the wood beam width (W_1).
[4]If structural composite lumber posts are used, installation of the fasteners into the wide face (fasteners perpendicular to the strands/veneers) is required in order to obtain the loads listed in this report. The structural composite lumber must have an ICC-ES report that shows fastener design specific gravity equivalent of 0.50 or better.
[5]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[6]Allowable uplift loads for the CC column caps do not apply to spliced beam conditions.
[7]Allowable uplift loads assume a beam height of 11 inches to ensure minimum edge distance for the top bolts in the U-shaped channel loaded perpendicular to the grain of the wood beam.
[8]Allowable downloads are for beams that are continuous over the length (L) of the CC connector.
[9]When a spliced beam condition occurs, that is, where the ends of two beams are supported by the post and connected to the CC post cap connector, the splice must occur at the middle of the connector and the maximum allowable download for spliced beams is one half of the tabulated allowable download. When spliced beams must be connected together to transfer design tension loads (i.e., lateral loads parallel to the beams), the connection must be by means other than the column cap.
[10]Tabulated allowable download capacity is the lesser of calculated capacity based on $Fc_{\perp}$ for the supported beam and the calculated capacity based on $Fc_{\parallel}$ for the supporting wood post. $Fc_{\perp}$ values are 560 psi and 625 psi for glulam beams and DFL beams, respectively. $Fc_{\parallel}$ values are 1,550 psi for glulam beams, 1,350 psi for 4-inch-wide DFL (W_2 dimension) posts, and 1,000 psi for 5-inch-wide and larger DFL (W_2 dimension) posts.
[11]Allowable downloads may not be increased for short-term loading.



CC Column Cap



ECC44 Column Cap

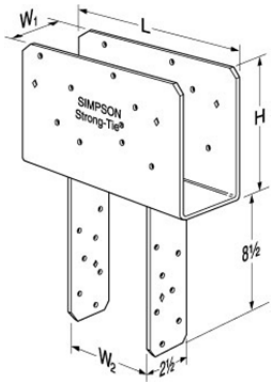
FIGURE 1—CC and ECC COLUMN CAPS

TABLE 2—CCQ AND ECCQ SERIES COLUMN CAPS

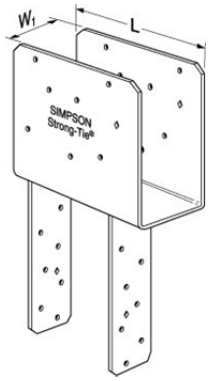
MODEL NO.	COLUMN CAP DIMENSIONS (inches)					QUANTITY OF SDS[1] 1/4 x 2 1/2 SCREWS[1]		ALLOWABLE LOADS[2,3,4,5] (lbs)			
	Width for Beam (W_1)	Width for Post (W_2)	Bearing Length for Beam (L)		U-Channel Height for Beam (H_1)			CCQ	ECCQ[6]	CCQ	ECCQ[6]
			CCQ	ECCQ		Into Beam	Into Post	Uplift[6,7,8]		Download[9,10,11,12]	
								C_D=1.6	C_D=1.6	C_D=1.0	
CCQ3-4-SDS2.5	3 1/4	3 5/8	11	8 1/2	7	16	14	5,680	3,695	16,980	6,125
CCQ3-6-SDS2.5		5 1/2						5,680	3,695	19,250	9,625
CCQ44-SDS2.5	3 5/8	3 5/8	11	8 1/2	7	16	14	5,680	4,040	19,020	7,655
CCQ46-SDS2.5		5 1/2						7,145	4,040	24,065	12,030
CCQ48-SDS2.5		7 1/2						7,145	4,040	24,065	16,405
CCQ54-SDS2.5	5 1/4	3 5/8	11	8 1/2	7	16	14	5,680	4,040	26,635	10,045
CCQ56-SDS2.5		5 1/2						7,245	5,535	28,190	15,785
CCQ58-SDS2.5		7 1/2						7,245	5,535	31,570	21,525
CCQ64-SDS2.5	5 1/2	3 5/8	11	8 1/2	7	16	14	5,680	4,040	28,585	12,030
CCQ66-SDS2.5		5 1/2						7,145	4,040	30,250	18,905
CCQ68-SDS2.5		7 1/2						7,145	4,040	37,815	25,780
CCQ74-SDS2.5	6 7/8	3 5/8	11	8 1/2	7	16	14	5,680	4,040	33,490	13,230
CCQ76-SDS2.5		5 1/2						7,245	5,535	37,125	20,790
CCQ77-SDS2.5		6 7/8						7,245	5,535	41,580	25,515
CCQ78-SDS2.5		7 1/2						7,245	5,535	41,580	28,350

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

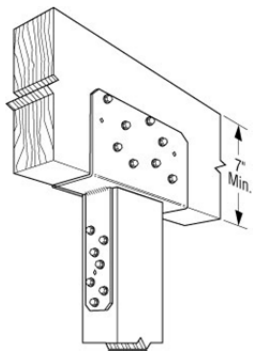
[1]The model number for the SDS1/4x21/2 is SDS25250 (see ESR-2236). The screws are included as components of the CCQ/ECCQ column caps.
[2]Tabulated allowable load must be selected based on duration of load as permitted by the applicable building code.
[3]The wood post depth must be equal to the wood beam width (W_1).
[4]If structural composite lumber posts are used, installation of the fasteners into the wide face (fasteners perpendicular to the strands/veneers) is required in order to obtain the loads listed in this report. The structural composite lumber must have an ICC-ES report that shows fastener design specific gravity equivalent of 0.50 or better.
[5]ECCQ uses 14–SDS 1/4 x 2 1/2 screws into the beam and 14–SDS 1/4 x 2 1/2 screws into the post.
[6]The uplift loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[7]Allowable uplift loads for the CCQ column caps do not apply to spliced beam conditions.
[8]Allowable uplift loads assume a minimum beam height of 7 inches to ensure minimum edge distance for the top SDS screws in the U-shaped channel loaded perpendicular to the grain of the wood beam.
[9]Allowable downloads for beams that are continuous over the length (L) of the CCQ connector.
[10]When a spliced beam condition occurs, that is, where the ends of two beams are supported by the post and connected to the CCQ post cap connector, the splice must occur at the middle of the connector and the maximum allowable download for spliced beams is one half of the tabulated allowable download. When spliced beams must be connected together to transfer design tension loads (i.e., lateral loads parallel to the beams), the connection must be by means other than the column cap.
[11]Tabulated allowable download capacity is the lesser of calculated capacity based on $F_{c\perp}$ for the supported beam and the calculated capacity based on $F_{c\parallel}$ for the supporting wood post. $F_{c\perp}$ values are 560 psi and 625 psi for glulam beams and DFL beams, respectively. $F_{c\parallel}$ values are 1,550 psi for glulam beams, 1,350 psi for 4-inch-wide DFL (W_2 dimension) posts, and 1,000 psi for 5-inch-wide and larger DFL (W_2 dimension) posts.
[12]Allowable downloads may not be increased for short-term loading.



CCQ46SDS2.5 Column Cap



ECCQ46SDS2.5 Column Cap for End Conditions



CCQ46SDS2.5 Installation

FIGURE 2—CCQ and ECCQ COLUMN CAPS

TABLE 3—AC AND ACE SERIES POST CAPS

MODEL NO. [1,2]		POST CAP DIMENSIONS (inches)		NAILS (Quantity–Type)		ALLOWABLE LOADS[3,4,5] (lbs)	
						Uplift[6]	Lateral[7]
		W	L	Into the Beam	Into the Post	C_D = 1.6	C_D = 1.6
AC4	MIN	$3^9/_{16}$	$6^1/_2$	8 – 16d	8 – 16d	1,430	715
	MAX			14 – 16d	14 – 16d	2,500	1,070
AC4R	MIN	4	7	8 – 16d	8 – 16d	1,430	715
	MAX			14 – 16d	14 – 16d	2,500	1,070
ACE4	MIN	—	$4^1/_2$	6 – 16d	6 – 16d	1,070	715
	MAX			10 – 16d	10 – 16d	1,785	1,070
AC6	MIN	$5^1/_2$	$8^1/_2$	8 – 16d	8 – 16d	1,430	715
	MAX			14 – 16d	14 – 16d	2,500	1,070
AC6R	MIN	6	9	8 – 16d	8 – 16d	1,430	715
	MAX			14 – 16d	14 – 16d	2,500	1,070
ACE6	MIN	—	$6^1/_2$	6 – 16d	6 – 16d	1,070	715
	MAX			10 – 16d	10 – 16d	1,785	1,070

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]"MIN" suffix to the model No. indicates that only the round holes must be filled with the quantity and type of nails specified in the table to achieve the tabulated allowable load values.
[2]"MAX" suffix to the model No. indicates that both round and triangular holes must be filled with the quantity of nails specified in the table to achieve the tabulated allowable load values.
[3]The allowable loads do not apply to spliced beams, that is, where the ends of two beams are supported by the wood post and connected to the AC post cap connector. When a spliced beam condition occurs, the splice must occur at the middle of the connector (middle of post) and the maximum allowable download for spliced beams is one half of the tabulated allowable download. A spliced beam condition occurs must be designed and detailed to transfer tension loads (i.e., tabulated allowable lateral loads) between spliced beams by means other than the column cap.
[4]Allowable uplift and lateral loads apply only for AC and ACE post cap connectors installed in pairs, as shown in Figure 3b, with each piece connected to the wood post and beam with an equal amount and type of nails.
[5]Allowable uplift and lateral loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[6]Allowable uplift loads for the AC column caps do not apply to spliced beam conditions.
[7]Allowable lateral loads are parallel to the length of the supported wood beam, as shown in Figure 3b.

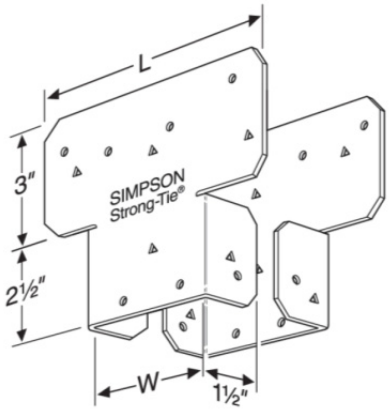


Figure 3a—AC post cap connector components

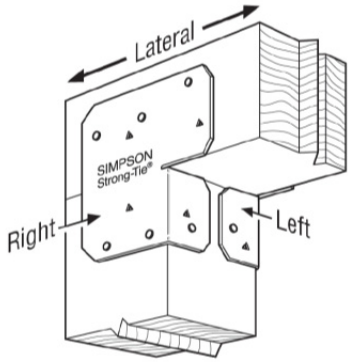


Figure 3b—Typical ACE Installation

FIGURE 3—AC AND ACE POST CAPS

TABLE 4—LPCZ LIGHT POST CAPS[1,2]

MODEL NO.	CONNECTOR WIDTH FOR WOOD POST (inches)	NAILS (Quantity-Type)		ALLOWABLE LOADS[3,4,5] (lbs.)	
				Uplift[6]	Lateral[7]
		Into the Beam	Into the Post	C_D = 1.6	C_D = 1.6
LPC4Z	$3^9/_{16}$	8 –10d	8 –10d	760	325
LPC6Z	$5^9/_{16}$	8 –10d	8 –10d	915	490

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]The LPCZ post cap is a two-piece wood-beam-to-post connector that is designed to be used with wood beams having a width less than the post width, as implied in Figure 4.
[2]The LPC4 and LPC6 models shown in the table end with the letter Z, indicating that they have a G185 zinc coating in accordance with ASTM A653.
[3]The allowable loads do not apply to spliced beams, that is, where the ends of two beams are supported by the wood post and connected to the LPC post cap connector. When a spliced beam condition occurs, the splice must occur at the middle of the connector (middle of post) and the maximum allowable download for spliced beams is one half of the tabulated allowable download. A spliced beam condition occurs must be designed and detailed to transfer tension loads (i.e., tabulated allowable lateral loads) between spliced beams by means other than the column cap.
[4]Allowable uplift and lateral loads apply only for LPC post cap connectors installed in pairs, as shown in Figure 4, with each piece connected to the wood post and beam with an equal amount and type of nails.
[5]Allowable uplift and lateral loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[6]Allowable uplift loads for the LPC column caps do not apply to spliced beam conditions.
[7]Allowable lateral loads are parallel to the length of the supported wood beam, as shown in Figure 4.

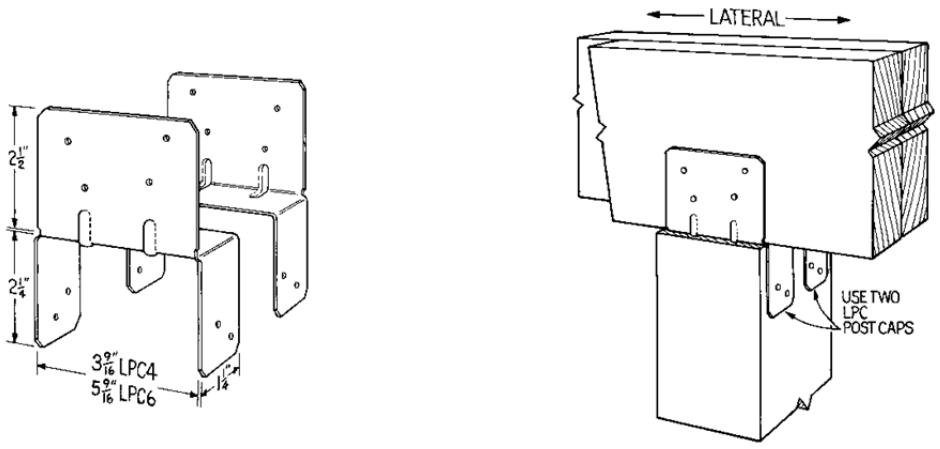


FIGURE 4—LPCZ POST CAPS

TABLE 5—PC AND EPC SERIES POST CAPS

MODEL NO.	POST CAP DIMENSIONS (in)					NAILS (Quantity-Type)			ALLOWABLE LOADS[1,2,3] (lbs)		
									PC and EPC	PC	EPC
	Width for Beam (W_1)	Width for Post (W_2)	Metal Flange Length			Into Wood Post	Into Wood Beam		Uplift[4,5]	Lateral[6]	
			PC & EPC	PC	EPC		PC Post Cap	EPC Post Cap	C_D = 1.6	C_D = 1.6	C_D = 1.6
			L_1	L_2	L_3						
PC44-16	$3^9/_{16}$	$3^9/_{16}$	$2^5/_8$	11	$7^3/_8$	8 –16d	12 –16d	8 –16d	1,000	925	1,000
PC44						8 –16d	12 –16d	8 –16d	1,700	925	1,070
PC46-16		$5^1/_2$	$2^5/_8$	13	$9^1/_4$	8 –16d	12 –16d	8 –16d	1,000	925	1,000
PC46						8 –16d	12 –16d	8 –16d	1,700	925	1,070
PC48-16		$7^1/_2$	$2^5/_8$	15	$11^1/_4$	8 –16d	16 - 16d	12 –16d	1,000	1,475	1,285
PC48						8 –16d	16 - 16d	12 –16d	1,700	2,075	1,610
PC64-16	$5^1/_2$	$3^9/_{16}$	$4^9/_{16}$	11	$7^3/_8$	8 - 16d	12 –16d	8 –16d	1,000	925	1,000
PC64						8 –16d	12 –16d	8 –16d	1,700	925	1,070
PC66-16		$5^1/_2$	$4^9/_{16}$	13	$9^1/_4$	8 –16d	12 –16d	12 –16d	1,000	925	1,285
PC66						8 –16d	12 –16d	12 –16d	1,700	925	1,610
PC68		$7^1/_2$	$4^9/_{16}$	15	$11^1/_4$	8 –16d	16 - 16d	12 –16d	1,700	2,075	1,610
PC84	$7^1/_2$	$3^9/_{16}$	$6^9/_{16}$	11	$7^3/_8$	8 –16d	12 –16d	12 –16d	1,700	925	1,610
PC86		$5^1/_2$	$6^9/_{16}$	13	$9^1/_4$	8 –16d	12 –16d	12 –16d	1,700	925	1,610
PC88		$7^1/_2$	$6^9/_{16}$	15	$11^1/_4$	8 –16d	16 - 16d	12 –16d	1,700	2,075	1,610

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads must be selected based on duration of load as permitted by the applicable building code.
[2]Tabulated allowable loads for the PC44-16, PC26-16, PC48-16, PC64-16, and the PC66-16 post cap connectors, which are fabricated from No. 16 gage galvanized steel, that are less than the values assigned to the PC44, PC26, PC48, PC64, and the PC66 post cap connectors, which are fabricated from No. 12 gage galvanized steel, are the result of nail lateral values determined in accordance with the NDS.
[3]The allowable loads do not apply to spliced beams, that is, where the ends of two beams are supported by the wood post and connected to the PC post cap connector. When a spliced beam condition occurs, the splice must occur at the middle of the connector (middle of post) and the maximum allowable download for spliced beams is one half of the tabulated allowable download. A spliced beam condition occurs must be designed and detailed to transfer tension loads (i.e., tabulated allowable lateral loads) between spliced beams by means other than the column cap.
[4]Allowable uplift and lateral loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[5]Allowable uplift loads for the PC column caps do not apply to spliced beam conditions.
[6]Allowable lateral loads are parallel to the length of the supported wood beam, as shown in Figure 5.

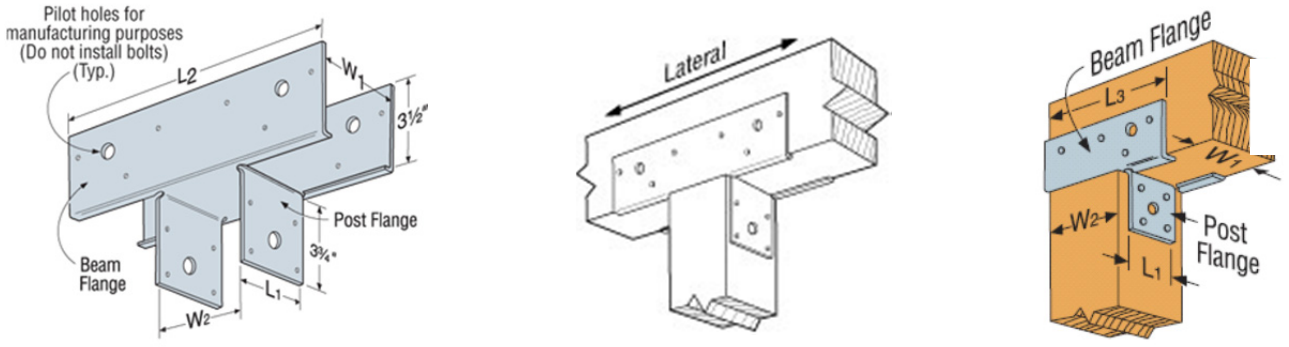


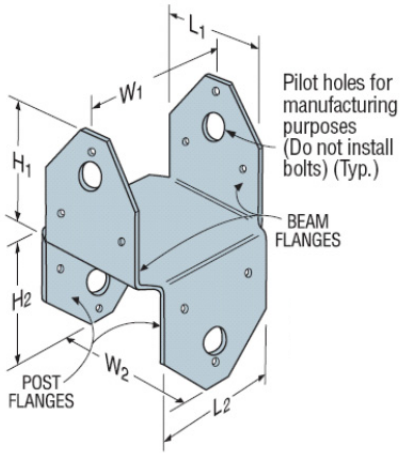
FIGURE 5—PC AND EPC POST CAPS

TABLE 6—BC AND BCS POST CAPS[1]

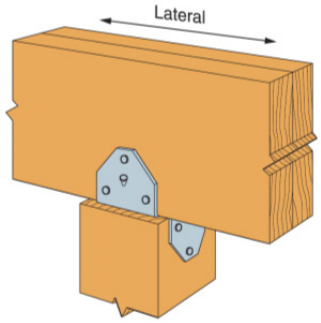
MODEL NO.	POST CAPS DIMENSIONS (in.)						NAILS[2] (Quantity-Type)		ALLOWABLE LOADS[3,4]	
	Width for Beam (W_1)	Width for Post (W_2)	Metal Flange Length		Metal Flange Height		Into the Wood Beam	Into the Wood Post	Uplift[5]	Lateral[6]
			Beam (L_1)	Post (L_2)	Beam (H_1)	Post (H_2)			C_D = 1.6	C_D = 1.6
BC4	$3^9/_{16}$	$3^9/_{16}$	$2^7/_8$	$2^7/_8$	3	3	6 –16d	6 –16d	980	1,000
BC46	$3^9/_{16}$	$5^1/_2$	$4^7/_8$	$4^7/_8$	$3^1/_2$	$2^1/_2$	12 –16d	6 –16d	980	1,000
BC4R	4	4	4	4	3	3	12 –16d	12 –16d	980	1,000
BC6	$5^1/_2$	$5^1/_2$	$4^3/_8$	$4^3/_8$	$3^3/_8$	$3^3/_8$	12 –16d	12 –16d	1,050	2,000
BC6R	6	6	6	6	3	3	12 –16d	12 –16d	1,050	2,000
BC8	$7^1/_2$	$7^1/_2$	$7^1/_2$	$7^1/_2$	4	4	12 –16d	12 –16d	1,800	2,000
BCS2-2/4	$3^1/_8$	$3^9/_{16}$	$2^7/_8$	$2^7/_8$	$2^{15}/_{16}$	$2^{15}/_{16}$	8 –10d	6 –10d	780	1,025
BCS2-3/6	$4^5/_8$	$5^9/_{16}$	$4^3/_8$	$2^7/_8$	$3^{15}/_{16}$	$2^{15}/_{16}$	12 –16d	6 –16d	800	1,495

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

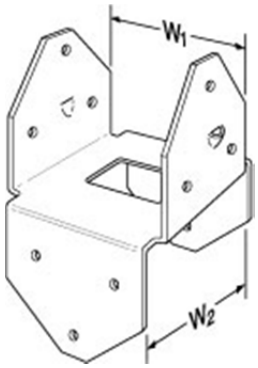
[1]The BCS2-2/4 post cap is designed for the connection of double 2x's to a nominally 4-inch-wide post, and the BCS2-3/6 post cap is designed for the connection of triple 2x's to a nominally 6-inch-wide post.
[2]The BCS has slant nail holes for nails that must be installed into the beam at a 45-degree angle and penetrate into the end grain of the supporting post. Nails must be minimum $3^1/_2$-inches long (i.e., 16d common nails).
[3]Tabulated allowable load capacities must be selected based on duration of load as permitted by the applicable building code.
[4]Spliced beams, where the ends of two beams are supported by the wood post and connected to the BC post cap connector, are not permitted. The supported wood beam must be continuous.
[5]Allowable uplift and lateral loads have been increased for wind or earthquake loading with no further increase allowed. The allowable loads must be reduced when other load durations govern.
[6]Allowable lateral loads are parallel to the length of the supported wood beam, as shown in Figure 6.



BC4 Post Cap



Typical BCS Post Cap Installation



Slant Nail Holes, typical both sides. (See footnote 2)

BCS2-2/4 Post Cap

FIGURE 6—BC AND BCS POST CAPS

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 560-9000
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® CONNECTORS USING SD-SERIES SCREWS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie® structural connectors described in this report are used as wood framing connectors in accordance with Section 2304.9.3 of the IBC. The products may also be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The structural connectors described in this report are used as wood-to-wood connections in structural systems that have been designed to transfer loads from their point of origin to load-resisting elements. All connectors are attached to wood using SD-Series screws recognized in ICC-ES evaluation report ESR-3046.

3.1.1 A21 and A23 Series Angles: The A21 and A23 angles are used to transfer lateral loads between wood framing members. They are fabricated from No. 18 gage steel. See Table 1 and Figure 1 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.2 A33 and A44 Series Angles: The A33 and A44 angles are used to transfer lateral loads between wood framing members. They are fabricated from No. 12 gage steel. See Table 2 and Figure 2 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.3 GA Gusset Angles: The GA1 and GA2 gusset angles are used to transfer lateral loads between wood framing members. They are fabricated from No. 18 gage steel. See Table 3 and Figure 3 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.4 L Framing Connectors: The L framing connectors are used to transfer lateral loads between wood framing members. They are fabricated from No. 16 gage steel. See Table 4 and Figure 4 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.5 A34 and A35 Framing Angles: The A34 and A35 framing angles are used to transfer lateral and uplift loads between wood framing members. They are fabricated from No. 18 gage steel. The connectors have cutouts on each leg and a prong to aid in installation. See Table 5 and Figure 5 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.6 LTP4 Lateral Tie Plate: The LTP4 lateral tie plate transfers shear force from the wood top plate to wood rim joist or blocking members. It is fabricated from No. 20 gage steel. See Table 6 and Figure 6 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.7 DJT14Z Deck Joist Tie: DJT14Z connector is used to attach joists to posts. It is fabricated from No. 14 gage steel. See Table 7 and Figure 7 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.8 Hurricane Ties: Hurricane Ties are designed to tie rafters or joists to wall plates or studs. The H1, H2.5, H2.5A, H5, H8, and H10 are fabricated from 18 gage steel. The H4 is fabricated from 20 gage steel. See Table 8 and Figure 8 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.9 RSP4 Reversible Stud Plate Tie: The RSP4 tie is designed to connect a nominally 2-inch-wide wood stud to either the double top plate or to the mudsill. The locating tabs aid in placing the tie on the double top plates or a single bottom plate. It is fabricated from 20 gage steel. See Table 9 and Figure 9 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.10 AC Series Post Caps: The AC post caps are used in pairs to transfer uplift and in-plane lateral loads between a beam and a post. They are fabricated from 18 gage steel. See Table 10 and Figure 10 for model types, dimensions, fastener schedules and allowable loads.

3.1.11 LCE4 Post Cap: The LCE post cap is used in pairs to transfer uplift and in-plane lateral loads between a beam and a post. It is fabricated from 20 gage steel. See Table 11 and Figure 11 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.12 BC and BCS Series Post Caps: The BC and BCS are used to connect a beam to the end of a post. The BC and BCS post caps are designed to be used with beams having a width less than or equal to the post width, and can connect a continuous beam or the end of a beam to a post. The BCS has dome-shaped nail holes through which screws must be driven into the beam at a 45-degree angle. They are fabricated from 18 gage steel. See Table 12 and Figure 12 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.13 BCO Series Post Bases: The BCO are used to connect the base of a post to a wood supporting member. They are fabricated from 18 gage steel. See Table 13 and Figure 13 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.14 LPC4Z Light Post Cap: The LPC Light Post Cap is used in pairs to transfer uplift and in-plane lateral loads between a beam and a post. It is fabricated from 18 gage steel. See Table 14 and Figure 14 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.15 PC and EPC Series Post Caps: The PC and EPC post caps are used to transfer uplift and in-plane lateral loads between a beam and a post. The EPC post caps are designed for end-post connections at the end of a beam. They are fabricated from 12 or 16 gage steel. Model numbers with a "-16" suffix are formed from 16 gage material. See Table 15 and Figure 15 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.16 ABA Post Base Standoff: The ABA post base standoff elevates the post above concrete floors. A standard plate washer must be installed between the nut and the device along the anchor bolt. The ABA44 and ABA44R are fabricated from 16 gage and all other sizes from 14 gage. See Table 16 and Figure 16 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.17 ABU Series Adjustable Post Base: The ABU adjustable post base connects a wood post to a concrete footing, elevating the base of the post 1 inch (25.4 mm) above the concrete footing. The ABU connector consists of a 16 gage channel, 12 gage standoff base and a 7 gage bearing plate. See Table 17 and Figure 17 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.18 LU Series Hangers: The LU series hangers connect a joist to a supporting member such as a ledger or header. The models that support a single ply joist are fabricated from 20 gage steel. See Table 18 and Figure 18 for model numbers, dimensions, fastener schedules and allowable loads.

3.1.19 LUCZ Series Hangers: The LUCZ hangers connect a joist to a supporting member such as a ledger or header. They have concealed flanges to allow for installation near the end of the supporting member. They are fabricated from 18 gage steel. See Table 19 and Figure 19 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.20 LUS Series Hangers: The LUS series hangers connect a joist to a supporting member such as a ledger or header. The joist fasteners must be driven at a 45-degree angle through the joist and into the header. They are fabricated from 18 gage steel. See Table 20 and Figure 20 for model numbers, dimensions, fastener schedules and allowable loads.

3.1.21 HUS Series Hangers: The HUS series hangers connect a joist to a supporting member such as a ledger or header. The joist fasteners must be driven at a 45-degree angle through the joist and into the header. They are fabricated from 16 gage steel. See Table 21 and Figure 21 for model numbers, dimensions, fastener schedules and allowable loads.

3.1.22 RR Ridge Rafter Connector: The RR ridge rafter connector supports a nominally 2-inch-wide rafter from a ridge board when the ridge board is a structural support. It is fabricated from 18 gage steel. The RR ridge rafter connector may be used with a rafter having a maximum slope of 7:12 (30 degrees). See Table 22 and Figure 22 for model numbers, dimensions, fastener schedules, allowable loads and a typical installation detail.

3.1.23 MTS Twist Straps: The MTS twist straps are used to connect wood trusses and wood rafters to double wood top plates, beams or studs and resist uplift loads. They are fabricated from 16 gage steel. See Table 23 and Figure 23 for model numbers, dimensions, fastener schedules, allowable loads and typical installation details.

3.1.24 ST Series Straps: The ST9, ST12, ST18, and ST 22 straps are 9 to $21^{5}/_{8}$ inches (229 to 549 mm) long and $1^{1}/_{4}$ inches (31.8 mm) wide. Each strap has unevenly spaced, $^{11}/_{64}$-inch-diameter (4.3 mm), prepunched fastener holes. One end of each strap has a "speed prong" which is formed from the steel strap. See Figure 24 for a drawing of the ST9, ST12, ST18, and ST 22 tie straps.

The ST292, ST2122, ST2215, ST6215, ST6224, and ST6236 straps are $9^{5}/_{16}$ to $33^{13}/_{16}$ inches (236.5 to 858.8 mm) long, and have a constant width of $1^{13}/_{16}$ inches (46 mm). The total strap width between longitudinal edges is $2^{1}/_{16}$ inches (52.4 mm). Notches are $^{9}/_{32}$ inch (7.1 mm) deep and are spaced $1^{3}/_{4}$ inches (44.5 mm) on center. Each longitudinal edge of an ST strap has a row of $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched fastener holes, spaced $1^{3}/_{4}$ inches (44.5 mm) on center. See Figure 25 for drawings of the ST292, ST2122, ST2215, ST6215, ST6224, and ST6236 tie straps.

The ST2115 strap is $16^{5}/_{16}$ inches (414.3 mm) long and $^{3}/_{4}$ inch (19.1 mm) wide, and has one row of $^{11}/_{64}$-inch-diameter (4.3 mm), prepunched fastener holes, spaced $1^{5}/_{8}$ inches (41.3 mm) on center. See Figure 26 for a drawing of the ST2115 tie strap.

See Table 24 for ST Series tie strap dimensions, fastener schedules, and allowable tension loads.

3.1.25 MST Series Straps: The MST Series tie straps are 27 to $37^{1}/_{2}$ inches (686 to 953 mm) long and $2^{1}/_{16}$ inches (52.4 mm) wide. Each strap has two rows of $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched fastener holes spaced $1^{3}/_{4}$ inches (43.7 mm) on center. Additionally, the straps have $^{5}/_{8}$-inch-diameter (15.9 mm) prepunched bolt holes spaced $5^{1}/_{4}$ inches (133.4 mm) on center. See Figure 27 for a drawing of the MST Series tie straps. See Table 25 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.26 LSTA and MSTA Series Straps: The LSTA and MSTA Series tie straps are 9 to 49 inches (229 to 1245 mm) long and $1^1/_4$ inches (32 mm) wide. Each strap has one row of staggered $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched fastener holes. The MSTA49 has $^5/_{32}$-inch-diameter (4.0 mm) prepunched fastener holes. Longitudinal spacing (pitch) of consecutive holes is $1^1/_2$ inches (38 mm), and the transverse distance (gage) between staggered holes is $^9/_{16}$ inch (14.3 mm). For the MSTA49, the longitudinal spacing (pitch) of consecutive holes is $1^{17}/_{32}$ inches (38.9 mm), and the transverse distance (gage) between staggered holes is $^1/_2$ inch (12.7 mm). Both ends of every strap (except for the MSTA49) have one fastener hole located between the last two staggered holes. See Figure 28 for a drawing of the LSTA and MSTA Series tie straps. See Table 26 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.27 LSTI Series Straps: The LSTI Series tie straps are either 49 or 73 inches (1244 or 1854 mm) long and $3^3/_4$ inches (95 mm) wide. Each strap has two rows of staggered $^5/_{32}$-inch diameter (4.0 mm) prepunched fastener holes. Longitudinal spacing (pitch) of consecutive holes in a row is 3 inches (76 mm), and the transverse distance (gage) between staggered holes in a row is $^3/_8$ inch (9.5 mm). See Figure 29 for a drawing of the LSTI Series tie straps. See Table 26 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.28 MSTI Series Straps: The MSTI Series tie straps are $2^1/_{16}$ inches (52.4 mm) wide and from 26 to 72 inches (660 to 1829 mm) long. Each strap has three rows of $^5/_{32}$-inch-diameter (4.0 mm) prepunched fastener holes spaced 3 inches (76 mm) on center. The holes in adjacent rows are offset by 1 inch (25.4 mm), resulting in one fastener hole per inch of strap. See Figure 30 for a drawing of the MSTI Series tie straps. See Table 26 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.29 MSTC Series Straps: The MSTC Series tie straps are $28^1/_4$ to $77^3/_4$ inches (718 to 1975 mm) long and 3 inches (76 mm) wide. The straps have two rows of staggered prepunched fastener holes spaced $1^1/_2$ inches (38.1 mm), measured from center-to-center of holes. On the screw head side of the strap, the holes are oblong and measure $^{13}/_{64}$ inch wide by $^9/_{32}$ inch long (5.1 mm by 7.1 mm), and are chamfered at 120 degrees. On the wood side of the strap, the holes are $^{11}/_{64}$ inch wide by $^1/_4$ inch long (4.4 mm by 6.4 mm). The long direction of the fastener holes is perpendicular to the length of the strap. See Figure 31 for a drawing of the MSTC Series tie straps. See Table 26 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.30 HTP37Z Tie Strap: The HPT37Z tie strap is 7 inches (178 mm) long and 3 inches (76 mm) wide. The straps have five staggered rows of $^5/_{32}$-inch-diameter (4.0 mm) prepunched fastener holes. See Figure 32 for a drawing of the HPT37Z tie strap. See Table 27 for strap dimension, fastener schedules, and allowable tension loads.

3.1.31 HRS Series Straps: The HRS Series tie straps are 6 to 12 inches (152 – 305 mm) long and $1^3/_8$ inches (35 mm) wide. The straps have two staggered rows of $^5/_{32}$-inch-diameter (4.0 mm) prepunched fastener holes. See Figure 33 for a drawing of the HRS series strap. See Table 27 for strap dimension, fastener schedules, and allowable tension loads.

3.2 Material:

3.2.1 Steel: The connectors described in this report are manufactured from galvanized steel complying with ASTM A653, SS designation, with grades, minimum yield and tensile strengths and thicknesses as given in Table 28. The connectors have a minimum G90 zinc coating specification in accordance with ASTM A653. Some models are available with a G185 zinc coating specification in accordance with ASTM A653 (denoted by model numbers ending in the letter Z). Some models are available with a batch hot-dipped galvanized coating having a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides in accordance with ASTM A123 (denoted by model numbers ending with the letters HDG). Model numbers noted in this report do not necessarily include the Z or HDG ending, but the information shown applies. The lumber treater or report holder's recommendations shall be followed as regards minimum corrosion resistance and connection capacities of connectors used with the specific proprietary preservative-treated or fire-retardant treated lumber.

3.2.2 Wood: Wood members with which the connectors are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber). The thickness of the wood members to which the connectors are attached must be equal to or greater than the length of the fasteners specified in the tables of this report, or as required by wood member design, whichever is greater.

3.2.3 Fasteners: All connectors are attached to wood with SD Series screws described in ESR-3046. For applications under the IBC, SD-Series screws may not be used in contact with preservative-treated or fire-retardant-treated wood, with the exception that for applications under the 2009 IBC, SD-Series screws may be used with SBX/DOT and zinc borate preservative-treated wood in interior, dry environments. For applications under the 2012, 2009 and 2006, IRC, the SD-Series wood screws may be used in contact with preservative-treated or fire-retardant-treated wood.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The tabulated allowable loads shown in this report are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the National Design Specification for Wood Construction and its supplement (NDS).

Tabulated allowable loads apply to products connected to wood used under dry conditions and where sustained temperatures are 100°F (37.8°C) or less. When products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable tension loads must be adjusted by the wet service factor, C_M, specified in the NDS. When connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C), the allowable loads in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

Connected wood members must be analyzed for load-carrying capacity at the connection in accordance with the NDS.

4.2 Installation:

Installation of the connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection:

4.3.1 Main Wind-force-resisting Systems under the IBC: Where required, periodic special inspection must be conducted for components within the main wind-force-resisting system in accordance with Sections 1704.2 and 1705.10 of the 2012 IBC, Sections 1704 and 1706 of the 2009 IBC, and Section 1704 of the 2006 IBC.

4.3.2 Seismic-force-resisting Systems under the IBC: Where required, periodic special inspection must be conducted for components within the seismic-force-resisting system in accordance with Sections 1704.2 and 1705.11 of the 2012 IBC, and Sections 1704 and 1707 of the 2009 and 2006 IBC.

4.3.3 Installations under the IRC: Special inspections are normally not required for connectors used in structures regulated under the IRC. However, for components and systems requiring an engineered design in accordance with IRC Section R301, periodic special inspection must be in accordance with Sections 4.3.1 and 4.3.2 of this report.

5.0 CONDITIONS OF USE

The Simpson Strong-tie connectors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of connectors with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 The design of anchorage to concrete and the concrete footings is outside the scope of this report.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010 (editorially revised December 2011).

6.2 Structural calculations.

6.3 Quality documentation.

7.0 IDENTIFICATION

The products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report (ESR-2523) which contains a summary of all the product model numbers in the ICC-ES evaluation reports, listed in that index report, for this manufacturer.

TABLE 1—A21 AND A23 ANGLES

MODEL NO.	DIMENSIONS (in)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS (lbs) [1,2,3,4]	
	L	W_1	W_2			F_1 [5]	F_2
				Base	Post	C_D= 1.6	C_D= 1.6
A21	$1^3/_8$	2	$1^1/_2$	2-SD9112	2-SD9112	430	165
A23	$2^3/_4$	2	$1^1/_2$	4-SD9112	4-SD9112	670	560

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
2. F_1 and F_2 loads cannot be combined.
3. The tabulated F_1 and F_2 allowable loads are for a single connector. The terminating member must be constrained against rotation for the F_2 load direction when the angle connectors are not used in pairs.
4. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
5. The F_1 load direction is that which results in the terminating member bearing on the flange of the connector. Connectors are required on both sides of the terminating member to resist allowable F_1 loads in both directions.

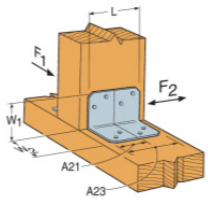


FIGURE 1—A21 AND A23 ANGLE INSTALLATION DETAIL

TABLE 2—A33 AND A44 ANGLES [1]

MODEL NO.	DIMENSIONS (in)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS (lbs) [2,3,4,5]	
	L	W_1	W_2			F_1 [6]	F_2
				Base	Post	C_D= 1.6	C_D= 1.6
A33	$1^1/_2$	3	3	4-SD9112	4-SD9112	830	335
A44	$1^1/_2$	$4^9/_{16}$	$4^3/_8$	4-SD9112	4-SD9112	805	290

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Dimension nomenclature is as follows: L is the width, W_1 is the length of the flange attached to the terminating member, and W_2 is the length of the flange attached to the continuous member.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. F_1 and F_2 loads cannot be combined.
4. The tabulated F_1 and F_2 allowable loads are for a single connector. The terminating member must be constrained against rotation for the F_2 load direction when the angle connectors are not used in pairs.
5. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
6. The F_1 load direction is that which results in the terminating member bearing on the flange of the connector. Connectors are required on both sides of the terminating member to resist allowable F_1 loads in both directions.

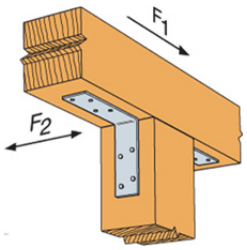


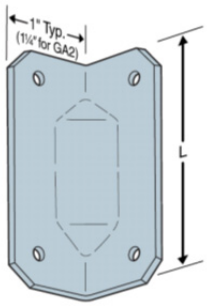
FIGURE 2—A33 AND A44 ANGLE INSTALLATION DETAIL

TABLE 3—GA ANGLES

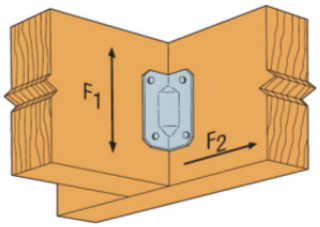
MODEL NO.	L (in)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS (lbs) [1,2,3,4]							
			F_1				F_2 [5]			
			C_D=1.0	C_D=1.15	C_D=1.25	C_D = 1.6	C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6
GA1	$2^3/_4$	4-SD9112	340	375	375	375	340	395	430	435
GA2	$3^1/_4$	6-SD9112	515	590	640	695	515	590	640	820

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. F_1 and F_2 loads cannot be combined.
3. The tabulated F_1 and F_2 allowable loads are for a single connector. The terminating member must be constrained against rotation for the F_1 load direction when the angle connectors are not used in pairs.
4. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
5. The F_2 load direction is that which results in the terminating member bearing on the flange of the connector. Connectors are required on both sides of the terminating member to resist allowable F_2 loads in both directions.



GA1



Typical GA Installation

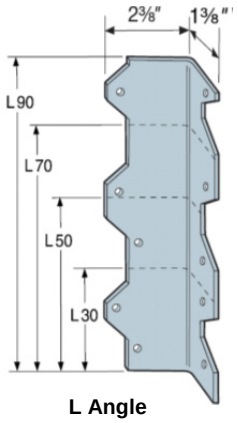
FIGURE 3—GA ANGLE

TABLE 4—L REINFORCING ANGLES

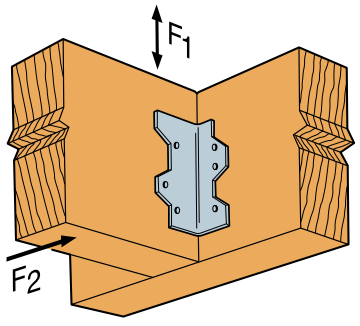
MODEL NO.	L (in)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS (lbs) [1,2,3,4]							
			F_1				F_2 [5]			
			C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6
L30	3	4-SD9112	290	290	290	290	340	395	430	545
L50	5	6- SD9112	515	535	535	535	515	590	640	820
L70	7	8- SD9112	685	785	855	1,015	685	785	855	1,095
L90	9	10- SD9112	855	985	1,070	1,180	855	985	1,070	1,370

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. F_1 and F_2 loads cannot be combined.
3. The tabulated F_1 and F_2 allowable loads are for a single connector. The terminating member must be constrained against rotation for the F_1 load direction when the angle connectors are not used in pairs.
4. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
5. The F_2 load direction is that which results in the terminating member bearing on the flange of the connector. Connectors are required on both sides of the terminating member to resist allowable F_2 loads in both directions.



L Angle



Typical L50 Installation

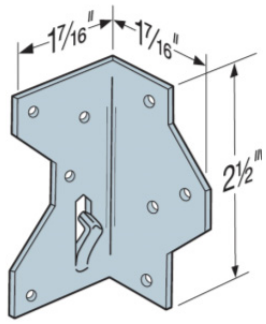
FIGURE 4—L REINFORCING ANGLE

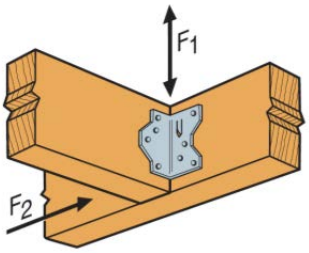
TABLE 5—A34 AND 35 FRAMING CONNECTORS[1]

MODEL NO.	FASTENERS (Quantity-Type)		DIRECTION OF LOAD	ALLOWABLE LOADS (lbs)[2,3,4,5]		
	Joist	Header/Plate		C_D=1.0	C_D=1.15	C_D=1.25 C_D=1.6
A34	4-SD9112	4- SD9112	F_1	640	640	640
	4-SD9112	4- SD9112	F_2[(6)]	495	495	495
A35	6-SD9112	6-SD9112	F_1	695	695	695
	6-SD9112	6-SD9112	F_2[(6)]	845	845	845
	3-SD9112	6-SD9112	A_1	260	295	320
	3-SD9112	6-SD9112	E	260	295	320
	3-SD9112	6-SD9112	C_1	170	170	170
	6-SD9112	6-SD9112	A_2	260	295	320
	6-SD9112	6-SD9112	C_2	260	295	315
	6-SD9112	6-SD9112	D	150	150	150

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Some illustrations show connections that could cause cross-grain tension or bending of the wood during loading if not reinforced sufficiently. In such cases, mechanical reinforcement should be considered.
2. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
3. Tabulated allowable loads given for different load directions cannot be combined.
4. The tabulated F_1 and F_2 allowable loads are for a single connector. The terminating member must be constrained against rotation for the F_1 load direction when the angle connectors are not used in pairs.
5. When angles are installed on each side of wood member, the minimum member thickness must be 3 inches.
6. The F_2 load direction is that which results in the terminating member bearing on the flange of the connector. Connectors are required on both sides of the terminating member to resist allowable F_2 loads in both directions.





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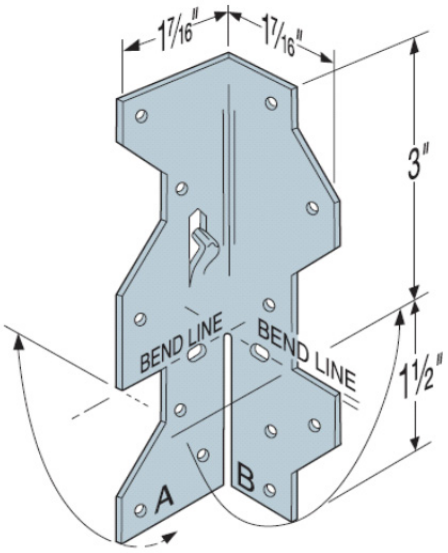
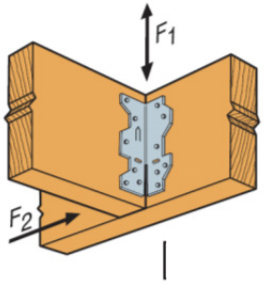
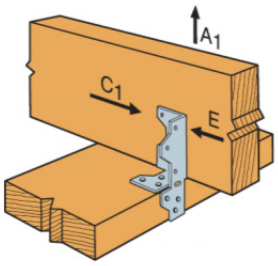
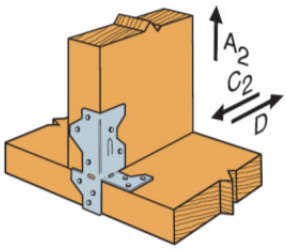








A35

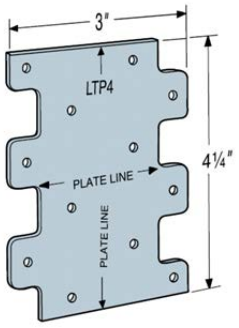
FIGURE 5—A ANGLES

TABLE 6—LTP4 FRAMING CONNECTOR

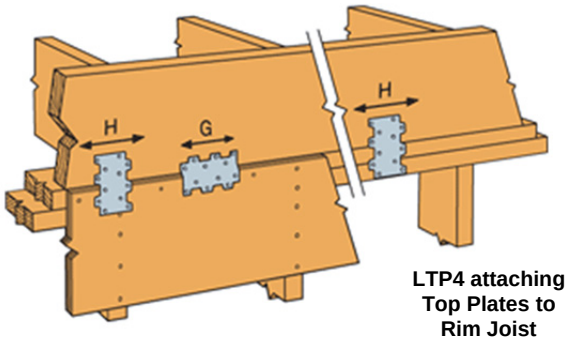
MODEL NO.	FASTENERS (Quantity-Type)		DIRECTION OF LOAD	ALLOWABLE LOADS (lbs)[1,2]			
	Plates	Rim Joist/Blocking		C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6
LTP4	6 – SD9112	6 – SD9112	G	910	910	910	910
	6 – SD9112	6 – SD9112	H	800	800	800	800

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. The LTP4 nay be installed over wood-based structural sheathing (as shown in Figure 6) having a maximum thickness of $^1/_2$ inch without adversely affecting the tabulated loads.



LTP4



LTP4 Installed over Sheathing

LTP4 attaching Top Plates to Rim Joist

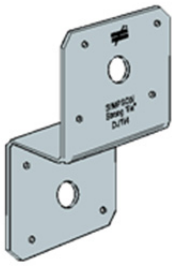
FIGURE 6—LTP4 FRAMING CONNECTOR

TABLE 7—DJTZ DECK JOIST TIE

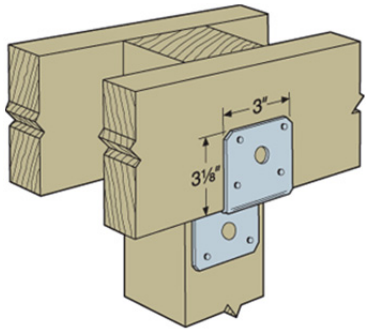
MODEL NO.	FASTENERS (Qty - Size)	ALLOWABLE DOWN LOADS (lbs)		
		SCREWS		
	SCREWS	C_D=1.0	C_D=1.15	C_D=1.25
DJT14Z	8-SD10212	1,250	1,460	1,490

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. The tabulated allowable loads are for a single connector.



DJT14Z



Typical DJT14Z Installation

FIGURE 7—DJTZ DECK JOIST TIE

TABLE 8—H-SERIES SEISMIC AND HURRICANE TIES

MODEL NO.	FASTENERS (qty – size)		ALLOWABLE LOADS (lbs)[1,2,3,4,5]		
			UPLIFT (C_D=1.6)	LATERAL (C_D=1.6)	
	TO RAFTER	TO PLATES		F_1	F_2
H1	6-SD9112	4- SD9112	505	600	390
H2.5	5-SD9112	5-SD9112	480	305	165
H2.5A	5-SD9112	5-SD9112	625	450	110
H4	4-SD9112	4-SD9112	325 [6]	200	135
H5	4-SD9112	4-SD9112	480	565	235
H8	5-SD9112	5-SD9112	820 [7]	85	-
H10	8-SD9112	8-SD9112	1135	840	325

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
2. Allowable loads are for one anchor. A minimum rafter thickness of $2^1/_2$ inches must be used when framing anchors are installed on each side of the joist and on the same side of the plate.
3. Allowable lateral loads in the F_1 direction (parallel to the plate) must not be used to replace diaphragm boundary members or nailing, or replace solid blocking required by code to laterally support the ends of joists or rafters.
4. When cross-grain bending or cross-grain tension cannot be avoided, mechanical reinforcement to all such forces must be provided where required.
5. Tabulated allowable loads given for different load directions cannot be simultaneously combined, i.e., the tie must be subjected to only one direction of load for each loading condition.
6. Maximum allowable uplift load for the H4 stud bottom plate installation is 415 lbs.
7. Maximum allowable uplift load for the H8 stud bottom plate installation is 380 lbs.

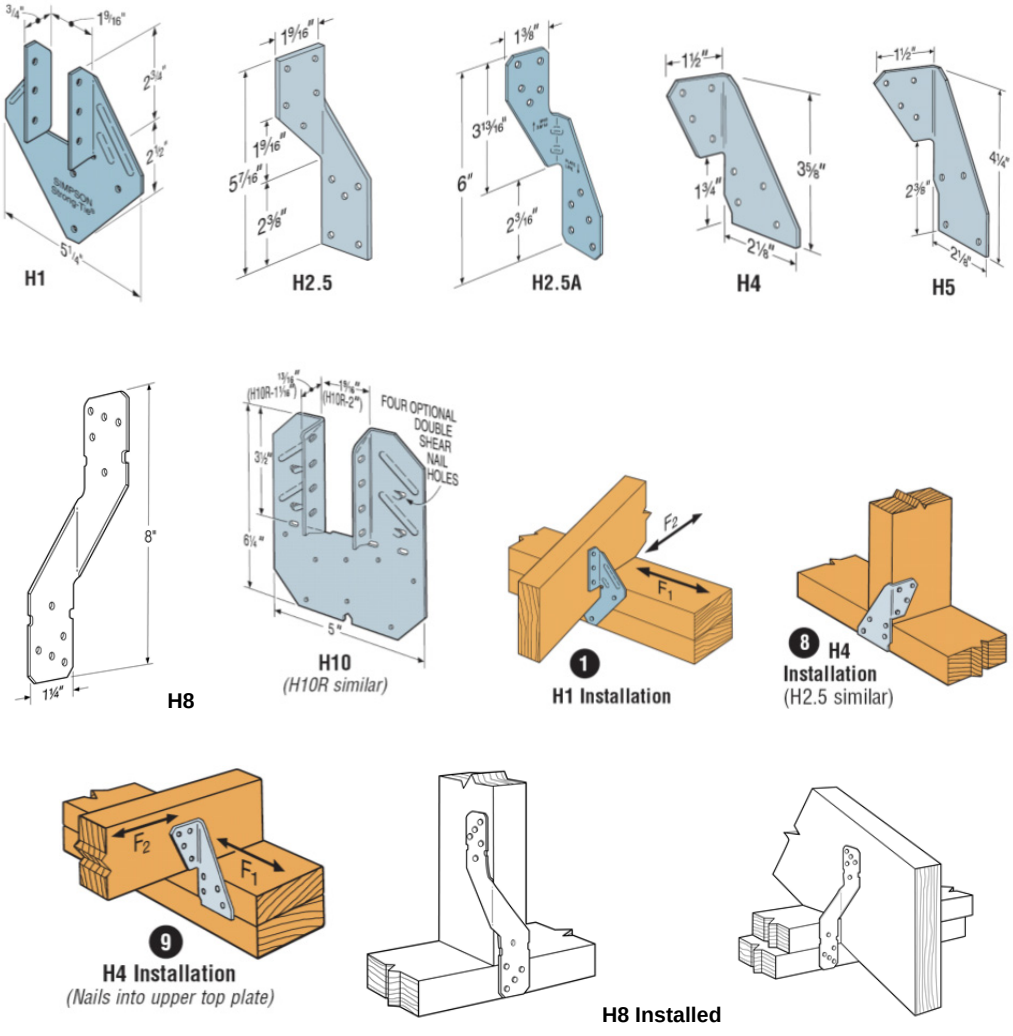


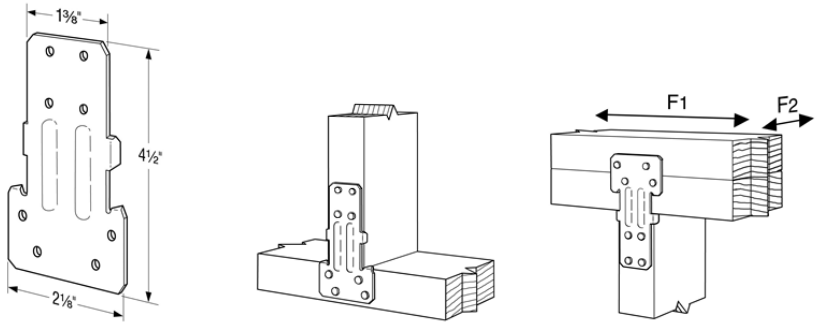
FIGURE 8—H-SERIES SEISMIC AND HURRICANE TIES

TABLE 9—RSP STUD PLATE TIE

MODEL NO.	DIMENSIONS (in)		FASTENERS (qty - size)		ALLOWABLE UPLIFT LOADS (lbs)	ALLOWABLE LOADS (lbs)[1,2,3]	
						F_1	F_2
	W	L	STUD	PLATE	C_D=1.6	C_D=1.6	C_D=1.6
RSP4(1)	$2^1/_8$	$4^1/_2$	4-SD9112	4-SD9112	520	205	190
RSP4(2)			4-SD9112	4-SD9112	520	275	255

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
2. F_1 and F_2 loads cannot be combined.
3. The F_1 load direction is parallel to the plate, and the F_2 load direction is perpendicular to the plate.



RSP4 **RSP4(1) Installation 1** **RSP4(2) Installation 2**

FIGURE 9—RSP STUD PLATE TIES

TABLE 10—AC SERIES POST CAPS

MODEL NO. [1]	DIMENSIONS (in)		FASTENERS (Qty - Size)		ALLOWABLE LOADS [2,3,4,5,6]	
					Uplift	Lateral
	W	L	Beam	Post	C_D=1.6	C_D=1.6
AC4 MAX	$3^9/_{16}$	$6^1/_2$	14 – SD10112	14 – SD10112	2,740	1,485
AC4R MAX	4	7	14 – SD10112	14 – SD10112	2,740	1,485
AC6 MAX	$5^1/_2$	$8^1/_2$	14 – SD10112	14 – SD10112	2,920	2,125
AC6R MAX	6	9	14 – SD10112	14 – SD10112	2,920	2,125

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. "MAX" suffix to the model number indicates that both round and triangular holes must be filled with the quantity of screws specified.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. Tabulated allowable loads are for a pair of connectors, with one connector installed on each side of the beam.
4. Tabulated allowable loads apply only to cases in which the beam is continuous through the connector.
5. Tabulated uplift and lateral loads cannot be combined.
6. Allowable lateral loads are for loads applied parallel to the length of the beam.

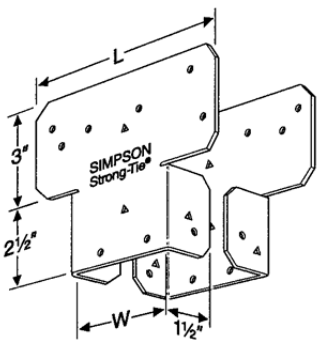


FIGURE 10—AC SERIES

TABLE 11—LCE4 POST CAP

MODEL NO.	FASTENERS (Qty - Size)		ALLOWABLE LOADS (lbs.)[1,2,3]	
			Uplift	Lateral [4]
	Beam	Post	C_D=1.6	C_D=1.6
LCE4	14-SD10112	10-SD10112	1,860	1,355

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
2. Tabulated allowable loads are for a pair of connectors, with one connector installed on each side of the beam.
3. Tabulated uplift and lateral loads cannot be combined.
4. Allowable lateral loads are for loads applied parallel to the length of the beam.

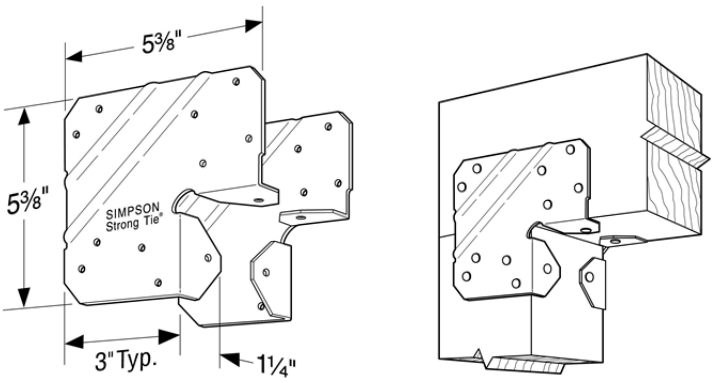


FIGURE 11—LCE4 POST CAP

TABLE 12—BC AND BCS SERIES POST CAPS[1]

MODEL NO.	DIMENSIONS (in)						FASTENERS (Qty - Size)		ALLOWABLE LOADS[2,3,4] (lbs)	
	W_1	W_2	L_1	L_2	H_1	H_2	Beam Flange	Post Flange	Uplift	Lateral [5]
									C_D=1.6	C_D=1.6
BC4	$3^9/_{16}$	$3^9/_{16}$	$2^7/_8$	$2^7/_8$	3	3	6-SD10112	6-SD10112	705	1,075
BCS2-2/4[6,7]	$3^1/_8$	$3^9/_{16}$	$2^7/_8$	$2^7/_8$	$2^{15}/_{16}$	$2^{15}/_{16}$	8-SD9212	6-SD9212	840	1,115

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. The BC and BCS post caps must be used with wood beams having a width less than or equal to the width of the supporting post.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. Tabulated allowable loads apply only to cases in which the beam is continuous through the connector.
4. Tabulated uplift and lateral loads cannot be combined.
5. Allowable lateral loads are for loads applied parallel to the length of the beam.
6. The BCS2-2/4 post cap is designed for the connection of double 2x's to a nominally 4-inch-wide post.
7. The BCS has slanted fastener holes for screws that must be installed into the beam at a 45-degree angle and penetrate into the end grain of the supporting post.

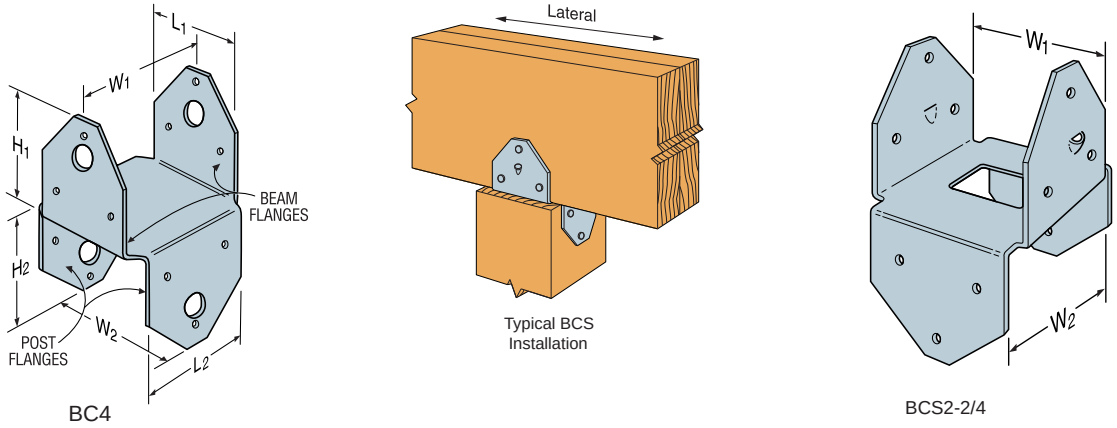


FIGURE 12—BC AND BCS SERIES

TABLE 13—BCO SERIES POST BASES

MODEL NO.	NOMINAL POST SIZE	FASTENERS (Qty - Size)		Allowable Uplift Loads[1,2] (lbs.) (C_D=1.6)	
		Post Flange	Base Bottom	Uplift	Lateral [3]
BC40	4x	6-SD10112	4-SD10112	805	770
BC60	6x	6-SD10112	4-SD10112	680	920

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
2. Tabulated uplift and lateral loads cannot be combined.
3. Allowable lateral loads are for loads applied perpendicular to the flanges of the connector.

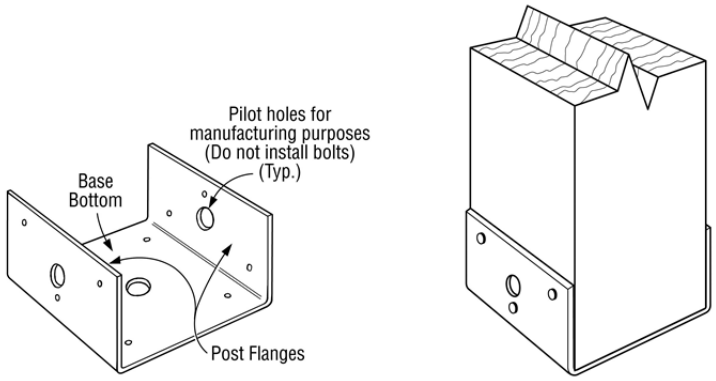


FIGURE 13—BCO SERIES

TABLE 14—LPC SERIES LIGHT POST CAP[1]

MODEL NO.	FASTENERS (Qty - Size)		ALLOWABLE LOADS (lbs.)[2,3,4,5]	
			Uplift	Lateral [6]
	Beam	Post	C_D=1.6	C_D=1.6
LPC4Z	8-SD9112	8-SD9112	695	830

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. The LPC post cap must be used with wood beams having a width less than or equal to the width of the supporting post.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. Tabulated allowable loads are for a pair of connectors, with one connector installed on each side of the beam.
4. Tabulated allowable loads apply only to cases in which the beam is continuous through the connector.
5. Tabulated uplift and lateral loads cannot be combined.
6. Allowable lateral loads are for loads applied parallel to the length of the beam.

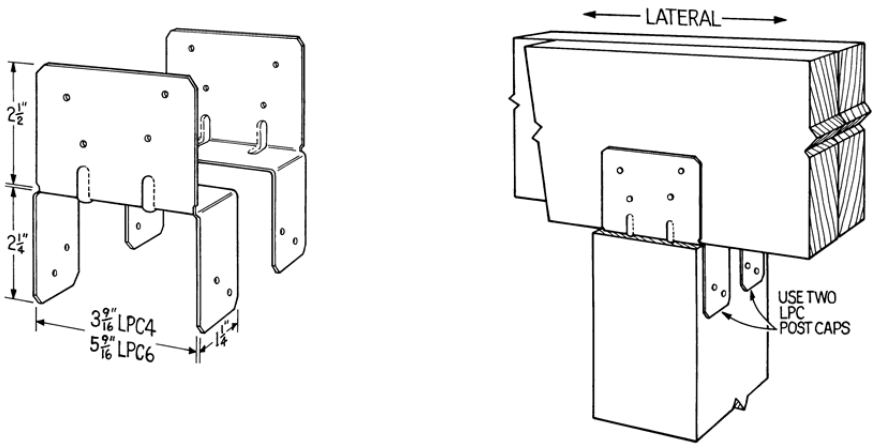


FIGURE 14—LPC SERIES

TABLE 15—PC AND EPC SERIES POST CAPS

MODEL NO.	POST SIZE	DIMENSIONS (in)					FASTENERS [1] (Qty per Flange - Size)			ALLOWABLE LOADS[2,3,4] (lbs)			
							SURFACES			UPLIFT		LATERAL[5]	
		W1	W2	L1	L2	L3	Post Flange	Beam Flange PC	Beam Flange EPC	PC	EPC	PC	EPC
										C_D=1.6	C_D=1.6	C_D=1.6	C_D=1.6
PC44-16	4x4	$3^{9}/_{16}$	$3^{9}/_{16}$	$2^{5}/_{8}$	11	$7^{3}/_{8}$	4-SD10112	6-SD10112	4-SD10112	730	890	1,260	1,105
PC44	4x4	$3^{9}/_{16}$	$3^{9}/_{16}$	$2^{5}/_{8}$	11	$7^{3}/_{8}$	4-SD10112	6-SD10112	4-SD10112	1,930	1,150	1,600	1,785

For **SI:** 1 inch = 25.4 **mm**, 1 lbf = 4.45 N.

1. The tabulated fastener quantity is the number of screws required in each flange of the PC or EPC connector.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. Tabulated allowable loads for the PC series post cap apply only to cases in which the beam is continuous through the connector.
4. Tabulated uplift and lateral loads cannot be combined.
5. Allowable lateral loads are for loads applied parallel to the length of the beam.

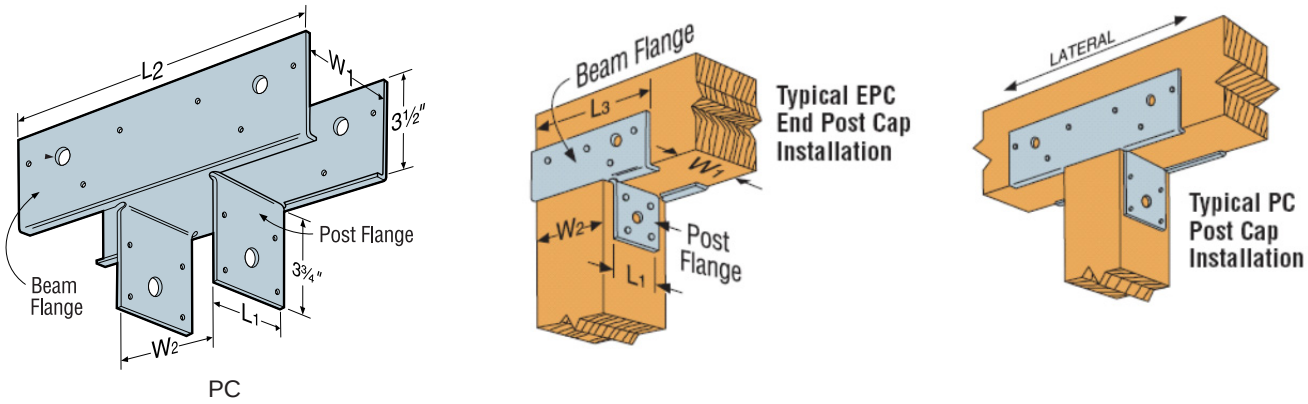


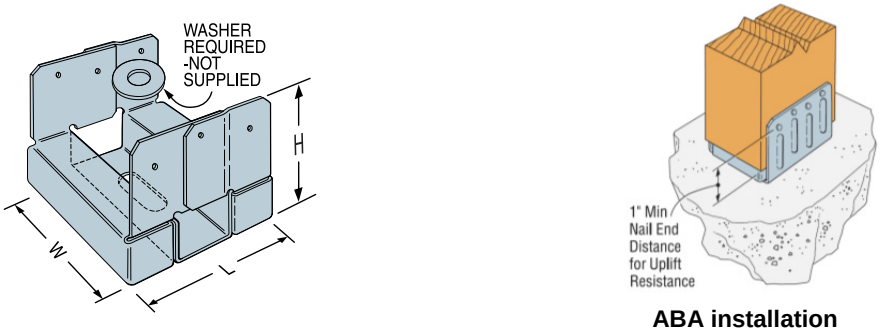
FIGURE 15—PC AND EPC SERIES

TABLE 16—ABA ADJUSTABLE POST BASE

MODEL NO.	DIMENSIONS (inches)			FASTENERS		ALLOWABLE LOADS (lbs) [1,2]	
	W	L	H	ANCHOR DIAMETER (inches)	NAILS (Qty-Size)	UPLIFT C_D=1.6	DOWNLOADS C_D=1.0, C_D=1.15, C_D=1.25
ABA44	$3^{9}/_{16}$	$3^{1}/_{8}$	$3^{1}/_{16}$	$^{1}/_{2}$	6-SD9112	610	6,000
ABA44R	$4^{1}/_{16}$	$3^{1}/_{8}$	$2^{13}/_{16}$	$^{1}/_{2}$	6-SD9112	610	8,000
ABA46	$3^{9}/_{16}$	$5^{3}/_{16}$	$3^{1}/_{8}$	$^{5}/_{8}$	8-SD10112	940	9,435
ABA46R	$4^{1}/_{16}$	$5^{3}/_{16}$	$2^{7}/_{8}$	$^{5}/_{8}$	8-SD10112	940	12,000
ABA66	$5^{1}/_{2}$	$5^{1}/_{4}$	$3^{1}/_{8}$	$^{5}/_{8}$	8-SD10112	970	10,665
ABA66R	6	$5^{3}/_{16}$	$2^{7}/_{8}$	$^{5}/_{8}$	8-SD10112	970	12,665

For **SI:** 1 **inch** = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. Anchor bolts and concrete footings must be capable of resisting all loads and forces transferred from the post base connector.



ABA installation

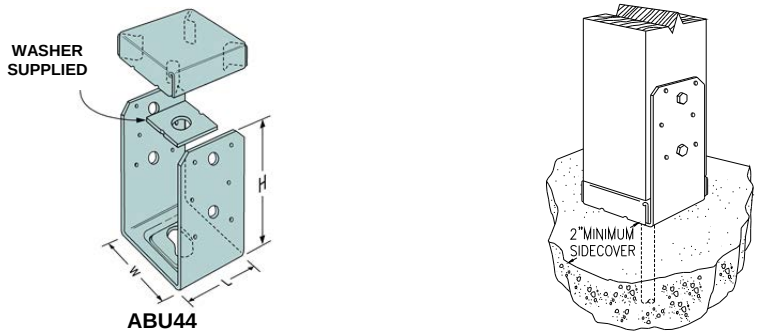
FIGURE 16—ABA ADJUSTABLE POST BASE

TABLE 17—ABU ADJUSTABLE POST BASE

MODEL NO.	DIMENSIONS (inches)			FASTENERS (Quantity-Size)		ALLOWABLE LOADS[1,2] (lbs)	
	W	L	H	Post	Anchor Diameter (inches)	Uplift C_D=1.6	Download C_D=1.0, C_D=1.15, C_D=1.25
ABU44	$3^{9}/_{16}$	3	$5^{1}/_{2}$	12-SD10112	$^{5}/_{8}$	2,140	6,665

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. Anchor bolts and concrete footings must be capable of resisting all loads and forces transferred from the post base connector.



ABU44

FIGURE 17—ABU44 POST BASE

TABLE 18—LU SERIES JOIST HANGERS

MODEL No.	DIMENSIONS (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] (lbs)			
	W	H	B	Header	Joist	Uplift	Download		
						C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
LU24	$1^{9}/_{16}$	$3^{1}/_{8}$	$1^{1}/_{2}$	4-SD9112	2-SD9112	340	685	725	725
LU26	$1^{9}/_{16}$	$4^{3}/_{4}$	$1^{1}/_{2}$	6-SD9112	4-SD9112	915	1,025	1,030	1,030
LU28	$1^{9}/_{16}$	$6^{3}/_{8}$	$1^{1}/_{2}$	8-SD9112	6-SD9112	995	1,370	1,380	1,380
LU210	$1^{9}/_{16}$	$7^{13}/_{16}$	$1^{1}/_{2}$	10-SD9112	6-SD9112	1,150	1,710	1,965	2,010

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. LU series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist unless additional lateral restraint is provided, as designed by others.

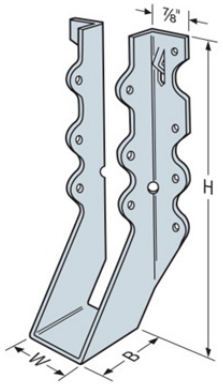


FIGURE 18—LU JOIST HANGER

TABLE 19—LUCZ SERIES JOIST HANGERS

MODEL No.	DIMENSIONS (inches)		FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] (lbs)			
	W	H	Header	Joist	Uplift	Download		
					C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
LUC26Z	$1^9/_{16}$	$4^3/_4$	6-SD9112	4-SD9112	865	1,025	1,180	1,285
			6-SD10112	4-SD10112	915	1,040	1,195	1,300
LUC210Z	$1^9/_{16}$	$7^3/_4$	10-SD9112	6-SD9112	1,605	1,710	1,965	2,030
			10-SD10112	6-SD10112	1,580	1,730	1,990	2,165

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. LUCZ series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist unless additional lateral restraint is provided, as designed by others.

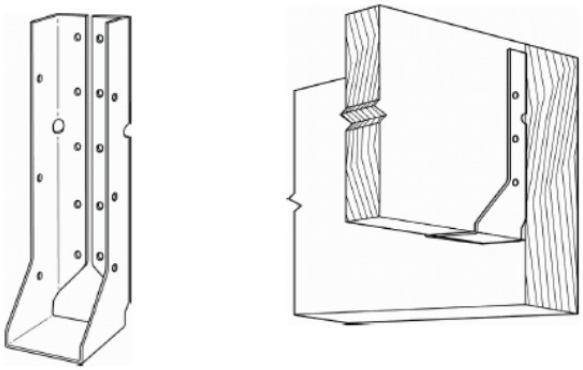


FIGURE 19—LUCZ SERIES HANGER

TABLE 20—LUS SERIES JOIST HANGERS[1]

MODEL NO.	DIMENSIONS (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3] (lbs)			
	W	H	B	Header	Joist[4]	Uplift	Download		
						C_D=1.6	C_D=1.0	C_D=1.15	C_D=1.25
LUS24	1 9/16	3 1/8	1 3/4	4-SD9212	2-SD9212	490	895	895	895
				4-SD9112	2-SD9212	490	840	895	895
LUS26	1 9/16	4 3/4	1 3/4	4-SD9212	4-SD9212	1,180	1,110	1,270	1,385
				4-SD9112	4-SD9212	1,180	990	1,140	1,240
LUS28	1 9/16	6 5/8	1 3/4	6-SD9212	4-SD9212	1,310	1,510	1,610	1,610
				6-SD9112	4-SD9212	1,310	1,335	1,530	1,610
LUS210	1 9/16	7 13/16	1 3/4	8-SD9212	4-SD9212	1,240	1,910	2,125	2,125
				8-SD9112	4-SD9212	1,240	1,675	1,925	2,095
LUS24-2	3 1/8	3 1/8	2	4-SD10212	2-SD10212	530	1,035	1,190	1,295
				4-SD10112	2-SD10212	530	860	990	1,075
LUS26-2	3 1/8	4 7/8	2	4-SD10212	4-SD10212	1,075	1,205	1,385	1,505
				4-SD10112	4-SD10212	1,075	1,030	1,185	1,285
LUS28-2	3 1/8	7	2	6-SD10212	4-SD10212	1,200	1,640	1,885	2,050
				6-SD10112	4-SD10212	1,200	1,375	1,580	1,720
LUS210-2	3 1/8	9	2	8-SD10212	6-SD10212	1,800	2,240	2,580	2,800
				8-SD10112	6-SD10212	1,800	1,890	2,175	2,360

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. The LUS24, LUS26, LUS28 and LUS210 are designed for use with nominal 2x lumber. The suffix "-2" to certain model numbers designates that these hangers are designed for built-up joists consisting of two nominal 2x members.
2. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
3. LUS series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist unless additional lateral restraint is provided, as designed by others.
4. Joist nails must be driven at a 45-degree angle through the joist and into the header/beam to achieve the tabulated loads.

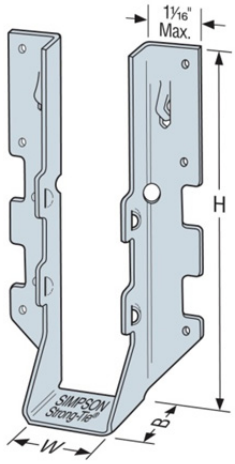


FIGURE 20—LUS HANGER

TABLE 21—HUS SERIES JOIST HANGERS

MODEL NO.	DIMENSIONS (inches)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] (lbs)			
						Uplift	Download		
	W	H	B	Header	Joist[3]	C_D = 1.6	C_D=1.0	C_D=1.15	C_D=1.25
HUS26	$1^5/_8$	$5^3/_8$	3	14-SD10212	6-SD10212	1,100	3,040	3,125	3,125
HUS28	$1^5/_8$	7	3	22-SD10212	8-SD10212	2,135	3,880	3,880	3,880

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. LUS series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist unless additional lateral restraint is provided, as designed by others.
3. Joist nails must be driven at a 45-degree angle through the joist and into the header/beam to achieve the tabulated loads.

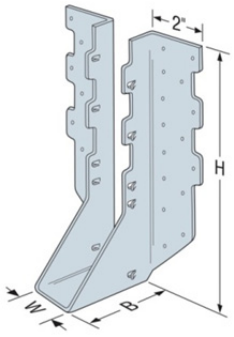


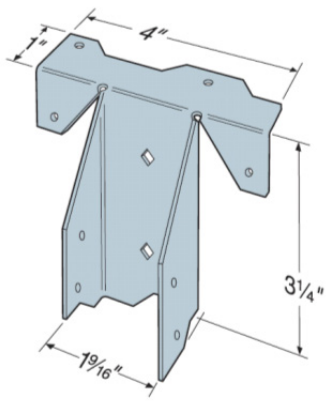
FIGURE 21—HUS HANGER

TABLE 22—ALLOWABLE LOADS FOR THE RR RIDGE RAFTER CONNECTOR

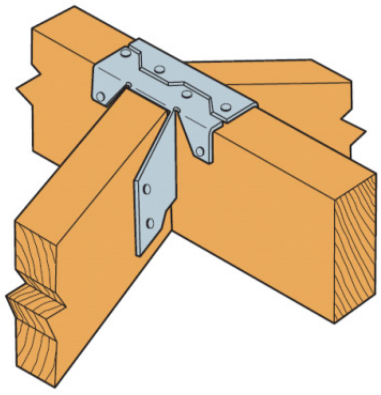
MODEL NO.	FASTENERS (Quantity – Size)		ALLOWABLE LOADS (lbs)			
			Uplift	Download		
	Header	Joist	C_D = 1.6	C_D = 1.0	C_D = 1.15	C_D = 1.25
RR	4 – SD9112	4 – SD9112	205	475	475	475

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Tabulated allowable loads have been adjusted for load duration factors, C_D, as shown, in accordance with the NDS, and are not permitted to be adjusted for other load durations.
2. RR series hangers provide torsional resistance, which is defined as a moment of not less than 75 pounds times the depth of the joist at which the lateral movement of the top or bottom of the joist with respect to its vertical position is 0.125 inch (3.2 mm). The height, H, of the joist hanger must be at least 60 percent of the height of the joist unless additional lateral restraint is provided, as designed by others.



RR



RR Installed

FIGURE 22—RR CONNECTOR

TABLE 23—ALLOWABLE LOADS FOR MTS TWIST STRAPS

MODEL NO.	LENGTH (in)	FASTENERS[1,3] (Quantity-Type)	ALLOWABLE UPLIFT LOADS[2] (lbs)
			C_D=1.6
MTS12	12	14-SD9112	870
MTS16	16	14-SD9112	870
MTS20	20	14-SD9112	940

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1. Half of the fasteners must be installed into each member to achieve the tabulated allowable uplift loads.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.
3. The MTS twist straps have more fastener holes than the minimum quantity of screws specified in the table.

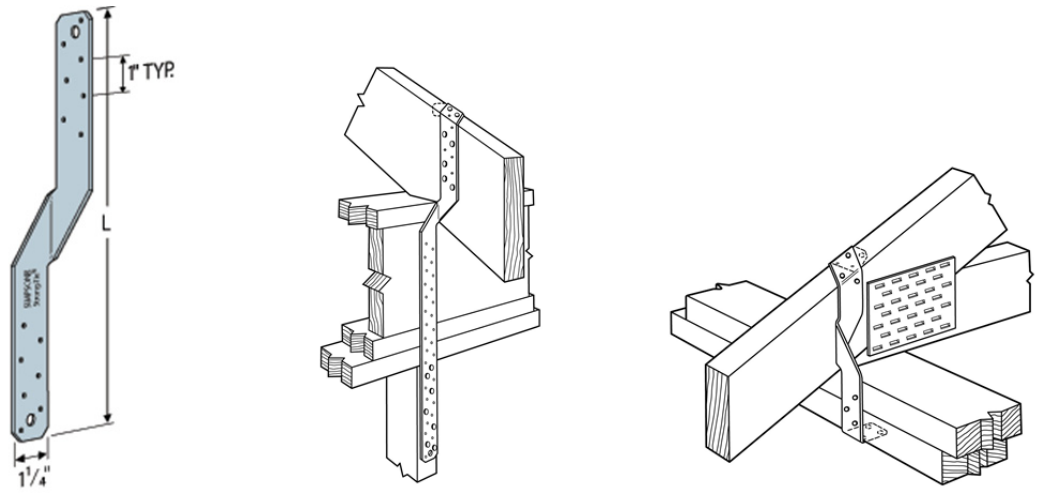


FIGURE 23—MTS TWIST STRAP AND TYPICAL INSTALLATIONS

TABLE 24—ALLOWABLE LOADS FOR ST STRAPS

MODEL SERIES	MODEL NO.	THE STRAP PROPERTIES				FASTENERS (Total Quantity-Size)	ALLOWABLE TENSION LOADS (lbs.)
		Thickness (Gage No.)	Length (in.)	Min. F_y (ksi)	Min. F_u (ksi)		C_D =1.6
ST	ST292	20	$9^{5}/_{16}$	33	45	12-SD10112	1,215
	ST2122	20	$12^{13}/_{16}$	40	55	12-SD10112	1,480
	ST2115	20	$16^{5}/_{16}$	50	65	6-SD10112	660
	ST2215	20	$16^{5}/_{16}$	50	65	14-SD10112	1,750
	ST6215	16	$16^{5}/_{16}$	33	45	16-SD10112	2,010
	ST6224	16	$23^{5}/_{16}$	40	55	20-SD10112	2,460
	ST6236	14	$33^{13}/_{16}$	50	65	28-SD10112	3,590
	ST9	16	9	33	45	8-SD10112	1,105
	ST12	16	$11^{5}/_{8}$	33	45	10-SD10112	1,385
	ST18	16	$17^{3}/_{4}$	33	45	12-SD10112	1,420
	ST22	16	$21^{5}/_{8}$	33	45	20-SD10112	1,420

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.895 MPa.

1. Half of the fasteners must be installed into each member to achieve the tabulated allowable uplift loads.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.

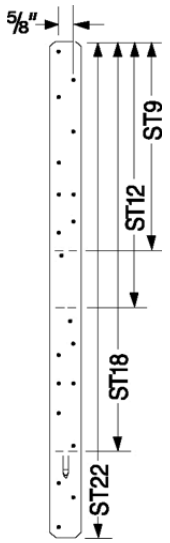


FIGURE 24—ST STRAPS

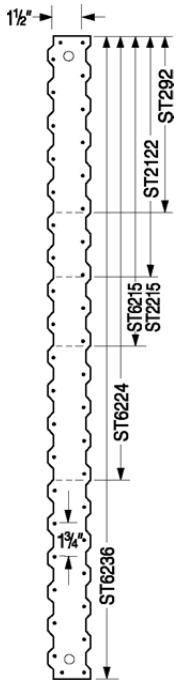


FIGURE 25—ST STRAPS

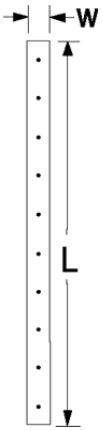


FIGURE 26—ST2115

TABLE 25—MST STRAPS

MODEL SERIES	MODEL NO.	THE STRAP PROPERTIES				FASTENERS[1] (Quantity-Size)	ALLOWABLE TENSION LOADS[2] (lbs.)
		Thick. (Gage No.)	Length (in.)	Min. F_y (ksi)	Min. F_u (ksi)	Screws	C_D =1.6
MST	MST27	12	27	40	55	30-SD10112	4,150
	MST37	12	$37^1/_2$	40	55	40-SD10112	5,070

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.895 MPa.

1. Half of the fasteners must be installed into each member to achieve the tabulated allowable uplift loads.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.

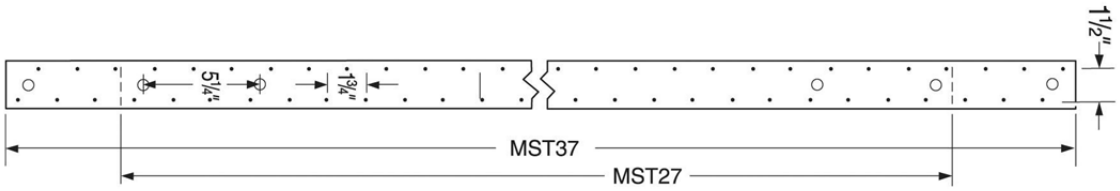


FIGURE 27—MST STRAPS

TABLE 26—LSTA, MSTA, LSTI, AND MSTI SERIES TIE STRAPS[1]

MODEL SERIES	MODEL NO.	THE STRAP PROPERTIES				FASTENERS[2] (Total Quantity-Size)	ALLOWABLE TENSION LOADS[3] (lbs.)
		Thickness (Gage No.)	Length (in.)	Min. F_y (ksi)	Min. F_u (ksi)		C_D =1.6
LSTA	LSTA9	20	9	50	65	8-SD9112	1,095
	LSTA12	20	12	50	65	10-SD9112	1,235
	LSTA15	20	15	50	65	12-SD9112	1,235
	LSTA18	20	18	50	65	14-SD9112	1,235
	LSTA21	20	21	50	65	14-SD9112	1,235
	LSTA24	20	24	50	65	14-SD9112	1,235
	LSTA30	18	30	50	65	14-SD9112	1,640
	LSTA36	18	36	50	65	14-SD9112	1,415
MSTA	MSTA9	18	9	50	65	8-SD9112	1,095
	MSTA12	18	12	50	65	10-SD9112	1,370
	MSTA15	18	15	50	65	12-SD9112	1,640
	MSTA18	18	18	50	65	14-SD9112	1,640
	MSTA21	18	21	50	65	14-SD9112	1,640
	MSTA24	18	24	50	65	14-SD9112	1,640
	MSTA30	16	30	50	65	16-SD9112	2,050
	MSTA36	16	36	50	65	16-SD9112	1,970
	MSTA49	16	49	50	65	16-SD9112	2,050
LSTI	LSTI49	18	49	40	55	32-SD9112	4,205
	LSTI73	18	73	40	55	32-SD9112	4,205
MSTI	MSTI26	12	26	40	55	26-SD9112	3,555
	MSTI36	12	36	40	55	36-SD9112	4,925
	MSTI48	12	48	40	55	38-SD9112	5,070
	MSTI60	12	60	40	55	38-SD9112	5,070
	MSTI72	12	72	40	55	60-SD9112	5,070
MSTC	MSTC28	16	$28^1/_4$	50	65	36-SD9112	4,735
	MSTC40	16	$40^1/_4$	50	65	46-SD9112	4,735
	MSTC52	16	$52^1/_4$	50	65	42-SD9112	4,735
	MSTC66	14	$65^3/_4$	50	65	44-SD9112	5,850
	MSTC78	14	$77^3/_4$	50	65	44-SD9112	5,850

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.895 MPa.

1. Refer to Figures 28, 29, 30 and 31 (following page) for diagrams depicting the LSTA/MSTA, LSTI, MSTI and MSTC straps, respectively.
2. Half of the fasteners must be installed into each member to achieve the tabulated allowable uplift loads.
3. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.

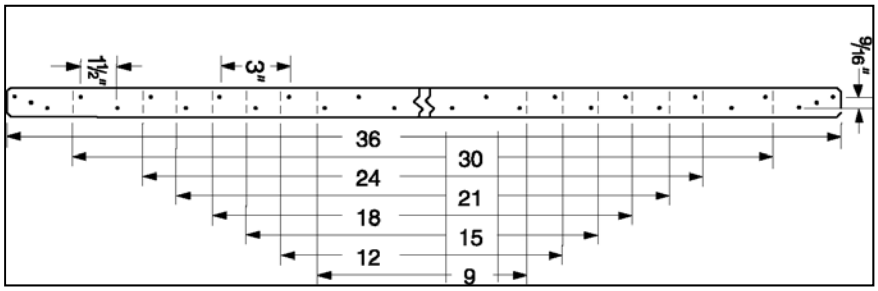


FIGURE 28—LSTA/MSTA STRAPS

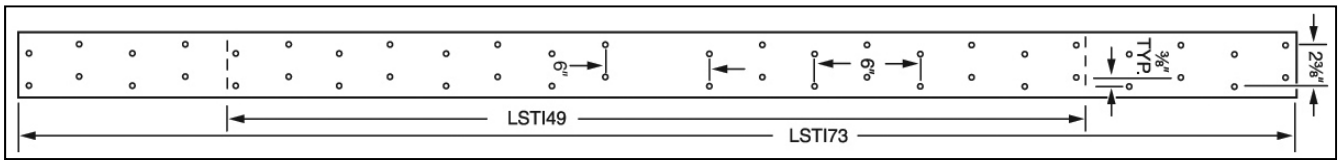


FIGURE 29—LSTI STRAPS

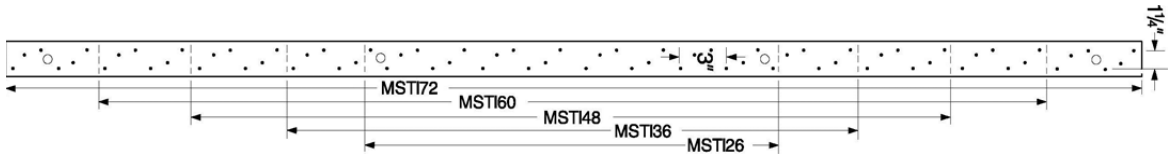


FIGURE 30—MSTI STRAPS

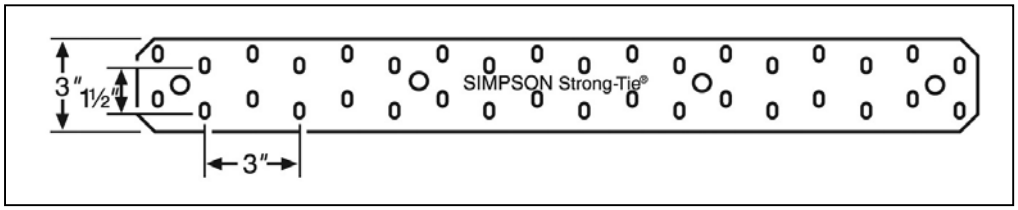


FIGURE 31—MSTC28, OTHER MODELS SIMILAR

TABLE 27—HTP37Z TIE STRAP

MODEL SERIES	MODEL NO.	THE STRAP PROPERTIES				FASTENERS (Total Quantity-Size)	ALLOWABLE TENSION LOADS (lbs.)
		Thickness (Gage No.)	Length (in.)	Min. F_y (ksi)	Min. F_u (ksi)		C_D =1.6
HTP	HTP37Z	16	7	33	45	20-SD9112	2,735
HRS	HRS6	12	6	33	45	6-SD9112	820
	HRS8	12	8	33	45	10-SD9112	1,370
	HRS12	12	12	33	45	14-SD9112	1,915

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi = 6.895 MPa.

1. Half of the fasteners must be installed into each member to achieve the tabulated allowable uplift loads.
2. Tabulated allowable loads have been adjusted for a load duration factor, C_D, of 1.6, corresponding to a ten-minute load duration (i.e., wind or earthquake loading), in accordance with the NDS. The allowable loads do not apply to loads of other durations.

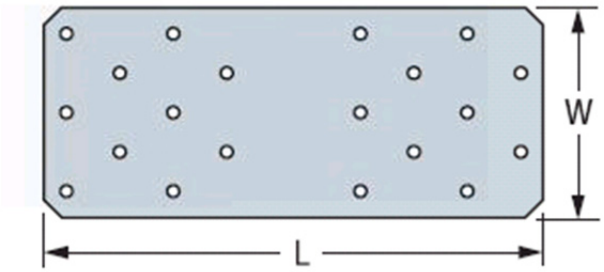


FIGURE 32—HTP37Z STRAP

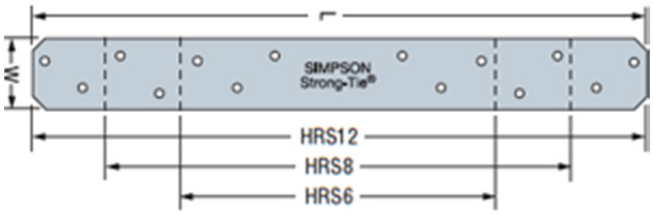


FIGURE 33—HRS STRAP

TABLE 28—STEEL SPECIFICATIONS, GRADES, MINIMUM TENSILE AND YIELD STRENGTHS, AND BASE METAL THICKNESS

MODEL	GAGE NO.	SPECIFICATION	F_y (ksi)	F_u (ksi)	BASE METAL THICKNESS (in.)
A21	18	A-653 SS GR 33	33	45	0.0445
A23	18	A-653 SS GR 33	33	45	0.0445
A33	12	A-653 SS GR 33	33	45	0.0975
A44	12	A-653 SS GR 33	33	45	0.0975
GA Series	18	A-653 SS GR 33	33	45	0.0445
L Series	16	A-653 SS GR 33	33	45	0.0555
A34	18	A-653 SS GR 33	33	45	0.0445
A35	18	A-653 SS GR 33	33	45	0.0445
LTP4	20	A-653 SS GR 33	33	45	0.0335
DJT14Z	14	A-653 SS GR 33	33	45	0.0685
H1	18	A-653 SS GR 33	33	45	0.0445
H2.5	18	A-653 SS GR 33	33	45	0.0445
H2.5A	18	A-653 SS GR 40	40	55	0.0445
H4	20	A-653 SS GR 33	33	45	0.0335
H5	18	A-653 SS GR 33	33	45	0.0445
H8	18	A-653 SS GR 40	40	55	0.0445
H10	18	A-653 SS GR 33	33	45	0.0445
RSP4	20	A-653 SS GR 33	33	45	0.0335
AC Series	18	A-653 SS GR 33	33	45	0.0445
LCE4	20	A-653 SS GR 40	40	55	0.0335
BC4	18	A-653 SS GR 33	33	45	0.0445
BCS2-2/4	18	A-653 SS GR 33	33	45	0.0445
BCO Series	18	A-653 SS GR 33	33	45	0.0445
LPC4Z	18	A-653 SS GR 33	33	45	0.0445
PC44-16	16	A-653 SS GR 33	33	45	0.0555
PC44	12	A-653 SS GR 33	33	45	0.0975
EPC44-16	16	A-653 SS GR 33	33	45	0.0555
EPC44	12	A-653 SS GR 33	33	45	0.0975
ABA44/44R	16	A-653 SS GR 33	33	45	0.0555
ABA Series	14	A-653 SS GR 33	33	45	0.0685
ABU44 Base	12	A-653 SS GR 33	33	45	0.0975
ABU44 Plate	7	A-653 SS GR 33	33	45	0.1715
LU Single Series	20	A-653 SS GR 33	33	45	0.0335
LUCZ Series	18	A-653 SS GR 33	33	45	0.0445
LUS Series	18	A-653 SS GR 33	33	45	0.0445
HUS Series	16	A-653 SS GR 33	33	45	0.0555
RR	18	A-653 SS GR 33	33	45	0.0445
MTS Series	16	A-653 SS GR 33	33	45	0.0555
ST292	20	A-653 SS GR 33	33	45	0.0335
ST2122	20	A-653 SS GR 40	40	55	0.0335
ST2115	20	A-653 SS GR 50 CL1	50	65	0.0335
ST2215	20	A-653 SS GR 50 CL1	50	65	0.0335
ST6215	16	A-653 SS GR 33	33	45	0.0555
ST6224	16	A-653 SS GR 40	40	55	0.0555
ST6236	14	A-653 SS GR 50 CL1	50	65	0.0685
ST9	16	A-653 SS GR 33	33	45	0.0555
ST12	16	A-653 SS GR 33	33	45	0.0555
ST18	16	A-653 SS GR 33	33	45	0.0555
ST22	16	A-653 SS GR 33	33	45	0.0555
MST27	12	A-653 SS GR 40	40	55	0.0975
MST37	12	A-653 SS GR 40	40	55	0.0975

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.895 MPa.

TABLE 28 (CONTINUED)—STEEL SPECIFICATIONS, GRADES, MINIMUM TENSILE AND YIELD STRENGTHS, AND BASE METAL THICKNESS

MODEL	GAGE NO.	SPECIFICATION	F_y (ksi)	F_u (ksi)	BASE METAL THICKNESS (in.)
LSTA9	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA12	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA15	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA18	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA21	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA24	20	A-653 SS GR 50 CL1	50	65	0.0335
LSTA30	18	A-653 SS GR 50 CL1	50	65	0.0445
LSTA36	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA9	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA12	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA15	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA18	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA21	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA24	18	A-653 SS GR 50 CL1	50	65	0.0445
MSTA30	16	A-653 SS GR 50 CL1	50	65	0.0555
MSTA36	16	A-653 SS GR 50 CL1	50	65	0.0555
MSTA49	16	A-653 SS GR 50 CL1	50	65	0.0555
LSTI Series	18	A-653 SS GR 40	40	55	0.0445
MSTI Series	12	A-653 SS GR 40	40	55	0.0975
MSTC28	16	A-653 SS GR 50 CL1	50	65	0.0555
MSTC40	16	A-653 SS GR 50 CL1	50	65	0.0555
MSTC52	16	A-653 SS GR 50 CL1	50	65	0.0555
MSTC66	14	A-653 SS GR 50 CL1	50	65	0.0685
MSTC78	14	A-653 SS GR 50 CL1	50	65	0.0685
HTP37Z	16	A-653 SS GR 33	33	45	0.0555
HRS	12	A-653 SS GR 33	33	45	0.0975

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.895 MPa.

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ICC-ES Evaluation Report

ESR-2330

Reissued April 1, 2013
This report is subject to renewal May 1, 2014.

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE® SCREW HOLD-DOWN CONNECTORS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

Simpson Strong-Tie® screw hold-down connectors are used as wood framing anchorage, such as to connect wood posts to concrete foundations or to connect an upper- story wood post to a lower-story supporting wood post, in accordance with IBC Sections 2304.9.3, 2305.1, 2305.3, 2308.9.3.1, and 2308.9.3.2; and 2008 AF&PA SDPWS Sections 4.3.6.4.2 and 4.3.6.1.2; and are used as anchorage of concrete and masonry walls to structural wood elements to provide lateral support for the walls as required by IBC Section 1604.8. The hold-down connectors may also be used in structures regulated under the IRC, when an engineered design is submitted in accordance with Section R301.1.3 of the IRC; or when used in accordance with the prescriptive provisions of 2012 IRC Sections R507.2.3, R602.10.2.2.1, R602.10.6.1, R602.10.6.2, R602.10.6.5 and R602.10.7; or 2009 IRC Sections R502.2.2.3, R602.10.1.4.1(2), R602.10.3.2, R602.10.3.3, R602.10.4.4 and R602.10.5.3.

3.0 DESCRIPTION

3.1 General:

3.1.1 HDU Hold-downs: HDU hold-downs consist of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and a base plate component that provides a seat for an anchor rod/bolt nut, as shown in Figure 1. The body of the HDU2, HDU4 and HDU5 hold-downs is formed from No. 14 gage galvanized steel; the HDU8 and HDU11 bodies are formed from No. 10 gage galvanized steel; and the HDU14 body is formed from No. 7 gage galvanized steel. The base plate component for all HDU hold-downs is formed from No. 3 gage galvanized steel. See Table 1A for HDU hold-down dimensions and fastener requirements.

3.1.2 HDQ8 and HHDQ Hold-downs: The HDQ8 hold-down consists of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the HDQ8 hold-down to the wood member, and steel crossbars and a washer for an anchor rod/bolt nut, as shown in Figure 2A. The HHDQ11 and HHDQ14 hold-downs also have a main structural steel component with pre-drilled holes for SDS wood screws used to connect HHDQ hold-downs to the wood member, and have a factory-welded load transfer plate at its base for an anchor rod or bolt. The HDQ8 body is formed from No. 7 gage galvanized steel, and its crossbars are formed from $^3/_8$-inch-thick-by-1-inch-deep (9.5 mm by 25.4 mm) steel bar stock, and the washers are formed from $^3/_8$-inch-thick (9.5 mm) steel plate. The HHDQ bodies are formed from No. 7 gage steel, and the load transfer plates are $^1/_2$-inch-thick (12.7 mm) steel plate. See Table 2A for HDQ8 and HHDQ hold-down dimensions and fastener requirements. See Figure 2B for typical installations of the HDQ8 and HHDQ hold-downs.

3.1.3 PHD Hold-downs: PHD hold-downs consist of a main structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and a base plate component that provides a seat for an anchor rod/bolt nut, as shown in Figure 3. The PHD2 and PHD5 bodies are formed from No. 14 gage galvanized steel and the PHD6 bodies are formed from No. 12 gage galvanized steel. The base plates are formed from No. 3 gage steel. See Table 3A for PHD hold-down dimensions and required fasteners.

3.1.4 DTT2 Hold-down: The DTT2 hold-down consists of a single-piece formed structural steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member as shown in Figure 4. The DTT2 is formed from No. 14 gage galvanized steel. One steel, plain (flat), standard plate (W) washer conforming to ASTM F844 and ASME B18.22.1, Type A, with a $1^3/_8$-inch (35 mm) outer diameter, is provided with the DTT2 hold-down, and must be installed between the nut and the seat of the hold-down. See Table 4 for product dimensions, required fasteners and allowable loads.

3.1.5 HDC10 Concentric Hold-downs: HDC10 concentric hold-downs consist of a main structural U-shaped steel component with prepunched holes for installation of SDS wood screws used to connect the hold-down to the wood member, and an aluminum support base component with a hole for a $^{7}/_{8}$-inch-diameter (22.2 mm) anchor bolt used to connect the hold-down to the concrete as shown in Figure 5. The body of the HDC10 hold-downs is formed from No. 10 gage galvanized steel. The aluminum base is die cast from aluminum alloy. One steel, plain (flat), SAE narrow (N) washer conforming to ASTM F844 and ASME B18.22.1, Type A, with a $1^{3}/_{4}$-inch (44.5 mm) outer diameter, is provided with the HDC10 hold-down, and must be installed between the nut and the bottom of the U-shaped steel component of the hold-down. See Tables 5A and 5B for product dimensions, required fasteners and allowable loads.

3.2 Materials:

3.2.1 Steel: The bodies of the HDU, PHD, HDQ8, and HDC10 hold-downs are fabricated from ASTM A653, SS, Grade 33, galvanized steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum tensile strength, F_u, of 45,000 psi (310 MPa). The load transfer base plates of the HDU and PHD series hold-downs are fabricated from ASTM A 1011, SS, Grade 33 steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum ultimate strength, F_u, of 52,000 psi (359 MPa). The crossbars and the load transfer washer for the HDQ8 hold-down are fabricated from No. 1018 carbon steel complying with SAE J403, and having a minimum yield strength, F_y, of 54,000 psi (371 MPa) and a minimum tensile strength, F_u, of 64,000 psi (440 MPa). The support base of the HDC10 hold-downs is die cast aluminum.

The bodies of the HHDQ hold-downs are fabricated from ASTM A1011, SS, Grade 33 steel, having a minimum yield strength, F_y, of 33,000 psi (227 MPa) and a minimum ultimate strength, F_u, of 52,000 psi (359 MPa). The load transfer plates for the HHDQ hold-downs are formed from ASTM A 36 steel, having a minimum yield strength, F_y, of 36,000 psi (248 MPa) and a minimum tensile strength, F_u, of 58,000 psi (399 MPa). The DTT2 hold-down is formed from ASTM A653, SS designation, Grade 33 steel.

The galvanized bodies of the HDU, HDQ8, PHD, DTT2, and HDC10 hold-downs have a minimum G90 zinc coating in accordance with ASTM A653. Some models may also be available with either a G185 zinc coating (denoted by model numbers ending in the letter Z) or with a batch hot-dipped galvanized coating (denoted by model numbers ending with the letters HDG) with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides in accordance with ASTM A123. Model numbers shown in this report do not list the -Z or -HDG suffix, but the information shown applies. The HHDQ hold-downs have a painted finish. PHD base plates, HDU base plates and HDQ8 washers and crossbars have a minimum ASTM B633, SC 1, Type I electro galvanized coating.

The lumber treater or the report holder (Simpson Strong-Tie Company) should be contacted for recommendations on minimum corrosion resistance protection of steel hold-down connectors in contact with the specific proprietary preservative-treated or fire-retardant treated lumber. The use of hold-downs in contact with preservative-treated or fire-retardant treated lumber is outside the scope of this report, and is subject to the approval of the code official.

The steel components of the hold-downs described in this report have the following minimum base-metal thicknesses:

NOMINAL THICKNESS	MINIMUM BASE-METAL THICKNESS (in.)
$^{1}/_{2}$ inch	0.4845
$^{3}/_{8}$ inch	0.3600
No. 3 gage	0.2285
No. 7 gage (ASTM A653)	0.1715
No. 7 gage (ASTM A1011)	0.1705
No. 10 gage	0.1275
No. 12 gage	0.0975
No. 14 gage	0.0685

For **SI:** 1 inch = 25.4 mm.

3.2.2 Wood: Wood members with which the hold-downs are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber). The required thickness (depth) of the wood members in the direction of the fastener penetration is specified in Table 1B for HDU hold-down assemblies, Tables 2B and 2D for HDQ8/HHDQ hold-down assemblies, Table 3B for PHD hold-down assemblies, Table 4 for DTT2 hold-down assemblies, and Table 5B for HDC10 hold-down assemblies. Unless noted otherwise, the minimum width of the wood members listed in Tables 1B, 2B, 2D, 3B, 4, and Table 5B is $3^{1}/_{2}$ inches (88.9 mm). Additionally, the wood members used with the HDC hold-downs must have a minimum F_c* of 1550 psi (10.7 MPa), where F_c* is the NDS-specified reference compression design value parallel-to-grain, multiplied by all applicable adjustment factors except C_P.

3.2.3 SDS Wood Screws: Fasteners used with the hold-down assemblies described in Tables 1B, 2B, 2D, 3B, 4, and 5B must be Simpson Strong-Tie SDS wood screws recognized in ESR-2236. Model numbers shown in this report do not include the SDS model number after the hold-down model number (e.g., HDU4-SDS2.5), but the information shown applies. SDS screws used in contact with preservative-treated or fire-retardant-treated lumber must, as a minimum, comply with ESR-2236. The lumber treater or Simpson Strong-Tie Company should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant-treated lumber.

3.2.4 Threaded Rods: As a minimum, threaded steel rods must comply with ASTM A307 A36 or F1554.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Hold-down Assembly: The allowable loads shown in Tables 1B, 2B, 2D, 3B, and 5B of this report are for hold-down assemblies consisting of the following components: (1) hold-down device; (2) an anchor bolt/rod attached to the seat of the device; (3) a wood member, having minimum specified dimensions and properties; (4) quantity and size of SDS wood screws used to attach the hold-down device to the wood member; and, in some cases as noted, (5) bearing plates or washers. The allowable loads for these assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the National Design Specification (NDS) for Wood Construction. The assembly must have an allowable strength equal to or exceeding the required strength of the assembly under the action of the ASD (Allowable Stress Design) load combinations referenced in the applicable code.

Where design load combinations include earthquake loads or effects, story drifts of the structure must be determined in accordance with Section 12.8.6 of ASCE 7

by using strength-level seismic forces without reduction for ASD. The deflection of a shear wall restrained from overturning by hold-downs installed in accordance with this report is calculated using Equation 23-2 shown in Section 2305.3 of the IBC, or Equation 4.3-1 shown in Section 4.3.2 of ANSI/AF&PA SDPWS-2008 (Special Design Provisions for Wind and Seismic). The total deflection values, Δ_{all} and Δ_s, at ASD-level and strength-level forces, respectively, for hold-down assemblies shown in Tables 1B, 2B, 3B, and 5B of this report, include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation where the unbraced length of the rod is a maximum of 6 inches (152 mm) for assemblies using HDU, HDQ, HHDQ, and PHD hold-downs; and a maximum of 4.5 inches (114 mm) for assemblies using DTT2 hold-downs. The contribution of the hold-down anchor rod elongation to the total elongation (deflection) of the hold-down assembly needs to be considered when the actual diameter, length, or ASTM steel specification of the anchor rod differs from that described in this report.

Please note: When seismic governs, the symbol Δ_s as used in this report for hold-down *assemblies* refers to the symbol d_a in Section 2305.3 of the IBC and to the symbol Δ_a in Section 4.3.2 of ANSI/AF&PA SDPWS-2008.

Tabulated allowable loads are for hold-downs connected to wood used under continuously dry interior conditions, and where sustained temperatures are 100ºF (37.8ºC) or less.

When hold-downs are fastened to wood having a moisture content greater than 19 percent (16 percent for engineered lumber), or where wet service is expected, the allowable loads shown in Tables 1B, 2B, 2D, 3B and 4 of this report must be adjusted by the wet service factor, C_M, specified in the NDS.

When hold-downs are fastened to wood that will experience sustained exposure to temperatures exceeding 100ºF (37.8ºC), the allowable loads shown in Tables 1B, 2B, 2D, 3B, and 5B in this report must be adjusted by the temperature factor, C_t, specified in the NDS.

The design of wood members fastened to the hold-down devices must consider combined stresses due to axial tension or compression, and flexural bending induced by eccentricities in the connection about either or both axes, relative to the centroid of the wood member. Stresses must be evaluated at the critical net section for total combined stress in accordance with the NDS.

The design of hold-downs used in series must account for the cumulative deformation of all hold-downs within that series.

4.1.2 Hold-down Devices Used as Anchorage of Structural Walls: Allowable tensile strengths and strength-level displacements are specified in Table 1C for HDU hold-down devices. Allowable tensile and compressive strengths and corresponding displacements are specified in Table 2C for HDQ8/HHDQ hold-down devices. These values are for the steel anchorage device independent of the SDS screws and anchor rod, and are used when designing structural wall anchorage in accordance with Section 12.11.2.2.2 of ASCE 7. Allowable compression loads of a structural wall anchorage system consisting of HDQ8/HHDQ hold-down devices, wood members, SDS wood screws, and threaded anchor rod, are shown in Table 2D. Axial compression of the anchor rod must be calculated when the actual diameter, length, or ASTM steel specification of the anchor rod differs from that described in the footnotes to Table 2D. The effective length and slenderness ratio of anchor rods subject to axial compression loads must be determined using accepted engineering principles.

4.1.3 Anchorage to Concrete or Masonry: Adequate embedment length and anchorage details, including edge and end distances, must be determined by a registered design professional in accordance with Chapters 19 or 21 of the IBC, as applicable, for design of anchorage to concrete and masonry structural members.

Where design load combinations include earthquake loads or effects, the design strength of anchorage to concrete must be determined in accordance with Section 1909 of the 2012 IBC or Section 1912 of the 2009 or 2006 IBC, except for detached one- and two-family dwellings assigned to Seismic Design Category A, B or C, or located where the mapped short-period spectral response acceleration, S_s, is less than 0.4g.

4.2 Installation:

Installation of the Simpson Strong-Tie hold-down connectors must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

4.3 Special Inspection:

4.3.1 IBC: For compliance with the 2012 or 2009 IBC, a statement of special inspection must be prepared by the registered design professional in responsible charge, and submitted to the code official for approval, where required by Section 1704.3 of the 2012 IBC or Section 1705 of the 2009 IBC. For compliance with the 2006 IBC, a quality assurance plan must be submitted to the code official for approval, where required by Sections 1705 or 1706 of the 2006 IBC. Special inspections for seismic resistance must be conducted as required, and in accordance with the appropriate sections of Chapter 17 of the IBC. Special inspections for anchor bolts in concrete or masonry must be conducted in accordance with Section 1705.3 or 1705.4 of the 2012 IBC; and Section 1704.4 or 1704.5 of the 2009 and 2006 IBC.

4.3.2 IRC: For installations under the IRC, special inspection is not normally required. However, for an engineered design where calculations are required to be signed by a registered design professional, periodic special inspection requirements and exemptions are as stated in Section 4.3.1, as applicable for installations under the IRC.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie hold-down connectors described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The connectors must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.5 Use of steel hold-down connectors with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.1 of this report. Use of fasteners with preservative- or fire-retardant-treated lumber must be in accordance with Section 3.2.3 of this report.

5.6 Anchorage to concrete or masonry structural members must be designed in accordance with Section 4.1.3 of this report.

5.7 No further duration of load increase for wind or earthquake loading is allowed.

5.8 Welded hold-downs (models HHDQ11 and HHDQ14) are manufactured under a quality control program with inspections by Benchmark Holdings, LLC (AA-660).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Hold-downs (Tie-downs) Attached to Wood Members (AC155), dated October 2005 (editorially revised September 2012).

7.0 IDENTIFICATION

The hold-down devices described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of the index evaluation report (ESR-2523) which contains a summary of all the product model numbers in the ICC-ES evaluation reports listed in that report for this manufacturer. The SDS wood screws are identified as described in evaluation report ESR-2236.

TABLE 1A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDU SERIES HOLD-DOWN CONNECTORS

HOLD-DOWN MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA. (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
HDU2	$8^{11}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	6
HDU4	$10^{15}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	10
HDU5	$13^{3}/_{16}$	3	$3^{1}/_{4}$	$1^{1}/_{4}$	$1^{3}/_{8}$	$^{5}/_{8}$	14
HDU8	$16^{5}/_{8}$	3	$3^{1}/_{2}$	$1^{1}/_{4}$	$1^{1}/_{2}$	$^{7}/_{8}$	20
HDU11	$22^{1}/_{4}$	3	$3^{1}/_{2}$	$1^{1}/_{4}$	$1^{1}/_{2}$	1	30
HDU14	$25^{21}/_{32}$	3	$3^{1}/_{2}$	$1^{9}/_{16}$	$1^{9}/_{16}$	1	36

For **SI:** 1 inch = 25.4 mm.

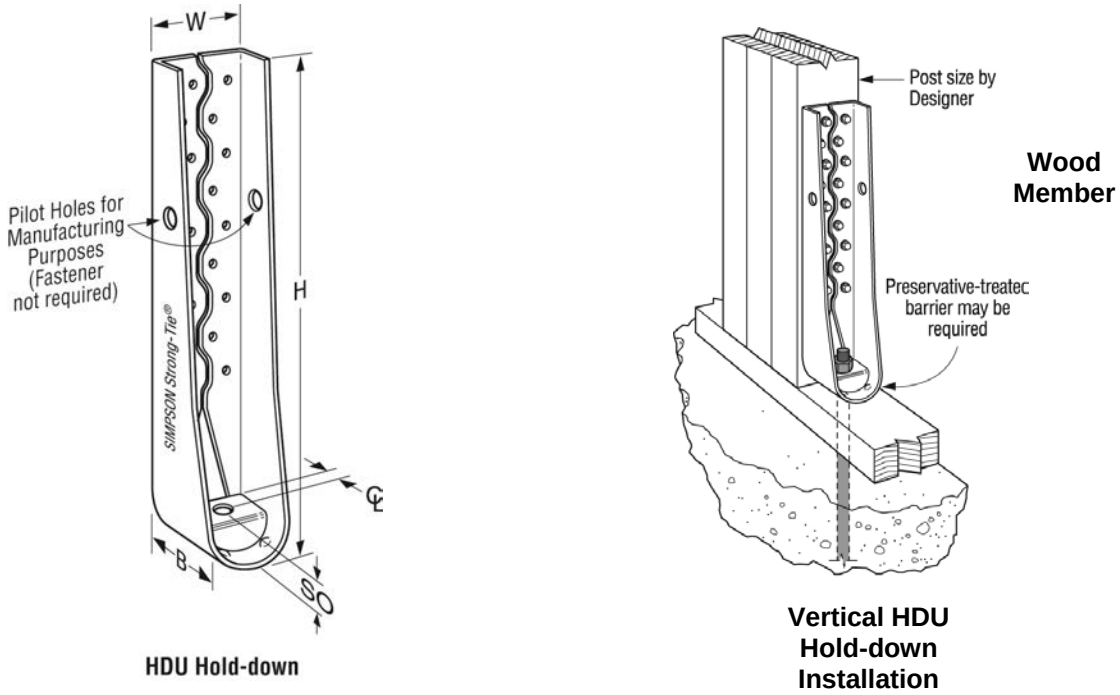


FIGURE 1—HDU SERIES HOLD-DOWNS

TABLE 1B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR HDU SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4]

HOLD-DOWN MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT Δ AT MAXIMUM LOAD[8,9] (in.)	
		Wood Member Thickness[6] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(7)]	Δ_{all}	Δ_s
HDU2	1/4 x1.5	1,810	1,810	1,810	1,810	1,810	1,810	0.069	0.090
	1/4x2.5	3,075	3,075	3,075	3,075	3,075	3,075	0.088	0.118
HDU4	1/4x1.5	3,105	3,105	3,105	3,105	3,105	3,105	0.083	0.108
	1/4x2.5	4,565	4,565	4,565	4,565	4,565	4,565	0.114	0.154
HDU5	1/4x1.5	3,960	3,960	3,960	3,960	3,960	3,960	0.109	0.142
	1/4x2.5	5,645	5,670	5,670	5,670	5,670	5,670	0.115	0.158
HDU8	1/4x1.5	5,980	5,980	5,980	5,980	5,980	5,980	0.087	0.115
	1/4x2.5	5,980	6,970	7,870	7,870	7,870	7,870	0.113	0.161
HDU11	1/4x2.5	—	—	—	9,535	11,175[(10)]	11,175	0.137	0.182
HDU14	1/4x2.5	—	—	—	—	14,390[(10)]	14,445	0.172	0.239

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 1A.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assembly must not be increased by 33 1/3 percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be 3 1/2 inches, except as noted.
[7]The minimum width of the wood members must be 5 1/2 inches (6x6 nominal).
[8]Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.
[10]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 1C—ALLOWABLE TENSION LOADS AND DISPLACEMENTS OF HDU SERIES HOLD-DOWN CONNECTORS[1,2,3]

HOLD-DOWN MODEL NO.	ALLOWABLE TENSION LOAD, P_{all} (lbs)	DISPLACEMENT Δ AT MAX LOAD[4] (in)	
		Δ_{all}	Δ_s
HDU2	3,505	0.081	0.110
HDU4	4,990	0.089	0.117
HDU5	5,670	0.078	0.107
HDU8	9,950	0.131	0.164
HDU11	11,905	0.121	0.157
HDU14	15,905[(5)]	0.124	0.172

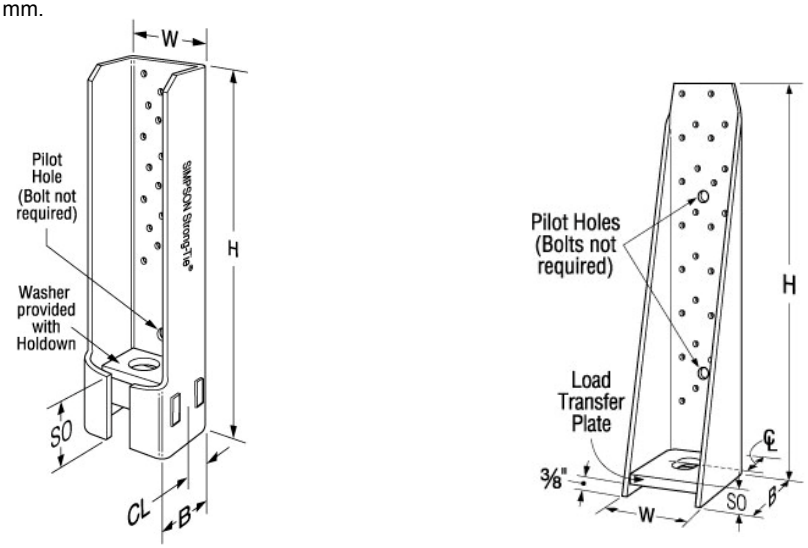
For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]This table lists the allowable tensile strength of the steel hold-down connectors exclusive of fasteners and anchor rods when tested on a steel jig.
[2]Allowable tension loads are applicable for designs complying with Section 12.11.2.2.2 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down must not be increased by 33 1/3 percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Δ_{all} is the displacement at the tabulated ASD load and Δ_S is displacement at the strength-level load. Tabulated displacement values in Table 1C consist only of deformation of the hold-down (tie-down) device when tested on a steel jig. Other variables contributing to total displacement, d_a, such as fastener slip, wood shrinkage, and anchor bolt/rod elongation, must be checked by the registered design professional. The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[5]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 2A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDQ8/HHDQ HOLD-DOWN CONNECTORS

HOLD-DOWN MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA. (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
HDQ8	14	$2^{7}/_{8}$	$2^{1}/_{2}$	$1^{1}/_{4}$	$2^{3}/_{8}$	$^{7}/_{8}$	20
HHDQ11	$15^{1}/_{8}$	3	$3^{1}/_{2}$	$1^{1}/_{2}$	$^{7}/_{8}$	1	24
HHDQ14	$18^{3}/_{4}$	3	$3^{1}/_{2}$	$1^{1}/_{2}$	$^{7}/_{8}$	1	30

For **SI:** 1 inch = 25.4 mm.



HDQ8 Hold-down **HHDQ Hold-down**

FIGURE 2A—HDQ8/HHDQ SERIES HOLD-DOWNS

TABLE 2B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR HDQ8/HHDQ SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4]

HOLD-DOWN MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS[5], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT[8,9] Δ AT MAX LOAD (in)	
		Wood Member Thickness[6] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(7)]	Δ_{all}	Δ_s
HDQ8	$^{1}/_{4}$x1.5	5,715	5,715	5,715	5,715	5,715	5,715	0.073	0.093
	$^{1}/_{4}$x2.5	5,715	5,715	7,280	7,280	7,280	7,280	0.091	0.121
	$^{1}/_{4}$x3	5,715	7,630	9,230	9,230	9,230	9,230	0.095	0.130
HHDQ11	$^{1}/_{4}$x2.5	—	—	—	11,810	11,810	11,810[(10)]	0.131	0.168
HHDQ14	$^{1}/_{4}$x2.5	—	—	—	—	13,015	13,710[(10)]	0.107	0.144

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table above. The quantity of SDS wood screws must comply with Table 2A.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads, that tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_S deformations.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^{1}/_{2}$ inches, except as noted.
[7]The minimum width of the wood members must be $5^{1}/_{2}$ inches (6x6 nominal).
[8]Tabulated displacement values, Δ_{all} and Δ_S, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.
[10]Requires a heavy hex anchor nut to achieve tabulated tension loads.

TABLE 2C—ALLOWABLE TENSION AND COMPRESSION LOADS AND DISPLACEMENTS FOR HDQ AND HHDQ SERIES HOLD-DOWN CONNECTORS[1,2,3]

MODEL NO.	ALLOWABLE LOAD[4], P_{all} (lbs)		DISPLACEMENT[5] Δ AT MAXIMUM LOAD (in.)			
			Tension		Compression	
	Tension	Compression	Δ_{all}	Δ_s	Δ_{all}	Δ_s
HDQ8	12,200	7,725	0.080	0.101	0.052	0.067
HHDQ11	12,290	9,745	0.053	0.068	0.086	0.120
HHDQ14	14,605[(6)]	11,010[(6)]	0.036	0.052	0.070	0.097

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]This table lists the allowable tensile and compressive strengths of the steel hold-down connectors exclusive of fasteners and anchor rods when tested on a steel jig.
[2]Allowable tension and compression loads are applicable for designs complying with Section 12.11.2.2.2 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]The designer must verify that the hold-down anchor bolt is adequate to resist compression forces based on the unbraced length of the anchor bolt.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. Tabulated displacement values in Table 2C consist only of deformation of the hold-down (tie-down) device when tested on a steel jig. Other variables contributing to total displacement, d_a, such as fastener slip, wood shrinkage, and anchor bolt/rod elongation, must be checked by the registered design professional. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]A heavy hex anchor nut is required to achieve tabulated loads.

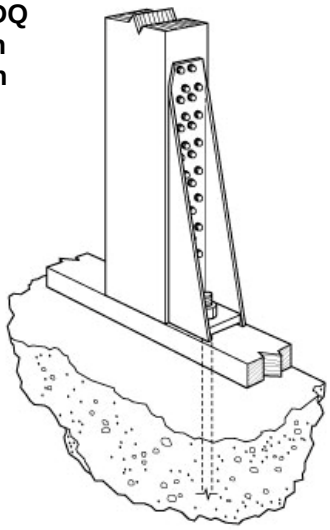
TABLE 2D—ALLOWABLE COMPRESSION LOADS AND DISPLACEMENTS FOR HDQ8/HHDQ SERIES HOLD-DOWN ASSEMBLIES[1,2,3]

MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE COMPRESSION LOADS[4], P_{all} (lbs) C_D = 1.33 or C_D = 1.6						DISPLACEMENT[5,6] Δ AT MAX LOAD (in)	
		Wood Member Thickness[7] (in.)							
		3	3.5	4.5	5.5	7.25	5.5[(8)]	Δ_{all}	Δ_s
HDQ8	$^1/_4$x1.5	5,570	5,570	5,570	5,570	5,570	5,570	0.038	0.045
	$^1/_4$x2.5	5,570	5,570	7,825	7,825	7,825	7,825	0.049	0.075
	$^1/_4$x3	5,570	5,570	8,995	8,995	8,995	8,995	0.053	0.076
HHDQ11	$^1/_4$x2.5	—	—	—	10,860	10,860	10,860[(9)]	0.109	0.143
HHDQ14	$^1/_4$x2.5	—	—	—	—	12,035	12,035[(9)]	0.081	0.110

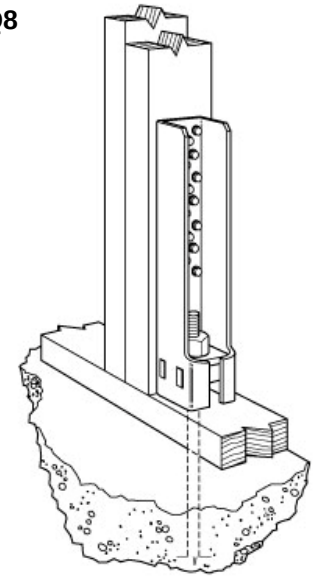
For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

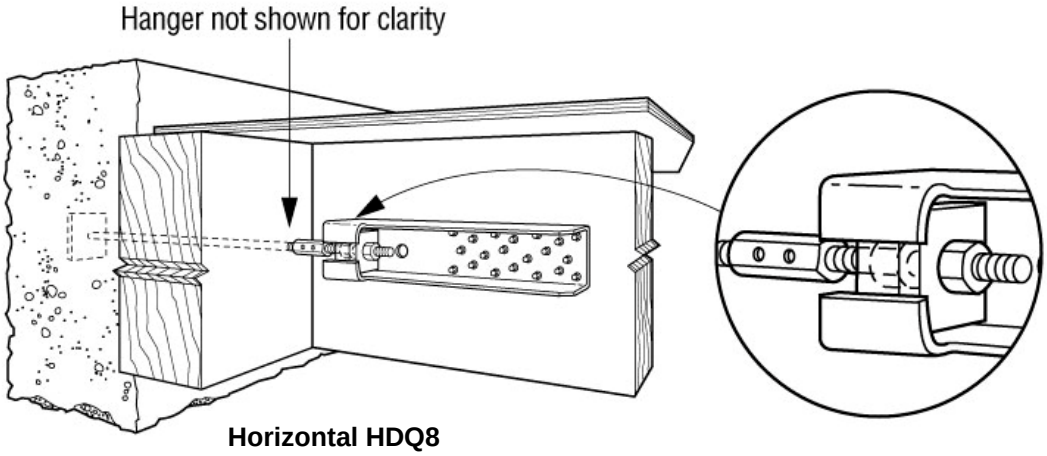
[1]Tabulated allowable compression loads are for a HDQ8 AND HHDQ Series hold-down assemblies consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 2A.
[2]Allowable compression loads are applicable for design of anchorage assemblies for structural walls in accordance with Section 12.11 of ASCE 7.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assemblies must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]The tabulated allowable compression load does not consider the end bearing capacity of the connected wood member.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]The registered design professional must verify that the hold-down anchor bolt is adequate to resist design compression forces based on the unbraced length of the anchor bolt.
[7]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^1/_2$ inches, except as noted.
[8]The minimum width of the wood members must be $5^1/_2$ inches (6x6 nominal).
[9]A heavy hex anchor nut is required to achieve tabulated loads.

Vertical HHDQ Hold-down Installation



Vertical HDQ8 Hold-down Installation





Horizontal HDQ8 Hold-down Installation

FIGURE 2B—TYPICAL INSTALLATIONS OF HDQ8/HHDQ SERIES HOLD-DOWNS

TABLE 3A—DIMENSIONS AND FASTENER REQUIREMENTS FOR PHD SERIES HOLD-DOWN CONNECTORS

MODEL NO.	DIMENSIONS (in)					ANCHOR BOLT DIA (in)	SDS SCREW QUANTITY
	H	W	B	CL	SO		
PHD2	$9^{5}/_{16}$	$2^{7}/_{8}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{5}/_{8}$	10
PHD5	$11^{9}/_{16}$	$2^{7}/_{8}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{5}/_{8}$	14
PHD6	$13^{13}/_{16}$	$2^{15}/_{16}$	$2^{13}/_{16}$	$1^{3}/_{8}$	$1^{3}/_{8}$	$^{7}/_{8}$	18

For **SI:** 1 inch = 25.4 mm.

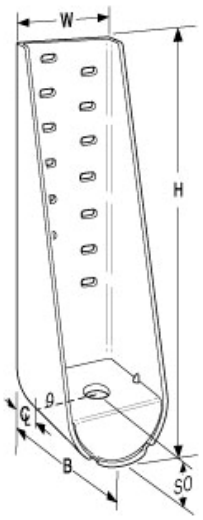
TABLE 3B—ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR PHD SERIES HOLD-DOWN ASSEMBLIES[1,2,3]

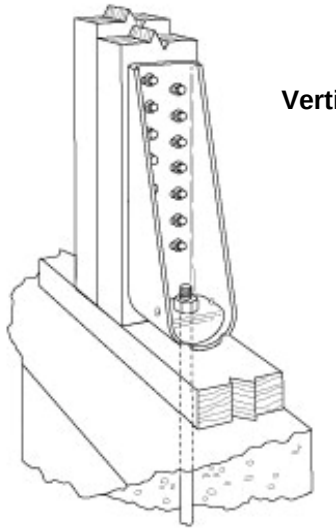
MODEL NO.	SDS SCREW SIZE (in)	ALLOWABLE TENSION LOADS, P_{all} (lbs) C_D = 1.33 or C_D = 1.6					DISPLACEMENT[5] Δ AT MAXIMUM LOAD (in)	
		Wood Member Thickness (in)						
		3	3.5	4.5	5.5	7.25	Δ_{all}	Δ_s
PHD2	$^{1}/_{4}$x1.5	2,785	2,785	2,785	2,785	2,785	0.085	0.110
	$^{1}/_{4}$x3.0	3,080	3,080	3,080	3,080	3,080	0.075	0.103
PHD5	$^{1}/_{4}$x1.5	3,395	3,395	3,395	3,395	3,395	0.081	0.107
	$^{1}/_{4}$x3.0	4,545	4,545	4,545	4,545	4,545	0.090	0.124
PHD6	$^{1}/_{4}$x1.5	4,535	4,535	4,535	4,535	4,535	0.069	0.092
	$^{1}/_{4}$x3.0	4,535	5,210	5,210	5,210	5,210	0.094	0.124

For **SI:** 1 inch = 25.4 mm, 1 lbs = 4.45 N.

[1]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the size of SDS wood screws noted in the table. The quantity of SDS wood screws must comply with Table 3A.
[2]The allowable tension loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, corresponding with wind/earthquake loading in accordance with the NDS. No further increase is allowed.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind of earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads that tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]Δ_{all} is the displacement at the tabulated ASD loads and Δ_S is displacement at strength-level loads. The tabulated allowable tension and compression (ASD) loads must be multiplied by 1.4 to obtain the strength-level loads associated with the tabulated strength-level deformations, Δ_S.
[6]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 6 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 6 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all} all, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_S, to account for anchor rod elongation.

PHD Hold-down





Vertical PHD Hold-down Installation

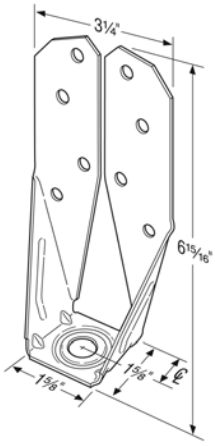
FIGURE 3—PHD SERIES HOLD-DOWNS

TABLE 4—DIMENSIONS, FASTENER REQUIREMENTS, ALLOWABLE TENSION LOADS AND DISPLACEMENTS FOR DTT2 SERIES HOLD-DOWN ASSEMBLIES[1,2,3,4,5]

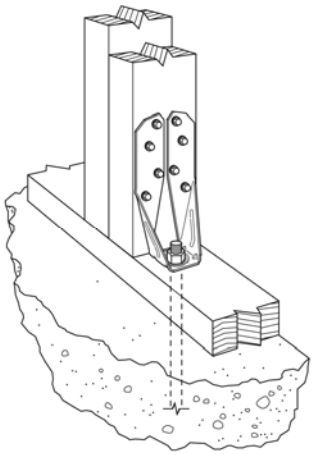
MODEL NO.	DIMENSIONS (inches)				REQUIRED FASTENERS			WOOD MEMBER THICKNESS[6] (inches)	ALLOWABLE TENSION LOADS[7], P_{all} (lbs)		DISPLACEMENT Δ AT MAXIMUM LOAD[8,9]	
					Anchor Bolt Dia.	SDS Screws						
	L	W	CL	B		Qty.	Size		C_D=1.0	C_D=1.6	Δ_{all}	Δ_s
DTT2	$6^{15}/_{16}$	$3^1/_4$	$^{13}/_{16}$	$1^5/_8$	$^1/_2$	8	SDS $^1/_4$ x $1^1/_2$	1.5	1,825	1,825	0.105	0.189
								3.0	2,000	2,145	0.128	0.241

For **SI:** 1 inch = 25.4 mm, 1 lb = 4.45 N.

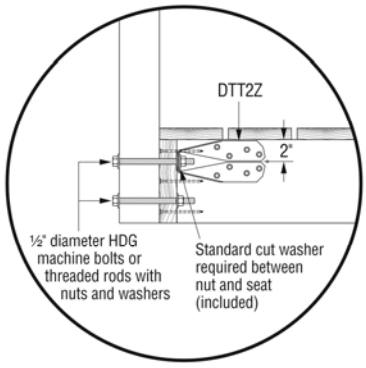
[1]One steel, plain (flat), standard plate (W) washer, as provided with the DTT2 hold-down, must be installed between the nut and the seat of the hold-down.
[2]Tabulated allowable loads are for a hold-down assembly consisting of the hold-down device attached to a wood structural member with the fasteners noted in Table 4.
[3]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factors, C_D, corresponding with a normal duration of load (C_D=1.0) and wind/earthquake loading (C_D=1.6) in accordance with the NDS. No further increase is allowed. Reduce where other load durations govern.
[4]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind or earthquake loading. When using the alternative basic load combinations in IBC Section 1605.3.2 that include wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by $33^1/_3$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[5]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[6]The minimum thickness of the wood members (i.e., the dimension parallel to the long axis of the SDS wood screws) must be as indicated in the table above. The minimum width of the wood members must be $3^1/_2$ inches.
[7]The tabulated allowable (ASD) tension loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_S deformations.
[8]Tabulated displacement values, Δ_{all} and Δ_S, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, hold-down device extension and rotation, and anchor rod elongation, at ASD-level and strength-level forces, respectively.
[9]Elongation of the hold-down anchor rod must be calculated when the ASTM steel specification of the anchor rod differs from that described in the Section 3.2.4 of this report, or the actual unbraced length is greater than 4.5 inches. In lieu of calculating the elongation of the hold-down anchor rod for hold-downs raised 4.5 inches to 18 inches above the concrete, an additional 0.010 inch may be added to the tabulated hold-down displacement at allowable load, Δ_{all}, and an additional 0.014 inch may be added to the tabulated hold-down displacement at strength-level load, Δ_s, to account for anchor rod elongation.



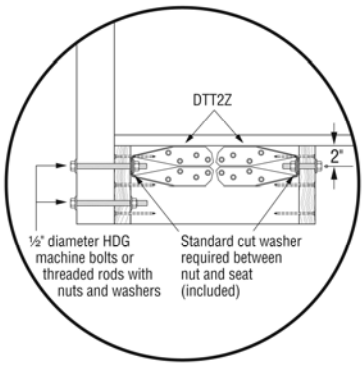
DTT2 Hold-Down



DTT2 Vertical Installation



DTT2 Horizontal Installation



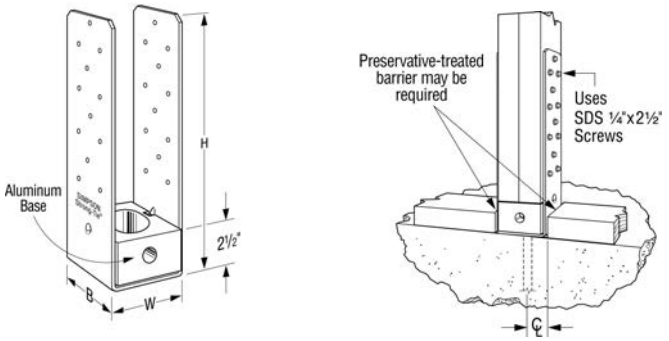
DTT2 Horizontal Installation

FIGURE 4—DTT2 HOLD-DOWN

TABLE 5A—DIMENSIONS AND FASTENER REQUIREMENTS FOR HDC SERIES HOLD-DOWN CONNECTORS

MODEL NO.	DIMENSIONS (inches)				REQUIRED FASTENERS		
	H	W	B	CL	Anchor Bolt Dia. (in)	SDS Screws	
						Qty.	Size
HDC10/22	$14^{3}/_{8}$	$3^{1}/_{8}$	3	$1^{9}/_{16}$	$^{7}/_{8}$	24	SDS $^{1}/_{4}$ x 2.5
HDC10/4	$14^{1}/_{8}$	$3^{9}/_{16}$	3	$1^{13}/_{16}$	$^{7}/_{8}$	24	SDS $^{1}/_{4}$ x 2.5

For **SI:** 1 lbf = 4.45N, 1 inch = 25.4 mm.



HDC10 Hold-Down **HDC10/22 Installation**

FIGURE 5—HDC10 HOLD-DOWN

TABLE 5B—ALLOWABLE TENSION/COMPRESSION LOADS AND DISPLACEMENTS FOR HDC SERIES HOLD-DOWN ASSEMBLES[1,2,3,4,12]

MODEL NO.	POST SIZE[7,9]	TENSION (Uplift)[5] C_D = 1.6			COMPRESSION (Download)[6,7]			
					C_D = 1.0	C_D = 1.6 [(8)]		
		Allowable Tension Load, P_{all} [(10)] (lbs)	Displacement, Δ, at maximum load (in) [(11)]		Allowable Compression Load, P_{all} (lbs)	Allowable Compression Load, P_{all} [(10)] (lbs)	Displacement, Δ, at maximum load (in) [(11)]	
			Δ_{all}	Δ_s			Δ_{all}	Δ_s
HDC10/22	2-2x4	9,135	0.054	0.073	7,070	9,255	0.027	0.034
HDC10/4	4x4	9,135	0.054	0.073	9,600	10,550	0.029	0.036

For **SI:** 1 lbf = 4.45N, 1 inch = 25.4 mm.

[1]One steel, plain (flat), SAE narrow (N) washer, as provided with the HDC10 hold-down, must be installed between the nut and the bottom of the U-shaped steel component of the hold-down.
[2]The allowable loads for the hold-down assemblies are based on allowable stress design (ASD) and include the load duration factor, C_D, as shown in the table in accordance with the NDS. No further increase is allowed, except as noted in footnote 8, below.
[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, the tabulated allowable loads for the hold-down assembly must not be increased for wind or earthquake loading. When using the alternate basic load combinations, in IBC Section 1605.3.2 that include wind or earthquake loads, the tabulated allowable loads for the hold-down assembly must not be increased by $33^{1}/_{3}$ percent, nor can the alternative basic load combinations be reduced by a factor of 0.75.
[4]Anchorage to concrete or masonry must be determined in accordance with Section 4.1.3 of this report.
[5]Allowable tension loads are for the hold-down assembly, consisting of the hold-down device attached to a wood structural member with the size and quantity of SDS wood screws noted in Table 5A.
[6]Allowable compression loads are based on the lesser of: a) the allowable compression load based on testing of the hold-down assembly, b) the calculated allowable concrete bearing strength, and c) the calculated bearing capacity of the wood members on the aluminum base.
[7]The wood member(s) must have a minimum F_c* of 1550 psi, where F_c* is the NDS-specified reference compression design value parallel-to-grain, multiplied by all applicable adjustment factors except C_P, and must be installed such that they bear directly upon the aluminum base. The bottom of the HDC10 hold-down must bear directly on concrete having a minimum compressive strength, f'_c, of 2,500 psi.
[8]Allowable compression loads corresponding to a load duration factor of C_D=1.6 are governed by the concrete bearing strength, based on an assumed f'_c of 2,500 psi and a gross bearing area of 9.38 in^2. The allowable compression loads, and the corresponding displacements may be linearly increased for higher concrete compressive strengths, up to maximum values as follows:

Model No.	P_{all} (lbs)	Δ_{all} (in)	Δ_s (in)
HDC10/22	11,315	0.031	0.038
HDC10/4	15,360	0.036	0.047

All other aspects of the foundation design, including but not limited to design for applicable shear and flexural stresses induced by the hold-down, must be considered by the designer.
[9]The cumulative thickness of the wood member(s) (i.e., the dimension parallel to the long axis of the SDS wood screws) must be 3 inches for the HDC10/22, and $3^{1}/_{2}$ inches for the HDC10/4. The minimum width of the wood members must be $3^{1}/_{2}$ inches.
[10]The tabulated allowable (ASD) loads must be multiplied by 1.4 to obtain the strength-level resistance loads associated with the tabulated Δ_s deformations.
[11]Tabulated displacement values, Δ_{all} and Δ_s, for hold-down assemblies include all sources of hold-down assembly elongation, such as fastener slip, and hold-down device extension or compression, at ASD-level and strength-level forces, respectively.
[12]Due to the possibility of galvanic action, the HDC10 must be limited to covered end-use installations with dry conditions of use.

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ESR-2105*

Reissued January 1, 2012
This report is subject to renewal January 1, 2014.

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

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PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE STRAPS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Simpson Strong-Tie FHA, HST, LSTA, LSTI, MST, MSTA, MSTC, MSTI, and ST Series Straight Tie Straps; CMST and CS Series Coiled Tie Straps; MSTC16 Coiled Tie Strap; CTS218 Compression/Tension Straps; and the MSTCB3 Pre-bent Tie Straps are used to transfer between wood members wind or seismic loads resulting from the critical load combination in accordance with Section 1605.3 of the IBC where allowable stress equations are used. The straps may also be used in structures regulated by the IRC where an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 Straight Tie Straps:

The FHA, HST, LSTA, LSTI, MST, MSTA, MSTC, MSTI, and ST Series straight tie straps are supplied in manufacturer-designated lengths with prepunched holes for nails or bolts.

3.1.1 FHA Series: The FHA Series tie straps are $6^{3}/_{8}$ to 30 inches (162 to 762 mm) long, and have a constant width of $1^{3}/_{16}$ inches (30.2 mm). The total strap width between longitudinal edges is $1^{7}/_{16}$ inches (36.5 mm). The longitudinal edges of the tie straps have $^{1}/_{4}$-inch-deep (6.4 mm) notches that are spaced 2 inches (51 mm) on center. Each end of an FHA strap has four $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched nail holes. See Figure 1 for a drawing of the FHA Series tie straps. See Table 1 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.2 ST Series: The ST9, ST12, ST18, and ST 22 straps are 9 to $21^{5}/_{8}$ inches (229 to 549 mm) long and $1^{1}/_{4}$ inches (31.8 mm) wide. Each strap has unevenly spaced $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched nail holes. One end of each strap has a "speed prong" which is formed from the steel strap. See Figure 2 for a drawing of the ST9, ST12, ST18, and ST 22 tie straps.

The ST292, ST2122, ST2215, ST6215, ST6224, and ST6236 straps are $9^{5}/_{16}$ to $33^{13}/_{16}$ inches (236.5 to 858.8 mm) long, and have a constant width of $1^{13}/_{16}$ inches (46 mm). The total strap width between longitudinal edges is $2^{1}/_{16}$ inches (52.4 mm). Notches are $^{9}/_{32}$ inch (7.1 mm) deep and are spaced $1^{3}/_{4}$ inches (44.5 mm) on center. Each longitudinal edge of an ST strap has a row of $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched nail holes, spaced $1^{3}/_{4}$ inches (44.5 mm) on center. See Figure 3 for a drawing of the ST292, ST2122, ST2215, ST6215, ST6224, and ST6236 tie straps.

The ST2115 strap is $16^{5}/_{16}$ inches (414.3 mm) long and $^{3}/_{4}$ inch (19.1 mm) wide, and has one row of $^{11}/_{64}$-inch-diameter (4.3 mm), prepunched nail holes, spaced $1^{5}/_{8}$ inches (41.3 mm) on center. See Figure 4 for a drawing of the ST2115 tie strap.

See Table 1 for ST Series tie strap dimensions, fastener schedules, and allowable tension loads.

3.1.3 HST Series: The HST Series tie straps are either $21^{1}/_{4}$ or $25^{1}/_{2}$ inches (540 or 648 mm) long and from $2^{1}/_{2}$ to 6 inches (63.5 to 152 mm) wide. Each end of an HST strap has either three or six prepunched holes to accommodate $^{5}/_{8}$-inch- or $^{3}/_{4}$-inch-diameter (15.9 and 19.1 mm) bolts. The spacing and the location of the bolt holes in the strap length comply with the code-required bolt spacing and end distances. See Figure 5 for a drawing of the HST Series tie straps. See Table 2 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.4 MST Series: The MST Series tie straps are 27 to 72 inches (686 to 1829 mm) long and $2^{1}/_{16}$ inches (52.4 mm) wide. Each strap has two rows of $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched nail holes spaced $1^{3}/_{4}$ inches (43.7 mm) on center. Additionally, the straps have $^{5}/_{8}$-inch-diameter (15.9 mm) prepunched bolt holes

spaced $5^1/_4$ inches (133.4 mm) on center. See Figure 6 for a drawing of the MST Series tie straps. See Table 2 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.5 LSTA and MSTA Series: The LSTA and MSTA Series tie straps are 9 to 49 inches (229 to 1245 mm) long and $1^1/_4$ inches (32 mm) wide. Each strap has one row of staggered $^{11}/_{64}$-inch-diameter (4.3 mm) prepunched nail holes. The MSTA49 has $^5/_{32}$-inch-diameter (4.0 mm) prepunched nail holes. Longitudinal spacing (pitch) of consecutive holes is $1^1/_2$ inches (38 mm), and the transverse distance (gage) between staggered holes is $^9/_{16}$ inch (14.3 mm). For the MSTA49, the longitudinal spacing (pitch) of consecutive holes is $1^{17}/_{32}$ inches (38.9 mm), and the transverse distance (gage) between staggered holes is $^1/_2$ inch (12.7 mm). Both ends of every strap (except for the MSTA49) has one nail hole located between the last two staggered holes. See Figure 7 for a drawing of the LSTA and MSTA Series tie straps. See Table 3 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.6 LSTI Series: The LSTI Series tie straps are either 49 or 73 inches (1244 or 1854 mm) long and $3^3/_4$ inches (95.3 mm) wide. Each strap has two rows of staggered $^5/_{32}$-inch-diameter (4.0 mm) prepunched nail holes. Longitudinal spacing (pitch) of consecutive holes in a row is 3 inches (76 mm), and the transverse distance (gage) between staggered holes in a row is $^3/_8$ inch (9.5 mm). See Figure 8 for a drawing of the LSTI Series tie straps. See Table 3 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.7 MSTI Series: The MSTI Series tie straps are $2^1/_{16}$ inches (52.4 mm) wide and from 26 to 72 inches (660 to 1829 mm) long. Each strap has three rows of $^5/_{32}$-inch-diameter (4.0 mm) prepunched nail holes spaced 3 inches (76 mm) on center. The holes in adjacent rows are offset by 1 inch (25.4 mm), resulting in one nail hole per inch of strap. See Figure 9 for a drawing of the MSTI Series tie straps. See Table 3 for strap dimensions, fastener schedules, and allowable tension loads.

3.1.8 MSTC Series: The MSTC Series tie straps are $28^1/_4$ to $77^3/_4$ inches (718 to 1975 mm) long and 3 inches (76.2 mm) wide. The straps have two rows of staggered prepunched holes spaced $1^1/_2$ inches (38.1 mm), measured from center-to-center of holes. On the nail head side of the strap, the holes are oblong and measure $^3/_{64}$ inch wide by $^9/_{32}$ inch long (5.1 mm by 7.1 mm), and are chamfered at 120 degrees. On the wood side of the strap, the holes are $^{11}/_{64}$ inch wide by $^1/_4$ inch long (4.4 mm by 6.4 mm). The long direction of the nail holes is perpendicular to the length of the strap. See Figure 10 for a drawing of the MSTC Series tie straps. See Table 3 for strap dimensions, fastener schedules, and allowable tension loads.

3.2 Coiled Tie Straps:

The CS Series, CMST Series, and CMSTC16 tie straps are supplied in coils and are cut to a specified length at the jobsite for engineered applications where the connected wood members are not abutting each other.

3.2.1 CS Series: The CS14, CS16, CS18, CS20, and CS22 straps are supplied as 100-, 150-, 200-, 250-, and 300-foot-long (30.5, 45.7, 61.0, 76.2, and 91.4 m) coils, respectively. The coiled steel is $1^1/_4$ inches (32 mm) wide and has two rows of prepunched, $^5/_{32}$-inch-diameter (4.0 mm) holes. The longitudinal spacing of the holes in each row is $2^1/_{16}$ inches (52.4 mm). See Figure 11 for a drawing of the CS Series tie straps and Figure 14 for a typical installation. See Table 4 for strap dimensions, fastener schedules, and allowable tension loads.

3.2.2 CMST Series: The CMST12 strap is supplied as a 40-foot-long (12.19 m) coil, and the CMST14 strap is supplied as a $52^1/_2$-foot-long (16.0 m) coil. The coiled steel is 3 inches (76 mm) wide and has two rows of prepunched round holes with $^{11}/_{64}$-inch (4.3 mm) diameters, and two rows of equilateral triangular holes sized to circumscribe an $^{11}/_{64}$-inch-diameter (4.3 mm) hole. The longitudinal spacing of the round and triangular holes in each row is 3.5 inches (88.9 mm). See Figure 12 for a drawing of the CMST14 tie strap, and Figure 13 for a typical installation. See Table 4 for strap dimensions, fastener schedules, and allowable tension loads.

3.2.3 CMSTC16: The CMSTC16 strap is supplied as a 54-foot-long (16.46 m) coil. The width of the coiled steel is 3 inches (76.2 mm). The strap has two rows of staggered prepunched holes spaced $1^1/_2$ inches (38.1 mm), measured from center-to-center of holes. On the nail head side of the strap, the holes are oblong and measure $^1/_4$ inch wide by $^{21}/_{64}$ inch long (6.4 mm by 8.3 mm), and are chamfered at 120 degrees. On the wood side of the strap, the holes are $^{11}/_{64}$ inch wide by $^1/_4$ inch long (4.4 mm by 6.4 mm). See Figure 13 for a drawing of the CMSTC16 tie strap and Figure 13 for a typical installation. See Table 4 for strap dimensions, fastener schedules, and allowable tension loads.

3.3 Compression/Tension Straps:

The CTS Series compression/tension strap is supplied in manufacturer-designated lengths with pre-punched holes for nails or Simpson Strong-Tie SD Series wood screws (ESR-3046). The straps have unique rolled edges and embossments allowing the straps to span gaps to partially restore compression as well as tension capacity to the notched or cut wood lumber framing.

The CTS218 is $1^1/_2$ inches wide by $17^7/_8$ inches long (38 by 454 mm). The flat portion of the strap is $1^3/_8$ inches wide (35 mm) and the rolled edge is $^3/_8$ inch deep (9.5 mm). The strap has one row of staggered $^5/_{32}$-inch-diameter (4.0 mm) prepunched fastener holes. Longitudinal spacing of consecutive holes is $^1/_2$ inch (12.7 mm), and the transverse distance between staggered holes is $^3/_8$ inch (9.5 mm). There are 24 total prepunched holes, 12 holes on either side of a $6^5/_{16}$-inch-long gap (161 mm). A $5^3/_4$-inch-long-by-$^9/_{32}$-inch-deep (147 by 7.1 mm) embossment is centered in the gap and on the strap. See Figure 15 for a drawing of the CTS218 strap and Figure 16 for a typical installation. See Table 5 for strap quantities, fastener schedule, and allowable tensile and compressive loads.

3.4 Pre-Bent Straps:

The MSTC48B3 and MSTC66B3 are pre-bent straps designed to transfer tension load from an upper-story wood column or post to joists or a beam at the story below. The MSTC48B3 and MSTC66B3 pre-bent tie straps are $44^7/_8$ and $62^7/_8$ inches (1140 and 1597 mm) long, respectively, and 3 inches (76.2 mm) wide. The straps have two rows of staggered prepunched holes spaced $1^1/_2$ inches (38.1 mm), measured from center-to-center of holes. On the nail head side of the strap, the holes are oblong and measure $^{13}/_{64}$ inch wide by $^9/_{32}$ inch long (5.1 mm by 7.1 mm), and are chamfered at 120 degrees. On the wood side of the strap, the holes are $^{11}/_{64}$ inch wide by $^1/_4$ inch

long (4.4 mm by 6.4 mm). The long direction of the nail holes is perpendicular to the length of the strap. See Figure 17 for drawings of the MSTCB3 Series pre-bent tie straps. See Table 6 for strap dimensions, fastener schedules, and allowable tension loads.

3.5 Materials:

3.5.1 Steel: The tie straps described in this report are manufactured from galvanized steel complying with ASTM A653, SS designation, and minimum G90 zinc coating specifications, except for the HST3 and HST6 tie straps, which are manufactured from galvanized steel complying with ASTM A1011, and the MST48, MST60, and MST72 tie straps, which are manufactured from galvanized steel complying with Simpson Strong-Tie's published specification for steel. Refer to the tables in this report for the minimum specified yield and tensile strengths, F_y and F_u, respectively, of the steel for each strap described in this report. Some models are available with a G185 continuous sheet galvanization in accordance with ASTM A653. The model numbers of tie straps with a G185 zinc coating are followed by the letter Z. Some models are available with a batch hot-dip galvanized coating with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides, in accordance with ASTM A123. The model numbers of tie straps with a batch hot-dipped zinc coating are followed by the letters HDG.

The galvanized steel tie straps have the following minimum base-metal thicknesses:

GAGE	BASE-METAL THICKNESS (inch)
No. 3	0.2285
No. 7	0.1715
No. 10	0.1275
No. 12	0.0975
No. 14	0.0685
No. 16	0.0555
No. 18	0.0445
No. 20	0.0334

3.5.2 Wood: Wood members with which the tie straps are used must be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber). The thickness (depth) of the wood main member must be equal to or greater than the length of the fasteners specified in the tables in this report, unless the reduced penetration effect on the load calculation per the applicable National Design Specification for Wood Construction and its Supplement (NDS) is taken into account, or as required by wood member design, whichever is greater.

3.5.3 Fasteners: Nails must comply with ASTM F1667 and have minimum bending yield strength, F_{yb}, of 90,000 psi (620.1 MPa). Bolts used with the MST and HST Series tie straps must as a minimum comply with ASTM F1554-07a Grade 36 and have a minimum bending yield strength of 45,000 psi (310.1 MPa).

Fasteners used in contact with preservative-treated or fire-retardant-treated lumber must, as a minimum, comply with IBC Section 2304.9.5, 2012 and 2009 IRC Section R317.3 or 2006 IRC Section R319.3, as applicable. The lumber treater or report holder should be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant-treated lumber.

4.0 DESIGN AND INSTALLATION

4.1 Design:

Tabulated allowable tension loads in this evaluation report are based on allowable stress design and are the lesser of the tie strap steel strength or the connection strength. When connection strength governs, the tabulated allowable loads include the load duration factor, C_D, corresponding to design wind and seismic loads in accordance with the NDS.

Tabulated allowable loads are for tie straps connected to wood used under continuously dry interior conditions, and where sustained temperatures are 100°F (37.8°C) or less.

When tie straps are fastened to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected, the allowable tension loads based on fastener lateral design values in this evaluation report must be adjusted by the wet service factor, C_M, specified in the NDS.

When tie straps are connected to wood that will experience sustained exposure to temperatures exceeding 100°F (37.7°C), the allowable loads in this evaluation report must be adjusted by the temperature factor, C_t, specified in the NDS.

Connected wood members must be analyzed for load-carrying capacity at the tie strap connection in accordance with the NDS.

4.2 Installation:

Installation of the tie straps must be in accordance with this evaluation report and the manufacturer's published installation instructions. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie Straight and Coiled Tie Straps described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The tie straps must be manufactured, identified, and installed in accordance with this report and the manufacturer's published installation instructions. A copy of the instructions must be available at the jobsite at all times during installation.

5.2 Calculations showing compliance with this report must be submitted to the code official. The calculations must be prepared by a registered design professional where required by the statues of the jurisdiction in which the project is to be constructed.

5.3 Adjustment factors noted in Section 4.1 of this report and the applicable codes must be considered, where applicable.

5.4 Connected wood members and fasteners must comply, respectively, with Sections 3.3.2 and 3.3.3 of this report.

5.5 Use of tie straps with preservative-treated and fire-retardant-treated lumber is outside the scope of this report. Use of fasteners with treated lumber must comply with Section 3.3.3 of this report.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Joist Hangers and Similar Devices (AC13), dated October 2010 (editorially revised December 2011).

6.2 Structural calculations.

6.3 Quality documentation.

7.0 IDENTIFICATION

Each tie strap described in this report is identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of an index evaluation report (ESR-2523) which contains a summary of all the product model numbers in the ICC-ES evaluation reports issued to this manufacturer.

TABLE 1—ALLOWABLE TENSION LOADS FOR THE ST AND FHA SERIES TIE STRAPS

MODEL SERIES	MODEL NO.	TIE STRAP PROPERTIES				COMMON NAILS[1] (Total Quantity–Size)	ALLOWABLE TENSION LOADS [2,3,4] (lbs.)
		Thickness (Gage No.)	Length (inches)	Minimum F_y (ksi)	Minimum F_u (ksi)		C_D = 1.6
FHA	FHA6	12	$6^{3}/_{8}$	33	45	8–16d	945
	FHA9	12	9	33	45	8–16d	945
	FHA12	12	$11^{5}/_{8}$	33	45	8–16d	945
	FHA18	12	$17^{3}/_{4}$	33	45	8–16d	945
	FHA24	12	$23^{7}/_{8}$	33	45	8–16d	945
	FHA30	12	30	33	45	8–16d	945
ST	ST292	20	$9^{5}/_{16}$	33	45	12–16d	1,265[5]
	ST2122	20	$12^{13}/_{16}$	40	55	16–16d	1,530[5]
	ST2115	20	$16^{5}/_{16}$	50	65	10–16d	660[5]
	ST2215	20	$16^{5}/_{16}$	50	65	20–16d	1,875[5]
	ST6215	16	$16^{5}/_{16}$	33	45	20–16d	2,095[5]
	ST6224	16	$23^{5}/_{16}$	40	55	28–16d	2,540[5]
	ST6236	14	$33^{13}/_{16}$	50	65	40–16d	3,845[5]
	ST9	16	9	33	45	8–16d	885
	ST12	16	$11^{5}/_{8}$	33	45	10–16d	1,105
	ST18	16	$17^{3}/_{4}$	33	45	14–16d	1,420[5]
	ST22	16	$21^{5}/_{8}$	33	45	18–16d	1,420[5]

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Quantity of fasteners is the minimum number of common nails required to achieve the tabulated allowable loads. One half of the tabulated quantity must be installed in each wood member forming the connection. Fasteners must comply with Section 3.3.3 of this report.
[2]Allowable tension loads are based on the steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50.
[3]Allowable tension loads are the lesser of the tie strap steel strength or the connection strength.
[4]Tabulated allowable tension loads are governed by connection strength, unless noted otherwise. Connection strength is derived by multiplying the number of nails by the minimum value from the yield mode equations in Section 11.3.1 from the NDS, where the side member (i.e., the steel tie strap) dowel bearing strength, F_{es}, is equal to $2.2F_u/C_D$, where C_D equals 1.6 as shown in the table, and where F_u equals the minimum specified tensile strength value of the steel shown in the table. The tabulated allowable tension loads governed by connection strength have been multiplied by the load duration factor, C_D, noted in the table, and are not permitted to be adjusted for other load durations.
[5]The tabulated allowable tension load is governed by steel strength, and does not include a one-third stress increase or the load duration factor, C_D. The steel strength is the lesser of yielding at the gross section of the strap, the fracture in the net section away from the connection, or fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of AISI S100-07 (2009 IBC) or AISI-NAS-01 (North American Specification for the Design of Cold-formed Steel Structural Members) (2006 IBC).

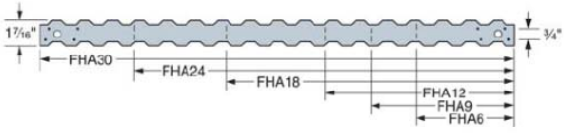


FIGURE 1—FHA SERIES TIE STRAPS

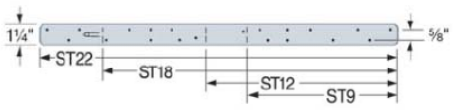


FIGURE 2—ST SERIES TIE STRAPS

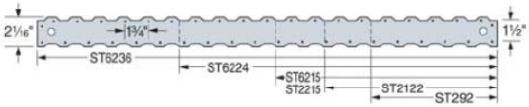


FIGURE 3—ST SERIES TIE STRAPS

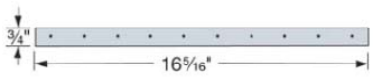


FIGURE 4—ST2115 TIE STRAP

TABLE 2—ALLOWABLE TENSION LOADS FOR THE HST AND MST SERIES TIE STRAPS

MODEL SERIES	MODE NO.	TIE STRAP PROPERTIES				FASTENERS[1] (Quantity–Size)		ALLOWABLE TENSION LOADS[2,3,4,5] (lbs.)			
								C_D = 1.6			
		Thick. (Gage No.)	Length (in.)	Min. F_y (ksi)	Min. F_u (ksi)	Nails	Bolts	Nails	Bolts		
									Wood Member Thickness (in.)		
									3	$3^1/_2$	$5^1/_2$
HST	HST2	7	$21^1/_4$	40	55	—	$6–^5/_8$"	—	5,280	5,260	5,220
	HST5	7	$21^1/_4$	40	55	—	$12–^5/_8$"	—	10,560	10,605	10,650
	HST3	3	$25^1/_2$	33	52	—	$6–^3/_4$"	—	6,875	7,740	7,680
	HST6	3	$25^1/_2$	33	52	—	$12–^3/_4$"	—	13,545	15,240	15,475
MST	MST27	12	27	40	55	30–16d	$4–^1/_2$"	3,705	2,175	2,170	2,165
	MST37	12	$37^1/_2$	40	55	42–16d	$6–^1/_2$"	5,080	3,075	3,060	3,030
	MST48	12	48	42	56	50–16d	$8–^1/_2$"	5,310[6]	3,695[6]	3,695[6]	3,675
	MST60	10	60	42	56	68–16d	$10–^1/_2$"	6,730[6]	4,665	4,605	4,490
	MST72	10	72	42	56	68–16d	$10–^1/_2$"	6,730[6]	4,665	4,605	4,490

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Quantity of fasteners is the total number of common nails or bolts, but not both, required to achieve the tabulated allowable loads. One half of the tabulated quantity must be installed in each wood member forming the connection. Fasteners must comply with Section 3.3.3 of this report.
[2]Allowable tension loads for nailed and bolted connections are not cumulative.
[3]Allowable tension loads are based on the steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50.
[4]Allowable tension loads are the lesser of the tie strap steel strength or the connection strength.
[5]Tabulated allowable tension loads are governed by connection strength, unless noted otherwise. Connection strength is derived by multiplying the number of fasteners by the minimum value from the yield mode equations in Section 11.3.1 from the NDS, where the dowel bearing strength, F_{es}, of the side member (i.e., the steel tie strap) is equal to $2.2F_u/C_D$ for nailed and bolted connections, where the load duration factor, C_D, equals 1.6 as shown in the table, and where the minimum specified tensile strength, F_u of the steel strap is as shown in the table. For bolted connections, the tabulated allowable tension loads include the load duration factor, C_D, noted in the table, and the applicable group action factor, C_g.
[6]The tabulated allowable tension load is governed by steel strength, and does not include a one-third stress increase or the load duration factor, C_D. The steel strength is the lesser of yielding at the gross section of the strap, the fracture in the net section away from the connection, or fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of AISI S100-07 (2009 IBC) or AISI-NAS-01 (North American Specification for the Design of Cold-formed Steel Structural Members) (2006 IBC).

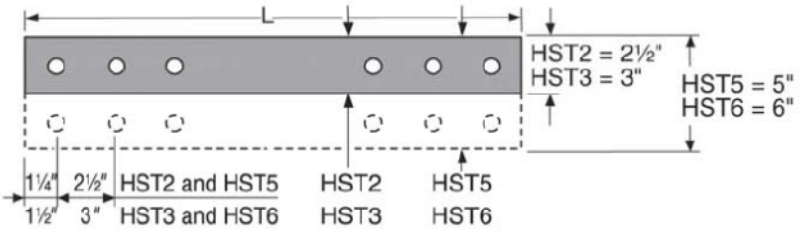


FIGURE 5—HST SERIES TIE STRAP

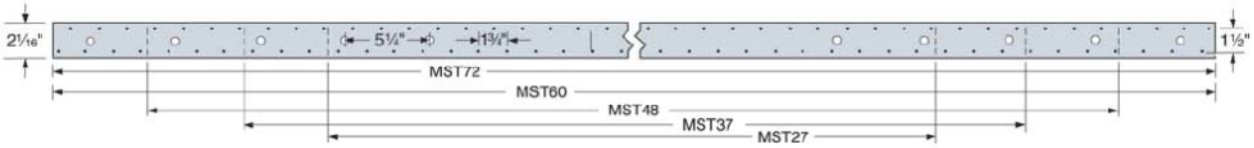


FIGURE 6—MST SERIES TIE STRAP

TABLE 3—ALLOWABLE TENSION LOADS FOR THE LSTA, MSTA, LSTI, AND MSTI SERIES TIE STRAPS

MODEL SERIES	MODEL NO.	TIE STRAP PROPERTIES				NAILS[1] (Total Quantity–Size)	ALLOWABLE TENSION LOADS[2,3,4] (lbs.)
		Thickness (Gage No.)	Length (inches)	Min. F_y (ksi)	*Min.* F_u (ksi)		C_D = 1.6
LSTA	LSTA9	20	9	50	65	8–10d common	740
	LSTA12	20	12	50	65	10–10d common	925
	LSTA15	20	15	50	65	12–10d common	1,110
	LSTA18	20	18	50	65	14–10d common	1,235[(5)]
	LSTA21	20	21	50	65	16–10d common	1,235[(5)]
	LSTA24	20	24	50	65	18–10d common	1,235[(5)]
	LSTA30	18	30	50	65	22–10d common	1,640[(5)]
	LSTA36	18	36	50	65	24–10d common	1,640[(5)]
MSTA	MSTA9	18	9	50	65	8–10d common	750
	MSTA12	18	12	50	65	10–10d common	940
	MSTA15	18	15	50	65	12–10d common	1,130
	MSTA18	18	18	50	65	14–10d common	1,315
	MSTA21	18	21	50	65	16–10d common	1,505
	MSTA24	18	24	50	65	18–10d common	1,640[(5)]
	MSTA30	16	30	50	65	22–10d common	2,050[(5)]
	MSTA36	16	36	50	65	26–10d common	2,050[(5)]
	MSTA49	16	49	50	65	26–10d common	2,020[(5)]
LSTI	LSTI49	18	49	40	55	32–10d×1$^1/_2$ common	2,975
	LSTI73	18	73	40	55	48–10d×1$^1/_2$ common	4,205[(5)]
MSTI	MSTI26	12	26	40	55	26–10d×1$^1/_2$ common	2,745
	MSTI36	12	36	40	55	36–10d×1$^1/_2$ common	3,800
	MSTI48	12	48	40	55	48–10d×1$^1/_2$ common	5,065
	MSTI60	12	60	40	55	60–10d×1$^1/_2$ common	5,080[(5)]
	MSTI72	12	72	40	55	72–10d×1$^1/_2$ common	5,080[(5)]
MSTC	MSTC28	16	28$^1/_4$	50	65	36–16d sinker	3,455
	MSTC40	16	40$^1/_4$	50	65	52–16d sinker	4,745[(5)]
	MSTC52	16	52$^1/_4$	50	65	62–16d sinker	4,745[(5)]
	MSTC66	14	65$^3/_4$	50	65	76–16d sinker	5,860[(5)]
	MSTC78	14	77$^3/_4$	50	65	76–16d sinker	5,860[(5)]

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Total fasteners are the minimum number of nails required to achieve the tabulated allowable loads. One half of the total must be installed in each wood member forming the connection. Fasteners must comply with Section 3.3.3 of this report.

[2]Allowable tension loads are based on the steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50.

[3]Allowable tension loads are the lesser of the tie strap steel strength or the connection strength.

[4]Tabulated allowable tension loads are governed by connection strength, unless noted otherwise. Connection strength is derived by multiplying the number of nails by the minimum value from the yield mode equations in Section 11.3.1 from the NDS, where the side member (i.e., the steel tie strap) dowel bearing strength, F_{es}, is equal to $2.2F_u/C_D$, where the load duration factor, C_D, equals 1.6 as shown in the table, and where the minimum specified tensile strength, F_u of the steel strap is as shown in the table. The tabulated allowable tension loads governed by connection strength have been multiplied by the load duration factor, C_D, noted in the table.

[5]The tabulated allowable tension load is governed by steel strength, and does not include a one-third stress increase or the load duration factor, C_D. The steel strength is the lesser of yielding at the gross section of the strap, the fracture in the net section away from the connection, or fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of AISI S100-07 (2009 IBC) or AISI-NAS-01 (North American Specification for the Design of Cold-formed Steel Structural Members) (2006 IBC).

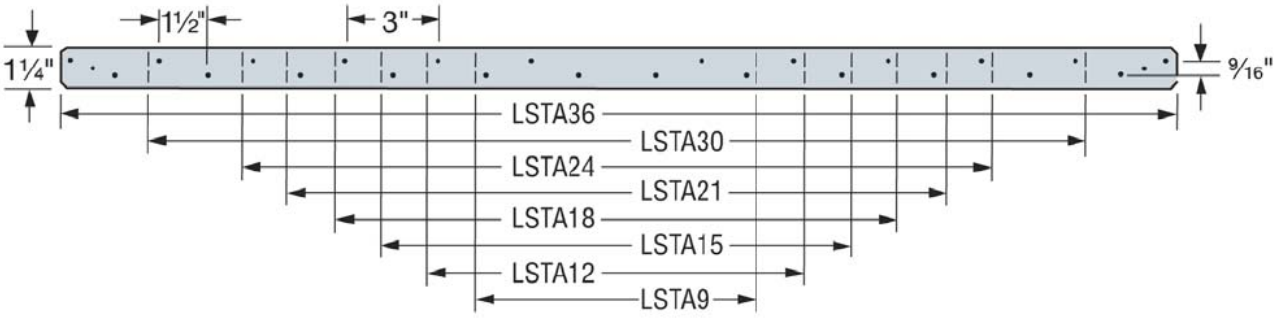


FIGURE 7—LSTA SERIES (MSTA SERIES SIMILAR) TIE STRAP

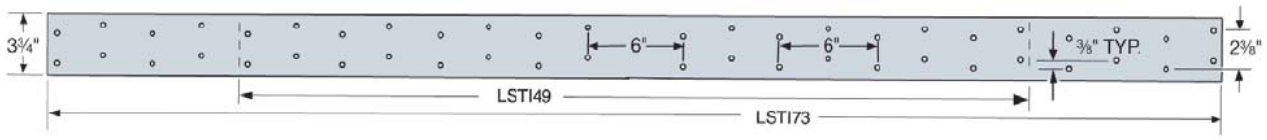


FIGURE 8—LSTI SERIES TIE STRAP

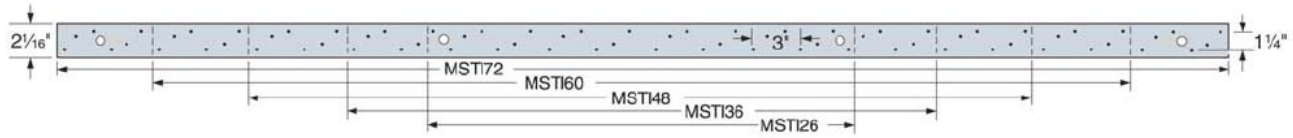


FIGURE 9—MSTI SERIES TIE STRAP

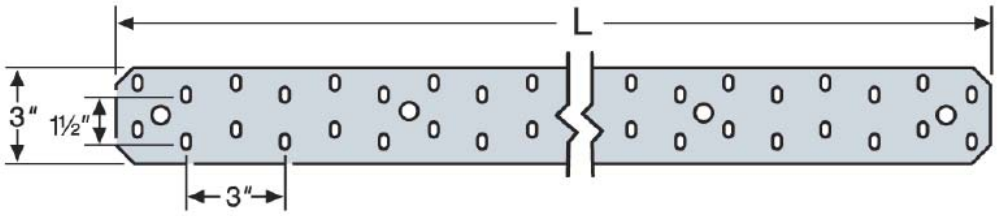


FIGURE 10—MSTC SERIES TIE STRAP

TABLE 4—ALLOWABLE TENSION LOADS FOR THE CS AND CMST SERIES COIL STRAPS AND THE CMSTC16 COIL TIE STRAP

MODEL SERIES	MODEL NO.	TIE STRAP PROPERTIES				NAILS1 (Quantity–Size)	ALLOWABLE TENSION LOADS[2,3] (lbs.)	
		Thickness (Gage No.)	Length	Min. F_y (ksi)	Min. F_u (ksi)		C_D = 1.6	Based on Steel Strength[5]
CS	CS14	14	Cut to length	50	65	30–10d common	2,985	2,490
						36–8d common	3,005	2,490
	CS16	16	Cut to length	40	55	22–10d common	2,080	1,705
						26–8d common	2,040	1,705
	CS18	18	Cut to length	40	55	18–10d common	1,675	1,370
						22–8d common	1,695	1,370
	CS20	20	Cut to length	40	55	14–10d common	1,280	1,030
						18–8d common	1,370	1,030
	CS22	22	Cut to length	40	55	12–10d common	1,100	845
						14–8d common	1,055	845
CMST	CMST12	12	Cut to length	50	65	84–16d common	10,710	9,215
						98–10d common	10,780	9,215
	CMST14	14	Cut to length	50	65	66–16d common	7,755	6,490
						78–10d common	7,760	6,490
CMSTC	CMSTC16	16	Cut to length	50	65	56–16d sinker	5,375	4,585

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Total fasteners are the minimum number of nails required to achieve the tabulated allowable loads. One half of the total must be installed in each wood member forming the connection. Fasteners must comply with Section 3.3.3 of this report.
[2]Allowable tension loads are based on the steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50.
[3]Allowable tension loads must be the lesser of the tie strap steel strength or the connection strength.
[4]Allowable tension loads based on connection strength are derived by multiplying the number of nails by the minimum value from the yield mode equations in Section 11.3.1, where the side member (i.e., the steel tie strap) dowel bearing strength, Fes, is equal to $2.2F_u/C_D$, where C_D equals 1.6 as shown in the table, and where the minimum specified tensile strength, F_u of the steel strap is as shown in the table. Allowable tension loads governed by connection strength have been multiplied by the load duration factor, C_D, noted in the table.
[5]The tabulated allowable tension loads based on steel strength do not include a one-third stress increase, and are the lesser of yielding at the gross section of the strap, the fracture in the net section away from the connection, or fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of AISI S100-07 (2009 IBC) or AISI-NAS-01 (North American Specification for the Design of Cold-formed Steel Structural Members) (2006 IBC).

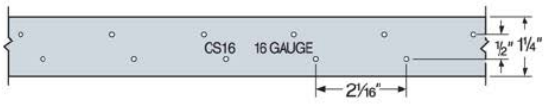


FIGURE 11—CS SERIES TIE STRAP

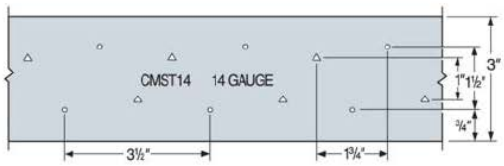


FIGURE 12—CMST14 TIE STRAP

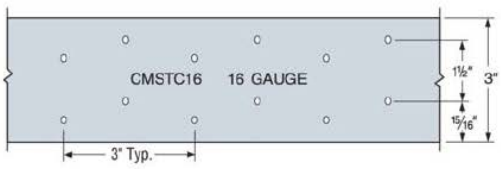


FIGURE 13—CMSTC16 TIE STRAP

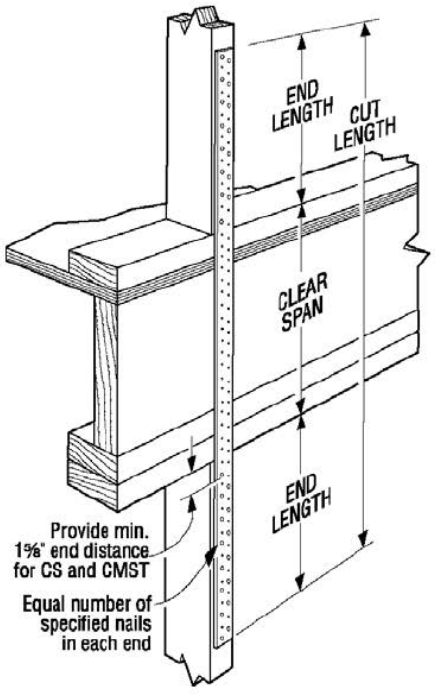


FIGURE 14—TYPICAL INSTALLATION OF CS, CMST, AND CMSTC16 TIE STRAP

TABLE 5—ALLOWABLE TENSION AND COMPRESION LOADS FOR CTS SERIES STRAP

MODLE NO.	STRAP QTY.	INSTALLATION	FASTENERS[2] (Qty.-Size)	ALLOWABLE LOADS[3] (LBS)	
				Compression (C_D = 1.60)[4,5]	Tension (C_D = 1.60)
CTS218[1]	1	One Side	24 – 10d x $1^1/_2$	1,020	2,270[6]
	2	One Side		2,045	4,540[6]
	2	Two Side		2,370	4,540[6]
	3	Two Side		3,725	6,810[6]
	4	Two Side		4,750	9,080[6]
	1	One Side	24 – SD#9 x $1^1/_2$	1,175	2,480[7]
	2	One Side		2,350	4,960[7]
	2	Two Side		2,735	4,960[7]
	3	Two Side		4,130	7,440[7]
	4	Two Side		5,470	9,920[7]

For **SI:** 1 inch = 25.4 mm, 1lbf = 4.45 N, 1 psi = 6.89 MPa.

[1]Strap properties: minimum F_y = 33, 000 pound per square inch (psi) and minimum F_u = 45, 000 psi. 14 gage steel.
[2]Fastener quantities are for a single strap.
[3]Allowable loads are based on steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50.
[4]The maximum gap between wood framing members is $4^1/_2$ inches (114 mm).
[5]The tabulated allowable compression capacity is controlled by steel buckling and is a tested load.
[6]The tabulated allowable tension loads are governed by the connection strength and have been multiplied by the load duration factor, C_D, of 1.60, as shown in the table. Connection strength is derived by multiplying half of the required number of nails by the minimum values in the yield mode equations in Section 11.3.1 of the NDS, where the side member (i.e. steel strap) dowel bearing strength, F_{es}, is equal to $2.2F_u/C_D$, where F_u of steel strap equals to 45,000 psi.
[7]The tabulated allowable tension loads are governed by the steel strength, and does not include the $^1/_3$ steel stress increase or the load during factor, C_D. The steel strength is the least of the yielding at the gross section of the strap, the fracture at the net section away from the connection, and fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of the AISI S100-07 (2009 IBC), or AISI-NAS-01, North American Specification for Design of Cold-formed Steel Structural Members (2006 IBC).

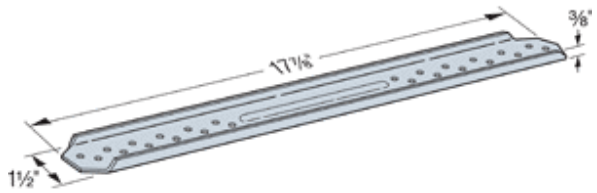


FIGURE 15—CTS218 COMPRESSION/TENSION STRAP

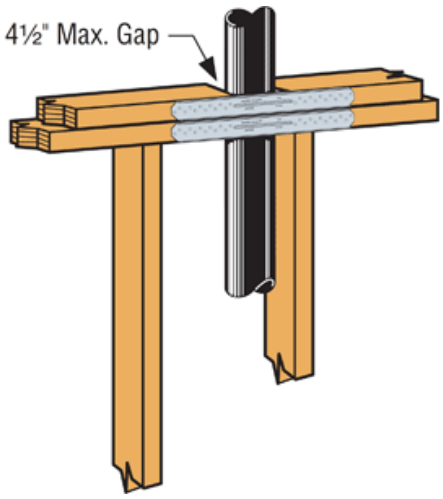


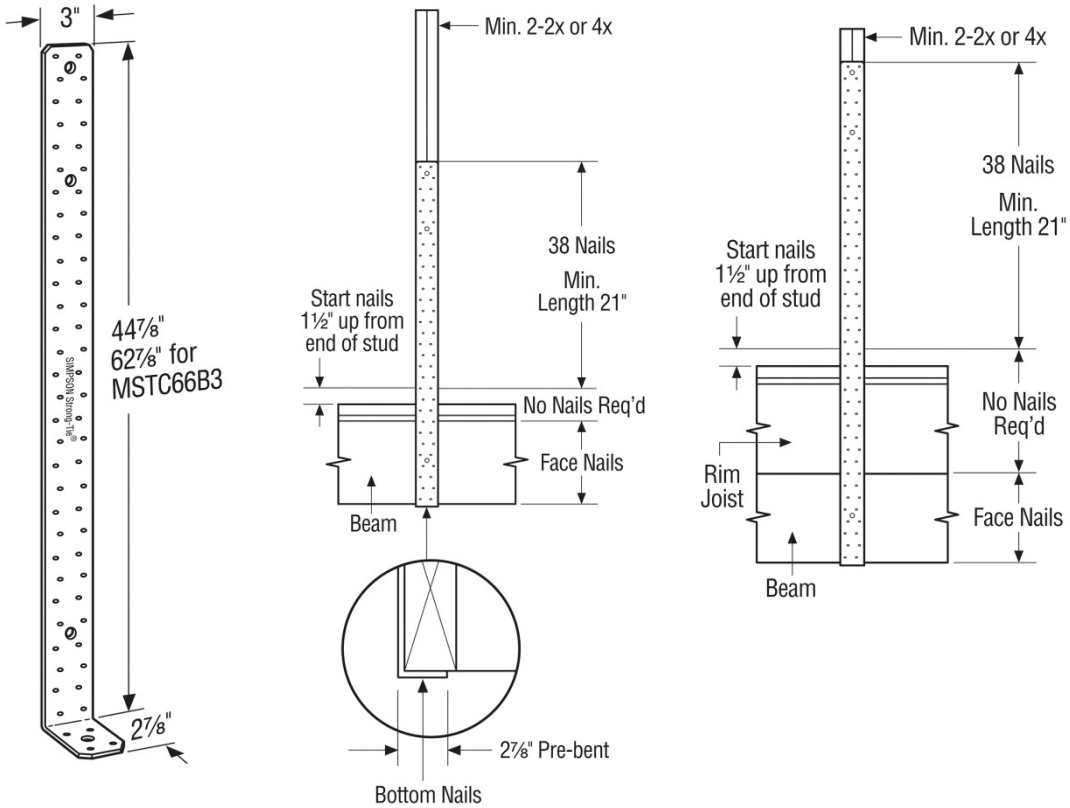
FIGURE 16—TYPICAL INSTALLATION OF CTS218 COMPRESSION/TENSION STRAP (TWO-STRAP, ONE-SIDED INSTALLATION SHOWN)

TABLE 6—ALLOWABLE TENSION LOADS FOR THE MSTCB3 SERIES PRE-BENT TIE STRAPS[1,2,3,4,5]

MODEL NO.	TIE STRAP PROPERTIES				MIN. WOOD BEAM DIMENSIONS		COMMON NAILS (Total Quantity-Size)			ALLOWABLE TENSION LOADS (lbs.)
							Beam		Studs/ Post	
	Thickness (Gage No.)	Length (inches)	Min. F_y (ksi)	Mini. F_u (ksi)	Width (min)	Depth (min)	Face	Bottom		C_D = 1.6
MSTC48B3	14	44 7/8	50	65	3	9¼	12-10d	4-10d	38-10d	3,975
MSTC66B3	14	62 7/8	50	65	3½	11¼	14-10d			4,505

For **SI:** 1 inch = 25.4 mm, 1lbf = 4.45 N, 1 psi = 6.89 MPa.

[1] Nails in studs/post must be installed symmetrically. Nails may be installed over the entire length of the strap over the studs/post.
[2] Allowable tension loads are based on steel straps connected to wood members having an assigned or equivalent minimum specific gravity of 0.50. The beam must also have a reference compression design value perpendicular to grain, $F_{c\perp}$, of 625 psi (4,310 MPa) or greater.
[3] Loads governed by the lower of 0.125" deflection from static tests on wood members, steel ultimate divided by 2.0 or the calculated nail values.
[4] Allowable tension loads based on connection strength are derived by multiplying the number of nails by the minimum value from the yield mode equations in NDS Section 11.3.1, where the side member (i.e., the steel tie strap) dowel bearing strength, F_{es}, is equal to $2.2F_u/C_D$, where C_D equals 1.6 as shown in the table, and where the minimum specified tensile strength, F_u of the steel strap is as shown in the table. Allowable tension loads governed by connection strength have been multiplied by the load duration factor, C_D, noted in the table.
[5] The tabulated allowable tension loads based on steel strength do not include a one-third stress increase, and are the lesser of yielding at the gross section of the strap, the fracture in the net section away from the connection, or fracture at the connection in accordance with Section C2 of AISI S100-07/S2-10 (2012 IBC), Section C2 of AISI S100-07 (2009 IBC) or AISI-NAS-01 (North American Specification for the Design of Cold-formed Steel Structural Members) (2006 IBC).



MSTC48B3 MSTC66B3 Installation with No Rim Joist MSTC66B3 Installation with Rim Joist

FIGURE 17—MSTCB3 SERIES PRE-BENT TIE STRAPS

EVALUATION REPORT

Report Number: 112
Originally Issued: 08/2008
Revised: 04/05/2013
Valid Through: 08/2013

DIVISION: 06—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:
SIMPSON STRONG-TIE COMPANY INC.
5956 WEST LAS POSITAS BOULEVARD
PLEASANTON, CALIFORNIA 94588
(800) 925-5099
www.strongtie.com

EVALUATION SUBJECT:

SIMPSON STRONG-TIE ANGLES, CLIPS, AND TIES

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes

- 2012 International Building Code® (IBC)
- 2012 International Residential Code® (IRC)
- 2009 International Building Code® (IBC)
- 2009 International Residential Code® (IRC)
- 2006 International Building Code® (IBC)
- 2006 International Residential Code® (IRC)

1.2 Evaluated in accordance with

IAPMO UES Evaluation Criteria for Joist Hangers and Miscellaneous Connectors (EC 002-2011)

1.3 Property evaluated

- Structural

2.0 USES

Simpson Strong-Tie structural angles, clips and ties are used as wood framing anchors and mechanical fastenings in accordance with Section 2304.9.3 of the IBC. The products may be used in structures regulated under the IRC when an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Product Information

3.1.1 A Series Angles: The A series angles transfer shear loads between wood members and are formed from No. 18 gage steel. Table 1 provides model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.2 A34 and A35 Framing Angles: The A34 and A35 framing angles connect wood framing members and are fabricated from No.18 gage steel. The connectors have cutouts on each leg and a prong to aid in installation. The A35 angle has slots and bend lines to permit field adjustments of the legs for two- and three-way tied connections. Table 2 and Figure 2 provides model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.3 DSP and SSP Stud Plate Tie Connectors: The SSP stud plate ties transfer uplift loads from a double top plate to a stud or from a stud to sill plate. The SSP is formed from No. 18 gage steel. The DSP is used to connect a double wood stud to a single or double wood plate, and is formed from No. 18 gage steel. Table 3 and Figure 3 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.4 FC Series Framing Clips: The FC series framing clips transfer shear loads between wood members and are formed from No. 16 gage steel. Table 4 and Figure 4 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.5 FSC Floor Span Connectors: The FSC connector transfer tension loads from member to member and may be used as an alternative to floor-to-floor strap connectors. The connector is formed from No. 12 gage steel. Table 5 and Figure 5 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.6 GA Series Gusset Angles: The GA series gusset angles connect wood framing members and are formed from No. 18 gage steel. Table 6 and Figure 6 contain model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.7 H2A, H2.5T, H8, H10A, H10A-2, H10S, H14 and HGA10 Hurricane Ties: The hurricane ties connect wood rafters or trusses to wood wall plates or studs. The H2A, H2.5T, H8, H10A, H10A-2, H10S, and H14 are formed from No. 18 gage steel, and the HGA10 is formed from No. 14 gage steel. Table 7 and Figure 7 contain model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.8 HH Series Header Hangers: The HH series header hangers transfer wind uplift and lateral loads between wood roof and wall members and are formed from No. 16 gage steel. Table 8 and Figure 8 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.9 L Series Reinforcing Angles: The L series reinforcing angles connect wood framing members and are formed from No. 16 gage steel. Table 9 and Figure 9 describe model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.10 LCE4 Post Cap: The LCE4 post cap transfers uplift and lateral forces from a wood beam to a wood post and is formed from No. 20 gage steel. Table 10 and Figure 10 describe model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.11 LS Series Skewable Angles: The LS series skewable angles transfer loads between wood framing members and are formed from No. 18 gage steel. The angles are designed to allow field skewing from 0 to 135 degrees. Table 11 and Figure 11 contain model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.12 LTP4 and LTP5 Lateral Tie Plates: The LTP4 and LTP5 lateral tie plates transfer shear loads from the wood top plate to wood rim joist or blocking members and is formed from No. 20 gage steel. Table 12 and Figure 12 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.13 RBC and RBCP Roof Boundary Clips: The RBC/RBCP roof boundary clips transfer loads between the roof diaphragm perimeter blocking and wall top plates and are formed from No. 20 gage steel. Table 13 and Figure 13 contain model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.14 TJC37 Jack Truss Connector: The TJC37 is a field skewable connector that transfers loads from jack trusses, joists, rafters and blocking members to supporting members and is formed from No. 16 gage steel. Table 14 and Figure 14 describe model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.15 Z Series Panel Stiffener Clips: The Z2 and Z4, Z44 panel stiffener clips are formed from No. 20 and No. 12 gage steel, respectively. The Z clips are used to support nominally 2-by-4 or 2-by-6 wood blocking between joists or trusses that provide solid backing for ceiling panel material. Table 15 and Figure 15 provide model numbers, dimensions, fastener schedules, allowable loads, and installation details.

3.1.16 FWANZ Foundation Wall Angles: The FWANZ foundation wall angles are used to attach the foundation or basement walls to the floor system to resist out-of-plane loads imposed by soil pressure. Each angle fastens to the wood rimboard and wood mudsill with nails. The FWANZ is formed from No.14 gauge steel. Table 16 and Figure 16 provide model numbers, dimensions, fastener schedule, allowable loads, and installation details.

3.2 Materials

3.2.1 Steel: The DSP, FWANZ, H2A, H2.5T, H8, H14, LCE4, LTP5, RBC, RBCP, SSP and TSP connectors described in this report are manufactured from galvanized steel complying with ASTM A 653, Grade 40, SS designation with a minimum yield strength of 40,000 psi (227 MPa) and a minimum ultimate tensile strength of 55,000 psi (358 MPa). All other connectors described in this report are manufactured from galvanized steel complying with ASTM A 653, Grade 33, SS designation with a minimum yield strength of 33,000 psi (227 MPa) and a minimum ultimate tensile strength of 45,000 psi (310 MPa). Base metal thicknesses for the connectors in this report are as follows:

GAGE	BASE METAL THICKNESS (inches)
No. 12	0.0975
No. 14	0.0720
No. 16	0.0555
No. 18	0.0445
No. 20	0.0335

For SI: 1 inch = 25.4 mm

The connectors have a minimum G90 zinc coating designation complying with ASTM A 653. Some models also are available with a G185 zinc coating designation in accordance with ASTM A 653 (denoted by model numbers ending in the letter Z). Some models are available with a batch hot-dipped galvanized coating in accordance with ASTM A 123, with a minimum specified coating weight of 2.0 ounces of zinc per square foot of surface area (600 g/m^2), total for both sides (denoted by model numbers ending with the letters HDG). Model numbers in this

report do not list the Z or HDG ending, but the information shown applies.

The holder of this report (Simpson Strong-Tie) or lumber treater shall be contacted for recommendations on minimum corrosion resistance of steel connectors in contact with specific proprietary preservative-treated or fire-retardant-treated lumber.

3.2.2 Wood: Wood members with which the connectors are used shall be either sawn lumber or engineered lumber having a minimum specific gravity of 0.50 (minimum equivalent specific gravity of 0.50 for engineered lumber), and having a maximum moisture content of 19 percent (16 percent for engineered lumber), except as noted in Section 4.1. The thickness (depth) of the wood main member shall be equal to or greater than the length of the fasteners specified in the tables in this report, unless the reduced penetration effect on the load calculation per the applicable National Design Specification for Wood Construction and its Supplement (NDS) is taken into account, or as required by wood member design, whichever is greater.

3.2.3 Fasteners: Common nails shall comply with ASTM F 1667 when used with connectors in this report and have the following minimum fastener dimensions and bending yield strengths (F_{yb}):

FASTENER	SHANK DIAMETER (inches)	FASTENER LENGTH (inches)	F_{yb} (psi)
8d x 1½	0.131	1½	100,000
8d	0.131	2½	100,000
10d x 1½	0.148	1½	90,000
10d	0.148	3	90,000
16d	0.162	3½	90,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

Fasteners used in contact with fire-retardant-treated or preservative-treated lumber shall comply with IBC Section 2304.9.5 or the 2012 and 2009 IRC Section R317.3 (2006 IRC Section R319.3), as applicable. The report holder or lumber treater shall be contacted for recommendations on minimum corrosion resistance and connection capacities of fasteners used with the specific proprietary preservative-treated or fire-retardant-treated lumber.

SDS wood screw fasteners described in Table 7 shall be Simpson Strong-Tie SDS wood screws recognized in ICC-ES ESR-2236.

4.0 DESIGN AND INSTALLATION

4.1 Design

The tabulated connector loads shown in this report are for allowable stress design and include the load duration factor, C_D, corresponding with the applicable loads in accordance with the National Design Specification for Wood Construction and its supplement (NDS). Further load duration increases are not permitted other than those shown.

Tabulated allowable loads apply to products connected to wood used where sustained temperatures are 100°F (37.8°C) or less and under dry conditions. The allowable loads shall be adjusted by the wet service factor, C_M, specified in the NDS for dowel-type fasteners, when products are installed to wood having a moisture content greater than 19 percent (16 percent for engineered wood products), or where wet service is expected. The allowable loads in this report shall be adjusted by the temperature factor, C_t, specified in the NDS when connectors are installed in wood that will experience sustained exposure to temperatures exceeding 100°F (37.8°C),

4.2 Installation

Installation of the connectors shown in this report shall be in accordance with the manufacturer's published installation instructions and this evaluation report. If there is a conflict between this report and the manufacturer's published installation instructions, the more restrictive prevails.

4.3 Special Inspection

4.3.1: Periodic special inspection shall be conducted in accordance with the 2012 IBC Section 1705.10, 2009 IBC Section 1706 or 2006 IBC Section 1704, as applicable, when the product series are components within the main wind-force-resisting system of structures constructed in areas listed in the 2012 IBC Section 1705.10, 2009 IBC Section 1706.1 and Section 1705.4 for the 2006 IBC. Special inspection requirements do not apply to structures, or portions thereof, that qualify for exception under the 2012 IBC Sections 1704.2, 1705.3, 1705.10.1 or 1705.10.2, 2009 IBC Sections 1704.1, 1704.4, 1706.2 or 1706.3 and 2006 IBC Sections 1704.1 and 1704.4.

4.3.2: Periodic special inspection shall be conducted in accordance with the applicable subsections of Section

1705.11 of the 2012 IBC and Section 1707 of the 2009 and 2006 IBC when the product series are components within the seismic-force-resisting system of structures constructed in Seismic Design Category C, D, E or F. Special inspection requirements do not apply to structures, or portions thereof, that qualify for exception under 2012 IBC Sections 1704.2 or 1705.11, 2009 IBC Sections 1704.1, 1707.3 or 1707.4 or 2006 IBC Sections 1704.1 or 1707.3.

4.3.3: For installations under the IRC, special inspection is not normally required. However, for an engineered design where calculations are required to be signed by a registered design professional, periodic special inspection requirements and exemptions are as stated in Sections 4.3.1 and 4.3.2 as applicable for installations under the IRC.

5.0 CONDITIONS OF USE

The Simpson Strong-Tie products described in this report are in compliance with, or are acceptable alternatives to what is specified in those codes listed in Section 1.0 of this report subject to the following conditions:

5.1 The connectors shall be manufactured, identified and installed in accordance with the manufacturer's published installation instructions and this report. A copy of the instructions shall be available at the jobsite continuously during installation.

5.2 Where applicable, adjustment factors noted in Section 4.1 and the applicable codes shall be considered.

5.3 Connected wood members and fasteners shall be in compliance, respectively, with Sections 3.2.2 and 3.2.3 of this report.

5.4 Use of connectors with fire-retardant-treated or preservative-treated lumber shall be in accordance with Section 3.2.1 of this report. Use of fasteners with fire-retardant-treated or preservative-treated lumber shall be in accordance with Section 3.2.3 of this report.

6.0 EVIDENCE SUBMITTED

Data in accordance with IAPMO UES Evaluation Criteria for the Testing and Analysis of Joist Hangers and Miscellaneous Connectors (EC 002-2011), inclusive of tests and calculations.

7.0 IDENTIFICATION

The products described in this report are identified with a die-stamped label indicating the name of the manufacturer (Simpson Strong-Tie), the model number, and the number of the index evaluation report (ER-102), which identifies products recognized in this report.

IAPMO UES ER-112

Richard Beck, PE, CBO, MCP
Director of Uniform Evaluation Service

GP Russ Chaney
CEO, The IAPMO Group

Report Number: 112
Originally Issued: 08/2008
Revised: 04/05/2013
Valid Through: 08/2013

TABLE 1: ALLOWABLE LOADS FOR THE A ANGLES

MODEL NO.	ANGLE DIMENSIONS[1] (in)			FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,3,4,5] (lbs)							
						F_1 where C_D =				F_2 where C_D =			
	L	W_1	W_2	Supporting Member (Base)	Supported Member (Post)	1.0	1.15	1.25	1.6[6]	1.0	1.15	1.25	1.6[6]
A21	$1^3/_8$	2	$1^1/_2$	2-10d x 1½	2-10d x 1½	235	270	290	365	175	175	175	175
A23	$2^3/_4$	2	$1^1/_2$	4-10d x 1½	4-10d x 1½	475	540	580	715	475	540	565	565
A33	$1^1/_2$	3	3	4-10d	4-10d	565	625	665	800	330	330	330	330
A44	$1^1/_2$	$4^9/_{16}$	$4^3/_8$	4-10d	4-10d	565	625	665	800	295	295	295	295

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Refer to Figure 1 for definitions of angle dimension nomenclature (L, W_1, W_2) and allowable load directions (F_1 and F_2).
2. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable building code.
3. F_1 and F_2 loads cannot be combined.
4. The F_1 allowable loads are for one connector. When angles are installed on each side of wood member, the minimum member thickness shall be 3 inches.
5. The F_2 allowable loads apply only when the connectors are used in pairs.
6. Allowable loads have been increased for wind or earthquake loading. No further increase is allowed.

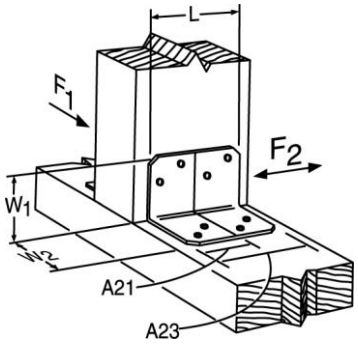


Figure 1 – A21 and A23 Angles

TABLE 2: ALLOWABLE LOADS FOR THE A34 / A35 FRAMING ANGLES

MODEL NO.	FASTENERS (Quantity-Type)		DIRECTION OF LOAD	ALLOWABLE LOADS[1,2] (lbs)			
	Joist	Header/Plate		C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6
A34	4-8dx1½	4-8dx1½	F_1	395	450	485	515
	4-8dx1½	4-8dx1½	F_2	395	450	455	455
A35	3-8dx1½	6-8dx1½	A_1	295	335	365	395
	3-8dx1½	6-8dx1½	C_1	210	210	210	210
	3-8dx1½	6-8dx1½	E	295	335	365	425
	6-8dx1½	6-8dx1½	A_2	295	335	365	380
	6-8dx1½	6-8dx1½	C_2	295	335	365	370
	6-8dx1½	6-8dx1½	D	230	230	230	230
	6-8dx1½	6-8dx1½	F_1	595	670	695	695
	6-8dx1½	6-8dx1½	F_2	595	670	670	670

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable NDS edition.
2. Connectors are required on both sides of joist to achieve F_2 loads in both directions.

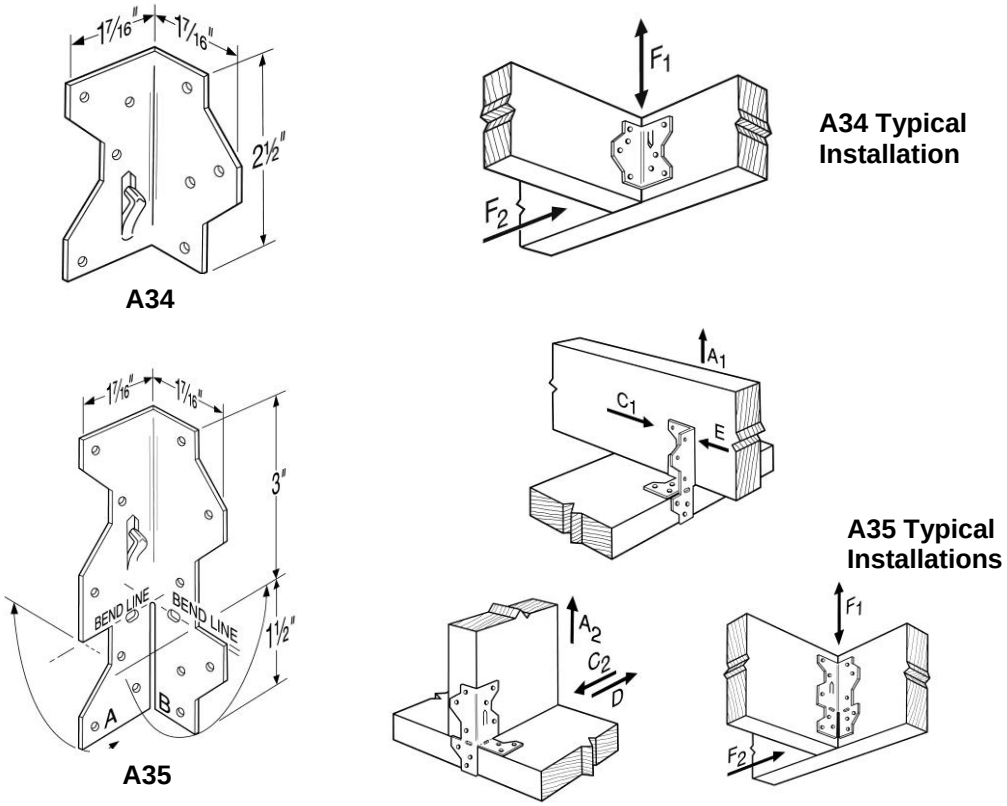


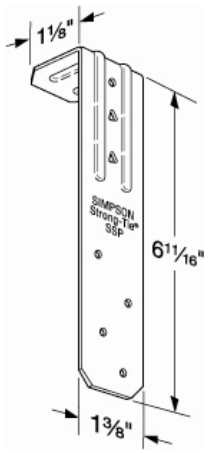
Figure 2 – A34 and A35 Framing Angles

TABLE 3: ALLOWABLE LOADS FOR SSP AND DSP STUD PLATE TIES

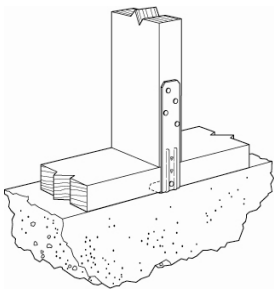
MODEL NO.	FASTENERS (Quantity-Type)			ALLOWABLE UPLIFT LOADS[1](lbs)	
	Studs	Double Top Plate	Sill Plate	Double Top Plate[3]	Sill Plate[4]
				C_D=1.60	C_D=1.60
SSP	4-10dX1½	3-10dX1½	-	350	-
		-	1-10dX1½	-	420
	4-10d	3-10d	-	435	-
		-	1-10d	-	455
DSP	8-10dX1½	6-10dX1½	-	775	-
		-	2-10dX1½	-	660
	8-10d	6-10d	-	825	-
		-	2-10d	-	825

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N

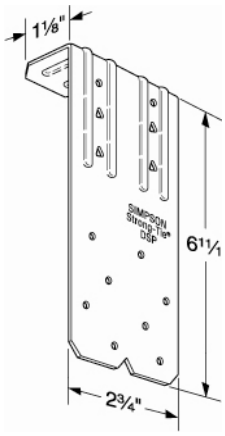
1. The allowable uplift loads have been increased for wind or earthquake loading using the tabulated value of C_D with no further increase allowed. Allowable loads shall be adjusted when other load durations govern.
2. When cross-grain bending or cross-grain tension cannot be avoided, mechanical reinforcement of the wood members to resist such loads shall be considered.
3. For Double Top Plate allowable load, all round and triangle holes shall be filled with the tabulated nails.
4. For Sill Plate allowable load, all round holes shall be filled with the tabulated nails.



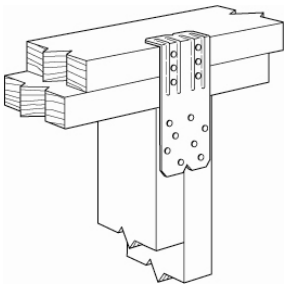
SSP



SSP Sill Plate Installation (DSP Similar)



DSP



DSP Top Plate Installation (SSP Similar)

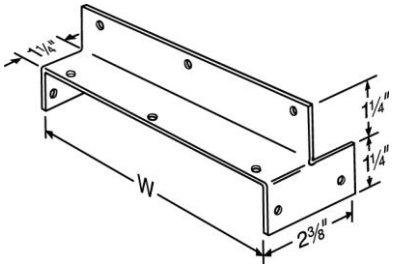
Figure 3 – SSP and DSP Stud Plate Ties

TABLE 4: ALLOWABLE LOADS FOR THE FC FRAMING CLIPS

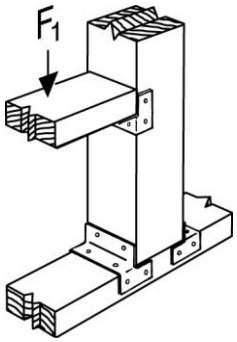
MODEL NO.	CONNECTOR WIDTH (W) (in)	FASTENERS (Quantity-Type)	ALLOWABLE DOWNLOAD, F_1[1,2] (lbs.)		
			C_D=1.0	C_D=1.15	C_D=1.25
FC4	$3^9/_{16}$	8-16d	865	920	920
FC6	$5^1/_2$	10-16d	1,010	1,145	1,235

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable building code.
2. Minimum thickness of the supporting member (post) shall be $2^1/_2$ inches to achieve the tabulated load value (similar to Figure 8).



FC Connector Dimensions



Typical FC Connector Installation

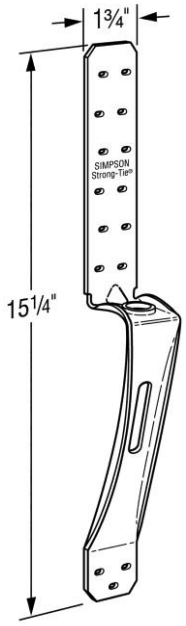
Figure 4- FC Framing Clips

TABLE 5: ALLOWABLE LOADS FOR FSC FLOOR SPAN CONNECTOR

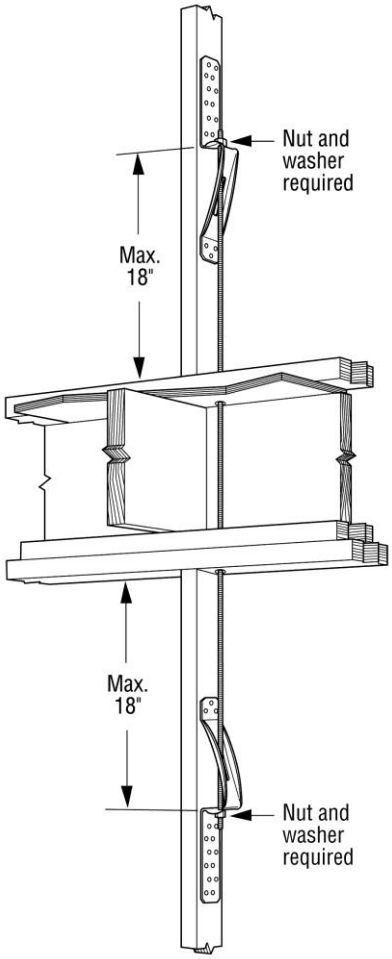
MODEL NO.	FASTENERS (Quantity-Type)		ALLOWABLE UPLIFT LOADS[1,2](lbs) C_D=1.6
	Stud	Anchor[3]	
FSC	15-10dx1 ½	3/8inch diameter ATR	**1,830**

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N

1. The uplift loads have been increased using the tabulated value of C_D for wind or earthquake loading with no further increase allowed. Allowable loads shall be adjusted when other load durations govern.
2. Load values are based on a minimum lumber thickness of 1½ inches.
3. Standard cut washer is required with the 3/8inch diameter all-thread rod.
4. The all-thread rod shall comply with minimum requirements of ASTM A307 Grade A.



FSC



FSC Stud to Stud Installation

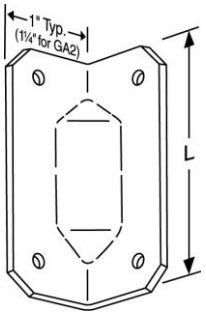
Figure 5 – FSC Floor Span Connector

TABLE 6: ALLOWABLE LOADS FOR GA GUSSET ANGLES

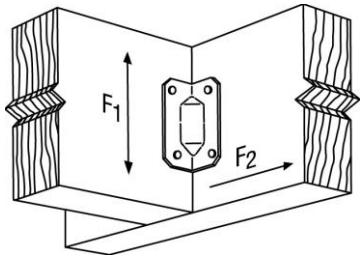
MODEL NO.	ANGLE LENGTH (L) (inches)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS[1] (lbs)							
			F_1 where C_D =				F_2 where C_D = [3]			
			1.0	1.15	1.25	1.6[2]	1.0	1.15	1.25	1.6[2]
GA1	$2^3/_4$	4-10d x 1 ½	235	270	290	330	235	270	290	365
GA2	$3^1/_4$	6-10d x 1 ½	355	405	435	550	355	405	435	550

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable NDS edition.
2. Allowable loads have been increased using the tabulated value of C_D for wind or earthquake loading. No further increase is allowed.
3. Connectors are required on both sides to achieve F_2 loads in both directions.



GA1



Typical GA Installation

Figure 6 – GA Gusset Angles

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TABLE 7: ALLOWABLE LOADS FOR H HURRICANE TIES

MODEL NO.	FASTENERS (Quantity-Type)			ALLOWABLE LOADS[1,2,3] (lbs)		
				Uplift[3] C_D=1.6	Lateral C_D=1.6	
	To Rafter	To Plates	To Studs		F_1[4]	F_2
H2A	5 - 8d x 1½	2 - 8d x 1½	5 - 8d x 1½	575	130	55
H2.5T	5 - 8d	5 - 8d	-	545[7]	135	145
H8	5 – 10d x 1 ½	5 – 10d x 1 ½	-	795	95	90
H10A	9 - 10d x 1 ½	9 - 10d x 1 ½	-	1,140	590	285
H10A-2	9 – 10d x 3	9 – 10d x 3	-	1,245	815	260
H10S	8 - 8d x 1½	8 - 8d x 1½	8 - 8d	1,010[7,8]	660[8]	215[8]
H14	12 - 8d x 1½	[1] 13 - 8d	-	1,350	725	285
	12 - 8d x 1½	[2] 15 - 8d	-	1,465	670	230
HGA10	4 – SDS 1/4 x 1½	4 – SDS 1/4 x 3	-	695	1,165	940[10]

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N

1. Allowable loads are for one anchor. A minimum rafter thickness of 2 ½ inches shall be used when framing anchors are installed on each side of the rafter and on the same side of the plate.
2. Allowable simultaneous loads in more than one direction on a single connector shall be evaluated as follows:
   Design Uplift/Allowable Uplift + Design Lateral Parallel to Plate/Allowable Lateral Parallel to Plate + Design Lateral Perpendicular to Plate/Allowable Lateral Perpendicular to Plate < 1.0. The number of terms considered in the equation is dependent on the designer's method of calculating wind forces and the utilization of the connector in the structural system.
3. The loads have been increased for wind or earthquake loading using the tabulated value of C_D with no further increase is allowed. Allowable loads shall be adjusted when other load durations govern.
4. Allowable loads in the F_1 direction are not intended to replace diaphragm boundary members or prevent cross-grain bending of the truss or rafter members.
5. When cross-grain bending or cross-grain tension cannot be avoided in the members, mechanical reinforcement of the wood members to resist such loads shall be considered.
6. Hurricane Ties are shown installed on the outside of the wall for clarity. Installation on the inside of the wall is acceptable. For a Continuous Load Path against uplift loads, connections in the same area (i.e. truss to plate connector and plate to stud connector) shall be on same side of the wall.
7. Allowable uplift load for the H2.5T and H10S with 8dX1½ fasteners is 425 lbs and 550 lbs, respectively.
8. H10S nails to plates are optional for uplift loads but required for lateral loads.
9. Stud may be offset 1inch maximum from center of rafter for reduced uplift and F_1 load capacities of 890 lbs and 545 lbs, respectively.
10. HGA10 F_2 value is for load acting toward the connector. For load away from the connector, F_2 = 780 lbs.

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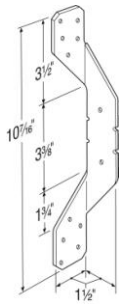
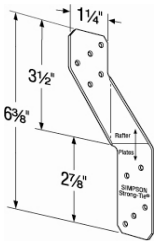
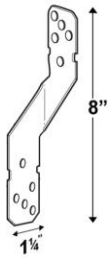


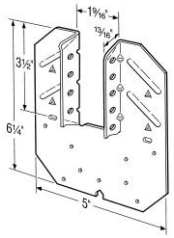
H2A



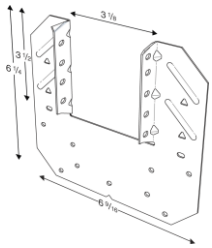
H2.5T



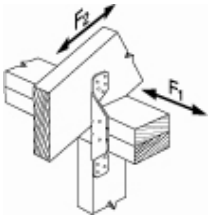
H8



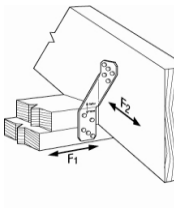
H10A



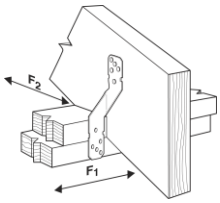
H10A-2



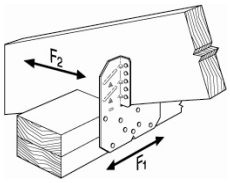
H2A Typical Installation



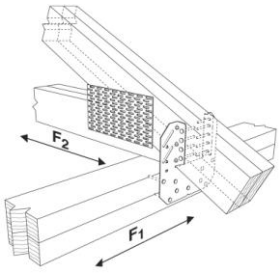
H2T Typical Installation



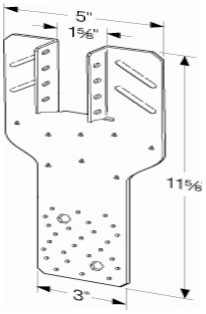
H8 Typical Installation



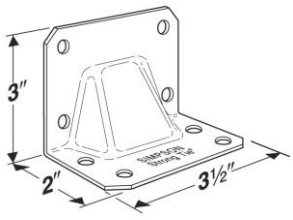
H10A Typical Installation



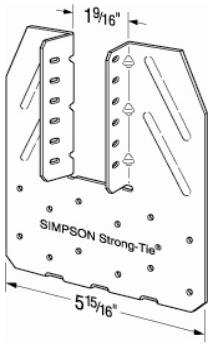
H10A-2 Typical Installation



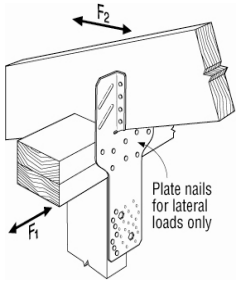
H10S



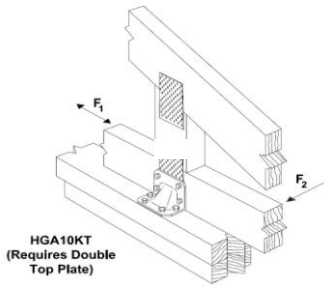
HGA10



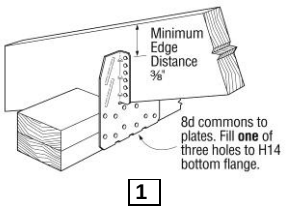
H14



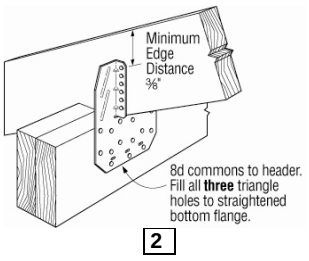
H10S Typical Installation



HGA10 Typical Installation



H14 Typical Top Plate Installation



H14 Typical Beam Installation

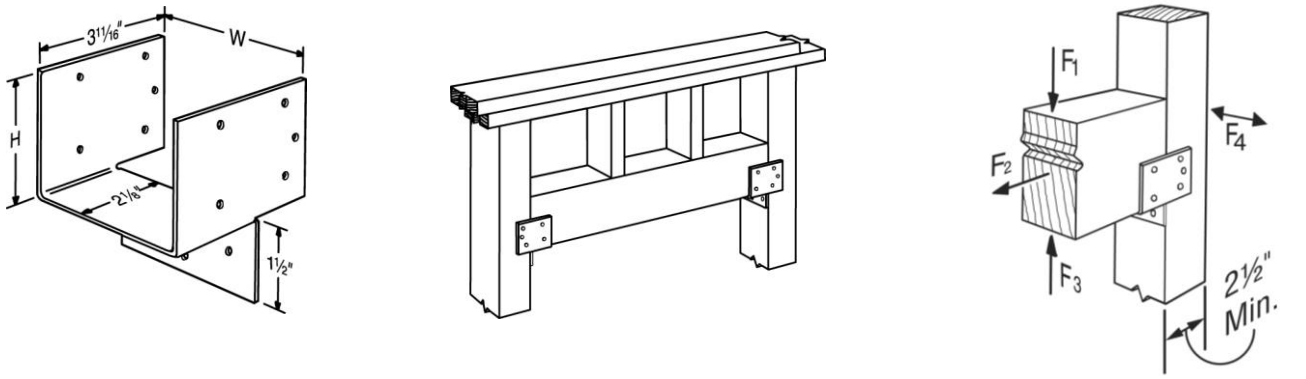
Figure 7 – H Hurricane Ties

TABLE 8: ALLOWABLE LOADS FOR THE HH HEADER HANGERS

MODEL NO.	HANGER DIMENSIONS[1] (in)		FASTENERS (Quantity-Type)		ALLOWABLE LOADS[2,5] (lbs)								
	W	H	Stud	Header	F_1 where C_D = [4]			F_2 where C_D =		F_3 where C_D =		F_4 where C_D =	
					1.0	1.15	1.25	1.0	1.6[3]	1.0	1.6[3]	1.0	1.6[3]
HH4	$3^1/_2$	$2^{13}/_{16}$	9-16d	4-16d	1,295	1,470	1,585	575	780	575	795	1,085	1,085
HH6	$5^1/_2$	$5^1/_8$	12-16d	6-16d	1,730	1,960	2,115	865	1,025	865	1,105	1,700	1,700

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Refer to Figure 8 for definitions of dimension nomenclature (W and H).
2. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable building code.
3. Allowable loads have been increased using the tabulated value of C_D for wind or earthquake loading. No further increase is allowed. Allowable loads shall be reduced when other load durations govern.
4. Duration of load increase may not exceed 25 percent.
5. Minimum lumber thickness shall be $2^1/_2$ inches to achieve tabulated allowable load values.



HH4 Hanger Dimensions **Typical HH Installation** **Allowable Load Directions**

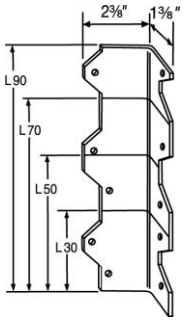
Figure 8 – HH Header Hangers

TABLE 9: ALLOWABLE LOADS FOR THE L REINFORCING ANGLES

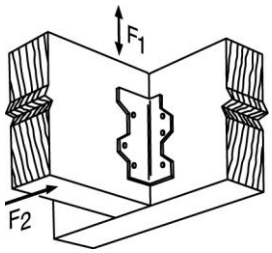
MODEL NO.	ANGLE LENGTH (L) (inches)	FASTENERS (Quantity-Type)	ALLOWABLE LOADS[1,3,4] (lbs)							
			F_1 where C_D =				F_2 where C_D =			
			1.0	1.15	1.25	1.6[2]	1.0	1.15	1.25	1.6[2]
L30	3	4-10d x 1 ½	245	250	250	250	245	275	295	370
L50	5	6-10d x 1 ½	365	415	445	555	365	415	445	555
L70	7	8-10d x 1 ½	485	550	595	740	485	550	595	740
L90	9	10-10d x 1 ½	610	690	740	925	610	690	740	925

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable building code.
2. Allowable loads have been increased for wind or earthquake loading. No further increase is allowed.
3. Minimum member thickness shall be 1¾ inches to achieve the tabulated allowable load values.
4. Connectors are required on both sides to achieve F_2 loads in both directions.



L Angle



Typical L50 Installation and Allowable Load Directions

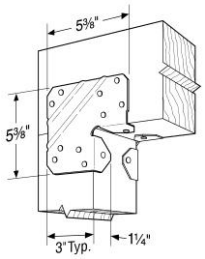
Figure 9 – L Reinforcing Angles

TABLE 10: ALLOWABLE LOADS FOR LCE4 POST CAP

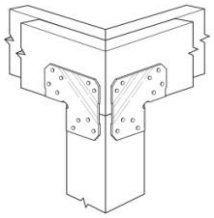
MODEL NO.	FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] (lbs)	
			Uplift[3]	Lateral
	Beam	Post	C_D=1.60	C_D=1.60
LCE4	14-16d	10-16d	1,955	1,425
LCE4 (Mitered Corner)	14-16d	10-16d	985	-

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N

1. The loads have been increased using the tabulated value of C_D for wind or earthquake loading, with no further increase allowed. Allowable loads shall be adjusted when other load durations govern.
2. Loads apply only when used in pairs. Loads in table above are for each connector.
3. Uplift loads do not apply to splice conditions.



LCE4



LCE4 (Mitered Corner)

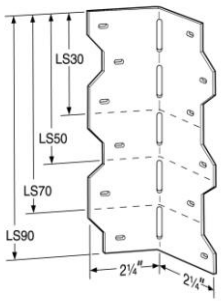
Figure 10 – LCE4 Post Cap

TABLE 11: ALLOWABLE LOADS FOR LS SKEWABLE ANGLES

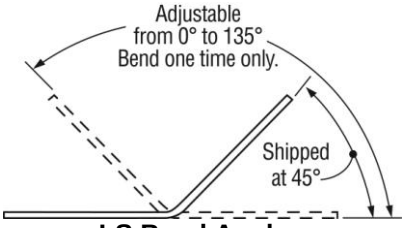
MODEL NO.	L (inches)	FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] (lbs)			
		Carried Member	Carrying Member	C_D=1.0	C_D=1.15	C_D=1.25	C_D=1.6
LS30	3 ⅜	3-10d x 1½	3-10d x 1½	325	325	325	325
		3-10d	3-10d	355	395	395	395
LS50	4 ⅞	4-10d x 1½	4-10d x 1½	475	540	565	565
		4-10d	4-10d	475	540	585	730
LS70	6 ⅜	5-10d x 1½	5-10d x 1½	595	640	640	640
		5-10d	5-10d	595	675	730	915
LS90	7 ⅞	6-10d x 1½	6-10d x 1½	715	810	845	845
		6-10d	6-10d	715	810	875	1,040

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

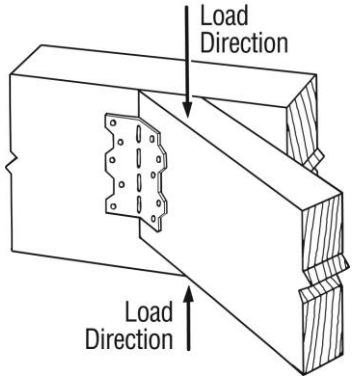
1. Tabulated allowable load capacities shall be selected based on duration of load as permitted by the applicable NDS edition.
2. Figure 11 indicates load directions.



LS



LS Bend Angles



LS Installed

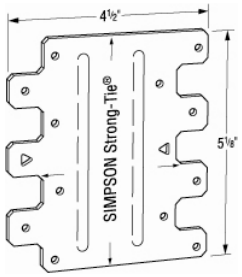
Figure 11 – LS Skewable Angles

TABLE 12: ALLOWABLE LOADS FOR LTP4 AND LTP5 LATERAL TIE PLATES

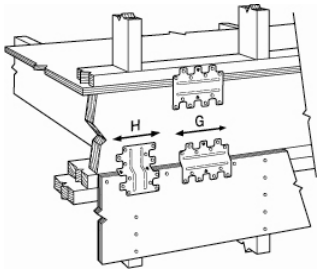
MODEL NO.	CONNECTOR CONFIGURATION	FASTENERS (Quantity-Type)		ALLOWABLE LATERAL LOADS[1] (lbs) C_D=1.6
		Rim Board	Plates	
LTP4	G	6-8d x 1 ½	6-8d x 1 ½	670
	H	6-8d x 1 ½	6-8d x 1 ½	600
LTP5	G	6-8d x 1 ½	6-8d x 1 ½	620
	H	6-8d x 1 ½	6-8d x 1 ½	545

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

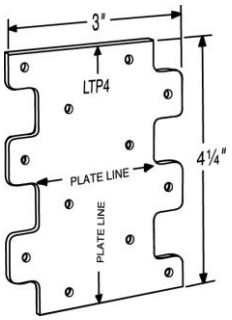
1. The loads have been increased using the tabulated value of C_D for wind or earthquake loading with no further increase allowed. Allowable loads shall be adjusted when other load durations govern
2. The LTP5 may be installed over wood structural panel sheathing no greater than ½" thick.



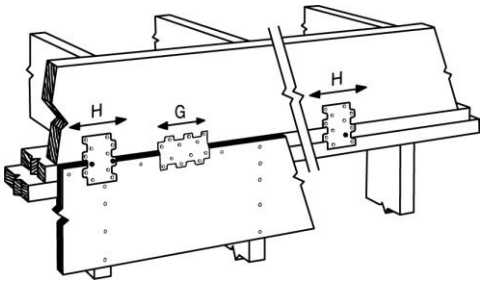
LTP5



LTP5 Typical Installations



LTP4



LTP4 Typical Installations

Figure 12 – LTP4 and LTP5 Lateral Tie Plates

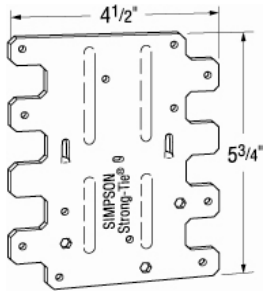
Report Number: 112
Originally Issued: 08/2008
Revised: 04/05/2013
Valid Through: 08/2013

TABLE 13: ALLOWABLE LOADS FOR RBC/RBCP ROOF BOUNDARY CLIPS

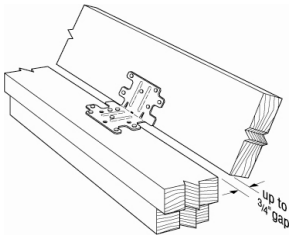
MODEL NO.	CONNECTION TYPE	BEND ANGLE[4]	FASTENERS (Quantity-Type)		ALLOWABLE LATERAL LOADS[1,2,3] (lbs) C_D=1.6
			Plate	Blocking	
RBC	Inside	45 to 90°	6-10dx1 ½	6-10dx1 ½	445
	Outside	0 to 29°			435
		30 to 45°			480

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

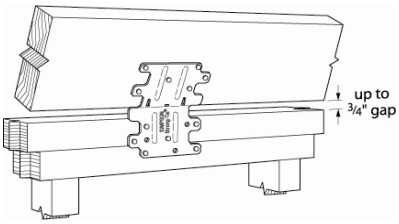
1. The loads have been increased using the tabulated value of C_D for wind or earthquake loading with no further increase allowed. Allowable loads shall be adjusted when other load durations govern.
2. Allowable loads are for one clip attached to blocking minimum 1½" thick.
3. RBCP replaces blocking fasteners with prongs. All load values are identical. Bend holes shall be aligned along lower edge of block as shown in Figure 13 below. All prongs in the RBCP shall be pressed (not hammered) into the block such that there is no more than a 1/32 inch gap between the face of the block and the bottom surface of the RBCP. RBCP prongs shall be installed in clear wood (no knots, etc.).
4. RBC/RBCP is shipped flat. Bending angle is measured from initial flat orientation. For inside installation, the bend angle = 90° - roof slope. For outside installation, the bend angle = roof slope.



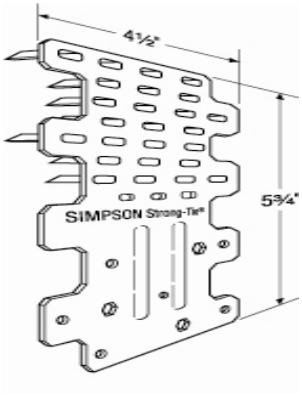
RBC



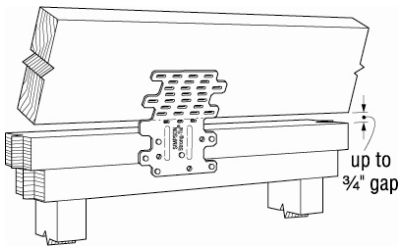
RBC Inside Installation (RBCP Similar)



RBC Outside Installation



RBCP



RBCP Outside Installation

Figure 13 – RBC and RBCP Roof Boundary Clips

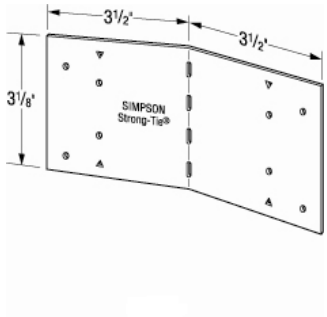
Report Number: 112
Originally Issued: 08/2008
Revised: 04/05/2013
Valid Through: 08/2013

TABLE 14: ALLOWABLE LOADS FOR TJC37 TRUSS JACK CONNECTOR

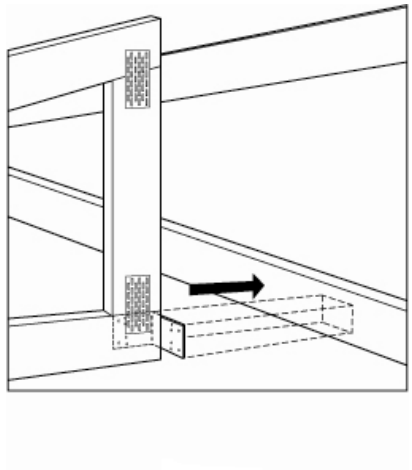
MODEL NO.	FASTENERS (Quantity-Type)		ALLOWABLE LOADS[1,2] Where C_D=1.0 C_D=1.15 C_D=1.25 C_D=1.6 (lbs.)		
	Carrying Member	Carried Member	0° Skew	1 to 60° Skew	61 to 67.5° Skew
TJC37	4-8dx1 ½	4-8dx1 ½	340	300	320
	6-8dx1 ½	6-8dx1 ½	580	485	425

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

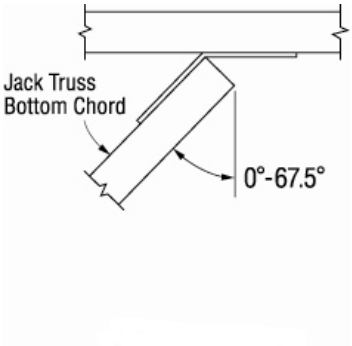
1. No load duration increase allowed.
2. Allowable loads are for vertical direction (uplift or download).



TJC37



TJC37 Typical Installation



TJC37 Bend Angles

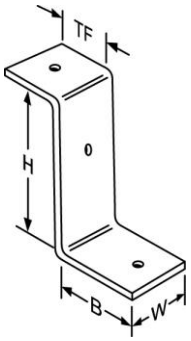
Figure 14 – TJC37 Truss Jack Connector

TABLE 15: ALLOWABLE LOADS FOR Z PANEL STIFFENER CLIPS

MODEL NO.	CLIP DIMENSIONS[1] (in)				FASTENERS (Quantity-Type)		ALLOWABLE DOWNLOAD Where C_D=1.0 C_D=1.15 C_D=1.25 C_D=1.6 (lbs.)
	W	H	B	TF	Top	Seat	
Z2	$2^5/_{16}$	$1^1/_2$	$1^3/_8$	$1^3/_8$	2-10d x $1^1/_2$	2-10d x $1^1/_2$	465
Z4	$1^1/_2$	$3^1/_2$	$2^1/_8$	$1^3/_4$	1-16d	1-16d	465
Z44	$2^1/_2$	$3^1/_2$	2	$1^3/_8$	2-16d	2-16d	865

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Figure 15 provides definitions of clip dimension nomenclature (W, H, B, TF).
2. No load duration increase permitted.
3. Compression perpendicular-to-grain capacity for the joists bearing on the clips shall be verified in accordance with the applicable NDS edition and shall not exceed the allowable loads noted in the table.



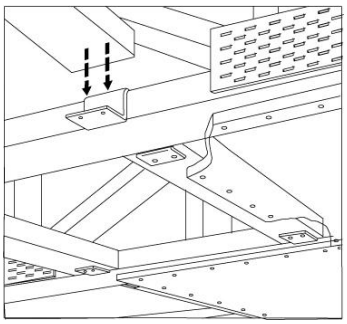


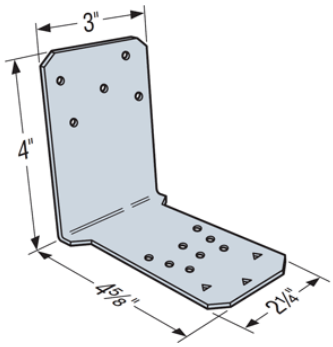
Figure 15 – Z Panel Stiffener Clips

TABLE 16: ALLOWABLE LOADS FOR FWANZ FOUNDATION WALL ANGLES

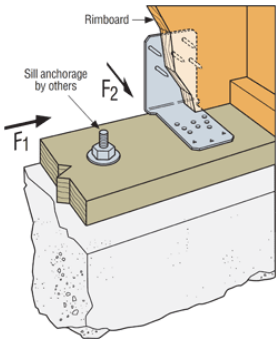
Model No.	Sill Plate	Fastener (Quantity-Type)		Rim Board Material	Allowable Load		
		Sill Plate	Rim Board		C_D = 0.90	C_D = 1.00	C_D = 1.60
FWANZ	2x4, 3x4, 2-2x4, 4x4	(8) 10d x 1½	(5) 10d x 1½	1" OSB	895	895	895
				1⅛" OSB	945	970	970
				1¾" I-Joist	945	1,050	1,275
				1¼" LSL	945	1,050	1,315
				2x DF/SP	945	1,050	1,410
				1¾" LVL	945	1,050	1,485
	2x6, 3x6, 2-2x6, 4x6	(11) 10d x 1½	(5) 10d x 1½	1" OSB	895	895	895
				1⅛" OSB	1,110	1,110	1,110
				1¾" I-Joist	1,135	1,135	1,135
				1¼" LSL	1,220	1,220	1,220
				2x DF/SP	1,300	1,440	1,445
				1¾" LVL	1,300	1,440	1,645

SI: 1 inch = 25.4 mm, 1 lbs = 4.45 N.

1. Tabulated allowable loads shall be selected based on duration of load as permitted by the applicable NDS edition.
2. FWANZ lateral F_1 load is equal to 310 lbs. No further increase in load permitted.
3. For simultaneous F_1 and F_2 loads, the connector shall be evaluated as follows: Design Lateral Parallel to Plate/Allowable Lateral Parallel to Plate + Design Lateral Perpendicular to Plate/Allowable Lateral Perpendicular to Plate ≤ 1.0. The number of terms in the equation is dependent on the utilization of the connector in the structural system.
4. For joist/blocking spacing greater than 16 inches on center. The FWANZ shall be located within 4 inches of the adjacent joist/blocking.
5. Splice joint not permitted on rim board in same bay as FWANZ unless blocking is placed on both sides of the splice joint.
6. When floor joists are parallel to the rimboard, the structural design professional shall ensure proper load transfer from rimboard into the diaphragm.
7. When I-joist rim material is used, backer blocks shall be used and installed according to the I-Joist manufacturer's instructions.



FWANZ



Typical Installation and Allowable Load Direction

Figure 16 – FWANZ Foundation Wall Angles

ICC-ES Evaluation Report

ESR-2233*

Reissued July 1, 2012

This report is subject to renewal on July 1, 2014.

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 12 00—Structural Panels

REPORT HOLDER:

AFM CORPORATION
17645 JUNIPER PATH, SUITE 260
LAKEVILLE, MINNESOTA 55044
www.r-control.com

EVALUATION SUBJECT:

R-CONTROL® STRUCTURAL INSULATED PANELS (SIPs)

ADDITIONAL LISTEES:

ACH FOAM TECHNOLOGIES, LLC
5250 NORTH SHERMAN STREET
DENVER, COLORADO 80216

BIG SKY INSULATIONS, INC.
15 ARDEN DRIVE
BELGRADE, MONTANA 59714

BRANCH RIVER PLASTICS, INC.
15 THURBER BOULEVARD
SMITHFIELD, RHODE ISLAND 02917

ENERGY SYSTEMS INC.
990 EPCO DRIVE
DANDRIDGE, TENNESSEE 37725

MID-ATLANTIC FOAM
326 McGHEE ROAD
WINCHESTER, VIRGINIA 22603

NOARK ENTERPRISES, INC.
10101 HIGHWAY 70 EAST
NORTH LITTLE ROCK, ARKANSAS 72117

THERMAL FOAMS, INC.
2101 KENMORE AVENUE
BUFFALO, NEW YORK 14207

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2012, 2009 and 2006 *International Residential Code®* (IRC)

Properties evaluated:

- Structural
- Thermal barrier
- Fire resistance

2.0 USES

R-Control Structural Insulated Panels (SIPs) are used as load-bearing wall, floor, and roof panels in fire-resistive and non-fire-resistive construction. The SIPs are alternatives to walls, floors, and roofs designed and constructed in accordance with IBC Section 2306; and walls, floors, and roofs installed in accordance with IBC Section 2308 or IRC Sections R502, R602, and R802. When R-Control SIPs are installed under the IRC, an engineered design is required in accordance with IRC Section R301.1.3 and Section 4.1.1 of this report.

3.0 DESCRIPTION

3.1 General:

R-Control SIPs are factory-laminated sandwich panels consisting of oriented strand board (OSB) facings with an expanded polystyrene (EPS) foam plastic core. R-Control SIPs vary in width from 4 to 8 feet (1.2 m to 2.4 m) and in length from 8 to 24 feet (2.4 m to 7.2 m).

3.2 Materials:

3.2.1 Expanded Polystyrene: The EPS foam plastic core is Foam-Control EPS with Perform Guard, which is recognized in ESR-1006 and complies with ASTM C578, Type I. EPS core nominal thickness is $3^5/_8$, $5^5/_8$, $7^3/_8$, $9^3/_8$, or $11^3/_8$ inches (92, 143, 187, 238, or 289 mm).

3.2.2 Facing: The facing material is nominally $^7/_{16}$-inch-thick (11.1 mm), Exposure 1 OSB rated sheathing with a $^{24}/_{16}$ span rating, which complies with U.S. DOC PS2 and additional requirements as specified in the approved quality control manual. The OSB facings are continuous for each SIP. The OSB may be Blazeguard FR Deck Panel A, recognized in ESR-1365. The OSB facings are supplied by manufacturers listed in the approved quality documentation.

3.2.3 Adhesive: Adhesives comply with Type II, Class 2, performance requirements set forth in the ICC-ES Acceptance Criteria for Sandwich Panel Adhesives (AC05). The adhesives are supplied by manufacturers listed in the approved quality documentation.

3.2.4 Splines: Splines are identified as surface, block, lumber block, lumber, or I-beam type splines. Spline thickness equals the EPS core thickness of the SIPs to be joined, except for surface splines, which have a thickness of $^7/_{16}$ inch (11.1 mm).

Surface splines are 4-inch-wide-by-$^7/_{16}$-inch-thick (102 mm by 11.1 mm) OSB as described in Section 3.2.2.

Block splines consist of two 3-inch-wide-by-$^7/_{16}$-inch-thick (76 mm by 11.1 mm) OSB facings as described in Section 3.2.2, laminated to an EPS core. Block splines are manufactured in depths of $3^1/_2$, $5^1/_2$, $7^1/_4$, $9^1/_4$, and

$11^1/_4$ inches (89, 133, 184, 235, and 286 mm) as specified in the approved quality control manual.

Lumber block splines consist of two nominally 1-by-4 spruce-pine-fir No. 2 grade or better wood members laminated to an EPS core. Lumber block splines are manufactured in depths of $3^1/_2$, $5^1/_2$, $7^1/_4$, $9^1/_4$, and $11^1/_4$ inches (89, 133, 184, 235, and 286 mm) as specified in the approved quality control manual.

Lumber splines consist of solid sawn lumber, nominally 2-by or 4-by spruce-pine-fir No. 2 or better wood members, or, when justified by the structural design professional, equivalent engineered wood material.

I-beam splines are single-web I-joists manufactured in depths of $9^1/_4$ and $11^1/_4$ inches (235 and 286 mm) with minimum $1^1/_2$-inch-by-$2^1/_2$-inch (38 mm by 63.5 mm) laminated veneer lumber flanges, as specified in the approved quantity control manual.

3.2.5 R-Control SIP Screws: R-Control SIP screws are used to fasten R-Control SIPs to underlying supports for horizontal diaphragms. R-Control SIP screws are corrosion-resistant steel screws having a minimum shank diameter of 0.188 inch (4.7 mm) and a minimum head diameter of 0.620 inch (15.5 mm). Screws are available in lengths from 3 inches to 18 inches (76.2 mm to 457.2 mm). The thread length for all screws is $2^3/_4$ inches (70 mm) measured from the tip. R-Control SIP Screws are manufactured as specified in the approved quality control manual.

3.2.6 R-Control Low VOC Do-All-Ply: R-Control Low VOC Do-All-Ply is specified as a sealant during installation of R-Control SIPs. R-Control Do-All-Ply is applied to the splines as indicated in the figures of this report. R-Control Low VOC Do-All-Ply is manufactured as specified in the approved quality control manual. Packaged in 20-ounce (828 ml) sausages, the sealant has a nine-month shelf life.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 R-Control SIP Walls, Floors, and Roofs: R-Control SIPs are limited to the allowable loads and loading conditions indicated in Tables 3 through 9 of this report for single span, simple support conditions. Continuous or multiple span installations and eccentric axial loadings to one face of SIPs used as walls are outside the scope of this report. The allowable loads shown in these tables are the allowable loads of the R-Control SIPs only and do not include consideration of the elements supporting the SIPs, which must be designed, detailed and constructed to comply with the requirements of the IBC or IRC, as applicable.

4.1.2 R-Control SIP Headers: Openings in R-Control SIP walls are limited to sizes, spans and the allowable loads specified in Table 10. Openings not covered by Table 10 must be framed to comply with requirements in the IBC or IRC, as applicable.

4.2 Installation:

4.2.1 General: R-Control SIPs must be installed in accordance with the manufacturer's published installation instructions, this evaluation report and the plans and specifications approved by the code official. The manufacturer's published installation instructions and this report must be strictly adhered to, and a copy of the instructions must be available at all times on the jobsite during installation. If there are any conflicts between the manufacturer's instructions and this report, the more restrictive governs.

4.2.2 Walls: The SIP core is recessed $1^1/_2$ inches (38 mm) from the bottom panel edge and $1^1/_2$ inches (38 mm) from the top panel edge. The recesses receive nominally 2-by or 4-by spruce-pine-fir No. 2 or better bottom and top plates in a width matching the core thickness. R-Control Low VOC Do-All-Ply is applied to the plates as indicated in the figures of this report. Bottom and top plates must be fastened to the facings with 8d box nails at 6 inches (152 mm) on center as indicated in the tables, or in an equivalent, approved fashion.

The SIP core is recessed on the vertical sides to receive splines and vertical boundary members in accordance with Section 3.2.4 and the tables and figures of this report. R-Control Low VOC Do-All-Ply is applied to the splines as indicated in the figures of this report. Splines must be connected to the SIPs by fastening through the SIP OSB facing in accordance with specifications in the tables and figures of this report.

The SIP may have factory-cut, $1^1/_2$-inch-diameter (38 mm) wiring chases centered within the core: a horizontal chase at receptacles height, a horizontal chase at switch height, and vertical chases spaced a minimum of 48 inches (1219 mm) from one another.

4.2.3 Floors and Roofs: R-Control SIPs used for floors or roofs are a maximum of 8 feet (2.4 m) wide when joined with surface splines, block splines, or lumber block splines, and are a maximum of 4 feet (1.2 m) wide when joined with other splines described in Section 3.2.4 of this report. The SIP core is recessed to receive splines. R-Control Low VOC Do-All-Ply is applied to the splines as indicated in the figures of this report. The splines must be connected to the SIP by fastening through the SIP OSB facing in accordance with specifications provided in the tables and figures of this report.

4.2.4 Headers: R-Control SIP headers must be constructed as described in Table 10 and the figures of this report.

4.2.5 SIP Protection:

4.2.5.1 Thermal Barrier at Wall, Roof and Floor: One-half-inch-thick (12.7 mm), regular gypsum wallboard, complying with ASTM C36 or ASTM C1396, must be installed on the interior surface of wall and roof panels, and the bottom side of floor panels having occupied space below the floor panel. The wallboard must be fastened to the face of the panels with minimum $1^1/_4$-inch-long (31.7 mm), No. 6, Type W drywall screws spaced in accordance with ASTM C840 for use under the IBC, or Table R702.3.5 of the IRC, using 16-inch-on-center (406.4 mm) framing spacing guidelines. Alternatively, the interior of the R-Control SIP must be Blazeguard FR Deck Panel A in accordance with Section 3.2.2 of this report.

4.2.5.2 Thermal Barrier at Floor Surface: An approved thermal barrier must be installed over the top surface of the floor panels, such as minimum $^7/_{16}$-inch-thick (76 mm) wood-based structural use sheathing installed in accordance with the applicable code.

4.2.5.3 Roof Exterior: R-Control SIPs must be protected by a roof covering, underlayment, and flashing installed in accordance with the IBC or IRC, as applicable, as indicated for $^7/_{16}$-inch-thick (11 mm) solidly sheathed decks.

4.2.5.4 Wall Exterior: R-Control SIPs must be protected on the exterior by weather protection consisting of a water-resistive barrier and wall covering as required by the IBC or IRC, as applicable.

4.2.6 Fire-resistance-rated Assemblies:

4.2.6.1 One-hour Limited Load-bearing Wall Assembly: R-Control SIPs with thicknesses of $4^1/_2$, $6^1/_2$, or $8^1/_4$ inches (114, 165, or 210 mm) are used to construct a one-hour fire-resistance rated wall assembly. The SIP core is recessed $1^1/_2$ inches (38 mm) from the bottom SIP edge and $1^1/_2$ inches (38 mm) from the top SIP edge. The recesses receive nominally 2-by spruce-pine-fir No. 2 or better lumber bottom and top plates with a depth to match the core thickness. The plates must be connected to the SIPs by fastening through the SIP OSB facing with 8d box nails spaced 6 inches (152 mm) on center, on each side of the SIP.

The SIP core is recessed on the vertical sides to receive surface or block splines in accordance with Section 3.2.2 of this report. R-Control Low VOC Do-All-Ply is applied to the splines as indicated in the figures of this report. The splines must be connected to the SIPs by fastening through the SIP OSB facing with $1^5/_8$-inch-long (41.3 mm), Type W, self-piercing tapping screws (ASTM C1002) spaced 6 inches (152 mm) on center.

The SIPs must be covered with two layers of $^5/_8$-inch-thick (15.9 mm) Type X gypsum wallboard, complying with ASTM C1396, on each side. Where the panels are exposed to the exterior, the exterior layers of gypsum boards must be $^5/_8$-inch-thick (15.9 mm), Type X gypsum sheathing complying with ASTM C1396. The vertical joints of the first layer of gypsum board must be offset a minimum of 16 inches (406 mm) from the spline joint. The first layer of gypsum board must be fastened to the panel facing with $1^5/_8$-inch-long (41.28 mm), Type W, self-piercing tapping screws complying with ASTM C1002, spaced 24 inches (610mm) on center vertically and 16 inches (406 mm) on center horizontally. The second layer of gypsum board must be installed with 2-inch-long (50.8 mm), Type W, self-piercing tapping screws complying with ASTM C1002, spaced 12 inches (305 mm) on center vertically, in rows offset 12 inches (305 mm) from screws securing the first layer of gypsum board, and 16 inches (406 mm) on center horizontally, in rows offset 8 inches (203 mm) from screws securing the first layer of gypsum board. The vertical joints in the second layer of gypsum board must be offset a minimum of 16 inches (406 mm) from vertical joints of the first layer of gypsum board.

Exposed gypsum board joints must be covered with joint tape and joint compound and the exposed screw heads covered with joint compound in accordance with ASTM C840.

This fire-resistance-rated wall assembly is limited to 9 feet (2.7 m) in height and a maximum superimposed allowable axial compression load of 1,800 plf (26 kN/m).

4.2.6.2 One-hour Limited Load-bearing Wall Assembly: R-Control SIPs with a $6^1/_2$- or $8^1/_4$-inch thickness (165 or 210 mm) may be used to construct a one-hour fire-resistance-rated wall assembly. The SIPs have a maximum width of 4 feet (2.4 m). The SIP core is recessed $1^1/_2$ inches (38 mm) from the bottom panel edge and 3 inches (76 mm) from the top panel edge. The recesses receive nominally 2-by-6 or 2-by-8 wood plates with a minimum 0.43 specific gravity, such as hem-fir, Grade No. 2. The SIP core is recessed $1^1/_2$ inches (38 mm) on the vertical sides to receive nominally 2-by-6 or 2-by-8 wood splines.

The bottom plate must be connected to the SIPS by fastening through the SIP OSB facing with 8d box nails spaced 6 inches (152 mm) on center, on each side of the SIP. Two nominally 2-by-6 or 2-by-8 wood splines must be fastened together with 16d coated sinker nails, spaced 24 inches (609.6 mm) on center and staggered. R-Control Low VOC Do-All-Ply is applied to the splines as indicated in the figures of this report. The 2-by-6 or 2-by-8 wood splines must be connected to the SIPS by fastening through the SIP OSB facing with 8d box nails, spaced 6 inches (152 mm) on center.

The top plate must be two nominally 2-by-6 or 2-by-8 wood plates fastened together with 16d coated sinker nails, spaced 16 inches (406.4 mm) on center and staggered. R-Control Low VOC Do-All-Ply is applied to the splines as indicated in the figures of this report. The top plate must be connected to the SIPS by fastening through the SIP OSB facing with 8d box nails spaced 6 inches (152 mm) on center placed through the SIP facing.

Electrical chases, $1^1/_2$ inches (38.1 mm) in diameter, are permitted to be located horizontally in the core of the SIP, 16 inches (406.4 mm) and 45 inches (1142 mm) above the bottom of the wall.

The SIP must be covered with one layer of $^5/_8$-inch-thick (15.88 mm) Standard Gypsum Co. Type SG-C gypsum board applied vertically on each side and fastened with phosphate-coated, cupped-head drywall nails, $1^5/_8$ inches (41.28 mm) long, spaced 8 inches (203 mm) on center along the perimeter of the wallboard and 12 inches (305 mm) on center vertically and 16 inches (406.4 mm) on center horizontally in the field of the board. The exposed joints of the gypsum board must be covered with joint tape and compound, and the exposed nails must be covered with joint compound in accordance with ASTM C840.

The fire-resistance-rated wall assembly is limited to 10 feet (3 m) in height and a superimposed allowable axial compression load of 2,200 plf (32 kN/m).

4.2.6.3 One-hour Roof-ceiling Assembly: The one-hour fire-resistance-rated roof-ceiling assembly must comply with the following requirements.

1. Structural wood beams must be a minimum of $4^1/_2$ inches wide by $9^1/_2$ inches deep (114 mm by 241 mm) and must be spaced in accordance with the IBC or IRC, as applicable.
2. The roof covering material must comply with the IBC. The roof construction must comply as a Class A, B or C roof assembly.
3. R-Control SIPs must be $4^1/_2$ inches to $12^1/_4$ inches (114 mm to 286 mm) thick.
4. R-Control SIPs must be connected with nominally 2-inch lumber splines installed in the recessed core. The lumber depth must be sized to match the core and must be connected to the SIP by fastening through the OSB facing with 8d common nails spaced 6 inches (152 mm) on center.
5. Each exposed SIP edge must be covered with nominally 2-inch wood blocking installed in the recessed core and connected to the SIP by fastening through the OSB facing with 8d common nails spaced 6 inches (152 mm) on center.
6. Minimum $^5/_8$-inch-thick (15.9 mm) gypsum board complying with ASTM C1396 must be installed in two layers on the underside of the SIPs and wood beams. The gypsum board's long dimension must be installed perpendicular to the wood beams. The first layer must be connected using $1^1/_4$-inch-long (31.7 mm), Type S, bugle-head steel screws complying with ASTM C1002, spaced 8 inches (203 mm) on center along the joints and in rows spaced 16 inches (406 mm) on center in the field. The joints of the first layer of gypsum board must

be staggered from the joints of the SIPs. The second layer of gypsum board must be fastened using 2-inch-long (51 mm), bugle-head, Type W, self-piercing steel screws complying with ASTM C1002, spaced 8 inches (203 mm) on center along the board edges and in rows 12 inches (305 mm) on center in the field. The joints of the gypsum board second layer must be staggered from the joints of the gypsum board first layer.

7. Exposed gypsum board joints must be covered with paper tape and joint compound. Screw heads must be covered with joint compound in accordance with ASTM C840.

4.2.6.4 One-hour Roof-ceiling Assembly: The one hour fire-resistance-rated roof-ceiling assembly must comply with the following requirements.

1. Open web steel joist must be Type 10K1, minimum size, and must be designed, constructed and installed in accordance with the Steel Joist Institute (SJI) specifications for open web joist and joist girders, as referenced in Section 2206 of the IBC.
2. The roof covering material must comply with the IBC. The roof construction must comply as a Class A, B or C roof assembly.
3. R-Control SIPs must be $4^1/_2$ inches to $12^1/_2$ inches (114 mm to 286 mm) thick.
4. Splines must be OSB surface splines complying with Section 3.2.2 of this report, and must be connected to the SIPs by fastening through the OSB facing with 8d common nails spaced 6 inches (152 mm) on center.
5. Each exposed SIP edge must be covered with nominally 2-inch-wide wood blocking installed in the recessed SIP core and connected to the SIP by fastening through the OSB facing with 8d common nails spaced 6 inches (152 mm) on center.
6. Diamond mesh expanded galvanized steel lath weighing 3.4 pounds per square yard (1.3 kg/m2) with $^3/_8$-inch (9.5 mm) ribs must comply with ASTM C847. Lath must be secured to one side of the joist using No. 20 SWG steel tie wire located at the mid-height of every other web member. Additional lath must be installed on the underside of the SIPs and must be secured by means of 1-inch-wide-by-$1^1/_2$-inch-long (25.4 mm by 38 mm), No. 14 gage staples spaced 7 inches (178 mm) on center laterally and longitudinally to the SIP facings.
7. CAFCO BLAZE-SHIELD Type DC-F spray-applied fire-resistant material, recognized in ESR-1649, must be applied to both the open-web steel joists and the underside of the SIP. Steel joists, SIPs, and metal lath must be free of dirt, oil and loose scale. The surfaces to receive the fireproofing material must be wetted first by spraying with water. The minimum average thickness of the Type DC/F material must be $2^1/_4$ inches (57 mm). The minimum average thickness of the Type DC/F material applied to the open-web steel joists is $2^1/_4$ inches (57 mm), but the size of the steel joist members may require a different thickness that must be determined in accordance with ESR-1649. The measured individual and average minimum in-place, dry densities must be 11 pcf and 12 pcf (176 and 192 kg/m^3), respectively.

4.3 Special Inspections:

4.3.1 Spray-applied Fire-resistant Material: Special inspection and tests must be provided in accordance with Section 1705.13 of the 2012 IBC, Section 1704.12 of the 209 IBC, or Section 1704.11 of the 2006 IBC for the spray-applied fire-resistant material described in Section 4.2.6.4, item 7.

5.0 CONDITIONS OF USE

The R-Control SIPs as described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The SIPs are fabricated, identified, and erected in accordance with this report and the manufacturer's published installation instructions. If there is a conflict between this report and the manufacturer's instructions, this report governs.

5.2 Design loads to be resisted by the SIPs must be determined in accordance with the IBC or IRC, as applicable, and must not exceed the allowable loads noted in this report.

5.3 All construction documents specifying the SIPs must comply with the design limitations of this report. Design calculations and details for the specific applications must be furnished to the code official, verifying compliance with this report and applicable codes. Connections and attachments of the SIPs must be addressed in the design calculations and details. The documents must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.4 R-Control SIPs and other wood elements must be installed as set forth in IBC Section 2304.11.2, 2012 or 2009 IRC Section R317.1, or 2006 IRC Section R319.1.

5.5 R-Control SIPs with thicknesses of 10¼ and 12¼ inches (260 and 311 mm) must be used only as roof or floor panels.

5.6 R-Control SIPs may be used as one-hour fire resistance-rated assemblies when constructed in accordance with Section 4.2.6.

5.7 The SIPs must be limited to use in buildings of Type V construction.

5.8 Wood-based materials, including SIP facings, must be protected from decay and termite damage in accordance with IBC Sections 2304.11.2.2 and 2304.11.2.6, or IRC Sections R319 and R320, as applicable.

5.9 When used as shear walls, the SIPs are recognized for use in Seismic Design Categories A, B and C. Use of SIPs as shear walls in Seismic Design Categories D, E, and F is outside the scope of this report.

5.10 The SIPs and their attachments are subject to inspection by the code official prior to covering with an approved water-resistive barrier or approved roof covering.

5.11 Special inspection for the spray-applied fire-resistant material must be provided in accordance with Section 4.3.1.

5.12 Justification must be submitted to the code official demonstrating that the R-Control SIPs with the roof covering comply as a Class A, B or C roof assembly as required by IBC Sections 1505 and 2603.6 or IRC Section R902, with the classification complying with the minimum classification requirements for the building.

5.13 The SIPs are manufactured by the listees noted in this report, at the locations specified in Table 1, under a quality control program with inspections by PFS Corporation (AA-652).

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Sandwich Panels (AC04), dated February 2012.

6.2 Reports of fire-resistance tests of wall and roof-ceiling assemblies in accordance with ASTM E119.

6.3 Report of room corner tests in accordance with UL 1715.

6.4 Reports of diaphragm load tests in accordance with ASTM E455.

7.0 IDENTIFICATION

7.1 Each R-Control SIP is marked with the report holder's name (AFM); plant identification number (see Table 1); the product name (R-Control® SIPs); the name or logo of the inspection agency (PFS Corporation); and the evaluation report number (ESR-2233).

7.2 R-Control SIPs with a Blazeguard FR Deckpanel A facer are also identified according to evaluation report ESR-1365.

7.3 I-beam splines are labeled with the words “for use with R-Control SIPs (ESR-2233).”

7.4 R-Control SIP Screws are labeled with the words “for use with R-Control SIPs (ESR-2233).”

TABLE 1—MANUFACTURING LOCATIONS

LISTEE	LOCATION	PLANT ID NO.
ACH Foam Technologies, LLC	5250 North Sherman Street Denver, Colorado 80216	U-01
ACH Foam Technologies, LLC	775 Waltham Way Suite 105 McCarron, Nevada 89434	U-53
Big Sky Insulations, Inc.	15 Arden Drive Belgrade, Montana 59714	U-30
Branch River Plastics, Inc.	15 Thurber Boulevard Smithfield, Rhode Island 02917	U-06
Energy Systems Inc.	990 Epco Drive Dandridge, Tennessee 37725	U-04A
Mid-Atlantic Foam	326 McGhee Road Winchester, Virginia 22603	U-14
Noark Enterprises, Inc.	10101 Highway 70 East North Little Rock, Arkansas 72117	U-24
Thermal Foams, Inc.	2101 Kenmore Ave Buffalo, New York 14207	U-26

TABLE 2—R-CONTROL SIP Weight (psf)

SIP Thickness (in.)	$4^1/_2$	$6^1/_2$	$8^1/_4$	$10^1/_4$	$12^1/_4$
Weight (psf)	3.2	3.4	3.6	3.8	4.0

For **SI:** 1 inch = 25.4 mm, 1 psf = 4.8 kg/m^2.

TABLE 3—ALLOWABLE AXIAL LOAD FOR R-CONTROL SIP WALLS[1,2,3,4,5] (plf)
(See Detail SIP-101c)

SIP HEIGHT (ft.)	$4^1/_2$ INCH THICK	$6^1/_2$ INCH THICK	$8^1/_4$ INCH THICK
8 WAB[6]	2,300	2,400	2,400
8	2,750	4,000	4,000
10	2,500	3,500	3,500
12	2,000	3,000	3,000
14	-	2,750	2,750
16	-	2,500	2,500

For **SI:** 1 inch = 25.4 mm, 1 ft. = 304.8 mm, 1 plf = 1.49 kg/m.

[1]See detail SIP-101c.
[2]Tabulated allowable axial load is the maximum uniform load (pounds per linear foot) applied concentrically to the full thickness of the SIPS, including facings, to the top. Eccentric axial loading to one face of the SIP is outside the scope of this report. The base of the SIPS must be fully bearing, including facings, on structural supports.
[3]Tabulated allowable axial load is based on a SIP with a maximum height to width ratio of 4:1.
[4]For fire-resistance-rated wall assemblies, axial load limitations in Section 4.2.6 must be observed.
[5]For simultaneous loads in more than one direction, the SIPs must be evaluated using the following straight line interaction equation:

$$\frac{design\ axial\ load}{allowable\ axial\ load} + \frac{design\ transverse\ load}{allowable\ transverse\ load} \le 1.0$$

[6]Tabulated values for 8 foot high weak axis bearing (WAB) are applicable to SIPs installed with the strong axis of the OSB facings perpendicular to the SIP height.

TABLE 4—ALLOWABLE LATERAL IN-PLANE LOAD FOR SHEAR WALL ASSEMBLIES CONSISTING OF R-CONTROL SIPs JOINED WITH SPLINES[1,2,3]

SPLINE TYPE	NAIL TYPE (Length x Shank Dia. x Head Dia., in.)	NAIL SPACING	ALLOWABLE LOADS (plf)[4]
SURFACE or BLOCK	8d box ($2^1/_2$" x 0.113" Φ x 0.281" Φ)	6" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	335 plf
4X LUMBER	8d cooler ($2^3/_8$" x 0.113" Φ x 0.281" Φ)	Two staggered rows 6" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	360 plf
LUMBER BLOCK	8d cooler ($2^3/_8$" x 0.113" Φ x 0.281" Φ)	Two staggered rows 4" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	540 plf
4X LUMBER	8d cooler ($2^3/_8$" x 0.113" Φ x 0.281" Φ)	Two staggered rows 4" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	540 plf
4X LUMBER	8d cooler ($2^3/_8$" x 0.113" Φ x 0.281" Φ)	Two staggered rows 3" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	720 plf
4X LUMBER	8d cooler ($2^3/_8$" x 0.113" Φ x 0.281" Φ)	Two staggered rows 2" o.c. both sides of spline joint, bottom plate, top plate and vertical boundary member - both sides of SIP	920 plf

For **SI:** 1 inch = 25.4 mm, 1 plf = 14.59 N/m.

[1]See details SIP- 101c, SIP101f, SIP-102, SIP-102k, and SIP-102m.
[2]Vertical boundaries of shear wall assemblies must be either double 2-inch-thick nominal studs or 4-inch-thick nominal or larger posts, framed to provide full end bearing in accordance with IBC Section 2304.9.7. OSB facings must be fully bearing on structural supports. Tension (uplift) force resulting from shear wall overturning forces must be resisted using an approved hold-down or tie-down anchorage device to ensure a complete load path to the foundation. When hold-down devices are installed, it is prohibited to cut the OSB facing material of the R-Control SIP panels. The hold-down device must be located and fastened to the post (vertical boundary member of the shear wall) such that the OSB facers of the R-Control SIP panels can be nailed to the bottom or top plate or end post at the corners of the shear wall.
[3]The maximum shear wall height-to-width ratio is 2:1.
[4]Top-of-wall horizontal in-plane drift (deflection) of R-Control SIP shear wall assemblies uniformly fastened throughout (top plate, bottom plate, and splines) is $^1/_8$ inch at the tabulated allowable lateral load.

TABLE 5—ALLOWABLE TRANSVERSE LOAD FOR R-CONTROLSIP WALLS WITH SURFACE, BLOCK, OR LUMBER BLOCK SPLINES[1,2,3,4] (psf)

SIP THICKNESS (in.)	DEFLECTION LIMITS[5]	SIP HEIGHT (ft.)					
		8	8 WAB[6]	10	12	14	16
$4^1/_2$	$^L/_{360}$	30	30	22	17	—	—
	$^L/_{240}$	46	40	33	25	—	—
	$^L/_{180}$	56	40	45	34	—	—
	Strength	56	40	45	38		
$6^1/_2$	$^L/_{360}$	48	40	36	28	22	18
	$^L/_{240}$	56	40	45	38	32	27
	$^L/_{180}$	56	40	45	38	32	28
	Strength	56	40	45	38	32	28
$8^1/_4$	$^L/_{360}$	56	40	45	38	32	25
	$^L/_{240}$	56	40	45	38	32	28
	$^L/_{180}$	56	40	45	38	32	28
	Strength	56	40	45	38	32	28

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m^2

[1]See details SIP-101c, SIP-102, SIP-102g, and SIP-102m.
[2]At panel ends, each OSB facing must be fastened to solid lumber sills and plates (minimum specific gravity of 0.42) end with 0.113 inch diameter by 2.5 inch long (8d box) nails spaced at 6 inches on center on both faces of the panels. The sills and plates must be connected to structural supports. Connection specifications, design and installation must be in accordance with the IBC and applicable ESRs.
[3]Tabulated values are uniformly applied loads and are based on the strong-axis of the facing material oriented parallel to the span direction, except as stated in footnote 6.
[4]Values apply to short duration seismic or wind loads only.
[5]Deflection limit must be selected by building designer based on the serviceability (deflection) requirements of the structure (IBC Section 1604.3).
[6]Tabulated values for 8 foot high weak axis bearing (WAB) are applicable to SIPs installed with the strong axis of the OSB facings perpendicular to the SIP height.

TABLE 6—ALLOWABLE TRANSVERSE LOAD FOR R-CONTROL SIP FLOORS AND ROOFS WITH SURFACE, BLOCK, OR LUMBER BLOCK SPLINES[1,2,3,4,5,6,7] (psf)

SIP THICKNESS (in.)	DEFLECTION LIMITS[4]	SIP SPAN (ft.)				
		4	6	8	10	12
$4^1/_2$	$L/_{360}$	69	44	30	22	—
	$L/_{240}$	104	65	46	33	—
	$L/_{180}$	127	85	61	45	—
	Strength	127	85	61	45	—
$6^1/_2$	$L/_{360}$	105	67	48	36	—
	$L/_{240}$	131	88	66	53	—
	$L/_{180}$	131	88	66	53	—
	Strength	131	88	66	53	—
$8^1/_4$	$L/_{360}$	135	88	63	48	38
	$L/_{240}$	135	90	68	54	45
	$L/_{180}$	135	90	68	54	45
	Strength	135	90	68	54	45
$10^1/_4$	$L/_{360}$	140	92	69	55	46
	$L/_{240}$	140	92	69	55	46
	$L/_{180}$	140	92	69	55	46
	Strength	140	92	69	55	46
$12^1/_4$	$L/_{360}$	138	92	69	55	46
	$L/_{240}$	138	92	69	55	46
	$L/_{180}$	138	92	69	55	46
	Strength	138	92	69	55	46

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m^2.

[1]See details SIP-102, SIP-102g, or SIP-102m.
[2]SIPs must be single span, simply supported and have a minimum $1^1/_2$-inch wide continuous bearing support at each end.
[3]Tabulated allowable transverse load is the maximum load (pounds per square foot) applied uniformly.
[4]The tabulated allowable transverse load is the lesser of the allowable load based on the applicable serviceability (deflection) limit (IBC Section 1604.3) or the strength limit (IBC Section 1604.2) using a factor of safety of three.
[5]Roofs must be designed to support a 300 lb. concentrated load according to IBC Section 1607.4 when the roof has access to maintenance workers.
[6]Values do not include dead weight of panels. Permanent loads, such as dead load, must not exceed 0.5 of the tabulated load.
[7]Tabulated values for 8 foot spans are applicable to SIPs installed with the strong axis of the OSB facings parallel or perpendicular to the SIP span.

TABLE 7—ALLOWABLE TRANSVERSE LOAD FOR R-CONTROL SIP, FLOORS AND ROOFS WITH DOUBLE 2x WOOD MEMBER SPLINES[1,2,3,4,5,6] (psf)

SIP THICKNESS (in.)	LIMITS	PANEL SPAN (ft.)							
		10	12	14	16	18	20	22	24
$6^1/_2$	$L/_{360}$	53	40	30	24	19	15	—	—
	$L/_{240}$	79	59	45	35	28	22	—	—
	$L/_{180}$	105	79	60	47	37	30	—	—
	Strength	105	88	75	66	59	51	—	—
$8^1/_4$	$L/_{360}$	89	65	48	37	28	22	—	—
	$L/_{240}$	109	91	72	55	42	33	—	—
	$L/_{180}$	109	91	78	68	57	44	—	—
	Strength	109	91	78	68	60	54	—	—
$10^1/_4$	$L/_{360}$	150	111	84	65	51	41	33	27
	$L/_{240}$	174	145	124	98	77	61	49	40
	$L/_{180}$	174	145	124	109	87	82	66	54
	Strength	174	145	124	109	87	87	79	73
$12^1/_4$	$L/_{360}$	177	148	115	89	70	56	45	37
	$L/_{240}$	177	148	127	111	99	84	68	55
	$L/_{180}$	177	148	127	111	99	89	81	74
	Strength	177	148	127	111	99	89	81	74

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m.

[1]See detail SIP-102d.
[2]Double 2x lumber splines must be continuous full length minimum spruce-pine-fir, minimum No. 2 grade, except the lumber must be Douglas fir–larch, minimum No. 2 grade, for $12^1/_4$ inch thick SIPs for all spans and $10^1/_4$-inch-thick SIP panels spanning greater than 22 ft.
[3]SIPs must be single span, simply supported and have a minimum $1^1/_2$-inch wide continuous bearing support at each end.
[4]Tabulated allowable transverse load is the maximum load (pounds per square foot) applied uniformly.
[5]The tabulated allowable transverse load is the lesser of the allowable load based on the applicable serviceability (deflection) limit (IBC Section 1604.3) or the strength limit (IBC Section 1604.2) using a factor of safety of 3.
[6]Roofs must be designed to support a 300 lb. concentrated load according to IBC Section 1607.4 when the roof has access to maintenance workers.

TABLE 8—ALLOWABLE TRANSVERSE LOAD FOR R-CONTROL SIP, FLOORS AND ROOFS WITH I-BEAM SPLINES[1,2,3,4,5,6] (psf)

SIP THICKNESS (in.)	LIMITS	SIP SPAN (ft.)							
		10	12	14	16	18	20	22	24
$10^1/_4$	$L/_{360}$	118	98	73	55	42	33	26	21
	$L/_{240}$	118	98	84	74	63	49	39	31
	$L/_{180}$	118	98	84	74	65	59	49	41
	Strength	118	98	84	74	65	59	49	42
$12^1/_4$	$L/_{360}$	131	109	87	69	55	45	37	30
	$L/_{240}$	131	109	93	82	72	65	55	46
	$L/_{180}$	131	109	93	82	72	65	57	48
	Strength	131	109	93	82	72	65	57	48

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 4.88 kg/m^2.

[1]See detail SIP-102b.
[2]I-beam splines must be continuous full length.
[3]SIPs must be single span, simply supported and have a minimum $1^1/_2$-inch wide continuous bearing support at each end
[4]Tabulated allowable transverse load is the maximum load (pounds per square foot) applied uniformly.
[5]The tabulated allowable transverse load is the lesser of the allowable load based on the applicable serviceability (deflection) limit (IBC Section 1604.3) or the strength limit (IBC Section 1604.2) using a factor of safety of three.
[6]Roofs must be designed to support a 300 lb. concentrated load according to IBC Section 1607.4 when the roof has access to maintenance workers.

TABLE 9—ALLOWABLE SHEAR LOAD FOR R-CONTROL SIPs ROOF AND FLOOR PANEL DIAPHRAGM ASSEMBLIES WITH SUPPORT FRAMING OF DOUGLAS FIR–LARCH OR SOUTHERN PINE FOR WIND OR SEISMIC LOADING[1,2,3,4,5,6]

SIP THICKNESS (in.)	FASTENER SPACING (in.)				MAXIMUM ASSEMBLY LENGTH (ft.) AND ASPECT RATIO	ALLOWABLE STRENGTH (plf)	APPARENT SHEAR STIFFNESS, G_a, (lbf/in.)
	Boundaries[3]		Splines[4]	Panels to Supports Parallel to Shear[5]			
	R-Control Screws	8d Box Nails	8d Box Nails	R-Control Screws			
$6^1/_2$ to $12^1/_4$	6	3 @ top and bottom	3, in two rows each side of joint and staggered	12	36, 3:1	500	12,900
$6^1/_2$ to $12^1/_4$	4	3 @ top and bottom	3, in two rows each side of joint and staggered	12	36, 3:1	750	9,500
$6^1/_2$ to $12^1/_4$[6]	3	3 @ top and bottom	3, in two rows each side of joint and staggered	12	24, 3:1	850	35,100

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 14.6 N/m, 1 lbf/in = 0.175 N/mm, 1 psi = 6895 Pa.

[1]See details SIP-139, SIP-140, and SIP-141.
[2]Deflections at mid-span of a simply supported diaphragm must be computed in accordance with the following equation:

$$\delta = \frac{5vL^3}{8EAW} + \frac{0.25\,vL}{1{,}000G_a} + \frac{\Sigma(x\Delta_c)}{2W}$$

where:

E = Modulus of elasticity of diaphragm chords, psi (Pa)
A = Area of chord cross-section, in.^{2}, (mm^2)
G_a = Apparent diaphragm shear stiffness from nail slip and panel shear deformation, lbf/in. (N/mm)
L = Diaphragm length, ft. (m)
v = Induced unit shear in diaphragm, lbf/ft (N/m)
W = Diaphragm width, ft. (m)
x = Distance from chord splice to nearest support, in. (mm)
Δ_c= Diaphragm chord splice slip at the induced unit shear in diaphragm, in. (mm)
δ = Maximum mid-span diaphragm deflection determined by elastic analysis, in. (mm)
[3]Diaphragm boundary elements must consist of full-depth, solid-sawn lumber, 2-inch minimum nominal width, minimum specific gravity of 0.50, inserted in SIP core, continuous across panel joints. Additionally, the diaphragm boundary elements must be supported by a continuous lumber member having a minimum 4-inch nominal width and minimum 3 inch nominal depth, minimum specific gravity of 0.50, and must be secured to the support member with the R-Control screws at the tabulated spacing and a minimum 1⅝ inch penetration into the receiving member.
[4]Nails connect SIP facings at joints perpendicular to shear to $^7/_{16}$-in. x 4-in. OSB surface splines located under top face at all panel edges, at the tabulated spacing.
[5]Panel edges parallel to applied shear shall be reinforced with solid-sawn lumber, 4-inch minimum nominal width, and minimum specific gravity of 0.50, secured with screws as tabulated above.
[6]SIP ends perpendicular to spans must be staggered from adjacent panels.

TABLE 10—ALLOWABLE VERTICAL LOAD FOR R-CONTROL SIP HEADERS[1,2,3,4,5,6,7] (plf)

SIP HEADER DEPTH (in.)	LIMITS	HEADER SPAN (ft.)		
		4	6	8
12	$L/480$	524	319	218
	$L/360$	703	374	248
	$L/240$	708	374	248
	Strength	708	374	248
18	$L/480$	762	466	351
	$L/360$	773	466	351
	$L/240$	773	466	351
	Strength	773	466	351
24	$L/480$	837	577	455
	$L/360$	837	577	455
	$L/240$	837	577	455
	Strength	837	577	455

For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 14.59 N/m.

[1]See details SIP-112, SIP-113 and SIP-114.
[2]Tabulated allowable load is the maximum load (pounds per square foot) applied uniformly.
[3]Headers are permitted to have splines at supported ends. Alternatively, the header may be continuous without splines.
[4]Top and bottom plates must have a minimum assigned specific gravity of 0.50, such as Douglas fir–larch, and minimum No. 2 grade. The nominally 2-inch-thick wood top plate must have a width equal to the SIP core thickness and be recessed into the pre-cut channel in the top of the header.
[5]Concentrated loads superimposed on SIP wall headers must be supported by conventional construction methods or by other methods designed and constructed to support the governing load combination defined in IBC Section 1605.3 without exceeding the appropriate specified allowable stresses for the materials of construction.
[6]The tabulated allowable vertical load is the lesser of the allowable load based on the applicable serviceability (deflection) limit (IBC Section 1604.3) or the strength limit (IBC Section 1604.2) using a factor of safety of three.
[7]Vertical members supporting each end of the SIP headers must be designed for the tributary vertical (gravity) and transverse (wind) loads carried by SIP headers.

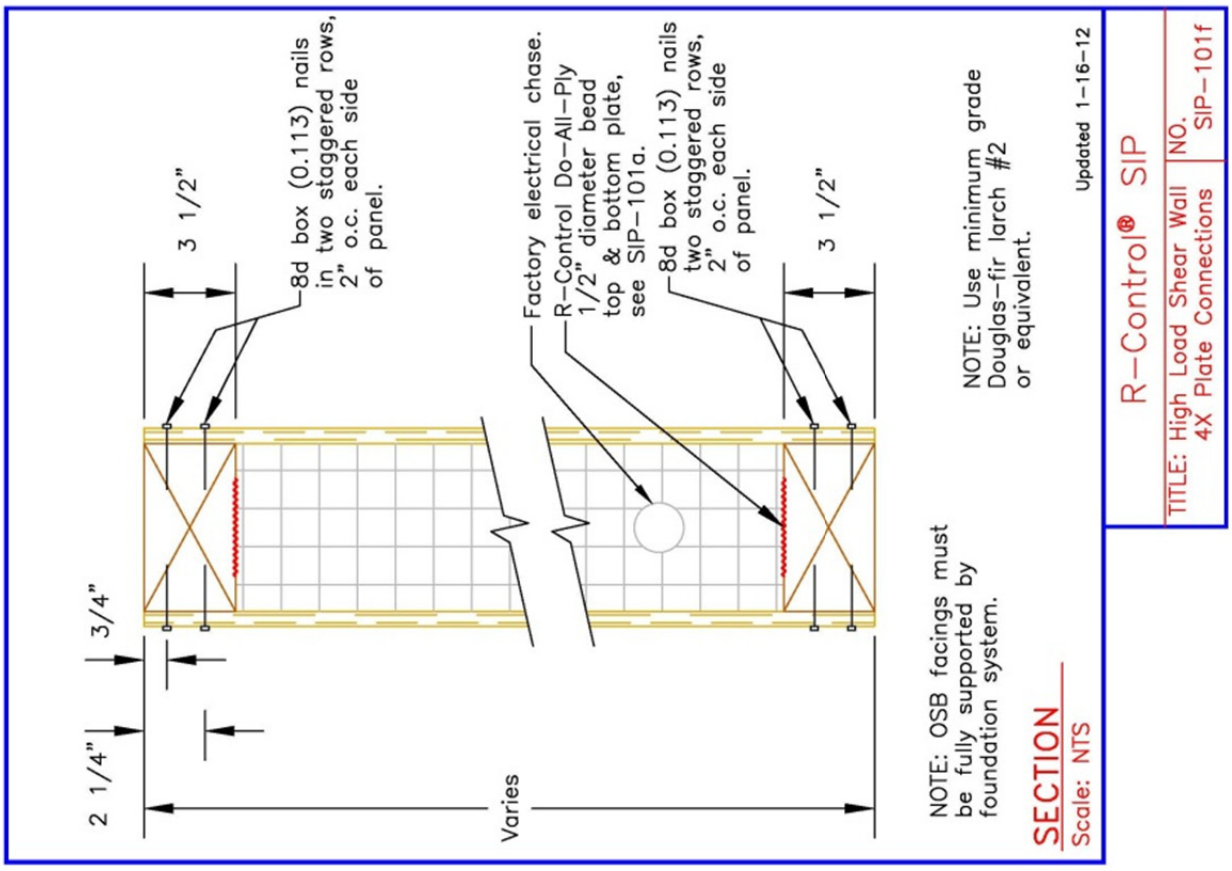

FIGURE 2

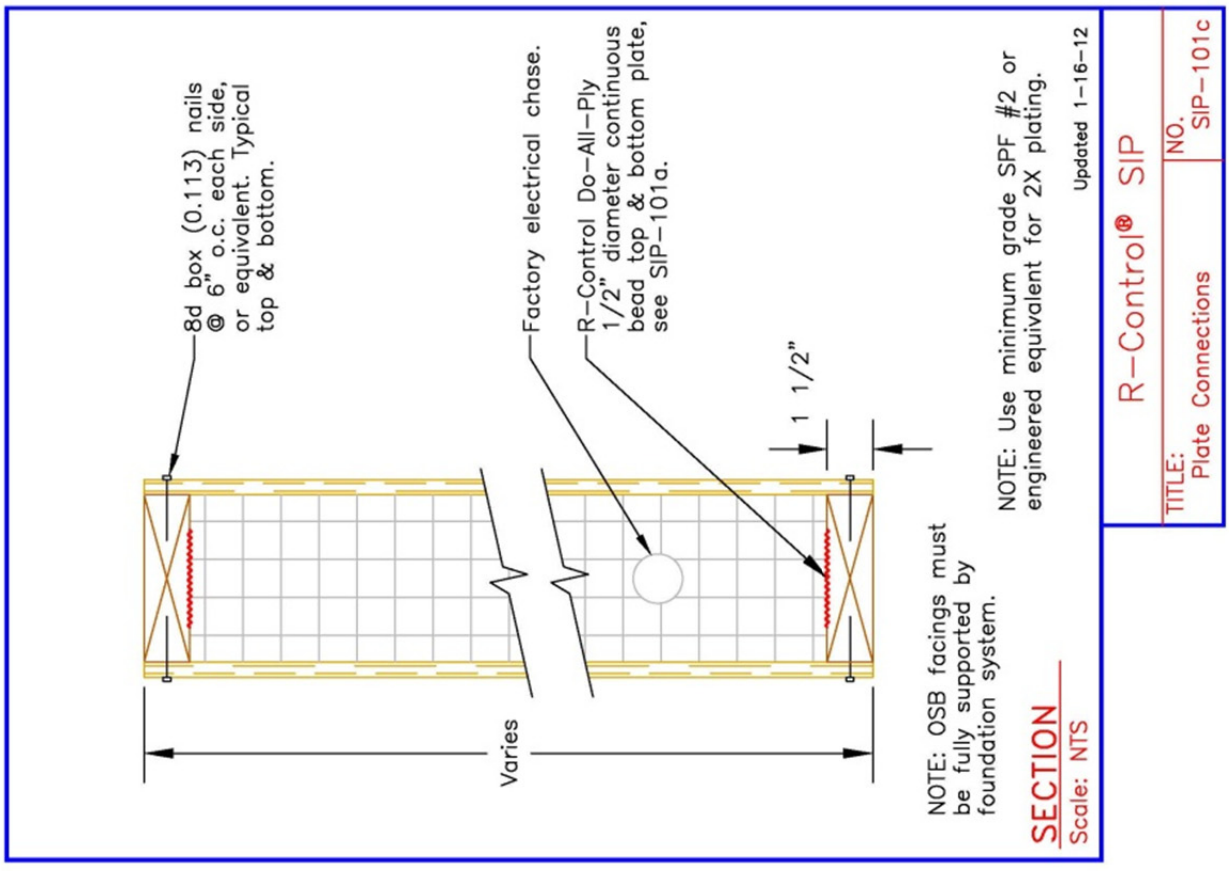

FIGURE 1

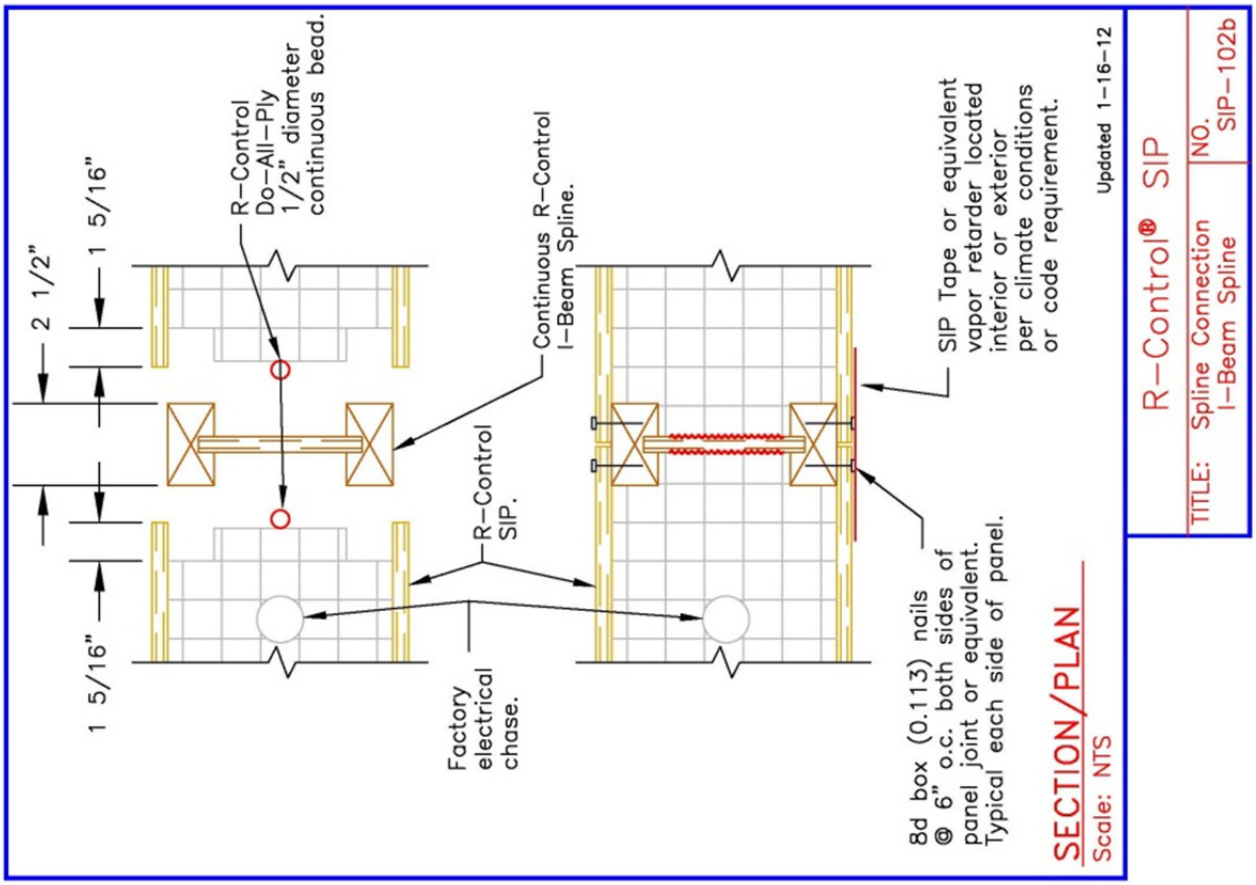

FIGURE 4

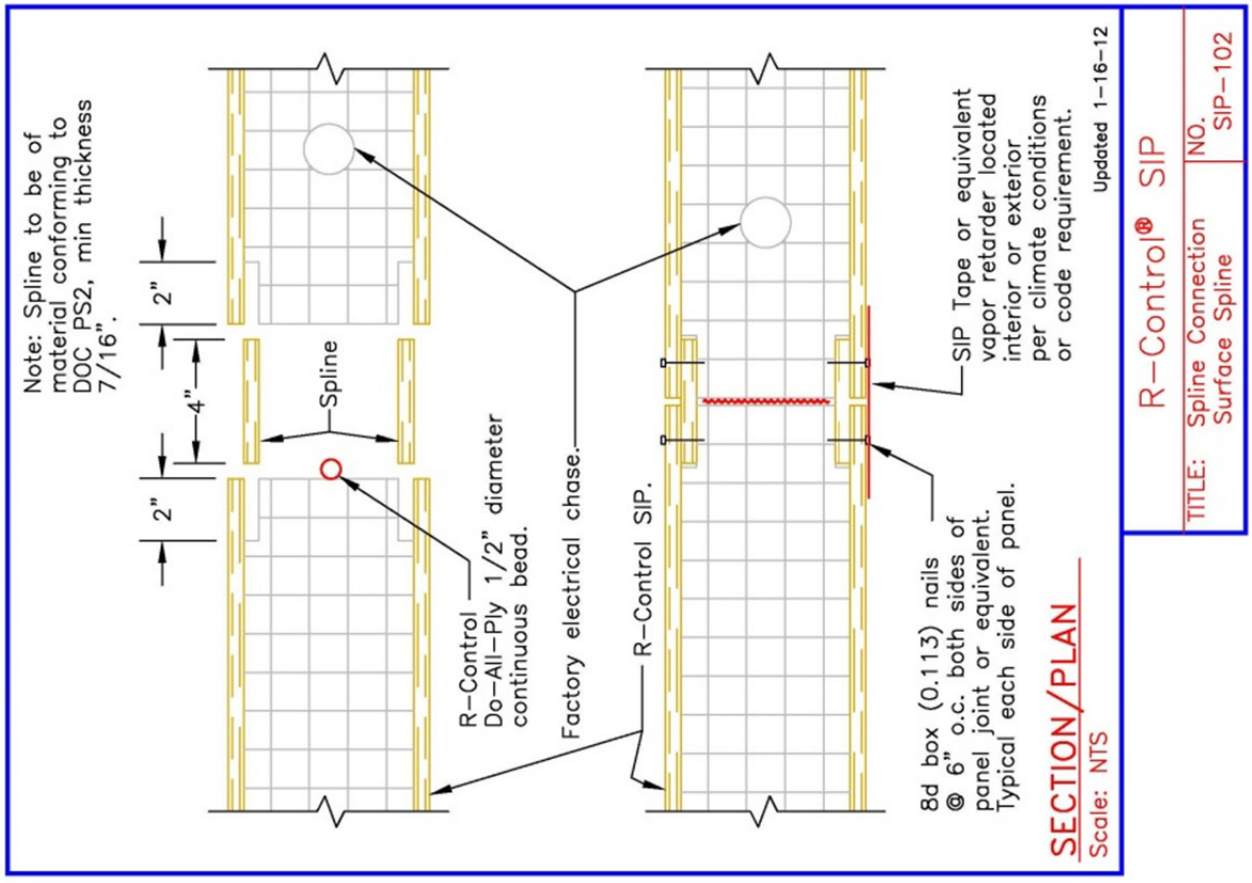

FIGURE 3

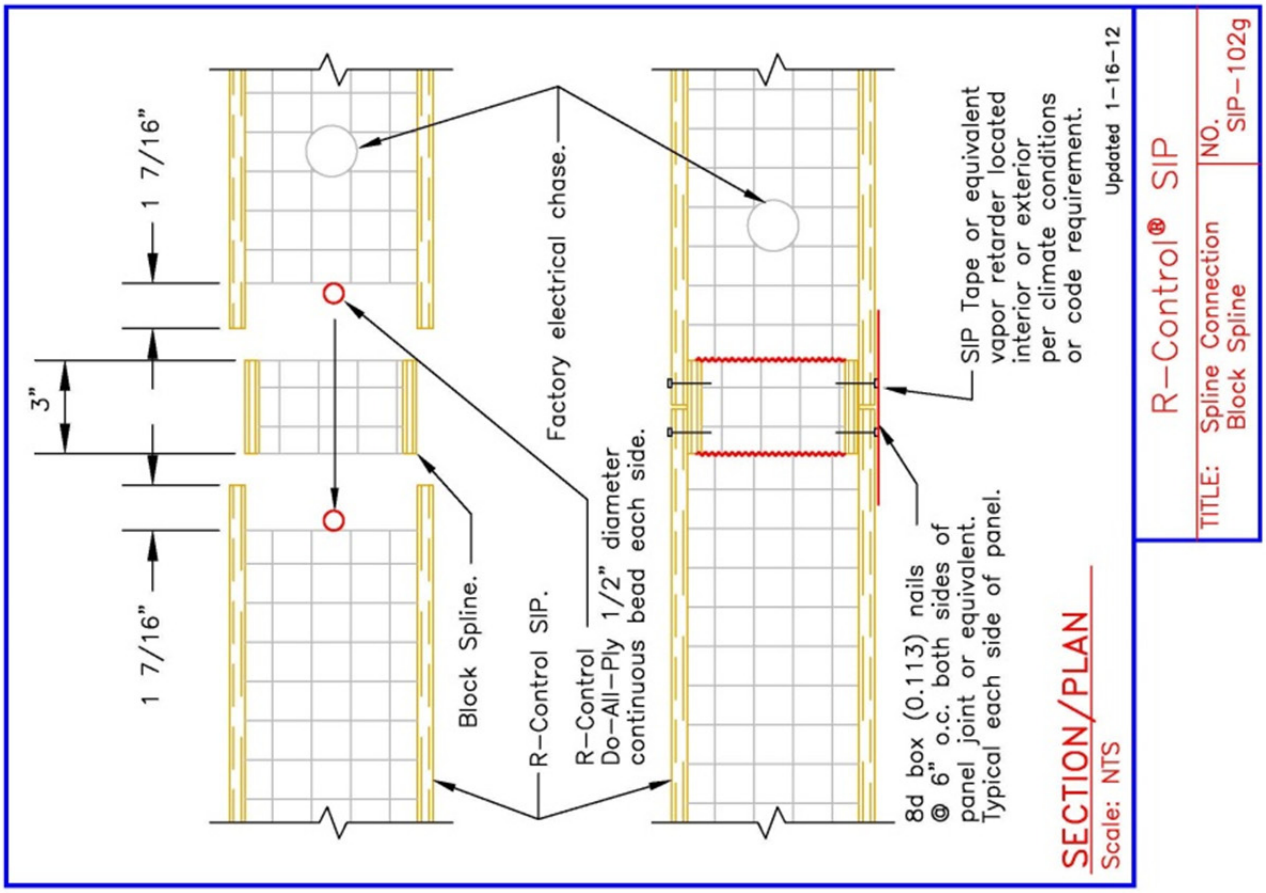

FIGURE 6

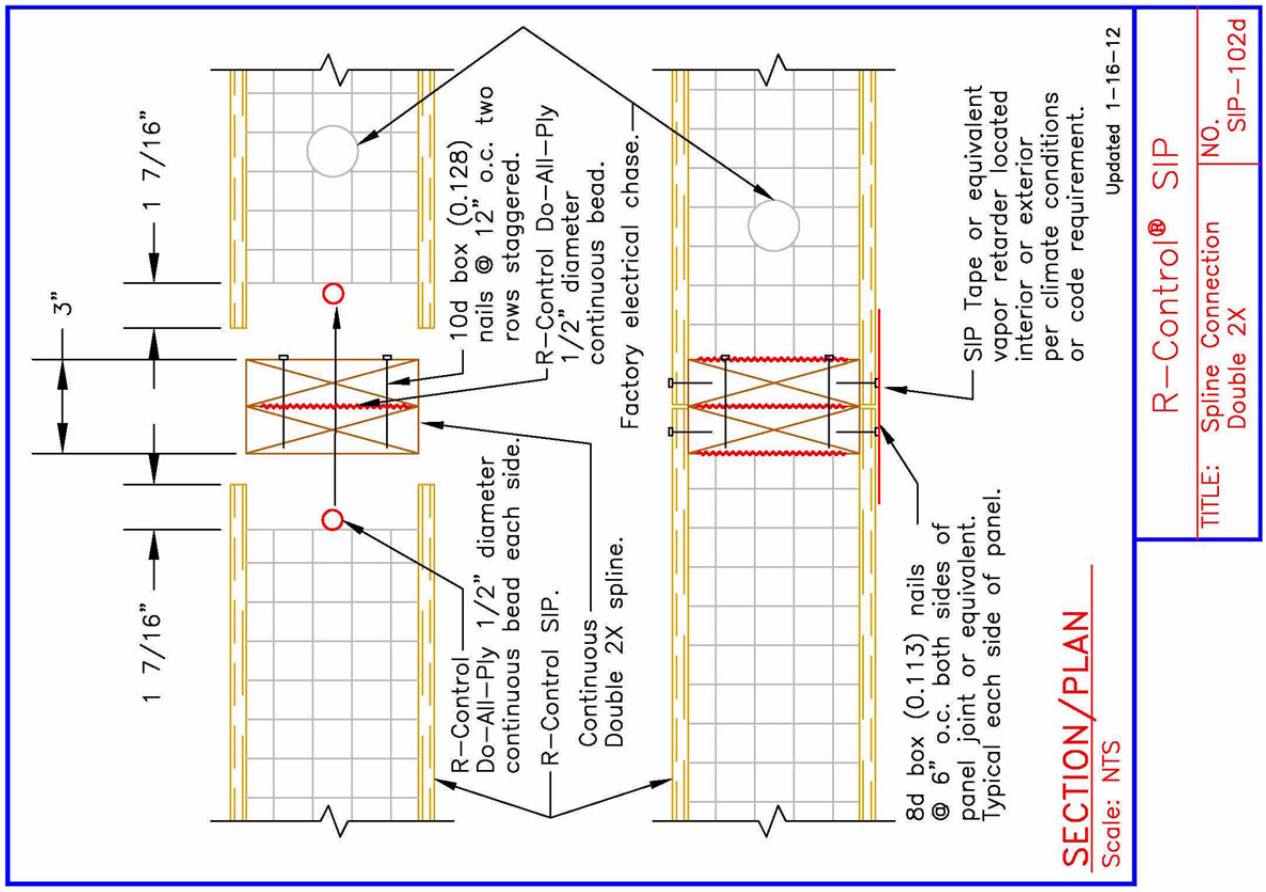

FIGURE 5

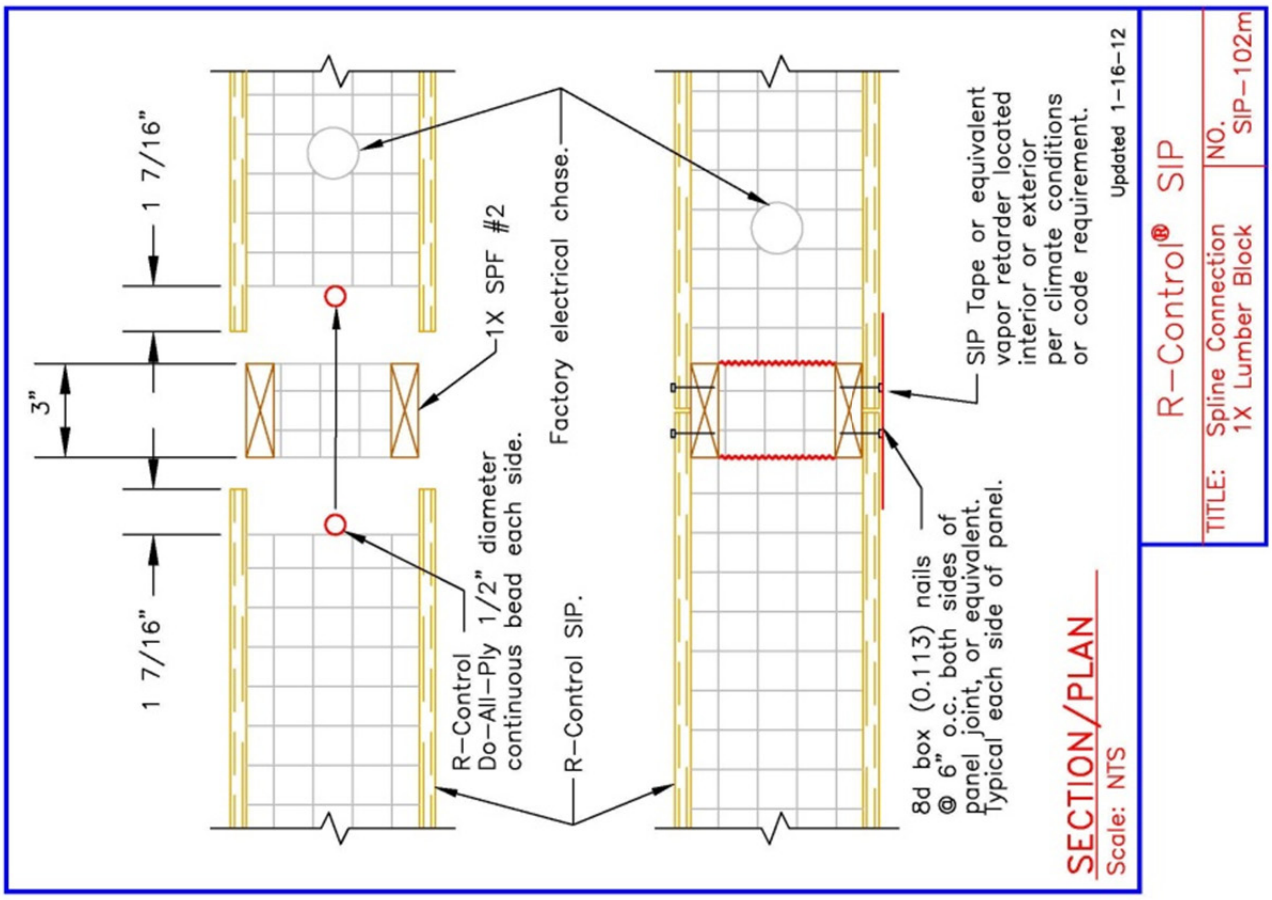

FIGURE 8

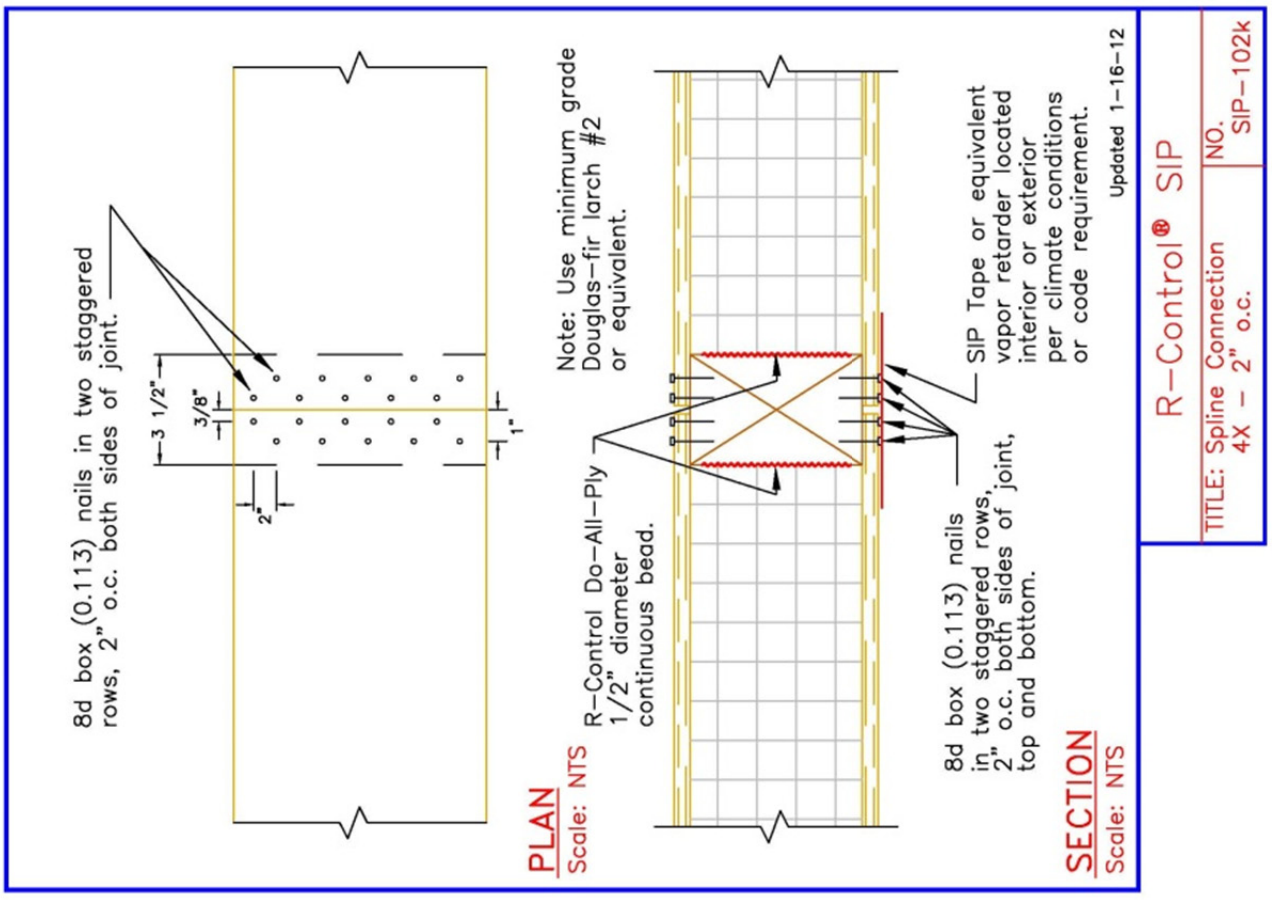

FIGURE 7

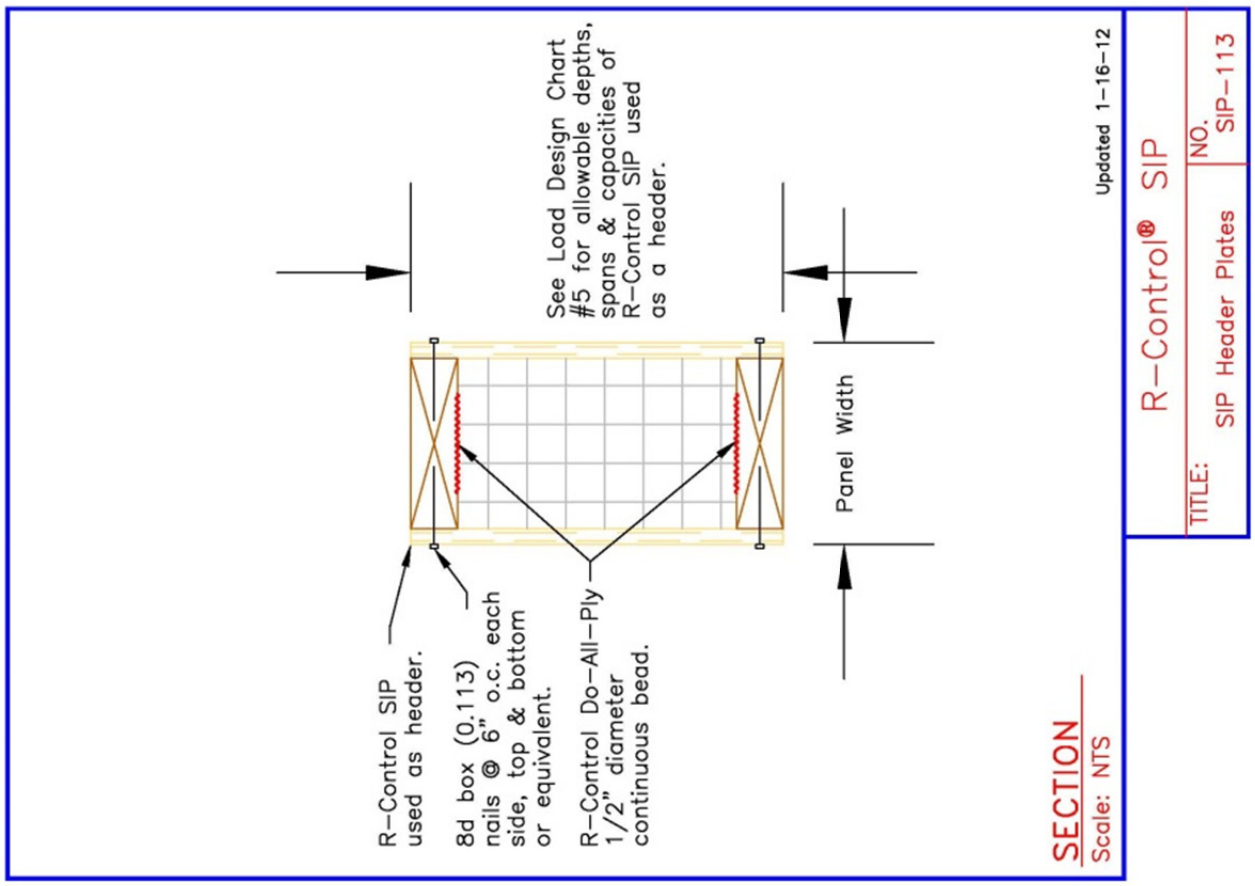

FIGURE 10

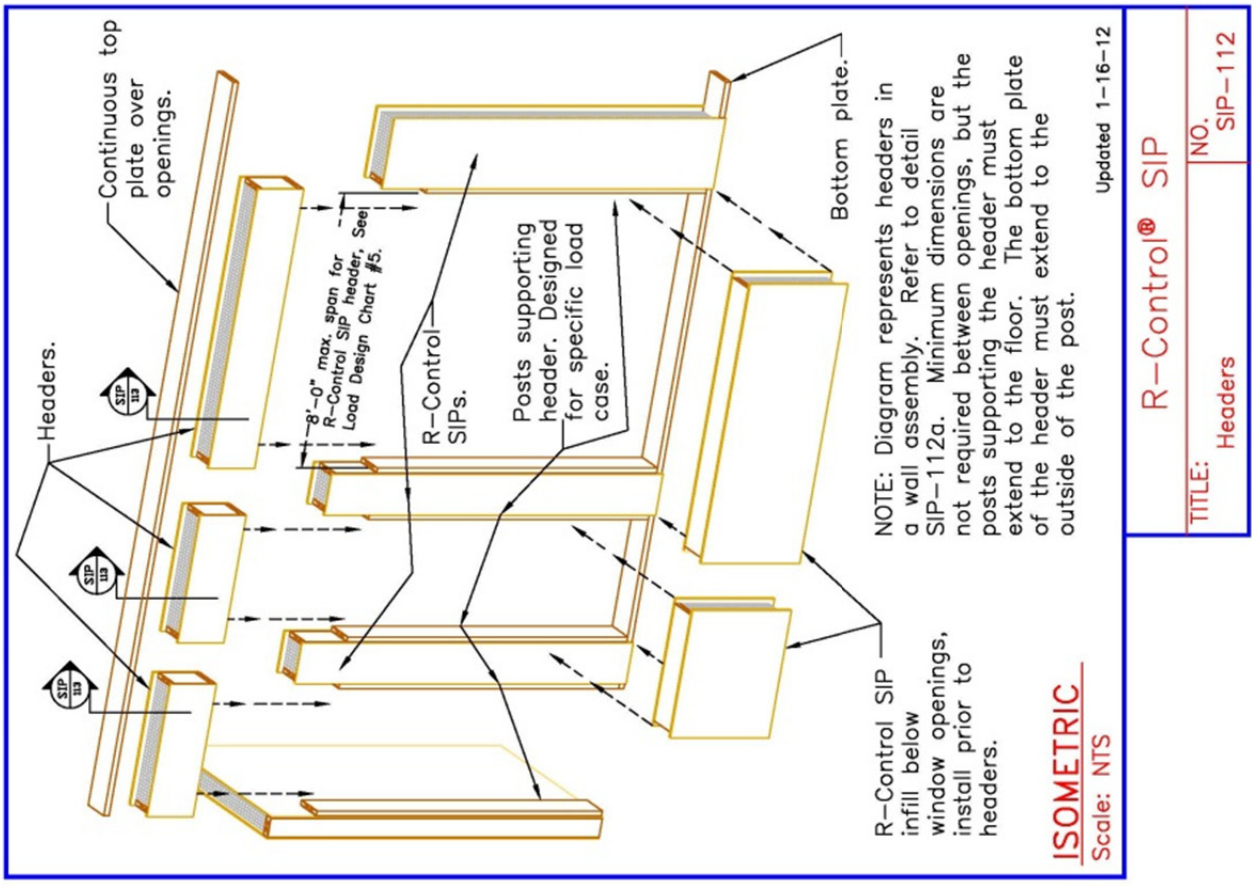

FIGURE 9

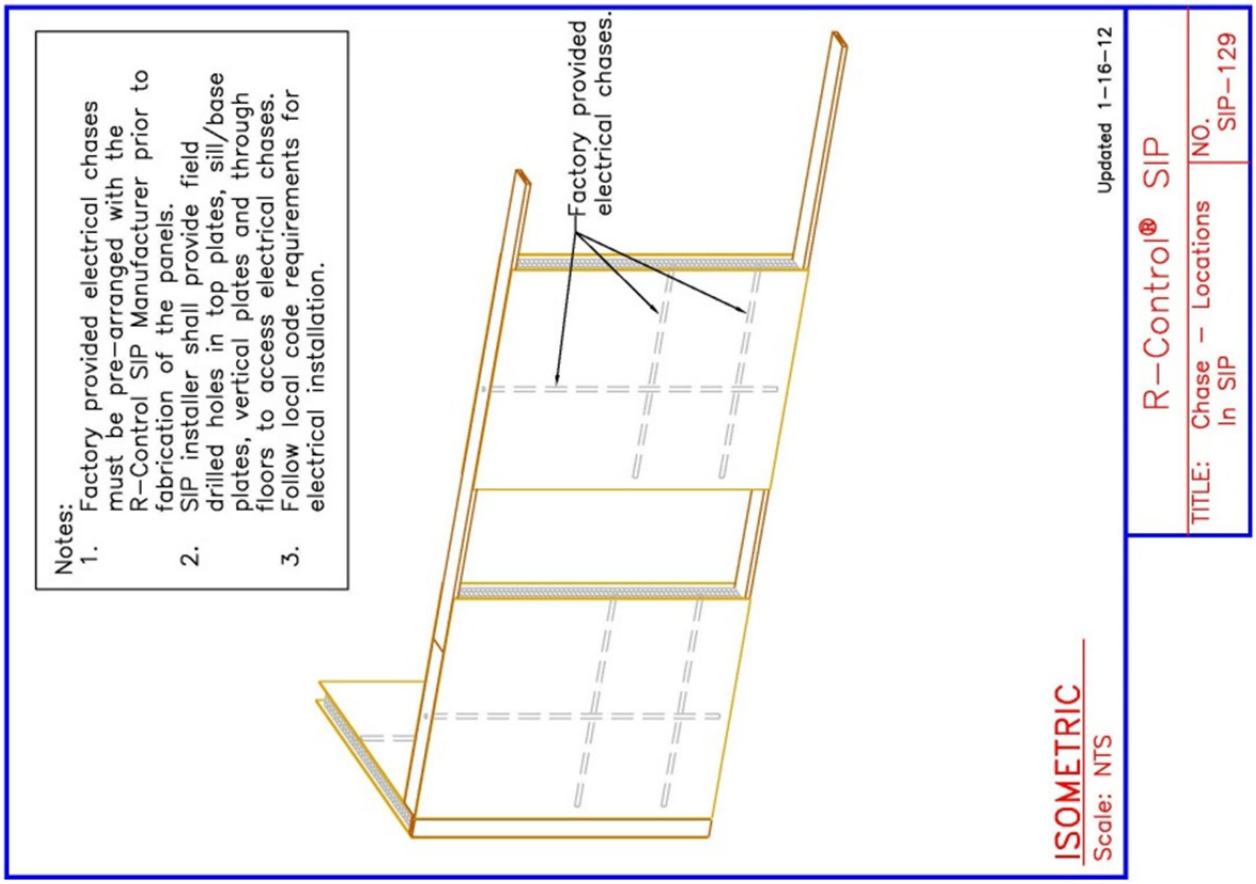

FIGURE 12

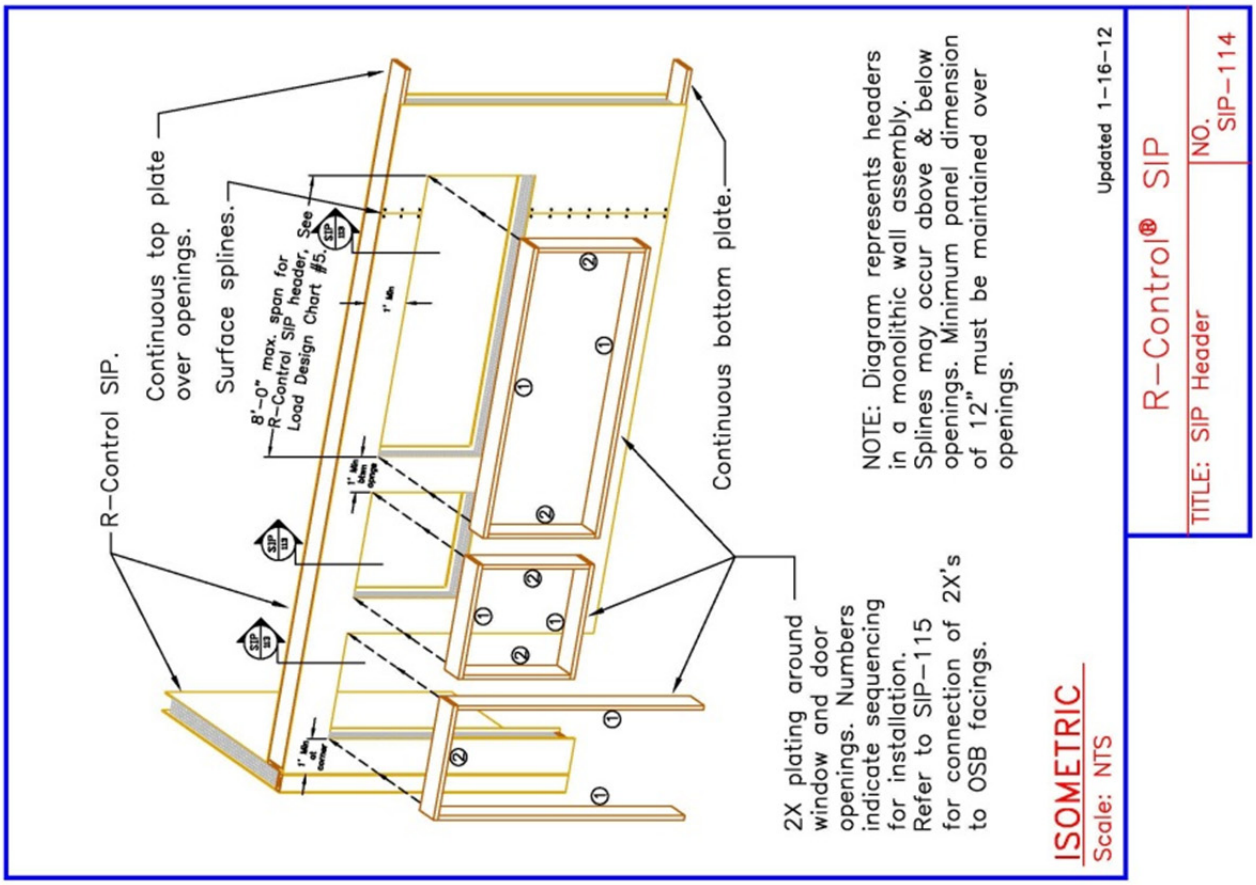

FIGURE 11

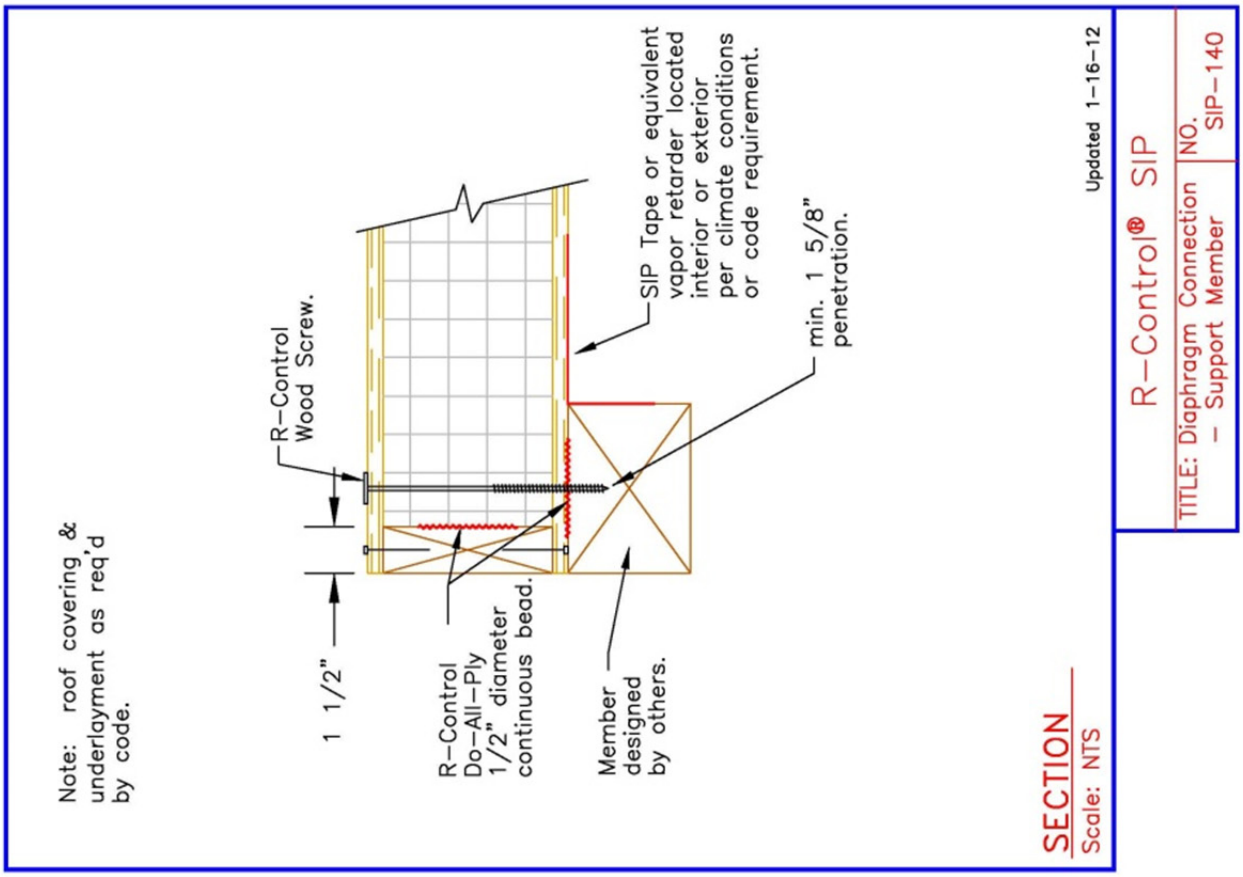

FIGURE 14

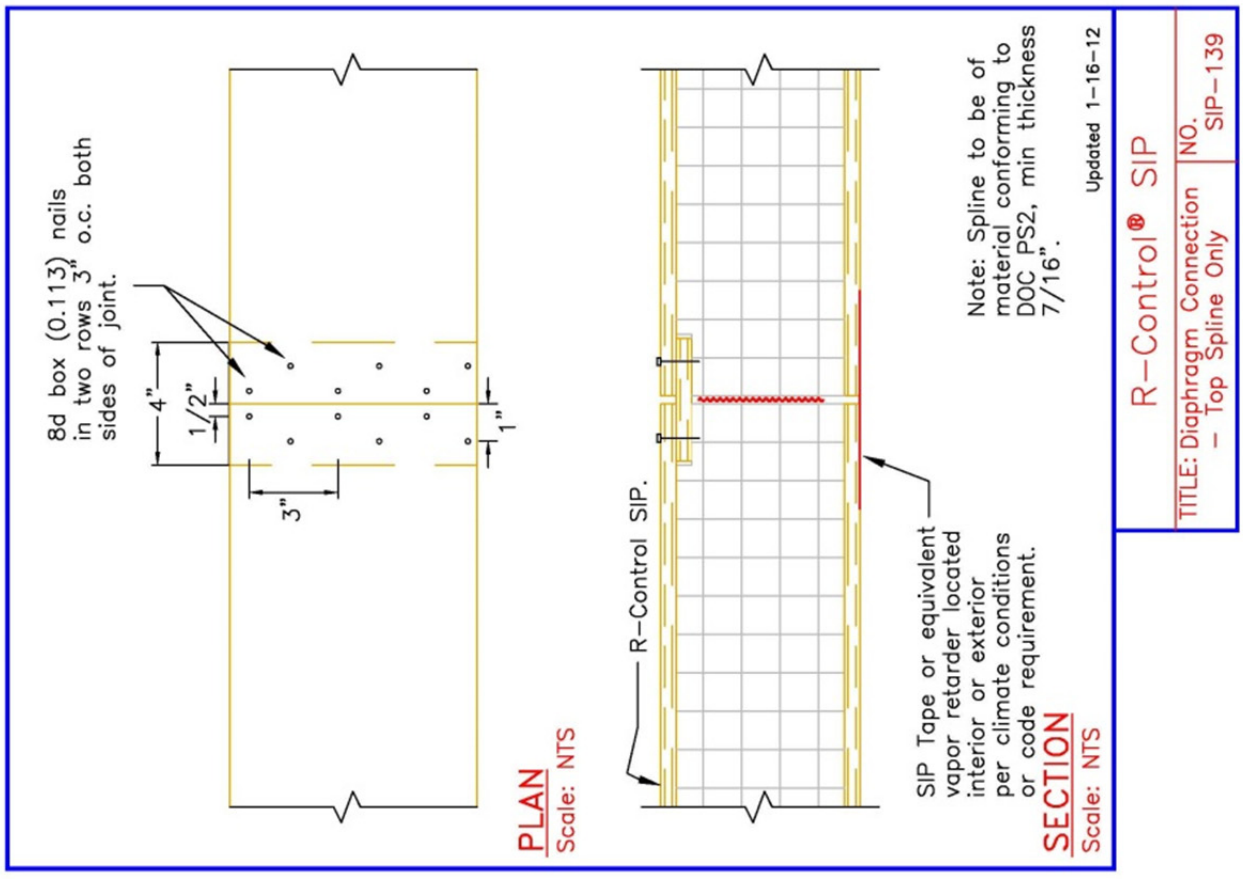

FIGURE 13

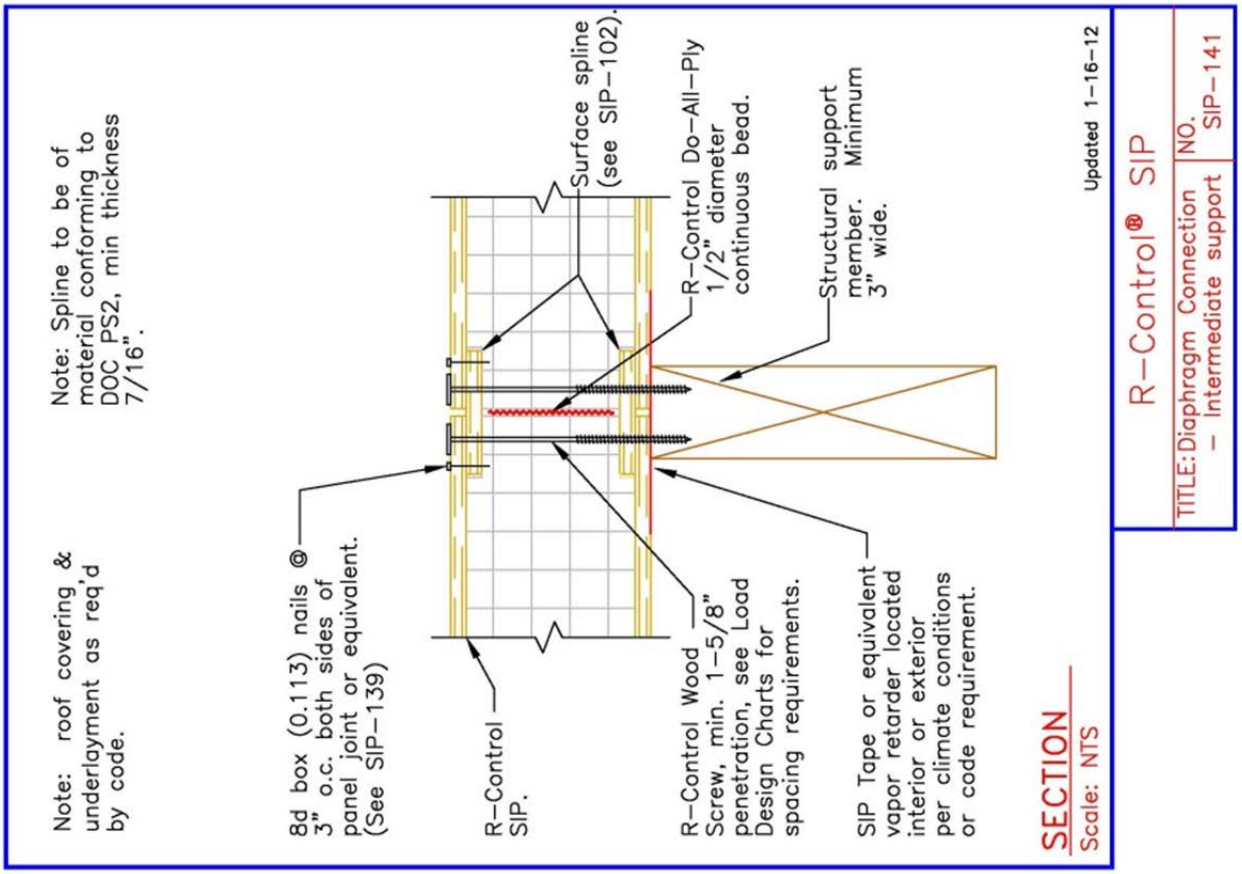
Note: roof covering & underlayment as req'd by code.
Note: Spline to be of material conforming to DOC PS2, min thickness 7/16".
8d box (0.113) nails @ 3" o.c. both sides of panel joint or equivalent. (See SIP-139)
R-Control SIP.
R-Control Wood Screw, min. 1-5/8" penetration, see Load Design Charts for spacing requirements.
SIP Tape or equivalent vapor retarder located interior or exterior per climate conditions or code requirement.
Surface spline (see SIP-102).
R-Control Do-All-Ply 1/2" diameter continuous bead.
Structural support member. Minimum 3" wide.
SECTION
Scale: NTS
Updated 1-16-12
R-Control® SIP
TITLE: Diaphragm Connection - Intermediate support
NO. SIP-141

FIGURE 15

Testing Summary

R-CONTROL SIPs

STRUCTURAL INSULATED PANELS

CONTROL,
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R SIPs Testing Summary

Structural

STANDARD	ASTM E72	ICC ES AC04	ASTM E455	ASTM E695	IBC Sec. 1607
TEST TITLE	STRENGTH TESTS OF PANELS FOR BUILDING CONSTRUCTION	ICC ES SANDWICH PANEL ACCEPTANCE CRITERIA	ROOF DIAPHRAGM CONSTRUCTIONS	RESISTANCE TO IMPACT LOADING	CONCENTRATED FLOOR LOAD
ALSO KNOWN AS:	ASTM E 1803				UBC Sec. 1607
RESULTS	- Axial Load - Transverse Load - Racking Shear [1] See R-Control SIP Load Design Charts for structural capacities	[1] R-Control SIPs meet AC04 requirements [4] See R-Control SIP ICC ES Code Report	Diaphragm design capacity up to 850 plf [1] See R-Control SIP Load Design Charts	Panel supported on short ends withstood repetitive impacts to the center of 90 ft. lbs., 240 ft. lbs., and 600 ft. lbs. with no deleterious effects.	Meets 2,000 lb. concentrated floor load requirement. Floor panels successfully supported 6,000 lbs placed on 30" x 30" area at various locations on the panel and panel joints.

Fire

STANDARD	ASTM E84	UL 1715	ASTM E119	ASTM E119	ASTM E119
TEST TITLE	SURFACE BURNING CHARACTERISTICS	CORNER ROOM BURN	FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS	FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS	FIRE TEST OF BUILDING CONSTRUCTION AND MATERIALS
ALSO KNOWN AS:	UL 723 UBC STAN. 8-1 NFPA 255	UBC 26-3	UL 263 UBC STAN. 7-1 NFPA 251	UL 263 UBC STAN. 7-1 NFPA 251	UL 263 UBC STAN. 7-1 NFPA 251
RESULTS	[3] EPS Core Flame Spread - 20 Smoke Development 150-300 [3] Interior of panel covered with 1/2" gypsum board Flame Spread - 10 Smoke Development-0 [3] Interior of panel covered With BlazeGuard[6] Flame Spread - 5 Smoke Development 10-35 [3] Exterior of panel covered with 3/8" plywood Flame Spread - 130-160 Smoke Development 95-190	Pass - Using 1/2" gypsum board on the interior of the R-Control SIP Pass - Using BlazeGuard[6] on the interior of the R-Control SIP	20 Min. Fire Resistant wall assembly 5/8" gypsum board as interior finish	[2] 60 Min. Fire Resistant wall assemblies 2 layers 5/8" Type X gypsum board as fire side finish. Passed 30 PSI hose stream. Double 2X connection and 1 layer 5/8" Type C gypsum board as fire side finish. Passed 30 PSI hose stream.	[2, 4] 60 Min. Fire Resistant Roof/Ceiling Assemblies UL P517 2 layers 5/8" Type X gypsum board as interior finish UL P822 sprayed fire proofing as interior finish

[1,2,3,4,5,6] See back for Notes

Energy/Sound

STANDARD	ORNL	ASTM C236	ORNL	ASTM E90	ASTM C423
TEST TITLE	STEADY STATE THERMAL PERFORMANCE OF BUILDING ASSEMBLIES	STEADY STATE THERMAL PERFORMANCE OF BUILDING PANELS BY GUARDED HOT BOX	BLOWER DOOR	SOUND TRANSMISSION CLASS (STC)	SOUND ABSORPTION
ALSO KNOWN AS:	WHOLE WALL R-VALUE	R-VALUE	AIR INFILTRATION		
RESULTS	4 1/2" R-Control SIP with 1/2" gypsum board and plywood siding R=14.1 2 x 4 and batt insulation with 1/2" gypsum board and plywood siding R=9.6 2 x 6 and batt insulation with 1/2" gypsum board and plywood siding R=13.7	6 1/2" R-Control SIP & 1/2" gypsum board mechanically fastened to the interior of the panel R=21.2 Typical 2 x 6 construction using fiberglass batts tested under same standard. R = 17.2	Controlled room built with 4 1/2" R-Control SIP 9 cfm air leakage Typical 2 x 6 construction using fiberglass batts tested under same configuration. 126 cfm air leakage	R-Control SIP and one layer 1/2" gypsum board STC = 29 R-Control SIP and one layer 1/2" gypsum board using resilient channels and 1/2" fiberglass STC = 39 R-Control SIP and two layers 5/8" Type X gypsum board on one side. Two layers 5/8" Type X gypsum board separated using 1 1/2" Z-furring channels and 1" sound attenuating fiberglass batt opposite side STC = 51	6 1/2" R-Control SIP Noise Reduction Coefficient = 0.15 Sound Absorption average = 0.17

Components

COMPONENT	OSB	ADHESIVE	ADHESIVE	EPS CORE	EPS CORE
TEST TITLE	WOOD-BASED STRUCTURAL PANELS	ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS	SANDWICH PANEL ADHESIVES	SPECIFICATION FOR POLYSTYRENE INSULATION	TERMITE EXPOSURE
STANDARD	DOC PS2-92	ASTM D 2559	ICC ES ACO5	ASTM C578	ICC ES EG239
RESULTS	OSB meets Exposure I 24/16 span rating	Adhesive meets strength requirements of Class 2 Type II adhesive	Adhesive used in R-Control SIP manufacture meets ICC ES Acceptance Criteria for sandwich panel adhesive	Foam-Control EPS with Perform Guard core exceeds the minimum values in ASTM C578	[2,5] Foam-Control EPS with Perform Guard core recognized by ICC ES to be in compliance with Evaluation Guide 239

[1,2,3,4,5,6] See back for Notes

Quality Assurance

R-Control SIPs are made to the standards of an industry leading Quality Control Program monitored by PFS Corporation and recognized by national codes agencies.

Notes:

[1] See R-Control SIP Load Design Charts for complete details.
[2] See ICC ES report, contact your R-Control SIP supplier for current copy.
[3] See AFM/PFS certificate for complete details.
[4] For specific Fire Resistance, see Underwriters Laboratories Fire Resistance Directory.
[5] See Foam-Control EPS with Perform Guard literature for complete details.
[5] Contact your R-Control SIP supplier for more information on BlazeGuard.

Abbreviations:

ASTM = American Society for Testing and Materials
IBC= International Building Code
ICC ES= International Code Council Evaluation Service
NFPA= National Fire Protection Association
UBC= Uniform Building Code
UL= Underwriters Laboratories Inc.

Ready to take control? Start here.

If you're wondering how R-Control SIPs can work on your next project, just contact your nearest R-Control supplier. They'll be happy to collaborate on design, walk you through R-Control SIP installation, provide test data, pricing, and answers to all your questions. Start by visiting our web site: www.r-control.com.

R-Control SIPs are made exclusively with Foam-Control EPS. R-Control SIPs and Foam-Control EPS are manufactured by AFM Corporation licensees.

RC29-02/08

Load Design Charts

R-CONTROL SIPs

STRUCTURAL INSULATED PANELS

Note: Information deemed reliable at time of printing.
Please visit www.r-control.com for latest information. June 2012

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SIPs

LOAD DESIGN CHARTS

When you choose R-Control SIPs, you're collaborating with a team of experts who work with you every step of the way. We're here to answer your questions, solve your problems, and do everything we can to make sure your project proceeds smoothly—and ends successfully.

R-Control SIPs are manufactured by a network of licensed manufacturers throughout North America and the world. R-Control SIP licensed facilities adhere to strict, consistent standards to ensure high-quality custom-made R-Control SIPs.

This network allows us to offer architects, engineers and builders the best of both worlds: the resources of the country's largest provider of SIP products and systems, and the superior attention and customer service of a local supplier.

R-Control SIPs are structural components for use in load bearing wall, roof, ceiling, or floor assemblies. An R-Control SIP Construction Manual, technical bulletins, and a building techniques video are available with additional information. These documents should be reviewed in detail prior to design and installation of R-Control SIPs. You can download these documents from www.r-control.com.

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Architect/Engineering Review

The Load Design Charts for R-Control SIPs have been developed from national testing standards, testing at independent laboratories, and qualified structural engineers. These charts cover most common construction requirements. Each building project should be reviewed by an architect/engineer to determine the suitability of R-Control SIPs.

Evaluation Reports

The International Code Council Evaluation Service (ICC-ES) has reviewed the independent testing, structural engineering, PFS Corporation third party inspections, and QC program for R-Control SIPs and has issued evaluation report ESR-2233. NTA Inc has also issued assembly report AFM031809-18.

Building Codes

R-Control SIPs are recognized as being in compliance with the 2006, 2009, and 2012 International Building Code and 2006, 2009, and 2012 International Residential Code. R-Control SIPs should be designed to comply with the deflection limits of the applicable building code.

R-Control SIP Weight

SIP THICKNESS	WEIGHT (psf)
4-1/2″	3.2
6-1/2″	3.4
8-1/4″	3.6
10-1/4″	3.8
12-1/4″	4.0

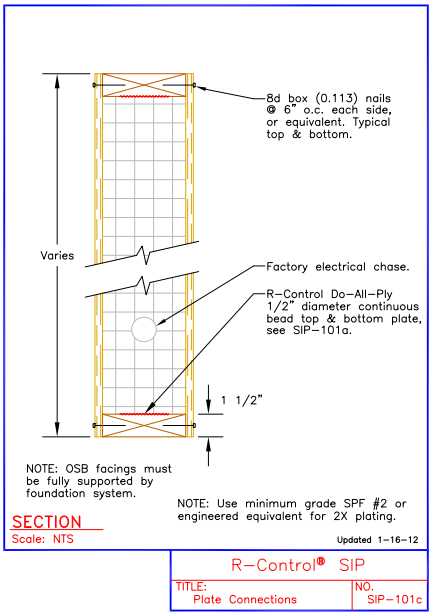
R-Control SIP R-value

SIP THICKNESS	R-VALUE @ 75°F	R-VALUE @ 40°F
4-1/2″	14.9	16.0
6-1/2″	22.6	24.4
8-1/4″	29.3	31.7
10-1/4″	37.0	40.0
12-1/4″	44.7	48.3

Wall - Uniform Axial Loads - PLF LOAD DESIGN CHART #2B DETAIL SIP-101c						
SIP THICKNESS	SIP HEIGHT (feet)					
	8	8 WAB[1]	10	12	14	16
4-1/2″	2750	2300	2500	2000		
6-1/2″	4000	2400	3500	3000	2750	2500
8-1/4″	4000	2400	3500	3000	2750	2500
10-1/4″	4000	2400	3500	3000	2750	2500
12-1/4″	4000	2400	3500	3000	2750	2500

[1] WAB = SIPS INSTALLED WITH THE STRONG AXIS OF THE OSB FACINGS PERPENDICULAR TO SIP HEIGHT.

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER LINEAL FOOT.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- WALL AXIAL LOADS SHALL BE DESIGNED TO THE LESSER OF THE UNIFORM AXIAL LOADS OF LOAD DESIGN CHART #2B OR THE POINT AXIAL LOADS OF LOAD DESIGN CHART #2C.



Wall-Unity Equation

This wall-unity equation is used to determine design suitability. The equation takes into account the ultimate load for a SIP subjected to both axial and transverse conditions:

$$\frac{\text{design axial load}}{\text{allowable axial load}} + \frac{\text{design transverse load}}{\text{allowable transverse load}} \leq 1$$

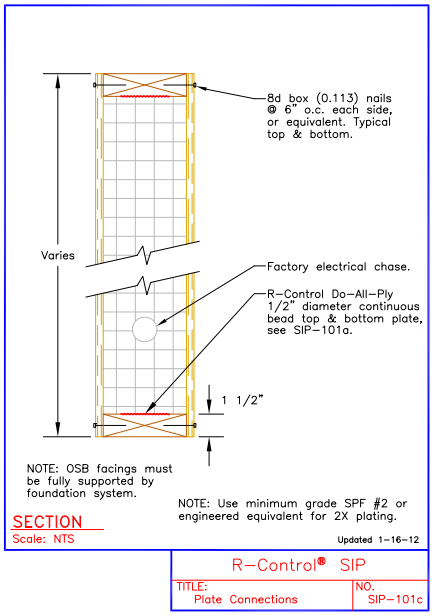
(SEE LOAD DESIGN CHART #2B) **(SEE LOAD DESIGN CHART #4)**

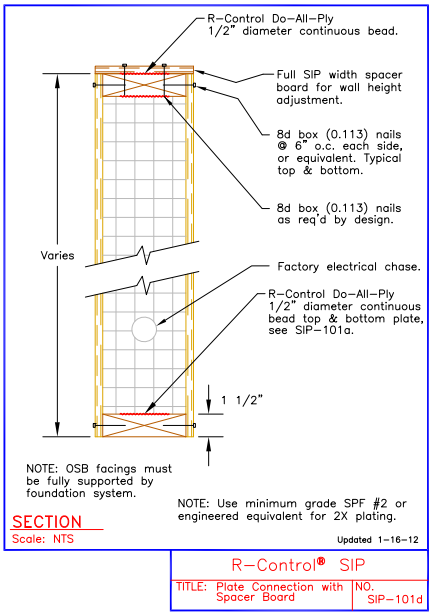
Wall - Point Axial Loads - LBS
LOAD DESIGN CHART #2C
DETAILS SIP-101c, SIP-101d, or SIP-101e

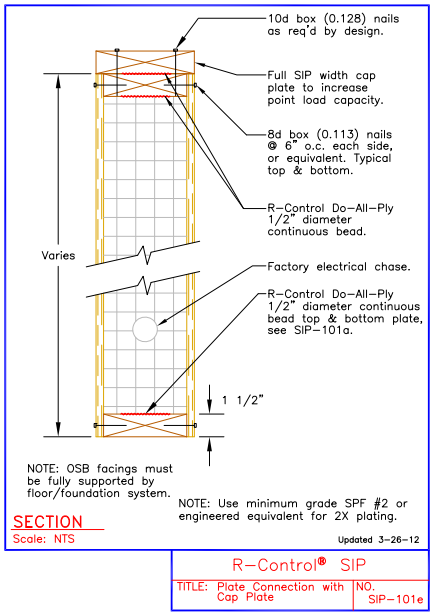
POINT LOAD WIDTH	SINGLE TOP PLATE	W/SPACER PLATE[1]	W/CAP PLATE[2]
1-1/2"	2000	2100	4000
3"	2150	3000	4150

[1] MINIMUM 3/8" CDX PLYWOOD OR EQUIVALENT
[2] MINIMUM SPF#2 2X OR EQUIVALENT

GENERAL NOTES:
- CHART VALUES ARE POUNDS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- WALL AXIAL LOADS SHALL BE DESIGNED TO THE LESSER OF THE POINT AXIAL LOADS OF LOAD DESIGN CHART #2C OR THE UNIFORM AXIAL LOADS OF LOAD DESIGN CHART #2B.
- FOR POINT LOADS EXCEEDING THESE CAPACITIES, USE POSTS TO TRANSFER LOADS AS REQUIRED.





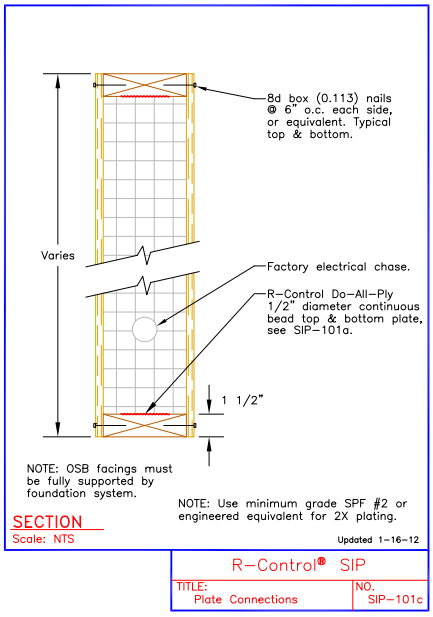


Wall - Transverse Loads - PSF
LOAD DESIGN CHART #4
DETAIL SIP-101c

SIP THICKNESS	DEFLECTION LIMIT	SIP HEIGHT (feet)					
		8	8WAB[1]	10	12	14	16
4-1/2″	L/360	30	30	22	17		
	L/240	46	40	33	25		
	L/180	56	40	45	34		
6-1/2″	L/360	48	40	36	28	22	18
	L/240	56	40	45	38	32	27
	L/180	56	40	45	38	32	28
8-1/4″	L/360	56	40	45	38	31	25
	L/240	56	40	45	38	32	28
	L/180	56	40	45	38	32	28
10-1/4″	L/360	56	40	45	38	32	28
	L/240	56	40	45	38	32	28
	L/180	56	40	45	38	32	28
12-1/4″	L/360	56	40	45	38	32	28
	L/240	56	40	45	38	32	28
	L/180	56	40	45	38	32	28

[1] WAB = SIPS INSTALLED WITH THE STRONG AXIS OF THE OSB FACINGS PERPENDICULAR TO SIP HEIGHT.

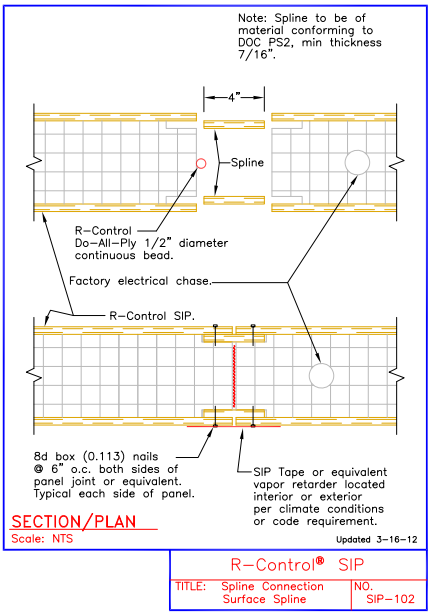
GENERAL NOTES:
- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- CHART VALUES ARE APPLICABLE TO ANY SPLINE CONNECTION.
- SURFACE, BLOCK, OR LUMBER BLOCK SPLINE CONNECTED TO SIP FACING WITH 8d BOX (0.113) @ 6″ O.C.
- SIP FACING CONNECTED TO TOP AND BOTTOM PLATE WITH 8d BOX (0.113) @ 6″ O.C.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.

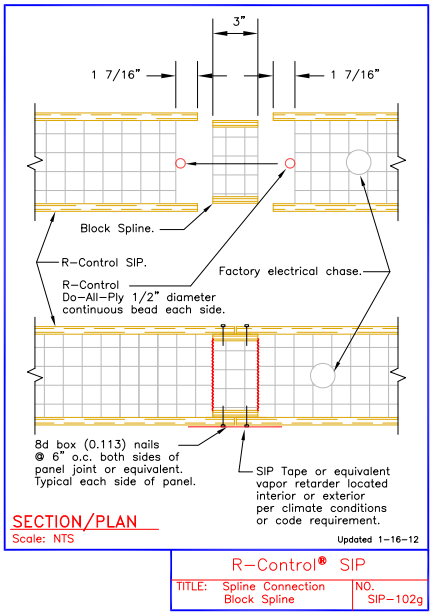


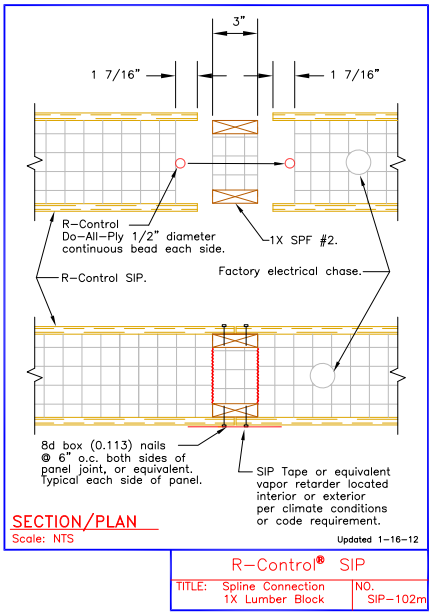
Wall - Shear Loads - PLF
LOAD DESIGN CHART #6
SPLINE DETAILS
SIP-102, SIP-102g, SIP-102m, or SIP-102k

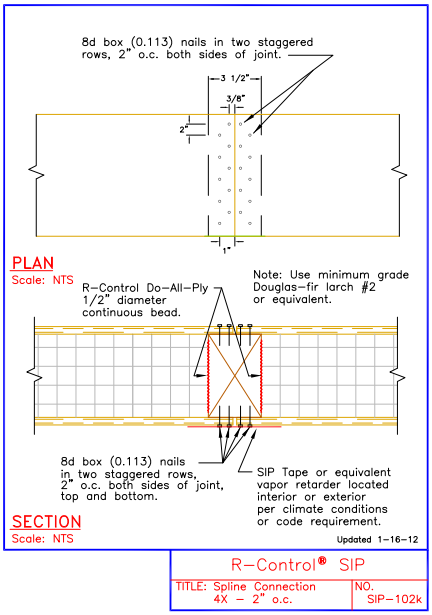
SPLINE TYPE	CONNECTIONS		SHEAR STRENGTH (PLF)
	NAIL TYPE	NAIL SPACING	
Surface or Block	8d Box (2-1/2" x 0.113")	6" o.c.	335
1X Lumber Block	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 4" o.c.	540
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 3" o.c.	720
4X Lumber	8d Cooler (2-3/8" x 0.113")	Two staggered rows 2" o.c.	920

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER LINEAL FEET.
- CHART VALUES ARE APPLICABLE TO ANY THICKNESS SIP.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- REQUIRED CONNECTIONS MUST BE MADE ON BOTH SIDES OF SPLINE JOINT, BOTTOM PLATE, TOP PLATE, AND EACH SIDE OF THE SIP.
- TOP PLATE JOINTS MUST BE STAGGERED A MINIMUM OF ONE FOOT FROM SPLINE JOINTS.
- PLATES, CHORDS, HOLDOWNS, AND CONNECTIONS TO OTHER STRUCTURAL ELEMENTS MUST BE DESIGNED BY A REGISTERED DESIGN PROFESSIONAL IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE.



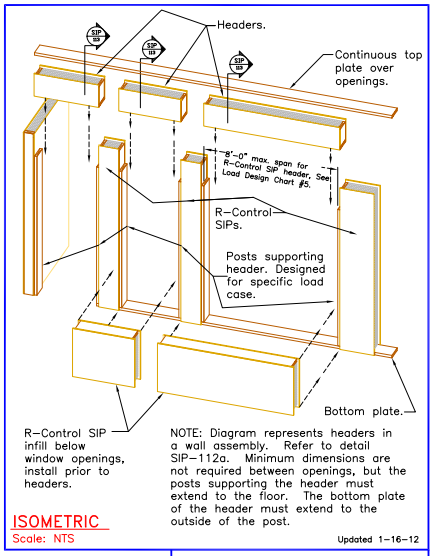


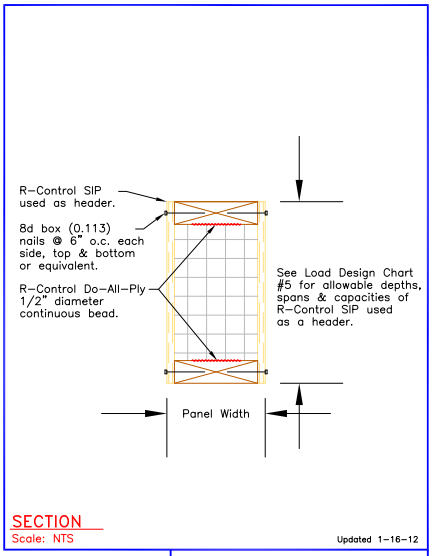


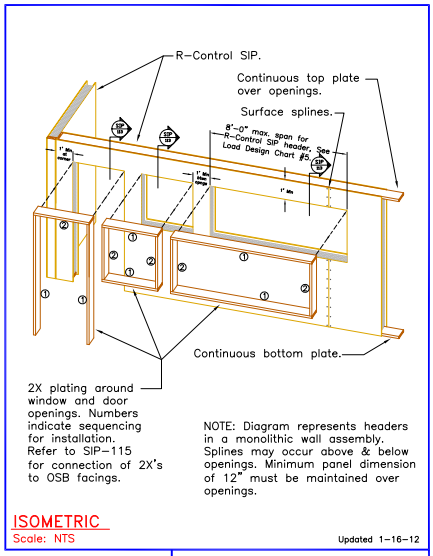


Wall - Header Loads - PLF LOAD DESIGN CHART #5 DETAILS SIP-112 through SIP-114				
HEADER DEPTH	DEFLECTION LIMIT	HEADER SPAN (feet)		
		4	6	8
12″	L/480	524	319	218
	L/360	703	374	248
	L/240	708	374	248
18″	L/480	762	466	351
	L/360	773	466	351
	L/240	773	466	351
24″	L/480	837	557	455
	L/360	837	557	455
	L/240	837	557	455

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER LINEAL FOOT.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- POSTS SUPPORTING HEADER, WHEN REQUIRED, MUST BE DESIGNED BY A REGISTERED DESIGN PROFESSIONAL IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE.







Refer to R-Control SIP Construction Manual for additional header details.

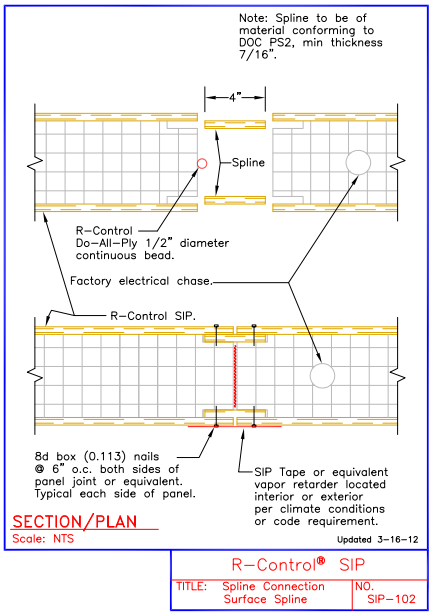
Roof/Floor - Transverse Loads - PSF
LOAD DESIGN CHART #1
SPLINE DETAILS SIP-102, SIP-102g, or SIP-102m

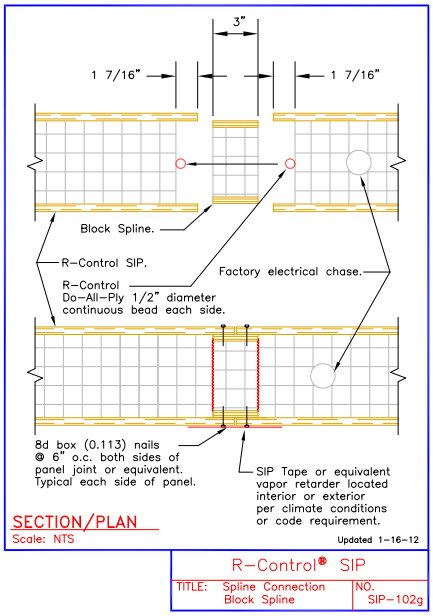
SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)				
		4	6	8[1]	10	12
4-1/2"	L/360	69	44	30	22	
	L/240	104	65	46	33	
	L/180	127	85	61	45	
6-1/2"	L/360	105	67	48	36	
	L/240	131	88	66	53	
	L/180	131	88	66	53	
8-1/4"	L/360	135	88	63	48	38
	L/240	135	90	68	54	45
	L/180	135	90	68	54	45
10-1/4"	L/360	140	92	69	55	46
	L/240	140	92	69	55	46
	L/180	140	92	69	55	46
12-1/4"	L/360	138	92	69	55	46
	L/240	138	92	69	55	46
	L/180	138	92	69	55	46

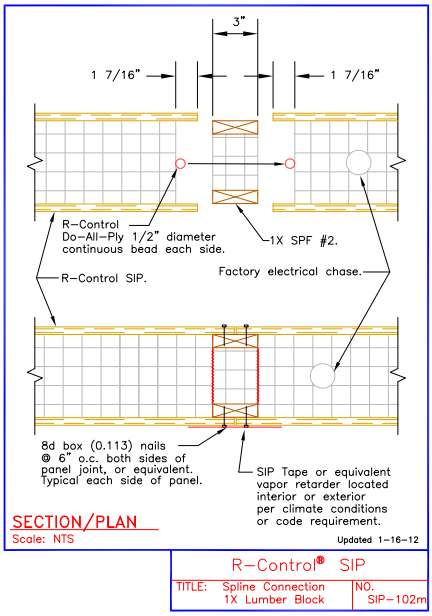
[1] VALUES FOR 8FT SPAN ARE APPLICABLE TO SIPS INSTALLED WITH THE STRONG AXIS OF THE OSB FACINGS PARALLEL OR PERPENDICULAR TO SIP SPAN.

GENERAL NOTES:

- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- SURFACE, BLOCK, OR LUMBER BLOCK SPLINE CONNECTED TO SIP FACING WITH 8d BOX (0.113) NAILS 6" O.C.
- CONTINUOUS SUPPORT WITH A MINIMUM BEARING OF 1-1/2" AT EACH END REQUIRED.
- CHART IS BASED UPON UNIFORM LOADS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- FLOORS MUST HAVE A MINIMUM 7/16" THICK OSB OR EQUIVALENT OVERLAY.
- FOR SLOPED SIPS, THE LOADING CONDITIONS AND SIP CAPACITIES SHOULD BE REVIEWED BASED UPON THE INCLINED SIP LENGTH. REFER TO R-CONTROL SIP TECHNICAL BULLETIN SIP NO. 2042.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- DEFLECTION BASED UPON K_{CR}=1.0. FOR LONG TERM DEFLECTION UNDER SUSTAINED LOAD (CREEP), ADDITIONAL DEFLECTION MUST BE EVALUATED.



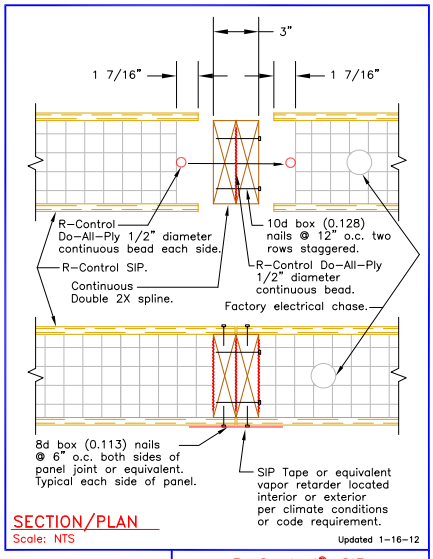


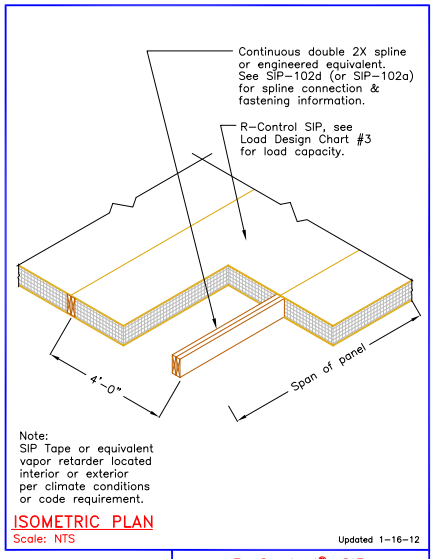


Roof/Floor - Transverse Loads - PSF
LOAD DESIGN CHART #3
DOUBLE 2X SPLINE DETAILS SIP-102d and SIP-108

SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)							
		10	12	14	16	18	20	22	24
6-1/2"	L/360	53	40	30	24	19	15		
	L/240	79	59	45	35	28	22		
	L/180	105	79	60	47	37	30		
8-1/4"	L/360	89	65	48	37	28	22		
	L/240	109	91	72	55	42	33		
	L/180	109	91	78	68	57	44		
10-1/4"	L/360	150	111	84	65	51	41	33	27
	L/240	174	145	124	98	77	61	49	40
	L/180	174	145	124	109	97	82	66	54
12-1/4"	L/360	177	148	115	89	70	56	45	37
	L/240	177	148	127	111	99	84	68	55
	L/180	177	148	127	111	99	89	81	74

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- DOUBLE 2X SPLINE MUST BE CONTINUOUS, SPACED 4' O.C., AND CONNECTED TO SIP FACING WITH 8d BOX (0.113) NAILS 6" O.C.
- CONTINUOUS SUPPORT WITH A MINIMUM DOUBLE 2X SPLINE BEARING OF 1-1/2" AT EACH END REQUIRED.
- CHART IS BASED UPON UNIFORM LOADS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- FLOORS MUST HAVE A MINIMUM 7/16" THICK OSB OR EQUIVALENT OVERLAY.
- FOR SPANS GREATER THAN 22' AND FOR ALL 12-1/4" SIPS, DOUBLE 2X SPLINE IS REQUIRED TO BE #2 DOUGLAS FIR OR BETTER.
- FOR SLOPED SIPS, THE LOADING CONDITIONS AND SIP CAPACITIES SHOULD BE REVIEWED BASED UPON THE INCLINED SIP LENGTH. REFER TO R-CONTROL SIP TECHNICAL BULLETIN SIP NO. 2042.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- DEFLECTION BASED UPON K_{CR}=1.0. FOR LONG TERM DEFLECTION UNDER SUSTAINED LOAD (CREEP), ADDITIONAL DEFLECTION MUST BE EVALUATED.

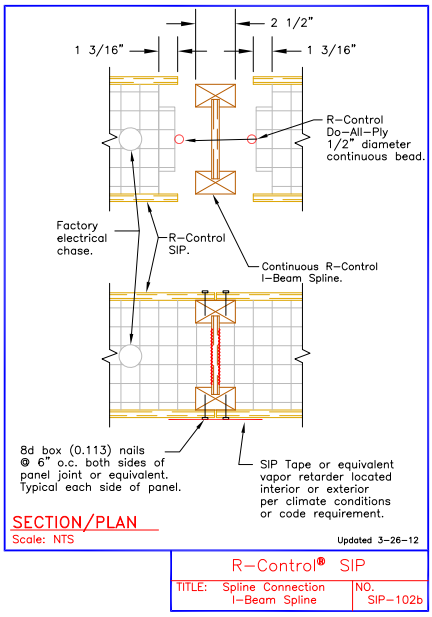


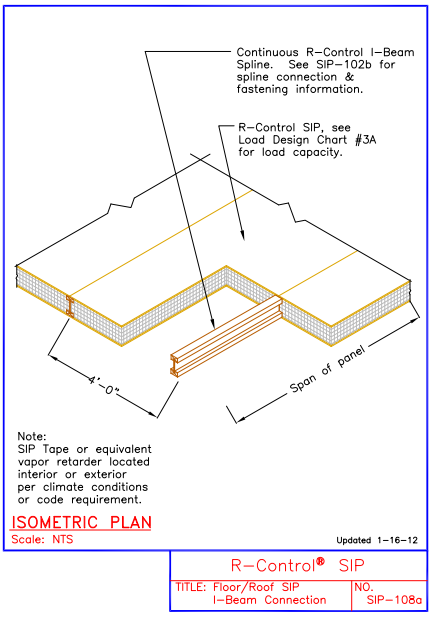


Roof/Floor - Transverse Loads - PSF
LOAD DESIGN CHART #3A
I-BEAM SPLINE DETAILS SIP-102b and SIP-108a

SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)							
		10	12	14	16	18	20	22	24
10-1/4"	L/360	118	98	73	55	42	33	26	21
	L/240	118	98	84	74	63	49	39	31
	L/180	118	98	84	74	65	59	49	41
12-1/4"	L/360	131	109	87	69	55	45	37	30
	L/240	131	109	93	82	72	65	55	46
	L/180	131	109	93	82	72	65	57	48

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- I-BEAM SPLINE MUST BE CONTINUOUS, SPACED 4' O.C., AND CONNECTED TO SIP FACING WITH 8d BOX (0.113) NAILS 6" O.C.
- CONTINUOUS SUPPORT WITH A MINIMUM I-BEAM SPLINE BEARING OF 1-1/2" AT EACH END REQUIRED.
- CHART IS BASED UPON UNIFORM LOADS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- FLOORS MUST HAVE A MINIMUM 7/16" THICK OSB OR EQUIVALENT OVERLAY.
- FOR SLOPED SIPS, THE LOADING CONDITIONS AND SIP CAPACITIES SHOULD BE REVIEWED BASED UPON THE INCLINED SIP LENGTH. REFER TO R-CONTROL SIP TECHNICAL BULLETIN SIP NO. 2042.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- DEFLECTION BASED UPON K_{CR}=1.0. FOR LONG TERM DEFLECTION UNDER SUSTAINED LOAD (CREEP), ADDITIONAL DEFLECTION MUST BE EVALUATED.

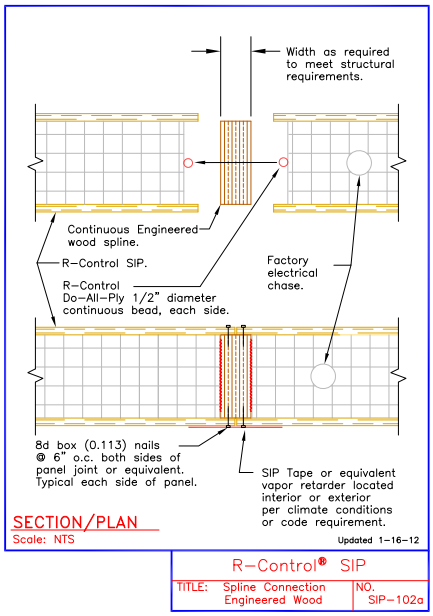




Roof/Floor - Transverse Loads - PSF LOAD DESIGN CHART #3C R-CONTROL LVL SPLINE DETAIL SIP-102a							
SIP THICKNESS	DEFLECTION LIMIT	SIP SPAN (feet)					
		10	12	14	16	18	20
		R-CONTROL LVL SPLINE WIDTH					
		1-3/4"				2-1/2"	
8-1/4"	L/360	81	63	49	38	30	24
	L/240	81	68	58	51	45	31
	L/180	81	68	58	51	45	40

GENERAL NOTES:

- CHART VALUES ARE POUNDS PER SQUARE FOOT.
- LVL SPLINE MUST BE CONTINUOUS, SPACED 4' O.C., AND CONNECTED TO SIP FACING WITH 8d BOX (0.113) NAILS 6" O.C.
- CONTINUOUS SUPPORT WITH A MINIMUM LVL SPLINE BEARING OF 1-1/2" AT EACH END REQUIRED.
- CHART IS BASED UPON UNIFORM LOADS.
- LOADS LIMITED BY DEFLECTION OR ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.
- FLOORS MUST HAVE A MINIMUM 7/16" THICK OSB OR EQUIVALENT OVERLAY.
- FOR SLOPED SIPS, THE LOADING CONDITIONS AND SIP CAPACITIES SHOULD BE REVIEWED BASED UPON THE INCLINED SIP LENGTH. REFER TO R-CONTROL SIP TECHNICAL BULLETIN SIP NO. 2042.
- VALUES ARE FOR TOTAL LOAD (DEAD LOAD + LIVE LOAD).
- DEFLECTION BASED UPON K_{CR}=1.0. FOR LONG TERM DEFLECTION UNDER SUSTAINED LOAD (CREEP), ADDITIONAL DEFLECTION MUST BE EVALUATED.



Roof - Uplift Loads
LOAD DESIGN CHART #8
Maximum Spacing of R-Control Wood Screws At Supports - INCHES[1]

ROOF PITCH	SIP SPAN[2] (FT)	2009 IBC[3] 2009 IRC/2012 IRC WIND SPEED, V_{ASD}	2012 IBC[4] WIND SPEED, V_{ULT}
		90 MPH	115 MPH
1.5:12	8	12	12
	12	12	12
	16	8	8
	20	8	8
	24	6	6
3:12	8	12	12
	12	12	12
	16	8	8
	20	8	8
	24	6	6
6:12	8	12	12
	12	12	12
	16	8	8
	20	8	8
	24	6	6
9:12	8	12	12
	12	12	12
	16	8	8
	20	6	6
	24	6	6

[1] FASTENER SPACING IS BASED ON FASTENER HEAD PULL-THROUGH AND WITHDRAWAL STRENGTH OF R-CONTROL WOOD SCREWS TESTED IN ACCORDANCE WITH ASTM D1037. THE ALLOWABLE WITHDRAWAL STRENGTH AND PULL-THROUGH STRENGTH WERE TAKEN AS THE AVERAGE ULTIMATE LOAD DIVIDED BY A FACTOR OF SAFETY OF 5.0 AND A LOAD DURATION FACTOR OF 1.6 (ALLOWABLE PULL-THROUGH STRENGTH = 179 LBF, ALLOWABLE WITHDRAWAL STRENGTH - 200 LBF).

[2] TABLE VALUES APPLY TO SIMPLY SUPPORTED SIP ROOF MEMBERS HAVING AN OVERHANG NOT TO EXCEED 24-INCHES. WOOD SUPPORT TO HAVE A MINIMUM SPECIFIC GRAVITY, G = 0.42 (SPRUCE-PINE-FUR). SCREW SHALL HAVE SUFFICIENT LENGTH AND BE INSTALLED SO THAT IT PENETRATES THE WOOD SUPPORT A MINIMUM OF 1.5-INCHES.

[3] THREE-SECOND-GUST WIND SPEED BASED ON A BUILDING HEIGHT OF 40-FEET, ZONE 2E, IMPORTANCE FACTOR, L_W=1.0 AND TOPOGRAPHIC FACTOR, K_{zt}=1.0, INTERNAL PRESSURE COEFFICIENT, GC_{PI}=0.18 IN ACCORDANCE WITH ASCE 7, 2005 EDITION, SECTION 6.5.12.2.2 (MAIN WIND FORCE RESISTING SYSTEM, LOW-RISE BUILDING). a MINIMUM ROOF ASSEMBLY DEAD LOAD OF 10 PSF IS CONSIDERED IN THE TABULATED VALUES (UPLIFT PRESSURE REDUCE BY 0.6 TIMES 10 PSF).

[4] THREE-SECOND-GUST WIND SPEED; BASED ON A BUILDING HEIGHT OF 40-FEET, ZONE 2E, IMPORTANCE FACTOR, L_W=1.0 AND TOPOGRAPHIC FACTOR, K_{zt}=1.0, INTERNAL PRESSURE COEFFICIENT, GC_{PI}=0.18 IN ACCORDANCE WITH ASCE 7, 2010 EDITION, CHAPTER 28 (WIND LOADS ON BUILDING - MWFRS (ENVELOPE PROCEDURE). A MINIMUM ROOF ASSEMBLY DEAD LOAD OF 10 PSF IS CONSIDERED IN THE TABULATED VALUES (UPLIFT PRESSURE REDUCE BY 0.6 TIMES 10 PSF).

GENERAL NOTES:
- CHART VALUES ARE IN INCHES.
- IN HIGH WIND SPEED AREAS, PLEASE REFER TO R-CONTROL SIP TECHNICAL BULLETINS FOR SPACING REQUIREMENTS.

Roof/Floor - Diaphragm Loads - PLF
LOAD DESIGN CHART #7
CONNECTION DETAILS
SIP 139, SIP-139a, SIP-140 and SIP-141

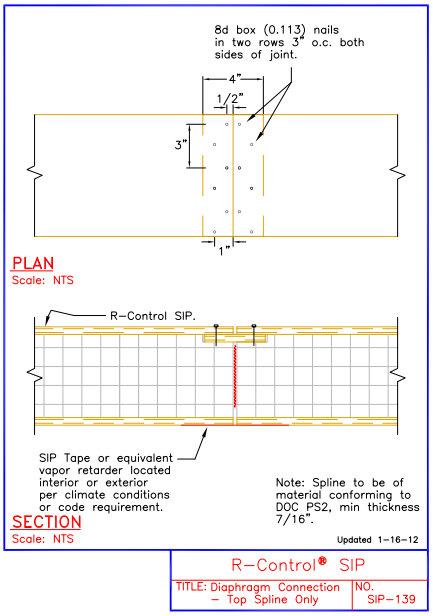
FASTENER SPACING				ALLOWABLE STRENGTH (PLF)
BOUNDARIES[1]		SPLINES[2]	SIPS TO SUPPORT PARALLEL TO SHEAR	
R-CONTROL SCREWS[3]	8D BOX NAILS	8D BOX NAILS	R-CONTROL SCREWS[3]	
6"	3" @ top and bottom	3", two rows each side of joint and staggered	12"	500
4"	3" @ top and bottom	3", two rows each side of joint and staggered	12"	750
3"	3" @ top and bottom	3", in two rows each side of joint and staggered	12"	850

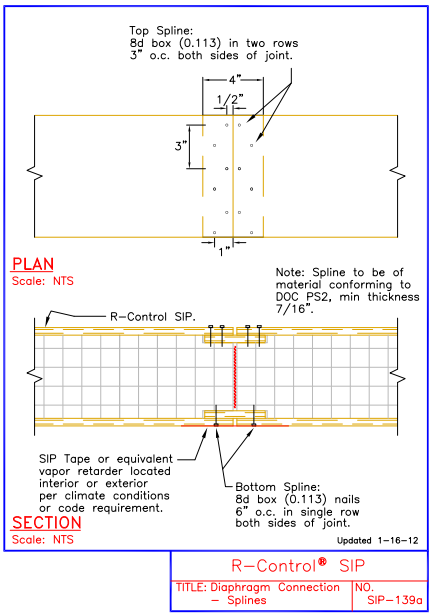
[1] DIAPHRAGM BOUNDARY ELEMENTS MUST CONSIST OF FULL-DEPTH, SOLID-SAWN LUMBER, 2-INCH MINIMUM NOMINAL WIDTH, MINIMUM SPECIFIC GRAVITY OF 0.50, INSERTED IN SIP CORE, CONTINUOUS ACROSS PANEL JOINTS. PANEL EDGES PARALLEL TO APPLIED SHEAR SHALL BE REINFORCED WITH SOLID-SAWN LUMBER, 4-INCH MINIMUM NOMINAL WIDTH, AND MINIMUM SPECIFIC GRAVITY OF 0.50.

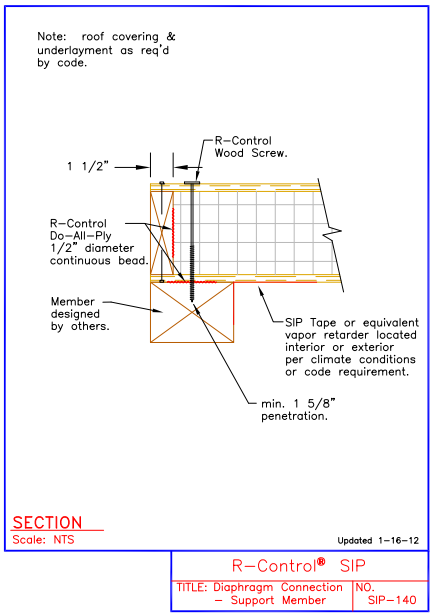
[2] NAILS CONNECT SIP FACINGS AT JOINTS TO OSB SURFACE SPLINES LOCATED UNDER TOP FACE AT ALL PANEL EDGES, AT THE TABULATED SPACING.

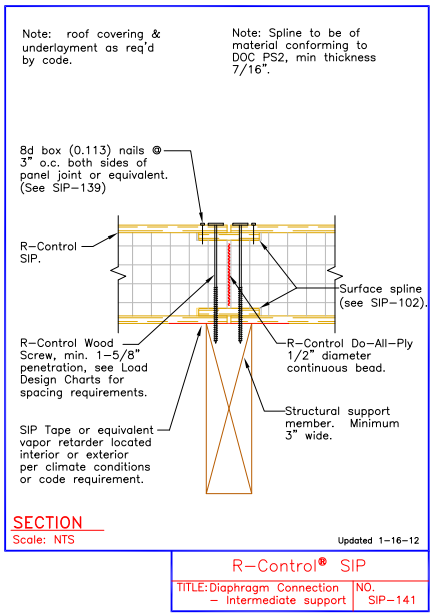
[3] DIAPHRAGM SECURED TO SUPPORT MEMBERS WITH R-CONTROL SCREWS AT THE TABULATED SPACING AND A MINIMUM 1-5/8 INCH PENETRATION INTO THE RECEIVING MEMBER.

GENERAL NOTES:
- CHART VALUES ARE POUNDS PER LINEAL FOOT.
- SURFACE, BLOCK, OR LUMBER BLOCK SPLINE.
- LOADS LIMITED BY ULTIMATE FAILURE LOAD DIVIDED BY A FACTOR OF SAFETY OF THREE.









Ready to take control? Start here.

If you're wondering how R-Control SIPs can work on your next project, just contact your nearest R-Control supplier. They'll be happy to collaborate on design, walk you through R-Control SIP installation, provide test data, pricing, and answers to all your questions. Start by visiting our web site: www.r-control.com.

R-Control SIPs are made exclusively with Foam-Control EPS. R-Control SIPs and Foam-Control EPS are manufactured by AFM Corporation licensees.

RC02-06/12

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USP SIP Connection Manual

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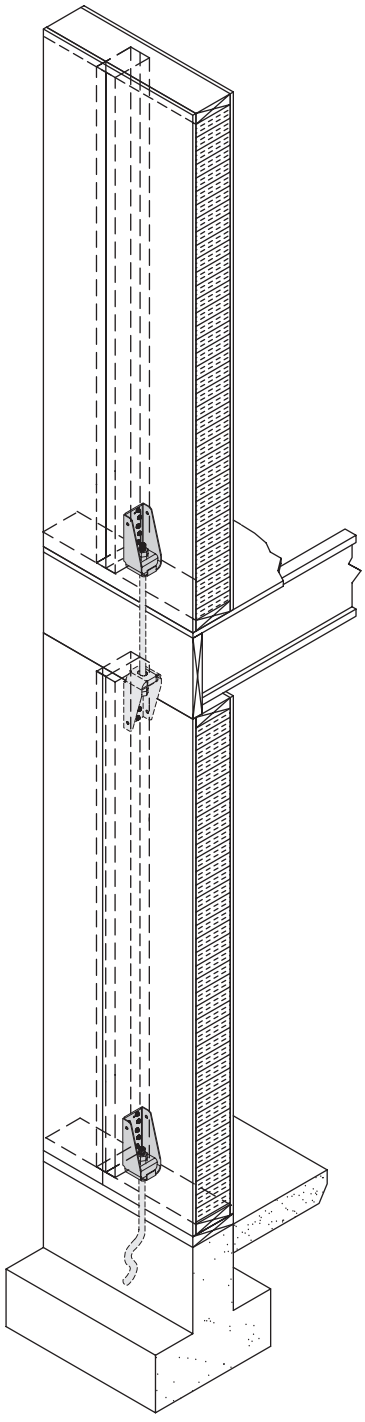
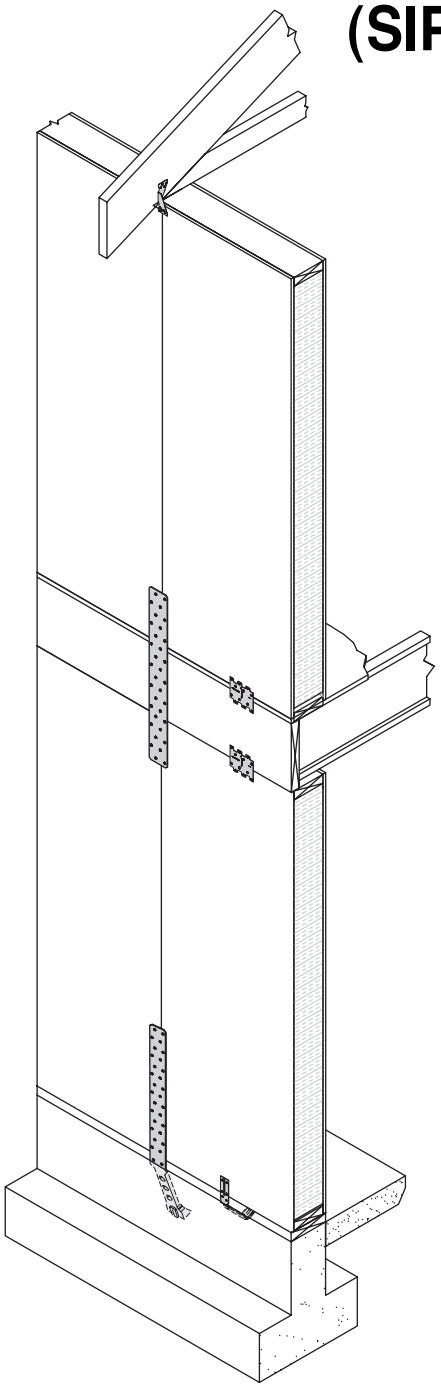
Structural Insulated Panels (SIP)





USP Structural Connectors™
A GIBRALTAR COMPANY

Safe Home Systems

USP supplies quality products to build Stronger Safer Structures

Los Angeles • San Francisco • Minneapolis • Houston • Tampa • Charlotte • Philadelphia

Company History

USP Structural Connectors™ (United Steel Products Company) has been designing, manufacturing, and marketing construction hardware for 49 years. The company's experience in marketing, engineering, and service has allowed USP to be a leader in developing new connectors for a changing construction industry.

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USP Operations Include

- Seven strategically placed manufacturing and warehousing locations.
- In-house quality control and testing with independent, third-party plant inspection, and test witnessing.
- On staff licensed professional engineers.
- Our National Factory Technical Sales Force is ready to help with application questions.
- Ongoing regional and national code evaluations as products are developed.

Product Questions & Answers

The Customer Service / Technical Assistance staff is ready to answer your questions and help solve your connector related problems. Our staff can assist you in developing economical solutions to your structural connection problems.

When calling for Technical Assistance, please have the following information ready:

- Which USP product are you using?
- What is connector application?
- What is the header material and application?
- What is the load requirement?

Table of Contents

Please Note

• *USP Structural Connectors*™ reserves the right to change specifications, designs and models without notice and liability for such changes. This catalog may not be reproduced in whole or in part without the prior written approval of *USP Structural Connectors*™.

• This SIP Connection publication was designed as a general reference for the USP Product Line. See USP's *Full Line Catalog* for complete product information.

• To achieve the allowable loads presented in this catalog, all specified fasteners must be used and proper installation procedures observed. Verify that the dimensions of supporting members are sufficient to receive specified fasteners. Any product modifications void the warranty unless *prior* written permission of *USP Structural Connectors*™ is obtained.

• Nails specified as 8d, 10d, 16d, and 20d are common wire nails.

• See USP's *Full Line Catalog* for testing, material, and Code information.

• This publication shows common SIP connections. Please refer to SIP manufacturers literature for complete SIP connection information.

• Allowable loads shown in this publication are based on connections to wood members. Fasteners connecting only to the panel skin have not been considered.

NDS® Standards

The load resistance values presented in this catalog reflect the calculation criteria set forth in the 1991 Revised and 1997 National *Design Specification for Wood Construction (NDS®)* published by the American Forest and Paper Association. The values shown in this catalog supercede those previously printed.

Douglas Fir-Larch or Hem Fir Equivalent Capacity

Unless otherwise noted, the published design loads in this catalog apply to Spruce-Pine-Fir lumber. When Douglas Fit-Larch, Southern Yellow Pine, or Hem Fir lumber is used with face mount hangers or straps, the nail shear capacity may be adjusted according to the chart to the right.

Allowable Load Adjustment Factor		
Wood Species	Specific Gravity	Adjustment Factor
Douglas Fir-Larch (DF-L)	0.50	1.16
Southern Yellow Pine (SYP)	0.55	1.16
Douglas Fir (S) Hem Fir (N)	0.46	1.02
Spruce-Pine-Fir (S-P-F)	0.42	1.00

1) Allowable loads must be adjusted according to the applicable wood species.
2) When using structural composite lumber, verify wood species and use above listed adjustment factors.

Testing

On all structurally-rated products, USP performs full-scale testing in accordance with ASTM D 1761, the standard recognized by all domestic code agencies. All final testing is conducted by a third-party testing laboratory.

Material

USP Structural Connectors™ are manufactured from prime quality steel which meets ASTM A 653 requirements for galvanized steel, and ASTM A 570, or ASTM A 36 for hot-rolled steel.

Finish

All galvanized products have a zinc coating as specified in ASTM A 653. Hot-dip galvanized parts are galvanized after fabrication per ASTM A 153 with a minimum of one ounce of zinc per square foot of surface.

Non-galvanized steel products are prime coated for corrosion protection.

Corrosion Resistant Finishes

USP Structural Connectors™ offers three options for improved corrosion resistance of their connectors.

Triple Zinc (TZ) – galvanizing provides a prefabrication coating of 1.85 (G-185) ounces of zinc per square foot of surface area measured in accordance with ASTM A 653.

Required Fastener: Hot-dip galvanized fasteners

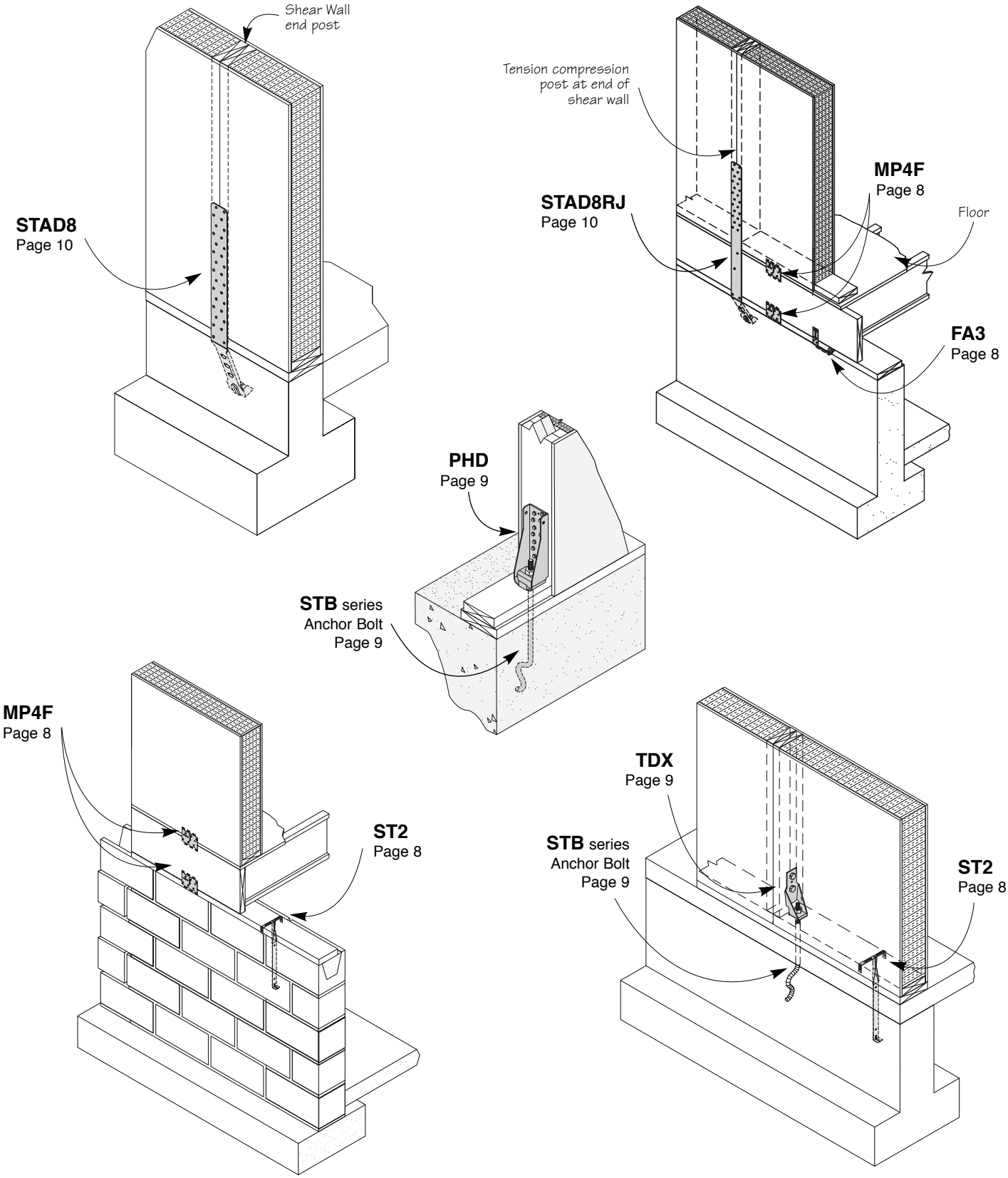
Hot-Dip Galvanized (HDG) – coating provides an after fabrication hot-dipped zinc coating. The coating thickness is dependent on the connector material, but generally ranges from 1.1 to 2.3 ounces of zinc per square foot of surface. Hot-dip products meet requirements set forth in ASTM A 153.

Required Fastener: Hot-dip galvanized fasteners

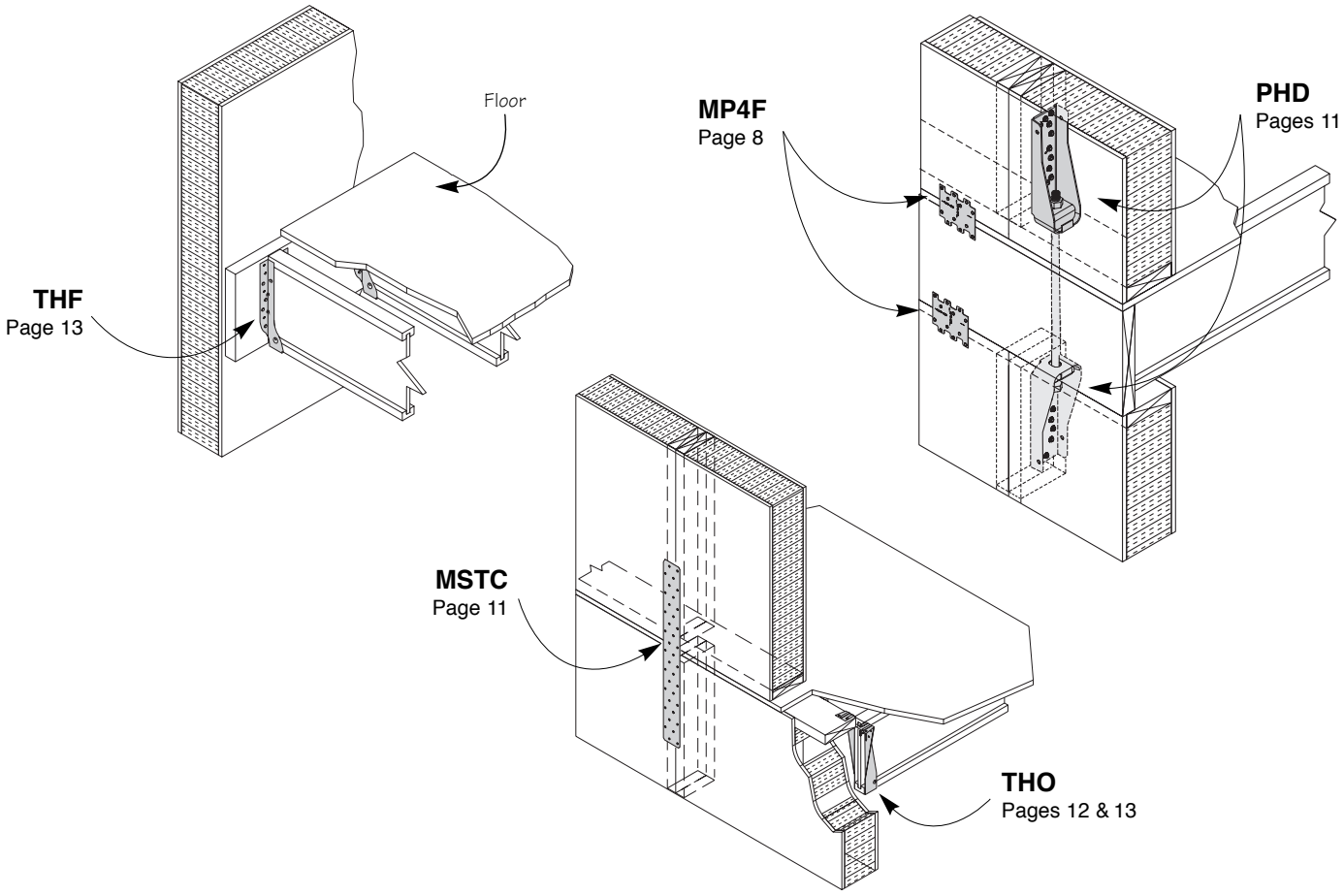
Stainless Steel (SS) – is the best option for corrosion protection. Quality stainless steel (316SS grade steel) is used to fabricate connectors. Although costs are higher, some applications may need the virtual corrosion proof quality of stainless steel.

Required Fastener: Stainless Steel fasteners

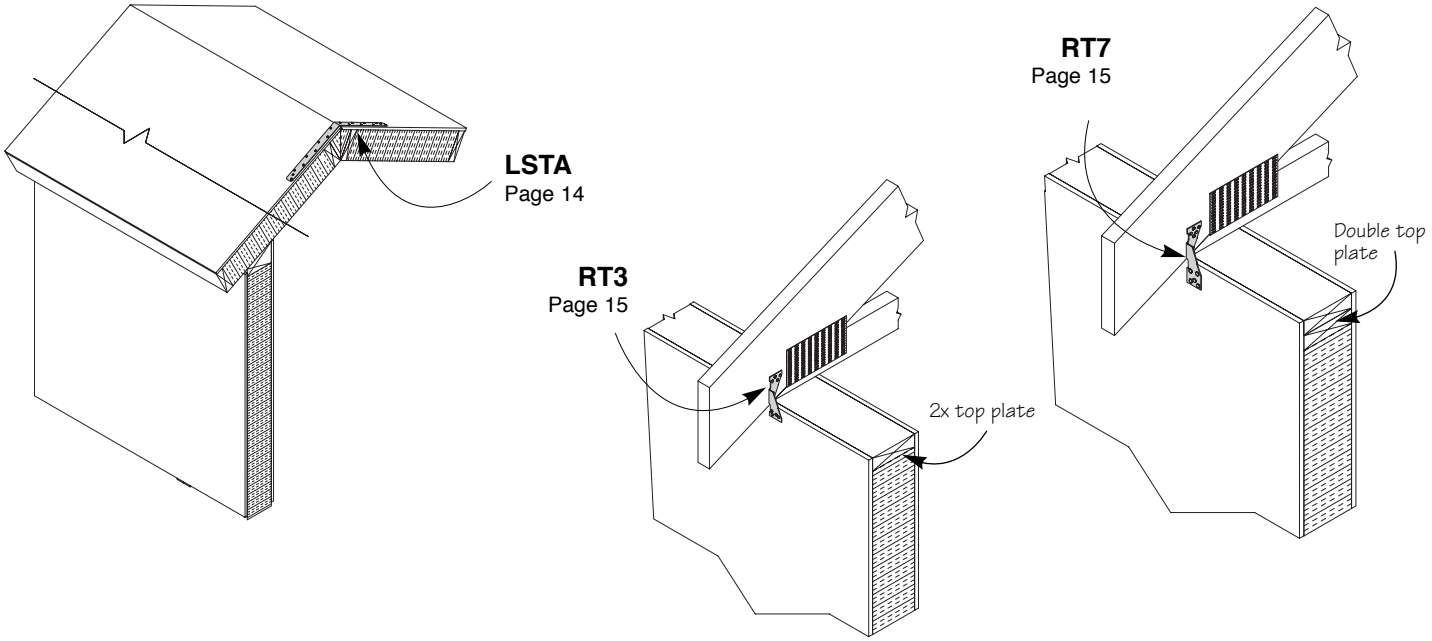
SIP Foundation Connections



SIP Multi-Story Connections



SIP Rafter & Truss Connections



Nails – NA series

Optional Nails for Face Mount Hangers and Straight Straps load table

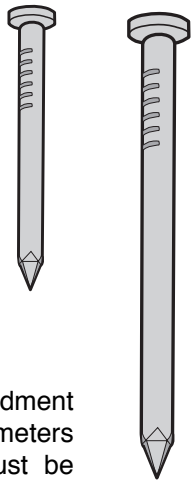
Catalog Nail	Replacement Fastener[1]	Allowable Load Adjustment Factor			
		DF-L	SYP	S-P-F	LVL
16d common	8d common	0.69	0.69	0.60	0.69
16d common	10d Box	0.67	0.67	0.58	0.67
16d common	10d common/12d common	0.84	0.84	0.72	0.84
16d common	10d x 1-1/2	0.67	0.67	0.59	0.67
16d common	10d Sinker	0.58	0.58	0.50	0.58
16d common	16d Box	0.74	0.74	0.64	0.74
16d common	16d Sinker	0.84	0.84	0.72	0.84
16d common	16d x 2-1/2	1.00	1.00	0.86	1.00
16d common	No. 8 x 1-1/2 Wood Screw	0.90	1.00	0.82	0.84
10d common	8d Box	0.65	0.65	0.56	0.65
10d common	10d Sinker	0.70	0.70	0.60	0.70
10d common	8d common	0.83	0.83	0.71	0.83
10d common	10d Box	0.80	0.80	0.69	0.80
10d common	8d x 1-1/4	0.66	0.66	0.56	0.66
10d common	No. 8 x 1-1/2 Wood Screw	1.00	1.00	1.00	1.00
10d common/12d common	10d x 1-1/2	0.80	0.80	0.68	0.79
10d common/12d common	16d Sinker	1.00	1.00	0.87	1.00
10d common/12d common	No. 8 x 1-1/2 Wood Screw	1.00	1.00	1.00	1.00
8d common	8d Box	0.77	0.77	0.66	0.77
8d common	8d x 1-1/4	0.80	0.80	0.68	0.80
8d common	No. 8 x 1-1/2 Wood Screw	1.00	1.00	1.00	1.00
8d x 1-1/2	8d x 1-1/4	0.86	0.86	0.74	0.86
8d x 1-1/2	No. 8 x 1-1/2 Wood Screw	1.00	1.00	1.00	1.00
10d x 1-1/2	8d x 1-1/2	0.93	0.93	0.80	0.93
10d x 1-1/2	No. 8 x 1-1/2 Wood Screw	1.00	1.00	1.00	1.00

1) No. 8 x 1-1/2 Wood Screw has a shank diameter of 0.164″ and shall conform to ANSI/ASME Standard B18.6.1-19

How to Use:
The base value is the catalog listed nail in Douglas Fir-Larch and the adjustment factor is the multiplier for the applicable replacement nail and wood combination.

- Adjustment factors may vary with some custom hangers or steel thicker than 10 gauge. Contact USP for exceptions.
- Roofing nails shall not be substituted for any nail size or type.

NA9D *NA16D*



Proper fasteners are a critical component in a sound wood frame structure. To ensure successful installations of its connectors, USP offers a full range of structurally-rated nails. All galvanized nails are finished using the Hot-dip method to assure total anti-corrosion coverage. Stainless steel nails are available on a stock basis in two sizes: 8d x 1 1/2″ and 10d x 1 1/2″ (see product chart).

Finish: See chart

Installation:

- Allowable shear values assume nail embedment into the wood of the entire nail or 12 nail diameters (whichever is less). Otherwise, the nail must be embedded at least 6 nail diameters, with the load reduced using the following equation:

$$\text{Reduced Load} = \frac{\text{Published Load} \times \text{Actual Penetration}}{\text{Nail Diameter} \times 12}$$

- Load reductions may occur if nails are used other than those specified. See the chart Optional Nails for Face Mount Hangers and Straight Straps for load reduction factors regarding nail substitutions.

Minimum Fastener penetration

Nail Penny	Wire Gauge	Shank Diameter (inches)	Minimum Penetration (inches)
6d	11-1/2 ga.	.113	1.37
8d	10-1/4 ga.	.131	1.57
10d/16d Sinker	9 ga.	.148	1.78
12d	9 ga.	.148	1.78
16d	8 ga.	.162	1.94
20d	6 ga.	.192	2.30

1) Less than the specified nail penetration shall be multiplied by the applicable adjustment factor.

Nail Specification table

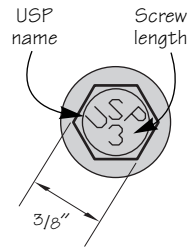
USP Stock No.	Ref. No.	Description	Finish[4]	Wire Gauge	Nail Diameter	Length	Withdrawal Load	Nails Per Lb.	Allowable Shear per Nail (Lbs.)[1,2,3]									
									Steel Gauge									
									3	7	10	12	13	14	16	18	20	22
NA11	N8	8d x 1-1/2	HDG	-- --	0.131	1-1/2	48	152	-- --	-- --	-- --	-- --	-- --	-- --	86	86	86	86
NA11SS	SSN8	8d x 1-1/2	SS	-- --	0.131	1-1/2	48	143	-- --	-- --	-- --	-- --	-- --	-- --	86	86	86	86
-- --	-- --	8d Common	Bright	10-1/4 ga.	0.131	2-1/2	80	126	-- --	-- --	-- --	99	97	95	93	93	92	92
NA9D	N10	10d x 1-1/2	HDG	-- --	0.148	1-1/2	54	100	-- --	-- --	-- --	94	92	92	92	92	92	92
NA9DSS	SSN10	10d x 1-1/2	SS	-- --	0.148	1-1/2	54	112	-- --	-- --	-- --	94	92	92	92	92	92	92
-- --	-- --	10d Common	Bright	9 ga.	0.148	3	108	70	158	139	126	119	116	114	113	112	112	112
-- --	-- --	16d Common	Bright	8 ga.	0.162	3-1/2	138	48	187	160	147	140	138	136	135	134	134	134

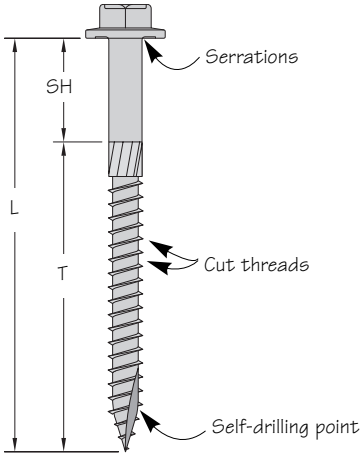
1) Loads are calculated according to specifications of Part 12 of the National Design Specifications for Wood Construction (NDS®), 1997 Edition.
2) Loads apply to Douglas Fir-Larch (G=0.50) and Southern Yellow Pine (G=0.55). For Spruce-Pine-Fir (G=0.42) multiply above values by 0.86, for other wood types refer to NDS® or consult USP.
3) Value assumes full penetration of at least 12 nail diameters.
4) HDG = Hot-Dip Galvanized; SS = Stainless Steel; Bright = No Finish.

Wood Screws – WS series

The *WS* Wood Screw is a self-drilling screw used for numerous framing applications. This screw features a reverse locking serration on the bottom of the screw head to prevent over tightening against a steel plate which could cause the screw head to shear off. The USP head stamp identifies screws for easy inspection.

Screw shear capacities are based on a diameter of 0.242″ when the shear plane is on the screw shank *(SH)* and 0.185″ when the shear plane is on the knurl or threads *(T)*. USP *WS Wood Screws* have a bending yield strength of 217,000 psi. For conditions not charted here, screw loads may be calculated as shown in the current NDS® and increased for duration of load.





Materials: 1/4″ diameter Grade 5 steel
Finish: Yellow zinc dichromate
Codes: ICBO 5634, L.A.City RR 25433

Installation:

- Screws are self-drilling.
- Install using a low speed clutch drill with 3/8″ hex head driver. The washer head should be flat to the surface and the serrations will oppose turning and release the clutch. Do not over-tighten the screws.

USP Stock No.	Ref. No.	Description	Dimensions L	SH	T	Finish[1]	DF-L / SYP[2,4] Wood to Wood (DF-L to DF-L)	Steel to Wood 12 Gauge Shear (100)	10 Gauge Shear (100)	7 Gauge Shear (100)	3 Gauge Shear (100)	S-P-F[2,4] Wood to Wood (S-P-F to S-P-F)	Steel to Wood 12 Gauge Shear (100)	10 Gauge Shear (100)	7 Gauge Shear (100)	3 Gauge Shear (100)
WS3	SDS1/4x3	1/4″ x 3″	3″	3/4″	2-1/4″	Zinc	229	304	306	313	327	177	262	264	271	284

1) Zinc = Yellow zinc dichromate.
2) Allowable loads are based on the 1997 NDS®. Light Gauge or 3 Gauge loads given assume use with metal side plates, Fes = 45 ksi.
3) Wood-to-wood loads are based on 1-1/2″ thick wood side members.
4) Loads are for 100% duration of load factors, and may be increased for other duration factors in accordance with the NDS.

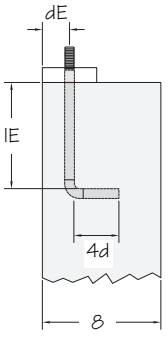
Additional Anchor Designs

Anchor types shown are made by others and used with USP holdowns. The design engineer may specify an alternate anchorage system, provided the anchor diameter is the same. See the *Strength Design of Anchorage in Concrete* by R.A. Cook, published by the Portland Cement Association and the 1997 Uniform Building Code.

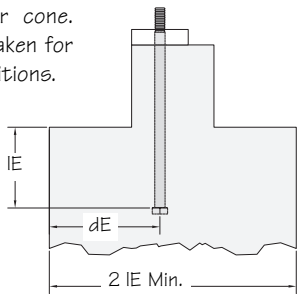
Anchor Type[2]	Dimensions Bolt Dia.	Min IE[1,3]	d_E	Min End Distance	Min Concrete Strength (psi)	Allowable Tension Loads (Lbs)[4,5] 133%
A	1	36	2-3/4	5	2500	9135
A	1-1/4	36	2-3/4	5	2500	9135
B	1, 1-1/4	8	8	8	3000	13635

1) Anchor embedment length is based on a single-pour concrete foundation. Double pour foundations systems, masonry walls and masonry footings must be evaluated by the designer.
2) Anchor bolt B must be ASTM A 307; anchor bolt A must be A36 steel or better.
3) Spacing between anchors is 2IE minimum for anchors in tension at the same time.
4) "A" bolt minimum end distance is for corner with 12″ return only. Otherwise, the minimum end distance is IE for the full table load.
5) Load values are for concrete without cracking.

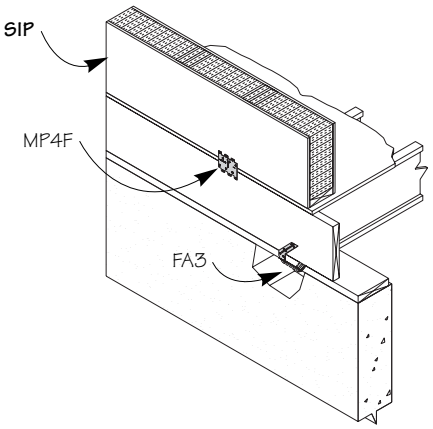
Anchor Type A L- bolt:
Bend without cracking the outside of the bend portion. Place #4 rebar 3″ to 5″ from the top center of the foundation.



Anchor Type B Hex-head bolt:
Design loads for Anchor Type B are calculated using a full shear cone. Multiple reductions must be taken for corner and edge distance conditions.

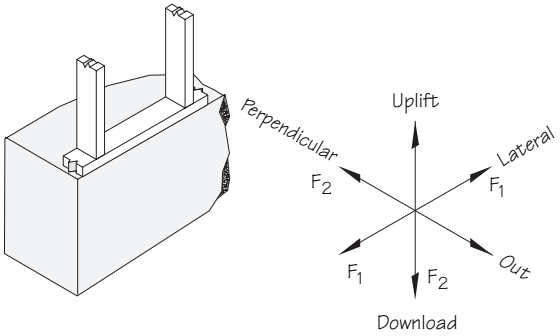


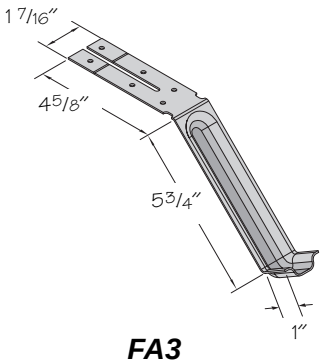
Foundation Anchors – FA3



***FA3** installation*

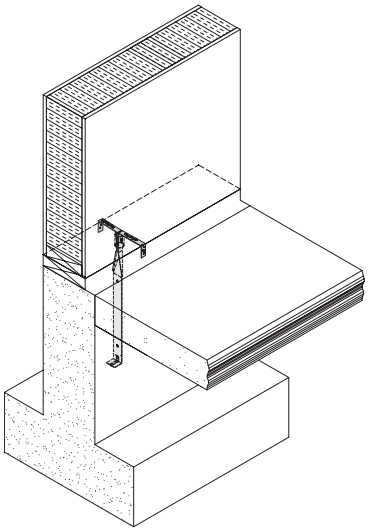
Load Direction Conventions



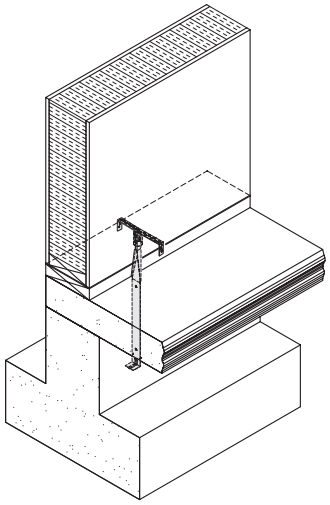


FA3

Foundation Anchors – ST2



***ST2** installation*



***ST2** Double pour installation*

ST2 & FA3 Capacity

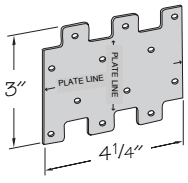
USP Stock No.	Fasteners Total	Min. Embed. (E)	Max. Spacing[2] (Feet)	S-P-F Allowable Loads (Lbs.)[1,2]		
				F1	F2	Uplift
ST2	(8) 8d x 1-1/2	16-1/2″	5-1/2	565	650	785
FA3	(8) 10d x 1-1/2	4″	5-1/2	435	375	600

1) Allowable loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitte
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

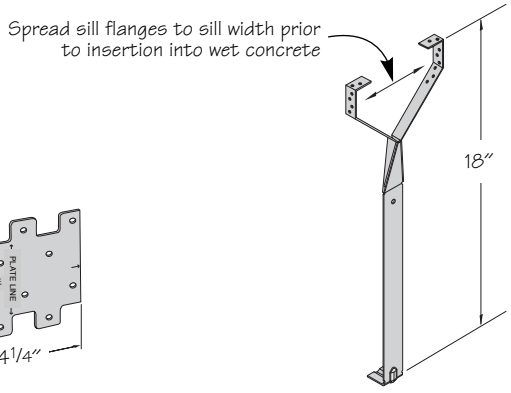
MP4F Capacity

USP Stock No.	Fasteners Total	Direction of Load	S-P-F Allowable Loads (Lbs.)[1,2]
			133%
MP4F	(12) 8d x 1-1/2	V	595
		H	595

1) Allowable loads have been increased 33-1/3% or 60% for wind or seismic loads; no further increase shall be permitted.
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.



MP4F



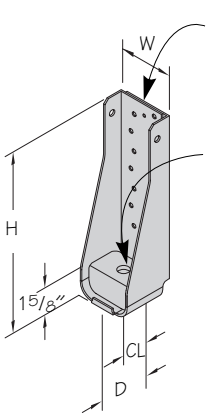
ST2

Holdowns – PHD & TDX series

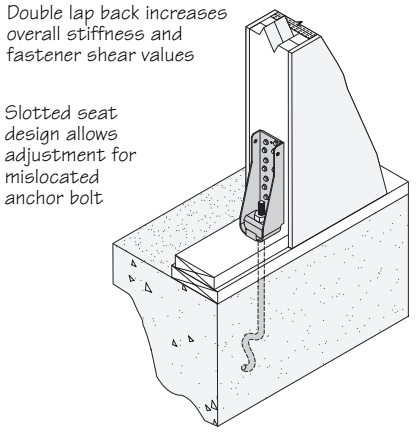
PHD Capacity

USP Stock No.	Dimensions W	H	D	CL	Fasteners Total Anchor Bolts[2]	Wood Screws	Nails	S-P-F Allowable Loads (Lbs.)[1,3,5,7] Uplift 133%
PHD2	3-1/4	7-1/2	3	1-3/8	(1) 5/8	(10) WS3	-- --	3670
PHD5	3-1/4	10-7/8	3	1-3/8	(1) 5/8	(14) WS3	-- --	5135
PHD6	3-1/4	13-1/16	3	1-3/8	(1) 7/8	(18) WS3	-- --	6605
PHD8	3-1/4	16-1/2	3	1-3/8	(1) 7/8	(24) WS3	-- --	8295
PHDN16	3-1/4	16-1/2	3	1-3/8	(1) 7/8	-- --	(36) 10d	6275

1) Allowable loads have been increased 33-1/3% for wind and seismic loads; no further increase shall be permitted.
2) The designer must specify anchor bolt type, length, and embedment.
3) The designer shall consider the effect of compression, bearing, tension, . and combined bending due to device eccentricity when applicable
4) The PHD/PHDN may be elevated off the sill.
5) Minimum post thickness is 3″. Consult USP for installations less than 3″.
6) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.



PHD

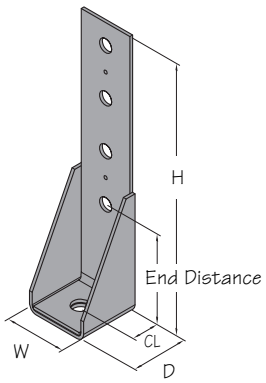


PHD, STB, & TDX *installation*

TDX Capacity

USP Stock No.	Dimensions W	H	D	CL	Fasteners Total Bolts	Anchor Bolts[4]	Minimum Required Bolt End Distance[5]	S-P-F Allowable Loads (Lbs.)[1,2,3,7] Length of Bolt in Vertical Member 1-1/2″	3″	3-1/2″	5-1/2″
TDX14	3-1/2	20-1/2	3-5/8	2-1/8	(4) 1	(1) 1	7	3680	7660	9100	12910
TDX20	4-3/4	20-3/4	4-1/4	2-3/8	(4) 1	(1) 1-1/4	7	4015	8035	9475	12960

1) Allowable loads shown are for single shear connections and may be doubled for back-to-back installations. The designer must verify post and anchor bolt capacities.
2) Allowable loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitted.
3) The designer must specify stud or post to resist published load values.
4) The designer must specify anchor bolt type, length, and embedment.
5) All models may be installed with greater than the required anchor end distance with no chart load reduction.
6) The designer shall consider the effect of compression, bearing, tension, and combined bending due to device eccentricity when applicable.
7) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.



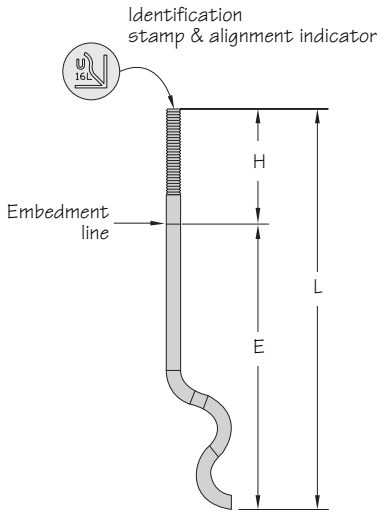
TDX

Anchor Bolts – STB series

STB Bolt Capacity

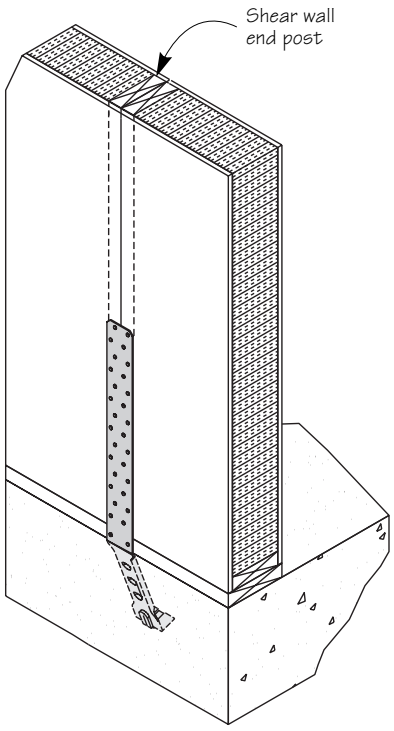
USP Stock No.	Bolt Dia.	Dimensions L	H	Min. Embed. (E)	S-P-F Allowable Tension Load[1,2,3,9] Concrete[5] Minimum End Distance[6] 5″ from end Wind / Seismic	24″ from end Wind / Seismic	Concrete Block[8] Minimum End Distance[6] 5″ from end Wind / Seismic	11″ or > from end Wind / Seismic
STB16	5/8	17-13/16	5	12-13/16	5215	5215	1850	4315
STB20	5/8	21-13/16	5	16-13/16	5215	5215	1850	4315
STB24	5/8	25-13/16	5	20-13/16	5215	5215	1850	4315
STB28	7/8	31	5	26	9335	10425	-- --	-- --
STB34	7/8	36	6	30	9335	10425	-- --	-- --
STB36	7/8	38	8	30	9335	10425	-- --	-- --

1) Design loads are based on the average ultimate, from a series of five tests, with a safety factor of three.
2) Loads may not be increased for short term loading. Loads apply to wind and seismic loading per 1997 U.B.C.
3) Minimum center to center spacing between bolts is 2(E) for anchors acting in tension.
4) Minimum edge distance is 1-3/4″.
5) Concrete stemwall shall be a minimum of 6″ thick for 5/8″ anchor bolts and 8″ for 7/8″ anchor bolts.
6) End distance shall be no less than 5″.
7) Connection is limited by lowest of bolt or holdown capacity.
8) Concrete block shall be minimum 10″ block.
9) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

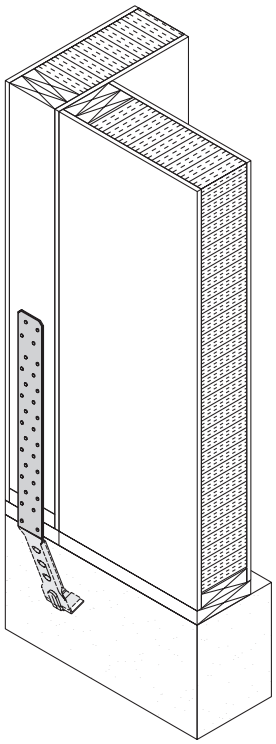


STB

Foundation Strap – STAD series

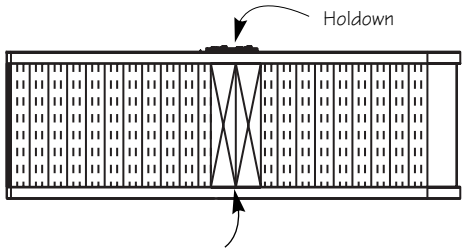


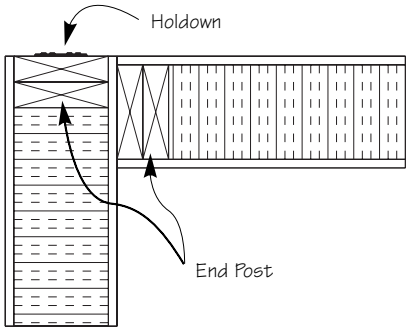
STAD edge *installation*



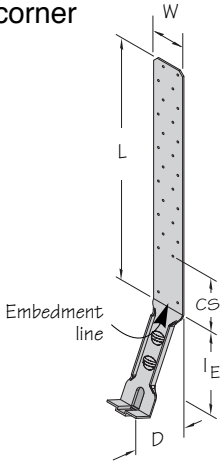
STAD corner *installation*

Plan View installations

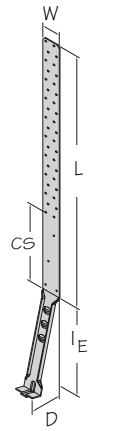




At corner



STAD



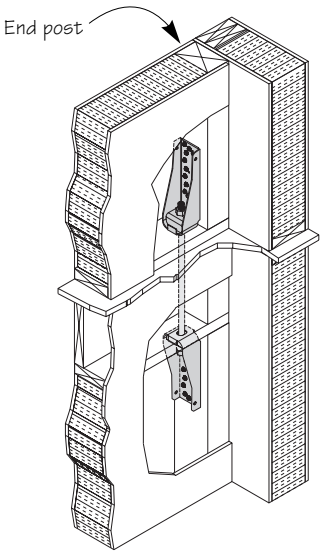
STADRJ

STAD Capacity

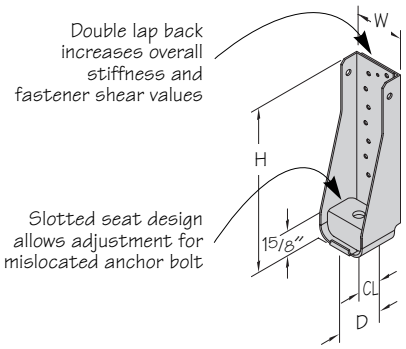
USP Stock No.[4]	Dimensions					Fastener Schedule[1,2]	Min. Stemwall	S-P-F Allowable Uplift Loads[7]								
								Edge Distance - Concrete								
								2000 psi			2500 psi			3000 psi		
	W	L	I_E	D	CS			1/2″	1-1/2″	I_E	1/2″	1-1/2″	I_E	1/2″	1-1/2″	I_E
STAD8	3	21-5/8	8	5	4-5/8	(24) 16d Sinker	6	3270	3270	3270	3270	3270	3270	3270	3270	3270
							8	3270	3270	3270	3270	3270	3270	3270	3270	3270
STAD8RJ	3	35-1/8	8	5	18-1/8	(24) 16d Sinker	6	3270	3270	3270	3270	3270	3270	3270	3270	3270
							8	3270	3270	3270	3270	3270	3270	3270	3270	3270
STAD10	3	21-5/8	10	5	1-5/8	(28) 16d Sinker	6	3270	3270	3625	3270	3270	3625	3270	3270	3625
							8	3270	3270	3885	3270	3270	3885	3270	3270	3885
STAD10RJ	3	36	10	5	16-1/8	(28) 16d Sinker	6	3270	3270	3625	3270	3270	3625	3270	3270	3625
							8	3270	3270	3885	3270	3270	3885	3270	3270	3885
STAD14	3	32-1/8	14	5	4-5/8	(38) 16d Sinker	6	4960	4960	4960	4960	4960	4960	4960	4960	4960
							8	4960	4960	5520	4960	4960	5520	4960	4960	5520
STAD14RJ[6]	3	39-5/8	14	5	12-1/8	(38) 16d Sinker	6	4960	4960	4960	4960	4960	4960	4960	4960	4960
							8	4960	4960	5520	4960	4960	5520	4960	4960	5520

1) Specified nails are 16d sinker nails. 10d common nails may be substituted with no load reduction.
2) Wood thickness shall be no less than 2″.
3) Uplift loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitted.
4) RJ after the model indicates STADs for rim joist applications as in STAD8RJ.
5) Interpolate allowable loads for edge distances between those listed. Nail quantities may be reduced for less than IE corner distance design loads- use the code allowable loads for fasteners in shear.
6) STAD14RJ with 17″ clear span, use (30) 16d sinker nails for a maximum (IE) load of 4360 lbs.
7) Where fewer fasteners are used in the structural wood member, reduce loads according to the code.
8) For two pour with 4" slab or less, install STAD14 and use STAD10 loads.
7) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

Holdowns – PHD & TDX series

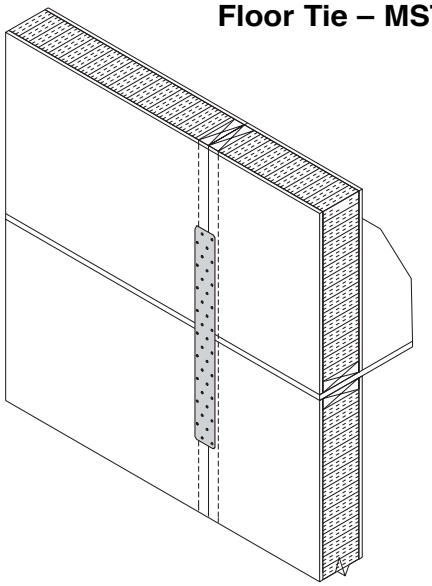


***PHD** installation*

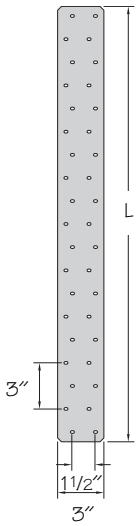


PHD

Floor Tie – MSTC series



***MSTC** installation*



MSTC

PHD Capacity

USP Stock No.	Dimensions				Fasteners Total			S-P-F Allowable Loads (Lbs.)[1,3,5,7]
	W	H	D	CL	Anchor Bolts[2]	Wood Screws	Nails	Uplift 133%
PHD2	3-1/4	7-1/2	3	1-3/8	(1) 5/8	(10) WS3	-- --	3670
PHD5	3-1/4	10-7/8	3	1-3/8	(1) 5/8	(14) WS3	-- --	5135
PHD6	3-1/4	13-1/16	3	1-3/8	(1) 7/8	(18) WS3	-- --	6605
PHD8	3-1/4	16-1/2	3	1-3/8	(1) 7/8	(24) WS3	-- --	8295
PHDN16	3-1/4	16-1/2	3	1-3/8	(1) 7/8	-- --	(36) 10d	6275

1) Allowable loads have been increased 33-1/3% for wind and seismic loads; no further increase shall be permitted.
2) The designer must specify anchor bolt type, length, and embedment.
3) The designer shall consider the effect of compression, bearing, tension, . and combined bending due to device eccentricity when applicable
4) The PHD/PHDN may be elevated off the sill.
5) Minimum post thickness is 3". Consult USP for installations less than 3".
6) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

MSTC Capacity

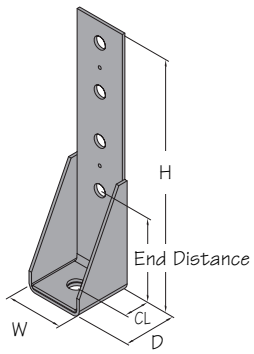
USP Stock No.	Dimensions		Fastener Schedule		S-P-F Allowable Loads (Lbs.)[1,2]
	W	L	Total Qty[3]	Min Qty[4,5]	Uplift 133%
MSTC28	3	28-1/4	38	(38) 10d	2110
MSTC40	3	40-1/4	54	(54) 10d	3170
MSTC52	3	52-1/4	70	(68) 10d	4090
MSTC66	3	65-3/4	88	(82) 10d	5115
MSTC78	3	77-3/4	104	(82) 10d	5115

1) Allowable loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitted.
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.
3) Total number of nail and/or bolt holes provided in the strap.
4) Minimum quantity of fasteners to be installed with equal fasteners at each end of the connection.
5) 16d sinker nails may be substituted for 10d nails with no reduction in load.

TDX Capacity

USP Stock No.	Dimensions				Fasteners Total		Minimum Required Bolt End Distance[5]	S-P-F Allowable Loads (Lbs.)[1,2,3,7] Length of Bolt in Vertical Member			
	W	H	D	CL	Bolts	Anchor Bolts[4]		1-1/2"	3"	3-1/2"	5-1/2"
TDX14	3-1/2	20-1/2	3-5/8	2-1/8	(4) 1	(1) 1	7	3680	7660	9100	12910
TDX20	4-3/4	20-3/4	4-1/4	2-3/8	(4) 1	(1) 1-1/4	7	4015	8035	9475	12960

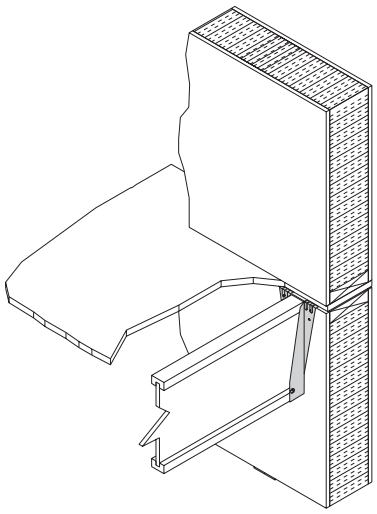
1) Allowable loads shown are for single shear connections and may be doubled for back-to-back installations. The designer must verify post and anchor bolt capacities.
2) Allowable loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitted.
3) The designer must specify stud or post to resist published load values.
4) The designer must specify anchor bolt type, length, and embedment.
5) All models may be installed with greater than the required anchor end distance with no chart load reduction.
6) The designer shall consider the effect of compression, bearing, tension, and combined bending due to device eccentricity when applicable.
7) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.



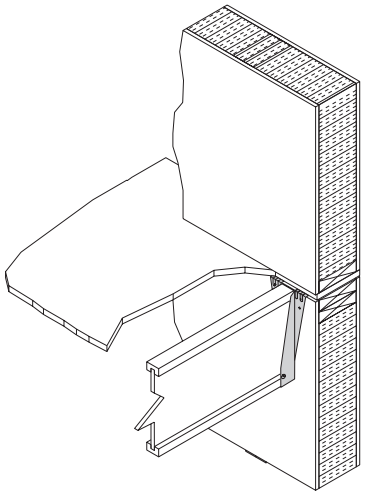
TDX

Top Mount Joist Hanger – THO series

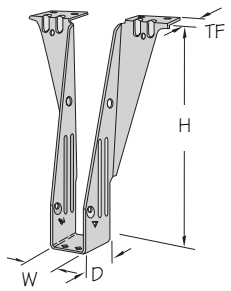
Joist Size	USP Stock No.	Dimensions W	H	D	TF	Top Plate/ Nailer Size	Fasteners Total Header	Joist	S-P-F Allowable Loads (Lbs.)[2] 100%	Uplift[1] 133%
1-1/2″ x 9-1/2″	THO15950	1-1/2	9-1/2	2	1-1/2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
1-1/2″ x 11-7/8″	THO15118	1-1/2	11-7/8	2	1-9/16	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
1-3/4″ x 9-1/2″	THO17950	1-3/4	9-1/2	2	1-1/2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
1-3/4″ x 11-7/8″	THO17118	1-3/4	11-7/8	2	1-9/16	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
1-3/4″ x 14″	THO17140	1-13/16	14	3	1-3/4	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
1-3/4″ x 16″	THO17160	1-13/16	16	3	1-5/8	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2″ x 9-1/2″	THO20950	2-1/8	9-1/2	2	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2″ x 11-7/8″	THO20118	2-1/8	11-7/8	2	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2″ x 14″	THO20140	2-1/8	14	2-1/8	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2″ x 16″	THO20160	2-1/8	16	2-1/8	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2-5/16″ x 11-7/8″	THO23118	2-3/8	11-7/8	2-3/8	1-7/8	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2-5/16″ x 14″	THO23140	2-3/8	14	2-3/8	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
2-5/16″ x 16″	THO23160	2-3/8	16	2-3/8	2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
(2) 1-1/2″ x 9-1/2″	THO15950-2	3-1/16	9-1/2	2-3/8	1-1/2	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
(2) 1-1/2″ x 11-7/8″	THO15118-2	3-1/16	11-7/8	2-3/8	1-1/2	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
3-1/2″ x 9-1/2″	THO35950	3-9/16	9-1/2	2-3/8	2-7/16	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
3-1/2″ x 11-7/8″	THO35118	3-9/16	11-7/8	2-3/8	2-1/2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
(2) 1-3/4″ x 11-7/8″	THO17118-2	3-9/16	11-7/8	2-3/8	1-9/16	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
3-1/2″ x 14″	THO35140	3-9/16	14	2-3/8	2-1/2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
3-1/2″ x 16″	THO35160	3-9/16	16	2-3/8	2-1/2	2X	(6) 10d x 1-1/2	(2) 10d x 1-1/2	1000	210
						(2) 2X	(6) 10d	(2) 10d x 1-1/2	1145	210
(2) 2″ x 9-1/2″	THO20950-2	4-3/16	9-1/2	3	2-1/16	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
(2) 2″ x 11-7/8″	THO20118-2	4-3/16	11-7/8	3	2-1/16	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
(2) 2-5/16″ x 11-7/8″	THO23118-2	4-3/4	11-7/8	3	2-1/8	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500



***THO** with 2x top plate installation*



***THO** with double top plate installation*



THO

continued on next page

THO series continued

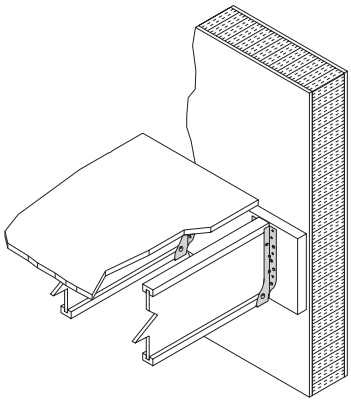
Joist Size	USP Stock No.	Dimensions W	H	D	TF	Top Plate/ Nailer Size	Fasteners Total Header	Joist	S-P-F Allowable Loads (Lbs.)[2] 100%	Uplift[1] 133%
(2) 2-5/16″ x 14″	THO23140-2	4-3/4	14	3	2-1/8	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500
(2) 2-5/16″ x 16″	THO23160-2	4-3/4	16	3	2-1/8	2X	(6) 10d x 1-1/2	(6) 10d	1225	210
						(2) 2X	(10) 10d	(6) 10d	1995	500

1) Uplift loads have been increased 33-1/3% or 60% for wind or seismic loads; no further increase shall be permitted
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

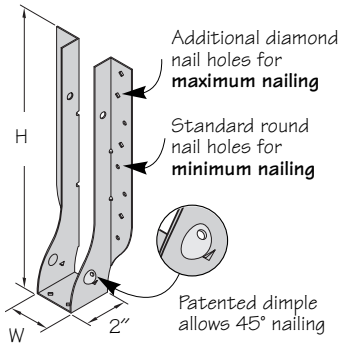
Face Mount I-Joist Hanger – THF series

Joist Size	USP Stock No.	Dimensions W	H	D	Fasteners Total Header	Joist	S-P-F Allowable Loads (Lbs.) 100%	Uplift[1] 133%
1-1/2″ x 9-1/4″ - 9-1/2″	THF15925 Min	1-1/2	9-1/16	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF15925 Max				(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
1-1/2″ x 11-1/4″ - 11-7/8″	THF15112 Min	1-1/2	11-1/16	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF15112 Max				(16) 10d x 1-1/2	(2) 10d x 1-1/2	1265	245
1-3/4″ x 9-1/4″ - 9-1/2″	THF17925 Min	1-3/4	8-15/16	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF17925 Max				(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
1-3/4″ x 11-1/4″ - 11-7/8″	THF17112 Min	1-3/4	10-15/16	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF17112 Max				(16) 10d x 1-1/2	(2) 10d x 1-1/2	1265	245
1-3/4″ x 14″	THF17140 Min	1-3/4	13-3/8	2	(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
	THF17140 Max				(20) 10d x 1-1/2	(2) 10d x 1-1/2	1580	245
1-3/4″ x 16″	THF17157	1-13/16	15-3/4	3-1/2	(24) 10d x 1-1/2	(2) 10d x 1-1/2	1895	245
2″ x 9-1/4″ - 9-1/2″	THF20925 Min	2-1/8	8-7/8	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF20925 Max				(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
2″ x 11-1/4″ - 11-7/8″	THF20112 Min	2-1/8	10-7/8	2	(8) 10d x 1-1/2	(2) 10d x 1-1/2	630	245
	THF20112 Max				(16) 10d x 1-1/2	(2) 10d x 1-1/2	1265	245
2″ x 14″	THF20140 Min	2-1/8	13-1/4	2	(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
	THF20140 Max				(20) 10d x 1-1/2	(2) 10d x 1-1/2	1580	245
2-5/16″ x 11-1/4″ - 12″	THF23118	2-5/16	11-3/16	2-1/2	(14) 10d x 1-1/2	(2) 10d x 1-1/2	1105	175
2-5/16″ x 14″	THF23140	2-5/16	13-1/2	2-1/2	(18) 10d x 1-1/2	(2) 10d x 1-1/2	1420	175
2-5/16″ x 16″	THF23160	2-5/16	15-5/8	2-1/2	(22) 10d x 1-1/2	(2) 10d x 1-1/2	1740	175
(2) 1-1/2″ x 9-1/4″ - 9-1/2″	THF15925-2	3-1/8	9-3/16	2-1/2	(12) 10d x 1-1/2	(6) 10d	950	900
(2) 1-1/2″ x 11-1/4″ - 11-7/8″	THF15112-2	3-1/8	10-13/16	2-1/2	(14) 10d x 1-1/2	(6) 10d	1105	900
3-1/2″ x 9-1/4″ - 9-1/2″	THF35925	3-1/2	8-5/8	2-1/2	(12) 10d x 1-1/2	(2) 10d x 1-1/2	950	245
3-1/2″ x 11-1/4″ - 12″	THF35112	3-1/2	10-5/8	2-1/2	(16) 10d x 1-1/2	(2) 10d x 1-1/2	1265	245
3-1/2″ x 14″	THF35140	3-1/2	12-15/16	2-1/2	(20) 10d x 1-1/2	(2) 10d x 1-1/2	1580	245
3-1/2″ x 15-3/4″ - 16″	THF35157	3-1/2	15	2-1/2	(22) 10d x 1-1/2	(2) 10d x 1-1/2	1740	245
(2) 2″ x 9-1/4″ - 9-1/2″	THF20925-2	4-3/16	8-11/16	2-1/2	(12) 10d x 1-1/2	(6) 10d	950	900
(2) 2″ x 11-1/4″ - 11-7/8″	THF20112-2	4-3/16	11	2-1/2	(16) 10d x 1-1/2	(6) 10d	1265	900
(2) 2″ x 14″	THF20140-2	4-3/16	13-5/8	2-1/2	(20) 10d x 1-1/2	(6) 10d	1580	900
(2) 2-5/16″ x 11-7/8″	THF23118-2	4-3/4	10-11/16	2-1/2	(16) 10d x 1-1/2	(6) 10d	1265	900
(2) 2-5/16″ x 14″	THF23140-2	4-3/4	13-5/16	2-1/2	(20) 10d x 1-1/2	(6) 10d	1580	950
(2) 2-5/16″ x 16″	THF23160-2	4-3/4	15-15/16	2-1/2	(24) 10d x 1-1/2	(6) 10d	1895	950

1) Uplift loads have been increased 33-1/3% or 60% for wind or seismic loads; no further increase shall be permitted.
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.



***THF** installation*



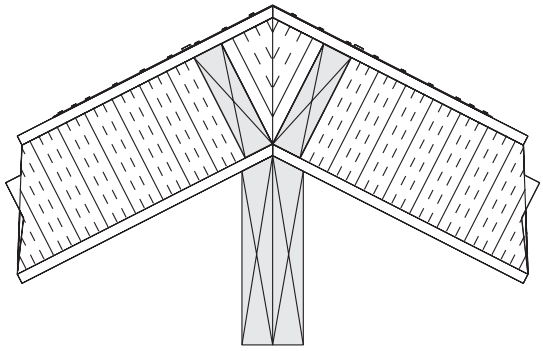
THF

Some model designs may vary from illustration shown

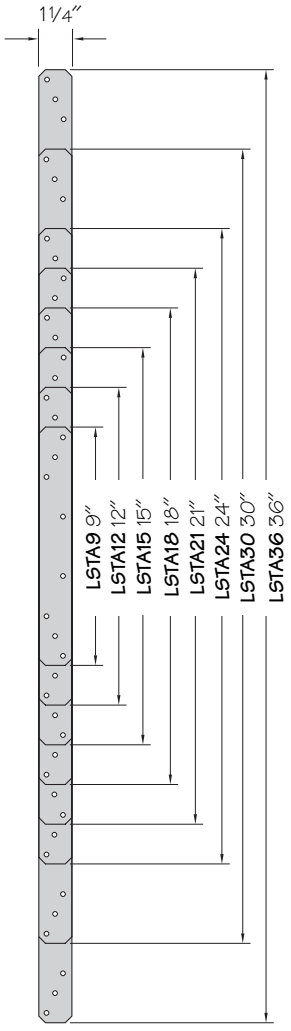
Ridge Tie – LSTA series

USP Stock No.	Steel Gauge	Dimensions		Fastener Schedule[3,5,6,7]		S-P-F Allowable Loads (Lbs.)[1,2,7]	
						Uplift	
		W	L	Total Qty[4]	Min Qty[5]	133%	160%
LSTA9	20	1-1/4	9	8	(8) 10d x 1-1/2	425	510
					(8) 10d	515	620
LSTA12	20	1-1/4	12	10	(10) 10d x 1-1/2	535	640
					(10) 10d	645	775
LSTA15	20	1-1/4	15	12	(12) 10d x 1-1/2	640	770
					(12) 10d	775	930
LSTA18	20	1-1/4	18	14	(14) 10d x 1-1/2	745	895
					(14) 10d	905	1085
					(14) 10d	**905**	**980**
LSTA21	20	1-1/4	21	16	(16) 10d x 1-1/2	855	1025
					(16) 10d x 1-1/2	**855**	**980**
					(16) 10d	1035	1240
					(14) 10d	**980**	**980**
LSTA24	20	1-1/4	24	18	(18) 10d x 1-1/2	960	1150
					(16) 10d x 1-1/2	**960**	**980**
					(18) 10d	1165	1305
					(14) 10d	**980**	**980**
LSTA30	18	1-1/4	30	22	(22) 10d x 1-1/2	1175	1410
					(22) 10d x 1-1/2	**1175**	**1305**
					(22) 10d	1435	1725
					(20) 10d	**1305**	**1305**
LSTA36	18	1-1/4	36	26	(26) 10d x 1-1/2	1385	1665
					(26) 10d x 1-1/2	**1305**	**1305**
					(26) 10d	1700	1740
					(20) 10d	**1305**	**1305**

1) Allowable loads have been increased 33-1/3% or 60% for wind or seismic loads; no further increase shall be permitted.
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.
3) Minimum nail embedment shall be 1-15/16″ for 16d nails and 1-3/4″ for 10d nails.
4) Total number of nail and/or bolt holes provided in the strap.
5) Minimum quantity of fasteners to be installed with equal fasteners at each end of the connection.
6) 10d x 1-1/2 nails are 9 gauge (0.148″ diameter) by 1-1/2″ long.
7) Products listed without an additional shaded row are not governed by steel stress. Values represent loads which do not include a stress increase on the steel calculations. See USP's Full Line Catalog or web site for additional information.



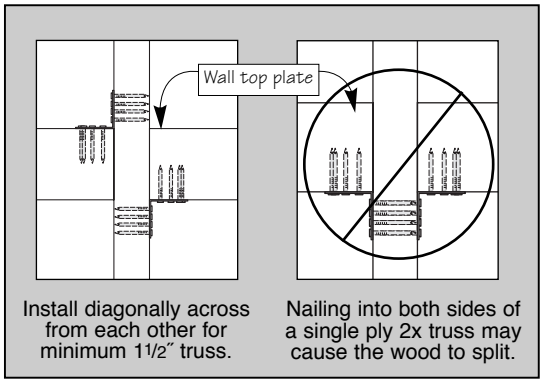
***LSTA** Ridge Tie installation*

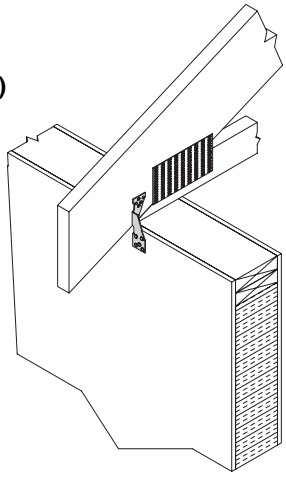


LSTA

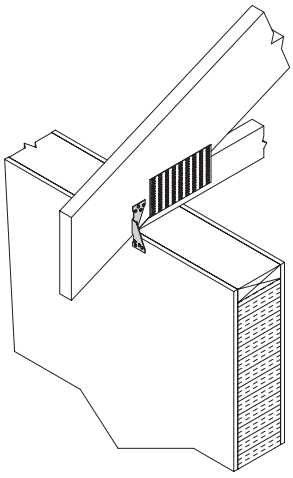
Tiedowns – RT3 & RT7

Hurricane Tie installations to achieve twice the load (Top View)





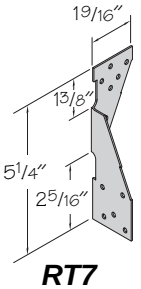
***RT7** installation*



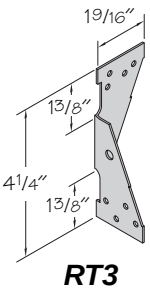
***RT3** installation*

USP Stock No.	Fasteners Total		S-P-F Allowable Loads (Lbs.)[1,2]		
	Rafter/ Truss	Plate	F1	F2	Uplift
RT3	(4) 8d	(4) 8d	130	130	425
RT3 (2)	(8) 10d	(8) 10d	260	260	950
RT7	(5) 8d	(5) 8d	150	150	535
RT7 (2)	(10) 10d	(10) 10d	300	300	1070

1) Allowable loads have been increased 33-1/3% for wind or seismic loads; no further increase shall be permitted.
2) Loads are for S-P-F (G=0.42). For Douglas Fir-Larch (G=0.50) multiply allowable loads by 1.16.

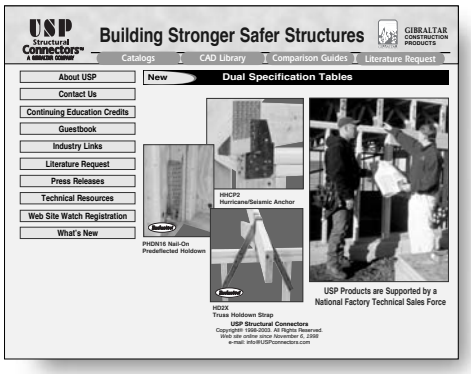


RT7



RT3

Specification Tools



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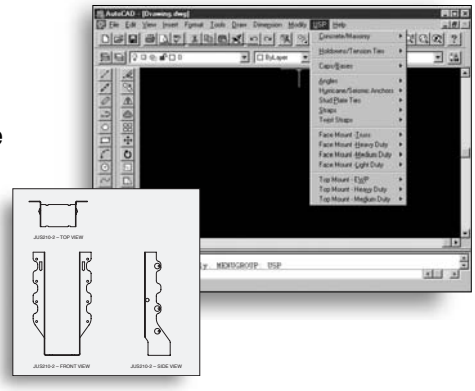

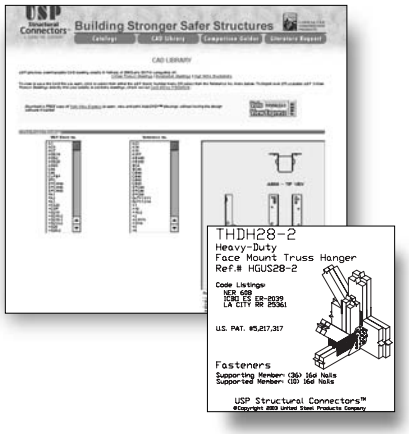

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- Find drawings quickly by USP Stock No. or Reference No.
- High Wind Illustrations are also available

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- Uniform and Predictable
- Minimal Bowing, Twisting, and Shrinking
- Strong and Straight
- Limited Product Warranty

The products in this guide are readily available through our nationwide network of distributors and dealers. For more information on other applications or other Trus Joist® products, contact your Weyerhaeuser representative.

TABLE OF CONTENTS

Why Choose Trus Joist® Beams, Columns, and Headers?

- Reliable performance
- Consistent quality and dependable uniformity
- Flexible solutions for your beam and header needs
- Backed by a limited product warranty

Using advanced technology, Weyerhaeuser manufactures engineered lumber that is consistently straight and strong, and resists bowing, twisting, and shrinking. That means less waste, easier installation, and higher design values for starters; plus fewer callbacks, shorter cycle times, more design flexibility, and lower overall installed cost in the end. Trus Joist® TimberStrand® LSL, Microllam® LVL, and Parallam® PSL are structural solutions you can count on—guaranteed.

This guide features Trus Joist® engineered lumber in the following widths and depths:

TimberStrand® LSL

1.55E TimberStrand® LSL sizes:
Widths: 1¾" and 3½"
Depths: 9¼", 9½", 11¼", 11⅞", 14", and 16"

1.3E TimberStrand® LSL header sizes:
Width: 3½"
Depths: 4⅜", 5½", 7¼", 8⅝", 9¼", and 11¼"

1.3E TimberStrand® LSL column and post sizes:
3½" x 3½" 3½" x 4⅜" 3½" x 5½" 3½" x 7¼" 3½" x 8⅝"

Microllam® LVL

1.9E Microllam® LVL header and beam sizes:
Width: 1¾"
Depths: 5½", 7¼", 9¼", 9½", 11¼", 11⅞", 14", 16", 18", and 20"

Parallam® PSL

2.0E Parallam® PSL header and beam sizes:
Widths: 3½", 5¼", and 7"
Depths: 9¼", 9½", 11¼", 11⅞", 14", 16", and 18"

1.8E Parallam® PSL column and post sizes:
3½" x 3½" 3½" x 5¼" 3½" x 7" 5¼" x 5¼" 5¼" x 7" 7" x 7"

For deeper depth Parallam® PSL beams, see the Trus Joist® 2.2E Parallam® PSL Deep Beam guide, TJ-7001, or contact your Weyerhaeuser representative.

Some sizes may not be available in your region.

Trus Joist® TimberStrand® Laminated Strand Lumber (LSL)

- One-piece members reduce labor time
- Every piece is straight and strong
- Unique properties allow you to drill larger holes through 1.55E TimberStrand® LSL. See Allowable Holes on page 36.

TimberStrand® LSL Grade Verification

TimberStrand® LSL is available in more than one grade. The product is stamped with its grade information, as shown in the examples below. With 1.55E TimberStrand® LSL, larger holes can be drilled through the beam.

TimberStrand® LSL 1.3E ICCES ESR-1387 CCMC 12627-R SFI Certified Sourcing SFI-00008 PFS 0572 Made in Canada 09-15-11 02 03:20

TimberStrand® LSL 1.55E **ROUND HOLE ZONE** **NO holes within 8" of beam ends** ICCES ESR-1387 CCMC 12627-R SFI Certified Sourcing SFI-00008 PFS 0572 Made in Canada 09-15-11 02 03:20

Actual stamps shown.

Code Evaluations: See ICC ES ESR-1387

Trus Joist® Microllam® Laminated Veneer Lumber (LVL)

- Can easily be built up on site to reduce heavy lifting
- Offers reliable and economical solutions for beam and header applications
- Manufacturing process minimizes many of the natural inconsistencies found in wood
- Available in some regions with a Watershed™ overlay for on-site weather protection

Code Evaluations: See ICC ES ESR-1387

Trus Joist® Parallam® Parallel Strand Lumber (PSL)

- Allows long spans for open floor plans without intermediate posts or columns
- Has warm, unique grain that is perfect for applications with exposed beams
- Provides ideal solutions for cantilever and multi-span applications
- Solid sections save time on site assembly
- Available in some regions with preservative treatment for exterior applications

Code Evaluations: See ICC ES ESR-1387

DESIGN PROPERTIES

Allowable Design Properties(1) (100% Load Duration)

Grade	Width	Design Property	Depth												
			4⅜"	5½"	5½" Plank Orientation	7¼"	8⅝"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
TimberStrand® LSL															
1.3E	3½"	Moment (ft-lbs)	1,735	2,685	1,780	4,550	6,335	7,242		10,521					
		Shear (lbs)	4,340	5,455	1,925	7,190	8,555	9,175		11,155					
		Moment of Inertia (in.⁴)	24	49	20	111	187	231		415					
		Weight (plf)	4.5	5.6	5.6	7.4	8.8	9.4		11.5					
1.55E	1¾"	Moment (ft-lbs)						4,950	5,210	7,195	7,975	10,920	14,090		
		Shear (lbs)						3,345	3,435	4,070	4,295	5,065	5,785		
		Moment of Inertia (in.⁴)						115	125	208	244	400	597		
		Weight (plf)						5.1	5.2	6.2	6.5	7.7	8.8		
	3½"	Moment (ft-lbs)						9,905	10,420	14,390	15,955	21,840	28,180		
		Shear (lbs)						6,690	6,870	8,140	8,590	10,125	11,575		
		Moment of Inertia (in.⁴)						231	250	415	488	800	1,195		
		Weight (plf)						10.1	10.4	12.3	13	15.3	17.5		
Microllam® LVL															
1.9E	1¾"	Moment (ft-lbs)		2,125		3,555		5,600	5,885	8,070	8,925	12,130	15,555	19,375	23,580
		Shear (lbs)		1,830		2,410		3,075	3,160	3,740	3,950	4,655	5,320	5,985	6,650
		Moment of Inertia (in.⁴)		24		56		115	125	208	244	400	597	851	1,167
		Weight (plf)		2.8		3.7		4.7	4.8	5.7	6.1	7.1	8.2	9.2	10.2
Parallam® PSL															
2.0E	3½"	Moment (ft-lbs)						12,415	13,055	17,970	19,900	27,160	34,955	43,665	
		Shear (lbs)						6,260	6,430	7,615	8,035	9,475	10,825	12,180	
		Moment of Inertia (in.⁴)						231	250	415	488	800	1,195	1,701	
		Weight (plf)						10.1	10.4	12.3	13.0	15.3	17.5	19.7	
	5¼"	Moment (ft-lbs)						18,625	19,585	26,955	29,855	40,740	52,430	65,495	
		Shear (lbs)						9,390	9,645	11,420	12,055	14,210	16,240	18,270	
		Moment of Inertia (in.⁴)						346	375	623	733	1,201	1,792	2,552	
		Weight (plf)						15.2	15.6	18.5	19.5	23.0	26.3	29.5	
	7"	Moment (ft-lbs)						24,830	26,115	35,940	39,805	54,325	69,905	87,325	
		Shear (lbs)						12,520	12,855	15,225	16,070	18,945	21,655	24,360	
		Moment of Inertia (in.⁴)						462	500	831	977	1,601	2,389	3,402	
		Weight (plf)						20.2	20.8	24.6	26.0	30.6	35.0	39.4	

(1) For product in beam orientation, unless otherwise noted.

Some sizes may not be available in your region.

PRODUCT STORAGE

Protect product from sun and water

CAUTION:
Wrap is slippery when wet or icy

Use support blocks at 10' on-center to keep bundles out of mud and water

Align stickers directly over support blocks

DESIGN PROPERTIES

Design Stresses[1] (100% Load Duration)

Grade	Orientation	G Shear Modulus of Elasticity (psi)	E Modulus of Elasticity (psi)	E_{min} Adjusted Modulus of Elasticity[2] (psi)	F_b Flexural Stress[3] (psi)	F_t Tension Stress[4] (psi)	$F_{c\perp}$ Compression Perpendicular to Grain[5] (psi)	$F_{c\parallel}$ Compression Parallel to Grain (psi)	F_v Horizontal Shear Parallel to Grain (psi)	SG Equivalent Specific Gravity[6]
TimberStrand® LSL										
1.3E	Beam/Column	81,250	1.3 x 10^6	660,750	1,700	1,075	710	1,835	425	0.50[7]
	Plank	81,250	1.3 x 10^6	660,750	1,900[8]	1,075	375[9]	1,835	150	0.50[7]
1.55E	Beam	96,875	1.55 x 10^6	787,815	2,325	1,070[10]	900	2,170	310[10]	0.50[7]
Microllam® LVL										
1.9E	Beam	118,750	1.9 x 10^6	965,710	2,600	1,555	750	2,510	285	0.50
Parallam® PSL										
1.8E	Column	112,500	1.8 x 10^6	914,880	2,400[11]	1,755	425[11]	2,500	190[11]	0.50
2.0E	Beam	125,000	2.0 x 10^6	1,016,535	2,900	2,025	750	2,900[12]	290	0.50

(1) Unless otherwise noted, adjustment to the design stresses for duration of load are permitted in accordance with the applicable code.

(2) Reference modulus of elasticity for beam stability and column stability calculations, per NDS® 2005.

(3) For 12" depth. For other depths, multiply F_b by the appropriate factor as follows:
- For TimberStrand® LSL, multiply by $\left[\frac{12}{d}\right]^{0.092}$
- For Microllam® LVL, multiply by $\left[\frac{12}{d}\right]^{0.136}$
- For Parallam® PSL, multiply by $\left[\frac{12}{d}\right]^{0.111}$

(4) F_t has been adjusted to reflect the volume effects for most standard applications.

(5) $F_{c\perp}$ may not be increased for duration of load.

(6) For lateral connection design only.

(7) Specific gravity of 0.58 may be used for bolts installed perpendicular to face and loaded perpendicular to grain.

(8) Values are for thickness up to 3½".

(9) $F_{c\perp}$ is 435 psi for thicknesses less than 1¾".

(10) Values account for large hole capabilities. See **Allowable Holes** on page 36.

(11) Values are for plank orientation.

(12) For column applications, use $F_{c\parallel}$ of 500 psi.

General Assumptions for Trus Joist® Beams

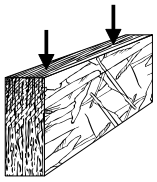
- Lateral support is required at bearing and along the span at 24" on-center, maximum.
- Bearing lengths are based on each product's bearing stress for applicable grade and orientation.
- All members 7¼" and less in depth are restricted to a maximum deflection of 5/16".
- Beams that are 1¾" x 16" and deeper require multiple plies.
- No camber.
- Beams and columns must remain straight to within $^{5L^2/4608}$ (in.) of true alignment. L is the unrestrained length of the member in feet.
- Tables on pages 8–15 include load reductions applied in accordance with code.

For applications not covered in this brochure, contact your Weyerhaeuser representative.

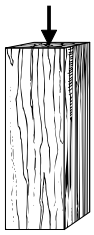
See pages 38 and 39 for multiple-member beam connections.

TimberStrand® LSL, Microllam® LVL, and untreated Parallam® PSL are intended for dry-use applications

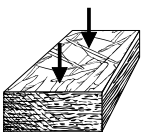
Beam Orientation



Column Orientation



Plank Orientation



How to Use This Table

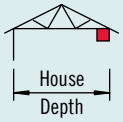
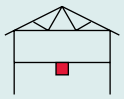
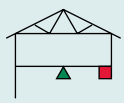
1. Determine **Header Condition**.
2. Locate **Rough Opening**.
3. Determine loading and **House Depth**.
4. Select TimberStrand® LSL header depth.

Note: ***Bold italic*** indicates that a 3½" x 5½" TimberStrand® LSL header can be installed in plank orientation in a 2x6 wall.

*Also see **General Notes** on page 7.*

1.3E TimberStrand® LSL

3½" Wide 1.3E TimberStrand® LSL Window and Door Headers

Header Condition	Rough Opening	Non-Snow Area 125%			Snow Area 115%								
		Roof Load = 20LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 30LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 40LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 55LL + 15DL Floor Load = 40LL + 12DL		
		House Depth			House Depth			House Depth			House Depth		
		24'	28'	32'	24'	28'	32'	24'	28'	32'	24'	28'	32'
Roof Only 	3'-2"	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	4⅜"
	3'-8"	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	4⅜"	4⅜"	5½"	5½"	5½"
	4'-2"	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	4⅜"	5½"	5½"	5½"	5½"	5½"	5½"	5½"
	4'-8"	4⅜"	4⅜"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	7¼"	7¼"	7¼"
	5'-2"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	7¼"	7¼"	7¼"	7¼"	7¼"
	5'-8"	5½"	5½"	5½"	5½"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	8⅝"(2)
	6'-2"	5½"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	8⅝"	8⅝"	8⅝"(2)
	6'-8"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	8⅝"	8⅝"	8⅝"	8⅝"(2)	9¼"(2)
	7'-2"	7¼"	7¼"	7¼"	7¼"	8⅝"	8⅝"	8⅝"	8⅝"	8⅝"	8⅝"	9¼"(2)	11¼"(2)
	8'-2"	8⅝"	8⅝"	8⅝"	8⅝"	8⅝"	8⅝"	8⅝"	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)
	9'-2"	8⅝"	8⅝"	9¼"	9¼"	9¼"	11¼"(2)	11¼"	11¼"(2)	11¼"(2)	11¼"(2)		
Floor – One Story 	3'-2"	***4⅜"***	***4⅜"***	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"	4⅜"
	3'-8"	***4⅜"***	4⅜"	5½"	4⅜"	4⅜"	5½"	4⅜"	4⅜"	5½"	4⅜"	4⅜"	5½"
	4'-2"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"
	4'-8"	5½"	5½"	7¼"	5½"	5½"	7¼"	5½"	5½"	7¼"	5½"	5½"	7¼"
	5'-2"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"
	5'-8"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"
	6'-2"	7¼"	7¼"	8⅝"	7¼"	7¼"	8⅝"	7¼"	7¼"	8⅝"	7¼"	7¼"	8⅝"
	6'-8"	7¼"	8⅝"	8⅝"	7¼"	8⅝"	8⅝"	7¼"	8⅝"	8⅝"	7¼"	8⅝"	8⅝"
	7'-2"	8⅝"	8⅝"	9¼"(2)	8⅝"	8⅝"	9¼"(2)	8⅝"	8⅝"	9¼"(2)	8⅝"	8⅝"	9¼"(2)
	8'-2"	9¼"	11¼"(2)	11¼"(2)	9¼"	11¼"(2)	11¼"(2)	9¼"	11¼"(2)	11¼"(2)	9¼"	11¼"(2)	11¼"(2)
	9'-2"	11¼"	11¼"(2)		11¼"	11¼"(2)		11¼"	11¼"(2)		11¼"	11¼"(2)	
Roof Plus One Story (Bearing) 	3'-2"	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	***4⅜"***	4⅜"	***4⅜"***	4⅜"	5½"	4⅜"	5½"	5½"
	3'-8"	***4⅜"***	4⅜"	4⅜"	4⅜"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	7¼"
	4'-2"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	7¼"	7¼"	7¼"	7¼"(2)
	4'-8"	5½"	5½"	7¼"	5½"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"(2)	8⅝"(2)
	5'-2"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	7¼"	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)
	5'-8"	7¼"	7¼"	7¼"	7¼"	7¼"	8⅝"(2)	7¼"	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)
	6'-2"	7¼"	7¼"	8⅝"	7¼"	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)
	6'-8"	8⅝"	8⅝"	8⅝"(2)	8⅝"	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)
	7'-2"	8⅝"	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	
	8'-2"	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)				
	9'-2"	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)								

■ Symbol represents location of TimberStrand® LSL header.

▲ Symbol represents supporting beam or structural bearing wall located at center of house, below floor.

( ) Symbol represents minimum number of 2x_ trimmers required at end of header.

▪ See ***Bearing Requirements*** on page 7 for bearing length requirements at continuous-span supports.

General Notes

- Tables are based on:
  - Uniform loads.
  - More restrictive of simple or continuous span. Ratio of short span to long span should be greater than 0.4 to prevent uplift.
  - Roof truss framing with 24" soffits.
  - Exterior wall weights of 80 plf, interior 60 plf.
  - Deflection criteria of L/360 live load and L/240 total load.
- Tables do not consider attic loads acting concurrently with roof or snow loads.

*Also see **How to Use This Table** on page 6 and **General Assumptions** on page 5.*

Bearing Requirements

Tables assume minimum header support to be one trimmer (1½") at each end and 4½" at continuous-span supports.

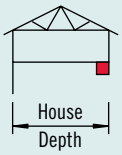
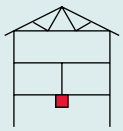
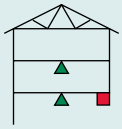
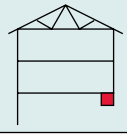
In **Sizing Tables** on pages 6 and 7:

(2) Indicates minimum header support to be two trimmers (3") at each end and 7½" at continuous-span supports.

(3) Indicates minimum header support to be three trimmers (4½") at each end and 11¼" at continuous-span supports.

For additional bearing information, see pages 34 and 36.

3½" Wide 1.3E TimberStrand® LSL Window and Door Headers *continued*

Header Condition	Rough Opening	Non-Snow Area 125%			Snow Area 115%								
		Roof Load = 20LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 30LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 40LL + 15DL Floor Load = 40LL + 12DL			Roof Load = 55LL + 15DL Floor Load = 40LL + 12DL		
		House Depth			House Depth			House Depth			House Depth		
		24'	28'	32'	24'	28'	32'	24'	28'	32'	24'	28'	32'
Roof Plus One Story (No bearing) 	3'-2"	***4⅜"***	4⅜"	4⅜"	4⅜"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	5½"
	3'-8"	5½"	5½"	5½"	5½"	5½"	7¼"	5½"	5½"	7¼"(2)	5½"	7¼"(2)	7¼"(2)
	4'-2"	5½"	5½"	7¼"	5½"	7¼"	7¼"(2)	7¼"	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	8⅝"(2)
	4'-8"	7¼"	7¼"	7¼"(2)	7¼"	7¼"(2)	7¼"(2)	7¼"	7¼"(2)	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)
	5'-2"	7¼"	7¼"	7¼"(2)	7¼"	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)
	5'-8"	7¼"	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)
	6'-2"	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)
	6'-8"	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	
	7'-2"	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)		11¼"(2)		
	8'-2"	11¼"(2)	11¼"(2)		11¼"(2)								
Floor – Two Stories 	3'-2"	5½"	5½"	7¼"	5½"	5½"	7¼"	5½"	5½"	7¼"	5½"	5½"	7¼"
	3'-8"	7¼"	7¼"	7¼"(2)	7¼"	7¼"	7¼"(2)	7¼"	7¼"	7¼"(2)	7¼"	7¼"	7¼"(2)
	4'-2"	7¼"	8⅝"(2)	8⅝"(2)	7¼"	8⅝"(2)	8⅝"(2)	7¼"	8⅝"(2)	8⅝"(2)	7¼"	8⅝"(2)	8⅝"(2)
	4'-8"	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)
	5'-2"	8⅝"(2)	9¼"(2)	11¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)
	5'-8"	9¼"(2)	11¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)
	6'-2"	11¼"(2)	11¼"(2)		11¼"(2)	11¼"(2)		11¼"(2)	11¼"(2)		11¼"(2)	11¼"(2)	
Roof Plus Two Stories (Bearing) 	3'-2"	***4⅜"***	4⅜"	5½"	4⅜"	5½"	5½"	5½"	5½"	5½"	5½"	5½"	7¼"(2)
	3'-8"	5½"	5½"	5½"	5½"	5½"	7¼"	5½"	7¼"	7¼"(2)	7¼"	7¼"(2)	7¼"(2)
	4'-2"	5½"	5½"	7¼"	7¼"	7¼"	7¼"(2)	7¼"	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	8⅝"(2)
	4'-8"	7¼"	7¼"	7¼"(2)	7¼"	7¼"(2)	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)
	5'-2"	7¼"	7¼"(2)	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	9¼"(2)
	5'-8"	7¼"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)
	6'-2"	8⅝"(2)	8⅝"(2)	9¼"(2)	9¼"(2)	9¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	
	6'-8"	8⅝"(2)	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	
	7'-2"	9¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)	11¼"(2)		11¼"(2)					
Roof Plus Two Stories (No Bearing) 	3'-2"	5½"	5½"	7¼"(2)	5½"	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)
	3'-8"	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	7¼"(2)	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)
	4'-2"	7¼"(2)	7¼"(2)	8⅝"(2)	7¼"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)
	4'-8"	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	8⅝"(2)	9¼"(2)	8⅝"(2)	9¼"(2)	11¼"(2)	8⅝"(2)	9¼"(2)	11¼"(3)
	5'-2"	8⅝"(2)	9¼"(2)	9¼"(2)	9¼"(2)	11¼"(2)	11¼"(2)	9¼"(2)	11¼"(2)	11¼"(3)	11¼"(2)	11¼"(3)	11¼"(3)
	5'-8"	9¼"(2)	11¼"(2)	11¼"(3)	11¼"(2)	11¼"(2)	11¼"(3)	11¼"(2)	11¼"(3)		11¼"(2)		
	6'-2"	11¼"(2)	11¼"(2)	11¼"(3)	11¼"(2)			11¼"(2)					

■ Symbol represents location of TimberStrand® LSL header.

▲ Symbol represents supporting beam or structural bearing wall located at center of house, below floor.

( ) Symbol represents minimum number of 2x_ trimmers required at end of header.

- See ***Bearing Requirements*** above for bearing length requirements at continuous-span supports.

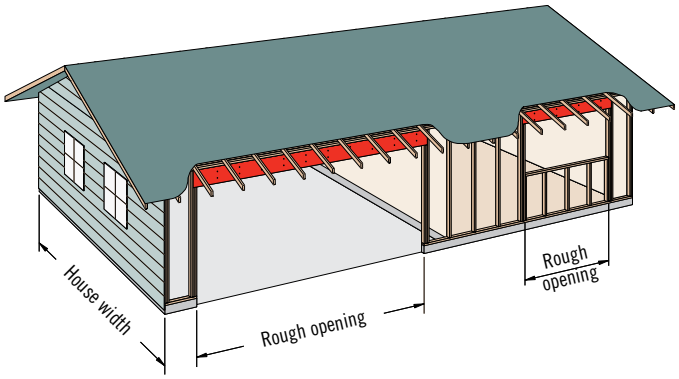
SIZING TABLES

How to Use This Table

1. Determine appropriate **Roof Load** and **House Width**.
2. Locate **Rough Opening**.
3. Select header size and material.

- Weyerhaeuser offers 1.55E TimberStrand® LSL pre-cut garage door headers in selected regions. Call 1-888-453-8358 to determine availability.

*Also see **General Notes** on page 9.*



Headers Supporting Roof

Roof Load (PSF)		House Width	Rough Opening																	
			8'				9'-3"				10'				12'					
Non-Snow Area 125%	20LL + 15DL	24'	1¾" x 9¼"	T	M		1¾" x 9¼"	T	M		1¾" x 9¼"		M		1¾" x 11¼"		M			
			3½" x 7¼"		M		3½" x 9¼"	T	M	P	1¾" x 11¼"	T	M		1¾" x 11⅞"	T	M			
			3½" x 9¼"	T	M	P	5¼" x 7¼"		M		3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P		
		30'	1¾" x 9¼"	T	M		1¾" x 9¼"		M		1¾" x 11¼"	T	M		1¾" x 14"	T	M			
			3½" x 7¼"		M		1¾" x 11¼"	T	M		3½" x 9¼"	T	M	P	3½" x 9¼"		M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P					3½" x 11¼"	T	M	P		
		36'	1¾" x 9¼"	T	M		1¾" x 11¼"	T	M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M			
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	1¾" x 11⅞"	T	M		3½" x 9½"		M	P		
			5¼" x 7¼"		M						3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P		
	20LL + 20DL	24'	1¾" x 9¼"	T	M		1¾" x 9¼"		M		1¾" x 11¼"	T	M		1¾" x 11⅞"		M			
			3½" x 7¼"		M		1¾" x 9½"	T	M		3½" x 9¼"	T	M	P	1¾" x 14"	T	M			
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P					3½" x 9½"	T	M	P		
		30'	1¾" x 9¼"	T	M		1¾" x 11¼"	T	M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M			
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	1¾" x 11⅞"	T	M		3½" x 9½"		M	P		
			5¼" x 7¼"		M						3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P		
		36'	1¾" x 9¼"		M		1¾" x 11¼"		M		1¾" x 11⅞"(3)		M		3½" x 11¼"	T	M	P		
			1¾" x 11¼"	T	M		1¾" x 11⅞"	T	M		1¾" x 14"(3)	T	M		5¼" x 9¼"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P						
Snow Area 115%	25LL + 15DL	24'	1¾" x 9¼"	T	M		1¾" x 9¼"		M		1¾" x 11¼"	T	M		1¾" x 14"	T	M			
			3½" x 7¼"		M		1¾" x 11¼"	T	M		3½" x 9¼"	T	M	P	3½" x 9½"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P					5¼" x 9¼"	T	M	P		
		30'	1¾" x 9½"	T	M		1¾" x 11¼"	T	M		1¾" x 11¼"		M		1¾" x 14"(3)		M			
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	1¾" x 11⅞"	T	M		3½" x 9½"		M	P		
			5¼" x 7¼"		M						3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P		
		36'	1¾" x 11¼"	T	M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P		
			3½" x 9¼"	T	M	P	1¾" x 11⅞"	T	M	P	3½" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P		
			5¼" x 7¼"		M		3½" x 9¼"	T	M	P										
	30LL + 15DL	24'	1¾" x 9¼"	T	M		1¾" x 11¼"	T	M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M			
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	1¾" x 11⅞"	T	M		3½" x 9¼"		M	P		
			5¼" x 7¼"		M						3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P		
		30'	1¾" x 9½"		M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P		
			1¾" x 11¼"	T	M		1¾" x 11⅞"	T	M		3½" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P										
		36'	1¾" x 11¼"	T	M		1¾" x 14"(3)	T	M		1¾" x 14"(3)	T	M		3½" x 11⅞"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9½"	T	M	P	5¼" x 9¼"		M	P		
			5¼" x 7¼"		M						5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P		
	40LL + 15DL	24'	1¾" x 9½"		M		1¾" x 11¼"		M		1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P		
			1¾" x 11¼"	T	M		1¾" x 11⅞"	T	M		3½" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P										
		30'	1¾" x 11¼"(3)	T	M		1¾" x 14"(3)	T	M		1¾" x 14"(3)		M		3½" x 11⅞"	T	M	P		
			3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	5¼" x 9¼"		M	P		
											3½" x 11¼"	T	M	P	5¼" x 11¼"	T	M	P		
		36'	1¾" x 14"(3)	T	M		3½" x 9¼"		M	P	3½" x 9½"			P	3½" x 11⅞"			P		
			3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P		
							5¼" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 9½"			P		

T 1.55E TimberStrand® LSL **M** 1.9E Microllam® LVL **P** 2.0E Parallam® PSL

General Notes

- Table is based on:
  - Uniform loads.
  - More restrictive of simple or continuous span. Ratio of short span to long span should be 0.4 or greater to prevent uplift.
  - Roof truss framing with 24" soffits.
  - Deflection criteria of L/240 live load and L/180 total load.
- Tables do not consider attic loads acting concurrently with roof or snow loads.

*Also see **How to Use This Table** on page 8 and **General Assumptions** on page 5.*

Bearing Requirements

Minimum header support to be two trimmers (3") at each end and 7½" at continuous-span supports.

In **Sizing Tables** on pages 8 and 9:

(3) Indicates requirement of three trimmers (4½") at each end and 11¼" at continuous-span supports.

Headers Supporting Roof *continued*

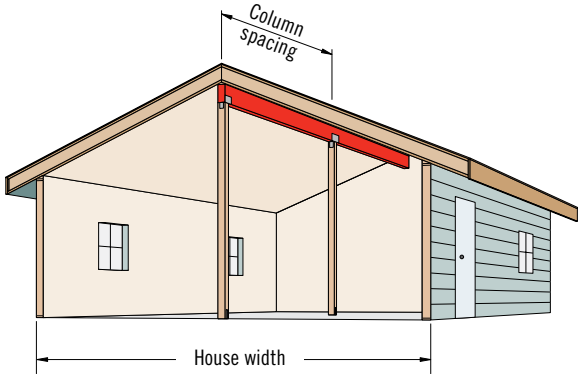
Roof Load (PSF)		House Width	Rough Opening											
			14'				16'-3"				18'-3"			
Non-Snow Area 125%	20LL + 15DL	24'	1¾" x 14"	T	M		3½" x 11⅞"		M	P	3½" x 14"	T	M	P
			3½" x 9½"			P	3½" x 14"	T	M	P	5¼" x 11¼"		M	P
			3½" x 11¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
		30'	3½" x 11¼"	T	M	P	3½" x 11⅞"			P	3½" x 14"		M	P
			5¼" x 9¼"		M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
							5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
		36'	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
			5¼" x 9½"		M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P				
	20LL + 20DL	24'	1¾" x 14"(3)		M		3½" x 11⅞"		M	P	3½" x 14"		M	P
			3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
			5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
		30'	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 14"			P
			5¼" x 9½"		M	P	5¼" x 11¼"		M	P	3½" x 16"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P	5¼" x 14"	T	M	P
		36'	3½" x 11⅞"		M	P	3½" x 14"		M	P	3½" x 16"		M	P
			3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P
Snow Area 115%	25LL + 15DL	24'	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"		M	P
			5¼" x 9¼"		M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
			5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
		30'	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 14"			P
			5¼" x 9½"		M	P	5¼" x 11¼"		M	P	3½" x 16"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P	5¼" x 14"	T	M	P
		36'	3½" x 11⅞"			P	3½" x 14"		M	P	3½" x 16"		M	P
			3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P
	30LL + 15DL	24'	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 14"		M	P
			5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	3½" x 16"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P	5¼" x 11⅞"			P
		30'	3½" x 11⅞"		M	P	3½" x 14"		M	P	3½" x 16"		M	P
			3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P				
		36'	3½" x 14"	T	M	P	3½" x 14"			P	3½" x 16"(3)			P
			5¼" x 11¼"	T	M	P	3½" x 16"	T	M	P	3½" x 18"(3)		M	P
							5¼" x 14"	T	M	P	5¼" x 14"		M	P
	40LL + 15DL	24'	3½" x 11⅞"		M	P	3½" x 14"		M	P	3½" x 16"		M	P
			3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"	T	M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P				
		30'	3½" x 14"	T	M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P
			5¼" x 11¼"		M	P	5¼" x 14"	T	M	P	5¼" x 14"		M	P
			5¼" x 11⅞"	T	M	P					5¼" x 16"	T	M	P
		36'	3½" x 14"(3)			P	3½" x 16"(3)			P	3½" x 18"(3)			P
			3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			5¼" x 11⅞"		M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P

T 1.55E TimberStrand® LSL **M** 1.9E Microllam® LVL **P** 2.0E Parallam® PSL

How to Use This Table

1. Determine appropriate **Roof Load** and **House Width**.
2. Locate **Column Spacing**.
3. Select beam size and material.

*Also see **General Notes** on page 11.*



Ridge Beams

Roof Load (PSF)		House Width	Column Spacing 10'				12'				14'				16'			
Non-Snow Area 125%	20LL + 15DL	24'	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P
											3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P
											5¼" x 9¼"	T	M	P				
		30'	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11¼"		M	P
											5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P
															5¼" x 11¼"	T	M	P
		36'	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"			P
			3½" x 11¼"				3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	3½" x 14"	T	M	P
							5¼" x 9¼"	T	M	P					5¼" x 11¼"	T	M	P
	20LL + 20DL	24'	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9½"			P	3½" x 11⅞"	T	M	P
											3½" x 11¼"	T	M	P	5¼" x 9½"		M	P
											5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P
		30'	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P
							3½" x 9½"	T	M	P	5¼" x 9¼"		M	P	3½" x 14"	T	M	P
							5¼" x 9¼"	T	M	P					5¼" x 11¼"	T	M	P
		36'	3½" x 9¼"	T	M	P	3½" x 9½"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9½"			P	5¼" x 11¼"		M	P
							5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
Snow Area 115%	25LL + 15DL	24'	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 9½"			P	3½" x 11⅞"	T	M	P
											3½" x 11¼"	T	M	P	5¼" x 9½"		M	P
											5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P
		30'	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P
							3½" x 9½"	T	M	P	5¼" x 9¼"		M	P	3½" x 14"	T	M	P
							5¼" x 9¼"	T	M	P					5¼" x 11¼"	T	M	P
		36'	3½" x 9¼"	T	M	P	3½" x 9½"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9½"			P	5¼" x 11¼"		M	P
							5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
	30LL + 15DL	24'	3½" x 9¼"	T	M	P	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P
											5¼" x 9¼"		M	P	3½" x 14"	T	M	P
											5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P
		30'	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9½"		M	P	5¼" x 11¼"		M	P
							5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
		36'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"	T	M	P
							5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
											5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
	40LL + 15DL	24'	3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	5¼" x 11¼"		M	P
							5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
		30'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"		M	P
							5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P
											5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
		36'	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 16"(3)	T	M	P
			3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P
			5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P				

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General Notes

- Table is based on:
  - Uniform loads.
  - More restrictive of simple or continuous span. Ratio of short span to long span should be 0.4 or greater to prevent uplift.
  - Deflection criteria of L/240 live load and L/180 total load.

*Also see **How to Use This Table** on page 10 and **General Assumptions** on page 5.*

Bearing Requirements

Minimum beam supports to be two trimmers (3") at each end and 7½" at continuous-span supports.

In **Sizing Tables** on pages 10 and 11:

(3) Indicates requirement of three trimmers (4½") at each end and 11¼" at continuous-span supports.

Ridge Beams *continued*

Roof Load (PSF)		House Width	Column Spacing											
			18'				20'				22'				24'			
Non-Snow Area 125%	20LL + 15DL	24'	3½" x 11⅞"		M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	3½" x 16"		M	P
			3½" x 14"	T	M	P	5¼" x 11¼"			P	5¼" x 14"	T	M	P	5¼" x 14"		M	P
			5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P					5¼" x 16"	T	M	P
		30'	3½" x 14"	T	M	P	3½" x 14"			P	3½" x 16"		M	P	3½" x 18"		M	P
			5¼" x 11¼"		M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P
			5¼" x 11⅞"	T	M	P	5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	7" x 14"			P
		36'	3½" x 14"		M	P	3½" x 16"		M	P	3½" x 18"		M	P	3½" x 18"		M	P
			3½" x 16"	T	M	P	5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P					7" x 14"			P	7" x 14"			P
	20LL + 20DL	24'	3½" x 14"	T	M	P	3½" x 14"		M	P	3½" x 16"		M	P	3½" x 18"		M	P
			5¼" x 11¼"		M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P
			5¼" x 11⅞"	T	M	P	5¼" x 11⅞"			P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 14"		M	P	3½" x 16"	T	M	P	3½" x 16"			P	3½" x 18"		M	P
			3½" x 16"	T	M	P	5¼" x 14"	T	M	P	3½" x 18"		M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P					5¼" x 14"			P	7" x 14"			P
		36'	3½" x 14"			P	3½" x 16"		M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"		M	P	5¼" x 18"		M	P
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	7" x 14"			P	7" x 16"			P
Snow Area 115%	25LL + 15DL	24'	3½" x 14"	T	M	P	3½" x 14"		M	P	3½" x 16"		M	P	3½" x 18"		M	P
			5¼" x 11¼"		M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P
			5¼" x 11⅞"	T	M	P	5¼" x 11⅞"			P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 14"		M	P	3½" x 16"	T	M	P	3½" x 16"			P	3½" x 18"		M	P
			3½" x 16"	T	M	P	5¼" x 14"	T	M	P	3½" x 18"		M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P					5¼" x 14"			P	7" x 14"			P
		36'	3½" x 14"			P	3½" x 16"			P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			3½" x 16"	T	M	P	3½" x 18"		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P
			5¼" x 14"	T	M	P	5¼" x 14"		M	P	5¼" x 16"		M	P	7" x 16"			P
	30LL + 15DL	24'	3½" x 14"	T	M	P	3½" x 14"			P	3½" x 16"		M	P	3½" x 18"		M	P
			5¼" x 11¼"		M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P
							5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 14"			P	3½" x 16"		M	P	3½" x 18"		M	P	3½" x 20"(3)		M	
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P	5¼" x 16"			P
			5¼" x 11⅞"			P	5¼" x 16"	T	M	P	7" x 14"			P	5¼" x 18"		M	P
		36'	3½" x 16"		M	P	3½" x 18"(3)		M	P	3½" x 18"(3)			P	5¼" x 18"		M	P
			5¼" x 14"	T	M	P	5¼" x 14"			P	3½" x 20"(3)		M		7" x 16"			P
							5¼" x 16"	T	M	P	5¼" x 16"		M	P				
	40LL + 15DL	24'	3½" x 14"		M	P	3½" x 16"		M	P	3½" x 18"		M	P	3½" x 18"(3)			P
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"	T	M	P	3½" x 20"(3)		M	
			5¼" x 11⅞"			P	5¼" x 16"	T	M	P	7" x 14"			P	5¼" x 16"		M	P
		30'	3½" x 16"		M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	5¼" x 16"		M	P	7" x 16"			P
							7" x 14"			P								
		36'	3½" x 18"(3)		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 18"(3)			P
			5¼" x 14"		M	P	5¼" x 16"		M	P	7" x 16"			P	5¼" x 20"(3)		M	
			5¼" x 16"	T	M	P	7" x 14"			P								

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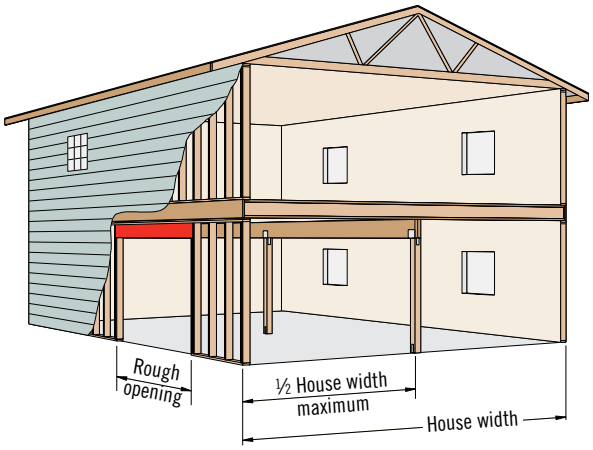
How to Use This Table

1. Verify that floor loading of 40 psf live load and 12 psf dead load is adequate.
2. Determine appropriate **Load** and **House Width**.
3. Locate **Rough Opening**.
4. Select header size and material.

*Also see **General Notes** on page 13.*



Headers Supporting Floor and Roof

Load (PSF)		House Width	Rough Opening															
			8'				9'-3"				10'				12'			
Non-Snow Area 125%	Roof Load 20LL + 15DL Floor Load 40LL + 12DL	24'	1¾" x 11¼"	T	M		1¾" x 11⅞"(3)		M		1¾" x 14"(3)	T	M		3½" x 11⅞"		M	P
			3½" x 9¼"	T	M	P	1¾" x 14"(3)	T	M		3½" x 9½"		M	P	3½" x 14"	T	M	P
							3½" x 9½"	T	M	P	3½" x 11¼"	T	M	P	5¼" x 11¼"	T	M	P
		30'	1¾" x 11⅞"(3)	T	M		1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	3½" x 9½"		M	P	5¼" x 9¼"		M	P	5¼" x 11¼"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9½"	T	M	P				
		36'	1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"(3)	T	M	P
			3½" x 9½"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 9½"		M	P	5¼" x 11¼"		M	P
			5¼" x 9¼"	T	M	P					5¼" x 11¼"	T	M	P				
	Roof Load 20LL + 20DL Floor Load 40LL + 12DL	24'	1¾" x 11¼"(3)	T	M		1¾" x 14"(3)	T	M		1¾" x 14"(3)	T	M		3½" x 11⅞"		M	P
			3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P
		30'	1¾" x 14"(3)	T	M		1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	3½" x 9½"			P	5¼" x 9¼"		M	P	5¼" x 11¼"		M	P
							3½" x 11¼"	T	M	P					5¼" x 11⅞"	T	M	P
		36'	1¾" x 14"(3)	T			3½" x 11¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"(3)		M	P
			3½" x 9¼"		M	P	5¼" x 9¼"		M	P	5¼" x 9½"			P	3½" x 16"(3)	T	M	P
			3½" x 11¼"	T	M	P	5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
Snow Area 115%	Roof Load 25LL + 15DL Floor Load 40LL + 12DL	24'	1¾" x 11¼"(3)	T	M		1¾" x 14"(3)	T	M		1¾" x 14"(3)		M		3½" x 11⅞"		M	P
			3½" x 9¼"	T	M	P	3½" x 9¼"		M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P
							3½" x 11¼"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P
		30'	1¾" x 14"(3)	T	M		3½" x 9½"			P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	5¼" x 11¼"		M	P
							5¼" x 9¼"	T	M	P					5¼" x 11⅞"	T	M	P
		36'	1¾" x 14"(3)	T			3½" x 11¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"(3)		M	P
			3½" x 9¼"		M	P	5¼" x 9¼"		M	P	5¼" x 9½"			P	3½" x 16"(3)	T	M	P
			3½" x 11¼"	T	M	P	5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
	Roof Load 30LL + 15DL Floor Load 40LL + 12DL	24'	1¾" x 11⅞"	T			1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 11⅞"			P
			1¾" x 14"(3)	T	M		3½" x 9¼"		M	P	5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P					5¼" x 11¼"	T	M	P
		30'	1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 9½"		M	P	5¼" x 11¼"		M	P
											5¼" x 11¼"	T	M	P				
		36'	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"(3)			P
			3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	3½" x 14"	T	M	P	3½" x 16"(3)	T	M	P
			5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
	Roof Load 40LL + 15DL Floor Load 40LL + 12DL	24'	1¾" x 14"(3)	T	M		3½" x 11¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P
			3½" x 9¼"	T	M	P	5¼" x 9¼"	T	M	P	5¼" x 9¼"		M	P	5¼" x 11¼"		M	P
											5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P
		30'	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"(3)		M	P
			3½" x 11¼"	T	M	P	5¼" x 9¼"		M	P	3½" x 14"	T	M	P	3½" x 16"(3)	T	M	P
			5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P
		36'	3½" x 11¼"	T	M	P	3½" x 11⅞"(3)		M	P	3½" x 14"(3)	T	M	P	3½" x 16"(3)	T	M	P
			5¼" x 9¼"	T	M	P	3½" x 14"(3)	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 14"	T	M	P
							5¼" x 9½"			P								

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General Notes

- Table is based on:
  - Uniform loads.
  - More restrictive of simple or continuous span. Ratio of short span to long span should be greater than 0.4 to prevent uplift.
  - Roof truss framing with 24" soffits.
  - Exterior wall weights of 80 plf, interior 60 plf.
  - Deflection criteria of L/360 live load and L/240 total load at floor.
- Tables do not consider attic loads acting concurrently with roof or snow loads.

*Also see **How to Use This Table** on page 12 and **General Assumptions** on page 5.*

Bearing Requirements

Minimum header supports to be two trimmers (3") at each end and 7½" at continuous-span supports.

In **Sizing Tables** on pages 12 and 13:

(3) Indicates requirement of three trimmers (4½") at each end and 11¼" at continuous-span supports.

Headers Supporting Floor and Roof *continued*

Roof Load (PSF)		House Width	Rough Opening 14'				Rough Opening 16'-3"				Rough Opening 18'-3"			
Non-Snow Area 125%	Roof Load 20LL + 15DL Floor Load 40LL + 12DL	24'	3½" x 14"		M	P	3½" x 16"		M	P	3½" x 18"(3)		M	P
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 14"			P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			3½" x 16"	T	M	P	5¼" x 14"			P	5¼" x 16"		M	P
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P				
		36'	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P	5¼" x 18"(3)		M	P
			5¼" x 14"	T	M	P	5¼" x 16"		M	P	7" x 16"			P
							7" x 14"			P				
	Roof Load 20LL + 20DL Floor Load 40LL + 12DL	24'	3½" x 14"		M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	5¼" x 18"		M	P
							7" x 14"			P	7" x 16"			P
		36'	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P	5¼" x 18"(3)		M	P
			5¼" x 14"		M	P	5¼" x 16"		M	P	7" x 16"			P
			5¼" x 16"	T	M	P	7" x 14"			P				
Snow Area 115%	Roof Load 25LL + 15DL Floor Load 40LL + 12DL	24'	3½" x 14"		M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P
			3½" x 16"	T	M	P	5¼" x 14"		M	P	5¼" x 16"		M	P
			5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P	7" x 14"			P
		30'	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	5¼" x 18"		M	P
							7" x 14"			P	7" x 16"			P
		36'	3½" x 16"(3)		M	P	3½" x 18"(3)			P	5¼" x 18"(3)		M	P
			5¼" x 14"		M	P	3½" x 20"(3)		M		7" x 16"			P
			5¼" x 16"	T	M	P	5¼" x 16"		M	P				
	Roof Load 30LL + 15DL Floor Load 40LL + 12DL	24'	3½" x 14"		M	P	3½" x 16"(3)			P	3½" x 18"(3)			P
			3½" x 16"	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			5¼" x 11⅞"			P	5¼" x 14"		M	P	5¼" x 16"		M	P
		30'	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	5¼" x 18"(3)		M	P
			5¼" x 14"	T	M	P	5¼" x 16"		M	P	7" x 16"			P
							7" x 14"			P				
		36'	3½" x 16"(3)			P	5¼" x 16"(3)		M	P	5¼" x 18"(3)		M	P
			3½" x 18"(3)		M	P					7" x 16"			P
			5¼" x 14"		M	P								
	Roof Load 40LL + 15DL Floor Load 40LL + 12DL	24'	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M	
			5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	5¼" x 18"		M	P
							7" x 14"			P	7" x 16"			P
		30'	3½" x 16"(3)			P	5¼" x 16"(3)		M	P	5¼" x 18"(3)		M	P
			3½" x 18"(3)		M	P	7" x 14"			P	7" x 16"			P
			5¼" x 14"		M	P								
		36'	5¼" x 16"(3)	T	M	P	5¼" x 18"(3)		M	P	5¼" x 20"(3)		M	
			7" x 14"			P	7" x 16"			P	7" x 18"(3)			P

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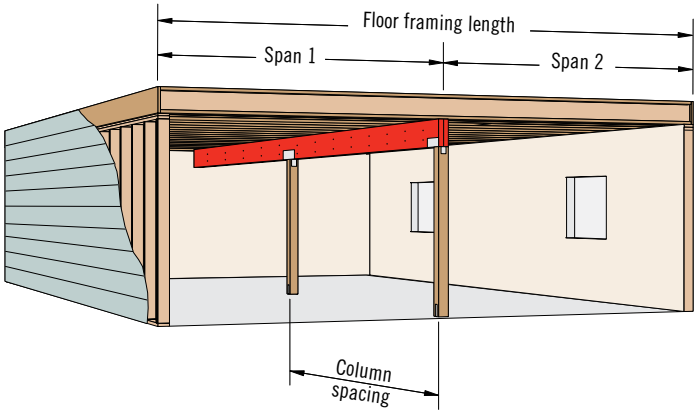
How to Use This Table

1. Determine appropriate **Floor Load**.
2. Find the **Floor Framing Length** that meets or exceeds the sum of Spans 1 and 2 for the supported floor joists. When floor joists are continuous span, Span 1 or 2 cannot be less than 40% of the **Floor Framing Length**. If floor joists are simple span (not continuous over the beam), then the **Floor Framing Length** may be taken as 80% of Span 1 plus Span 2.
3. Locate **Column Spacing**.
4. Select beam size and material.

*Also see **General Notes** on page 15.*



Floor Beams

Floor Load (PSF)	Floor Framing Length	Column Spacing																				
		8'				10'				12'				14'				16'				
40LL + 12DL	24'	3½" x 9¼"	T	M	P	3½" x 9½"		M	P	3½" x 11¼"		M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	
						3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P	
						5¼" x 9¼"	T	M	P	5¼" x 9½"			P									
	28'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"		M	P	3½" x 14"		M	P	3½" x 16"		M	P	
						5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	
										5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P	5¼" x 16"	T	M	P	
	30'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"			P	3½" x 14"		M	P	3½" x 16"		M	P	
						5¼" x 9¼"		M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"		M	P	
						5¼" x 9½"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"			P	5¼" x 16"	T	M	P	
	32'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 14"			P	3½" x 16"(3)			P	
						5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	3½" x 16"	T	M	P	3½" x 18"(3)		M	P	
										5¼" x 11⅞"	T	M	P	5¼" x 14"	T	M	P	5¼" x 14"		M	P	
	34'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	3½" x 16"(3)			P	
						5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P	3½" x 18"(3)		M	P	
										5¼" x 11⅞"	T	M	P					5¼" x 14"		M	P	
	36'	3½" x 9¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	3½" x 18"(3)		M	P	
						5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P	5¼" x 14"			P	
						5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P					5¼" x 16"	T	M	P	
	40'	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"		M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P	
		3½" x 11¼"	T	M	P	5¼" x 9½"		M	P	3½" x 16"	T	M	P	5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	
		5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P					7" x 14"			P	
40LL + 20DL	24'	3½" x 9¼"	T	M	P	3½" x 9½"		M	P	3½" x 11⅞"		M	P	3½" x 14"		M	P	3½" x 16"		M	P	
						3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	5¼" x 14"	T	M	P	
						5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P					
	28'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 11⅞"			P	3½" x 14"			P	3½" x 16"(3)			P	
						5¼" x 9¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"	T	M	P	3½" x 18"(3)		M	P	
										5¼" x 11¼"	T	M	P	5¼" x 11⅞"		M	P	5¼" x 14"		M	P	
	30'	3½" x 9¼"	T	M	P	3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 14"			P	3½" x 16"(3)			P	
						5¼" x 9¼"		M	P	5¼" x 11¼"	T	M	P	3½" x 16"	T	M	P	3½" x 18"(3)		M	P	
						5¼" x 9½"	T	M	P					5¼" x 14"	T	M	P	5¼" x 14"		M	P	
	32'	3½" x 9¼"	T	M	P	3½" x 11⅞"	T	M	P	3½" x 14"	T	M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P	
						5¼" x 9¼"		M	P	5¼" x 11¼"		M	P	5¼" x 14"	T	M	P	5¼" x 14"			P	
						5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P					5¼" x 16"	T	M	P	
	34'	3½" x 9¼"		M	P	3½" x 11⅞"	T	M	P	3½" x 14"		M	P	3½" x 16"(3)		M	P	3½" x 18"(3)		M	P	
		3½" x 9½"	T	M	P	5¼" x 9¼"		M	P	3½" x 16"	T	M	P	5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	
		5¼" x 9¼"	T	M	P	5¼" x 11¼"	T	M	P	5¼" x 11⅞"	T	M	P					7" x 14"			P	
	36'	3½" x 9¼"		M	P	3½" x 11⅞"		M	P	3½" x 14"(3)		M	P	3½" x 16"(3)			P	3½" x 18"(3)			P	
		3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M		
		5¼" x 9¼"	T	M	P	5¼" x 9½"		M	P	5¼" x 11⅞"	T	M	P	5¼" x 14"	T	M	P	5¼" x 16"	T	M	P	
	40'	3½" x 9½"			P	3½" x 11⅞"			P	3½" x 14"(3)			P	3½" x 16"(3)			P	3½" x 18"(3)			P	
		3½" x 11¼"	T	M	P	3½" x 14"	T	M	P	3½" x 16"(3)	T	M	P	3½" x 18"(3)		M	P	3½" x 20"(3)		M		
		5¼" x 9¼"	T	M	P	5¼" x 9½"			P	5¼" x 11⅞"		M	P	5¼" x 14"		M	P	5¼" x 16"		M	P	

T 1.55E TimberStrand® LSL **M** 1.9E Microllam® LVL **P** 2.0E Parallam® PSL

General Notes

- Table is based on:
  - Uniform loads.
  - More restrictive of simple or continuous beam span. Ratio of short span to long span should be greater than 0.4 to prevent uplift.
  - Deflection criteria of L/360 live load and L/240 total load.

*Also see **How to Use This Table** on page 14 and **General Assumptions** on page 5.*

Bearing Requirements

Minimum beam supports to be two trimmers (3") at each end and 7½" at continuous-span supports.

In **Sizing Tables** on pages 14 and 15:

(3) Indicates requirement of three trimmers (4½") at each end and 11¼" at continuous-span supports.

Floor Beams *continued*

Floor Load (PSF)	Floor Framing Length	Column Spacing											
		18'				20'				22'				24'			
40LL + 12DL	24'	3½" x 18"		M	P	3½" x 18"			P	3½" x 20"(3)		M		5¼" x 20"		M	
		5¼" x 14"			P	3½" x 20"		M		5¼" x 18"		M	P	7" x 18"			P
		5¼" x 16"	T	M	P	5¼" x 16"		M	P	7" x 16"			P				
	28'	3½" x 18"		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"		M	
		5¼" x 16"	T	M	P	5¼" x 16"			P	7" x 16"			P	7" x 18"			P
		7" x 14"			P	5¼" x 18"		M	P								
	30'	3½" x 18"(3)		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"		M	
		5¼" x 16"		M	P	5¼" x 18"		M	P	7" x 16"			P	7" x 18"			P
		7" x 14"			P	7" x 16"			P								
	32'	3½" x 18"(3)			P	3½" x 20"(3)		M		5¼" x 18"			P	5¼" x 20"		M	
		3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"		M		7" x 18"			P
		5¼" x 16"		M	P	7" x 16"			P								
	34'	3½" x 18"(3)			P	5¼" x 18"		M	P	5¼" x 20"		M		5¼" x 20"		M	
		3½" x 20"(3)		M		7" x 16"			P	7" x 18"			P	7" x 18"			P
		5¼" x 16"		M	P												
	36'	3½" x 18"(3)			P	5¼" x 18"		M	P	5¼" x 20"		M		7" x 18"			P
		3½" x 20"(3)		M		7" x 16"			P	7" x 18"			P				
		5¼" x 16"		M	P												
	40'	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"(3)		M					
		5¼" x 16"			P	7" x 16"			P	7" x 18"			P				
		5¼" x 18"		M	P												
40LL + 20DL	24'	3½" x 18"(3)		M	P	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"		M	
		5¼" x 16"	T	M	P	5¼" x 16"		M	P	7" x 16"			P	7" x 18"			P
		7" x 14"			P												
	28'	3½" x 18"(3)			P	5¼" x 18"		M	P	5¼" x 18"			P	5¼" x 20"		M	
		3½" x 20"(3)		M		7" x 16"			P	5¼" x 20"		M		7" x 18"			P
		5¼" x 16"		M	P												
	30'	3½" x 18"(3)			P	5¼" x 18"		M	P	5¼" x 20"		M		7" x 18"			P
		3½" x 20"(3)		M		7" x 16"			P	7" x 18"			P				
		5¼" x 16"		M	P												
	32'	3½" x 20"(3)		M		5¼" x 18"		M	P	5¼" x 20"(3)		M					
		5¼" x 16"		M	P	7" x 16"			P	7" x 18"			P				
		7" x 14"			P												
	34'	5¼" x 16"			P	5¼" x 18"		M	P	5¼" x 20"(3)		M					
		5¼" x 18"		M	P	7" x 16"			P	7" x 18"			P				
	36'	5¼" x 16"			P	5¼" x 18"(3)			P	7" x 18"			P				
		5¼" x 18"		M	P	5¼" x 20"(3)		M									
						7" x 16"			P								
	40'	5¼" x 18"(3)		M	P	5¼" x 20"(3)		M		7" x 18"			P				
		7" x 16"			P	7" x 18"			P								

T 1.55E TimberStrand® LSL **M** 1.9E Microllam® LVL **P** 2.0E Parallam® PSL

How to Use This Table

1. Calculate total and live load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total and live loads.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 17.*

TimberStrand® LSL: Floor—100% (PLF)

Span	Condition	1.3E Grade							1.55E Grade				
		3½" Width						5½" Plank Orientation	1¾" Width				
		4⅜"	5½"	7¼"	8⅝"	9¼"	11¼"	3½"	9¼"	9½"	11¼"	11⅞"	14"
3'	Total Load	1,538	2,381	4,036	5,624	6,428	7,442	1,210	3,024	3,166	4,333	4,717	4,717
	Live Load L/360	1,420	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.6	2.4/6.1	3.4/8.5	3.9/9.7	4.5/11.3	1.5/3.5	2.9/7.2	3/7.6	4.1/10.3	4.5/11.3	4.5/11.3
4'	Total Load	863	1,337	2,267	3,159	3,611	5,249	814	1,929	2,006	2,597	2,836	3,536
	Live Load L/360	651	1,215	*	*	*	*	546	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.8/4.6	2.6/6.4	2.9/7.3	4.2/10.6	1.5/3.5	2.5/6.1	2.6/6.4	3.3/8.3	3.6/9	4.5/11.3
5'	Total Load	517	853	1,448	2,019	2,308	3,355	425	1,416	1,467	1,853	2,004	2,577
	Live Load L/360	347	662	1,398	*	*	*	287	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.7	2/5.1	2.3/5.8	3.4/8.5	1.5/3.5	2.3/5.6	2.3/5.8	3/7.4	3.2/8	4.1/10.3
6'	Total Load	304	590	1,003	1,399	1,599	2,326	248	1,095	1,152	1,440	1,549	1,952
	Live Load L/360	206	397	857	1,367	*	*	169	978	1,048	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.3	1.9/4.9	2.8/7.1	1.5/3.5	2.1/5.2	2.2/5.5	2.8/6.9	3/7.4	3.7/9.3
7'	Total Load	171	336	735	1,025	1,172	1,706	138	803	845	1,168	1,262	1,570
	Live Load L/360	131	255	560	904	1092	*	107	651	699	1,089	1,250	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.4/6	1.5/3.5	1.8/4.5	1.9/4.7	2.6/6.5	2.8/7	3.5/8.8
8'	Total Load	99	198	443	783	895	1,303	79	613	646	893	990	1,313
	Live Load L/360	89	173	384	626	759	1,290	72	453	487	769	886	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.3	1.5/3.5	1.6/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.4/8.4
9'-6"	Total Load		98	224	552	632	921		416	448	631	700	960
	Live Load L/360		*	*	386	470	811		280	302	483	560	870
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5		1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.3
10'	Total Load		79	182	492	569	830		359	387	569	631	865
	Live Load L/360		*	*	333	407	704		242	261	420	487	760
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2		1.5/3.5	1.5/3.5	1.8/4.6	2/5.1	2.8/6.9
12'	Total Load			85	287	353	573		211	228	372	434	599
	Live Load L/360			*	197	241	423		144	155	252	293	464
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.8
14'	Total Load				180	222	397		133	144	237	278	438
	Live Load L/360				126	154	272		92	99	162	189	302
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5
16'-6"	Total Load				108	134	242		80	87	145	170	277
	Live Load L/360				77	95	169		57	61	101	118	189
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7
18'-6"	Total Load				74	93	170		56	60	102	120	197
	Live Load L/360				55	68	121		40	44	72	84	136
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
20'	Total Load				57	72	133				80	94	156
	Live Load L/360				44	54	96				57	67	109
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5				1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load						73					52	88
	Live Load L/360						56					39	64
	Min. End/Int. Bearing (in.)						1.5/3.5					1.5/3.5	1.5/3.5
28'	Total Load												53
	Live Load L/360												40
	Min. End/Int. Bearing (in.)												1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/240 total load (TL) and L/360 live load (LL).
- For live load deflection limits of L/240 or L/480, multiply **Live Load L/360** values by 1.5 or 0.75, respectively. The resulting live load must not exceed the total load shown.

*Also see **How to Use this Table** on page 16 and **General Assumptions** on page 5.*

TimberStrand® LSL: Floor—100% (PLF) *continued*

Span	Condition	1.55E Grade											
		3½" Width						5¼" Width (2- or 3-ply)					
		9¼"	9½"	11¼"	11⅞"	14"	16"	9¼"	9½"	11¼"	11⅞"	14"	16"
3'	Total Load	6,049	6,332	8,667	9,432	9,432	9,432	9,074	9,499	13,001	14,148	14,148	14,148
	Live Load L/360	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.9/7.2	3/7.6	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3	2.9/7.2	3/7.6	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3
4'	Total Load	3,859	4,012	5,195	5,673	7,070	7,070	5,788	6,018	7,793	8,510	10,605	10,605
	Live Load L/360	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.5/6.1	2.6/6.4	3.3/8.3	3.6/9	4.5/11.3	4.5/11.3	2.5/6.1	2.6/6.4	3.3/8.3	3.6/9	4.5/11.3	4.5/11.3
5'	Total Load	2,832	2,934	3,707	4,009	5,155	5,652	4,248	4,401	5,561	6,014	7,733	8,478
	Live Load L/360	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.3/5.6	2.3/5.8	3/7.4	3.2/8	4.1/10.3	4.5/11.3	2.3/5.6	2.3/5.8	3/7.4	3.2/8	4.1/10.3	4.5/11.3
6'	Total Load	2,190	2,305	2,881	3,098	3,904	4,707	3,286	3,458	4,321	4,648	5,857	7,061
	Live Load L/360	1,957	2,097	*	*	*	*	2,936	3,146	*	*	*	*
	Min. End/Int. Bearing (in.)	2.1/5.2	2.2/5.5	2.8/6.9	3/7.4	3.7/9.3	4.5/11.3	2.1/5.2	2.2/5.5	2.8/6.9	3/7.4	3.7/9.3	4.5/11.3
7'	Total Load	1,606	1,691	2,336	2,524	3,141	3,787	2,410	2,536	3,505	3,786	4,711	5,681
	Live Load L/360	1,302	1,399	2,179	2,501	*	*	1,954	2,098	3,269	3,752	*	*
	Min. End/Int. Bearing (in.)	1.8/4.5	1.9/4.7	2.6/6.5	2.8/7	3.5/8.8	4.2/10.6	1.8/4.5	1.9/4.7	2.6/6.5	2.8/7	3.5/8.8	4.2/10.6
8'	Total Load	1,227	1,292	1,786	1,981	2,626	3,138	1,841	1,938	2,679	2,971	3,939	4,708
	Live Load L/360	906	974	1,538	1,773	*	*	1,359	1,462	2,307	2,660	*	*
	Min. End/Int. Bearing (in.)	1.6/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.4/8.4	4/10	1.6/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.4/8.4	4/10
9'-6"	Total Load	832	897	1,263	1,401	1,920	2,480	1,248	1,346	1,894	2,101	2,880	3,720
	Live Load L/360	561	605	967	1,121	1,740	2,456	842	907	1,451	1,681	2,610	3,684
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.3	3.8/9.4	1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.3	3.8/9.4
10'	Total Load	718	775	1,138	1,263	1,731	2,236	1,077	1,162	1,708	1,894	2,597	3,355
	Live Load L/360	485	523	840	974	1,520	2,154	728	785	1,260	1,462	2,280	3,232
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.8/4.6	2/5.1	2.8/6.9	3.6/8.9	1.5/3.5	1.5/3.5	1.8/4.6	2/5.1	2.8/6.9	3.6/8.9
12'	Total Load	422	456	744	868	1,198	1,547	633	685	1,116	1,302	1,797	2,321
	Live Load L/360	288	311	504	587	928	1,334	432	467	756	881	1,393	2,001
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.8	3/7.5	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.8	3/7.5
14'	Total Load	266	288	475	556	876	1,132	400	433	713	834	1,314	1,698
	Live Load L/360	184	199	325	379	605	877	276	299	487	569	907	1,316
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5	2.6/6.4	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5	2.6/6.4
16'-6"	Total Load	161	174	291	341	554	810	241	262	436	512	831	1,215
	Live Load L/360	114	123	202	236	379	555	171	185	303	354	569	832
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.2/5.4	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.2/5.4
18'-6"	Total Load	112	121	205	241	395	584	168	182	307	362	592	876
	Live Load L/360	81	88	144	169	273	401	122	132	217	254	410	601
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4
20'	Total Load	87	94	160	189	312	463	130	142	240	284	468	695
	Live Load L/360	64	70	115	135	218	320	97	105	172	202	327	481
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8
24'	Total Load			88	105	177	266	69	76	133	158	265	400
	Live Load L/360			67	79	128	189	56	61	101	118	192	284
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load			51	62	107	163			77	93	160	245
	Live Load L/360			42	50	81	120			64	75	122	181
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total and live load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total and live loads.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 19.*

1.9E Microllam® LVL: Floor—100% (PLF)

Span	Condition	1¾" Width							3½" Width (2-ply)					
		5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"
6'	Total Load	432	762	1,027	1,062	1,324	1,424	1,794	864	1,525	2,055	2,125	2,648	2,848
	Live Load L/360	290	626	*	*	*	*	*	580	1,253	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.8/4.4	2.4/5.9	2.4/6.1	3.0/7.6	3.3/8.2	4.1/10.3	1.5/3.5	1.8/4.4	2.4/5.9	2.4/6.1	3.0/7.6	3.3/8.2
8'	Total Load	146	326	695	731	915	978	1,207	292	652	1,391	1,462	1,830	1,956
	Live Load L/360	126	280	555	597	*	*	*	253	561	1,110	1,195	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	2.8/7.0	3.0/7.5	3.7/9.3	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	2.8/7.0	3.0/7.5
9'-6"	Total Load	73	166	491	517	709	784	968	146	332	983	1,034	1,418	1,570
	Live Load L/360	*	*	344	370	592	687	*	*	*	688	741	1,185	1,374
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.8/4.5	1.9/4.7	2.6/6.5	2.9/7.2	3.5/8.8	1.5/3.5	1.5/3.5	1.8/4.5	1.9/4.7	2.6/6.5	2.9/7.2
10'	Total Load	59	135	441	466	639	707	908	118	270	883	932	1,279	1,415
	Live Load L/360	*	*	297	321	514	597	*	*	*	595	642	1,029	1,195
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.7/4.3	1.8/4.5	2.5/6.1	2.7/6.8	3.5/8.7	1.5/3.5	1.5/3.5	1.7/4.3	1.8/4.5	2.5/6.1	2.7/6.8
12'	Total Load		64	260	281	442	489	666	54	128	521	563	885	979
	Live Load L/360		*	176	190	309	360	569	*	*	353	381	618	720
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1	2.3/5.7	3.1/7.7	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1	2.3/5.7
14'	Total Load			164	178	293	342	487		66	329	357	586	685
	Live Load L/360			113	122	199	232	370		*	226	244	398	465
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.6/4.0	1.9/4.7	2.6/6.6		1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	1.9/4.7
16'-6"	Total Load			100	108	180	211	342			200	217	360	422
	Live Load L/360			69	75	123	145	232			139	151	247	290
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.2/5.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
18'-6"	Total Load			70	76	127	149	244			140	152	254	299
	Live Load L/360			49	54	88	103	167			99	108	177	207
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
20'	Total Load			54	59	100	118	193			109	119	200	236
	Live Load L/360			39	42	70	82	133			79	85	141	165
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
22'	Total Load					74	87	144			80	87	148	175
	Live Load L/360					53	62	101			59	64	106	125
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					56	66	110			60	65	112	133
	Live Load L/360					41	48	78			46	50	82	96
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
26'	Total Load						51	86					86	102
	Live Load L/360						38	62					65	76
	Min. End/Int. Bearing (in.)						1.5/3.5	1.5/3.5					1.5/3.5	1.5/3.5
28'	Total Load							67					67	80
	Live Load L/360							49					52	61
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5
30'	Total Load							54					52	62
	Live Load L/360							40					42	50
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/240 total load (TL) and L/360 live load (LL).
- For live load deflection limits of L/240 or L/480, multiply **Live Load L/360** values by 1.5 or 0.75, respectively. The resulting live load must not exceed the total load shown.

*Also see **How to Use This Table** on page 18 and **General Assumptions** on page 5.*

1.9E Microllam® LVL: Floor—100% (PLF) *continued*

Span	Condition	3½" Width (2-ply)				5¼" Width (3-ply)									
		14"	16"	18"	20"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
6'	Total Load	3,589	3,917	3,917	3,917	1,297	2,287	3,082	3,188	3,972	4,272	5,384	5,875	5,875	5,875
	Live Load L/360	*	*	*	*	870	1,879	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.8/4.4	2.4/5.9	2.4/6.1	3.0/7.6	3.3/8.2	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3
8'	Total Load	2,414	2,885	2,932	2,932	438	978	2,086	2,193	2,745	2,935	3,621	4,328	4,399	4,399
	Live Load L/360	*	*	*	*	380	842	1,666	1,792	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	3.7/9.3	4.4/11.1	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	2.8/7.0	3.0/7.5	3.7/9.3	4.4/11.1	4.5/11.3	4.5/11.3
9'-6"	Total Load	1,937	2,294	2,466	2,466	219	498	1,475	1,551	2,128	2,354	2,905	3,441	3,699	3,699
	Live Load L/360	*	*	*	*	*	*	1,032	1,112	1,778	2,061	*	*	*	*
	Min. End/Int. Bearing (in.)	3.5/8.8	4.2/10.5	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	1.8/4.5	1.9/4.7	2.6/6.5	2.9/7.2	3.5/8.8	4.2/10.5	4.5/11.3	4.5/11.3
10'	Total Load	1,817	2,147	2,342	2,342	177	406	1,325	1,398	1,919	2,123	2,725	3,221	3,513	3,513
	Live Load L/360	*	*	*	*	*	*	893	963	1,544	1,792	*	*	*	*
	Min. End/Int. Bearing (in.)	3.5/8.7	4.1/10.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	1.7/4.3	1.8/4.5	2.5/6.1	2.7/6.8	3.5/8.7	4.1/10.3	4.5/11.2	4.5/11.2
12'	Total Load	1,333	1,709	1,948	1,948	82	193	781	844	1,327	1,469	2,000	2,563	2,922	2,922
	Live Load L/360	1,138	1,635	*	*	*	*	530	572	927	1,080	1,707	2,453	*	*
	Min. End/Int. Bearing (in.)	3.1/7.7	3.9/9.9	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1	2.3/5.7	3.1/7.7	3.9/9.9	4.5/11.2	4.5/11.2
14'	Total Load	975	1,253	1,563	1,667		100	494	535	879	1,028	1,463	1,880	2,345	2,500
	Live Load L/360	741	1,075	1,483	*		*	339	366	597	697	1,112	1,613	2,225	*
	Min. End/Int. Bearing (in.)	2.6/6.6	3.4/8.5	4.2/10.5	4.5/11.3		1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	1.9/4.7	2.6/6.6	3.4/8.5	4.2/10.5	4.5/11.2
16'-6"	Total Load	684	897	1,120	1,365			300	326	540	634	1,026	1,346	1,680	2,048
	Live Load L/360	465	680	945	1,263			209	227	371	435	698	1,020	1,418	1,895
	Min. End/Int. Bearing (in.)	2.2/5.5	2.9/7.2	3.6/8.9	4.4/10.9			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.2/5.5	2.9/7.2	3.6/8.9	4.4/10.9
18'-6"	Total Load	488	710	887	1,082			210	228	382	449	733	1,066	1,331	1,623
	Live Load L/360	335	491	686	922			149	162	266	311	502	737	1,030	1,383
	Min. End/Int. Bearing (in.)	1.8/4.4	2.6/6.4	3.2/8.0	3.9/9.7			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4	2.6/6.4	3.2/8.0	3.9/9.7
20'	Total Load	387	573	756	922			164	178	300	354	580	860	1,134	1,384
	Live Load L/360	267	393	550	741			119	128	212	248	401	590	826	1,112
	Min. End/Int. Bearing (in.)	1.5/3.8	2.2/5.6	3.0/7.4	3.6/9.0			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.0/7.4	3.6/9.0
22'	Total Load	289	432	611	759			120	131	223	263	434	648	916	1,138
	Live Load L/360	202	298	419	566			89	97	160	187	304	448	629	850
	Min. End/Int. Bearing (in.)	1.5/3.5	1.9/4.7	2.6/6.6	3.3/8.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.7	2.6/6.6	3.3/8.2
24'	Total Load	221	332	471	634			89	98	168	199	332	498	707	951
	Live Load L/360	157	232	326	442			69	75	123	145	235	348	490	663
	Min. End/Int. Bearing (in.)	1.5/3.5	1.6/4.0	2.2/5.6	3.0/7.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	2.2/5.6	3.0/7.5
26'	Total Load	172	259	370	506			67	74	129	153	258	389	555	760
	Live Load L/360	124	183	259	351			54	59	97	114	186	275	388	527
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.9/4.8	2.6/6.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.6/6.5
28'	Total Load	135	205	294	405			51	56	100	120	203	308	442	607
	Live Load L/360	99	148	208	283			43	47	78	92	149	222	313	425
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.7			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.7
30'	Total Load	108	164	237	327					78	94	162	247	356	491
	Live Load L/360	81	120	170	232					63	75	122	181	256	348
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.7	2.0/5.0					1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.0/5.0

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total and live load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total and live loads.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 21.*

2.0E Parallam® PSL: Floor—100% (PLF)

Span	Condition	3½" Width							5¼" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	1,469	1,517	1,861	1,990	2,456	2,933	2,933	2,204	2,275	2,792	2,985	3,683	4,400	4,400
	Live Load L/360	1,169	1,257	*	*	*	*	*	1,753	1,886	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.3/5.6	2.3/5.8	2.9/7.1	3.1/7.6	3.8/9.4	4.5/11.3	4.5/11.3	2.3/5.6	2.3/5.8	2.9/7.1	3.1/7.6	3.8/9.4	4.5/11.3	4.5/11.3
9'-6"	Total Load	1,076	1,147	1,510	1,611	1,970	2,333	2,467	1,614	1,720	2,265	2,416	2,955	3,500	3,700
	Live Load L/360	724	780	1,248	1,446	*	*	*	1,086	1,171	1,872	2,170	*	*	*
	Min. End/Int. Bearing (in.)	2.0/4.9	2.1/5.2	2.8/6.9	2.9/7.3	3.6/9.0	4.3/10.6	4.5/11.3	2.0/4.9	2.1/5.2	2.8/6.9	2.9/7.3	3.6/9.0	4.3/10.6	4.5/11.3
10'	Total Load	930	1,003	1,420	1,514	1,848	2,184	2,342	1,395	1,505	2,130	2,271	2,772	3,276	3,514
	Live Load L/360	626	675	1,084	1,257	*	*	*	940	1,013	1,626	1,886	*	*	*
	Min. End/Int. Bearing (in.)	1.8/4.5	1.9/4.8	2.7/6.8	2.9/7.3	3.5/8.9	4.2/10.5	4.5/11.3	1.8/4.5	1.9/4.8	2.7/6.8	2.9/7.3	3.5/8.9	4.2/10.5	4.5/11.3
12'	Total Load	548	592	964	1,092	1,480	1,738	1,949	822	888	1,446	1,639	2,220	2,607	2,923
	Live Load L/360	372	401	651	758	1,198	1,721	*	558	602	976	1,137	1,797	2,582	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.3	3.4/8.5	4.0/10.0	4.5/11.3	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.3	3.4/8.5	4.0/10.0	4.5/11.3
14'	Total Load	347	375	616	721	1,093	1,409	1,660	520	563	925	1,082	1,639	2,113	2,490
	Live Load L/360	238	257	419	489	780	1,132	1,561	357	386	629	734	1,171	1,698	2,342
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.7/4.2	2.0/4.9	3.0/7.4	3.8/9.5	4.5/11.3	1.5/3.5	1.5/3.5	1.7/4.2	2.0/4.9	3.0/7.4	3.8/9.5	4.5/11.3
16'-6"	Total Load	210	228	379	444	720	1,009	1,263	316	342	568	667	1,080	1,514	1,895
	Live Load L/360	147	159	260	305	490	716	995	220	238	391	457	735	1,074	1,493
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.3/5.8	3.2/8.1	4.0/10.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.3/5.8	3.2/8.1	4.0/10.1
18'-6"	Total Load	147	160	268	315	514	759	1,000	221	240	402	473	771	1,138	1,501
	Live Load L/360	105	113	186	218	352	517	722	157	170	280	328	529	776	1,084
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.7	2.7/6.8	3.6/9.0	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.7	2.7/6.8	3.6/9.0
20'	Total Load	115	125	210	248	407	603	850	172	187	316	372	610	905	1,275
	Live Load L/360	83	90	148	174	281	414	579	125	135	223	261	422	621	869
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	2.4/5.9	3.3/8.3	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	2.4/5.9	3.3/8.3
22'	Total Load	84	91	156	184	304	454	642	126	137	234	277	457	681	964
	Live Load L/360	63	68	112	131	213	314	441	94	102	168	197	320	472	662
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/4.9	2.8/6.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/4.9	2.8/6.9
24'	Total Load	62	68	118	140	232	349	496	94	103	177	210	349	523	744
	Live Load L/360	48	52	86	102	165	244	343	73	79	130	153	248	366	515
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.4/5.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.4/5.9
26'	Total Load		51	90	107	180	272	389	71	77	135	161	271	409	584
	Live Load L/360		41	68	80	130	193	272	57	62	102	120	196	290	409
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.0/5.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.0/5.1
28'	Total Load			70	84	142	216	310	54	59	105	126	213	324	465
	Live Load L/360			55	64	105	155	219	46	50	82	97	157	233	329
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4
30'	Total Load			55	66	113	173	249			82	99	170	260	374
	Live Load L/360			44	52	85	127	179			67	79	128	190	269
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9
32'	Total Load				52	91	140	203			64	78	136	210	305
	Live Load L/360				43	70	105	148			55	65	106	157	223
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/240 total load (TL) and L/360 live load (LL).
- For live load deflection limits of L/240 or L/480, multiply **Live Load L/360** values by 1.5 or 0.75, respectively. The resulting live load must not exceed the total load shown.

*Also see **How to Use This Table** on page 20 and **General Assumptions** on page 5.*

2.0E Parallam® PSL: Floor—100% (PLF) *continued*

Span	Condition	7" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	2,939	3,034	3,723	3,981	4,912	5,866	5,866
	Live Load L/360	2,338	2,515	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.3/5.6	2.3/5.8	2.9/7.1	3.1/7.6	3.8/9.4	4.5/11.3	4.5/11.3
9'-6"	Total Load	2,153	2,294	3,020	3,222	3,940	4,667	4,934
	Live Load L/360	1,448	1,561	2,496	2,893	*	*	*
	Min. End/Int. Bearing (in.)	2.0/4.9	2.1/5.2	2.8/6.9	2.9/7.3	3.6/9.0	4.3/10.6	4.5/11.3
10'	Total Load	1,860	2,006	2,841	3,029	3,696	4,369	4,685
	Live Load L/360	1,253	1,351	2,168	2,515	*	*	*
	Min. End/Int. Bearing (in.)	1.8/4.5	1.9/4.8	2.7/6.8	2.9/7.3	3.5/8.9	4.2/10.5	4.5/11.3
12'	Total Load	1,096	1,184	1,928	2,185	2,960	3,476	3,898
	Live Load L/360	744	803	1,302	1,516	2,396	3,443	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.3	3.4/8.5	4.0/10.0	4.5/11.3
14'	Total Load	694	751	1,233	1,443	2,186	2,818	3,320
	Live Load L/360	476	514	839	979	1,561	2,264	3,122
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.7/4.2	2.0/4.9	3.0/7.4	3.8/9.5	4.5/11.3
16'-6"	Total Load	421	457	758	889	1,440	2,019	2,526
	Live Load L/360	294	318	521	610	980	1,432	1,991
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.3/5.8	3.2/8.1	4.0/10.1
18'-6"	Total Load	295	320	536	630	1,028	1,518	2,001
	Live Load L/360	210	227	373	437	705	1,035	1,445
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.7	2.7/6.8	3.6/9.0
20'	Total Load	230	250	421	497	814	1,207	1,700
	Live Load L/360	167	180	297	348	563	828	1,159
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.0	2.4/5.9	3.3/8.3
22'	Total Load	168	183	312	369	609	909	1,285
	Live Load L/360	126	136	224	263	426	629	883
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/4.9	2.8/6.9
24'	Total Load	125	137	236	280	465	698	992
	Live Load L/360	97	105	173	204	331	488	687
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.4/5.9
26'	Total Load	94	103	181	215	361	545	779
	Live Load L/360	76	83	137	161	261	387	545
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.0/5.1
28'	Total Load	72	79	140	168	285	432	620
	Live Load L/360	61	66	110	129	210	311	439
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4
30'	Total Load	54	60	110	132	226	346	499
	Live Load L/360	50	54	89	105	171	254	359
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9
32'	Total Load			86	104	182	280	406
	Live Load L/360			74	87	141	210	297
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 23.*

TimberStrand® LSL: Roof—Snow Load Area 115% (PLF)

Span	Condition	1.3E Grade							1.55E Grade				
		3½" Width						5½" Plank Orientation	1¾" Width				
		4⅜"	5½"	7¼"	8⅝"	9¼"	11¼"	3½"	9¼"	9½"	11¼"	11⅞"	14"
3'	Total Load	1,769	2,739	4,643	6,469	7,393	7,442	1,392	3,479	3,642	4,717	4,717	4,717
	Deflection L/240 / L/360	*/1,420	*/2,547	*/*	*/*	*/*	*/*	*/1,224	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.7/4.1	2.8/7	3.9/9.8	4.5/11.2	4.5/11.3	1.5/3.5	3.3/8.3	3.5/8.7	4.5/11.3	4.5/11.3	4.5/11.3
4'	Total Load	993	1,538	2,608	3,635	4,154	5,579	996	2,219	2,307	2,988	3,263	3,536
	Deflection L/240 / L/360	977/651	*/1,215	*/2,476	*/*	*/*	*/*	820/546	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.3	2.9/7.3	3.4/8.4	4.5/11.3	1.5/3.5	2.8/7.1	2.9/7.3	3.8/9.5	4.2/10.4	4.5/11.3
5'	Total Load	634	982	1,666	2,323	2,655	3,860	533	1,629	1,688	2,132	2,306	2,827
	Deflection L/240 / L/360	521/347	*/662	*/1,398	*/2,188	*/2605	*/*	431/287	*/1,553	*/1,658	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9	2.7/6.7	3.9/9.7	1.5/3.5	2.6/6.5	2.7/6.7	3.4/8.5	3.7/9.2	4.5/11.3
6'	Total Load	317	614	1,155	1,610	1,841	2,677	258	1,260	1,326	1,657	1,782	2,246
	Deflection L/240 / L/360	309/206	595/397	*/857	*/1,367	*/1,641	*/*	253/169	*/978	*/1,048	*/1,605	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	2/4.9	2.2/5.6	3.2/8.1	1.5/3.5	2.4/6	2.5/6.3	3.2/7.9	3.4/8.5	4.3/10.7
7'	Total Load	171	336	742	1,181	1,350	1,963	138	924	973	1,344	1,452	1,807
	Deflection L/240 / L/360	*/131	*/255	*/560	*/904	*/1,092	*/1,828	*/107	*/651	*/699	*/1,089	*/1,250	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	1.9/4.8	2.8/7	1.5/3.5	2.1/5.2	2.2/5.4	3/7.5	3.2/8.1	4/10.1
8'	Total Load	99	198	443	902	1,031	1,500	79	706	743	1,028	1,140	1,511
	Deflection L/240 / L/360	*/89	*/173	*/384	*/626	*/759	*/1,290	*/72	679/453	731/487	*/769	*/886	*/1,352
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	1.7/4.2	2.4/6.1	1.5/3.5	1.8/4.5	1.9/4.8	2.6/6.6	2.9/7.3	3.9/9.6
9'-6"	Total Load		98	224	637	728	1,061		499	525	727	806	1,105
	Deflection L/240 / L/360		*/*	*/*	579/386	706/470	*/811		421/280	453/302	725/483	*/560	*/870
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.1		1.5/3.8	1.6/4	2.2/5.5	2.5/6.1	3.4/8.4
10'	Total Load		79	182	574	656	956		450	474	655	727	996
	Deflection L/240 / L/360		*/*	*/*	500/333	611/407	*/704		364/242	392/261	630/420	*/487	*/760
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.9		1.5/3.6	1.5/3.8	2.1/5.3	2.3/5.8	3.2/8
12'	Total Load			85	386	453	660		283	306	453	503	690
	Deflection L/240 / L/360			*/*	296/197	362/241	634/423		216/144	233/155	378/252	440/293	*/464
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.6/4.1		1.5/3.5	1.5/3.5	1.8/4.4	1.9/4.9	2.7/6.6
14'	Total Load				243	300	482		179	194	318	367	504
	Deflection L/240 / L/360				189/126	232/154	409/272		138/92	149/99	243/162	284/189	453/302
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.7
16'-6"	Total Load				147	182	327		109	118	196	230	361
	Deflection L/240 / L/360				116/77	143/95	254/169		85/57	92/61	151/101	177/118	284/189
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8
18'-6"	Total Load				102	127	231		76	83	138	163	265
	Deflection L/240 / L/360				83/55	102/68	182/121		61/40	66/44	108/72	127/84	205/136
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4
20'	Total Load				79	99	181		59	64	109	128	210
	Deflection L/240 / L/360				66/44	81/54	145/96		48/32	52/35	86/57	101/67	163/109
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					53	101				61	72	120
	Deflection L/240 / L/360					47/31	84/56				50/33	59/39	96/64
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5				1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						60						73
	Deflection L/240 / L/360						53/35						61/40
	Min. End/Int. Bearing (in.)						1.5/3.5						1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.
- **For door and window applications, Weyerhaeuser recommends using the L/360 value for a live load deflection limit and the L/240 value for a total load limit.**

*Also see **How to Use This Table** on page 22 and **General Assumptions** on page 5.*

TimberStrand® LSL: Roof—Snow Load Area 115% (PLF) *continued*

Span	Condition	1.55E Grade											
		3½" Width						5¼" Width (2- or 3-ply)					
		9¼"	9½"	11¼"	11⅞"	14"	16"	9¼"	9½"	11¼"	11⅞"	14"	16"
3'	Total Load	6,958	7,284	9,432	9,432	9,432	9,432	10,437	10,926	14,148	14,148	14,148	14,148
	Deflection L/240 / L/360	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	3.3/8.3	3.5/8.7	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3	3.3/8.3	3.5/8.7	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3
4'	Total Load	4,439	4,615	5,976	6,526	7,070	7,070	6,659	6,923	8,965	9,790	10,605	10,605
	Deflection L/240 / L/360	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	2.8/7.1	2.9/7.3	3.8/9.5	4.2/10.4	4.5/11.3	4.5/11.3	2.8/7.1	2.9/7.3	3.8/9.5	4.2/10.4	4.5/11.3	4.5/11.3
5'	Total Load	3,258	3,376	4,265	4,612	5,652	5,652	4,887	5,064	6,398	6,919	8,478	8,478
	Deflection L/240 / L/360	*/3,106	*/3,316	*/*	*/*	*/*	*/*	*/4,659	*/4,975	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	2.6/6.5	2.7/6.7	3.4/8.5	3.7/9.2	4.5/11.3	4.5/11.3	2.6/6.5	2.7/6.7	3.4/8.5	3.7/9.2	4.5/11.3	4.5/11.3
6'	Total Load	2,521	2,652	3,315	3,565	4,492	4,707	3,781	3,979	4,972	5,348	6,739	7,061
	Deflection L/240 / L/360	*/1,957	*/2,097	*/3,210	*/*	*/*	*/*	*/2,936	*/3,146	*/4,816	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	2.4/6	2.5/6.3	3.2/7.9	3.4/8.5	4.3/10.7	4.5/11.3	2.4/6	2.5/6.3	3.2/7.9	3.4/8.5	4.3/10.7	4.5/11.3
7'	Total Load	1,849	1,946	2,689	2,904	3,614	4,032	2,774	2,919	4,034	4,357	5,421	6,048
	Deflection L/240 / L/360	*/1,302	*/1,399	*/2,179	*/2,501	*/*	*/*	*/1,954	*/2,098	*/3269	*/3,752	*/*	*/*
	Min. End/Int. Bearing (in.)	2.1/5.2	2.2/5.4	3/7.5	3.2/8.1	4/10.1	4.5/11.3	2.1/5.2	2.2/5.4	3/7.5	3.2/8.1	4/10.1	4.5/11.3
8'	Total Load	1,413	1,487	2,056	2,280	3,022	3,526	2,120	2,231	3,084	3,420	4,534	5,289
	Deflection L/240 / L/360	1,359/906	1,462/974	*/1,538	*/1,773	*/2,705	*/*	2,038/1,359	2,193/1,462	*/2,307	*/2,660	*/4,058	*/*
	Min. End/Int. Bearing (in.)	1.8/4.5	1.9/4.8	2.6/6.6	2.9/7.3	3.9/9.6	4.5/11.3	1.8/4.5	1.9/4.8	2.6/6.6	2.9/7.3	3.9/9.6	4.5/11.3
9'-6"	Total Load	999	1,051	1,454	1,613	2,211	2,854	1,499	1,577	2,181	2,419	3,316	4,282
	Deflection L/240 / L/360	842/561	907/605	1,451/967	*/1,121	*/1,740	*/2,456	1,263/842	1,361/907	2,176/1,451	*/1,681	*/2,610	*/3,684
	Min. End/Int. Bearing (in.)	1.5/3.8	1.6/4	2.2/5.5	2.5/6.1	3.4/8.4	4.3/10.8	1.5/3.8	1.6/4	2.2/5.5	2.5/6.1	3.4/8.4	4.3/10.8
10'	Total Load	901	948	1,311	1,454	1,993	2,574	1,351	1,422	1,967	2,182	2,990	3,862
	Deflection L/240 / L/360	728/485	785/523	1,260/840	*/974	*/1,520	*/2,154	1,092/728	1,178/785	1,890/1,260	*/1,462	*/2,280	*/3,232
	Min. End/Int. Bearing (in.)	1.5/3.6	1.5/3.8	2.1/5.3	2.3/5.8	3.2/8	4.1/10.3	1.5/3.6	1.5/3.8	2.1/5.3	2.3/5.8	3.2/8	4.1/10.3
12'	Total Load	566	612	907	1,006	1,380	1,782	850	918	1,360	1,509	2,070	2,674
	Deflection L/240 / L/360	432/288	467/311	756/504	881/587	*/928	*/1,334	649/432	700/467	1,135/756	1,322/881	*/1,393	*/2,001
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.8/4.4	1.9/4.9	2.7/6.6	3.4/8.6	1.5/3.5	1.5/3.5	1.8/4.4	1.9/4.9	2.7/6.6	3.4/8.6
14'	Total Load	359	388	637	735	1,009	1,305	538	582	956	1,103	1,514	1,957
	Deflection L/240 / L/360	276/184	299/199	487/325	569/379	907/605	*/877	415/276	448/299	731/487	854/569	1,361/907	*/1,316
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.7	2.9/7.3	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.3/5.7	2.9/7.3
16'-6"	Total Load	218	236	392	460	722	934	327	354	588	690	1,084	1,402
	Deflection L/240 / L/360	171/114	185/123	303/202	354/236	569/379	832/555	256/171	277/185	455/303	532/354	854/569	1,248/832
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.5/6.2	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.5/6.2
18'-6"	Total Load	152	166	277	326	531	739	229	249	416	489	797	1,109
	Deflection L/240 / L/360	122/81	132/88	217/144	254/169	410/273	601/401	183/122	198/132	326/217	381/254	615/410	902/601
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4	2.2/5.6	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4	2.2/5.6
20'	Total Load	119	129	218	257	421	624	179	194	327	385	631	936
	Deflection L/240 / L/360	97/64	105/70	172/115	202/135	327/218	481/320	145/97	157/105	259/172	304/202	491/327	722/481
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5.1
24'	Total Load	65	71	122	145	241	361	98	106	183	217	361	542
	Deflection L/240 / L/360	56/37	61/40	101/67	118/79	192/128	284/189	84/56	91/61	151/101	177/118	288/192	426/284
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6
28'	Total Load			73	87	147	224	56	61	109	130	221	336
	Deflection L/240 / L/360			64/42	75/50	122/81	181/120	53/35	58/38	96/64	112/75	183/122	271/181
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 25.*

1.9E Microllam® LVL: Roof—Snow Load Area 115% (PLF)

Span	Condition	1¾" Width							3½" Width (2-ply)					
		5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"
6'	Total Load	451	877	1,182	1,223	1,523	1,638	1,961	902	1,755	2,365	2,446	3,047	3,277
	Deflection L/240	435	*	*	*	*	*	*	870	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	2.0/5.0	2.7/6.8	2.8/7.0	3.5/8.7	3.8/9.4	4.5/11.3	1.5/3.5	2.0/5.0	2.7/6.8	2.8/7.0	3.5/8.7	3.8/9.4
8'	Total Load	146	326	800	841	1,053	1,126	1,389	292	652	1,601	1,682	2,106	2,252
	Deflection L/240	*	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.5/6.1	2.6/6.4	3.2/8.1	3.5/8.6	4.3/10.6	1.5/3.5	1.5/3.5	2.5/6.1	2.6/6.4	3.2/8.1	3.5/8.6
9'-6"	Total Load	73	166	566	595	816	903	1,114	146	332	1,132	1,190	1,633	1,807
	Deflection L/240	*	*	516	556	*	*	*	*	*	1,032	1,112	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.2	2.2/5.4	3.0/7.4	3.3/8.2	4.1/10.2	1.5/3.5	1.5/3.5	2.1/5.2	2.2/5.4	3.0/7.4	3.3/8.2
10'	Total Load	59	135	510	536	736	814	1,045	118	270	1,021	1,073	1,473	1,629
	Deflection L/240	*	*	446	481	*	*	*	*	*	893	963	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.0/4.9	2.1/5.2	2.8/7.1	3.1/7.8	4.0/10.0	1.5/3.5	1.5/3.5	2.0/4.9	2.1/5.2	2.8/7.1	3.1/7.8
12'	Total Load		64	348	371	509	564	767	54	128	697	742	1,019	1,128
	Deflection L/240		*	265	286	463	540	*	*	*	530	572	927	1,080
	Min. End/Int. Bearing (in.)		1.5/3.5	1.6/4.0	1.7/4.3	2.4/5.9	2.6/6.5	3.5/8.9	1.5/3.5	1.5/3.5	1.6/4.0	1.7/4.3	2.4/5.9	2.6/6.5
14'	Total Load			221	239	373	412	562		66	443	479	745	825
	Deflection L/240			169	183	298	348	556		*	339	366	597	697
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	2.0/5.0	2.2/5.6	3.0/7.6		1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.0	2.2/5.6
16'-6"	Total Load			135	146	242	283	402			270	292	484	567
	Deflection L/240			104	113	185	217	349			209	227	371	435
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6	2.6/6.4			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6
18'-6"	Total Load			95	103	171	201	318			190	206	343	403
	Deflection L/240			74	81	133	155	251			149	162	266	311
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.3/5.7			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7
20'	Total Load			74	81	135	159	260			149	162	271	319
	Deflection L/240			59	64	106	124	200			119	128	212	248
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
22'	Total Load			55	59	101	119	195			110	119	202	238
	Deflection L/240			44	48	80	93	152			89	97	160	187
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					76	90	150			83	90	153	181
	Deflection L/240					61	72	117			69	75	123	145
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
26'	Total Load					59	70	117			63	69	118	140
	Deflection L/240					48	57	93			54	59	97	114
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						55	92				53	93	110
	Deflection L/240						46	74				47	78	92
	Min. End/Int. Bearing (in.)						1.5/3.5	1.5/3.5				1.5/3.5	1.5/3.5	1.5/3.5
30'	Total Load							74					73	88
	Deflection L/240							61					63	75
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.

*Also see **How to Use This Table** on page 24 and **General Assumptions** on page 5.*

1.9E Microllam® LVL: Roof—Snow Load Area 115% (PLF) *continued*

Span	Condition	3½" Width (2-ply)				5¼" Width (3-ply)									
		14"	16"	18"	20"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
6'	Total Load	3,917	3,917	3,917	3,917	1,353	2,632	3,547	3,669	4,571	4,916	5,875	5,875	5,875	5,875
	Deflection L/240	*	*	*	*	1,305	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	2.0/5.0	2.7/6.8	2.8/7.0	3.5/8.7	3.8/9.4	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3
8'	Total Load	2,778	2,932	2,932	2,932	438	978	2,401	2,524	3,159	3,378	4,168	4,399	4,399	4,399
	Deflection L/240	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.3/10.6	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.5/6.1	2.6/6.4	3.2/8.1	3.5/8.6	4.3/10.6	4.5/11.3	4.5/11.3	4.5/11.3
9'-6"	Total Load	2,229	2,466	2,466	2,466	219	498	1,698	1,785	2,450	2,710	3,344	3,699	3,699	3,699
	Deflection L/240	*	*	*	*	*	*	1,548	1,669	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.1/10.2	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.1/5.2	2.2/5.4	3.0/7.4	3.3/8.2	4.1/10.2	4.5/11.3	4.5/11.3	4.5/11.3
10'	Total Load	2,091	2,342	2,342	2,342	177	406	1,531	1,610	2,209	2,444	3,137	3,513	3,513	3,513
	Deflection L/240	*	*	*	*	*	*	1,339	1,444	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.0/10.0	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.0/4.9	2.1/5.2	2.8/7.1	3.1/7.8	4.0/10.0	4.5/11.2	4.5/11.2	4.5/11.2
12'	Total Load	1,535	1,948	1,948	1,948	82	193	1,046	1,113	1,529	1,692	2,303	2,922	2,922	2,922
	Deflection L/240	*	*	*	*	*	*	795	859	1,391	1,620	*	*	*	*
	Min. End/Int. Bearing (in.)	3.5/8.9	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	1.6/4.0	1.7/4.3	2.4/5.9	2.6/6.5	3.5/8.9	4.5/11.2	4.5/11.2	4.5/11.2
14'	Total Load	1,124	1,444	1,667	1,667		100	664	719	1,118	1,238	1,686	2,166	2,500	2,500
	Deflection L/240	1,112	*	*	*		*	509	550	896	1,046	1,669	*	*	*
	Min. End/Int. Bearing (in.)	3.0/7.6	3.9/9.7	4.5/11.3	4.5/11.3		1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.0	2.2/5.6	3.0/7.6	3.9/9.7	4.5/11.2	4.5/11.2
16'-6"	Total Load	805	1,035	1,291	1,411			405	439	726	851	1,208	1,552	1,936	2,117
	Deflection L/240	698	1,020	*	*			314	340	557	652	1,047	1,530	*	*
	Min. End/Int. Bearing (in.)	2.6/6.4	3.3/8.3	4.1/10.3	4.5/11.3			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6	2.6/6.4	3.3/8.3	4.1/10.3	4.5/11.2
18'-6"	Total Load	637	820	1,023	1,247			285	309	515	605	956	1,230	1,534	1,871
	Deflection L/240	502	737	*	*			224	243	399	467	754	1,106	*	*
	Min. End/Int. Bearing (in.)	2.3/5.7	2.9/7.4	3.7/9.2	4.5/11.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.3/5.7	2.9/7.4	3.7/9.2	4.5/11.2
20'	Total Load	520	699	872	1,064			224	243	406	478	781	1,048	1,309	1,596
	Deflection L/240	401	590	826	*			178	193	318	372	602	885	1,239	*
	Min. End/Int. Bearing (in.)	2.0/5.1	2.7/6.8	3.4/8.5	4.1/10.3			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1	2.7/6.8	3.4/8.5	4.1/10.3
22'	Total Load	391	575	718	876			165	179	303	357	586	862	1,077	1,314
	Deflection L/240	304	448	629	850			134	145	240	281	456	672	944	1,275
	Min. End/Int. Bearing (in.)	1.7/4.2	2.5/6.2	3.1/7.7	3.8/9.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.5/6.2	3.1/7.7	3.8/9.4
24'	Total Load	300	448	600	732			124	135	230	272	450	672	900	1,099
	Deflection L/240	235	348	490	663			104	112	185	218	353	522	735	995
	Min. End/Int. Bearing (in.)	1.5/3.6	2.1/5.3	2.8/7.1	3.4/8.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.3	2.8/7.1	3.4/8.6
26'	Total Load	234	351	499	621			95	103	178	211	351	527	749	932
	Deflection L/240	186	275	388	527			82	88	146	172	279	413	583	790
	Min. End/Int. Bearing (in.)	1.5/3.5	1.8/4.6	2.6/6.4	3.2/7.9			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.6	2.6/6.4	3.2/7.9
28'	Total Load	185	279	399	533			73	80	139	166	278	419	599	799
	Deflection L/240	149	222	313	425			65	71	117	138	224	333	470	638
	Min. End/Int. Bearing (in.)	1.5/3.5	1.6/3.9	2.2/5.6	3.0/7.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/3.9	2.2/5.6	3.0/7.4
30'	Total Load	148	225	323	444			57	62	110	132	223	338	484	666
	Deflection L/240	122	181	256	348			53	58	95	112	183	271	384	522
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.0/4.9	2.7/6.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/4.9	2.7/6.6

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 27.*

2.0E Parallam® PSL: Roof—Snow Load Area 115% (PLF)

Span	Condition	3½" Width							5¼" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	1,691	1,746	2,142	2,291	2,826	2,933	2,933	2,537	2,619	3,213	3,436	4,240	4,400	4,400
	Deflection L/240	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.6/6.5	2.7/6.7	3.3/8.2	3.5/8.8	4.3/10.8	4.5/11.3	4.5/11.3	2.6/6.5	2.7/6.7	3.3/8.2	3.5/8.8	4.3/10.8	4.5/11.3	4.5/11.3
9'-6"	Total Load	1,255	1,320	1,738	1,854	2,268	2,467	2,467	1,883	1,980	2,607	2,781	3,402	3,700	3,700
	Deflection L/240	1,086	1,171	*	*	*	*	*	1,630	1,757	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.3/5.7	2.4/6.0	3.2/7.9	3.4/8.4	4.1/10.3	4.5/11.3	4.5/11.3	2.3/5.7	2.4/6.0	3.2/7.9	3.4/8.4	4.1/10.3	4.5/11.3	4.5/11.3
10'	Total Load	1,132	1,190	1,635	1,743	2,127	2,342	2,342	1,698	1,786	2,453	2,615	3,191	3,514	3,514
	Deflection L/240	940	1,013	1,626	*	*	*	*	1,410	1,520	2,439	*	*	*	*
	Min. End/Int. Bearing (in.)	2.2/5.4	2.3/5.7	3.1/7.8	3.3/8.4	4.1/10.2	4.5/11.3	4.5/11.3	2.2/5.4	2.3/5.7	3.1/7.8	3.3/8.4	4.1/10.2	4.5/11.3	4.5/11.3
12'	Total Load	734	793	1,135	1,258	1,704	1,949	1,949	1,101	1,190	1,703	1,887	2,557	2,923	2,923
	Deflection L/240	558	602	976	1,137	*	*	*	837	904	1,464	1,706	*	*	*
	Min. End/Int. Bearing (in.)	1.7/4.3	1.8/4.6	2.6/6.6	2.9/7.3	3.9/9.8	4.5/11.3	4.5/11.3	1.7/4.3	1.8/4.6	2.6/6.6	2.9/7.3	3.9/9.8	4.5/11.3	4.5/11.3
14'	Total Load	466	504	826	921	1,259	1,623	1,667	699	756	1,240	1,381	1,889	2,434	2,501
	Deflection L/240	357	386	629	734	1,171	*	*	535	579	943	1,102	1,757	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.2	3.4/8.5	4.4/10.9	4.5/11.3	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.2	3.4/8.5	4.4/10.9	4.5/11.3
16'-6"	Total Load	284	308	509	597	902	1,163	1,412	426	462	764	896	1,353	1,745	2,118
	Deflection L/240	220	238	391	457	735	1,074	*	331	358	587	686	1,103	1,611	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	2.9/7.2	3.7/9.3	4.5/11.3	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	2.9/7.2	3.7/9.3	4.5/11.2
18'-6"	Total Load	200	217	361	424	690	922	1,154	300	325	542	637	1,035	1,383	1,731
	Deflection L/240	157	170	280	328	529	776	1,084	236	256	420	492	794	1,164	1,626
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.3/8.3	4.1/10.3	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.3/8.3	4.1/10.3
20'	Total Load	157	170	285	335	548	786	984	235	255	427	503	822	1,179	1,476
	Deflection L/240	125	135	223	261	422	621	869	188	203	334	392	633	931	1,304
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.1/7.7	3.8/9.6	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.1/7.7	3.8/9.6
22'	Total Load	115	126	212	250	411	611	810	173	189	318	375	617	917	1,215
	Deflection L/240	94	102	168	197	320	472	662	141	153	252	296	480	708	994
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.5/8.7	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.5/8.7
24'	Total Load	87	95	161	191	315	471	668	130	142	242	286	473	707	1,002
	Deflection L/240	73	79	130	153	248	366	515	109	118	195	229	372	550	773
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9
26'	Total Load	66	72	124	148	246	369	525	100	109	187	222	369	554	788
	Deflection L/240	57	62	102	120	196	290	409	86	93	154	181	294	435	613
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8
28'	Total Load	51	56	97	116	195	294	420	77	84	146	174	292	441	630
	Deflection L/240	46	50	82	97	157	233	329	69	75	123	145	236	350	494
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9
30'	Total Load			77	92	156	236	339	60	65	116	138	234	355	509
	Deflection L/240			67	79	128	190	269	56	61	101	118	193	286	404
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1
32'	Total Load			61	74	126	192	277		51	92	111	189	289	416
	Deflection L/240			55	65	106	157	223		50	83	97	159	236	334
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.

*Also see **How to Use This Table** on page 26 and **General Assumptions** on page 5.*

2.0E Parallam® PSL: Roof—Snow Load Area 115% (PLF) *continued*

Span	Condition	7" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	3,383	3,492	4,285	4,582	5,653	5,866	5,866
	Deflection L/240	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.6/6.5	2.7/6.7	3.3/8.2	3.5/8.8	4.3/10.8	4.5/11.3	4.5/11.3
9'-6"	Total Load	2,511	2,641	3,477	3,709	4,536	4,934	4,934
	Deflection L/240	2,173	2,342	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.3/5.7	2.4/6.0	3.2/7.9	3.4/8.4	4.1/10.3	4.5/11.3	4.5/11.3
10'	Total Load	2,264	2,381	3,271	3,487	4,255	4,685	4,685
	Deflection L/240	1,880	2,027	3,252	*	*	*	*
	Min. End/Int. Bearing (in.)	2.2/5.4	2.3/5.7	3.1/7.8	3.3/8.4	4.1/10.2	4.5/11.3	4.5/11.3
12'	Total Load	1,468	1,586	2,271	2,517	3,409	3,898	3,898
	Deflection L/240	1,116	1,205	1,953	2,274	*	*	*
	Min. End/Int. Bearing (in.)	1.7/4.3	1.8/4.6	2.6/6.6	2.9/7.3	3.9/9.8	4.5/11.3	4.5/11.3
14'	Total Load	932	1,008	1,653	1,842	2,519	3,246	3,335
	Deflection L/240	714	772	1,258	1,469	2,342	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.5/6.2	3.4/8.5	4.4/10.9	4.5/11.3
16'-6"	Total Load	569	616	1,019	1,195	1,805	2,327	2,824
	Deflection L/240	441	477	782	915	1,470	2,148	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	2.9/7.2	3.7/9.3	4.5/11.3
18'-6"	Total Load	400	434	723	849	1,381	1,844	2,308
	Deflection L/240	315	341	560	656	1,058	1,553	2,168
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.3/8.3	4.1/10.3
20'	Total Load	314	340	570	671	1,096	1,572	1,969
	Deflection L/240	250	271	446	523	845	1,242	1,739
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.1/7.7	3.8/9.6
22'	Total Load	231	252	425	501	823	1,223	1,620
	Deflection L/240	189	204	337	395	640	944	1,325
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.5/8.7
24'	Total Load	174	190	323	382	631	942	1,336
	Deflection L/240	146	158	260	306	496	733	1,031
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9
26'	Total Load	133	145	249	296	492	739	1,051
	Deflection L/240	115	124	205	241	392	580	818
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8
28'	Total Load	102	112	195	232	390	588	840
	Deflection L/240	92	100	165	194	315	467	659
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9
30'	Total Load	80	87	154	184	312	473	679
	Deflection L/240	75	81	134	158	257	381	539
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1
32'	Total Load	62	68	123	148	253	385	555
	Deflection L/240	62	67	111	130	212	315	446
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 29.*

TimberStrand® LSL: Roof—Non-Snow Load Area 125% (PLF)

Span	Condition	1.3E Grade							1.55E Grade				
		3½" Width						5½" Plank Orientation	1¾" Width				
		4⅜"	5½"	7¼"	8⅝"	9¼"	11¼"	3½"	9¼"	9½"	11¼"	11⅞"	14"
3'	Total Load	1,924	2,978	5,047	7,032	7,442	7,442	1,514	3,782	3,959	4,717	4,717	4,717
	Deflection L/240 / L/360	*/1,420	*/2,547	*/4,885	*/*	*/*	*/*	*/1,224	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.8/4.5	3.1/7.6	4.3/10.6	4.5/11.3	4.5/11.3	1.5/3.5	3.6/9	3.8/9.4	4.5/11.3	4.5/11.3	4.5/11.3
4'	Total Load	1,080	1,673	2,836	3,951	4,516	5,579	1,084	2,413	2,508	3,248	3,536	3,536
	Deflection L/240 / L/360	977/651	*/1,215	*/2,476	*/3,764	*/4,423	*/*	820/546	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.3/5.7	3.2/8	3.6/9.1	4.5/11.3	1.5/3.5	3.1/7.7	3.2/8	4.1/10.3	4.5/11.3	4.5/11.3
5'	Total Load	647	1,068	1,812	2,526	2,887	4,197	533	1,771	1,835	2,318	2,507	2,827
	Deflection L/240 / L/360	521/347	993/662	*/1,398	*/2,188	*/2,605	*/4,154	431/287	*/1,553	*/1,658	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.8/4.6	2.6/6.4	2.9/7.3	4.2/10.6	1.5/3.5	2.8/7	2.9/7.3	3.7/9.2	4/10	4.5/11.3
6'	Total Load	317	614	1,256	1,751	2,002	2,911	258	1,370	1,442	1,802	1,938	2,354
	Deflection L/240 / L/360	309/206	595/397	*/857	*/1,367	*/1,641	*/2,692	253/169	*/978	*/1,048	*/1,605	*/1,831	*/*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.8	2.1/5.3	2.4/6.1	3.5/8.8	1.5/3.5	2.6/6.6	2.8/6.9	3.4/8.6	3.7/9.3	4.5/11.3
7'	Total Load	171	336	742	1,284	1,468	2,135	138	1,005	1,058	1,462	1,579	1,965
	Deflection L/240 / L/360	*/131	*/255	*/560	*/904	*/1,092	*/1,828	*/107	977/651	1,049/699	*/1,089	*/1,250	*/1,877
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.6	2.1/5.2	3/7.6	1.5/3.5	2.2/5.6	2.4/5.9	3.3/8.2	3.5/8.8	4.4/11
8'	Total Load	99	198	443	981	1,122	1,632	79	768	809	1,118	1,239	1,643
	Deflection L/240 / L/360	*/89	*/173	*/384	939/626	*/759	*/1,290	*/72	679/453	731/487	*/769	*/886	*/1,352
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4	1.8/4.6	2.6/6.6	1.5/3.5	2/4.9	2.1/5.2	2.9/7.1	3.2/7.9	4.2/10.5
9'-6"	Total Load		98	224	693	793	1,154		543	572	791	877	1,202
	Deflection L/240 / L/360		*/*	*/*	579/386	706/470	*/811		421/280	453/302	725/483	840/560	*/870
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6		1.7/4.1	1.7/4.4	2.4/6	2.7/6.7	3.6/9.1
10'	Total Load		79	182	624	714	1,040		480	515	713	791	1,084
	Deflection L/240 / L/360		*/*	*/*	500/333	611/407	*/704		364/242	392/261	630/420	731/487	*/760
	Min. End/Int. Bearing (in.)		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.3		1.5/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.5/8.7
12'	Total Load			85	386	474	719		283	306	493	547	750
	Deflection L/240 / L/360			*/*	296/197	362/241	634/423		216/144	233/155	378/252	440/293	696/464
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.4		1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.2
14'	Total Load				243	300	525		179	194	318	373	549
	Deflection L/240 / L/360				189/126	232/154	409/272		138/92	149/99	243/162	284/189	453/302
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.8		1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.5/6.2
16'-6"	Total Load				147	182	327		109	118	196	230	372
	Deflection L/240 / L/360				116/77	143/95	254/169		85/57	92/61	151/101	177/118	284/189
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5
18'-6"	Total Load				102	127	231		76	83	138	163	265
	Deflection L/240 / L/360				83/55	102/68	182/121		61/40	66/44	108/72	127/84	205/136
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4
20'	Total Load				79	99	181		59	64	109	128	210
	Deflection L/240 / L/360				66/44	81/54	145/96		48/32	52/35	86/57	101/67	163/109
	Min. End/Int. Bearing (in.)				1.5/3.5	1.5/3.5	1.5/3.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					53	101				61	72	120
	Deflection L/240 / L/360					47/31	84/56				50/33	59/39	96/64
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5				1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						60						73
	Deflection L/240 / L/360						53/35						61/40
	Min. End/Int. Bearing (in.)						1.5/3.5						1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.
- **For door and window applications, Weyerhaeuser recommends using the L/360 value for a live load deflection limit and the L/240 value for a total load limit.**

*Also see **How to Use This Table** on page 28 and **General Assumptions** on page 5.*

TimberStrand® LSL: Roof—Non-Snow Load Area 125% (PLF) *continued*

Span	Condition	1.55E Grade											
		3½" Width						5¼" Width (2- or 3-ply)					
		9¼"	9½"	11¼"	11⅞"	14"	16"	9¼"	9½"	11¼"	11⅞"	14"	16"
3'	Total Load	7,564	7,918	9,432	9,432	9,432	9,432	11,346	11,877	14,148	14,148	14,148	14,148
	Deflection L/240 / L/360	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	3.6/9	3.8/9.4	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3	3.6/9	3.8/9.4	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3
4'	Total Load	4,826	5,017	6,497	7,070	7,070	7,070	7,239	7,526	9,746	10,605	10,605	10,605
	Deflection L/240 / L/360	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	3.1/7.7	3.2/8	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3	3.1/7.7	3.2/8	4.1/10.3	4.5/11.3	4.5/11.3	4.5/11.3
5'	Total Load	3,542	3,670	4,637	5,015	5,652	5,652	5,313	5,506	6,956	7,522	8,478	8,478
	Deflection L/240 / L/360	*/3,106	*/3,316	*/*	*/*	*/*	*/*	*/4,659	*/4,975	*/*	*/*	*/*	*/*
	Min. End/Int. Bearing (in.)	2.8/7	2.9/7.3	3.7/9.2	4/10	4.5/11.3	4.5/11.3	2.8/7	2.9/7.3	3.7/9.2	4/10	4.5/11.3	4.5/11.3
6'	Total Load	2,741	2,884	3,604	3,876	4,707	4,707	4,111	4,326	5,406	5,814	7,061	7,061
	Deflection L/240 / L/360	*/1,957	*/2,097	*/3,210	*/3,662	*/*	*/*	*/2,936	*/3,146	*/4,816	*/5,493	*/*	*/*
	Min. End/Int. Bearing (in.)	2.6/6.6	2.8/6.9	3.4/8.6	3.7/9.3	4.5/11.3	4.5/11.3	2.6/6.6	2.8/6.9	3.4/8.6	3.7/9.3	4.5/11.3	4.5/11.3
7'	Total Load	2,011	2,116	2,924	3,158	3,930	4,032	3,016	3,174	4,386	4,737	5,895	6,048
	Deflection L/240 / L/360	1,954/1,302	2,098/1,399	*/2,179	*/2,501	*/3,755	*/*	2,931/1,954	3,148/2,098	*/3,269	*/3,752	*/5,633	*/*
	Min. End/Int. Bearing (in.)	2.2/5.6	2.4/5.9	3.3/8.2	3.5/8.8	4.4/11	4.5/11.3	2.2/5.6	2.4/5.9	3.3/8.2	3.5/8.8	4.4/11	4.5/11.3
8'	Total Load	1,537	1,618	2,236	2,479	3,286	3,526	2,306	2,427	3,354	3,719	4,930	5,289
	Deflection L/240 / L/360	1,359/906	1,462/974	*/1,538	*/1,773	*/2,705	*/*	2,038/1,359	2,193/1,462	*/2,307	*/2,660	*/4,058	*/*
	Min. End/Int. Bearing (in.)	2/4.9	2.1/5.2	2.9/7.1	3.2/7.9	4.2/10.5	4.5/11.3	2/4.9	2.1/5.2	2.9/7.1	3.2/7.9	4.2/10.5	4.5/11.3
9'-6"	Total Load	1,087	1,144	1,582	1,754	2,404	2,966	1,631	1,716	2,373	2,631	3,606	4,450
	Deflection L/240 / L/360	842/561	907/605	1,451/967	1,681/1,121	*/1,740	*/2,456	1,263/842	1,361/907	2,176/1,451	2,522/1,681	*/2,610	*/3,684
	Min. End/Int. Bearing (in.)	1.7/4.1	1.7/4.4	2.4/6	2.7/6.7	3.6/9.1	4.5/11.3	1.7/4.1	1.7/4.4	2.4/6	2.7/6.7	3.6/9.1	4.5/11.3
10'	Total Load	961	1,031	1,426	1,582	2,168	2,800	1,442	1,547	2,139	2,373	3,253	4,200
	Deflection L/240 / L/360	728/485	785/523	1,260/840	1,462/974	*/1,520	*/2,154	1,092/728	1,178/785	1,890/1,260	2,193/1,462	*/2,280	*/3,232
	Min. End/Int. Bearing (in.)	1.5/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.5/8.7	4.5/11.2	1.5/3.9	1.7/4.1	2.3/5.7	2.5/6.3	3.5/8.7	4.5/11.2
12'	Total Load	566	612	986	1,094	1,501	1,939	850	918	1,480	1,642	2,252	2,908
	Deflection L/240 / L/360	432/288	467/311	756/504	881/587	1,393/928	*/1,334	649/432	700/467	1,135/756	1,322/881	2,089/1,393	*/2,001
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.2	3.7/9.3	1.5/3.5	1.5/3.5	1.9/4.8	2.1/5.3	2.9/7.2	3.7/9.3
14'	Total Load	359	388	637	746	1,098	1,420	538	582	956	1,119	1,648	2,130
	Deflection L/240 / L/360	276/184	299/199	487/325	569/379	907/605	1,316/877	415/276	448/299	731/487	854/569	1,361/907	1,974/1,316
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.5/6.2	3.2/8	1.5/3.5	1.5/3.5	1.5/3.6	1.7/4.2	2.5/6.2	3.2/8
16'-6"	Total Load	218	236	392	460	744	1,017	327	354	588	690	1,116	1,526
	Deflection L/240 / L/360	171/114	185/123	303/202	354/236	569/379	832/555	256/171	277/185	455/303	532/354	854/569	1,248/832
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5	2.7/6.8	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5	2.7/6.8
18'-6"	Total Load	152	166	277	326	531	785	229	249	416	489	797	1,177
	Deflection L/240 / L/360	122/81	132/88	217/144	254/169	410/273	601/401	183/122	198/132	326/217	381/254	615/410	902/601
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4	2.4/5.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/4	2.4/5.9
20'	Total Load	119	129	218	257	421	624	179	194	327	385	631	936
	Deflection L/240 / L/360	97/64	105/70	172/115	202/135	327/218	481/320	145/97	157/105	259/172	304/202	491/327	722/481
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2/5.1
24'	Total Load	65	71	122	145	241	361	98	106	183	217	361	542
	Deflection L/240 / L/360	56/37	61/40	101/67	118/79	192/128	284/189	84/56	91/61	151/101	177/118	288/192	426/284
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6
28'	Total Load			73	87	147	224	56	61	109	130	221	336
	Deflection L/240 / L/360			64/42	75/50	122/81	181/120	53/35	58/38	96/64	112/75	183/122	271/181
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 31.*

1.9E Microllam® LVL: Roof—Non-Snow Load Area 125% (PLF)

Span	Condition	1¾" Width							3½" Width (2 ply)					
		5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"
6'	Total Load	451	954	1,285	1,329	1,656	1,781	1,961	902	1,908	2,571	2,659	3,313	3,563
	Deflection L/240	435	939	*	*	*	*	*	870	1,879	*	*	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2	4.5/11.3	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2
8'	Total Load	146	326	870	915	1,145	1,224	1,469	292	652	1,741	1,830	2,290	2,449
	Deflection L/240	*	*	833	896	*	*	*	*	*	1,666	1,792	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7.0	3.5/8.8	3.8/9.4	4.5/11.3	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7.0	3.5/8.8	3.8/9.4
9'-6"	Total Load	73	166	616	647	888	982	1,212	146	332	1,232	1,294	1,776	1,965
	Deflection L/240	*	*	516	556	*	*	*	*	*	1,032	1,112	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9	4.4/11.0	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9
10'	Total Load	59	135	555	583	801	886	1,137	118	270	1,110	1,167	1,602	1,772
	Deflection L/240	*	*	446	481	772	*	*	*	*	893	963	1,544	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5	4.4/10.9	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5
12'	Total Load		64	348	377	554	613	835	54	128	697	753	1,109	1,227
	Deflection L/240		*	265	286	463	540	*	*	*	530	572	927	1,080
	Min. End/Int. Bearing (in.)		1.5/3.5	1.6/4.0	1.7/4.4	2.6/6.4	2.8/7.1	3.9/9.6	1.5/3.5	1.5/3.5	1.6/4.0	1.7/4.4	2.6/6.4	2.8/7.1
14'	Total Load			221	239	392	449	611		66	443	479	785	898
	Deflection L/240			169	183	298	348	556		*	339	366	597	697
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	2.1/5.3	2.4/6.1	3.3/8.3		1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.3	2.4/6.1
16'-6"	Total Load			135	146	242	283	438			270	292	484	567
	Deflection L/240			104	113	185	217	349			209	227	371	435
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6	2.8/7.0			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6
18'-6"	Total Load			95	103	171	201	328			190	206	343	403
	Deflection L/240			74	81	133	155	251			149	162	266	311
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.4/5.9			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7
20'	Total Load			74	81	135	159	260			149	162	271	319
	Deflection L/240			59	64	106	124	200			119	128	212	248
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
22'	Total Load			55	59	101	119	195			110	119	202	238
	Deflection L/240			44	48	80	93	152			89	97	160	187
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
24'	Total Load					76	90	150			83	90	153	181
	Deflection L/240					61	72	117			69	75	123	145
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
26'	Total Load					59	70	117			63	69	118	140
	Deflection L/240					48	57	93			54	59	97	114
	Min. End/Int. Bearing (in.)					1.5/3.5	1.5/3.5	1.5/3.5			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5
28'	Total Load						55	92				53	93	110
	Deflection L/240						46	74				47	78	92
	Min. End/Int. Bearing (in.)						1.5/3.5	1.5/3.5				1.5/3.5	1.5/3.5	1.5/3.5
30'	Total Load							74					73	88
	Deflection L/240							61					63	75
	Min. End/Int. Bearing (in.)							1.5/3.5					1.5/3.5	1.5/3.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.

*Also see **How to Use This Table** on page 30 and **General Assumptions** on page 5.*

1.9E Microllam® LVL: Roof—Non-Snow Load Area 125% (PLF) *continued*

Span	Condition	3½" Width (2-ply)				5¼" Width (3-ply)									
		14"	16"	18"	20"	5½"	7¼"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"	20"
6'	Total Load	3,917	3,917	3,917	3,917	1,353	2,862	3,857	3,989	4,970	5,345	5,875	5,875	5,875	5,875
	Deflection L/240	*	*	*	*	1,305	2,819	*	*	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	2.2/5.5	2.9/7.4	3.1/7.6	3.8/9.5	4.1/10.2	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3
8'	Total Load	2,932	2,932	2,932	2,932	438	978	2,611	2,745	3,435	3,673	4,399	4,399	4,399	4,399
	Deflection L/240	*	*	*	*	*	*	2,499	2,688	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.7/6.7	2.8/7.0	3.5/8.8	3.8/9.4	4.5/11.3	4.5/11.3	4.5/11.3	4.5/11.3
9'-6"	Total Load	2,425	2,466	2,466	2,466	219	498	1,847	1,942	2,664	2,948	3,637	3,699	3,699	3,699
	Deflection L/240	*	*	*	*	*	*	1,548	1,669	*	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.4/11.0	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.2/5.6	2.4/5.9	3.2/8.1	3.6/8.9	4.4/11.0	4.5/11.3	4.5/11.3	4.5/11.3
10'	Total Load	2,275	2,342	2,342	2,342	177	406	1,666	1,751	2,403	2,659	3,412	3,513	3,513	3,513
	Deflection L/240	*	*	*	*	*	*	1,339	1,444	2,317	*	*	*	*	*
	Min. End/Int. Bearing (in.)	4.4/10.9	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.1/5.3	2.2/5.6	3.1/7.7	3.4/8.5	4.4/10.9	4.5/11.2	4.5/11.2	4.5/11.2
12'	Total Load	1,670	1,948	1,948	1,948	82	193	1,046	1,130	1,663	1,840	2,505	2,922	2,922	2,922
	Deflection L/240	*	*	*	*	*	*	795	859	1,391	1,620	*	*	*	*
	Min. End/Int. Bearing (in.)	3.9/9.6	4.5/11.3	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	1.6/4.0	1.7/4.4	2.6/6.4	2.8/7.1	3.9/9.6	4.5/11.2	4.5/11.2	4.5/11.2
14'	Total Load	1,223	1,571	1,667	1,667		100	664	719	1,178	1,347	1,835	2,356	2,500	2,500
	Deflection L/240	1,112	*	*	*		*	509	550	896	1,046	1,669	*	*	*
	Min. End/Int. Bearing (in.)	3.3/8.3	4.2/10.6	4.5/11.3	4.5/11.3		1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.3	2.4/6.1	3.3/8.3	4.2/10.6	4.5/11.2	4.5/11.2
16'-6"	Total Load	876	1,126	1,411	1,411			405	439	726	851	1,315	1,689	2,107	2,117
	Deflection L/240	698	1,020	*	*			314	340	557	652	1,047	1,530	*	*
	Min. End/Int. Bearing (in.)	2.8/7.0	3.6/9.0	4.5/11.3	4.5/11.3			1.5/3.5	1.5/3.5	1.6/3.9	1.8/4.6	2.8/7.0	3.6/9.0	4.5/11.2	4.5/11.2
18'-6"	Total Load	656	892	1,113	1,256			285	309	515	605	984	1,339	1,670	1,884
	Deflection L/240	502	737	1,030	*			224	243	399	467	754	1,106	1,545	*
	Min. End/Int. Bearing (in.)	2.4/5.9	3.2/8.0	4.0/10.0	4.5/11.3			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.7	2.4/5.9	3.2/8.0	4.0/10.0	4.5/11.2
20'	Total Load	520	761	950	1,158			224	243	406	478	781	1,142	1,425	1,737
	Deflection L/240	401	590	826	1,112			178	193	318	372	602	885	1,239	1,669
	Min. End/Int. Bearing (in.)	2.0/5.1	3.0/7.4	3.7/9.2	4.5/11.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/5.1	3.0/7.4	3.7/9.2	4.5/11.2
22'	Total Load	391	581	782	954			165	179	303	357	586	872	1,173	1,431
	Deflection L/240	304	448	629	850			134	145	240	281	456	672	944	1,275
	Min. End/Int. Bearing (in.)	1.7/4.2	2.5/6.3	3.4/8.4	4.1/10.2			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.5/6.3	3.4/8.4	4.1/10.2
24'	Total Load	300	448	635	798			124	135	230	272	450	672	952	1,197
	Deflection L/240	235	348	490	663			104	112	185	218	353	522	735	995
	Min. End/Int. Bearing (in.)	1.5/3.6	2.1/5.3	3.0/7.5	3.7/9.4			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.3	3.0/7.5	3.7/9.4
26'	Total Load	234	351	499	677			95	103	178	211	351	527	749	1,015
	Deflection L/240	186	275	388	527			82	88	146	172	279	413	583	790
	Min. End/Int. Bearing (in.)	1.5/3.5	1.8/4.6	2.6/6.4	3.5/8.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.6	2.6/6.4	3.5/8.6
28'	Total Load	185	279	399	547			73	80	139	166	278	419	599	820
	Deflection L/240	149	222	313	425			65	71	117	138	224	333	470	638
	Min. End/Int. Bearing (in.)	1.5/3.5	1.6/3.9	2.2/5.6	3.0/7.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.6/3.9	2.2/5.6	3.0/7.6
30'	Total Load	148	225	323	444			57	62	110	132	223	338	484	666
	Deflection L/240	122	181	256	348			53	58	95	112	183	271	384	522
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.0/4.9	2.7/6.6			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.0/4.9	2.7/6.6

* Indicates **Total Load** value controls.

How to Use This Table

1. Calculate total load (neglect beam weight) on the beam or header in pounds per linear foot (plf).
2. Select appropriate **Span** (center-to-center of bearing).
3. Scan horizontally to find the proper width, and a depth with a capacity that exceeds actual total load.
4. Review bearing length requirements to ensure adequacy.

*Also see **General Notes** on page 33.*

2.0E Parallam® PSL: Roof—Non-Snow Load Area 125% (PLF)

Span	Condition	3½" Width							5¼" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"	9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	1,839	1,899	2,330	2,491	2,933	2,933	2,933	2,759	2,848	3,494	3,737	4,400	4,400	4,400
	Deflection L/240	1,753	1,886	*	*	*	*	*	2,630	2,830	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.8/7.0	2.9/7.3	3.6/8.9	3.8/9.5	4.5/11.3	4.5/11.3	4.5/11.3	2.8/7.0	2.9/7.3	3.6/8.9	3.8/9.5	4.5/11.3	4.5/11.3	4.5/11.3
9'-6"	Total Load	1,365	1,436	1,890	2,017	2,467	2,467	2,467	2,048	2,154	2,836	3,025	3,700	3,700	3,700
	Deflection L/240	1,086	1,171	1,872	*	*	*	*	1,630	1,757	2,808	*	*	*	*
	Min. End/Int. Bearing (in.)	2.5/6.2	2.6/6.5	3.4/8.6	3.7/9.2	4.5/11.3	4.5/11.3	4.5/11.3	2.5/6.2	2.6/6.5	3.4/8.6	3.7/9.2	4.5/11.3	4.5/11.3	4.5/11.3
10'	Total Load	1,231	1,295	1,778	1,896	2,314	2,342	2,342	1,847	1,942	2,668	2,844	3,471	3,514	3,514
	Deflection L/240	940	1,013	1,626	1,886	*	*	*	1,410	1,520	2,439	2,830	*	*	*
	Min. End/Int. Bearing (in.)	2.4/5.9	2.5/6.2	3.4/8.5	3.6/9.1	4.4/11.1	4.5/11.3	4.5/11.3	2.4/5.9	2.5/6.2	3.4/8.5	3.6/9.1	4.4/11.1	4.5/11.3	4.5/11.3
12'	Total Load	734	793	1,235	1,369	1,854	1,949	1,949	1,101	1,190	1,853	2,053	2,781	2,923	2,923
	Deflection L/240	558	602	976	1,137	1,797	*	*	837	904	1,464	1,706	2,696	*	*
	Min. End/Int. Bearing (in.)	1.7/4.3	1.8/4.6	2.9/7.1	3.2/7.9	4.3/10.7	4.5/11.3	4.5/11.3	1.7/4.3	1.8/4.6	2.9/7.1	3.2/7.9	4.3/10.7	4.5/11.3	4.5/11.3
14'	Total Load	466	504	826	966	1,370	1,667	1,667	699	756	1,240	1,449	2,055	2,501	2,501
	Deflection L/240	357	386	629	734	1,171	*	*	535	579	943	1,102	1,757	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.6/6.5	3.7/9.2	4.5/11.3	4.5/11.3	1.5/3.5	1.5/3.5	2.2/5.6	2.6/6.5	3.7/9.2	4.5/11.3	4.5/11.3
16'-6"	Total Load	284	308	509	597	965	1,266	1,412	426	462	764	896	1,447	1,899	2,118
	Deflection L/240	220	238	391	457	735	1,074	*	331	358	587	686	1,103	1,611	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	3.1/7.7	4.0/10.1	4.5/11.3	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	3.1/7.7	4.0/10.1	4.5/11.3
18'-6"	Total Load	200	217	361	424	690	1,003	1,256	300	325	542	637	1,035	1,505	1,884
	Deflection L/240	157	170	280	328	529	776	1,084	236	256	420	492	794	1,164	1,626
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.6/9.0	4.5/11.3	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.6/9.0	4.5/11.3
20'	Total Load	157	170	285	335	548	810	1,071	235	255	427	503	822	1,216	1,607
	Deflection L/240	125	135	223	261	422	621	869	188	203	334	392	633	931	1,304
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.2/7.9	4.2/10.4	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.2/7.9	4.2/10.4
22'	Total Load	115	126	212	250	411	611	863	173	189	318	375	617	917	1,295
	Deflection L/240	94	102	168	197	320	472	662	141	153	252	296	480	708	994
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.7/9.3	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.7/9.3
24'	Total Load	87	95	161	191	315	471	668	130	142	242	286	473	707	1,002
	Deflection L/240	73	79	130	153	248	366	515	109	118	195	229	372	550	773
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9
26'	Total Load	66	72	124	148	246	369	525	100	109	187	222	369	554	788
	Deflection L/240	57	62	102	120	196	290	409	86	93	154	181	294	435	613
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8
28'	Total Load	51	56	97	116	195	294	420	77	84	146	174	292	441	630
	Deflection L/240	46	50	82	97	157	233	329	69	75	123	145	236	350	494
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9
30'	Total Load			77	92	156	236	339	60	65	116	138	234	355	509
	Deflection L/240			67	79	128	190	269	56	61	101	118	193	286	404
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1
32'	Total Load			61	74	126	192	277		51	92	111	189	289	416
	Deflection L/240			55	65	106	157	223		50	83	97	159	236	334
	Min. End/Int. Bearing (in.)			1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5		1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5

* Indicates **Total Load** value controls.

General Notes

- Table is based on:
  - Uniform loads (beam weight considered).
  - More restrictive of simple or continuous span.
  - Deflection criteria of L/180 total load. For stiffer deflection criteria, use L/240 values for total load deflection.

*Also see **How to Use This Table** on page 32 and **General Assumptions** on page 5.*

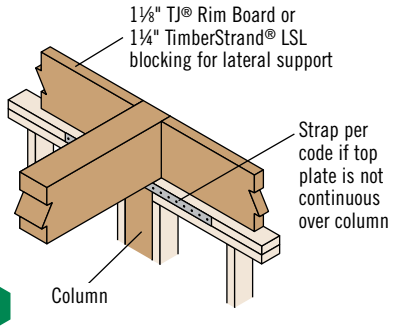
2.0E Parallam® PSL: Roof—Non-Snow Load Area 125% (PLF) *continued*

Span	Condition	7" Width						
		9¼"	9½"	11¼"	11⅞"	14"	16"	18"
8'	Total Load	3,679	3,798	4,660	4,983	5,866	5,866	5,866
	Deflection L/240	3,507	3,773	*	*	*	*	*
	Min. End/Int. Bearing (in.)	2.8/7.0	2.9/7.3	3.6/8.9	3.8/9.5	4.5/11.3	4.5/11.3	4.5/11.3
9'-6"	Total Load	2,731	2,872	3,781	4,034	4,934	4,934	4,934
	Deflection L/240	2,173	2,342	3,745	*	*	*	*
	Min. End/Int. Bearing (in.)	2.5/6.2	2.6/6.5	3.4/8.6	3.7/9.2	4.5/11.3	4.5/11.3	4.5/11.3
10'	Total Load	2,462	2,590	3,557	3,792	4,628	4,685	4,685
	Deflection L/240	1,880	2,027	3,252	3,773	*	*	*
	Min. End/Int. Bearing (in.)	2.4/5.9	2.5/6.2	3.4/8.5	3.6/9.1	4.4/11.1	4.5/11.3	4.5/11.3
12'	Total Load	1,468	1,586	2,471	2,738	3,708	3,898	3,898
	Deflection L/240	1,116	1,205	1,953	2,274	3,595	*	*
	Min. End/Int. Bearing (in.)	1.7/4.3	1.8/4.6	2.9/7.1	3.2/7.9	4.3/10.7	4.5/11.3	4.5/11.3
14'	Total Load	932	1,008	1,653	1,933	2,741	3,335	3,335
	Deflection L/240	714	772	1,258	1,469	2,342	*	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	2.2/5.6	2.6/6.5	3.7/9.2	4.5/11.3	4.5/11.3
16'-6"	Total Load	569	616	1,019	1,195	1,930	2,532	2,824
	Deflection L/240	441	477	782	915	1,470	2,148	*
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.6/4.1	1.9/4.8	3.1/7.7	4.0/10.1	4.5/11.3
18'-6"	Total Load	400	434	723	849	1,381	2,007	2,512
	Deflection L/240	315	341	560	656	1,058	1,553	2,168
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.9	2.5/6.2	3.6/9.0	4.5/11.3
20'	Total Load	314	340	570	671	1,096	1,621	2,143
	Deflection L/240	250	271	446	523	845	1,242	1,739
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	2.1/5.4	3.2/7.9	4.2/10.4
22'	Total Load	231	252	425	501	823	1,223	1,727
	Deflection L/240	189	204	337	395	640	944	1,325
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5	2.6/6.6	3.7/9.3
24'	Total Load	174	190	323	382	631	942	1,336
	Deflection L/240	146	158	260	306	496	733	1,031
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.8	2.2/5.6	3.1/7.9
26'	Total Load	133	145	249	296	492	739	1,051
	Deflection L/240	115	124	205	241	392	580	818
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.9/4.8	2.7/6.8
28'	Total Load	102	112	195	232	390	588	840
	Deflection L/240	92	100	165	194	315	467	659
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.7/4.2	2.3/5.9
30'	Total Load	80	87	154	184	312	473	679
	Deflection L/240	75	81	134	158	257	381	539
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.6	2.1/5.1
32'	Total Load	62	68	123	148	253	385	555
	Deflection L/240	62	67	111	130	212	315	446
	Min. End/Int. Bearing (in.)	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.5/3.5	1.8/4.5

* Indicates **Total Load** value controls.

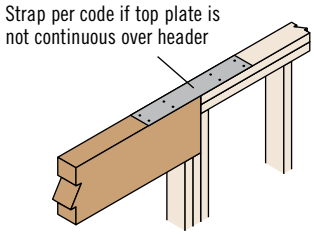
BEAM DETAILS

Bearing at Wall



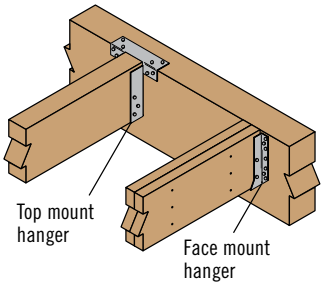
L1

Bearing for Door or Window Header



L2

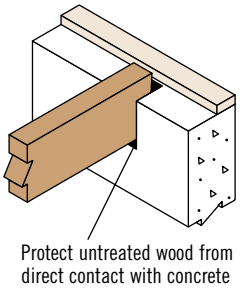
Beam to Beam Connection



L3

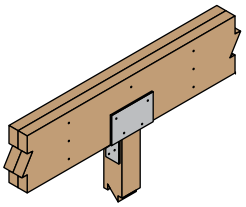
See Framing Connectors on pages 40 and 41

Bearing at Concrete Wall



L4

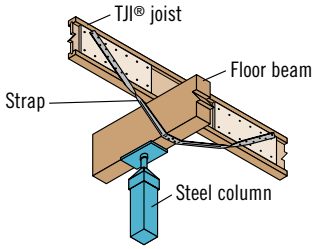
Bearing at Column



L5

Verify beam bearing length on page 36 and column capacity on page 42

Beam to Column Lateral Brace



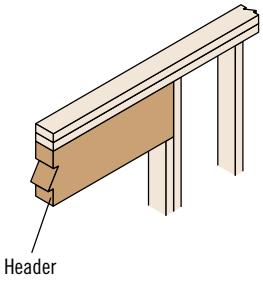
L14

Suggested lateral bracing detail for beams when required. Verify beam bearing length on page 36.

WINDOW AND DOOR HEADER DETAILS

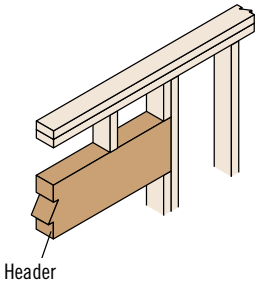
2x4 Wall Framing

Full Depth Header



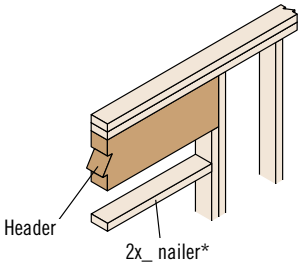
L7

Low Header



L8

High Header



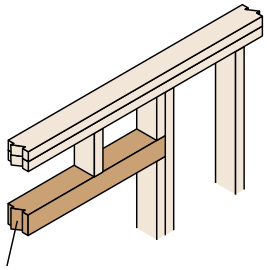
L9

**Double nailer may be required depending upon the opening size and window type*

2x6 Wall Framing

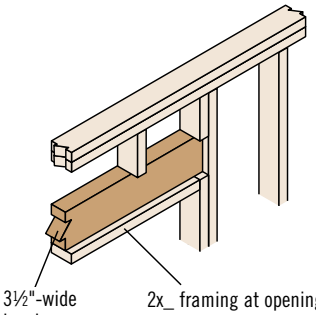
Headers not matching wall thickness may be installed flush to the inside or outside of the wall, depending upon sheathing and trim attachment requirements

Plank Orientation Header



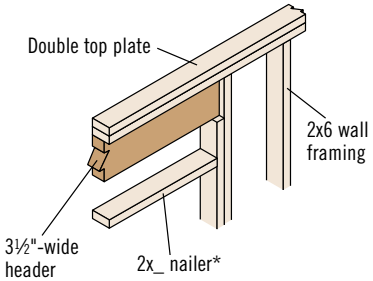
L10

Low Header



L11

High Header

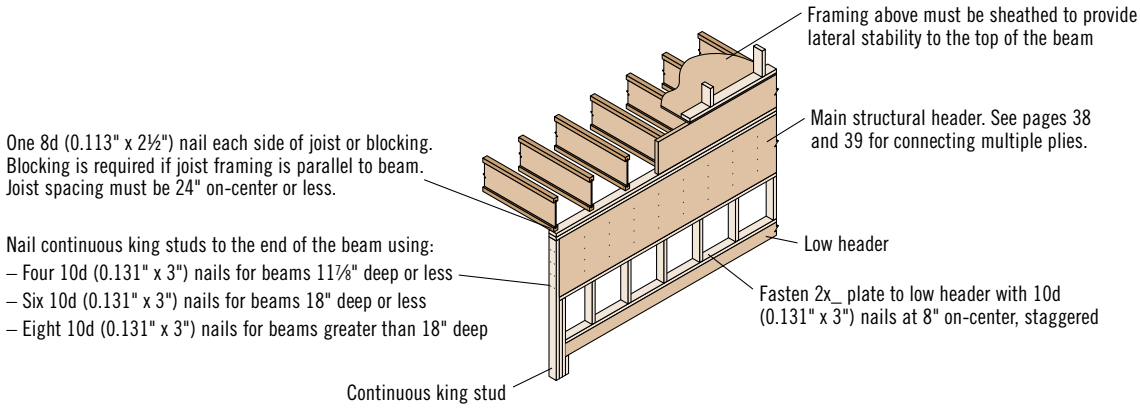


L12

**Double nailer may be required depending upon the opening size and window type*

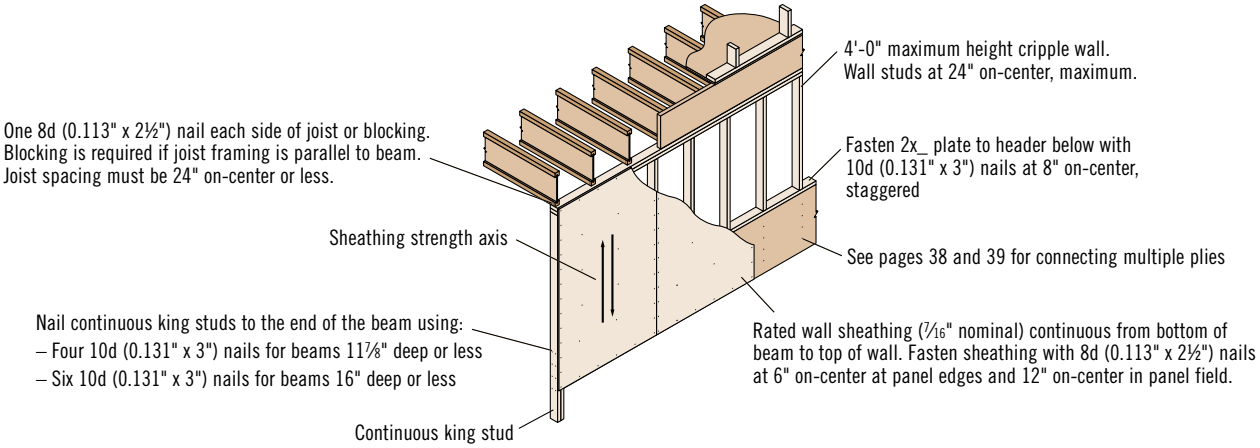
WINDOW AND DOOR HEADER DETAILS

Dropped Header with Full Lateral Bracing



L15

Dropped Header with Acceptable Lateral Bracing



L16

When framed as shown above, the following dropped headers are considered fully braced under uniform-load, simple-span conditions:

Single-ply:

– 1¾" wide headers, 11⅞" deep or less
– 3½" wide headers, 16" deep or less, with a maximum span of 18'-6"

Multiple-ply:

– Headers up to four 1¾" plies, 11⅞" deep or less
– Headers up to four 1¾" x 14" plies, with a maximum span of 8'-6"

NAILING ON NARROW FACE

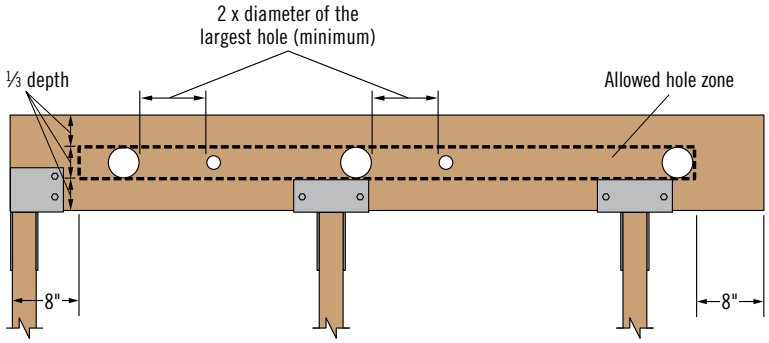
Nails Installed on the Narrow Face

Nail Size	Closest On-Center Spacing Per Row			
	1¾" TimberStrand® LSL	3½" TimberStrand® LSL	Microllam® LVL	Parallam® PSL
8d (0.131" x 2½") or 10d (0.128" x 3")	3"	3"	3"	3"
10d (0.148" x 3") or 12d (0.148" x 3¼")	4"	3"	4"	4"
16d (0.162" x 3½")	6"	3½"	8"	6"

- If more than one row of nails is used, the rows must be offset at least ½" and staggered.

ALLOWABLE HOLES

1.55E TimberStrand® LSL Headers and Beams



General Notes

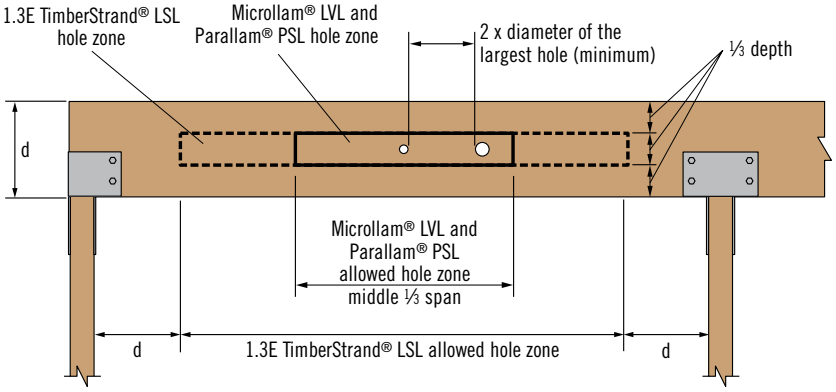
- Allowed hole zone suitable for headers and beams with **uniform and/or concentrated loads** anywhere along the member.
- Round holes only.
- No holes in headers or beams in plank orientation.

1.55E TimberStrand® LSL

Header or Beam Depth	Maximum Round Hole Size
9¼"–9½"	3"
11¼"–11⅞"	3⅝"
14"–16"	4⅝"

- See illustration for allowed hole zone.

Other Trus Joist® Headers and Beams



General Notes

- Allowed hole zone suitable for headers and beams with **uniform loads only**.
- Round holes only.
- No holes in cantilevers.
- No holes in headers or beams in plank orientation.

Other Trus Joist® Beams

Header or Beam Depth	Maximum Round Hole Size
4⅜"	1"
5½"	1¾"
7¼"–20"	2"

- See illustration for allowed hole zone.

DO NOT cut, notch, or drill holes in headers or beams except as indicated in the illustrations and tables

WARNING: Drilling, sawing, sanding or machining wood products generates wood dust. The paint and/or coatings on this product may contain titanium dioxide. Wood dust and titanium dioxide are substances known to the State of California to cause cancer. For more information on Proposition 65, visit wy.com/inform.

BEARING LENGTH REQUIREMENTS

Reaction (lbs)	1.3E TimberStrand® LSL		1.55E TimberStrand® LSL			1.9E Microllam® LVL			2.0E Parallam® PSL		
	Beam Orientation	Plank Orientation	Beam Orientation			Beam Orientation			Beam Orientation		
	Width	Width	Width			Width			Width		
	3½"	5½"	1¾"	3½"	5¼"	1¾"	3½"	5¼"	3½"	5¼"	7"
2,000	1½"	1½"	1½"	1½"	1½"	1¾"	1½"	1½"	1½"	1½"	1½"
4,000	1¾"	2"	2¾"	1½"	1½"	3¼"	1¾"	1½"	1¾"	1½"	1½"
6,000	2½"	3"	4"	2"	1½"	4¾"	2½"	1¾"	2½"	1¾"	1½"
8,000	3¼"	4"	5¼"	2¾"	1¾"	6¼"	3¼"	2¼"	3¼"	2¼"	1¾"
10,000	4¼"	5"	6½"	3¼"	2¼"	7¾"	4"	2¾"	4"	2¾"	2"
12,000	5"	6"	7¾"	4"	2¾"		4¾"	3¼"	4¾"	3¼"	2½"
14,000	5¾"	7"		4½"	3"		5½"	3¾"	5½"	3¾"	2¾"
16,000	6½"			5¼"	3½"		6¼"	4¼"	6¼"	4¼"	3¼"
18,000	7¼"			5¾"	4"		7"	4¾"	7"	4¾"	3½"
20,000				6½"	4¼"		7¾"	5¼"	7¾"	5¼"	4"
22,000				7"	4¾"			5¾"		5¾"	4¼"
24,000				7¾"	5¼"			6¼"		6¼"	4¾"
26,000					5¾"			6¾"		6¾"	5"
28,000					6"			7¼"		7¼"	5½"
30,000					6½"			7¾"		7¾"	5¾"

General Notes

- **Minimum bearing length:** 1½" at ends, 3½" at intermediate supports.
- Bearing across full beam width required.
- Interpolation between reaction loads is permitted for determining bearing lengths.
- Bearing lengths based on the following bearing stresses:
  - **1.3E TimberStrand® LSL:** 710 psi; 375 psi for plank orientation.
  - **1.55E TimberStrand® LSL:** 900 psi.
  - **1.9E Microllam® LVL:** 750 psi.
  - **2.0E Parallam® PSL:** 750 psi.

TAPERED END CUTS

Allowable Reactions for 3½"(1) TimberStrand® LSL Headers and Beams (lbs)

Bearing	Beam Depth	Outside Heel Height D_1							
		4½"	5"	5½"	6"	6½"	7"	7½"	8"
3½" Wood Plate(2)	7¼"	5,205	5,205	5,205	5,205				
	8⅝"	5,205	5,205	5,205	5,205	5,205	5,205	5,205	
	9¼"	4,860	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	9½"	4,860	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	11¼"	4,860	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	11⅞"	4,860	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	14"		5,205	5,205	5,205	5,205	5,205	5,205	5,205
	16"				5,205	5,205	5,205	5,205	5,205
5¼" Wood Plate(2)	7¼"	7,190	7,190	7,190					
	8⅝"	7,205	7,810	7,810	7,810	7,810	7,810		
	9¼"	5,255	5,710	6,160	6,610	6,690	6,690	6,690	
	9½"	5,255	5,710	6,160	6,610	6,870	6,870	6,870	6,870
	11¼"	5,255	5,710	6,160	6,610	7,065	7,515	7,810	7,810
	11⅞"	5,255	5,710	6,160	6,610	7,065	7,515	7,810	7,810
	14"	5,255	5,710	6,160	6,610	7,065	7,515	7,810	7,810
	16"			6,160	6,610	7,065	7,515	7,810	7,810
3½" Column(3)	7¼"	6,665	7,190	7,190	7,190				
	8⅝"	6,665	7,285	7,900	8,520	8,555	8,555	8,555	
	9¼"	4,860	5,310	5,765	6,215	6,670	6,690	6,690	6,690
	9½"	4,860	5,310	5,765	6,215	6,670	6,870	6,870	6,870
	11¼"	4,860	5,310	5,765	6,215	6,670	7,120	7,570	8,025
	11⅞"	4,860	5,310	5,765	6,215	6,670	7,120	7,570	8,025
	14"		5,310	5,765	6,215	6,670	7,120	7,570	8,025
	16"				6,215	6,670	7,120	7,570	8,025

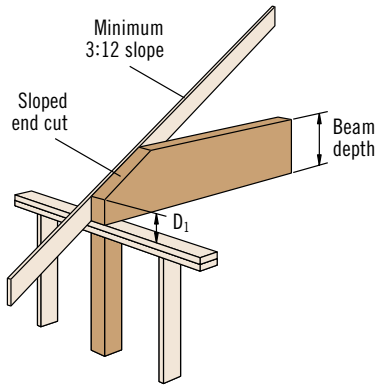
(1) For 1¾" and 5¼" beams, multiply by 0.5 and 1.5, respectively.

(2) Bearing lengths, based on $F_{c\perp}$ of 425 psi.

(3) Bearing lengths based on $F_{c\perp}$ of 710 psi for 1.3E TimberStrand® LSL and 900 psi for 1.55E TimberStrand® LSL.

General Notes

- No increase for duration of load is permitted.
- No holes or concentrated load within tapered cut.
- Table considers only downward loading. Contact your Weyerhaeuser representative for assistance with uplift loading or other conditions.



Tapered end cut detailed above is not allowed with TJI® joists

Allowable Reactions for 3½"(1) Microllam® LVL and Parallam® PSL Beams (lbs)

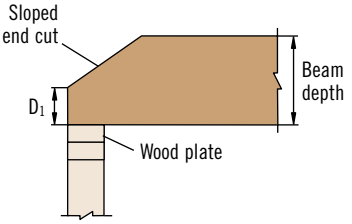
Bearing	Beam Depth	Outside Heel Height D_1								
		4½"	5"	5½"	6"	6½"	7"	7½"	8"	10"
3½" Wood Plate(2)	7¼"	4,470	4,820	4,820	4,820					
	9¼"	4,470	4,885	5,205	5,205	5,205	5,205	5,205	5,205	
	9½"	4,470	4,885	5,205	5,205	5,205	5,205	5,205	5,205	
	11¼"	4,470	4,885	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	11⅞"	4,470	4,885	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	14"		4,885	5,205	5,205	5,205	5,205	5,205	5,205	5,205
	16"				5,205	5,205	5,205	5,205	5,205	5,205
	18"					5,205	5,205	5,205	5,205	5,205
	20"							5,205	5,205	5,205
5¼" Wood Plate(2)	7¼"	4,820	4,820	4,820						
	9¼"	4,830	5,245	5,665	6,080	6,150	6,150	6,150		
	9½"	4,830	5,245	5,665	6,080	6,320	6,320	6,320	6,320	
	11¼"	4,830	5,245	5,665	6,080	6,495	6,910	7,325	7,480	
	11⅞"	4,830	5,245	5,665	6,080	6,495	6,910	7,325	7,740	7,810
	14"	4,830	5,245	5,665	6,080	6,495	6,910	7,325	7,740	7,810
	16"			5,665	6,080	6,495	6,910	7,325	7,740	7,810
	18"				6,080	6,495	6,910	7,325	7,740	7,810
	20"						6,910	7,325	7,740	7,810
3½" Column(3)	7¼"	4,470	4,820	4,820	4,820					
	9¼"	4,470	4,885	5,300	5,715	6,130	6,150	6,150	6,150	
	9½"	4,470	4,885	5,300	5,715	6,130	6,320	6,320	6,320	
	11¼"	4,470	4,885	5,300	5,715	6,130	6,545	6,960	7,375	7,480
	11⅞"	4,470	4,885	5,300	5,715	6,130	6,545	6,960	7,375	7,895
	14"		4,885	5,300	5,715	6,130	6,545	6,960	7,375	9,040
	16"				5,715	6,130	6,545	6,960	7,375	9,040
	18"					6,130	6,545	6,960	7,375	9,040
	20"							6,960	7,375	9,040

(1) For 1¾", 5¼", and 7" beams, multiply by 0.5, 1.5, and 2.0, respectively.

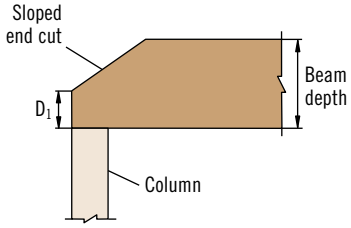
(2) Bearing lengths based on $F_{c\perp}$ of 425 psi.

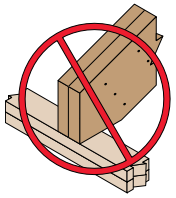
(3) Bearing lengths based on $F_{c\perp}$ of 750 psi.

Wood Plate Connection



Column Connection

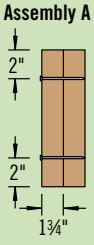
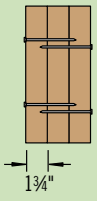
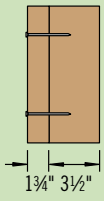
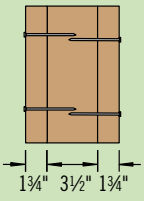
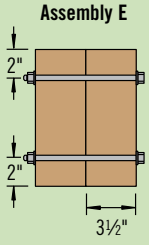
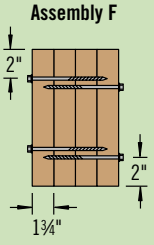




DO NOT overhang seat cuts on beams beyond inside face of support member

MULTIPLE-MEMBER CONNECTIONS FOR SIDE-LOADED BEAMS

L17 Uniform Load—Maximum Uniform Load Applied to Either Outside Member (PLF)

Fastener Type	Number of Rows	Fastener On-Center Spacing	Fastener Pattern					
			Assembly A 	Assembly B 	Assembly C 	Assembly D 	Assembly E 	Assembly F 
			3½" wide, 2-ply	5¼" wide, 3-ply	5¼" wide, 2-ply	7" wide, 3-ply	7" wide, 2-ply	7" wide, 4-ply
10d (0.128" x 3") Nail[1]	2	12"	370	***280***	280	***245***		
	3	12"	555	***415***	415	***370***		
½" A307 Through Bolts[2][3]	2	24"	505	380	520	465	860	340
		19.2"	635	475	655	580	1,075	425
		16"	760	570	785	695	1,290	505
SDS ¼" x 3½"[3]	2	24"	680	***510***	510	***455***		
		19.2"	850	***640***	640	***565***		
		16"	1,020	***765***	765	***680***		
SDS ¼" x 6"[3]	2	24"				***455***	***465***	***455***
		19.2"				***565***	***580***	***565***
		16"				***680***	***695***	***680***
USP WS35[3]	2	24"	480	***360***	360	***320***		
		19.2"	600	***450***	450	***400***		
		16"	715	***540***	540	***480***		
USP WS6[3]	2	24"				***350***	***525***	***350***
		19.2"				***440***	***660***	***440***
		16"				***525***	***790***	***525***
3⅜" TrussLOK®[3]	2	24"	535	***400***	400	***355***		
		19.2"	670	***500***	500	***445***		
		16"	800	***600***	600	***535***		
5" TrussLOK®[3]	2	24"		435	435	***385***		
		19.2"		545	545	***485***		
		16"		655	655	***580***		
6¾" TrussLOK®[3]	2	24"				385	580	385
		19.2"				485	725	485
		16"				580	870	580
3⅜" SDW22[3]	2	24"	800	***600***	600	***535***		
		19.2"	1,000	***750***	750	***665***		
		16"	1,200	***900***	900	***800***		
5" SDW22[3]	2	24"		450	450	***535***		
		19.2"		565	565	***665***		
		16"		675	675	***800***		
6¾" SDW22[3]	2	24"				400	800	400
		19.2"				500	1,000	500
		16"				600	1,200	600

(1) Nailed connection values may be doubled for 6" on-center or tripled for 4" on-center nail spacing.

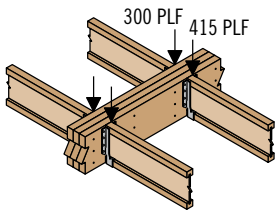
(2) Washers required. Bolt holes to be 9⁄16" maximum.

(3) 24" on-center bolted and screwed connection values may be doubled for 12" on-center spacing.

General Notes

- Connections are based on NDS® 2005 or manufacturer's test or code reports.
- Use specific gravity of 0.5 when designing lateral connections.
- Values listed are for 100% stress level. Increase 15% for snow-loaded roof conditions or 25% for non-snow roof conditions, where code allows.
- ***Bold Italic*** cells indicate **Fastener Pattern** must be installed on both sides. Stagger fasteners on the second side so they fall halfway between fasteners on the first side.
- Verify adequacy of beam in allowable load tables on pages 16–33.
- 7" wide beams should be side-loaded only when loads are applied to both sides of the members (to minimize rotation).
- Minimum end distance for bolts and screws is 6".
- Beams wider than 7" require special consideration by the design professional of record.

Uniform Load Design Example

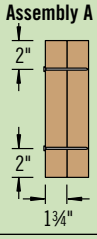
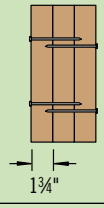
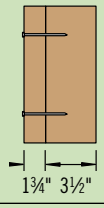
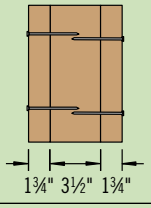
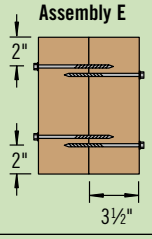
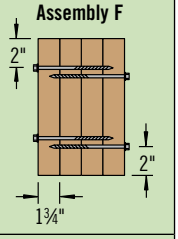


First, check the allowable load tables on pages 16–33 to verify that three pieces can carry the total load of 715 plf with proper live load deflection criteria. Maximum load applied to either outside member is 415 plf. For a 3-ply, 1¾" assembly, two rows of 10d (0.128" x 3") nails at 12" on-center is good for only 280 plf. Therefore, use three rows of 10d (0.128" x 3") nails at 12" on-center (good for 415 plf).

Alternative: Two rows of ½" bolts or ¼" x 3½" SDS screws at 19.2" on-center.

MULTIPLE-MEMBER CONNECTIONS FOR SIDE-LOADED BEAMS

L18 Point Load—Maximum Point Load Applied to Either Outside Member (lbs)

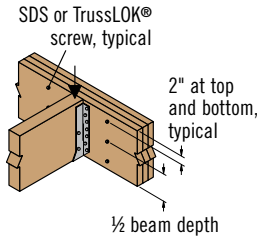
Fastener Type	Number of Fasteners	Fastener Pattern: Assembly A	Assembly B	Assembly C	Assembly D	Assembly E	Assembly F
							
		3½" wide, 2-ply	5¼" wide, 3-ply	5¼" wide, 2-ply	7" wide, 3-ply	7" wide, 2-ply	7" wide, 4-ply
10d (0.128" x 3") Nail	6	1,110	***835***	835	***740***		
	12	2,225	***1,670***	1,670	***1,485***		
	18	3,335	***2,505***	2,505	***2,225***		
	24	4,450	***3,335***	3,335	***2,965***		
¼" x 3½" or ¼" x 6" SDS, USP WS35, or USP WS6	4	1,915	***1,435***	1,435	***1,275***	***1,860***(3)	***1,405***(3)
	6	2,870	***2,155***	2,155	***1,915***	***2,785***(3)	***2,110***(3)
	8	3,825	***2,870***	2,870	***2,550***	***3,715***(3)	***2,810***(3)
3⅜", 5", or 6¾" TrussLOK®	4	2,135	***1,600***(1)	1,600	***1,425***(2)	2,320(4)	1,425(4)
	6	3,205	***2,405***(1)	2,405	***2,135***(2)	3,480(4)	2,135(4)
	8	4,270	***3,205***(1)	3,205	***2,850***(2)	4,640(4)	2,850(4)
3⅜", 5", or 6¾" SDW22	4	3,200	***1,800***(1)	1,800	***1,600***(2)	3,200(4)	1,600(4)
	6	4,800	***2,700***(1)	2,700	***2,400***(2)	4,800(4)	2,400(4)
	8	6,400	***3,600***(1)	3,600	***3,200***(2)	6,400(4)	3,200(4)

(1) 5" long screws screws may be installed from one side only.
(2) 6¾" long screws screws may be installed from one side only.
(3) 6" long screw required.
(4) 6¾" long screw required.

Bold italic cells indicate that fastener pattern must be installed from both sides. See General Notes on page 38.

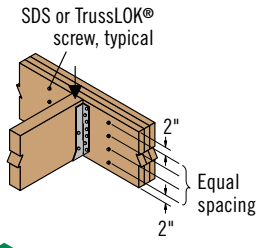
Point Load Connector Spacing

4- or 6-Screw Connection



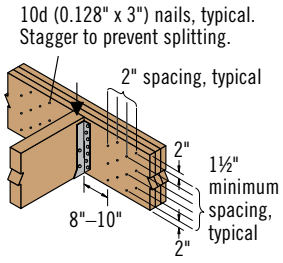
L19

8-Screw Connection



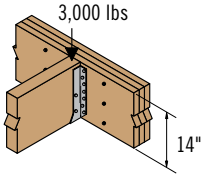
L20

Nail Connection



L21 ***There must be an equal number of nails on each side of the connection***

Point Load Design Example



First, verify that a 3-ply, 1¾" x 14" beam can support a 3,000 lb point load and all other loads applied. The 3,000 lb point load is being transferred to the beam with a face mount hanger. For a 3-ply, 1¾" assembly, eight 3⅜" TrussLOK® screws are good for 3,205 lbs with a face mount hanger.

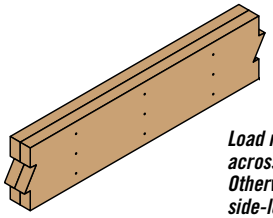
MULTIPLE-MEMBER CONNECTIONS FOR TOP-LOADED BEAMS

Fastener Installation Requirements

Piece Width	# of Plies	Fastener: Type(1)	Min. Length	# Rows	O.C. Spacing	Location
1¾"	2	10d nails	3"	3(2)	12"	One side
		12d–16d nails	3¼"	2(2)		
		Screws	3⅜" or 3½"	2	24"	
	3	10d nails	3"	3(2)	12"	Both sides
		12d–16d nails	3¼"	2(2)		
		Screws	3⅜" or 3½"	2	24"	Both sides
			5"			One side
	4	10d nails(3)	3"	3(2)	12"	One side (per ply)
		12d–16d nails(3)	3¼"	2(2)		
		Screws	5" or 6"	2	24"	Both sides
			6¾"			One side
3½"	2	Screws	5" or 6"	2	24"	Both sides
			6¾"			One side
		½" bolts	8"	2	24"	–

(1) 10d nails are 0.128" diameter; 12d–16d nails are 0.148"–0.162" diameter; screws are SDS, SDW, USP WS, or TrussLOK®.
(2) An additional row of nails is required with depths of 14" or greater.
(3) When connecting 4-ply members, nail each ply to the other and offset nail rows by 2" from the rows in ply below.

When fasteners are required on both sides, stagger fasteners on the second side so they fall halfway between fasteners on the first side.



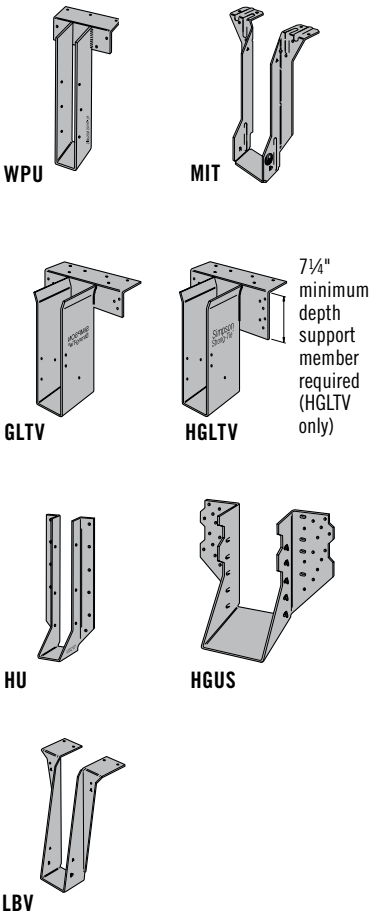
Load must be applied evenly across entire beam width. Otherwise, use connections for side-loaded beams

L6 ***Multiple pieces can be nailed or bolted together to form a header or beam of the required size, up to a maximum width of 7"***

Top Mount Hangers—Simpson Strong-Tie®

Supported Member Width	Supported Member Depth	Hanger	Nail Type		Allowable Load (lbs)—100%(1) Support Member Material		
			Header	Joist	LSL, LVL, PSL	DF/SP	SPF
1¾"	9¼"	WPU1.81/9.25	16d	10d x 1½"	3,650	4,165	4,165
		LBV1.81/9.25	16d	10d x 1½"	2,885	2,590	2,060
	9½"	MIT9.5	16d	10d x 1½"	2,115	2,305	1,665
		LBV1.81/9.5	16d	10d x 1½"	2,885	2,590	2,060
	11¼"	WPU1.81/11.25	16d	10d x 1½"	3,650	4,165	4,165
		LBV1.81/11.25	16d	10d x 1½"	2,885	2,590	2,060
	11⅞"	MIT11.88	16d	10d x 1½"	2,115	2,305	1,665
		BA1.81/11.88	16d	10d x 1½"	3,705	3,435	2,665
	14"	B1.81/14	16d	10d x 1½"	3,355	3,640	2,650
3½"	9¼"	HB3.56/9.25	16d	16d	5,640	5,650	3,820
	9½"	HB3.56/9.5	16d	16d	5,640	5,650	3,820
	11¼"	HB3.56/11.25	16d	16d	5,640	5,650	3,820
	11⅞"	HB3.56/11.88	16d	16d	5,640	5,650	3,820
	14"	GLTV3.514	16d	16d	5,750	7,000	5,145
	16"	GLTV3.516	16d	16d	5,750	7,000	5,145
	18"	HGLTV3.518	16d	16d	9,000	8,665	6,770
	20"	HGLTV3.520	16d	16d	9,000	8,665	6,770
5¼"	9¼"	GLTV5.50/9.25	16d	16d	5,750	7,000	5,145
	9½"	GLTV5.59	16d	16d	5,750	7,000	5,145
	11¼"	GLTV5.50/11.25	16d	16d	5,750	7,000	5,145
	11⅞"	HGLTV5.511	16d	16d	9,000	8,665	6,770
	14"	EGQ5.50-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	16"	EGQ5.50-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	18"	EGQ5.50-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	20"	EGQ5.50-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
7"	11⅞"	EGQ7.25-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	14"	EGQ7.25-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	16"	EGQ7.25-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–
	18"	EGQ7.25-SDS3	SDS ¼" x 3"	SDS ¼" x 3"	18,680	–	–

(1) Maximum load for top mount hangers may **not** be increased for duration of load.



Face Mount Hangers—Simpson Strong-Tie®

Supported Member Width	Supported Member Depth	Hanger	Nail Type		Allowable Load (lbs)—100% Support Member Material		
			Header	Joist	LSL, LVL, PSL	DF/SP	SPF
1¾"	7¼"–9½"	HU7	16d	10d x 1½"	1,610(1)	1,610(1)	1,390(1)
	11¼"–14"	HU11	16d	10d x 1½"	2,950(1)	2,950(1)	2,550(1)
		HUS1.81/10	16d	16d	4,900	4,900	4,355
3½"	7¼"–11¼"	HHUS48	16d	16d	3,885	3,885	3,275
	9½"–18"	HHUS410	16d	16d	5,190	5,190	4,385
		HGUS410	16d	16d	8,780	8,780	7,365
	14"–20"	HGUS414	16d	16d	10,015	10,015	7,890
5¼"	9¼"–11⅞"	HHUS5.50/10	16d	16d	5,190	5,190	4,385
	11¼"–14"	HGUS5.50/12	16d	16d	9,155	9,155	7,690
	14"–20"	HGUS5.50/14	16d	16d	10,015	10,015	8,415
		HGU5.50	SDS ¼" x 2½"	SDS ¼" x 2½"	14,145	14,145	10,185
7"	9¼"–11⅞"	HGUS7.25/10	16d	16d	8,780	8,780	7,595
	11¼"–16"	HGUS7.25/12	16d	16d	9,835	9,835	8,260
		HGU7.25	SDS ¼" x 2½"	SDS ¼" x 2½"	14,145	14,145	10,185
	14"–20"	HGUS7.25/14	16d	16d	11,110	11,110	9,330
		HHGU7.25	SDS ¼" x 2½"	SDS ¼" x 2½"	17,845	17,845	12,850

(1) Value may be increased for duration of load.

Hanger information on these two pages was provided by either Simpson Strong-Tie® or USP Structural Connectors®. For additional information, please refer to their literature.

General Notes

- Hanger capacity may be more or less than that of the supported member; therefore, check both the hanger and the beam capacities.
- Leave 1/16" clearance (⅛" maximum) between the end of the beam or header and its support member or hanger.

Header Assumptions

- Hangers to be supported by headers of TimberStrand® LSL, Microllam® LVL, Parallam® PSL, Douglas fir, southern pine, or spruce-pine-fir.
- When using top mount hangers in back-to-back applications, ensure that the supporting beam width is adequate to prevent hanger interference.
- Face mount hangers to be supported by 1¾" width headers, minimum.

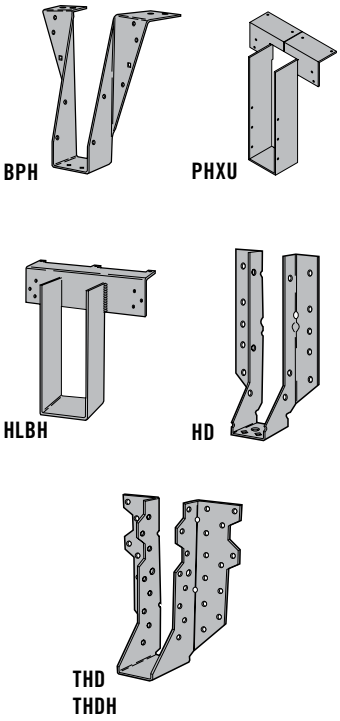
Nailing Requirements

- Fill all round and positive-angle nail holes with the proper nails.
  - 10d x 1½" nails are 0.148" dia. by 1½" long.
  - 10d nails are 0.148" dia. by 3" long.
  - 16d nails are 0.162" dia. by 3½" long.
  - **For USP:** 16d R.S. nails are (9 gauge) 0.148" dia. by 3½" long ring-shank nails.

Top Mount Hangers—USP Structural Connectors®

Supported Member Width	Supported Member Depth	Hanger	Nail Type		Allowable Load (lbs)—100%[1] Support Member Material		
			Header	Joist	LSL, LVL, PSL	DF/SP	SPF
1¾"	9¼"	BPH17925	16d	10d x 1½"	3,340	3,030	2,180
		PHXU17925	16d	10d x 1½"	4,420	4,420	3,155
	9½"	BPH1795	16d	10d x 1½"	3,340	3,030	2,180
		PHXU1795	16d	10d x 1½"	4,420	4,420	3,155
	11¼"	BPH17112	16d	10d x 1½"	3,340	3,030	2,180
		PHXU17112	16d	10d x 1½"	4,420	4,420	3,155
	11⅞"	BPH17118	16d	10d x 1½"	3,340	3,030	2,180
		PHXU17118	16d	10d x 1½"	4,420	4,420	3,155
	14"	BPH1714	16d	10d x 1½"	3,340	3,030	2,180
		PHXU1714	16d	10d x 1½"	4,420	4,420	3,155
3½"	9¼"	PHXU35925	16d	10d	5,785	5,285	3,590
	9½"	PHXU3595	16d	10d	5,785	5,285	3,590
	11¼"	PHXU35112	16d	10d	5,785	5,285	3,590
	11⅞"	PHXU35118	16d	10d	5,785	5,285	3,590
	14"	HLBH3514	NA16D-RS	16d	9,600	9,600	8,560
	16"	HLBH3516	NA16D-RS	16d	9,600	9,600	8,560
	18"	HLBH3518	NA16D-RS	16d	9,600	9,600	8,560
	20"	PHXU3520	16d	10d	5,785	5,285	3,590
		HLBH3520	NA16D-RS	16d	9,600	9,600	8,560
5¼"	9¼"	PHXU55925	16d	10d	5,785	5,285	3,590
	9½"	PHXU5595	16d	10d	5,785	5,285	3,590
	11¼"	PHXU55112	16d	10d	5,785	5,285	3,590
	11⅞"	PHXU55118	16d	10d	5,785	5,285	3,590
	14"	HLBH5514	NA16D-RS	16d	9,600	9,600	8,560
	16"	HLBH5516	NA16D-RS	16d	9,600	9,600	8,560
	18"	PHXU5518	16d	10d	5,785	5,285	3,590
		HLBH5518	NA16D-RS	16d	9,600	9,600	8,560
	20"	PHXU5520	16d	10d	5,785	5,285	3,590
		HLBH5520	NA16D-RS	16d	9,600	9,600	8,560
7"	11⅞"	PHXU71118	16d	10d	5,785	5,285	3,590
	14"	HLBH7114	NA16D-RS	16d	9,600	9,600	8,560
	16"	HLBH7116	NA16D-RS	16d	9,600	9,600	8,560
	18"	HLBH7118	NA16D-RS	16d	9,600	9,600	8,560

(1) Maximum load for top mount hangers may **not** be increased for duration of load.



Face Mount Hangers—USP Structural Connectors®

Supported Member Width	Supported Member Depth	Hanger	Nail Type		Allowable Load (lbs)—100% Support Member Material		
			Header	Joist	LSL, LVL, PSL	DF/SP	SPF
1¾"	9¼"–14"	HD17925	16d	10d x 1½"	2,540[1]	2,540[1]	2,080[1]
		THD179	16d	10d x 1½"	5,360[1]	5,360[1]	4,210[1]
	11¼"–14"	HD17112	16d	10d x 1½"	2,870[1]	2,870[1]	2,080[1]
	14"	HD1714	16d	10d x 1½"	3,100[1]	3,100[1]	2,280[1]
3½"	9¼"–14"	HD410	16d	10d	2,540[1]	2,540[1]	2,180[1]
		THD410	16d	10d	5,360[1]	5,360[1]	4,600[1]
	11¼"–18"	HD412	16d	10d	3,100[1]	3,100[1]	2,660[1]
		THD412	16d	10d	6,770[1]	6,770[1]	5,810[1]
		THDH412	16d	16d	9,845	9,845	8,270
	14"–20"	HD414	16d	10d	3,385[1]	3,385[1]	2,905[1]
		THD414	16d	10d	7,045	7,045	5,920
		THDH414	16d	16d	9,845	9,845	8,270
5¼"	9¼"–11⅞"	HD5210	16d	10d	2,540[1]	2,540[1]	2,180[1]
		THD610	16d	10d	5,660[1]	5,660[1]	4,900[1]
		THDH610	16d	16d	8,725[1]	8,725[1]	7,520[1]
	11¼"–16"	THDH612	16d	16d	9,935	9,935	8,345
	11¼"–18"	THD612	16d	10d	7,150[1]	7,150[1]	6,190[1]
	14"–20"	THD614	16d	10d	8,415	8,415	7,070
		THDH614	16d	16d	11,645	11,645	9,780
7"	9¼"–14"	HD7100	16d	10d	1,690[1]	1,690[1]	1,450[1]
		THDH7210	16d	16d	8,260[1]	8,260[1]	7,120[1]
	11¼"–16"	HD7120	16d	10d	2,255[1]	2,255[1]	1,935[1]
		THDH7212	16d	16d	9,845	9,845	8,270
	14"–18"	HD7140	16d	10d	2,820[1]	2,820[1]	2,420[1]
		THDH7214	16d	16d	9,845	9,845	8,270

(1) Value may be increased for duration of load.

See General Notes on page 40

Allowable Axial Loads (lbs) for 1.3E TimberStrand® LSL

Column Bearing Type	Effective Column Length	Column Size														
		3½" x 3½"			3½" x 4⅜"			3½" x 5½"			3½" x 7¼"			3½" x 8⅝"		
		100%	115%	125%	100%	115%	125%	100%	115%	125%	100%	115%	125%	100%	115%	125%
On Column Base	3'	12,165	13,665	14,625	15,210	17,085	18,280	19,120	21,475	22,980	25,205	28,310	30,290	29,985	33,680	36,035
	4'	10,745	11,830	12,490	13,435	14,790	15,610	16,885	18,590	19,625	22,260	24,505	25,870	26,480	29,155	30,780
	5'	9,120	9,810	10,215	11,400	12,265	12,765	14,335	15,420	16,050	18,895	20,325	21,155	22,480	24,180	25,170
	6'	7,550	7,985	8,235	9,440	9,980	10,295	11,865	12,550	12,945	15,640	16,540	17,060	18,610	19,680	20,300
	7'	6,235	6,525	6,695	7,795	8,160	8,370	9,800	10,255	10,520	12,915	13,520	13,870	15,365	16,085	16,500
	8'	5,195	5,400	5,515	6,490	6,750	6,895	8,160	8,485	8,670	10,755	11,185	11,430	12,795	13,305	13,595
	9'	4,375	4,525	4,610	5,465	5,655	5,765	6,870	7,110	7,245	9,060	9,370	9,550	10,775	11,150	11,360
	10'	3,725	3,840	3,905	4,655	4,795	4,880	5,850	6,030	6,135	7,715	7,950	8,085	9,175	9,460	9,620
	12'	2,785	2,855	2,895	3,480	3,565	3,615	4,375	4,485	4,545	5,770	5,910	5,995	6,860	7,030	7,130
	14'	2,155	2,200	2,225	2,695	2,750	2,780	3,385	3,455	3,495	4,465	4,555	4,610	5,310	5,420	5,485
On Wood Plate(1)	3'–7'	5,765	5,765	5,765	7,065	7,065	7,065	8,740	8,740	8,740	10,785	10,785	10,785	12,830	12,830	12,830
	8'	5,195	5,400	5,515	6,490	6,750	6,895	8,160	8,485	8,670	10,755	10,785	10,785	12,795	12,830	12,830
	9'	4,375	4,525	4,610	5,465	5,655	5,765	6,870	7,110	7,245	9,060	9,370	9,550	10,775	11,150	11,360
	10'	3,725	3,840	3,905	4,655	4,795	4,880	5,850	6,030	6,135	7,715	7,950	8,085	9,175	9,460	9,620
	12'	2,785	2,855	2,895	3,480	3,565	3,615	4,375	4,485	4,545	5,770	5,910	5,995	6,860	7,030	7,130
	14'	2,155	2,200	2,225	2,695	2,750	2,780	3,385	3,455	3,495	4,465	4,555	4,610	5,310	5,420	5,485

(1) See connection details below.

Allowable Axial Loads (lbs) for 1.8E Parallam® PSL

Column Bearing Type	Effective Column Length	Column Size																	
		3½" x 3½"			3½" x 5¼"			3½" x 7"			5¼" x 5¼"			5¼" x 7"			7" x 7"		
		100%	115%	125%	100%	115%	125%	100%	115%	125%	100%	115%	125%	100%	115%	125%	100%	115%	125%
On Column Base	6'	10,595	11,200	11,545	15,890	16,800	17,320	21,190	22,395	23,095	33,295	36,675	38,735	40,000	40,000	40,000	40,000	40,000	40,000
	7'	8,735	9,140	9,370	13,105	13,710	14,060	17,475	18,280	18,745	30,010	32,545	34,030	40,000	40,000	40,000	40,000	40,000	40,000
	8'	7,265	7,550	7,715	10,900	11,325	11,570	14,535	15,100	15,425	26,650	28,490	29,555	35,530	37,985	39,410	40,000	40,000	40,000
	9'	6,115	6,320	6,440	9,170	9,480	9,660	12,225	12,640	12,880	23,475	24,835	25,620	31,300	33,115	34,165	40,000	40,000	40,000
	10'	5,200	5,355	5,445	7,800	8,035	8,170	10,400	10,715	10,895	20,660	21,695	22,290	27,545	28,925	29,725	40,000	40,000	40,000
	12'	3,885	3,980	4,030	5,825	5,965	6,050	7,765	7,955	8,065	16,160	16,805	17,175	21,545	22,405	22,900	40,000	40,000	40,000
	14'	3,000	3,065	3,100	4,500	4,595	4,645	6,005	6,125	6,195	12,890	13,315	13,560	17,185	17,755	18,080	34,155	35,785	36,720
	16'	Slenderness ratio exceeds 50									10,480	10,775	10,950	13,970	14,370	14,595	28,485	29,640	30,300
	18'										8,670	8,885	9,010	11,560	11,850	12,010	24,020	24,860	25,345
	20'										7,285	7,445	7,535	9,710	9,925	10,050	20,475	21,110	21,475
	22'																17,630	18,125	18,405
	24'																15,325	15,715	15,935

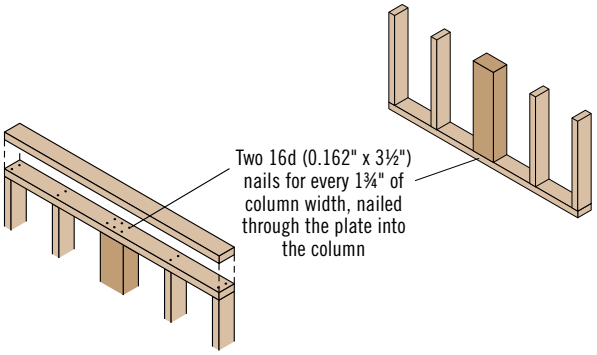
General Notes

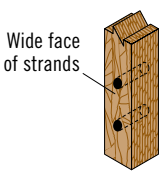
- Tables are based on:
  - Solid, one-piece column members used in dry-service conditions.
  - Bracing in both directions at column ends.
  - NDS® 2005.
  - Simple columns with axial loads only. For side loads or other combined bending and axial loads, see the NDS® 2005.
- Wood plate bearing is based on compression perpendicular-to-grain stress of 425 psi adjusted per the NDS® 2005, 3.10.4.
- Allowable loads have been adjusted to accommodate the worst case of the following eccentric conditions: ⅙ of column thickness (first dimension) or ⅙ of column width.
- Beams and columns must remain straight to within $^{5L^2}/_{4608}$ (in.) of true alignment. L is the unrestrained length of the member in feet.

For column allowable design stresses see page 5.

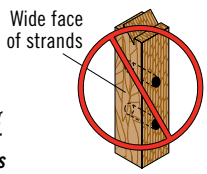
The column and connector values listed are for dry-service conditions ONLY. When wet-service conditions exist, contact your Weyerhaeuser representative for other product solutions.

Top or Bottom Plate Connection





In order to use the manufacturer's published capacities when designing column caps, bases, or holdowns for uplift, the bolts or self-drilling screws must be installed perpendicular to the wide face of strands as shown at left.



DO NOT install bolts or screws into the narrow face of strands

Column Caps for TimberStrand® LSL and Parallam® PSL

Column Product	Beam Width	Column Size	Location on Beam	Simpson Strong-Tie®		USP Structural Connectors®	
				Connector	Load (lbs)	Connector	Load (lbs)
1.3E TimberStrand® LSL	3½"	3½" x 3½"	End	ECC44	7,655	KECC44	13,090
			Intermediate	CC44	15,310	KCC44	16,660
		3½" x 5½"	End	ECC46	12,030	KECC46	20,230
			Intermediate	CC46	24,060	KCC46	24,065
		3½" x 7¼"	End	ECC48	16,405	KECC48	22,610
			Intermediate	CC48	24,060	KCC48	26,180
1.8E Parallam® PSL	3½"	3½" x 3½"	End	ECC44	7,655	KECC44	14,440
			Intermediate	CC44	15,310	KCC44	18,375
		3½" x 5¼"	End	ECC46	12,030	KECC45	19,690
			Intermediate	CC46	24,060	KCC45	28,875
	5¼"	5¼" x 3½"	End	ECC64	12,030	KECC54	29,530
			Intermediate	CC64	37,810	KCC54	43,315
		5¼" x 5¼"	End	ECC66	18,905	KECC55	24,610
			Intermediate	CC66	37,810	KCC55	43,315
		5¼" x 7"	End	ECC6-7⅛	24,060	KECC57	37,405
			Intermediate	CC6-7⅛	37,810	KCC57	43,315
	7"	7" x 3½"	End	ECC7⅛-4	18,375	KECC74	53,155
			Intermediate	CC7⅛-4	68,250	KCC74	65,815
		7" x 5¼"	End	ECC7⅛-6	28,875	KECC75X	55,125
			Intermediate	CC7⅛-6	68,250	KCC75X	68,250
		7" x 7"	End	ECC7⅛-7⅛	36,750	KECC77X	55,125
			Intermediate	CC7⅛-7⅛	68,250	KCC77X	68,250

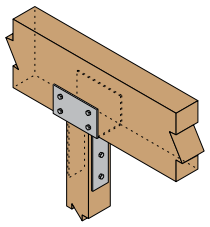
Column Bases for TimberStrand® LSL and Parallam® PSL

Column Product	Column Size	Simpson Strong-Tie®		USP Structural Connectors®	
		Connector	Load (lbs)	Connector	Load (lbs)
1.3E TimberStrand® LSL	3½" x 3½"	ABA44	6,000	PA44	5,135
				PAU44	6,775
		CB44	Post or concrete control	CBS44	6,775
				KCB44	Post or concrete control
	3½" x 5½"	CB46	Post or concrete control	PA46	6,285
				KCB46	Post or concrete control
	3½" x 7¼"	CB48	Post or concrete control	KCB48	Post or concrete control
1.8E Parallam® PSL	3½" x 3½"	LCB44	Post or concrete control	CBE44	Post or concrete control
		CB44		KCB44	
	3½" x 5¼"	CB46		CBE46	
				KCB45	
	3½" x 7"	CB7⅛-4		KCB47	
				KCB74	
	5¼" x 5¼"	CB66		CBE66	
				KCB55	
	5¼" x 7"	CB6-7		KCB57	
		CB7⅛-6		KCB76	
	7" x 7"	CB7⅛-7		KCB77	

General Notes

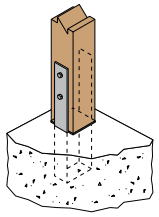
- Capacities shown cannot be adjusted for duration of load.
- Connector capacities assume a beam material with a minimum perpendicular-to-grain bearing of 625 psi.
- Connector capacities may be more than the column capacity; therefore, check both the connector and the column capacity and use the lower capacity.
- Other connectors may be available. Capacities may vary depending on orientation of member. Contact the hanger manufacturer for more information.

Beam on Column Cap



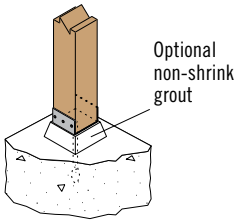
P1

Column Base



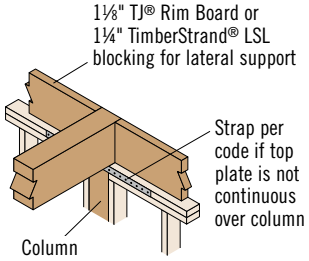
P2

Elevated Column Base



P3

Beam on Column



L1

WE CAN HELP YOU BUILD SMARTER

You want to build solid and durable structures—we want to help. Weyerhaeuser provides high-quality building products and unparalleled technical and field assistance to support you and your project from start to finish.

Floors and Roofs: Start with the best framing components in the industry: our Trus Joist® TJI® joists; TimberStrand® LSL rim board; and TimberStrand® LSL, Microllam® LVL, and Parallam® PSL headers and beams. Pull them all together with our self-gapping and self-draining Weyerhaeuser Edge Gold™ floor panels and durable Weyerhaeuser roof sheathing.

Walls: Get the best value out of your framing package—use TimberStrand® LSL studs for tall walls, kitchens, and bathrooms, and our traditional, solid-sawn lumber everywhere else. Cut down installation time by using TimberStrand® LSL headers for doors and windows, and Weyerhaeuser wall sheathing with its handy two-way nail lines. Use our TJ® Shear Brace for extra support in walls with large openings or in high wind or seismic areas.

Software Solutions: Whether you are a design professional or lumber dealer, Weyerhaeuser offers an array of software packages to help you specify individual framing members, create cut lists, manage inventories—even help you design a complete structural frame. Contact your Weyerhaeuser representative to find out how to get the software you need.

Technical Support: Need technical help? Weyerhaeuser has one of the largest networks of engineers and sales representatives in the business. Call us for help, and a skilled member from our team of experts will answer your questions and work with you to develop solutions that meet all your structural framing needs.

Visit **woodbywy.com/warranty** for copies of this and other Trus Joist® Engineered Wood Product warranties.

CONTACT US

1.888.453.8358 • woodbywy.com/contact

Contact your local representative or dealer at:

April 2013 • Reorder TJ-9000

This document supersedes all previous versions. If this is more than one year old, contact your dealer or Weyerhaeuser rep.

DuPont™ Energain®

ENERGY-SAVING THERMAL MASS SYSTEMS

Data Sheet - Measured Properties

THERMAL MASS PANEL

Descriptive Properties		Unit	Value
Thickness		mm	5.26
Width		mm	1000
Length		mm	1198
Area weight		kg/m^2	4.5
Aluminium thickness (sheet)		µm	130
Aluminium thickness (edges)		µm	75
Thermal properties	**Test Method**		
Paraffin loading	Comparative test by DSC	%	60
Melt point (paraffin)	DSC method (1°C/min)	°C	21.7
Latent heat storage capacity	DSC method (1°C/min)	kJ/kg	> 70
Total heat storage capacity (Temperature range 14°C to 30°C)	DSC method (1°C/min)	kJ/kg	> 170
Physical properties			
Aluminium sheet delamination force	Internal DuPont test method	N/cm	> 20
Conductivity solid	BS EN 12667-2001	W/(m.K)	0.18
Conductivity liquid	BS EN 12667-2001	W/(m.K)	0.14
Flash Point (paraffin)	ASTM D56	°C	148

PRODUCT DESCRIPTION

The panel is a fine mixture of ethylene based polymer (40%) designed by DuPont and paraffin wax (60%) laminated on both sides with a 130 µm aluminium sheet. The edges are closed with a 75 µm aluminium tape.

REACTION TO FIRE

Single-flame source test	EN 11925-2	Class E
Surface spread of flame test	BS476 part 7	Class 1
BS476 part 7 & BS476 part 6 (behind plasterboard)	Building Regulations (AD B)	Class 0

DURABILITY

Predicted to be durable for the life-time of a building
Chemically inert with most materials

ALUMINIUM TAPE

Descriptive Properties	Unit	Value
Thickness	µm	75
Width	mm	50

DuPont patented technology

All values correspond to average results obtained in our laboratories and outside institutes and are indicative. The right is reserved to make changes at any time without notice.

DuPont de Nemours (Luxembourg) S.à r.l.
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E-mail: energain@lux.dupont.com
www.energain.dupont.com

The miracles of science™

03/2007

Material Safety Data Sheet

The miracles of science™

DuPont™ Energain®

DE4500

Date of issue : 28.03.08
Revision : 02

1 Chemical Product and Company Identification

Material Identification

Commercial Generic Product name: DuPont™ Energain® (DE4500)

Use of the Product: Thermal mass panel for the construction

Company Identification

Manufacturer/Distributor

Du Pont de Nemours (Luxembourg) s.àr.l.
L - 2984 Luxembourg
Grand Duchy of Luxembourg

Phone Number: + (352) 3666 1000
Fax Number: + (352) 3666 5021

E-mail: stephane.nowak@lux.dupont.com

Emergency telephones: 24 hrs DUCHEM Help Emergency Response Centres

Spanish:	++ 34 985 124395
Italian:	++ 39 0471 202571
Dutch:	++ 31 (0)78 6301899
French:	++ 352 3666 6543
English:	++ 44 (0) 845 6006640
German:	++ 49 (0) 202 5296655
Danish,Norwegian, Finnish, Swedish:	++ 46 (0) 8 4542222

2 Hazards Identification

No particular hazard identified for the end-user of the thermal mass panel apart of possible cut on the aluminium foils.

N.B. Accidental thermal decomposition or melting state can produce toxic gases or present hazards of burns (see section §10).

3 Composition/Information on Ingredients

Major component	: Polyolefine elastomer modified, additives
Other component	: Aluminium (CAS N° 7429-90-5)
Binder	: none
Other major components	: none
Chemicals (in relevant concentrations)	
that are in the list of dangerous substances	: Maleic anhydride < 0.2% in concentration CAS N° 108-31-6 EC-N° 2035716 Classification: Xn, R22, R34, R42/43

For the full text of the R phrases mentioned in this Section, see Section 16.

4 First Aid Measures

General advice → Remove from exposure, lay down. Never give anything by mouth to an unconscious person. No hazards which require special first aid measures. If a person vomits when lying on his back, place him in the recovery position.

Inhalation → Under normal conditions, no specific measures to be taken.
If exposed to gases generated by the overheating or combustion of the material, remove to fresh air and get medical assistance if cough or other symptoms persist.

Eyes → No specific measure to be taken under normal conditions. Thoroughly flush the eyes using clean water for at least 15 minutes if necessary.

Skin → No specific measure to be taken under normal conditions. Cool skin rapidly with cold water after contact with molten material. Do not peel polymer from the skin. Get medical attention.

Ingestion → Seek medical advice that will decide if intervention is required.

5 Fire Fighting Measures

Suitable extinguishing media:
Carbon Dioxide (CO2), Dry powder, Foam, Water spray (except when fire is of electrical origin).

Extinguishing media not to be used: none

Special exposure hazard:
Large molten masses of the major component may ignite spontaneously in air. Under condition giving incomplete combustion, hazardous gases produced may consist of Carbon Monoxide. Water quenching is a good practice.

Special protective clothing for fire-fighter:
A self-contained breathing apparatus and suitable protective equipment should be worn to fight fire.

Further information:
Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. Do not allow run-off from fire fighting to enter drains or watercourses. The major component burns after ignition without external heat source (IEC 60695-11-10: HB).

6 Accidental Release Measures

Not applicable.

7 Handling and Storage

Normal requirements ➔ Temperature of storage < + 40°C
Store in a dry and well-ventilated area; avoid direct and prolonged exposure to sunlight
Store in a warehouse equipped with a sprinkler system

Use gloves (like Type Kevlar) to prevent cuts during manual slitting.

8 Exposure Controls / Personal Protection

Respiratory protection	: Under normal conditions of use, no respiratory protection is required.
Hand protection	: Wear protective gloves (like Type: Kevlar®).
Eye protection	: Not normally required, but safety glasses with side-shields are always bringing an efficient protection against any possible projection to workers.
Skin and body protection	: Regular cleaning of equipment, work area and clothing.
Hygiene measures	: Wash hands before breaks and at the end of the workday.
Protective measures	: No special protective equipment required.

9 Physical and Chemical Properties

Polyolefine elastomer modified

Appearance	**:**	solid
Colour	**:**	white to yellow
Odour	**:**	mild, hydrocarbon-like
pH	**:**	not applicable
Boiling Point (°C)	**:**	no data available
Melting Point (°C)	**:**	ca. 45-50°C
Decomposition temp. (°C)	**:**	above 300°C in the presence of oxygen
Flash Point (°C)	**:**	no data available
Flammability	**:**	flammable
Ignition Temp (°C)	**:**	220°C
Density (g/cm^3, 20 °C)	**:**	ca. 0.90
Solubility (water)	**:**	not soluble

Aluminium foil

Appearance	**:**	Bright solid
Colour	**:**	silver
Odour	**:**	none
pH	**:**	not applicable
Boiling Point (°C)	**:**	2450°C
Melting Point (°C)	**:**	660°C
Decomposition temp. (°C)	**:**	not applicable
Flash Point (°C)	**:**	not applicable
Flammability	**:**	not applicable
Auto ignition Temp (°C)	**:**	not applicable
Vapour pressure	**:**	not applicable
Density (g/cm^3, 20 °C)	**:**	2.7 – 2.9
Molecular Weight	**:**	26.98
Solubility (water)	**:**	not soluble

10 Stability and reactivity

Conditions to avoid

Avoid the contact with strong acids and oxidising agents. The hazardous decomposition products are aldehydes, alcohols and organic acids.

Above 300°C, toxic and flammable gases as carbon monoxide may be released. The generation of cleavage and oxidation products is subject of fire conditions. Non burned residues and contaminated water after fire fighting should be disposed of in compliance with the official regulations.

Molten material should not be allowed to enter in contact with the skin to which it can adhere and cause burns.

11 Toxicological Information

No toxic reaction known under normal conditions.

Note: under decomposition conditions: toxic fumes and contaminated water (see §10)

12 Ecological Information

No data.

13 Disposal Considerations

Disposal of the major component : Waste disposal number: 07 02 99. Can be landfilled, when in compliance with local regulations. If recycling is not practicable, dispose of in compliance with local regulations. Do not contaminate ponds, waterways or ditches with chemical. Where possible, recycling is preferred to disposal or incineration.

14 Transportation Information

Not regulated, not a dangerous good as defined by the following regulations:

Sea transportation:	IMO / IMDG
Air transportation:	ICAO / IATA
Road, Rail transportation:	ADR / RID

15 Regulatory Information

Labelling according to EC Directives

Not a hazardous substance or preparation according to EC-Directives 67/548/EEC or 1999/45/EC.
The product does not need to be labelled in accordance with EC Directives or respective national laws.

Contains
Maleic Anhydride - may produce an allergic reaction.

16 Other Information

Text of R phrases mentioned in Section 3

R22	Harmful if swallowed.
R34	Causes burns.
R42/43	May cause sensitisation by inhalation and skin contact.

Further information

All chemical consistuents are listed in: EINECS

The data in this MSDS was prepared for the DuPont™ Energain® DE4500 product. It is inspired from the EC recommendation for MSDS (Regulation (EC) N° 1907/2006 repelling Commission Directive 91/155/EEC).

DuPont has developed the information contained in this Material Safety Data Sheet on the express request of its customers and to the best of its knowledge. Therefore, DuPont does not assume any liability with respect to the correctness and/or completeness of the information provided by this MSDS. The customer in particular shall not be released from his duty to check all safety relevant properties of the delivered product and to refer to the official texts for full information on the local obligations.

For additional information on installation and use, please contact your distributor or the manufacturer.

MATERIAL SAFETY DATA SHEET

Products: **Jumbo Tex® Product Line, Fortify®, R-15, HWD-15, Aquabar "B" and Scribe-Rite® Black**

Effective: **September 12, 2005**
Supercedes: **February 2, 2002**

SECTION I

Company Name
Fortifiber Corporation

Emergency Telephone No.
508-222-3500

Address: 55 Starkey Ave., Attleboro, MA 02703

Chemical Name & Synonyms
N/A

Trade Name & Synonyms
JumboTex®
Two-Ply Jumbo Tex®
Jumbo Tex® HD 30 Minute
Two-Ply Jumbo Tex® HD 30 Minute
Super Jumbo Tex® 60 Minute
Two-Ply Super Jumbo Tex® 60 Minute
Fortify®
Aquabar® "B"
Scribe-Rite® Black
R-15
HWD-15

Chemical Family
Paper & Asphalt

Formula
N/A

SECTION II - HAZARDOUS INGREDIENTS

In the solid state the material is not considered a hazardous material as defined by 21CFR 1900.1210 (OSHA Hazards Communications Law) paragraph (b) (5) (iv). This product is supplied in compliance with TSCA reporting requirements.

SECTION III - PHYSICAL DATA

Boiling Point (^{o}F.)
N/A

Specific Gravity (Water=1)
> 1.0

Vapor Pressure (mmHg.)
N/A

Percent, Volatile by Volume (%)
N/A

Vapor Density (Air=1)
N/A

Evaporation Rate(Butyl Acetate=1)
N/A

Solubility in Water: Negligible

Appearance & Odor: Brown to black colored paper having an asphalt odor

MATERIAL SAFETY DATA SHEET

Products: **Jumbo Tex® Product Line, Fortify®, R-15, HWD-15, Aquabar "B" and Scribe-Rite® Black**

Effective: **September 12, 2005**
Supercedes: **February 2, 2002**

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point >450°F Method Cleveland Cup

Flammable Limits N/A Lel N/A Vel N/A

Extinguishing Media: Water spray, CO_2 fog or foam, Dry Chemical

Special Fire Fighting Procedures: The asphalt saturated paper requires that this product be treated as a fuel oil fire.

Unusual Fire and Explosion Hazards: None

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value Not established

Route(s) of entry
Inhalation: N/A. Skin: N/A Ingestion: N/A

Emergency and First Aid Procedures: N/A

SECTION VI - REACTIVITY DATA

Stability: Stable X Unstable _____

Conditions to Avoid: Fire

Hazardous Polymerization: May Occur ___ Will not Occur X .

Hazardous Decomposition Products:
During combustion: Carbon monoxide and hydrogen sulfide fumes

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: N/A

Waste Disposal Method: Incineration or landfill. Observe all federal, state and local laws concerning health and the environment.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection: N/A Ventilation: - Local Exhaust N/A Mechanical N/A
Special N/A Other N/A

Protective Gloves
To avoid paper cuts

Eye Protection
None

Other Protective Equipment
None

Work/Hygienic Practices
N/A

MATERIAL SAFETY DATA SHEET

Products: **Jumbo Tex® Product Line, Fortify®, R-15, HWD-15, Aquabar "B" and Scribe-Rite® Black**

Effective: **September 12, 2005**
Supercedes: **February 2, 2002**

Precautions to be Taken in Handling and Storing
Do not store near open flame.
Use reasonable care and caution in handling.

Other Precautions
N/A

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storing
Do not store near open flame.
Use reasonable care and caution in handling.

Other Precautions N/A

SECTION X – REGULATORY

SARA / TITLE III
This product does not contain a toxic chemical for routine annual toxic chemical reporting under section 313 (40 CFR 372).

GRACE

GRACE ICE & WATER SHIELD®

Self-adhered roofing underlayment

Product Description

Grace Ice & Water Shield® is a premier membrane composed of two waterproofing materials—an aggressive rubberized asphalt adhesive backed by a layer of high density cross laminated polyethylene. The rubberized asphalt surface is backed with a foldless release paper that protects its adhesive quality. During application, the release paper is easily removed, allowing the rubberized asphalt to bond tightly to the roof deck. In addition, embedded in the membrane is a split release on demand feature called Ripcord®.

The membrane is supplied in two roll sizes. See the Product Data chart for product information.

Membrane strips are also available in 75 ft (22.9 m) long rolls at widths of 6 in. (150 mm), 9 in. (225 mm), 12 in. (300 mm) and 18 in. (450 mm).

Features & Benefits

Easy to handle and apply—The self-adhesive membrane bonds firmly to the roof deck without heat or special adhesives.

Ripcord is a unique, patented feature that makes Grace Ice & Water Shield easier to apply by giving the applicator a split release on demand. Faster application of the membrane in the straightaways, as well as ease of membrane positioning in detailed areas (valleys, around dormers, etc.), are just some of the benefits.

Foldless release paper—The foldless release paper provides multiple performance enhancements: fewer edge catches, 180° pull-back, ease of membrane cutting (single cuts) and membrane positioning, quicker "one-man installs" resulting in an easier, more productive release.

Seals around nails—The rubberized asphalt layer in Grace Ice & Water Shield seals around roofing nails, resisting leakage caused by water back-up behind ice dams, or from wind-driven rain.

Dual barrier protection—Rubberized asphalt and polyethylene are combined to form two waterproofing barriers providing maximum protection.

Membrane will not crack, dry out or rot—Grace Ice & Water Shield resists attacks from fungus and bacteria; maintains its integrity for long lasting protection.

Protects under all standard sloped roof coverings—Grace Ice & Water Shield protects under slate, tile, cedar shakes or metal, as well as under conventional asphalt shingles.

Slip resistant surface—Grace Ice & Water Shield has a slip resistant embossed surface to maximize traction and safety for applicators.

Proven track record—Grace Ice & Water Shield is the name brand in roofing underlayments with a 30-year track record of protecting roofs from ice dams and wind-driven rain.

Reroofable—Unlike some granular surfaced membranes, Grace Ice & Water Shield will not adhere to the underside of the exposed roof covering. Grace Ice & Water Shield can be applied over the old Grace underlayment (except over Grace Basik® except over Grace Basik®, Grace Tri-Flex® and Grace Tri-Flex®Xtreme™). in retrofit applications, making reroofing easier, less costly (since there is no need for removing the existing underlayment), more durable and environmentally friendly (as the structural deck remains intact avoiding the need to purchase additional wood decking).

Grace technical support—Grace Ice & Water Shield is backed by a team of local technical support personnel that help ensure every application goes smoothly.

Guidelines for Use

Grace Ice & Water Shield is used as an underlayment for sloped roofs to resist water penetration due to water back-up behind ice dams or wind-driven rain. Grace Ice & Water Shield also offers leak protection in trouble prone spots like valleys, skylights, protrusions and other flashing areas.

Ice Dams

Grace Ice & Water Shield should be used in conjunction with designs which minimize ice dam formation. In cold climates, it is particularly important to provide proper insulation and ventilation to reduce the size of ice dams and to avoid interior condensation. Cathedral ceilings must include ventilation between rafters to allow for air flow to a ridge vent. Well ventilated cold roof designs are particularly important in alpine regions to reduce the size of ice dams which could contribute to structural damage.

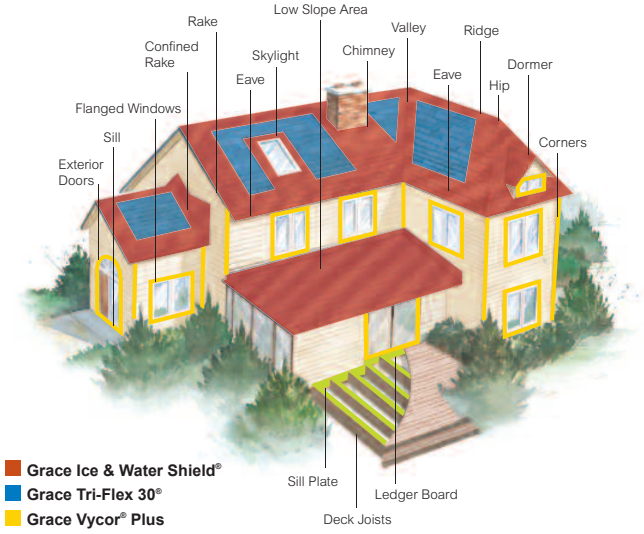
Several variables will influence the height of ice dams and the membrane coverage required.

1. **Climate**—The annual snow fall will affect the amount of membrane needed.
2. **Slope**—On a low slope, ice dams will extend farther inward from the roof edge.
3. **Overhang**—A wide overhang will require more membrane to reach the appropriate point on the roof.
4. **Insulation and ventilation**—A very well insulated building with a cold, well ventilated attic will have smaller ice dams.
5. **Valleys**—Any valleys formed by projections such as dormers or roof direction changes are likely to trap more snow and cause larger ice dams.
6. **Exposure**—A northern exposure or shaded areas will generally contribute to larger ice dams. While gutters may make it easier for an ice dam to start, large dams can occur on roofs with no gutters.

   Removing snow from a roof edge or installing heat cables may not prevent ice dam formation, but may shift the location of the ice dam. Under certain conditions, a dam can form at the edge of the remaining snow.

   Local building codes should be consulted for specific requirements.

Use Grace Ice & Water Shield on all of these critical areas



Installation Procedure

Surface Preparation

Install Grace Ice & Water Shield directly on a clean, dry, continuous structural deck. Some suitable deck materials include plywood, wood composition, wood plank, metal, concrete, or gypsum sheathing. Remove dust, dirt, loose nails, and old roofing materials. Protrusions from the deck area must be removed. Decks shall have no voids, damaged, or unsupported areas. Wood planks should be closely butted together. Repair deck areas before installing the membrane.

Prime concrete, masonry surfaces and DensGlass Gold® with Perm-A-Barrier® WB Primer. Prime wood composition and gypsum sheathing with Perm-A-Barrier WB Primer if adhesion is found to be marginal (refer to Technical Letter 12, *Use on Oriented Strand Board (OSB) Roof Sheathing*). Apply Perm-A-Barrier WB Primer at a rate of 250–350 ft²/gal (6–8 m²/L). Priming is not required for other suitable surfaces provided that they are clean and dry.

Membrane Installation

Apply Grace Ice & Water Shield in fair weather when the air, roof deck, and membrane are at temperatures of 40°F (5°C) or higher. Apply roof covering material at temperatures of 40°F (5°C) or higher.

Cut the membrane into 10–15 ft (3–5 m) lengths and reroll loosely. Peel back 1–2 ft (300–600 mm) of release liner, align the membrane, and continue to peel the release liner from the membrane. Press the membrane in place with heavy hand pressure. Side laps must be a minimum of 3.5 in. (90 mm) and end laps a minimum of 6 in. (150 mm). For valley and ridge application, peel the release liner, center the sheet over the valley or ridge, drape, and press it in place. Work from the center of the valley or ridge outward in each direction and start at the low point and work up the roof.

Alternatively, starting with a full roll of membrane, unroll a 3–6 ft (1–2 m) piece of membrane leaving the release liner in place. Align the membrane and roll in the intended direction of membrane application. Carefully cut the release liner on top of the roll in the cross direction being careful not to cut the membrane. Peel back about 6 in. (150 mm) of the release liner in the opposite direction of the intended membrane application exposing the black adhesive. Hold the release liner with one hand and pull the roll along the deck with the release liner, leaving the applied membrane behind. Use the other hand to apply pressure on the top of the roll. Stop frequently to press the membrane in place with heavy hand pressure. When finished with the roll go back to the beginning, reroll and pull the remaining release paper from the material, finishing the installation.

For successive membrane courses, align the edge of the release liner with the dashed line provided on the surface of the membrane to achieve the 3.5 in. (90 mm) side lap.

Consistent with good roofing practice, install the membrane such that all laps shed water. Always work from the low point to the high point of the roof. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. The membrane may be installed either vertically or horizontally.

Use smooth shank, electro-plated galvanized nails for fastening shingles to get the best seal. Hand nailing generally provides a better seal than power-activated nailing. If nailing of the membrane is necessary on steep slopes during hot or extreme cold weather, backnail and cover the nails by overlapping with the next sheet.

Extend the membrane on the roof deck above the highest expected level of water back-up from ice dams and above the highest expected level of snow and ice on the wall sheathing on vertical side walls (dormers) and vertical front walls for ice dam protection. Consider a double layer of membrane in critical areas, such as along the eaves or in valleys and in climates where severe ice dams are anticipated. Apply the membrane to the entire roof deck for wind-driven rain protection. Apply a new layer of Grace Ice & Water Shield directly over the old Grace underlayment in retrofit applications following the standard membrane application procedure.

Precautions & Limitations

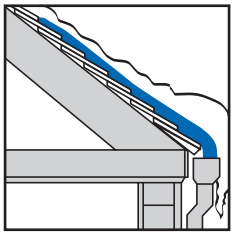
- Slippery when wet or covered by frost.
- Consistent with good roofing practice, always wear fall protection when working on a roof deck.
- Release liners are slippery. Remove from work area immediately after membrane application.
- Do not leave permanently exposed to sunlight. Cover within 30 days.
- Place metal drip edges or wood starter shingles over the membrane.
- Do not fold over the roof edge unless the edge is protected by a drip edge, gutter or other flashing material.
- Do not install on the chamfered edges of wood plank.
- Do not install directly on old roof coverings.
- Certain product applications are prohibited in hot desert areas in the southwestern United States. Check with your Grace Construction Products representative.
- Check with the manufacturer of the metal roofing system for any special requirements when used under metal roofing. Do not install directly under roof coverings especially sensitive to corrosion, such as zinc, without providing proper ventilation.
- Do not install under copper, Cor-Ten®, or zinc metal roofing in high altitudes. These roofs can reach extremely high temperatures due to the low reflectivity, high absorption, and high conductivity of the metals. Use Grace Ultra for these roof types. Check with your Grace Construction Products representative.
- Provide proper roof insulation and ventilation to help reduce ice dams and to minimize condensation. Grace Ice & Water Shield is an air and vapor barrier.
- Repair holes, fishmouths, tears, and damage to membrane with a round patch of membrane extending past the damaged area 6 in. (150 mm) in all directions. If fasteners are removed leaving holes in the membrane, they must be patched. The membrane may not self-seal open fastener penetrations.
- Do not install fasteners through the membrane over unsupported areas of the structural deck, such as over the joints between adjacent structural panels.
- Due to its slight asphaltic odor, do not apply where the membrane is exposed to interior living space. Refer to product literature for more complete information.
- Not compatible with EPDM or TPO; use Grace Ultra for tie-ins (refer to Technical Letter 5, *Chemical Compatibility*).
- Not compatible with polysulfides, flexible PVC, or high concentrations of resin (pitch). For more information, refer to Technical Letter 5.

Code Compliance

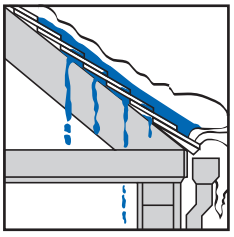
Grace Ice & Water Shield meets the following standards:

- Underwriters Laboratories Inc. Class A fire classification under fiber-glass shingles and Class C under organic felt shingles (per ASTM E108/UL 790)
- Underwriters Laboratories Inc. Classified Sheathing Material Fire Resistance Classification with Roof Designs: P225, P227, P230, P237, P259, P508, P510, P512, P514, P701, P711, P717, P722, P723, P732, P734, P736, P742, P803, P814, P818, P824
- International Conference of Building Officials (ICBO-ES) Report No. 3997
- Southern Building Code Congress International (SBCCI PST & ESI) Report No. 94133C
- Building Officials and Code Administrators (BOCA-ES) Evaluation Report No. 94-33
- Miami-Dade County Code Report NOA 09-0107.08.
- Canadian Construction Materials Centre (CCMC) 12693-R
- U.S. Department of Housing and Urban Development (HUD) Materials Release 1056f
- City of Los Angeles RR 25330
- Florida State Approval Report No. FL298-R1

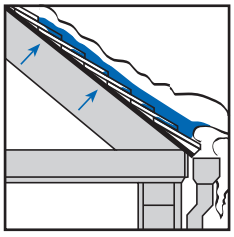
Ice Dams



Water from melting snow over the heated portion of the house runs down the roof. It freezes at the cold eave and an ice dam begins to form preventing drainage.

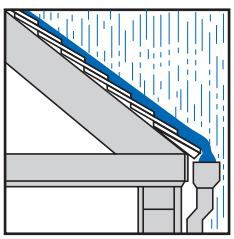


As the ice dam grows, water is trapped behind it and backs up under the shingles. Eventually it reaches the roof deck and leaks through, damaging the interior of the structure.

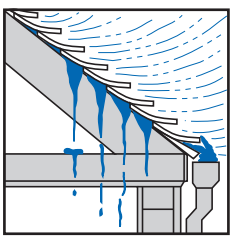


Grace Ice & Water Shield resists this leakage because of the seal around the fasteners, ability to make watertight laps, and the membrane's bond to the deck.

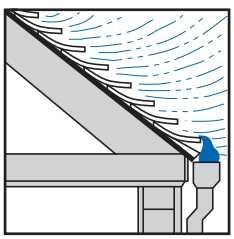
Wind-Driven Rain



Sloped roofs are not waterproof. They protect structures by shedding rain water.



Storm-driven winds can cause sloped roof coverings to lift. Rain can then be easily driven under the roof covering directly to the unprotected roof deck where it causes leaks and damage to the interior of the structure.



Grace Ice & Water Shield applied beneath the sloped roof covering helps prevent wind-driven rain from entering the structure.

Product Data

Roll length	75 ft (22.9 m)	66.6 ft (20.2 m)	36 ft (11.0 m)
Roll width	36 in. (914 mm)	36 in. (914 mm)	36 in. (914 mm)
Roll size	225 ft^2 (20.9 m^2)	200 ft^2 (18.6 m^2)	108 ft^2 (10.4 m^2)
Packaging	Corrugated cartons	Corrugated cartons	Corrugated cartons
Roll weight	61.4 lbs (27.9 kg)	55 lbs (24.9 kg)	33.6 lbs (15.3 kg)
Rolls per pallet	35	35	25

Performance Properties

Property	Value	Test Method
Color	Gray-black	
Thickness, membrane	40 mil (1.02 mm)	ASTM D3767 method A
Tensile strength, membrane	250 psi (1720 kN/m^2)	ASTM D412 (Die C modified)
Elongation, membrane	250%	ASTM D412 (Die C modified)
Low temperature flexibility	Unaffected @ -20°F (-29°C)	ASTM D1970
Adhesion to plywood	3.0 lbs/in. width (525 N/m)	ASTM D903
Permeance (max)	0.05 Perms (2.9 ng/m^2s Pa)	ASTM E96
Material weight installed (max)	0.3 lb/ft^2 (1.3 kg/m^2)	ASTM D461

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GRACE

GRACE VYCOR® PLUS
Self-adhered flashing

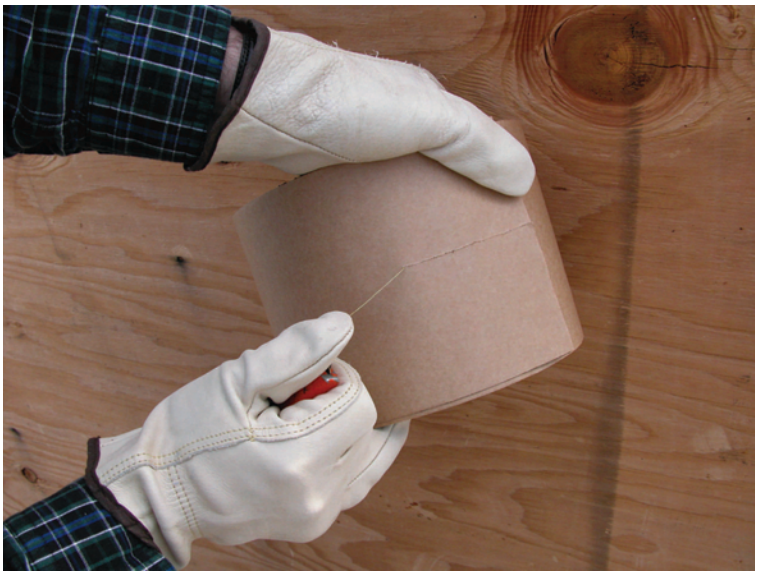
Moisture Control is the First Step to Mold Control

Water from both exterior and interior sources is among the worst enemies of building structures. When water enters the wall system and remains there for a long time, it creates a favorable environment for the development of rot, mold and mildew. Proper waterproofing and flashing practices are necessary to ensure high quality, long-lasting construction.

Repairs of rot and mold are major concerns for homebuilders, contractors, architects, and homeowners. Not only are such repairs difficult, but they are also extremely costly. Window and door openings, deck-to-wall intersections, foundation sill plates, corners, and other penetration areas are the most common water entry points. A self-adhered flashing membrane, properly integrated with the other elements of the building structure, creates a barrier to water entry and a drainage plane for water to drain out of the wall.

Grace Vycor® Plus, a high performance self-adhered flashing membrane, provides premium protection against water infiltration in all critical non-roof detail areas, that traditional building papers, felts and housewraps cannot match. When properly installed, it can reduce the risk of rot and mold development, often associated with costly call-backs.

ICBO APPROVED!



Product Advantages

- Available with Ripcord® split release on demand
- Easier and faster to install correctly
- Improved product performance
- Proper integration with housewrap/ other weather-resistive barriers
- Reduces the risk of rot and mold development

NAHB RESEARCH CENTER GREEN APPROVED

Product Description

Grace Vycor Plus self-adhered flashing is composed of durable, cross-laminated, high-density polyethylene sheet, backed by an aggressive, pressure-sensitive rubberized asphalt adhesive.

Grace Vycor Plus is available in a range of widths: 4 in. (100 mm), 6 in. (150 mm), 9 in. (225 mm), 12 in. (300 mm) and 18 in. (450 mm) to accommodate a variety of job requirements.

Ripcord is available in 6 in. (150 mm), 9 in. (225 mm) and 12 in. (300 mm) wide membranes.

Features & Benefits

Ripcord—With the sophistication of construction practices it becomes a must to follow the proper sequencing principles. Ripcord offers the flexibility to install half the membrane before and the other half after the other building envelope components are installed, i.e. housewrap or felt. Only in this way are the proper installation principles followed.

Easy to work with—Membrane installation is fast and easy—simply remove the release paper and press onto the substrate. With Grace Vycor Plus contractors can flash more windows with better quality.

Superior adhesion capabilities—
The membrane creates a strong bond to the substrate for long-lasting waterproofing protection.

Seals around fasteners—The specially formulated rubberized asphalt adhesive seals around fasteners, allowing no water to penetrate and get to the substrate.

Forms water-tight laps—Grace Vycor Plus' superior adhesion properties ensure strong laps, even in seams in the flashing.

Measurement markings—The membrane surface is clearly marked at every 6 in. (150 mm) and 12 in. (300 mm) intervals to facilitate the installation procedure.

Highly conformable and flexible—
Can accommodate settlement and shrinkage movement.

Proven track record—Grace Vycor Plus employs the same proven technology as our Grace Ice & Water Shield®—the market leader in self-adhered underlayments for over 30 years.

Long-lasting waterproofing protection—
Both the polyethylene film and the specially-formulated rubberized asphalt components create a water and moisture barrier that does not degrade from the effects of the environment.

Usage

Grace Vycor Plus is a unique solution, appropriate for working around a number of detail areas, including, but not limited to:

- Window and door openings (headers, sills, jambs, thresholds, nailing flanges)
- Deck-to-wall intersections
- Corner boards
- Wall-to-wall tie-ins
- Foundation sill plates
- Sheathing panel seams
- Under stucco finishes
- Masonry walls
- Other non-roof detail areas

Application Instructions

Surface Preparation

Apply Grace Vycor Plus in fair weather when the air, surface and membrane are at temperatures of 25°F (-4°C) or higher. After precipitation, allow a minimum of 24 hours for drying before installing the flashing.

Install directly onto a clean and dry surface. Some compatible substrates include wood, plywood, oriented strand board, metal, concrete and masonry. Remove dust, dirt, and loose nails. Protrusions must be removed. Surfaces shall have no voids, damaged, or unsupported areas. Repair surfaces before installing the membrane.

Product Data

Property	Grace Vycor Plus				
Product thickness	25 mil (0.64 mm)				
Carrier film	Cross-laminated HDPE				
Adhesive	Rubberized asphalt				
Release liner	Paper				
Color	Black-Gray				
Recommended exposure limit	30 Days				
Roll width(s)	4 in. (100 mm)	6 in. (150 mm)	9 in. (225 mm)	12 in. (300 mm)	18 in. (450 mm)
Roll length(s)	75 ft (22.9 m)	75 ft (22.9 m)	75 ft (22.9 m)	75 ft (22.9 m)	75 ft (22.9 m)
Rolls per carton	18	12	6	6	2
Shipping weight	74 lbs (33 kg)	74 lbs (33 kg)	56 lbs (25 kg)	74 lbs (33 kg)	36 lbs (16 kg)
Cartons per pallet	30	30	30	30	35

Priming is generally not required for most substrates provided they are clean and dry. However, on concrete, masonry and DensGlass Gold®, apply Perm-A-Barrier® WB Primer. If adhesion is found to be marginal, prime wood composition and gypsum sheathing also with Perm-A-Barrier WB Primer. The coverage rate for Perm-A-Barrier WB Primer is 250–350 ft^2/gal (6–8 m^2/L). Allow primer to dry completely, approximately 1 hour depending on weather conditions, before application of flashing.

Membrane Installation

Using the 6 in. (150 mm) and 12 in. (300 mm) measurement markings, cut the membrane to the desired length. Peel back the release paper to expose the adhesive. Align the membrane and press into place with heavy hand pressure.

Laps must be a minimum of 3 in. (75 mm). Mechanically fasten the membrane at all vertical terminations. Use only smooth shank fasteners.

Consistent with good construction practice, install the membrane such that all laps shed water (following the shingle principle). The top membrane layer should go over the bottom layer. Always work from the low point to the high point. When needed, use Ripcord to split the release paper and adhere half of the membrane, while leaving the other half with the paper on. This is required when flashing a window sill before the housewrap/weather resistive barrier is installed.

Precautions & Limitations

Grace Vycor Plus is designed for critical NON-ROOF flashing details. The membrane is slippery—DO NOT install on the roof; DO NOT walk on the membrane.

Do not leave the product permanently exposed to sunlight. Maximum recommended exposure time is 30 days. Due to its slight asphaltic odor, apply this product where the membrane is not exposed to interior living space. Grace Vycor Plus should not be used in hot desert areas in the southwestern United States.

Grace Vycor Plus is not compatible with flexible PVC. Contact window manufacturer for specific application instructions required when using a bituminous-based flashing. Certain metal window applications with integral nail fin may have specific limitations. Some solvents in certain caulking may be incompatible with the adhesive in Grace Vycor Plus.

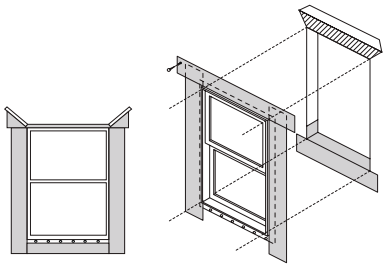
For more information, check with your local Grace representative.

Approvals

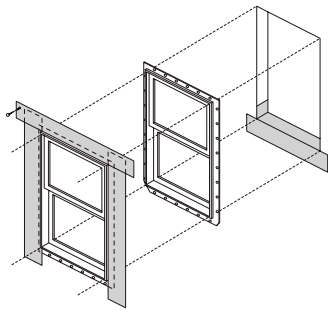
ICBO approved as a Flashing Material (Report ER-6141).

Key Details for Grace Vycor Plus

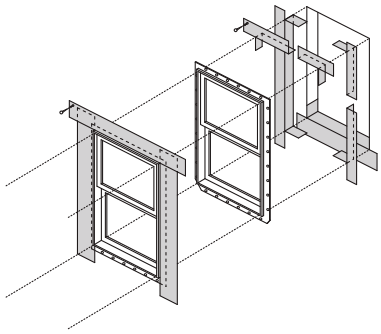
For most recent and additional details, consult our web site at www.graceconstruction.com



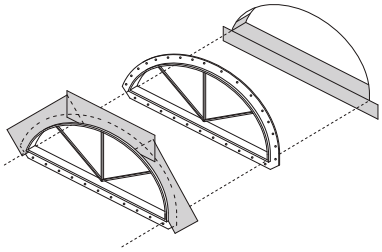
Flanged Window
Flashing Installation AFTER
Weather-Resistive Barrier



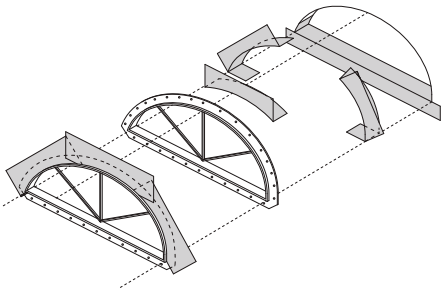
Flanged Window
Flashing Installation BEFORE
Weather-Resistive Barrier
Option 1 – Low Exposure



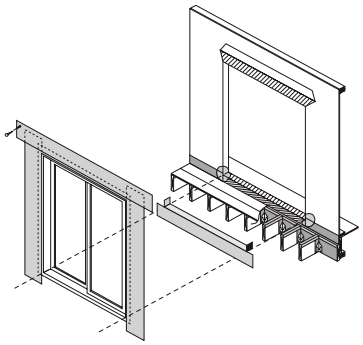
Flanged Window
Flashing Installation BEFORE
Weather-Resistive Barrier
Option 3 – Severe Exposure



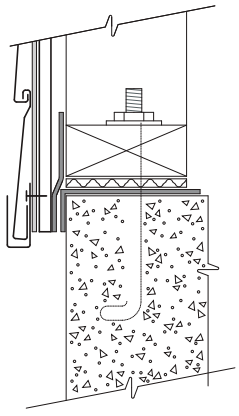
Half Round Window
Option 1 – Low to Moderate
Exposure



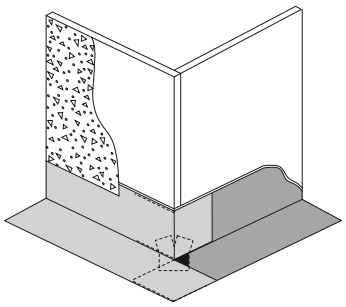
Half Round Window
Option 2 – Severe Exposure



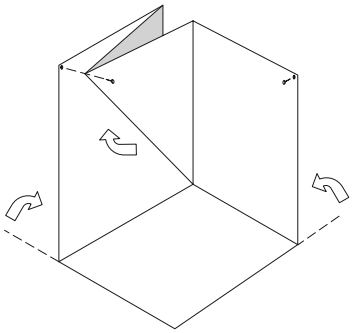
Exterior Sliding Door with Deck



Foundation Sill Plate
Option 1



Outside Corner



Inside Corner

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PALISADE™
SYNTHETIC UNDERLAYMENT

PALISADE™ SYNTHETIC UNDERLAYMENT : TECHNICAL DATA

PROPERTY	STANDARD	UNIT	PALISADE™	30# FELT
Tensile Strength	ASTM D226	lbs	**150**	30
Tear Strength	ASTM D4533	lbs	**50**	1.5
Puncture Strength	ASTM D751	psi	**300**	50
Cap Nail Pull Strength	TAS 117B	lbs	**230**	40
UV Rating	ASTM G90	%	**>90**	<50
Water Transmission	ASTM D4869	Pass/Fail	**Pass**	Pass
Surface Temperature	SDP	°F	**+10**	+50
Water Absorption	ASTM D1970	%	**0.1**	35
Oils Leaching	SDP	Pass/Fail	**N/A**	Fail
Moisture Buckling	SDP	inch	**N/A**	0.50
Permeability	ASTM E96-A	Perms	**0.10**	8
Temperature Rating	SDP	°F	**-70 to 300**	32 to 150
CLASS A Tile, Metal, Shingle, Slate, non-FR Shake	ASTM E108/UL 790	Pass/Fail	**Pass**	-
Thickness	ASTM D5147	mils	**25**	60
Weight Per Square	ASTM D5261	lbs	**4.0**	28

PALISADE™ meets or exceeds IBC/IRC 2003, ICC AC-188, ASTM D226 Type I & II requirements. Values, weights and measures are typical data and not limiting specifications. All values +/- 10%

STRONGHOLD SKID RESISTANT TECHNOLOGY

FELT FREE

UV SIX MONTHS

KOOL BLUE™

ESR-1847

FLORIDA 2004

FL-5325.1 (HVHZ)

CLASS A

ASTM E108/UL790

Intertek

SDP
ADVANCED POLYMER PRODUCTS

SDP Inc.
410-130 Bridgeland Ave.,
Toronto, Ontario,
Canada M6A 1Z4

Toll Free : 866-747-4035
Fax : 866-840-3857

info@sdp-products.com • sdp-products.com

Product Data Sheet
Edition: 06/2011
Version no.: 0001

Sarnafil® G410 Roof Membrane

__48 __60 __72 __80 __Feltback

Overview:	The G410 roof membrane is a heat-weldable membrane produced with an integral fiberglass mat reinforcement for excellent dimensional stability, for use in a Sika Sarnafil Adhered System.
Composition:	The G410 roof membrane is a high-quality, thermoplastic PVC membrane with a fiberglass reinforcement. The G410 roof membrane has a unique lacquer coating applied to the top of the membrane to reduce dirt pick up. The colors available for G410 are: Copper Brown, Evergreen, and Lead Gray. For a listing of EnergySmart colors, refer to the EnergySmart data sheet. Custom colors are available subject to minimum volume requirements.
Features and Benefits:	• Excellent dimensional stability • Lacquer coated to reduce dirt pick up • Hot-air welded seams for long-term performance • Proven membrane performance
Codes and Approvals:	Sika Sarnafil's Adhered Systems using G410 PVC membranes are classified by Underwriters Laboratories, Inc., Underwriters Laboratories of Canada, FM Global, Miami-Dade and Florida Building Code. Sika Sarnafil membranes also meet the material requirements of the International building code. For more information, please visit the "technical downloads" section of our website.
Packaging:	The G410 roof membrane rolls are wrapped in a protective film and strapped to a wood pallet. The G410 roof membrane is produced in 6.5 ft. (2 meters). The membrane rolls weigh between 161 - 195 lbs depending on thickness of membrane and feltbacking.
Installation:	G410 is installed by a Sika Sarnafil Authorized Applicator. After proper preparation of the substrate, G410 is unrolled into Sarnacol adhesive in accordance with Sika Sarnafil's Technical requirements and then pressed into place with a minimum 100 lb. linoleum roller. The G410 is then heat-welded together by trained operators using Sika Sarnafil's hot-air welding equipment. Different Sarnacol adhesives require different application methods. Please consult Sika Sarnafil's Applicator Handbook for detailed installation procedures.
Availability:	The G410 roof membrane is available directly from Sika Sarnafil Authorized Applicators. Contact your Sika Sarnafil Regional Office or visit our website for further information.
Warranty:	Upon successful completion of the installed roof by the Sika Sarnafil Authorized Applicator, Sika Sarnafil can provide a Warranty to the Building Owner via the Authorized Applicator.
Maintenance:	The G410 roof membrane requires no maintenance. As a prudent preventative measure, Sika Sarnafil recommends that the Owner or that the Owner's designated representative inspect the installed roof system for damage, plugged drains, weathered sealants, etc. at least twice a year and after each storm.

Sika®

Sarnafil®

Technical Support: Sika Sarnafil provides technical support. Please contact your local technical representative or technical manager if you need assistance.

Technical Data (as manufactured):

Parameters	ASTM Test Method	ASTM Type II D-4434 Spec. Requirement	Typical Physical Properties			
			48	60	72	80
Reinforcing Material	--	--	Fiberglass	Fiberglass	Fiberglass	Fiberglass
Overall Thickness, mil	D638	45	48	60	72	80
Thickness Above Scrim, mil	--	16	24	30	36	40
Felt Weight oz/yd^2	--	--	9	9	9	9
Tensile Strength, min., psi, (Mpa)	D638					
Machine Direction		1500psi (10.4)	1500	1575	1625	1675
Cross Direction		1500psi (10.4)	1500	1550	1575	1625
Elongation at Break, min.	D638					
Machine Direction %		250	250	250	250	250
Cross Direction %		220	220	220	220	220
Seam Strength, min., (% of original)*	D638	75	Pass	Pass	Pass	Pass
Retention of Properties After Heat Aging	D3045					
Tensile Strength, min., (% of original)	D638	90	Pass	Pass	Pass	Pass
Elongation, min., (% of original)	D638	90	Pass	Pass	Pass	Pass
Tearing Resistance (M.D.), min., lbf (N)	D1004	10 (45.0)	15	17.5	20.5	22
Low Temperature Bend, -40 °F (-40 °C)	D2136	Pass	Pass	Pass	Pass	Pass
Accelerated Weathering Test (Florescent Light, UV exposure)	G154	5,000 Hours	10,000 Hours	10,000 Hours	10,000 Hours	10,000 Hours
Cracking (7x magnification)		None	None	None	None	None
Discoloration (by observation)		Negligible	Negligible	Negligible	Negligible	Negligible
Crazing (7x magnification)		None	None	None	None	None
Linear Dimensional Change (C.D.), %	D1204	0.10% max.	-0.02	-0.02	-0.01	-0.01
Weight Change After Immersion in Water, %	D570	± 3.0% max.	2.4	1.9	1.8	1.7
Static Puncture Resistance, 33 lbf (15 kg)	D5602	Pass	Pass	Pass	Pass	Pass
Dynamic Puncture Resistance, 7.3 ft-lbf (10 J)	D5635	Pass	Pass	Pass	Pass	Pass

** Failure occurs through membrane rupture not seam failure.*

ENERGY STAR

MIAMI-DADE COUNTY APPROVED
Miami-Dade County
Product Control Approved

CRRC COOL ROOF RATING COUNCIL

Corporate Office
Sika Sarnafil
A Division of Sika Corporation
100 Dan Road
Canton, MA 02021

Tel.: (781) 828-5400
1-800-451-2504
Fax: (781) 828-5365
Web: usa.sarnafil.sika.com
Email: webmaster.sarnafil@us.sika.com

Canada Office
Sika Sarnafil
A Business Unit of Sika Canada
6820 Davand Drive
Mississauga, ON L5T 1J5

Tel.: (905) 670-2222
1-800-268-0479
Fax: (905) 670-5278
Web: can.sika.com

Sika Sarnafil
100 Dan Road
Canton, MA 02021-2842

Roofing/Waterproofing Membrane

REVISION DATE: 5/25/2011

Material Safety Information Sheet

(According to 29 CFR 1910.1200(5)(v)(c) this material is an article. No labeling or MSDS reporting is required.)

SECTION 1 Product and Company Identification

TRADE NAME:	Roofing/Waterproofing Membrane	
SYNONYMS:	Sarnafil G-410, G-459, G-476, S-327,	
MANUFACTURER:	Sika Sarnafil	
ADDRESS:	100 Dan Road, Canton, MA 02021-2842	
EMERGENCY NUMBERS:	CHEMTREC Transportation Emergency (24 hr.)	(800) 424-9300
	MSDS and Product Information (M -F, 8:30am -5:00pm EST)	(800) 451-2504

SECTION 2 Information on Hazardous Ingredients

This material is considered an article according to 29 CFR 1910.1200(5)(v)(c). An article is by definition a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees.

An MSDS is required only for chemicals in products that are hazardous as defined by the OSHA standard 29 CFR 1910.1200. This Material Safety Information Sheet is provided in lieu of a Material safety Data Sheet.

CHEMICAL/COMMON NAME	CAS NUMBER	PERCENT	OSHA-PEL	ACGIH-TLV
Antimony Trioxide	1309-64-4	<2.0 %	0.5 mg/m^3	0.5 mg/m^3
Barium Compounds	2457-01-4	<1.5 %	Not Listed	Not Listed

SECTION 3 Hazards Identification

EYES: May irritate eyes during thermal welding.

SKIN: May irritate skin during thermal welding.

INHALATION: None known.

INGESTION: None known.

SYMPTOMS: May cause skin sensitization in some people due to antimony trioxide.

SECTION 4 First Aid Measures

EYES: Immediately flush eyes with plenty of water for at least 15 minutes. If irritation persists, seek medical attention.

SKIN: Wash skin with soap and plenty of water.

INHALATION: If exposed to fumes from thermal decomposition (flame), remove to fresh air. If not breathing, give artificial respiration and seek medical attention immediately. Trained personnel should only administer oxygen.

INGESTION: If swallowed, call a physician immediately. ONLY induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

Roofing/Waterproofing Membrane

REVISION DATE: 5/25/2011

SECTION 5 Fire Fighting Measures

FLASH POINT (F/ C)	LEL (volume %)	UEL (volume %)
N/A	N/A	N/A

Extinguishing Media: Carbon dioxide, dry chemical, foam, or water spray.

Fire Fighting Procedures: Wear a self-contained breathing apparatus.

Unusual Hazards: None.

Combustion Products: Toxic gases such as carbon dioxide, carbon monoxide, metal oxides, and hydrochloric acid may form if ignited by flame.

SECTION 6 Accidental Release Measures

Use normal cleanup procedure for solid materials.

SECTION 7 Handling and Storage

Store material away from heat and flame.

SECTION 8 Exposure Controls / Personal Protection

Engineering Controls: Mechanical ventilation may be necessary if working with the product in enclosed areas at elevated temperatures as experienced during thermal welding.

Personal Protective Equipment:

EYES: Safety glasses. Consult your safety representative.

SKIN: Gloves recommended.

RESPIRATORY: NIOSH approved respirator is recommended if exposure to airborne contaminants exceeds acceptable limits.

Exposure Guidelines:

CHEMICAL	OSHA	ACGIH TLV
Antimony Trioxide	PEL = 0.5 mg/m^3	TWA = 0.5 mg/m^3
Barium Compounds	Not Listed	Not Listed

PEL = Permissible Exposure Limits
TLV = Threshold Limit Value
TWA = Time Weighted Average (8 hr.)
STEL = Short Term Exposure Limit (15 min.)

SECTION 9 Physical and Chemical Properties

Roofing/Waterproofing Membrane

REVISION DATE: 5/25/2011

APPEARANCE:	Solid flexible membrane.
ODOR:	None
BOILING POINT (@ 760 mm Hg):	N/A
SPECIFIC GRAVITY:	1.27
LIQUID DENSITY:	N/A
SOLUBILITY IN WATER:	Insoluble
% VOLATILE VOLUME:	N/A
EVAPORATION RATE (N-Butyl Acetate=1):	N/A
VAPOR PRESSURE (mm Hg):	N/A
VAPOR DENSITY (air=1):	N/A

SECTION 10 Stability and Reactivity

CONDITIONS TO AVOID:

Prolonged excessive heat, sparks, open flame, and smoking.

INCOMPATABILITY WITH OTHER MATERIALS:

N/A

HAZARDOUS DECOMPOSITION PRODUCTS:

Toxic gases such as carbon dioxide, carbon monoxide, metal oxides, and hydrochloric acid may form if ignited by flame.

HAZARDOUS POLYMERIZATION:

Will NOT undergo hazardous polymerization.

SECTION 11 Toxicological Information

Toxicological information is not available.

SECTION 12 Ecological Information

Ecological information is not available.

SECTION 13 Disposal Considerations

Dispose in accordance with applicable Federal, State, and Local regulations. Meets the Commonwealth of Massachusetts Department of Environmental Protection TCLP requirements for land fill disposal.

SECTION 14 Transportation Information

D.O.T. Primary Hazard Label:	Not Regulated
D.O.T. Hazard Class:	Not Regulated
D.O.T. Identification Number (UN/NA):	None Required
D.O.T. Packing Group:	Not Regulated

SECTION 15 Regulatory Information

U.S. Federal Regulations

SARA Title III, Section 302:

This product is NOT regulated under SARA Title III, Section 302 Extremely Hazardous Substances (40 CFR Part 355).

SARA Title III, Section 313:

This product contains toxic chemicals subject to the reporting requirements of SARA Title III, Section 313 (40 CFR 372) of the Emergency Planning and Community Right-To-Know Act of 1986.

State Regulations

CALIFORNIA SAFE DRINKING ACT (PROP 65 for Carcinogen and Teratogen):

This product contains chemicals currently on the California List of Known Carcinogens and Reproductive Toxins.

CAS #	Chemical Name
1309-64-4	Antimony Trioxide

SECTION 16 Other Information

	HMIS	NFPA
HEALTH:	**0**	**N/A**
FLAMMABILITY:	**1**	**1**
REACTIVITY:	**0**	**0**
PERSONAL PROTECTION:	**B**	**N/A**

Sika Sarnafil Disclaimer of Expressed and Implied Warranties

The information in this Material Safety Information Sheet is offered in good faith as accurate at the date of issuance. No warranty of merchantability, fitness for any particular purpose, or any other warranty is expressed or is to be implied regarding the accuracy or completeness of this information, the safety of this product, or the hazards related to its use. This information and product are furnished on the condition that the person receiving it shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of use thereof. Compliance with all applicable Federal, State, and Local laws and regulations remains the responsibility of the user.

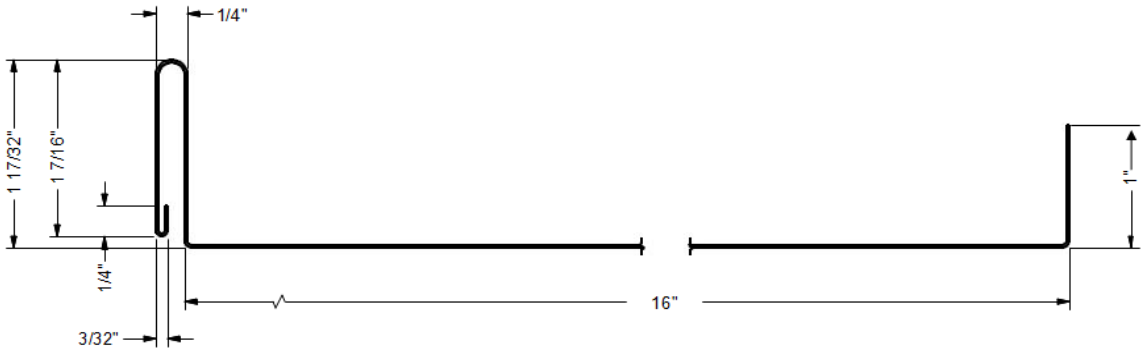
Sheffield Metals International

COOLR® GUARD

SMI 1.5 SnapLock 450
Standing Seam Metal Roof System

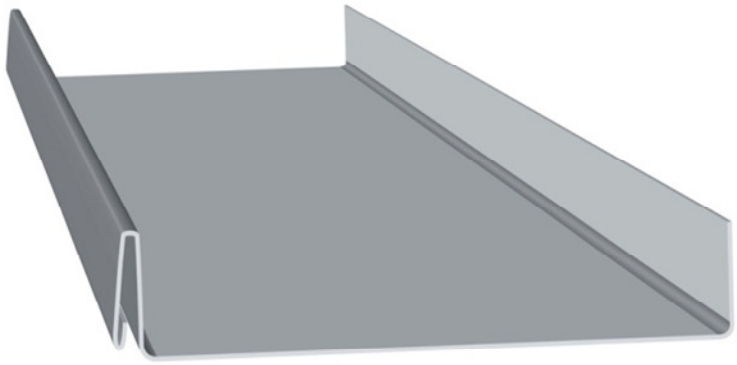
PANEL INFORMATION

Panel Type:	**Standing Seam**
Panel Seam:	**SnapLock**
Panel Width:	**16” Max**
Seam Height:	**1.5”**
Panel Material:	**24 GA Min**
Panel Surface:	**Smooth / Embossed Optional**
Panel Clip:	**Required Per Engineering**
Minimum Slope:	**2/12**
Substrate:	**Plywood**



PANEL TESTING

Uplift Resistance:	**UL 90**
Hail Rating:	**Class 4 Impact UL 2218**
Fire Rating:	**UL Class A**



PANEL NOTES

- **With this 24 GA, 16” wide panel engineering you may opt to use heavier gauge coil & narrower width panels. Clip spacing will not change.**
- **This panel uses a 20” coil.**
- **This panel uses 4” of material to form the panel.**
- **If you take the square footage of the roof and multiply that by 1.25 the total will be the amount coil needed to manufacture the panels.**
- **This panel is approved for weathertight Warrantys.**

ONLINE CERTIFICATIONS DIRECTORY

Construction No. 370
TGKX.370
Roof Deck Constructions

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Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Listed or Classified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered as Classified, Listed, or Recognized.

Roof Deck Constructions

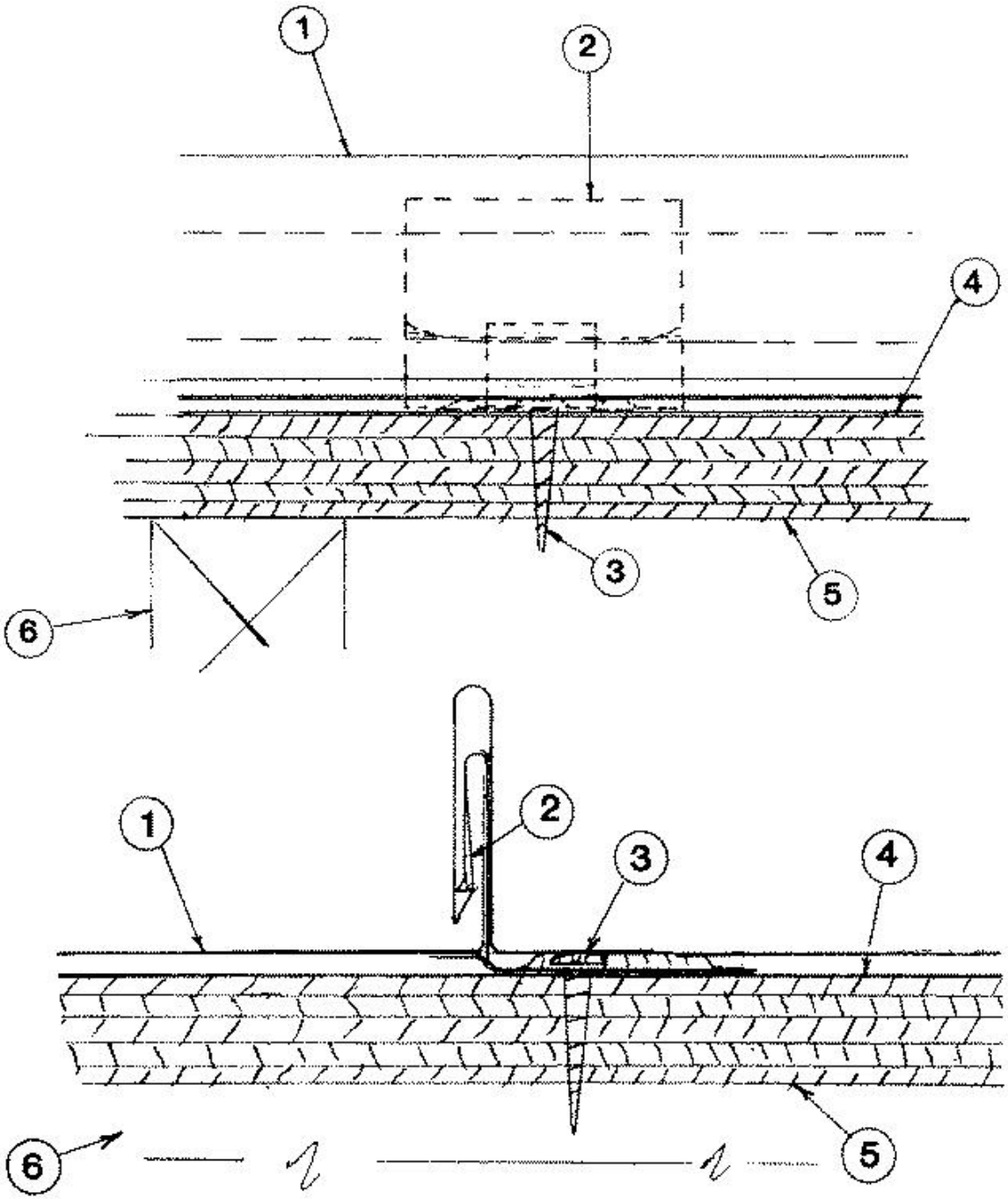
See General Information for Roof Deck Constructions

Construction No. 370

February 27, 2012

Uplift - Class 90

Fire Not Investigated



1. **Metal Roof Deck Panels* —** No. 24 MSG min coated steel panels, max 20 in. wide, min 9 in. wide, 1-1/2 in. high at female side rib. Panels continuous over three or more clips with no endlaps. A bead of sealant may be used at panel side joints.

AUSTIN SNAP LOC SUPPLY (View Classification) — "ASL 150"

CONSTRUCTION METAL PRODUCTS INC (View Classification) — "CMP Series 1000"

DREXEL METALS INC (View Classification) — "DMC 150SL"

DURO-LAST INC (View Classification) — "EM 150SL"

FABRAL INC (View Classification) — "High Seam"

METAL PANELS INC (View Classification) — "VPSL15"

NEW TECH MACHINERY CORP (View Classification) — "SS450"

PETERSEN DEAN COMMERCIAL INC (View Classification) — "1.5" Snap Lock"

PREMIUM PANELS INC (View Classification) — "Premium Snap 450" or "P.S. 450"

SHEFFIELD METALS INTERNATIONAL (View Classification) — "SMI 1 ½" SnapLock 450"

SPANN ROOFING & SHEET METAL INC (View Classification) — "Spann Series 1000"

2. **Roof Deck Fasteners* (Panel Clips) —** One piece assembly, No. 24 MSG min coated steel, 1-3/4 in. wide, 1-1/4 in. high. Min thickness 0.025 in. (No. 24 MSG). Clips spaced 18 in. OC fastened to plywood deck.

ENGLERT INC (View Classification) — "Series 1000 Interlocking Clip"

FABRAL INC (View Classification) — "High Seam Roof Clip"

3. **Fasteners (Screws) —** Fasteners used to attach panel clips (Item 2) to plywood to be No. 10-12 by 1 in. long pancake head, No. 2 Phillips drive, A-point, coated steel screw. Min one fastener per clip to be used.

4. **Underlayment —** Underlayment used over plywood deck to be type 30 organic felt. Sides overlapped min 2 in., end laps per manufacturer's instructions. Felt nailed to plywood deck with 1 in. long galv steel roofing nails, located per manufacturer's instructions. Nail spacing to be max 12 in. OC at the side lap and max 24 in. OC in interior rows.

5. **Plywood Decking —** Plywood decking to be graded per PS83 specifications, 19/32 in. thick min, exposure 1, APA rated, sq edged. Butt ends not blocked. All butt and side joints to be sealed with a one part urethane caulk sealant troweled smooth.

6. **Supports —** Spaced max of 24 in. OC. Any of the following types may be used to support the plywood decking:

a) 2 by 6 in. min, No. 2 grade or better A.F.P.A. S-P-F Hemlock Fir, Douglas Fir, Southern Pine or equivalent.

b) Wood trusses with a nom 2 by 4 in. upper chord of the same grade as Item a.

c) No. 22 MSG min cold formed coated steel (min yield to be 33,000 psi).

7. **Plywood Fasteners —** Fasteners used to attach the plywood deck to the supports to be as follows:

a) For plywood-to-wood supports No. 8-18 by 1-7/8 in. long bugle-head steel screws with a No. 2 Phillips drive, a "Hi-Low" thread pattern and an "S-Point."

b) For plywood-to-steel supports for a steel thickness less than No. 20 MSG, No. 7-19 by 1-1/4 in. long bugle-head steel screws with a No. 2 Phillips head drive "Hi-Low" threads and an "S-Point." For a steel thickness greater than No. 20 MSG to No. 16 MSG, No. 6-20 by 1-1/4 in. long bugle-head steel screws with a No. 2 Phillips drive and an S12 (TEKS/3)® point.

Spacing: Fastener spacing for all fastener types to be 6 in. OC at the plywood butt edges and 12 in. OC in the interior.

Refer to General Information, Roof Deck Construction (Roofing Materials & Systems Directory) for items not evaluated.

*Bearing the UL Classification Mark

Last Updated on 2012-02-27

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ONLINE CERTIFICATIONS DIRECTORY

TGAM.R27099
Roof-covering Materials, Impact Resistance

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Roof-covering Materials, Impact Resistance

See General Information for Roof-covering Materials, Impact Resistance

SHEFFIELD METALS INTERNATIONAL R27099
5467 EVERGREEN PKY
SHEFFIELD VILLAGE, OH 44054 USA

Class 4 formed coated steel panels designated "SMI 1\' SnapLock", "CR-150-ML", "SMI 1 ½" Mechanical Seam", "SMI 2" Mechanical Seam", "SMI 1 ½" SnapLock 450SL", "SMI 1 ½" SnapLock 450", "SMI 1 ¾" SnapLock", "SMI 2" A Mechanical Seam" or "SMI 1 1/2 " SnapLock 550".

Last Updated on 2012-02-27

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ONLINE CERTIFICATIONS DIRECTORY

TGAM.GuideInfo
Roof-covering Materials, Impact Resistance

View Listings Page Bottom

[Roof-covering Materials] Roof-covering Materials, Impact Resistance

See General Information for Roof-covering Materials

USE

This category covers Classes A, B and C roof-covering materials investigated for impact resistance.

Unless otherwise indicated in the individual Classifications, the roof coverings are intended for application to solid wood decks, including 3/8-in. thick (minimum) plywood or 3/8-in. thick (minimum) nonveneer APA Rated Series Sheathing (oriented strandboard, structural particleboard, composite panels, or waferboard).

Unless otherwise indicated in the individual Classifications, the Classifications are applicable for new work only, not for recovering purposes.

Where indicated in the individual Classifications, products covered under this category have also been evaluated by ICC Evaluation Service (ICC-ES).

CLASS DESIGNATIONS

The Classifications for impact resistance are expressed as Class 1, 2, 3 or 4, which relate to a roof covering's ability to withstand impacts from 1-1/4, 1-1/2, 1-3/4 and 2 in. diameter steel balls, respectively. The acceptance criteria used to establish roof-covering materials Classifications are as follows:

Prepared Roof-covering Materials

Withstand the assigned class designation impact without visible evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other opening of the roof-covering layer.

Roofing Systems — Fluid-applied Coating Systems

Withstand the assigned class designation impact without visible evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other opening which would expose the roof deck to the effects of weather.

Roofing Systems — Single-ply Membrane Systems

Withstand the assigned class designation impact without visible evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other opening which would expose the substrate beneath the membrane to the effects of weather.

Roofing Systems — Spray-applied Foam and Coating Systems

Withstand the assigned class designation impact without visible evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other opening which would expose the foam to the effects of weather.

Roofing Systems — Other Systems

Metal Roof Panels — Withstand the assigned class designation impact without visible evidence of tearing, fracturing, cracking, splitting, rupture, crazing or other opening of the roof-covering layer.

UNEVALUATED FACTORS

The effects of weathering on the impact resistance of these materials have not been investigated.

ADDITIONAL INFORMATION

For additional information, see Roof-covering Materials (TEVT) and Roofing Materials and Systems (AARM).

REQUIREMENTS

In order to be eligible for Classification under this category, roof-covering materials must also be Listed under Prepared Roof-covering Materials (TFWZ), Prepared Roof-covering Materials, Formed or Molded Metal, Fiber-Cement, Plastic or Fire Retardant-treated Wood (TFXX), or Classified under Roofing Systems (TGFU).

The Classifications for impact resistance are derived from tests conducted in accordance with UL 2218, "Impact Resistance of Prepared Roof-covering Materials."

UL MARK

The Classification Mark of UL on the product is the only method provided by UL to identify products manufactured under its Classification and Follow-Up Service. The Classification Mark for these products includes the appropriate Listing Mark for Prepared Roof-covering Materials (TFWZ), Prepared Roof-covering Materials, Formed or Molded Metal, Fiber-Cement, Plastic or Fire Retardant-treated Wood (TFXX), or Classification Mark for Roofing Systems (TGFU), and the following additional information:

ALSO CLASSIFIED AS TO IMPACT RESISTANCE
CLASS +
Control No.

In addition, an optional marking may appear on each shingle, only when the complete Listing/Classification Mark noted above is provided on each package. This marking includes the UL symbol, the word "CLASSIFIED" above the UL symbol (as illustrated in the Introduction of this Directory), and the statement "IMPACT RESISTANCE CLASS +."

+ **1**, **2**, **3** or **4**

* *

UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. UL shall not incur any obligation or liability for any loss, expense or damages, including incidental or consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Guide Information.

Last Updated on 2010-10-05

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S-5!®

The Right Way!

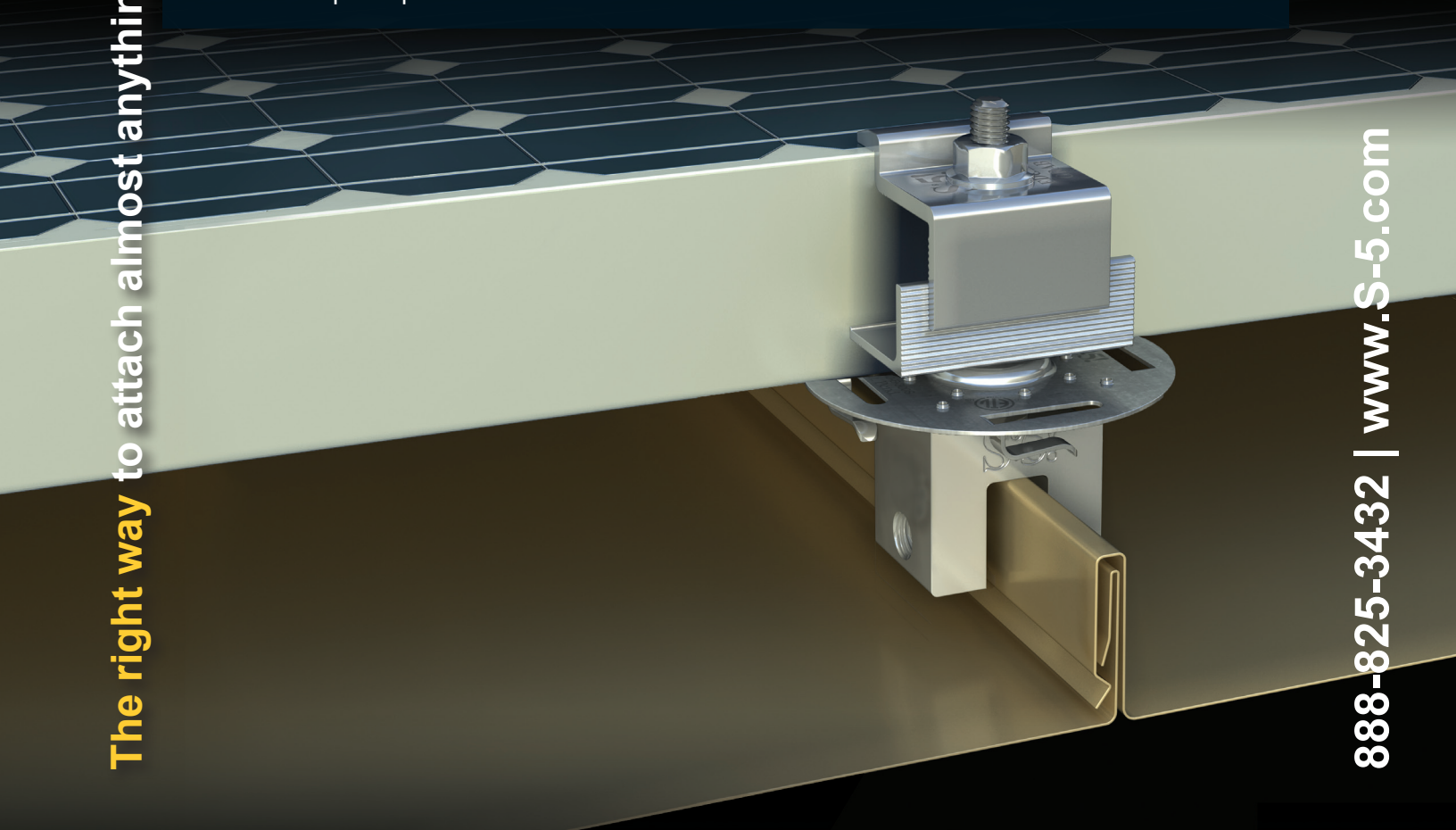
LISTED

S-5-PV Kit and EdgeGrab™

The concept of combining photovoltaic arrays with standing seam metal roofing is growing—and for good reasons. A standing seam metal roof has a life expectancy consistent with that of framed PV modules. A 30-year power source on a 40-year roof, along with zero-penetration technology, creates the most sustainable roof system available with alternative power generation, all without compromising the roof manufacturer's warranty!

The new S-5-PV Kit boasts an important breakthrough in PV mounting technology. It is one of the first solar module mounting solutions in the industry to be listed to the new UL subject 2703, a standard that covers both bonding and mounting. Furthermore, the S-5!® Mounting Disk has gained an ETL Listing to UL 1703.*

The S-5-PV Kit features a groundbreaking new stainless steel mounting disk with twelve nodes designed to ensure the module-to-module conductivity of anodized aluminum module frames. This means the module is simply anchored with the kit and is automatically bonded. No lugs or wire required except to connect one string of modules to another and to ground the system. This connection detail represents installed electrical cost savings of $6-$12 per unit. In most cases, the savings in time and materials is sufficient to pay for the entire S-5-PV Kit and clamp setup.



The right way to attach almost anything to metal roofs!

S-5-PV Kit and EdgeGrab™

888-825-3432 | www.S-5.com

S-5!®
The Right Way!

The S-5-PV Kit is a revolutionary new solution to attach solar PV panels to standing seam metal roofs!

The **S-5-PV Kit** is furnished with the hardware shown at right, excluding the attachment clamp, which is supplied separately. The S-5-PV Kit is compatible with most common metal roofing materials, including brass. The S-5!® **EdgeGrab™** and S-5-PV Kit together accommodate PV frame thicknesses 30–48 mm (if the L-flange is positioned below the stud's hex nut) and 34–51 mm (if the L-flange is positioned above the stud's hex nut).†

The embossed panel guide makes the module placement easier. The mounting disk is multi-directional and rails are not required. Flat mounting disks are available for use with the S-5! VersaBracket™ for exposed-fastened trapezoidal profiles.

Four strategically placed under-disk hooks assist in wire management. The PV grab ears that hold the solar panel in place are broader to allow for ease of installation and precise module engagement.

Accommodating module thicknesses between 30 and 51 mm, the S-5-PV Kit fits the majority of solar panels on the market. Using the S-5! mini clamps, it fits most standing seam metal roofs. When paired with other S-5! products, the S-5-PV Kit and EdgeGrab will work on most exposed-fastened and corrugated metal roofs. The standard grab is designed to fit field conditions (two adjacent panels), while the new EdgeGrab is designed specifically for end conditions.

Wind dynamics are complex; thus, each system should be reviewed by a qualified licensed professional who understands wind effects on metal roof design and construction prior to purchase and installation. For more detailed information including specifications, installation instructions, and CAD drawings, visit **www.S-5.com** or your S-5-PV Kit distributor.

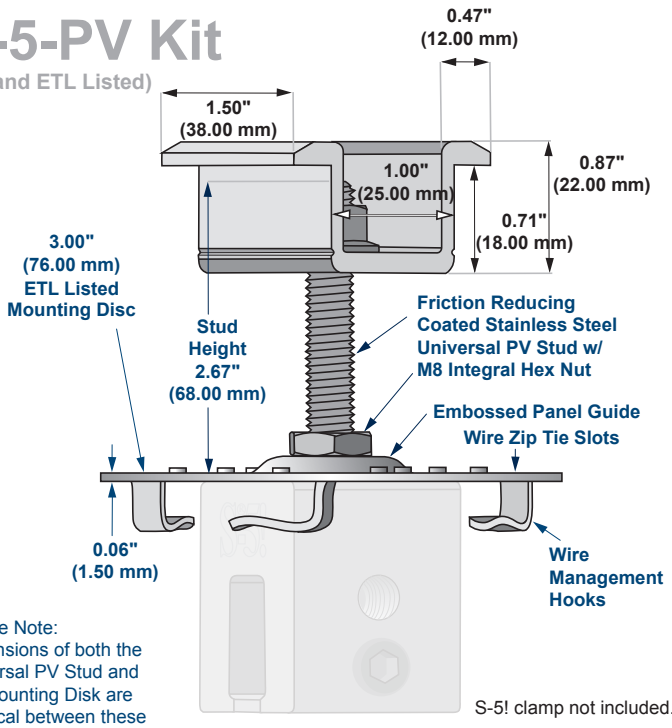
The S-5-PV Kit continues to be the easiest, most cost-effective way to install solar panels directly to standing seam metal roofs, remaining the most popular choice worldwide.

LISTED

Listed to UL subject 2703.
ETL Listed to UL 1703.*

S-5-PV Kit

(UL and ETL Listed)

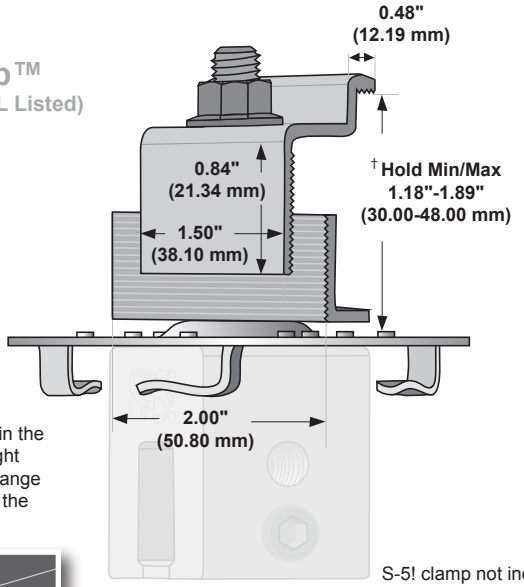


Please Note:
Dimensions of both the Universal PV Stud and the Mounting Disk are identical between these two illustrations.

S-5! clamp not included.

EdgeGrab™

(Not UL or ETL Listed)

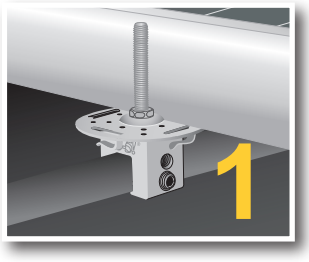


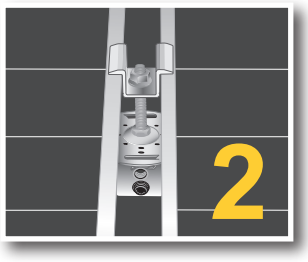
Please note: The assembly option in the diagram to the right illustrates the L-flange positioned below the stud's hex nut.

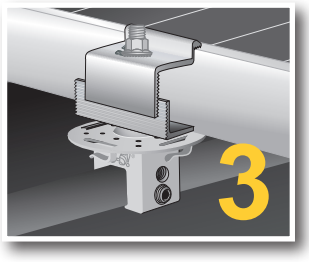
S-5! clamp not included.

Please note: All measurements are rounded to the second decimal place.

** Patents pending. Certain components featured in illustration may not be UL listed.*
Due to the variety of attachment needs, S-5-PV Kits are sold separately from S-5! mini clamps. The S-5-PV Kit fits only S-5! mini clamps, NOT standard clamps.







S-5!® Warning! Please use this product responsibly!

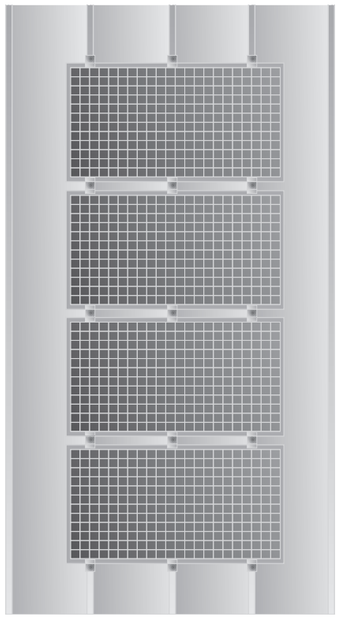
Products are protected by multiple U.S. and foreign patents. Visit the website at www.S-5.com for complete information on patents and trademarks. For maximum holding strength, setscrews should be tensioned and re-tensioned as the seam material compresses. Clamp setscrew tension should be verified using a calibrated torque wrench between 160 and 180 inch pounds when used on 22ga steel, and between 130 and 150 inch pounds for all other metals and thinner gauges of steel. Consult the S-5! website at www.S-5.com for published data regarding holding strength.

Distributed by

S-5!® suggestions for spacing of S-5! mini clamps for PV arrays.

The following suggestions assume that determination has been made that the roof to which the S-5!® mini clamps will be attached is structurally adequate. Any loads imposed on the S-5! mini clamps will be transferred to the panels. Panel seams must have sufficient flexural strength to carry these loads. Panels must also be adequately attached to the building structure, and the structure must be sufficient to carry these loads. The makers of S-5! mini clamps make no representations with respect to these variables. It is the responsibility of the user to verify this information, or seek assistance from a qualified design professional if necessary.

The key to frequency and spacing of attachment points for PV frames utilizing the S-5-PV Kit is to distribute loads to the metal standing seam panels in a manner that is consistent with the intended distribution of loads from the roof panels into the building structure. With very few exceptions, the attachment of a single S-5! mini clamp to the seam will be stronger than a single point of attachment of the seam to the building structure. Hence the "weak link" is not the S-5! mini clamp but the attachment clips that hold the metal panels to the building structure, or the beam strength of the roof panel seam itself.



The most conservative approach to the spacing/frequency of PV frame attachment to the roof is to determine the spacing/frequency of the roof's attachment to the building structure, then duplicate it at minimum. Determining panel attachment spacing in one axis is very simple. Standing seam panels' attachment will be made using concealed hold-down clips within the seam area of the panel. So, in that axis, the clip spacing is the same as the seam spacing. The location of the clips along the seam (in the other axis) can be determined by a) consultation with the roof system manufacturer or installer, b) checking from the underside or, c) close examination from the topside along the seam.

There will usually be a slight, but detectable, deformation of the seam at the clip location visible from the roof's topside. Many standing seam roof systems are installed on "pre-engineered" steel buildings. The attachment spacing in that industry is typically 5'-0" and is readily apparent by inspecting the spacing of the structural purlins to which the panel clips are attached from the roof underside (interior of the building).

If, for instance, the panel clips are spaced 5'-0" on center along the seam, then use the 5'-0" dimension as a maximum spacing for the S-5! mini clamps. (S-5! mini clamps may also be spaced at closer centers, but not wider.) When modules are attached directly without racking in the landscape orientation, this spacing dimension is dictated by the smallest dimension of the PV frame. Using the roof panel clip spacing as a maximum spacing template for S-5! mini clamps is a sound practice, whether the PV modules are attached directly to S-5! mini clamps, or to a racking system and then to the S-5! mini clamp (and panel seams). To evenly distribute loads, it is also necessary that each seam be involved in the finished assembly. Thus, every time a seam is traversed, it should be attached. Such an attachment scheme should evenly distribute wind loads into the building structure through the panels and their attachment, as was intended in the original roof construction assembly.

Please note these are only suggestions. Wind dynamics are complex, and S-5! advises review of the planned PV frame attachment design by a qualified professional who understands wind effects and metal roof design and construction. In certain solar installations, a design professional may determine that seams can be skipped as points of attachment, but this determination must be made on a job-specific basis.

S-5!® Warning! Please use this product responsibly!

S-5!®
The Right Way!

The right way to attach almost anything to metal roofs!

Installation Instructions

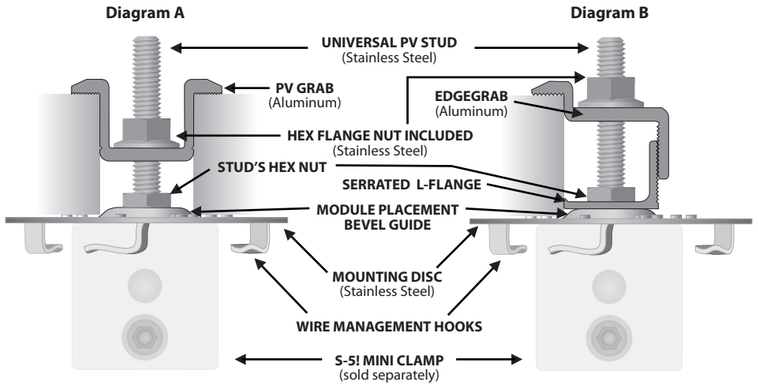
S-5!® Warning! Please use these products responsibly! Visit our website or contact your S-5! distributor for detailed installation instructions and available load test results. The user and/or the installer of these parts is responsible for all necessary engineering and design for the intended use of these parts in an assembly or application. Note that a continuous ground must be followed in accordance with National Electric Code (NEC), ANSI/NFPA 70. Installation in Canada must be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1. For use with PV Modules having a maximum fuse rating of 15A or less. Prior to installation, contact the local code Authority Having Jurisdiction (AHJ) to determine the proper grounding requirements.

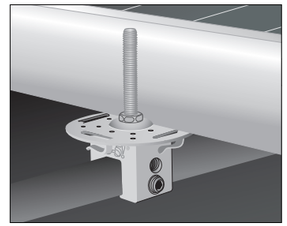
Install S-5! mini clamp. See mini clamp installation instructions.

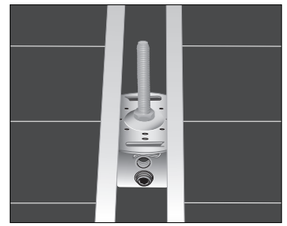
1. Place mounting disc on the S-5! mini clamp. Secure Universal PV stud through the mounting disc into the S-5! mini clamp. Using a 13 mm deepwell socket on the PV stud's hex nut, tighten universal PV stud to 140–160 inch pounds. Install one PV frame on top of the mounting disc utilizing the module placement bevel guide to ensure proper placement.
2. Install a second PV frame on top of the mounting disc again utilizing the module placement bevel guide to ensure proper placement.
3. Install the universal PV anchor grab to the universal PV stud, with the flanged nut to secure the two PV frames (see Diagram A). Tighten flange nut to 100–120 inch pounds.
4. For end/edge conditions, use the EdgeGrab™. There are two assembly options for the EdgeGrab, dependent upon the PV frame thickness. For frame thicknesses 30–48 mm, install the EdgeGrab by placing the serrated L-flange on top of the mounting disk (see Diagram B). Then, drive the universal PV stud through the serrated L-flange and the mounting disk, and into the S-5! mini clamp. The L-flange will be positioned beneath the stud's hex nut. Using a 13 mm deepwell socket, tighten the universal PV stud to 140–160 inch pounds. Next, set the PV module atop the mounting disk, making the thin edge of the L-flange flush against the PV frame. Slide the top component of the EdgeGrab onto the stud, allowing the serrated sides to interlock at the appropriate height. Add the flange nut to the stud to secure the PV frame. Tighten flange nut to 100–120 inch pounds.
5. For frame thicknesses 34–51 mm, position the serrated L-flange atop the stud's hex nut. Proceed with the remainder of step four.

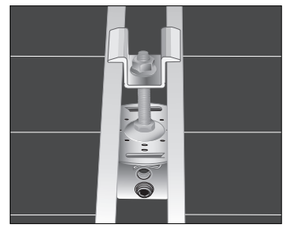
Note: An electric tool can be utilized for ease of installation provided proper torque is achieved.

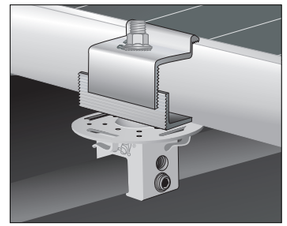
Diagram A **Diagram B**

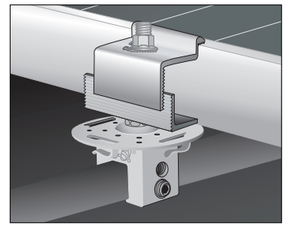












These instructions are for use by those experienced in the trade. Always follow appropriate safety precautions and use appropriate tools.

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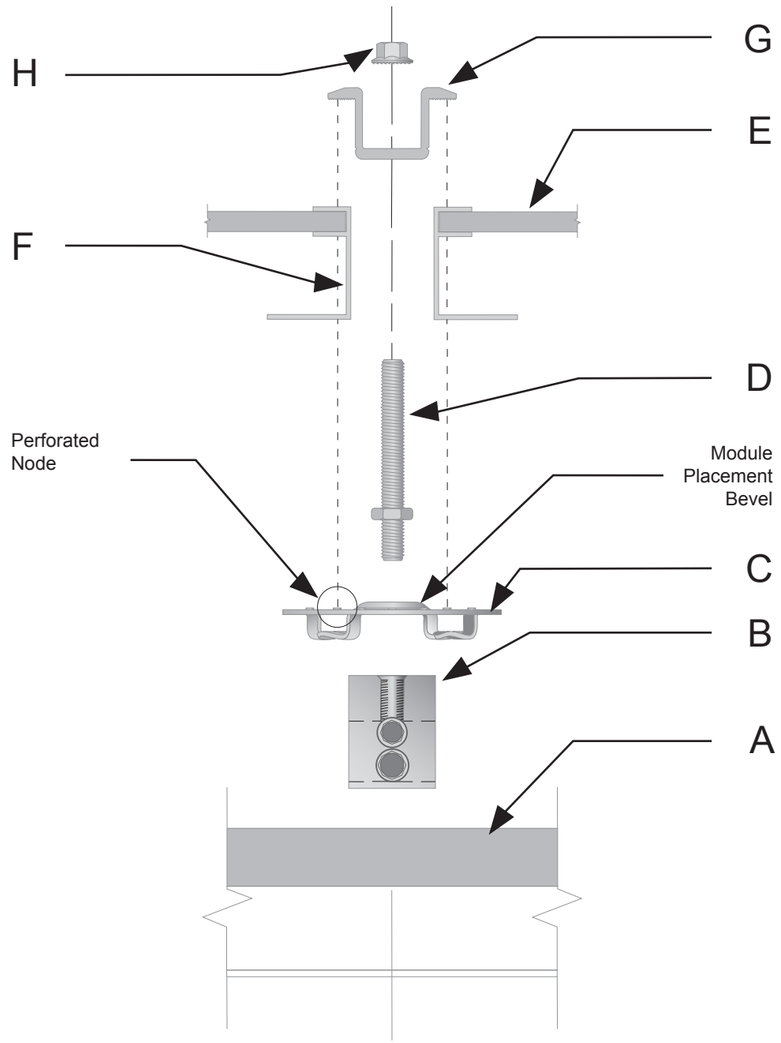
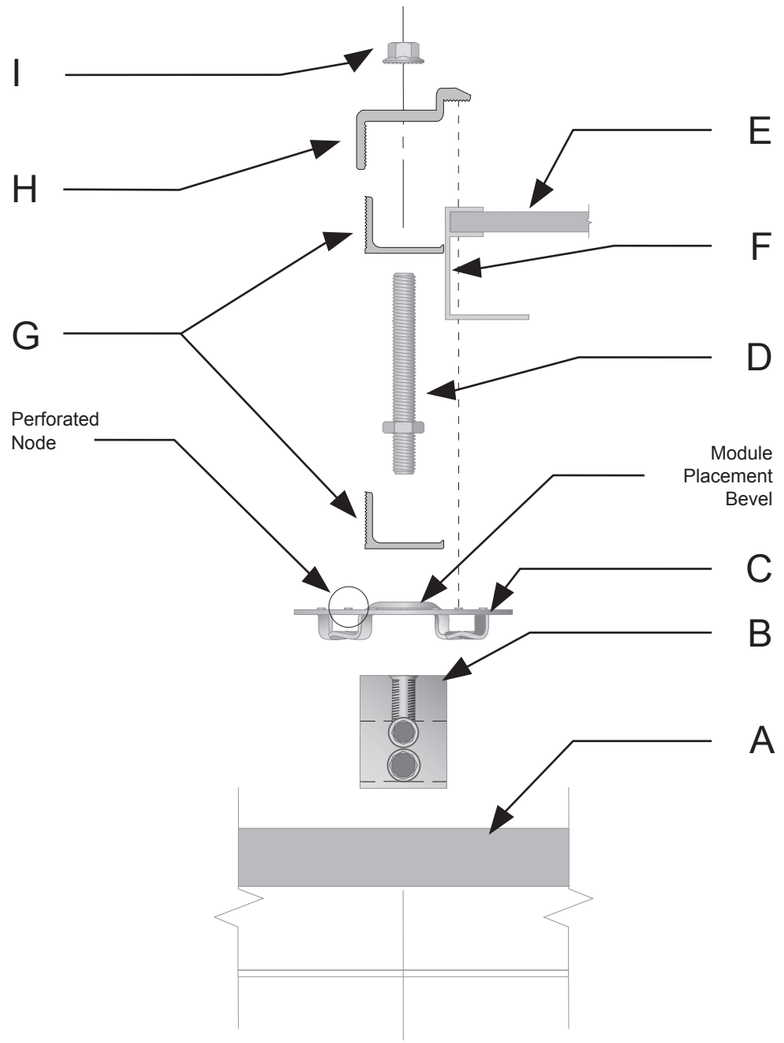
PV Mounting Assembly
Field Condition



A. Standing Seam Metal Roof
B. S-5!® Mini Clamp (Sold separately)
C. Stainless Steel Mounting Disc
D. Stainless Steel M8–1.25x68 mm Universal PV Stud w/hex nut(Tensioned between 140 and 160 inch pounds)
E. Glass
F. Module Frame Cross Section (Frame thickness from 1.3" [33 mm] to 2.5" [64 mm])
G. Universal PV Grab
H. Stainless Steel M8–1.25 Hex Flange Nut (Tensioned between 100 and 120 inch pounds)

S-5-PV Kit Installation Instructions

EdgeGrab™
Edge Condition



A. Standing Seam Metal Roof
B. S-5!® Mini Clamp (Sold separately)
C. Stainless Steel Mounting Disc
D. Stainless Steel M8–1.25x68 mm Universal PV Stud w/hex nut (Tensioned between 140 and 160 inch pounds)
E. Glass
F. Module Frame Cross Section (Frame thickness from 1.3″ [33 mm] to 2.5″ [64 mm])
G. EdgeGrab™ Serrated L-Flange (See installation instructions, Steps 4 and 5, for details on EdgeGrab)
H. EdgeGrab Serrated Top Component (See installation instructions, Steps 4 and 5, for details on EdgeGrab)
I. Stainless Steel M8–1.25 Hex Flange Nut (Tensioned between 100 and 120 inch pounds)

100 Series Unit Performance Data

100 Series Product	Performance Rating	Typical Air Infiltration	Standard		STC Upgrade		Low-E						SmartSun™ Low-E					
							Without Grilles			With Grilles			Without Grilles			With Grilles		
			Sound Transmittance Class (STC)	OITC	Sound Transmittance Class (STC)	OITC	U-Factor	SHGC	VT	U-Factor	SHGC	VT	U-Factor	SHGC	VT	U-Factor	SHGC	VT
Single-Hung	PG30	0.100 cfm/ft²	25	21	32	26	0.31	0.32	0.54	0.31	0.28	0.48	0.30	0.21	0.49	0.30	0.19	0.43
Gliding	PG30	0.080 cfm/ft²	25	21	32	26	0.31	0.32	0.54	0.31	0.28	0.48	0.30	0.21	0.49	0.30	0.19	0.43
Casement/Awning	PG30	<0.023 cfm/ft²	26	22	30	26	0.29	0.28	0.48	0.29	0.26	0.43	0.28	0.19	0.43	0.28	0.17	0.39
Fixed	PG30	<0.010 cfm/ft²	27	22	31	26	0.29	0.33	0.56	0.29	0.29	0.50	0.29	0.22	0.50	0.29	0.20	0.45
2-Panel Door	PG30	0.150 cfm/ft²	28	23	29	23	0.30	0.32	0.55	0.32	0.29	0.48	0.30	0.21	0.50	0.31	0.19	0.44
Sidelight/Transom	PG30	<0.010 cfm/ft²	29	24	31	25	0.30	0.25	0.43	0.30	0.23	0.38	0.30	0.17	0.39	0.30	0.15	0.35

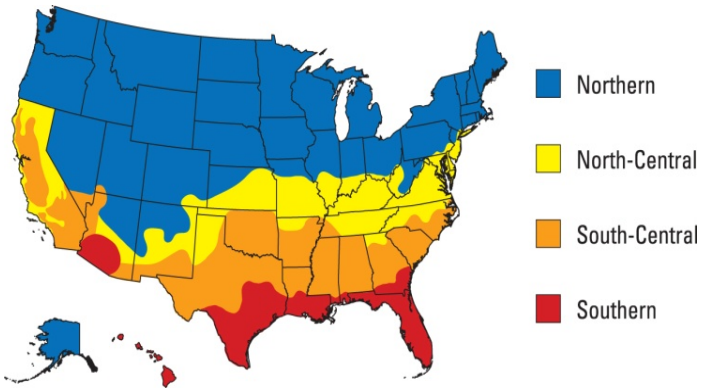
ANDERSEN® 100 SERIES WINDOW AND DOOR NFRC/ENERGY STAR® INFORMATION

This document provides NFRC certified U-Factor, Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) values for Andersen® products along with the corresponding ENERGY STAR® Version 5.0 (2010) climate zones that the product and glass type meet.

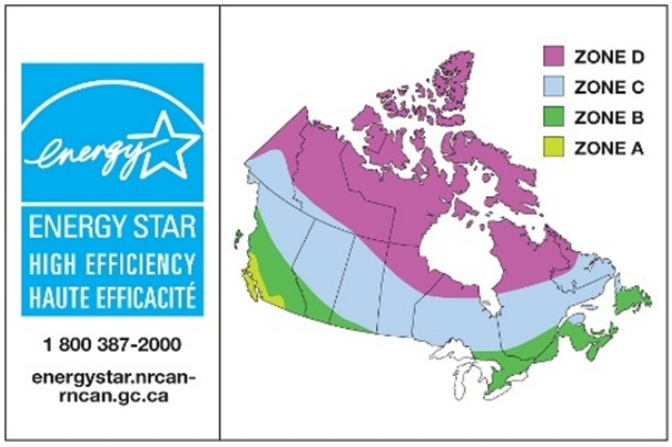
These products rated, certified and labeled y National Fenestration Rating Council® (NFRC) - a non-profit organization that provides fair, accurate and credible energy performance ratings for windows and doors.

Many of our products meet the stringent energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy. These guidelines are based on the heat gain and loss of each product in various regions of the country.

United States ENERGY STAR®
Climate Zone Criteria



Canada ENERGY STAR®
Climate Zone Criteria



ENERGY STAR® Qualification Criteria for Residential Windows and Doors

Windows

Climate Zone	U-Factor[1]	SHGC[2]	
Northern	≤ 0.30	Any	Prescriptive
	=0.31	≥ 0.35	Equivalent Energy Performance
	=0.32	≥ 0.40	
North-Central	≤ 0.32	≤ 0.40	
South-Central	≤ 0.35	≤ 0.30	
Southern	≤ 0.60	≤ 0.27	

Doors

Glazing Level	U-Factor[1]	SHGC[2]
Opaque	≤ 0.21	No Rating
≤ ½-Lite	≤ 027	≤ 0.30
> ½-Lite	≤ 0.32	≤ 0.30

[1] *Btu/h·ft²·°F*

[2] *Fraction of incident solar radiation*

Windows

Zone	Heating Degree-Day Range	Compliance Paths: Energy Rating (ER)	or	Compliance Paths: U-Factor	
		Minimum ER (unitless) Maximum U-Factor 2.00 W/m²•K (0.35 Btu/h•ft.²•°F)		Maximum U-Factor W/m²•K (Btu/h•ft.²•°F)	Minimum ER (unitless)
A	<= 3500	21	or	1.80 (0.32)	13
B	> 3500 to <= 5500	25	or	1.60 (0.28)	17
C	> 5500 to <= 8000	29	or	1.40 (0.25)	21
D	> 8000	34	or	1.20 (0.21)	25

Doors

Zone	Heating Degree-Day Range	Compliance Paths: Energy Rating (ER)	or	Compliance Paths: U-Factor	
		Minimum ER (unitless) Maximum U-Factor 2.00 W/m²•K (0.35 Btu/h•ft.²•°F)		Maximum U-Factor W/m²•K (Btu/h•ft.²•°F)	Minimum ER (unitless)
A	<= 3500	21	or	1.80 (0.32)	N/A
B	> 3500 to <= 5500	25	or	1.60 (0.28)	N/A
C	> 5500 to <= 8000	29	or	1.40 (0.25)	N/A
D	> 8000	34	or	1.20 (0.21)	N/A

For NFRC certified total unit performance for units with capillary breather tubes, please refer to the High Altitude information section for each unit.

[1]U-Factor defines the amount of heat loss through the total unit in BTU/hr*ft 2*°F, metric in W/m2*K. The lower the value, the less the heat is lost through the entire product.

[2]Solar Heat Gain Coefficient (SHGC defines the fraction of solar radiation admitted through the glass both directly transmitted and absorbed and subsequently released inward. The lower the value, the less heat is transmitted through the product.

[3]Visible Transmittance (VT) measures how much light comes through a product (glass and frame). The higher the value, from 0 to 1, the more daylight the product lets in over the product's total unit area. Visible Transmittance is measured over the 380 to 760 nanometer portion of the solar spectrum.

NFRC ratings are based on modeling by a third party agency as validated by an independent test lab in compliance with NFRC program and procedural requirements.

This data is accurate as of February 11, 2013. Due to ongoing product changes, updated test results or new industry standards or requirements, this data may changeover time. Due to variations in dealer and distributor inventory levels, products that were manufactured before February 11, 2013 that were designed, tested and labeled with different NFRC values may still be available. Check the labels on the product packaging to confirm NFRC values. Ratings are for sizes specified by NFRC for testing and certification. Ratings may vary depending on use of tempered glass, different grille options, glass for high altitude, etc. See your dealer for glass option availability.

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Single-Hung Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-80-00519-00001	0.30	1.70	0.32	0.54	21	0.07	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00527-00001	0.30	1.70	0.28	0.48	18	0.07	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00521-00001	0.29	1.65	0.21	0.49	15	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00529-00001	0.29	1.65	0.19	0.43	14	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00518-00001	0.30	1.70	0.53	0.60	33	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00526-00001	0.30	1.70	0.47	0.53	29	0.07	N	-	-	-	A	B	C	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-80-00535-00001	0.29	1.65	0.31	0.54	21	0.07	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00543-00001	0.29	1.65	0.28	0.48	19	0.07	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00537-00001	0.29	1.65	0.21	0.48	15	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00545-00001	0.29	1.65	0.19	0.43	14	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00534-00001	0.30	1.70	0.52	0.59	32	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00542-00001	0.30	1.70	0.46	0.52	29	0.07	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-80-00535-00009	0.29	1.65	0.31	0.53	21	0.07	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00543-00009	0.29	1.65	0.28	0.47	19	0.07	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00537-00009	0.29	1.65	0.21	0.48	15	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00545-00009	0.29	1.65	0.19	0.43	14	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00534-00004	0.30	1.70	0.47	0.59	29	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00542-00004	0.30	1.70	0.43	0.52	27	0.07	N	-	-	-	A	B	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-80-00535-00013	0.29	1.65	0.31	0.54	21	0.07	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00543-00013	0.29	1.65	0.28	0.48	19	0.07	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00534-00002	0.30	1.70	0.49	0.59	30	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00542-00002	0.30	1.70	0.44	0.52	27	0.07	N	-	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-80-00535-00014	0.29	1.65	0.31	0.53	21	0.07	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00543-00014	0.29	1.65	0.28	0.47	19	0.07	N	NC	SC	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Single-Hung Window	Low-E SmartSun™	No Grilles	AND-N-80-00537-00014	0.29	1.65	0.21	0.48	15	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00545-00014	0.29	1.65	0.19	0.43	14	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00534-00003	0.30	1.70	0.47	0.59	29	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00542-00003	0.30	1.70	0.43	0.52	27	0.07	N	-	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Single-Hung Window (w/ Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-80-00375-00001	0.33	1.87	0.32	0.54	17	0.07	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00383-00001	0.33	1.87	0.29	0.48	15	0.07	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00377-00001	0.33	1.87	0.21	0.49	10	0.07	-	-	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00385-00001	0.33	1.87	0.19	0.43	9	0.07	-	-	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00374-00001	0.34	1.93	0.52	0.60	27	0.07	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00382-00001	0.34	1.93	0.47	0.53	24	0.07	-	-	-	-	A	-	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-80-00391-00001	0.33	1.87	0.32	0.54	17	0.07	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00399-00001	0.33	1.87	0.28	0.48	15	0.07	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00393-00001	0.32	1.82	0.21	0.48	12	0.07	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00401-00001	0.32	1.82	0.19	0.43	10	0.07	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00390-00001	0.33	1.87	0.52	0.59	28	0.07	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00398-00001	0.33	1.87	0.46	0.52	25	0.07	-	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-80-00391-00009	0.33	1.87	0.31	0.53	16	0.07	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00399-00009	0.33	1.87	0.28	0.47	15	0.07	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00393-00009	0.32	1.82	0.21	0.48	12	0.07	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00401-00009	0.32	1.82	0.19	0.43	10	0.07	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00390-00004	0.33	1.87	0.47	0.59	25	0.07	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00398-00004	0.33	1.87	0.43	0.52	23	0.07	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-80-00391-00013	0.33	1.87	0.32	0.54	17	0.07	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00399-00013	0.33	1.87	0.28	0.48	15	0.07	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-80-00393-00013	0.32	1.82	0.21	0.48	12	0.07	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	nn	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00401-00013	0.32	1.82	0.19	0.43	10	0.07	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00390-00002	0.33	1.87	0.49	0.59	27	0.07	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00398-00002	0.33	1.87	0.44	0.52	24	0.07	-	-	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-80-00391-00014	0.33	1.87	0.31	0.53	16	0.07	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00399-00014	0.33	1.87	0.28	0.47	15	0.07	-	-	SC	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Single-Hung Window (w/ Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-80-00393-00014	0.32	1.82	0.21	0.48	12	0.07	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00401-00014	0.32	1.82	0.19	0.43	10	0.07	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-80-00390-00003	0.33	1.87	0.47	0.59	25	0.07	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-80-00398-00003	0.33	1.87	0.43	0.52	23	0.07	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-81-00519-00001	0.30	1.70	0.32	0.54	21	0.06	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00527-00001	0.30	1.70	0.29	0.48	19	0.06	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00521-00001	0.29	1.65	0.21	0.49	15	0.06	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00529-00001	0.29	1.65	0.19	0.43	14	0.06	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00518-00001	0.30	1.70	0.53	0.60	33	0.06	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00526-00001	0.30	1.70	0.47	0.53	29	0.06	N	-	-	-	A	B	C	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-81-00535-00001	0.29	1.65	0.31	0.54	21	0.06	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00543-00001	0.29	1.65	0.28	0.48	19	0.06	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00537-00001	0.29	1.65	0.21	0.48	15	0.06	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00545-00001	0.29	1.65	0.19	0.43	14	0.06	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00534-00001	0.30	1.70	0.52	0.59	32	0.06	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00542-00001	0.30	1.70	0.46	0.53	29	0.06	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-81-00535-00009	0.29	1.65	0.31	0.53	21	0.06	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00543-00009	0.29	1.65	0.28	0.47	19	0.06	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00537-00009	0.29	1.65	0.21	0.48	15	0.06	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00545-00009	0.29	1.65	0.19	0.43	14	0.06	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00534-00004	0.30	1.70	0.47	0.59	29	0.06	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00542-00004	0.30	1.70	0.43	0.52	27	0.06	N	-	-	-	A	B	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-81-00535-00013	0.29	1.65	0.31	0.54	21	0.06	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00543-00013	0.29	1.65	0.28	0.48	19	0.06	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00537-00013	0.29	1.65	0.21	0.48	15	0.06	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00545-00013	0.29	1.65	0.19	0.43	14	0.06	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00534-00002	0.30	1.70	0.49	0.59	30	0.06	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00542-00002	0.30	1.70	0.44	0.53	28	0.06	N	-	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-81-00535-00014	0.29	1.65	0.31	0.53	21	0.06	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00543-00014	0.29	1.65	0.28	0.47	19	0.06	N	NC	SC	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Window	Low-E SmartSun™	No Grilles	AND-N-81-00537-00014	0.29	1.65	0.21	0.48	15	0.06	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00545-00014	0.29	1.65	0.19	0.43	14	0.06	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00534-00003	0.30	1.70	0.47	0.59	29	0.06	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00542-00003	0.30	1.70	0.43	0.52	27	0.06	N	-	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Window (w/Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-81-00375-00001	0.33	1.87	0.32	0.54	17	0.06	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00383-00001	0.33	1.87	0.29	0.48	15	0.06	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00377-00001	0.33	1.87	0.21	0.49	11	0.06	-	-	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00385-00001	0.33	1.87	0.19	0.43	9	0.06	-	-	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00374-00001	0.34	1.93	0.52	0.60	27	0.06	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00382-00001	0.34	1.93	0.47	0.53	24	0.06	-	-	-	-	A	-	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-81-00391-00001	0.33	1.87	0.32	0.54	17	0.06	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00399-00001	0.33	1.87	0.28	0.48	15	0.06	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00393-00001	0.32	1.82	0.21	0.48	12	0.06	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00401-00001	0.32	1.82	0.19	0.43	11	0.06	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00390-00001	0.33	1.87	0.52	0.59	28	0.06	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00398-00001	0.33	1.87	0.46	0.53	25	0.06	-	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-81-00391-00009	0.33	1.87	0.31	0.53	16	0.06	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00399-00009	0.33	1.87	0.28	0.47	15	0.06	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00393-00009	0.32	1.82	0.21	0.48	12	0.06	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00401-00009	0.32	1.82	0.19	0.43	11	0.06	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00390-00004	0.33	1.87	0.47	0.59	26	0.06	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00398-00004	0.33	1.87	0.43	0.52	23	0.06	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-81-00391-00013	0.33	1.87	0.32	0.54	17	0.06	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00399-00013	0.33	1.87	0.28	0.48	15	0.06	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-81-00393-00013	0.32	1.82	0.21	0.48	12	0.06	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00401-00013	0.32	1.82	0.19	0.43	11	0.06	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00390-00002	0.33	1.87	0.49	0.59	27	0.06	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00398-00002	0.33	1.87	0.44	0.53	24	0.06	-	-	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-81-00391-00014	0.33	1.87	0.31	0.53	16	0.06	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00399-00014	0.33	1.87	0.28	0.47	15	0.06	-	-	SC	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Window (w/Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-81-00393-00014	0.32	1.82	0.21	0.48	12	0.06	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00401-00014	0.32	1.82	0.19	0.43	11	0.06	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-81-00390-00003	0.33	1.87	0.47	0.59	26	0.06	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-81-00398-00003	0.33	1.87	0.43	0.52	23	0.06	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Picture Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-82-00463-00001	0.29	1.65	0.33	0.56	23	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00001	0.29	1.65	0.30	0.50	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00001	0.28	1.59	0.22	0.51	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00001	0.28	1.59	0.20	0.45	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00001	0.29	1.65	0.55	0.62	36	0.01	N	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00001	0.29	1.65	0.49	0.55	32	0.01	N	-	-	-	A	B	C	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00463-00002	0.29	1.65	0.33	0.56	23	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00002	0.29	1.65	0.30	0.50	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00002	0.28	1.59	0.22	0.50	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00002	0.28	1.59	0.20	0.45	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00002	0.29	1.65	0.54	0.61	35	0.01	N	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00002	0.29	1.65	0.48	0.55	31	0.01	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00463-00010	0.29	1.65	0.32	0.55	22	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00010	0.29	1.65	0.29	0.49	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00010	0.28	1.59	0.22	0.50	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00010	0.28	1.59	0.20	0.44	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00004	0.29	1.65	0.53	0.61	34	0.01	N	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00004	0.29	1.65	0.47	0.54	31	0.01	N	-	-	-	A	B	C	-
		4.7 Annealed, or 4.7 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00463-00018	0.29	1.65	0.32	0.55	22	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00018	0.29	1.65	0.29	0.49	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00018	0.28	1.59	0.22	0.49	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00018	0.28	1.59	0.20	0.44	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00006	0.29	1.65	0.52	0.60	34	0.01	N	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00006	0.29	1.65	0.46	0.54	30	0.01	N	-	-	-	A	B	C	-
		5.7 Annealed, or 5.7 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00479-00001	0.28	1.59	0.32	0.54	24	0.01	N	NC	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00487-00001	0.29	1.65	0.29	0.48	21	0.01	N	NC	SC	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Picture Window	Low-E SmartSun™	No Grilles	AND-N-82-00481-00001	0.28	1.59	0.22	0.49	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00489-00001	0.29	1.65	0.20	0.43	15	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00478-00001	0.29	1.65	0.50	0.60	33	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00486-00001	0.30	1.70	0.45	0.53	29	0.01	N	-	-	-	A	B	C	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-82-00463-00026	0.29	1.65	0.33	0.56	23	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00026	0.29	1.65	0.30	0.50	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00026	0.28	1.59	0.22	0.50	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00026	0.28	1.59	0.20	0.45	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00008	0.29	1.65	0.51	0.61	33	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00008	0.29	1.65	0.46	0.55	30	0.01	N	-	-	-	A	B	C	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-82-00463-00027	0.29	1.65	0.32	0.55	22	0.01	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00471-00027	0.29	1.65	0.29	0.49	21	0.01	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00465-00027	0.28	1.59	0.22	0.50	18	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00473-00027	0.28	1.59	0.20	0.44	17	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00462-00009	0.29	1.65	0.49	0.61	32	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00470-00009	0.29	1.65	0.44	0.54	29	0.01	N	-	-	-	A	B	C	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Picture Window (w/ Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-82-00355-00001	0.32	1.82	0.33	0.56	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00001	0.32	1.82	0.30	0.50	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00001	0.32	1.82	0.22	0.51	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00001	0.32	1.82	0.20	0.45	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00001	0.33	1.87	0.55	0.62	31	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00001	0.33	1.87	0.49	0.55	27	0.01	-	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00355-00002	0.32	1.82	0.33	0.56	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00002	0.32	1.82	0.30	0.50	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00002	0.32	1.82	0.22	0.50	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00002	0.32	1.82	0.20	0.45	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00002	0.33	1.87	0.54	0.61	30	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00002	0.33	1.87	0.48	0.55	27	0.01	-	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00355-00010	0.32	1.82	0.33	0.55	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00010	0.32	1.82	0.29	0.49	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00010	0.32	1.82	0.22	0.50	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00010	0.32	1.82	0.20	0.44	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00004	0.33	1.87	0.52	0.61	29	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00004	0.33	1.87	0.47	0.54	26	0.01	-	-	-	-	A	B	-	-
		4.7 Annealed, or 4.7 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00355-00018	0.32	1.82	0.33	0.55	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00018	0.32	1.82	0.29	0.49	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00018	0.32	1.82	0.22	0.49	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00018	0.32	1.82	0.20	0.44	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00006	0.33	1.87	0.52	0.60	29	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00006	0.33	1.87	0.46	0.54	26	0.01	-	-	-	-	A	B	-	-
		5.7 Annealed, or 5.7 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-82-00371-00001	0.33	1.87	0.32	0.54	17	0.01	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00379-00001	0.34	1.93	0.29	0.48	14	0.01	-	-	SC	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Picture Window (w/ Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-82-00373-00001	0.32	1.82	0.23	0.49	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00381-00001	0.33	1.87	0.21	0.43	11	0.01	-	-	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00370-00001	0.33	1.87	0.50	0.60	28	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00378-00001	0.35	1.99	0.45	0.53	22	0.01	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-82-00355-00026	0.32	1.82	0.33	0.56	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00026	0.32	1.82	0.30	0.50	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00026	0.32	1.82	0.22	0.50	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00026	0.32	1.82	0.20	0.45	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00008	0.33	1.87	0.51	0.61	28	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00008	0.33	1.87	0.46	0.55	26	0.01	-	-	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-82-00355-00027	0.32	1.82	0.33	0.55	19	0.01	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00363-00027	0.32	1.82	0.29	0.49	17	0.01	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-82-00357-00027	0.32	1.82	0.22	0.50	13	0.01	-	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00365-00027	0.32	1.82	0.20	0.44	12	0.01	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-82-00354-00009	0.33	1.87	0.49	0.61	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-82-00362-00009	0.33	1.87	0.44	0.54	24	0.01	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-83-00519-00001	0.29	1.65	0.33	0.56	22	0.12	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00527-00001	0.29	1.65	0.30	0.50	20	0.12	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00521-00001	0.29	1.65	0.22	0.51	15	0.12	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00529-00001	0.29	1.65	0.20	0.45	14	0.12	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00518-00001	0.30	1.70	0.55	0.62	33	0.12	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00526-00001	0.30	1.70	0.49	0.55	30	0.12	N	-	-	-	A	B	C	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-83-00535-00001	0.29	1.65	0.33	0.56	22	0.12	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00543-00001	0.29	1.65	0.30	0.50	20	0.12	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00537-00001	0.28	1.59	0.22	0.50	17	0.12	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00545-00001	0.28	1.59	0.20	0.45	16	0.12	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00534-00001	0.30	1.70	0.54	0.61	33	0.12	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00542-00001	0.30	1.70	0.48	0.55	29	0.12	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-83-00535-00009	0.29	1.65	0.32	0.55	21	0.12	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00543-00009	0.29	1.65	0.29	0.49	19	0.12	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00537-00009	0.28	1.59	0.22	0.50	17	0.12	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00545-00009	0.28	1.59	0.20	0.44	16	0.12	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00534-00004	0.30	1.70	0.49	0.61	30	0.12	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00542-00004	0.30	1.70	0.44	0.54	27	0.12	N	-	-	-	A	B	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-83-00535-00013	0.29	1.65	0.33	0.56	22	0.12	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00543-00013	0.29	1.65	0.30	0.50	20	0.12	N	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00537-00013	0.28	1.59	0.22	0.50	17	0.12	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00545-00013	0.28	1.59	0.20	0.45	16	0.12	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00534-00002	0.30	1.70	0.51	0.61	31	0.12	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00542-00002	0.30	1.70	0.46	0.55	28	0.12	N	-	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-83-00535-00014	0.29	1.65	0.32	0.55	21	0.12	N	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00543-00014	0.29	1.65	0.29	0.49	19	0.12	N	NC	SC	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window	Low-E SmartSun™	No Grilles	AND-N-83-00537-00014	0.28	1.59	0.22	0.50	17	0.12	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00545-00014	0.28	1.59	0.20	0.44	16	0.12	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00534-00003	0.30	1.70	0.49	0.61	30	0.12	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00542-00003	0.30	1.70	0.44	0.54	27	0.12	N	-	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window (w/Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-83-00375-00001	0.33	1.87	0.33	0.56	17	0.12	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00383-00001	0.33	1.87	0.30	0.50	15	0.12	-	-	SC	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00377-00001	0.32	1.82	0.22	0.51	12	0.12	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00385-00001	0.32	1.82	0.20	0.45	10	0.12	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00374-00001	0.33	1.87	0.55	0.62	30	0.12	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00382-00001	0.33	1.87	0.49	0.55	26	0.12	-	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-83-00391-00001	0.32	1.82	0.33	0.56	18	0.12	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00399-00001	0.32	1.82	0.30	0.50	16	0.12	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00393-00001	0.32	1.82	0.22	0.50	12	0.12	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00401-00001	0.32	1.82	0.20	0.45	10	0.12	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00390-00001	0.33	1.87	0.54	0.61	29	0.12	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00398-00001	0.33	1.87	0.48	0.55	26	0.12	-	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-83-00391-00009	0.32	1.82	0.33	0.55	18	0.12	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00399-00009	0.32	1.82	0.30	0.49	16	0.12	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00393-00009	0.32	1.82	0.22	0.50	12	0.12	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-		-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-		-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00401-00009	0.32	1.82	0.20	0.44	10	0.12	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00390-00004	0.33	1.87	0.50	0.61	27	0.12	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00398-00004	0.33	1.87	0.44	0.54	23	0.12	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-83-00391-00013	0.32	1.82	0.33	0.56	18	0.12	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00399-00013	0.32	1.82	0.30	0.50	16	0.12	-	NC	SC	-	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-83-00393-00013	0.32	1.82	0.22	0.50	12	0.12	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00401-00013	0.32	1.82	0.20	0.45	10	0.12	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00390-00002	0.33	1.87	0.51	0.61	27	0.12	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00398-00002	0.33	1.87	0.46	0.55	24	0.12	-	-	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-83-00391-00014	0.32	1.82	0.33	0.55	18	0.12	-	NC	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00399-00014	0.32	1.82	0.30	0.49	16	0.12	-	NC	SC	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window (w/Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-83-00393-00014	0.32	1.82	0.22	0.50	12	0.12	-	NC	SC	S	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00401-00014	0.32	1.82	0.20	0.44	10	0.12	-	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-83-00390-00003	0.33	1.87	0.50	0.61	27	0.12	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-83-00398-00003	0.33	1.87	0.44	0.54	23	0.12	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Casement Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-84-00519-00001	0.28	1.59	0.28	0.48	21	0.07	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00527-00001	0.28	1.59	0.26	0.43	19	0.07	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00521-00001	0.27	1.53	0.19	0.43	17	0.07	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00529-00001	0.27	1.53	0.17	0.39	16	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00518-00001	0.28	1.59	0.47	0.53	32	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00526-00001	0.28	1.59	0.42	0.47	29	0.07	N	-	-	-	A	B	C	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-84-00535-00001	0.27	1.53	0.28	0.47	22	0.07	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00543-00001	0.27	1.53	0.25	0.43	20	0.07	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00537-00001	0.27	1.53	0.19	0.42	17	0.07	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00545-00001	0.27	1.53	0.17	0.38	16	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00534-00001	0.28	1.59	0.46	0.52	31	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00542-00001	0.28	1.59	0.42	0.47	29	0.07	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-84-00535-00009	0.27	1.53	0.28	0.47	22	0.07	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00543-00009	0.27	1.53	0.25	0.42	20	0.07	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00537-00009	0.27	1.53	0.19	0.42	17	0.07	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00545-00009	0.27	1.53	0.17	0.38	16	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-84-00535-00013	0.27	1.53	0.28	0.47	22	0.07	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00543-00013	0.27	1.53	0.25	0.43	20	0.07	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00537-00013	0.27	1.53	0.19	0.42	17	0.07	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00545-00013	0.27	1.53	0.17	0.38	16	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00534-00002	0.28	1.59	0.43	0.52	29	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00542-00002	0.28	1.59	0.39	0.47	27	0.07	N	NC	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-84-00535-00014	0.27	1.53	0.28	0.47	22	0.07	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00543-00014	0.27	1.53	0.25	0.42	20	0.07	N	NC	SC	S	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Casement Window	Low-E SmartSun™	No Grilles	AND-N-84-00537-00014	0.27	1.53	0.19	0.42	17	0.07	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00545-00014	0.27	1.53	0.17	0.38	16	0.07	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00534-00003	0.28	1.59	0.42	0.52	29	0.07	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00542-00003	0.28	1.59	0.38	0.47	26	0.07	N	NC	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Casement Window (w/ Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-84-00375-00001	0.30	1.70	0.28	0.48	18	0.07	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00383-00001	0.30	1.70	0.26	0.43	17	0.07	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00377-00001	0.30	1.70	0.19	0.43	13	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00385-00001	0.30	1.70	0.17	0.39	12	0.07	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00374-00001	0.31	1.76	0.46	0.53	27	0.07	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00382-00001	0.31	1.76	0.42	0.47	25	0.07	N	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-84-00391-00001	0.30	1.70	0.28	0.47	18	0.07	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00399-00001	0.30	1.70	0.26	0.43	17	0.07	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00393-00001	0.30	1.70	0.19	0.42	13	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00401-00001	0.30	1.70	0.17	0.38	12	0.07	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00390-00001	0.31	1.76	0.46	0.52	27	0.07	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00398-00001	0.31	1.76	0.41	0.47	24	0.07	N	-	-	-	A	-	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-84-00391-00009	0.30	1.70	0.28	0.47	18	0.07	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00399-00009	0.30	1.70	0.25	0.42	17	0.07	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00393-00009	0.30	1.70	0.19	0.42	13	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00401-00009	0.30	1.70	0.18	0.38	12	0.07	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-84-00391-00013	0.30	1.70	0.28	0.47	18	0.07	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00399-00013	0.30	1.70	0.26	0.43	17	0.07	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-84-00393-00013	0.30	1.70	0.19	0.42	13	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00401-00013	0.30	1.70	0.17	0.38	12	0.07	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00390-00002	0.31	1.76	0.43	0.52	26	0.07	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00398-00002	0.31	1.76	0.39	0.47	23	0.07	N	NC	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-84-00391-00014	0.30	1.70	0.28	0.47	18	0.07	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00399-00014	0.30	1.70	0.25	0.42	17	0.07	N	NC	SC	S	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Casement Window (w/ Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-84-00393-00014	0.30	1.70	0.19	0.42	13	0.07	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00401-00014	0.30	1.70	0.18	0.38	12	0.07	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-84-00390-00003	0.31	1.76	0.42	0.52	25	0.07	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-84-00398-00003	0.31	1.76	0.38	0.47	23	0.07	N	NC	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Awning Window		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-85-00499-00001	0.28	1.59	0.28	0.48	21	0.01	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00507-00001	0.28	1.59	0.26	0.43	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00501-00001	0.27	1.53	0.19	0.43	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	v	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a		-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00509-00001	0.27	1.53	0.17	0.39	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00498-00001	0.29	1.65	0.47	0.53	31	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00506-00001	0.29	1.65	0.42	0.48	28	0.01	N	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-85-00515-00001	0.28	1.59	0.28	0.47	21	0.01	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00523-00001	0.28	1.59	0.26	0.43	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00517-00001	0.27	1.53	0.19	0.43	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00525-00001	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00514-00001	0.28	1.59	0.46	0.52	32	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00522-00001	0.28	1.59	0.42	0.47	29	0.01	N	-	-	-	A	B	C	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-85-00515-00009	0.28	1.59	0.28	0.47	21	0.01	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00523-00009	0.28	1.59	0.25	0.42	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00517-00009	0.27	1.53	0.19	0.42	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00525-00009	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-El PassiveSun™	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-85-00515-00013	0.28	1.59	0.28	0.47	21	0.01	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00523-00013	0.28	1.59	0.26	0.43	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00517-00013	0.27	1.53	0.19	0.43	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00525-00013	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00514-00002	0.28	1.59	0.43	0.52	30	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00522-00002	0.28	1.59	0.39	0.47	28	0.01	N	NC	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-85-00515-00014	0.28	1.59	0.28	0.47	21	0.01	N	NC	SC	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00523-00014	0.28	1.59	0.25	0.42	20	0.01	N	NC	SC	S	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Awning Window	Low-E SmartSun™	No Grilles	AND-N-85-00517-00014	0.27	1.53	0.19	0.42	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00525-00014	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00514-00003	0.28	1.59	0.42	0.52	29	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00522-00003	0.28	1.59	0.38	0.47	27	0.01	N	NC	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Awning Window (w/ Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles Less Than 1"**															
	Low-E	No Grilles	AND-N-85-00355-00001	0.31	1.76	0.28	0.48	18	0.01	-	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00363-00001	0.31	1.76	0.26	0.43	16	0.01	-	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00357-00001	0.30	1.70	0.19	0.43	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00365-00001	0.30	1.70	0.17	0.39	12	0.01	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00354-00001	0.31	1.76	0.47	0.53	29	0.01	N	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00362-00001	0.31	1.76	0.42	0.48	26	0.01	N	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-85-00371-00001	0.30	1.70	0.28	0.47	19	0.01	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00379-00001	0.30	1.70	0.26	0.43	18	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00373-00001	0.30	1.70	0.19	0.43	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00381-00001	0.30	1.70	0.17	0.38	12	0.01	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00370-00001	0.31	1.76	0.46	0.52	28	0.01	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00378-00001	0.31	1.76	0.42	0.47	26	0.01	N	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles Less Than 1"															
	Low-E	No Grilles	AND-N-85-00371-00009	0.30	1.70	0.28	0.47	19	0.01	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00379-00009	0.30	1.70	0.26	0.42	18	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00373-00009	0.30	1.70	0.19	0.42	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00381-00009	0.30	1.70	0.18	0.38	13	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-El PassiveSun™	No Grilles	AND-N-85-00371-00013	0.30	1.70	0.28	0.47	19	0.01	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00379-00013	0.30	1.70	0.26	0.43	18	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-85-00373-00013	0.30	1.70	0.19	0.43	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00381-00013	0.30	1.70	0.17	0.38	12	0.01	N	NC	SC	S	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00370-00002	0.31	1.76	0.43	0.52	26	0.01	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00378-00002	0.31	1.76	0.39	0.47	24	0.01	N	NC	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles Less than 1"															
	Low-E	No Grilles	AND-N-85-00371-00014	0.30	1.70	0.28	0.47	19	0.01	N	NC	SC	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00379-00014	0.30	1.70	0.26	0.42	18	0.01	N	NC	SC	S	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Awning Window (w/ Capillary Breather Tubes)	Low-E SmartSun™	No Grilles	AND-N-85-00373-00014	0.30	1.70	0.19	0.42	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00381-00014	0.30	1.70	0.18	0.38	13	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-85-00370-00003	0.31	1.76	0.42	0.52	26	0.01	N	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-85-00378-00003	0.31	1.76	0.38	0.47	23	0.01	N	NC	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Sidelite Window		**3.1 Tempered Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-97-00792-00001	0.27	1.53	0.25	0.43	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00802-00001	0.27	1.53	0.23	0.38	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00794-00001	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00804-00001	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00791-00001	0.28	1.59	0.41	0.47	29	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00801-00001	0.28	1.59	0.37	0.42	26	0.01	-	-	-	-	A	B	-	-
		3.9 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00807-00004	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00817-00004	0.27	1.53	0.23	0.38	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00809-00004	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00819-00004	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00806-00003	0.28	1.59	0.38	0.47	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00816-00003	0.28	1.59	0.34	0.42	25	0.01	-	-	-	-	A	B	-	-
		4.7 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00822-00004	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00832-00004	0.28	1.59	0.22	0.37	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00824-00004	0.26	1.48	0.17	0.38	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00834-00004	0.28	1.59	0.15	0.34	14	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00821-00003	0.28	1.59	0.37	0.46	26	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00831-00003	0.28	1.59	0.34	0.41	25	0.01	-	-	-	-	A	B	-	-
		5.7 Tempered Glass - w/ No Grilles															
	Low-E	No Grilles	AND-N-97-00852-00001	0.28	1.59	0.24	0.41	19	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00854-00001	0.27	1.53	0.17	0.37	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00851-00001	0.28	1.59	0.38	0.46	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Sidelite Window		**3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-97-00792-00002	0.27	1.53	0.25	0.43	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00802-00002	0.27	1.53	0.23	0.38	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00794-00002	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00804-00002	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00791-00002	0.28	1.59	0.39	0.47	28	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00801-00002	0.28	1.59	0.35	0.42	25	0.01	-	-	-	-	A	B	-	-
		3.9 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00807-00005	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00817-00005	0.27	1.53	0.23	0.38	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00809-00005	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00819-00005	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00806-00004	0.28	1.59	0.38	0.47	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00816-00004	0.28	1.59	0.34	0.42	25	0.01	-	-	-	-	A	B	-	-
		4.7 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00822-00005	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00832-00005	0.28	1.59	0.22	0.37	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00824-00005	0.26	1.48	0.17	0.38	17	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00834-00005	0.28	1.59	0.15	0.34	14	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00821-00004	0.28	1.59	0.37	0.46	26	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00831-00004	0.28	1.59	0.34	0.41	25	0.01	-	-	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Sidelite Window (w/ Capillary Breather Tubes)		**3.1 Tempered Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-97-00707-00001	0.30	1.70	0.25	0.43	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00717-00001	0.30	1.70	0.23	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00709-00001	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00719-00001	0.29	1.65	0.15	0.34	12	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00706-00001	0.30	1.70	0.41	0.47	26	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00716-00001	0.30	1.70	0.37	0.42	24	0.01	-	-	-	-	A	-	-	-
		3.9 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00722-00004	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00732-00004	0.30	1.70	0.23	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00724-00004	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00734-00004	0.29	1.65	0.15	0.34	12	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00721-00003	0.30	1.70	0.38	0.47	25	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00731-00003	0.30	1.70	0.34	0.42	22	0.01	-	-	-	-	A	-	-	-
		4.7 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00737-00004	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00747-00004	0.31	1.76	0.22	0.37	14	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00739-00004	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00749-00004	0.30	1.70	0.15	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00736-00003	0.30	1.70	0.37	0.46	24	0.01	-	-	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00746-00003	0.31	1.76	0.34	0.41	21	0.01	-	-	-	-	A	-	-	-
		5.7 Tempered Glass - w/ No Grilles															
	Low-E	No Grilles	AND-N-97-00767-00001	0.31	1.76	0.25	0.41	16	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E Sun	No Grilles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00769-00001	0.30	1.70	0.17	0.37	12	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Sidelite Window (w/ Capillary Breather Tubes)	Low-E PassiveSun™	No Grilles	AND-N-97-00766-00001	0.31	1.76	0.38	0.46	23	0.01	-	-	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00707-00002	0.30	1.70	0.25	0.43	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00717-00002	0.30	1.70	0.23	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00709-00002	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00719-00002	0.29	1.65	0.15	0.34	12	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00706-00002	0.30	1.70	0.39	0.47	25	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00716-00002	0.30	1.70	0.35	0.42	23	0.01	-	-	-	-	A	-	-	-
		3.9 Pattern Glass - w/ No grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00722-00005	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00732-00005	0.30	1.70	0.23	0.38	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00724-00005	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00734-00005	0.29	1.65	0.15	0.34	12	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00721-00004	0.30	1.70	0.38	0.47	25	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00731-00004	0.30	1.70	0.34	0.42	22	0.01	-	-	-	-	A	-	-	-
		4.7 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-97-00737-00005	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00747-00005	0.40	1.76	0.22	0.37	14	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-97-00739-00005	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00749-00005	0.30	1.70	0.15	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-97-00736-00004	0.30	1.70	0.37	0.46	24	0.01	-	-	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-97-00746-00004	0.31	1.76	0.34	0.41	21	0.01	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window		**2.2 Annealed Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-98-00772-00001	0.27	1.53	0.25	0.43	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00782-00001	0.27	1.53	0.23	0.39	20	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00774-00001	0.27	1.53	0.17	0.39	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00784-00001	0.27	1.53	0.15	0.35	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00771-00001	0.28	1.59	0.42	0.48	29	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00781-00001	0.28	1.59	0.38	0.42	27	0.01	-	-	-	-	A	B	-	-
		3.1 Annealed, or 3.1 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00787-00001	0.27	1.53	0.25	0.43	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00797-00001	0.28	1.59	0.23	0.38	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00789-00001	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00799-00001	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00786-00001	0.28	1.59	0.41	0.47	29	0.01	-	-	-	-	A	B	C	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00796-00001	0.28	1.59	0.37	0.42	26	0.01	-	-	-	-	A	B	-	-
		3.9 Annealed, or 3.9 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00802-00004	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00812-00004	0.28	1.59	0.23	0.38	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00804-00004	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00814-00004	0.28	1.59	0.15	0.34	14	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00801-00003	0.28	1.59	0.38	0.47	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00811-00003	0.29	1.65	0.34	0.42	23	0.01	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00787-00002	0.27	1.53	0.25	0.43	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00797-00002	0.28	1.59	0.23	0.38	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00789-00002	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00799-00002	0.27	1.53	0.15	0.34	15	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00786-00002	0.28	1.59	0.39	0.47	28	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00796-00002	0.28	1.59	0.35	0.42	25	0.01	-	-	-	-	A	B	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window		**3.9 Pattern Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-98-00802-00005	0.27	1.53	0.25	0.42	21	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00812-00005	0.28	1.59	0.23	0.38	18	0.01	N	NC	SC	S	A	B	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00804-00005	0.27	1.53	0.17	0.38	16	0.01	N	NC	SC	S	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00814-00005	0.28	1.59	0.15	0.34	14	0.01	N	NC	SC	S	A	B	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00801-00004	0.28	1.59	0.38	0.47	27	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00811-00004	0.29	1.65	0.34	0.42	23	0.01	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window (w/ Capillary Breather Tubes)		**2.2 Annealed Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-98-00707-00001	0.30	1.70	0.26	0.43	18	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00717-00001	0.30	1.70	0.23	0.39	16	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00709-00001	0.30	1.70	0.17	0.39	12	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00719-00001	0.30	1.70	0.15	0.35	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00706-00001	0.31	1.76	0.42	0.48	26	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00716-00001	0.31	1.76	0.38	0.42	23	0.01	-	-	-	-	A	-	-	-
		3.1 Annealed, 3.1 or Tempered Glass - w/ Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00722-00001	0.30	1.70	0.25	0.43	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00732-00001	0.31	1.76	0.23	0.38	15	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00724-00001	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00734-00001	0.30	1.70	0.15	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00721-00001	0.30	1.70	0.41	0.47	26	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00731-00001	0.31	1.76	0.37	0.42	23	0.01	-	-	-	-	A	-	-	-
		3.9 Annealed, 3.9 or Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00737-00004	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00747-00004	0.31	1.76	0.23	0.38	15	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00739-00004	0.30	1.70	0.17	0.38	12	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00749-00004	0.31	1.76	0.16	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00736-00003	0.31	1.76	0.38	0.47	23	0.01	-	-	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00746-00003	0.32	1.82	0.34	0.42	20	0.01	-	-	-	-	A	-	-	-
		3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-98-00722-00002	0.30	1.70	0.25	0.43	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00732-00002	0.31	1.76	0.23	0.38	15	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00724-00002	0.29	1.65	0.17	0.38	14	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00734-00002	0.30	1.70	0.15	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00721-00002	0.30	1.70	0.39	0.47	25	0.01	-	-	-	-	A	B	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00731-00002	0.31	1.76	0.35	0.42	22	0.01	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Transom Window (w/ Capillary Breather Tubes)		**3.9 Pattern Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-98-00737-00005	0.30	1.70	0.25	0.42	17	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00747-00005	0.31	1.76	0.23	0.38	15	0.01	N	NC	SC	S	A	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-98-00739-00005	0.30	1.70	0.17	0.38	12	0.01	N	NC	SC	S	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00749-00005	0.31	1.76	0.16	0.34	11	0.01	N	NC	SC	S	A	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-98-00736-00004	0.31	1.76	0.38	0.47	23	0.01	-	-	-	-	A	-	-	-
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-98-00746-00004	0.32	1.82	0.34	0.42	20	0.01	-	-	-	-	A	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Patio Door		**3.1 Tempered Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-100-00776-00001	0.30	1.70	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00786-00001	0.30	1.70	0.29	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00778-00001	0.29	1.65	0.21	0.50	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00788-00001	0.29	1.65	0.19	0.44	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00775-00001	0.31	1.76	0.53	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00785-00001	0.31	1.76	0.47	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		3.9 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00791-00004	0.30	1.70	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00801-00004	0.30	1.70	0.28	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00793-00004	0.29	1.65	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00803-00004	0.29	1.65	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00790-00003	0.30	1.70	0.49	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00800-00003	0.30	1.70	0.43	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		4.7 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00806-00004	0.29	1.65	0.32	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00816-00004	0.31	1.76	0.28	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00808-00004	0.29	1.65	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00818-00004	0.30	1.70	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00805-00003	0.30	1.70	0.48	0.60	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00815-00003	0.32	1.82	0.43	0.52	n/a	n/a	-	-	-	-	A	B	C	D
		5.7 Tempered Glass - w/ No Grilles															
	Low-E	No Grilles	AND-N-100-00836-00001	0.30	1.70	0.31	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-100-00838-00001	0.29	1.65	0.22	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-100-00835-00001	0.31	1.76	0.50	0.59	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Patio Door		**3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-100-00776-00002	0.30	1.70	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00786-00002	0.30	1.70	0.29	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00778-00002	0.29	1.65	0.22	0.50	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00788-00002	0.29	1.65	0.19	0.44	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00775-00002	0.31	1.76	0.50	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00785-00002	0.31	1.76	0.44	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		3.9 Pattern Glass - w/ No Grille and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00791-00005	0.30	1.70	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00801-00005	0.30	1.70	0.28	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00793-00005	0.29	1.65	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00803-00005	0.29	1.65	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00790-00004	0.30	1.70	0.49	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00800-00004	0.30	1.70	0.43	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		4.7 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00806-00005	0.29	1.65	0.32	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00816-00005	0.31	1.76	0.28	0.48	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00808-00005	0.29	1.65	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00818-00005	0.30	1.70	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00805-00004	0.30	1.70	0.48	0.60	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00815-00004	0.32	1.82	0.43	0.52	n/a	n/a	-	-	-	-	A	B	C	D

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Patio Door (w/ Capillary Breather Tubes)		**3.1 Tempered Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-100-00691-00001	0.33	1.87	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00701-00001	0.33	1.87	0.29	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00693-00001	0.33	1.87	0.22	0.50	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00703-00001	0.33	1.87	0.19	0.44	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00690-00001	0.34	1.93	0.53	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00700-00001	0.34	1.93	0.47	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		3.9 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00706-00004	0.33	1.87	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00716-00004	0.33	1.87	0.28	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00708-00004	0.32	1.82	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00718-00004	0.32	1.82	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00705-00003	0.34	1.93	0.49	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00715-00003	0.34	1.93	0.43	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		4.7 Tempered Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00721-00004	0.33	1.87	0.32	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00731-00004	0.35	1.99	0.28	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00723-00004	0.32	1.82	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00733-00004	0.34	1.93	0.19	0.43	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00720-00003	0.33	1.87	0.48	0.60	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00730-00003	0.35	1.99	0.43	0.52	n/a	n/a	-	-	-	-	A	B	C	D
		5.7 Tempered Glass - w/ No Grilles															
	Low-E	No Grilles	AND-N-100-00751-00001	0.34	1.93	0.32	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E SmartSun™	No Grilles	AND-N-100-00753-00001	0.34	1.93	0.22	0.48	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
	Low-E PassiveSun™	No Grilles	AND-N-100-00750-00001	0.35	1.99	0.49	0.59	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-

Andersen® Product Line & Product Type	Andersen Glass Type	Grille Type	NFRC Certified Products Directory Number	U-Factor[1]	U-Factor[1] Metric	SHGC[2]	VT[3]	Canada ER	Air Infiltration	U.S. ENERGY STAR 2010				Canada ENERGY STAR 2010			
										Northern	N. Central	S. Central	Southern	Zone A	Zone B	Zone C	Zone D
100 Series Gliding Patio Door (w/ Capillary Breather Tubes)		**3.1 Pattern Glass - w/ No Grilles and Grilles 1" or Greater**															
	Low-E	No Grilles	AND-N-100-00691-00002	0.33	1.87	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00701-00002	0.33	1.87	0.29	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00693-00002	0.33	1.87	0.22	0.50	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00703-00002	0.33	1.87	0.19	0.44	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00690-00002	0.34	1.93	0.50	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00700-00002	0.34	1.93	0.44	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		3.9 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00706-00005	0.33	1.87	0.32	0.55	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00716-00005	0.33	1.87	0.28	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00708-00005	0.32	1.82	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00718-00005	0.32	1.82	0.19	0.43	n/a	n/a	N	NC	SC	S	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00705-00004	0.34	1.93	0.49	0.61	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00715-00004	0.34	1.93	0.43	0.53	n/a	n/a	-	-	-	-	A	B	C	D
		4.7 Pattern Glass - w/ No Grilles and Grilles 1" or Greater															
	Low-E	No Grilles	AND-N-100-00721-00005	0.33	1.87	0.32	0.54	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00731-00005	0.35	1.99	0.28	0.48	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E SmartSun™	No Grilles	AND-N-100-00723-00005	0.32	1.82	0.22	0.49	n/a	n/a	N	NC	SC	S	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00733-00005	0.34	1.93	0.19	0.43	n/a	n/a	-	-	-	-	A	B	C	D
	Low-E PassiveSun™	No Grilles	AND-N-100-00720-00004	0.33	1.87	0.48	0.60	n/a	n/a	-	-	-	-	A	B	C	D
		Simulated Divided Lite (SDL) or Installed Interior Removable	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Full Divided Lite (FDL)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-
		Finelight™ (grilles-between-the-glass)	AND-N-100-00730-00004	0.35	1.99	0.43	0.52	n/a	n/a	-	-	-	-	A	B	C	D

VELUX®
Skylights

Residential skylight

Tested performance information

VSE/VSS Tested Performance Information

Glass	04	06**	08	10	2099 93	2099 94
Air infiltration/exfiltration * [max. @ 75 Pa (1.57 lbs/ft²) differential pressure]						
l/s/m²	0.2	0.4	0.2	0.3	0.5	0.2
cfm/ft²	0.03	0.07	0.03	0.06	0.09	0.03
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]						
Pascals	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15
Thermal performance ratings (Certified, complete unit values)						
• VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory. • Ratings for products with standard available fitted shades are on the last page.						
U-Factor (Btu/hr·ft²·°F)	0.42	0.40	0.42	0.41	0.38	0.37
SHGC	0.23	0.23	0.22	0.23	0.23	0.23
VT	0.53	0.52	0.39	0.52	0.52	0.52
UV protection, %						
(300-380 nm)	99.9	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)						
(300-600 nm)	83.1	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *						
Tested Size	Uplift (lbs/ft²)					
S06	65	65	65	80	90	65
M08	105	65	105	85	120	105
C06	n.r.	n.r.	n.r.	90	n.r.	n.r.
Tested Size	Download (lbs/ft²)					
S06	370	300	370	860	300	370
M08	440	360	440	1090	400	440
C06	n.r.	n.r.	n.r.	1200	n.r.	n.r.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size

VSE and VSS skylights are WDMA Hallmark certified: Products 426-H-670,-678,-679,-682,-685 (not applicable to copper-clad variants)

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

VS Tested Performance Information

Glass	04	05	06**	08	10	2099 93	2099 94
Air infiltration/exfiltration * [max. @ 75 Pa (1.57 lbs/ft²) differential pressure]							
l/s/m²	0.2	0.5	0.4	0.2	0.3	0.5	0.2
cfm/ft²	0.03	0.09	0.07	0.03	0.06	0.09	0.03
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]							
Pascals	720	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15	15
Thermal performance (Certified, complete unit values)							
U-Factor (Btu/hr·ft²·°F)	0.42	0.43	0.40	0.42	0.41	0.38	0.37
SHGC	0.23	0.23	0.23	0.22	0.23	0.23	0.23
VT	0.53	0.54	0.52	0.39	0.52	0.52	0.52
UV protection, %							
(300-380 nm)	99.9	95.2	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)							
(300-600 nm)	83.1	79.2	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *							
Tested Size	Uplift (lbs/ft²)						
S06	65	90	65	65	80	90	65
M08	105	120	65	105	85	120	105
C06	n.r.	n.r.	n.r.	n.r.	90	n.r.	n.r.
Tested Size	Download (lbs/ft²)						
S06	370	370	300	370	860	300	370
M08	440	550	360	440	1090	400	440
C06	n.r.	n.r.	n.r.	n.r.	1200	n.r.	n.r.

- VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory.
- Ratings for products with standard available fitted shades are on the last page.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size

VS skylights are WDMA Hallmark certified: Products 426-H-670,-678,-679,-682,-685 (not applicable to copper-clad variants)

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

FS/FSR Tested Performance Information

Glass	04	05 (FSR)	06**	08	10	2099 93	2099 94
Air infiltration/exfiltration * [max. @ 75 Pa (1.57 lbs/ft²) differential pressure]							
l/s/m²	0.1	0.7	0.1	0.1	0.1	0.7	0.1
cfm/ft²	0.01	0.14	0.01	0.01	0.01	0.14	0.01
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]							
Pascals	720	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15	15
Thermal performance (Certified, complete unit values)							
U-Factor (Btu/hr·ft²·°F)	0.44	0.45	0.42	0.44	0.42	0.39	0.38
SHGC	0.26	0.26	0.26	0.25	0.26	0.26	0.26
VT	0.60	0.61	0.60	0.44	0.60	0.60	0.60
UV protection, %							
(300-380 nm)	99.9	95.2	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)							
(300-600 nm)	83.1	79.2	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *							
Tested Size	Uplift (lbs/ft²)						
S06	70	45 (40)	65	70	65	45	70
M08	105	90	120	105	100	90	105
C06	n.r.	n.r.	n.r.	n.r.	TBD	n.r.	n.r.
Tested Size	Download (lbs/ft²)						
S06	160	400 (150)	300	160	720	400	160
M08	350	400	300	350	1180	400	350
C06	n.r.	n.r.	n.r.	n.r.	TBD	n.r.	n.r.

- VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory.
- Ratings for products with standard available fitted shades are on the last page.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size

FS (and FSR) skylights are WDMA Hallmark certified: Products 426-H-669,-672,-673,-674,-675,-680 (-694) (not applicable to copper-clad variants)

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

FCM Tested Performance Information

Glass	04	05	06**	08	10	0099 93	0099 94
Air infiltration / exfiltration* [max. @ 75 Pa (1.57 lbs/ft²) differential pressure]							
l/s/m²	0.2	<.1	<.1	0.2	0.1	<.1	0.2
cfm/ft²	0.03	<0.01	<0.01	0.03	0.01	<0.01	0.03
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]							
Pascals	720	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15	15
Thermal performance (Certified, complete unit values)							
U-Factor (Btu/hr·ft²·°F)	0.48	0.49	0.46	0.48	0.47	0.43	0.43
SHGC	0.27	0.27	0.27	0.26	0.27	0.25	0.25
VT	0.63	0.64	0.62	0.46	0.62	0.57	0.57
UV protection, %							
(300-380 nm)	99.9	95.2	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)							
(300-600 nm)	83.1	79.2	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *							
Tested Size	Uplift (lbs/ft²)						
4646	120	140	80	120	135	140	120
2270	100	n.r.	n.r.	100	n.r.	n.r.	100
Tested Size	Download (lbs/ft²)						
4646	250	100	100	250	970	100	250
2270	200	n.r.	n.r.	200	n.r.	n.r.	200

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- Ratings for products with standard available fitted shades are on the last page.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size
FCM skylights are WDMA Hallmark certified: Products 426-H-671,-701,-702,-703

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
0099 93 glass: Same as 05, with i89 coating on interior surface
0099 94 glass: Same as 04, with i89 coating on interior surface

NOTE: The FCM 4646 0007 (or smaller) is the only VELUX skylight qualified for use in the Florida HVHZ (High Velocity Hurricane Zone).
See Miami-Dade NOA No. 12-0223.14

VCE/VCS Tested Performance Information

Glass	04	05	06**	08	10	2099 93	2099 94
Air infiltration/exfiltration*[max. @ 75 Pa (1.57 lbs/ft²) differential pressure]							
l/s/m²	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1
cfm/ft²	0.02	<0.01	0.01	0.02	<0.01	<0.01	0.02
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]							
Pascals	720	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15	15
Thermal performance (Certified, complete unit values)							
U-Factor (Btu/hr·ft²·°F)	0.53	0.53	0.49	0.53	0.51	0.48	0.48
SHGC	0.24	0.24	0.24	0.23	0.24	0.23	0.23
VT	0.55	0.56	0.54	0.40	0.54	0.54	0.54
UV protection, %							
(300-380 nm)	99.9	95.2	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)							
(300-600 nm)	83.1	79.2	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *							
Tested Size	Uplift (lbs/ft²)						
4646	45	30	60	45	40	30	45
2246	n.r.	n.r.	n.r.	n.r.	65	n.r.	n.r.
Tested Size	Download (lbs/ft²)						
4646	230	230	230	230	620	230	230
2246	n.r.	n.r.	n.r.	n.r.	1150	n.r.	n.r.

- VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory.
- Ratings for products with standard available fitted shades are on the last page.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size
VCE and VCS skylights are WDMA Hallmark certified: Products 426-H-695,-696,-697,-698

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

VCM Tested Performance Information

Glass	04	05	06**	08	10	2099 93	2099 94
Air infiltration/exfiltration* [max. @ 75 Pa (1.57 lbs/ft²) differential pressure]							
l/s/m²	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1
cfm/ft²	0.02	<0.01	0.01	0.02	<0.01	<0.01	0.02
Water resistance @ 3.4 L/m²/min (5 USgal/ft²/hr) * [max. tested differential pressure with no leakage]							
Pascals	720	720	720	720	720	720	720
lbs/ft²	15	15	15	15	15	15	15
Thermal performance (Certified, complete unit values)							
U-Factor (Btu/hr·ft²·°F)	0.53	0.53	0.49	0.53	0.51	0.48	0.48
SHGC	0.24	0.24	0.24	0.23	0.24	0.23	0.23
VT	0.55	0.56	0.54	0.40	0.54	0.54	0.54
UV protection, %							
(300-380 nm)	99.9	95.2	99.9	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)							
(300-600 nm)	83.1	79.2	84.6	88.4	83.2	81.6	85.1
Structural Performance [Performance Grade or DP] *							
Tested Size	Uplift (lbs/ft²)						
4646	45	30	60	45	40	30	45
2246	n.r.	n.r.	n.r.	n.r.	65	n.r.	n.r.
Tested Size	Download (lbs/ft²)						
4646	230	230	230	230	620	230	230
2246	n.r.	n.r.	n.r.	n.r.	1150	n.r.	n.r.

- VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory.
- Ratings for products with standard available fitted shades are on the last page.

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size
VCM skylights are WDMA Hallmark certified: Products 426-H-695,-696,-697,-698

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
10 glass: Temp. over laminated temp. (0.030" interlayer)
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

QPF Tested Performance Information						
Glass	04	05	06**	08	2099 93	2099 94
Air infiltration/exfiltration* [max. @ 75 Pa (1.57 lbs/ft^2) differential pressure]						
l/s/m^2	0.5	0.3	0.4	0.5	0.3	0.5
cfm/ft^2	0.09	0.06	0.08	0.09	0.06	0.09
Water resistance @ 3.4 L/m^2/min (5 USgal/ft^2/hr) * [max. tested differential pressure with no leakage]						
Pascals	580	720	720	580	720	580
lbs/ft^2	12	15	15	12	15	12
Thermal performance (Certified, complete unit values)						
• VELUX Glass Skylights are rated at 20° slope and labeled with NFRC-certified U-Factor, SHGC, and VT ratings listed in the NFRC Certified Products Directory. • Ratings for products with standard available fitted shades are on the last page.						
U-Factor (Btu/hr·ft^2·°F)	0.44	0.45	0.42	0.44	0.40	0.39
SHGC	0.24	0.24	0.24	0.24	0.24	0.24
VT	0.56	0.57	0.55	0.41	0.55	0.55
UV protection, %						
(300-380 nm)	99.9	95.2	99.9	99.9	95.3	99.9
Fading protection, % (Krochmann damage function)						
(300-600 nm)	83.1	79.2	84.6	88.4	81.6	85.1
Structural Performance [Performance Grade or DP] *						
Tested Size	Uplift (lbs/ft^2)					
4646	80	80	100	80	80	80
Tested Size	Download (lbs/ft^2)					
4646	320	300	300	320	300	320

* Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 (NAFS 2011)

** 06 variant is tested and WDMA Hallmark certified for Wind-Borne debris impact, in accordance with ASTM E 1886 and ASTM E 1996. Rated for Wind Zone 3, Missile Level C, Cycle Pressure +50/-50

Structural performance ratings also apply to sizes smaller than the Tested Size
QPF skylights are WDMA Hallmark certified: Products 426-H-677,-699,-700

04 glass: Tempered over laminated HS (0.030" interlayer)
05 glass: Tempered over tempered
06 glass: Tempered over laminated HS (0.090" interlayer)
08 glass: Same as 04, with white interlayer
2099 93 glass: Same as 05, with i89 coating on interior surface
2099 94 glass: Same as 04, with i89 coating on interior surface

Shaded A21 Skylights Technical Information

Model	VS / VSE / VSS		FS / FSR	FCM	VCM / VCE / VCS		QPF
Glass	04	05	04	04	04	05	04
Skylight with Fully Open Shade - U-Factor (Btu/hr·ft^2·°F)							
White Venetian	n.r.	0.42	0.43	0.46	n.r.	n.r.	0.44
Light Block	0.41	0.42	0.42	0.45	0.50	0.51	0.42
White Roller	0.41	0.42	0.42	0.45	0.50	0.51	0.42
Beige Roller	0.41	0.42	0.42	0.45	0.50	0.51	0.42
Dark Blue	0.41	0.42	0.42	0.45	0.50	0.51	0.42
Skylight with Fully Closed Shade - U-Factor (Btu/hr·ft^2·°F)							
White Venetian	n.r.	0.31	0.29	0.39	n.r.	n.r.	0.3
Light Block	0.27	0.27	0.24	0.35	0.34	0.34	0.25
White Roller	0.29	0.29	0.27	0.38	0.37	0.37	0.28
Beige Roller	0.29	0.29	0.27	0.38	0.37	0.37	0.28
Dark Blue	0.29	0.29	0.27	0.38	0.37	0.37	0.28
Skylight with Fully Open Shade - SHGC							
White Venetian	n.r.	0.19	0.22	0.21	n.r.	n.r.	0.21
Light Block	0.20	0.20	0.23	0.21	0.21	0.21	0.22
White Roller	0.20	0.20	0.23	0.21	0.21	0.21	0.22
Beige Roller	0.20	0.20	0.23	0.21	0.21	0.21	0.22
Dark Blue	0.20	0.20	0.23	0.21	0.21	0.21	0.22
Skylight with Fully Closed Shade - SHGC							
White Venetian	n.r.	0.12	0.14	0.13	n.r.	n.r.	0.13
Light Block	0.14	0.14	0.16	0.15	0.14	0.14	0.15
White Roller	0.15	0.15	0.17	0.16	0.15	0.15	0.16
Beige Roller	0.16	0.16	0.19	0.17	0.17	0.17	0.17
Dark Blue	0.21	0.21	0.24	0.21	0.22	0.22	0.22
Skylight with Fully Open Shade - VT							
White Venetian	n.r.	0.45	0.51	0.45	n.r.	n.r.	0.47
Light Block	0.46	0.47	0.53	0.47	0.48	0.49	0.49
White Roller	0.46	0.47	0.53	0.47	0.48	0.49	0.49
Beige Roller	0.46	0.47	0.53	0.47	0.48	0.49	0.49
Dark Blue	0.46	0.47	0.53	0.47	0.48	0.49	0.49

(VT not rated for Fully Closed Shades)

FUNCTIONAL FENESTRATION INC.

VEGA AC/DC Actuators

motorized actuator for windows & skylights

UL-Recognized models available

Vega Actuator Features

- Vega actuators are for awning windows, hoppers, curtain wall vents and skylights.
- Multiple vents can be wired in parallel, and can be operated by building automation systems.
- 12”/300mm chain operator; self-adjusting for proper closure at installation.
- Operator has stainless steel, double-link chain for rigidity and durability.
- Examples of 55 lbs operating force: 48” tall/440 lb. vent, 82” tall/752 lb. vent, or a 110 lb. skylight.
- Low-profile, attractive aluminum case; available in black, white or gray paint.
- Minimum sash height is 10”. Standard pivot brackets included.
- Vega F-Signal (DC) has opening and closing feedback signal, ask for data sheet.
- Two-year UCS manufacturer’s warranty. Requires reading FFI Install Guide before purchase, and confirmation of project and installation specs by licensed electrical contractor.
- Functional Fenestration Inc (FFI) has a wide range of actuators for institutional, commercial and residential applications. FFI has been providing motorized operators for windows and skylights since 1987, and today is an expert and leader in actuators for automation, natural ventilation, and smoke evacuation.

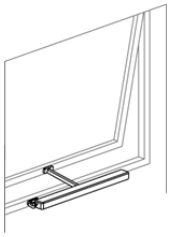
Vega Specifications

	Vega AC	**Vega DC UL**
supply voltage	100 Vac – 240 Vac, 60 Hz line current	24 Vdc ± 10% low voltage
normal current amp draw*****	0.3 amps – 0.15 amps average	0.7 amps average*****
push/pull force	55 lbs (250 N)	55 lbs (250 N)
power cable (1.5 m, white)	4 conductors (load/open, load/close, common, ground)	2 conductors (± polarity inversion)
items included	motor, standard brackets	motor, standard brackets
typical switch	momentary contact	maintained contact
safety marks	ANSI/UL pending; CE	ANSI/UL Recognized; CE
UL projects	DC models are UL Recognized	
chain stroke	300 mm (12 inches) opening length	
chain speed	9 mm (0.354”) per second	
limit stop	electronic limit switch	
safety stop	electronic overload switch	
environment	14 to 140 degrees F (-10 to 60 degrees C); maximum relative humidity 60%	
control options	Wall switch or CRM keypad; add remote control and weather sensors (rain, wind, thermostat) with CRM	

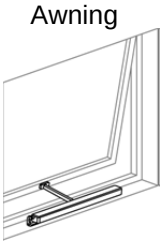
*** Vega DC start up current is 1.67 amps per actuator. Calculate power supplies and relay boxes needed based on peak draw of 2 times normal amp draw, or approx. 1.67 amps per actuator.**

Application Options

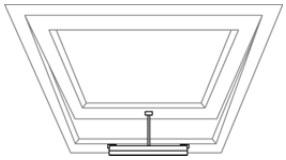
On Wall or Frame



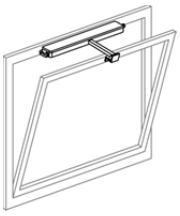
Awning



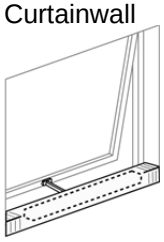
Skylight



Hopper



Concealed in Frame or Curtainwall



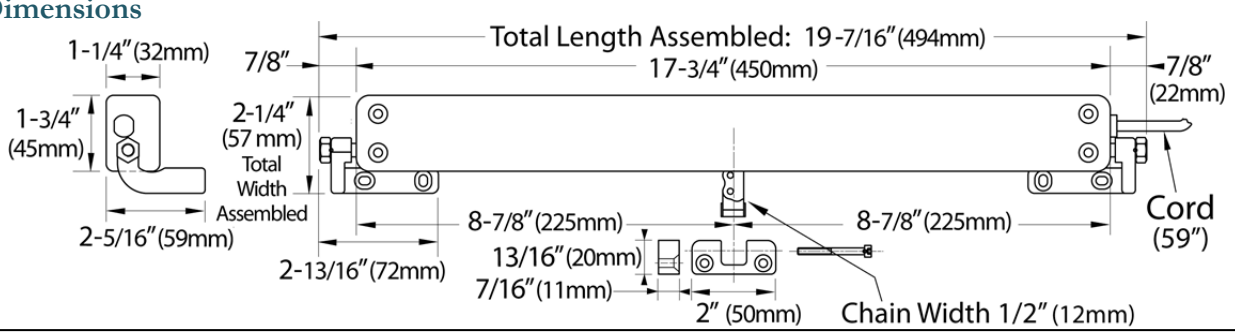
- Optional brackets may be required for hopper and wall mounting.
- Read FFI Installation & Maintenance Guide before specifying project details.
- CAD files available on request from FFI.

installs on sash, sill or wall

chain operator attached to frame

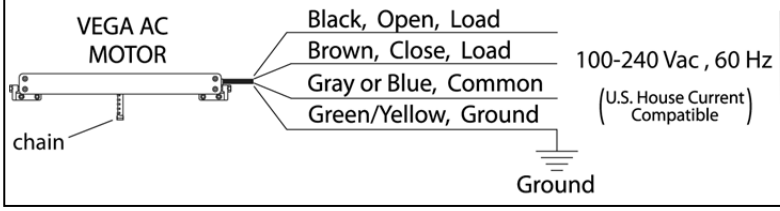
standard pivot brackets (included)

Case Dimensions

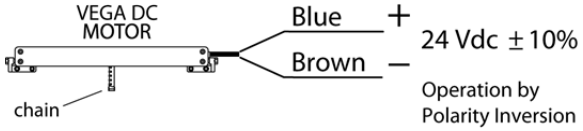


Wiring Examples (generic; not job specific):

Vega AC Power Cable 1.5 meter (59")



Vega DC Power Cable 1.5 m (59")



Vega AC/DC Actuators from FFI - If in-stock, items ship within 24-48 hours

paint color	Vega DC UL	Vega AC
gray RAL 9006	41148S	40900K
black RAL 9005	41149U	40901L
white RAL 9010	41150C	40902M

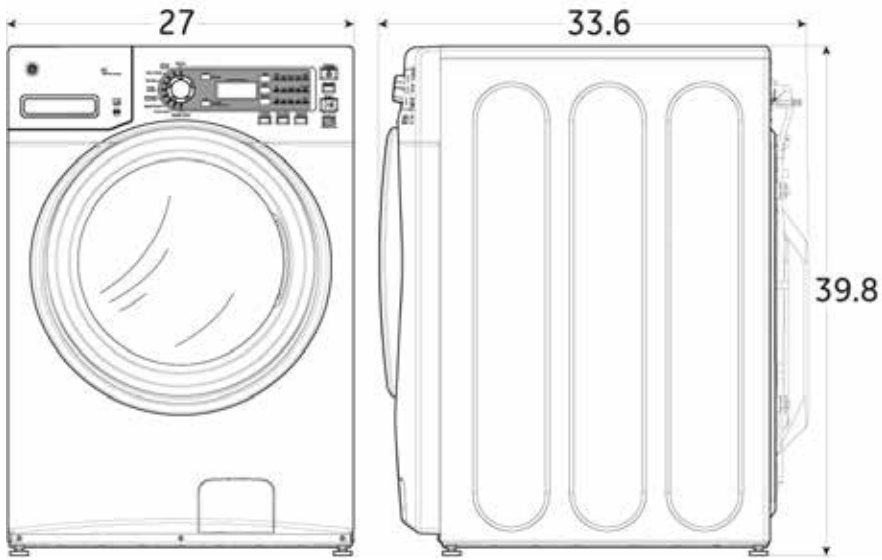
GFWH1400D

GE® ENERGY STAR® 4.1 DOE cu. ft. stainless steel capacity frontload washer

Dimensions and Installation Information (in inches)

Electric Rating	
120V	12.0A, 60Hz

Installation Information: For complete information, see installation instructions packed with your washer.



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Listed by Underwriters Laboratories

Specification Revised 3/13 360488

GFWH1400D

GE® ENERGY STAR® 4.1 DOE cu. ft. stainless steel capacity frontload washer

Special Installation Requirements:

Stacked Installation:

- Brackets for stacking dryer over washer are not included with the washer. Order part no. GEFLSTACK or part no. WE25X10018.

Alcove or Closet Installation:

- If your dryer is approved for installation in an alcove or closet, it will be stated on a label on the dryer back.
- The dryer MUST be exhausted to the outside.
- Minimum clearances between dryer cabinet and adjacent walls or other surfaces are: 0" either side, 3" front and rear
- Minimum vertical space from floor to overhead cabinets, ceilings, etc. is 52".
- Closet doors must be louvered or otherwise ventilated and must contain a minimum of 60 sq. in. of open area equally distributed. If this closet contains both a washer and a dryer, doors must contain a minimum of 120 sq. in. of open area equally distributed.
- No other fuel-burning appliance shall be installed in the same closet with a gas dryer.

Bathroom or Bedroom Installation:

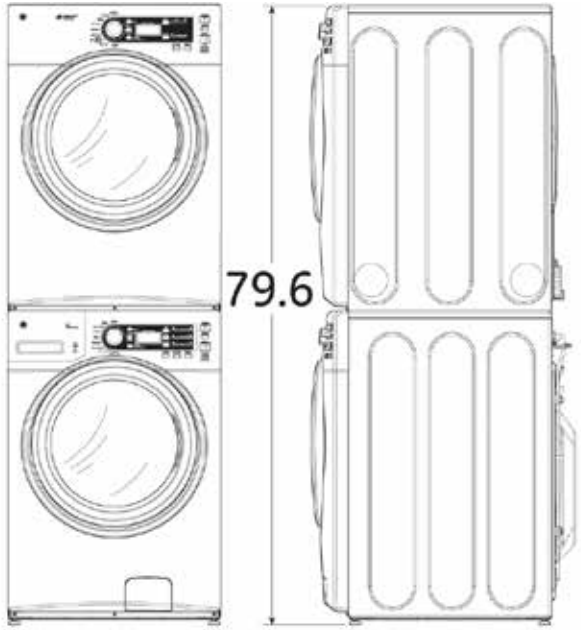
- The dryer MUST be exhausted to the outdoors.
- The installation must conform with the local codes, or in the absence of local codes, with the National Electric Code and National Fuel Gas Code, ANSI Z223.

Minimum Clearance other than Alcove or Closet Installations:

- Minimum clearances to combustible surfaces 0" both sides, 3" rear.

For more information on venting kits and accessories, please call 1-800-GE-CARES.

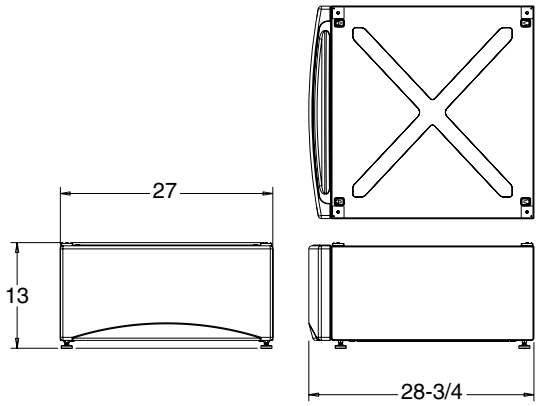
Stacked Dimensions (in inches



Pedestal Dimensions (in inches)

SBSD137HWW - white

This optional 13" pedestal raises the door opening and height of the washer or dryer. Feet on 13" pedestal allow it to adjust to 13-3/8" height.



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Listed by Underwriters Laboratories

Specification Revised 3/13 360488

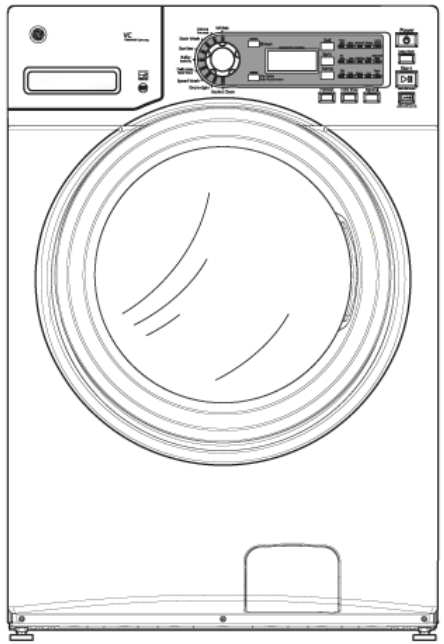
GFWH1400D

GE® ENERGY STAR® 4.1 DOE cu. ft. stainless steel capacity frontload washer

Features and Benefits

- Stain Wash Cycle - Tackles the toughest stains, from fresh grass marks to food spills
- Hydro Heater internal water heater - Boosts water temperatures and helps achieve sanitization
- eWash option - Energy-saving option uses a cold water wash on select cycles without sacrificing performance
- Bulky Bedding cycle - Washes larger items, such as comforters, blankets and jackets
- ENERGY STAR® qualified and CEE Tier III - Meets or exceeds federal guidelines for energy efficiency for year-round energy and money savings
- Vibration Control - Adjusts spin patterns for each floor typed for a smoother wash without walking or shaking
- 1100 RPM spin speed - Fast speeds remove more water during the spin cycle to minimize drying time
- Speed Wash - Provides a quick wash for lightly soiled items that are needed in a hurry
- Load-sensing adaptive fill - Washer automatically fills with just the right amount of water for the load
- Model GFWH1400DWW – White

ADA compliant



GFWH1400D

Modified Energy Factor (MEF)	2.65
Water Factor (WF)	3.6

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ENERGY STAR

Specification Revised 3/13 360488

GFDS140ED

GE® 7.0 cu. ft. capacity frontload electric dryer with steam

Dimensions and Installation Information (in inches)

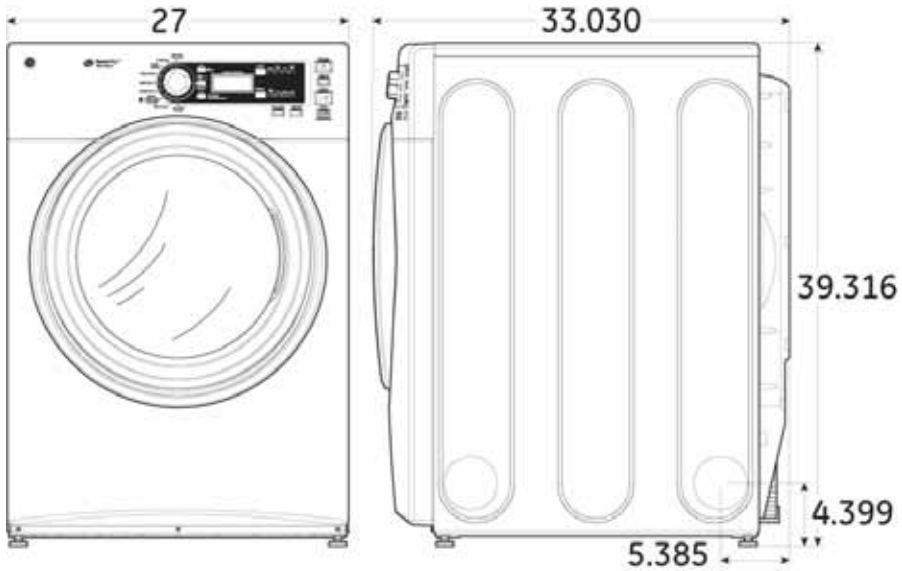
Electric Dryer Rating	
240V	5600W, 24A, 60Hz
208V	4400W, 22A, 60Hz

Exhaust Options: 4-way via rear, right, left and bottom.

Circuit Requirements: An individual, properly grounded branch circuit, protected by a 30-amp circuit breaker or a time-delay fuse, is required.

Note: Dryer wall outlet must be located within 36" of service cord entry and accessible when dryer is mounted in position.

Installation Information: For complete information, see installation instructions packed with your dryer.



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Listed by Underwriters Laboratories

Specification Revised 9/12 360493

GFDS140ED

GE® 7.0 cu. ft. capacity frontload electric dryer with steam

Special Installation Requirements:

Stacked Installation:
Brackets for stacking dryer over washer is not included with the dryer. Order part no. GEFLSTACK or part no. WE25X10018.

Alcove or Closet Installation:

- If your dryer is approved for installation in an alcove or closet, it will be stated on a label on the dryer back.
- The dryer MUST be exhausted to the outside.
- Minimum clearances between dryer cabinet and adjacent walls or other surfaces are: 0" either side, 3" front and rear
- Minimum vertical space from floor to overhead cabinets, ceilings, etc. is 52".
- Closet doors must be louvered or otherwise ventilated and must contain a minimum of 60 sq. in. of open area equally distributed. If this closet contains both a washer and a dryer, doors must contain a minimum of 120 sq. in. of open area equally distributed.
- No other fuel-burning appliance shall be installed in the same closet with a gas dryer.

Bathroom or Bedroom Installation:

- The dryer MUST be exhausted to the outdoors.
- The installation must conform with the local codes, or in the absence of local codes, with the National Electric Code and National Fuel Gas Code, ANSI Z223 for gas dryers.

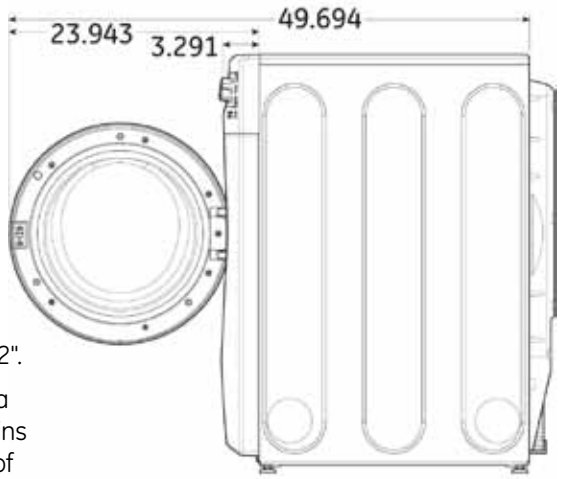
Minimum Clearance other than Alcove or Closet Installations:

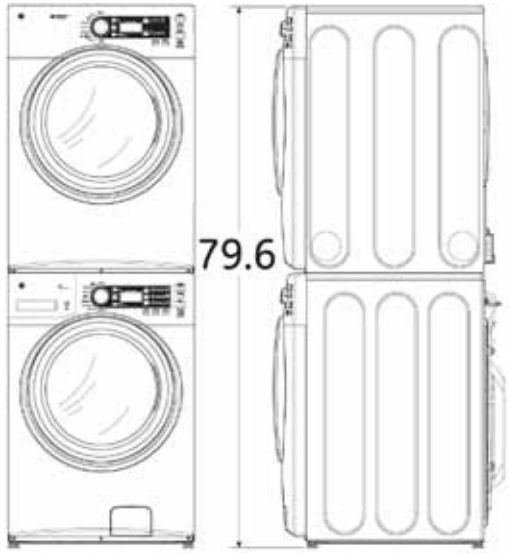
- Minimum clearances to combustible surfaces 0" both sides, 3" rear.

For more information on venting kits and accessories, please call 1-800-GE-CARES.

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

Stacked Dimensions (in inches)

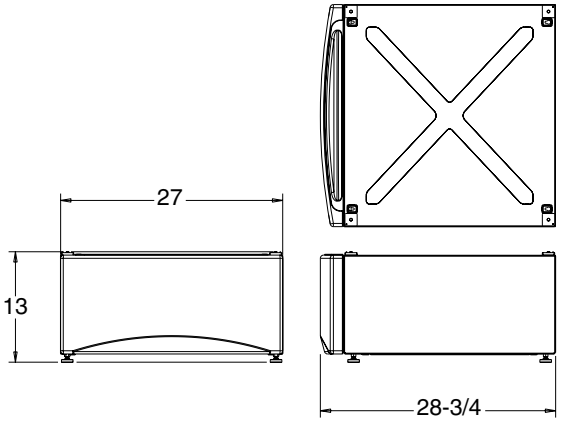




Pedestal Dimensions (in inches)

SBSD137HWW - white

This optional 13" pedestal raises the door opening and height of the washer or dryer. Feet on 13" pedestal allow it to adjust to 13-3/8" height.



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Specification Revised 9/12 360493

GFDS140ED

GE® 7.0 cu. ft. capacity frontload electric dryer with steam

Dryer Exhausting Information – Metal Duct Only

For complete information, see installation instructions packed with your dryer.

Ducting Materials: For best performance, this dryer should be vented with 4" diameter all rigid metal exhaust duct. If rigid metal duct cannot be used, then UL-listed flexible metal (semi-rigid) ducting can be used (Kit WX08X10077). In special installations, it may be necessary to connect the dryer to the house vent using a flexible metal (foil-type) duct. A UL-listed flexible metal (foil-type) duct may be used ONLY in installations where rigid metal or flexible metal (semi-rigid) ducting cannot be used AND where a 4" diameter can be maintained throughout the entire length of the transition duct. Please see installation instruction packed with your dryer for complete instructions when using flexible metal (foil type) ducting.

Exhaust Length Calculation:

1. Determine the number of 90° turns needed for your installation. If you exhaust to the side or bottom of dryer, add one turn.
2. The maximum length of 4' rigid (aluminum or galvanized) duct which can be tolerated is shown in the table.

   A turn of 45° or less may be ignored. Two 45° turns within the duct length should be treated as a 90° elbow.

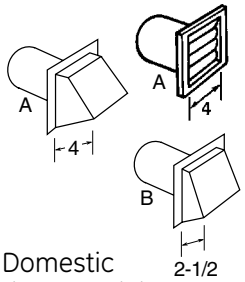
   A turn over 45° should be treated as a 90° elbow.

Dryers **must** be exhausted to the outside.

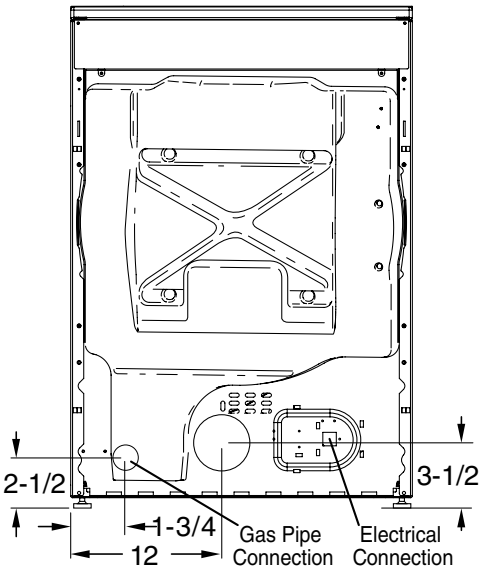
Caution: For personal safety do not terminate exhaust into a chimney, under any enclosed house floor (crawl space), or into an attic, since the accumulated lint could create a fire hazard or moisture could cause damage. Never terminate the exhaust into a common duct or plenum with a kitchen exhaust, since the combination of lint and grease could create a fire hazard.

Exhaust ducts should be terminated in a dampered wall cap to prevent back drafts, bird nesting, etc. The wall cap must also be located at least 12" above the ground or any other obstruction with the opening pointed down.

For more information on venting kits and accessories, please call 1-800-GE-CARES.



Domestic dryer models	Number of 90° turns	**Best performance** Maximum length of 4" dia. **rigid metal** duct — Exhaust hood type **A** 4" opening	**B** 2-1/2" opening
7.0, 6.0 and 5.8 cu. ft. capacity models all electric dryers	0	90 ft.	60 ft.
	1	60 ft.	45 ft.
	2	45 ft.	35 ft.
	3	35 ft.	25 ft.
	4	25 ft.	15 ft.



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Listed by Underwriters Laboratories

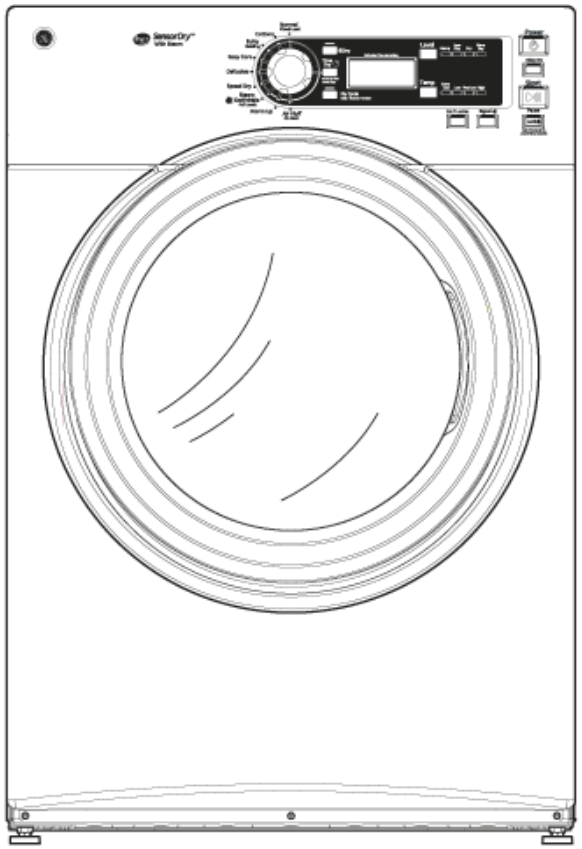
GFDS140ED

GE® 7.0 cu. ft. capacity frontload electric dryer with steam

Features and Benefits

- DuraDrum™ - Provides long-lasting durability
- HE SensorDry™ - With dual thermistors continually monitors moisture and temperature to prevent clothing wear and tear due to over-drying inconsistent heat
- Steam Dewrinkle - Reduces wrinkles and freshens clean clothes
- Speed Dry - Quickly dries items and small loads for families on the go
- eDry option - Energy-saving option reduces dry temperatures on select cycles without sacrificing performance
- Bulky Bedding cycle - Dries larger items, such as comforters, blankets and jackets
- 4 heat selections - Provide the right temperatures for your clothes-drying needs
- Delay start - Set the dryer to begin cycles whenever it's convenient for you
- Model GFDS140EDWW – White

ADA compliant



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Specification Revised 9/12 360493

JT5000SF
GE® 30" Built-In Single Convection Wall Oven

Dimensions and Installation Information (in inches)

Most 30" Wall Cabinets can be used with this unit.

Note: These ovens are not approved for stackable installations. Cabinets installed adjacent to wall ovens must have an adhesion spec of at least a 194°F temperature rating.

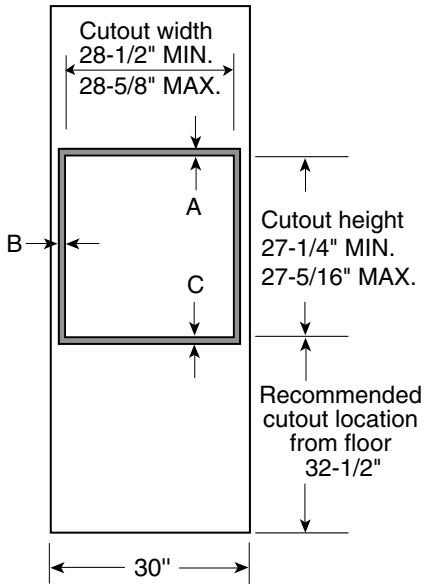
Door handle protrudes 3" from door face. Cabinets and drawers on adjacent 45° and 90° walls should be placed to avoid interference with the handle.

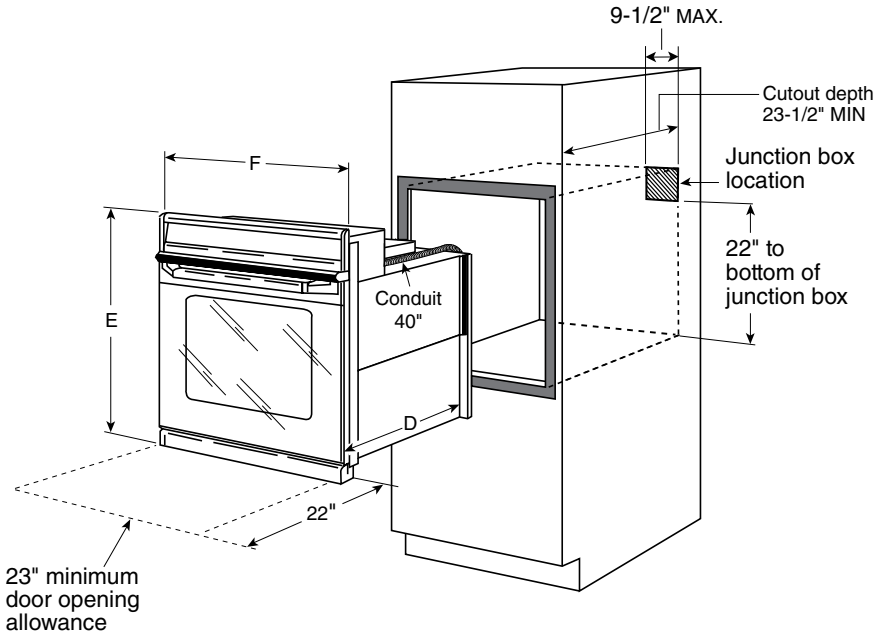
Electric wall ovens are not approved for installation with a plug and receptacle. They must be hard wired in accordance with installation instructions.

Installation Information: Before installing, consult installation instructions packed with product for current dimensional data.

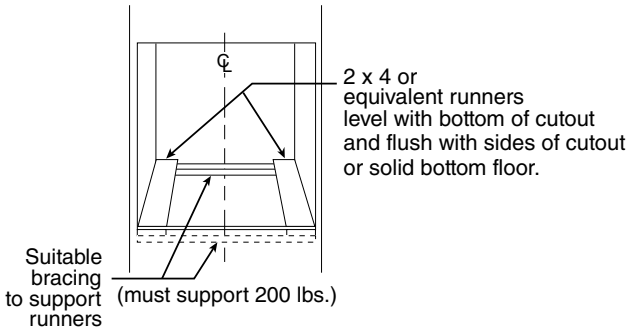
Side-by-side installations rerquire at least 2" between cutouts.

KW Rating	
240V	4.2
208V	3.2
Breaker Size	
240V	20 Amps
208V	20 Amps





	JT5000
Cabinet	**30"**
A – Overlap of oven at top of cutout	1"
B – Overlap of oven over side of edges of cutout	3/4"
C – Overlap of oven at bottom of cutout	1-1/4"
Oven	
D – Overall depth with handle	27-3/16"
E – Overall height with trim	28-3/8"
F – Overall width	29-3/4"



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ADA compliant* *ADA qualified based on Uniform Federal Accessibility Standards

Listed by Underwriters Laboratories

Specification Created 2/13

320236

JT5000SF
GE® 30" Built-In Single Convection Wall Oven

Optional Undercounter Dimensions and Installation Information

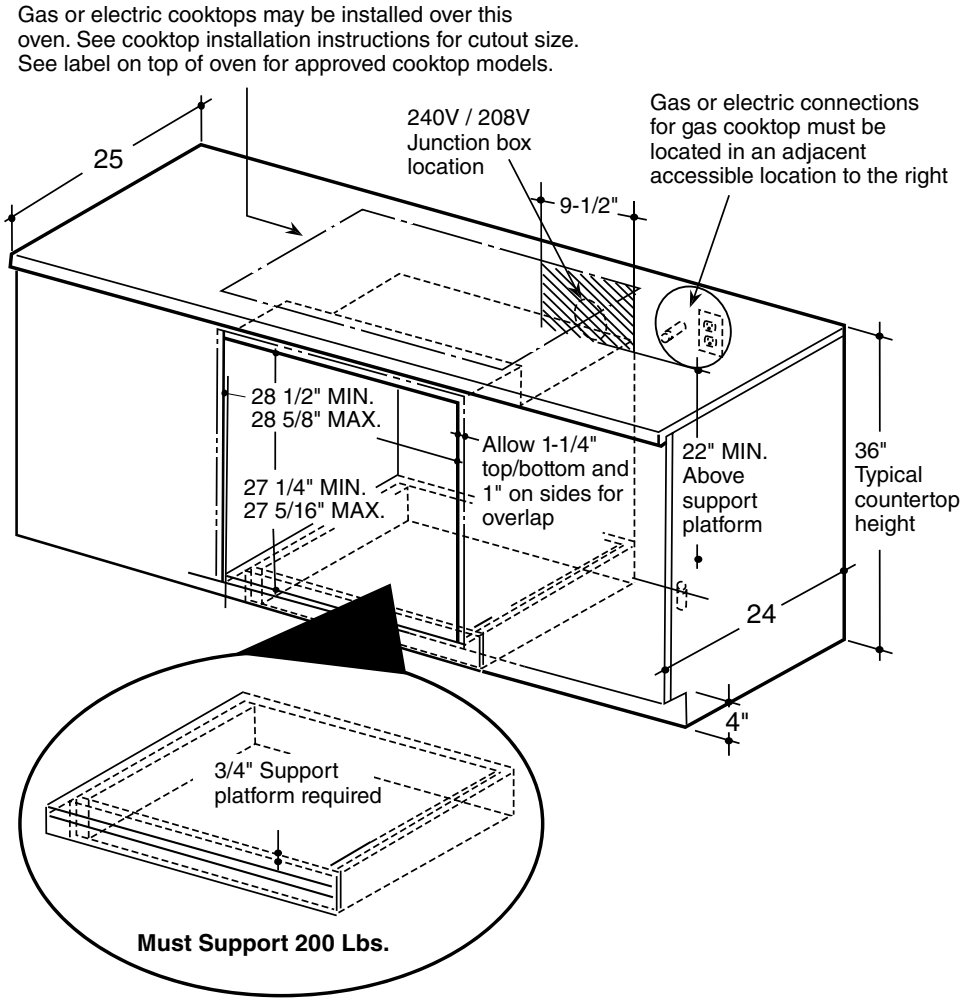
Dimension and installation information are shown in inches.

Note: 36" ribbon cooktop are approved for use over GE 30" single wall ovens and warming drawers. 30" ribbon cooktops are approved for use over 30" and GE 27" single wall ovens and warming drawers. Refer to cooktop and wall oven installation information packed with products for current dimensional data.

Note: Door handle protrudes 3" from door face. Cabinets and drawers on adjacent 45° and 90° walls should be placed to avoid interference with the handle.

Installation information: Before installing, consult installation instructions packed with products for current dimensional data and for alternate installation options.

Electric wall ovens are not approved for installation with a plug and receptacle. They must be hard wired in accordance with installation instructions.



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ADA compliant* *ADA qualified based on Uniform Federal Accessibility Standards

UL® Listed by Underwriters Laboratories

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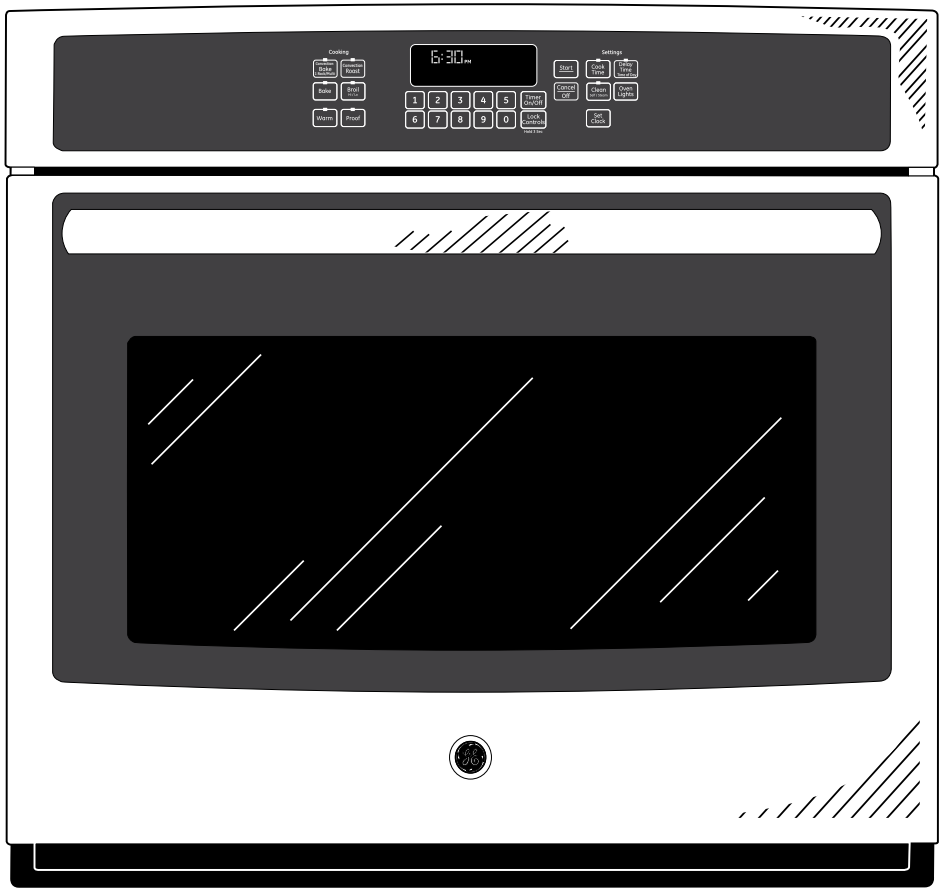
Specification Created 2/13

320236

JT5000SF
GE® 30" Built-In Single Convection Wall Oven

Features and Benefits

- True European Convection - Achieve delicious results from a third heating element and fan combination
- Self-Clean with Steam Clean Option - Clean your oven the way you want
- Self-Clean Heavy-Duty Oven Racks - Conveniently clean your oven and racks together
- Glass Touch Controls - Set temperatures quickly and clean with little effort
- Halogen Interior Oven Lighting - Easily see how your food is baking
- Ten-Pass Bake Element - Even baking is assured with heat that covers more surface area
- Eight-Pass Broil Element - Get full broil coverage and even browning from edge to edge
- 5.0 cu. ft. Oven Capacity - Cook more dishes at once
- Black Gloss Oven Interior - Enjoy a clean and sleek appearance
- Hidden Bake - Make cleanup easy by eliminating hard-to-reach areas
- Model JT5000SFSS - Stainless steel



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Specification Created 2/13
320236

GDT550HGD/HSD

GE® Hybrid Stainless Steel Interior Dishwasher with Hidden Controls

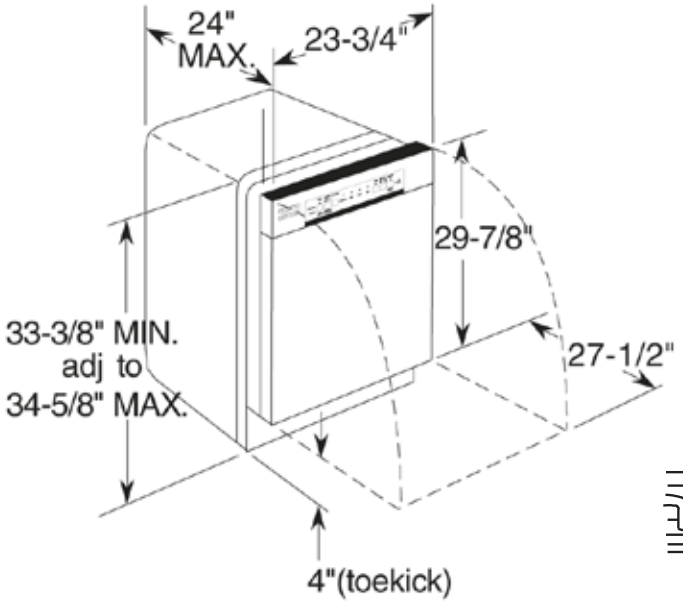
Dimensions and Installation Information (in ir

Electrical Rating

Voltage AC	120
Hertz	60
Total connected load amperage	7.1
Calrod® heater watts	415/800

For use on adequately wired 120-volt, 15-amp circuit having 2-wire service with a separate ground wire. This appliance must be grounded for safe operation.

Installation Information: Before installing, consult installation instructions packed with product for current dimensional data.



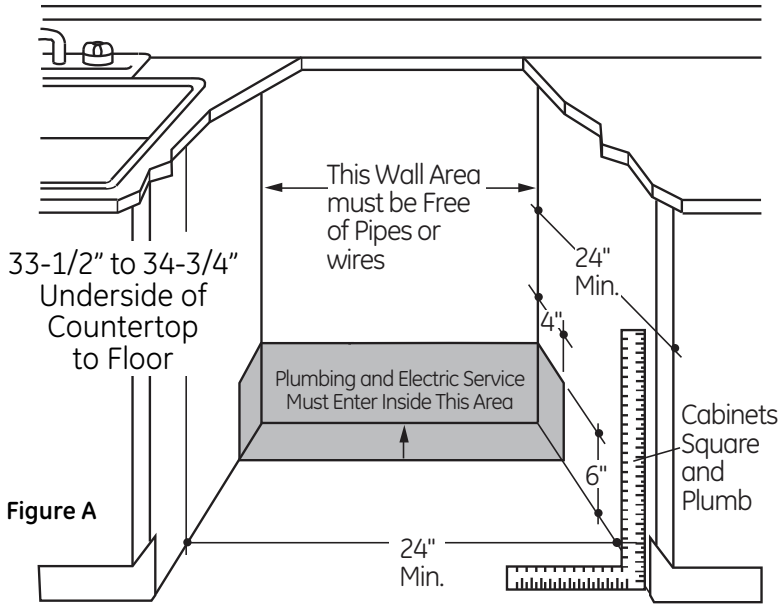


Figure A

For answers to your Monogram,® Cafe™ Series, Profile™ Series or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

imagination at work

Listed by Underwriters Laboratories

As an ENERGY STAR® partner, GE has determined that this product meets the ENERGY STAR guidelines for energy efficiency.

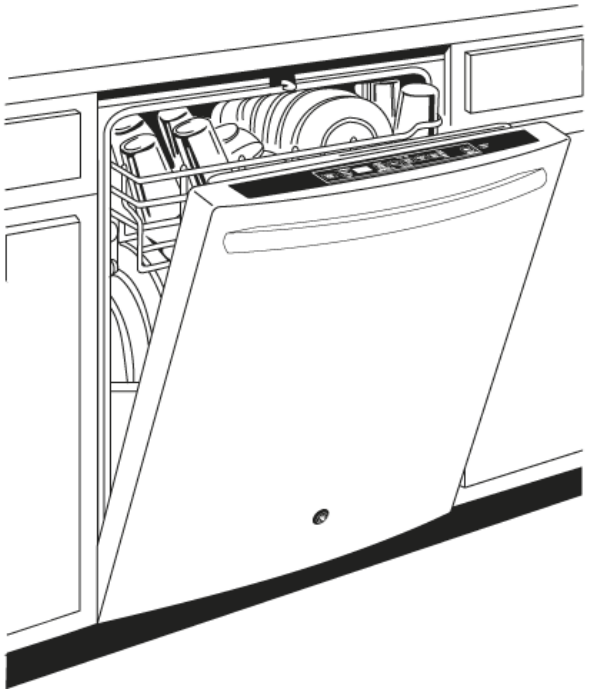
Specification Revised 8/13 350289

GDT550HGD/HSD

GE® Hybrid Stainless Steel Interior Dishwasher with Hidden Controls

Features and Benefits

- Hybrid Stainless Steel Interior - Enjoy the combination of stainless steel on the inner door and a durable plastic tub
- GE's most advanced wash system - Consistently clean, dry and sanitized dishes are ensured with GE's most advanced wash system, combining 65% more wash power* with advanced performance features *Wash power delivered to each rack. Compared to previous GE models
- Piranha™ hard-food disposer with removable filter - To ensure consistently clean items, this stainless steel blade rotates at 3,600 RPM to pulverize food particles. The disposer helps to prevent large particles from clogging the wash arms
- Wash Zones - Enjoy the convenience of washing dishes and silverware in just the upper or lower rack
- Easy Access Silverware Baskets - To help make loading silverware and small items easy, two baskets offer plenty of space, while dedicated silverware jets ensure table-ready results
- 3-digit countdown display with 1-12-hour Delay Start - Wash dishes at your convenience
- Adjustable upper rack - Fitting plates up to 10½" and other tall items in the upper rack is possible with an adjustment
- 48 dBA with status light on door - Nearly silent two-pump system cleans dirty dishes without disruption
- Wash Your Way Customizable Rack - Easy loading and unloading is assured with the ability to adjust the direction of the lower rack tines based on your kitchen layout
- Model GDT550HSDSS - Stainless steel
- Model GDT550HGDWW - White on white
- Model GDT550HGDBB - Black on black



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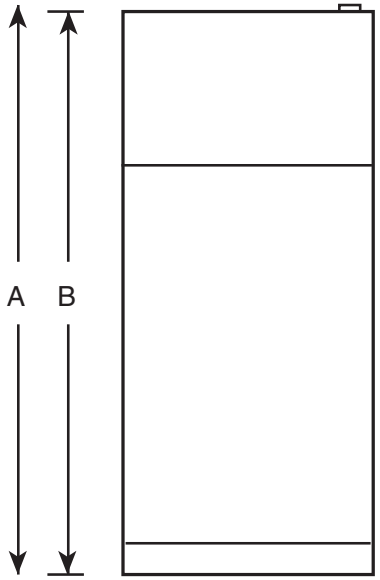
GTZ18GCE

GE® ENERGY STAR® 18.1 Cu. Ft. Top-Freezer Refrigerator

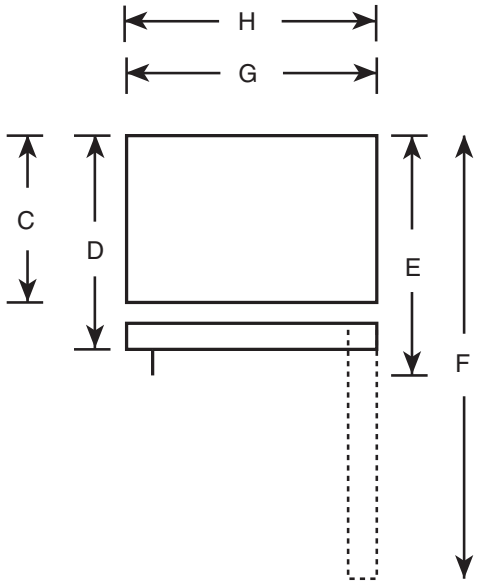
Dimensions and Installation Information (in inches)

Overall Dimensions	Height to top of hinge (in.) **A**	**67-3/8**
	Height to top of case (in.) **B**	**66-7/8**
	Case depth without door (in.) **C**	**26-3/4**
	Case depth less door handle (in.) **D**	**30-1/2**
	Case depth with door handle (in.) **E**	**32-3/8**
	Depth with fresh food door open 90˚ (in.) **F**	**56-3/8**
	Width (in.) **G**	**28**
	Width with door open 90˚ inc. door handle (in.) **H**	**30-3/4**
Air Clearances	Each side (in.)	**3/4**
	Top (in.)	**1**
	Back (in.)	**2**

Front View



Top View



For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

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As an ENERGY STAR® partner, GE has determined that this product meets the ENERGY STAR guidelines for energy efficiency.

Specification Created 2/13

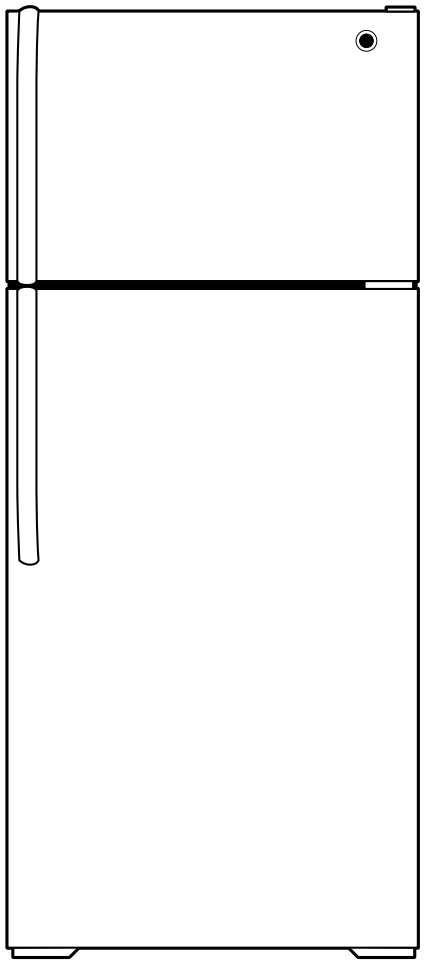
310324

GTZ18GCE

GE® ENERGY STAR® 18.1 Cu. Ft. Top-Freezer Refrigerator

Features and Benefits

- Stainless steel exterior - Adds elegance to any kitchen décor
- Adjustable spill-resistant glass shelves - Designed to contain spills for easy cleaning
- Factory-installed icemaker - Refrigerator comes ready to automatically create ice
- Upfront temperature controls - Easy-to-use controls regulate both fresh food and freezer sections
- Adjustable-humidity crisper drawers - Adjustable humidity controls keep fresh produce fresh
- Snack drawer - Conveniently stores favorite foods and allows for quick, easy access
- Gallon door storage - Larger items are easily accommodated in the door
- Can storage door shelf - Holds cans in the door for easy selection and quick access
- Wire freezer shelf - Provides additional storage for frozen foods
- Never Clean condenser - Sealed compartment keeps coils clean and simplifies maintenance
- Model GTZ18GCESS - Stainless steel



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As an ENERGY STAR® partner, GE has determined that this product meets the ENERGY STAR guidelines for energy efficiency.

Specification Created 2/13

310324

PP945SM

GE Profile™ Series 30" Built-In CleanDesign Electric Cooktop

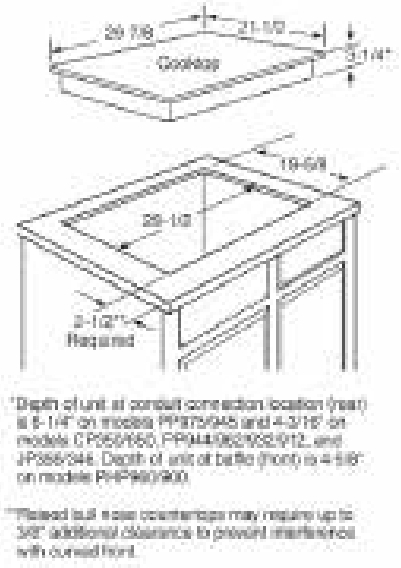
Dimensions and Installation Information (in inches)

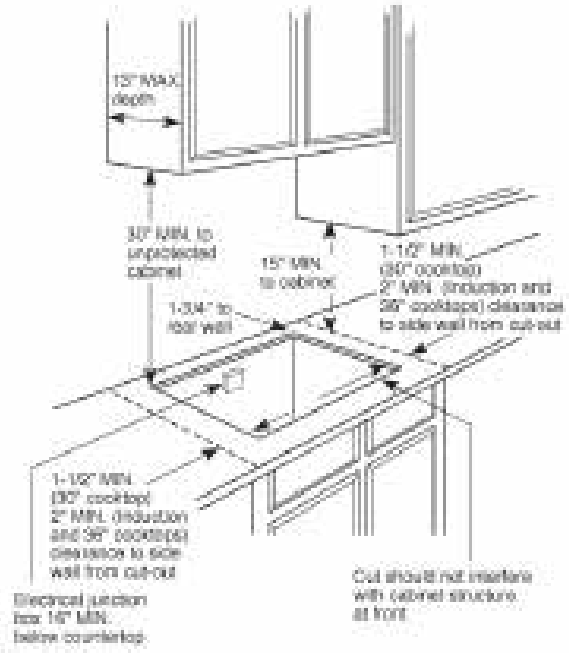
KW Rating	
240V	7.8
208V	5.9
Breaker Size	
240V	40 Amps†
208V	30 Amps†

†**Note:** Check local codes for required breaker size

Important: Requires a 5" free area between the bottom of the cooktop to any combustible material, i.e., shelving. Free area not required when installing wall oven underneath cooktop. Refer to installation instructions. Requires a 15" minimum from cooktop to adjacent overhead cabinets. Units are furnished with a 48" flexible armored cable.

Note: 30" Ribbon cooktops are approved for use over select GE 30" Single Wall Ovens and Warming Drawers. All 30" ribbon cooktops can be installed over 27" wall ovens and warming drawers. Refer to cooktop and wall oven/warming drawer installation instructions packed with product for current dimensional data. If installed with a GE Profile™ Telescopic Downdraft System, consult both the cooktop and downdraft installation instructions packed with product before installing. Cooktop gas/electric supply may need to be re-routed to install downdraft. The countertop must be at least 26" deep with a flat surface area of 23-1/2" or more, front to back. In addition, other clearances to the front edge of the countertop must be considered. Consult cabinet and countertop manufacturer's specs for flush mount installation prior to install. **Before installing, consult installation instructions packed with product for current dimensional data.**





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For answers to your Monogram® or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

Listed by Underwriters Laboratories

Specification Revised 3/13

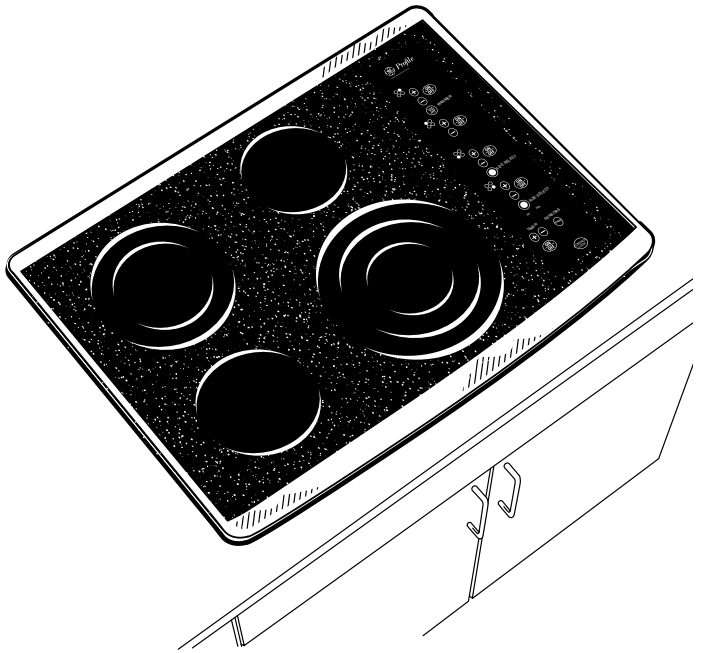
220591

PP945SM

GE Profile™ Series 30" Built-In CleanDesign Electric Cooktop

Features and Benefits

- Electronic Touch Controls - Offer easy, point-and-cook convenience
- Ribbon Heating Elements - Provide powerful heat beneath a smooth glass surface to ensure even heat and fast warm-up times
- 12"/9"/6" Tri-Ring Element - Accomodates various-sized pots or pans for the ultimate in cooking versatility
- Power Boil Element - Provides up to 3,000 watts of power to speed the boiling process
- Stainless Steel Frame - Brings an added touch of style to any decor and perfectly complements all other stainless steel appliances in the kitchen
- Control Lock Capability - Provides the ability to lock controls, helping protect from unintentional activation
- Model PP945SMSS - Stainless steel



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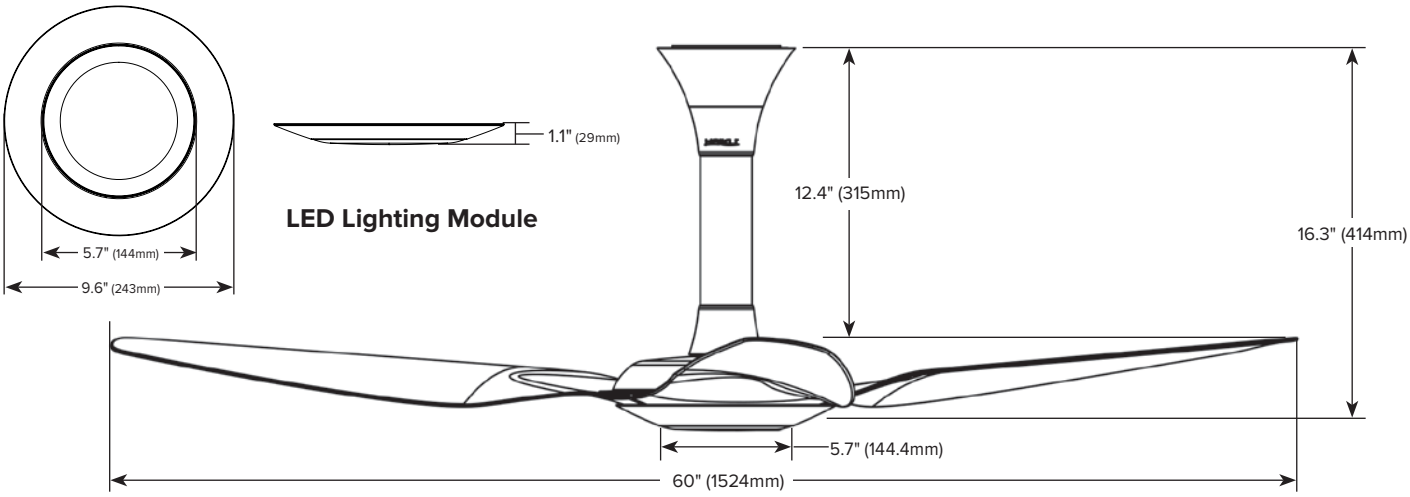
Technical Specifications

HAIKU™
POETRY IN MOTION



Technical Specifications

Model	Haiku®
Model number	K3150-A2
Fan diameter	60" (1524mm)
Motor and assembly finishes	Black or white
Airfoil material	Matrix composite
Airfoil finishes	Black or white
Number of airfoils	3
Motor type	EC motor with a digital inverter drive
Controller included	Yes, remote
Controller features	Fan on/off
	Sleep mode
	Off timer
	Whoosh® mode
	Reverse
	LED light on/off
Mount and drop tube	Standard length, included (10.2" [260mm])
Hanging weight	13.2 lb. (6kg) (fan only)
Number of fan speeds	7
Operating voltage	100–240 VAC, 1Φ
Operating frequency	50–60 Hz
RPM (min/max)	35/175 RPM
Amps (min/max)	0.05/0.363 A
Watts (min/max)	2/30 W (fan only)
Ambient operational temperature range	32–120°F (0–49°C)
Environment	UL listed for dry or damp (covered outdoor) locations
Fan mode indicator	LED display (not visible with light kit)
Warranty*	Limited lifetime

* See Haiku warranty in installation guide for complete details

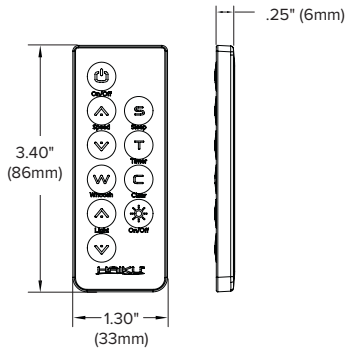
Optional Accessories

Haiku LED Lighting Module

Specifications	
Operating voltage	12V (+/- 0.5V)
Operating current	1.6 Adc (100% PWM)
Maximum input power	20 W
Operating temperature	32–104°F (0–40°C)
Nominal lumen output	1500Lm
Dimming range	0-100%
Operating life expectancy	50,000 hrs
Included lenses	Smoky and clear

Color Options

Controller



855-MY HAIKU (855-694-2458) | WWW.HAIKUFAN.COM

3128438

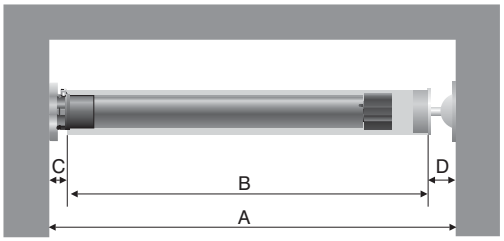
BIG ASS FANS
No Equal.

CAUTION LED LIGHT
NEVER STARE DIRECTLY INTO LED LIGHTS. DOING SO MAY CAUSE PERMANENT DAMAGE TO YOUR EYES.

May be protected by one or more of the following patents: U.S. Pat. Nos. D612476 and D614757 | ANSI/UL STD 507 | Can/CSA C22.2 NO 113
An ISO 9001:2008 certified company. HF400-0-K3150-A0-03/13-01-00

LT50/60 Motor Installation Instructions

Fig. 1



B =A-(C+D)

Fig. 2

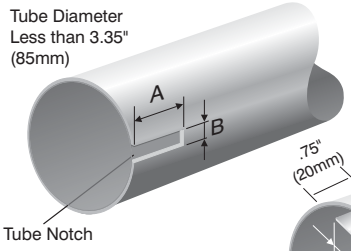
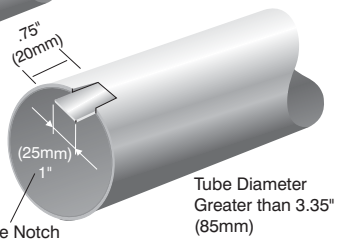


Fig. 3



		A	B
Notch:	**LT50**	Length = 25 mm	Width = 4 mm
	LT60	35 mm	8 mm

Fig. 4

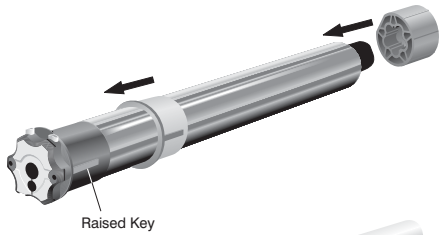


Fig. 5

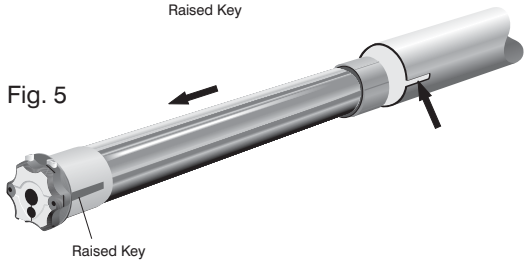


Fig. 6

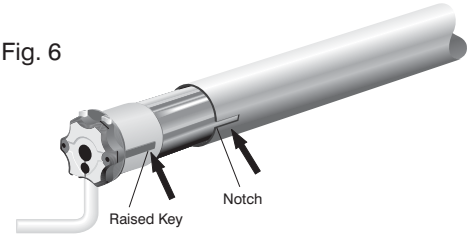
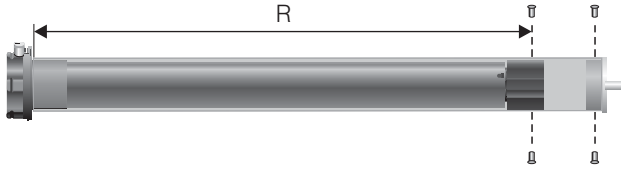


Fig. 7



1. TUBE PREPARATION

- Cut the tube to the required length (B), taking into account the width of the installation (A), the motor end clearance (C), and the idler end clearance (D). (See Fig. 1)
- USE FORMULA TO DETERMINE MEASUREMENTS.
- Remove all burrs from the ends of the tube and ensure that the inside of the tube is clean.
- For all round tube sizes up to 3.35" (85 mm) inclusive, notch the tube on the motor end to the dimensions A & B. (See Fig. 2)
- For all tubes over 3.35" (85 mm) form a tongue in the motor end of the tube by making two cuts 1" (25 mm) apart and .75" (20 mm) deep. (See Fig. 3)

2. PREPARING THE TUBULAR MOTOR

- Place the crown wheel over the body of the motor. Slide the slot in the motor crown over the raised key on the motor's limit switch unit. (See Fig. 4)
  A crown is not necessary on
  2.0" Tube when used with LT50, and
  2.5" Tube with LT60.
- Fit the drive wheel on to the output shaft of the motor. There are two types of LT drive wheels: Removable or **"SOFT CLIP"** type, and fixed or **"HARD CLIP"** type. The **"SOFT CLIP"** drives are only available for round tubes in 2.0", 2.5", and 2.75" diameters. The drive wheel can be removed by physically pulling it off the motor shaft. For the ease of identification all **"SOFT CLIP"** drives are **BROWN.** The **"HARD CLIP"** drives can only be removed from the shaft by pressing the two clips inward at the same time. The motor must be out of the tube in order to have access to the clips. These drives are **BLACK.**

3. FITTING THE MOTOR INTO THE TUBE

For round tubes: Measure the drilling length R according to the motor type listed in the table below. Fit the motor into the tube ensuring that the notch at the end of the tube slides over the raised key on the crown wheel. (See Fig. 5, 6) Secure the drive wheel to the tube using four 7/32 steel pop rivets or four 1/4 DIA. screws. Fit the end plug into the other side of the tube and secure it with three steel pop rivets. Use only fasteners with steel grades SAE 5 or higher. Metric fasteners must be grade 8.8 or higher. (See Fig. 7)

4. SUPPLY CABLE OUTPUT

AXIAL OUTPUT: Pass the supply cable through the center hole of the yellow motor head cover. (See Fig. 5)
RADIAL OUTPUT: Pass the supply cable through the groove in the motor head. (See Fig. 6)

LT50

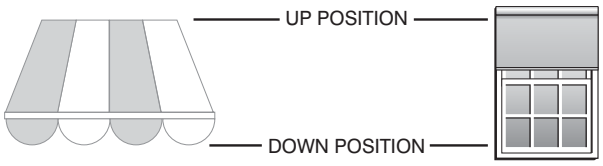
MOTOR TYPE	R in. / mm	MOTOR TYPE	R in. / mm
504S2	19.29/490	520R2	20.08/510
506S2	20.08/510	525A2	21.26/540
510S2	21.26/540	530R2	21.26/540
510R2	19.29/490	535A2	23.23/590
515S2	23.23/590	540R2	23.23/590
515A2	20.08/510	550R2	23.23/590

LT60

MOTOR TYPE	R in. / mm
660R2	25.3/642
680R2	25.3/642
6100R2	25.3/642

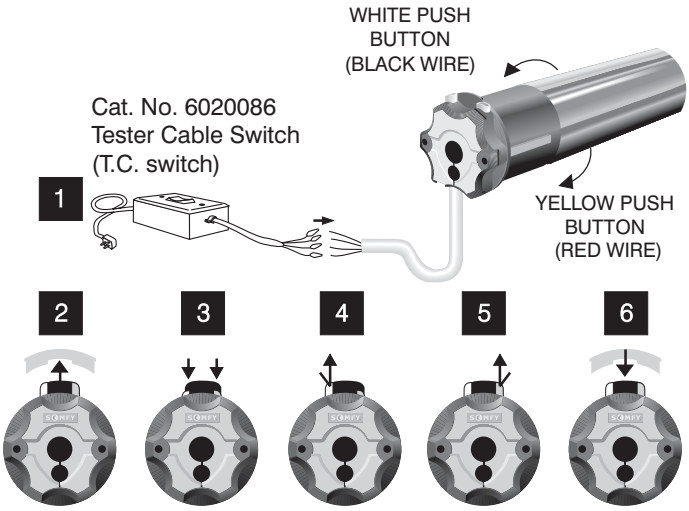
5. LIMIT SWITCH SETTING

SOMFY strongly recommends using a Tester Cable (T.C.) Cat. No. 6020086 to set the motor limits, and to ensure the system is operating correctly before the final electrical connection is made. Refer to Step 7 "Trouble Shooting Guide" for any problems encountered.
Two positions have to be set: the UP & DOWN positions, this is where the rolling shutter or awning will stop automatically.



Sequence:

1. Ensure the tester cable switch is in the center "OFF" position, and connect T.C. to motor leads by matching color codes.
2. Remove the protective cap covering the limit setting buttons on motor head, and replace when finished.
3. Depress fully both limit switch push buttons. They will automatically lock in the down position. Operate the T.C. switch and check that the system operates correctly. Identify the UP limit switch push button(refer to figure used for step 1). Press the T.C. switch in the UP direction until the required position is reached. Set the switch to the center "OFF" position.
4. Unlock the UP limit switch push button by depressing and releasing it.
5. Repeat the above operation to set the lower limit. Check with the switch that the motor stops at the up & down positions just set.
6. Always remember to affix the protective cap over the limit switch buttons.



NOTE: Tubular motors are not continuously rated. They have a built-in thermal overload device which limits their operation to approximately 5 minutes.

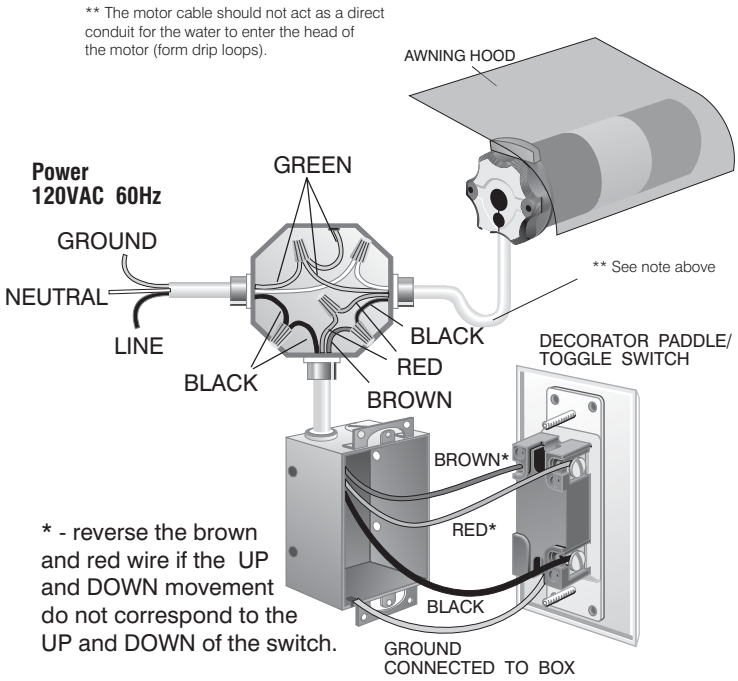
6. WIRING/INSTALLATION RECOMMENDATIONS

A. All wiring must conform to NEC (National Electrical Code) and local codes

B. Do not wire two or more motors to one SPDT (single pole double throw switch-NO PARALLEL WIRING).

C. Do not use light switches.

D. Do not wire two or more switches to one motor, without using SOMFY's multi switch command. Cat. No. 6300427.



NOTE: SOMFY motors conform to IP44 requirements and as such must be protected against direct weather elements such as rain, sleet,...etc.
SOMFY reserves the right to void the motor warranty if the wiring recommendations are not followed.

7. TROUBLESHOOTING GUIDE

SYSTEM DOES NOT RESPOND
- Is the power supply switched on - check any fuses in the system?
- Is control switch wired correctly? Refer to instructions.
- Are limit switches set properly? Review limit switch settings.
- The thermal protective device may have shut the motor off. Wait for the motor to cool down.
- Check the wiring between the motor & the switch.
- Disconnect the switch & test the motor with a tester cable.

THE SYSTEM IS NOT STOPPING
- Is the limit switch crown wheel being driven by the tube (has tube profile been properly notched)?
- Is motor drive wheel securely fastened to the tube?

NOTE: if the motor is tested outside the tube, the crown wheel has to be manually turned in order to stop the rotation of the output shaft.

REF. NO. 4500050 / 900240

SOMFY MEXICO S.A. De C.V.
Calle 3 No. 47, Loc. E-5
Fracc Ind. Alce Blanco
Nau., Edo. de Mex C.P. 53370

SOMFY SYSTEMS, INC.
47 Commerce Drive
Cranbury, NJ 08512

SOMFY CANADA
6315 Shawson Drive, Unit #1
Mississauga, Ontario L5T1J2

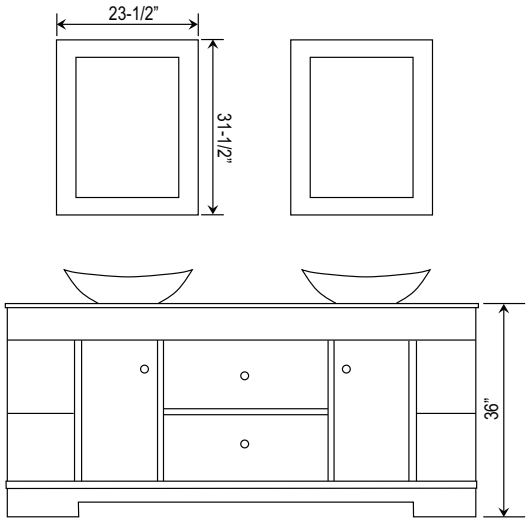
Design Element™
Bath Furniture

DEC105-D Oasis 72" Double Sink Vanity (Faucets Not Included)

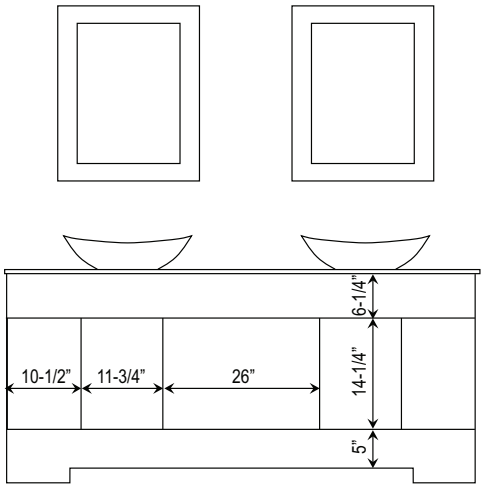
The Oasis Collection

The 72" Oasis Double Sink Vanity is stunning elegance in design and functionality. The rich espresso finished cabinet is made of solid hardwood, with ideally placed storage areas on shelves that lie behind soft-closing doors, cabinet sides or in the large soft closing drawers. Beautifully honed granite vessel sinks sit atop a thick, tempered glass countertop. Beneath the clear glass, hidden LEDs illuminate a large drawer the length and depth of the cabinet. Content, accents, and ideas are left to the whim of the decorator's imagination.

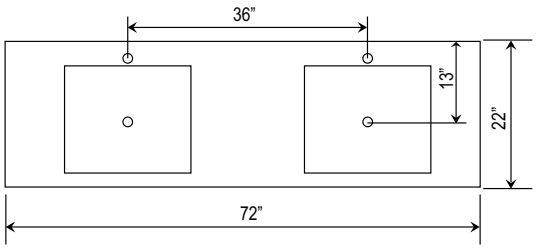
Oasis 72” Double Sink Vanity Set



FRONT VIEW



BACK VIEW



TOP VIEW

DEC105-D Product Features

- Solid Hardwood Construction
- Twin Granite Stone Sinks
- Clear Tempered Glass Countertop
- Two Drawers with Soft-Closing Slides
- Two Cabinet Doors with Soft-Closing Hinges
- Built-in, Under Counter LED Lights
- Demensions: 72”W x 22”D x 34”H

Oasis Collection

Oasis 36” Single Sink - Vanity Set DEC105-S

Design Element™

Bath Furniture

8715 Boston Place
Rancho Cucamonga, CA 91730

www.DesignElementUSA.com

Uponor AquaPEX® White

Submittal Information
Revision H: June 27, 2013

Project Information

Job Name:

Location: Part No. Ordered:

Engineer: Date Submitted:

Contractor: Submitted By:

Manufacturer's Representative: Approved By:

Technical Data

Material:	Crosslinked polyethylene PEX-a Engel Method; PEX 5106
Standard Grade Hydrostatic Ratings (PPI):	200°F (93°C) at 80 psi (551 kPa) 180°F (82°C) at 100 psi (689 kPa) 73.4°F (23°C) at 160 psi (1,103 kPa) ½", ¾", 1", 1¼", 1½" and 2" Uponor AquaPEX® White only: 120°F (49°C) at 130 psi (896 kPa)
Linear Expansion Rate:	1.1"/10°F/100' (27.94mm/5.56°C/30.48m)

Product Information and Application Use

Uponor AquaPEX White is tubing used for hot and cold domestic potable water distribution, residential fire safety and radiant heating and cooling systems containing no ferrous corrodible components or where ferrous components are isolated from the tubing.

✓	Description	Part Number	I.D.	O.D.	Weight
☐	¼" Uponor AquaPEX White, 100-ft. coil	F1040250	0.241"	0.375"	4.0 lbs.
☐	⅜" Uponor AquaPEX White, 400-ft. coil	F1090375	0.350"	0.500"	20.0 lbs.
☐	⅜" Uponor AquaPEX White, 1,000-ft. coil	F1120375	0.350"	0.500"	44.0 lbs.
☐	½" Uponor AquaPEX White, 100-ft. coil	F1040500	0.475"	0.625"	6.0 lbs.
☐	½" Uponor AquaPEX White, 300-ft. coil	F1060500	0.475"	0.625"	18.0 lbs.
☐	½" Uponor AquaPEX White, 500-ft. coil	F1100500	0.475"	0.625"	27.6 lbs.
☐	½" Uponor AquaPEX White, 1,000-ft. coil	F1120500	0.475"	0.625"	54.0 lbs.
☐	⅝" Uponor AquaPEX White, 300-ft. coil	F1060625	0.574"	0.750"	28.0 lbs.
☐	⅝" Uponor AquaPEX White, 1000-ft. coil	F1120625	0.574"	0.750"	86.0 lbs.
☐	¾" Uponor AquaPEX White, 100-ft. coil	F1040750	0.671"	0.875"	10.0 lbs.
☐	¾" Uponor AquaPEX White, 300-ft. coil	F1060750	0.671"	0.875"	34.0 lbs.
☐	¾" Uponor AquaPEX White, 500-ft. coil	F1100750	0.671"	0.875"	54.0 lbs.
☐	1" Uponor AquaPEX White, 100-ft. coil	F1041000	0.862"	1.125"	20.0 lbs.
☐	1" Uponor AquaPEX White, 300-ft. coil	F1061000	0.862"	1.125"	56.0 lbs.
☐	1" Uponor AquaPEX White, 500-ft. coil	F1101000	0.862"	1.125"	93.0 lbs.
☐	1¼" Uponor AquaPEX White, 100-ft. coil	F1061250	1.054"	1.375"	34.0 lbs.
☐	1¼" Uponor AquaPEX White, 300-ft. coil	F1021250	1.054"	1.375"	106.0 lbs.
☐	1½" Uponor AquaPEX White, 100-ft. coil	F1061500	1.244"	1.625"	44.0 lbs.
☐	1½" Uponor AquaPEX White, 300-ft. coil	F1021500	1.244"	1.625"	133.0 lbs.
☐	2" Uponor AquaPEX White, 100-ft. coil	F1062000	1.629"	2.125"	68.2 lbs.
☐	2" Uponor AquaPEX White, 200-ft. coil	F1052000	1.629"	2.125"	136.4 lbs.
☐	2" Uponor AquaPEX White, 300-ft. coil	F1022000	1.629"	2.125"	204.6 lbs.
☐	3" Uponor AquaPEX White, 100-ft. coil	F1063000	2.400"	3.125"	128.0 lbs.
☐	3" Uponor AquaPEX White, 350-ft. coil	F1023000	2.400"	3.125"	442.0 lbs.

Installation

Use ProPEX® fittings[1] for ⅜" through 2" tubing. Use WIPEX™ fittings for 3" tubing. Refer to the Uponor Professional Plumbing Installation Guide, Radiant Floor Heating Installation Handbook or AquaSAFE™ Residential Fire Sprinkler Installation Guide for more information.

Listings[2]	Codes	Standards
cNSFus-fs[3]; cNSFus-pw; cQAIus; UL; CSA; WH; ETL; PPI TR-4; ICC-ES; IAPMO; BMEC; CCMC	ICC; IPC; IMC; IRC; UPC; UMC; NSPC; HUD; UFGS; NPC of Canada; NBC of Canada	ANSI/NSF 14; ANSI/NSF 61; ASTM F876; ASTM F877; ASTM F1960; ASTM F2023; ASTM E84; CAN/ULC S102.2; ASTM E119/UL 263; CAN/ULC S101; ASTM E814/ULC S115; AWWA C904[4]; CSA B137.5; CSA B214; UL 1821[3]; ULC/ORD-C199P[3]

Related Applications

PEX-a Plumbing Systems
Radiant Heating and Cooling Systems
AquaSAFE™ Fire Safety Systems

Contact Information

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Apple Valley, MN 55124 USA
Phone: 800.321.4739
Fax: 952.891.2008
www.uponorpro.com

Uponor Ltd.
2000 Argentia Rd., Plaza 1, Ste. 200
Mississauga, ON L5N 1W1 CANADA
Phone: 888.994.7726
Fax: 800.638.9517
www.uponorpro.com

[1]ProPEX® is a registered trademark of Uponor, Inc. ProPEX™ is a trademark of Uponor Ltd.
[2]Visit listing agency's website for complete information; [3]For ½", ¾", 1", 1¼", 1½" and 2" tubing only; [4]For ¾" tubing and larger

Uponor AquaPEX® Red

Submittal Information
Revision E: May 24, 2013

Project Information

Job Name:

Location: Part No. Ordered:

Engineer: Date Submitted:

Contractor: Submitted By:

Manufacturer's Representative: Approved By:

Technical Data

Material:	Crosslinked polyethylene PEX-a Engel method; PEX 5206
Standard Grade Hydrostatic Ratings (PPI):	200°F at 80 psi (93°C at 5.5 bar) 180°F at 100 psi (82°C at 6.9 bar) 73.4°F at 160 psi (23°C at 11 bar)
Linear Expansion Rate:	1.10"/10°F/100' (27.94mm/5.56°C/30.48m)

Product Information and Application Use

Uponor AquaPEX® Red tubing is used primarily for hot potable-water distribution, but can also be used in radiant heating and cooling systems containing no ferrous corrodible components or where ferrous components are isolated from the tubing.

✓	Description	Part Number	I.D.	O.D.	Weight
☐	½" Uponor AquaPEX Red, 100-ft. coil	F2040500	0.475"	0.625"	6 lbs.
☐	½" Uponor AquaPEX Red, 300-ft. coil	F2060500	0.475"	0.625"	18 lbs.
☐	½" Uponor AquaPEX Red, 1,000-ft. coil	F2120500	0.475"	0.625"	54 lbs.
☐	¾" Uponor AquaPEX Red, 100-ft. coil	F2040750	0.671"	0.875"	10 lbs.
☐	¾" Uponor AquaPEX Red, 300-ft. coil	F2060750	0.671"	0.875"	34 lbs.
☐	¾" Uponor AquaPEX Red, 500-ft. coil	F2100750	0.671"	0.875"	54 lbs.
☐	1" Uponor AquaPEX Red, 100-ft. coil	F2041000	0.862"	1.125"	20 lbs.
☐	1" Uponor AquaPEX Red, 300-ft. coil	F2061000	0.862"	1.125"	56 lbs.
☐	1" Uponor AquaPEX Red, 500-ft. coil	F2101000	0.862"	1.125"	93 lbs.

Installation

Approved fitting system is ProPEX®.[1] Refer to the Uponor Professional Plumbing Installation Guide for more information.

Listings[2]

cNSFus-fs[3]; cNSFus-pw; cQAIus; UL; CSA; WH; ETL; PPI TR-4; ICC-ES; IAPMO; BMEC; CCMC

Codes

ICC; IPC; IMC; IRC; UPC; UMC; NSPC; HUD; UFGS; NPC of Canada; NBC of Canada

Standards

ANSI/NSF 14; ANSI/NSF 61; ASTM F876; ASTM F877; ASTM F1960; ASTM F2023; ASTM E84; CAN/ULC S102.2; ASTM E119/UL 263; CAN/ULC S101; ASTM E814/ULC S115; AWWA C904[4]; CSA B137.5; CSA B214; UL 1821[3]; ULC/ORD-C199P[3]

Related Applications

PEX-a Plumbing Systems
Radiant Heating and Cooling Systems

Contact Information

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Uponor Ltd.
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[1]ProPEX® is a registered trademark of Uponor, Inc. ProPEX™ is a trademark of Uponor Ltd.
[2]Visit listing agency's website for complete information; [3]For ½", ¾", 1", 1¼", 1½" and 2" tubing only; [4]For ¾" tubing and larger

uponor

PLUMBING SYSTEMS

PEX APPROVED IN CALIFORNIA PLUMBING CODE

INFORMATION SHEET

PEX Approved in California Plumbing Code

On Jan. 22, 2009, the California Building Standards Commission (CBSC) certified the Environmental Impact Report (EIR) on crosslinked polyethylene (PEX) tubing and unanimously adopted regulations approving PEX water distribution systems into the California Plumbing Code, which took effect Aug. 1, 2009.

Now contractors and consumers finally have access to an environmentally superior product which provides a durable solution that stands up to the state's water conditions, while meeting California's high standards for drinking-water quality.

The new regulations took effect Aug. 1, 2009. Prior to that, local jurisdictions had the ability to adopt the code to use PEX in new and remodel home construction before statewide adoption.

Conducted from October 2007 through December 2008, the EIR evaluated PEX tubing on its impact on air quality, water quality and performance, as well as PEX tubing installation, use and disposability and manufacturing processes in the areas of waste, recycling, energy consumption and natural resources.

The EIR concluded the adoption of PEX tubing into the California Plumbing Code with proposed regulations would be "an environmentally superior action with respect to public health and hazards, water quality and air quality."

In fact, 180 of the more than 530 municipalities and counties within the state have already approved the use of PEX tubing, which means millions of feet of PEX are currently in service in plumbing applications throughout California.

Hydrostatic Temperature and Pressure Ratings

- 200°F (93.3°C) at 80 psi
- 180°F (82.2°C) at 100 psi
- 73.4°F (23°C) at 160 psi
- 120°F (48.9°C) at 130 psi (½", ¾" and 1" AquaPEX® only)

Manufacturing Standards

- AWWA C904
- CSA B137.5
- CSA B214
- ASTM F876
- ASTM F877
- ASTM F2023
- ASTM E84/ULC S102.2
- ASTM E119/UL 263/ULC S101
- ASTM E814/ULC S115
- UL 1821/ULC ORD C199P
- NSF/ANSI-14
- NSF/ANSI-61

Product Listings

- cNSFus-fs (up to 2")
- cNSFus-pw
- cQAlus
- UL
- CSA
- WH
- ETL
- PPI TR-4
- ICC-ES
- IAPMO
- BMEC
- CCMC

Applicable Codes

- ICC
- IPC
- IRC
- IMC
- UPC
- UMC
- NSPC
- HUD
- UFGS
- NPC of Canada
- NBC of Canada

Warnock Hersey Plenum Rating

- 25 flame spread/50 smoke developed (plenum rated) to ASTM E84
- CAN/ULC S102.2

Fire-rated Assemblies

United States

- G573 — Two-hour Hambro floor/ceiling assembly
- K913 — Two-hour concrete floor/ceiling assembly
- L557 — One-hour wood frame floor/ceiling assembly
- U372 — One-hour wood frame wall assembly
- V444 — One-hour steel stud wall assembly

Canada

- G573 — Two-hour Hambro floor/ceiling assembly
- UW/WA 60-01 — One-hour steel stud wall assembly
- UW/WA 60-02 — One-hour wood frame wall assembly
- WC/FCA 60-01 — One-hour wood frame floor/ceiling assembly
- WC/FCA 120-01 — Two-hour concrete floor/ceiling assembly
- WC/FCA 120-02 — Two-hour concrete floor/ceiling assembly

California PEX Plumbing FAQs

What does the EIR say about PEX?

The EIR states that the adoption of PEX tubing into the California Plumbing Code with proposed regulations would be "an environmentally superior action with respect to public health and hazards, water quality and air quality." The EIR was a full study conducted from October 2007 through December 2008 on PEX tubing and its impact on air quality, water quality, performance, waste, recycling, energy consumption and natural resources in regard to manufacturing processes, installation, use and disposability.

How long did it take to get PEX tubing approved for use in California?

Uponor actively pursued the adoption of PEX in the California Plumbing Code since 2000. Three years of litigation resulted in a decision by the California Building Standards Commission to conduct the full Environmental Impact Report (EIR) on PEX tubing.

Has PEX tubing ever been used in California?

Prior to PEX being added to the California Plumbing Code, 180 of the more than 530 municipalities and counties within the state approved the use of PEX tubing as an alternate material to copper and other materials used for plumbing. In fact, millions of feet of Uponor PEX-a tubing is in use in residential and commercial applications throughout California, and more than 12 billion feet is installed worldwide.

Does including PEX tubing in the California Plumbing Code mean it can automatically be used everywhere in the state?

Local jurisdictions may try to amend PEX out during the 180-day period before it goes into law on Aug. 1, 2009. However, a jurisdiction must have valid justification and submit its proposed amendments to the CBSC. Any proposed amendments must be put into effect before Aug. 1 to be valid.

Who regulates the use of PEX tubing in California after the state plumbing code took effect Aug. 1, 2009?

The following agencies adopted regulations for the use of PEX tubing in the types of construction under their jurisdictions:

- Housing and Community Development (HCD) — Residential construction, hotels, motels, etc.
- Division of State Architect – Structural Safety (DSA-SS) — State-owned buildings, universities, etc.
- Building Standards Commission (BSC) — Commercial construction not state-owned (retail)
- Office of Statewide Health Planning and Development (OSHPD) — Hospitals, health care facilities, etc.

Why would builders and plumbers use PEX tubing instead of other water distribution piping materials, such as copper or CPVC?

In regards to plastic plumbing products, both PEX and CPVC are listed to their own respective ASTM standards for use in plumbing systems. However, CPVC lags PEX not only in market share (PEX has approximately 50%; CPVC has about 18%), but also in regards to features and installation characteristics.

- Both copper and CPVC are rigid piping products, requiring a connection with every direction change. Connections are usually created by bonding the pipe and fittings together with either solvents (CPVC) or torches (copper).
- Uponor PEX features the ProPEX® fitting system that requires one simple tool for fast, easy connections without the use of solvents, glues, torches or gauges. Additionally, the ProPEX system cannot be dry fit, so there's never a question whether the fitting is properly made.

For further information about the ProPEX system, go to www.uponorpro.com.

Does PEX tubing meet California's lead-free legislation?

Uponor offers a complete line of lead-free brass transition fittings and valves that meet California lead-free legislation and exceed the requirements of the United States Safe Drinking Water Act. Combining these fittings with our PEX tubing, our extensive engineered plastic (EP) offering and our innovative ProPEX Out-of-the-Wall Support System provides a complete lead-free plumbing solution from the inlet to the faucet.

Who should I contact at Uponor for more information?

For more information, contact **Dale Stroud**, Senior Director, Marketing/Offerings, at Dale.Stroud@uponor.com or 800.321.4739 ext. 4281.

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Fax: (800) 638-9517
www.uponorpro.com

uponor

MQ

Self-priming multistage pumps
60 Hz

Contents

General data

Technical data

Mission

- to successfully develop, produce, and sell high quality pumps and pumping systems worldwide, contributing to a better quality of life and healthier environment

Bjerringbro, Denmark

Fresno, California

Olathe, Kansas

Monterrey, Mexico

Allentown, Pennsylvania

Oakville, Ontario, Canada

- One of the largest pump companies in the world with over 11,000 employees worldwide
- World headquarters in Denmark
- North American headquarters in Kansas City - Manufacturing in Fresno, California
- 60 companies in 40 countries
- More than 10 million pumps produced annually worldwide
- North American companies operating in USA, Canada and Mexico
- Continuous reinvestment in growth and development enables the company to

  BE responsible, **THINK** ahead, and **INNOVATE**

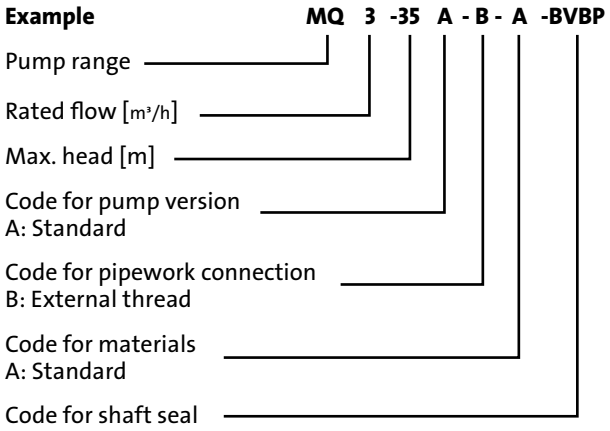
Application

The MQ pump is designed for water supply and pressure boosting ...

- homes
- cabbins, cottages
- on farms as well as
- gardens

The pump is suitable for pumping of potable water and rain water.

Type Key



Pumped liquids

Potable water, rain water or other clean, thin, non-aggressive liquids not containing solid particles or fibres.

Operating conditions

System pressure:	Max. 109 psi (7.5 bar).
Inlet pressure:	Max. 44 psi (3 bar).
Suction lift:	Max. 26 ft (8 m).
Liquid temperature:	32°F to +95°F (0°C to +35°C).
Ambient temperature:	32°F to +113°F (0°C to +45°C).

Technical data

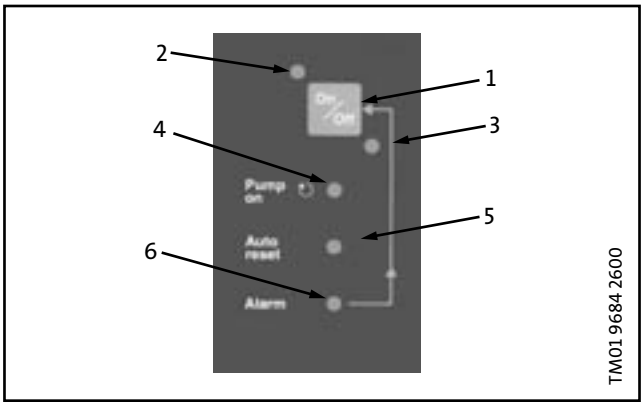
Mains voltage:

• 115 V models:	1 x 110-120 V, 60 Hz
• 230 V models:	1 x 220-240 V, 60 Hz.
Voltage tolerances:	–10%/+6%.
Enclosure class:	IP54.
Insulation class:	B.
Sound pressure level:	≤ 55 dB(A).
Agency approvals:	UL, cUL

Features and benefits

- **Complete system**
  The MQ is a complete, all-in-one unit, incorporating pump, motor, diaphragm tank, pressure and flow sensor, controller and check valve.
  The controller ensures that the pump starts automatically when water is consumed and stops automatically when the consumption ceases. In addition, the controller protects the pump in case of faults.
- **Installation**
  Due to its compact design, the pump does not take up much space and is easy to install. No space around the pump is required.
- **Simple operation**
  The pump features a user-friendly control panel with ON/OFF button and indicator lights for indication of the operational state of the pump.
- **Self-priming pump**
  As it is self-priming, the MQ is able to pump water from a level below the pump. Provided it is filled with water, the pump is able to lift water from a depth of 26 ft (8 m) in less than 5 minutes. This facilitates installation and start-up of the pump and provides more reliable water supply in installations where there is a risk of dry running and leakages in suction hose or pipes.
- **Built-in protective functions**
  If exposed to dry running, excessive temperature, or any overload condition the pump will stop automatically, thus preventing a motor burnout.
- **Automatic reset**
  The pump features an automatic reset function. In case of dry running or similar alarm, the pump will stop. Restarting will be attempted every 30 minutes for a period of 24 hours. The reset function can be deactivated.
- **Low noise level**
  Thanks to its hydraulic design and internal cooling, the pump is very quiet, which makes it suitable for many applications.
- **Pressure tank**
  The built-in pressure tank reduces the number of starts and stops in case of leakages in the pipe system, causing less wear on the pump.
- **Maintenance**
  No maintenance of the pump is required.

Control panel operation



Pos.	Function	Description
1	ON/OFF button	The Pump is started and stopped by means of the ON/OFF button.
2	Power indicator lights	Indicates that the pump is ready for operation (green).
3		Indicates that the pump is on standby (red).
4	Pump ON (green)	Indicates that the pump is running.
5	Auto reset (green)	Indicates that the auto reset function is active. After an alarm, restarting will be attempted every 30 minutes for a period of 24 hours.
6	Alarm (red)	Indicates that the pump is in alarm state. Manual resetting is possible by pressing the ON/OFF button.

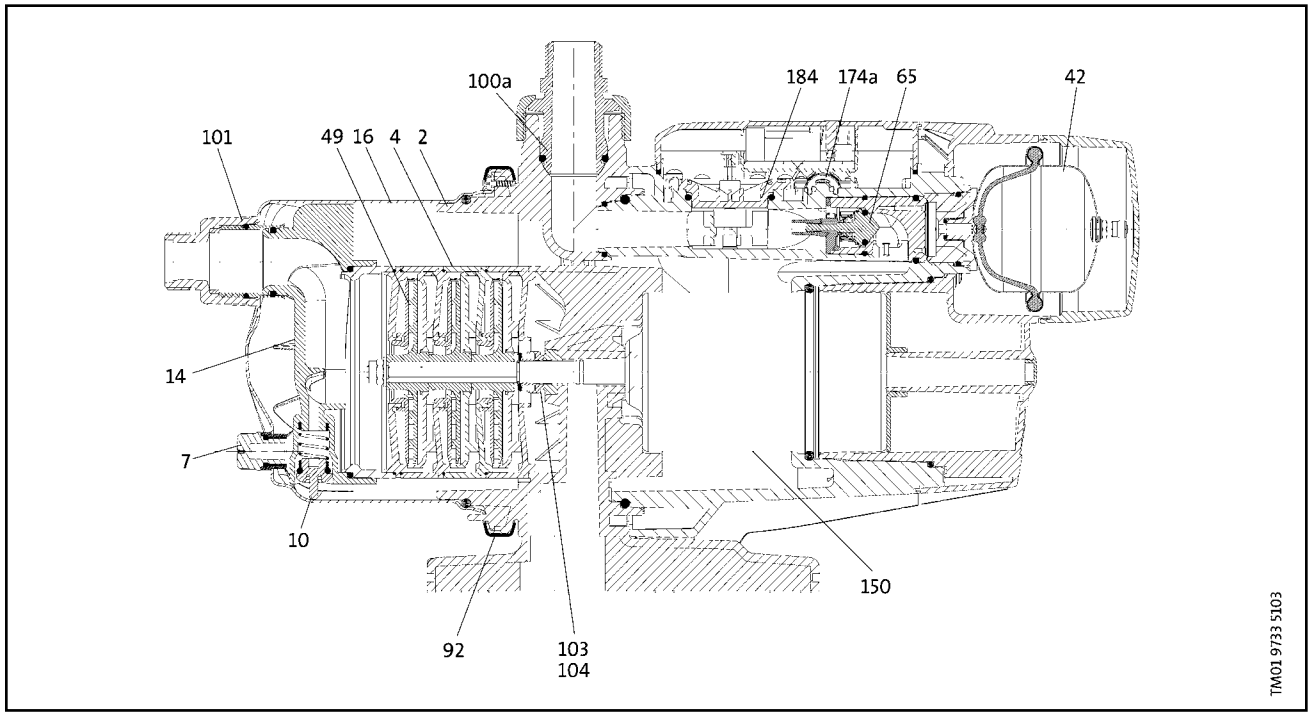
Product range

Region	Pump Type	Voltage	Connection
USA, Canada & Mexico	MQ 3-35	1 x 110 - 120 V	Power Cord w/plug
	MQ 3-45		Power Cord w/plug
	MQ 3-35	1 x 220 - 240 V	Power Cord w/plug
	MQ 3-45		Power Cord w/plug

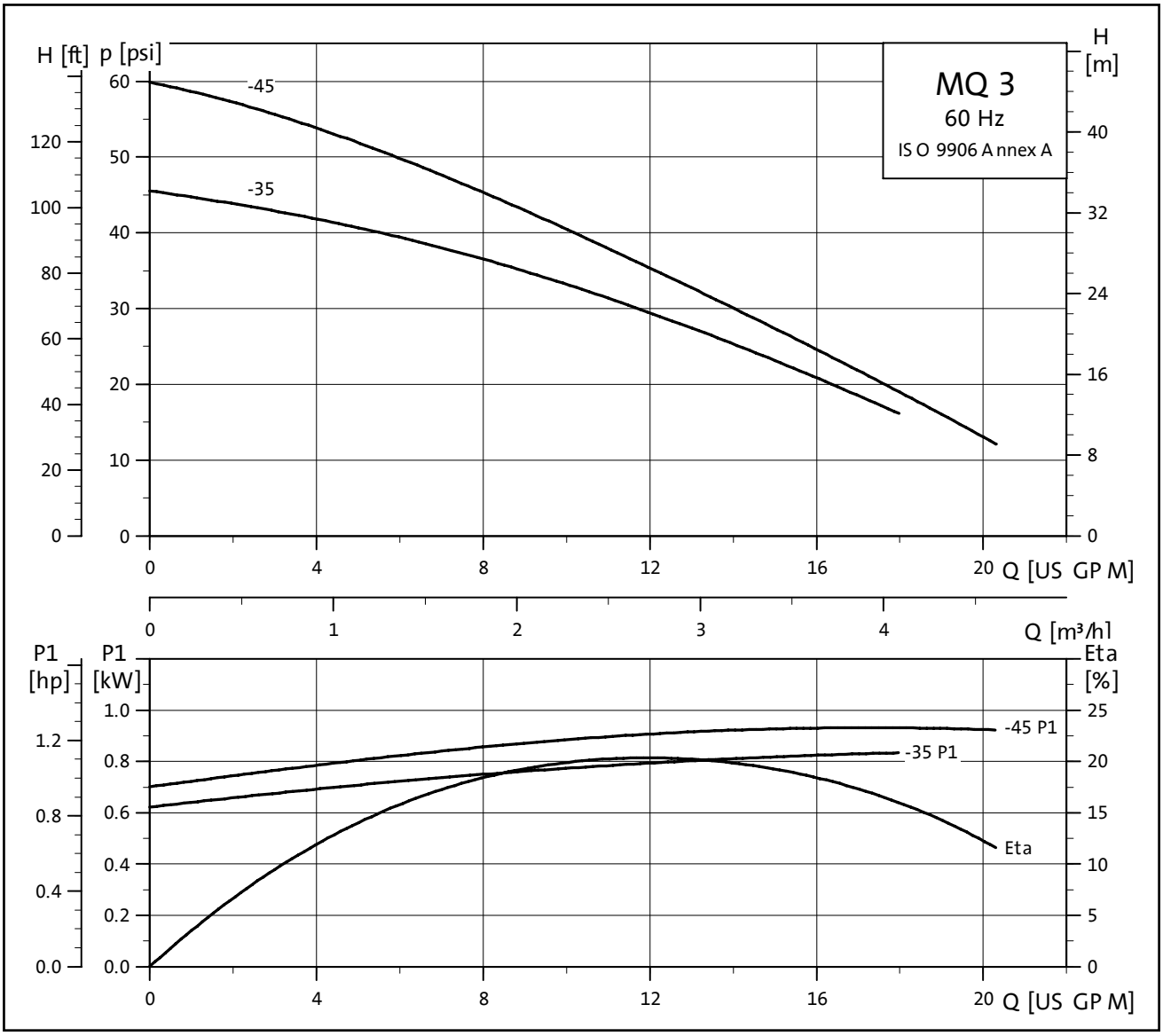
Material specification

Pos.	Components	Material
2	Motor stool with base plate	POM + 25% glass fiber
4	Chamber	PPO + 20% glass fiber
7	Drain and priming plug	POM + 25% glass fiber
10	Self-priming valve	PP + 30% glass fiber
14	Self-priming part	PPE/PS + 20 % glass fiber
16	Pump sleeve	Stainless steel, DIN W.-Nr. 1.4301, AISI 304
42	Pressure tank	Butyl (diaphragm)
49	Impeller	PPO + 20% glass fiber-PTFE
65	Non-return valve	POM + 25% glass fiber
92	Clamp	Stainless steel, DIN W.-Nr 1.4301, AISI 304
100a	Discharge port	POM + 25% glass fiber
101	Suction port	POM + 25% glass fiber
103 104	Shaft seal: Stationary and rotating part	Carbon/ceramics/NBR rubber
150	Shaft	Stainless steel, DIN W.-Nr 1.4005, AISI 416
	Motor sleeve	Stainless steel, DIN W.-Nr 1.4301, AISI 304
174a	Pressure switch	
184	Flow sensor	
	O-rings	NBR-rubber

POM: Polyoximetylen
NR-rubber: Natural Rubber
PPO: Polyphenylene Oxides
PP: Polypropylene
PPE/PS: Polyphenylene Oxides (the same as PPO but from different supplier)
NBR-rubber: Nitrile-Butadiene Rubber

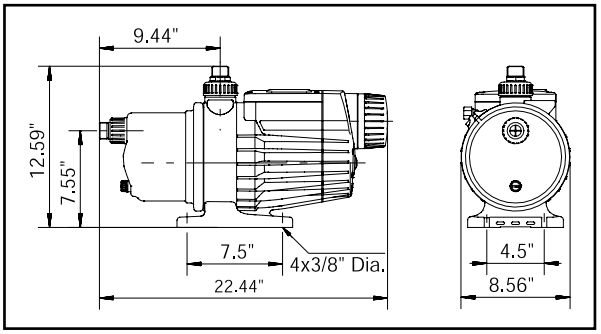


Flooded suction (0 PSI inlet) performance curves*



*See suction lift performance curves (page 8) for installations with water level below intake.

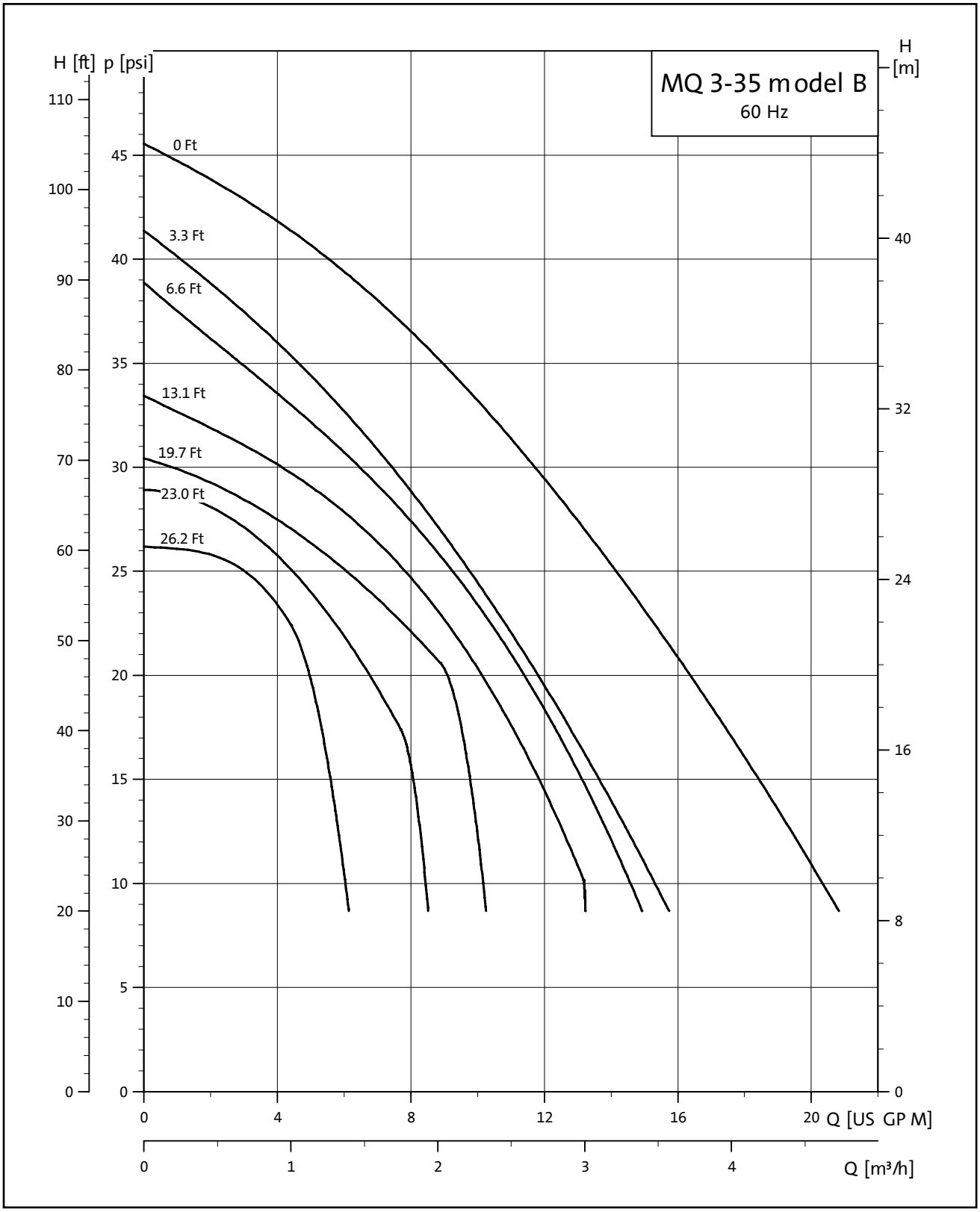
Dimensions



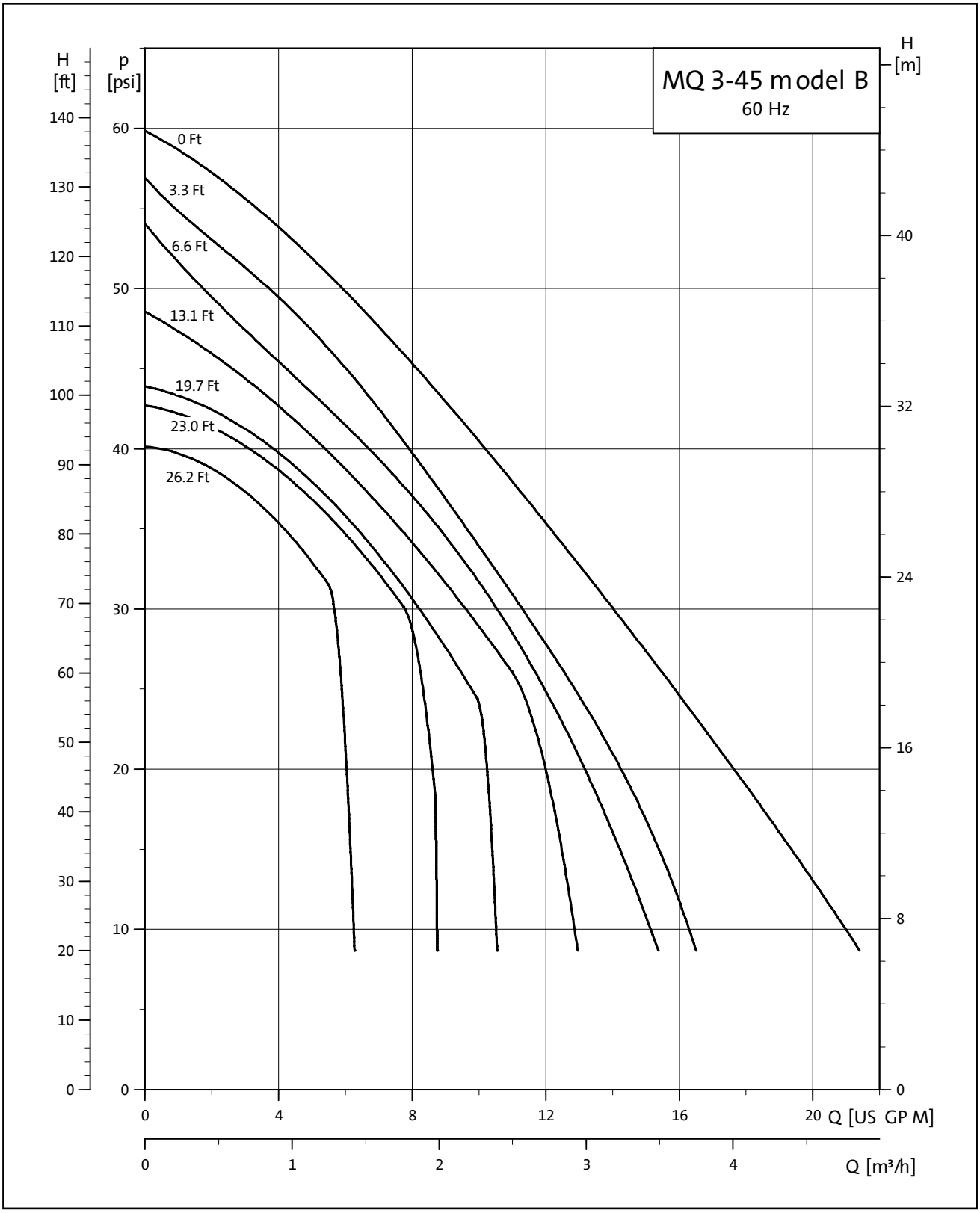
Technical data

Pump type	Voltage	I_n [A]	I_{start} [A]	P_2		Net weight [pounds]
				[W]	[hp]	
MQ 3-35	1 X 110-120 V	7.2	12.5	580	0.79	29
MQ 3-45	1 X 110-120 V	9.2	12.5	680	0.92	29
MQ 3-35	1 X 220-240 V	3.7	8.6	580	0.79	29
MQ 3-45	1 X 220-240 V	4.5	8.6	680	0.92	29

MQ 3-35 Suction lift performance curves



MQ 3-45 Suction lift performance curves



GRUNDFOS

Company name: _____
Prepared by: _____
Phone number: ( ) -
Fax number: ( ) -
Date: _____ Page 1 of: _____
Quote number: _____

Client Information

Project title:		Client name:	
Reference number:		Client number:	
Client contact:		Client phone no:	( ) -

Location Information

For:		Unit:	
Site:		Service:	
Address:		City:	State: Zip Code:

Technical Data

Flow (GPM) _____
Head (Ft) _____
Motor _____
Max Fluid Temp _____
Min Fluid Temp _____
Max Working Pressure _____
Min Required Inlet Pressure _____
Connection Type and Size _____

Motor Information

HP: _____
Phase: _____
Voltage: _____
Enclosure: _____

Pump Information

Model Information from Type Key and Codes: _____
Quantity Required: _____ Example: MQ 3-35
Minimum required flow: _____ NPSH required at duty point: _____

Product Guide additional information pages

Materials page number: _____ Performance curve page number: _____
Technical data page number: Motor data page number:

Custom-built pump information (optional): _____

Additional Information _____

Notes

L-MQ-PG-001	7/04
PRINTED IN USA	

Subject to alterations.

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Parque Industrial Stiva Aeropuerto
C.P. 66600 Apodaca, N.L. Mexico
Phone: 011-52-81-8144 4000
Telefax: 011-52-81-8144 4010

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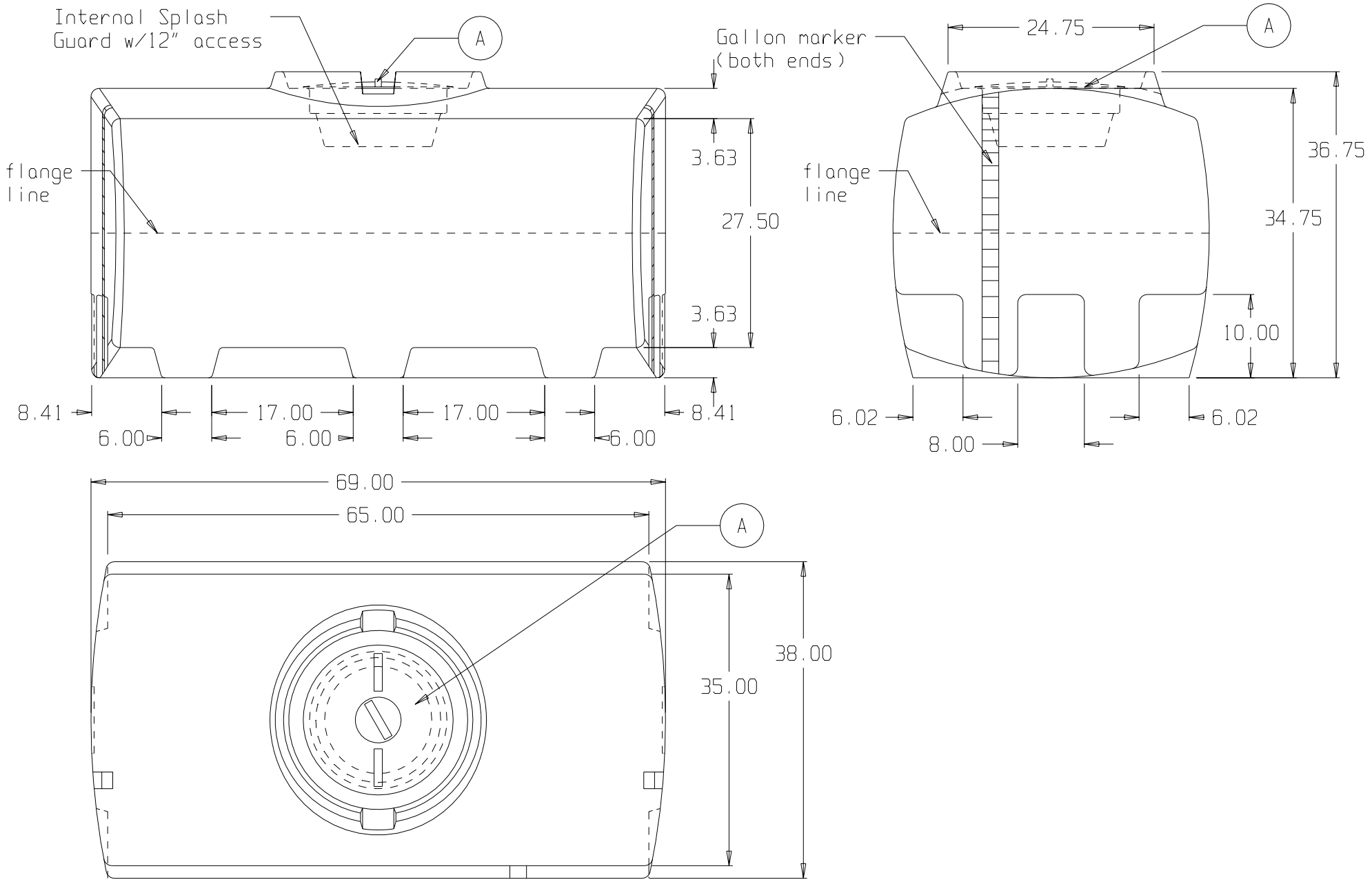


THIS TANK WILL BE SUPPLIED WITH NO HOLE CUTS OR FITTINGS.

A. 18" PE THREADED-VENTED MANWAY W/15" ACCESS [P/N 343012]

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE

(all dimensions in inches)

325 GALLON RECTANGULAR (PCO) TANK

PART # TANK: 172--

REF#: 0000 11/20/02

SNYDER INDUSTRIES INC.

Little GIANT®

5-ASP Series

Features

- Automatic or manual operation
- Epoxy coated die-cast aluminum housing
- Oil-filled motor
- 26.3' maximum lift
- 380 watts
- 1" FNPT discharge
- Thermal overload protection
- ASP On level: 6"–9", Off level: 1"–4"
- ASP-LL On level: 2"–3", Off level: ½"–1½"
- Piggyback diaphragm switch
- For submersible use only

Construction

- Motor — 1/6 HP oil filled

Intermittent Liquid Temp. up to — 120°F

Intake — Screened

Discharge — 1" MNPT

Housing — Epoxy coated cast aluminum

Cover — Epoxy coated cast aluminum

Volute — Nylon

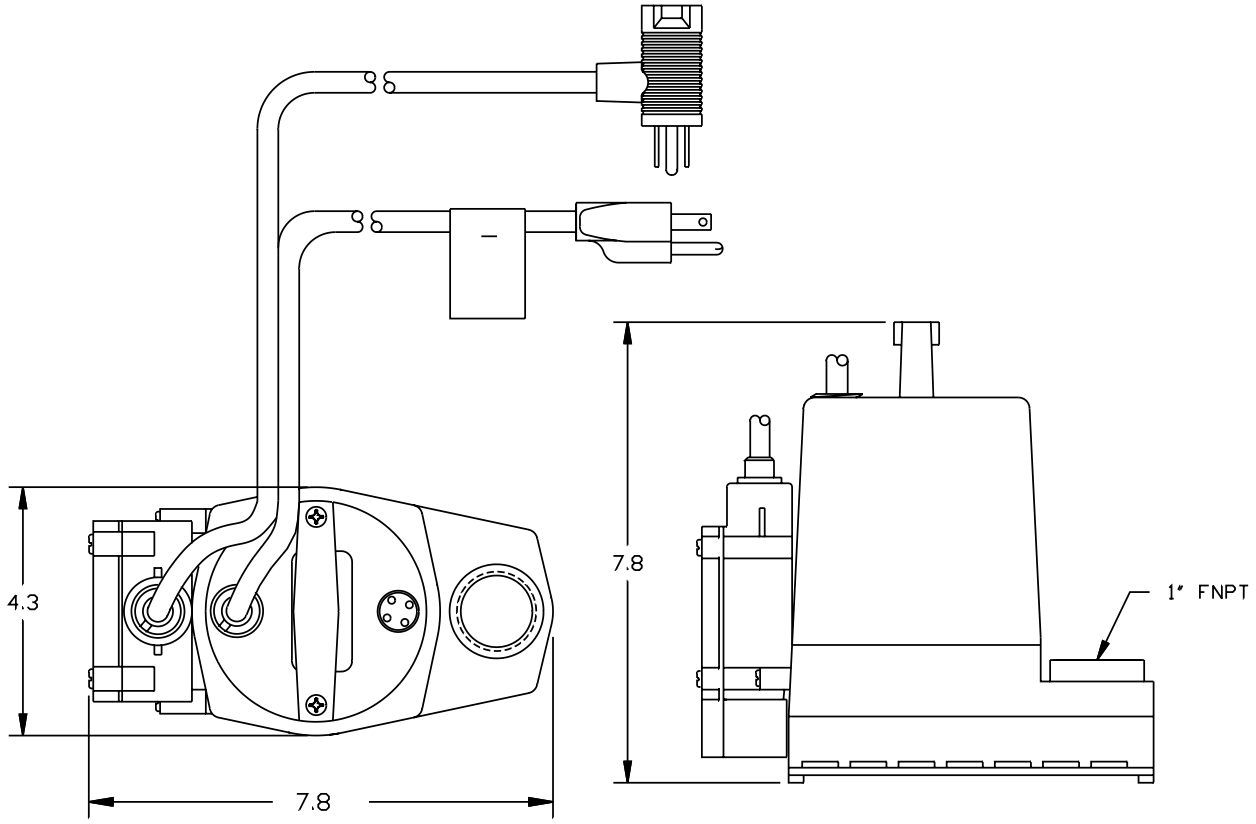
Impeller — Nylon

Shaft Seal — Viton®

Screen — Nylon

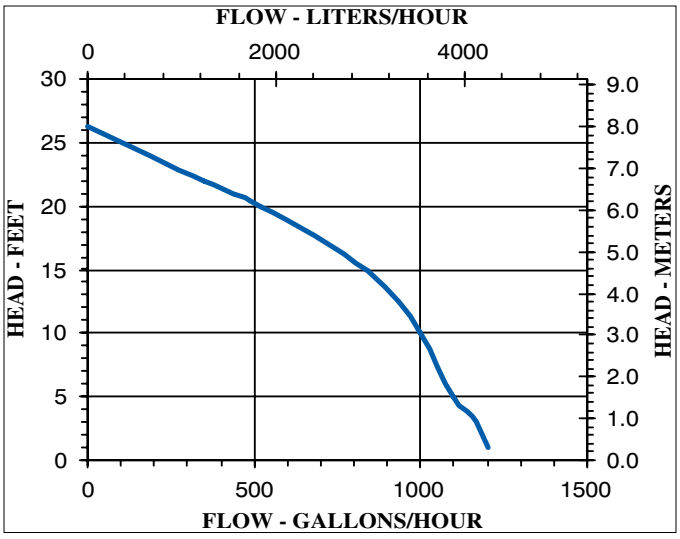
Automatic/Manual submersible utility pump with oil-filled motor and epoxy coated cast aluminum housing. For commercial, industrial and home applications where liquid must be transferred or recirculated. Pumps down to 1/8" in manual mode operation. This 1200 GPH pump features a 1" FNPT discharge with garden hose adaptor, 26.3' shut-off head capability, and screened inlet.

5-ASP Series



Specifications

Model No.	Item No.	Discharge Size	Intake	Listing(s)	HP	Volts	Hertz	Amps	Watts	Performance (GPH@Head) 1'	3'	5'	10'	20'	Shutoff Ft.	Shutoff P.S.I.	Cord Length (ft.)	Weight (lbs.)
5-ASP	505300	1" FNPT	Screened	UL/CSA	1/6	115	60	5.0	380	1200	1170	1100	1000	520	26.3	11.4	10	9.00
5-ASP-LL	505350	1" FNPT	Screened	UL/CSA	1/6	115	60	5.0	380	1200	1170	1100	1000	520	26.3	11.4	18	10.00



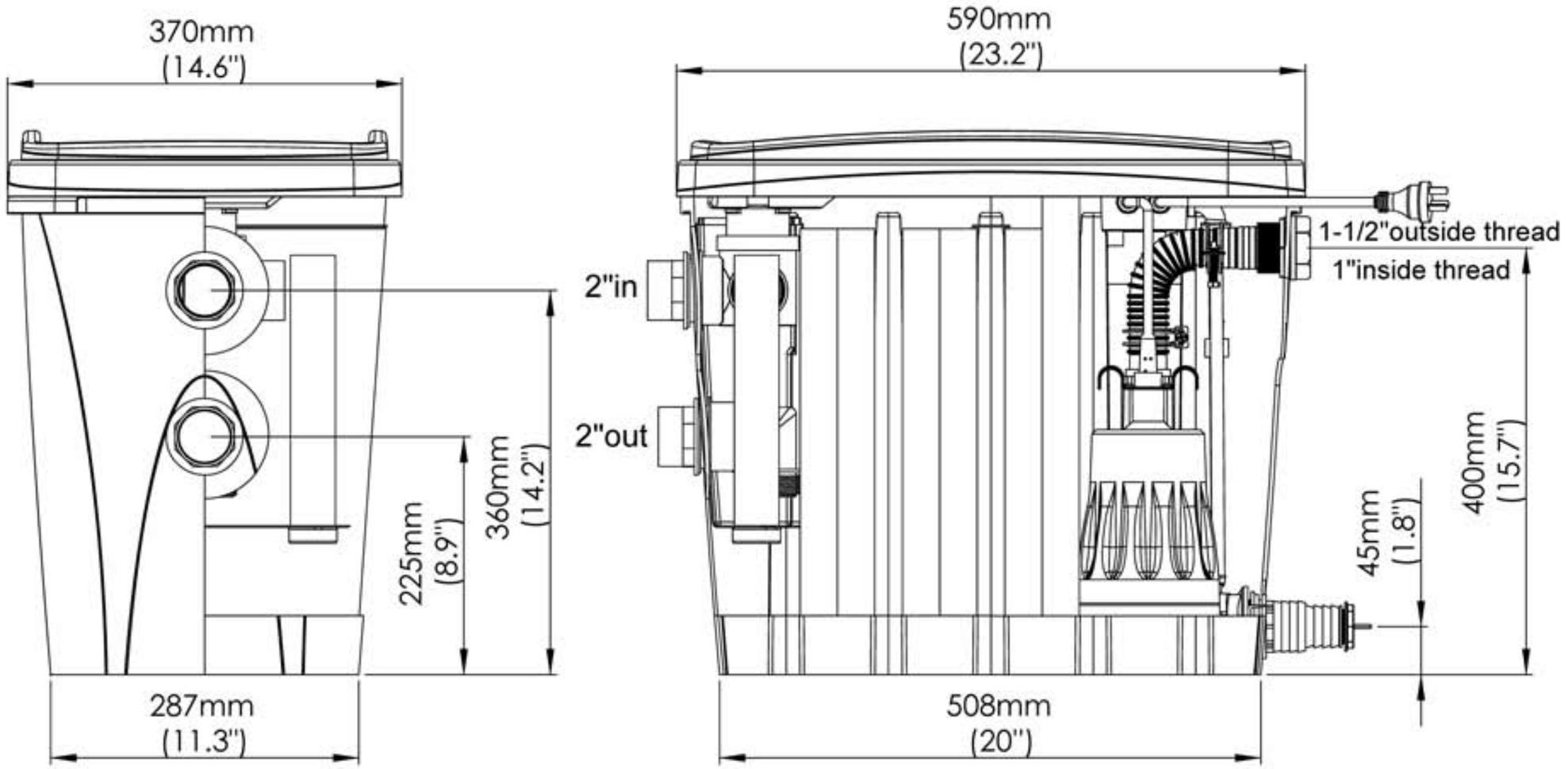
Replacement Parts

Volute	105200
Screen	105900
Impeller	105310
Handle	105911
Adapter (GH)	599030
Seal Ring	928024
RS-5 Switch, 10'	599008
RS-5-LL Switch, 18'	599014

Little GIANT®
PO Box 12010 • Oklahoma City, OK 73157
Phone: 800.701.7894 • Fax: 800.701.8046
E-mail: customerservice@littlegiant.com

2nd process code

Aqua2use GWDD Dimensions :



				Unless Otherwise Specified Fillet : R2 Parting Angle : 1° Chamfer : C1 Free Burrs Angular : ±0.5°	δ (standard dev.)				UNITS	MM	MATERIAL		ITEM	Aqua2use "The Answer for Greywater Reuse"	
					< 0.5 ~ 6	±0.10	±0.30								
					< 6 ~ 30	±0.20	±0.50	APPROVE	Marc	SCALE		FINISH			
				Matala® "Matala water alloy"	< 30 ~ 120	±0.30	±0.70	CHKD	Mike	DATE	990208	H.R.C		PART. NO.	Aqua2use GWDD
NO.	DESCRIPTION	APPR.	DATE	Matala Water Technology Co., Ltd.	< 120 ~ 315	±0.50	±1.20	DRAWN	Kimi	FIRST USED ON				SERIAL NO.	EDITION 1.0
					< 315 ~ 1000	±0.80	±2.00								
					<1000 ~2000	±1.20	±2.50								

Aqua2use®
"The Answer for Greywater Reuse"

Aqua2use® Greywater Diversion Device

Features and Benefits

- State of art progressive filtration
- High volume of Matala® filter media
  Aqua2use® GWDD: 30 litres (8 gallons) or
  Aqua2use® UG GWDD: 60 litres (16 gallons)
- Cross-flow depth filtration: Each filter web has a 3-dimensional structure, able to trap a high volume of impurities without clogging.
- Multichamber plug flow concept: If the first filter web gets clogged, the filtration is done by the second and third filter webs. If the second filter web gets clogged, the filtration is done by the third filter web.
- Submersible pump with integrated Electronic Pump Controller (EPC).
- Durability: The pump is protected from dry run, clogging and other damage.
- Built-in overflow safety.
- Easy to clean.
- Flexible installation: Systems can be installed above ground, half-submerged in the ground, or underground.
- WaterMark approved.

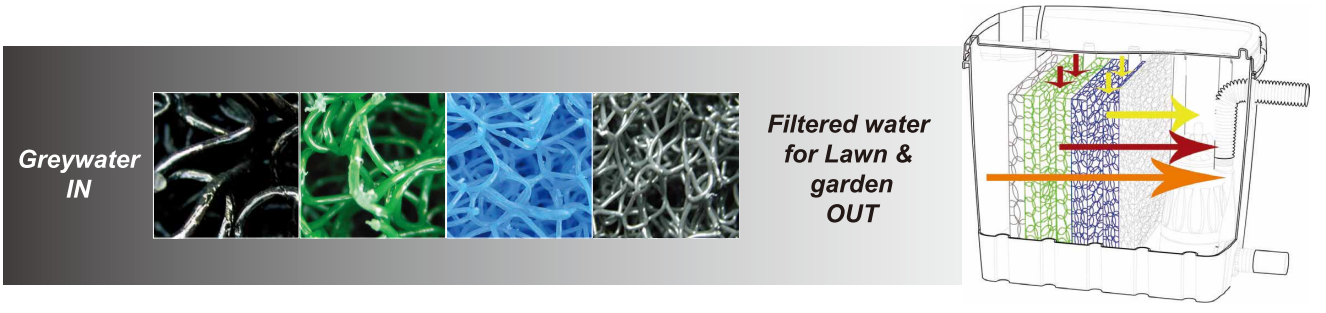
Step 1: Collect
The Aqua2use® GWDD diverts water from the laundry, bath and shower.

Step 2: Filter
Aqua2use® GWDD's state of art filter mats offer the best filtration available for greywater.

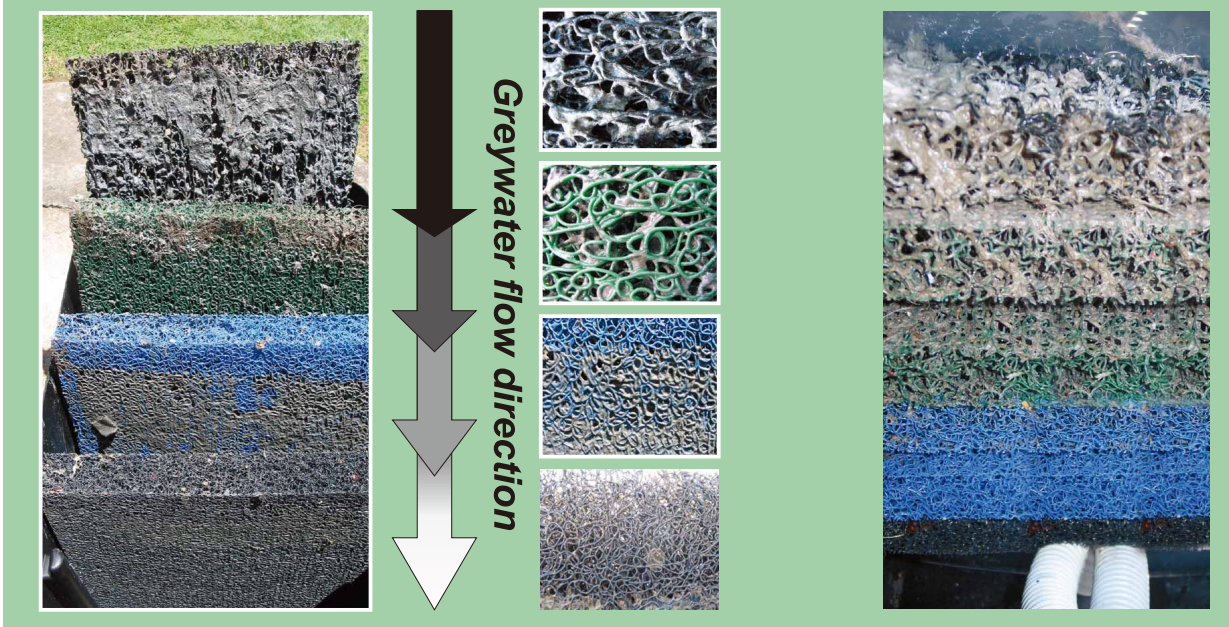
Step 3: Flourish
The subsurface dripline system delivers a slow and precise application of greywater throughout the garden.
Consult an irrigation specialist for the drippline systems available in your market

MATALA® PROGRESSIVE FILTRATION TECHNOLOGY APPLIED IN GREYWATER DIVERTER

The pictures attest to the high filtration efficiency achieved with the progressive density Matala® filter pads. The filter can hold a huge volume of hair, lint, sand, soap residue, and other particles.



Unit tested in a caravan park, Australia: Matala® Greywater Diverter checked after filtering 40,000L (10,810 gallons) of incoming greywater. This system was used with the public shower rooms and laundry facilities.



This is how Aqua2use® Greywater Diverter works:

Step 1: When the diverting valve's arrow points away from the Matala® filter, greywater flows directly to the main sewage.

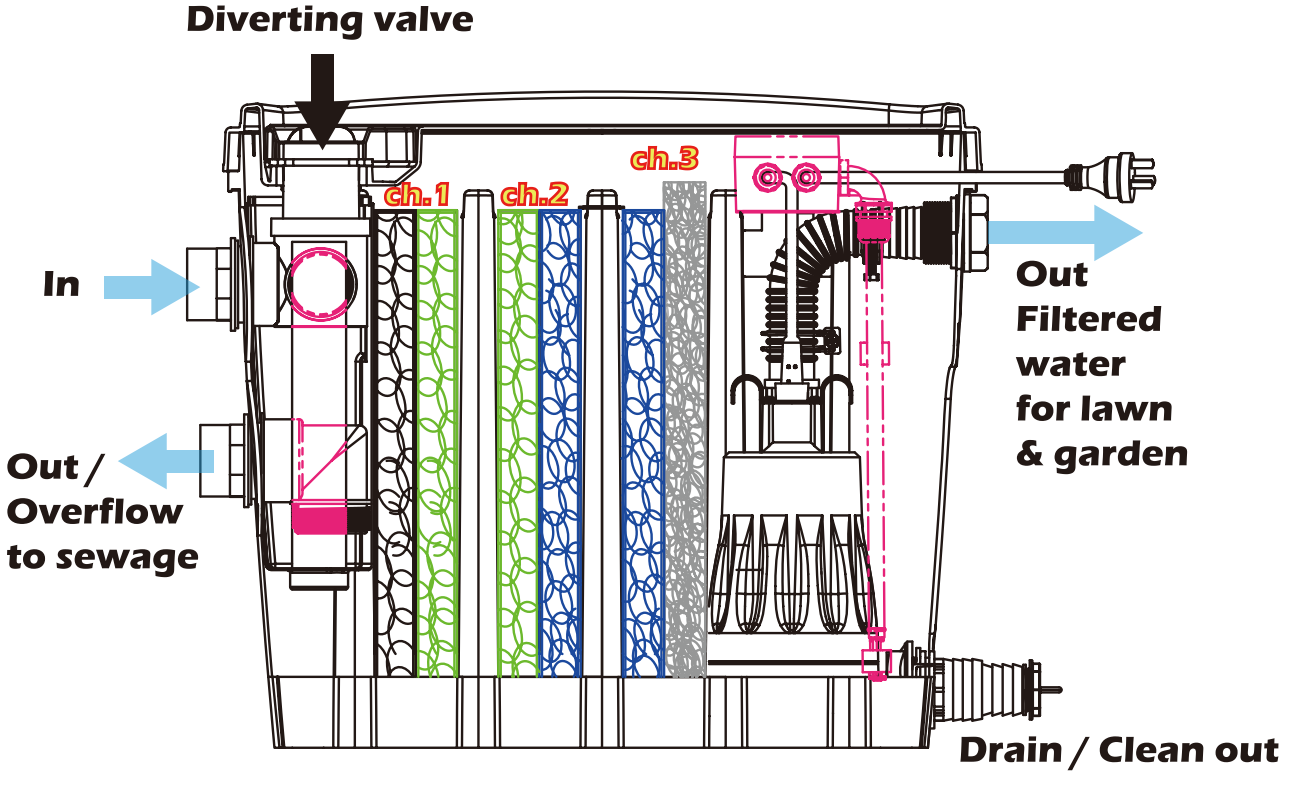
Step 2: When the diverting valve's arrow points towards the Matala® filter, greywater from the house is diverted to the inlet of the filter.

Step 3: The greywater flows through the first Matala® progressive filtration chamber (ch. 1), where major and medium particles (such as hair, lint, paper, detergent, and other impurities) are retained. Matala® black (low density) and Matala® green (medium density) filter pads are used.

Step 4: The greywater flows through the second Matala® progressive filtration chamber (ch. 2), where medium and small particles are retained. Matala® green (medium density) and Matala® blue (high density) filter pads are used.

Step 5: The greywater flows through the third Matala® progressive filtration chamber (ch. 3), where small and minor particles are retained. Matala® blue (high density) and Matala® grey (super high density) filter pads are used.

Step 6: Filtered greywater is pumped to the irrigation system.



Aqua2use®Greywater Diverter

A simple and easy way to keep your garden green all year round.

Aqua2use® GWDD

Dimensions: 59(L) x 37(W) x 51(H) cm
23(L) x 15(W) x 20(H) inches

Aqua2use® UG GWDD

Dimensions: 80(L) x 60(W) x 66(H) cm
32(L) x 24(W) x 26(H) inches

DISTRIBUTED BY

Aqua2use®
"The Answer for Greywater Reuse"

Matala Water Technology Co., Ltd. 121 Tzu Li 2St., Wu Chi Town, Taichung 435, Taiwan
Phone: +886(0)42630 4015 Fax: +886(0)42630 4067 www.aqua2use.com info@agua2use.com

Aqua2use

"The Answer for Greywater Reuse"

Aqua2use GWDD Filtration Test results in caravan park, Qld, Australia

> Step 1 Collect

The Aqua2use GWDD diverts water from the laundry,bath and shower

> Step 2 Filter

Aqua2use GWDD's state of art filter mats offer the best filtration available for grey water

> Step 3 Flourish

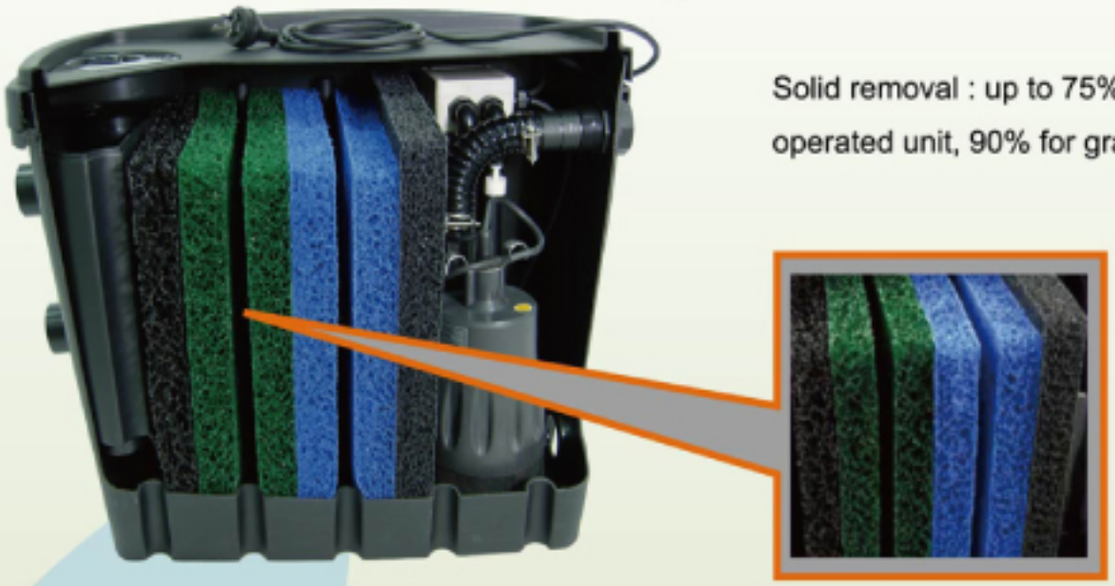
The subsurface dripline system delivers a slow and precise application of greywater throughout the garden. See Watering the garden section overleaf for more information

Aqua2use

"The Answer for Greywater Reuse"

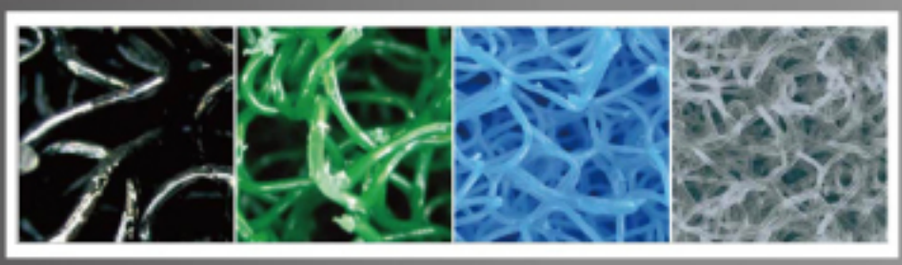
Matala 3D Progessive Filtration :

Technology Proved in more than 40 countries



Solid removal : up to 75% for pump operated unit, 90% for gravity unit

Greywater IN

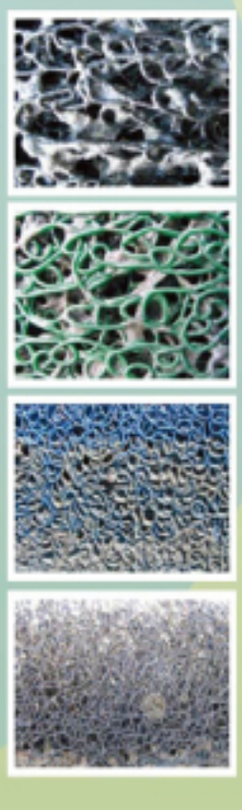


Filtered water for Lawn & garden

Unit tested in a Trailer Park, Australia:

Matala greywater diverter checked after filtering 40,000L (10,567gallons) incoming greywater :public shower rooms and laundry

Greywater flow direction

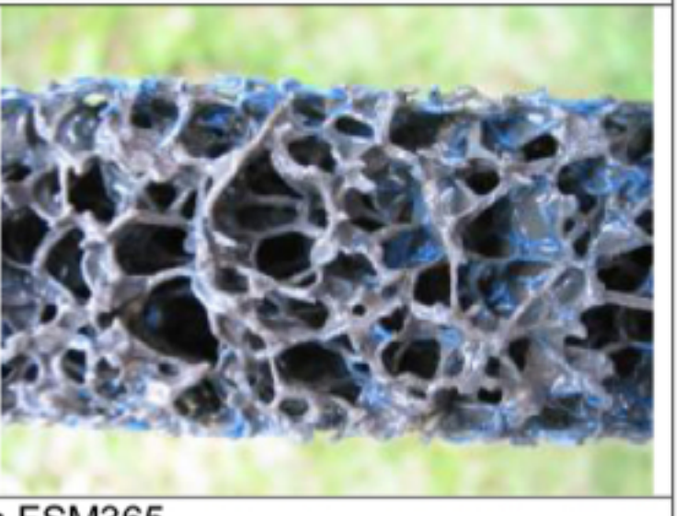


The pictures prove the high filtration efficiency, achieved with progressive density Matala filter sheets. The filter can take up a huge volume of hair, lint, sand, soap residus ect.....

Close up pictures on the detail of Matala filter mats


Black Matala FSM190


Green Matala FSM290

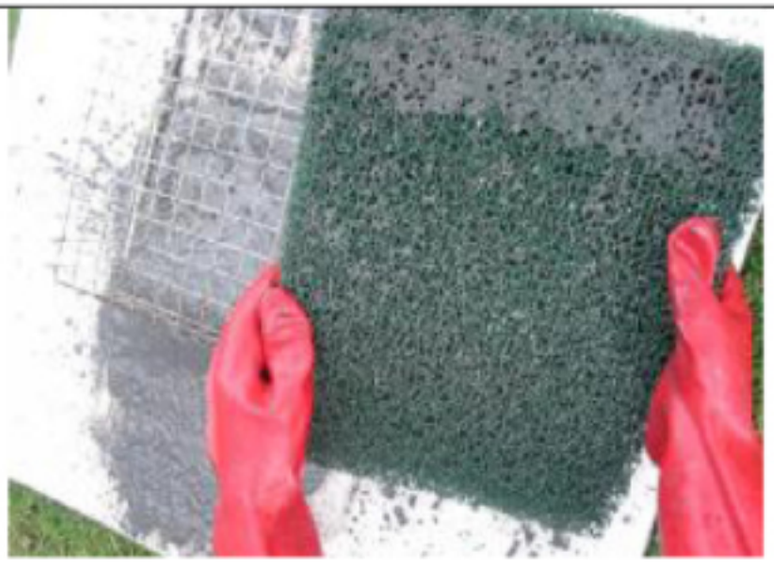



Blue Matala FSM365


Grey Matala FSM460

above pictures show Matala filter sheets removed from system after 40,000litres of greywater flow through

Macro picture of Black Matala FSM190



90% of the sludge will immediately come out when tapping the wet mats

See the sludge chemical analysis in the next page

Aqua2use

"The Answer for Greywater Reuse"

Effluent Average Test Results :

CHEMICAL TEST REPORT

	Biosteps filter (prefilter)		**Flow Rate : 300 l/hr SS removal rate : 90%**			
Analyte	influent	Effluent	Units	Test Method	Error Assess ment	Detection Limit
BOD	248	124	mg/L	TM02	± 8%	3
COD	771	269	mg/L			
SS	473	47	mg/L	TM12	± 5%	2

CHEMICAL TEST REPORT

	Matala effluent filter (prefilter)		Flow Rate : 1380 l/hr SS removal rate : 75%			
Analyte	**Influent**	**Effluent**	**Units**	**Test Method**	**Error Assessment**	**Detection Limit**
SS	680	171	mg/L	TM12	± 5%	2

Sludge Analysis : (9.6 kgs of wet sludge was collected from the filter pads after 40,000 lts had flown through the device)

CHEMICAL TEST REPORT (SLUDGE)

Analyte	**Sludge**	**Units**	**Test Method**	**Error**	**Detection Limit**
Ammonia N	26.7	mg/L	TM22F	± 4%	0.02
BOD	**15060**	mg/L	TM02	± 8%	3
Soluble BOD	1590	mg/L	TM02	± 8%	3
COD	26900	mg/L			
Soluble COD	1800	mg/L			
NOx	0.02	mg/L	TM23F	± 8%	0.02
Organic N	779.1	mg/L	TM25F	± 15%	0.5
VSS	**45.2**	%	TM12	± 5%	2
SS	**38750**	mg/L	TM12	± 5%	2
TKN	805.8	mg/L	TM25A	± 10%	0.5
Total N	805.8	mg/L	TM25F	± 15%	0.5
TKP	197.60	mg/L	TM16TKP	± 7%	2.00

WaterMark

LEVEL 2

International Standards Certifications Pty Ltd

Suite 2/10 Gladstone Road
Castle Hill NSW 2154
AUSTRALIA
Phone: +61 2 9894 6242
Fax: +61 2 9894 6808
www.isc-worldwide.com

Certificate of Conformity

This is to certify that

Matala Water Technology (Australia) Pty Ltd
ABN: 99127077481
4 Dylan Crt, Sandstone Point, Brisbane QLD 4511, AUSTRALIA

Manufacturing Address:

Matala Water Technology Co., Ltd.
No. 121 Tzu Li 2nd St , Wu Chi District, Taichung City, TAIWAN

Evaluated to:

ATS 5200.460 – Grey Water Diversion Devices (GWDD)

subject to the following conditions and limitations

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Tony Wilde
Group Chairman
International Standards Certification Pty Ltd

20th March 2011	20th March 2014	WMKT 30004
Date of issue	**Date of expiry**	**Certificate Number**

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LEVEL 2

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Suite 2/10 Gladstone Road
Castle Hill NSW 2154
AUSTRALIA
Phone: +61 2 9894 6242
Fax: +61 2 9894 6808
www.isc-worldwide.com

Certificate of Conformity

Product Schedule

This is to certify that

Matala Water Technology (Australia) Pty Ltd
ABN: 99127077481

4 Dylan Crt, Sandstone Point, Brisbane QLD 4511, AUSTRALIA

Manufacturing Address:

Matala Water Technology Co., Ltd.

No. 121 Tzu Li 2nd St , Wu Chi District, Taichung City, TAIWAN

Evaluated to:

ATS 5200.460 – Grey Water Diversion Devices (GWDD)

DESCRIPTION	MODEL ID#	MATERIAL
Matala Greywater diverter is a pump operated or gravity operated device enclosing 3 Dimensional progressive filtration media.	**MATALA GREYWATER DIVERTER**	Heavy duty UV stabilized plastics

STANDARDS

ISC International Standards Certifications Pty. Ltd.

JAS-ANZ

www.jas-anz.org/register

Tony Wilde
Group Chairman
International Standards Certification Pty Ltd

20th March 2011	20th March 2014	WMKT 30004
Date of issue	**Date of expiry**	**Certificate Number**

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GEH50DEEDSR
GeoSpring™ hybrid water heater

Dimensions and Installation Information (in inches)

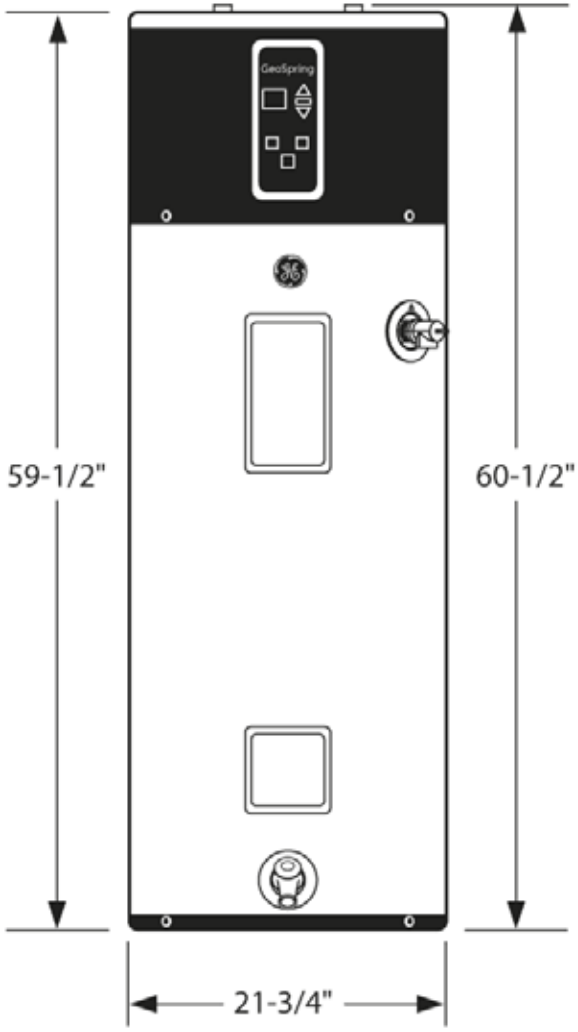
Local Installation Regulations: This water heater must be installed in accordance with these instructions, local codes, utility codes, utility company requirements or, in the absence of local codes, the latest edition of the National Electrical Code. It is available from some local libraries or can be purchased from the National Fire Prevention Association, Batterymarch park, Quincy, MA 02169 as booklet ANSI/NFPA 70.

Installation Information: For complete information, see installation instructions packed with your water heater.

Power Requirements: Check the markings on the rating plate of the water heater to be certain the power supply corresponds to the water heater requirements.

Location: Locate the water heater in a clean dry area as near as practical to the area of greatest heated water demand. Long uninsulated hot water lines can waste energy and water.

Note: Because this unit draws in air from the room to heat the water, the room must be at least 10' x 10' x 7' (700 cubic feet) or larger. If the room is smaller, there must be a louvered door. Place the water heater in such a manner that the air filter, cover and front panels can be removed to permit inspection and servicing, such as removal of elements or cleaning of the filter. The water heater and water lines should be protected from freezing temperatures and high-corrosive atmospheres. Do not install the water heater in outdoor, unprotected areas.



Above illustration intended for dimensional reference only.
Refer to photograph for actual product appearance.

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000.

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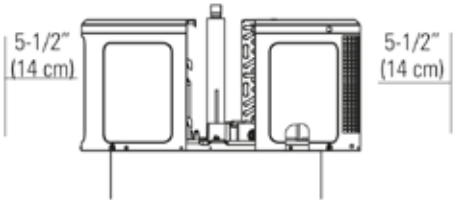
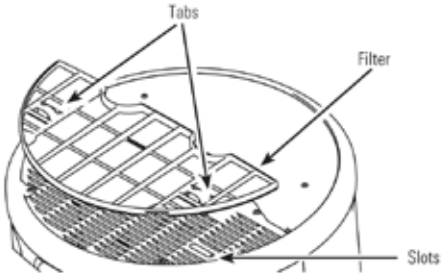
GEH50DEEDSR
GeoSpring™ hybrid water heater

Dimensions and Installation Information (in inches)

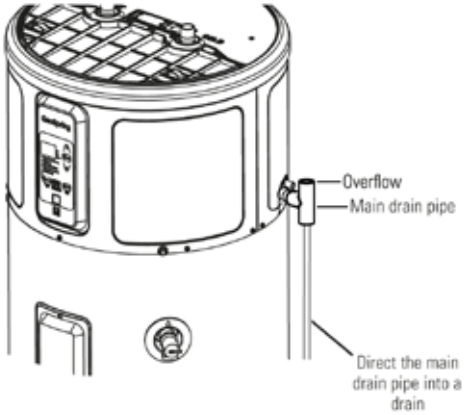
Front & back clearance requirements: A 7" clearance is recommended with a minimum of 5-1/2" air space between any object and the front and back of the water heater and 7" on each side. Clearance is needed to allow for removal of the front and back covers in the event service is needed.



Top filter removal clearance requirements: A minimum 6" clearance is required at the top of the water heater to pull the filter up and remove it for cleaning. It is critical that the hot and cold water plumbing and the electrical connections do not interfere with the removal of the filter.



Condensate drain required: A primary drain pipe must be installed at the top right side of the water heater. The primary drain is intended to carry all condensate away.



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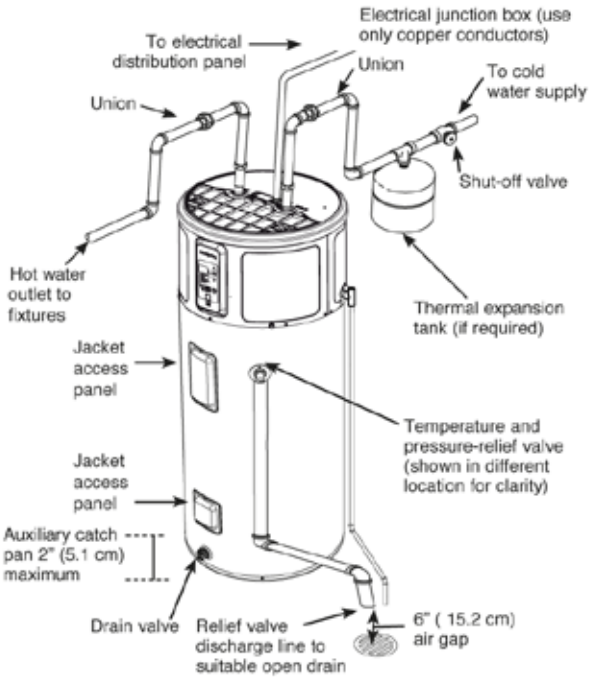
Water Supply Connections: Refer to the illustration below for suggested typical installation. The installation of unions or flexible copper connectors is recommended on the hot and cold water connections so that the water heater may be easily disconnected for servicing if necessary. The HOT and COLD water connections are clearly marked and are 3/4" NPT on all models.

Note: Install a shut-off valve in the cold water line near the water heater. This will enable easier service or maintenance of the unit later.

IMPORTANT: Do not apply heat to the HOT or COLD water connections. If sweat connections are used, sweat tubing to adapter before fitting the adapter to the cold water connections on heater. Any heat applied to the hot or cold water connection will permanently damage the dip tube.

TYPICAL INSTALLATION



Above illustration intended for dimensional reference only. Refer to photograph for actual product appearance.

GEH50DEEDSR
GeoSpring™ hybrid water heater

Verification Checklist:

☐	**1**	**Tank location:** - Is **room size** less than 10x10x7 (700 cu. ft.)? If yes, Louvered door or similar ventilation is needed. - Back of unit **away from wall** by 7 inches. - **Front** of unit is free and clear. - Is the water heater **level**? If no, add shims under the base of the unit.
☐	**2**	**Plumbing connections:** - Do not prevent **air filter** removal. - No leaks after **filling** the tank with water, either when water is flowing or not.
☐	**3**	**Condensate lines are in place:** - Longer PVC pipe on lower drain nozzle and directed into a floor drain or a condensate pump.
☐	**4**	**T & P valve** is working and drain line completed per local code.
☐	**5**	**Electrical** connection does not prevent air filter removal.
☐	**6**	Verify **control panel** displays 120°F (49°C) Hybrid Mode.
☐	**7**	Verify **filter** is in place.

Normal startup—what to expect after pressing the POWER button

Elapsed time	Hybrid water heater actions	Comments
:00 to 2:00 minutes	Unit will go through self-check	This 2 minute off-time prevents compressor from being “short cycled” (improved reliability).
2:00 to 10:00 minutes	Compressor and fan turn on and run for 8 minutes	This 8 minute period is used to ensure tank is full of water (dry fire prevention algorithm).
10:00 to 30:00 minutes	Compressor and fan turn off, heating elements turn on for approximately 20 minutes.	Quickly provides initial amount of hot water for user (~25 gallons).
30 minutes and beyond	Upper element turns off, and compressor turns back on.	Uses efficient heat pump for majority of heating.

NOTE: Heat pump operating range is 45°F to 120°F.

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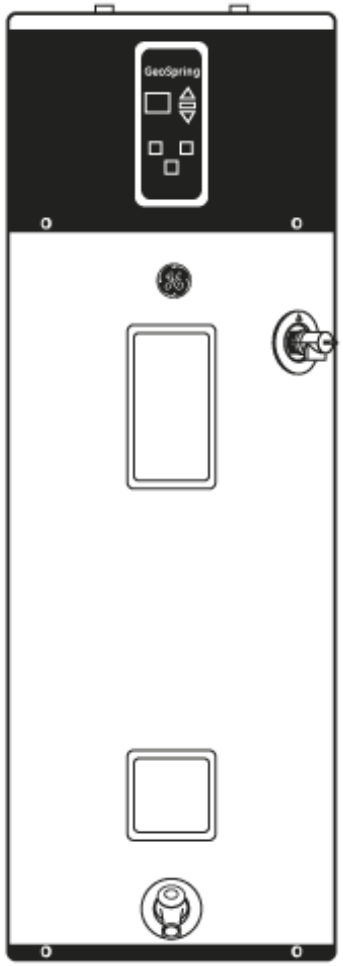
imagination at work

GEH50DEEDSR
GeoSpring™ hybrid water heater

Features and Benefits

- Saves $325 every year* in water heating expenses
- Uses up to 62% less energy than a standard electric 50-gallon water heater
- Proudly assembled in Louisville, KY
- Provides the same hot water recovery as a traditional 50-gallon standard electric water heater with 65 gallons first hour rating
- Installs like a standard electric water heater with the same water and electrical connections
- Limited 10 year warranty provides peace of mind and dependability
- ENERGY STAR® qualified – exceeds federal guidelines for energy efficiency and provides year-round energy and money savings
- Offers remote funtionality to control modes and temperatures when connected to a GE Nucleus™ energy manager
- GEH50DEEDSR - Red

*Based on DOE test procedure and comparison of a 50-gallon standard electric tank water heater using 4879 kWh per year vs. the GeoSpring hybrid water heater using 1830 kWh per year.



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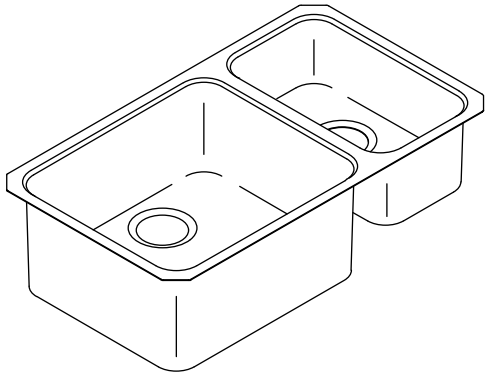
KOHLER®

UNDERTONE®

UNDER-MOUNT KITCHEN SINK
K-3352
ALSO K-3352-L

Features

- *18-gauge stainless steel*
- *Includes installation hardware*
- *Under-mount*
- *Squared bowl(s)*
- *Double (high/low) bowl*
- *29-1/4″ (743 mm) x 15-3/4″ (400 mm)*
- *7-1/2″ (191 mm) deep left bowl and 5-1/2″ (140 mm) deep right bowl (K-3352)*
- *5-1/2″ (140 mm) deep left bowl and 7-1/2″ (191 mm) deep right bowl (K-3352-L)*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.19.3/CSA B45.4*

Colors/Finishes

- NA: None applicable

Accessories

- CP: Polished Chrome
- 0: White
- NA: None applicable
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes
K-3352	Under-mount sink with 7-1/2″ (191 mm) deep left bowl and 5-1/2″ (140 mm) deep right bowl	❑ NA
K-3352-L	Under-mount sink with 5-1/2″ (140 mm) deep left bowl and 7-1/2″ (191 mm) deep right bowl	❑ NA

Optional Accessories			
K-3277	Wire basket (for large bowl)	❑ 0	❑ Other_____
K-3294	Hardwood cutting board (for large bowl)	❑ NA	
K-8801	Duostrainer® sink strainer	❑ CP	❑ Other_____

Product Specification

The under-mount sink shall be 29-1/4″ (743 mm) in length and 15-3/4″ (400 mm) in width. Sink shall be made of 18-gauge stainless steel. Sink shall be double (high/low) squared bowl. Kohler Model K-3352 sink shall have 7-1/2″ (191 mm) deep left bowl and 5-1/2″ (140 mm) deep right bowl. Kohler Model K-3352-L sink shall have 5-1/2″ (140 mm) deep left bowl and 7-1/2″ (191 mm). Sink shall include installation hardware. Sink shall be Kohler Model K-3352-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

UNDERTONE®

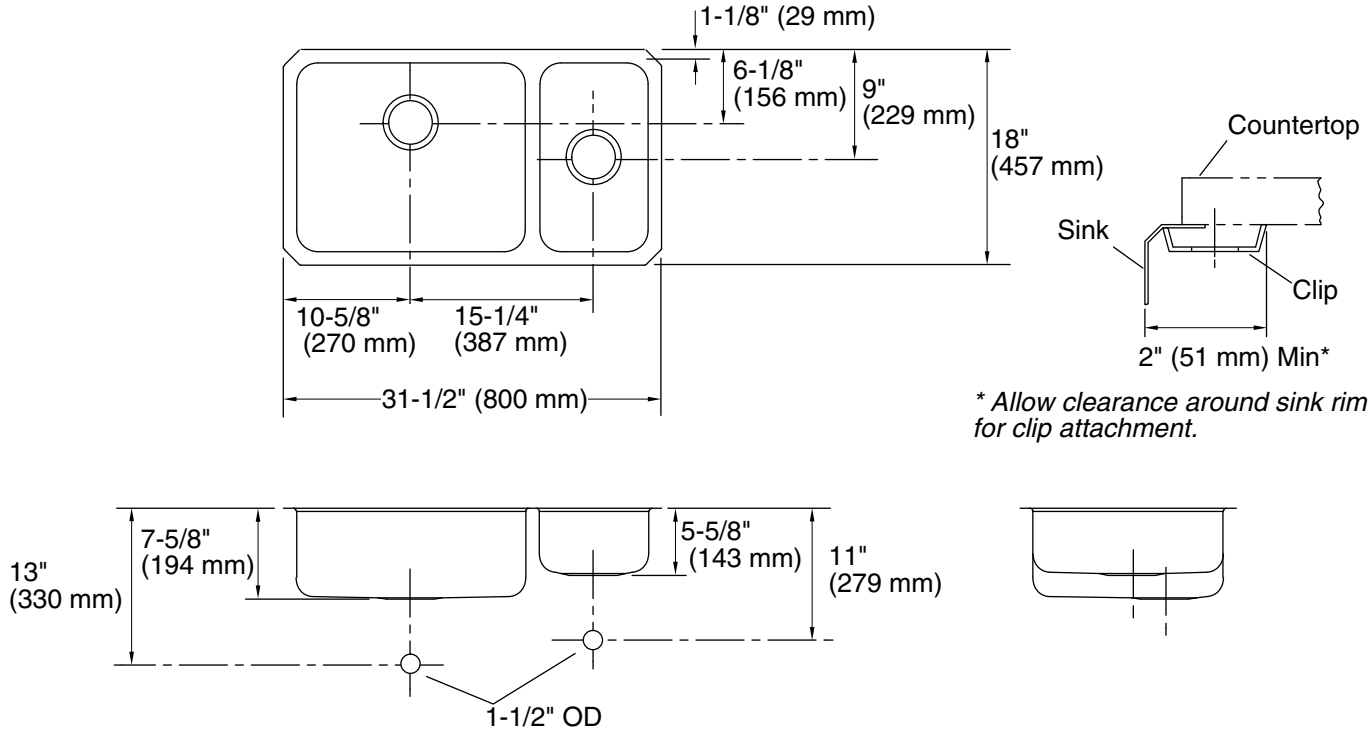
Technical Information

Dimensions shown for K-3352; sink dimensions are opposite for K-3352-L.		
Fixture:*	Bowl area	Water depth
Sink, left	19″ (483 mm) x 16″ (406 mm)	7-1/2″ (191 mm)
Sink, right	9″ (229 mm) x 16″ (406 mm)	5-1/2″ (140 mm)
Drain Holes	Ø 3-5/8″ (92 mm)	
* Approximate measurements for comparison only.		

Included Components:	
Hardware kit (4 required)	91915
Cut-out template	1040556-7

Installation Notes

Install this product according to the installation guide.



Product Diagram

KOHLER® FAUCETS

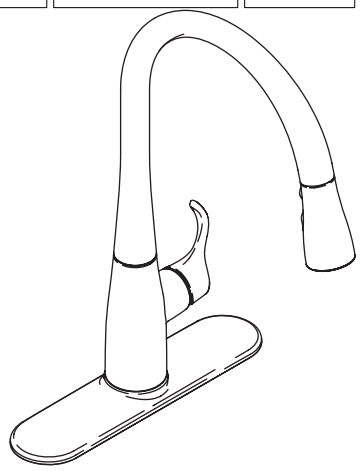
SIMPLICE®

PULL-DOWN KITCHEN SINK FAUCET

K-596

ALSO K-597

ADA | **CSA B651** | **OBC**



Features

- *Metal construction*
- *One-piece, self-contained ceramic disc valve allows both volume and temperature control*
- *Temperature memory allows faucet to be turned on and off at any temperature setting*
- *Touch control for stream-to-spray water flow*
- *Promotion™ technology with nylon hose and ball joint for easy operation*
- *Flexible connections for easy installation*
- *Three-function sprayhead with spray, aerated stream, and pause settings*
- *360° spout rotation*
- *For single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used*
- *Meets CalGreen requirements for kitchen faucets*
- *1.8 gallons (6.8 L) per minute maximum flow rate at 60 psi (4.1 bar)*

Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ICC/ANSI A117.1*
- *CSA B651*
- *OBC*
- *ASME A112.18.1/CSA B125.1*
- *NSF 61*
- *Energy Policy Act of 1992*
- *All applicable US Federal and State material regulations*

Colors/Finishes

- CP: Polished Chrome
- VS: Stainless Steel

Specified Model

Model	Description	Colors/Finishes	
K-596	Pull-down kitchen sink faucet – 9″ (229 mm) swing spout reach (shown)	❑ CP	❑ VS
K-597	Pull-down kitchen sink faucet – 8″ (203 mm) swing spout reach	❑ CP	❑ VS

Product Specification

The kitchen sink faucet shall be of metal construction with a one-piece, self-contained ceramic disc valve, which allows both volume and temperature control. Product shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting. Product shall feature a touch control for stream-to-spray water flow and Promotion technology with nylon hose and ball joint for easy operation. Product shall feature a 360° spout rotation and have flexible connections for easy installation. Product shall be available with a three-function sprayhead with spray, aerated stream, and pause settings. Product shall be for single-hole or three-hole installation when included 10-1/2″ (267 mm) escutcheon plate is used. Product shall be 1.8 gallon (6.8 L) per minute maximum flow rate. Product shall meet CalGreen requirements for kitchen faucets. Product shall be Kohler Model K-____-____.

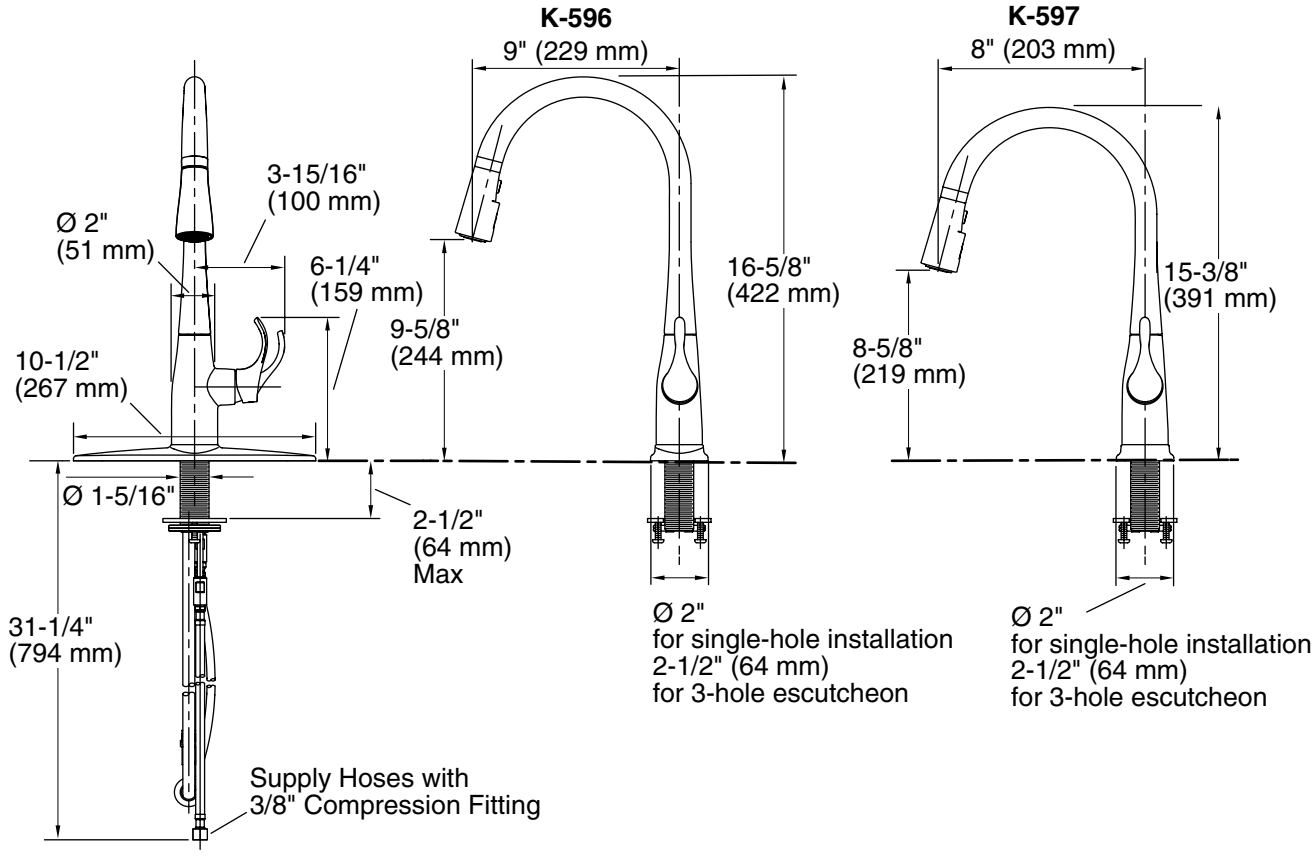
USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Optional Accessories		
1012715	Deep roughing-in kit – provides an additional 2″ (51 mm) assembly depth	❑ NA
1167289	Low flow kit – reduces maximum flow to 1.5 gpm (5.7 L) at 60 psi (4.1 bar)	❑ NA
1167290	High flow kit – increases maximum flow to 2.2 gpm (8.3 L) at 60 psi (4.1 bar)	❑ NA

Installation Notes

Install this product according to the installation guide.

ADA, **CSA B651**, **OBC** compliant when installed to the specific requirements of these regulations.



Product Diagram

THE BOLD LOOK OF KOHLER®

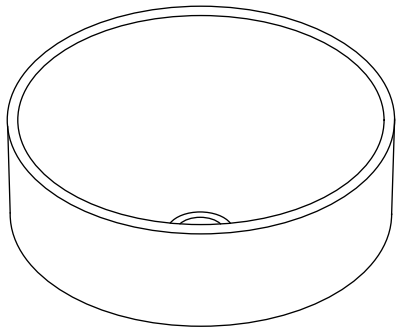
KOHLER®

VOX®

VESSELS BATHROOM SINK
K-14800

Features

- *Vitreous china*
- *Above-the-counter*
- *With overflow*
- *16-1/2″ (419 mm) diameter*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.19.2/CSA B45.1*

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description	Colors/Finishes	
K-14800	Vessels bathroom sink	❑ 0	❑ Other____

Product Specification

The vessels bathroom sink shall be made of vitreous china. Bathroom sink shall be 16-1/2″ (419 mm) in diameter. Bathroom sink shall be for above-the-counter installation and with overflow. Bathroom sink shall be Kohler Model K-14800-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

VOX®

Technical Information

Fixture:*	
Basin area	Ø 15-1/2″ (394 mm)
Water depth	5-3/4″ (146 mm)
Drain hole	Ø 1-3/4″ (44 mm)
* Approximate measurements for comparison only.	

Included components:	
Cut-out template	1144643-7

Installation Notes

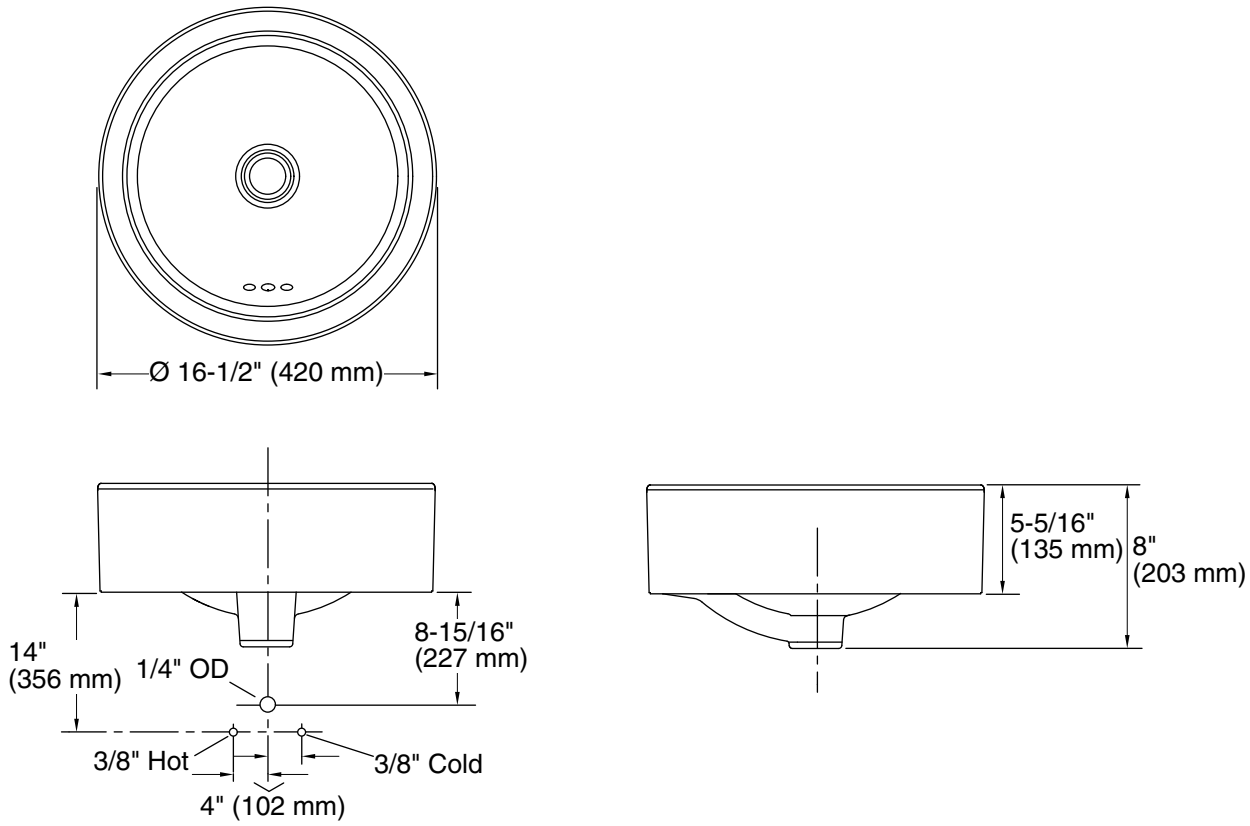
Install this product according to the installation guide.

Choose a faucet that will provide adequate clearance and will direct the water stream to the center of the bathroom sink.

Spout must be mounted high enough to clear 5-5/16″ (135 mm) rim height and provide a 1″ (25 mm) min air gap per ASME A112.1.2.

NOTICE: Countertop manufacturer or cutter must use the cut-out template provided with the product, or a current one provided by Kohler Co. (call 1-800-4KOHLER). Kohler Co. is not responsible for cutout errors when incorrect cut-out template is used.

Product rests on a countertop. Consider height of product when designing installation.



Product Diagram

THE BOLD LOOK OF KOHLER®

SPECIFICATIONS

SIRIUS™ TRIM LINE TWO HANDLE WIDESPREAD LAVATORY FAUCET

Model
D304544 (Replaces D331544 series)

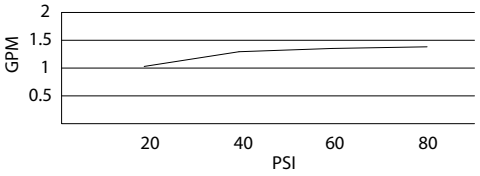
Description
- Ceramic disc valve
- 7 ½" high spout, 5 ½" spout length
- Natural water stream
- Metal touch down drain assembly
- 3 hole mount, 4" - 12" installation

Standards
- NSF 61-9
- Energy Policy Act of 1992

NSF/ANSI 372
- ASME A112.18.1M/A112.18.1
- NSF/ANSI 372
- CSA B125.1

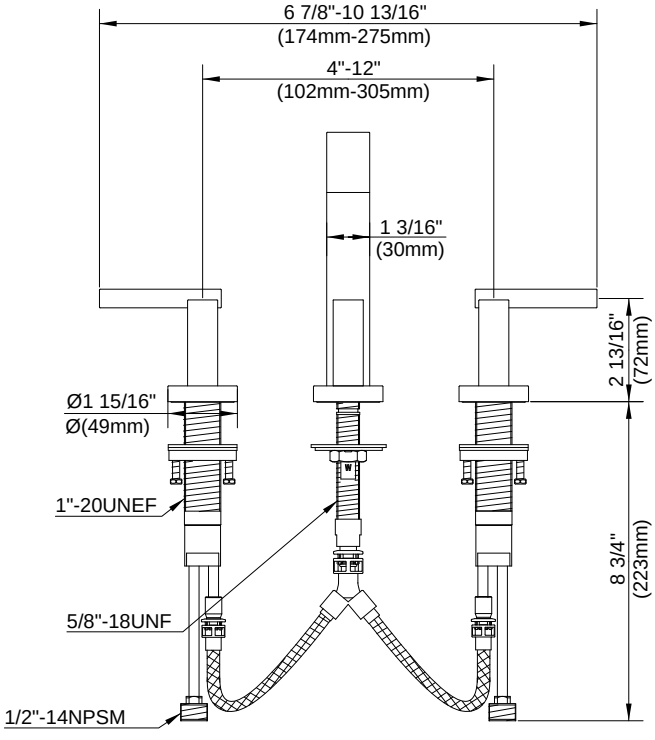
- ADA Accessibility Guidelines for Buildings and Facilities - 4.27.4 Controls and Mechanisms

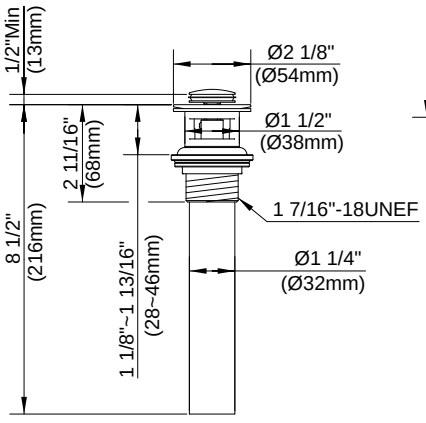
Warranty
Danze products are covered by a manufacturer's limited "lifetime" warranty for manufacturing defects.

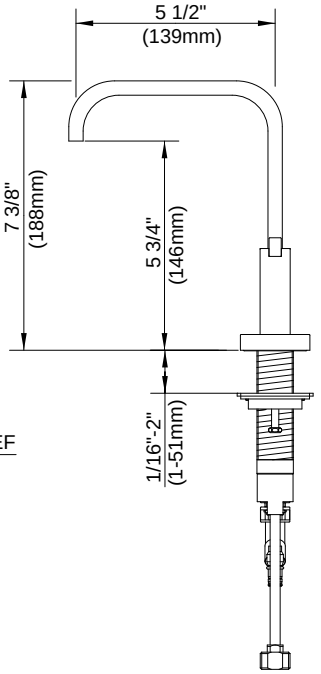
Flow Rate


WaterSense Meets EPA Criteria℠
Certified by IAPMO R&T

Finishes Available
- Chrome
- Other: Refer to Price List for additional finish







Submittal Information:

Job Name: _____ *Location:* _____

Contractor: _____ *Contact #:* _____

caroma®

CI/SfB	(74.1)	g3	
Date	October 2008		

Supersedes all previous issues

Sydney Smart 305 Round Front Plus

2.8.11

1.28/0.8 gpf (4.8/3 l) Water Saving Dual Flush High Efficiency Toilet (HET) Two Piece Ultra Low Flush (ULF) Vitreous China Washdown Toilet

WaterSense℠ Meets EPA Criteria
Certified by IAPMO R&T

HIGH EFFICIENCY TOILET HET

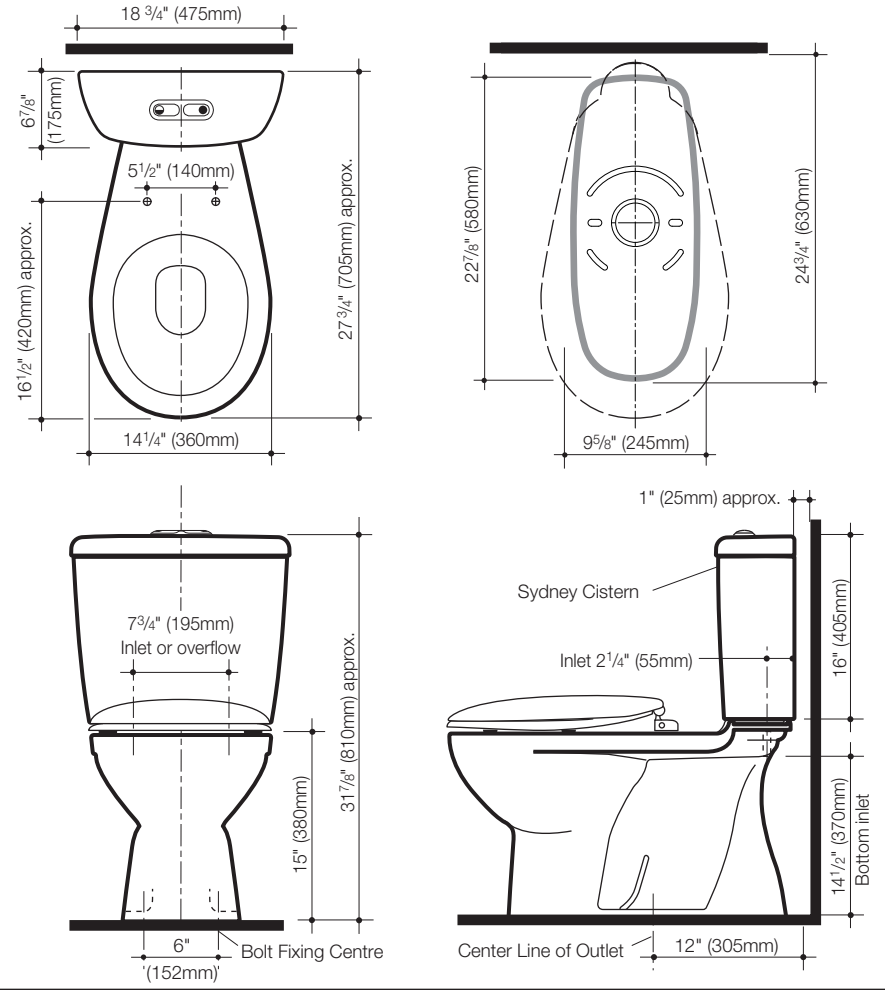
c-UPC®
IAPMO listed for USA & Canada

Sydney Smart 305 Round Front Plus 1.28/0.8 gpf (4.8/3 l) Dual Flush HET

Two Piece Ultra Low Flush (ULF)
Vitreous China Washdown Toilet

A modern concept close coupled washdown **1.28/0.8 gpf (4.8/3 l) Sydney Smart 305** dual flush high efficiency toilet (HET) featuring unique two button activation providing substantial water saving compared to other HET or standard toilets and smooth rounded contours for easy cleaning. The closet bowl has been designed with a 12" (305mm) outlet rough-in. The tank incorporates a high performance outlet valve which has been specially developed with the 305 Round Front Plus bowl to ensure optimum flushing performance. Due to the substantial water saving benefits achieved by the 1.28/0.8 gpf (4.8/3 l) dual flush system, the toilet is suitable for multi-purpose applications where **water conservation** is important.

Closet bowl:	**305 Round Front Plus** 1.28/0.8 gpf (4.8/3 l) full flush washdown closet bowl with open flushing rim.
Outlet:	Floor mounted 305 outlet connection.
Tank:	**Sydney Smart Tank** – has a free fitting lid and is suitable for domestic and light commercial applications. **Vandal Resistant Conversion Kit** – A simple to install conversion is available for the standard mechanism to lock lid onto the tank, recommended for use in heavy duty commercial areas. Code No. 750109.
Weight:	93 lbs (42 kg).
Water Control Valve:	**Standard Bottom Entry Tank** – available as left hand inlet and incorporates a super quiet water control assembly. Internal overflow only.
Fixing:	The tank is fixed directly to the closet bowl with a robust base fixing system without the need for wall fixing.
Seats:	The following Caroma seats are recommended: **Detachable** Code No. 301032, **Easy Closing** Code No. 326222, and **Standard** Code No. 326707.
Colors:	White and biscuit.
Dimensions:	All dimensions are in inches and millimetres and are subject to normal manufacturing variations. Caroma pursues a policy of continuing improvement in design and performance of its products. The right is therefore reserved to vary specifications without notice.



Sydney Smart 305		Code No.
Tank	LH inlet	622322
Bowl		609151A

HIGH EFFICIENCY TOILET HET

c-UPC®
IAPMO listed for USA & Canada

WaterSense Meets EPA Criteria
Certified by IAPMO R&T

Note: All height dimensions to underside of closet bowl. Make allowance for bedding.

Closet bowl fixing: The closet bowl should be bedded with an approved silicon caulking.

STERLING®

A KOHLER® COMPANY

ENSEMBLE™

60″ (1524 mm) SHOWER BASE AND WALL SURROUND

72130100

ALSO 72230100

VIKRELL®

MATERIAL STRENGTH. PROVEN PERFORMANCE.™

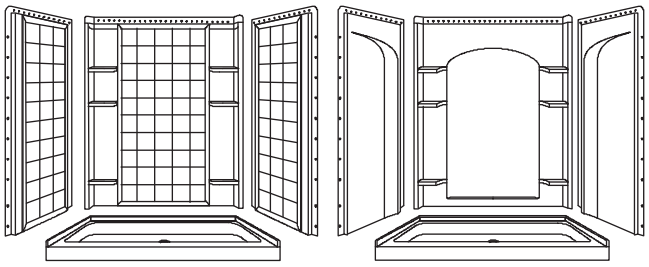
Features

- *Compression molded from our exclusive solid Vikrell® material*
- *Tongue-and-groove 4-piece modular design allows for easy "snap together" installation*
- *Convenient shelves provide generous storage*
- *Shaving ledge and foot rest added for comfort*
- *Shower base can be ordered separately*
- *Durable high-gloss finish*
- *10-year consumer/3-year commercial limited warranty*
- *60-1/4″ (1530 mm) x 35-1/4″ (895 mm) x 77″ (1956 mm) unit rough-in dimensions include nailing flange*
- *60″ (1524 mm) x 34″ (864 mm) x 75-3/4″ (1924 mm) complete unit finished dimensions*

Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASTM E162*
- *ASTM E662*
- *CSA B45.5/IAPMO Z124*



72130100 **72230100**

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Complete Unit Description	Colors/Finishes	
72130100	60″ (1524 mm) shower base and wall surround, tile wall	❑ 0	❑ Other_____
72230100	60″ (1524 mm) shower base and wall surround, curve wall	❑ 0	❑ Other_____

Model	Wall Component Description	Colors/Finishes	
72132100	Back wall, tile	❑ 0	❑ Other_____
72105100	End wall set, tile	❑ 0	❑ Other_____
72232100	Back wall, curve	❑ 0	❑ Other_____
72205100	End wall set, curve	❑ 0	❑ Other_____

Technical Information

Model	Door maximum width	Door maximum height
72130100 72230100	56-5/8″ (1438 mm)	70-1/2″ (1791 mm)

Installation Notes

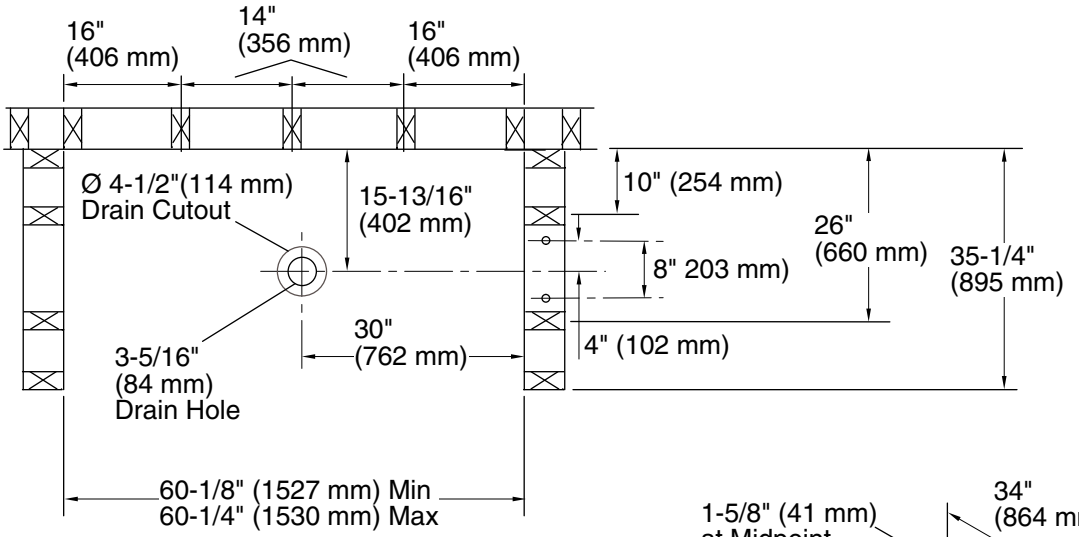
Install this product according to the installation guide.

Size the drain cutout to fit the drain assembly that will be used.

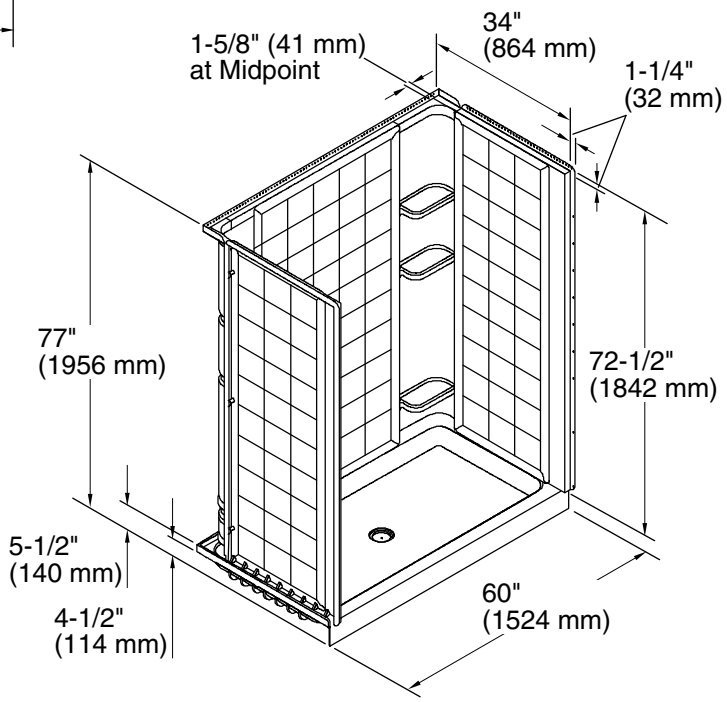
Double studding is recommended for pivot shower door installations.

Studs should be positioned as shown.

Both tile and curve wall surrounds share the same dimensions.



72130100



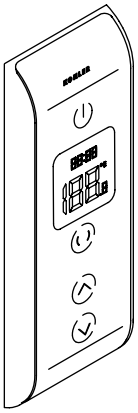
Product Diagram

KOHLER®

DTV PROMPT™ DIGITAL SHOWER INTERFACE
K-527

Features

- *Digitally controlled*
- *High-temperature limit setting for added safety*
- *Mounts on finished wall surface*
- *One touch control of 2 valve outlets*
- *Interface includes a 20 ft (6.1 m) cable*
- *Low profile design*
- *Selectable water-saving functionality*
- *Selectable Fahrenheit or Celsius*
- *Selectable outlet delivery*



Codes/Standards Applicable

Specified model meets or exceeds the following:

- *FCC Part 15*
- *UL 1951*

Colors/Finishes

- 1CP: Complements Chrome Finishes
- 1SN: Complements Nickel Finishes
- 0: White
- 7: Black Black™

Accessories

- NA: None applicable

Specified Model

Model	Description	Colors/Finishes			
K-527	DTV Prompt™ digital shower interface	❑ 1CP	❑ 1SN	❑ 0	❑ 7

Required Accessories		
K-528-K	Thermostatic valve	❑ NA

Product Specification

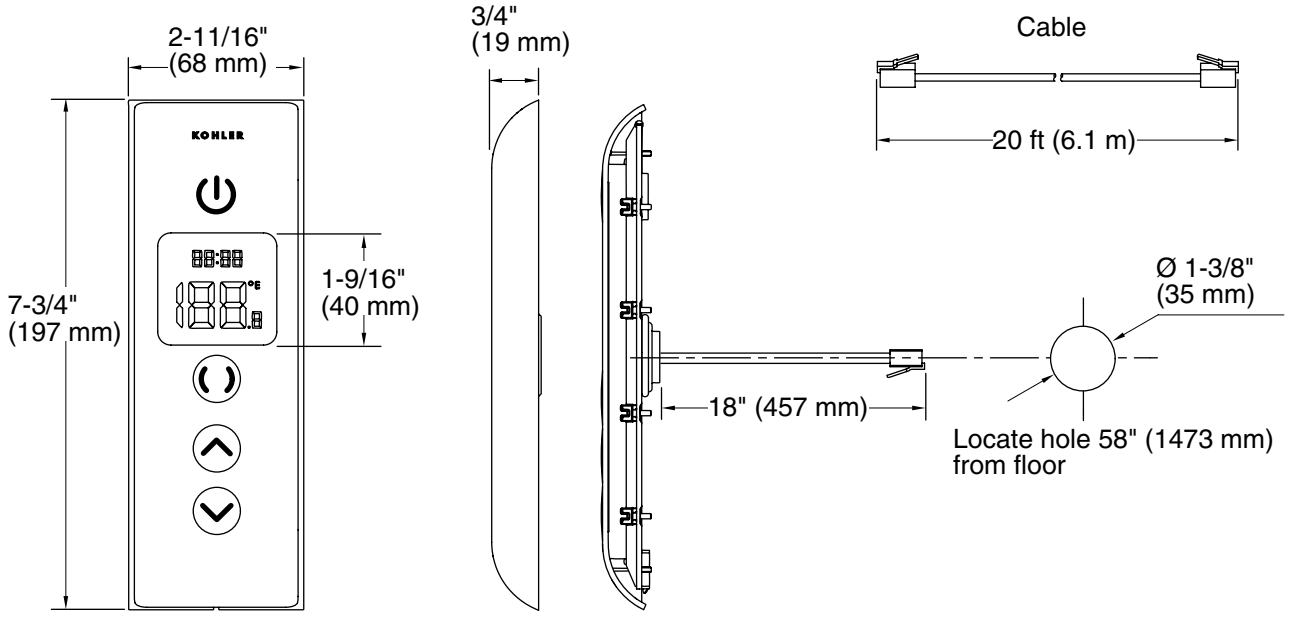
The digital interface shall mount on finished wall surface. Product shall be digitally controlled. Product shall include a high-temperature limit setting for added safety. Product shall feature one touch control of 2 valve outlets. An interface includes a 20 ft (6.1 m) cable, and low profile design. Product shall have selectable water-saving functionality and selectable outlet delivery. Product shall have selectable Fahrenheit or Celsius. Product shall be Kohler Model K-527-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

Installation Notes

Install this product according to the installation guide.

Recommended install height 58″ (1473 mm) from floor to center of interface.



Product Diagram

THE BOLD LOOK OF KOHLER®

KOHLER® FAUCETS

PURIST®

MULTI-FUNCTION SHOWERHEAD
K-997

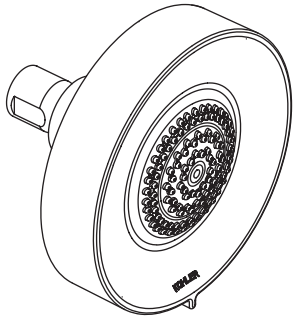
Features

- *3-function showerhead with wide coverage, medium coverage, and concentrated spray options*
- *1.75 gpm (6.6 L) per minute flow rate*
- *5-1/2″ (14 cm) diameter showerhead*
- *Complements Purist® Suite*
- *MasterClean™ spray nozzles to prohibit mineral build-up for easy cleaning*
- *1/2″ - 14 NPT connection*

Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ASME A112.18.1/CSA B125.1*
- *EPA WaterSense®*



Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Accessories

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

Model	Description		
K-997	Multi-function showerhead	❑ CP	❑ Other ____

Recommended Accessories			
K-7397	Shower arm and flange – 7-1/2″ (13.7 cm) length, 1/2″ NPT	❑ CP	❑ Other ____

Product Specification

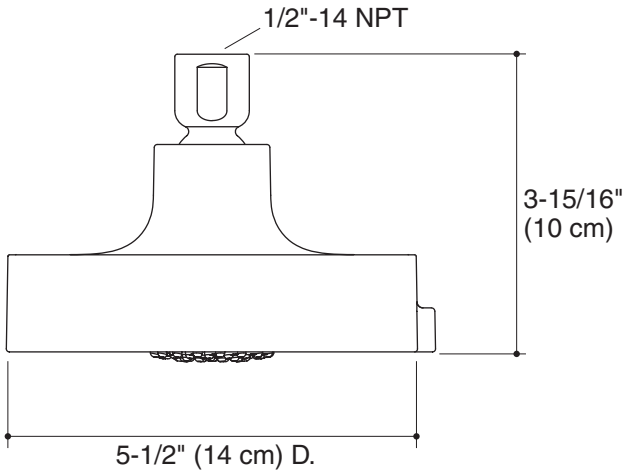
The showerhead shall feature a Masterclean sprayface nozzles to prohibit mineral build-up for easy cleaning. Showerhead shall have a 5-1/2″ (14 cm) diameter showerhead and a 1/2″-14 NPT connection. Showerhead shall feature a 1.75 gpm (6.6 L) per minute flow rate. Showerhead shall be available with a 3-function showerhead with wide coverage, medium coverage and concentrated spray options. Showerhead shall complement Purist suite. Multi-function showerhead shall be Kohler Model K-997-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

PURIST®

Installation Notes

Install this product according to the installation guide.



Product Diagram

THE BOLD LOOK OF KOHLER®

WhisperRecessed™ VENTILATION FAN

FV-08VRL1

Specification Submittal Data / Panasonic Ventilation Fan

Description

Ventilation fan/light shall be low sone ceiling mount rated for continuous run. Fan shall be ENERGY STAR® rated and certified by the Home Ventilating Institute (HVI). Fan shall include energy efficient compact fluorescent lighting. Evaluated by Underwriters Laboratories and conform to both UL and cUL safety standards.

Motor/Blower:

- Four–pole fully enclosed condenser motor rated for continuous operation.
- Power rating shall be 120 volts and 60 Hz.
- Fan shall be UL listed for tub/shower enclosure when used with a GFCI branch circuit wiring and use in insulated ceiling (TYPE I.C.).
- Motor equipped with thermal–cutoff fuse.
- Removable, permanently lubricated, plug–in motor.

Housing:

- Rust proof paint, galvanized steel body.
- Detachable dual 4" or 6" diameter duct adapter.
- Built in backdraft damper.
- Expandable extension bracket up to 24".
- Double hanger bar system allowing for ideal positioning.

Grille:

- Attractive design using PP material.
- Attaches directly to housing with torsion springs.

Light:

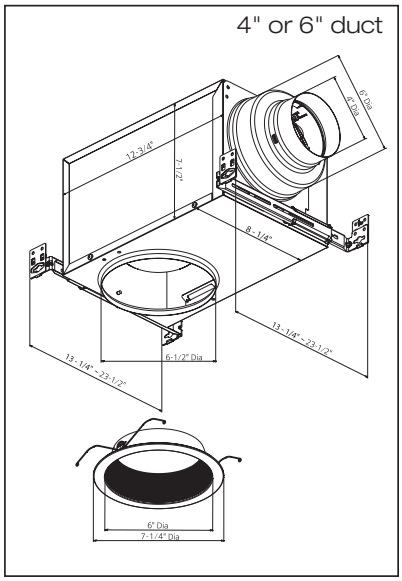
- One 18-Watt electronic ballast GU24 spiral compact fluorescent lamp included.
- FCC Part 18 compliant.

Warranty:

- ALL Parts: 3 Years from original purchase date. CFL: 10,000 hours.

Architectural Specifications:

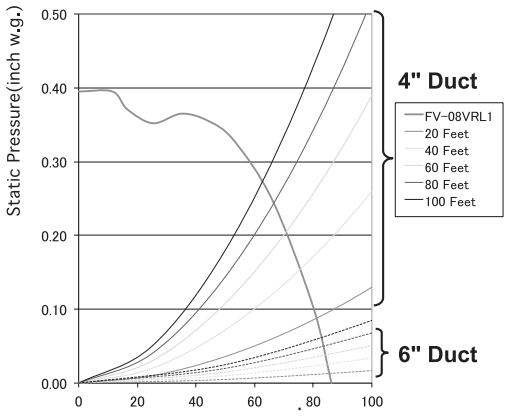
Ventilation fan and light combination shall be ceiling mount, ENERGY STAR rated type, with no less than 80 CFM and no more than 0.8 sone as certified by the Home Ventilating Institute (HVI) at 0.1 w.g. with no less than 66 CFM and no more than 0.7 sone at .25 w.g. Power consumption shall be no greater than 20.5 watts at 0.1 w.g. and 19.5 Watts at 0.25 w.g. ENERGY STAR rated with efficiency of no less than 4 CFM/watt at 0.1 w.g. and than 3.4 CFM/watt at 0.25 w.g. The motor shall be fully enclosed, four pole condenser type engineered to operate continuously for no less than 30,000 hours. Power rating shall be 120v/60Hz. Duct diameter shall be no less than 4", inclusive of a detachable dual 4" or 6" duct adapter. Fan shall be UL and cUL listed for tub/shower enclosure when used with GFCI branch circuit wiring. Fan can be used to comply with ASHRAE 62.2, LEED, ENERGY STAR IAP, EarthCraft, California Title-24, WA Ventilation Code. Lamp shall be one 18-Watt energy efficient, GU24 spiral compact fluorescent incorporating integral electronic ballast.



FV-08VRL1

Specifications: **WhisperRecessed** FV-08VRL1	**4" or 6" Duct**	
Static Pressure in inches w.g.	0.1	0.25
Air Volume (CFM)	80	66
Noise (sones)	0.8	0.7
Power Consumption (watts)	20.5	19.5
Energy Efficiency (CFM/Watt)	4.0	3.4
Speed (RPM)	1378	1501
Power Rating (V/Hz)	120/60	
ENERGY STAR rated	YES	

Performance Curve 4" or 6" duct



For complete Installation Instructions visit **www.panasonic.com/building**

Model	Quantity	Comments	Project:
			Location:
			Architect:
			Engineer:
			Contractor:
			Submitted by:
			Date:

Panasonic Eco Solutions North America
Eco Products Divsion
One Panasonic Way
Secaucus, NJ 07094

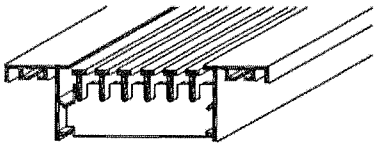
www.panasonic.com/building

Panasonic ideas for life

Linear Bar Diffusers
Aluminum • Fixed Bars

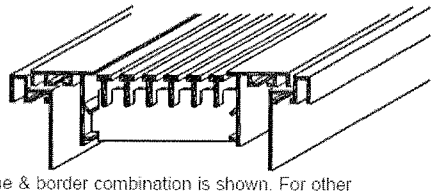
Models: CT-480 • 1/4" Spacing • 1/8" Bars • 0° Deflection
CT-481 • 1/4" Spacing • 1/8" Bars • 15° Deflection
CT-580 • 1/2" Spacing • 1/8" Bars • 0° Deflection
CT-581 • 1/2" Spacing • 1/8" Bars • 15° Deflection
CT-540 • 1/2" Spacing • 1/4" Bars • 0° Deflection
CT-541 • 1/2" Spacing • 1/4" Bars • 15° Deflection

Core with Border



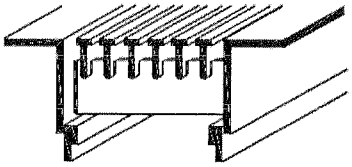
Type 13 border is shown. For other available types, please see next page.

Core with Frame & Border



Type 1A frame & border combination is shown. For other available types, please see next page.

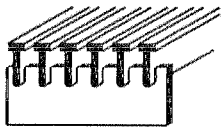
Core with Heavy Duty Mounting Frame for Floor Applications



Type 5 heavy duty mounting frame is shown. For other available types, please see next page.

Core is always furnished with Type H additional reinforcing.

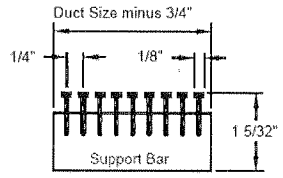
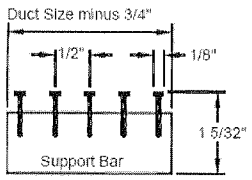
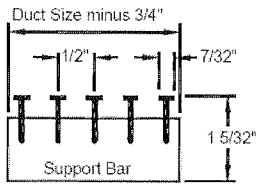
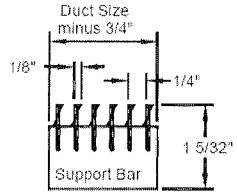
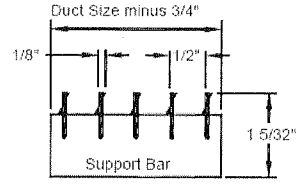
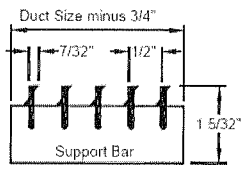
Core only



Model CT-540 core is shown. For other available models, please see below.

Available Cores

Check ☐ selection

1/4" Spacing	1/2" Spacing	
1/8" Bars	1/8" Bars	1/4" Bars
☐ Model CT-480 • 0° Deflection 	☐ Model CT-580 • 0° Deflection † 	☐ Model CT-540 • 0° Deflection † 
☐ Model CT-481 • 15° Deflection 	☐ Model CT-581 • 15° Deflection † 	☐ Model CT-541 • 15° Deflection † 

All dimensions are in inches.

† **NOTE:** Not recommended for floor applications with heavy loads or high traffic.

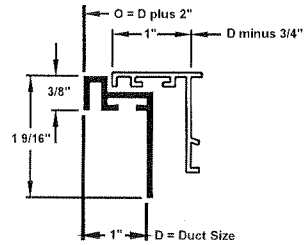
Note: If placing furniture on cores, furniture legs should be a minimum of core spacing plus two bars wide to avoid placing a horizontal load on core.

D-4.0-S

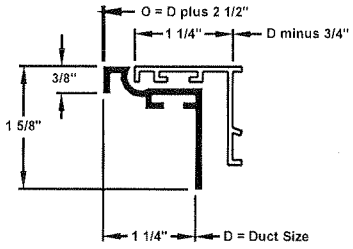
(Please see reverse side.)

Frame & Border Types • Dimensions Check ☑ if provided.

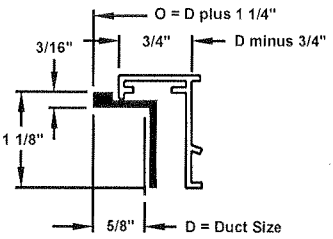
☐ Frame & Border Type 1A • 1" Border



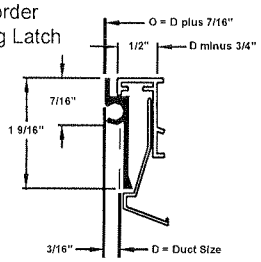
☐ Frame & Border Type 1B • 1 ¼" Border



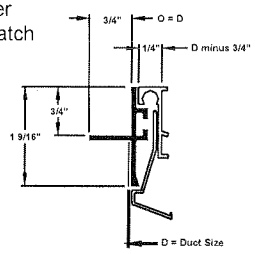
☐ Frame & Border Type 2 • ¾" Border



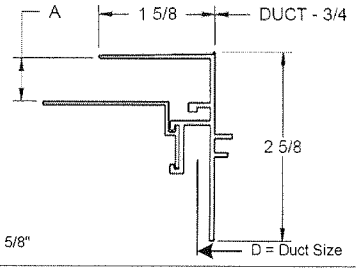
☐ Frame & Border Type 3
• ½" Border
• Spring Latch



☐ Frame & Border Type 4
• ¼" Border
• Spring Latch

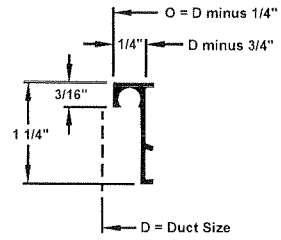


☐ Border Type 22 Tape & Spackle

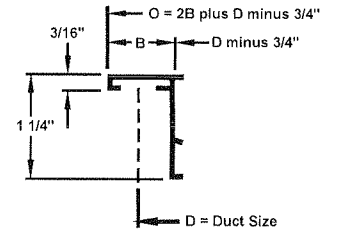


Border Types • Dimensions Check ☑ if provided.

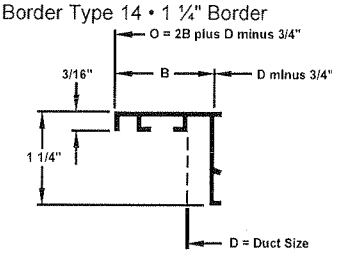
☐ Border Type 7 • ¼" Border



☐ Border Type 11 • ½" Border
☐ Border Type 12 • ¾" Border



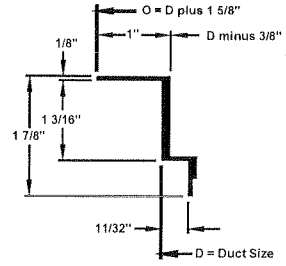
☐ Border Type 13 • 1" Border
☐ Border Type 14 • 1 ¼" Border



Heavy Duty Mounting Frames for Floor Applications Check ☑ if provided.

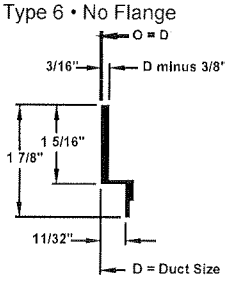
(See submittal D-CT-HD for loading limitations.)

☐ Frame Type 5 • 1" Flange



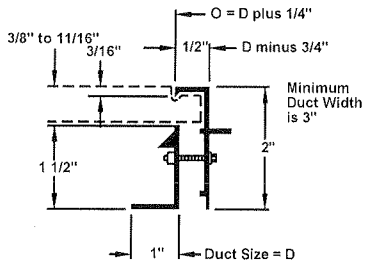
Removable core is furnished with frame. See front page for core selections. When spring clip is furnished, add an additional ¼" to duct width.

☐ Frame Type 6 • No Flange



Removable core is furnished with frame. See front page for core selections. When spring clip is furnished, add an additional 1/4" to duct width.

☐ Frame Type 15 • Carpet Clamp Flange

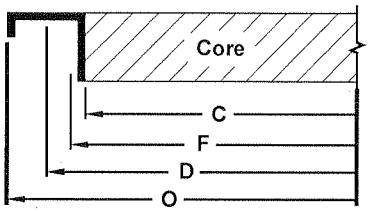


Removable core is always furnished with H reinforcing. See front page for core selections. (Frame 15 is not available for CT480/481).

Core Only (No Frame, No Border) ☐ Type CO

Overall Length and Widths for Various Frame & Border Types

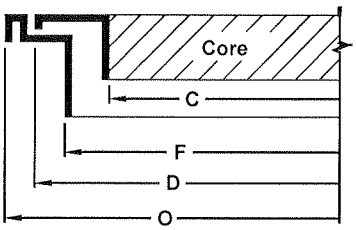
Border Types
(Type 11 shown)



Type	F Border Length	O Overall Length	C Core Opening Length
5	D	D plus 1 5/8	D minus 3/8
6	D	D	D minus 3/8
7	D minus 5/8	D minus ¼	D minus ¾
11	D minus 5/8	D plus ¼	D minus ¾
12	D minus 5/8	D plus ¾	D minus ¾
13	D minus 5/8	D plus 1 ¼	D minus ¾
14	D minus 5/8	D plus 1 ¾	D minus ¾
22	D minus 5/8	D plus 2 ½	D minus ¾

Dimensions are for length or width.

Frame & Border Types
(Type 1A & 1B shown)



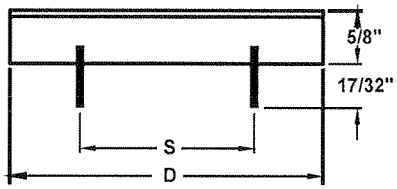
Type	F Border Length	O Overall Length	C Core Opening Length
1A	D	D plus 2	D minus ¾
1B	D	D plus 2 ½	D minus ¾
2	D	D plus 1 ¼	D minus ¾
3	D	D plus 7/16	D minus ¾
4	D	D	D minus ¾
15	D	D plus ¼	D minus ¾

Dimensions are for length or width.

Standard Core Width Information

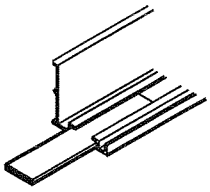
Duct Size	¼" Spacing		½" or 7/16" Spacing	
D	Core Opening C	Number of Bars	Core Opening C	Number of Bars
2	1 ¼	3	1 ¼	2
2 ½	1 ¾	5	1 ¾	3
3	2 ¼	7	2 ¼	4
3 ½	2 ¾	9	2 ¾	5
4	3 ¼	11	3 ¼	6
5	4 ¼	15	4 ¼	8
6	5 ¼	19	5 ¼	10

Core Only



S=9" Maximum Support Bar Spacing. D=72" Maximum for One Piece. Core Only is an option available for field framing. Standard widths are as shown. Core will ship 3/4" smaller than the duct width.

Alignment Strips

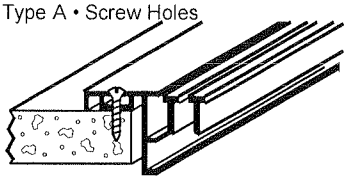


Used with border width 1/2" or wider. Alignment pins used with 1/4" borders.

Available Fastenings

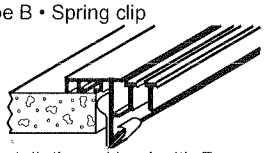
Check ☑ if provided.

☐ Type A • Screw Holes



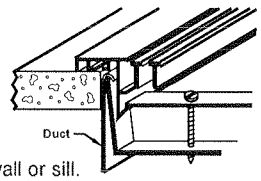
For ceiling, side wall or sill.
Used with Frame & Border Types 1B, 5, 11, 12, 13, 14.

☐ Type B • Spring clip



For sill installations. Used with Frame & Border Types 7, 11, 12, 13, 14.
Must use AG-35B instead of AG-35 with Type B fastening. Sill opening size must be slightly larger to accommodate spring clips.

☐ Type C • Concealed Fastening



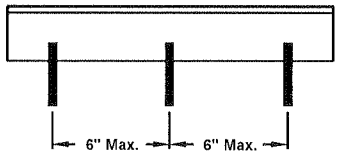
For ceiling, side wall or sill.
Used with Frame & Border Types 1A, 1B, 2, 7, 11, 12, 13, 14, & Border Type 22

"C" fastening in not available on models CT480/481

Additional Reinforcing (optional)

Check ☑ if provided.

☐ Type H • Optional Heavy Duty Core
• Standard with Heavy Duty Mounting Frame Types 5, 6, 15

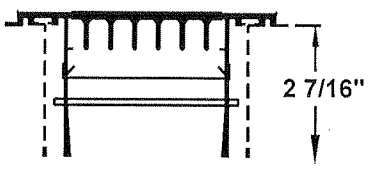


Optional Heavy Duty Core has support bars on 6" maximum centers. (Standard core has 9" maximum centers.) See Submittal CT-HD for maximum loading.

All dimensions are in inches.

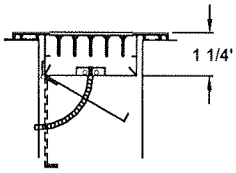
Additional Reinforcing (optional) Check ☑ if provided.

☐ Model 07 Directional Blades



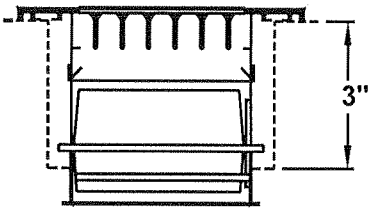
For all widths of Model CT diffusers 3" or greater. Cannot be attached to Frame & Border Types 3 and 4. Can be used with Type 5, 6, 15 if Type B Spring Clip Fastening is omitted.

☐ Model AG-30 Single Blade Damper



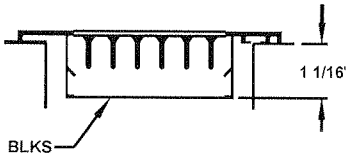
For Model CT diffuser widths 11/2 through 4". Friction hinge on 11/2" and 2" widths. Screwdriver operator on 21/2" through 4 ". Cannot be attached to Frame & Border Types 3, 4, 5, 6 or 15. For those types use Model AG-35B damper on diffusers 3" and wider.

☐ Model AG-35 Opposed Damper



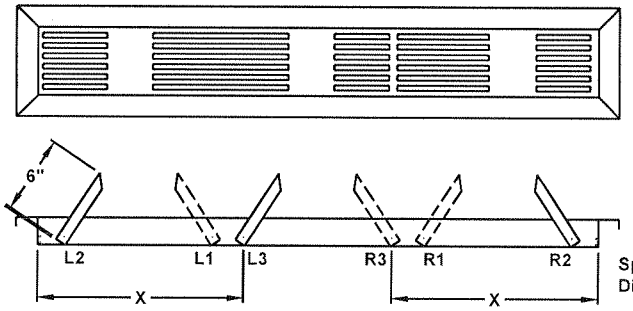
For Model CT diffusers 3" and wider. Cannot be attached to Frame & Border Types 3 and 4. Use Model AG-35 B damper for those types. Note: Minimum duct width is 3".

☐ Model BLKS Steel Blank-Off



For all widths of Model CT diffusers. Furnished in 6 foot lengths for field cutting and installation. Steel, painted flat black.

☐ Model AD Access Door (Not available on Types 3, 4 5, 6, 15 and 22)



Note: Maximum Length is 6 Feet

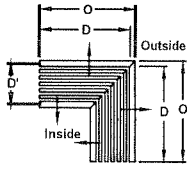
Specify Dimension X

Optional Mitered Corners

☐ MC-480 • 1/4" Spacing • 1/8" Bars • 0° Deflection
☐ MC-481 • 1/4" Spacing • 1/8" Bars • 15° Deflection

☐ MC-580 • 1/2" Spacing • 1/8" Bars • 0° Deflection
☐ MC-581 • 1/2" Spacing • 1/8" Bars • 15° Deflection

☐ MC-540 • 1/2" Spacing • 1/4" Bars • 0° Deflection
☐ MC-541 • 1/2" Spacing • 1/4" Bars • 15° Deflection

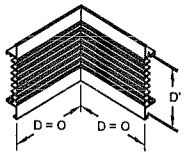


Floor, Ceiling or Sill

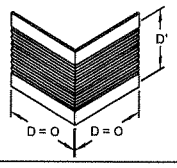
☐ Type O • 0° Deflection

☐ Type A • Deflection Inside

☐ Type B • Deflection Outside



☐ Type C • Side Wall, Inside



☐ Type D • Side Wall, Outside

Duct Width D'	Duct Length D	Frame & Border Type													
		1A	1B	2	3	4	5	6	7	11	12	13	14	15	CO
2 - 4	12	12 15/16	13 3/16	12 5/8	12 3/16	12	12 13/16	12	11 7/8	12 1/8	12 3/8	12 5/8	12 7/8	12 1/8	12
4 ½ - 6	18	18 15/16	19 3/16	18 5/8	18 3/16	18	18 13/16	18	17 7/8	18 1/8	18 3/8	18 5/8	18 7/8	18 1/8	18

Standard Finish: #26 White

General Description

- TITUS linear bar diffusers are designed for both supply and return applications.
- Standard lengths are 1, 2, 3, 4, 5 and 6 feet, furnished as complete, welded assemblies.
- Lengths greater than 6 feet are furnished in multiple sections, the number and size determined by the factory.
- Sections can be joined end-to-end for continuous appearance, using standard alignment strips or alignment pins.
- All deflection bars are fixed and are parallel to the long dimension.
- Fixed Bars are extruded aluminum.
- Border Types 5, 6 and 15 are the only frame styles available for floor applications.

This submittal is meant to demonstrate general dimensions of this product. The drawings are not meant to detail every aspect of the product. Drawings are not to scale. Titus reserves the right to make changes without written notice.

JVE40ST
GE® 30" ENERGY STAR® Qualified Ventilation Hood

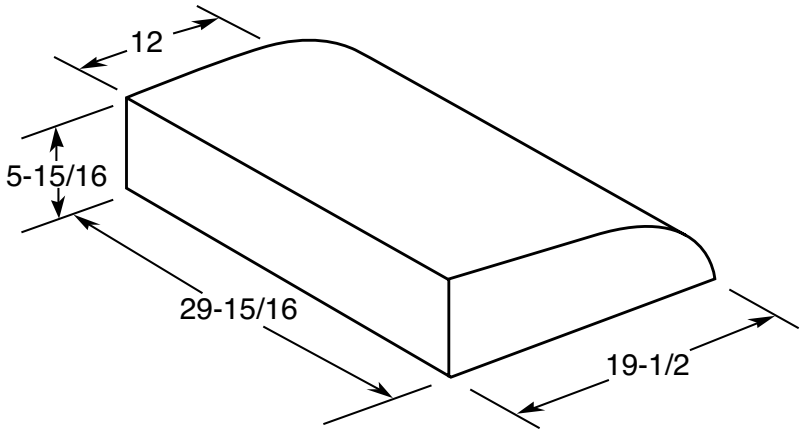
Dimensions and Installation Information (in inches)

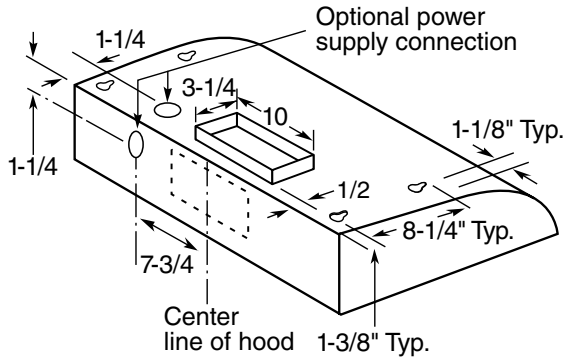
Amp Rating	
120V	1.0

WB02X11537 replacement grease filter and WB02X11000 replacement charcoal filter are available for additional cost. Call toll-free 800.626.2000.

JXHC1 Cord Kit: Allows a receptacle in the cabinet over the range to accommodate either an over-the-range microwave oven or a standard hood.

Installation Information: Before installing, consult installation instructions,packed with product, for current dimensional data.





Exhaust outlet connects to 3-1/4" x 10" rectangular duct. Vent top or rear. Includes rectangular damper.

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000

imagination at work

ENERGY STAR

Listed by Underwriters Laboratories

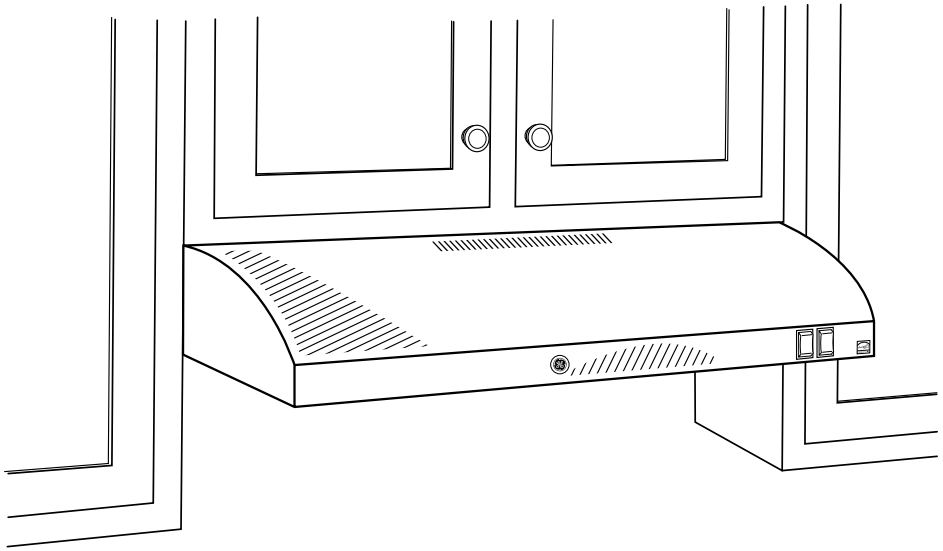
TESTED/CERTIFIED 2100 HVI Home Ventilating Institute

Specification Revised 11/11 321455

JVE40ST
GE® 30" ENERGY STAR® Qualified Ventilation Hood

Features and Benefits

- ENERGY STAR qualified - Meets or exceeds federal guidelines for energy efficiency for year-round energy and money savings
- Convertible venting - Hood designed to accommodate a vented configuration, which channels exhaust outside of the home, or a non-vented configuration, which filters and returns the air into the kitchen
- Vertical and rear exhaust - Hood design gives installers total flexibility to connect the exhaust vent to your home's duct work from either the top or rear of the unit
- 2 Fan Speed Selections
- Cooktop light - Enjoy the convenience of light under the hood to help you better see your cooking surface
- Removable grease filter - Durable grease filter collects the grease that builds up from cooking and removes quickly and easily for cleaning
- Rectangular ducting - Designed to fit standard rectangular duct work for quick and simple installation
- Rectangular damper included - Included damper keeps the vent sealed when it is not in use, so your home's heat doesn't escape
- Model JVE40STSS – Stainless steel



CFM/Sones Ratings	
Rear Exhaust High Speed (HS)	240/5.5
Rear Exhaust Working Speed (WS)	120/1.2
Top Exhaust (HS)	210/6.0
Top Exhaust (WS)	110/1.3

*Not ENERGY STAR qualified if hood is installed in a non-vented configuration

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at geappliances.com or call GE Answer Center® service, 800.626.2000

imagination at work

Specification Revised 11/11 321455

Fantech

Heat Recovery Ventilator

SH704

S = Side discharge
H = Heat recovery
704 = 70cfm, 4 port design

Compact HRV with easy-mount wall bracket. Brings a continuous supply of fresh air into a home while exhausting an equal amount of contaminated air. HRVs use what is called a "sensible" heat recovery core. This special core transfers heat from the exhaust air stream to the incoming air stream. Fresh incoming air is tempered by the heat that is transferred from the outgoing air to save on energy costs. The SH704 is equipped with automatic defrost mechanisms so even if you live in the coldest climates you can use your HRV all year long.

FEATURES

- Super Compact Size
- Includes Easy-Mount Wall Bracket
- Aluminum Heat Recovery Core
- 4˝ (100mm) Duct Connections
- No Balancing Required
- Easy Access Service Door
- 3' (914mm) Plug-in Power Cord
- Automatic Exhaust Defrost Allows Units to Always Stay in Ventilation Mode
- Only 25 lbs (11 kg)
- Electrostatic Filters (washable)
- Easy Core Guide Channels For Removing Core
- Single Speed Ventilation

ACCESSORIES

- FDT 7 – 7 Day Digital Programmable Timer
- COM 4P – 4˝ Weather Hoods (1 supply & 1 exhaust)
- FEL 4 – 4˝ 90° Elbow
- CG 4 – 4˝ Adjustable Grille

Distributed by:

SPECIFICATIONS

CASE 24 gauge galvanized steel. Baked powder coated paint, antique white. Cabinet fully insulated with 1" (25 mm) aluminum foil-face high density polystyrene foam to prevent condensation and meet the requirements of the UL 94HF.

MOTORS Two (2) German-manufactured, factory-balanced ebm™ motors with backward curved blades. Motors come with permanently lubricated sealed ball bearings guarantee long life and maintenance-free operation. Seven (7) year warranty. Steep fan curves requires no balancing of airflows.

CORE Aluminum heat recovery core configured for efficient cross-flow ventilation. Core is 8.5˝ x 8.5˝ (216 x 216mm) with a 8˝ (203mm) depth. Cores are manufactured by Fantech to withstand extreme temperature variations.

FILTERS Two (2) Washable Electrostatic Panel Type Air Filters, 8.5˝ (216mm) x 8˝ (203mm) x 0.125˝ (3mm).

CONTROLS Unit is designed to operate continuously on a single speed. See FDT 7 under accessories or contact Tech Support for possible intermittent, line-voltage options.

DEFROST The automatic defrost cycle consists of a fan shutdown. When the supply air stream temperature goes below 23°F (-5°C), the supply motor shuts down while the exhaust motor continues to ventilate. Ambient air is passed through the unit for a period of 3 or 5 minutes. (see chart below) The supply motor will then re-start and run at the preset speed. This fan shutdown defrost cycle continues until the supply air stream rises above 23°F (-5°C).

Temperature range °F (°C)	Run/Defrost cycle (minutes)
23 (-5) to 14 (-10)	40 / 3
14 (-10) to 5 (-15)	30 / 5
5 (-15) & lower	20 / 5

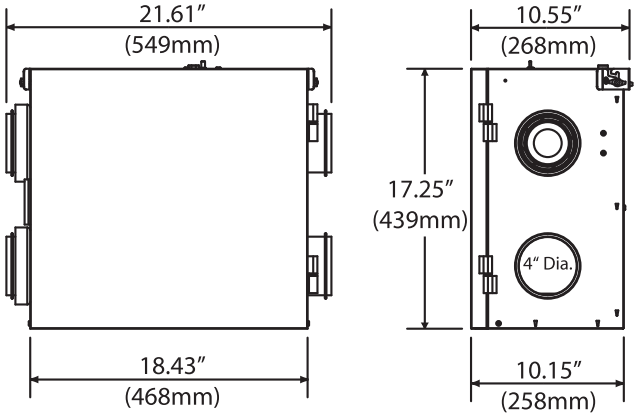
SERVICEABILITY Core, filters, motors and drain pan can be easily accessed through latched door. Core conveniently slides out on our new easy glide core guides. 10˝ (250mm) of clearance is recommended for removal of core.

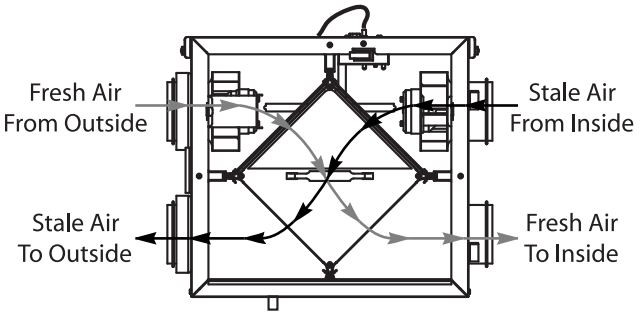
DUCT CONNECTION 4˝ (100mm) steel duct connections with rubber gasket for easy sealing.

DRAIN 1/2˝ (13mm) OD (outside diameter) drain spout (provided), and the entire bottom of unit covered by pan.

WARRANTY Limited lifetime on aluminum core, 7 years on motors, and 5 years on parts.

Dimensions & Airflow - All units feature three foot plug-in power cord with 3-prong plug.

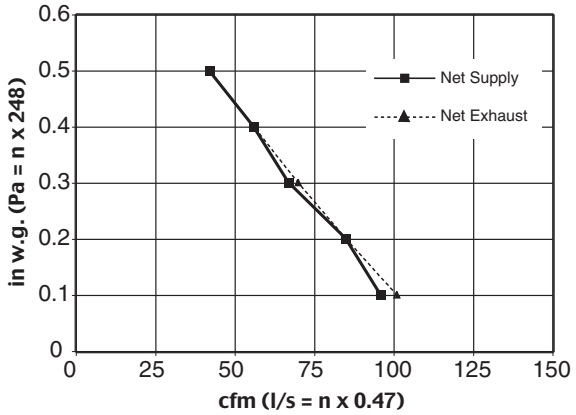




- Continuous ventilation mode of supply and exhaust airstreams
- 10″ (254mm) of clearance is recommended for removal of core

Ventilation Performance

EXT. STATIC PRESSURE		NET SUPPLY AIR FLOW		GROSS AIR FLOW SUPPLY		GROSS AIR FLOW EXHAUST	
Pa	in wg	L/s	cfm	L/s	cfm	L/s	cfm
25	0.1	45	96	47	99	49	104
50	0.2	40	85	41	88	41	88
75	0.3	32	67	33	69	34	72
100	0.4	26	56	27	58	28	58
125	0.5	20	42	20	43	20	43



Energy Performance

	SUPPLY TEMPERATURE		NET AIRFLOW		POWER CONSUMED WATTS	SENSIBLE RECOVERY EFFICIENCY	APPARENT SENSIBLE EFFECTIVENESS	LATENT RECOVERY/MOISTURE TRANSFER
	˚C	˚F	L/s	cfm				
Heating	0	32	26	55	36	57	67	–
	0	32	32	68	40	55	63	–
	0	32	39	83	40	54	60	–
	-25	-13	34	72	35	53	66	–

Specifications and Ratings

- Model: SH704
- Total assembled weight: 25 lbs (11kg)
- Cabinet: 24 ga. steel w/powder coat finish
- Motors: ebm motors w/backward curved blades
- Filters: 2 washable electrostatic filters 8.5″ (216mm) x 8″ (205mm) x 0.125″ (3mm)
- Insulated with 1" (25 mm) aluminum foil-face high density polystyrene foam to prevent condensation and meet the requirements of the UL 94HF.
- Core: Aluminum 8.5″ (216mm) x 8.5″ (216mm) x 8″ (205mm)
- Supply & exhaust ducts: 4″ (100mm)
- Mounting: Wall bracket included
- Electrical requirements:

Volts	Frequency	Amps	Watts
115V	60Hz	0.36A	40W

3' plug-in power cord w/ 3-prong plug

Contacts

Submitted by: Date:

Qty: Model #:

Comments:

Project #:

Location:

Architect:

Engineer:

Contractor:

Fantech

United States
10048 Industrial Blvd.,
Lenexa, KS. 66215
(T) 1.800.747.1762
(F) 1.800.487.9915
(T) 1.913.752.6000
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50 Kanalflakt Way,
Bouctouche, NB E4S 3M5
(T) 1.800.565.3548
(F) 1.877.747.8116
(T) 1.506.743.9500
(F) 1.506.743.9600
www.fantech.net
info@fantech.net

Article #: 403297
Rev Date: 092810

MITSUBISHI ELECTRIC
COOLING & HEATING

M-SERIES

SUBMITTAL DATA: MSZ-GE06NA-8

6,000 BTU/H WALL-MOUNTED INDOOR UNIT FOR MXZ-B MULTI-ZONE HEAT-PUMP SYSTEMS

Job Name:	Location:	Date:
Purchaser:	Engineer:	
Submitted to:	For ☐Reference ☐Approval ☐Construction	
System Designation:	Schedule No.:	

Indoor Unit: MSZ-GE06NA-8

Wireless Remote Controller

GENERAL FEATURES

- Wall-mounted indoor unit
- Standard Hybrid Catechin Prefilter is included with indoor unit
- Quiet operation
- Auto fan speed control: Quiet, Low, Medium, High, and Super High
- Hand-held Wireless Remote Controller
- Indoor unit powered from outdoor unit using A-Control
- Auto restart following a power outage
- Anti-allergy Enzyme Filter
- Limited warranty: five years parts and seven years compressor

ACCESSORIES

Indoor Unit

☐ Condensate Pump (230V; SI3100-230)

Controller Options

☐ Wireless Wall-mounted Remote Controller Kit (MHK1)*
☐ Portable Controller (MCCH1)*
☐ Outdoor Air Sensor (MOS1)*
*See Submittal for information on each option.

☐ Wired Wall-mounted Controller
(PAR-21MAAU requires MAC-333IF)
☐ System Control Interface (MAC-333IF)
☐ Remote Temperature Sensor (M21-JKO-307)
☐ Lockdown Bracket for Hand-held Controller (RCMKP1CB)

SPECIFICATIONS

Cooling Capacity* . . . . . 6,000 Btu/h
Heating Capacity* . . . . . 7,200 Btu/h

*** Rating Conditions per AHRI Standard**
Cooling | Indoor: 80° F (27° C) DB / 67° F (19° C) WB
Cooling | Outdoor: 95° F (35° C) DB / 75° F (24° C) WB
Heating at 47°F | Indoor: 70° F (21° C) DB / 60° F (16° C) WB
Heating at 47°F | Outdoor: 47° F (8° C) DB / 43° F (6° C) WB

(For data on specific indoor units [all ducted, all non-ducted, and both ducted and non-ducted] combinations, see the MXZ-B Technical and Service Manual.)

Electrical Requirements
Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
MCA . . . . . 1 A

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . .DC ±24V
Indoor - Remote Controller . . . . . MKH1 DC 3V
PAR-21MAAU DC 12V
PAR-FL32MA DC 3V

Blower Motor (ECM) . . . . . 0.76 F.L.A.

Airflow (Quiet - Lo - Med - Hi - Super Hi)
Cooling . . . . . 145 - 170 - 237 - 321 - 399 Dry CFM
109 - 134 - 201 - 286 - 364 Wet CFM
Heating . . . . . 145 - 170 - 233 - 321 - 406 CFM

Sound Pressure Level (Quiet - Lo - Med - Hi - Super Hi)
Cooling . . . . . 19 - 22 - 30 - 37 - 43 dB(A)
Heating . . . . . 19 - 22 - 30 - 37 - 43 dB(A)

DIMENSIONS	UNIT INCHES / MM
W	31-7/16 / 799
D	9-1/8 / 232
H	11-5/8 / 295

Weight . . . . . 22 lbs. / 10 kg
External Finish . . . . . Munsell No. 1.0Y 9.2 / 0.2
Field Drainpipe Size O.D. . . . . 5/8" / 15.88 mm

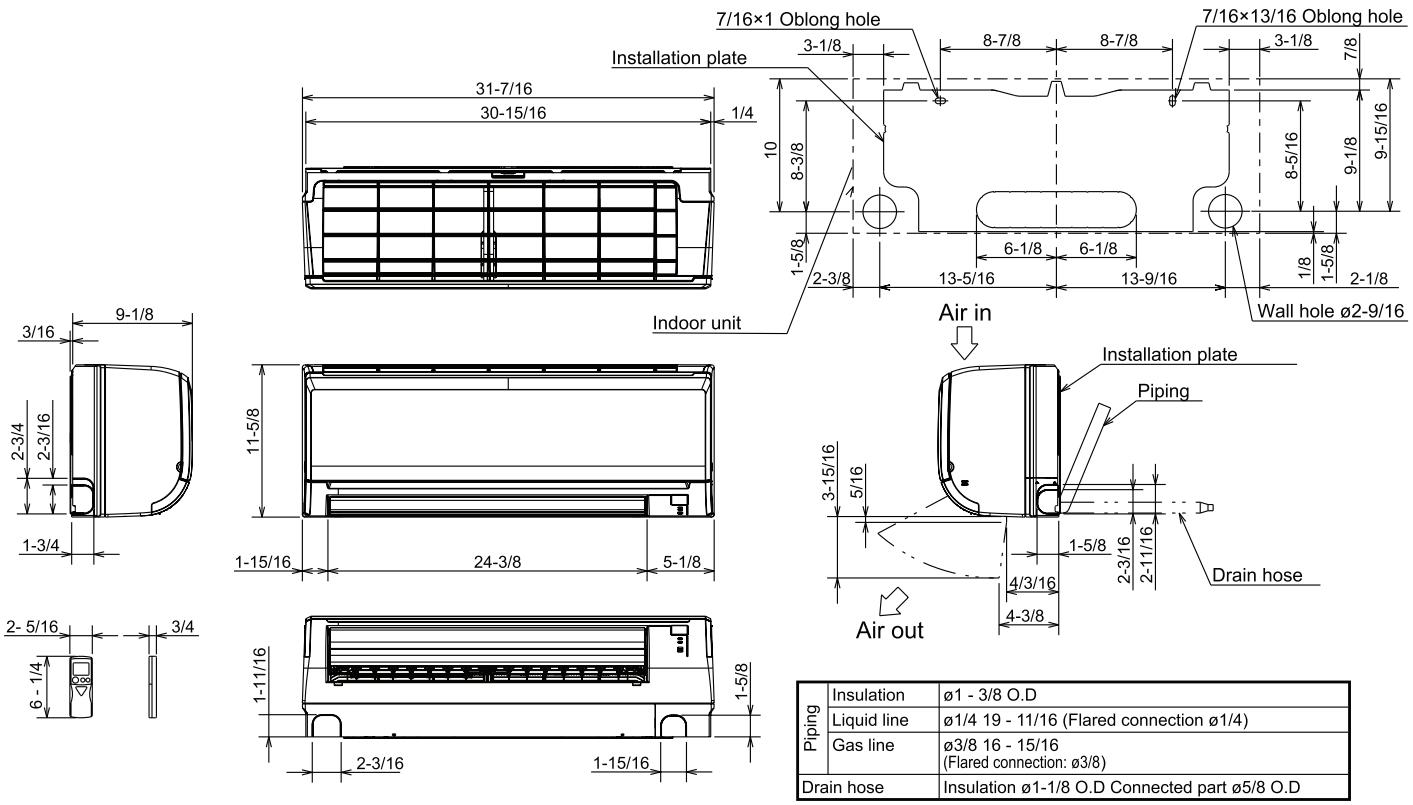
Refrigerant Type R410A
Refrigerant Pipe Size O.D.
Gas Side . . . . . 3/8" / 9.52 mm
Liquid Side . . . . . 1/4" / 6.35 mm
Connection Method . . . . . Flared

R410A INVERTER

Specifications are subject to change without notice.

DIMENSIONS: MSZ-GE06NA-8

Unit: inch



Piping	Insulation	ø1 - 3/8 O.D
	Liquid line	ø1/4 19 - 11/16 (Flared connection ø1/4)
	Gas line	ø3/8 16 - 15/16 (Flared connection: ø3/8)
Drain hose		Insulation ø1-1/8 O.D Connected part ø5/8 O.D

AHRI CERTIFIED™ www.ahridirectory.org
Unitary Small HP
AHRI Standard 210/240
Certification applies only when the complete system is listed with AHRI.

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www.mehvac.com

FORM# MSZ-GE06NA-8 FOR MXZ MULTI-ZONE SYSTEMS - 201308

Specifications are subject to change without notice.

MITSUBISHI ELECTRIC
COOLING & HEATING

M-SERIES

SUBMITTAL DATA: MSZ-GE09NA-8 & MUZ-GE09NA

9,000 BTU/H WALL-MOUNTED HEAT-PUMP SYSTEMS

Job Name:	Location:	Date:
Purchaser:	Engineer:	
Submitted to:	For ☐Reference ☐Approval ☐Construction	
System Designation:	Schedule No.:	

Indoor Unit: MSZ-GE09NA-8

Outdoor Unit: MUZ-GE09NA

Most Efficient 2013
ENERGY STAR
www.energystar.gov

Wireless Remote Controller

GENERAL FEATURES
- Wall-mounted indoor unit
- Standard Hybrid Catechin Prefilter is included with indoor unit
- Quiet operation
- Auto fan speed control: Quiet, Low, Medium, High, and Super High;
- Hand-held Wireless Remote Controller
- Indoor unit powered from outdoor unit using A-Control
- Auto restart following a power outage
- Base heater is available as an option
- Anti-allergy Enzyme Filter
- Limited warranty: five years parts and seven years compressor

ACCESSORIES

Outdoor Unit
- ☐ Base Heater (MAC-640BH-U)
- ☐ Drain Socket Assembly (MAC-860DS)

Indoor Unit
- ☐ Condensate Pump (230V; SI3100-230)

Controller Options
- ☐ Wireless Wall-mounted Remote Controller Kit (MHK1)*
- ☐ Portable Controller (MCCH1)*
- ☐ Outdoor Air Sensor (MOS1)*

*See Submittal for information on each option.

- ☐ Wired Wall-mounted Controller (PAR-21MAAU requires MAC-333IF)
- ☐ System Control Interface (MAC-333IF)

R410A INVERTER

Specifications are subject to change without notice.

SPECIFICATIONS: MSZ-GE09NA-8 & MUZ-GE09NA

Cooling*
Rated Capacity . . . . . 9,000 Btu/h
Minimum Capacity . . . . . 3,800 Btu/h
SEER . . . . . 21.0 Btu/h/W
Total Input . . . . . 660 W

Heating at 47°F*
Rated Capacity . . . . . 10,900 Btu/h
Minimum Capacity** . . . . . 4,500 Btu/h
HSPF . . . . . 10.0 Btu/h/W
Total Input . . . . . 760 W

Heating at 17°F*
Rated Capacity . . . . . 6,600 Btu/h
Rated Total Input . . . . . 700 W
Maximum Capacity** . . . . . 8,700 Btu/h
Maximum Total Input . . . . . 950 W

*** Rating Conditions per AHRI Standard**
Cooling | Indoor: 80º F (27º C) DB / 67º F (19º C) WB
Cooling | Outdoor: 95º F (35º C) DB / 75º F (24º C) WB
Heating at 47ºF | Indoor: 70º F (21º C) DB / 60º F (16º C) WB
Heating at 47ºF | Outdoor: 47º F (8º C) DB / 43º F (6º C) WB
Heating at 17º F | Indoor: 70º F (21º C) DB / 60º F (16º C) WB
Heating at 17º F | Outdoor: 17º F (-8º C) DB / 15º F (-9º C) WB

**** Maximum Capacity is at full speed and performance for INVERTER-driven System.**

Electrical Requirements
Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
Breaker Size . . . . . 15 A

OPERATING RANGE

		Indoor Intake Air Temp.	Outdoor Intake Air Temp.
Cooling	Maximum	90º F (32º C) DB, 73º F (23º C) WB	115º F (46º C) DB
	Minimum	67º F (19º C) DB, 57º F (14º C) WB	14º F (-10º C) DB
Heating	Maximum	80º F (27º C) DB, 67º F (19º C) WB	75º F (24º C) DB, 65º F (18º C) WB
	Minimum	70º F (21º C) DB, 60º F (16º C) WB	-4º F (-20º C) DB, -5º F (-21º C) WB

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . DC ±24V
Indoor - Remote Controller . . . . . MHK1 DC 3V
PAR-21MAAU DC 12V
PAR-FL32MA DC 3V

Indoor Unit
MCA . . . . . 1 A
Blower Motor (ECM) . . . . . 0.76 F.L.A.
Airflow (Quiet - Low - Medium - High - Super High)
Cooling . . . . . 145 - 170 - 237 - 321 - 399 Dry CFM
109 - 134 - 201 - 286 - 364 Wet CFM
Heating . . . . . 145 - 170 - 237 - 321 - 406 Dry CFM

Sound Pressure Level (Quiet - Low - Medium - High - Super High)
Cooling . . . . . 19 - 22 - 30 - 37 - 43 dB(A)
Heating . . . . . 19 - 22 - 30 - 37 - 43 dB(A)

DIMENSIONS	UNIT INCHES / MM
W	31-7/16 / 799
D	9-1/8 / 232
H	11-5/8 / 295

Weight . . . . . 22 lbs. / 10 kg
External Finish . . . . . Munsell No. 1.0Y 9.2 / 0.2
Field Drainpipe Size O.D. . . . . 5/8" / 15.88 mm

Outdoor Unit
Compressor . . . . . DC Inverter-driven
MCA . . . . . 12 A
Fan Motor (ECM) . . . . . 0.50 F.L.A.
Sound Pressure Level
Cooling . . . . . 46 dB(A)
Heating . . . . . 50 dB(A)

DIMENSIONS	INCHES / MM
W	31-1/2 / 800
D	11-1/4 / 286
H	21-5/8 / 549

Weight . . . . . 66 lbs. / 30 kg
External Finish . . . . . Munsell No. 3Y 7.8 / 1.1

Refrigerant Type R410A
Refrigerant Pipe Size O.D.
Gas Side . . . . . 3/8" / 9.52 mm
Liquid Side . . . . . 1/4" / 6.35 mm
Max. Refrigerant Pipe Length . . . . . 65 ft. / 20 m
Max. Refrigerant Pipe Height Difference . . . . . 40 ft. / 12 m
Connection Method . . . . . Flared

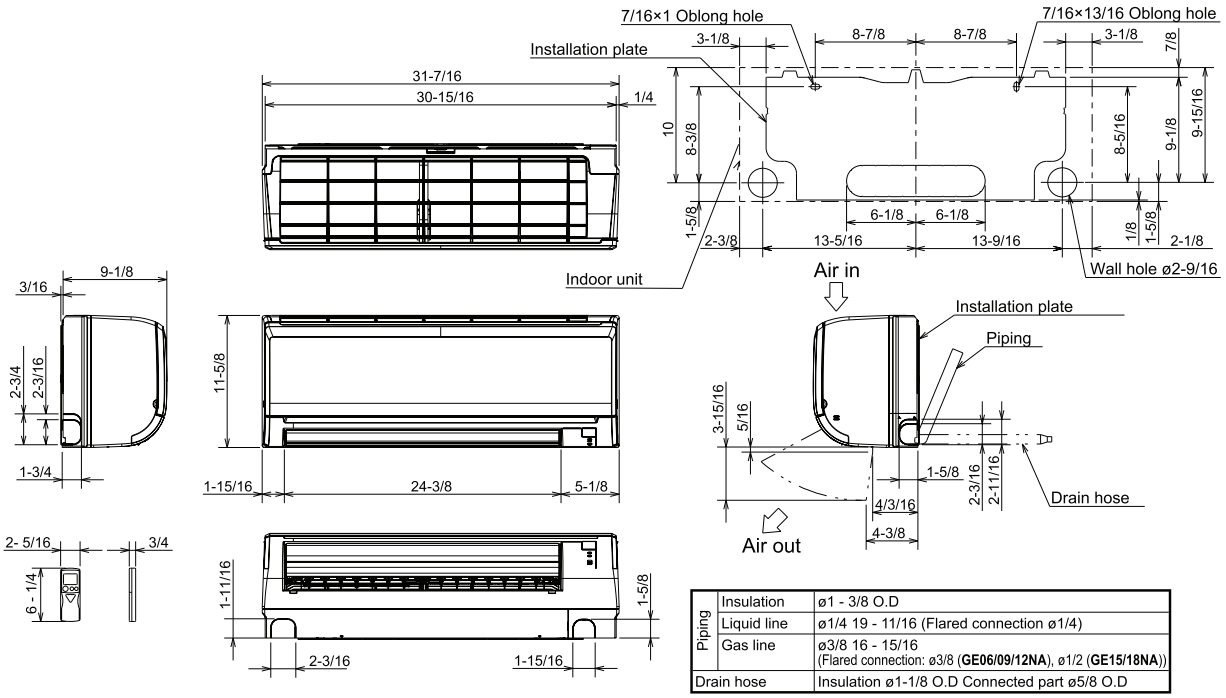
Notes:

Specifications are subject to change without notice.

DIMENSIONS: MSZ-GE09NA-8 & MUZ-GE09NA

MSZ-GE09NA-8

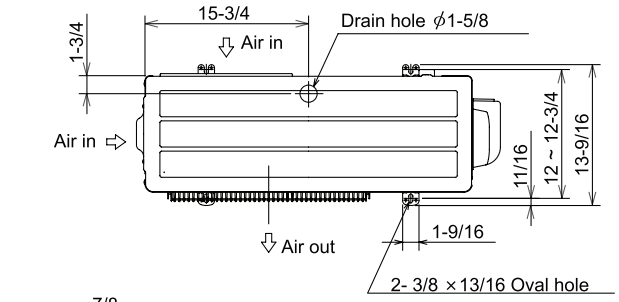
Unit: inch

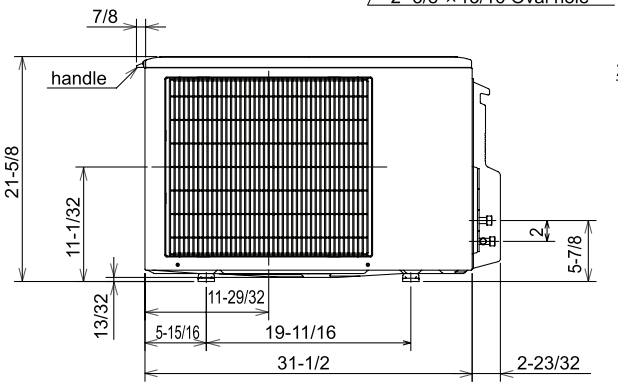


Piping	Insulation	ø1 - 3/8 O.D
	Liquid line	ø1/4 19 - 11/16 (Flared connection ø1/4)
	Gas line	ø3/8 16 - 15/16 (Flared connection: ø3/8 (**GE06/09/12NA**), ø1/2 (**GE15/18NA**))
Drain hose		Insulation ø1-1/8 O.D Connected part ø5/8 O.D

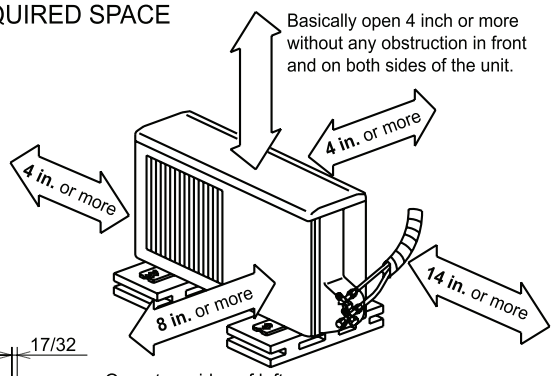
MUZ-GE09NA

Unit: inch

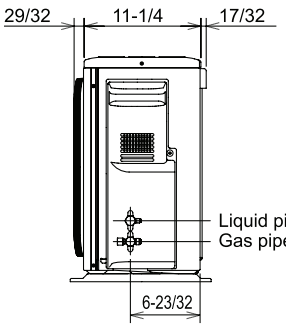




REQUIRED SPACE



Open two sides of left, right, or rear side.



Liquid pipe :1/4 (flared)
Gas pipe :3/8 (flared) **(GE09/12)**
1/2 (flared) **(GE15)**

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AHRI Standard 210/240
Certification applies only when the complete system is listed with AHRI.

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FORM# MSZ-GE09NA-8 & MUZ-GE09NA - 201304

Specifications are subject to change without notice.

MITSUBISHI ELECTRIC

COOLING & HEATING

Mr.SLIM®

Split-ductless A/C and Heat Pumps

SUBMITTAL DATA: MXZ-3B24NA ..... MULTI-INDOOR INVERTER HEAT-PUMP SYSTEM

Job Name:	Location:	Date:
Purchaser:	Engineer:	
Submitted to:	For ☐Reference ☐Approval ☐Construction	
System Designation:	Schedule No.:	

GENERAL FEATURES

- Compact side discharge outdoor unit
- Wireless or wired remote controller, depending on the indoor units used
- Quiet operation—both indoor and outdoor units
- Automatic fan speed control
- Auto restart following a power outage
- Self-check function—integrated diagnostics
- Advanced microprocessor control
- Limited warranty: five years on parts and defects and seven years on compressors

Outdoor Unit: MXZ-3B24NA

OPTIONAL OUTDOOR UNIT ACCESSORIES

- ☐ Air Outlet Guide (MAC-856SG)
- ☐ 3/8" x 1/2" Port Adapter (MAC-A454JP-E)
- ☐ 1/2" x 3/8" Port Adapter (MAC-A455JP-E)
- ☐ 1/2" x 5/8" Port Adapter (MAC-A456JP-E)

Cooling*
Rated Capacity (Non-ducted/Ducted) . . . 22,000 Btu/h / 23,600 Btu/h
Minimum Capacity (Non-ducted/Ducted) . . 12,600 Btu/h / 12,600 Btu/h
Total Input (Non-ducted/Ducted) . . . . . 1,760 W / 2,460 W

Heating at 47°F*
Rated Capacity (Non-ducted/Ducted) . . . 25,000 Btu/h / 24,600 Btu/h
Minimum Capacity (Non-ducted/Ducted). . 11,400 Btu/h / 11,400 Btu/h
Total Input (Non-ducted/Ducted) . . . . . 1,750 W / 1,900 W

Heating at 17°F*
Rated Capacity (Non-ducted/Ducted). . 14,000 Btu/h / 14,000 Btu/h
Total Input (Non-ducted/Ducted). . . . . 1,380 W / 1,570 W

* Rating Conditions (Cooling) - Indoor: 80°F (27°C) DB / 67°F (19°C) WB. Outdoor: 95°F (35°C) DB / 75°F (24°C) WB.
(Heating) - Indoor: 70°F (21°C) DB / 60°F (16°C) WB. Outdoor: 47°F (8°C) DB / 43°F (6°C) WB.
(Heating at 17°F) - Indoor: 70°F (21°C) DB / 60°F (16°C) WB. Outdoor: 17°F (-8°C) DB / 15°F (-9°C) WB.
(For data on specific indoor units [all ducted, all non-ducted, and both ducted and non-ducted] combinations, see the Technical and Service Manuals.)

Electrical Requirements

Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
Recommended Fuse/Breaker Size. . . . . 20 A
MCA . . . . . 15 A

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . DC 12 - 24V

OPERATING RANGE

		Indoor Intake Air Temp.	Outdoor Intake Air Temp.
Cooling	Maximum	95°F (35°C) DB, 71°F (22°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F (14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F (19°C) WB	75°F (24°C) DB, 65°F (18°C) WB
	Minimum	70°F (21°C) DB, 60°F (16°C) WB	6°F (-14°C) DB, 5°F (-15°C) WB

Compressor . . . . . DC Inverter-driven Twin Rotary
Fan Motor . . . . . 0.93 F.L.A.

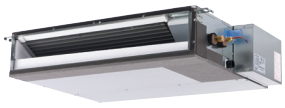
Sound Pressure Level
Cooling (Non-ducted/Ducted). . . . . 54 dB(A)
Heating (Non-ducted/Ducted). . . . . 49 dB(A)

DIMENSIONS	INCHES / MM
W	35-7/16 / 900
D	12-5/8 / 321
H	35-7/16 / 900

Weight . . . . . 150 lbs. / 68 kg
External Finish . . . . . Munsell No. 3Y 7.8 / 1.1
Refrigerant Type. R410A
Refrigerant Pipe Size O.D. — Three Ports
Gas Side. . . . . A: 1/2" / 12.7mm; B,C: 3/8" / 9.52 mm
Liquid Side . . . . . 1/4" / 6.35 mm
Max. Refrigerant Pipe Length. . . . . 230' / 70 m
Max. Piping Length for Each Indoor Unit . . . . . 82' / 25 m
Max. Refrigerant Pipe Height Difference
If Indoor Unit is Above Outdoor Unit . . . . . 49' / 15 m
If Indoor Unit is Below Outdoor Unit. . . . . 33' / 10 m
Connection Method . . . . . Flared

COMPATIBLE INDOOR UNITS

Horizontal-ducted Indoor Units:
SEZ-KD09,12,15,18NA



Floor-standing Indoor Units:
MFZ-KA09,12,18NA

Wall-mounted Indoor Units:
MSZ-GE06,09,12,15,18NA

Wall-mounted Indoor Units:
MSZ-FE09,12,18NA

MXZ-3B24NA ENERGY EFFICIENCIES

Indoor Unit Type	SEER	EER	HSPF	COP @ 47°F	COP @ 17°F
Non-ducted (06 + 06 + 09)	17.5	12.5	9.3	4.2	2.97
Ducted and Non-ducted	16.25	11.05	8.9	4.0	2.79
Ducted (09 + 09 + 09)	15.0	9.6	8.5	3.8	2.61

Ceiling-cassette Indoor Units:
SLZ-KA09,12,15NA and PLA-A18BA Only

R410A INVERTER

Refer to the separate submittal forms for the SEZ, SLZ, MSZ, MFZ, and PLA Indoor Units.

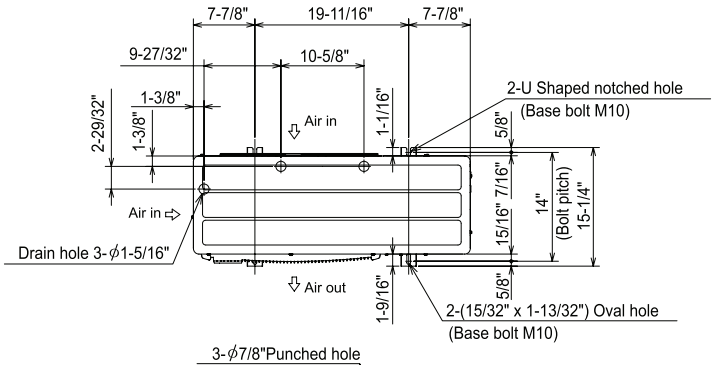
MXZ-3B24NA OPERATION PERFORMANCE

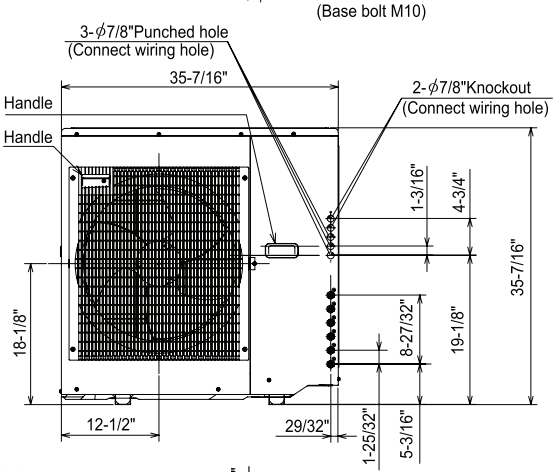
- Minimum of two Indoor Units must be connected to the MXZ-3B24NA.
- Minimum installed capacity cannot be less than 12,000 Btu/h.
- System can operate with only one Indoor Unit turned on (see table below for single Indoor Unit performance).
- Indoor Units can be All Non-ducted, All Ducted, or a Combination of Non-ducted and Ducted (Select style as installation requires).
- Information provided at 208/230V. Refer to the MXZ Outdoor Unit Service Manual for detailed specifications and additional information per Indoor Unit Combination.

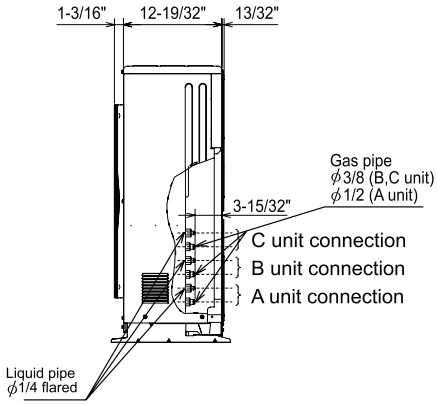
Operation Performance for Indoor Unit Combinations (Unit A + Unit B + Unit C)	Cooling Capacity Range (Btu/h) Heating Capacity Range (Btu/h)				Power Usage Range (W)
	Unit A	Unit B	Unit C	Total Range	
6	6,500	-	-	5,200 - 6,500	460 - 580
	7,800	-	-	6,800 - 14,400	540 - 1,460
9	9,000	-	-	7,200 - 9,000	580 - 820
	10,900	-	-	8,600 - 15,400	780 - 1,520
12	12,000	-	-	7,200 - 12,000	580 - 1,020
	13,600 - 14,400	-	-	8,600 - 16,400	780 - 1,600
15	14,000 - 15,000	-	-	7,200 - 15,000	580 - 1,340
	18,000	-	-	8,600 - 21,100	780 - 2,280
18	17,200	-	-	7,200 - 17,200	600 - 1,590
	21,600	-	-	8,600 - 24,900	780 - 2,770
6 + 6	6,500	6,500	-	12,000 - 13,000	920 - 960
	7,800	7,800	-	11,000 - 25,800	740 - 2,240
6 + 9	6,500	9,000	-	12,000 - 15,500	940 - 1,260
	7,800	10,900	-	11,000 - 25,800	740 - 2,240
6 + 12	6,500	12,000	-	12,000 - 18,500	920 - 1,600
	7,800	13,600 - 14,400	-	11,000 - 27,400	740 - 2,520
6 + 15	6,100 - 6,400	13,600 - 13,900	-	12,000 - 20,500	920 - 1,840
	7,200	16,400	-	11,000 - 27,400	740 - 2,620
6 + 18	5,500	14,500	-	12,000 - 23,700	920 - 2,460
	6,300	17,300	-	11,000 - 29,000	740 - 2,840
9 + 9	9,000	9,000	-	12,000 - 18,000	920 - 1,840
	10,900	10,900	-	11,000 - 27,400	740 - 2,560
9 + 12	8,600	11,400	-	12,000 - 21,000	920 - 2,040
	10,000 - 10,200	13,200 - 13,400	-	11,000 - 27,400	740 - 2,800
9 + 15	7,500	12,500	-	12,000 - 24,000	920 - 2,540
	9,000	14,600	-	11,000 - 29,000	740 - 2,920
9 + 18	6,800	13,200	-	12,000 - 26,000	920 - 2,840
	8,000	15,600	-	11,000 - 29,000	740 - 2,920
12 + 12	10,000	10,000	-	12,000 - 24,000	920 - 2,540
	11,800 - 12,200	11,400 - 11,800	-	11,000 - 29,000	740 - 2,920
12 + 15	8,900 - 9,300	10,700 - 11,100	-	12,000 - 26,000	920 - 2,840
	10,200 - 10,500	13,100 - 13,400	-	11,000 - 29,000	740 - 2,860
6 + 6 + 6	6,500	6,500	6,500	12,600 - 19,500	1,000 - 1,600
	7,800	7,800	7,800	11,400 - 30,600	740 - 2,420
6 + 6 + 9	6,500	6,500	9,000	12,600 - 22,000	1,000 - 1,940
	7,400	7,400	9,600 - 10,200	11,400 - 30,600	740 - 2,480
6 + 6 + 12	5,800	5,800	10,400 - 10,600	12,600 - 25,000	1,000 - 2,330
	6,500	6,500	11,600 - 12,000	11,400 - 30,600	740 - 2,500
6 + 6 + 15	5,300	5,300	11,400 - 11,900	12,600 - 27,000	1,000 - 2,580
	5,900	5,900	13,000 - 13,200	11,400 - 30,600	740 - 2,520
6 + 9 + 9	6,000	8,000 - 8,200	8,000 - 8,200	12,600 - 24,500	1,000 - 2,290
	6,600	8,900 - 9,200	8,900 - 9,200	11,400 - 30,600	740 - 2,540
6 + 9 + 12	5,200	7,200 - 7,700	9,600 - 10,100	12,600 - 27,000	1,000 - 2,690
	5,900	8,200 - 8,300	10,600 - 10,800	11,400 - 30,600	740 - 2,560
9 + 9 + 9	7,300 - 7,866	7,300 - 7,900	7,333 - 7,900	12,600 - 27,000	1,000 - 2,950
	8,200 - 8,333	8,200 - 8,333	8,200 - 8,333	11,400 - 30,600	740 - 2,600

DIMENSIONS: MXZ-3B24NA

Unit: inch

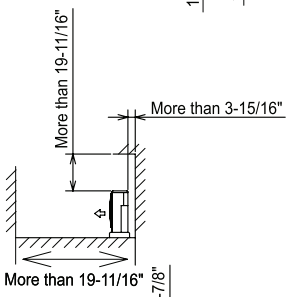




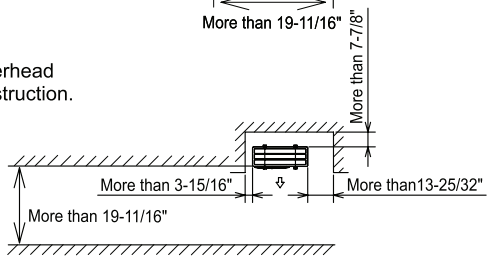


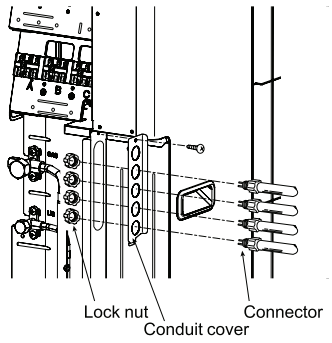
1.Installation space

Note : Leave both sides free of obstruction.

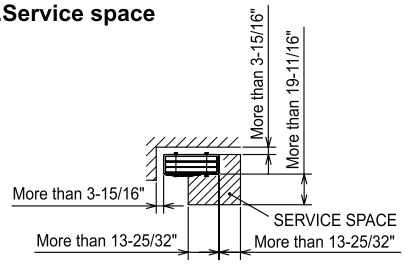


Note : Leave overhead free of obstruction.





2.Service space



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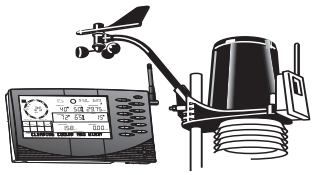
Specifications are subject to change without notice.

FORM# MXZ-3B24NA for Multiple Indoor Unit Styles - 201109

Wireless Vantage Pro2™ & Vantage Pro2™ Plus Stations

(Including Fan-Aspirated Models)



6152 6162
6153 6163

WIRELESS VANTAGE PRO2™

Vantage Pro2™ (6152, 6153) and Vantage Pro2™ Plus (6162, 6163) Wireless Weather Stations include two components: the Integrated Sensor Suite (ISS) which houses and manages the external sensor array, and the console which provides the user interface, data display, and calculations. The ISS and Vantage Pro2 console communicate via an FCC-certified, license-free, spread-spectrum frequency-hopping (FHSS) transmitter and receiver. User-selectable transmitter ID codes allow up to eight stations to coexist in the same geographic area. The frequency hopping spread spectrum technology provides greater communication strength over longer distances and areas of weaker reception. The Wireless Vantage Pro2 Plus weather station includes two additional sensors that are optional on the Vantage Pro2: the UV sensor and the solar radiation sensor.

The console may be powered by batteries or by the included AC-power adapter. The wireless ISS is solar powered with a battery backup. Use WeatherLink® for Vantage Pro2 and Vantage Vue® to let your weather station interface with a computer, to log weather data, and to upload weather information to the internet.

The 6152 and 6162 rely on passive shielding to reduce solar-radiation induced temperature errors in the outside temperature sensor readings. The Fan-aspirated 6153 and 6163 combine passive shielding with a solar-powered fan that draws outside air in over the temperature and humidity sensors, providing a much more accurate temperature reading than that available using passive shielding alone.

Integrated Sensor Suite (ISS)

Operating Temperature	-40° to +150°F (-40° to +65°C)
Non-operating Temperature	-40° to +158°F (-40° to +70°C)
Current Draw (ISS SIM only)	0.14 mA (average), 30 mA (peak) at 4 to 6 VDC
Solar Power Panel	0.5 Watts (ISS SIM), plus 0.75 Watts (Fan-Aspirated)
Battery (ISS SIM /Fan-Aspirated)	CR-123 3-Volt Lithium cell / 2 - 1.2 Volt NiCad C-cells
Battery Life (3-Volt Lithium cell)	8 months without sunlight - greater than 2 years depending on solar charging
Battery Life (NiCad C-cells, Fan-Aspirated)	1 year
Fan Aspiration Rate (Fan-Aspirated only)	
Intake Flow Rate, full sun	190 feet/min. (0.9 m/s)
Intake Flow Rate, battery only	80 feet/min. (0.4 m/s)
Sensor Chamber Flow Rate, full sun	500 feet/min. (2.5 m/s)
Sensor Chamber Flow Rate, battery only	280 feet/min. (1.4 m/s)
Connectors, Sensor	Modular RJ-11
Cable Type	4-conductor, 26 AWG
Cable Length, Anemometer	40’ (12 m) (included) 240’ (73 m) (maximum recommended)

Note: Maximum displayable wind decreases as the length of cable increases. at 140’ (42 m) of cable, the maximum wind speed displayed is 135 mph (60 m/s); at 240’ (73 m), the maximum wind speed displayed is 100 mph (34 m/s).

Wind Speed Sensor	Solid state magnetic sensor
Wind Direction Sensor	Wind vane with potentiometer
Rain Collector Type	Tipping bucket, 0.01" per tip (0.2 mm with metric rain adapter), 33.2 in^2 (214 cm^2) collection area
Temperature Sensor Type	PN Junction Silicon Diode
Relative Humidity Sensor Type	Film capacitor element
Housing Material	UV-resistant ABS, ASA plastic

DAVIS® Davis Instruments 3465 Diablo Ave., Hayward, CA 94545-2778 USA
(510) 732-9229 • FAX (510) 670-0589 • sales@davisnet.com • www.davisnet.com

ISS Dimensions:

Product #	(Length x Width x Height)	Package Weight
6152	11.00" x 9.38" x 14.00" (279 mm x 238 mm x 355 mm)	5.7 lbs. (2.6 kg)
6162		6.1 lbs. (2.6 kg)
6153	11.00" x 9.38" x 21.00" (279 mm x 238 mm x 533 mm)	8.6 lbs. (3.9 kg)
6163		9 lbs. (4.1 kg)

Console

Console Operating Temperature . . . . . +32° to +140°F (0° to +60°C)
Non-Operating (Storage) Temperature . . . . . +14° to +158°F (-10° to +70°C)
Current Draw . . . . . 0.9 mA average, 30 mA peak, (add 120 mA for display lamps, add 0.125 mA for each optional wireless transmitter received by the console) at 4 - 6 VDC
AC Power Adapter . . . . . 5 VDC, 300 mA, regulated
Batteries . . . . . 3 C-cells
Battery Life . . . . . up to 9 months
Connectors . . . . . Modular RJ-11
Housing Material . . . . . UV-resistant ABS plastic
Console Display Type . . . . . LCD Transflective
Display Backlight . . . . . LEDs
Console Dimensions
- Console with antenna down (L x H x D) . . . . . 10.625" x 6.125" x 1.625" (270 mm x 156 mm x 41 mm)
- Console with antenna extended up (L x H x D). . . . . 10.625" x 9.625" x 1.625" (270 mm x 245 mm x 41 mm)
- Display (L x H). . . . . 5.94" x 3.375" (151 mm x 86 mm)

Weight (with batteries) . . . . . 1.88 lbs. (.85 kg)

Data Displayed on Console

Data display categories are listed with General first, then in alphabetical order.

General

Historical Data . . . . . Includes the past 24 values listed unless otherwise noted; all can be cleared and all totals reset
Daily Data . . . . . Includes the earliest time of occurrence of highs and lows; period begins/ends at 12:00 am
Monthly Data . . . . . Period begins/ends at 12:00 am on the first of the month
Yearly Data . . . . . Period begins/ends at 12:00 am on the first of January unless otherwise noted
Current Display Data . . . . . Current display data describes the current reading for each weather variable. In most cases, the variable lists the most recently updated reading or calculation. Some current variable displays can be adjusted so there is an offset for the reading
Current Graph Data . . . . . Current graph data appears in the right-most column in the console graph and represents the latest value within the last period on the graph; totals can be set or reset. Display intervals vary. Examples include: Instant, 15-min., and Hourly Reading; Daily, Monthly, High and Low
Graph Time Interval . . . . . 1 min., 10 min., 15 min., 1 hour, 1 day, 1 month, 1 year (user-selectable, availability depends upon variable selected)
Graph Time Span. . . . . 24 Intervals + Current Interval (see Graph Intervals to determine time span)
Graph Variable Span (Vertical Scale). . . . . Automatic (varies depending upon data range); Maximum and Minimum value in range appear in ticker
Alarm Indication . . . . . Alarms sound for only 2 minutes (time alarm is always 1 minute) if operating on battery power. Alarm message is displayed in ticker as long as threshold is met or exceeded. Alarms can be silenced (but not cleared) by pressing the DONE key.
Transmission Interval. . . . . Varies with transmitter ID code from 2.25 seconds (#1=shortest), to 3 seconds (#8=longest)
Update Interval . . . . . Varies with sensor - see individual sensor specs

Barometric Pressure

Resolution and Units	0.01" Hg, 0.1 mm Hg, 0.1 hPa/mb (user-selectable)
Range	16.00" to 32.50" Hg, 410 to 820 mm Hg, 540 to 1100 hPa/mb
Elevation Range	-999' to +15,000' (-600 m to 4570 m) (Note that console screen limits entry of lower elevation to -999' when using feet as elevation unit.)
Uncorrected Reading Accuracy	±0.03" Hg (±0.8 mm Hg, ±1.0 hPa/mb) (at room temperature)
Sea-Level Reduction Equation Used	United States Method employed prior to use of current "R Factor" method
Equation Source	Smithsonian Meteorological Tables
Equation Accuracy	±0.01" Hg (±0.3 mm Hg, ±0.3 hPa/mb)
Elevation Accuracy Required	±10' (3m) to meet equation accuracy specification
Overall Accuracy	±0.03" Hg (±0.8 mm Hg, ±1.0 hPa/mb)
Trend (change in 3 hours)	Change 0.06" (2 hPa/mb, 1.5 mm Hg) = Rapidly Change 0.02" (.7hPa/mb, .5 mm Hg)= Slowly
Trend Indication	5 position arrow: Rising (rapidly or slowly), Steady, or Falling (rapidly or slowly)
Update Interval	1 minute or when console BAR key is pressed twice
Current Display	Instant
Current Graph Data	Instant, 15-min., and Hourly Reading; Daily, Monthly, High and Low
Historical Graph Data	15-min. and Hourly Reading; Daily, Monthly Highs and Lows
Alarms	High Threshold from Current Trend for Storm Clearing (Rising Trend Low Threshold from Current Trend for Storm Warning (Falling Trend)
Range for Rising and Falling Trend Alarms	0.01 to 0.25" Hg (0.1 to 6.4 mm Hg, 0.1 to 8.5 hPa/mb)

Clock

Resolution	1 minute
Units	Time: 12 or 24 hour format (user-selectable)
Date	US or International format (user-selectable)
Accuracy	±8 seconds/month
Adjustments	Time: Automatic Daylight Savings Time (for users in North America and Europe that observe it in AUTO mode, MANUAL setting available for all other areas) Date: Automatic Leap Year
Alarms	Once per day at set time when active

Dewpoint (calculated)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-105° to +130°F (-76° to +54°C)
Accuracy	±3°F (±1.5°C) (typical)
Update Interval	10 to 12 seconds
Source	World Meteorological Organization (WMO)
Equation Used	WMO Equation with respect to saturation of moist air over water
Variables Used	Instant Outside Temperature and Instant Outside Relative Humidity
Current Display Data	Instant Calculation
Current Graph Data	Instant Calculation; Daily, Monthly High and Low
Historical Graph Data	Hourly Calculations; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Calculation

Evapotranspiration (calculated, requires solar radiation sensor)

Resolution and Units	0.01" or 0.1 mm (user-selectable)
Range	Daily to 32.67" (832.1 mm); Monthly & Yearly to 199.99" (1999.9 mm)
Accuracy	Greater of 0.01" (0.25 mm) or ±5%, Reference: side-by-side comparison against a CIMIS ET weather station
Update Interval	1 hour
Calculation and Source	Modified Penman Equation as implemented by CIMIS (California Irrigation Management Information System) including Net Radiation calculation

Current Display Data	Latest Hourly Total Calculation
Current Graph Data	Latest Hourly Total Calculation, Daily, Monthly, Yearly Total
Historical Graph Data	Hourly, Daily, Monthly, Yearly Totals
Alarm	High Threshold from Latest Daily Total Calculation

Forecast

Variables Used	Barometric Reading & Trend, Wind Speed & Direction, Rainfall, Temperature, Humidity, Latitude & Longitude, Time of Year
Update Interval	1 hour
Display Format	Icons on top center of display; detailed message in ticker at bottom
Variables Predicted	Sky Condition, Precipitation, Temperature Changes, Wind Direction and Speed

Heat Index (calculated)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-40° to +165°F (-40° to +74°C)
Accuracy	±3°F (±1.5°C) (typical)
Update Interval	10 to 12 seconds
Source	United States National Weather Service (NWS)/NOAA
Formulation Used	Steadman (1979) modified by US NWS/NOAA and Davis Instruments to increase range of use
Variables Used	Instant Outside Temperature and Instant Outside Relative Humidity
Current Display Data	Instant Calculation
Current Graph Data	Instant Calculation; Daily, Monthly High
Historical Graph Data	Hourly Calculations; Daily, Monthly Highs
Alarm	High Threshold from Instant Calculation

Humidity

Inside Relative Humidity (sensor located in console)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Update Interval	1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; Hourly Reading; Daily, Monthly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Reading

Outside Relative Humidity (sensor located in ISS)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Temperature Coefficient	0.03% per °F (0.05% per °C), reference 68°F (20°C)
Drift	±0.5% per year
Update Interval	50 seconds to 1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; Hourly Reading; Daily, Monthly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly Highs and Lows
Alarms	High and Low Threshold from Instant Reading

Extra Outside Relative Humidity (sensor located inside Temperature/Humidity Station)

Resolution and Units	1%
Range	1 to 100% RH
Accuracy	±3% (0 to 90% RH), ±4% (90 to 100% RH)
Temperature Coefficient	0.03% per °F (0.05% per °C), reference 68°F (20°C)
Drift	±0.5% per year
Update Interval	50 seconds to 1 minute
Current Display Data	Instant Reading (user adjustable)
Alarms	High and Low Threshold from Instant Reading

Leaf Wetness (requires leaf wetness sensor)

Resolution	1
Range	0 to 15
Dry/Wet Threshold	User-selectable
Accuracy	±0.5
Update Interval	46 to 54 seconds
Current Graph Data	Instant Reading; Daily High and Low; Monthly High
Historical Graph Data	Hourly Readings; Daily Highs and Lows; Monthly Highs
Alarms	High and Low Thresholds from Instant Reading

Moon Phase

Console Resolution	1/8 (12.5%) of a lunar cycle, 1/4 (25%) of lighted face on console
WeatherLink Resolution	0.09% of a lunar cycle, 0.18% of lighted face maximum (depends on screen resolution)
Range	New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, Waning Crescent
Accuracy	±38 minutes

Rainfall

Resolution and Units	0.01" or 0.2 mm (user-selectable) (1 mm at totals ≥ 2000 mm)
Daily/Storm Rainfall Range	0 to 99.99" (0 to 999.8 mm)
Monthly/Yearly/Total Rainfall Range	0 to 199.99" (0 to 6553 mm)
Rain Rate	0 to 96" (0 to 2438 mm)
Accuracy	For rain rates up to 2"/hr (50 mm/hr): ±4% of total or +0.01" (0.2mm) (0.01" = one tip of the bucket), whichever is greater. For rain rates from 2"/hr (50 mm/hr) to 4"/hr (100 mm/hr): ±4% of total or +0.01" (0.25 mm) (0.01" = one tip of the bucket), whichever is greater
Update Interval	20 to 24 seconds
Storm Determination Method	0.02" (0.5 mm) begins a storm event, 24 hours without further accumulation ends a storm event
Current Display Data	Totals for Past 15-min
Current Graph Data	Totals for Past 15-min, Past 24-hour, Daily, Monthly, Yearly (start date user-selectable) and Storm (with begin date); Umbrella is displayed when 15-minute total exceeds zero
Historical Graph Data	Totals for 15-min, Daily, Monthly, Yearly (start date user-selectable) and Storm (with begin and end dates)
Alarms	High Threshold from Latest Flash Flood (15-min. total, default is 0.50", 12.7 mm), 24-Hour Total, Storm Total,
Range for Rain Alarms	0 to 99.99" (0 to 999.7 mm)

Rain Rate

Resolution and Units	0.01" or 0.1 mm (user-selectable) at typical rates (see Fig. 2 and 3)
Range	0, 0.04"/hr (1 mm/hr) to 96"/hr (0 to 2438 mm/hr)
Accuracy	±5% for rates less than 5" per hour (127 mm/hr)
Update Interval	20 to 24 seconds
Calculation Method	Measures time between successive tips of tipping bucket. Elapsed time greater than 15 minutes or only one tip of the rain collector constitutes a rain rate of zero.
Current Display Data	Instant
Current Graph Data	Instant and 1-min. Reading; Hourly, Daily, Monthly and Yearly High
Historical Graph Data	1-min Reading; Hourly, Daily, Monthly and Yearly Highs
Alarm	High Threshold from Instant Reading

Soil Moisture (requires soil moisture sensor)

Resolution	1 cb
Range	0 to 200 cb
Update Interval	77 to 90 seconds
Current Graph Data	Instant Reading; Daily and Monthly High and Low
Historical Graph Data	Hourly Readings; Daily and Monthly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading

Solar Radiation (requires solar radiation sensor)

Resolution and Units	1 W/m^2
Range	0 to 1800 W/m^2
Accuracy	±5% of full scale (Reference: Eppley PSP at 1000 W/m^2)
Drift	up to ±2% per year
Cosine Response	±3% for angle of incidence from 0° to 75°
Temperature Coefficient	-0.067% per °F (-0.12% per °C); reference temperature = 77°F (25 °C)
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Instant Reading and Hourly Average; Daily, Monthly High
Historical Graph Data	Hourly Average, Daily, Monthly Highs
Alarm	High Threshold from Instant Reading

Sunrise and Sunset

Resolution	1 minute
Accuracy	±1 minute
Reference	United States Naval Observatory

Temperature

Inside Temperature (sensor located in console)	
Resolution and Units	Current Data: 0.1°F or 1°F or 0.1°C or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)
Range	+32° to +140°F (0° to +60°C)
Sensor Accuracy	±1°F (±0.5°C), (see Fig. 1)
Update Interval	1 minute
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant Reading; Daily and Monthly High and Low
Historical Graph Data	Hourly Readings; Daily and Monthly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading
Outside Temperature (sensor located in ISS)	
Resolution and Units	Current Data: 0.1°F or 1°F or 0.1°C or 1°C (user-selectable) nominal °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)
Range	-40° to +150°F (-40° to +65°C)
Sensor Accuracy	±1°F (±0.5°C) above 20°F (-7°C), ±2°F (±1°C) under 20°F (-7°C) (see Fig. 2)
Radiation Induced Error (Passive Shield)	+4°F (2°C) at solar noon (insolation = 1040 W/m^2, avg. wind speed ≤ 2 mph (1 m/s)) (reference: RM Young Model 43408 Fan-Aspirated Radiation Shield)
Radiation Induced Error (Fan-Aspirated Shield)	+0.6°F (0.3°C) at solar noon (insolation = 1040 W/m^2, avg. wind speed ≤ 2 mph (1 m/s)) (reference: RM Young Model 43408 Fan-Aspirated Radiation Shield)
Update Interval	10 to 12 seconds
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant Reading; Daily, Monthly, Yearly High and Low
Historical Graph Data	Hourly Readings; Daily, Monthly, Yearly Highs and Lows
Alarms	High and Low Thresholds from Instant Reading
Extra Temperature Sensors or Probes	
Resolution and Units	Current Data: 1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C Historical Data and Alarms: 1°F or 1°C (user-selectable)

Range	-40° to +150°F (-40° to +65°C)
Sensor Accuracy	±1°F (±0.5°C) above 20°F (-7°C), ±2°F (±1°C) under 20°F (-7°C) (see Fig. 1)
Update Interval	10 to 12 seconds (77 to 90 seconds for Leaf Wetness/Temperature and Soil Moisture/Temperature Stations)
Current Display Data	Instant Reading (user-adjustable offset available)
Alarms	High and Low Thresholds from Instant Reading

Temperature Humidity Sun Wind Index (requires solar radiation sensor)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-90° to +165°F (-68° to +74°C)
Accuracy	±4°F (±2°C) (typical)
Update Interval	10 to 12 seconds
Sources and Formulation Used	United States National Weather Service (NWS)/NOAA Steadman (1979) modified by US NWS/NOAA and Davis Instruments to increase range of use and allow for cold weather use
Variables Used	Instant Outside Temperature, Instant Outside Relative Humidity, 10-minute Average Wind Speed, 10-minute Average Solar Radiation
Formulation Description	Uses Heat Index as base temperature, affects of wind and solar radiation are either added or subtracted from this base to give an overall effective temperature
Current Graph Data	Instant and Hourly Calculation; Daily, Monthly High
Historical Graph Data	Hourly Calculation; Daily, Monthly Highs
Alarm	High Threshold from Instant Reading

Ultra Violet (UV) Radiation Dose (requires UV sensor)

Resolution and Units	0.1 MEDs to 19.9 MEDs; 1 MED above 19.9 MEDS
Range	0 to 199 MEDs
Accuracy	±5% of daily total
Drift	up to ±2% per year
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Latest Daily Total (user resetable at any time from Current Screen)
Historical Graph Data	Hourly, Daily Totals (user reset from Current Screen does not affect these values)
Alarm	High Threshold from Daily Total
Alarm Range	0 to 19.9 MEDs

Ultra Violet (UV) Radiation Index (requires UV sensor)

Resolution and Units	0.1 Index
Range	0 to 16 Index
Accuracy	±5% of full scale (Reference: Yankee UVB-1 at UV index 10 (Extremely High))
Cosine Response	±4% (0° to 65° incident angle); 9% (65° to 85° incident angle)
Update Interval	50 seconds to 1 minute (5 minutes when dark)
Current Graph Data	Instant Reading and Hourly Average; Daily, Monthly High
Historical Graph Data	Hourly Average, Daily, Monthly Highs
Alarm	High Threshold from Instant Calculation

Wind

Wind Chill (Calculated)

Resolution and Units	1°F or 1°C (user-selectable) °C is converted from °F rounded to the nearest 1°C
Range	-110° to +135°F (-79° to +57°C)
Accuracy	±2°F (±1°C) (typical)
Update Interval	10 to 12 seconds
Source	United States National Weather Service (NWS)/NOAA
Equation Used	Osczevski (1995) (adopted by US NWS in 2001)
Variables Used	Instant Outside Temperature and 10-min. Avg. Wind Speed
Current Display Data	Instant Calculation

Current Graph Data	Instant Calculation; Hourly, Daily and Monthly Low
Historical Graph Data	Hourly, Daily and Monthly Lows
Alarm	Low Threshold from Instant Calculation
Wind Direction	
Range	0 - 360°
Display Resolution	16 points (22.5°) on compass rose, 1° in numeric display
Accuracy	±3°
Update Interval	2.5 to 3 seconds
Current Display Data	Instant (user-adjustable offset available)
Current Graph Data	Instant; 10-min. Dominant; Hourly, Daily, Monthly Dominant
Historical Graph Data	Past 6 10-min. Dominants on compass rose only; Hourly, Daily, Monthly Dominants
Wind Speed	
Resolution and Units	1 mph, 1 km/h, 0.4 m/s, or 1 knot (user-selectable). Measured in mph, other units are converted from mph and rounded to nearest 1 km/hr, 0.1 m/s, or 1 knot.
Range	1 to 200 mph, 1 to 173 knots, 0.5 to 89 m/s, 1 to 322 km/h
Update Interval	Instant Reading: 2.5 to 3 seconds, 10-minute Average: 1 minute
Accuracy	±2 mph (2 kts, 3 km/h, 1 m/s) or ±5%, whichever is greater
Maximum Cable Length	240’ (73 m) (See note on page 1)
Current Display Data	Instant
Current Graph Data	Instant; 10-minute and Hourly Average; Hourly High; Daily, Monthly and Yearly High with Direction of High
Historical Graph Data	10-min. and Hourly Averages; Hourly Highs; Daily, Monthly and Yearly Highs with Direction of Highs
Alarms	High Thresholds from Instant Reading and 10-minute Average

Wireless Communications

Transmit/Receive Frequency	US Models: 902-928 MHz FHSS, Overseas Models: 868.0 - 868.6 MHz FHSS
ID Codes Available	8
Output Power	902-928 MHz FHSS: FCC-certified low power, less than 8 mW, no license required 868.0 - 868.6 MHz FHSS. CE-certified, less than 8 mW, no license required
Range	
Line of Sight	up to 1000 feet (300 m)
Through Walls	200 to 400 feet (60 to 120 m)
Sensor Inputs	
RF Filtering	RC low-pass filter on each signal line

Sensor Charts

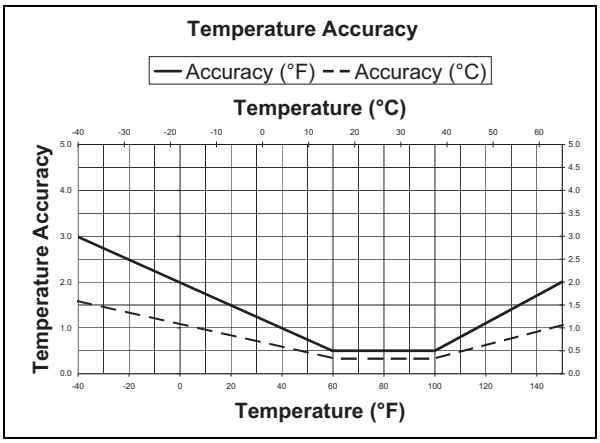


Figure 1. Temperature Accuracy

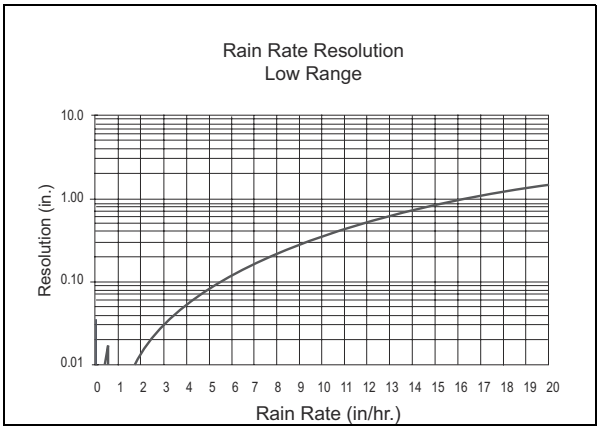


Figure 2. Low Range Rain Rate Resolution

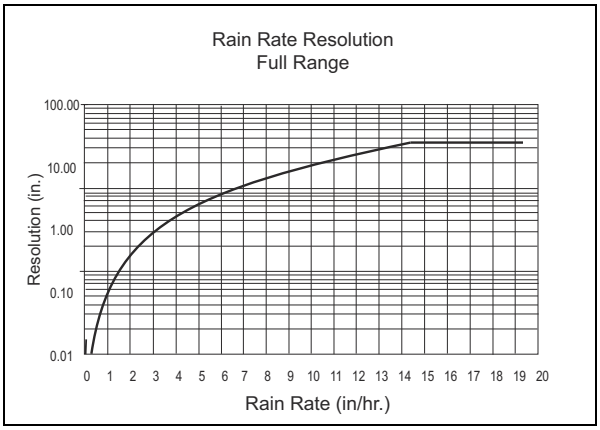


Figure 3. Full Range Rain Rate Resolution

Package Dimensions

Product #	Package Dimensions (Length x Width x Height)	Package Weight	UPC Codes
6152 6152EU 6152UK	17.0" x 11.0" x 13.0" (410 mm x 264 mm x 330 mm)	12.8 lbs. (5.8 kg)	011698 00229 0 011698 00347 1 011698 00348 8
6162 6162EU 6162UK		13.3 lbs. (6.0 kg)	011698 00306 8 011698 00307 5 001698 00308 2
6153 6153EU 6153UK	15.0" x 13.0" x 24.0" (378 mm x 327 mm x 594 mm)	12.8 lbs. (5.8 kg)	011698 00335 8 011698 00336 5 001698 00337 2
6163 6163EU 6163UK		13.3 lbs. (6.0 kg)	011698 00341 9 011698 00342 6 001698 00342 3

Product data sheet
Characteristics

HOM4252M200C
LD CTR HOM MB 240V 200A 1PH 42SP NEMA 1

Product availability: Stock - Normally stocked in distribution facility
Price*: 1313.00 USD

Main

Commercial Status	Commercialised
Product or component type	Load Center
Range of product	Homeline
Load center type	Convertible Mains (breaker)
[In] rated current	200 A
Number of spaces	42
Short-circuit current	22 kA
Number of circuits	52
Number of tandem circuit breakers	10
Network number of phases	1 phase
[Ue] rated operational voltage	120/240 V AC

Complementary

AWG gauge	4...250 AWG/kcmil copper 4...250 AWG/kcmil aluminium
NEMA degree of protection	NEMA 1 indoor
Cover type	Combination flush/surface cover
Device composition	Grounding bar (ordered separately)
Electrical connection	Lugs
Wiring configuration	3-wire
Material	Tin plated aluminium busbar
Enclosure material	Welded sheet steel
Cover finish	Gray baked enamel
Product certifications	UL listed file E-6294

Ordering and shipping details

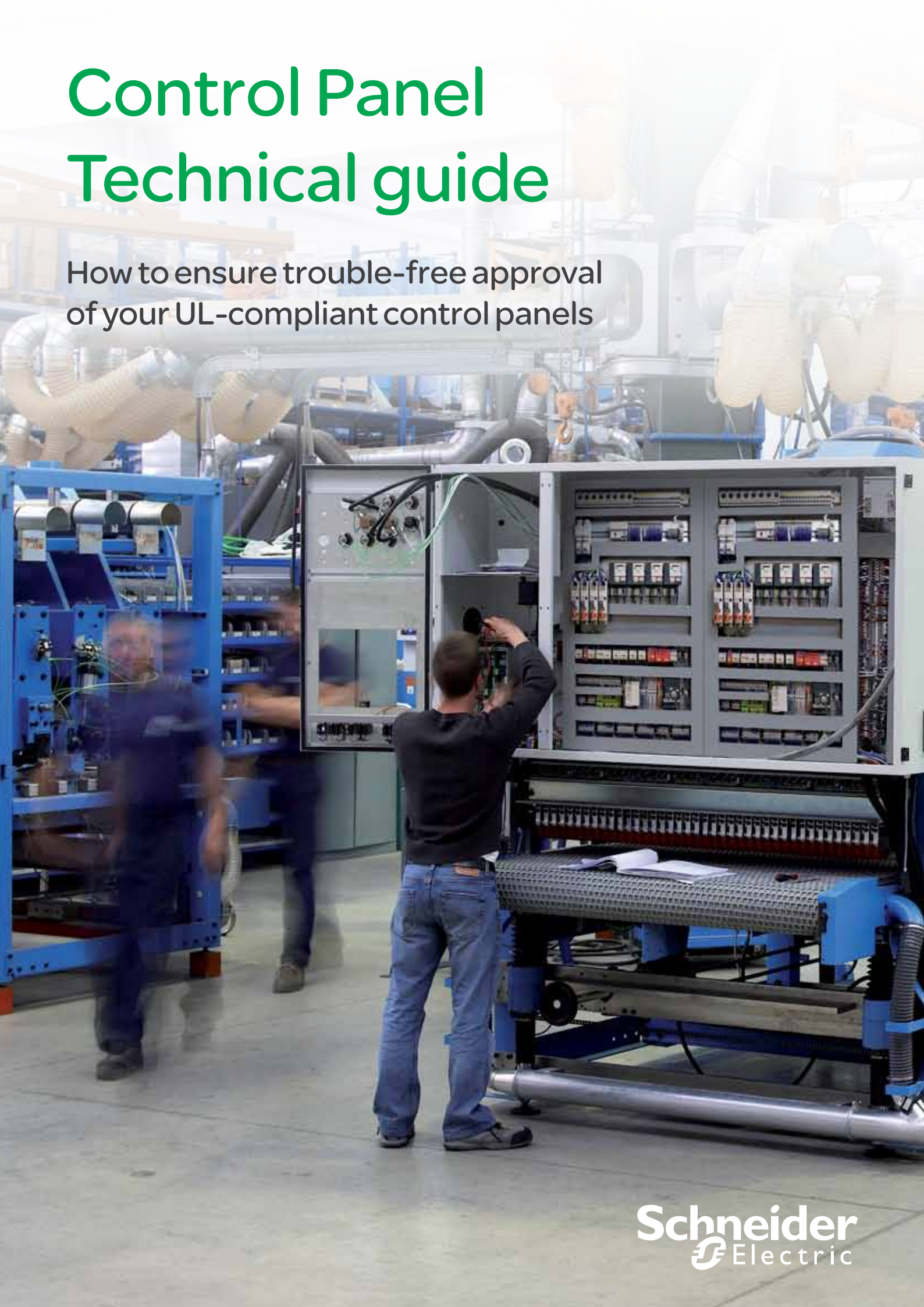
Category	00045 - HOM LC&CVR,12-42 CKT,NEMA1
Discount Schedule	DE3C
GTIN	00785901685340
Nbr. of units in pkg.	1
Package weight(Lbs)	38.00
Product availability	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	US

Contractual warranty

Period	Lifetime

Control Panel Technical guide

How to ensure trouble-free approval of your UL-compliant control panels



Schneider Electric

This guide* **explains certain points requiring special attention** for trouble-free **export sales**.

***This guide replaces neither the standards** (including UL 508A) that electrical equipment must comply with nor the requirements of standard professional practice. It is the responsibility of the equipment manufacturer to ensure compliance with all applicable standards.
Excerpts from UL 508A (Standard for Safety for Industrial Control Panels) are the property of Underwriter's Laboratories Inc.

Contents

UL compliance = Your visa for

Designing and building control panels for the U.S. market

UL standards = the key to the U.S. market

UL is the main certifying organisation in the United States. It develops standards for products, functional solutions and installation rules.

UL has laboratories that certify products submitted by manufacturers who wish to export to the U.S. They also certify that locally made products comply with applicable standards.

In U.S. industry, UL standards play the same role as IEC standards in Europe. Harmonisation efforts are underway.

Approval problems are frequent

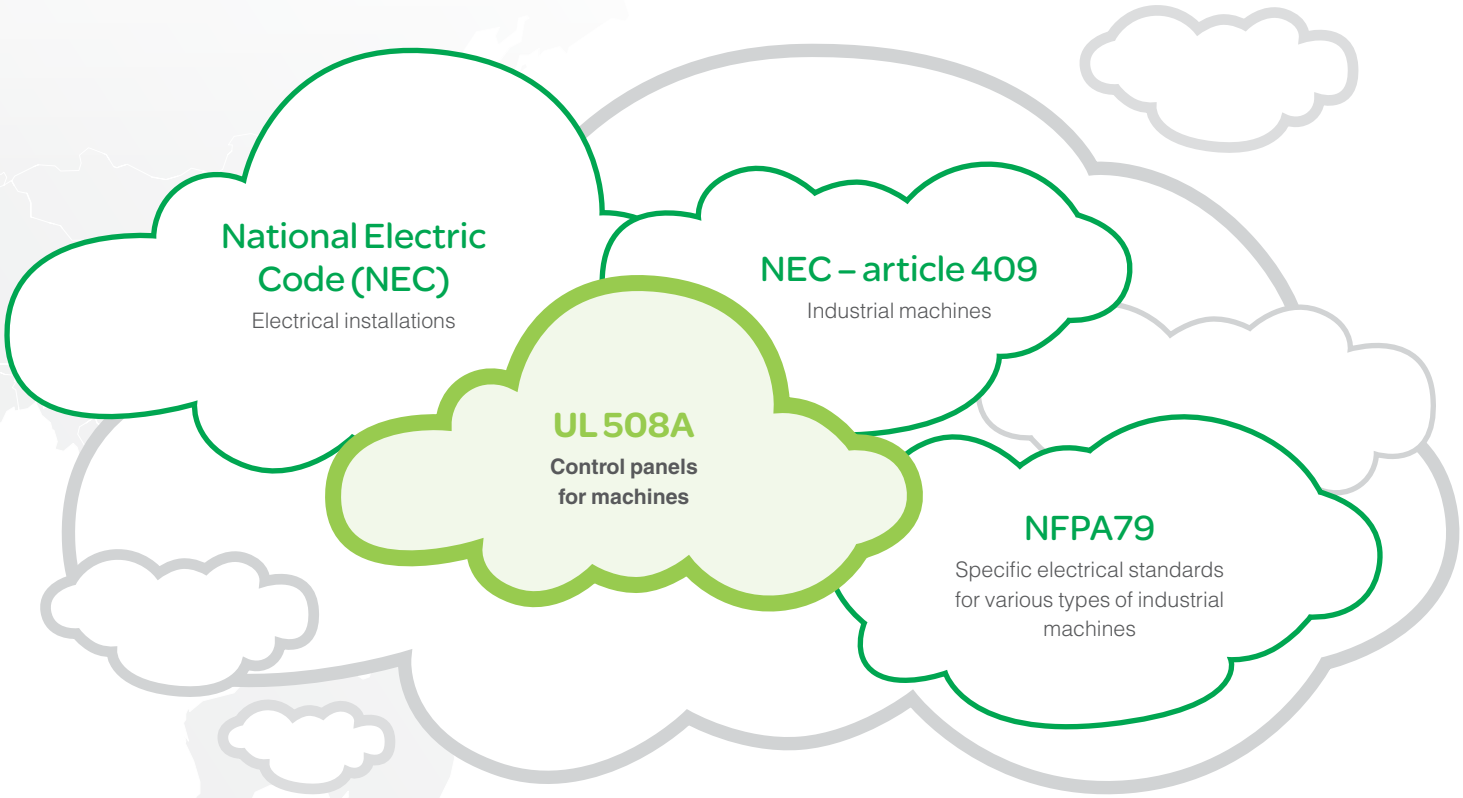
When machines are delivered in the U.S., an inspector delegated by an Authority Having Jurisdiction (AHJ) checks for compliance with UL standards and in particular with UL 508A.

The most frequently encountered problems with control panels are:

> Circuit breakers refused in spite of **UL certification**
> Non-compliant electrical clearances in a wiring distribution block, pre-wiring system or device
> Absence of name plates or incomplete indications of control panel characteristics.

the United States

Applicable standards in North America



These standards are presented on page 34.

AHJ inspections focus primarily on standard UL 508A.
This technical guide highlights certain critical aspects of this standard and proposes appropriate solutions.

Applicable standards from beginning to end of a project

1. Functional design of circuits: **UL 508A**
   For functional design and the calculation of ratings
2. Product selection: **UL 508-489-1077-98-508-508C-512**
   For verification of the presence of certificates of product compliance with applicable manufacturing standards.
3. Control panel design: **UL 508A**
   For wiring design, creation of name plate indications, etc.

1 UL standards and control

Definition of electrical circuits as per standard UL 508A *(chap. 2 and 6)*

Two types of power circuits are defined:

> **feeder circuits**: intended exclusively to supply power,

> **branch circuits**: connected to a load, with or without control functions.

Mandatory functions of feeder circuits

> Disconnection.

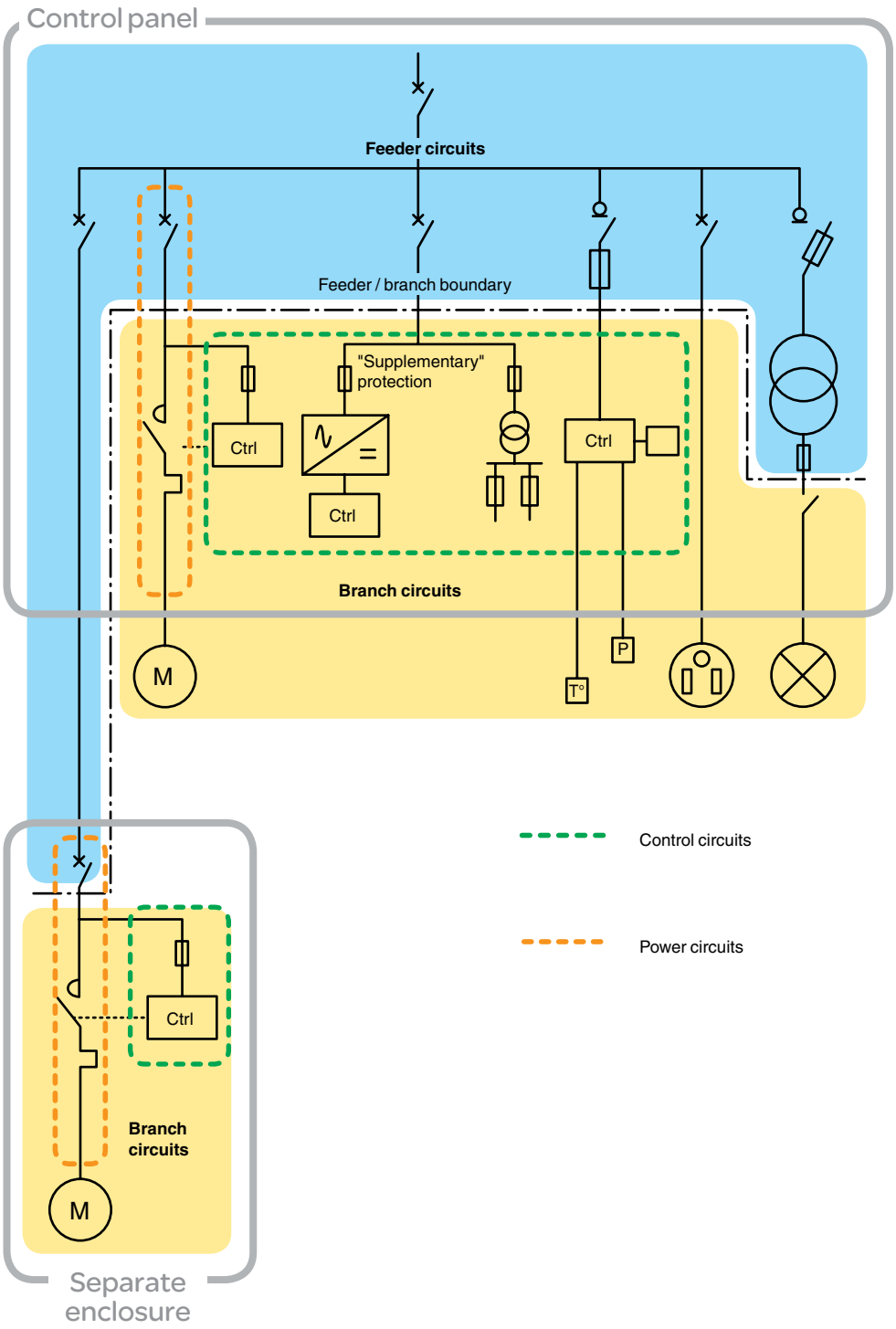
> Protection of branch circuits against overcurrents and short-circuits.
Disconnection and protection functions may be provided by a single device, e.g. a circuit breaker.

Feeder / branch circuit boundaries

Branch circuits begin **on the downstream side of the last short-circuit protective device**.

For a series of protective devices on a feeder circuit, it is the **last** device that marks the end of the feeder circuit.

For a transformer supplying a power circuit, the boundary is on the downstream terminals of the protective device on the secondary winding.



panel design

> Certifications required *(UL 508A chap. 30 to 32)* for feeder products

UL 489 for circuit breakers		**UL 98** for switches (with or without fuses) **UL 248** for fuses (if switches with fuses are used)	
			
PowerPact circuit breakers	*Multi9 C60* miniature circuit breakers	*Interpact* switch-disconnectors	*TeSys GS* switch-disconnector-fuse

The main disconnecting means may be supplied by the end user.
In this case, the machine supplier must clearly specify the required characteristics.

> Certifications required *(UL 508A chap. 40.1)* for supplementary protection

UL 1077	**UL 512 + UL 248**
	
Multi9 C60 miniature circuit breakers	*TeSys DF* fuseholder + fuses

Required electrical clearances differ considerably depending on the intended use of the product:

> Larger clearances for products on feeder circuits.

> Standard clearances for products on branch circuits.

Many approval problems arise because a product is not suited to the type of circuit (feeder, branch or control circuit).

LISTED

UL certifies that the product meets UL safety requirements for general use.

UL certifies that the system component meets UL safety requirements for use under restricted conditions known by the manufacturer.

2 UL standards and circuit

Design of a motor circuit as per standard UL 508 part IV and UL 508A *(chap. 31.3)*

Standard UL 508A distinguishes circuits according to their intended applications. For each, protection and control functions are stipulated. In the case of a motor feeder, a number of component combinations may be used to ensure the functions, however **six are recommended, namely A, B, C, D, E and F.**

The products used must satisfy a reference standard.

Recommended functions and devices

Disconnection

This function must disconnect all ungrounded conductors of a circuit from their electrical supply.

Approved devices

> Switches complying with UL 98.
> Moulded-case switches complying with UL 489.
> Instantaneous-trip (magnetic-only) or inverse-time (thermal-magnetic) circuit breakers complying with UL 489.
> Self-protected combination motor controllers complying with UL 508 (type E).

Alternatively, standard UL 508A allows the disconnecting means to be installed in the branch circuit.

Cable protection against overcurrents and short-circuits

Approved devices

> Fuses complying with UL 248 and approved for motor protection.
> Circuit breakers complying with UL 489 and UL 508.

Disconnection and protection functions may be provided by a single device.

Motor control

Approved devices

> Contactor.
> Manual self-protected combination motor controller.
> Any type of power-circuit controller (variable-speed drive, etc.).

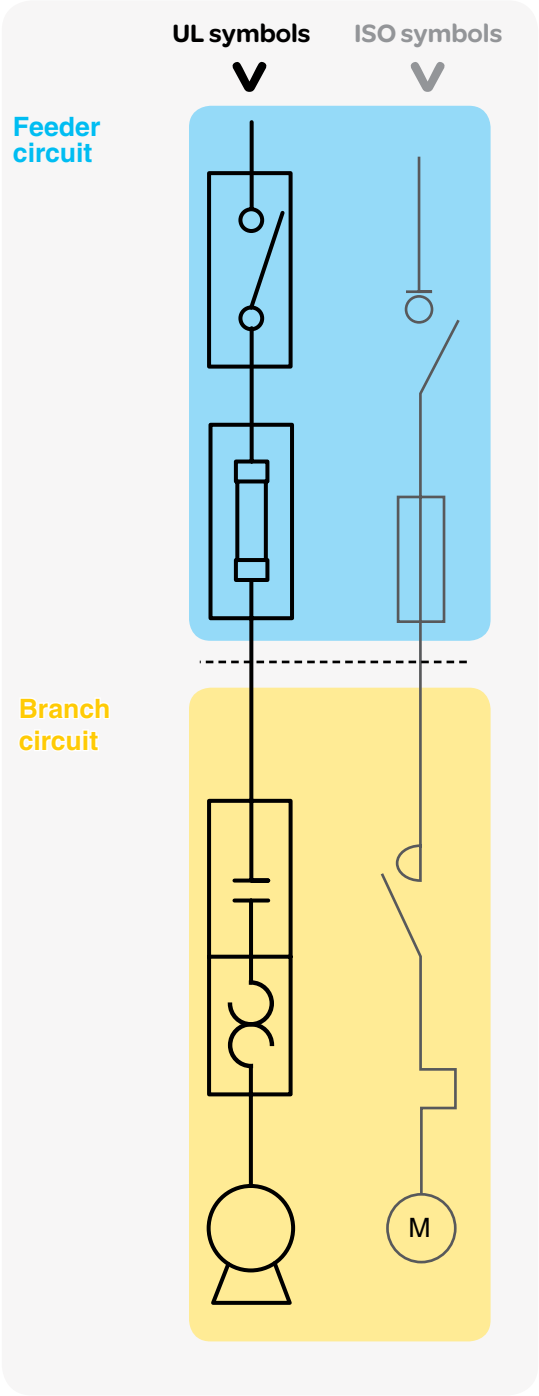
It may be advisable to select a product providing a disconnecting means as well. It must be certified as "suitable as motor disconnect" as per UL 508.

Motor protection against overloads

Approved devices

> Thermal relay or other type of device.
> Protective device built into the motor.

No particular requirements apply when the motor is "self-protected" by its design, e.g. by the impedance of the windings.



design

Standardised typical solutions for motor circuits *(UL 508 part IV and UL 508A chap.31.3, 33, 34)*

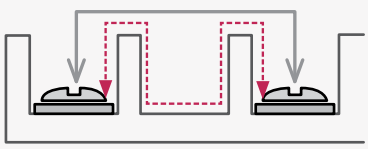
Separate protection and control devices[1]		Combination protection and control devices[2]	
UL 508 type A	**UL 508 type C or D**	**UL 508 type E**	**UL 508 type F**
Feeder circuit			
 Disconnection: UL 98 Fuses: UL 248 *Tesys GS*	 **C:** Inverse-time circuit breaker UL 489 *PowerPact* **D:** Instantaneous-trip circuit breaker UL 489	Self-protected combination motor controller: UL 508  Manual starter *Tesys GV2P* Combined starter controller *TeSys U*	Manual self-protected combination motor controller: UL 508 *TeSys GV2P*  Contactor: UL 508 *TeSys D*
Branch circuit			
 Contactor: UL 508 *TeSys D*	 Contactor: UL 508 *TeSys D*		
 Overload protection: UL 508 *TeSys LRD*	 Overload protection: UL 508 *TeSys LRD*		

[1] *Type B: UL 508 instantaneous-trip (magnetic-only) circuit breaker - rarely used.*
[2] *These solutions simultaneously provide the necessary functions for the feeder and branch circuits.*

Warning
When choosing each product, **check that it complies with its reference standard** and that it is suitable for motor control and/or protection.

Visually distinguish between feeder and branch products

The required clearances for the terminals of devices connected to feeder circuits are greater. This rule applies to all devices, e.g. distribution blocks, fuseholders, circuit breakers, switches, etc.



Minimum clearances

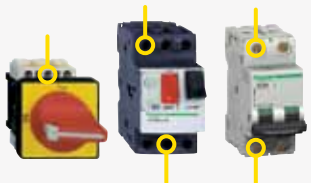
⟷	In air: 1 inch (25.4 mm)
◂----▸	Creepage distance: 2 inches (50.8 mm)

Products certified UL 489, UL 98 and UL 508 type E comply with these clearances, often through the use of spacing accessories.
It is necessary to check that the accessories are included.

> Terminals with larger clearances
= Products for use on feeder circuits

Interpact, Multi9 C60,TeSys GS, TeSys GV2P

> Terminals with standard clearances
= Products for use on branch circuits



Vario,TeSys GV2ME, Multi9 C60

2 UL standards and circuit

Sizing single-motor protective devices *(UL 508A chap. 31.3)*

Protective devices avoid damage to conductors in the event of overcurrents or short-circuits. For maximum protection ratings, see the table below. Use of certain types of devices imposes significant oversizing.

Protection performance is the main criterion

Overcurrent/short-circuit protection is optimised when its rating is equal to the full-load current of the motor.

Why are UL 508 type E and F solutions preferred?

UL 508 type E and F solutions are highly effective because they are the only ones for which the maximum rating = motor full-load current.

They combine all the mandatory protection functions in a very compact format:

- **protection of the branch circuit** against short-circuits and overcurrents,
- **protection of the motor cable**,
- **protection of the motor** against overloads.

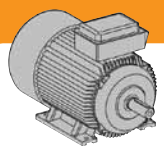
These solutions saves space by using special installation systems (comb busbars, terminal blocks).

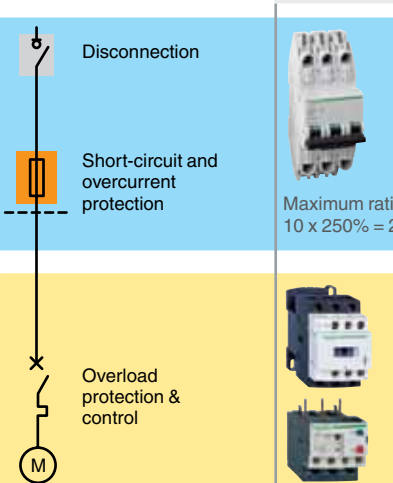
Maximum rating of motor branch circuit device, % of full-load amperes

Type of branch circuit protective device	Ampere rating	Maximum rating	Type of protection (UL 508)
	(A)	% full load	
Nontime-delay fuse	0-600	300	A
	> 600	300	A
Dual-element fuse (time delay) except class CC	All	175	A
Class CC dual-element fuse (time delay)	0-30	300	A
Inverse-time (thermal-magnetic) circuit breaker	0-100	250	C
	> 100	250	C
Instantaneous-trip (magnetic) circuit breaker	All	800	D
Self-protected combination motor controller	**All**	**100**	**E**
Manual self-protected combination motor controller	**All**	**100**	**F**

Feeder circuit

Example: **What are the solutions for this 10 A motor?**





	1 x	1 x	2... N x	
	Conventional	Optimised for single motor		For motor group
	Type C	Type E	Type F	Type E	Type F
Feeder circuits	Maximum rating 10 x 250% = 25 A				
Branch circuits	Rating 10 A	Maximum rating 10 x 100% = 10 A		Maximum rating 10 x 100% = 10 A With comb busbars and terminal blocks	

design (cont.)

Design of a single-motor circuit controlled by a variable-speed drive (VSD)

Required functions and devices
(UL 508A chap. 31.3.2)

Disconnection

This function must disconnect all ungrounded conductors of a circuit from their electrical supply.

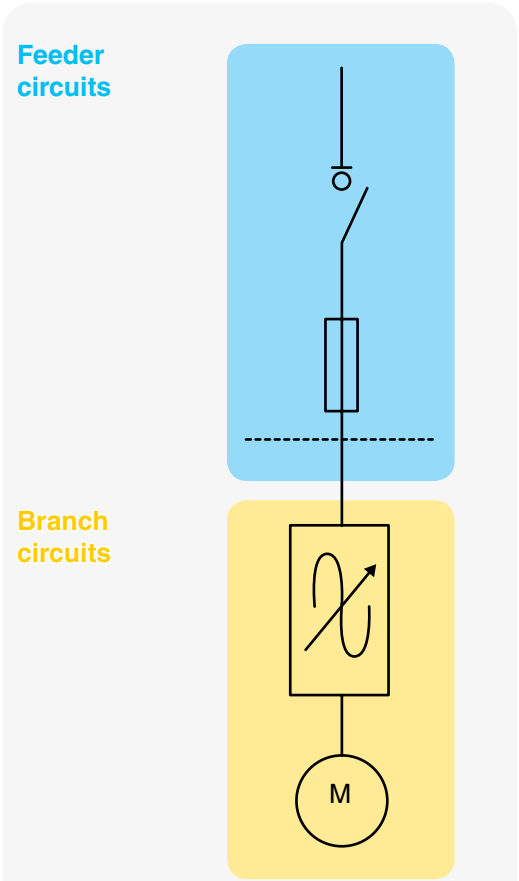
Approved devices

> Switch complying with UL 98.
> Moulded-case switch complying with UL 489.
> Inverse-time (thermal-magnetic) circuit breaker complying with UL 489.
> Self-protected combination motor controller complying with UL 508 type E or F.

Cable protection against overcurrents and short-circuits

> Comply with the devices and ratings recommended by the VSD manufacturer, e.g. fuse (UL 248), circuit breaker (UL 489) or self-protected combination motor controller (UL 508 type E).

> If no recommendations are made, then use fuses (UL 248) or circuit breakers (UL 489). See the ratings in the table on page 10 *(250% of VSD full-load current for a circuit breaker).*



In addition to protection using fuses or a circuit breaker, Schneider Electric **Altivar** VSDs have been **certified for TeSys GV2P and GV3P UL 508 type E self-protected combination motor controllers**.

Disconnection / protection using a TeSys GV2P motor starter and an Altivar ATV32 VSD.

2 UL standards and circuit

Protecting a group of motors using a single device *(UL 508A chap. 31.4)*

The standard authorises a group of motors to be supplied by a single feeder circuit, in which case there is a single protective device.

Rules to check that the rating of the single device complies with the standard

1

This rule is applicable when:
the protection setting for the group does not exceed 20 A / 125 V or 15 A / 240, 480 or 600 V, and the rated current of each motor is less than 6 A.

> Each component in the circuits must be effectively protected by the device protecting the group.
> Other non-motor loads must have their own short-circuit protection.

2

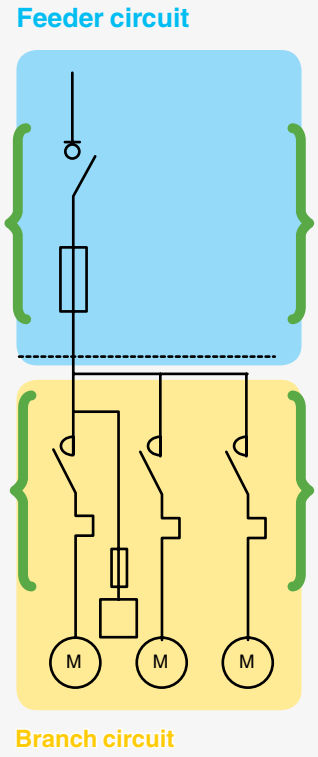
This rule is applicable when:
the circuit of the smallest motor in the group is protected.

> The size of cables in each circuit of the group must be ≥1/3 the size of the upstream cable.
> Other non-motor loads must have their own short-circuit protection.

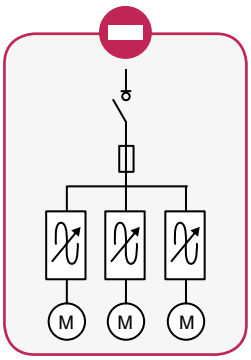
3

This rule is applicable when:
all components (contactors and overload protection) on the downstream side of the group protection are certified for "group installation".

The rating of the group protection is less than both of the following:
> the protection rating for the largest load (similar to the method for a single-motor circuit) + the total of the currents of all other loads in the group,
> the maximum protection rating indicated for each component on the downstream side.



Protection for a group of VSDs



This configuration is not authorised.

design (cont.)

Typical solutions for protection and control of a group of motors

Group protection

Protection against overcurrents and short-circuits: UL 489

Circuit breakers or fuses

PowerPact

Multi9 C60

Single-motor protection and control

Contactor + thermal relay (UL 508)

TeSys D

TeSys LRD

Manual starter + contactor (UL 508)

TeSys GV2ME

+

TeSys K

Combined starter controller (UL 508)

TeSys U

Application example

Protecting and controlling a group of six motors

> **1 motor 1.1 kW / 480 V (2.7 A)**
> **5 motors 0.55 kW / 480 V (1.1 A)**

The selected rule is the "each motor < 6 A" rule.

Group protection

> Multi9 C60 C curve circuit breakers, certified UL 489

> Maximum current = (250% x 2.7) + (5 x 1.1) = 12.25 A

> Next lowest rating selected = 10 A

Protection for single-motor circuits

> Distribution via 2 busbars (GV2G345 + GV2G445) + 1 terminal block (GV1G09)

> 1 x GV2ME07 and 5 x GV2ME06 motor starters, can be coordinated with protection rated up to 125 A, 6 x LC1K09 contactors

> Direct link between GV2ME starters and contactors using GV2AF01 manual starter combo blocks

2 UL standards and circuit

Sizing single-load protective devices **for other circuits** *(UL 508A chap. 31.6, 31.7, 31.8)*

Heater loads
UL 508A – chap. 31.6

Maximum protection rating = 60 A
> 125% of the heater load current.

Appliance loads
UL 508A – chap. 31.7

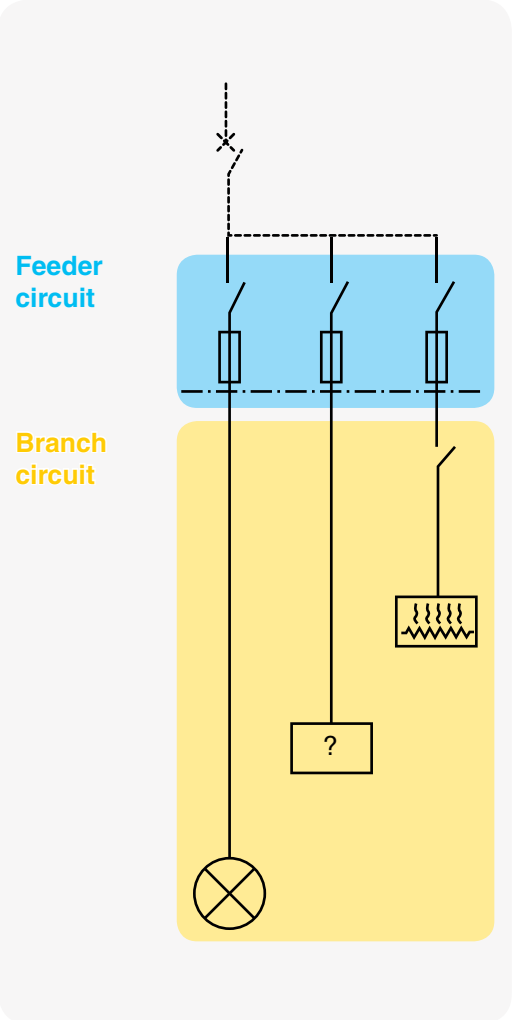
Sizing shall be based on the required branch protection as marked on the appliance AND:

Maximum protection rating = 20 A
> for loads rated less than 13.3 A:
  - 100% of the load ampere rating
> for loads rated 13.3 A and more:
  - 150% of the load ampere rating.

Lighting loads
UL 508A – chap. 31.8

Standard-duty lighting
> Incandescent lampholders
> Fluorescent ballasts
  - Maximum protection rating = 20 A

Heavy duty lighting
> Incandescent lampholders
> Infrared lamps
  - Maximum protection rating = 50 A.



The protection rating may **never** exceed the ampacity of the anticipated field wiring.

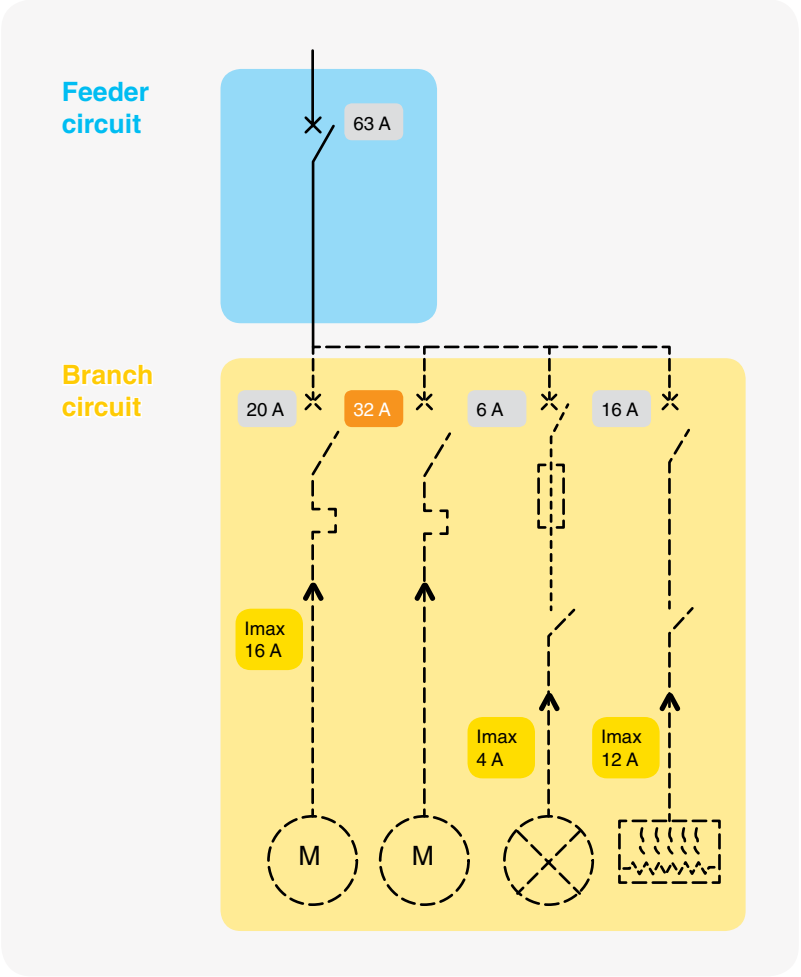
design (cont.)

Sizing the protection for a control panel incomer (feeder circuit)

Protection using a circuit breaker
As part of the feeder circuit, the disconnection and protection circuit breaker must be **certified UL 489.**

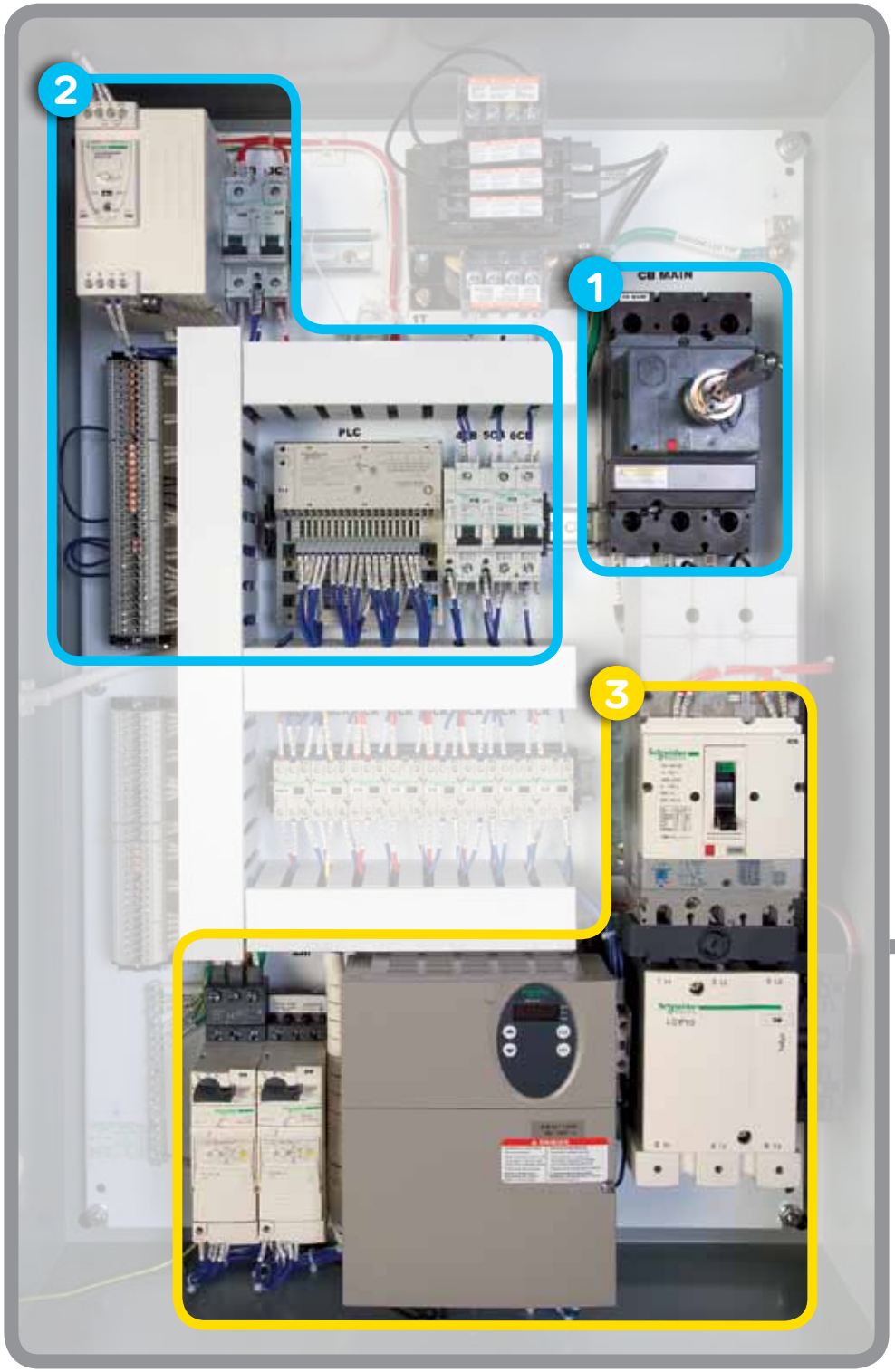
Maximum rating
Protection rating of the largest load **+** the sum total of the maximum currents of the other loads

Example (see opposite)
***32** + **16** + **4** + **12** = 64*
*I.e. **rating = 63 A***



The protection rating must **never** exceed the ampacity of the anticipated field wiring.

Selecting products for UL control panels



1

Feeder circuits

Disconnection devices

Incoming protective devices.

2

Feeder circuits

Branch circuit protective devices.

3

Branch circuits

Motor control and overload protection devices

Variable-speed drives.

1 Feeder circuits / panel incomer

Moulded-case circuit breakers

PowerPact UL 489 / IEC 947-2

> With its robust design and many innovative features, the **PowerPact** range is intended mainly for **industrial applications**.

> Range from **5 to 600 A**.

> Auxiliary devices and accessories for maximum flexibility of use.

PowerPact										
Breaker type		HD	HG	HJ	JD	JG	JJ	LD	LG	LJ
Number of poles		3	3	3	3	3	3	3	3	3
Current range		15-150	15-150	15-150	150-250	150-250	150-250	250-600	250-600	250-600
Interrupting ratings										
UL/CSA/NOM rating (kA RMS) (50/60 Hz AC)	240 Vac	25	65	100	25	65	100	25	65	100
	480 Y/277 Vac	...	...	...	...	...	...	...	...	...
	480 Vac	18	35	65	18	35	65	18	35	65
	600 Y/347 Vac	...	...	...	...	...	...	...	...	...
	600 Vac	14	18	25	14	18	25	14	18	25
DC ratings	250 Vdc	20	20	20	20	20	20	...	...	...
	500 Vdc	...	...	...	...	20	...	...	...	...
IEC 60947-2 kA RMS (50/60 Hz AC) Icu/Ics	220/240 Vac	25/25	65/65	100/100	25/25	65/65	100/100	25/25	65/65	100/100
	380/415 Vac	18/18	35/35	65/65	18/18	35/35	65/65	18/18	35/35	65/65
Accessories										
Shunt Trip		●	●	●	●	●	●	●	●	●
Undervoltage Trip		●	●	●	●	●	●	●	●	●
Auxiliary Switches		●	●	●	●	●	●	●	●	●
Handle Operators		●	●	●	●	●	●	●	●	●
Mechanical Interlocks		●	●	●	●	●	●	●	●	●
Handle Padlock Attachment		●	●	●	●	●	●	●	●	●
Trip System Type										
Thermal magnetic		●	●	●	●	●	●	...	...	...
Electronic		●	●	●	●	●	●	●	●	●
Enclosure										
Dimensions (3-pole unit mount)	Height mm (in.)	163 (6.4)			191 (7.5)			340 (13.38)		
	Width mm (in.)	104 (4.1)			104 (4.1)			140 (5.51)		
	Height mm (in.)	111 (4.4)			127 (5)			168 (6.6)		

Moulded-case switches

InterPact UL 489 / IEC 947-3

> The InterPact UL 489 provides the **mandatory disconnection** function, in particular when the branch circuit protection is installed outside the control panel.

> Range from **40 to 400 A**

> Auxiliary devices and accessories for maximum flexibility of use.

InterPact	Short-circuit current rating (SCCR)	Associated upstream protective device
INSE80 – 3, 4 poles 40, 60, 80 A		
	10 kA / 600 V	All protective devices
	100 kA / 240 V	PowerPact H 100 A circuit breaker
	65 kA / 480 V	
	18 kA / 600 V	
	50 kA / 600 V	Special Class T or RK 100 A fuse
INSJ400 – 3, 4 poles 250, 400 A		
	20 kA / 600 V	All protective devices
	150 kA / 240 V	PowerPact L 400 A circuit breaker
	100 kA / 480 V	
	25 kA / 600 V	
	50 kA / 600 V	Special Class T or RK 100 A fuse

2 Feeder circuits / branch circuit

Miniature circuit breakers
Multi 9 C60 UL 489 / IEC 947-2

Installation system for Multi9 C60 UL

Comb busbars with accessories, e.g. terminal blocks, terminal shields, tooth-caps, etc.

Miniature circuit breakers							
Breaker type		**Multi 9**	**UL 489 C60 (120/240 V)**		**UL 489 C60 (480Y/277 Vac)**		
Number of poles		1	2	3	1	2	3
Current range		0.5-35	0.5-35	0.5-35	0.5-20	1-20	1-20
Interrupting ratings							
UL/CSA rating (kA RMS) (50/60 Hz AC)	120 Vac	10	...	...	10	...	...
	120/240 Vac	...	...	...	...	...	...
	240 Vac	10	10	10	10	10	10
	277 Vac	...	...	...	10	10	10
	480 Y/277 Vac	...	...	...	10	10	10
	480 Vac	...	...	...	...	...	...
	600 Y/347 Vac	...	...	...	...	...	...
	600 Vac	...	...	...	...	...	...
DC ratings	48 Vdc	...	...	...	...	...	...
	60 Vdc	10	10	...	...	...	...
	125 Vdc	...	10	...	...	...	...
	250 Vdc	...	...	...	...	...	...
	500 Vdc	...	...	...	...	...	...
IEC 60947-2 (50/60 Hz AC)	240 V	10	20	20	10	10	10
	415 V	10	10	10	10	10	10
	440 V	...	6	6	...	6	6
Accessories							
Shunt Trip		●	●	●	●	●	●
Undervoltage Trip		●	●	●	●	●	●
Auxiliary Switches		●	●	●	●	●	●
Handle Operators		●	●	●	●	●	●
Handle Padlock Attachment		●	●	●	●	●	●
GF Protection (GFP)		●	●	●	●	●	●
Enclosures							
Dimensions (3-pole unit mount)	Height mm (in.)	107 (4.21) (box lug)			141 (5.55)		
	Width mm (in.)	54 (2.13)			54 (2.13)		
	Depth mm (in.)	76 (3.00)			76 (3.00)		

Switch-disconnector-fuses

TeSys GS UL 98 / IEC 947-3

Switches					
Type	**GS1DDU3**	**GS1DU3**	**GS1 EERU**		**GS2…**
Number of poles	3	3	2	3	3
Interrupting rating	30	30	30	30	30… 80
Fuse type	J	CC	CC	CC	CC, J, L
Handle operator					
Front	●	●	●	●	●
Side			●	●	
Direct	●	●	●	●	●
Remote	●	●			●
Auxiliaries					
	Early-break contacts On/off and test position indication contacts				

Fuseholders

TeSys DF UL 512 / IEC 947-3

Fuseholders					
Type	**DF8**	**DF10**	**DF14**	**DF22**	**DFCC**
Number of poles	1-2-3-N 1+N-3+N	1-2-3-N 1+N-3+N	1-2-3-N 1+N-3+N	1-2-3-N 1+N-3+N	1-2-3-N
Maximum rating (A)	25	32	50	125	30
Fuse type	8.5 x 31.5	10 x 38	14 x 51	22 x 58	CC
UL certification	UR	UR	UR	UR	UL
Auxiliaries					
	Early-break contacts Fuse-blown indication contacts				

2 Feeder circuits + 3 Branch

Motor starters – Type E UL 508 – Type F UL 508 / IEC 947-4-1

TeSys GV2P motor starters – TeSys LC1D contactors

TeSys GV2P with GV2GH7 line spacer for one motor starter or with GV1G09 terminal block and GV2G busbars for several motor starters — File UL E164871.

Standard motor ratings for motors 50/60 Hz (HP)						Associated cable	Type of manual Self protected starter	Overload trip range (A)	Type of contactor required	SCCR (KA) 480Y/277V
1Ph - 120 V	1Ph - 240 V	3Ph - 200 V	3Ph - 240 V	3Ph - 480 V	3Ph - 600 V	Type 75°C-Cu	Type E		Type F GV2P + x	
				-		AWG10	GV2P01	0.1 - 0.6	LC1D09 or D12	100
				-		AWG10	GV2P02	0.16 - 0.25	LC1D09 or D12	100
				-		AWG10	GV2P03	0.25 - 0.4	LC1D09 or D12	100
				-		AWG10	GV2P04	0.4 - 0.63	LC1D09 or D12	100
				0.5		AWG10	GV2P05	0.63 - 1	LC1D09 or D12	100
				0.75		AWG10	GV2P06	1 - 1.6	LC1D09 or D12	100
		0.5	0.5	1		AWG10	GV2P07	1.6 - 2.5	LC1D09 or D12	100
		0.75	1	2		AWG10	GV2P08	2.5 - 4	LC1D09 or D12	100
		1.5	1.5	4		AWG10	GV2P10	4 - 6.3	LC1D09 or D12	100
0.5	1	2	3	5	7.5	AWG10	GV2P14	6 -10	LC1D09 or D12	100
1	2	3	3	10	10	AWG8	GV2P16	9 - 14	LC1D12 or D18	42
1	3	5	5	10	15	AWG8	GV2P20	13 - 18	LC1D12 or D18	42
2	3	5	7.5	15	20	AWG8	GV2P21	17 - 23	LC1D25 or D32	42
2	3	5	7.5	15	20	AWG8	GV2P22	20 - 25	LC1D25 or D32	42

TeSys GV3P UL 508 motor starters – TeSys LC1D contactors

TeSys GV3P with GV3G66 line spacer and GVAM11 magnetic trip unit for one motor starter — File UL E164871.

Standard motor ratings for motors 50/60 Hz (HP)						Associated cable	Type of manual Self protected starter	Overload trip range (A)	Type of contactor required	SCCR (kA) 480Y/277V	SCCR (kA) 600Y/347V
1Ph - 120 V	1Ph - 240 V	3Ph - 200 V	3Ph - 240 V	3Ph - 480 V	3Ph - 600 V	Type 75°C-Cu	Type E		Type F GV3P + x		
1	2	3	3	7.5	10	AWG8	GV3P13	9 - 13	LC1D18	65	25
1	3	3	5	7.5	10	AWG8	GV3P18	12 - 18	LC1D18	65	25
2	3	5	7.5	15	20	AWG6	GV3P25	17 - 25	LC1D25	65	25
2	3	7.5	7.5	20	25	AWG6	GV3P32	23 - 32	LC1D32	65	25
3	5	10	10	25	30	AWG3	GV3P40	30 - 40	LC1D40A/50A/65A	65	25
3	7.5	10	10	30	40	AWG3	GV3P50	37 - 50	LC1D50A/65A	65	25
5	10	15	15	40	50	AWG3	GV3P65	48 - 65	LC1D65A/80	65	25

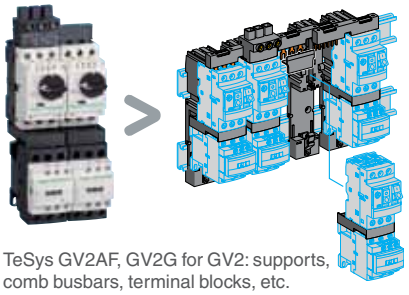
TeSys U combination motor starters

TeSys U with LU9SPO line spacer for one motor starter or with GV1G09 terminal block and GV2G09 busbars for several motor starters — File UL E164871.

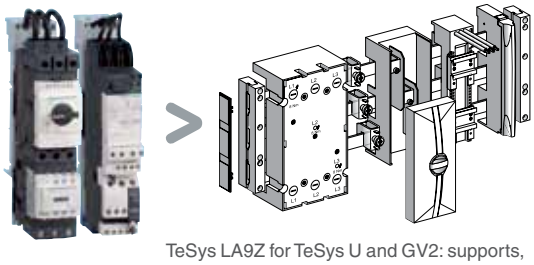
Standard motor ratings for motors 50/60 Hz (HP)						Associated cable	Type of self protected combination starter	Overload trip range (A)	SCCR (kA) 480VY/277V	SCCR (kA) 480 V	SCCR (kA) 600 V
1Ph - 120 V	1Ph - 240 V	3Ph - 200 V	3Ph - 240 V	3Ph - 480 V	3Ph - 600 V	Type 75°C-Cu	Type E			with LUALB1 limiter	with LUALB1 limiter
1.5	2	3	3	10	10	AWG8	LUB12	... 12	65	130	65
2	5	10	10	20	25	AWG8	LUB12	... 32	65	130	

SCCR values are for one motor starter or several starters (with GV1G09 terminal block + GV2G busbars) when a limiter block is used.
TeSys U comprises a power control base and functional modules, e.g. alarms, measurement, communication. A reverser unit is available for reverse operation (see illustration below). Certification obtained with LU9SPO line spacer on LUB12 and LUB32.

Mounting and connection systems for several motor starters



TeSys GV2AF, GV2G for GV2: supports, comb busbars, terminal blocks, etc.



TeSys LA9Z for TeSys U and GV2: supports, busbars, terminal blocks, etc.

Starter + VSD combination

GV2P or GV3P motor starter with ATV32 variable-speed drive

Type E manual self-protected combination motor controllers protect circuits controlled by a variable-speed drive. Schneider Electric has had a number of combinations certified.

VSD	Type E combination motor controller	
Type	Model	Characteristics at 500 V: rating, SCCR
ATV32H018M2	GV2P08/P09 + GV2GH7	4 A, 65 kA
ATV32H037M2	GV2P10 + GV2GH7	6.3 A, 65 kA
ATV32H055M2	GV2P14 + GV2GH7	10 A, 65 kA
ATV32H075M2	GV3P13 + GV3G66 + GVAM11	12 A, 65 kA
ATV32HU11M2	GV3P18 + GV3G66 + GVAM11	18 A, 65 kA
ATV32HU15M2	GV3P25 + GV3G66 + GVAM11	25 A, 65 kA
ATV32HU22M2	GV3P25 + GV3G66 + GVAM11	25 A, 65 kA
ATV32H037N4	GV2P07 + GV2GH7	2,5 A, 65 kA
ATV32H055N4	GV2P07 + GV2GH7	2,5 A, 65 kA
ATV32H075N4	GV2P09 + GV2GH7	4 A, 65 kA
ATV32HU11N4	GV2P08 + GV2GH7	4 A, 65 kA
ATV32HU15N4	GV2P10 + GV2GH7	6.3 A, 65 kA
ATV32HU22N4	GV2P14 + GV2GH7	10 A, 65 kA
ATV32HU30N4	GV2P14 + GV2GH7	10 A, 65 kA
ATV32HU40N4	GV3P13 + GV3G66 + GVAM11	13 A, 65 kA
ATV32HU55N4	GV3P18 + GV3G66 + GVAM11	18 A, 65 kA
ATV32HU75N4	GV3P25 + GV3G66 + GVAM11	25 A, 65 kA
ATV32HD11N4	GV3P32 + GV3G66 + GVAM11	32 A, 65 kA
ATV32HD15N4	GV3P40 + GV3G66 + GVAM11	40 A, 65 kA

3 Branch circuits

Miniature circuit breakers for supplementary protection

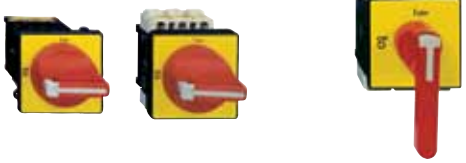
Multi 9 C60 UL1077 / IEC 947-2

Miniature circuit breakers						
Breaker type		**UL 1077 C60N**			**UL 1077 C60H-DC**	
Number of poles		1	2	3, 4	1	2
Current range		0.5-63	0.5-63	1-63	0.5-40	0.5-40
Interrupting ratings						
UL/CSA rating (kA RMS) (50/60 Hz AC)	120 Vac	10	...	...	...	...
	120/240 Vac	...	...	...	...	...
	240 Vac	10	10	10	...	...
	277 Vac	5	...	...	...	...
	480 Y/277 Vac	...	5	5	...	...
	480 Vac	...	...	...	...	...
	600 Y/347 Vac	...	...	...	...	...
	600 Vac	...	...	...	...	...
DC ratings	48 Vdc	...	...	...	5	5
	60 Vdc	10	...	...	5	5
	125 Vdc	...	10	...	5	5
	250 Vdc	...	...	...	5	5
	500 Vdc	...	...	...	...	5
IEC 60947-2 (50/60 Hz AC)	240 V	20	20	20	10	20
	415 V				...	...
	440 V	...	6	6	...	10
Accessories						
Shunt Trip		●	●	●	●	●
Undervoltage Trip		●	●	●	●	●
Auxiliary Switches		●	●	●	●	●
Handle Operators		●	●	●	●	●
Handle Padlock Attachment		●	●	●	●	●
GF Protection (GFP)		●	●	●	●	●
Enclosures						
Dimensions (3-pole unit mount)	Height mm (in.)	81.02 (3.19)			81 (3.19)	
	Width mm (in.)	54 (2.13)			18 (.71)	36 (1.42)
	Depth mm (in.)	76 (3.00)			65 (2.56)	

Switches

TeSys Vario UL 508 / IEC 947-3

> **UL 508 certified**, suitable for use as a motor disconnect in a branch circuit.



Warning
NOT UL 98 certified

May not be used in a feeder circuit.

TeSys Vario loadbreak switches				
Vario range	**Standard Mini-Vario**	**Vario High performance**		**Vario High performance**
Thermal current	12 – 20 A	12 – 20 A	63 – 80 A	125-175 A
Number of poles	3…5	3…6	3…6	3 + N + PE
Handle attachment	Diam. 22.5 or 4 screws	Diam. 22.5 or 4 screws	4 screws	4 screws

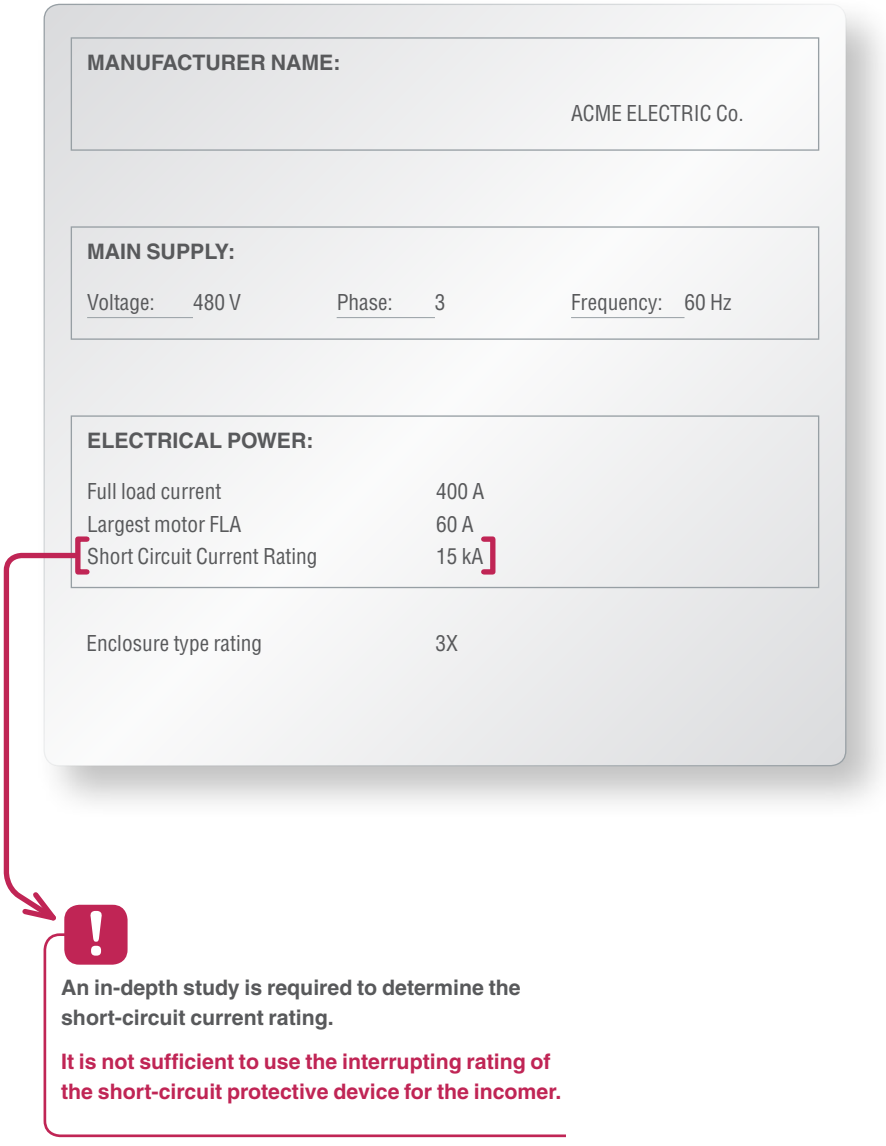
Control panel name plate

All control panels containing power circuits must have a name plate indicating:

- the main characteristics, in particular the **Short Circuit Current Rating (SCCR)**,
- any specific characteristics concerning its functions.

The name plate must be **clearly visible** after installation, with the door open.

Control panels containing only control devices are exempted.



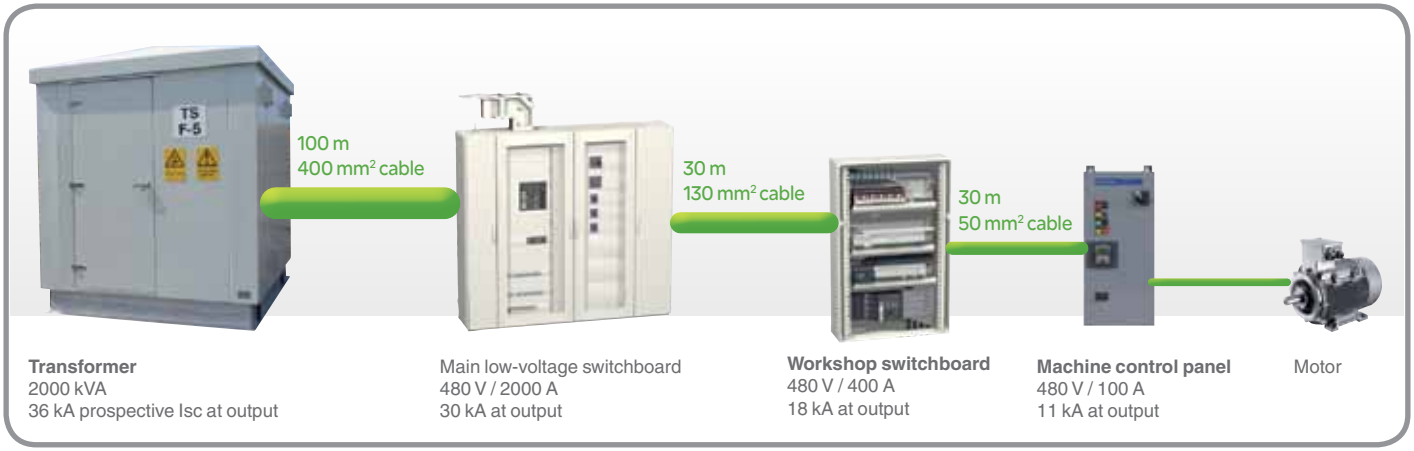
SCCR (short-circuit current rating) of the control panel

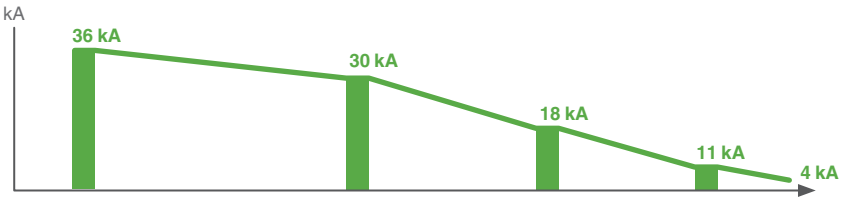
- UL 508A supplement SB

SCCR, a critical characteristic for safety

If the design calculations do not take the electro-dynamic effects of short-circuits into account, they can result in deformation, destruction of connectors and even the explosion of certain components.

The SCCR is an essential characteristic in the technical specifications of the control panel that contributes to overall dependability.
It is used when sizing the power conductors and components.





Value calculated at the connection point to the switchboard/control panel

= Decrease of short-circuit current with the size and length of the conductor

An over-designed SCCR = money down the drain

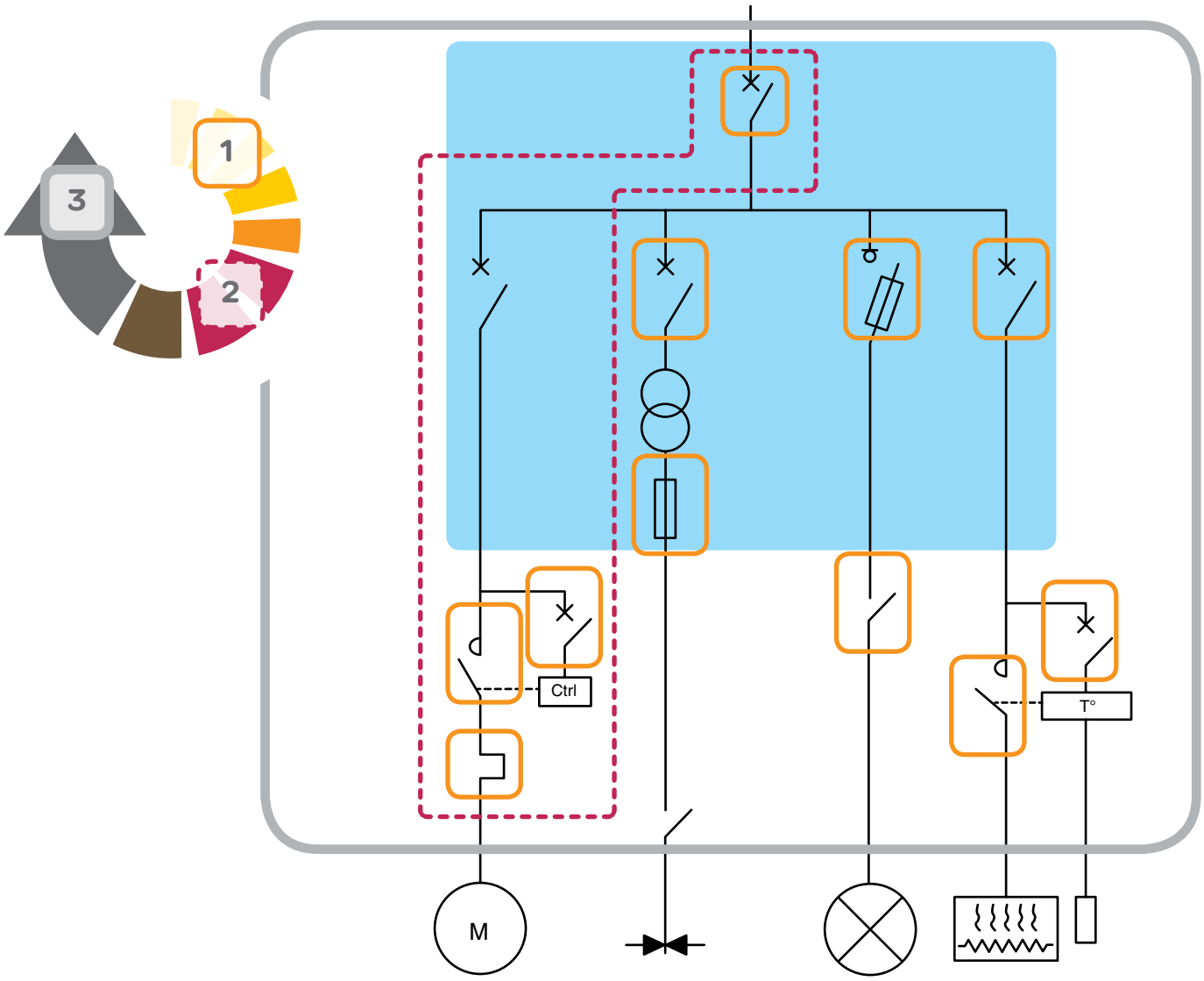
Designing panels with high SCCR values impacts heavily on technological choices (connection systems, type and size of conductors) and on the selection of components. The cost of a control panel is directly proportional to the SCCR imposed by the customer.

It is important in terms of cost effectiveness to check that the requested SCCR is consistent with the expected characteristics of the electrical installation. If in doubt, discuss the matter with the customer.

A control panel with an SCCR of 5 kA is just as safe as a panel with an SCCR of 65 kA if the short-circuit current is correctly calculated.

SCCR calculation method

> Three design phases



1 SCCR of components

Identify the SCCR of **each protection and/or control component and each distribution block and element in the distribution system**. Use manufacturer data if available or standard values.

2 SCCR of circuits

Determine the SCCR of **each branch circuit**. Use the values of the components of the circuit and apply the rules provided by UL 508A.

3 SCCR of the control panel

Determine the SCCR of **the complete control panel**. Use the values of the circuits and apply the rules provided by UL 508A.

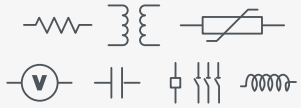
> Phase 1. Identify the SCCR of each component

What is the SCCR of this component?

UL LISTED

No → ⛔

Ok ↓



Yes → **SCCR not required for this component**

No ↓

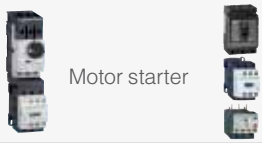
Exists → **Use the SCCR on the name plate or in the manual**

Applicable for a circuit not supplying more than:

Prot. type	I max.	V max.	SCCR (kA)	Group installation*	
C.I. fuse	90	600	100	480Y/277V	600Y/347V
C.B.	110	480	**100**	50 kA	25 kA
C.B.	-	600	25	50 kA	25kA

** With GV3P motor starter, maximum rating 300 A.*

~~Does not exist~~ ↓



Yes → Assembly SCCR assessed by **UL 508** tests with upstream protection of circuit?

Yes → **Use the SCCR indicated by the manufacturer's test. Use only products tested together.**

No

No ↓

Use the standard value shown in table SB4.1 (see annex)

↓

Other component?

No → Phase 2. Determine the SCCR of each branch circuit

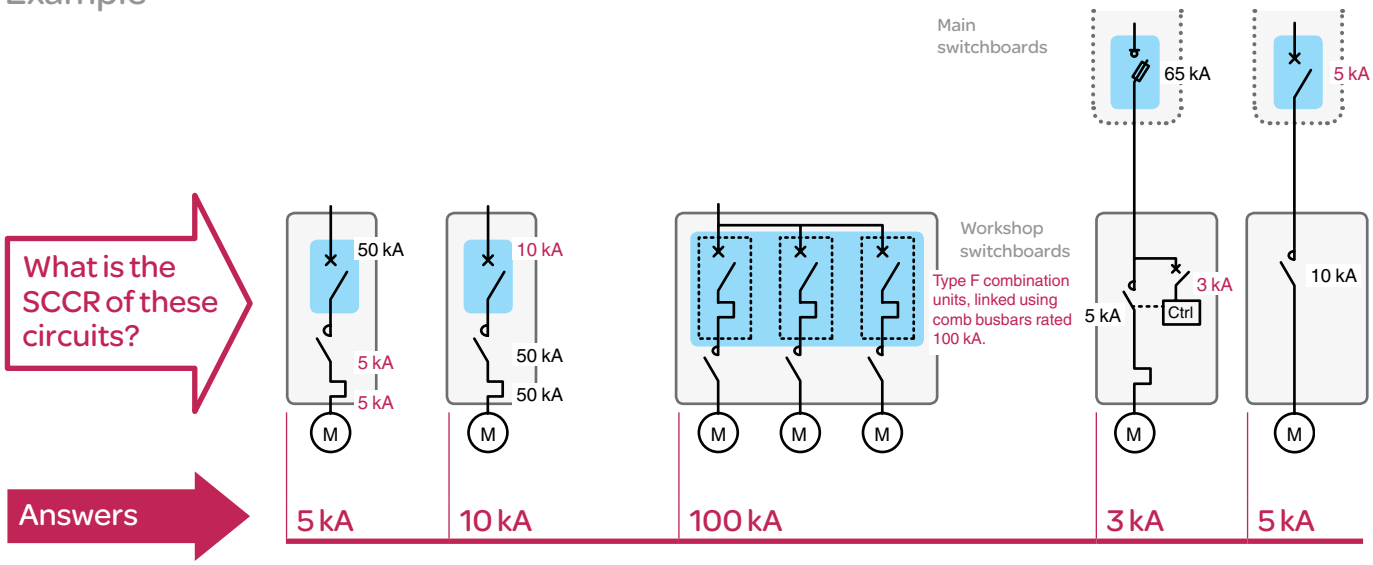
> Phase 2. Determine the SCCR of each branch circuit

General rule

Use **the lowest SCCR value** of each component in the circuit and the SCCR of the branch circuit protective device.

> Take into account the SCCR values of distribution blocks, comb busbars, etc.

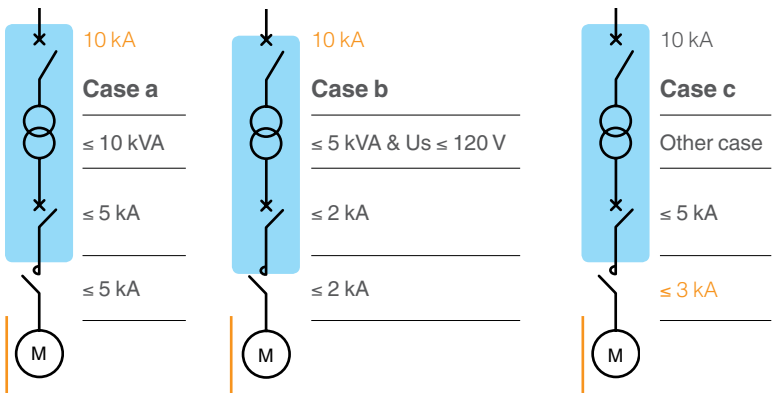
Example



Special case of **transformer circuits (UL 508A chap. SB4.3.1)**

Take into account the characteristics of the:

- **> transformer**
- **> downstream protection**
- **> downstream control components,**
- **> if applicable, the upstream protection.**



SCCR =	10 kA	10 kA	3 kA
	SCCR of the upstream protection		Lowest SCCR of the downstream components

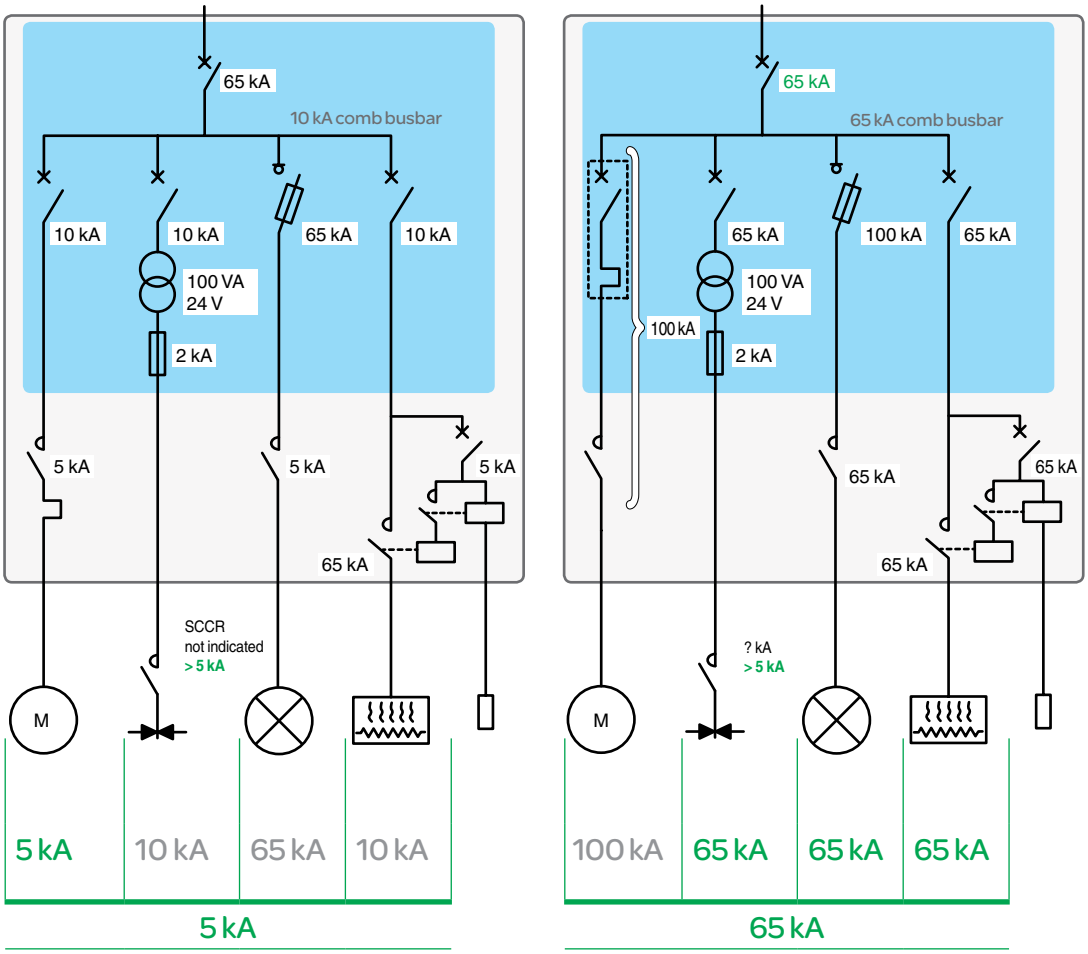
> Phase 3. Determine the SCCR of the control panel

General rule

The SCCR is obtained using the lowest SCCR value in each of the branch circuits.

Example

What is the SCCR of these panels?



Answers

For the panel on the right, compliance with a 65 kA SCCR required selection of different components:

> Combination motor controller certified 100 kA, instead of separate components
> Circuit breakers with higher short-circuit ratings
> Components with higher SCCR.

Annexes

Acceptance procedure for electrical equipment

One-of-a kind equipment or special specifications

> The manufacturer or component supplier must be UL certified.

and

> Prior to commissioning, the electrical equipment must be checked by an inspector from the AHJ (Authority Having Jurisdiction).

Mass-produced equipment

> The complete control panel must be UL certified by a national recognised testing laboratory (NRTL).

or

> The equipment must be UL certified on the basis of manufacturer tests, with or without UL supervision. In all cases, the manufacturer must have received UL approval to do so.

and

> Prior to commissioning, the electrical equipment must be checked by an inspector from the AHJ (Authority Having Jurisdiction).

Reference texts

NEC – National Electric Code, also called NFPA70 (edited by the National Fire Protection Association)

Set of legally binding rules applicable in all 50 states of the United States. They may be locally filled out, amended or replaced by other texts. That is the case for the UL Standards for Safety.

NEC contains the rules for electrical conductors in electrical installations and switchboards.

Article 409 deals in particular with control panels.

NFPA79 (edited by the National Fire Protection Association)

The provisions of this standard apply to the electrical/electronic equipment, apparatus or systems for industrial machines operating from a nominal voltage of 600 volts or less.

They are intended to minimize the potential hazard of electrical shock and electrical fire hazards.

The term "industrial machinery" refers to:

> metalworking machine tools, including machines that cut or form metal,
> plastics machinery, including injection moulding, extrusion, blow moulding, specialised processing, thermoset moulding and size reduction machines
> woodworking equipment, including laminating and sawmill machines,
> assembly machines,
> material-handling machines, including industrial robots and transfer machines,
> inspection and testing machines, including coordinate measuring and in-process gauging machines.

Standards for safety – UL 508A Underwriters Laboratories Inc. (UL)

Set of safety standards covering industrial control panels intended for general industrial use, operating from a voltage of 600 volts or less.

This equipment is intended for installation in ordinary locations, where the ambient temperature does not exceed 40°C maximum.

Controlled equipment (motors, heaters, lighting) and equipment mounted remotely from the panel are not subject to these rules unless specifically noted on the wiring diagram of the industrial control panel.

Standard SCCR values as per UL 508A

Table SB4.1

In the absence of SCCR values indicated by the manufacturer on the name plate or in the installation manual, this table specifies the standard values to be used for each type of component.

Component			SCCR in kA
Busbars			10
Circuit breaker (including GFCI type)			5
Current meters			(a)*
Current shunt			10
Fuse holder			10
Industrial control equipment	Auxiliary devices (overload relay)		5
	Switches (other than mercury-tube type)		5
	Mercury-tube switches		
		rated > 60 A or > 250 V	5
		rated ≤ 250 V, ≤ 60 A and > 2 kVA	3.5
		rated ≤ 250 V and ≤ 2 kVA	1
Motor controllers (including combination motor controllers, float and pressure operated motor controllers, power conversion equipment and solid state motor controllers), rated in horsepower (kW)	0-50 (0 – 37.3)		5(c)
	51-200 (38-149)		10(c)
	201-400 (150-298)		18(c)
	401-600 (299-447)		30(c)
	601-900 (448-671)		42(c)
	901-1500 (672-1193)		85(c)
Meter socket base			10
Miniature or miscellaneous fuse			10(b)
Receptacle (GFCI type)			2
Receptacle (other than GFCI type)			10
Supplementary protector			0,2
Switch unit			5
Terminal block or power distribution block			10

* ***a)*** *A short-circuit current rating is not required when connected via a current transformer or current shunt. A directly connected current meter shall have a marked short-circuit current rating.*

b) *The use of a miniature fuse is several motor startersed to 125 V circuits.*

c) *Standard fault-current rating for motor controller rated within specified horsepower range.*

Table of authorised ampacities of insulated conductors

Determining conductor sizes

Control-circuit conductors *(UL 508A chap. 38.2)*

> The minimum size is 18 AWG (0.82 mm²).

Power conductors *(UL 508A chap. 28.3)*

> The minimum size is 14 AWG (2.1 mm²).
> If there is only one down-line load, the conductor must be sized to 125% of the maximum calculated current.
> If there is more than one down-line load, the conductor must be sized to 125% of the current of the largest load + 100% of the other loads.

Grounding conductor *(UL 508A chap. 15.1)*

> The minimum size is 14 AWG (2.1 mm²).

Table 28.1. Ampacities of insulated conductors

Table 28.1 effective 25 April 2003

Wire size		60°C (140°F)		75°C (167°F)	
AWG	(mm²)	Copper	Aluminum	Copper	Aluminum
14	(2.1)	15	-	15	-
12	(3.3)	20	15	20	15
10	(5.3)	30	25	30	25
8	(8.4)	40	30	50	40
6	(13.3)	55	40	65	50
4	(21.2)	70	55	85	65
3	(26.7)	85	65	100	75
2	(33.6)	95	75	115	90
1	(42.4)	110	85	130	100
1/0	(53.5)	-	-	150	120
2/0	(67.4)	-	-	175	135
3/0	(85.0)	-	-	200	155
4/0	(107.2)	-	-	230	180
250 kcmil	(127)	-	-	255	205
300	(152)	-	-	285	230
350	(177)	-	-	310	250
400	(203)	-	-	335	270
500	(253)	-	-	380	310
600	(304)	-	-	420	340
700	(355)	-	-	460	375
750	(380)	-	-	475	385
800	(405)	-	-	490	395
900	(456)	-	-	520	425
1000	(506)	-	-	545	445
1250	(633)	-	-	590	485
1500	(760)	-	-	625	520
1750	(887)	-	-	650	545
2000	(1013)	-	-	665	560

Note. For multiple-conductors of the same size (1/0 AWG or larger) at a terminal, the ampacity is equal to the value in this table for that conductor multiplied by the number of conductors that the terminal is able to accommodate.

Notes:

Notes:

Useful links

Below are various sources of additional information (in English) on system design in compliance with standards NEC 409 and UL 508A.

Multistandard offer. The control protection solution that meets standards worldwide

www2.schneider-electric.com/sites/corporate/en/products-services/product-launch/multistandard-offer/multistandard-offer.page

UL 508A support. Welcome to the Schneider Electric NEC 409/UL 508A Support Web Site

http://www.schneider-electric.us/sites/us/en/support/product-support-resources/ul-508a-support/ul-508a-support.page

UL approved, tested combination spreadsheets with SCCR data

http://www.schneider-electric.us/sites/us/en/support/product-support-resources/ul-508a-support/ul-approved-tested-combination-spreadsheets-with-sccr-data.page

Motor-control solution for the North American market

http://www2.schneider-electric.com/documents/product-services/en/product-launch/multistandard/tesys-motor-starters-solutions-for-the-na-market.pdf

Data Bulletin 8536DB0901. Technical characteristics of our solutions

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Printed on ecological paper

Published by: Schneider Electric
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CIGS Thin-Film Solar Modules

STN-135 / STN-140 / STN-145 / STN-150 Solar Modules

Stion's solar modules provide exceptional efficiency and superior performance. The modules utilize Stion's breakthrough technology, developed and manufactured in the USA by a world class team with unmatched solar expertise in thin films.

High Efficiency

Advanced proprietary copper, indium, gallium, selenium, and sulfur (CIGS) thin-film technology yields high efficiency modules.

Superior Power Performance

Low temperature coefficient and excellent shade and debris tolerance provide outstanding energy delivery per watt.

Aesthetics and Design

Black design has virtually invisible cell lines that offer superior aesthetics. The black anodized aluminum frame is compatible with most racking systems. Convenient form factor enables easy installation and more modules per rack.

Long-term Reliability

Proven glass-glass package provides a robust design for installation in a variety of environments. Backed by a 10 year workmanship warranty and a 25 year limited power warranty.

Made in the USA

All of Stion's modules are designed and manufactured in the United States under the highest quality standards.

Elevation Series solar modules are specifically designed for use in most solar applications including residential, commercial, government, utility, and off-grid projects.

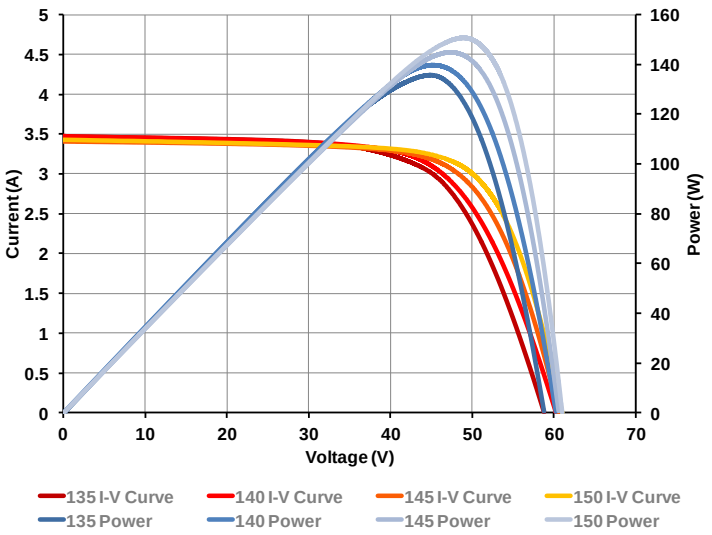
STION

Electrical Data*

Nominal Power, PMAX (W)	135	140	145	150
Module Efficiency (%)	12.4%	12.9%	13.3%	13.8%
Vmpp (V)	44.3	45.5	46.8	47.9
Impp (A)	3.05	3.08	3.10	3.13
Voc (V)	58.7	59.5	60.9	62.1
Isc (A)	3.45	3.45	3.45	3.45
Series Fuse Rating (A)	6			
Maximum System Voltage (V)	600(UL) 1000 (IEC)			
Temp. Coefficient (P^{mpp})	-0.34%/ºC			
Temp Coefficient (V^{oc})	-0.28%/ºC			
Temp Coefficient (I^{SC})	0.003%/ºC			
Factory Binning (W)	+ / - 2.5			
NOCT**	45.2ºC			

** Normal Operating Cell Temperatures (NOCT): 800 W/m², 20ºC, 1m/s wind speed

I-V Curves



* Measured at Standard Testing Conditions (STC): 25ºC, 1000 W/m², AM 1.5
All ratings are ± 10% unless noted otherwise

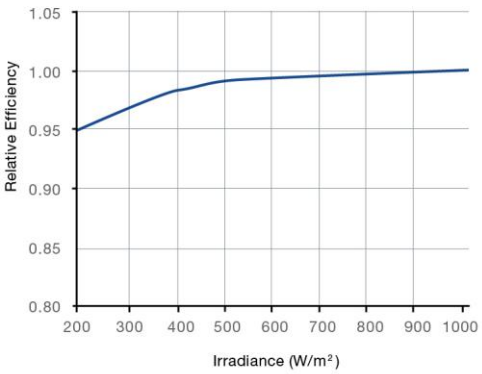
Mechanical Data

Width	25.8 in (656mm)
Length	65.2 in (1656mm)
Depth	1.4 in (35mm)
Weight	37.0 lbs (16.8kg)
Total Area	11.68 ft² (1.09m²)
Frame	Black Anodized Aluminum
Cable	14 AWG Cable 39.4 in (1m)
Connectors	MC-4 type
J-Box	IP 65 rated
Cover Type	3.2mm high transmission tempered front glass laminated to 2 mm float glass

Warranty and Qualifications

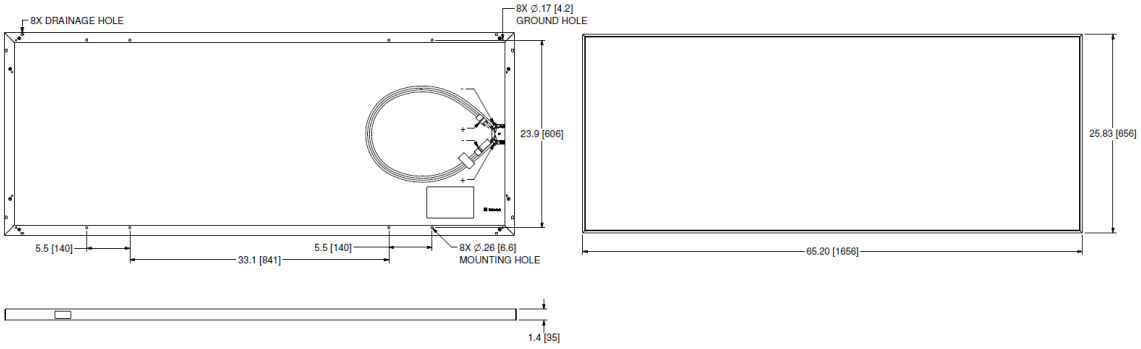
Limited Power	90% at 10 years 80% at 25 years
Workmanship	10 years
Fire Resistance	Class C
Safety	Class II (IEC 61140)
Mechanical / Wind Load	2400 Pa (50 psf)

Performance at Low Irradiance



Typical relative change in module efficiency from 1000 W/m² irradiance to 200 W/m² is 5%, measured at STC.

Dimensions Inches [mm]



Caution! Read Safety & Installation Manual before handling, installing or operating Stion products.

Specification included in this datasheet are subject to change without notice.

General Safety & Installation Instructions

This document covers the following Stion Products:

STN-100	STN-130
STN-110	STN-135
STN-115	STN-140
STN-120	STN-145
STN-125	STN-150

For more information please visit:

www.stion.com

Last Revised: 11/27/12

Danger of death from electric shock!

Solar modules generate direct current (DC) electricity as soon as the front face is exposed to light. Individual modules and especially connected systems can be an electrical hazard. Follow the general safety and installation guidelines to avoid safety and electrical hazards.

1.0 Introduction:

This document covers safety and installation information for Stion products bearing the Intertek-ETL mark for certification to ANSI/UL1703, and the CE mark for conformity with EC directives 2004/108/EC (EMC – Electromagnetic Compatibility) and 2006/95/EC (LVD – Low Voltage Electrical Safety Directive).

Read carefully through these installation instructions before use, installation, operation, or maintenance of any products of Stion Corporation. Failure to do so may result in bodily injury or damage to property. Additionally, failure to do so may void Stion Corporation's Limited Warranties.

1.1 Disclaimer of Liability

The use of this General Safety and Installation Guide and the conditions and methods of installation, operation, use and maintenance of the module are beyond Stion control. Therefore, Stion assumes no responsibility and expressly disclaims liability for loss, damage, injury or expense arising out of or in any connected with such installation, operation, use or maintenance of the module. Furthermore, Stion assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the modules, unless we are automatically liable by law.

No license is granted by implication or otherwise under any patent or patent rights. The information in this Guide is based on Stion knowledge and experience and is believed to be reliable; but such information including product specifications (without limitations) and suggestions do not constitute a warranty, expressed or implied. Stion reserves the right to make changes to the product, specifications or this Guide without prior notice.

Note: This document may be provided in multiple languages. If there is a conflict among versions, the English version dominates.

1.2 Module Limited Warranties

Information and instructions provided in this Guide are based on Stion knowledge and believed to be reliable. However, this document and any other product specifications (without limitations) do not constitute a warranty. Information on limited power and workmanship warranties and associated certificates and product registration can be found at www.stion.com or by contacting the Company or authorized Stion representative.

1.3 ANSI/UL 1703 Listing

The Stion PV Modules which this Guide covers meet or exceed the requirements of ANSI/UL 1703. This standard covers flat-plate modules in standard freestanding, rack, or stand-off installation only, and does not cover products that are integrated into building surfaces or materials.

2.0 Safety

Working on a PV system requires specialized knowledge and must therefore be carried out only by appropriately qualified and authorized personnel.

- Keep these instructions!
- Keep children away!

2.1 Warning notices

Danger of death from electric shock!

Solar modules generate electricity as soon as the front face is exposed to light. When modules are connected in series, voltages are additive. When modules are connected in parallel, current is additive. Consequently, a multi-module system can produce high voltages and current.

Although touch protection is provided in the form of the fully insulated cables and connectors, the following points must be observed when handling the solar modules to avoid the risk of fire, arcing and fatal electric shock:

•The installation of modules requires a great degree of skill and should (if DC voltage exceeds 100 V: *must*) only be performed by a qualified licensed professional, including, without limitation, licensed contractors and licensed electricians.
•Installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock.
•All installations in the US should be installed in strict compliance with the latest or applicable National Electrical Code (NEC) requirements for the appropriate jurisdiction. Installations in Canada shall be in accordance with CSA C22.1, Safety Standards for Electrical Installations, Canadian Electrical Code, Part 1.
•When making or breaking electrical circuits, cover all modules in the array with an opaque material or cloth to prevent light from electrifying the array.
•Do not insert electrically conducting parts into plugs or sockets!
•Do not wear metallic jewelry while performing mechanical or electrical Installation.
•Work only under dry conditions, and use only dry tools. Do not handle modules when they are wet unless wearing the appropriate protective equipment.
•Exercise extreme caution when carrying out work on wiring and use the appropriate safety equipment (insulated tools, insulated gloves, etc.)!
•Do not use damaged modules! Do not dismantle modules! Do not remove any part or label fitted by the manufacturer! Do not treat the rear of the laminate with paint, adhesives or mark it using sharp objects!
•Exercise extreme caution when working on the inverter and wiring the system.
•After switching off the inverter, it is essential to wait for the time interval specified by the manufacturer before beginning any further work. This allows the high voltage components time to discharge.
•Be sure to carefully follow the inverter manufacturer's installation instructions.

Danger of death from arcing!

Modules generate direct current (DC) when any amount of light shines on them. When breaking a connected string of modules (e.g. when disconnecting the DC line from the inverter under load), a lethally strong arc can occur:

• Never remove the solar generator from the inverter while it is still connected to the main grid!
• Ensure that the cable connections are in perfect condition (no cracking, soiling or other contamination)!

When disconnecting a connected module under load, follow these directions and all cautions and warnings that appear above. These steps should only be performed by a fully licensed and qualified electrician or contractor:

Step 1: Take all precautions noted above, including reading the inverter manufacturer's manual and specifications and wearing and using insulated gloves and tools.
Step 2: Shade the active module or modules with an opaque material.
Step 3: Disconnect the inverter from both the grid and from the system of modules according to the specifications provided by the inverter manufacturer.
Step 4: Wait the minimum amount of time specified by the inverter manufacturer before disconnecting any PV modules under load.
Step 5: Disconnect or connect PV modules only as absolutely needed.

2.2 Unpacking the modules and storage

Observe the warnings on the packaging!

The utmost care is required when handling the modules. Take care when unpacking, transporting, and storing them. Leave modules in packaging until they are to be installed. A module with broken glass cannot be repaired and must not be used since contact with any module surface or the frame can produce electrical shock. Broken or damaged modules must be handled carefully and disposed of properly. Broken glass can be sharp and cause injury if not handled with the appropriate protective equipment. Carry modules with both hands. Do not use the cables, connectors, or junction box as a handle. Do not stand modules on hard or rough ground. Do not stand modules on their corners. Ensure modules do not bow. Do not place modules on top of each other. Do not subject to load, do not stand on them, do not drop. Do not mark or work on them with sharp objects. Keep all electrical contacts clean and dry. In order to keep a record of your system, we recommend that you make a note of the serial numbers. If it is necessary to store the modules temporarily, always cover the modules and use a dry, ventilated room.

2.3 General safety information

Ensure that the module is used for its intended purpose only. Modules are intended for outdoors, land-based applications only. Modules are not intended for indoor use or application on moving vehicles of any kind. Pay attention to local ordinances, building standards and accident- prevention regulations during installation. Use only equipment, connectors, wiring and support frames suitable for use in a solar electric system. The safety information for other system components must also be followed.

3.0 Electrical Specifications:

Electrical Ratings										
	STN-100	**STN-110**	**STN-115**	**STN-120**	**STN-125**	**STN-130**	**STN-135**	**STN-140**	**STN-145**	**STN-150**
Pmax	100	110	115	120	125	130	135	140	145	150
Voc (V)	54.2	54.2	54.5	55.2	58	58.33	58.66	59.5	60.9	62.1
Isc (A)	3.14	3.37	3.4	3.4	3.45	3.45	3.45	3.45	3.45	3.45
Imp (A)	2.67	2.71	2.98	3	3	3.02	3.05	3.08	3.1	3.13
Vmp (V)	38.5	40.6	41.1	42.7	41.7	43	44.3	45.5	46.8	47.9
Series Fuse Rating (A)	6									
Tolerance Pmax	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+5/-10%

Measured at Standard Test Conditions (STC): 25°C, 1000W/m^2, AM 1.5G

Maximum System Voltage: 1000V (IEC), 600V (UL)

Application Class: A

3.1 Fire Class Rating:

These modules are rated to Fire Class C.

3.2 Wiring

The module contains factory-installed Leoni Studer Betaflam 125 cables with factory provided Lumberg locking connectors and a Diotec F1200-D bypass diode rated for 12A, located inside the junction box. Under no circumstances should the junction box be opened or tampered with. This will void the warranty.

For the wiring, pay attention to:

• Correct wiring scheme
In order to decrease voltage caused by indirect lightning strikes, all connecting cables should be as short as possible. Check that the wiring is correct before commissioning the system. If the measured open circuit voltage differs from the specifications, then there is a wiring fault. Match the polarities of cables and terminals when making the connections; failure to do so may result in damage to the module.

• Correct plug connections
Make connections only in dry conditions. Ensure connections are secure and tight.

• Use of suitable materials
Use special solar cable and suitable connectors only. Ensure that they are in perfect electrical and mechanical condition. Use only single wire cables. Select a suitable conductor diameter to minimize voltage drop. We recommend using the following parts for connection and wiring:

Name/Description	Manufacturer/ Distributor	Part Number
Field Attachable Connector	Lumberg	LC4-CP-30-2 IT 2.5, LC4-CP-31-1 2.5
Leoni Studer Betaflam 125 (14 AWG, 2.5mm2)	Leoni Studer	226243

• Cable protection
We recommend securing the cables to the mounting system using UV-resistant cable ties. Protect exposed cables from damage using suitable precautions (e.g. laying them in plastic pipes). Avoid direct exposure to sunlight.

ANSI/UL 1703 Information (U.S. and Canada)

• The solar module electrical characteristics are within +/-10% of the module label indicated values of Isc, Voc, and Pmax under Standard Test Conditions (irradiance of 1000 W/m^2, AM 1.5 spectrum, and a cell temperature of 25°C/77°F), unless otherwise indicated.
• Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at STC. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.55 at 125 mW/cm2, AM1.5 spectrum, cell temperature -10C for Voc and +75C for Isc, when determining component voltage ratings, conductor capacities, and fuse and control sizes connected to the PV output.
• Refer to section 690-8 of the NEC for an additional multiplying factor of 125% (80% de-rating) which may be applicable.
• Over-current protection shall be in accordance with the requirements of Article 240 of the NEC, or less than 6A according to Stion's max series fuse rating, whichever is lower.
• Conductor recommendations: 8-14 AWG (2.5-10 mm^2) USE-2 (non-conduit)/ THWN-2 (conduit), 90°C wet rated, -40°C min. For conduits, do not use PV-wire.
• Cable conduits should be used in locations where the wiring is accessible to children or small animals.
• Modification or tampering of diodes by unqualified personnel is not permitted. Please consult Stion for additional information regarding diode replacement/repair.

3.3 Grounding

The company installing the PV module is also responsible for the professional grounding. The factory-provided aluminum frame must be grounded. All grounding must be performed to be compliant with the latest National Electrical Code (NEC) regulations that are applicable for the jurisdiction. If the building is already equipped with an exterior lightning protection system, the PV-installation must be integrated in the protection system against direct effects of lightning. Country-specific standards must be adhered to.

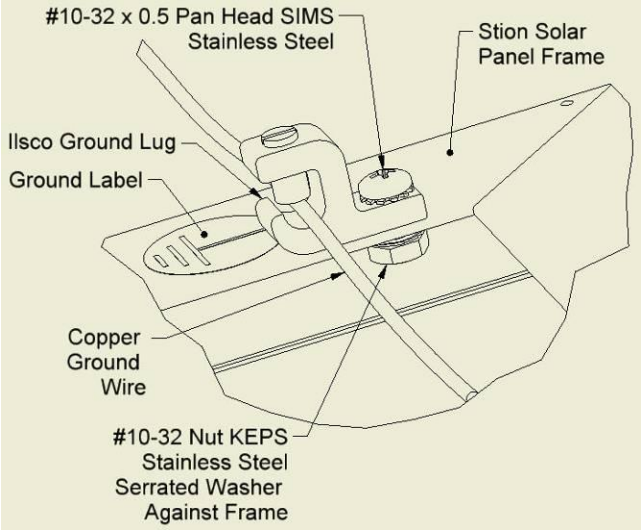
A grounding method and components that are compliant with appropriate ANSI/UL standards including UL467, UL1703, UL 1741 must be adhered to in the US and Canada and for use of this module.

An example of UL or IEC approved grounding for 600V systems or less:

The modules can be connected to the grounding holes using a lay-in lug and a bolt with serrated washer and a nut with serrated washer contacting the back of the frame as shown in the diagram. Please note that the nut must have a serrated washer to break through the anodized coating of the frame. The recommended hardware is as follows:

Item	Name/Description	Manufacturer/ Distributor	Part Number
Ground Lug	Lay-in Lug	Ilsco	GBL-4DBT
Bolt	#10-32 X 0.5" Pan Head, SIMS, Stainless	McMaster-Carr	95345A566
Nut	#10-32 Nut, KEPS, Stainless	McMaster-Carr	96278A411

Diagram of Grounding Method (600V)



We recommend using the components listed above, including a lay-in lug, a bolt, with integral stainless steel serrated washer (SIMS), and a nut, with integral stainless steel serrated washer (KEPS). The serrated washer should be used in order to break through the anodized coating and contact the frame. A torque assembly must be used to ensure contact with the aluminum (torque 35-40 in-lb). A solid copper grounding conductor must be secured with the set screw provided by the lay-in lug manufacturer to prevent galvanic corrosion due to contact by dissimilar metals.

Please also refer to NEC Article 690 for further information on grounding PV systems and specific requirements.

4.0 Installation

When installing the modules, please pay attention to:

4.1 Installation Safety

Do not carry out installation work when there are strong winds. Follow appropriate safety practices and use required safety equipment to avoid falling hazards. Secure work materials to prevent articles from falling. Create a work zone to avoid accidents with other people. The modules have no on/off switch. Fully cover their front surface with an opaque material during installation.

4.2 Maximum Loading

Make sure the support structure adheres to maximum permissible load requirements. The system has been load tested to ANSI/UL 1703 at 45 PSF. Building departments often require a design safety factor of 1.5 or greater for structures. The maximum structural loading listed in this guide does not include an added safety factor. Check with your local building department for code information as prescribed by local ordinances, particularly in regions of high snow accumulations and high wind velocities. Take notice of possible bowing of the modules under high loads. Avoid installing fasteners, cable ties, etc. between the module backside and support structure (i.e. on mounting rails) as any sharp edges can damage the modules.

4.3 Fire Safety

The roof construction and installation may affect the fire safety of a building; improper installation may contribute to hazards in the event of fire. For roof application, the modules should be mounted over a fire-resistant covering rated for the application. It may be necessary to use components such as earth ground fault circuit breakers, fuses and circuit breakers. The module is “non-explosion-protected equipment”. Hence it must not be installed in proximity of highly flammable gases and vapors (e.g. filling stations, gas containers, paint spraying equipment). The module must not be installed near open flames or flammable materials. Refer to your local authority for guidelines and requirements for building or structural fire safety.

4.4 Suitable Environment

The module is intended for use in temperate climatic conditions where operating temperatures range from -40 to +90°C (-40 to +194°F). The module must not be subjected to concentrated light. It must not be immersed in water or constantly exposed to water spray (e.g. from fountains). There is risk of corrosion with exposure to salt (it is recommended that modules are installed at least 500 m or 1700 ft from the sea) and sulfur (sulfur sources, volcanoes). The module may not be exposed to extremely corrosive chemicals (e.g. emissions from manufacturing plants).

4.5 Suitable Design

Make sure the module meets the technical requirements of the system as a whole. Ensure that other system components do not exert damaging mechanical or electrical influences on the modules. When connected in series, modules must all have the same amperage. When connected in parallel, the modules must all have the same voltage. The modules must not be connected together to create a voltage higher than the permitted system voltage. Modules must not be fitted as overhead glazing or vertical glazing (façade). Ensure that the mounting system can also withstand the anticipated wind and snow loads. There are drainage holes at the corners of the module frame to allow water from precipitation to drain. Ensure that these openings are not blocked nor partially blocked by the module installation method.

Array-Sizing & Performance: Follow requirements of the NEC and local jurisdictions to evaluate, derate, and size the number of maximum modules per string accordingly so that the added voltage of the specified module model numbers and the quantity of modules do not exceed the maximum system voltage allowed. Be sure to size arrays and strings sizes according to potential changes in temperature during module operation. Lower temperatures can increase voltage and may require fewer modules to be installed in each series string.

Parallel connection is a function of the Inverter used in the system. Please refer to the Inverter specification to determine the number of modules which can be supported when connected in parallel. Each module must be individually fused when connected in parallel (at the series fuse rating).

Angle & Tilt: To obtain maximum yield from the system, we recommend you determine the best direction and tilt angle for the modules. Conditions for generating electricity are considered ideal when the sun's rays strike the module perpendicular to its surface. To avoid performance drops in series circuits, ensure that all modules have the same orientation and tilt. Stion recommends the modules be mounted in portrait to avoid possible power loss from shade and debris. If landscape mounting is required at the site, Stion recommends regular inspection and cleaning, so as not to shade a larger portion of one cell with buildup or debris. In dry climates with low-tilt angle (<15°), the modules should not be mounted in landscape. Modules should not be mounted in landscape without a regime of regular inspection and cleaning.

Shading: Even partial shading will cause a yield reduction. A module is "shade free" when the entire surface is shade free all year round and, even on the most unfavorable days of the year, receives unobstructed sunlight. Even partial shadowing can substantially reduce module and system output.

Ventilation: Provide adequate rear ventilation under a module (100mm: 4 in. gap minimum) to avoid the build-up of heat that can reduce performance. Clearance of 7mm: ¼ in or more between modules is required to allow for thermal expansion of the frames.

4.6 Mounting & Configurations

Modules are only ANSI/UL 1703 listed when the factory provided frame is still intact. Do not tamper with, alter, or remove the frame or create additional mounting holes. Doing so will void the warranty. Each module must be securely fastened at a minimum of 4 points. There are 8 approved, factory-provided mounting holes that are on the long sides of the frame, 10.5 inches (268mm) and 16.0 inches (408mm) from the short edge of the frame. The mounting holes at the middle of the long frame sides are optional to provide additional support. Mounting at these holes does not preclude the need to mount at 4 points designated at the approved mounting holes or the approved mounting zones. The frame has been stress tested by Stion and ANSI/UL 1703 listed for mounting by the long sides only. The module should not be mounted by the short sides of the frame.

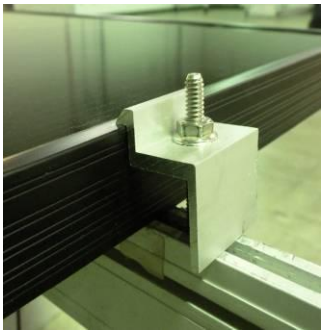
Stion PV modules can be mounted to the substructure by using the following method:

1) *Bolting*: The module may be secured to the structure by bolting or screwing through the factory-provided holes in the long sides of the frame. Refer to Stion's module datasheet for exact mounting hole locations. We recommend using four ¼ in. stainless steel bolts/screws with nuts, washers, and lock washers. The bolt/screw should be long enough to enable full engagement with

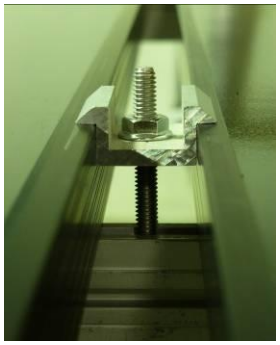
the nut but allow for at least ¼ in. gap between the end of the bolt/screw and the glass surface of the module. Use appropriate corrosion-proof fastening materials.

2) *Clamping*: The module may be secured to the structure by clamping. A clamping solution requires a top clamp piece that braces the front of the module frame and a rail or bottom clamp piece that supports or clamps the bottom of the module. The top clamps hold the module securely at four points against rails or bottom clamps. An example of top down end-clamping and mid-clamping is shown in the diagrams below.

End-Clamping



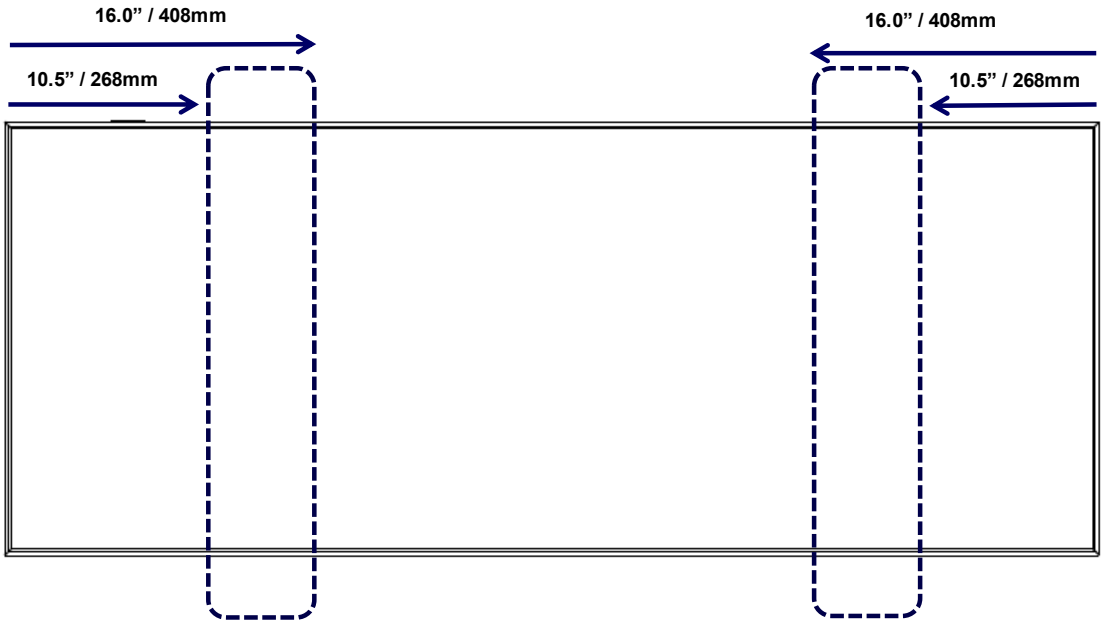
Mid-Clamping



Stion's module should only be clamped on the long sides. The center of the clamps should be located in the mounting zones. The mounting zones are located between 10.5 inches (268mm) and 16.0 inches (408mm) from the short edge of the module and are shown in the diagram below.

Finger tighten flange nuts, center and align the module as needed, and securely tighten the flange nuts (10 ft lbs). Please refer to the Unirac Solar Mount installation manual for additional information.

Mounting Zone Diagram



We recommend using anodized aluminum top and bottom clamps. An example is UniRac SolarMount's top-down solution for clamping. For the top clamp piece, we recommend using SolarMount size "C" end-clamps at the edge of an array, or SolarMount size "C" mid-clamps if clamping between modules. For the bottom clamp/brace we recommend using Unirac SolarMount rails which brace and

support the underside of the modules. SolarMount equipment comes in kits with a product and necessary hardware. The length and quantity of rail, number of feet, clamps, etc. will depend on the number of modules being installed. Refer to Unirac's SolarMount product price list for the appropriately sized rails and number of clamps.

Item	Name/Description	Manufacturer/ Distributor	Part Number
SolarMount Standard 2 Rail Kits	2-60" anodized aluminum rails, 4 L-feet, hardware to join L-feet to rails	UniRac	300202
SolarMount End Clamps C Pro-Pak	20 size C anodized aluminum end clamps with stainless steel t-bolts, ¼" x 2", and flange nuts	UniRac	320014
SolarMount Mid Clamps C Pro-Pak	20 size C anodized aluminum mid clamps with stainless steel t-bolts, ¼" x 2", and flange nuts	UniRac	320020

4.7 Maintenance and cleaning

PV modules and systems do not require routine maintenance. However, we recommend regular inspection to ensure:
1. All cable connections are secure, tight, clean, and free of corrosion.
2. All mounting points are tight, secure, and free of corrosion.
3. Cable, glass, frame, junction box or external electrical connections are not damaged in any way.
4. The conductivity of module frame to earth ground is sufficient.

Given a sufficient tilt (>15°), cleaning of the modules is not typically necessary (rainfall will have a self-cleaning effect). In dry and other unique climates, and in case of heavy soiling, we recommend cleaning the modules using plenty of water (from a hose) without any cleaning agents and using a gentle cleaning implement (a sponge). To remove ingrained dirt, the coated glass can be washed with a micro-fiber cloth and ethanol or a conventional glass cleanser. Deposits of foreign material on the frame surface can be cleaned using a wet sponge or cloth and dried in air or by using a clean chamois. Alternatively, a mild detergent or glass cleaner may be used. Always wear rubber gloves for electrical insulation while maintaining, washing or cleaning modules. Dirt must never be scraped or rubbed away when dry, as this may cause micro-scratches. Do not use harsh cleaning materials such as scouring powder, alkali based chemicals, steel wool, scrapers, blades, or other sharp instruments to clean the glass surface of the module. Use of such materials or cleaning without consultation will void the product warranty.

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Instructions générales de sécurité et d'installation

Ce document concerne les produits Stion suivants :

STN-100	STN-130
STN-110	STN-135
STN-115	STN-140
STN-120	STN-145
STN-125	STN-150

Pour en savoir plus, visitez le site suivant :

www.stion.com

Dernière révision : 27/11/2012

Attention : risque d'électrocution mortelle!

Les modules solaires génèrent du courant continu (CC) dès que le panneau avant est exposé à la lumière. Les modules individuels et plus particulièrement les systèmes connectés peuvent présenter un danger électrique. Respectez les directives générales de sécurité et d'installation pour éviter tout risque en matière de sécurité et tout danger électrique.

1.0 Introduction :

Ce document fournit des renseignements sur la sécurité et l'installation des produits Stion conformément au certificat ANSI/UL 1703 et CE marque pour 2004/108/EC (EMC – Compatibilité électromagnétique) and 2006/95/EC (LVD – Directive Basse Tension de sécurité électrique).

Intertek

Lisez attentivement les instructions d'installation ci-après avant d'installer, utiliser ou assurer la maintenance de l'un quelconque des produits de Stion Corporation. Le non-respect de ces consignes peut entraîner des blessures corporelles ou des dommages matériels. Par ailleurs, il pourrait en résulter une annulation de la garantie limitée proposée par Stion Corporation.

1.1 Dénégation de responsabilité

Stion n'a aucun contrôle sur l'utilisation de ce manuel général de sécurité et d'installation ni sur les conditions et méthodes d'installation, d'utilisation et de maintenance du module. Par conséquent, Stion n'assume aucune responsabilité et décline expressément toute responsabilité en cas de perte, dommage, blessure ou dépense découlant de ou en rapport avec l'installation, le fonctionnement, l'utilisation ou la maintenance du module. Par ailleurs, Stion décline toute responsabilité concernant la violation de brevets ou toute autre propriété de tiers pouvant résulter de l'utilisation des modules, à moins que la société ne soit automatiquement reconnue responsable par la loi.

Aucune licence n'est accordée par implication ou autre sous couvert d'un brevet ou d'une propriété industrielle. Les renseignements contenus dans ce manuel reposent sur les connaissances et l'expérience de Stion et sont considérés comme fiables. Cependant, ces renseignements, y compris mais sans s'y limiter les spécifications et les suggestions sur le produit ne constituent pas une garantie implicite ou explicite. Stion se réserve le droit de modifier le produit, ses spécifications ou ce manuel sans préavis.

Remarque : Ce document peut être fourni en plusieurs langues. En cas de discordance entre les diverses versions de ce document, la version anglaise fait foi.

1.2 Garantie limité du module

Les renseignements et les instructions fournis dans ce guide reposent sur les connaissances de Stion et sont considérés comme fiables. Ce document et les spécifications du produit (sans s'y limiter) ne constituent toutefois pas une garantie. Les renseignements sur les garanties limitées concernant l'alimentation et la main-d'œuvre, ainsi que les certificats et les formulaires d'enregistrement du produit sont disponibles sur le site www.stion.com ou auprès de l'entreprise ou d'un représentant Stion agréé.

1.3 Norme ANSI/UL 1703

Les modules photovoltaïques Stion décrits dans ce manuel sont conformes ou excèdent les exigences de la norme ANSI/UL 1703. Cette norme s'applique aux modules plans autonomes classiques, montés en rack ou installés à la verticale uniquement et ne concerne pas les produits intégrés à la surface des bâtiments ou aux matériaux. Les modules appartiennent à la classe A.

2.0 Sécurité

Manipuler un système photovoltaïque requérant des compétences spécifiques, seuls des agents habilités et qualifiés doivent prendre cette tâche en charge.

- Conservez ces instructions!
- Maintenez les enfants à l'écart!

2.1 Avertissements

Attention : risque d'électrocution mortelle!

Les modules solaires génèrent de l'électricité dès que le panneau avant est exposé à la lumière. Lorsque plusieurs modules sont reliés en série, les tensions s'additionnent. Lorsque plusieurs modules sont reliés en parallèle, le courant s'additionne. Par conséquent, un système constitué de plusieurs modules peut produire des tensions et des courants élevés.

Bien que le système soit protégé contre les contacts physiques grâce à l'isolation totale des câbles et des connecteurs, vous devez respecter les points suivants lors de la manipulation des modules solaires pour pallier tout risque d'incendie, de formation d'un arc et d'électrocution mortelle :

•L'installation des modules aux Etats-Unis requiert des compétences poussées et ne devrait (*doit* si la tension en courant continu est supérieure à 100 V) être exécutée que par un professionnel licencié et qualifié, y compris mais sans s'y limiter, des sous-traitants et des électriciens agréés. Installations au Canada doivent être conformes aux CSA C22.1, Normes de Sécurité Relative aux Installations Électriques, Code Électrique Canadien, Partie 1.
•L'installateur assume tous les risques de blessure pouvant se produire pendant l'installation, y compris, mais sans s'y limiter, le risque d'électrocution.
•Toutes les installations doivent être réalisées conformément aux dernières exigences ou aux exigences en vigueur du NEC (Code national de l'électricité) de la juridiction concernée.
•Lors de la connexion/déconnexion des circuits électriques, recouvrez tous les modules de l'installation d'un matériau ou tissu opaque pour éviter que la lumière n'électrifie le système.
•N'introduisez pas de conducteurs électriques dans les prises et les fiches!
•Ne portez pas de bijoux métalliques lors de l'installation mécanique ou électrique du système.
•Travaillez uniquement dans un environnement sec et n'utilisez que des outils secs. Ne manipulez pas les modules lorsqu'ils sont mouillés à moins de porter le matériel de protection approprié.
•Soyez extrêmement prudent lors de la réalisation du câblage et utilisez le matériel de sécurité approprié (outils isolés, gants de protection, etc.)!
•N'utilisez pas de modules endommagés! Ne démontez pas les modules! Ne retirez aucune pièce ni étiquette fournie par le fabricant! N'appliquez ni peinture ni adhésif sur la partie arrière du panneau. De même, ne rayez pas la surface arrière avec des objets tranchants!
•Soyez extrêmement prudent lorsque vous manipulez l'inverseur et procédez au câblage.
•Une fois l'inverseur à l'arrêt, vous devez attendre que le délai spécifié par le fabricant soit écoulé avant de commencer toute autre tâche. Ceci permet aux composants haute tension de se décharger.
•Veillez à respecter les instructions d'installation de l'inverseur fournies par le fabricant.

Attention : la formation d'un arc constitue un danger mortel!

Les modules génèrent du courant continu (CC) dès qu'ils sont exposés à la lumière. Lors de la déconnexion d'une chaîne de modules connectés (par exemple lors de la déconnexion de la ligne CC de l'inverseur sous tension), un arc mortel peut se produire :

• Ne retirez pas le générateur solaire de l'inverseur tant que ce dernier est toujours connecté au réseau principal!
• Vérifiez que les connecteurs des câbles sont en parfait état (aucune fissure, salissure ou autre contamination)!

Lors de la déconnexion d'un module connecté sous tension, observez les directives suivantes, de même que tous les avertissements et toutes les mises en garde ci-après. Les étapes suivantes ne doivent être exécutées que par un électricien ou un sous-traitant qualifié et agréé :

Étape 1 : Respectez toutes les précautions susmentionnées, sans oublier la lecture du manuel et des spécifications du fabricant de l'inverseur et le port et l'utilisation d'outils isolés et de gants de protection.
Étape 2 : Recouvrez le ou les modules actifs d'un matériau opaque.
Étape 3 : Déconnectez l'inverseur du réseau et du système de modules conformément aux spécifications fournies par le fabricant de l'inverseur.
Étape 4 : Patientez le temps minimal requis mentionné par le fabricant de l'inverseur avant de déconnecter des modules photovoltaïques sous tension.
Étape 5 : Ne déconnectez ou connectez les modules photovoltaïques que si cela est absolument nécessaire.

2.2 Déballage et stockage des modules

Respectez les avertissements mentionnés sur l'emballage!

Les modules doivent être manipulés avec le plus grand soin. Faites attention lors du déballage, du transport et du stockage des modules. Conservez les modules dans leur emballage jusqu'au moment de l'installation. Un module dont la vitre est brisée n'est pas réparable et ne doit pas être utilisé puisque tout contact avec la surface du module ou du châssis peut entraîner une électrocution. Les modules cassés ou endommagés doivent être manipulés avec le plus grand soin et mis au rebut correctement. Une vitre brisée peut s'avérer tranchante et entraîner des blessures si elle n'est pas manipulée avec le matériel de protection adéquat. Transportez les modules en vous aidant des deux mains. Les câbles, les connecteurs ou la boîte de raccordement ne doivent pas servir de poignée. Ne posez pas les modules sur une surface dure ou rugueuse. N'utilisez pas les coins des modules comme support d'appui. Assurez-vous que les modules ne sont pas arqués. Ne placez pas les modules les uns par- dessus les autres. Aucune charge ne doit être posée sur les modules. De même, vous ne devez pas marcher dessus, ni les laisser tomber. N'utilisez pas d'objets tranchants sur les modules. Assurez-vous que tous les contacts électriques sont propres et secs. Afin de conserver une trace de votre système, nous vous recommandons de noter les numéros de série. Si vous devez stocker provisoirement les modules, recouvrez-les et placez-les dans une pièce ventilée à l'abri de l'humidité.

2.3 Renseignements généraux sur la sécurité

Assurez-vous que le module est utilisé exclusivement pour l'usage prévu. Les modules sont prévus pour les applications terrestres en extérieur uniquement. Les modules ne sont pas prévus pour être utilisés en intérieur ou sur des véhicules en mouvement, quels qu'ils soient. Soyez particulièrement attentif à la réglementation locale, aux normes du bâtiment et aux consignes de prévention contre les accidents pendant l'installation. N'utilisez que du matériel, des connecteurs, des câbles et des châssis compatibles avec un système électrique solaire. Vous devez également vous conformer aux renseignements sur la sécurité relatifs aux autres composants du système.

3.0 Spécifications électriques :

Spécifications électriques										
	STN-100	**STN-110**	**STN-115**	**STN-120**	**STN-125**	**STN-130**	**STN-135**	**STN-140**	**STN-145**	**STN-150**
Pmax	100	110	115	120	125	130	135	140	145	150
Voc (V)	54.2	54.2	54.5	55.2	58	58.33	58.66	59.5	60.9	62.1
Isc (A)	3.14	3.37	3.4	3.4	3.45	3.45	3.45	3.45	3.45	3.45
Imp (A)	2.67	2.71	2.98	3	3	3.02	3.05	3.08	3.1	3.13
Vmp (V)	38.5	40.6	41.1	42.7	41.7	43	44.3	45.5	46.8	47.9
Fusible série (A)	6									
Tolerance Pmax	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+/-10%	+5/-10%

Mesures effectuées dans des conditions de test standard : 25°C, 1 000 W/m^2, AM 1,5 G

Tension maximale du système: 1000V (IEC), 600V (UL)

Classe d'application: A

3.1 Indice de résistance au feu :

Ces modules sont conformes à la norme de résistance au feu de classe C.

3.2 Câblage

Le module intègre des câbles Leoni Studer Betaflam 125 installés en usine, des connecteurs à verrouillage Lumberg fournis en usine et une diode de dérivation Diotec F1200-D d'une puissance nominale de 12 A montée dans la boîte de raccordement. En aucun cas vous ne devez ouvrir ou modifier la boîte de raccordement. Ceci annulera la garantie.

Concernant le câblage, accordez une attention particulière aux points suivants :

• Le schéma de câblage doit être correct

Afin de réduire la tension induite indirectement par la foudre, tous les câbles doivent être aussi courts que possible. Vérifiez que le câblage est correct avant de mettre le système en service. Si la tension de circuit ouvert mesurée diffère des spécifications, cela signifie que le câblage n'est pas correct. Faites attention à la polarité des câbles et des bornes lorsque vous procédez aux branchements. Dans le cas contraire, vous pourriez endommager le module.

• Les connecteurs doivent être branchés correctement
Ne procédez aux branchements que dans un environnement sec. Assurez-vous que les connecteurs sont branchés de manière adéquate et fiable.

• Vous devez utiliser des matériaux adaptés
Utilisez uniquement un câble solaire spécial et des connecteurs appropriés. Assurez-vous qu'ils sont en parfait état tant sur le plan mécanique qu'électrique. N'utilisez que des câbles unifilaires. Sélectionnez un diamètre de conducteur adapté pour réduire les chutes de tension. Nous vous recommandons d'utiliser les composants suivants pour les branchements et le câblage :

Nom/Description	Fabricant/Distributeur	Référence
Connecteur assemblable sur site	Lumberg	LC4-CP-30-2 IT 2.5, LC4-CP-31-1 2.5
Leoni Studer Betaflam 125 (14 AWG, 2,5 mm2)	Leoni Studer	226243

• Protection de câble
Nous vous recommandons de fixer les câbles au système de montage à l'aide de colliers de serrage résistants aux rayons ultraviolets. Protégez les câbles exposés contre tout dommage au moyen de précautions adaptées (en les recouvrant de tubes en plastique). Évitez toute exposition directe au soleil.

Renseignements sur la norme ANSI/UL 1703 (États-Unis et Canada)

• Les caractéristiques électriques du module solaire sont comprises dans une plage de +/-10 % des valeurs Isc, Voc et Pmax indiquées sur l'étiquette du module dans des conditions de test standard (irradiation de 1 000 W/m^2, spectre AM 1,5 et température de cellule de 25 °C/77 °F), à moins de toute autre indication contraire.
• Dans des conditions normales d'utilisation, un module photovoltaïque est susceptible de produire davantage de courant et/ou de tension que dans les conditions de test standard. En conséquence, les valeurs Isc et Voc indiquées sur ce module doivent être multipliées par un facteur de 1.55 à 125 mW/cm^2, AM1,5 G, température de la cellule -10C pour Voc et +75C pour Isc, afin de déterminer la puissance nominale de la tension des composants, la capacité des conducteurs, ainsi que la taille des fusibles et des dispositifs de contrôle reliés à la sortie photovoltaïque.
• Reportez-vous à la section 690-8 du NEC pour plus de renseignements sur le facteur de multiplication supplémentaire de 125 % (80 % de réduction de puissance) pouvant être appliqué.
• La protection contre la surintensité doit être conforme aux exigences de l'Article 240 du NEC ou inférieure à 6 A conformément à la puissance nominale maximale des fusibles Stion, en fonction de la valeur la plus basse.
• Recommandations concernant les conducteurs : 8 à 14 AWG (2,5 à 10 mm^2) USE-2 (non conducteur)/THWN-2 (conducteur), utilisation dans les milieux humides à 90 °C, -40 °C min. Ne placez pas les câbles photovoltaïques dans des conduits de câble.
• Vous devez utiliser des conduits de câble aux endroits où le câblage est accessible par les enfants et les animaux de petite taille.
• Toute modification des diodes par du personnel non qualifié est interdite. Veuillez consultez Stion pour obtenir de plus amples renseignements sur le remplacement/la réparation des diodes.

3.3 Mise à la terre

La société en charge de l'installation du module photovoltaïque doit également garantir une mise à la terre de qualité professionnelle. Le châssis en aluminium fourni en usine doit être relié à la terre. Toutes les mises à la terre doivent être réalisées conformément aux dernières réglementations NEC (Code national de l'électricité) en vigueur dans la juridiction concernée. Si le bâtiment est déjà équipé d'un système d'éclairage externe, l'installation photovoltaïque doit être intégrée au système de protection contre les effets directs de la foudre. Les normes en vigueur dans le pays concerné doivent être respectées.

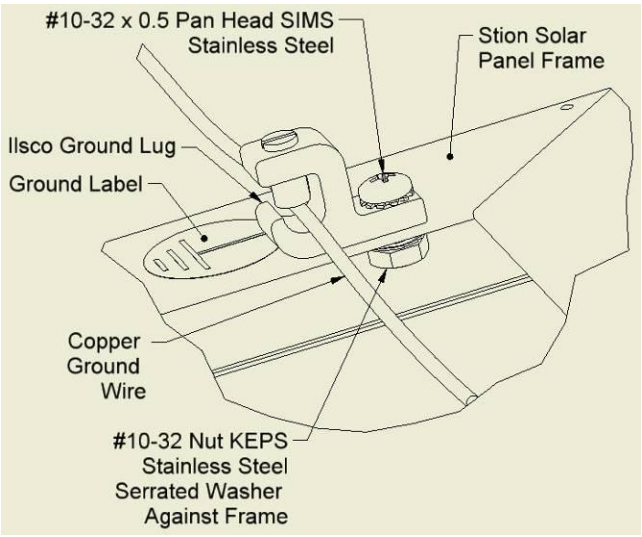
Vous devez opter pour une méthode de mise à la terre et des composants compatibles avec les normes ANSI/UL appropriées, y compris les normes UL467, UL1703 et UL 1741, si vous résidez aux États-Unis et au Canada et pour utiliser ce module.

Exemple de mise à la terre conforme à la réglementation UL ou CEI pour les systèmes de 600 V maximum :

Vous pouvez connecter les modules à la terre via les orifices prévus à cet effet au moyen d'une cosse de mise à la terre et d'une boulon munie d'une rondelle striée et d'un écrou muni d'une rondelle striée. S'il vous plaît noter que l'écrou doit avoir une rondelle striée de percer le revêtement anodisé du cadre. Les outils suivants sont recommandés :

Élément	Nom/Description	Fabricant/Distributeur	Référence
Borne de mise à la terre	Cosse de mise à la terre	Ilsco	GBL-4DBT
Boulon	Boulon 10-32 x 0,5" à tête cylindrique large de type SIMS en acier inoxydable	McMaster-Carr	95345A566
Écrou	Écrou 10-32 de type KEPS en acier inoxydable	McMaster-Carr	96278A411

Schéma de la méthode de mise à la terre (600 V)



Nous vous recommandons d'utiliser les composants listés ci-dessus, y compris une cosse de mise à la terre, un boulon avec rondelle striée en acier inoxydable (SIMS) et un écrou avec rondelle striée en acier inoxydable (KEPS). Vous devez utiliser la rondelle striée pour transpercer le revêtement anodisé afin d'entrer en contact avec le châssis. Un couple doit être appliqué pour garantir le contact avec l'aluminium (couple de 35 à 40 po.lb). Un conducteur en cuivre massif à la terre doit être fixé avec la vis de serrage fournie par le fabricant de la cosse de mise à la terre pour prévenir la corrosion galvanique liée au contact avec d'autres métaux.

Reportez-vous également à l'article 690 de la réglementation NEC pour obtenir de plus amples renseignements sur la mise à la terre et les exigences spécifiques des systèmes photovoltaïques.

4.0 Installation

Lors de l'installation des modules, accordez une attention particulière aux points suivants :

4.1 Sécurité de l'installation

Ne procédez pas à l'installation lorsque le vent est fort. Respectez les pratiques de sécurité appropriées et utilisez le matériel de sécurité requis pour prévenir tout risque de chute. Fixez le matériel de travail pour éviter de faire tomber des composants. Déterminez une zone de travail pour prévenir tout accident impliquant des tiers. Les modules n'intègrent aucune fonction de marche/arrêt. Recouvrez complètement le panneau avant avec un matériau opaque pendant l'installation.

4.2 Charge maximale

Assurez-vous que la structure de support est conforme aux exigences maximales autorisées en termes de charge. En matière de charge, le système a été testé par rapport à la réglementation ANSI/UL 1703 à 45 PSF. Le service des bâtiments et de l'entretien exige généralement un facteur de sécurité de conception minimal de 1,5 pour les structures. La charge structurelle maximale mentionnée dans

ce manuel ne comprend pas de facteur de sécurité ajouté. Vérifiez auprès de votre service des bâtiments et de l'entretien les renseignements relatifs au code conformément à la réglementation locale, notamment dans les régions soumises à de fortes intempéries (accumulation de neige et vents forts). N'oubliez pas que les modules peuvent s'arquer s'ils sont soumis à de fortes charges. Évitez d'installer des crochets, des colliers de serrage, etc. entre le panneau arrière des modules et la structure de support (par exemple, des rails de montage) étant donné que n'importe quel bord tranchant peut endommager les modules.

4.3 Protection contre les incendies

La construction du toit et l'installation peuvent affecter la protection contre les incendies d'un bâtiment, une installation inappropriée pouvant contribuer à augmenter les risques d'incendie. Dans le cadre d'un montage sur le toit, les modules doivent être installés par-dessus une couverture résistante au feu dont les caractéristiques nominales sont conformes à l'application. Il peut s'avérer nécessaire d'utiliser des composants spécifiques comme des disjoncteurs de panne reliés à la terre, des fusibles et des coupe-circuits. Le module est un « dispositif n'intégrant aucune protection contre les explosions ». C'est pourquoi il ne doit pas être installé à proximité de gaz ou vapeurs hautement inflammables (stations de pompage, barils de gaz, pulvérisateur de peinture, etc.). De même, le module ne doit pas être installé à proximité d'appareils à flamme nue ou de matériaux inflammables. Consultez les autorités locales pour plus de renseignements sur la sécurité et la protection contre les incendies des bâtiments.

4.4 Environnement adapté

Le module est conçu pour être utilisé dans une zone climatique tempérée où les températures de fonctionnement sont comprises entre -40 et +90 °C (-40 et +194 °F). Le module ne doit pas être exposé à une lumière concentrée. Il ne doit pas non plus être immergé sous l'eau ou constamment exposé à un jet d'eau (à partir d'une fontaine, par exemple). L'exposition au sel (nous recommandons d'installer les modules à 500 m ou 1 700 pi minimum de la mer) et au soufre (sources de soufre et volcans) entraîne un risque de corrosion. Le module ne doit pas être explosé à des produits chimiques extrêmement corrosifs (rejets des usines de fabrication, par exemple).

4.5 Conception appropriée

Assurez-vous que le module est conforme aux exigences techniques du système complet. Assurez-vous que les autres composants du système n'exercent aucune pression susceptible d'endommager les modules d'un point de vue mécanique ou électrique. Lors d'un branchement en série, les modules doivent tous posséder la même intensité. Lors d'un branchement en parallèle, les modules doivent tous posséder la même tension. Les modules ne doivent pas être connectés ensemble ; ceci pourrait créer une tension supérieure à la tension supportée par le système. Les modules ne doivent pas être montés en double vitrage de toiture ou de façade (montage vertical). Assurez-vous que le système de montage est capable de supporter le vent et le poids de la neige attendus dans la région. Le châssis du module intègre des orifices de drainage à chaque coin pour permettre l'évacuation des eaux de pluie. Vérifiez que ces orifices ne sont pas obstrués entièrement ou partiellement suite à l'installation du module.

Performances et dimensions du réseau : Respectez les exigences de la réglementation NEC et de la juridiction locale pour évaluer, réduire la puissance et déterminer le nombre maximal de modules par réseau sorte que la tension a ajouté des numéros de modèle spécifié module et la quantité de modules ne dépassent pas la tension de système maximale autorisée. Veillez à dimensionner les réseaux et les installations en série conformément aux changements potentiels de température pendant le fonctionnement des modules. Des températures plus basses peuvent augmenter la tension et exiger l'installation d'un nombre moindre de modules en série.

Le branchement parallèle est une fonction de l'inverseur utilisé dans le système. Consultez les spécifications de l'inverseur pour déterminer le nombre de modules qu'un branchement en parallèle permet de prendre en charge. Chaque module doit posséder son propre court-circuit lors d'un branchement en parallèle (conforme à la puissance nominale des fusibles).

Angle et inclinaison : Pour que le système offre un rendement optimal, nous vous recommandons de déterminer la meilleure orientation et le meilleur angle d'inclinaison des modules. Les conditions de génération de l'électricité sont considérées comme idéales lorsque les rayons du soleil atteignent la surface du module à la perpendiculaire. Pour éviter une chute de performances dans les installations en série, vérifiez que tous les modules possèdent la même orientation et la même inclinaison. Stion recommande les modules sont montés en mode portrait pour éviter la perte de puissance possible de l'ombre et des débris. Si le paysage de montage est requis sur le site, Stion recommande une inspection et un nettoyage réguliers, afin de ne pas faire de l'ombre une grande partie d'une cellule à l'accumulation de débris. Dans les climats secs à faible angle d'inclinaison (<15 °), les modules ne doit pas être monté dans le paysage. Modules ne doivent pas être monté dans le paysage sans un régime d'inspection et un nettoyage réguliers.

Ombrage : Même un ombrage partiel diminue le rendement. Un module est dit « sans ombre » lorsque l'intégralité de sa surface n'est jamais exposée à l'ombre de toute l'année et qu'elle reçoit les rayons du soleil sans obstruction, y compris les jours les moins favorables de l'année. Même un ombrage partiel peut considérablement réduire la production du module et du système.

Ventilation : Il est nécessaire de garantir une ventilation adéquate au niveau du panneau arrière du module (espacement minimal de 100 mm (4 po)) pour éviter toute surchauffe susceptible de réduire les performances du système. Un espacement de 7 mm (¼ po) minimum entre les modules est indispensable pour permettre l'expansion thermique des châssis.

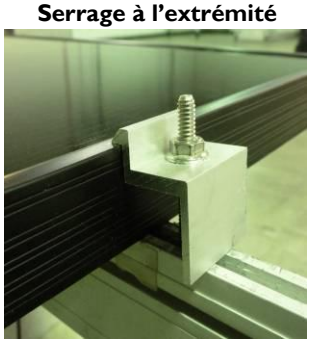
4.6 Montage et configuration

Les modules sont uniquement conformes à la norme ANSI/UL 1703 lorsque le châssis fourni en usine est encore intact. Vous ne devez ni modifier, ni altérer ni retirer le châssis. De même, vous ne devez pas percer d'orifices de montage supplémentaires. Ceci annulerait la garantie. Chaque module doit être correctement fixé en 4 points minimum. Le châssis intègre 8 orifices de montage approuvés en usine le long de ses côtés à 10,5 pouces (268mm) et 16,0 pouces (408mm) du bord court du châssis. Les orifices de montage au centre des bords longs du châssis sont facultatifs et permettent d'assurer un support additionnel. Le montage à partir de ces orifices est additionnel. Il ne dispense pas de l'obligation de fixer le système au moyen des 4 points désignés comme les orifices de montage approuvés ou les zones de montage approuvées. Le châssis a été testé contre la contrainte par Stion et son montage à partir des côtés longs uniquement est conforme à la norme ANSI/UL 1703. Le module ne doit pas être monté à partir des côtés courts du châssis.

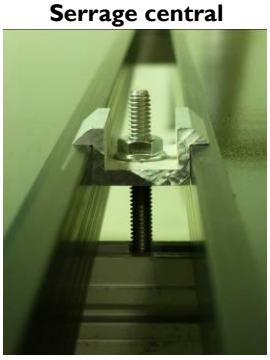
Il est possible de monter les modules photovoltaïques de Stion sur une sous-structure conformément aux méthodes suivantes :

3) *Fixation par boulons* : Le module peut être maintenu sur la structure à l'aide de boulons ou de vis via les orifices percés en usine sur les côtés longs du châssis. Reportez-vous à la fiche technique du module de Stion pour de plus amples renseignements sur l'emplacement exact des orifices de montage. Nous vous recommandons d'utiliser 4 boulons/vis de ¼ po en acier inoxydable avec écrous, rondelles et rondelles de blocage. Le boulon (ou la vis) doit être suffisamment long pour permettre l'engagement complet de l'écrou tout en garantissant un espacement d'au moins ¼ po entre l'extrémité du boulon (de la vis) et la surface vitrée du module. Utilisez des matériaux de fixation appropriés résistant à la corrosion.
4) *Fixation par serrage* : Il est possible de fixer le module à la structure au moyen d'un dispositif de serrage. Une solution de serrage comprend un élément de serrage supérieur qui permet de fixer la partie avant du châssis du module et un rail ou un élément de serrage inférieur qui supporte ou maintient la partie inférieure du module. Les éléments de serrage supérieurs maintiennent fixement le module en quatre points distincts contre les rails ou les éléments de serrage inférieurs. Un exemple de fixation par serrage central et au niveau des extrémités est illustré dans les schémas ci-après.

Serrage à l'extrémité



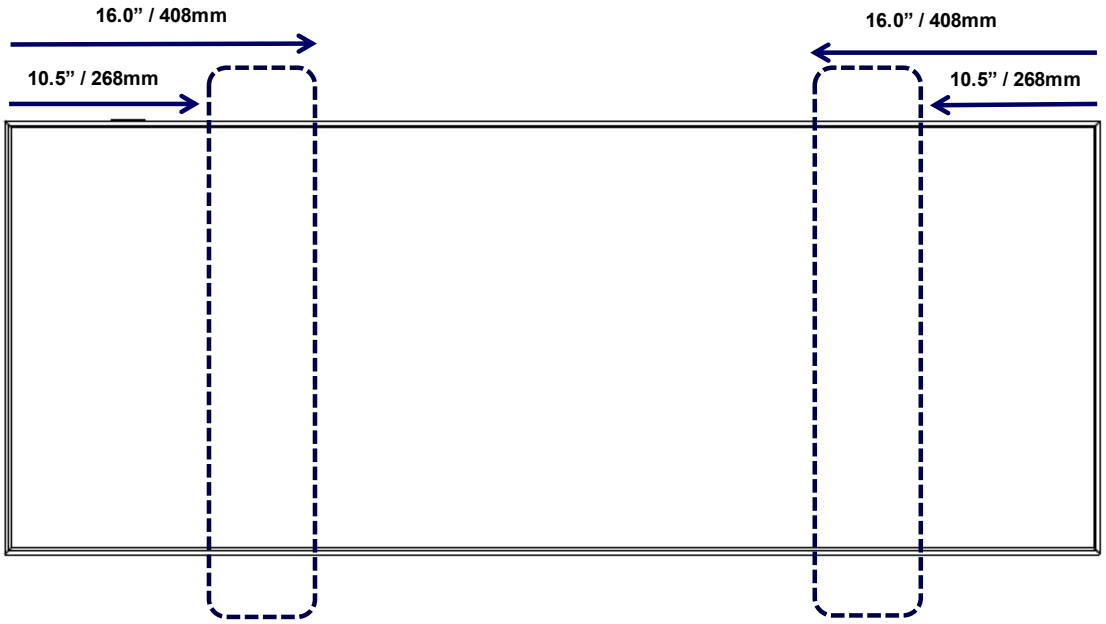
Serrage central



Le module de Stion ne devrait être serré sur les côtés longs. Le centre des pinces devraient être situés dans les zones de montage. Les zones de montage sont situés entre 10,5 pouces (268mm) et 16,0 pouces (408mm) du bord court du module et sont présentés dans le diagramme ci-dessous.

Serrer les écrous à rebord, centrer et aligner le module selon les besoins, et serrer les écrous de bride (10 lb pi). S'ilvous plaît se référer au manuel d'installation Unirac SolarMount pour des informations supplémentaires.

Schéma Zone de Montage



Nous vous recommandons d'utiliser des dispositifs de serrage inférieurs et supérieurs en aluminium anodisé. Exemple : la solution de montage SolarMount d'UniRac. Au niveau de l'élément *de* serrage supérieur fixé en bordure, nous vous recommandons les éléments de serrage d'extrémité « C » SolarMount. Pour la fixation par serrage entre les modules, nous vous recommandons les éléments de serrage central « C » SolarMount.. Pour la fixation par serrage inférieure, nous vous recommandons les rails Unirac SolarMount qui permettent de maintenir et supporter le panneau arrière des modules. Les éléments de montage SolarMount sont disponibles en kits complets (produit + matériel nécessaire). La longueur et le nombre de rails, le nombre de pieds, de dispositifs de serrage, etc. varient en fonction du nombre de modules à installer. Consultez la liste tarifaire des produits SolarMount d'Unirac pour déterminer la taille des rails et le nombre d'éléments de serrage requis.

Élément	Nom/Description	Fabricant/Distributeur	Référence
Kits 2 rails standard SolarMount	Rails en aluminium anodisé 2-60 po, 4 pieds en L, matériel de fixation des pieds en L aux rails	UniRac	300202
Dispositifs de serrage aux extrémités SolarMount C Pro-Pak	20 éléments de serrage aux extrémités en aluminium anodisé C avec boulons en T en acier inoxydable, ¼ po x 2 po, écrous à bride	UniRac	320014
Dispositifs de serrage central SolarMount C Pro-Pak	20 éléments de serrage central en aluminium anodisé C avec boulons en T en acier inoxydable, ¼ po x 2 po, écrous à bride	UniRac	320020

4.7 Maintenance et nettoyage

Les modules et systèmes photovoltaïques ne nécessitent pas de maintenance périodique. Nous vous recommandons toutefois d'effectuer une inspection régulièrement pour vérifier les points suivants :

5. Tous les câbles sont correctement raccordés et fixés. Ils sont propres et aucune trace de corrosion n'est visible.
6. Tous les points de montage sont correctement fixés et serrés et aucune trace de corrosion n'est visible.
7. Les câbles, la vitre, le châssis, la boîte de raccordement et les connexions électriques externes ne sont pas endommagés.
8. La conductivité du châssis du module à la mise à la terre est suffisante.

Garantir une inclinaison suffisante (> 15°) pour le nettoyage des modules n'est généralement pas nécessaire (la pluie assure généralement un effet d'autonettoyage). Si le climat est sec (ou tout autrement unique) et en cas de salissure importante, nous vous recommandons de nettoyer les modules à grande eau (à l'aide d'un tuyau) sans aucun agent de nettoyage à l'aide d'une simple éponge sans frotter. Pour retirer la saleté incrustée, il est possible de nettoyer la vitre à l'aide d'un chiffon en microfibre imbibé d'éthanol ou d'un produit à vitre classique. Les dépôts étrangers à la surface du châssis peuvent être nettoyés à l'aide d'une éponge humide avec séchage à l'air libre ou à l'aide d'un chamois propre. Vous pouvez également utiliser un détergent doux ou du produit à vitre. Portez toujours des gants en caoutchouc pour garantir l'isolation électrique lors de l'entretien, le lavage ou le nettoyage des modules. Vous ne devez pas frotter les salissures lorsqu'elles sont sèches car ceci risque de provoquer des microrayures. N'utilisez pas de produits de nettoyage abrasif (poudre à récurer, produits chimiques alcalins, laine d'acier, grattoirs, couteaux ou tout autre instrument tranchant) pour nettoyer la surface vitrée du module. L'utilisation de tels ustensiles ou produits d'entretien sans consultation annulera la garantie du produit.

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AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

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Applicant:	Stion Corporation	**Manufacturer:**	Stion Corporation
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Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Lake Forest, CA

Control Number: *4004749* **Authorized by:** Ellen Swialek

for Thomas J. Patterson, Certification Manager

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Intertek

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
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Standard(s):	Standard for Flat Plate Photovoltaic Modules and Panels (ANSI/UL 1703 Third Edition dated March 15, 2002 with revisions dated May 8, 2012) and Flat Plate Photovoltaic Modules and Panels (ULC ORD-C1703-01 First Edition with Amendments through October 2001)
Product:	Flat Plate Thin-Film Photovoltaic Modules
Brand Name:	Stion ELEVATION

AUTHORIZATION TO MARK

Models:	SN-100, STN-100, STNL-100 SN-110, STN-110, STNL-110 SN-115, STN-115, STNL-115 SN-120, STN-120, STNL-120 SN-125, STN-125, STNL-125 SN-130, STN-130, STNL-130 SN-135, STN-135, STNL-135 SN-140, STN-140, STNL-140 SN-145, STN-145, STNL-145 SN-150, STN-150, STNL-150 STO-125, STO-125-600, STL-125, STL-125-600 STO-130, STO-130-600, STL-130, STL-130-600 STO-135, STO-135-600, STL-135, STL-135-600 STO-140, STO-140-600, STL-140, STL-140-600 STO-145, STO-145-600, STL-145, STL-145-600 STO-150, STO-150-600, STL-150, STL-150-600

MOBILE CONNECTOR

SUMMARY SHEET

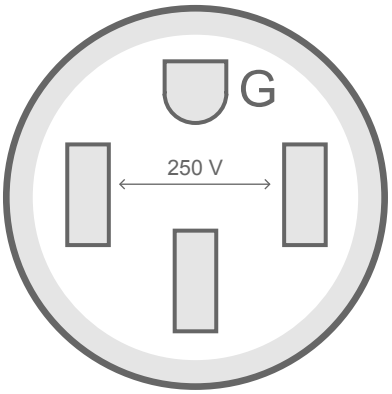
To take full advantage of your Tesla Mobile Connector, work with an electrician to install a 240 volt outlet where you plan to park your Model S.

To ensure uninterrupted charging at full power, the circuit breaker should be rated for 50 amps.

Your Mobile Connector also comes with a 110 volt adapter, which you can use to charge from any household outlet. While this isn't a very fast way to charge, it allows you to charge almost anywhere.

DETAILS

- Single phase, 208-250 volt AC supply, 60 hertz
- 50 amp circuit breaker / 40 amp continuous draw
- No GFCI (Ground Fault Circuit Interrupter) required
- Service disconnect not required
- The connector is 20 feet long. Install your new outlet less than 18 feet from the driver side taillight, at least 18 inches above the ground.
- Do NOT use an extension cord



NEMA 14-50, Ground on Top
Image to scale (~2.25" diameter)

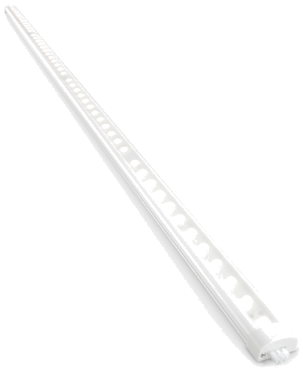
SolarCity is our recommended charging equipment installer. They are experts in preparing homes for Tesla vehicles. If you need an electrician, contact SolarCity to schedule a consultation: tesla@solarcity.com or 1-855-515-7652.

SolarCity

Questions?
Contact the Tesla Ownership Experience Team: ownership@teslamotors.com or 1-877-778-3752.

Vaya Cove LP, White & Mono

Philips Vaya Cove LP is a reliable and cost-effective light fixture providing white or mono color light for interior use. Designed for cove and accent lighting applications and with two lengths, two standard white CCTs and standard 24V DC power, this product is versatile and easy to use. Vaya Cove LP works as on/off product or with any standard current sinking 0-10V/1-10V controller.



Key Features

- Available in standard 3000K and 4000K
- Custom options: 2700K, 5000K, Red, Green. Blue, Amber
- Flat and angled mounting clips (Energy Star)
- Low Voltage, 24V DC input power
- Standard 0-10V dimming control compatible
- 3-Year Warranty

Product Data

Height	0.85 in (21.5 mm) (including surface mount clip)	
Width	1.25 in (32 mm) (including surface mount clip)	
Lengths	0.3 m (12 in)	1.2m (48 in)
Mounting	Removable mounting clips for flush mounting and 45deg angled mounting clips (Energy Star rated)	
Source	High-brightness White, Red, Green, Blue or Amber LEDs	
Beam Angle	100°	
Luminous Flux	250 lm	1,000 lm
CRI	80 Ra	
Efficacy (System)	55 Lumens / Watt	
Lumen Maintenance	White: 50,000 hrs L_{70} at 25°C Mono: 50,000 hrs L_{50} at 25°C	
Luminous Flux (Red)	95 lm	380 lm
Luminous Flux (Green)	120 lm	480 lm
Luminous Flux (Blue)	35 lm	150 lm
Luminous Flux (Amber)	75 lm	300 lm
Housing / Lens	Extruded polycarbonate, white housing with clear lens	
Weight	90 g (0.2 lbs)	360 g (0.8 lbs)
Leader Cables	2 m (6.5 ft) and 8 m (25 ft)	
Jumper Cables	0.3 m (1 ft) and 5 m (15 ft)	
Control	0-10V/1-10V dimming (IEC 60929) via Philips Xitanium Dimming Module	
Input Power	24V DC	

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Fax 617 338 0454

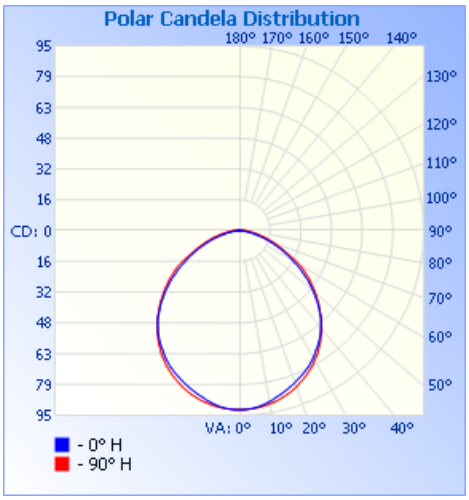
Rev. 20130520

Power Consumption	White: 3.5 W Mono: 3.2 W	White: 14 W Mono: 12.8 W
Temperature Range	-20°C to 40°C (-4°F to 104°F) operating temperature	
Protection Rating	IP20, Interior applications	
Certifications	UL / cUL, FCC Class B, CE, CB	
Warranty	3 Years	

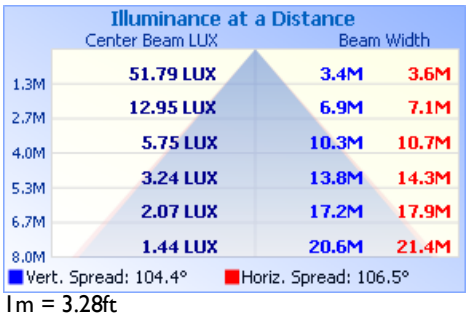
Photometrics (Per IESNA LM-79):

Vaya Cove LP, 0.3m (12 in), 3000K

Polar Candela Distribution



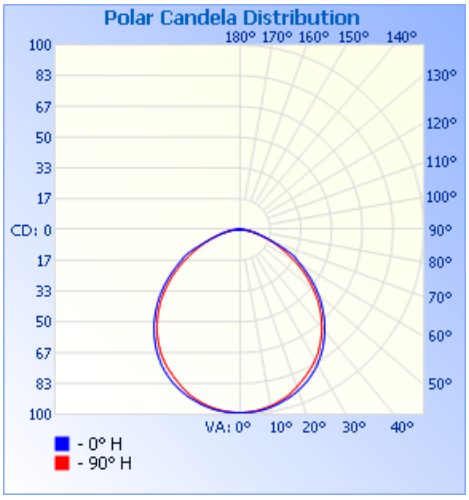
Illuminance at a Distance



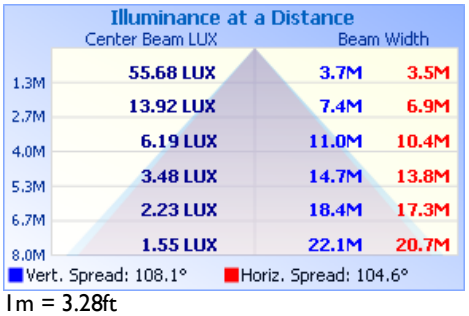
1m = 3.28ft

Vaya Cove LP, 0.3m (12 in), 4000K

Polar Candela Distribution



Illuminance at a Distance



1m = 3.28ft

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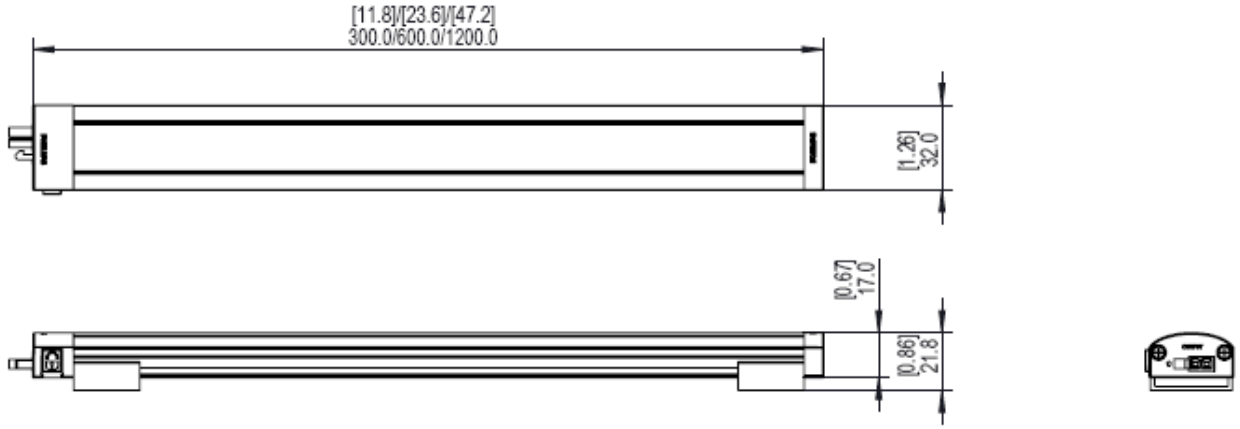
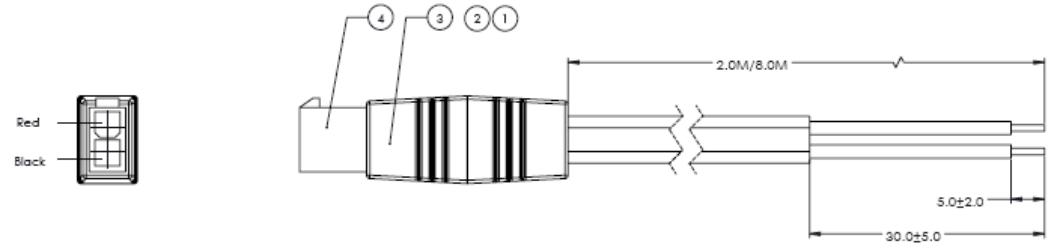
Light Fixture Dimensions:

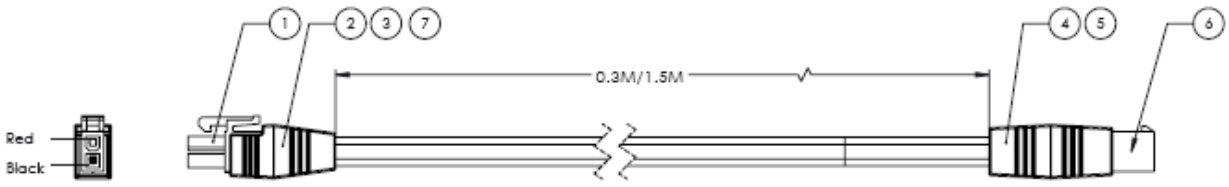


With optional 45deg mounting bracket (included):

Power Leader Cable Dimensions:



Power Jumper Cable Dimensions:



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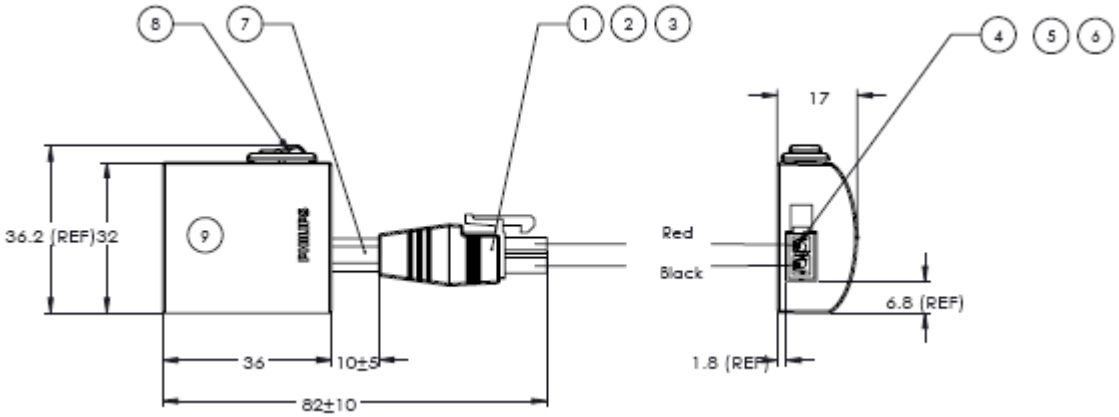
On-Off Rocker Switch Module:



Maximum Connected Lengths[1]

Fixture Type	Power Supply Wattage (24V DC)	Max. Number of 0.3 m Fixtures	Max. Number of 1.2 m Fixtures
White & Mono	100W	24	6

1. Maximum connected lengths assume little or no voltage drop in power leader and jumper cables. For installations with long leader and jumpers, wire should be sized to prevent voltage drop and fixture count should be reduced.

Recommended Power Supplies:

Philips Xitanium

Wattage	Input Voltage	Philips 12 NC	Item Number	Certification
100W	120-277V	9137 102 99702	309-000001-00	UL
100W	100-240V	9137 006 21091		CE

NEMA 3R Enclosure

Item Name	Description	Philips 12NC	CK Item Number
ACCESSORY, POWER SUPPLY ENCLOSURE (NEMA3R, 15x3)	Electrical Enclosure compliant to NEMA3R and UL-outdoor ratings, 15"x3"	913710841202	320-000001-00 (US and Canada only)

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PHILIPS

Ordering Codes:

CCT	Length	Philips 12NC	Item Number	Certification
3000K	0.3 m (12 in)	910503704589	350-000012-06	UL/cUL, CE
3000K	1.2 m (48 in)	910503704591	350-000012-08	UL/cUL, CE
4000K	0.3 m (12 in)	910503704592	350-000012-09	UL/cUL, CE
4000K	1.2 m (48 in)	910503704594	350-000012-11	UL/cUL, CE

[1]Custom options include 0.6m (2ft) versions as well as 2700K, 5000K, Red, Green, Blue, Amber versions.

Cables:

Product	Length	Philips 12NC	Item Number	Certification
Leader Cable	2 m (6.5 ft)	910503704620	308-000001-17	UL/cUL, CE, CQC
Leader Cable	8 m (25 ft)	910503704621	308-000001-18	UL/cUL, CE, CQC
Jumper Cable	0.3 m (12 in)	910503704622	308-000001-19	UL/cUL, CE, CQC
Jumper Cable	1.5 m (59 in)	910503704623	308-000001-20	UL/cUL, CE, CQC

Accessories:

Product	Details	Philips 12NC	Item Number	Certification
On-Off Switch	Rocker Switch	910503704624	320-000003-00	UL/cUL, CE, CQC
45deg Mounting Bracket	Energy Star compliant	910503704728	320-000003-01	UL/cUL, CE, CQC
CE Starter Kit	1x PSU, 8m Leader Cable, On-Off Switch	910503704729	320-000003-02	CE
UL Starter Kit	1x PSU, NEMA Enclosure, 8m Leader Cable, On-Off Switch	910503704730	320-000003-03	UL/cUL

0-10V Dimming Module (Philips Xitanium)

Wattage	Input Voltage	Philips 12 NC	Item Number	Certification
100W	12-24V	9137 108 30902	309-000003-00	UL, CE (Bulk Pack)
100W	12-24V		309-000003-01	UL, CE (Individual Pack)

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CCT	Length	Philips 12NC	Item Number	Certification
3000K	0.6 m (24.0 in)	910503704590	350-000012-07	UL/cUL, CE
4000K	0.6 m (24.0 in)	910503704593	350-000012-10	UL/cUL, CE
2700K	0.3 m (12 in)	910503704602	350-000012-18	UL/cUL, CE
2700K	0.6 m (24.0 in)	910503704603	350-000012-19	UL/cUL, CE
2700K	1.2 m (48 in)	910503704604	350-000012-20	UL/cUL, CE
5000K	0.3 m (12 in)	910503704605	350-000012-21	UL/cUL, CE
5000K	0.6 m (24.0 in)	910503704606	350-000012-22	UL/cUL, CE
5000K	1.2 m (48 in)	910503704607	350-000012-23	UL/cUL, CE
Red	0.3 m (12 in)	910503704608	325-000012-00	UL/cUL, CE, CQC
Red	0.6 m (24.0 in)	910503704609	325-000012-01	UL/cUL, CE, CQC
Red	1.2 m (48 in)	910503704610	325-000012-02	UL/cUL, CE, CQC
Green	0.3 m (12 in)	910503704611	325-000012-03	UL/cUL, CE, CQC
Green	0.6 m (24.0 in)	910503704612	325-000012-04	UL/cUL, CE, CQC
Green	1.2 m (48 in)	910503704613	325-000012-05	UL/cUL, CE, CQC
Blue	0.3 m (12 in)	910503704614	325-000012-06	UL/cUL, CE, CQC
Blue	0.6 m (24.0 in)	910503704615	325-000012-07	UL/cUL, CE, CQC
Blue	1.2 m (48 in)	910503704616	325-000012-08	UL/cUL, CE, CQC
Amber	0.3 m (12 in)	910503704617	325-000012-09	UL/cUL, CE, CQC
Amber	0.6 m (24.0 in)	910503704618	325-000012-10	UL/cUL, CE, CQC
Amber	1.2 m (48 in)	910503704619	325-000012-11	UL/cUL, CE, CQC

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Rev. 20130520

NUTP8-16LED
24V 16' Damp Label
High Output LED Tape Light Roll

Source: 58W - 3.6 Watts Per Foot

NORALIGHTING.

Type

Project

Catalog No.

Lamp/Wattage

PRODUCT DESCRIPTION

High Output LED Tape Light has three times the light output of our standard tape, and is a perfect solution for your LED linear lighting needs. Very low profile High Output LED Tape is great for use in cove lighting, architectural enhancements, under cabinet or many more discreet locations. Each roll comes with (16) 12" sections linked together.

FEATURES

- Available in 16' roll, 12" section, or 4" section
- 205 lumens per foot with 4200K CCT
- Separable every 12", easily disconnected and connected without soldering
- Field cuttable every 4" or 6 LEDs
- Easy to install; pre-applied 3M™ tape or 15 acrylic mounting clips (included with roll)
- 6 available colors: Blue, Green, Red, Yellow (Amber), Cool White (4200K), Warm White (3000K)
- cULus Listed for Damp Locations
- Exceeds Title 24 high efficacy requirements
- No soldering or additional wiring is required
- No flicker delay or warm up like compact fluorescent products
- No UV light or infrared wavelengths
- Three Year Limited Warranty

Included with every roll:
(1) 16' Tape Light Roll, (15) Acrylic Mounting Clips with screws [NATHR-685], and (1) 12" Power Line Interconnector [NAHO-609].

CONSTRUCTION

The tape can be cut every 6 LEDs at marked intervals, cutting does not effect circuit. LED Tape Light is also separable every 12", simply separate pieces as this eliminates soldering when using partial rolls.

MOUNTING

Each Tape Light roll comes with 15 clear acrylic clips and also comes with pre-applied 3M™ adhesive tape for simple installation. An optional aluminum channel is available.

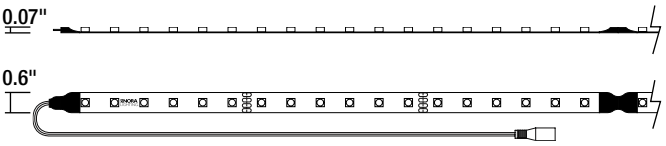
ELECTRICAL

Voltage: 24V DC
Power Consumption: 3.6 Watts Per Foot (58W Total)
Lumens: Up to 205 Lumens Per Foot
Light Source: 18 LEDs Per Foot (288 LEDs Total)
Operating Temperature: -13ºF to 140ºF (-25ºC to 60ºC)
Life Expectancy: 50,000 Hours
Maximum Run Length: 16' on a single run (w/ 100W Driver)

Labels and Warranty
cULus Listed for Damp Location
IP44 Rated
Title 24 Compliant
California Energy Commission
Three Year Warranty

c UL us LISTED — TITLE 24 2008 — committed to GREEN

DIMENSIONS



Length: 16'
Width: 0.6"
Depth: 0.07"

ACCESSORIES

Item Number	Description
NAHO-602	2" Interconnection Cable
NAHO-606	6" Interconnection Cable
NAHO-618	18" Interconnection Cable
NAHO-636	36" Interconnection Cable
NAHO-672	72" Interconnection Cable
NAHO-600	"Y" Splitter Cable
NAHO-601	"X" Splitter Cable
NATHR-685	Clear Acrylic Mounting Clips (Pack of 15)
NATL-403	End Cap
NATHR-680	4' Aluminum Channel
NAHO-609	12" 24V Power Line Interconnector
NAHO-611	11" 24V Power Line Interconnector with Switch

LED DRIVERS

Item Number	Description
HARDWIRE DRIVERS	
NATL-530HW	24V 30W Class II Hardwired LED Driver (Requires NUSP-JBox or NRA-6035)
NATL-560HW	24V 60W Class II Hardwired LED Driver (Requires NUSP-JBox or NRA-6035)
NATL-5100HW	24V 100W Class II Hardwired LED Driver
NMT-48/24C2D1	120V/24V 48W Dimmable Class II Remote Hardwire Magnetic Driver w/ Regulator
NMT-48/24C2D2	277V/24V 48W Dimmable Class II Remote Hardwire Magnetic Driver w/ Regulator
NMT-96/24C2D1	120V/24V 96W Dimmable Class II Remote Hardwire Magnetic Driver w/ Regulator
NMT-96/24C2D2	277V/24V 96W Dimmable Class II Remote Hardwire Magnetic Driver w/ Regulator
NMT-303/24C2D1	120V/24V 300W Dimmable Class II Remote Hardwire Magnetic Driver w/Regulator
NMT-303/24C2D2	277V/24V 300W Dimmable Class II Remote Hardwire Magnetic Driver w/Regulator
PLUG-IN DRIVERS	
NATL-524	24V 24W Direct Plug-In LED Driver
NATL-545	24V 45W Direct Plug-In LED Driver
NATL-596	24V 96W Class II Plug-In Electronic LED Driver
DRIVER ACCESSORIES	
NALTL-10	Replacement 10' Power Line Connector for NMT Series & NATL-5100HW
NALTL-30	Replacement 30' Power Line Connector for NMT Series & NATL-5100HW
NATL-415	Low Voltage Splice Box
NRA-125/6	6" Extension Cord for NATL-530HW & NATL-560HW
NRA-125/12	12" Extension Cord for NATL-530HW & NATL-560HW
NRA-125/18	18" Extension Cord for NATL-530HW & NATL-560HW
NRA-125/72	72" Extension Cord for NATL-530HW & NATL-560HW
NRA-6035W/6	6' Cord and Plug for NATL-530HW & NATL-560HW
NRA-6035W/10	10' Cord and Plug for NATL-530HW & NATL-560HW
NUSP-JBox	Junction Box required for hardwiring NATL-530HW & NATL-560HW

24V 16' Damp Label High Output LED Tape Light Roll

- **NUTP8-16LED30:** 16' 24V High Output Damp Label LED Tape Light Roll, 3000K
- **NUTP8-16LED42:** 16' 24V High Output Damp Label LED Tape Light Roll, 4200K
- **NUTP8-16LEDB:** 16' 24V High Output Damp Label LED Tape Light Roll, Blue
- **NUTP8-16LEDG:** 16' 24V High Output Damp Label LED Tape Light Roll, Green
- **NUTP8-16LEDR:** 16' 24V High Output Damp Label LED Tape Light Roll, Red
- **NUTP8-16LEDY:** 16' 24V High Output Damp Label LED Tape Light Roll, Yellow (Amber)

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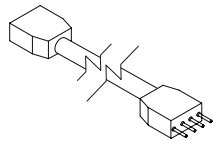
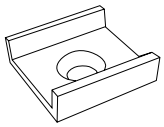
High Output LED Tape Light Optional Accessories

Interconnection Cable
The interconnection cables allow for linking of any tape lights in any direction or extension of power line interconnectors. The arrow on the interconnection cable must always be facing upward to maintain polarity. Interconnection cables may be joined together for custom lengths.



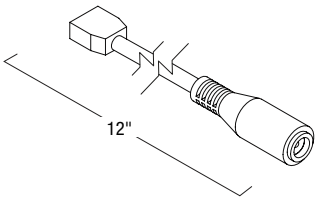
☐ **NAHO-602:** 2" Interconnection Cable
☐ **NAHO-606:** 6" Interconnection Cable
☐ **NAHO-618:** 18" Interconnection Cable
☐ **NAHO-636:** 36" Interconnection Cable
☐ **NAHO-672:** 72" Interconnection Cable

Clear Acrylic Mounting Clips (Pack of 15)
Used to mount tape light to surface, includes mounting screws. Pack of 15 are included with every Tape Light roll.



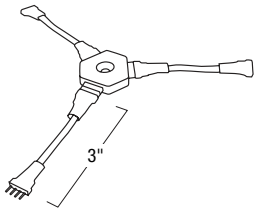
☐ **NATHR-685:** Clear Acrylic Mounting Clips (Pack of 15)

Power Line Interconnector
To connect a Tape Light run directly to LED Driver. NAHO-609 is included with every Tape Light roll.



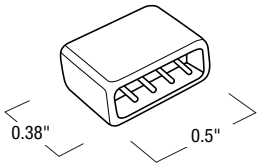
☐ **NAHO-609:** 12" 24V Power Line Interconnector

"Y" Splitter Cable
Splits connection from one tape light or driver into two separate tape lights.



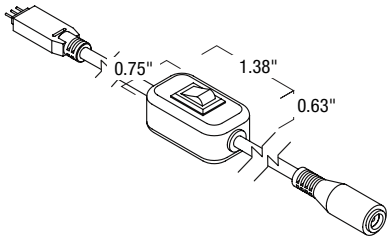
☐ **NAHO-600:** "Y" Splitter Cable

End Cap
Used to cover open end of Tape Light.



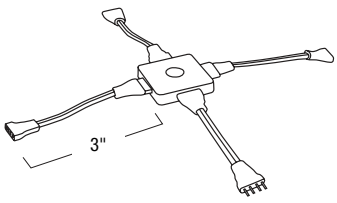
☐ **NATL-403:** End Cap

Power Line Interconnector with Switch
Allows for individual switching on any Tape Light run. Connects a Tape Light run directly to LED Driver.



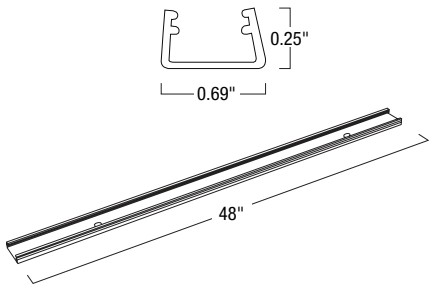
☐ **NAHO-611:** 11" Power Line Interconnector w/Switch

"X" Splitter Cable
Splits connection from one tape light or driver into three separate tape lights.



☐ **NAHO-601:** "X" Splitter Cable

Aluminum Channel
Used to mount tape light to various surfaces. Tape Light snaps into the channel. Field Cuttable. Recommended for most installations.



☐ **NATHR-680:** 4' Aluminum Channel

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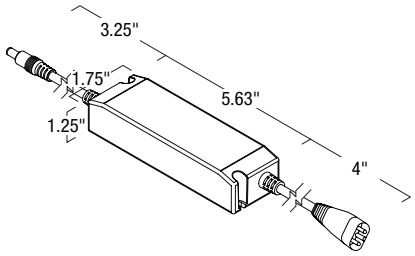
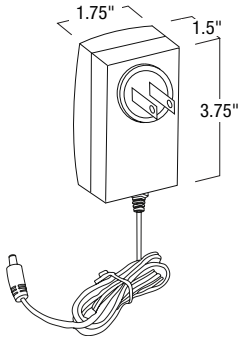
24V High Output LED Tape Light Drivers

30W 24V Class II Hardwire Electronic LED Driver
Allows hardwiring Tape Light run by using NUSP-JBox. Can also be converted into direct plug-in driver by using NRA-6035. Non-Dimmable.



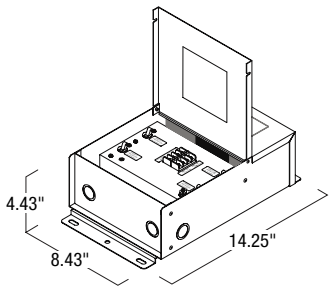
☐ **NATL-530HW:** 24V 30W Class II Hardwire Driver

24V Direct Plug-In LED Drivers
Allows direct connection a wall outlet with 6' cord and plug. Non-Dimmable.



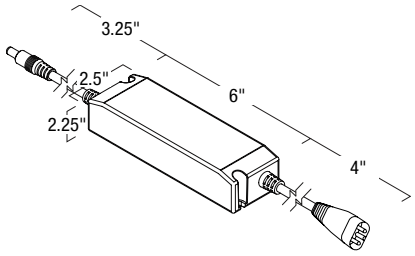
☐ **NATL-524:** 24V 24W Direct Plug-In LED Driver
☐ **NATL-545:** 24V 45W Direct Plug-In LED Driver

300W 24V Class II Dimmable Hardwire LED Driver
Includes three 100W breakers, which allows hardwiring three Tape Light runs and dimming with Magnetic Low Voltage Dimmer. Includes (3) 10' power line connector (NALTL-10). Manual reset thermal circuit - secondary side. Integral regulator for constant current and voltage. Can be mounted 30' from start of fun.



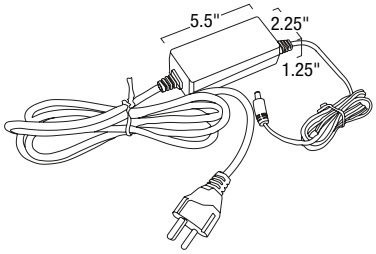
☐ **NMT-303/24C2D1:** 120V/24V 300W C2 Dimm. Driver
☐ **NMT-303/24C2D2:** 277V/24V 300W C2 Dimm. Driver

60W 24V Class II Hardwire Electronic LED Driver
Allows hardwiring Tape Light run by using NUSP-JBox. Can also be converted into direct plug-in driver by using NRA-6035. Non-Dimmable.



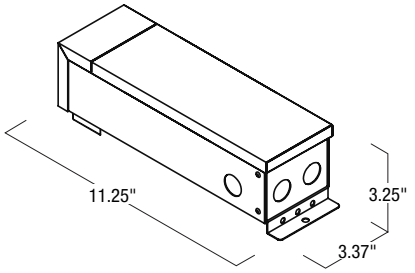
☐ **NATL-560HW:** 24V 60W Class II Hardwire Driver

96W 24V Direct Plug-In LED Driver
Allows direct connection a wall outlet with 5' cord and plug and 44" power line connector. Non-Dimmable.



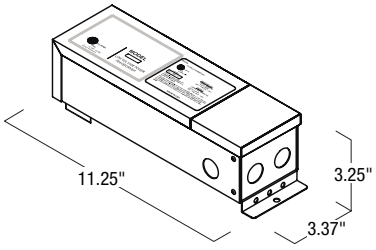
☐ **NATL-596:** 24V 96W Class II Dimmable Driver

100W 24V Class II Hardwire Electronic LED Driver
Allows hardwiring Tape Light run. Includes 10' power line connector (NALTL-10). Non-Dimmable.



☐ **NATL-5100HW:** 24V 100W C2 Hardwire Driver

24V Class II Dimmable Hardwire LED Driver
Allows hardwiring Tape Light run and dimming with Magnetic Low Voltage Dimmer. Includes 10' power line connector (NALTL-10). Manual reset thermal circuit - secondary side. Integral regulator for constant current and voltage. Can be mounted 30' from start of fun.



☐ **NMT-48/24C2D1:** 120V/24V 48W C2 Dimm. Driver
☐ **NMT-48/24C2D2:** 277V/24V 48W C2 Dimm. Driver
☐ **NMT-96/24C2D1:** 120V/24V 96W C2 Dimm. Driver
☐ **NMT-96/24C2D2:** 277V/24V 96W C2 Dimm. Driver

6505 Gayhart St., Commerce, CA 90040

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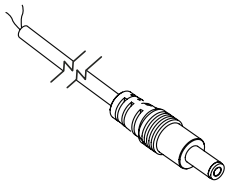
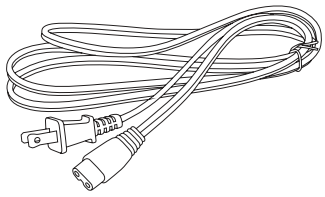
24V High Output LED Tape Light Drivers Accessories

Replacement Power Line Connector
For use with NMT Series and NATL-5100HW. Replaces included 10' lead wire, to allow for 30' or less length between Tape Light run and LED Driver.



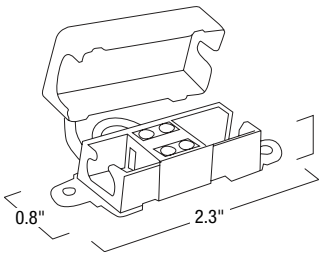
☐ **NALTL-10:** 10' 24V Power Line Connector
☐ **NALTL-30:** 30' 24V Power Line Connector

Cord and Plug for NATL-530HW or NATL-560HW
Used to convert NATL-530HW or NATL-560HW into a direct plug-in driver.



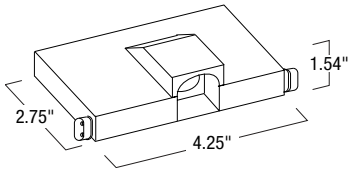
☐ **NRA-6035W/6:** 6' Cord and Plug
☐ **NRA-6035W/10:** 10' Cord and Plug

Low Voltage Splice Box
Use to join Romex® low voltage lead to power line connector.



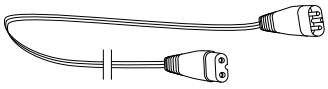
☐ **NATL-415:** Low Voltage Splice Box

Junction Box for Hardwiring
Required for hardwiring NATL-530HW or NATL-560HW. Can be used to feed to separate runs. Accepts Romex®.



☐ **NUSP-JBox:** Junction Box for Hardwiring

Extension Cord for NATL-530HW or NATL-560HW
Used to extend length between NUSP-JBox and NATL-530HW or NATL-560HW. Can be joined together to create custom lengths.



☐ **NRA-125/6:** 6" Flexible Extension Cord
☐ **NRA-125/12:** 12" Flexible Extension Cord
☐ **NRA-125/18:** 18" Flexible Extension Cord
☐ **NRA-125/72:** 72" Flexible Extension Cord

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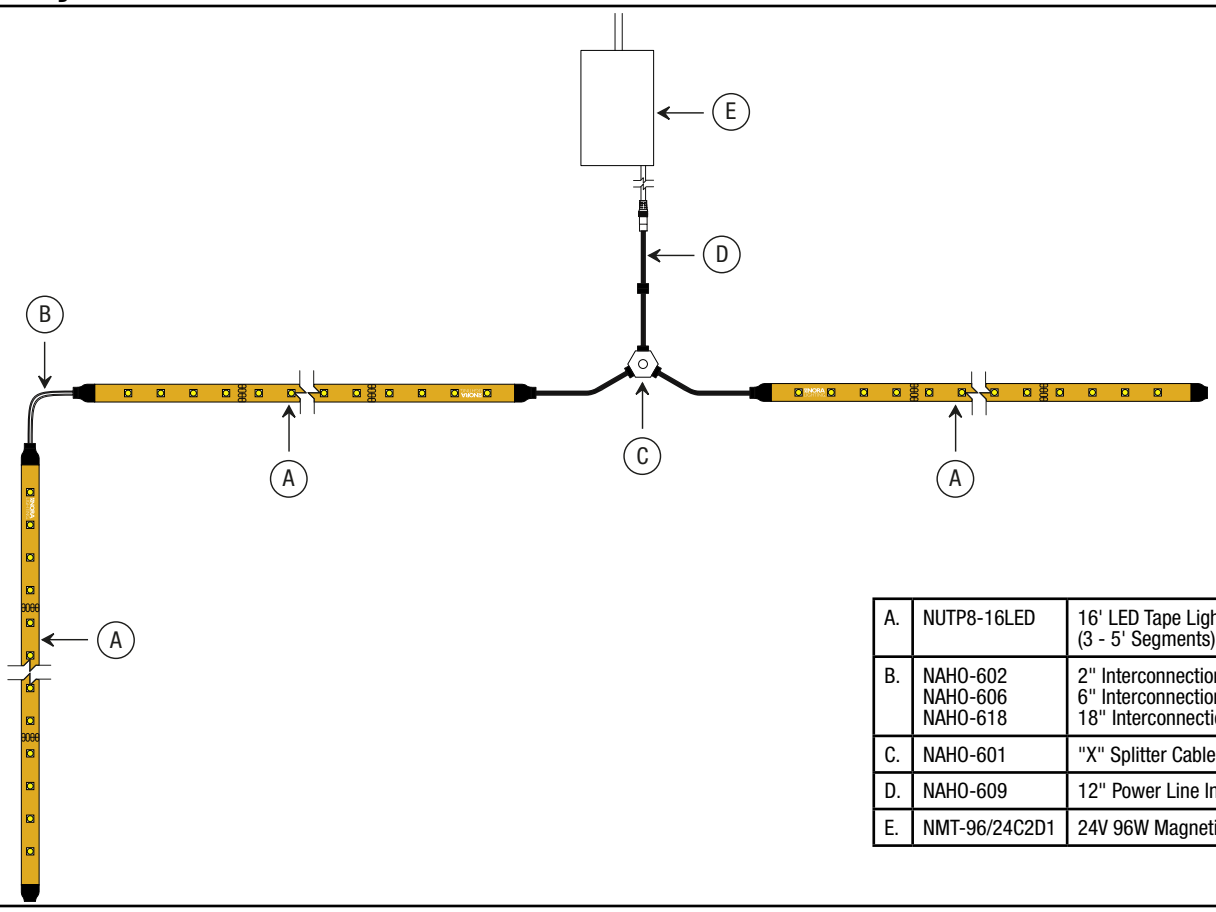
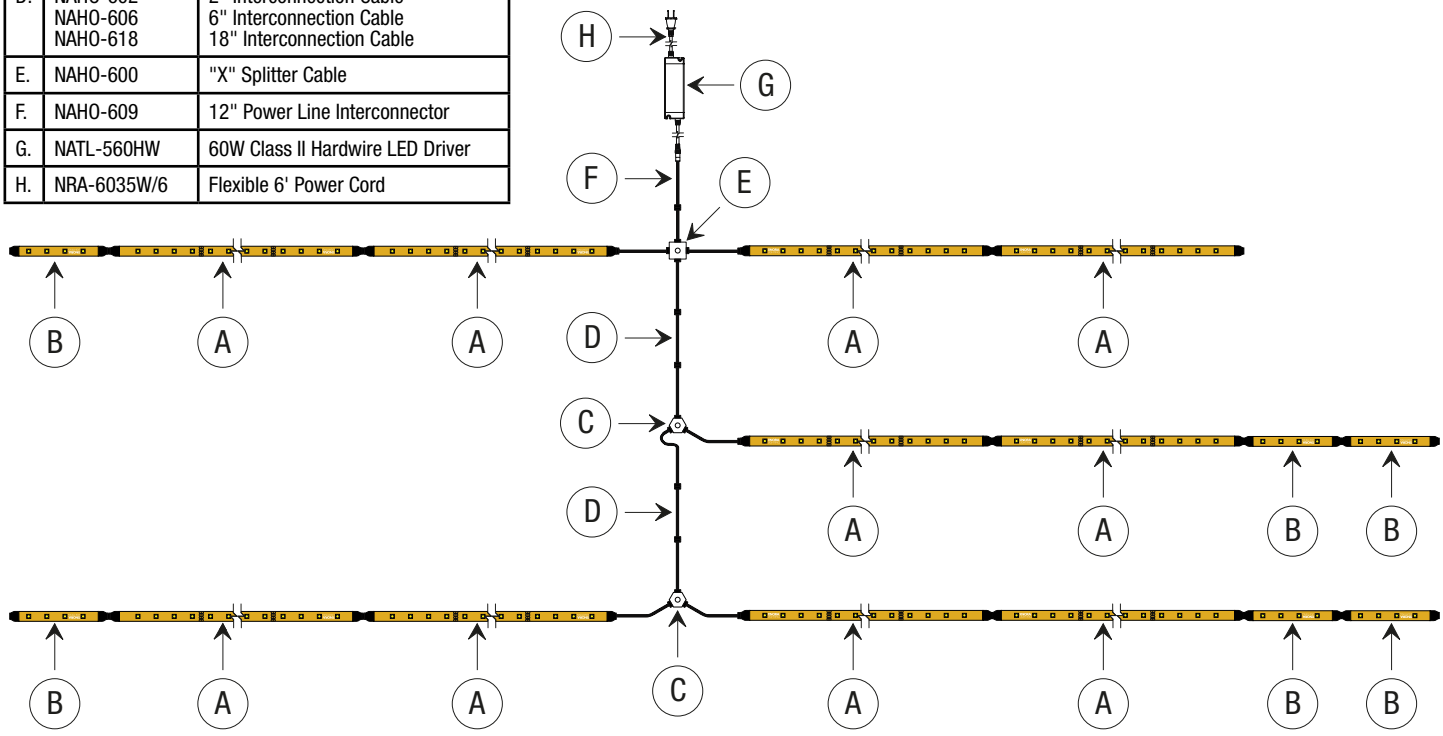
Sample Layouts



A.	NUTP8-16LED	16' LED Tape Light Roll (3 - 5' Segments)
B.	NAHO-602 NAHO-606 NAHO-618	2" Interconnection Cable 6" Interconnection Cable 18" Interconnection Cable
C.	NAHO-601	"X" Splitter Cable
D.	NAHO-609	12" Power Line Interconnector
E.	NMT-96/24C2D1	24V 96W Magnetic LED Driver

A.	NUTP8-LED/12	(10) 12" LED Tape Light Sections
B.	NUTP8-LED/4	(6) 4" LED Tape Light Sections
C.	NAHO-600	"Y" Splitter Cable
D.	NAHO-602 NAHO-606 NAHO-618	2" Interconnection Cable 6" Interconnection Cable 18" Interconnection Cable
E.	NAHO-600	"X" Splitter Cable
F.	NAHO-609	12" Power Line Interconnector
G.	NATL-560HW	60W Class II Hardwire LED Driver
H.	NRA-6035W/6	Flexible 6' Power Cord



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CRS8

Quick Release
8W LED Gravity-Fit Pendants

Catalog No. _____

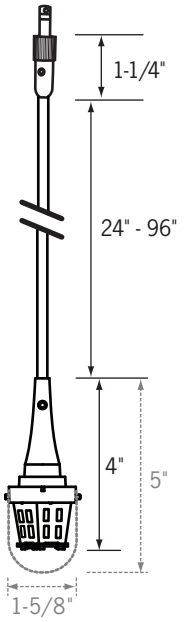
Type _____

Project _____

Specifications/Features

Fixture

High performance, eco-friendly 8W LED pendant delivering 600+ lumens; matching the output and uniformity of a 50W T4 Halogen, while only consuming 8W, and achieving an efficacy of over 75 lumen/watt.
Omni-directional light output provides even illumination of the shade, as well as a strong downward punch of light; providing functional task illumination.
Available in four (4) standard lengths (24", 48", 72", and 96") eliminating the need for field adjustment. For installations requiring a custom length, the pendant is easily field adjustable.
Must be used with one of the mounting options listed below. Choose from line voltage track, line voltage flexible track or mono-point mounting options (details below).
Dimming allows smooth illumination down to 10%.
Compatible with Gravity-Fit Decorative Shades. Shade options include hand crafted glass, case glass, fabric, and metal (shades sold separately).
A frosted diffusion lens is included for use as needed.



Lamp/Electrical

The 8W LED pendant includes six (6) LED Arrays with twenty-six (26) total LEDs achieving an efficacy of over 75 lumens/watt.
Available in 3000K, CRI 80min., 83 typical.
Excellent fixture to fixture color consistency within a 4-step MacAdam Ellipse tolerance.
System designed and rated for 50,000 hours at 70% lumen maintenance.

Driver

Triac Dimming Driver: Input Wattage 8W; Input Voltage 120VAC, 50/60Hz
0-10V Dimming Driver: Input Wattage 8W; Input Voltage 120/277VAC, 50/60Hz

Warranty

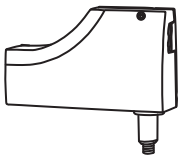
Fixture is covered by Con-Tech's full five (5) year replacement guarantee after date of purchase.

Labels/Usage

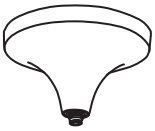
CSA Certified to UL Standards. Suitable for dry locations.

Mounting Options

Line Voltage Track Adapter
To connect pendant to standard line voltage track. Triac LED dimming driver included. 7" L x 2" H. Black, white and silver finish only.
CRS8-LVTQRD1-(B,P,S) - Triac Dimming Driver



Odyssey Line Voltage Flexible Track Adapter
To connect pendant to Odyssey line voltage flexible track. Triac LED dimming driver included. 6" L x 3-1/2" H. Antique bronze and silver finish only.
CRS8-ODYQRD1-(AB,S) - Triac Dimming Driver



Decorative Ceiling Canopy
Mounts to NEC approved 4" round or octagon junction box with minimum depth of 1-1/2". 0-10V LED Dimming driver included. 2-1/2" H, 4-3/8" Dia.
CRS8-DQRCD2-(AB,B,P,S) - 0-10V Dimming Driver

Thin Ceiling Canopy
Mounts to NEC approved 4" round or octagon junction box with minimum depth of 1-1/2". 0-10V LED Dimming driver included. 1/4" H, 4-3/8" Dia.
CRS8-TQRCD2-(AB,B,P,S) - 0-10V Dimming Driver

Ceiling Canopy
LED Dimming driver included. 1-5/16" H, 4-3/8" Dia.
CRS8-QRCD1-(AB,B,P,S) - Triac Dimming Driver
CRS8-QRCD2-(AB,B,P,S) - 0-10V Dimming Driver

Ordering Information

Example Order: CRS8483OK – S CRS8-QRCD2 – S

Fixture	Color Temp*	Finish	Mounting Option	Finish
	30K	–		–

CRS824 - 2' Pendant
CRS848 - 4' Pendant
CRS872 - 6' Pendant
CRS896 - 8' Pendant

30K - 3000K Warm White

AB - Antique Bronze
B - Black
P - White
S - Silver

CRS8-LVTQRD1 - Line Voltage Track Adapter, Triac Dimming (B,P,S only)
CRS8-ODYQRD1 - Odyssey Line Voltage Flexible Track Adapter, Triac Dimming (AB,S only)
CRS8-DQRCD2 - Decorative Ceiling Canopy, 0-10V Dimming
CRS8-TQRCD2 - Thin Ceiling Canopy, 0-10V Dimming
CRS8-QRCD1 - Ceiling Canopy, Triac Dimming
CRS8-QRCD2 - Ceiling Canopy, 0-10V Dimming

AB - Antique Bronze
B - Black
P - White
S - Silver

**Consult Factory for additional color temperatures*

CRS8

Quick Release
8W LED Gravity-Fit Pendants

Catalog No. _____

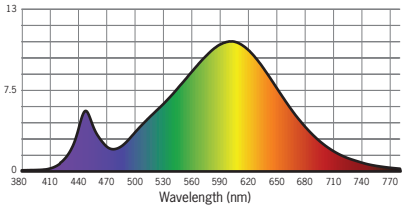
Type _____

Project _____

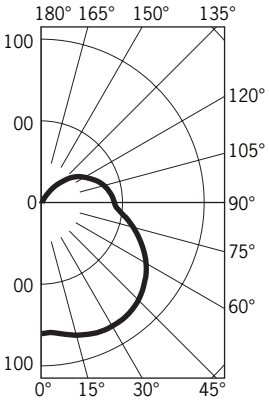
CRS84830K

Designed for 50,000 Hour Lamp Life[1]; LM-63 Test No. 75970

Light Output (Fixture Delivered Lumens): 616
Total Watts@120V: 8
Lumens Per Watt: 76
Color Rendering Index (CRI)[2]: 80
Color Temperature (CCT)[3]: 3011K Warm White
Spectral Power Distribution Chart[4]
LM-79 Test No. 75973



Candela Curve



Candlepower Summary

FROM 0	CANDELA	LUMENS
0	80	
5	79	8
15	82	24
25	85	40
35	85	54
45	82	64
55	76	69
65	68	68
75	58	61
85	48	52
95	43	47

Intensity Distribution

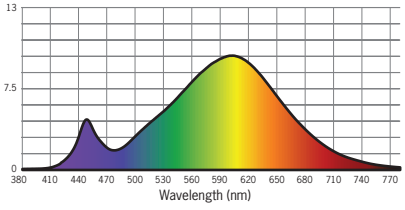
DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
4'	5.0	6.5
6'	2.2	9.8
8'	1.2	13.1
10'	0.8	16.3
12'	0.6	19.6

Beam Distribution: 210°

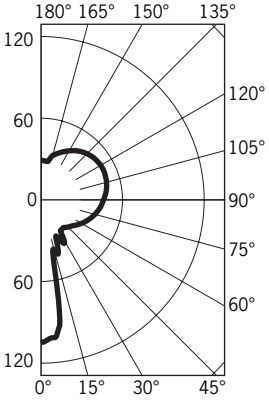
CRS84830K, MLA106-W

Designed for 50,000 Hour Lamp Life[1]; LM-63 Test No. 75972

Light Output (Fixture Delivered Lumens): 528
Total Watts@120V: 8
Lumens Per Watt: 65
Color Rendering Index (CRI)[2]: 80
Color Temperature (CCT)[3]: 2996K Warm White
Spectral Power Distribution Chart[4]
LM-79 Test No. 75975



Candela Curve



Candlepower Summary

FROM 0	CANDELA	LUMENS
0	105	
5	102	9
15	38	12
25	32	15
35	27	17
45	28	22
55	32	29
65	37	37
75	41	44
85	45	49
95	48	52

Intensity Distribution

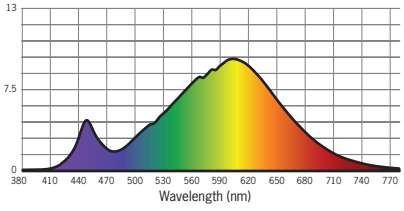
DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
4'	7.0	1.6
6'	2.9	2.4
8'	1.6	3.1
10'	1.0	3.9
12'	0.7	4.7

Beam Distribution: 23°

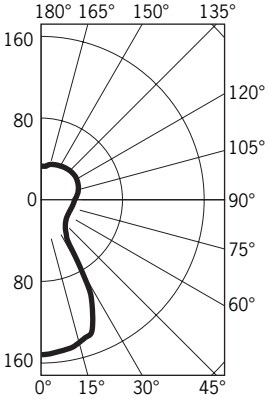
CRS84830K, OFG201

Designed for 50,000 Hour Lamp Life[1]; LM-63 Test No. 75971

Light Output (Fixture Delivered Lumens): 521
Total Watts@120V: 8
Lumens Per Watt: 62
Color Rendering Index (CRI)[2]: 80
Color Temperature (CCT)[3]: 3014K Warm White
Spectral Power Distribution Chart[4]
LM-79 Test No. 75974



Candela Curve



Candlepower Summary

FROM 0	CANDELA	LUMENS
0	151	
5	149	14
15	144	41
25	117	52
35	43	29
45	33	26
55	30	27
65	30	29
75	30	32
85	32	35
95	34	37

Intensity Distribution

DISTANCE (FT.)	FOOTCANDLES (FC)	BEAM DIAMETER (FT.)
4'	9.0	4.1
6'	4.2	6.4
8'	2.4	8.2
10'	1.5	10.2
12'	1.0	12.3

Beam Distribution: 60°

All photometric tests were conducted without the optional frosted diffusion lens.

1. Accuracy of rendering colors
2. Color appearance of light source
3. Colors present within the light source

**Dependent on surrounding temperatures*

HALO LED H4 Series

The Halo H4 LED is a family of 4" aperture recessed downlight housings designed for exclusive use with Halo EL4, ELG4, ELSG4 Series LED Light Engines and compatible 4" LED trims. Halo H4 LED housings have integral LED drivers that offer dimming as a standard feature.

H455TUNVD010 is a Non-IC, AIR-TITE™ housing designed for non-insulated ceiling installations, and offers dimming capability with 0-10VDC control systems. Designed for use with EL4 series LED Light Engines, and TL4, TLS4 LED Series Trims; and ELG4, ELSG4 Adjustable Gimbal Light Engine/Trim combinations. The H455TUNVD010 offers high quality downlighting along with high efficacy – the result being great lighting and significant energy savings.

Catalog #		Type
Project		
Comments		Date
Prepared by		

DESIGN FEATURES

MECHANICAL

(A) Housings

- Single wall die-formed construction.
- Openings are gasketed for AIR-TITE installation.

(B) Plaster Frame

- Galvanized steel die-formed construction.
- Plaster frame designed with removable bar hangers for installation in new construction.
- HALO identity embossed on plaster frame.

MOUNTING

(C) GOT NAIL! Pass -N-Thru™ Bar Hangers

Bar Hanger Features include:

- Pre-installed nail easily installs in regular lumber, engineered lumber and laminated beams.
- Safety and guidance system prevents snagging, ensures smooth straight nail penetration and allows bar hangers to be easily removed if necessary.
- Automatic leveling flange aligns the housing and lets you hold the housing in place with one hand while driving nails.
- Housing can be positioned at any point within 24" joist span.
- Score lines allow "tool-less" shortening for 12" joists.
- Bar hangers may be repositioned 90°.
- Bar hangers do not need to be removed from frame for shortening.
- Integral T-bar clips snaps onto T-bars - no additional clips required.

ELECTRICAL

(D) Junction Box

- Positioned to accommodate straight conduit runs.
- Seven 1/2" trade size conduit knockouts with true pry-out slots.
- Slide-N-Side™ connectors allow non metallic sheathed cable to be installed without tools and without removing knockouts.
- Accepts a wide range of non-metallic sheathed cables.
  - The standard cable types used in lighting in both U.S. and Canada.
  - Allows wiring connections to be made outside the junction box.
  - Simply insert the cable directly into the trap after connections are made.
  - Accommodates the following standard nonmetallic sheathed cable types:
    US: #14/2, #14/3, #12/2, #12/3
    Canada: #14/2, #14/3, #12/2

(E) LED Connection

- LED connector is a non-screw base connector offering easy installation with the EL4, ELG4, ELSG4 Series LED Light Engines.
- LED connector meets California Title-24 high-efficacy luminaire requirement for a non-screw base socket, and where required to qualify as a high-efficacy luminaire.

(F) LED Driver

- LED dimmable driver mounts to the housing junction box.
- Driver is a120V-277V Universal Voltage, high efficiency, electronic power supply providing low voltage power to EL Series LED Light Engines.
- Driver meets FCC EMI/RFI Consumer Level limits for use in residential and commercial installations.
- Driver features power factor >.90, THD <20% and has integral thermal protection in the event of over temperature or internal failure.
- Driver is specifically designed for compatibility with EL4 LED Light Engines, and ELG4, ELSG4 Adjustable Gimbal Light Engine / Trims; and operates the LED for long life, meeting 50,000 hour / 70% lumen maintenance standard.
- If dimming is not required the fixture can be operated from a standard wall switch.

Dimming

- Dimmable with compatible 0-10V DC low voltage dimmers.
- 0-10V DC dimmers operate using two low voltage dimming wires (color coded violet and gray). The low voltage dimming wires are separate from the 120V AC or 277V AC power.
- Switching on/off is controlled via the line voltage (120V AC or 277V AC) power, and dimming operation is controlled with the 2-wire 0-10V DC low voltage wiring connection between the dimmer and the LED driver.

Warranty

Cooper Lighting provides a three year limited warranty on Halo LED Luminaires which includes the LED Recessed Housing, LED Light Engine, and LED trims.

Labels

- UL/cUL Listed 1598 Luminaire
- UL/cUL Listed for Damp Location
- UL/cUL Listed for Wet Location, covered ceiling - with select trims

Compliance

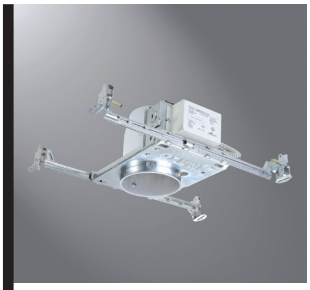
- Use with designated LED light engines and trims for ENERGY STAR® qualification.
- Can be used for State of California Title 24 high efficacy compliance with designated LED light engines and trims.
- Can be used for International Energy Conservation Code (IECC) high efficacy compliance with designated LED light engines and trims.
- Refer to specification sheets online for compliance information.

Qualification

AIR-TITE™

Certified under ASTM-E283 and listed UL/cUL 1598. May be used to meet restricted air-flow requirements such as:

- Washington State Energy Code
- International Energy Conservation Code (IECC)
- New York State Energy Conservation Construction Code (NY-ECCC)
- State of California Title 24 "Recessed Luminaires in Insulated Ceilings."



H455TUNVD010

4-Inch LED Recessed Housing New Construction Non-Insulated Ceiling -- With 4" LED Light Engines and 4" LED Trims

High Efficacy LED Housing - Dimmable when used with 0-10VDC Controls

FOR USE IN NON-INSULATED CEILINGS

CAN BE USED IN INSULATED CEILINGS BUT INSULATION MUST BE KEPT 3" FROM ALL SIDES OF THE HOUSING

H4 Series LED Energy Data:

(Values at non-dimming line voltage)

Minimum Starting Temp:	-30°C (-22°F)
EMI/RFI:	FCC Title 47 CFR, Part 18, (Consumer)
Sound Rating:	Class A standards
Input Voltage:	120V-277V
Power Factor:	>0.90
Input Frequency:	50/60Hz
THD:	<25%
Rated Wattage:	15W max.
Input Power:	13.9W
Input Current:	121mA
Driver Compliance:	UL8750, Class II rated

Maximum Non-IC (Non-Insulated Ceilng) Ambient Continuous Operating Room Temperature: 40°C (104°F)

H4 Series LED Summary Lighting Data:

Lumen range: 534-700

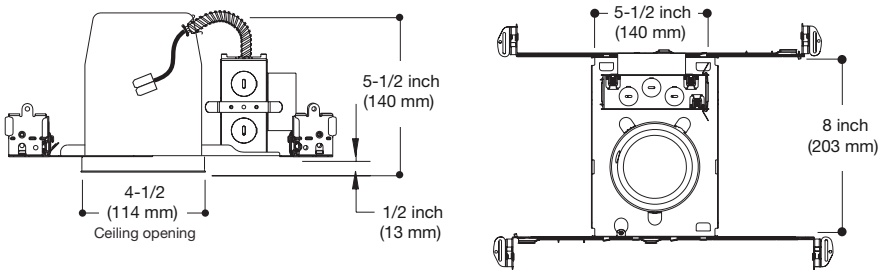
Lumens per watt: . . . . . up to 46

Color

Correlated Color Temperature (CCT): 2700-4000K

Color Rendering Index (CRI, R_a): 80

DIMENSIONS



ORDERING INFORMATION - H4 LED Downlights

SAMPLE NUMBER: H455TUNVD010 EL405827 TL400SC

Complete unit includes LED housing, light engine, and trim, ordered separately

H4 LED Housing

H455=
4˝ Housing
H4 LED Series
Downlight

T=
New Construction,
NON-Insulated
Ceilng, AIR-TITE

UNVD010=
LED driver,
120V-277V,
50/60Hz,
Dimmable with
0-10V DC
dimming controls
(see dimming
application
notes, and refer
to dimmer
manufacturers
for compatibility)

H4 LED Light Engine

EL4=
4˝ LED
Downlight
Light Engine

05=
550
Design
Lumens*

8=
80 CRI

27=2725°K
30=3045°K
35=3465°K
40=3985°K

* Lumen output range of 534-700 lumens (depending upon color temperature and trim)

H4 LED Trim

TL400SC=Specular Clear Refector, White Trim Ring
TL400H=Haze Reflector, White Trim Ring
TL400WH=White Reflector, White Trim Ring
TL400SBK=Specular Black Reflector, White Trim Ring
TL400SN=Satin Nickel Reflector, Satin Nickel Trim Ring
TL400TBZ=Tuscan Bronze Reflector, Tuscan Bronze Trim Ring
TL401WB=White Baffle, White Trim Ring
TL401BB=Black Baffle, White Trim Ring
TL402SCS=Specular Clear Reflector with Solite® Lens, White Trim Ring
TL402HS=Haze Reflector with Solite® Lens, White Trim Ring
TL402WHS=White Reflector with Solite® Lens, White Trim Ring
TL402SBKS=Specular Black Reflector with Solite® Lens, White Trim Ring
TL402SNS=Satin Nickel Reflector with Solite® Lens, Satin Nickel Trim Ring
TL402TBZS=Tuscan Bronze Reflector with Solite® Lens, Tuscan Bronze Trim Ring
TL403WBS=White Baffle with Solite® Lens, White Trim Ring
TL403BBS=Black Baffle with Solite® Lens, White Trim Ring
TLS408WHWB=Square Baffle Trim with Solite® Regressed Lens, White Baffle, White Ring
TLS408WHBB=Square Baffle Trim with Solite® Regressed Lens, Black Baffle, White Ring
TLS408SNBB=Square Baffle Trim with Solite® Regressed Lens, Black Baffle, Satin Nickel Ring
TLS408TBZBB=Square Baffle Trim with Solite® Regressed Lens, Black Baffle, Tuscan Bronze Ring
TL409WW=Wall Wash Downlight - Semi-Specular Clear Reflector with Specular Wall Wash Optic, Diffusing Lens and White Ring
TL409WHWW=Wall Wash Downlight - White Reflector with Specular Wall Wash Optic, Diffusing Lens and White Ring
TL422PS=White Polymer Baffle and Ring, and Regressed Prismatic Polymer Lens. Shower Trim front is non-electrically conductive with “dead-front” polymer material.

Accessories

Designer Trim Rings, Thin Profile
For use with Round TL4 trims (not compatible with Square TLS4 trims).
TRM400WH=White, die-cast trim ring
TRM400BK=Black, die-cast trim ring
TRM400SN=Satin Nickel, die-cast trim ring
TRM400TBZ=Tuscan Bronze, die-cast trim ring
TRM400PC=Polished Chrome, die-cast trim ring

ORDERING INFORMATION - H4 LED Downlights

SAMPLE NUMBER: H455TUNVD010 ELG405827TBZ

Complete unit includes H4 LED housing and Adjustable Gimbal Light Enginer, ordered separately.
(Note H4 LED TL4xx Downlight Trims are not compatible with H4 LED ELG4xx Adjustable Gimbals.)

H4 LED Adjustable Gimbal Light Engine

ELG4	05	8		
ELG4= 4" Round LED Adjustable Gimbal Light Engine **ELSG4**= 4" Square LED Adjustable Gimbal Light Engine	**05**= H4 LEDs exceed 550 Design Lumens*	**8**= 80 CRI	**Nominal CCT** **27**= 2700°K **30**= 3000°K **35**= 3500°K **40**= 4000°K	**Finish** *(Gimbal and Trim)* **WH**=White **SN**=Satin Nickel **TBZ**=Tuscan Bronze

***** Lumen output of 598 lumens based upon 2700°K color temperature.

Optional Accessory Reflector Kit *(ordered separately)*

TL412RK includes:

- **25° reflector** *(one is included with gimbal)*
- **35° reflector**
- **50° reflector**

TL412RK is for use with ELGxx and ELSGxx Gimbals only.

Optional Lens Media *(ordered separately)*

One lens media may be used in place of clear lens.

Optical Lenses

- **L110** Diffuse Sand Blasted Lens
- **L111** Soft Focus Textured Lens
- **L113** Prismatic Lens
- **L115** Linear Spread Lens

Dichroic Color Films

- **L114** UV Filter
- **L120** Red
- **L121** Amber
- **L122** Yellow
- **L123** Green
- **L124** Daylight
- **L125** Blue
- **L127** Cosmetic Color Filters
- **L130** Yellow

PROGRESS LIGHTING

Fluorescent

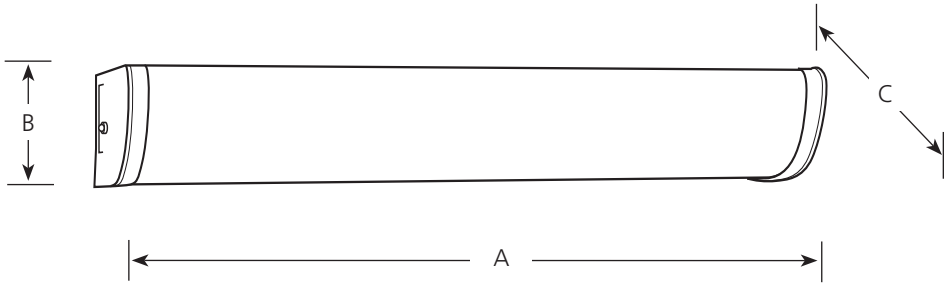
Metal Edge Acrylic Electronic Ballast

Bath & Vanity

Type _____

	-15EB
P7230	☐
P7231	☐
P7232	☐

Catalog No.	Finish: Polished Chrome	Lamping	Dimensions (Inches) A	B	C
P7230	-15EB	2-F17 T8	24-1/2	3-1/4	5-1/4
P7231	-15EB	2-F25 T8	36-1/2	3-1/4	5-1/4
P7232	-15EB	2-F32 T8	48-1/2	3-1/4	5-1/4



Specifications:

Diffuser

- White acrylic diffuser
- Polished chrome metal end caps remove to release the diffuser
- Flat top with curved face

Housing

- 20 ga white chassis complete with ends
- 24 ga cover plate
- Easily removable cover for ballast access

Mounting

- Wall mounted

Electrical

- 120/277 volt HPF electronic ballast
- Quick connect for ease of installation
- Safety quick disconnect of ballast
- Bi-pin twist in sockets

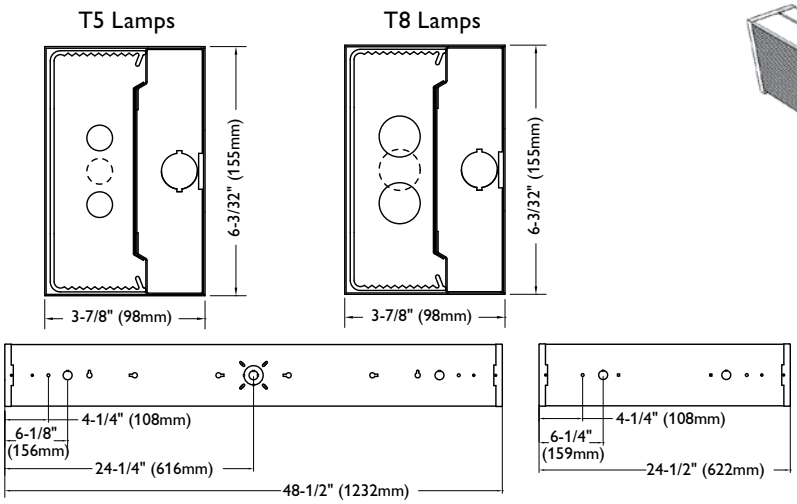
Labeling

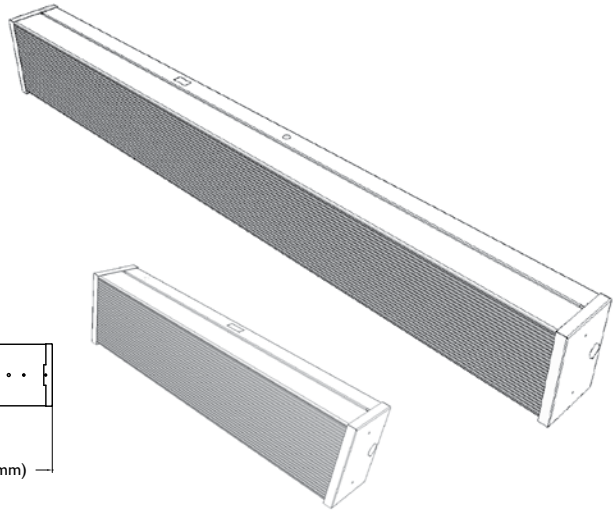
- UL and CUL lamp location listed

Progress Lighting
701 Millennium Blvd.
Greenville, South Carolina
29607

LSW Series

Ceiling/Wall Fluorescent, T5 or T8





Ordering Information

LSW	Fixture Length	Lens Type	Lamp Qty.	Lamps (by others)	Voltage	Ballast Type		Options
LS		**R**					–	
Surface/Wall Fluorescent	**2** = 24" **4** = 48" (Nominal Size)	**R** = Linear prismatic virgin acrylic lens	**1** = 1 Lamp **2** = 2 Lamps	**14** = T5 2' Length **17** = T8 2' Length **28** = T5 4' Length **32** = T8 4' Length **54** = T5HO 4' Length	**120** = 120v **277** = 277v **UNV** = 120-277v			Add appropriate suffix to catalog no., i.e.: (**C**)

Ballast Type	<20THD	<10THD
1 or 2 Lamp Elec. T8	—	**HI***
1 or 2 Lamp Elec. T8	—	**P2‡**
1 or 2 Lamp Elec. T5	—	**PG‡**
LOL Dimming T5	**PF**	
LOL Dimming T8	**PS**	

*Instant Start Standard
‡Program Rapid Start (**UNV** only)
NOTE: For T8 **UNV**, you must use **HI** Ballast Code.

Features

- For ceiling or wall mounted applications.
- Can be vertically or horizontally mounted on wall.
- Only 3 7/8" deep, meets Americans with Disabilities Act for wall mounted fixtures.
- Low brightness .125 thick linear prismatic virgin acrylic refractor.
- Invisible spring steel latches align refractor to housing.
- 20 gauge cold rolled steel post painted baked white enamel end caps.
- Nominal 2' and 4' lengths.
- 73.9% efficient (T8 lamps).

Job Information **Type:**

Job Name:

Cat. No.:

Notes:

PHILIPS
LIGHTOLIER

LSW Series

Ceiling/Wall Fluorescent, T5 or T8

Specifications

Materials: Chassis Parts–Die-formed code gauge cold rolled steel. **End Caps**–20 gauge cold rolled steel.

Finish: Chassis exterior–Post painted white baked acrylic enamel. **End Caps**–Post painted baked white enamel. Rust preventative undercoating.

Refractor: Low brightness .125 linear prismatic, extruded virgin acrylic lens.

Electrical: Thermally protected class "P" ballast C.B.M. approved, non PCB. If K.O. is within 3" of ballast, use wire suitable for at least 90°.

Labels: I.B.E.W., UL and ULc listed. UL listed for damp locations

This product may have a mercury containing lamp. Manage in accord with Disposal Laws. See: www.lamprecycle.org

Options & Accessories

Fusing: Internal fast blow fusing: Suffix: **A**.
Internal slow blow fusing: Suffix: **C**.

Radio Interference Filter: 120 or 277 volt, 50 or 60 Hz. One per fixture standard. Suffix: **R**. One per ballast. Suffix: **B**.

Emergency Power Pack: Factory installed emergency power pack includes charger and inverter concealed in fixture channel. Upon loss of AC power, operates one lamp at reduced light. T8 Suffix: **E1**. (consult factory for T5 option)

Stem and Canopy Sets: Suspends fixture 6", 12", 18" or 24" from surface. Catalog Number: **ASC6 CSP (6")**
ASC12 CSP (12")
ASC18 CSP (18")
ASC24 CSP (24")

Job Information **Type:**

PHILIPS
LIGHTOLIER

LSW Series

Ceiling/Wall Fluorescent, T5 or T8

Photometry

Model No. LS4R232UNVHI

LER = 66.9 IW = 55.4 BF = 0.88

Comparative yearly lighting energy cost per 1000 lumens = $3.59

Report Number: G2010291

Catalog Number: LS4R232UNVHI

Lamps: (2) F032T8

Luminaire: LSW Series 4' luminaire

Ballast: RIC2S40TP

Report is based on 2850 lumens per lamp.

Efficiency: 73.9%

CIE Type: Direct/Indirect

Plane:	0-Deg.	90-Deg.
Spacing Criteria:	1.1	1.2
Shielding Angles:	90	90
Plane:	0-Deg.	90-Deg.
Luminous Length:	6.000	48.000

Candela Distribution

Vertical Angle	Horizontal Angle 0	45	90	Zonal Lumens
0	1176	1176	1176	
5	1162	1175	1188	112
15	1116	1155	1184	326
25	1028	1093	1134	502
35	899	973	993	598
45	724	696	665	542
55	483	485	526	443
65	235	367	508	377
75	110	309	468	319
85	20	229	404	243
90	6	202	364	
95	6	203	351	208
105	5	185	300	180
115	5	155	253	143
125	5	124	201	103
135	5	88	142	63
145	6	58	94	34
155	6	34	56	15
165	6	14	24	4
175	5	2	3	
180	2	2	2	

Coefficients of Utilization

Ceiling	80%			50%			30%		
Wall	70	50	30	50	30	10	50	30	10
RC / RW	Zonal Cavity Method Effective Floor Reflectance = 20%								
Room Cavity Ratio 1	76	72	69	64	61	59	58	56	55
2	69	63	57	55	51	48	51	48	45
3	63	55	49	49	44	40	45	41	38
4	58	49	42	43	38	34	40	36	32
5	53	44	37	39	34	30	36	32	28
6	49	39	33	35	30	26	33	28	25
7	45	36	29	32	27	23	30	25	22
8	42	33	26	29	24	21	27	23	20
9	40	30	24	27	22	19	25	21	18
10	37	28	22	25	20	17	24	19	16

Average Luminance data in candela / sq. meter

Angle	0°	45°	90°
45	3992.	4363.	4830.
55	2937.	3485.	4620.
65	1648.	3204.	5869.
75	946.	3573.	8263.
85	231.	4105.	16163.

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixt.
0- 30	940	16.5	22.3
0- 40	1538	27.0	36.5
0- 60	2523	44.3	59.9
0- 90	3463	60.8	82.2
90-120	531	9.3	12.6
90-130	634	11.1	15.1
90-150	732	12.8	17.4
90-180	751	13.2	17.8
0-180	4214	73.9	100.0

Model No. LS2R217UNVHI

LER = 66.9 IW = 29.8 BF = 0.93

Comparative yearly lighting energy cost per 1000 lumens = $3.59

Report Number: G2010296

Catalog Number: LS2R217UNVHI

Lamps: (2)F17 T8

Luminaire: LSW Series 2' luminaire

Ballast: ICN-2P32-SC

Report is based on 1400 lumens per lamp.

Efficiency: 76.6%

CIE Type: Direct/Indirect

Plane:	0-Deg.	90-Deg.
Spacing Criteria:	1.1	1.2
Shielding Angles:	90	90
Plane:	0-Deg.	90-Deg.
Luminous Length:	6.000	48.000

Candela Distribution

Vertical Angle	Horizontal Angle 0	45	90	Zonal Lumens
0	553	553	553	
5	549	553	557	53
15	526	541	554	153
25	482	509	529	234
35	418	454	481	283
45	337	381	417	293
55	234	300	341	264
65	140	217	268	212
75	66	154	216	158
85	13	99	164	105
90	3	79	151	
95	3	82	158	91
105	2	94	150	90
115	2	83	131	76
125	3	72	112	59
135	3	53	85	38
145	3	36	57	21
155	5	23	36	10
165	9	17	23	5
175	9	10	11	1
180	8	8	8	

Coefficients of Utilization

Ceiling	80%			50%			30%		
Wall	70	50	30	50	30	10	50	30	10
RC / RW	Zonal Cavity Method Effective Floor Reflectance = 20%								
Room Cavity Ratio 1	88	88	88	77	77	77	71	71	71
2	79	75	71	66	63	61	61	59	57
3	72	65	59	57	53	50	53	49	46
4	65	57	50	50	45	41	46	42	39
5	59	50	43	44	39	35	41	37	33
6	55	45	38	40	34	30	37	32	29
7	50	40	33	36	30	26	33	29	25
8	47	36	30	33	27	23	30	26	22
9	43	33	27	30	24	21	28	23	20
10	40	30	24	27	22	19	26	21	18

Average Luminance data in candela / sq. meter

Angle	0°	45°	90°
45	4845.	4785.	4649.
55	3982.	4259.	4153.
65	3031.	3671.	3721.
75	2048.	3349.	3615.
85	753.	3147.	3592.

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixt.
0- 30	439	15.7	20.5
0- 40	722	25.8	33.7
0- 60	1279	45.7	59.6
0- 90	1755	62.7	81.8
90-120	257	9.2	12.0
90-130	316	11.3	14.7
90-150	375	13.4	17.5
90-180	391	13.9	18.2
0-180	2145	76.6	100.0

Philips Lightolier
e: lol.webmaster@philips.com
t: (508) 679-8131, Technical info. (978) 657-7600
w: www.lightolier.com

LSW Series July 28, 2011

Job Information **Type:**

Green Matters Link 1-Light Brushed Nickel Tube Wall Sconce

Model # HD-3953

PRODUCT OVERVIEW

The Green Matters Link 1-Light Brushed Nickel Tube Wall Sconce features a unique tubular design and a glass shade colored in satin white. Finished in brushed nickel, it is ideal for lighting dining rooms and hallways.

- Unique design with Energy Star efficiency
- Satin white glass shade
- Brushed nickel finish
- Uses one 13 watt CFL fluorescent bulb; (included) 13 watt maximum
- CFL bulb uses 13 watts of energy while giving out an equivalent of 60 watts of light
- 1-UL listed
- Click image to enlarge:

- MFG Model # : HD-3953
- MFG Part # : HD-3953

Return To Top

SPECIFICATIONS

Assembled Depth (in.)	3.75 in	Assembled Height (in.)	11.54 in
Assembled Width (in.)	4.5 in	Certifications and Listings	1-UL Listed

Assembled Depth (in.)	3.75 in	Assembled Height (in.)	11.54 in
ENERGY STAR Certified	Yes	Fixture Color/Finish Family	Nickel
Light Source	Fluorescent	Manufacturer Warranty	Lite Line warrants your product to be free from defects in materials & workmanship for a period of (1) year from date of purchase. Lite Line's only obligation, & your exclusive remedy, is the repair or replacement of the product at Lite Line's discretion, provided that the product has not been damaged through misuse.
Maximum Bulb Wattage	13 W	Number of Bulbs Required	1
Product Weight (lb.)	1.59 lb	Recommended bulb type	CFL
Returnable	90-Day	Wattage (watts)	13 W

Incandescent

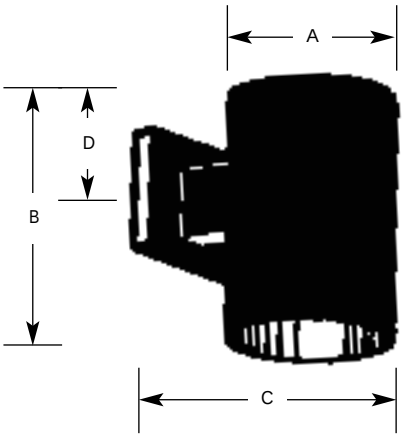
5" Cylinders
Wall Mount

Outdoor

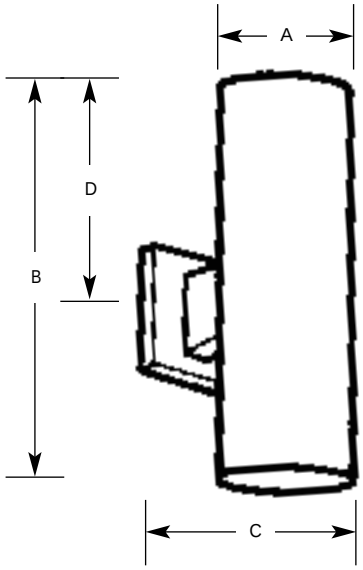
Type	-20	-30	-31	-82
P5674	☐	☐	☐	☐
P5675	☐	☐	☐	☐

	Finish					Dimensions (Inches)			
Catalog No.	Bronze	White	Black	Metallic Gray	Lamping	A	B	C	D
P5674	-20	-30	-31	-82	1-75w PAR30, 65w BR30	5	7-1/4	8	2-1/2
P5675	-20	-30	-31	-82	2-75w PAR30	5	14	8	7

P5674



P5675



Specifications:

General

- Extruded aluminum .125 wall thickness one piece cylinder
- Cast aluminum wall bracket
- P5674 - Down lighting
- P5675 - Up/Down lighting. P8799-31 top cover lens recommended when unit is used outdoors
- Interior finish matches exterior finish

Mounting

- Covers any outlet box
- Cast mounting bracket is 4-1/2" square
- Outlet box mounting bracket supplied permitting attachment of unit to wall with one almost invisible set screw

Electrical

- Medium base porcelain socket with nickel plated brass screw shell

Options

- Bronze finish - specify “20” suffix
- White finish - specify “30” suffix
- Black finish - specify “31” suffix
- Metallic Gray finish - specify “82” suffix

Accessories

- P8799-31 Top lens cover for P5675 fixture

Labeling

- UL-CUL wet location listed - P5674 and P5675 with top cover
- P5675 UL-CUL listed for indoor use with no cover

Progress Lighting
701 Millennium Blvd.
Greenville, South Carolina
29607

www.progresslighting.com

Rev. 1/04

Malibu 8-Light Outdoor Black Tier/Flood Light Kit

Model # 8301-9907-08

PRODUCT OVERVIEW

The Malibu 8-Light Outdoor Black Tier/Flood Light Kit features 6 tier lights and 2 flood lights made of durable, corrosion-resistant metal. Use the kit to create a unique exterior lighting design for your home. In addition to the 6 lights, the kit comes w

- Durable metal construction is ideal for outdoor installation
- Clear glass lenses and plastic ribbed globes for diverse illumination options
- Lights install in the ground to deliver targeted spot- and walkway lighting
- Waterproof and corrosion resistant for durability
- Tier lights use amber, 7-watt incandescent wedge bulbs (included)
- flood lights use amber, 20-watt halogen bi-pin bulbs (included)
- Brightness - 29 Lumens (tier)
- Brightness - 145 Lumens (flood)
- CSA listed
- Includes six 7-watt tier lights, two 20-watt flood lights, a 150-watt transformer and 75 ft. of low-voltage cable
- MFG Model # : 8301-9907-08
- MFG Part # : 8301-9907-08

Info & Guides

- **Installation Guide**
- **Instructions / Assembly**
- **Specification**

You will need Adobe® Acrobat® Reader to view PDF documents. Download a free copy from the Adobe Web site.

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SPECIFICATIONS

Adjustable Lamp Head	Yes	Assembled Depth (in.)	4.75 in
Assembled Height (in.)	21 in	Assembled Width (in.)	4.75 in
Bulb Type	Halogen	Certifications and Listings	CSA Listed
Color/Finish	Black	Dusk to Dawn	Yes
ENERGY STAR Certified	No	Exterior Lighting Product Type	Landscape Light
Fixture Finish	Black	Fixture Material	Metal
Glass/Lens Type	Clear	Landscape Lighting Application	Walk & Path Lighting
Light Source	Halogen	Lighting Kit	Yes

Adjustable Lamp Head	Yes	Assembled Depth (in.)	4.75 in
Manufacturer Warranty	1-Year Limited Warranty	Maximum Bulb Wattage	20 W
Motion Sensor	No	Mounting Type	Ground
Number of Bulbs Required	8	Number of Housings Included	8.0
Power Type	Low voltage	Product Height (in.)	21 in
Product Length (in.)	21 in	Product Weight (lb.)	15.2 lb
Product Width (in.)	4.8 in	Returnable	90-Day
Size	Medium	Solar Powered	No
Waterproof	Yes	Weather Resistant	Yes

120V AC/DC Wire-in Smoke Alarm

Front Battery Door

Part Number 21006376 **Model i12060**

- Ionization Sensing Technology
- Front Loading Battery Door
- One button design (operates Smart Hush™ and test)
- Large mounting base
- 9V Battery Backup (included)
- Tamper resist feature
- Alarm memory
- Pre-stripped wiring harness with tinned strands

Description

The Kidde i12060 is an AC/DC powered, ionization smoke alarm that operates on a 120V power source with 9V battery backup.

This alarm uses ionization sensing technology. Ionization sensing alarms may detect invisible fire particles (associated with flaming fires) sooner than photoelectric alarms. Photoelectric sensing alarms may detect visible particles (associated with smoldering fires) sooner than ionization alarms.

Kidde strongly recommends that both ionization and photoelectric smoke alarms be installed to help insure maximum detection of the various types of fire that can occur within the home.

The front-loading battery door allows user to change the battery without removing the alarm from the mounting bracket making battery replacement easy and convenient. This smoke alarm is available in a 6-piece cut case with tray for easy display as well as a 6-piece bulk pack for contractors and property owners. This unit is a UL Listed product with a 10-year limited warranty.

10 YEAR LIMITED WARRANTY

SIGNALING UL LISTED

Install Confidence:

Easy Installation

- Front battery pull tab allows battery activation without removing alarm from mounting bracket.
- Large mounting base makes mounting easier, protects surface paint from dirt and covers imperfections.
- Pre-stripped wiring harness with easy off cap does not require stripper tool. Tinned strands increase conductivity and wire nut grip

Fewer Callbacks

- Front battery door makes replacing the battery easy for anyone.
- One button design for easy operation and less confusion. Operates Smart Hush™ and alarm test
- Battery run down protection will shut down alarm memory when AC power is not present, reducing low battery chirp.
- Dust cover protects sensor from contaminates during construction reducing nuisance alarms

User-Friendly Features

- Tamper resist locking feature deters alarm theft
- Alarm memory flashes red LED indicating which unit was the initiating alarm in interconnected system.
- Battery backup provides protection in case of power failure
- Interconnectable with up to 24 devices (of which 18 can be initiating) including smoke, CO and heat alarms. See user's guide for complete instructions

120V AC/DC Wire-in Smoke Alarm
Front Battery Door

Part# 21006376
Model i12060

Architectural and Engineering Specifications

The smoke alarm shall be Kidde Model i12060 or approved equal. It shall be powered by a 120VAC, 60Hz source along with a 9V battery backup. The unit shall incorporate an ionization sensor with nominal sensitivity of 0.50 to 1.06%/ft. The temperature operating range shall be between 40°F and 100°F (4°C and 38°C) and the humidity operating range shall be 5% - 95% relative humidity.

The smoke alarm can be installed on any standard single gang electrical box, up to a 4" octagon junction box. The electrical connection (to the alarm) shall be made with a plug-in connector. A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiating devices, of which 12 can be smoke alarms. With 18 initiating devices (Smoke, heat, CO, etc), interconnected, it is still possible to interconnect 6 strobe lights and/or relay modules. The alarm shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling and locks the battery door closed. No additional pieces shall be required to activate this feature.

The alarm shall include an easy access battery compartment that is opened and closed by pressing on the battery door. The 9V battery carrier will ensure proper battery backup protection by not allowing the battery door to close if the battery is placed in the unit incorrectly or if a battery is not present. The unit shall also provide an optional tamper resistant switch that will prevent the battery door from being opened.

The unit shall include a piezoelectric horn that is rated at 85 decibels at 10 feet. The unit shall include the Smart Hush™ feature that silences the unit for approximately 7 minutes if a nuisance condition occurs.

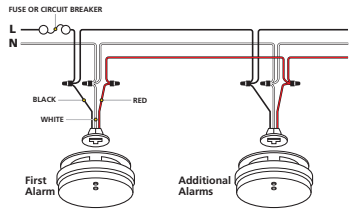
The unit shall incorporate red and green LED indicators. The green LED (when illuminated) indicates the presence of AC power. The red LED (located under the TEST/Hush button) has **four modes of operation:**

Standby Condition: The red LED will flash every 30-40 seconds to indicate that the smoke alarm is operating properly. ***Alarm Condition:*** When the alarm senses products of combustion and goes into alarm the red LED will flash one flash per second. The flashing LED and pulsating alarm will continue until the air is cleared.When units are interconnected, only the red LED of the alarm that senses the smoke or is being tested (the originating unit) will flash. All other units in the interconnected system will sound an alarm but their red LED's will NOT flash. ***Alarm Memory:*** This smoke alarm is equipped with an alarm memory, which provides a visual indication when an alarm has been activated. The red LED will illuminate for about 1.5 seconds every 16 seconds to indicate the memory condition. ***Smart Hush™ Mode:*** The red LED will illuminate for 1.5 seconds every 8 seconds, indicating the smoke alarm is in the Smart Hush™ Mode.

The unit shall at a minimum meet the requirements of UL217, NFPA72, and (chapter 11), The State of California Fire Marshall, NFPA101 (One and two family dwellings), Federal Housing Authority (FHA), Housing and Urban Development (HUD).

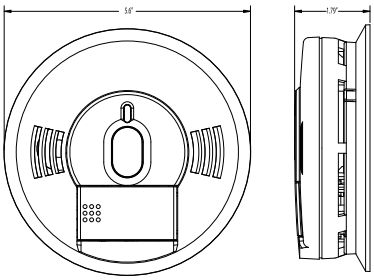
Installation of Smoke Alarm

The smoke alarm should be installed to comply with all local codes having jurisdiction in your area, Article 760 of the National Electric Code, and NFPA 72. Make certain all alarms are wired to a single, continuous (non-switched) power line, which is not protected by a ground fault interrupter. A maximum of 1000 ft. of wire can be used in the interconnect system. Use standard UL listed household wire as required by code.



Technical Specifications

Model:	i12060
Power Source:	120VAC (80mA), 60HZ, 9V battery backup
Audio Alarm:	85dB at 10ft
Temperature Range:	40˚F to 100˚F (4˚C to38˚C)
Humidity Range:	5%-95% relative humidity (RH)
Sensor:	Ionization
Size:	5" in diameter x 1.75" depth
Weight:	.5lbs
Interconnects:	Up to 24 Kidde devices
LED:	Green, receiving AC power Red, 4 modes of operation
Warranty:	10 year limited warranty



Ordering Information

Ordering Number	UPC	I2F5	Pack Quantity	Dimensions (w x d x h inches)	Weight	Case/ Skid	Layers/ Skid	Skid Weight
N/A	7-84908-00135-1	N/A	individual*	5.75 x 1.5 x 5.75	0.5 lbs	N/A	N/A	N/A
21006376	7-84908-00135-1	107-84908-00135-8	Cut Case (6 units)	6.5 x 13.25 x 6	3 lbs	147	7	441 lbs
21005927	0-47871-05927-0	200-47871-05927-4	Bulk Pack (6 units)	6 x 10.5 x 6	3 lbs	147	7	441 lbs
21006932	7-84908-00135-1	407-84908-00135-9	Bulk Pack (36 units)	19.5 x 11.75 x 12	18 lbs	24	4	432 lbs.
21006933	7-84908-00135-1	307-84908-00135-2	Display Pallet (36 units)	20 x 24 x 40	20 lbs.	4	1	90 lbs.
21005928	0-47871-27689-9	100-47871-27689-6	Cut Case (3 Twin Packs)	6.5 x 13.25 x 6	3 lbs	147	7	441 lbs
Alk. Btry 21006931	0-47871-27695-0	100-47871-27695-7	Cut Case (6 units)	6.5 x 13.25 x 6	3 lbs	147	7	441 lbs

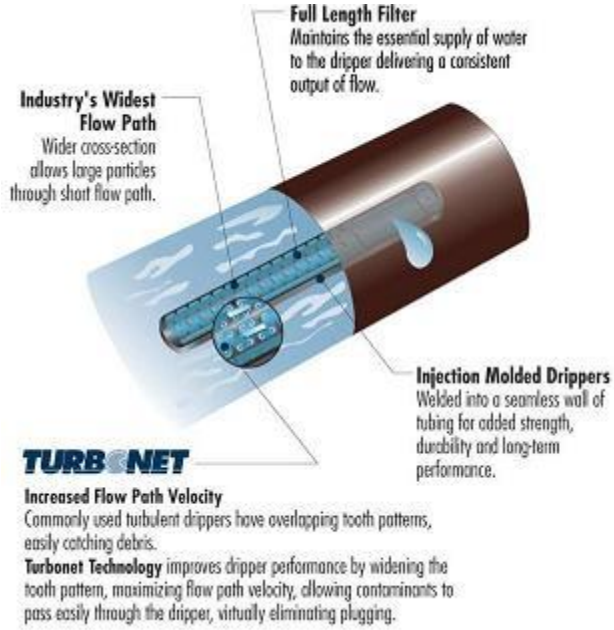
**Not for sale by individual unit*

1016 Corporate Park Drive
Mebane NC 27302
1-800-880-6788
www.Kidde.com

Distributed by:

IrriGRAY™ graywater dripperline

For graywater and potable water irrigation applications



Features & Benefits

- Superior TurboNet™ flow regime
- Largest filtration area and cross section flow path on the market. Dripper is 2.2" in length. Increases clog resistance from source
- The position of the filter to the dripper draws cleaner water from the center of the flow path, reducing the risk of clogging

Specifications

- Dripper flow rate 2 GPH
- Dripper spacing 12"
- Pressure range 2 - 45 PSI
- Tubing diameter 0.540" I.D. 16mm O.D.
- Tubing color - black with purple stripes @ 10 o'clock & 2 o'clock
- Coil Length 150'
- UV resistant
- Tubing Material - Low Density Polyethylene (LPDE)

Dripperline Separation

Soil Type	Separation
Gravel and Sands	1.8 Feet
Sandy Loams	1.8 Feet
Loams	2.4 Feet
Clay Loams	2.7 Feet
Light Clays	3.0 Feet
Medium to Heavy Clays	4.5 Feet

Maximum Lateral Length

Inlet Pressure	Nominal flow	Max Lateral Line Length
3'	0.7 GPH	52'
6'	0.9 GPH	56'
15'	1.4 GPH	56'
30'	1.9 GPH	59'

Tigo® energy

Tigo Energy® Dual Maximizer™- ES (MM-2ES) Data Sheet

For residential, commercial and utility scale photovoltaic solar arrays, the Tigo Energy® Maximizer™ system optimizes the power output of each module; delivers module-level data for operational management and performance monitoring; and provides the ability to deactivate the high voltage DC bus for safer installation, maintenance or fire fighting. Tigo Energy Dual Maximizers are key components of the system which reside at each module (one per up to two solar modules). The Dual Maximizer provides data acquisition, communication to the Tigo Energy® Maximizer™ Management Unit, and power point control. The very small electronics footprint of the Maximizer has been designed to minimize cost and maximize reliability. Tigo Energy Maximizer MM-2ES is ideal for new construction or retrofit applications around the world.

Tigo Energy's patented "Impedance Matching" approach manages the energy harvest and sends information to the Maximizer Management Unit for reporting and control. The Tigo Energy Dual Maximizer (MM-2ES) connects in a series topology. MM-2ES maintains best-in-class system conversion efficiencies.

The Tigo Energy Dual Maximizer includes the PV-Safe™ technology which greatly enhances the safety of a PV solar installation. As part of the Tigo Energy Maximizer system, this function can be activated with a safety button or via a remote management console. The system can also be activated by fire personnel to avoid exposure to voltage levels typically in excess of 400 volts.

The Tigo Energy Dual Maximizer is packaged in a NEMA3R enclosure (water and weather resistant), and conforms to UL and IEEE safety standards. There are Module Maximizer options to fit any PV module, crystalline silicon or thin-film, regardless of output voltage or power rating.

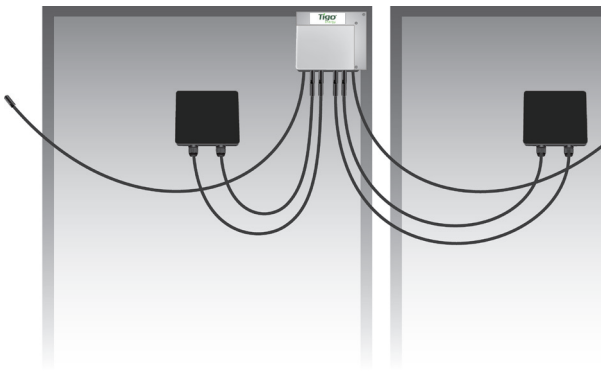
Green Business Bay Area

The Tigo Energy Dual Maximizer is designed to integrate seamlessly with the industry-leading Tigo Energy Maximizer System. Each unit can be used with either one or two PV modules, giving system designers added flexibility. In addition, the Dual Maximizer can be mixed with single Module Maximizers in the same system – they can be connected on the same string, and can use the same MMU and Gateway communications system simultaneously.

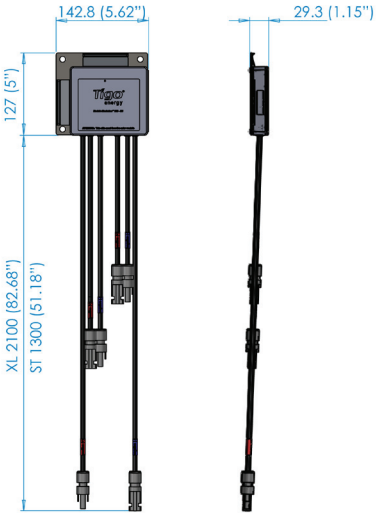
Dual Maximizer - ES Technical Specifications

Input data (per module)	MM-2ES50	MM-2ES75
Maximum power	300W	350W
Maximum input DC voltage (Voc)	52V	75V
Vmp range*	16-48V	30-65V
Maximum continuous current (Imp)	9.5A	6.5A
Maximum input current (Isc)	10A	7.5A
* Vmp = Voltage at maximum power = Maximum power voltage		
Output Data (DC)		
Maximum output power	600W	700W
Maximum continuous current	9.5A	6.5A
Maximum string voltage	1000V	1000V
Mechanical Data		
Operating temperature range	-30°C +70°C	
Cooling	Natural Convection	
Enclosure environmental rating	IP-65, NEMA3R	
Features		
Compliance	UL1741  TÜV EN 62109-1:2010	
Panel connector	NEC 2008 compliant, MC4 compatible (for retrofit) MC3 connectors	
Bus connector	NEC 2008 compliant 40AMP	

Specifications subject to change. Always check the table on the Tigo Energy Module Maximizer label for specifications as supported by that particular unit.



Tigo Energy Dual Maximizer - ES shown connected to two PV modules.



Optimize the energy harvest of your PV system using the Tigo Energy Maximizer to:

- accelerate system payback
- maximize the power output of the array under any condition
- reconsider previously rejected projects because of unfavorable shade or orientation
- maintain best-in-class conversion efficiency
- manage the system with module-level data to minimize operational costs and keep the system at peak performance throughout its lifetime
- introduce an unprecedented level of safety for new and existing PV solar installations
- simplify the balance-of-system design, especially for high Voc or thin-film modules

ORDERING INFORMATION:

MM - 2ES50 - MC4 - ST

50/75*
Maximum Voltage must be highher than PV module Voc

MC3/MC4/TYCO
Connector type

XL/ST**
Output cable length

XL (2100mm) for -

ST (1300mm) for -

* MM2-ES75 is available only with MC4 connectors

** MM2-ES XL version is available only with MC4 connectors

Tigo Energy, Inc.
P +1.408.402.0802 | F +1.408.358.6279
420 Blossom Hill Road, Los Gatos, CA 95032 U.S.A.
www.tigoenergy.com
sales@tigoenergy.com

MM2ES_05.10.13

Printed on recycled paper

Innovative

- First transformerless SMA inverter to be certified in accordance with UL 1741
- First inverter with arc-fault circuit interrupter listed according to UL 1699B

Economical

- Maximum efficiency of 98.7%
- Class-leading CEC efficiency of 98.5%
- Superior MPP tracking with OptiTrac™
- Transformerless, with H5 topology

Reliable

- OptiCool™ active temperature management

Convenient

- Integrated DC disconnect
- SMA Power Balancer for three-phase grid connection

SUNNY BOY 6000TL-US / 7000TL-US / 8000TL-US / 9000TL-US / 10000TL-US / 11000TL-US

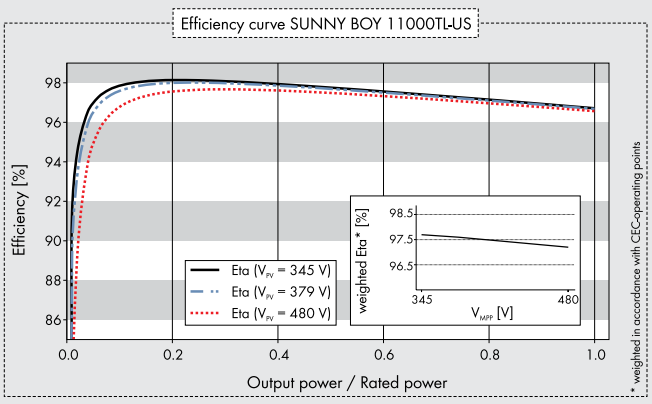
Transformerless design, maximum energy production

The Sunny Boy TL-US series is UL listed for North America and features SMA's innovative H5 topology, resulting in superior efficiencies of more than 98 percent and unmatched solar power production. The transformerless design reduces weight, increases the speed of payback and provides optimum value for any residential or decentralized commercial PV system. The Sunny Boy TL-US series for North America is the ideal choice in transformerless technology.

Technical data	Sunny Boy 6000TL-US 208 V	Sunny Boy 6000TL-US 240 V	Sunny Boy 7000TL-US 208 V	Sunny Boy 7000TL-US 240 V
Input (DC)				
Max. recommended PV power (@ module STC)	7500 W	7500 W	8750 W	8750 W
Max. DC power (@ cos φ = 1)	6300 W	6200 W	7300 W	7300 W
Max. input voltage	600 V	600 V	600 V	600 V
MPP voltage range / rated input voltage	300 V – 480 V / 345 V	345 V – 480 V / 379 V	300 V – 480 V / 345 V	345 V – 480 V / 379 V
Min. input voltage / initial input voltage	300 V / 360 V	345 V / 360 V	300 V / 360 V	345 V / 360 V
Max. input current	20.9 A	18.1 A	24.4 A	21.1 A
Max. input current per string	20.9 A	18.1 A	24.4 A	21.1 A
Number of independent MPP inputs	1	1	1	1
Strings per MPP input @ Combiner Box	6	6	6	6
Output (AC)				
Rated power / max. apparent AC power	6000 W / 6000 VA	6000 W / 6000 VA	7000 W / 7000 VA	7000 W / 7000 VA
Nominal AC voltage / nominal AC voltage range	208 V / 183 V – 229 V	240 V / 211 V – 264 V	208 V / 183 V – 229 V	240 V / 211 V – 264 V
AC power frequency / range	60 Hz / 59.3 Hz ... 60.5 Hz		60 Hz / 59.3 Hz ... 60.5 Hz	
Max. output current	28.8 A	25 A	33.7 A	29.2 A
Power factor at rated power	1	1	1	1
Feed-in phases / connection phases	1 / 2	1 / 2	1 / 2	1 / 2
Efficiency				
CEC efficiency / max. efficiency	98 % / 98.6 %	98.5 % / 98.7 %	98 % / 98.6 %	98.5 % / 98.7 %
Protective devices				
DC reverse polarity protection	●	●	●	●
AC short-circuit current capability	●	●	●	●
Galvanic isolation	–	–	–	–
All-pole-sensitive residual-current monitoring unit	●	●	●	●
Arc-fault circuit interrupter (according to UL 1699B)	●	●	●	●
Protection class	I	I	I	I
Overvoltage category	IV	IV	IV	IV
General data				
Dimensions (W / H / D)	470 / 615 / 240 mm (18.4 / 24.1 / 9.5 inch)		470 / 615 / 240 mm (18.4 / 24.1 / 9.5 inch)	
Dimensions of DC Disconnect (W / H / D)	187 / 297 / 190 mm (7.28 / 11.7 / 7.5 inch)		187 / 297 / 190 mm (7.28 / 11.7 / 7.5 inch)	
Weight	35 kg / 78 lb	35 kg / 78 lb	35 kg / 78 lb	35 kg / 78 lb
Weight of DC Disconnect	3.5 kg / 8 lb	3.5 kg / 8 lb	3.5 kg / 8 lb	3.5 kg / 8 lb
Operating temperature range	-40 °C ... +60 °C / -40 °F ... +140 °F		-40 °C ... +60 °C / -40 °F ... +140 °F	
Noise emission (typical)	46 dB(A)	46 dB(A)	46 dB(A)	46 dB(A)
Self-consumption (night)	0.15 W	0.15 W	0.15 W	0.15 W
Topology	Transformerless H5	Transformerless H5	Transformerless H5	Transformerless H5
Cooling concept	OptiCool	OptiCool	OptiCool	OptiCool
Degree of protection	NEMA 3R	NEMA 3R	NEMA 3R	NEMA 3R
Degree of protection of connection area	NEMA 3R	NEMA 3R	NEMA 3R	NEMA 3R
Max. permissible value for relative humidity (non-condensing)	100 %	100 %	100 %	100 %
Features				
DC connection	Screw terminal	Screw terminal	Screw terminal	Screw terminal
AC connection	Screw terminal	Screw terminal	Screw terminal	Screw terminal
Display	Text line	Text line	Text line	Text line
Interface: RS485 / *Bluetooth*	o / o	o / o	o / o	o / o
Warranty: 10 / 15 / 20 years	● / o / o	● / o / o	● / o / o	● / o / o
Certificates and approvals (more available on request)	UL1741, UL1998, IEEE1547, FCC Part 15 (Class A & B), CAN/CSA C22.2 107.1-1, UL 1699B			
Type designation	SB 6000TLUS-12		SB 7000TLUS-12	

Sunny Boy 8000TL-US 208 V	Sunny Boy 8000TL-US 240 V	Sunny Boy 9000TL-US 208 V	Sunny Boy 9000TL-US 240 V
10000 W	10000 W	11250 W	11250 W
8400 W	8300 W	9400 W	9300 W
600 V	600 V	600 V	600 V
300 V – 480 V / 345 V	345 V – 480 V / 379 V	300 V – 480 V / 345 V	345 V – 480 V / 379 V
300 V / 360 V	345 V / 360 V	300 V / 360 V	345 V / 360 V
27.9 A	24.1 A	31.4 A	27.1 A
27.9 A	24.1 A	31.4 A	27.1 A
1	1	1	1
6	6	6	6
8000 W/8000 VA		9000 W / 9000 VA	
208 V / 183 V – 229 V	240 V / 211 V – 264 V	208 V / 183 V – 229 V	240 V / 211 V – 264 V
60 Hz / 59.3 Hz ... 60.5 Hz	60 Hz / 59.3 Hz ... 60.5 Hz	60 Hz / 59.3 Hz ... 60.5 Hz	60 Hz / 59.3 Hz ... 60.5 Hz
38.5 A	33.4 A	43.3 A	37.5 A
1		1	
1 / 2		1 / 2	
98 % / 98.6 %	98 % / 98.6 %	98 % / 98.6 %	98 % / 98.7 %
●		●	
●		●	
–		–	
●		●	
●		●	
I		I	
IV		IV	
470 / 615 / 240 mm (18.4 / 24.1 / 9.5 inch)		470 / 615 / 240 mm (18.4 / 24.1 / 9.5 inch)	
187 / 297 / 190 mm (7.28 / 11.7 / 7.5 inch)		187 / 297 / 190 mm (7.28 / 11.7 / 7.5 inch)	
35 kg / 78 lb		35 kg / 78 lb	
3.5 kg / 8 lb		3.5 kg / 8 lb	
-40 °C ... +60 °C / -40 °F ... +140 °F		-40 °C ... +60 °C / -40 °F ... +140 °F	
46 dB(A)		46 dB(A)	
0.15 W		0.15 W	
Transformerless H5		Transformerless H5	
OptiCool		OptiCool	
NEMA 3R		NEMA 3R	
NEMA 3R		NEMA 3R	
100 %		100 %	
Screw terminal		Screw terminal	
Screw terminal		Screw terminal	
Text line		Text line	
○ / ○		○ / ○	
● / ○ / ○		● / ○ / ○	
UL1741, UL1998, IEEE1547, FCC Part 15 (Class A & B), CAN/CSA C22.2 107.1-1, UL 1699B			
SB 8000TLUS-12		SB 9000TLUS-12	

Technical data	Sunny Boy 10000TL-US 208 V	Sunny Boy 10000TL-US 240 V	Sunny Boy 11000TL-US 240 V
Input (DC)			
Max. recommended PV power (@ module STC)	12500 W	12500 W	13750 W
Max. DC power (@ cos φ = 1)	10500 W	10350 W	11500 W
Max. input voltage	600 V	600 V	600 V
MPP voltage range / rated input voltage	300 V – 480 V / 345 V	345 V – 480 V / 379 V	345 V – 480 V / 379 V
Min. input voltage / initial input voltage	300 V / 360 V	345 V / 360 V	345 V / 360 V
Max. input current	35 A	30.2 A	33.3 A
Max. input current per string	35 A	30.2 A	33.3 A
Number of independent MPP inputs	1	1	1
Strings per MPP input @ Combiner Box	6	6	6
Output (AC)			
Rated power / max. apparent AC power	10000 W / 10000 VA		11000 W / 11000 VA
Nominal AC voltage / nominal AC voltage range	208 V / 183 V – 229 V	240 V / 211 V – 264 V	240 V / 211 V – 264 V
AC power frequency / range	60 Hz / 59.3 Hz ... 60.5 Hz	60 Hz / 59.3 Hz ... 60.5 Hz	60 Hz / 59.3 Hz ... 60.5 Hz
Max. output current	48.1 A	41.7 A	45.8 A
Power factor at rated power	1		1
Feed-in phases / connection phases	1 / 2		1 / 2
Efficiency			
CEC efficiency / max. efficiency	97.5 % / 98.6 %	98 % / 98.7 %	98 % / 98.7 %
Protective devices			
DC reverse polarity protection	●		●
AC short-circuit current capability	●		●
Galvanic isolation	–		–
All-pole-sensitive residual-current monitoring unit	●		●
Arc-fault circuit interrupter (according to UL 1699B)	●		●
Protection class	I		I
Overvoltage category	IV		IV
General data			
Dimensions (W / H / D)	470 / 615 / 240 mm (18.4 / 24.1 / 9.5 inch)		
Dimensions of DC Disconnect (W / H / D)	187 / 297 / 190 mm (7.28 / 11.7 / 7.5 inch)		
Weight	35 kg / 78 lb		
Weight of DC Disconnect	3.5 kg / 8 lb		
Operating temperature range	-40 °C ... +60 °C / -40 °F ... +140 °F		
Noise emission (typical)	46 dB(A)		46 dB(A)
Self-consumption (night)	0.15 W		0.15 W
Topology	Transformerless H5		Transformerless H5
Cooling concept	OptiCool		OptiCool
Degree of protection	NEMA 3R		NEMA 3R
Degree of protection of connection area	NEMA 3R		NEMA 3R
Max. permissible value for relative humidity (non-condensing)	100 %		100 %
Features			
DC connection	Screw terminal		Screw terminal
AC connection	Screw terminal		Screw terminal
Display	Text line		Text line
Interface: RS485 / *Bluetooth*	O / O		O / O
Warranty: 10 / 15 / 20 years	● / O / O		● / O / O
Certificates and approvals (more available on request)	UL1741, UL1998, IEEE1547, FCC Part 15 (Class A & B), CAN/CSA C22.2 107.1-1, UL 1699B		
NOTE: US inverters ship with gray lids			
Type designation	SB 10000TLUS-12		SB 11000TLUS-12



Accessories


Sunny Boy Combiner Box
SBCBTL6-10


Bluetooth Piggy-Back
BTPBINV-NR
with External Antenna
BTPB-EXTANT-NR


Interface RS485
485USPB-NR


SMA Power Balancer Set
PBL-SBUS-10-NR

● Standard feature O Optional feature – Not available
Data at nominal conditions

Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

CERTIFICATE OF COMPLIANCE

Certificate Number	20120621-E210376
Report Reference	E210376-20100817
Issue Date	2012-JUNE-21
Issued to:	SMA SOLAR TECHNOLOGY AG SONNENALLEE 1 34266 NIESTETAL GERMANY
This is to certify that representative samples of	STATIC INVERTERS, CONVERTERS AND ACCESSORIES FOR USE IN INDEPENDENT POWER SYSTEMS See Addendum Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, UL 1741, Second Edition. Standard for Interconnecting Distributed Resources with Electric Power Systems, IEEE 1547. Standard for Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems, IEEE 1547.1. Standard for General Use Power Supplies, CSA C22.2 No. 107.1-2001. This description also includes a complementary Listed, integral Type 1 Photovoltaic DC Arc-Fault Circuit Interrupter Protection, Sunny Boy Cat nos. SB6000TLUS-12, SB7000TLUS-12, SB8000TLUS-12, SB9000TLUS-12, SB10000TLUS-12, SB11000TLUS-12. This Listing was evaluated for compliance with the applicable provisions of the Standard for Safety for Arc Fault Circuit Interrupters, UL 1699, Second Edition, including revisions dated February 11, 2011, and Outline of Investigation Subject 1699B, Photovoltaic (PV) DC Arc-Fault Circuit Protection, Issue Number 1, dated April 29, 2011.
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Listing Mark for the US and Canada should be considered as being covered by UL's Listing and Follow-Up Service meeting the appropriate requirements for US and Canada.
The UL Listing Mark for the US and Canada generally includes: the UL in a circle symbol with “C” and “US” identifiers: c UL us the word “LISTED”; a control number (may be alphanumeric) assigned by UL; and the product category name (product identifier) as indicated in the appropriate UL Directory.

Look for the UL Listing Mark on the product.

William R. Carney, Director, North American Certification Programs

UL LLC

CERTIFICATE OF COMPLIANCE

Certificate Number	20120621-E210376
Report Reference	E210376-20100817
Issue Date	2012-JUNE-21

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Permanently connected, utility interactive, non-isolated (transformerless), inverters:

SMA Solar Technology AG Models: SB6000TL-US, SB7000TL-US, SB8000TL-US, SB9000TL-US, SB10000TL-US and SB11000TL-US inverters, which are intended for DC input from the following sources: photovoltaic modules from an ungrounded PV array.
Models may also be provided with suffix "-12."

William R. Carney, Director, North American Certification Programs

UL LLC

TECHNICAL NOTE

TOPIC: DC Disconnect UL Listing Update

SUMMARY

The UL Listing for the SMA DC disconnect used with SMA Sunny Boy inverters has recently been updated. Effective April 21st, 2009, the new maximum fuse rating will be 20 A_{DC}. The SMA DC disconnect will continue to be shipped with 15 A_{DC}, 600 V_{DC} rated fuses as standard.

UL required no redesign for this update. Therefore, units that were manufactured prior to the effective date will bear the original ratings label. Please use this document if needed of proof of this change until such time as new units with updated labels are available.

STRING FUSE SIZING REVIEW

In any electrical system, fuses are used to protect wiring and equipment from excessive currents that can cause damage, heating or in extreme cases even fire. If the fuse rating is too small it could open during normal operation. If the fuse rating is too large, it cannot provide the needed protection. In PV systems, the minimum and maximum size of the series fuse is determined by the electrical ratings of the PV module as well as by UL and National Electrical Code (NEC) requirements. Be sure to consult with your PV module manufacturer for appropriate PV string fuse ratings.

The minimum size of fuses and wiring are calculated using the Short Circuit Current Rating (I_{SC}) of the PV module. The NEC requires that all fuses and wiring be sized for a minimum of 1.56 times the Isc of the PV module used in the system. The proper size PV string fuse is determined by calculating 1.56 x I_{SC} (of the PV module) and then rounding up to the next standard fuse size.

If there are additional questions or if further clarification is needed, please refer to the inverter manual or contact technical support at SMA America, Inc.

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Rocklin, CA 95677
+1 916 625 0870
Service@SMA-America.com

TECHNOTE20A-HUS091712

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34266 Niestetal
Tel.: +49 561 9522-0
Fax: +49 561 9522-100
E-Mail: info@SMA.de
Internet: www.SMA.de

Niestetal, 2 November 2009

Document of compliance for the operation of SMA inverters in combination with "Module Power Maximizers"

Applies exclusively to the following products: *Module Maximizer* by *Tigo Energy*.

In case the design of a solar power system with e.g. "Sunny Design" (www.SMA.de/SunnyDesign) ensures that the permitted operating range of all components is kept to at all times, the operation of the above mentioned module power maximizers in combination with the SMA products Sunny Boy, Sunny Mini Central and Sunny Tripower poses no breach of the warranty conditions of these SMA products. The specification of the operating range of the inverters is documented in the respective manuals or installation instructions.

A requirement for obtaining the warranty claim is:

1. The maximum input voltage of the inverter is not exceeded at any time by the operation of the module power maximizers
2. SMA takes no responsibility for the achieved yield of the PV power system because the MPP tracking of the inverter no longer controls the operation of the PV panels
3. SMA takes no responsibility for the compliance of the complete system in terms of EMC regulations
4. The manufacturer of the installed module power maximizers has approved the operation of its products with the according SMA products

SMA Solar Technology AG

ppa. Dr. Bernd Engel
Senior Vice President Technology

i. V. Tobias Henne
Director Product Management