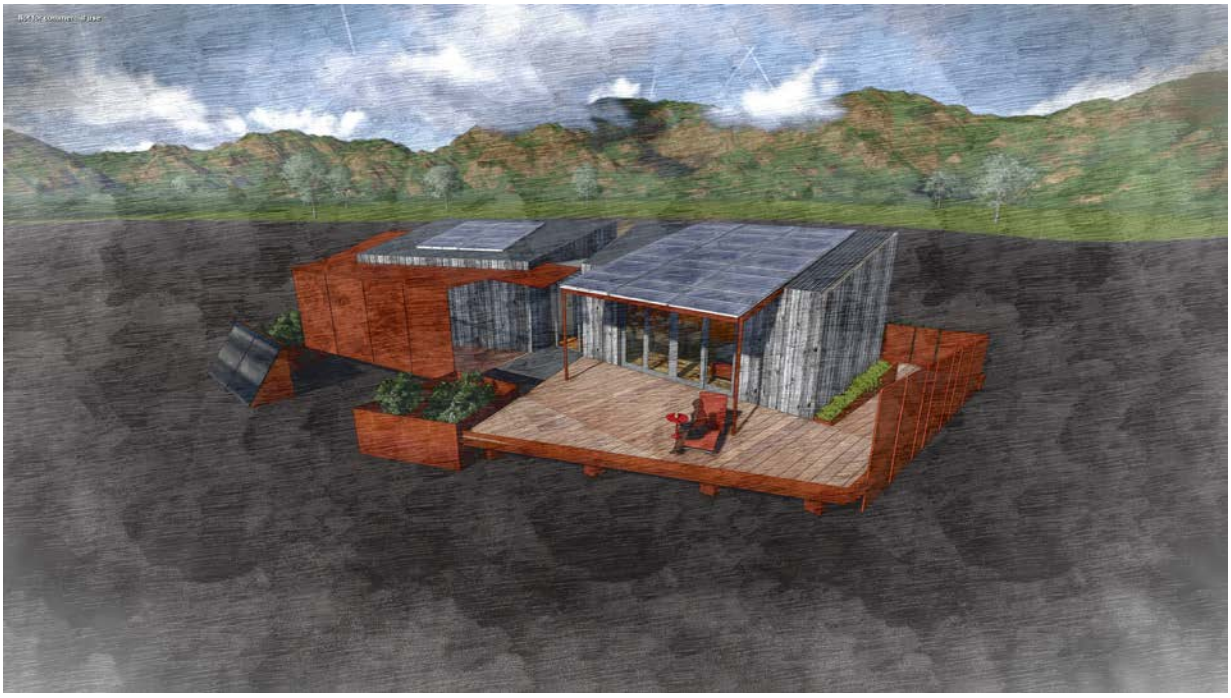
DESERTSOL

TEAM LAS VEGAS . SOLAR DECATHLON 2013



U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2013

As-Built Phase Project Manual

22 August 2013

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Summary of Changes

Significant changes to the project manual that have occurred between submissions have been outlined below.

August 22, 2013 Revision

The major design changes between the Construction Documentation Phase and the As-Built Phase include the following:

- Floor finish in Room 101 changed from end grain flooring to Viridian reclaimed wood.
- Metal grating deck in front of door 101 changed to Timbersil.
- Wall finish in Room 102, 103, 106 changed from paint to wall covering.
- Stainless handrail changed to mild steel handrails.
- Radiant floor in Room 105 changed to be located in the wall cavity.
- Ceiling finish wood paneling fastening methods changed from z-clips to direct fastening with screws.
- Spray foam insulation in wall, ceiling, and floor cavity changed to fill the 1" of closed cell foam and fill the rest of the cavity with open cell foam.
- Bathroom counter top changed to wood construction.
- Bathroom built-in mill work changed to wall-hung FF&E shelving unit and detached bench.
- Updated lighting quantities. (see lighting plan and schedule)
- Hot water storage tank size changed to 100gal
- Added heat rejection to solar thermal loop
- Gray water changed to only use for irrigation
- Reduced waste tank from 4 to 3

Rules Compliance Checklist: The table has been updated to reflect changes in the Drawings and Specifications.

Reconfigurable Features: The methods that the reconfigurable features will be included in the project and juries have been revised. The descriptions have also been modified to better explain the reconfigurable features.

Energy Analysis Results and Discussions: Updated energy analysis results have been added. This includes the hydronic radiant floor simulation, hot water simulation, and whole building energy modeling.

Quantity Takeoff of Competition Prototype House: The table has been updated to reflect new counts and changes in the Drawings and Specification.

Construction Specifications: The following specifications have been revised to reflect actual products and materials used in the design: 04 20 00 (Masonry), 05 52 00 (Metal Railings), 06 05 73 (Composite Glass Wood Products), 06 10 00 (Miscellaneous Rough Carpentry), 06 16 00 (Sheathing), 06 20 00 (Finish Carpentry), 07 21 00 (Thermal Insulation), 07 25 00 (Weather Barriers), 07 61 00 (Sheet Metal Roofing), 07 62 00 (Sheet Metal Flashing and Trim), 07 92 00 (Joint Sealants), 08 14 16 (Flush Wood Doors), 08 71 00 (Door Hardware), 08 80 00 (Glazing), 09 22 16 (Non-Structural Metal Framing), 09 30 00 (Tiling), 09 64 00 (Wood Flooring), 09 90 00 (Painting and Coating), 10 28 00 (Toilet, Bath, and Laundry Accessories), 11 31 00 (Residential Appliances), 12 22 00 (Curtains and

Drapes), 12 36 61 (Simulated Stone Countertops), 22 11 00 (Facility Water Distribution), 22 13 00 (Facility Sanitary Waste and Vent Piping), 22 33 30.00 (Solar Water Heating Equipment), 22 40 00 (Plumbing Fixtures), 23 83 16 (Radiant Heating Hydronic Piping), 25 10 00 (Integrated Automation Network Equipment), 26 05 26 (Grounding and Bonding for Electrical Systems), 26 24 16 (Panelboards), 26 27 26 (Wiring Devices), and 26 31 00(Photovoltaic Collectors). The following specifications have been deleted due to incorporation of their information into other related specifications: 06 15 33 (Wood Patio Decking) and 06 73 00 (Composite Decking) incorporated into 06 05 73 (Composite Glass Wood Products) and 12 24 13 (Roller Window Shades) incorporated into 12 22 00 (Curtains and Drapes).

Structural Calculations: The deck framing plan and the full deck calculations sections have been revised. The simply supporter and joist section is combined with the overhand beam design section. The foundation and tie down anchor design calculation have been updated and a layout plan included. The Module B Window Moment Connection calculations were added.

Mechanical Cut Sheets: Appendix III has been added with the MEPs equipment cut sheets.

February 14, 2013 Revision

Major design changes to DesertSol since the Design Development Phase include the removal of the cooltower, revised reconfigurable screen assembly, the overhang at the entry was changed from a perforated screen to a galvanized steel construction, and revision of photovoltaic system including new model of panel and relocating the combiner box from inside the bedroom to the exterior wall of Module B.

Rules Compliance Checklist: The table has been updated to reflect changes in the Drawings.

Summary of Reconfigurable Features: Window coverings have been added to the list of reconfigurable features within the house. Also, a description of how the reconfigurable features will be demonstrated during the juried contests has been added.

Interconnection Application Form: Form has been updated to reflect a change in the photovoltaic panel model and number of panels.

Energy Analysis Results and Discussion: Revised photovoltaic panel calculations for Irvine, California and Las Vegas, Nevada have added.

Quantity Takeoff of Competition Prototype House: The table has been updated to reflect new counts and changes in the Drawings.

Construction Specifications: Specifications have been revised as necessary to reflect changes in the design and Drawings. The following specification sections were added 06 05 73 (Composite Glass Wood Products), 09 65 00 (Resilient Flooring), 09 77 23 (Fabric-Wrapped Panels), 12 22 00 (Curtains and Drapes), and 32 84 00 (Planting Irrigation). The following specification sections were deleted 06 42 00 (Wood Paneling), 08 11 13 (Hollow Metal Doors and Frames), and 08 50 00 (Windows).

Structural Calculations: The structural calculations have been updated to reflect competition site specifications and updates to the design.

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 O-102
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	C-102
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	C-102
Rule 4-5	Generators	Specifications for generators (including sound rating)	Not Applicable
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-101
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	21 13 13 22 XX XX 23 23 00 23 83 16
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 12 in. (30.48 cm) of vertical elevation change exists	Appendix I Structural Calculations
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 12 in. (30.48 cm) of vertical elevation change exists on the lot	S-101
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A-201 A-202
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	Not Applicable
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 Drawings and Appendix I 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	Not Applicable
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-102 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	P-103 P-106
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	26 31 00
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	Not Applicable
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	Not Applicable
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	Not Applicable
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	Not Applicable
Rule 8-5	Village Grid	Completed interconnection application form	Manual Page 14
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	A-203 E-104 E-105 E-601
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	26 31 00 26 24 16 E-104
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	Manual Page 15 E-001
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	E-105
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-105
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

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	Manual Page 11
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	P-103 P-601 P-603
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	A-121 P-601 P-603
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	P-602
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	22 33 30.00 P-001
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	Not Applicable
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 13 53
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103

Structural Calculations

Structural Calculations are included as Appendix I in this Project Manual.

Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	10% is added to account for any unexpected losses.
Dishwasher	40	5	8	
Clothes Washer	112	14	8	
Fire Protection	280	280	1	
Solar Thermal Loop	5	-	-	4.9 gal total = 1.4 gal in solar loop + 3.5 in bottom HEX
Radiant Floor Heating	11	-	-	10.8 gal total = 8.3 in radiant loop + 2.5 in top HEX
Hot Water Storage Tank	165	-	-	
Kitchen Faucet	180	-	-	120 minutes of use
Lavatory Faucet	90	-	-	60 minutes of use
Testing	50	-	-	
Evaporation	5	-	-	
Safety Factor	100	-	-	
WATER REQUIRED	**1278**	**gallons**		

Summary of Unlisted Electrical Components

DesertSol does not contain any unlisted electrical components.

Summary of Reconfigurable Features

Molowall

Molowall is a Tyvek partition system, when deployed it will allow privacy to the guest sleeping area from the kitchen and dining areas. When not in use, the molowall will be stored within the casework along the north wall. The screen can be partially or fully deployed to demonstrate the flexibility and ease of use during the juried contests.

Couch

The living area sofa will provide seating for residents and guests while the space is used for entertaining. It is also reconfigurable into a full size bed to be used in combination with the Molowall screen when the living space is converted into the guest sleeping area. The sofa and guest space configuration will be shown in a rendered perspective as part of the public exhibit.

Screens

The perforated metal sliding screen panels at the south edge of the bedrooms private deck are designed to have the panels to slide together and stack. When fully expanded, the screens will provide shade from the harsh sun in the warmer months, protect the residence from occasional desert wind gusts and provide added privacy to the more intimate bedroom deck. When fully retracted, the deck is transformed into an open sunny space to warm the deck and bedroom in cooler months. The screens will be fully retracted and fully closed during the juried contests to demonstrate the various features that add to the versatility and interest of the house. Both configurations of the screens will also be shown in renderings in the public exhibit

Acoustic Wall

The east wall of the living area will be devoted to entertainment equipment that will be concealed when not in use. Fabric covered doors with a lateral opening system will reveal a large television when open and the fabric covered frames will hide the screen when not in use. For the competition, the doors will be retracted to reveal the television and renderings showing the screen both hidden and revealed will be included in public exhibit.

Window Coverings

Flat fold, hand drawn curtains will cover the south and north glazing in the bedroom and south glazing living room. The draperies and shades will remain open during the competition and each window treatment will be operated to demonstrate the privacy and shading features.

Interconnection Application Form

Team Las Vegas and Lot 114

PV SYSTEMS

MODULE MANUFACTURER	SHORT DESCRIPTION OF ARRAY	DC RATING OF ARRAY (SUM OF DC RATINGS)
SunPower	21 SunPower SPR-225-BLK-U Solar Panel on Module B standing seam metal roof	4,725 Watts
SunPower	9 Sunpower SPR-225-BLK-U Solar Panel on Module A standing seam metal roof	2,025 Watts

Total DC power of all arrays is 6.750 kW.

INVERTERS

INVERTER MANUFACTURER	MODEL NUMBER	VOLTAGE	RATING (KW)	QUANTITY
Power-One	MICRO-0.25-I-OUTD-US-208/240	240	0.250	30

Total AC power of all inverters is 7.500 kW.

REQUIRED INFORMATION

The following information must be included in the project manual or construction documents. If located in the construction documents, list the drawing locations in this section of the project manual. (Example: B3/E-201)

	LOCATION
One-Line Electrical Schematic	E-601
Calculations of service/feeder net computed load and neutral load (NEC 220)	Manual Page 15
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	E-101 E-104 E-105

Service Feeder Calculations (using part IV)

SERVICE LOADS	RATING	VOLTAGE	AMPACITY	DEMAND FACTOR	CALCULATED LOAD
MAIN SERVICE PANEL					
GENERAL LIGHTING AND RECEPTACLES (NEC 2210.11(C))					
General Lighting and Receptacles (NEC 220.10)	2025 VA	120 V	2.95 A	35%	708.75 VA
Small Appliance Circuits (NEC 220.52)	3000 VA	120 V	12.50 A	100%	3,000 VA
Laundry (NEC 220.52)	1,500 VA	120 V	2.19 A	35%	525 VA
Subtotal			17.64 A		4,233.75 VA
COOKING					
Stove (NEC 220.55)	3,600 VA	240 V	11.25 A	75%	2,700 VA
Oven/Microwave (NEC 220.55)	2,800 VA	240 V	8.75 A	75%	2,100 VA
Subtotal			20.00 A		4,800 VA
FIXED APPLIANCES					
Water Heater (NEC 220.53)	13,000 VA	240 V	40.63 A	75%	9,750 VA
Dishwasher (NEC 220.53)	1,440 VA	120 V	4.50 A	75%	1,080 VA
Washing Machine (NEC 220.53)	2,400 VA	240 V	7.50 A	75%	1,800 VA
Rangehood/Exhaust Fan (NEC 220.53)	348 VA	120 V	1.09 A	75%	261 VA
ERV (NEC 220.53)	25 VA	120 V	0.08 A	75%	18.75 VA
Sprinkler Pump (NEC 220.53)	680 VA	240 V	2.13 A	75%	510 VA
Refrigerator (NEC 220.53)	450 VA	120 V	1.41 A	75%	337.5 VA
Subtotal			57.32 A		13,757.25 VA
Dryer (W=VA from NEC 220.54)	7,200 VA	240 V	30.00 A	100%	7,200 VA
HVAC Compressor and Units (NEC 220.82C)	1,500 VA	240 V	6.25 A	100%	1,500 VA
Motor (NEC 430.24)	2,016 VA	240 V	2.10 A	25%	504 VA
Subtotal			38.35 A		9,204 VA
Total			133.31 A		31,995 VA
MAIN SERVICE PANEL BREAKER					
NEUTRAL CONDUCTOR					
General Lighting and Receptacles (NEC 220.61(A))	4233.75 VA	120 V	17.64	100%	4,233.75 VA
Cooking (NEC 220.61(B))	6,400 VA	240 V	18.67 A	70%	4,480 VA
Fixed Appliances (NEC 220.61(A))	13,757.25 VA	240 V	57.32 A	100%	13,757.25 VA
Dryer (NEC 220.619(B))	7,200 VA	240 V	21.00 A	70%	5,040 VA
Total			114.63 A		27,511 VA

*All NEC references are to the 2011 NEC

Energy Analysis Results and Discussion

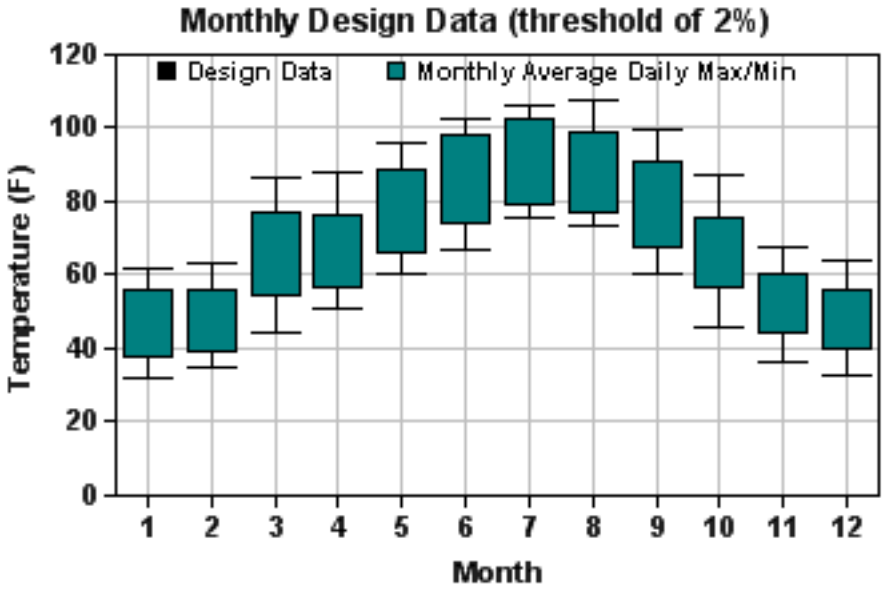
Introduction and Background

DesertSol's design philosophy revolves around building an ultra-efficient high performing house for the harsh desert environment. Since the inception of the project, extensive building energy simulation has been implemented and various tools have been explored to predict the performance of the prototype home.

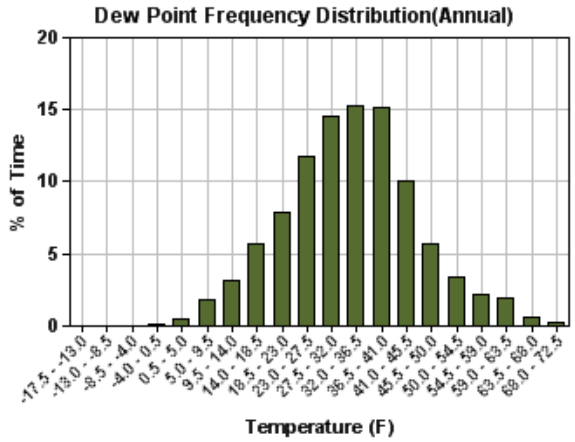
It is easy to come across sustainable building strategies. However, is the technology cost-effective? Does it work for DesertSol's climate? How to integrate the technology into the building and still be able to preserve the aesthetic nature of the house? These constantly evolving check and balance conversation drove DesertSol's design phase.

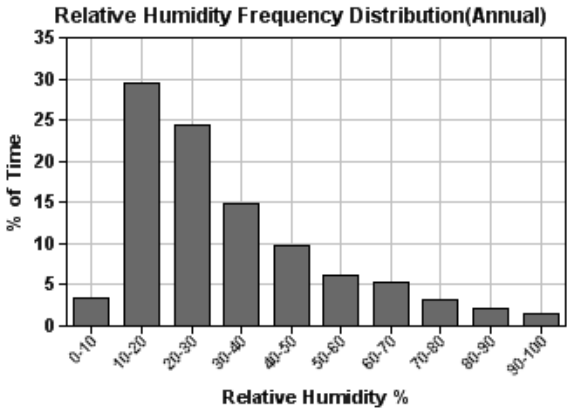
Buildings live and breeze as one piece. Each and every component inside the building plays a part in the energy modeling. DesertSol embraced whole building design strategy to try to optimize its performance.

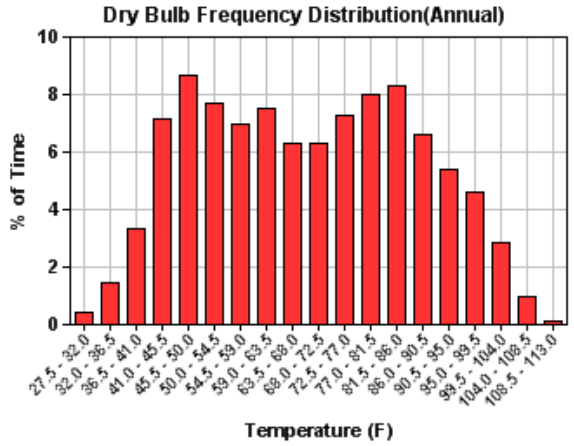
To understand the building, we first needed to understand our environment. The following weather data was used as baseline design parameters for Las Vegas:

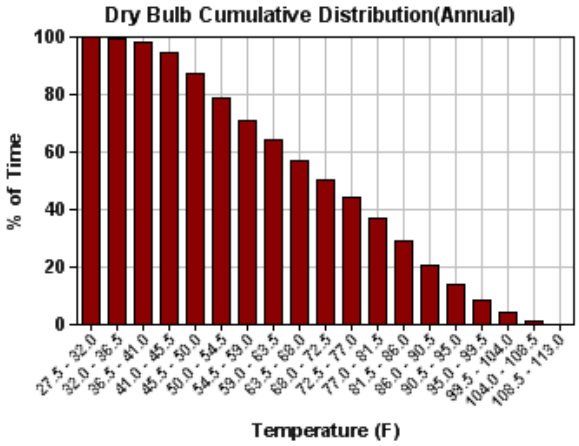


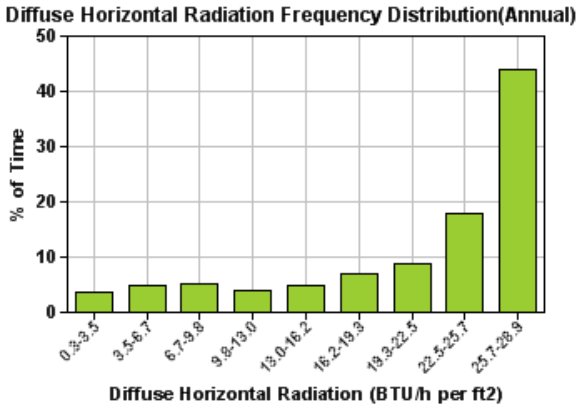
Cooling Degree Day		Heating Degree Day	
Threshold	Value	Threshold	Value
65 °F	3307	65 °F	2180
70 °F	2331	60 °F	1464
75 °F	1522	55 °F	816
80 °F	878	50 °F	346

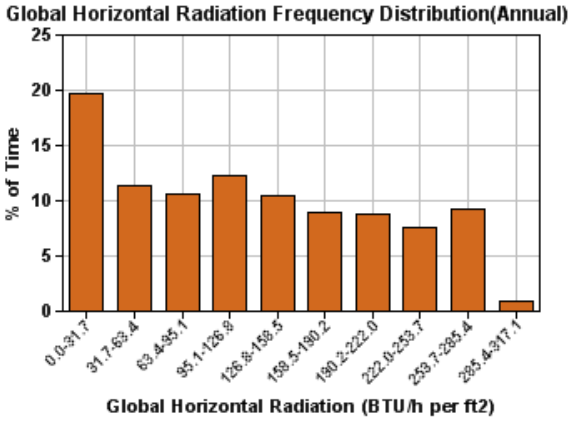

Dew Point Frequency Distribution(Annual)
% of Time
Temperature (F)

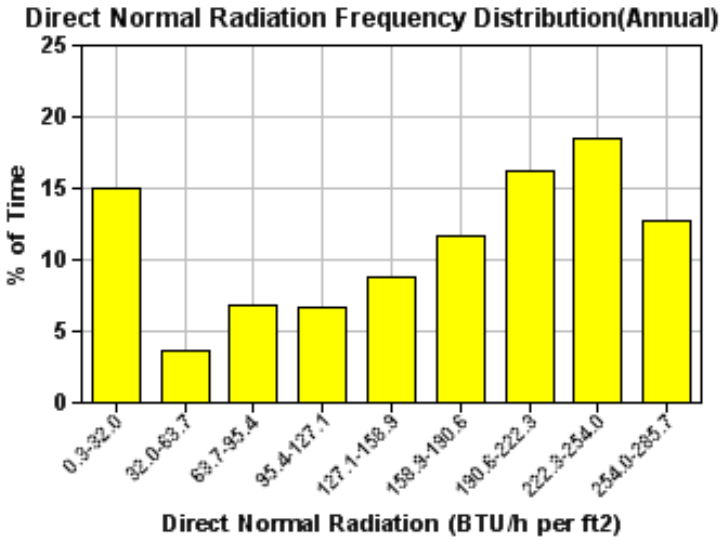

Relative Humidity Frequency Distribution(Annual)
% of Time
0-10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
Relative Humidity %

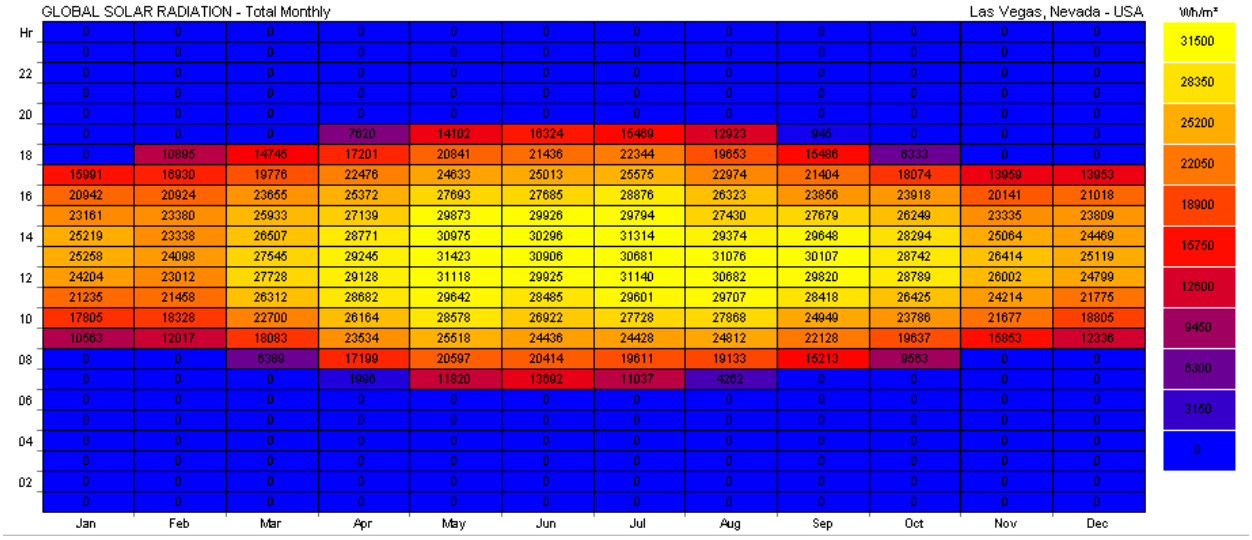

Dry Bulb Frequency Distribution(Annual)
% of Time
Temperature (F)


Dry Bulb Cumulative Distribution(Annual)
% of Time
Temperature (F)


Diffuse Horizontal Radiation Frequency Distribution(Annual)
% of Time
0.3-3.5
3.5-6.7
6.7-9.8
9.8-13.0
13.0-16.2
16.2-19.3
19.3-22.5
22.5-25.7
25.7-28.9
Diffuse Horizontal Radiation (BTU/h per ft2)


Global Horizontal Radiation Frequency Distribution(Annual)
% of Time
0.0-31.7
31.7-63.4
63.4-95.1
95.1-126.8
126.8-158.5
158.5-190.2
190.2-222.0
222.0-253.7
253.7-285.4
285.4-317.1
Global Horizontal Radiation (BTU/h per ft2)





It is not surprising that the Mojave Desert has some distinct hot dry summer, but the solar is an abundant resource that we could utilize.

The design team came up with a comprehensive strategy list as follows:

Use passive strategies to reduce demand-side load as much as possible

- Work with solar geometry to reduce building loads
- Take advantage of daylighting
- Design sun control and shading devices with careful selection of glazing
- Use nature ventilation and water conservation

- Design a high-performing envelope

Use highly efficient active system to deliver project performance

- Maximize the usage of solar energy as fuel source as much as possible
- Specify energy efficient HVAC equipment and design systems that exceeds the highest energy standards
- Design a lighting system that consume less than 1w/square foot
- Specify Energy Star approved energy efficient appliance and products
- Use energy recovery system that pre-heat or pre-cool incoming ventilation air
- Use automatic controls to operate the building always at the highest efficiency

General Procedure and Tools

During conceptual design period, Autodesk Vasari was as rapid energy modeling tool to help with creating basic mass elements and parametric. Models with different orientation, different glazing ratios and different roof angles were examined to help with design decision evaluations.

Once getting into design development phase, Revit was used exclusively for building information modeling. Traditionally, a building uses more than 30% of its energy in space heating and cooling, we used Revit's HVAC load tool to actively check if our envelope is high-performing.

In the process, we quickly learned that cost could become a major concern in real construction scenario. Using BEopt developed by NREL, the platform allowed us to analyze the building with cost optimization. BEopt can use DOE2.2 or Energy Plus as the back calculating engine. The detailed simulation-based analysis was then examined and compared.

Results and Discussion

Envelope
It was determined in the design development phase that the high efficient envelope needs to have the R value of the following to achieve the thermal goals:

Ceiling : R-55

Wall: R-30

Floor: R-45

During specification and construction, this was achieved by:

Ceiling: 1" Closed Cell Spray Foam (R-6.7) and 11" Open Cell Spray Foam (R-40.7) and Radiant Barrier Rigid Foam Insulation (R-6) resulting Total R-Value of 53.4

Wall: 1” Closed Cell Spray Foam (R-6.7) and 4.5” Open Cell Spray Foam (R-16.65) and Radiant Barrier Rigid Foam Insulation (R-6) resulting Total R-Value of 29.35

Floor: 1” Closed Cell Spray Foam (R-6.7) and 9” Open Cell Spray Foam (R-33.3) and Radiant Barrier Rigid Foam Insulation (R-6) resulting Total R-Value of 46

Electrical Load

Appliance	Usage (Hours/Week)	Rated Power Consumption (Watts)	Annual Electricity Consumption (kWh)
Refrigerator/Freezer	168	410	407
Dishwasher	4	1000	259
Oven	3	2200	343
Stove	3	3600	562
Clothes Washer	8	510	212
Clothes Dryer	8	2800	1165
Ceiling Fan	42	30	66
Notebook Computer	35	40	73
Television	35	270	491
Home Theater	35	250	455
HVAC	28	750	1092
Lighting	19	500	790
Water Heater	2	12000	2400
Total Annual Power Consumption (kWh)			**11078**

Appliance	Total Time (Hours)	Rated Power Consumption (Watts)	Electricity Consumption During Competition (kWh)
Refrigerator/Freezer	199.5	410	9
Dishwasher	12.5	1000	16
Oven	12	2200	26
Stove	12	3600	43
Clothes Washer	24	510	8
Clothes Dryer	24	2800	67.2
Ceiling Fan	42	30	1
Notebook Computer	34	40	1
Television	36.5	270	10
Home Theater	36.5	250	9
HVAC	28	750	21
Lighting	19	800	15
Water Heater	8	12000	96
Total Power Consumption During Competition (kWh)			**327**

Thermal Load

Project Summary

Location and Weather	
Project	UNLV Solar Decathlon
Address	4505 S. Maryland Pkwy, Las Vegas, NV
Latitude	36.26°
Longitude	-115.24°
Summer Dry Bulb	109 °F
Summer Wet Bulb	73 °F
Winter Dry Bulb	28 °F
Mean Daily Range	25 °F

BUILDING SUMMARY

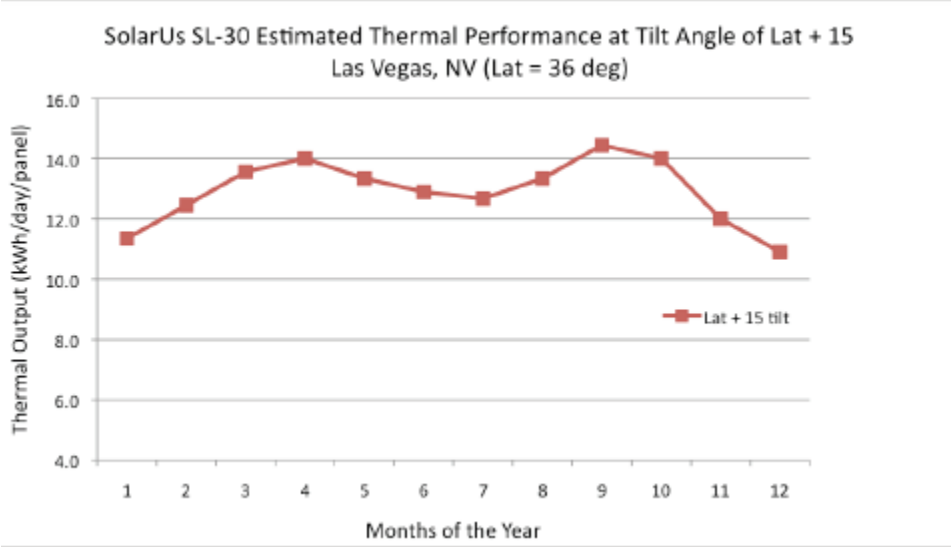
Inputs	
Building Type	SingleFamily
Area (SF)	681
Volume (CF)	4,678.97
Calculated Results	
Peak Cooling Total Load (Btu/h)	**9,004.80**
Peak Cooling Month and Hour	August 5:00 PM
Peak Cooling Sensible Load (Btu/h)	8,953.80
Peak Cooling Latent Load (Btu/h)	51
Maximum Cooling Capacity (Btu/h)	9,004.80
Peak Cooling Airflow (CFM)	322
Peak Heating Load (Btu/h)	**6,466.00**
Peak Heating Airflow (CFM)	265
Checksums	
Cooling Load Density (Btu/(h·ft²))	15.5
Cooling Flow Density (CFM/SF)	0.55
Cooling Flow / Load (CFM/ton)	429.64
Cooling Area / Load (SF/ton)	774.12
Heating Load Density (Btu/(h·ft²))	11.13
Heating Flow Density (CFM/SF)	0.46

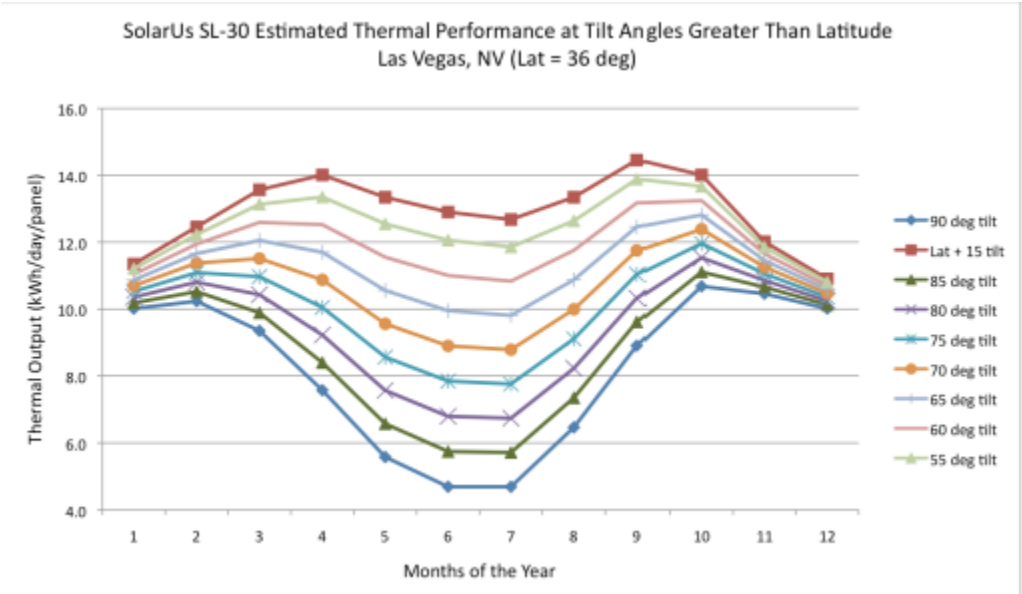
COMPONENTS	COOLING		HEATING	
	Loads (Btu/h)	Percentage of Total	Loads (Btu/h)	Percentage of Total
Wall	1,499.40	16.65%	1,706.30	26.39%
Window	1,436.60	15.95%	467	7.22%
Door	3,787.10	42.06%	3,893.30	60.21%
Roof	783.7	8.70%	399.4	6.18%
Skylight	0	0.00%	0	0.00%
Partition	0	0.00%	0	0.00%
Infiltration	0	0.00%	0	0.00%
Ventilation	0	0.00%	0	0.00%
Lighting	598.7	6.65%		
Power	598.7	6.65%		
People	111.1	1.23%		
Plenum	0	0.00%		
Fan Heat	189.4	2.10%		
Reheat	0	0.00%		
Total	**9,004.80**	**100%**	**6,466.00**	**100%**

Solar Thermal Simulation

Extensive simulations were conducted to optimize the angle of solar thermal collector to meet both domestic water heating demand and radiant heating demand.

In order to estimate the thermal output of the collector, the evacuated tube collector's SRCC certificate was used to in conjunction with solar radiation data. It was found that mounting the collector at 51 degrees for our application will reach optimal performance.





Hydronic Radiant Floor Simulation

Uponor's advanced design suite was used to design the radiant flooring system. The resulting total project heat loss can be considered the rate of heat that the system is designed to provide.

The heating of the house is thus primarily met by hydronic radiant, which is driven by solar thermal energy input.

Project Summary

Project #:	1
Project Name:	UNLV Solar Decathlon 2013
Location:	
CloseDate:	
Engineer:	
Design Data Location:	(User-Specified Location)
Outdoor Temperature:	40 °F
Wind Speed:	19 mph
Total Area:	546 ft²
Construction Quality:	Best
RFH Glycol Level:	100% Water
Design Temp. Drop:	10 °F
Radiant Tubing Volume:	8.3 gallons(US)
Volume Water:	8.3 gallons(US)
Volume Glycol:	0 gallons(US)
Total-Components Load:	3,132 Btu/hr
Total Infiltration Load:	1,088 Btu/hr
Total Floor Downward Load:	1,816 Btu/hr
Total-Radiant Load:	4,221 Btu/hr
Total-Supplemental Load:	0 Btu/hr
Total-Project Heat Loss:	6,037 Btu/hr

Radiant Design Data

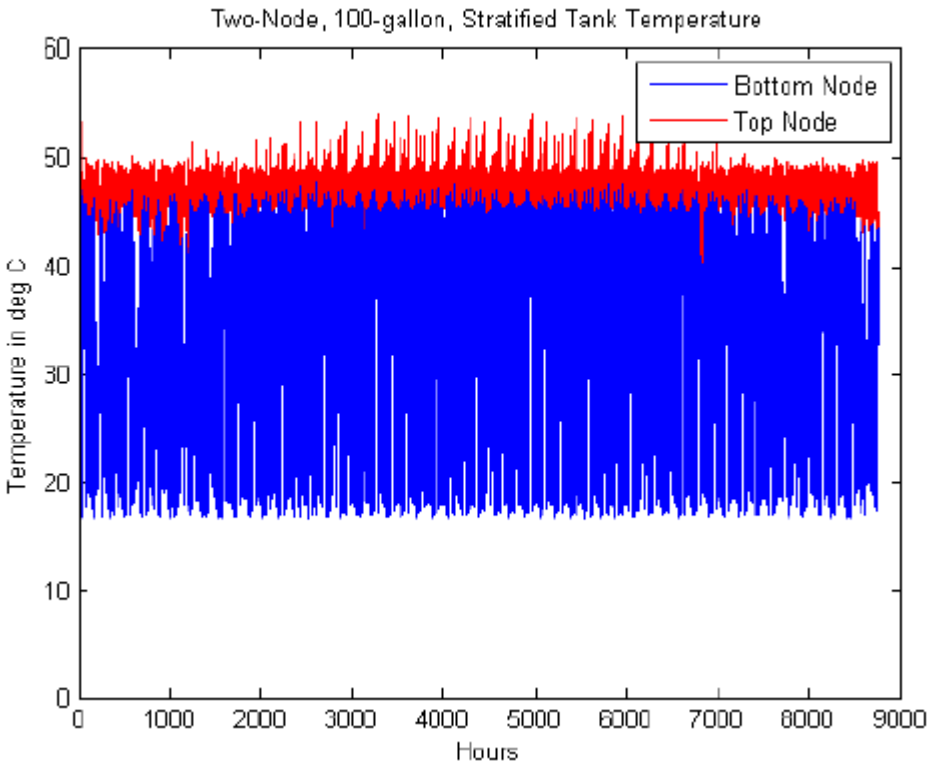
Manifold 1

Water Temperature:	85.8 °F	**Flow Rate:**	1.2 USGPM
Zone Control:	None	**Head Loss:**	2.1 ft(H2O)
Control Method:	Tempering Valve	**Head Loss S/R:**	0 ft(H2O)
Control Valve Headloss:	0.2 ft(H2O)	**S/R Tube Length (One way):**	0 ft
Total Loops:	4	**S/R Tube Type:**	hePEX 3/4"

Room	Zone #	Attach Method	Tube Type	Loop #	Area	Unit Heat	Tube Spacing	Leader Length	Loop Length	Flow Rate	Head Loss	Valve Turns	Cover Rv	Surface Temp.	Req. Water Temp.	Design Temp. Drop
Bedroom - Floor	2	Joist Trak Plates	hePEX 1/2"	1	154	7.9	8	10	251	0.5	2.1	3.73	0.3	78.9	84.6	10
Bathroom - Floor	2	Joist Trak Plates	hePEX 1/2"	2	42	8.5	8	10	83	0.1	0.1	1.23	0.3	79.3	85.8	10
Living Area - Floor	1	Joist Trak Plates	hePEX 1/2"	3	175.3	7.6	8	10	283	0.3	1.2	4.2	0.3	78.8	84	10
Living Area - Floor	1	Joist Trak Plates	hePEX 1/2"	4	175.3	7.6	8	10	283	0.3	1.2	4.2	0.3	78.8	84	10

Hot Water Storage Tank Simulation

The hot water storage tank provides a liquid thermal mass for the whole solar hydronic system. There are two heat exchangers in the tank. The lower heat exchanging coil is connected with the closed loop that takes thermal input from the evacuated tube collectors. The upper heat exchanging coil is connected with the hydronic radiant manifold system. The tank is modeled as stratified tank, the sizing of the tank was critical for proper temperature control.



Photovoltaic Simulation

The photovoltaic system performance was calculated using PVsim. The goal is to size the system to meet the annual electric load that was estimated in the early design process. The two modules are simulated separately due to orientation. The total power generation will meet the demand of the building.

Las Vegas, Nevada

Output of photovoltaic system was evaluated for the energy production for Las Vegas, Nevada. A day by day PV generation analysis was performed using typical meteorology data.

Module A Simulation

Station Identification	
City:	Las_Vegas
State:	Nevada
Latitude:	36.08° N
Longitude:	115.17° W
Elevation:	664 m
PV System Specifications	
DC Rating:	2.0 kW
DC to AC Derate Factor:	0.800
AC Rating:	1.6 kW
Array Type:	Fixed Tilt
Array Tilt:	11.0°
Array Azimuth:	153.6°
Energy Specifications	
Cost of Electricity:	9.7 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.76	180	17.46
2	4.76	202	19.59
3	5.87	278	26.97
4	7.29	326	31.62
5	8.05	359	34.82
6	8.32	347	33.66
7	8.15	344	33.37
8	7.51	319	30.94
9	6.74	281	27.26
10	5.37	244	23.67
11	4.23	192	18.62
12	3.53	166	16.10
Year	6.14	3237	313.99

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Solar Decathlon Las Vegas
West Building

Grid-Connected System: Simulation parameters

Project :	**Solar Decathlon Las Vegas**			
Geographical Site	**Las Vegas Mccarran Intl Ap**		**Country**	**USA**
Situation	Latitude	36.1°N	Longitude	115.2°W
Time defined as	Legal Time	Time zone UT-8	Altitude	648 m
	Albedo	0.20		
Meteo data :	Las Vegas Mccarran Intl Ap, NREL TMY3			

Simulation variant :	**Solar Decathlon Las Vegas West Building**			
	Simulation date	06/02/13 07h56		

Simulation parameters

Collector Plane Orientation	Tilt	11°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-mono	Model	**SPR-225-BLK-U**		
		Manufacturer	SunPower		
Number of PV modules		In series	1 modules	In parallel	9 strings
Total number of PV modules		Nb. modules	9	Unit Nom. Power	225 Wp
Array global power		Nominal (STC)	**2025 Wp**	At operating cond.	1828 Wp (50°C)
Array operating characteristics (50°C)		U mpp	37 V	I mpp	50 A
Total area		Module area	**11.2 m²**	Cell area	9.6 m²

Inverter		Model	**MICRO-0.25-I-OUTD-US 240V**		
		Manufacturer	Power-One Inc.		
Characteristics		Operating Voltage	20-50 V	Unit Nom. Power	0.250 kW AC
Inverter pack		Number of Inverter	9 units	Total Power	2.250 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)			NOCT	45 °C
Wiring Ohmic Loss	Global array res.	12 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	0.1 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

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Solar Decathlon Las Vegas
West Building

Grid-Connected System: Main results

Project : **Solar Decathlon Las Vegas**

Simulation variant : **Solar Decathlon Las Vegas West Building**

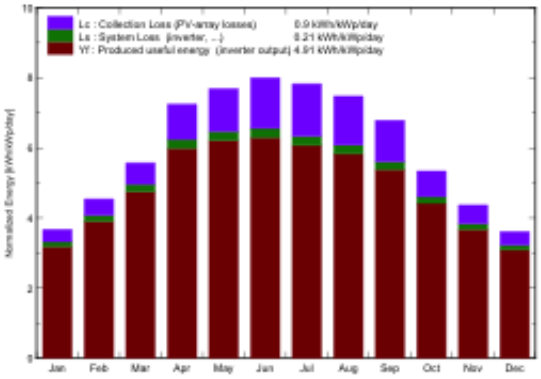
Main system parameters				
System type	**Grid-Connected**			
PV Field Orientation	tilt	11°	azimuth	0°
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp
PV Array	Nb. of modules	9	Pnom total	**2025 Wp**
Inverter	Model	MICRO-0.25-I-OUTD-US-240V	Pnom	250 W ac
Inverter pack	Nb. of units	9.0	Pnom total	**2250 W ac**
User's needs	Unlimited load (grid)			

Main simulation results

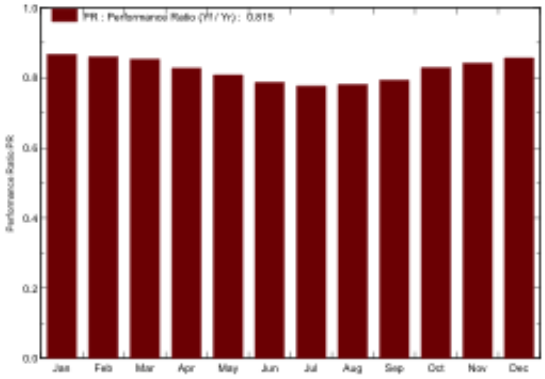
System Production

Produced Energy	**3626 kWh/year**	Specific prod.	1791 kWh/kWp/year
Performance Ratio PR	81.5 %		

Normalized productions (per installed kWp): Nominal power 2025 Wp



Performance Ratio PR



Solar Decathlon Las Vegas West Building
Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	%	%
January	93.4	7.75	113.9	108.9	208.8	199.9	10.37	15.68
February	106.5	9.31	127.2	122.4	231.2	221.4	10.23	15.55
March	157.7	12.89	172.8	167.8	311.6	298.3	10.11	15.42
April	207.6	19.43	217.3	210.7	379.4	364.1	9.59	14.96
May	236.8	24.79	238.4	231.8	406.4	390.8	9.23	14.61
June	242.7	30.22	240.1	233.4	396.7	382.8	8.83	14.23
July	243.4	33.87	242.6	236.8	397.4	381.4	8.63	14.04
August	224.8	31.54	231.8	225.8	381.5	366.3	8.79	14.12
September	167.2	27.58	200.7	197.2	340.8	327.2	8.85	14.25
October	141.6	19.55	165.5	159.5	269.5	257.7	8.63	14.08
November	106.7	13.84	131.8	126.1	213.3	203.2	8.88	15.21
December	85.6	8.27	112.8	106.7	202.7	194.1	9.17	15.48
Year	2022.3	19.84	2196.1	2123.6	3781.5	3626.0	10.38	14.75

Legends: GlobHor Horizontal global irradiation; EArray Effective energy at the output of the array
T Amb Ambient Temperature; E_Grid Energy injected into grid
GlobInc Global incident in coll. plane; EffArrR Effic. Eout array / rough area
GlobEff Effective Global, corr. for IAM and shadings; EffSysR Effic. Eout system / rough area

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Solar Decathlon Las Vegas
West Building

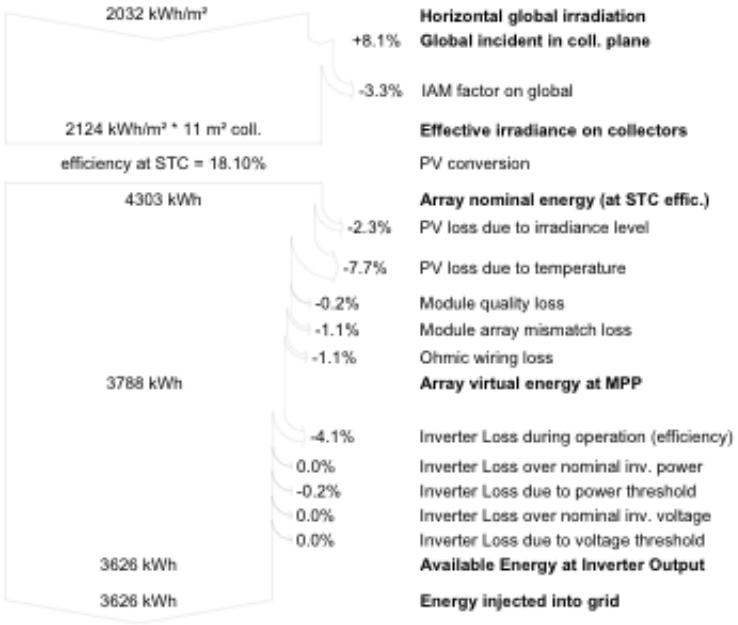
Grid-Connected System: Loss diagram

Project : **Solar Decathlon Las Vegas**

Simulation variant : **Solar Decathlon Las Vegas West Building**

Main system parameters				
	System type	**Grid-Connected**		
PV Field Orientation	tilt	11°	azimuth	0°
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp
PV Array	Nb. of modules	9	Pnom total	**2025 Wp**
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac
Inverter pack	Nb. of units	9.0	Pnom total	**2250 W ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Module B Simulation

Station Identification	
City:	Las_Vegas
State:	Nevada
Latitude:	36.08° N
Longitude:	115.17° W
Elevation:	664 m
PV System Specifications	
DC Rating:	4.7 kW
DC to AC Derate Factor:	0.800
AC Rating:	3.8 kW
Array Type:	Fixed Tilt
Array Tilt:	11.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	9.7 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.85	427	41.42
2	4.84	480	46.56
3	5.92	652	63.24
4	7.31	761	73.82
5	8.05	836	81.09
6	8.31	810	78.57
7	8.14	807	78.28
8	7.51	744	72.17
9	6.79	660	64.02
10	5.45	574	55.68
11	4.32	459	44.52
12	3.62	400	38.80
Year	6.18	7610	738.17

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Solar Decathlon Las Vegas
East Building

Grid-Connected System: Simulation parameters

Project :	**Solar Decathlon Las Vegas**				
Geographical Site	**Las Vegas Mccarran Intl Ap**			**Country**	**USA**
Situation		Latitude	36.1°N	Longitude	115.2°W
Time defined as		Legal Time	Time zone UT-8	Altitude	648 m
		Albedo	0.20		
Meteo data :	Las Vegas Mccarran Intl Ap, NREL TMY3				

Simulation variant :	**Solar Decathlon Las Vegas East Building**		
	Simulation date	06/02/13 07h54	

Simulation parameters

Collector Plane Orientation	Tilt	11°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-mono	Model	**SPR-225-BLK-U**		
		Manufacturer	SunPower		
Number of PV modules		In series	1 modules	In parallel	21 strings
Total number of PV modules		Nb. modules	21	Unit Nom. Power	225 Wp
Array global power		Nominal (STC)	**4725 Wp**	At operating cond.	4266 Wp (50°C)
Array operating characteristics (50°C)		U mpp	37 V	I mpp	117 A
Total area		Module area	**26.1 m²**	Cell area	22.5 m²

Inverter		Model	**MICRO-0.25-I-OUTD-US 240V**		
		Manufacturer	Power-One Inc.		
Characteristics		Operating Voltage	20-50 V	Unit Nom. Power	0.250 kW AC
Inverter pack		Number of Inverter	21 units	Total Power	5.250 kW AC

PV Array loss factors

Thermal Loss factor		Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)				NOCT	45 °C
Wiring Ohmic Loss		Global array res.	12 mOhm	Loss Fraction	3.5 % at STC
Module Quality Loss				Loss Fraction	0.1 %
Module Mismatch Losses				Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization		IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs :	Unlimited load (grid)

PVSYST V5.60	Bombard Electric	06/02/13	Page 2/3

Solar Decathlon Las Vegas
East Building

Grid-Connected System: Main results

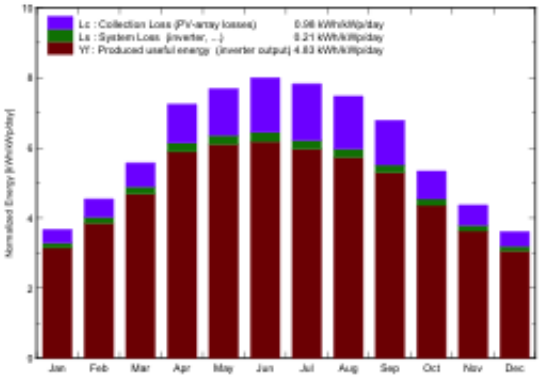
Project : **Solar Decathlon Las Vegas**

Simulation variant : **Solar Decathlon Las Vegas East Building**

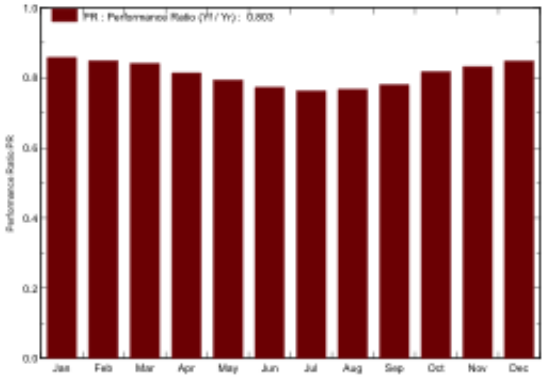
Main system parameters				
System type	**Grid-Connected**			
PV Field Orientation	tilt	11°	azimuth	0°
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp
PV Array	Nb. of modules	21	Pnom total	**4725 Wp**
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac
Inverter pack	Nb. of units	21.0	Pnom total	**5.25 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**8330 kWh/year**	Specific prod.	1763 kWh/kWp/year
	Performance Ratio PR	80.3 %		

Normalized productions (per installed kWp): Nominal power 4725 Wp



Performance Ratio PR



Solar Decathlon Las Vegas East Building
Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	%	%
January	93.4	7.75	113.8	108.8	482.2	461.6	10.28	15.51
February	106.5	9.31	127.2	122.4	552.8	531.1	10.83	15.35
March	157.7	12.89	172.8	167.8	719.8	696.2	10.88	15.28
April	207.6	19.43	217.3	210.7	870.7	845.5	10.33	14.71
May	236.8	24.79	238.4	231.8	931.7	904.8	10.36	14.35
June	242.7	30.22	240.1	233.4	913.3	886.3	10.36	13.97
July	243.4	33.87	242.6	236.8	919.5	874.8	10.37	13.79
August	224.8	31.54	231.8	225.8	874.5	839.8	10.44	13.87
September	167.2	27.58	200.7	197.2	782.6	750.6	10.78	14.11
October	141.6	19.55	165.5	159.5	666.4	639.1	10.42	14.78
November	106.7	13.84	131.8	126.1	536.2	514.8	10.72	15.04
December	85.6	8.27	112.8	106.7	468.3	448.4	10.81	15.33
Year	2020.3	19.84	2196.1	2123.6	8697.4	8338.4	10.14	14.52

Legends: GlobHor Horizontal global irradiation; EArray Effective energy at the output of the array
T Amb Ambient Temperature; E_Grid Energy injected into grid
GlobInc Global incident in coll. plane; EffArrR Effic. Eout array / rough area
GlobEff Effective Global, corr. for IAM and shadings; EffSysR Effic. Eout system / rough area

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Solar Decathlon Las Vegas
East Building

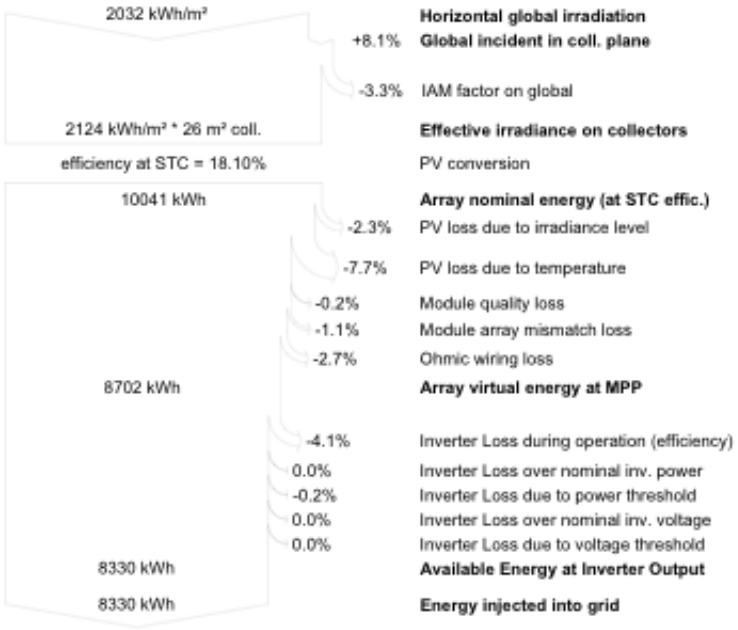
Grid-Connected System: Loss diagram

Project : **Solar Decathlon Las Vegas**

Simulation variant : **Solar Decathlon Las Vegas East Building**

Main system parameters				
	System type	**Grid-Connected**		
PV Field Orientation	tilt	11°	azimuth	0°
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp
PV Array	Nb. of modules	21	Pnom total	**4725 Wp**
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac
Inverter pack	Nb. of units	21.0	Pnom total	**5.25 kW ac**
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



Irvine, California

Output of photovoltaic system was evaluated for the energy production for Irvine, California. A day by day PV generation analysis was performed using typical meteorology data.

Module A Simulation

Station Identification	
City:	Long_Beach
State:	California
Latitude:	33.82° N
Longitude:	118.15° W
Elevation:	17 m
PV System Specifications	
DC Rating:	2.0 kW
DC to AC Derate Factor:	0.800
AC Rating:	1.6 kW
Array Type:	Fixed Tilt
Array Tilt:	11.0°
Array Azimuth:	153.1°
Energy Specifications	
Cost of Electricity:	12.5 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.39	157	19.62
2	4.14	176	22.00
3	4.99	235	29.38
4	6.13	276	34.50
5	6.48	298	37.25
6	6.62	295	36.88
7	7.15	323	40.38
8	6.84	306	38.25
9	5.73	252	31.50
10	4.64	213	26.62
11	3.74	169	21.12
12	3.23	149	18.62
Year	5.26	2849	356.12

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Solar Decathlon Santa Ana
West Building

Grid-Connected System: Simulation parameters

Project :	**Solar Decathlon Santa Ana**			
Geographical Site	**Santa Ana John Wayne Ap**		**Country**	**USA**
Situation	Latitude	33.7°N	Longitude	117.9°W
Time defined as	Legal Time	Time zone UT-8	Altitude	16 m
	Albedo	0.20		
Meteo data :	Santa Ana John Wayne Ap, NREL TMY3			

Simulation variant :	**Solar Decathlon Santa Ana West Building**			
	Simulation date	06/02/13 07h43		

Simulation parameters

Collector Plane Orientation	Tilt	11°	Azimuth	-26°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-mono	Model	**SPR-225-BLK-U**		
		Manufacturer	SunPower		
Number of PV modules		In series	1 modules	In parallel	9 strings
Total number of PV modules		Nb. modules	9	Unit Nom. Power	225 Wp
Array global power		Nominal (STC)	**2025 Wp**	At operating cond.	1828 Wp (50°C)
Array operating characteristics (50°C)		U mpp	37 V	I mpp	50 A
Total area		Module area	**11.2 m²**	Cell area	9.6 m²

Inverter		Model	**MICRO-0.25-I-OUTD-US 240V**		
		Manufacturer	Power-One Inc.		
Characteristics		Operating Voltage	20-50 V	Unit Nom. Power	0.250 kW AC
Inverter pack		Number of Inverter	9 units	Total Power	2.250 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)			NOCT	45 °C
Wiring Ohmic Loss	Global array res.	12 mOhm	Loss Fraction	1.5 % at STC
Array Soiling Losses			Loss Fraction	0.1 %
Module Quality Loss			Loss Fraction	0.1 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

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Solar Decathlon Santa Ana
West Building

Grid-Connected System: Main results

Project : **Solar Decathlon Santa Ana**

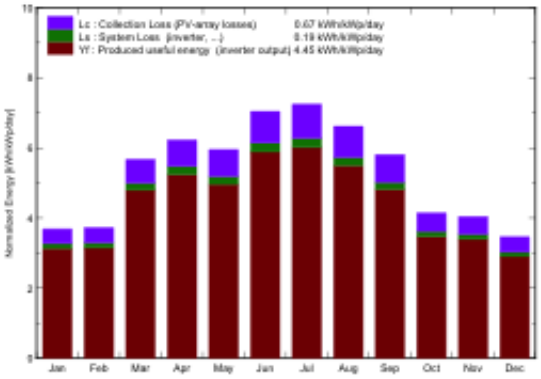
Simulation variant : **Solar Decathlon Santa Ana West Building**

Main system parameters	System type	**Grid-Connected**			
PV Field Orientation	tilt	11°	azimuth	-26°	
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp	
PV Array	Nb. of modules	9	Pnom total	**2025 Wp**	
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac	
Inverter pack	Nb. of units	9.0	Pnom total	**2250 W ac**	
User's needs	Unlimited load (grid)				

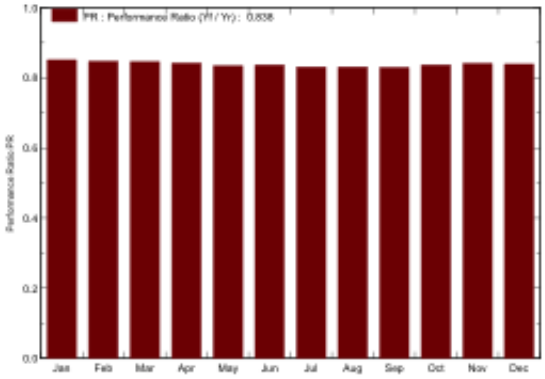
Main simulation results

System Production	**Produced Energy**	**3286 kWh/year**	Specific prod.	1623 kWh/kWp/year
	Performance Ratio PR	83.8 %		

Normalized productions (per installed kWp): Nominal power 2025 Wp



Performance Ratio PR



Solar Decathlon Santa Ana West Building
Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	%	%
January	99.4	13.28	114.3	109.5	305.6	286.9	16.87	15.39
February	93.8	15.89	104.2	100.3	287.1	278.8	16.83	15.32
March	160.5	16.28	175.8	170.3	313.7	301.1	15.94	15.29
April	152.2	16.88	166.8	161.4	332.5	318.4	15.98	15.22
May	165.9	19.88	184.5	179.8	325.6	311.7	15.76	15.09
June	216.7	19.11	211.2	206.4	373.1	357.8	15.77	15.13
July	225.9	20.56	224.6	218.5	369.8	377.8	15.66	15.03
August	202.5	20.82	205.1	199.4	359.5	345.1	15.65	15.03
September	155.5	20.62	174.2	169.6	304.6	292.6	15.63	15.00
October	116.9	19.85	128.5	124.8	227.5	217.6	15.82	15.13
November	103.8	15.82	121.3	116.3	215.1	206.4	15.84	15.20
December	89.1	14.85	107.3	102.5	199.4	192.3	15.85	15.17
Year	1848.3	17.21	1937.8	1875.5	3438.9	3306.5	15.88	15.15

Legends: GlobHor Horizontal global irradiation
T Amb Ambient Temperature
GlobInc Global incident in coll. plane
GlobEff Effective Global, corr. for IAM and shadings
EArray Effective energy at the output of the array
E_Grid Energy injected into grid
EffArrR Effic. Eout array / rough area
EffSysR Effic. Eout system / rough area

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Solar Decathlon Santa Ana
West Building

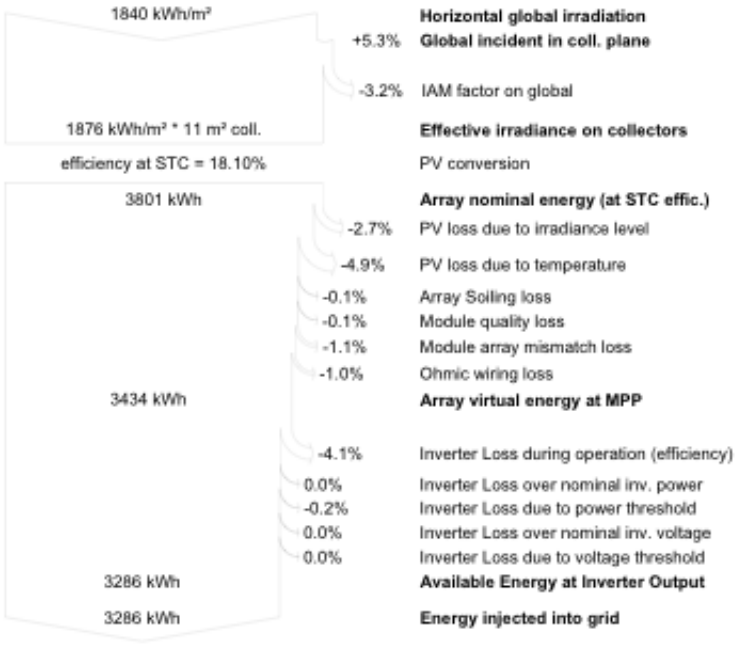
Grid-Connected System: Loss diagram

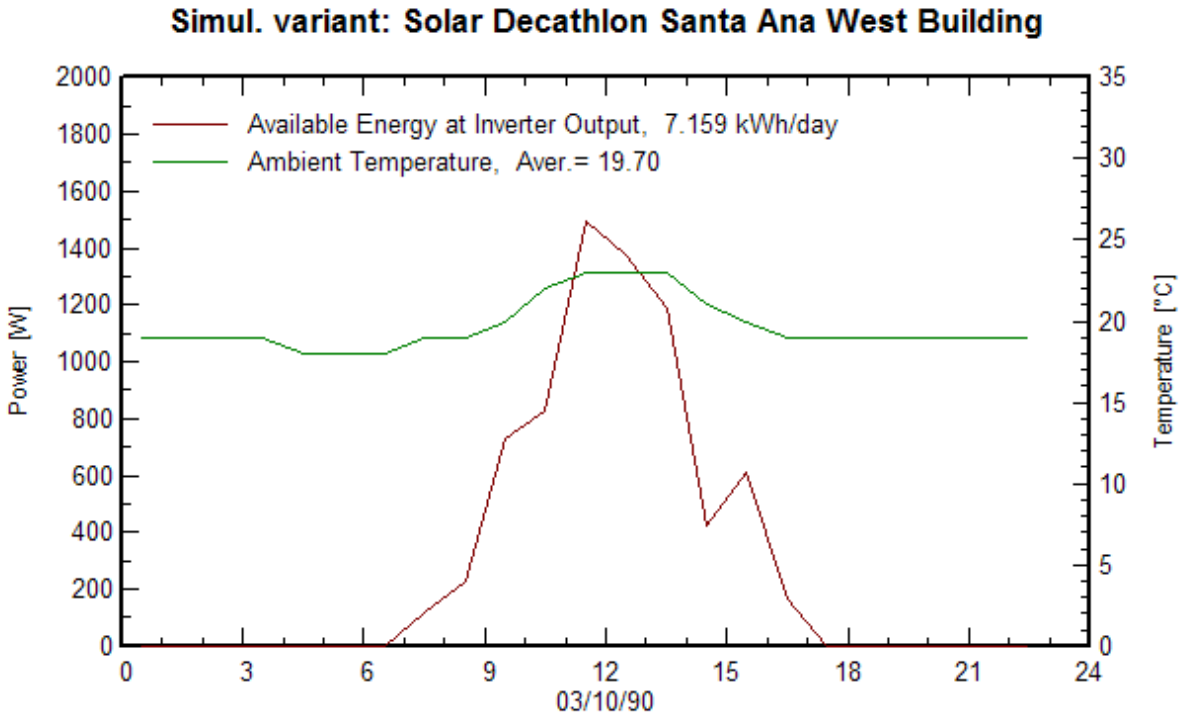
Project : **Solar Decathlon Santa Ana**

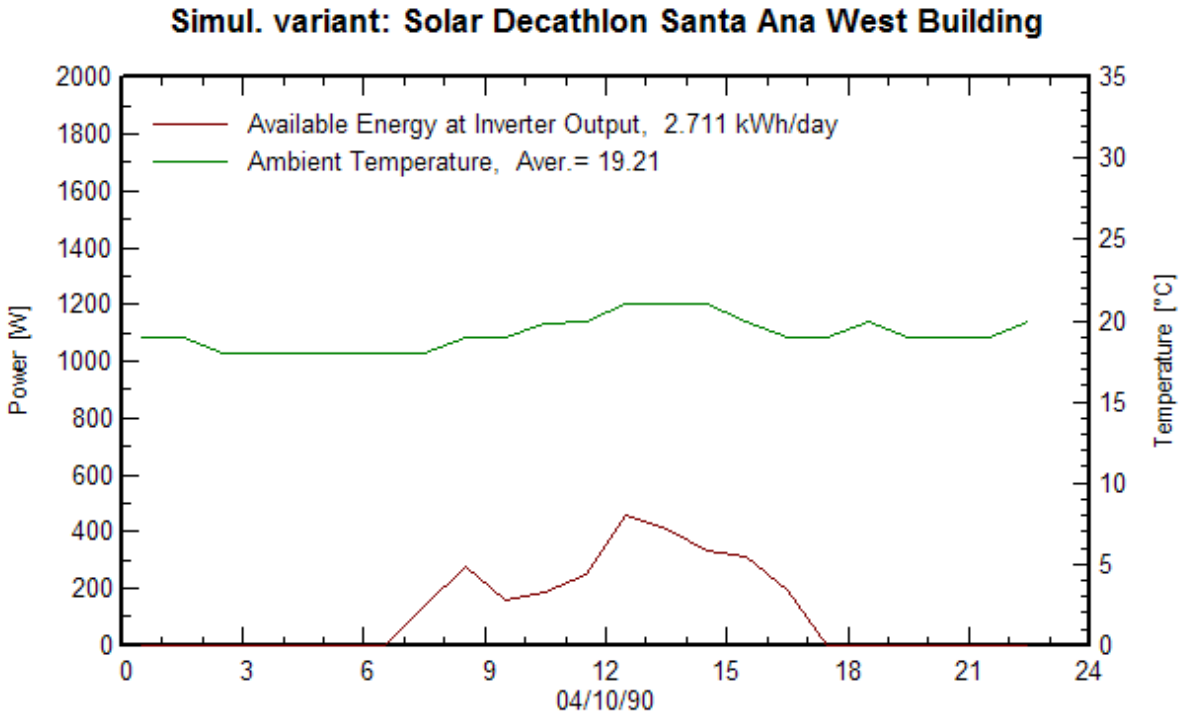
Simulation variant : **Solar Decathlon Santa Ana West Building**

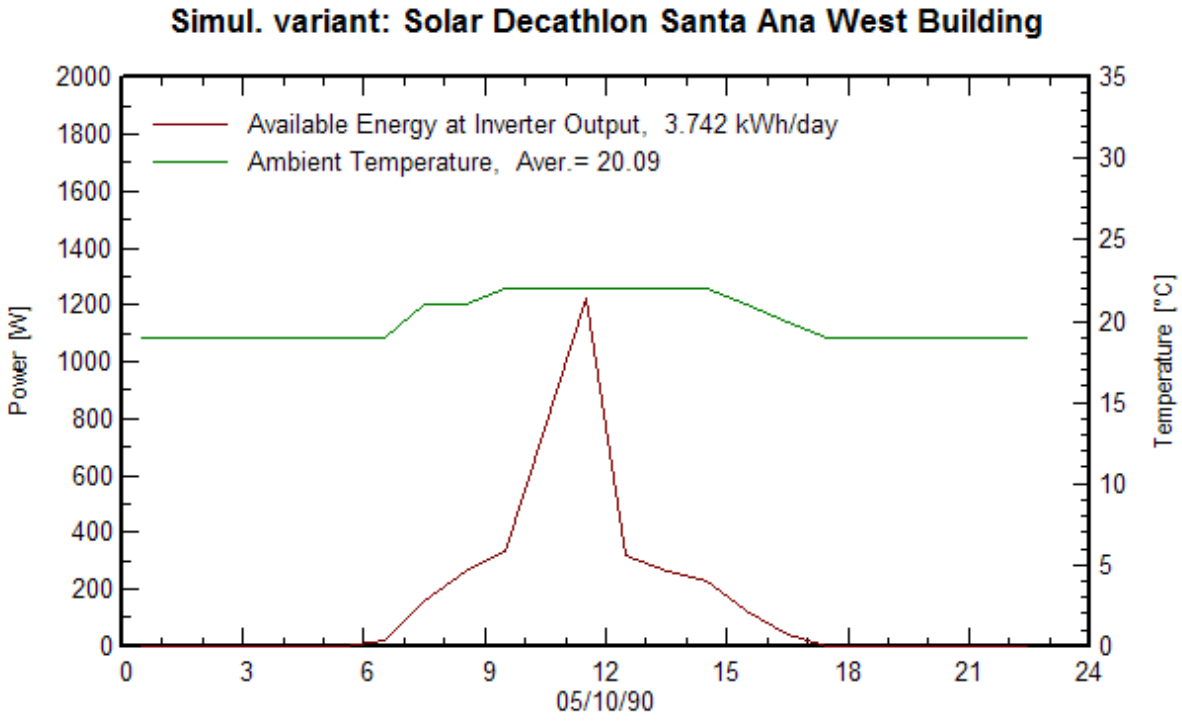
Main system parameters	System type	**Grid-Connected**			
PV Field Orientation	tilt	11°	azimuth	-26°	
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp	
PV Array	Nb. of modules	9	Pnom total	**2025 Wp**	
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac	
Inverter pack	Nb. of units	9.0	Pnom total	**2250 W ac**	
User's needs	Unlimited load (grid)				

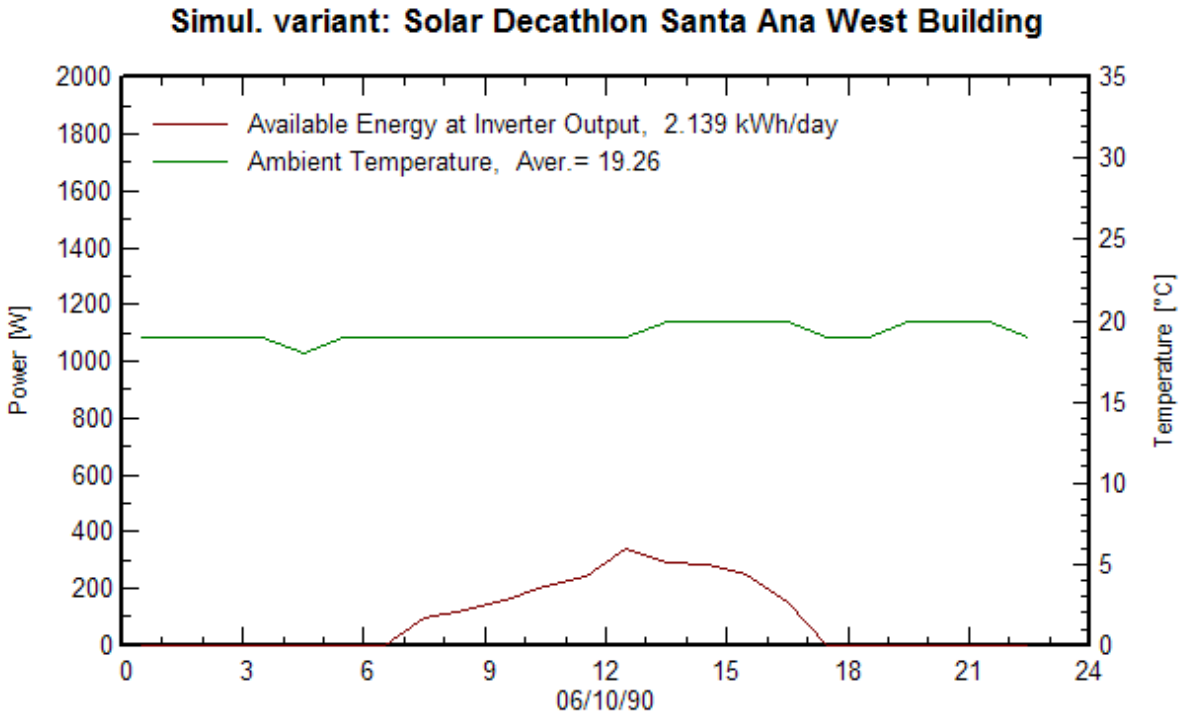
Loss diagram over the whole year

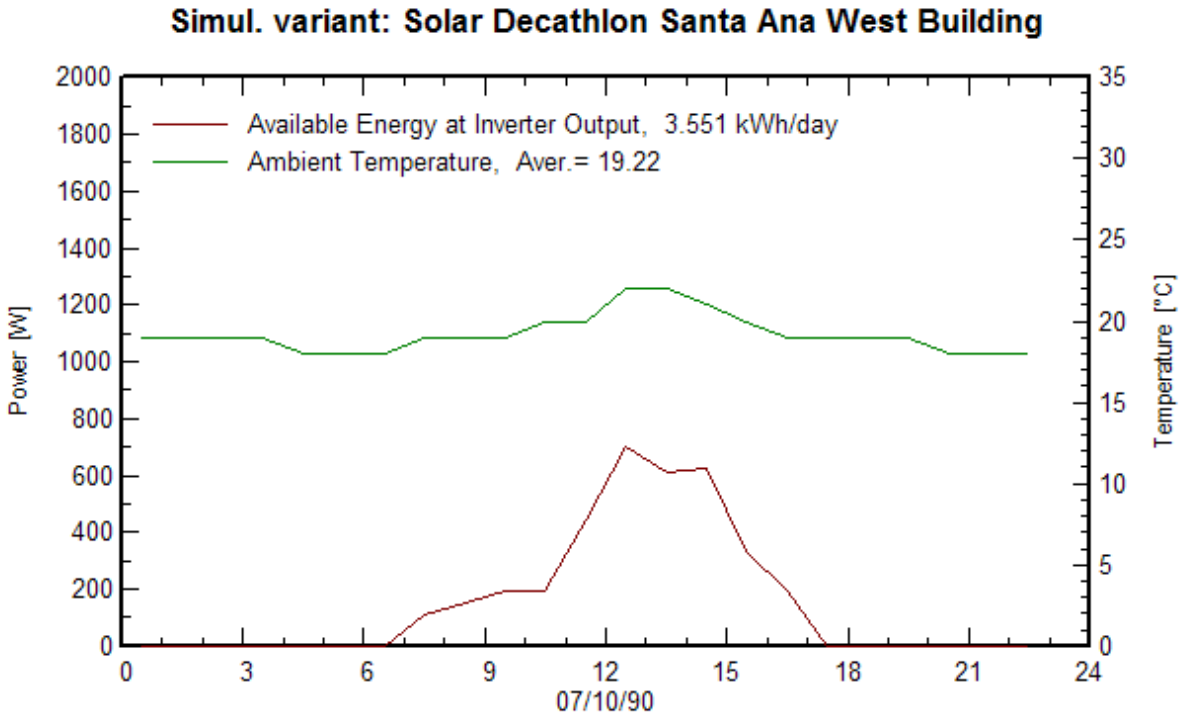


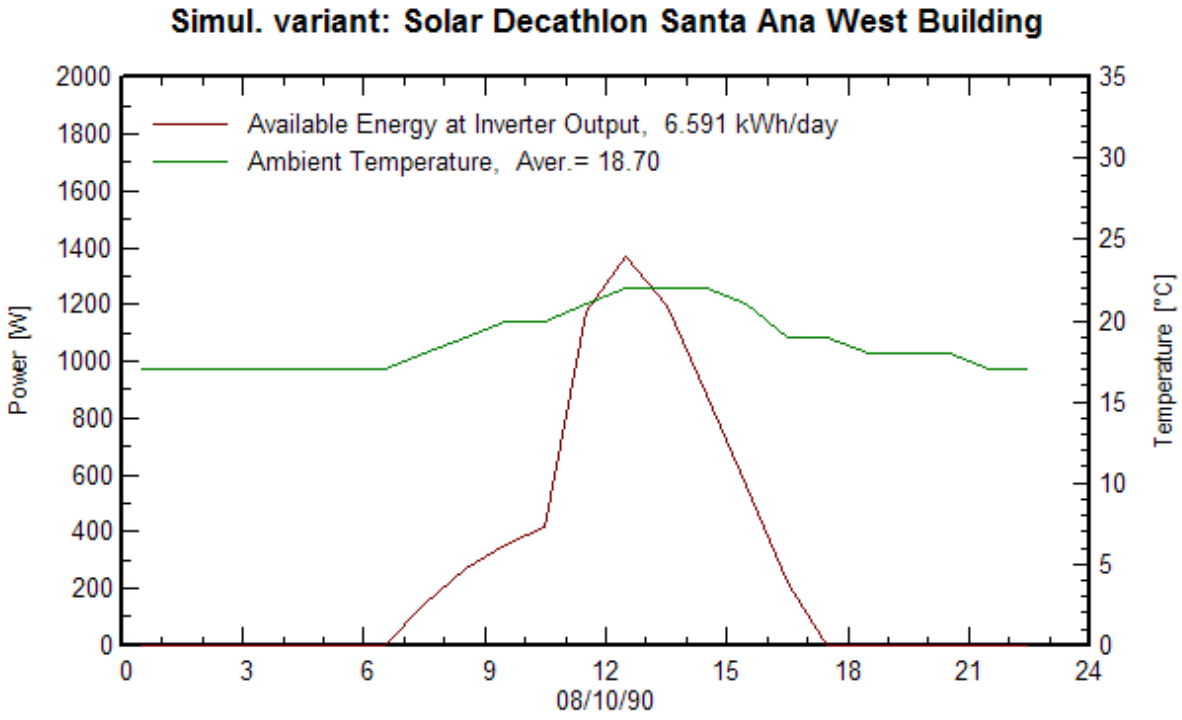

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 7.159 kWh/day
Ambient Temperature, Aver.= 19.70
Power [W]
Temperature [°C]
03/10/90

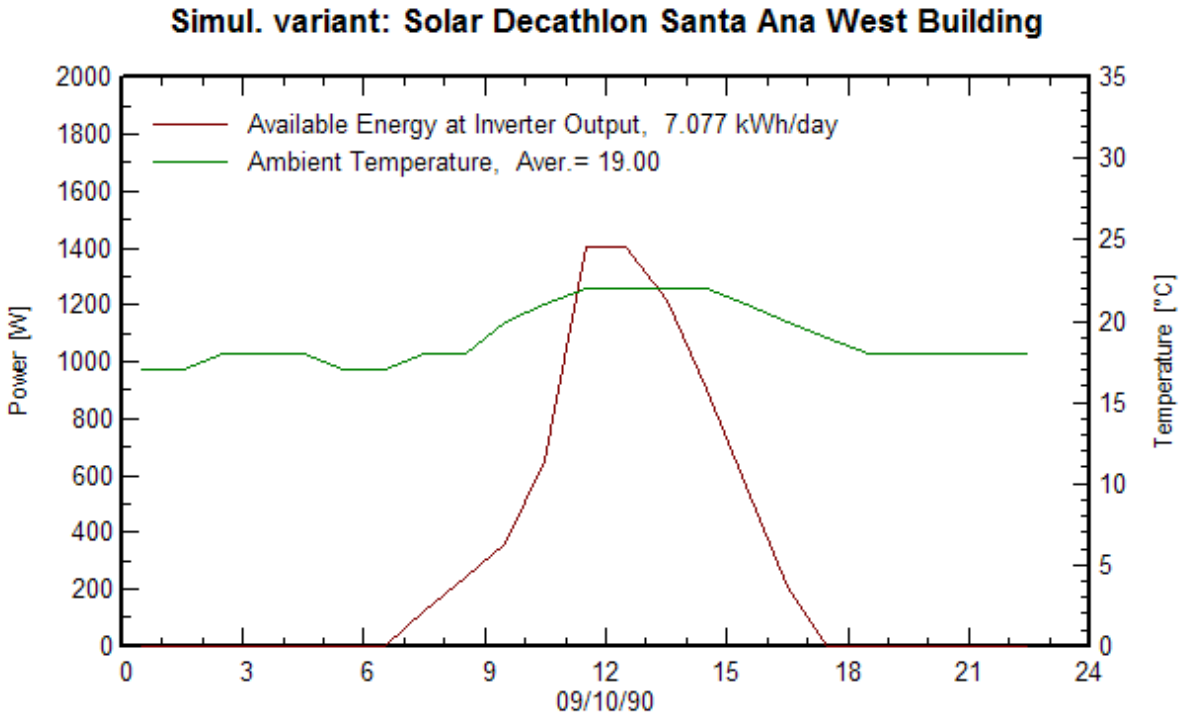

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 2.711 kWh/day
Ambient Temperature, Aver.= 19.21
Power [W]
Temperature [°C]
04/10/90

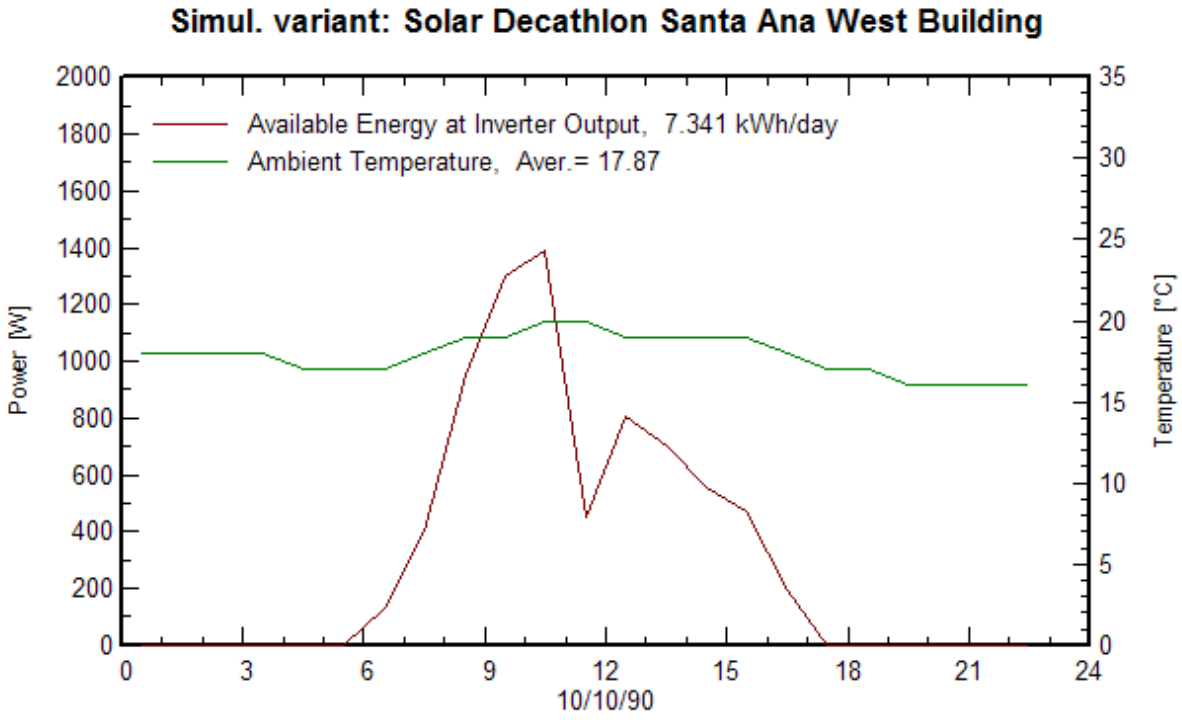

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 3.742 kWh/day
Ambient Temperature, Aver.= 20.09
Power [W]
Temperature [°C]
05/10/90

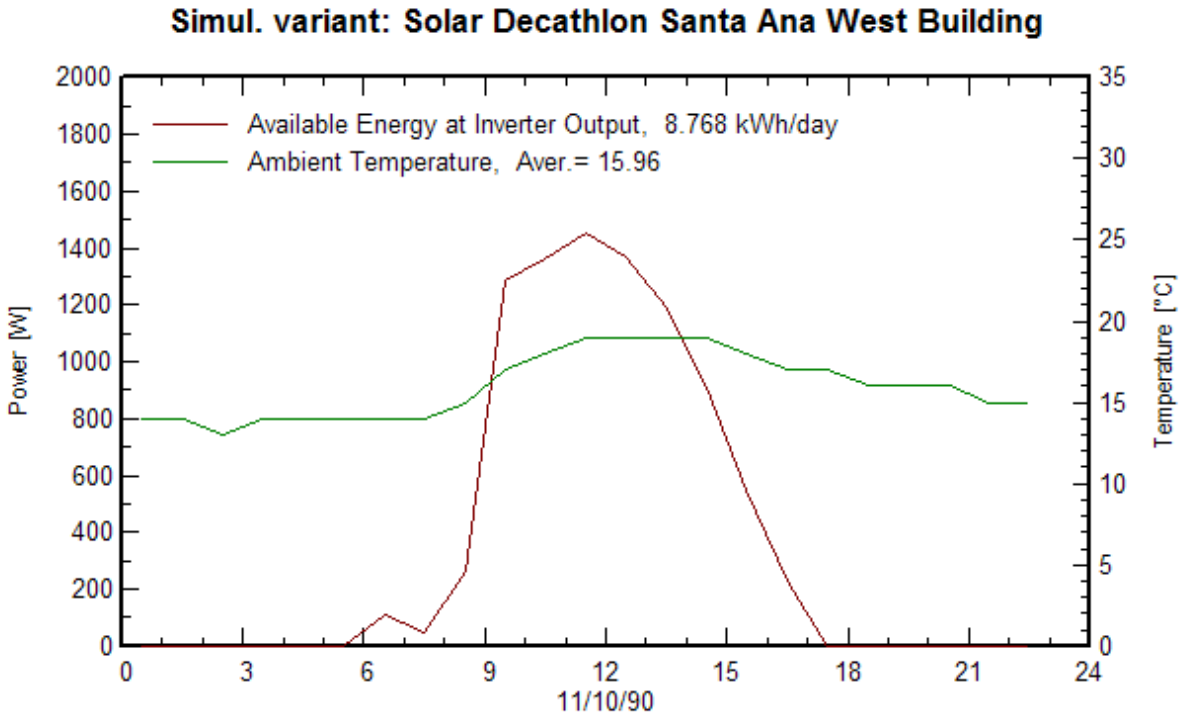

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 2.139 kWh/day
Ambient Temperature, Aver.= 19.26
Power [W]
Temperature [°C]
06/10/90

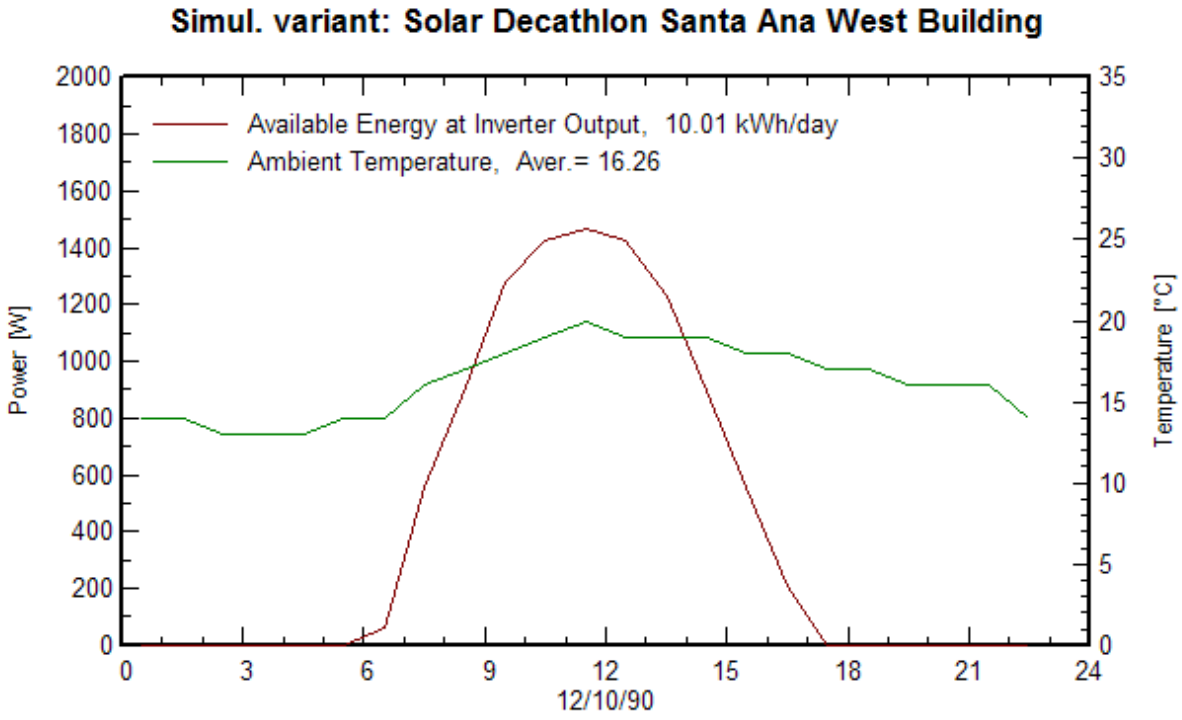

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 3.551 kWh/day
Ambient Temperature, Aver.= 19.22
Power [W]
Temperature [°C]
07/10/90

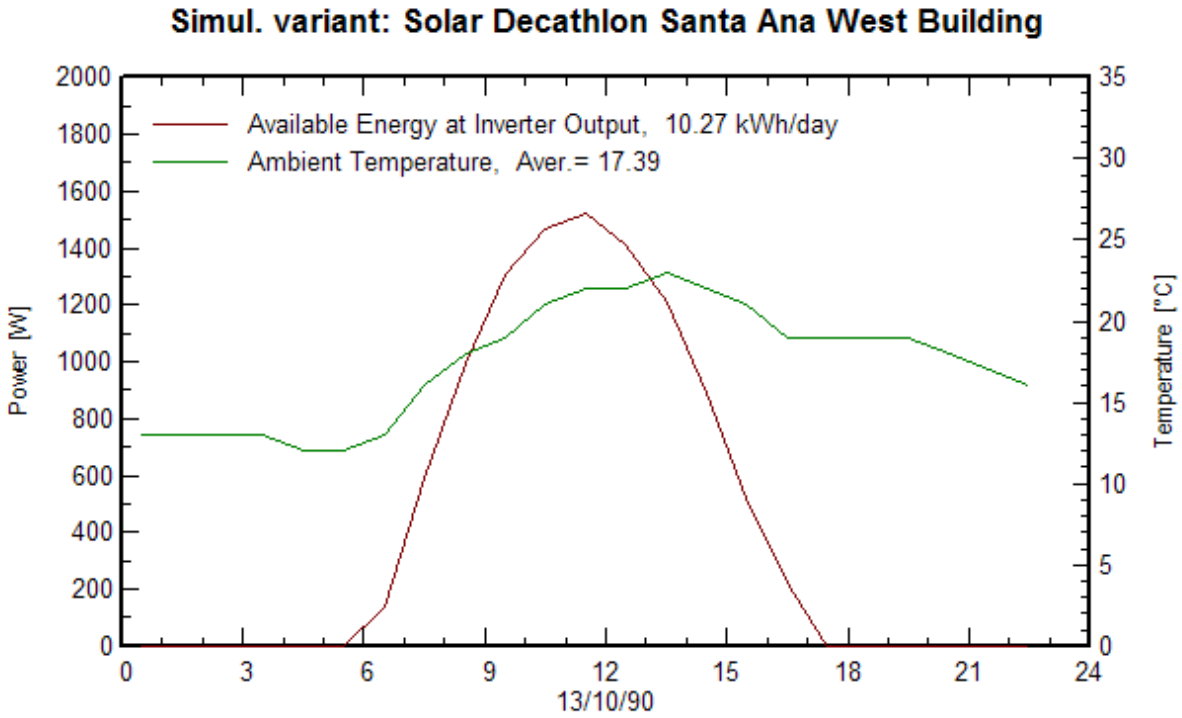

Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 6.591 kWh/day
Ambient Temperature, Aver.= 18.70
Power [W]
Temperature [°C]
08/10/90


Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 7.077 kWh/day
Ambient Temperature, Aver.= 19.00
Power [W]
Temperature [°C]
09/10/90


Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 7.341 kWh/day
Ambient Temperature, Aver.= 17.87
Power [W]
Temperature [°C]
10/10/90


Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 8.768 kWh/day
Ambient Temperature, Aver.= 15.96
Power [W]
Temperature [°C]
11/10/90


Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 10.01 kWh/day
Ambient Temperature, Aver.= 16.26
Power [W]
Temperature [°C]
12/10/90


Simul. variant: Solar Decathlon Santa Ana West Building
Available Energy at Inverter Output, 10.27 kWh/day
Ambient Temperature, Aver.= 17.39
Power [W]
Temperature [°C]
2000
1800
1600
1400
1200
1000
800
600
400
200
0
35
30
25
20
15
10
5
0
0
3
6
9
12
15
18
21
24
13/10/90

Module B Simulation

Station Identification	
City:	Long_Beach
State:	California
Latitude:	33.82° N
Longitude:	118.15° W
Elevation:	17 m
PV System Specifications	
DC Rating:	4.7 kW
DC to AC Derate Factor:	0.800
AC Rating:	3.8 kW
Array Type:	Fixed Tilt
Array Tilt:	11.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	12.5 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.47	376	47.00
2	4.24	422	52.75
3	5.09	558	69.75
4	6.23	653	81.62
5	6.57	707	88.38
6	6.71	701	87.62
7	7.21	764	95.50
8	6.95	729	91.12
9	5.87	601	75.12
10	4.74	509	63.62
11	3.84	404	50.50
12	3.31	355	44.38
Year	5.36	6780	847.50

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Solar Decathlon Santa Ana
East Building

Grid-Connected System: Simulation parameters

Project :	**Solar Decathlon Santa Ana**				
Geographical Site	**Santa Ana John Wayne Ap**			**Country**	**USA**
Situation		Latitude	33.7°N	Longitude	117.9°W
Time defined as		Legal Time	Time zone UT-8	Altitude	16 m
		Albedo	0.20		
Meteo data :	Santa Ana John Wayne Ap, NREL TMY3				

Simulation variant :	**Solar Decathlon Santa Ana East Building**		
	Simulation date	06/02/13 07h48	

Simulation parameters

Collector Plane Orientation	Tilt	11°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-mono	Model	**SPR-225-BLK-U**		
		Manufacturer	SunPower		
Number of PV modules		In series	1 modules	In parallel	21 strings
Total number of PV modules		Nb. modules	21	Unit Nom. Power	225 Wp
Array global power		Nominal (STC)	**4725 Wp**	At operating cond.	4266 Wp (50°C)
Array operating characteristics (50°C)		U mpp	37 V	I mpp	117 A
Total area		Module area	**26.1 m²**	Cell area	22.5 m²

Inverter		Model	**MICRO-0.25-I-OUTD-US 240V**		
		Manufacturer	Power-One Inc.		
Characteristics		Operating Voltage	20-50 V	Unit Nom. Power	0.250 kW AC
Inverter pack		Number of Inverter	21 units	Total Power	5.250 kW AC

PV Array loss factors

Thermal Loss factor		Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)				NOCT	45 °C
Wiring Ohmic Loss		Global array res.	12 mOhm	Loss Fraction	3.5 % at STC
Module Quality Loss				Loss Fraction	0.1 %
Module Mismatch Losses				Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization		IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs :	Unlimited load (grid)

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Solar Decathlon Santa Ana
East Building

Grid-Connected System: Main results

Project : **Solar Decathlon Santa Ana**

Simulation variant : **Solar Decathlon Santa Ana East Building**

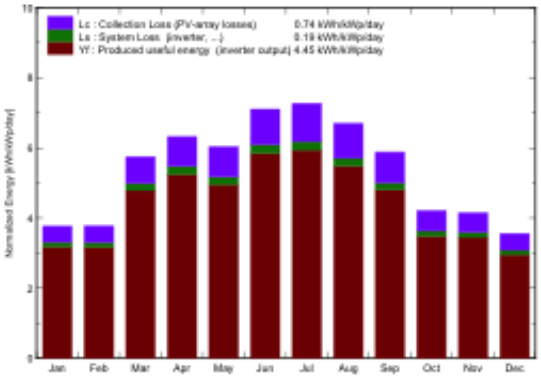
Main system parameters	System type	**Grid-Connected**			
PV Field Orientation	tilt	11°	azimuth	0°	
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp	
PV Array	Nb. of modules	21	Pnom total	**4725 Wp**	
Inverter	Model	MICRO-0.25-I-OUTD-US-240V	Pnom	250 W ac	
Inverter pack	Nb. of units	21.0	Pnom total	**5.25 kW ac**	
User's needs	Unlimited load (grid)				

Main simulation results

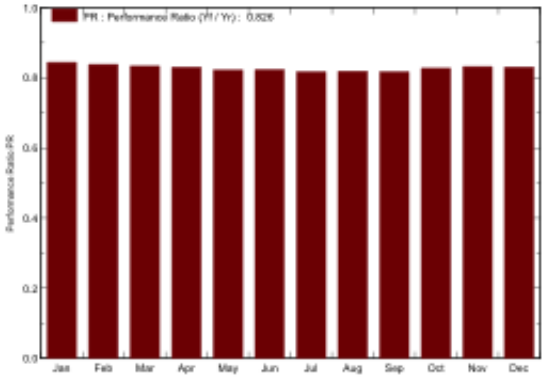
System Production

Produced Energy	**7670 kWh/year**	Specific prod.	1623 kWh/kWp/year
Performance Ratio PR	82.6 %		

Normalized productions (per installed kWp): Nominal power 4725 Wp



Performance Ratio PR



Solar Decathlon Santa Ana East Building
Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	%	%
January	99.4	13.28	119.7	112.1	466.8	465.3	15.83	15.26
February	93.8	15.89	105.7	101.7	437.8	418.4	15.85	15.15
March	160.5	16.28	178.2	172.7	731.2	701.5	15.71	15.07
April	152.2	15.88	169.6	164.4	775.1	743.8	15.88	15.21
May	165.9	19.88	187.8	181.6	758.5	726.4	15.52	14.87
June	216.7	19.11	213.1	207.2	866.2	828.8	15.62	14.89
July	225.9	20.56	225.4	219.3	905.8	870.8	15.38	14.78
August	202.5	20.82	207.6	201.8	836.5	803.2	15.42	14.81
September	165.5	20.62	175.4	171.2	709.8	680.8	15.48	14.78
October	116.9	18.85	130.5	126.1	532.8	510.8	15.63	14.96
November	103.8	15.62	126.4	119.6	508.8	488.8	15.68	15.04
December	89.1	14.85	119.3	105.5	452.3	432.7	15.76	15.02
Year	1846.3	17.21	1964.9	1903.4	8031.0	7678.0	15.59	14.94

Legends: GlobHor Horizontal global irradiation; EArray Effective energy at the output of the array
T Amb Ambient Temperature; E_Grid Energy injected into grid
GlobInc Global incident in coll. plane; EffArrR Effic. Eout array / rough area
GlobEff Effective Global, corr. for IAM and shadings; EffSysR Effic. Eout system / rough area

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Solar Decathlon Santa Ana
East Building

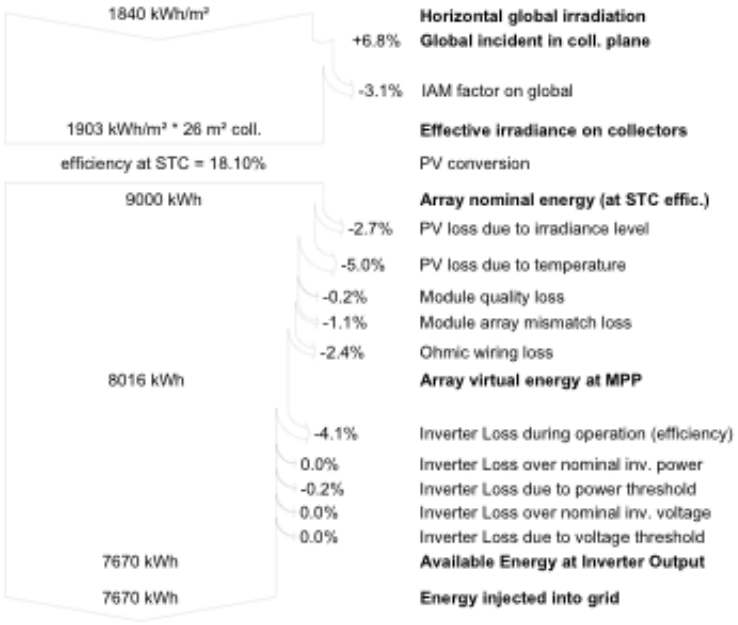
Grid-Connected System: Loss diagram

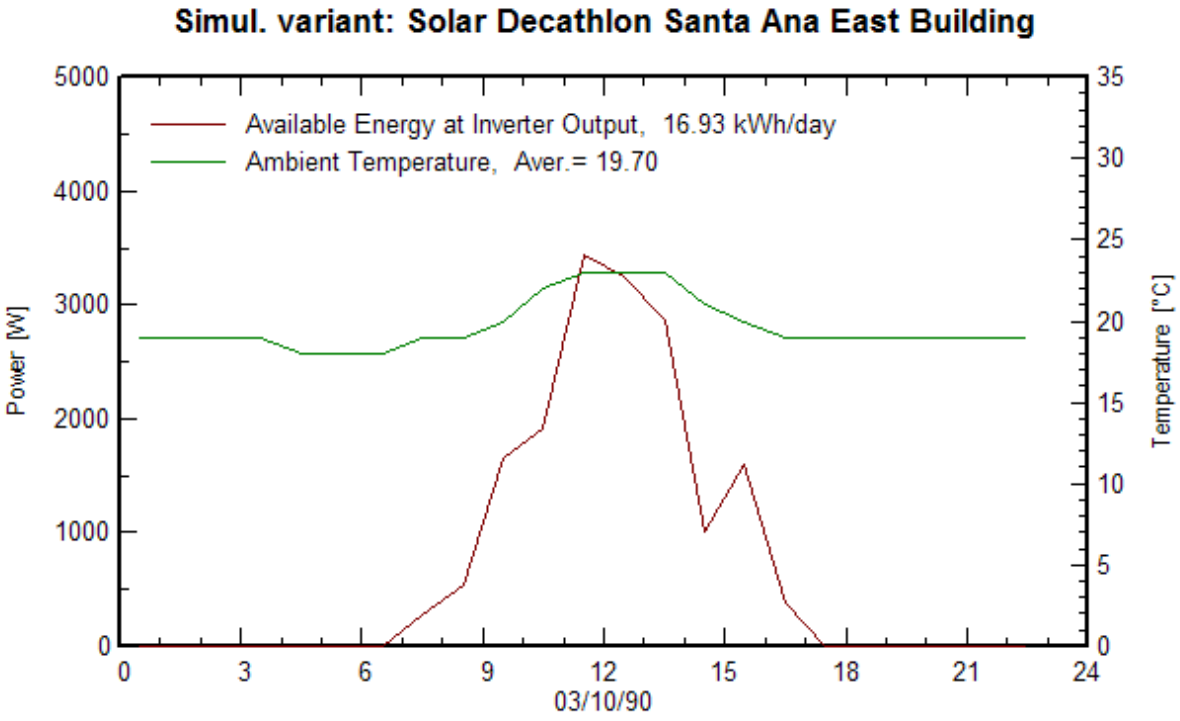
Project : **Solar Decathlon Santa Ana**

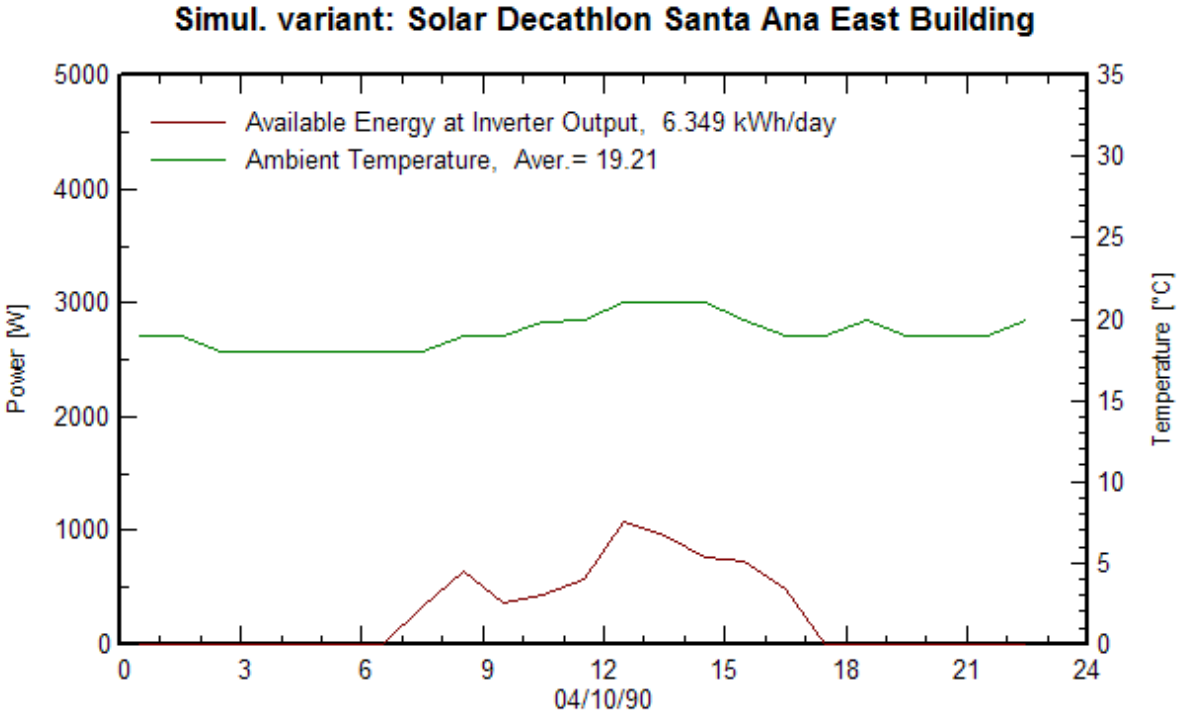
Simulation variant : **Solar Decathlon Santa Ana East Building**

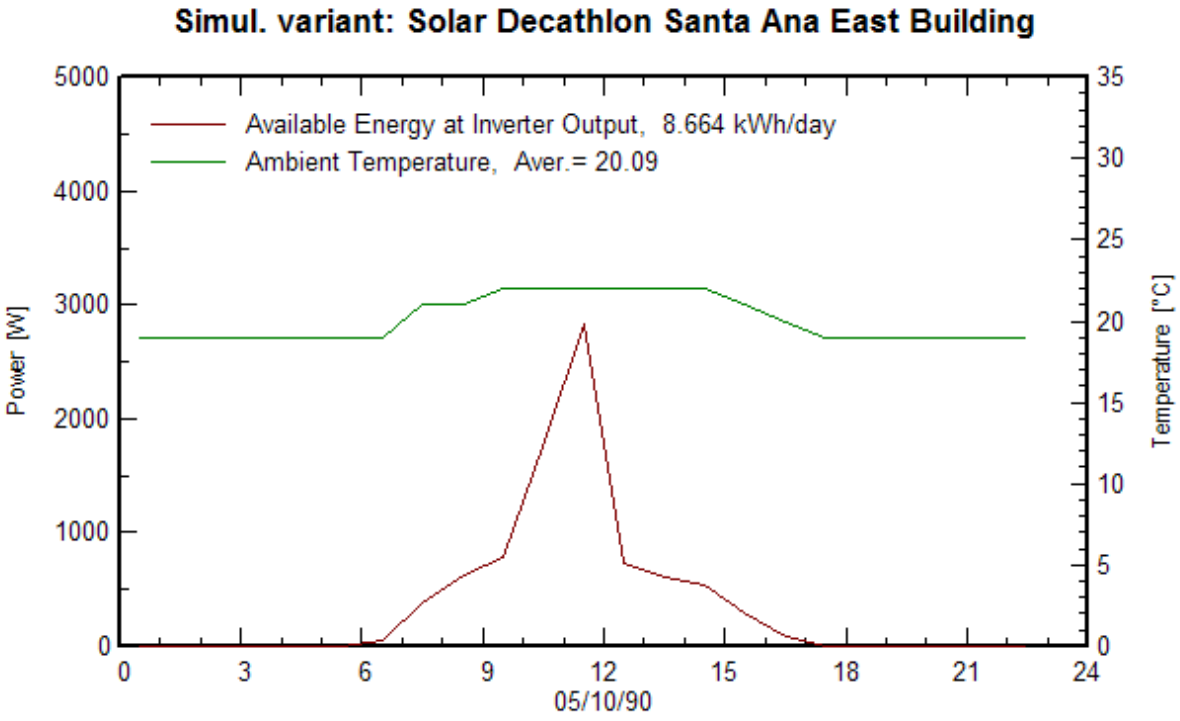
Main system parameters				
	System type	**Grid-Connected**		
PV Field Orientation	tilt	11°	azimuth	0°
PV modules	Model	SPR-225-BLK-U	Pnom	225 Wp
PV Array	Nb. of modules	21	Pnom total	**4725 Wp**
Inverter	Model	MICRO-0.25-I-OUTD-US-240-V	Pnom	250 W ac
Inverter pack	Nb. of units	21.0	Pnom total	**5.25 kW ac**
User's needs	Unlimited load (grid)			

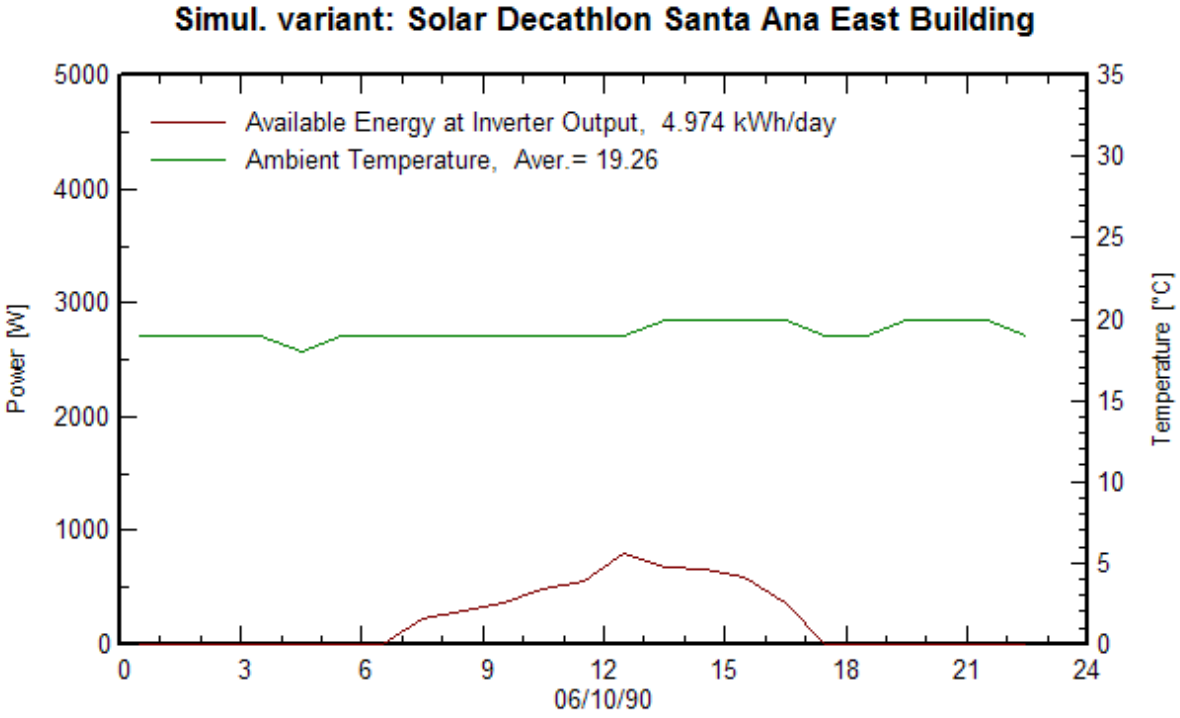
Loss diagram over the whole year

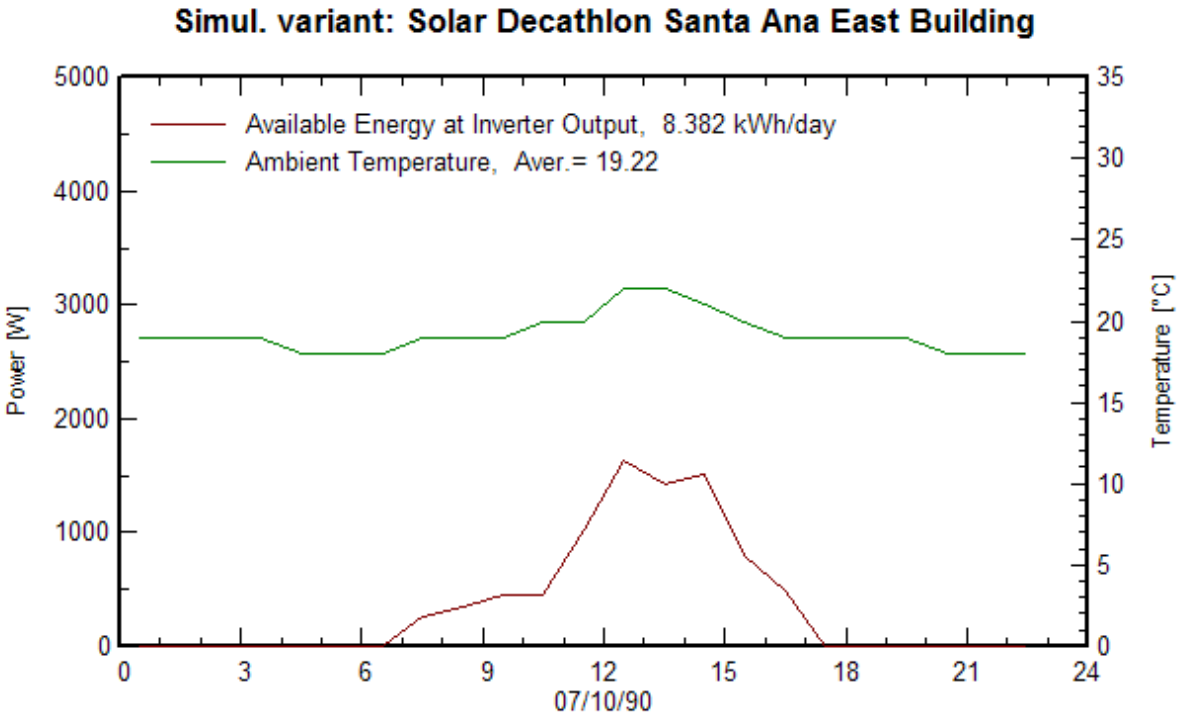


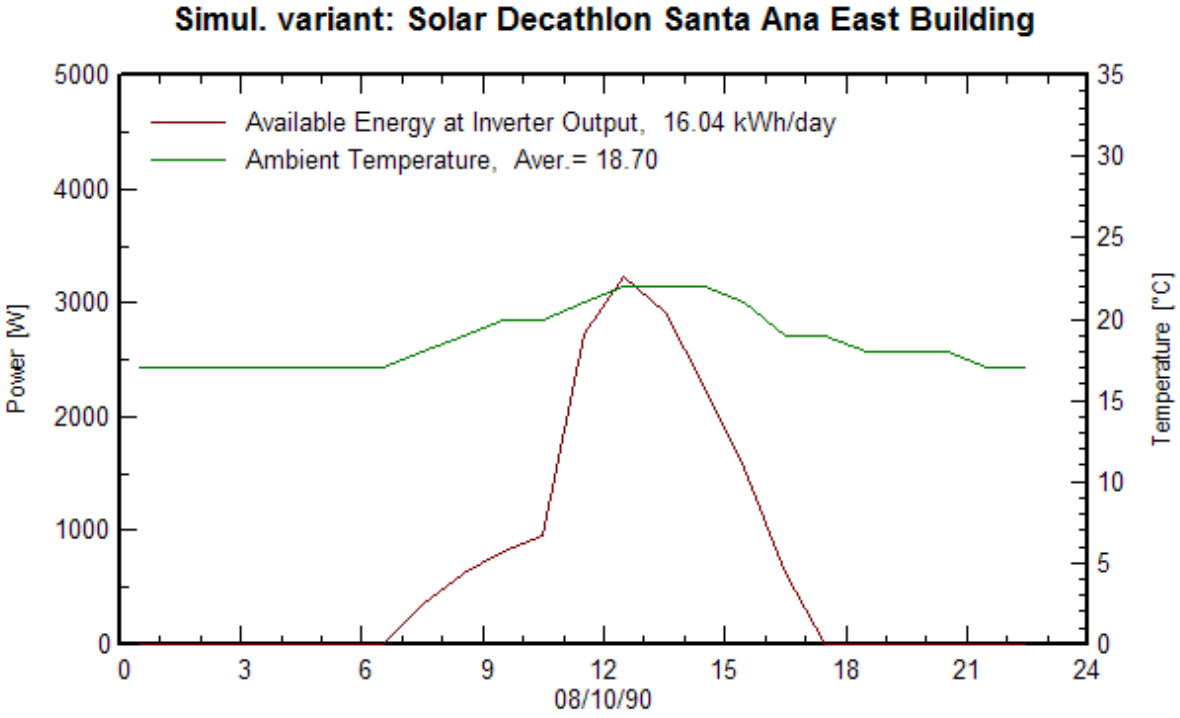

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 16.93 kWh/day
Ambient Temperature, Aver.= 19.70
Power [W]
Temperature [°C]
03/10/90

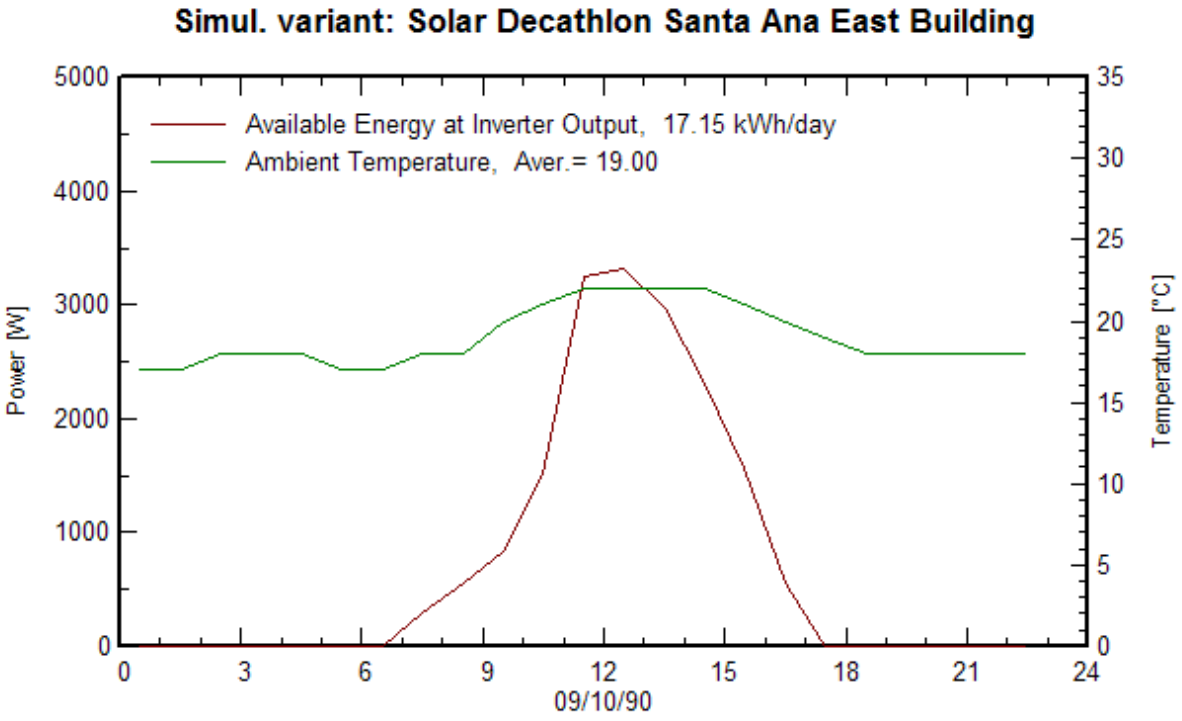

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 6.349 kWh/day
Ambient Temperature, Aver.= 19.21
Power [W]
Temperature [°C]
04/10/90

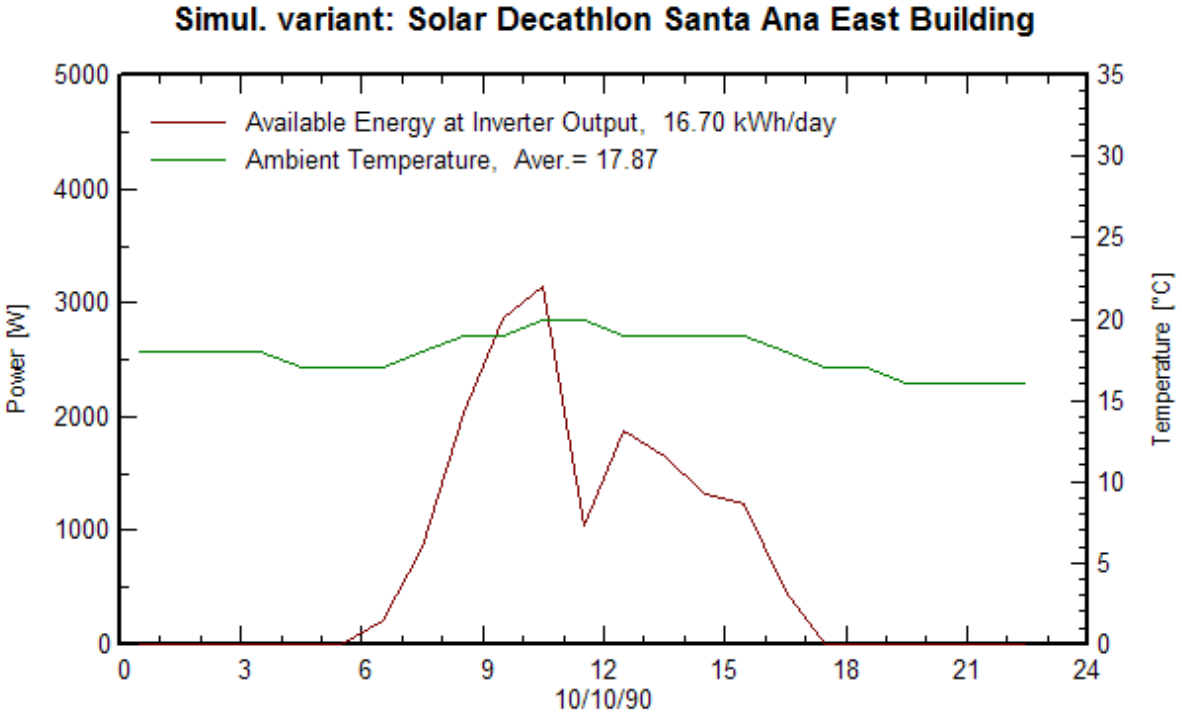

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 8.664 kWh/day
Ambient Temperature, Aver.= 20.09
Power [W]
Temperature [°C]
05/10/90

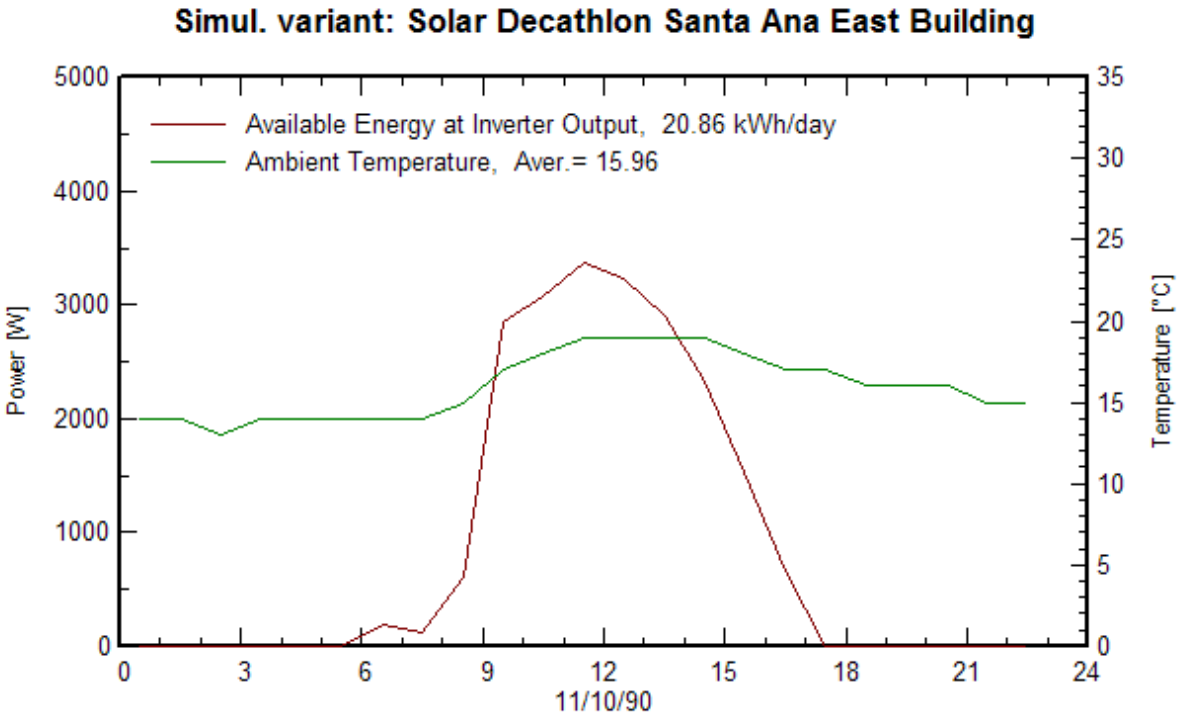

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 4.974 kWh/day
Ambient Temperature, Aver.= 19.26
Power [W]
Temperature [°C]
06/10/90

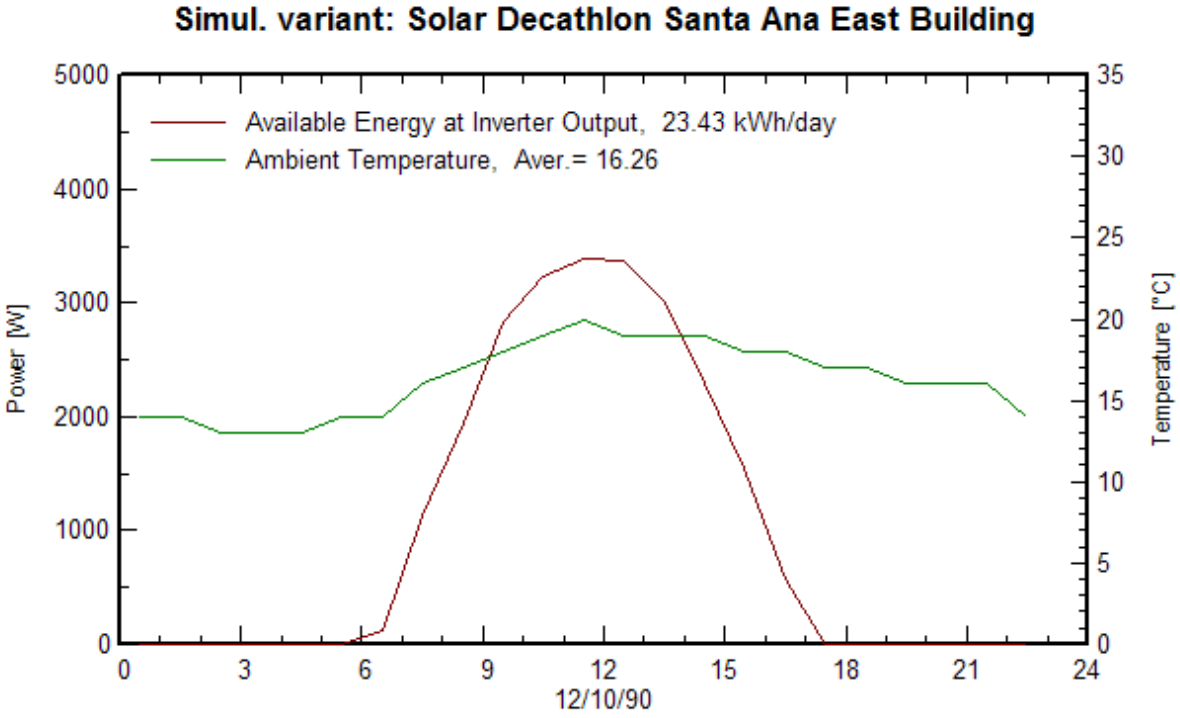

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 8.382 kWh/day
Ambient Temperature, Aver.= 19.22
Power [W]
Temperature [°C]
07/10/90

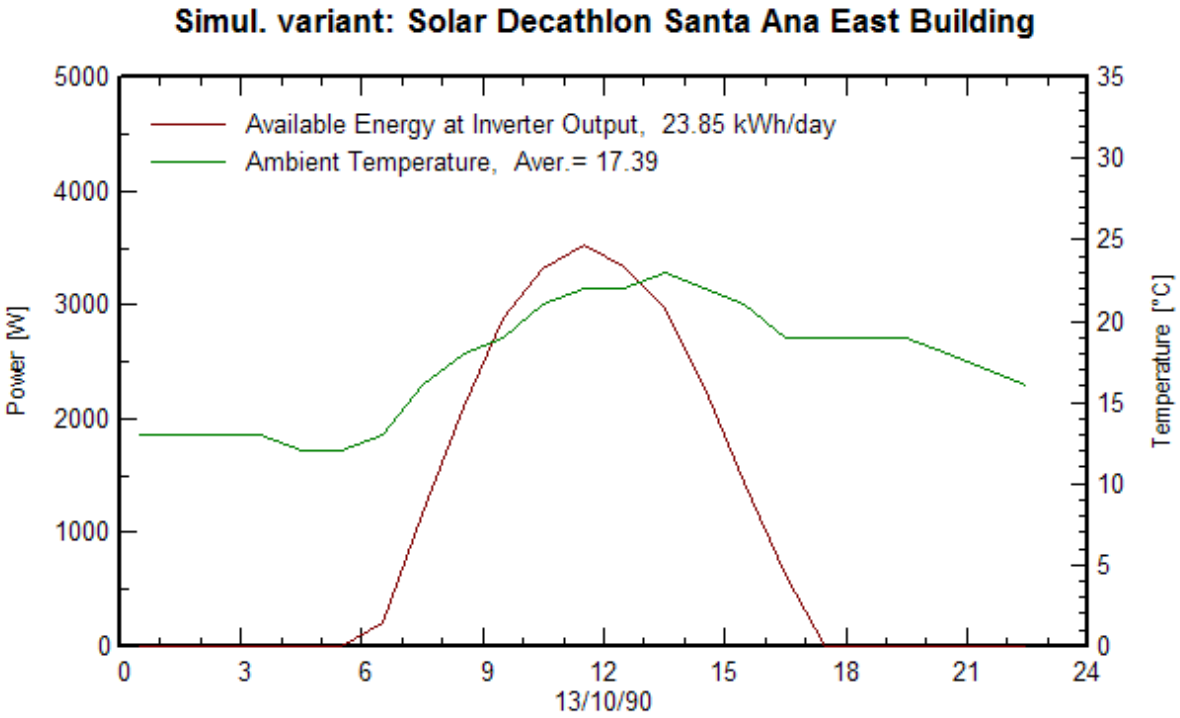

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 16.04 kWh/day
Ambient Temperature, Aver.= 18.70
Power [W]
Temperature [°C]
08/10/90


Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 17.15 kWh/day
Ambient Temperature, Aver.= 19.00
Power [W]
Temperature [°C]
09/10/90


Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 16.70 kWh/day
Ambient Temperature, Aver.= 17.87
Power [W]
Temperature [°C]
10/10/90

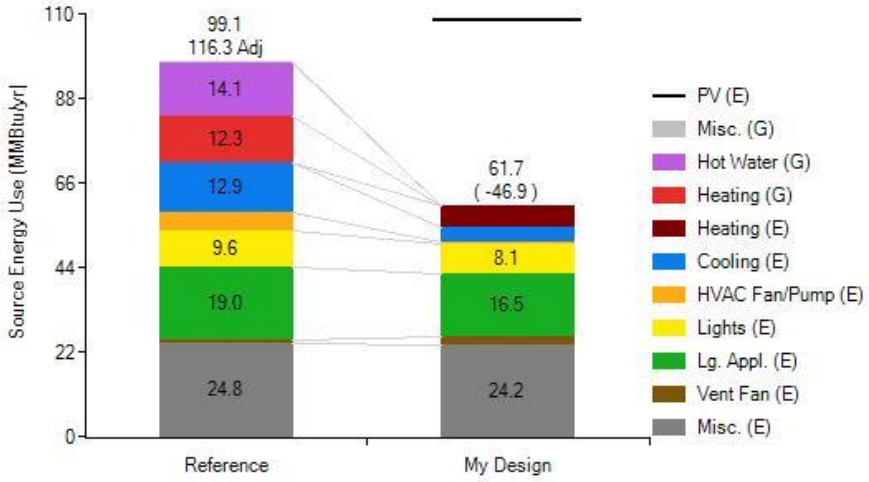

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 20.86 kWh/day
Ambient Temperature, Aver.= 15.96
Power [W]
Temperature [°C]
11/10/90

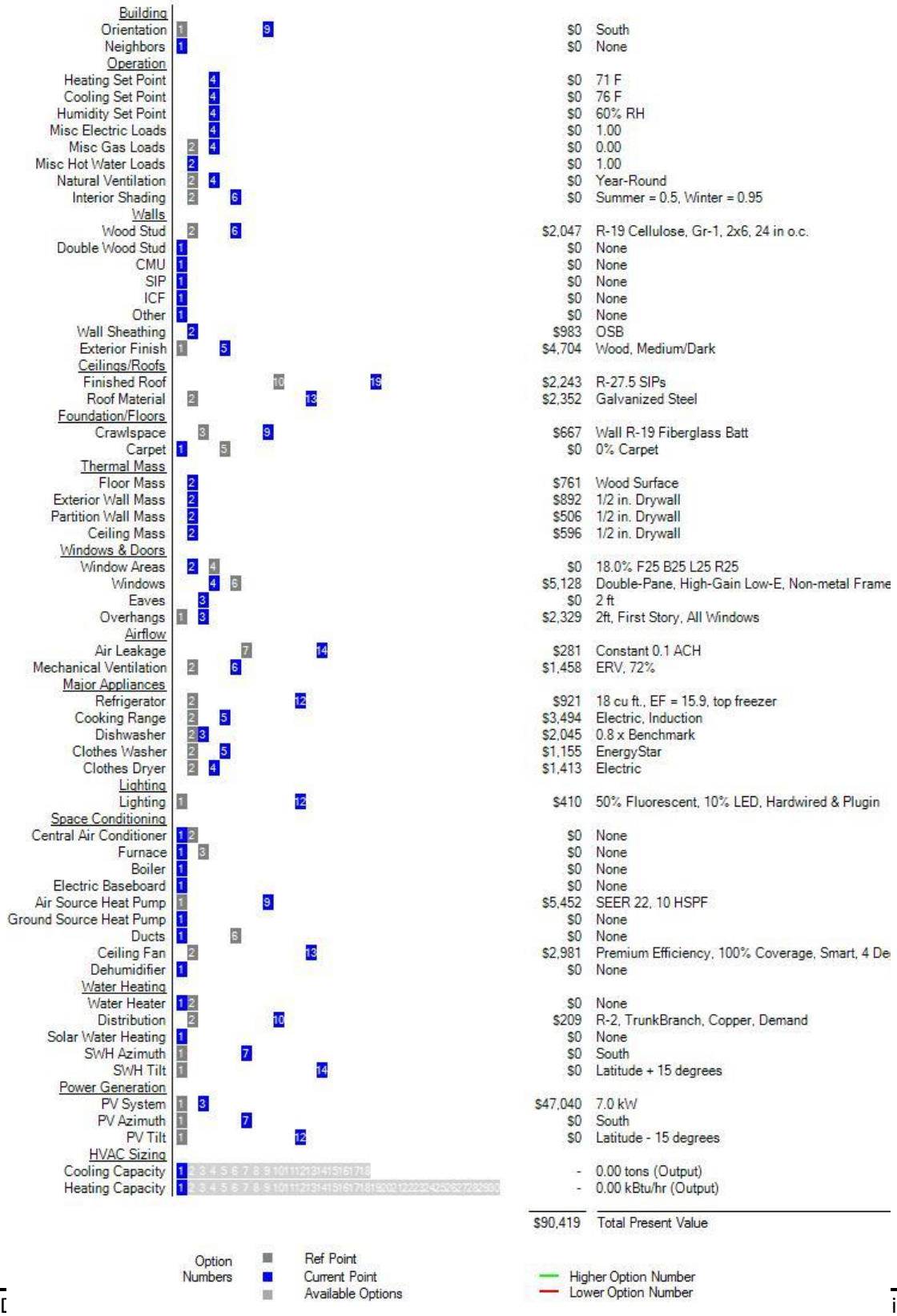

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 23.43 kWh/day
Ambient Temperature, Aver.= 16.26
Power [W]
Temperature [°C]
12/10/90

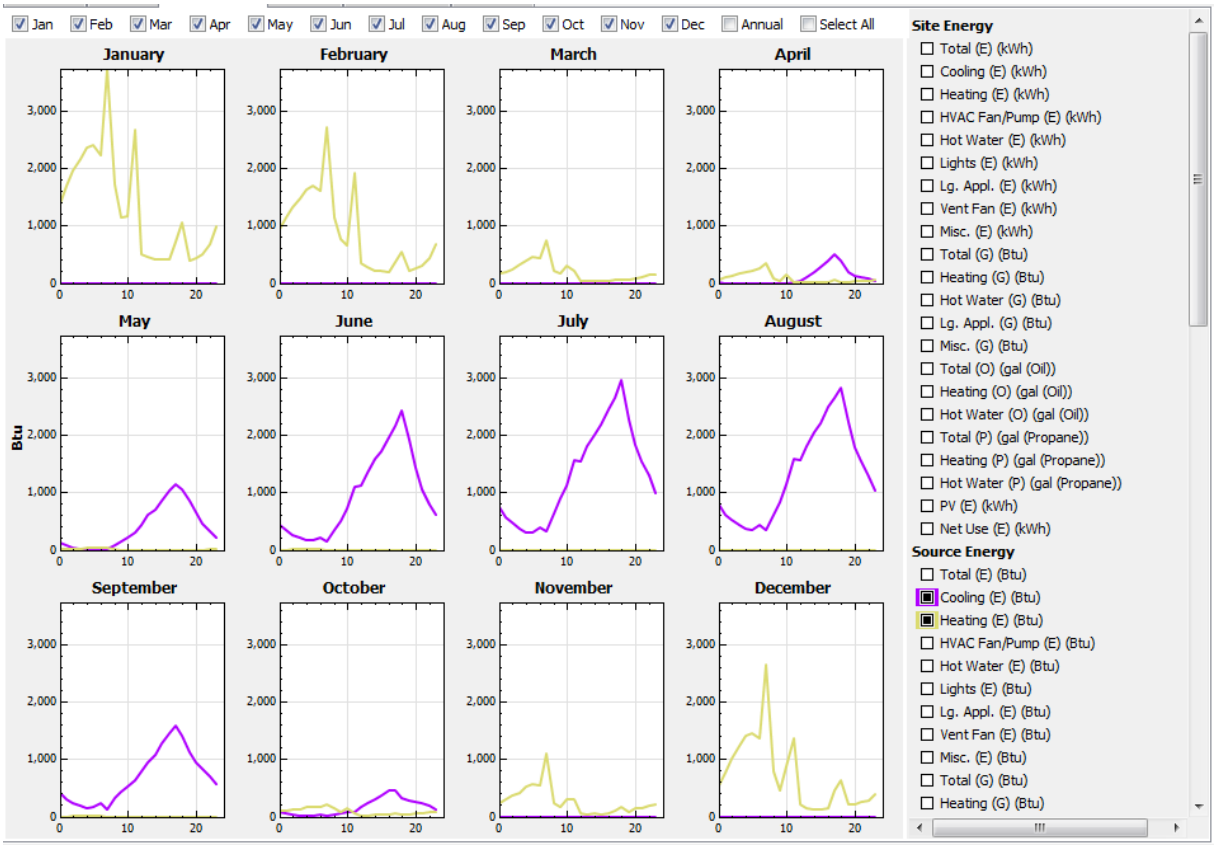

Simul. variant: Solar Decathlon Santa Ana East Building
Available Energy at Inverter Output, 23.85 kWh/day
Ambient Temperature, Aver.= 17.39
Power [W]
Temperature [°C]
5000
4000
3000
2000
1000
0
35
30
25
20
15
10
5
0
0
3
6
9
12
15
18
21
24
13/10/90

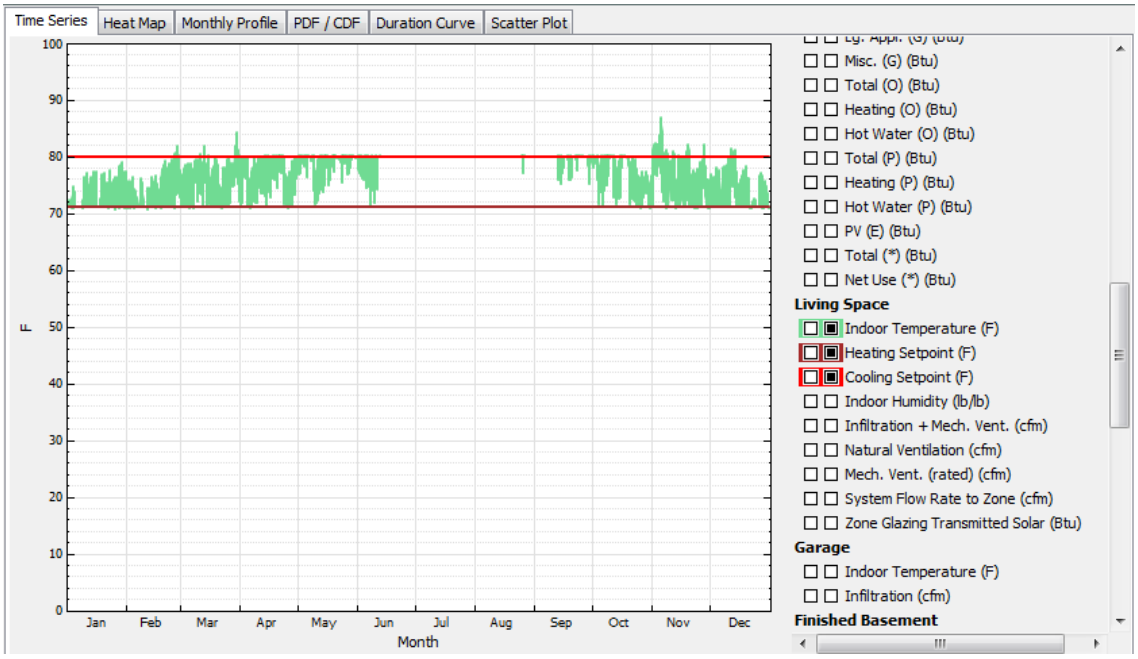
Whole Building Energy Modeling

NREL's BEopt with Energy Plus as back engine was used to integrate all the system design and optimize the design decisions. Being able to account for cost in the model is important and essential in a realistic development application. The resultant energy model predicts that DesertSOL uses about half of what a "benchmark" energy efficient building from Build America of the same square footage would use and will achieve net-zero.

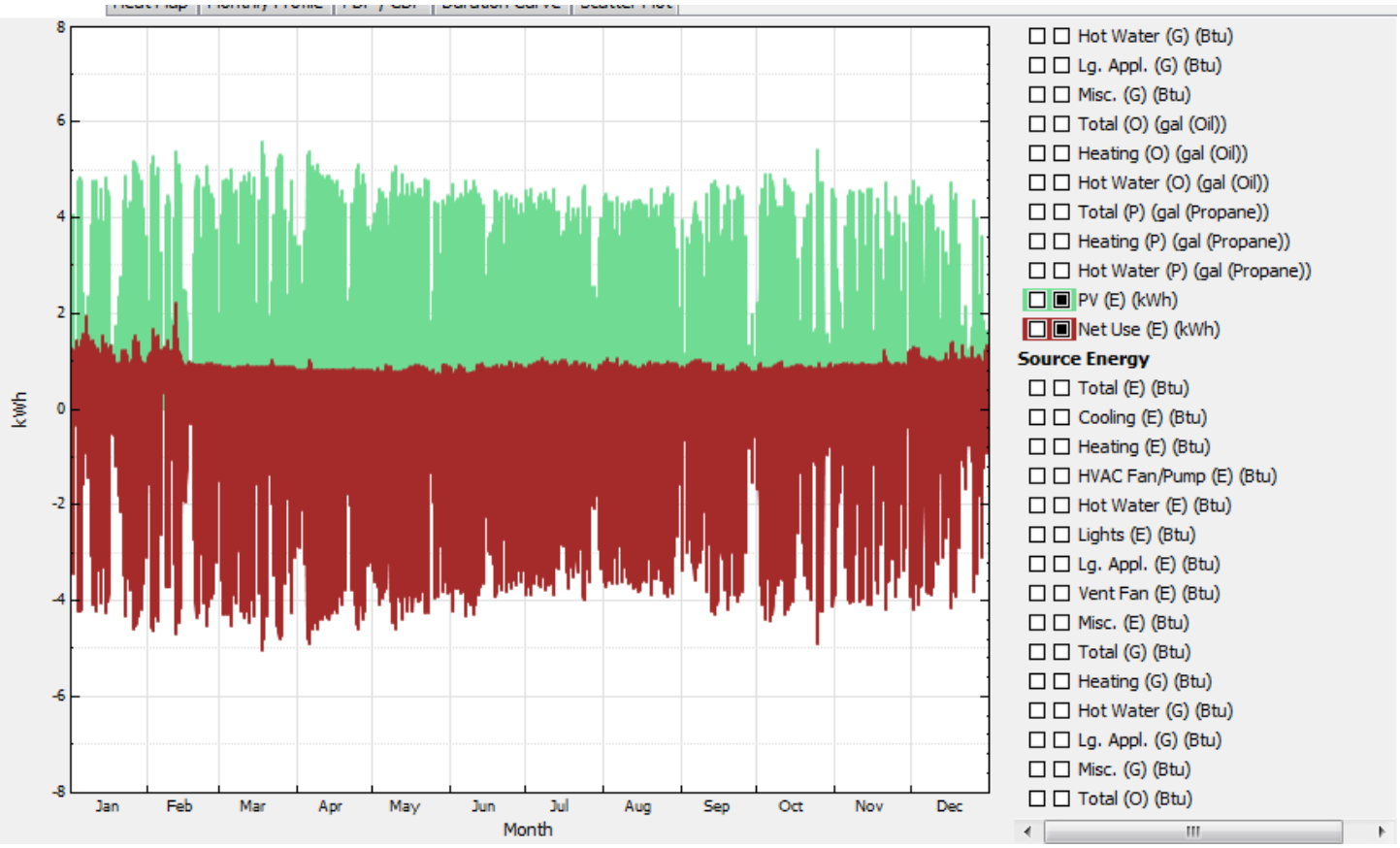



Building
Orientation
Neighbors
Operation
Heating Set Point
Cooling Set Point
Humidity Set Point
Misc Electric Loads
Misc Gas Loads
Misc Hot Water Loads
Natural Ventilation
Interior Shading
Walls
Wood Stud
Double Wood Stud
CMU
SIP
ICF
Other
Wall Sheathing
Exterior Finish
Ceilings/Roofs
Finished Roof
Roof Material
Foundation/Floors
Crawlspace
Carpet
Thermal Mass
Floor Mass
Exterior Wall Mass
Partition Wall Mass
Ceiling Mass
Windows & Doors
Window Areas
Windows
Eaves
Overhangs
Airflow
Air Leakage
Mechanical Ventilation
Major Appliances
Refrigerator
Cooking Range
Dishwasher
Clothes Washer
Clothes Dryer
Lighting
Lighting
Space Conditioning
Central Air Conditioner
Furnace
Boiler
Electric Baseboard
Air Source Heat Pump
Ground Source Heat Pump
Ducts
Ceiling Fan
Dehumidifier
Water Heating
Water Heater
Distribution
Solar Water Heating
SWH Azimuth
SWH Tilt
Power Generation
PV System
PV Azimuth
PV Tilt
HVAC Sizing
Cooling Capacity
Heating Capacity
$0 South
$0 None
$0 71 F
$0 76 F
$0 60% RH
$0 1.00
$0 0.00
$0 1.00
$0 Year-Round
$0 Summer = 0.5, Winter = 0.95
$2,047 R-19 Cellulose, Gr-1, 2x6, 24 in o.c.
$0 None
$0 None
$0 None
$0 None
$0 None
$0 None
$983 OSB
$4,704 Wood, Medium/Dark
$2,243 R-27.5 SIPs
$2,352 Galvanized Steel
$667 Wall R-19 Fiberglass Batt
$0 0% Carpet
$761 Wood Surface
$892 1/2 in. Drywall
$506 1/2 in. Drywall
$596 1/2 in. Drywall
$0 18.0% F25 B25 L25 R25
$5,128 Double-Pane, High-Gain Low-E, Non-metal Frame
$0 2 ft
$2,329 2ft, First Story, All Windows
$281 Constant 0.1 ACH
$1,458 ERV, 72%
$921 18 cu ft., EF = 15.9, top freezer
$3,494 Electric, Induction
$2,045 0.8 x Benchmark
$1,155 EnergyStar
$1,413 Electric
$410 50% Fluorescent, 10% LED, Hardwired & Plugin
$0 None
$0 None
$0 None
$0 None
$5,452 SEER 22, 10 HSPF
$0 None
$0 None
$2,981 Premium Efficiency, 100% Coverage, Smart, 4 De
$0 None
$0 None
$209 R-2, TrunkBranch, Copper, Demand
$0 None
$0 South
$0 Latitude + 15 degrees
$47,040 7.0 kW
$0 South
$0 Latitude - 15 degrees
- 0.00 tons (Output)
- 0.00 kBtu/hr (Output)
$90,419 Total Present Value
Option Numbers
Ref Point
Current Point
Available Options
Higher Option Number
Lower Option Number





With the balanced heating and cooling system, the temperature of the home will always stay within set points.



With superior energy efficient technologies, DesertSOL will exceed net-zero and produce more energy than it actually consumes, from the energy modeling prediction.

Quantity Takeoff of Competition Prototype House

SPECIFICATION NUMBER	BRIEF DESCRIPTION	DETAILED DESCRIPTION	QTY	UNIT
Division 01	**General Requirements**			
01 54 23	Temporary Scaffolding and Platforms		N/A	
Division 04	**Masonry**			
04 20 00	Masonry Anchorage and Reinforcing	Anchor Bolts Typical Cinder Block Footings (8x8x16 CMU blocks, 1500 psi) Grout - ASTM C 1107, nonmetalic, shrinkage resistant, factory packaged	30 46 9	No. No. Yd^3
Division 05	**Metals**			
05 12 00	Structural Steel Framing	Steel Chassis Metal Piers	2 32	No. No.
05 50 00	Metal Fabrications	2” x 2” x 1/8” HSS Steel tube 2” x 3” x 1/4” HSS Steel tube 3” x 2” x 5/16” HSS Steel Tube 4” x 4” x 1/8” HSS Steel Tube 4” x 3” x 3/16” HSS Steel Tube 5” x 2” x 1/8” HSS Steel Tube 3” x 0.25” round HSS 3.5” x 0.3” Round HSS 4.5” x 0.337 Round HSS 2” x 2” x ¼” Angle Iron (PV panel connection) 1/16” Custom Perforated Metal Screen - Vertical w/ Weathered Finish 1/16” Perforated Metal Screen - Horiz. w/ Weathered Finish Steel Overhang (Over Main Entry) w/ Weathered Finish 1/16” Perforated Metal Screen - Guardrails w/ Weathered Finish Movable Custom Perforasted Screen System w/ Weathered Finish Deck Edge Steel Plates w/ Weathered Finish Steel Angles 1”x 4” x ¼” 2” x 2” x 1/8” 2” x 2” x ¼” 2” x 2” x 3/8” 4” x 4” x ¼” 2” x 3” x ¼”	610 117.6 226 19 38 15.5 10 36 18 16 141 172 18 192 168 75 6 17 14.5 5.75 4 10	L.F. L.F. L.F. L.F. L.F. L.F. L.F. L.F L.F. L.F. S.F. S.F. S.F. S.F. S.F. S.F. L.F. L.F. L.F. L.F. In L.F.

		3” x 3” x ¼” 6” x 6” x 3/8” Hot Rolled Flats 3/16” x 2” 3/16” x 4” 3/16” x 12” 3/16” x 4” ¼” x 14” 3/8” x 2” 3/8” x 4” ¼” 6” ¼” x 8” Steel Plate 3/16”	2 6 40 26 26 22’5 22’5 4 4 1’6 984	L.F. In In L.F. L.F. L.F. L.F. L.F. L.F. L.F S.F.
05 52 00	Metal Railings	Inside and outside railings at a height of 3’-0” 1 ¼” Textured steel plate (ramp entry) 3/8” Round Stainless Steel Baluster ¾” Solid Round	154 64 4 55	L.F. S.F. L.F. L.F.
Division 06	**Wood, Plastics and Composites**			
06 05 73	Composite Glass Wood Products	TimberSIL 5/4x6x12 TimberSIL 2x8x8 TimberSIL 2x6x8 TimberSIL 4x8x8	1,000 85 153 30	S.F. No. No. No.
06 10 00	Rough Carpentry	2 x 6 wooden joists at 24” O.C. 2 x 8 wooden joists 2 x 10 4 x 8 4 x 10 RedBuilt 2 1/2" x 11 7/8" Wood Joists 2 x 6 engineered studs 24 OC	328 313.58 37 47.66 369.75 360 1354	L.F. L.F. L.F. L.F. L.F. L.F. L.F.
06 10 53	Miscellaneous Rough Carpentry	Plywood for Metal Piers Base plywood for metal piers	32 32	No. No.
06 16 00	Sheathing	1 1/8” floor plywood sheathing 15/32” roof plywood sheathing 3/8” plywood sheathing on exterior walls	754 864 1,600	S.F. S.F. S.F.
06 20 00	Finish Carpentry	Hardwood Veneer Plywood Paneling	704	S.F.
06 41 00	Architectural Wood Casework	Base Kitchen Cabinets 24”D X 34”H Upper Kitchen Cabinets 12”D X 33”H Full Kitchen Cabinets 24”D X 88”H	13 11 2	L.F. L.F. L.F.
Division 07	**Thermal and Moisture Protection**			
07 21 00	Thermal Insulation	Ceiling Area: Spray 1” Closed Cell Foam in Main Roof Line (Against Roof Line) Ceiling Area: Cover Closed Cell Foam with 10 7/8” of ½ lb Open Cell Foam Crawl Space/Floor: Spray 1” Closed	1,130 2,820 1,130	S.F. S.F. S.F.

		Cell Foam (Against Living Side of Floor)		
		Crawl Space/Floor: Spray 9" Open Cell Foam Over Closed Cell Foam	2,310	S.F.
		Crawl Space/Floor: Spray Ignition Barrier Over Open Cell Foam	377	S.F.
		Exterior Walls: Spray 1" Closed Cell Foam	2,820	S.F.
		Exterior Walls: Spray 4.5" of Open Cell Foam over Closed Cell Foam	Fill Cavity	
		4x8 Foil Face Polyisocyanurate	80	sheets
07 25 00	Weather Barriers	Tyvek Stucco Wrap	1,027	S.F.
07 53 23	EPDM Roofing	EPDM Roofing	29	S.F.
07 61 00	Sheet Metal Roofing	Roofing Metal Sheet	738	S.F.
07 62 00	Sheet Metal Flashing and Trim	N/A	N/A	
07 84 13	Penetrations and Joint Firestopping	N/A	N/A	
07 92 00	Joint Sealants	N/A	N/A	
Division 08	**Openings**			
08 14 16	Flush Wood Doors	Interior Solid Core Wood Door Laundry (88 X 36)	1	Each
		Mechanical Room Door - swing (80 X 36)	1	Each
		Interior Solid Core Wood door Bathroom Sliding (88 X 42)	1	Each
		Interior Solid Core Wood door Bedroom Sliding (88 X 48)	1	Each
08 52 00	Wood Windows and Doors	Main Entrance Door – Swing (80 x 36)	1	Each
		Living Room Sliding	1	Each
		Bedroom Sliding Doors	1	Each
		Interior solid core wood door bedroom	1	Each
		Exterior Windows:	7	Total
		Living Room Clerestory (awning)		
		Living room view window (casement)		
		Kitchen floor window (awning)		
		Bedroom/Bathroom window (casement)		
08 71 00	Door Hardware	Top Flush Mount Bedroom Sliding Door Hardware	1	Each
		Bedroom 1 pc custom steel door pull	1	
		Bathroom 2 pc custom Door Pull Steel	1	
		Top Hung System Sliding (Bathroom)	1	
		Invisible Hinges Laundry Door	3	
		Touch Latch Magnetic (Laundry Large Doors)	1	
08 80 00	Glazing	Living Room clerestory fixed glazing	31	S.F.
		Kitchen countertop fixed glazing		

		Bathroom Window – fixed glazing Foyer Window		
08 83 00	Mirrors	Bathroom Mirror (30” X 42”) Bedroom Mirror (48” X 88”)	1 1	EA EA
Division 09	**Finishes**			
09 22 16	Non-Structural Metal Framing	N/A	N/A	
09 29 00	Gypsum Board	5/8" Type X Gypsum Board on exterior walls, roof covering, fixed partitions, wall board, wall board ceiling finishes.	3,800	S.F.
09 30 00	Tiling	Bathroom Wall Tiles Bathroom Accent Tiles Bathroom Floor Tile	190 25 56	S.F S.F S.F
09 64 00	Wood Flooring	Living Area Wood Plank Foyer Wood Plank Bedroom Wood Plank	325 28 185	S.F. S.F. S.F.
09 65 00	Resilient Flooring	Laundry Linoleum Sheet	13	S.F.
09 72 00	Wall Coverings			
09 77 23	Fabric-Wrapped Panels	Fiber fabric panels living	85	S.F.
09 90 00	Painting and Coating	Benjamin Moore Eco-Spec Primer and Eggshell Interior Wall Paint Seal-Pro Deck Stain Translucent Wood Finish	242 1,00 704	S.F. S.F. S.F.
Division 10	**Specialties**			
10 28 00	Toilet, Bath and Laundry Accessories	Kohler Toilet Tissue Dispenser Kirsch Shower Curtain Rod Kohler Robe Hook Kohler Towel Bar Kohler Towel Rack	1 1 1 1 1	Each Each Each Each Each
Division 11	**Equipment**			
11 31 00	Residential Appliances	Clothes washer Clothes Dryer Living Room and Bedroom Ceiling Fan Bedroom Ceiling Fan with Light Refrigerator Stove Oven/Dishwasher 3D LED Television 65"	1 1 2 1 1 1 1 1	Each Each Each Each Each Each Each No.
Division 12	**Furnishings**			
12 20 00	Curtain Track Hardware	Kirsch 9046	45	L.F.
12 36 61	Simulated Stone Countertops	Eco by Cosentino – Iron Ore (24” X 3/4")	13	L.F.
Division 21	**Fire Suppression**			
21 13 13	Wet-Pipe Sprinkler System	Tubing: 1” PEX Fittings: Brass	100 2	L.F. Bags

		Flat Conceal Sprinkler	7	No.
		Concealed Cover Plate	7	No.
Division 22	**Plumbing**			
22 11 00	Water Distribution	Ball Valves	2	No.
		Check Valves	1	No.
22 11 16	Domestic Water Piping	Copper piping, 1”	30	L.F.
		Tubing: ½” PEX	300	L.F.
		Fittings: Adapters	50	No.
		Fittings: Plastic Multi-Port Tees	3	No.
		Fittings: Copper	40	No.
22 11 19	Domestic Water Piping Specialties	PEX ½”	1	Coil
		Wall Cabinet	1	Each
		Heat Transfer Panel ½”	200	No.
		Bend Support ½”	8	No.
		Valve	1	No.
		Adapter ¾” to 1”	2	No.
		Coupling Nipple	4	No.
		Fitting Assembly ½”	16	No.
		Ring with Stop ½”	8	No.
		Thermal Actuator	4	No.
		Tempering Valve 3-way 1”	1	No.
		Drains	3	No.
		Cleanouts	2	No.
		Hose Bibs	2	No.
		Water Hammer Arrestor	1	No.
22 11 23	Domestic Water Pumps	Booster Pump	1	No.
22 12 19	Facility Potable-Water Storage Tanks	Water Tank - 1500 gallon	1	No.
22 13 00	Facility Sanitary Waste and Vent Piping	ABS (Schedule 40)	100	L.F.
22 13 53	Facility Septic Tanks	Water Tank, 300 gallon	3	No.
22 33 00	Electric Domestic Water Heaters	Electric Tankless Water Heater	1	No.
22 33 30.00	Solar Water Heating Equipment	Evacuate Tube Collectors	2	No.
		Solar Storage Tank, 100 gallon	1	No.
		Solarflex Tubing	100	L.F.
		Expansion Tank	1	No.
		P&T Valve	1	No.
		Ball Valves	4	No.
		Fill/Drain Vlave	2	No.
		Check Valve	2	No.
		Three Way Tempering Valve	1	No.
		Recirculation Pump	1	No.
		Automatic Air Vent	1	No.
22 40 00	Residential Plumbing Fixtures	Water Closets	1	No.
		Bath Lavatory	1	No.
		Bath Lavatory Mixing Valve	1	No.
		Bath Lavatory Faucet	1	No.
		Kitchen Sink	1	No.

		Kitchen Sink Bottle Trap	1	No.
		Kitchen Faucet	1	No.
		Shower Nozzle	1	No
		Shower Mixing Valve	1	No.
		Laundry Box	1	No.
		Floor Drain – Mechanical Room	1	No.
		Shower Drain	1	No.
		Water Feature Drain	1	No..
Division 23	**Heating, Ventilating and Air-Conditioning**			
23 23 00	Refrigerant Piping	Copper Tube	100	L.F.
		Insulation	100	L.F.
23 72 00	Air-to-Air Energy Recovery Equipment	ERV	1	No.
23 81 26	Split System Air-Conditioners	Minisplit Heat Pump, 26 SEER	2	No.
23 83 16	Radiant-Heating Hydronic Piping	Tubing: hePEX ½"	1,000	L.F.
		Manifolds: TruFLOW Jr. with Balancing and Isolation Valves	1	No.
		Fittings: ProPEX Fittings and Rings	10	No.
		Three Way Mixing Valve	1	No.
		Thermal Actuators	4	No.
		Joint Trak Plates	174	No.
		Expansion Tank	1	No.
		P&T Valve	1	No.
		Isolation Valve	2	No.
		Fill/Drain Valve	2	No.
		Check Valve	2	No.
		Recirculation Pump	1	No.
Division 25	**Integrate Automation**			
25 10 00	Integrate Automation Network Equipment	United Devises ISY-994i ZS/IR PRO Automation	1	No.
		Insteon Powerlinc Modem	3	No.
		Insteon OutletLinc Relay	8	No.
		Insteon Wireless Thermostat	2	No.
		Global Cache iTach WF2IR IR	2	No.
		EZIO8SA Low-Voltage I/O	2	No.
		Insteon SwitchLinc Switch	10	No.
		Insteon SwitchLinc Dimmer	5	No.
		Datalogger	1	No.
		Wall Charger	1	No.
		Power Supply	1	No.
		Multiplexer	1	No.
		Switch Enclosure Module	1	No.
		Ethernet Communications	1	No.
		Thermistor	1	No.
		Immersion Thermistor	1	No.
		Thermocouples, Type T	10	No.
		Thermocouple Extension Wires	500	L.F.
		Thermocouple Wire Connectors	15	No.

		Pyranometer	2	No.
		Temperature and Relative Humidity Sensor	2	No.
				No.
		Flow Measuremtn Sensor	2	No.
		Power Measurement Sensor	6	No.
		Apple IPAD2	1	No.
		Ethernet Cable	400	L.F.
		Phone Cable	85	L.F.
		Coax Cable	100	L.F.
		Router	1	No.
		Patch Panel	1	No.
Division 26	**Electrical**			
26 05 19	Low Voltage Electrical Power Conductors and Cables	12/3G SO	200	L.F.
		12/2G SO	200	L.F.
		4/3G Romex	50	L.F.
		12/2G Romex	300	L.F.
		12/3G Romex	1,400	L.F.
		#2 THHN	100	L.F.
		#2 THHN White	50	L.F.
		#2 Ground	50	L.F.
26 05 26	Grounding and Bonding for Electrical Systems	2/O Type W Conductor	45	L.F.
26 05 33	Raceway and Boxes for Electrical Systems	¾" EMT	100	L.F.
		1" EMT	250	L.F.
26 24 16	Panelboard	Main Panel – 200A	1	No.
		Sub Panel – 100A	1	No.
		Circuit Breakers	25	No.
		AC Disconnect	1	No.
26 27 26	Wiring Devices	Weatherproof Receptacles	8	No.
		Duplex Receptacles	12	No.
		Ground Fault Interrupter Duplex Receptacles	12	No.
		Toggle Switch	8	No.
26 31 00	Photovoltaic Collectors	Photovoltaic Panels	30	No.
		S-5! Clamps	144	No.
		Microinverters	30	No.
26 50 00	Lighting	Recessed Can Light	6	No.
		Outdoor Sconce	2	No.
		Dining Pendant	1	No.
		Surface Mount Light	1	No.
		Under Cabinet Light	6	No.
		Bath Mirror Light	6	No.
		Patio Downlight	3	No.
		Wall Art Light	2	No.
		Water Feature Light	2	No.
Division 28	**Electronic Safety and Security**			
28 31 00	Fire Detection and Alarm	Smoke Detector	4	No.
Division 31	**Earthwork**			

31 31 16	Termite Control	N/A	N/A	
31 66 00	Special Foundations	N/A	N/A	
Division 32	**Exterior Improvements**			
32 84 00	Planting Irrigation	N/A	N/A	
32 93 00	Plants	Globemallow	5	No.
		Creosote Bush	1	No.
		Desert Marigold	10	No.
		Joshua Tree	2	No.
		Utah Agave	5	No.
		Brittle Bush	2	No.
		Mormon Tea	2	No.
		Firecracker Penstemon	6	No.
		White Dune Primrose	8	No.
		Scarlet Gaura	3	No.
		Coffeeberry	1	No.
		Cliffrose	1	No.
		Desert 5 Spot	5	No.
		Apache Plume	3	No.
		Purple Sage	4	No.
		Compass Barrel Cactus	2	No.

Construction Specifications

Division 01 - General Requirements

SECTION 01 54 23 – TEMPORARY SCAFFOLDING AND PLATFORMS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install staging aids and fall protection equipment to withstand structural loads required by OSHA and ANSI Z359.1 standards.

B. Submittals: Product Data. Structural analysis data signed and sealed by a qualified professional engineer registered in the state where project is located

C. Structural and Accessory Components shall conform to the following Standards:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: Cold-formed steel tubing, ASTM A 500.
3. Aluminum Extrusions: ASTM B 221.

PART 2 - PRODUCTS

2.01 FALL PROTECTION EQUIPMENT – STANDING SEAM ROOF

A. Manufacturers:

1. Guardian Fall Protection.

B. Models:

1. Standing Seam Roof Clamp, Model #00250.

C. Operation:

1. Portable and reusable anchor for use on standing seam roofs.
2. Seam spacing range: 24” – 36”
3. Retractable Rotation: 360 degrees
4. Self-retracting lifeline adaptable
5. Meets or exceeds all applicable industry standards, including OSHA and ANSI Z359.1.

2.02 FALL PROTECTION EQUIPMENT – SELF-ADHERING SHEET WATERPROOFING

A. Manufacturers:

1. Guardian Fall Protection.

B. Models:

1. CB-12 Roof Anchor, Model #00845.

C. Operation:

1. Deck mounted anchor post.
2. Load rating: 5000 lbs.
3. Base and mount plates flashed into roof membrane per manufacturer specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prepare substrate by cleaning, removing projections, filling voids, sealing joints, and as otherwise recommended in fall protection and deck eye manufacturer's written instructions.

B. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place, for permanent installation or duration of use.

C. Fasten fall protection securely in place, with provisions for thermal and structural movement.

D. Correct deficiencies in or remove and reinstall fall protection anchor that do not comply with requirements.

E. Repair, refinish, or replace fall protection anchors and deck eyes damaged during installation, as directed by Architect.

END OF SECTION 01 54 23

Division 04 - Masonry

SECTION 04 20 00 – MASONRY

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Structural Performance: Masonry standard; comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

B. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the contract documents.

B. Defective Units: reference masonry unit manufacturer information, which may allow a certain percentage of chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed work.

C. Fire Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS (CMUs)

A. Subject to compliance with requirements, available products that may be included in the Work include, but are not limited to, the following:

1. CMUs: ASTM C 90.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
3. Density Classification: Normal weight.

B. Grout: ASTM C 1107, nonmetallic, shrinkage resistant, factory packaged.

PART 3 - EXECUION

3.01 MASONRY UNITS, GENERAL

A. Prepare ground by cleaning, removing projections, and as otherwise recommended in stand manufacturer's written instructions and DOE Solar Decathlon Building Code foundation provisions.

B. Use full size units without cutting if possible. If cutting is required, provide continuous pattern or fit adjoining construction, cut units with motor driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, conceal cut edges.

C. Repair, refinish, or replace products damaged during installation, as directed by Architect.

END OF SECTION 04 20 00

Division 05 – Metals

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Shop Drawings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator.

1. Use ASD; data are given at service-load level.

B. Comply with applicable provisions of the following:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

2.02 STRUCTURAL STEEL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M and ASTM A 572/A 572M, Grade 50 (345) when appropriate.

C. C Channels, Angles: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50 (345) when appropriate.

D. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50 (345**)** when appropriate.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

2.03 ACCESSORIES

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

B. Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-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.

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

2.04 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

C. Shop Priming: Prepare surfaces according to SSPC-SP 2, "Hand Tool Cleaning"; or SSPC-SP 3, "Power Tool Cleaning." Shop prime steel to a dry film thickness of at least 1.5 mils (0.038 mm). Do not prime surfaces to be embedded in concrete or mortar or to be field welded.

D. Uncoated ferrous metal surfaces indicated as ‘weathered steel’ shall have all oil removed by application of degreaser as required. No further surface treatment required.

PART 3 - EXECUTION

3.01 ERECTION

A. Structural Steel Frames are built to be transportable.

B. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

C. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.

3. 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.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

D. Align and adjust various members forming 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.

E. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

F. 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.

Joint Type: Snug tightened

G. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

END OF SECTION 05 12 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

1.02 SECTION REQUIREMENTS

A. Submittals: Shop Drawings.

PART 2 - PRODUCTS

2.01 METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).

E. Rolled Steel Floor Plate: ASTM A 786/A 786M.

F. Steel Tubing: ASTM A 500.

G. Steel Pipe: ASTM A 53, standard weight (Schedule 40), black finish.

H. Slotted Channel Framing: Cold-formed steel channels complying with MFMA-4, 1-5/8 by 1-5/8 inches (41 by 41 mm).

I. Cast Iron: ASTM A 48/A 48M or ASTM A 47/A 47M.

J. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

2.02 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

G. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

K. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

L. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.03 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 Interior Painting."

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.04 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107; recommended by manufacturer for exterior applications.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports at all exterior locations.

D. Prime miscellaneous framing and supports with primer specified in Section 099000 "Painting and Coating".

2.06 DECORATIVE STEEL SHADE SCREENS AND WALLS

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Except where noted as “Custom Pattern Screen,” perforated panels shall be 16 gauge, with 3/16” holes at ¼” staggered centers.

2.07 FABRICATION

A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges. Form bent-metal corners to smallest radius possible without impairing work.

B. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

C. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use recessed hexagonal flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

D. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

E. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

F. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. Form exposed work with accurate angles and surfaces and straight edges.

H. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

I. Fabricate steel pipe columns with 1/2-inch (12-mm) steel base plates and 1/4-inch (6-mm) steel top plates welded to pipe with continuous fillet weld same size as pipe wall thickness. Drill top plates for connection bolts and base plates for 5/8-inch (16-mm) anchor bolts.

J. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

K. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

L. Fabricate nosings and ramp transition plates from steel with an integral abrasive finish.

1. Manufacturers: One of the following:

a. American Safety Tread Co., Inc.
b. Balco Inc.
c. Barry Pattern & Foundry Co., Inc.

d. Granite State Casting Co.
e. Safe-T-Metal Company, Inc.
f. Wooster Products Inc.
g. Or Architect approved equal

2.08 STEEL AND IRON FINISHES

A. Hot-dip galvanize steel fabrications at exterior locations where specified in drawings.

B. Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning," and paint with a fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 where specified in drawings.

C. Uncoated ferrous metal surfaces indicated as 'weathered steel' shall have all oil removed by application of degreaser as required. No further surface treatment required.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide anchorage devices and fasteners where needed to secure items to in-place construction.

B. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack.

C. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

END OF SECTION 05 50 00

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide anchorage devices and fasteners where needed to secure items to in-place construction.

B. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack.

C. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

END OF SECTION 05 50 00

SECTION 05 52 00 - METAL RAILINGS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Shop Drawings.

PART 2 - PRODUCTS

2.01 RAILING SYSTEMS

A. Steel Pipe and Tubing Railings

1. Provide railings as indicated in drawings.

B. Provide railings capable of withstanding a uniform load of 50 lbf/ft. (0.73 kN/m) and a concentrated load of 200 lbf (0.89 kN) applied to handrails and top rails of guards in any direction. Uniform and concentrated loads need not be assumed to act concurrently.

C. Provide railing infill capable of withstanding a concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m). Infill load and other railing loads need not be assumed to act concurrently.

2.02 METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

Primary difference between round steel tubing and steel pipe is in outside dimensions. Pipe sizes are normally indicated by use of nominal pipe size designator and weight class or schedule number; for tubing, OD and wall thickness are used. See Elevations.

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

E. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.03 Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.04 FASTENERS

A. General: Provide the following:

B. Fasteners for Anchoring Railing to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components.

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.05 FABRICATION

A. Assemble railing systems in shop to the greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Form changes in direction of railing members by bending or mitering at elbow bends per Drawings.

C. Fabricate railing systems and handrails for connecting members by welding and with concealed mechanical fasteners and fittings as indicated in Drawings.

D. Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other construction.

E. Provide wall returns at ends of wall-mounted handrails per Drawings.

2.06 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

Delete first paragraph below if no variable finishes, such as color anodized aluminum, are used.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

Retain paragraph below if exposed fasteners are allowed, especially with color anodic finish.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.07 STEEL AND IRON FINISHES

A. Railings, railing supports and fastener: Unfinished steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Set railings accurately in location, alignment, and elevation and free of rack.

C. Anchor posts where required as indicated in Drawings.

D. Attach handrails to wall with wall brackets as indicated in Drawings.

END OF SECTION 05 52 00

Division 06 – Wood, Plastics, and Composites

SECTION 06 05 73 – COMPOSITE GLASS WOOD PRODUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Composite Glass Wood Products - Strengthened, Stabilized, And Protected By Millions Of Non-Toxic Glass Barriers

1.02 SUSTAINABILITY REQUIREMENTS

A. Local/Regional Materials: Provide wood products and protection process that are harvested/extracted, processed, and manufactured within 500 miles of the Project Site

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide Composite Glass Wood products - strengthened, stabilized, and protected by millions of non-toxic glass barriers.

B. EPA Exempt, Non-toxic Barrier Product: determined by EPA under 40 CFR Part 152.10, May 14, 2008.

C. Ignition Resistant Material, Class A Fire Retardant: Class A rating when tested with accelerated, weathered samples according to ASTM 4898, in accordance with 30 minute extended ASTM E 84 method.

1. Flame-Spread Index: Test result 8.6 (Class A rating is 25 or less).
2. Smoke-Developed Index: Test result 119 (Class A rating is 450 or less).

D. Corrosion of Fasteners, per AWPA E12-94: Below allowable loss level of 25 mils/year.

E. Required Strength:

1. Modulus of Rupture, per ASTM D4761, ASTM D143: 16,080 psi; F_b: 2,700 psi.
2. Modulus of Elasticity at L/360, per ASTM D4761, ASTM D143: E: 1,900,000 psi.
3. Compression Parallel to Grain, per ASTM D143: 7,120 psi; F_c: 1,875 psi.
4. Compression Perpendicular to Grain, per ASTM D143: 2,700 psi; F_{CP}: 920 psi.

F. Structural Performance

1. Deck: 100 lb/ft^2 live load.

G. Deck structural support members: Lumber, sizes per drawing. Refer to Section 061000 Rough Carpentry for addition requirements as applicable.

Foundation below deck: Max 6,000 lb/ft^2 bearing load.

H. Fungus Resistance (White & Brown Rot), per ASTM D1413: No decay.

I. Termite Resistance, per AWPA E1-72: 10 (Sound, no decay).

J. Insolubility of glass in situ, per molybdate assay: insoluble.

K. Microscopic Evaluation with electron microscopy; Composite Glass Wood versus raw wood control: Composite Glass Wood cellular structures straight, intact vs. raw wood macerated.

L. Toxic Chemical Content and Known Carcinogens: None. Per X-ray diffraction, glass portion is non-toxic amorphous glass.

M. Accelerated weathering of Composite Glass Wood products without coatings, per ASTM G151: meets or exceeds standards.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's printed data indicating the usage of Composite Glass Wood Products, and instructions for installation and finishing.

B. Shop Drawings and Structural Calculations: Indicate materials and details of construction, methods of fastening, erection, and installation. Confirm compliance with structural engineering requirements.

C. Samples: For each type of field finishing indicated, provide samples not less than 12 inches long, showing the typical range in color and texture.

D. Material Certificates: Composite Glass Wood Products to be stamped by manufacturer and by wood certifier.

E. Sustainability Submittals:

1. Manufacturer’s certification of the geographical location of the harvesting, processing, and manufacturing for Composite Glass Wood products.

F. Manufacturer's Composite Glass Wood Span Tables, “Maximum Spans for Composite Glass Wood Joists & Rafters and Columns & Studs”. These tables describe increased span distances due to the increased strength of Composite Glass Wood Products.

G. Summaries of Third Party Data on Composite Glass Wood Properties, including strength, fire retardance, durability, and insolubility.

H. Maintenance Data: For Composite Glass Wood glass wood fusion products, to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Identify each piece or each bundle of Composite Glass Wood fusion product, by the grade mark and manufacturer's end tag.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Follow separate Manufacturer's Guidelines for delivery, storage and handling. In general, protect against dampness from weather or adjacent surfaces, before, during, and after delivery, and comply with manufacturer's storage and handling instructions. Deliver materials to job site in an undamaged condition. Store materials under cover or in a well-ventilated enclosure; keep wrapped and banded until Composite Glass Wood products are installed. Boards or lumber that are left unused should be restacked evenly and re-banded if sufficient overage is being kept stored for more than several days.

1.07 WARRANTY

A. Residential Warranty: Manufacturer's transferable residential warranty agrees to replace Composite Glass Wood boards exhibiting structural failure due to termites, rot or decay within the specified warranty period, not including incorrect installation, cracking, or splitting, provided that terms and conditions of the warranty have been met.

1. Warranted failures: structural failure due to termites, rot or decay.

2. Warranty Period: Forty years from date of purchase for residential uses.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. TimberSIL® Products; 5415 Backlick Rd., Suite C, Springfield, VA 22151; (703) 941-5171; www.timbersilwood.com; info@timbersilwood.com.

B. Or Architect approved equal.

2.02 COMPOSITE GLASS WOOD PRODUCTS – STRENGTHENED, STABILIZED, AND PROTECTED BY MILLIONS OF NON-TOXIC GLASS BARRIERS

A. Provide Composite Glass Wood glass strengthened, glass stabilized and glass protected wood products formed from millions of molecules-thin ribbon barriers of non-toxic amorphous silicon dioxide

(glass) intimately commingled with intact wood fibers and cell walls. Composite Glass Wood glass strengthened and glass stabilized wood products provide major improvements in strength, resilience, dimensional stability, resistance to fire, biological inertness, sustainability, and permanent carbon sequestration in comparison to raw wood or treated wood products.

B. Composite Glass Wood products to contain harmless, EPA determined non-toxic, non-carcinogenic, non-corrosive, insoluble, non-leaching amorphous glass. Composite Glass Wood Products to be stainable, paintable products that retain their natural wood appearance. Products to contain no arsenic, chromium, copper, volatile organic compounds, or pesticides. The Manufacturer's process to make the Composite Glass Wood Materials unavailable as a food source to insects and decay.

C. Composite Glass Wood to be manufactured using kiln-dried Southern Yellow Pine, inspected by SPIB or TPI.

1. Provide Composite Glass Wood products where improved strength, increased spacing, and reductions in cost are indicated in residential or commercial buildings.
2. Provide Composite Glass Wood products where non-toxic, extra strong, replacements for treated wood are indicated, or where fencing and related structural elements are indicated.

2.03 HARDWARE

A. Provide sizes, and types of Non-Corrosive fasteners. Extra protection for corrosive wood is not required or recommended. High grade fasteners, used for corrosive treated lumber, are not required for Composite Glass Wood.

B. Fasteners for Exterior Finish Carpentry: Exterior grade coated screws or triple-dipped galvanized nails.

C. Composite Glass Wood Products to be installed using techniques that are similar to tropical hardwoods.

D. Recommend one level upgrade of saw blades and cutting tools; and recommend operating pneumatic pressure increases of 10-15%

2.04 TREATED MATERIALS

A. Preservative Treated Boards and Dimension Lumber: AWPA U1, Use Category UC3b.

Use treatment containing no arsenic or chromium.

B. Apply treatment to top composite decking boards according to TimberSIL manufacturer guidelines.

2.05 FINISHES, GENERAL

A. Appearance of Finished Work: Variations in appearance of materials are acceptable if they are within the range of overall color of natural unfinished southern yellow pine, or slightly darker.

B. Field Finishing: Contact the Composite Glass Wood manufacturer for specific recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, supports, and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates to be clean and dry, and free of projections and detrimental substances.

3.03 INSTALLATION, GENERAL

A. Prepare ground by cleaning, removing projections, and as otherwise recommended in manufacturer's written instructions and DOE Solar Decathlon Building Code foundation provisions.

B. General: Install Composite Glass Wood to comply with manufacturer's written instructions and as indicated in Division 06.

C. Install Composite Glass Wood products in sizes, types, and configurations indicated. Place members to keep warranty end tags in inconspicuous locations. Where both ends are exposed, relocate end tags to underside of other unexposed surface. Apply any coating, including primer, to sanded surface before installing.

D. Install items in maximum lengths practical. Construct tight joints, following standard constriction practices.

E. Install Composite Glass Wood decking with one quarter inch (1/4") spacing between boards, except in cases where boards have been allowed to expand with moisture.

F. To remove misplace fasteners, use pry bar and scarp block to protect the surface.

3.04 FINISH WORK

A. To prepare Composite Glass Wood surfaces for the application of a coating, machine sand the surfaces with medium grit sand paper, making sure to completely sand all surface that are to be coated.

B. Wire brush or sand to remove occasional chalky deposits.

C. Apply finishes indicated to pre-sanded surfaces.

D. Newly available silicate-based coatings do not require sanding or other surface preparation; contact Composite Glass Wood manufacturer for more information.

3.05 CLEANING AND PROTECTION (MAINTENANCE)

A. Protect finished work from other trades.

B. Depending upon environmental conditions of the site, horizontal surfaces may require seasonal cleaning with a mild detergent and removal of debris.

END OF SECTION 06 05 73

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for wood-preservative treated wood, fire-retardant treated wood, engineered wood products, shear wall panels, and metal framing anchors.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.02 TREATED MATERIALS

A. Preservative-Treated Materials: 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.

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Fire-Retardant-Treated Materials: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A unless otherwise indicated.
3. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with design adjustment factors of not less than 0.85 for modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
4. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

5. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

2.03 FRAMING

A. Dimension Lumber:

1. Maximum Moisture Content: 19 percent.
2. Retain one grade requirement and one or more species group in "Non-Load-Bearing Interior Partitions" and "Framing Other Than Non-Load-Bearing Interior Partitions" subparagraphs below depending on availability and suitability for Project. Designate load-bearing walls on Drawings.
3. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3: Western woods: WCLIB or WWPA.
4. Framing Other Than Non-Load-Bearing Interior Partitions: Douglas fir-larch: WCLIB, or WWPA.
5. 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.
   Species: As specified for framing other than non-load-bearing interior partitions.
   Grade: Select Structural.

B. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.

1. Manufacturers:

   a. RedBuilt
   b. Or Architect approved equal

2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20.0 MPa) for 12-inch nominal- (286-mm actual-) depth members.
3. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa).

C. Wood I-Joists: Prefabricated units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Manufacturers:

   a. RedBuilt
   b. Or Architect approved equal

2. Web Material: Either oriented strand board or plywood, Exposure 1. Install per manufacturer.
3. Structural Properties: Provide units with depths and design values not less than those indicated.
4. Provide units complying with APA PRI-400, factory marked with nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.

D. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

1. Manufacturer: Provide products by same manufacturer as I-joists.

2. Material: All-veneer product glued-laminated wood or product made from any combination solid lumber, wood strands, and veneers.

3. Thickness: 1 inch (25 mm)

2.04 SHEAR WALL PANELS

A. Manufacturers: Any APA Certified PS-1 C-C or C-D Plywood Sheathing Manufacturer

B. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

C. Allowable Design Loads: Shear wall panels shall have allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.05 MISCELLANEOUS LUMBER

A. Miscellaneous Dimension Lumber: Construction, or No. 2 Standard or Stud grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

2.06 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, Exterior, AC or C-C Plugged or Exposure 1, C-D Plugged, fire-retardant treated, not less than 1/2-inch (13-mm) nominal thickness.

2.07 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Power-Driven Fasteners: CABO NER-272.

2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Structural capacity, type, and size indicated.

1. Manufacturers: Simpson Strong-Tie.

2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. Cleveland Steel Specialty Co.
   b. KKC Metals Products, Inc.
   c. Phoenix Metal Products, Inc.
   d. Simpson Strong-Tie Co., Inc.
   e. USP Structural Connectors.

3. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 (Z180) coating designation for interior locations where stainless steel is not indicated.

4. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.

PART 3 - EXECUTION

3.01 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 construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports unless otherwise indicated.

D. Securely attach rough carpentry to substrates, complying with the following:

   1. CABO NER-272 for power-driven fasteners.

   2. Published requirements of metal framing anchor manufacturer.

   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

END OF SECTION 06 10 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for treated wood.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

2.02 TREATED MATERIALS

A. Preservative-Treated Materials: 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.

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing members that are less than 18 inches (460 mm) above the ground.
4. Wood floor plates that are installed over concrete slabs-on-grade.

C. Fire-Retardant-Treated Materials: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A unless otherwise indicated.
3. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with design adjustment factors of not less than 0.85 for modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

4. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
5. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Provide fire-retardant treated materials for all items indicated on Drawings.

2.03 LUMBER

A. Interior Partition Framing: Standard, Stud, or No. 3 with 19 percent maximum moisture content.

B. Miscellaneous Dimension Lumber: Standard, Stud, or No. 3 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

C. Utility Shelving: Hem-fir, Select Merchantable or No. 1 Common: NLGA, WCLIB, or WWPA with 19 percent maximum moisture content.

D. Concealed Boards: Western woods, Standard: WCLIB; or No. 3 Common: WWPA; with 19 percent maximum moisture content.

2.04 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, Exterior, C-C Plugged, fire-retardant treated, not less than 3/4-inch (19-mm) nominal thickness.

2.05 FASTENERS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Power-Driven Fasteners: CABO NER-272.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set miscellaneous 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 construction.

B. Securely attach miscellaneous rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

END OF SECTION 06 10 53

SECTION 06 16 00 – SHEATHING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: ICC-ES evaluation reports for preservative-treated plywood.

PART 2 - PRODUCTS

2.01 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

2.02 TREATED PLYWOOD

A. Preservative-Treated Plywood: AWPA U1; Use Category UC2.

1. Use treatment containing no arsenic or chromium.
2. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

B. Provide preservative-treated plywood for items indicated on Drawings and plywood used with roofing, flashing, vapor barriers, and waterproofing.

2.03 WALL SHEATHING

A. Plywood Wall Sheathing: Exposure 1, Structural I sheathing.

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core.

D. C 1177/1177M

2.04 ROOF SHEATHING

A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.

B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.05 SUBFLOORING AND UNDERLAYMENT

A. Combination Subfloor-Underlayment:

1. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, C-C Plugged single-floor panels.

B. Subflooring:

1. Plywood Subflooring: Exposure 1, Structural I single-floor panels or sheathing.

C. Underlayment:

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior, C-C Plugged with fully sanded face.
2. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch (15.9-mm) nominal thickness, for ceramic tile set in latex-portland cement mortar.

2.06 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Power-Driven Fasteners: CABO NER-272.

B. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Securely attach to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

B. Fastening Methods:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.

2. Subflooring:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.

3. Wall and Roof Sheathing:

a. Nail to wood framing.
b. Screw to cold-formed metal framing.

4. Underlayment:

a. Glue and screwed to subflooring.

END OF SECTION 06 16 00

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Samples for siding, hardwood veneer plywood paneling.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

B. Softwood Plywood: DOC PS 1.

C. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

D. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

E. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper.

F. Certified Wood: Wood-based materials produced from tropical forests shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

2.02 EXTERIOR FINISH CARPENTRY

A. Exterior Lumber Trim and Siding

1. Manufacturers.

a. Centennial Wood
b. Natures Element
c. Or Architect approved equal

2.03 INTERIOR STANDING AND RUNNING TRIM

A. Interior Hardwood Lumber Trim: Clear, kiln-dried, white maple, birch, or honey mesquite per Drawings.

2.04 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock panels complying with HPVA HP-1, made without urea-formaldehyde adhesive.

1. Manufacturers:

a. Chesapeake Hardwood Products, Inc.
b. Georgia-Pacific Corp.
c. Holland Southwest International.
d. Peterman Lumber
e. Other manufacturers acceptable.

2. Face Veneer Species: Plain sliced birch per Drawings.
3. Veneer Matching: Slip Match, Random, Balanced.
4. Thickness: 1/2 inch (12.8 mm).
5. All Hardwood Birch Plywood shall meet or exceed Class C flame spread per ASTM E119. Flame spread ASTM E-84 test by HPVA, Hardwood Plywood Veneer Association, ranges between 114 and 127

2.05 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: hot-dip galvanized steel or stainless steel.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer; made with binder containing no urea-formaldehyde resin.

1. Wood glue shall have a VOC content of 30 g/L or less.

2. Use waterproof resorcinol glue for interior and exterior applications.

C. Adhesive shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Condition interior finish carpentry in installation areas for 24 hours before installing.

B. Apply clear, matte-finish sealer on both sides of interior finish carpentry per specification section 099000, Painting and Coating; as directed by Architect. Cut to length and seal ends.

C. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.

1. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

D. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.

E. Screw siding at each metal furring strip. Do not allow screws to penetrate more than one thickness of metal furring strip, unless otherwise recommended by siding manufacturer. Seal joints at inside and outside corners and at trim locations.

F. Select and arrange paneling for best match of adjacent units. Install with uniform tight joints.

G. Z-Clips for paneling installation shall be attached at 2'-0" on center, or as indicated in Drawings.

END OF SECTION 06 20 00

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Shop Drawings.

B. Grades of interior architectural woodwork shall comply with AWI's "Architectural Woodwork Quality Standards."

PART 2 - PRODUCTS

2.01 ARCHITECTURAL CABINETS

A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."

B. Certified Wood: Wood-based materials shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Wood Cabinets for Transparent Finish: Custom grade.

1. Type of Construction: Frameless.
2. Cabinet and Door and Drawer Front Interface Style: Flush overlay.
3. Wood Species for Exposed Surfaces: Brown Ash.
4. Cut: Plain sliced/plain saw**n**.
5. Grain Direction: Vertically for doors and fixed panels, horizontally for drawer fronts, except as noted in Drawings.
6. Matching of Veneer Leaves: Random match.
7. Veneer Matching within Panel Face: Running match.
8. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
9. Drawer Subfronts, Sides, and Backs: Baltic birch plywood.
10. Drawer Bottoms: Baltic birch plywood.

D. Wood Bench and Countertop for Transparent Finish: Custom grade.

1. Type of Construction: As indicated per Drawings.
2. Wood Species for Exposed Surfaces: Teak wood with hand rubbed Tung oil finish or Architect approved equal.

2.02 MATERIALS

A. Wood Moisture Content: 5 to 10 percent.

B. Medium-Density Fiberboard: ANSI A208.2, Grade 130**,** made with binder containing no urea formaldehyde.

C. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde, or Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.

D. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

E. High-Pressure Decorative Laminate: NEMA LD 3.

1. Manufacturers:

a. Abet Laminati, Inc.
b. Formica Corporation.
c. Lamin-Art, Inc.
d. Panolam Industries International, Inc.
e. Wilsonart International; Div. of Premark International, Inc.
f. Or Architect approved equal.

2.03 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 CABINET HARDWARE AND ACCESSORY MATERIALS

A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100-170 degrees of opening as indicated in Drawings**,** self-closing.

B. Wire Pulls: Back mounted, solid metal, lengths as indicated in Drawings, 5/16 inch (8 mm) in diameter, and 2-1/2 inches (63.5 mm) deep.

C. Catches: Push-in magnetic catches, BHMA A156.9, B03131 or Roller catches, BHMA A156.9, B03071. Locations as indicated in Drawings.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.

E. Shelf Rests: ¼" nickel "L" shelf pin with vinyl; see 4/A522 or BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

F. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
3. Keyboard Slides: Grade 1.
4. Trash Bin Slides: Grade 1HD-100.

G. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: 3 inches (75 mm) OD, color as selected, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "XG series" by Doug Mockett & Company, Inc.

K. Exposed Hardware Finishes: Comply with BHMA A156.18 for BHMA code number indicated.

1. Finish: Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9

M. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to 15 percent moisture content.

2.05 FABRICATION

A. Complete fabrication to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

2.06 SHOP FINISHING OF WOOD CABINETS

A. Finishes: Same grades as items to be finished.

B. Finish cabinets at the fabrication shop; defer only final touch up until after installation.

1. Apply one coat of sealer or primer to concealed surfaces of cabinets. Apply two coats to end-grain surfaces.
2. Apply a wash coat sealer to woodwork made from closed-grain wood before staining and finishing.
3. After staining, if any, apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

C. Transparent Finish:

1. Finish: System - 11, catalyzed polyurethane.
2. Staining: Match Architect's sample.
3. Sheen: Satin

PART 3 - EXECUTION

3.01 INSTALLATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Install cabinets to comply with referenced quality standard for grade specified.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed attachments, countersunk and filled flush.

F. Install teak and other countertops as indicated on drawings.

G. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips, or as indicated in Drawings.

END OF SECTION 06 41 00

Division 07 – Thermal and Moisture Protection

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation
2. Glass-fiber blanket insulation
3. Mineral-wool blanket insulation
4. Spray polyurethane foam insulation
5. Spray-applied fire-ignition thermal barrier coating for spray foam insulation
6. Sill sealer insulation

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Environmental Quality Submittals:

1. Product Data: For glass-fiber blanket insulation, documentation indicating that product and binder contains no urea formaldehyde.
2. Product Data: For VOC limit of fire-ignition thermal barrier coating. Must comply with SCAQMD and EPA VOC requirements. Documentation including printed statement of VOC content.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of fire-ignition thermal barrier coating.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

D. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

E. Research/Evaluation Reports: For fire-ignition thermal barrier coating, from ICC-ES.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by spray-applied polyurethane foam insulation and fire-ignition thermal barrier coating manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.05 FIELD CONDITIONS

A. Environmental Limitations: Do not apply spray-applied polyurethane foam insulation and fire-ignition thermal barrier coating when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire-ignition thermal barrier coating, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until thermal barrier coating dries thoroughly.

PART 2 - PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION

A. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:

a. Atlas Roofing Corporation.
b. Dow Chemical Company (The).
c. Rmax, Inc.
d. Or Architect approved equal.

2.02 GLASS-FIBER BLANKET INSLULATION

A. Manufacturers:

1. Johns Manville Microlite “L” or Thermal-SHIELD Free.
2. Or Architect approved equal.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Blanket insulation shall be R-11 minimum, unless noted otherwise on drawings.

D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2.03 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:

a. Demilec (USA) LLC; HeatLoc Soy 200
b. Icynene Inc.; MD-C-200
c. Or Architect approved equal

2. Minimum density of 2.0 lb/cu. ft.

B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:

a. Demilec (USA) LLC; Sealection AgriBalance
b. Icynene Inc.; MD-R-200
c. Or Architect approved equal

2. Minimum density of 0.6 lb/cu. ft.

2.04 SPRAY-APPLIED THERMAL BARRIER COATING FOR SPRAY FOAM INSULATION

A. NFPA 286 and IBC Compliant spray-applied, polymer-based 15 minute thermal barrier coating for Closed-Cell Polyurethane Foam Insulation and Open-Cell Polyurethane Foam Insulation.

1. Manufacturers:

a. Demilec LLC; Blazelok TB 200.
b. Energsmart; Fire-Lok Thermal-Ignition Barrier.
c. Foam It Green; Thermal Barrier.
d. PSI Inc.; Stayflex 2505 Thermal Barrier Coating.

e. SprayFoam; GacoFirestop FireShell Coating.
f. Or Architect approved equal.

2. Applied in accordance with manufacturer's requirements to meet fire resistance requirements of applicable codes.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
4. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 50 or less.

5. Hardness: Not less than 50, Type D durometer, according to ASTM D 2240.

B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Under-coaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Fireproofing Exterior Coatings: 350 g/L.

Low-Emitting Materials: Low VOC; not to exceed SCAQMD requirements for indoor environments.

C. Asbestos: Provide products containing no detectable asbestos.

2.05 SILL SEALER INSULATION

A. Closed cell polyethylene foam insulation roll stock.

1. Manufacturers:

   a. Owens Corning Formular ; 1/4 in. thick x 5 1/2 in. wide
   b. Pactiv Green Guard sill sealer; 1/4 in. thick x 5 1/2 in. wide
   c. Reflectix, Inc.; 1/4 in. thick x 5 1/2 in. wide
   d. Or Architect approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer. Tape joints as recommended by manufacturer.

C. Glass-Fiber Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.

D. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

1. Spray-Applied fire-ignition thermal barrier coating shall be applied where indicated over spray-applied insulated surfaces in accordance with manufacturer’s requirements to meet fire resistance requirements of applicable codes.

E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

F. Sill sealer insulations. Install below wall sill plates per manufacturer's recommendations.

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

Test and inspect fire-ignition thermal barrier coating as required by the IBC, 1704.11.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire-ignition thermal barrier coating for the next area until test results for previously completed applications of fire-ignition thermal barrier coating show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fire-ignition thermal barrier coating will be considered defective if it does not pass tests and inspections.

1. Apply additional fire-ignition thermal barrier coating, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

3.05 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fire-ignition thermal barrier coating, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire-ignition thermal barrier coating will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fire-ignition thermal barrier coating and repair damaged areas and fire-ignition thermal barrier coating removed due to work of other trades.

D. Repair fire-ignition thermal barrier coating damaged by other work before concealing it with other construction.

E. Repair fire-ignition thermal barrier coating by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

F. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Building wrap.
2. Flexible flashing.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing joint and penetration treatment.

1.02 SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

B. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.01 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. DuPont (E. I. du Pont de Nemours and Company); Tyvek StucoWrap.
b. Or Architect approved equal

2. Water-Vapor Permeance: Not less than 50g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.02 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.0 mm).

1. Products: Subject to compliance with requirements, provide one of the following:

a. As recommended by Water-Resistant Barrier Manufacturer.
b. Or Architect approved equal

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

C. Spray Foams: As recommended by Water-Resistant Barrier Manufacturer.

D. Sealants: As recommended by Water-Resistant Barrier or Flashing Manufacturers.

E. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.01 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.02 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates

END OF SECTION 07 25 00

SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

1.02 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.03 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7. Wind loads as indicated on drawings.

D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

E. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Environmental Quality Compliance Submittals:

1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
2. Product Data: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Roof insulation.
3. Roof paver in each color and texture required.
4. Termination bars.
5. Battens.
6. Six insulation fasteners of each type, length, and finish.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

C. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

D. Warranties: Sample of special warranties.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, vapor barrier, adhesives, roofing membrane, roofing accessories, and other components of membrane roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, adhesives, for the following warranty period:

Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle SynTec Incorporated.
b. Firestone Building Products.
c. GAF Materials Corporation.
d. Johns Manville.

e. Or Architect approved equal.

2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: White on black.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier, or inside the vapor barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Non-membrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.
j. Other Adhesives and Sealants: 250 g/L.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, 55- to 60-mil- (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant**,** colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.03 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.

2.04 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

2.05 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multi-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Continuously seal side and end laps with tape and adhesive.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.04 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

E. Mechanically Fastened and Adhered Insulation: Install insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

3.05 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

H. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

I. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

J. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.06 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.07 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.08 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: 20 years
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. Lightning;
   b. Peak gust wind speed exceeding 90 mph (m/sec);
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION 07 53 23

SECTION 07 61 00 - SHEET METAL ROOFING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

B. Comply with SMACNA's "Architectural Sheet Metal Manual" unless otherwise indicated.

C. Warranties: Provide manufacturer's standard written warranty, signed by manufacturer agreeing to promptly repair or replace roofing sheet metal that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

D. Warranties: Standard form in which roofing Installer agrees to repair or replace sheet metal roofing that fails in materials or workmanship within 5 years from date of Substantial Completion.

1.02 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system including, but not limited to, metal roof panels, cleats, clips, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim**,** battens, underlayment, and accessories shall comply with requirements indicated without failure due to defective manufacture, fabrication, installation, or other defects in construction. Sheet metal roofing shall remain watertight.

B. Fabricate and install roof edges capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

Retain wind zone from four subparagraphs below to suit Project. Wind zones are areas of a roof as they relate to roof slope and design wind speed. See FMG Loss Prevention Data Sheet 1-28, Table 4. Wind Zone 1 is subdivided into two ranges. FMG Loss Prevention Data Sheet 1-49 tabulates a range of metal types and thicknesses that meet Wind Zones 1 and 2 and prescribes minimum anchoring of wood nailers, continuous cleats (hook strips), roof edge flashing, copings, and counterflashing. Wind Zone 3 requires assemblies of special design.

C. Wind Zone and wind loading structural design pressures: As indicated on structural drawings and calculations.

Thermal Movements: Provide sheet metal roofing that allows for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.Differential values (for aluminum in particular) in subparagraph below are suitable for most of the U.S.

Temperature Change (Range): [120 deg F (67 deg C), ambient; material surfaces.

PART 2 - PRODUCTS

2.01 ROOFING SHEET METALS

A. Energy Performance of Roofing Sheet Metal: Initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

B. Solar Reflectance Index of Roofing Sheet Metal: Not less than 78 when calculated according to ASTM E 1980.

C. Metallic-Coated Steel Sheet: Galvanized structural-steel sheet, ASTM A 653/A 653M, G90 (Z275), Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); 0.025-inch (0.64-mm) nominal thickness.

1. Finish: Manufacturer's standard uncoated panels as described above.
2. Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish.

2.02 ACCESSORIES

A. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

1. Products:

a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
c. Henry Company; Blueskin PE200 HT.
d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High-Temperature Underlayment.
f. Or Architect approved equal.

B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners.

1. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanized steel or Series 300 stainless steel.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Metal Accessories: Matching sheet metal roofing in finish and material required for a complete weathertight roofing system, including clips, flashings, ridge closure strips, trim, copings, fasciae, gutters, and louvers.

2.03 FABRICATION

A. Fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of installation indicated.

1. Flat-Seam Roofing: Form flat-seam pans from metal sheets 20 by 28 inches (510 by 710 mm) with 1/2-inch (13-mm) notched and folded edges.

2. Standing-Seam Roofing: Form standing-seam pans with minimum finished seam height of 1 inch (25 mm).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with SMACNA's "Architectural Sheet Metal Manual." Allow for thermal expansion; set true to line and level. Install Work with laps, joints, and seams permanently watertight and weatherproof; conceal fasteners where possible.

B. Apply self-adhering sheet underlayment at eaves and rakes from edges of roof to at least 24 inches (600 mm) exterior wall line.

C. Apply slip sheet over underlayment before installing metal roof panels.

D. Anchor roofing securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

E. Separate dissimilar metals with a polymer-modified, bituminous sheet underlayment.

F. Install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering temper and reflectivity of metal. Provide uniform, neat seams with minimum exposure of solder and sealant. Fold back sheet metal to form a hem on concealed side of exposed edges unless otherwise indicated.

1. Install cleats to hold sheet metal panels in position. Attach each cleat with two fasteners to prevent rotation.
2. Screw cleats not more than 12 inches (300 mm) o.c. Bend tabs over nails.
3. Double the number of cleats installed along aoutside four foot perimeter of roof eaves, rakes and ridges to resist wind uplift loads.

G. Seal joints as shown and as required for leakproof construction. Provide low-slope transverse seams using cleats where backup of moisture may occur. Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

1. Do not solder metallic-coated steel

H. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

END OF SECTION 07 61 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data**,** Shop Drawings, and Samples.

B. Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

C. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.02 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

Retain first paragraph below for roof edge flashing and copings if Project is FMG insured or if FMG requirements will set a minimum quality standard and if delegating design to Contractor. Delete if requirements for copings or roof edge flashing are fully specified and drawn. Minimum thickness of sheet metal may also be governed by fastening patterns, continuous or intermittent cleats, and coping or roof edge flashing profiles. In addition to FMG Loss Prevention Data Sheet 1-49, SMACNA and NRCA offer limited design guidance.

B. Fabricate and install roof edge flashing and trim capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

Retain wind zone from four subparagraphs below to suit Project. Wind zones are areas of a roof as they relate to roof slope and design wind speed. See FMG Loss Prevention Data Sheet 1-28, Table 4. Wind Zone 1 is subdivided into two ranges. FMG Loss Prevention Data Sheet 1-49 tabulates a range of metal types and thicknesses that meet Wind Zones 1 and 2 and prescribes minimum anchoring of wood nailers, continuous cleats (hook strips), roof edge flashing, copings, and counterflashing. Wind Zone 3 requires assemblies of special design.

C. Wind Zone and wind loading structural design pressures: As indicated on structural drawings and calculations.

Thermal Movements: Provide sheet metal roofing that allows for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Differential values (for aluminum in particular) in subparagraph below are suitable for most of the U.S.

Temperature Change (Range): [120 deg F (67 deg C), ambient; material surfaces.

PART 2 - PRODUCTS

2.01 SHEET METAL

A. Metallic-Coated Steel Sheet: Galvanized structural-steel sheet, ASTM A 653/A 653M, G90 (Z275), Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); 0.025-inch (0.64-mm) nominal thickness.

1. Finish: Manufacturer's standard uncoated panels as described above.
2. Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish.

2.02 ACCESSORIES

A. Self-Adhering Sheet Underlayment, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970..

B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners.

1. Exposed Fasteners: Heads matching color of sheet metal roofing using plastic caps or factory-applied coating.
2. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
3. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanized steel or Series 300 stainless steel.

D. Butyl Sealant: ASTM C 1311, solvent-release butyl rubber sealant.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION

A. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Window Sill flashing – fabricated from 26 ga. galvanized steel

E. Window and door head flashing – fabricated from .032 aluminum

F. Clerestory sill flashing – fabricated from 24 ga. galvanized steel or weathered steel as indicated in Drawings.

G. Receiver flashings and counter flashings – fabricated from 26 ga. galvanized steel

H. Module C roof flashings - fabricated from 24 ga. galvanized steel

I. Drip edges - fabricated from 26 ga. galvanized steel

J. Fascia panels - fabricated from 24 ga. galvanized steel or weathered steel as indicated in Drawings.

K. Gutters – fabricated from 24 ga. galvanized steel, profile as shown in Drawings.

L. 4” Round Downspouts - fabricated from 24 ga. galvanized steel

M. Concealed Cleats – fabricated from 24 ga. galvanized steel

2.04 INSTALLATION

A. Comply with SMACNA's "Architectural Sheet Metal Manual." Allow for thermal expansion; set true to line and level. Install Work with laps, joints, and seams permanently watertight and weatherproof; conceal fasteners where possible.

B. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

C. Fabricate nonmoving seams in sheet metal with flat-lock seams.

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.

1. Do not solder metallic-coated steel sheet.

E. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.

END OF SECTION 07 62 00

SECTION 07 84 13 - PENETRATION AND JOINT FIRESTOPPING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Installer certificates signed by Installer certifying that products have been installed in compliance with requirements.

PART 2 - PRODUCTS

2.01 PENETRATION AND JOINT FIRESTOPPING

A. Manufacturers:One of the following:

1. Grace Construction Products.
2. Hilti, Inc.
3. 3M Fire Protection Products.
4. USG Corporation.

B. Provide penetration and joint firestopping materials that are compatible with one another, substrates, and penetrating items if any.

C. Penetrations and joints in Fire-Resistance-Rated Walls and Horizontal Assemblies: Provide penetration and joint firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating at Fire-Resistance-Rated Walls: Not less than that of construction penetrated.
2. F-Rating at Horizontal Assemblies: At least 1 hour, but not less than that of construction penetrated.
3. T-Rating at Horizontal Assemblies: At least 1 hour, but not less than the fire-resistance rating of construction penetrated except for penetrations within the cavity of a wall.

D. Penetrations and joints in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. VOC Content: Penetration and joint firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

F. Exposed Penetration and Joint Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. Accessories: Provide components for each penetration and joint firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install penetration and joint firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Designation of applicable testing and inspecting agency.
3. Manufacturer's name.
4. Installer's name.

C. Owner will engage a qualified testing agency to perform tests and inspections.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

1.02 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 JOINT SEALANTS

A. Low-Emitting Materials: Sealants shall comply with the following limits for VOC content:

1. Architectural Sealants: 250 g/L.
2. Nonmembrane Roof Sealants: 300 g/L.
3. Single-Ply Roof Membrane Sealants: 450 g/L.
4. Other Sealants: 420 g/L.
5. Sealant Primers for Nonporous Substrates: 250 g/L.
6. Sealant Primers for Porous Substrates: 775 g/L.
7. Modified Bituminous Sealant Primers: 500 g/L.
8. Other Sealant Primers: 750 g/L.

B. Low-Emitting Materials:

1. Exterior reactive sealants shall have a VOC content of not more than 50 g/L or 4 percent by weight, whichever is greater.
2. Other exterior caulks and sealants shall have a VOC content of not more than 30 g/L or 2 percent by weight, whichever is greater.

C. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.

D. Sealant for Use in Building Expansion Joints, One of the Following:

1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 50; for Use NT.

a. Products:

i Dow Corning Corporation; 795.

2. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 100/50; for Use NT.

a. Products:

i Dow Corning Corporation; 790.

E. Sealant for General Exterior Use Where Another Type Is Not Specified**,** One of the Following:

1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT.

a. Products:

i Dow Corning Corporation; 799.
ii Dow Corning Coporation; 756 SMS.

F. Sealant for Use in Interior Joints in Ceramic Tile and Other Hard Surfaces in Kitchens and Toilet Rooms and Around Plumbing Fixtures:

1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; for Use NT; formulated with fungicide.

a. Products:

i Dow Corning Corporation; 786 Mildew Resistant.

G. Gap Fillers:

1. Gaps & cracks insulating foam sealant. Single-component, closed cell polyurethane post-expanding foam. UL Classified.

a. Products:

i Dow Great Stuff Gaps & Cracks insulating foam sealant.

2. Single-component closed cell polyurethane foam sealant. UL Classified.

a. Products:

i Dow Great Stuff Window & Door.

H. Roofing sealants:

1. Butyl rubber sealants.

a. Products:

i Red Devil Butyl Rubber Sealant.
ii Firestone Water-Block Seal (S-20) Butyl Rubber Sealant.

I. Sealant for Interior Use at Perimeters of Door and Window Frames:

1. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

a. Products:

i BASF Building Systems; Sonolac.
ii Tremco Incorporated; Tremflex 834.

2.02 MISCELLANEOUS MATERIALS

A. Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

D. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with ASTM C 1193.

B. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal perimeters, control joints, openings, and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions. Comply with ASTM C 919.

END OF SECTION 07 92 00

Division 08 – Opening

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Samples for factory-finished doors.

PART 2 - PRODUCTS

2.01 Manufacturers:

A. Algoma Hardwoods, Inc.

B. Ampco, Inc.

C. Buell Door Company Inc.

D. Eggers Industries.

E. Ideal Architectural Doors & Plywood.

F. Marshfield Door Systems, Inc.

G. Mohawk Flush Doors, Inc.; a Masonite company.

H. Vancouver Door Company.

I. or equal approved by custom fabricator

2.02 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: WDMA I.S.1-A.

B. Fire-Rated Wood Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Where indicated provide doors that have a temperature rise rating of 450 deg F (250 deg C).

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784 and installed in compliance with NFPA 105.

D. Certified Wood: Wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification.".

E. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

F. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.

G. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated. Provide the following for mineral-core doors:

1. Composite blocking where required to eliminate through-bolting hardware.
2. Laminated-edge construction.
3. Formed-steel edges and astragals for pairs of doors.

2.03 FLUSH WOOD DOORS

A. Doors for Transparent Finish:

1. Exterior Solid-Core Doors: Premium grade, five-ply, structural composite lumber cores.

a. Faces: Grade A plain-sliced select any closed-grain hardwood.
b. Veneer Matching: Slip and running match.
c. Pair matching.

2. Interior Solid-Core Doors: Premium grade, five-ply, particleboard or structural composite lumber cores as indicated in Drawings.

a. Faces: Grade A plain-sliced select white birch.
b. Veneer Matching: Slip and running match.
c. Pair matching and set matching.
d. Continuous matching for doors with transoms.

B. Doors for Opaque Finish:

1. Exterior Solid-Core Doors: Custom grade, five-ply, structural composite lumber cores.

a. Faces: Any closed-grain hardwood.

2. Interior Solid-Core Doors: Custom grade, five-ply, structural composite lumber cores.

a. Faces: Any closed-grain hardwood, Hardboard, or MDF.

2.04 FABRICATION AND FINISHING

A. Factory fit doors to suit frame-opening sizes indicated and to comply with clearances specified.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.

C. Cut and trim openings to comply with referenced standards.

1. Trim light openings with moldings indicated.
2. Factory install glazing in doors indicated to be factory finished.
3. Factory install louvers in prepared openings.

D. Factory finish doors indicated for transparent finish with manufacturer's standard finish complying with WDMA TR-6, catalyzed polyurethane for grade specified for doors.

1. Sheen: Satin.

E. Factory finish doors indicated for opaque finish with manufacturer's standard finish complying with WDMA OP-6, catalyzed polyurethane for grade specified for doors.

1. Sheen: Satin.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated.

Install fire-rated doors to comply with NFPA 80.

B. Align and fit doors in frames with uniform clearances and bevels. Machine doors for hardware. Seal cut surfaces after fitting and machining.

C. Clearances: As follows unless otherwise indicated:

1. 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
2. 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering.
3. 1/4 inch (6.4 mm) from bottom of door to top of threshold.
4. Comply with NFPA 80 for fire-rated doors.

D. Repair, refinish, or replace factory-finished doors damaged during installation, as directed by Architect.

END OF SECTION 08 14 16

SECTION 08 52 00 - WOOD WINDOWS AND DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Engineered sliding/folding wood and glass door system, including wood/aluminum frame.
2. Fixed wood windows similar to the engineered sliding/folding wood and glass door system.
3. Operable wood windows similar to the engineered sliding/folding wood and glass door system.
4. Wood and glass entry swing doors.

B. Related Sections:

1. Section 087100, Door Hardware
2. Section 088000, Glazing
3. Section 099300, Staining and Transparent Finishing

1.02 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.
2. Owner's manual with installation instructions.

B. Shop Drawings: Include dimensioned plans, elevations, sections, hardware, accessories, direction of swing, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

D. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units

E. Product Schedule: For wood windows. Use same designations indicated on Drawings.

F. Qualification Data: For manufacturer and Installer.

G. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.

H. Sample Warranties: For manufacturer's warranties.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: A certified trained installer acceptable to wood window manufacturer for installation of units required for this Project to obtain 2-year warranty on window components.

1.04 PERFORMANCE

A. All windows and doors shall comply with Passive House Standards.

1.05 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows and doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Rollers: 10 years from date of Substantial Completion
b. Glazing Units: 10 years from date of Substantial Completion for seal failure.
c. All other components: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide NanaWall WA67 for sliding/folding windows and doors and matching doors for fixed windows and similar operable windows provide WD68 for windows and W66 for door #101A (also similar matching unclad door and fixed windows) as manufactured by Nana Wall Systems; website: www.nanawall.com; phone: 1-800-873-567, or comparable product by one of the following:

1. approved equal

B. Source Limitations: Obtain wood windows from single source from single manufacturer.

2.02 WINDOW AND DOOR PERFORMANCE REQUIREMENTS

A. Folding Door and Frame System:

1. Air leakage shall not exceed 0.10 cfm per square foot of overall frame when tested at 1.57 psf according to ASTM E 283.
2. No water penetration when tested at 9.0 psf according to ASTM E 547.
3. Assembly shall withstand a positive or negative uniform static air pressure difference of 35 psf without damage when tested according to ASTM E 330-90.

B. Thermal Transmittance: Provide folding door and frame systems with a whole-panel U-value maximum of 0.30 at 15-mph exterior wind velocity and winter condition temperatures when tested according to NFRC 100.

C. Solar Heat-Gain Coefficient: Provide wood windows with a whole-window SHGC maximum of 0.38, determined according to NFRC 200 procedures.

2.03 WOOD WINDOWS AND DOOR

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Engineered Sliding/Folding.
2. Engineered Fixed and Operable.
3. Engineered Swing Entry Doors.

B. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.

1. Provide panels with Standard one lite
2. Provide stile and rail width of 3 1/16”
3. Provide stile and rail depth of 2 5/8”
4. Provide standard bottom rail at windows; rail at entry door as shown on the drawings.
5. Type of Wood: Solid, three layer, cross-grained, kiln dried **Douglas fir** – PEFC
6. Construction of wood panels to include close tolerance mortise and tenon, glued and pinned corners
7. Wood Finish: Finishes to be water based, open pored clear sanding sealer for stain. Field finish with minimum two coats of final protected finish prior to installation, see Section 099300, Staining and Transparent Finishes
8. Aluminum Extrusion: Extrusions with nominal thickness of .078”. Alloy specified as AlMgSi0.5 with strength rated as 6063-T5. Anodized conforming to AAMA 611.98.

C. Insulating-Glass Units: See Section 088000, Glazing.

1. Provide manufacturer's standard dark bronze spacers.

D. Glazing System: See Section 088000, Glazing.

E. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range unless indicated otherwise.

F. Sliding/Folding Window Hardware:

1. Locking Hardware and Handles: On all pairs of folding panels, provide manufacture's standard flat 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.

a. Flat Handle Finish: Stainless steel in a brushed finish.
b. Provide handle height centered at 18" from bottom of panel.
c. Aluminum locking rods with fiber glass reinforced polyamine end caps at top and bottom. Rods to have stroke of 15/16".

2. Sliding/Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks and threshold. All running carriages to be sealed, self-lubrication, ball bearing multi-rollers. Surface mounted hinges and running carriages will not be allowed.

a. For each pair of folding panels: Floor mounted system WD66/u, provide upper guide carriage and lower running carriage with four vertical stainless wheels and two horizontal wheels. The vertical wheels to ride on stainless steel guide track covers over the full length of the sill track. Carrying capacity of lower carriage to be 220 lbs. minimum.
b. Threshold: Provide thermally broken with polyamide, clear anodized flush sill. Cover plate over the sill will not be allowed.
c. Provide manufacturer's standard dark bronze anodized aluminum hinges and spine on edge panel. For structural strength, hinges to be connected to spine and not directly into wood. 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, 1/8" per hinge and in height, ¼" up and down.

G. Other Operable Window Hardware:

1. Locking Hardware and Handles: On all other operable window panels, provide manufacture's standard flat handles and concealed two point locking hardware operated by 180 degree turn of handle. Face applied flush bolt locking will not be allowed.

a. Flat Handle Finish: Stainless steel in a brushed finish.

b. Provide handle location as shown on drawings, or centered on window panels if not shown.
c. Aluminum locking rods with fiber glass reinforced polyamine end caps at top and bottom. Rods to have stroke of 15/16".

H. Main Entry Door Hardware: On the main entry swing panel, see section 087100, Door Hardware.

I. Weather Stripping: Provide manufacturer's standard double layer EPDM seals with two layer polyamide fin at both the inner and outer edge of door panels or on frame for sealing between panels and between panels and frame. Single layer weather stripping will not be allowed. Provide full-perimeter weather stripping for each operable sash and door unless otherwise indicated.

J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.04 ACCESSORIES

A. Roller Shades: See specification section 122413, Roller Window Shades

2.05 FABRICATION

A. Use solid, three layer, cross grained frame and panel profiles, hinges and spines, sliding and folding hardware, locking hardware and handles, threshold and track, glass and glazing and weather stripping with all components and installation instructions.

B. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.

C. Glaze wood windows in the factory.

D. Weather strip each operable sash to provide weathertight installation.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Because of the large dimensions involved and the weight and movement of the panels, verify the structural integrity of the header such that the maximum deflection with the live and dead loads is limited to be the lesser of L/270 or ¼". Structural support for lateral loads (both wind and eccentric load when the panels are stacked open) must be provided.

2. If building deadloads are applied to the header prior to installing the sliding/folding and swinging panels/door, and if a reasonable amount of time has been allowed for the effect of the dead load on the header, then only the building's live load may be used to meet the requirements of L/720 or ¼". If dead loads are not in place, both dead and live loads need to be considered.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Entry Door: Coordinate with door hardware contractor to prepare door for approved hardware.

3.03 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.04 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating panels and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 52 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Allowances: Door hardware is included in Hardware Allowance.

B. Submittals: Hardware schedule.

PART 2 - PRODUCTS

2.01 HARDWARE

A. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated. On exit devices provide label indicating "Fire Exit Hardware."

B. Hinges:

1. Manufacturers:

a. Baldwin Hardware Corporation.
b. Hager Companies.
c. IVES Hardware; an Ingersoll-Rand company.
d. McKinney Products Company; an ASSA ABLOY Group company.
e. Trimco.
f. Stanley

2. Stainless-steel hinges with stainless-steel pins.
3. Nonremovable hinge pins for exterior.
4. Ball-bearing hinges for doors with closers and entry doors.
5. Two hinges for 1-3/8-inch- (35-mm-) thick wood doors.
6. Three hinges for 1-3/4-inch- (45-mm-) thick doors 90 inches (2300 mm) or less in height; four hinges for doors more than 90 inches (2300 mm) in height.

C. Locksets and Latchsets:

1. Manufacturers:

a. Accurate Lock & Hardware Co.
b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
c. Arrow USA; an ASSA ABLOY Group company.
d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
e. Falcon Lock; an Ingersoll-Rand Company.

f. Hager Companies.
g. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
h. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
i. Sargent Studio Collection; an ASSA ABLOY Group company.
j. Rockwood, an ASSA ABLOY Group company.
k. Schlage

2. BHMA A156.2, Series 4000, Grade 1 for bored locks and latches.
3. BHMA A156.3, Grade 1 for exit devices.
4. BHMA A156.5, Grade 1 for auxiliary locks.
5. BHMA A156.12, Series 5000, Grade 1 for interconnected locks and latches.
6. BHMA A156.13, Series 1000, Grade 1 for mortise locks and latches.
7. Lever handles on locksets and latchsets.
8. Provide trim on exit devices matching locksets.

D. Key locks to Owner's new master-key system.

1. Cylinders with six-pin tumblers.
2. Provide construction keying.
3. Provide key control system, including cabinet.

E. Provide wall stops or floor stops for doors without closers.

1. Manufacturers:

a. Hager Co.
b. Trimco

F. Hardware Finishes:

1. Hinges: Matching finish of lockset/latchset.
2. Locksets, Latchsets, and Exit Devices: Satin Stainless Steel.
3. Closers: Matching finish of lockset/latchset.
4. Other Hardware: Matching finish of lockset/latchset.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount hardware in locations required to comply with governing regulations and according to SDI A250.8 and DHI WDHS.3.

B. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet.

C. Deliver keys to Owner.

3.02 HARDWARE SCHEDULE

A. Hardware Set No. 1 (Doors #101A): All hardware to be determined and supplied by NanaWall Representative and Architect.

1. Hinges.
2. Entry Lock
3. Floor Stop
4. Threshold
5. Door Bottom
6. Seal

B. Hardware Set No. 2 (Door #107):

1. Hinges: Hager 4-1/2 x 4-1/2" hinges AB800(US32D) (3 per door).
2. Threshold: Pemko or equiv. aluminum plate 3-1/2 x ¼" 14_1
3. Bush Door Shoe: Pemko – 234APK
4. Edge Seal: McKinney adhesive-backed gasket MCKS88BL
5. Lockset: Sargent Metro Elements MI Aventura series cylinder lockset (US32D)
6. Floor Door Stop: Trimco #7280 (US32D)

C. Hardware Set No.3 (Doors #105):

1. Sliding Track: Hafele top-hung system, ALU 40
2. Pulls: Custom pulls per Drawings

D. Hardware Set No. 4 (Doors # 106A, Bedroom Barn Door):

1. Sliding Track: Sugatsune flush mount system, KS-85, Track, KS-3490, Flush, KS-3502
2. Pulls: Custom per Drawings

E. Hardware Set No. 5 (Doors #103A, 106B):

1. All hardware to be determined and supplied by NanaWall Representative and Architect.

F. Hardware Set No. 6 (Doors #108):

1. Hinges: Simonswerk 'Tectus' TE 240 3D-SSL (3 per leaf)
2. Touch Latch: Sugatsune ML-120, white finish, long stroke magnetic touch latch for large doors.
3. Silencer Magnetic Door Hold-Open: Hager 307D, (6) per leaf.

END OF SECTION 08 71 00

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

1. GANA Publications: GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

C. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

D. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

PART 2 - PRODUCTS

2.01 GLASS, GENERAL

A. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated.

B. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201. Provide safety glazing labeling where safety glass is indicated.

C. Windborne-Debris Resistance: Glazing passes basic protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886.

2.02 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3.

C. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

2.03 MONOLITHIC-GLASS TYPES

A. Glass Type: Clear heat-strengthened float glass or fully tempered float glass.

1. Thickness: As Required.
2. Provide safety glass.

B. Glass Type: Tinted float glass heat-strengthened float glass or fully tempered float glass.

1. Thickness: As required.
2. Tint Color: Green.
3. Solar Heat Gain Coefficient: 0.23 maximum.
4. Provide safety glass.

2.04 INSULATING-GLASS TYPES

A. Glass Type: Low-e-coated insulating glass.

1. Overall Unit Thickness: As Required.

2. Thickness of Each Glass Lite: As Required.
3. Outdoor Lite: Tinted heat-strengthened float glass or fully tempered float glass.
4. Tint Color: Green.
5. Interspace Content: Argon.
6. Indoor Lite: Clear heat-strengthened float glass or fully tempered float glass.
7. Winter Nighttime U-Factor: .29 maximum.
8. Summer Daytime U-Factor: .29 maximum.
9. Solar Heat Gain Coefficient: 0.23 maximum.

2.05 GLAZING SEALANTS

A. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: One of the following:

a. Dow Corning Corporation; 799 or 756 SMS.

B. Low-Emitting Materials: Sealants shall have a VOC content of not more than 250 g/L.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual."

B. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

C. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

B. Glazing Publications: Comply with the following published recommendations:

1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

PART 2 - PRODUCTS

2.01 MIRRORS, GENERAL

A. Manufacturers:

1. Arch Aluminum & Glass Co., Inc.
2. Avalon Glass and Mirror Company.
3. Guardian Industries.
4. Lenoir Mirror Company.
5. National Glass Industries.
6. Sunshine Mirror; Westshore Glass Corp.
7. Or Architect approved equal.

B. Glass Mirrors, General: ASTM C 1503**;** manufactured using copper-free, low-lead mirror coating process.

C. Safety Glazing Products: Provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

2.02 MATERIALS

A. Clear Glass: Mirror Glazing Quality, 6.0-mm nominal thickness.

B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; 6.0-mm nominal thickness.

C. Mirror Mastic: An adhesive setting compound, asbestos free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. Manufacturers:
   a. Laurence, C. R. Co., Inc.
   b. Pecora Corporation.
   c. Sommer & Maca Industries, Inc.
   d. Or Architect approved equal.

2. Low-Emitting Materials: Mastic shall have a VOC content of not more than 70 g/L.
3. Low-Emitting Materials: Mastic shall comply with Green Seal's GS-36 and 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."

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

E. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of each mirror in a single piece.

1. Finish: Clear bright anodized.

2.03 FABRICATION

A. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

B. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

B. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed so heads do not impose point loads on backs of mirrors.

1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points.
2. Mirror Clips: Place a felt or plastic pad between mirror and each clip. Locate clips so they are symmetrically placed and evenly spaced.
3. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 08 83 00

Division 09 – Finishes

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.02 METAL FRAMING AND SUPPORTS

A. Steel Framing Members, General: ASTM C 754.

1. Steel Sheet Components: ASTM C 645. Thickness specified is minimum uncoated base-metal thickness.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

B. Framing Systems:

1. Studs and Runners: In depth indicated and 0.018 inch (0.45 mm) thick unless otherwise indicated.
2. Flat Strap and Backing: 0.018 inch (0.45 mm) thick.
3. Hat-Shaped, Rigid Furring Channels: In depth indicated and 0.018 inch (0.45 mm) thick.
4. Resilient Furring Channels: 1/2 inch (13 mm) deep, with single- or double-leg configuration.
5. Cold-Rolled Furring Channels: 0.053 inch (1.34 mm) thick, 3/4 inch (19 mm) deep.
6. Z-Furring: In depth required by insulation or as shown, 1-1/4-inch (32-mm) face flange, 7/8-inch (22-mm) wall-attachment flange, and 0.018 inch (0.45 mm) thick.

2.03 ACCESSORIES

A. General: Comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: foam gasket.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install steel framing to comply with ASTM C 754."

1. Gypsum Plaster Assemblies: Also comply with ASTM C 841.
2. Portland Cement Plaster Assemblies: Also comply with ASTM C 1063.
3. Gypsum Veneer Plaster Assemblies: Also comply with ASTM C 844.
4. Gypsum Board Assemblies: Also comply with ASTM C 840.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Isolate steel framing from building structure, except at floor, to prevent transfer of loading imposed by structural movement.

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.

D. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.02 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Type X where indicated, type as required for specific fire-resistance-rated assemblies. Sag-resistant type for ceiling surfaces. Other types as indicated on Drawings.

1. Manufacturers:

a. American Gypsum.
b. CertainTeed Corp.
c. Georgia-Pacific Gypsum LLC.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Temple-Inland.
h. USG Corporation.

C. Glass-Mat, Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M, of thickness indicated. Type X where required for fire-resistance-rated assemblies and where indicated.

1. Products: One of the following:

a. CertainTeed Corp.; GlasRoc Tile Backer.
b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.

D. Cementitious Backer Units: ANSI A118.9, ASTM C 1288, or ASTM C 1325.

1. Products:

a. C-Cure; C-Cure Board 990.
b. CertainTeed Corp.; FiberCement.
c. Custom Building Products; Wonderboard.
d. James Hardie Building Products, Inc.; Hardiebacker.
e. National Gypsum Company, Permabase Cement Board.
f. USG Corporation; DUROCK Cement Board.

2.03 ACCESSORIES

A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, or rolled zinc.

1. Provide cornerbead at outside corners unless otherwise indicated.
2. Provide LC-bead (J-bead) at exposed panel edges.
3. Provide control joints where indicated.
4. Provide other trim accessories as indicated in Drawings.

B. Aluminum Accessories: Extruded-aluminum accessories indicated with Class II, clear anodic finish; AA-C12C22A31.

1. Manufacturers:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

C. Joint-Treatment Materials: ASTM C 475/C 475M.

1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
2. Joint Compounds: Setting-type compounds for fire resistance rated construction and penetrations. Drying-type, ready-mixed, all-purpose compounds for other conditions.
3. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
4. Cementitious Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer.

D. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.

1. Sealants shall have a VOC content of 250 g/L or less.
2. Sealants 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."

E. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced) and free of formaldehyde.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.

1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
2. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.

B. Install cementitious backer units to comply with ANSI A108.11.

C. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

D. Finishing Gypsum Board: ASTM C 840.

1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
3. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
4. Where indicated, provide Level 5 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Apply skim coat to entire surface.

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Obtain tile of each type and color or finish from same production run for each contiguous area

C. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling ceramic tile packages.

PART 2 - PRODUCTS

2.01 CERAMIC TILE

A. Ceramic tile that complies with Standard grade requirements in ANSI A137.1, "Specifications for Ceramic Tile."

B. Tile Type: Factory-mounted unglazed, impervious natural clay or porcelain cushion-edged ceramic mosaic tile.

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

    a. American Olean; Division of Dal-Tile International Inc.
    b. Crossville, Inc.
    c. Daltile; Division of Dal-Tile International Inc.
    d. Deutsche Steinzeug America, Inc.
    e. Interceramic.
    f. Heath Ceramics.
    g. Imola Ceramic.
    h. Hirsch Glass Corp.

3. Module Size: 1 by 1 inch (25.4 by 25.4 mm).
4. Surface: Smooth, without abrasive admixture, except where indicated in Drawings.
5. Color and Pattern: As selected.
6. Grout Color: As selected.
7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile and matching characteristics of adjoining flat tile:

    a. External Corners for Portland Cement Mortar Installations: Glazed edge tile.

b. External Corners for Thin-Set Mortar Installations: Glazed edge tile.
c. Internal Corners: Field-butted square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

2.02 INSTALLATION MATERIALS

A. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall have a VOC content of 65 g/L or less.

B. Decoupling Membrane: DITRA, by Schluter Systems, ANSI A118.10 1/8" high-density polyethylene membrane with 1/2x1/2" square cavities each cut back in dovetail configuration, and polypropylene anchoring fleece laminated to its underside.

C. Waterproof Membrane: KERDI, by Schluter Systems, ANSI A118.10 0.008" thick, orange polyethylene membrane with polypropylene fleece laminated on both sides. Or Architect approved equal.

D. Shower Waterproofing: KERDI-Drain Shower ST/SC, by Schluter Systems, ANSI A118.10 0.008" thick, orange polyethylene membrane with polypropylene fleece laminated on both sides.

E. Threshold Strips: Metal Edging Strips by Schluter Systems or approved equal, profile as indicated in Drawings.

F. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.

G. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.

1. Thin-Set Mortar Type for Wood Subfloors: Unmodified thin-set mortar. ANSI A118.1 (per Schulter's recommendation).

a. Manufacturers:
b. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

i Bostik, Inc.
ii C-Cure.
iii Custom Building Products.
iv Laticrete International, Inc.
v MAPEI Corporation.
vi TEC; a subsidiary of H. B. Fuller Company.

2. Thick-Set Mortar Type for Wood Subfloors: Unmodified thick-set mortar. ANSI A108.2.

a. Manufacturers:

b. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

i Bostik, Inc.
ii C-Cure.
iii Custom Building Products.
iv Laticrete International, Inc.
v MAPEI Corporation.
vi TEC; a subsidiary of H. B. Fuller Company.

3. Grout Type: Grout incompliance with ANSI A118.3, A118.6, A118.7.

a. Manufacturers:
b. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

i Bostik, Inc.
ii C-Cure.
iii Custom Building Products.
iv Laticrete International, Inc.
v MAPEI Corporation.
vi TEC; a subsidiary of H. B. Fuller Company.

H. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: As recommended by tile and grout manufacturers. Formulated to resist grease, oil, water stains and dirt on porous polished and dense surfaces.

PART 3 -

3.01 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For installations indicated below, follow procedures in ANSI's "Specifications for the Installation of Ceramic Tile" for providing 95 percent mortar coverage.

a. Tile floors in wet areas.
b. Tile floors in laundries.
c. Tile floors composed of rib-backed tiles.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11.

E. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

F. Install waterproofing to comply with ANSI A108.13.

G. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

END OF SECTION 09 30 00

SECTION 09 64 00 - WOOD FLOORING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.01 WOOD FLOORING, GENERAL

A. Hardwood Flooring: Comply with NOFMA grading rules for species, grade, and cut.

1. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.

B. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.

1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.

C. Softwood Flooring: Comply with WCLIB grading rules for species, grade, and cut.

D. Certified Wood: Wood-based materials shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

2.02 FIELD-FINISHED WOOD FLOORING

A. Solid-Wood Strip and Plank Flooring: Kiln dried and as follows:

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Viridian Reclaimed Wood; Assorted tropical hardwoods
b. Or Architect approved equal.

3. Species and Grade: Varies.
4. Cut: Varies.
5. Thickness: 5/8 inch (16mm) [engineered product].
6. Face Width: 2-1/2 inches (63 mm).
7. Lengths: Random-length strips complying with applicable grading rules.
8. Edge Style: T & G.

B. Urethane Finish System: Complete water-based system of compatible components that is recommended by finish manufacturer for application indicated.

1. VOC Content:

a. Finish Coats and Floor Sealers: Not more than 50 g/L.
b. Stains: Not more than 100 g/L.

2. Stain: Penetrating and nonfading type.

a. Color: As selected.

3. Floor Sealer: Pliable, penetrating type.
4. Finish Coats: Formulated for multicoat application on wood flooring.

C. Wood Filler: Compatible with finish system and recommended by filler and finish manufacturers. If required to match approved samples, provide pigmented filler.

2.03 ACCESSORY MATERIALS

A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils (0.15 mm) thick. See SECTION 072100 - THERMAL INSULATION.

B. Asphalt-Saturated Felt: ASTM D 4869, Type II.

C. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

1. Low-Emitting Materials: Adhesives shall have a VOC content of 100 g/L or less.

D. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines: Wood Flooring."

E. Floating Floor Peel and Stick Membrane: Elastilon Strong; 3mm thick. (alternate installation method)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."

B. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 1/4 inch (7 mm) or as recommended by wood flooring manufacturer.

C. Vapor Retarder: Comply with NOFMA's "Installing Hardwood Flooring" for vapor retarder installation and the following:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.

D. Install Floating Floor Peel and Stick Membrane per manufacturer's recommendations.

3.02 SANDING AND FINISHING

A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.

B. Fill open-grained hardwood.

C. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats.

1. Apply stains to achieve an even color distribution matching approved Samples.

END OF SECTION 09 64 00

SECTION 09 65 00 – RESILIENT FLOORING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Extra Materials:

1. Resilient Wall Base: Deliver to Owner at least 12 linear feet (3.66 linear m) of each type and color of resilient wall base installed.

2. Resilient Sheet Flooring: Deliver to Owner at least 8 linear feet (2.44 linear m), in roll form and in full roll width, for each type and color of resilient sheet flooring installed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE

A. Manufacturers:

1. Johnsonite.
2. Or approved equal.

B. Color and Pattern: as indicated on Drawings.

C. ASTM F 1861, Ecolibrium Bio-Based resilient wall base.

D. Group (Manufacturing Method): I (solid).

E. Style: EBT toeless.

F. Minimum Thickness: 0.125 inch (3.2 mm).

G. Height: 2-1/2 inches (64 mm).

H. Lengths: Cut lengths 48 inches (1219.2 mm) long or coils in manufacturer's standard lengths.

I. Outside Corners: Job formed.

J. Inside Corners: Job formed.

K. Finish: Matte.

2.02 LINOLEUM SHEET FLOOR COVERING

A. Products:

1. Armstrong World Industries, Inc.; Marmorette.

2. Or approved equal.

B. Color and Pattern: as indicated on Drawings.

C. Linoleum Floor Covering: ASTM F 2034, Type I, linoleum sheet with backing.

D. Fire-Test Response: Critical radiant flux classification of Class I, not less than 0.45 W/sq. cm per ASTM E 648.

E. 0.45 W/sq. cm per ASTM E 648.

F. Roll Size: In manufacturer's standard length, but not less than 78 inches (1980 mm) wide.

G. Seaming Method: Heat welded or S-671 seam adhesive.

2.03 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement- or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Ashesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.

1. Low-Emitting Materials: Adhesives shall have a VOC content of 50 g/L or less.
2. Low-Emitting Materials: Adhesives shall comply with Green Seal's GS-36 and 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."

C. Heat-Welding Bead: Solid-strand product of floor covering manufacturer.

1. Color: Match floor covering.

D. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

1. Low-Emitting Materials: Chemical-bonding compound shall have a VOC content of 510 g/L or less.

2. Low-Emitting Materials: Chemical-bonding compound 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."

E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

B. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting.

C. Maintain uniformity of resilient sheet flooring direction, and match edges for color shading at seams.

D. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in substrates.

E. Adhesively install resilient wall base and accessories.

F. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required.

G. Install reducer strips at edges of floor coverings that would otherwise be exposed.

H. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.

1. Apply three coat(s).

END OF SECTION 09 65 00

SECTION 09 72 00 –WALL COVERINGS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

B. Extra Materials: Deliver to Owner full-width rolls of wall covering equal to 5 percent of amount of each type installed, packaged with protective covering for storage.

PART 2 - PRODUCTS

2.01 VINYL WALL COVERING

A. Vinyl Wall-Covering Standards: Provide products complying with the following:

1. FS CCC-W-408D and CFFA-W-101-D for Type I, Light Duty products.
2. ASTM F 793 for strippable wall coverings that qualify as Category V, Type II, Commercial Serviceability products.
3. Surface-Burning Characteristics: As follows, per ASTM E 84.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

4. Basis of Design Products: Subject to compliance with requirements, products that may be incorporated into the Work include the following:

    a. CIRQA Selections G11-057.
    b. Tri-Kes Symphony Select IV SDP319.
    c. Or Architect approved equal.

2.02 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer.

1. Low-Emitting Materials. Adhesives shall have a VOC content of 50 g/L or less.

2. Low-Emitting Materials: Primer/sealer shall have a VOC content of 200 g/L or less.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Preparation

1. Clean substrates of substance that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, and dirt.

2. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects.

3. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.

4. Prime new gypsum board.

5. Allow new plaster to cure. Treat areas of high alkalinity.

6. Check painted surfaces for pigment bleeding and treat areas susceptible to pigment bleeding. Snad gloss, semigloss, and eggshell finishes with fine sandpaper.

7. Acclimatize wall covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

B. Install seams vertical and plumb, with no horizontal seams.

C. Match pattern 72 inches (1830 mm) above finish floor.

D. Remove excess adhesive at finished seams, perimeter edges, and adjacent surface using cleaning methods recommended by wall covering manufacturer. Replace strips that cannot be cleaned.

END OF SECTION 09 72 00

SECTION 09 77 23 – FABRIC-WRAPPED PANELS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings and Samples.

PART 2 - PRODUCTS

2.01 FABRIC-WRAPPED PANEL

A. Basis-of-Design Product: As indicated on Drawings or a comparable product of one of the following:

1. Armstrong World Industries
2. Or approved equal.

B. Fabric as follows:

1. Manufacturer: Pollack.
2. Product Line/Pattern: As indicated on Drawings.
3. Style Number: As indicated on Drawings.
4. Color: As indicated on Drawings.

C. Surface-Burning Characteristics: Flame-spread and smoke-developed indexes of not more than 25 and 450, respectively, per ASTM E 84.

D. Edge Profile: Square.

E. Corner Detail: Square.

F. Core Material: Mineral-fiber board; 20-lb/cu. ft. (320-kg/cu. m) density.

G. Nominal Core Thickness: 3/4 inch (20 mm).

H. Edge Construction: Wood frame.

I. Mounting Devices: Metal "Z" clips concealed on backside of panels, or as indicated on Drawings.

J. Mounting Adhesives: As recommended by fabric-wrapped, panel manufacturer.

1. Low-Emitting Materials: Adhesive shall have a VOC content of 70 g/L or less.

2. Low-Emitting Materials: Adhesive shall comply with Green Seal's GS-36 and 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 FABRICATION

A. Fabricate panels with fabric straight on the grain, without seams, and with patterned or directional weave fabrics matched in adjacent panels.

B. Stretch fabric tight and square without puckers, ripples, sagging, or distortion.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panels level and aligned at top and bottom, vertical and plumb, with faces flush.

B. Panel Joints: No greater than 1/8 inch (3.2 mm) wide.

END OF SECTION 09 77 23

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals:

1. Product Data. Include printout of MPI's "MPI Approved Products List" with product highlighted.
2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Compliance: Interior paints and coatings shall comply with the following limits for VOC content:

1. Flat Paints and Coatings: 50g/L.
2. Nonflat Paints and Coatings: 50g/L.
3. Industrial Maintenance Coatings: 100g/L.
4. Primers, Sealers, and Undercoaters: 100g/L.
5. Pretreatment Wash Primers: 300g/L.
6. Clear Wood Finishes, Varnishes: 350 g/L.
7. Floor Coatings: 100 g/L.
8. Stains: 250 g/L.

D. Extra Materials: Deliver to Owner 1 gal. (3.8 L) of each color and type of finish coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.01 PAINT

A. Manufacturers:

1. Latex Paint MPI #145:

a. Benjamin Moore & Co.: 219 Eco-Spec Zero VOC Interior Semi-Gloss.
b. Sherwin Williams: ProMar 200 Zero VOC Interior Latex Semi-Gloss.
c. Or Architect specified equal.

2. Pigmented Polyurethane Paint: MPI #72

a. Benjamin Moore & Co.: Corotech Aliphatic Acrylic Urethane Gloss V500.
b. Sherwin Williams: Protective & Marine Acrolon 218 HS B65W611/B65V600.
c. Or Architect specified equal.

3. Epoxy Paint: MPI #151:

   a. Benjamin Moore & Co.: Product as recommended by manufacturer Benjamin Moore.
   b. Sherwin Williams: Pro Industrial Pre-Catalized Water based Epoxy Eg-Shel K45W00151.
   c. Or Architect specified equal.

4. Staining and Clear Finishing Materials:

   a. Interior finish: Sikkens Cetol water based SRD translucent wood finish or approved equal. 2 coats, Clear Finish No. SIK77000, Color No. 78 Natural.
   b. Exterior wood deck finish: Sikkens Cetol water based SRD translucent wood finish or approved equal. 2 coats, Clear Finish No. SIK77000, Color No. 78 Natural.
   c. Or Architect approved equal.

B. Material Compatibility: Provide materials that are compatible with one another and with substrates.

1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: As selected.

PART 3 - EXECUTION

3.01 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.02 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces, unless otherwise indicated.

1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint the back side of access panels.
4. Color-code mechanical piping in accessible ceiling spaces.

5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.

1. Use brushes only for exterior painting and where the use of other applicators is not practical.
2. Use rollers for finish coat on interior walls and ceilings.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

E. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.03 INTERIOR PAINT APPLICATION SCHEDULE

A. Gypsum Board:

1. Eggshell Latex System: Two coats over latex primer/sealer.
2. Pigmented Polyurethane System: Two coats over primer/sealer as recommended by manufacturer.
3. Epoxy System: Two coats over primer/sealer as recommended by manufacturer.

3.04 EXTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood, traffic surfaces, including wood decks and ramps.

1. Deck Stain over Wood Preservative: Two coats over preservative: MPI EXT 6.5D.
2. Deck Stain: Two coats: MPI EXT 6.5F.

a. Seal-Once.: Semi-Transparent Tinted Stain
b. Or Architect approved equal.

3.05 INTERIOR STAIN AND CLEAR FINISH APPLICATION SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork, doors, windows, and wood-based panel products.

1. Semitransparent Stain: Two coats: MPI INT 6.1G
2. Semitransparent Stain: Two coats: MPI INT 6.3C.
3. Satin Water-Based Varnish over Stain: Two coats over stain: MPI INT 6.1R.
4. Satin Water-Based Varnish: Three coats: MPI INT 6.1F.

END OF SECTION 09 90 00

Division 10 – Specialties

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 TOILET AND BATH ACCESSORIES

A. Manufacturers:

Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

B. Toilet Tissue Dispenser:

1. Basis-of-Design Product: Kohler K-14459-CP.
2. Type: Single-roll dispenser.
3. Mounting: Surface mounted flanges with concealed fasteners to solid backing.
4. Material and Finish: Chrome plated brass or steel.
5. Operation: Fixed rod, toilet tissue slides onto rod.
6. Or Architect approved equal.

C. Shower Curtain Track:

1. Basis-of-Design Product: Kirsch 9046 or approved equal.
2. Outside Width: 5/8 inch (25.4 mm).
3. Mounting: Per manufacturer's recommendations to solid backing.
4. Material and Finish: Anodized aluminum.
5. Or Architect approved equal.

D. Robe Hook:

1. Basis-of-Design Product: Kohler K-14458-CP.
2. Description: Single-prong unit.
3. Material and Finish: Chrome plated brass or steel.
4. Or Architect approved equal.

E. Towel Bar:

1. Basis-of-Design Product: Kohler K-14451-CP.
2. Mounting: Surfaced mounted flanges with concealed fasteners to solid backing.
3. Material and Finish: Chrome plated brass or steel.
4. Or Architect approved equal.

F. Towel Rack:

1. Basis-of-Design Product: Kohler K-14450-CP.
2. Mounting: Surfaced mounted flanges with concealed fasteners to solid backing.
3. Material and Finish: Chrome plated brass and steel.
4. Or Architect approved equal.

2.02 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, ASTM B 16 (ASTM B 16M), or ASTM B 30.

C. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T6 or 6463-T6.

D. Sheet Steel: ASTM A 1008/A 1008M, 0.0359-inch (0.9-mm) minimum nominal thickness.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

F. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.

H. Tempered Glass: ASTM C 1048, Kind FT (fully tempered).

I. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

J. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

K. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 28 00

Division 11 – Equipment

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 RESIDENTIAL APPLIANCES

A. Regulatory Requirements: Comply with the following:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with ICC A117.1.

C. Electric Cooktop: 31-inch (788-mm), built-in induction cooktop with four heating elements and touch control.

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. BOSCH Home Appliances. 300 Series NIT3065UC30
b. Or Architect approved equal.

3. Color: Black ceramic glass surface with stainless steel trim.

D. Electric Wall Oven with 2000-3600 watt Bake Broil Oven: Built-in, single, electric, wall European convection oven with convention broil unit.

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. BOSCH Home Appliances. HBN5450UC
b. Or Architect approved equal.

3. Color: Stainless steel and clear ceramic glass.

E. Exhaust Hood: 28.7-inch (730-mm) undercabinet, ventilating exhaust hood.

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. BOSCH Home Appliances. DHL755BUC
   b. Or Architect approved equal

3. Color: Silver metallic finish.
4. Fan Control: Hood mounted switch, with separate light switch.
5. Weatherproof through-wall cap with backdraft damper and rodent-proof perforated metal screening as indicated in Drawings.

F. Refrigerator/Freezer: Cabinet-mounted, frost-free, glass with stainless steel trim-door refrigerator with bottom-mounted freezer, interior cabinet liners.

1. Manufacturers:

   a. BOSCH Home Appliances. B30BB830SS
   b. Or Architect approved equal

2. Color: Stainless steel.
3. Fresh Food Compartment and Freezer Compartment Volume: 16 cu. ft. **(0.xx cu. m).**
4. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

G. Dishwasher: Built-in, undercounter, automatic dishwasher, sized to replace 18-inch- (407-mm-) base cabinet, four wash cycles with hot-air and heat-off drying cycles, stainless steel tub and door liner, adjustable sliding dish racks.

1. Manufacturers:
2. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. BOSCH Home Appliances. SHV5ES53UC
   b. Or Architect approved equal.

3. Color: Stainless steel.
4. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

H. Clothes Washer: Freestanding, front-loading, automatic clothes washer with 2.2-cu. ft. **(0.xx-cu. m)** capacity stainless-steel tub and 15 wash cycles including regular, delicate, and permanent press.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. BOSCH Home Appliances. Axis Series WAS20160UC
   b. Or Architect approved equal

2. Color: White.
3. Energy Performance: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

I. Electric Clothes Dryer: Freestanding, front-loading clothes dryer, 3.9-cu. ft. **(0.xx-cu. m)** capacity with stainless-steel interior.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. BOSCH Home Appliances. WTV76100CN
   b. Or Architect approved equal.

2. Color: White

J. Ceiling Fan:

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. Big Ass Fans, Model #Haiku Bamboo, one unit with light and one unit without light
   b. Or Architect approved equal.

2. Color: Motor and Assembly Finishes, black and Airfoil Finishes, Caramel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

D. Verify that accessories required have been furnished and installed.

END OF SECTION 11 31 00

Division 12 – Furnishings

SECTION 12 22 00 – CURTAINS AND DRAPES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.01 DRAPERY TRACKS

A. Manufacturers:

1. Kirsch.
2. Or approved equal.

B. Construction: Kirsch 9046, extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c., and bendable to radii indicated.

C. Finish: Clear anodized.

D. Support Capability: Weight of drapery indicated.

E. Mounting: As indicated on Drawings.

F. Manual Operation: Baton.

G. Draw: As indicated on Drawings.

H. Carriers: Ball bearing rollers with hooks.

2.02 DRAPERIES

A. Provide curtains and drapes passing flame-resistance testing according to NFPA 701.

B. Heading: Flat fold, with grommets.

C. Drapery Fabric:

1. Manufacturer: Pollack.
2. Designation: As indicated on Drawings.

3. Pattern: As indicated on Drawings.
4. Color: As indicated on Drawings.

2.03 DRAPERY FABRICATION

A. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. One-Way-Stacking Draperies: Add 5 inches (127 mm) to overall width for returns.
2. Center-Opening Draperies: Add 10 inches (254 mm) to overall width for overlap.

B. Seams: Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.

C. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide, blindstitched hems.

D. Bottom Hems: Double-turned, 3-inch- (76-mm-) wide, weighted and blindstitched hems.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install track systems level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of window treatment hardware from concrete or mortar to prevent galvanic action. Use tape or another method recommended by manufacturer.

C. Where draperies abut overhead construction, hang draperies with 1/4-inch (6.4-mm) clearance.

D. Where draperies extend to floor, install with not more than 1-inch (25-mm) and not less than 1/2-inch (13-mm) clearance.

E. Where draperies extend to windowsill, install with not more than 1/2-inch (13-mm) clearance.

END OF SECTION 12 22 00

SECTION 12 36 61 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and material Samples.

PART 2 - PRODUCTS

2.01 QUARTZ COUNTERTOPS

A. Quartz Countertops: 3/4-inch- (12.7-mm-)

1. Front: Straight, slightly eased at top

B. Retain option in "Manufacturers" Subparagraph below to limit manufacturers to those listed.

1. Manufacturers:

a. Eco Stone by Cosentino, Style “Iron Ore”

i Composition: Recycled glass ceramic granite aggregate, porcelain, mirror, and metals’ quartz aggregate; com-based resin; and color pigments formed into flat slabs.

b. Or approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install countertops according to manufacturer's written directions. Fasten to substrates with adhesive. Align adjacent surfaces. Seal seams and perimeter with mildew-resistant silicone sealant.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

B. Maximum variation form level and plumb: 1/8 inch in 10 feet, noncumulative.

C. Maximum variation in plane between adjacent pieces at joint: Plus or minus 1/16 inch.

3.02 CLEANING

A. Clean countertops in accordance with manufacturer's instructions.

3.03 PROTECTION

A. Protect installed countertops with nonstaining sheet coverings.

END OF SECTION 12 36 61

Division 21 – Fire Suppression

SECTION 21 13 13 – WET-PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Multipurpose residential fire suppression system integrated with the potable cold water distribution system, using crosslinked polyethylene (PEX) tubing and ASTM F 1960 cold expansion fittings.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Regulatory Requirements and Approvals: Provide domestic potable system that complies with requirements of the following:

1. International Plumbing Code (IPC)

   a. ICBO Evaluation Service (ES) Evaluation Report No. 5142
   b. SBCCI Standard Plumbing Code (PST and ESI Report No. 9661).

2. Building Officials and Code Administrators International (BOCA)

   a. 1993 BOCA National Plumbing Code

3. Uniform Plumbing Code (IPC)

   a. IAPMO Files 3558,3946, and 3960

4. National Standard Plumbing Code (NSPC)

5. HUD Material Release No. 1269

PART 2 - PRODUCTS

2.01 MULTI-PURPOSE RESIDENTIAL FIRE SUPPRESSION SYSTEM

A. Manufacturer: Uponor, Inc.
5925 148th Street West, Apple Valley, MN 55124
Telephone: (800) 321-4739, (9520 891-2000
Fax: (952) 891-1409
Website: www.uponor-usa.com

1. Tubing:

a. AquaPEX 1”

2. Fittings:

a. Material: UNS 3600 series brass.
b. Material Standard: Comply with ASTM F1960.
c. Type: PEX-a cold expansion fitting.

i Assembly consisting of brass insert and PEX-a cold expansion ring.

3. Sprinklers:

a. Concealed assembly type shall consist of the following.

i Type 316 stainless steel sprinkler adapter fitting with four Uponor ProPEX outlets.
ii Reliable Model RFC 49 flat concealed sprinkler.
iii Reliable Model CRFCW concealed cover plate designed to detach from the assembly at 135 degrees F (57 degrees C).
iv Reliable protective construction cap.

PART 3 - EXECUTION

3.01 MANUFACTURER’S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. Uponor Residential Fire Safety AQUASAFE Looped System Installation Guide
2. Uponor Professional Plumbing Installation Guide

3.02 INSTALLATION

A. Uponor Plumbing System:

1. Install the Uponor Plumbing System in accordance with the PEX tubing manufacturer's recommendations and as indicated in the installation handbook.
2. Do not install PEX tubing within 12 inches (305 mm) of any recessed light fixtures.
3. Do not solder within 18 inches (457 mm) of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
4. Do not expose PEX tubing to direct sunlight for more than 30 days.
5. Ensure that no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the PEX tubing manufacturer.
6. PEX tubing passing through metal studs shall use grommets or sleeves at the penetration.
7. Protect PEX tubing with sleeves where abrasion may occur.
8. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
9. PEX tubing manufacturer supplied bend supports shall be used where bends are less than six times the outside pipe diameter.
10. Tubing shall be supported to structural members using support methods required by local plumbing codes and the PEX tubing manufacturer's installation handbook.
11. Pressurize the plumbing system with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
12. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Water shall not be used to pressurize the system if ambient air temperature has the possibility of dropping below 32 degrees F (0 degrees C).

B. Uponor Fire Suppression System:

1. Perform no fabrication of piping systems or other components until approval of submittals is received.
2. Install PEX tubing as indicated on the drawings. Comply with shop drawings for tube layout, manifold location and sprinkler configuration.
3. Do not paint the sprinkler heads or cover plates.
4. Install sprinkler heads in accordance with the PEX tubing manufacturer’s specifications and NFPA 13D.
5. Ensure sprinklers are positioned so that discharge will not be affected by obstructions such as beams or light fixtures.
6. Ensure sprinkler heads maintain minimum distances from heat sources as specified in the PEX tubing manufacturer’s installation manual and NFPA 13D.
7. Support tubing to structural members using support methods required by local plumbing codes and the PEX tubing manufacturer's installation handbook.
8. Ensure system meets or exceeds flow requirements specified in hydraulic calculations by completing a flow verification test on any single sprinkler head.
9. Ensure the protective cap assembly remains in place until construction is complete.

END OF SECTION 21 13 13

Division 22 – Plumbing

SECTION 22 11 00 – FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. International Plumbing Code (IPC)

1. ICBO Evaluation Service (ES) Evaluation Report No. 5142
2. SBCCI Standard Plumbing Code (PST and ESI Report No. 9661)

B. Building Officials and Code Administrators International (BOCA)

1. 1993 BOCA National Plumbing Code

C. Uniform Plumbing Code (UPC)

1. IAPMO Files 3558, 3946 and 3960

D. National Standard Plumbing Code (NSPC)

E. HUD Material Release No. 1269

PART 2 - PRODUCTS

2.01 PIPING AND FITTINGS

A. Hard Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Types B and C), water tube, drawn temper with wrought-copper, solder-joint fittings and ProPress fittings.

1. Copper Unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint ends.
2. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.

B. PEX

Manufacturer: Uponor, Inc.
5925 148th Street West, Apple Valley, MN 55124
Telephone: (800) 321-4739, (9520 891-2000
Fax: (952) 891-1409
Website: www.uponor-usa.com

1. Tubing:

   a. ½" & ¾" AquaPEX White

2. Fittings:

   a. ProxPEX adapters with rings
   b. EP multi-port tees

C. PVC Pipe: ASTM D 1785, Schedule 40.

1. PVC Fittings: ASTM D 2466, Schedule 40, socket type.

D. Transition Fittings: Manufactured piping coupling or specified piping system fitting.

1. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install union and shut-off valve on pressure piping at connections to equipment.

B. Piping shall conform to the following:

1. Domestic Water:

a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

C. Soldered Joints:Comply with procedures in ASTM B 828 unless otherwise indicated

D. Uponor Plumbing System:

1. Install the Uponor Plumbing System in accordance with the PEX tubing manufacturer's recommendations and as indicated in the installation handbook.
2. Do not install PEX tubing within 12 inches (305 mm) of any recessed light fixtures.
3. Do not solder within 18 inches (457 mm) of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
4. Do not expose PEX tubing to direct sunlight for more than 30 days.
5. Ensure that no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the PEX tubing manufacturer.
6. PEX tubing passing through metal studs shall use grommets or sleeves at the penetration.
7. Protect PEX tubing with sleeves where abrasion may occur.
8. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
9. PEX tubing manufacturer supplied bend supports shall be used where bends are less than six times the outside pipe diameter.
10. Tubing shall be supported to structural members using support methods required by local plumbing codes and the PEX tubing manufacturer's installation handbook.
11. Pressurize the plumbing system with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
12. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Water shall not be used to pressurize the system if ambient air temperature has the possibility of dropping below 32 degrees F (0 degrees C).

3.02 INSPECTING AND CLEANING

A. Inspect and test piping systems as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired by visual inspection of all joints.

B. Clean and disinfect potable domestic water piping by filling system with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time by flushing out a volume equal to the system volume, then stopping the flow of water for one hour, and then flushing the system.

3.03 PIPING SCHEDULE

A. Aboveground Distribution Piping: PEX

B. Mechanical Room Piping: Copper

C. Landscape: PVC and Poly Tubing

D. Exterior Solar Loop: Flexible stainless steel insulated piping SolarFlex

3.04 VALVE SCHEDULE

A. Valve types:

1. Shutoff Duty: Use dezincification resistant brass ball valve
2. Throttling Duty: Use dezincification resistant brass ball valve
3. Hot-Water-Piping, Balancing Duty
4. Drain Duty: Hose-end drain valves

B. Install ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.

C. PVC ball, butterfly, and check valves may be used in matching piping materials.

D. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.

E. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.

END OF SECTION 22 11 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Potable hot and cold water distribution system, using crosslinked polyethylene (PEX) tubing and ASTM F1960 cold expansion fittings.

1.02 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. ASTM International

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials
3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
4. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing
5. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
6. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing

C. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF)

1. ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials
2. ANSI/NSF Standard 61 Drinking Water System Components - Health Effects

D. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL)

1. ANSI/UL 263 Standard for Safety for Fire Tests of Building Construction and Materials

E. Canadian Standards Association (CSA)

1. CAN/CSA B137.5: Cross-linked Polyethylene (PEX) Tubing Systems for Pressure applications

F. International Code Council (ICC)

1. International Plumbing Code (IPC)
2. ICC Evaluation Service (ES) Evaluation Report No. ESR 1099

G. Building Officials and Code Administrators International (BOCA)

1. 1993 BOCA National Plumbing Code

H. International Association of Plumbing Officials (IAPMO)

1. Uniform Plumbing Code (UPC)

I. National Association of Plumbing, Heating and Cooling Contractors (NAPHCC)

1. National Standard Plumbing Code (NSPC)

J. U.S. Department of Housing and Urban Development (HUD)

1. HUD Material Release No. 1269

K. Plastics Pipe Institute (PPI)

1. PPI Technical Report TR-4/06

L. Uponor, Inc.

1. Uponor Professional Plumbing Installation Guide, 2006

1.03 SYSTEM DESCRIPTION

A. Design Requirements

1. Standard grade hydrostatic pressure ratings from Plastics Pipe Institute (PPI) in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required.

a. 200°F (93°C) at 80 psi (551 kPa)
b. 180°F (82°C) at 100 psi (689 kPa)
c. 73.4°F (23°C) at 160 psi (1,102 kPa)

2. Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 provided the installation meets one of the following requirements.

a. Tubing spacing is a minimum of 18 inches apart for the following sizes.

i ⅜ inch [9.53mm]
ii ½ inch [12.7mm]
iii ⅝ inch [15.88mm]
iv ¾ inch [19.05mm]

b. Tubing is wrapped with ½" fiberglass insulation with a flame spread of not more than 20 and a smoke-developed rating of not more than 30 and a nominal density of 4.0 to 4.5 pcf. Tubing can run with three tubes separated by zero inches and then 18 inches between the next group of three tubes for the following sizes.

i ⅜ inch [9.53mm]
ii ½ inch [12.7mm]
iii ⅝ inch [15.88mm]
iv ¾ inch [19.05mm]
v 1 inch [25.4mm]
vi 1¼ inch [31.75mm]
vii 1½ inch [38.1mm]
viii 2 inch [50.8mm]

B. Performance Requirements: To provide a PEX tubing hot and cold potable water distribution system, which is manufactured, fabricated and installed to comply with regulatory agencies and to maintain performance criteria stated by the PEX tubing manufacturer without defects, damage or failure.

1. Comply with ANSI/NSF Standard 14.
2. Comply with ANSI/NSF Standard 61.
3. Show compliance with ASTM F877.
4. Show compliance with ASTM E119 and ANSI/UL 263 through certification listings with Underwriters Laboratories, Inc. (UL).

a. UL Design No. L557 — 1 hour wood frame floor/ceiling assemblies
b. UL Design No. K913 — 2 hour concrete floor/ceiling assemblies
c. UL Design No. U372 — 1 hour wood stud/gypsum wallboard wall assemblies
d. UL Design No. V444 — 1 hour steel stud/gypsum wallboard wall assemblies

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

C. Shop Drawings: Provide installation drawings indicating tubing layout, manifold locations, plumbing fixtures supported and schedules with details required for installation of the system.

D. Samples: Submit selection and verification samples of tubing.

E. Quality Assurance/Control Submittals: Submit the following:

1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
2. Certificates: Submit the following:

a. Manufacturer's certificate that products comply with specified requirements.
b. Certificate indicating that the installer is authorized to install the manufacturer's products.

F. Closeout Submittals: Submit the following:

Warranty documents specified herein
Operation and maintenance data

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of PEX plumbing installation training by the PEX tubing manufacturer.

B. Regulatory Requirements and Approvals: Provide domestic potable system that complies with requirements of the following:

1. International Code Conference (ICC) – International Plumbing Code (IPC)

a. ICC Evaluation Service (ES) Evaluation Report No. ESR 1099

2. Building Officials and Code Administrators International (BOCA)

a. 1993 BOCA National Plumbing Code

3. Uniform Plumbing Code (UPC)

a. IAPMO Files 3558, 3946 and 3960

4. National Standard Plumbing Code (NSPC)

5. HUD Material Release No. 1269

C. Certifications: Provide letters of certification as follows:

1. Installer is trained by the PEX tubing manufacturer to install the PEX potable water distribution system.
2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional

D. Pre-installation Meetings: [Specify requirements for meeting.] Verify project timeline requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.

2. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of tubing exposed to direct sunlight.

1.07 WARRANTY

A. Uponor offers a limited warranty of up to 25 years for its Wirsbo AQUAPEX® tubing and Wirsbo hePEX™ tubing and ProPEX® Fittings when installed by an Uponor-trained contractor and certified plumbing professional. See www.uponor-usa.com for details in the Customer Service section.

PART 2 - PRODUCTS

2.01 HOT AND COLD POTABLE WATER DISTRIBTUION SYSTEM

A. Manufacturer: Uponor

1. Contact: 5925 148th Street West, Apple Valley, MN 55124; Toll free (800) 321-4739, (952) 891-2000; Fax: (952) 891-2008; website: www.uponor-usa.com

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

2.03 MATERIALS

A. Tubing

1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
2. Type: Wirsbo AQUAPEX
3. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
4. Standard grade hydrostatic design and pressure ratings from PPI
5. Fire-rated assembly listings in accordance with ANSI/UL 263

    a. UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
    b. UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
    c. UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies

6. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
7. Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.

    a. ⅜ inch [9.53mm]
    b. ½ inch [12.7mm]
    c. ¾ inch [19.05mm]
    d. 1 inch [25.4mm]
    e. 1¼ inch [31.75mm]
    f. 1½ inch [38.1mm]
    g. 2 inch [50.8mm]

B. Fittings

1. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.

2. Material Standard: Comply with ASTM F1960.

3. Type: PEX-a cold expansion fitting.

    a. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

C. Manifolds

1. Material

    a. Type L copper body with UNS 3600 series brass ProPEX outlet connections
    b. Engineered Plastic (EP) body with ProPEX outlet connections

2. Manifold Type

    a. Uponor ProPEX 1" Copper Manifold
    b. Uponor engineered plastic (EP) Manifold

3. All manifolds manufactured with the appropriate-sized ProPEX fittings on the manifold supply inlets.

D. Accessories

1. Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.
2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
3. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
4. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.

5. All horizontal tubing hangers and riser clamps are epoxy-coated material.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings and the Uponor Professional Plumbing Installation Guide.

3.02 EXAMINATION

A. Site Verification of Conditions:

1. Verify that site conditions are acceptable for installation of the PEX potable water system.
2. Do not proceed with installation of the PEX potable water system until unacceptable conditions are corrected.

3.03 INSTALLATION

A. Wirsbo AQUAPEX Tubing

1. Install Wirsbo AQUAPEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
2. Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures.
3. Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
4. Do not expose PEX tubing to direct sunlight for more than 30 days.
5. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
6. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
7. Protect PEX tubing with sleeves where abrasion may occur.
8. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
9. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
10. Minimum horizontal supports are installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
11. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
12. A mid-story support is required for riser applications.
13. Pressurize Wirsbo AQUAPEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.

14. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).

B. Through-penetration Firestop

1. Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with ASTM E814.
2. A list of firestop manufacturers that list PEX tubing with their firestop systems is available from the PEX tubing manufacturer.

C. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.

3.04 FIELD QUALITY CONTROL

A. Site Tests

1. Specify applicable test requirements to be performed during and after product installation.

B. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.05 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

3.06 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. American Society of Sanitary Engineers (ASSE):

1. ANSI/ASSE (Plumbing) 1001-2008: Pipe Applied Atmospheric Type Vacuum Breakers
2. ANSI/ASSE 1010-2004: Water Hammer Arresters
3. ANSI/ASSE (Plumbing) 1020-2004: Pressure Vacuum Breaker Assembly

B. Plumbing and Drainage Institute (PDI):

1. PDI W H-201 2007: Water Hammer Arrestor

PART 2 - PRODUCTS

2.01 DRAINS

A. Manufacturers:

1. Zurn Industries, Inc., www.zurn.com

2.02 CLEANOUTS

A. Manufacturers:

1. Zurn Industries, Inc., www.zurn.com

B. Cleanouts at Exterior Surfaced Areas

1. Round cast nickel bronze access frame and non-skid cover

C. Cleanouts at Interior Finished Wall Areas

1. Line type with lacquered cast iron body and round epoxy coasted gasketed cover, and round stainless steel access cover secured with machine screw.

2.03 HOSE BIBBS

A. Manufacturers:

1. Zurn Industries, Inc., www.zurn.com
2. Watts Regulator Company, www.wattsregulator.com
3. Jay R. Smith Manufacturing Company, www.jayrsmith.com

2.04 BACKFLOW PREVENTERS

A. Manufacturers:

1. Zurn Industries, Inc., www.zurn.com
2. Watts Regulator Company, www.wattsregulator.com
3. Conbraco Industries, www.conbraco.com

2.05 WATER HAMMER ARRESTOR

A. Manufacturers:

1. SharkBite

a. Model #: 22630, Part #: 22630
b. ½" residential water hammer arrestor
c. DZR brass fittings
d. Certified to 200PSI of pressure and 200 degrees Fahrenheit

2.06 BALL VALVES

A. Manufacturers:

1. Milwaukee Valve Company
2. Uponor

2.07 CLOTHES WASHER OUTLET BOX

A. Manufacturers:

1. Uponor

a. Part #: LF5930500
b. High-impact polystyrene
c. 5 year limited warranty
d. Certified to 200PSI of pressure and 200 degrees Fahrenheit
e. Come with ½" lead free brass valves

2.08 SHOWER MIXING VALVE

A. Manufacturers:

1. Kohler

a. Model #: K304-KS-NA

2.09 SHOWER VOLUME CONTROL VALVE

A. Manufacturers:

1. Kohler

a. Model #: K-671-K-NA

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install backflow preventers at each water-supply connection to mechanical equipment and where required by authorities having jurisdiction.

C. Install hose bibs with integral or field-installed vacuum breaker.

D. Install water hammer arrestors at all solenoid valves.

E. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

F. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.

G. Valves shall be installed in horizontal piping with stem at or above center of pipe.

H. Valves shall be installed in a position to allow full stem movement.

END OF SECTION 22 11 19

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Domestic water pressure booster system.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

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. Product Data: Submit manufacturer's product submittal data and installation instructions.

PART 2 - PRODUCTS

2.01 DOMESTIC PRESSURE BOOST

A. Manufacturers:

1. Grundfos Pumps Corporation
   17100 W. 118th Terrace, Olathe, KS 66061;
   Telephone: (913) 227-3400
   Fax: (913) 227-3500;
   Website: www.groundfos.com
   a. EZ Booster BMQE Booster Pump
      i Model#:22BMQE 05B-120
   b. Diaphragm Tank
      i 2 U.S. Gallons(8 liter)/130 psi
      ii Material #: 91121984
   c. Controller
      i Material #: 91121987
   d. Pressure Sensor
      i Material #: 96437852

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including.

1. EZ Boost Quick Installation Guide

3.02 INSTALLATION

A. Provide mounting brackets for piping and pump support and flex connector between pump and pipe for vibration isolation.

B. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Support pumps and piping so weight of piping is not supported by pump volute.

D. Install electrical connections for power, controls, and devices.

E. Connect piping with valves that are at least the same size as piping connecting to pumps.

F. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

G. Install shutoff valve and strainer on suction side of pumps.

H. Install nonslam check valve and throttling valve on discharge side of pumps.

I. Install thermostats in hot-water return piping.

J. Install test plugs on suction and discharge of each pump. Install at integral pressure gauge tappings where provided.

END OF SECTION 22 11 23

SECTION 22 12 19 - FACILITY POTABLE – WATER STORAGE TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Water tank for supply and storage of domestic water supply systems and fire sprinkler system, completed, including piping and all accessories.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. NFPA 22-08: Water Tanks for Private Fire Protection
2. NFPA 25-08: Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

B. NSF INTERNATIONAL (NSF):

1. NSF/ANSI 61 (2010) Drinking Water System Components -Health Effects

PART 2 - PRODUCTS

2.01 LOW PROFILE WATER TANK

A. Manufacturers:

1. Norwesco, www.norwesco.com
   a. Part #: 41392
   b. Capacity: 1500 gallon
   c. Width 81", Overall height 44", Length 130", Fill Opening 16", Outlet 2"

2.02 ACCESSORIES

A. Manufacturers:

1. Norwesco, www.norwesco.com

2.03 PIPING

A. PVC, ASTM D 1785, Schedule 40

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install tank in accordance with NFPA 22.

B. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.

C. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.

D. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

END OF SECTION 22 12 19

SECTION 22 13 00 – FACILITY SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Comply with NSF 14, "Plastic Piping Components and Related Materials," for plastic piping components.

PART 2 - PRODUCTS

2.01 PIPES AND FITTINGS

A. Pipe and fittings shall be manufactured from ABS compound with a cell class of 42222 for pipe and 32222 for fittings as per ASTM D 3965 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM F 628. Fittings shall conform to ASTM D 2661.

2.02 CLEANOUTS

A. Cleanouts shall be the same size as the pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line

B. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable

without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

C. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.

B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.

D. All pipe runs shall be laid out to avoid interference with other work.

E. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Aboveground ABS piping shall be installed according to ASTM D2661.

G. For ABS piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2235 and ASTM D2661 appendixes.

H. Slope:

1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

J. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.02 PIPE SCHEDULE

A. Aboveground Applications: ABS, Schedule 40.

END OF SECTION 22 13 00

SECTION 22 13 53 – FACILITY SEPTIC TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Grey water and waste receptor and all necessary accessories as designated in this section.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Comply with NSF 14, "Plastic Piping Components and Related Materials," for plastic piping components.

PART 2 - PRODUCTS

2.01 LOW PROFILE HOLDING TANK

A. Manufacturers:

1. Den Hartog
   4010 Hospers Drive S, Box 425, Hospers, Iowa 51238-0421
   www.denhartogindustries.com
   a. Part #: LP0300-RT
   b. Capacity: 300 Gallon
   c. Width 80", overall height 19 1/4", Length 77 3/4", 8" vented lid, 2" outlet

2.02 ACCESSORIES

A. Manufacturers:

1. Den Hartog
   4010 Hospers Drive S, Box 425, Hospers, Iowa 51238-0421
   www.denhartogindustries.com

2.03 PIPING

A. PVC, ASTM D 2665

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.

B. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.

C. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

END OF SECTION 22 13 53

SECTION 22 33 00 – RESIDENTIAL ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Electrical components, devices and accessories shall be listed and labeled B as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label equipment components that will be in contract with potable water to comply with NSF 61, "Drinking Water System Components – Health Effects".

C. UL

PART 2 - PRODUCTS

2.01 TANKLESS ELECTRIC WATER HEATER

A. Manufacturers:

1. Stiebel Eltron Inc.
   17 West Street, West Hatfield MA 01088
   Phone: (413) 247-3380
   Fax: (413) 247-3369
   www.stiebel-eltron-usa.com
   a. Model #: DHC-E 12

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. DHC-E Operating and Installation

3.02 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.

B. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.

C. Separate dissimilar metals and metal products from contact with wood or cementations materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

D. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

E. Repair, refinish, or replace products damaged during installation, as directed by architect.

F. Adjust operating parts and hardware for smooth, quiet operation

END OF SECTION 22 33 00

SECTION 22 33 30.00 – SOLAR WATER HEATING EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. A solar energy system arranged for heating or preheating of service domestic hot water using evacuated tube collector array, storage tank, pumps, automatic controls, instrumentation, interconnecting piping and fittings, heat exchanger, expansion tank, and accessories required for the operation of the system.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. ASHRAE 93 Methods of testing to determine the thermal performance of solar collectors.

B. ANSI Z21.22/CSA 4.4 Relief valves for hot water supply systems.

C. ASME B40.100 Pressure gauges and gauge attachments.

PART 2 - PRODUCTS

2.01 EVACUATED TUBE COLLECTORS, MANIFOLD, AND FRAME

A. Manufacturers:

1. SolarUS Inc.
   965 West Main Street
   Brandford, CT 06405, USA
   www.solarusmgf.com
   Model #: SL-30

2.02 SOLAR STORAGE TANK

A. Manufacturers:

1. Thermotechnology Corp.
   50 Wentworth Ave
   Londonderry, NH 03053, USA
   Phone: (603) 552-110
   Fax: (603) 965-7568
   www.buderus.us
   Model #: SM100, vertical dual coil models
   Capacity: 103 GALLON, Dry weight 298 lbs
   Heat Input to Tank: Upper coil at 97.2 MBH, Lower Coil at 157 MBH, Dual Coil 228.8 MBH
   Boiler water flow rate: 11GPM

2.03 EXPANSION TANK

A. Manufacturers:

1. Bosch

a. Part #: 7747202342
b. 3/4", Male
c. 18 liter, 6 bar white
d. Max operating pressure: 87.02 psi/6 bar

2.04 PIPING, FITTINGS, VALVES AND ACCESSORIES

A. Pressure and Temperature Relief Valve – ¾", stainless steel spring, ASME rated, CSA certified and meet ANSI Z21.22 standard

B. Isolation Valve – ¾", brass ball valve, in line with FNPT

C. Fill/Drain Valve – ¾" hose bib

D. Check Valve – ¾" swing style, brass, NPT

2.05 GAUGES AND INSTRUMENTATION

A. Manufacturers:

1. Omega Engineering, Inc.

2.06 PUMPS

A. Manufacturers: Taco

1. Model #: 003-84
2. ¾" SWT

2.07 AUTOMATIC AIR VENT

A. Manufacturers: Bosch

1. Part #: 63015362

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. Operating and installation instructions" for Single and dual heat exchanger solar storage tanks

3.02 INSTALLATION

A. Install tank in accordance with NFPA 22.

B. Install safety ladders in accordance with NFPA 22 and OSHA requirements.

C. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.

D. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.

E. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

F. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

G. Adjust operating parts and hardware for smooth, quiet operation.

END OF SECTION 22 33 30.00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals:

1. Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.
2. Documentation indicating flow and water consumption requirements.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"**;** Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

2.02 WATER CLOSET

A. Vitreous-China Water Closet: Elongated, siphon-jet type, floor-mounted, floor outlet with close-coupled, hydrolic pressurized tank.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Kohler. Saile one-piece elongated duel-flush Quiet-Close toilet K-3564-0; with Kohler K-7637-CP angle stop valve.
b. Or Architect approved equal.

2.03 TOILET SEAT

A. Toilet Seat: Elongated, solid plastic closed front with cover with bumpers and hardware, Residential class.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. Kohler. Included with water closet.
   b. Or Architect approved equal.

2.04 LAVATORY

A. Vitreous-China Lavatory: Wall-mounting.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. Kohler. K-2661-0
   b. Or Architect approved equal.

B. Faucets: ASME A112.18.1; solid-brass underbody and chrome cover plate.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

   a. Kohler. K-T945-4-CP
   b. Or Architect approved equal.

2. Type: Counter surface mounted.
3. Finish: Porcelain white.
4. Handle(s): Dual lever.
5. Maximum Flow Rate: 1.0 gpm (3.78 L/min).
6. Aerator: Nigara 1.0 GPM Tamperproof, Male Threaded N3210MT (if needed).

C. Drain & Trap:

Kohler. K-9033-4-CP; trap with slip-joint inlet and wall flange and K-7129-CP drain piece.

D. Angle Stop Valves

Kohler. K-7065-P-CP

E. Supply and Drain Insulation: Soft-plastic covering; removable at stops.

2.05 SHOWER

A. Mixing-Valve Faucet and Miscellaneous Fittings: Single-lever, pressure-balance; maximum 2.5-gpm (0.16-L/s) flow rate.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Kohler. K-9059-CP
b. Or Architect approved equal.

2. Shower mixing valve and trim: K-304-KS-NA and K-T950-4-CP.
3. Body Material: Solid-brass underbody and chrome cover plate.
4. Finish: Polished chrome-plate.
5. Hand-held showers: 2.0 GPM Hand-held Shower with hose and slidebar bracket to be included.

B. Drain: Schluter, Chrome-plated-strainer, floor drain by others.

2.06 KITCHEN SINK

A. Stainless-Steel Sink: Undercounter type, 0.063 inch (1.6 mm) thick, one bowl.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Kohler. K-3822-3-NA
b. Or Architect approved equal.

B. Faucet: Solid-brass underbody and chrome cover plate. Maximum 2.5-gpm (0.16-L/s) flow rate.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Kohler. K-7547-4-CP
b. Or Architect approved equal.

2. Type: Center set with inlets on 4-inch (102-mm) centers.
3. Finish: Polished chrome-plate.
4. Handle(s): Dual lever.
5. Spout: Non-fixed position gooseneck with 1-1/2-gpm (0.1-L/s) laminar flow or 2-gpm (0.13-L/s) laminar flow.

C. Aerator: Nigara 1.0 GPM Tamperproof, Male Threaded N3210MT.

2.07 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings:

1. Manufacturers:
2. Basis-of-Design Product: **Product indicated on Drawings** or a comparable product of one of the following:

a. B & K Industries, Inc.
b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
c. Brasstech Inc.; Newport Brass Div.

d. Dearborn Brass; a div. of Moen, Inc.
e. Geberit Manufacturing, Inc.
f. JB Products; a Federal Process Corporation Company.
g. Sioux Chief Manufacturing Company, Inc.
h. Watts Brass & Tubular; a division of Watts Regulator Co.
i. Or Architect approved equal.

3. ASSE 1021, Hose Connections: 5/8-inch- (16-mm-) ID inlet and 7/8-inch- (22-mm-) ID outlet, Capacity: At least 5 gpm (0.32 L/s); at inlet pressure of at least 5 psig (35 kPa) and at temperature of at least 140 deg F (60 deg C), with deck mounting.

2.08 LAUNDRY TRAY

A. Plastic Laundry Trays: Floor-stand type.

1. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:

a. Crane Plumbing, L.L.C./Fiat Products.
b. Florestone Products Co., Inc.
c. Gerber Plumbing Fixtures LLC.
d. Mustee, E. L. & Sons, Inc.
e. Swan Corporation (The).
f. Zurn Plumbing Products Group; Light Commercial Operation.
g. Or Architect approved equal.

B. Faucet: Solid brass, wall mounting, including swing spout and dual lever or four-arm handles.

C. Drain(s): Manufacturer's standard grid drain with NPS 1-1/2 (DN 40) tubular-brass tailpiece.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. Install fitting insulation kits on fixtures for people with disabilities.

B. Install fixtures with flanges and gasket seals.

C. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

D. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

E. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

F. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

G. Fasten wall-mounted fittings to reinforcement built into walls.

H. Fasten counter-mounting plumbing fixtures to casework.

I. Secure supplies to supports or substrate within pipe space behind fixture.

J. Set shower receptors and mop basins in leveling bed of cement grout.

K. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at fixture.

L. Install water-supply stop valves in accessible locations.

M. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes unless otherwise indicated.

N. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.

O. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.

P. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

R. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

S. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.

T. Ground equipment.

END OF SECTION 22 40 00

Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

PART 2 - PRODUCTS

2.01 TUBES AND FITTINGS

A. Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B) and ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

D. Brazing Filler Metals: AWS A5.8.

2.02 VALVES

A. Thermostatic Expansion Valve: Comply with ARI 750; forged brass or steel body, stainless-steel internal parts, copper tubing filled with refrigerant charge for 46 deg F (8 deg C) heating and 71 deg F (22 deg C) cooling suction temperature; 102-411 psig (710-2834 kPa) working pressure, and 240 deg F (116 deg C) operating temperature.

B. Solenoid Valves: Comply with ARI 760; 240 deg F (116 deg C) temperature rating, 400-psig (2760-kPa) working pressure, 240 deg F (116 deg C) operating temperature; and 24-V normally closed holding coil.

2.03 REFRIGERANT PIPING SPECIALTIES

A. Strainers: Welded steel with corrosion-resistant coating and 100-mesh stainless-steel screen with socket ends; 500-psig (3450-kPa) working pressure and 275 deg F (135 deg C) working temperature.

B. Moisture/Liquid Indicators: 500-psig (3450-kPa) operating pressure, 240 deg F (116 deg C) operating temperature; with replaceable, polished, optical viewing window and color-coded moisture indicator.

C. Refrigerant: ASHRAE 34, R-410A.

D. Insulation:

1. Conform to ASTEM C534 Grade 1, Type I.
2. Shall have a closed cell structure to prevent moisture from wicking, which makes it an efficient insulation.
3. Shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.
4. Shall have a maximum thermal conductivity of 0.27 Btu-in/h-ft^2 F at 75F mean temperature as tested in accordance with ASTM C 177 or ASTM C 518.
5. Shall have a maximum water vapor transmission of 0.08 per-inches when tested in accordance with ASTEm E96, Procedure A.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight.

B. Install refrigerant piping and charge with refrigerant according to ASHRAE 15.

C. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

D. Install solenoid valves upstream from each thermostatic expansion valve. Install solenoid valves in horizontal lines with coil at top.

E. Install thermostatic expansion valves as close as possible to distributors on evaporator coils.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to solenoid valves, thermostatic expansion valves, and compressors unless they are furnished as an integral assembly for device being protected.

H. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

3.02 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines: Copper, Type L (B), annealed- or drawn-temper tubing and wrought- copper fittings with soldered joints.

END OF SECTION 23 23 00

SECTION 23 72 00 – AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Energy recovery ventilator that transfer humidity and recover energy from that humidity, helps maintain a fresh environment even when the heating or cooling system is not operating.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Comply with NFPA 70 and 2011 NEC.

PART 2 - PRODUCTS

2.01 ENERGY RECOVERY VENTILATOR

A. Manufacture: Panasonic.

1. Model #: FV-04VE1.
2. 4" duct.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. ERV Panasonic FV-04VE1 Installation Instructions.

END OF SECTION 23 72 00

SECTION 23 81 26 – SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Mini-split heat pumps.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

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. Product shall comply with National Electrical Manufacturers Association (NEMA) and UL

PART 2 - PRODUCTS

2.01 OUTDOOR UNIT

A. Manufacture: Mitsubishi.

1. Model #: MUZ-FE09-18NA.

2.02 INDOOR UNIT

A. Manufacture: Mitsubishi.

1. Model #: MSZ-FE09-18NA.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. MUZ-FE09-18NA Outdoor Unit Service Manual.

2. MSZ-FE09-18NA Indoor Unit Service Manual.

3.02 INSTALLATION

A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

B. Handle and install units in accordance with manufacturer's written instructions.

C. Support units rigidly so they remain stationary at all times. Cross bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

D. Locate units to provide proper functioning of volume controls.

END OF SECTION 23 81 26

SECTION 23 83 16 - RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Radiant floor heating systems for various floor constructions and control strategies, using cross-linked polyethylene (PEX) tubing, manifold for distribution, and applicable fittings.

1.02 SUBMITTALS

A. General: Submit listed submittals .

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. Regulatory Requirements and Approvals: Provide a radiant floor heating system that complies with the following requirements.

1. International Code Council (ICC)

    a. International Mechanical Code (IMC)
    b. International Building Code (IBC)
    c. ICC Evaluation Service (ES) Evaluation Report

2. International Association of Plumbing and Mechanical Officials (IAPMO)

    a. Uniform Mechanical Code (UMC)

PART 2 - PRODUCTS

2.01 HYDRONIC RADIANT FLOOR HEATING SYSTEM

A. Manufacturer:

1. Uponor, Inc.
   5925 148th Street West, Apple Valley, MN 55124;
   Telephone: (800) 321-4739, (952) 891-2000;
   Fax: (952) 891-1409;
   Website: www.uponor-usa.com

B. Tubing

1. hePEX ½”

C. Manifolds (residential and light commercial, valved brass)

1. TruFlOW Jr. with balancing and isolation valves.

D. Fittings

1. ProPEX Fittings and Rings.

E. Supply Water Temperature Control (Single-temperature with Variable-speed Injection)

1. Three Way Mixing Valve

a. Part # A5401112
b. Set to 90 degrees.

2. Thermal Actuators

a. Part # A3030523
b. 24VAC, 167 mA
c. Max 17psi

2.02 HEAT TRANSFER PLATES

A. Joint Trak Plates

1. Part # A5080500

2.03 EXPANSION TANK

A. Manufacturer:

1. Bosch

a. Part #: 7747202342
b. ¾”, Male
c. 18 L, 6 bar white
d. Max. operating pressure: 87.02 psi/6 bar

2.04 PIPING, FITTINGS, VALVES AND ACCESSORIES

A. Pressure and Temperature Relief Valve – ¾” stainless steel spring, ASME rate, CSA certified and meet ANSI Z21.22 standard

B. Isolation Valve – ¾" brass ball valve, in line with FNPT

C. Fill/Drain Valve – ¾" hose bib

D. Check Valve – ¾" swing style, brass, NPT

2.05 GAUGES AND INSTRUMENTATION

A. Manufacturer:

1. Omega Engineering, Inc.

2.06 PUMP

A. Manufacturer:

1. Taco
2. Model #: 003-84
3. ¾" SWT

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. Uponor Complete Design Assistance Manual (CDAM)
2. Uponor Radiant Floor Installation Handook
3. Uponor proMIX 201 Installation Manual

3.02 INSTALLATION

A. Above the structural subfloor will be the layer of subflooring specifically for hydronic radiant tubing and plates.

B. Use a round nose router bit with diameter at least ½" and portable electric router to remove wood material where tubing and Joist Track plates are to be layed.

C. Do not exceed 8 inches (203mm) on center. Refer to the submitted radiant floor design.

D. Attach PEX tubing to inverted Joist Trak heat transfer plates by snapping the tube into the channel as they are layed in the routed subfloor grooves.

E. Adhere to the PEX tubing manufacturer's recommendations. Also refer to the Joist Trak Heat Transfer Panel Installation Handbook for additional information.

F. The plate faces should be resting level with the upper surface of the subfloor and the tubing and channel clip should be resting down into the subflooring grooves.

G. Leave a minimum ¼" gap between all plate edges to allow for thermal expansion.

H. Using the pre-punched mounting holes, secure the Joist Trak panels to the uppermost surface of the wood subfloor using screws or nails.

I. Install insulation underneath the structural subflooring and between the joists. Do not allow any air gap between the wood structural subfloor and the top of the insulation.

J. Use the recommended amount of insulation in the joist cavity below the structural subfloor in accordance with the submitted radiant floor design.

K. To compute insulation amount, the base guideline is a minimum of 5:1 ratio in R-value of the joist insulation to upward resistance.

L. Use edge insulation if the heated panel directly contacts an exterior wall or panel.

M. Perform a water pressure test of the system at 100 psi before laying plywood sheathing and finished flooring.

3.03 ADJUSTING

A. Balancing Across the Manifold

1. Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.
2. Balancing is unnecessary when all loop lengths across the manifold are within 3 percent of each other in length. Install the supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.

B. Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains.

3.04 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 23 83 16

Division 25 – Integrated Automation

SECTION 25 10 00 – INTEGRATED AUTOMATION NETWORK EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes advanced metering of the home energy consumption and automation system.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

1.03 COMPLIANCE

A. ASHRAE 135-2008 A Data Communication Protocol for Building Automation and Control Networks (ANSI).

B. Underwriters Laboratories, Inc. (UL):

1. 916-2007 Energy Management Equipment
2. 5085-3-2007 UL Standard for Safety Standard Low Voltage
3. 1244-2000 Electrical and Electronic Measuring and Testing Equipment
4. 1581-2006 Electrical Wires, Cables, and Flexible Cords

C. International Electrotechnical Commission (IEC):

1. IEC 61000-2005 Electromagnetic Compatibility (EMC)- Part 4-5: Testing and Measurement Techniques; Surge Immunity Test

D. National Electrical Contractors Association

1. NECA 1-2006 Good Workmanship in Electrical Construction

PART 2 - PRODUCTS

2.01 POWERLINE AUTOMATION SYSTEM

A United Devices ISY-994i ZS/IR PRO Automation Controller

B Insteon Powerlinc Modem

C Insteon SignaLinc

D Insteon OutletLinc Relay

E Insteon In-LineLinc Relay

F Insteon Wireless Thermostat

G Global Cache iTach WF2IR IR Transreceiver

H EZIO8SA Low-voltage I/O Controller

I Insteon SwitchLinc Dimmer

2.02 DATA ACQUISITION SYSTEM

A. Datalogger:

1. Campbell Scientific CR1000-XT-SW-NC

B. Wall charger:

1. Campbell Scientific 9591
2. 18V, 1.2A, 110V ac input, 6ft cable

C. Power supply:

1. Campbell Scientific PS100-SW
2. 12V power supply with charging regulator and 7Ahr sealed rechargeable battery
3. Standard 1 year warranty

D. Multiplexer:

1. Campbell Scientific AM16/32B

E. Switch enclosure module:

1. Campbell Scientific SDM-SW8A-SW
2. 8 Channel switch enclosure input module
3. Standard 1 year warranty

F. Ethernet communications:

1. Campbell Scientific NL120-ST-SW
2. Standard 1 year warranty

G. Multiplexer cable:

1. Campbell Scientific CABLE4DBL-L2

2.03 SENSORS

A. Thermocouples:

1. Omega Engineering SA2F-T-72-SMPW
2. Type T

B. Thermocouple extension wires:

1. Omega Engineering TT-T-24S-TWSH-SLE-500

C. Thermocouple wire connectors:

1. Omega Engineering HGMP-T-MF
2. Type T calibration

D. Pyranometer:

1. Campbell Scientific LI200X-L20-PT

E. Temperature and relative humidity sensoR:

1. Campbell Scientific HMP60-L50_PT

F. Flow measurement sensor:

1. Omega Engineering FTB-4115A-P

G. Power measurement sensor:

1. kWh transducer: Continental Control Systems WNB-3Y-208-P-PV
2. Current transformer: Continental Control Systems ACT-0750

2.04 USER INTERFACE

A. APPLE IPAD2

1. Dual core Apple A5X chip
2. Wi-Fi with Bluetooth
3. 16GB

2.05 NETWORK INFRASTRUCTURE

A. Ethernet Cable – CAT5e

B. Phone Cable – CAT3

C. Patch Panel – 12-port CAT5e

PART 3 - EXECUTION

3.01 INSTALLATION

A. Network Hardware

1. System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable wired or wireless data transmission system shall be provided and shall be fully integrated with the configured network chosen for the project.

B. Computer Hardware

1. Provide the server(s) or personal computer workstation(s) where shown on the plans or indicated diagrammatically.

C. Computer Software

1. User friendly software shall be suitable for operation on computer workstations which serve as site data aggregation devices by monitoring the meters in the system, recording events, indicating energy use and control indoor comfort.
2. The software shall be developed by the configured and programmed with ability of customization and shall interface with the server or computer workstation via internet browsers.

END OF SECTION 25 10 00

Division 26 – Electrical

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.02 SUBMITTALS

A. Manufacturer's Literature and Data: Showing each cable type and rating.

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. 70-08 National Electrical Code (NEC)

B. National Electrical Manufacturers Association (NEMA):

1. WC 70-09 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

C. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA WC-70 and as specified herein.

B. Single Conductor:

1. Shall be annealed copper.
2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. XHHW-2 or THHN-THWN shall be in accordance with NEMA WC-70, UL 44, and UL 83.

D. Color Code:

1. Secondary service feeder and branch circuit conductors shall be color-coded as follows:

240/120 volt	Split-Phase
Black	Hot
White	Neutral
Green/Yellow	Ground

2. Use solid color insulation or solid color coating for No. 12 AWG and No. 10 AWG branch circuit hot, 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 SPLICES AND JOINTS

A. In accordance with UL 486A, C, D, E, and NEC.

B. Aboveground Circuits (No. 10 AWG and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F [105˚ C], with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.

C. Aboveground Circuits (No. 8 AWG and larger):

1. 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.
2. 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.
3. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.03 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. 14 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.

2.04 WIRE LUBRICATING COMPOUND

A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with the NEC, and as specified.

B. Install all wiring in raceway systems.

C. Splice cables and wires only in outlet boxes, junction boxes, pull-boxes, manholes, or handholes.

D. 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.

E. For panel boards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.

F. Seal cable and wire entering a building from underground between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

G. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables. Use lubricants approved for the cable.
2. Use nonmetallic ropes for pulling feeders.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the //Resident Engineer// //COTR//.
4. All cables in a single conduit shall be pulled simultaneously.
5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the general grounding and bonding requirements for electrical equipment and operations to provide a low impedance path for possible ground fault currents.

1.02 SUBMITTALS

A. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA) 70:

1. National Electrical Code B

B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

A. 2/O Type W conductor

PART 3 - EXECUTION

A. Provide conductor from main service equipment to the organizer utility panel.

B. Ensure location of grounding conductors are not a trip hazard.

C. Organizers will bond the dwelling grounding conductor to the organizer grounding electrode.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

1.02 SUBMITTALS

A. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. 70-08 National Electrical Code (NEC)

B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 0.5 in [13 mm] unless otherwise shown.

B. Conduit:

1. Electrical metallic tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4 in [105 mm] and shall be permitted only with cable rated 600 V or less.
2. Flexible galvanized steel conduit: Shall conform to UL 1.
3. Liquid-tight flexible metal conduit: Shall conform to UL 360.

C. Conduit Fittings:

1. Electrical metallic tubing fittings:

a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
b. Only steel or malleable iron materials are acceptable.

c. Compression couplings and connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
d. Setscrew couplings and connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.

2. Flexible steel conduit fittings:

a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
b. Clamp-type, with insulated throat.

3. Liquid-tight flexible metal conduit fittings:

a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
b. Only steel or malleable iron materials are acceptable.
c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

D. Conduit Supports:

1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 1.5 x 1.5 in [38 mm x 38 mm], 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in [9 mm] diameter steel hanger rods.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

PART 3 - EXECUTION

3.01 PENETRATIONS

A. Cutting or Holes: Cut holes in advance where they should be placed in the structural elements, such as ribs or beams.

B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

3.02 INSTALLATION

A. In accordance with UL, NEC, as shown, and as specified herein.

B. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8 ft [2.4 M] on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
7. Support within 12 in [300 mm] of changes of direction, and within 12 in [300 mm] of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 61 00 and Section 07 62 00.
12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

C. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

D. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences.

3.03 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 lbs [90 kg]. Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Bolts supported only by plaster or gypsum wallboard are not acceptable.

F. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

G. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

3.04 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush-mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 24 in [600 mm] center-to-center lateral spacing shall be maintained between boxes.

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 in [100 mm] square x 2.125 in [55 mm] deep, with device covers for the wall material and thickness involved.

F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1.".

G. On all branch circuit junction box covers, identify the circuits with black marker.

END OF SECTION 26 05 33

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.02 SUBMITTALS

A. Manuals: Complete maintenance and operating manuals, including technical data sheets and wiring diagrams

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. 70-2005 National Electrical Code (NEC)
2. 70E-2004 Standard for Electrical Life Safety in the Workplace

B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Main Panel

Manufacturer: Schneider Electric
Model #: SC2636M200FPV
Semi-flush, 200A

B. Sub Panel

Manufacturer: Schneider Electric
Model #: HOM20L125C
Indoor enclosure, 125A

C. Circuit Breakers

Manufacturer: Schneider Electric
Model #: HOM2000, HOM220, HOM120, HOM120CAFI, HOM230

D. Back-Fed Circuit Breaker Retaining Kit

Manufacturer: Schneider Electric
Model #: PK2SCPV

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected.

C. Install a printed schedule of circuits in each panelboard. Schedules shall be printed on the panelboard directory cards, installed in the appropriate panelboards, and incorporate all applicable contract changes. Information shall indicate outlets, lights, devices, or other equipment controlled by each circuit, and the final room numbers served by each circuit.

D. Mount the fully-aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 in [1980 mm]. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 in [150 mm] above the finished floor.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation and connection of wiring devices.

1.02 SUBMITTALS

A. Manuals: Technical data sheets and information for ordering replacement units.

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. 70 National Electrical Code (NEC)

B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 RECEPTACLES

A. General: All receptacles shall be listed by Underwriters Laboratories, Inc.

B. Duplex Receptacles: The ungrounded pole of each receptacle shall be provided with a separate terminal.

1. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box.

C. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof cover plate. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

D. Cover Plates: White

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.

C. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

D. Test GFCI devices for tripping values specified in UL 1436 and UL 943.

END OF SECTION 26 27 26

SECTION 26 31 00 – PHOTOVOLTAIC COLLECTORS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

B. Comply with NFPA 70, “National Electrical Code.”

1. Related Sections: 48 19 16 Electrical Power Generation Inverters

PART 2 - PRODUCTS

2.01 MODULES

A. Manufacturer: SunPower.

Model: SPR-225-BLK-U
Mono-crystalline photovoltaic module
25 year limited power warranty

2.02 MOUNTING KIT

A. Manufacturer: S-5!

Model: S-5-U
http://www.s-5.com/common/downloads/S-5-PV_101510.pdf
http://www.s-5.com/clamps/index_927.cfm#1
Stainless steel finishes: No. 6, dull satin

2.03 MICRO - INVERTER

A. Manufacturer: PowerOne Aurora

Model: MICRO-0.25-1-OUTD-US 208/240

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prepare substrate by cleaning, removing projections, filling voids, sealing joints, and as otherwise recommended in photovoltaic mounting clip manufacturer's written instructions.

B. Affix S-5! U-Clamps to standing seam metal roof per manufacturer instructions with provisions for thermal and structural movements.

C. Set units level, plumb, and true to line, without warp or rack of frames or panels and anchor securely in place to torque pressures required in manufacturer's specifications.

D. Make connections between S-5! U-Clamps and PV Kit per manufacturer instructions.

E. Correct deficiencies in or remove and reinstall mountings and modules that do not comply with requirements.

F. Repair, refinish, or replace mountings and modules damaged during installation or transit, as directed by Architect.

END OF SECTION 26 31 00

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data for each luminaire, including lamps.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fixtures, Emergency Lighting Units, 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.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Exterior Luminaires: Comply with UL 1598 and listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

C. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

D. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.03 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Recessed Can Light

Manufacturers:

Nora Lighting: NSIC-401QAT, NS-44HZ Finish
Or approved equal.

B. Outdoor Sconce

Manufacturers:

Hevilite: HL-340-2X-xLED, Natural, Stainless, or Anodized Aluminum
Or approved equal.

C. Dining Pendant

Manufacturers:

Gamalux: G-Beam Series GB35B, Semi-Gloss Satin Aluminum
Or approved equal.

D. Surface Mount Light

Manufacturers:

Skyline: 14-Round
Or approved equal.

E. Under Cabinet Light

Manufacturers:

Diode LED: DI-0255 or DI-0250
Or approved equal.

F. Bath Mirror Light

Manufacturers:

Diode LED: DI-0255
Or approved equal.

G. Patio Downlight

Manufacturers:

Hevilite: HL-336, Anodized Satin Aluminum
Or approved equal.

H. Wall Art Light

Manufacturers:

Feng Shui Lighting: FRM 12X12 AL, Natural Ultimatte Aluminum Finish
Or approved equal.

I. Water Feature Light

Manufacturers:

Diode LED: CASCADE Light Bar
Or approved equal.

J. Deck Accent Light

Manufacturers:

Fiberstars: BritePak
Or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.

B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Comply with NFPA 70 for minimum fixture supports.

D. Seismic Protection: Luminaire attachments to building walls and ceilings shall comply with seismic criteria in applicable electrical code.

E. Suspended Lighting Fixture Support:

Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

F. Adjust aimable lighting fixtures to provide required light intensities.

END OF SECTION 26 50 00

Division 28 – Electronic Safety and Security

SECTION 28 31 00 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This specification addresses fire alarm systems installations.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product submittal data and installation instructions ,detailed wiring diagrams

1.03 COMPLIANCE

A. National Fire Protection Association (NFPA):

1. NFPA 70 National Electrical Code
2. NFPA 72 National Fire Alarm Code
3. NFPA 101 Life Safety Code

B. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 SMOKE DETECTORS

A. Combination smoke & carbon monoxide detectors.

2.02 WIRE AND CABLE

A. UL listed and labeled as complying with NFPA 70.

B. Solid copper conductors with 600-V rated, 75 deg C, color-coded insulation. No. 12 AWG or larger as required by local codes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and test systems according to NFPA 72.

B. Install wiring in concealed spaces and exposed on ceilings and walls where indicated.

C. Wire devices per manufacturer specifications.

END OF SECTION 28 31 00

Division 31 – Earthwork

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Spray and roll-on wood applied borate treatment for primary termite control.

1.02 SYSTEM DESCRIPTION

A. Performance Requirements: Provides structural termite protection when applied according to the applicable sections of the U.S. Environmental Protection Agency registered label.

1.03 SUBMITTALS

A. Product Data: Submit applicable manufacturer's technical data and application instructions.

1.04 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer’s instructions and recommendations for work, including preparation of structure and application.

B. Engage a professional pest control operator, state licensed in accordance with regulations of governing authorities and trained in the application of wood applied termiticide treatment solution.

1.05 JOB CONDITIONS

A. Restrictions: Treatment will be performed when access to all structural wood members is available. This is normally at the “dried-in” stage of construction when all structural wood and sheathing is in place and prior to installation of drywall, insulation, mechanical systems and electrical wiring.

1.06 SPECIFIC PRODUCT WARRANTY

A. Furnish written warranty certifying that the applied termite treatment will prevent infestation of subterranean termites and, that if subterranean termite activity is discovered during warranty period, Contractor will re-treat structure and repair or replace damage caused by termite infestation.

PART 2 - PRODUCTS

2.01 TERMITICIDE, INSECTICIDE, AND FUNGICIDE

A. Preferred Manufacturer: Nisus Corporation, 100 Nisus Drive, Rockford TN 37853, 1-800-264-0870.

B. Product/System: Bora-Care Termiticide, Insecticide and Fungicide.

C. Termiticide requirements:

1. Bora-Care is an EPA-registered primary termiticide treatment that complies with requirements of authorities having jurisdiction over such an application.
2. Bora-Care will be provided in a concentrated formulation that dilutes with water or foaming agent.
3. Bora-Care is registered by label as a primary treatment to prevent termite infestation.
4. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use according to the Bora-Care's EPA registered label.

a. Syngenta; IMPASSE Termite System.

2.02 PRODUCT SUBSTITUTIONS

A. Or Architect approved equal.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product literature, technical bulletins and U.S. EPA registered label.

3.02 APPLICATION

A. Site Preparation: Remove foreign matter that could decrease thoroughness of treatment, such as sawdust, away from treatment surfaces. Move building materials that block or prevent product application to required treatment areas.

B. Application Rates: Apply termite treatment by label directions to include:

1. The treatment of all structural wood framing and sill plates. Apply a second application to wood within treated area when only one or two surfaces are exposed.
2. The treatment of all cellulosic floor, wall and roof sheathing.
3. The treatment of all plumbing, mechanical, electrical and structural penetrations.

END OF SECTION 31 31 16

SECTION 31 66 00 – SPECIAL FOUNDATIONS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install foundation system to withstand structural loads required by the U.S. Department of Energy Solar Decathlon Building Code.

B. Submittals: Product Data

PART 2 - PRODUCTS

2.01 ADJUSTABLE PREFABRICATED STEEL PIERS

A. TJT, Inc. Prefabricated Steel Piers

1. PCI Listing # 2470-1
2. Adjustable height, ABS/Plywood/Steel plate and post with threaded adjustment
3. Load Rating: 6,000 lbs.
4. Minimum/Maximum Height: 6.0”/36”
5. Website: http://www.tjt-inc.com/TJT%20Products.htm

B. D-Mac, LLC Prefabricated Steel Piers

1. PCI Listing #2440-1
2. Adjustable height, ABS/Plywood/Steel plate and post with threaded adjustment
3. Load Rating: 6,000 lbs.
4. Minimum/Maximum Height: 6.0”/36”

C. Sedco Piers, Inc. Prefabricated Steel Piers

1. PCI Listing #2440-1
2. Adjustable height, ABS/Plywood/Steel plate and post with threaded adjustment
3. Load Rating: 6,000 lbs.
4. Minimum/Maximum Height: 6.0”/36”
5. Website: http://sedco-pier.com/

D. or approved equivalent.

2.02 CONCRETE MASONRY UNIT (CMU) PIERS

A. CMU Pier Pads

1. Size: 8”x16”x various heights
2. Compressive strength: 1,900 psf
3. Grout for threaded bolts, non-structural use

2.03 PIER PADS

A. ABS Pier Pads

1. Size: 16” x 18.5” x 3/4”
2. Compressive strength: 6,000 psf (for 3,000 psf soil)
3. Color: Black

B. Plywood Pads

1. Size: 18” x 18” x 3/4”
2. For 6,000 psf capacity steel piers

C. or approved equivalent.

2.04 FINISHES

A. Steel Finishes: Cleaned, primed, and painted by manufacturer.

2.05 TIE-DOWN & STRAPPING

A. Simpson Strong-Tie Strong-Bolt 2

1. 5/8’’ x 10’’ Carbon Steel STB2-62100

B. Longitudinal Frame Tie 4-bolt

1. MMA 31

C. Minute Man Corner Tie w/G-60 Strap Min

1. Model: CT/WS

D. Minute Man Galv. Steel Strap Min G-60

1. Cert. ANSI 225.1 and ASTM D 3953
2. Crimp Seals for Strap - MMAS Seal

E. or approved equivalent.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prepare ground by cleaning, removing projections, and as otherwise recommended in stand manufacturer's written instructions and DOE Solar Decathlon Building Code foundation provisions.

B. Set units level, plumb, and true to line, without warp or rack of materials. Adjust products to achieve level foundation within manufacturer's specified minimum and maximum heights. Provide appropriate blocking if necessary.

C. Fasten stands securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated in drawings. Adjust as needed to integrate stability throughout system.

D. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

E. Correct deficiencies in or remove and reinstall products that do not comply with requirements.

F. Repair, refinish, or replace products damaged during installation, as directed by Architect.

G. Lubricate hardware and moving parts.

H. Secure with approved anchoring system.

END OF SECTION 31 66 00

Division 32 – Exterior Improvements

SECTION 32 84 00 – PLANTING IRRIGATION

PART 1 - GENERAL

1.01 SCOPE

A. This section specification information is for Rain Bird low volume dripline irrigation products including Control Zone Kits, XFS and XFD Dripline and compatible fittings, and Low Volume Emission Devices.

B. Provide labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the drip irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein.

1.02 SUBMITTALS

A. Submittals: Materials list, manufacturer's data, and shop drawings.

1.03 FLUSHING AND TESTING

A. Schedule testing with Owner's Representative a minimum of three (3) days in advance of testing.

B. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct line flushing and testing procedures.

C. Recommended Dripline and Emitter Lateral Flushing Procedures.

1. Flush the system every two weeks for the first six (6) weeks and check the water that is flushed out for cleanliness. Establish a regular system flushing schedule for the future based on results from the initial six-week flushing schedule.

2. Flush the system completely after any repairs are made and monitor system operation closely under regular system flushing schedule.

3. Check the pressure at the supply and flush headers on a regular basis and compare with the pressure readings taken after installation.

D. Recommended Dripline and Emitter Lateral Leakage Testing Procedures.

1. Subject installed dripline tubing and emitter lateral piping to water pressure equal to specified operating pressure for ten (10) minutes. Test with control zone components and dripline flush valve components installed.

2. Partially backfill buried pipe and tubing to prevent movement under pressure. Expose couplings, fittings, and valve components.

3. Visually inspect valve assemblies and fittings for leakage and replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until test segment is free from leaks. Cement or caulking to seal leaks is prohibited.

E. Recommended Dripline and Emitter Lateral Operational Testing Procedures.

1. Activate each dripline and emitter lateral control zone valve in sequence from controller. Provide either one additional person with radio or use handheld remote to activate remote control valves from controller. Manually activating remote control valve using manual bleed mechanism at remote control valve is not an acceptable method of activation. Owner's Representative will visually observe operation, water application patterns, and leakage.

2. Replace or adjust defective valve, fitting, dripline segment, emitter lateral segment, or appurtenance to correct operational and coverage uniformity deficiencies.

3. Repeat test(s) until each dripline or emitter lateral test segment passes testing procedures. Repeat tests, replace components, and correct deficiencies at no additional cost to Owner and/or Owner's Representative.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Product indicated herein (or on Drawings); or a n approved comparable product of one of the following:

Hunter Industries
Rainbird
Toro
Or Architect approved equal.

2.02 LATERAL PIPE AND FITTINGS

A. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.

B. Use Class 160, SDR-26, rated at 160 PSI (11 bar), conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are not manufactured in Class 160.

(or)

Use Class 200, SDR-21, rated at 200 PSI (13,8 bar), conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the cases where small nominal diameters are not manufactured in Class 200.

(or)

Use Schedule 40 conforming to dimensions and tolerances established by ASTM Standard D1785; UV radiation resistant.

C. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

D. Use PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings for threaded pipe connections as specified on the drawings and details.

E. Threaded joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

2.03 DRIP IRRIGATION COMPONENTS

A. Rain Bird Control Zone Kits

1. General Information

a. Provide control zone kits manufactured by Rain Bird as indicated on construction drawings.

b. Control zone kit assemblies for dripline irrigation zones must include control valve, filtration, and pressure regulation components sized to meet the hydraulic demands and flow requirements of the zones that they service.

2. Rain Bird Low Flow Control Zone Kit for dripline zones with flows from 0.2 to 5.0 GPM (0.8 to 18.9 lpm), including low flow valve (LFV) and pressure regulating filter (PRF).

a. Available model numbers:
   1) XCZ-075-PRF [3/4” (19 mm) Low Flow valve and 3/4” (19 mm) PR filter]
   2) XCZ-LF-100-PRF [1” (25 mm) Low Flow valve and 3/4” (19 mm) PR filter]
   3) XACZ-075-PRF [3/4” (19 mm) Low Flow Anti-siphon valve and 3/4” (19 mm) PR filter]

b. Low Flow Valve (LFV) component specifications include:
   1) Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials
   2) Diaphragm with a double-knife seal, constructed of durable Buna-N rubber with a clog-resistant metering orifice
   3) Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
   4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
   5) Inlet pressure rating: 20 to 120 PSI (1,4 to 8,3 bar)
   6) Female threaded inlet and outlet connections
   7) Anti-siphon valve configuration includes listed features and incorporates atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval

c. Pressure Regulating Filter (PRF) combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
   1) Compact “Y” filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 4 1/2" (11,4 cm), Length: 5 1/2" (14 cm), Width: 2" (5,1 cm)
   2) Standard 200 mesh (75 micron) filter screen constructed of durable polyester fabric attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
   3) Normally-open pressure regulating device with preset outlet pressure of approximately 30 PSI (2,1 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
   4) Male threaded 3/4” (19 mm) inlet and outlet connections.

(or)

3. Rain Bird Medium Flow Control Zone Kit for dripline zones with flows from 3.0 to 15.0 GPM (11.4 to 56.8 lpm), including Rain Bird DV or ASVF valve and pressure regulating filter (PRF).

   a. Available model numbers:
      1) XCZ-100-PRF [1” (25 mm) DV valve and 1” (25 mm) PR filter]
      2) XACZ-100-PRF [1” (25 mm) Anti-siphon Valve and 1” (25 mm) PR Filter]

   b. DV Valve component specifications include:
      1) Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials
      2) Diaphragm with a double-knife seal, constructed of durable Buna-N rubber with a clog-resistant metering orifice
      3) Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
      4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
      5) Inlet pressure rating: 20 to 120 PSI (1.4 to 8.3 bar)
      6) Female threaded inlet and outlet connections
      7) Anti-siphon valve configuration includes listed features and incorporates atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval

   c. Pressure Regulating Filter (PRF) combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
      1) Compact “Y” filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 4 1/2" (11,4 cm), Length: 5 1/2" (14 cm), Width: 2" (5,1 cm)

2) Standard 200 mesh (75 micron) filter screen constructed of durable polyester fabric attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
3) Normally-open pressure regulating device with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
4) Male threaded 1" (25 mm) inlet and outlet connections.

(or)

4. Rain Bird Medium Flow Commercial Control Zone Kit for dripline zones with flows from 3.0 to 20.0 GPM (11.4 to 75.7 lpm), including PVC ball valve, Rain Bird PESB valve, and Rain Bird pressure regulating quick-check basket filter.

a. Available model numbers:
1) XCZ-100-B-COM [1" (25 mm) PVC ball valve, 1" (25 mm) Rain Bird PESB valve, and 1" (25 mm) PRB-QKCHK pressure regulating basket filter]

b. PESB valve assembly component specifications include:
1) 1" (25 mm) PVC full-port ball valve with female threaded inlet and outlet connections
2) PESB valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials
3) Diaphragm constructed of a durable Buna-N rubber material reinforced with nylon
4) One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
5) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
6) Inlet pressure rating: 20 to 200 PSI (1,4 to 13,8 bar)
7) Female threaded inlet and outlet connections

c. Pressure Regulating Quick Check Basket Filter combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. Pressure regulating basket filter component specifications include:
1) Basket style body and jar-top cap constructed of heavy-duty glass-filled, UV-resistant polypropylene, with 150 PSI (10,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 6 1/2" (16,5 cm), Length: 6 1/2" (16,5 cm), Width: 3 1/2" (8,9 cm)
2) Indicator incorporated into filter cap that changes color from green to red during operation when the filter element requires cleaning.
3) Standard 200 mesh (75 micron) filter screen constructed of stainless steel attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
4) Normally-open in-line pressure regulating device, constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 PSI (10,3 bar), with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.

5) Male threaded 1” (25 mm) inlet and outlet connections.

(or)

5. Rain Bird High Flow Commercial Control Zone Kit for dripline zones with flows from 15.0 to 40.0 GPM (56,8 to 151,4 lpm), including Rain Bird PESB valve and two parallel Rain Bird pressure regulating quick-check basket filters.

a. Available model numbers:
1) XCZ-150-COM [1 1/2” (38 mm) Rain Bird PESB valve, and two 1” (25 mm) PRB-QKCHK pressure regulating basket filters]

b. PESB valve assembly component specifications include:
1) PESB valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials
2) Diaphragm constructed of a durable Buna-N rubber material reinforced with nylon
3) One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
5) Inlet pressure rating: 20 to 200 PSI (1,4 to 13,8 bar)
6) Female threaded inlet and outlet connections

c. Pressure Regulating Quick Check Basket Filter combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. Pressure regulating basket filter component specifications include:
1) Basket style body and jar-top cap constructed of heavy-duty glass-filled, UV-resistant polypropylene, with 150 PSI (10,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 6 1/2" (16,5 cm), Length: 6 1/2" (16,5 cm), Width: 3 1/2" (8,9 cm)
2) Indicator incorporated into filter cap that changes color from green to red during operation when the filter element requires cleaning.
3) Standard 200 mesh (75 micron) filter screen constructed of stainless steel attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
4) Normally-open in-line pressure regulating device, constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 PSI (10,3 bar), with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
5) Male threaded 1” (25 mm) inlet and outlet connections

B. Rain Bird XF Series Dripline Components

1. General Information

a. Provide flexible dual-layered pressure-compensating inline XF Series Dripline manufactured by Rain Bird, with emitter spacing and dripline row spacing as indicated on construction drawings.

b. Provide insert or compression fittings manufactured by Rain Bird that are compatible with inline emitter tubing as indicated on construction drawings.

2. Rain Bird XFD On-Surface Dripline with pressure-compensating inline emitters.

a. Available Rain Bird XFD On-Surface Dripline model numbers for POTABLE water systems; brown colored dripline tubing with emitter flow rates and spacing as shown:
   1) Rain Bird XFD-06-12; 0.6 GPH (2,3 lph) emitters spaced 12" (30,5 cm) on-center
   2) Rain Bird XFD-06-18; 0.6 GPH (2,3 lph) emitters spaced 18" (45,7 cm) on-center
   3) Rain Bird XFD-06-24; 0.6 GPH (2,3 lph) emitters spaced 24" (61 cm) on-center
   4) Rain Bird XFD-09-12; 0.9 GPH (3,4 lph) emitters spaced 12" (30,5 cm) on-center
   5) Rain Bird XFD-09-18; 0.9 GPH (3,4 lph) emitters spaced 18" (45,7 cm) on-center
   6) Rain Bird XFD-09-24; 0.9 GPH (3,4 lph) emitters spaced 24" (61 cm) on-center

b. Available Rain Bird XFDP On-Surface Dripline model numbers for NON-POTABLE water systems; purple colored dripline tubing with emitter flow rates and spacing as shown:
   1) Rain Bird XFDP-06-12; 0.6 GPH (2,3 lph) emitters spaced 12" (30,5 cm) on-center
   2) Rain Bird XFDP-06-18; 0.6 GPH (2,3 lph) emitters spaced 18" (45,7 cm) on-center
   3) Rain Bird XFDP-06-24; 0.6 GPH (2,3 lph) emitters spaced 24" (61 cm) on-center
   4) Rain Bird XFDP-09-12; 0.9 GPH (3,4 lph) emitters spaced 12" (30,5 cm) on-center
   5) Rain Bird XFDP-09-18; 0.9 GPH (3,4 lph) emitters spaced 18" (45,7 cm) on-center
   6) Rain Bird XFDP-09-24; 0.9 GPH (3,4 lph) emitters spaced 24" (61 cm) on-center

c. Dripline tubing material specifications and features include:
   1) XFD tubing; brown in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   2) XFDP tubing; purple in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference of the polyethylene tubing at spacing specified by model number
   4) Inline emitters designed to pressure-compensate by lengthening the emitter's turbulent flow path (Rain Bird patent pending)
   5) Consistent flow rate from each installed inline emitter when emitter inlet pressure is supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)
   6) Required filtration for XF Series dripline tubing and emitters is 120 mesh (125 micron)

d. Dripline tubing material specifications and features include:
   1) XFS tubing; copper in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   2) XFSP tubing; purple in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference of the polyethylene tubing at spacing specified by model number

4) Inline XFS Sub-Surface Dripline emitters include Rain Bird's exclusive Copper Shield™ Technology (patent pending), which protects the emitter from root intrusion without requiring EPA-approved handling procedures or supplementary equipment for chemical treatment of water as recommended by some manufacturer's of inline drip equipment.
5) Inline emitters designed to pressure-compensate by lengthening the emitter's turbulent flow path (Rain Bird patent pending)
6) Consistent flow rate from each installed inline emitter when emitter inlet pressure is supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)
7) Required filtration for XF Series dripline tubing and emitters is 120 mesh (125 micron)

3. Rain Bird XF Series Blank Dripline Tubing

a. Available model numbers for POTABLE water systems:
1) Rain Bird XFD blank tubing, brown in color.

b. Available model numbers for NON-POTABLE water systems:
1) Rain Bird XFDP blank tubing, purple in color.

4. Rain Bird Easy Fit Dripline Tubing Compression Fittings

a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
1) Tee: MDCFTEE
2) Coupling: MDCFCOUP
3) Elbow: MDCFEL
4) Adapters:
a) 1/2" (13 mm) Male pipe thread adapter: MDCF50MPT
b) 3/4" (19 mm) Male pipe thread adapter: MDCF75MPT
c) 1/2" (13 mm) Female pipe thread adapter: MDCF50FPT
d) 3/4" (19 mm) Female pipe thread adapter: MDCF75FPT
e) 3/4" (19 mm) Female hose thread adapter: MDCF75FHT
5) Flush Cap end closure for POTABLE system: MDCFCAP
6) Flush Cap end closure for NON-POTABLE system: MDCFPCAP

b. Easy Fit compression fitting specifications and features include:
1) Easy Fit directional fittings and flush cap fittings constructed from molded UV-resistant ABS material with Buna-N rubber seal for long-term, leak free connections
2) Easy Fit adapters constructed from UV-resistant ABS materials for use exclusively with Easy Fit Compression Fittings
3) Easy Fit Compression Fittings are intended for use with polyethylene tubing from .630" to .710" (16 mm-18 mm) OD to provide a leak-free compression fit
4) Maximum pressure loss for the Easy Fit adapters estimated to be 0.1 PSI (0,007 bar) per adapter
5) Operating pressure range for Easy Fit compression fittings and adapters is 0 to 60 PSI (0 to 4,1 bar)

(or)

5. Rain Bird XF Series Dripline Tubing Insert Fittings

   a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
      1) Tee: XFD-TEE insert tee (17 x17 x 17 mm)
      2) Coupling: XFD-COUP insert coupling (17 x 17 mm)
      3) Elbow: XFD-ELBOW insert elbow (17 x 17 mm)
      4) Cross: XFD-CROSS insert cross (17 x 17 x 17 x 17 mm)
      5) Insert Adapters:
         a) 1/2" (13 mm) Male pipe thread adapter: XFD-MA-050 [17 mm x 1/2" (13 mm) MPT]
         b) 3/4" (19 mm) Male pipe thread adapter: XFD-MA-075 [17 mm x 3/4" (19 mm)MPT]
         c) 3/4" (19 mm) Female pipe thread adapter: XFD-FA-075 [17 mm x 3/4" (19 mm)FPT]
         d) 1/2" (13 mm) Tee male pipe thread adapter: XFD-TMA-050 [17 mm x 1/2" (13 mm)MPT x 17 mm]
         e) 3/4" (19mm) Tee female pipe thread adapter: XFD-TFA-075 [17 mm x 3/4" (19 mm)FPT x 17 mm]

   b. XF Series insert fitting specifications and features include:
      1) Constructed from black acetyl plastic for long-term, leak free connections
      2) Intended for use with polyethylene tubing with ID of 0.536" (13,6 mm), including Rain Bird XF Dripline and XF Series Blank Tubing
      3) Operating pressure range is 0 to 50 PSI (0 to 3,5 bar)

6. Rain Bird Air Relief Valves.

   a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
      1) ARValve Kit; includes 3/4" (19 mm) air/relief valve, Easy Fit compression tee, and Easy Fit flush cap.
      2) ARV12 Air Relief Valve ; includes 1/2" (13 mm) air relief valve.

C. Rain Bird Point Source Irrigation Emission Devices

1. General Information

   a. Provide low-volume point-source emission devices, manufactured by Rain Bird, to efficiently deliver irrigation water at the plant rootzone as indicated on construction drawings.

2. Rain Bird Single-outlet Xeri-Bug™ Emitters

   a. Available model numbers with self-piercing barb inlet:
      1) XB-05PC (Blue); 0.5 GPH (1,89 lph)
      2) XB-10PC (Black); 1.0 GPH (3,79 lph)

3) XB-20PC (Red); 2.0 GPH (7,57 lph)

b. Available model numbers with 10-32 threaded inlet:
1) XB-05PC-1032 (Blue); 0.5 GPH (1,89 lph)
2) XB-10PC-1032 (Black); 1.0 GPH (3,79 lph)
3) XB-20PC-1032 (Red); 2.0 GPH (7,57 lph)

c. Available model numbers with 1/2" (13 mm) threaded inlet:
1) XBT-10 (Black); 1.0 GPH (3,79 lph)
2) XBT-20 (Red); 2.0 GPH (7,57 lph)

d. Single-outlet Xeri-Bug Emitter specifications and features include:
1) Available with three inlet options:
a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with Rain Bird Xeriman tool.
b) 10-32 threaded inlet; Emitters with 10-32 threaded inlet allow threaded connection into PolyFlex Riser, 1032 Thread Adapter, or 1800 Xeri-Bubbler Adapter
c) 1/2" (13 mm) threaded inlet; Emitters with 1/2" (13 mm) threaded inlet allow threaded connection into 1/2" (13 mm) PVC male adapter.
2) External surfaces constructed from UV resistant acetyl materials
3) Self-flushing to minimize clogging
4) Color-coded to identify flow rate;
a) Blue emitter indicates a flow rate of 0.5 GPH (1,89 lph)
b) Black emitter indicates a flow rate of 1.0 GPH (3,79 lph)
c) Red emitter indicates a flow rate of 2.0 GPH (7,57 lph)
5) Pressure-compensating over the pressure range of 15 to 50 PSI (1,0 to 3,5 bar) with consistent flow rate of [0.5 GPH (1,89 lph)] or [1.0 GPH (3,79 lph)] or [2.0 GPH (7,57 lph)] over this pressure range

3. Rain Bird Single-outlet Pressure-Compensating Modules

a. Available model numbers with self-piercing inlet barb:
1) PC-05: light brown, 5 GPH (18,95 lph)
2) PC-07: violet, 7 GPH (26,53 lph)
3) PC-10: green, 10 GPH (37,90 lph)
4) PC-12: dark brown, 12 GPH (45,48 lph)
5) PC-18: white, 18 GPH (68,22 lph)
6) PC-24: orange, 24 GPH (90,96 lph)

b. Available model numbers with 10-32 threaded inlet:
1) PC-05 10-32: light brown, 5 GPH (18,95 lph)
2) PC-07 10-32: violet, 7 GPH (26,53 lph)
3) PC-10 10-32: green, 10 GPH (37,90 lph)

c. Pressure-Compensating Module specifications and features include:
1) Available with two inlet options:

a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with Rain Bird Xeriman tool.
b) 10-32 threaded inlet; Emitters with 10-32 threaded inlet allow threaded connection into PolyFlex Riser, 1032 Thread Adapter, or 1800 Xeri-Bubbler Adapter

2) External surfaces constructed from UV resistant acetyl materials
3) Color-coded to identify flow rate;
a) Tan outlet indicates a flow rate of 5 GPH (18,93 lph)
b) Violet outlet indicates a flow rate of 7 GPH (26,50 lph)
c) Green outlet indicates a flow rate of 10 GPH (37,85 lph)
d) Dark brown outlet indicates a flow rate of 12 GPH (45,42 lph)
e) White outlet indicates a flow rate of 18 GPH (68,13 lph)
f) Orange outlet indicates a flow rate of 24 GPH (90,84 lph)
4) Pressure-compensating over the pressure range of 10 to 50 PSI (0.7 to 3,5 bar) with consistent flow rate of [5 GPH (18,93 lph)] or [7 GPH 26,50 lph)] or [10 GPH (37,85 lph)] or [12 GPH (45,42 lph)] or [18 GPH (68,13 lph)] or [24 GPH (90,84 lph)] over this pressure range.

d. Rain Bird PC Diffuser Cap specifications and features include:
1) Available with two color options:
a) PC Diffuser (Black); This Diffuser Cap is to be used for Pressure-Compensating Module zones serviced by a potable water source.
b) PC DIFF-PPL (Purple); This Diffuser Cap is to be used for Pressure-Compensating Module zones serviced by a non-potable water source.
2) Constructed from UV-resistant polyethylene material
3) Capable of snapping onto Rain Bird Pressure-Compensating Modules to create a bubbler effect and prevent wash out

4. Rain Bird Multi-outlet Xeri-Bug Emission Devices

a. Available model numbers with barb inlet:
1) XB-05-6: Blue, 0.5 GPH (1,89 lph/outlet)
2) XB-10-6:Black, 1.0 GPH (3,79 lph/outlet)
3) XB-20-6:Red, 2.0 GPH (7,57 lph/outlet)

b. Available model numbers with 1/2" (13 mm) female threaded inlet:
1) XBT-05-6: Blue, 0.5 GPH (1,89 lph/outlet)
2) XBT-10-6:Black, 1.0 GPH (3,79 lph/outlet)
3) XBT-20-6:Red, 2.0 GPH (7,57 lph/outlet)

c. Multi-outlet Xeri-Bug specifications and features include:
1) Available with two inlet options:
a) Barb inlet; Emitters with barb inlet permit insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing
b) 1/2" (13 mm) threaded inlet; Emitters with 1/2" (13 mm) threaded inlet allow threaded connection into 1/2" (13 mm) PVC male adapter.
2) Six outlet ports, barbed to retain 1/4" (6,4mm) distribution tubing
3) External surfaces constructed from UV resistant acetyl materials

4) Self-flushing to minimize clogging
5) Color-coded to identify flow rate;
   a) Blue emitter indicates a flow rate of 0.5 GPH (1,89 lph) per outlet
   b) Black emitter indicates a flow rate of 1.0 GPH (3,79 lph) per outlet
   c) Red emitter indicates a flow rate of 2.0 GPH (7,57 lph) per outlet
6) Pressure-compensating over the pressure range of 15 to 50 PSI (1,0 to 3,5 bar) with consistent flow rate of [0.5 GPH (1,89 lph)] or [1.0 GPH (3,79 lph)] or [2.0 GPH (7,57 lph)] GPH over this pressure range

5. Rain Bird 6-outlet Manifold Emission Device

   a. Available model number:
      1) EMT-6XERI

   b. 6-outlet Manifold specifications and features include:
      1) 1/2" (13 mm) female threaded inlet
      2) Six free-flowing outlet ports, barbed to retain 1/4" (6,4 mm) distribution tubing and sealed by manufacturer with durable plastic caps removable with pliers during installation
      3) Recommended operating pressure range between 15 to 50 PSI (1,0 to 3,5 bar)

6. Rain Bird Multi-Outlet Xeri-Bird™ 8 Emission Device

   a. Available model numbers:
      1) XBD-80: Xeri-Bird™ 8 unit (includes seven removable port plugs) with filter
      2) XBD-81: Xeri-Bird™ 8 unit with eight 1 GPH (3,79 lph) Xeri-Bug (XB-10-PC) emitters factory installed and filter

   b. Xeri-Bird™ 8 specifications and features include:
      1) 1/2" (13 mm) threaded device inlet with union base nut to allow removal of the Xeri-Bird 8 body from riser for easy installation and maintenance
      2) Eight independent ports, each capable of accepting a Rain Bird Xeri-Bug™ emitter or Rain Bird PC Module for independent flows from 0.5 to 24 GPH (1,89 to 90,96 lph), or a self-piercing barb connector (SPB-025) for unrestricted flow
      3) Eight barbed outlet ports mounted on bottom of device capable of securely retaining 1/4" (6,4 mm) distribution tubing
      4) 200 mesh (75 micron) filter, easily serviceable from top of unit.
      5) Capable of being used with retrofit pressure regulator (PRS-050-30) when pressure regulation is required at unit

D. Rain Bird Low Volume Broadcast Irrigation Emission Devices

1. General Information

   a. Provide low-volume broadcast emission devices, manufactured by Rain Bird, to efficiently deliver irrigation water in a short-radius wetting pattern to planting areas as indicated on construction drawings.

2. Rain Bird Xeri-Bubbler™

a. Available model numbers with 1/4" (6,4 mm)barb inlet:
   1) SXB-180-025; half-circle, 5 streams
   2) SXB-360-025; full-circle, 8 streams
   3) UXB-360-025; full-circle, umbrella

b. Available model numbers with 10-32 thread inlet:
   1) SXB-180-1032; half-circle, 5 streams
   2) SXB-360-1032; full-circle, 8 streams
   3) UXB-360-1032; full-circle, umbrella

c. Available model numbers with 5" (12,7 cm) spike inlet:
   1) SXB-180-SPYK; half-circle, 5 streams
   2) SXB-360-SPYK; full-circle, 8 streams
   3) UXB-360-SPYK; full-circle, umbrella

d. Xeri-Bubbler™ specifications and features include:
   1) Three inlet connection options:
      a) 10-32 self-tapping thread
      b) 1/4" (6,4 mm) barb
      c) 5" (12,7 cm) spike
   2) Three flow pattern options:
      a) Half-circle with 5 streams
      b) Full-circle with 8 streams
      c) Full-circle umbrella pattern
   3) Flow and radius adjustment capability by turning outer cap
   4) SXB series features flow range of 0 to 13 GPH (0 to 49,2 lph)
   5) UXB series features flow range of 0 to 35 GPH (0 to 132,5 lph)
   6) Operating pressure range between 15 to 30 PSI (1,0 to 2,1 bar)

3. Rain Bird Xeri-Pop™ Micro-Spray

a. Available model numbers:
   1) XP-400X; 4-inch (101,6 mm) pop-up
   2) XP-600X; 6-inch (152,4 mm) pop-up
   3) XP-1200X; 12-inch (304,8 mm) pop-up

b. Xeri-Pop™ Micro-Spray specifications and features include:
   1) 1/4" (6,4 mm) barb inlet located in base of unit for connection to 1/4" (6,4 mm) distribution tubing
   2) Three pop-up height options:
      a) 4-inch (10,16 cm) pop-up
      b) 6-inch (15,24 cm) pop-up
      c) 12-inch (30,5 cm) pop-up
   3) Compatible with the following Rain Bird nozzles:
      a) Multi-port Series nozzles
      b) 5-series MPR plastic nozzles
      c) 5-series plastic bubbler nozzle (use in conjunction with Rain Bird PCS-series pressure compensating screen)
      d) 8-series MPR plastic nozzles

4) External body construction using UV-resistant ABS material
5) Self-flushing, pressure-activated wiper seal
6) Operating pressure range between 20 to 50 PSI (1,4 to 3,5 bar). Optimum performance achieved with 40 PSI (2,8 bar) pressure regulator.

4. Rain Bird Xeri-Sprays™

a. Available model numbers:
1) XS-90; Quarter-circle, spray pattern
2) XS-180; Half-circle, spray pattern
3) XS-360; Full-circle, stream spray pattern
4) 360 ADJ Mister

b. Xeri-Spray™ specifications and features include:
1) 10-32 self-tapping threaded inlet
2) Four flow pattern options:
a) Quarter-circle spray pattern
b) Half-circle spray pattern
c) Full-circle spray pattern
d) Full-circle mister
3) Operating pressure range between 10 to 30 PSI (0,75 to 2,1 bar)
4) Adjustable flow and radius with integral ball valve
a) Flow adjustability between 0 to 31 GPH (0 to 117,3 lph)
b) Radius adjustability for full-circle sprays between 0 to 13.4 feet (0 to 4,1 m)
c) Radius adjustability for part-circle sprays between 0 to 10.6 feet (0 to 3,2 m)

E. Rain Bird Drip Irrigation Accessories

1. 1/4” (6,4 mm) Barb Transfer Fittings

a. Available model numbers:
1) XBF1CONN:1/4” (6,4 mm) Barb Connector
2) XBF2EL: 1/4” (6,4 mm) Barb x Barb Elbow
3) XBFTEE: 1/4” (6,4 mm) Barb x Barb Tee

b. 1/4” (6,4 mm) Barb Transfer Fittings specifications and features include:
1) Three fitting configurations:
a) Connector
b) Elbow
c) Tee
2) Designed for connections of Rain Bird XQ 1/4” (6,4 mm) distribution tubing with an ID of 0.17” (4,3 mm)
3) Barbed on one end to permit easy insertion into any 1/2” (13 mm) or 3/4” (19 mm) polyethylene tubing using a Rain Bird Xeriman® tool (XM-TOOL)
4) Constructed from UV resistant acetyl.
5) Operating pressure range between 0 to 50 PSI (0 to 3.5 bar)

2. Rain Bird Diffuser Bug Cap

a. Available model numbers:
   1) DBC-025 (Black); for potable water source
   2) DBC-025-PPL (Purple); for non-potable water source

b. Diffuser Bug Cap specifications and features include:
   1) Barb inlet designed to fit into 1/4" (6,4 mm) distribution tubing with ID of 0.16" (4 mm)
   2) Flanged shield designed to diffuse water to minimize soil erosion at emission point
   3) Constructed from polyethylene material
   4) Operating pressure range between be 0 to 50 PSI (0 to 3,5 bar)

PART 3 – EXECUTION

3.01 DRIPLINE LAYOUT OF WORK

A. Stake out dripline irrigation system. Items staked include manifold/header pipe and tubing, sleeves, control zone assemblies, flush valves, air relief valves, and check valves.

B. Dripline Irrigation System Layout Review: Dripline irrigation system layout review will occur after staking has been completed. Notify Owner's Representative one week in advance of review. Modifications will be identified by Owner's Representative at this review.

C. General:

1. Keep pipe free from dirt and debris. Cut pipe ends square, debur and clean as recommended by pipe manufacturer.

2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

D. PVC Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.

2. PVC Solvent Weld Pipe and Fittings:

   a. Use appropriate primer and solvent cement. Join pipe in manner recommended by pipe and fitting manufacturers and in accordance with accepted industry practices.

   b. Cure for thirty (30) minutes before handling and twenty-four (24) hours before pressurizing or installing with vibratory plow.

   c. Snake pipe from side to side within trench.

3. PVC Threaded Connections:

   a. Use only factory-formed threads. Field-cut threads are not permitted.

b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.

E. Dripline Tubing and Fittings:

1. Use only Rain Bird XF-Series Insert Fittings or Rain Bird Easy Fit Compression Fittings for Rain Bird XF-Series dripline tubing connections or transitions as recommended by the Manufacturer's representative for the specific site and system conditions.

2. Dripline Insert Fittings:

a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.

3. Dripline Compression Fittings:

a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.

3.02 INSTALLATION OF DRIPLINE IRRIGATION COMPONENTS

A. Control Zone Kit Assembly:

1. Flush mainline pipe before installing Control Zone Kit assembly.

2. Locate where shown on drawings. Connect control wires to remote control valve wires using specified wire connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.

3. Install a maximum of four (4) Low Flow or Medium Flow Control Zone Kits per standard rectangular valve box. Install a maximum of one (1) Medium Flow Commercial Control Zone Kits per standard rectangular valve box. Install a maximum of one High Flow Commercial Control Zone Kits per jumbo rectangular valve box.

a. Locate valve boxes at least 12" (30,5 cm) from, and align with, nearby walls or edges of paved areas.

b. Group Control Zone Kit assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12" (30,5 cm) between valve boxes.

c. Brand controller letter and station numbers on valve box lid in 2" (50 mm) high letters.

B. Lateral Piping and Dripline Tubing:

1. Install lateral piping and dripline tubing at locations and in grid patterns as indicated on drawings and installation details, and in strict accordance with manufacturer recommendations.

2. Thoroughly flush PVC lateral piping, supply headers, and dripline tubing immediately upon installation.

C. Air Relief Valve Kit Assembly: Install at all high points in dripline tubing grid as shown and directed on drawings and installation details.

D. Flush Point Assembly: Install in flush header or at ends of each dripline zone segment as shown and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas.

END OF SECTION 32 84 00

SECTION 32 93 00 – PLANTS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product data and certificates.

PART 2 - PRODUCTS

2.01 PLANTING MATERIALS

A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

B. Tree and Shrub Material: Nursery grown, with healthy root systems, well-shaped, fully branched, healthy, and free of insects, eggs, larvae, defects, and disfigurement.

C. Ground Covers and Plants: Established and well rooted in pots or similar containers.

2.02 MISCELLANEOUS

A. Edgings: Weathered stell not less than 4 inches deep, with accessories and stakes.

1. Manufacturers:
2. Basis-of-Design Product: [Product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product of one of the following:

a. Border Concepts, Inc.
b. Collier Metal Specialties, Inc.
c. Curv-Rite, Inc.
d. Oly-Ola Edgings, Inc.
e. Permaloc Corporation.
f. Russell, J. D. Company (The).
g. Sure-Loc Edging Corporation.
h. Russell, J. D. Company (The).
i. Sure-Loc Edging Corporation.
j. Valley View Industries.
k. Or Architect approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Trees and Shrubs: All trees and shrubs are to remain in their containers for this is not a permanent structure.

3.02 MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Maintain trees and shrubs until established, but not less than six months.

C. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

D. Maintain ground covers and plants until established, but not less than six months.

END OF SECTION 32 93 00

Appendix I

Structural Calculations

STRUCTURAL CALCULATIONS

US Department of Energy Solar Decathlon
Team Las Vegas
August 18, 2013

Joanna Ayson	Brittany Radke
Iani Batilov	Suzanne Trabia
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Ankush Sehdev	Jerome Hugo
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CONTENTS

APPENDIX I - STRUCTURAL CALCULATIONS

Basis for Design

1.1 Building Code: International Building Code 2012

1.2 Roof Live Load (PSF): 20

1.3 Floor Live Loads (PSF): 50 Interior, 100 Exterior Deck

1.4 Wind Load: 90 MPH (3 Second Gusts) Exposure Category C

1.5 Seismic Load: Seismic Design Category D

1.6 Snow Load (PSF): 0

2.1 Foundation: Fabricated steel piers with 6,000LB capacity
1.25' X 1.25' Concrete Pad

3.1 Roof Sheathing: 5/8" Plywood IRC SEC.R803

4.1 Structural Steel:

Shape:	Standard:	Fy
Bars and Plates:	ASTM A36	36 KSI
Bolts (except in wood connections):	ASTM A325X	
Nuts:	ASTM A563	
Washers:	ASTM F436	
Anchor Rods:	ASTM F1554, Grade 36	36 KSI
	Or Grade 55 where noted	55 KSI
Welds:	E-70 Series	

5.1 Sawn Lumber shall have the following minimum grade (unless noted otherwise):

Use:	Material:
4X Deck Girders	TimberSIL Glass Wood
2X Deck Girders	TimberSIL Glass Wood
2X Deck Joists	TimberSIL Glass Wood

5.2 Glulam Beams: None

5.3 Laminated Strand Lumber (LSL): None

5.4 Laminated Veneer Lumber (LVL):

Use:	Material:
2X6 Studs	2.0E Redlam LVL
Roof I-Joists	I-65 & I-45 RedBuilt

5.5 Parallel Strand Lumber (PSL): None

5.6 Plywood:

Pattern U.N.O:

Thickness:	Span Rating:	Edge Nailing:	Field Nailing:
3/8"	*24/0*	8d at 6" O.C	8d at 12" O.C.
3/4"	*48/24*	10d at 6" O.C.	10d at 12"O.C.
7/16"	*24/16*	8d at 6" O.C.	8d at 12" O.C.
1"	*60/48*	10d at 6" O.C.	10d at 12"O.C.
15/32"	*32/16*	8d at 6" O.C.	8d at 12" O.C.
1 1/8"	*60/48*	10d at 6"O.C.	10d at 12"O.C.

5.7 All nails except 16d nails shall be common nails U.N.O. 16d Nails may be 16d sinker, 16d box or 12d common U.N.O.

Design Dead Loads

DESIGN DEAD LOADS

Roof:	Solar PV Panels	3
	Standing Seam Metal	1.4
	Rigid Insulation 1"	0.2
	Plywood Sheathing 15/32"	1.5
	I-Joist-Redbuilt	1.8
	5/8" Gypboard	2.8
	1/2" Plywood Ceiling	1.5
	Piping/Lighting	1
	Misc.	0.8
	DL (psf):	14

Floor:	Floor Finish Material	3.3
	Floor Padding 1/8"	0.2
	Radiant Floor Plates	0.3
	5/8" Plywood OSB with radiant floor	1.9
	Plywood 1 1/8" Base Layer	3.75
	Spray Insulation	0.5
	Plywood Underside Layer	1.5
	Misc.	1.55
	Dead Load to Steel Beams	13.0
	Steel Beams	8
	Total Dead Load to the floor	21.0

Walls:	Rainscreen 15/16"	3
	Hat Channels	0.4
	Rigid Insulation 1"	0.2
	Plywood Sheathing 1/2"	1.5
	Studs LVL 2x6 @24"O.C.	1.3
	Spray Insulation 5.5"	0.3
	5/8" Gypboard	2.8
	Misc	1.5
	DL (psf):	11.0

PV Overhang:	Solar PV Panels	3
	Steel WT supports Type: WT2.5x9.5	4.75
	Steel Rect HSS supports Type: HSS 3x2x5/16	0.55
	Misc	1.2
	DL (psf):	9.5

Shader Overhang:	Perforated Steel Plate	8.1
	Steel Rect HSS Beam supports Type: HSS 4x2 1/2x 3/8	2
	Steel Rect HSS supports Type: HSS 3x2x5/16	2.2
	Misc.	1.2
	DL (psf):	13.5

Foyer:	Standing Seam Metal	1.4
	Rigid Insulation 1"	0.2
	Plywood Sheathing 15/32"	1.5
	I-Joist-Redbuilt	1.1
	5/8" Gypboard	2.8
	1/2" Plywood Ceiling	1.5
	Piping/Lighting	1
	Misc.	1
	DL (psf):	10.5

Building Weight

Summary of Module A Gravity Loads (Permanent Location)

Wall DL	North Wall Height	12
	South Wall Height	9
	East Wall Height	11
	West Wall Height	11
	North Wall Length	23
	South Wall Length	20
	East Wall Length	16
	West Wall Length	16
	North Wall Area	281
	South Wall Area	176
	East Wall Area	171
	West Wall Area	166
	North Wall Dead Load	3091
	South Wall Dead Load	1939
	East Wall Dead Load	1882
	West Wall Dead Load	1829
Floor DL	Floor Area	340
	Floor Dead Load	4425
Roof DL	Roof Area	346
	Roof Dead Load	4851
	Trib Area North Wall	148
	Trib Area South Wall	145
	Trib Area East Wall	37
	Trib Area West Wall	16
	Trib DL North Wall	2074
	Trib DL South Wall	2029
	Trib DL East Wall	522
	Trib DL West Wall	226
Overhang DL	South Overhang Area	117
	West Overhang Area	34
	South Overhang DL	760
	West Overhang DL	221
Floor LL	Live Load psf	50
	Total Live Load	17021
Roof Liver Loff	Roof Live psf	20
	Total Roof Live Load	6929
	Trib Lr North Wall	2963
	Trib Lr South Wall	2899
	Trib Lr East Wall	745
	Trib Lr West Wall	322

Summary of Module B Gravity Loads (Permanent Location)

Wall DL	North Wall Height	12
	South Wall Height	9
	East Wall Height	11
	West Wall Height	11
	North Wall Length	27
	South Wall Length	22
	East Wall Length	16
	West Wall Length	17
	North Wall Area	329
	South Wall Area	198
	East Wall Area	166
	West Wall Area	176
	North Wall Dead Load	3619
	South Wall Dead Load	2178
	East Wall Dead Load	1828
	West Wall Dead Load	1933
Floor DL	Floor Area	391
	Floor Dead Load	5086
Roof DL	Roof Area	398
	Roof Dead Load	5574
	Trib Area North Wall	184
	Trib Area South Wall	169
	Trib Area East Wall	16
	Trib Area West Wall	30
	Trib DL North Wall	2570
	Trib DL South Wall	2361
	Trib DL East Wall	226
	Trib DL West Wall	418
Overhang DL	South Overhang Area	48
	Trib Foyer Area	31
	South Overhang DL	459
	Foyer DL	330
Floor LL	Live Load psf	50
	Total Live Load	19561
Roof Lr	Roof Live psf	20
	Total Roof Live Load	7963
	Trib Lr North Wall	3671
	Trib Lr South Wall	3372
	Trib Lr East Wall	322
	Trib Lr West Wall	598

Summary of Dead Loads (During Transportation)

Roof:	Standing Seam Metal	1.4
	Rigid Insulation 1"	0.2
	Plywood Sheathing 15/32"	1.5
	I-Joist-Redbuilt	1.8
	5/8" Gypboard	2.8
	1/2" Plywood Ceiling	1.5
	Piping/Lighting	1
	Misc.	0.8
	DL (psf):	11.0
Floor:	Floor Finish Material	3.3
	Floor Padding 1/8"	0.2
	Radiant Floor Plates	0.3
	5/8" Plywood OSB with radiant floor	1.9
	Plywood 1 1/8" Base Layer	3.75
	Spray Insulation	0.5
	Plywood Underside Layer	1.5
	Misc.	1.55
	Dead Load to Steel Beams (psf):	13.0
	Steel Beams (psf):	8
	Total Dead Load to the floor (psf):	21.0
Walls:	Rainscreen 15/16"	3
	Hat Channels	0.4
	Rigid Insulation 1"	0.2
	Plywood Sheathing 1/2"	1.5
	Studs LVL 2x6 @24"O.C.	1.3
	Spray Insulation 5.5"	0.3
	5/8" Gypboard	2.8
	Misc	1.5
	DL (psf):	11.0

Summary of Module A Dead Loads (During Transportation)

Wall DL	North Wall Height	12
	South Wall Height	9
	East Wall Height	11
	West Wall Height	11
	North Wall Length	23
	South Wall Length	20
	East Wall Length	16
	West Wall Length	16
	North Wall Area	281
	South Wall Area	176
	East Wall Area	171
	West Wall Area	166
	North Wall Dead Load	3091
	South Wall Dead Load	1939
	East Wall Dead Load	1882
	West Wall Dead Load	1829
Floor DL	Floor Area	340
	Floor Dead Load	4425
Roof DL	Roof Area	346
	Roof Dead Load	3811
	Trib Area North Wall	148
	Trib Area South Wall	145
	Trib Area East Wall	37
	Trib Area West Wall	16
	Trib DL North Wall	1630
	Trib DL South Wall	1594
	Trib DL East Wall	410
	Trib DL West Wall	177

Weight of Chassis	2723.3	lbs
Total Dead Load	19700	lbs
No. of Axles	4	
Dead Load per Axle	4925	lbs

Summary of Module B Dead Loads (During Transportation)

Wall DL	North Wall Height	12
	South Wall Height	9
	East Wall Height	11
	West Wall Height	11
	North Wall Length	27
	South Wall Length	22
	East Wall Length	16
	West Wall Length	17
	North Wall Area	329
	South Wall Area	198
	East Wall Area	166
	West Wall Area	176
	North Wall Dead Load	3619
	South Wall Dead Load	2178
	East Wall Dead Load	1828
	West Wall Dead Load	1933
Floor DL	Floor Area	391
	Floor Dead Load	5086
Roof DL	Roof Area	398
	Roof Dead Load	4380
	Trib Area North Wall	184
	Trib Area South Wall	169
	Trib Area East Wall	16
	Trib Area West Wall	30
	Trib DL North Wall	2019
	Trib DL South Wall	1855
	Trib DL East Wall	177
	Trib DL West Wall	329

Weight of Chassis	3129.7	lbs
Total Dead Load	22154	lbs
	4	
Dead Load per Axle	5538	lbs

MODULE TOTAL WEIGHTS

Robot Loads Module A

North Wall Dead Load	132	plf
South Wall Dead Load	99	plf
East Wall Dead Load	116	plf
West Wall Dead Load	116	plf
Trib DL North Wall	89	plf
Trib DL South Wall	104	plf
Trib DL East Wall	32	plf
Trib DL West Wall	14	plf
Shader Overhang South Wall	81	plf
Shader Overhang West Wall	29	plf
North Wall Lr	127	plf
South Wall Lr	148	plf
East Wall Lr	46	plf
West Wall Lr	20	plf

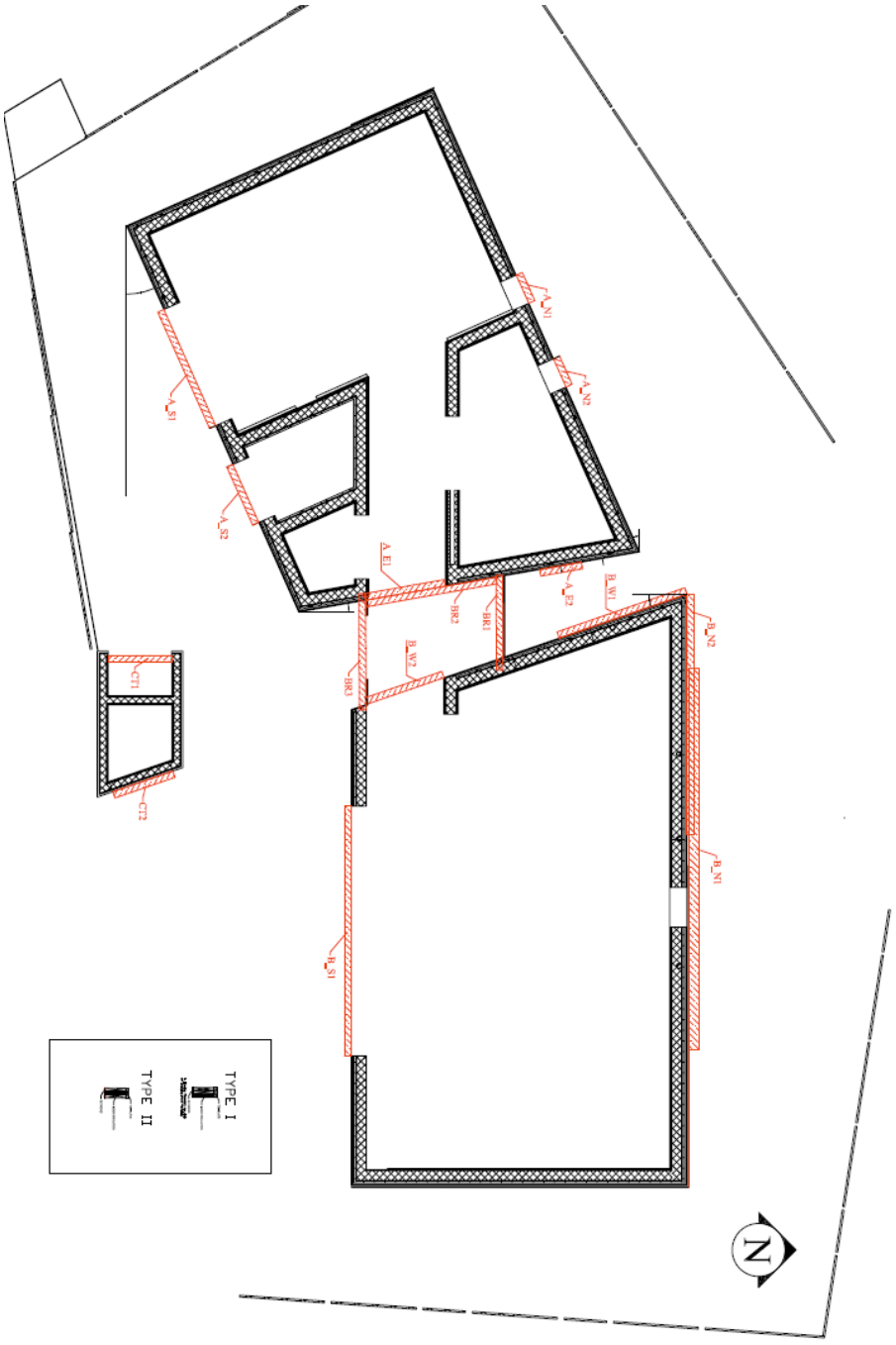
Chassis Dead Load	2723	lbs
Total Dead Load	20739	lbs

Robot Loads Module B

North Wall Dead Load	132	plf
South Wall Dead Load	99	plf
East Wall Dead Load	116	plf
West Wall Dead Load	116	plf
Trib DL North Wall	94	plf
Trib DL South Wall	107	plf
Trib DL East Wall	14	plf
Trib DL West Wall	25	plf
Shader Overhang South Wall	21	plf
Foyer (West Wall) Dead Load	20	plf
North Wall Lr	134	plf
South Wall Lr	153	plf
East Wall Lr	20	plf
West Wall Lr	36	plf
Foyer (West Wall) Roof Live Load	38	plf

Chassis Dead Load	3130	lbs
Total Dead Load	23348	lbs

Header Key Plan



Insulated Header Sizing Schedule

		LVL SIZE				
NAME	DESCRIPTION	LENGTH (FT)	WIDTH (IN)	DEPTH (IN)	# OF PLATES	HEADER TYPE
B-N1	Module B Header Over T-Window on North Wall - Window Frame Fins Accounted For	18.00	1.75	11.875	2	I
B-N2	Module B Header on Corner Window North Face	11.38	1.5	7.25	2	DETAIL 6 / S-501
B-S1	Module B Header over 4 Wing Slide Door	11.88	1.5	9.25	2	I
B-W1	Module B Corner Window Header on West Side	6.38	1.5	7.25	2	DETAIL 6 / S-501
B-W2	Module B Corridor Entry Way Header on West Side	4.04	1.5	5.5	2	II
A-N1	Module A Header Over Long Windows on the North Face	2.00	1.5	5.5	2	II
A-N2	Module A Header Over Long Windows on the North Face	2.00	1.5	5.5	2	III
A-S1	Module A Header South Face Double Slide Door	5.88	1.5	5.5	2	II
A-S2	Module A Header Over Mechanical Room Door on South Face Wall	3.00	1.5	5.5	2	II
A-E1	Module A Header Over Corridor Entry Way on East Face	4.20	1.5	5.5	2	II
A-E2	Module A Header Over Floor Bathroom Window on East Face	2.00	1.5	5.5	2	II
BR1	Bridge Header on North Face of Bridge Corridor	4.50	1.5	9.25	2	I
BR2	Bridge Header on West Face of Bridge Corridor	6.50	1.5	9.25	1	II
BR3	Bridge Header on South Face of Bridge Corridor	6.00	1.5	9.25	2	I

LVL Header Design

UNLV Solar Decathlon MODULE A Structural Composite Lumber Simply Supported Header Beam Design

Header Name:	**A-S1**		**Material:**	2.0E RedLam LVL							
Description:	*Module A Header South Face Double Slide Door*					**FACTORS**					
Width (b)	1.5	in	**Roof DL**	113.40 PLF	Actual Flexural Stress	F_b	3224.61	psi	Euler-based A	F_{bE}	9,929 psi
Depth (d)	5.5	in	**Roof LL (L_r)**	162.00 PLF	ontal shear parallel to	F_v	285	psi	Modulus of El	E_{min}	1000000 psi
Material Type			**Wall DL**	16.50 PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000 psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24 in
Length	5.875	ft	**Floor LL (L)**	0.00 PLF	Volume Factor	C_V	1.3886			l_u/d	4.364 <7
Unsupported Length	5.875	ft	$K_{LL}A_T$	95.175 ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44 in
Roof Trib. Length	8.1	ft	**LL Reduc.**	0 PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	10.99 n/a
Floor Trib. Length	0	ft	**Self Weight**	4.84 PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750 psi
									ASD Adj. Compr. Stregth	**F'_c**	750 **psi**
Top of Header to Edge of Roof	1.5	ft	**TOTAL LOAD**	**296.74** PLF	Repetitive member fac	C_r	1.00				
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor	C_b	1.00				
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2								
Roof Tributary Area (A_T)	47.5875	ft^2							**Bearing Contact Area**	$A_{bearing}$	8.25 in^2
Floor Tributary Area (A_T)	0	ft^2							**Max Support Bearing Pressure**	P	871.6835 lb
									Bearing Stress	**f'_c**	105.66 psi
									Beam Section Modulus	**S_{actual}**	15.13 **in^3**
Seismic Force (0.7E)	18.355	**PLF**	$0.2S_{DS}D$						**Actual Cross Sectional Area**	**A_{actual}**	16.50 **in^2**
Wind Force (W)	102.870	**PLF**	See Components & Cladding						Modulus of Elasticity	E	2000000 psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)					Maximum Allowed Deflection	Δ_{max}	0.196 in
Point Load	0	**0**	**0**	0					Actual Moment of Inertia	**I_{actual}**	41.59 in^4

Dist Load ***Reactions***

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	w	R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9803	2902.15	3950.47	256.50	134.74	395.8085	395.81	395.809	581.344	1.77	2.31	0.043	9.22
D + L	1.00	0.9773	3224.61	4375.83	285.00	134.74	395.8085	395.81	395.809	581.344	1.59	2.08	0.043	9.22
D + (Lr or S)	1.25	0.9686	4030.76	5421.29	356.25	296.74	871.6835	871.68	871.684	1280.29	**2.83**	**3.67**	**0.096**	**20.31**
D + 0.75L	1.15	0.9723	3708.30	5006.46	327.75	134.74	395.8085	395.81	395.809	581.344	1.39	1.81	0.043	9.22
D + (W or 0.7E)	1.60	0.9532	5159.38	6828.99	456.00	237.61	697.9891	697.99	697.989	1025.17	1.80	2.30	0.077	16.26
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9532	5159.38	6828.99	456.00	211.90	622.444	622.44	622.444	914.215	1.61	2.05	0.068	14.50
0.6D + W	1.60	0.9532	5159.38	6828.99	456.00	183.72	539.6657	539.67	539.666	792.634	1.39	1.78	0.059	12.57
0.6D + 0.7E	1.60	0.9532	5159.38	6828.99	456.00	99.20	291.4033	291.4	291.403	427.999	0.75	0.96	0.032	6.79

Header Name:	**A-S2**		**Material:**	2.0E RedLam LVL							
Description:	*Module A Header Over Mechanical Room Door on South Face Wall*					**FACTORS**					
Width (b)	1.5	in	**Roof DL**	113.40 PLF	Actual Flexural Stress	F_b	3224.61	psi	Euler-based A	F_{bE}	9,929 psi
Depth (d)	5.5	in	**Roof LL (L_r)**	162.00 PLF	ontal shear parallel to	F_v	285	psi	Modulus of El	E_{min}	1000000 psi
Material Type			**Wall DL**	16.50 PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000 psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24 in
Length	3	ft	**Floor LL (L)**	0.00 PLF	Volume Factor	C_V	1.4851			l_u/d	4.364 <7
Unsupported Length	3	ft	$K_{LL}A_T$	48.6 ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44 in
Roof Trib. Length	8.1	ft	**LL Reduc.**	0 PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	10.99 n/a
Floor Trib. Length	0	ft	**Self Weight**	4.84 PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750 psi
									ASD Adj. Compr. Stregth	**F'_c**	750 **psi**
Top of Header to Edge of Roof	1.5	ft	**TOTAL LOAD**	**296.74** PLF	Repetitive member fac	C_r	1.00				
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor	C_b	1.00				
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2								
Roof Tributary Area (A_T)	24.3	ft^2							**Bearing Contact Area**	$A_{bearing}$	8.25 in^2
Floor Tributary Area (A_T)	0	ft^2							**Max Support Bearing Pressure**	P	445.115 lb
									Bearing Stress	**f'_c**	53.95 psi
									Beam Section Modulus	**S_{actual}**	15.13 **in^3**
Seismic Force (0.7E)	18.355	**PLF**	$0.2S_{DS}D$						**Actual Cross Sectional Area**	**A_{actual}**	16.50 **in^2**
Wind Force (W)	102.870	**PLF**	See Components & Cladding						Modulus of Elasticity	E	2000000 psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)					Maximum Allowed Deflection	Δ_{max}	0.100 in
Point Load	0	**0**	**0**	0					Actual Moment of Inertia	**I_{actual}**	41.59 in^4

Dist Load ***Reactions***

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	w	R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9803	2902.15	4225.11	256.50	134.74	202.115	202.11	202.115	151.586	0.43	1.18	0.003	1.23
D + L	1.00	0.9773	3224.61	4680.03	285.00	134.74	202.115	202.11	202.115	151.586	0.39	1.06	0.003	1.23
D + (Lr or S)	1.25	0.9686	4030.76	5798.17	356.25	296.74	445.115	445.11	445.115	333.836	**0.69**	**1.87**	**0.007**	**2.70**
D + 0.75L	1.15	0.9723	3708.30	5354.51	327.75	134.74	202.115	202.11	202.115	151.586	0.34	0.93	0.003	1.23
D + (W or 0.7E)	1.60	0.9532	5159.38	7303.74	456.00	237.61	356.42	356.42	356.42	267.315	0.44	1.17	0.005	2.17
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9532	5159.38	7303.74	456.00	211.90	317.8437	317.84	317.844	238.383	0.39	1.05	0.005	1.93
0.6D + W	1.60	0.9532	5159.38	7303.74	456.00	183.72	275.574	275.57	275.574	206.68	0.34	0.91	0.004	1.67
0.6D + 0.7E	1.60	0.9532	5159.38	7303.74	456.00	99.20	148.8017	148.8	148.802	111.601	0.18	0.49	0.002	0.90

Header Name:	**A-N1 / A-N2**	**Material:**	2.0E RedLam LVL				
Description:	*Module A Header Over Long Windows on the North Face*			**FACTORS**			
Width (b)	1.5 in	**Roof DL**	113.40 PLF	Actual Flexural Stress F_b	3224.61 psi	Euler-based A F_{bE}	9,929 psi
Depth (d)	5.5 in	**Roof LL (L_r)**	162.00 PLF	ontal shear parallel to F_V	285 psi	Modulus of El E_{min}	1000000 psi
Material Type		**Wall DL**	0.00 PLF	Wet-Service Factor C_M	1.00	Adjusted ASD E'_{min}	1000000 psi
Unit Weight	42.269 Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor C_t	1.00	Unbraced Len l_u	24 in
Length	1.875 ft	**Floor LL (L)**	0.00 PLF	Volume Factor C_V	1.5566	l_u/d	4.364 <7
Unsupported Length	1.875 ft	$K_{LL}A_T$	30.375 ft^2	Flat-use Factor C_{fu}	1.00	Effective Unbr l_e	49.44 in
Roof Trib. Length	8.1 ft	**LL Reduc.**	0 PLF	Curvature Factor C_c	1.00	Slenderness F R_B	10.99 n/a
Floor Trib. Length	0 ft	**Self Weight**	2.42 PLF	Incising Factor C_i	1.00	Compressive S F_c	750 psi
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**277.82** PLF	Repetitive member fac C_r	1.00	**ASD Adj. Compr. Stregth** F'_c	750 **psi**
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor C_b	1.00		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	15.1875 ft^2			**Bearing Contact Area**	$A_{bearing}$	8.25 in^2	
Floor Tributary Area (A_T)	0 ft^2			**Max Support Bearing Pressure**	P	260.4578 lb	
				Bearing Stress	f'_c	31.57 psi	
				Beam Section Modulus	S_{actual}	7.56 in^3	
Seismic Force (0.7E)	16.024 **PLF**	$0.2S_{DS}D$		**Actual Cross Sectional Area**	A_{actual}	8.25 in^2	
Wind Force (W)	102.870 **PLF**	See Components & Cladding		Modulus of Elasticity	E	2000000 psi	
	P_1 (lbs) / x_1 (ft)	P_2 (lbs) / x_2 (ft)		Maximum Allowed Deflection	Δ_{max}	0.063 in	
Point Load	0 / 0	0 / 0		Actual Moment of Inertia	I_{actual}	20.80 in^4	

Dist Load ***Reactions***

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9803	2902.15	4428.43	256.50	115.82	108.5828	108.58	108.583	50.8982	0.14	0.63	0.001	0.26
D + L	1.00	0.9773	3224.61	4905.25	285.00	115.82	108.5828	108.58	108.583	50.8982	0.12	0.57	0.001	0.26
D + (Lr or S)	1.25	0.9686	4030.76	6077.20	356.25	277.82	260.4578	260.46	260.458	122.09	0.24	1.10	0.002	0.62
D + 0.75L	1.15	0.9723	3708.30	5612.18	327.75	115.82	108.5828	108.58	108.583	50.8982	0.11	0.50	0.001	0.26
D + (W or 0.7E)	1.60	0.9532	5159.38	7655.21	456.00	218.69	205.0234	205.02	205.023	96.1047	0.15	0.67	0.001	0.49
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9532	5159.38	7655.21	456.00	192.97	180.9133	180.91	180.913	84.8031	0.13	0.60	0.001	0.43
0.6D + W	1.60	0.9532	5159.38	7655.21	456.00	172.36	161.5903	161.59	161.59	75.7455	0.12	0.53	0.001	0.38
0.6D + 0.7E	1.60	0.9532	5159.38	7655.21	456.00	85.52	80.17185	80.172	80.1719	37.5806	0.06	0.26	0.001	0.19

Header Name:	**A-E1**	**Material:**	2.0E RedLam LVL				
Description:	*Module A Header Over Corridor Entry Way on East Face*			**FACTORS**			
Width (b)	1.5 in	**Roof DL**	49.00 PLF	Actual Flexural Stress F_b	3224.61 psi	Euler-based A F_{bE}	9,929 psi
Depth (d)	5.5 in	**Roof LL (L_r)**	70.00 PLF	ontal shear parallel to F_V	285 psi	Modulus of El E_{min}	1000000 psi
Material Type		**Wall DL**	38.50 PLF	Wet-Service Factor C_M	1.00	Adjusted ASD E'_{min}	1000000 psi
Unit Weight	42.269 Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor C_t	1.00	Unbraced Len l_u	24 in
Length	4.2 ft	**Floor LL (L)**	0.00 PLF	Volume Factor C_V	1.4359	l_u/d	4.364 <7
Unsupported Length	4.2 ft	$K_{LL}A_T$	29.4 ft^2	Flat-use Factor C_{fu}	1.00	Effective Unbr l_e	49.44 in
Roof Trib. Length	3.5 ft	**LL Reduc.**	0 PLF	Curvature Factor C_c	1.00	Slenderness F R_B	10.99 n/a
Floor Trib. Length	0 ft	**Self Weight**	4.84 PLF	Incising Factor C_i	1.00	Compressive S F_c	750 psi
Top of Header to Edge of Roof	3.5 ft	**TOTAL LOAD**	**162.34** PLF	Repetitive member fac C_r	1.00	**ASD Adj. Compr. Stregth** F'_c	750 **psi**
Sandwich Header?	Yes Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor C_b	1.00		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	14.7 ft^2			**Bearing Contact Area**	$A_{bearing}$	8.25 in^2	
Floor Tributary Area (A_T)	0 ft^2			**Max Support Bearing Pressure**	P	340.921 lb	
				Bearing Stress	f'_c	41.32 psi	
				Beam Section Modulus	S_{actual}	15.13 in^3	
Seismic Force (0.7E)	12.364 **PLF**	$0.2S_{DS}D$		**Actual Cross Sectional Area**	A_{actual}	16.50 in^2	
Wind Force (W)	44.450 **PLF**	See Components & Cladding		Modulus of Elasticity	E	2000000 psi	
	P_1 (lbs) / x_1 (ft)	P_2 (lbs) / x_2 (ft)		Maximum Allowed Deflection	Δ_{max}	0.140 in	
Point Load	0 / 0	0 / 0		Actual Moment of Inertia	I_{actual}	41.59 in^4	

Dist Load ***Reactions***

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9803	2902.15	4085.31	256.50	92.34	193.921	193.92	193.921	203.617	0.60	1.13	0.008	2.31
D + L	1.00	0.9773	3224.61	4525.18	285.00	92.34	193.921	193.92	193.921	203.617	0.54	1.02	0.008	2.31
D + (Lr or S)	1.25	0.9686	4030.76	5606.33	356.25	162.34	340.921	340.92	340.921	357.967	0.77	1.44	0.014	4.06
D + 0.75L	1.15	0.9723	3708.30	5177.34	327.75	92.34	193.921	193.92	193.921	203.617	0.47	0.89	0.008	2.31
D + (W or 0.7E)	1.60	0.9532	5159.38	7062.07	456.00	136.79	287.266	287.27	287.266	301.629	0.51	0.94	0.012	3.42
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9532	5159.38	7062.07	456.00	125.68	263.9297	263.93	263.93	277.126	0.47	0.87	0.011	3.14
0.6D + W	1.60	0.9532	5159.38	7062.07	456.00	99.86	209.6976	209.7	209.698	220.182	0.37	0.69	0.008	2.50
0.6D + 0.7E	1.60	0.9532	5159.38	7062.07	456.00	67.77	142.3168	142.32	142.317	149.433	0.25	0.47	0.006	1.69

RedSpec™ by RedBuilt™
v7.0.16

Project: Project
Location: UNLV Solar Decatholon House
Folder: Folder
Date: 10/8/12 2:33 PM
Designer: Collinsworth
Comment:

Type: Type

11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	18%	502	2819	125% - All Loads		PASS
Positive Moment (ft-lb)	22%	1854	8438	125% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	22%	0.108	0.492	L / 999+	L / 360	PASS
Span Total	26%	0.190	0.738	L / 932	L / 240	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	290 (125)	290 (125)
Dead Reaction (lb)	221	221
Total Reaction (lb) (DOL%)	511 (125)	511 (125)
Bearing	Flush	Flush
Support	Beam	Beam
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

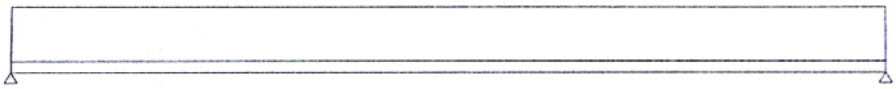
HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV2.56/11.88X*SLU11	6-10dx1.5"	4-10dx1.5"	2-10dx1.5"	Sawn DF	2x6 (Nailer)
Right	LBV2.56/11.88X*SLD11	6-10dx1.5"	4-10dx1.5"	2-10dx1.5"	Sawn DF	2x6 (Nailer)

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: 2.3/12



14'- 6.0"

APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Sloped length multiplier = 1.018. Bevel cut add = 2.28".

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Page 1 of 1

Header Name:	**B-N1**		**Material:**	2.0E RedLam LVL									
Description:	*Module B Header Over T-Window on North Wall - Window Frame Fins Accounted for*						**FACTORS**						
Width (b)	1.75	in	**Roof DL**	113.40	PLF	Actual Flexural Stress	F_b	2904.13	psi	Euler-based A	F_{bE}	6,260	psi
Depth (d)	11.875	in	**Roof LL (L_r)**	162.00	PLF	ontal shear parallel to	F_V	285	psi	Modulus of El	E_{min}	1000000	psi
Material Type			**Wall DL**	0.00	PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000	psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00	PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24	in
Length	18	ft	**Floor LL (L)**	0.00	PLF	Volume Factor	C_V	1.1319			l_u/d	2.021	<7
Unsupported Length	6	ft	$K_{LL}A_T$	291.6	ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44	in
Roof Trib. Length	8.1	ft	**LL Reduc.**	0	PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	13.85	n/a
Floor Trib. Length	0	ft	**Self Weight**	12.20	PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750	psi
										ASD Adj. Compr. Stregth	**F'_c**	750	**psi**
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**287.60**	PLF	Repetitive member fac	C_r	1.00					
Sandwich Header?	YES	Yes/No	**L_r Reduc.**	0	PLF	Bearing Area Factor	C_b	1.00					
Live Load Element Factor	2	K_{LL}	ASCE 7-10 Table 4-2										
Roof Tributary Area (A_T)	145.8	ft^2								**Bearing Contact Area**	$A_{bearing}$	8.25	in^2
Floor Tributary Area (A_T)	0	ft^2								**Max Support Bearing Pressure**	P	1277.8	lb
										Bearing Stress	**f'_c**	154.88	psi
										Beam Section Modulus	**S_{actual}**	82.26	**in^3**
Seismic Force (0.7E)	16.024	**PLF**	$0.2S_{DS}D$							**Actual Cross Sectional Area**	**A_{actual}**	41.56	**in^2**
Wind Force (W)	102.870	**PLF**	See Components & Cladding							Modulus of Elasticity	E	2000000	psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)						Maximum Allowed Deflection	Δ_{max}	0.200	in
Point Load	830	3	0	0						Actual Moment of Inertia	**I_{actual}**	488.41	in^4

Dist Load ***Reactions***

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	**w** (PLF)	**R_1** (lbs)	**R_2** (lbs)	**V_{max}** (lbs)	**M_{max}** (lb-ft)	**S_{req}** in^3	**A_{req}** in^2	**Δ_{actual}** in	**I_{req}** in^4
D	0.90	0.9672	2613.72	2861.58	256.50	125.60	791.8001	791.8	791.8	1810.2	7.59	4.63	0.010	25.29
D + L	1.00	0.9613	2904.13	3160.04	285.00	125.60	791.8001	791.8	791.8	1810.2	6.87	4.17	0.010	25.29
D + (Lr or S)	1.25	0.9431	3630.17	3875.16	356.25	287.60	1277.8	1277.8	1277.8	2588.4	**8.02**	**5.38**	**0.015**	**37.10**
D + 0.75L	1.15	0.9510	3339.75	3595.16	327.75	125.60	791.8001	791.8	791.8	1810.2	6.04	3.62	0.010	25.29
D + (W or 0.7E)	1.60	0.9067	4646.61	4768.75	456.00	228.47	1100.41	1100.4	1100.41	2273.12	5.72	3.62	0.013	32.79
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9067	4646.61	4768.75	456.00	202.75	1023.258	1023.3	1023.26	2157.39	5.43	3.37	0.013	30.92
0.6D + W	1.60	0.9067	4646.61	4768.75	456.00	178.23	949.6901	949.69	949.69	2047.04	5.15	3.12	0.012	29.13
0.6D + 0.7E	1.60	0.9067	4646.61	4768.75	456.00	91.38	689.151	689.15	689.151	1656.23	4.17	2.27	0.009	22.80

Header Name:	**B-N2**		**Material:**	2.0E RedLam LVL									
Description:	*Module B Header on Corner Window North Face*						**FACTORS**						
Width (b)	1.5	in	**Roof DL**	113.40	PLF	Actual Flexural Stress	F_b	3105.71	psi	Euler-based A	F_{bE}	7,533	psi
Depth (d)	7.25	in	**Roof LL (L_r)**	162.00	PLF	ontal shear parallel to	F_V	285	psi	Modulus of El	E_{min}	1000000	psi
Material Type			**Wall DL**	81.13	PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000	psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00	PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24	in
Length	11	ft	**Floor LL (L)**	0.00	PLF	Volume Factor	C_V	1.2686			l_u/d	3.310	<7
Unsupported Length	5.5	ft	$K_{LL}A_T$	178.2	ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44	in
Roof Trib. Length	8.1	ft	**LL Reduc.**	0	PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	12.62	n/a
Floor Trib. Length	0	ft	**Self Weight**	6.38	PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750	psi
										ASD Adj. Compr. Stregth	**F'_c**	750	**psi**
Top of Header to Edge of Roof	7.375	ft	**TOTAL LOAD**	**362.91**	PLF	Repetitive member fac	C_r	1.00					
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0	PLF	Bearing Area Factor	C_b	1.00					
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2										
Roof Tributary Area (A_T)	89.1	ft^2								**Bearing Contact Area**	$A_{bearing}$	8.25	in^2
Floor Tributary Area (A_T)	0	ft^2								**Max Support Bearing Pressure**	P	2709.819	lb
										Bearing Stress	**f'_c**	328.46	psi
										Beam Section Modulus	**S_{actual}**	26.28	**in^3**
Seismic Force (0.7E)	27.487	**PLF**	$0.2S_{DS}D$							**Actual Cross Sectional Area**	**A_{actual}**	21.75	**in^2**
Wind Force (W)	102.870	**PLF**	See Components & Cladding							Modulus of Elasticity	E	2000000	psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)						Maximum Allowed Deflection	Δ_{max}	0.183	in
Point Load	2690	2	0	0						Actual Moment of Inertia	**I_{actual}**	95.27	in^4

Dist Load ***Reactions***

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	**w** (PLF)	**R_1** (lbs)	**R_2** (lbs)	**V_{max}** (lbs)	**M_{max}** (lb-ft)	**S_{req}** in^3	**A_{req}** in^2	**Δ_{actual}** in	**I_{req}** in^4
D	0.90	0.9725	2795.14	3448.57	256.50	200.91	2264.319	1530.7	2264.32	4126.82	**14.36**	**13.24**	0.092	47.93
D + L	1.00	0.9679	3105.71	3813.32	285.00	200.91	2264.319	1530.7	2264.32	4126.82	12.99	11.92	0.092	47.93
D + (Lr or S)	1.25	0.9539	3882.14	4697.77	356.25	362.91	2709.819	1976.2	2709.82	4693.82	11.99	11.41	**0.108**	**56.23**
D + 0.75L	1.15	0.9599	3571.56	4349.26	327.75	200.91	2264.319	1530.7	2264.32	4126.82	11.39	10.36	0.092	47.93
D + (W or 0.7E)	1.60	0.9270	4969.13	5843.88	456.00	303.78	2547.211	1813.6	2547.21	4486.86	9.21	8.38	0.102	53.20
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9270	4969.13	5843.88	456.00	278.06	2476.488	1742.9	2476.49	4396.85	9.03	8.15	0.100	51.88
0.6D + W	1.60	0.9270	4969.13	5843.88	456.00	223.42	2326.211	1592.6	2326.21	4205.59	8.64	7.65	0.094	49.09
0.6D + 0.7E	1.60	0.9270	4969.13	5843.88	456.00	148.03	2118.907	1385.3	2118.91	3941.75	8.09	6.97	0.087	45.23

Header Name:	**B-W1**		**Material:**	2.0E RedLam LVL									
Description:	*Module B Corner Window Header on West Side*						**FACTORS**						
Width (b)	1.5	in	**Roof DL**	14.00 PLF	Actual Flexural Stress	F_b	3105.71	psi	Euler-based A	F_{bE}	7,533	psi
Depth (d)	7.25	in	**Roof LL (L_r)**	20.00 PLF	ontal shear parallel to	F_v	285	psi	Modulus of El	E_{min}	1000000	psi
Material Type			**Wall DL**	81.13 PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000	psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24	in
Length	6.5	ft	**Floor LL (L)**	0.00 PLF	Volume Factor	C_V	1.3371			l_u/d	3.310	<7
Unsupported Length	6.5	ft	$K_{LL}A_T$	13 ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44	in
Roof Trib. Length	1	ft	**LL Reduc.**	0 PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	12.62	n/a
Floor Trib. Length	0	ft	**Self Weight**	6.38 PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750	psi
									ASD Adj. Compr. Stregth	**F'_c**	750	**psi**
Top of Header to Edge of Roof	7.375	ft	**TOTAL LOAD**	**121.51** PLF	Repetitive member fac	C_r	1.00					
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor	C_b	1.00					
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2									
Roof Tributary Area (A_T)	6.5	ft^2							**Bearing Contact Area**	$A_{bearing}$	8.25	in^2
Floor Tributary Area (A_T)	0	ft^2							**Max Support Bearing Pressure**	P	394.9055	lb
									Bearing Stress	**f'_c**	47.87	psi
									Beam Section Modulus	**S_{actual}**	26.28	**in^3**
Seismic Force (0.7E)	13.441	**PLF**	$0.2S_{DS}D$						**Actual Cross Sectional Area**	**A_{actual}**	21.75	**in^2**
Wind Force (W)	12.700	**PLF**	See Components & Cladding						Modulus of Elasticity	E	2000000	psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)					Maximum Allowed Deflection	Δ_{max}	0.217	in
Point Load	0	**0**	**0**	0					Actual Moment of Inertia	**I_{actual}**	95.27	in^4

Dist Load ***Reactions***

Load Cases	Load Dur. Factor **C_D**	Stability Factor **C_L**	Ref/ ASD Bending Value **F^*_{bx} (psi)**	ASD Adj. Flexural Stress **F'_b (psi)**	ASD Adj. Horiz. shear parallel **F'_v (psi)**	**w** (PLF)	**R_1** (lbs)	**R_2** (lbs)	**V_{max}** (lbs)	**M_{max}** (lb-ft)	**S_{req}** in^3	**A_{req}** in^2	**Δ_{actual}** in	**I_{req}** in^4
D	0.90	0.9725	2795.14	3634.85	256.50	101.51	329.9055	329.91	329.905	536.096	**1.77**	**1.93**	0.021	9.41
D + L	1.00	0.9679	3105.71	4019.30	285.00	101.51	329.9055	329.91	329.905	536.096	1.60	1.74	0.021	9.41
D + (Lr or S)	1.25	0.9539	3882.14	4951.54	356.25	121.51	394.9055	394.91	394.905	641.721	1.56	1.66	**0.026**	**11.26**
D + 0.75L	1.15	0.9599	3571.56	4584.20	327.75	101.51	329.9055	329.91	329.905	536.096	1.40	1.51	0.021	9.41
D + (W or 0.7E)	1.60	0.9270	4969.13	6159.56	456.00	114.95	373.5899	373.59	373.59	607.084	1.18	1.23	0.024	10.65
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9270	4969.13	6159.56	456.00	111.59	362.6688	362.67	362.669	589.337	1.15	1.19	0.024	10.34
0.6D + W	1.60	0.9270	4969.13	6159.56	456.00	73.61	239.2183	239.22	239.218	388.73	0.76	0.79	0.016	6.82
0.6D + 0.7E	1.60	0.9270	4969.13	6159.56	456.00	74.35	241.6277	241.63	241.628	392.645	0.76	0.79	0.016	6.89

Header Name:	**B-S1**		**Material:**	2.0E RedLam LVL									
Description:	*Module B Header over 4 Wing Slide Door*						**FACTORS**						
Width (b)	1.5	in	**Roof DL**	113.40 PLF	Actual Flexural Stress	F_b	3004.49	psi	Euler-based A	F_{bE}	5,904	psi
Depth (d)	9.25	in	**Roof LL (L_r)**	162.00 PLF	ontal shear parallel to	F_v	285	psi	Modulus of El	E_{min}	1000000	psi
Material Type			**Wall DL**	0.00 PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000	psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24	in
Length	11.375	ft	**Floor LL (L)**	0.00 PLF	Volume Factor	C_V	1.2339			l_u/d	2.595	<7
Unsupported Length	11.375	ft	$K_{LL}A_T$	184.275 ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44	in
Roof Trib. Length	8.1	ft	**LL Reduc.**	0 PLF	Curvature Factor	C_c	1.00		Slenderness R	R_B	14.26	n/a
Floor Trib. Length	0	ft	**Self Weight**	8.15 PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750	psi
									ASD Adj. Compr. Stregth	**F'_c**	750	**psi**
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**283.55** PLF	Repetitive member fac	C_r	1.00					
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor	C_b	1.00					
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2									
Roof Tributary Area (A_T)	92.1375	ft^2							**Bearing Contact Area**	$A_{bearing}$	8.25	in^2
Floor Tributary Area (A_T)	0	ft^2							**Max Support Bearing Pressure**	P	1612.666	lb
									Bearing Stress	**f'_c**	195.47	psi
									Beam Section Modulus	**S_{actual}**	42.78	**in^3**
Seismic Force (0.7E)	16.024	**PLF**	$0.2S_{DS}D$						**Actual Cross Sectional Area**	**A_{actual}**	27.75	**in^2**
Wind Force (W)	102.870	**PLF**	See Components & Cladding						Modulus of Elasticity	E	2000000	psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)					Maximum Allowed Deflection	Δ_{max}	0.379	in
Point Load	0	**0**	**0**	0					Actual Moment of Inertia	**I_{actual}**	197.86	in^4

Dist Load ***Reactions***

Load Cases	Load Dur. Factor **C_D**	Stability Factor **C_L**	Ref/ ASD Bending Value **F^*_{bx} (psi)**	ASD Adj. Flexural Stress **F'_b (psi)**	ASD Adj. Horiz. shear parallel **F'_v (psi)**	**w** (PLF)	**R_1** (lbs)	**R_2** (lbs)	**V_{max}** (lbs)	**M_{max}** (lb-ft)	**S_{req}** in^3	**A_{req}** in^2	**Δ_{actual}** in	**I_{req}** in^4
D	0.90	0.9621	2704.04	3210.16	256.50	121.55	691.2905	691.29	691.291	1965.86	7.35	4.04	0.116	60.38
D + L	1.00	0.9549	3004.49	3540.03	285.00	121.55	691.2905	691.29	691.291	1965.86	6.66	3.64	0.116	60.38
D + (Lr or S)	1.25	0.9321	3755.62	4319.58	356.25	283.55	1612.666	1612.7	1612.67	4586.02	**12.74**	**6.79**	**0.270**	**140.85**
D + 0.75L	1.15	0.9421	3455.17	4016.64	327.75	121.55	691.2905	691.29	691.291	1965.86	5.87	3.16	0.116	60.38
D + (W or 0.7E)	1.60	0.8856	4807.19	5252.87	456.00	224.42	1276.364	1276.4	1276.36	3629.66	8.29	4.20	0.214	111.48
D + 0.75L + 0.75(W or 0.7E)	1.60	0.8856	4807.19	5252.87	456.00	198.70	1130.095	1130.1	1130.1	3213.71	7.34	3.72	0.189	98.70
0.6D + W	1.60	0.8856	4807.19	5252.87	456.00	175.80	999.8474	999.85	999.847	2843.32	6.50	3.29	0.167	87.33
0.6D + 0.7E	1.60	0.8856	4807.19	5252.87	456.00	88.95	505.9088	505.91	505.909	1438.68	3.29	1.66	0.085	44.19

Header Name:	**B-W2**		**Material:**	2.0E RedLam LVL							
Description:	*Module B Corridor Entry Way Header on West Side*					**FACTORS**					
Width (b)	1.5	in	**Roof DL**	56.00 PLF	Actual Flexural Stress	F_b	3224.61 psi	Euler-based A	F_{bE}	9,929	psi
Depth (d)	5.5	in	**Roof LL (L_r)**	80.00 PLF	ontal shear parallel to	F_V	285 psi	Modulus of El	E_{min}	1000000	psi
Material Type			**Wall DL**	33.00 PLF	Wet-Service Factor	C_M	1.00	Adjusted ASD	E'_{min}	1000000	psi
Unit Weight	42.269	Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor	C_t	1.00	Unbraced Len	l_u	24	in
Length	4	ft	**Floor LL (L)**	0.00 PLF	Volume Factor	C_V	1.4430		l_u/d	4.364	<7
Unsupported Length	4	ft	$K_{LL}A_T$	32 ft^2	Flat-use Factor	C_{fu}	1.00	Effective Unbr	l_e	49.44	in
Roof Trib. Length	4	ft	**LL Reduc.**	0 PLF	Curvature Factor	C_c	1.00	Slenderness R	R_B	10.99	n/a
Floor Trib. Length	0	ft	**Self Weight**	4.84 PLF	Incising Factor	C_i	1.00	Compressive S	F_c	750	psi
								ASD Adj. Compr. Stregth	**F'_c**	750	**psi**
Top of Header to Edge of Roof	3	ft	**TOTAL LOAD**	**173.84** PLF	Repetitive member fac	C_r	1.00				
Sandwich Header?	Yes	Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor	C_b	1.00				
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2								
Roof Tributary Area (A_T)	16	ft^2						**Bearing Contact Area**	$A_{bearing}$	8.25	in^2
Floor Tributary Area (A_T)	0	ft^2						**Max Support Bearing Pressure**	P	347.6866	lb
								Bearing Stress	**f'_c**	42.14	psi
								Beam Section Modulus	**S_{actual}**	15.13	**in^3**
Seismic Force (0.7E)	12.576	**PLF**	$0.2S_{DS}D$					**Actual Cross Sectional Area**	**A_{actual}**	16.50	**in^2**
Wind Force (W)	50.800	**PLF**	See Components & Cladding					Modulus of Elasticity	E	2000000	psi
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)				Maximum Allowed Deflection	Δ_{max}	0.133	in
Point Load	0	**0**	**0**	0				Actual Moment of Inertia	**I_{actual}**	41.59	in^4

						Dist Load	***Reactions***									
	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	**w**	**R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
Load Cases	**C_D**	**C_L**	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9803	2902.15	4105.29	256.50	93.84	187.6866	187.69	187.687	187.687	0.55	1.10	0.006	2.03
D + L	1.00	0.9773	3224.61	4547.31	285.00	93.84	187.6866	187.69	187.687	187.687	0.50	0.99	0.006	2.03
D + (Lr or S)	1.25	0.9686	4030.76	5633.75	356.25	173.84	347.6866	347.69	347.687	347.687	**0.74**	**1.46**	**0.012**	**3.76**
D + 0.75L	1.15	0.9723	3708.30	5202.67	327.75	93.84	187.6866	187.69	187.687	187.687	0.43	0.86	0.006	2.03
D + (W or 0.7E)	1.60	0.9532	5159.38	7096.61	456.00	144.64	289.2866	289.29	289.287	289.287	0.49	0.95	0.010	3.12
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9532	5159.38	7096.61	456.00	131.94	263.8866	263.89	263.887	263.887	0.45	0.87	0.009	2.85
0.6D + W	1.60	0.9532	5159.38	7096.61	456.00	107.11	214.212	214.21	214.212	214.212	0.36	0.70	0.007	2.31
0.6D + 0.7E	1.60	0.9532	5159.38	7096.61	456.00	68.88	137.7637	137.76	137.764	137.764	0.23	0.45	0.005	1.49

Header Name:	**BR1**	**Material:**	2.0E RedLam LVL				
Description:	*Bridge Header on North Face of Bridge Corridor*			**FACTORS**			
Width (b)	1.5 in	**Roof DL**	49.00 PLF	Actual Flexural Stress F_b	3004.49 psi	Euler-based A F_{bE}	5,904 psi
Depth (d)	9.25 in	**Roof LL (L_r)**	70.00 PLF	ontal shear parallel to F_V	285 psi	Modulus of El E_{min}	1000000 psi
Material Type		**Wall DL**	11.00 PLF	Wet-Service Factor C_M	1.00	Adjusted ASD E'_{min}	1000000 psi
Unit Weight	42.269 Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor C_t	1.00	Unbraced Len l_u	24 in
Length	4.5 ft	**Floor LL (L)**	0.00 PLF	Volume Factor C_V	1.3538	l_u/d	2.595 <7
Unsupported Length	4.5 ft	$K_{LL}A_T$	31.5 ft^2	Flat-use Factor C_{fu}	1.00	Effective Unbr l_e	49.44 in
Roof Trib. Length	3.5 ft	**LL Reduc.**	0 PLF	Curvature Factor C_c	1.00	Slenderness F R_B	14.26 n/a
Floor Trib. Length	0 ft	**Self Weight**	8.15 PLF	Incising Factor C_i	1.00	Compressive S F_c	750 psi
Top of Header to Edge of Roof	1 ft	**TOTAL LOAD**	**138.15** PLF	Repetitive member fac C_r	1.00	**ASD Adj. Compr. Stregth** F'_c	750 **psi**
Sandwich Header?	Yes Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor C_b	1.00		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	15.75 ft^2			**Bearing Contact Area**	$A_{bearing}$	8.25 in^2	
Floor Tributary Area (A_T)	0 ft^2			**Max Support Bearing Pressure**	P	310.8276 lb	
				Bearing Stress	f'_c	37.68 psi	
				Beam Section Modulus	S_{actual}	42.78 in^3	
Seismic Force (0.7E)	8.478 **PLF**	$0.2S_{DS}D$		**Actual Cross Sectional Area**	A_{actual}	27.75 in^2	
Wind Force (W)	44.450 **PLF**	See Components & Cladding		Modulus of Elasticity	E	2000000 psi	
	P_1 (lbs) / x_1 (ft)	P_2 (lbs) / x_2 (ft)		Maximum Allowed Deflection	Δ_{max}	0.150 in	
Point Load	0 / 0	0 / 0		Actual Moment of Inertia	I_{actual}	197.86 in^4	

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9621	2704.04	3522.09	256.50	68.15	153.3276	153.33	153.328	172.494	0.59	0.90	0.002	2.10
D + L	1.00	0.9549	3004.49	3884.01	285.00	68.15	153.3276	153.33	153.328	172.494	0.53	0.81	0.002	2.10
D + (Lr or S)	1.25	0.9321	3755.62	4739.31	356.25	138.15	310.8276	310.83	310.828	349.681	0.89	1.31	0.003	4.25
D + 0.75L	1.15	0.9421	3455.17	4406.93	327.75	68.15	153.3276	153.33	153.328	172.494	0.47	0.70	0.002	2.10
D + (W or 0.7E)	1.60	0.8856	4807.19	5763.29	456.00	112.60	253.3401	253.34	253.34	285.008	0.59	0.83	0.003	3.46
D + 0.75L + 0.75(W or 0.7E)	1.60	0.8856	4807.19	5763.29	456.00	101.48	228.3369	228.34	228.337	256.879	0.53	0.75	0.002	3.12
0.6D + W	1.60	0.8856	4807.19	5763.29	456.00	85.34	192.009	192.01	192.009	216.01	0.45	0.63	0.002	2.62
0.6D + 0.7E	1.60	0.8856	4807.19	5763.29	456.00	49.37	111.0723	111.07	111.072	124.956	0.26	0.37	0.001	1.52

Header Name:	**BR2**	**Material:**	2.0E RedLam LVL				
Description:	*Bridge Header on West Face of Bridge Corridor*			**FACTORS**			
Width (b)	1.5 in	**Roof DL**	14.00 PLF	Actual Flexural Stress F_b	3004.49 psi	Euler-based A F_{bE}	5,904 psi
Depth (d)	9.25 in	**Roof LL (L_r)**	20.00 PLF	ontal shear parallel to F_V	285 psi	Modulus of El E_{min}	1000000 psi
Material Type		**Wall DL**	11.00 PLF	Wet-Service Factor C_M	1.00	Adjusted ASD E'_{min}	1000000 psi
Unit Weight	42.269 Lbs/Cu. Ft.	**Floor DL**	0.00 PLF	Temperature Factor C_t	1.00	Unbraced Len l_u	24 in
Length	6.5 ft	**Floor LL (L)**	0.00 PLF	Volume Factor C_V	1.3050	l_u/d	2.595 <7
Unsupported Length	6.5 ft	$K_{LL}A_T$	13 ft^2	Flat-use Factor C_{fu}	1.00	Effective Unbr l_e	49.44 in
Roof Trib. Length	1 ft	**LL Reduc.**	0 PLF	Curvature Factor C_c	1.00	Slenderness F R_B	14.26 n/a
Floor Trib. Length	0 ft	**Self Weight**	8.15 PLF	Incising Factor C_i	1.00	Compressive S F_c	750 psi
Top of Header to Edge of Roof	1 ft	**TOTAL LOAD**	**53.15** PLF	Repetitive member fac C_r	1.00	**ASD Adj. Compr. Stregth** F'_c	750 **psi**
Sandwich Header?	Yes Yes/No	**L_r Reduc.**	0 PLF	Bearing Area Factor C_b	1.00		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	6.5 ft^2			**Bearing Contact Area**	$A_{bearing}$	8.25 in^2	
Floor Tributary Area (A_T)	0 ft^2			**Max Support Bearing Pressure**	P	172.7232 lb	
				Bearing Stress	f'_c	20.94 psi	
				Beam Section Modulus	S_{actual}	42.78 in^3	
Seismic Force (0.7E)	3.533 **PLF**	$0.2S_{DS}D$		**Actual Cross Sectional Area**	A_{actual}	27.75 in^2	
Wind Force (W)	12.700 **PLF**	See Components & Cladding		Modulus of Elasticity	E	2000000 psi	
	P_1 (lbs) / x_1 (ft)	P_2 (lbs) / x_2 (ft)		Maximum Allowed Deflection	Δ_{max}	0.217 in	
Point Load	0 / 0	0 / 0		Actual Moment of Inertia	I_{actual}	197.86 in^4	

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9621	2704.04	3394.93	256.50	33.15	107.7232	107.72	107.723	175.05	0.62	0.63	0.003	3.07
D + L	1.00	0.9549	3004.49	3743.78	285.00	33.15	107.7232	107.72	107.723	175.05	0.56	0.57	0.003	3.07
D + (Lr or S)	1.25	0.9321	3755.62	4568.20	356.25	53.15	172.7232	172.72	172.723	280.675	0.74	0.73	0.005	4.93
D + 0.75L	1.15	0.9421	3455.17	4247.82	327.75	33.15	107.7232	107.72	107.723	175.05	0.49	0.49	0.003	3.07
D + (W or 0.7E)	1.60	0.8856	4807.19	5555.20	456.00	45.85	148.9982	149	148.998	242.122	0.52	0.49	0.005	4.25
D + 0.75L + 0.75(W or 0.7E)	1.60	0.8856	4807.19	5555.20	456.00	42.67	138.6794	138.68	138.679	225.354	0.49	0.46	0.004	3.95
0.6D + W	1.60	0.8856	4807.19	5555.20	456.00	32.59	105.9089	105.91	105.909	172.102	0.37	0.35	0.003	3.02
0.6D + 0.7E	1.60	0.8856	4807.19	5555.20	456.00	23.42	76.11469	76.115	76.1147	123.686	0.27	0.25	0.002	2.17

BR3 **Material:** 2.0E RedLam LVL

Bridge Header on South Face of Bridge Corridor

1.5	in	**Roof DL**	49.00	PLF	Actual Flexural Stress	F_b	3004.49	psi	Euler-based A	F_{bE}	5,904 psi
9.25	in	**Roof LL (L_r)**	70.00	PLF	ontal shear parallel to	F_V	285	psi	Modulus of El	E_{min}	1000000 psi
		Wall DL	11.00	PLF	Wet-Service Factor	C_M	1.00		Adjusted ASD	E'_{min}	1000000 psi
42.269	Lbs/Cu. Ft.	**Floor DL**	0.00	PLF	Temperature Factor	C_t	1.00		Unbraced Len	l_u	24 in
6	ft	**Floor LL (L)**	0.00	PLF	Volume Factor	C_V	1.3154			l_u/d	2.595 <7
6	ft	$K_{LL}A_T$	42	ft^2	Flat-use Factor	C_{fu}	1.00		Effective Unbr	l_e	49.44 in
3.5	ft	**LL Reduc.**	0	PLF	Curvature Factor	C_c	1.00		Slenderness F	R_B	14.26 n/a
0	ft	**Self Weight**	4.07	PLF	Incising Factor	C_i	1.00		Compressive S	F_c	750 psi
									ASD Adj. Compr. Stregth	**F'_c**	750 **psi**
1	ft	**TOTAL LOAD**	**134.07**	PLF	Repetitive member fac	C_r	1.00				
No	Yes/No	**L_r Reduc.**	0	PLF	Bearing Area Factor	C_b	1.00				
2	K_{LL}	ASCE 7-05 Table 4-2									
21	ft^2										
0	ft^2										

Bearing Contact Area	$A_{bearing}$	8.25	in^2
Max Support Bearing Pressure	P	402.2184	lb
Bearing Stress	**f'_c**	**48.75**	psi
Beam Section Modulus	**S_{actual}**	**21.39**	**in^3**
Actual Cross Sectional Area	**A_{actual}**	**13.88**	**in^2**
Modulus of Elasticity	E	2000000	psi
Maximum Allowed Deflection	Δ_{max}	**0.200**	in
Actual Moment of Inertia	**I_{actual}**	**98.93**	in^4

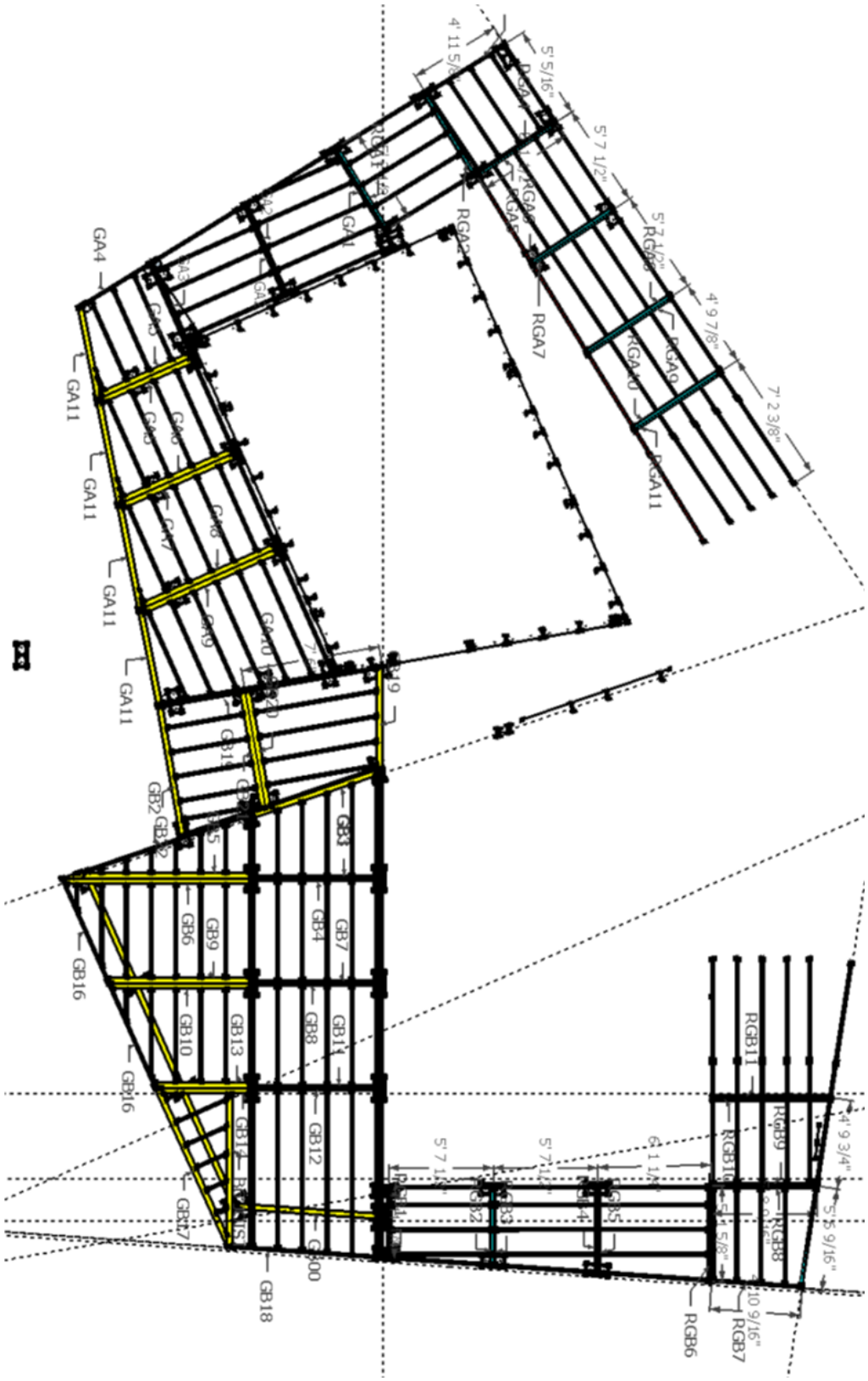
8.478	**PLF**	$0.2S_{DS}D$		
44.450	**PLF**	See Components & Cladding		

P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
0	**0**	**0**	0

Dist Load ***Reactions***

Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	**w**	**R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
C_D	**C_L**	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
0.90	0.9621	2704.04	3422.21	256.50	64.07	192.2184	192.22	192.218	288.328	1.01	1.12	0.009	4.67
1.00	0.9549	3004.49	3773.87	285.00	64.07	192.2184	192.22	192.218	288.328	0.92	1.01	0.009	4.67
1.25	0.9321	3755.62	4604.91	356.25	134.07	402.2184	402.22	402.218	603.328	**1.57**	**1.69**	**0.020**	**9.77**
1.15	0.9421	3455.17	4281.96	327.75	64.07	192.2184	192.22	192.218	288.328	0.81	0.88	0.009	4.67
1.60	0.8856	4807.19	5599.85	456.00	108.52	325.5684	325.57	325.568	488.353	1.05	1.07	0.016	7.91
1.60	0.8856	4807.19	5599.85	456.00	97.41	292.2309	292.23	292.231	438.346	0.94	0.96	0.014	7.10
1.60	0.8856	4807.19	5599.85	456.00	82.89	248.681	248.68	248.681	373.022	0.80	0.82	0.012	6.04
1.60	0.8856	4807.19	5599.85	456.00	46.92	140.7654	140.77	140.765	211.148	0.45	0.46	0.007	3.42

Deck Framing Key Plan and Schedule



Deck Framing Girder/Joist/Overhanging Beam Design

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	GA1		**Material:**	TimberSil Glasswood
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5	in	**Roof DL**	0.00 PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00 PLF
Material Type			**Wall DL**	0.00 PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	32.50 PLF
Length	6.17	ft	**Floor LL (L)**	325.00 PLF
Unsupported Length	6.17	ft	**$K_{LL}A_T$**	40.105 ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0 PLF
Floor Trib. Length	3.25	ft	**Self Weight**	1.74 PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**359.24** PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0 PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2	
Roof Tributary Area (A_T)	20.0525	ft^2		
Floor Tributary Area (A_T)	0	ft^2		

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grai	F_V	205 psi					
			F_b	F_V	Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
			E	E_{min}			
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	1108.2461	lb
Bearing Stress	f'_c	246.28	psi
Beam Section Modulus	S_{actual}	13.14	in^3
Actual Cross Sectional Area	A_{actual}	10.88	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.206	in
Actual Moment of Inertia	I_{actual}	47.63	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$	
Wind Force (W)	23.342	**PLF**	See Components & Cladding	
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	34.24	105.62	105.62	105.621	162.921	1.04	0.89	0.014	3.17
D + L	1.00	0.9794	2125.00	2081.12	198.85	359.24	1108.25	1108.2	1108.25	1709.47	9.86	8.36	0.144	33.31
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	34.24	105.62	105.62	105.621	162.921	0.76	0.64	0.014	3.17
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	277.99	857.59	857.59	857.59	1322.83	6.66	5.63	0.111	25.77
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	57.58	177.63	177.63	177.63	273.994	1.01	0.84	0.023	5.34
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	295.49	911.60	911.6	911.596	1406.14	5.18	4.30	0.118	27.40
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	43.88	135.38	135.38	135.381	208.825	0.77	0.64	0.018	4.07
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	20.54	63.37	63.373	63.3726	97.7523	0.36	0.30	0.008	1.90

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: GA2 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF	Actual Flexural Stress	F_b	2500 psi	Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF	Horizontal shear parallel to grai	F_V	205 psi	Modulus of Elasticity	E_{min}	690000	psi
Material Type		**Wall DL**	0.00 PLF				Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	31.20 PLF				Unbraced Length	l_u	16	in
Length	5.42 ft	**Floor LL (L)**	312.00 PLF					l_u/d	2.207	<7
Unsupported Length	5.42 ft	$K_{LL}A_T$	33.8208 ft²				Effective Unbraced Lenth	l_e	32.96	in
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF				Slenderness Ratio	R_B	10.31	n/a
Floor Trib. Length	3.12 ft	**Self Weight**	1.74 PLF				Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**344.94** PLF				**ASD Adj. Compr. Stregth**	F'_c	616.4	**psi**
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF							
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2								
Roof Tributary Area (A_T)	16.9104 ft²									
Floor Tributary Area (A_T)	0 ft²									

FACTORS

Factor			F_b	F_V	Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
			E	E_{min}			
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Bearing Contact Area	$A_{bearing}$	4.5	in²
Max Support Bearing Pressure	P	934.77921	lb
Bearing Stress	f'_c	207.73	psi
Beam Section Modulus	S_{actual}	13.14	in³
Actual Cross Sectional Area	A_{actual}	10.88	in²
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.181	in
Actual Moment of Inertia	I_{actual}	47.63	in⁴

Roof Dead Load	0	lb/ft²
Roof Live Load	0	lb/ft²
Wall Dead Load	0	lb/ft²
Floor Dead Load	10	lb/ft²
Floor Live Load	100	lb/ft²
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$	
Wind Force (W)	22.408 **PLF**	See Components & Cladding	
	P_1 (lbs) / x_1 (ft)	P_2 (lbs) / x_2 (ft)	
Point Load	0 / 0	0 / 0	

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	32.94	89.26	89.259	89.2592	120.946	0.77	0.75	0.008	2.07
D + L	1.00	0.9794	2125.00	2081.12	198.85	344.94	934.78	934.78	934.779	1266.63	**7.30**	**7.05**	**0.082**	**21.68**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	32.94	89.26	89.259	89.2592	120.946	0.56	0.54	0.008	2.07
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	266.94	723.40	723.4	723.399	980.206	4.94	4.75	0.064	16.78
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	55.34	149.98	149.98	149.984	203.229	0.75	0.71	0.013	3.48
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	283.74	768.94	768.94	768.943	1041.92	3.84	3.63	0.068	17.83
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	42.17	114.28	114.28	114.281	154.85	0.57	0.54	0.010	2.65
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	19.76	53.56	53.556	53.5555	72.5677	0.27	0.25	0.005	1.24

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GA3**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	29.60	PLF
Length	4.58	ft	**Floor LL (L)**	296.00	PLF
Unsupported Length	4.58	ft	$K_{LL}A_T$	27.1136	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.96	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**327.34**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	13.5568	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	749.60168	lb
Bearing Stress	f'_c	**166.58**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.153**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	21.259	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
						w	R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9821	1912.50	1878.18	178.97	31.34	71.76	71.762	71.7617	82.1671	0.52	0.60	0.004	1.19
D + L	1.00	0.9794	2125.00	2081.12	198.85	327.34	749.60	749.6	749.602	858.294	**4.95**	**5.65**	**0.040**	**12.41**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	31.34	71.76	71.762	71.7617	82.1671	0.38	0.43	0.004	1.19
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	253.34	580.14	580.14	580.142	664.262	3.35	3.81	0.031	9.61
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	52.60	120.44	120.44	120.444	137.909	0.51	0.57	0.006	1.99
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	269.28	616.65	616.65	616.654	706.068	2.60	2.91	0.033	10.21
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	40.06	91.74	91.739	91.7395	105.042	0.39	0.43	0.005	1.52
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.80	43.06	43.057	43.057	49.3003	0.18	0.20	0.002	0.71

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GA4**		**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*					
Width (b)	1.5	in	**Roof DL**	0.00	PLF	
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	
Material Type			**Wall DL**	0.00	PLF	
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF	
Length	4.25	ft	**Floor LL (L)**	258.00	PLF	
Unsupported Length	4.25	ft	**$K_{LL}A_T$**	21.93	ft^2	
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF	
Floor Trib. Length	2.58	ft	**Self Weight**	1.74	PLF	
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**285.54**	PLF	
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF	
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2			
Floor Tributary Area (A_T)	10.965	ft^2				
Roof Tributary Area (A_T)	0	ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi								
Horizontal shear parallel to grain	F_V	205 psi								
		F_b	F_V		Fc_{perp}	E	E_{min}			
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9		
		E	E_{min}							
Temperature Factor	C_t	1.00	0.9	0.9						
Size Factor	C_F	1.00	1.00							
Flat-use Factor	C_{fu}	1.00								
Curvature Factor	C_c	1.00								
Incising Factor	C_i	1.00								
Repetitive member factor	C_r	1.00								
Bearing Area Factor	C_b	1.00								

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	606.76608	lb
Bearing Stress	f'_c	**134.84**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.142**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	18.530 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	27.54	58.52	58.516	58.5161	62.1733	0.40	0.49	0.002	0.83
D + L	1.00	0.9794	2125.00	2081.12	198.85	285.54	606.77	606.77	606.766	644.689	**3.72**	**4.58**	**0.026**	**8.65**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	27.54	58.52	58.516	58.5161	62.1733	0.29	0.35	0.002	0.83
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	221.04	469.70	469.7	469.704	499.06	2.51	3.08	0.020	6.70
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	46.07	97.89	97.891	97.8914	104.01	0.38	0.46	0.004	1.40
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	234.93	499.24	499.24	499.235	530.437	1.95	2.35	0.021	7.12
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	35.05	74.48	74.485	74.485	79.1403	0.29	0.35	0.003	1.06
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	16.52	35.11	35.11	35.1096	37.304	0.14	0.17	0.001	0.50

UNLV Solar Decathlon Lumber Overhanging Beam Design

Header Name:	**GA5**		**Material:**	TimberSil Glasswood	
Description:	*Overhanging Beam With Distributed Load and Point Load*				
Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF
Total Length	5.33	ft	**Floor LL (L)**	258.00	PLF
Unsupported Length (l)	3.08	ft	$K_{LL}A_T$	27.5028	ft^2
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF
x	1.54	ft	**Self Weight**	4.05	PLF
x_1	2.25	ft	**TOTAL LOAD**	**287.85**	PLF
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF
Floor Trib. Length	2.58	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	13.7514	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load	740.00	lb			
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	18.530	**PLF**	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi						
orizontal shear parallel to gra	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2067.5301	lb
Bearing Stress	f'_c	196.91	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.178	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	29.85	562.02	877.68	877.677	1740.57	10.95	7.36	0.062	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	287.85	747.31	2067.53	2067.53	2393.63	13.56	15.60	0.077	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	29.85	562.02	877.68	877.677	1740.57	7.89	5.30	0.062	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	223.35	700.99	1770.07	1770.07	2230.36	10.99	11.61	0.073	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	48.38	575.33	963.13	963.132	1787.47	6.34	4.54	0.063	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	237.25	710.97	1834.16	1834.16	2265.54	8.03	8.65	0.074	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	36.44	566.76	908.06	908.061	1757.24	6.23	4.28	0.063	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	17.91	553.45	822.61	822.606	1710.34	6.07	3.88	0.062	37.86

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name: GA6, GA7 **Material:** TimberSil Glasswood

Description: *Overhanging Beam With Distributed Load and Point Load*

Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF
Total Length	6.58	ft	**Floor LL (L)**	258.00	PLF
Unsupported Length (l)	4.33	ft	$K_{LL}A_T$	33.9528	ft^2
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF
x	2.165	ft	**Self Weight**	4.05	PLF
x_1	2.25	ft	**TOTAL LOAD**	**287.85**	PLF
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF
Floor Trib. Length	2.58	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	16.9764	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load	740.00	lb			
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	18.530	**PLF**	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi						
orizontal shear parallel to gra	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2179.1451	lb
Bearing Stress	f'_c	207.54	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.219	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	29.85	431.71	889.25	889.252	1740.57	10.95	7.45	0.076	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	287.85	839.45	2179.15	2179.15	2393.63	13.56	16.44	0.085	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	29.85	431.71	889.25	889.252	1740.57	7.89	5.37	0.076	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	223.35	737.52	1856.67	1856.67	2230.36	10.99	12.18	0.082	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	48.38	460.99	981.89	981.892	1787.47	6.34	4.63	0.076	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	237.25	759.48	1926.15	1926.15	2265.54	8.03	9.08	0.083	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	36.44	442.12	922.19	922.192	1757.24	6.23	4.35	0.076	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	17.91	412.83	829.55	829.551	1710.34	6.07	3.91	0.075	37.86

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name: GA8, GA9 **Material:** TimberSil Glasswood

Description: *Overhanging Beam With Distributed Load and Point Load*

Width (b)	3.5	in	**Roof DL**	0.00	PLF	Actual Flexural Stress	F_b	2500 psi
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	orizontal shear parallel to gra	F_V	205 psi
Material Type			**Wall DL**	0.00	PLF			
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	32.50	PLF	Wet-Service Factor	C_M	
Total Length	7.83	ft	**Floor LL (L)**	325.00	PLF			
Unsupported Length (l)	5.58	ft	$K_{LL}A_T$	50.895	ft^2	Temperature Factor	C_t	
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF	Size Factor	C_F	
x	2.79	ft	**Self Weight**	4.05	PLF	Flat-use Factor	C_{fu}	1.00
x_1	2.25	ft	**TOTAL LOAD**	**361.55**	PLF	Curvature Factor	C_c	1.00
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF	Incising Factor	C_i	1.00
Floor Trib. Length	3.25	ft	ASCE 7-05 Table 4-2			Repetitive member factor	C_r	1.00
Top of Header to Edge of Roof	0	ft				Bearing Area Factor	C_b	1.00
Sandwich Header?	No	Yes/No						
Live Load Element Factor	2	K_{LL}						
Floor Tributary Area (A_T)	25.4475	ft^2						
Roof Tributary Area (A_T)	0	ft^2						
Point Load	740.00	lb						
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$					
Wind Force (W)	23.342	**PLF**	See Components & Cladding					

FACTORS

Factor						
	F_b	F_V	Fc_{perp}	E	E_{min}	
C_M	1.00	0.85	0.97	0.67	0.9	0.9
	E	E_{min}				
C_t	1.00	0.9	0.9			
C_F	1.00	1.00				

Euler-based ASD critical buckling value for bend	F_{bE}	38,202 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	4.42 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	10.5 in^2	Roof Dead Load	0 lb/ft^2
Max Support Bearing Pressure	P	2726.2378 lb	Roof Live Load	0 lb/ft^2
Bearing Stress	f'_c	259.64 psi		
Beam Section Modulus	S_{actual}	30.66 in^3	Wall Dead Load	0 lb/ft^2
Actual Cross Sectional Area	A_{actual}	25.38 in^2		
Modulus of Elasticity	E	1710000 psi	Floor Dead Load	10 lb/ft^2
Maximum Allowed Deflection	Δ_{max}	0.261 in	Floor Live Load	100 lb/ft^2
Actual Moment of Inertia	I_{actual}	111.15 in^4	*Bearing Length, l_u*	3 in

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	36.55	383.79	940.81	940.808	1757.52	11.06	7.89	0.088	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	361.55	1143.11	2726.24	2726.24	2580.18	14.61	20.57	0.081	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	36.55	383.79	940.81	940.808	1757.52	7.97	5.68	0.088	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	280.30	953.28	2279.88	2279.88	2374.52	11.70	14.95	0.083	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	59.89	438.32	1069.04	1069.04	1816.61	6.44	5.04	0.088	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	297.81	994.18	2376.05	2376.05	2418.83	8.58	11.20	0.082	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	45.27	404.16	988.71	988.715	1779.60	6.31	4.66	0.088	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	21.93	349.63	860.49	860.485	1720.51	6.10	4.06	0.088	37.86

UNLV Solar Decathlon Lumber Continuous Beam - Two Unequal Spans

Entry Fields

Header Name:	**GA10**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Continuous Beam with Two Unequal Spans*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	37.50	PLF
Length	9.27	ft	**Floor LL (L)**	375.00	PLF
Unsupported Length (1)	5.5	ft	$K_{LL}A_T$	69.525	ft^2
Unsupported Length (2)	3.77		**LL Reduc.**	0	PLF
Roof Trib. Length	0	ft	**Self Weight**	1.74	PLF
Floor Trib. Length	3.75	ft	**TOTAL LOAD**	**414.24**	PLF
Top of Header to Edge of Roof	0	ft	L_r **Reduc.**	0	PLF
Sandwich Header?	No	Yes/No	ASCE 7-05 Table 4-2		
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	34.7625	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
			$0.2S_{DS}D$		
Seismic Force (0.7E)	0.000	**PLF**	See Components & Cladding		
Wind Force (W)	26.933	**PLF**			

FACTORS

Actual Flexural Stress	F_b	2500 psi							
Horizontal shear parallel to grain	F_V	205 psi							
		F_b	F_V	Fc_{perp}	E	E_{min}			
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9		
		E	E_{min}						
Temperature Factor	C_t	1.00	0.9	0.9					
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	2469.2685	lb
Bearing Stress	f'_c	548.73	psi
Beam Section Modulus	S_{actual}	13.14	in^3
Actual Cross Sectional Area	A_{actual}	10.88	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.309	in
Maximum Allowed Deflection	Δ_{max}	0.309	in
Actual Moment of Inertia	I_{actual}	47.63	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	R_3	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	39.24	86.74	233.89	43.0926	129.06104	116.3763897	0.74	1.08	0.010	0.0022	1.53
D + L	1.00	0.9794	2125.00	2081.12	198.85	414.24	915.77	2469.3	454.942	1362.5375	1228.621702	7.08	10.28	0.105	0.0231	16.14
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	39.24	86.74	233.89	43.0926	129.06104	116.3763897	0.54	0.78	0.010	0.0022	1.53
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	320.49	708.51	1910.4	351.98	1054.1684	950.5603741	4.79	6.91	0.081	0.0179	12.49
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	66.17	146.28	394.44	72.6717	217.64931	196.2578481	0.72	1.03	0.017	0.0037	2.58
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	340.69	753.17	2030.8	374.164	1120.6096	1010.471468	3.72	5.28	0.086	0.0190	13.27
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	50.47	111.59	300.88	55.4346	166.0249	149.7072922	0.55	0.78	0.013	0.0028	1.97
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	23.54	52.05	140.34	25.8556	77.436622	69.82583385	0.26	0.37	0.006	0.0013	0.92

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields | Point Loads for Overhanging beams

Header Name:	**GA11**	**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	3.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	67.50 PLF		
Length	5.83 ft	**Floor LL (L)**	150.00 PLF		
Unsupported Length	5.83 ft	$K_{LL}A_T$	17.49 ft²		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	1.5 ft	**Self Weight**	4.05 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**221.55** PLF		
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2			
Floor Tributary Area (A_T)	8.745 ft²				
Roof Tributary Area (A_T)	0 ft²				

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	8,188 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	81 in
	l_u/d	11.172 <7
Effective Unbraced Lenth	l_e	153.78 in
Slenderness Ratio	R_B	9.54 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	3.5 in²
Max Support Bearing Pressure	P	645.82685 lb
Bearing Stress	f'_c	**184.52** psi
Beam Section Modulus	S_{actual}	**30.66** in³
Actual Cross Sectional Area	A_{actual}	**25.38** in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.194** in
Actual Moment of Inertia	I_{actual}	**111.15** in⁴

Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	45 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	1 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$			
Wind Force (W)	10.773 **PLF**	See Components & Cladding			
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)	
Point Load	0	0	0	0	

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load **w**	***Reactions*** R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in³	in²	in	in⁴
D	0.90	0.9853	1912.50	1884.34	178.97	71.55	208.58	208.58	208.577	304.001	1.94	1.75	0.010	5.60
D + L	1.00	0.9832	2125.00	2089.21	198.85	221.55	645.83	645.83	645.827	941.293	5.41	4.87	0.030	17.33
D + (Lr or S)	1.25	0.9773	2656.25	2595.99	248.56	71.55	208.58	208.58	208.577	304.001	1.41	1.26	0.010	5.60
D + 0.75L	1.15	0.9798	2443.75	2394.28	228.68	184.05	536.51	536.51	536.514	781.97	3.92	3.52	0.025	14.40
D + (W or 0.7E)	1.60	0.9675	3400.00	3289.54	318.16	82.33	239.98	239.98	239.98	349.771	1.28	1.13	0.011	6.44
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9675	3400.00	3289.54	318.16	192.13	560.07	560.07	560.067	816.297	2.98	2.64	0.026	15.03
0.6D + W	1.60	0.9675	3400.00	3289.54	318.16	53.70	156.55	156.55	156.549	228.171	0.83	0.74	0.007	4.20
0.6D + 0.7E	1.60	0.9675	3400.00	3289.54	318.16	42.93	125.15	125.15	125.146	182.4	0.67	0.59	0.006	3.36

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGA1 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Input	Value	Unit	Load	Value	Unit
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	27.90	PLF
Length	5.17	ft	**Floor LL (L)**	279.00	PLF
Unsupported Length	5.17	ft	$K_{LL}A_T$	28.8486	ft²
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.79	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**308.64**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	14.4243	ft²			
Roof Tributary Area (A_T)	0	ft²			

FACTORS

Factor	Symbol	Values					
Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Property	Symbol	Value	Unit
Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Property	Symbol	Value	Unit
Bearing Contact Area	$A_{bearing}$	4.5	in²
Max Support Bearing Pressure	P	797.82659	lb
Bearing Stress	f'_c	177.29	psi
Beam Section Modulus	S_{actual}	13.14	in³
Actual Cross Sectional Area	A_{actual}	10.88	in²
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.172	in
Actual Moment of Inertia	I_{actual}	47.63	in⁴

Load	Value	Unit
Roof Dead Load	0	lb/ft²
Roof Live Load	0	lb/ft²
Wall Dead Load	0	lb/ft²
Floor Dead Load	10	lb/ft²
Floor Live Load	100	lb/ft²
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

	Value	Unit	Note
Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	20.038	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	29.64	76.61	76.612	76.6116	99.0205	0.63	0.64	0.006	1.62
D + L	1.00	0.9794	2125.00	2081.12	198.85	308.64	797.83	797.83	797.827	1031.19	**5.95**	**6.02**	**0.061**	**16.84**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	29.64	76.61	76.612	76.6116	99.0205	0.46	0.46	0.006	1.62
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	238.89	617.52	617.52	617.523	798.148	4.02	4.05	0.047	13.03
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	49.67	128.41	128.41	128.409	165.969	0.61	0.61	0.010	2.71
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	253.92	656.37	656.37	656.371	848.36	3.12	3.09	0.050	13.85
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	37.82	97.76	97.765	97.7646	126.361	0.47	0.46	0.007	2.06
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	17.78	45.97	45.967	45.967	59.4123	0.22	0.22	0.004	0.97

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA2**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	27.90	PLF
Length	5.17	ft	**Floor LL (L)**	279.00	PLF
Unsupported Length	5.17	ft	$K_{LL}A_T$	28.8486	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.79	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**308.64**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	14.4243	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi							
Horizontal shear parallel to grain	F_V	205 psi							
		F_b	F_V		Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9	
		E	E_{min}						
Temperature Factor	C_t	1.00	0.9	0.9					
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	797.82659	lb
Bearing Stress	f'_c	**177.29**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.172**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	20.038	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	29.64	76.61	76.612	76.6116	99.0205	0.63	0.64	0.006	1.62
D + L	1.00	0.9794	2125.00	2081.12	198.85	308.64	797.83	797.83	797.827	1031.19	**5.95**	**6.02**	**0.061**	**16.84**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	29.64	76.61	76.612	76.6116	99.0205	0.46	0.46	0.006	1.62
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	238.89	617.52	617.52	617.523	798.148	4.02	4.05	0.047	13.03
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	49.67	128.41	128.41	128.409	165.969	0.61	0.61	0.010	2.71
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	253.92	656.37	656.37	656.371	848.36	3.12	3.09	0.050	13.85
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	37.82	97.76	97.765	97.7646	126.361	0.47	0.46	0.007	2.06
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	17.78	45.97	45.967	45.967	59.4123	0.22	0.22	0.004	0.97

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA3**	**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	25.00 PLF		
Length	5.0 ft	**Floor LL (L)**	250.00 PLF		
Unsupported Length	5.0 ft	$K_{LL}A_T$	25 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	2.5 ft	**Self Weight**	1.74 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**276.74** PLF		
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0 PLF	
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	12.5 ft^2				
Roof Tributary Area (A_T)	0 ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	**616.4 psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	691.84245 lb
Bearing Stress	f'_c	**153.74** psi
Beam Section Modulus	S_{actual}	**13.14** in^3
Actual Cross Sectional Area	A_{actual}	**10.88** in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.167** in
Actual Moment of Inertia	I_{actual}	**47.63** in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	17.955 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load — ***Reactions***

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	26.74	66.84	66.842	66.8424	83.5531	0.53	0.56	0.005	1.32
D + L	1.00	0.9794	2125.00	2081.12	198.85	276.74	691.84	691.84	691.842	864.803	**4.99**	**5.22**	**0.048**	**13.65**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	26.74	66.84	66.842	66.8424	83.5531	0.39	0.40	0.005	1.32
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	214.24	535.59	535.59	535.592	669.491	3.37	3.51	0.037	10.57
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	44.69	111.73	111.73	111.73	139.662	0.51	0.53	0.008	2.21
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	227.70	569.26	569.26	569.258	711.573	2.62	2.68	0.039	11.24
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	34.00	84.99	84.993	84.993	106.241	0.39	0.40	0.006	1.68
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	16.04	40.11	40.105	40.1055	50.1318	0.18	0.19	0.003	0.79

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA4**		**Material:**	TimberSil Glasswood			
Description:	*Some Kind of Simply Supported Beam*						
Width (b)	1.5	in	**Roof DL**	0.00	PLF	Actual Flexural Stress	F_b
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	Horizontal shear parallel to grai	F_V
Material Type			**Wall DL**	0.00	PLF		
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF	Wet-Service Factor	C_M
Length	5.12	ft	**Floor LL (L)**	258.00	PLF		
Unsupported Length	5.12	ft	$K_{LL}A_T$	26.4192	ft^2	Temperature Factor	C_t
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF	Size Factor	C_F
Floor Trib. Length	2.58	ft	**Self Weight**	1.74	PLF	Flat-use Factor	C_{fu}
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**285.54**	PLF	Curvature Factor	C_c
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF	Incising Factor	C_i
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2			Repetitive member factor	C_r
Floor Tributary Area (A_T)	13.2096	ft^2				Bearing Area Factor	C_b
Roof Tributary Area (A_T)	0	ft^2					

FACTORS

F_b	2500 psi						
F_V	205 psi						
		F_b	F_V	Fc_{perp}	E	E_{min}	
C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}				
C_t	1.00	0.9		0.9			
C_F	1.00	1.00					
C_{fu}	1.00						
C_c	1.00						
C_i	1.00						
C_r	1.00						
C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	730.97467	lb
Bearing Stress	f'_c	162.44	psi
Beam Section Modulus	S_{actual}	13.14	in^3
Actual Cross Sectional Area	A_{actual}	10.88	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.171	in
Actual Moment of Inertia	I_{actual}	47.63	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	18.530	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load w	*Reactions* R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9821	1912.50	1878.18	178.97	27.54	70.49	70.495	70.4947	90.2332	0.58	0.59	0.005	1.46
D + L	1.00	0.9794	2125.00	2081.12	198.85	285.54	730.97	730.97	730.975	935.648	5.40	5.51	0.054	15.13
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	27.54	70.49	70.495	70.4947	90.2332	0.42	0.43	0.005	1.46
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	221.04	565.85	565.85	565.855	724.294	3.65	3.71	0.042	11.71
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	46.07	117.93	117.93	117.93	150.951	0.56	0.56	0.009	2.44
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	234.93	601.43	601.43	601.431	769.832	2.83	2.84	0.045	12.45
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	35.05	89.73	89.732	89.7325	114.858	0.42	0.42	0.007	1.86
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	16.52	42.30	42.297	42.2968	54.1399	0.20	0.20	0.003	0.88

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	RGA5		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	5.12	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	5.12	ft	$K_{LL}A_T$	28.9792	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	313.04	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	14.4896	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	801.37467	lb
Bearing Stress	f'_c	178.08	psi
Beam Section Modulus	S_{actual}	13.14	in^3
Actual Cross Sectional Area	A_{actual}	10.88	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.171	in
Actual Moment of Inertia	I_{actual}	47.63	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	20.325	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load — *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	76.89	76.895	76.8947	98.4252	0.63	0.64	0.006	1.59
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	801.37	801.37	801.375	1025.76	5.91	6.05	0.059	16.58
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	76.89	76.895	76.8947	98.4252	0.46	0.46	0.006	1.59
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	620.25	620.25	620.255	793.926	4.00	4.07	0.046	12.84
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	128.93	128.93	128.927	165.026	0.61	0.61	0.010	2.67
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	659.28	659.28	659.279	843.877	3.11	3.11	0.049	13.64
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	98.17	98.169	98.169	125.656	0.46	0.46	0.007	2.03
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	46.14	46.137	46.1368	59.0551	0.22	0.22	0.003	0.95

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA6, RGA7**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	5.33	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	5.33	ft	$K_{LL}A_T$	30.1678	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	15.0839	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	834.24355	lb
Bearing Stress	f'_c	**185.39**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.178**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	20.325	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	80.05	80.049	80.0485	106.665	0.68	0.67	0.007	1.80
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	834.24	834.24	834.244	1111.63	**6.41**	**6.29**	**0.070**	**18.71**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	80.05	80.049	80.0485	106.665	0.50	0.48	0.007	1.80
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	645.69	645.69	645.695	860.388	4.33	4.24	0.054	14.48
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	134.21	134.21	134.215	178.841	0.66	0.63	0.011	3.01
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	686.32	686.32	686.32	914.521	3.37	3.24	0.057	15.39
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	102.20	102.2	102.195	136.175	0.50	0.48	0.009	2.29
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	48.03	48.029	48.0291	63.9988	0.24	0.23	0.004	1.08

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA8**		**Material:**	TimberSil Glasswood									
Description:	*Some Kind of Simply Supported Beam*							**FACTORS**					
Width (b)	1.5	in	**Roof DL**	0.00	PLF	Actual Flexural Stress	F_b	2500 psi		Euler-based ASD critical buckling value for bendin	F_{bE}	9,356	psi
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	Horizontal shear parallel to grai	F_V	205 psi		Modulus of Elasticity	E_{min}	690000	psi
Material Type			**Wall DL**	0.00	PLF			F_b / F_V / Fc_{perp} / E / E_{min}		Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF	Wet-Service Factor	C_M	1.00 / 0.85 / 0.97 / 0.67 / 0.9 / 0.9		Unbraced Length	l_u	12	in
Length	5.5	ft	**Floor LL (L)**	283.00	PLF			E / E_{min}			l_u/d	1.655	<7
Unsupported Length	5.5	ft	$K_{LL}A_T$	#VALUE!	ft^2	Temperature Factor	C_t	1.00 / 0.9 / 0.9		Effective Unbraced Lenth	l_e	24.72	in
Roof Trib. Length		ft	**LL Reduc.**	#VALUE!	PLF	Size Factor	C_F	1.00 / 1.00		Slenderness Ratio	R_B	8.92	n/a
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF	Flat-use Factor	C_{fu}	1.00		Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**#VALUE!**	PLF	Curvature Factor	C_c	1.00		**ASD Adj. Compr. Stregth**	F'_c	616.4	**psi**
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF	Incising Factor	C_i	1.00					
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2			Repetitive member factor	C_r	1.00					
Floor Tributary Area (A_T)	15.565	ft^2				Bearing Area Factor	C_b	1.00					
Roof Tributary Area (A_T)	#VALUE!	ft^2											

Bearing Contact Area	$A_{bearing}$	4.5	in^2				
Max Support Bearing Pressure	P	#VALUE!	lb	Roof Dead Load		0	lb/ft^2
Bearing Stress	f'_c	**#VALUE!**	psi	Roof Live Load		0	lb/ft^2
Beam Section Modulus	S_{actual}	**13.14**	in^3				
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2	Wall Dead Load		0	lb/ft^2
Modulus of Elasticity	E	1710000	psi				
Maximum Allowed Deflection	Δ_{max}	**0.183**	in	Floor Dead Load		10	lb/ft^2
Actual Moment of Inertia	I_{actual}	**47.63**	in^4	Floor Live Load		100	lb/ft^2
				Bearing Length, l_u		3	in
				Bearing Distance from end of member		0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$					
Wind Force (W)	20.325	**PLF**	See Components & Cladding					
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)				
Point Load	0	0	0	0				

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9875	1912.50	1888.62	178.97	30.04	82.60	82.602	82.6017	113.577	**0.72**	**0.69**	**0.008**	**1.97**
D + L	1.00	0.9858	2125.00	2094.78	198.85	#VALUE!	#VALUE!	######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
D + (Lr or S)	1.25	0.9811	2656.25	2605.94	248.56	30.04	82.60	82.602	82.6017	113.577	**0.52**	**0.50**	**0.008**	**1.97**
D + 0.75L	1.15	0.9830	2443.75	2402.25	228.68	#VALUE!	#VALUE!	######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
D + (W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	50.36	138.50	138.5	138.496	190.431	**0.69**	**0.65**	**0.013**	**3.31**
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	#VALUE!	#VALUE!	######	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
0.6D + W	1.60	0.9734	3400.00	3309.43	318.16	38.35	105.45	105.45	105.455	145.001	**0.53**	**0.50**	**0.010**	**2.52**
0.6D + 0.7E	1.60	0.9734	3400.00	3309.43	318.16	18.02	49.56	49.561	49.561	68.1464	**0.25**	**0.23**	0.005	1.18

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA9**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	24.20	PLF
Length	5.5	ft	**Floor LL (L)**	242.00	PLF
Unsupported Length	5.5	ft	$K_{LL}A_T$	26.62	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.42	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**267.94**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	13.31	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi							
Horizontal shear parallel to grain	F_V	205 psi							
		F_b	F_V		Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9	
		E	E_{min}						
Temperature Factor	C_t	1.00	0.9	0.9					
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bending	F_{bE}	9,356	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	12	in
	l_u/d	1.655	<7
Effective Unbraced Lenth	l_e	24.72	in
Slenderness Ratio	R_B	8.92	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	736.82669	lb
Bearing Stress	f'_c	**163.74**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.183**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	17.380	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9875	1912.50	1888.62	178.97	25.94	71.33	71.327	71.3267	98.0742	0.62	0.60	0.007	1.70
D + L	1.00	0.9858	2125.00	2094.78	198.85	267.94	736.83	736.83	736.827	1013.14	**5.80**	**5.56**	**0.068**	**17.60**
D + (Lr or S)	1.25	0.9811	2656.25	2605.94	248.56	25.94	71.33	71.327	71.3267	98.0742	0.45	0.43	0.007	1.70
D + 0.75L	1.15	0.9830	2443.75	2402.25	228.68	207.44	570.45	570.45	570.452	784.371	3.92	3.74	0.052	13.62
D + (W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	43.32	119.12	119.12	119.123	163.794	0.59	0.56	0.011	2.84
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	220.47	606.30	606.3	606.299	833.661	3.02	2.86	0.056	14.48
0.6D + W	1.60	0.9734	3400.00	3309.43	318.16	32.94	90.59	90.592	90.5922	124.564	0.45	0.43	0.008	2.16
0.6D + 0.7E	1.60	0.9734	3400.00	3309.43	318.16	15.56	42.80	42.796	42.796	58.8445	0.21	0.20	0.004	1.02

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGA10**		**Material:**	TimberSil Glasswood						
Description:	*Some Kind of Simply Supported Beam*						**FACTORS**			
Width (b)	1.5	in	**Roof DL**	0.00	PLF	Actual Flexural Stress	F_b	2500 psi		
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	Horizontal shear parallel to grain	F_V	205 psi		
Material Type			**Wall DL**	0.00	PLF					
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	24.20	PLF	Wet-Service Factor	C_M			
Length	5.67	ft	**Floor LL (L)**	242.00	PLF					
Unsupported Length	5.67	ft	$K_{LL}A_T$	27.4428	ft^2	Temperature Factor	C_t			
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF	Size Factor	C_F			
Floor Trib. Length	2.42	ft	**Self Weight**	1.74	PLF	Flat-use Factor	C_{fu}			
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**267.94**	PLF	Curvature Factor	C_c			
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF	Incising Factor	C_i			
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2			Repetitive member factor	C_r			
Floor Tributary Area (A_T)	13.7214	ft^2				Bearing Area Factor	C_b			
Roof Tributary Area (A_T)	0	ft^2								

Factor		F_b	F_V	Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9
						0.9
		E	E_{min}			
Temperature Factor	C_t	1.00	0.9	0.9		
Size Factor	C_F	1.00	1.00			
Flat-use Factor	C_{fu}	1.00				
Curvature Factor	C_c	1.00				
Incising Factor	C_i	1.00				
Repetitive member factor	C_r	1.00				
Bearing Area Factor	C_b	1.00				

Euler-based ASD critical buckling value for bending	F_{bE}	9,356	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	12	in
	l_u/d	1.655	<7
Effective Unbraced Lenth	l_e	24.72	in
Slenderness Ratio	R_B	8.92	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	759.60134	lb
Bearing Stress	f'_c	**168.80**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.189**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	17.380	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9875	1912.50	1888.62	178.97	25.94	73.53	73.531	73.5313	104.231	0.66	0.62	0.007	1.87
D + L	1.00	0.9858	2125.00	2094.78	198.85	267.94	759.60	759.6	759.601	1076.73	**6.17**	**5.73**	**0.076**	**19.28**
D + (Lr or S)	1.25	0.9811	2656.25	2605.94	248.56	25.94	73.53	73.531	73.5313	104.231	0.48	0.44	0.007	1.87
D + 0.75L	1.15	0.9830	2443.75	2402.25	228.68	207.44	588.08	588.08	588.084	833.609	4.16	3.86	0.059	14.93
D + (W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	43.32	122.80	122.8	122.805	174.076	0.63	0.58	0.012	3.12
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	220.47	625.04	625.04	625.039	885.993	3.21	2.95	0.063	15.86
0.6D + W	1.60	0.9734	3400.00	3309.43	318.16	32.94	93.39	93.392	93.3923	132.384	0.48	0.44	0.009	2.37
0.6D + 0.7E	1.60	0.9734	3400.00	3309.43	318.16	15.56	44.12	44.119	44.1188	62.5384	0.23	0.21	0.004	1.12

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGA11 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	40.00 PLF		
Length	5.67 ft	**Floor LL (L)**	400.00 PLF		
Unsupported Length	5.67 ft	$K_{LL}A_T$	45.36 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	4 ft	**Self Weight**	1.74 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**441.74** PLF		
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0 PLF	
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	22.68 ft^2				
Roof Tributary Area (A_T)	0 ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	9,356 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	12 in
	l_u/d	1.655 <7
Effective Unbraced Lenth	l_e	24.72 in
Slenderness Ratio	R_B	8.92 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	1252.3243 lb
Bearing Stress	f'_c	278.29 psi
Beam Section Modulus	S_{actual}	13.14 in^3
Actual Cross Sectional Area	A_{actual}	10.88 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.189 in
Actual Moment of Inertia	I_{actual}	47.63 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	28.728 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9875	1912.50	1888.62	178.97	41.74	118.32	118.32	118.324	167.725	1.07	0.99	0.012	3.00
D + L	1.00	0.9858	2125.00	2094.78	198.85	441.74	1252.32	1252.3	1252.32	1775.17	10.17	9.45	0.126	31.78
D + (Lr or S)	1.25	0.9811	2656.25	2605.94	248.56	41.74	118.32	118.32	118.324	167.725	0.77	0.71	0.012	3.00
D + 0.75L	1.15	0.9830	2443.75	2402.25	228.68	341.74	968.82	968.82	968.824	1373.31	6.86	6.35	0.098	24.59
D + (W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	70.46	199.77	199.77	199.768	283.171	1.03	0.94	0.020	5.07
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9734	3400.00	3309.43	318.16	363.28	1029.91	1029.9	1029.91	1459.89	5.29	4.86	0.104	26.14
0.6D + W	1.60	0.9734	3400.00	3309.43	318.16	53.77	152.44	152.44	152.438	216.082	0.78	0.72	0.015	3.87
0.6D + 0.7E	1.60	0.9734	3400.00	3309.43	318.16	25.04	70.99	70.995	70.9946	100.635	0.36	0.33	0.007	1.80

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB00**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	35.00	PLF
Length	8.25	ft	**Floor LL (L)**	350.00	PLF
Unsupported Length	8.25	ft	**$K_{LL}A_T$**	57.75	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	3.5	ft	**Self Weight**	4.05	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**389.05**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	28.875	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	**F'_c**	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	1604.8434	lb
Bearing Stress	f'_c	**152.84**	psi
Beam Section Modulus	S_{actual}	**30.66**	in^3
Actual Cross Sectional Area	A_{actual}	**25.38**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.275**	in
Actual Moment of Inertia	I_{actual}	**111.15**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	25.137	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	**0**	**0**	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	39.05	161.09	161.09	161.093	332.255	2.09	1.35	0.021	8.66
D + L	1.00	0.9971	2125.00	2118.78	198.85	389.05	1604.84	1604.8	1604.84	3309.99	**18.75**	**12.11**	**0.213**	**86.23**
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	39.05	161.09	161.09	161.093	332.255	1.51	0.97	0.021	8.66
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	301.55	1243.91	1243.9	1243.91	2565.56	12.64	8.16	0.165	66.84
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	64.19	264.78	264.78	264.784	546.116	1.94	1.25	0.035	14.23
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	320.41	1321.67	1321.7	1321.67	2725.95	9.67	6.23	0.176	71.02
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	48.57	200.35	200.35	200.346	413.214	1.47	0.94	0.027	10.77
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	23.43	96.66	96.656	96.6561	199.353	0.71	0.46	0.013	5.19

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB1**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	3.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	29.20	PLF
Length	7.5 ft	**Floor LL (L)**	292.00	PLF
Unsupported Length	7.5 ft	$K_{LL}A_T$	43.8	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.92 ft	**Self Weight**	4.05	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**325.25**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	21.9 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grai	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bendin	F_{bE}	38,202 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	4.42 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	10.5 in^2
Max Support Bearing Pressure	P	1219.6986 lb
Bearing Stress	f'_c	116.16 psi
Beam Section Modulus	S_{actual}	30.66 in^3
Actual Cross Sectional Area	A_{actual}	25.38 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.250 in
Actual Moment of Inertia	I_{actual}	111.15 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	20.971 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	33.25	124.70	124.7	124.699	233.81	1.47	1.05	0.012	5.54
D + L	1.00	0.9971	2125.00	2118.78	198.85	325.25	1219.70	1219.7	1219.7	2286.93	**12.95**	**9.20**	**0.122**	**54.16**
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	33.25	124.70	124.7	124.699	233.81	1.06	0.75	0.012	5.54
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	252.25	945.95	945.95	945.949	1773.65	8.74	6.20	0.094	42.01
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	54.22	203.34	203.34	203.341	381.265	1.35	0.96	0.020	9.03
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	267.98	1004.93	1004.9	1004.93	1884.25	6.68	4.74	0.100	44.63
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	40.92	153.46	153.46	153.462	287.741	1.02	0.72	0.015	6.81
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	19.95	74.82	74.819	74.8191	140.286	0.50	0.35	0.007	3.32

UNLV Solar Decathlon Lumber Continuous Beam - Two Unequal Spans

Entry Fields

Header Name: GB2 **Material:** TimberSil Glasswood

Description: *Some Kind of Continuous Beam with Two Unequal Spans*

Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	16.00 PLF		
Length	10 ft	**Floor LL (L)**	160.00 PLF		
Unsupported Length (1)	7 ft	$K_{LL}A_T$	32 ft²		
Unsupported Length (2)	3	**LL Reduc.**	0 PLF		
Roof Trib. Length	0 ft	**Self Weight**	1.74 PLF		
Floor Trib. Length	1.6 ft	**TOTAL LOAD**	**177.74** PLF		
Top of Header to Edge of Roof	0 ft	**L_r Reduc.**	0 PLF		
Sandwich Header?	No Yes/No	ASCE 7-05 Table 4-2			
Live Load Element Factor	2 K_{LL}				
Floor Tributary Area (A_T)	16 ft²				
Roof Tributary Area (A_T)	0 ft²				
Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$			
Wind Force (W)	11.491 **PLF**	See Components & Cladding			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	4.5 in²
Max Support Bearing Pressure	P	1280.1294 lb
Bearing Stress	f'_c	284.47 psi
Beam Section Modulus	S_{actual}	13.14 in³
Actual Cross Sectional Area	A_{actual}	10.88 in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.333 in
Actual Moment of Inertia	I_{actual}	47.63 in⁴

Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	10 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	3 in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	R_3 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	17.74	50.36	127.75	-0.73904	73.798503	82.03352865	0.52	0.62	0.012	1.68
D + L	1.00	0.9794	2125.00	2081.12	198.85	177.74	504.65	1280.1	-7.40571	739.51279	822.0335286	4.74	5.58	0.118	16.85
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	17.74	50.36	127.75	-0.73904	73.798503	82.03352865	0.38	0.45	0.012	1.68
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	137.74	391.07	992.03	-5.73904	573.08422	637.0335286	3.21	3.76	0.091	13.05
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	29.23	82.99	210.51	-1.21784	121.6101	135.1803286	0.50	0.57	0.019	2.77
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	146.36	415.54	1054.1	-6.09814	608.94292	676.8936286	2.49	2.87	0.097	13.87
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	22.13	62.84	159.41	-0.92222	92.090702	102.3669172	0.38	0.43	0.015	2.10
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	10.64	30.22	76.649	-0.44342	44.279102	49.22011719	0.18	0.21	0.007	1.01

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: GB3, GB4, GB7, GB8, GB11

Description: *Some Kind of Simply Supported Beam*

Material: TimberSil Glasswood

Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	7.08	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	7.08	ft	$K_{LL}A_T$	40.0728	ft²
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	20.0364	ft²			
Floor Tributary Area (A_T)	0	ft²			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		F_c	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in²
Max Support Bearing Pressure	P	1108.1509	lb
Bearing Stress	f'_c	**246.26**	psi
Beam Section Modulus	S_{actual}	**13.14**	in³
Actual Cross Sectional Area	A_{actual}	**10.88**	in²
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.236**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in⁴

Roof Dead Load	0	lb/ft²
Roof Live Load	0	lb/ft²
Wall Dead Load	0	lb/ft²
Floor Dead Load	10	lb/ft²
Floor Live Load	100	lb/ft²
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	20.325 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	106.33	106.33	106.331	188.206	1.20	0.89	0.021	4.21
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	1108.15	1108.2	1108.15	1961.43	**11.31**	**8.36**	**0.217**	**43.85**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	106.33	106.33	106.331	188.206	0.87	0.64	0.021	4.21
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	857.70	857.7	857.696	1518.12	7.65	5.63	0.168	33.94
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	178.28	178.28	178.282	315.558	1.16	0.84	0.035	7.06
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	911.66	911.66	911.659	1613.64	5.94	4.30	0.179	36.08
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	135.75	135.75	135.749	240.276	0.88	0.64	0.027	5.37
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	63.80	63.799	63.7985	112.923	0.42	0.30	0.013	2.52

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name:	**GB5,GB6**		**Material:**	TimberSil Glasswood	
Description:	*Overhanging Beam With Distributed Load and Point Load*				
Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF
Total Length	10.17	ft	**Floor LL (L)**	258.00	PLF
Unsupported Length (l)	7.92	ft	$K_{LL}A_T$	52.4772	ft^2
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF
x	3.96	ft	**Self Weight**	4.05	PLF
x_1	2.25	ft	**TOTAL LOAD**	**287.85**	PLF
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF
Floor Trib. Length	2.58	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	26.2386	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load	740.00	lb			
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	18.530	**PLF**	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi					
orizontal shear parallel to gra	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2619.5653	lb
Bearing Stress	f'_c	**249.48**	psi
Beam Section Modulus	S_{actual}	**30.66**	**in^3**
Actual Cross Sectional Area	A_{actual}	**25.38**	**in^2**
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.339**	in
Actual Moment of Inertia	I_{actual}	**111.15**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	**w** (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	29.85	318.90	934.93	934.928	1740.57	10.95	7.84	0.108	**37.86**
D + L	1.00	0.9971	2125.00	2118.78	198.85	287.85	1258.13	2619.57	2619.57	2393.63	**13.56**	**19.76**	**0.169**	**37.86**
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	29.85	318.90	934.93	934.928	1740.57	7.89	5.64	0.108	**37.86**
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	223.35	1023.32	2198.41	2198.41	2230.36	10.99	14.42	0.145	**37.86**
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	48.38	386.36	1055.92	1055.92	1787.47	6.34	4.98	0.103	**37.86**
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	237.25	1073.91	2289.15	2289.15	2265.54	8.03	10.79	0.150	**37.86**
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	36.44	342.89	977.95	977.947	1757.24	6.23	4.61	0.106	**37.86**
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	17.91	275.43	856.96	856.957	1710.34	6.07	4.04	0.111	**37.86**

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name: GB9,GB10 **Material:** TimberSil Glasswood

Description: *Overhanging Beam With Distributed Load and Point Load*

Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	25.80	PLF
Total Length	7.6	ft	**Floor LL (L)**	258.00	PLF
Unsupported Length (l)	5.35	ft	$K_{LL}A_T$	39.216	ft^2
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF
x	2.675	ft	**Self Weight**	4.05	PLF
x_1	2.25	ft	**TOTAL LOAD**	**287.85**	PLF
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF
Floor Trib. Length	2.58	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	19.608	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load (P)	740.00	lb			
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	18.530	**PLF**	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi							
orizontal shear parallel to gra	F_V	205 psi							
			F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9		0.9
			E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9				
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2293.8679	lb
Bearing Stress	f'_c	218.46	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.253	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	29.85	376.95	901.15	901.15	1740.57	10.95	7.55	0.086	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	287.85	945.03	2293.87	2293.87	2393.63	13.56	17.30	0.084	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	29.85	376.95	901.15	901.15	1740.57	7.89	5.44	0.086	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	223.35	803.01	1945.69	1945.69	2230.36	10.99	12.76	0.084	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	48.38	417.75	1001.18	1001.18	1787.47	6.34	4.72	0.086	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	237.25	833.61	2020.71	2020.71	2265.54	8.03	9.53	0.084	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	36.44	391.45	936.72	936.715	1757.24	6.23	4.42	0.086	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	17.91	350.65	836.69	836.69	1710.34	6.07	3.94	0.086	37.86

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB12**		**Material:**	TimberSil Glasswood				
Description:	*Some Kind of Simply Supported Beam*							
Width (b)	1.5	in	**Roof DL**	0.00	PLF			
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF			
Material Type			**Wall DL**	0.00	PLF			
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	40.00	PLF			
Length	5.08	ft	**Floor LL (L)**	400.00	PLF			
Unsupported Length	5.08	ft	**$K_{LL}A_T$**	40.64	ft²			
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF			
Floor Trib. Length	4	ft	**Self Weight**	1.74	PLF			
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**441.74**	PLF			
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF			
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	20.32	ft²						
Floor Tributary Area (A_T)	0	ft²						

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	F_c	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	**F'_c**	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in²
Max Support Bearing Pressure	P	1122.0119	lb
Bearing Stress	f'_c	249.34	psi
Beam Section Modulus	S_{actual}	13.14	in³
Actual Cross Sectional Area	A_{actual}	10.88	in²
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.169	in
Actual Moment of Inertia	I_{actual}	47.63	in⁴

Roof Dead Load	0	lb/ft²
Roof Live Load	0	lb/ft²
Wall Dead Load	0	lb/ft²
Floor Dead Load	10	lb/ft²
Floor Live Load	100	lb/ft²
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$		
Wind Force (W)	28.728 **PLF**	See Components & Cladding		
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
						w	**R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
Load Cases	**C_D**	**C_L**	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in³	in²	in	in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	41.74	106.01	106.01	106.012	134.635	0.86	0.89	0.008	2.16
D + L	1.00	0.9794	2125.00	2081.12	198.85	441.74	1122.01	1122	1122.01	1424.96	8.22	8.46	0.081	22.86
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	41.74	106.01	106.01	106.012	134.635	0.63	0.64	0.008	2.16
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	341.74	868.01	868.01	868.012	1102.38	5.55	5.69	0.063	17.68
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	70.46	178.98	178.98	178.981	227.306	0.84	0.84	0.013	3.65
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	363.28	922.74	922.74	922.739	1171.88	4.32	4.35	0.067	18.80
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	53.77	136.58	136.58	136.576	173.452	0.64	0.64	0.010	2.78
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	25.04	63.61	63.607	63.6072	80.7811	0.30	0.30	0.005	1.30

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name:	GB13		Material:	TimberSil Glasswood
Description:	*Overhanging Beam With Distributed Load and Point Load*			
Width (b)	3.5	in	Roof DL	0.00 PLF
Depth (d)	7.25	in	Roof LL (L_r)	0.00 PLF
Material Type			Wall DL	0.00 PLF
Unit Weight	23	Lbs/Cu. Ft.	Floor DL	25.80 PLF
Total Length	5.17	ft	Floor LL (L)	258.00 PLF
Unsupported Length (l)	2.92	ft	$K_{LL}A_T$	26.6772 ft^2
Overhang Length (a)	2.25	ft	LL Reduc.	0 PLF
x	1.46	ft	Self Weight	4.05 PLF
x_1	2.25	ft	**TOTAL LOAD**	**287.85** PLF
Roof Trib. Length	0	ft	L_r Reduc.	0 PLF
Floor Trib. Length	2.58	ft	ASCE 7-05 Table 4-2	
Top of Header to Edge of Roof	0	ft		
Sandwich Header?	No	Yes/No		
Live Load Element Factor	2	K_{LL}		
Floor Tributary Area (A_T)	13.3386	ft^2		
Roof Tributary Area (A_T)	0	ft^2		
Point Load (P)	740.00	lb		
Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$	
Wind Force (W)	18.530	PLF	See Components & Cladding	

FACTORS

Actual Flexural Stress	F_b	2500 psi					
orizontal shear parallel to gra	F_V	205 psi					
			F_b	F_V	Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
			E	E_{min}			
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bend	F_{bE}	38,202 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	4.42 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	10.5 in^2
Max Support Bearing Pressure	P	2057.4645 lb
Bearing Stress	f'_c	195.95 psi
Beam Section Modulus	S_{actual}	30.66 in^3
Actual Cross Sectional Area	A_{actual}	25.38 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.172 in
Actual Moment of Inertia	I_{actual}	111.15 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	29.85	587.91	876.63	876.633	1740.57	10.95	7.35	0.060	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	287.85	740.94	2057.46	2057.46	2393.63	13.56	15.52	0.075	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	29.85	587.91	876.63	876.633	1740.57	7.89	5.29	0.060	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	223.35	702.68	1762.26	1762.26	2230.36	10.99	11.56	0.072	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	48.38	598.90	961.44	961.44	1787.47	6.34	4.53	0.062	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	237.25	710.93	1825.86	1825.86	2265.54	8.03	8.61	0.073	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	36.44	591.82	906.79	906.787	1757.24	6.23	4.28	0.061	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	17.91	580.83	821.98	821.98	1710.34	6.07	3.88	0.060	37.86

UNLV Solar Decathlon Lumber Overhanging Beam Design

Entry Fields

Header Name:	GB14		Material:	TimberSil Glasswood	
Description:	*Overhanging Beam With Distributed Load and Point Load*				
Width (b)	3.5	in	Roof DL	0.00	PLF
Depth (d)	7.25	in	Roof LL (L_r)	0.00	PLF
Material Type			Wall DL	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	Floor DL	27.50	PLF
Total Length	4.92	ft	Floor LL (L)	275.00	PLF
Unsupported Length (l)	2.67	ft	$K_{LL}A_T$	27.06	ft^2
Overhang Length (a)	2.25	ft	LL Reduc.	0	PLF
x	1.335	ft	Self Weight	4.05	PLF
x_1	2.25	ft	TOTAL LOAD	306.55	PLF
Roof Trib. Length	0	ft	L_r Reduc.	0	PLF
Floor Trib. Length	2.75	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	13.53	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load (P)	740.00	lb			
Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$		
Wind Force (W)	19.751	PLF	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi						
orizontal shear parallel to gra	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	psi

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2129.6149	lb
Bearing Stress	f'_c	202.82	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.164	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	31.55	635.81	883.03	883.031	1744.87	10.98	7.40	0.058	37.86
D + L	1.00	0.9971	2125.00	2118.78	198.85	306.55	742.22	2129.61	2129.61	2440.96	13.82	16.06	0.074	37.86
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	31.55	635.81	883.03	883.031	1744.87	7.91	5.33	0.058	37.86
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	237.80	715.62	1817.97	1817.97	2266.94	11.17	11.92	0.070	37.86
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	51.30	643.45	972.56	972.56	1794.86	6.37	4.59	0.059	37.86
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	252.62	721.35	1885.12	1885.12	2304.43	8.17	8.89	0.071	37.86
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	38.68	638.56	915.35	915.348	1762.91	6.25	4.32	0.058	37.86
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	18.93	630.92	825.82	825.818	1712.92	6.07	3.89	0.057	37.86

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields | Point Loads for Overhanging beams

Header Name:	GB16	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	20.00	PLF
Length	6.17 ft	**Floor LL (L)**	200.00	PLF
Unsupported Length	6.17 ft	**$K_{LL}A_T$**	24.68	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2 ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**221.74**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	12.34 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	1,624	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	74.04	in
	l_u/d	10.212	<7
Effective Unbraced Lenth	l_e	142.435	in
Slenderness Ratio	R_B	21.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	1.5	in^2
Max Support Bearing Pressure	P	684.05858	lb
Bearing Stress	f'_c	**456.04**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.206**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$				
Wind Force (W)	14.364	**PLF**	See Components & Cladding				
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)			
Point Load	0	0	0	0			

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.7422	1912.50	1419.39	178.97	21.74	67.06	67.059	67.0586	103.438	0.87	0.56	0.009	2.02
D + L	1.00	0.6882	2125.00	1462.33	198.85	221.74	684.06	684.06	684.059	1055.16	8.66	5.16	0.089	20.56
D + (Lr or S)	1.25	0.5729	2656.25	1521.64	248.56	21.74	67.06	67.059	67.0586	103.438	0.82	0.40	0.009	2.02
D + 0.75L	1.15	0.6152	2443.75	1503.48	228.68	171.74	529.81	529.81	529.809	817.23	6.52	3.48	0.069	15.92
D + (W or 0.7E)	1.60	0.4582	3400.00	1557.81	318.16	36.10	111.37	111.37	111.372	171.791	1.32	0.53	0.014	3.35
D + 0.75L + 0.75(W or 0.7E)	1.60	0.4582	3400.00	1557.81	318.16	182.51	563.04	563.04	563.043	868.494	6.69	2.65	0.073	16.92
0.6D + W	1.60	0.4582	3400.00	1557.81	318.16	27.41	84.55	84.548	84.5481	130.415	1.00	0.40	0.011	2.54
0.6D + 0.7E	1.60	0.4582	3400.00	1557.81	318.16	13.04	40.24	40.235	40.2351	62.0627	0.48	0.19	0.005	1.21

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: GB17 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	15.00	PLF
Length	9.46	ft	**Floor LL (L)**	150.00	PLF
Unsupported Length	9.46	ft	$K_{LL}A_T$	28.38	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.5	ft	**Self Weight**	4.05	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	169.05	PLF
Sandwich Header?	No	Yes/No	L_r **Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	14.19	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	6,089	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	113.52	in
	l_u/d	15.658	<7
Effective Unbraced Lenth	l_e	206.788	in
Slenderness Ratio	R_B	11.06	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	3.5	in^2
Max Support Bearing Pressure	P	799.62046	lb
Bearing Stress	f'_c	228.46	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.315	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	10.773 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9783	1912.50	1871.00	178.97	19.05	90.12	90.12	90.1205	213.135	1.37	0.76	0.018	6.37
D + L	1.00	0.9749	2125.00	2071.59	198.85	169.05	799.62	799.62	799.62	1891.1	10.95	6.03	0.160	56.49
D + (Lr or S)	1.25	0.9649	2656.25	2563.09	248.56	19.05	90.12	90.12	90.1205	213.135	1.00	0.54	0.018	6.37
D + 0.75L	1.15	0.9692	2443.75	2368.37	228.68	131.55	622.25	622.25	622.245	1471.61	7.46	4.08	0.125	43.96
D + (W or 0.7E)	1.60	0.9469	3400.00	3219.41	318.16	29.83	141.08	141.08	141.077	333.647	1.24	0.67	0.028	9.97
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9469	3400.00	3219.41	318.16	139.63	660.46	660.46	660.463	1561.99	5.82	3.11	0.132	46.66
0.6D + W	1.60	0.9469	3400.00	3219.41	318.16	22.20	105.03	105.03	105.029	248.393	0.93	0.50	0.021	7.42
0.6D + 0.7E	1.60	0.9469	3400.00	3219.41	318.16	11.43	54.07	54.072	54.0723	127.881	0.48	0.25	0.011	3.82

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB18**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	100.00	PLF
Length	1.33	ft	**Floor LL (L)**	50.00	PLF
Unsupported Length	1.33	ft	$K_{LL}A_T$	1.33	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	0.5	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**151.74**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	0.665	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,034	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	15.96	in
	l_u/d	2.201	<7
Effective Unbraced Lenth	l_e	32.8776	in
Slenderness Ratio	R_B	10.29	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	1.5	in^2
Max Support Bearing Pressure	P	100.90509	lb
Bearing Stress	f'_c	**67.27**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.044**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	200	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	3.591 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.29	178.97	101.74	67.66	67.655	67.6551	22.4953	0.14	0.57	0.000	0.09
D + L	1.00	0.9794	2125.00	2081.27	198.85	151.74	100.91	100.91	100.905	33.5509	0.19	0.76	0.000	0.14
D + (Lr or S)	1.25	0.9718	2656.25	2581.42	248.56	101.74	67.66	67.655	67.6551	22.4953	0.10	0.41	0.000	0.09
D + 0.75L	1.15	0.9750	2443.75	2382.72	228.68	139.24	92.59	92.593	92.5926	30.787	0.16	0.61	0.000	0.13
D + (W or 0.7E)	1.60	0.9586	3400.00	3259.30	318.16	105.33	70.04	70.043	70.0431	23.2893	0.09	0.33	0.000	0.10
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9586	3400.00	3259.30	318.16	141.93	94.38	94.384	94.3836	31.3825	0.12	0.44	0.000	0.13
0.6D + W	1.60	0.9586	3400.00	3259.30	318.16	64.63	42.98	42.981	42.9811	14.2912	0.05	0.20	0.000	0.06
0.6D + 0.7E	1.60	0.9586	3400.00	3259.30	318.16	61.04	40.59	40.593	40.5931	13.4972	0.05	0.19	0.000	0.06

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: GB19 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	3.5 in	**Roof DL**	0.00 PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF
Material Type		**Wall DL**	0.00 PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	35.00 PLF
Length	5.67 ft	**Floor LL (L)**	350.00 PLF
Unsupported Length	5.67 ft	$K_{LL}A_T$	39.69 ft²
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF
Floor Trib. Length	3.5 ft	**Self Weight**	4.05 PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**389.05** PLF
Sandwich Header?	No Yes/No	L_r **Reduc.**	0 PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2	
Floor Tributary Area (A_T)	19.845 ft²		
Roof Tributary Area (A_T)	0 ft²		

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	38,202 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	4.42 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	10.5 in²
Max Support Bearing Pressure	P	1102.9651 lb
Bearing Stress	f'_c	105.04 psi
Beam Section Modulus	S_{actual}	30.66 in³
Actual Cross Sectional Area	A_{actual}	25.38 in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.189 in
Actual Moment of Inertia	I_{actual}	111.15 in⁴

Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	10 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	25.137 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load **w** (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9974	1912.50	1907.49	178.97	39.05	110.72	110.72	110.715	156.939	0.99	0.93	0.005	2.81
D + L	1.00	0.9971	2125.00	2118.78	198.85	389.05	1102.97	1103	1102.97	1563.45	8.85	8.32	0.048	27.99
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	39.05	110.72	110.72	110.715	156.939	0.71	0.67	0.005	2.81
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	301.55	854.90	854.9	854.903	1211.82	5.97	5.61	0.037	21.70
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	64.19	181.98	181.98	181.979	257.955	0.91	0.86	0.008	4.62
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	320.41	908.35	908.35	908.35	1287.59	4.57	4.28	0.039	23.05
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	48.57	137.69	137.69	137.692	195.179	0.69	0.65	0.006	3.49
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	23.43	66.43	66.429	66.4291	94.1632	0.33	0.31	0.003	1.69

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB20**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	3.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	35.00	PLF
Length	6.42 ft	**Floor LL (L)**	350.00	PLF
Unsupported Length	6.42 ft	$K_{LL}A_T$	44.94	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	3.5 ft	**Self Weight**	4.05	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**389.05**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	22.47 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	1248.86	lb
Bearing Stress	f'_c	**118.94**	psi
Beam Section Modulus	S_{actual}	**30.66**	in^3
Actual Cross Sectional Area	A_{actual}	**25.38**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.214**	in
Actual Moment of Inertia	I_{actual}	**111.15**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$	
Wind Force (W)	25.137 **PLF**	See Components & Cladding	

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	39.05	125.36	125.36	125.36	201.203	1.27	1.05	0.008	4.08
D + L	1.00	0.9971	2125.00	2118.78	198.85	389.05	1248.86	1248.9	1248.86	2004.42	11.35	9.42	0.078	40.64
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	39.05	125.36	125.36	125.36	201.203	0.91	0.76	0.008	4.08
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	301.55	967.98	967.98	967.985	1553.62	7.65	6.35	0.061	31.50
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	64.19	206.05	206.05	206.05	330.71	1.17	0.97	0.013	6.70
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	320.41	1028.50	1028.5	1028.5	1650.75	5.85	4.85	0.064	33.47
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	48.57	155.91	155.91	155.906	250.229	0.89	0.74	0.010	5.07
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	23.43	75.22	75.216	75.216	120.722	0.43	0.35	0.005	2.45

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB21**	**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	3.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	21.20 PLF		
Length	6.42 ft	**Floor LL (L)**	212.00 PLF		
Unsupported Length	6.42 ft	**$K_{LL}A_T$**	27.2208 ft²		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	2.12 ft	**Self Weight**	4.05 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**237.25** PLF		
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2			
Floor Tributary Area (A_T)	13.6104 ft²				
Roof Tributary Area (A_T)	0 ft²				

FACTORS

Actual Flexural Stress	F_b	2500 psi							
Horizontal shear parallel to grai	F_V	205 psi							
		F_b	F_V		Fc_{perp}	E		E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67		0.9	0.9
			E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9					
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bendin	F_{bE}	38,202 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	4.42 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	10.5 in²
Max Support Bearing Pressure	P	761.58197 lb
Bearing Stress	f'_c	**72.53** psi
Beam Section Modulus	S_{actual}	**30.66** in³
Actual Cross Sectional Area	A_{actual}	**25.38** in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.214** in
Actual Moment of Inertia	I_{actual}	**111.15** in⁴

Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	10 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	15.226 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load **w**	*Reactions* **R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in³	in²	in	in⁴
D	0.90	0.9974	1912.50	1907.49	178.97	25.25	81.06	81.062	81.062	130.104	0.82	0.68	0.005	2.64
D + L	1.00	0.9971	2125.00	2118.78	198.85	237.25	761.58	761.58	761.582	1222.34	**6.92**	**5.74**	**0.048**	**24.78**
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	25.25	81.06	81.062	81.062	130.104	0.59	0.49	0.005	2.64
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	184.25	591.45	591.45	591.452	949.28	4.68	3.88	0.037	19.25
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	40.48	129.94	129.94	129.937	208.549	0.74	0.61	0.008	4.23
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	195.67	628.11	628.11	628.108	1008.11	3.58	2.96	0.039	20.44
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	30.38	97.51	97.512	97.5121	156.507	0.56	0.46	0.006	3.17
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	15.15	48.64	48.637	48.6372	78.0627	0.28	0.23	0.003	1.58

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**GB22**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	3.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	21.20	PLF
Length	7.25 ft	**Floor LL (L)**	212.00	PLF
Unsupported Length	7.25 ft	**$K_{LL}A_T$**	30.74	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.12 ft	**Self Weight**	4.05	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**237.25**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	15.37 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	860.04195	lb
Bearing Stress	f'_c	**81.91**	psi
Beam Section Modulus	S_{actual}	**30.66**	in^3
Actual Cross Sectional Area	A_{actual}	**25.38**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.242**	in
Actual Moment of Inertia	I_{actual}	**111.15**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	15.226 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	**w** (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	25.25	91.54	91.542	91.5419	165.92	1.04	0.77	0.008	3.80
D + L	1.00	0.9971	2125.00	2118.78	198.85	237.25	860.04	860.04	860.042	1558.83	**8.83**	**6.49**	**0.078**	**35.69**
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	25.25	91.54	91.542	91.5419	165.92	0.75	0.55	0.008	3.80
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	184.25	667.92	667.92	667.917	1210.6	5.96	4.38	0.060	27.72
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	40.48	146.74	146.74	146.736	265.958	0.94	0.69	0.013	6.09
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	195.67	709.31	709.31	709.312	1285.63	4.56	3.34	0.064	29.43
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	30.38	110.12	110.12	110.119	199.59	0.71	0.52	0.010	4.57
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	15.15	54.93	54.925	54.9252	99.5519	0.35	0.26	0.005	2.28

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB1**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	4	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	4	ft	**$K_{LL}A_T$**	22.64	ft²
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	11.32	ft²			
Roof Tributary Area (A_T)	0	ft²			
Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$		
Wind Force (W)	20.325	PLF	See Components & Cladding		

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V		Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in²
Max Support Bearing Pressure	P	626.07396	lb
Bearing Stress	f'_c	139.13	psi
Beam Section Modulus	S_{actual}	13.14	in³
Actual Cross Sectional Area	A_{actual}	10.88	in²
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.133	in
Actual Moment of Inertia	I_{actual}	47.63	in⁴

Roof Dead Load	0	lb/ft²
Roof Live Load	0	lb/ft²
Wall Dead Load	0	lb/ft²
Floor Dead Load	10	lb/ft²
Floor Live Load	100	lb/ft²
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	60.07	60.074	60.074	60.074	0.38	0.50	0.002	0.76
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	626.07	626.07	626.074	626.074	3.61	4.72	0.022	7.91
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	60.07	60.074	60.074	60.074	0.28	0.36	0.002	0.76
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	484.57	484.57	484.574	484.574	2.44	3.18	0.017	6.12
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	100.72	100.72	100.724	100.724	0.37	0.47	0.004	1.27
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	515.06	515.06	515.062	515.062	1.90	2.43	0.018	6.51
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	76.69	76.694	76.6945	76.6945	0.28	0.36	0.003	0.97
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	36.04	36.044	36.0444	36.0444	0.13	0.17	0.001	0.46

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB2, RGB3**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	4.33 ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	4.33 ft	**$K_{LL}A_T$**	24.5078	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83 ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	12.2539 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V	Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	F'_c	**616.4 psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	677.72506 lb
Bearing Stress	f'_c	150.61 psi
Beam Section Modulus	S_{actual}	13.14 in^3
Actual Cross Sectional Area	A_{actual}	10.88 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.144 in
Actual Moment of Inertia	I_{actual}	47.63 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 PLF	$0.2S_{DS}D$		
Wind Force (W)	20.325 PLF	See Components & Cladding		
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load — *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	65.03	65.03	65.0301	70.395	0.45	0.55	0.003	0.96
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	677.73	677.73	677.725	733.637	4.23	5.11	0.030	10.03
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	65.03	65.03	65.0301	70.395	0.33	0.39	0.003	0.96
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	524.55	524.55	524.551	567.827	2.86	3.44	0.024	7.76
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	109.03	109.03	109.034	118.029	0.43	0.51	0.005	1.61
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	557.55	557.55	557.554	603.552	2.22	2.63	0.025	8.25
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	83.02	83.022	83.0218	89.8711	0.33	0.39	0.004	1.23
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	39.02	39.018	39.018	42.237	0.16	0.18	0.002	0.58

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB4**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	4.75	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	4.75	ft	**$K_{LL}A_T$**	26.885	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	13.4425	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	**F'_c**	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	743.46283	lb
Bearing Stress	f'_c	165.21	psi
Beam Section Modulus	S_{actual}	13.14	in^3
Actual Cross Sectional Area	A_{actual}	10.88	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.158	in
Actual Moment of Inertia	I_{actual}	47.63	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$	
Wind Force (W)	20.325	PLF	See Components & Cladding	

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	71.34	71.338	71.3378	84.7137	0.54	0.60	0.004	1.27
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	743.46	743.46	743.463	882.862	5.09	5.61	0.044	13.24
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	71.34	71.338	71.3378	84.7137	0.39	0.43	0.004	1.27
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	575.43	575.43	575.432	683.325	3.44	3.77	0.034	10.25
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	119.61	119.61	119.61	142.037	0.52	0.56	0.007	2.13
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	611.64	611.64	611.636	726.317	2.67	2.88	0.036	10.89
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	91.07	91.075	91.0747	108.151	0.40	0.43	0.005	1.62
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	42.80	42.803	42.8027	50.8282	0.19	0.20	0.003	0.76

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGB5 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	30.80 PLF		
Length	4.92 ft	**Floor LL (L)**	308.00 PLF		
Unsupported Length	4.92 ft	$K_{LL}A_T$	30.3072 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	3.08 ft	**Self Weight**	1.74 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**340.54** PLF		
Sandwich Header?	No	Yes/No	L_r Reduc.	0 PLF	
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	15.1536 ft^2				
Roof Tributary Area (A_T)	0 ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grai	F_V	205 psi					
			F_b	F_V	Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
			E	E_{min}			
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	837.72097 lb
Bearing Stress	f'_c	186.16 psi
Beam Section Modulus	S_{actual}	13.14 in^3
Actual Cross Sectional Area	A_{actual}	10.88 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.164 in
Actual Moment of Inertia	I_{actual}	47.63 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 PLF	$0.2S_{DS}D$	
Wind Force (W)	22.121 PLF	See Components & Cladding	

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
						w	R_1	R_2	V_{max}	M_{max}	S_{req}	A_{req}	Δ_{actual}	I_{req}
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9821	1912.50	1878.18	178.97	32.54	80.04	80.041	80.041	98.4504	0.63	0.67	0.005	1.53
D + L	1.00	0.9794	2125.00	2081.12	198.85	340.54	837.72	837.72	837.721	1030.4	**5.94**	**6.32**	**0.055**	**16.01**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	32.54	80.04	80.041	80.041	98.4504	0.46	0.48	0.005	1.53
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	263.54	648.30	648.3	648.301	797.41	4.02	4.25	0.043	12.39
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	54.66	134.46	134.46	134.458	165.383	0.61	0.63	0.009	2.57
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	280.13	689.11	689.11	689.113	847.609	3.12	3.25	0.045	13.17
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	41.64	102.44	102.44	102.441	126.003	0.46	0.48	0.007	1.96
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	19.52	48.02	48.025	48.0246	59.0702	0.22	0.23	0.003	0.92

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGB6 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Input	Value	Unit	Load	Value	Unit
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	30.80	PLF
Length	5.17	ft	**Floor LL (L)**	308.00	PLF
Unsupported Length	5.17	ft	**$K_{LL}A_T$**	31.8472	ft²
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	3.08	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**340.12**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	15.9236	ft²			
Roof Tributary Area (A_T)	0	ft²			

FACTORS

Factor	Symbol						
Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Property	Symbol	Value
Euler-based ASD critical buckling value for bending	F_{bE}	9,249 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.909 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	8.98 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Item	Symbol	Value
Bearing Contact Area	$A_{bearing}$	4.5 in²
Max Support Bearing Pressure	P	879.20428 lb
Bearing Stress	f'_c	**195.38** psi
Beam Section Modulus	S_{actual}	**7.56** in³
Actual Cross Sectional Area	A_{actual}	**8.25** in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.172** in
Actual Moment of Inertia	I_{actual}	**20.80** in⁴

Load	Value
Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	10 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$	
Wind Force (W)	22.121 **PLF**	See Components & Cladding	
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	**w** (PLF)	**R_1** (lbs)	**R_2** (lbs)	**V_{max}** (lbs)	**M_{max}** (lb-ft)	**S_{req}** in³	**A_{req}** in²	**Δ_{actual}** in	**I_{req}** in⁴
D	0.90	0.9873	1912.50	1888.28	178.97	32.12	83.02	83.024	83.0243	107.309	0.68	0.70	0.015	1.75
D + L	1.00	0.9856	2125.00	2094.35	198.85	340.12	879.20	879.2	879.204	1136.37	**6.51**	**6.63**	**0.154**	**18.55**
D + (Lr or S)	1.25	0.9808	2656.25	2605.17	248.56	32.12	83.02	83.024	83.0243	107.309	0.49	0.50	0.015	1.75
D + 0.75L	1.15	0.9828	2443.75	2401.63	228.68	263.12	680.16	680.16	680.159	879.106	4.39	4.46	0.119	14.35
D + (W or 0.7E)	1.60	0.9729	3400.00	3307.91	318.16	54.24	140.21	140.21	140.206	181.216	0.66	0.66	0.025	2.96
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9729	3400.00	3307.91	318.16	279.71	723.05	723.05	723.046	934.536	3.39	3.41	0.126	15.26
0.6D + W	1.60	0.9729	3400.00	3307.91	318.16	41.39	107.00	107	106.996	138.293	0.50	0.50	0.019	2.26
0.6D + 0.7E	1.60	0.9729	3400.00	3307.91	318.16	19.27	49.81	49.815	49.8146	64.3853	0.23	0.23	0.009	1.05

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGB7 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	28.30 PLF		
Length	4.92 ft	**Floor LL (L)**	283.00 PLF		
Unsupported Length	4.92 ft	$K_{LL}A_T$	27.8472 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	2.83 ft	**Self Weight**	1.74 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**313.04** PLF		
Sandwich Header?	No Yes/No	L_r **Reduc.**	0 PLF		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2			
Floor Tributary Area (A_T)	13.9236 ft^2				
Roof Tributary Area (A_T)	0 ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grai	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendin	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	770.07097 lb
Bearing Stress	f'_c	171.13 psi
Beam Section Modulus	S_{actual}	13.14 in^3
Actual Cross Sectional Area	A_{actual}	10.88 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.164 in
Actual Moment of Inertia	I_{actual}	47.63 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	20.325 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	73.89	73.891	73.891	90.8859	0.58	0.62	0.005	1.41
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	770.07	770.07	770.071	947.187	5.46	5.81	0.051	14.72
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	73.89	73.891	73.891	90.8859	0.42	0.45	0.005	1.41
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	596.03	596.03	596.026	733.112	3.69	3.91	0.039	11.39
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	123.89	123.89	123.891	152.385	0.56	0.58	0.008	2.37
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	633.53	633.53	633.526	779.237	2.87	2.99	0.042	12.11
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	94.33	94.334	94.3342	116.031	0.43	0.44	0.006	1.80
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	44.33	44.335	44.3346	54.5315	0.20	0.21	0.003	0.85

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB8**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	28.30	PLF
Length	5.75	ft	**Floor LL (L)**	283.00	PLF
Unsupported Length	5.75	ft	$K_{LL}A_T$	32.545	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	2.83	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**313.04**	PLF
Sandwich Header?	No	Yes/No	L_r **Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	16.2725	ft^2			
Roof Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi							
Horizontal shear parallel to grain	F_V	205 psi							
		F_b	F_V		Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9	
		E	E_{min}						
Temperature Factor	C_t	1.00	0.9	0.9					
Size Factor	C_F	1.00	1.00						
Flat-use Factor	C_{fu}	1.00							
Curvature Factor	C_c	1.00							
Incising Factor	C_i	1.00							
Repetitive member factor	C_r	1.00							
Bearing Area Factor	C_b	1.00							

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	899.98132	lb
Bearing Stress	f'_c	**200.00**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.192**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$					
Wind Force (W)	20.325	PLF	See Components & Cladding					
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)				
Point Load	0	0	0	0				

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	30.04	86.36	86.356	86.3563	124.137	0.79	0.72	0.009	2.25
D + L	1.00	0.9794	2125.00	2081.12	198.85	313.04	899.98	899.98	899.981	1293.72	7.46	6.79	0.095	23.49
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	30.04	86.36	86.356	86.3563	124.137	0.58	0.52	0.009	2.25
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	242.29	696.58	696.58	696.575	1001.33	5.04	4.57	0.073	18.18
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	50.36	144.79	144.79	144.791	208.137	0.77	0.68	0.015	3.78
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	257.53	740.40	740.4	740.401	1064.33	3.92	3.49	0.078	19.33
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	38.35	110.25	110.25	110.248	158.482	0.58	0.52	0.012	2.88
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	18.02	51.81	51.814	51.8138	74.4823	0.27	0.24	0.005	1.35

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB9**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00 PLF	
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF	
Material Type		**Wall DL**	0.00 PLF	
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	24.20 PLF	
Length	5.83 ft	**Floor LL (L)**	242.00 PLF	
Unsupported Length	5.83 ft	**$K_{LL}A_T$**	28.2172 ft²	
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF	
Floor Trib. Length	2.42 ft	**Self Weight**	1.74 PLF	
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**267.94** PLF	
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF	
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	14.1086 ft²			
Roof Tributary Area (A_T)	0 ft²			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V	Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	**F'_c**	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	4.5 in²
Max Support Bearing Pressure	P	781.03629 lb
Bearing Stress	f'_c	**173.56** psi
Beam Section Modulus	S_{actual}	**13.14** in³
Actual Cross Sectional Area	A_{actual}	**10.88** in²
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.194** in
Actual Moment of Inertia	I_{actual}	**47.63** in⁴

Roof Dead Load	0 lb/ft²
Roof Live Load	0 lb/ft²
Wall Dead Load	0 lb/ft²
Floor Dead Load	10 lb/ft²
Floor Live Load	100 lb/ft²
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	17.380 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.9821	1912.50	1878.18	178.97	25.94	75.61	75.606	75.6063	110.196	0.70	0.63	0.008	2.03
D + L	1.00	0.9794	2125.00	2081.12	198.85	267.94	781.04	781.04	781.036	1138.36	6.56	5.89	0.086	20.96
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	25.94	75.61	75.606	75.6063	110.196	0.51	0.46	0.008	2.03
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	207.44	604.68	604.68	604.679	881.319	4.44	3.97	0.066	16.23
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	43.32	126.27	126.27	126.27	184.039	0.68	0.60	0.014	3.39
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	220.47	642.68	642.68	642.677	936.701	3.45	3.03	0.070	17.25
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	32.94	96.03	96.028	96.0278	139.96	0.52	0.45	0.011	2.58
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	15.56	45.36	45.364	45.3638	66.1177	0.24	0.21	0.005	1.22

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name: RGB10 **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF	
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF	
Material Type		**Wall DL**	0.00 PLF	
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	24.20 PLF	
Length	6.5 ft	**Floor LL (L)**	242.00 PLF	
Unsupported Length	6.5 ft	$K_{LL}A_T$	31.46 ft^2	
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF	
Floor Trib. Length	2.42 ft	**Self Weight**	1.74 PLF	
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**267.94** PLF	
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0 PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	15.73 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
			F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
			E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	7,017 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	16 in
	l_u/d	2.207 <7
Effective Unbraced Lenth	l_e	32.96 in
Slenderness Ratio	R_B	10.31 n/a
Compressive Stregth Perp to Grain	F_c	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	4.5 in^2
Max Support Bearing Pressure	P	870.79518 lb
Bearing Stress	f'_c	193.51 psi
Beam Section Modulus	S_{actual}	13.14 in^3
Actual Cross Sectional Area	A_{actual}	10.88 in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	0.217 in
Actual Moment of Inertia	I_{actual}	47.63 in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	3 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	17.380 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load **w** (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9821	1912.50	1878.18	178.97	25.94	84.30	84.295	84.2952	136.98	0.88	0.71	0.013	2.81
D + L	1.00	0.9794	2125.00	2081.12	198.85	267.94	870.80	870.8	870.795	1415.04	**8.16**	**6.57**	**0.132**	**29.05**
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	25.94	84.30	84.295	84.2952	136.98	0.64	0.51	0.013	2.81
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	207.44	674.17	674.17	674.17	1095.53	5.52	4.42	0.102	22.49
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	43.32	140.78	140.78	140.782	228.77	0.84	0.66	0.021	4.70
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	220.47	716.54	716.54	716.535	1164.37	4.29	3.38	0.109	23.90
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	32.94	107.06	107.06	107.064	173.978	0.64	0.50	0.016	3.57
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	15.56	50.58	50.577	50.5771	82.1878	0.30	0.24	0.008	1.69

UNLV Solar Decathlon Sawn Lumber Simply Supported Beam Design

Entry Fields

Header Name:	**RGB11**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00	PLF
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	30.00	PLF
Length	6.5 ft	**Floor LL (L)**	300.00	PLF
Unsupported Length	6.5 ft	$K_{LL}A_T$	39	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	3 ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**331.74**	PLF
Sandwich Header?	No Yes/No	L_r **Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Floor Tributary Area (A_T)	19.5 ft^2			
Roof Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.00					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	7,017	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	10.31	n/a
Compressive Stregth Perp to Grain	F_c	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	4.5	in^2
Max Support Bearing Pressure	P	1078.1452	lb
Bearing Stress	f'_c	**239.59**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.217**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	21.546 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load **w**	*Reactions* **R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.9821	1912.50	1878.18	178.97	31.74	103.15	103.15	103.145	167.611	1.07	0.86	0.016	3.44
D + L	1.00	0.9794	2125.00	2081.12	198.85	331.74	1078.15	1078.1	1078.15	1751.99	10.10	8.13	0.164	35.96
D + (Lr or S)	1.25	0.9717	2656.25	2581.15	248.56	31.74	103.15	103.15	103.145	167.611	0.78	0.62	0.016	3.44
D + 0.75L	1.15	0.9749	2443.75	2382.51	228.68	256.74	834.40	834.4	834.395	1355.89	6.83	5.47	0.127	27.83
D + (W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	53.28	173.17	173.17	173.17	281.401	1.04	0.82	0.026	5.78
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9584	3400.00	3258.71	318.16	272.90	886.91	886.91	886.914	1441.23	5.31	4.18	0.135	29.58
0.6D + W	1.60	0.9584	3400.00	3258.71	318.16	40.59	131.91	131.91	131.912	214.356	0.79	0.62	0.020	4.40
0.6D + 0.7E	1.60	0.9584	3400.00	3258.71	318.16	19.04	61.89	61.887	61.8871	100.567	0.37	0.29	0.009	2.06

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**TOP BOARD**		**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*					
Width (b)	5.25	in	**Roof DL**	0.00	PLF	
Depth (d)	1	in	**Roof LL (L_r)**	0.00	PLF	
Material Type			**Wall DL**	0.00	PLF	
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	5.00	PLF	
Length	1.33	ft	**Floor LL (L)**	50.00	PLF	
Unsupported Length	1.33	ft	**$K_{LL}A_T$**	1.33	ft^2	
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF	
Floor Trib. Length	0.5	ft	**Self Weight**	0.84	PLF	
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**55.84**	PLF	
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF	
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2			
Roof Tributary Area (A_T)	0.665	ft^2				
Floor Tributary Area (A_T)	0	ft^2				

FACTORS

Actual Flexural Stress	F_b	2700 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	707,900	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	15.96	in
	l_u/d	15.960	<7
Effective Unbraced Lenth	l_e	29.0148	in
Slenderness Ratio	R_B	1.03	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	3.9375	in^2
Max Support Bearing Pressure	P	37.13263	lb
Bearing Stress	f'_c	9.43	psi
Beam Section Modulus	S_{actual}	0.88	in^3
Actual Cross Sectional Area	A_{actual}	5.25	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.044	in
Actual Moment of Inertia	I_{actual}	0.44	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	0.75	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	3.591	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9998	2375.33	2374.93	178.97	5.84	3.88	3.88	3.88	1.29	0.01	0.03	0.001	0.01
D + L	1.00	0.9998	2639.25	2638.76	198.85	55.84	37.13	37.13	37.13	12.35	0.06	0.28	0.005	0.05
D + (Lr or S)	1.25	0.9998	3299.06	3298.29	248.56	5.84	3.88	3.88	3.88	1.29	0.00	0.02	0.001	0.01
D + 0.75L	1.15	0.9998	3035.14	3034.48	228.68	43.34	28.82	28.82	28.82	9.58	0.04	0.19	0.004	0.04
D + (W or 0.7E)	1.60	0.9997	4222.80	4221.53	318.16	9.43	6.27	6.27	6.27	2.08	0.01	0.03	0.001	0.01
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9997	4222.80	4221.53	318.16	46.03	30.61	30.61	30.61	10.18	0.03	0.14	0.004	0.04
0.6D + W	1.60	0.9997	4222.80	4221.53	318.16	7.09	4.72	4.72	4.72	1.57	0.00	0.02	0.001	0.01
0.6D + 0.7E	1.60	0.9997	4222.80	4221.53	318.16	3.50	2.33	2.33	2.33	0.77	0.00	0.01	0.000	0.00

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JA1**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	6.17	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	6.17	ft	**$K_{LL}A_T$**	16.4122	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	8.2061	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	2,222	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	74.04	in
	l_u/d	13.462	<7
Effective Unbraced Lenth	l_e	137.1852	in
Slenderness Ratio	R_B	18.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	455.40063	lb
Bearing Stress	f'_c	**202.40**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.206**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	9.552	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.7885	2375.33	1873.01	178.97	14.62	45.10	45.10	45.10	69.56	0.45	0.38	0.013	1.36
D + L	1.00	0.7380	2639.25	1947.84	198.85	147.62	455.40	455.40	455.40	702.46	**4.33**	**3.44**	**0.135**	**13.69**
D + (Lr or S)	1.25	0.6223	3299.06	2053.07	248.56	14.62	45.10	45.10	45.10	69.56	0.41	0.27	0.013	1.36
D + 0.75L	1.15	0.6658	3035.14	2020.88	228.68	114.37	352.82	352.82	352.82	544.23	3.23	2.31	0.105	10.60
D + (W or 0.7E)	1.60	0.5011	4222.80	2115.96	318.16	24.17	74.56	74.56	74.56	115.01	0.65	0.35	0.022	2.24
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5011	4222.80	2115.96	318.16	121.53	374.93	374.93	374.93	578.32	3.28	1.77	0.111	11.27
0.6D + W	1.60	0.5011	4222.80	2115.96	318.16	18.32	56.53	56.53	56.53	87.19	0.49	0.27	0.017	1.70
0.6D + 0.7E	1.60	0.5011	4222.80	2115.96	318.16	8.77	27.06	27.06	27.06	41.74	0.24	0.13	0.008	0.81

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JA2, JA3**	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00	PLF
Depth (d)	5.5 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	5.08 ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	5.08 ft	**$K_{LL}A_T$**	13.5128	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33 ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	6.7564 ft^2			
Floor Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi					
Horizontal shear parallel to gr.	F_V	205 psi					
		F_b	F_V		Fc_{perp}	**E**	E_{min}
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9
							0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.15					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bendi	F_{bE}	2,631	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	60.96	in
	l_u/d	11.084	<7
Effective Unbraced Lenth	l_e	115.8648	in
Slenderness Ratio	R_B	16.83	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	374.94898	lb
Bearing Stress	f'_c	**166.64**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.169**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 PLF	$0.2S_{DS}D$
Wind Force (W)	9.552 PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load **w** (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8552	2375.33	2031.34	178.97	14.62	37.13	37.13	37.13	47.15	0.28	0.31	0.006	0.76
D + L	1.00	0.8160	2639.25	2153.61	198.85	147.62	374.95	374.95	374.95	476.19	**2.65**	**2.83**	**0.062**	**7.64**
D + (Lr or S)	1.25	0.7104	3299.06	2343.66	248.56	14.62	37.13	37.13	37.13	47.15	0.24	0.22	0.006	0.76
D + 0.75L	1.15	0.7525	3035.14	2283.93	228.68	114.37	290.49	290.49	290.49	368.93	1.94	1.91	0.048	5.92
D + (W or 0.7E)	1.60	0.5825	4222.80	2459.58	318.16	24.17	61.39	61.39	61.39	77.97	0.38	0.29	0.010	1.25
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5825	4222.80	2459.58	318.16	121.53	308.69	308.69	308.69	392.04	1.91	1.46	0.051	6.29
0.6D + W	1.60	0.5825	4222.80	2459.58	318.16	18.32	46.54	46.54	46.54	59.11	0.29	0.22	0.008	0.95
0.6D + 0.7E	1.60	0.5825	4222.80	2459.58	318.16	8.77	22.28	22.28	22.28	28.29	0.14	0.11	0.004	0.45

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JA4**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	7	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	7	ft	**$K_{LL}A_T$**	18.62	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	9.31	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	1,987	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	84	in
	l_u/d	15.273	<7
Effective Unbraced Lenth	l_e	153.42	in
Slenderness Ratio	R_B	19.37	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	516.66198	lb
Bearing Stress	f'_c	229.63	psi
Beam Section Modulus	S_{actual}	7.56	in^3
Actual Cross Sectional Area	A_{actual}	8.25	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.233	in
Actual Moment of Inertia	I_{actual}	20.80	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	9.552	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
						w	**R_1**	**R_2**	**V_{max}**	**M_{max}**	**S_{req}**	**A_{req}**	**Δ_{actual}**	**I_{req}**
Load Cases	**C_D**	**C_L**	**F^*_{bx} (psi)**	**F'_b (psi)**	**F'_V (psi)**	(PLF)	(lbs)	(lbs)	(lbs)	(lb-ft)	in^3	in^2	in	in^4
D	0.90	0.7348	2375.33	1745.31	178.97	14.62	51.16	51.16	51.16	89.53	0.62	0.43	0.022	1.98
D + L	1.00	0.6804	2639.25	1795.86	198.85	147.62	516.66	516.66	516.66	904.16	6.04	3.90	0.224	19.99
D + (Lr or S)	1.25	0.5655	3299.06	1865.65	248.56	14.62	51.16	51.16	51.16	89.53	0.58	0.31	0.022	1.98
D + 0.75L	1.15	0.6076	3035.14	1844.25	228.68	114.37	400.29	400.29	400.29	700.50	4.56	2.63	0.174	15.48
D + (W or 0.7E)	1.60	0.4519	4222.80	1908.38	318.16	24.17	84.59	84.59	84.59	148.04	0.93	0.40	0.037	3.27
D + 0.75L + 0.75(W or 0.7E)	1.60	0.4519	4222.80	1908.38	318.16	121.53	425.36	425.36	425.36	744.38	4.68	2.01	0.185	16.45
0.6D + W	1.60	0.4519	4222.80	1908.38	318.16	18.32	64.13	64.13	64.13	112.23	0.71	0.30	0.028	2.48
0.6D + 0.7E	1.60	0.4519	4222.80	1908.38	318.16	8.77	30.70	30.70	30.70	53.72	0.34	0.14	0.013	1.19

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRA5-8**	**Material:**	TimberSil Glasswood					
Description:	*Some Kind of Simply Supported Beam*			**FACTORS**				
Width (b)	1.5 in	**Roof DL**	0.00 PLF	Actual Flexural Stress	F_b	2700 psi	Euler-based ASD critical buckling value for bendi F_{bE}	2,393 psi
Depth (d)	5.5 in	**Roof LL (L_r)**	0.00 PLF	rizontal shear parallel to gr F_V		205 psi	Modulus of Elasticity E_{min}	690000 psi
Material Type		**Wall DL**	0.00 PLF			F_b / F_V / Fc_{perp} / E / E_{min}	Adjusted ASD Mod. Of Elasticity E'_{min}	621000 psi
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	13.30 PLF	Wet-Service Factor	C_M	1.00 / 0.85 / 0.97 / 0.67 / 0.9 / 0.9	Unbraced Length l_u	68.04 in
Length	5.67 ft	**Floor LL (L)**	133.00 PLF			E / E_{min}	l_u/d	12.371 <7
Unsupported Length	5.67 ft	$K_{LL}A_T$	15.0822 ft²	Temperature Factor	C_t	1.00 / 0.9 / 0.9	Effective Unbraced Lenth l_e	127.4052 in
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF	Size Factor	C_F	1.00 / 1.00	Slenderness Ratio R_B	17.65 n/a
Floor Trib. Length	1.33 ft	**Self Weight**	1.32 PLF	Flat-use Factor	C_{fu}	1.00	Compressive Stregth Perp to Grain Fc_{perp}	920 psi
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**147.62** PLF	Curvature Factor	C_c	1.00	**ASD Adj. Compr. Stregth** F'_c	616.4 **psi**
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF	Incising Factor	C_i	1.00		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		Repetitive member factor	C_r	1.15		
Roof Tributary Area (A_T)	7.5411 ft²			Bearing Area Factor	C_b	1.00		
Floor Tributary Area (A_T)	0 ft²							

Bearing Contact Area	$A_{bearing}$	2.25 in²		
Max Support Bearing Pressure	P	418.4962 lb	Roof Dead Load	0 lb/ft²
Bearing Stress	f'_c	**186.00** psi	Roof Live Load	0 lb/ft²
Beam Section Modulus	S_{actual}	**7.56** in³		
Actual Cross Sectional Area	A_{actual}	**8.25** in²	Wall Dead Load	0 lb/ft²
Modulus of Elasticity	E	1710000 psi		
Maximum Allowed Deflection	Δ_{max}	**0.189** in	Floor Dead Load	10 lb/ft²
Actual Moment of Inertia	I_{actual}	**20.80** in⁴	Floor Live Load	100 lb/ft²
			Bearing Length, l_u	1.5 in
			Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$	
Wind Force (W)	9.552 **PLF**	See Components & Cladding	

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in³	A_{req} in²	Δ_{actual} in	I_{req} in⁴
D	0.90	0.8202	2375.33	1948.32	178.97	14.62	41.44	41.44	41.44	58.74	0.36	0.35	0.010	1.05
D + L	1.00	0.7740	2639.25	2042.89	198.85	147.62	418.50	418.50	418.50	593.22	**3.48**	**3.16**	**0.097**	**10.62**
D + (Lr or S)	1.25	0.6609	3299.06	2180.33	248.56	14.62	41.44	41.44	41.44	58.74	0.32	0.25	0.010	1.05
D + 0.75L	1.15	0.7044	3035.14	2138.02	228.68	114.37	324.23	324.23	324.23	459.60	2.58	2.13	0.075	8.23
D + (W or 0.7E)	1.60	0.5357	4222.80	2262.27	318.16	24.17	68.52	68.52	68.52	97.13	0.52	0.32	0.016	1.74
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5357	4222.80	2262.27	318.16	121.53	344.54	344.54	344.54	488.39	2.59	1.62	0.079	8.74
0.6D + W	1.60	0.5357	4222.80	2262.27	318.16	18.32	51.94	51.94	51.94	73.63	0.39	0.24	0.012	1.32
0.6D + 0.7E	1.60	0.5357	4222.80	2262.27	318.16	8.77	24.86	24.86	24.86	35.25	0.19	0.12	0.006	0.63

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRA9**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	4.83	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	4.83	ft	**$K_{LL}A_T$**	12.8478	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	6.4239	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V	Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.15					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	2,747	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	57.96	in
	l_u/d	10.538	<7
Effective Unbraced Lenth	l_e	110.9748	in
Slenderness Ratio	R_B	16.47	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	356.49677	lb
Bearing Stress	f'_c	**158.44**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.161**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 PLF	$0.2S_{DS}D$
Wind Force (W)	9.552 PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8688	2375.33	2063.71	178.97	14.62	35.30	35.30	35.30	42.63	0.25	0.30	0.005	0.65
D + L	1.00	0.8330	2639.25	2198.59	198.85	147.62	356.50	356.50	356.50	430.47	**2.35**	**2.69**	**0.051**	**6.57**
D + (Lr or S)	1.25	0.7324	3299.06	2416.34	248.56	14.62	35.30	35.30	35.30	42.63	0.21	0.21	0.005	0.65
D + 0.75L	1.15	0.7732	3035.14	2346.91	228.68	114.37	276.20	276.20	276.20	333.51	1.71	1.81	0.039	5.09
D + (W or 0.7E)	1.60	0.6044	4222.80	2552.13	318.16	24.17	58.37	58.37	58.37	70.48	0.33	0.28	0.008	1.08
D + 0.75L + 0.75(W or 0.7E)	1.60	0.6044	4222.80	2552.13	318.16	121.53	293.50	293.50	293.50	354.40	1.67	1.38	0.042	5.41
0.6D + W	1.60	0.6044	4222.80	2552.13	318.16	18.32	44.25	44.25	44.25	53.43	0.25	0.21	0.006	0.81
0.6D + 0.7E	1.60	0.6044	4222.80	2552.13	318.16	8.77	21.18	21.18	21.18	25.58	0.12	0.10	0.003	0.39

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name: JB1A **Material:** TimberSil Glasswood

Description: *Some Kind of Simply Supported Beam*

Width (b)	1.5 in	**Roof DL**	0.00 PLF				
Depth (d)	7.25 in	**Roof LL (L_r)**	0.00 PLF				
Material Type		**Wall DL**	0.00 PLF				
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	66.50 PLF				
Length	7 ft	**Floor LL (L)**	133.00 PLF				
Unsupported Length	7 ft	**$K_{LL}A_T$**	18.62 ft^2				
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF				
Floor Trib. Length	1.33 ft	**Self Weight**	1.74 PLF				
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**201.24** PLF				
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF				
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2					
Roof Tributary Area (A_T)	9.31 ft^2						
Floor Tributary Area (A_T)	0 ft^2						

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V	Fc_{perp}	E	E_{min}		
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	1,458 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	84 in
	l_u/d	11.586 <7
Effective Unbraced Lenth	l_e	158.67 in
Slenderness Ratio	R_B	22.61 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	2.25 in^2
Max Support Bearing Pressure	P	704.32943 lb
Bearing Stress	f'_c	**313.04** psi
Beam Section Modulus	S_{actual}	**13.14** in^3
Actual Cross Sectional Area	A_{actual}	**10.88** in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.233** in
Actual Moment of Inertia	I_{actual}	**47.63** in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	50 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	1.5 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 PLF	$0.2S_{DS}D$
Wind Force (W)	9.552 PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.5748	2375.33	1365.28	178.97	68.24	238.83	238.83	238.83	417.95	3.67	2.00	0.045	9.24
D + L	1.00	0.5235	2639.25	1381.65	198.85	201.24	704.33	704.33	704.33	1232.58	**10.71**	**5.31**	**0.133**	**27.25**
D + (Lr or S)	1.25	0.4260	3299.06	1405.40	248.56	68.24	238.83	238.83	238.83	417.95	3.57	1.44	0.045	9.24
D + 0.75L	1.15	0.4606	3035.14	1397.87	228.68	167.99	587.95	587.95	587.95	1028.92	8.83	3.86	0.111	22.74
D + (W or 0.7E)	1.60	0.3366	4222.80	1421.48	318.16	77.79	272.26	272.26	272.26	476.46	4.02	1.28	0.052	10.53
D + 0.75L + 0.75(W or 0.7E)	1.60	0.3366	4222.80	1421.48	318.16	175.15	613.03	613.03	613.03	1072.80	9.06	2.89	0.116	23.71
0.6D + W	1.60	0.3366	4222.80	1421.48	318.16	50.49	176.73	176.73	176.73	309.28	2.61	0.83	0.033	6.84
0.6D + 0.7E	1.60	0.3366	4222.80	1421.48	318.16	40.94	143.30	143.30	143.30	250.77	2.12	0.68	0.027	5.54

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JB1B**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	66.50	PLF
Length	4.25	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	4.25	ft	**$K_{LL}A_T$**	11.305	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.74	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**201.24**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	5.6525	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	2,205	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	51	in
	l_u/d	7.034	<7
Effective Unbraced Lenth	l_e	104.88	in
Slenderness Ratio	R_B	18.38	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	427.62858	lb
Bearing Stress	f'_c	**190.06**	psi
Beam Section Modulus	S_{actual}	**13.14**	in^3
Actual Cross Sectional Area	A_{actual}	**10.88**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.142**	in
Actual Moment of Inertia	I_{actual}	**47.63**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	50	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	9.552	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.7850	2375.33	1864.65	178.97	68.24	145.00	145.00	145.00	154.07	0.99	1.22	0.006	2.07
D + L	1.00	0.7341	2639.25	1937.57	198.85	201.24	427.63	427.63	427.63	454.36	**2.81**	**3.23**	**0.018**	**6.10**
D + (Lr or S)	1.25	0.6183	3299.06	2039.86	248.56	68.24	145.00	145.00	145.00	154.07	0.91	0.88	0.006	2.07
D + 0.75L	1.15	0.6618	3035.14	2008.58	228.68	167.99	356.97	356.97	356.97	379.28	2.27	2.34	0.015	5.09
D + (W or 0.7E)	1.60	0.4975	4222.80	2101.05	318.16	77.79	165.30	165.30	165.30	175.63	1.00	0.78	0.007	2.36
D + 0.75L + 0.75(W or 0.7E)	1.60	0.4975	4222.80	2101.05	318.16	175.15	372.20	372.20	372.20	395.46	2.26	1.75	0.016	5.31
0.6D + W	1.60	0.4975	4222.80	2101.05	318.16	50.49	107.30	107.30	107.30	114.01	0.65	0.51	0.005	1.53
0.6D + 0.7E	1.60	0.4975	4222.80	2101.05	318.16	40.94	87.00	87.00	87.00	92.44	0.53	0.41	0.004	1.24

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	JB2	**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in	**Roof DL**	0.00	PLF
Depth (d)	5.5 in	**Roof LL (L_r)**	0.00	PLF
Material Type		**Wall DL**	0.00	PLF
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	5.42 ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	5.42 ft	$K_{LL}A_T$	14.4172	ft^2
Roof Trib. Length	0 ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33 ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	7.2086 ft^2			
Floor Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	2,488	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	65.04	in
	l_u/d	11.825	<7
Effective Unbraced Lenth	l_e	122.5152	in
Slenderness Ratio	R_B	17.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	400.04399	lb
Bearing Stress	f'_c	**177.80**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.181**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$		
Wind Force (W)	9.552 **PLF**	See Components & Cladding		
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	W (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8355	2375.33	1984.49	178.97	14.62	39.61	39.61	39.61	53.68	0.32	0.33	0.008	0.92
D + L	1.00	0.7920	2639.25	2090.31	198.85	147.62	400.04	400.04	400.04	542.06	3.11	3.02	0.081	9.28
D + (Lr or S)	1.25	0.6814	3299.06	2247.93	248.56	14.62	39.61	39.61	39.61	53.68	0.29	0.24	0.008	0.92
D + 0.75L	1.15	0.7245	3035.14	2199.08	228.68	114.37	309.94	309.94	309.94	419.96	2.29	2.03	0.062	7.19
D + (W or 0.7E)	1.60	0.5547	4222.80	2342.40	318.16	24.17	65.50	65.50	65.50	88.75	0.45	0.31	0.013	1.52
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5547	4222.80	2342.40	318.16	121.53	329.35	329.35	329.35	446.27	2.29	1.55	0.066	7.64
0.6D + W	1.60	0.5547	4222.80	2342.40	318.16	18.32	49.65	49.65	49.65	67.28	0.34	0.23	0.010	1.15
0.6D + 0.7E	1.60	0.5547	4222.80	2342.40	318.16	8.77	23.77	23.77	23.77	32.21	0.16	0.11	0.005	0.55

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JB3, JB4**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	5.42	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	5.42	ft	$K_{LL}A_T$	14.4172	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	7.2086	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi					
Horizontal shear parallel to grain	F_V	205 psi					
		F_b	F_V		Fc_{perp}	E	E_{min}
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9 / 0.9
		E	E_{min}				
Temperature Factor	C_t	1.00	0.9	0.9			
Size Factor	C_F	1.00	1.00				
Flat-use Factor	C_{fu}	1.00					
Curvature Factor	C_c	1.00					
Incising Factor	C_i	1.00					
Repetitive member factor	C_r	1.15					
Bearing Area Factor	C_b	1.00					

Euler-based ASD critical buckling value for bending	F_{bE}	2,488	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	65.04	in
	l_u/d	11.825	<7
Effective Unbraced Lenth	l_e	122.5152	in
Slenderness Ratio	R_B	17.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	400.04399	lb
Bearing Stress	f'_c	**177.80**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.181**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$
Wind Force (W)	9.552	**PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8355	2375.33	1984.49	178.97	14.62	39.61	39.61	39.61	53.68	0.32	0.33	0.008	0.92
D + L	1.00	0.7920	2639.25	2090.31	198.85	147.62	400.04	400.04	400.04	542.06	3.11	3.02	0.081	9.28
D + (Lr or S)	1.25	0.6814	3299.06	2247.93	248.56	14.62	39.61	39.61	39.61	53.68	0.29	0.24	0.008	0.92
D + 0.75L	1.15	0.7245	3035.14	2199.08	228.68	114.37	309.94	309.94	309.94	419.96	2.29	2.03	0.062	7.19
D + (W or 0.7E)	1.60	0.5547	4222.80	2342.40	318.16	24.17	65.50	65.50	65.50	88.75	0.45	0.31	0.013	1.52
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5547	4222.80	2342.40	318.16	121.53	329.35	329.35	329.35	446.27	2.29	1.55	0.066	7.64
0.6D + W	1.60	0.5547	4222.80	2342.40	318.16	18.32	49.65	49.65	49.65	67.28	0.34	0.23	0.010	1.15
0.6D + 0.7E	1.60	0.5547	4222.80	2342.40	318.16	8.77	23.77	23.77	23.77	32.21	0.16	0.11	0.005	0.55

UNLV Solar Decathlon Sawn Lumber Overhanging Joist Design

Entry Fields

Header Name:	**B5**		**Material:**	TimberSil Glasswood															
Description:	*Some Kind of Simply Supported Beam*																		
Width (b)	1.5	in	**Roof DL**	0.00	PLF	Actual Flexural Stress	F_b	2500	psi							Euler-based ASD critical buckling value for benc	F_{bE}	1,458	psi
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF	orizontal shear parallel to gra	F_V	205	psi							Modulus of Elasticity	E_{min}	690000	psi
Material Type			**Wall DL**	0.00	PLF			F_b	F_V	Fc_{perp}	E	E_{min}				Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF	Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9			Unbraced Length	l_u	84	in
Total Length	9.08	ft	**Floor LL (L)**	133.00	PLF			E	E_{min}								l_u/d	11.586	<7
Unsupported Length (l)	6.83	ft	$K_{LL}A_T$	24.1528	ft^2	Temperature Factor	C_t	1.00	0.9	0.9						Effective Unbraced Lenth	l_e	158.67	in
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF	Size Factor	C_F	1.00	1.00							Slenderness Ratio	R_B	22.61	n/a
x	3.415	ft	**Self Weight**	1.74	PLF	Flat-use Factor	C_{fu}	1.00								Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
x_1	2.25	ft	**TOTAL LOAD**	**148.04**	PLF	Curvature Factor	C_c	1.00								**ASD Adj. Compr. Stregth**	**F'_c**	616.4	**psi**
Roof Trib. Length	0	ft	**L_r Reduc.**	0	PLF	Incising Factor	C_i	1.00											
Floor Trib. Length	1.33	ft	ASCE 7-05 Table 4-2			Repetitive member factor	C_r	1.15											
Top of Header to Edge of Roof	0	ft				Bearing Area Factor	C_b	1.00											
Sandwich Header?	No	Yes/No																	
Live Load Element Factor	2	K_{LL}																	
Floor Tributary Area (A_T)	12.0764	ft^2																	
Roof Tributary Area (A_T)	0	ft^2																	
Point Load	200.00	lb																	
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$																
Wind Force (W)	9.552	**PLF**	See Components & Cladding																

Bearing Contact Area	$A_{bearing}$	4.5	in^2	Roof Dead Load	0	lb/ft^2													
Max Support Bearing Pressure	P	1093.4931	lb	Roof Live Load	0	lb/ft^2													
Bearing Stress	**f'_c**	**243.00**	psi																
Beam Section Modulus	**S_{actual}**	**13.14**	**in^3**	Wall Dead Load	0	lb/ft^2													
Actual Cross Sectional Area	**A_{actual}**	**10.88**	**in^2**																
Modulus of Elasticity	E	1710000	psi	Floor Dead Load	10	lb/ft^2													
Maximum Allowed Deflection	Δ_{max}	0.303	in	Floor Live Load	100	lb/ft^2													
Actual Moment of Inertia	I_{actual}	47.63	in^4	*Bearing Length, l_u*	3	in													

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	***Reactions***								
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	**w** (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4	
D	0.90	0.6139	2199.38	1350.20	178.97	15.04	111.66	290.76	290.757	488.06	4.34	2.44	0.061	10.23	
D + L	1.00	0.5607	2443.75	1370.12	198.85	148.04	516.57	1093.49	1093.49	824.72	**7.22**	**8.25**	**0.094**	**10.36**	
D + (Lr or S)	1.25	0.4578	3054.69	1398.50	248.56	15.04	111.66	290.76	290.757	488.06	4.19	1.75	0.061	10.23	
D + 0.75L	1.15	0.4945	2810.31	1389.59	228.68	114.79	415.34	892.81	892.809	740.55	6.40	5.86	0.080	10.23	
D + (W or 0.7E)	1.60	0.3625	3910.00	1417.26	318.16	24.59	140.74	348.41	348.41	512.24	4.34	1.64	0.058	10.23	
D + 0.75L + 0.75(W or 0.7E)	1.60	0.3625	3910.00	1417.26	318.16	121.95	437.15	936.05	936.049	758.69	6.42	4.41	0.083	10.23	
0.6D + W	1.60	0.3625	3910.00	1417.26	318.16	18.57	122.43	312.11	312.107	497.02	4.21	1.47	0.060	10.23	
0.6D + 0.7E	1.60	0.3625	3910.00	1417.26	318.16	9.02	93.35	254.45	254.454	472.84	4.00	1.20	0.062	10.23	

UNLV Solar Decathlon Sawn Lumber Overhanging Joist Design

Entry Fields

Header Name:	**B6 Joist**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	3.5	in	**Roof DL**	0.00	PLF
Depth (d)	7.25	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	20.00	PLF
Total Length	8.33	ft	**Floor LL (L)**	200.00	PLF
Unsupported Length (l)	6.08	ft	$K_{LL}A_T$	33.32	ft^2
Overhang Length (a)	2.25	ft	**LL Reduc.**	0	PLF
x	3.04	ft	**Self Weight**	4.05	PLF
x_1	2.25	ft	**TOTAL LOAD**	**224.05**	PLF
Roof Trib. Length	0	ft	L_r **Reduc.**	0	PLF
Floor Trib. Length	2	ft	ASCE 7-05 Table 4-2		
Top of Header to Edge of Roof	0	ft			
Sandwich Header?	No	Yes/No			
Live Load Element Factor	2	K_{LL}			
Floor Tributary Area (A_T)	16.66	ft^2			
Roof Tributary Area (A_T)	0	ft^2			
Point Load	800.00	lb			
Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	0.000	**PLF**	See Components & Cladding		

FACTORS

Actual Flexural Stress	F_b	2500 psi						
orizontal shear parallel to gra	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.00						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bend	F_{bE}	38,202	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	16	in
	l_u/d	2.207	<7
Effective Unbraced Lenth	l_e	32.96	in
Slenderness Ratio	R_B	4.42	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	10.5	in^2
Max Support Bearing Pressure	P	2078.5187	lb
Bearing Stress	f'_c	197.95	psi
Beam Section Modulus	S_{actual}	30.66	in^3
Actual Cross Sectional Area	A_{actual}	25.38	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	0.278	in
Actual Moment of Inertia	I_{actual}	111.15	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	3	in

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	Reactions R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9974	1912.50	1907.49	178.97	24.05	359.16	937.25	937.254	1860.88	11.71	7.86	0.101	40.93
D + L	1.00	0.9971	2125.00	2118.78	198.85	224.05	883.89	2078.52	2078.52	2367.13	13.41	15.68	0.089	40.93
D + (Lr or S)	1.25	0.9963	2656.25	2646.40	248.56	24.05	359.16	937.25	937.254	1860.88	8.44	5.66	0.101	40.93
D + 0.75L	1.15	0.9966	2443.75	2435.46	228.68	174.05	752.71	1793.20	1793.2	2240.57	11.04	11.76	0.092	40.93
D + (W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	24.05	359.16	937.25	937.254	1860.88	6.60	4.42	0.101	40.93
D + 0.75L + 0.75(W or 0.7E)	1.60	0.9952	3400.00	3383.56	318.16	174.05	752.71	1793.20	1793.2	2240.57	7.95	8.45	0.092	40.93
0.6D + W	1.60	0.9952	3400.00	3383.56	318.16	14.43	333.92	882.35	882.352	1836.53	6.51	4.16	0.101	40.93
0.6D + 0.7E	1.60	0.9952	3400.00	3383.56	318.16	14.43	333.92	882.35	882.352	1836.53	6.51	4.16	0.101	40.93

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	JB6		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	3.08	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	3.08	ft	**$K_{LL}A_T$**	8.1928	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	4.0964	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	4,004	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	36.96	in
	l_u/d	6.720	<7
Effective Unbraced Lenth	l_e	76.1376	in
Slenderness Ratio	R_B	13.64	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	227.33127	lb
Bearing Stress	f'_c	**101.04**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.103**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	**PLF**	$0.2S_{DS}D$		
Wind Force (W)	9.552	**PLF**	See Components & Cladding		
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)	
Point Load	0	0	0	0	

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.9406	2375.33	2234.28	178.97	14.62	22.51	22.51	22.51	17.33	0.09	0.19	0.001	0.17
D + L	1.00	0.9271	2639.25	2446.97	198.85	147.62	227.33	227.33	227.33	175.05	**0.86**	**1.71**	**0.008**	**1.70**
D + (Lr or S)	1.25	0.8824	3299.06	2911.26	248.56	14.62	22.51	22.51	22.51	17.33	0.07	0.14	0.001	0.17
D + 0.75L	1.15	0.9023	3035.14	2738.73	228.68	114.37	176.13	176.13	176.13	135.62	0.59	1.16	0.007	1.32
D + (W or 0.7E)	1.60	0.7945	4222.80	3355.21	318.16	24.17	37.22	37.22	37.22	28.66	0.10	0.18	0.001	0.28
D + 0.75L + 0.75(W or 0.7E)	1.60	0.7945	4222.80	3355.21	318.16	121.53	187.16	187.16	187.16	144.11	0.52	0.88	0.007	1.40
0.6D + W	1.60	0.7945	4222.80	3355.21	318.16	18.32	28.22	28.22	28.22	21.73	0.08	0.13	0.001	0.21
0.6D + 0.7E	1.60	0.7945	4222.80	3355.21	318.16	8.77	13.51	13.51	13.51	10.40	0.04	0.06	0.000	0.10

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRB6,JRB7**		**Material:**	TimberSil Glasswood
Description:	*Some Kind of Simply Supported Beam*			
Width (b)	1.5 in		**Roof DL**	0.00 PLF
Depth (d)	5.5 in		**Roof LL (L_r)**	0.00 PLF
Material Type			**Wall DL**	0.00 PLF
Unit Weight	23 Lbs/Cu. Ft.		**Floor DL**	13.30 PLF
Length	5.58 ft		**Floor LL (L)**	133.00 PLF
Unsupported Length	5.58 ft		**$K_{LL}A_T$**	14.8428 ft^2
Roof Trib. Length	0 ft		**LL Reduc.**	0 PLF
Floor Trib. Length	1.33 ft		**Self Weight**	1.32 PLF
Top of Header to Edge of Roof	0 ft		**TOTAL LOAD**	**147.62** PLF
Sandwich Header?	No Yes/No		**L_r Reduc.**	0 PLF
Live Load Element Factor	2 K_{LL}		ASCE 7-05 Table 4-2	
Roof Tributary Area (A_T)	7.4214 ft^2			
Floor Tributary Area (A_T)	0 ft^2			

FACTORS

Actual Flexural Stress	F_b	2700 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85	0.97	0.67	0.9	0.9	
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	2,426 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	66.96 in
	l_u/d	12.175 <7
Effective Unbraced Lenth	l_e	125.6448 in
Slenderness Ratio	R_B	17.53 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	2.25 in^2
Max Support Bearing Pressure	P	411.85341 lb
Bearing Stress	f'_c	**183.05** psi
Beam Section Modulus	S_{actual}	**7.56** in^3
Actual Cross Sectional Area	A_{actual}	**8.25** in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.186** in
Actual Moment of Inertia	I_{actual}	**20.80** in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	1.5 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$
Wind Force (W)	9.552 **PLF**	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load w (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8258	2375.33	1961.48	178.97	14.62	40.78	40.78	40.78	56.89	0.35	0.34	0.009	1.00
D + L	1.00	0.7805	2639.25	2060.01	198.85	147.62	411.85	411.85	411.85	574.54	**3.35**	**3.11**	**0.091**	**10.12**
D + (Lr or S)	1.25	0.6682	3299.06	2204.37	248.56	14.62	40.78	40.78	40.78	56.89	0.31	0.25	0.009	1.00
D + 0.75L	1.15	0.7116	3035.14	2159.84	228.68	114.37	319.09	319.09	319.09	445.12	2.47	2.09	0.070	7.84
D + (W or 0.7E)	1.60	0.5424	4222.80	2290.55	318.16	24.17	67.43	67.43	67.43	94.07	0.49	0.32	0.015	1.66
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5424	4222.80	2290.55	318.16	121.53	339.07	339.07	339.07	473.01	2.48	1.60	0.075	8.33
0.6D + W	1.60	0.5424	4222.80	2290.55	318.16	18.32	51.12	51.12	51.12	71.31	0.37	0.24	0.011	1.26
0.6D + 0.7E	1.60	0.5424	4222.80	2290.55	318.16	8.77	24.47	24.47	24.47	34.14	0.18	0.12	0.005	0.60

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRB8**		**Material:**	TimberSil Glasswood	
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5	in	**Roof DL**	0.00	PLF
Depth (d)	5.5	in	**Roof LL (L_r)**	0.00	PLF
Material Type			**Wall DL**	0.00	PLF
Unit Weight	23	Lbs/Cu. Ft.	**Floor DL**	13.30	PLF
Length	6.17	ft	**Floor LL (L)**	133.00	PLF
Unsupported Length	6.17	ft	**$K_{LL}A_T$**	16.4122	ft^2
Roof Trib. Length	0	ft	**LL Reduc.**	0	PLF
Floor Trib. Length	1.33	ft	**Self Weight**	1.32	PLF
Top of Header to Edge of Roof	0	ft	**TOTAL LOAD**	**147.62**	PLF
Sandwich Header?	No	Yes/No	**L_r Reduc.**	0	PLF
Live Load Element Factor	2	K_{LL}	ASCE 7-05 Table 4-2		
Roof Tributary Area (A_T)	8.2061	ft^2			
Floor Tributary Area (A_T)	0	ft^2			

FACTORS

Actual Flexural Stress	F_b	2500 psi						
Horizontal shear parallel to grain	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E		E_{min}
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9		0.9			
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bending	F_{bE}	2,222	psi
Modulus of Elasticity	E_{min}	690000	psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000	psi
Unbraced Length	l_u	74.04	in
	l_u/d	13.462	<7
Effective Unbraced Lenth	l_e	137.1852	in
Slenderness Ratio	R_B	18.31	n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920	psi
ASD Adj. Compr. Stregth	F'_c	616.4	**psi**

Bearing Contact Area	$A_{bearing}$	2.25	in^2
Max Support Bearing Pressure	P	455.40063	lb
Bearing Stress	f'_c	**202.40**	psi
Beam Section Modulus	S_{actual}	**7.56**	in^3
Actual Cross Sectional Area	A_{actual}	**8.25**	in^2
Modulus of Elasticity	E	1710000	psi
Maximum Allowed Deflection	Δ_{max}	**0.206**	in
Actual Moment of Inertia	I_{actual}	**20.80**	in^4

Roof Dead Load	0	lb/ft^2
Roof Live Load	0	lb/ft^2
Wall Dead Load	0	lb/ft^2
Floor Dead Load	10	lb/ft^2
Floor Live Load	100	lb/ft^2
Bearing Length, l_u	1.5	in
Bearing Distance from end of member	0	in

Seismic Force (0.7E)	0.000	PLF	$0.2S_{DS}D$
Wind Force (W)	9.552	PLF	See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Dist Load *Reactions*

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8214	2199.38	1806.65	178.97	14.62	45.10	45.10	45.10	69.56	0.46	0.38	0.013	1.36
D + L	1.00	0.7754	2443.75	1895.01	198.85	147.62	455.40	455.40	455.40	702.46	4.45	3.44	0.135	13.69
D + (Lr or S)	1.25	0.6625	3054.69	2023.63	248.56	14.62	45.10	45.10	45.10	69.56	0.41	0.27	0.013	1.36
D + 0.75L	1.15	0.7060	2810.31	1984.02	228.68	114.37	352.82	352.82	352.82	544.23	3.29	2.31	0.105	10.60
D + (W or 0.7E)	1.60	0.5372	3910.00	2100.33	318.16	24.17	74.56	74.56	74.56	115.01	0.66	0.35	0.022	2.24
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5372	3910.00	2100.33	318.16	121.53	374.93	374.93	374.93	578.32	3.30	1.77	0.111	11.27
0.6D + W	1.60	0.5372	3910.00	2100.33	318.16	18.32	56.53	56.53	56.53	87.19	0.50	0.27	0.017	1.70
0.6D + 0.7E	1.60	0.5372	3910.00	2100.33	318.16	8.77	27.06	27.06	27.06	41.74	0.24	0.13	0.008	0.81

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRB9**	**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	5.5 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	13.30 PLF		
Length	5.58 ft	**Floor LL (L)**	133.00 PLF		
Unsupported Length	5.58 ft	**$K_{LL}A_T$**	14.8428 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	1.33 ft	**Self Weight**	1.32 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**147.62** PLF		
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2			
Roof Tributary Area (A_T)	7.4214 ft^2				
Floor Tributary Area (A_T)	0 ft^2				

FACTORS

Actual Flexural Stress	F_b	2500 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	2,426 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	66.96 in
	l_u/d	12.175 <7
Effective Unbraced Lenth	l_e	125.6448 in
Slenderness Ratio	R_B	17.53 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	2.25 in^2
Max Support Bearing Pressure	P	411.85341 lb
Bearing Stress	f'_c	**183.05** psi
Beam Section Modulus	S_{actual}	**7.56** in^3
Actual Cross Sectional Area	A_{actual}	**8.25** in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.186** in
Actual Moment of Inertia	I_{actual}	**20.80** in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	1.5 in
Bearing Distance from end of member	0 in

Seismic Force (0.7E)	0.000 **PLF** $0.2S_{DS}D$
Wind Force (W)	9.552 **PLF** See Components & Cladding

	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)
Point Load	0	0	0	0

Load Cases	Load Dur. Factor C_D	Stability Factor C_L	Ref/ ASD Bending Value F^*_{bx} (psi)	ASD Adj. Flexural Stress F'_b (psi)	ASD Adj. Horiz. shear parallel F'_V (psi)	Dist Load **w** (PLF)	*Reactions* R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8538	2199.38	1877.88	178.97	14.62	40.78	40.78	40.78	56.89	0.36	0.34	0.009	1.00
D + L	1.00	0.8143	2443.75	1989.98	198.85	147.62	411.85	411.85	411.85	574.54	**3.46**	**3.11**	**0.091**	**10.12**
D + (Lr or S)	1.25	0.7083	3054.69	2163.64	248.56	14.62	40.78	40.78	40.78	56.89	0.32	0.25	0.009	1.00
D + 0.75L	1.15	0.7505	2810.31	2109.12	228.68	114.37	319.09	319.09	319.09	445.12	2.53	2.09	0.070	7.84
D + (W or 0.7E)	1.60	0.5804	3910.00	2269.37	318.16	24.17	67.43	67.43	67.43	94.07	0.50	0.32	0.015	1.66
D + 0.75L + 0.75(W or 0.7E)	1.60	0.5804	3910.00	2269.37	318.16	121.53	339.07	339.07	339.07	473.01	2.50	1.60	0.075	8.33
0.6D + W	1.60	0.5804	3910.00	2269.37	318.16	18.32	51.12	51.12	51.12	71.31	0.38	0.24	0.011	1.26
0.6D + 0.7E	1.60	0.5804	3910.00	2269.37	318.16	8.77	24.47	24.47	24.47	34.14	0.18	0.12	0.005	0.60

UNLV Solar Decathlon Sawn Lumber Simply Supported Joist Design

Entry Fields

Joist Name:	**JRB10**	**Material:**	TimberSil Glasswood		
Description:	*Some Kind of Simply Supported Beam*				
Width (b)	1.5 in	**Roof DL**	0.00 PLF		
Depth (d)	5.5 in	**Roof LL (L_r)**	0.00 PLF		
Material Type		**Wall DL**	0.00 PLF		
Unit Weight	23 Lbs/Cu. Ft.	**Floor DL**	13.30 PLF		
Length	4.83 ft	**Floor LL (L)**	133.00 PLF		
Unsupported Length	4.83 ft	**$K_{LL}A_T$**	12.8478 ft^2		
Roof Trib. Length	0 ft	**LL Reduc.**	0 PLF		
Floor Trib. Length	1.33 ft	**Self Weight**	1.32 PLF		
Top of Header to Edge of Roof	0 ft	**TOTAL LOAD**	**147.62** PLF		
Sandwich Header?	No Yes/No	**L_r Reduc.**	0 PLF		
Live Load Element Factor	2 K_{LL}	ASCE 7-05 Table 4-2			
Roof Tributary Area (A_T)	6.4239 ft^2				
Floor Tributary Area (A_T)	0 ft^2				
Seismic Force (0.7E)	0.000 **PLF**	$0.2S_{DS}D$			
Wind Force (W)	9.552 **PLF**	See Components & Cladding			
	P_1 (lbs)	x_1 (ft)	P_2 (lbs)	x_2 (ft)	
Point Load	0	**0**	**0**	0	

FACTORS

Actual Flexural Stress	F_b	2500 psi						
rizontal shear parallel to gr	F_V	205 psi						
		F_b	F_V		Fc_{perp}	E	E_{min}	
Wet-Service Factor	C_M	1.00	0.85		0.97	0.67	0.9	0.9
		E	E_{min}					
Temperature Factor	C_t	1.00	0.9	0.9				
Size Factor	C_F	1.00	1.00					
Flat-use Factor	C_{fu}	1.00						
Curvature Factor	C_c	1.00						
Incising Factor	C_i	1.00						
Repetitive member factor	C_r	1.15						
Bearing Area Factor	C_b	1.00						

Euler-based ASD critical buckling value for bendi	F_{bE}	2,747 psi
Modulus of Elasticity	E_{min}	690000 psi
Adjusted ASD Mod. Of Elasticity	E'_{min}	621000 psi
Unbraced Length	l_u	57.96 in
	l_u/d	10.538 <7
Effective Unbraced Lenth	l_e	110.9748 in
Slenderness Ratio	R_B	16.47 n/a
Compressive Stregth Perp to Grain	Fc_{perp}	920 psi
ASD Adj. Compr. Stregth	F'_c	616.4 **psi**

Bearing Contact Area	$A_{bearing}$	2.25 in^2
Max Support Bearing Pressure	P	356.49677 lb
Bearing Stress	f'_c	**158.44** psi
Beam Section Modulus	S_{actual}	**7.56** in^3
Actual Cross Sectional Area	A_{actual}	**8.25** in^2
Modulus of Elasticity	E	1710000 psi
Maximum Allowed Deflection	Δ_{max}	**0.161** in
Actual Moment of Inertia	I_{actual}	**20.80** in^4

Roof Dead Load	0 lb/ft^2
Roof Live Load	0 lb/ft^2
Wall Dead Load	0 lb/ft^2
Floor Dead Load	10 lb/ft^2
Floor Live Load	100 lb/ft^2
Bearing Length, l_u	1.5 in
Bearing Distance from end of member	0 in

	Load Dur. Factor	Stability Factor	Ref/ ASD Bending Value	ASD Adj. Flexural Stress	ASD Adj. Horiz. shear parallel	Dist Load	*Reactions*							
Load Cases	C_D	C_L	F^*_{bx} (psi)	F'_b (psi)	F'_V (psi)	w (PLF)	R_1 (lbs)	R_2 (lbs)	V_{max} (lbs)	M_{max} (lb-ft)	S_{req} in^3	A_{req} in^2	Δ_{actual} in	I_{req} in^4
D	0.90	0.8898	2199.38	1957.00	178.97	14.62	35.30	35.30	35.30	42.63	0.26	0.30	0.005	0.65
D + L	1.00	0.8600	2443.75	2101.61	198.85	147.62	356.50	356.50	356.50	430.47	**2.46**	**2.69**	**0.051**	**6.57**
D + (Lr or S)	1.25	0.7702	3054.69	2352.76	248.56	14.62	35.30	35.30	35.30	42.63	0.22	0.21	0.005	0.65
D + 0.75L	1.15	0.8078	2810.31	2270.09	228.68	114.37	276.20	276.20	276.20	333.51	1.76	1.81	0.039	5.09
D + (W or 0.7E)	1.60	0.6442	3910.00	2518.98	318.16	24.17	58.37	58.37	58.37	70.48	0.34	0.28	0.008	1.08
D + 0.75L + 0.75(W or 0.7E)	1.60	0.6442	3910.00	2518.98	318.16	121.53	293.50	293.50	293.50	354.40	1.69	1.38	0.042	5.41
0.6D + W	1.60	0.6442	3910.00	2518.98	318.16	18.32	44.25	44.25	44.25	53.43	0.25	0.21	0.006	0.81
0.6D + 0.7E	1.60	0.6442	3910.00	2518.98	318.16	8.77	21.18	21.18	21.18	25.58	0.12	0.10	0.003	0.39

WOOD STUD WALL: 9' WALL

STUD LENGTH (FT): 9
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_e/d: 19.6

Building: Module B

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_{pi} (+/-):	0.18
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	1.1
EDGE GC_p:	1.4
INT. ZONE LOAD (PSF):	19.2
EDGE LOAD (PSF):	23.7
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_e:	1
S_{ds}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.236	458	0.291	371
EQ-8	0.177	611	0.218	495

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	10	8
(2) 2 X 6	34	26
(3) 2 X 6	52	42
(4) 2 X 6	70	56
4 x 4	8	6
6 x 4	14	10
8 x 4	20	16

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending								Max <1	
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi		
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1701	186	2549	0	2549	0	257	0	257	0	0.012	0.012
EQ-2	D + L	1.00	1770	186	2726	0	2726	0	285	0	285	0	0.011	0.011
EQ-3	D + S	1.15	1845	186	2925	0	2925	0	328	0	328	0	0.010	0.010
EQ-4	D + Lr	1.25	1881	277	3020	0	3020	0	356	0	356	0	0.022	0.022
EQ-5	D + 0.75(L + S)	1.15	1845	186	2925	0	2925	0	328	0	328	0	0.010	0.010
EQ-6	D + 0.75(L + Lr)	1.25	1881	254	3020	0	3020	0	356	0	356	0	0.018	0.018
EQ-7	D + (W or 0.7E)	1.60	1961	219	3207	1466	3207	1810	456	75	456	92	0.522	0.641
EQ-8	D + 0.75[L + (W or E) + (Lr or S)]	1.60	1961	279	3207	1100	3207	1357	456	56	456	69	0.415	0.507

WOOD STUD WALL: 10.5' WALL

STUD LENGTH (FT): 10.5
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_e/d: 22.9

Building: Module B

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_{pi} (+/-):	0.18
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	1.1
EDGE GC_p:	1.4
INT. ZONE LOAD (PSF):	19.2
EDGE LOAD (PSF):	23.7
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_e:	1
S_{DS}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.182	693	0.225	561
EQ-8	0.136	924	0.168	748

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	6	4
(2) 2 X 6	20	16
(3) 2 X 6	32	26
(4) 2 X 6	44	34
4 x 4	4	2
6 x 4	8	6
8 x 4	12	8

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending									
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	Max <1	
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1376	87	1994	0	1994	0	257	0	257	0	0.004	0.004
EQ-2	D + L	1.00	1406	87	2038	0	2038	0	285	0	285	0	0.004	0.004
EQ-3	D + S	1.15	1437	87	2080	0	2080	0	328	0	328	0	0.004	0.004
EQ-4	D + Lr	1.25	1452	125	2099	0	2099	0	356	0	356	0	0.007	0.007
EQ-5	D + 0.75(L + S)	1.15	1437	87	2080	0	2080	0	328	0	328	0	0.004	0.004
EQ-6	D + 0.75(L + Lr)	1.25	1452	116	2099	0	2099	0	356	0	356	0	0.006	0.006
EQ-7	D + (W or 0.7E)	1.60	1485	101	2137	840	2137	1037	456	37	456	45	0.425	0.523
EQ-8	D + 0.75[L + (W or E) + (Lr or S)]	1.60	1485	126	2137	630	2137	777	456	27	456	34	0.328	0.403

WOOD STUD WALL: 12' WALL

STUD LENGTH (FT): 12
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_o/d: 26.2

Building: Module B

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_{pi} (+/-):	0.18
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	1.1
EDGE GC_p:	1.4
INT. ZONE LOAD (PSF):	19.2
EDGE LOAD (PSF):	23.7
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_E:	1
S_{DS}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.308	467	0.381	378
EQ-8	0.231	623	0.285	505

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	2	2
(2) 2 X 6	12	10
(3) 2 X 6	20	16
(4) 2 X 6	28	22
4 x 4	2	0
6 x 4	4	2
8 x 4	6	4

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending								Max <1	
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi		
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1103	95	1805	0	1805	0	257	0	257	0	0.007	0.007
EQ-2	D+L	1.00	1117	95	1833	0	1833	0	285	0	285	0	0.007	0.007
EQ-3	D+S	1.15	1132	95	1860	0	1860	0	328	0	328	0	0.007	0.007
EQ-4	D+Lr	1.25	1139	134	1873	0	1873	0	356	0	356	0	0.014	0.014
EQ-5	D+0.75(L+S)	1.15	1132	95	1860	0	1860	0	328	0	328	0	0.007	0.007
EQ-6	D+0.75(L+Lr)	1.25	1139	124	1873	0	1873	0	356	0	356	0	0.012	0.012
EQ-7	D+(W or 0.7E)	1.60	1156	109	1899	1097	1899	1354	456	42	456	52	0.644	0.793
EQ-8	D+0.75[L+(W or E)+(Lr or S)]	1.60	1156	135	1899	823	1899	1015	456	31	456	39	0.502	0.616

WOOD STUD WALL: 9' WALL

STUD LENGTH (FT): 9
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_e/d: 19.6

Building: Module A

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_p (+/-):	0.55
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	-1.1
EDGE GC_p:	-1.4
INT. ZONE LOAD (PSF):	24.717
EDGE LOAD (PSF):	29.211
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_E:	1
S_{DS}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.128	846	0.151	716
EQ-8	0.096	1128	0.113	954

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	8	6
(2) 2 X 6	18	16
(3) 2 X 6	30	24
(4) 2 X 6	40	34
4 x 4	6	4
6 x 4	10	8
8 x 4	14	12

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending								Max <1	
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi		
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1701	78	2203	0	2203	0	257	0	257	0	0.002	0.002
EQ-2	D + L	1.00	1770	78	2276	0	2276	0	285	0	285	0	0.002	0.002
EQ-3	D + S	1.15	1845	78	2347	0	2347	0	328	0	328	0	0.002	0.002
EQ-4	D + Lr	1.25	1881	117	2378	0	2378	0	356	0	356	0	0.004	0.004
EQ-5	D + 0.75(L + S)	1.15	1845	78	2347	0	2347	0	328	0	328	0	0.002	0.002
EQ-6	D + 0.75(L + Lr)	1.25	1881	107	2378	0	2378	0	356	0	356	0	0.003	0.003
EQ-7	D + (W or 0.7E)	1.60	1961	92	2440	794	2440	939	456	40	456	48	0.342	0.404
EQ-8	D + 0.75[L + (W or E) + (Lr or S)]	1.60	1961	117	2440	596	2440	704	456	30	456	36	0.262	0.309

WOOD STUD WALL: 10.5' WALL

STUD LENGTH (FT): 10.5
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_e/d: 22.9

Building: Module A

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_{pi} (+/-):	0.55
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	-1.1
EDGE GC_p:	-1.4
INT. ZONE LOAD (PSF):	24.717
EDGE LOAD (PSF):	29.211
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_E:	1
S_{DS}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.234	538	0.277	455
EQ-8	0.176	717	0.208	607

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	4	2
(2) 2 X 6	10	8
(3) 2 X 6	18	14
(4) 2 X 6	24	20
4 x 4	2	2
6 x 4	6	4
8 x 4	8	6

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending								Max <1	
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi		
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1376	87	1994	0	1994	0	257	0	257	0	0.004	0.004
EQ-2	D+L	1.00	1406	87	2038	0	2038	0	285	0	285	0	0.004	0.004
EQ-3	D+S	1.15	1437	87	2080	0	2080	0	328	0	328	0	0.004	0.004
EQ-4	D+Lr	1.25	1452	125	2099	0	2099	0	356	0	356	0	0.007	0.007
EQ-5	D+0.75(L+S)	1.15	1437	87	2080	0	2080	0	328	0	328	0	0.004	0.004
EQ-6	D+0.75(L+Lr)	1.25	1452	116	2099	0	2099	0	356	0	356	0	0.006	0.006
EQ-7	D+(W or 0.7E)	1.60	1485	101	2137	1081	2137	1278	456	47	456	56	0.545	0.644
EQ-8	D+0.75[L+(W or E)+(Lr or S)]	1.60	1485	126	2137	811	2137	958	456	35	456	42	0.420	0.495

WOOD STUD WALL: 12' WALL

STUD LENGTH (FT): 12
INT. ZONE SPACING: 24" OC
LUMBER GRADE: LVL
STUD SIZE: 2 x 6
Δ: L/240
L_e/d: 26.2

Building: Module A

WIND	
LEAST HORIZ. DIM. (FT):	
MEAN ROOF HT, h (FT):	10.5
ROOF PITCH:	3:15.83
EXPOSURE:	C
V (MPH):	90
K_{zt}:	1
I_w:	1
GC_p (+/-):	0.55
EFFECTIVE AREA:	348
K_d:	0.85
K_h, C&C:	0.85
q_h, C&C (PSF):	14.98
INT. ZONE GC_p:	-1.1
EDGE GC_p:	-1.4
INT. ZONE LOAD (PSF):	24.717
EDGE LOAD (PSF):	29.211
ROOF PRESSURE (C&C), (+)	7.2
a:	5.2

SNOW LOAD	
S:	0

SEISMIC LOAD	
I_E:	1
S_{DS}:	1.009
SEISMIC LOAD (PSF):	9.50

GRAVITY	DL	LL	TRIB
ROOF	14.04	20.00	7.92
WALL	23.54	--	1.00
FLOOR	16.80	60.00	0.00

DEFLECTION	Interior		Edge	
	(In)		(In)	
EQ	Δ	L/Δ	Δ	L/Δ
EQ-7	0.397	363	0.469	307
EQ-8	0.298	484	0.352	409

Note: Components and Cladding Wind Loads were reduced by 30% per Table 1604.3 Footnote F

KING STUDS-MAX OPENING	(ft)	(ft)
KING STUDS/POST	INT	EDGE
(1) 2 X 6	2	2
(2) 2 X 6	6	6
(3) 2 X 6	12	10
(4) 2 X 6	16	14
4 x 4	0	0
6 x 4	2	2
8 x 4	4	4

Any King Stud lying within 10.4' of a building corner is within the edge zone

			Compression		Bending								Max <1	
					Interior		Edge		Interior		Edge			
			psi	psi	psi	psi	psi	psi	psi	psi	psi	psi		
EQ.	ASD LOAD COMBOS	C_D	F_c'	f_c	F_b'	f_b	F_b'	f_b	F_v'	f_v	F_v'	f_v	Int	Edge
EQ-1	D	0.90	1103	95	1805	0	1805	0	257	0	257	0	0.007	0.007
EQ-2	D + L	1.00	1117	95	1833	0	1833	0	285	0	285	0	0.007	0.007
EQ-3	D + S	1.15	1132	95	1860	0	1860	0	328	0	328	0	0.007	0.007
EQ-4	D + Lr	1.25	1139	134	1873	0	1873	0	356	0	356	0	0.014	0.014
EQ-5	D + 0.75(L + S)	1.15	1132	95	1860	0	1860	0	328	0	328	0	0.007	0.007
EQ-6	D + 0.75(L + Lr)	1.25	1139	124	1873	0	1873	0	356	0	356	0	0.012	0.012
EQ-7	D + (W or 0.7E)	1.60	1156	109	1899	1412	1899	1669	456	54	456	64	0.827	0.976
EQ-8	D + 0.75[L + (W or E) + (Lr or S)]	1.60	1156	135	1899	1059	1899	1251	456	40	456	48	0.642	0.756

Wind Design

Building: **Module A**

Procedure: **ASCE 7-10 Regular Approach "Envelope Procedure" ASD**

Exposure Category:	C
I_w:	1
V (mph):	90
K_{zt}:	1
K_z:	0.85
K_d:	0.85
q_h:	14.98
Least Horiz. Dim. (ft):	23.63
a (ft):	4.9
Mean Roof Ht,h (ft):	12.25
Roof Angle (deg):	10.7
GCpi (+/-):	0.55

Load Case A

Zones	GC_{pf}	P (psf)
1	0.45	15.0
2	-0.69	-18.6
3	-0.41	-14.4
4	-0.34	-13.4
1E	0.68	18.5
2E	-1.07	-24.3
3E	-0.59	-17.1
4E	-0.51	-15.9

Load Case B

Zones	GC_{pf}	P (psf)
1	-0.45	-15.0
2	-0.69	-18.6
3	-0.37	-13.8
4	-0.45	-15.0
5	0.40	14.2
6	-0.29	-12.6
1E	-0.48	-15.4
2E	-1.07	-24.3
3E	-0.53	-16.2
4E	-0.48	-15.4
5E	0.61	17.4
6E	-0.43	-14.7

ASCE 7-10 Equations:

$$p=q_h[(GC_{pf})-(GC_{pi})]$$

$$q_z=0.00256K_zK_{zt}K_d(V^2)I_w$$

Design Wind Shear (lbs)	
East and West Walls	3210
North and South Walls	1784

Summary of Reaction Forces on the Walls of the Building (lbs)

	North	South	West	East
Case 1	n/a	n/a	2137	2137
Case 2	n/a	n/a	3210	3210
Case 3	n/a	n/a	2137	2137
Case 4	n/a	n/a	3210	3210
Case 5	1784	1784	2282	2282
Case 6	1784	1784	1860	1860
Case 7	1784	1784	2282	2282
Case 8	1784	1784	1860	1860

Building: **Module A**

Case 1	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-24.3	n/a	n/a
Roof Int. Pres. (psf)	n/a	-18.6	n/a	n/a
Total Force (lbs)	n/a	-2592	n/a	n/a
Largest Force (lbs)	n/a	-1378	n/a	n/a
Smallest Force (lbs)	n/a	-1214	n/a	n/a
Wall Zone	4/4E	1/1E	n/a	n/a
Wall Trib (ft)	6	3.75	n/a	n/a
Wall Edge Pres. (psf)	-15.9	18.5	n/a	n/a
Wall Int Pres. (psf)	-13.4	15.0	n/a	n/a
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.625	23.625
Length - 2a (ft)	18.2	18.2	n/a	n/a
Total Force (lbs)	-2395	1700.3	**n/a**	**n/a**
Largest Force (lbs)	-1245	892	**n/a**	**n/a**
Smallest Force (lbs)	-1150	809	**n/a**	**n/a**
Total Reaction (lbs)	-1245	892	**n/a**	**n/a**

Case 2	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-17.1	n/a	n/a
Roof Int. Pres. (psf)	n/a	-14.4	n/a	n/a
Total Force (lbs)	n/a	-1934	n/a	n/a
Largest Force (lbs)	n/a	-1005	n/a	n/a
Smallest Force (lbs)	n/a	-928	n/a	n/a
Wall Zone	1/1E	4/4E	n/a	n/a
Wall Trib (ft)	6	3.75	n/a	n/a
Wall Edge Pres. (psf)	18.5	-15.9	n/a	n/a
Wall Int Pres. (psf)	15.0	-13.4	n/a	n/a
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.63	23.63
Length - 2a (ft)	18.2	18.2	n/a	n/a
Total Force (lbs)	2721	-1497	**n/a**	**n/a**
Largest Force (lbs)	1427	-778	**n/a**	**n/a**
Smallest Force (lbs)	1294	-719	**n/a**	**n/a**
Total Reaction (lbs)	1427	-1784	**n/a**	**n/a**

Case 3	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-24.27	n/a	n/a
Roof Int. Pres. (psf)	n/a	-18.58	n/a	n/a
Total Force (lbs)	n/a	-2592	n/a	n/a
Largest Force (lbs)	n/a	-1378	n/a	n/a
Smallest Force (lbs)	n/a	-1214	n/a	n/a
Wall Zone	4/4E	1/1E	n/a	n/a
Wall Trib (ft)	6	3.75	n/a	n/a
Wall Edge Pres. (psf)	-15.88	18.461	n/a	n/a
Wall Int Pres. (psf)	-13.38	14.973	n/a	n/a
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.625	23.625
Length - 2a (ft)	18.2	18.2	n/a	n/a
Total Force (lbs)	-2395	1700.3	n/a	n/a
Largest Force (lbs)	-1245	891.81	n/a	n/a
Smallest Force (lbs)	-1150	808.5	n/a	n/a
Total Reaction (lbs)	-1245	891.81	n/a	n/a

Case 4	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-17.09	n/a	n/a
Roof Int. Pres. (psf)	n/a	-14.41	n/a	n/a
Total Force (lbs)	n/a	-1934	n/a	n/a
Largest Force (lbs)	n/a	-1005	n/a	n/a
Smallest Force (lbs)	n/a	-928.5	n/a	n/a
Wall Zone	1/1E	4/4E	n/a	n/a
Wall Trib (ft)	6	3.75	n/a	n/a
Wall Edge Pres. (psf)	18.46	-15.88	n/a	n/a
Wall Int Pres. (psf)	14.97	-13.38	n/a	n/a
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.63	23.63
Length - 2a (ft)	18.2	18.2	n/a	n/a
Total Force (lbs)	2721	-1497	n/a	n/a
Largest Force (lbs)	1427	-778.2	n/a	n/a
Smallest Force (lbs)	1294	-718.6	n/a	n/a
Total Reaction (lbs)	1427	-1784	n/a	n/a

Building: **Module A**

Case 5	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-24.3	n/a	n/a
Roof Int. Pres. (psf)	n/a	-18.6	n/a	n/a
Total Force (lbs)	n/a	-2592	n/a	n/a
Largest Force (lbs)	n/a	-1378	n/a	n/a
Smallest Force (lbs)	n/a	-1214	n/a	n/a
Wall Zone	4/4E	1/1E	6/6E	5/5E
Wall Trib (ft)	6	3.75	5.25	5.25
Wall Edge Pres. (psf)	1.0	-15.4	-14.7	17.4
Wall Int Pres. (psf)	1.5	-15.0	-12.6	14.2
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.625	23.625
Length - 2a (ft)	18.2	18.2	18.725	18.725
Total Force (lbs)	225.27	-1590	-1615	1846.2
Largest Force (lbs)	104	-800	-829	955
Smallest Force (lbs)	121	-789	-786	891
Total Reaction (lbs)	104	-2178	-829	955

Case 6	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-16.2	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.8	n/a	n/a
Total Force (lbs)	n/a	-1842	n/a	n/a
Largest Force (lbs)	n/a	-956	n/a	n/a
Smallest Force (lbs)	n/a	-887	n/a	n/a
Wall Zone	1/1E	4/4E	6/6E	5/5E
Wall Trib (ft)	6	3.75	5.25	5.25
Wall Edge Pres. (psf)	1.0	-15.4	-14.7	17.4
Wall Int Pres. (psf)	1.5	-15.0	-12.6	14.2
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.63	23.63
Length - 2a (ft)	18.2	18.2	18.73	18.73
Total Force (lbs)	225.3	-1590	-1615	1846
Largest Force (lbs)	104	-800	-829	955
Smallest Force (lbs)	121	-789	-786	891
Total Reaction (lbs)	104	-1756	-829	955

Case 7	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-24.3	n/a	n/a
Roof Int. Pres. (psf)	n/a	-18.6	n/a	n/a
Total Force (lbs)	n/a	-2592	n/a	n/a
Largest Force (lbs)	n/a	-1378	n/a	n/a
Smallest Force (lbs)	n/a	-1214	n/a	n/a
Wall Zone	4/4E	1/1E	5/5E	6/6E
Wall Trib (ft)	6	3.75	5.25	5.25
Wall Edge Pres. (psf)	1.0	-15.4	17.4	-14.7
Wall Int Pres. (psf)	1.5	-15.0	14.2	-12.6
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.625	23.625
Length - 2a (ft)	18.2	18.2	18.725	18.725
Total Force (lbs)	225.27	-1590	1846.2	-1615
Largest Force (lbs)	104	-800	955	-829
Smallest Force (lbs)	121	-789	891	-786
Total Reaction (lbs)	104	-2178	955	-829

Case 8	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	4.5	n/a	n/a
Roof Edge Pres. (psf)	n/a	-16.2	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.8	n/a	n/a
Total Force (lbs)	n/a	-1842	n/a	n/a
Largest Force (lbs)	n/a	-956	n/a	n/a
Smallest Force (lbs)	n/a	-887	n/a	n/a
Wall Zone	1/1E	4/4E	5/5E	6/6E
Wall Trib (ft)	6	3.75	5.25	5.25
Wall Edge Pres. (psf)	1.0	-15.4	17.4	-14.7
Wall Int Pres. (psf)	1.5	-15.0	14.2	-12.6
a or 2a (ft)	9.8	9.8	4.9	4.9
Length (ft)	28	28	23.63	23.63
Length - 2a (ft)	18.2	18.2	18.73	18.73
Total Force (lbs)	225.3	-1590	1846	-1615
Largest Force (lbs)	104	-800	955	-829
Smallest Force (lbs)	121	-789	891	-786
Total Reaction (lbs)	104	-1756	955	-829

Enclosure Classification

***All areas in ft² ***

Building: **Module B**

Area of Openings in Roof: 0
Gross Area of Roof: 478.4
Total Area of Openings (A_T): 0.0
Total Gross Area of Building Envelope (A_{ENV}): 1376.03

Open Classification Check

Wall	Area of Openings in Wall (A_O)	Gross Area of Wall (A_g)	$A_O > 0.8A_g$?
North	0	329	No
East	0	203.44	No
South	0	198.94	No
West	0	166.25	No

Does the building satisfy the criteria of being classified as open? No

Partially Enclosed Classification Check

	Wall	Area of Openings in Wall (A_O)	Area of Openings of the Rest of the Envelope (A_{bal})	$A_O > 1.1*A_{bal}$?
Condition 1)	North	0	0.0	No
	East	0	0.0	No
	South	0	0.0	No
	West	0	0.0	No

	Wall	Area of Openings in Wall (A_O)	Gross Area of Wall (Ag)	$A_O > 4$ or $0.01A_g$?
Condition 2a)	North	0	329	No
	East	0	203.44	No
	South	0	198.94	No
	West	0	166.25	No

	Wall	Area of Openings of the Rest of the Envelope (A_{bal})	% of Openings in the balance of the Building Envelope (P_{ENV})	$P_{ENV} < 20\%$?
Condition 2b)	North	0.0	0%	Yes
	East	0.0	0%	Yes
	South	0.0	0%	Yes
	West	0.0	0%	Yes

Does the building satisfy the criteria of being classified as partially enclosed? No

ENCLOSURE CLASSIFICATION: ENCLOSED

Comments: The Photovoltaic Overhang (PV) was included in Module B, however the walls were Module B's Walls. Only the Roof of the PV Overhang was considered.

Wind Design

Building: Module B

Procedure: **ASCE 7-10 Regular Approach "Envelope Procedure" ASD**

Exposure Category:	C
I_w:	1
V (mph):	90
K_{zt}:	1
K_z:	0.85
K_d:	0.85
q_h:	14.98
Least Horiz. Dim. (ft):	15.83
a (ft):	5.2
Mean Roof Ht,h (ft):	13
Roof Angle (deg):	10.7
GCpi (+/-):	0.18

Load Case A		
Zones	GC_{pf}	P (psf)
1	0.45	9.4
2	-0.69	-13.0
3	-0.41	-8.9
4	-0.34	-7.8
1E	0.68	12.9
2E	-1.07	-18.7
3E	-0.59	-11.5
4E	-0.51	-10.3

Load Case B		
Zones	GC_{pf}	P (psf)
1	-0.45	-9.4
2	-0.69	-13.0
3	-0.37	-8.2
4	-0.45	-9.4
5	0.40	8.7
6	-0.29	-7.0
1E	-0.48	-9.9
2E	-1.07	-18.7
3E	-0.53	-10.6
4E	-0.48	-9.9
5E	0.61	11.8
6E	-0.43	-9.1

ASCE 7-10 Equations:

$$p=q_h[(GC_{pf})-(GC_{pi})]$$

$$q_z=0.00256K_zK_{zt}K_d(V^2)I_w$$

Design Wind Shear (lbs)	
East and West Walls	1796
North and South Walls	773

Summary of Reaction Forces on the Walls of the Building (lbs)

	North	South	West	East
Case 1	n/a	n/a	1359	1359
Case 2	n/a	n/a	1796	1796
Case 3	n/a	n/a	1359	1359
Case 4	n/a	n/a	1796	1796
Case 5	773	773	443	443
Case 6	773	773	184	184
Case 7	773	773	443	443
Case 8	773	773	184	184

Building: Module B

Case 1	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-18.7	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.0	n/a	n/a
Total Force (lbs)	n/a	-1145	n/a	n/a
Largest Force (lbs)	n/a	-624	n/a	n/a
Smallest Force (lbs)	n/a	-521	n/a	n/a
Wall Zone	4/4E	1/1E	n/a	n/a
Wall Trib (ft)	6	4.5	n/a	n/a
Wall Edge Pres. (psf)	-10.3	12.9	n/a	n/a
Wall Int Pres. (psf)	-7.8	9.4	n/a	n/a
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.833	15.833
Length - 2a (ft)	14.35	14.35	n/a	n/a
Total Force (lbs)	-1320	1213.4	**n/a**	**n/a**
Largest Force (lbs)	-705	654	**n/a**	**n/a**
Smallest Force (lbs)	-615	559	**n/a**	**n/a**
Total Reaction (lbs)	-705	654	**n/a**	**n/a**

Case 2	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-11.5	n/a	n/a
Roof Int. Pres. (psf)	n/a	-8.9	n/a	n/a
Total Force (lbs)	n/a	-742	n/a	n/a
Largest Force (lbs)	n/a	-395	n/a	n/a
Smallest Force (lbs)	n/a	-347	n/a	n/a
Wall Zone	1/1E	4/4E	n/a	n/a
Wall Trib (ft)	6	4.5	n/a	n/a
Wall Edge Pres. (psf)	12.9	-10.3	n/a	n/a
Wall Int Pres. (psf)	9.4	-7.8	n/a	n/a
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.83	15.83
Length - 2a (ft)	14.35	14.35	n/a	n/a
Total Force (lbs)	1618	-989.8	**n/a**	**n/a**
Largest Force (lbs)	872	-529	**n/a**	**n/a**
Smallest Force (lbs)	746	-461	**n/a**	**n/a**
Total Reaction (lbs)	872	-924	**n/a**	**n/a**

Case 3	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-18.73	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.03	n/a	n/a
Total Force (lbs)	n/a	-1145	n/a	n/a
Largest Force (lbs)	n/a	-624.2	n/a	n/a
Smallest Force (lbs)	n/a	-521.2	n/a	n/a
Wall Zone	4/4E	1/1E	n/a	n/a
Wall Trib (ft)	6	4.5	n/a	n/a
Wall Edge Pres. (psf)	-10.33	12.917	n/a	n/a
Wall Int Pres. (psf)	-7.838	9.4295	n/a	n/a
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.833	15.833
Length - 2a (ft)	14.35	14.35	n/a	n/a
Total Force (lbs)	-1320	1213.4	n/a	n/a
Largest Force (lbs)	-705	654.04	n/a	n/a
Smallest Force (lbs)	-614.7	559.4	n/a	n/a
Total Reaction (lbs)	-705	654.04	n/a	n/a

Case 4	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-11.55	n/a	n/a
Roof Int. Pres. (psf)	n/a	-8.866	n/a	n/a
Total Force (lbs)	n/a	-742	n/a	n/a
Largest Force (lbs)	n/a	-395.2	n/a	n/a
Smallest Force (lbs)	n/a	-346.7	n/a	n/a
Wall Zone	1/1E	4/4E	n/a	n/a
Wall Trib (ft)	6	4.5	n/a	n/a
Wall Edge Pres. (psf)	12.92	-10.33	n/a	n/a
Wall Int Pres. (psf)	9.43	-7.838	n/a	n/a
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.83	15.83
Length - 2a (ft)	14.35	14.35	n/a	n/a
Total Force (lbs)	1618	-989.8	n/a	n/a
Largest Force (lbs)	872.1	-528.8	n/a	n/a
Smallest Force (lbs)	745.9	-461	n/a	n/a
Total Reaction (lbs)	872.1	-924	n/a	n/a

Building: Module B

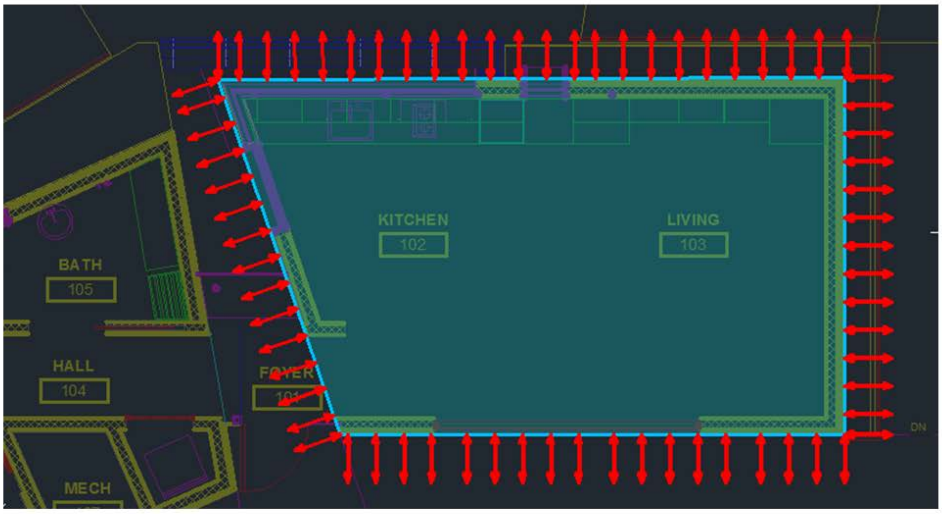
Case 5	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-18.7	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.0	n/a	n/a
Total Force (lbs)	n/a	-1145	n/a	n/a
Largest Force (lbs)	n/a	-624	n/a	n/a
Smallest Force (lbs)	n/a	-521	n/a	n/a
Wall Zone	4/4E	1/1E	6/6E	5/5E
Wall Trib (ft)	6	4.5	5.25	5.25
Wall Edge Pres. (psf)	-9.9	-9.9	-9.1	11.8
Wall Int Pres. (psf)	-9.4	-9.4	-7.0	8.7
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.833	15.833
Length - 2a (ft)	14.35	14.35	10.633	10.633
Total Force (lbs)	-1430	-1072	-642.6	808.18
Largest Force (lbs)	-723	-542	-341	433
Smallest Force (lbs)	-707	-530	-302	375
Total Reaction (lbs)	-723	-1166	-341	433

Case 6	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-10.6	n/a	n/a
Roof Int. Pres. (psf)	n/a	-8.2	n/a	n/a
Total Force (lbs)	n/a	-686.6	n/a	n/a
Largest Force (lbs)	n/a	-365	n/a	n/a
Smallest Force (lbs)	n/a	-322	n/a	n/a
Wall Zone	1/1E	4/4E	6/6E	5/5E
Wall Trib (ft)	6	4.5	5.25	5.25
Wall Edge Pres. (psf)	-9.9	-9.9	-9.1	11.8
Wall Int Pres. (psf)	-9.4	-9.4	-7.0	8.7
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.83	15.83
Length - 2a (ft)	14.35	14.35	10.63	10.63
Total Force (lbs)	-1430	-1072	-642.6	808.2
Largest Force (lbs)	-723	-542	-341	433
Smallest Force (lbs)	-707	-530	-302	375
Total Reaction (lbs)	-723	-907	-341	433

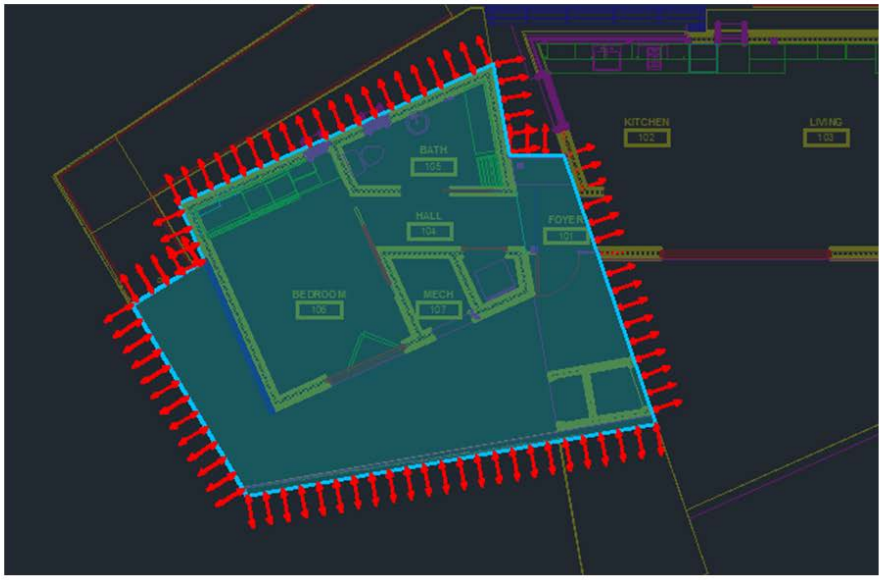
Case 7	North	South	East	West
Roof Zone	n/a	2/2E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-18.7	n/a	n/a
Roof Int. Pres. (psf)	n/a	-13.0	n/a	n/a
Total Force (lbs)	n/a	-1145	n/a	n/a
Largest Force (lbs)	n/a	-624	n/a	n/a
Smallest Force (lbs)	n/a	-521	n/a	n/a
Wall Zone	4/4E	1/1E	5/5E	6/6E
Wall Trib (ft)	6	4.5	5.25	5.25
Wall Edge Pres. (psf)	-9.9	-9.9	11.8	-9.1
Wall Int Pres. (psf)	-9.4	-9.4	8.7	-7.0
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.833	15.833
Length - 2a (ft)	14.35	14.35	10.633	10.633
Total Force (lbs)	-1430	-1072	808.18	-642.6
Largest Force (lbs)	-723	-542	433	-341
Smallest Force (lbs)	-707	-530	375	-302
Total Reaction (lbs)	-723	-1166	433	-341

Case 8	North	South	East	West
Roof Zone	n/a	3/3E	n/a	n/a
Roof Trib (ft)	n/a	3	n/a	n/a
Roof Edge Pres. (psf)	n/a	-10.6	n/a	n/a
Roof Int. Pres. (psf)	n/a	-8.2	n/a	n/a
Total Force (lbs)	n/a	-686.6	n/a	n/a
Largest Force (lbs)	n/a	-365	n/a	n/a
Smallest Force (lbs)	n/a	-322	n/a	n/a
Wall Zone	1/1E	4/4E	5/5E	6/6E
Wall Trib (ft)	6	4.5	5.25	5.25
Wall Edge Pres. (psf)	-9.9	-9.9	11.8	-9.1
Wall Int Pres. (psf)	-9.4	-9.4	8.7	-7.0
a or 2a (ft)	10.4	10.4	5.2	5.2
Length (ft)	24.75	24.75	15.83	15.83
Length - 2a (ft)	14.35	14.35	10.63	10.63
Total Force (lbs)	-1430	-1072	808.2	-642.6
Largest Force (lbs)	-723	-542	433	-341
Smallest Force (lbs)	-707	-530	375	-302
Total Reaction (lbs)	-723	-907	433	-341

MODULE B WIND BOUNDARY



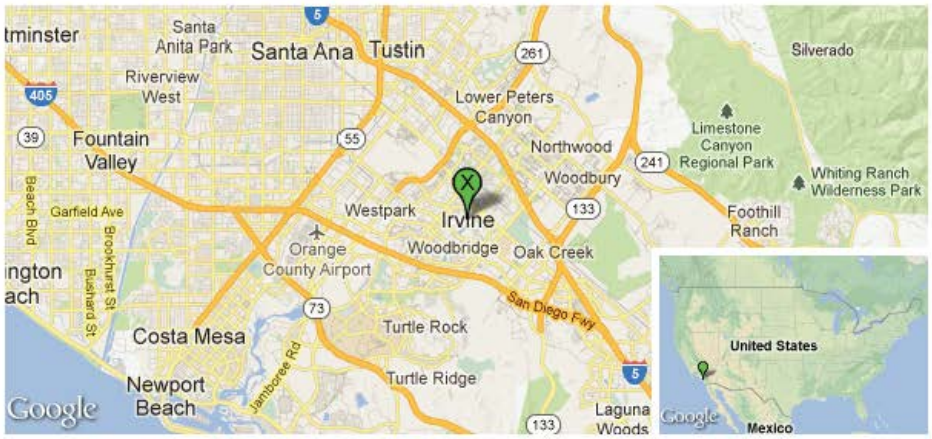
MODULE A WIND BOUNDARY



USGS Design Maps Summary Report

User-Specified Input

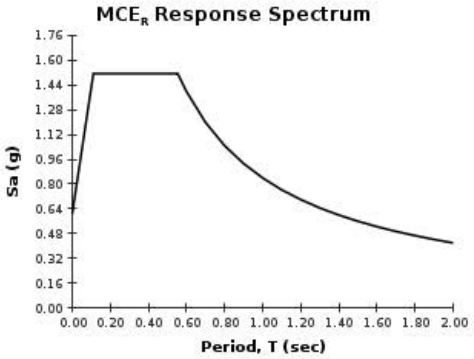
Report Title	DesertSol Solar Decathlon House Thu November 15, 2012 05:39:57 UTC
Building Code Reference Document	ASCE 7-10 Standard (which makes use of 2008 USGS hazard data)
Site Coordinates	33.68393°N, 117.79469°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

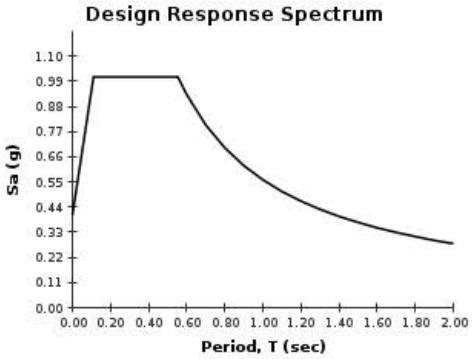


USGS-Provided Output

S_S =	1.514 g	S_{MS} =	1.514 g	S_{DS} =	1.009 g
S_1 =	0.559 g	S_{M1} =	0.839 g	S_{D1} =	0.559 g

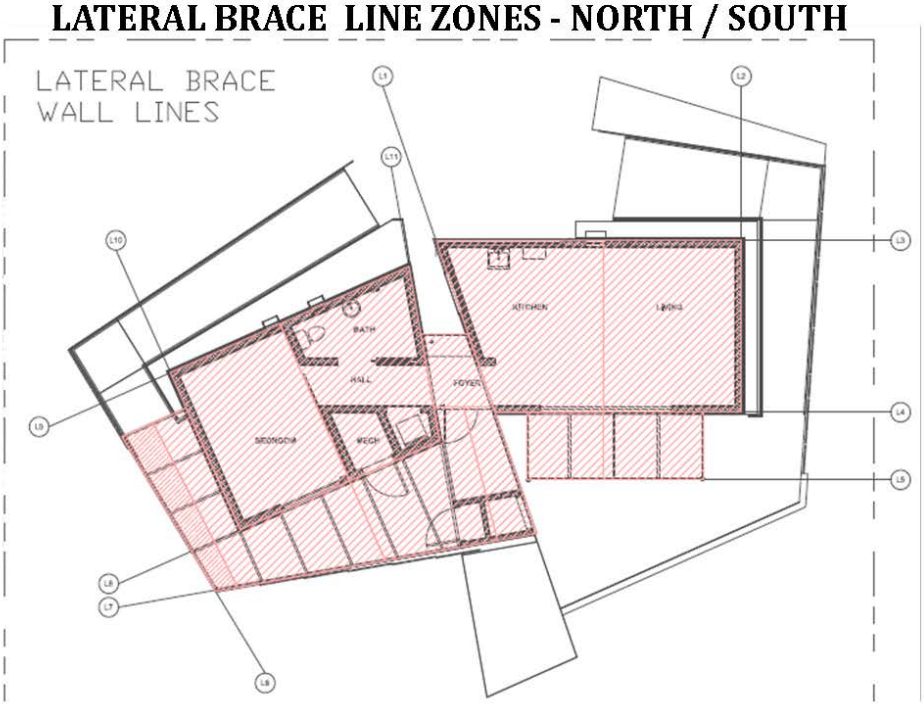
For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.



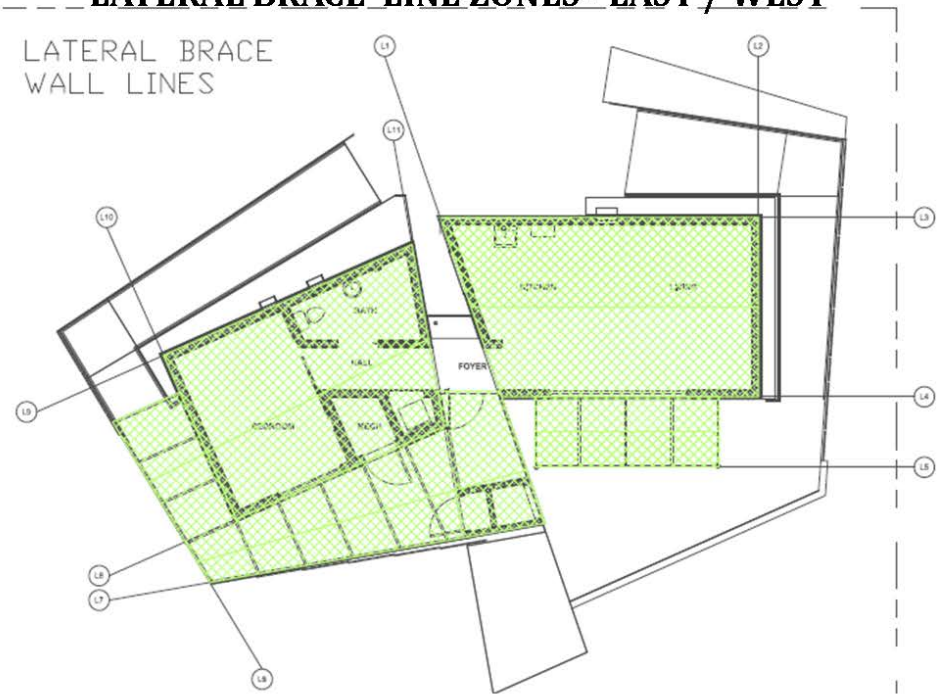


For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

LATERAL BRACE LINE ZONES - NORTH / SOUTH



LATERAL BRACE LINE ZONES - EAST / WEST



MODULE A - SEISMIC FORCE ANALYSIS

Equivalent Lateral Force Procedure Seismic Design Procedure	Variable Description	Notation	Value		Units	Code	Section & Page	Comments
Step 1: Find Mapped Acceleration Parameters	Occupancy Category	n/a	II		n/a	ASCE 7-10	Ch. 1 Table 1.5-1, pg. 2	
	Site Soil Classification	n/a	D		n/a	ASCE 7-10	11.4.2 pg. 65	Stiff Soil by default
	spectral response acceleration parameter at short periods	S_s	1.514		g	ASCE 7-10	Figs 22-1 thru 22-14 or USGC Seismic Report	
	spectral response acceleration parameter at a period of 1 s	S_1	0.559		g	ASCE 7-10	Figs 22-1 thru 22-14 or USGC Seismic Report	
Step 2: Find Adjusted MCE Spectral response parameters	short-period site coefficient (at 0.2 s-period)	F_a	1.0		n/a	ASCE 7-10	11.4.3 Table 11.4-1, pg. 66	
	long-period site coefficient (at 1.0 s-period)	F_v	1.5		n/a	ASCE 7-10	11.4.3 Table 11.4-2, pg. 66	
	the MCE, 5 percent damped, spectral response acceleration at short periods	S_{MS}	1.514		g	ASCE 7-10	eq. 11.4-1, pg. 65	
	the MCE, 5 percent damped, spectral response acceleration at a period of 1 s	S_{M1}	0.8385		g	ASCE 7-10	eq. 11.4-2, pg. 65	
Step 3: Find design spectral acceleration parameters	design, 5 percent damped, spectral response acceleration parameter at short periods	S_{DS}	1.0093		g	ASCE 7-10	eq. 11.4-3, pg. 65	
	design, 5 percent damped, spectral response acceleration parameter at a period of 1 s	S_{D1}	0.559		g	ASCE 7-10	eq. 11.4-4, pg. 65	
Step 5: find R-factor & Occupancy importance factor	Response modification factor	R	6.5		n/a	ASCE 7-10	Table 12.2-1, pg. 73	Bearing Wall System type 15
	Occupancy Importance Factor	I	1.0		n/a	ASCE 7-10	Sec. 1.5.1, table 1.5-2, pg. 5	Based on occupancy category
Step 6: Finding T	Coefficient for upper limit on calculated period	C_u	1.4		n/a	ASCE 7-10	Sec 12.8.2, Table 12.8-1, pg. 90	$S_{DS} \geq 0.4$
	Fundamental period coefficients	C_t	0.02		n/a	ASCE 7-10	12.8.2.1, table 12.8-2	All other structural systems
	Fundamental period coefficients	x	0.75		n/a	ASCE 7-10	12.8.2.1, table 12.8-2	All other structural systems
	height in ft. above base of to the highest level of the structure	h_n	12		ft	Design	12.8.2.1	
	Approximate fundamental period	T_a	0.129		sec	ASCE 7-10	12.8.2.1, eq 12.8-7	
	Fundamental period of structure	T	0.181		sec	ASCE 7-10	12.8.2	$T=C_u*T_a$
	long-period transition period	T_L	8		sec	ASCE 7-10	11.4.5, Figure 22-12, pg.224	Orange County
Step 7: Finding Seismic Response Coefficient	Maximum Seismic Response Coefficient	C_{s_max}	0.476		g	ASCE 7-10	12.8.1.1, eq. 12.8-3, pg. 89	$T \leq T_L$
	Minimum Seismic Response Coefficient	C_{s_min}	0.044		g	ASCE 7-10	12.8.1.1, eq. 12.8-5. pg. 90	given set value
	Seismic Response Coefficient	C_s	**0.15528**		g	ASCE 7-10	12.8.1.1, eq. 12.8-2, pg. 89	Check that it fits within boundary

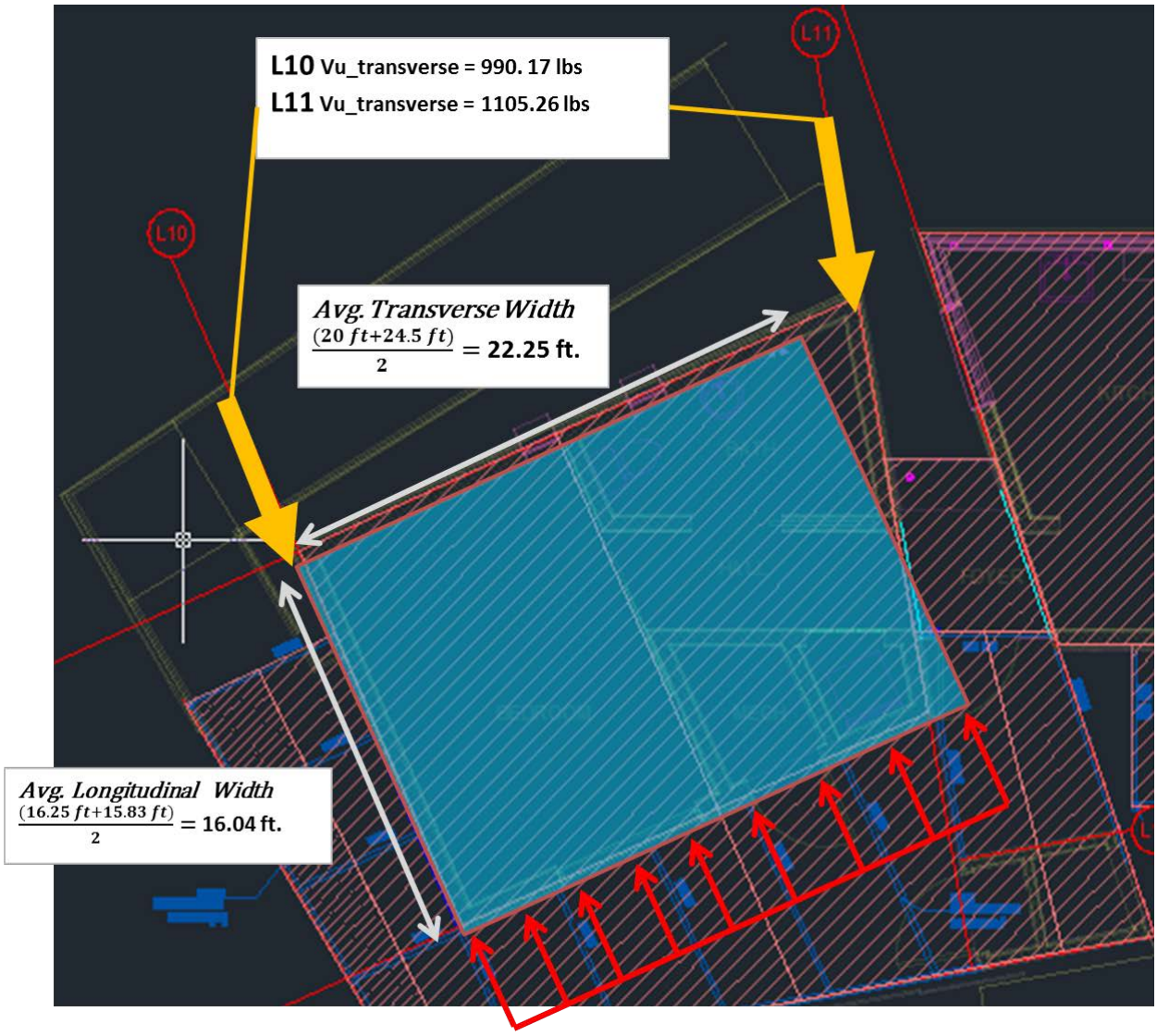
MODULE A Transverse	Effective Weight	W_A	12.98		kips	ASCE 7-10	12.7.2
	Seismic Base Shear	V_A	**2.02**		kips	ASCE 7-10	12.8.1, eq. 12.8-1
	Redundancy Factor	ρ	1.3		n/a	ASCE 7-10	12.3.4.2, pg. 84
MODULE A Longitudinal	Effective Weight	W_A	13.47		kips	ASCE 7-10	12.7.2
	Seismic Base Shear	V_A	**2.09**		kips	ASCE 7-10	12.8.1, eq. 12.8-1
	Redundancy Factor	ρ	1.3		n/a	ASCE 7-10	12.3.4.2, pg. 84

MODULE A

Tributary Roof Dead Loads — **TRANSVERSE FORCES**

Module A Roof			Weight/Area (lb/sq. ft.)	Length (ft.)	Roof Dead Load (PLF)		Exterior Module Walls		
Roof Dead Load			14.00	16.04	224.56		East Wall	16.25	ft
		Weight/Area (lb/sq. ft.)	Tributary wall height	Weight/PLF (lb/PLF)	Wall Dead Load (PLF)		West Wall	15.83	ft
Wall Dead Load		11.00	5.25	57.75	115.50		North Wall	24.50	ft
			W_1	at roof 2 end walls accounted for	340.08	lbs/ft	South Wall	20.00	ft
				Dead Load of 2 end walls	1852.81	lb			
				TOTAL Roof Dead Load (W_r)	9,419.67	lb			
Force to Roof from Module weight	$W_{u\_tansverse}$	52.81	lb/ft	TOTAL Module + Overhang/PV Weight (W_{total})	12,983.67	lb			

LATERAL BRACE WALL LINE (BWL)	L10 (West)			L11 (East)		
Tributary Shader or PV Overhang Area		158	ft^2		106	ft^2
Shader/PV Overhang Unit Weight		13.5	lb/ft^2		13.5	lb/ft^2
# of Shader/PVO HSS Columns		0	ea		0	ea
Column Lump Weight		0	lb		0	lb
Concentrated Forces on BWL	$R_{u\_transverse}$	918.71	lbs	$R_{u\_transverse}$	809.71	lbs
Diaphrahm/Brace Wall Line Width	b	16.04	ft	b	16.04	ft
Unit Shear in Diaphrahm	$v_{u\_transverse}$	57.27	lb/ft	$v_{u\_transverse}$	50.48	lb/ft
Transverse Wall Area		96.25	ft^2		96.25	ft^2
Wall Seismic Force	R_{uWall_trans}	164.40	lb	R_{uWall_trans}	164.40	lb
Angle of BWL		0	degrees		14	degrees
Wall Shear	$V_{u\_transverse}$	1083.12	lbs	$V_{u\_transverse}$	1197.73	lbs
ASD Design Wall Force	$0.7E = 0.7\rho Q_E$	985.64	lb	$0.7E = 0.7\rho Q_E$	1089.93	lb
ASD Unit Wall Shear	$V_{u\_wall\_trans}$	61.44	lb/ft	$V_{u\_wall\_trans}$	67.94	lb/ft
Shear Wall Width	A7	15.83	ft	A3	4.27	ft
Aspect Ratio		0.663	<2 so nom shear capacity does not apply		2.459	>2 so nom shear capacity does apply
$2b_s/h$		3.02			0.81	
Shear Wall Width		0	ft	A4	3.354	ft
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		3.131	>2 so nom shear capacity does apply
$2b_s/h$		0.00			0.64	
Shear Wall Width		0	ft		0	ft
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		#DIV/0!	<2 so nom shear capacity does not apply
$2b_s/h$		0.00			0.00	
Largest Unit Shear	62.26	lbs/ft		142.96	lbs/ft	

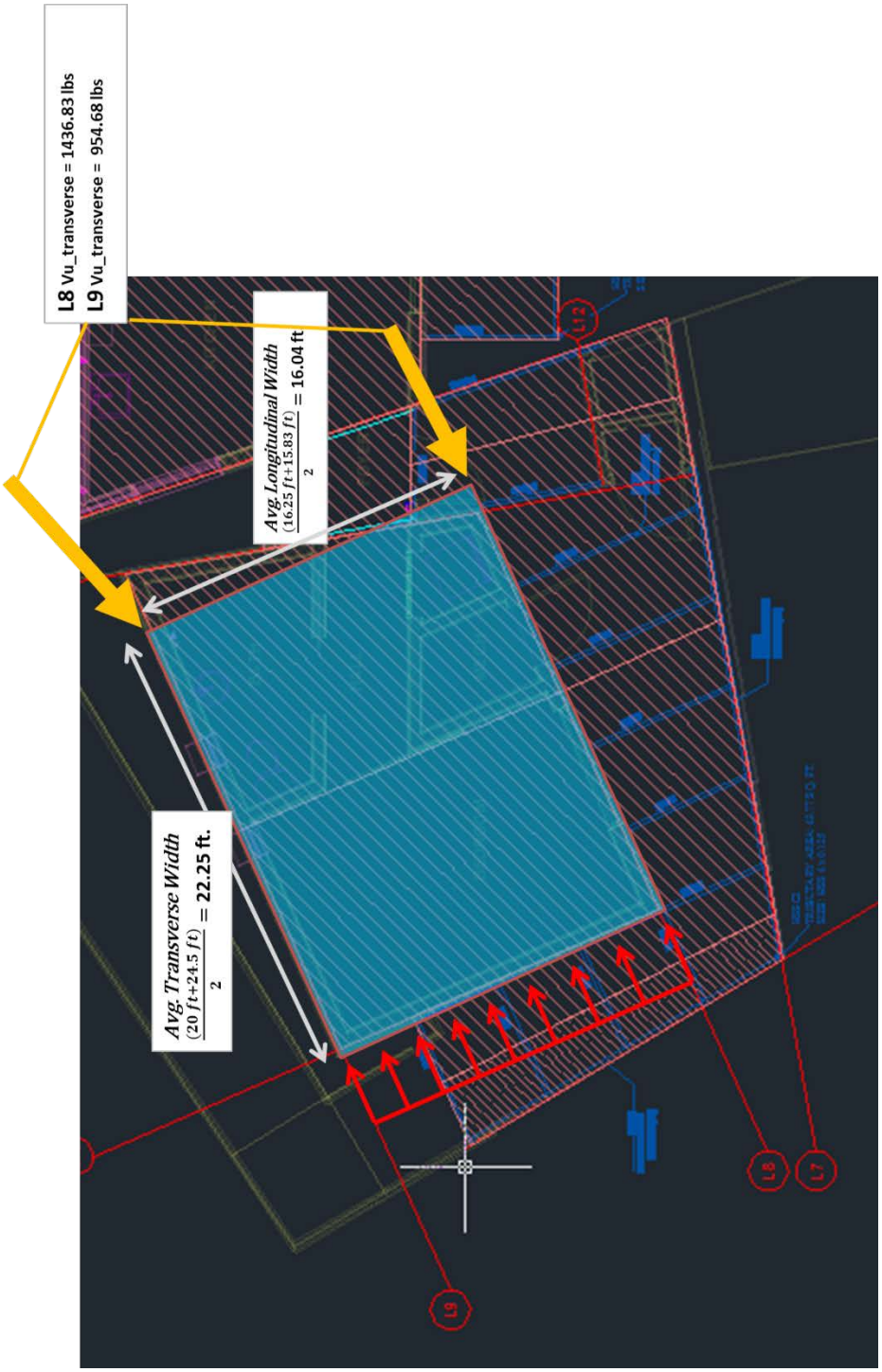

L10 Vu_transverse = 990. 17 lbs
L11 Vu_transverse = 1105.26 lbs
L10
L11
Avg. Transverse Width
$\frac{(20\ ft+24.5\ ft)}{2}$ = 22.25 ft.
Avg. Longitudinal Width
$\frac{(16.25\ ft+15.83\ ft)}{2}$ = 16.04 ft.

MODULE A

Tributary Roof Dead Loads — **LONGITUDINAL FORCES**

Module A Roof			Weight/Area (lb/sq. ft.)	Length (ft.)	Roof Dead Load (PLF)		Exterior Module Walls		
Roof Dead Load			14.00	22.25	311.50		East Wall	16.25	ft
		Weight/Area (lb/sq. ft.)	Tributary wall height	Weight/PLF (lb/PLF)	Wall Dead Load (PLF)		West Wall	15.83	ft
Wall Dead Load		11.00	5.25	57.75	115.50		North Wall	24.50	ft
			W_1	strip at roof 2 end walls accounted for	427.00	lbs/ft	South Wall	20.00	ft
				Dead Load of 2 end walls	2569.88	lb			
				TOTAL Roof Dead Load (W_1)	9,419.67	lb			
Force to Roof from Module weight	$W_{u\_longitudinal}$	66.31	lb/ft	TOTAL Module + Overhang/PV Weight (W_{TOTAL})	13,469.67	lb			

LATERAL BRACE WALL LINE (BWL)	L8 (South)			L9 (North)		
Tributary Shader or PV Overhang Area		265 ft^2			35 ft^2	
Shader/PV Overhang Unit Weight		13.5 lb/ft^2			13.5 lb/ft^2	
# of Shader/PVO HSS Columns		1 ea			1 ea	
Column Lump Weight		23.31 lb			23.31 lb	
Concentrated Forces on BWL	$R_{u\_longitudinal}$	1090.97 lbs		$R_{u\_longitudinal}$	608.82 lbs	
Diaphrahm/Brace Wall Line Width	b	22.25 ft		b	22.25 ft	
Unit Shear in Diaphrahm	$v_{u\_longitudinal}$	49.03 lb/ft		$v_{u\_longitudinal}$	27.36 lb/ft	
Transverse Wall Area		133.5 ft^2			133.5 ft^2	
Wall Seismic Force	R_{uWall_longit}	228.03 lb		R_{uWall_longit}	228.03 lb	
Angle of BWL		0 degrees			0 degrees	
Wall Shear	$V_{u\_longitudinal}$	1436.83 lbs		$V_{u\_longitudinal}$	954.68 lbs	
ASD Design Wall Force	$0.7E = 0.7\rho Q_E$	1307.51 lb		$0.7E = 0.7\rho Q_E$	868.76 lb	
ASD Unit Wall Shear	$V_{u\_wall\_longit}$	58.76 lb/ft		$V_{u\_wall\_longit}$	39.05 lb/ft	
Shear Wall Width	A5	4.57	ft	A1	9.57	ft
Aspect Ratio		1.969	<2 so nom shear capacity does not apply		1.254	<2 so nom shear capacity does not apply
$2b_s/h$		0.87			1.82	
Shear Wall Width	A6	4.54	ft	A2	8.45	ft
Aspect Ratio		1.982	<2 so nom shear capacity does not apply		1.420	<2 so nom shear capacity does not apply
$2b_s/h$		0.86			1.61	
Shear Wall Width		0	ft		0	ft
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		#DIV/0!	<2 so nom shear capacity does not apply
$2b_s/h$		0.00			0.00	
Largest Unit Shear	143.52	lbs/ft		48.21	lbs/ft	


L8 Vu_transverse = 1436.83 lbs
L9 Vu_transverse = 954.68 lbs
Avg. Longitudinal Width
(16.25 ft+15.83 ft) / 2 = 16.04 ft
Avg. Transverse Width
(20 ft+24.5 ft) / 2 = 22.25 ft.

MODULE B - SEISMIC FORCE ANALYSIS

Equivalent Lateral Force Procedure Seismic Design Procedure	Variable Description	Notation	Value		Units	Code	Section & Page	Comments
Step 1: Find Mapped Acceleration Parameters	Occupancy Category	n/a	II		n/a	ASCE 7-10	Ch. 1 Table 1.5-1, pg. 2	
	Site Soil Classification	n/a	D		n/a	ASCE 7-10	11.4.2 pg. 65	Stiff Soil by default
	spectral response acceleration parameter at short periods	S_s	1.514		g	ASCE 7-10	Figs 22-1 thru 22-14 or USGC Seismic Report	
	spectral response acceleration parameter at a period of 1 s	S_1	0.559		g	ASCE 7-10	Figs 22-1 thru 22-14 or USGC Seismic Report	
Step 2: Find Adjusted MCE Spectral response parameters	short-period site coefficient (at 0.2 s-period)	F_a	1.0		n/a	ASCE 7-10	11.4.3 Table 11.4-1, pg. 66	
	long-period site coefficient (at 1.0 s-period)	F_v	1.5		n/a	ASCE 7-10	11.4.3 Table 11.4-2, pg. 66	
	the MCE, 5 percent damped, spectral response acceleration at short periods	S_{MS}	1.514		g	ASCE 7-10	eq. 11.4-1, pg. 65	
	the MCE, 5 percent damped, spectral response acceleration at a period of 1 s	S_{M1}	0.8385		g	ASCE 7-10	eq. 11.4-2, pg. 65	
Step 3: Find design spectral acceleration parameters	design, 5 percent damped, spectral response acceleration parameter at short periods	S_{DS}	1.0093		g	ASCE 7-10	eq. 11.4-3, pg. 65	
	design, 5 percent damped, spectral response acceleration parameter at a period of 1 s	S_{D1}	0.559		g	ASCE 7-10	eq. 11.4-4, pg. 65	
Step 5: find R-factor & Occupancy importance facotr	Response modification factor	R	6.5		n/a	ASCE 7-10	Table 12.2-1, pg. 73	Bearing Wall System type 15
	Occupancy Importance Factor	I	1.0		n/a	ASCE 7-10	Sec. 1.5.1, table 1.5-2, pg. 5	Based on occupancy category
Step 6: Finding T	Coefficient for upper limit on calculated period	C_u	1.4		n/a	ASCE 7-10	Sec 12.8.2, Table 12.8-1, pg. 90	$S_{DS} \geq 0.4$
	Fundamental period coefficients	C_t	0.02		n/a	ASCE 7-10	12.8.2.1, table 12.8-2	All other structural systems
	Fundamental period coefficients	x	0.75		n/a	ASCE 7-10	12.8.2.1, table 12.8-2	All other structural systems
	height in ft. above base of to the highest level of the structure	h_n	12		ft	Design	12.8.2.1	
	Approximate fundamental period	T_a	0.129		sec	ASCE 7-10	12.8.2.1, eq 12.8-7	
	Fundamental period of structure	T	0.181		sec	ASCE 7-10	12.8.2	$T=C_u*T_a$
	long-period transition period	T_L	8		sec	ASCE 7-10	11.4.5, Figure 22-12, pg.224	Orange County
Step 7: Finding Seismic Response Coefficient	Maximum Seismic Response Coefficient	C_{s_max}	0.476		g	ASCE 7-10	12.8.1.1, eq. 12.8-3, pg. 89	$T \leq T_L$
	Minimum Seismic Response Coefficient	C_{s_min}	0.044		g	ASCE 7-10	12.8.1.1, eq. 12.8-5. pg. 90	given set value
	Seismic Response Coefficient	C_s	**0.15528**		g	ASCE 7-10	12.8.1.1, eq. 12.8-2, pg. 89	Check that it fits within boundary

MODULE B Transverse	**Effective Weight**	W_A	12.12	**kips**	ASCE 7-10	12.7.2	
	Seismic Base Shear	V_A	**1.88**	**kips**	ASCE 7-10	12.8.1, eq. 12.8-1	
	Redundancy Factor	ρ	1.3	n/a	ASCE 7-10	12.3.4.2, pg. 84	
MODULE B Longitudinal	**Effective Weight**	W_A	11.65	**kips**	ASCE 7-10	12.7.2	
	Seismic Base Shear	V_A	**1.81**	**kips**	ASCE 7-10	12.8.1, eq. 12.8-1	
	Redundancy Factor	ρ	1.3	n/a	ASCE 7-10	12.3.4.2, pg. 84	

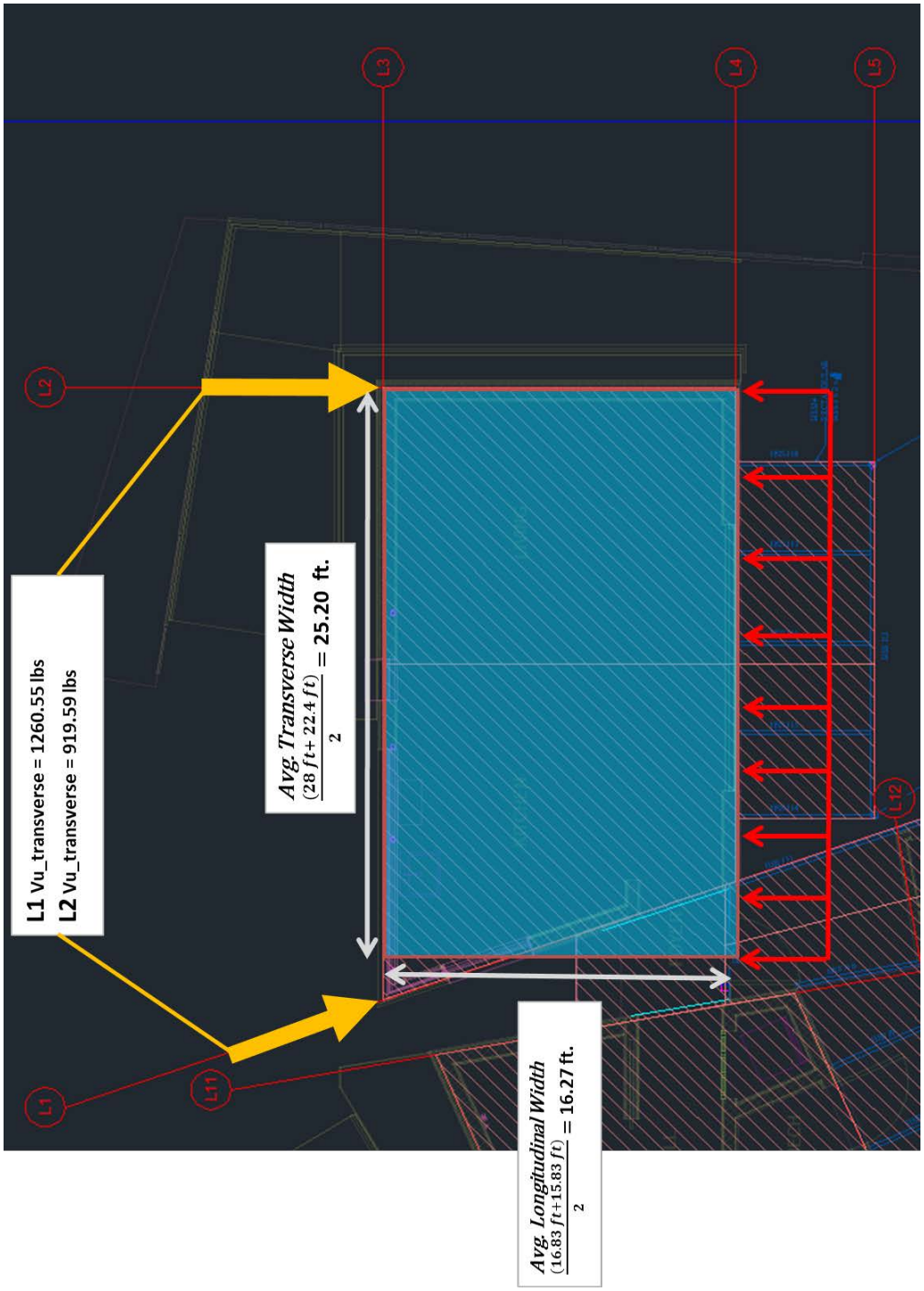
MODULE B

Tributary Roof Dead Loads — **TRANSVERSE FORCES**

Module B Roof			Weight/Area (lb/sq. ft.)	Length (ft.)	Roof Dead Load (PLF)		Exterior Module Walls	
Roof Dead Load			14.00	16.27	**227.80**		East Wall	15.83
		Weight/Area (lb/sq. ft.)	Tributary wall height	Weight/PLF (lb/PLF)	Wall Dead Load (PLF)		West Wall	16.71
Wall Dead Load		11	5.25	57.75	**115.50**		North Wall	28.00
			W_1	**strip at roof 2 end walls accounted for**	**343.30**	**lbs/ft**	South Wall	22.40
				Dead Load of 2 end walls	**1879.38**	**lb**		
				TOTAL Roof Dead Load (W_t)	**10,530.62**	**lb**		
Force to Roof from Module weight	$w_{u\_tansverse}$	**53.31**	lb/ft	**TOTAL Module + Overhang/PV Weight (W_{TOTAL})**	**12,118.12**	**lb**		

LATERAL BRACE WALL LINE (BWL)	**L2 (East)**			**L1 (West)**		
Tributary Shader or PV Overhang Area		55	ft^2		42	ft^2
Shader/PV Overhang Unit Weight		9.5	lb/ft^2		9.5	lb/ft^2
# of Shader/PVO HSS Columns		0	ea		0	ea
Column Lump Weight		0	lb		0	lb
Concentrated Forces on BWL	$R_{u\_transverse}$	**752.83**	lbs	$R_{u\_transverse}$	**837.07**	lbs
Diaphrahm/Brace Wall Line Width	**b**	16.27	ft	**b**	16.27	ft
Unit Shear in Diaphrahm	$v_{u\_transverse}$	46.27	lb/ft	$v_{u\_transverse}$	51.44	lb/ft
Transverse Wall Area		97.63	ft^2		97.63	ft^2
Wall Seismic Force	R_{uWall_trans}	166.76	lb	R_{uWall_trans}	166.76	lb
Angle of BWL		0	degrees		19	degrees
Wall Shear	$V_{u\_transverse}$	**919.59**	lbs	$V_{u\_transverse}$	**1260.55**	lbs
ASD Design Wall Force	$0.7E = 0.7\rho Q_E$	**836.83**	**lb**	$0.7E = 0.7\rho Q_E$	**1147.10**	**lb**
ASD Unit Wall Shear	$V_{u\_wall\_trans}$	**51.43**	**lb/ft**	$V_{u\_wall\_trans}$	**70.50**	**lb/ft**

Shear Wall Width	**A7**	15.83	ft	**A3**	4.27	ft	
Aspect Ratio		0.663	<2 so nom shear capacity does not apply		2.459	>2 so nom shear capacity does	
$2b_s/h$		3.02			0.81		
Shear Wall Width		0	ft	**A4**	4.354	ft	
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		2.412	<2 so nom shear capacity does	
$2b_s/h$		0.00			0.83		
Shear Wall Width		0	ft		0	ft	
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		#DIV/0!	<2 so nom shear capacity does	
$2b_s/h$		0.00			0.00		
Largest Unit Shear	**52.86**	**lbs/ft**		**133.01**	**lbs/ft**		

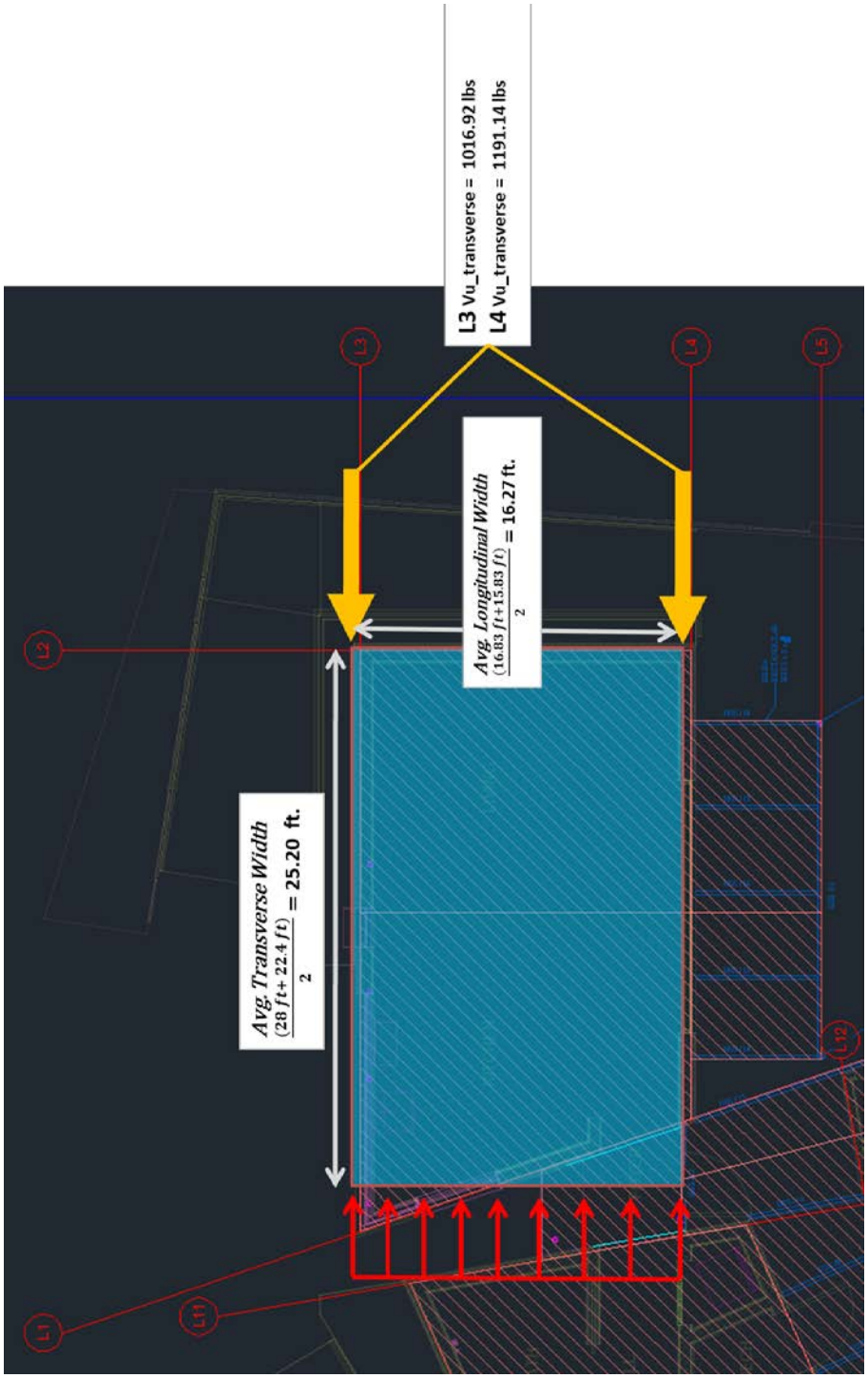

L3
L4
L5
L2
L1
L11
L12
L1 Vu_transverse = 1260.55 lbs
L2 Vu_transverse = 919.59 lbs
Avg. Transverse Width
(28 ft+ 22.4 ft) / 2 = 25.20 ft.
Avg. Longitudinal Width
(16.83 ft+15.83 ft) / 2 = 16.27 ft.

MODULE B

Tributary Roof Dead Loads — **LONGITUDINAL FORCES**

Module B Roof			Weight/Area (lb/sq. ft.)	Length (ft.)	Roof Dead Load (PLF)		Exterior Module Walls		
Roof Dead Load			14.00	25.20	**352.80**		East Wall	15.83	
		Weight/Area (lb/sq. ft.)	Tributary wall height	Weight/PLF (lb/PLF)	Wall Dead Load (PLF)		West Wall	16.71	
Wall Dead Load		11	5.25	57.75	**115.50**		North Wall	28.00	
			W_1	**strip at roof 2 end walls**	**468.30**	**lbs/ft**	South Wall	22.40	
				Dead Load of 2 end walls	**2910.60**	**lb**			
				TOTAL Roof Dead Load (W_r)	**10,530.62**	**lb**			
Force to Roof from Module weight	$W_{u\_tansverse}$	**72.72**	lb/ft	**TOTAL Module + Overhang/PV Weight (W_{TOTAL})**	**11,652.62**	**lb**			

LATERAL BRACE WALL LINE (BWL)	L3 (North)			L4 (South)		
Tributary Shader or PV Overhang Area		0	ft^2		48	ft^2
Shader/PV Overhang Unit Weight		9.5	lb/ft^2		9.5	lb/ft^2
# of Shader/PVO HSS Columns		1	ea		1	ea
Column Lump Weight		23.31	lb		23.31	lb
Concentrated Forces on BWL	$R_{u\_transverse}$	**595.25**	lbs	$R_{u\_transverse}$	**769.47**	lbs
Diaphrahm/Brace Wall Line Width	**b**	25.20	ft	**b**	25.20	ft
Unit Shear in Diaphrahm	$v_{u\_transverse}$	23.62	lb/ft	$v_{u\_transverse}$	30.53	lb/ft
Transverse Wall Area		151.2	ft^2		151.2	ft^2
Wall Seismic Force	R_{uWall_trans}	258.27	lb	R_{uWall_trans}	258.27	lb
Angle of BWL		0	degrees		0	degrees
Wall Shear	$V_{u\_transverse}$	**1016.92**	lbs	$V_{u\_transverse}$	**1191.14**	lbs
ASD Design Wall Force	$0.7E = 0.7\rho Q_E$	**925.40**	**lb**	$0.7E = 0.7\rho Q_E$	**1083.94**	**lb**
ASD Unit Wall Shear	$V_{u\_wall\_trans}$	**36.72**	**lb/ft**	$V_{u\_wall\_trans}$	**43.01**	**lb/ft**
Shear Wall Width	**A5**	4.57	ft	**A1**	9.57	ft
Aspect Ratio		1.969	<2 so nom shear capacity does not apply		1.254	<2 so nom shear capacity does not apply
$2b_s/h$		0.87			1.82	
Shear Wall Width	**A6**	4.54	ft	**A2**	8.45	ft
Aspect Ratio		1.982	<2 so nom shear capacity does not apply		1.420	<2 so nom shear capacity does not apply
$2b_s/h$		0.86			1.61	
Shear Wall Width		0	ft		0	ft
Aspect Ratio		#DIV/0!	<2 so nom shear capacity does not apply		#DIV/0!	<2 so nom shear capacity does not apply
$2b_s/h$		0.00			0.00	
Largest Unit Shear	**101.58**	**lbs/ft**		**60.15**	**lbs/ft**	


L3 Vu_transverse = 1016.92 lbs
L4 Vu_transverse = 1191.14 lbs
Avg. Longitudinal Width
(16.83 ft+15.83 ft) / 2 = 16.27 ft.
Avg. Transverse Width
(28 ft+ 22.4 ft) / 2 = 25.20 ft.

Shear Wall Schedule

1. LVL framing with studs at 24" O.C.
2. Seismic Design Category D.
3. Panels must be installed horizontally.
4. All panel edges shall be back with 2-inch nominal or wider framing U.N.O.
5. 16d nails shall be common or galvanized box. 8d and 10d nails shall be common nails. All nails at gypsum board shear walls shall be cooler or wallboard nails.
6. Staples not permitted without prior written approval of engineer.
7. Capacities shown reflect IBC table values and engineer imposed limits. Plywood wind capacities are increased by 40% (2306.3.2) except as governed by other limits.

Shear Wall Schedule

MODULE A

IBC 2305.2.2(1) — ***Strength Level***

Name		Height	Length (bs)	H/W Ratio	BWL Length (b)	Mod. Of Elast. of Chord	Chord Stud Size		Studs per Chord	Cross-Sect. Area of Chord	Panel Rigidity	No. of Fasteners per ft	Load per fastener	Nail Deformation	Anchorage Slip (HDU2-SDS2.5)	Q_E	w	
		h, ft	ft		ft	E, psi	w	d	#	A, in^2	G_a, lb/in		V_n, lb	e_n, in	d_a, in	Seismic	Wind	
A1	*North wall 1*	12	9.57	1.25			2	6	2	16.50				0.012	0.088	954.68	1784.00	lb
A2	*North wall 2*	12	8.45	1.42	18.02	2,000,000	2	6	2	16.50	12,000	2	49.50	0.012	0.088	**52.98**	**99.00**	lb/ft
A3	*East Wall 1*	10.5	10.85	0.97			2	6	2	16.50				0.012	0.088	1197.73	3210.00	lb
A4	*East Wall 2*	10.5	3.27	3.21	14.12	2,000,000	2	6	2	16.50	17,000	4	56.83	0.012	0.088	**84.83**	**227.34**	lb/ft
A5	*South Wall 1*	9	4.57	1.97			2	6	2	16.50				0.034	0.088	1436.83	1784.00	lb
A6	*South Wall 2*	9	4.54	1.98	9.11	2,000,000	2	6	2	16.50	12,000	2	97.91	0.034	0.088	**157.72**	**195.83**	lb/ft
							2	6	2	16.50				0.034	0.088	1083.12	3210.00	lb
A7	*West Wall*	10.5	15.86	0.66	15.86	2,000,000	2	6	2	16.50	12,000	2	101.20	0.034	0.088	**68.29**	**202.40**	lb/ft

ASCE 7 12.14-1 — ***Controlling Unit Shears***

Bending Defl. Of Shear Wall	Shear Defl. Of Shear Wall	Nail Slip Defl.	Anchorage Slip Defl.	TOTAL STORY DRIFT	Response Modification Coefficient	Total Deflection at Story	Total Deflection % at Story	Allowable Story Drift	Deflection Limit Check	0.7E = 0.7pQE	w		$2b_s$/ft	Controlling Shear	ASD Capacity Reduction	SHEAR WALL DETAIL	E/W	ACTUAL CAPACITY	CAPACITY CHECK
Δ_b (in)	Δ_v (in)	Δ_n (in)	Δ_a (in)	Δ_s (in)	c_d	δ_s, in	% δ_s	Δ_{allow} (in)		Seismic	Wind					SPDWS A.4.3A	Capacity, ft	lb/ft	
0.00230	0.09900	0.10800	0.05860	0.26790	4.0	1.07	0.74%	2.88	OK	868.76	1784.00	lb	1.00			3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.00230	0.09900	0.10800	0.05860	0.26790	4.0	1.07	0.74%	2.88	OK	**48.21**	**99.00**	lb/ft	1.00	WIND	2	1/2" DIA A.B. AT 24" O.C.	365	**365**	OK
0.00452	0.14041	0.09450	0.06544	0.30487	4.0	1.22	0.97%	2.52	OK	1089.93	3210.00	lb	1.00			3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 3" O.C. FIELD 12" O.C.			
0.00452	0.14041	0.09450	0.06544	0.30487	4.0	1.22	0.97%	2.52	OK	**77.19**	**227.34**	lb/ft	0.62	WIND	2	1/2" DIA A.B. AT 12" O.C.	685	**427**	OK
0.00380	0.14687	0.22680	0.08694	0.46441	4.0	1.86	1.72%	2.16	OK	1307.51	1784.00	lb	1.00			3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.00380	0.14687	0.22680	0.08694	0.46441	4.0	1.86	1.72%	2.16	OK	**143.52**	**195.83**	lb/ft	1.00	WIND	2	1/2" DIA A.B. AT 24" O.C.	365	**365**	OK
0.00358	0.17710	0.26460	0.05826	0.50354	4.0	2.01	1.60%	2.52	OK	985.64	3210.00	lb				3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.00358	0.17710	0.26460	0.05826	0.50354	4.0	2.01	1.60%	2.52	OK	**62.15**	**202.40**	lb/ft	1.00	WIND	2	1/2" DIA A.B. AT 24" O.C.	365	**365**	OK

SDPWS 4.3.3 — SDPWS A.4.3A

MODULE B

IBC 2305.2.2(1) — ***Strength Level***

Name		Height	Length (bs)	H/W Ratio	BWL Length (b)	Mod. Of Elast. of Chord	Chord Stud Size		Studs per Chord	Cross-Sect. Area of Chord	Panel Rigidity	No. of Fasteners per ft	Load per fastener	Nail Deformation	Anchorage Slip (HDU2-SDS2.5)	Q_E	w	
		ft	ft		ft	E, psi	w	d	#	A, in^2	G_a, lb/in		V_n, lb	e_n, in	d_a, in	Seismic	Wind	
							2	6	2	16.50				0.024	0.088	1191.14	773	lb
B1	*North wall*	12	6.39	1.88	6.39	2,000,000	2	6	2	16.50	12,000	2	93.20	0.024	0.088	**186.41**	**120.97**	lb/ft
							2	6	2	16.50				0.012	0.088	1260.55	1796.00	lb
B2	*East Wall*	10.5	15.83	0.66	15.83	2,000,000	2	6	2	16.50	12,000	2	56.73	0.012	0.088	**79.63**	**113.46**	lb/ft
B3	*South Wall 1*	9	6.125	1.47			2	6	2	16.50				0.012	0.088	1016.92	773	lb
B4	*South Wall 2*	9	4.55	1.98	10.68	2,000,000	2	6	2	16.50	12,000	2	47.63	0.012	0.088	**95.26**	**72.41**	lb/ft
							2	6	2	16.50				0.012	0.088	919.59	1796.00	lb
B5	*West Wall 1*	10.5	4.85	2.16	4.85	2,000,000	2	6	2	16.50	17,000	6	61.72	0.012	0.088	**189.61**	**370.31**	lb/ft

					ASCE 7 12.14-1						*Controlling Unit Shears*								
Bending Defl. Of Shear Wall	**Shear Defl. Of Shear Wall**	**Nail Slip Defl.**	**Anchorage Slip Defl.**	**TOTAL STORY DRIFT**	**Response Modification Coefficient**	**Total Deflection at Story**	**Total Deflection % at Story**	**Allowable Story Drift**	**Deflection Limit Check**	**0.7E = 0.7ρQE**	**W**		**2b$_s$/h**	**Controlling Shear**	**ASD Capacity Reduction**	SHEAR WALL DETAIL	E/W	**ACTUAL CAPACITY**	**CAPACITY CHECK**
Δ_b (in)	**Δ_v (in)**	**Δ_n (in)**	**Δ_a (in)**	**Δ_s (in)**	**c_d**	**δ_x , in**	**% δ_x**	**Δ_{allow} (in)**		Seismic	Wind					SPDWS A.4.3A	Capacity	lb/ft	
0.01222	0.18641	0.21600	0.16526	0.57989	4.0	2.32	1.61%	2.88	OK	1083.94	773	lb				3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.01222	0.18641	0.21600	0.16526	0.57989	4.0	2.32	1.61%	2.88	OK	169.63	**120.97**	lb/ft	1.00	SEISMIC	2	1/2" DIA A.B. AT 24" O.C.	260	260	OK
0.00201	0.09927	0.09450	0.05837	0.25416	4.0	1.02	0.81%	2.52	OK	1147.10	1796.00	lb				3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.00201	0.09927	0.09450	0.05837	0.25416	4.0	1.02	0.81%	2.52	OK	**72.46**	113.46	lb/ft	1.00	WIND	2	1/2" DIA A.B. AT 24" O.C.	365	365	OK
0.00158	0.07145	0.08100	0.07419	0.22822	4.0	0.91	0.85%	2.16	OK	925.40	773	lb	1.00			3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 6" O.C. FIELD 12" O.C.			
0.00158	0.07145	0.08100	0.07419	0.22822	4.0	0.91	0.85%	2.16	OK	86.69	**72.41**	lb/ft	1.00	SEISMIC	2	1/2" DIA A.B. AT 24" O.C.	260	260	OK
0.02143	0.22872	0.09450	0.19052	0.53516	4.0	2.14	1.70%	2.52	OK	836.83	1796.00	lb				3/8" PLYWOOD ONE SIDE OF WALL EDGE 8d AT 3" O.C. FIELD 12" O.C.			
0.02143	0.22872	0.09450	0.19052	0.53516	4.0	2.14	1.70%	2.52	OK	**172.54**	370.31	lb/ft	0.92	WIND	2	1/2" DIA A.B. AT 12" O.C.	685	**633**	OK
															SDPWS 4.3.3		SDPWS A.4.3A		

MODULE A: Center of Mass Story Drift Check

Name		Height	Total Deflection at Story	Center Of Mass Shear Wall Deflection	TOTAL DiaphragmDeflection	Total Story Deflection % at Story	
		h, ft	δx , in	Avg. δx , in	Δ_s (in)	% δ_x	CHECK
A1	*North wall 1*	12	1.07162	1.4646	0.3635	1.45%	OK
A2	*North wall 2*						
A5	*South Wall 1*	9	1.85763				
A6	*South Wall 2*						
A3	*East Wall 1*	10.5	1.21949	1.6168	0.1933	1.44%	OK
A4	*East Wall 2*						
A7	*West Wall*	10.5	2.01415				

MODULE B: Center of Mass Story Drift Check

Name		Height	Total Deflection at Story	Center Of Mass Shear Wall Deflection	TOTAL DiaphragmDeflection	Total Deflection % at Story	
		ft	δx , in	Avg. δx , in	Δ_s (in)	% δ_x	CHECK
B1	*North wall*	12	2.31954	1.6162	0.2842	1.51%	OK
B3	*South Wall 1*	9	0.91286				
B4	*South Wall 2*						
B2	*East Wall*	10.5	1.01662	1.5786	0.1306	1.36%	OK
B5	*West Wall 1*	10.5	2.14065				

Diaphragm Design

ROOF SHEATHING

Dead Load	14	lb/ft^2
Live Load	20	lb/ft^2
TOTAL Load	34	lb/ft^2

Roof Joist Spacing	24	in
Load Duration Factor C_D	1.25	7-Day Duration NDS Appendix B

Refering to APA Q225D Table 1a, Perpendicular Panel Orientation to Joists

Span Rating	24/0	per APA Q225 Table 1a; 32/16 also applicable if loads insufficient
	Adj. ASD	
	uniform load	

Load governed by:					Check
L/240 Deflection Limit	43	lb/ft^2	>	20 lb/ft^2	OK
L/180 Deflection Limit	57	lb/ft^2	>	34 lb/ft^2	OK
Bending Strength	65	lb/ft^2	>	34 lb/ft^2	OK
Shear Strength	172.5	lb/ft^2	>	34 lb/ft^2	OK

Available Plywood Thicknesses	3/8, 7/16, 15/32	in	per APA D510 Table 11
Specified Thickness	15/32		
Max Span without Support	24	in	per ASD/LRFD Manual Table M9.4-1

FLOOR SHEATHING

Type	Combined subfloor-underlayment
APA performance rating	Stud-I-Floor
Type	Exterior or Exposure 1?
span rating	24 oc
	Adj. ASD
	uniform load

Dead Load	13	lb/ft^2
Live Load	60	lb/ft^2
TOTAL Load	73	lb/ft^2

Floor Joist Spacing	24	in
Load Duration Factor C_D	1	10 year Duration NDS Appendix B

Refering to APA Q225D Table 1d, Perpendicular Panel Orientation to Joists

Load governed by:					Check
L/360 Deflection Limit	143	lb/ft^2	>	60 lb/ft^2	OK
L/240 Deflection Limit	215	lb/ft^2	>	73 lb/ft^2	OK
Bending Strength	160	lb/ft^2	>	73 lb/ft^2	OK
Shear Strength	404	lb/ft^2	>	73 lb/ft^2	OK

Available Plywood Thicknesses	1 1/8	in	per APA D510 Table 11
Specified Thickness	1 1/8	in	

	Strength Level Force	Strength Level Force	Controlling Force	Length	Width	Strength Level								
Roof Diaphragm Design	Wind, w_U	Seismic, w_U		L, ft	b, ft	M_U	Shear V_U	Unit Shear v_U	Load Case	ASD Adjusted Unit Shear	ASD Reduction Factor	Plywood Diaphrahm Type (See SDPWS Table A.4.2B)	Allowable Unit Shear, v_{allow}	Shear Check
Module A Transverse	288.54 lb/ft	52.81 lb/ft	WIND	22.25	16.04	17,855.63 ft-lb	3210.00 lb	200.12 lb/ft	1	200.12 lb/ft	2	8d Common Nail Size 1-3/8" Min. Fastener Penetration 15/32" Min. Nominal Panel Thickness 2" Min. Nominal Framing Width UNBLOCKED, 6" Edge Nail 12" Field Nail Spacing	335.00 lb/ft	OK
Module A Longitudinal	222.44 lb/ft	66.31 lb/ft	WIND	16.04	22.25	7,153.84 ft-lb	1784.00 lb	80.18 lb/ft	2	80.18 lb/ft	2	8d Common Nail Size 1-3/8" Min. Fastener Penetration 15/32" Min. Nominal Panel Thickness 2" Min. Nominal Framing Width UNBLOCKED, 6" Edge Nail 12" Field Nail Spacing	252.50 lb/ft	OK
Module B Transverse	142.54 lb/ft	53.31 lb/ft	WIND	25.2	16.27	11,314.80 ft-lb	1796.00 lb	110.39 lb/ft	1	110.39 lb/ft	2	8d Common Nail Size 1-3/8" Min. Fastener Penetration 15/32" Min. Nominal Panel Thickness 2" Min. Nominal Framing Width UNBLOCKED, 6" Edge Nail 12" Field Nail Spacing	335.00 lb/ft	OK
Module B Longitudinal	95.02 lb/ft	72.72 lb/ft	WIND	16.27	25.2	3,144.18 ft-lb	773.00 lb	30.67 lb/ft	2	30.67 lb/ft	2	8d Common Nail Size 1-3/8" Min. Fastener Penetration 15/32" Min. Nominal Panel Thickness 2" Min. Nominal Framing Width UNBLOCKED, 6" Edge Nail 12" Field Nail Spacing	252.50 lb/ft	OK

From SDPWS A.4.2B

			Chord/Top Plate Check					Diaphragm Deflection			Per SPDWS 4.2.2			
						RedLam LVL Plank	per IBC 2305.2.3				**Bending Defl. Of Diaphragm**	**In-Plane Shear Deformation**	**Chord Slip Defl.**	**TOTAL Diaphragm Deflection**
T_U / C_U	ASD Load T / C	# of Top Plate	Chord Cross-Section Area A, (in^2)	Stress (psi)	F_t (psi)	F_{c_perp} (psi)	Chord Check	L/b	LVL Chord Mod. Of Elasticity E, (psi)	Shear Stiffness G_a, kips/in	Δ_b (in)	$\Delta_v + \Delta_n$ (in)	Δ_c (in)	Δ_t (in)
1,113.19 lb	779.24 lb	1	8.25	94.45	1660	480	OK	1.4	2,000,000	5.5	0.00521	0.20240	0.15586	***0.363***
321.52 lb	225.06 lb	1	8.25	27.28	1660	480	OK	0.7	2,000,000	4.0	0.00056	0.08038	0.11236	***0.193***
695.44 lb	486.81 lb	1	8.25	59.01	1660	480	OK	1.5	2,000,000	5.5	0.00411	0.12644	0.153657	***0.284***
124.77 lb	87.34 lb	1	8.25	10.59	1660	480	OK	0.6	2,000,000	4.0	0.00020	0.03119	0.099206	***0.131***

													Seismic Force E = E_h+E_v			ASD Adjusted M_{OT}								
MODULE A: Chord Design Check													($E_h = \rho Q_E$)	($E_v = 0.2 S_{DC} D$)	Wind	0.7E	W		0.6D+[0.7E or W]	D+[0.7E or W]				
Name		Height	Length (bs)	H/W Ratio	BWL Length (b)	Chord Stud Size		Studs per Chord	red/reliability factor	spectral response acceleration	Tributary Dead Load	Horiz Load at Top of Shear Wall	Vertical Load at Top of Shear Wall	Wind Load	Seismic Overturning Moment	Wind Overturning Moment	Resisting Moment	Max Uplift / Tension (For Sizing Shear Wall Anchoring Hold Down)	Max Compression	Tension in Chord	Diameter of Anchor Bolt in Chord	Net Chord Cross-Sect. Area	Tension Stress
		h_i ft	ft		ft	w	d	#	ρ	S_{DC}	W_{DL}, lb/ft	E_h, lb/ft	E_v, lb/ft	lb/ft	$M_{OTseismic}$ lb-ft	M_{OTwind} lb-ft	M_R, lb-ft	F_{Tmax}, Lbs	F_{Cmax} Lbs	T, lbs	(in)	A_n, in^2	f_T, psi
A1	*North wall 1*		9.57	1.25											7,117.45	11,369.29	11,188.01	513.39	2,487.02				
A2	*North wall 2*	12	8.45	0.00	18.02	2	6	2	1.30	1.01	244.32	68.87	49.32	99.00	6,121.11	10,038.71	8,722.53	604.43	2,359.90	604.43	-	16.50	**36.63**
A3	*East Wall 1*		4.27	2.46											6,666.02	19,087.58	1,308.94	4,854.70	5,410.22				
A4	*East Wall 2*	10.5	3.27	3.21	7.54	2	6	2	1.30	1.01	143.58	206.51	28.98	425.73	5,071.72	14,617.42	767.64	5,110.77	5,554.17	5,110.77	-	16.50	**309.74**
A5	*South Wall 1*		4.57	1.97											6,215.00	8,054.44	2,206.70	1,653.67	2,521.16				
A6	*South Wall 2*	9	4.54	1.98	9.11	2	6	2	1.30	1.01	211.32	205.04	42.66	195.83	6,172.17	8,001.56	2,177.82	1,657.15	2,519.65	1,657.15	-	16.50	**100.43**
A7	*West Wall*	10.5	15.86	0.66	15.86	2	6	2	1.30	1.01	143.58	88.78	28.98	202.40	12,900.93	33,705.00	18,058.03	1,488.94	3,369.99	1,488.94	-	16.50	**90.24**

MODULE A: Chord Design Check

Simpson Strong-Tie

CHORD MATERIAL TABULATED DESIGN VALUES RedBuilt RedLam LVL 2.0E			ASD Adjusted Tension Design	Tensile Strength Check	Anchor Bracket Type Capacity, lb	Anchor Capacity Check
Is it Dimensional Lumber?	NO		F'_t, psi			
F_t	*1660*	*psi*			**HDU2-SDS2.5**	
$F_{c\_parallel}$	*2635*	*psi*	2,656.00	OK	3,075	OK
F_{c_perp}	*750*	*psi*			**HDU5-SDS2.5**	
E_{min}	*1000000*	*psi*	2,656.00	OK	5,645	OK
C_D	*1.6*				**HDU2-SDS2.5**	
C_M	*1.0*		2,656.00	OK	3,075	OK
C_t	*1.0*				**HDU2-SDS2.5**	
C_F *(only if lumber)	*1.3*		2,656.00	OK	3,075	OK

MODULE B: Chord Design Check

Name		Height	Length	H/W Ra	BWL Length (b)	Chord Stud Size		Studs per Chord	red/reliability factor	spectral response acceleration	Tributary Dead Load	Seismic Force E = E_h+E_v Horiz Load at Top of Shear Wall ($E_h = \rho Q_E$)	Vertical Load at Top of Shear Wall ($E_v = 0.2 S_{DC} D$)	Wind Load	ASD Adjusted M_{OT} Seismic Overturning Moment	Wind Overturning Moment	Resisting Moment	Max Uplift / Tension (For Sizing Shear Wall Anchoring Hold Down)	Max Compression	Tension in Chord	Diameter of Anchor Bolt in Chord	Net Chord Cross-Sect. Area	Tension Stress
												0.7E	W		0.6D+[0.7E or W]		D+[0.7E or W]					
		ft	ft		ft	w	d	#	ρ	S_{DC}	W_{DL}, lb/ft	E_h, lb/ft	E_v, lb/ft	lb/ft	$M_{OTseismic}$, lb-ft	M_{OTwind}, lb-ft	M_R, lb-ft	F_{Tmax}, Lbs	F_{Cmax}, Lbs	T, lbs	(in)	A_n, in^2	f_T, psi
B1	*North wall*	12	6.39	1.88	6.39	2	6	2	1.30	1.01	244.32	242.33	49.32	120.97	13,712.15	9,276.00	4,988.05	1,121.51	2,476.49	1,121.51	-	16.50	**67.97**
B2	*East Wall*	10.5	15.83	0.66	15.83	2	6	2	1.30	1.01	143.58	103.52	28.98	113.46	14,586.58	18,858.00	17,989.78	526.04	2,403.64	526.04	-	16.50	**31.88**
B3	*South Wall 1*		6.125	1.47											5,338.81	3,991.72	3,963.90	286.82	1,414.33				
B4	*South Wall 2*	9	4.55	1.98	10.68	2	6	2	1.30	1.01	211.32	123.84	42.66	72.41	3,858.98	2,965.28	2,187.43	408.10	1,272.27	408.10	-	16.50	**24.73**
B5	*West Wall 1*	10.5	4.85	2.16	4.85	2	6	2	1.30	1.01	143.58	246.49	28.98	370.31	9,025.29	18,858.00	1,688.68	4,102.25	4,723.37	4,102.25	-	16.50	**248.62**

MODULE B: Chord Design Check

Simpson Strong-Tie

CHORD MATERIAL TABULATED DESIGN VALUES RedBuilt RedLam LVL 2.0E			ASD Adjusted Tension Design Value	Tensile Strength Check	Anchor Bracket Type Capacity, lb	Anchor Capacity Check
Is it Dimensional Lumber?	NO		F'_t, psi			
F_t	*1660*	*psi*			HDU2-SDS2.5	
$F_{c\_parallel}$	*2635*	*psi*	2,656.00	OK	3,075	OK
F_{c_perp}	*750*	*psi*			HDU2-SDS2.5	
E_{min}	*1000000*	*psi*	2,656.00	OK	3,075	OK
C_D	*1.6*				HDU2-SDS2.5	
C_M	*1.0*		2,656.00	OK	3,075	OK
C_t	*1.0*				HDU5-SDS2.5	
C_F *(only if lumber)	*1.3*		2,656.00	OK	5,645	OK

TABLE 1a

UNIFORM LOADS (PSF) ON APA RATED PLYWOOD SHEATHING.
MULTI-SPAN, NORMAL DURATION OF LOAD, DRY CONDITIONS, PANELS 24 INCHES OR WIDER

Span Rating[b]	Load Governed By[c]	Strength Axis[a]: Perpendicular to Supports, Span Center-to-Center of Supports (inches)										Parallel to Supports, Span Center-to-Center of Supports (inches)		
		12	16	19.2	24	30	32	36	40	48	60	12	16	24
24/0	L/360	287	108	59	29	14	11	10				16		
	L/240	431	162	89	43	21	17	15				23		
	L/180	574	216	118	57	28	23	20				31		
	Bending	208	117	81	52	33	29	19				45		
	Shear	295	214	175	138	109	102	86				524		
32/16	L/360	544	205	112	54	27	22	19	14			35	13	
	L/240	816	307	168	81	40	32	29	21			53	20	
	L/180	1,088	409	224	108	53	43	38	27			70	27	
	Bending	308	173	120	77	49	43	27	22			77	43	
	Shear	381	276	226	178	140	131	111	100			657	476	
40/20	L/360	1,088	409	224	108	53	43	38	27	18		78	29	10
	L/240	1,631	614	336	163	80	65	57	41	27		117	44	15
	L/180	2,175	818	448	217	106	87	76	55	36		157	59	20
	Bending	521	293	203	130	83	73	46	38	26		125	70	25
	Shear	467	338	277	218	172	161	136	122	106		819	593	367
48/24	L/360	1,914	720	394	191	94	76	67	48	31	15	283	106	36
	L/240	2,871	1,080	591	286	140	114	100	72	47	23	424	160	54
	L/180	3,828	1,440	788	382	187	152	134	96	63	31	566	213	72
	Bending	775	436	303	194	124	109	69	56	39	25	225	127	45
	Shear	571	414	339	267	211	197	167	150	129	102	1,381	1,000	619

(a) The strength axis is the long panel dimension unless otherwise identified.
(b) Nominal thickness may vary within Span Rating. For range of thicknesses, see Table 5 of APA's *Panel Design Specification*, Form D510.
(c) Tabulated values are based on the most conservative plywood construction, as shown in Table 6. Some capacities may be increased by application of formulas in *Panel Design Specification*, Form D510.

TABLE 1d

UNIFORM LOADS (psf) ON APA RATED PLYWOOD STRUCTURAL I STURD-I-FLOOR.
MULTI-SPAN, NORMAL DURATION OF LOAD, DRY CONDITIONS, PANELS 24 INCHES OR WIDER

Span Rating[b]	Load Governed By[c]	Strength Axis[a]: Perpendicular to Supports, Span Center-to-Center of Supports (inches)										Parallel to Supports, Span Center-to-Center of Supports (inches)		
		12	16	19.2	24	30	32	36	40	48	60	12	16	24
16 oc	L/360	718	270	148	72	35	29	25	18	12		157	59	20
	L/240	1,077	405	222	107	53	43	38	27	18		235	88	30
	L/180	1,436	540	295	143	70	57	50	36	24		313	118	40
	Bending	379	213	148	95	61	53	34	27	19		140	79	28
	Shear	653	473	388	305	241	225	191	171	148		1,587	1,149	711
20 oc	L/360	1,001	376	206	100	49	40	35	25	16		282	106	36
	L/240	1,501	565	309	150	73	60	53	38	25		423	159	54
	L/180	2,001	753	412	200	98	80	70	50	33		564	212	72
	Bending	479	270	187	120	77	67	43	35	24		313	176	63
	Shear	707	512	419	330	260	243	206	185	160		390	283	175
24 oc	L/360	1,436	540	295	143	70	57	50	36	24	11	560	211	71
	L/240	2,154	810	443	215	105	86	75	54	35	17	841	316	107
	L/180	2,871	1,080	591	286	140	114	100	72	47	23	1,121	422	142
	Bending	642	361	251	160	103	90	57	46	32	21	481	271	96
	Shear	867	628	514	404	319	298	253	227	196	155	476	345	213
32 oc	L/360	3,111	1,170	640	310	152	124	109	78	51	25	1,636	615	208
	L/240	4,666	1,755	960	465	228	186	163	117	77	37	2,454	923	312
	L/180	6,221	2,340	1,280	620	304	248	218	156	102	50	3,272	1,231	415
	Bending	875	492	342	219	140	123	78	63	44	28	856	482	171
	Shear	1,040	753	617	485	383	358	304	272	236	186	571	414	256
48 oc	L/360	5,503	2,070	1,133	549	269	219	193	138	90	44	3,446	1,296	438
	L/240	8,255	3,105	1,699	823	403	329	289	208	135	66	5,168	1,944	656
	L/180	11,007	4,141	2,265	1,097	538	438	385	277	181	88	6,891	2,592	875
	Bending	1,583	891	618	396	253	223	141	114	79	51	1,500	844	300
	Shear	1,333	966	791	622	491	459	390	349	302	238	733	531	329

(a) The strength axis is the long panel dimension unless otherwise identified.
(b) Nominal thickness may vary within Span Rating. For range of thicknesses, see Table 5 of APA's *Panel Design Specification*, Form D510.
(c) Tabulated values are based on the most conservative plywood construction, as shown in Table 6. Some capacities may be increased by application of formulas in *Panel Design Specification*, Form D510.

Tie Down Design

Tie Down Angles and Corresponding Forces				
Pullout Force (lbs)	Shear Force (lbs)	Sum	Angle (°)	Tension Force (lbs)
500	900	1	29.05	1029.56
504.17	895	1	29.39	1027.23
508.33	890	1	29.73	1024.94
512.5	885	1	30.07	1022.68
516.67	880	1	30.42	1020.46
520.83	875	1	30.76	1018.28
525	870	1	31.11	1016.13
529.17	865	1	31.46	1014.02
533.33	860	1	31.81	1011.95
537.5	855	1	32.16	1009.92
541.67	850	1	32.51	1007.92
545.83	845	1	32.86	1005.96
550	840	1	33.22	1004.04
554.17	835	1	33.57	1002.16
558.33	830	1	33.93	1000.32
562.5	825	1	34.29	998.51
566.67	820	1	34.65	996.75
570.83	815	1	35.01	995.03
575	810	1	35.37	993.34
579.17	805	1	35.73	991.70
583.33	800	1	36.10	990.09
587.5	795	1	36.46	988.52
591.67	790	1	36.83	987.00
595.83	785	1	37.20	985.52
600	780	1	37.57	984.07
604.17	775	1	37.94	982.67
608.33	770	1	38.31	981.31
612.5	765	1	38.68	979.99
616.67	760	1	39.06	978.71
620.83	755	1	39.43	977.48
625	**750**	**1**	**39.81**	**976.28**
630	744	1	40.26	974.90
635	738	1	40.71	973.59
640	732	1	41.16	972.33
645	726	1	41.62	971.13
650	720	1	42.08	970.00
655	714	1	42.53	968.93
660	708	1	42.99	967.92
665	702	1	43.45	966.97
670	696	1	43.91	966.08
675	690	1	44.37	965.26
680	684	1	44.83	964.50
685	678	1	45.29	963.80
690	672	1	45.76	963.16
695	666	1	46.22	962.59
700	660	1	46.68	962.08

Sum of Pullout Force and Shear Force Ratios ≤ 1

[(Pullout Force)/1250 + (Shear Force)/1500] ≤ 1

Max Pullout Force (lbs): 1250
Max Shear Force (lbs): 1500

Angle (°) = arctan(Pullout Force/Shear Force)

Tension Force (lbs)= $[(\text{Pullout Force})^2 + (\text{Shear Force})^2]^{1/2}$

Selected Angle and Forces for Module B and N & S Walls of Module A

Selected Angle and Forces for E & W Walls of Module A

Module A: CROSS STAKE DESIGN

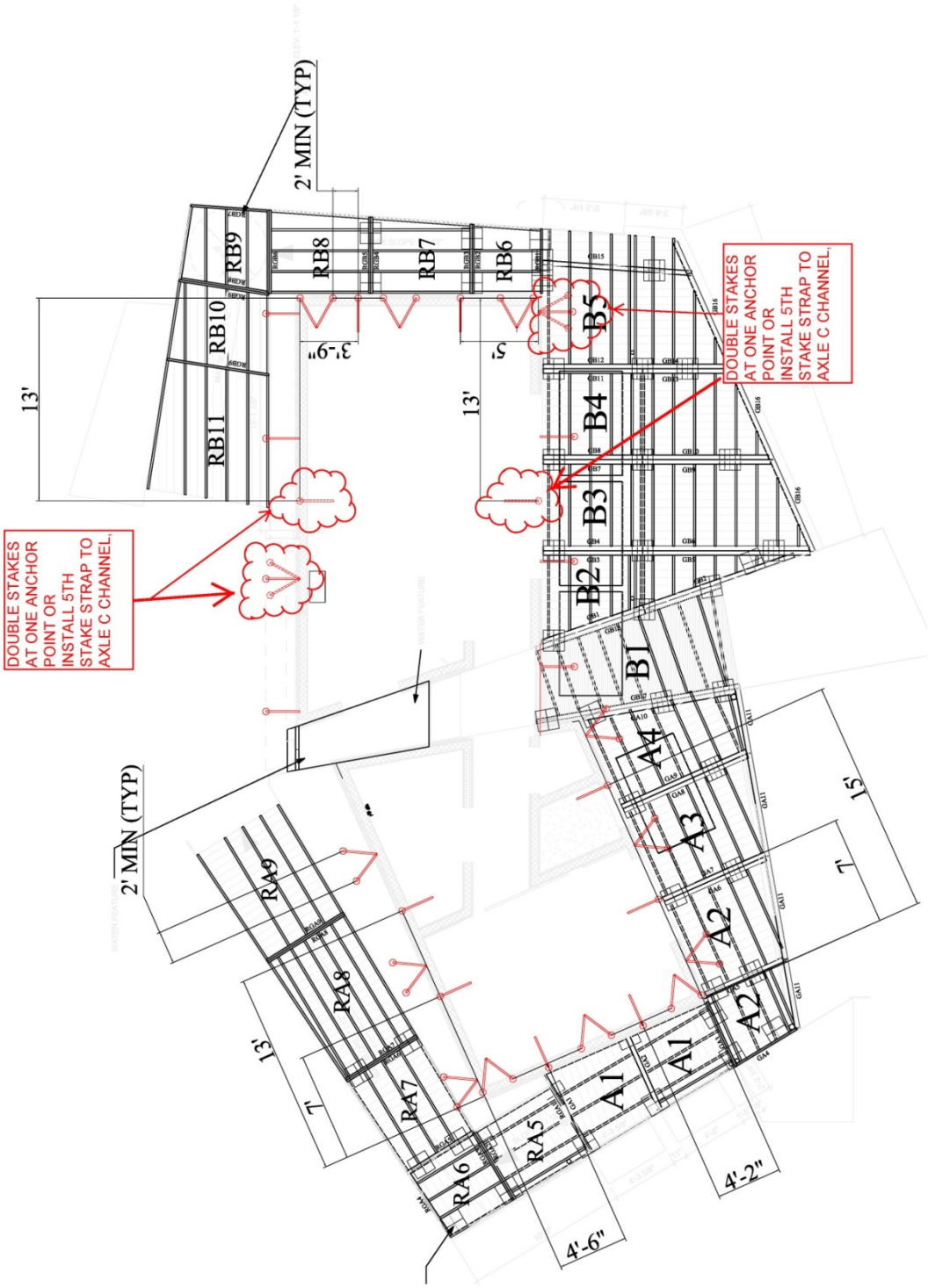
	Avg Tie Down Wall Length	Force to Resist (lbs)	Tie Down Angle	Allowed Resistance per Tie Down (lbs)	# of Tie Downs Required per Side	# of Tie Downs Provided	Tension Force on ea Anchor	Ult Tensional Force Capacity	Provided Factor of Safety
Transverse Direction	21.5	6420	30	885	7.25	8	926.65	1,022	1.10
Longitudinal Direction	16	5240	30	678	7.73	8	756.33	964	1.27

Note* Combined Longitudinal Force of both Modules

Module B: CROSS STAKE DESIGN

	Avg Tie Down Wall Length	Force to Resist (lbs)	Tie Down Angle	Allowed Resistance per Tie Down (lbs)	# of Tie Downs Required per Side	# of Tie Downs Provided	Tension Force on Anchors	Ult Tensional Force Capacity	Provided Factor of Safety
Transverse Direction	24.5	3600	30	885	4.07	5	831.38	1,022	1.23
Longitudinal Direction	16.5	5240	30	678	7.73	8	756.33	964	1.27

Note* Combined Longitudinal Force of both Modules


2' MIN (TYP)
RB8
RB7
RB6
RB9
RB10
RB11
13'
3'-9"
5"
13'
B5
B4
B3
B2
B1
DOUBLE STAKES AT ONE ANCHOR POINT OR INSTALL 5TH STAKE STRAP TO AXLE C CHANNEL.
DOUBLE STAKES AT ONE ANCHOR POINT OR INSTALL 5TH STAKE STRAP TO AXLE C CHANNEL.
2' MIN (TYP)
A4
A3
A2
A2
A1
A1
15'
7'
RA9
RA8
RA7
RA6
RA5
13'
7'
4'-2"
4'-6"

Foundation Design

Deck Foundations

Foundation Capacity:	6000	lbs
Allowable Bearing Capacity:	6000	psf

Deck Surface Area:	925	ft^2

Deck Supports	Area of Support
Deck Pier	0.8127 ft^2
Footing (ABS under CMU Piers)	1.7689 ft^2

Ramp Supports	Area of Support	
Option #1:		
12"x12" Concrete Footing	1 ft^2	
Diameter of Rod	0.75 in	
Thread adjusted diameter	0.69 in	
3/4" Adjustable Steel Bracket/ Threaded Rod	0.3712234 in^2	
Option #2:		
4x4 Pier - TimberSil	0.0850694 ft^2	
Footing under 4x4 Pier	0.765625 ft^2	psi

TimberSil 4x4 Design Properties

Design Compression Strength			
Parallel to Grain	F_c	1700	psi
Load Duration factor	C_D	1	psi
Wet Service Factor	C_M	0.8	psi
Temperature Factor	C_t	0.8	
Size Factor	C_F	1	in
Incising Factor	C_i	1	
Column Stability Factor	C_P	0.983219	in
Modulus of Elasticity	E_{min}	1,900,000	in
Adjusted Modulus of Elasticity	$E_{min'}$	1,216,000	psi
Buckling Stiffness Factor	C_T	1	
Worst Case Length	l	30	psi
Buckling Length Coefficient	K_e	1	psi
Effective Column Length (K_e*$l_)$	l_e	30	
Representative value	d	3.5	
Critical ASD Buckling Value (Euler)	F_{cE}	13605.01	
C_p variable	c	0.8	
C_p variable	F_c*	1088	
Adjusted Compression Strength	F_c'	1069.742	

Deck Loads

	Weight (psf)	Weight (lbs)
Deck DL	20	18500
Deck LL	100	92500
Total (lbs)		111000
Total (psf)		120

Worst Case CMU Pier

Tributary Area:	40.0	ft^2
Weight:	5122.5	lbs
Pressure from CMU footing:	2895.87	**psf**
Pressure from CMU Pier:	43.7713	**psi**
Ground Pressure Check	OK	

Worst Case Ramp Option #1

Tributary Area:	16.7	ft^2
Weight:	2324.1	lbs
Pressure from footing:	16.1396	**psi**
Pressure from footing:	2324.1	**psf**
Pressure from steel bracket:	6260.66	**psi**
Ground Pressure Check	OK	

Worst Case Ramp Option #2

Tributary Area:	16.7	ft^2
Weight:	2324.1	lbs
Pressure from footing:	21.0803	**psi**
Pressure from footing:	3035.56	**psf**
Pressure from 4x4 Pier:	189.723	**psi**
Pressure from 4x4 Pier:	27320.1	**psf**
Pier Design Check	OK	
Ground Pressure Check	OK	

Sliding Calculations

Module A		
Weight (lbs):	20739	
Transverse Seismic Base Shear (lbs):	2020	controls
Transverse Wind Shear (lbs):	1784	
Longitudinal Seismic Base Shear (lbs):	2090	
Longitudinal Wind Shear (lbs):	3210	controls

Transverse Direction						
F_N (lbs)	μ	$F_f=\mu F_N$ (lbs)	Controlling Transverse Shear Force (lbs)	Sliding Ratio=F_f/contolling force	Sliding Ratio > 2.0?	Tie-Downs Required?
20739	0.5	10369.5	2020	5.13	ok	No
Longitudinal Direction						
F_N (lbs)	μ	$F_f=\mu F_N$ (lbs)	Controlling Longitudinal Shear Force (lbs)	Sliding Ratio=F_f/contolling force	Sliding Ratio > 2.0?	Tie-Downs Required?
20739	0.5	10369.5	3210	3.23	ok	No

Module B		
Weight (lbs):	23348	
Transverse Seismic Base Shear (lbs):	1880	controls
Transverse Wind Shear (lbs):	773	
Longitudinal Seismic Base Shear (lbs):	1810	controls
Longitudinal Wind Shear (lbs):	1796	

Transverse Direction						
F_N (lbs)	μ	$F_f=\mu F_N$ (lbs)	Controlling Transverse Shear Force (lbs)	Sliding Ratio=F_f/contolling force	Sliding Ratio > 2.0?	Tie-Downs Required?
23348	0.5	11674	1880	6.21	ok	No
Longitudinal Direction						
F_N (lbs)	μ	$F_f=\mu F_N$ (lbs)	Controlling Longitudinal Shear Force (lbs)	Sliding Ratio=F_f/contolling force	Sliding Ratio > 2.0?	Tie-Downs Required?
23348	0.5	11674	1810	6.45	ok	No

Uplift and Overturn Design

Overturning Calculations

Module A:

Controlling Shear Forces	
Transverse (N&S) Seismic (lbs):	2020
Longitudinal (E&W) Wind (lbs):	3210

Dead Loads	
Floor (lbs):	4425
Roof (lbs):	4851
North Wall (lbs):	3091
South Wall (lbs):	1939
East Wall (lbs):	1882
West Wall (lbs):	1829

Wall Dimensions		
Wall	Height (ft)	Length (ft)
North	12	23
South	9	20
East	11	16
West	11	16
Chassis	2.5	N/A

Overturning Moment (M_O) = (F_{shear})[(Wall + Chassis Height)/2]

Restoring Moment (M_R) = (DL_{floor})(L_1) +(DL_{roof})(L_2) +($DL_{N.Wall}$)(L_3) +($DL_{S.Wall}$)(L_4) +($DL_{E.Wall}$)(L_5)+ ($DL_{W.Wall}$)(L_6)

Overturning Moments				
Wall	F_{shear} (lbs)	Wall Height (ft)	Chassis Height (ft)	M_O (lb-ft)
North	2020	12	2.5	14645
South	2020	9	2.5	11615
East	3210	11	2.5	21667.5
West	3210	11	2.5	21667.5

Restoring Moments:

North Wall				DL x L (lb-ft)
DL_{floor} (lbs):	4425	L_1 (ft):	8	35400
DL_{roof} (lbs):	4851	L_2 (ft):	8	38808
$DL_{N.Wall}$ (lbs):	3091	L_3 (ft):	16	49456
$DL_{S.Wall}$ (lbs):	1939	L_4 (ft):	0	0
$DL_{E.Wall}$ (lbs):	1882	L_5 (ft):	8	15056
$DL_{W.Wall}$ (lbs):	1829	L_6 (ft):	8	14632
			M_R (lb-ft):	**153352**

East Wall				DL x L (lb-ft)
DL_{floor} (lbs):	4425	L_1 (ft):	11.5	50887.5
DL_{roof} (lbs):	4851	L_2 (ft):	11.5	55786.5
$DL_{N.Wall}$ (lbs):	3091	L_3 (ft):	11.5	35546.5
$DL_{S.Wall}$ (lbs):	1939	L_4 (ft):	10	19390
$DL_{E.Wall}$ (lbs):	1882	L_5 (ft):	23	43286
$DL_{W.Wall}$ (lbs):	1829	L_6 (ft):	0	0
			M_R (lb-ft):	**204896.5**

South Wall				DL x L (lb-ft)
DL_{floor} (lbs):	4425	L_1 (ft):	8	35400
DL_{roof} (lbs):	4851	L_2 (ft):	8	38808
$DL_{N.Wall}$ (lbs):	3091	L_3 (ft):	0	0
$DL_{S.Wall}$ (lbs):	1939	L_4 (ft):	16	31024
$DL_{E.Wall}$ (lbs):	1882	L_5 (ft):	8	15056
$DL_{W.Wall}$ (lbs):	1829	L_6 (ft):	8	14632
			M_R (lb-ft):	**134920**

West Wall				DL x L (lb-ft)
DL_{floor} (lbs):	4425	L_1 (ft):	11.5	50887.5
DL_{roof} (lbs):	4851	L_2 (ft):	11.5	55786.5
$DL_{N.Wall}$ (lbs):	3091	L_3 (ft):	11.5	35546.5
$DL_{S.Wall}$ (lbs):	1939	L_4 (ft):	10	19390
$DL_{E.Wall}$ (lbs):	1882	L_5 (ft):	0	0
$DL_{W.Wall}$ (lbs):	1829	L_6 (ft):	23	42067
			M_R (lb-ft):	**203677.5**

Overturning Analysis				
Wall	U=M_O-M_R (lb-ft)	M_R/M_O	M_R/M_O > 2.0?	Tie-Downs Required?
North	-138707	10.47	ok	No
South	-123305	11.62	ok	No
East	-183229	9.46	ok	No
West	-182010	9.40	ok	No

Module B:

Controlling Shear Forces	
Transverse (N&S) Seismic (lbs):	1880
Longitudinal (E&W) Seismic (lbs):	1810

Dead Loads	
Floor (lbs):	5086
Roof (lbs):	5574
North Wall (lbs):	3619
South Wall (lbs):	2178
East Wall (lbs):	1828
West Wall (lbs):	1933

Wall Dimensions		
Wall	Height (ft)	Length (ft)
North	12	27
South	9	22
East	11	16
West	11	17
Chassis	2.5	N/A

Overturning Moment (M_O) = (F_{shear})[(Wall + Chassis Height)/2]

Restoring Moment (M_R) = (DL_{floor})(L_1) +(DL_{roof})(L_2) +($DL_{N.Wall}$)(L_3) +($DL_{S.Wall}$)(L_4) +($DL_{E.Wall}$)(L_5)+ ($DL_{W.Wall}$)(L_6)

Overturning Moments				
Wall	F_{shear} (lbs)	Wall Height (ft)	Chassis Height (ft)	M_O (lb-ft)
North	1880	12	2.5	13630
South	1880	9	2.5	10810
East	1810	11	2.5	12217.5
West	1810	11	2.5	12217.5

Restoring Moments:

North Wall				DL x L (lb-ft)
DL_{floor} (lbs):	5086	L_1 (ft):	8.5	43231
DL_{roof} (lbs):	5574	L_2 (ft):	8.5	47379
$DL_{N.Wall}$ (lbs):	3619	L_3 (ft):	17	61523
$DL_{S.Wall}$ (lbs):	2178	L_4 (ft):	0	0
$DL_{E.Wall}$ (lbs):	1828	L_5 (ft):	8	14624
$DL_{W.Wall}$ (lbs):	1933	L_6 (ft):	8.5	16430.5
			M_R (lb-ft):	**183187.5**

East Wall				DL x L (lb-ft)
DL_{floor} (lbs):	5086	L_1 (ft):	13.5	68661
DL_{roof} (lbs):	5574	L_2 (ft):	13.5	75249
$DL_{N.Wall}$ (lbs):	3619	L_3 (ft):	13.5	48856.5
$DL_{S.Wall}$ (lbs):	2178	L_4 (ft):	11	23958
$DL_{E.Wall}$ (lbs):	1828	L_5 (ft):	27	49356
$DL_{W.Wall}$ (lbs):	1933	L_6 (ft):	0	0
			M_R (lb-ft):	**266080.5**

South Wall				DL x L (lb-ft)
DL_{floor} (lbs):	5086	L_1 (ft):	8.5	43231
DL_{roof} (lbs):	5574	L_2 (ft):	8.5	47379
$DL_{N.Wall}$ (lbs):	3619	L_3 (ft):	0	0
$DL_{S.Wall}$ (lbs):	2178	L_4 (ft):	17	37026
$DL_{E.Wall}$ (lbs):	1828	L_5 (ft):	8	14624
$DL_{W.Wall}$ (lbs):	1933	L_6 (ft):	8.5	16430.5
			M_R (lb-ft):	**158690.5**

West Wall				DL x L (lb-ft)
DL_{floor} (lbs):	5086	L_1 (ft):	13.5	68661
DL_{roof} (lbs):	5574	L_2 (ft):	13.5	75249
$DL_{N.Wall}$ (lbs):	3619	L_3 (ft):	13.5	48856.5
$DL_{S.Wall}$ (lbs):	2178	L_4 (ft):	11	23958
$DL_{E.Wall}$ (lbs):	1828	L_5 (ft):	0	0
$DL_{W.Wall}$ (lbs):	1933	L_6 (ft):	27	52191
			M_R (lb-ft):	**268915.5**

Overturning Analysis				
Wall	$U=M_O-M_R$ (lb-ft)	M_R/M_O	M_R/M_O > 2.0?	Tie-Downs Required?
North	-169557.5	13.44	ok	No
South	-147880.5	14.68	ok	No
East	-253863	21.78	ok	No
West	-256698	22.01	ok	No

Tie-Down Calcs. Brittany Radke

Module A

Weight = 20,739 lbs

Transverse Seismic Base Shear = 2,020 lbs ← controls

Transverse Wind Shear = 1,784 lbs

Longitudinal Seismic Base Shear = 2,090 lbs

Longitudinal Wind Shear = 3,210 lbs ← controls

Module B

Weight = 23,348 lbs

Transverse Seismic Base Shear = 1,880 lbs ← controls

Transverse Wind Shear = 773 lbs

Longitudinal Seismic Base Shear = 1,810 lbs ← controls

Longitudinal Wind Shear = 1,796 lbs

Check for Sliding

Module A

Transverse Direction:

$F_F = \mu F_N$, where μ (asphalt) = 0.5-0.8; choose lower boundary $\mu = 0.5$

$F_F = (0.5)(20,739 \text{ lbs}) = 10,369.5 \text{ lbs}$

$$\text{Sliding Ratio} = \frac{F_F}{\text{controlling force}} = \frac{10,369.5 \text{ lbs}}{2,020 \text{ lbs}} = 5.13 > 2.0 \quad \text{ok}$$

Longitudinal Direction:

$F_F = \mu F_N = (0.5)(20,739 \text{ lbs}) = 10,369.5 \text{ lbs}$

$$\text{Sliding Ratio} = \frac{F_F}{\text{controlling force}} = \frac{10,369.5 \text{ lbs}}{3,210 \text{ lbs}} = 3.23 > 2.0 \quad \text{ok}$$

Module B

Transverse Direction:

$F_F = \mu F_N = (0.5)(23,348 \text{ lbs}) = 11,674 \text{ lbs}$

$$\text{Sliding Ratio} = \frac{F_F}{\text{controlling force}} = \frac{11,674 \text{ lbs}}{1,880 \text{ lbs}} = 6.21 > 2.0 \quad \text{ok}$$

Longitudinal Direction:

$F_F = \mu F_N = (0.5)(23,348 \text{ lbs}) = 11,674 \text{ lbs}$

$$\text{Sliding Ratio} = \frac{F_F}{\text{controlling force}} = \frac{11,674 \text{ lbs}}{1,810 \text{ lbs}} = 6.45 > 2.0 \quad \text{ok}$$

Tie-Down Calcs. Brittany Radke 2

→ No tie downs are required to prevent Modules A and B from sliding.

Overturning Moment

Module A

Controlling Shear Forces:

Transverse (N+S) Seismic = 2,020 lbs

Longitudinal (E+W) Wind = 3,210 lbs

Dead Loads:

Floor = 4,425 lbs Roof = 4,351 lbs

North Wall = 3,091 lbs South Wall = 1,939 lbs

East Wall = 1,882 lbs West Wall = 1,829 lbs

Wall Dimensions:

North Wall:	South Wall:	East Wall:	West Wall:
Height = H_N = 12 ft	Height = H_S = 9 ft	Height = H_E = 11 ft	Height = H_W = 11 ft
Length = L_N = 28 ft	Length = L_S = 20 ft	Length = L_E = 16 ft	Length = L_W = 16 ft

Chassis Height = 2.5 ft

North Wall

Overturning Moment → $M_O = (F_{shear})\left[(\text{Wall + Chassis Height})/2\right]$

$M_O = (2{,}020 \text{ lbs})\left[(12+2.5 \text{ ft})/2\right] = 14{,}645$ lb-ft

Restoring Moment → $M_R = (D.L._{floor})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{roof})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{N.wall})(\text{Longest of } L_E \text{ or } L_W) + (D.L._{S.wall})(0) + (D.L._{E.wall})(L_E/2) + (D.L._{W.wall})(L_W/2)$

$M_R = (4{,}425 \text{ lbs})(16 \text{ ft}/2) + (4{,}851 \text{ lbs})(16 \text{ ft}/2) + (3{,}091 \text{ lbs})(16 \text{ ft}) + (1{,}939 \text{ lbs})(0) + (1{,}882 \text{ lbs})(16 \text{ ft}/2) + (1{,}829 \text{ lbs})(16 \text{ ft}/2) = 153{,}352$ lb-ft

$U = M_O - M_R$

$U = 14{,}645 \text{ lb-ft} - 153{,}352 \text{ lb-ft} = -138{,}707$ lb-ft ok

$\frac{M_R}{M_O} = \frac{153{,}352 \text{ lb-ft}}{14{,}645 \text{ lb-ft}} = 10.47 > 2.0$ ok

Tie-Down Calcs. Brittany Radke

South Wall

$M_O = (F_{shear})[(Wall + Chassis\ Height)/2] = (2,020\ lbs)[(9+2.5\ ft)/2] = 11,615\ lb\text{-}ft$

$M_R = (D.L._{floor})\left(\frac{Longest\ of\ L_E\ or\ L_W}{2}\right) + (D.L._{roof})\left(\frac{Longest\ of\ L_E\ or\ L_W}{2}\right) + (D.L._{N.wall})(0) +$

$(D.L._{S.wall})(Longest\ of\ L_E\ or\ L_W) + (D.L._{E\ wall})(L_E/2) + (D.L._{W.wall})(L_W/2)$

$M_R = (4425\ lbs)(16\ ft/2) + (4851\ lbs)(16\ ft/2) + (3091\ lbs)(0) + (1,939\ lbs)(16\ ft)$

$+ (1,882\ lbs)(16\ ft/2) + (1,829\ lbs)(16\ ft/2) = 134,920\ lb\text{-}ft$

$U = M_O - M_R = 11,615\ lb\text{-}ft - 134,920\ lb\text{-}ft = -123,305\ lb\text{-}ft$ ok

$\frac{M_R}{M_O} = \frac{134,920\ lb\text{-}ft}{11,615\ lb\text{-}ft} = 11.62 > 2.0$ ok

East Wall

$M_O = (F_{shear})[(Wall + Chassis\ Height)/2] = (3210\ lbs)[(11+2.5\ ft)/2] = 21,667.5\ lb\text{-}ft$

$M_R = (D.L._{floor})\left(\frac{Longest\ of\ L_W\ or\ L_S}{2}\right) + (D.L._{roof})\left(\frac{Longest\ of\ L_W\ or\ L_S}{2}\right) + (D.L._{N.wall})(L_W/2)$

$+ (D.L._{S.wall})(L_S/2) + (D.L._{E\ wall})(Longest\ of\ L_W\ or\ L_S) + (D.L._{W.wall})(0)$

$M_R = (4425\ lbs)(23\ ft/2) + (4851\ lbs)(23\ ft/2) + (3091\ lbs)(23\ ft/2) + (1939\ lbs)(20\ ft/2)$

$+ (1882\ lbs)(23\ ft) + (1829\ lbs)(0) = 204,896.5\ lb\text{-}ft$

$U = M_O - M_R = 21,667.5\ lb\text{-}ft - 204,896.5\ lb\text{-}ft = -183,229\ lb\text{-}ft$ ok

$\frac{M_R}{M_O} = \frac{204,896.5\ lb\text{-}ft}{21,667.5\ lb\text{-}ft} = 9.46 > 2.0$ ok

West Wall

$M_O = (F_{shear})[(Wall + Chassis\ Height)/2] = (3210\ lbs)[(11+2.5\ ft)/2] = 21,667.5\ lb\text{-}ft$

$M_R = (D.L._{floor})\left(\frac{Longest\ of\ L_W\ or\ L_S}{2}\right) + (D.L._{roof})\left(\frac{Longest\ of\ L_W\ or\ L_S}{2}\right) + (D.L._{N.wall})(L_W/2)$

$+ (D.L._{S.wall})(L_S/2) + (D.L._{E\ wall})(0) + (D.L._{W.wall})(Longest\ of\ L_W\ or\ L_S)$

$M_R = (4425\ lbs)(23\ ft/2) + (4851\ lbs)(23\ ft/2) + (3091\ lbs)(23\ ft/2) + (1939\ lbs)(20\ ft/2)$

$+ (1882\ lbs)(0) + (1829\ lbs)(23\ ft) = 203,677.5\ lb\text{-}ft$

$U = M_O - M_R = 21,667.5\ lb\text{-}ft - 203,677.5\ lb\text{-}ft = -182,010\ lb\text{-}ft$ ok

$\frac{M_R}{M_O} = \frac{203,677.5\ lb\text{-}ft}{21,667.5\ lb\text{-}ft} = 9.40 > 2.0$ ok

Tie-Down Calcs. Brittany Redke 4

→ No tie-downs required to prevent overturning of Module A.

Module B

Controlling Shear Forces:

Transverse (N+S) Seismic = 1,880 lbs

Longitudinal (E+W) Seismic = 1,810 lbs

Dead Loads:

Floor = 5086 lbs Roof = 5,574 lbs

North Wall = 3,619 lbs South Wall = 2,178 lbs

East Wall = 1,828 lbs West Wall = 1,933 lbs

Wall Dimensions:

North Wall:	South Wall	East Wall	West Wall
Height = H_N = 12 ft	Height = H_S = 9 ft	Height = H_E = 11 ft	Height = H_W = 11 ft
Length = L_N = 27 ft	Length = L_S = 22 ft	Length = L_E = 16 ft	Length = L_W = 17 ft

Chassis Height = 2.5 ft

North Wall

$M_O = (F_{shear})[(\text{Wall+Chassis Height})/2] = (1{,}880\ \text{lbs})[(12+2.5\ \text{ft})/2] = 13{,}630\ \text{lb-ft}$

$M_R = (D.L._{Floor})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{roof})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{N.wall})(\text{Longest of } L_E \text{ or } L_W) + (D.L._{S.wall})(0) + (D.L._{E.wall})(L_E/2) + (D.L._{W.wall})(L_W/2)$

$M_R = (5086\ \text{lbs})(17\ \text{ft}/2) + (5574\ \text{lbs})(17\ \text{ft}/2) + (3619\ \text{lbs})(17\ \text{ft}) + (2178\ \text{lbs})(0) + (1828\ \text{lbs})(16\ \text{ft}/2) + (1933\ \text{lbs})(17\ \text{ft}/2) = 183{,}187.5\ \text{lb-ft}$

$U = M_O - M_R = 13{,}630\ \text{lb-ft} - 183{,}187.5\ \text{lb-ft} = -169{,}557.5\ \text{lb-ft}$ ok

$\frac{M_R}{M_O} = \frac{183{,}187.5\ \text{lb-ft}}{13{,}630\ \text{lb-ft}} = 13.44 > 2.0$ ok

South Wall

$M_O = (F_{shear})[(\text{Wall+Chassis Height})/2] = (1{,}880\ \text{lbs})[(9+2.5\ \text{ft})/2] = 10{,}810\ \text{lb-ft}$

$M_R = (D.L._{Floor})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{roof})\left(\frac{\text{Longest of } L_E \text{ or } L_W}{2}\right) + (D.L._{N.wall})(0) + (D.L._{S.wall})(\text{Longest of } L_E \text{ or } L_W) + (D.L._{E.wall})(L_E/2) + (D.L._{W.wall})(L_W/2)$

$M_R = (5086\ \text{lbs})(17\ \text{ft}/2) + (5574\ \text{lbs})(17\ \text{ft}/2) + (3619\ \text{lbs})(0) + (2178\ \text{lbs})(17\ \text{ft}) + (1828\ \text{lbs})(16\ \text{ft}/2) + (1933\ \text{lbs})(17\ \text{ft}/2) = 158{,}690.5\ \text{lb-ft}$

Tie-Down Calcs. Brittany Radke 5

$U = M_O - M_R = 10{,}810 \text{ lb-ft} - 158{,}690.5 \text{ lb-ft} = -147{,}880.5 \text{ lb-ft}$ ok

$\frac{M_R}{M_O} = \frac{158{,}690.5 \text{ lb-ft}}{10{,}810 \text{ lb-ft}} = 14.68 > 2.0$ ok

East Wall

$M_O = (F_{shear})\left[\left(\text{Wall + Chassis Height}\right)/2\right] = (1{,}810 \text{ lbs})\left[(11+2.5 \text{ ft})/2\right] = 12{,}217.5 \text{ lb-ft}$

$M_R = (D.L._{floor})\left(\frac{\text{Longest of } L_W \text{ or } L_S}{2}\right) + (D.L._{roof})\left(\frac{\text{Longest of } L_W \text{ or } L_S}{2}\right) + (D.L._{N.wall})(L_W/2)$

$+ (D.L._{S.wall})(L_S/2) + (D.L._{E.wall})(\text{Longest of } L_W \text{ or } L_S) + (D.L._{W.wall})(0)$

$M_R = (5086 \text{ lbs})(27 \text{ ft}/2) + (5574 \text{ lbs})(27 \text{ ft}/2) + (3619 \text{ lbs})(27 \text{ ft}/2) + (2178 \text{ lbs})(22 \text{ ft}/2)$

$+ (1828 \text{ lbs})(27 \text{ ft}) + (1933 \text{ lbs})(0) = 266{,}080.5 \text{ lb-ft}$

$U = M_O - M_R = 12{,}217.5 \text{ lb-ft} - 266{,}080.5 \text{ lb-ft} = -253{,}863 \text{ lb-ft}$ ok

$\frac{M_R}{M_O} = \frac{266{,}080.5 \text{ lb-ft}}{12{,}217.5 \text{ lb-ft}} = 21.78 > 2.0$ ok

West Wall

$M_O = (F_{shear})\left[\left(\text{Wall + Chassis Height}\right)/2\right] = (1{,}810 \text{ lbs})\left[(11+2.5 \text{ ft})/2\right] = 12{,}217.5 \text{ lb-ft}$

$M_R = (D.L._{floor})\left(\frac{\text{Longest of } L_W \text{ or } L_S}{2}\right) + (D.L._{roof})\left(\frac{\text{Longest of } L_W \text{ or } L_S}{2}\right) + (D.L._{N.wall})(L_W/2)$

$+ (D.L._{S.wall})(L_S/2) + (D.L._{E.wall})(0) + (D.L._{W.wall})(\text{Longest of } L_W \text{ or } L_S)$

$M_R = (5086 \text{ lbs})(27 \text{ ft}/2) + (5574 \text{ lbs})(27 \text{ ft}/2) + (3619 \text{ lbs})(27 \text{ ft}/2) + (2178 \text{ lbs})(22 \text{ ft}/2)$

$+ (1828 \text{ lbs})(0) + (1933 \text{ lbs})(27 \text{ ft}) = 268{,}915.5 \text{ lb-ft}$

$U = M_O - M_R = 12{,}217.5 \text{ lb-ft} - 268{,}915.5 \text{ lb-ft} = -256{,}698 \text{ lb-ft}$

$\frac{M_R}{M_O} = \frac{268{,}915.5 \text{ lb-ft}}{12{,}217.5 \text{ lb-ft}} = 22.01 > 2.0$ ok

→ No tie-downs required to prevent overturning of Module B.

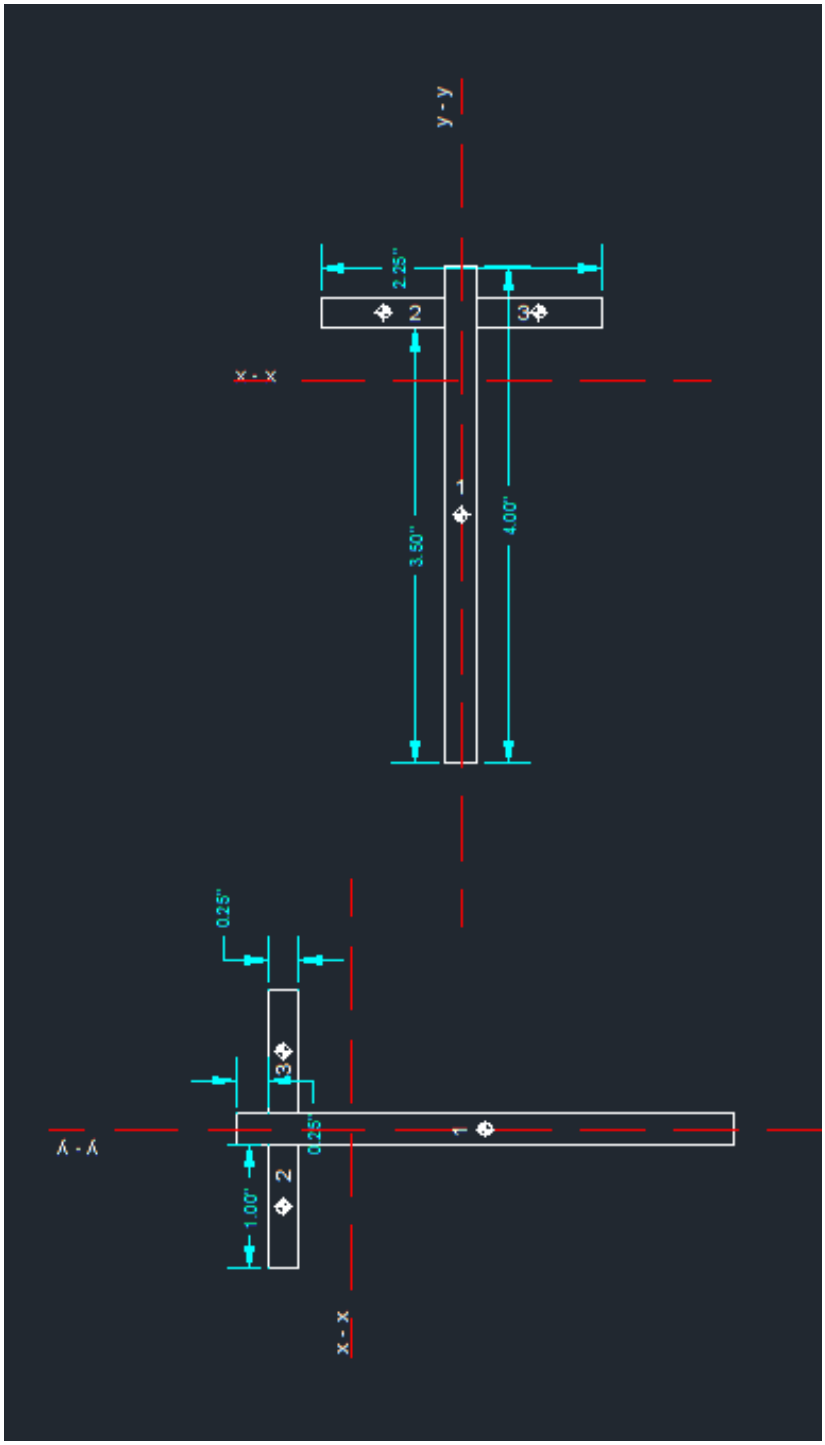
Uplift- Deck

	Weight (psf)	Weight (lbs)		
Deck DL	20	18500	Uplift Pressure (psf): -18.7	psf
			Deck Surface Area: 925	ft^2

			Uplift Force(lbs)
Total DL (lbs)	18500	>	17297.5

Steel Window Frame Fin

Clerestory Steel Window Frame Fin Column Calculations



Steel Window frame Fin Calculations
Module B Wrap Around Window Fins

Local Stability

Yield Stress	F_y	36 ksi			
	b_f	1 in		b_{stem}	3.5 in
	t_f	0.25 in		t_{stem}	0.25 in
	b_f/t_f	4		b_{stem}/t_{stem}	14
Flange Buckling Coefficient	λ_{r_flange}	15.89	Slender Flange?	**NO**	
Stem Buckling Coefficient	λ_{r_stem}	21.29	Slender Stem?	**NO**	
Effective Stem Width	b_e	3.50 in			
Effective Area	A_e	1.50 in^2			
Slender Elem. Reduction Factc	Q	1.00			

Cross Sectional Area	A	1.5 in^2		
Radius of Gyration	r_y	0.402 in		
	r_x	1.215 in		
Effective Length Factor	K	1.0	Max Slenderness Check	
MAX Slenderness Ratio	KL/r	29.86	**OK**	

Modulus of Elasticity	E	29,000.00 ksi		
Moment of Inertia	I_y	0.242 in^4		
	I_x	2.216 in^4		
Max Yield Length	L_y	35.83 in		
Unsupported Length	L	12 in		
Failure Type		**Short Column; YEILD Failure**		

THEORETICAL COLUMN STRENGTH

Yield Capacity	P_y	54 kips		
X-X Critical Buckling Load	P_{cr_x}	4,404.87 kips		
Y-Y Critical Buckling Load	P_{cr_y}	481.38 kips		

Elastic / Inelastic Buckling	133.68			133.68
	INELASTIC BUCKLING DOMINATES			**If Slender Flange or Stem**
Euler Buckling Stress	F_e	320.92 ksi		
Critical Stress	F_{cr}	34.35 ksi		34.35 ksi
Nominal Strength	P_n	51.52 kips		51.52 kips
ASD Allowable Strength	P_n/Ω	30.85 kips		30.85 kips

Load Cases	P lb	Capacity Check	Capacity %	Safety Factor
D	402.80	**OK**	1.306%	77
D + L	726.80	**OK**	2.356%	42
D + (Lr or S)	726.80	**OK**	2.356%	42
D + 0.75L	645.80	**OK**	2.093%	48
D + (W or 0.7E)	608.54	**OK**	1.972%	51
D + 0.75L + 0.75(W or 0.7E)	**800.11**	**OK**	2.593%	39
0.6D + W	447.42	**OK**	1.450%	69
0.6D + 0.7E	298.60	**OK**	0.968%	103

Shape Geometry	x-x Direction			
	shape 1	shape 2	shape 3	
b	0.25	1	1	
h	4	0.25	0.25	
Area	1	0.25	0.25	
distance from origin	2	3.625	3.625	in
finding $\bar{y}$	2.541667	in		
	d_1	d_2	d_3	
Transfer Distance	0.541667	1.083333	1.083333	
axd^2	0.293403	0.293403	0.293403	
Segment I	1.333333	0.001302	0.001302	
$I_x = \Sigma Io + \Sigma ad^2$	2.216146	in^4		

Shape Geometry	y-y Direction			
	shape 1	shape 2	shape 3	
b	4	0.25	0.25	
h	0.25	1	1	
Area	1	0.25	0.25	
distance from orig	1.125	1.75	0.5	
finding $\bar{x}$	1.125	in		
	d_1	d_2	d_3	
Transfer Distance	0	0.625	0.625	
axd^2	0	0.097656	0.097656	
Segment I	0.005208	0.020833	0.020833	
$I_y = \Sigma Io + \Sigma ad^2$	0.242188	in^4		

Roof Trib. Length	8.1 ft	Roof Dead Load	14 lb/ft^2
Wall Trib. Height	8 ft	Roof Live Load	20 lb/ft^2
Fin Spacing	2 ft	Wall Dead Load	11 lb/ft^2
Roof Trib. Area	**16.2 ft^2**		
Wall Trib Area	**16 ft^2**		

Dead Load	402.80 lb	
Live Load	324 lb	
Seismic Force (0.7E)	56.92 lb	$0.2S_{DS}D$
Wind Force (W)	205.74 lb	Components & Cladding

Seismic Force (0.7E)	1.0093	S_{DS}	design, 5 percent damped, spectral response acceleration parameter at short periods
Wind Pressure	12.7	lb/ft^2	Maximum positive value from Roof Components & Cladding

Steel Window frame Fin Calculations
Module B North T Window

Local Stability

Yield Stress	F_y	36 ksi			
	b_f	1 in		b_{stem}	3.5 in
	t_f	0.25 in		t_{stem}	0.25 in
	b_f/t_f	4		b_{stem}/t_{stem}	14
Flange Buckling Coefficient	λ_{r_flange}	15.89	Slender Flange?	**NO**	
Stem Buckling Coefficient	λ_{r_stem}	21.29	Slender Stem?	**NO**	
Effective Stem Width	b_e	3.50 in			
Effective Area	A_e	1.50 in^2			
Slender Elem. Reduction Factc	Q	1.00			

Cross Sectional Area	A	1.5 in^2		
Radius of Gyration	r_y	0.402 in		
	r_x	1.215 in		
Effective Length Factor	K	1.0	Max Slenderness Check	
MAX Slenderness Ratio	KL/r	29.86	**OK**	

Modulus of Elasticity	E	29,000.00 ksi		
Moment of Inertia	I_y	0.242 in^4		
	I_x	2.216 in^4		
Max Yield Length	L_y	35.83 in		
Unsupported Length	L	12 in		
Failure Type		**Short Column; YEILD Failure**		

THEORETICAL COLUMN STRENGTH			
Yield Capacity	P_y	54 kips	
X-X Critical Buckling Load	P_{cr_x}	4,404.87 kips	
Y-Y Critical Buckling Load	P_{cr_y}	481.38 kips	
Elastic / Inelastic Buckling	133.68		133.68
	INELASTIC BUCKLING DOMINATES		**If Slender Flange or Stem**
Euler Buckling Stress	F_e	320.92 ksi	
Critical Stress	F_{cr}	34.35 ksi	34.35 ksi
Nominal Strength	P_n	51.52 kips	51.52 kips
ASD Allowable Strength	P_n/Ω	30.85 kips	30.85 kips

Load Cases	P lb	Capacity Check	Capacity %	Safety Factor
D	270.80	**OK**	0.878%	114
D + L	594.80	**OK**	1.928%	52
D + (Lr or S)	594.80	**OK**	1.928%	52
D + 0.75L	513.80	**OK**	1.665%	60
D + (W or 0.7E)	476.54	**OK**	1.545%	65
D + 0.75L + 0.75(W or 0.7E)	**668.11**	**OK**	2.166%	46
0.6D + W	368.22	**OK**	1.193%	84
0.6D + 0.7E	200.74	**OK**	0.651%	154

Shape Geometry	x-x Direction			
	shape 1	shape 2	shape 3	
b	0.25	1	1	
h	4	0.25	0.25	
Area	1	0.25	0.25	
distance from origin	2	3.625	3.625	in
finding $\bar{y}$	2.541667	in		
	d_1	d_2	d_3	
Transfer Distance	0.541667	1.083333	1.083333	
axd^2	0.293403	0.293403	0.293403	
Segment I	1.333333	0.001302	0.001302	
$I_x = \Sigma Io + \Sigma ad^2$	2.216146	in^4		

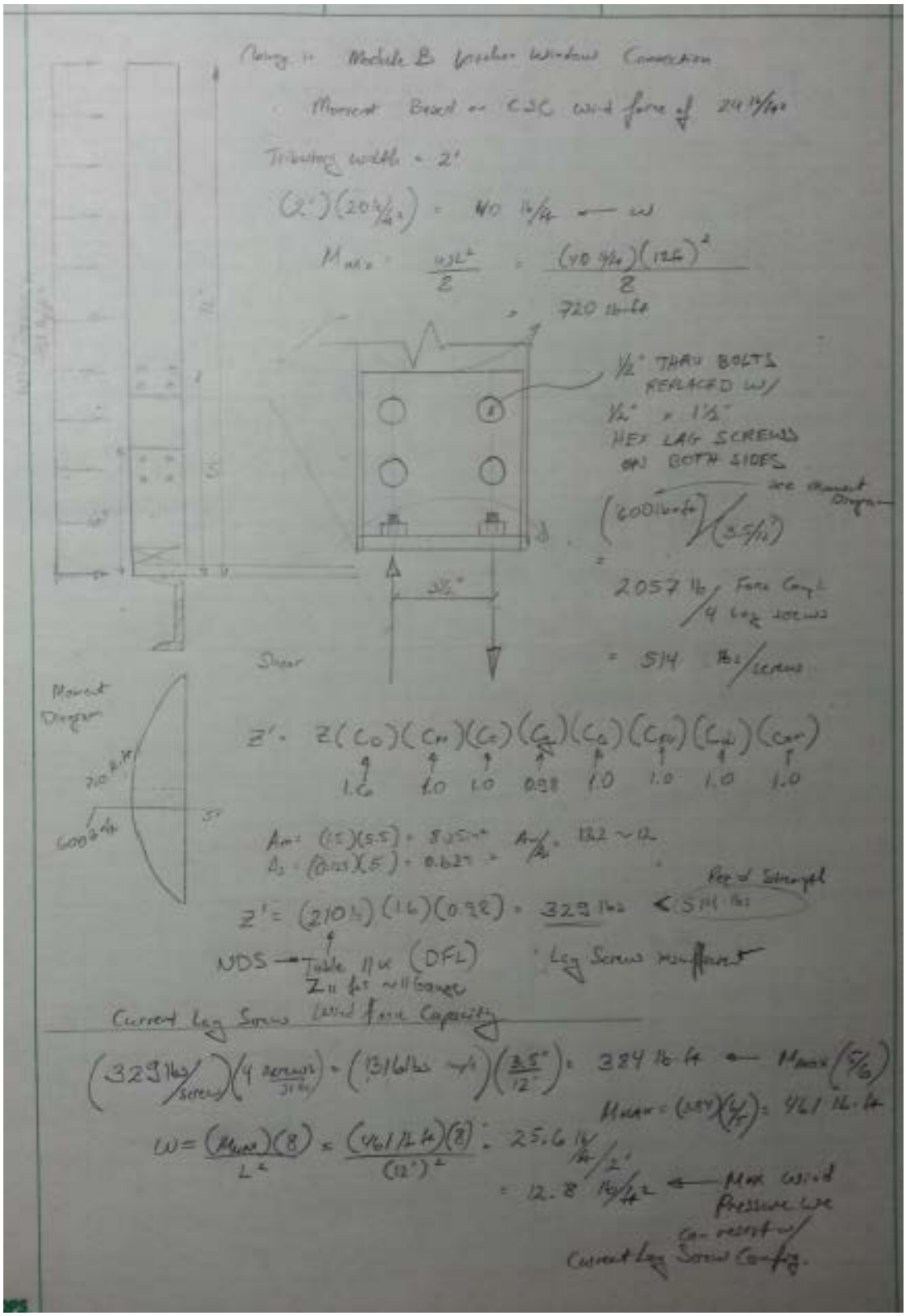
Shape Geometry	y-y Direction			
	shape 1	shape 2	shape 3	
b	4	0.25	0.25	
h	0.25	1	1	
Area	1	0.25	0.25	
distance from orig	1.125	1.75	0.5	
finding $\bar{x}$	1.125	in		
	d_1	d_2	d_3	
Transfer Distance	0	0.625	0.625	
axd^2	0	0.097656	0.097656	
Segment I	0.005208	0.020833	0.020833	
$I_y = \Sigma Io + \Sigma ad^2$	0.242188	in^4		

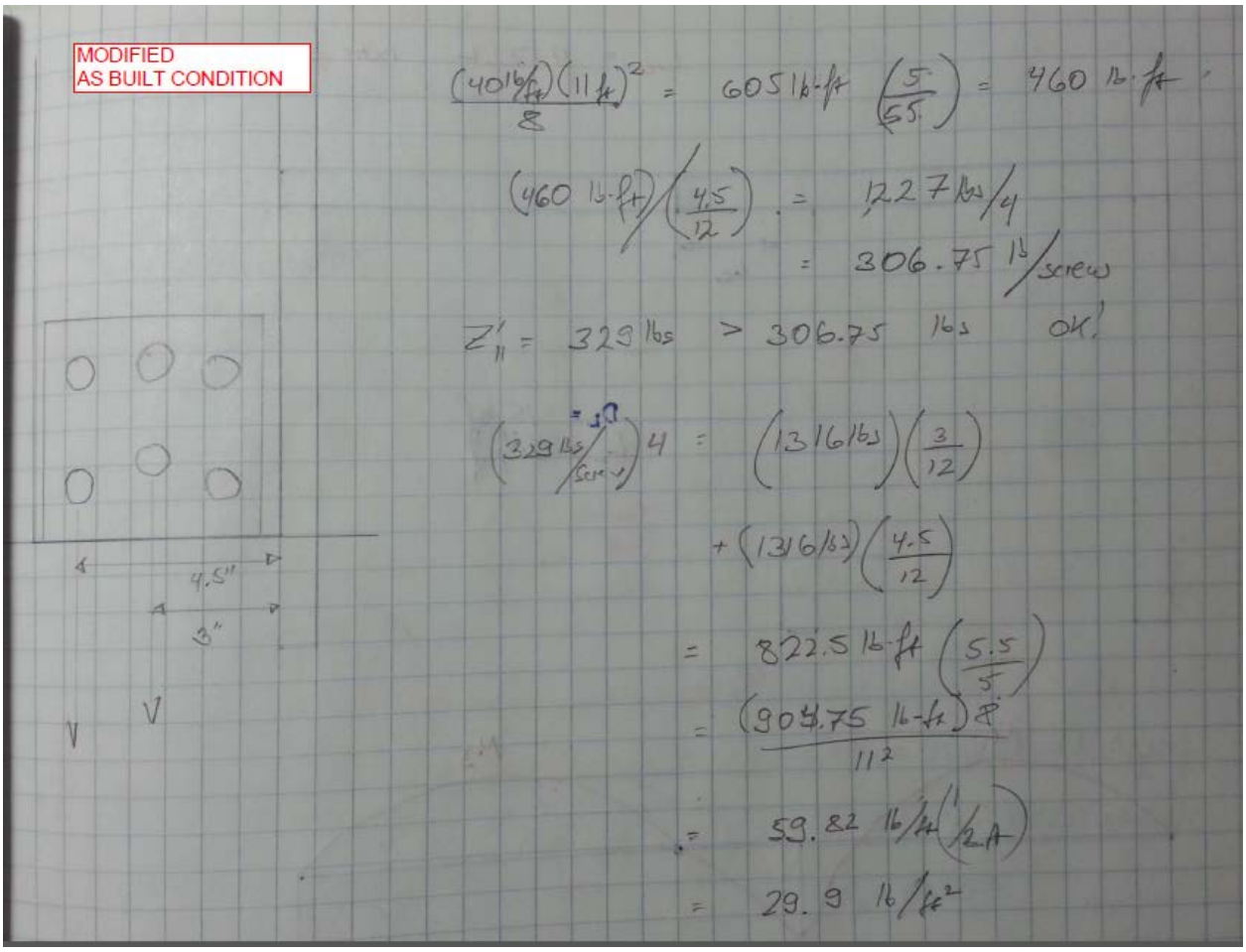
Roof Trib. Length	8.1 ft	Roof Dead Load	14 lb/ft^2
Wall Trib. Height	2 ft	Roof Live Load	20 lb/ft^2
Fin Spacing	2 ft	Wall Dead Load	11 lb/ft^2
Roof Trib. Area	**16.2 ft^2**		
Wall Trib Area	**4 ft^2**		

Dead Load	270.80 lb	
Live Load	324 lb	
Seismic Force (0.7E)	38.26 lb	$0.2S_{DS}D$
Wind Force (W)	205.74 lb	Components & Cladding

Seismic Force (0.7E)	1.0093	S_{DS}	design, 5 percent damped, spectral response acceleration parameter at short periods
Wind Pressure	12.7	lb/ft^2	Maximum positive value from Roof Components & Cladding

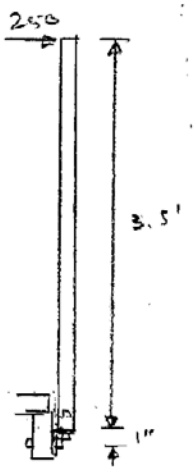
Module B Window Moment Connection




MODIFIED
AS BUILT CONDITION
4.5"
3"
V
V

SCREEN #1 – NORTH WEST

D.L. = 98.5417 lbs



$M_{D.L.} = 98.5417(1) = 8.212$ lb·ft

$M = 250(3.583) = 895.83$ lb·ft

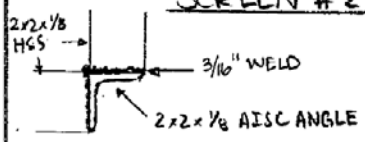
$M_T = 904.04$ lb·ft $= 10.85$ kip·in

$\frac{\text{MOMENT}}{\#\text{BOLTS}} = \frac{10.85}{2} = 5.424$ kip·in/bolt

$\frac{5.424 \text{ kip·in}}{1 \text{ in}} = 5.424$ kip/bolt

TABLE 7.1 → BOLT SIZE REQUIRED: 3/4"

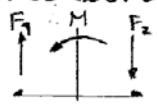
SCREEN #2 – NORTH WEST



MOMENT OF CONCENTRATED LOAD:

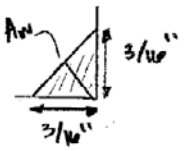
$M = 250(3.5)(12) = 10500$ lb·in $= 10.5$ kip·in

FORCE COUPLE AT WELD:



$F_2(2) - 10.5 = 0 \quad F_2 = 5.25$ kip

WELD REQUIRED:



$A_W = 0.132582(2) = 0.265$ in²

$F_W = 0.60 F_{EXX} = 42$ ksi $\qquad F_{EXX}$ = FILLER METAL = 70ksi

$R_n = F_W A_W = 42(0.265) = 11.13$ kips $\qquad \frac{R_n}{\Omega} = \frac{11.13}{1.88} = 5.92$ kips

GUARDRAIL PLANTER CONNECTION – NORTH EAST RAMP

D.L. = 111.40 lbs

$M_{D.L.} = 111.40\ (1) = 111.40\ lb \cdot in = 0.1114\ kip \cdot in$

$M = 250\ (40.5) = 10125\ lb \cdot in = 10.125\ kip \cdot in$

$M_T = 10.2364\ kip \cdot in$

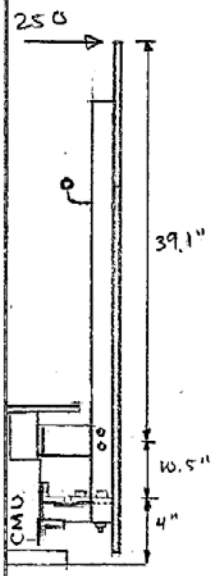
$\frac{MOMENT}{\#BOLTS} = \frac{10.2364}{2} = 5.1182\ kip \cdot in/bolt$

TABLE 7-1 IN AISC STEEL CONSTRUCTION MANUAL

BOLT SIZE REQUIRED:

3/4"

GUARDRAIL MOMENT AND SHEAR RESISTANCE



D.L. = 78.03 lb

$M_{D.L.} = 78.03\ (1) = 78.03\ lb \cdot in = 0.07803\ kip \cdot in$

$M = 250\ [39.1 + (10.5/2)] = 11087.5\ lb \cdot in = 11.0875\ kip \cdot in$

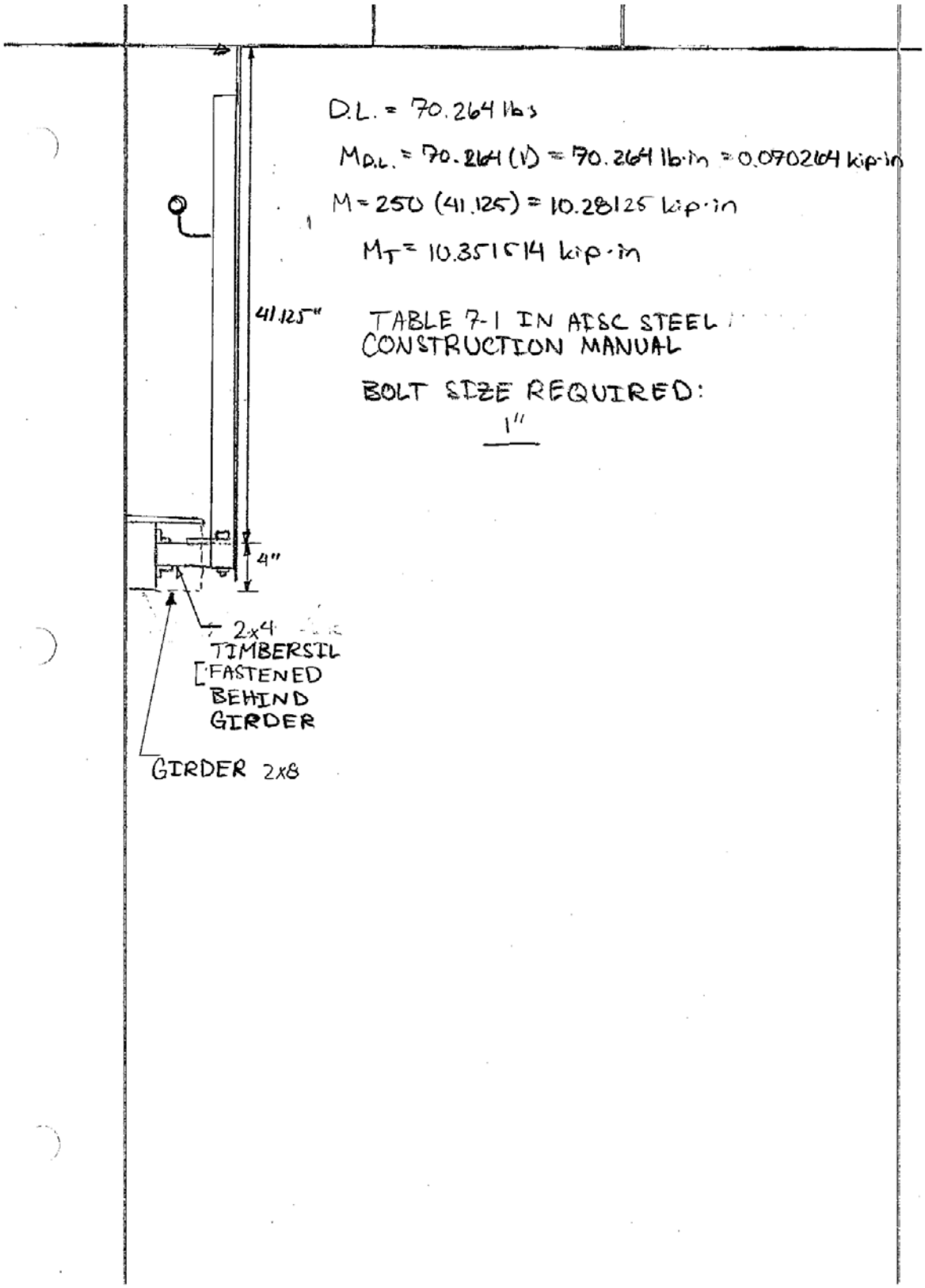
$M_T = 11.16553\ kip \cdot in$

$\frac{MOMENT}{\#BOLTS} = \frac{11.16553}{3} = 3.728\ kip \cdot in/bolt$

TABLE 7-1 IN AISC STEEL CONSTRUCTION MANUAL

BOLT SIZE REQUIRED:

5/8"

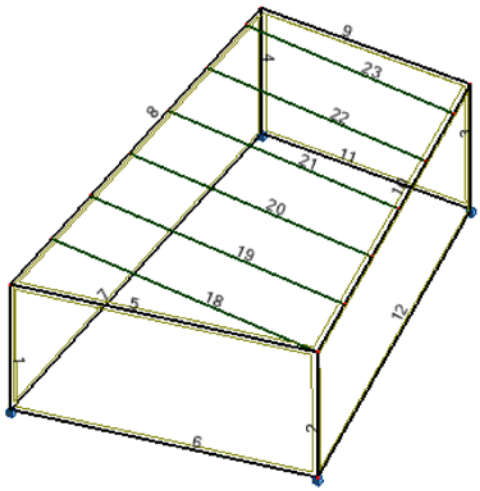

D.L. = 70.264 lbs
$M_{D.L.}$ = 70.264 (1) = 70.264 lb·in = 0.070264 kip·in
M = 250 (41.125) = 10.28125 kip·in
M_T = 10.351514 kip·in
41.125"
TABLE 7-1 IN AISC STEEL CONSTRUCTION MANUAL
BOLT SIZE REQUIRED:
1"
4"
2x4 TIMBERSIL FASTENED BEHIND GIRDER
GIRDER 2x8

Planter Design

Realistic View

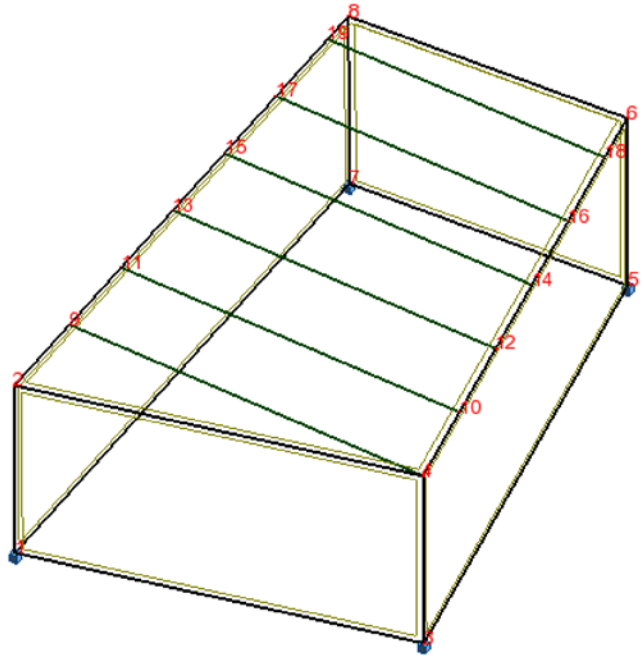
Cases: 11 (Wx-)

Bar Names

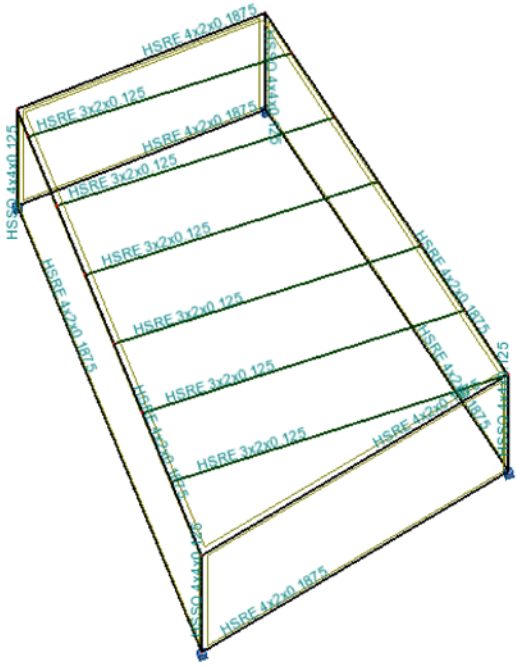


Cases: 11 (Wx-)

Node Names

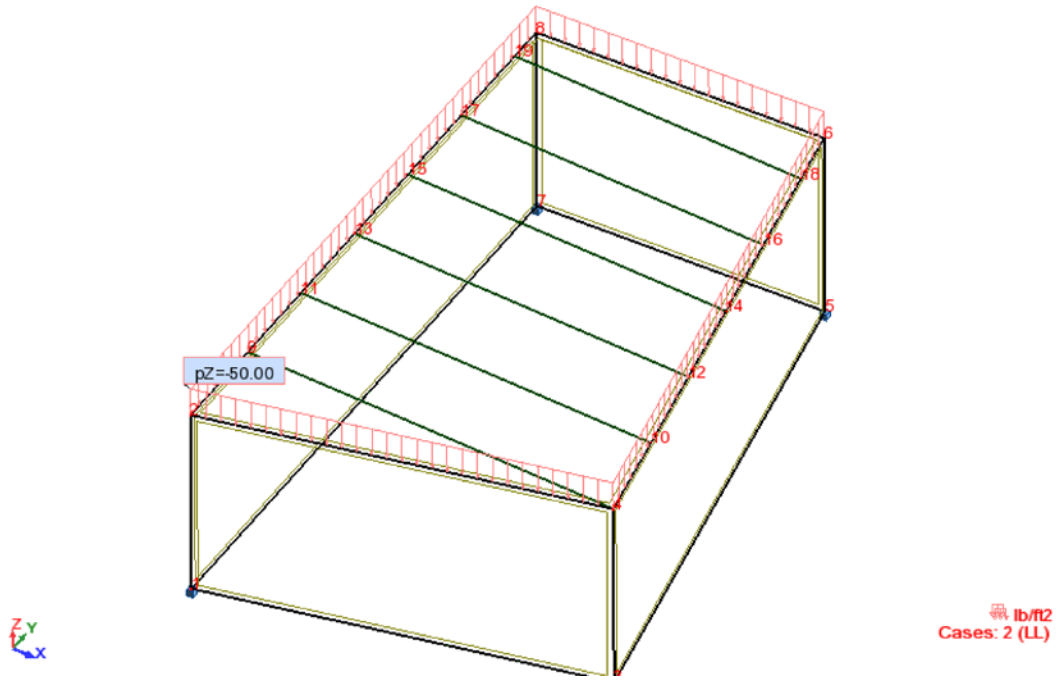


Sections

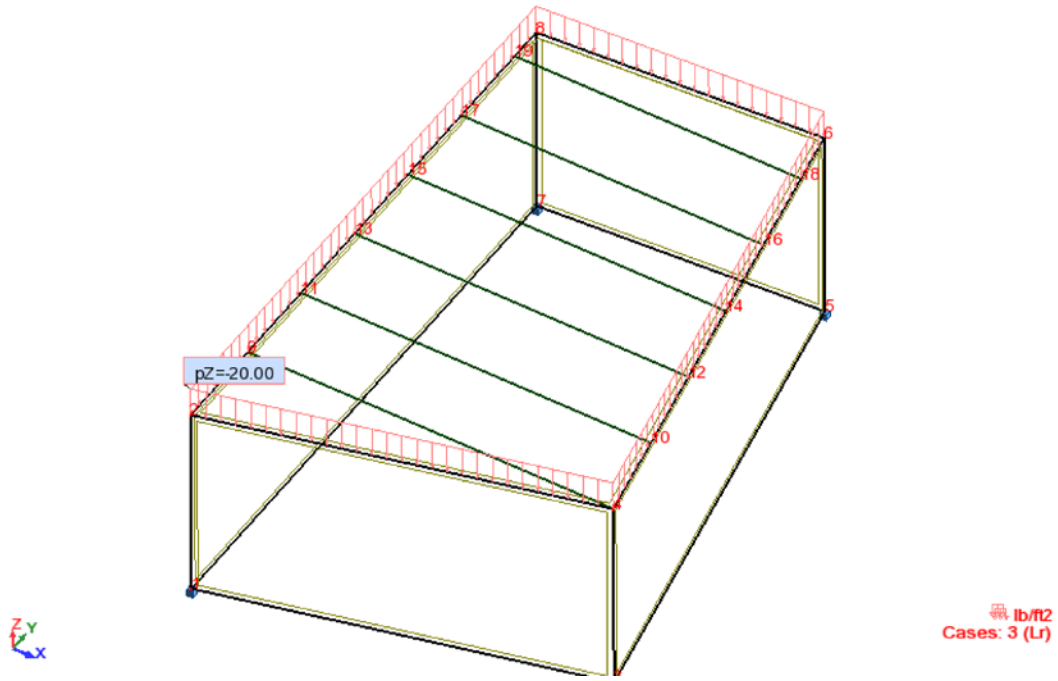


View - Cases: 1 (DL)

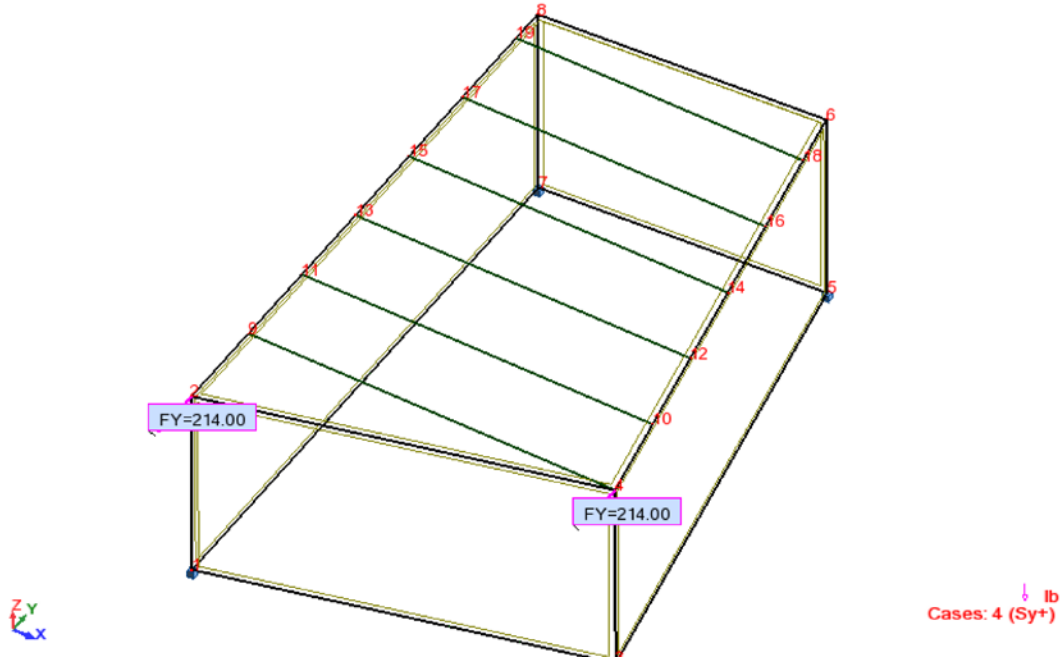
View - Cases: 2 (LL)



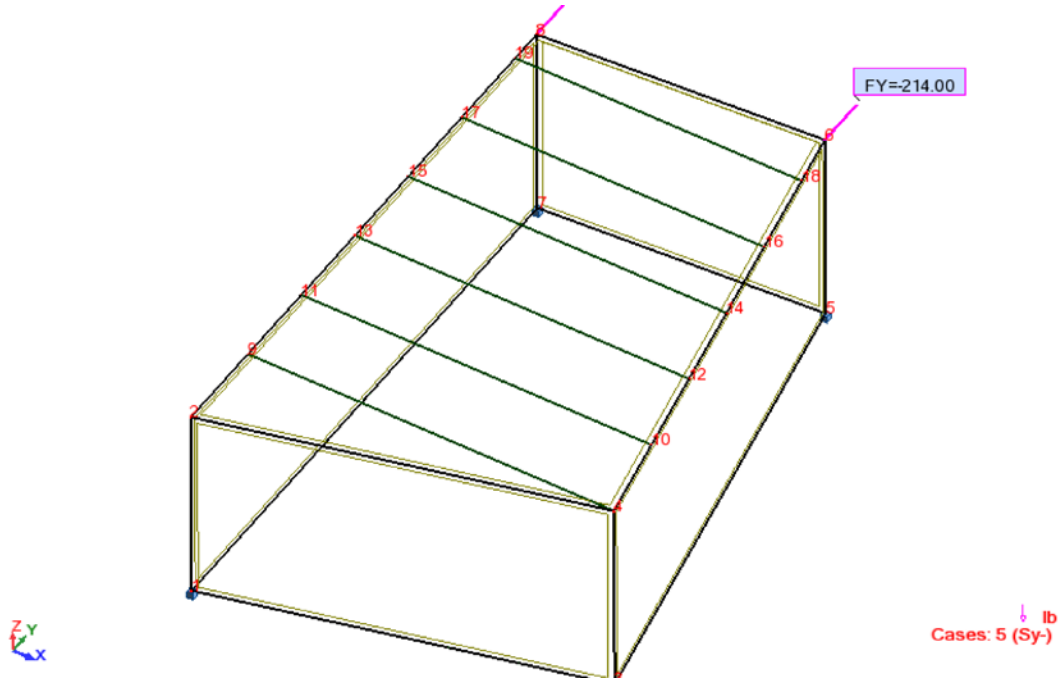
View - Cases: 3 (Lr)



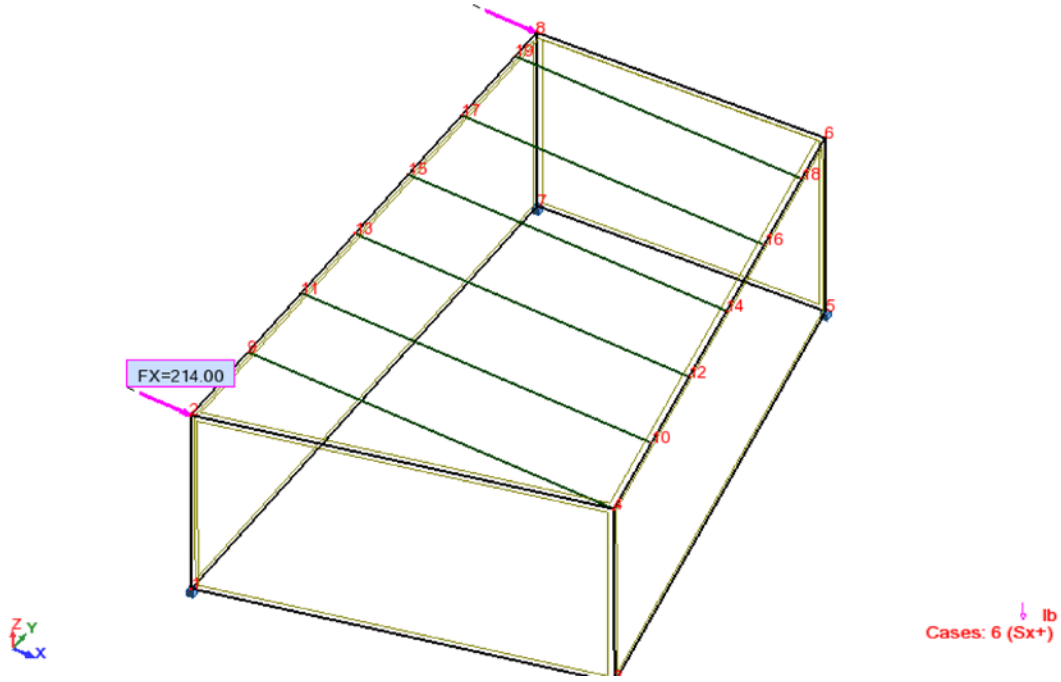
View - Cases: 4 (Sy+)



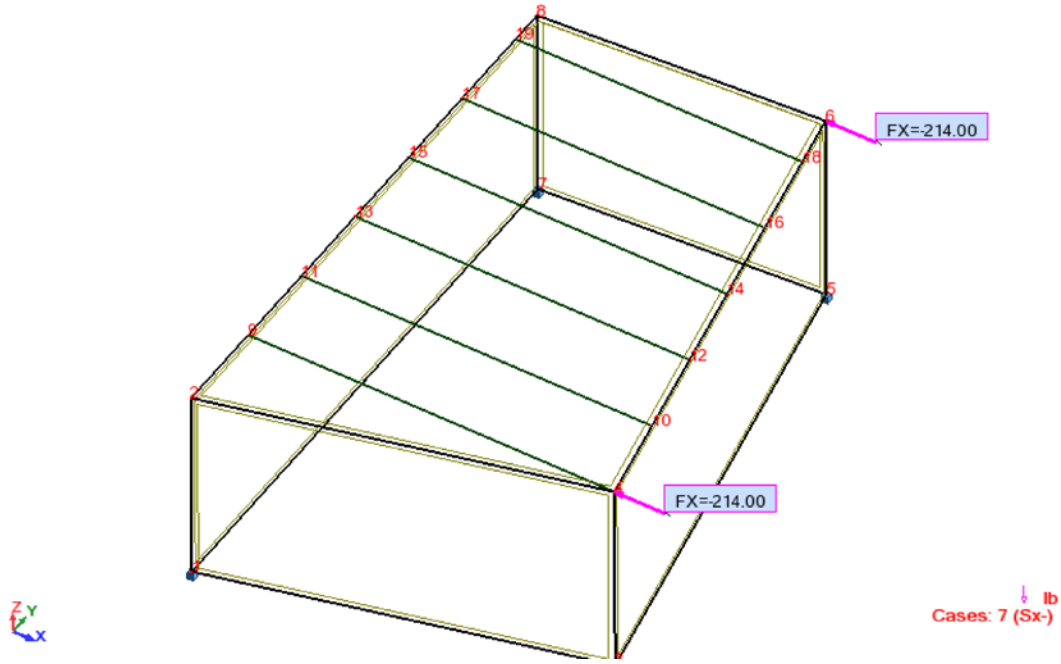
View - Cases: 5 (Sy-)



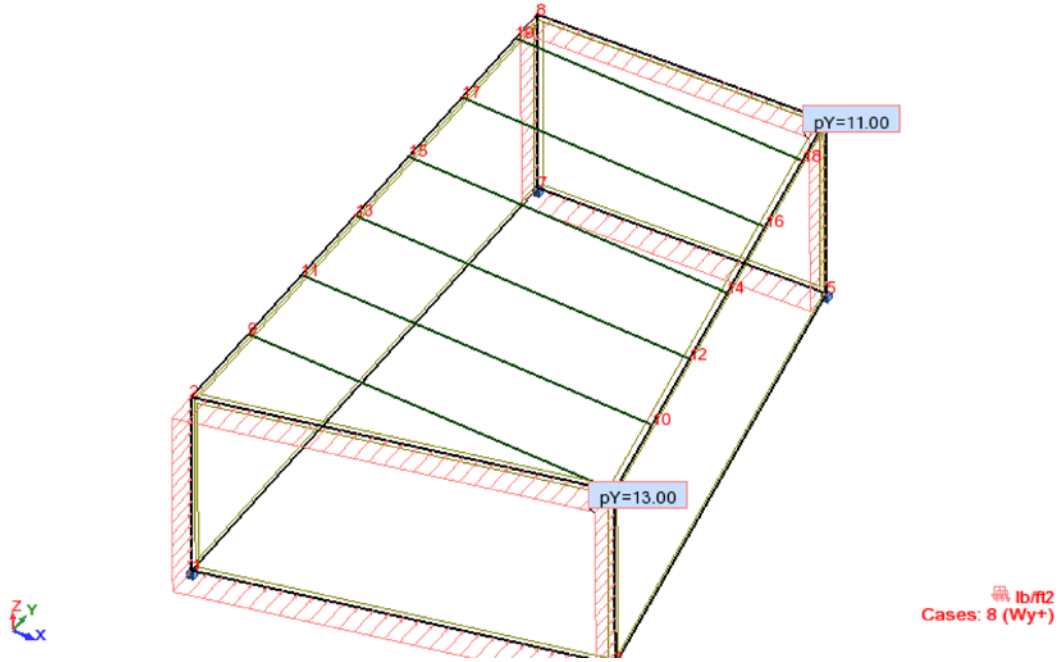
View - Cases: 6 (Sx+)



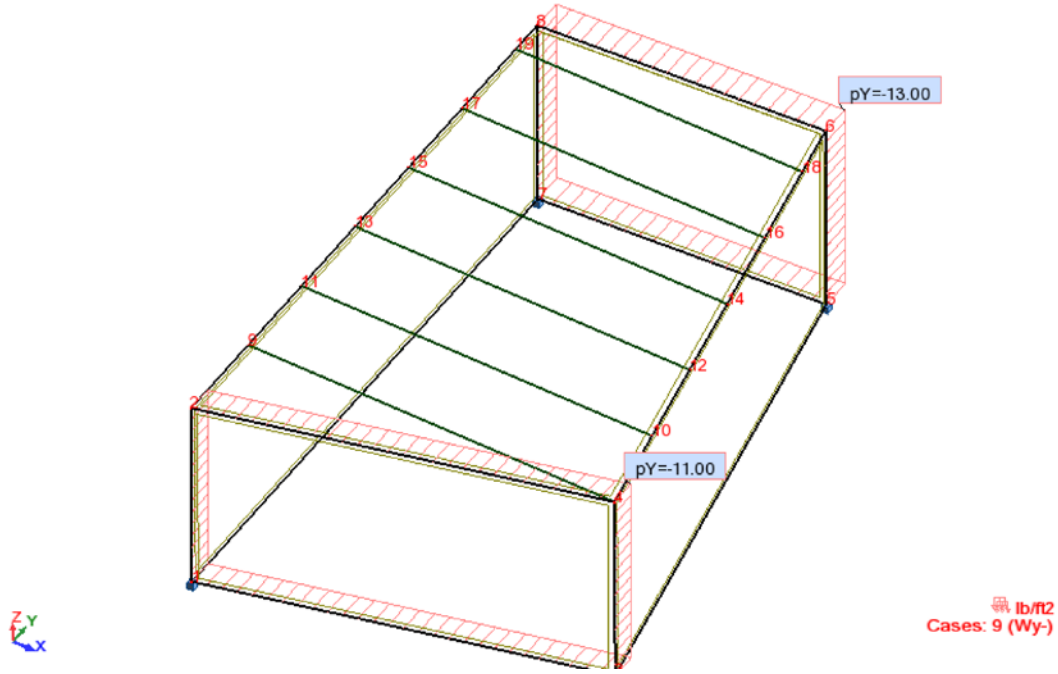
View - Cases: 7 (Sx-)



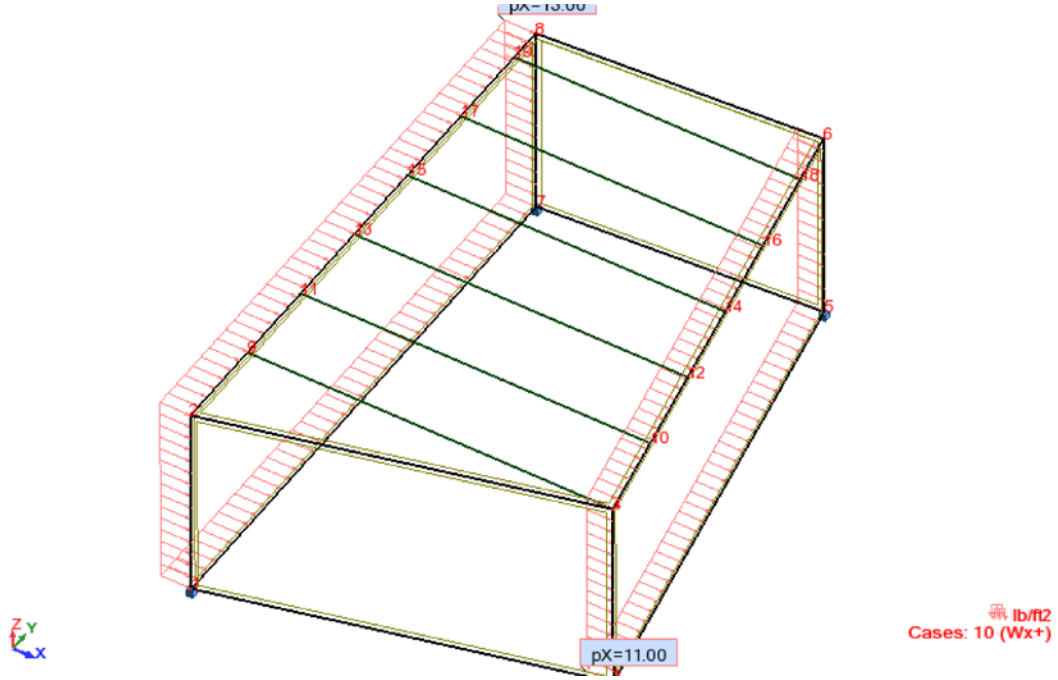
View - Cases: 8 (Wy+)



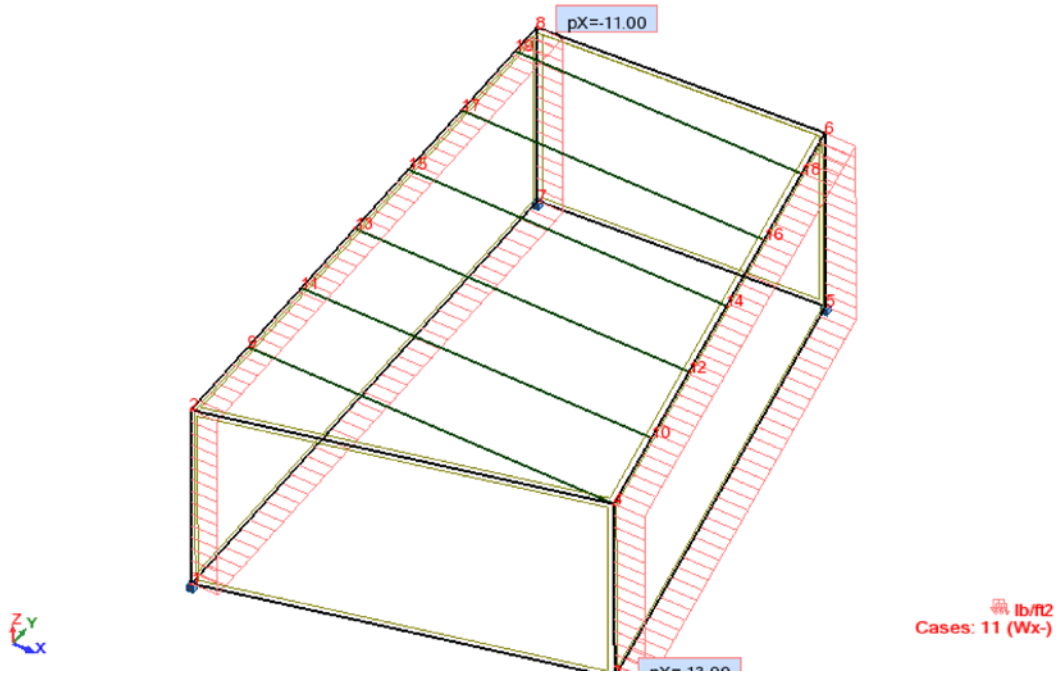
View - Cases: 9 (Wy-)



View - Cases: 10 (Wx+)



View - Cases: 11 (Wx-)



Member Results

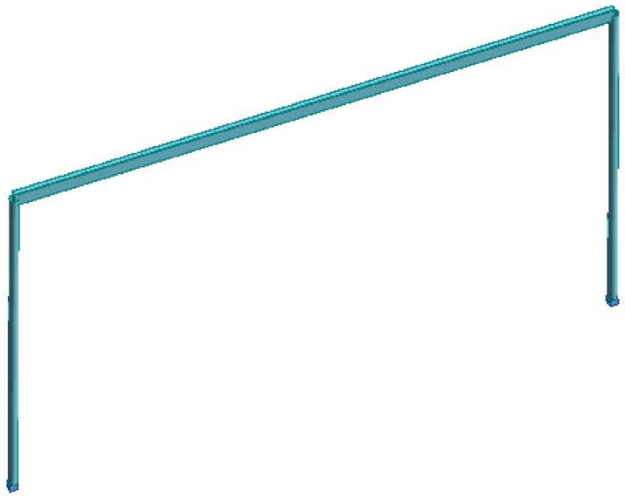
Member	Section	Material	Lay	Laz	Ratio	Case
1 Column_1	HSSQ 4x4x0.125	STEEL	36.15	36.15	0.81	27 D+0.75L+0.75Lr+0.75(0.6Wx-)
2 Column_2	HSSQ 4x4x0.125	STEEL	36.15	36.15	0.74	26 D+0.75L+0.75Lr+0.75(0.6Wx+)
3 Column_3	HSSQ 4x4x0.125	STEEL	36.15	36.15	0.66	27 D+0.75L+0.75Lr+0.75(0.6Wx-)
4 Column_4	HSSQ 4x4x0.125	STEEL	36.15	36.15	0.80	27 D+0.75L+0.75Lr+0.75(0.6Wx-)
5 Beam_5	HSRE 4x2x0.1875	STEEL	75.98	131.61	0.14	26 D+0.75L+0.75Lr+0.75(0.6Wx+)
6 Beam_6	HSRE 4x2x0.1875	STEEL	75.98	131.61	0.08	16 D+0.6Wy+
7 Beam_7	HSRE 4x2x0.1875	STEEL	111.50	193.12	0.18	18 D+0.6Wx+
8 Beam_8	HSRE 4x2x0.1875	STEEL	111.50	11.95	0.89	27 D+0.75L+0.75Lr+0.75(0.6Wx-)
9 Beam_9	HSRE 4x2x0.1875	STEEL	55.84	96.71	0.15	19 D+0.6Wx-
10 Beam_10	HSRE 4x2x0.1875	STEEL	98.59	30.38	0.67	26 D+0.75L+0.75Lr+0.75(0.6Wx+)
11 Beam_11	HSRE 4x2x0.1875	STEEL	55.84	96.71	0.04	17 D+0.6Wy-
12 Beam_12	HSRE 4x2x0.1875	STEEL	98.59	170.76	0.14	19 D+0.6Wx-
18 Joist_18	HSRE 3x2x0.125	STEEL	93.08	127.58	0.51	26 D+0.75L+0.75Lr+0.75(0.6Wx+)
19 Joist_19	HSRE 3x2x0.125	STEEL	89.03	122.03	0.59	25 D+0.75L+0.75Lr+0.75(0.6Wy-)
20 Joist_20	HSRE 3x2x0.125	STEEL	84.99	116.48	0.54	24 D+0.75L+0.75Lr+0.75(0.6Wy+)
21 Joist_21	HSRE 3x2x0.125	STEEL	80.94	110.93	0.49	27 D+0.75L+0.75Lr+0.75(0.6Wx-)
22 Joist_22	HSRE 3x2x0.125	STEEL	76.89	105.38	0.46	26 D+0.75L+0.75Lr+0.75(0.6Wx+)
23 Joist_23	HSRE 3x2x0.125	STEEL	72.84	99.84	0.31	27 D+0.75L+0.75Lr+0.75(0.6Wx-)

Deflection Results

Bar/Case	UX (in)	UY (in)	UZ (in)
1/ 40 (C)	0.0000	-0.0359	-0.0015
2/ 40 (C)	0.0000	-0.0261	-0.0092
3/ 40 (C)	-0.0000	0.0263	-0.0027
4/ 40 (C)	-0.0000	0.0351	-0.0015
5/ 40 (C)	-0.0000	0.0004	-0.0275
6/ 40 (C)	0.0	0.0	-0.0016
7/ 40 (C)	0.0	0.0	-0.0076
8/ 40 (C)	-0.0000	-0.0015	-0.4818
9/ 40 (C)	0.0000	-0.0003	-0.0009
10/ 40 (C)	0.0000	0.0011	-0.2970
11/ 40 (C)	0.0	0.0	-0.0005
12/ 40 (C)	0.0	0.0	-0.0047
18/ 40 (C)	-0.0000	0.0000	-0.3196
19/ 40 (C)	-0.0000	-0.0000	-0.3467
20/ 40 (C)	-0.0000	0.0000	-0.2872
21/ 40 (C)	-0.0000	-0.0000	-0.2357
22/ 40 (C)	-0.0000	-0.0000	-0.1988
23/ 40 (C)	-0.0000	0.0000	-0.1187

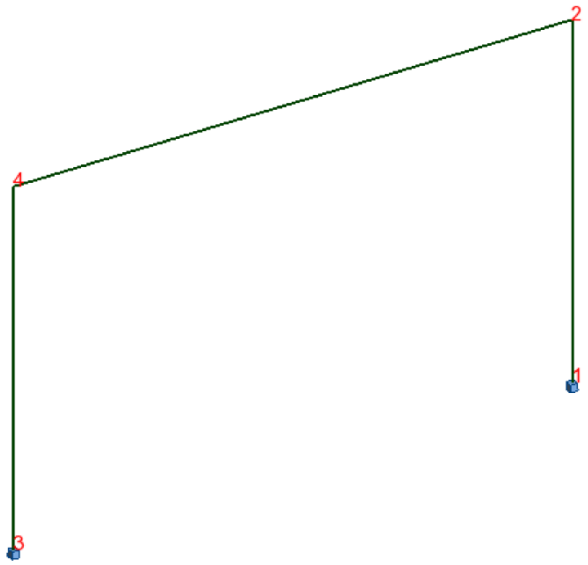
PV Moment Frame

Realistic View



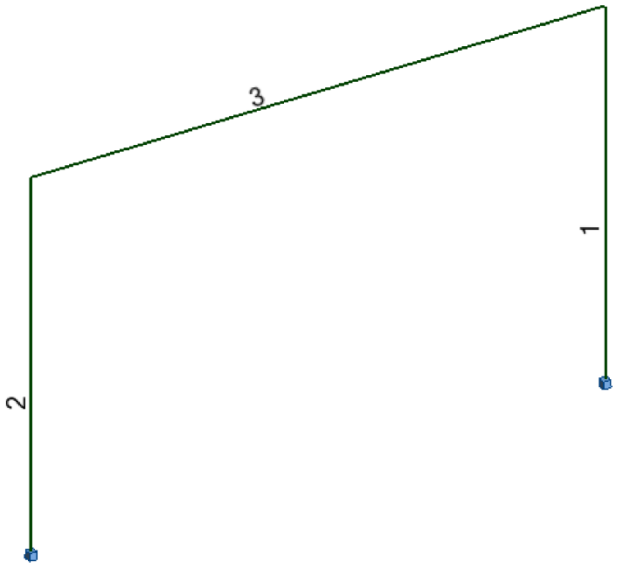
Cases: 1 (PV DL)

Node Numbers



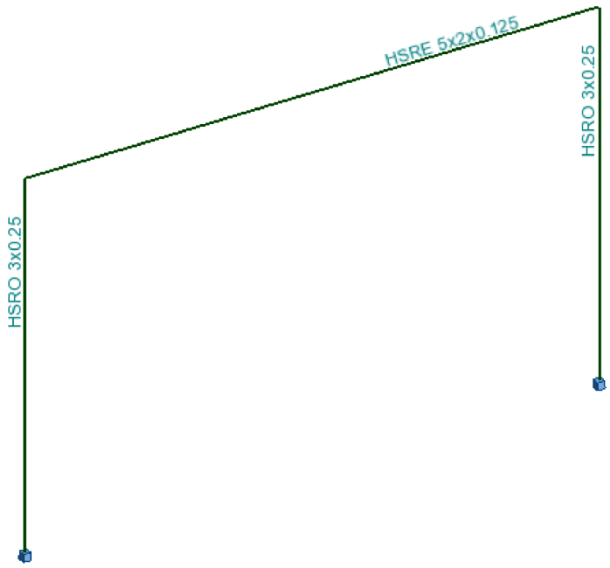
Cases: 1 (PV DL)

Bar Names



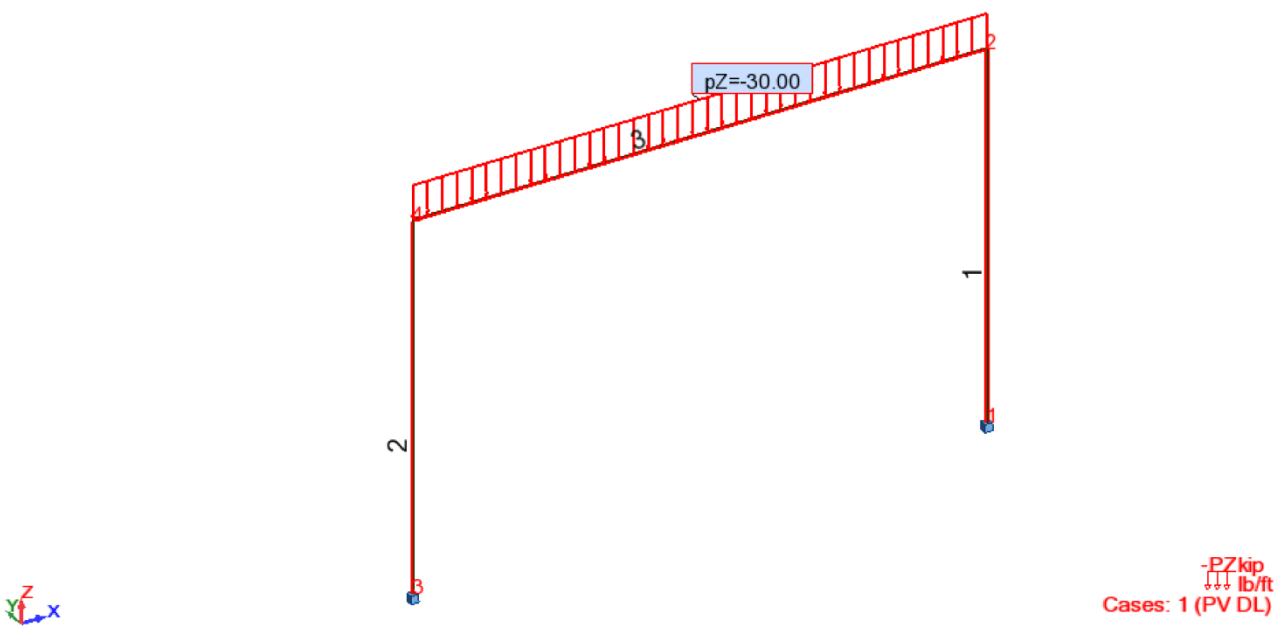
Cases: 1 (PV DL)

Sections

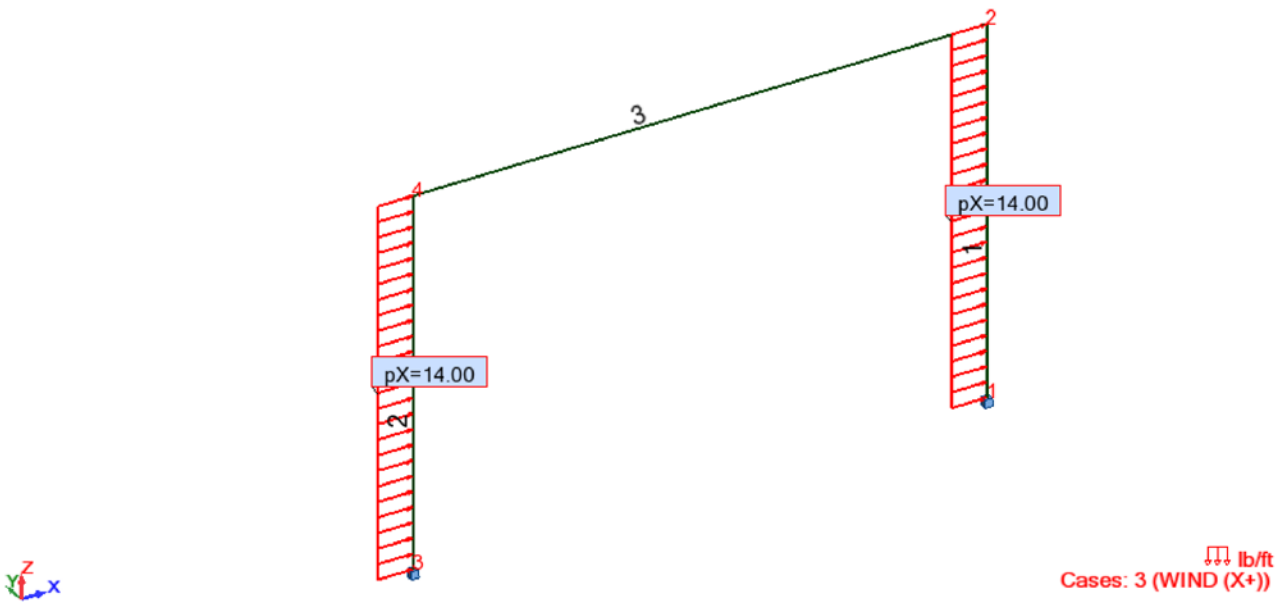


Cases: 1 (PV DL)

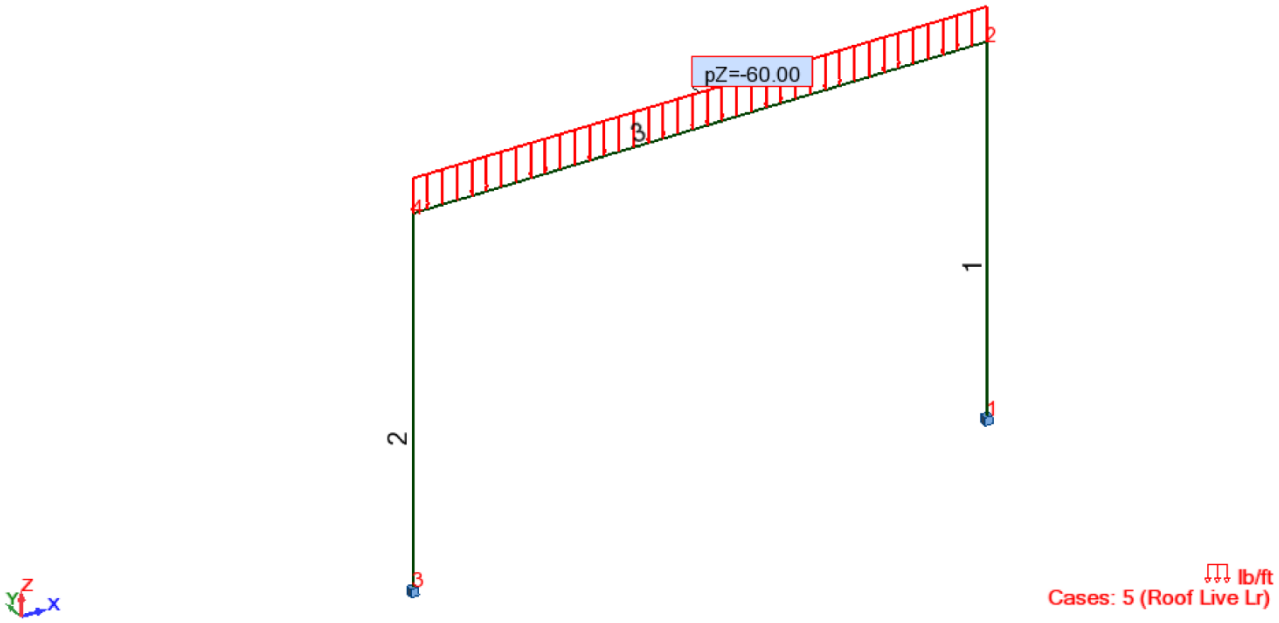
View - Cases: 1 (PV DL



View - Cases: 3 (WIND (X+))



View - Cases: 5 (Roof Live Lr)



Member Results

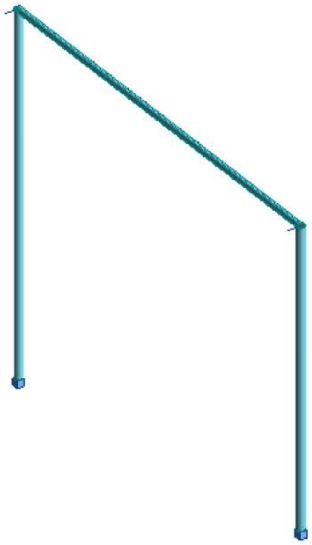
Member	Section	Material	Lay	Laz	Ratio	Case
1 Column_1	HSRO 3x0.25	STEEL	126.01	126.01	0.24	10 D+W
2 Column_2	HSRO 3x0.25	STEEL	126.01	126.01	0.24	10 D+W
3 PV_3	HSRE 5x2x0.125	STEEL	27.62	56.79	0.05	11 D+Lr

Deflection Results

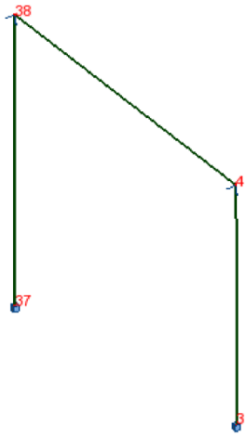
Bar/Case	UX (in)	UY (in)	UZ (in)
1/ 10 (C)	0.0000	-0.0943	0.0000
2/ 10 (C)	0.0000	-0.0943	0.0000
3/ 10 (C)	0.0000	0.0	-0.3853

West Shader Frame

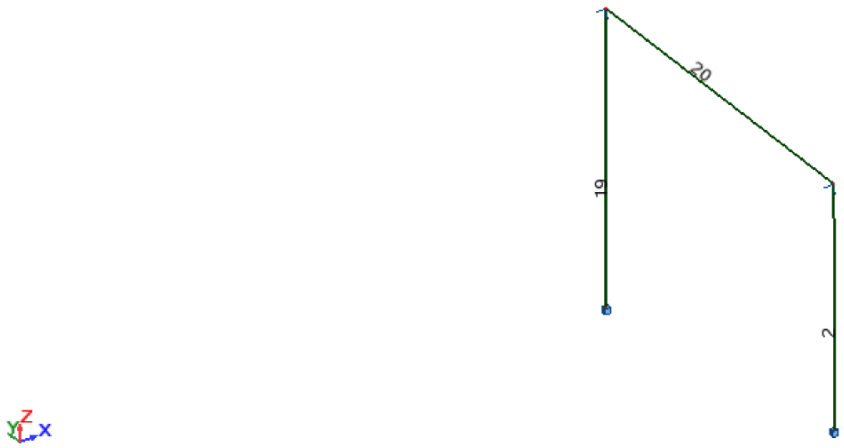
Realistic View



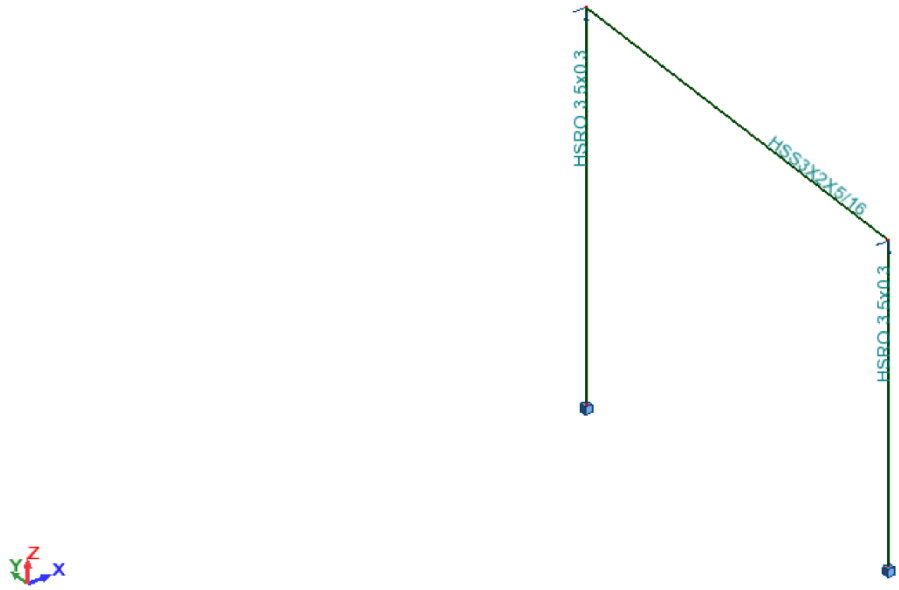
Node Names



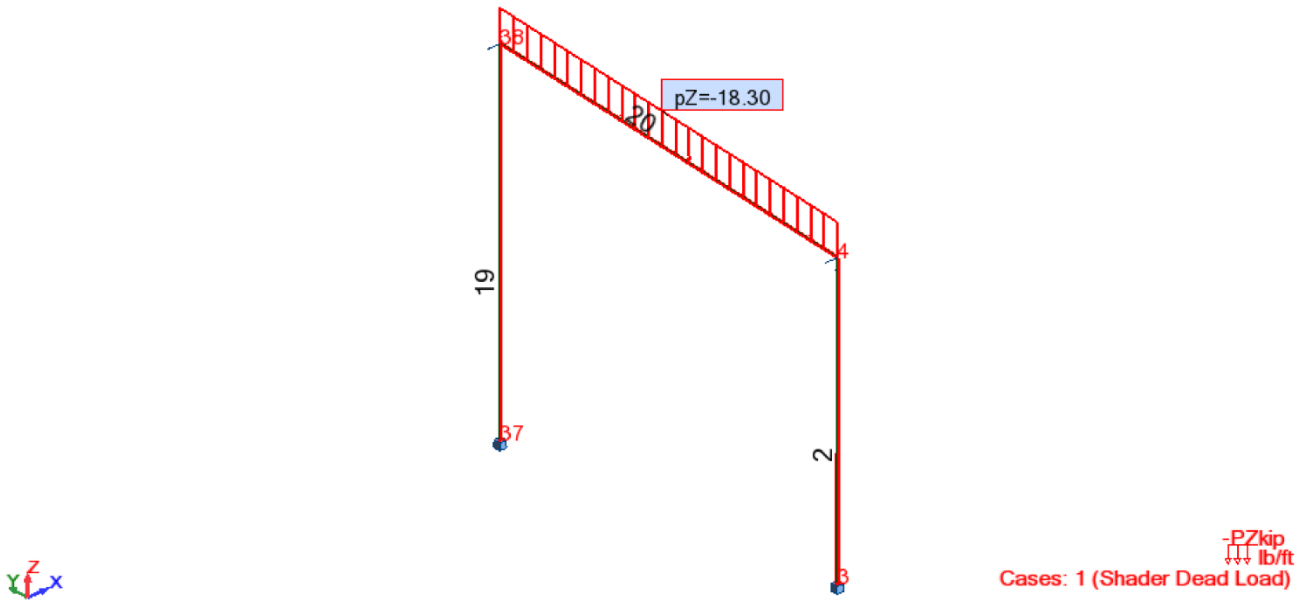
Bar Names



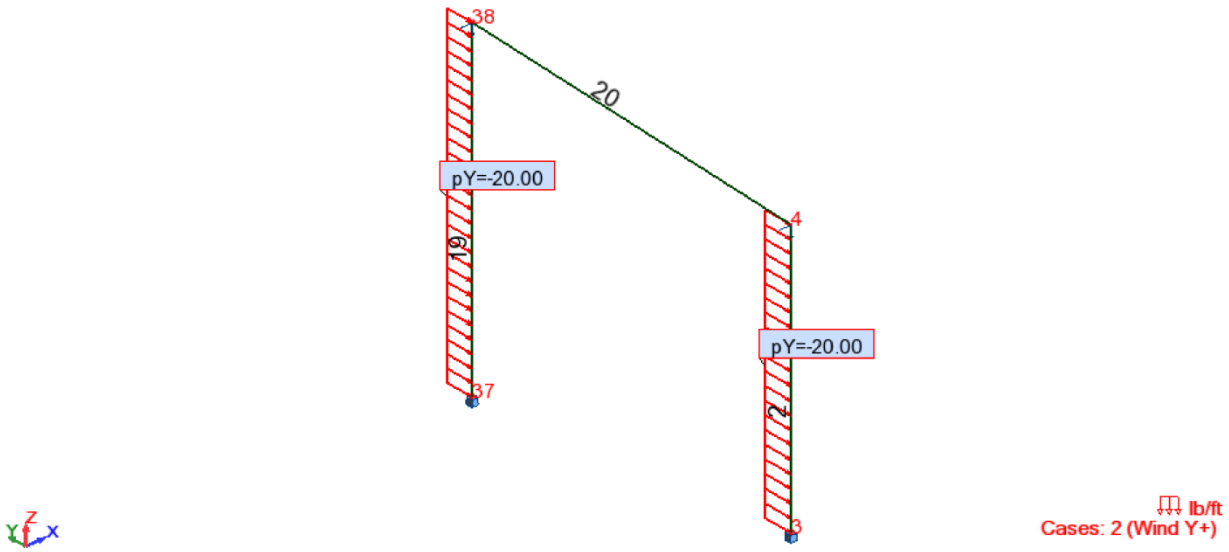
Section



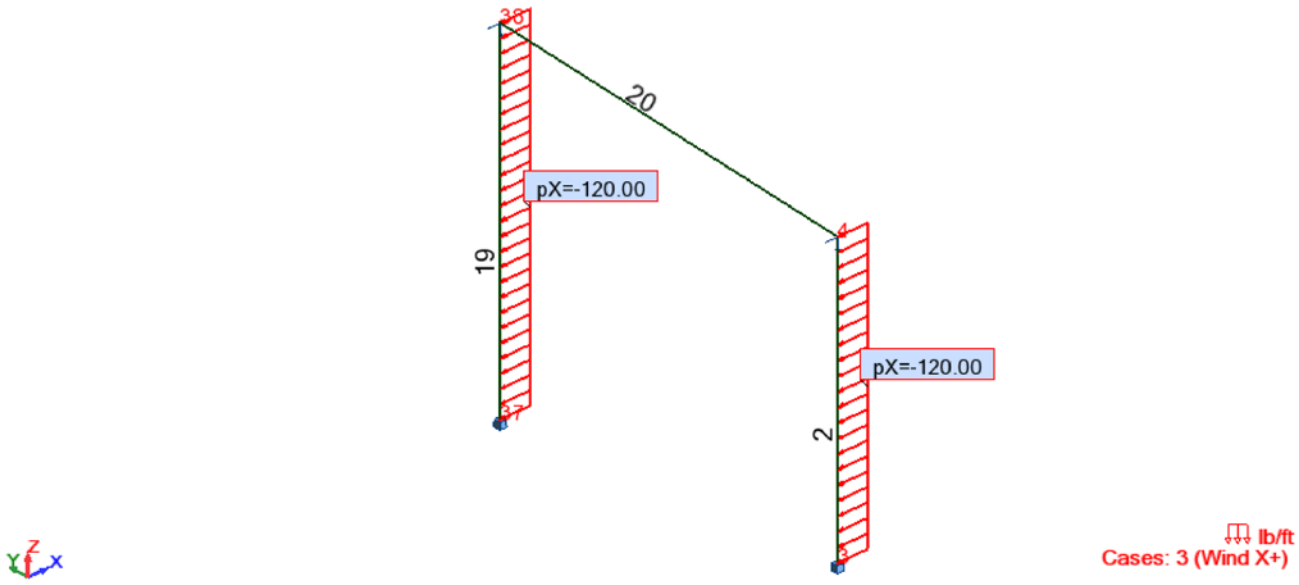
View - Cases: 1 (Shader Dead Load)



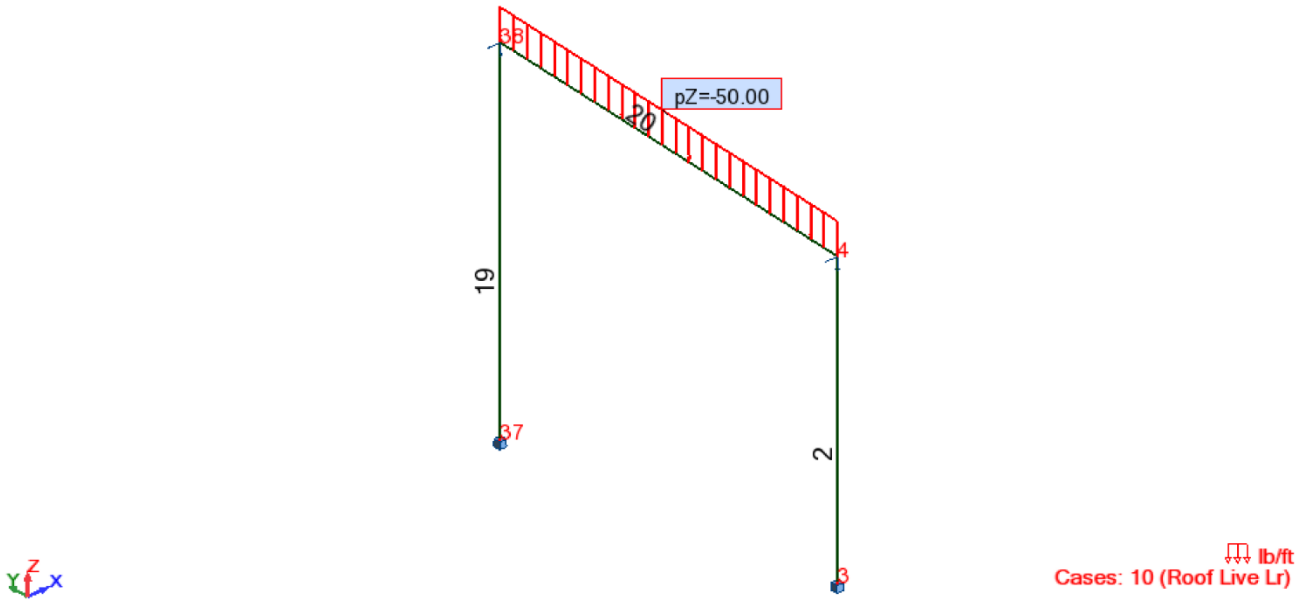
View - Cases: 2 (Wind Y+)



View - Cases: 3 (Wind X+)



View - Cases: 10 (Roof Live Lr)



Member Results

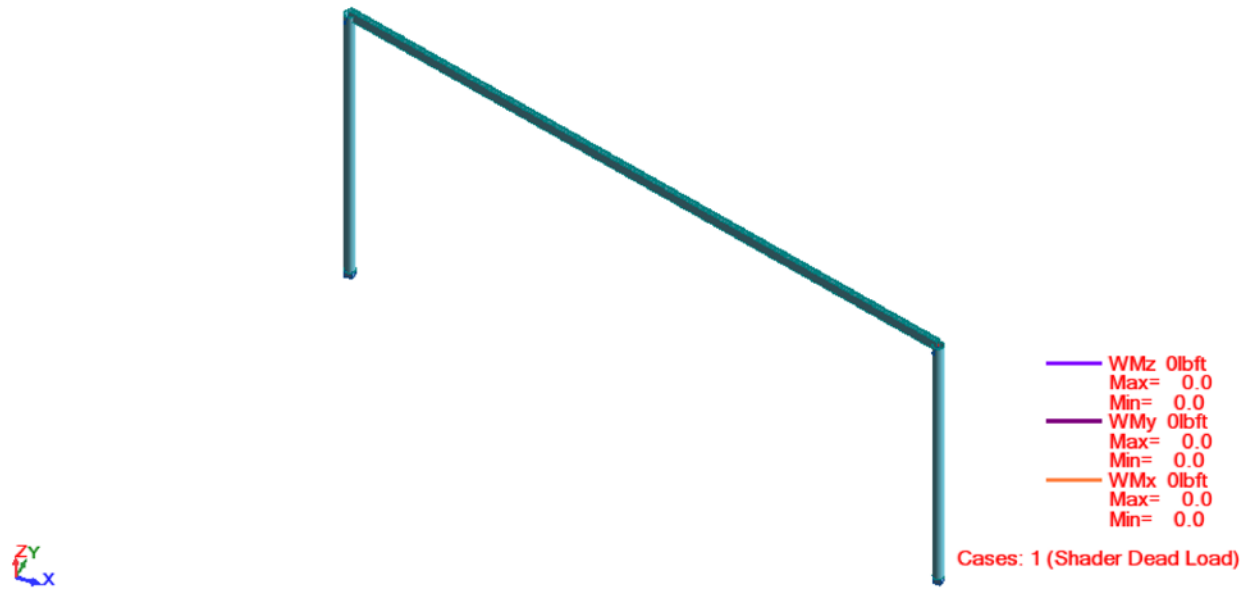
Member	Section	Material	Lay	Laz	Ratio	Case	Case (vy)
2 Column_2	HSRO 3.5x0.3	STEEL	110.15	110.15	0.32	7 D+W (X+)	2 Wind Y+
19 Column_19	HSRO 3.5x0.3	STEEL	133.96	133.96	0.47	7 D+W (X+)	2 Wind Y+
20 west shader_20	HSS3X2X5/16	Metal - Steel - ASTM A500 - G	50.02	69.30	0.29	11 D+Lr	-

Deflection Results

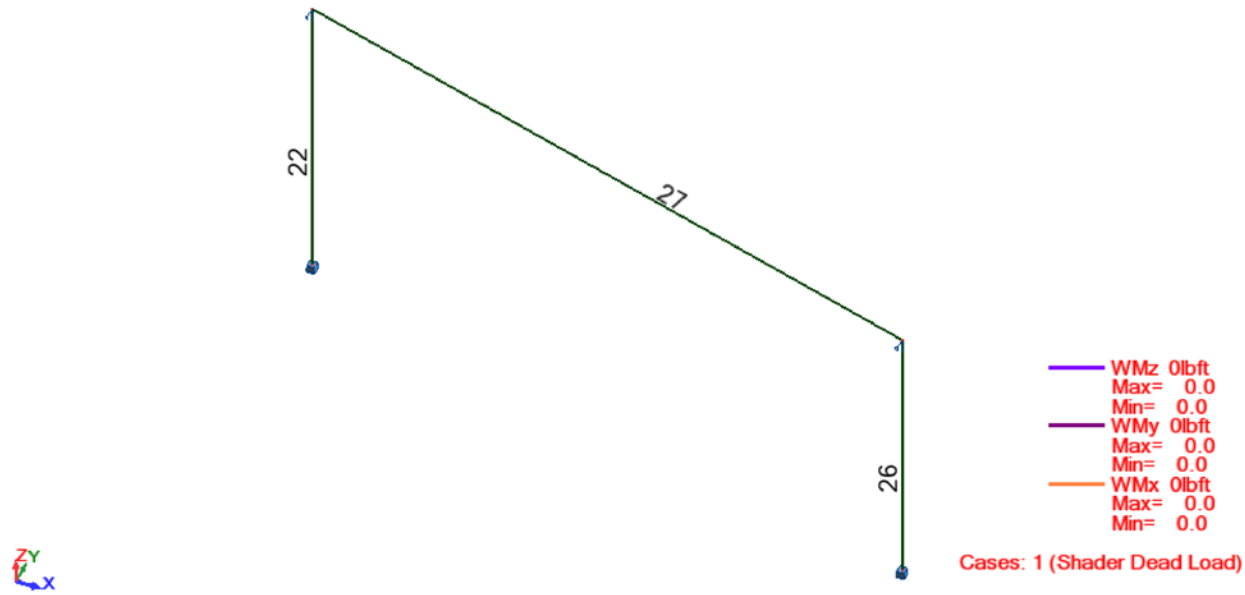
Bar/Case	UX (in)	UY (in)	UZ (in)
2/ 11 (C)	0.0000	0.0	0.0
19/ 11 (C)	0.0000	0.0	0.0
20/ 11 (C)	-0.0000	0.0	-0.5393

South Shader Frame

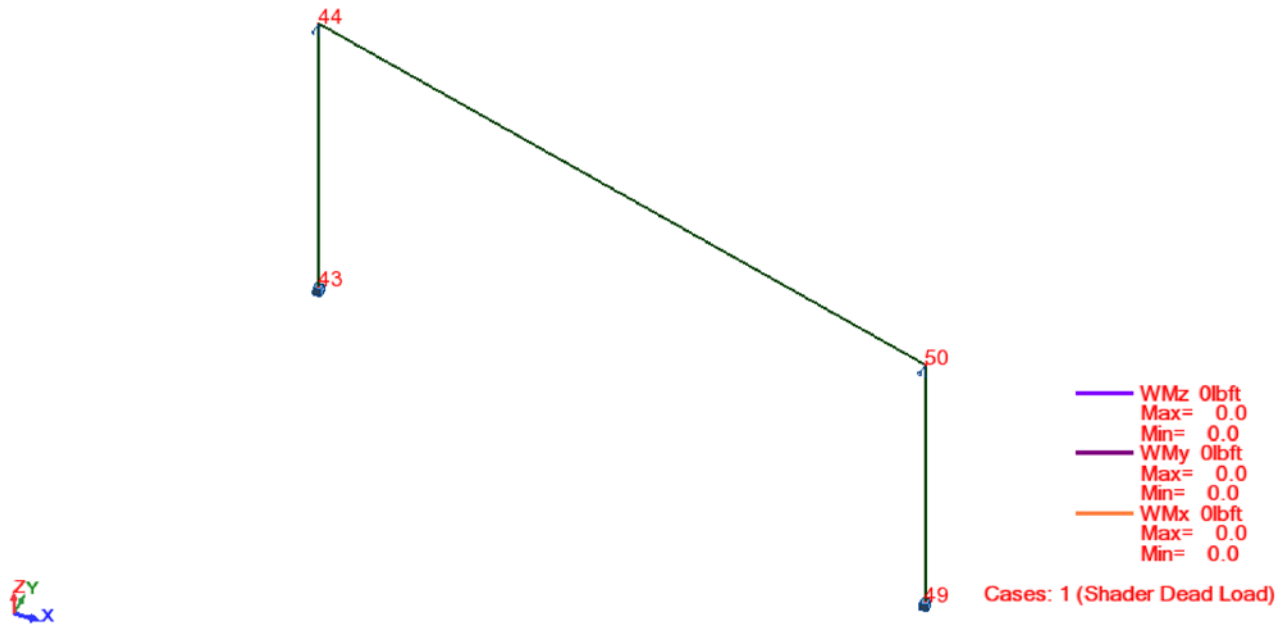
Realistic View



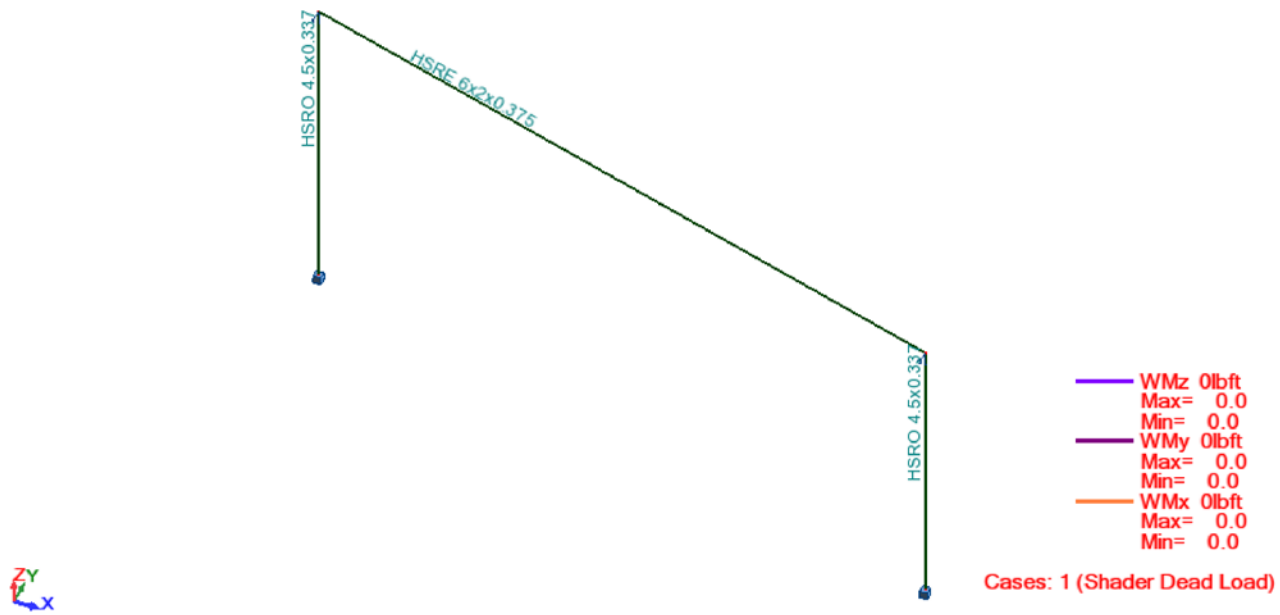
Bar Names



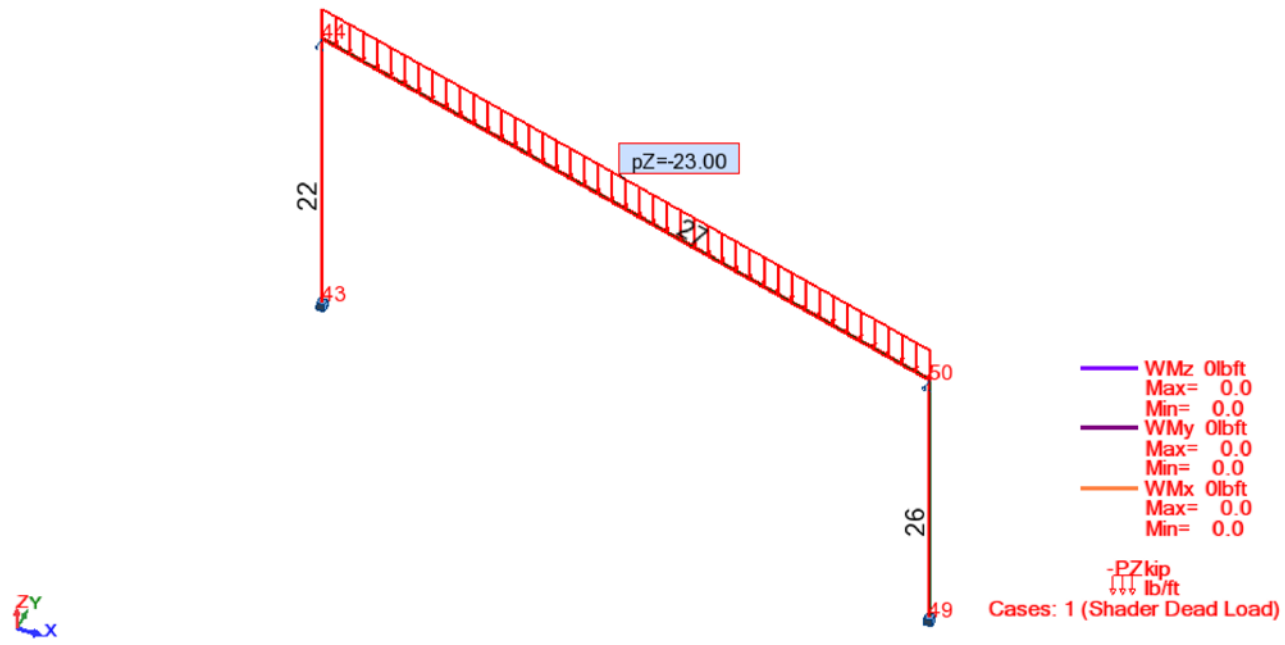
Node Names



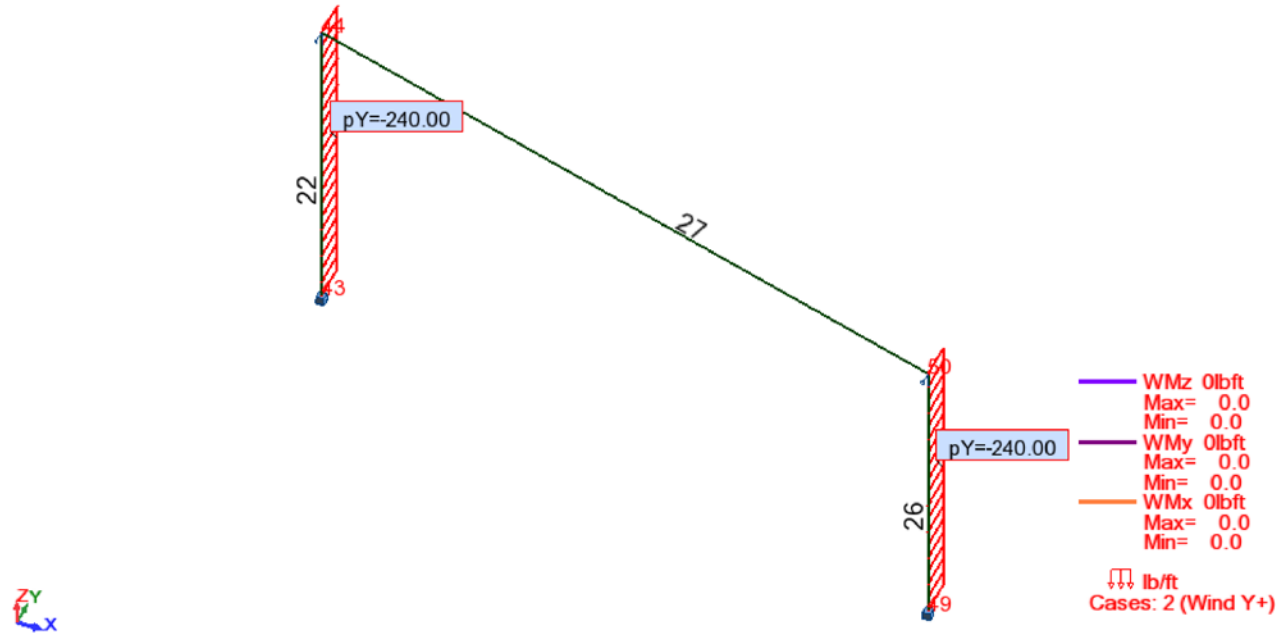
Section



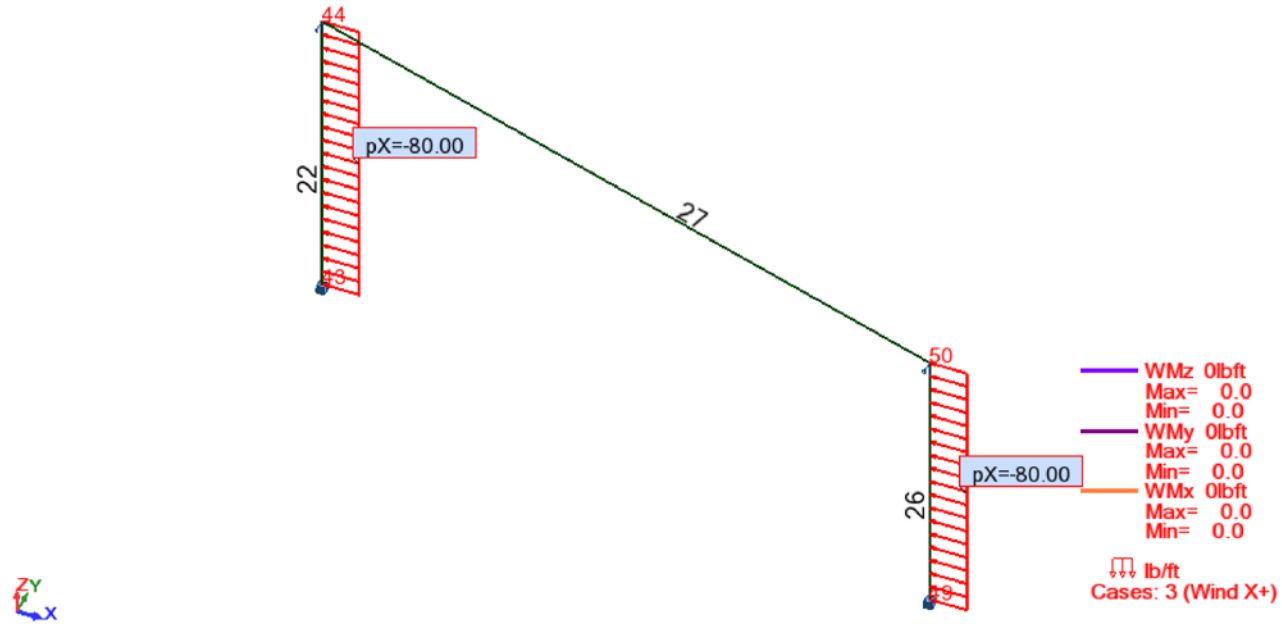
View - Cases: 1 (Shader Dead Load)



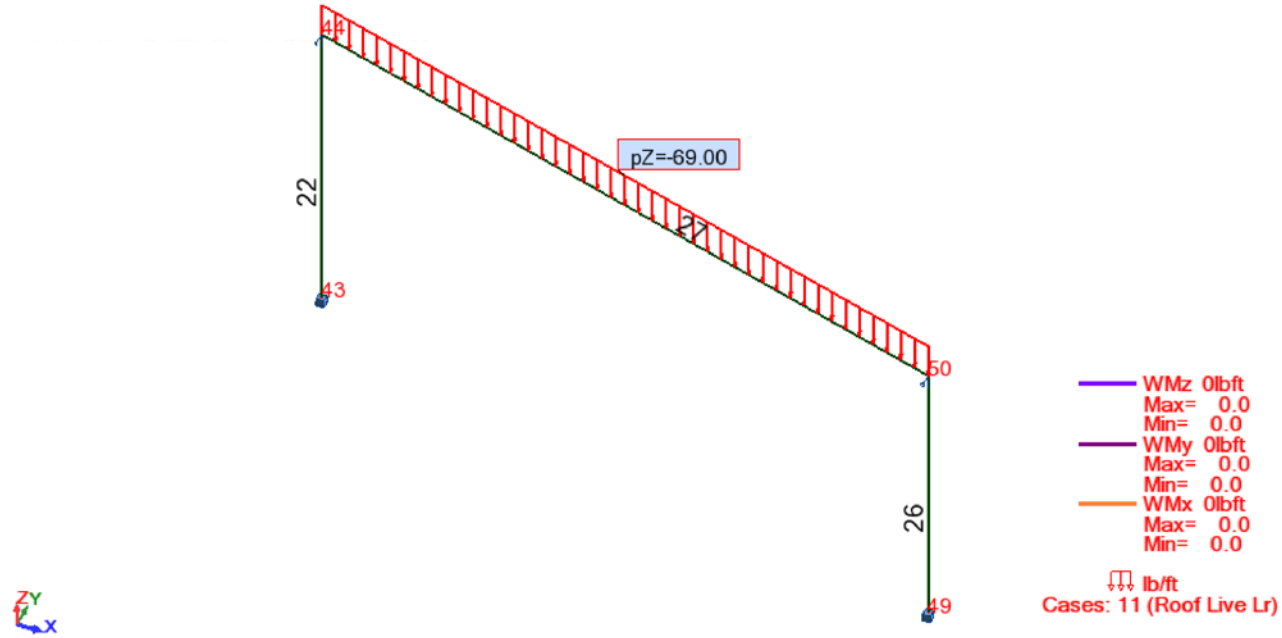
View - Cases: 2 (Wind Y+)



View - Cases: 3 (Wind X+)



View - Cases: 11 (Roof Live Lr)



Member Results

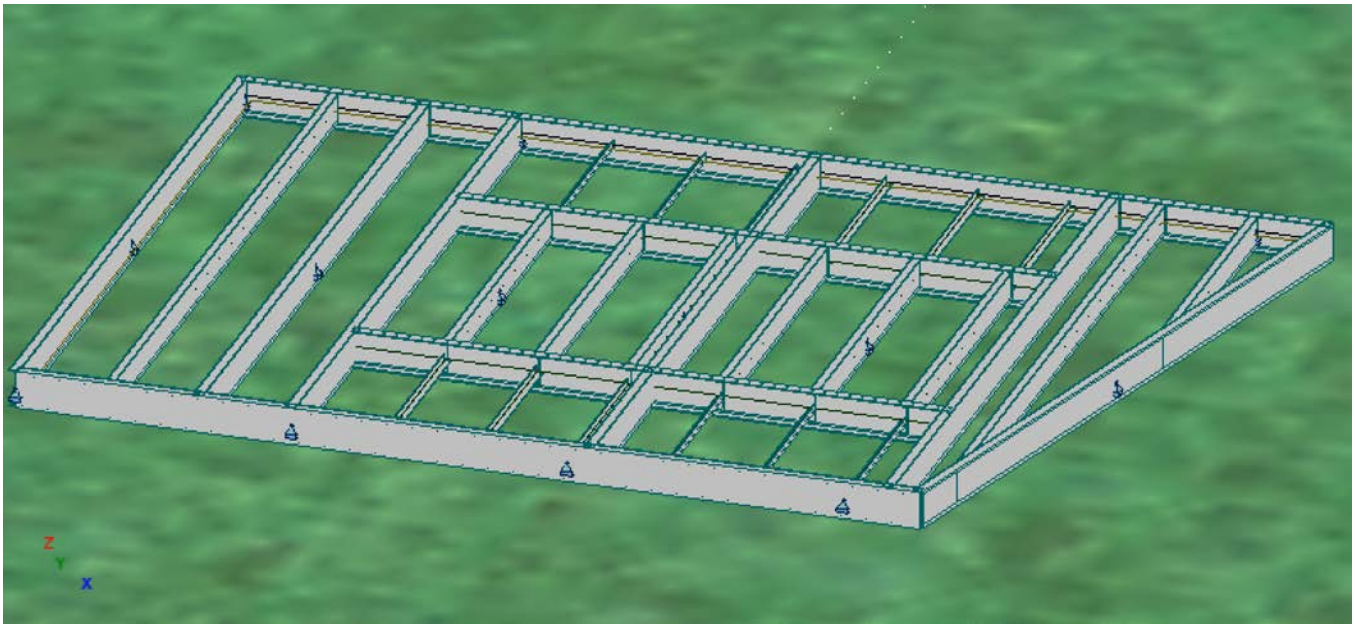
Member	Section	Material	Lay	Laz	Ratio	Case
22 Column_22	HSRO 4.5x0.337	STEEL	87.02	87.02	0.40	7 D+W (X+)
26 Column_26	HSRO 4.5x0.337	STEEL	78.45	78.45	0.44	7 D+W (X+)
27 south shader beam_27	HSRE 6x2x0.375	STEEL	28.54	70.91	0.48	12 D+Lr

Deflection Results

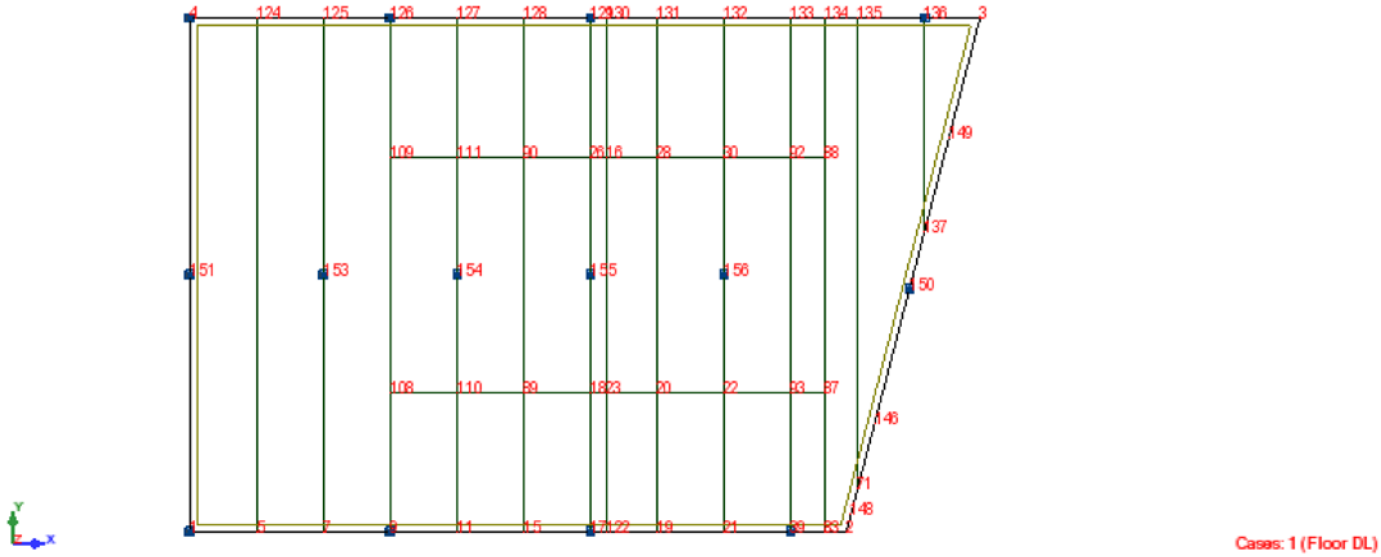
Bar/Case	UX (in)	UY (in)	UZ (in)
22/ 12 (C)	0.0000	0.0	-0.0000
26/ 12 (C)	0.0000	0.0	-0.0000
27/ 12 (C)	0.0000	-0.0000	-1.2557

Module A Chassis Stationary

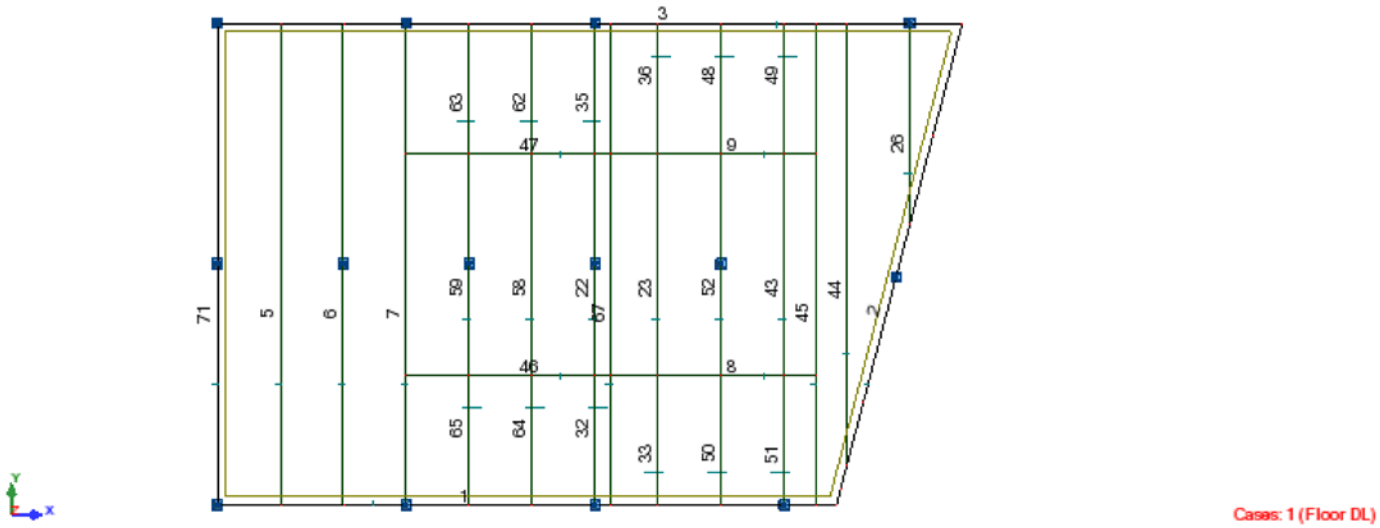
Module A- Realistic View



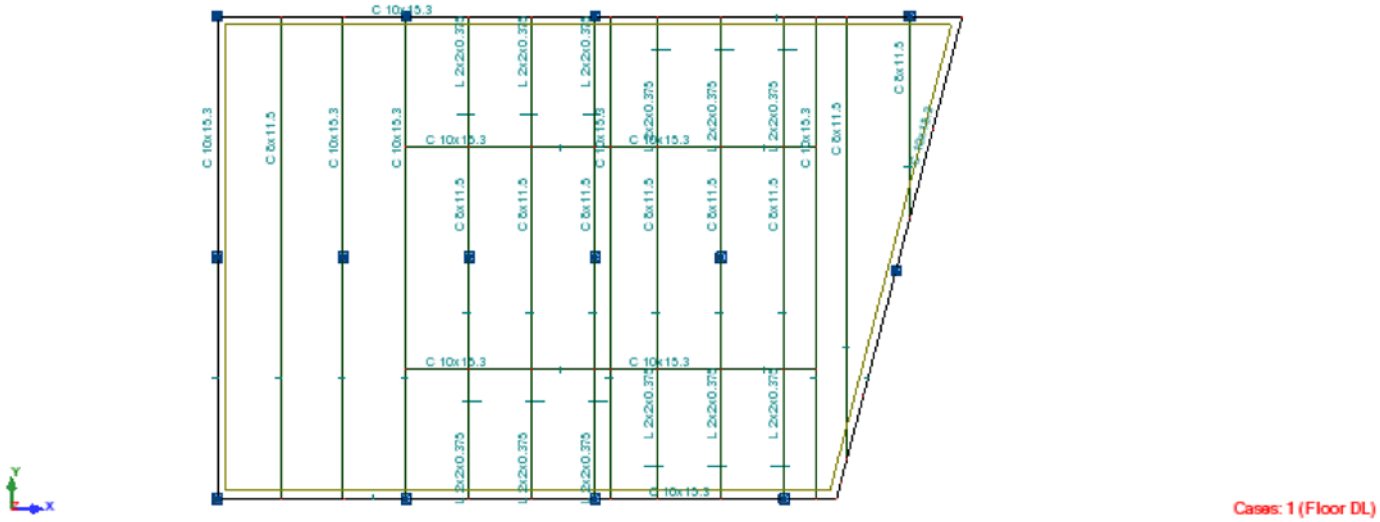
Node Names



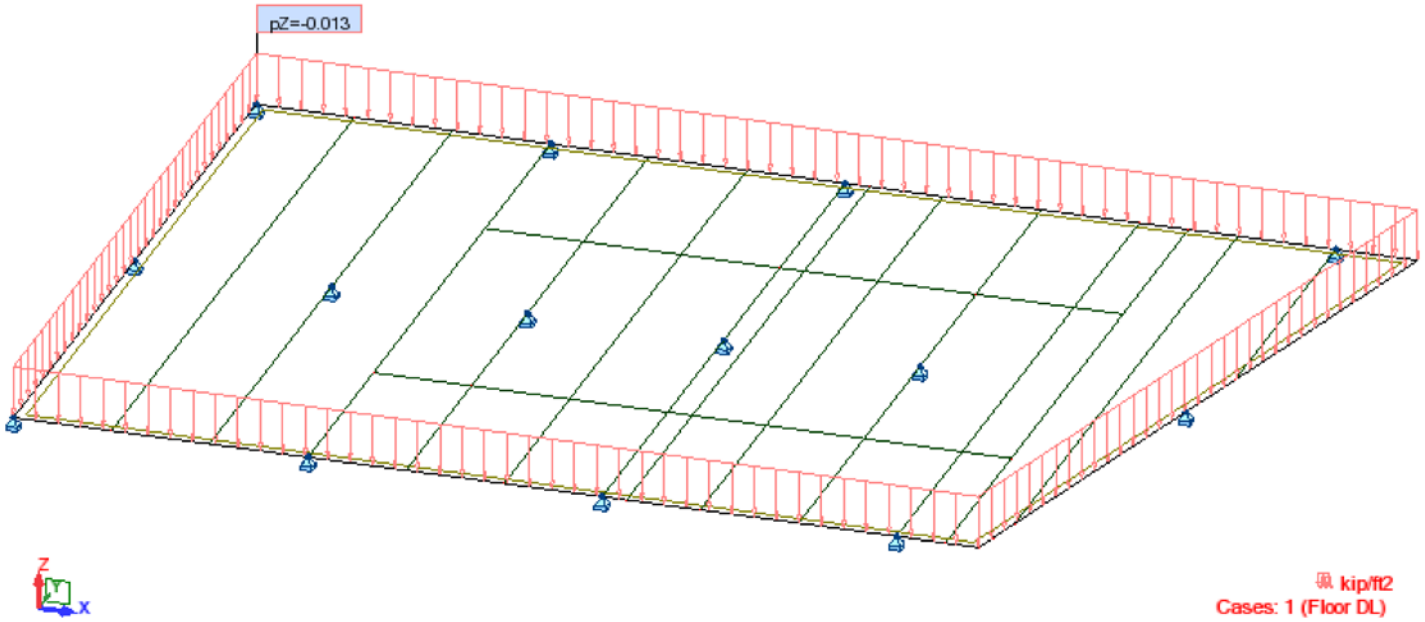
Bar Names



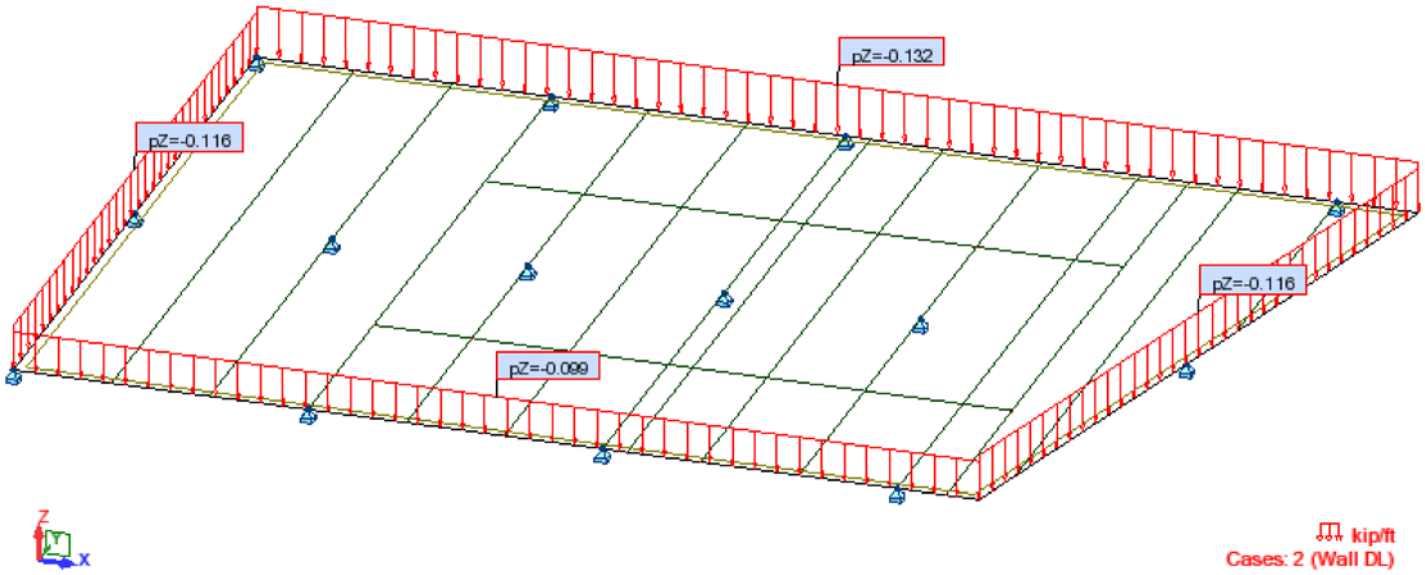
Sections



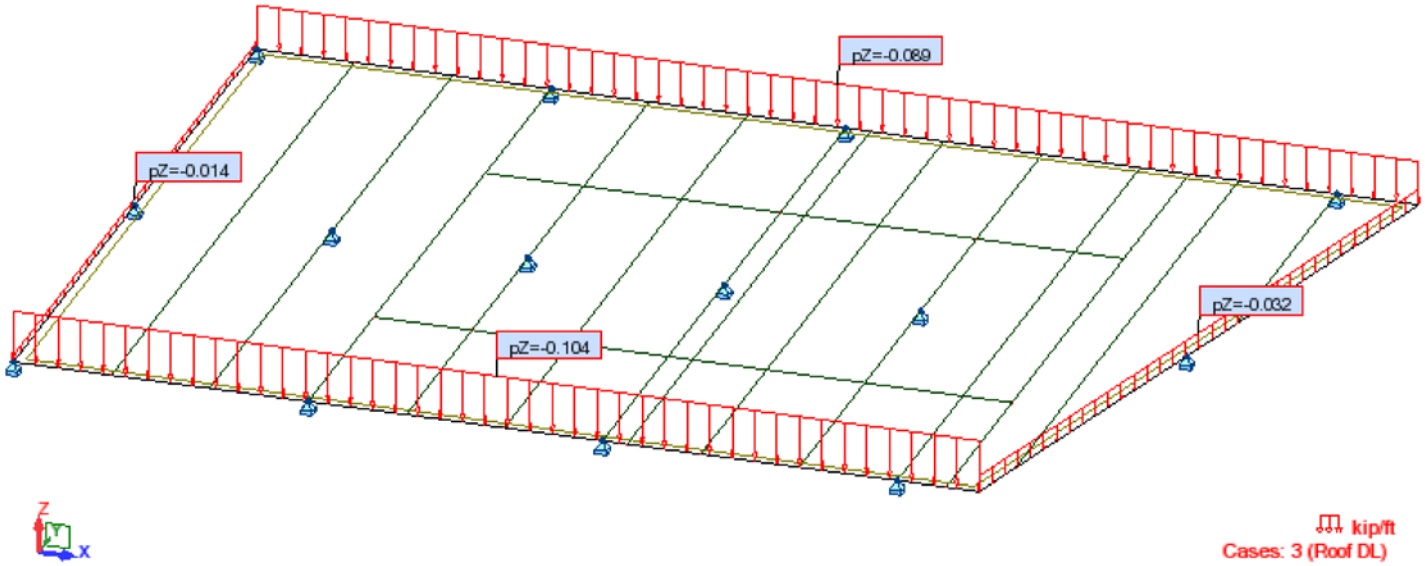
View - Cases: 1 (Floor DL) 2



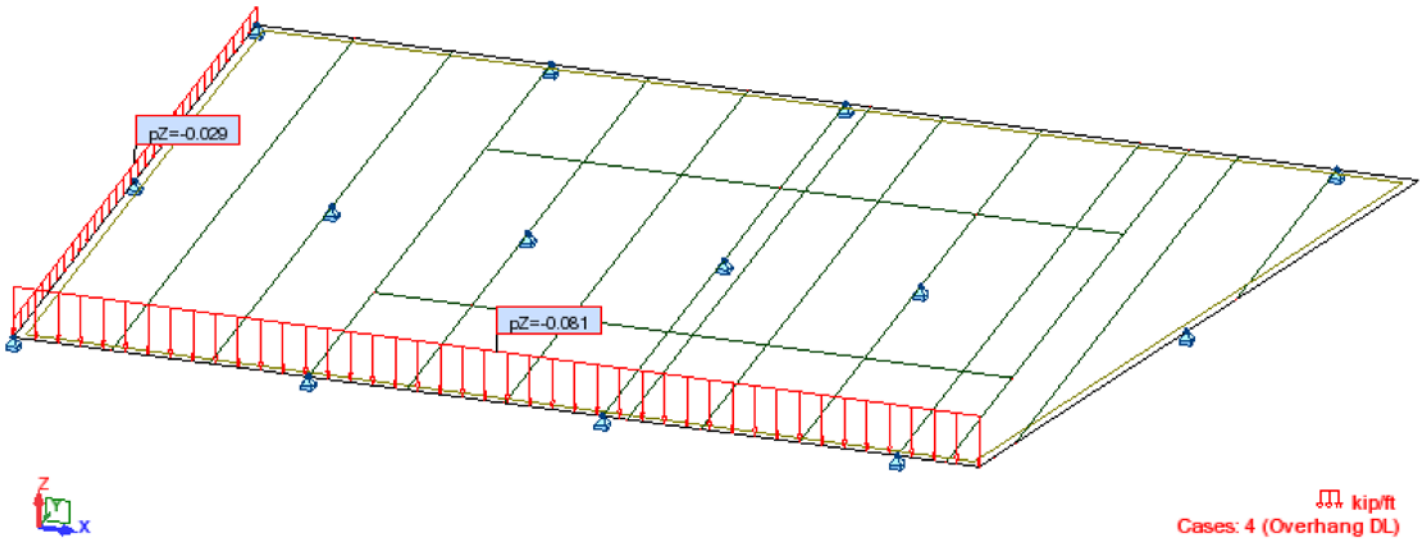
View - Cases: 2 (Wall DL) 1



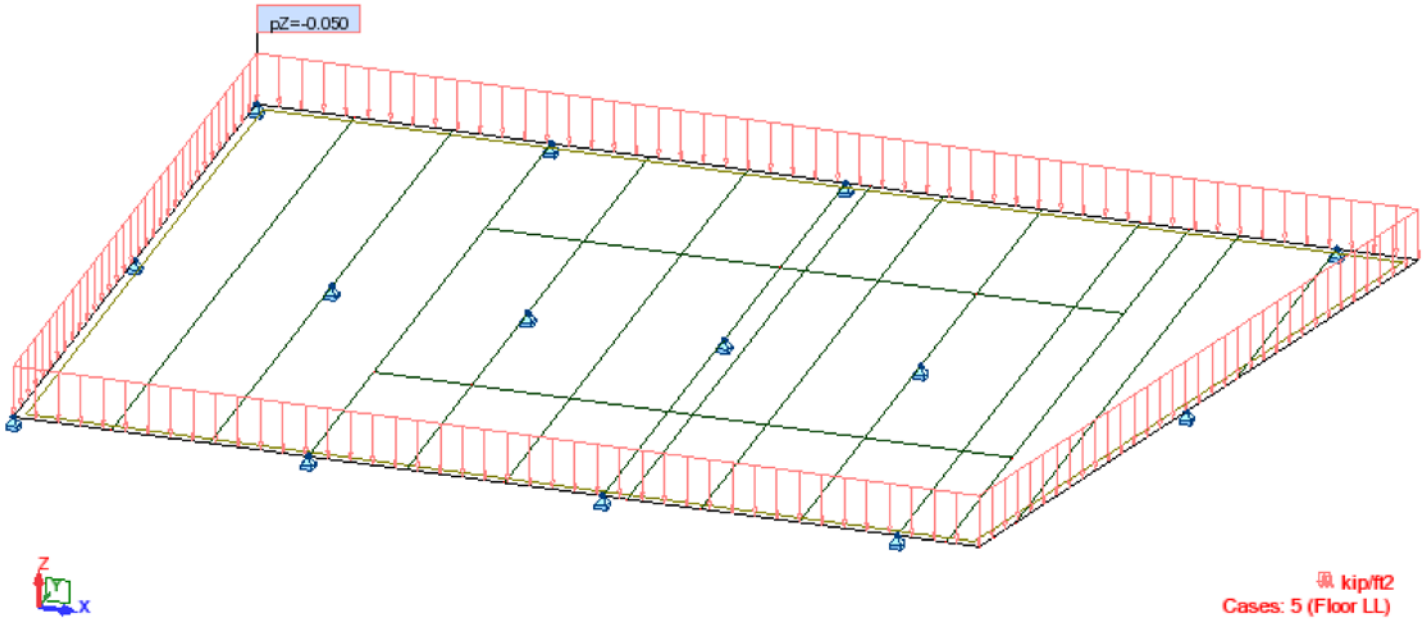
View - Cases: 3 (Roof DL) 1



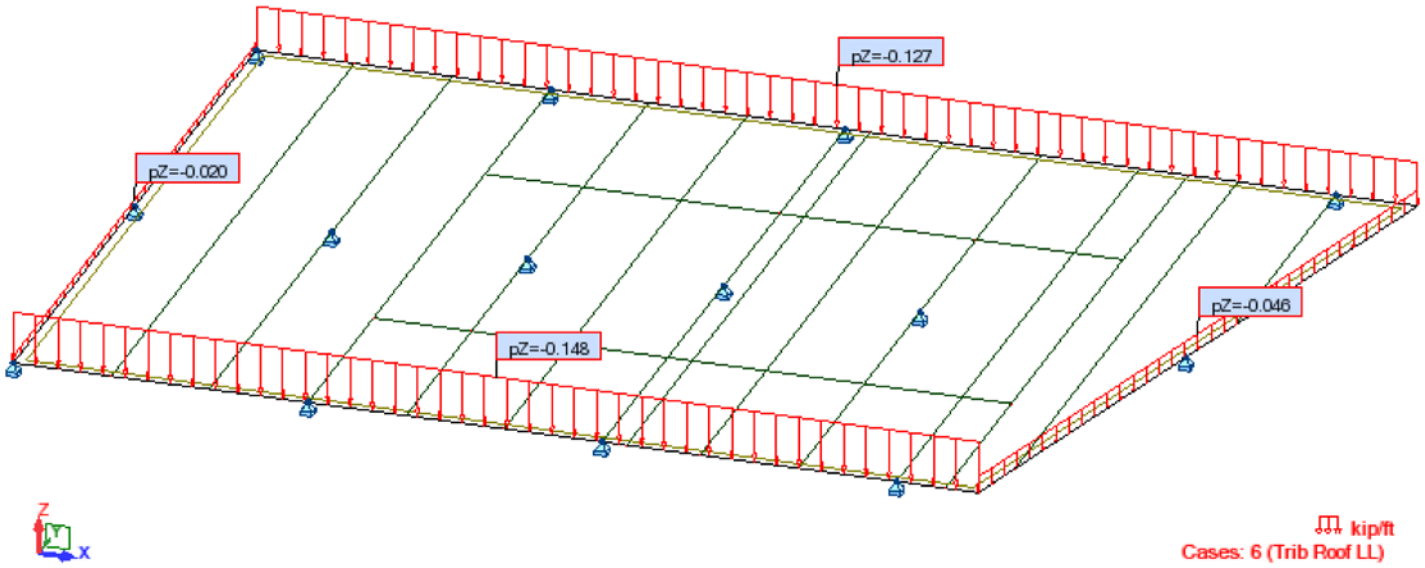
View - Cases: 4 (Overhang DL) 1



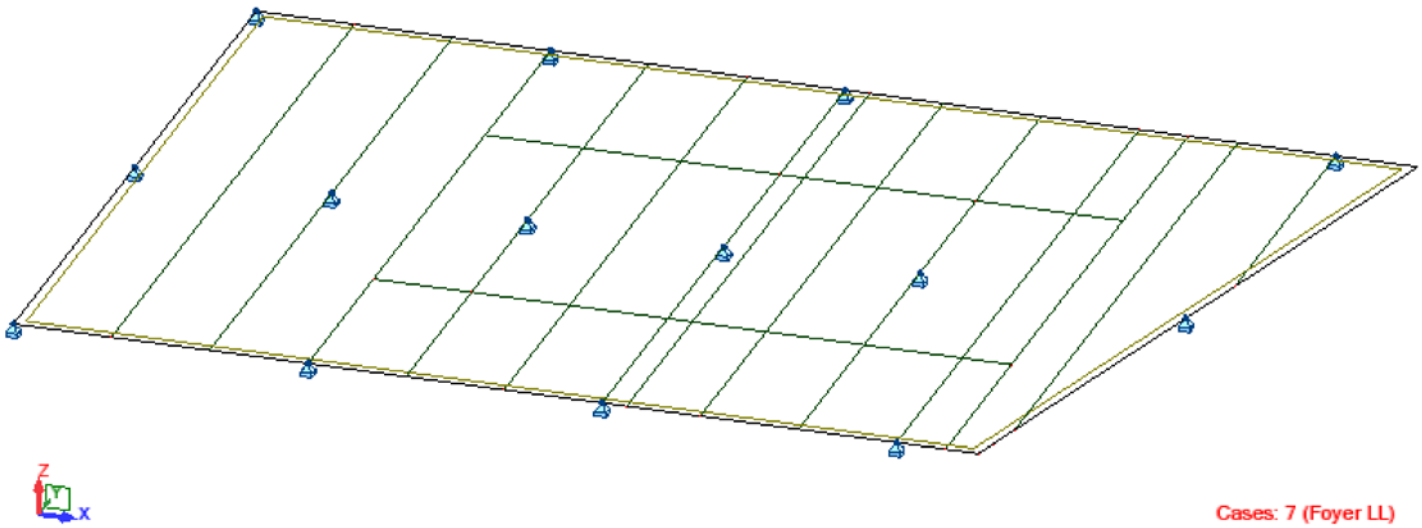
View - Cases: 5 (Floor LL) 1



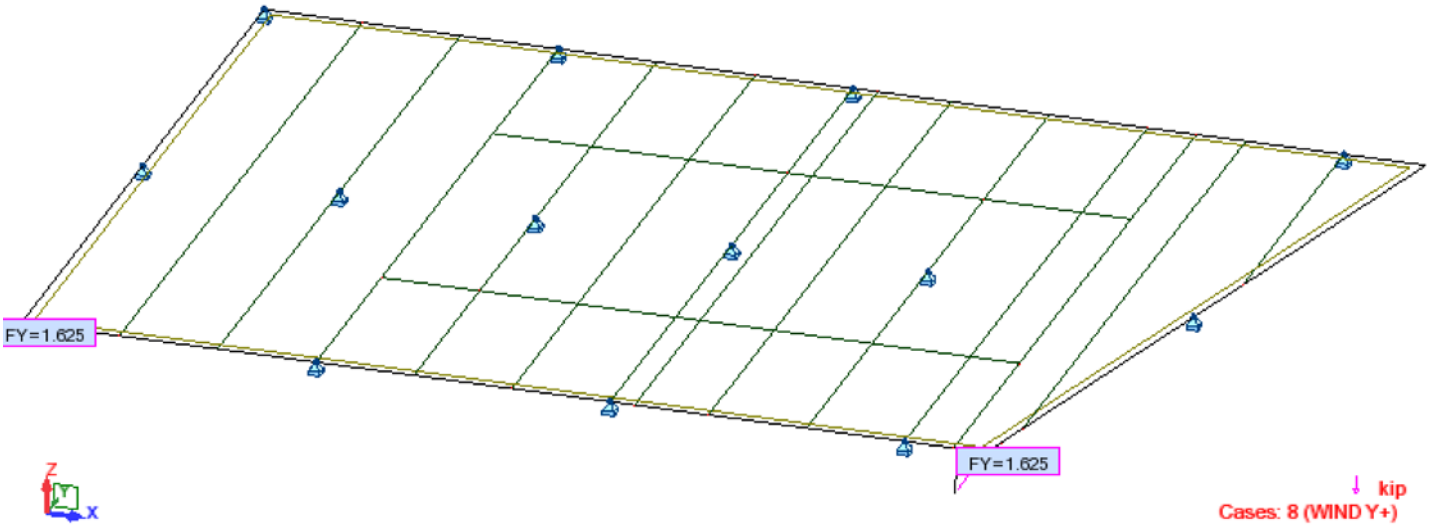
View - Cases: 6 (Trib Roof LL) 1



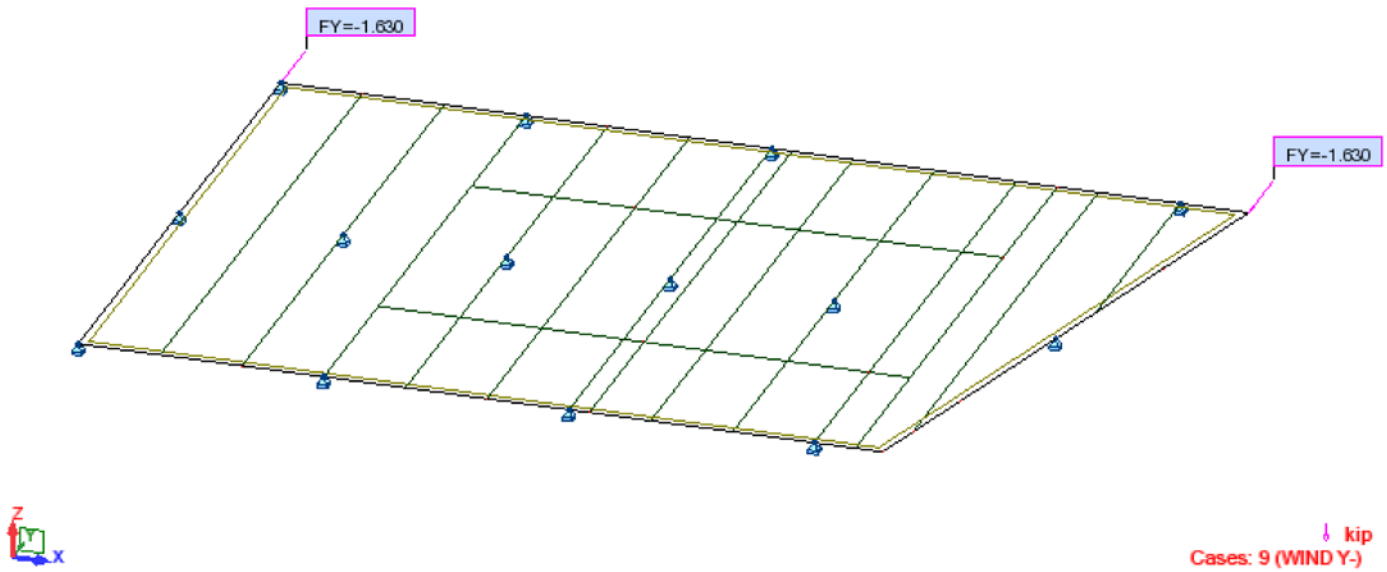
View - Cases: 7 (Foyer LL) 1



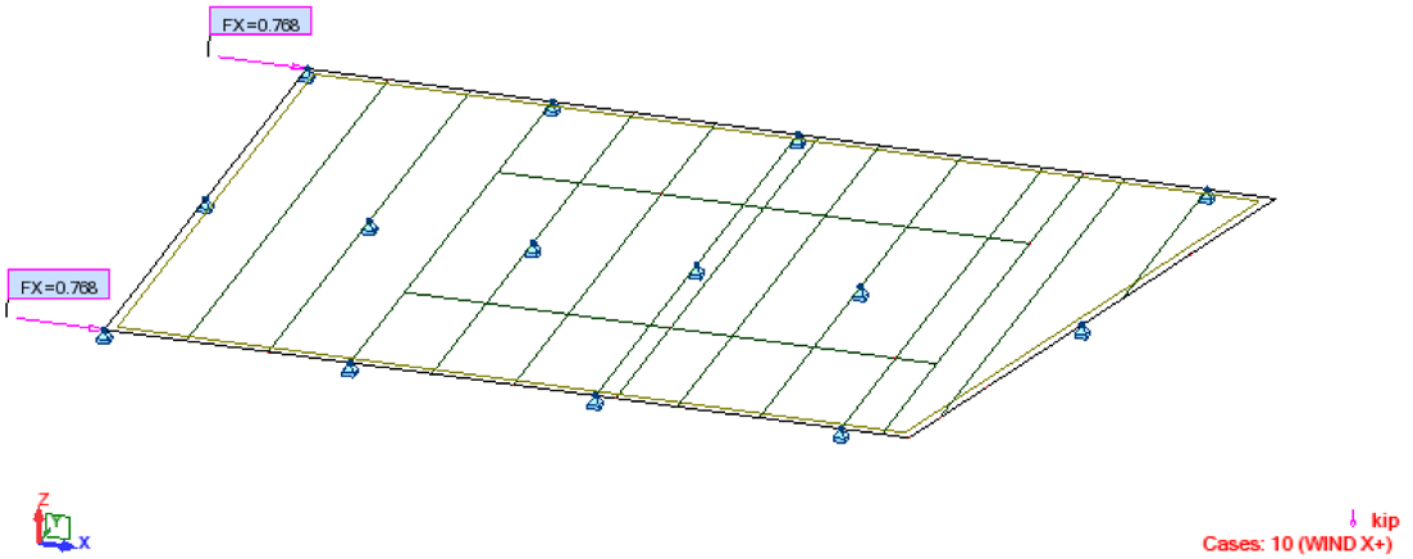
View - Cases: 8 (WIND Y+) 1



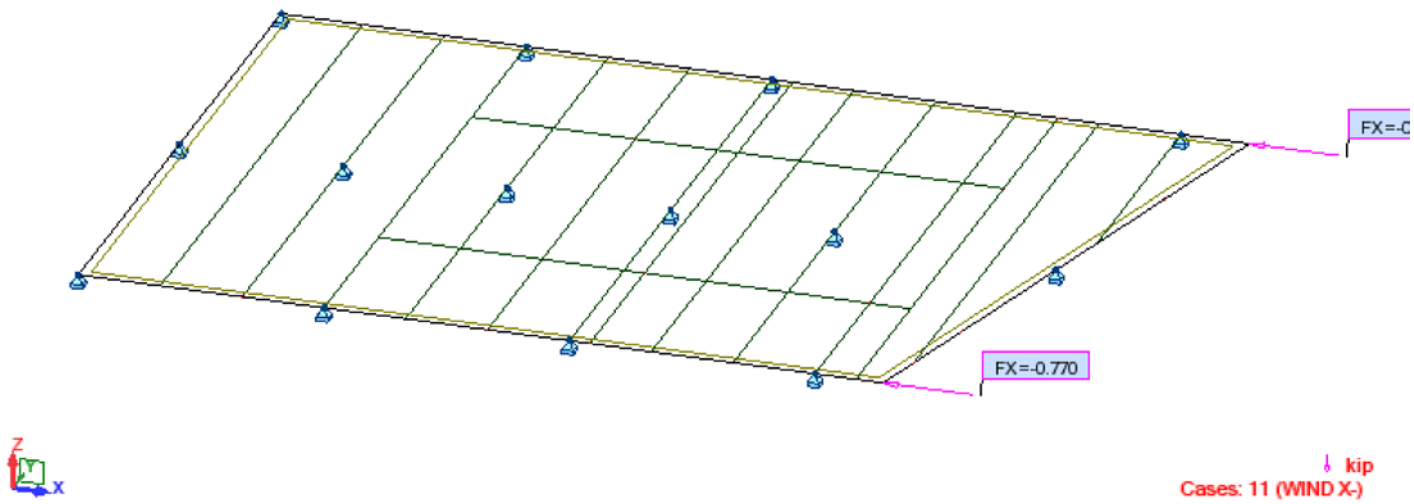
View - Cases: 9 (WIND Y-) 1



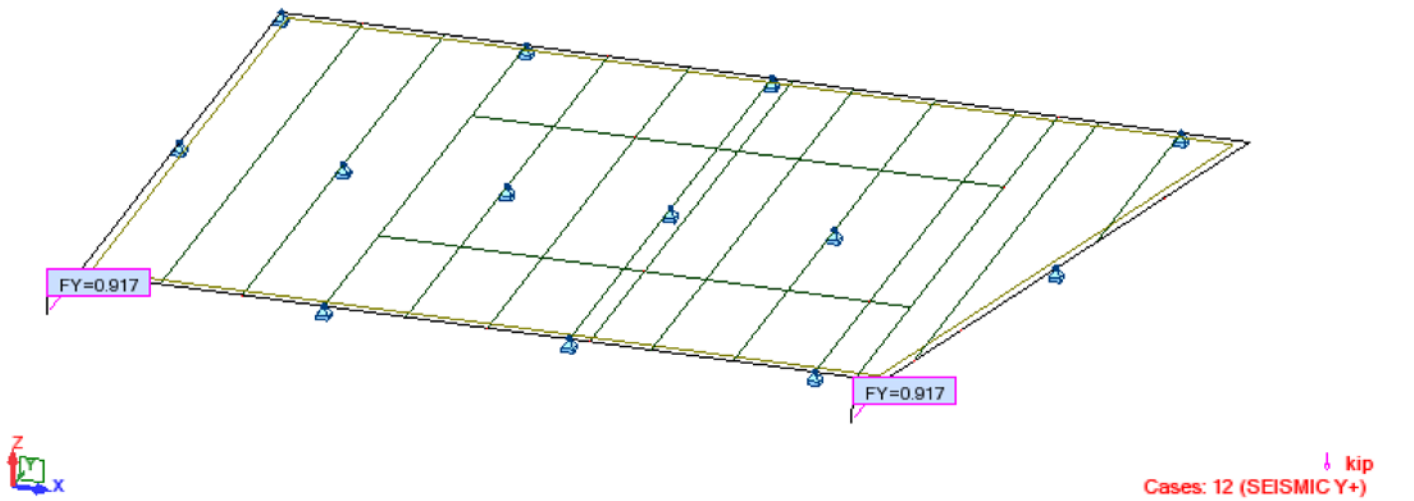
View - Cases: 10 (WIND X+) 1



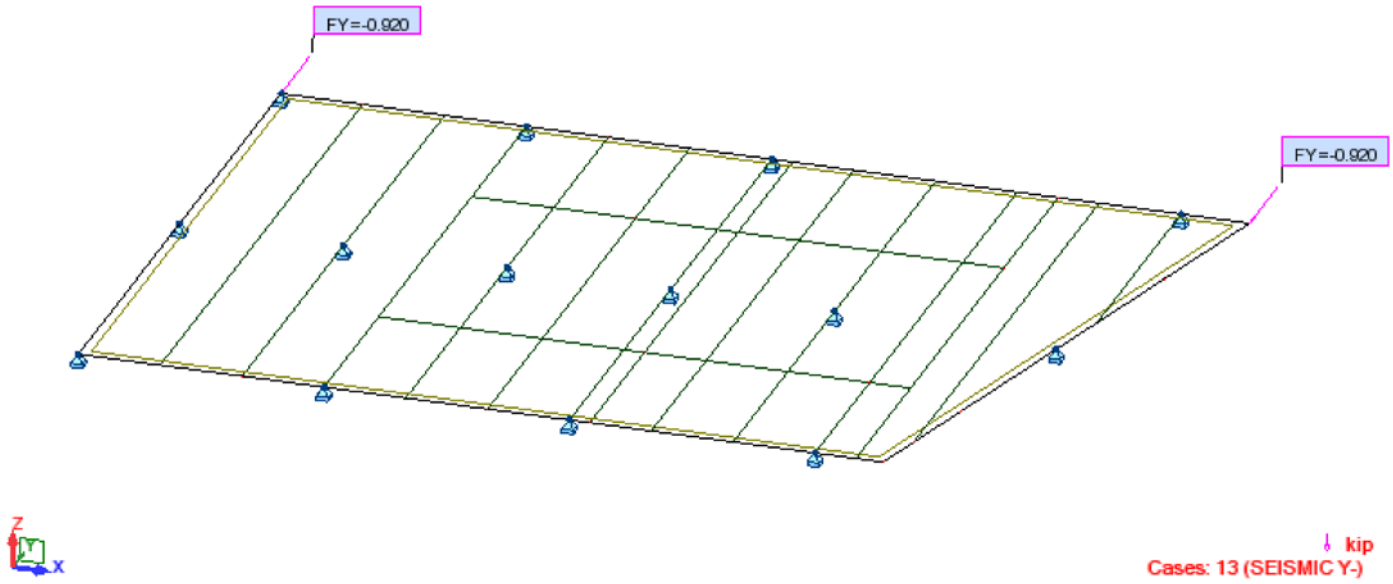
View - Cases: 11 (WIND X-) 1



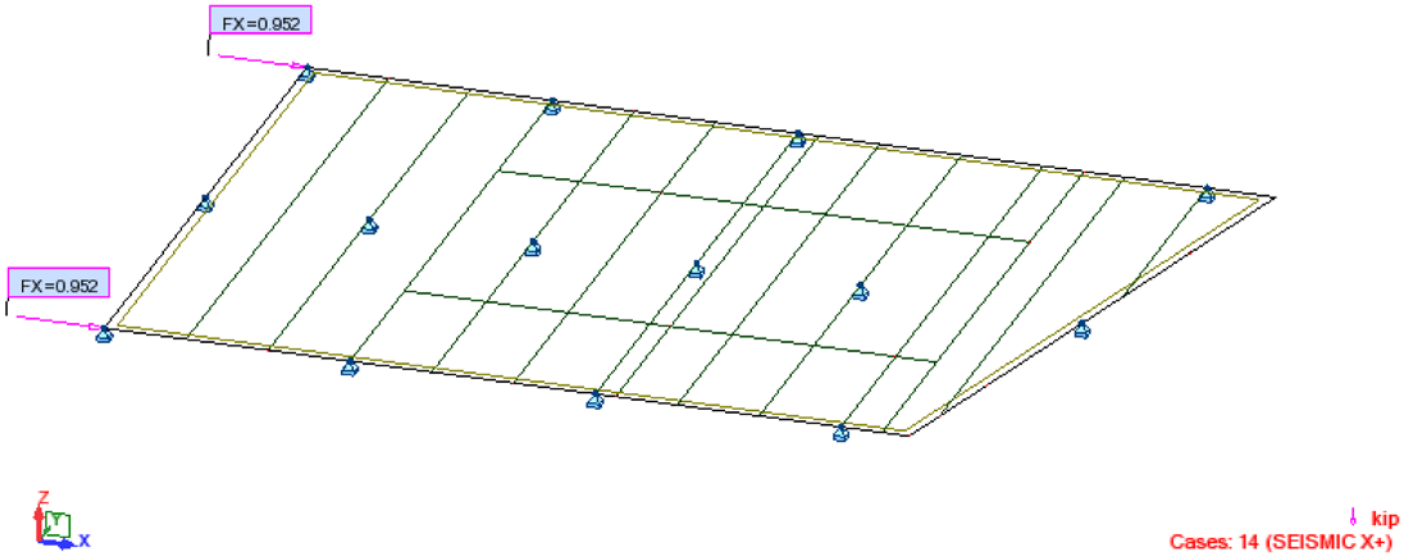
View - Cases: 12 (SEISMIC Y+) 1



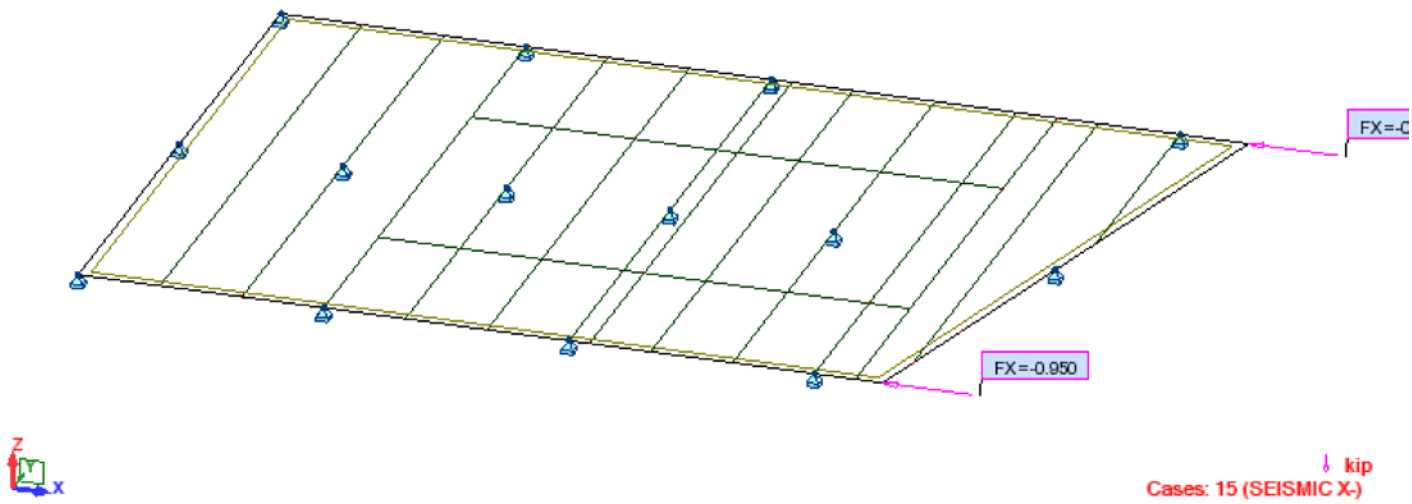
View - Cases: 13 (SEISMIC Y-) 1



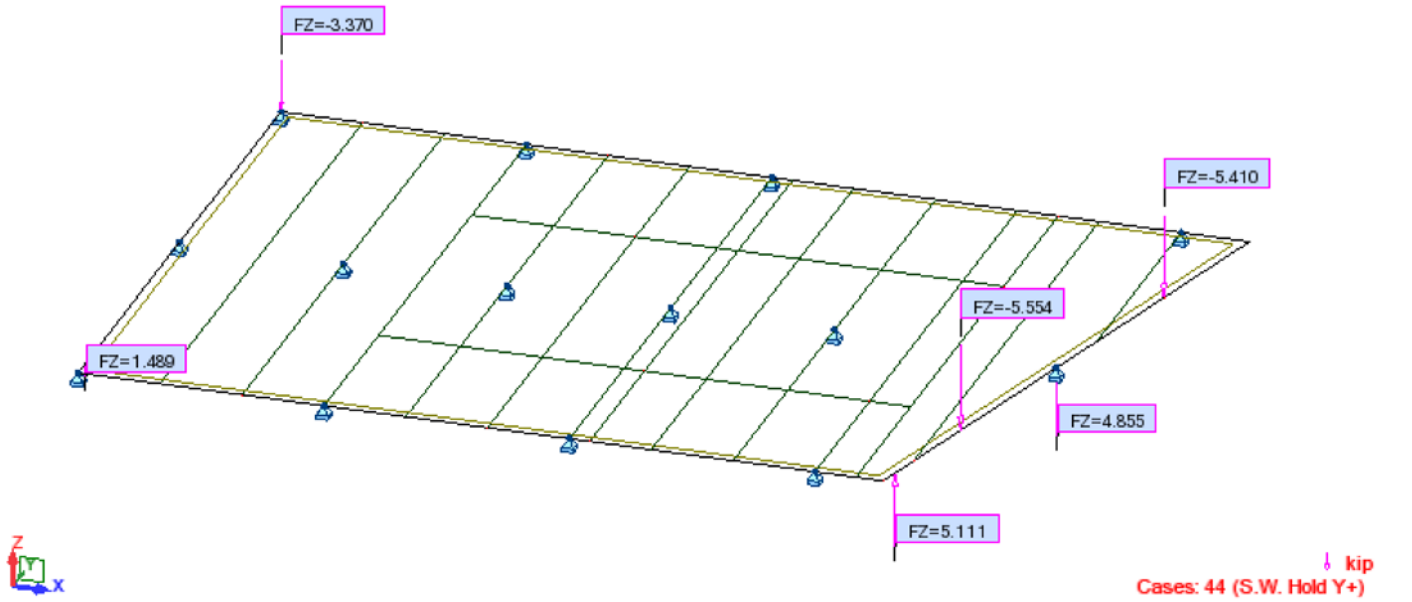
View - Cases: 14 (SEISMIC X+) 1



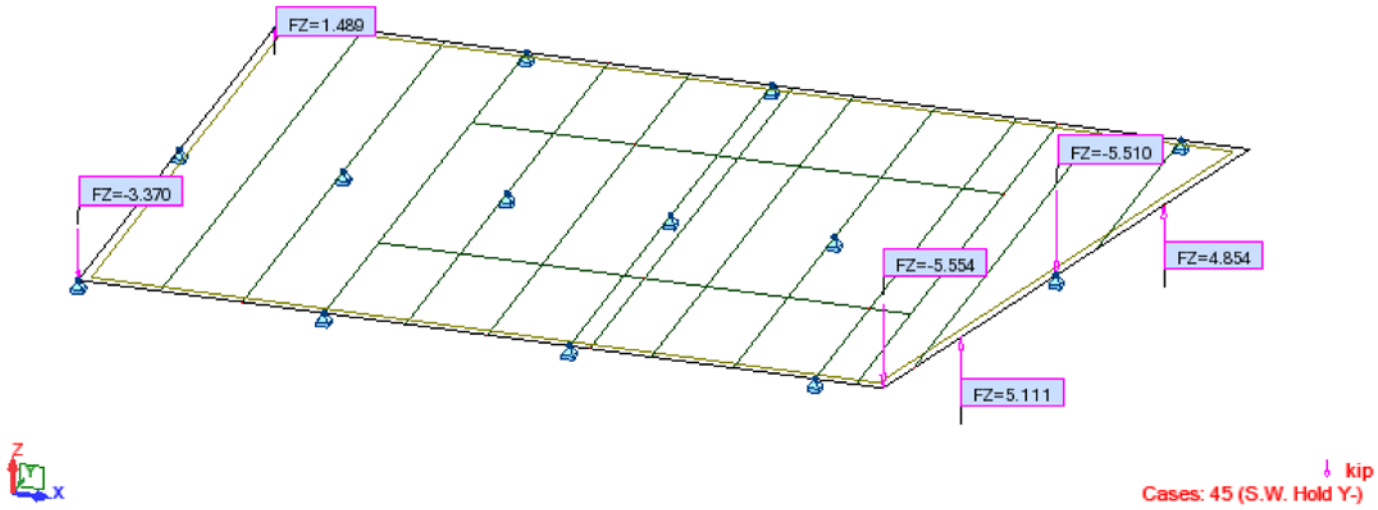
View - Cases: 15 (SEISMIC X-) 1



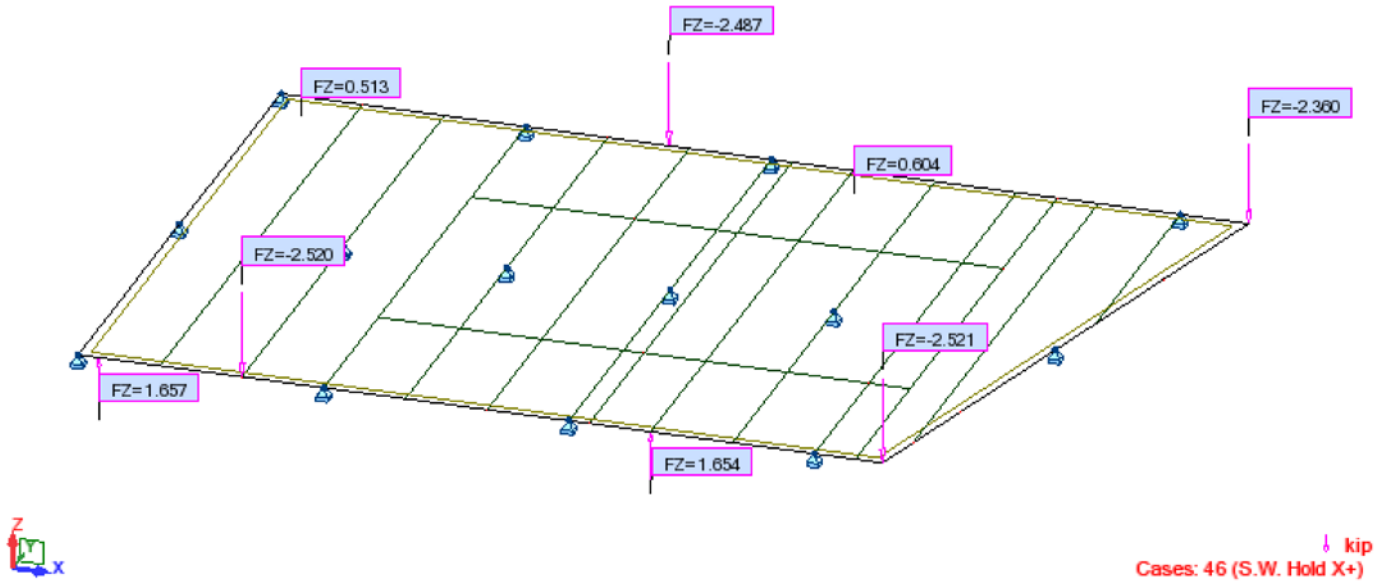
View - Cases: 44 (S.W. Hold Y+) 1



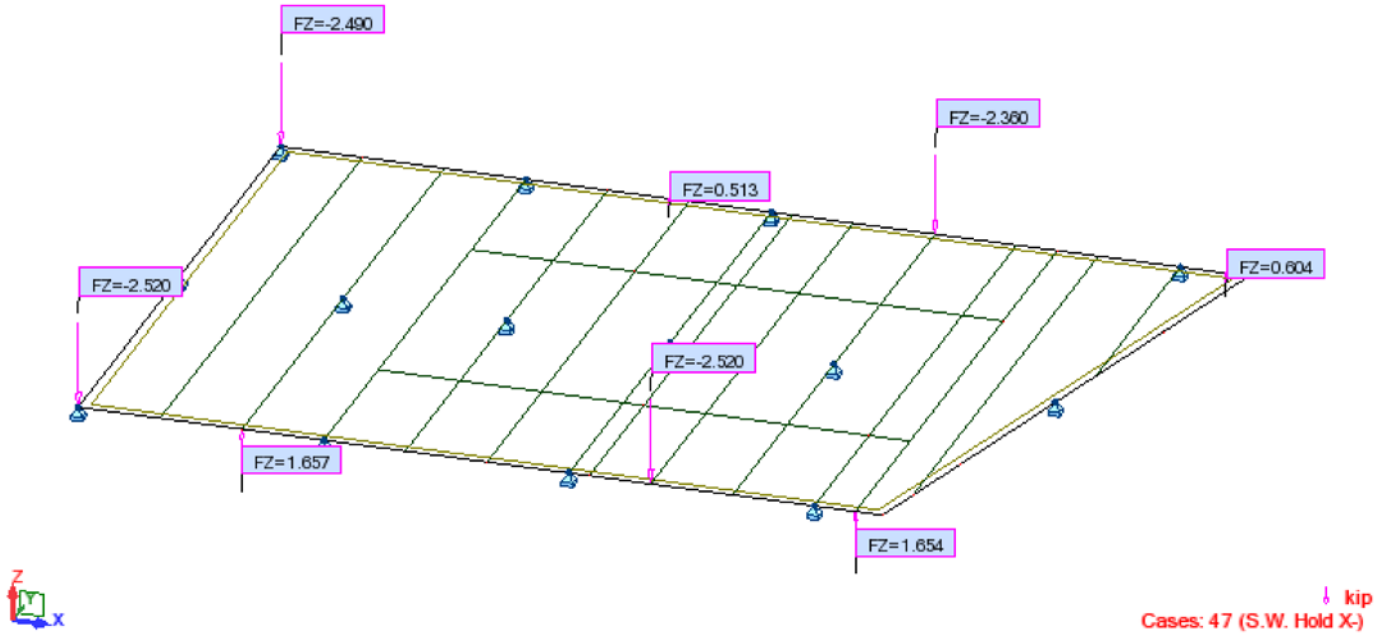
View - Cases: 45 (S.W. Hold Y-) 1



View - Cases: 46 (S.W. Hold X+) 1



View - Cases: 47 (S.W. Hold X-) 1



Member Results

Member	Name	Components	Code group	Section	Type	Ly (ft)	Lz (ft)
1	South Perimeter C	1	(N/A)	C 10x15.3	Bracing South Member	19.67	19.67
2	East Perimeter C	2	(N/A)	C 10x15.3	At Junc Bot	15.84	15.84
3	North Perimeter C	3	(N/A)	C 10x15.3	Bracing North Member	23.67	23.67
5	At Junc Bot_5	5	(N/A)	C 8x11.5	At Junc Bot	15.33	15.33
6	At Junc Bot_6	6	(N/A)	C 10x15.3	At Junc Bot	15.33	15.33
7	Bracing Upper Flange_7	7	(N/A)	C 10x15.3	At Junc Bot	15.33	15.33
8	At Junc Bot_8	8	(N/A)	C 10x15.3	At Junc Bot	6.50	6.50
9	At Junc Bot_9	9	(N/A)	C 10x15.3	At Junc Bot	6.50	6.50
22	At Junc Bot_22	22	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
23	At Junc Bot_23	23	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
26	At Junc Bot_26	26	(N/A)	C 8x11.5	At Junc Bot	6.39	6.39
32	At Junc Bot_32	32	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
33	At Junc Bot_33	33	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
35	At Junc Bot_35	35	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
36	At Junc Bot_36	36	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
43	At Junc Bot_43	43	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
44	At Junc Bot_44	44	(N/A)	C 8x11.5	At Junc Bot	14.05	14.05
45	At Junc Bot_45	45	(N/A)	C 10x15.3	At Junc Bot	15.33	15.33
46	At Junc Bot_46	46	(N/A)	C 10x15.3	At Junc Bot	6.50	6.50
47	At Junc Bot_47	47	(N/A)	C 10x15.3	At Junc Bot	6.50	6.50

48	At Junc Bot_48	48	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
49	At Junc Bot_49	49	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
50	At Junc Bot_50	50	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
51	At Junc Bot_51	51	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
52	At Junc Bot_52	52	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
58	At Junc Bot_58	58	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
59	At Junc Bot_59	59	(N/A)	C 8x11.5	At Junc Bot	7.05	7.05
62	At Junc Bot_62	62	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
63	At Junc Bot_63	63	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
64	At Junc Bot_64	64	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
65	At Junc Bot_65	65	(N/A)	L 2x2x0.375	At Junc Bot	4.14	4.14
67	At Junc Bot_67	67	(N/A)	C 10x15.3	At Junc Bot	15.33	15.33
71	At Junc Bot_71	71	(N/A)	C 10x15.3	At Junc Bot	15.33	15.33

Calculations

Member	Section	Material	Lay	Laz	Ratio	Case
1 South Perimeter C	C 10x15.3	STEEL	60.89	110.41	0.31	25 D+W (Y-)
2 East Perimeter C	C 10x15.3	STEEL	49.05	26.71	0.40	24 D+W (Y+)
3 North Perimeter C	C 10x15.3	STEEL	73.28	110.52	0.25	29 D+0.75L+0.75W(X-)+0.75Lr
5 At Junc Bot_5	C 8x11.5	STEEL	59.24	29.51	0.21	17 D+L
6 At Junc Bot_6	C 10x15.3	STEEL	47.46	25.84	0.10	17 D+L
7 Bracing Upper Flange_7	C 10x15.3	STEEL	47.46	25.84	0.07	17 D+L
8 At Junc Bot_8	C 10x15.3	STEEL	20.12	10.96	0.03	33 D+0.75L+0.75W(Y-)+0.75Lr
9 At Junc Bot_9	C 10x15.3	STEEL	20.12	10.96	0.04	33 D+0.75L+0.75W(Y-)+0.75Lr
22 At Junc Bot_22	C 8x11.5	STEEL	27.24	13.57	0.28	17 D+L
23 At Junc Bot_23	C 8x11.5	STEEL	27.24	13.57	0.04	17 D+L

26 At Junc Bot_26	C 8x11.5	STEEL	24.69	12.30	0.03	17 D+L
32 At Junc Bot_32	L 2x2x0.375	STEEL	83.97	8.40	0.20	17 D+L
33 At Junc Bot_33	L 2x2x0.375	STEEL	83.97	8.40	0.29	17 D+L
35 At Junc Bot_35	L 2x2x0.375	STEEL	83.97	8.40	0.20	17 D+L
36 At Junc Bot_36	L 2x2x0.375	STEEL	83.97	8.40	0.29	17 D+L
43 At Junc Bot_43	C 8x11.5	STEEL	27.24	13.57	0.03	17 D+L
44 At Junc Bot_44	C 8x11.5	STEEL	54.31	27.05	0.11	17 D+L
45 At Junc Bot_45	C 10x15.3	STEEL	47.46	25.84	0.07	17 D+L
46 At Junc Bot_46	C 10x15.3	STEEL	20.12	10.96	0.03	17 D+L
47 At Junc Bot_47	C 10x15.3	STEEL	20.12	10.96	0.04	17 D+L
48 At Junc Bot_48	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
49 At Junc Bot_49	L 2x2x0.375	STEEL	83.97	8.40	0.24	17 D+L
50 At Junc Bot_50	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
51 At Junc Bot_51	L 2x2x0.375	STEEL	83.97	8.40	0.24	17 D+L
52 At Junc Bot_52	C 8x11.5	STEEL	27.24	13.57	0.35	17 D+L
58 At Junc Bot_58	C 8x11.5	STEEL	27.24	13.57	0.04	17 D+L
59 At Junc Bot_59	C 8x11.5	STEEL	27.24	13.57	0.30	17 D+L
62 At Junc Bot_62	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
63 At Junc Bot_63	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
64 At Junc Bot_64	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
65 At Junc Bot_65	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
67 At Junc Bot_67	C 10x15.3	STEEL	47.46	25.84	0.06	17 D+L
71 At Junc Bot_71	C 10x15.3	STEEL	47.46	25.84	0.14	19 D+0.75L+0.75Lr

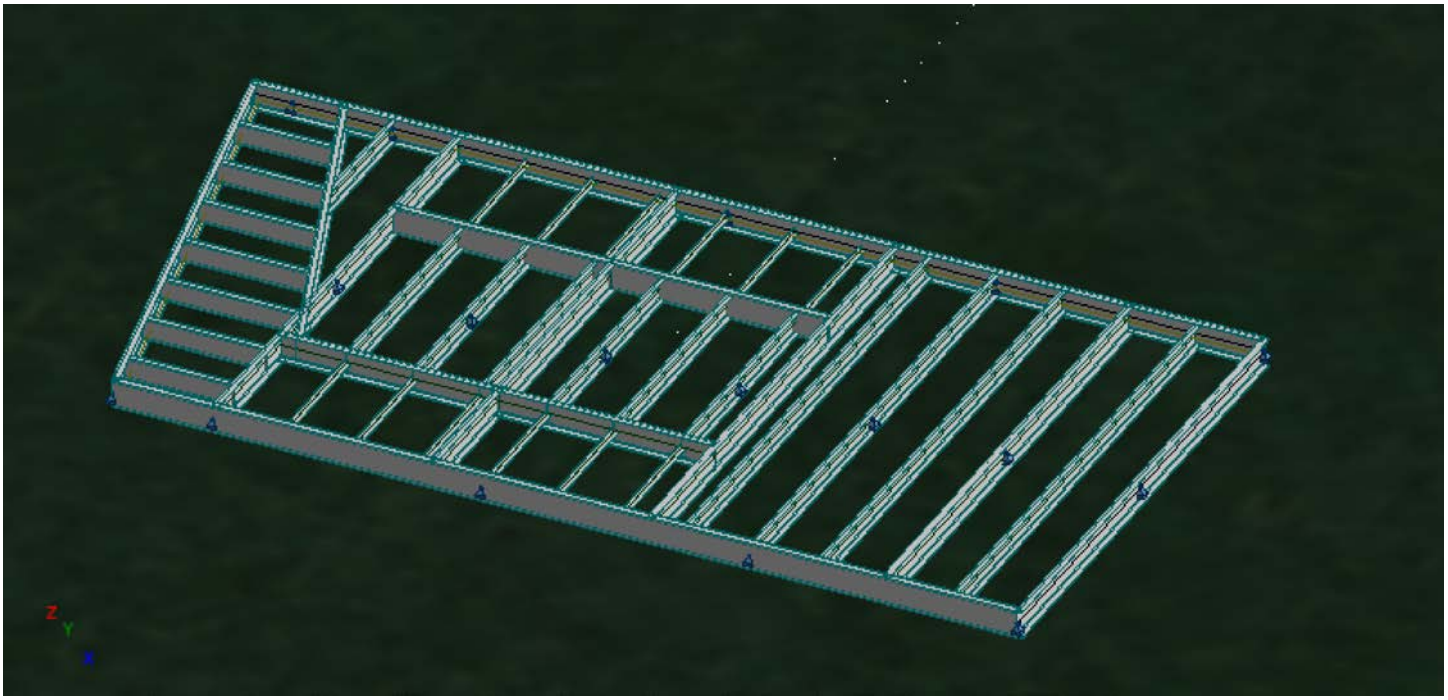
Deflection Results

Bar/Case	UX (in)	UY (in)	UZ (in)
1/ 17 (C)	0.0000	0.0000	-0.0044
2/ 17 (C)	0.0000	0.0000	-0.0074
3/ 17 (C)	0.0000	0.0000	-0.0343
5/ 17 (C)	0.0000	-0.0000	-0.1603
6/ 17 (C)	-0.0000	0.0000	0.0041
7/ 17 (C)	0.0000	-0.0000	-0.0437
8/ 17 (C)	0.0000	-0.0000	0.0024
9/ 17 (C)	0.0000	0.0000	0.0029
22/ 17 (C)	0.0000	0.0000	0.0276
23/ 17 (C)	-0.0000	-0.0000	-0.0061
26/ 17 (C)	-0.0000	-0.0000	-0.0034
32/ 17 (C)	-0.0000	0.0000	-0.0338
33/ 17 (C)	-0.0000	0.0000	-0.0485

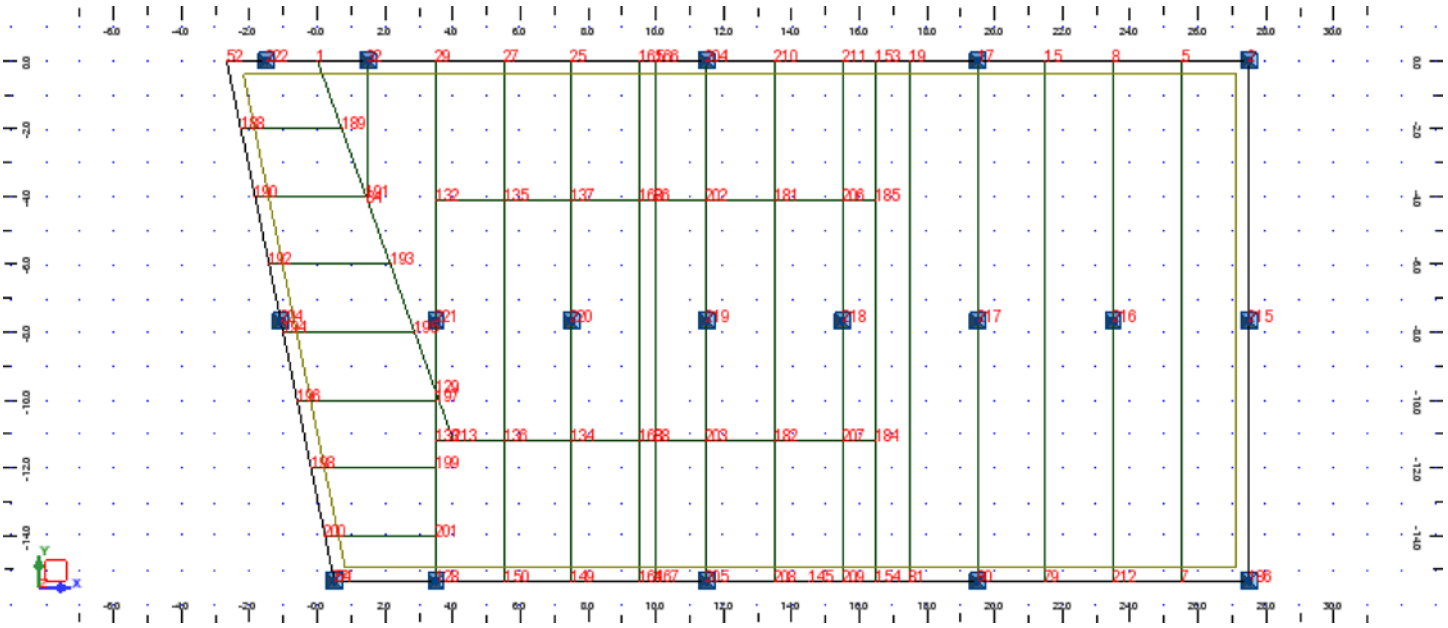
35/	**17 (C)**	-0.0000	-0.0000	-0.0338
36/	**17 (C)**	-0.0000	-0.0000	-0.0485
43/	**17 (C)**	0.0000	-0.0000	-0.0053
44/	**17 (C)**	-0.0000	-0.0000	-0.0739
45/	**17 (C)**	-0.0000	-0.0000	-0.0421
46/	**17 (C)**	0.0000	0.0000	0.0017
47/	**17 (C)**	0.0000	-0.0000	0.0022
48/	**17 (C)**	0.0000	-0.0000	-0.0551
49/	**17 (C)**	0.0000	-0.0000	-0.0408
50/	**17 (C)**	0.0000	0.0000	-0.0551
51/	**17 (C)**	0.0000	0.0000	-0.0408
52/	**17 (C)**	0.0000	0.0000	0.0338
58/	**17 (C)**	0.0000	-0.0000	-0.0072
59/	**17 (C)**	0.0000	0.0000	0.0294
62/	**17 (C)**	0.0000	-0.0000	-0.0551
63/	**17 (C)**	-0.0000	-0.0000	-0.0551
64/	**17 (C)**	0.0000	0.0000	-0.0551
65/	**17 (C)**	-0.0000	0.0000	-0.0551
67/	**17 (C)**	0.0000	-0.0000	-0.0353
71/	**17 (C)**	0.0	0.0000	-0.0036

Module B Chassis Stationary

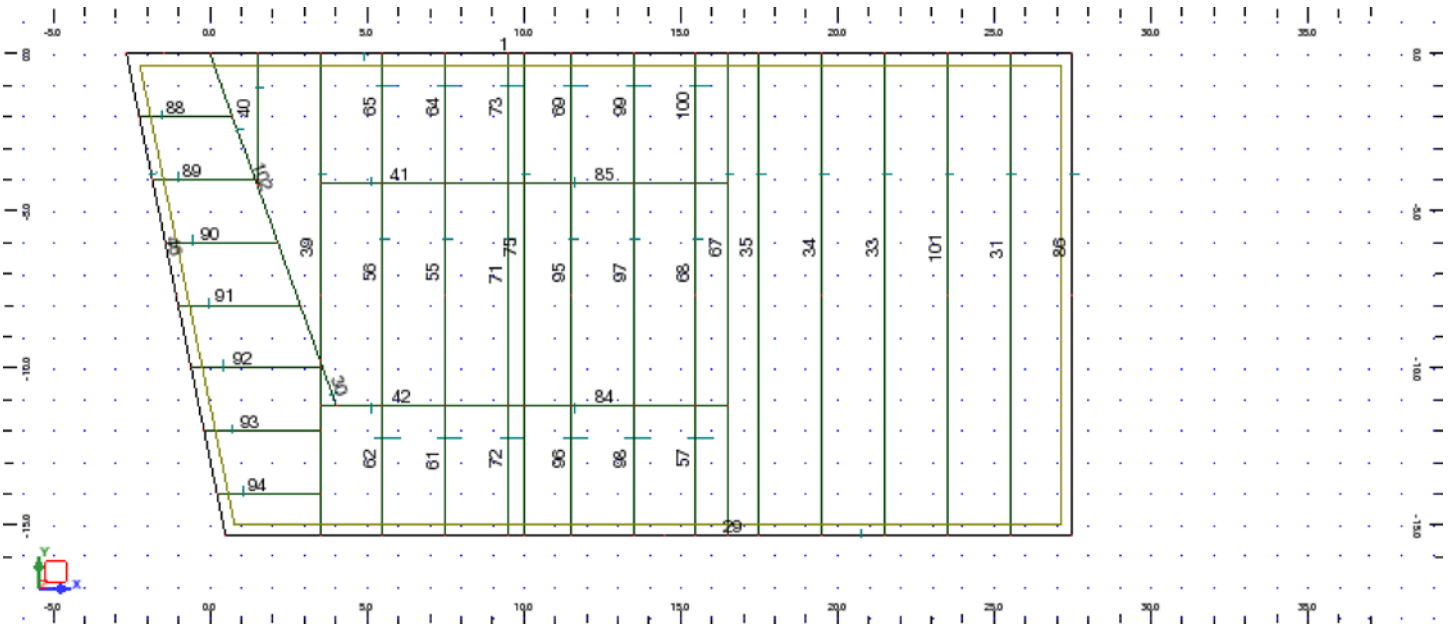
Module B- Realistic View



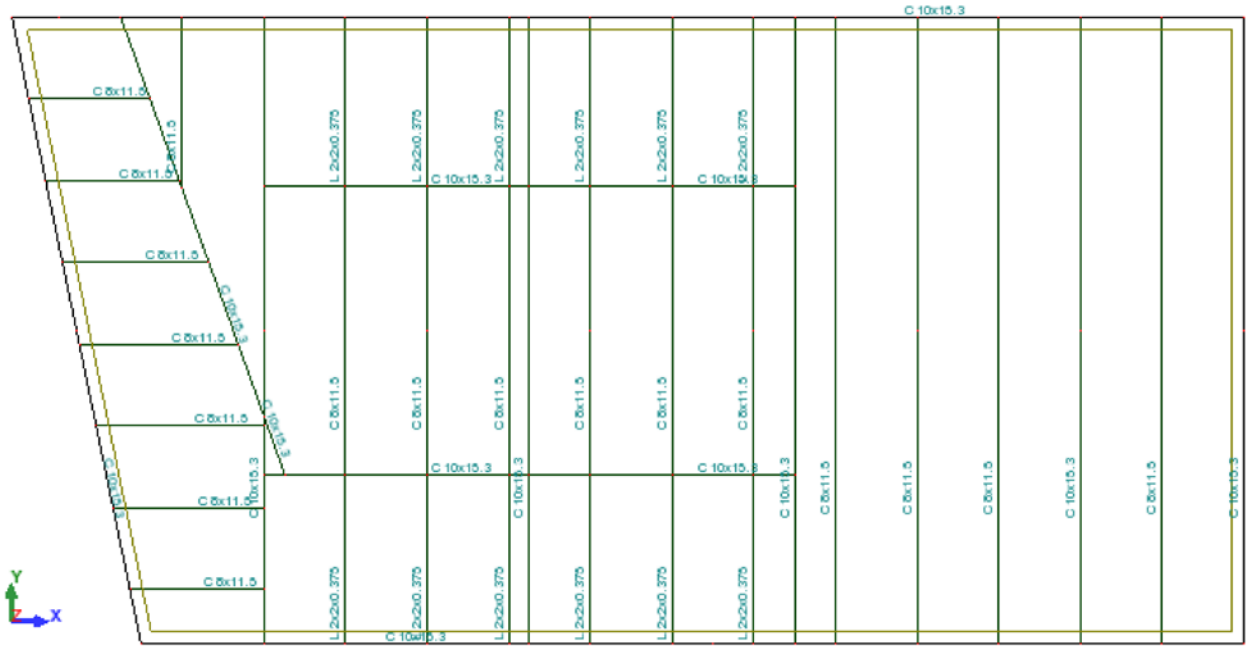
Node Names



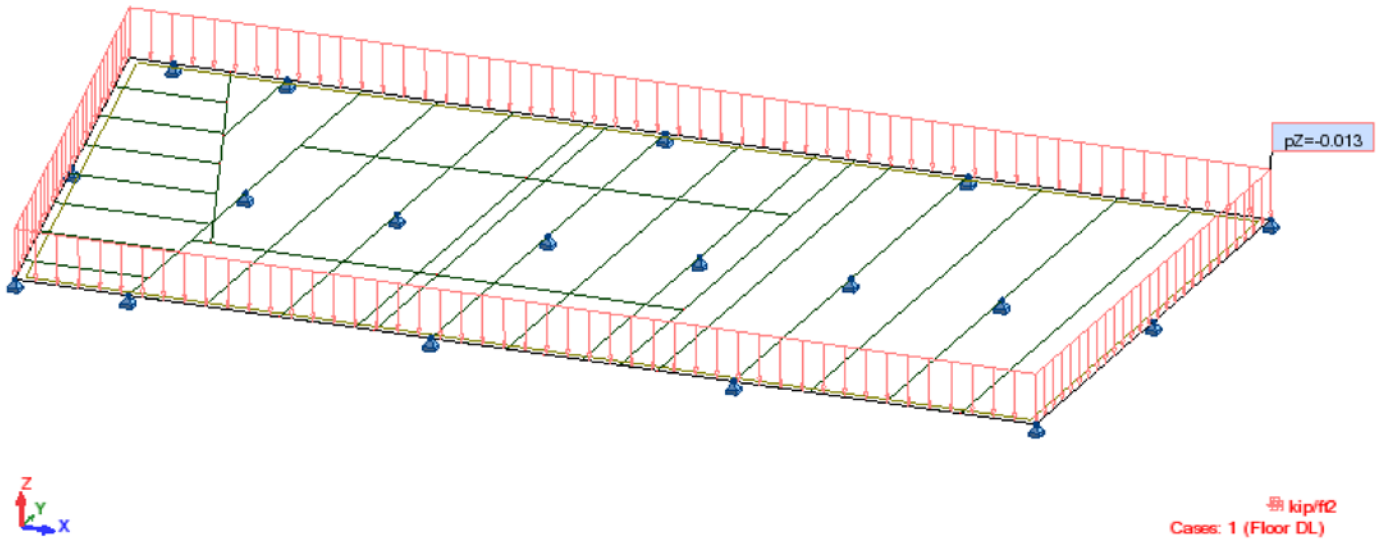
Bar Names



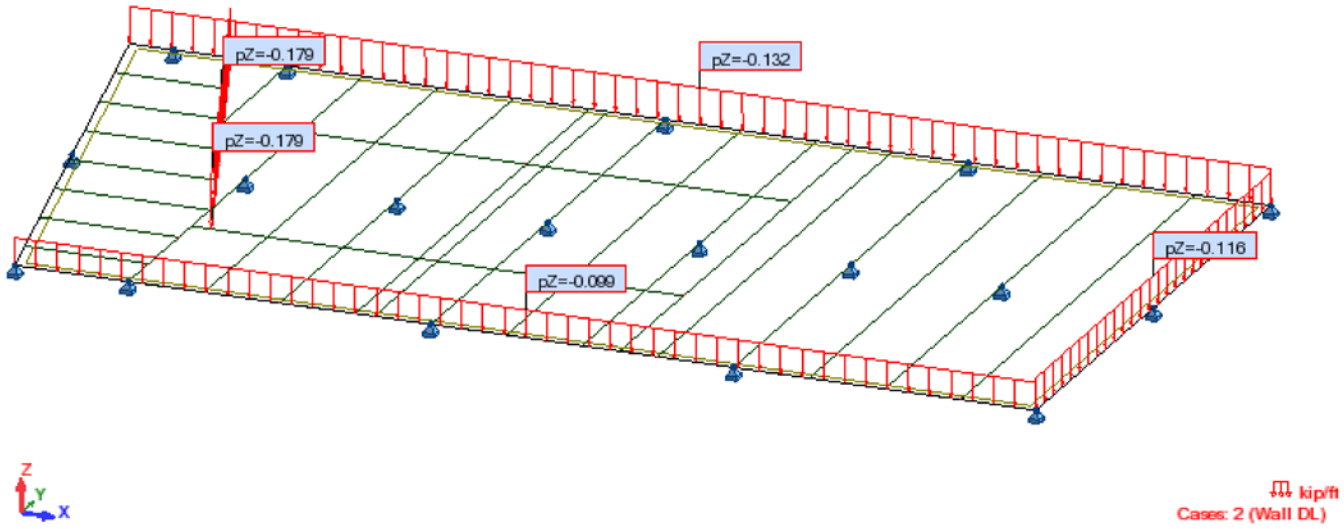
Sections



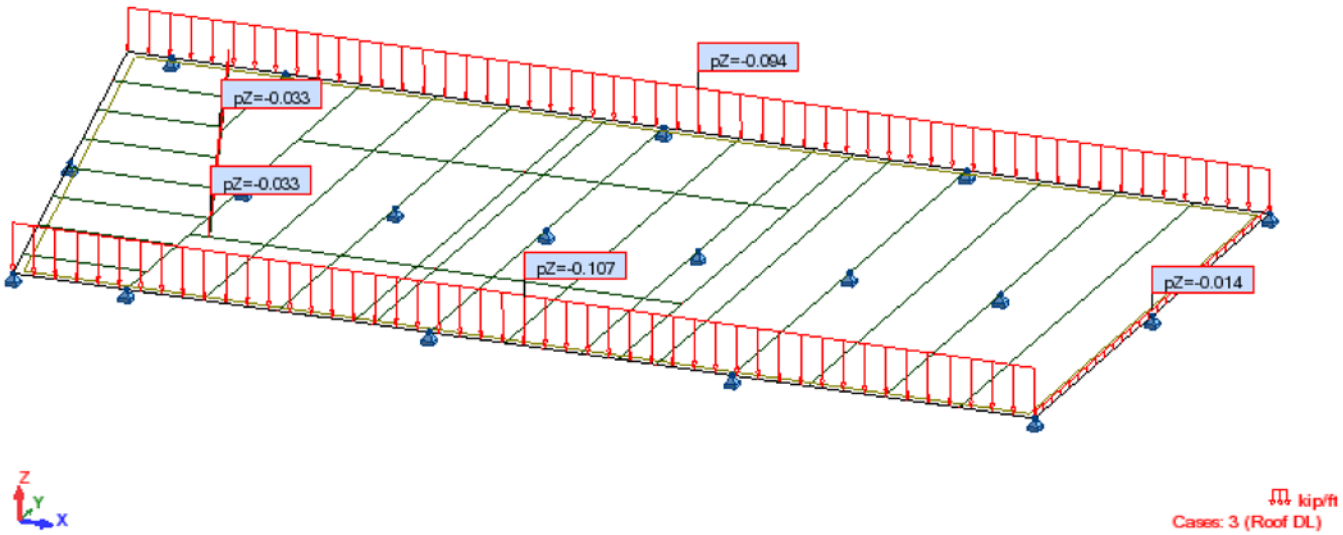
View - Cases: 1 (Floor DL)



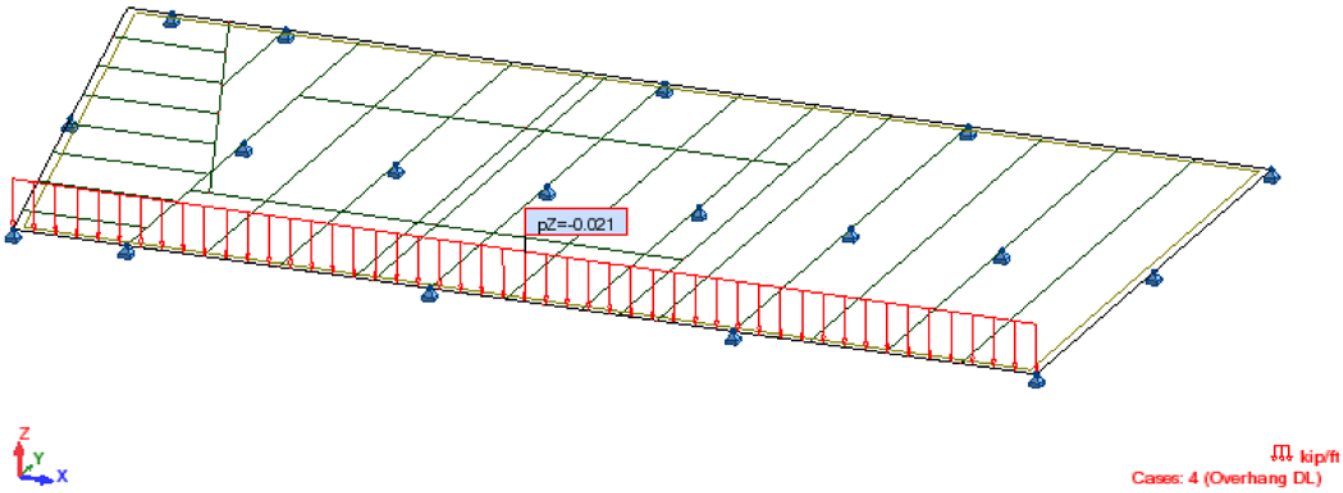
View - Cases: 2 (Wall DL)



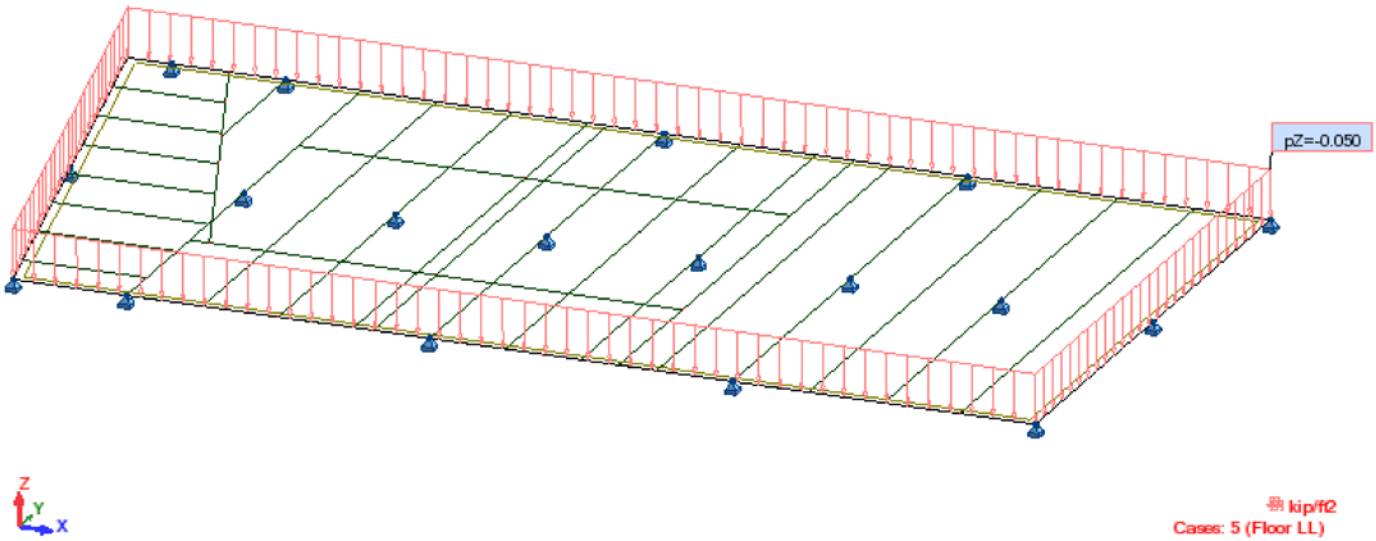
View - Cases: 3 (Roof DL)



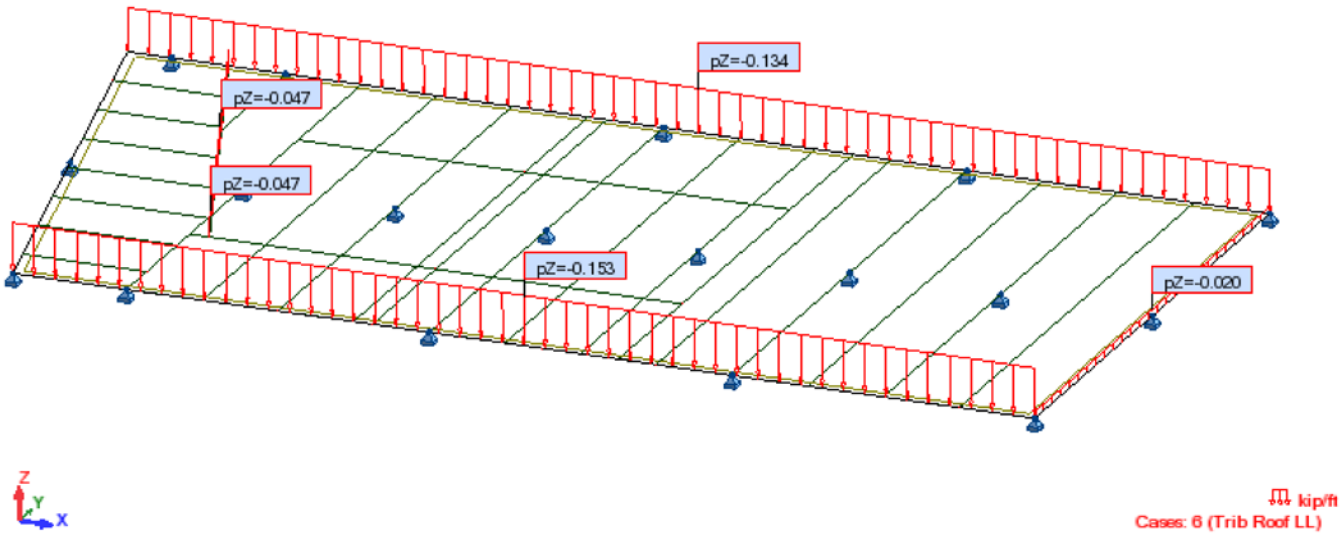
View - Cases: 4 (Overhang DL)



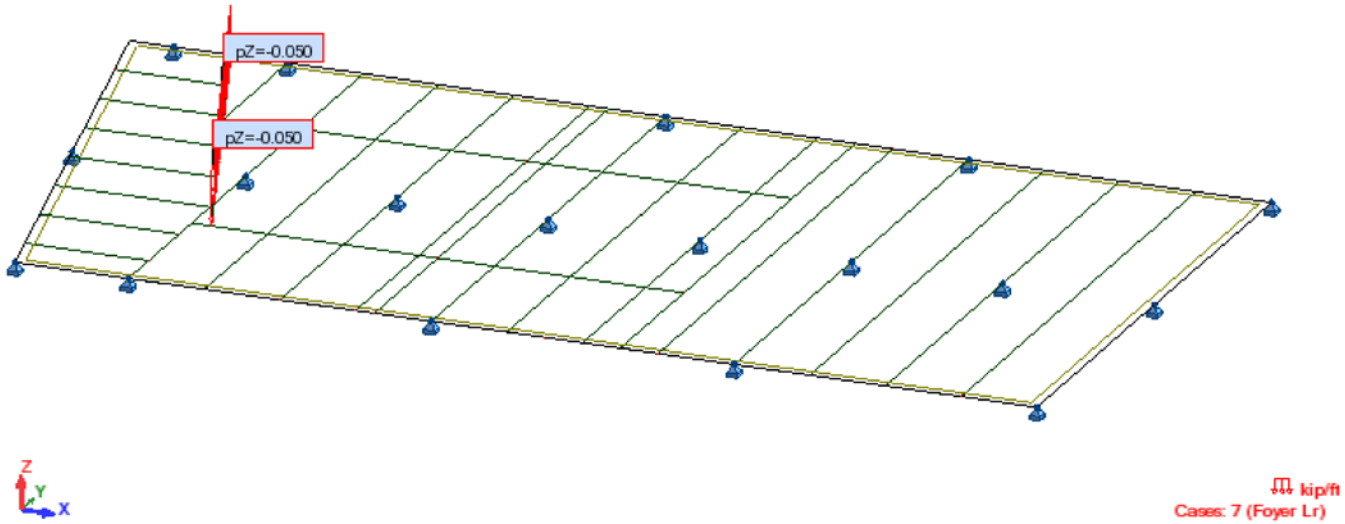
View - Cases: 5 (Floor LL)



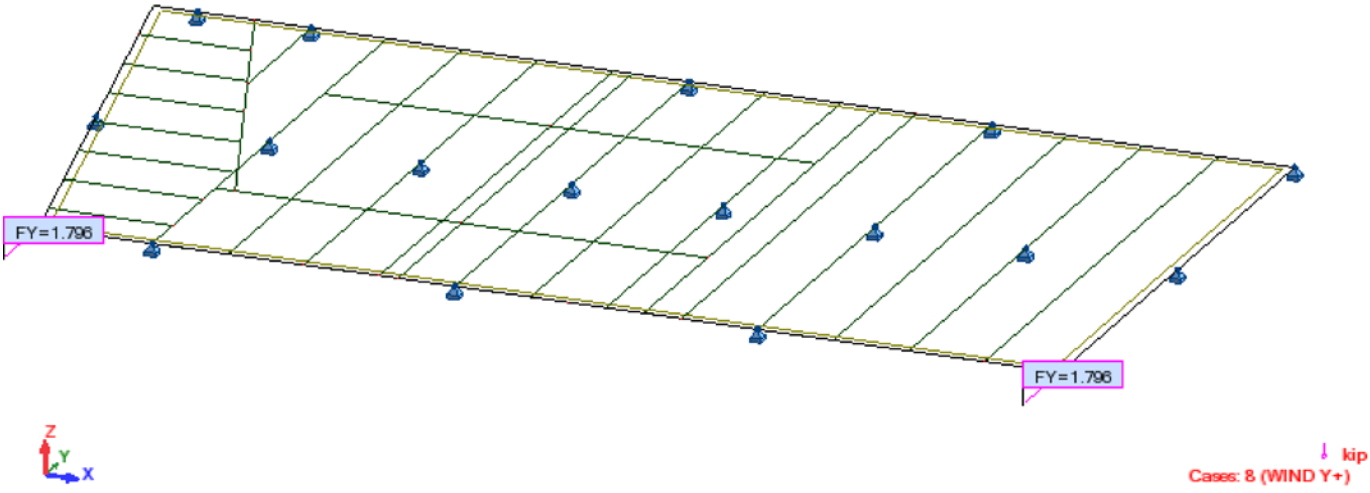
View - Cases: 6 (Trib Roof LL)



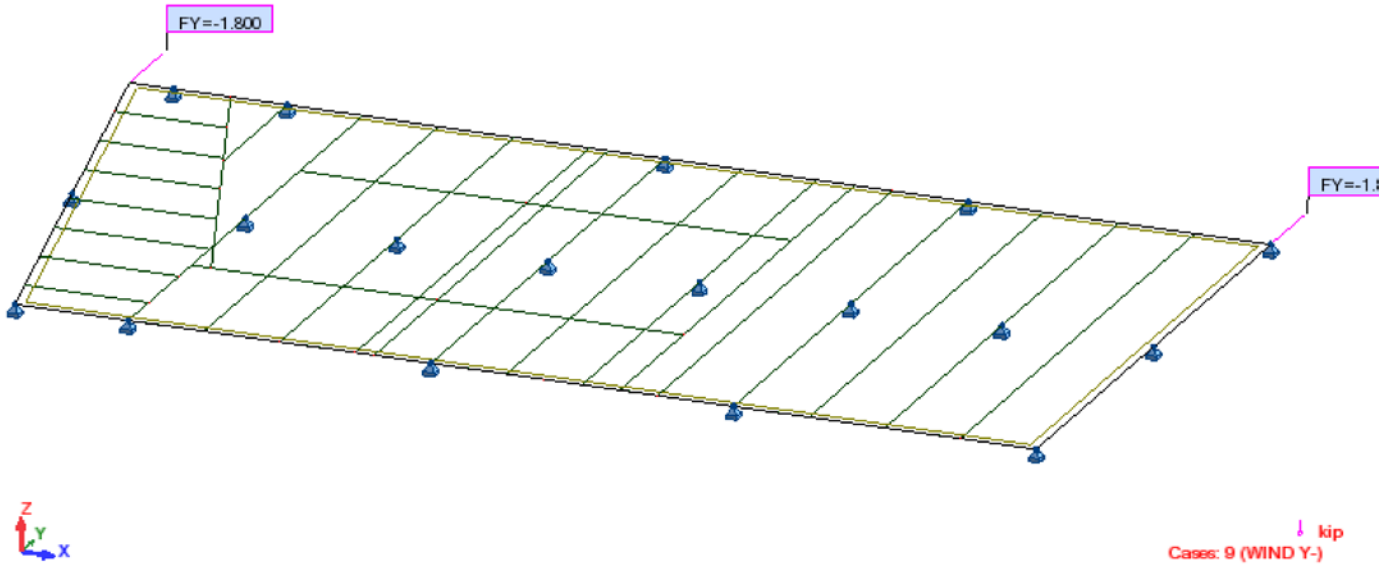
View - Cases: 7 (Foyer Lr)



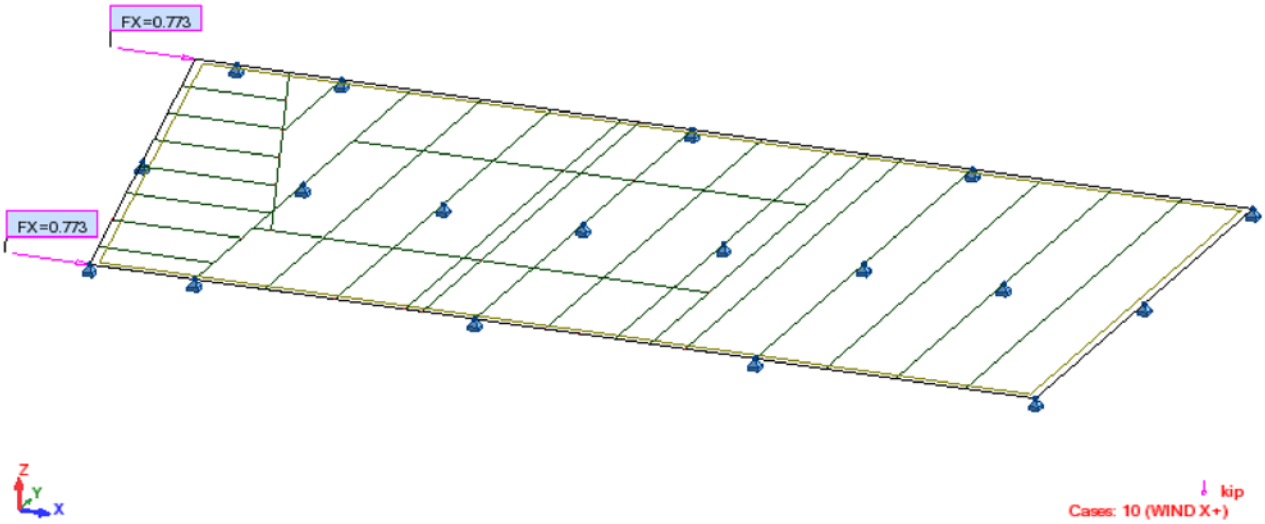
View - Cases: 8 (WIND Y+)



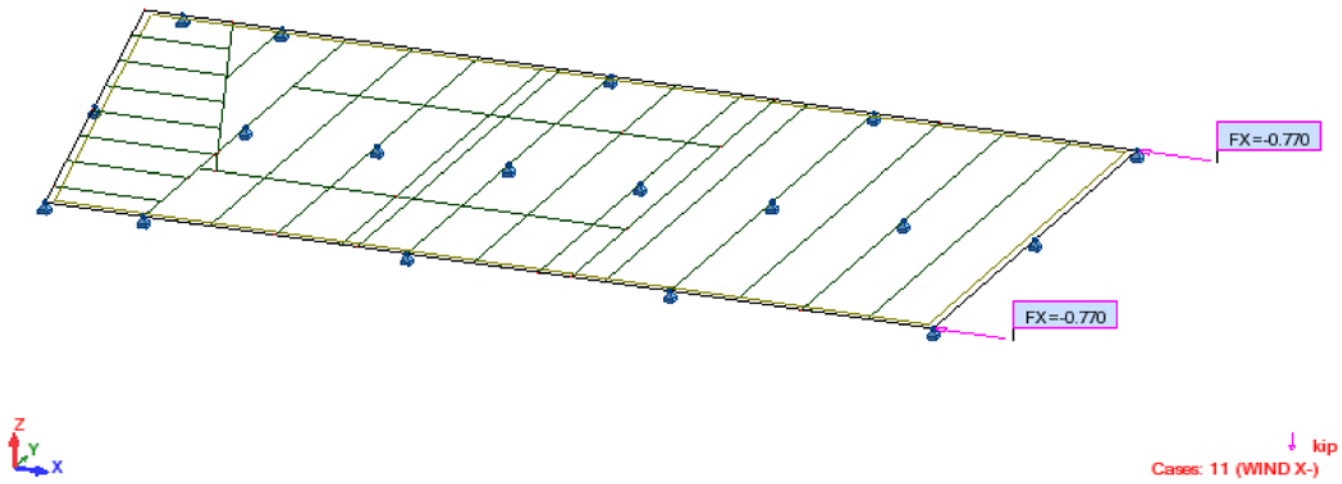
View - Cases: 9 (WIND Y-)



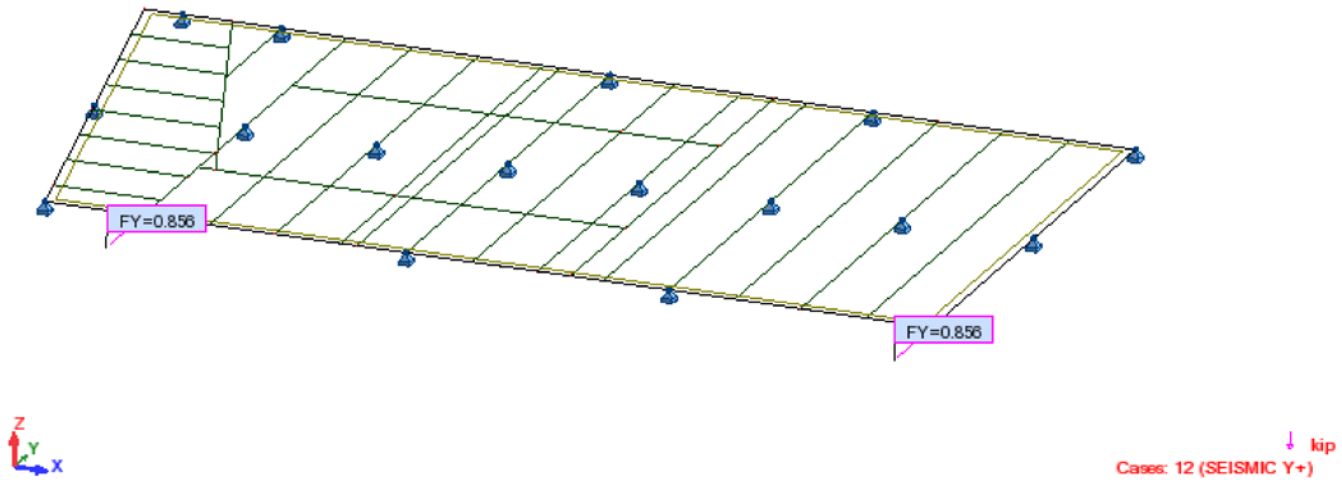
View - Cases: 10 (WIND X+)



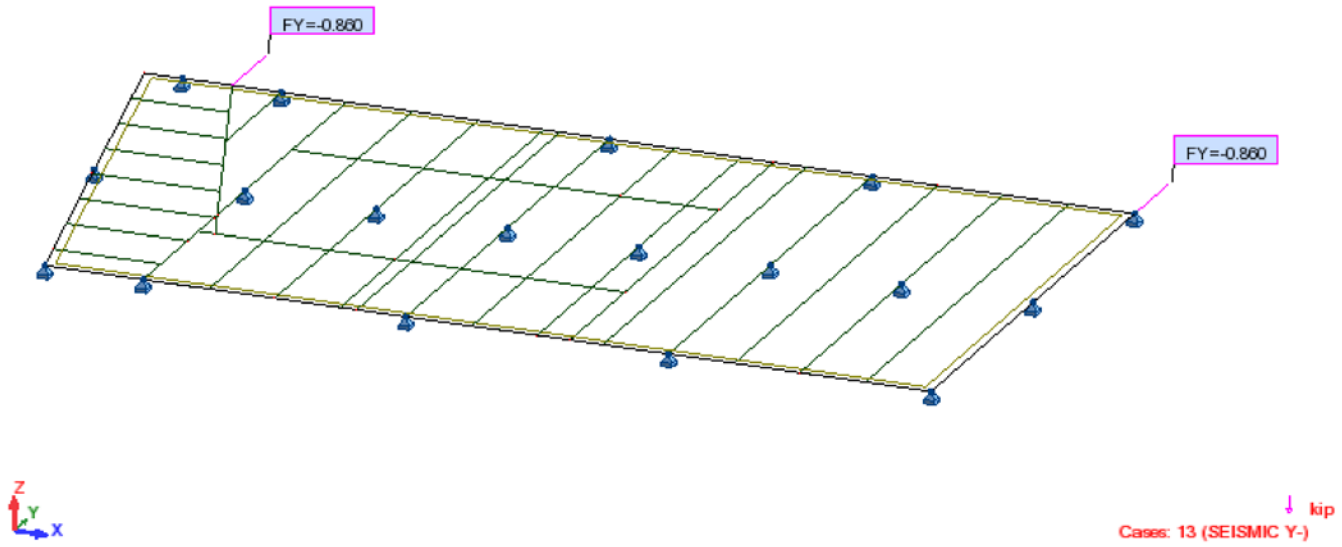
View - Cases: 11 (WIND X-)



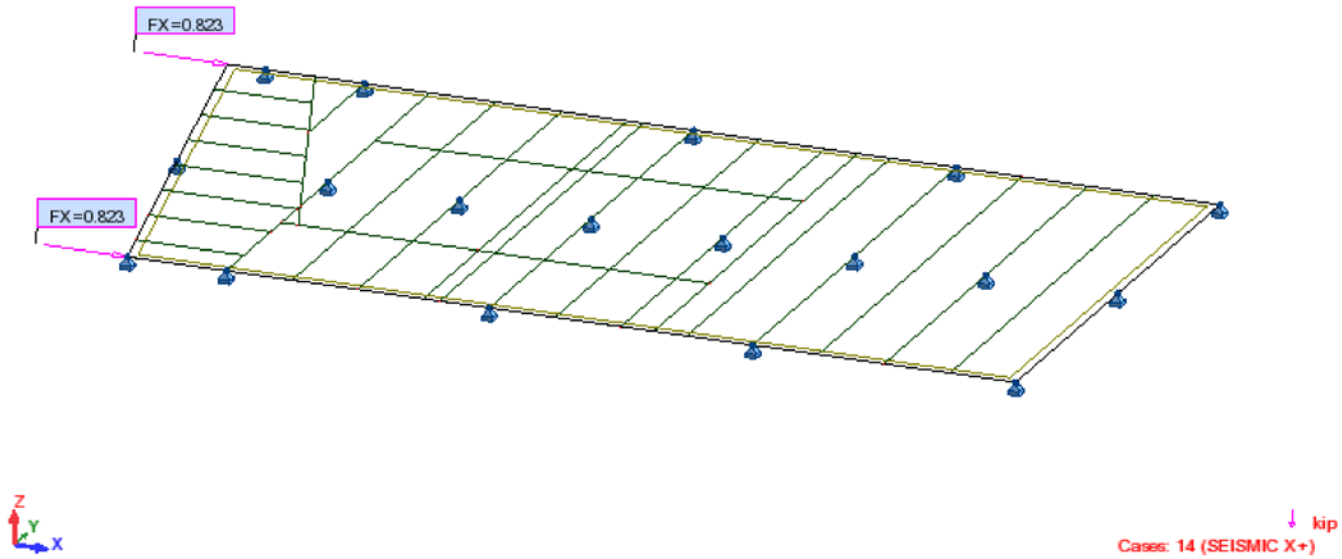
View - Cases: 12 (SEISMIC Y+)



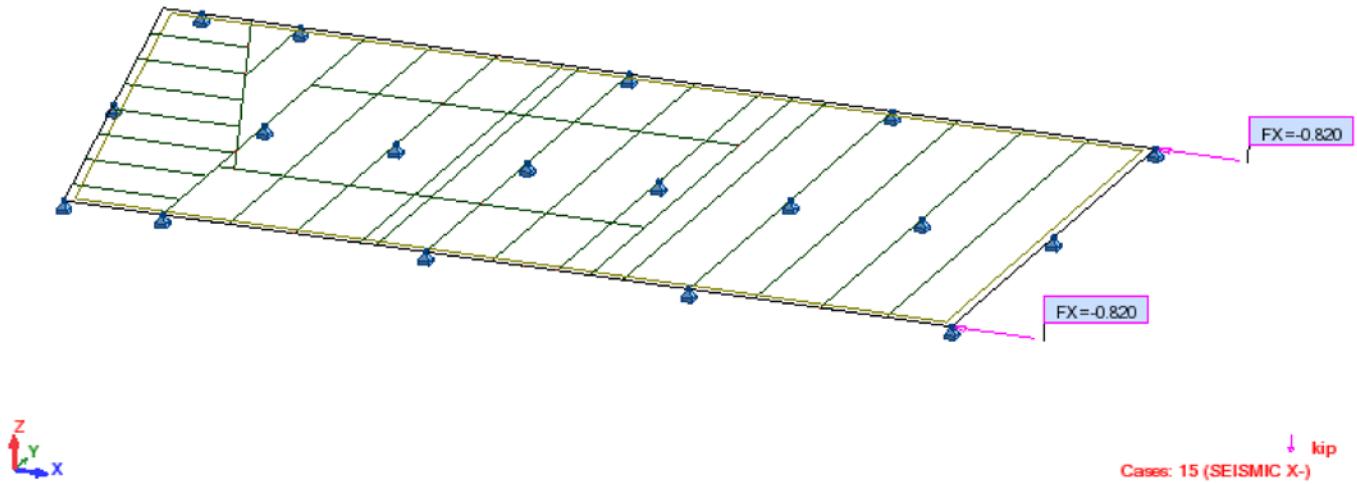
View - Cases: 13 (SEISMIC Y-)



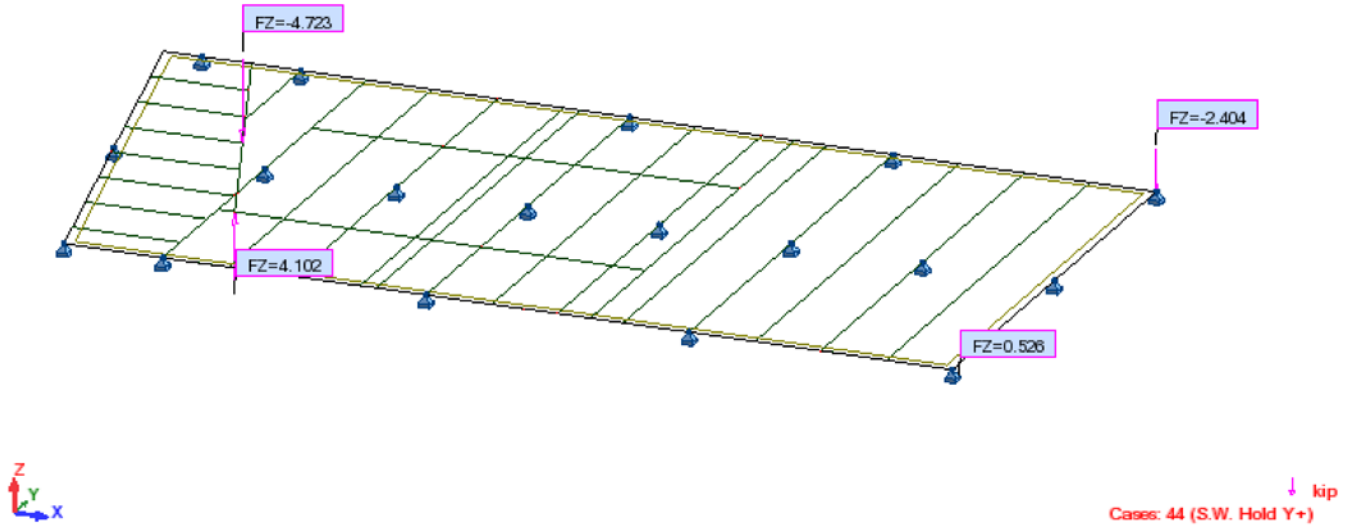
View - Cases: 14 (SEISMIC X+)



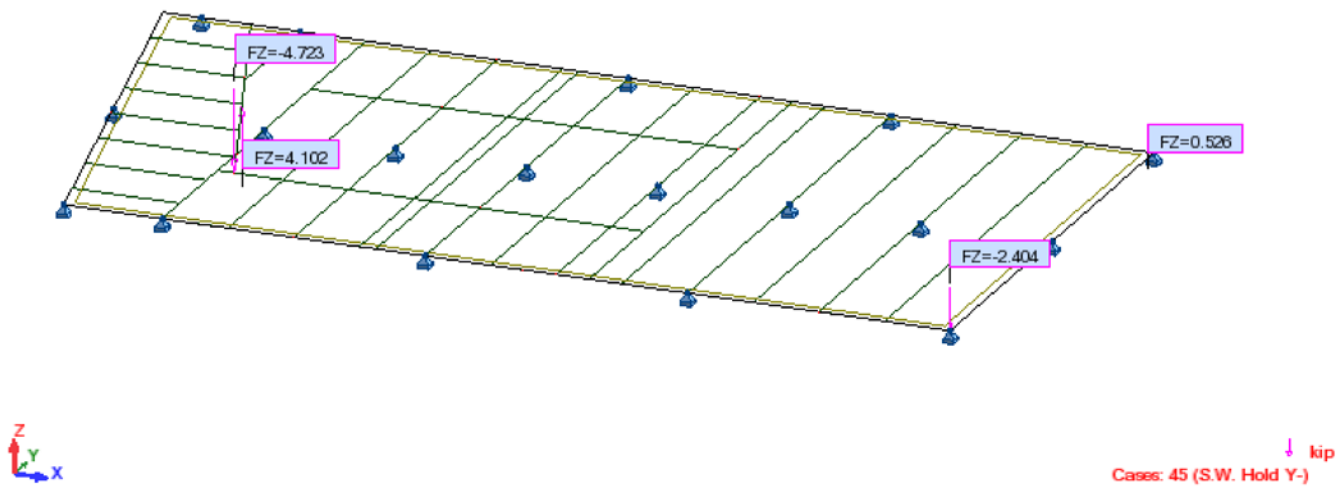
View - Cases: 15 (SEISMIC X-)



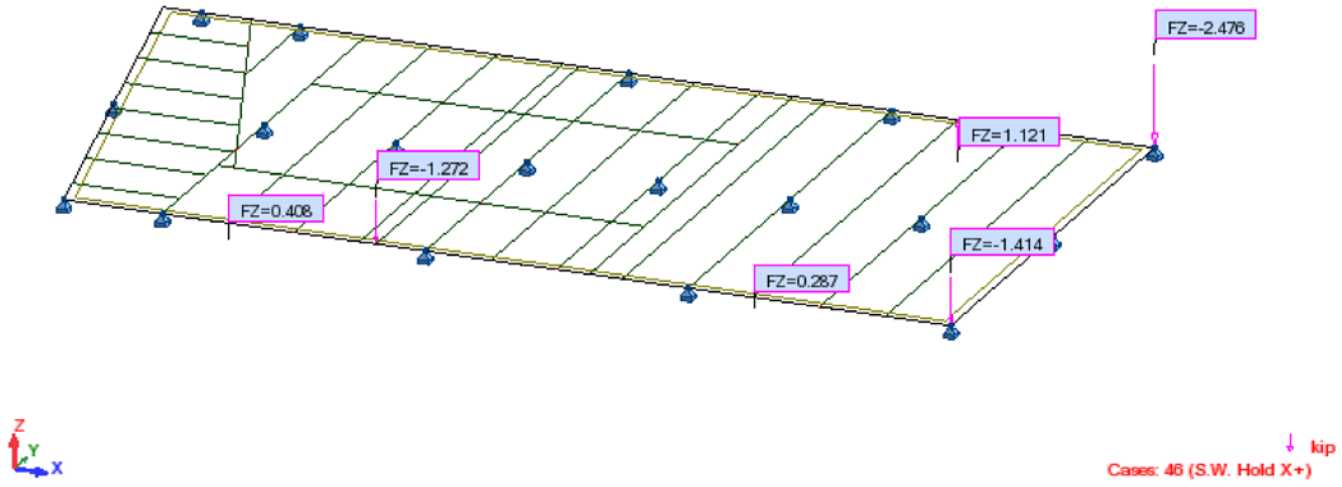
View - Cases: 44 (S.W. Hold Y+)



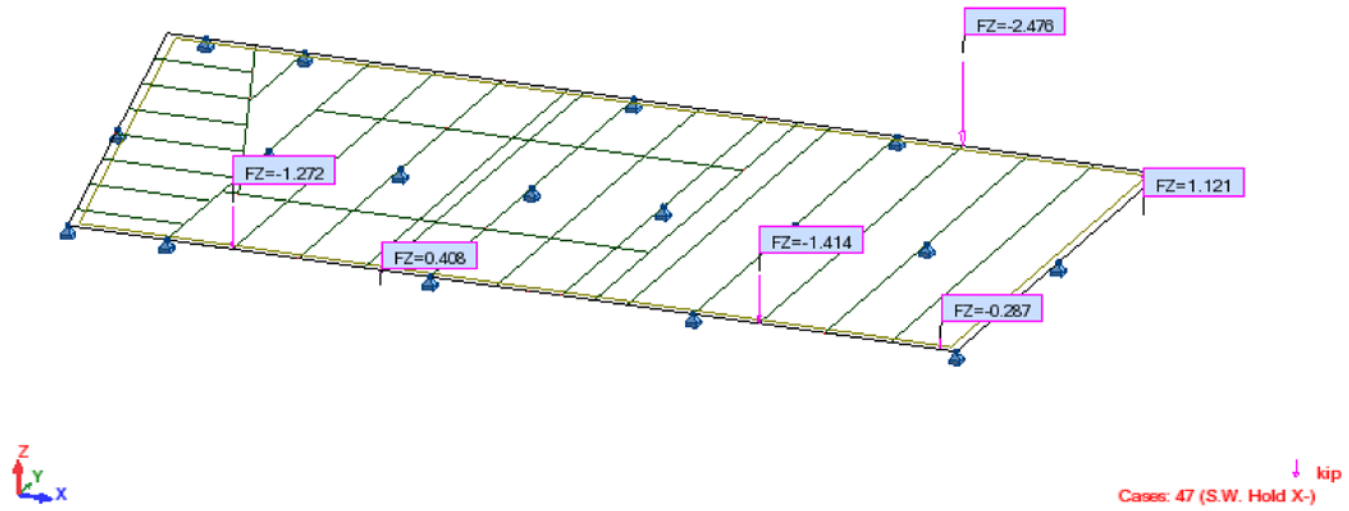
View - Cases: 45 (S.W. Hold Y-)



View - Cases: 46 (S.W. Hold X+)



View - Cases: 47 (S.W. Hold X-)



Member Results

Member	Name	Components	Code group	Section	Type	Ly (ft)	Lz (ft)
1	North C	1	(N/A)	C 10x15.3	North C	30.17	30.17
29	South C_29	29	(N/A)	C 10x15.3	South C	27.00	27.00
30	At Junc_30	30	(N/A)	C 10x15.3	At Junc	1.52	1.52
31	At Junc_31	31	(N/A)	C 8x11.5	At Junc	15.33	15.33
33	At Junc_33	33	(N/A)	C 8x11.5	At Junc	15.33	15.33
34	At Junc_34	34	(N/A)	C 8x11.5	At Junc	15.33	15.33
35	At Junc_35	35	(N/A)	C 8x11.5	At Junc	15.33	15.33
39	At Junc_39	39	(N/A)	C 10x15.3	At Junc	15.33	15.33
40	At Junc_40	40	(N/A)	C 8x11.5	At Junc	4.18	4.18
41	At Junc_41	41	(N/A)	C 10x15.3	At Junc	6.50	6.50
42	At Junc_42	42	(N/A)	C 10x15.3	At Junc	6.50	6.50
46	At Junc_46	46	(N/A)	C 10x15.3	At Junc	15.66	15.66
55	At Junc_55	55	(N/A)	C 8x11.5	At Junc	7.05	7.05
56	At Junc_56	56	(N/A)	C 8x11.5	At Junc	7.05	7.05
57	At Junc_57	57	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
61	At Junc_61	61	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
62	At Junc_62	62	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
64	At Junc_64	64	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
65	At Junc_65	65	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
67	At Junc_67	67	(N/A)	C 10x15.3	At Junc	15.33	15.33
68	At Junc_68	68	(N/A)	C 8x11.5	At Junc	7.05	7.05
69	At Junc_69	69	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
71	At Junc_71	71	(N/A)	C 8x11.5	At Junc	7.05	7.05
72	At Junc_72	72	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
73	At Junc_73	73	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
75	At Junc_75	75	(N/A)	C 10x15.3	At Junc	15.33	15.33
84	At Junc_84	84	(N/A)	C 10x15.3	At Junc	6.50	6.50
85	At Junc_85	85	(N/A)	C 10x15.3	At Junc	6.50	6.50
86	At Junc_86	86	(N/A)	C 10x15.3	At Junc	15.33	15.33
88	South C_88	88	(N/A)	C 8x11.5	South C	2.97	2.97

89	South C_89	89	(N/A)	C 8x11.5	South C	3.28	3.28
90	South C_90	90	(N/A)	C 8x11.5	South C	3.58	3.58
91	South C_91	91	(N/A)	C 8x11.5	South C	3.88	3.88
92	South C_92	92	(N/A)	C 8x11.5	South C	4.10	4.10
93	South C_93	93	(N/A)	C 8x11.5	South C	3.69	3.69
94	South C_94	94	(N/A)	C 8x11.5	South C	3.28	3.28
95	At Junc_95	95	(N/A)	C 8x11.5	At Junc	7.05	7.05
96	At Junc_96	96	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
97	At Junc_97	97	(N/A)	C 8x11.5	At Junc	7.05	7.05
98	At Junc_98	98	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
99	At Junc_99	99	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
100	At Junc_100	100	(N/A)	L 2x2x0.375	At Junc	4.14	4.14
101	At Junc_101	101	(N/A)	C 10x15.3	At Junc	15.33	15.33
102	At Junc_102	102	(N/A)	C 10x15.3	At Junc	10.36	10.36

Calculations

Member	Section	Material	Lay	Laz	Ratio	Case
1 North C	C 10x15.3	STEEL	9.34	106.80	0.17	29 D+0.75L+0.75W(X-)+0.75Lr
29 South C_29	C 10x15.3	STEEL	8.36	31.86	0.16	29 D+0.75L+0.75W(X-)+0.75Lr
30 At Junc_30	C 10x15.3	STEEL	4.72	2.57	0.01	19 D+0.75L+0.75Lr
31 At Junc_31	C 8x11.5	STEEL	59.24	29.51	0.21	17 D+L
33 At Junc_33	C 8x11.5	STEEL	59.25	29.51	0.21	17 D+L
34 At Junc_34	C 8x11.5	STEEL	59.25	29.51	0.13	17 D+L
35 At Junc_35	C 8x11.5	STEEL	59.25	29.51	0.16	17 D+L
39 At Junc_39	C 10x15.3	STEEL	47.46	25.84	0.21	33 D+0.75L+0.75W(Y-)+0.75Lr
40 At Junc_40	C 8x11.5	STEEL	16.16	8.05	0.01	17 D+L
41 At Junc_41	C 10x15.3	STEEL	20.12	10.96	0.04	33 D+0.75L+0.75W(Y-)+0.75Lr

42 At Junc_42	C 10x15.3	STEEL	20.12	10.96	0.14	25 DL8
46 At Junc_46	C 10x15.3	STEEL	48.47	26.39	0.04	35 D+0.75L+0.75(0.7E(Y-))
55 At Junc_55	C 8x11.5	STEEL	27.24	13.57	0.23	17 D+L
56 At Junc_56	C 8x11.5	STEEL	27.24	13.57	0.04	17 D+L
57 At Junc_57	L 2x2x0.375	STEEL	83.97	8.40	0.24	17 D+L
61 At Junc_61	L 2x2x0.375	STEEL	84.00	8.40	0.33	17 D+L
62 At Junc_62	L 2x2x0.375	STEEL	83.99	8.40	0.33	17 D+L
64 At Junc_64	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
65 At Junc_65	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
67 At Junc_67	C 10x15.3	STEEL	47.46	25.84	0.05	17 D+L
68 At Junc_68	C 8x11.5	STEEL	27.24	13.57	0.25	17 D+L
69 At Junc_69	L 2x2x0.375	STEEL	83.97	8.40	0.29	17 D+L
71 At Junc_71	C 8x11.5	STEEL	27.24	13.57	0.03	17 D+L
72 At Junc_72	L 2x2x0.375	STEEL	83.97	8.40	0.20	17 D+L
73 At Junc_73	L 2x2x0.375	STEEL	83.97	8.40	0.20	17 D+L
75 At Junc_75	C 10x15.3	STEEL	47.46	25.84	0.06	35 D+0.75L+0.75(0.7E(Y-))
84 At Junc_84	C 10x15.3	STEEL	20.12	10.96	0.02	34 D+0.75L+0.75(0.7E(Y+))
85 At Junc_85	C 10x15.3	STEEL	20.12	10.96	0.06	17 D+L
86 At Junc_86	C 10x15.3	STEEL	47.47	25.85	0.12	29 D+0.75L+0.75W(X-)+0.75Lr
88 South C_88	C 8x11.5	STEEL	1.15	13.73	0.01	17 D+L
89 South C_89	C 8x11.5	STEEL	1.27	15.13	0.01	17 D+L
90 South C_90	C 8x11.5	STEEL	1.38	16.54	0.01	17 D+L

91 South C_91	C 8x11.5	STEEL	1.50	17.94	0.01	17 D+L
92 South C_92	C 8x11.5	STEEL	1.58	18.95	0.01	17 D+L
93 South C_93	C 8x11.5	STEEL	1.43	17.04	0.01	17 D+L
94 South C_94	C 8x11.5	STEEL	1.27	15.13	0.01	17 D+L
95 At Junc_95	C 8x11.5	STEEL	27.24	13.57	0.28	17 D+L
96 At Junc_96	L 2x2x0.375	STEEL	83.97	8.40	0.30	17 D+L
97 At Junc_97	C 8x11.5	STEEL	27.24	13.57	0.04	17 D+L
98 At Junc_98	L 2x2x0.375	STEEL	83.97	8.40	0.33	17 D+L
99 At Junc_99	L 2x2x0.375	STEEL	83.97	8.40	0.30	17 D+L
100 At Junc_100	L 2x2x0.375	STEEL	83.97	8.40	0.21	17 D+L
101 At Junc_101	C 10x15.3	STEEL	47.47	25.85	0.16	29 D+0.75L+0.75W(X-)+0.75Lr
102 At Junc_102	C 10x15.3	STEEL	32.09	17.47	0.51	24 D+W (Y+)

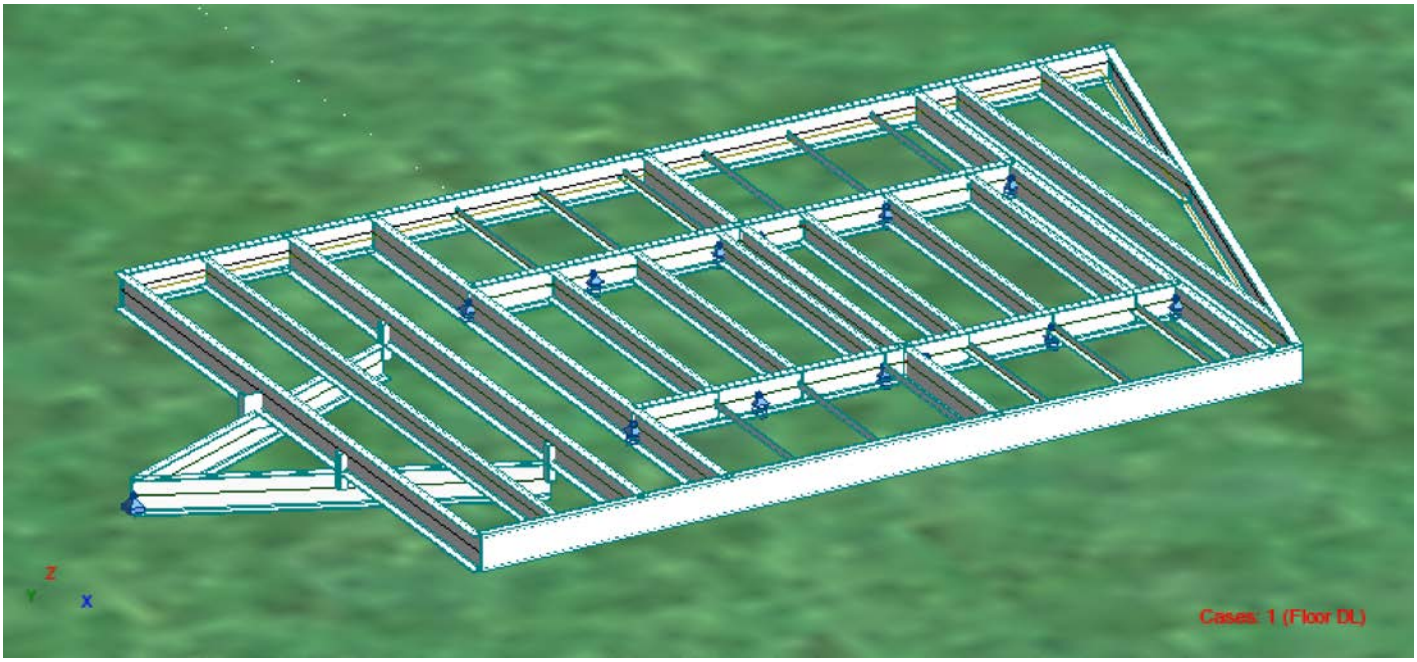
Deflection Results

Bar/Case		UX (in)	UY (in)	UZ (in)
1/	**17 (C)**	-0.0000	-0.0000	0.0137
29/	**17 (C)**	-0.0000	0.0000	0.0128
30/	**17 (C)**	-0.0000	0.0000	0.0000
31/	**17 (C)**	-0.0000	-0.0000	-0.1603
33/	**17 (C)**	-0.0000	-0.0000	-0.1604
34/	**17 (C)**	0.0	-0.0000	-0.0040
35/	**17 (C)**	0.0000	-0.0000	-0.1211
39/	**17 (C)**	0.0000	-0.0000	-0.0111
40/	**17 (C)**	0.0000	-0.0000	-0.0006
41/	**17 (C)**	-0.0000	-0.0000	-0.0041
42/	**17 (C)**	0.0000	0.0000	0.0031
46/	**17 (C)**	0.0000	-0.0000	0.0022
55/	**17 (C)**	0.0000	0.0000	0.0221
56/	**17 (C)**	-0.0000	-0.0000	-0.0072

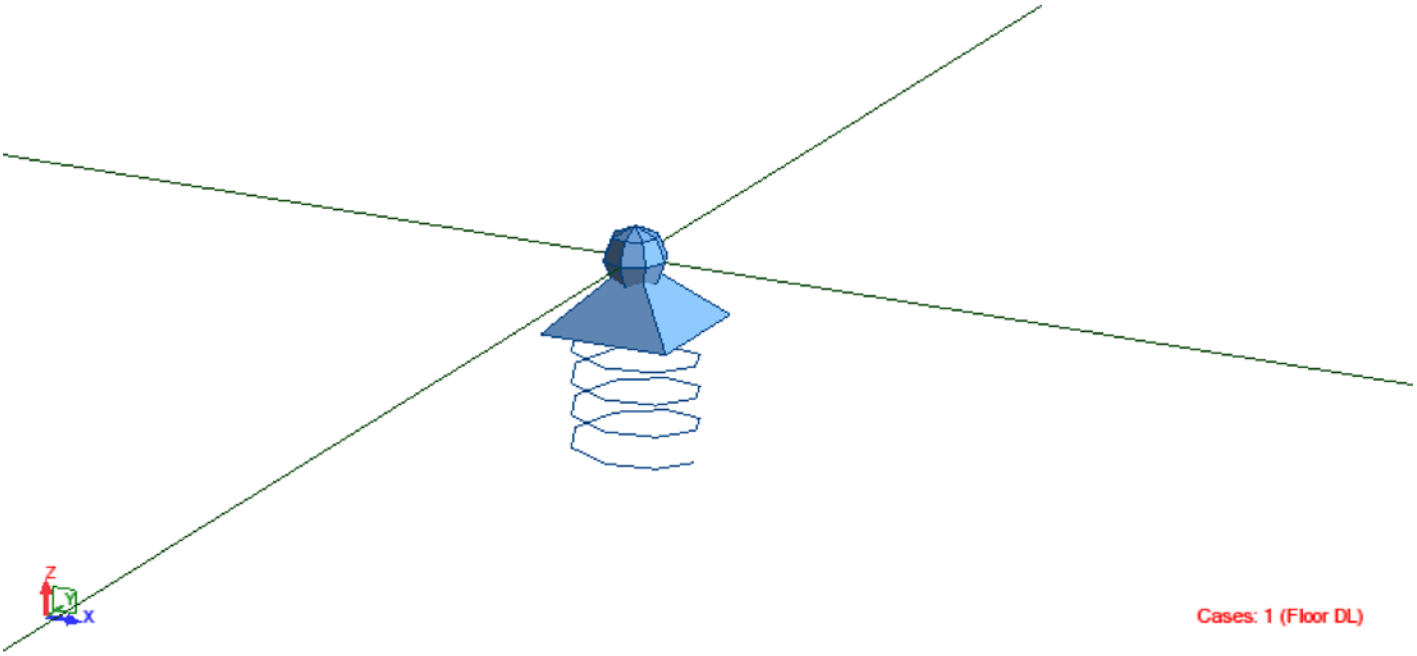
57/	**17 (C)**	0.0000	-0.0000	-0.0408
61/	**17 (C)**	-0.0000	-0.0000	-0.0551
62/	**17 (C)**	0.0000	-0.0000	-0.0551
64/	**17 (C)**	-0.0000	-0.0000	-0.0551
65/	**17 (C)**	-0.0000	-0.0000	-0.0551
67/	**17 (C)**	0.0000	-0.0000	-0.0286
68/	**17 (C)**	0.0000	0.0000	0.0239
69/	**17 (C)**	0.0000	-0.0000	-0.0485
71/	**17 (C)**	-0.0000	-0.0000	-0.0044
72/	**17 (C)**	-0.0000	-0.0000	-0.0338
73/	**17 (C)**	-0.0000	-0.0000	-0.0338
75/	**17 (C)**	0.0000	-0.0000	-0.0307
84/	**17 (C)**	-0.0000	0.0000	0.0016
85/	**17 (C)**	-0.0000	-0.0000	-0.0027
86/	**17 (C)**	0.0	-0.0000	-0.0031
88/	**17 (C)**	-0.0000	-0.0000	-0.0002
89/	**17 (C)**	-0.0000	-0.0000	-0.0003
90/	**17 (C)**	0.0000	-0.0000	-0.0004
91/	**17 (C)**	-0.0000	-0.0000	-0.0006
92/	**17 (C)**	-0.0000	-0.0000	-0.0008
93/	**17 (C)**	0.0000	0.0000	-0.0005
94/	**17 (C)**	-0.0000	0.0000	-0.0003
95/	**17 (C)**	0.0000	0.0000	0.0270
96/	**17 (C)**	-0.0000	-0.0000	-0.0491
97/	**17 (C)**	0.0000	-0.0000	-0.0072
98/	**17 (C)**	0.0000	-0.0000	-0.0550
99/	**17 (C)**	-0.0000	-0.0000	-0.0493
100/	**17 (C)**	-0.0000	-0.0000	-0.0342
101/	**17 (C)**	0.0000	-0.0000	0.0133
102/	**17 (C)**	0.0000	0.0000	-0.0473

Module A Moving Complete

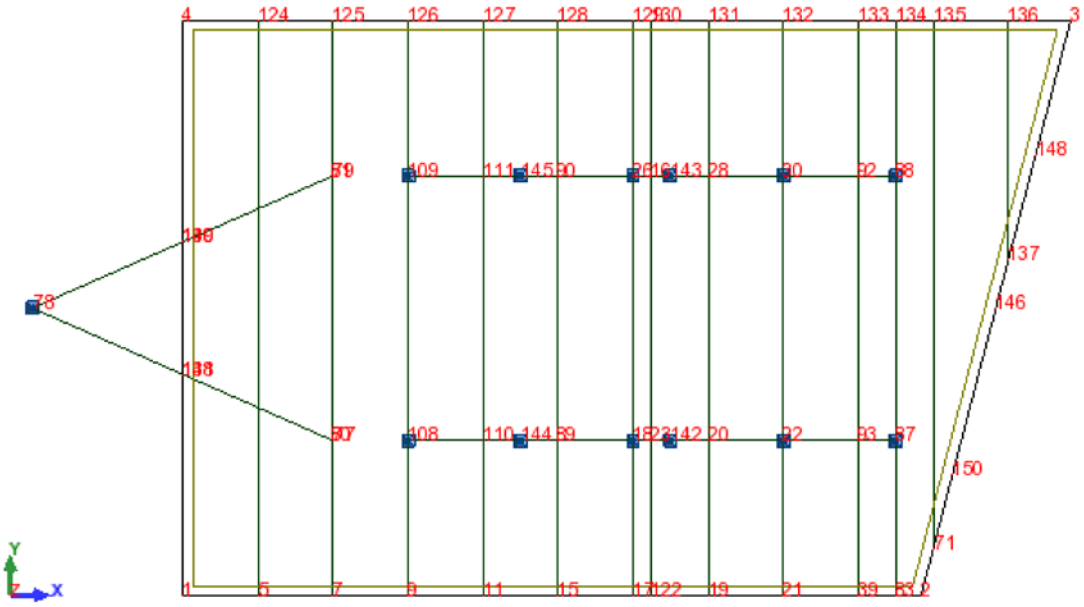
Module A- Realistic View



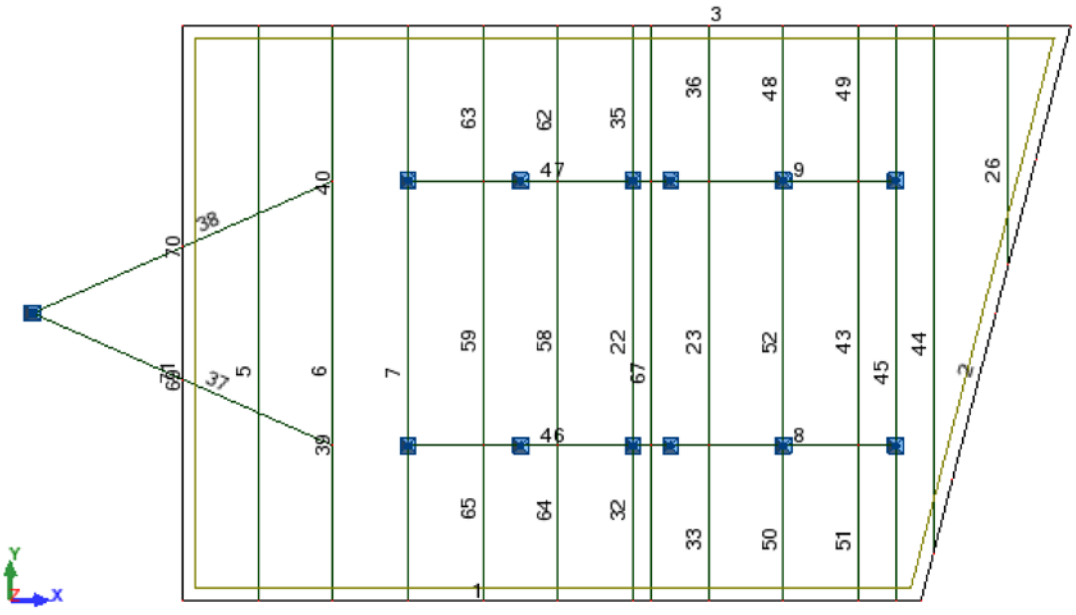
Leaf Spring Support



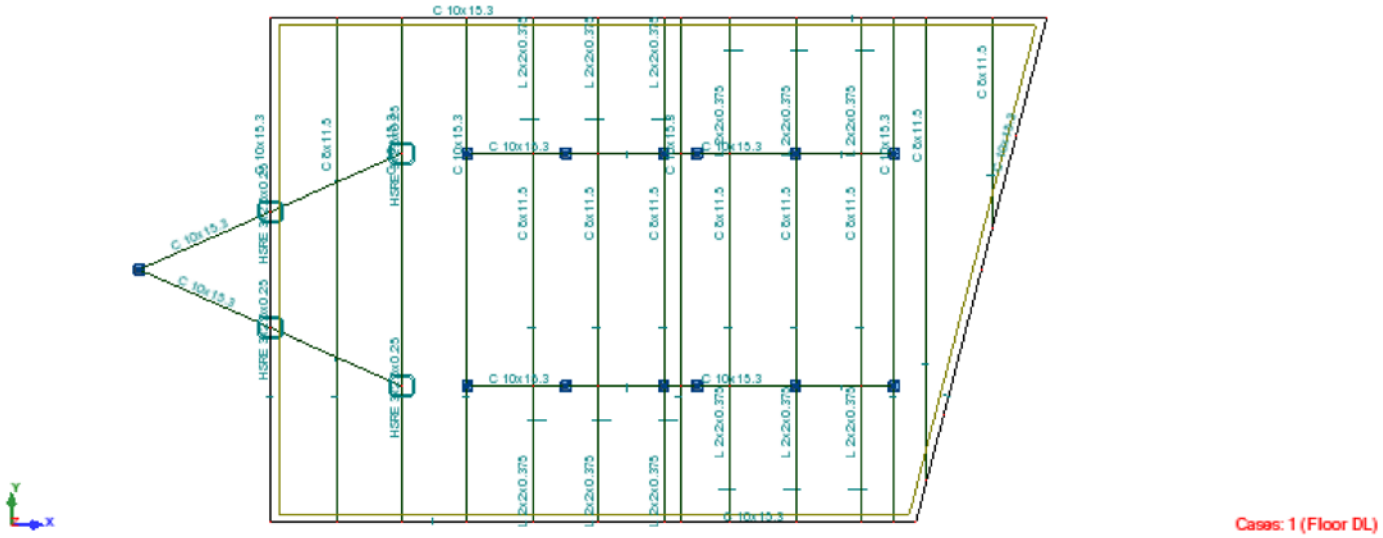
Node Names



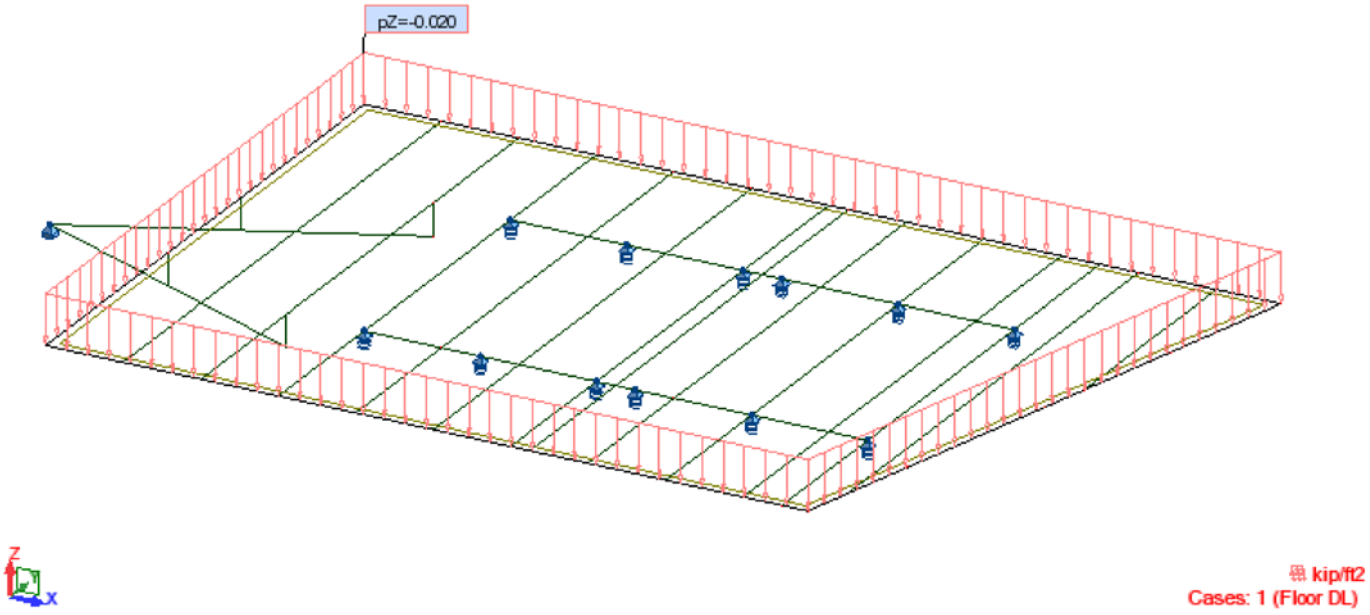
Bar Names



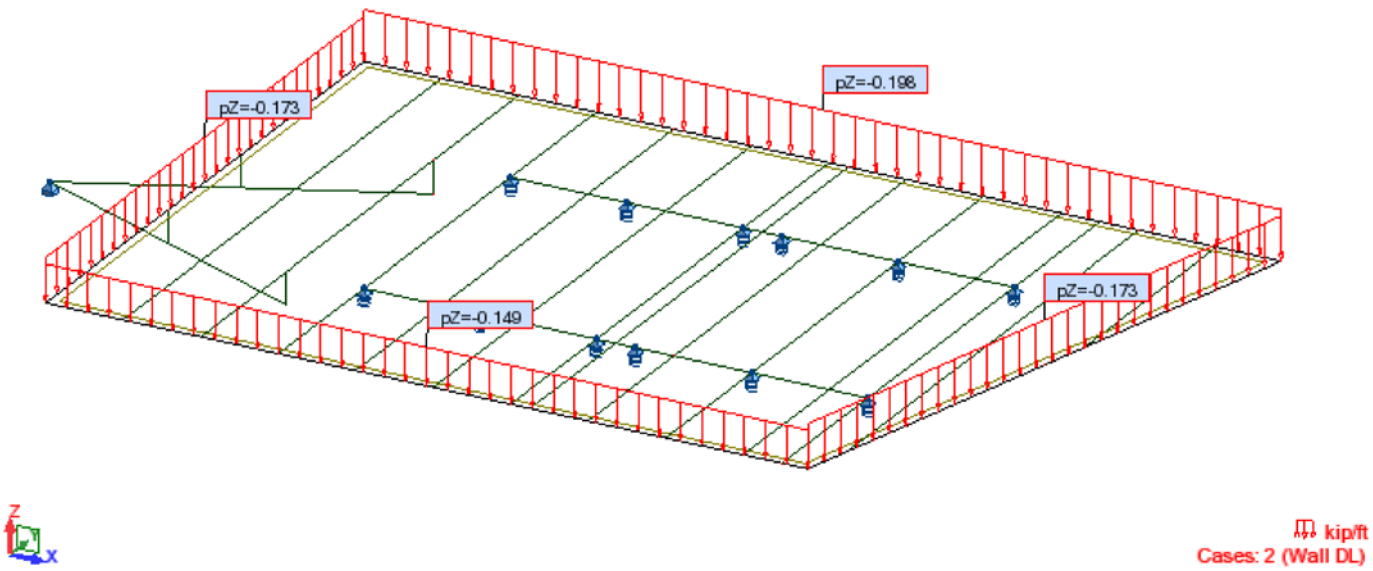
Sections



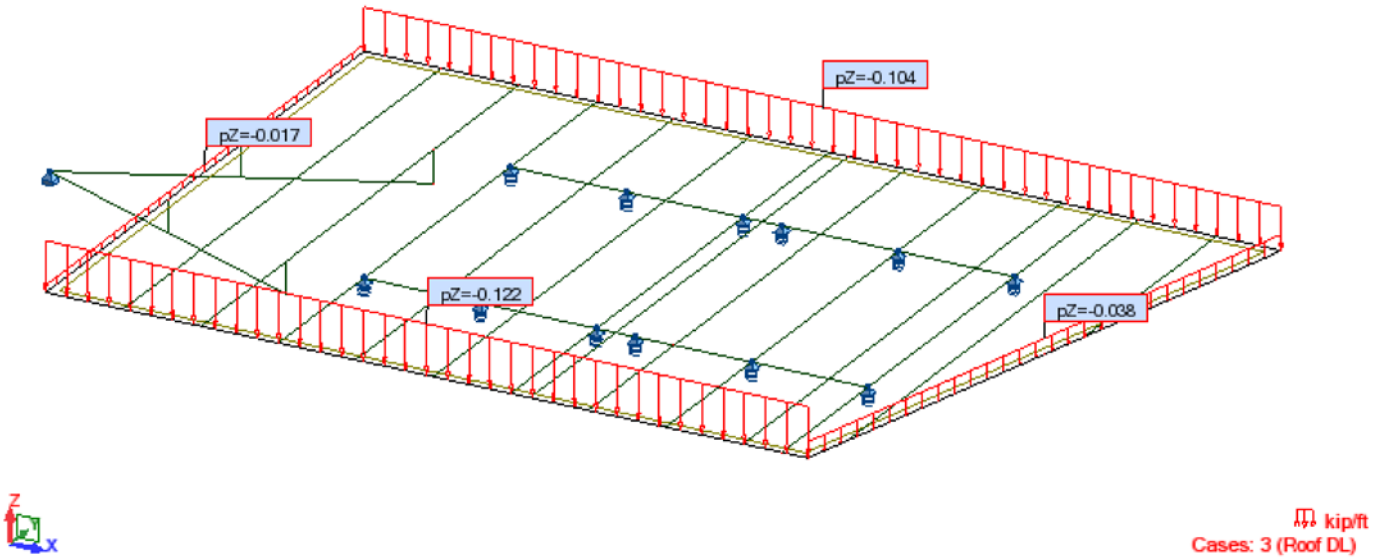
View - Cases: 1 (Floor DL) 1



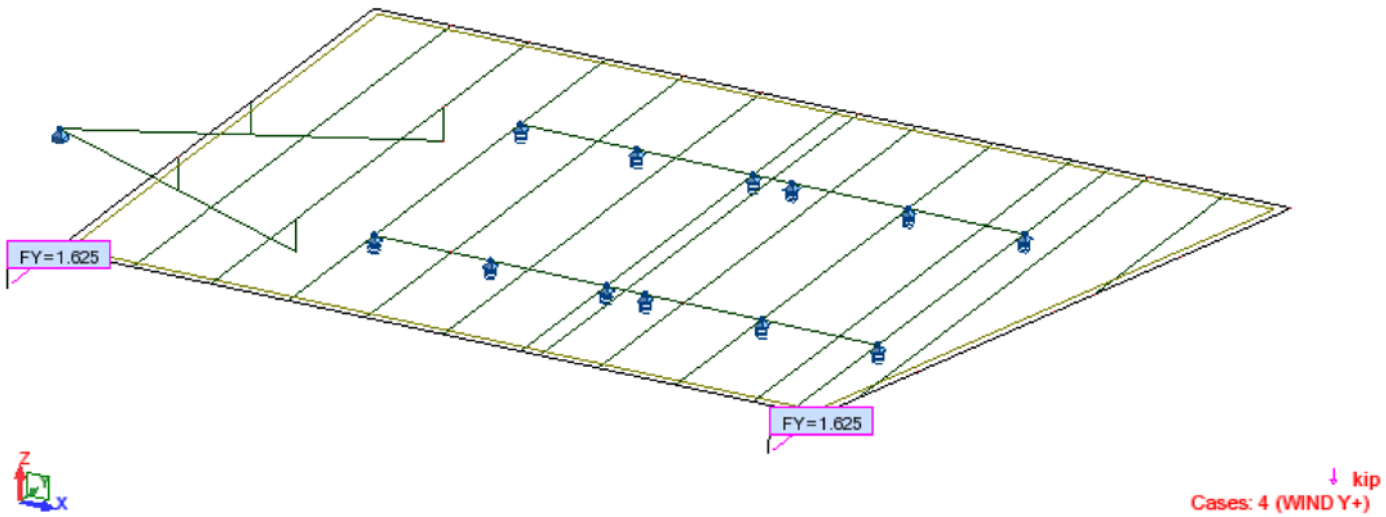
View - Cases: 2 (Wall DL)



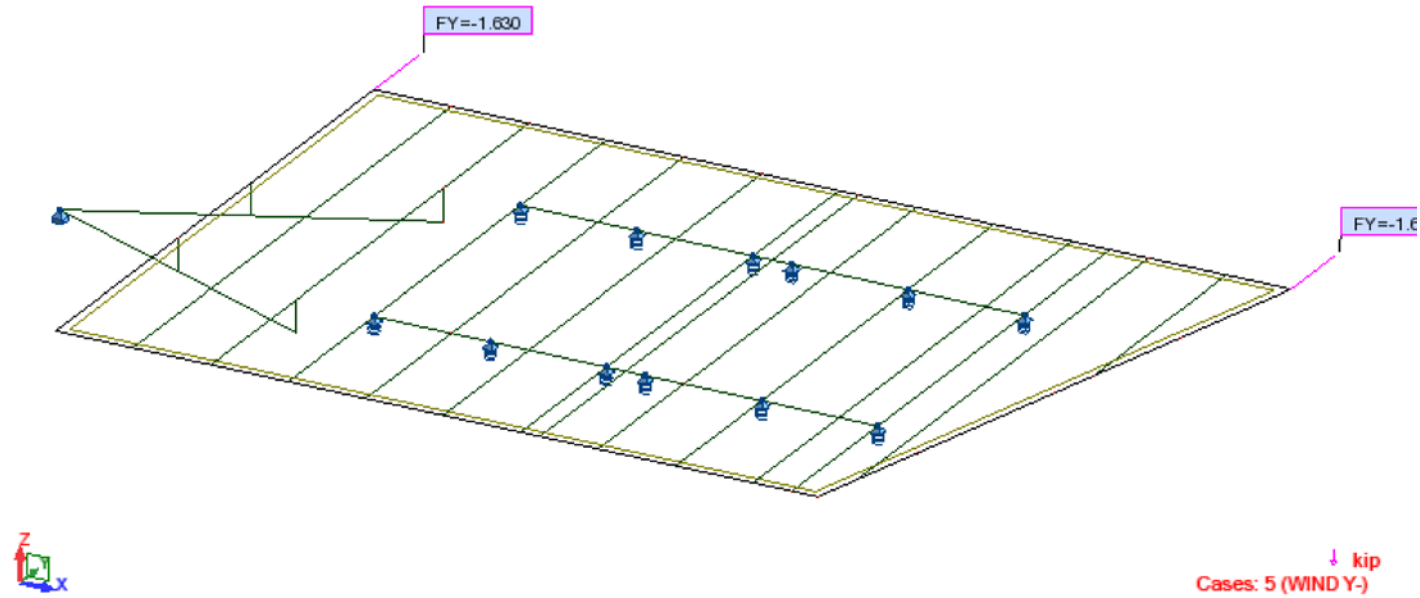
View - Cases: 3 (Roof DL)



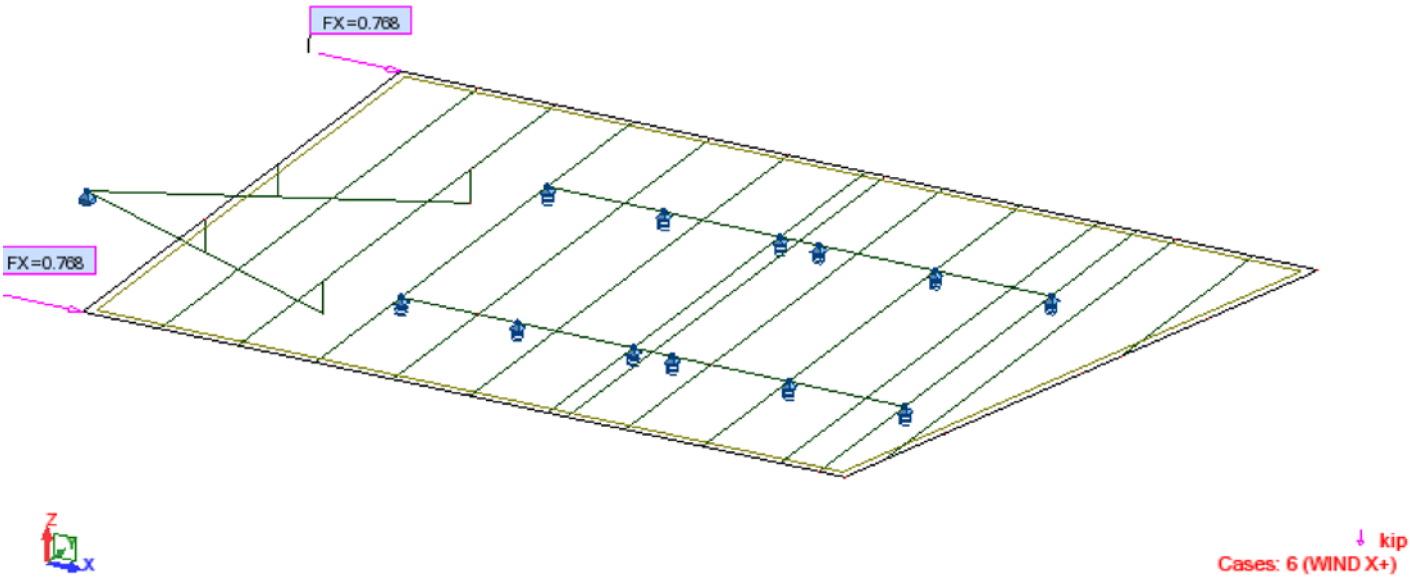
View - Cases: 4 (WIND Y+)



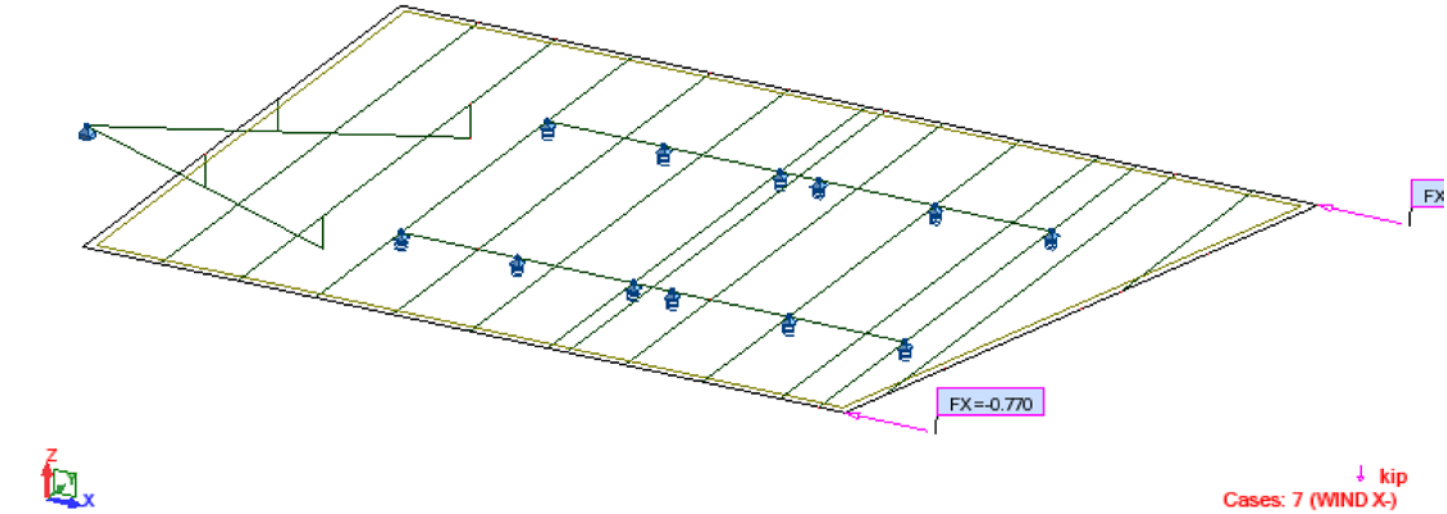
View - Cases: 5 (WIND Y-)



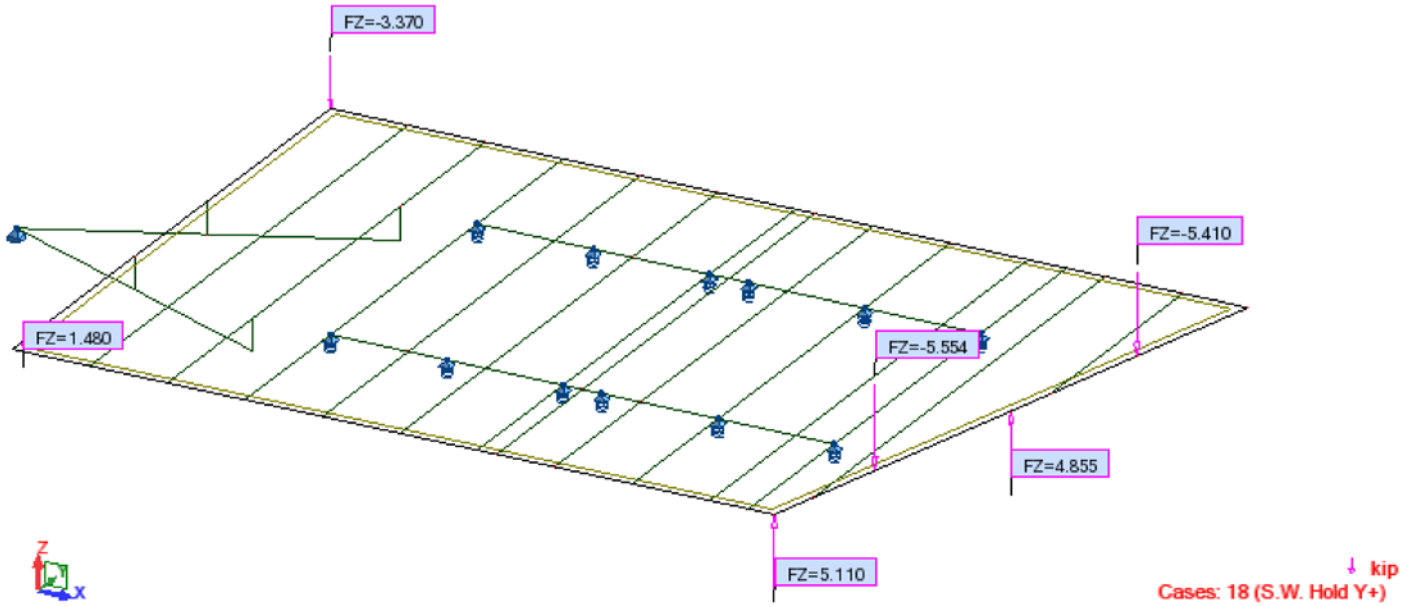
View - Cases: 6 (WIND X+)



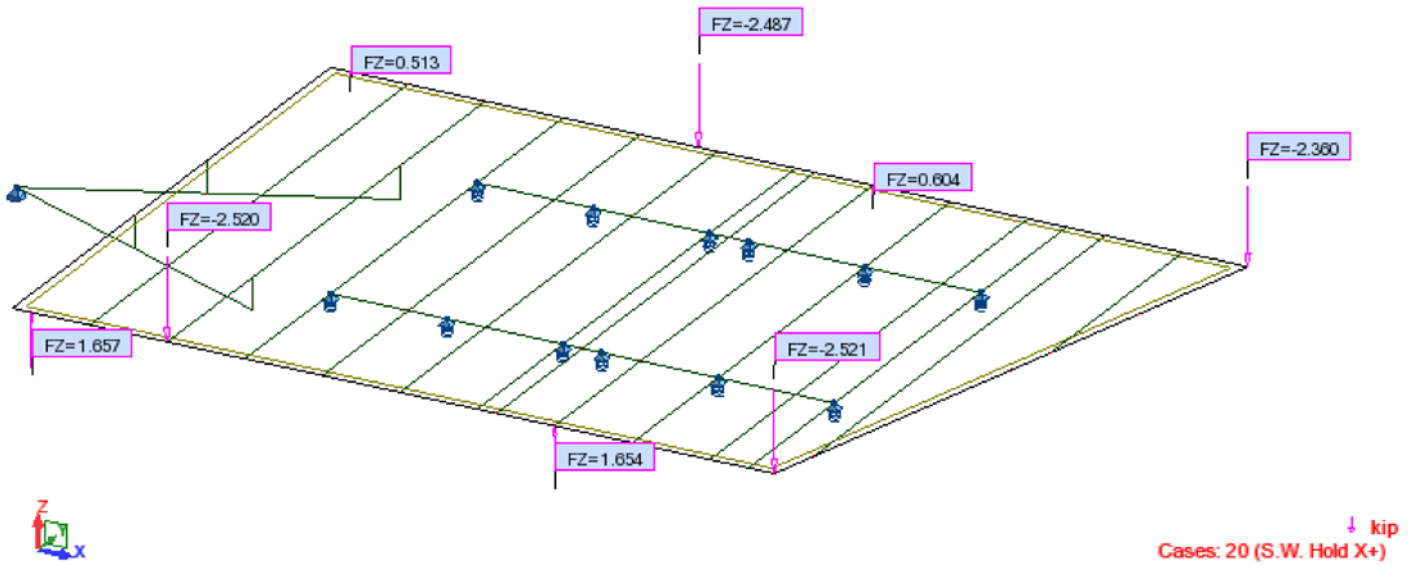
View - Cases: 7 (WIND X-)



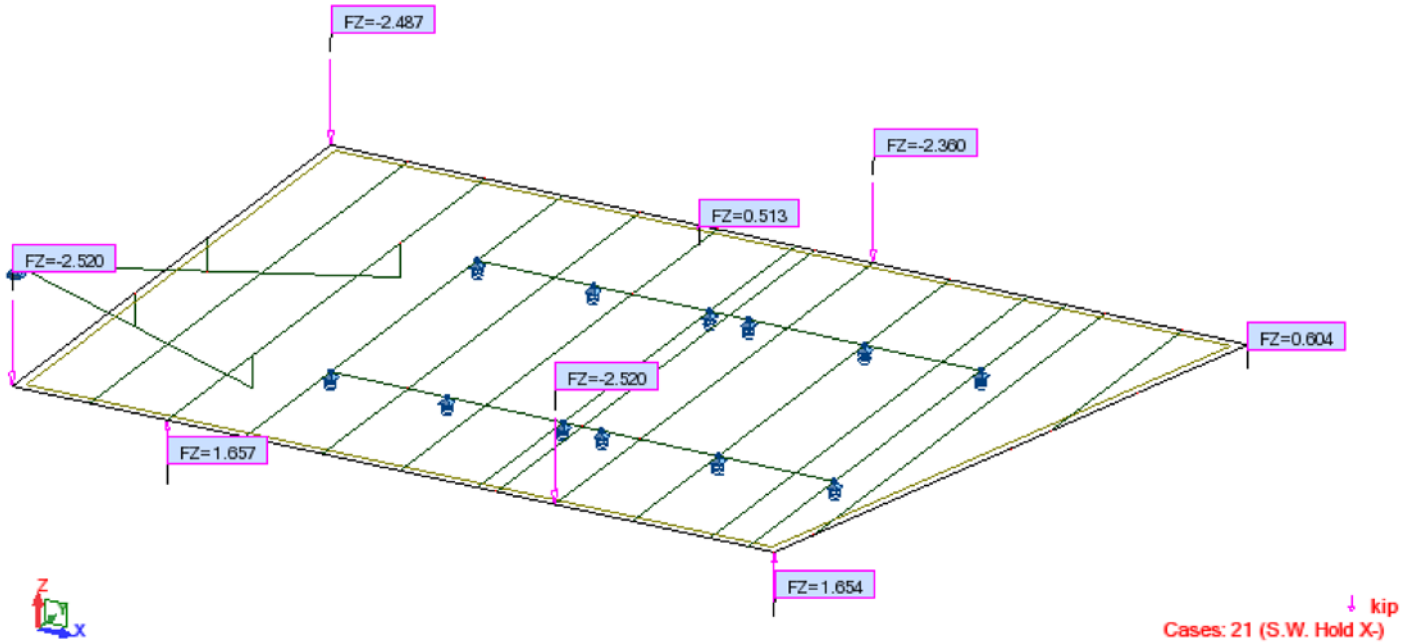
View - Cases: 18 (S.W. Hold Y+)



View - Cases: 20 (S.W. Hold X+)



View - Cases: 21 (S.W. Hold X-)



Member Results

Member	Section	Material	Lay	Laz	Ratio	Case
1 South Perimeter C	C 10x15.3	STEEL	60.89	16.86	0.70	8 1.5D
2 East Perimeter C	C 10x15.3	STEEL	49.05	22.23	0.25	8 1.5D
3 North Perimeter C	C 10x15.3	STEEL	73.28	1.12	0.43	8 1.5D
5 At Junc_5	C 8x11.5	STEEL	59.24	29.51	0.06	8 1.5D
6 At Junc_6	C 10x15.3	STEEL	12.82	25.84	0.40	8 1.5D
7 Bracing Upper Flange_7	C 10x15.3	STEEL	47.46	7.74	0.50	8 1.5D
8 At Junc_8	C 10x15.3	STEEL	20.12	10.96	0.10	8 1.5D
9 At Junc_9	C 10x15.3	STEEL	20.12	6.74	0.25	8 1.5D
22 At Junc_22	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
23 At Junc_23	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
26 At Junc_26	C 8x11.5	STEEL	24.69	12.30	0.01	8 1.5D
32 At Junc_32	L 2x2x0.375	STEEL	83.97	8.40	0.06	8 1.5D
33 At Junc_33	L 2x2x0.375	STEEL	83.97	8.40	0.09	8 1.5D
35 At Junc_35	L 2x2x0.375	STEEL	83.97	8.40	0.06	8 1.5D
36 At Junc_36	L 2x2x0.375	STEEL	83.97	8.40	0.09	8 1.5D
37 At Junc_37	C 10x15.3	STEEL	13.54	14.74	0.55	8 1.5D
38 At Junc_38	C 10x15.3	STEEL	13.53	14.73	0.06	8 1.5D
39 At Junc_39	HSRE 3x2.5x0.25	STEEL	9.24	1.07	0.05	8 1.5D
40 At Junc_40	HSRE 3x2.5x0.25	STEEL	9.24	1.07	0.02	8 1.5D
43 At Junc_43	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
44 At Junc_44	C 8x11.5	STEEL	54.31	27.05	0.04	8 1.5D
45 At Junc_45	C 10x15.3	STEEL	47.46	7.74	0.86	8 1.5D
46 At Junc_46	C 10x15.3	STEEL	20.12	10.96	0.12	8 1.5D
47 At Junc_47	C 10x15.3	STEEL	20.12	8.43	0.23	8 1.5D
48 At Junc_48	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
49 At Junc_49	L 2x2x0.375	STEEL	83.97	8.40	0.08	8 1.5D
50 At Junc_50	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
51 At Junc_51	L 2x2x0.375	STEEL	83.97	8.40	0.08	8 1.5D
52 At Junc_52	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
58 At Junc_58	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
59 At Junc_59	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
62 At Junc_62	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
63 At Junc_63	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
64 At Junc_64	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D

65 At Junc_65	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
67 At Junc_67	C 10x15.3	STEEL	47.46	7.74	0.58	8 1.5D
69 At Junc_69	HSRE 3x2.5x0.25	STEEL	9.24	1.07	0.11	8 1.5D
70 At Junc_70	C 10x15.3	STEEL	2.57	1.40	0.03	8 1.5D
71 At Junc_71	C 10x15.3	STEEL	18.28	25.84	0.71	8 1.5D

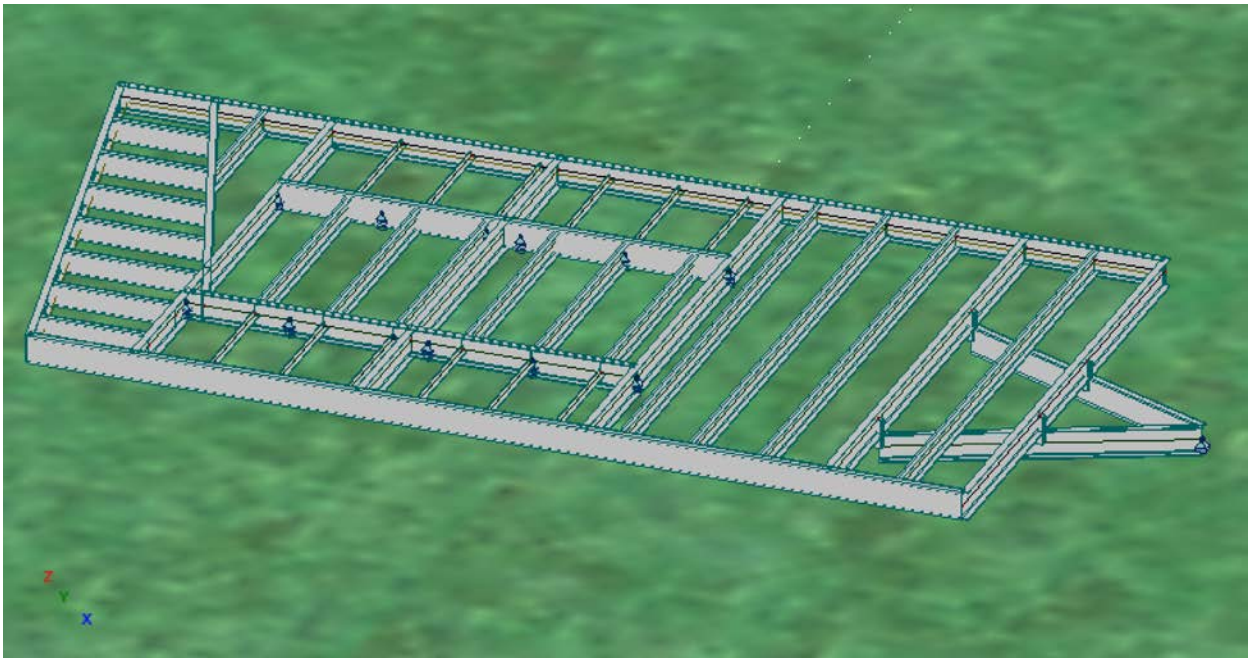
Deflection Results

Bar/Case		UX (in)	UY (in)	UZ (in)
1/	**8 (C)**	-0.0000	0.0281	-0.0442
2/	**8 (C)**	-0.0000	-0.0003	-0.1620
3/	**8 (C)**	0.0000	-0.0298	0.4868
5/	**8 (C)**	0.0000	0.0000	-0.0496
6/	**8 (C)**	-0.0000	-0.0924	-0.1686
7/	**8 (C)**	0.0000	0.0061	0.2602
8/	**8 (C)**	0.0000	0.0002	0.0104
9/	**8 (C)**	0.0000	0.0002	0.0283
22/	**8 (C)**	0.0	0.0	-0.0014
23/	**8 (C)**	-0.0000	0.0000	-0.0019
26/	**8 (C)**	0.0000	-0.0000	-0.0010
32/	**8 (C)**	-0.0000	-0.0000	-0.0105
33/	**8 (C)**	0.0000	-0.0000	-0.0150
35/	**8 (C)**	-0.0000	0.0000	-0.0105
36/	**8 (C)**	0.0000	0.0000	-0.0150
37/	**8 (C)**	0.0000	-0.0333	-0.0738
38/	**8 (C)**	0.0000	0.0167	0.0005
39/	**8 (C)**	0.0000	-0.0001	0.0000
40/	**8 (C)**	0.0000	0.0001	-0.0001
43/	**8 (C)**	0.0000	0.0000	-0.0016
44/	**8 (C)**	0.0000	-0.0000	-0.0229
45/	**8 (C)**	-0.0000	0.0059	0.3654
46/	**8 (C)**	0.0000	-0.0004	0.0126
47/	**8 (C)**	0.0000	-0.0003	0.0218
48/	**8 (C)**	0.0000	0.0000	-0.0170
49/	**8 (C)**	-0.0000	0.0000	-0.0126
50/	**8 (C)**	-0.0000	-0.0000	-0.0170
51/	**8 (C)**	-0.0000	-0.0000	-0.0126
52/	**8 (C)**	0.0	0.0	-0.0022
58/	**8 (C)**	-0.0000	0.0000	-0.0022

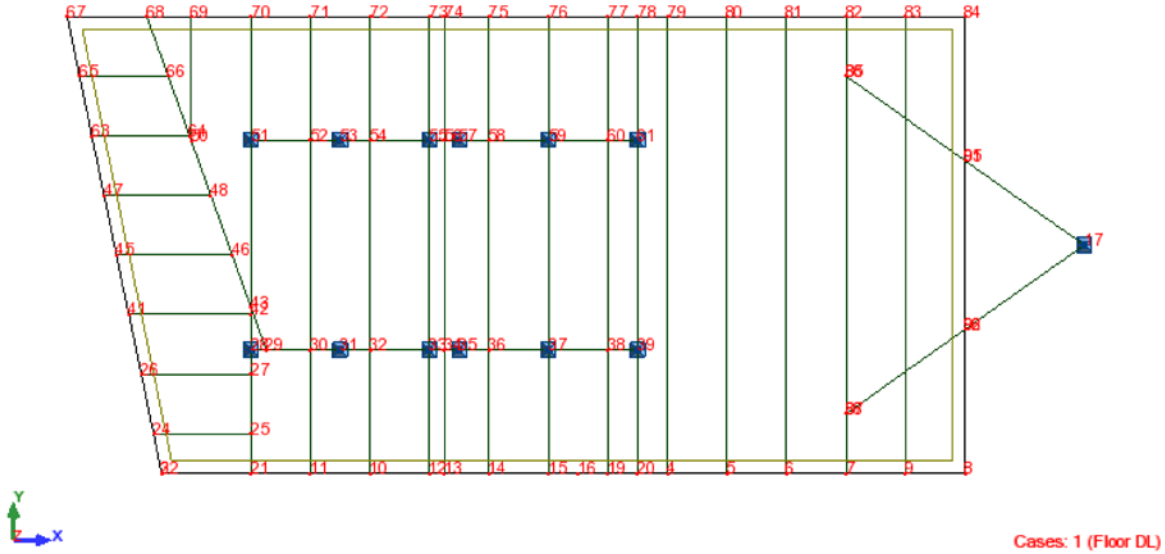
59/	**8 (C)**	-0.0000	0.0000	-0.0022
62/	**8 (C)**	0.0000	0.0000	-0.0171
63/	**8 (C)**	0.0000	0.0000	-0.0170
64/	**8 (C)**	-0.0000	-0.0000	-0.0171
65/	**8 (C)**	0.0000	-0.0000	-0.0170
67/	**8 (C)**	-0.0000	0.0058	0.2912
69/	**8 (C)**	0.0000	0.0002	-0.0000
70/	**8 (C)**	0.0000	-0.0001	-0.0000
71/	**8 (C)**	-0.0000	-0.0875	0.2333

Module B Moving Complete

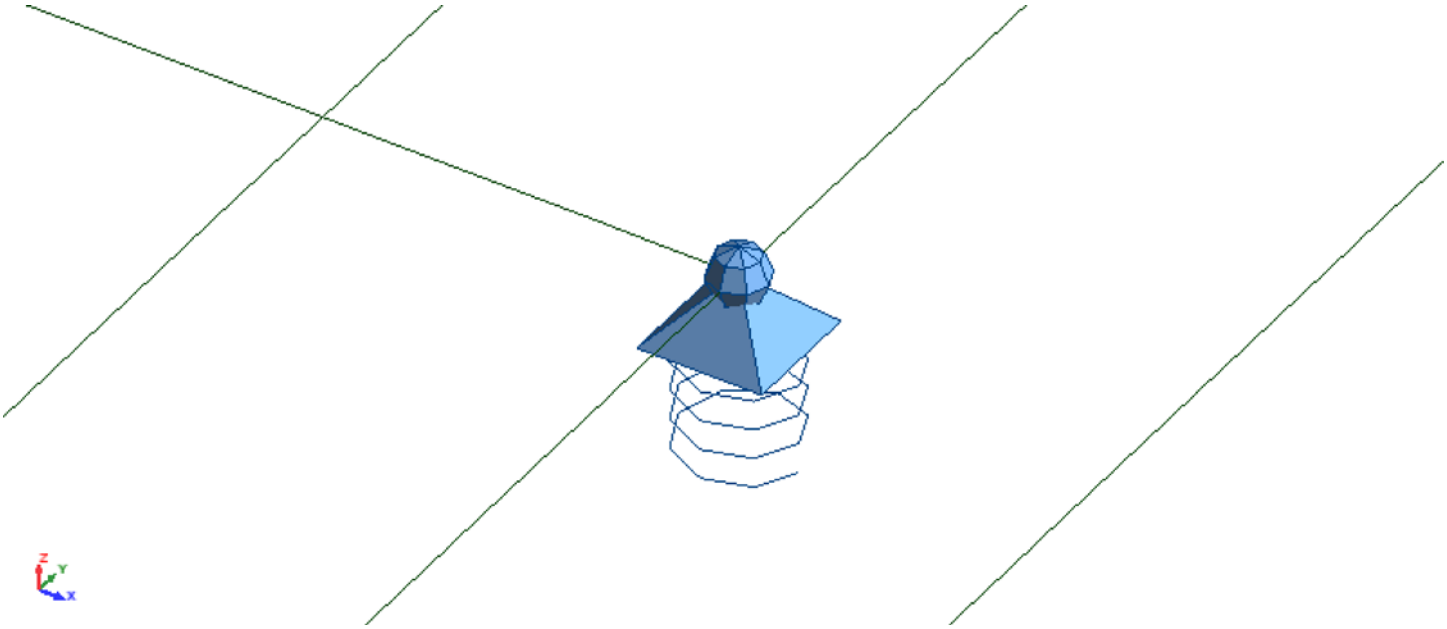
Module B- Realistic View



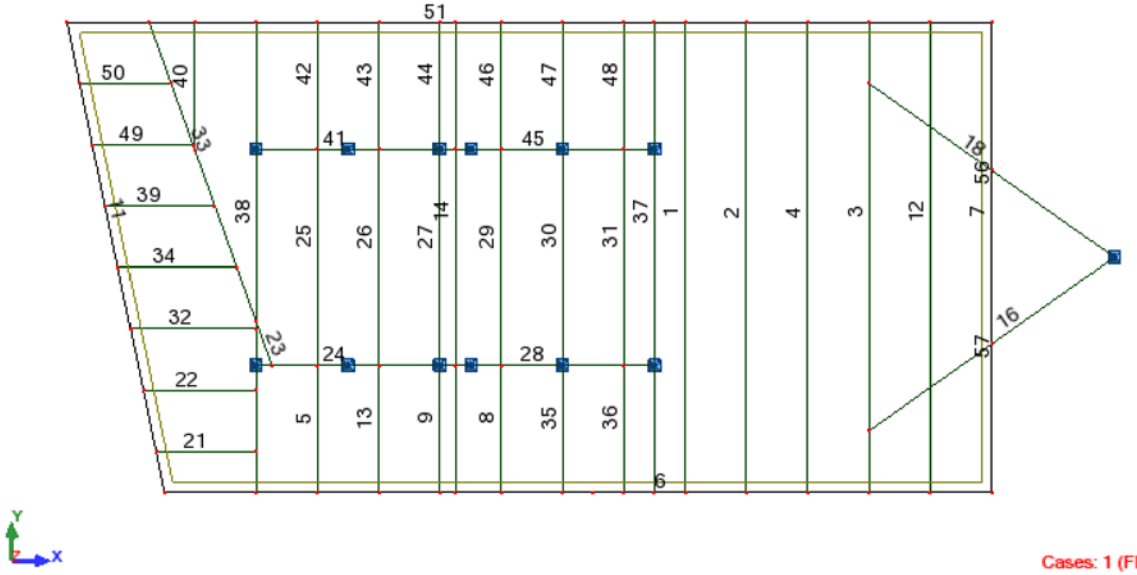
Node Names



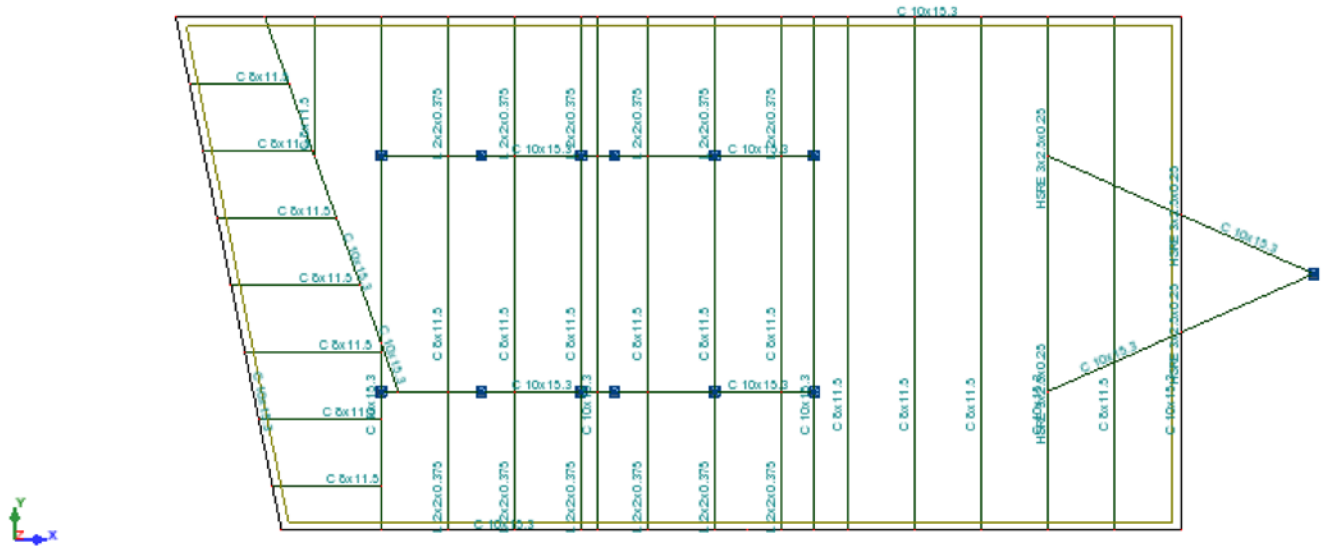
Leaf Spring



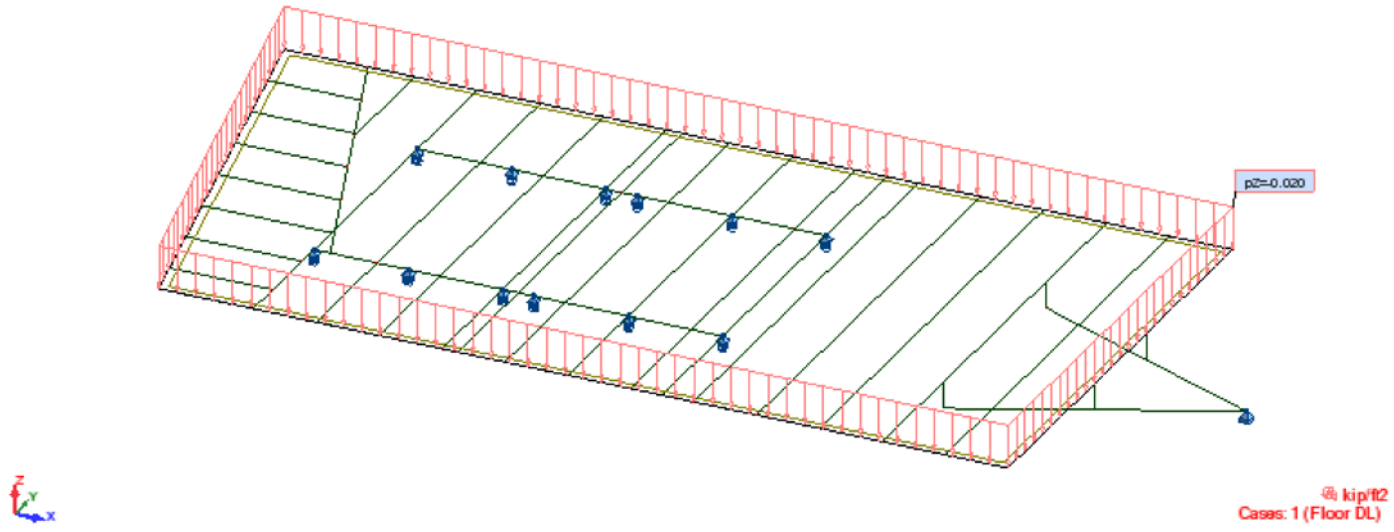
Bar Names



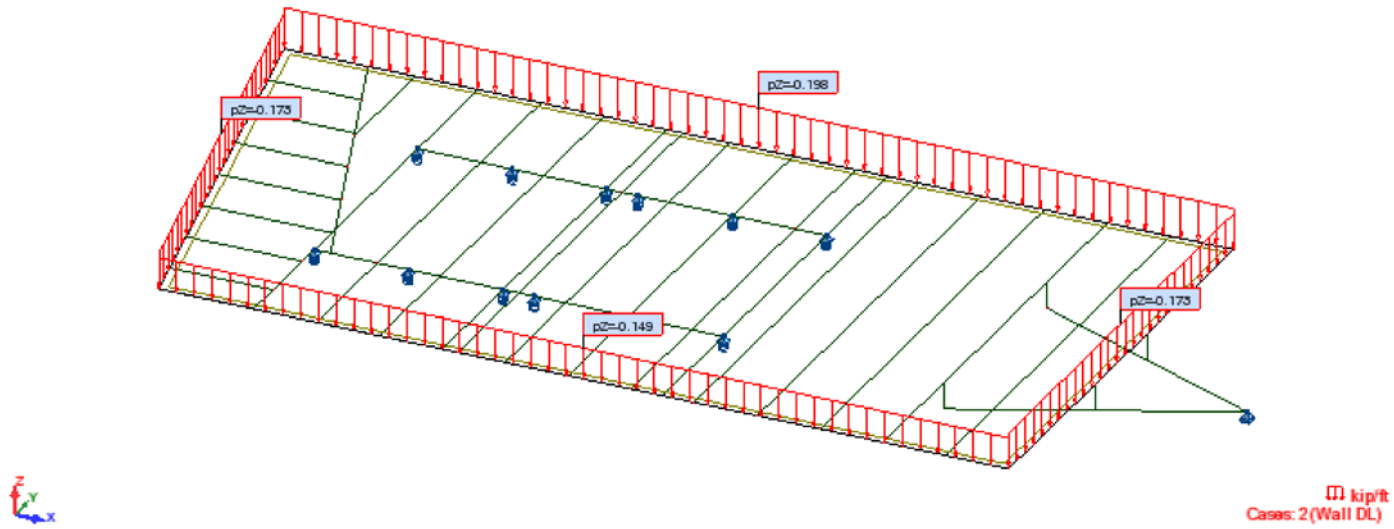
Sections



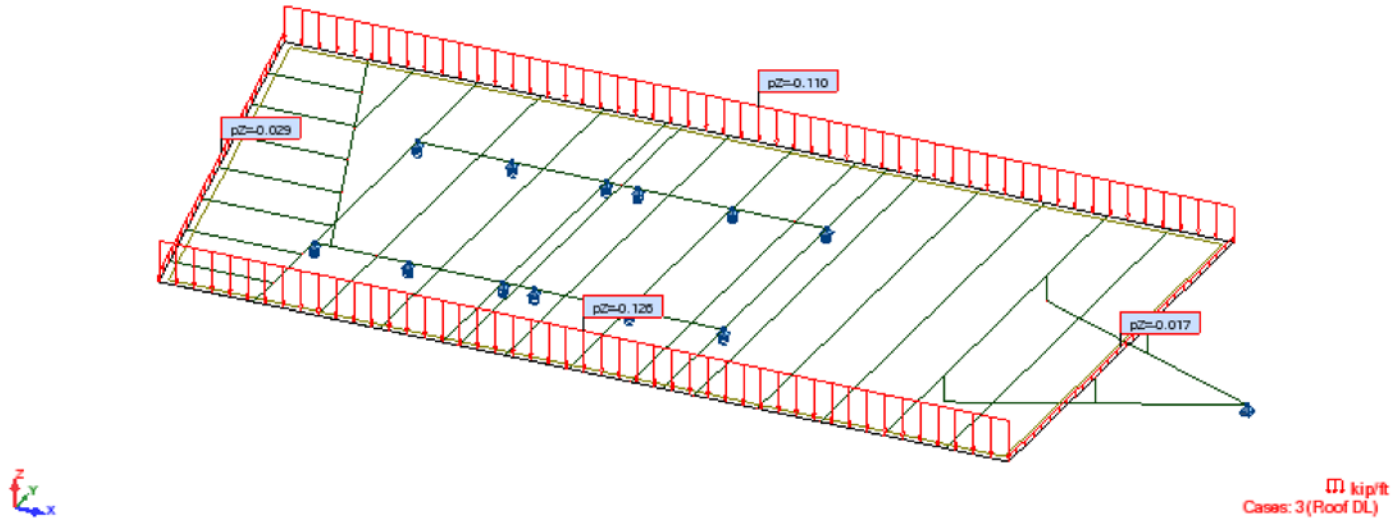
View - Cases: 1 (Floor DL)



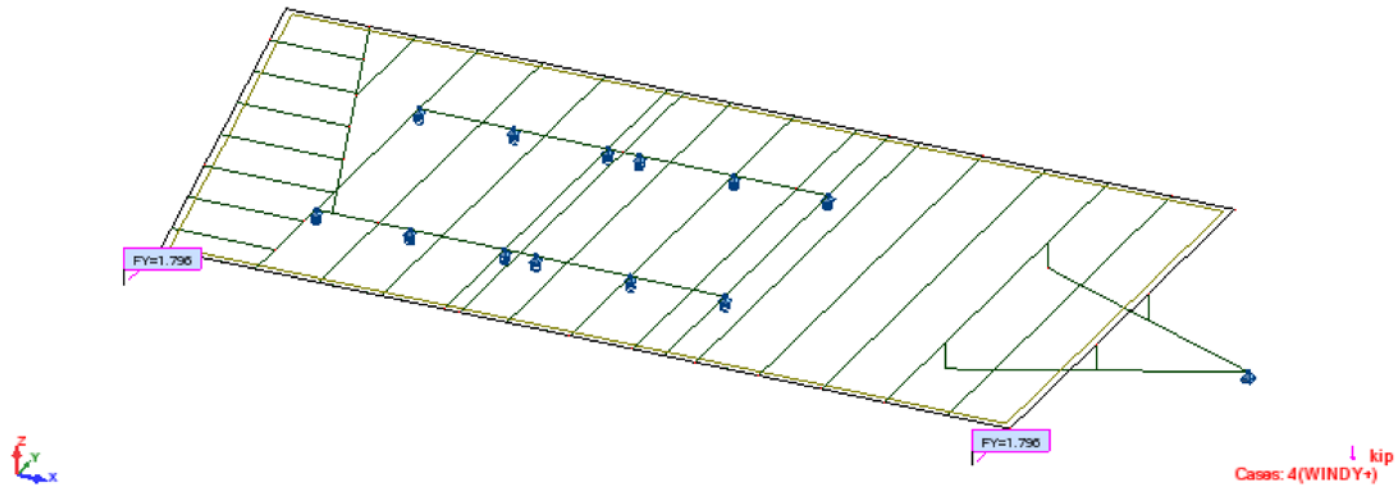
View - Cases: 2 (Wall DL)



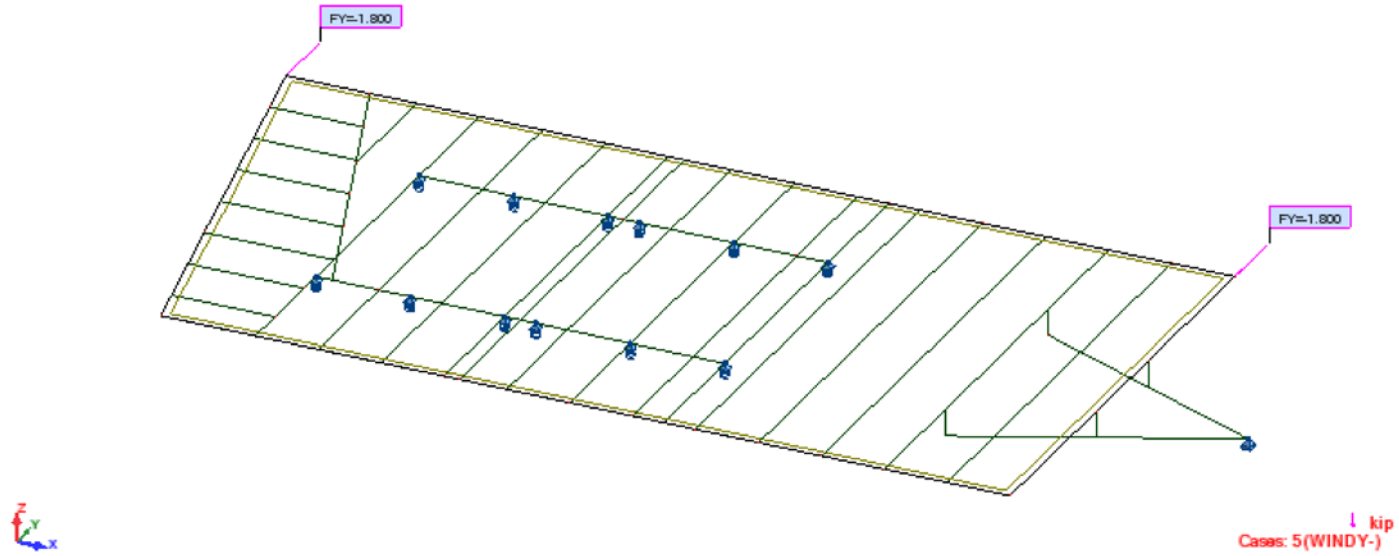
View - Cases: 3 (Roof DL)



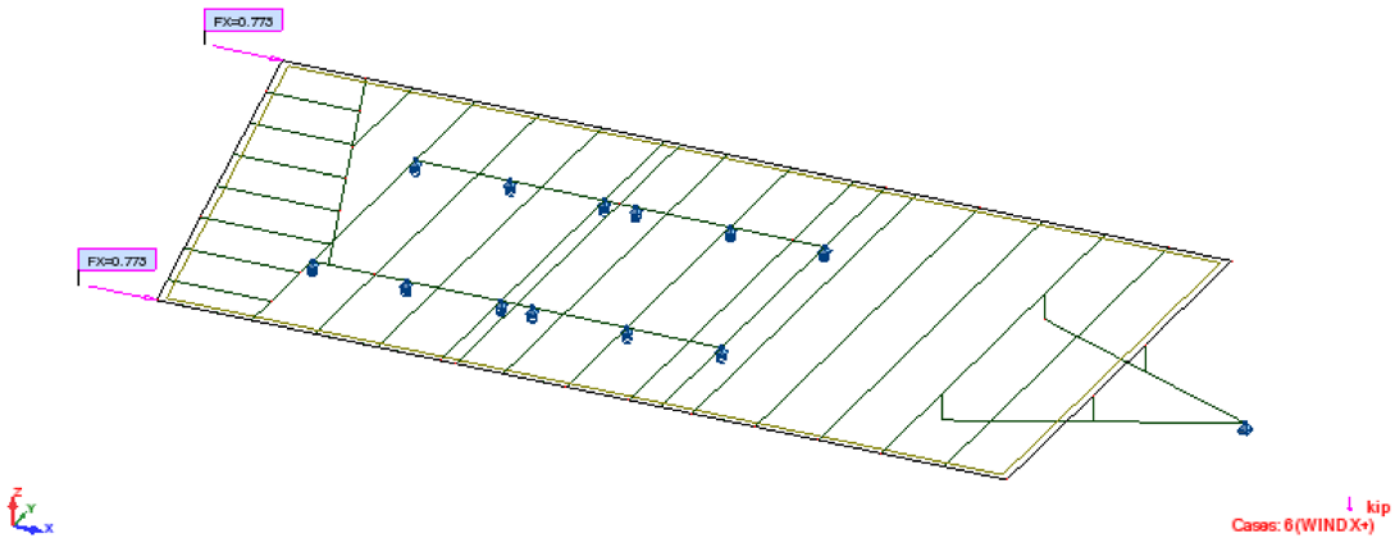
View - Cases: 4 (WIND Y+)



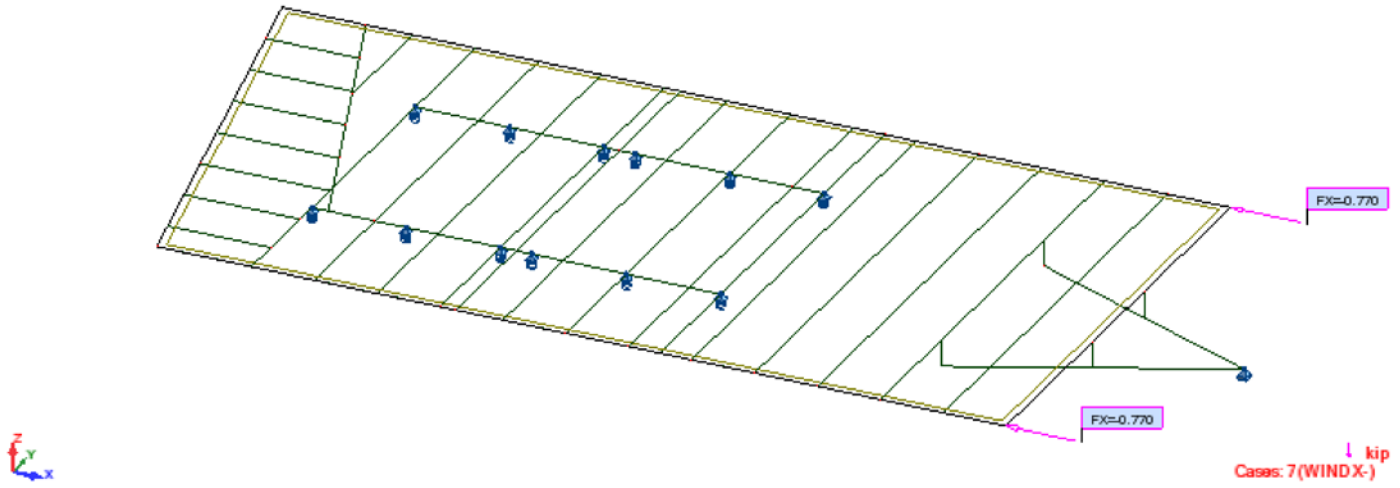
\View - Cases: 5 (WIND Y-)



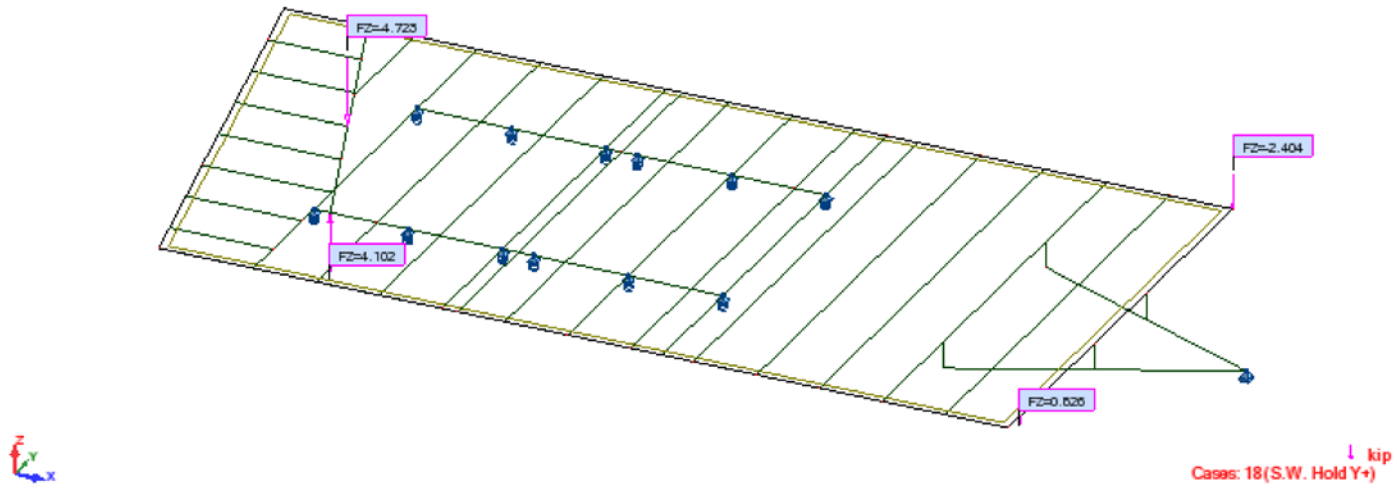
View - Cases: 6 (WIND X+)



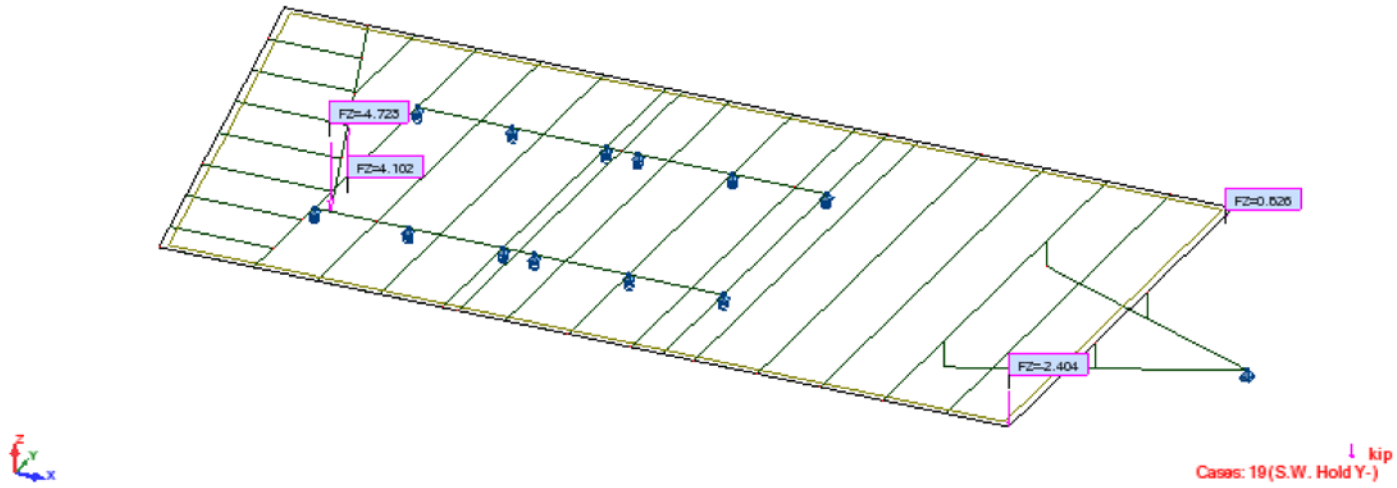
View - Cases: 7 (WIND X-)



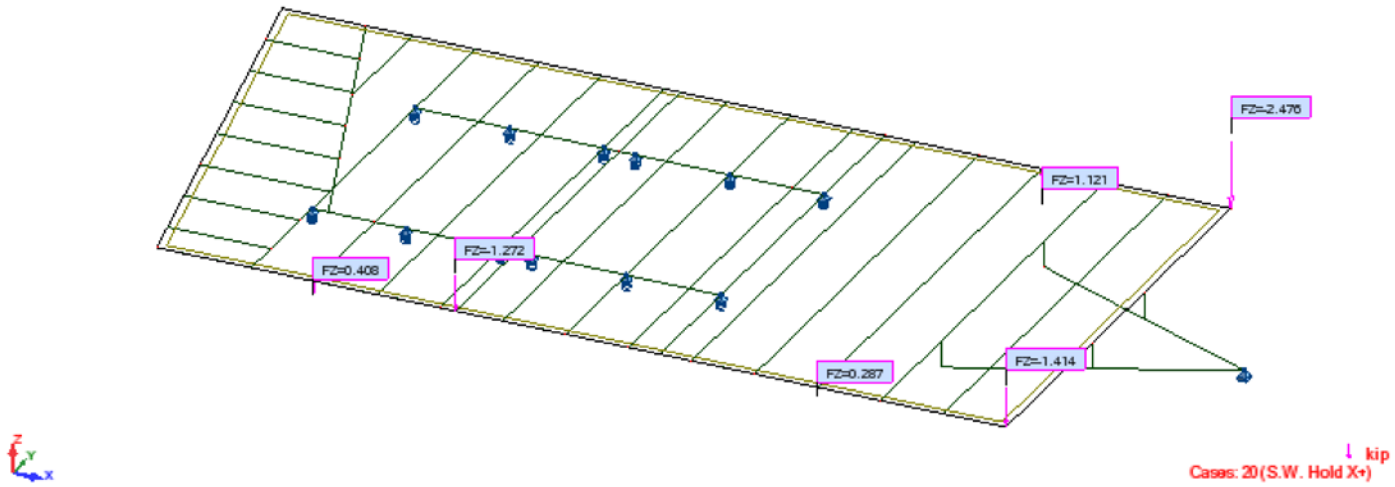
View - Cases: 18 (S.W. Hold Y+)



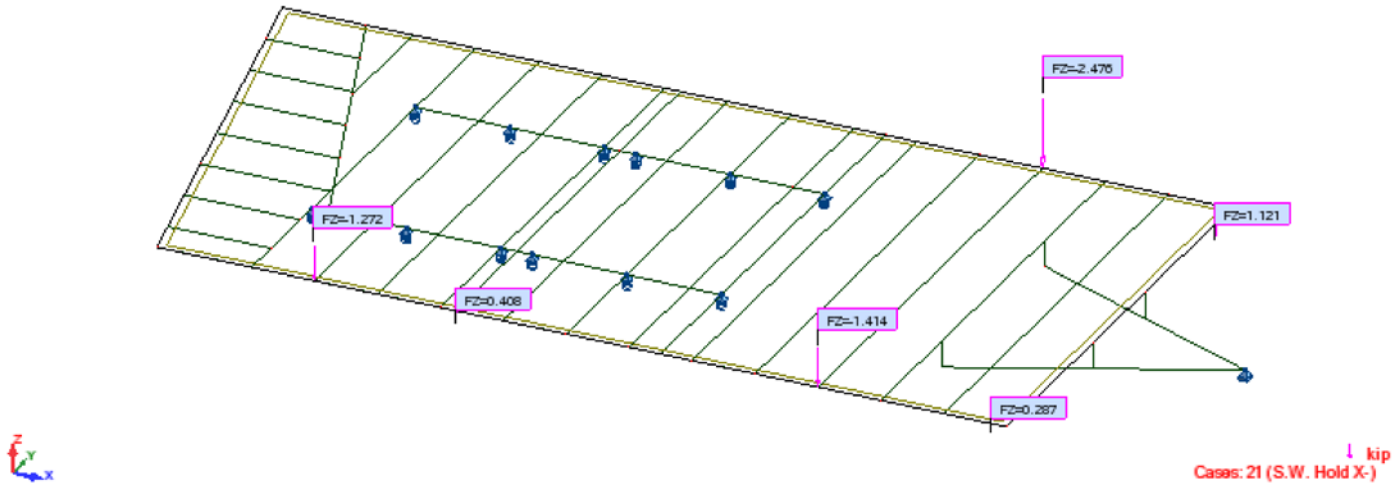
View - Cases: 19 (S.W. Hold Y-)



View - Cases: 20 (S.W. Hold X+)



View - Cases: 21 (S.W. Hold X-)



Member Results

Member	Section	Material	Lay	Laz	Ratio	Case
1 At Junc_1	C 8x11.5	STEEL	59.25	29.51	0.05	8 1.5D
2 At Junc_2	C 8x11.5	STEEL	59.25	29.51	0.06	8 1.5D
3 At Junc_3	C 10x15.3	STEEL	6.20	25.85	0.33	8 1.5D
4 At Junc_4	C 8x11.5	STEEL	59.25	29.51	0.06	8 1.5D
5 At Junc_5	L 2x2x0.375	STEEL	83.99	8.40	0.10	8 1.5D
6 At Junc_6	C 10x15.3	STEEL	83.60	23.60	0.47	8 1.5D
7 At Junc_7	C 10x15.3	STEEL	0.72	25.85	0.88	8 1.5D
8 At Junc_8	L 2x2x0.375	STEEL	83.97	8.40	0.09	8 1.5D
9 At Junc_9	L 2x2x0.375	STEEL	83.97	8.40	0.07	8 1.5D
11 At Junc_11	C 10x15.3	STEEL	48.47	20.65	0.26	8 1.5D
12 At Junc_12	C 8x11.5	STEEL	59.25	29.51	0.07	8 1.5D
13 At Junc_13	L 2x2x0.375	STEEL	84.00	8.40	0.10	8 1.5D
14 At Junc_14	C 10x15.3	STEEL	47.46	7.74	0.62	8 1.5D
15 At Junc_15	HSRO 4x0.125	STEEL	7.26	0.73	0.14	8 1.5D
16 At Junc_16	C 10x15.3	STEEL	15.17	16.52	0.72	8 1.5D
18 At Junc_18	C 10x15.3	STEEL	15.18	16.53	0.44	8 1.5D
20 At Junc_20	HSRO 4x0.125	STEEL	7.26	0.73	0.14	8 1.5D
21 At Junc_21	C 8x11.5	STEEL	12.66	6.30	0.00	8 1.5D
22 At Junc_22	C 8x11.5	STEEL	14.25	7.10	0.00	8 1.5D
23 At Junc_23	C 10x15.3	STEEL	4.72	2.57	0.00	8 1.5D
24 At Junc_24	C 10x15.3	STEEL	20.12	8.43	0.18	8 1.5D
25 At Junc_25	C 8x11.5	STEEL	27.24	13.57	0.02	8 1.5D
26 At Junc_26	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
27 At Junc_27	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
28 At Junc_28	C 10x15.3	STEEL	20.12	10.96	0.19	8 1.5D
29 At Junc_29	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
30 At Junc_30	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
31 At Junc_31	C 8x11.5	STEEL	27.24	13.57	0.01	8 1.5D
32 At Junc_32	C 8x11.5	STEEL	15.85	7.89	0.00	8 1.5D
33 At Junc_33	C 10x15.3	STEEL	32.09	17.47	0.07	8 1.5D
34 At Junc_34	C 8x11.5	STEEL	15.01	7.48	0.00	8 1.5D
35 At Junc_35	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
36 At Junc_36	L 2x2x0.375	STEEL	83.97	8.40	0.08	8 1.5D
37 At Junc_37	C 10x15.3	STEEL	47.46	7.74	0.73	8 1.5D
38 At Junc_38	C 10x15.3	STEEL	47.46	7.74	0.89	8 1.5D
39 At Junc_39	C 8x11.5	STEEL	13.83	6.89	0.00	8 1.5D
40 At Junc_40	C 8x11.5	STEEL	16.16	8.05	0.00	8 1.5D

41 At Junc_41	C 10x15.3	STEEL	20.12	8.43	0.33	8 1.5D
42 At Junc_42	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
43 At Junc_43	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
44 At Junc_44	L 2x2x0.375	STEEL	83.97	8.40	0.07	8 1.5D
45 At Junc_45	C 10x15.3	STEEL	20.12	10.96	0.33	8 1.5D
46 At Junc_46	L 2x2x0.375	STEEL	83.97	8.40	0.09	8 1.5D
47 At Junc_47	L 2x2x0.375	STEEL	83.97	8.40	0.10	8 1.5D
48 At Junc_48	L 2x2x0.375	STEEL	83.97	8.40	0.08	8 1.5D
49 At Junc_49	C 8x11.5	STEEL	12.66	6.30	0.00	8 1.5D
50 At Junc_50	C 8x11.5	STEEL	11.48	5.72	0.00	8 1.5D
51 Simple bar_1	C 10x15.3	STEEL	93.40	33.72	0.66	8 1.5D
56 Front_56	HSRE 4x2.5x0.125	STEEL	0.68	0.97	0.16	8 1.5D
57 Front_57	HSRE 4x2.5x0.125	STEEL	0.68	0.97	0.31	8 1.5D

Deflection Results

Bar/Case	UX (in)	UY (in)	UZ (in)
1/ 8 (C)	-0.0000	-0.0000	-0.0375
2/ 8 (C)	0.0000	-0.0000	-0.0496
3/ 8 (C)	0.0000	-0.1478	-0.1473
4/ 8 (C)	-0.0000	-0.0000	-0.0496
5/ 8 (C)	-0.0000	-0.0000	-0.0170
6/ 8 (C)	-0.0001	0.0279	-0.1483
7/ 8 (C)	0.0001	-0.1138	0.4052
8/ 8 (C)	-0.0000	-0.0000	-0.0152
9/ 8 (C)	0.0000	-0.0000	-0.0105
11/ 8 (C)	0.0000	0.0218	-0.1620
12/ 8 (C)	-0.0000	-0.0000	-0.0496
13/ 8 (C)	-0.0000	-0.0000	-0.0171
14/ 8 (C)	-0.0000	0.0208	0.3054
15/ 8 (C)	-0.0000	-0.0002	-0.0001
16/ 8 (C)	-0.0001	-0.0601	-0.1141
18/ 8 (C)	0.0001	-0.0550	-0.0605
20/ 8 (C)	-0.0000	0.0002	-0.0003
21/ 8 (C)	0.0000	0.0000	-0.0001
22/ 8 (C)	0.0000	0.0000	-0.0002
23/ 8 (C)	0.0000	0.0000	0.0000
24/ 8 (C)	0.0000	0.0005	-0.0191

25/	**8 (C)**	0.0000	-0.0000	-0.0022
26/	**8 (C)**	-0.0000	-0.0000	-0.0022
27/	**8 (C)**	0.0	-0.0000	-0.0014
28/	**8 (C)**	0.0000	-0.0004	-0.0195
29/	**8 (C)**	-0.0000	-0.0000	-0.0019
30/	**8 (C)**	0.0	-0.0000	-0.0022
31/	**8 (C)**	0.0000	-0.0000	-0.0016
32/	**8 (C)**	-0.0000	0.0000	-0.0002
33/	**8 (C)**	0.0000	-0.0045	0.0027
34/	**8 (C)**	-0.0000	-0.0000	-0.0002
35/	**8 (C)**	0.0000	-0.0000	-0.0170
36/	**8 (C)**	0.0000	-0.0000	-0.0126
37/	**8 (C)**	-0.0000	0.0230	0.3640
38/	**8 (C)**	-0.0000	0.0219	0.4181
39/	**8 (C)**	0.0000	0.0000	-0.0001
40/	**8 (C)**	0.0000	-0.0000	-0.0002
41/	**8 (C)**	0.0000	0.0007	0.0357
42/	**8 (C)**	-0.0000	-0.0000	-0.0170
43/	**8 (C)**	0.0000	-0.0000	-0.0171
44/	**8 (C)**	0.0000	-0.0000	-0.0105
45/	**8 (C)**	0.0000	-0.0003	0.0301
46/	**8 (C)**	-0.0000	-0.0000	-0.0150
47/	**8 (C)**	0.0000	-0.0000	-0.0170
48/	**8 (C)**	0.0000	-0.0000	-0.0126
49/	**8 (C)**	-0.0000	0.0000	-0.0001
50/	**8 (C)**	-0.0000	0.0000	-0.0001
51/	**8 (C)**	0.0001	-0.0304	-0.9648
56/	**8 (C)**	0.0000	-0.0003	0.0002
57/	**8 (C)**	-0.0000	0.0003	0.0002

Appendix II

Structural Material Cut Sheets

RBC *Roof Boundary Clip*

The RBC Roof Boundary Clip is designed to aid installation and transfer shear loads between the roof diaphragm and wall. The locator tabs make proper location of the clip easy. The RBC can be used on wood or masonry walls and will handle roof pitches from 0/12 to 12/12.

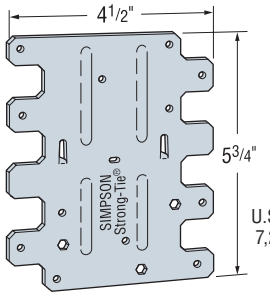
MATERIAL: 20 gauge **FINISH**: Galvanized

INSTALLATION: • Use all specified fasteners. See General Notes.
- Field bend to desired angle – one time only.
- See flier F-RBC for more information on installation and code requirements *(see page 229 for details)*.

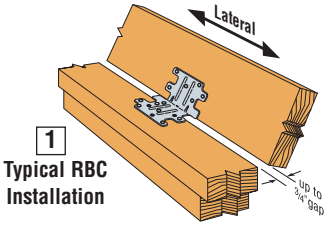
CODES: See page 13 for Code Reference Key Chart.

The RBC installed to blocking resists rotation and lateral displacement of rafter or truss.
Code references:
- IRC 2009/2012, R802.8 Lateral Support
- IBC 2009/2012, 2308.10.6 Blocking

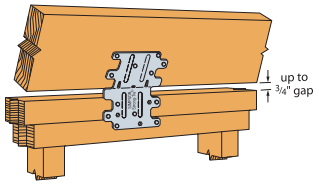
Blocking allows proper edge nailing of sheathing.
Code references:
- IRC 2009/2012, Table R602.3(1), footnote i
- IBC 2009/2012, 2305.1.4 Shear Panel Connections



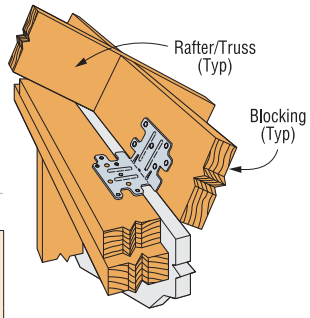
RBC
U.S. Patent 7,293,390



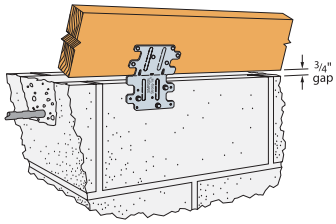
1 **Typical RBC Installation**



2 **Typical RBC Installation**



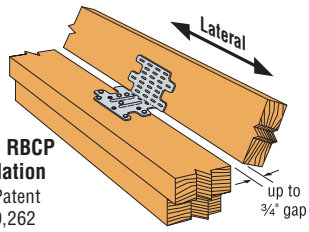
Typical RBC Installation Over 1" Foamboard[5]



3 **Typical RBC Installation to CMU Block**

Model No.	Type of Connection	Bending Angle	Fasteners		DF/SP Allowable Loads	SPF/HF Allowable Loads	Code Ref.
			To Wall	To Blocking	Lateral (160)	Lateral (160)	
RBC	1	45° to 90°	6-10dx1½	6-10dx1½	445	380	IP1, L18, F25
	2	< 30°	6-10dx1½	6-10dx1½	435	375	
		30° to 45°	6-10dx1½	6-10dx1½	480	415	
	3	0° to 45°	3-¼x2¼ Titen[4]	6-10dx1½	350	350	

1. Allowable loads are for one anchor attached to blocking minimum 1½" thick.
2. RBC can be installed with up to ¾" gap and achieve 100% of the listed load.
3. Allowable loads have been increased for wind or earthquake loading with no further increase allowed. Reduce where other loads govern.
4. When attaching to concrete use 3-¼x1¾" Titen® screws.
5. RBC installed over 1" foamboard has a load of 395 lbs. (160) in a parallel to wall (F_1) load direction for Douglas Fir. For SPF, the load is 340 lbs.
6. RBC may be installed over ½" structural sheathing using 10dx1½ nails with no load reduction.
7. **NAILS:** 10dx1½ = 0.148" dia. x 1½" long. See page 22-23 for other nail sizes and information.



Typical RBCP Installation
U.S. Patent 7,549,262

The RBC is available with prongs into one side (RBCP) for pre-attachment of the part to a block at the truss plant. Refer to technical bulletin T-RBCP for more information.

A *Angles*

Our line of angles provides a way to make a wide range of 90° connections.

MATERIAL: A21 and A23—18 ga.; all other A angles—12 ga.

FINISH: Galvanized. Some products available in stainless steel or ZMAX® coating; see Corrosion Information, page 14-15.

INSTALLATION: • Use all specified fasteners. See General Notes.

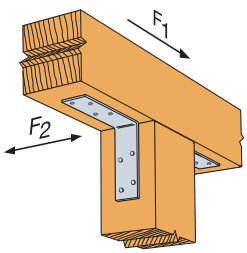
CODES: See page 13 for Code Reference Key Chart.

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

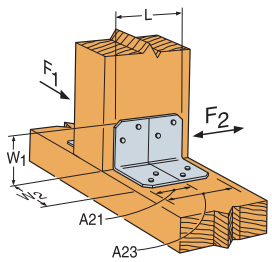
These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 27 for more information.

Model No.	Dimensions			Fasteners				Allowable Loads DF/SP (160)		Code Ref.
	W_1	W_2	L	Base		Post		F_1	F_2	
				Bolts	Nails	Bolts	Nails			
A21	2	1½	1⅜	—	2-10dx1½	—	2-10dx1½	245	175	I14, L5, F13
A23	2	1½	2¾	—	4-10dx1½	—	4-10dx1½	585	565	
A33	3	3	1½	—	4-10d	—	4-10d	750	330	180
A44	4⁹⁄₁₆	4⅜	1½	—	4-10d	—	4-10d	750	295	
A66	5⅞	5⅞	1½	2-⅜	3-10d	2-⅜	3-10d	—	—	
A88	8	8	2	3-⅜	4-10d	3-⅜	4-10d	—	—	
A24	3⅞	2	2½	1-½	—	1-½	2-10d	—	—	
A311	11	3⅝	2	1-½	—	1-½	4-10d	—	—	

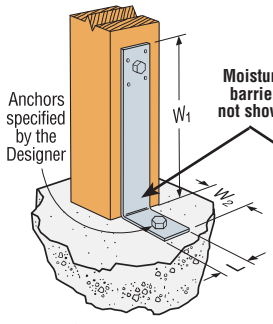
1. Allowable loads have been increased for wind or earthquake loading with no further increase allowed. Reduce where other loads govern.
2. For SPF/HF lumber use 0.86 of table loads.
3. **NAILS:** 10dx1½ = 0.148" dia. x 1½" long, 10d = 0.148" dia. x 3" long. See page 22-23 for other nail sizes and information.



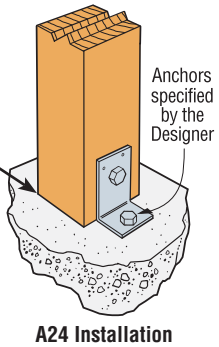
A44 Installation
(A33 similar)



A21/A23 Installation



A311 Installation



A24 Installation

TOP FLANGE HANGERS W/WPU/WNP/WM/WMU/HW/HWU/GLT/HGLT

The W, WPU, HWU and HW series purlin hangers offer the greatest design flexibility and versatility. WMs are designed for use on standard 8" grouted masonry block wall construction.

MATERIAL: See tables on pages 80-82.

FINISH: Simpson Strong-Tie® gray paint; hot-dip galvanized available: specify HDG, contact Simpson Strong-Tie.

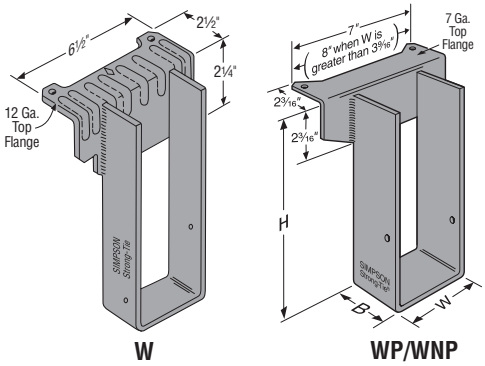
INSTALLATION: • Use all specified fasteners. WM—two 16d duplex nails must be installed into the top flange and embedded into the grouted wall. Verify that the grouted wall can take the required fasteners specified in the table.

- H dimensions are sized to account for normal joist shrinkage. W dimensions are for dressed timber widths.
- Hangers may be welded to steel headers with weld size to match material thickness *(approximate thickness shown)* ⅛" for W, 3⁄16" for WNP/WPU and ¼" for HW/HWU, by 1½" fillet welds located at each end of the top flange *(see page 17 for welding information)*. Weld-on applications produce maximum allowable load listed. For uplift loads refer to technical bulletin T-WELDUPLFT *(HWU and WPU hangers only) (see page 232 for details)*.
- GLT/HGLT may be welded to steel headers, see page 94 for requirements.
- Hangers can support multi-ply carried members; the individual members must be secured together to work as a single unit before installation into the hanger.
- Embed WM into block with a minimum of one course above and one course below the top flange with one #5 vertical rebar minimum 24" long in each cell. Minimum grout strength is 2000 psi.

OPTIONS:

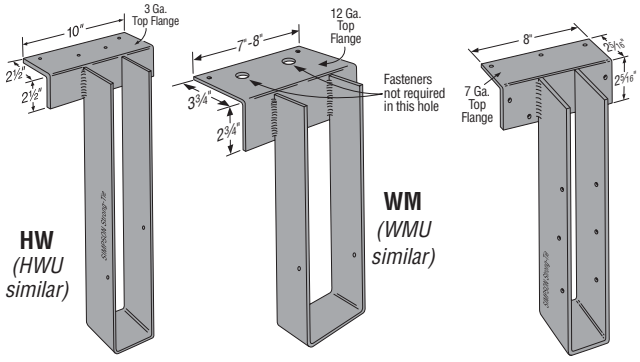
- Refer to technical bulletin T-SLOPEJST for information regarding load reductions on selected hangers which can be used without modification to support joists which have shallow slopes (≤¾:12) *(see page 232 for details)*.
- See Hanger Options, page 215-224 for hanger modifications and associated load reductions.

CODES: See page 13 for Code Reference Key Chart.



W **WP/WNP**

Some model configurations may differ from those shown. Contact Simpson Strong-Tie for details.



HW *(HWU similar)*

WM *(WMU similar)*

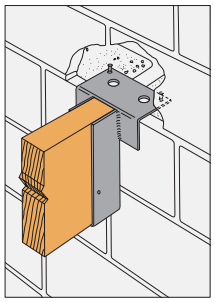
WPU

Model	Nailer	Top Flange Nailing	Uplift[1] (160)	Allowable Down Loads DF/SP	SPF/HF	LSL
W	2x	2-10dx1½	—	1600	1600	—
	2-2x	2-10d	—	1665	1665	—
	3x	2-16dx2½	—	1765	—	—
	4x	2-10d	—	2200	—	—
WP and WNP	2x	2-10dx1½	—	2525	2500	3375
	2-2x	2-10d	—	3255	3255	—
	3x	2-16dx2½	—	3000	2510	3375
	4x	2-10d	—	3255	3255	—
WPU	2-2x	7-10d	700	3255	—	—
	3x	7-16dx2½	970	3000	—	—
	4x	7-16d	1095	3255	—	—
HW	2-2x	4-10d	—	4860	—	—
	3x	4-16dx2½	—	4845	—	—
	4x	4-16d	—	5285	—	—
HWU	2-2x	8-16dx2½	710	5430	—	—
	3x	8-16dx2½	970	5430	—	—
	4x	8-16d	1160	5430	—	—

NAILER TABLE

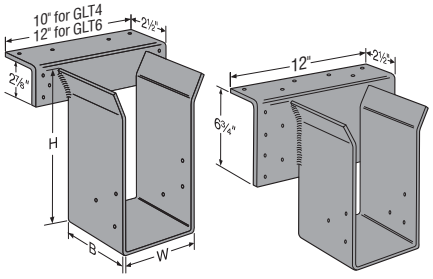
The table indicates the maximum allowable loads for W, WNP and HW hangers used on wood nailers. Nailers are wood members attached to the top of a steel I-beam, concrete or masonry wall.

1. Uplift value for the HWU hanger is for depths ≤18" and are for DF/SP values only. Refer to uplift values in table below for taller depths.
2. Attachment of nailer to supporting member is the responsibility of the Designer.



Typical WM Mid-Wall Installation

See pages 159-160 for models and information.



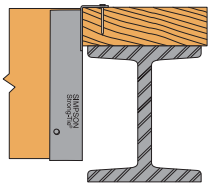
GLT *(fasteners included)*

HGLT *(fasteners included)*

See pages 94-95 for GLT and HGLT information.

W SERIES WITH VARIOUS HEADER APPLICATIONS

Model	Joist Width	Joist Depth	Fasteners Top	Fasteners Face	Fasteners Joist	Allowable Loads Header Type Uplift (160)	LVL	PSL	LSL	DF/SP	SPF/HF	I-Joist	Masonry	Code Ref.
W	1½ to 4	3½ to 30	2-10dx1½	—	2-10dx1½	—	1635	1740	—	1600	1415	—	—	170
	1½ to 4	3½ to 30	2-10d	—	2-10dx1½	—	2150	2020	—	2200	1435	—	—	I10, F9, L14
	1½ to 4	3½ to 30	2-16d	—	2-10dx1½	—	2335	1950	2335	1765	1435	—	—	
WM	1½ to 7½	3½ to 30	2-16d DPLX	—	2-10dx1½	—	MID-WALL INSTALLATION[4]						4175	IL12, L1, L11
	1½ to 7½	3½ to 30	2-¼x1¾ Titens	—	2-10dx1½	—	TOP OF WALL INSTALLATION						3380	
WMU	1½ to 7½	9 to 28	2-16d DPLX	4-¼x1¾ Titens	6-10dx1½	625	MID-WALL INSTALLATION[4]						4175	170
	1½ to 7½	9 to 28	2-¼x1¾ Titens	4-¼x1¾ Titens	6-10dx1½	545	TOP OF WALL INSTALLATION						3380	
WP/ WNP	1½ to 7½	3½ to 30	3-10dx1½	—	2-10dx1½	—	2865	3250	—	2500	2000	2030	—	I10, I19, F9, F18, L11, L14
	1½ to 7½	3½ to 30	3-10d	—	2-10dx1½	—	2525	3250	3650	3255	2525	—	—	
	1½ to 7½	3½ to 30	3-16d	—	2-10dx1½	—	3635	3320	3650	3255	2600	—	—	
WPU/ WNPU	1½ to 5½	7¼ to 18	3-16d	4-16d	6-10dx1½	1095	4700	4880	3650	4165	4165	—	—	
	1½ to 5½	18½ to 28	3-16d	4-16d	6-10dx1½	390	4700	4880	3650	4165	4165	—	—	
HW	1½ to 7½	3½ to 32	4-10d	—	2-10dx1½	—	3100	4000	—	5285	3100	—	—	I10, I19, F9, F18, L11, L14
	1½ to 7½	3½ to 32	4-16d	—	2-10dx1½	—	5100	4000	4500	5285	3665	—	—	
HWU	1½ to 3½	9 to 18	4-16d	4-16d	6-10dx1½	1160	6335	5500	5535	6335	5415	—	—	
	1½ to 3½	18½ to 28	4-16d	4-16d	6-10dx1½	965	6335	5500	5535	6335	5415	—	—	
	1½ to 3½	28½ to 32	4-16d	4-16d	8-10dx1½	985	6335	5500	5535	6335	5415	—	—	
	4½ to 7	9 to 18	4-16d	4-16d	6-10dx1½	1160	6000	5500	5535	6000	5415	—	—	
	4½ to 7	18½ to 28	4-16d	4-16d	6-10dx1½	965	6000	5500	5535	6000	5415	—	—	
	4½ to 7	28½ to 32	4-16d	4-16d	8-10dx1½	985	6000	5500	5535	6000	5415	—	—	



Installation on Wood Nailer

1. Code values are based on DF/SP header species.
2. WMU, WPU and HWU uplift loads have been increased for wind or earthquake loading with no further increase allowed. Reduce where other loads govern.
3. For hanger heights exceeding the joist height, the allowable load is 0.50 of the table load.
4. Mid-wall Installation requires minimum of one grouted course above and below the hanger.
5. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long, 10dx1½ = 0.148" dia. x 1½" long. See page 22-23 for other nail sizes and information.

CCQ/ECCQ *Column Caps*

SIMPSON Strong-Tie®

This product is preferable to similar connectors because of a) easier installation, b) higher loads, c) lower installed cost, or a combination of these features.

Column caps provide a high-capacity connection for column-beam combinations. This design uses Simpson Strong-Tie® Strong-Drive® SDS screws to provide faster installation and provides a greater net section area of the column compared to bolts. The SDS screws provide for a lower profile compared to standard through bolts.

MATERIAL: CCQ3, ECCQ3, CCQ4, CCQ4.62, ECCQ4, ECCQ4.62, CCQ6, ECCQ6—7 gauge; all others—3 gauge

FINISH: Simpson Strong-Tie® gray paint, available in HDG; CCOQ and ECCOQ—no coating

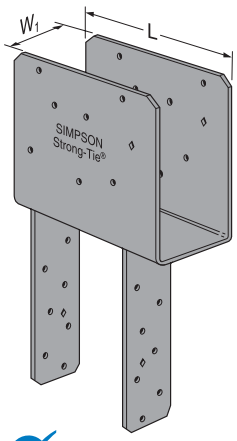
INSTALLATION:

- Install Simpson Strong-Tie SDS ¼"x2½" wood screws, which are provided with the column cap. *(Lag screws will not achieve the same load.)*
- CCOQ and ECCOQ column cap only *(no straps)* may be ordered for field-welding to pipe or other columns. Dimensions are same as CCQ and ECCQ.
- For rough cut lumber sizes, provide dimensions. An optional W_2 dimension may be specified with any column size given. *(Note that the W_2 dimension on straps rotated 90° is limited by the W_1 dimension.)*

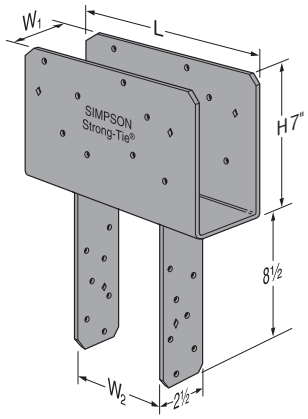
OPTIONS:

- For end conditions, specify ECCQ.
- Straps may be rotated 90° where $W_1 \geq W_2$ and for CCQ5-6.

CODES: See page 13 for Code Reference Key Chart.

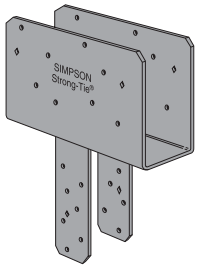


ECCQ46SDS2.5



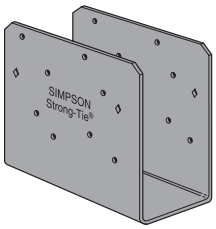
CCQ46SDS2.5

Optional CCQ with straps rotated 90°

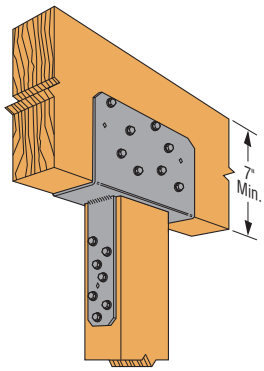


These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

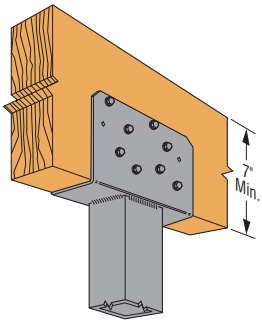
Model No.	Beam Width	Dimensions W1	W2	L CCQ	L ECCQ	H	No. of[8] SDS ¼"x2½" Screws Beam	Screws Post	Allowable Loads (DF/SP) CCQ Uplift (160)	CCQ Down (100)	ECCQ Uplift (160)	ECCQ Down (100)	Code Ref.	CCOQ Model No. (No Legs)
CCQ3-4SDS2.5	3⅛	3¼	3⅝	11	8½	7	16	14	5680	16980	3695	6125	I12, L4, F11	CCOQ3-SDS2.5
CCQ3-6SDS2.5	3⅛	3¼	5½	11	8½	7	16	14	5680	19250	3695	9625		
CCQ44SDS2.5	4x	3⅝	3⅝	11	8½	7	16	14	5680	19020	4040	7655		CCOQ4-SDS2.5
CCQ46SDS2.5	4x	3⅝	5½	11	8½	7	16	14	7145	24065	4040	12030		
CCQ48SDS2.5	4x	3⅝	7½	11	8½	7	16	14	7145	24065	4040	16405		
CCQ4.62-3.62SDS	4½	4⅝	3⅝	11	8½	7	16	14	5680	19020	4040	7655	170	CCOQ4.62-SDS2.5
CCQ4.62-4.62SDS	4½	4⅝	4⅝	11	8½	7	16	14	5680	24450	4040	9845		
CCQ4.62-5.50SDS	4½	4⅝	5½	11	8½	7	16	14	7145	28585	4040	12030		
CCQ5-4SDS2.5	5⅛	5¼	3⅝	11	8½	7	16	14	5680	26635	4040	10045	I12, L4, F11	CCOQ5-SDS2.5
CCQ5-6SDS2.5	5⅛	5¼	5½	11	8½	7	16	14	7245	28190	5535	15785		
CCQ5-8SDS2.5	5⅛	5¼	7½	11	8½	7	16	14	7245	31570	5535	21525		
CCQ64SDS2.5	6x	5½	3⅝	11	8½	7	16	14	5680	28585	4040	12030		CCOQ6-SDS2.5
CCQ66SDS2.5	6x	5½	5½	11	8½	7	16	14	7145	30250	4040	18905		
CCQ68SDS2.5	6x	5½	7½	11	8½	7	16	14	7145	37815	4040	25780		
CCQ6-7.13SDS2.5	6x	5½	7⅛	11	8½	7	16	14	7145	37815	4040	24490	160	
CCQ74SDS2.5	6¾	6⅞	3⅝	11	8½	7	16	14	5680	33490	4040	13230	I12, L4, F11	CCOQ7-SDS2.5
CCQ76SDS2.5	6¾	6⅞	5½	11	8½	7	16	14	7245	37125	5535	20790		
CCQ77SDS2.5	6¾	6⅞	6⅞	11	8½	7	16	14	7245	41580	5535	25515		
CCQ78SDS2.5	6¾	6⅞	7½	11	8½	7	16	14	7245	41580	5535	28350		
CCQ7.1-4SDS2.5	7	7⅛	3⅝	11	8½	7	16	14	5680	34730	4040	18375	160	CCOQ7.1-SDS2.5
CCQ7.1-6SDS2.5	7	7⅛	5½	11	8½	7	16	14	7245	38500	5535	28875		
CCQ7.1-7.1SDS2.5	7	7⅛	7⅛	11	8½	7	16	14	7245	57750	5535	36750		
CCQ7.1-8SDS2.5	7	7⅛	7½	11	8½	7	16	14	7245	52500	5535	39375		
CCQ86SDS2.5	8x	7½	5½	11	8½	7	16	14	7245	41250	5535	25780		CCOQ8-SDS2.5
CCQ88SDS2.5	8x	7½	7½	11	8½	7	16	14	7245	51565	5535	35155		
CCQ96SDS2.5	8¾	8⅞	5½	11	8½	7	16	14	7245	48125	5535	26950		CCOQ9-SDS2.5
CCQ98SDS2.5	8¾	8⅞	7½	11	8½	7	16	14	7245	53900	5535	36750		
CCQ106SDS2.5	10x	9½	5½	11	8½	7	16	14	7245	52250	5535	32655		CCOQ10-SDS2.5



CCOQ4-SDS2.5



Typical CCQ46SDS2.5 Installation



CCOQ Installation on Steel Column

1. Uplift loads have been increased for wind or earthquake with no further increase allowed; reduce where other loads govern.
2. Down loads may not be increased for short-term loading and shall not exceed the post capacity. See pages 226-227 for common post allowable loads.
3. Uplift loads do not apply to splice conditions.
4. Spliced conditions must be detailed by the Designer to transfer tension loads between spliced members by means other than the column cap.
5. Column sides are assumed to lie in the same vertical plane as the beam sides. CCQ4.62 models assume a minimum 3½" wide post.
6. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. Values in the tables reflect installation into the wide face. See technical bulletin T-SCLCOLUMN for values on the narrow face (edge) *(see page 232 for details)*.
7. ECCQ uses 14-SDS screws into the beam and 14-SDS screws into the post.
8. Beam depth must be a minimum 7".
9. For 5¼" engineered lumber, use CCQ 6X or ECCQ 6X models.
10. CCOQ welded to steel column will achieve same load as CCQ. Steel column width shall not be less than beam width. Weld by Designer.

BC/BCS *Post Caps*

The BCS allows for the connection of 2-2x's to a 4x post or 3-2x's to a 6x post. Double shear nailing between beam and post gives added strength! The BC series offers dual purpose post cap/base for light cap or base connections.

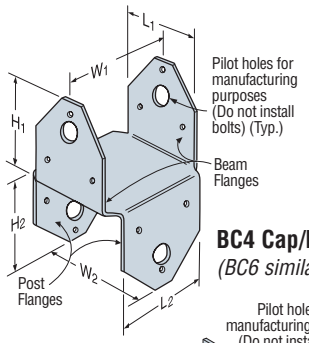
MATERIAL: 18 gauge **FINISH**: Galvanized. Some products available in ZMAX® coating; see Corrosion Information, page 14-15.

INSTALLATION:
- Use all specified fasteners. See General Notes.
- Do not install bolts into pilot holes.
- BCS: install dome nails on beam; drive nails at an angle through the beam into the post below to achieve the table loads
- BC: install with 16d commons or 16dx2½" joist hanger nails.
- Post bases do not provide adequate resistance to prevent members from rotating about the base and therefore are not recommended for non top-supported installations *(such as fences or unbraced carports)*.
- To tie multiple 2x members together, the Designer must determine the fasteners required to join members to act as one unit without splitting the wood.

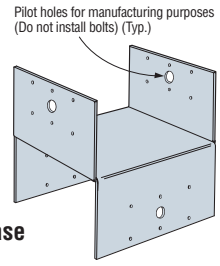
CODES: See page 13 for Code Reference Key Chart.

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

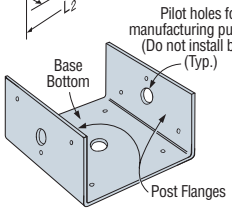
These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 27 for more information.



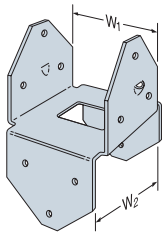
BC4 Cap/Base
(BC6 similar)



BC8 Cap/ Base



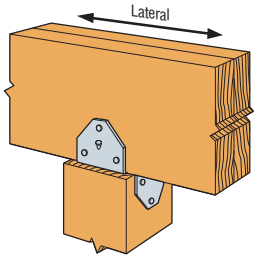
BC60 Half Base
(other similar)



BCS2-2/4
U.S. Patent 5,603,580

Model No.	Dimensions						Fasteners			Allowable Loads (DF/SP) (160)[1]		Code Ref.
	W_1	W_2	L_1	L_2	H_1	H_2	Beam Flange	Post Flange	Base Bottom	Uplift	Lateral	
CAPS												
BC4	3⁹⁄₁₆	3⁹⁄₁₆	2⅞	2⅞	3	3	6-16d	6-16d	—	980	1000	I12, L4, F11
BC46	3⁹⁄₁₆	5½	4⅞	2⅞	3½	2½	12-16d	6-16d	—	980	1000	
BC4R	4	4	4	4	3	3	12-16d	12-16d	—	980	1000	
BC6	5½	5½	4⅜	4⅜	3⅜	3⅜	12-16d	12-16d	—	1050	2000	
BC6R	6	6	6	6	3	3	12-16d	12-16d	—	1050	2000	
BC8	7½	7½	7½	7½	4	4	12-16d	12-16d	—	1800	2000	
BCS2-2/4	3⅛	3⁹⁄₁₆	2⅞	2⅞	2¹⁵⁄₁₆	2¹⁵⁄₁₆	8-10d	6-10d	—	780	1025	
BCS2-3/6	4⅝	5⁹⁄₁₆	4⅜	2⅞	3⁵⁄₁₆	2¹⁵⁄₁₆	12-16d	6-16d	—	800	1495	
BASES												
BC40	3⁹⁄₁₆	—	3¼	—	2¼	—	—	6-16d	4-16d	510	735	170
BC40R	4	—	4	—	3	—	—	6-16d	4-16d	510	735	
BC460	5½	—	3⅜	—	3	—	—	6-16d	4-16d	450	735	
BC60	5½	—	5½	—	3	—	—	6-16d	4-16d	450	735	
BC60R	6	—	6	—	3	—	—	6-16d	4-16d	450	735	
BC80	7½	—	7½	—	4	—	—	6-16d	4-16d	450	735	
BC80R	8	—	8	—	4	—	—	6-16d	4-16d	450	735	

1. Allowable loads have been increased for wind or earthquake with no further increase allowed; reduce where other loads govern.
2. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. Values in the tables reflect installation into the wide face. See technical bulletin T-SCLCOLUMN for values on the narrow face (edge) *(see page 232 for details)*.
3. Base allowable loads assumes nails have full penetration into supporting member. Loads do not apply to end grain post installations.
4. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long. See page 22-23 for other nail sizes and information.



Typical BCS Installation

LCC *Lally Column Caps* / CCOS *Steel Column Caps*

Lally column caps and steel column caps provide adequate bearing length for larger girder reactions.

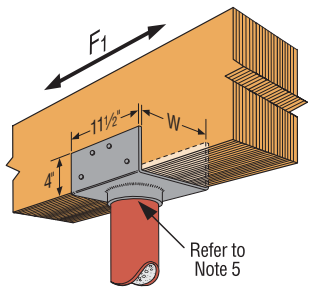
MATERIAL: LCC—12 gauge; CCOS—7 gauge **FINISH**: LCC—Simpson Strong-Tie® gray paint; CCOS—G90 Galvanized

INSTALLATION:
- Use all specified fasteners. See General Notes.
- LCC—Fit the lally column cap over the lally column and attach to the girder.
- CCOS—Attach steel column cap to column end plate with (4) Simpson Strong-Tie Quik Drive® XQ112S1224 self-tapping screws *(provided)* and attach to girder. Install with ⁵⁄₁₆" hex driver. See flier F-CCOS for additional CCOS applications.

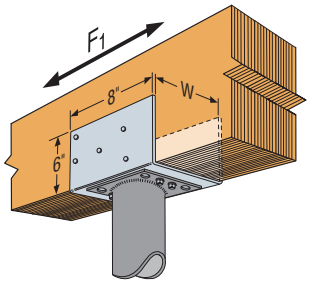
CODES: See page 13 for Code Reference Key Chart.

Model No.	W	Girder	Nails[7]	Lally Column Outside Diameter	Allowable Loads				Code Ref.
					Download[1,2,3,4]		Uplift	F_1[5]	
					DF/SP/SPF	LVL/PSL/LSL	(160)	(160)	
LCC4.5-3.5	4⅝	Triple 2x10/12	8-16d	3½	15820	—	—	1615	170
CCOS3.12	3⅛	Double 2x10/12	10-10d	—	10200	—	1020	2200	
LCC3.5-3.5	3⅝	3.5 LVL/PSL/LSL	8-16d	3½	—	15820	—	1615	
LCC3.5-4	3⅝	3.5 LVL/PSL/LSL	8-16d	4	—	20670	—	1615	
CCOS3.62	3⅝	3.5 LVL/PSL/LSL	10-10d	—	—	16665	1020	2200	
LCC4.5-4	4⅝	Triple 2x10/12	8-16d	4	20670	—	—	1615	
CCOS4.62	4⅝	Triple 2x10/12	10-10d	—	15300	—	1020	2200	
LCC5.25-3.5	5⅜	5.25 LVL/PSL/LSL	8-16d	3½	—	15820	—	1615	
LCC5.25-4	5⅜	5.25 LVL/PSL/LSL	8-16d	4	—	20670	—	1615	
CCOS5.50	5½	5.25 LVL/PSL/LSL	10-10d	—	—	22100	1020	2200	
LCC6-3.5	6⅛	Quad 2x10/12	8-16d	3½	15820	—	—	1615	
LCC6-4	6⅛	Quad 2x10/12	8-16d	4	20670	—	—	1615	
LCC7-3.5	7⅛	7 LVL/PSL/LSL	8-16d	3½	—	15820	—	1615	
LCC7-4	7⅛	7 LVL/PSL/LSL	8-16d	4	—	20670	—	1615	
CCOS7.25	7¼	7 LVL/PSL/LSL	10-10d	—	—	27525	1020	2200	

1. Loads may not be increased for short-term loading.
2. Allowable loads are determined using the lowest of the bearing loads using F_{C}-perp equal to 425 psi for SPF, 625 psi for DF and 700 psi for LVL/PSL/LSL.
3. Loads are for a continuous beam.
4. Spliced conditions for the LCC must be detailed by the Designer to transfer tension loads between spliced members by means other than the lally column. The splice condition load is 6750 lbs per beam side for LCC must be evenly loaded.
5. To achieve lateral loads, the LCC pipe must be welded to the column with an ⅛" fillet weld around the entire pipe.
6. The CCOS must be attached to the column cap plate with (4) Quik Drive XQ112S1224 self-tapping screws through the end plate and into the bottom of the CCOS. Max column cap plate thickness = ½".
7. All pipe columns need to be designed by a qualified Designer. CCOS minimum column diameter is 3".
8. CCOS caps can resist out-of-plane (F_2) forces up to 2200 lbs. provided the beam is braced to resist torsional rotation.
9. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long. See page 22-23 for other nail sizes and information.



Typical LCC5.25-3.5 Installation connecting a 3-ply LVL and a 3½" diameter (O.D.) steel column



Typical CCOS5.50 Installation connecting a 3-ply LVL and a steel column

FACE MOUNT HANGERS LUC/LU/U/HU/HUC *Standard Joist Hangers*

LUCZ concealed flange hanger available for 2x6, 2x8, 2x10 and 2x12 lumber. Ideal for end of ledger/ header or post conditions, the LUCZ also provides cleaner lines for exposed conditions such as overhead decks.

See Hanger tables on pages 71-77. See Hanger Options on pages 215-224 for hanger modifications, which may result in reduced loads.

LU—Value engineered for strength and economy. Precision-formed—engineered for installation ease and design value.

U—The standard U hanger provides flexibility of joist to header installation. Versatile fastener selection with tested allowable loads.

HU/HUC—Most models have triangle and round holes. To achieve maximum loads, fill both round and triangle holes with common nails. These heavy-duty connectors are designed for schools and other structures requiring additional strength, longevity and safety factors.

MATERIAL: See tables on pages 71-77.

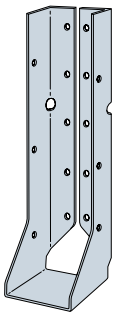
FINISH: Galvanized. Some products available in ZMAX® coating.

INSTALLATION:

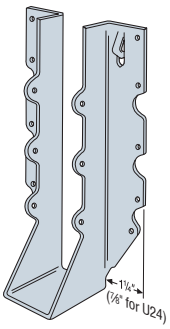
- Use all specified fasteners. See General Notes.
- HU/HUC—Can be installed filling round holes only, or filling round and triangle holes for maximum values.
- Joists sloped up to ¼:12 achieve table loads.
- For installations to masonry or concrete see page 161.
- HU/HUC hangers can be welded to a steel member. Allowable loads are the lesser of the values in the Hanger tables on pages 71-77 or the weld capacity – refer to technical bulletin T-HUHUC-W *(see page 231 for details)*.

OPTIONS:

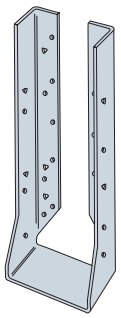
- HU hangers available with the header flanges turned in for 2⁵⁄₁₆" width and larger, with no load reduction–order HUC hanger.
- See Hanger Options on pages 216-217 for sloped and/or skewed U/HU models, and HUC *(concealed flange)* models.
- HU only—Rough beam sizes available by special order.
- See page 77 for stocked U hanger rough sizes tables.
- Also see LUS and HUS series.



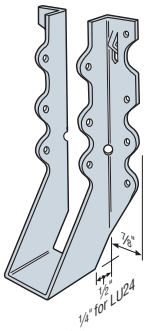
LUC210Z
(LUC26Z Similar)



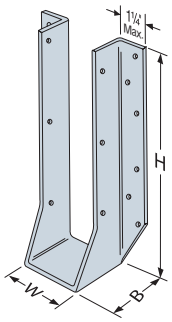
U210



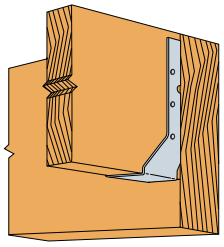
HUC412
Concealed Flanges



LU28
(except LU Roughs)

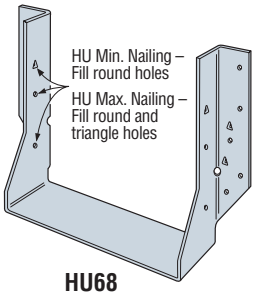


HU214
Projection seat on most models for maximum bearing and section economy.

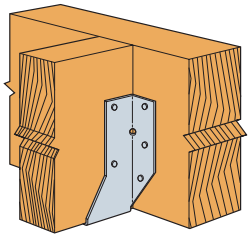


Typical LUCZ Installation

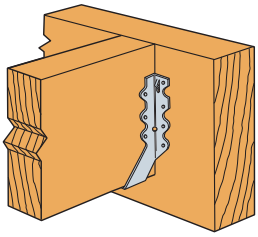
Model configurations may differ from those shown. Some HU models do not have triangle holes. Contact Simpson Strong-Tie.



HU68



Typical HU Installation



Typical LU28 Installation

HUCQ *Heavy-Duty Joist Hangers*

The HUCQ series are heavy-duty joist hangers that incorporate Simpson Strong-Tie® Strong-Drive® wood screws (SDS). Designed and tested for installation at the end of a beam or on a post, they provide a strong connection with fewer fasteners than nailed hangers. See page 107 for structural composite lumber hangers.

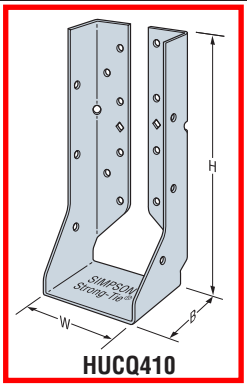
MATERIAL: 14 gauge **FINISH**: Galvanized. Most models available in stainless steel or ZMAX® coating.

INSTALLATION: • Use all specified fasteners. See General Notes.

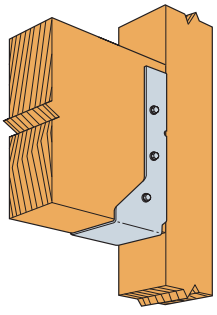
- Install Simpson Strong-Tie SDS ¼"x2½" wood screws, which are provided, in all round holes. *(Lag screws will not achieve the same load.)*
- For use on solid sawn wood members.

OPTIONS: These hangers cannot be modified.

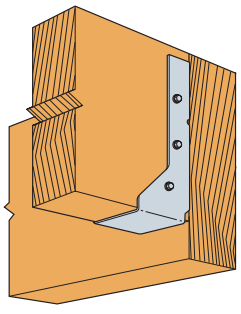
CODES: See page 13 for Code Reference Key Chart.



HUCQ410



Typical HUCQ Installation on a Post



Typical HUCQ Installation on a Beam

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Dimensions			Fasteners		Allowable Loads								Code Ref.
						DF/SP				SPF/HF				
	W	H	B	Face	Joist	Uplift (160)	Floor (100)	Snow (115)	Roof (125)	Uplift (160)	Floor (100)	Snow (115)	Roof (125)	
HUCQ310-SDS	2⁹⁄₁₆	9	3	8-SDS ¼"x2½"	4-SDS ¼"x2½"	1370	3120	3590	3900	985	2245	2585	2810	F23
HUCQ210-2-SDS	3¼	9	3	12-SDS ¼"x2½"	6-SDS ¼"x2½"	2510	4680	4955	4955	1805	3370	3570	3570	
HUCQ410-SDS	3⁹⁄₁₆	9	3	12-SDS ¼"x2½"	6-SDS ¼"x2½"	2510	4680	4955	4955	1805	3370	3570	3570	
HUCQ412-SDS	3⁹⁄₁₆	11	3	14-SDS ¼"x2½"	6-SDS ¼"x2½"	2510	5460	5560	5560	1805	3930	4005	4005	
HUCQ210-3-SDS	4⅝	9	3	12-SDS ¼"x2½"	6-SDS ¼"x2½"	2510	4680	4955	4955	1805	3370	3570	3570	
HUCQ610-SDS	5½	9	3	12-SDS ¼"x2½"	6-SDS ¼"x2½"	2520	4680	5380	5715	1815	3370	3875	4115	
HUCQ612-SDS	5½	11	3	14-SDS ¼"x2½"	6-SDS ¼"x2½"	2520	5315	5315	5315	1815	3825	3825	3825	

1. Uplift loads have been increased for wind or earthquake loading. Reduce where other loads govern.
2. See page 107 for additional engineered wood products sizes.
3. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. Values in the tables reflect installation into the wide face. See technical bulletin T-SCLCOLUMN for values on the narrow face (edge) *(see page 232 for details)*.

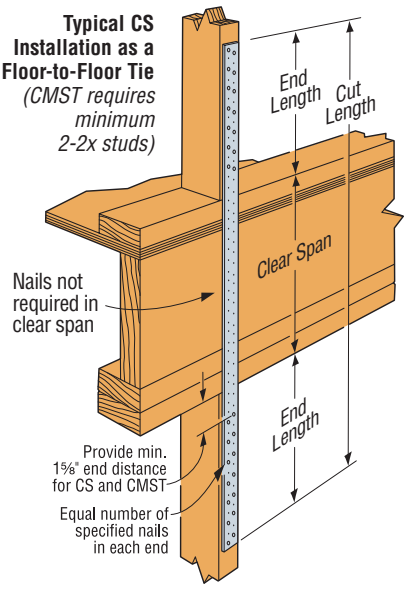
CS/CMST *Coiled Straps*

CMSTC provides nail slots for easy installation; it can be cut to length. CS are continuous utility straps which can be cut to length on the job site. Packaged in lightweight *(about 40 pounds)* cartons.
FINISH: Galvanized. Some products available in ZMAX® coating; see Corrosion Information, page 14-15.
INSTALLATION: • Use all specified fasteners. See General Notes.

- Wood shrinkage after strap installation across horizontal wood members may cause strap to buckle outward.
- Refer to the applicable code for minimum nail penetration and minimum wood edge and end distances.
- The table shows the maximum allowable loads and the nails required to obtain them. Fewer nails may be used; reduce the allowable load as shown in footnote #3.
- The cut length of the strap shall be equal to twice the "End Length" noted in the table plus the clear span dimension.
- CMST only–Use every other round hole if the wood tends to split. Use round and triangle holes for comparable MST loads, providing wood does not tend to split.
- For lap slice and alternate nailing information, refer to technical bulletin T-CMST *(see page 230 for details).*
- CS straps are available in 25' lengths, order CS14-R, CS16-R, CS18-R, CS20-R or CS22-R.

CODES: See page 13 for Code Reference Key Chart.

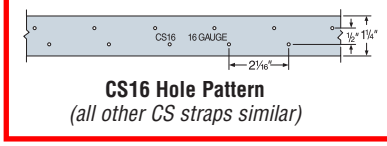
Typical CS Installation as a Floor-to-Floor Tie *(CMST requires minimum 2-2x studs)*



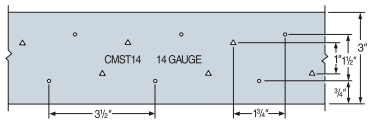
These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 27 for more information.

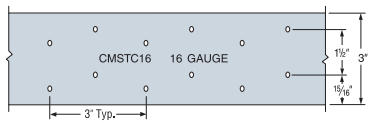
Model No.	Total L	Ga	DF/SP Fasteners 160	DF/SP End Length 160	SPF/HF Fasteners 160	SPF/HF End Length 160	Allowable Tension Loads (160)	Code Ref.
CMST12	40'	12	74 - 16d	33"	84 - 16d	38"	9215	I4, L3, F2
			86 - 10d	39"	98 - 10d	44"	9215	
CMST14	52½'	14	56 - 16d	26"	66 - 16d	30"	6490	
			66 - 10d	30"	76 - 10d	34"	6490	
CMSTC16	54'	16	50 - 16d sinker	20"	58 - 16d sinker	25"	4585	
CS14	100'	14	26 - 10d	15"	30 - 10d	16"	2490	
			30 - 8d	16"	36 - 8d	19"	2490	
CS16	150'	16	20-10d	11"	22 - 10d	12"	1705	
			22 - 8d	13"	26 - 8d	14"	1705	
CS18	200'	18	16 - 10d	9"	18 - 10d	10"	1370	
			18 - 8d	11"	22 - 8d	12"	1370	
CS20	250'	20	12 - 10d	6"	14 - 10d	8"	1030	
			14 - 8d	9"	16 - 8d	9"	1030	
CS22	300'	22	10 - 10d	7"	12 - 10d	7"	845	
			12 - 8d	6"	14 - 8d	8"	845	



CS16 Hole Pattern
(all other CS straps similar)



CMST14 Hole Pattern
(CMST12 similar)



CMSTC16 Hole Pattern

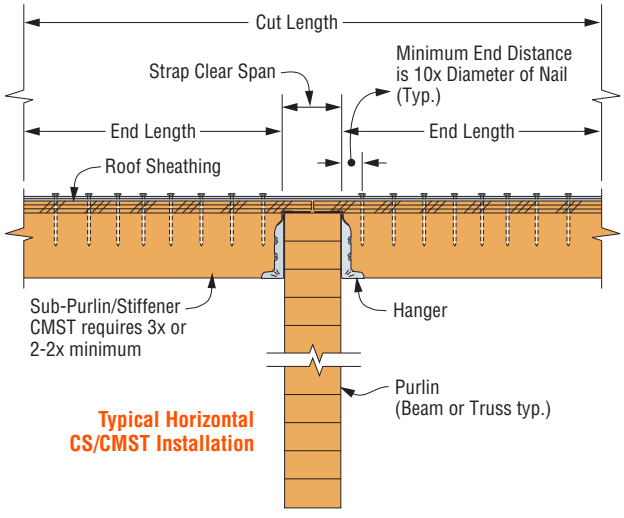
Gauge stamped on part for easy identification

1. Loads include a 60% load duration increase on the fasteners for wind or seismic loading.
2. Use half of the required nails in each member being connected to achieve the listed loads.
3. Calculate the connector value for a reduced number of nails as follows: $\text{Allowable Load} = \frac{\text{No. of Nails Used}}{\text{No. of Nails in Table}} \times \text{Table Load}$

   Example: CMSTC16 in DF/SP with 40 nails total. *(Half of the nails in each member being connected)* $\text{Allowable Load} = \frac{\text{40 Nails (Used)}}{\text{50 Nails (Table)}} \times 4585 \text{ lbs} = 3668 \text{ lbs}$
4. Tension loads apply for uplift when installed vertically.
5. **NAILS:** 16d = 0.162" dia. x 3½" long, 16d Sinker = 0.148" dia. x 3¼" long, 10d = 0.148" dia. x 3" long. See page 22-23 for other nail sizes and information.

NOT SURE HOW MUCH COIL STRAP YOU NEED?
Simpson Strong-Tie has a web-based app, the Coil Strap Length Calculator, which can help you quickly determine the cut length of each strap and the total amount of coil strap needed for each application on a project.

For more information or to access, go to ***www.strongtie.com/software***.



Typical Horizontal CS/CMST Installation

SDS & SD *Wood Screws*

SIMPSON Strong-Tie®

The Simpson Strong-Tie® Strong-Drive® screw (SDS) is a ¼" diameter structural wood screw ideal for various connector installations as well as wood-to-wood applications. It installs with no predrilling and has been extensively tested in various applications. The new SDS is improved with a patented easy driving 4CUT™ tip and a corrosion resistant double-barrier coating.

The SD8 #8x1¼" wafer head screw is ideal for miscellaneous fastening applications. The needle point ensures fast starts and deep #2 Phillips drive reduces cam-out and stripping.

SDS FEATURES:

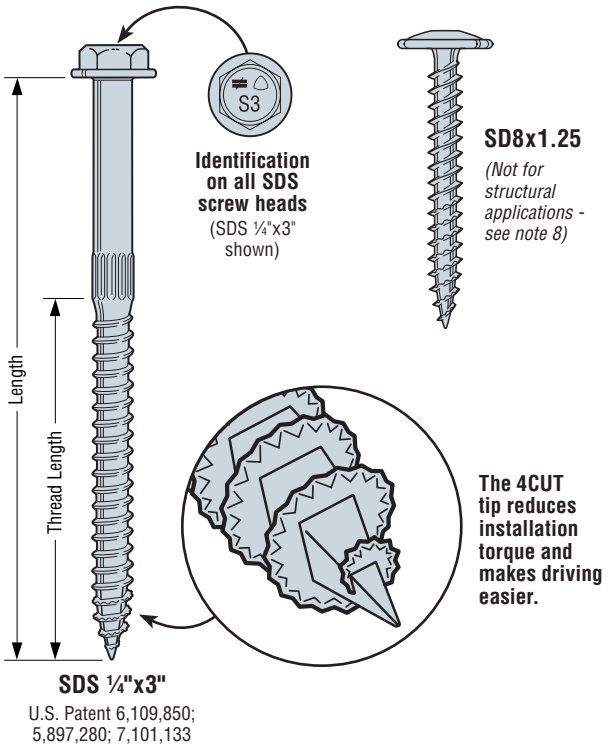
- The patented 4CUT tip has a square core and serrated threads to reduce installation torque and make driving easier with no predrilling and minimal wood splitting.
- A double-barrier coating finish provides corrosion resistance equivalent to hot-dip galvanization. Now one screw can handle interior, exterior and certain pressure-treated wood applications *(see Corrosion Information on page 14-15 for more information).*
- ⅜" hex washer head is stamped with the No-Equal sign and fastener length for easy identification after installation.

MATERIAL: Heat-treated carbon steel, Type-316 stainless steel

FINISH: SDS—Double-barrier coating. SDS screws may also be available yellow zinc dichromate or HDG *(Not all sizes are available in all coatings – Contact Simpson Strong-Tie for product availability and ordering information)*; SD8x1.25—Electro Galvanized.

CODES: See page 13 for Code Reference Key Chart.

WARNING: Industry studies show that hardened fasteners can experience performance problems in wet or corrosive environments. Accordingly, the SD8x1.25 should be used in dry, interior, and noncorrosive environments only.



These products feature additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

SDS and SD Wood Screws

Size (in.)	Model No.	Thread Length (in.)	Fasteners per Carton[6]	DF/SP Allowable Loads[4]						SPF/HF Allowable Loads[4]						Code Ref.
				Shear (100)[1]					Withdrawal[5] (100)	Shear (100)					Withdrawal[5] (100)	
				Wood Side Plate[3]		Steel Side Plate				Wood Side Plate[3]		Steel Side Plate				
				1½"	1¾" SCL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plate	1½"	1¾" SPF LVL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plate	
5/32 x 1¼	SD8x1.25[8]	—	—	—	—	50	50	50	—	—	—	45	45	45	—	170
¼ x 1½	SDS25112	1	1500	—	—	250	250	250	170	—	—	180	180	180	120	
¼ x 2	SDS25200	1¼	1300	—	—	250	290	290	215	—	—	180	210	210	150	
¼ x 2½	SDS25212	1½	1100	190	—	250	390	420	255	135	—	180	280	300	180	
¼ x 3	SDS25300	2	950	280	—	250	420	420	345	200	—	180	300	300	240	I5,
¼ x 3½	SDS25312	2¼	900	340	340	250	420	420	385	245	245	180	300	300	270	L1,
¼ x 4½	SDS25412	2¾	800	350	340	250	420	420	475	250	245	180	300	300	330	F20
¼ x 5	SDS25500	2¾	500	350	340	250	420	420	475	250	245	180	300	300	330	
¼ x 6	SDS25600	3¼	600	350	340	250	420	420	560	250	245	180	300	300	395	
¼ x 8	SDS25800	3¼	400	350	340	250	420	420	560	250	245	180	300	300	395	

Stainless-Steel SDS Wood Screws

Size (in.)	Model No.	Thread Length (in.)	Fasteners per Carton[6]	DF/SP Allowable Loads[4]						SPF/HF Allowable Loads[4]						Code Ref.
				Shear (100)					Withdrawal[5] (100)	Shear (100)					Withdrawal[5] (100)	
				Wood Side Plate		Steel Side Plate				Wood Side Plate		Steel Side Plate				
				1½"	1¾" SCL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plates	1½"	1¾" SCL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plates	
¼ x 1½	SDS25112SS	1	1500	—	—	250	250	250	170	—	—	180	180	180	120	
¼ x 2	SDS25200SS	1¼	1300	—	—	250	290	290	215	—	—	180	210	210	150	I5,
¼ x 2½	SDS25212SS	1½	1100	190	—	250	390	420	255	135	—	180	280	300	180	L1,
¼ x 3	SDS25300SS	2	950	280	—	250	420	420	345	200	—	180	300	300	240	F20
¼ x 3½	SDS25312SS	2¼	900	340	340	250	420	420	385	245	245	180	300	300	270	

1. Screws may be provided with the 4CUT or Type 17 tip.
2. SDS screws install best with a low speed ½" drill with a ⅜" hex head driver.
3. All applications are based on full thread penetration into the main member. For other wood side plate values, see *Fastening Systems* catalog (C-FS).
4. Allowable loads are shown at the wood load duration factor of C_D=1.00. Loads may be increased for load duration per the building code up to a C_D=1.60.
5. Withdrawal loads shown are in pounds (lbs.) and are based on the entire threaded section installed into the main member. If thread penetration into the main member is less than the Thread Length as shown in the table, reduce allowable load by 172 lbs. x inches of thread not in main member. Use 121 lbs./inch for SPF.
6. Fasteners per Carton represent the quantity of screws which are available in bulk packaging. Screws are also available in mini bulk and retail packs. Refer to Simpson Strong-Tie® List Price book. Contact Simpson Strong-Tie for more information.
7. LSL wood-to-wood applications that require 4½", 5", 6" or 8" SDS screws are limited to interior-dry use only.
8. SD8x1.25 requires ¾" minimum penetration. DO NOT USE SD8x1.25 wood screws with structural connectors unless specified and stated in this catalog.
9. Where predrilling is required for SDS, predrill diameter is 5/32".
10. Minimum spacing edge and end distance requirements are listed in ICC-ES ESR-2236.

HDU/DTT2Z *Holdowns*

SIMPSON Strong-Tie®

This product is preferable to similar connectors because of a) easier installation, b) higher loads, c) lower installed cost, or a combination of these features.

HDU holdowns are pre-deflected during the manufacturing process, virtually eliminating deflection under load due to material stretch. They use Simpson Strong-Tie® Strong-Drive® SDS screws which install easily, reduce fastener slip and provide a greater net section when compared to bolts.

The HDU series of holdowns are designed to replace previous versions of the product such as PHD's as well as bolted holdowns. The HDU2, 4 and 5 are direct replacements for the PHD2, 5 and 6, respectively.

The DTT2Z tension tie is suitable for lighter-duty holdown applications on single or double 2x posts, and installs easily with Strong-Drive SDS screws *(included)*. The DTT2Z has been tested in accordance with the ICC-ES acceptance criteria for Holdowns Attached to Wood Members (AC155) and meets the minimum requirements for many alternate braced wall panels per section R602.10.3.2 of the 2009 IRC *(see table R602.10.6, item 1)*.

For more information on holdown options, contact Simpson Strong-Tie.

HDU SPECIAL FEATURES:

- Pre-deflected body virtually eliminates deflection due to material stretch.
- Uses SDS screws which install easily, reduce fastener slip, and provide a greater net section area of the post compared to bolts.
- SDS screws are supplied with the holdowns to ensure proper fasteners are used.
- No stud bolts to countersink at openings.

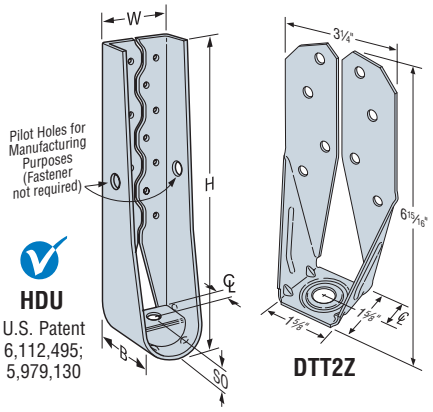
MATERIAL: See table

FINISH: HDU – Galvanized; DTT2Z – ZMAX® coating; DTT2SS – stainless steel

INSTALLATION:
- Use all specified fasteners. See General Notes.
- For use in vertical and horizontal applications.
- The HDU requires no additional washer, the DTT requires a standard cut washer *(included)* be installed between the nut and the seat.
- To tie multiple 2x members together, the Designer must determine the fasteners required to join the members without splitting the wood. See page 26 for SDS values.
- See SB and SSTB Anchor Bolts on pages 33-37 for anchorage options.
- SDS screws install best with a low speed high torque drill with a ⅜" hex head driver.

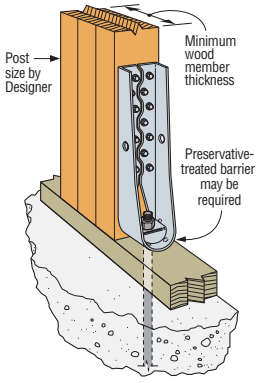
CODES: See page 13 for Code Reference Key Chart.

For holdowns, per ASTM test standards, anchor bolt nut should be finger-tight plus ⅓ to ½ turn with a hand wrench, with consideration given to possible future wood shrinkage. Care should be taken to not over-torque the nut. Impact wrenches should not be used.

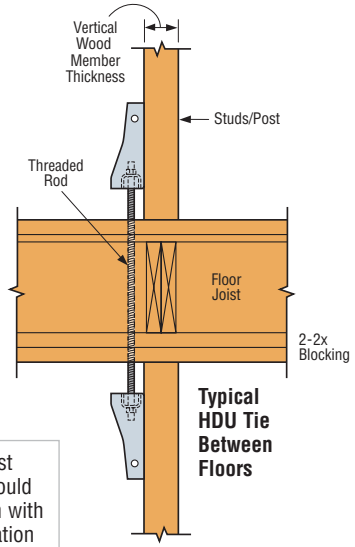


HDU
U.S. Patent 6,112,495; 5,979,130

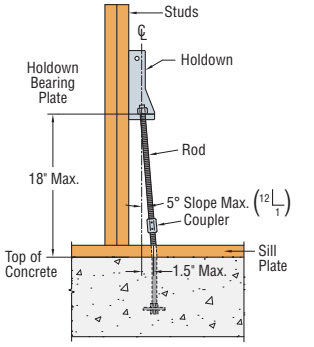
DTT2Z



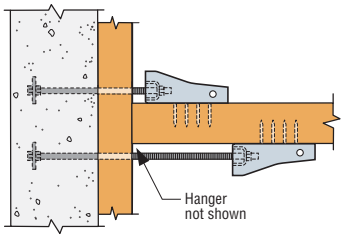
Vertical HDU Installation



Typical HDU Tie Between Floors



Holdown Raised Off Sill Plate



Horizontal HDU Offset Installation *(Plan View)*

See footnote 7

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Ga	Dimensions (in.) W	H	B	℄	SO	Fasteners Anchor Bolt Dia. (in.)	SDS Screws	Minimum Wood Member Thickness[4] (in.)	Allowable Tension Loads (lbs.) (160)[1] DF/SP	SPF/HF	Deflection at Allowable Load (in.)	Code Ref.
DTT2Z	14	3¼	6¹⁵⁄₁₆	1⅝	¹³⁄₁₆	⅜	½	8-SDS ¼"x1½"	1½	1825	1800	0.105	I6, L8, F5
DTT2Z-SDS2.5								8-SDS ¼"x1½"	3	2145	1835	0.128	
								8-SDS ¼"x2½"	3	2145	2105	0.128	170
HDU2-SDS2.5	14	3	8¹¹⁄₁₆	3¼	1⅝	1⅜	⅝	6-SDS ¼"x2½"	3	3075	2215	0.088	
HDU4-SDS2.5	14	3	10¹⁵⁄₁₆	3¼	1⅝	1⅜	⅝	10-SDS ¼"x2½"	3	4565	3285	0.114	
HDU5-SDS2.5	14	3	13³⁄₁₆	3¼	1⅝	1⅜	⅝	14-SDS ¼"x2½"	3	5645	4065	0.115	
HDU8-SDS2.5	10	3	16⅝	3½	1⅜	1½	⅞	20-SDS ¼"x2½"	3	5980	4305	0.084	I6, L8, F5
									3½	6970	5020	0.116	
									4½	7870	5665	0.113	
HDU11-SDS2.5	10	3	22¼	3½	1⅜	1½	1	30-SDS ¼"x2½"	5½	9535	6865	0.137	
									7¼	11175	8045	0.137	
HDU14-SDS2.5	7	3	25¹¹⁄₁₆	3½	1⅝	1⅝	1	36-SDS ¼"x2½"	4x6[10]	10770	7755	0.122	170
									7¼	14375[9]	10435[9]	0.177	I6, L8, F5
									5½[8]	14445[8,9]	10350[9]	0.177	

1. Allowable loads have been increased for earthquake or wind load durations with no further increase allowed; reduce where other load durations govern.
2. The Designer must specify anchor bolt type, length and embedment. See SB and SSTB Anchor Bolts *(pages 33-37)*.
3. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. Values in the tables reflect installation into the wide face. See technical bulletin T-SCLCOLUMN for values on the narrow face (edge) *(see page 232 for details)*.
4. Post design by Specifier. Tabulated loads are based on a minimum 3½" wide post (in a 3½" wall). Post may consist of multiple members provided they are connected independently of the holdown fasteners. See pages 226-227 for common post allowable loads.
5. Tension values are valid for holdowns flush or raised off of sill plate.
6. Deflection at Allowable Tension Load includes fastener slip, holdown deformation and anchor rod elongation for holdowns installed up to 6" above top of concrete. Holdowns may be installed raised up to 18" above top of concrete with no load reduction provided that additional elongation of the anchor rod is accounted for.
7. Tabulated loads may be doubled when the holdowns are installed on opposite sides of the wood member provided either the post is large enough to prevent opposing holdown screw interference or the holdowns are offset to eliminate screw interferences.
8. Noted HDU14 allowable loads are based on a 5½" wide post *(6x6 min.)*.
9. Requires heavy hex anchor nut to achieve tabulated loads *(supplied with holdown)*.
10. Loads are applicable to installation on either narrow or wide face of post.

LUS/HUS Double Shear Joist Hangers

SIMPSON Strong-Tie

This product is preferable to similar connectors because of a) easier installation, b) higher loads, c) lower installed cost, or a combination of these features.

See Hanger tables on pages 74-79. See Hanger Options on pages 200-202 for hanger modifications, which may result in reduced loads.

All hangers in this series have double shear nailing. This innovation distributes the load through two points on each joist nail for greater strength. It also allows the use of fewer nails, faster installation, and the use of standard nails for all connections. *(Do not bend or remove tabs.)*

MATERIAL: See tables, pages 74-79.

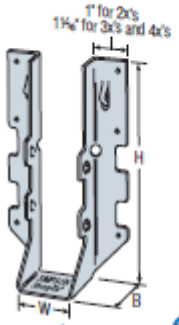
FINISH: Galvanized. Some products available in stainless steel or ZMAX® coating; see Corrosion Information, page 18-19.

INSTALLATION • Use all specified fasteners. See General Notes.

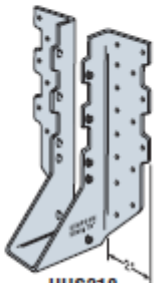
- Nails must be driven at an angle through the joist or truss into the header to achieve the table loads.
- Not designed for welded or nailer applications.
- 16d sinkers (0.148" dia. x 3¼" long) may be used where 10d commons are specified with no reduction in load. Where 16d commons are specified, 10d commons or 16d sinkers (0.148" dia. x 3¼" long) may be used at 0.85 of the table load.
- With 3x carrying members, use 16dx2½" nails into the header and 16d commons into the joist with no load reduction.
- With 2x carrying members, use 10dx1½" nails into the header and 10d commons into the joist, reduce the load to 0.64 of the table value.
- Use stainless-steel (SS) nails with stainless-steel (SS) hangers.

OPTIONS: • LUS hangers cannot be modified.

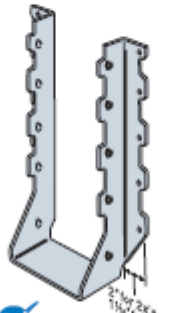
- HUS hangers available with the header flanges turned in for 2-2x (3⅛") and 4x only, with no load reduction. See the HUSC Concealed Flange illustration.
- See Hanger Options, pages 200-202.



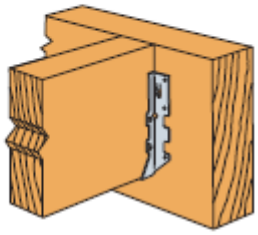
LUS28



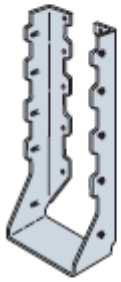
HUS210
(HUS26, HUS28, and HHUS similar)



HUS412



Typical LUS28 Installation
use .148x3" (10d common) or .148x3¼" (16d sinker) nail



HUSC
Concealed Flanges
(not available for HHUS, HGUS and HUS2x)

Double Shear Nailing Top View

Double Shear Nailing Side View
Do not bend tab

Dome Double Shear Nailing Side View *(available on some models)*
U.S. Patent 5,603,580

LOAD TABLE EXPLANATION

This icon identifies products approved for installation with the Simpson Strong-Tie Strong-Drive® SD structural-connector screw. See pages 29-30 for more information.

Min/Max: Refers to min. or max. nailing for products with round and triangle holes. Min. nailing uses round holes, and max. nailing uses round and triangle holes to achieve maximum load.

Load Duration: Assumed duration factor used to determine the allowable load.

Code Ref.: See page 20 for the Code Reference Key Chart, to determine which code reports include this product.

Joist Size: This shows the size of joist member.

Model No.: This is the Simpson Strong-Tie product name.

Gauge: Product material

Nails: This shows the fastener quantity and type required to achieve the table loads.

Allowable Design Loads: The maximum load that a connection is designed to provide. There may be multiple design loads acting in different directions *(up, down, lateral, perpendicular, etc.)* imposed on a connection.

Uplift

Floor, Snow, Roof

Installed Cost Index: This indicates the products relative installed cost *(combined cost and installation cost)*.

Joist Size	Model No.	Ga	Dimensions W	H	B	Min/ Max	Fasteners Header 10d	Header 16d	Joist	DF/SP Allowable Loads Uplift (160)	Floor (100) 10d	Floor (100) 16d	Snow (115) 10d	Snow (115) 16d	Roof (125) 10d	Roof (125) 16d	Installed Cost Index (ICI)	Code Ref.
DBL 2x6	LUS26-2	18	3⅛	4⅛	2	—	—	4-16d	4-16d	1165	—	1030	—	1180	—	1280	Lowest	I7, L17, F6
	U26-2	16	3⅛	5	2	—	8-10d	8-16d	4-10d	740	975	1150	1100	1305	1185	1410	+65%	
	HUS26-2	14	3⅛	5⅞₁₆	2	—	—	4-16d	4-16d	1235	—	1065	—	1210	—	1305	+172%	
	HU26-2/HUC26-2	14	3⅛	5⅞	2½	Min	—	8-16d	4-10d	760	—	1190	—	1345	—	1445	+233%	
		14	3⅛	5⅞	2½	Max	—	12-16d	6-10d	1135	—	1785	—	2015	—	2145	+254%	

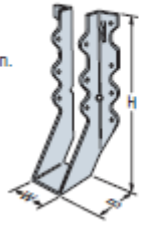
This icon identifies products that are available with additional corrosion protection. See pages 18-19 for additional information.

Dimensions W, H, B: This shows the product dimensions *(width, height and base in this case.)* referenced in the product drawing.

NAILS: 16d = 0.162" dia. x 3½" long, 10dx1½ = 0.148" dia. x 1½" long. See page 24-25 for other nail sizes and information.

Throughout this catalog a footnote will typically be provided indicating the required nail diameter and length.

All installations should be designed only in accordance with the allowable load values set forth in this catalog.



Product Drawing: Provides a graphic presentation of the product with dimensional information *(often cross referenced to the table)*.

CATALOG DEFINITION:
Deflection: The distance a point moves when a load is applied.

FACE MOUNT HANGERS – SOLID SAWN LUMBER (DF & SP)

SIMPSON Strong-Tie

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 30 for the correct substitution and SD screw size.

Joist Size	Model No.	Ga	Dimensions W	H	B	Min/ Max	Fasteners Header 10d	Header 16d	Joist	DF/SP Allowable Loads Uplift (160)	Floor (100) 10d	Floor (100) 16d	Snow (115) 10d	Snow (115) 16d	Roof (125) 10d	Roof (125) 16d	Installed Cost Index (ICI)	Code Ref.
SAWN LUMBER SIZES																		
2x4	LU24	20	1⅜	3½	1½	—	4-10d	4-16d	2-10dx1½	265	465	555	530	635	575	685	Lowest	
	LUS24	18	1⅜	3½	1¾	—	4-10d	—	2-10d	490	670	—	765	—	825	—	3%	
	U24	16	1⅜	3½	1½	—	4-10d	4-16d	2-10dx1½	265	485	575	550	655	595	705	67%	
	HU26	14	1⅜	3⅝	2¼	—	—	4-16d	2-10dx1½	335	—	595	—	670	—	720	I9	
DBL 2x4	LUS24-2	18	3⅛	3½	2	—	—	4-16d	2-16d	440	—	800	—	910	—	985	Lowest	
	U24-2	16	3⅛	3	2	—	4-10d	4-16d	2-10d	370	485	575	550	655	595	705	33%	
	HU24-2/HUC24-2	14	3⅛	3⅝	2½	—	—	4-16d	2-10d	380	—	595	—	670	—	720	240%	
2x6	LUS26	18	1⅜	4¾	1¾	—	4-10d	—	4-10d	1165	865	—	990	—	1070	—	Lowest	
	U26	16	1⅜	4¾	1½	—	6-10d	6-16d	4-10dx1½	565	700	835	795	950	860	1030	6%	I7, F6, L17
	U26	16	1⅜	4¾	2	—	6-10d	6-16d	4-10dx1½	585	730	865	825	980	890	1055	43%	
	LUC26Z	18	1⅜	4¾	1¾	—	6-10d	6-16d	4-10dx1½	730	710	845	810	965	875	1040	160%	
	HU26	14	1⅜	3⅝	2¼	—	—	4-16d	2-10dx1½	335	—	595	—	670	—	720	179%	
	HUS26	16	1⅝	5⅜	3	—	—	14-16d	6-16d	1550	—	2720	—	3095	—	3335	276%	
DBL 2x6	LUS26-2	18	3⅛	4¾	2	—	—	4-16d	4-16d	1165	—	1030	—	1180	—	1280	179%	
	U26-2	16	3⅛	5	2	—	8-10d	8-16d	4-10d	740	975	1150	1100	1305	1185	1410		
	HUS26-2	14	3⅛	5⅜	2	—	—	4-16d	4-16d	1235	—	1065	—	1210	—	1305		
	HU26-2/HUC26-2	14	3⅛	5⅜	2½	Min	—	8-16d	4-10d	760	—	1190	—	1345	—	1445	233%	
		14	3⅛	5⅜	2½	Max	—	12-16d	6-10d	1135	—	1785	—	2015	—	2165	254%	
TPL 2x6	LUS26-3	18	4⅝	4¾	2	—	—	4-16d	4-16d	1165	—	1030	—	1180	—	1280	*	160
	U26-3	16	4⅝	4¾	2	—	8-10d	8-16d	4-10d	740	975	1150	1100	1305	1185	1410	*	
	HU26-3/HUC26-3	14	4⅝	5½	2½	Min	—	8-16d	4-10d	760	—	1190	—	1345	—	1445	*	
		14	4⅝	5½	2½	Max	—	12-16d	6-10d	1135	—	1785	—	2015	—	2165	*	
2x8	LUS26	18	1⅜	4¾	1¾	—	4-10d	—	4-10d	1165	865	—	990	—	1070	—	Lowest	
	U26	16	1⅜	4¾	1½	—	6-10d	6-16d	4-10dx1½	565	700	835	795	950	860	1030	6%	
	LUS28	18	1⅜	6¾	1¾	—	6-10d	—	4-10d	1165	1100	—	1255	—	1360	—	23%	
	LU28	20	1⅜	6¾	1½	—	8-10d	8-16d	6-10dx1½	850	930	1110	1060	1270	1150	1335	39%	
	U26	16	1⅜	4¾	2	—	6-10d	6-16d	4-10dx1½	585	730	865	825	980	890	1055	43%	
	LUC26Z	18	1⅜	4¾	1¾	—	6-10d	6-16d	4-10dx1½	730	710	845	810	965	875	1040	160%	
	HU28	14	1⅜	5¼	2¼	—	—	6-16d	4-10dx1½	610	—	895	—	1005	—	1085	251%	
	HUS26	16	1⅝	5⅜	3	—	—	14-16d	6-16d	1550	—	2720	—	3095	—	3335	276%	I7, F6, L17
	HUS28	16	1⅝	7	3	—	—	22-16d	8-16d	2000	—	3965	—	4120	—	4220	409%	
DBL 2x8	LUS26-2	18	3⅛	4¾	2	—	—	4-16d	4-16d	1165	—	1030	—	1180	—	1280	Lowest	
	LUS28-2	18	3⅛	7	2	—	—	6-16d	4-16d	1165	—	1315	—	1500	—	1625	8%	
	U26-2	16	3⅛	5	2	—	8-10d	8-16d	4-10d	740	975	1150	1100	1305	1185	1410	65%	
	HUS28-2	14	3⅛	7⅜	2	—	—	6-16d	6-16d	1550	—	1595	—	1815	—	1960	188%	
	HU28-2/HUC28-2	14	3⅛	7	2½	Min	—	10-16d	4-10d	760	—	1490	—	1680	—	1805	397%	
		14	3⅛	7	2½	Max	—	14-16d	6-10d	1135	—	2085	—	2350	—	2530	418%	
TPL 2x8	LUS28-3	18	4⅝	6¼	2	—	—	6-16d	4-16d	1165	—	1315	—	1500	—	1625	*	160
	U26-3	16	4⅝	4¼	2	—	8-10d	8-16d	4-10d	740	975	1150	1100	1305	1185	1410	*	
	HU26-3/HUC26-3	14	4⅝	5½	2½	Min	—	8-16d	4-10d	760	—	1190	—	1345	—	1445	*	
		14	4⅝	5½	2½	Max	—	12-16d	6-10d	1135	—	1785	—	2015	—	2165	*	
QUAD 2x8	HU28-4/HUC28-4	14	6⅛	6⅝	2½	Min	—	10-16d	4-16d	900	—	1490	—	1680	—	1805	*	
		14	6⅛	6⅝	2½	Max	—	14-16d	6-16d	1345	—	2085	—	2350	—	2530	*	
2x10	LUS28	18	1⅜	6⅝	1¾	—	6-10d	—	4-10d	1165	1100	—	1255	—	1360	—	Lowest	
	LU28	20	1⅜	6⅝	1½	—	8-10d	8-16d	6-10dx1½	850	930	1110	1060	1270	1150	1335	13%	
	LUS210	18	1⅜	7⅞	1¾	—	8-10d	—	4-10d	1165	1340	—	1525	—	1650	—	15%	
	LU210	20	1⅜	7⅞	1½	—	10-10d	10-16d	6-10dx1½	850	1165	1390	1325	1585	1435	1715	28%	
	U210	16	1⅜	7⅞	2	—	10-10d	10-16d	6-10dx1½	1110	1215	1440	1375	1635	1485	1685	76%	
	LUC210Z	18	1⅜	7¾	1¾	—	10-10d	10-16d	6-10dx1½	1100	1185	1410	1345	1605	1455	1735	180%	
	HU210	14	1⅜	7⅛	2¼	—	—	8-16d	4-10dx1½	610	—	1190	—	1345	—	1445	225%	
	HUS210	16	1⅝	9	3	—	—	30-16d	10-16d	3000	—	4255	—	4445	—	4575	450%	I7, F6, L17
DBL 2x10	LUS28-2	18	3⅛	7	2	—	—	6-16d	4-16d	1165	—	1315	—	1500	—	1625	Lowest	
	LUS210-2	18	3⅛	9	2	—	—	8-16d	6-16d	1745	—	1830	—	2090	—	2265	34%	
	U210-2	16	3⅛	8½	2	—	14-10d	14-16d	6-10d	1110	1705	2015	1930	2285	2075	2465	88%	
	HUS210-2	14	3⅛	9⅜	2	—	—	8-16d	8-16d	3295	—	2125	—	2420	—	2615	217%	
	HU210-2/ HUC210-2	14	3⅛	8¹³⁄₁₆	2½	Min	—	14-16d	6-10d	1135	—	2085	—	2350	—	2530	441%	
		14	3⅛	8¹³⁄₁₆	2½	Max	—	18-16d	10-10d	1895	—	2680	—	3020	—	3250	467%	
	HHUS210-2	14	3½	8⅛	3	—	—	30-16d	10-16d	4000	—	5635	—	6380	—	6880	*	
TPL 2x10	LUS28-3	18	4⅝	6¼	2	—	—	6-16d	4-16d	1165	—	1315	—	1500	—	1625	*	160
	LUS210-3	18	4⅝	8⅜	2	—	—	8-16d	6-16d	1745	—	1830	—	2090	—	2265	*	
	U210-3	16	4⅝	7¾	2	—	14-10d	14-16d	6-10d	1110	1705	2015	1930	2285	2075	2465	*	
	HU210-3/ HUC210-3	14	4⅛	8⅝	2½	Min	—	14-16d	6-10d	1135	—	2085	—	2350	—	2530	*	I7, F6, L17
		14	4⅛	8⅝	2½	Max	—	18-16d	10-10d	1895	—	2680	—	3020	—	3250	*	
	HHUS210-3	14	4⅛	9	3	—	—	30-16d	10-16d	4000	—	5635	—	6380	—	6880	*	
	HGUS210-3	12	4⅝	9⅛	4	—	—	46-16d	16-16d	4095	—	9100	—	9100	—	9100	*	F23, 160

See footnotes on page 76.

CODES: See page 20 for Code Reference Key Chart.

LSU/LSSU *Adjustable Light Slopeable/Skewable U Hangers*

SIMPSON Strong-Tie

This product is preferable to similar connectors because of a) easier installation, b) higher loads, c) lower installed cost, or a combination of these features.

The LSU and LSSU series of hangers may be sloped and skewed in the field, offering a versatile solution for attaching joists and rafters. These hangers may be sloped up or down and skewed left or right, up to 45°.

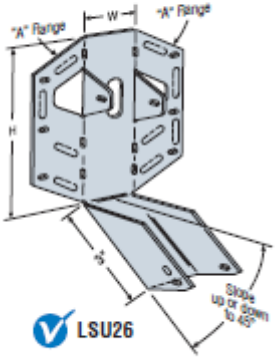
MATERIAL: See table

FINISH: Galvanized. Some products available in ZMAX® coating; see Corrosion Information, page 18-19.

INSTALLATION:

- Use all specified fasteners. See General Notes.
- Attach the sloped joist at both ends so that the horizontal force developed by the slope is fully supported by the supporting members.
- To see an installation video on this product, visit ***www.strongtie.com***.

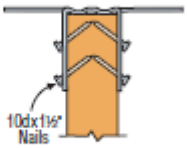
CODES: See page 20 for Code Reference Key Chart.



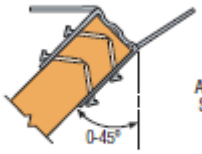
LSU26

LSU and LSSU INSTALLATION SEQUENCE

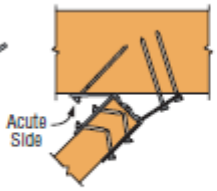
(For Skewed or Sloped/Skewed Applications)



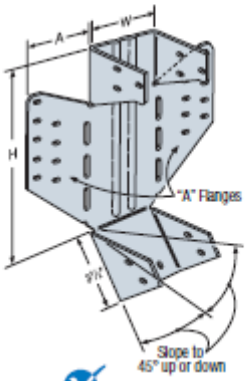
STEP 1
Nail hanger to slope-cut carried member, installing seat nail first. No bevel necessary for skewed installation. Install joist nails at 45° angle.



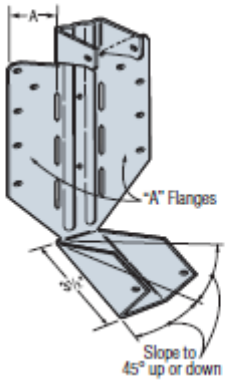
STEP 2
Skew flange from 0-45°. Bend other flange back along centerline of slots until it meets the header. Bend one time only.



STEP 3
Attach hanger to the carrying member, acute angle side first *(see footnote 4)*. Install nails at an angle.



LSSU410
(LSSU210-2 similar)



LSSU28

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Joist Width	Model No.	Ga	Dimensions W	H	A	Fasteners Face	Joist	DF/SP Allowable Loads Uplift[2] (160)	Floor (100)	Snow (115)	Roof (125)	SPF/HF Allowable Loads Uplift[2] (160)	Floor (100)	Snow (115)	Roof (125)	Code Ref.
Sloped Only Hangers																
1½	LSU26	18	1⁹⁄₁₆	4⅛	1½	6-10d	5-10dx1½	535	665	765	800	415	575	660	690	
1½	LSU28	18	1⁹⁄₁₆	7⅛	1½	9-10d	5-10dx1½	535	1110	1275	1390	415	960	1105	1200	I8, F7, L15
1½	LSU210	18	1⁹⁄₁₆	8½	1⅝	10-10d	7-10dx1½	875	1110	1275	1390	625	960	1105	1200	
2½	LSUH310	16	2⁹⁄₁₆	8½	3⅛	18-16d	12-10dx1½	1150	2205	2205	2205	990	1930	1930	1930	170
3	LSU210-2	16	3⅛	8½	2⅛	18-16d	12-10dx1½	1150	2430	2795	3035	990	2160	2485	2700	I8, F7, L15
3½	LSU410	16	3⁹⁄₁₆	8½	2⅛	18-16d	12-10dx1½	1150	2430	2795	3035	990	2160	2485	2700	
Skewed Hangers or Sloped and Skewed																
1½	LSU26	18	1⁹⁄₁₆	4⅛	1½	6-10d	5-10dx1½	535	665	765	800	415	575	660	690	
1½	LSU28	18	1⁹⁄₁₆	7⅛	1½	9-10d	5-10dx1½	450	885	885	885	415	765	765	765	I8, F7, L15
1½	LSU210	18	1⁹⁄₁₆	8½	1⅝	9-10d	7-10dx1½	785	995	1145	1205	625	860	995	1050	
2½	LSUH310	16	2⁹⁄₁₆	8½	3⅛	14-16d	12-10dx1½	1150	1600	1600	1600	990	1385	1385	1385	170
3	LSU210-2	16	3⅛	8½	2⅛	14-16d	12-10dx1½	1150	1625	1625	1625	990	1365	1365	1365	I8, F7, L15
3½	LSU410	16	3⁹⁄₁₆	8½	2⅛	14-16d	12-10dx1½	1150	1625	1625	1625	990	1365	1365	1365	

1. Roof loads are 125% of floor loads unless limited by other criteria.
2. Uplift loads include an increase for wind or earthquake loading with no further increase allowed; reduce when other loads govern.
3. Truss chord cross-grain tension may limit allowable loads. Refer to technical bulletins T-ANSITPISPF, T-ANSITPISP and T-ANSITPIDF *(see page 213 for details)* for allowable loads that consider ANSI/TPI 1-2007 wood member design criteria.
4. For skewed LSSU hangers, the inner most face fasteners on the acute angle side are not installed.
5. Do not substitute 10dx1½" nails for face nails on slope and skew combinations or skewed only LSU and LSSU.
6. **NAILS:** 16d = 0.162" dia. x 3½" long, 10d = 0.148" dia. x 3" long, 10dx1½ = 0.148" dia. x 1½" long. See page 24-25 for other nail sizes and information.

H/TSP *Seismic & Hurricane Ties*

The Hurricane Tie series features various configurations of wind and seismic ties for trusses and rafters.

The TSP stud plate tie has now been tested in the top-plate-to-rafter connection.

The H2A features an improved design and higher uplift loads to replace the H2. The H10A has a similar design as the H10 but offers higher uplift capacity. The H10S provides a high capacity connection from truss/rafter to stud.

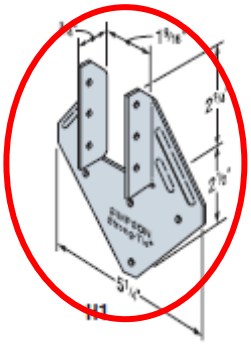
The H2.5T's truncated design was developed to accommodate trusses with 2x4 bottom chords. The easy to install, five nail pattern is stronger and gets better uplift loads than our popular H2.5 hurricane tie. H1, H10, H10S, H10-2, H11Z and H14 have also been rated for download to provide additional bearing capacity between the truss and wall.

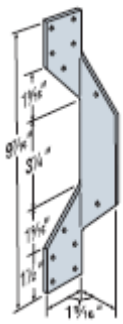
MATERIAL: See table.

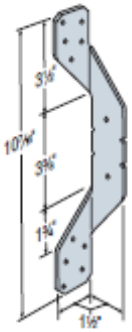
FINISH: Galvanized. H7Z and H11Z—ZMAX® coating. Some models available in stainless steel or ZMAX; see Corrosion Information, page 18-19.

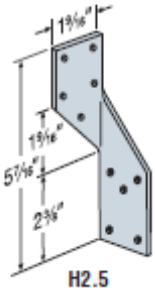
INSTALLATION: • Use all specified fasteners. See General Notes.
- H1 can be installed with flanges facing inwards *(reverse of H1 drawing number 1).*
- H2.5, H2.5T, H3, H4, H5 and H6 ties are only shipped in equal quantities of rights and lefts. *(Rights shown.)*
- Hurricane Ties do not replace solid blocking.
- Do not drive nails through the truss plate on the opposite side of single-ply trusses, which could force the plate off the truss.

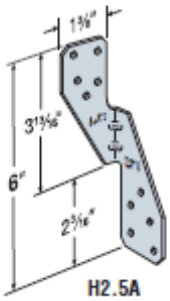
CODES: See page 20 for Code Reference Key Chart.

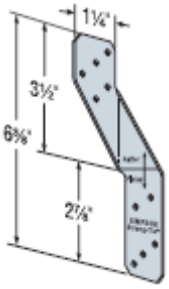

H1

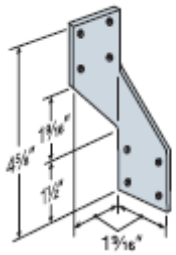

H2


H2A


H2.5


H2.5A


H2.5T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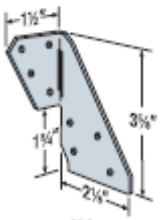
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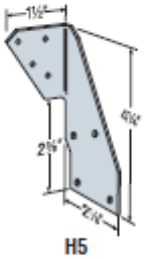
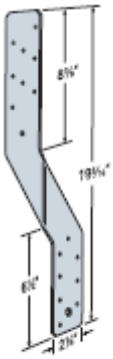
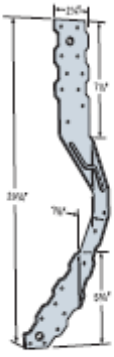
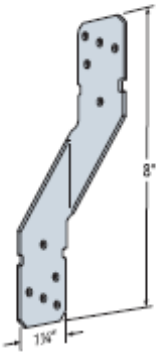
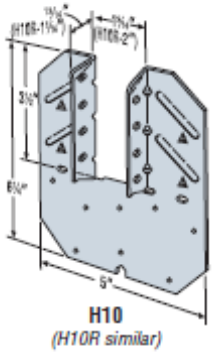

H5

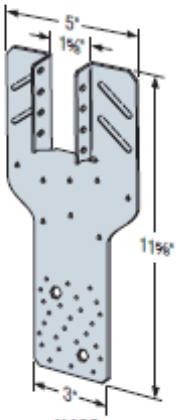

TSP

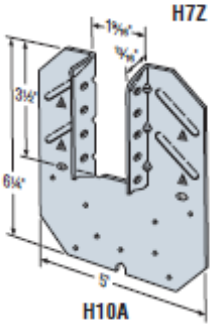

H6

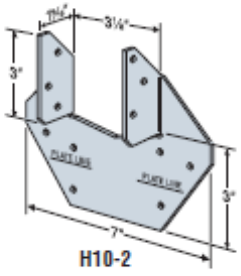

H7Z

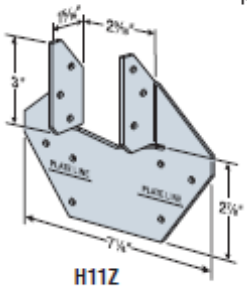

H8

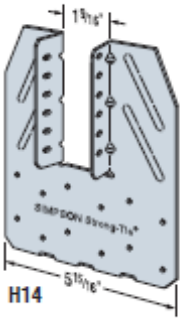

H10
(H10R similar)

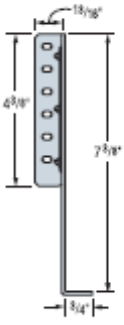

H10S


H10A


H10-2


H11Z


H14


H14 Profile

H/TSP *Seismic & Hurricane Ties*

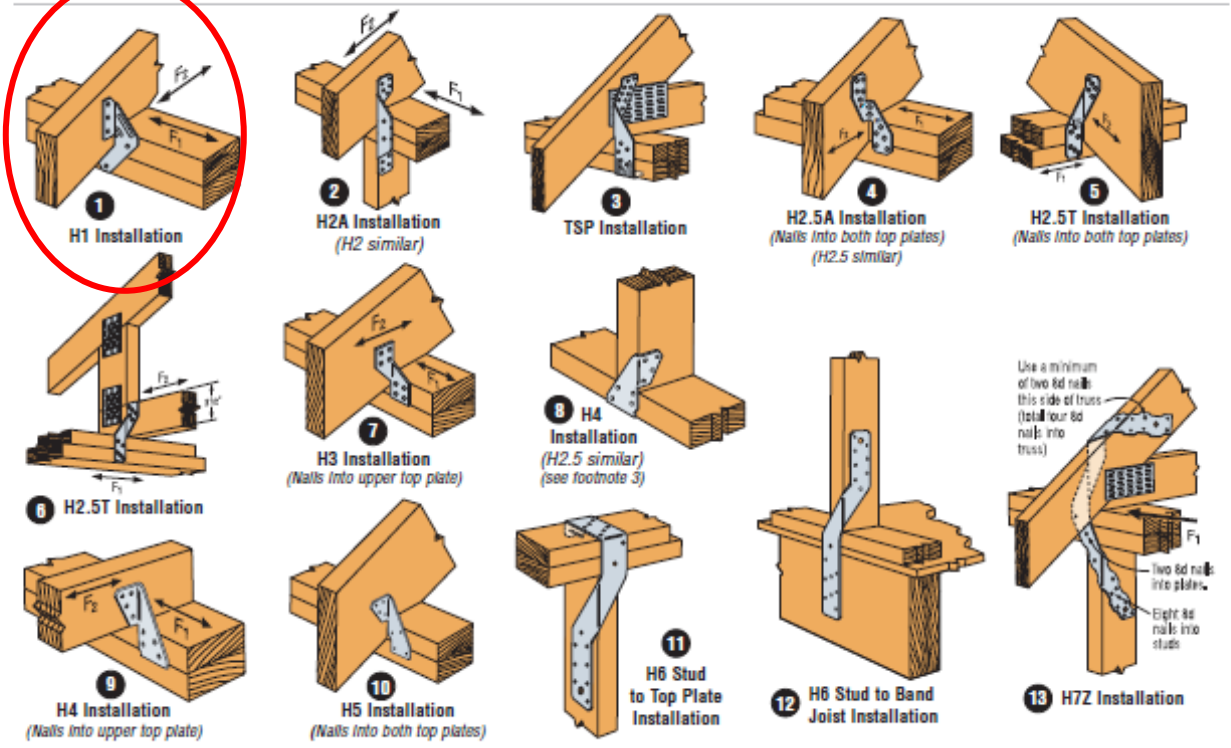
SIMPSON Strong-Tie

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 30 for the correct substitution and SD screw size.

Model No.	Ga	Fasteners: To Rafters/ Trusses	Fasteners: To Plates	Fasteners: To Studs	DF/SP Allowable Loads: Uplift (160)	DF/SP Allowable Loads: Lateral (160) F_1	DF/SP Allowable Loads: Lateral (160) F_2	Uplift Load with 8dx1½ Nails (160)	SPF/HF Allowable Loads: Uplift (160)	SPF/HF Allowable Loads: Lateral (160) F_1	SPF/HF Allowable Loads: Lateral (160) F_2	Uplift Load with 8dx1½ Nails (160)	Code Ref.
H1	18	6-8dx1½	4-8d	—	585	485	165	455	400	415	140	230	I17, L6, F16
H2	18	5-8d		5-8d	335			335	230	—	—	230	
H2A	18	5-8dx1½	2-8dx1½	5-8dx1½	575	130	55	—	495	130	55	—	IP1, L18, F25
H2.5	18	5-8d	5-8d	—	415	150	150	415	365	130	130	365	I17, L6, F16
H2.5A	18	5-8d	5-8d	—	600	110	110	480	535	110	110	480	I17, F16
H2.5T	18	5-8d	5-8d	—	545	135	145	425	545	135	145	425	IP1, L18, F25
H3	18	4-8d	4-8d	—	455	125	160	415	320	105	140	290	I17, L6, F16
H4	20	4-8d	4-8d	—	360	165	160	360	235	140	135	235	
H5	18	4-8d	4-8d	—	455	115	200	455	265	100	170	265	
H6	16	—	8-8d	8-8d	950	—	—	—	820	—	—	—	I17, F16
H7Z	16	4-8d	2-8d	8-8d	985	400	—	—	845	345	—	—	
H8	18	5-10dx1½	5-10dx1½	—	745	75	—	630	565	75	—	510	F26
H10	18	8-8dx1½	8-8dx1½	—	995	590	275	—	850	505	235	—	I17, F16
H10A	18	9-10dx1½	9-10dx1½	—	1140′	590	285	—	1015	505	285	—	I17, L18, F25
H10S[8,10]	18	8-8dx1½	8-8dx1½[10]	8-8d	1010	660	215	550	870	570	185	475	IP1, L18, F25
H10-2	18	6-10d	6-10d	—	760	455	395	—	655	390	340	—	I17, F16
H11Z	18	6-16dx2½	6-16dx2½	—	830	525	760	—	715	450	655	—	170
H14	18	[1] 12-8dx1½	13-8d	—	1350′	515	265	—	1050	480	245	—	IP1, L18, F25
		[2] 12-8dx1½	15-8d	—	1350′	515	265	—	1050	480	245	—	
TSP	16	9-10dx1½	6-10dx1½	—	740	310	190	—	635	265	160	—	170
		9-10dx1½	6-10d	—	890	310	190	—	765	265	160	—	

1. Loads have been increased 60% for wind or earthquake loading with no further increase allowed; reduce where other loads govern.
2. Allowable loads are for one anchor. A minimum rafter thickness of 2½" must be used when framing anchors are installed on each side of the joist and on the same side of the plate *(exception: connectors installed such that nails on opposite sides don't interfere)*.
3. Allowable DF/SP uplift load for stud to bottom plate installation *(see detail 15)* is 400 lbs. (H2.5); 390 lbs. (H2.5A); 360 lbs. (H4) and 310 lbs. (H8). For SPF/HF values multiply these values by 0.86.
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 to resist such forces may be considered.
6. Hurricane Ties are shown installed on the outside of the wall for clarity and assume a minimum overhang of 3½" installation on the inside of the wall is acceptable *(see General Instructions for the Installer notes u on page 22)*. For uplift Continuous Load Path, connections in the same area *(i.e. truss to plate connector and plate to stud connector)* must be on same side of the wall.
7. Southern Pine allowable uplift loads for H10A = 1340 lbs. and for H14 = 1465 lbs.
8. Refer to technical bulletin T-HTIEBEARING for H1, H10, H10S, H10-2, H11Z, H14 allowable bearing enhancement loads *(see page 214 for details)*.
9. H10S can have the stud offset a maximum of 1" from rafter *(center to center)* for a reduced uplift of 890 lbs. (DF/SP), and 765 lbs. (SPF).
10. H10S nails to plates are optional for uplift but required for lateral loads.
11. **NAILS:** 16dx2½ = 0.162" dia. x 2½" long, 10d = 0.148" dia. x 3" long, 10dx1½ = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½ = 0.131" dia. x 1½" long. See page 24-25 for other nail sizes and information.



Certified Galvanized Strapping

HUD Code 3280 and 3285(2) require 1-1/4" X .035" or larger steel strapping conforming to ASTM D3953-97, standard specifications for strapping, flat steel and seals. Type 1, Grade 1, Finish B, with a minimum total capacity of 4,725 lbs. and a working capacity of 3,150 lbs. marked every 5 ft. The straps must be provided with protections against weather deterioration and corrosion at least equivalent to that provided by a coating of zinc on steel of not less than .30 oz./ft. of surface coated. Slit or cut edges of coated strapping need not be zinc coated.

Tie Down Marked & Certified Galvanized Strapping

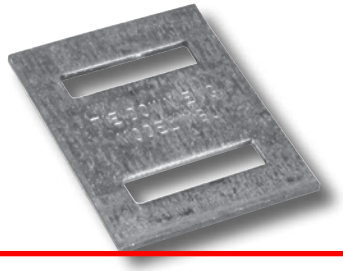
Galvanized	Part #	Length
G60	59150	35'
G60	59155	37'
G60	59165	60'
G60	59170	600'
G120	59218	37'
G120	59219	600'

Crimping Tool

Tie Down crimp tools are designed for use with .035 thickness, 1-1/4" wide strap and steel crimp seals.
Part #59180

Crimping Seals

Semi-Closed style for ease of use and strong bonds. Fits 1-1/4" strapping.
Part #59175



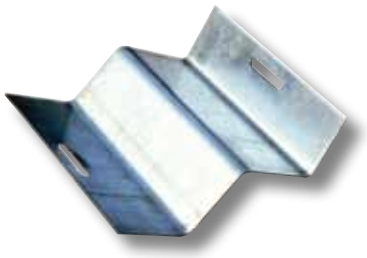
Double Slot Strap Buckle

High strength steel buckle with rust resistant hot dipped galvanized finish. Secures strap around mobile home frame.
Part #59140

Swivel Head Bracket

For use with Beam Clamps, Longitudinal Clamps and Vector Foundation Systems.
Part #59002

Strap Protectors
Attaches between strap and I-beam to prevent cutting or breaking of strap on sharp edges.
Bulk Part #59232
24 Pack Part #59232P



Galvanized Roof Bracket
Designed to hold strap or cable ties away from the roof and sides of mobile homes.
Part #59145

Angle Frame Bracket
For attaching longitudinal anchors to I-beam at each end of the home.
Part #59009

Jacking Plate

Jacking plate is used to add support to frame when adjusting trailer height with a jack. Required by many manufacturers when setting, to keep from bending the I-beam. Heavy gauge steel.

3-1/2" Wide	Part #59000
5" Wide	Part #59001

No more knuckle busting pliers!

Speed Wrench
Tie Down's SPEED WRENCH simplifies anchor installation with a design that allows for one handed operation for installing slotted bolts and tensioning strap. The SPEED WRENCH has a 15/16" (or 24 mm) impact socket on one side and a 15/16" "nut" on the other. Combine this with your own ratchet and 15/16" (or 24 mm) socket and you have the fastest way to tighten slotted bolts!
Part #48900

Strap Installation

1. Place Speed Wrench over the bolt head. Insert the strap end into the slot in bolt until flush with opposite side of bolt.

2. Hold Speed Wrench in place, tighten bolt with socket wrench on outside of Speed Wrench (bolt head side).

3. Move socket to the opposite (nut) side. Hold Speed Wrench in place. Use socket wrench to tighten nut.

Products and Properties | Specifications

Paints & Stains, Non-corrosion, Hardness

Installation Guidelines [PDF]

Microscopic Illustrations

Leaching Studies

Specifications

Material Safety Data Sheet [PDF]

Products List [PDF]

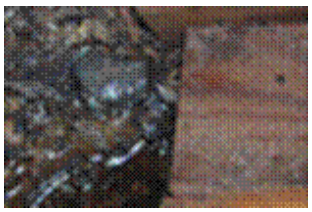
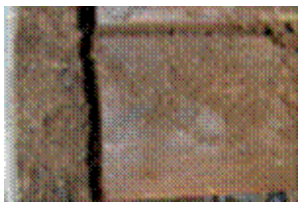
TimberSIL® wood/glass fusion products are exceptionally strong, resistant to fire, and durable, in addition to providing an effective barrier that is resistant to rot, decay and common wood problems.

A key feature of TimberSIL®'s patented technology is insolubility. TimberSIL®'s glassy matrix will not dissolve in water, no matter how long it is soaked, no matter how long it is exposed to the elements.

Properties	Test Method/Protocol	Results
Class A Fire Retardant, Ignition Resistant Material	ASTM E84, 30 minute extended, after 1000 hr of weathering cycles of rain, heat, and UV light per ASTM 2898	Meets standard for Class A fire retardant, Flame spread: 8.6 (up to 25 is Class A)
Flame & smoke Spread, Class A	ASTM E84, 30 minute extended, after 1000 hr of weathering cycles of rain, heat, and UV light per ASTM 2898	Meets or exceeds standards Smoke Developed: 129 Smoke Developed Standard: 0-450
Resistance to heat transfer	ASTM E84, 30 minute extended, after 1000 hr of weathering cycles of rain, heat, and UV light per ASTM 2898	Resistance to heat transfer greater than non-flammable control
Strength (rupture) MOR (psi)	ASTM D4761, ASTM D143	16,000 psi Fb 2700 psi
Strength (elasticity) MOE (psi)	ASTM D4761, ASTM D143	1,900,000 psi
Fastener Holding Strength	ASTM D-1037	30% greater than composite products, up to 75% greater than treated wood
Stains: 10 yr accelerated weathering, TimberSIL® stain samples (5 types)	ASTM G151	Meets or exceeds standards; no blistering, no loss of coating
TimberSIL® wood: 10 yr accelerated weathering	ASTM G151	Meets or exceeds standards; no rot, no decay, wood silvering
Corrosivity	AWPA E12-94	Non-corrosive
Termite Resistance	AWPA E1-97, ASTM D3345-74; ASTM D 1758; AWPA E7-93	Formosan Termite Grade 10-9.5 Sound, No Weight Loss
Resistance to Decay (field)	ASTM D 1758; AWPA E7-93	Decay Grade 10 Sound, No Weight Loss
	Flamer et al	

Resistance to Decay (laboratory)	Fiemer et al, Hydrobiologia. 485(1-3):83-96. (ERL,GB 1080). Kurtz, et al, Environ. Toxicol. Chem. 17(7):1274-1281. (ERL,GB 1004)	Decay Grade 10, unchanged
Insolubility	Molybdate spectrometry	Insoluble
Chemical Structure Analysis	X-ray diffraction	Composed of non-toxic amorphous glass; no crystalline structure present
Cellular Structure Analysis	polarized light microscopy	Cellular fibers resistant to maceration

Detrital Microcosm Study:

		
After 30 days: showing Leaf & Twig Litter, Soil & Swampy Debris	**After 12 months: Mold, Bacteria, and Fungi grow on top of wood**	**After 12 Months: Wood after cleaning No Rot!**

TimberSIL® Products

1-864-277-7007
4 Augusta Arbor Way
Greenville, SC 29605

40-Year Guarantee 40

Installation of TimberSIL® GlassWood Boards, Decking and Lumber

What about the TimberSIL® process?

TimberSIL® is a solid, DRY, southern yellow pine lumber product which has amorphous glass microscopically infused as a matrix on the interior and exterior surfaces of the lumber. Molecules-thin ribbon barriers of non-toxic amorphous, silicon dioxide (glass) intimately commingled with wood fibers and cell walls adds significant strength, resilience, dimensional stability, resistance to fire, biological inertness, sustainability, and permanent carbon sequestration to wood.

It is entirely non-toxic, non-corrosive and non-leaching. This patented process also adds unique characteristics to how the lumber material behaves in the environment. It looks and feels like normal lumber, but the difference is the glass content. There is enough glass added throughout the board to produce significant advantages in durability, strength, hardness, stiffness and resistance to insects and fire.

TimberSIL® is not like pressure treated (PT) lumber. TimberSIL® Glass Wood is an entirely new product category and has earned an exemption from EPA pesticide registration. EPA classifies TimberSIL® as a barrier product—the first of its kind.

In contrast, typical PT lumber is a registered pesticide product, inherently toxic, and is both wet (30-50% moisture) and weaker than the mill material started with. TimberSIL, like PT is southern yellow pine (SYP) but this GlassWood material is much stronger, harder and stiffer than the usual wet, green lumber. And for the most part, TimberSIL GlassWood is a higher grade than what you find in the market for PT lumber. TimberSIL® is always a #1, #1 prime or #1 dense TPI® or SPIB® graded material.

Receiving your TimberSIL®Glass Wood for your project

When your TimberSIL® materials arrive to the project site, some preparations for storage and handling should be in order. All authorized distributors and dealers are required to store TimberSIL® materials inside or at least in a three-sided shed for storing dry lumber. TimberSIL® Glass Wood is a **kiln dried to 19% wood product.** Therefore, unless you are going to immediately install the materials, adequate storage must be provided. Obviously, it cannot be treated like normal wet, PT building materials. It

should NOT be left exposed out in the weather or laid directly on the ground. TimberSIL® should be kept wrapped, banded if possible and stored in the dry and off the ground using sticker boards and plastic on the ground. Since these wood products are dry and effectively pre-shrunk it is important to handle and store the materials properly to maintain dimensional stability. If you have material that is banded, it is best to leave it banded until you are ready to install. Keep your dry building materials dry. Boards or lumber that is left unused should be restacked evenly and covered to maintain straightness. It is recommended to re-band if possible if sufficient overage is being kept stored for more than several days.

TimberSIL® Decking in freeze-thaw climates: It is highly recommended to sand and apply a top quality transparent sealer to all surfaces of decking prior to installation to alleviate checking and splitting due to the intrusion of water that freezes. Flat horizontal surfaces, including decking, that can accept water then freeze will weather much more rapidly than surfaces that are sealed.

TimberSIL®Glass Wood 5/4 Decking

Building a TimberSIL® Glass Wood Deck is easier than building with pressure treated or composite decking materials. Stronger TimberSIL® lumber means using less material for structure—and less material is less labor. Many composite decking materials require added joists, special care and exotic fasteners. Treated lumber is toxic and will require replacement way before TimberSIL® Glass Wood. To determine the best use of materials, have your designer, architect or engineer consult the TimberSIL® Span Tables for the specific spans and post spacing your contractor can build to.

The premium 5/4 radius edge decking product is a full 1” thick X 5.5” wide and is graded with one (1) premium side per the Southern Pine Inspection Bureau grading guidelines. You should also take note of the direction of the end-grain of each board to determine the best position for potential cupping—make sure the crown is ‘up’ so any warp will not trap water. The radius edges make for a smoother surface with less splintering. While it is necessary to sand and seal your deck boards to achieve the best product performance and yield the longest service life, you may choose to sand and seal prior to installation or complete the process after deck boards are in place.

TimberSIL® GlassWood Decking is also available by special order in a DSS Commercial Grade 2x6 dimension and the FL-2x6 Profile shown here.

Cutting TimberSIL®Glass Wood

Sawing or cutting TimberSIL® is very similar to normal wood, but it is denser. Your saw cut will take slightly longer. Think of cutting hardwood—it is denser so the saw has to work harder to get through it. The glass surrounding the fiber is microscopic flakes and is not harmful like the fibrous silica in cementious boards. It is recommended that the same breathing protection and eye protection you would wear with any wood cutting job be used with TimberSIL® GlassWood. The woodcut waste and sawdust is completely safe and can be ground up for mulch or put in the trash. No special precautions are necessary for landfill acceptance as this product is completely non-toxic. **TimberSIL® Glass Wood is safe for ground contact (non-cut ends only).** Boards that are ripped are not warranted. If cut ends are placed in the ground we require the use of an end sealer such as an epoxy-based, *Anchor Seal* product to protect the cut surface in the ground.

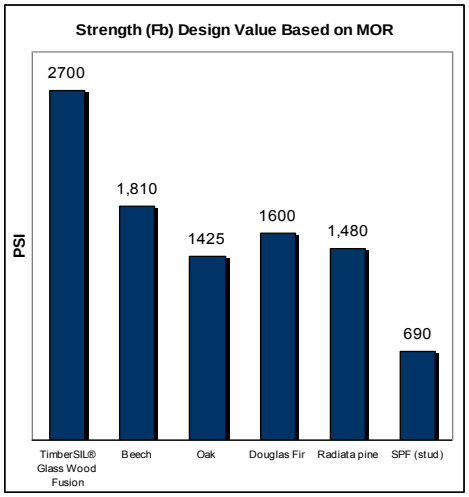
Fastening TimberSIL® Glass Wood

Since TimberSIL® is not corrosive, it is not necessary to use expensive stainless steel screws in fastening TimberSIL® decking or fencing to the framing. Exterior grade coated screws or triple-dipped galvanized nails are acceptable fasteners for this product. It is important to pre-drill decking and certain locations on framing for fasteners as this product is harder and stiffer than PT lumber. In order to minimize wood splitting from fasteners, installers must pre-drill holes at the ends of deck boards (within 2.5” of the end) prior to screwing or nailing. Remembering that this lumber is KD-19 dry and harder than normal SYP, care in nailing at the ends of framing members should be noted. Gap your decking boards 1/8” to 3/16” to allow for slight swelling.

The gripping power of TimberSIL® Glass Wood has been proven to be much higher than even normal kiln dried lumber, so your fasteners, especially nails will be very difficult to remove. If you must remove a nail, use a pry bar and scrap block to protect the surface of your installed material.

Building with TimberSIL® Glass Wood

As mentioned, TimberSIL® Glass Wood is a higher grade than what you find in the market for PT lumber. TimberSIL® is always a #1, #1 prime or #1 dense TPI® or SPIB® graded material. More importantly, TimberSIL® Glass Wood is much stronger than conventional framing lumber that less material can be used to frame up a structure and still provide more than adequate structural integrity. Comparing TimberSIL® with PT lumber or composites means less joists and less vertical post supports for the same sized deck. What does this mean to the installing contractor?



Contractors can be more competitive in offering a more responsible, value-added product at the same price of other less desirable toxic products. With the assistance of a licensed engineer or designer utilizing the TimberSIL® Span Tables, the contractor can build with significantly less material saving both material and labor costs.

The same glass content within the cellular structure of the lumber, decking or boards that makes them stronger also makes these materials denser and therefore stiffer and harder. So, in a word, it's going to be less 'forgiving.' That means if the board is slightly bowed or crooked, it will take more effort to get it straight. This was not an issue as long as the wood was wet and weak. But now it's stronger, up to 40% stronger than the pine lumber before TimberSIL® processing. If a board is slightly crooked, simply fasten one end securely then use a temporary level attached near the other end to move the board to the desired position. You may use temporary wedges along the way to keep the board straight along its length.

The following link is a good resource for planning the construction of your deck:

http://outdoor-living.hardwarestore.com/learning/a-guide-to-building-a-deck.aspx

Sanding and Painting TimberSIL® Glass Wood Residential 5/4 Decking and Railings

TimberSIL® Products recommends Keim® silicate-based paints and stains which can be applied directly on the surface without sanding. For added color selections TimberSIL® also recommends Seal-Once Sealers and tints (see www.seal-once.com for details). If using tints sanding prep is required for proper adherence.

If sanding, use a medium to heavy grit paper PRIOR TO sealing, staining or painting in order to improve proper adherence.

Occasionally, a white residue is visible on portions of the lumber surface; remove with a wire brush and/or sander with medium to heavy grit prior to painting, staining or sealing.

Surface Checking: In the case of an exposed deck in full sun, it is not uncommon for some surface checking (small cracks) to occur as a result of thermal expansion and drying of the wood fibers near the surface. The outside (top surface) of the lumber heats and dries at a faster rate over the inside of the

lumber resulting in the surface checking. The glass limits the length and depth of surface checking and prevents structural checking. This surface checking is normal and is necessary to relieve stress and prevent structural checking so common to pressure treated lumber where no added structural component is present in the wood.

TimberSIL® Glass Wood for Commercial/Industrial Applications

For high pedestrian traffic or specific commercial or industrial uses in all areas including freeze-thaw climates, we recommend TimberSIL® Glass Wood in a #1 Dense, MSR, or Dense Select Structural (DSS) grade when available. TimberSIL® #1 Dense for commercial/industrial applications is available in 2x6", 2x8", 2x10", 3x8" & 3x12" dimensions up to 16ft in length and do not require coatings of any kind. Because TimberSIL® Glass Wood is a dry product, gap your decking boards approximately 3/16" to allow for slight swelling.

Installing TimberSIL® Glass Wood Tongue and Groove (T&G) Porch Flooring

TimberSIL® requires following the guidelines of the Southern Pine Council, specifically the **Guide to Porch Flooring & Construction**, which can be viewed at http://www.southernpine.com/porch.shtml in installing our T&G products.

Preparing TimberSIL® tongue & groove boards: Store your TimberSIL® tongue & groove boards properly until use. The porch flooring and framing components should be allowed to acclimate with the exterior environment for a period of one-to-two weeks prior to installation.

Proper acclimation of the flooring includes storing the boards with stringers allowing good air circulation, using plastic sheeting on the ground below and as a loose fitting cover to allow air circulation. Do NOT store where boards are in the sun all day. Occasionally, a white residue is visible on portions of the lumber surface. This residue is easily removed with a wire brush or orbital sander. If the lumber surface is rough, either due to a mill or grain defect, or the appearance of excess silicate, a light sanding with a medium grit paper may be necessary.

Follow common sense techniques to minimize dimensional changes by sealing and painting ALL surfaces of each board. Never allow boards or finished flooring to be subject to standing water and provide an environment where moisture distribution is even as possible.

Required Design Features for Tongue & Groove Porches:

- Slope the porch framing 1/4" per foot away from the house to permit adequate water runoff.
- Allow a ½ inch gap at wall to allow for expansion; cover with trim if desired.
- Encourage air flow beneath the porch by using ornamental vents or lattice skirting.
- Orient tongue & groove flooring perpendicular to the house, so any water runs along the sloping porch boards.
- Locate porch flooring beneath a porch roof-Never install flooring open to direct rain.

- Beneath the porch, install a moisture barrier, such as 4-mil polyethylene to reduce the upward migration of moisture beneath the porch.
- Beneath the porch, slope the soil downward from house to outside edge of porch so any runoff water will be directed away from the house and porch.
- Columns and newell posts should be vented at top and bottom.
- Extend flooring beyond the porch front band joist to allow a 1" overhang.

Other products are available through special order and/or distribution: TimberSIL® GlassWood residential siding and roof shingles; marine products—poles and pilings; industrial products—railroad ties and utility poles.

Please contact us with any questions regarding our fine products.

TimberSIL® Products
4 Augusta Arbor Way
Greenville, SC 29605
864-277-7007
info@timbersilwood.com
www.timbersilwood.com

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RedBUILT
Engineered Wood Products

Product Package

DESERTSOL - Solar Decathlon 2013

Las Vegas, NV

RedBuilt™ Project Number: 080845

Reference Documents: ***1/16/2013***

Drawing Section	By	Date	Revision	Type	Sheets
Architectural	UNLV	11/20/2012			Full set
Structural	UNLV	11/20/2012			Full set
Mechanical	UNLV	11/20/2012			Full set

If you have questions, please contact:

Technical Representative:
Gary Collinsworth
(702) 871-4920

Design Center Contact:
Rex Flegel
(208) 395-2412

Return reviewed drawings to:

Gary Collinsworth
2780 S. Jones Blvd. Ste 120
Las Vegas, NV 89146

Material List & Calculations pp. 1-9, Drawings pp. 1-3

Our responsibility is limited to the design of RedBuilt products in accordance with the above referenced documents based on design loads specified by the engineer of record.

Please sign and date below and check the appropriate box.

**** One set of shop drawings must be returned to the technical representative (see above for address). ****

I warrant that this RedBuilt submittal package has been provided to the contractor/installer and responsible design professional and that it has been verified and/or corrected for accuracy, including any clouded items. I also agree that all materials shall be furnished by others unless specifically noted "by RB" herein and that installation of the materials is the sole responsibility of the installer.

Please indicate your current ***requested date for product delivery:*** _____

Check One:

☐ Approved, no change*

☐ Approved, as corrected

☐ Revise & Resubmit

Company _____

Name _____

Title _____

Date _____

* If there are no changes to the approval drawings, fax this signed cover sheet to the technical representative.

RedBuilt LLC
200 E Mallard Dr • Boise ID 83706 • Mail: PO Box 60 • Boise ID 83707
Ph: (208) 395-2400 • Fx: (208) 395-2443

RedBUILT™ Engineered Wood Products

Material List

RB Number	080845	*Operator*	Rex Flegel
Project Name	Desertsol - Solar Decathlon 2013	*Office*	Boise
Location	Las Vegas, NV		
Delivery	D1: Roof Package	*Comment*	Preliminary: Not For Production
Plant	Stayton	*Status*	Out For Approval
Latest Revision	:	*Report Type*	Customer

I-Joist Products — *Joists*

Quantity	Type	Series	Depth	Length	Profile	Bevel Cut	WS Att.	Knockouts	Camber	P.E.T.		Footage	Notes
21	A1	Red-I65	11.88	15'-6.00"	None					No		325.5	
3	A2	Red-I65	11.88	8'-6.00"	None					No		25.5	
3	A3	Red-I65	11.88	6'-0.00"	None					No		18.0	
2	B1	Red-I45	9.5	7'-0.00"	None					No		14.0	
27	• • •	Red-I65	11.88	• • • • •	• • • • • • • • •	• • • • • • •	• • • • •	• • • • •	• • • • •	• • • • •	*Total*	369.0	
2	• • •	Red-I45	9.5	• • • • •	• • • • • • • • •	• • • • • • •	• • • • •	• • • • •	• • • • •	• • • • •	*Total*	14.0	

I-Joist Products — *Web Stiffeners*

Quantity	Type	Series	Depth	Installation	Location	Standard	Beveled	Angle	Length	Width	Bevel Cut	Notes
8		Red-I45	9.5	Loose	End	Standard	Beveled	10.5	3.813	3.500	0.625	
84		Red-I65	11.875	Loose	End	Standard	Beveled	10.5	6.375	3.500	0.625	
48		Red-I65	11.875	Loose	End	Standard	Not Beveled	0.0	6.250	3.500	0.000	

Connectors

Quantity	Type	Model	Top	Face	Member	Slope	Skew	Flg. Slope	Flg. Angle	Flg. Offset	NetH	Finish	Notes
4	8	LSSUI25		9-10d	7-N10								
17	1	LBV2.56/11.88X	6-10d	4-10d	6-N10	SLD11			TFO11				
17	2	LBV2.56/11.88X	6-10d	4-10d	6-N10	SLU11			TFC11				
2	3	LBV5.12/11.88X	6-N10	4-N10	6-N10	SLD11			TFO11				
2	4	LBV5.12/11.88X	6-N10	4-N10	6-N10	SLU11			TFC11				
6	7	LBV2.56/11.88X	6-N10	4-N10	6-N10		SKR14						
12	5	LBV2.56/11.88	6-N10	4-N10	2-N10								
6	6	LBV2.56/11.88X	6-N10	4-N10	6-N10		SKL19						

RedLam™ Products — *LVL Beams*

Quantity	Type	Size	Length	Grade								Footage	Notes
1	ME1	3.5x11.88	18'-6.00"	2.0E								18.5	
1	• • •	3.5x11.88	• • • • • • • •	• • • • •	• • • • • • • • •	• • • • • • •	• • • • •	• • • • •	• • • • •	• • • • •	*Total*	18.5	

RedLam™ Products				LVL Wall Framing			
Quantity	Type	Size	Length	Grade	End Cut	Footage	Notes
2	MD5	1.5x5.5	3'-6.00"	2.0E		7.0	
2	MD3	1.5x5.5	3'-0.00"	2.0E		6.0	
2	MD3	1.5x5.5	3'-0.00"	FALSE		6.0	
2	MB1	1.5x7.25	11'-6.00"	2.0E		23.0	
2	MD2	1.5x5.5	2'-0.00"	2.0E		4.0	
2	MD1	1.5x5.5	4'-6.00"	2.0E		9.0	
2	MD4	1.5x5.5	6'-0.00"	2.0E		12.0	
2	MC1	1.5x3.5	4'-6.00"	2.0E		9.0	
2	MB2	1.5x7.25	6'-6.00"	2.0E		13.0	
12	...	1.5x5.5			*Total*	44.0	
4	...	1.5x7.25			*Total*	36.0	
2	...	1.5x3.5			*Total*	9.0	

RedLam™ Products				LVL Rim Board		
Lineal Ft	Type	Size	Grade		Footage	Notes
8	MA1	1.5x11.88	1.6E		8.0	
13	MA3	1.5x11.88	1.6E		13.0	
9	MA2	1.5x11.88	1.6E		9.0	
12	MA4	1.5x11.88	1.6E		12.0	
24	MA5	1.5x11.88	1.6E		24.0	

				Bearing Plate									
Lineal Ft	Type	Size	Net	Beveled	Notched	Grade	Profile	Angle	Thick	Thin	Width	W2	Notes
94		2x6	Nom	Bev. (Sgl.)	Not Notched	2.0E RedLam	P1	10.6	1.500	0.438	5.500		

			Hardware
Quantity	Type	Description	Notes
6.0 lb		N10 (10dx1.5) Nails	
5.5 lb		10d (10dx3) Nails	

RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/14/13 10:51 AM
Designer: Flegel
Comment: Worst case calc

Type: A1

11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	18%	497	2819	125% - All Loads		PASS
Positive Moment (ft-lb)	21%	1811	8438	125% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	14%	0.103	0.729	L / 999+	L / 240	PASS
Span Total	19%	0.182	0.972	L / 962	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	287 (125)	287 (125)
Dead Reaction (lb)	219	219
Total Reaction (lb) (DOL%)	505 (125)	505 (125)
Bearing	Flush	Flush
Support	Wall	Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV2.56/11.88X*SLD11	6-10d	4-10d	6-10dx1.5"	Sawn DF	2x6 DBL (Nailer)
Right	LBV2.56/11.88X*SLU11	6-10d	4-10d	6-10dx1.5"	Sawn DF	2x6 DBL (Nailer)

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: -2.25/12 ↘

14'- 4.0"

APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Sloped length multiplier = 1.017. Bevel cut add = 2.23".

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RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/14/13 10:51 AM
Designer: Flegel
Comment: Wind uplift hanger check

Type: A1 Wind

11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	7%	-262	3608	160% - All Loads		PASS
Positive Moment (ft-lb)	0%	5	6075	90% - Dead Load		PASS
Negative Moment (ft-lb)	9%	-955	10800	160% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	13%	-0.096	-0.729	L / 999+	L / 240	PASS
Span Total	10%	-0.096	-0.972	L / 999+	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	0	0
Dead Reaction (lb)	1	1
Total Reaction (lb) (DOL%)	1 (90)	1 (90)
Net Uplift Reaction (lb) (DOL%)	-267 (160)	-267 (160)
Bearing	Flush	Flush
Support	Wall	Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

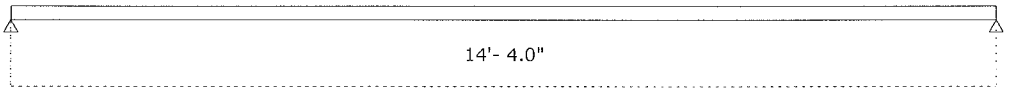
HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV2.56/11.88X*SLD11	6-10d	4-10d	6-10dx1.5"	Sawn DF	2x6 DBL (Nailer)
Right	LBV2.56/11.88X*SLU11	6-10d	4-10d	6-10dx1.5"	Sawn DF	2x6 DBL (Nailer)

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: -2.25/12



APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

ADDITIONAL LOADS

Type	Units	DOL	Live	Dead	Location from left	Application	Comment
Uniform	psf	Wind(160%)	-18.7	0.1	0'-0.0" to 14'-4.0"	Replaces	UPLIFT

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Net uplift over 200 lb detected.
- Sloped length multiplier = 1.017. Bevel cut add = 2.23".

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RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/14/13 10:56 AM
Designer: Flegel
Comment: Worst case double with side framing

Type: AD

DOUBLE 11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	15%	-863	5638	125% - All Loads		PASS
Positive Moment (ft-lb)	17%	2793	16875	125% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	11%	0.079	0.729	L / 999+	L / 240	PASS
Span Total	14%	0.139	0.972	L / 999+	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	382 (125)	499 (125)
Dead Reaction (lb)	292	379
Total Reaction (lb) (DOL%)	674 (125)	878 (125)
Bearing	Flush	Flush
Support	Wall	Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

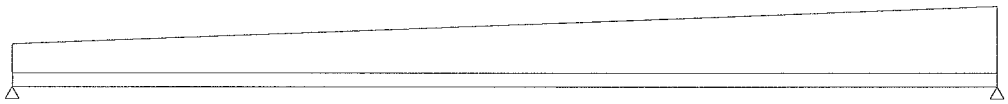
HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV5.12/11.88X*SLD11	6-10dx1.5"	4-10dx1.5"	6-10dx1.5"	Sawn DF	2x6 DBL
Right	LBV5.12/11.88X*SLU11	6-10dx1.5"	4-10dx1.5"	6-10dx1.5"	Sawn DF	2x6 DBL

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: -2.25/12 ↘



14'- 4.0"

APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

ADDITIONAL LOADS

Type	Units	DOL	Live	Dead	Location from left	Application	Comment
Tapered	plf	Roof(125%)	37 to 86	28 to 64	0'-0.0" to 14'-4.0"	Replaces	Side framed double loading

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Connect multiple ply members per RedBuilt™ Installation Guidelines.
- Sloped length multiplier = 1.017. Bevel cut add = 2.23".

S:\Engineering\Production II - Boise\08xxxx\0808xx\080845 DESERTSOL - Solar Decathlon 2013\Design\080845 Calcs.red

RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/14/13 11:04 AM
Designer: Flegel
Comment: Worst case double with side framing

Type: AD
WIND

DOUBLE 11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	9%	-373	4059	90% - Dead Load		PASS
Positive Moment (ft-lb)	10%	1207	12150	90% - Dead Load		PASS
Negative Moment (ft-lb)	1%	-263	21600	160% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	10%	-0.073	-0.729	L / 999+	L / 240	PASS
Span Total	6%	0.060	0.972	L / 999+	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	0	0
Dead Reaction (lb)	292	379
Total Reaction (lb) (DOL%)	292 (90)	379 (90)
Net Uplift Reaction (lb) (DOL%)	-62 (160)	-84 (160)
Bearing	Flush	Flush
Support	Wall	Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

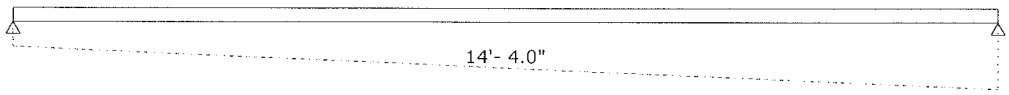
HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV5.12/11.88X*SLD11	6-10dx1.5"	4-10dx1.5"	6-10dx1.5"	Sawn DF	2x6 DBL
Right	LBV5.12/11.88X*SLU11	6-10dx1.5"	4-10dx1.5"	6-10dx1.5"	Sawn DF	2x6 DBL

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: -2.25/12 ↘



APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

ADDITIONAL LOADS

Type	Units	DOL	Live	Dead	Location from left	Application	Comment
Tapered	plf	Wind(160%)	-34 to -80	28 to 64	0'-0.0" to 14'-4.0"	Replaces	Wind uplift

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Connect multiple ply members per RedBuilt™ Installation Guidelines.
- Sloped length multiplier = 1.017. Bevel cut add = 2.23".

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RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/14/13 11:34 AM
Designer: Flegel
Comment: Side framing

Type: A2

11.875" Red-I65™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	7%	210	2819	125% - All Loads		PASS
Positive Moment (ft-lb)	4%	315	8438	125% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	2%	0.005	0.300	L / 999+	L / 240	PASS
Span Total	2%	0.009	0.400	L / 999+	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	120 (125)	120 (125)
Dead Reaction (lb)	90	90
Total Reaction (lb) (DOL%)	210 (125)	210 (125)
Bearing	Flush	Flush
Support	Wall	Beam
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

HANGERS	Model	Top	Face	Member	Header	Size
Left	LBV2.56/11.88X*SKL19	6-10dx1.5"	4-10dx1.5"	6-10dx1.5"	Sawn DF	2x6 (Nailer)
Right	LBV2.56/11.88	6-10dx1.5"	4-10dx1.5"	2-10dx1.5"	I Joist DF (1.500)	2.5x11.875 DBL
	(* = Web stiffeners required)					

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: 0/12

6'- 0.0"

APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.

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8

RedSpec™ by RedBuilt™
v7.0.16

Project: Solar Decathlon
Location: UNLV
Folder: Roof
Date: 1/15/13 2:56 PM
Designer: Flegel
Comment:

Type: B1

9.5" Red-I45™ @ 24" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	% Allow.	Design	Allow.	DOL - Control		Pass/Fail
Shear (lb)	5%	-121	2544	160% - All Loads		PASS
Positive Moment (ft-lb)	0%	1	3258	90% - Dead Load		PASS
Negative Moment (ft-lb)	3%	-196	5792	160% - All Loads		PASS
DEFLECTIONS (in)	**% Allow.**	**Design**	**Allow.**	**Design**	**Allow.**	**Pass/Fail**
Span Live	4%	-0.013	-0.325	L / 999+	L / 240	PASS
Span Total	3%	-0.012	-0.434	L / 999+	L / 180	PASS

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	0	0
Dead Reaction (lb)	1	1
Total Reaction (lb) (DOL%)	1 (90)	1 (90)
Net Uplift Reaction (lb) (DOL%)	-121 (160)	-121 (160)
Bearing	Flush	Flush
Support	Wall	Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

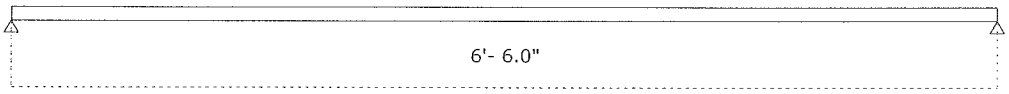
HANGERS	Model	Top	Face	Member	Header	Size
Left	LSSUI25*		9-10d	7-10dx1.5"	LVL DF/SP	1.75x11.875 DBL
Right	LSSUI25*		9-10d	7-10dx1.5"	LVL DF/SP	1.75x11.875 DBL

(* = Web stiffeners required)

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: 0.5/12



APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Roof(125%)	20	15	0	24"	Roof Joist

ADDITIONAL LOADS

Type	Units	DOL	Live	Dead	Location from left	Application	Comment
Uniform	psf	Wind(160%)	-18.7	0.1	0'-0.0" to 6'-6.0"	Replaces	

NOTES

- Building code: IBC. Methodology: Allowable Stress Design
- Birdsmouth and beveled plate conditions require additional consideration.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.
- Sloped length multiplier = 1.001. Bevel cut add = 0.40".

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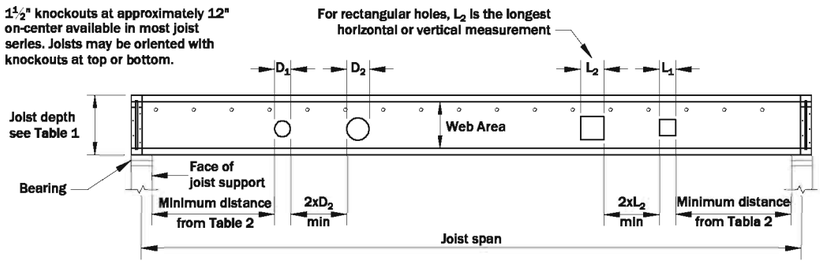
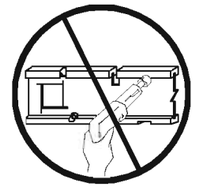
8 ALLOWABLE HOLES





DO NOT cut, drill, or notch flanges

How to determine hole location

1. Determine the joist depth and desired hole size and find hole factor (letter) or hole location (distance) in Table 1. If the table reports a hole factor, proceed to step 2.
2. Refer to Table 2. The dimension shown where the joist span row and hole factor column from Table 1 intersect is the required minimum distance from nearest edge of hole to inside face of support.

General Notes

- Tables are based on:
  -Simple spans.
  -More restrictive of either uniform loads or code-required concentrated loads (2000 lbs over 2½ feet square and over two joists) with 25 psf dead and 20 psf partition load.
- The sizes given in the table are hole sizes, not duct sizes. Rectangular hole sizes are based on measurement of the longest side.
- Multiple holes require spacing 2 times the length of the largest hole.
- For joists continuous over a support, add 1" to distance shown in table for each foot of joist span (see Example below).
- Holes may be located vertically anywhere in the web. Leave ⅛" of web (minimum) at top and bottom of hole.
- Do not cut holes in cantilever eree without consulting your RedBuilt™ representative.

Table 1 - Hole Size Factors and Locations(1)

Round Hole Size	Rectangular Hole Size	Joist Depth									
		11⅞"	14"	16"	18"	20"	22"	24"	26"	28"	30" or 32"
2"	1¼"	A	A	A	*4"*	*4"*	4"	4"	4"	4"	4"
3"	1¾"	*A*	A	A	*1'-3"*	*1'-3"*	1'-3"	4"	4"	4"	4"
4"	2¼"	*B*	B	A	A	A	1'-3"	1'-3"	1'-3"	1'-3"	4"
5"	3"	*C*	C	B	*A*	A	A	A	A	1'-3"	1'-3"
6"	3½"	*E*	C	C	B	B	A	A	A	A	1'-3"
7"	4"		*D*	C	C	B	B	A	A	A	A
8"	4¾"		*E*	D	C	C	B	B	B	A	A
9"	5¼"			E	D	C	C	B	B	B	A
10"	6"			*E*	E	D	C	C	B	B	B
11"	6½"				*E*	D	D	C	C	B	B
12"	7"					E	D	D	C	C	B
13"	7¾"					*E*	E	D	D	C	C
14"	8¼"						E	E	D	D	C
15"	9"							E	D	D	C
16"	9½"							E	E	D	D
17"	10"								E	E	D
18"	10¾"									E	E
19"	11¼"									E	E
20"	12"										E

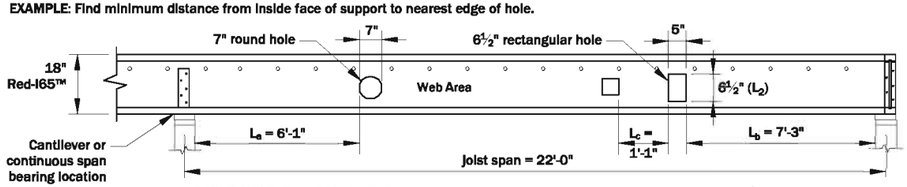
(1) *Bold italic* indicates that for Red-I90HS™ joists, hole factor (letter) values must be increased by one letter and hole locations (distance) must be converted to Hole Factor A. No holes are allowed with Hole Factor E for Red-I90HS™ joists.
(2) Rectangular holes based on measurement of longest side.

Table 2 - Hole Locations(1)

Joist Span	Hole Factor				
	A	B	C	D	E
14'	1'-3"	2'-0"	2'-6"	3'-9"	5'-0"
15'	1'-3"	2'-0"	3'-0"	4'-0"	5'-3"
16'	1'-3"	2'-3"	3'-3"	4'-6"	5'-9"
17'	1'-6"	2'-9"	3'-9"	5'-0"	6'-3"
18'	1'-6"	3'-0"	4'-3"	5'-6"	6'-9"
19'	1'-9"	3'-0"	4'-3"	5'-6"	7'-0"
20'	1'-9"	3'-0"	4'-3"	5'-6"	7'-0"
21'	2'-0"	3'-0"	4'-3"	5'-9"	7'-3"
22'	2'-0"	3'-0"	4'-3"	5'-9"	7'-3"
23'	2'-0"	3'-3"	4'-3"	5'-9"	7'-6"
24'	2'-3"	3'-3"	4'-6"	5'-9"	7'-6"
25'	2'-3"	3'-6"	4'-9"	5'-9"	7'-9"
26'	2'-3"	3'-9"	4'-9"	6'-0"	7'-9"
27'	2'-6"	3'-9"	5'-0"	6'-3"	7'-9"
28'	2'-6"	4'-0"	5'-3"	6'-6"	8'-0"
29'	2'-6"	4'-0"	5'-6"	6'-9"	8'-3"
30'	2'-9"	4'-3"	5'-9"	7'-0"	8'-6"
31'	3'-0"	4'-3"	5'-9"	7'-3"	8'-9"
32'	3'-0"	4'-6"	6'-0"	7'-6"	9'-3"
33'	3'-0"	4'-9"	6'-3"	7'-9"	9'-6"
34'	3'-0"	5'-0"	6'-6"	8'-0"	9'-9"
35'	3'-3"	5'-0"	6'-6"	8'-3"	10'-0"
36'	3'-3"	5'-0"	6'-9"	8'-6"	10'-3"

(1) For Red-I90HS™ joists, add 2 feet to table value.

EXAMPLE: Find minimum distance from inside face of support to nearest edge of hole.



For concentrated loads and other exceptions, contact your RedBuilt™ Representative

Do not cut holes in cantilever without consulting your RedBuilt™ representative

ROUND HOLE: For a 7" hole, find L_a
1. From Table 1, hole factor is C
2. From Table 2, distance is 4'-3"
3. Increase for joist continuity - one inch for each foot of span = 22"; L_a = 4'-3"+22"= 6'-1"

RECTANGULAR HOLES: For a 6½" hole, find L_b and L_c
1. From Table 1, hole factor is E
2. From Table 2, distance L_b is 7'-3". Hole is nearest to an end support, so no distance increase is required.
3. Minimum distance L_c between holes = 2xL_2; L_c = 2x(6½") = 1'-1"

Rev 05/11

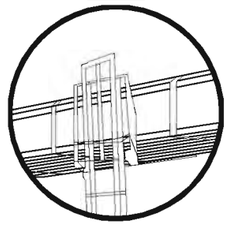
RedBuilt™ Engineered Wood Products

I-JOIST INSTALLATION INFORMATION

ATTENTION BUILDER
Enclosed is IMPORTANT information on how to safely and properly install RedBuilt™ Joists.
Personal injury or death may result from failure to read and follow this information.

1 PRODUCT HANDLING

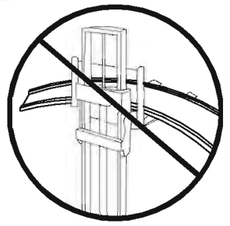
THIS



Lift I-joists from underside only.
DO NOT dump or drop from truck.

NOT THIS

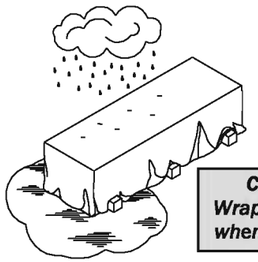
DO NOT lift I-joists by top flange



DO NOT lift I-joists in the flat orientation

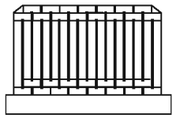
2 PRODUCT STORAGE

THIS



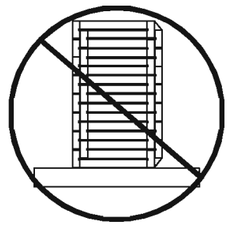
CAUTION
Wrap is slippery when wet or icy.

- Protect products from sun and water.
- Use support blocks at 10' on-center to keep products out of mud and water.



Store and handle joists in vertical orientation. Leave joists banded together until ready to install.

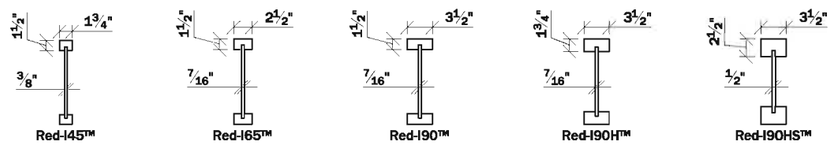
NOT THIS



DO NOT store I-joists in the flat orientation

WARNING
Workers should stay clear when cutting the banding to avoid possible injury from flying banding or toppling joists.

RedBuilt™ Red-I® Product Sections Refer to plan for series and depth



If you have questions or concerns:
Call your RedBuilt™ Representative directly, or for general customer service call (866) 859-6757

3 GENERAL INFORMATION

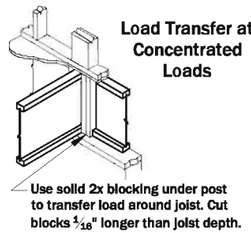
- All nails specified in framing package to be "common" nails unless noted otherwise. Use proper size nails to fill all nail holes in bearing clips, bridging clips, bracing, etc.
- Do not scale drawings: written dimensions take precedence.
- Manufacturer's responsibility is only for the design of the RedBuilt™ products and not for any supporting structure or loads other than indicated herein. All materials shall be supplied by others, unless specifically noted as "by RB" or "by RedBuilt™" herein.

Abbreviation	Term
AFP	Approved for Production
AOR	Architect of Record
CL	Centerline
DBL	Double
DL	Dead Load
EOR	Engineer of Record
FBO	Framing by Others
FOC	Face of Concrete
FOS	Face of Stud
GC	General Contractor
LL	Live Load
LSL	Laminated Strand Lumber
LVL	Laminated Veneer Lumber
OFA	Out for Approval
OW	Open-Web Trusses by RedBuilt™
PLT	Plate
PSL	Parallel Stranded Lumber
RB	RedBuilt™

4 WEB STIFFENER REQUIREMENTS

Web Stiffener Size and Material

Flange Width	Web Stiffener Size	Web Stiffener Material
1¾"	⅝"x2⅝16"	Sheathing (with face grain vertical) that meets the requirements of PS1 or PS2
2½"	1"x2⅝16"	
3½"	2x4	Construction grade or better

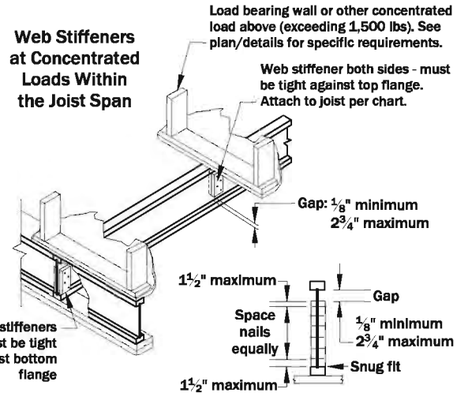


- *Web stiffener requirements vary based on joist series and depth; they are always required at bearing on joists 20" in depth or greater.*
- *See plan/details for requirements specific to the joists being used on this project.*
- *If web stiffeners are required at hanger locations, they must be attached before placing joist in hanger.*

Nailing Quantities for Web Stiffener Attachment

I-Joist Depth	Red-I45™ Joists	Red-I65™ Joists	Red-I90™ & Red-I90H™ Joists		Red-I90HS™ Joists
	8d (2½") Nails	8d (2½") Nails	16d (3½") Nails		16d (3½") Nails
	End or Intermediate	End or Intermediate	End	Intermediate	End or Intermediate
9½"	3	N/A	N/A	N/A	N/A
11⅞"	3	3	3	3	4
14"	3	5	3	3	6
16"	3	6	4	4	6
18"	3	7	4	4	8
20"	3	8	5	5	10
22"	N/A	9	6	11	10
24"	N/A	10	6	13	12
26"	N/A	11	7	14	14
28"	N/A	12	8	15	14
30"	N/A	13	8	17	16
32"	N/A	N/A	9	18	18

Web Stiffeners at Concentrated Loads Within the Joist Span



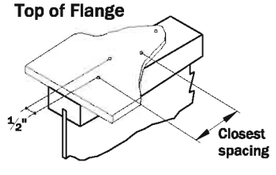
Web Stiffeners at Bearing Points

5 FLANGE AND BEAM NAILING

Nailing pattern to be per contract drawings and specifications. In addition, nail spacing shall comply with the criteria listed.

IMPORTANT
Nailing closer than specified may cause the flange to split.

Top of Flange



Nailing of sheathing

Nail Type	Nail Size	Closest On-Center Spacing Per Row(1)	
		I-Joist Flange(2)	RedLam™ LVL Narrow Face
8d(3)	.113" x 2½"	2"	3"
	.131" x 2½"	2"	3"
10d	.128" x 3"	2"	3"
	.148" x 3"	3"	4"(4)
12d	.128" x 3¼"	2"	3"
	.148" x 3¼"	3"	4"(4)
16d	.135" x 3½"	3"	4"
	.148" x 3¼"	3"	4"(4)
	.162" x 3½"	4"	8"(5)

(1) If more than one row of nails is used, offset rows at least ½" and stagger. Maintain ⅜" minimum edge distance.
(2) Sheathing must be nailed to the full length of the top (or compression) flange on the I-joist with the maximum nail spacing as follows:
- 18" OC for I-joists with flange widths less than 2".
- 24" OC for I-joists with flange widths greater than 2".

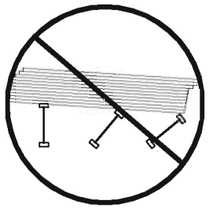
(3) 14-gauge staples may be a direct substitute for 8d (2½") nails if a minimum penetration of 1" into the flange is maintained.
(4) Minimum spacing must be 5" for 4 rows of nails.
(5) Spacing may be reduced to 5" where nail penetration does not exceed 1⅜".

6 INSTALLATION BRACING

DO NOT walk on the joists until all joist bearings and bracing have been permanently attached. Injury may result.

WARNING
Without correctly installed bracing, joists can buckle sideways or roll over, causing death, serious personal injury, or property damage.

NOTICE
Installation bracing and procedures, as well as the safety of workers, are the responsibility of the installer. The installer should make sure that this installation information is understood by all persons involved in the joist installation.



DO NOT stack building materials on unsheathed joists. Stack only over beams or walls.

IMPORTANT
Strut lines must extend to braced end wall, beam or sheathing.

Strut lines (1x4 minimum)
- 6' on-center for joists with 1¾" wide flanges
- 8' on-center for joists with 2½" wide flanges
- 10' on-center for joists with 3½" wide flanges

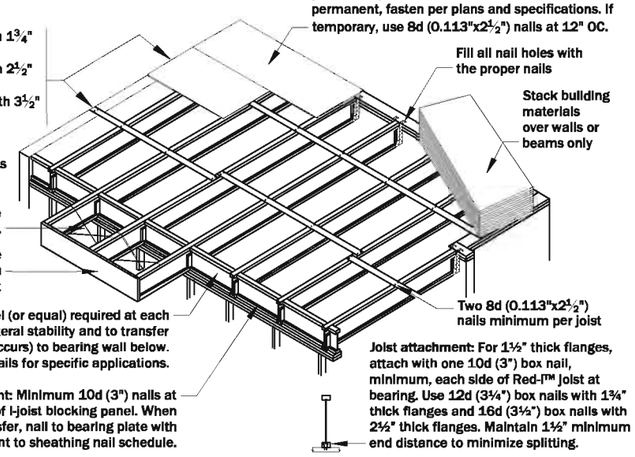
Strut lines are required at all bearing locations where joists are not otherwise braced.

Cantilever bracing may be required. See plan.

Ends of cantilevers must be laterally stabilized with blocking, bracing or rim joist

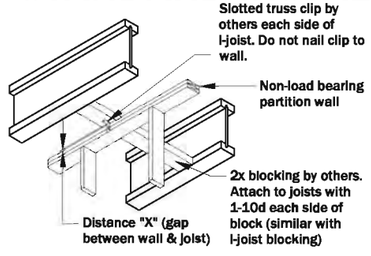
I-joist blocking panel (or equal) required at each side of I-joist for lateral stability and to transfer wall load above (as occurs) to bearing wall below. See plan/details for specific applications.

Blocking attachment: Minimum 10d (3") nails at 12" OC each side of I-joist blocking panel. When used for shear transfer, nail to bearing plate with connections equivalent to sheathing nail schedule.



WARNING
- *All blocking, hangers, rim boards, and rim joists at the end supports of the I-joists must be completely installed and properly nailed.*
- *I-joist flanges must remain straight within ½" from true alignment.*
- *Sheathing must be completely attached to each I-joist before additional loads can be placed on the system.*
- *Without bracing, buckling sideways or rollover is highly probable under light construction loads like a worker or stacked sheathing.*

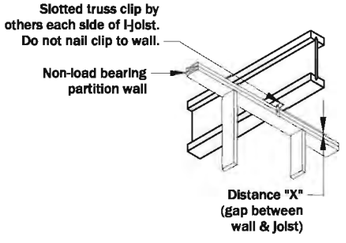
7 STANDARD INSTALLATION DETAILS

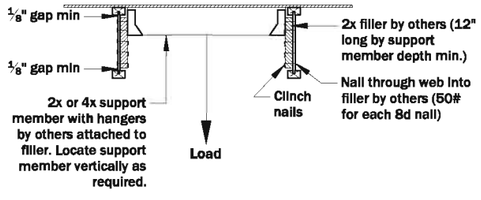


Spacing of clips and blocks per EOR

Distance "X"			
Under Roof		Under Floor	
Span	"X"	Span	"X"
0'-20'	1¼"	0'-20'	¾"
20'-40'	2½"	20'-40'	1¼"
40'-60'	4"	40'-60'	2"

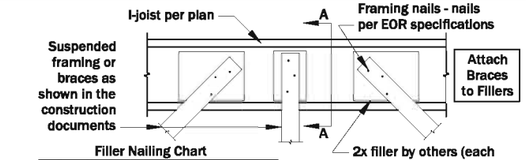
Recommended Attachment for Non-load Bearing Partitions





Note: Use this detail for loads exceeding 250 lbs. per I-joist. A 250 lb. load can be supported on each side of the joist's bottom flange at 5'-0" on center, provided the load is included in normal design loads.

Support Detail for Loads Supported from I-joist



Filler Nailing Chart

Specified Framing Nails	Req'd Filler Nails* (each side)
2-10d	2
4-10d	3
6-10d	5
2-16d	2
4-16d	3
6-16d	5

* Filler nails shall be 16d sinker or 12d common (0.148"Ø, 3¼" long)

Suspended Framing from I-joists

RedBUILT™
Engineered Wood Products

INNOVATION CELEBRATING 50 YEARS EXCELLENCE

Red-I™ Joists

Including Red-I45™, Red-I65™, Red-I90™, Red-I90H™ and Red-I90HS™ Joists

- Lightweight for Fast Installation
- Compatible with Standard Framing
- Available in Long Lengths
- FSC Chain-of-Custody Now Available
- Resists Bowing, Twisting, and Shrinking
- Works with Multiple Spans
- Limited Product Warranty

RedSPEC™
Product Sizing Software

Download your free copy of RedSpec™ here.

Specify Red-I™ Joists for your next project using RedSpec™ single-member sizing software.

TABLE OF CONTENTS

Welcome to RedBuilt™

RedBuilt™ is an exciting business offering building solutions for a broad range of commercial and custom residential applications; pioneering unique manufacturing technologies; and providing world-class service and technical support for architects, specifiers, and builders.

You'll find reliable, innovative products including RedBuilt™ open-web trusses, Red-I™ joists and RedLam™ LVL beams and headers. And you'll work with one service-oriented supplier to get all of these products and the support you need to build smarter.

RedBuilt™: A family of brand-name building products…a source for innovative ideas and solutions…a supplier that's simpler to do business with.

The RedBuilt™ Red-I™ Joist Advantage

Red-I™ joists are lightweight joists suitable for use in roofs and floors in custom residential, multifamily, institutional, and commercial applications. This product is available in multiple series so you can design the most cost-effective system. Other Red-I™ joist benefits include:

- **Dependable Delivery**—RedBuilt™ plants are in key market areas enabling us to deliver materials quickly. Each plant is staffed with experienced personnel who can talk to you about any special requirements and help solve problems.
- **Minimum Waste**—Red-I™ joists are manufactured to resist twisting and shrinking, and they can be cut to size at the factory so there's virtually no time or material waste prior to installation.
- **Compatibility**—All Red-I™ joists fit into wood frame, masonry, or steel construction, and they can accommodate a wide variety of decking and ceiling materials—including wood, plywood, steel, and gypsum.
- **Easy Mechanical Access**—Knockout holes for ventilation and flexible conduit are provided in the web of the Red-I™ joists. The web can also be cut or drilled to accommodate larger ductwork (see pages 19), so costly suspended ceilings can often be eliminated.

ABOUT THIS GUIDE

The RedBuilt™ Red-I45,™ I65, I90, I90H and I90HS Joist Specifier's Guide is one of several guides that offer technical information and design recommendations for RedBuilt™ products. This guide provides architects, designers, and engineers with information regarding Red-I™ joists for commercial and custom residential applications.

Product Selection

This guide provides specifiers with technical information about the RedBuilt™ Red-I™ joist product line. However, you will often find that a variety of products can work in many applications when you consider span, wind or load-carrying capacity, and design constraints. Your local RedBuilt™ technical representative, with support from our Design Centers, can assist you in choosing the best system for your specific application. Contact us for help with any of the following:

- Product selection
- Building department calculations
- Complete cost analysis
- System selection (system packages can include horizontal framing, main carrying beams, headers, wall framing, mansard framing, and accessories)

Products for Every Application

In addition to Red-I™ joists, RedBuilt™ offers a variety of other engineered lumber products that are ideal for use in commercial and custom residential projects. For more information, contact your RedBuilt™ technical representative or visit www.RedBuilt.com to download literature for products such as tapered Red-I™ joists, open-web trusses and RedLam™ LVL.

Unsurpassed Technical Support

RedBuilt™ has one of the largest networks of technical representatives in the business. Their services include consultation, computer-assisted design and layout, delivery coordination, and installation review. They can suggest cost-reduction techniques and check special application requirements. In addition, they're backed by a staff of professional engineers who provide comprehensive technical support when needed. Special requests are accommodated wherever practical, and they offer cost analysis, engineering analysis, assistance with building code approvals—even the creation of special product applications for more creative designs. The goal of RedBuilt™ technical support is to help architects and engineers achieve quality design applications with the most cost-efficient product selection possible.

Our network of technical representatives offers a wide range of services to help guide your projects through planning and construction.

Resource Efficiency

Consider all of the positive attributes of wood when selecting your building material of choice. In addition to its structural properties, high strength-to-weight ratio, and ease of construction, wood is a naturally occurring, renewable resource that requires less energy to produce than steel or concrete. And it sequesters carbon–whether on the stump or in your structure.

Our Red-I™ joists, as well as other RedBuilt™ products, are now available with FSC credits. Whether you're looking for LEED certification or simply because you want to ensure efficient use of raw materials, we can help. By making better use of every tree, RedBuilt™ produces cost-effective, consistently available engineered wood products that reduce environmental impact. The result is a quality wood product that offers superior strength and reliable performance.

FSC®
www.fsc.org
FSC® C002542

The mark of responsible forest management

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DESIGN CENTER SERVICES

Upon request, RedBuilt™ can provide the following services for the products described in this Red-I™ Joist Specifier's Guide:

- A complete design package including layout drawings (placement diagrams) and detailed design calculations.
- Review and analysis of the application.
- Drawings or calculations sealed by a professional engineer.

Installation Review

Although responsibility for proper installation lies with the contractor-builder, RedBuilt™ provides detailed suggestions and guidelines for installation. If requested, a RedBuilt™ representative will visit the site to verify the contractor's understanding of proper installation. RedBuilt™ professional engineers also are available to help solve jobsite application problems.

Our technical support team offers professional capabilities in the design and application of all RedBuilt™ products.

Engineering Responsibility Position Statement

RedBuilt™ is a manufacturer of proprietary structural components.

It employs a staff of professional engineers to aid in the development, manufacture, and marketing of its products. RedBuilt™ does not replace or accept the responsibility of the design professional of record for any structure.

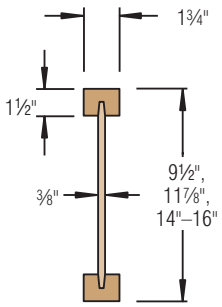
RedBuilt™ accepts the delegation of engineering responsibility only for the products it manufactures, provided that the application conditions are specified by the design professional of record, or other responsible party when a design professional is not engaged. RedBuilt™ provides engineering in the design of its products and does not displace the need on any project for a design professional of record.

RED-I™ JOIST DESCRIPTIONS

This guide covers five series of joists: Red-I45™, Red-I65™, Red-I90™, Red-I90H™ and Red-I90HS™. These joists are primarily intended for commercial applications such as retail stores, office buildings, schools, restaurants, multi-family, hotels, warehouses, and nursing homes. They are typically designed, manufactured, and sold by RedBuilt™ for each specific job. Contact your RedBuilt™ representative for more information.

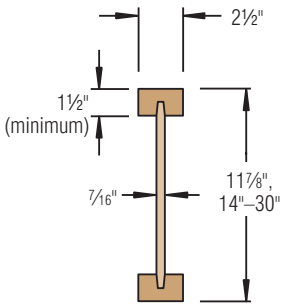
Some series of Red-I™ joists are available with tapered profiles for use in certain roof applications. Contact your RedBuilt™ representative for determining availability and for application assistance.

Red-I™ joists are normally produced without camber. However, camber is available at 2,250' radius as a special order for I45, I65, I90 and I90H series joists. Camber is not recommended for floors, or for multiple-span or cantilever applications.



Red-I45™

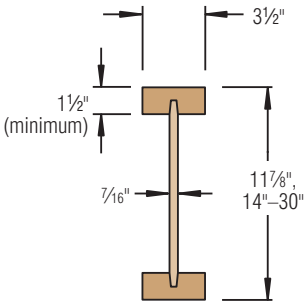
Top and bottom flanges of 1½" x 1¾" RedLam™ LVL with ⅜" OSB web.



Red-I65™

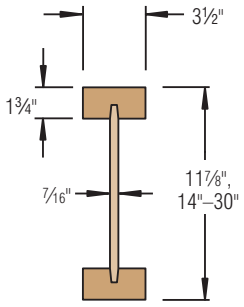
Top and bottom flanges of 1½" (minimum) x 2½" RedLam™ LVL with 7⁄16" OSB web.

- Available in a tapered profile. (Red-I65T™) Check with your technical representative for availability



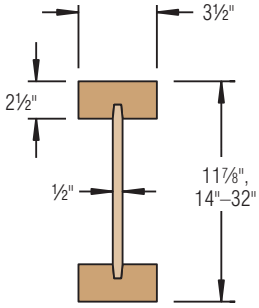
Red-I90™

Top and bottom flanges of 1½" (minimum) x 3½" RedLam™ LVL with 7⁄16" OSB web.



Red-I90H™

Top and bottom flanges of 1¾" x 3½" RedLam™ LVL with 7⁄16" OSB web.



Red-I90HS™

Top and bottom flanges of 2½" x 3½" RedLam™ LVL with ½" OSB web.

- For heavy loads and 8' on-center roof systems
- Increased bending strength and stiffness

Joist depths from 14" to 32" are available in 2" increments.

Building Codes and Product Acceptance: See ICC-ES ESR-2993, ICC-ES ESR-2994
L.A. City RR #25832 and #25833, DSA IR 23-9

Joist Depth	Joist Weight (lbs/ft)	Reference Design Values												
		Moment[1] Mr (ft-lbs)	Shear[2] Vr (lbs)	EI x 10⁶ (in.²-lbs)	EI[3] x 10⁶ Red-I™ Joist with Nailed Floor Sheathing (in.²-lbs)	EI[3] x 10⁶ Red-I™ Joist with Glue-Nailed Floor Sheathing (in.²-lbs)	End Reaction (lbs) [4] [5]				Intermediate Reaction (lbs) [4] [5]			
							Bearing Length				Bearing Length			
							1¾" (2½" for I90HS)		3½"		3½"		5¼"	
							Web Stiffeners[6]		Web Stiffeners[6]		Web Stiffeners[6]		Web Stiffeners[6]	
							No	Yes	No	Yes	No	Yes	No	Yes
Red-I45™ Joist														
9½"	2.2	3,620	1,590	185	221	250	1,015	NA	1,560	NA	2,025	NA	2,575	NA
11⅞"	2.5	4,685	1,785	319	375	420	1,015	1,225	1,560	1,785	2,025	2,385	2,575	2,930
14"	2.8	5,570	1,960	474	553	615	1,015	1,225	1,560	1,915	2,025	2,385	2,575	2,930
16"	3.0	6,390	2,120	653	756	839	1,015	1,225	1,560	1,915	2,025	2,385	2,575	2,930
Red-I65™ Joist														
11⅞"	3.6	6,750	2,255	450	512	561	1,375	1,745	1,885	2,255	2,745	3,120	3,365	3,735
14"	3.9	8,030	2,540	666	752	821	1,375	1,750	1,885	2,505	2,745	3,365	3,365	3,985
16"	4.2	9,210	2,810	913	1,025	1,116	1,375	1,750	1,885	2,625	2,745	3,490	3,365	4,105
18"	4.4	10,380	3,080	1,205	1,348	1,462	1,375	1,750	1,885	2,750	2,745	3,615	3,365	4,230
20"	4.7	11,540	3,345	1,545	1,722	1,864	NA	1,750	NA	2,875	NA	3,740	NA	4,355
22"	5.0	12,690	3,615	1,934	2,149	2,322	NA	1,750	NA	3,000	NA	3,860	NA	4,480
24"	5.3	13,830	3,200	2,374	2,632	2,838	NA	1,750	NA	3,125	NA	3,875	NA	4,605
26"	5.5	14,960	3,200	2,868	3,172	3,416	NA	1,750	NA	3,200	NA	4,725[7]	NA	5,345[8]
28"	5.8	16,085	3,200	3,417	3,772	4,056	NA	1,750	NA	3,200	NA	4,850[7]	NA	5,470[8]
30"	6.1	17,205	3,200	4,025	4,434	4,762	NA	1,750	NA	3,200	NA	4,975[7]	NA	5,590[8]
Red-I90™ Joist														
11⅞"	4.6	9,605	2,255	621	687	741	1,400	1,715	1,885	2,200	3,350	3,665	3,965	4,285
14"	4.9	11,430	2,540	913	1,005	1,079	1,400	1,875	1,885	2,355	3,350	3,825	3,965	4,440
16"	5.2	13,115	2,810	1,246	1,366	1,462	1,400	2,030	1,885	2,515	3,350	3,980	3,965	4,600
18"	5.4	14,785	3,080	1,635	1,786	1,908	1,400	2,030	1,885	2,515	3,350	3,980	3,965	4,600
20"	5.7	16,435	3,345	2,085	2,272	2,422	NA	2,190	NA	2,675	NA	4,140	NA	4,755
22"	6.0	18,075	3,615	2,597	2,824	3,006	NA	2,345	NA	2,830	NA	5,090	NA	5,705
24"	6.3	19,700	3,400	3,172	3,442	3,659	NA	2,345	NA	2,830	NA	5,405	NA	6,020
26"	6.5	21,315	3,400	3,814	4,132	4,387	NA	2,450	NA	2,990	NA	6,180[7]	NA	6,795[8]
28"	6.8	22,915	3,400	4,525	4,895	5,191	NA	2,450	NA	3,145	NA	6,335[7]	NA	6,800[8]
30"	7.1	24,510	3,400	5,306	5,732	6,073	NA	2,450	NA	3,145	NA	6,655[7]	NA	6,800[8]
Red-I90H™ Joist														
11⅞"	4.6	10,960	2,300	687	755	810	1,400	1,715	1,885	2,200	3,495	3,810	4,100	4,420
14"	4.9	13,090	2,600	1,015	1,109	1,185	1,400	1,875	1,885	2,355	3,495	3,970	4,100	4,575
16"	5.2	15,065	2,880	1,389	1,512	1,610	1,400	2,030	1,885	2,515	3,495	4,130	4,100	4,735
18"	5.4	17,010	3,160	1,827	1,982	2,106	1,400	2,030	1,885	2,515	3,495	4,130	4,100	4,735
20"	5.7	18,945	3,445	2,331	2,522	2,676	NA	2,190	NA	2,675	NA	4,285	NA	4,890
22"	6.0	20,855	3,725	2,904	3,136	3,321	NA	2,345	NA	2,830	NA	5,235	NA	5,840
24"	6.3	22,755	3,800	3,549	3,825	4,046	NA	2,345	NA	2,830	NA	5,425	NA	6,155
26"	6.5	24,645	3,800	4,266	4,590	4,850	NA	2,450	NA	2,990	NA	6,315[7]	NA	6,920[8]
28"	6.8	26,520	3,800	5,059	5,436	5,737	NA	2,450	NA	3,145	NA	6,470[7]	NA	7,080[8]
30"	7.1	28,380	3,800	5,930	6,363	6,710	NA	2,450	NA	3,145	NA	6,790[7]	NA	7,395[8]
Red-I90HS™ Joist														
11⅞"	6.0	16,050	2,320	900	974	1,034	1,835	2,320	2,150	2,320	3,995	4,650	4,690	5,345
14"	6.3	19,425	2,565	1,355	1,457	1,538	1,835	2,565	2,150	2,565	3,995	4,980	4,690	5,670
16"	6.6	22,550	2,790	1,876	2,008	2,113	1,835	2,790	2,150	2,790	3,995	4,980	4,690	5,670
18"	7.0	25,640	3,020	2,488	2,654	2,787	1,835	3,020	2,150	3,020	3,995	5,310	4,690	6,000
20"	7.3	28,695	3,250	3,195	3,399	3,562	NA	3,250	NA	3,250	NA	5,425	NA	6,330
22"	7.6	31,725	3,480	3,998	4,244	4,442	NA	3,475	NA	3,480	NA	5,425	NA	6,330
24"	7.9	34,730	3,710	4,901	5,194	5,428	NA	3,500	NA	3,710	NA	5,425	NA	6,655
26"	8.2	37,715	3,940	5,905	6,249	6,523	NA	3,500	NA	3,940	NA	6,985[7]	NA	7,675[8]
28"	8.5	40,680	4,165	7,014	7,412	7,730	NA	3,500	NA	4,165	NA	6,985[7]	NA	7,675[8]
30"	8.8	43,630	4,375	8,230	8,687	9,052	NA	3,500	NA	4,375	NA	7,310[7]	NA	8,005[8]
32"	9.1	46,560	4,375	9,555	10,075	10,490	NA	3,500	NA	4,375	NA	7,640[7]	NA	8,335[8]

- The stated allowable design properties are for loads of normal duration. Adjustments to the allowable design values shall be in accordance with the applicable code.

(1) Do not increase joist resistive moment properties by a repetitive-member-use factor.

(2) For possible increases in shear capacity see below.

(3) For deflection calculation only. Assumes 24" joist spacing with a 24" span-rated panel.

(4) Interpolation between bearing lengths is permitted for allowable design reactions.

(5) Reaction capacity has been determined based on RedBuilt™ products. Allowable bearing on supporting members shall be checked.

(6) Refer to page 16 for web stiffener details.

(7) 5¼" bearing length is required at intermediate reactions.

(8) 7" bearing length is required at intermediate reactions.

Red-I™ Joist Shear Design

When joists are used as simple-span members, the design shear is equal to the shear at the face of the support.

When joists **up to 24" in depth** are used as multiple-span members, the design shear is the calculated shear at the interior support reduced by the following:

$$R = \frac{W}{\left(\frac{V_{12}}{100}\right)} \leq 18\%$$

Where: R is the percent reduction
W is uniform load in plf
V_{12} is the reference design shear for an 11⅞" deep joist (lbs.)

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Load Table Instructions

To size floor joists:

- Calculate total load and live load in pounds per linear foot (plf).
- Check both total load (100% TL) and live load (100% LL). Live load (100% LL) values may be increased with a glue-nailed floor system, contact your RedBuilt™ representative for assistance.

To size roof joists:

- Calculate total load in pounds per linear foot (plf).
- Check the appropriate snow load area (115% TL) value or non-snow load area (125% TL) value to determine the maximum allowable total load.

Consult local codes to verify deflection limits required for specific applications.

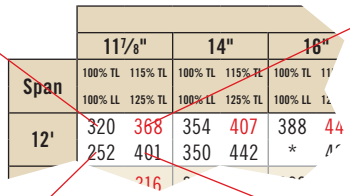
Visit www.RedBuilt.com to find your local representative.

General Notes

- Values shown are maximum allowable load capacities based on the following assumptions:
  - Simple span; horizontal clear distance between supports.
  - Uniformly loaded conditions with 2½" bearing length. Web stiffeners are assumed for joist depths greater than 9½". Other capacities may be possible with different criteria; contact your RedBuilt™ representative.
  - Positive drainage in roof applications (¼" per foot slope minimum).
  - Composite action is not considered for deflection.
  - **Floor Total Load** deflection limit is L/240.
  - **Floor Live Load** deflection limit is based on commercial deflection criteria shown on page 20.
  - **Roof Total Load** deflection limit is L/180.
- Camber (2,250' radius) is available for simple-span applications only (not available for I90HS). **Contact your RedBuilt™ representative for availability.**
- For span or loading conditions not covered by these tables (such as multiple spans or concentrated loads), contact your RedBuilt™ representative for assistance.

100% TL (Total Load)

Use this and the 100% LL to select floor member. This is the maximum allowable total load in pounds per linear foot of joist. Values are limited by deflection equal to L/240 at total load.



115% TL (Total Load)

Use this to select roof member in snow load areas. This is the maximum allowable total load in pounds per linear foot of joist. Values are limited by deflection equal to L/180 at total load.

100% LL (Live Load)

Use this and the 100% TL to select floor member. This number is the maximum allowable live load capacity in pounds per linear foot of joist. Value is based on the **Commercial Floor Deflection Limit** shown on page 20.

125% TL (Total Load)

Use this to select roof member in non-snow load areas. This is the maximum allowable total load in pounds per linear foot of joist. Values are limited by deflection equal to L/180 at total load.

Red-I45™ Allowable Uniform Load (PLF)

Span	Depth							
	9½"		11⅞"		14"		16"	
	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL
10'	245 160	282 307	288 257	331 360	299 *	344 373	299 *	344 373
12'	195 98	224 244	240 162	276 301	249 230	287 312	249 *	287 312
14'	129 64	165 173	186 107	214 233	214 154	246 268	214 205	246 268
16'	89 44	119 119	143 74	164 179	170 106	196 213	188 143	216 235
18'	64 28	85 85	107 47	130 141	135 69	155 168	154 92	178 193
20'		63 63	80 32	105 106	109 46	126 136	125 63	144 157
22'		48 48		81 81	89 35	104 113	104 48	119 130

* Indicates that total load (TL) value controls.

- Red numbers refer to 115% total load (TL).

Red-I65™ Allowable Uniform Load (PLF)

Span	Depth																	
	11⅞"		14"		16"		18"		20"		22"		24"		26"		28"		30"	
	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL
10'	386 347	444 482	407 *	469 509	418 *	480 522	428 *	492 535	439 *	504 548	449 *	517 562	460 *	529 575	466 *	536 583	466 *	536 583	466 *	536 583
12'	322 220	371 403	340 310	391 426	349 *	401 436	358 *	411 447	366 *	421 458	375 *	432 469	384 *	442 480	389 *	448 487	389 *	448 487	389 *	448 487
14'	269 147	309 336	292 210	336 365	300 277	345 375	307 *	353 384	315 *	362 393	322 *	371 403	330 *	379 412	334 *	385 418	334 *	385 418	334 *	385 418
16'	206 102	237 258	245 146	282 307	262 194	302 328	269 249	309 336	276 *	317 345	282 *	325 353	289 *	332 361	293 *	337 366	293 *	337 366	293 *	337 366
18'	149 65	188 199	194 94	223 243	223 126	256 279	239 163	275 299	245 204	282 307	251 248	289 314	257 *	296 321	261 *	300 326	261 *	300 326	261 *	300 326
20'	111 44	148 148	157 64	181 197	181 86	208 226	204 112	234 255	221 140	254 276	226 172	260 283	231 206	266 289	235 *	270 293	235 *	270 293	235 *	270 293
22'	85 34	113 113	123 49	150 163	149 66	172 187	168 86	194 211	187 108	216 234	206 133	237 257	211 161	242 263	213 190	246 267	213 *	246 267	213 *	246 267
24'		88 88	96 38	126 129	126 52	145 157	142 68	163 177	158 85	181 197	173 105	199 217	189 127	217 236	196 151	225 245	196 177	225 245	196 *	225 245
26'		70 70	77 30	102 102	104 41	123 134	121 54	139 151	134 68	155 168	148 84	170 185	161 102	185 201	174 122	201 218	181 143	208 226	181 166	208 226
28'		56 56		83 83	84 33	106 112	104 44	120 130	116 55	133 145	127 69	147 159	139 83	160 174	150 100	173 188	162 117	186 202	168 136	193 210
30'		46 46		68 68		92 92	90 36	104 114	101 46	116 126	111 57	128 139	121 69	139 151	131 82	151 164	141 97	162 176	151 113	173 189
32'		38 38		56 56		77 77	75 30	92 100	89 38	102 111	98 47	112 122	106 57	122 133	115 69	133 144	124 81	143 155	133 95	152 166
34'		32 32		47 47		64 64		81 84	79 32	90 98	86 40	100 108	94 48	108 118	102 58	117 128	110 68	126 137	117 80	135 147
36'				40 40		54 54		71 71		81 88	77 34	89 97	84 41	97 105	91 49	105 114	98 58	113 122	105 68	121 131
38'				34 34		46 46		61 61		72 78	69 29	80 87	75 35	87 94	82 42	94 102	88 50	101 110	94 58	108 118
40'				29 29		40 40		52 52		65 67		72 78	68 30	78 85	74 36	85 92	79 43	91 99	85 50	98 106

* Indicates that total load (TL) value controls.

- Red numbers refer to 115% total load (TL).

LOAD TABLES

Red-I90™ Allowable Uniform Load (PLF)

Span	Depth																			
	11⅞"		14"		16"		18"		20"		22"		24"		26"		28"		30"	
	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL
14'	271 192	312 339	293 268	337 367	315 *	363 394	315 *	363 394	338 *	389 423	360 *	414 450	360 *	414 450	378 *	435 473	387 *	446 484	387 *	446 484
16'	237 134	273 297	257 189	296 321	276 249	318 346	276 *	318 346	296 *	341 370	315 *	363 394	315 *	363 394	331 *	381 414	339 *	390 424	339 *	390 424
18'	198 87	243 264	229 124	263 286	246 164	283 307	246 209	283 307	263 258	303 329	281 *	323 351	281 *	323 351	295 *	339 369	302 *	347 378	302 *	347 378
20'	148 59	198 198	206 85	237 257	221 113	255 277	221 144	255 277	237 179	273 297	253 217	291 316	253 *	291 316	265 *	305 332	272 *	313 340	272 *	313 340
22'	114 45	152 152	164 65	214 219	201 87	232 252	201 112	232 252	216 140	248 270	230 170	264 287	230 203	264 287	241 239	278 302	247 *	285 309	247 *	285 309
24'	89 35	119 119	129 51	172 172	172 69	206 224	185 89	212 231	198 111	228 248	211 135	242 264	211 162	242 264	221 191	255 277	227 222	261 284	227 *	261 284
26'	71 28	95 95	103 41	137 137	138 55	176 184	171 71	196 213	183 89	210 229	195 109	224 243	195 131	224 243	204 155	235 256	210 181	241 262	210 208	241 262
28'		77 77	83 33	111 111	112 45	150 150	145 58	171 186	165 73	190 207	181 89	208 226	181 108	208 226	190 127	218 237	195 149	224 243	195 172	224 243
30'		63 63		91 91	92 37	123 123	120 48	149 160	144 60	166 180	158 74	182 198	169 89	194 211	177 106	204 222	182 124	209 227	182 143	209 227
32'		52 52		76 76	77 30	103 103	100 40	131 133	126 50	146 158	139 62	160 174	152 75	175 190	164 89	189 206	170 104	196 213	170 120	196 213
34'		44 44		64 64		86 86	84 33	112 112	106 42	129 140	123 52	142 154	135 63	155 168	146 75	167 182	157 88	180 196	160 102	184 201
36'		37 37		54 54		73 73	71 28	95 95	90 36	115 120	110 44	127 138	120 54	138 150	130 64	149 162	140 75	161 175	149 87	172 187
38'		31 31		46 46		63 63		82 82	77 31	103 103	95 38	114 124	108 46	124 135	117 55	134 146	125 65	144 157	134 75	154 168
40'				40 40		54 54		70 70		89 89	82 33	103 110	97 40	112 122	105 47	121 132	113 56	130 142	121 65	139 151
42'				34 34		47 47		61 61		77 77	72 28	93 96	87 34	101 110	95 41	110 119	103 49	118 128	110 57	126 137

Red-I90H™ Allowable Uniform Load (PLF)

Span	Depth																			
	11⅞"		14"		16"		18"		20"		22"		24"		26"		28"		30"	
	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL	100% TL / 100% LL	115% TL / 125% TL
14'	271 208	312 339	293 290	337 367	315 *	363 394	315 *	363 394	338 *	389 423	360 *	414 450	360 *	414 450	378 *	435 473	387 *	446 484	387 *	446 484
16'	237 146	273 297	257 206	296 321	276 270	318 346	276 *	318 346	296 *	341 370	315 *	363 394	315 *	363 394	331 *	381 414	339 *	390 424	339 *	390 424
18'	211 95	243 264	229 135	263 286	246 179	283 307	246 227	283 307	263 *	303 329	281 *	323 351	281 *	323 351	295 *	339 369	302 *	347 378	302 *	347 378
20'	162 65	217 217	206 93	237 257	221 123	255 277	221 158	255 277	237 196	273 297	253 237	291 316	253 *	291 316	265 *	305 332	272 *	313 340	272 *	313 340
22'	125 50	167 167	180 72	215 234	201 96	232 252	201 123	232 252	216 153	248 270	230 186	264 287	230 222	264 287	241 *	278 302	247 *	285 309	247 *	285 309
24'	98 39	131 131	142 56	189 189	185 76	212 231	185 97	212 231	198 122	228 248	211 149	242 264	211 178	242 264	221 209	255 277	227 *	261 284	227 *	261 284
26'	78 31	104 104	113 45	151 151	152 61	196 203	171 78	196 213	183 98	210 229	195 120	224 243	195 144	224 243	204 170	235 256	210 198	241 262	210 *	241 262
28'		84 84	92 36	123 123	124 49	165 165	158 64	182 198	170 80	195 212	181 98	208 226	181 118	208 226	190 140	218 237	195 163	224 243	195 188	224 243
30'		69 69	76 30	101 101	102 41	136 136	132 53	170 177	158 66	182 198	169 82	194 211	169 98	194 211	177 116	204 222	182 136	209 227	182 157	209 227
32'		57 57		84 84	85 34	114 114	111 44	148 148	139 55	168 183	158 68	182 198	158 82	182 198	166 98	191 208	170 114	196 213	170 132	196 213
34'		48 48		70 70	71 28	95 95	93 37	124 124	118 47	149 157	142 58	164 178	149 70	171 186	156 83	180 196	160 97	184 201	160 112	184 201
36'		41 41		60 60		81 81	79 31	106 106	100 40	133 133	123 49	146 159	139 59	160 173	148 71	170 185	151 83	174 189	151 96	174 189
38'		35 35		51 51		69 69		90 90	86 34	114 114	106 42	131 141	124 51	143 156	135 61	155 169	143 71	165 179	143 83	165 179
40'		30 30		44 44		60 60		78 78	74 29	99 99	92 36	118 122	111 44	129 141	122 53	140 152	131 62	151 164	136 72	157 171
42'				38 38		52 52		68 68		86 86	80 32	106 106	97 38	117 127	110 46	127 138	119 54	137 149	127 63	146 159

* Indicates total load (TL) value controls.

▪ Red numbers refer to 115% total load (TL).

See Load Table Instructions and General Notes on page 6

Red-I90HS™ Allowable Uniform Load (PLF)

Span	Depth																					
	11⅞"		14"		16"		18"		20"		22"		24"		26"		28"		30"		32"	
	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL	100% TL	115% TL
	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL	100% LL	125% TL
14'	327	376	362	416	393	452	426	490	458	527	490	564	494	568	494	568	494	568	494	568	494	568
	263	409	*	452	*	492	*	532	*	573	*	613	*	617	*	617	*	617	*	617	*	617
16'	287	330	317	364	345	396	373	429	402	462	429	494	432	497	432	497	432	497	432	497	432	497
	186	358	265	396	*	431	*	467	*	502	*	537	*	541	*	541	*	541	*	541	*	541
18'	255	293	282	324	307	353	332	382	357	411	382	439	385	443	385	443	385	443	385	443	385	443
	121	319	175	352	232	383	295	415	*	447	*	478	*	481	*	481	*	481	*	481	*	481
20'	209	264	254	292	276	318	299	344	322	370	344	396	347	399	347	399	347	399	347	399	347	399
	83	278	121	317	161	345	207	374	256	402	310	430	*	433	*	433	*	433	*	433	*	433
22'	161	215	231	266	251	289	272	313	293	337	313	360	315	363	315	363	315	363	315	363	315	363
	64	215	94	289	126	314	162	340	202	366	245	391	292	394	*	394	*	394	*	394	*	394
24'	127	169	185	244	230	265	249	287	268	309	287	330	289	333	289	333	289	333	289	333	289	333
	50	169	74	247	100	288	129	312	161	336	197	359	235	362	276	362	*	362	*	362	*	362
26'	101	135	149	199	201	245	230	265	248	285	265	305	267	307	267	307	267	307	267	307	267	307
	40	135	59	199	80	266	104	288	131	310	160	332	192	334	226	334	262	334	*	334	*	334
28'	82	109	121	162	164	219	214	246	230	265	246	283	248	285	248	285	248	285	248	285	248	285
	32	109	48	162	65	219	85	268	107	288	132	308	158	310	187	310	217	310	*	310	*	310
30'		90	100	133	136	181	177	230	215	247	230	264	232	266	232	266	232	266	232	266	232	266
		90	40	133	54	181	70	236	89	269	109	287	132	290	156	290	182	290	210	290	*	290
32'		75	83	111	113	151	148	197	187	232	216	248	217	250	217	250	217	250	217	250	217	250
		75	33	111	45	151	59	197	75	250	92	270	111	272	131	272	154	272	177	272	203	272
34'		63	70	93	95	127	125	167	158	211	195	233	204	235	204	235	204	235	204	235	204	235
		63	28	93	38	127	50	167	63	211	78	254	94	256	112	256	131	256	151	256	173	256
36'		53		79	81	108	106	142	135	180	167	220	193	222	193	222	193	222	193	222	193	222
		53		79	32	108	42	142	54	180	66	222	80	241	96	241	112	241	130	241	149	241
38'		45		68		93	91	122	116	155	143	191	174	210	183	210	183	210	183	210	183	210
		45		68		93	36	122	46	155	57	191	69	229	82	229	97	229	112	229	129	229
40'		39		58		80	79	105	100	134	124	166	151	198	174	200	174	200	174	200	174	200
		39		58		80	31	105	40	134	49	166	60	201	71	217	84	217	98	217	112	217
42'		34		51		70		91	87	116	108	144	131	175	157	190	166	190	166	190	166	190
		34		51		70		91	35	116	43	144	52	175	62	207	73	207	85	207	98	207
44'		29		44		61		80	76	102	95	126	115	154	138	177	158	182	158	182	158	182
		29		44		61		80	30	102	38	126	46	154	55	184	64	198	75	198	86	198
46'				39		53		70		90	83	111	101	135	121	162	143	174	151	174	151	174
				39		53		70		90	33	111	40	135	48	162	57	189	66	189	76	189
48'				34		47		62		79	74	99	90	120	108	144	127	161	145	167	145	167
				34		47		62		79	29	99	36	120	43	144	50	169	59	181	68	181
50'				30		42		55		70		88	80	107	96	128	113	148	132	159	139	160
				30		42		55		70		88	32	107	38	128	45	151	52	173	60	174

* Indicates that total load (TL) value controls.

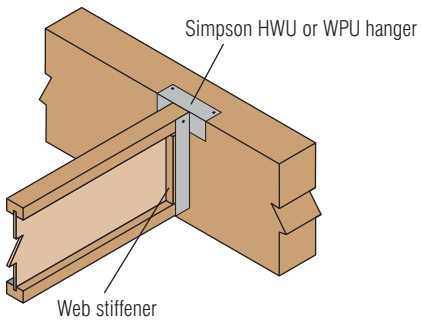
- Red numbers refer to 115% total load (TL).

See Load Table Instructions and General Notes on page 6

8' ON-CENTER ROOF SPAN TABLE

Red-I90HS™ Joist 8' On-Center Roof Span

Joist Depth	12 PSF Dead Load	14 PSF Dead Load	16 PSF Dead Load
16"	27'- 0"	26'- 0"	24'- 5"
18"	29'- 9"	28'- 5"	26'- 7"
20"	32'- 7"	31'- 0"	28'- 11"
22"	35'- 3"	33'- 7"	31'- 4"
24"	38'- 0"	36'- 3"	33'- 9"
26"	40'- 2"	38'- 9"	36'- 3"
28"	41'- 11"	40'- 4"	37'- 10"
30"	43'- 7"	42'- 0"	39'- 0"
32"	45'- 3"	***42'- 2"***	***39'- 0"***

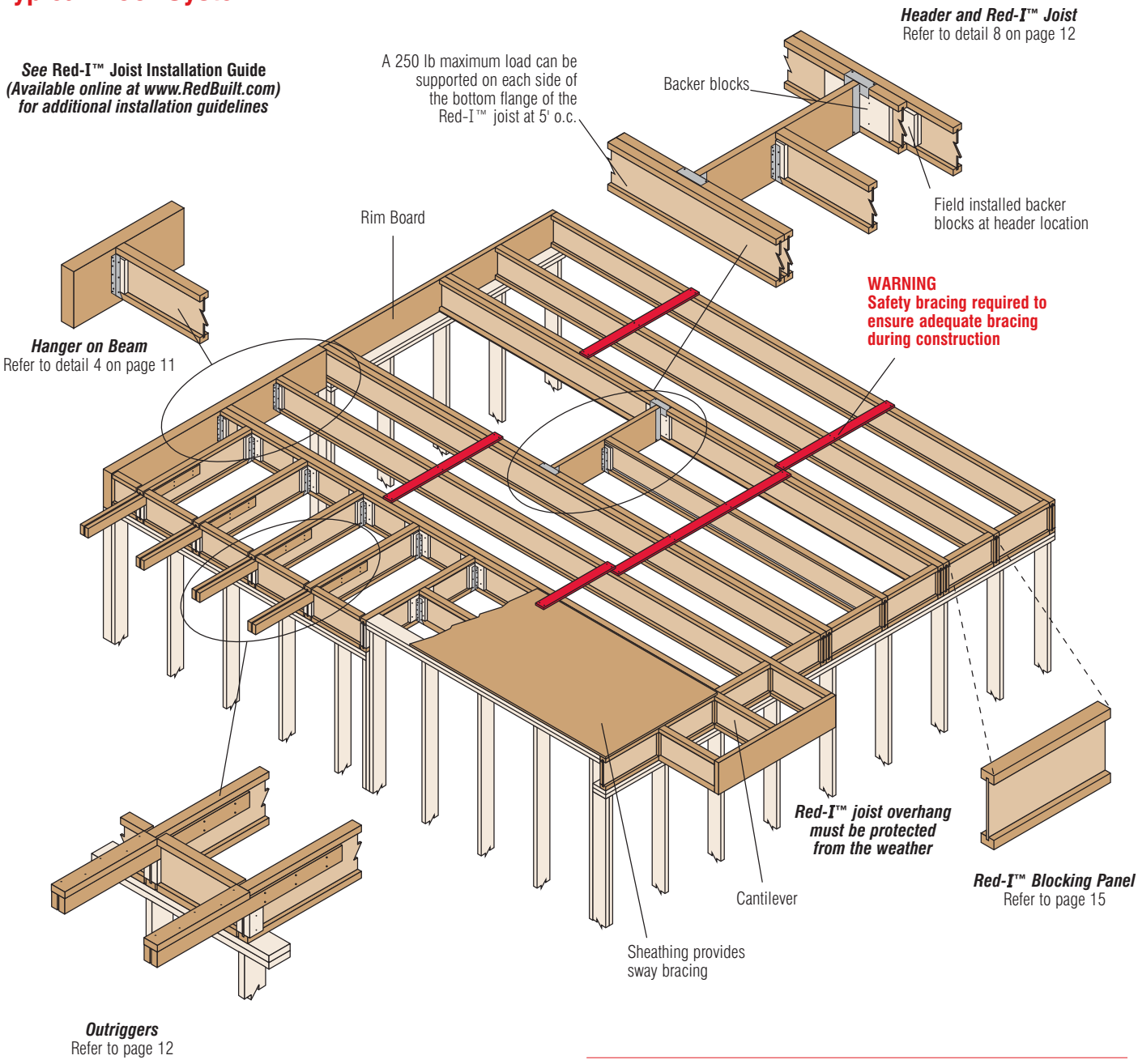


General Notes

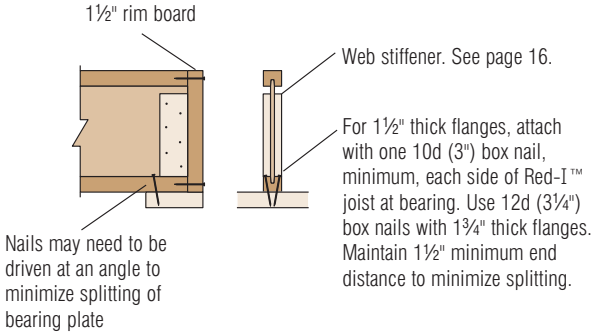
- Table assumes uniformly loaded, simple-span joists.
- Roof live load is 20 psf with live load reductions applied per 2009 IBC Section 1607.11.2.
- Red-I™ joists are spaced at 8' on-center.
- Spans are limited by total load deflection of L/180.
- Span is defined as horizontal clear distance between inside face of beam/wall supports. Spans reflect 125% duration of load adjustment.
- Roof is assumed to be sloped ¼" per foot.
- Reaction based on 3" minimum bearing length and web stiffeners. See web stiffener information on page 16.
- ***Bold italic*** numbers indicate span may be increased by 1 foot when HWU hanger is used.
- Fill all nail holes in hanger. Use 10d (3") common nails into joists and 16d (3½") common nails into header.

FLOOR DETAILS

Typical Floor System



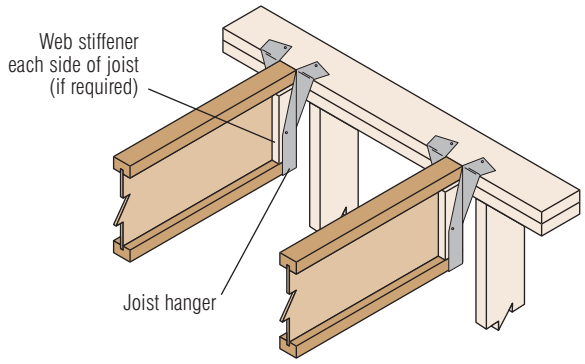
1 Nailing Red-I™ Joist to Bearing Plate



General Notes

- Details shown on pages 10–14 are conceptual. Attachments and connections shall be made to the supporting structure in accordance with the specific design requirements.
- Rim board or Red-I™ blocking panels (or an equivalent alternative) must always be used to prevent rollover and to provide structural attachment of the deck sheathing to the supporting structure in accordance with the specific design requirements.

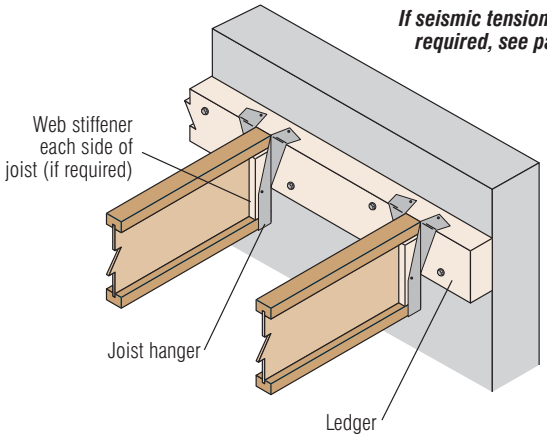
2 Hanger on Stud Wall



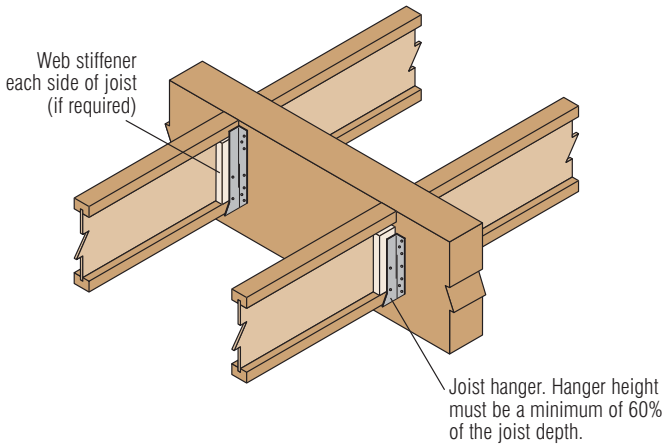
The potential for top plate rotation may reduce hanger capacities. Contact RedBuilt™ for assistance.

3 Hanger on Ledger

If seismic tension ties are required, see page 17

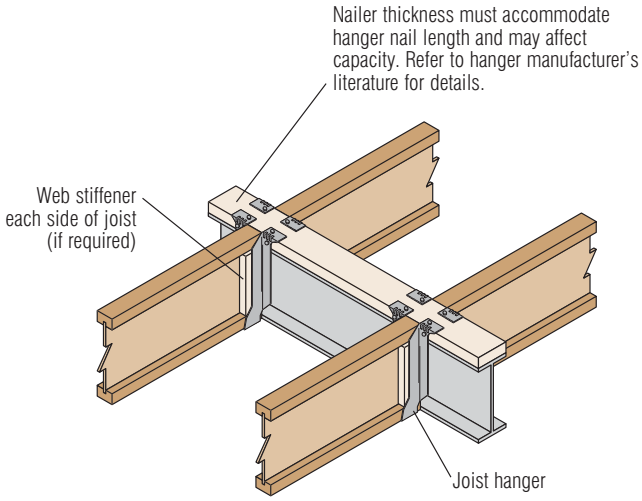


4 Hanger on Beam



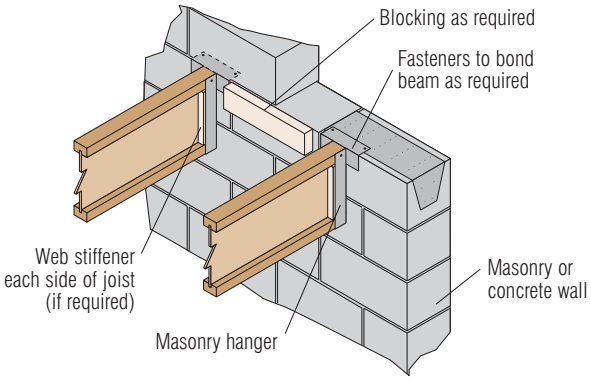
Web stiffeners are required if the sides of the hanger do not laterally support at least ⅜" of the Red-I™ joist top flange

5 Hanger on Steel Beam



6 Hanger on Masonry Wall

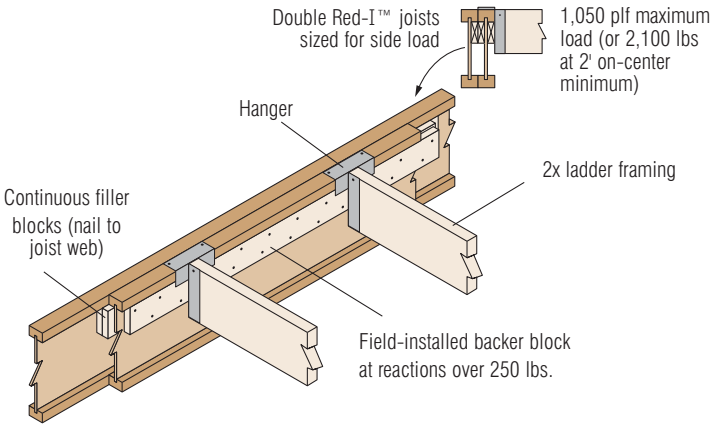
If seismic tension ties are required, see page 17



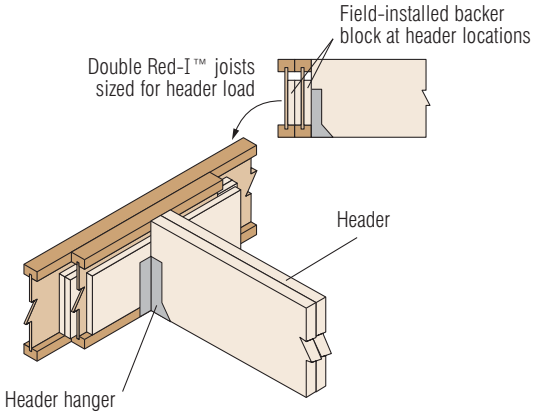
Traditional masonry hangers will not support construction loads without a minimum amount of cured masonry construction above hanger level. Refer to hanger manufacturer's literature for information on the correct installation and use of masonry hangers.

FLOOR DETAILS

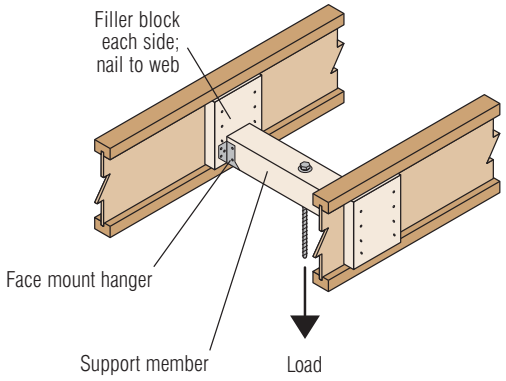
7 Side-Loaded Double Joist
(Ladder Framing)



8 Side-Loaded Double Joist
(Header Location)



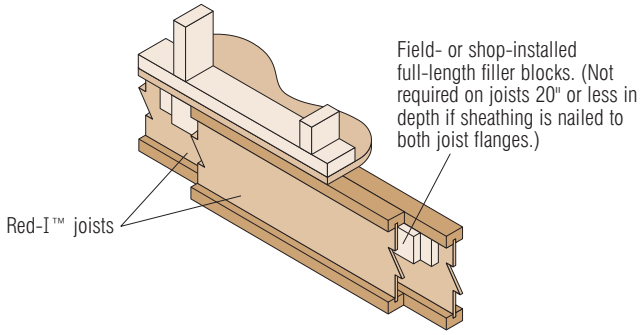
9 Support Detail



A 250 lb maximum load can be supported on each side of the Red-I™ joist bottom flange at 5' on-center, provided the load is included in normal design loads. Use this detail for loads exceeding these limits.

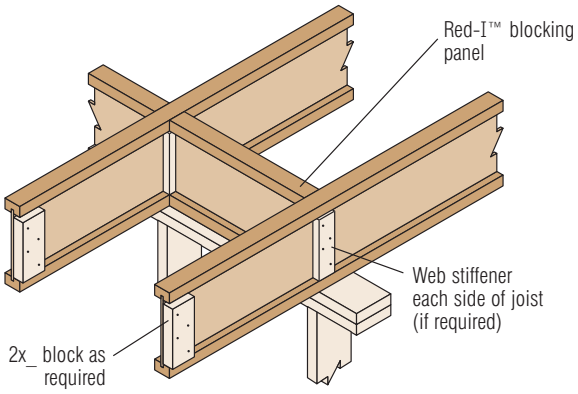
***For additional information on supporting hanging loads and sprinkler systems, see the* Sprinkler System Installation Guide (Available online at www.RedBuilt.com).**

10 Top-Loaded Double Joist



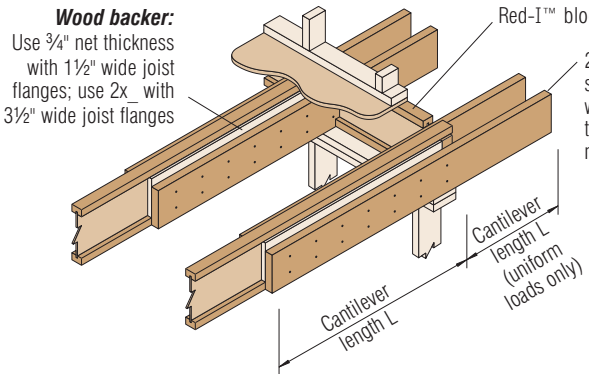
CANTILEVERS AND OUTRIGGERS

11 Red-I™ Joist Cantilever



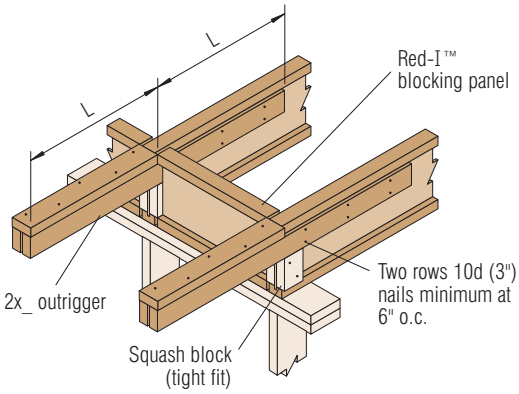
Red-I™ joists are intended for dry-use applications

12a Cantilevers
(Field Assembled Only)



Red-I™ joists and cantilevers/outriggers are intended for dry-use applications

12b Outriggers
(Available as Plant Asembled)



Double application shown in details 12 & 13. Single application is similar. See general notes regarding allowable loads.

Double 2x_ Capacities

Cantilever/ Outrigger Length L	Allowable Uniform Loads (plf)														
	Solid Sawn Lumber														
	Two 2x4			Two 2x6			Two 2x8			Two 2x10			Two 2x12		
	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof
24"	342	393	427	393	451	491	393	451	491	393	451	491	393	451	491
30"	219	251	273	384	441	***480***	384	441	***480***	384	441	***480***	384	441	***480***
36"	152	174	189	323	371	***403***	***378***	***435***	***473***	***378***	***435***	***473***	***378***	***435***	***473***
42"	111	128	139	237	272	295	***374***	***430***	***467***	***374***	***430***	***467***	***374***	***430***	***467***
48"	77	97	106	181	208	225	289	***330***	***358***	***371***	***426***	***463***	***371***	***426***	***463***
54"	54	77	83	143	163	177	227	260	***281***	***337***	***384***	***414***	***368***	***424***	***460***
60"		62	63	115	132	143	183	209	227	***271***	***308***	***332***	***362***	***410***	***441***
66"			47	95	109	118	151	172	186	***222***	***252***	***271***	***296***	***335***	***359***
72"				79	91	99	126	144	156	186	***210***	***226***	***246***	***277***	***295***
78"				68	77	84	107	122	132	157	178	***190***	***207***	***232***	***246***
84"				56	66	72	92	105	113	135	152	162	***177***	***197***	***208***
90"					57	62	80	91	97	116	131	139	153	***169***	***178***
96"					50	54	70	79	85	102	114	121	133	146	***153***
Cantilever/ Outrigger Length L	**RedLam™ LVL**														
	Two 2x4			Two 2x6			Two 2x8			Two 2x10			Two 2x12		
	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof	Floor	Snow Roof	Non-Snow Roof
24"	393	451	491	393	451	491	393	451	491	393	451	491	393	451	491
30"	292	441	***467***	384	441	***480***	384	441	***480***	384	441	***480***	384	441	***480***
36"	173	277	277	***378***	***435***	***473***	***378***	***435***	***473***	***378***	***435***	***473***	***378***	***435***	***473***
42"	110	177	177	***374***	***430***	***467***	***374***	***430***	***467***	***374***	***430***	***467***	***374***	***430***	***467***
48"	74	119	119	***277***	***417***	***444***	***371***	***426***	***463***	***371***	***426***	***463***	***371***	***426***	***463***
54"	53	84	84	***198***	***317***	***317***	***368***	***424***	***460***	***368***	***424***	***460***	***368***	***424***	***460***
60"		62	62	146	***233***	***233***	***322***	***421***	***456***	***366***	***421***	***458***	***366***	***421***	***458***
66"		46	46	110	177	***177***	***246***	***348***	***371***	***365***	***419***	***456***	***365***	***419***	***456***
72"		36	36	85	137	137	***191***	***288***	***306***	***363***	***410***	***425***	***363***	***418***	***454***
78"				67	108	108	***152***	***242***	***243***	***306***	***339***	***350***	***362***	***417***	***425***
84"				54	87	87	***122***	***196***	***196***	***247***	***283***	***291***	***334***	***346***	***351***
90"					71	71	100	***160***	***160***	***203***	***238***	***244***	***281***	***289***	***293***
96"					58	58	83	***132***	***132***	***168***	***202***	***206***	***238***	***245***	***247***

General Notes

- ***Bold Italic*** cells indicate a single 2x can be used; use half of the allowable load shown for double 2x members. For all other cells single 2x members are not permitted.
- Members have been evaluated for 300 lb. point load.

Table is based on:

Solid Sawn

F_v = 175 psi
F_b = 900 psi(1)
E = 1.6 x 10^6 psi

RedLam™ LVL

F_v = 285 psi
F_b = 2140 psi(2)
E = 1.6 x 10^6 psi

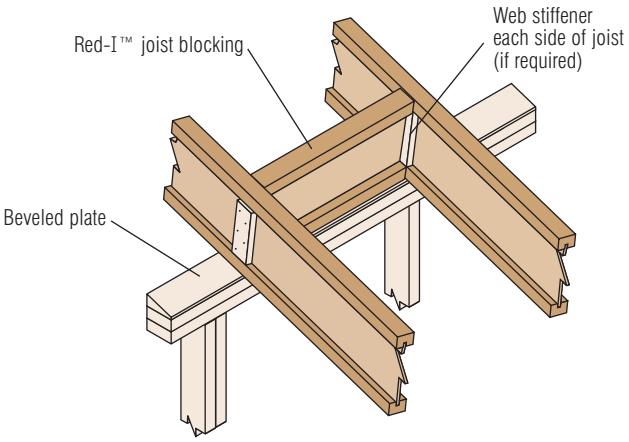
Cantilever/Outrigger Deflection

- 2L/480 at floor live load (live load = 0.80 x total load)
- 2L/240 at roof total load

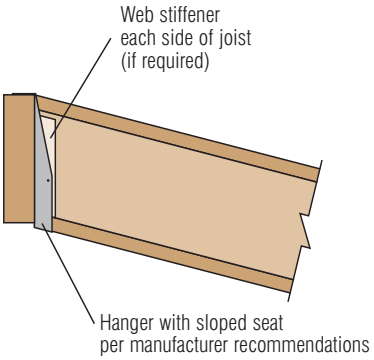
(1) Size Factor, C_F, per NDS Table 4a may be applied.
(2) For 12" depth. For other depths, multiply by $(12/d)^{0.136}$

98

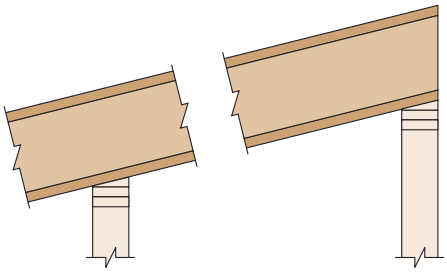
13 Slope Detail



14 Slope Detail at High End

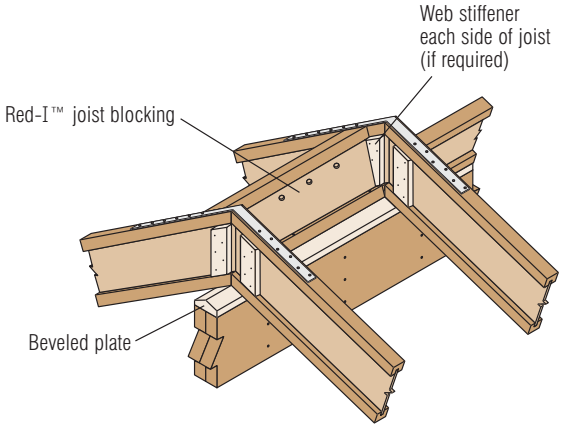


15 Beveled Plate Requirements



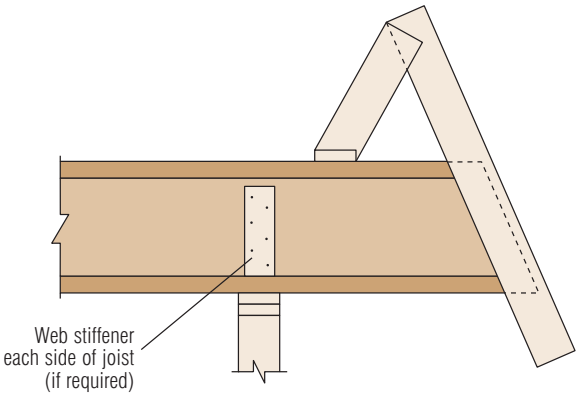
Required Bearing Length	Maximum Slope Without Beveled Plate
1¾"	½" in 12"
3½"	¼" in 12"
5½"	⅛" in 12"

16 Ridge Detail

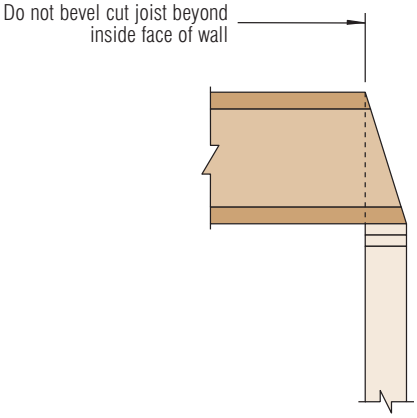


A strap and alternating blocking panels, or two rows of blocking panels, are required for lateral stability.

17 Cantilever with Mansard Framing

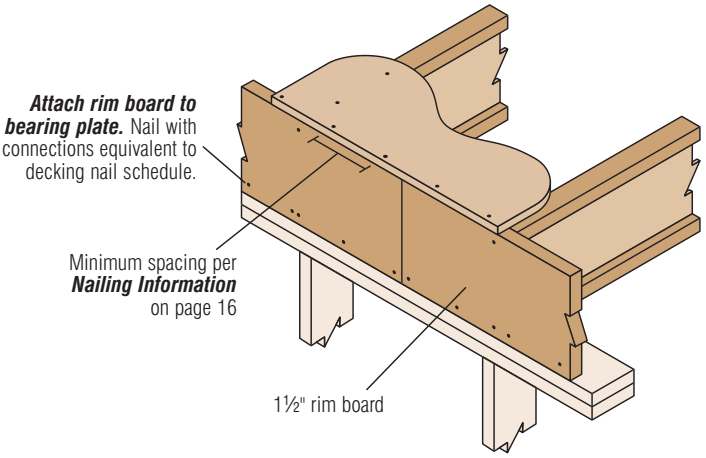


18 Bevel Cut or Fire Cut



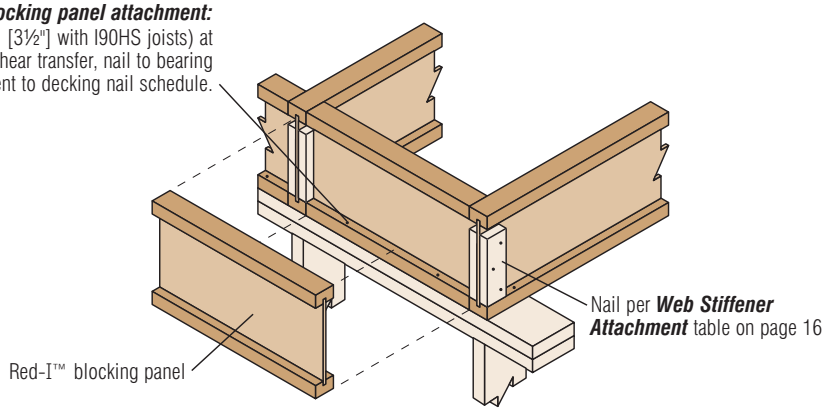
Rim board (up to 24" in depth) is available from RedBuilt™ and may be used for:

- Shear transfer (nailing must be established by design).
- Vertical load transfer.
- General closure.
- Helping to prevent rollover during joist installation.



RED-I™ BLOCKING PANELS

Minimum Red-I™ blocking panel attachment: Use 10d (3") box nails (16d [3½"] with I90HS joists) at 6" on-center. When used for shear transfer, nail to bearing plate with connections equivalent to decking nail schedule.



Red-I™ blocking panels are available from RedBuilt™ and may be used for:

- Shear transfer. Shear transfer capacity is 1,925 lbs per linear foot for Red-I65,™ I90, and I90H joists; 2,320 lbs for I90HS joists. Nailing must be established by design.
- Vertical load transfer.
- General closure.
- Helping to prevent rollover during joist installation.

When Red-I™ blocking panels are used for vertical load transfer, the following values may be used:

Allowable Uniform Vertical Load Transfer (PLF)

Red-I™ Joist Series	Red-I™ Blocking Panel Depth				
I45	9½"	11⅞"–14"	16"	–	–
	2,100	2,100	2,100	–	–
I65, I90, I90H and I90HS	9½"	11⅞"–14"	16"–20"	22"–24"	26"–30"
	–	3,050	2,450	1,850	1,200

- Loads are for Red-I™ blocking panels or Red-I™ joists as rim board.
- Loads shown may not be increased for duration of load.

Concentrated vertical loads

The allowable concentrated vertical loads on Red-I™ blocking panels or rim joist can be determined by using the equation provided below. Loads exceeding the calculated value should be supported by squash blocks.

$$P_{allow} = W_{allow}\left[\frac{L_c + 2t_s + 2t_f}{12}\right]$$

Where:

P_{allow} = Allowable concentrated vertical load (lbs)

W_{allow} = Allowable uniform vertical load for blocking panel (plf)

L_c = Bearing length of column on blocking panel (in.)

t_s = Sheathing thickness (in.)

t_f = Effective flange thickness: ⅞" for Red-I45™ Red-I65™ and Red-I90™; 1⅛" for Red-I90H™; and 1¼" for Red-I90HS™

Example:

4x4 post applied to 20" Red-I65™ joist through 23/32" sheathing.

$$P_{allow} = 2{,}700\left[\frac{3.5 + 2(23/32) + 2(7/8)}{12}\right] = 1{,}505 \text{ lbs}$$

100

WEB STIFFENERS

The Importance of Web Stiffeners

Web stiffeners are available from RedBuilt™ in pre-cut sizes and can be installed at the plant on one or both ends upon request. Web stiffeners are an important part of almost all Red-I™ joist installations because they will:

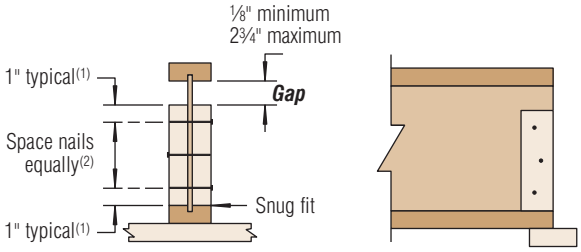
- Stiffen the Red-I™ joist web material and prevent buckling.
- Minimize the bearing length required for the Red-I™ joist.
- Help transfer reaction loads into the Red-I™ joist web.
- Provide stabilization in hangers.

To Ensure System Performance

- Web stiffeners must be installed at bearing points as shown in the details below and at points of concentrated loads exceeding 1,500 lbs.
- Web stiffeners are required on joists 20" and greater in depth.
- Web stiffeners are available from RedBuilt™ and typically have the maximum gap shown below. Verify that hanger nails adequately engage the web stiffener.
- Gap must be at top for all bearing conditions. For concentrated loads, the gap must be at the bottom (see details below).

Web Stiffener Attachment - Nail Quantities

Joist Depth	Red-I45™	Red-I65™	Red-I90™ and Red-I90H™		Red-I90HS™
	8d (2½") Nails	8d (2½") Nails	16d (3½") Nails		16d (3½") Nails
	End or Intermediate	End or Intermediate	End	Intermediate	End or Intermediate
9½"	3	–	–	–	–
11⅞"	3	3	3	3	4
14"	3	5	3	3	6
16"	3	6	4	4	6
18"	–	7	4	4	8
20"	–	8	5	5	10
22"	–	9	6	11	10
24"	–	10	6	13	12
26"	–	11	7	14	14
28"	–	12	8	15	14
30"	–	13	8	17	16
32"	–	–	–	–	18



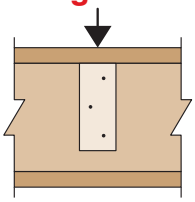
(1) 1½" (typical) with 2x4 solid sawn lumber web stiffeners.
(2) Nails may be driven from one side only.

Web Stiffener Size and Material

Flange Width	Web Stiffener Size	Web Stiffener Material
1¾"	⅝" x 2 5/16"	Sheathing (with face grain vertical) that meets the requirements of PS1 or PS2
2½"	1" x 2 5/16"	Sheathing (with face grain vertical) that meets the requirements of PS1 or PS2
3½"	2x4	Construction grade or better

Concentrated Load (No Bearing Wall Below)

If concentrated loads from above exceed 1,500 lbs, install web stiffeners tight to Red-I™ joist top flange. See tables at left for nailing and material requirements.



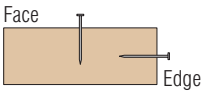
NAILING INFORMATION

Minimum Nail Spacing

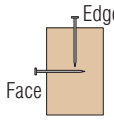
Nail Type		Nail Size	RedLam™ LVL			Sawn Lumber	
			Face	Edge		Face	Edge
				Joist Flange	Rim Board, Header, Beam		
8d(1)	Box	0.113" x 2½"	2"	4"	3"	4"	2"
	Common	0.131" x 2½"	2"	6"	3"	6"	2"
10d	Box	0.128" x 3"	2"	6"	3"	6"	2"
	Common	0.148" x 3"	3"	6"	4"	6"	2½"
12d	Box	0.128" x 3¼"	2"	6"	3"	6"	2"
	Common	0.148" x 3¼"	3"	6"	4"	6"	2½"
16d	Box	0.135" x 3½"	3"	6"	4"	6"	2½"
	Sinker	0.148" x 3¼"	3"	6"	4"	6"	2½"
	Common	0.162" x 3½"	4"	8"	8"	8"	4"

(1) 14 gauge staples may be a direct substitute for 8d nails if a minimum penetration of 1" into the flange is maintained.

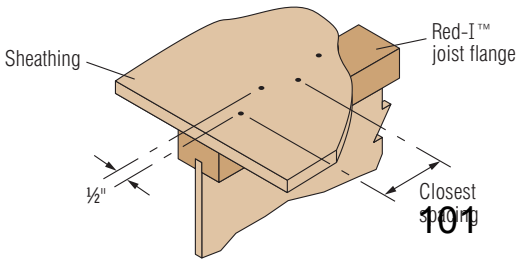
- If more than one row of nails is used, offset rows at least ½" and stagger. Use 10d (3") common nails, maximum, and maintain ⅜" minimum edge distance. **Exception: Wind/Seismic Connections** (page 17).
- Nailing pattern to be per plans and specifications, and nail spacing should comply with criteria listed on this page.
- For member stability, nail sheathing to the full length of the member (24" on-center, maximum).



Flatwise orientation
(typical with Red-I™ joists and plywood edge blocking)

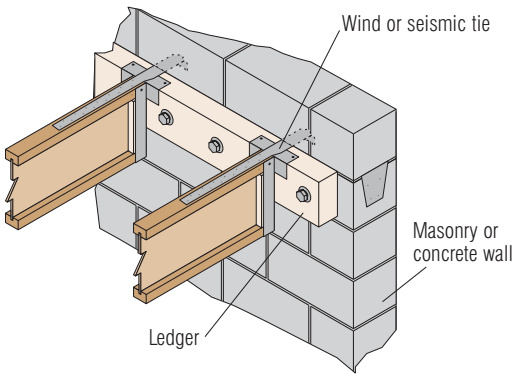


Edgewise orientation
(typical with rim board, beams, and headers)



19 Wall Tension Tie—With Straps

For 2½" or wider Red-I™ joists.



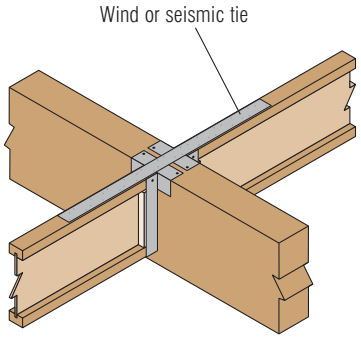
Strap Tension Tie Nailing and Capacities

Simpson Strap Model	Strap Length	10d (1½") Common Nails[1]		Allowable Loads[2] (lbs)			
				Masonry		Concrete	
		Masonry	Concrete	133%	160%	133%	160%
1¾" RedLam™ LVL or 3x_ Ledger							
PAI18	18"	8 nails	10 nails	1,000	1,205	1,255	1,505
PAI23	23"	13 nails	15 nails	1,630	1,955	1,880	2,255
PAI28	29"	19 nails	21 nails	2,380	2,815	2,630	3,160
PAI35	35"	24 nails	27 nails	2,815	2,815	3,385	3,685
MPAI32[3]	32"	16 nails	16 nails	1,960	2,355	1,960	2,355
MPAI44[3]	44"	24 nails	24 nails	2,865	2,865	2,865	2,865
LTT20B	20"	10 nails	10 nails	1,120	1,120	1,120	1,120
4x_ Ledger							
PAI18	18"	7 nails	9 nails	875	1,055	1,130	1,355
PAI23	23"	12 nails	14 nails	1,505	1,805	1,755	2,105
PAI28	29"	18 nails	20 nails	2,255	2,705	2,505	3,010
PAI35	35"	23 nails	26 nails	2,815	2,815	3,260	3,685
MPAI32[3]	32"	16 nails	16 nails	1,960	2,355	1,960	2,355
MPAI44[3]	44"	24 nails	24 nails	2,865	2,865	2,865	2,865
LTT20B	20"	10 nails	10 nails	1,120	1,120	1,120	1,120

(1) 10d (3") nails are permitted with same design values.
(2) Based on adequate connection to the wall.
(3) Requires 3½" wide flanges.

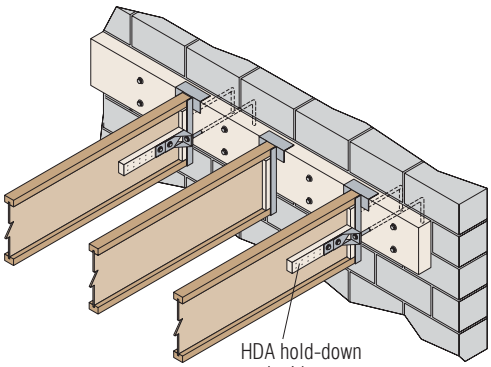
20 Wind or Seismic Tie at Butting Joists

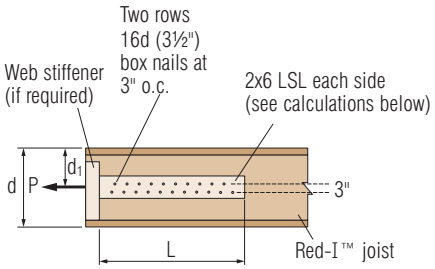
Tension straps must have a minimum nail spacing of 3" on-center per row, with a minimum of ⅜" between rows and maximum nail diameter of 0.148" (10d common).



See strap manufacturer's literature for allowable loads.

21 Wall Tension Tie—HDA Connections





To calculate the length of the LSL block (to transfer shear to joist flange):

1. Find

$$L_1 = \frac{0.75(P/K)d_1}{C_D V_A - [V_{DL} + (0.75V_{LL})]}$$

2. Find

$$L_2 = \tfrac{3}{2}(n) + 3, \text{ where } n = \frac{P}{V_n C_D}$$

3. Compare L_1 and L_2. Use maximum of the two values for the length of the LSL block.

C_D = Load duration factor
d_1 = Distance to axial load (in.) from top of joist
L_1, L_2 = Length of block (in.)
K = 1.0 for wind; 1.4 for seismic (accounts for strength-based seismic load)
n = Number of nails
P = Axial load (lbs)
V_A = Allowable shear load (lbs) for Red-I™ joist (see page 5)
V_{DL} = Shear load due to gravity dead load (lbs)
V_{LL} = Shear load due to gravity live load (lbs)
V_n = Nail shear capacity; see table below

16d Nail Shear Capacity

Red-I™ Web Thickness	V_n (100%) in lbs
⅜"	164
7/16"	169
½"	175

Fire Assembly Details

For Fire Assemblies and other construction-related fire information, please refer to resources on our website at www.RedBuilt.com.

Sound Assemblies and Noise Measurement

The ability of a wall or floor/ceiling system to reduce airborne sound transmission is measured using ASTM E90, and reported using the ASTM E413 Sound Transmission Class (STC) rating system. The ratings listed at right, from the Acoustical and Insulation Materials Association, provides practical references for a range of STC numbers. In general, the higher the number, the better the acoustical performance. It is important to note that this table is valid only for a given level of background noise and should be used only for generalized comparisons.

Floor/ceiling systems can also be rated for impact noise transmitted through an assembly. Ratings are determined using the ASTM E492 Impact Insulation Class (IIC) system, and like STC ratings, a high IIC rating indicates significantly reduced impact noise.

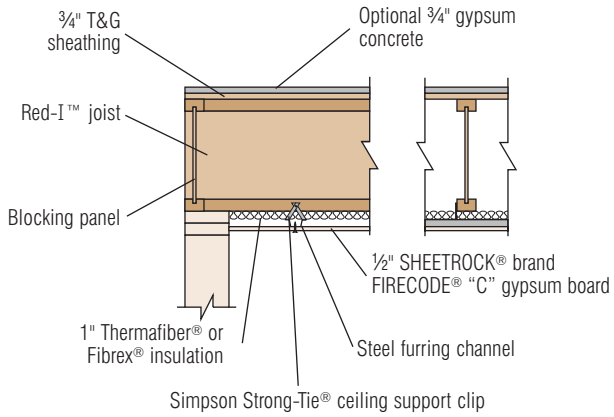
STC Ratings

25	Normal speech can be understood quite clearly
30	Loud speech can be understood fairly well
35	Loud speech audible but not intelligible
42	Loud speech audible as a murmur
45	Must strain to hear loud speech
48	Some loud speech barely audible
50	Loud speech not audible

Testing

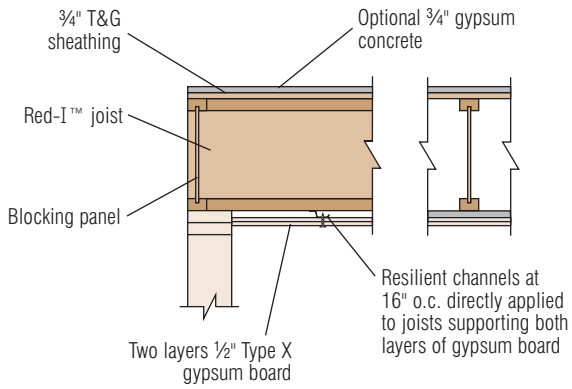
The acoustical assemblies provided below have been tested and rated by recognized acoustical laboratories, and the ratings shown are well within the acceptable range for multi-family buildings. However, in order to achieve these ratings, precautions should be taken to prevent flanking noise and sound leaks, and to ensure that actual construction conforms to the assembly shown.

22



Without Gypsum Concrete	With Gypsum Concrete
STC = 47	STC = 59
Pad and carpet IIC = 54	Pad and carpet IIC = 54
Cushioned vinyl IIC = 43	Cushioned vinyl IIC = 43

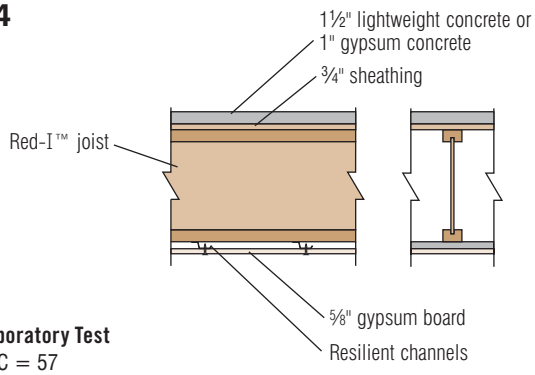
23



Without Gypsum Concrete	With Gypsum Concrete
STC = 50	STC = 58
Pad and carpet IIC = 60	Pad and carpet IIC = 54
Cushioned vinyl IIC = 45	Cushioned vinyl IIC = 46
Granit Acoustiflor® IIC = 51(1)	Granit Acoustiflor® IIC = 54(1)

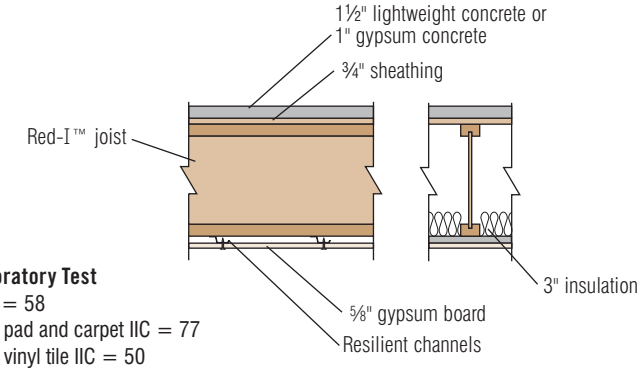
(1) Requires two layers of ⅝" Type X gypsum board with one layer of 3½" thick batt insulation.

24



Laboratory Test
STC = 57
G&H No. USDA-11xST

25



Laboratory Test
STC = 58
With pad and carpet IIC = 77
With vinyl tile IIC = 50
G&H No. USDA-11xST

Granit Acoustiflor® is a registered trademark of Tarkett Sommer. FIRECODE® and SHEETROCK® are registered trademarks of USG Corporation. Thermafiber® is a registered trademark of Thermafiber, Inc. Fibrex® is a registered trademark of Fibrex® Insulations Inc.

RED-I™ JOIST ALLOWABLE HOLES

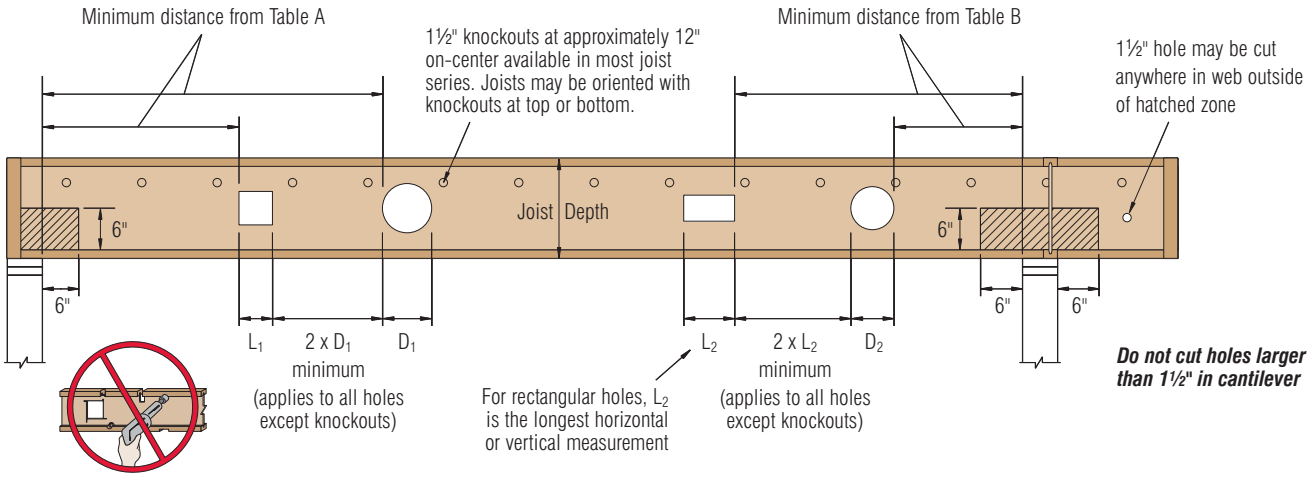


Table A – End Support

Minimum distance from edge of hole to inside face of nearest end support.

Joist Depth	Joist Series	Round Hole Size									
		2"	4"	6"	8"	10"	12"	14"	16"	18"	20"
		Square or Rectangular Hole Size									
		1.25"	2.5"	4"	5"	6"	7"	8.5"	9.5"	10.5"	13"
9½"	I45 / I65	1'-6"	***3'-0"***	***5'-0"***	-	-	-	-	-	-	-
	I90	2'-0"	3'-6"	***5'-6"***	-	-	-	-	-	-	-
11⅞"	I45 / I65	1'-6"	2'-6"	***4'-0"***	***5'-6"***	-	-	-	-	-	-
	I90 / I90H	1'-6"	3'-6"	5'-6"	***7'-0"***	-	-	-	-	-	-
	I90HS	2'-0"	4'-0"	6'-6"	-	-	-	-	-	-	-
14"	I45 / I65	1'-0"	2'-0"	3'-6"	***4'-6"***	***6'-6"***	-	-	-	-	-
	I90 / I90H	1'-0"	3'-0"	5'-0"	6'-6"	***9'-0"***	-	-	-	-	-
	I90HS	2'-0"	4'-0"	6'-0"	8'-0"	-	-	-	-	-	-
16"	I45 / I65	1'-0"	1'-6"	3'-0"	4'-0"	***5'-0"***	***8'-0"***	-	-	-	-
	I90 / I90H	1'-0"	2'-0"	4'-0"	6'-0"	8'-6"	***10'-6"***	-	-	-	-
	I90HS	2'-0"	4'-0"	6'-0"	8'-0"	10'-0"	-	-	-	-	-
18"	I45 / I65	1'-0"	1'-0"	2'-6"	3'-6"	4'-6"	***6'-0"***	***9'-0"***	-	-	-
	I90 / I90H	1'-0"	1'-0"	2'-6"	5'-0"	7'-0"	9'-6"	***12'-6"***	-	-	-
	I90HS	2'-0"	4'-0"	6'-0"	8'-0"	10'-0"	12'-0"	-	-	-	-
20"	I45 / I65	1'-0"	1'-0"	2'-0"	3'-0"	4'-0"	5'-0"	***7'-0"***	***10'-6"***	-	-
	I90 / I90H	1'-0"	1'-0"	2'-0"	4'-0"	6'-0"	8'-0"	11'-0"	***14'-0"***	-	-
	I90HS	2'-0"	4'-0"	6'-0"	8'-0"	9'-6"	11'-6"	14'-0"	-	-	-
22"	I65	1'-0"	1'-0"	1'-6"	2'-6"	3'-6"	4'-6"	5'-6"	7'-6"	***11'-6"***	-
	I90 / I90H	1'-0"	1'-0"	1'-0"	3'-0"	5'-0"	7'-0"	9'-0"	12'-6"	***16'-0"***	-
	I90HS	2'-0"	4'-0"	6'-0"	8'-0"	9'-6"	11'-6"	13'-6"	16'-0"	-	-
24"–26"	I65	1'-0"	1'-6"	2'-6"	3'-6"	4'-0"	5'-0"	6'-0"	7'-6"	***10'-0"***	-
	I90 / I90H	1'-0"	1'-0"	2'-0"	3'-6"	5'-0"	6'-6"	8'-6"	10'-6"	14'-6"	***18'-6"***
	I90HS	2'-0"	4'-0"	6'-0"	7'-6"	9'-6"	11'-6"	13'-6"	15'-0"	18'-0"	-
28"–32"	I65	1'-0"	2'-0"	2'-6"	3'-6"	4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	10'-6"
	I90 / I90H	1'-0"	1'-6"	2'-6"	4'-0"	5'-6"	6'-6"	8'-0"	9'-6"	11'-6"	14'-6"
	I90HS	2'-0"	3'-6"	5'-0"	7'-0"	8'-6"	10'-0"	12'-0"	13'-6"	16'-0"	18'-6"

Table B – Intermediate or Cantilever Support

Minimum distance from edge of hole to inside face of nearest intermediate or cantilever support.

Joist Depth	Joist Series	Round Hole Size									
		2"	4"	6"	8"	10"	12"	14"	16"	18"	20"
		Square or Rectangular Hole Size									
		1.25"	2.5"	4"	5"	6"	7"	8.5"	9.5"	10.5"	13"
9½"	I45 / I65	1'-6"	***4'-0"***	***6'-6"***	-	-	-	-	-	-	-
	I90	3'-0"	5'-6"	***8'-0"***	-	-	-	-	-	-	-
11⅞"	I45 / I65	1'-0"	2'-0"	***4'-6"***	***7'-0"***	-	-	-	-	-	-
	I90 / I90H	2'-0"	4'-6"	7'-6"	***10'-0"***	-	-	-	-	-	-
	I90HS	3'-6"	6'-0"	9'-0"	-	-	-	-	-	-	-
14"	I45 / I65	1'-0"	1'-0"	3'-6"	***5'-6"***	***8'-6"***	-	-	-	-	-
	I90 / I90H	1'-0"	3'-6"	6'-0"	9'-0"	***12'-6"***	-	-	-	-	-
	I90HS	4'-0"	6'-6"	9'-0"	11'-6"	-	-	-	-	-	-
16"	I45 / I65	1'-0"	1'-0"	2'-0"	***4'-0"***	***6'-6"***	***10'-0"***	-	-	-	-
	I90 / I90H	1'-0"	1'-6"	4'-6"	8'-0"	11'-0"	***14'-6"***	-	-	-	-
	I90HS	3'-0"	6'-0"	8'-6"	11'-6"	14'-0"	-	-	-	-	-
18"	I45 / I65	1'-0"	1'-0"	1'-0"	2'-6"	***5'-0"***	***8'-0"***	***12'-0"***	-	-	-
	I90 / I90H	1'-0"	1'-0"	2'-6"	5'-6"	9'-0"	12'-6"	***17'-0"***	-	-	-
	I90HS	2'-6"	5'-6"	8'-0"	11'-0"	13'-6"	16'-6"	-	-	-	-
20"	I45 / I65	1'-0"	1'-0"	1'-0"	1'-0"	3'-6"	***6'-0"***	***9'-0"***	***13'-6"***	-	-
	I90 / I90H	1'-0"	1'-0"	1'-0"	3'-6"	7'-0"	10'-6"	14'-6"	***19'-6"***	-	-
	I90HS	2'-0"	5'-0"	7'-6"	10'-6"	13'-6"	16'-0"	19'-6"	-	-	-
22"	I65	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"	4'-6"	7'-0"	10'-0"	***15'-0"***	-
	I90 / I90H	1'-0"	1'-0"	1'-6"	4'-0"	6'-6"	9'-6"	12'-0"	16'-0"	-	-
	I90HS	1'-0"	3'-0"	6'-0"	9'-0"	12'-6"	15'-6"	18'-6"	22'-0"	-	-
24"–26"	I65	1'-0"	1'-0"	1'-6"	3'-0"	4'-6"	6'-0"	7'-6"	10'-0"	***13'-6"***	-
	I90 / I90H	1'-6"	3'-0"	4'-6"	6'-0"	7'-6"	9'-0"	11'-0"	14'-0"	***18'-6"***	-
	I90HS	1'-6"	4'-0"	6'-6"	9'-0"	11'-6"	14'-0"	17'-0"	20'-0"	23'-0"	-
28"–32"	I65	1'-0"	1'-0"	1'-6"	3'-0"	4'-6"	6'-0"	7'-6"	9'-0"	11'-0"	***13'-6"***
	I90 / I90H	1'-6"	3'-0"	4'-6"	6'-0"	7'-6"	9'-0"	11'-0"	12'-6"	15'-6"	18'-6"
	I90HS	1'-0"	2'-6"	4'-6"	7'-0"	9'-6"	12'-0"	14'-6"	17'-0"	19'-6"	21'-6"

General Notes

- Tables are based on maximum allowable uniform loads. ***Bold Italic*** cells indicate 2000 lb. concentrated load spread over 2 joists has not been considered, use RedSpec™ software or contact your RedBuilt™ technical representative if concentrated load check is required.
- For other hole sizes, hole locations, or loads, use RedSpec™ software or contact your RedBuilt™ technical representative.
- Holes may be located vertically anywhere in the web. Leave ⅛" of web (minimum) at top and bottom of hole. **DO NOT cut joist flanges.**
- Knockouts are located in web at approximately 12" on-center; they do not affect hole placement.
- **Do not cut holes in cantilever without consulting your RedBuilt™ representative.**

How to Use Tables A and B

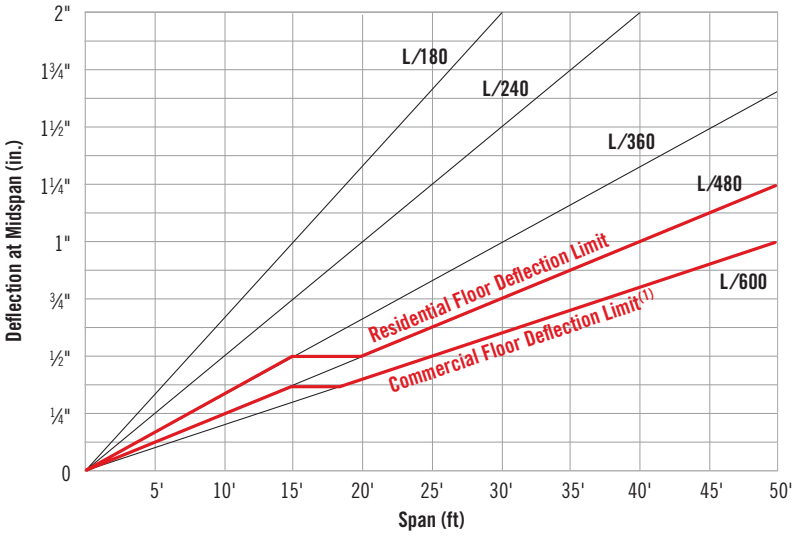
1. Determine the hole shape and size. For rectangular holes, use the largest dimension of the rectangle. Sizes given in the tables are hole sizes, not duct sizes.
2. Determine the Red-I™ joist series and depth.
3. Determine the type of support on each side of the hole. If the Red-I™ joist is continuous over a support, use both tables. Use Table A if the joist terminates at both supports.
4. Find the table cell at the intersection of the Red-I™ joist and the hole.
5. The measurement shown is the minimum distance from the edge of the hole to the inside face of the support.
6. Maintain the minimum required distance from both supports.
7. It is permissible to interpolate between holes sizes shown in the tables.

DEFLECTION CRITERIA

RedBuilt™ Recommended Deflection Criteria

Full-scale tests have shown repeatedly that RedBuilt™ products have deflection characteristics that are consistently predictable by calculation, with minimal set after load withdrawal.

The graph below shows that the RedBuilt™ recommended deflection limit for residential and commercial floors is more restrictive than the minimum of L/360 required by building codes. The floor load portions of the tables shown on pages 7–9 were developed based on the **Commercial Floor Deflection Limit** shown in the graph below.



Deflection criteria will vary by application. In a roof system, excessive deflection would be unsightly and could cause ceiling cracks and/or drainage problems. Floor systems, however, have entirely different—and usually much more restrictive—deflection requirements due to an occupant's perception of floor performance and feel.

Floors:

- Maximum deflection at live load limited as indicated here.
- Movable partition loads need not be considered.

Roofs:

- Sloped Roofs—¼" to 12" per foot, maximum deflection L/180 at total load
- Plaster Ceilings—Also check L/360 at live load

(1) For live load applications greater than 50 psf, check the L/600 deflection limit using a 50 psf live load, and check the code-prescribed deflection limit using the full live load.

Deflection Calculations

The deflection characteristics of Red-I™ joists can be closely approximated by analyzing beams using the EI values for flexural deflections shown in the **Design Properties** table on page 5. The EI values selected from the **Design Properties** table must be determined by application (i.e., for roof applications use the EI for joists; for floor applications use the EI for nailed panels or glue-nailed panels).

For uniformly loaded simple spans, the mid-span deflection (in inches) can be calculated as shown at right:

Red-I45™:

$$\Delta = \frac{22.5wL^4}{EI} + \frac{2.67wL^2}{d \times 10^5}$$

Red-I65™, I90, and I90H Joists:

$$\Delta = \frac{22.5wL^4}{EI} + \frac{2.26wL^2}{d \times 10^5}$$

Red-I90HS™ Joists:

$$\Delta = \frac{22.5wL^4}{EI} + \frac{2.00wL^2}{d \times 10^5}$$

(The second function is shear deflection)

Where:

w = Uniform load in plf
L = Span in feet
d = Depth of Red-I™ joist in inches
EI = Value from the proper column in the **Design Properties** table (page 5)

Example:

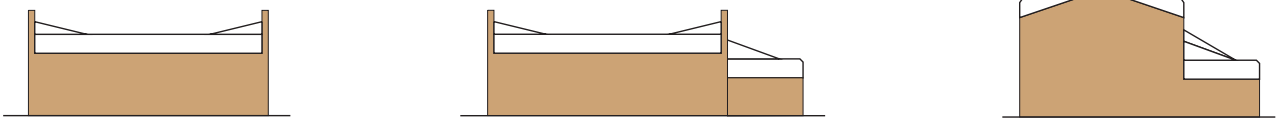
14" Red-I65™ floor joist
Nailed floor sheathing
20' span floor
100 plf uniform load

$$\Delta = \frac{22.5 \times 100 \times 20^4}{752 \times 10^6} + \frac{2.26 \times 100 \times 20^2}{14 \times 10^5} = 0.54"$$

In this same example, if the deck was glue-nailed to the Red-I™ joists the deflection would reduce to:

$$\Delta = \frac{22.5 \times 100 \times 20^4}{821 \times 10^6} + \frac{2.26 \times 100 \times 20^2}{14 \times 10^5} = 0.50"$$

SNOWDRIFT LOADING



Wind direction, site exposure, and roof type and shape are some of the factors that can dramatically influence the accumulation of snow on a roof structure. ASCE 7 *(Minimum Design Loads for Buildings and Other Structures)* and the applicable building code, as well as other local state and regional codes, provide guidelines for calculating snowdrift loadings on all types of building construction.

Drifts usually occur at locations of discontinuity in a roof such as at parapet walls, valleys, or where a high roof meets a low roof. Closer on-center spacing or additional support may be required at these locations. The examples above illustrate potential snowdrift conditions.

The project design professional is responsible for determining any additional loads due to snow drifting.

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Technical Support Organization and Functions

RedBuilt™ has four strategically located Design Centers staffed by professional engineers and designers. Their role is to provide technical support and service to our RedBuilt™ representatives, the professional design community, and the manufacturing plants. Design Center personnel have access to extensive test data, production standards, building code product acceptance criteria, and the most current computer design software.

The Design Centers work closely with our RedBuilt™ representatives and can provide the following services:

- Review and analysis of potential applications submitted by our RedBuilt™ representatives
- Drawings showing placement, bearing conditions, dimensions, and installation suggestions
- Custom design of the product
- Assistance in resolving field problems should they arise

This design guide contains technical data and design information frequently required by the design professional when using our products. Because of the variety of possible conditions, the design professional is strongly encouraged to request support from RedBuilt™ Design Centers through one of our representatives.

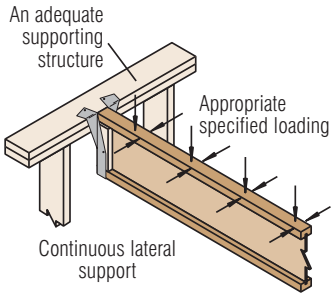
Product Application Assumptions

Our warranty is subject to an adequate supporting structure for our products. The design of the entire structure is not the role of RedBuilt™, nor can we assume accountability for the full function of the roof or floor system. We can only be responsible for the internal design integrity of our own products, which are structural components of roof and floor systems that are necessarily designed by others.

Our warranty is also subject to continuous lateral support to the compression flange of our products unless specific design provisions account for other lateral support conditions. Continuous lateral support is provided by 8d (2½") nails at 24" on-center (minimum) for Red-I™ joists that are connected to an adequate diaphragm or total lateral strength system.

The magnitude, direction, and location of all design loads are as specified by the building designer. The review of this loading by our personnel is only for purposes of designing our product.

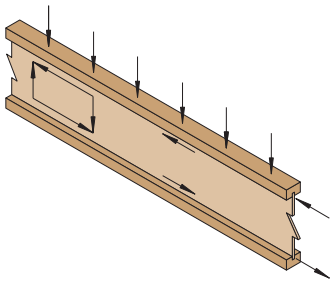
Other application assumptions are referenced on the terms and conditions of our purchase agreement contract.



Analysis Procedure—Red-I™ Joists

Using the allowable stresses found in our code approvals, Red-I™ joists are analyzed according to the procedures outlined in ASTM D5055. Bending capacity is determined using the net area of the flanges (rout area deducted) as sole flexural strength, while stiffness considers the contributions of the web material as well. Shear and reaction capacity have been established through product tests, and properties are routinely confirmed through ongoing quality-control testing. Local web buckling in high shear locations, as well as bearing load transfer to the web, may require reinforcement of the web (usually by use of web stiffeners). Web stiffener requirements and fastening details have been established by test.

The composite nature of the Red-I™ joist results in multiple control mechanisms—all of which are accounted for in testing but are generally unrelated to the shear mechanics of solid joists and timbers. For this reason, ignoring loads near supports is not generally appropriate, and the basic design shear is the vertical shear at the face of the support. In some cases, web confinement and inelastic beam behavior are observed to cause increases in shear strength during testing of members that are continuous over a support. Deflection of Red-I™ joists is closely predicted through flexural and shear deflection analysis, using composite action with the sheathing for nailed or glue-nailed attachments.



Concentrated and Non-Uniform Loads

For the most efficient use of RedBuilt™ Commercial products resisting concentrated loads, non-uniform loads, and/or in conditions other than simple spans, consult your RedBuilt™ representative for precise sizing. As a general rule, extra members should be added to the system to carry concentrated loads such as bearing partitions, air conditioners, and other mechanical equipment. Handling concentrated loads in this manner usually provides the most economical system and also helps ensure more uniform deflection.

RED-I™ SPECIFICATIONS

1.0 General

1.1 Scope
This work includes the complete furnishings and installation of all Red-I™ joists, as shown on the drawings herein specified and necessary to complete the work.

1.2 Code Approvals
These products shall be designed and manufactured to the standards set forth in the International Code Council Report No. ESR-2994.

1.3 Related Work Specified Elsewhere
A. Carpentry and Millwork
B. Glu-Laminated Members

1.4 Design
A. Products: RedBuilt™ products shall be designed to fit the dimensions and loads indicated on the plans.

B. Design Calculations: When requested, a complete set of design calculations shall be prepared by RedBuilt™.

1.5 Submittals
A. Drawings: Drawings showing layout and detail necessary for determining fit and placement in the building shall be provided by RedBuilt™.

B. Production: Fabrication and/or cutting shall not proceed until the architect and/or engineer have approved the submittal package.

2.0 Products

2.1 Materials
Flange members, web members and adhesives shall conform to the provisions of ICC-ES Report No. ESR-2994.

2.2 Fabrication
Red-I™ joists shall be manufactured by RedBuilt™ in a plant listed in the report referred to above and under the supervision of an approved third-party inspection agency.

2.3 Tolerances
Depth: ± 1/16"
Flange Width: ± 1/16"

2.4 Identification
Each of the joists shall be identified by a stamp indicating the joist series, ICC-ES report number, manufacturer's name, plant number, date of fabrication, and the independent inspection agency's logo.

2.5 Hardware
Not applicable.

3.0 Execution

3.1 Installation
Red-I™ joists, if stored prior to installation, shall be protected from the weather. They shall be handled with care so they are not damaged. Red-I™ joists shall be installed in accordance with the plans, and any RedBuilt™ 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 Red-I™ joists straight and plumb as required, and to ensure adequate lateral support for the individual Red-I™ joist members and the entire system until the sheathing material is applied.

3.2 Installation Review
Prior to enclosing the Red-I™ joists, the Contractor shall give notification to the RedBuilt™ representative to provide an opportunity for review of the installation.

3.3 Performance Standards
Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5055.

3.4 Fire Rating/Sound Rating
Fire and sound ratings are to be established in accordance with the assemblies detailed in ICC-ES Report No. ESR-2994, or the *Directory of Listed Products* published by Intertek Testing Services.

3.5 Warranty
The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building.

4.0 Alternates and/or Equals

4.1 Base Bid
Due to the customized detailing and engineering characteristics of the roof and/or floor framing assembly, it is a requirement that Red-I™ joists be used in the base bid.

4.2 Alternate Manufacturers
Other manufacturers' bids are to be listed in the alternate section of your proposal. All framing plans, detailing, and calculations for the alternate bids will be reviewed by the owner, architect, and engineer for structural performance, possible conflicts with related trades, and compatibility with the overall building requirements and building code.

4.3 Alternate Products
Alternate products will only be permitted if written approval and acceptance is obtained by both architect and owner at least seven days prior to the bid date. Any monetary savings that may be realized by using an alternate product shall be forwarded to the owner.

4.4 Acceptable Alternatives
At the discretion of the specifier of record, accepted alternates will be listed on the final addendum prior to the bid date.

Refer to local building codes for live load design requirements.

Composition Roofing

2–15 and 1–90 lb . . . . . 1.7 psf
3–15 and 1–90 lb . . . . . 2.2 psf
3-ply and gravel . . . . . 5.6 psf
4-ply and gravel . . . . . 6.0 psf
5-ply and gravel . . . . . 6.5 psf
Insulated Roof Membrane Assembly (IRMA)
2" thick . . . . . 13.0 psf
Single-ply roofs (insulation not included)
Ballasted system . . . . . 13.0 psf
Mechanically fastened . . . . . 2.0 psf
Fully adhered . . . . . 2.0 psf

Douglas Fir Sheathing*
(Based on 36 pcf for plywood, 40 pcf for OSB)

½" plywood . . . . . 1.5 psf
⅝" plywood . . . . . 1.8 psf
¾" plywood . . . . . 2.3 psf
1⅛" plywood . . . . . 3.4 psf
½" OSB . . . . . 1.7 psf
⅝" OSB . . . . . 2.0 psf
¾" OSB . . . . . 2.5 psf
⅞" OSB . . . . . 2.9 psf
1⅛" OSB . . . . . 3.7 psf

*For southern pine weights, increase Douglas fir weights by 10%.

Miscellaneous Roofing Materials

Corrugated galvanized steel
16 ga. . . . . 2.9 psf
20 ga. . . . . 1.8 psf
22 ga. . . . . 1.5 psf
24 ga. . . . . 1.3 psf
Asphalt shingles . . . . . 2.5 psf
Wood shingles . . . . . 2.0 psf
Clay tile . . . . . 9.0 to 14.0 psf
Slate (⅜" thick) . . . . . 15.0 psf

Rigid Insulation (1" thick)

Hemlock . . . . . 1.2 psf
Cork . . . . . 0.7 psf
Gold bond . . . . . 1.5 psf
Polystyrene foam . . . . . 0.2 psf
Foamglass . . . . . 0.8 psf
Rigid fiberglass . . . . . 1.5 psf

Roll or Batt Insulation (1" thick)

Rock wool . . . . . 0.2 psf
Glass wool . . . . . 0.1 psf

Floors

Hardwood (nominal 1") . . . . . 4.0 psf
Concrete (1" thick)
Regular . . . . . 12.0 psf
Lightweight . . . . . 8.0 to 10.0 psf
Gypsum concrete (¾" thick) . . . . . 6.5 psf
Sheet vinyl . . . . . 0.5 psf
Carpet and pad . . . . . 1.0 psf
¾" ceramic or quarry tile . . . . . 10.0 psf

Ceilings

Acoustical fiber tile . . . . . 1.0 psf
½" gypsum board . . . . . 2.2 psf
⅝" gypsum board . . . . . 2.8 psf
Plaster (1" thick) . . . . . 8.0 psf
Metal suspension system (including tile) . . . . . 1.8 psf

To calculate total dead load, use a minimum of 1.5 psf for "miscellaneous" with all dead loads

Weights of Douglas Fir Framing Members

Nominal Size (in.)	Joist Spacing		
	12"	16"	24"
2x4	1.4 psf	1.1 psf	0.7 psf
2x6	2.2 psf	1.7 psf	1.1 psf
2x8	2.9 psf	2.2 psf	1.5 psf
2x10	3.7 psf	2.8 psf	1.9 psf
2x12	4.4 psf	3.3 psf	2.2 psf
3x6	3.6 plf		
4x6	5.0 plf		
4x8	6.8 plf		
4x10	8.6 plf		
4x12	10.4 plf		

- For southern pine weights, increase Douglas fir weights by 10%.

Weights of Sprinkler Lines

Size of Pipe	Schedule 40, Standard Pipe		Schedule 10, Thin Wall Pipe	
	Dry (plf)	Wet (plf)	Dry (plf)	Wet (plf)
1"	1.7	2.1	1.4	1.8
1¼"	2.3	3.0	1.8	2.5
1½"	2.7	3.6	2.1	3.1
2"	3.7	5.2	2.7	4.2
2½"	5.8	7.9	3.6	5.9
3"	7.6	10.8	4.3	8.0
3½"	9.2	13.5	5.0	9.8
4"	10.9	16.4	5.6	11.8
5"	14.8	23.5	7.8	17.3
6"	19.2	31.7	9.3	23.1
8"	28.6	50.8	16.9	40.1
10"	40.5	74.6		

- For additional information on sprinkler systems, see RedBuilt™ *Sprinkler System Installation Guide* (Available online at www.RedBuilt.com).

Approximate Weights of RedBuilt™ Products

	Series	PLF Weight
Trusses	Red-L™, Red-LT™	3.75–4.25
	Red-W™	4.50–5.25
	Red-S™	4.75–5.75
	Red-M™	8.00–9.00
	Red-H™	10.00–12.00
Joists	Red-I45™	2.2–3.5
	Red-I65™	3.0–5.8
	Red-I90™	4.2–6.6
	Red-I90H™	4.6–7.1
	Red-I90HS™	6.0–9.1

Structural Composite Lumber	Density (pcf)
2.0E RedLam™ LVL	42
LSL	45

- PLF Unit Weight = (density) x (width) x (depth).

RedBUILT™
Engineered Wood Products

INNOVATION CELEBRATING 50 YEARS EXCELLENCE

2.0E RedLam™ LVL

Beams, Headers & Columns

RedSPEC™
Product Sizing Software

Download your free copy of RedSpec™ here.

Specify RedLam™ LVL for your next project using RedSpec™ single-member sizing software.

Laminated Veneer Lumber

- Engineered to project specifications
- Consistent strength
- Consistent quality
- Finished lengths up to 80 feet

2.0E REDLAM™ LAMINATED VENEER LUMBER

RedLam™ LVL can be used as main carrying beams, flush beams, headers and wall framing. The RedLam™ LVL manufacturing process removes and disperses the natural defects inherent in wood and produces a product that is strong, dimensionally stable and very reliable.

STRONGER THAN NATURE

Our production process creates wood members with structural qualities equal to or greater than equivalent sizes of dimensional lumber and most glulam beams.

SIZES FOR EVERY NEED

RedLam™ LVL is manufactured in standard widths from 1½" – 3½", in lengths up to 80 feet, with depths of 9½" – 24" including wall framing in 2x and 3x sizes from 3½" – 11¼".

REDLAM™ LVL BEAMS AND HEADERS

RedLam™ LVL beams work well in applications all over the structure. No matter where they're used, they install quickly with little or no waste. RedLam™ LVL is very stable and resists warping, splitting and shrinking.

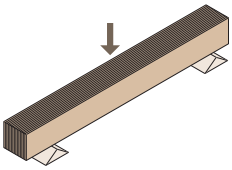
RedLam™ LVL rim board is available in sizes that match Red-I™ joists up to 24" deep. See the RedBuilt™ LVL Rim Board Product Memo at www.RedBuilt.com

2.0E RedLam™ LVL Available Sizes

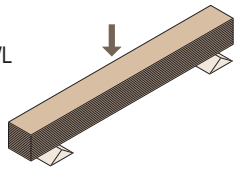
	Depth												
Available Width	**3½"**	**5½"**	**7¼"**	**9¼"**	**9½"**	**11¼"**	**11⅞"**	**14"**	**16"**	**18"**	**20"**	**22"**	**24"**
1½"	x	x	x	x		x							
1¾"	x	x	x	x	x	x	x	x	x	x			
2½"	x	x	x	x		x							
3½"	x	x	x	x	x	x	x	x	x	x	x	x	x
5¼"		x	x		x		x	x	x	x	x	x	x
7"			x		x		x	x	x	x	x	x	x

Beam, Plank and Column Orientation Diagrams

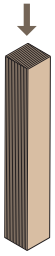
Beam Orientation
Load RedLam™ LVL parallel to glue line.



Plank Orientation
Load RedLam™ LVL perpendicular to glue line.



Column Orientation



Resource Efficiency

Consider all of the positive attributes of wood when selecting your building material of choice. In addition to its structural properties, high strength-to-weight ratio, and ease of construction, wood is a naturally occurring, renewable resource that requires less energy to produce than steel or concrete. And it sequesters carbon–whether on the stump or in your structure.

Our RedLam™ LVL, as well as other RedBuilt™ products, are now available with FSC credits. Whether you're looking for LEED certification or simply because you want to ensure efficient use of raw materials, we can help. By making better use of every tree, RedBuilt™ produces cost-effective, consistently available engineered wood products that reduce environmental impact. The result is a quality wood product that offers superior strength and reliable performance.

FSC®
www.fsc.org
FSC® C002542
The mark of responsible forest management

BEAM DESIGN STRESSES

Orientation			RedLam™ LVL Beam/Joist	RedLam™ LVL Plank (5)
Grade			2.0E	2.0E
Shear modulus of elasticity	G	=	125,000 psi	125,000 psi
Modulus of elasticity	E	=	2.0 x 10^6 psi (1)	2.0 x 10^6 psi (1)
Flexural stress	F_b	=	2,900 psi (2)	3,430 psi
Tension stress	F_t	=	1,660 psi (3)	1,660 psi (3)
Compression perpendicular to grain	$F_{c\perp}$	=	750 psi (4)	480 psi (4)
Compression parallel to grain	$F_{c\|\|}$	=	2,635 psi	2,635 psi
Horizontal shear parallel to grain	F_v	=	285 psi	190 psi
Equivalent specific gravity	SG	=	0.50	0.50

(1) The reference modulus of elasticity for beam and column stability, E_{min}, per the 2005 NDS® is 1.0 x 10^6 psi.

(2) For 12" depth. For other depths, multiply F_b by $\left[\frac{12}{d}\right]^{0.136}$

(3) F_t is adjusted for volume effects for a range of common conditions.

(4) $F_{c\perp}$ may not be increased for duration of load.

(5) Values shown are for thickness up to 3½".

For uniformly loaded simple span beams, deflection is calculated as follows:

$$\Delta = \frac{270wL^4}{Ebd^3} + \frac{28.8wL^2}{Ebd}$$

Where: Δ = Deflection, inches; w = Uniform load in plf; L = Span, feet; E = Modulus of Elasticity, psi; b = Beam width, inches; d = Beam depth, inches

RedLam™ LVL is intended for dry-use, untreated applications

Code Evaluations: See ICC ESR-2993

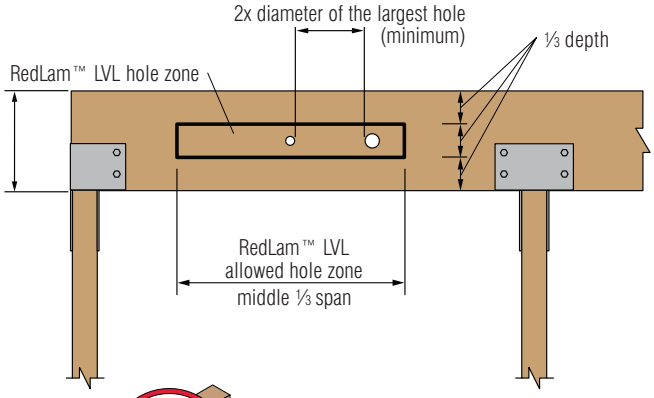
For RedLam™ LVL rim board properties see the RedBuilt™ LVL Rim Board Product Memo available at www.RedBuilt.com.

BEAM DESIGN PROPERTIES

100% Load Duration

Width (in)	Depth (in)	Weight (plf)	Shear (lbs)	Moment (ft-lbs)	I (in^4)	EIx10^6 (in^2-lbs)
1.75	9.5	4.8	3,160	6,600	125	250
	11.875	6.1	3,950	10,000	244	490
	14	7.1	4,660	13,500	400	800
	16	8.2	5,320	17,400	597	1,190
	18	9.2	5,990	21,600	851	1,700
3.5	9.5	9.7	6,320	13,100	250	500
	11.875	12.1	7,900	19,900	488	980
	14	14.3	9,310	27,100	800	1,600
	16	16.3	10,640	34,700	1,195	2,390
	18	18.4	11,970	43,200	1,701	3,400
	20	20.4	13,300	52,600	2,333	4,670
	22	22.5	14,630	62,800	3,106	6,210
	24	24.5	15,960	73,900	4,032	8,060
5.25	9.5	14.5	9,480	19,700	375	750
	11.875	18.2	11,850	29,900	733	1,470
	14	21.4	13,970	40,600	1,201	2,400
	16	24.5	15,960	52,100	1,792	3,580
	18	27.6	17,960	64,800	2,552	5,100
	20	30.6	19,950	78,900	3,500	7,000
	22	33.7	21,950	94,200	4,659	9,320
	24	36.8	23,940	110,800	6,048	12,100
7	9.5	19.4	12,640	26,300	500	1,000
	11.875	24.2	15,790	39,800	977	1,950
	14	28.6	18,620	54,100	1,601	3,200
	16	32.7	21,280	69,400	2,389	4,780
	18	36.8	23,940	86,400	3,402	6,800
	20	40.8	26,600	105,200	4,667	9,330
	22	44.9	29,260	125,700	6,211	12,420
	24	49.0	31,920	147,800	8,064	16,130

HEADERS AND BEAMS



DO NOT cut, notch, or drill holes in headers or beams except as indicated in the illustrations and tables

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.

Header or Beam Depth	Maximum Round Hole Size
5½"	1¾"
7¼" – 20"	2"

- See illustration for allowed hole zone.

NAILING INFORMATION

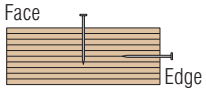
Minimum Nail Spacing

Nail Type		Nail Size	RedLam™ LVL Face	RedLam™ LVL Edge (1)
8d	Box	0.113" x 2½"	2"	3"
	Common	0.131" x 2½"	2"	3"
10d	Box	0.128" x 3"	2"	3"
	Common	0.148" x 3"	3"	4" (2)
12d	Box	0.128" x 3¼"	2"	3"
	Common	0.148" x 3¼"	3"	4" (2)
16d	Box	0.135" x 3½"	3"	4"
	Sinker	0.148" x 3¼"	3"	4" (2)
	Common	0.162" x 3½"	4"	8" (3)

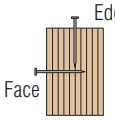
(1) For headers and beams. For Red-I™ joists and open-web trusses, see the nailing criteria in the respective specifier's guide.

(2) Minimum spacing must be 5" for 4 rows of nails.

(3) Spacing may be reduced to 5" where nail penetration does not exceed 1⅜".



Flatwise orientation
(typical with Red-I™ joists and plywood edge blocking)



Edgewise orientation
(typical with rim board, beams, and headers)

- If more than one row of nails is used, offset rows at least ½" and stagger. Maintain ⅜" minimum edge distance.
- Nailing pattern to be per plans and specifications, and nail spacing should comply with criteria listed on this page.

HDU/DTT2Z Holdow ns

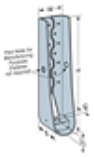
VALUE ENGINEERED

HDU Holdowns are pre-deflected during the manufacturing process, virtually eliminating deflection under load due to material stretch. They use Simpson Strong-Tie® Strong-Drive® screws (SDS) which install easily and provide reduced fastener slip. Using SDS screws results in a greater net section, when compared to bolts, as no material is removed.

The HDU series of holdowns are designed to replace previous versions of the product such as PHD's as well as bolted holdowns. The HDU2, 4 and 5 are direct replacements for the PHD2, 5 and 6, respectively.

The DTT2Z tension tie is suitable for lighter-duty holdown applications on single or double 2x posts, and installs easily with Strong-Drive SDS screws (included). The DTT2Z has been tested in accordance with the ICC-ES acceptance criteria for Holdowns Attached to Wood Members (AC155) and meets the minimum requirements for many alternate braced wall panels per section R602.10.3.2 of the 2009 IRC (see table R602.10.6, item 1).

For more information on holdown options, contact Simpson Strong-Tie.



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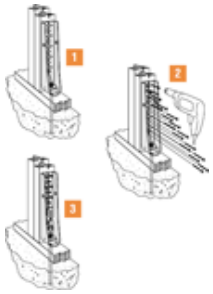
INSTALLATION



View step-by-step installation instructions

HDU Special Features:

- Pre-deflected body virtually eliminates deflection due to material stretch.
- Uses SDS screws which install easily, reduces fastener slip, and provides a greater net section area of the post compared to bolts.
- SDS screws are supplied with the holdowns to ensure proper fasteners are used.
- No stud bolts to countersink at openings.

Material: See table.

Finish: HDU—Galvanized; DTT2Z—ZMAX® coatings.

Installation:

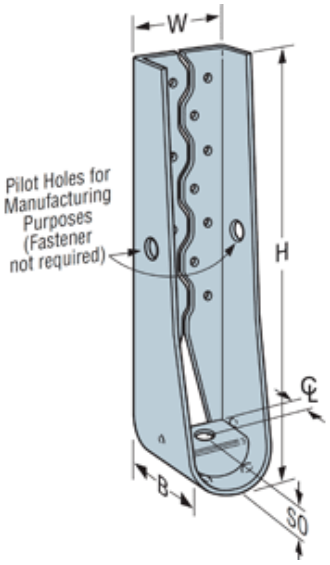
- Use all specified fasteners. See General Notes.
- For use in vertical and horizontal applications.
- The HDU requires no additional washer, the DTT requires a standard cut washer (included) be installed between the nut and the seat.
- To tie multiple 2x members together, the Designer must determine the fasteners required to join the members to act as one unit without splitting the wood. See SDS Screw information.
- See SB and SSTB Anchor Bolts for anchorage options.
- SDS screws install best with a low-speed, high-torque drill with a 3/8" hex head driver.
- Refer to Anchor Designer Software™ for ACI 318 for anchoring solutions.

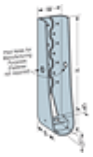
For holdowns, per ASTM test standards, anchor bolt nuts should be finger-tight plus 1/3 to 1/2 turn with a hand wrench, with consideration given to possible future wood shrinkage. Care should be taken to not over-torque the nut. Impact wrenches should not be used.

Gallery:

▲top

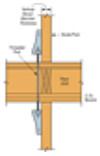
roll over images below to see larger image



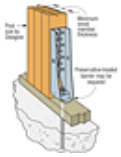


HDU
U.S. Patents 6,112,495 and 5,979,130

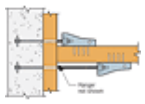
DTT2Z



Typical HDU Tie Between Floors



Vertical HDU Installation



Horizontal HDU Offset Installation (Plan View) See footnote 7.

Load Table: See code report listings below ▲top

These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Ga	Dimensions (in.)					Fasteners		Minimum Wood Member Thickness[4] (in.)	Allowable Tension Loads (lbs.) (160)[1]		
		W	H	B	℄	SO	Anchor Bolt Dia. (in.)	SDS Screws		DF/SP	SPF/HF	Deflection at Allowable Load[5,6] (in.)
DTT2Z	14	3¼	6 15/16	1⅜	13/16	⅜	½	8-SDS ¼"x1½"	1½	1825	1800	0.105
								8-SDS ¼"x1½"	3	2145	1835	0.128
DTT2Z-SDS2.5								8-SDS ¼"x2½"	3	2145	2105	0.128
HDU2-SDS2.5	14	3	8 1/16	3¼	1 5/16	1⅜	⅝	6-SDS ¼"x2½"	3	3075	2215	0.088
HDU4-SDS2.5	14	3	10 15/16	3¼	1 5/16	1⅜	⅝	10-SDS ¼"x2½"	3	4565	3285	0.114
HDU5-SDS2.5	14	3	13 3/16	3¼	1 5/16	1⅜	⅝	14-SDS ¼"x2½"	3	5645	4065	0.115
HDU8-SDS2.5	10	3	16⅝	3½	1⅜	1½	⅞	20-SDS ¼"x2½"	3	5980	4305	0.084
									3½	6970	5020	0.116
									4½	7870	5665	0.113
HDU11-SDS2.5	10	3	22¼	3½	1⅜	1½	1	30-SDS ¼"x2½"	5½	9535	6865	0.137
									7¼	11175	8045	0.137
HDU14-SDS2.5	7	3	25 1/16	3½	1 9/16	1 9/16	1	36-SDS ¼"x2½"	7¼	14375[9]	10435[9]	0.177
									5½[8]	14445[8,9]	10350[9]	0.177

1. Allowable loads have been increased for wind or earthquake load durations with no further increase allowed; reduce where other load durations govern.
2. The Designer must specify anchor bolt type, length and embedment. See SB and SSTB Anchor Bolts. Refer to Anchor Designer Software™ for ACI 318 for anchoring solutions.
3. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers. Values in the tables reflect installation into the wide face. See technical bulletin T-SCLCOLUMN for values on the narrow face (edge).
4. Post design by Specifier. Tabulated loads are based on a minimum 3 1/2" wide post (in a 3 1/2" wall). Post may consist of multiple members provided they are connected independently of the holdown fasteners. See Post Capacities for common post allowable loads.
5. Tension values are valid for holdowns flush or raised off of sill plate.
6. Deflection at Allowable Tension Load includes fastener slip, holdown deformation and anchor rod elongation for holdowns installed up to 6" above top of concrete. Holdowns may be installed raised up to 18" above top of concrete with no load reduction provided that additional elongation of the anchor rod is accounted for.
7. Tabulated loads may be doubled when the HDU is installed on opposite sides of the wood member provided either the post is large enough to prevent opposing holdown screw interference or the holdowns are offset to eliminate screw interferences.
8. Noted HDU14 allowable loads are based on a 5 1/2" wide post (6x6 min.).
9. Requires heavy hex anchor nut to achieve tabulated loads (supplied with holdown).

Code Reports (PDFs): ▼next ▲top

					LEGACY REPORTS		
	IAPMO UES ER	ICC-ES ESR	CITY OF LOS ANGELES	STATE OF FLORIDA	ICC-ES NER	ICC-ES ER	ICC-ES ES
DTT2Z		ESR-2330 / ESR-2523 *	RR25720	FL10441			

DTT2Z-SDS2.5	No code listing. Please contact us for test data.						
HDU	See specific model numbers for code listings.						
HDU11-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU11-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU14-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU14-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU2-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU4-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU5-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			
HDU8-SDS2.5		ESR-2330 / ESR-2523 *	RR25720	FL10441			

* ESR-2523 is an Index of many of Simpson Strong-Tie Stamped and Welded Cold-formed Steel Products for Wood or Cold-formed Steel Construction

Revit Drawings (2D & 3D Families): ▲top

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Drawings: To download drawings, right-click or Ctrl-click on the link, then choose "Save Target As..." ▼next ▲top

Download the Simpson Strong-Tie® AutoCAD® Menu, which allows you to insert Ortho views directly into your AutoCAD drawing.

	ORTHOGRAPHIC	PERSPECTIVE
DTT2Z	DTT2Z: DWG | DXF DTT2Z front view: DWG | DXF DTT2Z left view: DWG | DXF DTT2Z right view: DWG | DXF DTT2Z top view: DWG | DXF	DTT2Z: DWG | DXF DTT2Z installed: DWG | DXF
HDU	None for this model	None for this model
HDU11	HDU11: DWG | DXF HDU11 front view: DWG | DXF HDU11 right view: DWG | DXF HDU11 top view: DWG | DXF	None for this model
HDU14	HDU14: DWG | DXF HDU14 front view: DWG | DXF HDU14 left view: DWG | DXF HDU14 right view: DWG | DXF HDU14 top view: DWG | DXF	None for this model
HDU2	HDU2: DWG | DXF HDU2 front view: DWG | DXF HDU2 right view: DWG | DXF HDU2 top view: DWG | DXF	High Wind-Resistant Construction D46: Stud to Band Joist: DWG | DXF High Wind-Resistant Construction D9: Girder/Truss to Wall Framing: DWG | DXF
HDU4	HDU4: DWG | DXF HDU4 front view: DWG | DXF HDU4 right view: DWG | DXF	High Wind-Resistant Construction D8: Girder/Truss to Wall Framing: DWG | DXF
HDU5	HDU5: DWG | DXF HDU5 front view: DWG | DXF HDU5 right view: DWG | DXF	High Wind-Resistant Construction D101: Holdowns: DWG | DXF High Wind-Resistant Construction D21: Girder/Truss To Masonry/Concrete: DWG | DXF High Wind-Resistant Construction D49: Floor to Masonry/Concrete: DWG | DXF
HDU8	HDU8: DWG | DXF HDU8 front view: DWG | DXF HDU8 right view: DWG | DXF	None for this model

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C-2011 (Wood Construction Connectors), page 50

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Deck Framing Connection Guide

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Strong-Bolt® 2 *Wedge Anchor for Cracked and Uncracked Concrete*

The Strong-Bolt®2 wedge anchor is the next-generation solution for cracked and uncracked concrete. Following rigorous testing according to ICC-ES acceptance criteria, the Strong-Bolt 2 anchor received classification as a Category 1 anchor, the highest attainable anchor category for performance in cracked concrete under static and seismic loading. Available in stainless steel, it is code-listed by ICC-ES under the 2009 IBC requirements for post-installed anchors in cracked and uncracked concrete.

Strong-Bolt®2 Wedge Anchor

FEATURES:

- **Category 1 anchor classification:** The Strong-Bolt 2 anchor received classification as a Category 1 anchor, which is established by performance in reliability tests in accordance with AC193 and ACI355.2 test criteria. Category 1 is the highest attainable anchor category for reliability.
- **Tri-segmented clip:** Each segment adjusts independently, increasing follow-up expansion should the hole increase in size as a result of a crack
- **Dual embossments on each clip segment:** Enables clip to undercut into the concrete thereby increasing follow-up expansion should a crack occur
- **The ⅜" anchor solution approved for 3¼" concrete thickness:** The Strong-Bolt 2 anchor can be installed in cracked concrete with a minimum thickness of 3¼", including concrete-over-metal decking
- **High-strength alloy clip on carbon-steel anchors:** This special alloy clip offers improved performance
- **Standard (ANSI) fractional anchor:** Fits most fixtures and installs with common drill bit sizes and tools
- **Type 316 stainless-steel clip on stainless steel anchors:** In addition to superior corrosion resistance, a stainless-steel clip offers "memory" that contributes to the anchor's performance if the hole increases in size because of a crack

MATERIAL: Carbon-steel stud with special alloy clip; stainless-steel stud with stainless-steel clip

FINISH: Zinc-plated (carbon steel)

CODES: ICC-ES ESR-3037 (carbon and stainless steel in concrete); IAPMO ES ER-240 (carbon steel in CMU); City of Los Angeles RR25891; Underwriters Laboratories File Ex3605; Factory Mutual 3043442; Florida – Pending

TEST CRITERIA: The Strong-Bolt 2 wedge anchor has been tested in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC 193) and ACI 355.2 for the following:

- Static tension and shear loading in cracked and uncracked concrete
- Seismic and wind loading in cracked and uncracked concrete
- Performance in cracked concrete
- Performance in lightweight concrete over metal deck

INSTALLATION:

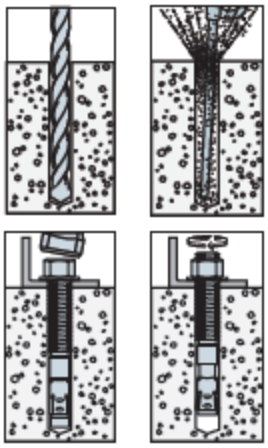
- Do not use an impact wrench to set or tighten the Strong-Bolt 2 anchor.

Caution: Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.

- Drill a hole in the base material using a carbide drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified embedment depth and blow it clean using compressed air. Overhead installations need not be blown clean. Alternatively, drill the hole deep enough to accommodate minimum hole depth and dust from drilling.
- Assemble the anchor with nut and washer so that the top of the nut is flush with the top of the anchor. Place the anchor in the fixture and drive into the hole until washer and nut are tight against the fixture.
- Tighten to the required installation torque.

DESIGN EXAMPLE: See pages 233–234

Installation Sequence



Length Identification Head Marks on Strong-Bolt®2 Wedge Anchors (corresponds to length of anchor – inches)

Mark	Units	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
From	in.	1⅛	2	2⅛	3	3⅛	4	4⅛	5	5⅛	6	6⅛	7	7⅛	8	8⅛	9	9⅛	10	11	12	13	14	15	16	17	18
Up To But Not Including	in.	2	2⅛	3	3⅛	4	4⅛	5	5⅛	6	6⅛	7	7⅛	8	8⅛	9	9⅛	10	11	12	13	14	15	16	17	18	19

Strong-Bolt® 2 *Wedge Anchor Product Information*

SIMPSON Strong-Tie®

Strong-Bolt®2 Anchor Product Data

Size (in.)	Carbon Steel Model No.	316 Stainless Steel Model No.	Drill Bit Dia. (in.)	Thread Length (in.)	Quantity	
					Box	Carton
⅜ x 2¾	STB2-37234	STB2-372346SS	⅜	1⅝	50	250
⅜ x 3	STB2-37300	STB2-373006SS	⅜	1⅝	50	250
⅜ x 3 1/2	STB2-37312	STB2-373126SS	⅜	2⅛	50	250
⅜ x 3¾	STB2-37334	STB2-373346SS	⅜	2⅛	50	250
⅜ x 5	STB2-37500	STB2-375006SS	⅜	3⅛	50	200
⅜ x 7	STB2-37700	STB2-377006SS	⅜	5⅛	50	200
½ x 3¾	STB2-50334	STB2-503346SS	½	2⅛	25	125
½ x 4¼	STB2-50414	STB2-504146SS	½	2⅝	25	100
½ x 4¾	STB2-50434	STB2-504346SS	½	3 1/16	25	100
½ x 5½	STB2-50512	STB2-505126SS	½	3⅝	25	100
½ x 7	STB2-50700	STB2-507006SS	½	5⅝	25	100
⅝ x 8⅛	STB2-50812	STB2-508126SS	½	6	25	50
½ x 10	STB2-50100	STB2-501006SS	½	6	25	50
⅝ x 4½	STB2-62412	STB2-624126SS	⅝	2⅝	20	80
⅝ x 5	STB2-62500	STB2-625006SS	⅝	2⅝	20	80
⅝ x 6	STB2-62600	STB2-626006SS	⅝	3⅝	20	80
⅝ x 7	STB2-62700	STB2-627006SS	⅝	4⅝	20	80
⅝ x 8½	STB2-62812	STB2-628126SS	⅝	6	20	40
⅝ x 10	STB2-62100	STB2-621006SS	⅝	6	10	20
¾ x 5½	STB2-75512	STB2-755126SS	¾	3⅝	10	40
¾ x 6 1/4	STB2-75614	STB2-756146SS	¾	3⅝	10	40
¾ x 7	STB2-75700	STB2-757006SS	¾	4⅝	10	40
¾ x 8½	STB2-75812	STB2-758126SS	¾	6	10	20
¾ x 10	STB2-75100	STB2-751006SS	¾	6	10	20

Material Specifications

Carbon Steel - Zinc Plated[1]			
Component Materials			
Anchor Body	Nut	Washer	Clip
Carbon Steel	Carbon Steel ASTM A 563, Grade A	Carbon Steel ASTM F844	Carbon Steel ASTM A 568

1. Zinc meets ASTM B 633, Class SC 1 (Fe / Zn 5), Type III.

Stainless Steel			
Component Materials			
Anchor Body	Nut	Washer	Clip
Type 316 Stainless Steel	Type 316 Stainless Steel	Type 316 Stainless Steel	Type 316 Stainless Steel

Carbon Steel Strong-Bolt®2 Wedge Anchor Installation Information[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter, Carbon Steel							
			⅜ inch		½ inch			⅝ inch		¾ inch	
Installation Information											
Nominal Diameter	d_a[2]	in.	⅜		½			⅝		¾	
Drill Bit Diameter	d	in.	⅜		½			⅝		¾	
Baseplate Clearance Hole Diameter[3]	d_c	in.	⅝		⅞			1 1/16		1 1/4	
Installation Torque	T_{inst}	ft-lbf	30		60			90		150	
Nominal Embedment Depth	h_{nom}	in.	1⅜	2⅜	2¾		3⅜	3⅜	5⅛	4⅛	5⅛
Effective Embedment Depth	h_{ef}	in.	1⅜	2⅜	2¾		3⅜	2¾	4⅜	3⅜	5
Minimum Hole Depth	h_{hole}	in.	2	3	3		4 1/8	3⅝	5⅝	4⅝	6
Minimum Overall Anchor Length	ℓ_{anch}	in.	2⅝	3⅛	3⅝		5⅛	4⅛	6	5⅛	7
Critical Edge Distance	c_{ac}	in.	6⅛	6	6⅛	6⅛	7⅛	7⅛	9	9	8
Minimum Edge Distance	c_{min}	in.	6		7	4	4	6½		6½	
	for $s \geq$	in.	—		—	—	—	—		8	
Minimum Spacing	s_{min}	in.	3		7	4	4	5		7	
	for $c \geq$	in.	—		—	—	—	—		8	
Minimum Concrete Thickness	h_{min}	in.	3¼	4½	4½	5½	6	5½	7⅝	6⅝	8⅝
Additional Data											
Yield Strength	f_{ya}	psi	92,000		85,000					70,000	
Tensile Strength	f_{uta}[4]	psi	115,000							110,000	
Minimum Tensile and Shear Stress Area	A_{se}	in²	0.0514		0.105			0.166		0.270	
Axial Stiffness in Service Load Range - Cracked and Uncracked Concrete	β	lb/in	34,820		63,570			91,370		118,840	

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. For the 2006 IBC, d_o replaces d_a.
4. For the 2003 IBC, f_{ut} replaces f_{uta}.

Stainless-Steel Strong-Bolt® 2 Wedge Anchor Installation Information[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Installation Information										
Nominal Diameter	d_a[3]	in.	⅜		½		⅝		¾	
Drill Bit Diameter	d	in.	⅜		½		⅝		¾	
Baseplate Clearance Hole Diameter[2]	d_c	in.	7/16		9/16		11/16		7/8	
Installation Torque	T_{inst}	ft-lbf	30		60		80		150	
Nominal Embedment Depth	h_{nom}	in.	1 ⅞	2 ⅜	2 ¾	3 ⅜	3 ⅜	5 ⅛	4 ⅛	5 ⅛
Effective Embedment Depth	h_{ef}	in.	1 ⅜	2 ⅛	2 ⅜	3 ⅛	2 ⅞	4 ⅜	3 ⅜	5
Minimum Hole Depth	h_{hole}	in.	2	3	3	4 ½	3 ¾	5 ¾	4 ¾	6
Minimum Overall Anchor Length	ℓ_{anch}	in.	2 ⅝	3 ⅛	3 ⅝	5 ⅛	4 ⅛	6	5 ⅛	7
Critical Edge Distance	c_{ac}	in.	6 ½	8 ½	4 ½	7	7 ½	9	8	8
Minimum Edge Distance	c_{min}	in.	6		6 ½	5 / 4	4		6	
	for $s \geq$	in.	10		—	— / 8	8		—	
Minimum Spacing	s_{min}	in.	3		8	5 ½ / 4	6 ¼		6 ½	
	for $c \geq$	in.	10		—	— / 8	5 ½		—	
Minimum Concrete Thickness	h_{min}	in.	3 ½	4 ½	4 ½	6	5 ½	7 ⅝	6 ½	8 ¼
Additional Data										
Yield Strength	f_{ya}	psi	80,000		92,000		82,000		68,000	
Tensile Strength	f_{uta}[4]	psi	100,000		115,000		108,000		95,000	
Minimum Tensile and Shear Stress Area	A_{se}	in²	0.0514		0.105		0.166		0.270	
Axial Stiffness in Service Load Range - Cracked and Uncracked Concrete	β	lb/in	29,150		54,900		61,270		154,290	

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.
2. The clearance must comply with applicable code requirements for the connected element.
3. For the 2006 IBC, d_o replaces d_a.
4. For the 2003 IBC, f_{nt} replaces f_{uta}.

Carbon Steel Strong-Bolt®2 Wedge Anchor Tension Strength Design Data[1]

* See page 13 for a nexplanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Carbon Steel							
			¾ inch		⅞ inch		1 inch		1¼ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅜	2¾	3⅜	3⅝	5⅛	4⅛	5⅝
Steel Strength in Tension (ACI 318 Section D.5.1)										
Steel Strength in Tension	N_{sa}	lb	5,600		12,100		19,070		29,700	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.75							
Concrete Breakout Strength in Tension (ACI 318 Section D.5.2)[8]										
Effective Embedment Depth	h_{ef}	in.	1⅝	2½	2¾	3⅜	2⅝	4½	3⅝	5
Critical Edge Distance	c_{ac}	in.	6⅛	6	6⅛	7⅛	7⅛	9	9	8
Effectiveness Factor - Uncracked Concrete	k_{uncr}	—	24		24		24		24	
Effectiveness Factor - Cracked Concrete	k_{cr}	—	17		17		17		17	
Modification Factor	$\Psi_{c,N}$[7]	—	1.00		1.00		1.00		1.00	
Strength Reduction Factor - Concrete Breakout Failure[3]	ϕ_{cb}	—	0.65							
Pull-Out Strength in Tension (ACI 318 Section D.5.3)[8]										
Pull-Out Strength Cracked Concrete (f'_c = 2500 psi)	$N_{p,cr}$	lb	1,300[5]	2,775[5]	N/A[4]	3,735[5]	N/A[4]	6,895[5]	N/A[4]	8,500[5]
Pull-Out Strength Uncracked Concrete (f'_c = 2500 psi)	$N_{p,uncr}$	lb	N/A[4]	3,340[5]	3,615[5]	5,255[5]	N/A[4]	9,025[5]	7,115[5]	8,870[5]
Strength Reduction Factor - Pullout Failure[6]	ϕ_p	—	0.65							
Tensile Strength for Seismic Applications (ACI Section D.3.3.3)[8]										
Tension Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$N_{p,eq}$	lb	1,300[5]	2,775[5]	N/A[4]	3,735[5]	N/A[4]	6,895[5]	N/A[4]	8,500[5]
Strength Reduction Factor - Pullout Failure[6]	ϕ_{eq}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.5(c).
4. N/A (Not Applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500\ psi)^{0.5}$.
6. The tabulated value of ϕ_p or ϕ_{eq} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5(c).
7. For the 2003 IBC, Ψ_s replaces $\Psi_{c,N}$.
8. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength, $N_{p,cr}$, $N_{p,uncr}$ and N_{eq} by 0.6. All-lightweight concrete is beyond the scope of this table.

Strong-Bolt® 2 *Wedge Anchor Performance Data*

SIMPSON Strong-Tie

Stainless Steel Strong-Bolt® 2 Wedge Anchor Tension Strength Design Data[1]

* See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅝	2⅜	2¾	3⅜	3⅝	5⅛	4½	5⅝
Steel Strength in Tension (ACI 318 Section D.5.1)										
Steel Strength in Tension	N_{sa}	lb	5,140		12,075		17,930		25,650	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.75							
Concrete Breakout Strength in Tension (ACI 318 Section D.5.2)[10]										
Effective Embedment Depth	h_{ef}	in.	1⅝	2⅜	2¾	3⅜	2⅝	4⅛	3⅝	5
Critical Edge Distance	c_{ac}	in.	6⅛	8⅝	4⅝	7	7⅝	9	8	8
Effectiveness Factor - Uncracked Concrete	k_{uncr}	—	24		24		24		24	
Effectiveness Factor - Cracked Concrete	k_{cr}	—	17		17		17		17	
Modification Factor	$\psi_{c,N}$[3]	—	1.00		1.00		1.00		1.00	
Strength Reduction Factor - Concrete Breakout Failure[3]	ϕ_{cb}	—	0.65							
Pull-Out Strength in Tension (ACI 318 Section D.5.3)[10]										
Pull-Out Strength Cracked Concrete (f'_c = 2500 psi)	$N_{p,cr}$	lb	1,720[4]	3,145[5]	2,560[6]	4,305[5]	N/A[4]	6,545[7]	N/A[4]	8,230[5]
Pull-Out Strength Uncracked Concrete (f'_c = 2500 psi)	$N_{p,uncr}$	lb	N/A[4]	4,770[5]	3,230[6]	4,495[5]	N/A[4]	7,615[5]	7,725[7]	9,625[7]
Strength Reduction Factor - Pullout Failure[8]	ϕ_p	—	0.65							
Tensile Strength for Seismic Applications (ACI Section D.3.3.3)[10]										
Tension Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$N_{p,eq}$	lb	1,720[5]	2,830[5]	2,560[5]	4,305[5]	N/A[4]	6,545[7]	N/A[4]	8,230[5]
Strength Reduction Factor - Pullout Failure[8]	ϕ_{eq}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt®2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 D.4.5(c).
4. N/A (Not Applicable) denotes that pullout resistance does not need to be considered.
5. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500\ psi)^{0.5}$.
6. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500\ psi)^{0.33}$.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 2{,}500\ psi)^{0.14}$.
8. The tabulated value of ϕ_p or ϕ_{eq} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5(c).
9. For the 2003 IBC, ψ_3 replaces $\psi_{c,N}$.
10. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength, $N_{p,cr}$, $N_{p,uncr}$ and N_{eq} by 0.6. All-lightweight concrete is beyond the scope of this table.

Carbon Steel Strong-Bolt®2 Wedge Anchor Shear Strength Design Data[1]

* See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Carbon Steel							
			⅜ inch		½ inch		⅝ inch		¾ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅞	2⅜	2¾	3⅜	3⅝	5⅛	4½	5¾
Steel Strength in Shear (ACI 318 Section D.6.1)										
Steel Strength in Shear	V_{sa}	lb	1,800		7,235		11,035		14,480	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							
Concrete Breakout Strength in Shear (ACI 318 Section D.6.2)[6]										
Outside Diameter	d_a'	in.	0.375		0.500		0.625		0.750	
Load Bearing Length of Anchor in Shear	ℓ_e	in.	1.500	2.500	2.250	3.375	2.750	4.500	3.375	5.000
Strength Reduction Factor – Concrete Breakout Failure[3]	ϕ_{cb}	—	0.70							
Concrete Pryout Strength in Shear (ACI 318 Section D.6.3)										
Coefficient for Pryout Strength	k_{cp}	—	1.0	2.0	1.0	2.0	2.0		2.0	
Effective Embedment Depth	h_{ef}	in.	1⅛	2⅛	2⅛	3⅛	2⅝	4⅛	3⅛	5
Strength Reduction Factor – Concrete Pryout Failure[4]	ϕ_{cp}	—	0.70							
Steel Strength in Shear for Seismic Applications (ACI 318 Section D.3.3.3)										
Shear Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$V_{sa,eq}$	lb	1,800		6,510		9,930		11,775	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt®2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 Section D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.5(c).
4. The tabulated value of ϕ_{cp} applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cp} must be determined in accordance with ACI 318 D.4.5(c).
5. For the 2006 IBC, d_o replaces d_a.
6. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength by 0.6. All-lightweight concrete is beyond the scope of this table.

*See page 13 for an explanation of the load table icons

Stainless-Steel Strong-Bolt®2 Wedge Anchor Shear Strength Design Data[1]

Characteristic	Symbol	Units	Nominal Anchor Diameter							
			Stainless Steel							
			¾ inch		⅞ inch		1 inch		1¼ inch	
Anchor Category	1,2 or 3	—	1							
Nominal Embedment Depth	h_{nom}	in.	1⅝	2⅜	2⅝	3⅜	3⅝	5⅛	4⅛	5⅛
Steel Strength in Shear (ACI 318 Section D.6.1)										
Steel Strength in Shear	V_{sa}	lb	3,085		7,245		6,745	10,760	15,045	
Strength Reduction Factor - Steel Failure[2]	ϕ_{sa}	—	0.65							
Concrete Breakout Strength in Shear (ACI 318 Section D.6.2)[6]										
Outside Diameter	d_a[5]	in.	0.375		0.500		0.625		0.750	
Load Bearing Length of Anchor in Shear	ℓ_e	in.	1.500	2.500	2.250	3.375	2.750	4.500	3.375	5.000
Strength Reduction Factor – Concrete Breakout Failure[3]	ϕ_{cb}	—	0.70							
Concrete Pryout Strength in Shear (ACI 318 Section D.6.3)										
Coefficient for Pryout Strength	k_{cp}	—	1.0	2.0	1.0	2.0	2.0		2.0	
Effective Embedment Depth	h_{ef}	in.	1⅝	2⅜	2⅝	3⅜	2⅝	4⅜	3⅜	5
Strength Reduction Factor – Concrete Pryout Failure[4]	ϕ_{cp}	—	0.70							
Steel Strength in Shear for Seismic Applications (ACI 318 Section D.3.3.3)										
Shear Strength of Single Anchor for Seismic Loads (f'_c = 2500 psi)	$V_{sa,eq}$	lb	3,085		6,100		6,745	10,760	13,620	
Strength Reduction Factor – Steel Failure[2]	ϕ_{sa}	—	0.65							

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. The tabulated value of ϕ_{sa} applies when the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{sa} must be determined in accordance with ACI 318 D.4.5. Strong-Bolt® 2 anchors are ductile steel elements as defined in ACI 318 D.1.
3. The tabulated value of ϕ_{cb} applies when both the load combinations of Section 1605.2.1 of the IBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4(c) for Condition B are met. Condition B applies where supplementary reinforcement is not provided. For installations where complying supplementary reinforcement can be verified, the ϕ_{cb} factors described in ACI 318 Section D.4.4 for Condition A are allowed. If the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 Section D.4.4 for Condition A are met, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.4(c). If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cb} must be determined in accordance with ACI 318 Section D.4.5(c).
4. The tabulated value of ϕ_{cp} applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ_{cp} must be determined in accordance with ACI 318 D.4.5(c).
5. For the 2006 IBC, d_o replaces d_a.
6. For sand-lightweight concrete, in lieu of ACI 318 Section D.3.4, modify the value of concrete breakout strength by 0.6. All-lightweight concrete is beyond the scope of this table.

Carbon Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Strength Design Data for the Soffit of Concrete Over Profile Steel Deck Floor and Roof Assemblies[1,2,5,8,9]

*See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Nominal Anchor Diameter								
			Carbon Steel								
			Lower Flute							Upper Flute	
			⅜ inch		½ inch		⅝ inch		¾ inch	⅝ inch	½ inch
Nominal Embedment Depth	h_{nom}	in.	2	3 ⅜	2 ¾	4 ⅛	3 ¾	5 ⅝	4 ⅛	2	2 ¾
Effective Embedment Depth	h_{ef}	in.	1 ⅝	3	2 ¼	4	2 ¾	5	3 ⅝	1 ⅝	2 ¼
Installation Torque	T_{inst}	ft-lbf	30		60		90		150	30	60
Pullout Strength, concrete on metal deck (cracked)[3,4]	$N_{p,deck,cr}$	lb	1,040[7]	2,615[7]	2,040[7]	2,730[7]	2,615[7]	4,990[7]	2,815[7]	1,340[7]	3,785[7]
Pullout Strength, concrete on metal deck (uncracked)[3,4]	$N_{p,deck,uncr}$	lb	1,765[7]	3,150[7]	2,580[7]	3,840[7]	3,685[7]	6,565[7]	3,800[7]	2,275[7]	4,795[7]
Pullout Strength, concrete on metal deck (seismic)[3,4]	$N_{p,deck,eq}$	lb	1,040[7]	2,615[7]	2,040[7]	2,730[7]	2,615[7]	4,990[7]	2,815[7]	1,340[7]	3,785[7]
Steel Strength in Shear, concrete on metal deck[5]	$V_{sa,deck}$	lb	1,595	3,490	2,135	4,580	2,640	7,000	4,535	3,545	5,920
Steel Strength in Shear, concrete on metal deck (seismic)[5]	$V_{sa,deck,eq}$	lb	1,595	3,490	1,920	4,120	2,375	6,300	3,690	3,545	5,330

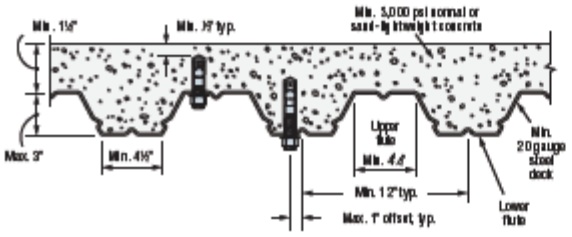
1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. Profile steel deck must comply with the configuration in the figure below, and have a minimum base-steel thickness of 0.035 inch [20 gauge]. Steel must comply with ASTM A 653/A 653M SS Grade 33 with minimum yield strength of 33,000 psi. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$. For seismic loads, $N_{p,deck,eq}$ shall be substituted for N_p.
5. In accordance with ACI 318 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies $V_{sa,deck}$ shall be substituted for V_{sa}. For seismic loads, $V_{sa,deck,eq}$ shall be substituted for V_{sa}.
6. The minimum anchor spacing along the flute must be the greater of $3.0h_{ef}$ or 1.5 times the flute width.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000\ psi)^{0.5}$.
8. Concrete shall be normal-weight or structural sand-lightweight concrete having a minimum specified compressive strength, f'_c, of 3,000 psi.
9. Minimum distance to edge of panel is $2h_{ef}$.

Stainless Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Strength Design Data for the Soffit of Concrete Over Profile Steel Deck Floor and Roof Assemblies[1,2,5,10,11]

*See page 13 for an explanation of the load table icons

Characteristic	Symbol	Units	Stainless Steel								
			Lower Flute							Upper Flute	
			⅜ inch		½ inch		⅝ inch		¾ inch	⅝ inch	½ inch
Nominal Embedment Depth	h_{nom}	in.	2	3 ⅜	2 ¾	4 ½	3 ⅜	5 ⅝	4 ½	2	2 ¾
Effective Embedment Depth	h_{ef}	in.	1 ⅝	3	2 ¼	4	2 ¾	5	3 ¾	1 ⅝	2 ¼
Installation Torque	T_{inst}	ft-lbf	30		60		80		150	30	60
Pullout Strength, concrete on metal deck (cracked)[3]	$N_{p,deck,cr}$	lb	1,230[6]	2,605[6]	1,990[7]	2,550[7]	1,750[6]	4,020[6]	3,030[7]	1,550[6]	2,055[7]
Pullout Strength, concrete on metal deck (uncracked)[3]	$N_{p,deck,uncr}$	lb	1,580[6]	3,960[6]	2,475[7]	2,660[7]	2,470[7]	5,000[6]	4,275[6]	1,990[6]	2,560[7]
Pullout Strength, concrete on metal deck (seismic)[3]	$N_{p,deck,eq}$	lb	1,230[6]	2,345[6]	1,990[6]	2,550[6]	1,750[6]	4,020[6]	3,030[7]	1,550[6]	2,055[7]
Steel Strength in Shear, concrete on metal deck[4]	$V_{sa,deck}$	lb	2,285	3,085	3,430	4,680	3,235	5,430	6,135	3,085	5,955
Steel Strength in Shear, concrete on metal deck (seismic)[5]	$V_{sa,deck,eq}$	lb	2,285	3,085	2,400	3,275	3,235	5,430	5,520	3,085	4,170

1. The information presented in this table must be used in conjunction with the design criteria of ACI 318 Appendix D, except as modified below.
2. Profile steel deck must comply with the configuration in the figure below, and have a minimum base-steel thickness of 0.035 inch [20 gauge]. Steel must comply with ASTM A 653/A 653M SS Grade 33 with minimum yield strength of 33,000 psi. Concrete compressive strength shall be 3,000 psi minimum.
3. For anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies, calculation of the concrete breakout strength may be omitted.
4. In accordance with ACI 318 Section D.5.3.2, the nominal pullout strength in cracked concrete for anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies $N_{p,deck,cr}$ shall be substituted for $N_{p,cr}$. Where analysis indicates no cracking at service loads, the normal pullout strength in uncracked concrete $N_{p,deck,uncr}$ shall be substituted for $N_{p,uncr}$. For seismic loads, $N_{p,deck,eq}$ shall be substituted for N_p.
5. In accordance with ACI 318 Section D.6.1.2(c), the shear strength for anchors installed in the soffit of sand-lightweight or normal-weight concrete over metal deck floor and roof assemblies $V_{sa,deck}$ shall be substituted for V_{sa}. For seismic loads, $V_{sa,deck,eq}$ shall be substituted for V_{sa}.
6. The minimum anchor spacing along the flute must be the greater of $3.0h_{ef}$ or 1.5 times the flute width.
7. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000\ psi)^{0.5}$.
8. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000\ psi)^{0.33}$.
9. The characteristic pull-out strength for greater concrete compressive strengths shall be increased by multiplying the tabular value by $(f'_c / 3{,}000\ psi)^{0.4}$.
10. Concrete shall be normal-weight or structural sand-lightweight concrete having a minimum specified compressive strength, f'_c, of 3,000 psi.
11. Minimum distance to edge of panel is $2h_{ef}$.



Strong-Bolt® 2 *Wedge Anchor Performance Data*

SIMPSON Strong-Tie®

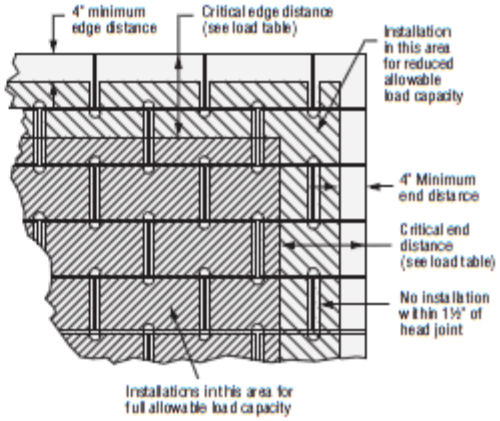
Carbon-Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Loads in 8-inch Lightweight, Medium-weight and Normal-Weight Grout-Filled CMU

* See page 13 for an explanation of the load table icons

Size in. (mm)	Drill Bit Dia. in.	Min. Embed. Depth. in. (mm)	Install. Torque ft-lbs (N-m)	Critical Edge Dist. in. (mm)	Critical End Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load		Shear Load	
							Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
Anchor Installed in the Face of the CMU Wall (See Figure 1)										
3/8 (9.5)	3/8	2 5/8 (67)	20 (27.1)	12 (305)	12 (305)	8 (203)	2,185 (9.7)	435 (1.9)	3,875 (17.2)	775 (3.4)
1/2 (12.7)	1/2	3 1/2 (89)	35 (47.5)	12 (305)	12 (305)	8 (203)	2,645 (11.8)	530 (2.4)	5,055 (22.5)	1,010 (4.5)
5/8 (15.9)	5/8	4 3/8 (111)	55 (74.6)	20 (508)	20 (508)	8 (203)	4,460 (19.8)	890 (4.0)	8,815 (39.2)	1,765 (7.9)
3/4 (19.1)	3/4	5 1/4 (133)	100 (135.6)	20 (508)	20 (508)	8 (203)	5,240 (23.3)	1050 (4.7)	12,450 (55.4)	2,490 (11.1)

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Listed loads may be applied to installations on the face of the CMU wall at least 1¼ inch away from head joints.
3. Values for 8-inch wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, f'_m, at 28 days is 1500 psi.
4. Embedment depth is measured from the outside face of the concrete masonry unit.
5. Tension and shear loads may be combined using the parabolic interaction equation (n = 5/3).
6. Refer to allowable load adjustment factors for edge distance and spacing on page 105.

Figure 1



Carbon-Steel Strong-Bolt® 2 Wedge Anchor Tension and Shear Loads in 8-inch Lightweight, Medium-weight and Normal-Weight Grout-Filled CMU

* See page 13 for an explanation of the load table icons

Size in. (mm)	Drill Bit Dia. in.	Min. Embed. Depth. in. (mm)	Install. Torque ft-lbs (N-m)	Min. Edge. Dist. in. (mm)	Critical End Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load		Shear Load Perp. To Edge		Shear Load Parallel To Edge	
							Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
Anchor Installed in Cell Opening or Web (Top of Wall) (See Figure 2)												
1/2 (12.7)	1/2	3 1/2 (89)	35 (47.5)	1 3/4 (44)	12 (305)	8 (203)	2,080 (9.3)	415 (1.8)	1,165 (5.2)	235 (1.0)	3,360 (14.9)	670 (3.0)
5/8 (15.9)	5/8	4 3/8 (111)	55 (74.6)	1 3/4 (44)	12 (305)	8 (203)	3,200 (14.2)	640 (2.8)	1,370 (6.1)	275 (1.2)	3,845 (17.1)	770 (3.4)

1. The tabulated allowable loads are based on a safety factor of 5.0 for installation under the IBC and IRC.
2. Values for 8-inch wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, f'_m, at 28 days is 1500 psi.
3. Tension and shear loads may be combined using the parabolic interaction equation (n = 5/3).
4. Refer to allowable load adjustment factors for edge distance and spacing on page 105.

Figure 2

Load Adjustment Factors for Carbon-Steel Strong-Bolt® 2 Anchors in Face-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Located the edge distance (C_{act}) or spacing (S_{act}) at which the anchor is to be installed.
5. The load adjustment factor (f_c or f_s) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

Edge or End Distance Tension (f_c)

* See page 13 for an explanation of the load table icons

C_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2⅝	3⅛	4⅝	5¼
	C_{cr}	12	12	20	20
	C_{min}	4	4	4	4
	f_{cmin}	1.00	1.00	1.00	0.97
4		1.00	1.00	1.00	0.97
6		1.00	1.00	1.00	0.97
8		1.00	1.00	1.00	0.98
10		1.00	1.00	1.00	0.98
12		1.00	1.00	1.00	0.99
14				1.00	0.99
16				1.00	0.99
18				1.00	1.00
20				1.00	1.00

Edge or End Distance Shear (f_c)

* See page 13 for an explanation of the load table icons

C_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2⅝	3⅛	4⅝	5¼
	C_{cr}	12	12	20	20
	C_{min}	4	4	4	4
	f_{cmin}	0.71	0.60	0.36	0.28
4		0.71	0.60	0.36	0.28
6		0.78	0.70	0.44	0.37
8		0.86	0.80	0.52	0.46
10		0.93	0.90	0.60	0.55
12		1.00	1.00	0.68	0.64
14				0.76	0.73
16				0.84	0.82
18				0.92	0.91
20				1.00	1.00

Spacing Tension (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2⅝	3⅛	4⅝	5¼
	S_{cr}	8	8	8	8
	S_{min}	4	4	4	4
	f_{smin}	1.00	0.93	0.86	0.80
4		1.00	0.93	0.86	0.80
6		1.00	0.97	0.93	0.90
8		1.00	1.00	1.00	1.00

Spacing Shear (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	⅜	½	⅝	¾
	E	2⅝	3⅛	4⅝	5¼
	S_{cr}	8	8	8	8
	S_{min}	4	4	4	4
	f_{smin}	1.00	1.00	1.00	1.00
4		1.00	1.00	1.00	1.00
6		1.00	1.00	1.00	1.00
8		1.00	1.00	1.00	1.00

Load Adjustment Factors for Carbon-Steel Strong-Bolt® 2 Anchors in Top-of-Wall Installation in 8" Grout-Filled CMU: Edge Distance and Spacing, Tension and Shear Loads

How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Located the edge distance (C_{act}) or spacing (S_{act}) at which the anchor is to be installed.
5. The load adjustment factor (f_c or f_s) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load adjustment factor.
7. Reduction factors for multiple edges or spacings are multiplied together.

End Distance Tension (f_c)

S_{act} (in.)	Dia.	⅛	⅜
	E	3⅛	4⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	1.00	1.00
4		1.00	1.00
6		1.00	1.00
8		1.00	1.00
10		1.00	1.00
12		1.00	1.00

End Distance Shear Perpendicular to Edge (f_c)

C_{act} (in.)	Dia.	⅛	⅜
	E	3⅛	4⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	0.90	0.83
4		0.90	0.83
6		0.93	0.87
8		0.95	0.92
10		0.98	0.96
12		1.00	1.00

End Distance Shear Parallel to Edge (f_c)

C_{act} (in.)	Dia.	⅛	⅜
	E	3⅛	4⅜
	C_{cr}	12	12
	C_{min}	4	4
	f_{cmin}	0.53	0.50
4		0.53	0.50
6		0.65	0.63
8		0.77	0.75
10		0.88	0.88
12		1.00	1.00

Spacing Tension (f_s)

S_{act} (in.)	Dia.	⅛	⅜
	E	3⅛	4⅜
	S_{cr}	8	8
	S_{min}	4	4
	f_{smin}	0.93	0.86
4		0.93	0.86
6		0.97	0.93
8		1.00	1.00

Spacing Shear Perpendicular or Parallel to Edge (f_s)

* See page 13 for an explanation of the load table icons

S_{act} (in.)	Dia.	⅛	⅜
	E	3⅛	4⅜
	S_{cr}	8	8
	S_{min}	4	4
	f_{smin}	1.00	1.00
4		1.00	1.00
6		1.00	1.00
8		1.00	1.00

Appendix III

Mechanical Equipment Cut Sheets

27" Single Wall Oven

HBN5450UC - Stainless steel

BOSCH
Invented for Life

	500 Series
	
Alternative colors available	**Stainless steel(HBN5450UC)**
Product Features	**Appearance** - Contemporary Stainless Steel Design - ClearTouch® Glass Control - Retractable Controls for Sleek and Easy to Clean Design - Flush-to-Cabinet Design **Capacity** - #1 in Capacity at 4.2 Cu.Ft. - Recessed Broil Element for Increased Capacity and Safety - Hidden Bake Element for Increased Capacity **Convenience** - Amber Colored Full Text Display - Timer with Cook Time and Delay Start Function - Extra Large Door Window for Easy Monitoring of Cooking - High Quality Self-cleaning Rack Supports - Two Oven Lights to Better Monitor Cooking Progress - Sabbath Mode **Performance** - Genuine European Convection With ACS - Speed Convection Saves up to 30% Time - Fast Preheat Reduces Preheat Time to around 7 Minutes - 14 Specialized Cooking Modes - Gourmet Cooking Made Easy - Custom Cooking Modes: Pizza, Pie, Warm and Proof - Meat Probe Takes Guesswork out of Cooking - Recipe Mode Provides 30 Pre-Programmed Auto Settings **Efficiency** - EcoClean™ 2-Hour Self-Clean Cycle

Technical Data

BOSCH
Invented for Life

500 Series

Product Features
Cooking method first cavity : Bake, Broil, Convection Bake, Convection Broil, Convection Roast, Dehydrate, Pie, Pizza, Proof, Sabbat function, Speed Convection, Top heating, 1/3 bottom heat., True Convection, Warm
Cleaning system - cavity 1 : Self Clean
Interior Lights - cavity 1 : 2
Timer settings : Alarm, timer
Included accessories : 3 x Oven racks /upper, 1 x Broiler pan /upper, 1 x Temperature probe /upper
Bake Element Wattages cavity 1 (W) : 2000
Broil Element Wattages cavity 1 (W) : 3600
Convection Element Wattages cavity 1 (W) : 2000

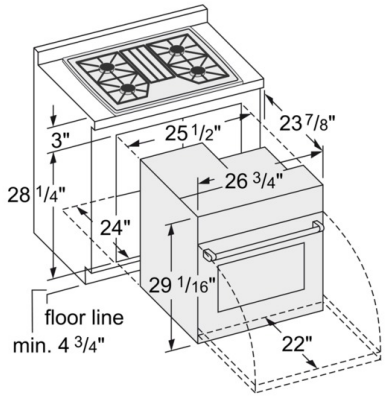
Consumption and connection features
UPC code : 825225840220
Product color : Stainless steel
Energy source : Electric
Watts (W) : 7300
Current (A) : 30
Volts (V) : 240/208
Frequency (Hz) : 60
Approval certificates : CSA
Power cord length (in) : 50"
Power cord length (cm) : 127.0
Plug type : Fixed connection, No plug
Required cutout size (HxWxD) (in) : 28 1/4" x 25 1/2" x 24"
Required cutout size (HxWxD) (mm) : 718 x 648 x 610
Overall appliance dimensions (HxWxD) (mm) : 738.2 x 679 x 606
Product packaging dimensions (HxWxD) (in) : 34" x 34" x 31"
Net weight (lbs) : 153
Net weight (kg) : 69.000
Gross weight (lbs) : 179
Gross weight (kg) : 81.000

2013-03-22

Optional accessories
HEZ1077 Telescopic Oven Rack 27"

Included accessories
3 x Oven racks /upper
1 x Broiler pan /upper
1 x Temperature probe /upper

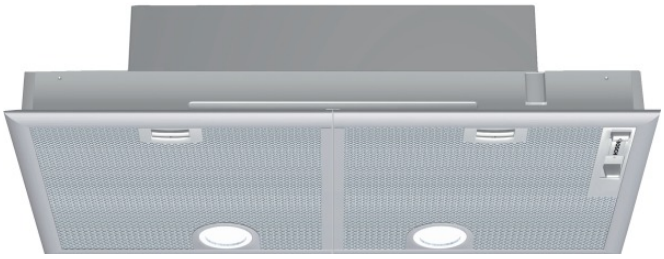
EAN code
4242002388311



29" Custom Insert Hood

DHL755BUC

BOSCH
Invented for Life



	Specialty Ventilation
Alternative colors available	**Silver metallic(DHL755BUC)**
Product Features	**Appearance** - Wall or Island Installations Up to 36" Wide **Convenience** - Dishwasher-safe Mesh Filters - Slide-Switch Control - 2 Halogen Lights **Performance** - Four Power Levels - Quickly and Quietly Clears the Air of Smoke and Odor - 400 CFM Blower Included

Technical Data

Invented for Life

Specialty Ventilation

Product Features
Operating Mode : Ducted
Number of speed settings : 3-stage
Number of lights : 2
Type of lamps used : Halogen
Total power of the lamps (W) : 40
Grease filter material : aluminium
Grease filter type : Multilayer cassette

Consumption and connection features
UPC code : 825225853299
Watts (W) : 270
Volts (V) : 120
Frequency (Hz) : 60
Approval certificates : ETL
Power cord length (cm) : 150.0
Plug type : 120V-3 prong
Overall appliance dimensions (HxWxD) (in) : 6 1/4 " / x 28 11/16 " x 15 "
Overall appliance dimensions (HxWxD) (mm) : 159 MM x 730 x 380
Product packaging dimensions (HxWxD) (in) : 11.81 x 31.49 x 17.32
Required distance above cooktop/ranges : 30 "/30 "
Net weight (lbs) : 22
Net weight (kg) : 10.000
Gross weight (lbs) : 26
Gross weight (kg) : 12.000
Maximum CFM : 440
No-return airflow flap : No

2013-03-22

EAN code

4242002443126

800 Series - Stainless Steel

B30BB830SS

BOSCH
Invented for Life

	30" Built-In Bottom-Freezer
	
Alternative colors available	**(B30BB830SS)**
Product Features	**Key Features** - Installs completly flush or framed - ALL LED sidewall and theater lighting - Dual compressor and dual evaporator - Full width meat drawer - ENERGY STAR® Qualified **Design** - ALL LED sidewall and theater lighting - Full height door - True cabinet integration without exposed venting grille - Optiflex Hinge™ - Opens out and away from cabinetry up to 115° door opening angle - Pre-assembled with stainless steel panels and handles - Frame kit for flush installations (25" deep cut-outs) or framed installations (24" deep cut-outs) , pre-assembled **Performance** - Dual compressor and dual evaporator - Electronic Controls for precise temperature management - Full width meat drawer - Carbon air filter reduces odors and keeps air clean and fresh - Humidity controlled crisper - Filtered ice-maker - SuperCool™ - SuperFreeze™ - Sabbath Mode - Economy Mode - Vacation Mode **Efficiency** - ENERGY STAR® Qualified **Convenience** - Full width glass shelves with metal trim - Full extension drawers at 90° door opening angle - Door Open Alarm **Capacity** - Full length cantilever racks for ultimate adjustability - Large capacity freezer drawer - Gallon door bins - 16 Cu. Ft.

Technical Data

BOSCH
Invented for Life

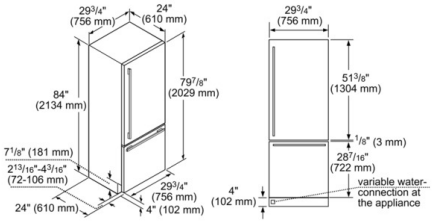
30" Built-In Bottom-Freezer

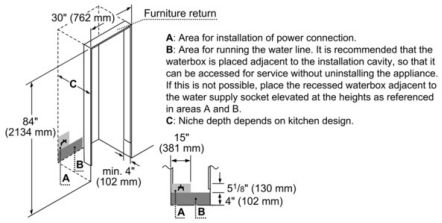
Product Features
Multi-Flow Air Tower : Yes
SUPERCOOL : Yes
SUPERFREEZE : Yes
Carbon Air Filter : No
Temperature Controlled Drawer : No
Humidity Control Drawer : Yes
Number of Door Bins - Refrigerator : 2
Adjustable Door Bins - Refrigerator : No
Tilt-Out Door Bins - Refrigerator : Yes
Gallon Storage Bins : 1
Number of Shelves - Refrigerator : 3
Door hinge : Right reversible
Adjustable Shelves - Refrigerator : 2
Reversible Door Hinge : Yes
Adjustable Shelves - Freezer : No

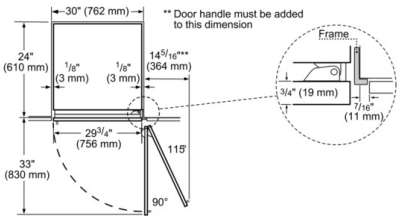
Consumption and connection features
UPC code : 825225800989
Silence level (dBA) : 43
Watts (W) : 588
Current (A) : 15
Volts (V) : 120
Frequency (Hz) : 60
Energy Star® qualified : Yes
Approval certificates : ETL, ETL C
Power cord length (in) : 78 3/4"
Required cutout size (HxWxD) (in) : 84" x 30" x 24 3/4"
Appliance Width (in) : 29 3/4"
Height (in) : 83 3/4 "
Depth (in) : 24"
Total unit gross capacity (cu. ft.) - AHAM : 16
Product packaging dimensions (HxWxD) (in) : 90.55 x 33.07 x 29.52
Refrigerator Gross capacity (cu. ft.) : 11
Freezer Gross capacity (cu ft) : 5
Net weight (lbs) : 451
Gross weight (lbs) : 492
SKU : B30BB830SS

2013-03-22

EAN code
4242002680323



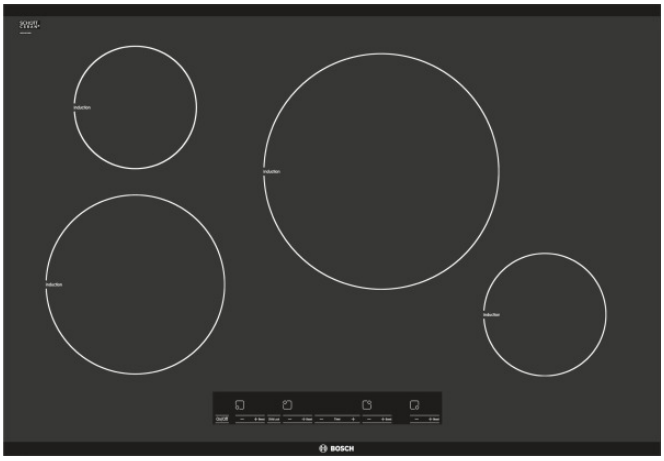




300 Series

30” Induction Cooktop with Touch Control

BOSCH
Invented for Life



	NIT3065UC
	TouchControl · 80 cm
Alternative colors available	**Black(NIT3065UC)**
Product Features	**Performance** - 11" Heating Element with Powerful 3600W - SpeedBoost™ - This Fast-heat Mode Boils Water Twice as Fast as Conventional Electric Cooktops, Saving Time and Energy. **Convenience** - CountDown Timer - Built-In Timers for Each Element. Doubles as General-Purpose Kitchen Timer. - Keep Warm Function - Perfect for Melting Chocolate or Butter or Keeping Food Warm **Safety** - Overflow Detection - Sounds Alarm and Shuts off Cooktop in Case of an Overflow - ChildLock - Prevents the Cooktop from Being Accidentially Switched on. Locks Temperature Settings if in Use. - SafeStart - Ensures that Element is Only Activated, if Suitable Cookware is in Position; no Activation When Other Metal Objects are Placed on Element - Anti-Overheat System - Shuts off Cooktop, if Surface Temperature Exceeds a Set Value - 2-Level Heat Indicator - Warns if Cooktop is Warm or Hot **Efficiency** - PotSense™ - Automatically Adjusts Cooking Element to the Size of the Pan Bottom

Technical Data

BOSCH
Invented for Life

NIT3065UC

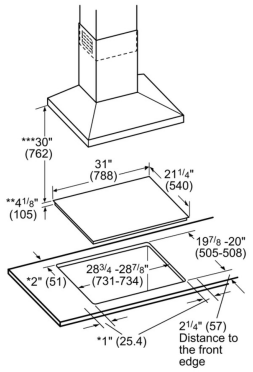
Product Features
Sealed Burners : No
Burners with booster : All
Dimension of 1st heating element (in) : 9"
Power of 1st heating element (W) : 2.2
Dimension of 2nd heating element (in) : 6"
Power of 2nd heating element (W) : 1.4
Dimension of 3rd heating element (in) : 11"
Power of 3rd heating element (W) : 2.4
Dimension of 4th heating element (in) : 6"
Power of 4th heating element (W) : 1.4

Consumption and connection features
UPC code : 825225876526
Variant color : Black
Energy source : Electric
Watts (W) : 7200
Current (A) : 40
Volts (V) : 208-240
Frequency (Hz) : 60
Approval certificates : CSA
Power cord length (in) : 37"
Power cord length (cm) : 96.0
Plug type : No plug
Required cutout size (HxWxD) (in) : 4 1/8" x 28 3/4" x 20"
Required cutout size (HxWxD) (mm) : 105 x 734-731 x 505-508
Minimum distance from counter front (in) : 2 1/4"
Minimum distance from rear wall (in) : 2"
Overall appliance dimensions (HxWxD) (in) : 1/4"+4 1/8" x 31" x 21 1/4"
Overall appliance dimensions (HxWxD) (mm) : 111.0 x 788 x 540
Product packaging dimensions (HxWxD) (in) : 7 1/16" x 36 5/8" x 26 5/8"
Net weight (lbs) : 39
Net weight (kg) : 18.000
Gross weight (lbs) : 49
Gross weight (kg) : 22.000
Total number of cooktop burners : 4

2013-03-22

EAN code

4242002524870



* Minimum distance from the cooktop cutout to the wall
** Installed depth includes 1" (26 mm) air clearance
*** Minimum distance between surface of the cooktop and lower edge of the exhaust hood.

Dimensions in inches (mm)

Axxis - White

WAS20160UC

BOSCH
Invented for Life

	24" Compact Washer
	
Alternative colors available	**White(WAS20160UC)**
Product Features	**Key Features** - 15 Wash Cycles and 6 Options - Multi-Function Status LED - Unique Raindrop Stainless Steel Drum - AntiVibration Technology for Second Floors Installation **Design** - Neat White - European Design - See-thru Silver Door - Multi-Function Status LED - Advanced Touch Control Technology - Snag Free Stainless Steel Structured Drum - Stackable - Space Saving - AntiVibration Design Reduces Vibration by up to 30% **Performance** - Sensor-controlled Automatic Washing Programs - Unique Raindrop Drum Pattern for Powerful & Gentle Cleaning - Up to 1000 rpm Maximum Spin Speed - 5 Spin Speed Settings - 3D Sensor controls imbalance - Sanitary Cycle Heats Water Up to 161° F to Kills Bacteria - KIDSCARE™ Cycle Removes a Variety of Tough Stains - Refresh Cycle Refreshes Loads Up to 4 lbs - Wool / Handwash Cycle - Heavy Duty Option Targets the Toughest Stains - Reduced Ironing Option - Rinse Plus Option Improved Rinsing Result **Efficiency** - Energy Star® Qualified - Exceed Energy Star Requirements by up to 63% - Internal Water Heater Heats Water Quickly and Efficiently - Advanced SensoTronic® Plus for Maximum Efficency **Convenience** - Stackable - Space Saving - Washer Plugs into Dryer for Easy Installation - End of Cycle Signal - Self-cleaning Detergent Dispenser **Capacity** - Wash Up to 17.6 lbs – Fits Up to 14 Pairs of Pants in One Load

Technical Data

BOSCH
Invented for Life

24" Compact Washer

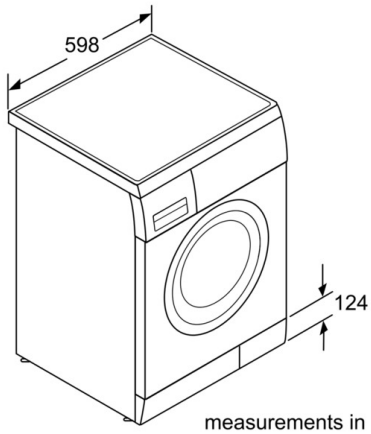
Product Features
UPC code : 825225855620
Variant color : White
Door ring : silver-grey
Buttons : silver
Dial : white
Noise level washing (dB(A) re 1 pW) : 54
Watts (W) : 2300
Current (A) : 12
Volts (V) : 208-240
Frequency (Hz) : 60
Energy consumption (kWh/yr) : 140
Water Consumption (gal/y) : 3904
Energy Star® qualified : Yes
Power cord included : Yes
Power cord length (cm) : 175.0
Plug type : 240V-3 prong
Length of drain hose : 150.00
Length of supply hose : 120.00
Product packaging dimensions (HxWxD) (mm) : 842 x 600 x 590
Net weight (kg) : 74.00
Gross weight (kg) : 75
Capacity (cu. ft.) : 2.2

Consumption and connection features
Leak protection system : Multiple water protection
Number of Options : 6
Maximum spin speed (rpm) : 1000
Spin speed options : Variable
Internal Water Heater : Yes
Display : No
Status indicator : LED

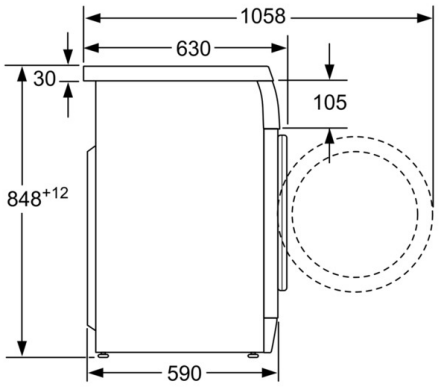
2013-03-22

Optional accessories
WMZ20490 Platform with pull-out

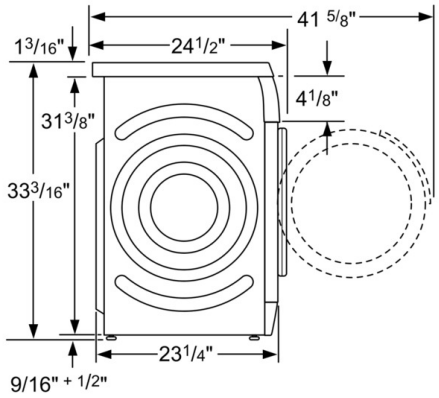
EAN code
4242002453248



measurements in mm



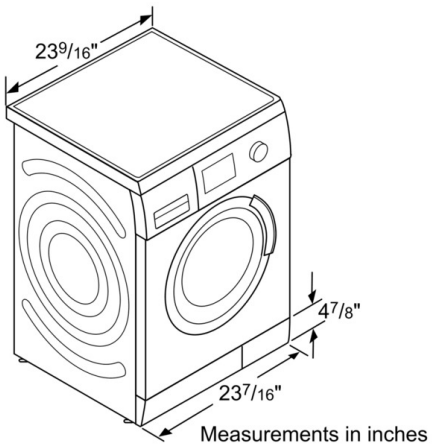
measurements in mm



Measurements in inches

Technical Data

24" Compact Washer



Axxis

Vented Dryer Dryer

BOSCH
Invented for Life

	WTV76100CN
	SensitiveDrying System
Alternative colors available	**White(WTV76100CN)**
Product Features	**Performance** - 9 Drying Programs - 3.9 Cubic Foot Drum - LED - High Quality, Snag Free Stainless Steel Drum - High Volume Air Flow and Moderate Heat for Gentle Drying - Backed by Good Housekeeping Seal - Two Year Limited Warranty **Gentle Care** - WRINKLEBLOCK® - Tumbling up to 1 Hour Prevents Wrinkles - Touch Up Cycle Reduces Drying Time for Lighter Loads - Delicate Option to Dry Items Usually Only Line Dried

Technical Data

BOSCH
Invented for Life

WTV76100CN

Product Features
UPC code : 825225852193
Door ring : Silver
Buttons : silver
Dial : white
Door hinge : Right
Silence level (dBA) : 65
Energy Source : Electric
Watts (W) : 2800
Current (A) : 12
Volts (V) : 208-240
Frequency (Hz) : 60
Power cord included : Yes
Power cord length (cm) : 145.0
Plug type : 240V-4 prong
Vent hose length (cm) : 200.00
Overall appliance dimensions (HxWxD) (mm) : 842 x 598 x 625
Product packaging dimensions (HxWxD) (mm) : 900 x 640 x 680
Net weight (kg) : 38
Gross weight (kg) : 39
Tub Material : Stainless steel
Capacity (cu. ft.) : 3.9
Stackability : Yes
Dryer type : Vented

Consumption and connection features
Number of Options : 2
Timed Dry : Yes
Location of Vent : At rear, Left-hand
Display : No
Status indicator : LED

2013-03-22

Optional accessories

WMZ20500 Platform with pull-out
WTZ11300UC Connection set with pull out tray
WTZ11310UC Connection set

EAN code

4242002438672

18" Special Application Panel Ready Dishwasher SPV5ES53UC

BOSCH

Features and Benefits

Key Features

- 46 dBA- Quietest in its class
- ActiveTab™ Tray Optimizes Detergent Dissolving
- Water Softener Ensures Perfect Cleaning Results
- AquaStop® Plus 4-Part Leak Protection Works 24/7

Design

- Stainless Steel EuroTub
- Real Stainless Steel Fascia Panel
- Red Remaining Time Display

Performance

- 46 dBA- Quietest in its class
- InfoLight® Beams on the Floor to Indicate Dishwasher is Running
- 4 Wash Cycles and 3 Options
- Sanitize Option eliminates bacteria and enhances drying results
- Variable Spray Pressure
- ActiveTab™ Tray Optimizes Detergent Dissolving
- Water Softener Ensures Perfect Cleaning Results

Efficiency

- 259 kwh/yr - Energy Star®
- Exceeds ENERGY STAR Requirements for Water by 68%
- EcoSense™ Reduces Energy Usage by up to 20%
- Half Load Option for small loads

Convenience

- AquaStop® Plus 4-Part Leak Protection Works 24/7

LEARN MORE AT energystar.gov

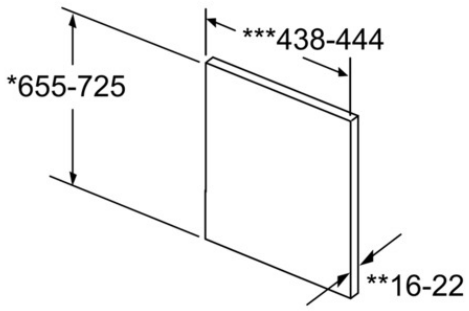
Notes: All height, width and depth dimensions are shown in inches. *Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice.Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be foundin a ccompanying product literature or you may contact your account manager for further details.

For more information on our entire line of products, go to boschappliances.com or call 1-800-944-2904.

Litho Date: 05/2013

18" Special Application Panel Ready Dishwasher SPV5ES53UC

BOSCH

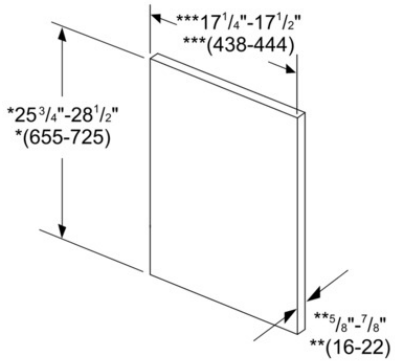


* measured from the bottom edge of the countertop panel

** thickness recommended 20 mm, panel weight 2,5-7,5 kg

*** 450 mm wide panel may be used depending on cabinet design

measurements in mm



* measured from the bottom edge of the countertop panel

** thickness recommended 3/4" (20 mm), panel weight 6-16 lb (2.5-7.5 kg)

*** 18" (450 mm) wide panel may be used depending on cabinet design

measurements in inches (mm)

Features

Leak Protection System	24/7 Aqua Stop Plus
ChildLock	No
Water softener	Yes
Upper Rack	mid
Adjustable upper rack	Rackmatic 3-stage
Upper rack cup shelf	2
Lower Rack	mid
Lower rack cup shelf	
3rd Rack	no
Silverware basket	Standard
Optional accessories	SMZ5003

Technical Specification

UPC code	825225802143
Panel ready	Yes
Alternative colors available	
Silence level (dBA)	46
Watts (W)	1300
Current (A)	12
Volts (V)	120
Frequency (Hz)	60
Energy Consumption (kWh/yr)	259
Energy Star® qualified	Yes
NSF certified	No
Plug type	120V-3 prong
Power cord length (in)	
Length outlet hose (in)	
Length inlet hose (in)	
Required cutout size (HxWxD) (in)	32 1/16" x 17 3/4" x 22 7/16"
Product packaging dimensions (HxWxD) (in)	34 7/16" x 20" x 26 3/4"
Net weight (lbs)	73
Gross weight (lbs)	76
Adjustable feet	Yes
Tub material	Stainless steel
Tub type	EuroTub/ADA
ADA Compliant	Yes
Number of place settings	9

Notes: All height, width and depth dimensions are shown in inches. *Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice.Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be foundin a ccompanying product literature or you may contact your account manager for further details.

For more information on our entire line of products, go to boschappliances.com or call 1-800-944-2904.

Litho Date: 05/2013

Quick Start Guide

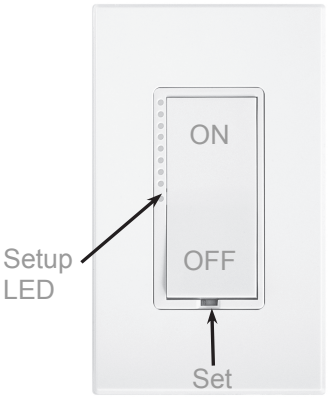
SwitchLinc™ On/Off (Dual-Band)
INSTEON® Remote Control Switch - Model: 2477S

What's in the Box?

- SwitchLinc On/Off
- Two (2) screws
- Four (4) wire nuts

Tools Needed

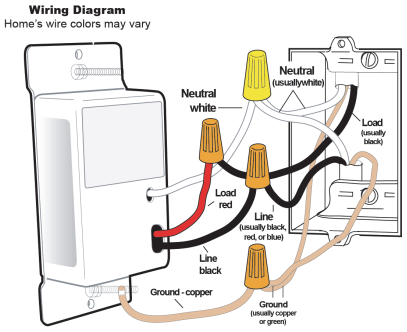
- Slotted screwdriver
- Wire cutter/stripper
- Phillips screwdriver
- Voltage meter



Installing SwitchLinc

1) Turn off breaker[1] supplying power to wall box.
2) Remove wallplate and unscrew old switch.
3) Gently pull out and disconnect wires from switch.[2]
4) After making sure the wires are not touching, turn breaker back on.
5) Check switch wires with a voltage meter to identify Line and Load.
6) Identify Neutral and Ground wires.
7) Turn breaker back off.
8) Connect wires (confirm firm attachment with no exposed wire):

SwitchLinc Wires	Wall Box Wires
Bare copper	Ground (bare copper, green wire or green screw)
White	Neutral (commonly white)
Red	Load (light)
Black	Line (commonly black)

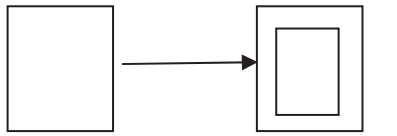


9) Mount SwitchLinc back into wall box, orienting the LED bar on left.
10) Turn breaker back on.
    SwitchLinc LED bar and connected light/load will turn on.
11) Test by tapping SwitchLinc on and off.
    Connected light/load will turn on and off.
12) Reinstall the wallplate.

Making SwitchLinc an INSTEON Responder

Follow the steps below to control SwitchLinc from another INSTEON device.

1) Press and hold controller button until it beeps.
    Controller LED will start blinking.
2) Tap SwitchLinc on.
    Connected light/load will turn on.
3) Press and hold SwitchLinc Set button until it double-beeps.
    Controller LED will stop blinking and unit will double-beep.
4) Confirm link by tapping controller's button on and off
    Connected light/load will turn on and off.



Owner's Manual and Tech Support

For the complete Owner's Manual and the most up-to-date Quick Start Guide visit http://www.insteon.com/support.
Call: INSTEON Support Line at 800-762-7845

[1] If multi-gang box, turn off all breakers (or fuses) that could possibly be supplying power to the box.
[2] If the wires cannot be detached by unscrewing them, cut the wires where they enter the switch, then strip ½" of insulation off the ends.

Quick Start Guide

SwitchLinc™ Dimmer - INSTEON® Remote Control Switch (Dual-Band)
Model: 2477D

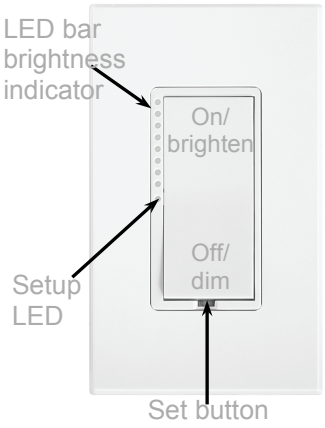
What's in the Box?

- SwitchLinc Dimmer
- Two (2) screws
- Four (4) wire nuts

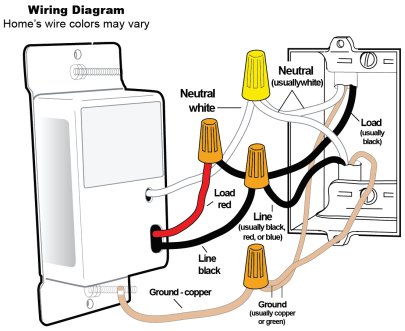
Tools Needed

- Slotted screwdriver
- Wire cutter/stripper
- Phillips screwdriver
- Voltage meter

Installing SwitchLinc



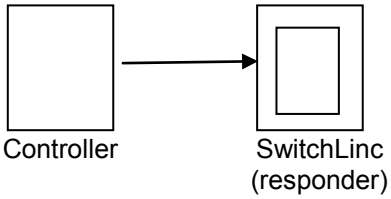
1) At electrical panel, turn off circuit breaker(s) and/or remove fuse(s) feeding wall box. Verify that the power is off before continuing.
2) Remove wallplate from the switch. Unscrew switch and pull out.
3) Disconnect wires from switch
4) Turn on power
5) Use a voltage meter to identify the line and load wires connected to the switch
6) Identify neutral and ground wires
7) Turn off power
8) Connect wires as per diagram (confirm firm attachments with no exposed wire)
9) With LEDs on left, gently place SwitchLinc into wall box and screw into place
10) Turn on power
    SwitchLinc and connected load will turn on
11) Verify SwitchLinc is working properly by tapping SwitchLinc on and off
    SwitchLinc and connected load will turn on and off
12) Reinstall the wallplate



Make SwitchLinc a Responder

Control SwitchLinc from another INSTEON device:

1) Press and hold controller button until it beeps
    Controller LED will start blinking
2) Tap SwitchLinc on
    Connected light/load will turn on
3) Press and hold SwitchLinc Set button until it double-beeps
    Controller LED will stop blinking and unit will double-beep
4) Confirm link by tapping controller's button on and off
    Connected light/load will turn on and off



Owner's Manual and Tech Support

For the complete Owner's Manual and the most up-to-date Quick Start Guide visit http://www.insteon.com/support
Call: INSTEON Support Line at 800-762-7845

FCC and ETL/UL Warnings

This device complies with FCC Rules and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorise aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, mme si le brouillage est susceptible d'en compromettre le fonctionnement.

CAUTION - To reduce the risk of overheating and possible damage to other equipment do not install to control a receptacle, a motor-operated appliance, a fluorescent lighting fixture, or a transformer-supplied appliance.
Gradateurs commandant une lampe a filament de tungstene – afin de reduire le risqué de surchauffe et la possibilite d'endommagement a d'autres materiels, ne pas installer pour commader une prise, un appareil a moteur, une lampe fluorescente ou un appareil alimente par un transformateur.

2477D Rev. 8/30/2012 2:21 PM / See Owner's Manual for Warranty Information.

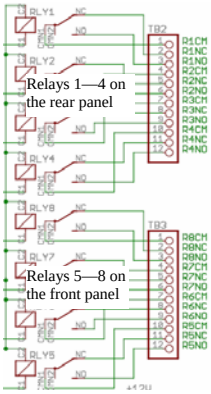
INSTEON

Quick-Start Guide EZIO8SA 7-Input/8-Relay INSTEON/X10 Controller - Model #EZIO8SA

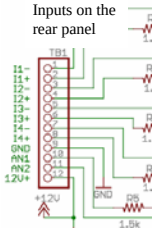
Your EZIO8SA puts control and monitoring of external loads and signals where you need it, thus simplifying your wiring. The unit has 8 SPDT relays rated 3 Amps @ 120VAC/24VDC to control AC or DC loads with INSTEON or X10 commands. Timers can be enabled to individually turn the relays off automatically after 1-255 seconds or minutes. External signals such as those from contact closures, voltage, and temperature values can send INSTEON messages on their on and off transitions to cause INSTEON events only limited by your imagination. External sensing flexibility is provided by four opto-isolated, two analog/digital and one digital-only set of inputs. A dedicated connector may be used for monitoring sensors via the Dallas Semiconductor 1-Wire bus. This input is pre-programmed for a DS18B20 temperature sensor. EZIO8SA requires a SmartLabs, Inc. PLM as a power source and to communicate with other INSTEON and X10 devices over the power lines.

Installation

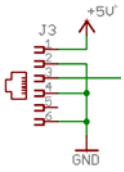
- Select a suitable power outlet that is close to the loads and sensors to be connected. Avoid exposure to moisture. If installing outdoors, use only an approved outdoor weather-proof enclosure.
- **Connection of the Output Relays:** Follow the picture on the label and note the naming (CM for common, NC for normally closed, and NO for normally closed) for the relays. Note that each relay acts as a switch (rated 3A at 24VDC or 120VAC.) Connect the controlled loads (e.g. valve motors, curtain actuators, door lock solenoids, garage door switches, etc.) to relay terminals as desired. Each relay is individually controlled by either direct or group INSTEON messages, or by X10 commands. A subsequent section of this guide describes how to link an INSTEON sender or X10 controller to each relay. Using INSTEON, it is also possible to take a "snapshot" of the state of the relays for single command "recollection" of the snapshot as part of a scene.



- **Connecting the Inputs:** Two sets of inputs to your EZIO8SA are available through the same terminal connector pictured and described separately below. Notice also that separate terminals are provided for +12VDC (unregulated, 50 mA. maximum) and Ground.
  - **Opto-Isolated Inputs:** Inputs I1 - I4 can be used in a way that the signal source is totally isolated from the EZIO8SA, as may be the requirement for certain alarm panel monitoring. In this case, the input must provide a voltage between 3 and 30 VDC, connected between the positive (Ix+) and negative (I1– or I2-) terminals. If isolation is not required, these inputs can easily be connected to "dry" contact closures such as those from external relays, proximity detectors or door closure sensors. In this case, connect the positive (I1+ or I2+) terminal to the +12V terminal, and the contact closure between the negative (I1- or I2-) terminal and the GND terminal.



  - **AN1 and AN2 as Digital Inputs:** As configured by default, inputs AN1 and AN2 can be used to monitor voltage levels that have distinct thresholds (0—1VDC for ON, and 2.5—5VDC for OFF.) These are the levels typically produced by digital devices such as a control output from a liquid level detector or telephone answering device. Keep in mind that the device output can not be of the "dry" type; in other words, the output connecting to the EZIO8SA AN1 or AN2 inputs must provide a voltage level required to cause a change that the EZIO8SA can recognize. If needed, a "pull-up" resistor can be connected between AN1 or AN2 and a +3.3VDC source.
  - **AN1 and AN2 as Analog Inputs:** A software program such as our free utility or a home automation program may be used to configure AN1 and AN2 as inputs that respond to and measure the level of voltages between 0 and 3.3VDC. Typical uses for this type of monitoring could be light, temperature, pressure, humidity, or other slowly and discretely varying levels. The value of the voltage at each of the inputs is internally converted to a number between 0 and 1023 (10 bits) which can be read via INSTEON commands or used to trigger alarm conditions. Alarms are simply events when the EZIO8SA sends a group message to the INSTEON network. Using this facility, an alarm can be set to send an INSTEON OFF group command when the voltage on the given input goes over a certain level, and an INSTEON ON group command when the voltage falls below a different level. This allows many possibilities for closed-loop control such as for maintaining the level of a pool, the temperature in a room, the humidity in a greenhouse, etc.
  - **1-Wire Input:** Your EZIO8SA accommodates the versatile Dallas Semiconductor 1-Wire bus for interfacing sensors. The RJ12 connector permits the use of either a 6-pin connector (RJ12) or 4-pin connector (RJ11). The unit comes pre-programmed to support one DS18B20 temperature sensor. Other sensors will be supported in the future or units may be custom-programmed at the factory. The sensor is set for 8 bits of resolution (values range from 0 to 255 degrees centigrade) and alarms may be set for both low to high and high to low trip points. This programmability allows a simple thermal controller to be easily implemented. If so desired, this input can be used as a regular digital input. An internal pull-up resistor is provided so the input can accommodate a "dry" contact.



Plug your EZIO8SA PLM into an AC outlet. The LED on the PLM will flash on and off rapidly a few times, then turn on and off for about 1 second (indicating successful internal diagnostics), and finally glow steadily.

Programming Your EZIO8SA

EZIO8SA can be set up as a "Sender" that sends INSTEON group commands or broadcast messages upon changes on any of its inputs (OFF to ON or ON to OFF), or as a "Responder" that activates one or both of its relays in response to a command from a controller such as a KeypadLinc or ControlLinc. The relays on the EZIO8SA can also be controlled with INSTEON direct commands.

The many features of the EZIO8SA are best exploited with an automation PC/Server application or our free Windows-XP configuration and setup utility. The PC application can be used to alter the behavior of the inputs, such as, what command is sent on the detection of an OFF or ON condition, the INSTEON group number, a timer to delay the input OFF response, and/or the alarms on the 1-Wire and Analog inputs.

The unit is usable out-of-the-box manually as described below. Please note that a "Press and Hold" refers to pushing and holding, then releasing the set-button on the side of the PLM attached to the EZIO8SA. A "Tap" refers to gently and rapidly depressing and releasing the button.

Controlling One or Multiple INSTEON Devices with Signals on the Inputs

1) Put the EZIO8SA PLM in linking mode by pressing the set-button and releasing it after **10-12** seconds. The PLM will turn off its LED indicating it is waiting to be told which input is to be used for this link.
2) Tap the set-button on the PLM a number of times corresponding to the input to be used for control (e.g. once for input 1, twice for input 2, etc.) After the last tap, press the set-button on the PLM and release it after **3-4** seconds. Its LED will begin to flash about once per second indicating it is listening for an INSTEON device to link with.
3) On the INSTEON device to be controlled, press its set-button and release it after 3-4 seconds (or use method specific to device.) A successful link will be indicated by a flash of the LED on the controlled device (device

specific) and by the LED on the EZIO8SA PLM flashing, then continuing to blink about once per second.
4) Continue to link additional INSTEON devices using step 3 above, or end the linking session by holding the set-button on the EZIO8SA PLM for **3-4** seconds.

Stopping (Unlinking) an INSTEON Responder Device from being controlled by the EZIO8SA

1) Put the EZIO8SA PLM in unlinking mode by pressing its set-button and releasing it after **10-12** seconds. The PLM will turn off its LED indicating it is waiting to be told which input the INSTEON device is to be unlinked from.
2) Tap the set-button on the EZIO8SA PLM a number of times corresponding to the input to be unlinked (e.g. once for input 1, twice for input 2, etc.) After the last tap, press the set-button on the PLM and release it after **18-20** seconds. Its LED will begin to flash about once per second indicating it is listening for an INSTEON device to unlink from.
3) On the INSTEON device to be unlinked, press its set-button and release it after **3-4** seconds (or use method specific to device.) A successful unlink will be indicated by a flash of the LED on the controlled device (device specific) and by the LED on the EZIO8SA PLM turning on solidly.

Triggering EZIO8SA Inputs from another INSTEON Controller

1) Put controller in linking mode by holding the button to be used for controlling until it indicates linking mode (4-10 seconds depending on controller.) Usually its LED will blink or a light connected to it will flash.
2) Hold the set-button on the EZIO8SA PLM and release it after **3-4** seconds. The LED on the EZIO8SA PLM will turn off when the link is established with the controller. The controller will also give an indication of a successful link by flashing its LED or a load connected to it.
3) The EZIO8SA must be told which input to link by tapping the set-button on its PLM a number of times corresponding to the input number (e.g. once for input 1, twice for input 2, etc.) After the last tap, press the set-button on the EZIO8SA PLM and release it after **10-12** seconds. Its LED will turn on solidly indicating the end of the linking process.

Controlling the Relays with an INSTEON Controller

1) Put controller in linking mode by holding the button to be used for controlling until it indicates linking mode (4-10 seconds depending on controller.) Usually its LED will blink or a light connected to it will flash.
2) Hold the set-button on the EZIO8SA PLM and release it after **3-4** seconds. Its LED will turn off when the link is established with the controller. The controller will also give an indication of a successful link by flashing its LED or a load connected to it.
3) To link the current status of all the relays (status snapshot) to be recalled by a command from the controller, hold the set-button on the EZIO8SA PLM and release it after **3-4** seconds. Its LED will turn on solidly indicating the end of the linking process.
4) Alternatively to step 3 above, an individual relay is linked by tapping the set-button on the EZIO8SA PLM a number of times corresponding to the relay number (e.g. once for relay 1, twice for relay 2, etc.) After the last tap, press the set-button on the EZIO8SA PLM and release it after **3-4** seconds. Its LED will turn on solidly indicating the end of the linking process.

Unlinking the Relays from an INSTEON Controller

1) Follow the instructions specific to the INSTEON controller in use to place it in unlinking mode.
2) Press the set-button on the EZIO8SA PLM and release it after **3-4** seconds. Its LED will flash briefly and then go solid indicating a successful unlink. The LED on the controller will also go solid.

About the Links Database

The EZIO8SA maintains an internal table of up to 128 links where the information on each linked device is stored. The database can be accessed and altered with the use of our PC utility such that links can be entered, modified or deleted without having to use the "press and hold" method described earlier.

Controlling the Relays with X10 Controllers

EZIO8SA allocates all 16 units of a house code. Relays 1 through 8 respond to commands on X10 units 1 through 8. To setup the unit to respond to X10 commands follow these steps:

1) Press and hold the set-button on the EZIO8SA PLM and release it after about 4 seconds—the LED will now blink at a low rate;
2) Enter an ON (or OFF for disabling) command from your X10 controller—the LED will stop flashing indicating X10 enabling or disabling was successful. The outputs will now respond to X10 ON and OFF commands.

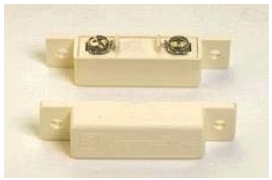
- To **disable X10 control**, substitute an OFF command in step 2 above.

Restoring All Parameters to Default Values (Factory Reset)

To restore all settings to their original factory values and to reset the links database, unplug your EZIO8SA PLM for about 10 seconds. Then, plug it back in WHILE HOLDING ITS SET-BUTTON for about 10 seconds. Upon release of the set-button, the unit will go through the normal power on sequence, and all parameters will be reset.

Possible Applications for your EZIO8SA

Given its ability to send INSTEON commands in response to events, and to cause actions upon receiving X10 or INSTEON messages, the possible applications for your EZIO8SA are practically limitless. The complement of relays, digital inputs, analog inputs, and temperature sensor bus allow for a wide variety of applications. The following are summaries of some possibilities. Please note that these are given as possibilities and Simplehomenet makes no claims as to the suitability or accuracy on the implementation of these ideas:



Complete Garage Manager: In this example the EZIO8SA is used to monitor the state of a garage door (open or closed) and to control the manual switch that activates the door opener. EZIO8SA is set up to send an INSTEON ON group command to a set of devices when the door is open, and an OFF command some minutes later. The door open detection can also be programmed to send a command to close the door through one of the EZIO8SA relays some minutes later if the door is detected to be open. A readily available magnetically activated sensor (reed switch type) is used as a door open/close sensor. This switch simply closes when next to a magnet, and opens when away from the magnet. Our setup PC utility is used to modify the device input parameters. Set up the unit as follows:

1. The picture on the right shows a typical magnetically activated sensor/switch. Some may come with wires already terminated, and others, as the one pictured, come with screw terminals. Connect I1+ to the +5V terminal and I1– to one wire of the door sensor. Connect the other sensor wire to the GND terminal.
2. Connect the two wires from the opener pushbutton to the R1CM and R1NO terminals on the EZIO8SA.
3. Link INSTEON devices to respond to door open or close events by following the steps in the section "**Controlling One or Multiple INSTEON Devices with Signals on the Inputs".** It is possible to link one or several INSTEON devices (lights, sirens, telephone dialers, etc.) that will be given commands when the door opens or closes.
4. If needed, use the set up utility to set the ON to OFF (door opening) and/or OFF to ON (door closing) commands to be sent. INSTEON commands are 13 00 for "Rapid OFF" and 11 FF for "Rapid ON".
5. **Programming Relay 1 to Activate the Door Opener Switch:** Use the setup utility to a) set the output timers in seconds; b) program the output 1 timer to 2 seconds; and c) establish a link to have relay 1 respond to group 1.

Greenhouse Manager: The unit could be set up to monitor the greenhouse temperature through a 1-Wire temperature sensor. An alarm would be set to send a group command upon the temperature reaching a certain threshold. Another alarm point would be set for when the temperature falls below a certain point. An INSTEON responder switch to control a heating element would activate upon receipt of the first group command and turn off upon receiving the second alarm from the temperature sensor. This would create a basic temperature controller to maintain the greenhouse at an optimum point. Any of the EZIO8SA relays could be used to control the heating element, or for controlling ancillary items such as window shutters, sunlight reflectors, fogging systems, irrigation valves, air baffles, etc., in response to other conditions. Some of the digital inputs could be used for checking the state of doors, light conditions, etc.

Quick-Start Guide

SIGNALINC V2 HARDWIRED

SignaLinc™ V2 Hardwired (#2406H)

Your new SignaLinc V2 will increase your INSTEON-enabled system's reliability without the need for plug-in phase couplers.

INSTEON COMPATIBLE

Need Help? For assistance call your friendly support person @ 800-SMARTHOME (800-762-7846)

Preparation

Installation should be performed only by a qualified electrician or by a homeowner who is familiar and comfortable with electrical circuitry. If there are any questions, consult an electrician. For setup questions contact Tech Support at Smarthome for guidance.

Tools you will need:

- A standard screwdriver
- A Phillips screwdriver
- A wire cutter/stripper
- A voltage tester to identify wires inside the junction box

Installation Procedures

Step 1. At the service entrance, shut off all power to the breaker box. In some homes, this will be the "Main" breaker in the circuit breaker panel. If there isn't a main power shutoff (master switch) or you can't find it, do not attempt the work. Call a licensed electrician.

Step 2. Remove the circuit breaker panel cover.

Step 3. Use the circuit tester or AC voltmeter to be sure the circuits are OFF. Check to make sure that there is no voltage from the screw terminals of several circuit breakers to the ground or neutral bus bar.

Step 4. The SignaLinc will need to be wired directly to two circuit breakers. It is a violation of the electrical code to use an existing breaker that already has a wire connected to it. Install a new 220-volt 15-amp (double-pole) circuit breaker. These breakers have a bar between the paddles so that if one breaker detects an overloaded condition, both will trip.

Step 5. Install a single-gang electrical box for the SignaLinc near the breaker box. Use either a metal or plastic outlet box. The sales people at your local home improvement center or electrical supply store can help guide you to the right choice that will comply with local electrical ordinances.

Step 6. Run electrical cable between the circuit breaker panel and the mounting box for the SignaLinc. The cable should be secured with a clamp or wire nail to the wall stud within a few inches of the mounting box. We recommend using 14/3 cable, which has three conductors plus a ground wire.

Step 7. Connect the bare copper ground wires together. Using a pair of pliers, twist ground wire from the SignaLinc and the ground wire going to the breaker box together in a clockwise motion. Make several turns to ensure a good connection. Place a wire nut on this connection (this is a code requirement).

Step 8. Connect the black wire on the SignaLinc to the black wire going to the panel. Strip back about ¾" of insulation. Using pliers, twist the conductors together in a clockwise motion. Cut the exposed twisted copper wires back to about ½". Place a wire nut over this connection.

Step 9. Connect the red wires following the same instructions above. If you are using 14/2 wire, use a black marker to color the white wires black (at both ends, at the SignaLinc and the breaker box). This, too, is typically an electrical code requirement.

Step 10. If you have a white wire left over, place a wire nut on it. It is not connected to the SignaLinc.

Step 11. At the circuit breaker box, connect the ground wire to the ground bus bar. Some panels do not have a separate ground bus bar so the ground wire must be connected to the neutral bus bar. The ground wire must be connected for safety purposes.

Step 12. Connect the BLACK wire to one of the 15-Amp circuit breakers.

Step 13. Connect the RED wire (or the white wire colored black with a marker if you are using 14/2 cable) to the other 15-Amp breaker.

Step 14. Check to be sure that all the wires are securely fastened, no copper is exposed (except for the ground wire), and all screws are tight.

Step 15. Restore power to the main breaker.

Step 16. You can confirm that the SignaLinc is wired to the correct breakers if you can read 220 to 240 volts AC between the two breakers when the power is turned on. If there is no voltage between the two breakers, check to be sure that both of the breakers and the master breaker are "ON". If there is still no voltage between the two breakers, then they are probably on the same leg, and you will have to select another breaker for one of the wires.

Step 17. Replace the circuit breaker panel cover.

Quick-Start Guide

SIGNALINC V2 HARDWIRED

SignaLinc™ V2 Hardwired (#2406H)

INSTEON COMPATIBLE

Need Help? For assistance call your friendly support person @ 800-SMARTHOME (800-762-7846)

Notes

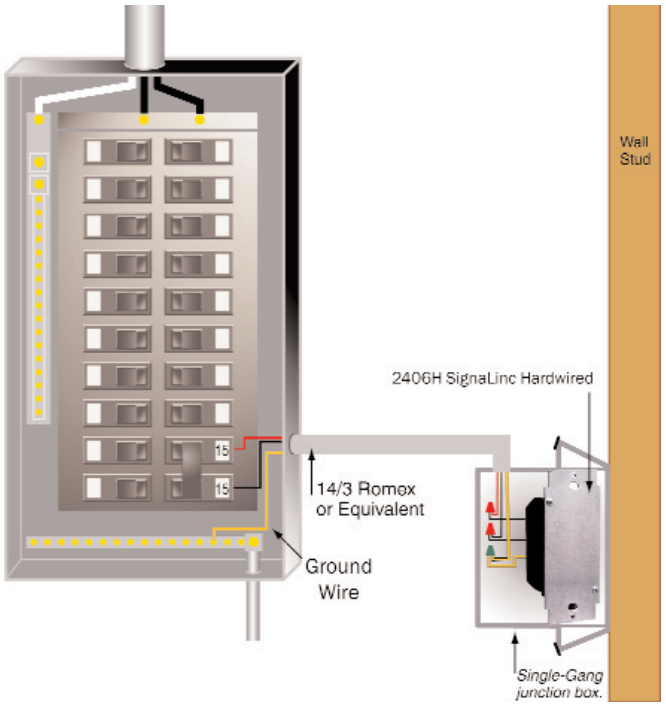
- The advanced User's Guide can be found at http://**www.smarthome.com/2406h.html.**

How Does a Signal Bridge work?

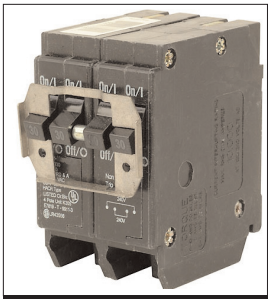
The SignaLinc V2 is a passive coupler and does not amplify the PLC signals. This means the signals coupled onto the receiving phase will only be as strong as the signals on the transmitting phase. How well the SignaLinc works in your home is dependent on many factors, including signal strength for the transmission phase. Other considerations include:

1. The phase receiving the signal through the SignaLinc may have electrical devices plugged in that will attenuate the signal from the transmission phase. Some of the electrical devices that might cause the receiving phase to absorb the transmitted signal include power line carrier (PLC) X10 transmitters, noise/surge suppressors (like those found in multi-outlet strips), and any electrical device that contains a complex power supply like those found in computers and audio-video products. If the PLC signal is severely attenuated, it may cause devices that once worked on the transmission phase to stop working.

2. Noise on the receiving phase may be transferred through the SignaLinc onto the transmitting phase, resulting in some interference among receivers. This interference may prevent PLC devices from receiving the signal correctly, even if they were once working properly before the SignaLinc was installed. Noise from the transmission phase may also be transmitted to the receiving phase, resulting in missed signals.



TIP: If you don't have any space in your panel for new circuit breakers, use a quad-pole breaker like the one pictured on the right. You will need to remove two existing breakers that are adjoining each other. The quad breaker will need to have two of the poles rated for the amperage as the ones removed. For example, if you removed two 20-amp breakers, you would need a 20/15/15/20 quad breaker. The two 15-amp poles will be for the new SignaLinc while the two 20-amp poles will be for the circuits that were connected to the old breakers. A home improvement or electrical supply store should have a good assortment of these.



Quad Breakers can help if you don't have space for more breakers.

rev.010809

Quick Start Guide

PowerLinc Modem™ – INSTEON® USB Interface (Dual-Band)
Model: 2413U

Install PowerLinc Modem

1) Ensure PowerLinc Modem is *not* plugged into your computer
2) Go to http://ftdichip.com/Drivers/VCP.htm and download the driver file
   Under the "VCP Drivers" section, select the Windows .exe file
3) Open and run the downloaded driver file
4) Plug PowerLinc Modem into an AC wall outlet
5) Plug square end of included USB cable into PowerLinc Modem's USB jack
6) Plug rectangular end of cable into an available USB port on your PC
   PC will detect new hardware
   PowerLinc Modem is now ready

Tips for Using PowerLinc Modem

- Do not use a USB cable longer than 10' (6' or less is recommended)
- Do not plug PowerLinc Modem into a power strip or AC line filter
- Use only one PowerLinc Modem per computer
- Do not place near large metal objects, such as refrigerators or TVs
- Some computers and their accessories can absorb PowerLinc Carrier (PLC) signals off the powerlines. Since PowerLinc Modem will be close to the computer, the power strip for the computer should be filtered. Use an INSTEON FilterLinc (#1626-10) on the computer's power strip to keep PowerLinc Modem signals from getting absorbed by the computer equipment
- If computer's serial port is shared with another hardware device (scanner, PDA, etc.) be sure to turn off that device's program on the PC. If left running, the home automation software will not be able to communicate with PowerLinc Modem.
- To reset PowerLinc Modem to its original factory settings, unplug from wall outlet and wait 10 seconds. Press and hold Set button; while continuing to press and hold, plug back in. A long beep will sound; continue holding Set button until beep stops, then release.
  After several seconds, status LED will turn on to indicate reset is complete

Use PowerLinc Modem as a Phase Bridge

1) Install additional dual-band INSTEON devices if they are not already installed
2) Start Phase Detection Mode by tapping the Set button on PowerLinc Modem four times quickly
   PowerLinc Modem will begin beeping and status LED will turn on solid green
3) Check the LED behavior of the other dual-band devices to see if they are on the opposite phase
   If at least one of the dual-band device LEDs is blinking green or is bright solid white or blue, the device is on the opposite phase. Continue on to step 4.
   If none of the dual-band devices exhibit the behavior above, they are on the same electrical phase. Try the following:
   - Follow steps 2 and 3 with the other dual-band devices to see if they are exhibiting the desired LED behavior
   - Move a dual-band device to another location until it exhibits the desired LED behavior
4) Tap PowerLinc Modem Set button
   PowerLinc Modem will stop beeping

Owner's Manual and Tech Support

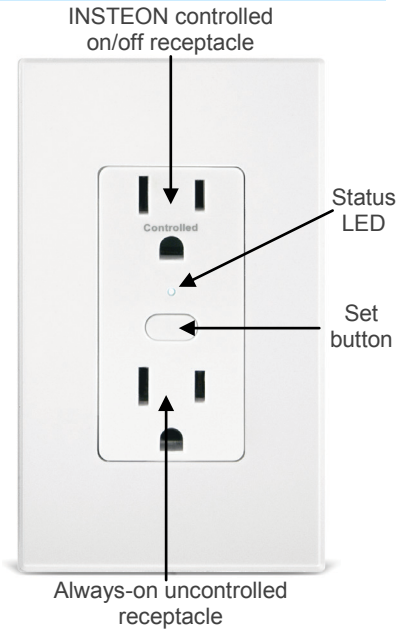
Owner's Manual and current Quick Start Guide: http://www.insteon.com/support
Call: INSTEON Support Line at 800-762-7845

2413U Rev. 7/20/2012 10:53 AM / See Owner's Manual for Warranty Information.
Protected under U.S. and foreign patents (see *www.insteon.com*)

INSTEON®

Quick Start Guide

INSTEON® OutletLinc™ On/Off Outlet
Model: 2473S



Tools Needed

- Flathead screwdriver
- Wire cutter/stripper
- Phillips screwdriver
- Voltage tester

Installing OutletLinc

Installation should only be performed by a qualified electrician or a homeowner who is familiar and comfortable with electrical circuitry. If you have questions, consult an electrician or call the INSTEON Support Line at 866-243-8022

1) At the circuit breaker or fuse panel, disable circuit supplying power to outlet
2) Remove existing outlet and wallplate
3) Disconnect wires from existing outlet and ensure you have ½" of bare wire on the ends
4) Enable power to the outlet, then use voltage meter to identify line, neutral and ground wires. Once wires are identified, turn off circuit breaker.
5) Twist OutletLinc ground wire (bare copper) to outlet ground wire with included wire nut
6) Twist OutletLinc neutral wire (white) to outlet neutral wire with included wire nut
7) Twist OutletLinc line wire (black) to outlet line wire with included wire nut
8) After ensuring all wire connectors are firmly attached and that there is no exposed copper (except for ground wire), carefully place OutletLinc into wall box and replace wallplate
9) Turn on circuit breaker
10) Plug lamp, appliance or other device you want to control (load) into OutletLinc top outlet
11) Test by tapping OutletLinc Set button a few times
    Connected light/load will turn on and off

Make OutletLinc a Responder

Control OutletLinc from another INSTEON device:

1) Put controller into linking mode.* (For most controllers press and hold Set button for 3 seconds or an on/scene button for 10 seconds.)
2) Turn on load plugged into OutletLinc
3) Press and hold OutletLinc Set button for 3 seconds
    Status LED will flash, then turn on solid
4) Confirm link by tapping controller's button on and off
    Connected light/load will turn on and off

Owner's Manual and Tech Support

For the complete Owner's Manual and the most up-to-date Quick Start Guide visit: http://www.insteon.com/support
Call: INSTEON Support Line at 866-243-8022

*Linking mode will time out after 30 seconds

2473S Rev. 11/8/2012 6:54 PM / See Owner's Manual for Warranty Information.

INSTEON®

ISY-99i User Guide

May 5, 2011
(based on firmware 2.8.16)

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1.0 Introduction

Thank you for purchasing an ISY-99i Series device – Universal Devices, Inc.'s second series of intelligent, stand-alone, web-enabled INSTEON controllers.

With the ISY-99i Series, you can:

- Program, configure and manage your INSTEON devices
- Automate your home using sophisticated timers, triggers, and macros
- Conserve energy in your home
- Remotely control your home using the ISY's web interface
- ...and MUCH more!

This Quick Start Guide will help you to get your ISY-99i installed and configured, and will provide links to additional resources which you may find helpful. Please read through this guide before beginning installation.

1.1 What's Included

Depending on the package you have purchased, you should receive at a minimum:

- ISY-99i Series device
- (2) standard Category 5e Ethernet patch cables
- (1) one RS-232 null-modem serial cable (PRO version only)
- Quick Start guide

The ISY-99i Series controller also requires a Smarthome 2412S or 2413S Power-Line Modem (PLM), which is sold separately direct from Smarthome.

NOTE: If using a 2412S PLM, no separate power supply is required for the ISY since the necessary power is supplied directly from the PLM. If using a 2413S PLM, the ISY will require a separate power supply. If needed, use a power supply with the following specs:

- 5-30 VDC
- 300 mA minimum
- Center positive 2mm male barrel jack

NOTE: The serial cable (included with the PRO version only) is a standard, DB9M-DB9F null-modem cable.

1.2 Requirements

- The ISY requires a Smarthome 2412S or 2413S Power-Line Modem (PLM) to communicate to and from your INSTEON devices:
  http://www.smarthome.com/2412s.html
  http://www.smarthome.com/2413s.html

- A Java-enabled web browser (such as Internet Explorer or FireFox) is required to launch the ISY's Administrative Console. The latest version of Java can be downloaded from:
  http://www.java.com

- A DHCP-enabled router (or other DHCP-enabled network) is recommended for easiest installation and configuration of the ISY.

- If using a non-DHCP-enabled router, or a direct connection to a computer which is not a DHCP server using an Ethernet **cross-over** cable (not included), the following are required in order to configure the ISY's network parameters:
  - A null-modem serial cable (included with PRO version)
  - A serial port (or USB-to-serial adapter) on the computer
  - Start a terminal program (such as Windows HyperTerminal) and configure for 115200bps, 8N1, Xon/Xoff, and for the appropriate COM port.
  - Type a few characters until prompted for Username: and enter admin (lower case) followed by <ENTER>. When prompted for Password: enter admin (lower case) followed by <ENTER> (Figure 9A). The ISY Shell is displayed. All input to the ISY shell must be in UPPER CASE.

1.3 Getting To Know Your ISY

The ISY's front panel has several elements you should be familiar with:

- The LEDs on the front of your unit show the current status of your ISY. They can also assist with troubleshooting any issues you may be having. For more infromation on the ISY's front panel LEDs and what they mean, please see **Appendix A: Front Panel LEDs**.

- A Reset Button is located on the front of your ISY. To simply reboot your ISY, use a sharp object to briefly press the ISY's recessed Reset Button. To factory reset your ISY, please see **Appendix B: Reset.Button**

- Certain ISY-99i Series controllers include an integrated IR receiver located on the front of the unit. This IR receiver can be used to control your home using an RC-5-capable universal remote control.

The rear panel of the ISY features the following:

- An AC adapter jack is included for customers who would like to power their ISY using a separate AC adapter. Please use an AC adapter that provides 5VDC, a minimum of 300mA, and is center terminal positive. There might be several reasons for using a separate AC adapter instead of power provided by the PLM:

    - An AC adapter can be plugged into a UPS to help protect the ISY from power outages and power surges. The PLM **cannot** be plugged into a UPS.

    - Powering the ISY using a separate AC adapter may help improve (by a small amount) the signal strength of the INSTEON PLM.

    - Future INSTEON PLMs may not be able to provide power to the ISY. In this case, a separate AC adapter would be required.

- **Port A** is an RJ-45 connector used to attach your INSTEON PLM to the ISY. This allows the ISY to communicate with your INSTEON devices. Please use a standard Category 5e network patch cable (included) to connect between your ISY and the PLM. **WARNING: DO NOT use this port to connect to an Ethernet router or switch.**

- **Port B** is a 9-pin female RS-232 serial port used for initial configuration for users without a DHCP-enabled network, or for advanced troubleshooting. Please use a standard 9-pin null-modem serial cable (included with the PRO version) to connect your ISY to your PC's serial port.

- The Network jack is used to attach the ISY to your Ethernet network. Use a standard Category 5e network patch cable (included) to plug your ISY into an available network jack on your router or switch. If connecting directly to a PC for programming, please use an Ethernet cross-over cable (not included). **WARNING: DO NOT use this port to connect to an INSTEON PLM.**

Some versions of the ISY-99i may also include an externally accessible SD card slot. Please DO NOT removed the SD card while the ISY is running. ISY-99i's without an external SD slot must be opened in order to replace the SD card.

For instructions on replacing your SD card, please see **Appendix C: Replacing / Upgrading Your SD Card**.

2.0 Installation

Installation of the ISY is completed in several easy steps. The following instructions assume that you are installing the ISY on a DHCP-enabled network (true in the vast majority of cases) and are using a Windows-based PC to connect to the ISY.

If you do not have a router or other DHCP-enabled network to plug the ISY into and plan on using a direction connection to a PC, or if you are using an OS other than Windows, please see our online Wiki for more advanced installation instructions: http://www.universal-devices.com/mwiki/

2.1 Hardware Installation

Installation of the ISY-99i hardware is completed in several easy steps:

1. Plug your ISY into your home network. Simply plug one end of an included Ethernet cable into the ISY's **Network** jack. Plug the other end of the cable into your router or network switch/hub.

2. Plug your ISY into the INSTEON PLM. Connect one end of the included Ethernet cable and attach it to **Port A** on the ISY. The other end of the cable plugs into your INSTEON PLM.

3. Apply power to the PLM and ISY by plugging it into a standard power outlet. Do not plug the PLM into a UPS or surge protector of any kind. If possible, avoid plugging the PLM into an outlet on the same circuit as other electronic devices to ensure optimal communications with your INSTEON devices. For information on troubleshooting INSTEON communication issues, and tips on creating a reliable INSTEON network, see **Appendix H: Troubleshooting INSTEON Communication Issues**.

Once power is supplied to your ISY, it will automatically boot up. The RX, TX, and Mem LEDs may flash briefly, and the PWR LED should be on steady. The two small green LEDs on the ISY's Network jack should be on (indicating a good network connection) and may flash (indicating network activity).

2.2 Connecting to the ISY From a Local PC

There are several requirements for connecting to your ISY from a PC on your network:

- **Java.** Please ensure that the latest edition of Java is installed on your computer. The latest Java downloads may be found at:
  http://www.java.com
  After installing Java, please reboot your computer before attempting to connect to the ISY.

- **Web Browser.** Please be sure your PC is running a Java-enabled web browser, such as Internet Explorer or FireFox.

As shipped from the factory, the ISY is configured to obtain an IP address via DHCP. There are a couple of easy ways to connect to your ISY and find it's local URL:

Option 1. In most cases, the quickest and easiest way to connect to the ISY for the first time on a Windows PC is to open a web browser and type in the following URL:

http://isy

The default login information is:
Username: admin
Password: admin

Option 2. You can also double-click the My Lighting icon that you'll find in your PC's My Network Places (in Windows XP) or Network (in Windows 7 or Vista).

The My Lighting icon requires that Windows is configured to discover UpnP devices on your network. If you do not see a My Lighting icon, look for an option on the left-hand pane called "Show icons for networked UPnP devices". Please click this option to allow Windows to automatically find the ISY on your network. In Windows 7 and Vista, please be sure Network Discovery is turned on.

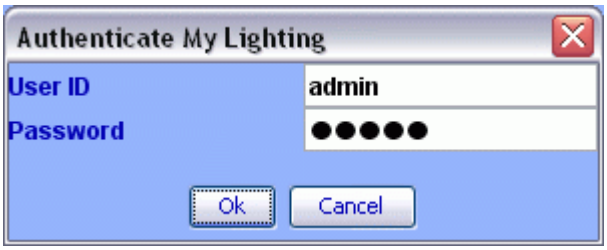
Please add this page to your web browser's Favorites for easy access in the future.

Option 3. If the above options are not working for you, or if you are on a non-Windows platform, please visit the following URL:
http://www.universal-devices.com/99i

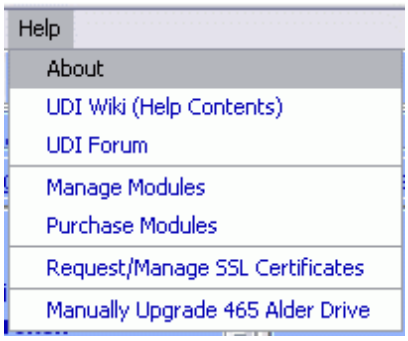
This will launch a UDI-hosted version of the ISY's Administrative Console and attempt to locate the ISY on your network.

Once you launch the Administrative Console, you will be presented with a login window asking you to authenticate to your ISY. The default login information is:

Username: admin
Password: admin



To find your ISY's login URL, click the HELP -> ABOUT pull down menu and look for the address listed after "My URL". Type this into your web browser to quickly connect to your ISY in the future. Feel free to add this URL to your web browser's Favorites.



When using DHCP, in some cases your ISY may receive a new IP address from your router (or other DHCP server). If this happens, you will not be able to use the old address to connect to your ISY. To find out your ISY's new address, simply double-click your My Lighting icon or visit the following URL to automatically find the ISY (and its new address) on your network:
http://www.universal-devices.com/99i

If you wish to assign your ISY a static IP address, please see **Appendix E: Assigning a Static IP Address to the ISY**.

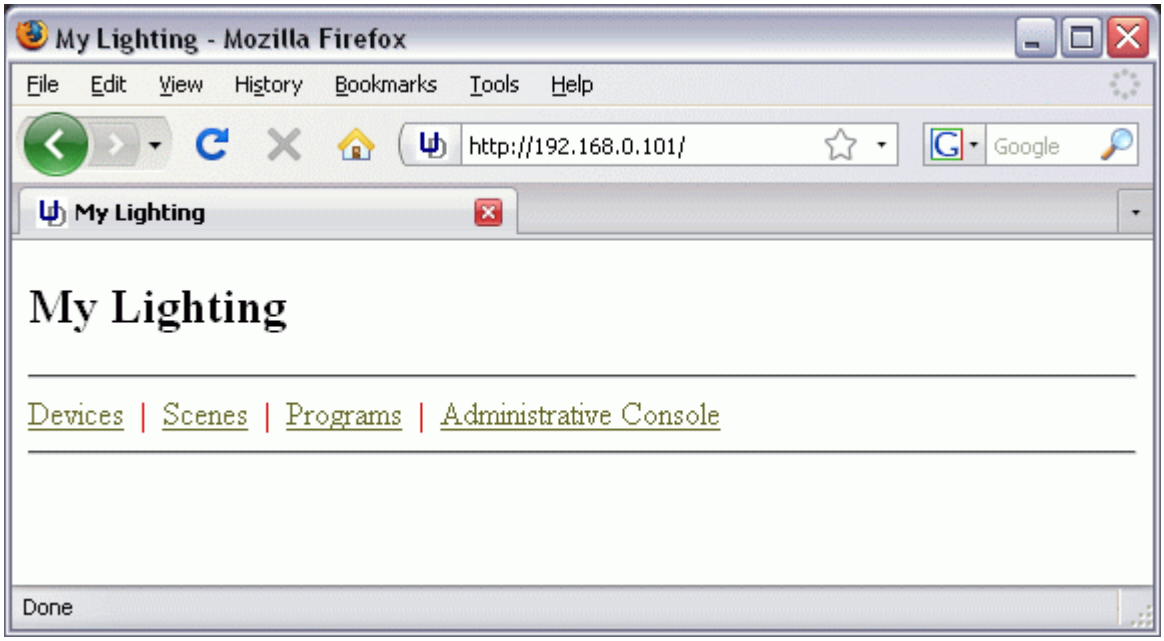
Once you find your URL, you are ready to start using the ISY. To connect to the ISY, launch your web browser and type the URL into the address bar. You will then be asked to authenticate. The default login information is:

Username: admin
Password: admin

Once you login you will be presented with the ISY's HTML interface.

2.3 The HTML Interface

The ISY's HTML interface provides an easy way to interact with your ISY. The HTML interface does not require Java, and is accessible from just about any web browser – including mobile phones and other devices!



You won't be able to do much with it until you starting configuring your ISY, but here is a summary of what you can do with the HTML Interface:

- **Devices –** Within this link, you will find INSTEON devices you have added to your ISY. You can not only see their current status, but also control them. Use this page turn lights and other devices on or off, adjust your thermostats, and much more.

- **Scenes –** On this page you can control scenes configured on your ISY. You will learn more about Scenes in the section titled **The Administrative Console.**

- **Programs –** By clicking this link you can view the status of any Programs you have stored on your ISY and also control them. You will learn more about Programs in the section titled **3.0 The Administrative Console.**

- **Administrative Console –** Clicking this link will launch the ISY's Administrative Console, which does require Java. The Administrative Console is where you will be configuring your ISY, adding INSTEON devices, creating Programs, configuring the IR interface, and MUCH more.

There may be other links available in the HTML interface as well depending on how your ISY is configured, and what optional modules you may have purchased.

2.4 Launching The Administrative Console

The Administrative Console is where you will spend most of your time configuring and tuning the ISY, programming your INSTEON devices, etc.

Click the Administrative Console link on the ISY's HTML Interface to launch (Java required).

You will again be asked to authenticate to your ISY. The default login information is:
Username: admin
Password: admin

In the future you may go directly to the ISY's Administrative Console by appending */admin* to the URL. For example:
http://192.168.0.101/admin

3.0 The Administrative Console

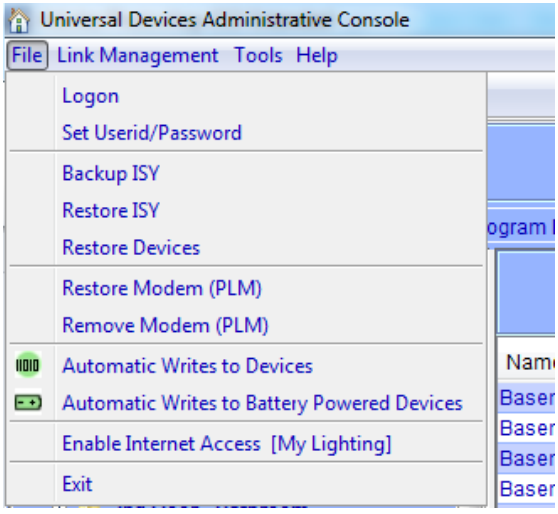
The Administrative Console is divided into several tabs, each used to configure different aspects of your ISY.

3.1 Basic Configuration

Before getting started, it's important to configure a few basic things on the ISY.

3.1.1 Setting the User ID and Password

For security reasons, please change the default username and password used to connect to your ISY. Choose the Set **Userid/Password** option with the Administrative Console's **File** pull-down menu as shown below.

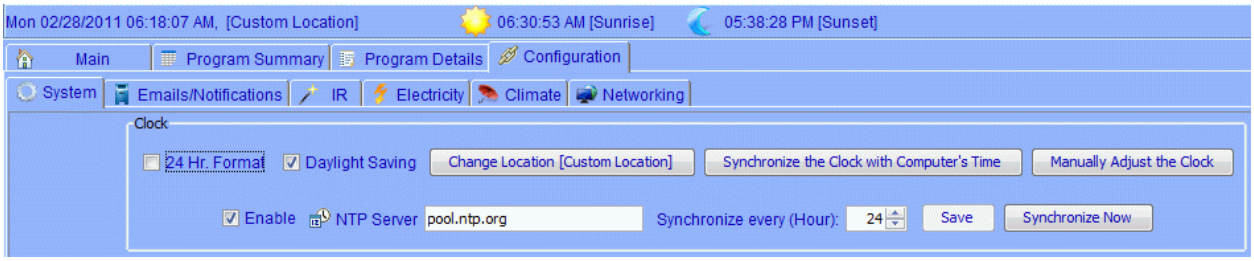


When choosing your new username and password, please consider the following:

- Both the User ID and password must be entered
- User ID and passwords are case sensitive
- The ID and password must be between 3 and 10 characters
- The following characters are NOT allowed: < > / ; &

3.1.2 Setting the Time and Location

Click the ISY's Configuration tab to set your time (used for Program schedules) and location (used to calculate sunrise/sunset times).



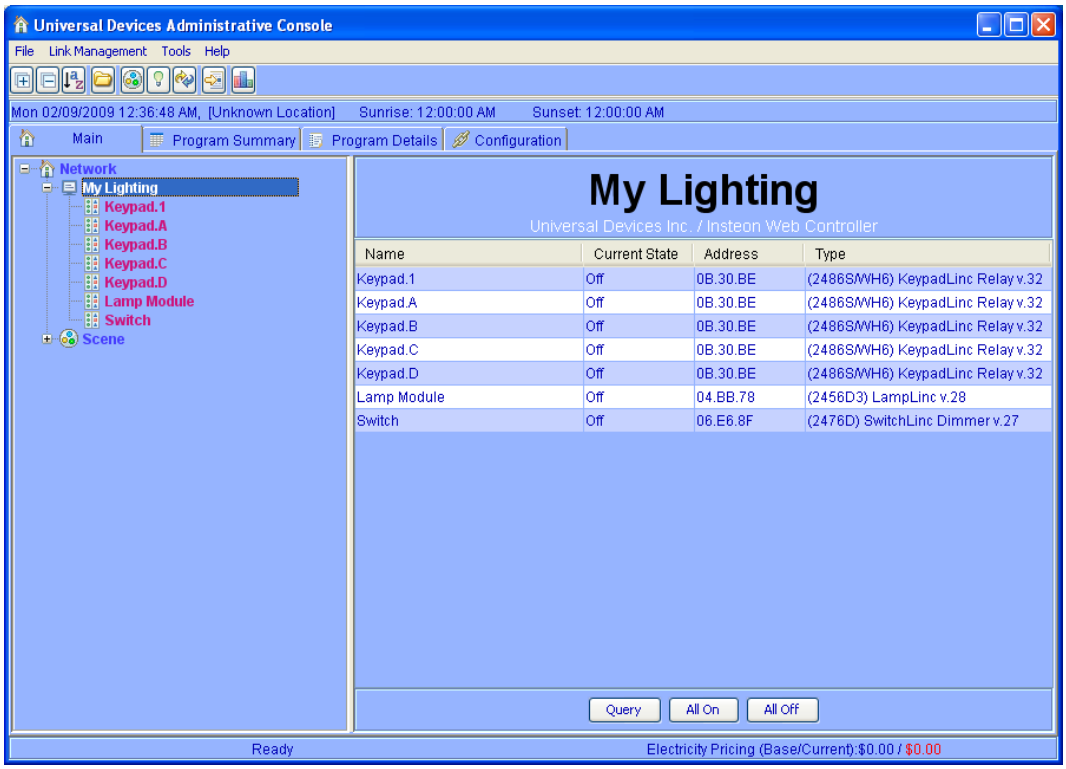
Please be sure to check the Daylight Saving option if applicable in your area.

Also feel free to check and configure the **NTP Server** option if your ISY is able to access the internet. The ISY will periodically sync its clock with the specified NTP server to ensure accurate time. We recommend syncing every 24 hours, as too frequent connections can result in the NTP server refusing the ISY's request.

After adjusting your settings, please be sure to hit the **SAVE** button.

3.2 The Main Tab

The **Main** tab is where you can add, configure, and manage your INSTEON devices.

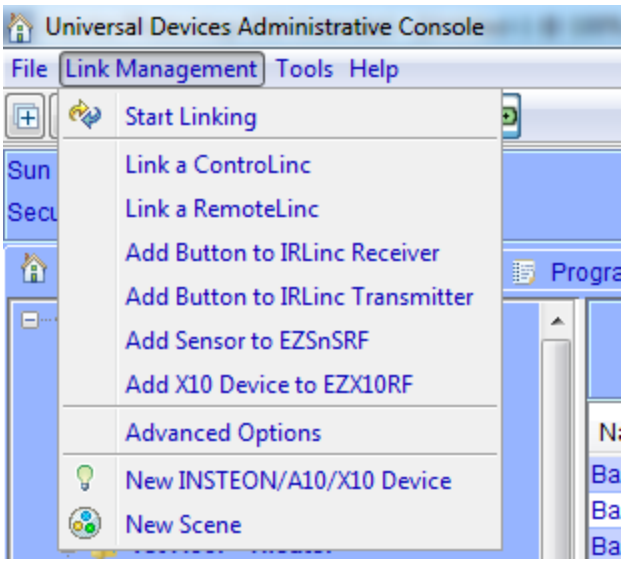


The left-hand pane displays a hierarchy of folders, devices, and scenes contained within your ISY. The right-hand pane displays detailed information on what you have selected on the left.

3.2.1 Adding INSTEON Devices

Adding INSTEON devices to the ISY can be done via several different methods. Some devices require a particular method; other devices can be added to the ISY in multiple ways. For more specific information, see **Appendix F: INSTEON Device Notes.**

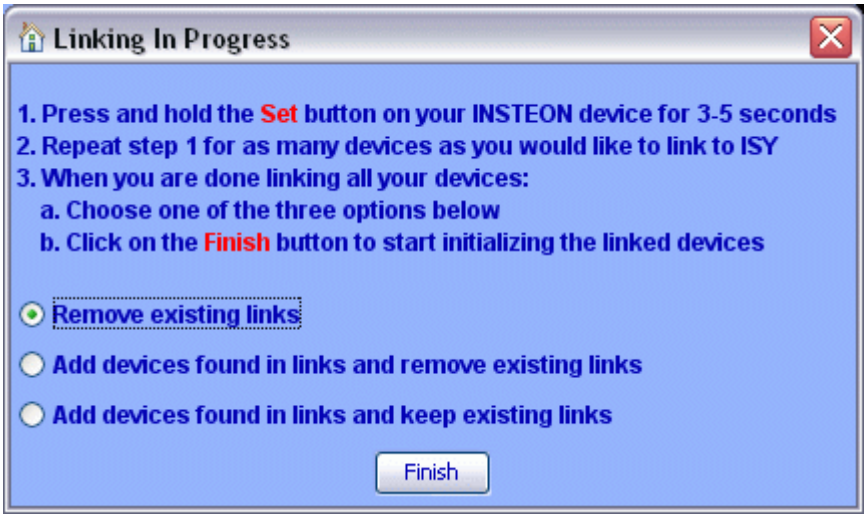
Adding devices to the ISY is done through the **Link Management** pull-down menu. Within that menu are several different options:



- **Start Linking.** The majority of INSTEON devices can be added using this method. Once this option is selected, simply go to each Insteon device installed and hold the SET button for 3-5 seconds. The ISY will then see each device, and add it to the device list.

  As you hold the SET button on each device, you will see the device added to the left-hand pane. Once you are finished adding devices, hit the FINISH button which will complete the process. Adding devices to the ISY can take anywhere from a few seconds to minutes per device, depending on how many existing links are contained within each device. Please be patient.

Before adding devices to the ISY, it's important to understand the 3 different options presented:



- **Remove Existing Links.** This option will add the device to the ISY, and also remove any existing links in the device. This is the default and the best option to choose if you would like a clean start, or if it is a brand new device.

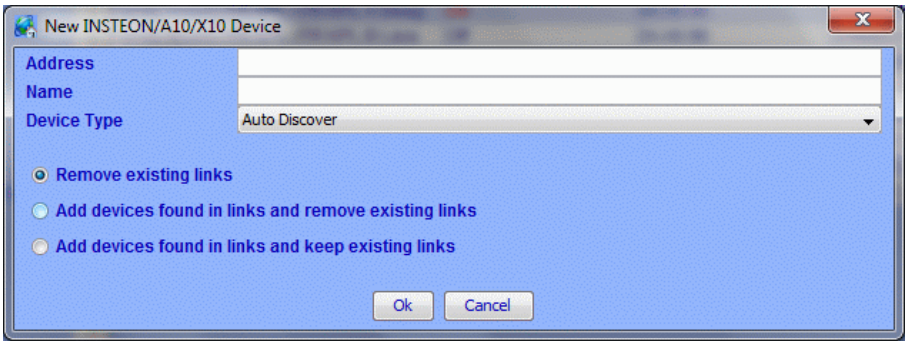
- **Add Devices Found in Links and Remove Existing Links.** This option will not only add the particular device you press the SET button on, but will also add any devices that the particular device is linked to. Once complete, it will then remove any links contained within the devices. This helps save some time if you have a device you have already linked with other devices, but still clears out all links to give you a fresh start.

- **Add Devices Found in Links and Keep Existing Links.** The option not only adds the particular device you press the SET button on, but will also add any devices that the particular device is linked to. It will also keep any pre-existing links between devices, and build ISY scenes out of those links. This is the best option to choose if you'd like to preserve all existing links between devices.

- **Link a ControLinc, Link a RemoteLinc, Add Button to IRLinc Receiver/Transmitter, Add Sensor to EZSnSRF and Add X10 Device to EZX10RF.** These are specific options used to add the respective devices to the ISY. If you are adding one of these devices to the ISY, choose the corresponding menu option and follow the on-screen instructions.

- **Advanced Options.** This option adjusts the method used when the ISY is programming your devices. Please do not touch this option unless instructed by a UDI support rep.

- **New Insteon Device.** This method works much like the Start Linking method, with one exception – instead of hitting the SET button on each device, you must type in the device's INSTEON address. The ISY will then initiate communications with the device in order to add it to your system. In most cases you can leave the Device Type option set to Auto Discover, but some devices may require you to specify the Device Type. For more information please see: **Appendix F: INSTEON Device Notes.**



3.2.2 Adjusting Settings on INSTEON Devices

Some INSTEON devices have settings that can be changed through the ISY. For example, dimmable devices have On Levels and Ramp Rates that can be adjusted.

- **On Levels** are the brightness levels at which a device is turned on when pressed (25%, 75%, etc.).

- **Ramp Rates** are the speeds at which a device is turned on when activated. Use a slower ramp rate to ramp a light on more slowly when pressed.

To adjust settings on a device, simply click to select a device. Available settings will be displayed on the right-hand pane.

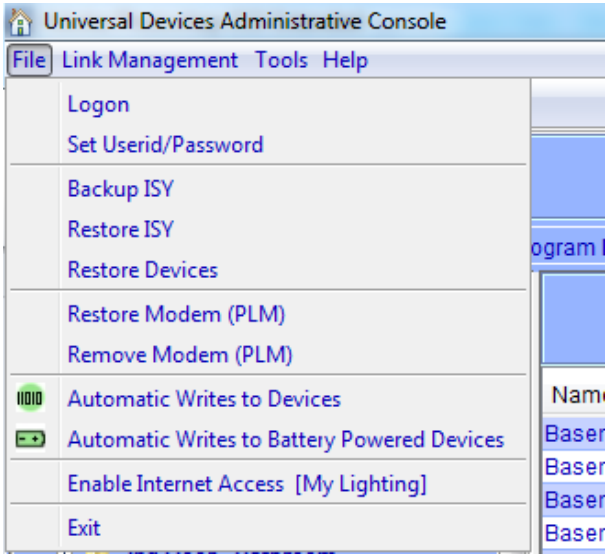
Some devices may have other options available. To find out more information for a particular device, please see **Appendix F: INSTEON Device Notes**.

The Pro version of the ISY firmware includes a **Batch Mode**.

Making changes to INSTEON devices, whether adjusting settings or creating/modifying Scenes (see **3.2.3 Creating INSTEON Scenes**), can be a time consuming process. While making minor changes can be relatively quick, making changes to large scenes (for example) can take many minutes.

By default, the ISY is set to automatically write updates to devices as you make changes in the Admin Console. In some cases, you might prefer to queue your changes and write all changes to devices at a more convenient time.

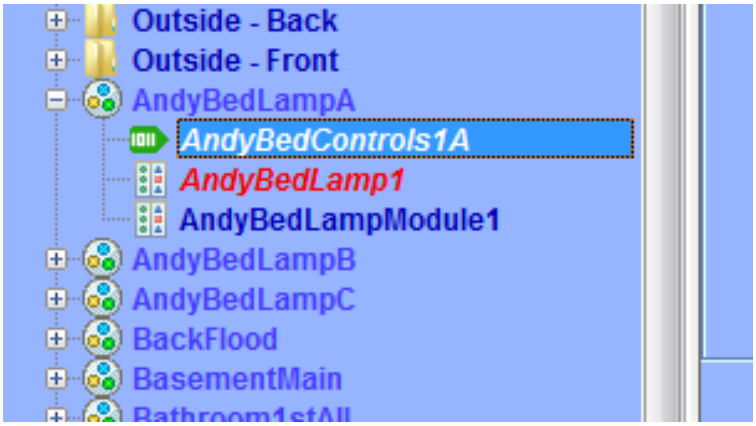
To toggle this option, click the FILE menu:



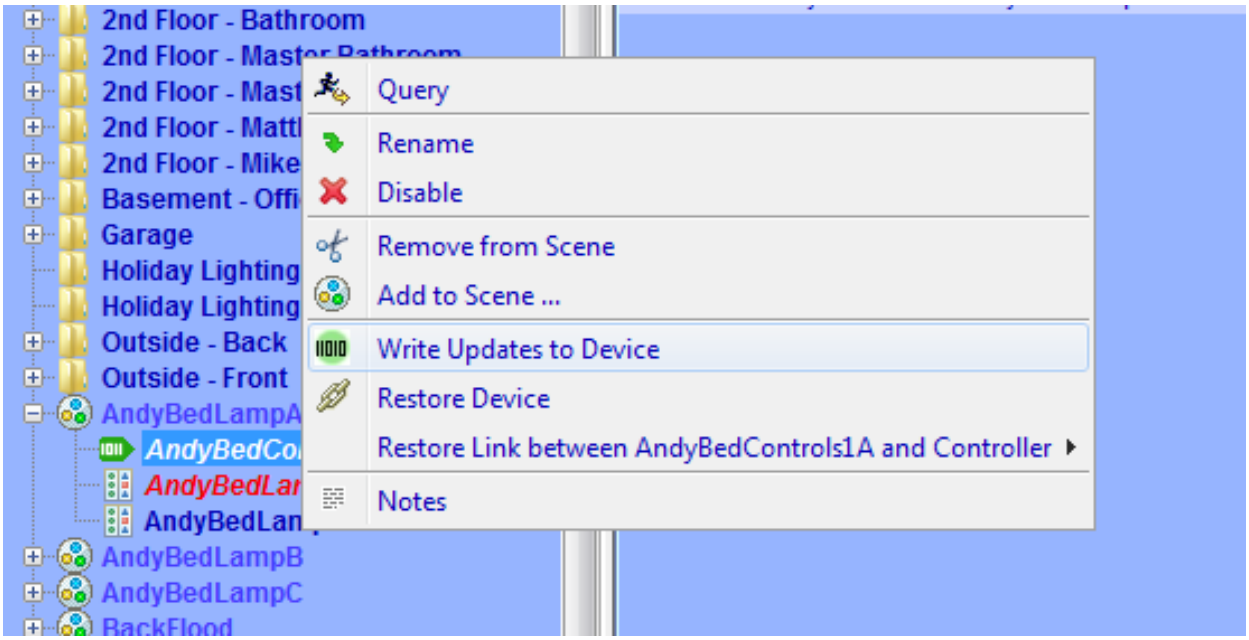
- **Automatic Writes to Devices.** When this option is on, changes are written automatically to devices. Toggle this option off to disable automatic writes. When toggled back on, all pending changes will be sent to devices.

- **Automatic Writes to Battery Powered Devices.** This option toggles automatic writes only for battery powered devices. Most battery powered devices need to be manually set to linking mode to accept changes, so utilizing this option to queue up multiple changes can help save time.

Devices that have pending changes waiting to be written or marked with a green icon in the device tree as pictured here:



To write all pending changes for a single device (without turning Automatic Writes back on), simply right-click the device and choose Write Updates to Device:



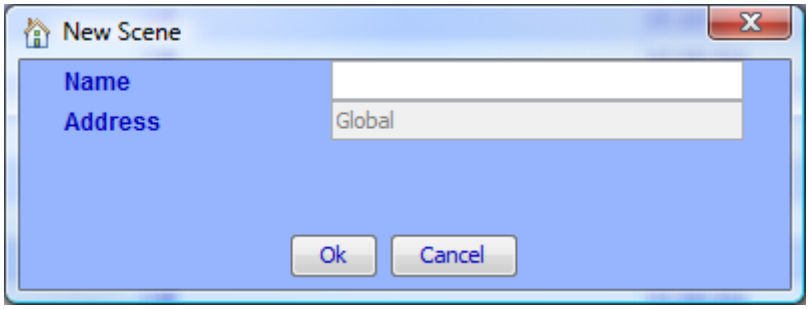
3.2.3 Creating INSTEON Scenes

Scenes are collections of INSTEON devices that react to and with one another in various ways. Scenes are comprised of both Responders and Controllers.

- **Responders** are devices contained within scenes that only respond to commands issued to the scene. For example, a lamp module with a table lamp attached would likely be a Responder to the scene. When the scene is turned on, the lamp module might turn on. When the scene is turned off, the lamp module will turn off. Responders are colored blue within a scene.

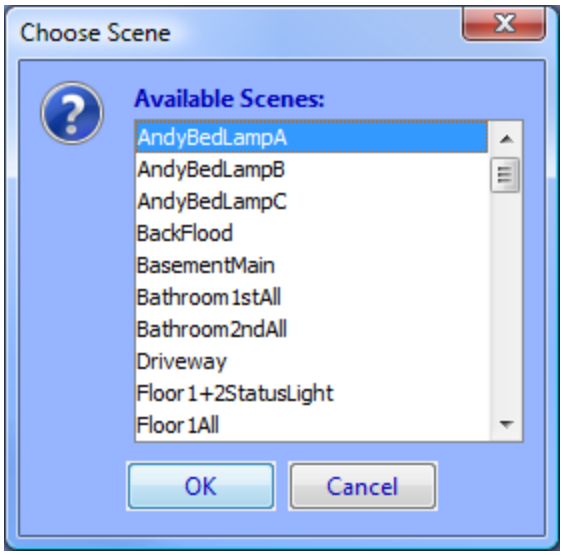
- **Controllers** not only respond to commands issued to the scene, the also control the scene. An example of a Controller might be a button located on a Keypad – when that Keypad button is pressed, all members of the scene will respond as programmed. Controllers are colored red within a scene.

To create a Scene, simply click the New Scene option under the Link Management pull-down menu, or click the New Scene button on the ISY's toolbar.



Name the Scene accordingly, click OK, and your scene will appear in the left-hand pane.

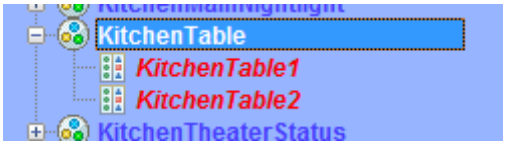
To add devices to a scene, simply right-click a device, choose Add To Scene, and choose the appropriate Scene. You can also hold the CTRL key down, click multiple devices, then right-click and choose **Add To Scene** to add multiple devices at once.



If appropriate, the ISY will ask you if the device should be added to the Scene as a Responder or a Controller. Some devices cannot be Controllers.

To remove devices from a scene, simply right-click a device from within a scene and choose **Remove from Scene**. To remove an entire scene, simply right-click the scene and choose **Remove Scene**.

One example of a scene might be a group of 2 devices that control the same light – typically called a "virtual 3-way circuit". For example, you might have 2 switches in your kitchen that you'd like to control your kitchen table light. One switch is physically attached to the kitchen table light, but you'd like the other switch to control it as well. In this case you would add both devices as Controllers. In the scene below, both devices in the scene are Controllers (shown below in red). This is commonly called "cross-linking".



Another example of a scene might be a keypad button that you want to control multiple lights in a room. When the keypad button is turned on, you might want multiple devices to turn on at various levels to create a lighting "mood". When the keypad button is turned off, the devices would all turn off. In the screenshot below, the KitchenDinner scene contains multiple Responder devices (in blue) with a single Controller (in red):

Scenes can contain multiple controllers, and each controller can be programmed to set Responders to various on levels and ramp rates.

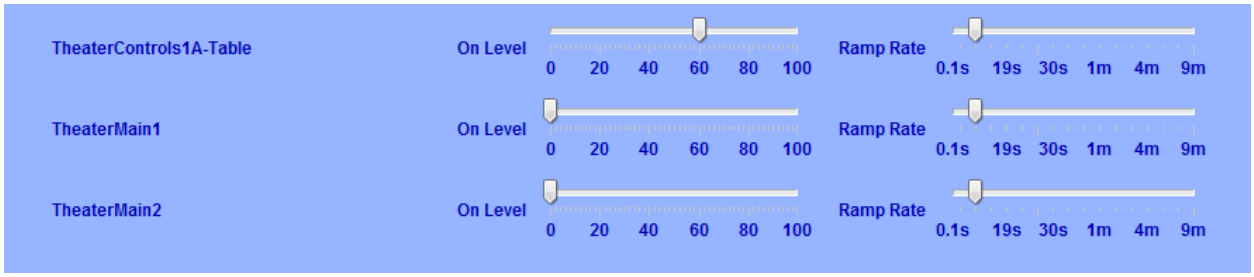
- **On Levels** are levels at which a Responder is turned on when activated (25%, 75%, etc.). Devices can have multiple on levels (one per Controller). Relay devices can only be ON or OFF.

- **Ramp Rates** (dimmable devices only) are the speeds at which a device is turned on when activated. Use a slower ramp rate to ramp a light on more slowly.

To set the properties of a scene, click on a Controller within a scene. On the right-hand pane will be options to set each scene member's on levels and ramp rates used when the highlighted Controller is pressed. Simply move the appropriate slider left or right to adjust the values. Once the slider is released, changes will be saved to the device.

To set values when the ISY itself is the controller (for example when controlled through the Administrative Console or through ISY Programs), click the scene itself on the left-hand pane.

In the example below, when the highlighted controller is pressed the TheaterControls1A-Table device will turn on to 60% and the TheaterMain1 and TheaterMain2 devices will turn off. All devices are set to use a 2 second ramp rate.



There are a couple of other options available when adjusting scenes:

- **Apply Changes To All Devices.** This option will merge all Responder sliders to one slider to make bulk changes easier. For example, if you want all responders in a scene to turn on to 50%, simply check the Apply Changes To All Devices option and drag the single slider to 50%.

- **Copy Scene Attributes From...** As noted above, the ISY itself is also a controller of every scene. If a controller within a scene should use the same values as the ISY uses when controlling a scene, simply click this button to copy the values from the ISY over to the currently selected Controller.

NOTE: Once programmed, scenes operate independently of the ISY – all programming is saved to the INSTEON devices. If the ISY is turned off or is offline for some reason, programmed Scenes will still operate as expected.

NOTE: It's important that all links between devices are created from within the ISY. Avoid creating links manually between devices or using other software packages – unexpected results will occur.

3.2.4 Organizing INSTEON Devices and Scenes

Once added to your ISY, you can manage and organize your INSTEON devices and scenes in a variety of ways:

- **Rename.** When added to the ISY, devices are named their INSTEON address. If you right-click a device or scene, a Rename option is available to help make your devices more identifiable.

- **Folders.** Feel free to create folders to help organize your Devices and Scenes. Folders can be created by either right-clicking on the Network node (located on the left-hand pane) and choosing New Folder, or using the New Folder icon located on the Administrative Console's top toolbar. Devices and Scenes can be dragged and dropped onto folders, or simply right-click a Device or Scene and choose Move To Folder and select the appropriate folder to move it to. Folders can also be moved within other Folders to create a nested hierarchy.

- **My Lighting.** Clicking the My Lighting node on the left-hand pane will display a summary of all your devices, their current states, their INSTEON addresses, and their device types / firmware versions. You can sort by any field simply by clicking the column header.

3.2.5 Controlling INSTEON Devices and Scenes

The Administrative Console also allows you to control your INSTEON devices and scenes. Simply click on a device or scene, and appropriate controls will be shown on the bottom of the Console as follows:

- **On.** Clicking the ON button turns the INSTEON device or scene on to its programmed On Level using it's programmed Ramp Rate.

- **Off.** Clicking the OFF button turns the INSTEON device or scene off using it's programmed Ramp Rate.

- **Fast On.** Clicking the FAST ON button turns the INSTEON device or scene on to its maximum (100%) level instantly (ignoring its programmed On Level and Ramp Rate).

- **Fast Off.** Clicking the FAST OFF button turns the INSTEON device or scene off instantly (ignoring its programmed Ramp Rate).

- **Brighten.** Pressing and holding the BRIGHTEN button starts ramping up the brightness level of a dimmable INSTEON device. Release the button to stop the ramp up.

- **Dim.** Pressing and holding the DIM button starts ramping down the brightness level of a dimmable INSTEON device. Release the button to stop the ramp down.

Some devices may have other controls or options available. To find out more information for a particular device, please see **Appendix F: INSTEON Device Notes**.

3.2.6 Other Functions (Restore, Disable, Query, & more)

There are several other functions available when working with INSTEON devices in the Administrative Console's Main tab:

- **Restore Device.** If an INSTEON device has lost all or some of its programming, you can try right-clicking the device and choosing Restore Device. This will attempt to re-write all links in a device, recreating all scenes to match the ISY's internal database.

- **Disable Device.** If an INSTEON device will be taken offline for an extended period of time, it might be desirable to disable that device to stop the ISY from trying to access it. Simply right-click the device you wish to disable, and choose the Disable option.

- **Query.** The Query option is available when right-clicking a device or scene. This will cause the ISY to communicate with the highlighted device or devices to find out their current states.

- **Group Devices.** Some INSTEON devices will create multiple entries within the ISY. For example, KeypadLincs have 6 or 8 nodes in the ISY (one for each button). You can choose to group these nodes together by right-clicking the primary node and choosing "Group Devices".

3.3 The Program Details Tab

The Program Details tab is where you can create ISY Programs. ISY Programs are the true power of the ISY, where you can extend the capabilities of INSTEON and other devices using timers, triggers, macros, etc. Programs also allow you to utilize the ISY's IR receiver, optional modules, and more.

The Program Details screen is divided into several sections. The left-pane is used to show your program hierarchy. As you create ISY programs and folders, they will show here. The bottom-left "Manage Programs" section holds several buttons used to create and manage your Programs.

The top-right portion of the screen shows the details of a highlighted folder or program. The bottom right is where you will create and edit your Program.

3.3.1 The Basics of ISY Programs

ISY Programs are created using simple buttons and pull-down menus. The ISY allows you to easily create simple programs, yet is flexible and sophisticated enough to allow powerful and complex programming.

NOTE: Unlike Scenes, Programs require that the ISY is online in order to function.

There are several buttons available on the bottom-left of the Administrative Console used to create and manage your Programs:

- **New Program.** This button will create a new ISY Program. Once a Program is created, it can be edited and modified as needed.

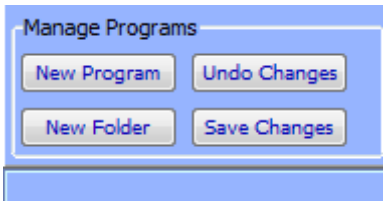
- **New Folder.** This button will create a new folder in your Program hierarchy.

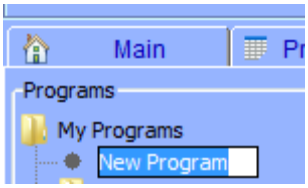
- **Save Changes.** The ISY requires that you SAVE your changes before they become active. Please be sure to save periodically as you create and edit your ISY Programs.

- **Undo Changes.** If you have made changes to your ISY Programs, click the UNDO button to discard those changes and revert to the last time your changes were saved.

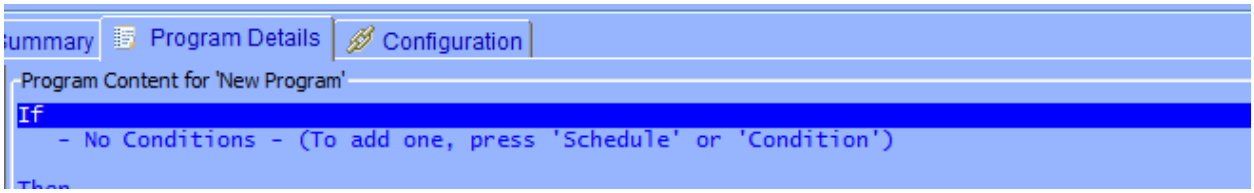
3.3.2 Creating Your First Program

To create a Program click the New Program button and a new program will appear. The ISY will prompt you to name your program – type in something descriptive so you will be able to easily identify it in the future.



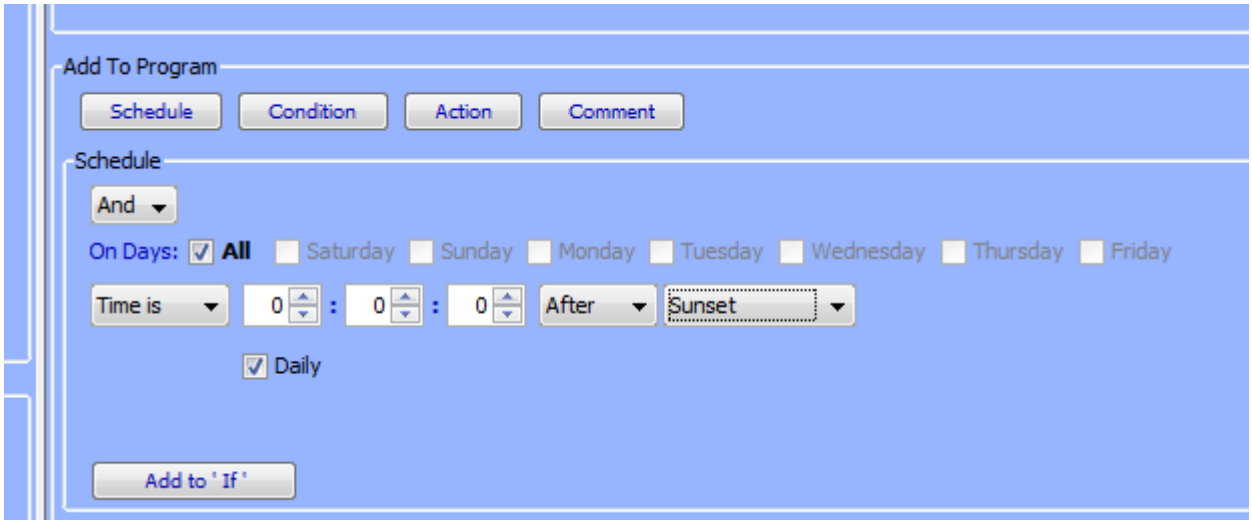


Once you name your program click the IF statement to set your conditions.

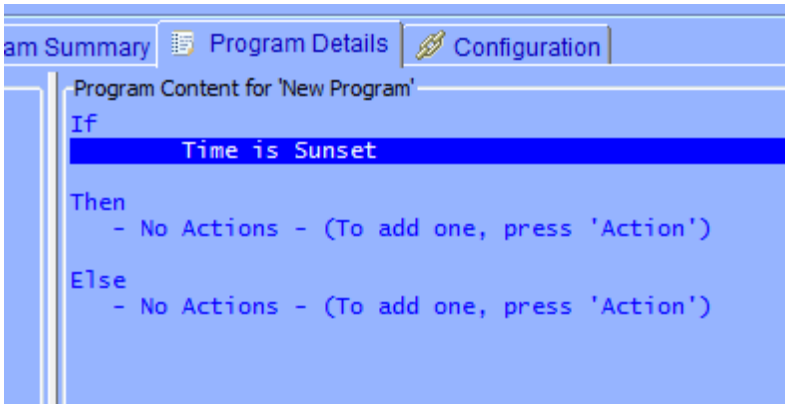


Once highlighted, the bottom portion of the screen allows you to set your conditions using simple buttons and pull-down menus. For this example, we will create a program to turn your front door lights on at sunset.

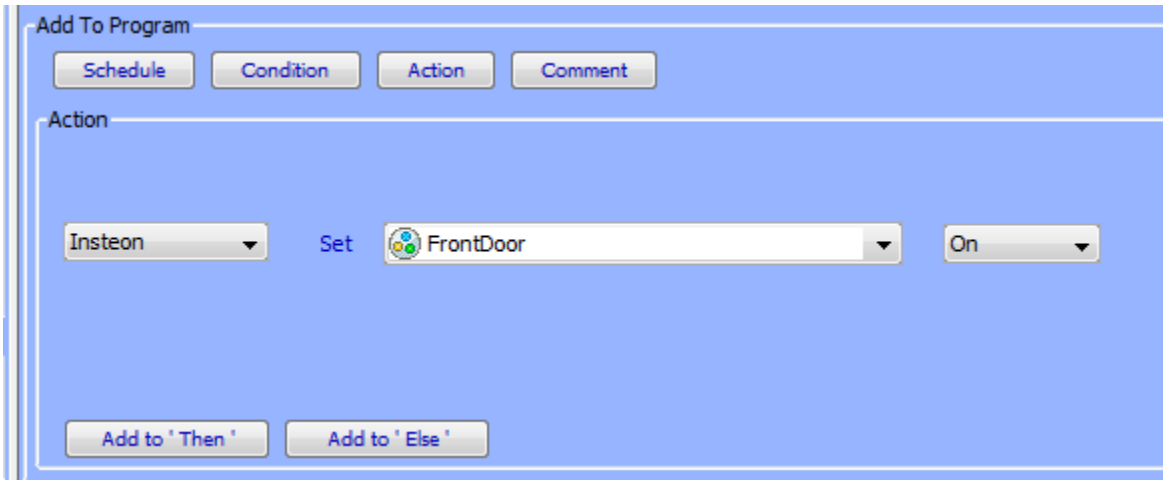
To set your sunset condition, click the SCHEDULE button and change the right-most drop down menu to SUNSET as shown below.



Once your Sunset condition is set, click ADD TO IF and you will see the IF statement added to the top portion of the screen, which shows the actual program you are creating.



Next, click on the THEN statement to highlight it. The THEN portion of a program runs once the IF portion of a program is true. At the bottom of the screen choose the device or scene that you want to turn on at sunset.

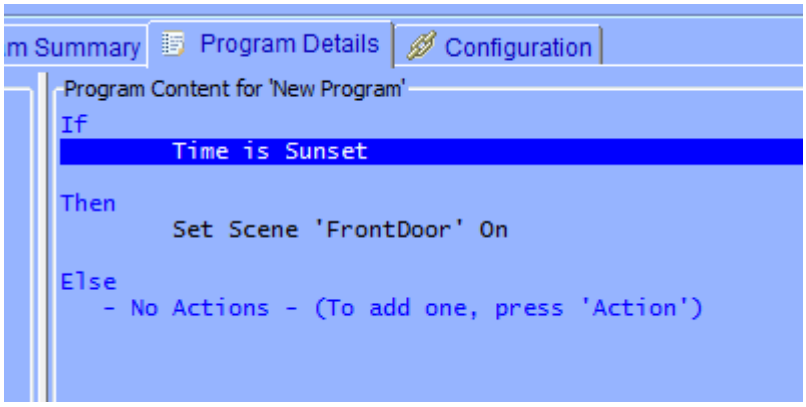


This time hit the ADD TO THEN button to add the THEN statement to your program.

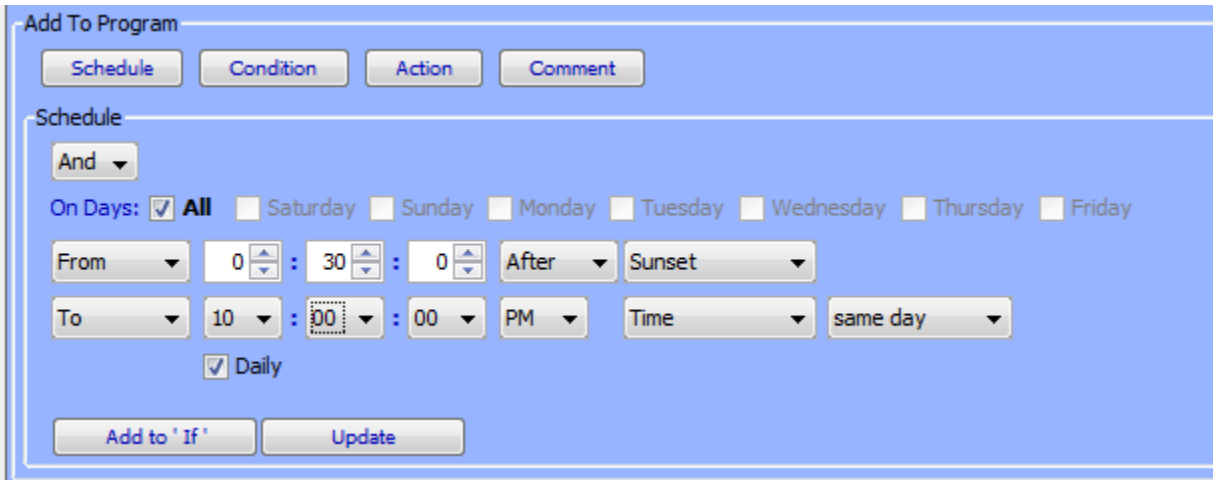
Hit the SAVE CHANGES button to save your program, and you're done! In just a few steps we've created a simply program to turn on your front door lights at sunset.

But, let's say we wanted something slightly more sophisticated. Say we want to turn the lights on 30 minutes AFTER sunset, and turn them off at 10pm. To do that, we'll make a couple of quick adjustments to the program.

First we'll click the "Time is Sunset" IF statement to highlight it.

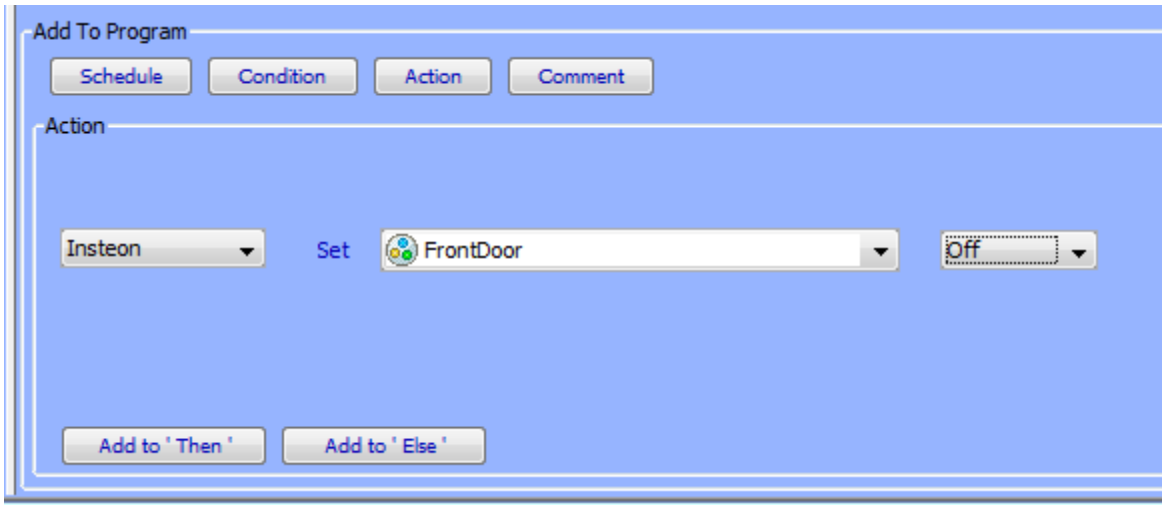


Once the statement is highlighted we can edit it on the bottom of the screen. Change the TIME IS pull-down mention to a FROM and change the middle numeric value to 30. Then change the FOR pull-down menu to TO and change the values to 10pm as shown below:

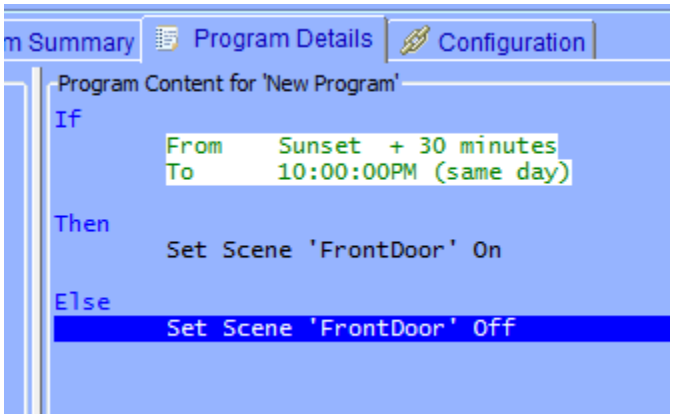


Click the UPDATE button to update the highlighted statement. Clicking the ADD TO IF button would add an additional IF statement, which is not what we want to do in this case.

The ELSE portion of a program runs one the IF statement is no longer true. After 10pm the IF statement is no longer true, so the ELSE statement will run. Next click the ELSE statement on the top portion of the screen to highlight it, and on the bottom portion set your Front Door lights to turn off.



Click ADD TO ELSE and your final program should look like this:



Hit the SAVE CHANGES button, and your new program is complete!

There is a practically unlimited number of things you can do using ISY programs. For more examples, see **Appendix G: Sample ISY Programs**.

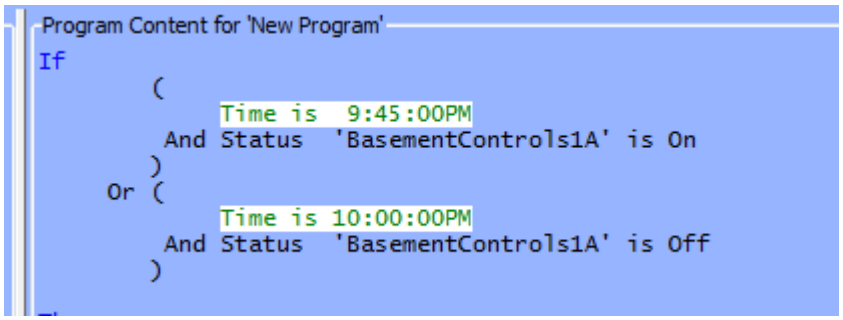
3.3.3 Building Your Programs

There are a variety of on-screen buttons to help build your Programs to suit your needs. Programs are not limited to one condition or action – you can add multiple IF, THEN, and ELSE statements to your program. When adding multiple lines, be sure to choose AND or OR as appropriate.

When working with Programs containing multiple lines, additional buttons will appear to help arrange your lines and group them together with AND / OR parenthesis.

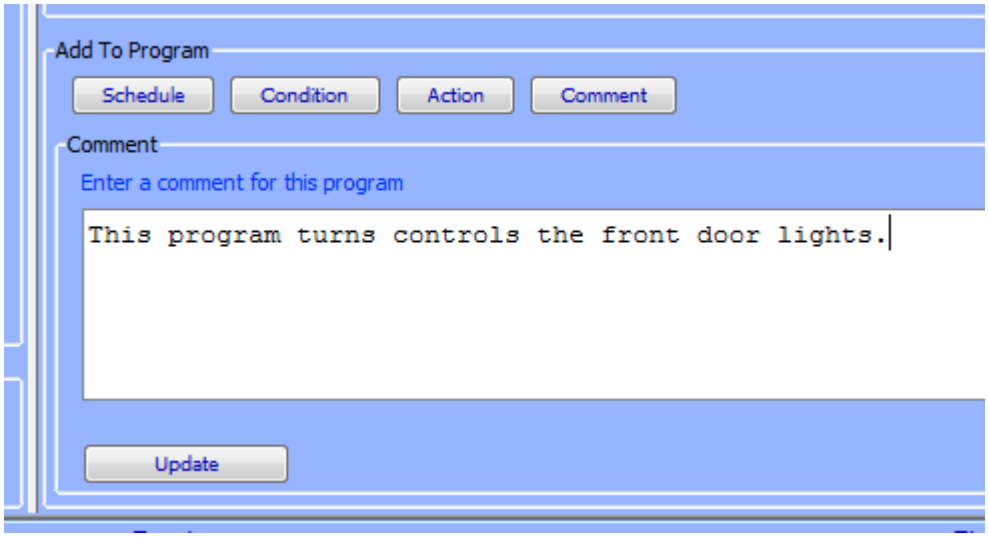
To remove a line, simply highlight it and click REMOVE LINE. To rearrange your lines, highlight them and click MOVE LINE UP or MOVE LINE DOWN.

To group conditions together, use the ADD AND (..) and ADD OR (..) buttons as shown below:

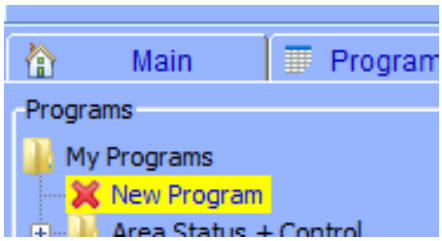


This program will execute only if the time is 9:45pm and the BasementControls1A device is On OR if the time is 10:00pm and the BasementControls1A device is Off.

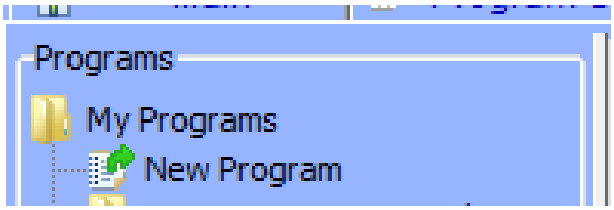
Click the COMMENT button to add comments to your program as needed. Click the UPDATE button to save your comment.



To temporarily disable a program, un-check the ENABLED box on the right-hand side of the screen and hit the SAVE CHANGES button. Disabled programs are displayed with a red X in the Program list as shown below:



Programs that have changes and need to be saved are displayed in the program list with a green arrow:

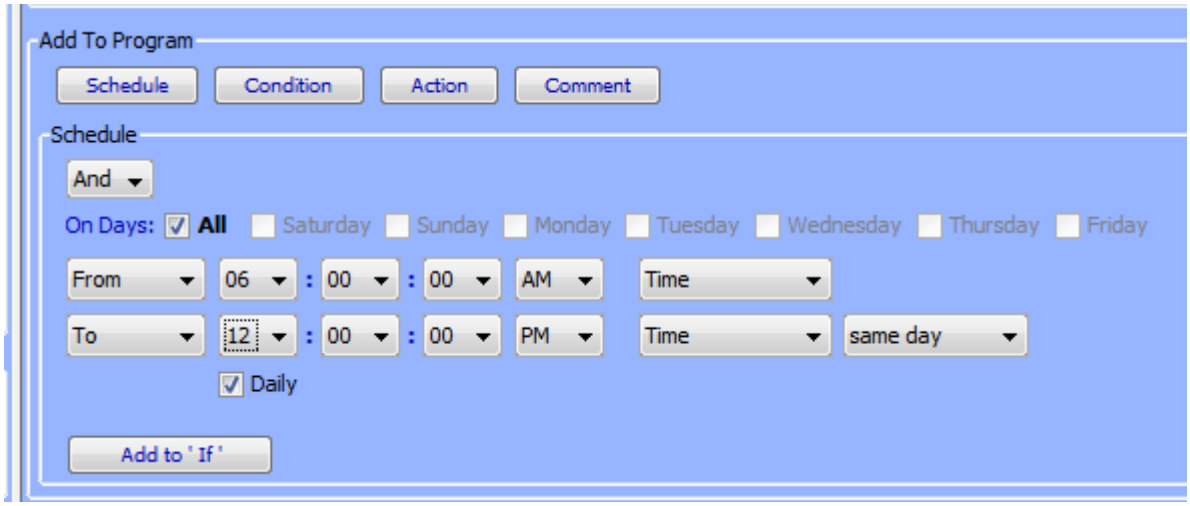


3.3.4 Program Schedules

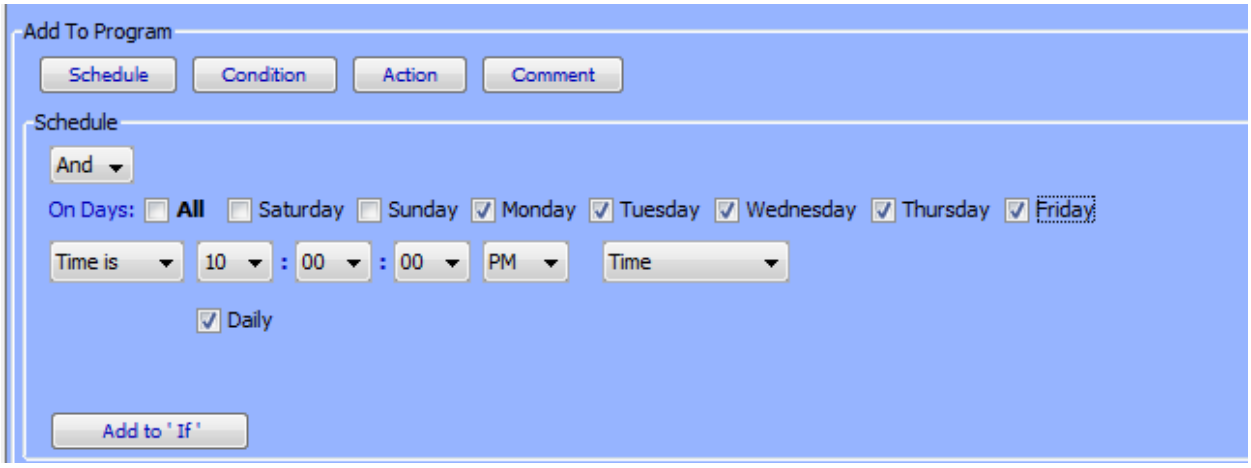
In the Add To Program button section, click SCHEDULE to add a Schedule to your Program.

Schedules allow you to add IF statement based on time of day, ranges of times, sunrise/set, days of the week, etc.

For example, a program that would run from 6am to 12pm:



Or a program that would run at 10pm on weekdays:



Once your Schedule statement is as intended, click the ADD TO IF button to add it to your program.

3.3.5 Program Conditions

In the Add To Program button section, click CONDITION to add a Condition to your Program.

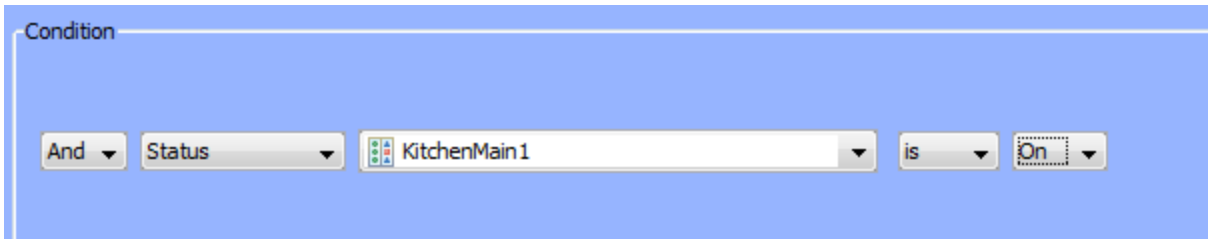
Program Conditions add other criteria to your IF statement. When adding a Condition to your Program, be sure to choose if you would like to added as an AND or OR.

Types of Conditions are:

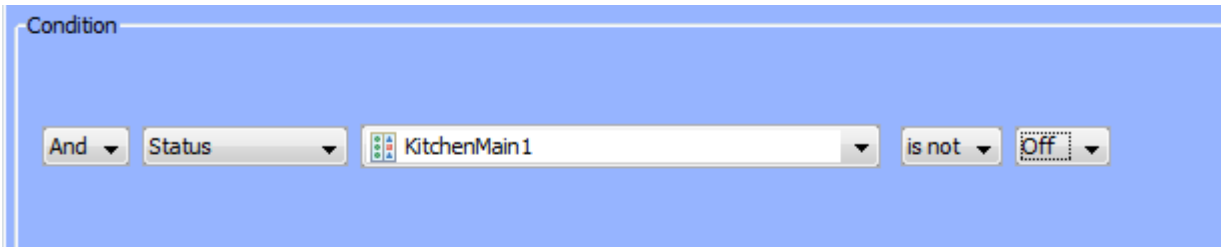
- **Status conditions** are true if a selected INSTEON device is at the state you specify. You can check to see if a device is ON, OFF, is NOT ON, is NOT OFF, if a dimmable device is at a specific level, if it's greater than a specific level, etc.

  ON means a device is at 100% brightness. So, if your program is checking to see if a dimmable device is on at ANY level, check to see if it is NOT OFF instead.

  For example, to see if your kitchen light is at 100% brightness you could do the following:

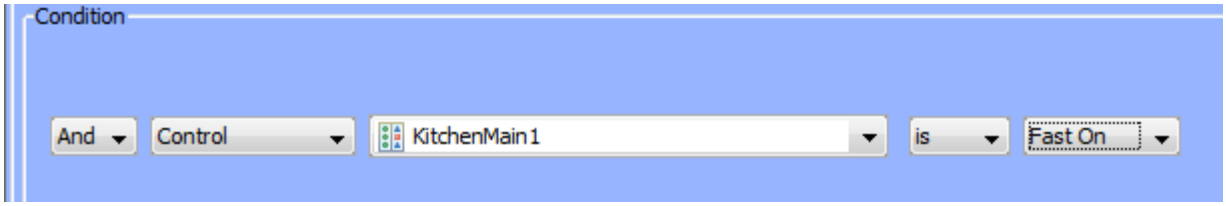


  But, to see if the same lights is on at ANY brightness you might do this instead:



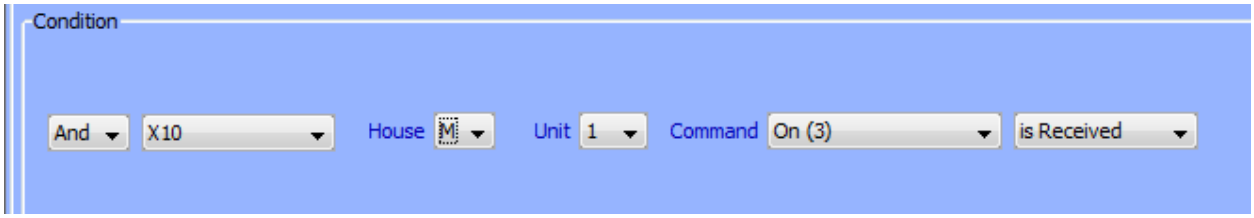
- **Control conditions** trigger only if a specified switch is pressed. The following types of presses are selectable (not all options available for all devices):
    - ON
    - OFF
    - FAST ON (double-tap ON)
    - FAST OFF (double-tap OFF)
    - FADE UP (press and hold ON)
    - FADE DOWN (press and hold OFF)
    - FADE STOP (release of a press and hold)
    - BRIGHT (bright button pressed)
    - DIM (dim button pressed)

  For example if you want to trigger a program if your Kitchen switch is double-tapped on you could do the following:



- **Program conditions** check to see whether or not other ISY Programs are currently True or False.

- **X10 conditions** trigger programs when X10 commands are received by the ISY. For example, to run a program if an X10 M1 ON command is received:



- **IR conditions** trigger programs when IR commands are received from a remote control. See the section titled **3.5 The Integrated IR Receiver** for more information.

- **Module conditions** trigger programs based on option ISY modules, such as the Electricity meter module or the Climate module. See the section titled **Optional Modules** for more information.

3.3.6 Program Actions

In the Add To Program button section, click ACTION to add an Action to your Program.

Program Actions are commands that are run when the IF statement is true (a THEN action) or if the IF statement is no longer true (an ELSE action). When adding an Action to your program, be sure to click the ADD TO THEN or ADD TO ELSE button depending on your intended result.

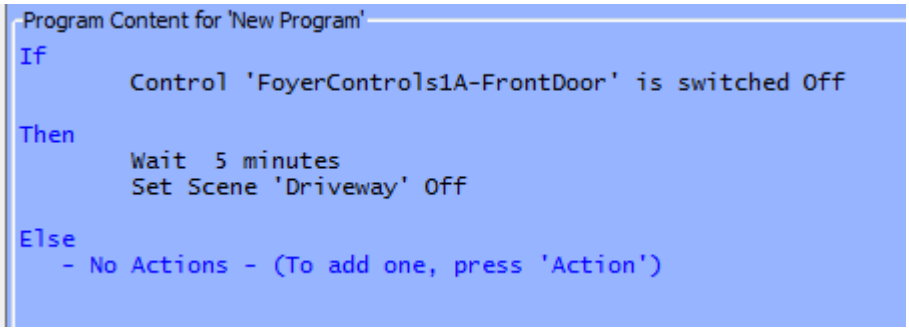
- **Insteon actions** send INSTEON commands to devices or scenes to turn them ON, OFF, etc. Not all options available for all devices:
    - ON (send a standard ON command)
    - OFF (send a standard OFF command)
    - FAST ON (turn device full on ignoring programmed on level or ramp rate)
    - FAST OFF (turn device full off ignoring programmed ramp rate)
    - FADE UP (start the ramp up of a dimmable device
    - FADE DOWN (start the ramp down of a dimmable device)
    - FADE TOP (stop the ramping up or down of a dimmable device)
    - BRIGHT (small increase in brightness of a dimmable device)
    - DIM (small decrease in brightness of a dimmable device)
    - QUERY (query the current state of a device)

- **Send X10 actions** send X10 commands to X10-compatible devices. Using this feature, ISY programs can control a wide range of X10-compatible devices.

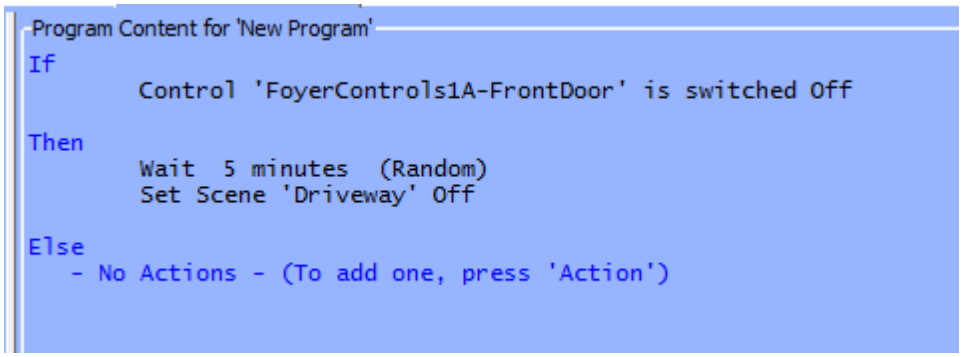
- **Notify actions** sends an email or SMS text message to recipients. Please see the section titled **3.6 Notifications** for more information.

- **Program actions** run or modify other ISY programs. The following options are available:
    - Run (If) (runs the IF portion of a program)
    - Run Then (runs the THEN portion of a program)
    - Run Else (runs the ELSE portion of a program)
    - Stop (stops a currently running program)
    - Enable (enables a disabled program)
    - Disable (disables and enabled program)
    - Enable Run at Startup (sets a program to run at startup)
    - Disable Run at Startup (sets a program to NOT run at startup)

- **Wait actions** create a pause in a running program. For example, to turn your driveway lights off 5 minutes after your front door lights are turned off, you could do the following:

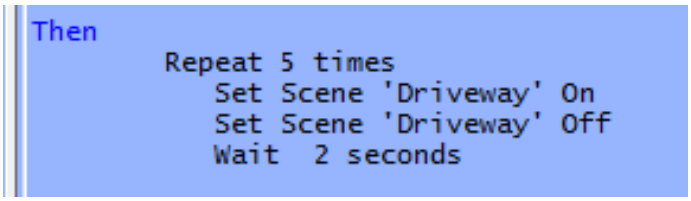


If the RANDOM checkbox is checked, a random time between 0 and the specified time is used. For example, this program would wait between 0 and 5 minutes:



- **Repeat actions** will repeat an action or group of actions multiple times. If the RANDOM button is checked, a random number of repeats between 0 and the specified value is used.

  For example, to flash your driveway lights on and off 5 times, every 2 seconds, you could:



- **Adjust Scene** actions adjust the On Levels and Ramp Rates of devices or scenes. For example, use this function to adjust scenes so that they turn on at brighter levels during the day, and perhaps at dimmer levels during the evening. Please keep in mind that many devices require a reboot before On Level or Ramp Rate changes take effect, so this function may not be useful in all cases.

- **System actions** are used to notify compatible clients of energy related alerts.

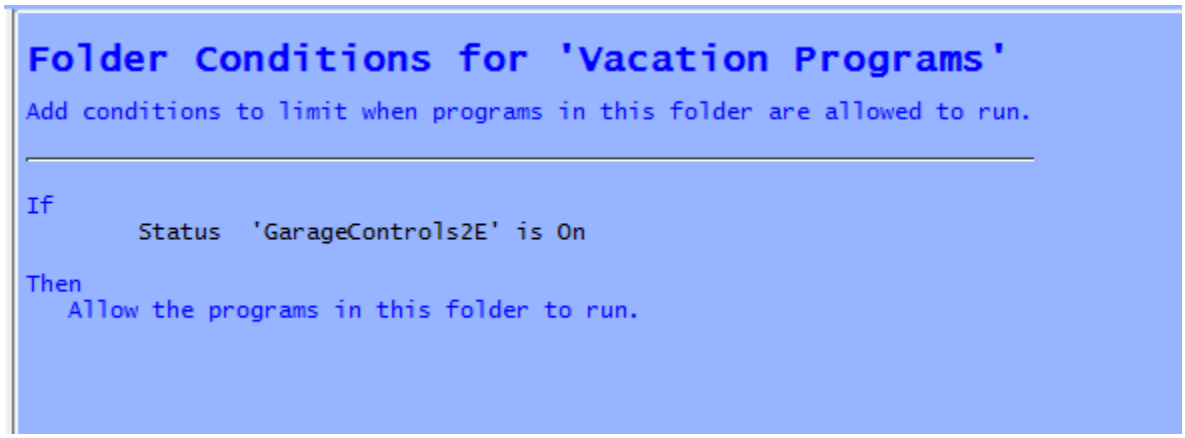
Other Actions may be available depending on what optional modules you may have installed. For more information, see the section titled **3.8 Optional Modules**.

3.3.7 Program Folders

To create a new folder, simply click the NEW FOLDER button on the bottom-left corner of the screen. You can also create new folders by right-clicking on the program hierarchy (left-hand side of the screen) and choosing New Folder.

Folders can be used to store Programs to help organize them by type, category, etc.

Folders can also have conditions set on them to aid in program functionality. For example, you could create a Vacation Programs folder that contains only programs that should run when you are on vacation. In the following example, the user turns a keypad button called “GarageControls2E” on if they are going away on vacation. The folder is set with the following conditions so that the contained programs will run only if that vacation keypad button is on:



To set conditions on a folder, simply click the folder to select it and adjust conditions as you would any ISY Program.

3.3.8 Other Functions (Status, Copy, Import & more)

- **Status.** To quickly view the current status of a Program, simply right-click it and choose Status which brings you to the Program Summary tab with the selected program highlighted.

- **Copy / Copy Tree.** To duplicate a program, simply right-click the Program and choose Copy. This is especially useful if creating several similar Programs. To duplicate a Folder and all contained Programs, right-click the Folder and choose Copy Tree.

- **Import / Export.** Programs can be imported and exported to the ISY by right-clicking a Program or Folder and choosing the desired function.

- **Find / Replace.** Right-click within your Program hierarchy to start a Fine / Replace. This function allows you to search your programs for specific devices or text strings, and optionally replace the results.

- **Copy To Clipboard.** To copy a specific Program as text to your clipboard, simply right-click it and choose Copy To Clipboard. The text can then be pasted into practically any Windows application, text editor, web browser, etc.

- **Rename.** To rename a Program or Folder, simply right-click it and choose the Rename function.

- **Remove.** To remove a Program or Folder (and all contained Programs), simply right-click it and choose Remove. Remember to hit the SAVE CHANGES button when complete.

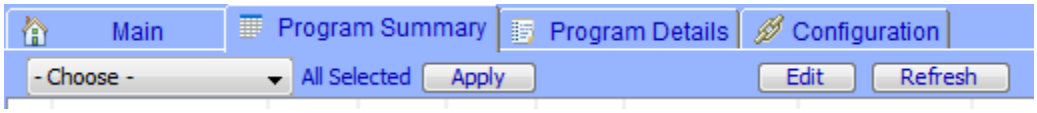
3.4 The Program Summary Tab

The Program Summary page displays a list of all your Programs, Folders, and information about each. Here are the columns of information available:

- **Name** (the Program or Folder's name)
- **Enabled** (shows whether the Program is currently enabled or disabled)
- **Run At Startup** (shows whether the Program is set to run at startup)
- **Activity** (shows if the Program is currently running or is idle)
- **Status** (shows if the Program's IF statements are currently true or false)
- **Path** (shows the Folder that the program is located in)
- **Last Run Time** (shows the last time the Program's IF statements were evaluated)
- **Last Finish Time** (shows the last time the Program completed)
- **Next Scheduled Run** (shows the next time the Program is scheduled to run, if applicable)

Each column can be sorted by clicking its column header.

There is a toolbar on the top portion of the screen that you can use to interact with ISY programs in a variety of ways.



To perform an action on a program, simply selecting it by clicking on it, click the left-most pull-down menu labeled "Choose" to select an action, and click the Apply button.

Available actions are:

- **Enable** – enable a program that has been disabled
- **Disable** – disable a program so that it will not run
- **Run (If)** – force the evaluation of the IF statement and run the program
- **Run Then** – force the run of the THEN portion of a program
- **Run Else** – force the run of the ELSE portion of a program
- **Stop** – stop a currently running program
- **Enable Run At Startup** – set a program so that it will automatically start running when the ISY reboots
- **Disable Run At Startup** – set a program so that it will not automatically run when the ISY reboots

On the left-most side of the tool bar are the EDIT button which will bring you to the Program Details tab and allow you to edit the currently highlighted program. The REFRESH button forces a refresh of the screen.

3.5 The Integrated IR Receiver

If your ISY came equipped with an integrated IR receiver (model numbers that contain "/IR"), Programs can be triggered using an RC5-compatible remote control. To program IR codes into the ISY, click the Configuration tab, then the IR sub-tab.

The IR configuration page lists all IR codes currently recognized by the ISY. The first column titled "Name" allows you to customize the name of a stored IR code. Simply double-click the IR code you'd like to change, and type the desired name. This is how the IR code will be listed under ISY Program Conditions.

The "IR Code" is an internal number used to identify the IR code. It cannot be change and for the most part should be ignored.

The "Status" column contains the last Condition received from a particular IR code. The following conditions are available:

- **Pressed –** indicates the remote control button was pressed and released normally.
- **Double-Pressed –** indicates the remote control button was pressed twice quickly (similar to a mouse double-click).
- **Held –** indicates the remote control button was pressed and held (not yet released).
- **Released –** indicates the remote control button was pressed and held, then released.

The above Conditions are available in ISY Programs, allowing you to control your home in a wide variety of ways from a simple remote control.

There are also 3 buttons on the bottom of the IR Configuration Page:

- **Save –** this button saves the currently displayed IR codes to the ISY.
- **Reload –** this button aborts any IR codes learned since the last Save, and "reloads" the last saved IR database from the ISY.
- **Restore Defaults –** this button restores the ISY to its default, blank IR database.

3.5.1 Using the 40 Default IR Codes

The ISY is able to download 40 pre-configured IR codes. These 40 pre-configured codes make it easier to configure remote controls that contain the ISY in their database (such as the Logitech Harmony), or remote controls that can import CCF files.

To import these 40 pre-configured IR codes into your ISY, simply click the "Import Default IR Codes" button at the top of the screen. This will auto-populate the IR Configuration page with 40 codes labeled "IR_001, IR_002, etc." This will overwrite any IR codes you may already have stored on your ISY.

With Logitech Harmony remote controls, you can simply choose the Universal Devices ISY from the Harmony software's built-in database. The Harmony software will allow you to drag and drop the ISY's 40 default IR codes onto buttons on your remote control.

If you're using a Pronto or other CCF-compatible remote control, we have a CCF file available for download here:
http://www.universal-devices.com/ir/99/isy-99.ccf

If you're using a Universal Remote Control (URC) brand remote, we have a MXJ file available for download here:
http://www.universal-devices.com/ir/99/isy-99.mxj

Once your remote control is configured, create Programs to have your ISY perform actions or a series of actions based on your remote's button press. IR codes stored on the ISY will be available as Conditions when creating ISY Programs.

3.5.2 Using the IR Learning Mode

If more than 40 IR codes are needed, or if you prefer to “teach” your own IR codes, the ISY features a learning mode that is capable of reading most codes sent from RC5 compatible remote controls. For best results, try using codes compatible with Philips-brand devices, which are typically RC-5 compatible.

To use the ISY’s learning mode, hit the button titled “Enter Learning Mode”. The ISY will now wait for IR codes, and once received they will be entered into the ISY’s IR database. Simply point your remote control at the front of the ISY and press the button you’d like the ISY to learn.

If a button press is not recognized, or a button is not recognized as expected, please try a different button/code.

Some symptoms of an incompatible IR code are:

- Multiple entries created from a single button press

- Inaccurate Status values (eg. you PRESS a button but the ISY shows it as HELD)

We highly recommend testing an IR code well to ensure it is 100% reliable with the ISY before saving. Make sure the ISY consistently displays the code correctly when the button is Pressed, Held, Released, etc.

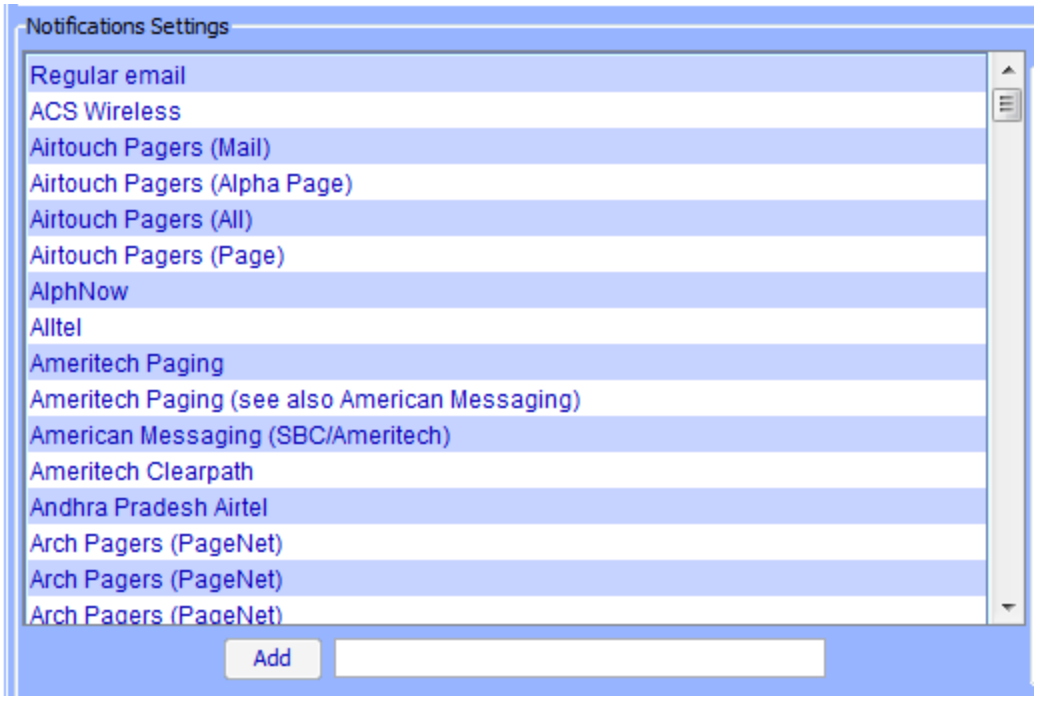
When done teaching IR codes to your ISY, hit the “Leave Learning Mode” button on the top of the screen and be sure to “Save” your changes. If you wish to revert to the last saved IR codes stored on your ISY, hit the “Reload” button located on the bottom of your screen.

3.6 Notifications

Using Programs, you can configure the ISY to send you notifications via text message or email. For example, the ISY could notify you if your thermostat drops below or above a pre-defined temperature, when motion is detected in an area of your home, or when your garage door opens unexpectedly.

To configure recipients of these notifications, click on the Administrative Console's Configuration tab, and choose the System sub-tab.

On the Notification Settings portion of the screen, choose the type of recipient you'd like to add:



In the text field type in your email address or phone number as specified, then click the Add button to add this entry to your recipient list.

In the center of your screen you'll see the Recipients window where you can Remove a recipient, Edit a recipient, or Save the listed recipients to your ISY:

On the right-side of the screen you'll find the "SMTP Settings" window where you can specify the email server used to deliver notifications. If "Use Default" is checked, the ISY will utilize the Universal-Devices server to send out notifications.

For advanced users, or if your ISP is blocking access to outside email servers, you can uncheck this box and specify a custom SMTP server to use.

The Test button will test communications with the SMTP server and send a test notification.

3.7 Interfacing with the Elk

If you have an Elk M1 alarm/automation panel installed, it can be configured to communicate with the ISY. Once communication is established, you can:

- Arm/Disarm your Elk from the ISY's web interface and Administrative Console

- Control Devices and Scenes stored on the ISY from your Elk (through Elk keypads, programs stored on the Elk, etc.)

On the Elk side, you will need an Elk M1XEP which provides an Ethernet-interface for your Elk. We highly recommend configuring your Elk with a static IP address (see your Elk documentation for instructions). Using Elk's ElkRP software, ensure that you enable the Elk's "Non-Secure" port in the M1XEP setup.

In the ISY's Administrative Console, click the Configuration tab, then the System sub-tab. On the bottom-right of the screen you will find a section titled "ELK M1XEP" where you can configure your Elk:

Type your Elk's IP address in the appropriate field, and enter your Elk's Non-Secure Port (default is 2101). Then enter your Elk's security code, and hit the SAVE button to save your settings and initiate communications.

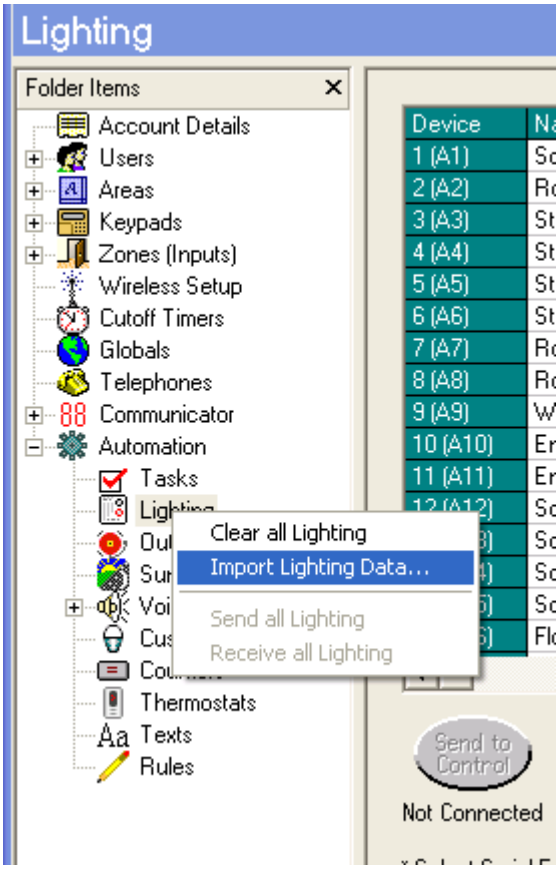
If successful, a "Security System" bar will appear on the top of your Administrative Console showing you the current state of your Elk and allowing you to type your Elk's security code and arm/disarm it:

You will also see a Security System tab on your ISY's HTML web interface.

To allow control of your ISY-configured Devices and Scenes from the Elk, you must export your lighting information from the Administrative Console and import this file onto your Elk using ElkRP. Simply click the “Generate ELK Export File” button on the bottom-right of the ISY’s Elk Configuration window.

This will create an XML file containing your ISY’s information and display it in your default web browser. Save this to your PC as an XML file and import this saved file into your Elk. Using ElkRP:

- Open the Automation folder
- Right-click the Lighting icon and choose “Import Lighting Data”



Follow the on-screen instructions to finish importing the ISY’s information into your Elk.

3.8 Optional Modules

Universal-Devices offers a variety of optional modules that enhance the capabilities of your ISY in a variety of ways.

To purchase a module, click the HELP pull-down menu in the ISY's Administrative Console, choose the "Purchase Modules" option, and follow the on-screen instructions.

3.8.1 Network Module

The ISY's Network Module enhances the ISY with several key features:

- **Web Server –** using the Network Module, the ISY can be used as a web server to server up your own applications, pictures and files.

- **Network Resources –** with the Network Module, the ISY allows you to call any network resource (TCP, UDP, HTTP, HTTPS) using ISY Programs. You can also control serial devices using Ethernet to RS-232 adapters.

- **Wake On LAN –** this feature allows you to turn on PCs and other compatible network devices using their Wake On LAN feature.

Web Server

Once installed, click on the Configuration tab in the ISY's Administrative Console, then the Networking sub-tab, then the Web Server tab to copy files and folders to your ISY's internal web server.

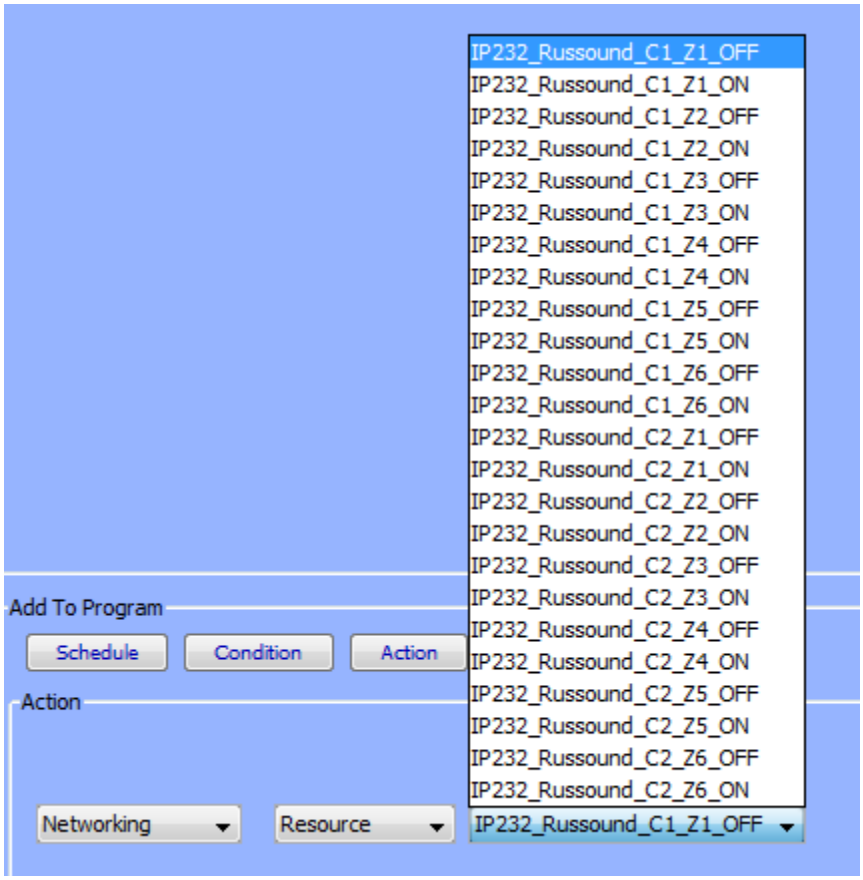
The left side of the screen will allow you to browse your local PC's files and folders. The right side of the screen displays the file/folder structure within your ISY. Simply drag-and-drop files and folders from the left side of the screen to your ISY's /USER/WEB folder on the right-side of your screen.

Right-click a file or folder stored on your ISY to rename, remove, or set it as your ISY Web Interface's default page. To restore the ISY Web Interface to its default home page, click the "Use Default" button on the bottom of the screen.

Network Resources

Once installed, click on the Configuration tab in the ISY's Administrative Console, then the Networking sub-tab, then the Network Resources tab to configure your resources.

Once devices have been added, they will be available in ISY Programs as Actions under the Networking category:



More information on known-compatible 3rd party devices and how to control them is available in this Wiki article:
http://www.universal-devices.com/mwiki/index.php?title=ISY-99i_Series_INSTEON:Networking:Network_Resources

Wake On LAN

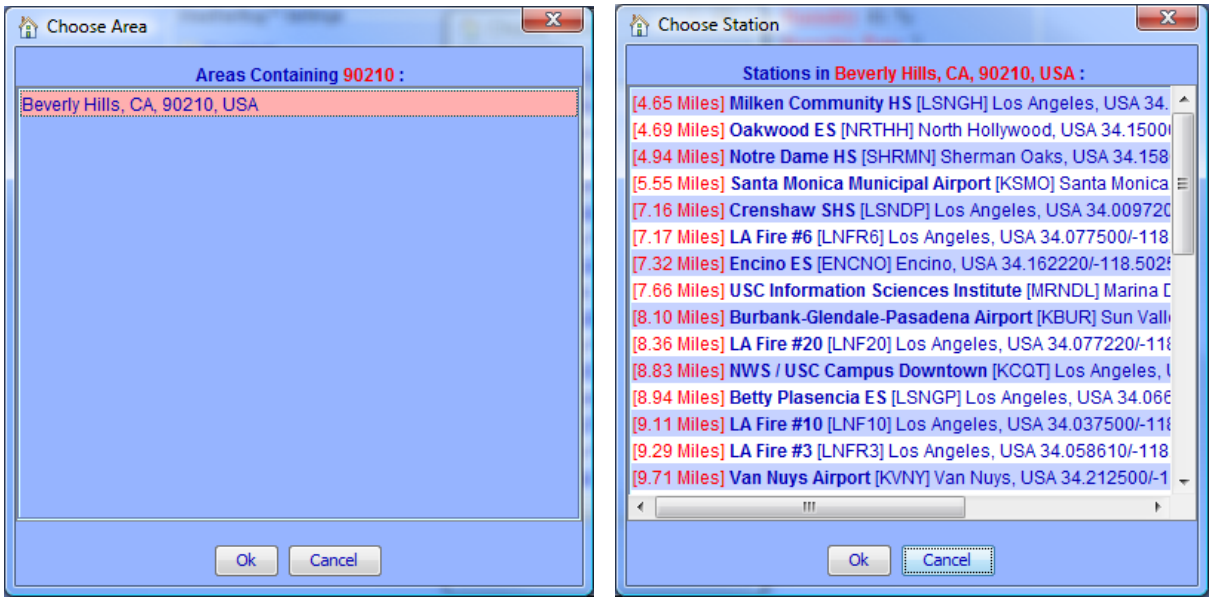
Once installed, click on the Configuration tab in the ISY's Administrative Console, then the Networking sub-tab, then the Wake On LAN tab to configure.

Once Wake On LAN devices have been added to your ISY, they will be available in ISY Programs as Actions under the Networking category.

3.8.2 WeatherBug Module

Using the WeatherBug Module, you can create ISY Programs using local weather information as conditions. The WeatherBug service provides a huge number of weather stations to pull information from.

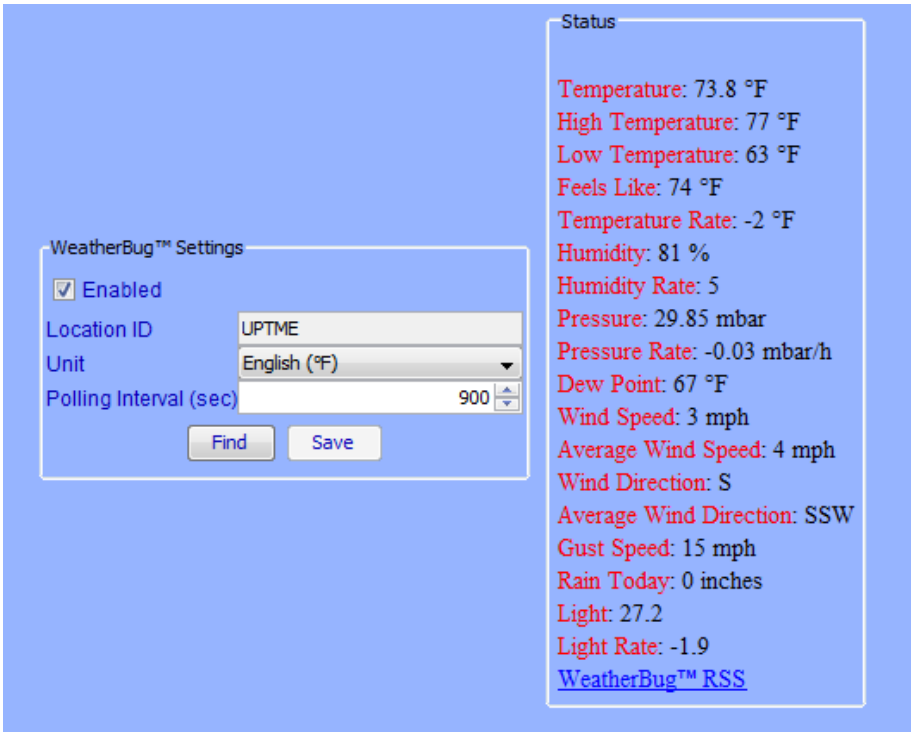
To view and configure your WeatherBug Module, click the Configuration tab in the ISY's Administrative Console then the Climate sub-tab. To choose your local weather station, click the FIND button and type your local zip code. Double-click your Area to see a list of weather stations within your area.



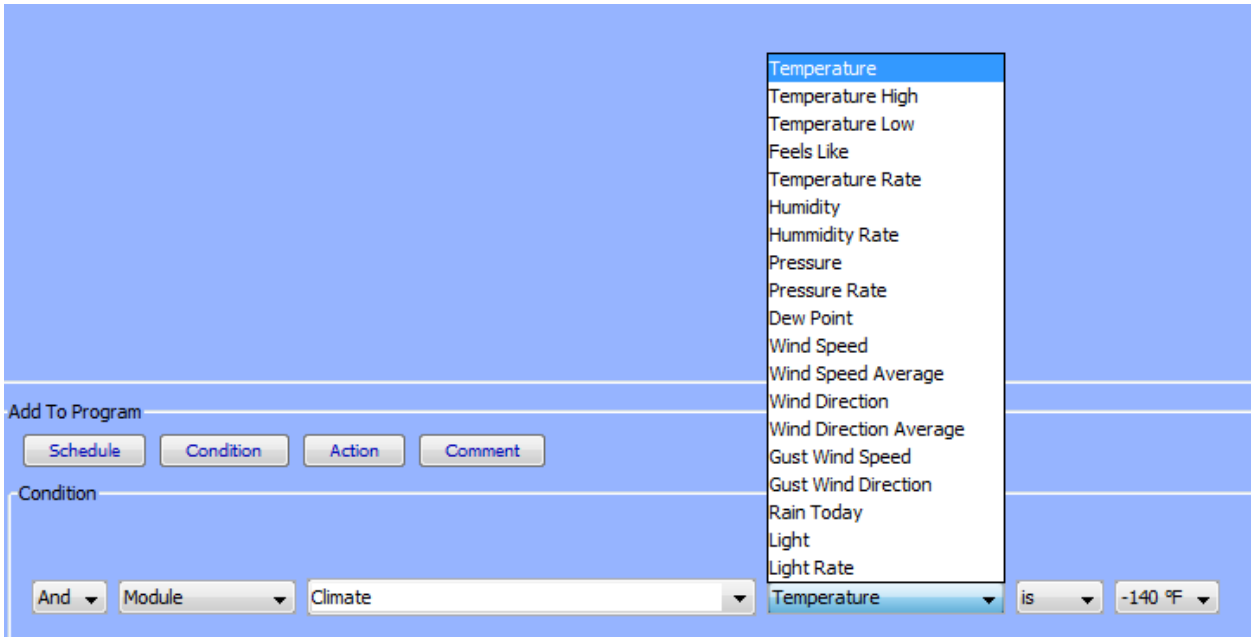
Double-click a station to utilize it with your ISY. For best results, choose a station as close to your location as possible.

Once selected, choose how you would like the information displayed (English or Metric). Also feel free to adjust the Polling Interface, which is how often your ISY connects to WeatherBug for updated weather information. Hit the SAVE button to save your configuration.

You should now see local weather information as shown below:



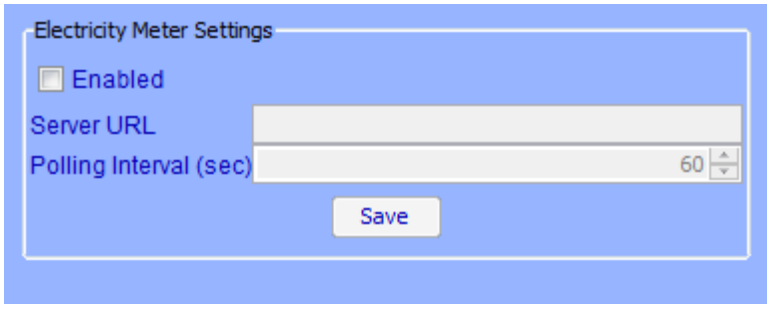
Now that your WeatherBug module has been configured, you can use this information as Conditions in ISY Programs. When choosing a condition, choose Module and Climate to see all available conditions:



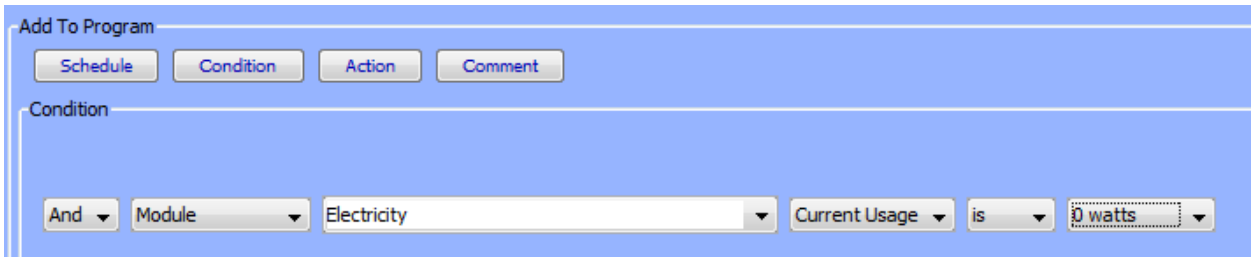
3.8.3 Brultech Electricity Module

Brultech Electricity Meters can be utilized to monitor electricity consumption. This information can be used as conditions within ISY Programs.

To configure the ISY to pull information from your Brultech meter, click the Configuration tab in the ISY's Administrative Console and choose the Electricity sub-tab. Check the "Enabled" box, enter your Brultech meter's URL, and choose the preferred polling interval in seconds. Hit SAVE to save your settings to the ISY.



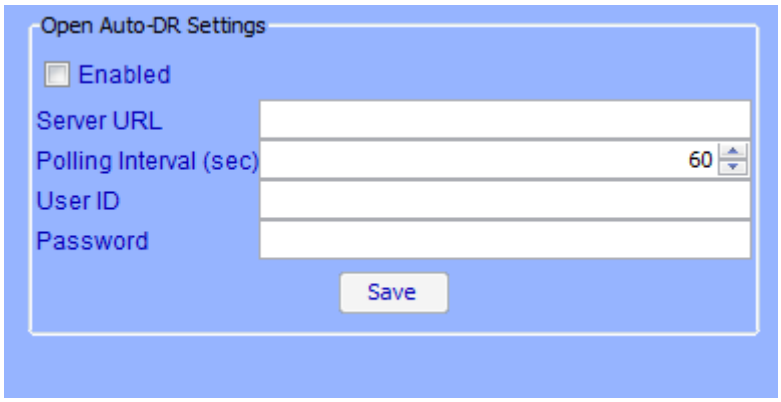
Once your Brultech meter is configured, you can use this information as Conditions in ISY Programs. When choosing a condition, choose Module and Electricity to see all available conditions:



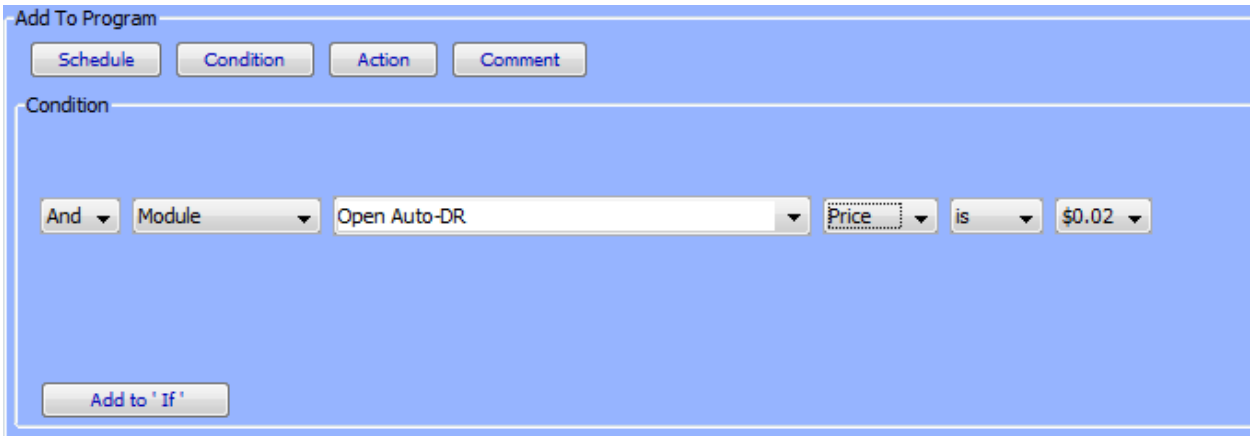
3.8.4 Open Auto Demand / Response Module

Demand Response is a feature provided by some utility companies. This provides you with information which could be utilized to help curb local demand. Please consult with your electricity provider to make sure you are eligible for this service.

Simply enable this option, provide your server URL, polling interval, user ID and password, then hit SAVE:



Once your Open Auto Demand / Response is configured, you can use this information as Conditions in ISY Programs. When choosing a condition, choose Module and Open Auto-DR to see all available conditions:



3.9 The Event Viewer

The Administrative Console's Event Viewer can be an invaluable tool in helping to diagnose problems you might be having. To access the Event Viewer, click on the Tools pull-down menu, then Diagnostics, then Event Viewer.

The Event Viewer window displays information on what is happening on your ISY, such as commands sent to devices, information received from devices, and much more.

There are several levels of detail available using the Change Level button (level 3 being the most detailed). Use the "Save Log To" button to save the current Event Viewer output to a text file.

Appendix A: Front Panel LEDs

Understanding the ISY's front panel LEDs can be helpful when troubleshooting problems.

Here is a table that helps explain each LED and LED combinations:

PWR on steady	The PWR LED indicates that the ISY has power, either through the PLM or via a separate AC adapter. If the PWR LED is not lit, the ISY does not have power.
RX, TX and MEM off	If all three of these LEDs is off, the ISY is idle.
RX blinking	The RX LED blinks when the ISY is receiving INSTEON traffic.
TX blinking	The TX LED blinks when the ISY is sending INSTEON traffic.
MEM blinking	The MEM LED blinks when the ISY is accessing its internal memory.
RX on steady	If the RX LED is on steady, the ISY is having a problem communicating with the PLM. Unplug the PLM for 10 seconds, then plug it back in to reboot. If the problem continues, either the PLM or cable is most likely defective.
ERR blinking	A blinking ERR LED indicates a file system error. Please power off the ISY and try to re-seat the SD card. If that does not help, the SD card may be defective. Please see **Appendix C: Replacing / Upgrading Your SD Card**

MEM and ERR blinking	If both the MEM and ERR LEDs are blinking, the ISY is unable to communicate with your Ethernet network. Please check all cable connections, try rebooting your router or switch, and ensure that you have a DHCP server available.

There are also 2 LEDs on the rear of the ISY where the Ethernet cable attaches. One LED indicates a good network connection (should be on solid) while the other should flash with network activity.

Appendix B: Reset Button

Reboot ISY

A quick press and release of the Reset Button will cause the ISY to reboot. This will read all the devices, scenes, and programs from the SD card and will optionally query all devices and run programs as defined on the Configuration panel.

This is similar to Removing and Restoring power or using the Reset button on the Configuration Panel.

Reset Password

- Use a sharp object to push in the Reset Button till the RX, TX, Mem, Error lights start blinking (every second)
- Hold for **5 seconds** till the RX, TX, Mem, Error lights turn on/off consecutively (RX -> Tx -> Mem -> Error)
- Release
- Log in using admin/admin
- See Set Userid/Password to set a new UserID and password.

Factory Reset

There are only a few reasons why you might want to factory reset your ISY. In most cases, a factory reset will not help any problems you might be having.

Please be sure to thoroughly investigate your problem before trying a factory reset. If possible, be sure to have a known good backup of your ISY's configuration before factory resetting.

NOTE: A factory reset of the ISY will not erase any programming stored on INSTEON devices.

To factory reset your ISY:

- Use a sharp object to push in the Reset button (located below the ERR LED) until the RX, TX, MEM, and ERR LEDs start flashing (once per second).

- Hold the Reset button for approximate 10 seconds, until the above LEDs turn off and the MEM LED starts flashing quickly.

- Release the Reset button and wait for the ISY to reboot (when the MEM LED stops flashing).

Appendix C: Replacing / Upgrading Your SD Card

In some instances you may want to upgrade or replace your SD card. For example:

- You have purchased the ISY's Networking Module and need more storage for the internal web server.

- You are experiencing a blinking ERR light which could indicated a bad SD card.

The ISY supports up to an 8GB SD card.

Once your SD card is replaced, you will need to re-load the firmware onto your ISY as well as restore your configuration from a backup. Please be sure to have a good backup before attempting an SD card upgrade.

Newer ISY
Newer ISYs have an externally accessible SD card. Simply unplug all cables from your ISY, pull out the old SD card, and insert the new SD card. You will also need to reload the firmware onto your ISY. Proceed to the paragraph labeled "Reloading The ISY Firmware and Restoring From Backup".

Older ISY
Older ISY's have internal SD cards, so the unit must be taken apart for the SD card to be replaced. Please proceed with caution, and only if you feel comfortable taking apart your ISY.

There are 4 screws holding on the cover to the ISY. Remove those screws, and simply slide the cover off. Once off you will see 4 screws holding the ISY's circuit board to the bottom of the ISY's case. Simply unscrew all four screws, remove the ISY's circuit board with caution, and replace the SD card.

Once you screw the ISY back together, you will need to reload the firmware. Proceed to the paragraph labeled “Reloading The ISY Firmware and Restoring From Backup”.

Reloading the ISY Firmware and Restoring From Backup
Once you've replaced your ISY's SD card, you will need to re-load the firmware as well as restore your configuration from a backup.

- Boot your ISY with the new SD card installed
- From a PC on your LAN, visit the following URL to launch the Administrative Console and locate your ISY: http://www.universal-devices.com/99i
- Login to the Administrative Console (default username and password are both "admin")
- Click on the HELP pull-down menu, then MANUALLY UPGRADE MY LIGHTING.
- Browse to the firmware file you wish to install. If you do not have a copy of the ISY firmware, please visit our forum for the download link: http://forum.universal-devices.com/viewforum.php?f=25
- After the firmware is installed your ISY will reboot. Please re-launch the Administrative Console and login: http://www.universal-devices.com/99i
- Click on the FILE pull-down menu, then RESTORE ISY and choose your last backup.

Appendix D: Upgrading Your Firmware

The ISY's Administrative Console checks for latest release firmware automatically. When a new release is detected, you will be notified and given on-screen instructions on performing the update.

In some cases, however, you may want to manually download and install a newer firmware. Some beta firmware releases may contain important features or device support that you may want to utilize. The Administrative Console will NOT notify you of beta firmware releases.

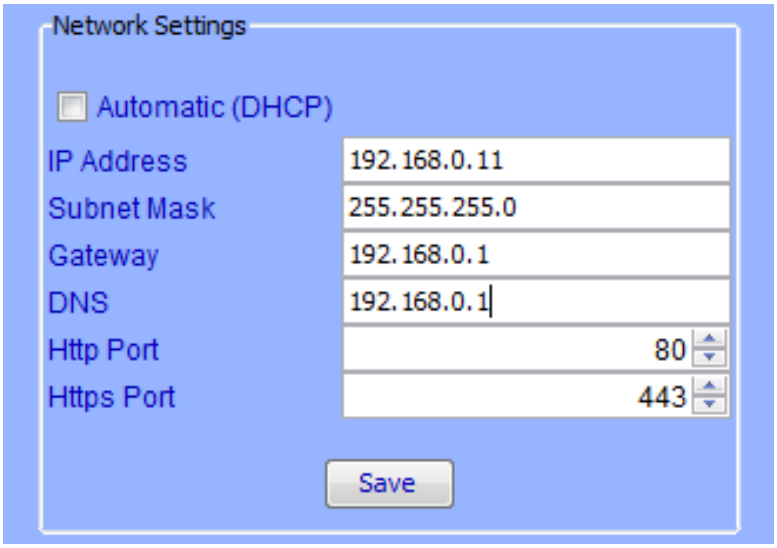
To manually download and install a firmware release, please see the following forum where both final and beta releases are regularly posted along with specific upgrade instructions:
http://forum.universal-devices.com/viewforum.php?f=25

In general, please note the following before performing a firmware update:

- The downloaded firmware MUST remain zipped. DO NOT unzip the downloaded file.
- Please ensure you have a good backup before attempting a firmware update.
- Disable all anti-virus and firewall software before attempting a firmware update.
- Be sure to run firmware updates from a stable and, if possible, hardwired network connection. Avoid running firmware upgrades from marginal wifi connections or off-site locations if possible.
- Once downloaded, click the HELP pull-down menu, then MANUALLY UPGRADE MY LIGHTING, and browse to the firmware file you have downloaded.
- After upgrading your firmware, please close all browser windows and clear your Java cache as outlined in this article:
http://www.universal-devices.com/mwiki/index.php?title=ISY-99i/ISY-26_INSTEON:Clearing_Your_Java_Cache

Appendix E: Assigning a Static IP Address to the ISY

If you wish to assign a static IP address to your ISY, please open the Configuration tab, then the System sub-tab. Uncheck the “Automatic (DHCP)” box and fill out the fields in the Network Settings section:



To avoid IP address conflicts, be sure to choose an address outside of the DHCP range set on your router. Also be sure to type the correct Gateway and DNS addresses (typically your router IP address), otherwise the ISY will not have access to the internet.

You can also configure custom HTTP and HTTPS ports on this screen.

If you check the “Automatic (DHCP)” option, the ISY will not use a static IP address but instead get an IP address automatically from a DHCP server on your network.

Appendix F: INSTEON Device Notes

Some INSTEON devices require special care when used with the ISY. Some need to be added to the system in a specific way, and some have unique options available when configuring with the ISY. This section details some of this information and more.

As always, please refer to the manufacturer's documentation first. Please consider the following notes as a secondary source of information.

The following notes are sorted alphabetically by device name.

ApplianceLinc

Current ApplianceLincs will not act as controllers – they will not notify the ISY or control other linked devices if turned on or off locally (via the SET button or using load sensing).

EZI/O Devices (SimpleHomeNet)

Due to variations in firmware on SimpleHomeNet devices, some units (especially older firmware) may not work well with the ISY. Symptoms include the ISY not being notified of sensor state changes.

If you're having an issue with the ISY receiving status updates from an EZIO device, try the following steps:

- remove the device from the ISY
- factory reset the device
- add the device back to the ISY by using "New INSTEON Device" and typing in the address

I/OLinc

Several options are available when configuring an I/OLinc on the ISY. These include:

- Timeout (seconds) - Sets the length of time the relay will close when Momentary is selected.
- Program Lock - Disables Set Button programming.
- Relay Follows Input - Sets Relay On when Sensor is On and Off when sensor if Off.
- Send X10 Send On (or Off) - Send X10 when the sensor changes.
- Trigger Off - If the TrigOff bit is set, Close Switch sends an OFF and Open Switch sends an ON. If the TrigOff bit is clear, Close Switch sends an ON and Open Switch sends an OFF.
- LED on TX - The LED will flash when the device sends Insteon commands.
- Momentary: A - The relay will close momentary. If it is Linked while On it will respond to On. If it is Linked while Off it will respond to Off.
- Momentary: Look at Sensor - If the sensor is On the relay will close momentarily when an On command is received. If the sensor is Off the relay will close momentarily when an Off command is received.
- Momentary: Both - On and Off both cause the relay to close momentary.

KeypadLinc

KeypadLincs show up as multiple nodes on the ISY (6 button or 8 button, depending on which model KeypadLinc). When switching between 6 and 8 button modes on the KeypadLinc, the device must be removed and re-added to the ISY.

Only the KeypadLinc's primary load button can be controlled directly by the ISY (through the Admin Console and ISY Programs). To control secondary buttons, create a Scene containing the button and control the scene.

KeypadLincs support several unique options, such as:

- Manually Exclusive Buttons – groupings of buttons so that one and only one button in the group can be ON at any one time.
- Toggle Mode – toggle a button to always stay ON or OFF (and only send the respective command when pressed)
- LED Brightness – adjust the KeypadLinc button LED brightness

Due to variations in KeypadLinc firmware, some configuration options may or may not be available.

LampLinc

Most LampLincs will not act as controllers – they will not notify the ISY or control other linked devices if turned on or off locally (via the SET button or using load sensing). LampLincs labeled v4.2 or higher (firmware v33+) should act as controllers.

Motion Sensor

Motion Sensors are RF devices, thus require the installation of an INSTEON RF receiver (such as an INSTEON AccessPoint).

The Motion Sensor cannot be linked using Auto Discover. To link a Motion Sensor to the ISY, please choose the LINK MANAGEMENT pulldown, then NEW INSTEON DEVICE. Enter the device address manually (found inside the battery compartment), then select the "2420M INSTEON Motion Sensor" from the Device Type list.

Since the Motion Sensor is a battery-saving RF device, you must put the device into linking mode to add it to the ISY (and make any changes to the device, such as adding/removing from scenes). Please follow the on-screen instructions to put the Motion Sensor into linking mode when prompted (hold SET button for 5 seconds).

Once added to the ISY, the Motion Sensor will show up as 3 nodes. The primary node is the motion sensing portion of the device, which updates according to sensed motion (or lack of motion).

There is also a DUSK/DAWN node that will show ON when the device senses darkness and show OFF when the device senses light. The Motion Sensor will not update this node until approximately 3.5 minutes after a state change has persisted.

Finally, a Low Battery node will show as ON when the Motion Sensor senses a low battery condition and notifies the ISY.

Motion Sensors support several unique options, such as:

- Timeout (minutes) - Defines the period of inactivity before the Motion Sensor will send an Off. Default = 1 minute. Range = 0.5 - 8.5 minutes in 30 second increments.
- LED Brightness - Default = 100. Range is 0 - 255.
- Darkness Sensitivity - The higher the value, the darker it needs to be for the unit to see night. Default = 35. Range = 0 - 255.
- Sensing mode (Occupancy): when checked an On command is sent for every motion detected. When unchecked an On command is sent only after the Timeout interval has expired.
- On only mode: when checked only On commands are sent. When unchecked an Off command is sent when the Timeout value expires.
- Night mode: when checked MS signals motion all the time. When unchecked MS signals motion only when Dark.

RemoteLinc

RemoteLincs are RF devices, thus require the installation of an INSTEON RF receiver (such as an INSTEON AccessPoint).

RemoteLincs link differently than other INSTEON devices, this require a separate linking routine. To link a RemoteLinc to your ISY, click the LINK MANAGEMENT pulldown and choose LINK A REMOTELINC and follow the on-screen instructions. Since the RemoteLinc is a battery-saving RF device, it must be put into linking mode whenever adding to the ISY or making changes (such as adding or removing from a scene). To put the device in linking mode, hold Button 1 down for 10 seconds, or until the light starts flashing.

To EXIT linking mode, either wait for the RemoteLinc to time out and the LED to stop flashing (4 minutes), or simply hit the BRIGHT or DIM button. DO NOT hit one of the 6 rocker buttons.

RemoteLincs show up as a multiple nodes on the ISY (one node per button).

Thermostat Adapter

Older INSTEON Thermostat Adapters cannot act as controllers, thus they do not notify the ISY of any state changes. To get the most current information from your thermostat, we recommend using an ISY Program to poll the device periodically. See **Appendix G: Sample ISY Programs**.

Newer Thermostat Adapters (V2) do notify the ISY of state changes, so a poll Program will not be necessary.

TriggerLinc

TriggerLincs are RF devices, thus require the installation of an INSTEON RF receiver (such as an INSTEON AccessPoint).

The TriggerLinc cannot be linked using Auto Discover. To link a TriggerLinc to the ISY, please choose the LINK MANAGEMENT pulldown, then NEW INSTEON DEVICE. Enter the device address manually (found inside the battery compartment), then select the "2421 TriggerLinc" from the Device Type list.

Since the TriggerLinc is a battery-saving RF device, you must put the device into linking mode to add it to the ISY (and make any changes to the device, such as adding/removing from scenes). Please follow the on-screen instructions to put the TriggerLinc into linking mode when prompted (hold SET button for 5 seconds).

Once added to the ISY, the TriggerLinc will show up as 2 nodes. The secondary node is only used when the TriggerLinc is in "Multi-Scene" mode.

When in Normal mode, the TriggerLinc will send an ON command to the primary node when the sensor is open (magnet pulled away) and an OFF command when the sensor is closed (magnet close to sensor).

When in Multi-Scene mode, the TriggerLinc will send an ON command to the first node when the sensor is open, and an ON command to the second node when the sensor is closed. It will NOT send an OFF command to either node when in Multi-Scene mode.

Appendix G: Sample ISY Programs

This section contains some sample ISY Programs to get you started.

Periodically poll your Thermostat Adapter:

If
From 12:00:00AM
For 24 hours

Then
Repeat Every 15 minutes
Wait 10 minutes
Set 'Thermostat' Query

Else
- No Actions - (To add one, press 'Action')

Front door light ON 20 minutes after sunset, OFF at 10pm:

If
From Sunset + 20 minutes
To 10:00:00PM (same day)

Then
Set Scene 'FrontDoor' On

Else
Set Scene 'FrontDoor' Off

Turn off closet light after 10 minutes:

If
Status 'Closet' is not Off

Then
Wait 10 minutes
Set 'Closet' Off

Else
- No Actions - (To add one, press 'Action')

Notify you of extreme temperature conditions:

If
Status 'Thermostat' > 90° (Temperature)
Or Status 'Thermostat' < 60° (Temperature)

Then
Send Notification to All

Else
- No Actions - (To add one, press 'Action')

Turn driveway lights ON and OFF with an X10 remote:

If
X10 'A2/On (3)' is Received
And X10 'A2/Off (11)' is not Received

Then
Set Scene 'Driveway' On

Else
Set Scene 'Driveway' Off

Appendix H: Troubleshooting INSTEON Communication Issues

It is important to have a pair of INSTEON AccessPoints or other INSTEON RF devices (or an INSTEON-compatible hardwired coupler) installed to ensure good communications between both legs of power in your home. See Smarthome's documentation for ensuring your AccessPoints are installed on opposite legs of power. We recommend placing them as close to your electrical panel as possible.

An AccessPoint (or other INSTEON RF receiver, such as their 2413S Dual-Band PLM) is also required to communicate with INSTEON RF devices.

Most INSTEON devices use powerline technology to communicate with one another. Some devices on in your home may interfere with device communications. Some known offenders are:

- Low voltage lighting
- Fluorescent lighting
- CFLs
- Desktop computers and notebooks
- Surge protectors
- UPSs

In many cases these devices can exist on your powerline with no problem. But, if you are experiencing communication issues, we highly recommend unplugging any devices you have on the above list. Once you establish reliable communications, add the devices back in one at a time to find the cause. Most troublesome plug-in devices can be filtered using FilterLincs from Smarthome.

Because the ISY sends and receives all INSTEON signals through the PLM, we highly recommend plugging it in to an outlet away from potentially noisy electrical devices, such as PCs and UPSs, and as close to your electrical panel as possible. DO NOT plug your PLM into a surge protector or UPS. We also highly recommend installing an AccessPoint as close to your PLM as possible.

Appendix I: Connecting to the ISY Shell Using Telnet

Note: In order to telnet to ISY, ISY's current IP address must be known.

If using the Windows *telnet* command (**Note:** The Windows *telnet* command is installed by default on Windows XP, but not on Vista. On Vista, you will need to install the *telnet* command from *Windows Components*.):

- Go to the **Start** menu and choose **Run**.
- In the **Run** dialog, enter *cmd* and click **OK**.
- At the command prompt, type the following command, replacing *isy.current.ip.address* with your ISY's current IP address:
  - *telnet isy.current.ip.address <ENTER>* (Figure 8A).
  - When prompted for **Username:** enter *admin* (lower case) followed by *<ENTER>*.
  - When prompted for **Password:** enter *admin* (lower case) followed by *<ENTER>*

Connecting to the ISY Shell Using the Serial Port

1. Connect one end of a serial null-modem cable (included with PRO version) to ISY's Port B, and connect the other end to the serial connector (or USB-to-serial adapter) on the computer.

2. Start a terminal program (such as Windows HyperTerminal) and configure for 115200bps, 8N1, Xon/Xoff, and for the appropriate COM port.

3. Type a few characters until prompted for Username: and enter admin (lower case) followed by <ENTER>. When prompted for Password: enter admin (lower case) followed by <ENTER> (Figure 9A). The ISY Shell is displayed (Figure 9B).

Appendix J: Advanced Configuration Guide

Please refer to Appendix I: **Connecting to the ISY Shell** to begin a Telnet or HyperTerminal session.

All commands are case sensitive and must be entered in upper case.

CI - Configure Infra-Red

To modify the settings for Infra-red use (only available on ISY-99i/IR)

- IR Hold detection [Default = 600 MilliSec](range 50-3000 MilliSec)
- IR Hold maintain [Default = 300 MilliSec](range 50-3000 MilliSec)

CL – Configure Maximum Log Size

To change the amount of log space allowed, type CL at the shell prompt.

- Default = 3 MB
- Range = 1-16 MB

CME - Configure Maximum Emails per minute

- Default = 60
- Range 1-3600

CR - Max Device Command Retries

- Default = 2
- Range 1-16

CT – Configure TCP/IP

TCP/IP configuration command enables you to either assign static IP address information or instruct the ISY to use DHCP. The default is DHCP. To perform TCP/IP configuration, type CT at the shell prompt.

Assigning a Static IP Address

- When prompted for IP Address, enter the desired static IP address
- When prompted for NetMask, enter the desired subnet mask
- When prompted for Gateway, enter the IP address for the gateway
- When prompted for DNS Server, enter the IP address for the DNS server

When prompted with Save Changes, enter Y. The system will reboot using the provided information for TCP/IP configuration. Note: If you enter the wrong Gateway and/or DNS server, some of the notifications and time functions will become inoperable.

Requesting a DHCP Assigned IP Address

- When prompted for IP Address, enter 0.0.0.0
- When prompted for NetMask, ignore
- When prompted for Gateway, ignore
- When prompted for DNS Server, ignore

When prompted with Save Changes, enter Y. The system will reboot and attempt to get DHCP assigned TCP/IP information upon system start.

CWP - Configure Webserver Ports

This command allows you to configure the Webserver ports.

- HTTP Port [Default = 80] (range 1-65536)
- HTTPS Port [Default = 443] (range 1-65536)

CWT - Configure Webserver Timeouts

- HTTPS Timeout [Default = 20000 MilliSec](range 5000-50000 MillisSec)
- HTTP Timeout [Default = 10000 MilliSec](range 5000-50000 MillisSec)

DBG - Debug [0|1|2|3]

To log key messages received to the java console, do the following

- **DBG 0**: this tells the box to not send messages to the GUI
- **DBG 1**: this tells the box to send basic messages to the GUI
- **DBG 2**: this tells the box to send more specific messages to the GUI
- **DBG 3**: this tells the box to send even more specific messages to the GUI

Open the Java console to see the messages. A line surrounded by square brackets is written to the Java console whenever a button is pressed, an X10 message is received, or a status change occurs. This is useful for determining whether or not the PLM has seen a button press or X10 message and sent it to the ISY.

EI|DI – Enable/Disable Internet Access

To enable access to this device from the internet, type EI at the shell prompt. By default internet access is disabled.

To disable access to this device from the internet, type DI at the shell prompt.

ET|DT – Enable/Disable Telnet Access

To enable telnet access, type ET at the shell prompt. By default, Telnet Access is enabled.

To disable telnet access, type DT at the shell prompt.

Note: If there's already a telnet session open, the session will continue to function until the user exits the shell.

FR – Factory Reset

To reset the ISY to factory settings, type FR at the shell prompt. Note: By performing a factory reset, the following information shall be lost (irrecoverable) and the Username and Password shall revert back to admin/admin.

- All the schedules
- All the notifications settings
- All the alarm settings
- Time zone
- All the discovered devices, their names, their groups
- The network name

FS – Format SD Card

To format the SD Card, type FS at the shell prompt. Answer the "Are you sure question" with an upper case "Y"

Please note: the ISY works with both FAT 16/32, but FS function formats it specifically for use with ISY with some performance improvements so its preferred you use this method.

LS – List All Files & Directories

To view the listing of files and directories on the memory card, type LS at the shell prompt.

MN – Menu

To show the menu, type MN on the shell prompt. You may also enter any unrecognized command to get the menu to be shown.

RL – Reset Login Credentials

To reset the login credentials back to the initial state of admin/admin, type RL at the shell prompt.

Note: If you have forgotten your Username and Password and are thus unable to login to the shell, please see this page: Resetting Your Userid/Password

RS – Reboot the System

To reboot the system, type RS on the shell prompt.

SM – Show Memory Utilization

To view the ISY's memory utilization, type SM at the shell prompt.

SMR - Maximum Retries Before Client Is Considered Offline

- Default = 3
- Range 1-255

ST – Show System Time

To view the ISY's system time, type ST at the shell prompt.

SU – Show External URL

If this device has been configured for internet access, you may use the SU command – at the shell prompt – to view the external URL through which this device is accessible on the internet.

VE - Display Version

Displays the version information of the ISY. This information includes the following:

- Product
- App
- Platform
- Version
- Build Date
- Other Services

XS – Exit the Shell

To exit the shell, type XS on the shell prompt.

Quick Start Guide

INSTEON® Wireless Thermostat
Models: 2441ZTH, 2732-432, 2732-532

About INSTEON Wireless Thermostat

INSTEON Wireless Thermostat is a wireless, battery-operated, one-day programmable, INSTEON-compatible thermostat. INSTEON Wireless Thermostat includes a humidity sensor and the ability to communicate via RF to other INSTEON devices and thermostats.

INSTEON Wireless Thermostat does not connect directly to the HVAC (Heating, Ventilating and Air Conditioning) system. If you want to control the HVAC system you need to install INSTEON Thermostat and connect it directly to the HVAC system.

INSTEON Wireless Thermostat may be used as a standalone INSTEON controller capable of controlling other INSTEON responders. On its own, INSTEON Wireless Thermostat sends out notifications based on temperature status and can even control standalone heaters and fans plugged into INSTEON On/Off modules.

INSTEON Wireless Thermostats can also be linked to your main INSTEON Thermostat controller to create extra temperature zones in your home. INSTEON Thermostat displays the temperature readouts from up to two linked INSTEON Wireless Thermostats on its display.

Preparation

Proper installation of INSTEON Wireless Thermostat will be accomplished by following these steps. The product will mainly be used in a tabletop stand; wall mounting is optional.

1) Make sure the location that you have selected for INSTEON Wireless Thermostat will not be affected by daily movement of sunlight or is not in direct line of sight of a nearby HVAC vent or fan.
2) Insert 2 AA batteries into INSTEON Wireless Thermostat.
3) Close the cover on INSTEON Wireless Thermostat.
   - After a few seconds INSTEON Wireless Thermostat will display ambient temperature and humidity.
   - Mode will default to OFF.
   - Battery segment should show full with fresh batteries.
   - Time will show default (12:00 PM) and become active.
4) Snap INSTEON Wireless Thermostat into the supplied tabletop stand or mount safely on a wall.

Adding an INSTEON Wireless Thermostat to INSTEON Thermostat

Link INSTEON Wireless Thermostat to INSTEON Thermostat to provide a portable thermostat wherever you want temperature control. You can add up to two INSTEON Wireless Thermostats to an INSTEON Thermostat.

1) Press and hold INSTEON Wireless Thermostat Set button.
   INSTEON Wireless Thermostat Set LED will blink green and unit will beep.
2) Press and hold INSTEON Thermostat Set button.
   INSTEON Thermostat will beep, then double-beep.
   INSTEON Wireless Thermostat will double-beep.
3) Test the scene by pressing and holding INSTEON Wireless Thermostat's Master button.

2441ZTH,2732-432, 2732-532 Rev. 11/6/2012 3:09 PM / See Owner's Manual for Warranty Information.
Protected under U.S. and foreign patents (see *www.insteon.com*)

INSTEON

- *When properly synchronized, pressing the Master button on one INSTEON Wireless Thermostat will illuminate the "Master" segment on that same screen. Additionally, the present room temperature of the INSTEON Thermostat will be displayed in position 1 as small temperature segments at the display's top center.*
- *A visual inspection of each display will reveal Master status of INSTEON Thermostat or INSTEON Wireless Thermostat.*

Note: Only INSTEON Thermostat is directly wired to the HVAC system. If you plan on operating multiple INSTEON Wireless Thermostats, you must have at least one INSTEON Thermostat installed to control the HVAC.

Control Settings

Master button	Press and hold Master to make a specific INSTEON Wireless Thermostat the "active" thermostat for a system with one or two INSTEON Wireless Thermostats.
Fan button	Tap Fan to keep "FAN ALWAYS" on (tap again to return to automatic mode).
Hold button	Tap Hold to keep current settings active. Tap Hold again to release/send a "release Hold" INSTEON command.
Energy (Leaf)	Tap Energy to "relax" the heat and cool setpoints by 4° (adjustable with software).

Owner's Manual and Tech Support

For the complete Owner's Manual and the most up-to-date Quick Start Guide visit http://www.insteon.com/support
Call: INSTEON Support Line at 866-243-8022

FCC and IC Warnings

This device complies with FCC Rules and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorise aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radiolectrique subi, mme si le brouillage est susceptible d'en compromettre le fonctionnement.

CAUTION - To reduce the risk of overheating and possible damage to other equipment do not install to control a receptacle, a motor-operated appliance, a fluorescent lighting fixture, or a transformer-supplied appliance.
Gradateurs commandant une lampe a filament de tungstene – afin de reduire le risqué de surchauffe et la possibilite d'endommagement a d'autres materiels, ne pas installer pour commader une prise, un appareil a moteur, une lampe fluorescente ou un appareil alimente par un transformateur.

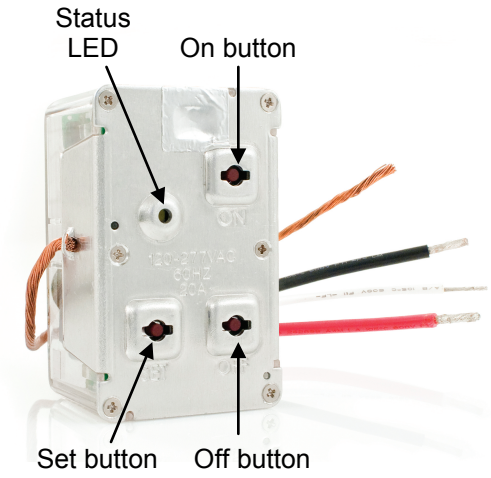
2441ZTH,2732-432, 2732-532 Rev. 11/6/2012 3:09 PM / See Owner's Manual for Warranty Information.

INSTEON

Quick Start Guide

In-LineLinc™ Relay (Dual-Band)

Models: 2475SDB



Installation

Note: *Installation should be performed only by a qualified electrician or a homeowner who is familiar and comfortable with electrical circuitry. If you have any questions regarding installation, consult an electrician or call the INSTEON Support Line at 800-762-7845.*

1) Be sure to write down the INSTEON I.D. and location of the fixture you'll be controlling (e.g., 01.F7.G5, Upstairs Bathroom Fan)
2) Turn off circuit breaker supplying power to the fixture
3) Disconnect the wires from the fixture you will be controlling and ensure that you have ½" of bare wire on the ends
4) See Figure 1 to identify and connect the line, load, neutral and ground wires on In-LineLinc. Be sure you have correctly identified the wires in the junction box before connecting them.
5) After you have connected all the wires, ensure that the wire connectors are firmly attached and that there is no exposed copper except for the ground wire
6) Prior to reinstalling the fixture, turn on circuit breaker supplying power to the fixture
7) Use the on/off buttons to test that the module is working and controlling the load
8) Add In-LineLinc to a scene as a responder:

   Use the On and Off button on In-LineLinc to set the load to the state you wish to activate from the controller (turn it on if you wish it to be on when the controller activates the scene, etc.). Press and hold the scene controller button until it beeps.*

   Controller LED will blink

   Press and hold In-LineLinc's Set button until it double-beeps

   *In-LineLinc status LED will flash once and then turn on steady. Controller will double-beep** and its LED will stop blinking*

   Confirm that scene addition was successful by tapping On then Off on the controller's scene button

   The load connected to the In-LineLinc will respond appropriately
9) Gently place In-LineLinc into the junction box, making sure that nothing could accidentally press any of the buttons on its face
10) Reinstall the fixture

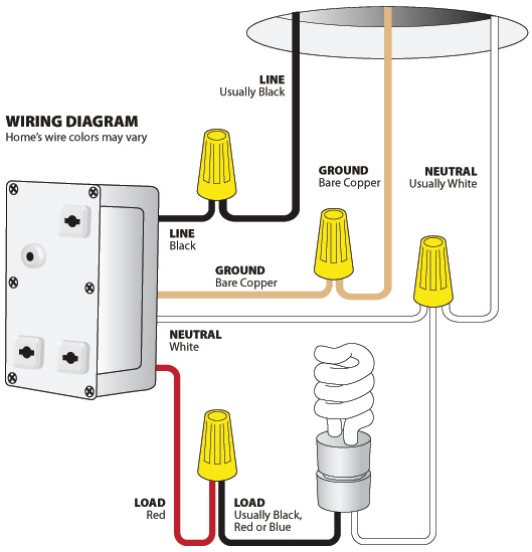


Figure 1

Owner's Manual and Tech Support

Owner's Manual and current Quick Start Guide: http://www.insteon.com/support
Call: INSTEON Support Line at 800-762-7845

*If the controller does not have a beeper, wait until its LED begins blinking
**Most products

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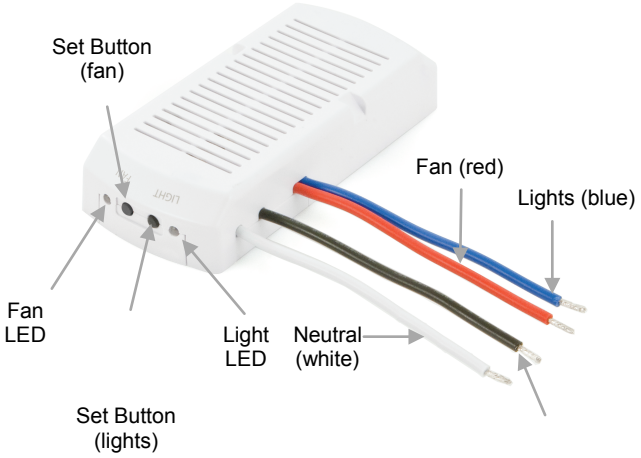
INSTEON

Quick Start Guide

FanLinc™ INSTEON® Ceiling Fan and Light Remote Controller (Dual-Band)

Model: 2475F

FOR CEILING FANS ONLY



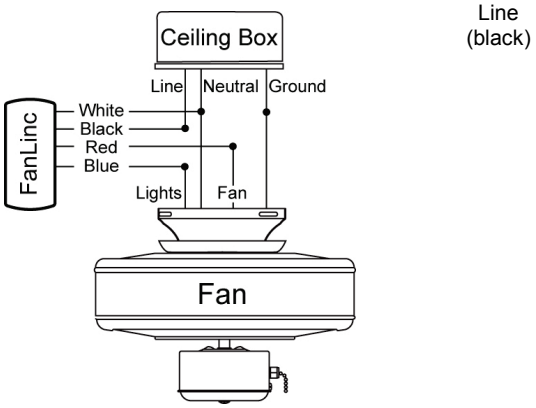
What's Included

- FanLinc
- Four (4) wire nuts
- One (1) cable tie

Installation

1) Using your fan pull chains, turn light on and set fan to highest speed
   Note: *All fan and light controls will be conducted through FanLinc once installed*
2) Turn off the breaker (remove fuse) supplying power to the fan's box
3) Identify line, neutral and load lines for light and fan separately
4) Remove the ceiling fan from the electrical box
5) Disconnect the wires from the ceiling fan and light (if applicable)
6) Connect FanLinc white wire and the fixture neutral wire to the house Neutral with a wire nut
7) Connect FanLinc blue wire to the fixture's light wire (if fixture does not have a light, cap the blue wire)
8) Connect FanLinc red wire to the fixture fan wire with a wire nut
9) Connect FanLinc black wire to line with a wire nut
10) Ensure all connections are secure with no exposed copper
11) Turn breaker back on
    FanLinc light LED will turn green
    FanLinc fan LED will turn red

IMPORTANT: If you don't have home control software (HouseLinc) or a SmartLinc Hub, program all manual links now before reinstalling fan.



Program Fan as an INSTEON Responder

1) Referencing the table below, tap FanLinc fan Set button until beeper and fan LED indicate the desired fan speed. (For safety, fan will not spin when fan Set button is tapped.)

1st	Low	Single beep	Blinks green slow
2nd	Medium	Double-beep	Blinks green medium
3rd	High	Fast double-beep	Blinks green fast
4th	Off	None	Red

2) Press and hold the scene controller Set button until it beeps[1]
   Controller LED will start blinking
3) Press and hold FanLinc fan Set button until FanLinc double-beeps
   Controller will double-beep[1] and its LED will stop blinking
4) Temporarily hang fan from the mounting ring so the fan can spin safely. While clear of fan blades confirm the scene addition was successful by pressing On/Off on your controller.
   FanLinc fan LED will toggle between green and red
5) To program fan from another controller, turn fan off, remove from mounting ring and repeat steps 1-4

Program Light as an INSTEON Responder

1) Press and hold controller button until it beeps[2]
   Controller LED will start blinking
2) Tap FanLinc light Set button until the ceiling fan light is on
   FanLinc light LED will turn green
3) Press and hold FanLinc light Set button until FanLinc double-beeps
   FanLinc light LED will flash once
   Controller will double-beep[3] and its LED will stop blinking
4) Test by tapping On/Off on controller
   Ceiling fan light will toggle between on and off
5) To program light from another controller, repeat steps 1-4

Reinstall Fan

1) Carefully remount cowling with FanLinc inside (or in electrical box)
2) Align cable tie with the notches of the FanLinc case, ensuring that cable tie and wires will not interfere with any moving parts. Secure to fan bracket.

Support

Owner's Manual and current Quick Start Guide:
http://www.insteon.com/support
Call: INSTEON Support Line at 800-762-7845

[1] Most models
[2] If the controller does not have a beeper, wait until its LED begins blinking.
[3] Most models

2475F Rev. 7/16/2012 12:33 PM / See Owner's Manual for Warranty Information, Patented

INSTEON®

ACCU-CT®

SPLIT-CORE CURRENT TRANSFORMER

Revenue-Grade Accuracy, Unprecedented Linearity

Patent pending

0.75 Inch Window, 5 to 250 Amps

The Accu-CT revenue-grade, split-core current transformer offers outstanding accuracy and one-handed operation.

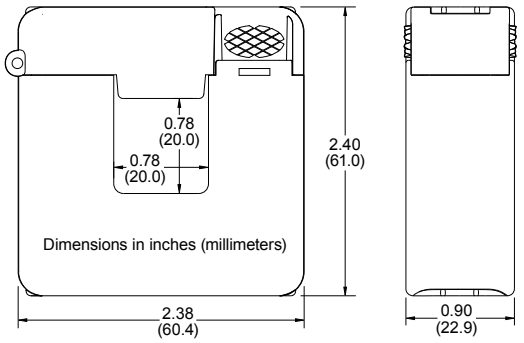
- **Exceptionally low phase angle error:** essential for accurate power and energy measurements
- **IEEE/ANSI C57.13 and IEC 60044-1 accuracy** over full temperature range and down to 1% of rated current
- **Glove-friendly** operation with one hand.

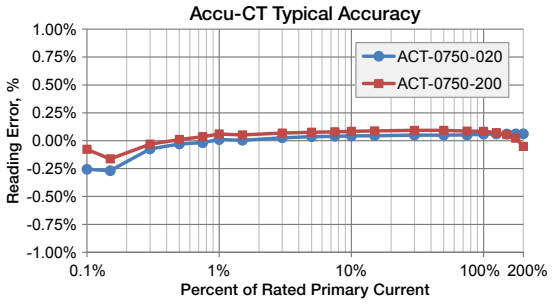
Specifications

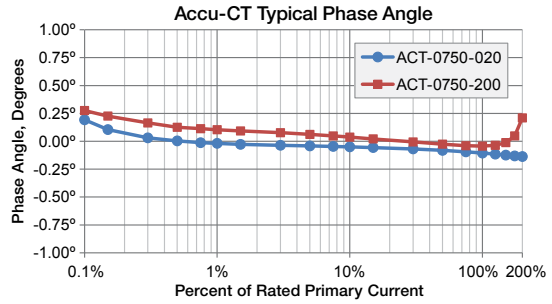
- **Accuracy:** ±0.75% from 1% to 120% of rated primary current (±0.5% with Option C0.6)
- **Phase angle:** ±0.5 degrees (30 minutes) from 1% to 120% of rated current (With Option 0.6: ±0.25 degrees from 1% to 120%, ±0.50 degrees below 0°C from 1% to 10% of rated current)
- **Accuracy standards:** IEEE C57.13 class 1.2 and IEC 60044-1 class 1.0 (Opt C0.6: class 0.6 and class 0.5S, respectively)
- **Primary rating:** 5 to 250 Amps, 600 Vac, 60 Hz nominal
- **Output:** 333.33 mVac or 1.00 Vac (with Option 1V) at rated current
- **Operating temperature:** -30°C to 55°C
- **Safe:** integral burden resistor, no shorting block needed, unless otherwise noted
- **Standard lead length:** 8 ft (2.4 m), 18 AWG
- **UL recognized,** CE mark, RoHS
- **Assembled in USA:** qualified under Buy American provision in ARRA of 2009

Models	Amps	MSRP
ACT-0750-005	5	$43.50
ACT-0750-020	20	$43.50
ACT-0750-050	50	$43.50
ACT-0750-100	100	$43.50
ACT-0750-200	200	$43.50
ACT-0750-250	250	$43.50

- **Non-stock:** 15, 30, 70, and 150 amp
- **Option C0.6:** meets IEEE/ANSI C57.13 class 0.6 accuracy and IEC 60044-1 class 0.5 and 0.5 S accuracy – $57
- **Option 1V:** 1.00 Vac full-scale output
- **Option 50Hz:** calibrate for 50 Hz operation







- Graphs show typical performance at 23°C, 60 Hz
- Graph shows a positive phase angle when the output leads the primary current.

ACT-1.23.13: Specifications are subject to change

Continental Control Systems LLC

3131 Indian Road • Boulder, CO 80301 USA
sales@ccontrolsys.com • www.ccontrolsys.com
(888) 928-8663 • Fax (303) 444-2903

SPECIFICATIONS

DESCRIPTION:
Compact surface mount MR16 accent light.
Suitable for wet/damp/dry location installations.

MATERIAL:
Standard overall material is 6061 aluminum.
HL-336 - Machined Aluminum

FINISH:
AA - Anodized Satin Aluminum
AP - Powder Coat Aluminum
BK - Powder Coat Black
BZ - Powder Coat Bronze
WT - Powder Coat White

LAMPING:
Halogen Lamps
Lamp Type - 12V halogen MR16 lamp, bi-pin GX5.3 base, 50W max, not included.
LED Lamps
Lamp Type - High output LED, warm white (3000K CCT) standard, others available.
3LED - 3x1W LED, ave light output 260 lm
8LED - 3x2.7W LED, ave light output 457 lm
Optics
SP - Spot, 12º
NF - Narrow Flood, 24º
FL - Flood, 36º

VOLTAGE:
12 - 12 VAC output transformer required, not included.

MOUNTING:
Fixture is designed with a fixed 1/2" NPS mount.

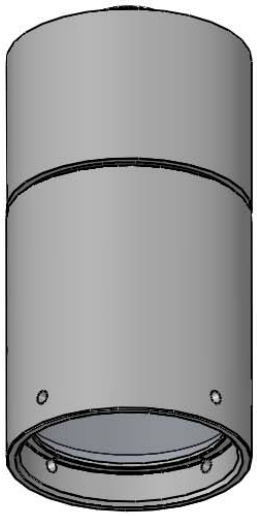
OPTIONS:
Glare shields
GL-10 - Short Angled, aluminum
GL-11 - Angled, aluminum
GL-13 - Straight, aluminum
Lenses/Louvers/Color Filters
LA-1 - Hexcell Louver (Black)
LA-2 - Prismatic lens
LA-3 - Linear spread lens
LA-4 - Soft focus lens (diffused)
LA-5 - Moonlight lens
LA-6 - Blue lens
See fixture accessories for more information.

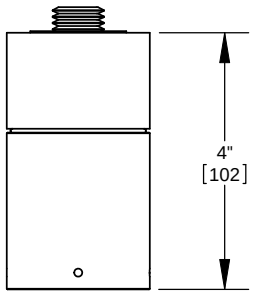
SAMPLE ORDER SPECIFICATION:
HL-336-BZ-12-GL-10-LA-2

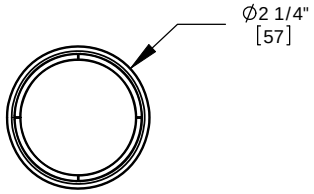
RATING:
Wet/damp/dry location.

Intertek

MADE IN THE USA







ORDER SPECIFICATION: _____ - _____ - _____ - _____ - _____
Fixture | Finish | Lamping | Voltage | Options/Access.

PROJECT:

APPROVED:

NOTE:

TYPE:

HEVI LITE, INC.
9714 Variel Ave, Chatsworth, CA 91311
Tel., (818) 341-8091 - Fax (818) 998-1986
Web Site http://www.hevilite.com

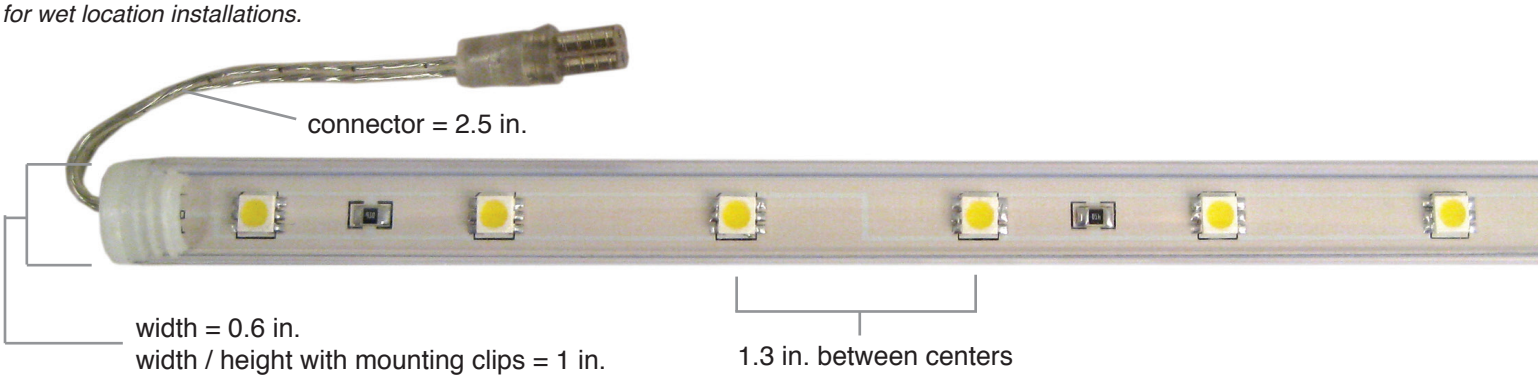
CATALOG NUMBER:
HL-336

TRUE FOCUS LED Tube Light

The TRUE FOCUS LED Tube Light is Diode LED's most versatile indoor 12V LED light fixture, offering maximum light angle adjustment. Its cylindrical shape and rounded mounting clips allow it to be positioned at any angle needed for back-splashes and unique applications. Furthermore, the TRUE FOCUS LED Tube Light is manufactured with high-power tri-chip SMDs (spaced at 1.3 in. between centers) and consumes as low as 1.44 watts per fixture – emitting a considerable amount of light while remaining extremely energy-efficient.

2-pin male and female waterproof connectors come installed on each TRUE FOCUS LED Tube Light for simple plug-and-play installation, which attach easily to additional waterproof connectors and accessories. Included with each TRUE FOCUS LED Tube Light is a pair of TRUE FOCUS mounting clips and screws, and a pair of Waterproof Solder Connectors (male and female) to connect the fixture directly to a hard-wired driver.

Please note: although the TRUE FOCUS LED Tube Light attaches directly to waterproof connectors and accessories, it is not suitable for wet location installations.



TECHNICAL SPECIFICATIONS

item #	length	color	color temp.	lumens	beam angle	power consumption	IP rating	CRI	# of LEDs	max. bars per run
DI-0255	8.9 in.	warm white	2700k	120	120°	1.44W / 120mA	IP64	75	6	7
DI-0256	8.9 in.	cool white	5000k	120	120°	1.44W / 120mA	IP64	80	6	7
DI-0250	13 in.	warm white	2700k	180	120°	2.16W / 180mA	IP64	75	9	6
DI-0251	13 in.	cool white	5000k	180	120°	2.16W / 180mA	IP64	80	9	6
DI-0252	19.9 in.	warm white	2700k	300	120°	3.6W / 300mA	IP64	75	15	5
DI-0253	19.9 in.	cool white	5000k	300	120°	3.6W / 300mA	IP64	80	15	5

FEATURES

Certifications: ETL Listed (Conforms to UL 2108), RoHS
Dimmable: Yes
Environment: Indoor/Outdoor (IP68)
Warranty: Warranty: 3 years (limited)
Operating Temp.: +68° ~ +90° F (+20º ~ +32º C)
Ambient Operating Temp.: -4º ~ +176º F (-20° ~ +80° C)
Mounting: One pair of TRUE FOCUS mounting clips and screws included with each bar.
Rated Lamp Life: 50,000 hours
Fixture Length: 8.9 in.; 13 in.; 20 in.
Width: 0.6 in.
Height: 0.6 in. (1 in. with mounting clips)

Connectors: Waterproof male and female plugs
LED Chip Type: 5050 tri-chip SMD
Chips Per Fixture: 8.9 in. (6 chips), 13 in. (9 chips), 20 in. (15 chips)
Power Use Per Fixture: See Technical Specifications
Rated Lumens Per Fixture: See Technical Specifications
Luminous Efficacy: 83.33 lm/W
LED Spacing: 1.3 in. (between centers)
Input Voltage: 12V DC
Max. Run: See Technical Specifications
** Each maximum run requires a dedicated line from the power supply to avoid voltage drop.*

c UL us LISTED

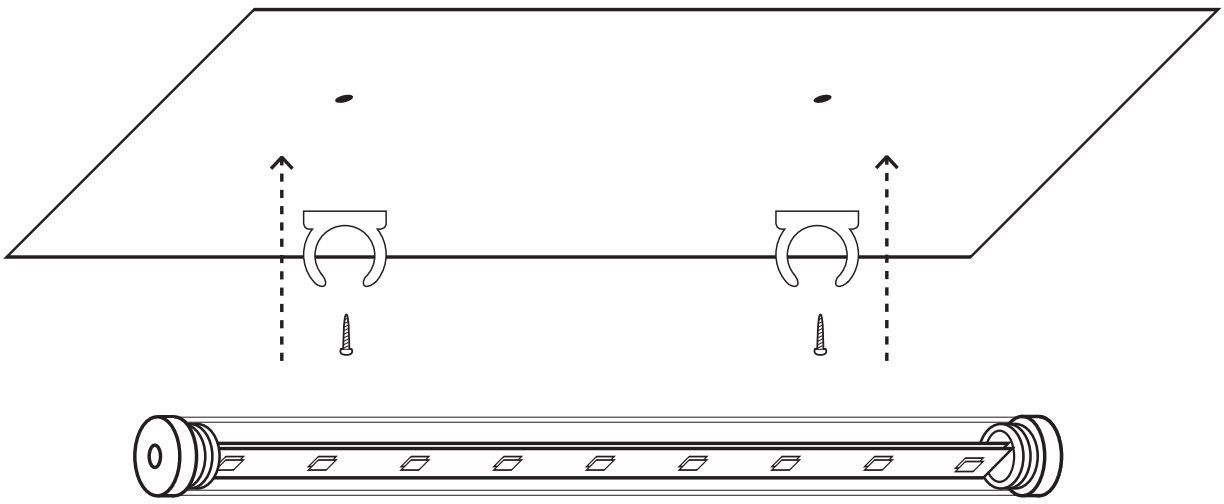
RoHS compliant

APPLICATIONS

- Bookcases & shelves
- Soffits & windows
- Bar & club lighting
- Home theater lighting
- Accent & decorative lighting
- Edge-lighting
- Restaurants, retail stores, bars, lounges, & casinos
- Lighting art, accent pieces, & framed photos
- Wine caves & wine cellars
- Under cabinet lighting, shelves, cupboards, closets, & drawers
- Coin-operated vending machines & arcade games
- Architectural models & doll houses
- Boat interiors

IN USE PHOTOS

MOUNTING



1. Always turn off the power at the main breaker prior to installation.
2. Configure the design and layout of the system and test functionality. See wiring diagrams on pages 5-7 for examples.
3. After confirming the functionality, disassemble the system and attach the mounting clips.
4. Fit the fixtures into the mounting clips and connect any additional accessories.
5. When installation is complete, turn on the power at the main breaker.

WARNINGS ⚠

1. *Always* consult a qualified, licensed electrician prior to the installation of this product. Diode LED recommends that a qualified, licensed electrician perform the installation of this product.
2. *Always* pre-test your strip light assembly by making all connections and connecting the strip to the appropriate power supply and ensure that all components are joined properly before they are installed.
3. It is recommended that adequate airflow and heat-sink be taken into account in the application and installation of this product. Improper thermal management may lead to premature failure.
4. Exceeding the operating temperature values may damage LED chips by reducing the total lamp life and lumen output, and may adversely impact color consistency.
5. Each maximum run requires a dedicated line from the power supply to avoid voltage drop.Voltage drop is a gradual lessening of power through a wire over a long distance. The farther the light is from the power source, the more voltage drop will occur. Voltage drop becomes a significant factor in any LED light application when the distance between the light fixture and the power source is greater than 30 feet. Consult a qualified, licensed electrician and an online voltage drop calculator to learn what gauge wire will work best for your configuration. For more tips, visit the Tools & Resources page at www.DiodeLED.com.
6. The manufacturer rates each power supply for maximum power output at optimum thermal and voltage conditions. As with any power supply, true actual maximum continuous current output depends upon various environmental factors such as ambient temperature, line voltage fluctuations, and orientation, which may affect heat dissipation. Dimmable driver note: For optimum performance, make sure the load is between 50% and 80% of the driver's capacity.
7. Actual color may vary from what is pictured on this sheet and other Diode LED print materials due to the limitations of photographic processes.
8. Please note, color temperature or kelvin (k), as well as light output or lumens (lm) and product appearance may vary from order to order. Variation in kelvin is +/- 250k and lumens is +/- 10%.
9. Diode LED reserves the right to modify the design of our products as part of the company's program of continuous improvement. Diode LED cannot guarantee to match existing installed product with subsequent orders of the product you are replacing in appearance, color, or brightness. Specifications are subject to change without notice.

NOTE ABOUT AMBIENT OPERATION TEMP:

This fixture is rated for use in an environment where the ideal ambient operating temperature is -4° ~ +176° F (-20° ~ +80° C).

WARRANTY

Limited Warranty: This product has a three (3) year limited warranty from the date of shipment. The complete warranty details are posted on the website at www.diodeled.com under the tools and resources tab. Specific warranty periods can also be found on the individual published Product Specification Sheets.

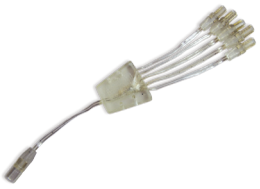
If you have any warranty related questions please contact Diode customer service at info@doideled.com or call (877) 817-6028.

CONNECTORS & ACCESSORIES

Waterproof Connectors:
2-pin male and female waterproof connectors come installed on each TRUE FOCUS LED Tube Light. Waterproof connectors can be attached to the TRUE FOCUS LED Tube Light to create splits or extensions. Additionally, DC connectors can be attached to create splits or extensions upon attaching a male or female Waterproof plug to a DC Adapter Connector (item #DI-0710M, or #DI-0710F).

Waterproof Plug to DC Adapter Connector
female (item #DI-0710F) 7.5 in. x 0.4 ir
male (item #DI-0710M) 7.5 in. x 0.3 in.
Connects the TRUE FOCUS LED Tube Light to a Plug-In Adapter and to DC accessories. DC plug Input is a female DC Connection.

Waterproof Solder Connector Pair
(item #DI-0725) 4.7 in. x 0.3 in.
Connects the TRUE FOCUS LED Tube Light to a Hard-Wired Driver. One pair (male & female) included with each fixture.



Waterproof Splitter Cables
2-way (item #DI-0804)
3-way (item #DI-0805)
5-way (item #DI-0806)
L 8 in. x W 1 in. x D 0.3 in.
This splitter will divide the current in multiple directions to connect to a female Waterproof Connector.

Waterproof Male to Female Extension Cables
Available Lengths: 6 in. (item #DI-0757); 12 in. (item #DI-0758); 24 in. (item #DI-0759); 39 in. (item #DI-0709); 16 ft. (item #DI-0810)
Connector Width: 0.3 in.
Creates an extension between Waterproof connectors.

Additional Connectors & Accessories: (Not rated for wet locations)

Adapter Splice Cable
(item #DI-0712F) 42 in. x 0.45 in.
(item #DI-0712M) 42 in. x 0.45 in.
Converts a DC connection to a hard-wired connection.

DC Splitter Plugs
2-Way (item #DI-0720) 5.7 in. x 0.4 in.
3-Way (item #DI-0705) 8 in. x 0.6 in.
5-Way (item #DI-0707) 8 in. x 0.6 in.
This splitter will divide the current in multiple directions to connect to a female DC plug connection.

39 in. DC Extension Cable
(item #DI-0708) 39.4 in. x 0.5 in.
Creates an extension between any fixtures or accessories that use DC plugs.

DC Wire Plug
female white (item #DI-1713F)
male white (item #DI-1713M)
1.6 in. x 0.6 in. x 0.5 in.
Converts 14/2, 16/2, 18/2, and 20/2 AWG wire to a DC plug without soldering.

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This 12V-24V on/off switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W

Additional TRUE FOCUS LED Tube Mounting Clips
(item #DI-0752) 0.75 in. x 0.5 in. x 0.6 in.
Qty of 10 clips and 10 Phillips head screws.
Two clips and screws are included with each bar.

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W
Note: This switch makes a slight audible noise.

REIGN 12V - 24V Dimmer Switches
Available in 3 styles and 3 colors.
See www.DiodeLED.com for details.

Option 1: POWERING WITH A HARD-WIRED NON-DIMMABLE DRIVER

Wet Location Drivers

12V - 20 Watt Class 2 Non-Dimmable Driver
(item #DI-0904) 4.6 in. x 1.35 in. x 1 in.
12V - 35 Watt Class 2 Non-Dimmable Driver
(item #DI-0918) 5.75 in. x 1.5 in. x 1.2 in.
12V - 60 Watt Class 2 Non-Dimmable Driver
(item #DI-0906) 6.25 in. x 1.6 in. x 1.25 in.

Indoor Drivers

12V - 25 Watt Mini Class 2 Non-Dimmable Driver
(item #DI-0939) 3.1 in. x 2.1 in. x 1.2 in.
12V - 150 Watt Non-Dimmable Driver
(item #DI-0908) 8.25 in. x 3.9 in. x 2 in.
12V - 200 Watt Non-Dimmable Driver
(item #DI-0909) 8.25 in. x 3.9 in. x 1.9 in.
12V - 300 Watt Non-Dimmable Driver
(item #DI-0928) 8.5 in. x 4.9 in. x 1.6 in.
12V - 600 Watt Non-Dimmable Driver
(item #DI-0929) 9.75 in. x 4.1 in. x 2.5 in.

DIMMER SWITCHES & JUNCTION BOXES

REIGN 12V-24V Dimmer Switches
(Page 73 of the 2012-A Catalog or visit www.DiodeLED.com for more information)

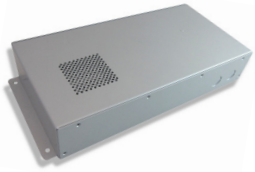
- **For use with non-dimmable drivers only**
- **100%-0% dimming**
- **Maximum load: 100W**

Diode LED carries many non-dimmable drivers and some have multiple DC outputs. Only one REIGN 12-24V Dimmer Switch can be installed per output or flickering will occur.
Do not connect to 120V.

Lo-Pro Junction Box
(item #DI-0940) 7.7" x 1.8" x 4.9"
Designed for use with the following drivers.

12V - 20 Watt (item #DI-0904)
12V - 35 Watt (item #DI-0918)
12V - 60 Watt (item #DI-0906)

NEMA 1 steel enclosure
ETL Listed to UL STD 508A



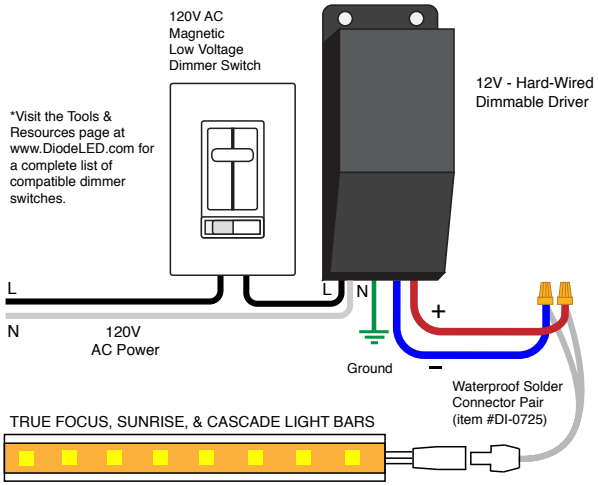
Meanwell Junction Box
(item #DI-0940) 15.5 in. x 6.5 in. x 2.6 in.
Designed for use with the following drivers

12V - 150 Watt (item #DI-0908)
12V - 200 Watt (item #DI-0909)

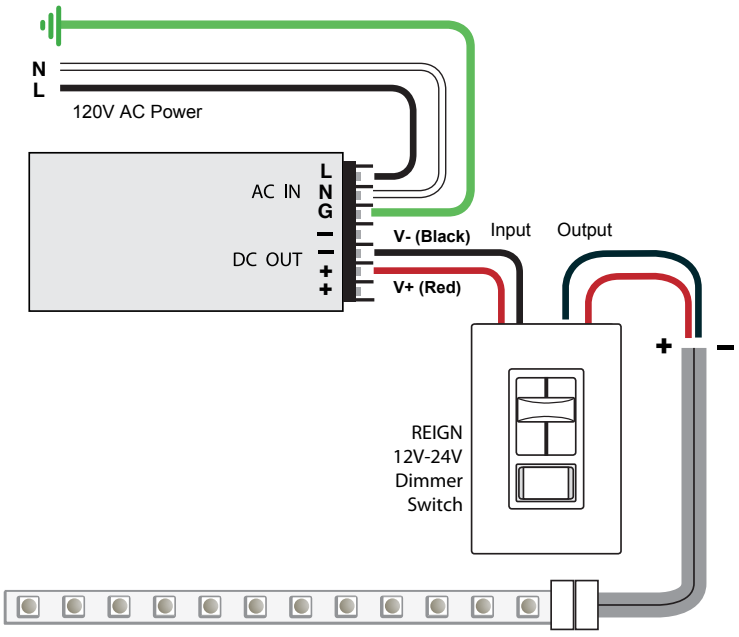
NEMA 1 steel enclosure
ETL Listed to UL STD 508A

WIRING DIAGRAMS

12V - 20 Watt Class 2 Non-Dimmable Driver (item #DI-0904)
12V - 35 Watt Class 2 Non-Dimmable Driver (item #DI-0918)
12V - 60 Watt Class 2 Non-Dimmable Driver (item #DI-0906)



12V - 25 Watt Mini Class 2 Non-Dimmable Driver (item #DI-0939)
12V - 150 Watt Non-Dimmable Driver (item #DI-0908)
12V - 200 Watt Non-Dimmable Driver (item #DI-0909)
12V - 300 Watt Non-Dimmable Driver (item #DI-0928)
12V - 600 Watt Non-Dimmable Driver (item #DI-0929)



Waterproof Solder Connector Pair (item #DI-0725)

Waterproof Solder Connector Pair (item #DI-0725)

Option 2: POWERING WITH A HARD-WIRED DIMMABLE DRIVER

12V - 20 Watt Class 2 Listed Dimmable Driver
(item #DI-0920) 5.6 in. x 2.14 in. x 2.25 in.
12V - 60 Watt Class 2 Listed Dimmable Driver
(item #DI-0922) 6.5 in. x 2.6 in. x 2.25 in.
12V - 100 Watt Dimmable Driver
(item #DI-0925) 9.8 in. x 3 in. x 2.75 in.
12V - 200 Watt Dimmable Driver
(item #DI-0923) 9.8 in. x 3 in. x 2.75 in.
12V - 300 Watt Dimmable Driver
(item #DI-0926) 9.8 in. x 4.125 in. x 3.375 in.

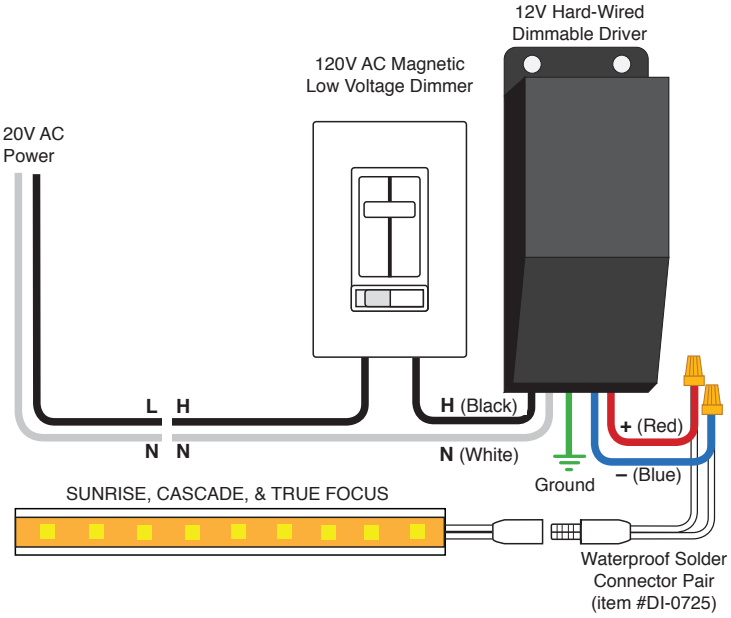
Hard-Wired Dimmable Drivers should be installed by a licensed electrician. Any of our dimmable light fixtures are compatible with our hard-wired dimmable drivers, but must be installed with a 120V AC magnetic low voltage dimmer switch. For optimum performance, install a load between 50% and 80% of the driver's capacity.

DO NOT TEST OR INSTALL WITH A 120V ON/OFF SWITCH OR WITHOUT AN ATTACHED LOAD:
Pair these drivers *only* with recommended 120V magnetic low voltage dimmer switches.
These drivers are not compatible with our REIGN 12V-24V Dimmer Switches or the 12V-24V In-line Dimmer Switch. For a complete list of compatible dimmer switches, see the Tools and Resources page at www.DiodeLED.com.

WIRING DIAGRAMS

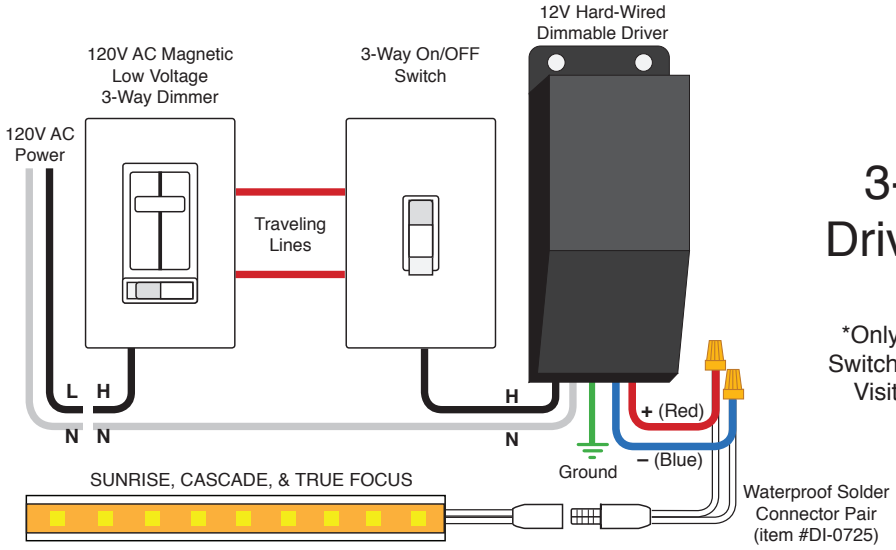
Standard Dimmable Driver Configuration*

*Visit the Tools & Resources page at www.DiodeLED.com for a complete list of compatible dimmer switches.



3-Way Dimmable Driver Configuration*

*Only use recommended 3-way On/Off Switches for 3-way dimming applications. Visit www.DiodeLED.com for details.



Option 3: POWERING WITH A PLUG-IN ADAPTER

12V - 12 Watt Class 2 Listed Adapter
(item #DI-0927) 2.35 in. x 1.75 in. x 1.4 in., total cable length: 48 in.
12V - 36 Watt Class 2 Listed Adapter
(item #DI-0912) 3.8 in. x 1.75 in. x 1.4 in., total cable length: 70 in.
12V - 60 Watt Class 2 Listed Adapter
(item #DI-0913) 4.7 in. x 2 in. x 1.25 in., total cable length: 108 in.
12V - 96 Watt Adapter*
(item #DI-0930) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.
12V -120 Watt Adapter*
(item #DI-0931) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.

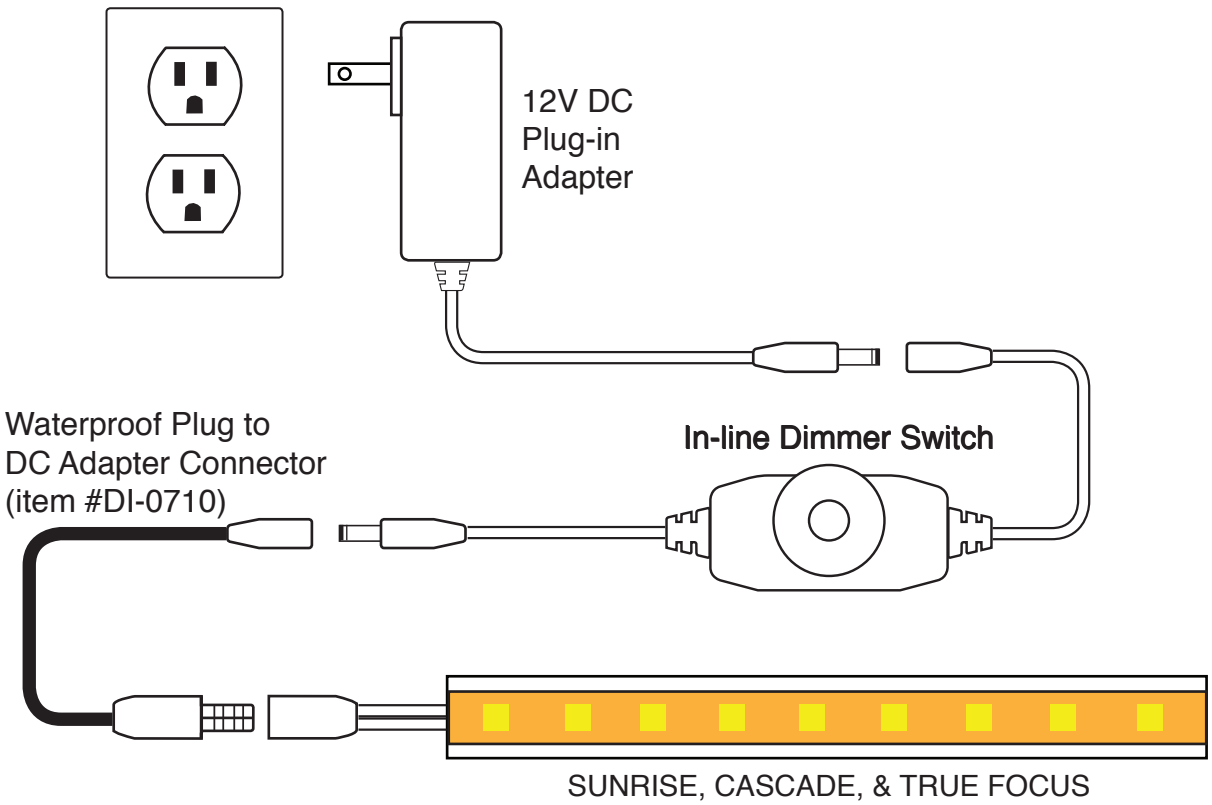
*96W & 120W Plug-In Adapters have a built-in fan that makes audible noise.

DIMMING & SWITCHING WITH A PLUG-IN ADAPTER

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W

WIRING DIAGRAMS



TYPE:	ORDERING CODE:	APPROVAL:
JOB:	REFER TO TABLE BELOW	DATE:

SPECIFICATIONS

- Side emitting stranded fiber optic cable in flexible PMMA (polymer)
- Can be cut and harnessed at the factory or in the field
- Patented cabling method allows maximum light distribution through the clear outer jacket
- Recommended maximum length up to 50’ for indirect applications and 100’ for direct view applications
- Minimum bend radius is 4x outer diameter
- Little color shift over long lengths

Product Name	Qty. of Strands*	Outer Diameter inches	Outer Diameter mm	Min Bend Radius inches	Min Bend Radius mm	Max Spool Length ft	Outer Jacket
BPAK-15	14	0.21	5	0.83	21	1000	Clear PVC
BPAK-42	42	0.34	9	1.29	33	1000	Clear PVC
BPAK -50	49	0.34	9	1.30	33	1000	Clear PVC
BPAK -75	77	0.43	11	1.58	40	800	Clear PVC
BPAK -100	98	0.51	13	1.86	47	600	Clear PVC
BPAK -150	140	0.61	15	2.24	57	500	Clear PVC
SS-15	14	0.21	5	0.77	20	500	Clear PVC w/ Black Tedlar Tape
SS-50	49	0.34	9	1.29	33	500	Clear PVC w/ Black Tedlar Tape

Use LB-HK-3 or FS-163 tools for harnessing. See page xx for more details.
** Fiber is cabled in bundles of seven*

Fiberstars 6678 Owens Drive Suite 105 Pleasanton, CA 94588 **T** (888) 704-2276 **F** (888) 704-2292 **W** energyfocusinc.com

FiberLamp™

The LED Solution for Fiberoptic Illumination

FiberLamp™ OUTDOOR FANLESS
FL211

Don't let a little rain spoil your fun. Use the FL211 fiberoptic illuminator. With a newly designed passive thermal management system, the FL211 delivers over 1000 lumens in absolute silence. Use the 16.7 million color palette to channel your creativity to the on-board flash memory. Let the DiCon FL211 do all the work while you do all the play.

Features

- High efficiency LED light source
- Dynamic, programmable color control
- Quiet, fanless operation
- Low Profile
- No electricity or heat at illumination point
- IP67 Rating
- Low power
- DMX512 Compatible

Applications

- Fiber illumination
- Neon light replacement
- Decorative Lighting
- Indoor Illumination

Optical Characteristics For MIXED RGB At Ta=25°C

COLOR	CCT (K)	FLUX (lm)	λ_D(nm)
White	6500±500	700	
Red		240	625± 5
Green		480	525±10
Blue		100	470± 5

Optical Characteristics For R, G, or B At Ta=25°C

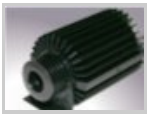
COLOR	CCT (K)	FLUX (lm)	λ_D(nm)
Red		735	625± 5
Green		1260	525±10
Blue		357	470± 5

Optical Characteristics For White At Ta=25°C

COLOR	TYPICAL CCT (K)	FLUX (lm)	λ_D(nm)
Cool	6500±500	1100	75
Neutral	4000±500	900	85
warm	2900±500	900	85

FiberLamp with Passive Cooling


FL210 36W Indoor Fanless FiberLamp™


FL211 36W Outdoor Fanless FiberLamp™

FiberLamp with Dynamic Thermal Management (DTM) System


FL2100 36W w/DTM Std Indoor FiberLamp™


FL2110 36W w/DTM Std Outdoor FiberLamp™


FL5100B 96W w/DTM Std Indoor FiberLamp™

Absolute Maximum Rating

PARAMETER	RATING
DC Forw ard Voltage	12V (+5%)
DC Forw ard Current	3.3A
Operating Temp	-20°C to 45°C
Storage Temp	-40°C /to 100°C
Weight	1.33kg
Luminaire Outdoor Rating	IP67

Mechanical Dimensions

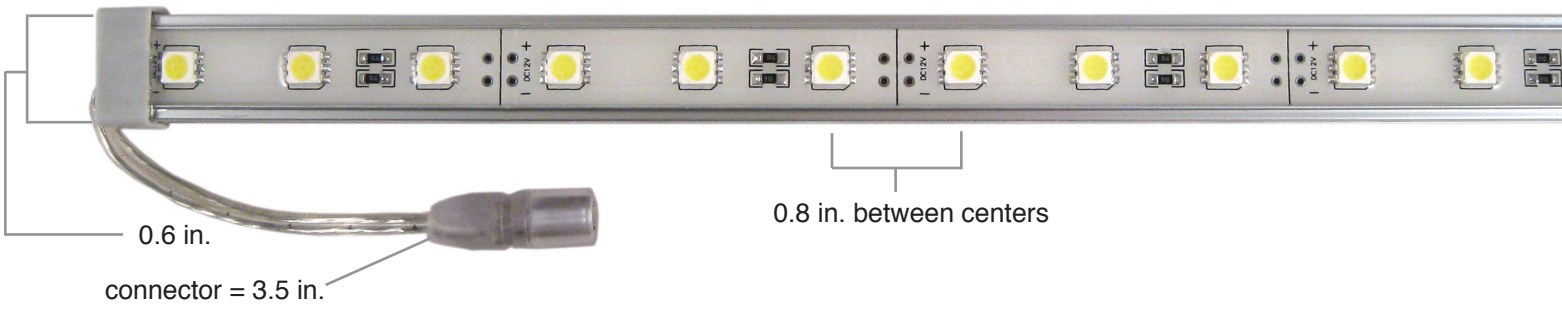
PARAMETER	DIMENSION
Length	210 mm
Diameter	111 mm

CASCADE Light Bar

The CASCADE Light Bar is Diode LED's most durable wet-location 12V LED light fixture, emitting up to 615 lumens per fixture, and is twice as bright as the SUNRISE Light Bar. The CASCADE Light Bar is manufactured with high-power tri-chip SMDs (spaced at 0.8 in. between centers), which radiate minimal heat, making this fixture a perfect lighting solution for heat-sensitive items such as plants, food display cases, wine, and art.

2-pin male and female waterproof connectors come installed on each CASCADE Light Bar for simple plug-and-play installation, which attach easily to additional waterproof connectors and accessories. Included with each CASCADE Light Bar is a pair of CASCADE mounting clips and screws, and a pair of Waterproof Solder Connectors (male and female) to connect the fixture directly to a hard-wired driver.

The CASCADE Light Bar is not recommended to be submerged in water or to be installed near treated, chlorinated, or salt water.



TECHNICAL SPECIFICATIONS

item #	length	color	color temp.	lumens	beam angle	power consumption	IP rating	CRI	# of LEDs	max. bars per run
DI-0220	12 in.	warm white	2700k	310	120°	3.6W / 300mA	IP68	75	15	6
DI-0221	12 in.	cool white	5000k	310	120°	3.6W / 300mA	IP68	80	15	6
DI-0222	23.8 in.	warm white	2700k	615	120°	7.2W / 600mA	IP68	75	30	3
DI-0223	23.8 in.	cool white	5000k	615	120°	7.2W / 600mA	IP68	80	30	3

FEATURES

Certifications: ETL Listed (Conforms to UL 2108), RoHS
Dimmable: Yes
Environment: Indoor/Outdoor (IP68)
Warranty: 3 years (limited)
Operating Temp.: +68° ~ +90° F (+20° ~ +32° C)
Ambient Operating Temp.: -4° ~ +176° F (-20° ~ +80° C)
Mounting: One pair of mounting clips and screws are included with each bar
Rated Lamp Life: 50,000 hours
Fixture Length: 12 in. & 23.8 in.
Width: 0.6 in.
Height: 0.3 in. (0.5 in. with mounting clips)
Connectors: Waterproof male and female plugs

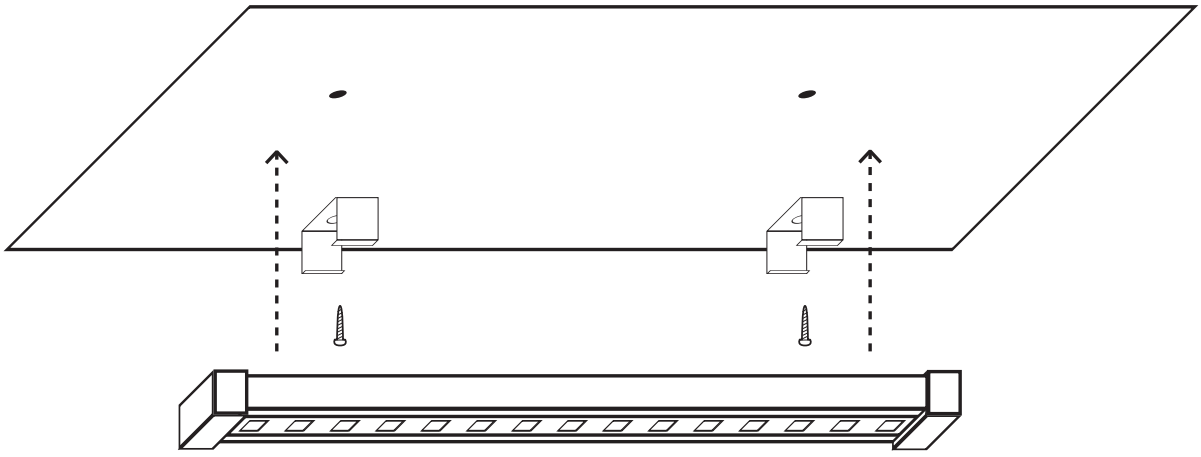
LED Chip Type: 5050 tri-chip SMD
Chips Per Fixture: 12 in. (15 chips); 23.8 in. (30 chips)
Power Use Per Fixture: See Technical Specifications
Rated Lumens Per Fixture: See Technical Specifications
Luminous Efficacy: 86 lm/W
LED Spacing: 0.8 in. (between centers)
Input Voltage: 12V DC
Max. Run: See Technical Specifications
** Each maximum run requires a dedicated line from the power supply to avoid voltage drop.*

APPLICATIONS

- Patios, decks, yards, gardens & greenhouse
- Walk-in coolers, grocery stores, & deli counters
- Kitchens, bathrooms, & laundry rooms
- Basements & garages
- Motor boats, fishing boats, yachts, & cruise ships
- Spas, restaurants, bars, lounges, clubs, & coffee shops
- Wine caves & cellars
- Vehicular accent lighting for cars, trucks, limousines, & RVs (12V DC power)

IN USE PHOTOS

MOUNTING



1. Always turn off the power at the main breaker prior to installation.
2. Configure the design and layout of the system and test functionality. See wiring diagrams on pages 5-7 for examples.
3. After confirming the functionality, disassemble the system and attach the mounting clips.
4. Fit the fixtures into the mounting clips and connect any additional accessories.
5. When installation is complete, turn on the power at the main breaker.

WARNINGS / NOTIFICATIONS / DISCLOSURES ⚠

1. *Always* consult a qualified, licensed electrician prior to the installation of this product. Diode LED recommends that a qualified, licensed electrician perform the installation of this product.
2. *Always* pre-test your strip light assembly by making all connections and connecting the strip to the appropriate power supply and ensure that all components are joined properly before they are installed.
3. It is recommended that adequate airflow and heat-sink be taken into account in the application and installation of this product. Improper thermal management may lead to premature failure.
4. Exceeding the operating temperature values may damage LED chips by reducing the total lamp life and lumen output, and may adversely impact color consistency.
5. Each maximum run requires a dedicated line from the power supply to avoid voltage drop.Voltage drop is a gradual lessening of power through a wire over a long distance. The farther the light is from the power source, the more voltage drop will occur. Voltage drop becomes a significant factor in any LED light application when the distance between the light fixture and the power source is greater than 30 feet. Consult a qualified, licensed electrician and an online voltage drop calculator to learn what gauge wire will work best for your configuration. For more tips, visit the Tools & Resources page at www.DiodeLED.com.
6. The manufacturer rates each power supply for maximum power output at optimum thermal and voltage conditions. As with any power supply, true actual maximum continuous current output depends upon various environmental factors such as ambient temperature, line voltage fluctuations, and orientation, which may affect heat dissipation. Dimmable driver note: For optimum performance, make sure the load is between 50% and 80% of the driver's capacity.
7. Actual color may vary from what is pictured on this sheet and other Diode LED print materials due to the limitations of photographic processes.
8. Please note, color temperature or kelvin (k), as well as light output or lumens (lm) and product appearance may vary from order to order. Variation in kelvin is +/- 250k and lumens is +/- 10%.
9. Diode LED reserves the right to modify the design of our products as part of the company's program of continuous improvement. Diode LED cannot guarantee to match existing installed product with subsequent orders of the product you are replacing in appearance, color, or brightness. Specifications are subject to change without notice.

NOTE ABOUT AMBIENT OPERATION TEMP:

This fixture is rated for use in an environment where the ideal ambient operating temperature is -4° ~ +176° F (-20° ~ +80° C).

WARRANTY

Limited Warranty: This product has a three (3) year limited warranty from the date of shipment. The complete warranty details are posted on the website at www.diodeled.com under the tools and resources tab. Specific warranty periods can also be found on the individual published Product Specification Sheets.

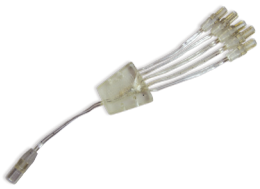
If you have any warranty related questions please contact Diode customer service at info@doideled.com or call (877) 817-6028.

CONNECTORS & ACCESSORIES

Waterproof Connectors:
2-pin male and female waterproof connectors come installed on each CASCADE Light Bar. Waterproof connectors can be attached to the CASCADE Light Bar to create splits or extensions. DC connectors can be attached to create splits or extensions by attaching a male or female Waterproof plug to DC Adapter Connector (item #DI-0710M or #DI-0710F).

Waterproof Plug to DC Adapter Connector
female (item #DI-0710F) 7.5 in. x 0.4 ir
male (item #DI-0710M) 7.5 in. x 0.3 in.
Connects the CASCADE Light Bar to a Plug-In Adapter and to DC accessories.
DC plug Input is a female DC Connection.

Waterproof Solder Connector Pair
(item #DI-0725) 4.7 in. x 0.3 in.
Connects the CASCADE Light Bar to a Hard-Wired Driver. One pair (male & female) included with each fixture.



Waterproof Splitter Cables
2-way (item #DI-0804)
3-way (item #DI-0805)
5-way (item #DI-0806)
L 8 in. x W 1 in. x D 0.3 in.
This splitter will divide the current in multiple directions to connect to a female Waterproof Connector.

Waterproof Male to Female Extension Cables
Available Lengths: 6 in. (item #DI-0757); 12 in. (item #DI-0758); 24 in. (item #DI-0759); 39 in. (item #DI-0709); 16 ft. (item #DI-0810)
Connector Width: 0.3 in.
Creates an extension between waterproof connectors.

Additional Connectors & Accessories: (Not rated for wet locations)

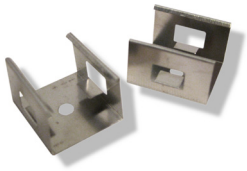
Adapter Splice Cable
(item #DI-0712F) 42 in. x 0.45 in.
(item #DI-0712M) 42 in. x 0.45 in.
Converts a DC connection to a hard-wired connection.

DC Splitter Plugs
2-Way (item #DI-0720) 5.7 in. x 0.4 in.
3-Way (item #DI-0705) 8 in. x 0.6 in.
5-Way (item #DI-0707) 8 in. x 0.6 in.
This splitter will divide the current in multiple directions to connect to a female DC plug connection.

39 in. DC Extension Cable
(item #DI-0708) 39.4 in. x 0.5 in.
Creates an extension between any fixtures or accessories that use DC plugs.

DC Wire Plug
female white (item #DI-1713F)
male white (item #DI-1713M)
1.6 in. x 0.6 in. x 0.5 in.
Converts 14/2, 16/2, 18/2, and 20/2 AWG wire to a DC plug without soldering.

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This 12V-24V on/off switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W



Additional CASCADE Light Bar Mounting Clips
(item #DI-0752) 0.75 in. x 0.5 in. x 0.6 in.
Qty of 10 clips and 10 Phillips head screws. Two clips and screws are included with each bar.

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W
Note: This switch makes a slight audible noise.

REIGN 12V - 24V Dimmer Switches
Available in 3 styles and 3 colors.
See www.DiodeLED.com for details.

Option 1: POWERING WITH A HARD-WIRED NON-DIMMABLE DRIVER

Wet Location Drivers

12V - 20 Watt Class 2 Non-Dimmable Driver
(item #DI-0904) 4.6 in. x 1.35 in. x 1 in.
12V - 35 Watt Class 2 Non-Dimmable Driver
(item #DI-0918) 5.75 in. x 1.5 in. x 1.2 in.
12V - 60 Watt Class 2 Non-Dimmable Driver
(item #DI-0906) 6.25 in. x 1.6 in. x 1.25 in.

Indoor Drivers

12V - 25 Watt Mini Class 2 Non-Dimmable Driver
(item #DI-0939) 3.1 in. x 2.1 in. x 1.2 in.
12V - 150 Watt Non-Dimmable Driver
(item #DI-0908) 8.25 in. x 3.9 in. x 2 in.
12V - 200 Watt Non-Dimmable Driver
(item #DI-0909) 8.25 in. x 3.9 in. x 1.9 in.
12V - 300 Watt Non-Dimmable Driver
(item #DI-0928) 8.5 in. x 4.9 in. x 1.6 in.
12V - 600 Watt Non-Dimmable Driver
(item #DI-0929) 9.75 in. x 4.1 in. x 2.5 in.

DIMMER SWITCHES & JUNCTION BOXES

REIGN 12V-24V Dimmer Switches
(Page 73 of the 2012-A Catalog or visit www.DiodeLED.com for more information)

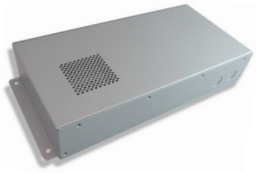
- **For use with non-dimmable drivers only**
- **100%-0% dimming**
- **Maximum load: 100W**

Diode LED carries many non-dimmable drivers and some have multiple DC outputs. Only one REIGN 12-24V Dimmer Switch can be installed per output or flickering will occur.
Do not connect to 120V.

Lo-Pro Junction Box
(item #DI-0940) 7.7" x 1.8" x 4.9"
Designed for use with the following drivers.

12V - 20 Watt (item #DI-0904)
12V - 35 Watt (item #DI-0918)
12V - 60 Watt (item #DI-0906)

NEMA 1 steel enclosure
ETL Listed to UL STD 508A



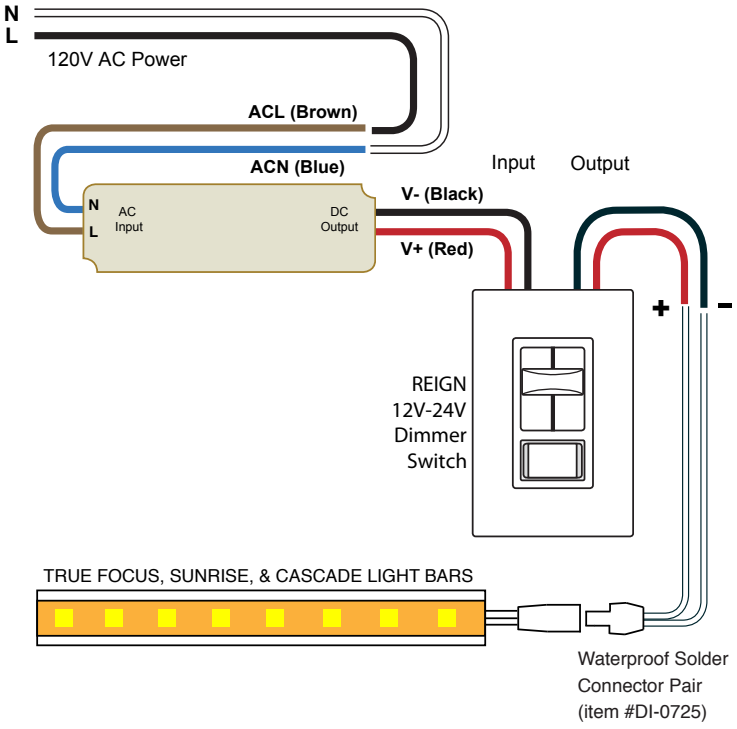
Meanwell Junction Box
(item #DI-0940) 15.5 in. x 6.5 in. x 2.6 in.
Designed for use with the following drivers

12V - 150 Watt (item #DI-0908)
12V - 200 Watt (item #DI-0909)

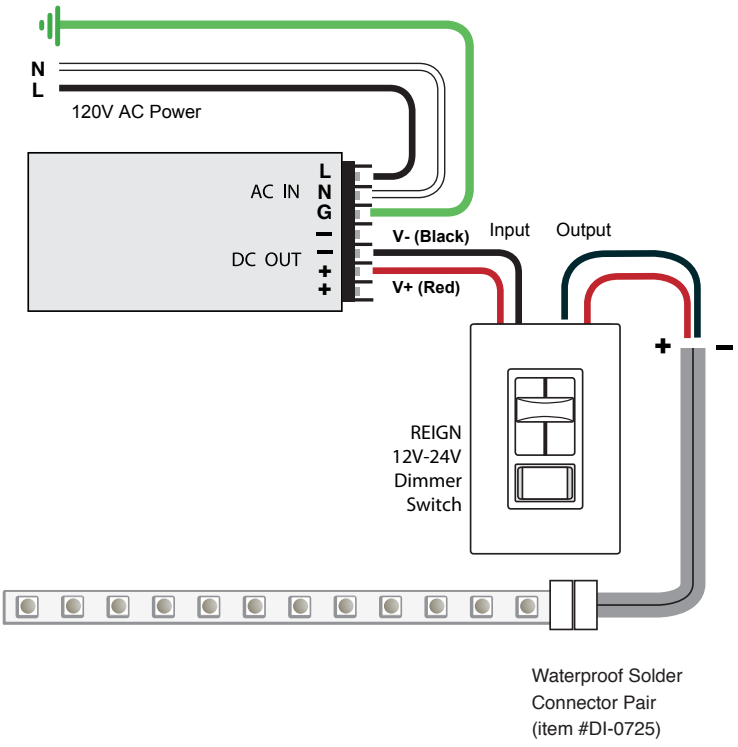
NEMA 1 steel enclosure
ETL Listed to UL STD 508A

WIRING DIAGRAMS

12V - 20 Watt Class 2 Non-Dimmable Driver (item #DI-0904)
12V - 35 Watt Class 2 Non-Dimmable Driver (item #DI-0918)
12V - 60 Watt Class 2 Non-Dimmable Driver (item #DI-0906)



12V - 25 Watt Mini Class 2 Non-Dimmable Driver (item #DI-0939)
12V - 150 Watt Non-Dimmable Driver (item #DI-0908)
12V - 200 Watt Non-Dimmable Driver (item #DI-0909)
12V - 300 Watt Non-Dimmable Driver (item #DI-0928)
12V - 600 Watt Non-Dimmable Driver (item #DI-0929)



Option 2: POWERING WITH A HARD-WIRED DIMMABLE DRIVER

12V - 20 Watt Class 2 Listed Dimmable Driver
(item #DI-0920) 5.6 in. x 2.14 in. x 2.25 in.
12V - 60 Watt Class 2 Listed Dimmable Driver
(item #DI-0922) 6.5 in. x 2.6 in. x 2.25 in.
12V - 100 Watt Dimmable Driver
(item #DI-0925) 9.8 in. x 3 in. x 2.75 in.
12V - 200 Watt Dimmable Driver
(item #DI-0923) 9.8 in. x 3 in. x 2.75 in.
12V - 300 Watt Dimmable Driver
(item #DI-0926) 9.8 in. x 4.125 in. x 3.375 in.

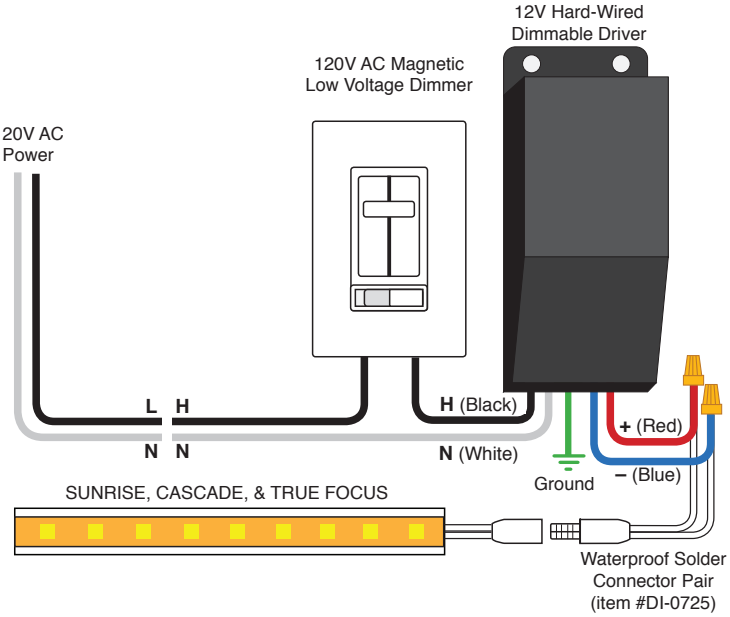
Hard-Wired Dimmable Drivers should be installed by a licensed electrician. Any of our dimmable light fixtures are compatible with our hard-wired dimmable drivers, but must be installed with a 120V AC magnetic low voltage dimmer switch. For optimum performance, install a load between 50% and 80% of the driver's capacity.

DO NOT TEST OR INSTALL WITH A 120V ON/OFF SWITCH OR WITHOUT AN ATTACHED LOAD:
Pair these drivers *only* with recommended 120V magnetic low voltage dimmer switches.
These drivers are not compatible with our REIGN 12V-24V Dimmer Switches or the 12V-24V In-line Dimmer Switch. For a complete list of compatible dimmer switches, see the Tools and Resources page at www.DiodeLED.com.

WIRING DIAGRAMS

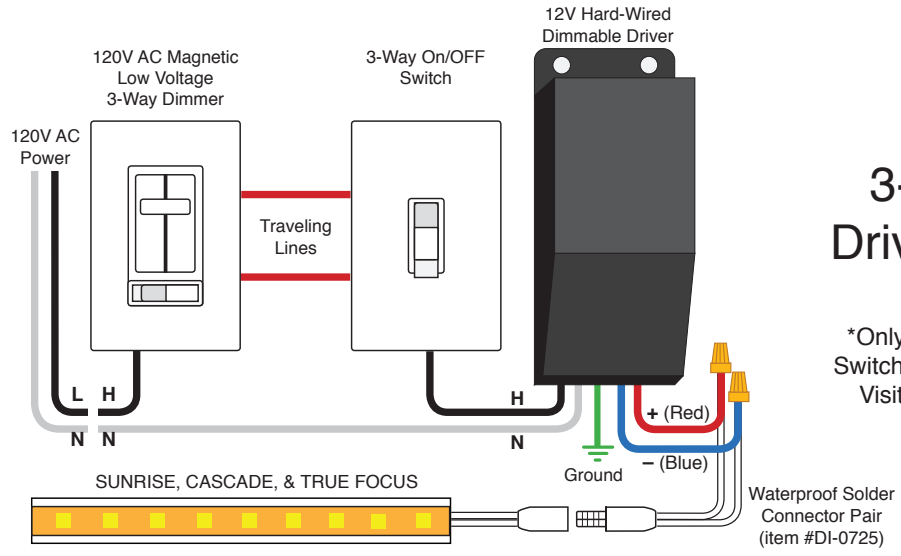
Standard Dimmable Driver Configuration*

*Visit the Tools & Resources page at www.DiodeLED.com for a complete list of compatible dimmer switches.



3-Way Dimmable Driver Configuration*

*Only use recommended 3-way On/Off Switches for 3-way dimming applications. Visit www.DiodeLED.com for details.



Option 3: POWERING WITH A PLUG-IN ADAPTER

12V - 12 Watt Class 2 Listed Adapter
(item #DI-0927) 2.35 in. x 1.75 in. x 1.4 in., total cable length: 48 in.
12V - 36 Watt Class 2 Listed Adapter
(item #DI-0912) 3.8 in. x 1.75 in. x 1.4 in., total cable length: 70 in.
12V - 60 Watt Class 2 Listed Adapter
(item #DI-0913) 4.7 in. x 2 in. x 1.25 in., total cable length: 108 in.
12V - 96 Watt Adapter*
(item #DI-0930) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.
12V -120 Watt Adapter*
(item #DI-0931) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.

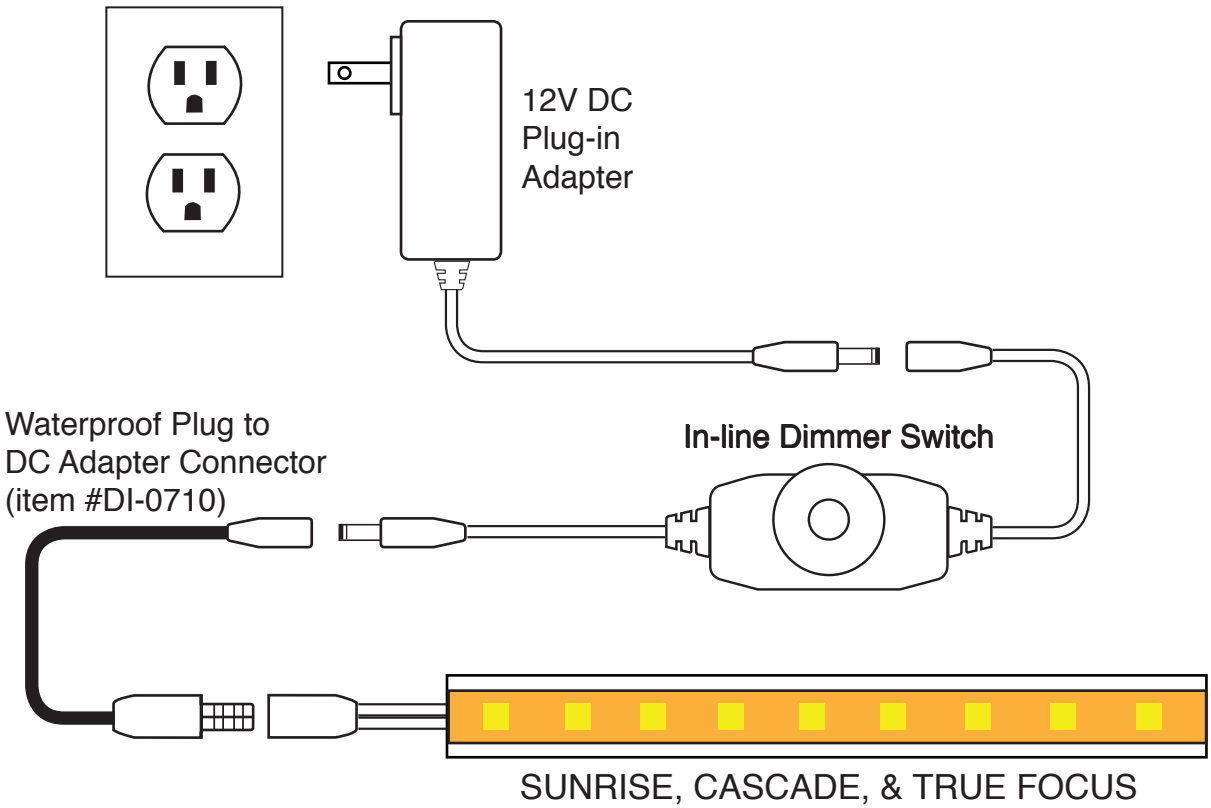
*96W & 120W Plug-In Adapters have a built-in fan that makes audible noise.

DIMMING & SWITCHING WITH A PLUG-IN ADAPTER

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W

WIRING DIAGRAMS



Frame Light

Flat 1/3" thick edge-lit LED pad with Aluminum Frame and Exposure Photo Application

FSL's Frame Light (Thin Single-Sided) provides the aesthetic and application benefit of a snap frame that is 1" (25.4mm) deep with a 1 3/16" (30mm) front profile width and has the even and consistent illumination benefit of our FSLED Edge-Lit Light Panel. The snap frame design includes our Exposure Photo Application which features original custom photographic images applied to the panel. FSL offers several standard images or the specifier can supply their own image or graphic. The results are photographic images captured at a moment in time and illuminated to be appreciated over time.

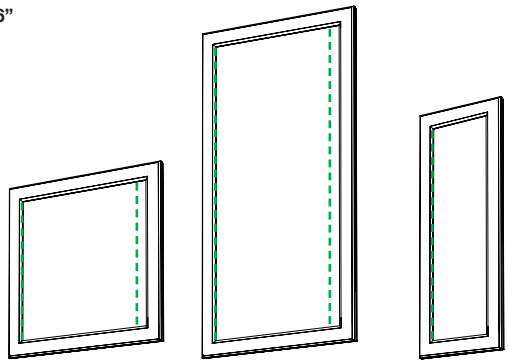
The LED light source is a slim profile, edge-lit panel. The panel is only 1/3" thick and has LEDs along the long sides of each panel (Two 12" sides on 12x12, two 24" sides on 12x24, one 18" side on 6x18). An interior connector provides a solid power connection directly on the panel itself. Available in both daylight and tungsten color temperatures.

- **Three standard sizes or any size up to 48" x 96"**
- **Super slim and super bright**
- **Easy to install**
- **Edge lit from four sides for maximum light performance**
- **Dimmable**
- **Available in 3000K, 4100K and 5300K**
- **Low heat - Cool to the touch at center**
- **Low power consumption - .25 watts per LED**
- **Lamp Life: 60,000 hrs**
- **Operating Temperature: -30°C - +85°C**
- **Power: 12V DC Input**

Includes transformer and power cable. Consult factory for accessories.

FSL offers a wide range of Exposure Photographic options and can accommodate any custom photographic image. See the other side of this page for specification details.

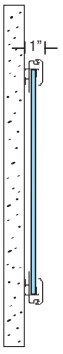
Standard Sizes



12 X 12 **12 X 24** **6 X 18**

LED's are located along two long sides of each panel. (One side on 6x18)

= LED Side Location



FSL Light Panel

FRM-58-6x18-120

FRM-58-12x12-120

FRM-36-12x24-120

ORDERING INFO

Style	LED Color Temperature	Size	Voltage
FRM = Frame Light Wall Fixture	**30** = 3000K White **41** = 4100K White **53** = 5300K White	**6X18** = 6" x 18" **12X12** = 12" x 12" **12X24** = 12" x 24"	**120** = 120 volts

FENG SHUI LIGHTING

Diffuser Panel Options

Exposure Collection - Custom photographic images applied to LED light pad

HL-372

Product Specification

Description
Surface mount PAR20 accent fixture. Suitable for wet/damp/dry location installations.

Fixture Type
Wall & Surface Lights

Material
Machined Aluminum

Finish
Black Powder Coat (BK)
Bronze Powder Coat (BZ)
White Powder Coat (WT)
Anodized Satin Aluminum (AA)
Aluminum Powder Coat (AP)

Rating
Dry/Damp/Wet Location

Lamp Type
PAR20 Incand./Halogen Med Base

Lamp Included
No

Wattage
50W

Voltage
120 Volts

Transformer
Not Req'd

Mounting
1/2 NPS Thread

Size
Diameter = 2.75"
Length = 5.62"

Product Downloads

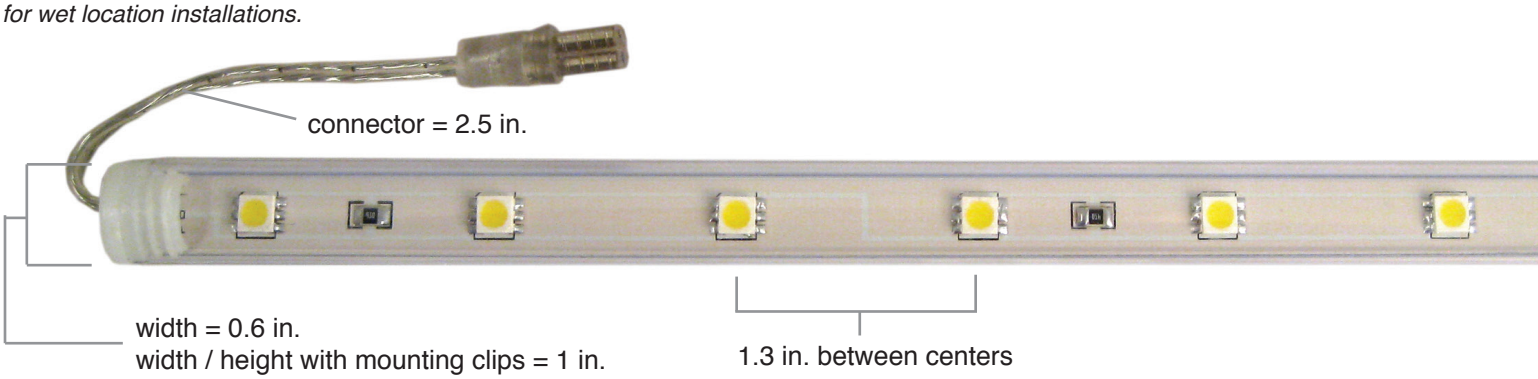
Specification Sheet (http://www.hevilite.com/wp-content/uploads/2013/05/HL372-SPEC-SHEET-Sheet1.pdf) (http://www.hevilite.com/wp-content/uploads/2013/05/HL372-SPEC-SHEET-Sheet1.pdf)

TRUE FOCUS LED Tube Light

The TRUE FOCUS LED Tube Light is Diode LED's most versatile indoor 12V LED light fixture, offering maximum light angle adjustment. Its cylindrical shape and rounded mounting clips allow it to be positioned at any angle needed for back-splashes and unique applications. Furthermore, the TRUE FOCUS LED Tube Light is manufactured with high-power tri-chip SMDs (spaced at 1.3 in. between centers) and consumes as low as 1.44 watts per fixture – emitting a considerable amount of light while remaining extremely energy-efficient.

2-pin male and female waterproof connectors come installed on each TRUE FOCUS LED Tube Light for simple plug-and-play installation, which attach easily to additional waterproof connectors and accessories. Included with each TRUE FOCUS LED Tube Light is a pair of TRUE FOCUS mounting clips and screws, and a pair of Waterproof Solder Connectors (male and female) to connect the fixture directly to a hard-wired driver.

Please note: although the TRUE FOCUS LED Tube Light attaches directly to waterproof connectors and accessories, it is not suitable for wet location installations.



TECHNICAL SPECIFICATIONS

item #	length	color	color temp.	lumens	beam angle	power consumption	IP rating	CRI	# of LEDs	max. bars per run
DI-0255	8.9 in.	warm white	2700k	120	120°	1.44W / 120mA	IP64	75	6	7
DI-0256	8.9 in.	cool white	5000k	120	120°	1.44W / 120mA	IP64	80	6	7
DI-0250	13 in.	warm white	2700k	180	120°	2.16W / 180mA	IP64	75	9	6
DI-0251	13 in.	cool white	5000k	180	120°	2.16W / 180mA	IP64	80	9	6
DI-0252	19.9 in.	warm white	2700k	300	120°	3.6W / 300mA	IP64	75	15	5
DI-0253	19.9 in.	cool white	5000k	300	120°	3.6W / 300mA	IP64	80	15	5

FEATURES

Certifications: ETL Listed (Conforms to UL 2108), RoHS
Dimmable: Yes
Environment: Indoor/Outdoor (IP68)
Warranty: Warranty: 3 years (limited)
Operating Temp.: +68° ~ +90° F (+20º ~ +32º C)
Ambient Operating Temp.: -4º ~ +176º F (-20° ~ +80° C)
Mounting: One pair of TRUE FOCUS mounting clips and screws included with each bar.
Rated Lamp Life: 50,000 hours
Fixture Length: 8.9 in.; 13 in.; 20 in.
Width: 0.6 in.
Height: 0.6 in. (1 in. with mounting clips)

Connectors: Waterproof male and female plugs
LED Chip Type: 5050 tri-chip SMD
Chips Per Fixture: 8.9 in. (6 chips), 13 in. (9 chips), 20 in. (15 chips)
Power Use Per Fixture: See Technical Specifications
Rated Lumens Per Fixture: See Technical Specifications
Luminous Efficacy: 83.33 lm/W
LED Spacing: 1.3 in. (between centers)
Input Voltage: 12V DC
Max. Run: See Technical Specifications
** Each maximum run requires a dedicated line from the power supply to avoid voltage drop.*

c UL us LISTED

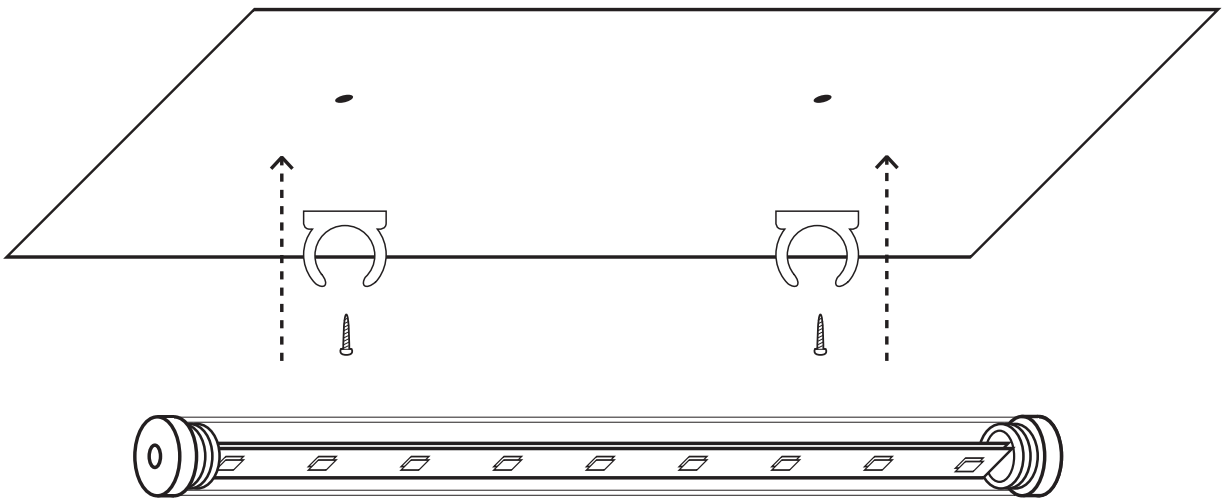
RoHS compliant

APPLICATIONS

- Bookcases & shelves
- Soffits & windows
- Bar & club lighting
- Home theater lighting
- Accent & decorative lighting
- Edge-lighting
- Restaurants, retail stores, bars, lounges, & casinos
- Lighting art, accent pieces, & framed photos
- Wine caves & wine cellars
- Under cabinet lighting, shelves, cupboards, closets, & drawers
- Coin-operated vending machines & arcade games
- Architectural models & doll houses
- Boat interiors

IN USE PHOTOS

MOUNTING



1. Always turn off the power at the main breaker prior to installation.
2. Configure the design and layout of the system and test functionality. See wiring diagrams on pages 5-7 for examples.
3. After confirming the functionality, disassemble the system and attach the mounting clips.
4. Fit the fixtures into the mounting clips and connect any additional accessories.
5. When installation is complete, turn on the power at the main breaker.

WARNINGS ⚠

1. *Always* consult a qualified, licensed electrician prior to the installation of this product. Diode LED recommends that a qualified, licensed electrician perform the installation of this product.
2. *Always* pre-test your strip light assembly by making all connections and connecting the strip to the appropriate power supply and ensure that all components are joined properly before they are installed.
3. It is recommended that adequate airflow and heat-sink be taken into account in the application and installation of this product. Improper thermal management may lead to premature failure.
4. Exceeding the operating temperature values may damage LED chips by reducing the total lamp life and lumen output, and may adversely impact color consistency.
5. Each maximum run requires a dedicated line from the power supply to avoid voltage drop.Voltage drop is a gradual lessening of power through a wire over a long distance. The farther the light is from the power source, the more voltage drop will occur. Voltage drop becomes a significant factor in any LED light application when the distance between the light fixture and the power source is greater than 30 feet. Consult a qualified, licensed electrician and an online voltage drop calculator to learn what gauge wire will work best for your configuration. For more tips, visit the Tools & Resources page at www.DiodeLED.com.
6. The manufacturer rates each power supply for maximum power output at optimum thermal and voltage conditions. As with any power supply, true actual maximum continuous current output depends upon various environmental factors such as ambient temperature, line voltage fluctuations, and orientation, which may affect heat dissipation. Dimmable driver note: For optimum performance, make sure the load is between 50% and 80% of the driver's capacity.
7. Actual color may vary from what is pictured on this sheet and other Diode LED print materials due to the limitations of photographic processes.
8. Please note, color temperature or kelvin (k), as well as light output or lumens (lm) and product appearance may vary from order to order. Variation in kelvin is +/- 250k and lumens is +/- 10%.
9. Diode LED reserves the right to modify the design of our products as part of the company's program of continuous improvement. Diode LED cannot guarantee to match existing installed product with subsequent orders of the product you are replacing in appearance, color, or brightness. Specifications are subject to change without notice.

NOTE ABOUT AMBIENT OPERATION TEMP:

This fixture is rated for use in an environment where the ideal ambient operating temperature is -4° ~ +176° F (-20° ~ +80° C).

WARRANTY

Limited Warranty: This product has a three (3) year limited warranty from the date of shipment. The complete warranty details are posted on the website at www.diodeled.com under the tools and resources tab. Specific warranty periods can also be found on the individual published Product Specification Sheets.

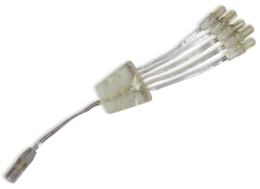
If you have any warranty related questions please contact Diode customer service at info@doideled.com or call (877) 817-6028.

CONNECTORS & ACCESSORIES

Waterproof Connectors:
2-pin male and female waterproof connectors come installed on each TRUE FOCUS LED Tube Light. Waterproof connectors can be attached to the TRUE FOCUS LED Tube Light to create splits or extensions. Additionally, DC connectors can be attached to create splits or extensions upon attaching a male or female Waterproof plug to a DC Adapter Connector (item #DI-0710M, or #DI-0710F).

Waterproof Plug to DC Adapter Connector
female (item #DI-0710F) 7.5 in. x 0.4 ir
male (item #DI-0710M) 7.5 in. x 0.3 in.
Connects the TRUE FOCUS LED Tube Light to a Plug-In Adapter and to DC accessories. DC plug Input is a female DC Connection.

Waterproof Solder Connector Pair
(item #DI-0725) 4.7 in. x 0.3 in.
Connects the TRUE FOCUS LED Tube Light to a Hard-Wired Driver. One pair (male & female) included with each fixture.



Waterproof Splitter Cables
2-way (item #DI-0804)
3-way (item #DI-0805)
5-way (item #DI-0806)
L 8 in. x W 1 in. x D 0.3 in.
This splitter will divide the current in multiple directions to connect to a female Waterproof Connector.

Waterproof Male to Female Extension Cables
Available Lengths: 6 in. (item #DI-0757); 12 in. (item #DI-0758); 24 in. (item #DI-0759); 39 in. (item #DI-0709); 16 ft. (item #DI-0810)
Connector Width: 0.3 in.
Creates an extension between Waterproof connectors.

Additional Connectors & Accessories: (Not rated for wet locations)

Adapter Splice Cable
(item #DI-0712F) 42 in. x 0.45 in.
(item #DI-0712M) 42 in. x 0.45 in.
Converts a DC connection to a hard-wired connection.

DC Splitter Plugs
2-Way (item #DI-0720) 5.7 in. x 0.4 in.
3-Way (item #DI-0705) 8 in. x 0.6 in.
5-Way (item #DI-0707) 8 in. x 0.6 in.
This splitter will divide the current in multiple directions to connect to a female DC plug connection.

39 in. DC Extension Cable
(item #DI-0708) 39.4 in. x 0.5 in.
Creates an extension between any fixtures or accessories that use DC plugs.

DC Wire Plug
female white (item #DI-1713F)
male white (item #DI-1713M)
1.6 in. x 0.6 in. x 0.5 in.
Converts 14/2, 16/2, 18/2, and 20/2 AWG wire to a DC plug without soldering.

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This 12V-24V on/off switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W

Additional TRUE FOCUS LED Tube Mounting Clips
(item #DI-0752) 0.75 in. x 0.5 in. x 0.6 in.
Qty of 10 clips and 10 Phillips head screws.
Two clips and screws are included with each bar.

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W
Note: This switch makes a slight audible noise.

REIGN 12V - 24V Dimmer Switches
Available in 3 styles and 3 colors.
See www.DiodeLED.com for details.

Option 1: POWERING WITH A HARD-WIRED NON-DIMMABLE DRIVER

Wet Location Drivers

12V - 20 Watt Class 2 Non-Dimmable Driver
(item #DI-0904) 4.6 in. x 1.35 in. x 1 in.
12V - 35 Watt Class 2 Non-Dimmable Driver
(item #DI-0918) 5.75 in. x 1.5 in. x 1.2 in.
12V - 60 Watt Class 2 Non-Dimmable Driver
(item #DI-0906) 6.25 in. x 1.6 in. x 1.25 in.

Indoor Drivers

12V - 25 Watt Mini Class 2 Non-Dimmable Driver
(item #DI-0939) 3.1 in. x 2.1 in. x 1.2 in.
12V - 150 Watt Non-Dimmable Driver
(item #DI-0908) 8.25 in. x 3.9 in. x 2 in.
12V - 200 Watt Non-Dimmable Driver
(item #DI-0909) 8.25 in. x 3.9 in. x 1.9 in.
12V - 300 Watt Non-Dimmable Driver
(item #DI-0928) 8.5 in. x 4.9 in. x 1.6 in.
12V - 600 Watt Non-Dimmable Driver
(item #DI-0929) 9.75 in. x 4.1 in. x 2.5 in.

DIMMER SWITCHES & JUNCTION BOXES

REIGN 12V-24V Dimmer Switches
(Page 73 of the 2012-A Catalog or visit www.DiodeLED.com for more information)

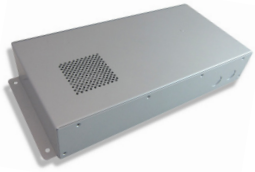
- **For use with non-dimmable drivers only**
- **100%-0% dimming**
- **Maximum load: 100W**

Diode LED carries many non-dimmable drivers and some have multiple DC outputs. Only one REIGN 12-24V Dimmer Switch can be installed per output or flickering will occur.
Do not connect to 120V.

Lo-Pro Junction Box
(item #DI-0940) 7.7" x 1.8" x 4.9"
Designed for use with the following drivers.

12V - 20 Watt (item #DI-0904)
12V - 35 Watt (item #DI-0918)
12V - 60 Watt (item #DI-0906)

NEMA 1 steel enclosure
ETL Listed to UL STD 508A



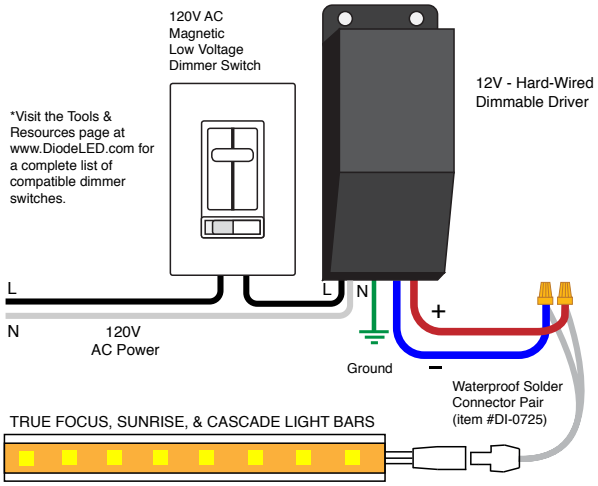
Meanwell Junction Box
(item #DI-0940) 15.5 in. x 6.5 in. x 2.6 in.
Designed for use with the following drivers

12V - 150 Watt (item #DI-0908)
12V - 200 Watt (item #DI-0909)

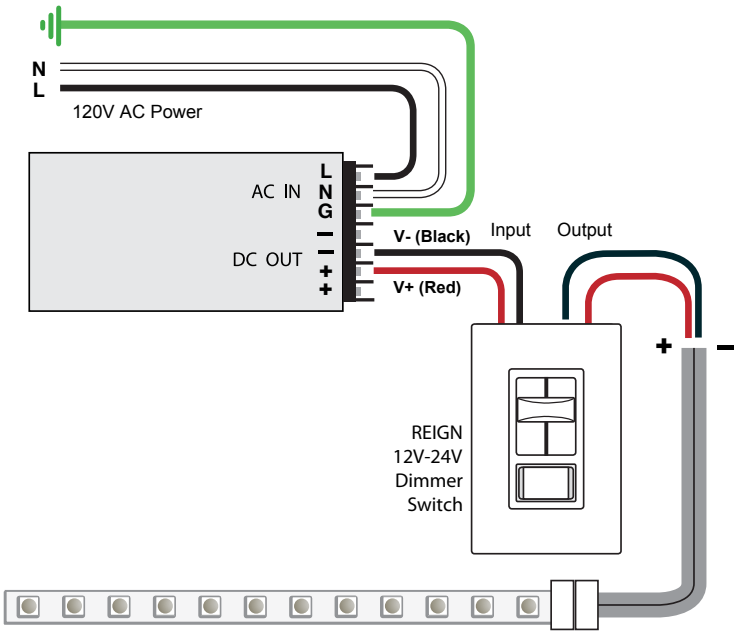
NEMA 1 steel enclosure
ETL Listed to UL STD 508A

WIRING DIAGRAMS

12V - 20 Watt Class 2 Non-Dimmable Driver (item #DI-0904)
12V - 35 Watt Class 2 Non-Dimmable Driver (item #DI-0918)
12V - 60 Watt Class 2 Non-Dimmable Driver (item #DI-0906)



12V - 25 Watt Mini Class 2 Non-Dimmable Driver (item #DI-0939)
12V - 150 Watt Non-Dimmable Driver (item #DI-0908)
12V - 200 Watt Non-Dimmable Driver (item #DI-0909)
12V - 300 Watt Non-Dimmable Driver (item #DI-0928)
12V - 600 Watt Non-Dimmable Driver (item #DI-0929)



Waterproof Solder Connector Pair (item #DI-0725)

Waterproof Solder Connector Pair (item #DI-0725)

Option 2: POWERING WITH A HARD-WIRED DIMMABLE DRIVER

12V - 20 Watt Class 2 Listed Dimmable Driver
(item #DI-0920) 5.6 in. x 2.14 in. x 2.25 in.
12V - 60 Watt Class 2 Listed Dimmable Driver
(item #DI-0922) 6.5 in. x 2.6 in. x 2.25 in.
12V - 100 Watt Dimmable Driver
(item #DI-0925) 9.8 in. x 3 in. x 2.75 in.
12V - 200 Watt Dimmable Driver
(item #DI-0923) 9.8 in. x 3 in. x 2.75 in.
12V - 300 Watt Dimmable Driver
(item #DI-0926) 9.8 in. x 4.125 in. x 3.375 in.

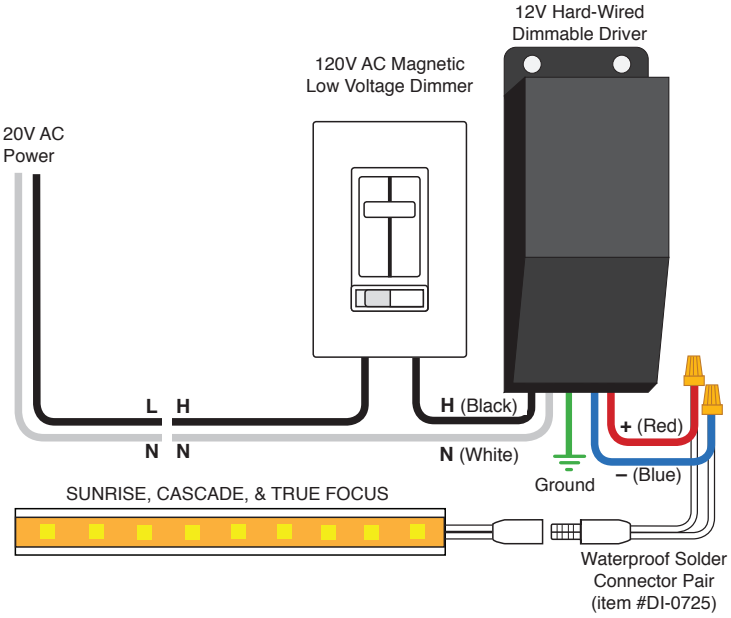
Hard-Wired Dimmable Drivers should be installed by a licensed electrician. Any of our dimmable light fixtures are compatible with our hard-wired dimmable drivers, but must be installed with a 120V AC magnetic low voltage dimmer switch. For optimum performance, install a load between 50% and 80% of the driver's capacity.

DO NOT TEST OR INSTALL WITH A 120V ON/OFF SWITCH OR WITHOUT AN ATTACHED LOAD:
Pair these drivers *only* with recommended 120V magnetic low voltage dimmer switches.
These drivers are not compatible with our REIGN 12V-24V Dimmer Switches or the 12V-24V In-line Dimmer Switch. For a complete list of compatible dimmer switches, see the Tools and Resources page at www.DiodeLED.com.

WIRING DIAGRAMS

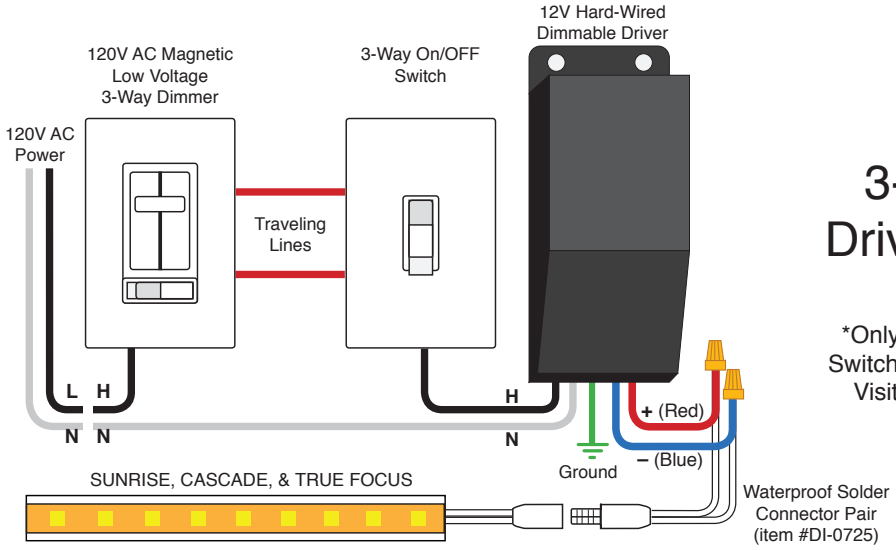
Standard Dimmable Driver Configuration*

*Visit the Tools & Resources page at www.DiodeLED.com for a complete list of compatible dimmer switches.



3-Way Dimmable Driver Configuration*

*Only use recommended 3-way On/Off Switches for 3-way dimming applications. Visit www.DiodeLED.com for details.



Option 3: POWERING WITH A PLUG-IN ADAPTER

12V - 12 Watt Class 2 Listed Adapter
(item #DI-0927) 2.35 in. x 1.75 in. x 1.4 in., total cable length: 48 in.
12V - 36 Watt Class 2 Listed Adapter
(item #DI-0912) 3.8 in. x 1.75 in. x 1.4 in., total cable length: 70 in.
12V - 60 Watt Class 2 Listed Adapter
(item #DI-0913) 4.7 in. x 2 in. x 1.25 in., total cable length: 108 in.
12V - 96 Watt Adapter*
(item #DI-0930) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.
12V -120 Watt Adapter*
(item #DI-0931) 6.8 in. x 2.5 in. x 1.6 in., total cable length: 108 in.

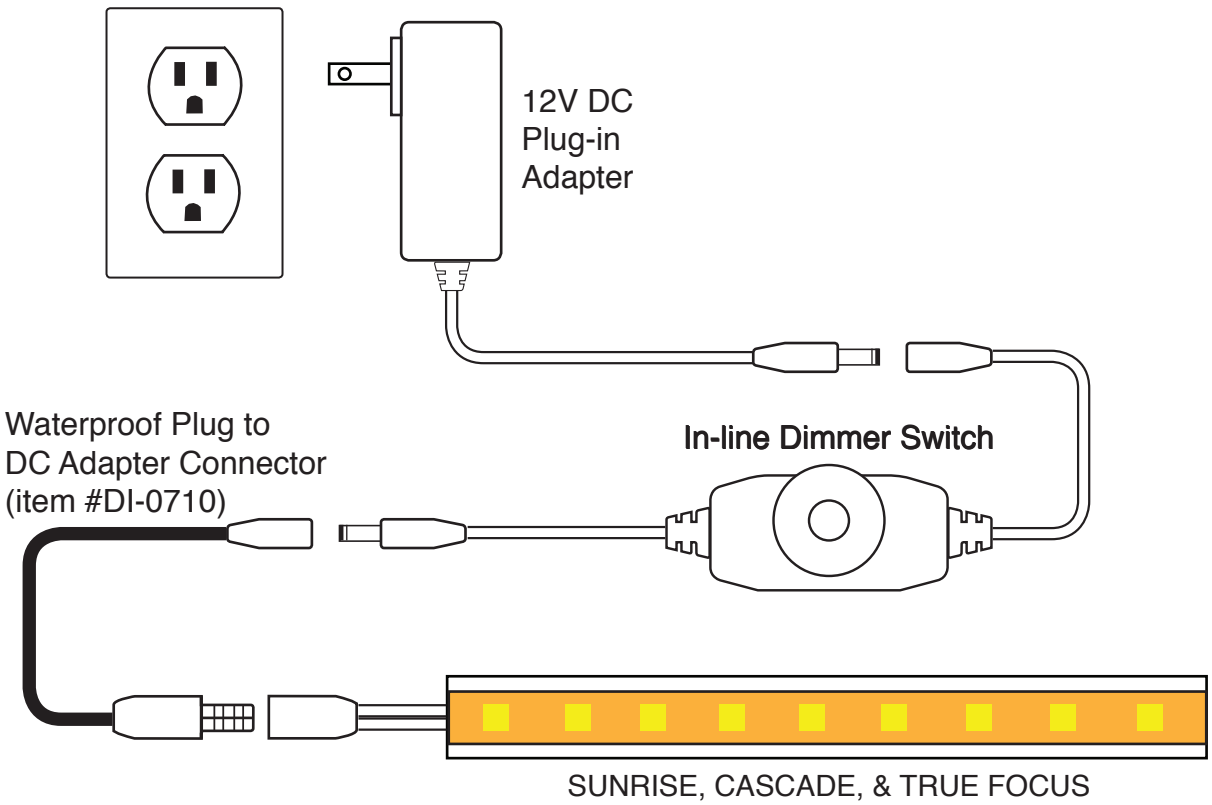
*96W & 120W Plug-In Adapters have a built-in fan that makes audible noise.

DIMMING & SWITCHING WITH A PLUG-IN ADAPTER

Inline Dimmer Switch
black (item #DI-0715-B)
white (item #DI-0715)
switch: 2.6 in. x 1.4 in. x 1.3 in.
cable lengths: 7.8 in.
This 12V-24V rotary dimmer connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 24W

Inline On/Off Switch
black (item #DI-0714-B)
white (item #DI-0714)
switch: 2.5 in. x 0.9 in. x 0.7 in.
cable lengths: 3.25 in.
This switch connects directly between a Plug-In Adapter and the Waterproof Plug to DC Adapter Connector.
Maximum load: 100W

WIRING DIAGRAMS



Skyline ™

763/1,200 lumens

14/22 watts

Product	Skyline 14-Round	Skyline 22-Round	Skyline Module 22 277V-Round
Watts / Volts	14W/120V	22W/120V	22W/120V-277V
Lumens	763	1,200	1,200
Color Temp	2700K/3000K/4000K/5000K	2700K/3000K/4000K/5000K	2700K/3000K/4000K/5000K
Base	N/A	N/A	N/A
Rated Life	40,000 hours	40,000 hours	40,000 hours
Beam Angle	N/A	N/A	N/A
CRI	80	80	80
Dimension	11 inches x 12.375 inches	11 inches x 12.375 inches	11 inches x 12.375 inches
Dimmable	Yes	Yes	No

Ready to switch on the savings?
Contact us today.

SMC LED
340 Franklin Rd.
Marietta, GA 30067 USA
www.smcled.com

877 367 1883 Toll free
770 544 0855 Local
770 956 0324 Fax

Order Number Example: 22SL/27K/R

Wattage	Product	/	Color Temp	/	Voltage	/	Finish
14	SL		27K = 2700		(Blank) = 120V		R = Round
22			30K = 3000		277V = 277V		
			40K = 4000				
			50K = 5000				

The Green Light Guarantee

We back our products with a five-year* manufacturer's warranty. This means you not only get the green light on savings, but you also get the peace of mind that comes from knowing your investment is protected.

*See Details

Switch on the Savings™

G-Beam Series GB35B

General Illumination - Suspended, Wall Mount
Bi-directional Distribution

Click or scan QR code to view latest spec sheet.

REVIT DOWNLOAD

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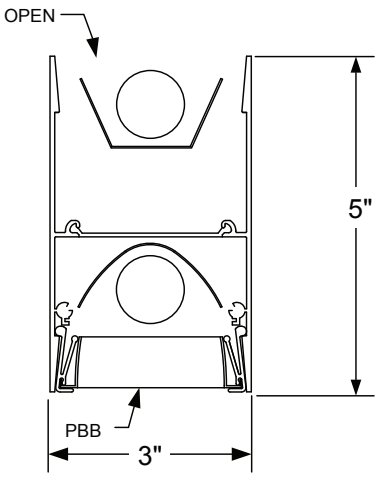
MADE IN U.S.A.



GB35B-1/1T8-OP/PBB

Gammalux Lighting Systems reserves the right to change details of fixture designs and construction at any time.

Product Overview (for complete specifications, see page 2)

Construction: Extruded aluminum housing is available in standard lengths up to 16'. Continuous runs have hairline joints with no light leak. Runs of fixtures can be built to lengths matching field conditions.

Electrical: Gammalux products are **UL** and **cUL** listed with quick electrical connectors and ballasts by OSRAM SYLVANIA or equal. Runs of fixtures are tested as a complete system prior to shipping.

Parabolic Blade Baffle: Shall be 3/4" high, semi specular aluminum parabolic blade baffle (specify **PBB**).

Optical: Reflectors and parabolic louver are high reflectance aluminum. Optional dust cover available for upper lamp chamber.

Finish/Color: High quality paint finish in high gloss or semi-gloss. Custom colors available.

Packing and Shipping: Our packing, labeling and shipping systems ensure products arrive safely, ready to install.

Standard Nomenclature

Manufacturer
Gammalux

Cross Section (nom)
3.00" x **5**.00"

Distribution
B
Bi-directional

No. of Lamps
1/1

Lamp Type
T8

Ballast
ERS Electronic Rapid Start<10% THD
DIM Dimming (consult factory)

Voltage
120, 277, UNIV

Mounting Method
C Cable
S Swivel Stem
SEQ CA Earthquake Stems/fittings
WM Wall Mount, Flush
WSP Wall Spacer, 1/2"

Upper Shielding
OP Open
DC Dust Cover, Clear

Options
GLR Fuse w/holder
BPE Battery Pack EM. Kit
DL UL Damp Label
EMERG Emergency ckt.
2CKT Dual Circuiting

Paint Finish
H High Gloss
SG Semi-Gloss

GB35B – 1/1 32T8 – 120V – ERS – 4' – C24" – OP/PBB – WH – XX

Cross Section Shape
Beam

Nominal Lamp Watts
32 (4'-T8)
LED available (consult factory)

Fixture Length
4' to 16' units available. Consult factory for other lengths. For multiple units coupled end to end, specify total length followed by **ROW.**

(if suspended) **Suspension Length**
Blank for Wall Spacer, and Wall Mount.
24" (Ceiling to top of fixture)

Shielding
PBB Parabolic Blade Baffle

Paint Colors
W White (Consult Color Chart for other standard colors)
CCM Custom Color Match.

GAMMALUX Lighting Systems

248 East Arrow Highway, San Dimas, CA 91773 Tel 909.599.9669 800.356.3275
Fax 909.599.5288 E-mail: info@gammalux.com

Gammalux products comply with ARRA Buy American requirements.

Specifications

Construction

Housing: Extruded aluminum body 3.00” wide x 5.00” high, 6063T5, 0.070” minimum thickness. Available in one piece, unbroken lengths up to 16’.

Joiner System: Automatic alignment, no loose parts, one tool to tighten two factory installed bolts for hairline seam. No light leaks. Fixtures that are built for continuous runs and patterns are assembled into a complete pattern and tested for fit and finish at the factory prior to being individually packed and shipped.

Mounting: Aircraft cable is 7 x 7 stranded stainless steel with machined stainless steel stopper fitting at the top end (specify **C**). Lower end strands are welded and grounded for easy insertion into continuously adjustable cable gripper. Feed cord straight, white 3/C SVT or SJT #18 AWG. Stems are 3/8” schedule 40 pipe with top swivels (specify **S**). California UBC compliant stems with internal safety cables available (specify **SEQ**). Wall Spacer mounting (specify **WSP**) allows projection from wall of 3.50” to meet ADA compliant requirements. Housing can be mounted direct to wall (specify **WM**).

Electrical

Ballast: OSRAM SYLVANIA or equal Electronic Rapid Start ballast with less than 10% Total Harmonic Distortion is standard (specify **ERS**). Additional ballast options are available. UL listed wiring and components throughout. Housing wired with quick-connect plugs at all mating joints and individually tested. Max ballast cross section size 1.7” x 1.2”.
Fixtures that are built for individual use or continuous runs and patterns are assembled into a complete pattern and tested with lamps at the factory prior to being individually packed and shipped. All fixtures bear UL & cUL Dry Location labels. Damp Location labels are available (specify **DL** in the options field).

Optical Performance

Reflectors: Shall be diffused formed high reflectance aluminum.
Parabolic Blade Baffle: Shall be 3/4” high, semi specular aluminum parabolic blade baffle (specify **PBB**).
Dust Cover: Clear acrylic dust cover, snap-in fitting (specify **DC**).
Performance: Independent photometric laboratory testing - ITL or equal - is required. Luminaire is a minimum of **78.6%** efficient.

Finish

Housing assembly is electrostatically sprayed with high solids aliphatic two component polyurethane to an average thickness of 2 mils. over acid etching primer. High gloss or semi-gloss are standard. Specify **H** for high gloss in Paint Finish field. Specify **SG** for semi-gloss. Consult with factory for other finishes.

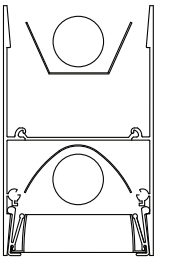
Packing and Shipping

Fixtures built for continous rows and patterns are given a specific location identifier, clearly identified on factory layout drawings provided to installing contractor. Location identifier is printed on the fixture’s ID Label, protective wrapping and on each end of fixture carton. Shipping pallets are built with 2” clearence, extending beyond the length and width of cartons, providing shipping protection.

Photometric Report

IESNA: LM-63-2002
ISSUE DATE: 10/5/12
TEST: 1
TESTLAB: PHOTOTOPIA 3.2.6 SEE: WWW.LTIOPTICS.COM/IES
MANUFAC: GAMMALUX LIGHTING SYSTEMS
LUMCAT: GB35B-1/132-T8-OP/PBB-4'
LUMINAIRE: EXTRUDED ALUMINUM HOUSING WITH WHITE PAINTED GENERAL INTERIOR FINISH AND FABRICATED METAL END PIECES, FORMED PEENED METAL UPPER REFLECTOR WITH PREMIUM SPECULAR FINISH, FORMED SEMI-SPECULAR METAL LOWER REFLECTOR, METAL PARABOLIC 46-CELL LOUVER, OPEN TOP.
LAMP: 1/1 FLUOR. 32W 4' SILHOUETTE T8

IES DOWNLOAD



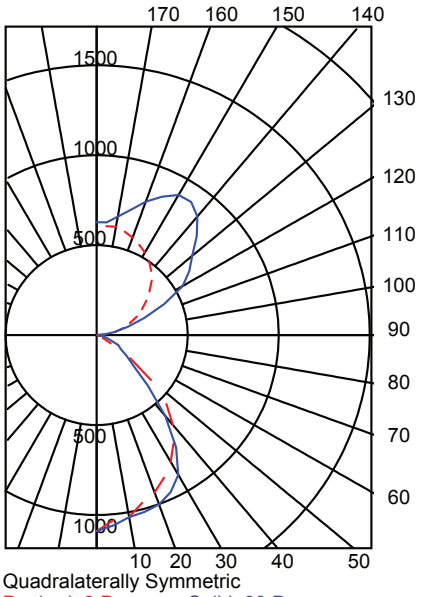
Summary Data

EFFICIENCY (Total):	**78.6%**
EFFICIENCY (Downlight):	**31.9%**
EFFICIENCY (Uplight):	**46.8%**
CIE CLASSIFICATION:	GENERAL DIFFUSE
SPACING CRITERION (0-Deg.):	1.12
SPACING CRITERION (90-Deg.):	1.21
LUMENS/LAMP:	2900
NO. OF LAMPS:	2
LUMINOUS OPENING:	RECTANGULAR
Width:	0.25 (Feet)
Length:	4.00
Height:	0.45
INPUT WATTS:	64

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Luminaire
0-30	785.9	13.5	17.2
0-40	1238.8	21.4	27.2
0-60	1742.2	30.0	38.2
60-90	106.1	1.8	2.3
0-90	1848.2	31.9	40.5
90-180	2712.3	46.8	59.5
0-180	4560.5	78.6	100.0

Candela Plot



Quadralaterally Symmetric
Dashed: 0 Degrees Solid: 90 Degrees

Average Luminance

(Candelas / Square Meter)

Angle	0	22.5	45	67.5	90
0	11704	11704	11704	11704	11704
45	7405	4229	2851	2151	2165
55	3634	1509	873	859	1050
65	750	242	311	489	686
75	193	124	201	256	301
85	124	106	52	37	45

Coefficient of Utilization Table

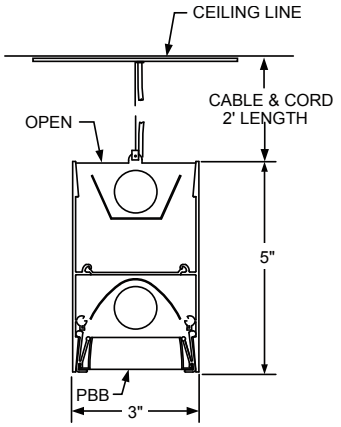
Effective Floor Cavity Reflectance = 20%

Pcc...	80				70				50			30			10			0
Pw...	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	.82	.82	.82	.82	.75	.75	.75	.75	.61	.61	.61	.49	.49	.49	.37	.37	.37	.32
1	.76	.73	.70	.68	.69	.67	.64	.62	.55	.53	.52	.44	.43	.42	.34	.34	.33	.29
2	.70	.65	.60	.57	.64	.59	.56	.53	.49	.47	.44	.40	.38	.37	.31	.30	.29	.25
3	.64	.58	.52	.48	.59	.53	.49	.45	.44	.41	.38	.36	.34	.32	.28	.27	.26	.22
4	.59	.52	.46	.42	.54	.47	.43	.39	.40	.36	.33	.33	.30	.28	.26	.24	.23	.20
5	.55	.46	.41	.36	.50	.43	.38	.34	.36	.32	.29	.30	.27	.25	.24	.22	.21	.18
6	.51	.42	.36	.32	.46	.39	.34	.30	.33	.29	.26	.27	.24	.22	.22	.20	.19	.16
7	.47	.38	.32	.28	.43	.35	.30	.26	.30	.26	.23	.25	.22	.20	.20	.18	.17	.15
8	.44	.35	.29	.25	.40	.32	.27	.24	.27	.23	.21	.23	.20	.18	.19	.17	.15	.13
9	.41	.32	.26	.22	.37	.29	.25	.21	.25	.21	.19	.21	.18	.16	.17	.15	.14	.12
10	.38	.29	.24	.20	.35	.27	.22	.19	.23	.20	.17	.20	.17	.15	.16	.14	.13	.11

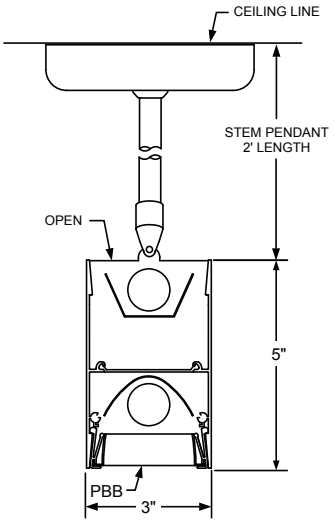
Mounting Details

Factory Drawings: Fully dimensioned factory drawings will be provided upon receipt of purchase order.

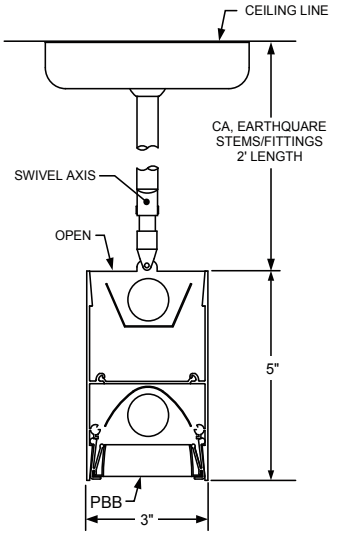
Cable Mount:
Specify **C** code in catalog #



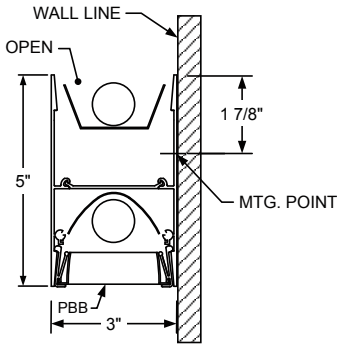
Swivel Stem Mount:
Specify **S** code in catalog #



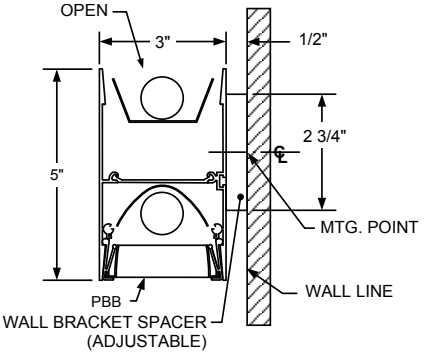
CA Earthquake Stem Mount:
Specify **SEQ** code in catalog #



Wall Mount:
Specify **WM** code in catalog #



Wall Spacer Mount:
Specify **WSP** code in catalog #



Gammalux Lighting Systems reserves the right to change details of fixture design and construction at any time.

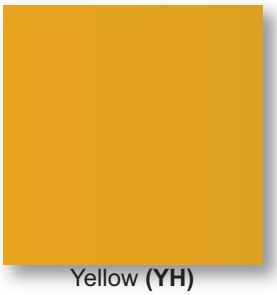
Standard Colors/Finishes

Due to variances in computer monitors and color printers, this page should be used for general reference only. For a sheet of physical color samples, please consult factory.

High Gloss Finish

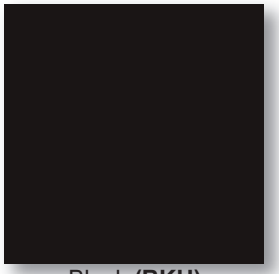

White **(WH)**


Red **(RH)**

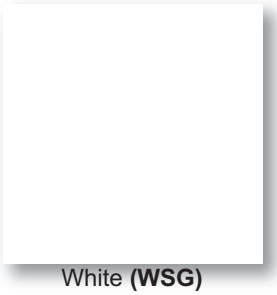

Yellow **(YH)**


Green **(GH)**


Blue **(BH)**

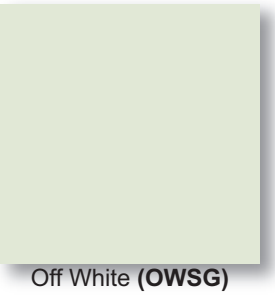

Black **(BKH)**

Semi Gloss Finish

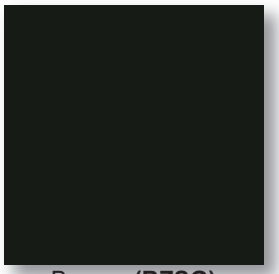

White **(WSG)**

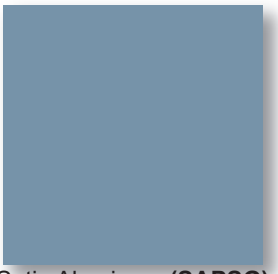

Silver **(SSG)**


Gray **(GYSG)**


Off White **(OWSG)**


Light Gray **(LGYSG)**


Bronze **(BZSG)**


Satin Aluminum **(SAPSG)**

Due to variances in computer monitors and color printers, this page should be used for general reference only. For a sheet of physical color samples, please consult factory.

SPECIFICATIONS

DESCRIPTION:
Wall mount Up/Down LED accent fixture.
Suitable for wet/damp/dry location installations.

MATERIAL:
Standard overall material is 6061 aluminum.
HL-340-2X-xLED - Machined Aluminum (Standard)
HL-340-2X-xLED-2b - Machined Brass

FINISH:
AA - Anodized Satin Aluminum
AP - Powder Coat Aluminum
BK - Powder Coat Black
BZ - Powder Coat Bronze
WT - Powder Coat White
N - Natural, for Stainless Steel and Brass

LAMPING:
Lamp Type - High output LED, warm white (3000K CCT) standard, others available.
3LED - 3x1W LED, ave light output 260 lm
8LED - 3x2.7W LED, ave light output 457 lm
Optics
SP - Spot, 12º
NF - Narrow Flood, 24º
FL - Flood, 36º

VOLTAGE:
12 - 12 VAC output transformer required, not included.

MOUNTING:
Fixture is equipped with a 4.75" mounting plate and (2) mounting screws.

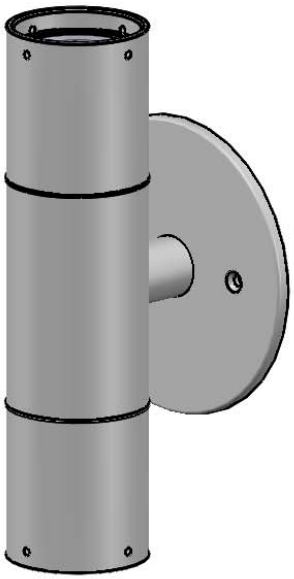
OPTIONS:
Glare shields
GL-10 - Short Angled, aluminum
GL-11 - Angled, aluminum
GL-12 - Angled, brass
GL-12 - Straight, aluminum
GL-13 - Straight, brass
Lenses/Louvers/Color Filters
LA-1 - Hexcell Louver (Black)
LA-2 - Prismatic lens
LA-3 - Linear spread lens
LA-4 - Soft focus lens (diffused)
LA-5 - Moonlight lens
LA-6 - Blue lens
See fixture accessories for more information.

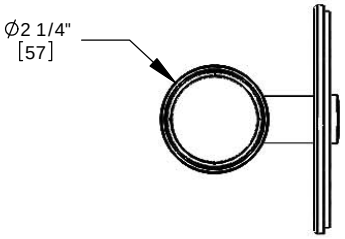
SAMPLE ORDER SPECIFICATION:
HL-340-2X-3LED-BZ-SP-12-LA-5

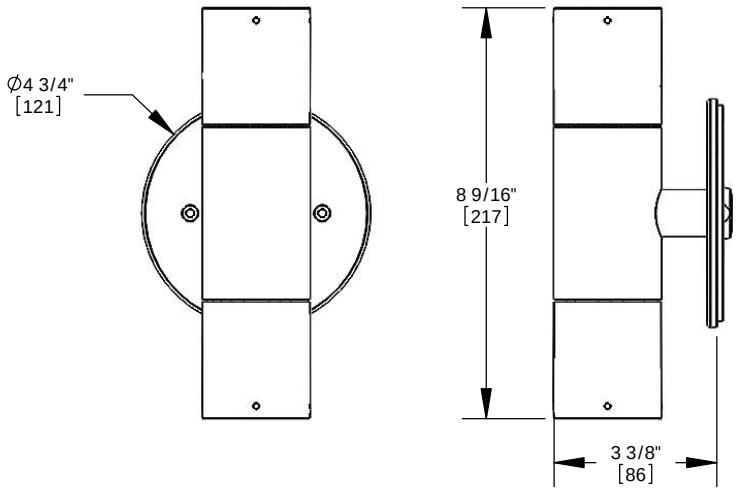
RATING:
Wet/damp/dry location.

Intertek

MADE IN THE USA







ORDER SPECIFICATION: _____ - _____ - _____ - _____ - _____
Fixture | Finish | Optics | Voltage | Options/Access.

PROJECT:

APPROVED:

NOTE:

TYPE:

HEVI LITE, INC.
9714 Variel Ave, Chatsworth, CA 91311
Tel., (818) 341-8091 - Fax (818) 998-1986
Web Site http://www.hevilite.com

CATALOG NUMBER:
HL-340-2X-xLED

NSIC-401QAT
4" IC Air-Tight Line Voltage Double Wall New Construction Housing

Source: 50W Max. (Varies with trim)

NORALIGHTING®

Type

Project

Catalog No.

Lamp/Wattage

PRODUCT DESCRIPTION

New construction housing for use in insulated ceilings can be in direct contact with thermal insulation. Rated for use with a line voltage lamp.

CONSTRUCTION

Plaster Frame

0.040 steel frame with integral bar hanger brackets. Brackets can accommodate longer 27" accessory flat bar hangers. Brackets run along all sides of frame to allow bar hangers to be run parallel or perpendicular to junction box.

Housing

0.035 white baked enamel one-piece drawn steel. Adjustable for ceiling thickness from 5/8" to 1-3/8".

Air Flow Restriction

Air tight (AT) housings have factory installed gaskets to restrict airflow from room into ceiling plenum to <2CFM (cubic feet per minute) in accordance with ASTM-283 Air-Tight requirements.

Socket

Galvanized steel socket plate adjusts inside housing for optimum light performance. Contains a single medium base socket. Protective cap included to protect socket interior during ceiling painting. Socket plate can be removed in the field to convert to a floating socket.

Bar Hangers

Two 13-3/4" to 24-1/2" adjustable bar hangers with captive nails are included on frame. Bar hangers are parallel to junction box, but can be repositioned 90º perpendicular to junction box if desired. "L" Shaped bar hanger foot to align to bottom of construction joist. A T-Bar notch allow for easy installation in a suspended ceiling.

Junction Box

Prewired 25 cubic inch 0.060" thick galvanized steel, with seven 1/2" knockouts, four Romex® pryouts, and snap on covers. All leads are #18AWG wire, the ground wire is connected to the bottom, and quick connectors are supplied on all leads. Through branch circuit wiring, (4-in, 4-out).

Lamp

50W max. - lamp and wattage varies with trim (ordered separately)

ELECTRICAL

Wiring

Standard flex whip carries wire lead from junction box into housing. Wire leads extend from housing and thermal device to medium base socket.

Thermal Protector

Standard UL thermal protector rated for 90ºC (194ºF) is affixed to side wall surface of housing.

Optional Accessories

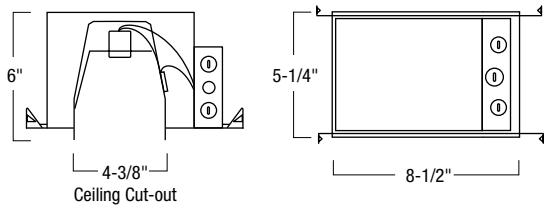
NRA-126: One Hour Fire Rated Enclosure
NRA-28: 27" Flat Bar Hangers

Labels and Listings

cULus Listed for Damp Location w/ Feed Through
cULus Wet Listed (Only with designated trims)
Meets or exceeds ASTM-283 Air-Tight Requirements
Washington State Approved

c UL us LISTED AIR TIGHT

DIMENSIONS



Cut-out: 4-3/8"
ID: 4"

Housing Length: 8-1/2"
Housing Width: 5-1/4"
Housing Height: 6"

Housing

☐ **NSIC-401QAT:** 4" IC Air-Tight Line Voltage Double Wall New Construction Housing

6505 Gayhart St., Commerce, CA 90040
www.noralighting.com • Specifications subject to change without notice.
Phone: 800.686.6672 • FAX: 800.500.9955 • e-mail: nora@noralighting.com

NORALIGHTING®

Type

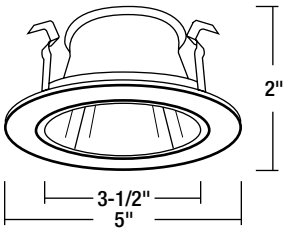
Project

Catalog No.

Lamp/Wattage

NS-42 / NS-43 / NS-44
NS-46 / NS-52 / NS-53
Reflector with Ring

TRIM DIMENSIONS



Trim OD: 5"
Aperture: 3-1/2"
Height: 2"

FEATURES

Trim
Precision spun 0.050 aluminum high grade reflector. Separate trim ring available in metal, may also be used with custom combination of plastic or metal ring finishes.

Mounting
Trim includes three trim clips that securely mount trim in housing.

Compatible Housings
Compatible with Line Voltage, Compact Fluorescent, and GU24 Compact Fluorescent housings. See individual specification sheets for more information.

Lamp
Line Voltage
50W R20/PAR20 Max. (NS-401QAT; NSIC-401QAT; NSR-404QAT)
Compact Fluorescent
13W Quad/Triple (NS-406Q; NS-406EL; NSR-408Q; NSR-408EL)
GU24 Compact Fluorescent
13W-26W GU24 (NHIC-4G24AT, NHRIC-4G24AT)

Labels and Listings
cULus Listed for Damp Location when used with compatible housing.

Reflector with Ring

- ☐ **NS-42:** Specular Gold Reflector with White Metal Ring
- ☐ **NS-42G:** Specular Gold Reflector with Gold Metal Ring
- ☐ **NS-43:** Specular Black Reflector with White Metal Ring
- ☐ **NS-43B:** Specular Black Reflector with Black Metal Ring
- ☐ **NS-44:** Specular Clear Reflector with White Metal Ring
- ☐ **NS-44C:** Specular Clear Reflector with Chrome Metal Ring
- ☐ **NS-44HZ:** Haze Reflector with White Metal Ring
- ☐ **NS-44N:** Specular Clear Reflector with Natural Metal Ring
- ☐ **NS-46:** Specular White Reflector with White Metal Ring
- ☐ **NS-52:** Natural Metal Reflector with Natural Metal Ring
- ☐ **NS-53:** Copper Reflector with Copper Metal Ring
- ☐ **NS-53BZ:** Bronze Reflector with Bronze Metal Ring

Compatible Housings

Item Number	Installation Type	Lamp	Dimensions
LINE VOLTAGE			
☐ **NS-401QAT**	Non-IC Air-Tight New Const.	50W R/PAR20	W: 5-5/8" L: 8-1/2" H: 5-5/8"
☐ **NSIC-401QAT**	IC Air-Tight New Construction	50W R/PAR20	W: 5-1/4" L: 8-1/2" H: 6-3/8"
☐ **NSR-404QAT**	Non-IC Air-Tight Remodel	50W R/PAR20	W: 4-1/4" L: 11-1/4" H: 5-5/8"
COMPACT FLUORESCENT			
☐ **NS-406Q**	Non-IC New Constr., Magnetic	13W Quad	W: 6-1/4" L: 10" H: 5-1/2"
☐ **NS-406EL**	Non-IC New Constr., Electronic	13W Quad/Triple	W: 6-1/4" L: 9" H: 5-1/2"
☐ **NSR-408Q**	Non-IC Remodel, Magnetic	13W Quad	W: 4-3/4" L: 11-7/8" H: 5-1/2"
☐ **NSR-408EL**	Non-IC Remodel, Electronic	13W Quad/Triple	W: 4-3/4" L: 11-7/8" H: 5-1/2"
GU24 COMPACT FLUORESCENT			
☐ **NHIC-4G24AT**	IC Air-Tight New Construction	13W-26W GU24	W: 6-1/4" L: 13-1/4" H: 6-3/8"
☐ **NHRIC-4G24AT**	IC Air-Tight Remodel Housing	13W-26W GU24	W: 4-1/4" L: 13" H: 6-3/8"

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LONGSTAR

ECONOMY SERIES

Dimmable LED PAR20

Ordering Information

Model No.	Item name	Chips	Lumens[2] (lm)	CBCP (cd)	Watts (w)	CCT[1] (k)	Efficacy (lm/w)	CRI	Lifetime[3] (h)	Beam Angle	Base type	Voltage (v)	Weight (lb)	Cerification	Equivalent[4] (w)
PAR20D-9W-30SS25-B01	PAR20	Samsung	700	2000	9	3000	78	80	35000	25°	E26	120	0.29	UL,FCC	70
PAR20D-9W-50SS25-B01	PAR20	Samsung	800	2150	9	5000	89	80	35000	25°	E26	120	0.29	UL,FCC	70

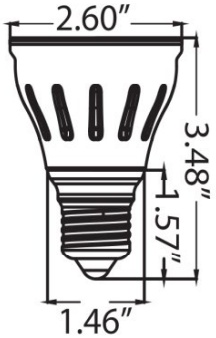
2 TWO YEARS WARRANTY DIMMABLE FC c UL us LISTED

1. CCT Range complies to ANSI C78.377-2008.
2. Thermally stable typical lumens (± 10%)
3. Rated life is based on 70% lumen maintenance, and engineering testing and probability analysis.
4. Equivalency based on the Energy Star® Integral LED Lamp Center Beam Intensity Benchmark Tool.

Note: All Information consistent with IESNA LM-80-08 results and IESNA LM-79-08 testing completed by a qualified third party facility.

Dimensions

Model	MOL	Diameter
PAR20	4.62"	3.74"



Note: Lamp shape conforms to ANSI C78.21-2003.

Note: Designed to comply with RoHS Directive 2002/95/EC.

Energy Savings

Model No.	Equivalent	Energy Savings
PAR20D-9W-30SS25-B01 PAR20D-9W-50SS25-B01	70W Halogen	**$235**

*Actual Equivalent Replacement, based on the Energy Star® Integral LED Lamp Center Beam Intensity Benchmark Tool.

Note: Energy Savings based on using one bulb for 35,000 hr rated life at 11¢/kWh. Does not include maintenance and replacement lamp savings.

Ordering Guide

PAR20D-9W-30SS25-B01

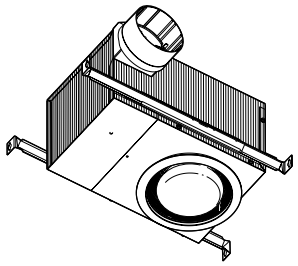
PAR20D	--	9W	--	30SS25	--	B01
Lamp Type		Wattage		CCT + Chip + Beam Angle		Structure + Voltage
PAR20D = Dimmable PAR20		9W = 9 Watts		30SS25 = 3000K + Samsung + Narrow Flood 25°		B01= Extrude+ 120V

Xiamen Longstar Lighting • 5 Houbin Road, XiangAn • Xiamen, China • 361101 • tel 0086-592-7073311 • info@longstarlighting.com

BROAN®

SPECIFICATION SHEET

MODEL 744 RECESSED FAN / LIGHT



Add lighting and ventilation to your room - with the look of an ordinary recessed light.

FEATURES

TRIM RING BAFFLE:
- Polymeric construction with matte white finish
- Recessed styling, mounts flush with finished ceiling
- Accepts any one of these bulbs (bulb not included): 75W, R30, BR30, PAR30L, or PAR30LN

BLOWER:
- Plug-in, permanently lubricated, motor
- Dynamically balanced centrifugal blower wheel for quiet, efficient performance
- Low RPM for quiet operation

HOUSING:
- Rugged, 26 gage, galvanized steel construction
- 4" round, polymeric duct connector with 2" tapered sleeve and no metallic clatter
- Adjustable mounting brackets span up to 24"

CONTROLS: Designed for use with this product (purchase separately)
- Model 59V (Ivory) / 59W (White) - 60-minute time control
- Model 61V (Ivory) / 61W (White) - 15-minute time control
- Model 69VL (Ivory) / 69WL (White) - One rocker switch with "on" indicator light
- Model 269VL (Ivory) / 269WL (White) - One rocker switch with "on" indicator light and one non-lit rocker switch
- Model 68V (Ivory) / 68W (White) - Two rocker switches - fits in single-gang box

U.L. Listed for use over bathtubs and showers when connected to a GFCI protected branch circuit and used with a PAR30L or PAR30LN bulb.

U.L. Listed for use in insulated ceilings (TYPE I.C.)

TYPICAL SPECIFICATION

Fan / Light shall be Broan Model 744.

Fan / Light shall have corrosion resistant steel housing and adjustable mounting brackets.

Motor assembly to be removable and permanently lubricated.

Non-metallic damper/duct connector to be included.

Fan and Light to operate separately (or in combination).

Fan / Light must use an R30 / BR30 Max. 75W bulb (PAR30L or PAR30LN Max. 75W bulb for use over bath tub and shower) - recessed into ceiling.

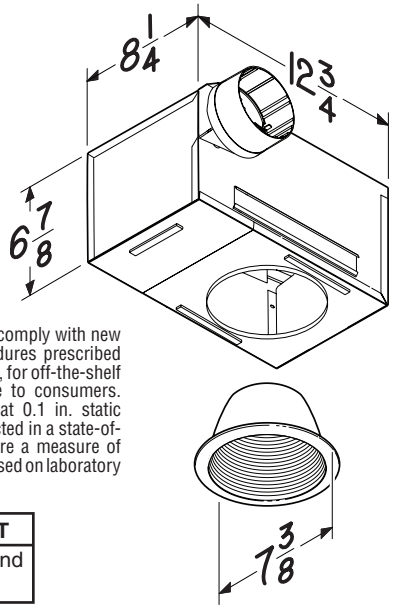
Air delivery shall be no less than 70 CFM and sound level no greater than 1.5 Sones. All air and sound ratings shall be certified by HVI.

Fan / Light must be U.L. and cU.L.listed for use in insulated ceilings (Type I.C.) and for use over bathtubs and showers when connected to a GFCI protected branch circuit and used with a PAR30L or PAR30LN bulb.

c UL us

® 2100 HVI CERTIFIED

HVI-2100 CERTIFIED RATINGS comply with new testing technologies and procedures prescribed by the Home Ventilating Institute, for off-the-shelf products, as they are available to consumers. Product performance is rated at 0.1 in. static pressure, based on tests conducted in a state-of-the-art test laboratory. Sones are a measure of humanly-perceived loudness, based on laboratory measurements.



SPECIFICATIONS

MODEL	VOLTS	AMPS*	WATTS	STATIC PRESSURE	CFM	SONES	FAN WATTS	DUCT
744	120	1.2	125**	0.10	70	1.5	28.2	4" Round
				0.25	56			

* Total Connected Load

** BR30-size bulb.

Broan-NuTone LLC Hartford, Wisconsin www.broan.com 800-558-1711

REFERENCE	QTY.	REMARKS	Project
			Location
			Architect
			Engineer
			Contractor
			Submitted by Date

MITSUBISHI ELECTRIC

Mr.SLIM

SPLIT-TYPE AIR CONDITIONERS

INDOOR UNIT

MSZ-FE09NA
MSZ-FE12NA

OPERATING INSTRUCTIONS For user
- To use this unit correctly and safely, be sure to read these operating instructions before use.

English

MANUAL DE INSTRUCCIONES Para los clientes
- Para utilizar esta unidad de forma correcta y segura, lea previamente estas instrucciones de funcionamiento.

Español

NOTICE D'UTILISATION A l'attention des clients
- Pour avoir la certitude d'utiliser cet appareil correctement et en toute sécurité, veuillez lire cette notice d'instructions avant de mettre le climatiseur sous tension.

Français

CONTENTS

SAFETY PRECAUTIONS

- Since rotating parts and parts which could cause an electric shock are used in this product, be sure to read these “Safety Precautions” before use.
- Since the cautionary items shown here are important for safety, be sure to observe them.
- After reading this manual, keep it together with the installation manual in a handy place for easy reference.
- Be sure to receive a guarantee card from your dealer and check that the purchased date and shop name, etc. are entered correctly.

Marks and their meanings

⚠ WARNING : Incorrect handling could cause serious hazard, such as death, serious injury, etc. with a high probability.

⚠ CAUTION : Incorrect handling could cause serious hazard depending on the conditions.

Meanings of symbols used in this manual

: Be sure not to do.

: Be sure to follow the instruction.

: Never insert your finger or stick, etc.

: Never step onto the indoor/outdoor unit and do not put anything on them.

: Danger of electric shock. Be careful.

: Be sure to disconnect the power supply plug from the power outlet.

: Be sure to shut off the power.

⚠ WARNING

Do not connect the power cord to an intermediate point, use an extension cord, or connect multiple devices to a single AC outlet.
- This may cause overheating, fire, or electric shock.

Make sure the power plug is free of dirt and insert it securely into the outlet.
- A dirty plug may cause fire or electric shock.

Do not bundle, pull, damage, or modify the power cord, and do not apply heat or place heavy objects on it.
- This may cause fire or electric shock.

Do not turn the breaker OFF/ON or disconnect/connect the power plug during operation.
- This may create sparks, which can cause fire.
- After the indoor unit is switched OFF with the remote controller, make sure to turn the breaker OFF or disconnect the power plug.

Do not expose your body directly to cool air for a prolonged length of time.
- This could be detrimental to your health.

The unit should not be installed, relocated, or repaired by the user.
- An improperly handled air conditioner may cause fire or electric shock.

Do not insert your finger, a stick, or other objects into the air inlet or outlet.
- This may cause injury, since the fan inside rotates at high speeds during operation.

In case of an abnormal condition (such as a burning smell), stop the air conditioner and disconnect the power plug or turn the breaker OFF.
- A continued operation in the abnormal state may cause a malfunction, fire, or electric shock. In this case, consult your dealer.

When the air conditioner does not cool or heat, there is a possibility of refrigerant leakage. In this case, consult your dealer. If a repair involves recharging the unit with refrigerant, ask the service technician for details.
- The refrigerant used in the air conditioner is safe. Normally, it does not leak. However, if refrigerant leaks and comes in contact with a heat source such as a fan heater, kerosene heater, or cooking stove, it will create a harmful gas.

⚠ CAUTION

Do not touch the air inlet or the aluminum fins of the indoor/outdoor unit.
- This may cause injury.

Do not use insecticides or flammable sprays on the unit.
- This may cause a fire or deformation of the unit.

Do not expose pets or houseplants to direct airflow.
- This may cause injury to the pets or plants.

Do not place other electric appliances or furniture under the indoor/outdoor unit.
- Water may drip down from the unit, which may cause damage or malfunction.

Do not leave the unit on a damaged installation stand.
- The unit may fall and cause injury.

SAFETY PRECAUTIONS

⚠ CAUTION

Do not step on an unstable bench to operate or clean the unit.
- This may cause injury if you fall down.

Do not pull the power cord.
- This may cause a portion of the core wire to break, which may cause overheating or fire.

Do not charge or disassemble the batteries, and do not throw them into a fire.
- This may cause the batteries to leak, or cause a fire or explosion.

Do not operate the unit for more than 4 hours at high humidity (80% RH or more) and/or with windows or outside door left open.
- This may cause the water condensation in the air conditioner, which may drip down, wetting or damaging the furniture.
- The water condensation in the air conditioner may contribute to growth of fungi, such as mold.

Do not use the unit for special purposes, such as storing food, raising animals, growing plants, or preserving precision devices or art objects.
- This may cause deterioration of quality, or harm to animals and plants.

Do not expose combustion appliances to direct airflow.
- This may cause incomplete combustion.

Before cleaning the unit, switch it OFF and disconnect the power plug or turn the breaker OFF.
- This may cause injury, since the fan inside rotates at high speeds during operation.

When the unit will be unused for a long time, disconnect the power plug or turn the breaker OFF.
- The unit may accumulate dirt, which may cause overheating or fire.

Replace all batteries of the remote controller with new ones of the same type.
- Using an old battery together with a new one may cause overheating, leakage, or explosion.

If the battery fluid comes in contact with your skin or clothes, wash them thoroughly with clean water.
- If the battery fluid comes in contact with your eyes, wash them thoroughly with clean water and immediately seek medical attention.

Ensure that the area is well-ventilated when the unit is operated together with a combustion appliance.
- Inadequate ventilation may cause oxygen starvation.

Turn the breaker OFF when you hear thunder and there is a possibility of a lightning strike.
- The unit may be damaged if lightning strikes.

After the air conditioner is used for several seasons, perform inspection and maintenance in addition to normal cleaning.
- Dirt or dust in the unit may create an unpleasant odor, contribute to growth of fungi, such as mold, or clog the drain passage, and cause water to leak from the indoor unit. Consult your dealer for inspection and maintenance, which require specialized knowledge and skills.

Do not operate switches with wet hands.
- This may cause electric shock.

Do not clean the air conditioner with water or place an object that contains water, such as a flower vase, on it.
- This may cause fire or electric shock.

Do not step on or place any object on the outdoor unit.
- This may cause injury if you or the object falls down.

! IMPORTANT

Dirty filters cause condensation in the air conditioner which will contribute to the growth of fungi such as mold. It is therefore recommended to clean air filters every 2 weeks.

For installation

⚠ WARNING

Consult your dealer for installing the air conditioner.
- It should not be installed by the user since installation requires specialized knowledge and skills. An improperly installed air conditioner may cause water leakage, fire, or electric shock.

Provide a dedicated power supply for the air conditioner.
- A non-dedicated power supply may cause overheating or fire.

Do not install the unit where flammable gas could leak.
- If gas leaks and accumulates around the unit, it may cause an explosion.

Ground the unit correctly.
- Do not connect the ground wire to a gas pipe, water pipe, lightning rod, or a telephone ground wire. Improper grounding may cause electric shock.

⚠ CAUTION

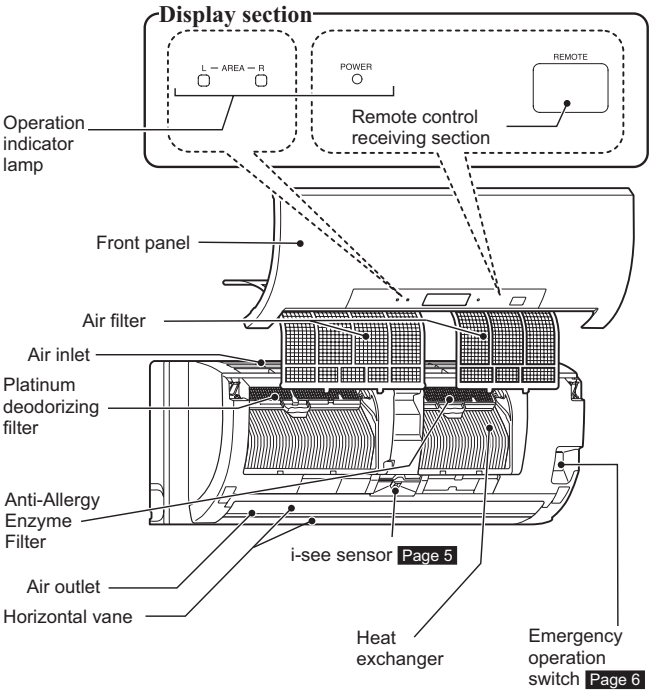
Install a Ground Fault Interrupt (GFI) circuit breaker depending on the installation location of the air conditioner (such as highly humid areas).
- If the Ground Fault Interrupt (GFI) breaker is not installed, it may cause electric shock.

Ensure that the drain water is properly drained.
- If the drain passage is improper, water may drip down from the indoor/outdoor unit, wetting and damaging the furniture.

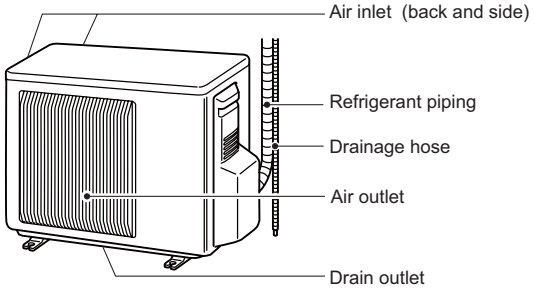
In case of an abnormal condition
Immediately stop operating the air conditioner and consult your dealer.

NAME OF EACH PART

Indoor unit

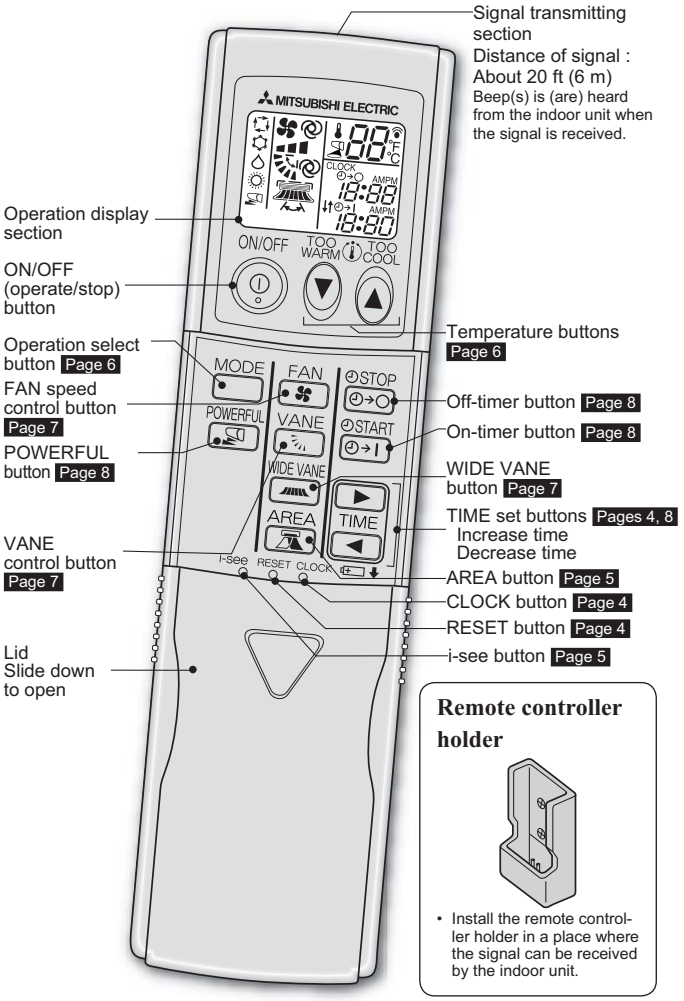


Outdoor unit



Outdoor units may be different in appearance.

Remote controller



Remote controller holder

- Install the remote controller holder in a place where the signal can be received by the indoor unit.

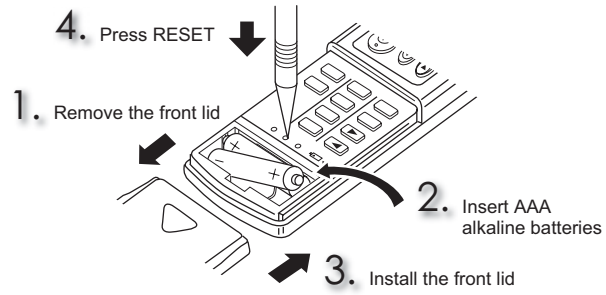
Only use the remote controller provided with the unit.
Do not use other remote controllers.

PREPARATION BEFORE OPERATION

Before operation: Insert the power supply plug into the power outlet and/or turn the breaker on.

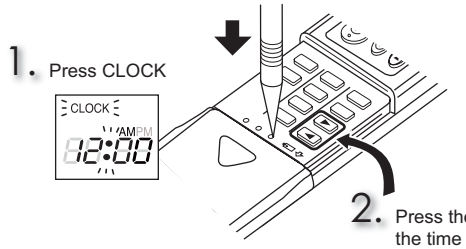
Installing the remote controller batteries

Be sure to set the installation position before installing the batteries. Page 5



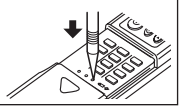
- Make sure the polarity of the batteries is correct.
- Do not use manganese batteries. The remote controller could malfunction.
- Do not use rechargeable batteries.
- Replace all batteries with new ones of the same type.
- Batteries can be used for approximately 1 year. However, batteries with expired shelf lives last shorter.
- Press RESET gently using a thin instrument.
  If the RESET button is not pressed, the remote controller may not operate correctly.

Setting current time



3. Press CLOCK again

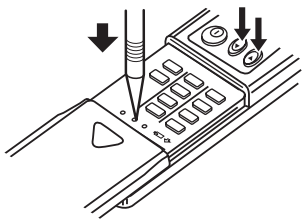
- Press CLOCK gently using a thin instrument.



Changing temperature units (ºF→ºC)

Unit is preset with ºF.

1. Press RESET while the temperature buttons are pressed.



- Press RESET gently using a thin instrument.
- To change temperature unit from ºC to °F, press RESET.

PREPARATION BEFORE OPERATION

Setting the installation position

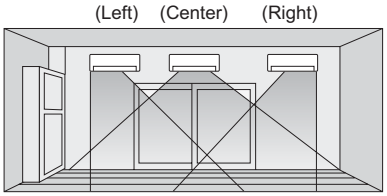
Be sure to set the slide switch inside the remote controller in accordance with the installed position of the indoor unit.

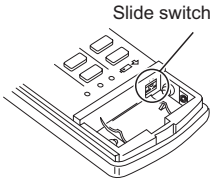
Installation position:

Left: Distance to objects (wall, cabinet, etc.) is less than 19-11/16 in. (50 cm) to the left

Center: Distance to objects (wall, cabinet, etc.) is more than 19-11/16 in. (50 cm) to the left and right

Right: Distance to objects (wall, cabinet, etc.) is less than 19-11/16 in. (50 cm) to the right

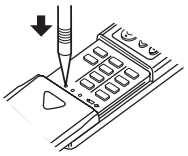




Area	Left	Center	Right
Slide switch	L . C . R	L . C . R	L . C . R
Remote controller display			

Press i-see ○ during COOL mode to activate i-see control operation.

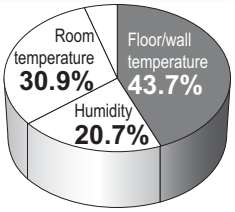
- Press gently using a thin instrument.
- lights. (Operation display section)



Press i-see ○ again to release i-see control operation.

i-see control operation

The sensors constantly measure the room and floor/wall temperature to automatically adjust to the set temperature by estimating the temperature actually perceived by a person inside the room (“sensible temperature”).



i-see sensor

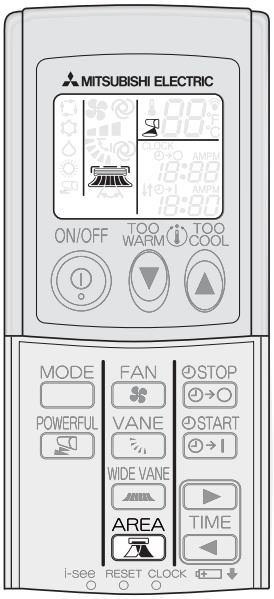
When the AREA setting is not activated, the sensing range of the i-see sensor differs depending on the installation location of the air conditioner.

Installation position	Left	Center	Right
Sensing range			

Note:

Do not touch the i-see sensor. This may cause malfunction of the i-see sensor.

AREA SETTING



Press AREA to select AREA. Each press changes AREA in the following order:

(AUTO) → (Left) → (Right) → Cancel *1

- The i-see control operation has to be active to select AREA.
- Horizontal airflow direction WIDE VANE cannot be selected when AREA is set.

*1 Horizontal airflow direction set by WIDE VANE. Page 7

Press AREA until “Cancel” is selected to release AREA setting.

- Pressing WIDE VANE also releases AREA setting.

Area

(AUTO) ....The i-see sensor detects temperature disparities, efficiently cooling and heating the whole room.

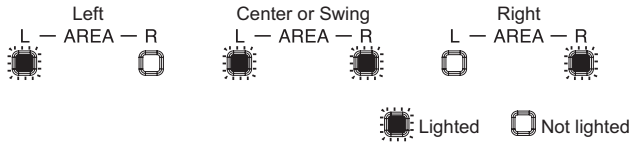
In COOL mode:

(LEFT) / (RIGHT)

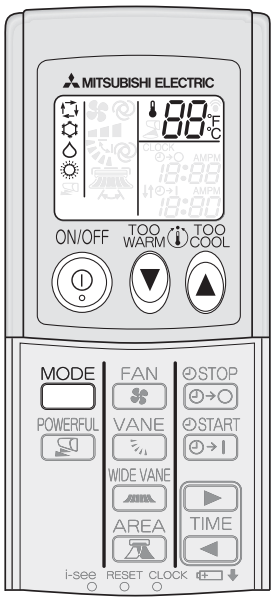
Select the desired area to be air conditioned.

Indoor unit display

Horizontal airflow direction:



SELECTING OPERATION MODES



1 Press ON/OFF to start the operation.

2 Press MODE to select operation mode. Each press changes mode in the following order:

(AUTO) → (COOL) → (DRY) → (HEAT)

3 Press TOO COOL or TOO WARM to set the temperature.
Each press raises or lowers the temperature by 1°F (1°C).

Press ON/OFF to stop the operation.
- The same setting is selected the next time by simply pressing ON/OFF.

AUTO mode (Auto change over)

The unit selects the operation mode according to the difference between the room temperature and the set temperature. During AUTO mode, the unit changes mode (COOL↔HEAT) when the room temperature is 4°F (2°C) away from the set temperature for more than 15 minutes.

Note:

- Auto Mode is not recommended if this indoor unit is connected to a MXZ type outdoor unit.
- Two or more indoor units can be operated by one outdoor unit. When several indoor units are operated simultaneously, the unit may not be able to switch operation mode between COOL and HEAT. In this case, the indoor unit becomes standby mode.

COOL mode

Enjoy cool air at your desired temperature.
Do not operate COOL mode at very low outside temperatures.
(less than 14°F [-10°C])
Water condensed in the unit may drip and wet or damage furniture, etc.

DRY mode

Dehumidify your room. The room may be cooled slightly.
Temperature cannot be set during DRY mode.

HEAT mode

Enjoy warm air at your desired temperature.

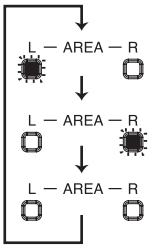
Emergency operation

When the remote controller cannot be used...

Emergency operation can be activated by pressing the emergency operation switch (E.O.SW) on the indoor unit.

Each time the E.O.SW is pressed, the operation changes in the following order:

Operation indicator lamp



Emergency COOL

Emergency HEAT

Stop

Set temperature : 75°F (24°C)
Fan speed : Medium
Horizontal vane : Auto

Note:

The first 30 minutes of operation is test run. Temperature control does not work, and fan speed is set to High.

Auto restart function

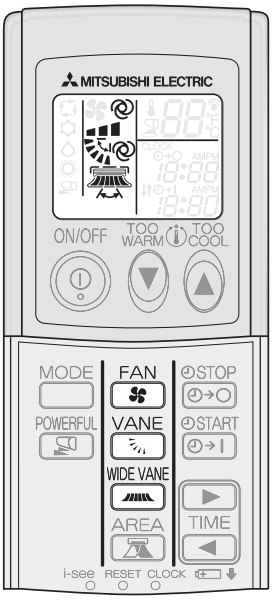
If a power failure occurs or the main power is turned off during operation, “Auto restart function” automatically starts operation in the same mode as the one set **with the remote controller** just before the shutoff of the main power. When timer is set, timer setting is cancelled and the unit starts operation when power is resumed.

If you do not want to use this function, please consult the service representative because the setting of the unit needs to be changed.

Multi system operation

Two or more indoor units can be operated by one outdoor unit. When several indoor units are operated simultaneously, cooling and heating operations cannot be done at the same time. When COOL is selected with one unit and HEAT with another or vice versa, the unit selected last goes into standby mode. The POWER lamp lights and the AREA lamps blink (display section).

FAN SPEED AND AIRFLOW DIRECTION ADJUSTMENT



FAN

Press [ ] to select fan speed. Each press changes fan speed in the following order:

(AUTO) → (Low) → (Med.) → (High)

• Two short beeps are heard from the indoor unit when set to AUTO.

VANE

Press [ ] to select vertical airflow direction. Each press changes airflow direction in the following order:

(AUTO) → (1) → (2) → (3) → (4) → (5) → (SWING)

• Two short beeps are heard from the indoor unit when set to AUTO.

WIDE VANE

Press [ ] to select horizontal airflow direction. Each press changes airflow direction in the following order:

→ → → → → (SWING)

Vertical airflow direction

(AUTO)

The vane is set to the most efficient airflow direction. COOL/DRY:horizontal position. HEAT:downward position.

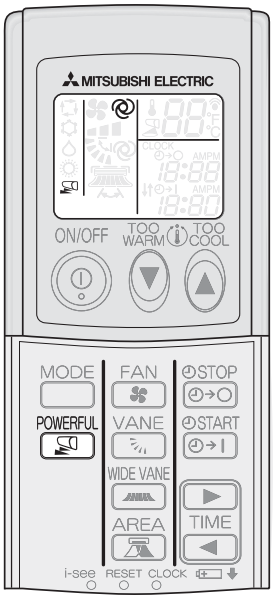
(Manual)

For efficient air conditioning, select upper position for COOL/DRY, and lower position for HEAT. During COOL/DRY, when the vane is set to position (4) or (5), the vane automatically moves to horizontal position after 1 hour to prevent any condensation from dripping.

(Swing)

The vane moves up and down intermittently.

POWERFUL OPERATION



Press POWERFUL during COOL or HEAT mode Page 6 to start POWERFUL operation.

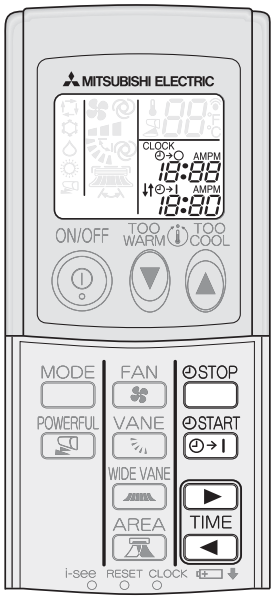
Fan speed : Exclusive speed for POWERFUL mode
Horizontal vane : Set position, or downward airflow position during AUTO setting

- Temperature cannot be set during POWERFUL operation.

Press POWERFUL again to cancel POWERFUL operation.

- POWERFUL operation also is cancelled automatically in 15 minutes, or when the ON/OFF or, FAN button is pressed.

TIMER OPERATION (ON/OFF TIMER)



1 Press START or STOP during operation to set the timer.

START (ON timer) : The unit will turn ON at the set time.

STOP (OFF timer) : The unit will turn OFF at the set time.

* **⏲→I or ⏲→○ blinks.**
* **Make sure that the current time is set correctly.** Page 4

2 Press ► (Increase) and ◄ (Decrease) to set the time of timer.
Each press increases or decreases the set time by 10 minutes.

Press START or STOP again to cancel timer.

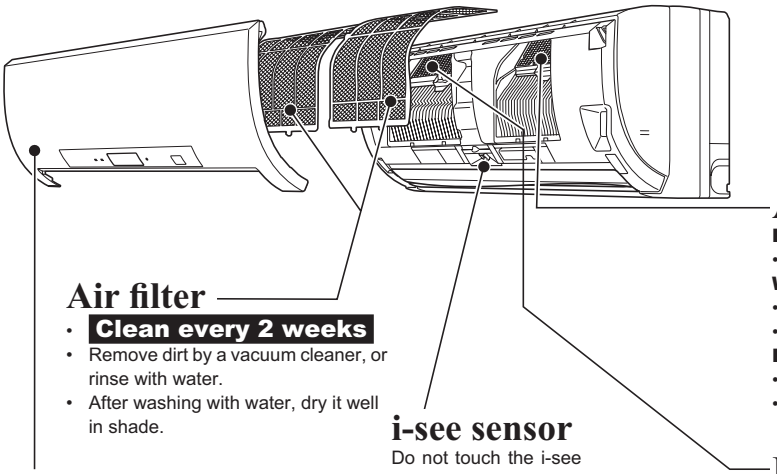
Note:

- ON and OFF timers can be set together. ⇵ mark indicates the order of timer operations.
- If power failure occurs while ON/OFF timer is set, see Page 6 “Auto restart function”

CLEANING

Instructions:

- Switch off the power supply or turn off the breaker before cleaning.
- Be careful not to touch the metal parts with your hands.
- Do not use benzine, thinner, polishing powder, or insecticide.
- Use only diluted mild detergents.
- Do not expose parts to direct sunlight, heat, or fire to dry.
- Do not use water hotter than 120°F (50°C).



Air filter

- **Clean every 2 weeks**
- Remove dirt by a vacuum cleaner, or rinse with water.
- After washing with water, dry it well in shade.

i-see sensor

Do not touch the i-see sensor.

Anti-Allergy Enzyme Filter

Every 3 months:

- Remove dirt by a vacuum cleaner.

When dirt cannot be removed by vacuum cleaning:

- Soak the filter and its frame in lukewarm water before rinsing it.
- After washing, dry it well in shade.

Every year:

- Replace it with a new air cleaning filter for best performance.
- Parts Number MAC-418FT-E

Platinum deodorizing filter

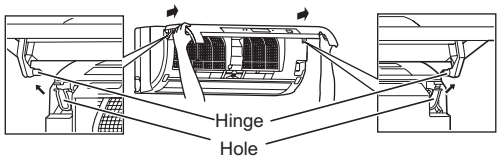
Every 3 months:

- Remove dirt by a vacuum cleaner, or soak the filter in lukewarm water (86 to 104°F [30 to 40°C]) for about 15 minutes. Rinse well.
- After washing, dry it well in shade.
- Deodorizing feature recovers by cleaning the filter.

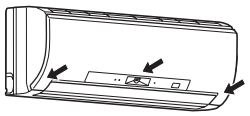
When dirt or smell cannot be removed by cleaning:

- Replace it with a new air cleaning filter.
- Parts Number MAC-308FT-E

Front panel



1. Lift the front panel until a “click” is heard.
2. Hold the hinges and pull to remove as shown in the illustration above.
   - Wipe with a soft dry cloth or rinse it with water.
   - Do not soak it in water for more than two hours.
   - Dry it well in shade before installing it.
3. Install the panel by following the removal procedure in reverse. Close the front panel securely and press the positions indicated by the arrows.



Important

- **Clean the filters regularly for best performance and to reduce power consumption.**
- **Do not touch the i-see sensor.**
- **Dirty filters cause condensation in the air conditioner which will contribute to the growth of fungi such as mold. It is therefore recommended to clean air filters every 2 weeks.**

WHEN YOU THINK THAT TROUBLE HAS OCCURRED

Even if these items are checked, when the unit does not recover from the trouble, stop using the air conditioner and consult your dealer.

Symptom	Explanation & Check points
Indoor Unit	
The unit cannot be operated.	• Is the breaker turned on? • Is the power supply plug connected? • Is the ON timer set? Page 8
The horizontal vane does not move.	• Are the horizontal vane and the vertical vane installed correctly? Page 9
The unit cannot be operated for about 3 minutes when restarted.	• This protects the unit according to instructions from the microprocessor. Please wait.
Mist is discharged from the air outlet of the indoor unit.	• The cool air from the unit rapidly cools moisture in the air inside the room, and it turns into mist.
The swing operation of the HORIZONTAL VANE is suspended for a while, then restarted.	• This is for the swing operation of the HORIZONTAL VANE to be performed normally.
The airflow direction changes during operation. The direction of the horizontal vane cannot be adjusted with the remote controller.	• When the unit is operated in COOL or DRY mode, if the operation continues with air blowing down for 0.5 to 1 hour, the direction of the airflow is automatically set to horizontal position to prevent water from condensing and dripping. • In the heating operation, if the airflow temperature is too low or when defrosting is being done, the horizontal vane is automatically set to horizontal position.
The operation stops for about 10 minutes in the heating operation.	• Outdoor unit is in defrost. Since this is completed in max.10 minutes, please wait. (When the outside temperature is too low and humidity is too high, frost is formed.)
The unit starts operation by itself when the main power is turned on, but hasn't received sign from the remote controller.	• These models are equipped with an auto restart function. When the main power is turned off without stopping the unit with the remote controller and is turned on again, the unit starts operation automatically in the same mode as the one set with the remote controller just before the shutoff of the main power. Refer to "Auto restart function". Page 6
Multi system	
The indoor unit which is not operating becomes warm and a sound, similar to water flowing, is heard from the unit.	• A small amount of refrigerant continues to flow into the indoor unit even though it is not operating.
When heating operation is selected, operation does not start right away.	• When operation is started during defrosting of outdoor unit is done, it takes a few minutes (max. 10 minutes) to blow out warm air.
Outdoor Unit	
The fan of the outdoor unit does not rotate even though the compressor is running. Even if the fan starts to rotate, it stops soon.	• When the outside temperature is low during cooling operation, the fan operates intermittently to maintain sufficient cooling capacity.
Water leaks from the outdoor unit.	• During COOL and DRY operations, pipe or pipe connecting sections are cooled and this causes water to condense. • In the heating operation, water condensed on the heat exchanger drips down. • In the heating operation, the defrosting operation makes ice forming on the outdoor unit melt and drip down.

Symptom	Explanation & Check points
Outdoor Unit	
White smoke is discharged from the outdoor unit.	• In the heating operation, vapor generated by the defrosting operation looks like white smoke.
Remote controller	
The display on the remote controller does not appear or it is dim. The indoor unit does not respond to the remote control signal.	• Are the batteries exhausted? Page 4 • Is the polarity (+, -) of the batteries correct? Page 4 • Are any buttons on the remote controller of other electric appliances being pressed?
Does not cool or heat	
The room cannot be cooled or heated sufficiently.	• Is the temperature setting appropriate? Page 6 • Is the fan setting appropriate? Please change fan speed to higher setting. Page 7 • Are the filters clean? Page 9 • Is the fan or heat exchanger of the indoor unit clean? • Are there any obstacles blocking the air inlet or outlet of the indoor or outdoor unit? • Is a window or door open?
The room cannot be cooled sufficiently.	• When a ventilation fan or a gas cooker is used in a room, the cooling load increases, resulting in an insufficient cooling effect. • When the outside temperature is high, the cooling effect may not be sufficient.
The room cannot be heated sufficiently.	• When the outside temperature is low, the heating effect may not be sufficient.
Air does not blow out soon in the heating operation.	• Please wait as the unit is preparing to blow out warm air.
Airflow	
The air from the indoor unit smells strange.	• Are the filters clean? Page 9 • Is the fan or heat exchanger of the indoor unit clean? • The unit may suck in an odor adhering to the wall, carpet, furniture, cloth, etc. and blow it out with the air.
Sound	
Cracking sound is heard.	• This sound is generated by the expansion/contraction of the front panel, etc. due to change in temperature.
"Burbling" sound is heard.	• This sound is heard when the outside air is absorbed from the drain hose by turning on the range hood or the ventilation fan, making water flowing in the drain hose to spout out. This sound is also heard when the outside air blows into the drain hose in case the outside wind is strong.
Mechanical sound is heard from the indoor unit.	• This is the switching sound in turning on/off the fan or the compressor.
The sound of water flowing is heard.	• This is the sound of refrigerant or condensed water flowing in the unit.
Hissing sound is sometimes heard.	• This is the sound when the flow of refrigerant inside the unit is changed.

In the following cases, stop using the air conditioner and consult your dealer.

- When water leaks or drips from the indoor unit.
- When the POWER lamp blinks.
- When the breaker trips frequently.
- The remote control signal is not received in a room where an electronic ON/OFF type fluorescent lamp (inverter-type fluorescent lamp, etc.) is used.
- Operation of the air conditioner interferes with radio or TV reception. An amplifier may be required for the affected device.
- When an abnormal sound is heard.

WHEN THE AIR CONDITIONER IS NOT GOING TO BE USED FOR A LONG TIME

1 Set to the highest temperature in manual COOL mode, and operate for 3 to 4 hours. Page 6
- This dries the inside of the unit.
- Moisture in the air conditioner contributes to favorable conditions for growth of fungi, such as mold.

2 Press ON/OFF to stop the operation.

3 Turn off the breaker and/or disconnect the power supply plug.

4 Remove all batteries from the remote controller.

When using the air conditioner again:

1 Clean the air filter. Page 9

2 Check that the air inlet and outlet of the indoor and outdoor units are not blocked.

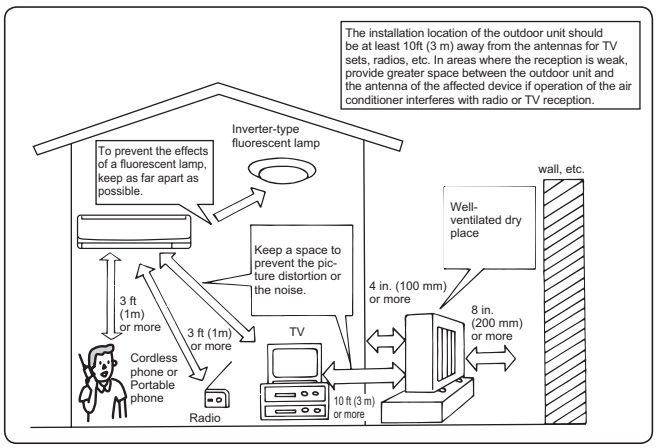
3 Check that the ground wire is connected correctly.

4 Refer to the “PREPARATION BEFORE OPERATION”, and follow the instructions. Page 4

INSTALLATION PLACE AND ELECTRICAL WORK

Installation place

Avoid installing the air conditioner in the following places.
- Where there is much machine oil.
- Salty places such as the seaside.
- Where sulfide gas is generated such as a hot spring.
- Where oil is splashed or where the area is filled with oily smoke.
- Where there is high-frequency or wireless equipment.
- Where the air from the outdoor unit air outlet is blocked.
- Where the operation sound or air from the outdoor unit does not bother the house next door.



Electrical work

- Provide an exclusive circuit for the power supply of the air conditioner.
- Be sure to observe the breaker capacity.

If you have any questions, consult your dealer.

SPECIFICATIONS

Guaranteed operating range

		Indoor	Outdoor
Cooling	Upper limit	90°F (32.2°C) DB	115°F (46.1°C) DB
		73°F (22.8°C) WB	—
	Lower limit	67°F (19.4°C) DB	14°F (-10°C) DB
		57°F (13.9°C) WB	—
Heating	Upper limit	80°F (26.7°C) DB	75°F (23.9°C) DB
		—	65°F (18.3°C) WB
	Lower limit	70°F (21.1°C) DB	-13°F (-25°C) DB
		—	-14°F (-25.6°C) WB

DB : Dry Bulb
WB : Wet Bulb

Note:

If the outdoor temperature is below the lower limit of guaranteed operating range, the outdoor unit may stop operation until the outdoor temperature exceeds the lower limit.

ÍNDICE

MEDIDAS DE SEGURIDAD

- Puesto que este producto tiene piezas rotatorias y piezas que pueden provocar descargas eléctricas, lea atentamente las “Medidas de seguridad” antes de usarlo.
- Tome las precauciones aconsejadas en este manual, ya que son importantes para una utilización segura del producto.
- Después de leer este manual, guárdelo a mano junto con el manual de instalación para poder recurrir a él con facilidad.
- Asegúrese de recibir la garantía de su distribuidor y comprobar que contiene la fecha de compra, el nombre del establecimiento, etc. correctos.

Indicaciones y sus significados

⚠ ATENCIÓN: Una manipulación incorrecta podría conllevar con toda probabilidad un peligro grave, por ejemplo, de muerte o de heridas graves.

⚠ CUIDADO: Una manipulación incorrecta podría conllevar, según las condiciones, un peligro grave.

Símbolos utilizados en este manual y su significado

: Asegúrese de no hacerlo.

: Siga las instrucciones estrictamente.

: No introduzca nunca los dedos ni objetos, etc.

: No se suba a la unidad interior/exterior ni ponga nada encima.

: Peligro de descarga eléctrica. Tenga cuidado.

: Asegúrese de desconectar el enchufe de alimentación de la toma de corriente.

: Asegúrese de desconectar la corriente.

⚠ ATENCIÓN

No conecte el cable de alimentación a un punto intermedio; utilice una alargadera o conecte varios dispositivos a una sola toma de CA.
- Podría causar sobrecalentamiento, fuego o descarga eléctrica.

Asegúrese que el enchufe no tiene polvo e insértelo de forma segura en la toma de corriente.
- Si el enchufe está sucio puede provocar fuego o una descarga eléctrica.

Asegúrese que el enchufe no tiene polvo e insértelo de forma segura en la toma de corriente.
- Podría causar fuego o una descarga eléctrica.

No accione el disyuntor OFF/ON ni desconecte/conecte el enchufe de alimentación durante el funcionamiento.
- Podría generar chispas y originar un fuego.
- Una vez que la se apaga la unidad interior con el controlador remoto, asegúrese de que coloca el disyuntor en OFF o que desconecta el enchufe de alimentación.

Evite la exposición directa de la piel al aire frío durante un periodo de tiempo prolongado.
- Puede ser perjudicial para la salud.

El usuario no debe instalar, cambiar de sitio ni reparar la unidad.
- Si no se maneja correctamente, el acondicionador de aire puede causar fuego o descarga eléctrica.

No introduzca los dedos, palos, etc. en las entradas/salidas de aire.
- Podría causar daños, puesto que el ventilador del interior gira a alta velocidad durante el funcionamiento.

En caso de que se produzca una condición anómala (como olor a quemado), pare el aparato y desconecte el enchufe de alimentación o coloque el disyuntor en OFF.
- Si se prolonga el funcionamiento en la condición anómala puede producirse un fallo, fuego o una descarga eléctrica. En tal caso, consulte a su distribuidor.

Cuando el acondicionador de aire no enfría o no calienta, es posible que haya una fuga del refrigerante. En tal caso, consulte a su distribuidor. Si una reparación exige la recarga de la unidad con refrigerante, solicite más información al técnico de servicio.
- El refrigerante que se usa en el acondicionador de aire es seguro. Normalmente no tiene fugas. Ahora bien, si hay fuga de refrigerante y éste entra en contacto con una fuente de calor como un calentador de ventilador, un calentador de parafina o un horno de cocina, generará gases perjudiciales.

⚠ CUIDADO

No toque la entrada de aire ni la aleta de aluminio de la unidad interior/exterior.
- Podría hacerse daño.

No eche insecticidas ni pulverizadores inflamables sobre la unidad.
- Podrían provocar incendios o deformaciones de la unidad.

Evite la exposición directa de animales domésticos o plantas al flujo de aire.
- Puede causar daños a los animales y las plantas.

No coloque otros electrodomésticos o muebles debajo de la unidad interior/exterior.
- Podría gotear agua desde la unidad, que podría causar daños o hacer que funcionara mal.

No instale la unidad en un soporte roto.
- La unidad podría caer y causar daños.

MEDIDAS DE SEGURIDAD

⚠ CUIDADO

Mientras limpia o hace funcionar la unidad, no tenga los pies en una superficie inestable.
- Si se cayera, podría hacerse daño.

No tire del cable de alimentación.
- Podría hacer que se rompa parte del núcleo del cable, lo que puede causar sobrecalentamiento o fuego.

No cargue ni desarme las pilas y no las arroje al fuego.
- Podría provocar fugas en las pilas, o causar fuego o una explosión.

La unidad no debe estar en funcionamiento más de 4 horas en condiciones de humedad elevada (80% de humedad relativa o superior) y/o con la puerta de entrada o las ventanas abiertas.
- Esto podría causar un descenso en la condensación de agua en el acondicionador de aire que podría humedecer o dañar el mobiliario.
- La condensación de agua en el acondicionador de aire podría contribuir a la formación de hongos, como el moho.

No use la unidad para fines especiales, como para almacenar alimentos, criar animales, cultivar plantas o guardar dispositivos de precisión u objetos de arte.
- Podría deteriorar la calidad o causar daños a los animales y plantas.

Evite la exposición directa de aparatos de combustión al flujo de aire.
- Podría interrumpir la combustión.

Antes de limpiar la unidad, apáguela y desconecte el cable de alimentación o coloque el disyuntor en OFF.
- Podría causar daños, puesto que el ventilador del interior gira a alta velocidad durante el funcionamiento.

Si la unidad va a dejar de usarse un tiempo prolongado, desconecte el cable de alimentación o coloque el disyuntor en OFF.
- La unidad puede acumular polvo y provocar sobrecalentamiento o fuego.

Sustituya las 2 pilas viejas del controlador remoto por otras nuevas de la misma clase.
- La utilización de una pila usada junto con una nueva puede causar sobrecalentamiento, provocar una fuga o producir una explosión.

Si el líquido de la pila entra en contacto con la piel o la ropa, lávelas a fondo con agua limpia.
- Si el líquido de la pila entra en contacto con los ojos, lávelos a fondo con agua limpia y acuda a un médico de inmediato.

Asegúrese de que la zona está bien ventilada cuando la unidad esté en funcionamiento junto con un aparato de combustión.
- Una ventilación inadecuada puede originar falta de oxígeno.

Coloque el disyuntor en OFF si oye truenos y hay posibilidad de que caigan rayos.
- La unidad puede resultar dañada si cae algún rayo.

Tras varias estaciones con el acondicionador de aire en funcionamiento, efectúe una inspección y el mantenimiento además de la limpieza habitual.
- Si hay polvo o suciedad en la unidad se puede producir un olor desagradable, contribuir al crecimiento de hongos, como el moho, o bien bloquear el conducto de drenaje, lo que hace que gotee agua de la unidad interior. Consulte con su distribuidor sobre la inspección y el mantenimiento, puesto que exigen conocimientos y capacidades especializadas.

No utilice los mandos con las manos mojadas.
- Podría producirse una descarga eléctrica.

No limpie el acondicionador de aire con agua ni coloque sobre él un objeto que contenga agua, como un florero.
- Podría causar fuego o una descarga eléctrica.

No se suba a la unidad exterior ni coloque ningún objeto encima.
- Si se cayera usted o el objeto, podría haber daños.

! IMPORTANTE

Los filtros sucios pueden provocar condensación en el acondicionador de aire que contribuye a la formación de hongos, como el moho. Por lo tanto, es recomendable limpiar los filtros cada 2 semanas.

Para la instalación

⚠ ATENCIÓN

Pida a su distribuidor que instale el aire acondicionado.
- No debe instalarlo el usuario, puesto que requiere conocimientos y capacidades especializadas. Si no se instala correctamente, puede provocar fugas, fuego o descargas eléctricas.

Dedique una toma de alimentación en exclusiva al acondicionador de aire.
- Si no se utiliza una toma de alimentación en exclusiva, pueden producirse sobrecalentamiento o fuego.

No instale la unidad donde pueda haber fugas de gas inflamable.
- Si hay una fuga de gas y éste se acumula cerca de la unidad, podría producirse una explosión.

Conecte la unidad a una toma a tierra.
- No conecte el cable de tierra a una tubería de gas, tubería de agua, pararrayos o cable de tierra de un teléfono. Si no, podría producirse una descarga eléctrica.

⚠ CUIDADO

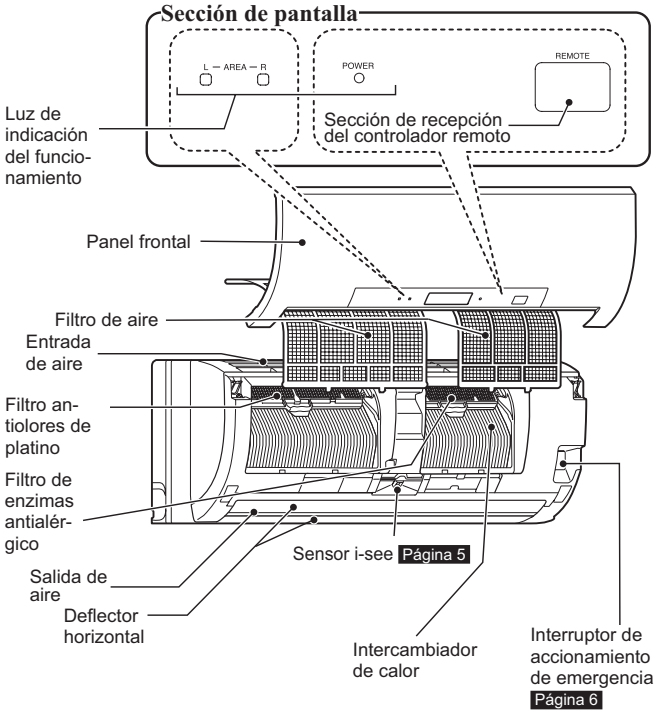
Instale un disyuntor de pérdidas de tierra en función del lugar de instalación del aire acondicionado (por ejemplo, áreas muy húmedas).
- Si no instala el disyuntor de pérdidas de tierra, podrían producirse descargas eléctricas.

Asegúrese de que se drena correctamente el agua de drenaje.
- Si el conducto de drenaje no es correcto, el agua podría caer desde la unidad interior/exterior, causando humedad y daños en el mobiliario.

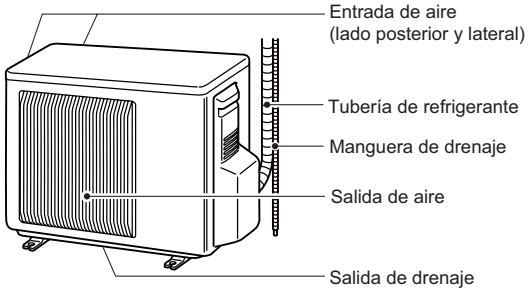
Si se produce una condición anómala
Pare de inmediato el acondicionador de aire y consulte a su distribuidor.

NOMBRE DE LAS PARTES

Unidad interior

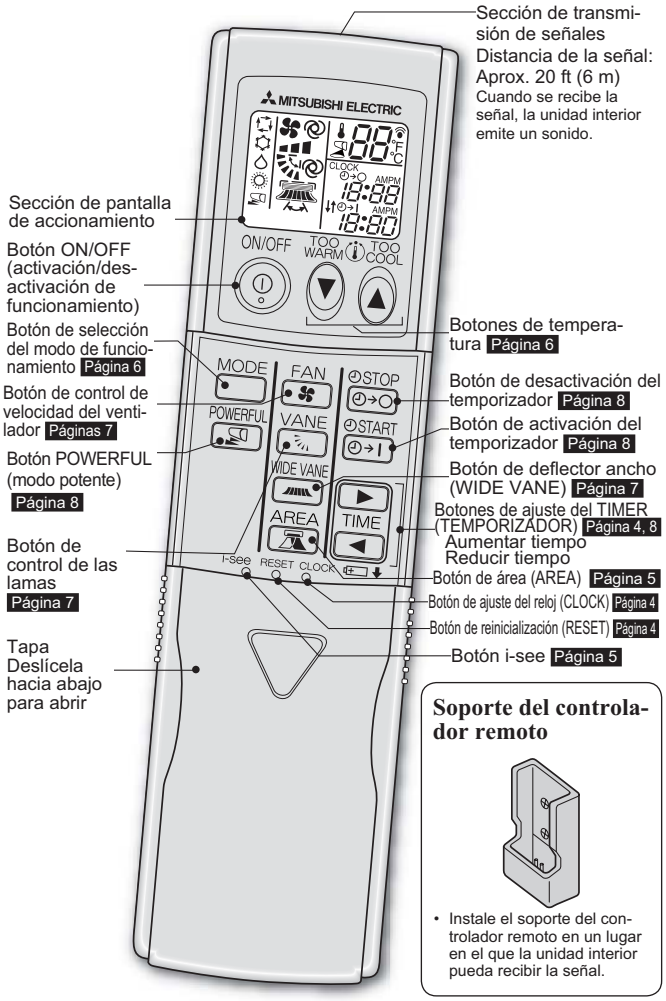


Unidad exterior



La apariencia de las unidades exteriores puede ser diferente.

Controlador remoto



Soporte del controlador remoto

- Instale el soporte del controlador remoto en un lugar en el que la unidad interior pueda recibir la señal.

Use únicamente el controlador remoto suministrado con la unidad.
No use otro controlador remoto.

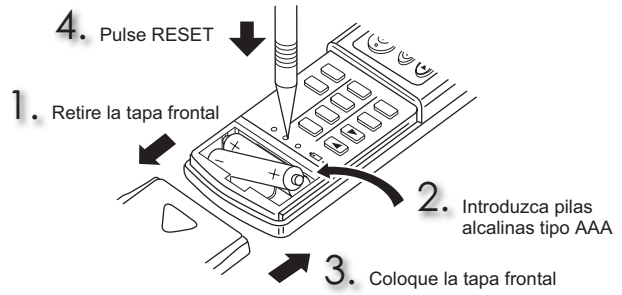
PREPARACIÓN ANTES DE LA PUESTA EN MARCHA

Antes de la puesta en funcionamiento: Inserte el enchufe de alimentación en la toma de corriente y/o encienda el disyuntor.

Instalación de las pilas del controlador remoto

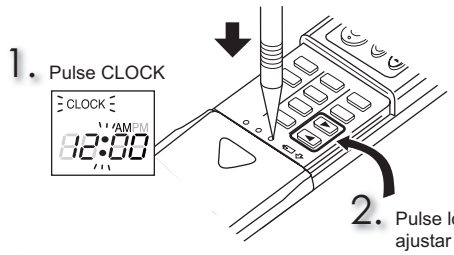
Asegúrese de ajustar la posición de instalación antes de instalar las pilas.

Página 5



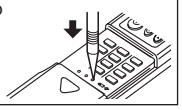
- Asegúrese de que la polaridad de las pilas es la correcta.
- No utilice pilas de manganeso. El controlador remoto podría funcionar inadecuadamente.
- No utilice pilas recargables.
- Sustituya todas las pilas por otras nuevas de la misma clase.
- Las pilas pueden durar 1 año aproximadamente. Ahora bien, las pilas caducadas pueden durar menos.
- Pulse RESET (reiniciar) suavemente utilizando un objeto en punta. Si no se pulsa el botón de reinicialización (RESET), el controlador remoto no funcionará correctamente.

Ajuste de la hora actual



3. Pulse otra vez CLOCK

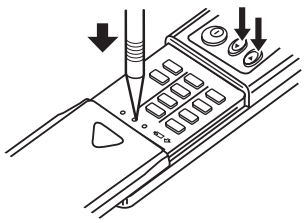
- Pulse CLOCK (temporizador) suavemente utilizando un objeto en punta.



Cambio de unidades de temperatura (ºF→ºC)

La unidad esta configurada por defecto con ºF.

1. Pulse RESET (reiniciar) con los botones de temperatura pulsados.



- Pulse RESET (reiniciar) suavemente utilizando un objeto en punta.
- Para cambiar la unidad de temperatura de °C a °F, pulse RESET.

PREPARACIÓN ANTES DE LA PUESTA EN MARCHA

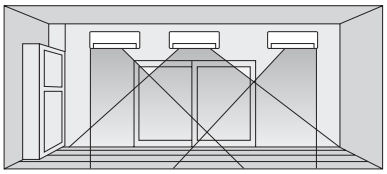
Ajuste de la posición de instalación

Asegúrese de ajustar el interruptor deslizante dentro del controlador remoto de acuerdo con la posición instalada de la unidad interior.

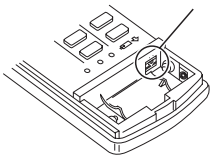
Posición de instalación:

Izquierda: distancia a objetos (pared, armario, etc.) es de menos de 19-11/16 in. (50 cm) a la izquierda
Centro: distancia a objetos (pared, armario, etc.) de más de 19-11/16 in. (50 cm) a la izquierda y la derecha
Derecha: distancia a objetos (pared, armario, etc.) es de menos de 19-11/16 in. (50 cm) a la derecha

(Izquierda)(Centro) (Derecha)



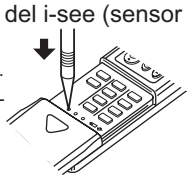
Interruptor deslizante



Zona	Izquierda	Centro	Derecha
Interruptor deslizante	L . C . R	L . C . R	L . C . R
Pantalla del controlador remoto			

Pulse i-see ○ durante el modo COOL (REFRIGERACIÓN) para activar el funcionamiento del i-see (sensor de temperatura).

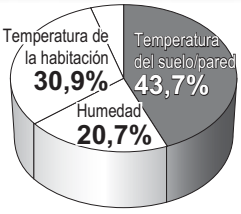
- Pulse suavemente utilizando un objeto en punto.
- se enciende. (Sección de pantalla de funcionamiento)



Vuelva a pulsar i-see ○ para desactivar el funcionamiento del i-see (sensor de temperatura).

Funcionamiento del i-see (sensor de temperatura)

Los sensores miden constantemente la temperatura de la habitación y del suelo/pared para ajustar automáticamente la temperatura definida calculando la temperatura real percibida por una persona dentro de la sala (“temperatura inteligente”).



sensor i-see

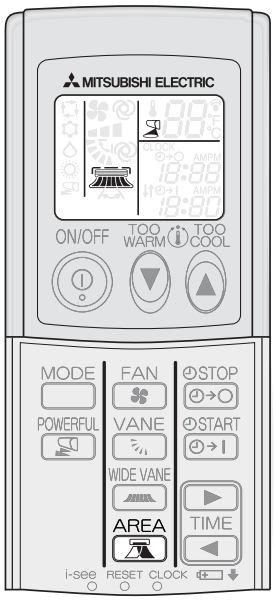
Si el ajuste AREA (zona) no está activado, el rango de detección del sensor i-see varía en función del lugar de instalación del aire acondicionado.

Posición de instalación	Izquierda	Centro	Derecha
Rango de detección			

Nota:

No toque el sensor i-see. Esto podría provocar que el sensor i-see funcionara mal.

AJUSTE DE AREA (ZONA)



Pulse AREA para seleccionar AREA (ZONA). AREA (ZONA) cambia con cada pulsación de la manera siguiente:

(AUTO) → (Izquierda) → (Derecha) → Cancelar *1

- El funcionamiento del i-see (sensor de temperatura) debe estar activado para seleccionar AREA (ZONA).
- La dirección de flujo de aire horizontal WIDE VANE no se puede seleccionar si está ajustado AREA (ZONA).

*1 Dirección de flujo de aire horizontal ajustada por WIDE VANE. Página 7

Pulse AREA hasta que “Cancel” (Cancelar) esté seleccionado para liberar el ajuste AREA (ZONA).

- Al pulsar WIDE VANE también se libera el ajuste AREA (ZONA).

Zona

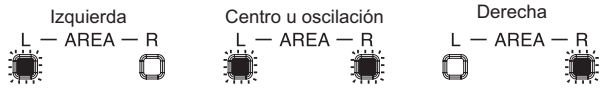
(AUTO) ....El sensor i-see detecta las diferencias de temperatura, refrigerando de forma eficaz toda la habitación.

En modo COOL (REFRIGERACIÓN):

(IZQUIERDA) / (DERECHA)
Seleccione la zona que desee acondicionar.

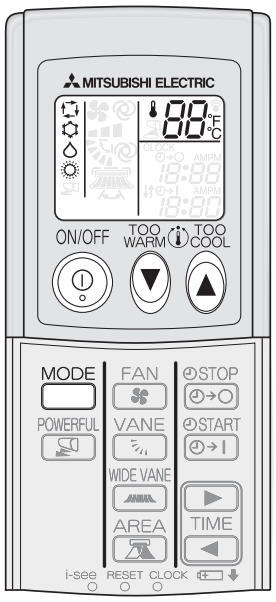
Pantalla de unidad interior

Dirección de flujo de aire horizontal:



Encendido Apagado

SELECCIÓN DE MODOS DE FUNCIONAMIENTO



1 Pulse ON/OFF para que se ponga en funcionamiento.

2 Pulse MODE para seleccionar el modo de funcionamiento. El modo cambia con cada pulsación de la manera siguiente:

(AUTO) → (REFRIGERACIÓN) → (DESHUMIDIFICACIÓN) → (CALEFACCIÓN)

3 Pulse TOO COOL o TOO WARM para ajustar la temperatura. Cada pulsación eleva o disminuye la temperatura en 1°F (1°C).

Pulse ON/OFF para apagarlo.

- Cuando vuelva a encenderlo, se activará la misma configuración seleccionada si pulsa ON/OFF.

Modo de AUTO (Cambio automático)

La unidad selecciona el modo de funcionamiento de acuerdo con la diferencia que haya entre la temperatura ambiente y la temperatura establecida. Durante el modo de AUTO, la unidad cambia el modo (REFRIGERACIÓN↔ CALEFACCIÓN) cuando la temperatura ambiente difiere en 4°F (2°C) de la temperatura establecida durante más de 15 minutos.

Nota:

- No se recomienda utilizar el modo de Auto si esta unidad interior está conectada a una unidad exterior de tipo MXZ.
- Dos o más unidades interiores pueden funcionar con una unidad exterior. Cuando se ponen en funcionamiento simultáneamente varias unidades interiores, puede que la unidad no alterne el modo de funcionamiento entre el de REFRIGERACIÓN y el de CALEFACCIÓN. En tal caso, la unidad interior se coloca en el modo de espera.

Modo de REFRIGERACIÓN

Disfrute de aire frío a la temperatura que desee.
No ponga en funcionamiento el modo de REFRIGERACIÓN con temperaturas muy bajas en el exterior. (inferior a 14°F [-10°C]). El agua condensada en la unidad puede gotear y humedecer o dañar el mobiliario, etc.

Modo de DESHUMIDIFICACIÓN

Deshumedezca su habitación. Puede refrigerarla ligeramente.
La temperatura no se puede ajustar mientras el aparato está en el modo de DESHUMIDIFICACIÓN.

Modo de CALEFACCIÓN

Disfrute de aire cálido a la temperatura que desee.

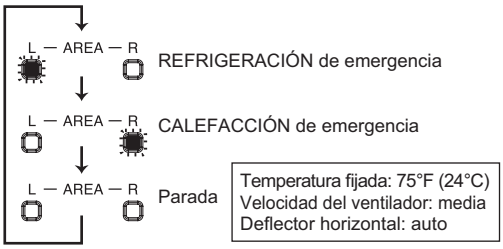
Funcionamiento de emergencia

Si no se puede utilizar el controlador remoto...

Se puede activar el funcionamiento de emergencia pulsando el interruptor de accionamiento de emergencia (E.O.SW) en la unidad interior.

Cada vez que se pulsa el interruptor de emergencia, el funcionamiento cambia en el orden siguiente:

Luz de indicación de funcionamiento



Nota:

Los primeros 30 minutos de funcionamiento son de prueba. El control de temperatura no funciona y la velocidad del ventilador está fijada en “Alta”.

Función de reinicio automático

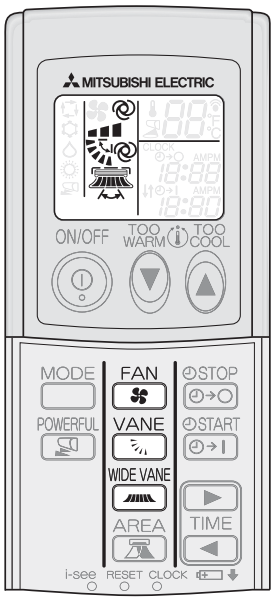
En caso de que se produzca un corte en el suministro eléctrico o se apague la unidad mientras esté funcionando, la “función de reinicio automático” se activará automáticamente en el mismo modo seleccionado con **el controlador remoto** antes de que se interrumpiese el funcionamiento. Cuando está configurado el temporizador, los ajustes se anulan y la unidad empieza a funcionar al volver a encenderla.

Si no desea utilizar esta función, póngase en contacto con el servicio técnico ya que tendrá que modificar los ajustes de la unidad.

Funcionamiento multisistema

Dos o más unidades interiores pueden funcionar con una unidad exterior. Si se activan varias unidades interiores al mismo tiempo, las operaciones de refrigeración y calefacción no pueden realizarse simultáneamente. Cuando se selecciona REFRIGERACIÓN en una unidad y CALEFACCIÓN en otra o viceversa, la última unidad seleccionada entra en modo de espera. La luz de funcionamiento se enciende (POWER) y las luces de la zona (AREA) parpadean (sección de pantalla).

VELOCIDAD DEL VENTILADOR Y AJUSTE DE LA DIRECCIÓN DEL AIRE



FAN

Pulse [ ] para seleccionar la velocidad del ventilador. La velocidad del ventilador cambia con cada pulsación en el orden siguiente:

(AUTO) → (Baja) → (Media) → (Alta)

- Al configurar la unidad interior en AUTO, se escuchan dos pitidos cortos.

VANE

Pulse [ ] para seleccionar la dirección del aire. La dirección del aire cambia con cada pulsación en el orden siguiente:

(AUTO) → (1) → (2) → (3) → (4) → (5) → (OSCILACIÓN)

- Al configurar la unidad interior en AUTO, se escuchan dos pitidos cortos.

WIDE VANE

Pulse [ ] para seleccionar la dirección horizontal del aire. La dirección del aire cambia con cada pulsación en el orden siguiente:

→ → → → → (OSCILACIÓN)

Dirección vertical del aire

(AUTO)

El deflector se ajusta en la dirección con mayor rendimiento de la dirección del aire. REFRIGERACIÓN/DESHUMIDIFICACIÓN:posición horizontal. CALEFACCIÓN: posición hacia abajo.

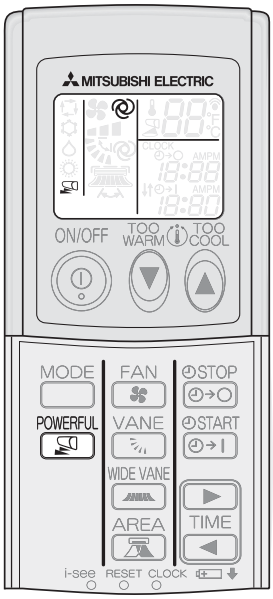
(Manual)

Para un mejor rendimiento del acondicionador de aire, seleccione la posición superior para REFRIGERACIÓN/DESHUMIDIFICACIÓN, y la posición inferior para CALEFACCIÓN. Durante los modos REFRIGERACIÓN/DESHUMIDIFICACIÓN, cuando el deflector está en la posición (4) o (5), éste se mueve automáticamente hasta la posición horizontal al cabo de 1 hora para evitar que gotee agua.

(Oscilación)

El deflector asciende y desciende de forma intermitente.

FUNCIONAMIENTO POWERFUL (POTENTE)



Pulse POWERFUL durante el modo de REFRIGERACIÓN o de CALEFACCIÓN Página 6 para iniciar el funcionamiento POWERFUL (potente).

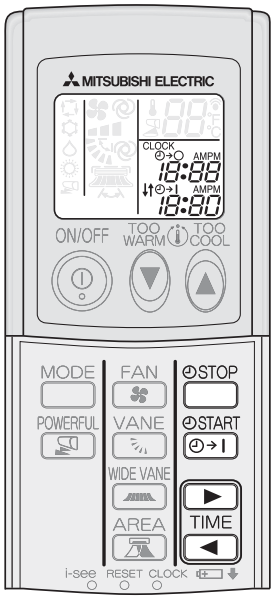
Velocidad del ventilador : velocidad exclusiva del modo de funcionamiento POTENTE
Deflector horizontal : posición original, o bien posición hacia abajo durante la configuración en AUTO (automático)

- La temperatura no puede configurarse mientras está funcionando en POWERFUL (potente).

Vuelva a pulsar POWERFUL para cancelar el modo POWERFUL (potente).

- El funcionamiento en POWERFUL (potente) también se cancela automáticamente en 15 minutos, o bien cuando se pulsan los botones ON/OFF (encendido/apagado) o FAN (ventilador).

FUNCIONAMIENTO DEL TEMPORIZADOR (ACTIVACIÓN/DESACTIVACIÓN DEL TEMPORIZADOR)



1 Pulse START o STOP durante el funcionamiento para ajustar el temporizador.

START (ACTIVACIÓN del temporizador):
La unidad se encenderá (ON) a la hora establecida.

STOP (DESACTIVACIÓN del temporizador):
La unidad se apagará (OFF) a la hora establecida.

*** ⏲→I o ⏲→○ parpadea.**
*** Asegúrese de que la hora actual es la correcta.** Página 4

2 Pulse ► (Aumentar) y ◄ (Disminuir) para ajustar la hora del temporizador.
Con cada pulsación la hora establecida aumenta o disminuye en 10 minutos.

Pulse START o STOP de nuevo para cancelar el temporizador.

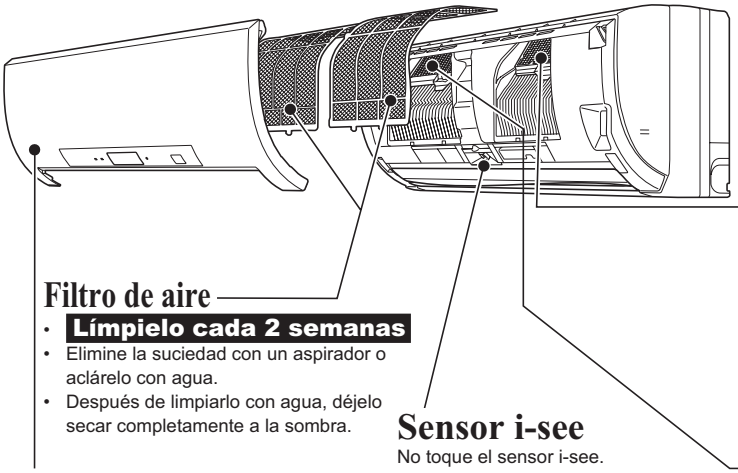
Nota:

- Los temporizadores de ON (encendido) y OFF (apagado) se pueden configurar a la vez. La marca "↓↑" muestra el orden en el que se activarán los temporizadores.
- Si se produce un corte en el suministro eléctrico mientras está configurado el temporizador en ACTIVACIÓN/DESACTIVACIÓN, consulte la Página 6 "Función de reinicio automático".

LIMPIEZA

Instrucciones:

- Durante la limpieza, apague el disyuntor o desenchúfelo de la toma de corriente.
- Tenga cuidado de no tocar las partes metálicas con las manos.
- No utilice bencina, polvo de pulimentación ni insecticida.
- Use sólo detergentes suaves diluidos.
- No exponga directamente al sol, al calor o a las llamas ninguna pieza con el fin de secarla.
- No use agua con temperatura superior a 120°F (50°C).



Filtro de aire

- **Límpielo cada 2 semanas**
- Elimine la suciedad con un aspirador o aclárelo con agua.
- Después de limpiarlo con agua, déjelo secar completamente a la sombra.

Sensor i-see

No toque el sensor i-see.

Filtro de enzimas antialérgico

Cada 3 meses:

- Elimine la suciedad con un aspirador.

Si la suciedad no se puede eliminar con un aspirador:

- Empape el filtro y el marco en agua tibia antes de aclararlo.
- Tras el lavado, séquelo bien a la sombra.

Una vez al año:

- Cambie el filtro de aire por uno nuevo para un mejor rendimiento.
- Número de pieza MAC-418FT-E

Filtro antiolores de platino

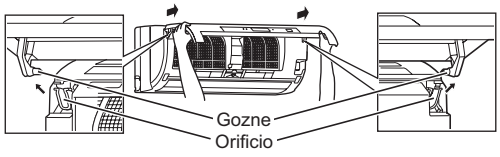
Cada 3 meses:

- Retire la suciedad con un aspirador o sumerja el filtro en agua templada (86 a 104°F [30 a 40°C]) durante unos 15 minutos. Aclárelo bien.
- Tras el lavado, séquelo bien a la sombra.
- La función desodorante se recupera al limpiar el filtro.

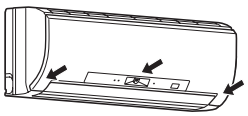
Si la suciedad o el olor no pueden eliminarse mediante la limpieza:

- Cámbielo por un filtro de aire nuevo.
- Número de pieza MAC-308FT-E

Panel frontal



1. Suba el panel frontal hasta que oiga un “clic”.
2. Sujete los goznes y tire de él para extraerlo, como se muestra en la ilustración anterior.
   - Pásele un paño suave seco o aclárelo con agua.
   - No lo empape en agua más de dos horas.
   - Séquelo bien a la sombra antes de instalarlo.
3. Instale el panel siguiendo las instrucciones de extracción en orden inverso. Cierre el panel frontal de forma segura y pulse las posiciones que indican las flechas.



Importante

- **Limpie los filtros con regularidad para un mejor rendimiento y para reducir el consumo de electricidad.**
- **No toque el sensor i-see.**
- **Los filtros sucios pueden provocar condensación en el acondicionador de aire que contribuye a la formación de hongos, como el moho. Por lo tanto, es recomendable limpiar los filtros cada 2 semanas.**

SI CREE QUE HA OCURRIDO ALGÚN PROBLEMA

Si después de comprobar estas cuestiones el acondicionador de aire sigue sin funcionar bien, póngase en contacto con su distribuidor.

Síntoma	Explicación y puntos de comprobación
Unidad interior	
La unidad no puede ponerse en funcionamiento.	• ¿Está activado el disyuntor? • ¿Está puesto el enchufe de la alimentación? • ¿Está configurada la activación del temporizador? Página 8
El deflector horizontal no se mueve.	• ¿Están correctamente montados el deflector horizontal y el deflector vertical? Página 9
Cuando se vuelve a poner en marcha, la unidad tarda unos 3 minutos en funcionar.	• Se trata de una instrucción del microprocesador para proteger la unidad. Espere.
El vapor se descarga a través de la salida de aire de la unidad interior.	• El aire refrigerado de la unidad enfría rápidamente la humedad del interior de la habitación y la convierte en vapor.
La operación de oscilación del DEFLECTOR HORIZONTAL se suspende durante un tiempo y, a continuación, se reanuda.	• Es para que la operación de oscilación del DEFLECTOR HORIZONTAL se realice con normalidad.
La dirección del flujo de aire cambia en pleno funcionamiento. La dirección del deflector horizontal no puede ajustarse con el controlador remoto.	• Cuando el aire acondicionado sigue funcionando en el modo de REFRIGERACIÓN o de DESHUMIDIFICACIÓN, después de llevar entre 30 minutos y 1 hora expulsando el aire hacia abajo, la dirección del flujo de aire se ajusta automáticamente en la posición horizontal para evitar que el agua condensada gotee. • En el modo de calefacción, si la temperatura de la corriente de aire es demasiado baja o se está eliminando la escarcha, el deflector horizontal se ajusta automáticamente en la posición horizontal.
El funcionamiento se detiene durante unos 10 minutos en modo calefacción.	• Se está desescarchando la unidad exterior. Espere hasta que acabe el proceso, que dura unos 10 minutos. (La escarcha se forma cuando al temperatura exterior es demasiado baja y la humedad demasiado alta).
La unidad se pone en marcha por sí misma al conectar la alimentación principal, aunque no haya recibido la señal del controlador remoto.	• Estos modelos están equipados con la función de reinicio automático. Cuando se desconecta la alimentación principal sin detener la unidad mediante el controlador remoto y se vuelve a encender, la unidad se pone en marcha automáticamente en el mismo modo seleccionado con el controlador remoto justo antes de que se desconectara la alimentación principal. Consulte “Función de reinicio automático” Página 6.
Multisistema	
La unidad interior que no está en funcionamiento se calienta y emite un sonido parecido al agua que corriente.	• En la unidad interior, continúa circulando una pequeña cantidad de líquido refrigerante aunque esta unidad no esté en funcionamiento.
Cuando se selecciona la operación de calefacción, no se pone en marcha de forma inmediata.	• Cuando se inicia la operación durante el desescarchado de la unidad exterior, la expulsión del aire cálido lleva unos minutos (máximo 10).
Unidad exterior	
El ventilador de la unidad exterior no gira aunque el compresor está funcionando. Aunque el ventilador empiece a girar, se para en seguida.	• Cuando la temperatura exterior es baja durante la operación de refrigeración, el ventilador funciona intermitentemente para mantener suficiente capacidad de enfriamiento.
En la unidad exterior hay una fuga de agua.	• Durante la REFRIGERACIÓN o la DESHUMIDIFICACIÓN, el enfriamiento de los tubos y de las conexiones de los tubos hace que se condense el agua. • En el modo de calefacción, el agua se condensa en el intercambiador de calor y empieza a gotear. • En el modo de calefacción, la función de desescarchado derrite el hielo adherido a la unidad exterior y el agua empieza a gotear.

Síntoma	Explicación y puntos de comprobación
Unidad exterior	
Sale humo blanco de la unidad exterior.	• En el modo de calefacción, el vapor que se genera debido al funcionamiento de desescarchado tiene el aspecto de humo blanco.
Controlador remoto	
La pantalla del controlador remoto no aparece o se oscurece. La unidad interior no responde a la señal del controlador remoto.	• ¿Están agotadas las pilas? Página 4 • ¿Es correcta la polaridad (+, -) de las pilas? Página 4 • ¿Se ha pulsado algún botón del controlador remoto de otros aparatos eléctricos?
No refrigera o no calienta	
La sala no se refrigera ni se calienta lo suficiente.	• ¿Es correcto el ajuste de la temperatura? Página 6 • ¿Es adecuado el ajuste del ventilador? Cambie la velocidad del ventilador a un valor mayor. Página 7 • ¿Están limpios los filtros? Página 9 • ¿Están limpios el ventilador o el intercambiador de calor de la unidad interior? • ¿Hay algún obstáculo que bloquee la entrada o salida de aire de las unidades interior o exterior? • ¿Se ha abierto una ventana o puerta?
La habitación no se refrigera lo suficiente.	• Cuando se utiliza un ventilador de aire o una cocina de gas en la habitación, aumenta la carga de refrigeración, con lo cual el efecto de refrigeración resulta insuficiente. • Cuando la temperatura del aire exterior es alta, el efecto de refrigeración puede resultar insuficiente.
La habitación no se calienta lo suficiente.	• Cuando la temperatura de aire exterior es baja, el efecto de calentamiento puede resultar insuficiente.
Durante el funcionamiento en modo de calefacción, el aire no circula rápidamente.	• Espere hasta que la unidad esté lista para expulsar aire caliente.
Flujo de aire	
El aire de la unidad interior tiene un olor raro.	• ¿Están limpios los filtros? Página 9 • ¿Están limpios el ventilador o el intercambiador de calor de la unidad interior? • La unidad puede absorber el olor adherido a las paredes, alfombras, muebles, prendas, etc. y expulsarlo junto con el aire.
Sonido	
Se oye un ruido de rotura.	• Se trata de un sonido provocado por la dilatación/contracción del panel frontal, etc. a causa de los cambios de temperatura.
Se oye un ruido de “burbujeo”.	• Este ruido se oye cuando, al encenderse la campana o el ventilador, la manguera de drenaje absorbe aire del exterior y el agua que fluye por la manguera sale expulsada. Este ruido también se oye cuando hace mucho viento y entra aire en la manguera de drenaje.
Se escucha un sonido mecánico en la unidad interior.	• Corresponde al sonido de encendido/apagado del ventilador o del compresor.
Se oye correr agua.	• Se trata del ruido del refrigerante o del agua condensada que fluye por la unidad.
A veces se oye un silbido.	• Se trata del ruido que hace el refrigerante al cambiar la dirección de la circulación en el interior de la unidad.

En los casos siguientes pare el equipo y póngase en contacto con su distribuidor.

- Cuando cae o gotea agua de la unidad interior.
- Cuando la luz de funcionamiento parpadea.
- Cuando el disyuntor se desconecta con frecuencia.
- Es posible que la señal del controlador remoto no se reciba en habitaciones en las que se utilicen fluorescentes de accionamiento electrónico (de tipo inversor, etc.).
- El funcionamiento del acondicionador de aire interfiere con la capacidad de recepción del televisor o la radio. Puede ser necesario conectar el receptor afectado a un amplificador.
- Si se oye un ruido anómalo.

CUANDO EL ACONDICIONADOR DE AIRE NO SE VAYA A UTILIZAR DURANTE MUCHO TIEMPO

1 Ajuste a la máxima temperatura en el modo manual de REFRIGERACIÓN, y déjelo en funcionamiento durante 3 a 4 horas. Página 6
- Esto hace que se seque el interior de la unidad.
- La humedad condensada en el aparato de aire acondicionado puede contribuir a la formación y expansión de hongos, como el moho.

2 Pulse ON/OFF para que se detenga.

3 Desconecte el disyuntor o desconecte el enchufe de la alimentación.

4 Quite todas las pilas del controlador remoto.

Al volver a usar el acondicionador de aire:

1 Limpie el filtro de aire. Página 9

2 Compruebe que no estén bloqueadas las entradas y salidas de aire de las unidades interior/exterior.

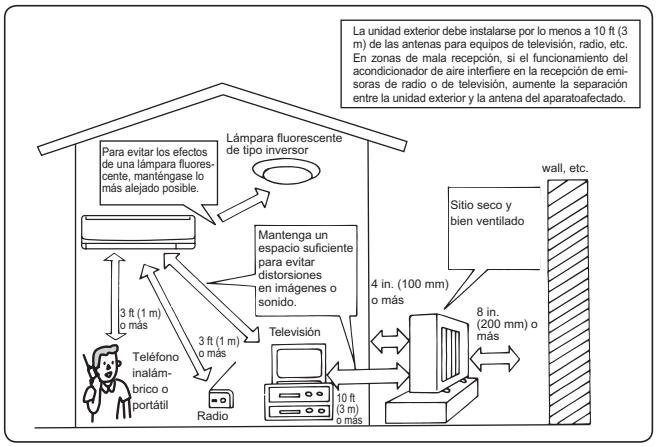
3 Compruebe que el cable de tierra esté conectado correctamente.

4 Consulte la sección “PREPARACIÓN ANTES DE LA PUESTA EN MARCHA” y siga las instrucciones. Página 4

LUGAR DE INSTALACIÓN Y TRABAJO ELÉCTRICO

Lugar de instalación

Procure no instalar el acondicionador de aire en los siguientes lugares.
- Donde haya demasiado aceite para maquinaria.
- En ambientes salobres, como las zonas costeras.
- Donde haya gas sulfúrico, como en zonas de baños termales.
- Donde se haya derramado aceite o haya mucho humo aceitoso en el ambiente.
- Donde existe equipo inalámbrico o de alta frecuencia.
- Donde el aire de la salida de aire de la unidad exterior esté bloqueado.
- Donde el sonido del funcionamiento o el del aire de la unidad exterior no moleste a los vecinos.



Instalación eléctrica

- Procure que el acondicionador de aire disponga de un circuito de alimentación exclusivo.
- Procure que la capacidad del disyuntor sea la adecuada.

Si tiene alguna pregunta, consulte a su distribuidor.

ESPECIFICACIONES

Intervalo garantizado de funcionamiento

		Interior	Exterior
Refrigeración	Margen superior	90°F (32,2°C) DB	115°F (46,1°C) DB
		73°F (22,8°C) WB	—
	Margen inferior	67°F (19,4°C) DB	14°F (-10°C) DB
		57°F (13,9°C) WB	—
Calefacción	Margen superior	80°F (26,7°C) DB	75°F (23,9°C) DB
		—	65°F (18,3°C) WB
	Margen inferior	70°F (21,1°C) DB	-13°F (-25°C) DB
		—	-14°F (-25,6°C) WB

DB : Temperatura seca
WB : Temperatura húmeda

Nota:

Si la temperatura exterior se encuentra por debajo del margen inferior del intervalo garantizado de funcionamiento, es posible que la unidad exterior detenga el funcionamiento hasta que la temperatura exterior supere el margen inferior.

TABLE DES MATIERES

CONSIGNES DE SECURITE

- Avant toute utilisation, veuillez lire les "Consignes de sécurité" car cet appareil contient des pièces rotatives ou autres pouvant entraîner des risques d'électrocution.
- Les consignes contenues dans cette section sont importantes pour la sécurité et doivent donc impérativement être respectées.
- Après avoir lu cette notice, conservez-la avec le manuel d'installation à portée de main pour pouvoir la consulter aisément.
- Veillez à recevoir une carte de garantie de votre revendeur et vérifiez que la date d'achat et le nom du magasin, etc. sont saisis correctement.

Symboles et leur signification

⚠ AVERTISSEMENT: toute manipulation incorrecte peut avoir des conséquences graves, provoquer des blessures corporelles voire la mort de l'utilisateur.

⚠ PRECAUTION: toute manipulation incorrecte peut avoir des conséquences graves selon les circonstances.

Signification des symboles utilisés dans ce manuel

: à éviter absolument.

: suivre rigoureusement les instructions.

: ne jamais insérer le doigt ou un objet long, etc.

: ne jamais monter sur l'unité interne/externe et ne rien poser dessus.

: risque d'électrocution ! Attention !

: veiller à débrancher la fiche d'alimentation électrique de la prise secteur.

: couper l'alimentation au préalable.

⚠ AVERTISSEMENT

Ne pas utiliser de raccord intermédiaire ou de rallonge pour brancher le cordon d'alimentation et ne pas brancher plusieurs appareils à une même prise secteur.
- Ceci pourrait provoquer une surchauffe de l'appareil, un incendie ou un risque d'électrocution.

Nettoyer la fiche d'alimentation électrique et l'insérer prudemment dans la prise secteur.
- Une fiche d'alimentation électrique encrassée peut entraîner un risque d'incendie ou d'électrocution.

Ne pas enrouler, tendre de façon excessive, endommager, modifier ou chauffer le cordon d'alimentation, et ne rien poser dessus.
- Ceci pourrait provoquer un risque d'incendie ou d'électrocution.

Ne pas enclencher/couper le disjoncteur ou débrancher/brancher la fiche d'alimentation électrique pendant le fonctionnement de l'appareil.
- Des étincelles pourraient se produire et provoquer un risque d'incendie.
- Toujours couper le disjoncteur ou débrancher la fiche d'alimentation électrique suite à l'arrêt de l'unité interne avec la télécommande.

Il est déconseillé à toute personne de s'exposer au flux d'air froid pendant une période prolongée.
- Ceci pourrait entraîner des problèmes de santé.

L'utilisateur ne doit en aucun cas installer, déplacer ou tenter de réparer le climatiseur.
- Toute manipulation incorrecte du climatiseur pourrait provoquer un risque d'incendie ou d'électrocution.

Ne jamais insérer le doigt ou tout autre objet dans les entrées ou sorties d'air.
- La vitesse de rotation extrêmement rapide du ventilateur pendant le fonctionnement du climatiseur pourrait provoquer un accident.

En cas d'anomalie (odeur de brûlé, etc.), arrêter le climatiseur et débrancher la fiche d'alimentation électrique ou couper le disjoncteur.
- Si le climatiseur continue à fonctionner en présence d'une anomalie, une défaillance technique, un risque d'incendie ou d'électrocution ne sont pas à exclure. Dans ce cas, consulter un revendeur agréé.

Si la fonction de refroidissement ou de chauffage du climatiseur est inopérante, cela peut indiquer la présence d'une fuite de réfrigérant. Dans ce cas, consulter un revendeur agréé. Si la réparation consiste à recharger l'appareil en réfrigérant, demander conseil auprès d'un technicien responsable de l'entretien.
- Le réfrigérant contenu dans le climatiseur ne pose aucun problème de sécurité. En règle générale, aucune fuite ne doit se produire. Cependant, si le réfrigérant fuit et entre en contact avec la partie chauffante d'un appareil de chauffage à ventilation, d'un chauffage d'appoint, d'une cuisinière, etc., des substances toxiques se produiront.

⚠ PRECAUTION

Ne pas toucher à l'entrée d'air ou aux ailettes en aluminium de l'unité interne/externe.
- Risque de blessures.

Ne vaporiser ni insecticide ni substance inflammable sur l'appareil.
- Ceci pourrait provoquer un incendie ou une déformation de l'appareil.

Ne pas exposer un animal domestique ou une plante d'intérieur directement sous le courant d'air pulsé.
- Le bien-être des animaux et des plantes pourrait en être affecté.

Ne placer ni appareil électrique ni meuble sous l'unité interne/externe.
- De l'eau pourrait s'écouler de l'appareil et les endommager ou provoquer une panne de leur système.

Ne jamais laisser le climatiseur posé sur un support endommagé.
- Il pourrait tomber et provoquer un accident.

CONSIGNES DE SECURITE

⚠ PRECAUTION

Veiller à ne pas monter sur une surface instable pour allumer ou nettoyer le climatiseur.
- Risque de chute et de blessures.

Ne jamais tirer sur le cordon d'alimentation.
- Le fil central du cordon d'alimentation pourrait se rompre et provoquer un incendie.

Ne jamais recharger ou tenter d'ouvrir les piles et ne pas les jeter au feu.
- Les piles pourraient fuir et présenter un risque d'incendie ou d'explosion.

Ne pas faire fonctionner le climatiseur pendant plus de 4 heures avec un taux d'humidité important (80% HR ou plus), et/ou lorsqu'une porte ou une fenêtre est ouverte.
- Ceci peut provoquer de la condensation à l'intérieur du climatiseur, qui risque de s'écouler et de mouiller ou d'endommager le mobilier.
- La présence d'humidité dans la climatisation peut contribuer à la croissance de certains champignons tels que la moisissure.

Ne pas utiliser le climatiseur pour conserver des aliments, élever des animaux, faire pousser des plantes, ranger des outils de précision ou des objets d'art.
- Leur qualité pourrait s'en ressentir, et le bien-être des animaux et des plantes pourrait en être affecté.

Ne pas exposer des appareils à combustion directement sous la sortie d'air pulsé.
- Une combustion imparfaite pourrait en résulter.

Avant de procéder au nettoyage du climatiseur, le mettre hors tension et débrancher la fiche d'alimentation électrique ou couper le disjoncteur.
- La vitesse de rotation extrêmement rapide du ventilateur pendant le fonctionnement du climatiseur pourrait provoquer un accident.

Si le climatiseur doit rester inutilisé pendant une période prolongée, débrancher la fiche d'alimentation électrique ou couper le disjoncteur.
- Il pourrait s'encrasser et présenter un risque d'incendie ou d'électrocution.

Remplacer les piles de la télécommande par des piles neuves du même type.
- Ne jamais mélanger piles usagées et piles neuves ; ceci pourrait provoquer une surchauffe, une fuite ou une explosion.

Si du liquide provenant des piles entre en contact avec la peau ou les vêtements, les rincer abondamment à l'eau claire.
- Si du liquide alcalin entre en contact avec les yeux, les rincer abondamment à l'eau claire et contacter d'urgence un médecin.

Si le climatiseur est utilisé conjointement avec un appareil à combustion, veiller à ce que la pièce soit parfaitement ventilée.
- Une ventilation insuffisante pourrait provoquer un manque d'oxygène dans la pièce.

Couper le disjoncteur par temps d'orage.
- La foudre pourrait endommager le climatiseur.

Si le climatiseur a été utilisé pendant plusieurs saisons consécutives, procéder à une inspection et à un entretien rigoureux en plus du nettoyage normal.
- Une accumulation de saletés ou de poussière à l'intérieur du climatiseur peut être à l'origine d'une odeur désagréable, contribuer au développement de moisissures ou bloquer l'écoulement des condensats et provoquer une fuite d'eau de l'unité interne. Consulter un revendeur agréé pour procéder à une inspection et des travaux d'entretien nécessitant l'intervention de personnel qualifié et compétent.

Ne pas actionner les commandes du climatiseur avec les mains mouillées.
- Risque d'électrocution !

Ne pas nettoyer le climatiseur avec de l'eau et ne placer ni vase ni verre d'eau dessus.
- Ceci pourrait provoquer un risque d'incendie ou d'électrocution.

Ne jamais marcher sur l'unité externe et ne rien poser dessus.
- Risque de chute et de blessures.

! IMPORTANT

Des filtres encrassés peuvent provoquer de la condensation dans le climatiseur, ce qui contribuera à la croissance de certains champignons tels que la moisissure. Il est donc recommandé de nettoyer les filtres à air toutes les 2 semaines.

A propos de l'installation

⚠ AVERTISSEMENT

Consulter un revendeur agréé pour qu'il procède à l'installation du climatiseur.
- L'utilisateur ne doit en aucun cas tenter d'installer le climatiseur lui-même ; seul du personnel qualifié et compétent est en mesure de le faire. Toute installation incorrecte du climatiseur pourrait être à l'origine de fuites d'eau et provoquer un risque d'incendie ou d'électrocution.

Prévoir un circuit réservé à l'alimentation du climatiseur.
- Dans le cas contraire, un risque de surchauffe ou d'incendie n'est pas à exclure.

Ne pas installer l'appareil dans un endroit susceptible d'être exposé à des fuites de gaz inflammable.
- L'accumulation de gaz autour de l'appareil entraîne des risques d'explosion.

Raccorder correctement le climatiseur à la terre.
- Ne jamais raccorder le câble de terre à un tuyau de gaz, une évacuation d'eau, un paratonnerre ou un câble téléphonique de mise à la terre. Une mise à la terre incorrecte pourrait provoquer un risque d'électrocution.

⚠ PRECAUTION

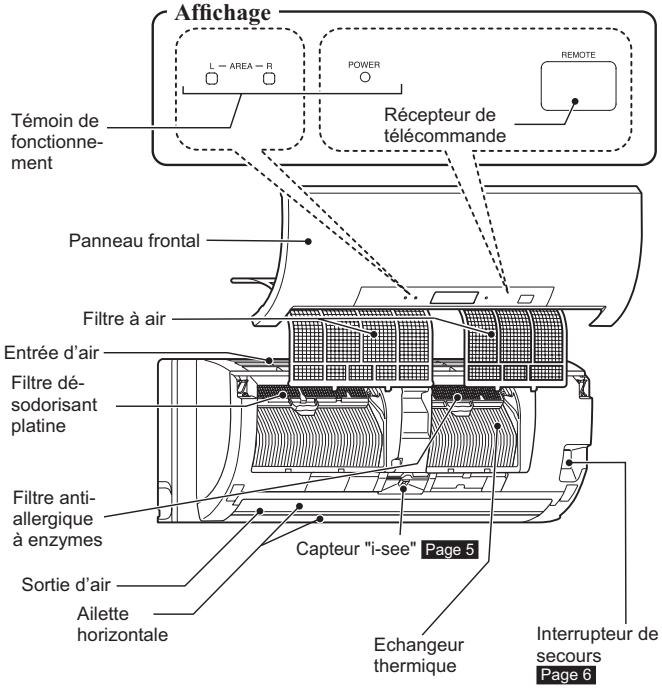
Installer un disjoncteur de fuites à la terre selon l'endroit où le climatiseur sera monté (pièce humide par ex.).
- L'absence de disjoncteur de fuites à la terre peut entraîner un risque d'électrocution.

Veiller à ce que l'eau de vidange s'écoule correctement.
- Si l'écoulement des condensats est bouché, l'eau de vidange risque de s'écouler de l'unité interne/externe et d'endommager le mobilier.

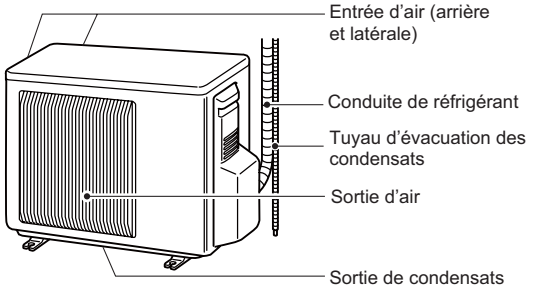
En présence d'une situation anormale
Arrêter immédiatement le climatiseur et consulter un revendeur agréé.

NOMENCLATURE

Unité interne

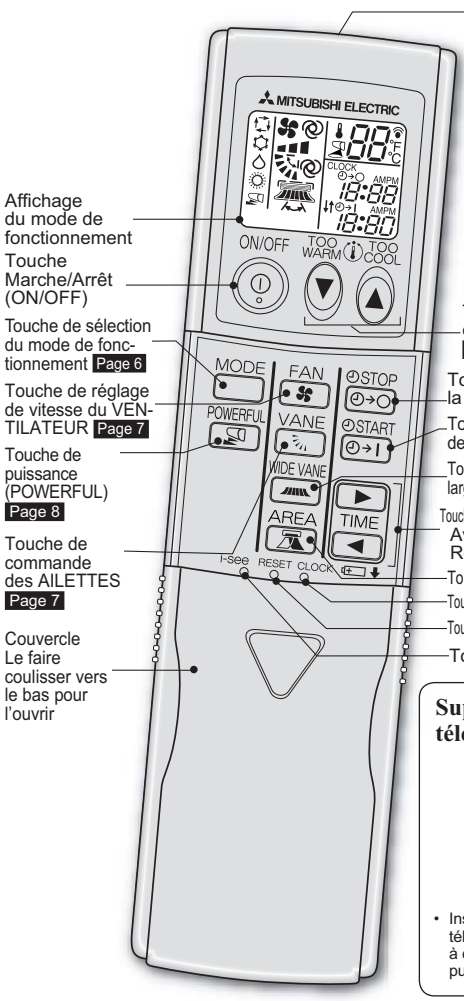


Unité externe

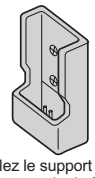


L'apparence des unités externes peut varier d'un modèle à l'autre.

Télécommande



Support de la télécommande



- Installez le support de la télécommande de façon à ce que l'unité interne puisse recevoir les signaux.

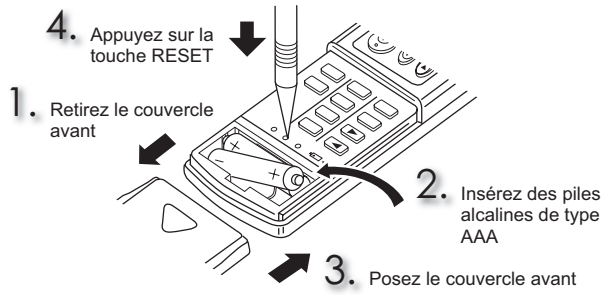
Utilisez uniquement la télécommande fournie avec le climatiseur.
N'en utilisez pas d'autres.

PREPARATIF D'UTILISATION

Avant la mise en marche : Insérez la fiche d'alimentation électrique dans la prise secteur et/ou enclenchez le disjoncteur.

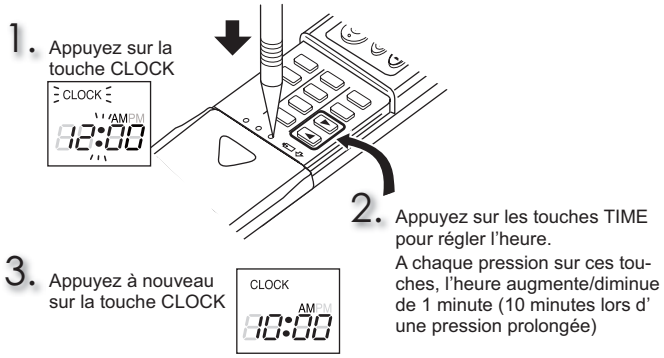
Insertion des piles dans la télécommande

Veuillez régler la position d'installation avant d'insérer les piles. Page 5

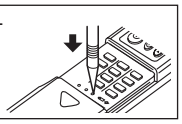


- Veillez à respecter la polarité des piles.
- N'utilisez pas de piles au manganèse. Elles pourraient provoquer un dysfonctionnement de la télécommande.
- N'utilisez pas de piles rechargeables.
- Remplacez toutes les piles par des piles de même type.
- La durée de vie des piles est de 1 an environ. Cependant, les piles dont la date d'utilisation est dépassée durent moins longtemps.
- Appuyez doucement sur RESET à l'aide d'un instrument fin. Si la touche RESET n'est pas enfoncée, la télécommande risque de ne pas fonctionner correctement.

Réglage de l'heure



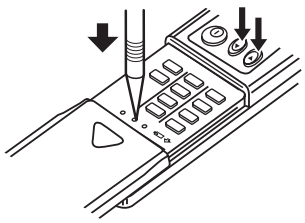
- Appuyez doucement sur CLOCK à l'aide d'un instrument fin.



Changement des unités de température (ºF→ºC)

L'unité prédéfinie est ºF.

1. Appuyez sur RESET lorsque vous enfoncez les touches de température.



- Appuyez doucement sur RESET à l'aide d'un instrument fin.
- Pour changer l'unité de la température entre degrés Celsius (°C) et degrés Fahrenheit (°F), appuyez sur la touche RESET.

PREPARATIF D'UTILISATION

Réglage de la position d'installation

Veuillez régler l'interrupteur à glissière de la télécommande selon la position d'installation de l'unité interne.

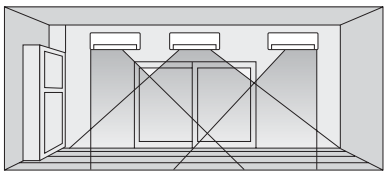
Position d'installation :

A gauche : La distance par rapport aux objets (mur, habillage, etc.) est inférieure à 19-11/16 in. (50 cm) à gauche

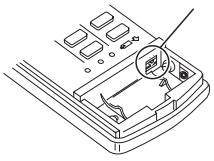
Au centre : La distance par rapport aux objets (mur, habillage, etc.) est supérieure à 19-11/16 in. (50 cm) à gauche et à droite

A droite : La distance par rapport aux objets (mur, habillage, etc.) est inférieure à 19-11/16 in. (50 cm) à droite

(A gauche)(Au centre)(A droite)



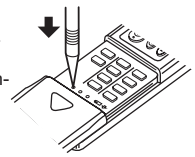
Interrupteur à glissière



Zone	A gauche	Au centre	A droite
Interrupteur à glissière	L . C . R	L . C . R	L . C . R
Affichage de la télécommande			

Appuyez sur la touche i-see ○ en mode de REFROIDISSEMENT pour lancer le contrôle "i-see".

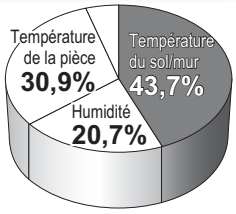
- Appuyez doucement à l'aide d'un instrument fin.
- s'allume. (Affichage du mode de fonctionnement)



Appuyez à nouveau sur la touche i-see ○ pour annuler le contrôle "i-see".

Contrôle "i-see"

Les capteurs mesurent en permanence la température de la pièce et du sol/mur de façon à ajuster automatiquement la température définie en faisant une estimation de la température réellement perçue par une personne présente dans la pièce ("température sensible").



capteur "i-see"

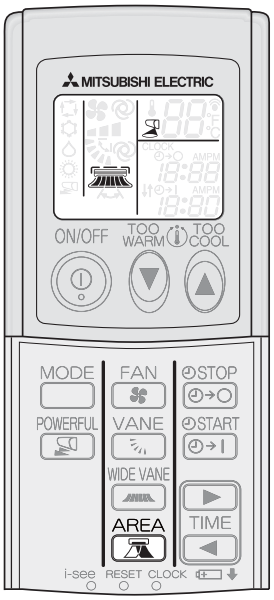
Lorsque le réglage du mode AREA (zone) est inactif, la plage de détection du capteur "i-see" dépend de la position d'installation du climatiseur.

Position d'installation	A gauche	Au centre	A droite
Plage de détection			

Remarque :

Ne touchez pas le capteur "i-see". Vous risquez de provoquer un dysfonctionnement du capteur "i-see".

REGLAGE DE ZONE



Appuyez sur la touche AREA pour sélectionner AREA (zone). Chaque nouvelle pression sur cette touche vous permet de passer d'une ZONE à l'autre dans l'ordre suivant :

(AUTO) → (A gauche) → (A droite) → Annuler *1

- Le contrôle "i-see" doit être actif pour que vous puissiez sélectionner AREA (zone).
- Vous ne pouvez pas sélectionner la direction horizontale du flux d'air WIDE VANE tant que AREA (zone) est actif.

*1 Direction horizontale du flux d'air réglée au moyen de WIDE VANE. Page 7

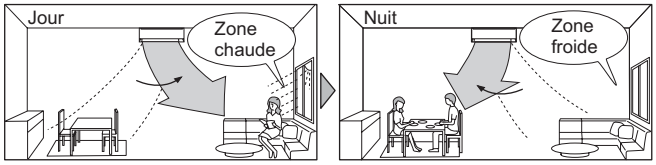
Appuyez sur AREA jusqu'à ce que "Annuler" soit sélectionné pour annuler le réglage du mode AREA (zone).

- Vous pouvez aussi appuyer sur WIDE VANE pour annuler le réglage du mode AREA (zone).

Zone

(AUTO) ....Le capteur "i-see" détecte les différences de température pour refroidir et réchauffer la pièce de façon efficace.

En mode de REFROIDISSEMENT :



(A GAUCHE) / (A DROITE)

Sélectionnez la zone que vous désirez climatiser.

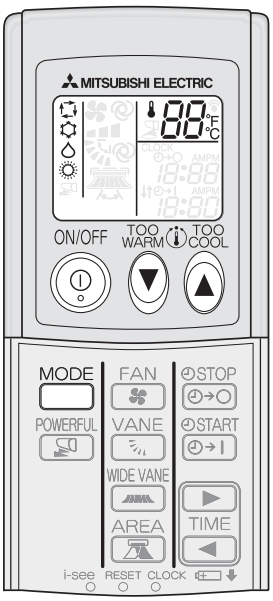
Affichage de l'unité interne

Direction horizontale du flux d'air :

A gauche	Centre ou oscillation	A droite
L — AREA — R	L — AREA — R	L — AREA — R

■ Eclairé □ Non éclairé

SELECTION DES MODES DE FONCTIONNEMENT



1 Appuyez sur la touche ON/OFF pour lancer le fonctionnement du climatiseur.

2 Appuyez sur la touche MODE pour sélectionner le mode de fonctionnement. Chaque nouvelle pression sur cette touche vous permet de passer d'un mode à l'autre dans l'ordre suivant :

(AUTO) → (REFROIDISSEMENT) → (DESHUMIDIFICATION) → (CHAUFFAGE)

3 Appuyez sur les touches TOO COOL ou TOO WARM pour régler la température.
Chaque nouvelle pression sur ces touches vous permet d'augmenter ou de diminuer la température de 1°F (1°C).

Appuyez sur la touche ON/OFF pour arrêter le fonctionnement du climatiseur.

- Vous avez la possibilité de recouvrer les mêmes réglages lors de la prochaine utilisation du climatiseur en appuyant simplement sur ON/OFF.

Mode AUTO (permutation automatique)

Le climatiseur sélectionne le mode de fonctionnement selon la différence qui existe entre la température de la pièce et la température programmée. En mode AUTO, le climatiseur passe d'un mode à l'autre (REFROIDISSEMENT↔CHAUFFAGE) lorsque la température de la pièce est inférieure de 4°F (2°C) à la température programmée pendant plus de 15 minutes.

Remarque :

- Le mode Auto est déconseillé si cette unité interne est connectée à une unité externe de type MXZ.
- Une unité externe peut fonctionner avec deux unités internes ou davantage. Si plusieurs unités internes fonctionnent simultanément, le climatiseur risque de ne pas pouvoir alterner entre les modes de REFROIDISSEMENT et de CHAUFFAGE. Dans ce cas, l'unité interne passe en mode de veille.

Mode de REFROIDISSEMENT

Le confort de l'air frais à votre température.
Ne faites pas fonctionner le climatiseur en mode de REFROIDISSEMENT lorsque les températures extérieures sont extrêmement basses. (inférieure à 14°F [-10°C]). L'eau de condensation présente à l'intérieur duclimatiseur risque de s'écouler et d'endommager le mobilier, etc.

Mode de DESHUMIDIFICATION

Eliminez l'humidité de votre pièce. Il se peut que la pièce refroidisse légèrement.
Il n'est pas possible de régler la température en mode de DESHUMIDIFICATION.

Mode de CHAUFFAGE

Le confort de l'air ambiant à votre température.

Fonctionnement d'urgence

Lorsqu'il est impossible d'utiliser la télécommande...

Vous pouvez lancer le fonctionnement d'urgence en appuyant sur l'interrupteur de secours (E.O.SW) de l'unité interne.

A chaque fois que vous appuyez sur l'interrupteur de secours (E.O.SW), le fonctionnement du climatiseur change dans l'ordre suivant :

Témoin de fonctionnement

L — AREA — R REFROIDISSEMENT d'urgence

L — AREA — R CHAUFFAGE d'urgence

L — AREA — R Arrêt

Température programmée: 75°F (24°C)
Vitesse du ventilateur: moyenne
Ailette horizontale: auto

Remarque :

Les premières 30 minutes de fonctionnement constitue un essai de fonctionnement. La commande de température ne fonctionne pas, et la vitesse du ventilateur est réglée sur Rapide.

Fonction de redémarrage automatique

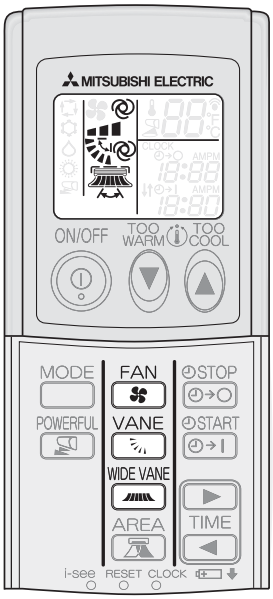
En cas de coupure d'électricité ou d'interruption de l'alimentation principale pendant le fonctionnement du climatiseur, la "fonction de redémarrage automatique" prend automatiquement le relais et permet de remettre le climatiseur en marche en respectant le mode sélectionné à l'aide la **télécommande** juste avant la coupure de l'alimentation. Si vous avez recours au fonctionnement manuel de la minuterie, le réglage de la minuterie sera annulé et le climatiseur redémarrera au retour de l'alimentation.

Si vous ne voulez pas utiliser cette fonction, veuillez vous adresser au représentant du service technique afin qu'il modifie le réglage du climatiseur.

Fonctionnement multi-système

Une unité externe peut fonctionner avec deux unités internes ou davantage. Lorsque plusieurs unités internes fonctionnent simultanément, les modes de refroidissement et de chauffage ne peuvent pas fonctionner en même temps. Lorsque le mode de REFROIDISSEMENT est sélectionné pour une unité et le mode CHAUFFAGE sur une autre, ou inversement, la dernière unité sélectionnée passe en mode de veille. Le témoin d'alimentation (POWER) s'allume et les témoins de zone (AREA) clignotent (affichage).

REGLAGE DE LA VITESSE DU VENTILATEUR ET DE LA DIRECTION DU FLUX D'AIR



FAN

Appuyez sur la touche pour sélectionner la vitesse du ventilateur. Chaque nouvelle pression sur cette touche vous permet de modifier la vitesse du ventilateur dans l'ordre suivant :

(AUTO) → (Faible) → (Moy.) → (Elevée)

• L'unité interne émet deux bips courts lorsqu'elle est réglée en mode AUTO.

VANE

Appuyez sur la touche pour sélectionner la direction du flux d'air. Chaque nouvelle pression sur cette touche vous permet de modifier la direction du flux d'air dans l'ordre suivant :

(AUTO) → (1) → (2) → (3) → (4) → (5) → (OSCILLATION)

• L'unité interne émet deux bips courts lorsqu'elle est réglée en mode AUTO.

WIDE VANE

Appuyez sur la touche pour sélectionner la direction horizontale du flux d'air. Chaque nouvelle pression sur cette touche vous permet de modifier la direction du flux d'air dans l'ordre suivant :

→ → → → → (OSCILLATION)

Direction du flux d'air verticale

(AUTO)

L'ailette se place de façon à ce que la direction du flux d'air soit la plus efficace possible. REFROIDISSEMENT/DESHUMIDIFICATION : position horizontale. CHAUFFAGE : orientation vers le bas.

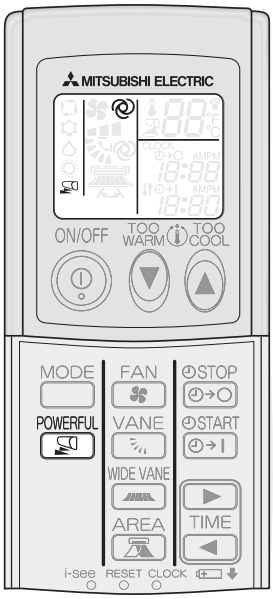
(Manuel)

Pour obtenir une climatisation efficace, l'ailette doit être dirigée vers le haut en mode de REFROIDISSEMENT/DESHUMIDIFICATION, et vers le bas en mode de CHAUFFAGE. En mode de REFROIDISSEMENT/DESHUMIDIFICATION, si l'ailette est réglée en position (4) ou (5), elle se place automatiquement en position horizontale au bout d'1 heure pour éviter la formation de gouttes de condensation.

(Oscillation)

L'ailette monte et descend de façon intermittente.

MODE DE FONCTIONNEMENT PUISSANCE



Appuyez sur cette touche (POWERFUL) en mode de REFROIDISSEMENT ou de CHAUFFAGE Page 6 pour lancer le mode de fonctionnement PUISSANCE.

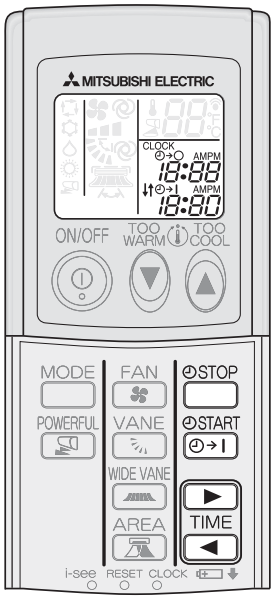
Vitesse du ventilateur : Vitesse exclusive au mode PUISSANCE
Ailette horizontale : Définissez la position ou la position du flux d'air vers le bas lors du réglage AUTO

- Il est impossible de régler la température en mode de fonctionnement PUISSANCE.

Appuyez à nouveau sur cette touche (POWERFUL) pour annuler le mode de fonctionnement PUISSANCE.

- Le mode de fonctionnement PUISSANCE s'annule également automatiquement en 15 minutes ou lorsque vous appuyez sur la touche Marche/Arrêt (ON/OFF) ou sur la touche de réglage de vitesse du VENTILATEUR.

FONCTIONNEMENT DE LA MINUTERIE (MARCHE/ARRET)



1 Appuyez sur les touches (START) ou (STOP) pendant le fonctionnement du climatiseur pour régler la minuterie.

(START) (Démarrage de la minuterie [ON]) :
Le climatiseur démarrera (ON) à l'heure programmée.

(STOP) (Arrêt de la minuterie [OFF]) :
Le climatiseur s'arrêtera (OFF) à l'heure programmée.

* **⏲→I ou ⏲→○ clignote.**
* **La minuterie doit être réglée à l'heure juste.** Page 4

2 Appuyez sur les touches (►) (Augmenter) et (◄) (Diminuer) pour régler l'heure de la minuterie.
Chaque pression sur ces touches vous permet de faire avancer ou reculer l'heure programmée de 10 minutes.

Appuyez à nouveau sur les touches (START) ou (STOP) pour annuler le fonctionnement de la minuterie.

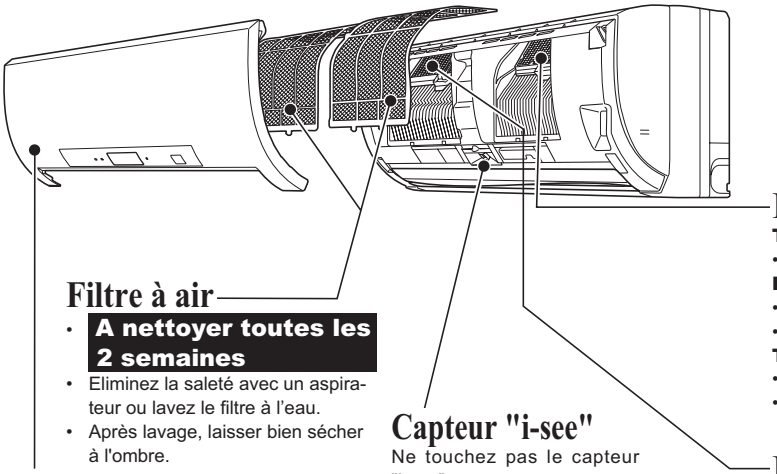
Remarque :

- Les fonctions de démarrage (ON) et d'arrêt (OFF) de la minuterie peuvent être réglées conjointement. Le symbole ⇵ indique l'ordre d'application des modes de fonctionnement de la minuterie.
- En cas de coupure d'électricité survenant après le réglage de la minuterie (MARCHE/ARRET), voir Page 6 "Fonction de redémarrage automatique".

NETTOYAGE

Instructions :

- Coupez l'alimentation ou le disjoncteur avant de procéder au nettoyage du climatiseur.
- Veillez à ne pas toucher les parties métalliques avec les mains.
- N'utilisez ni benzine, ni diluant, ni poudre abrasive, ni insecticide.
- Utilisez uniquement un détergent doux dilué avec de l'eau.
- N'exposez pas les pièces aux rayons directs du soleil, à la chaleur ou à une flamme pour les faire sécher.
- N'utilisez pas d'eau dont la température est supérieure à 120°F (50°C).



Filtre à air

- **A nettoyer toutes les 2 semaines**
- Eliminez la saleté avec un aspirateur ou lavez le filtre à l'eau.
- Après lavage, laisser bien sécher à l'ombre.

Capteur "i-see"

Ne touchez pas le capteur "i-see".

Filtre antiallergique à enzymes

Tous les 3 mois :

- Enlever la saleté à l'aide d'un aspirateur.

Lorsque cela ne suffit pas :

- Faites tremper le filtre et son cadre dans de l'eau tiède avant de les nettoyer.
- Lorsqu'ils sont propres, faites-les sécher correctement à l'ombre.

Tous les ans :

- Pour des performances optimales, remplacer le filtre d'épuration d'air.
- Référence MAC-418FT-E

Filtre désodorisant platine

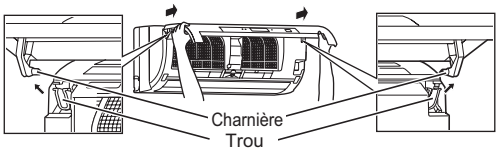
Tous les 3 mois :

- Eliminez la saleté avec un aspirateur, ou immergez le filtre dans un récipient d'eau tiède (86 à 104°F [30 à 40°C]) pendant 15 minutes environ. Rincez abondamment.
- Lorsqu'ils sont propres, faites-les sécher correctement à l'ombre.
- La fonction de désodorisation se régénère grâce au nettoyage du filtre.

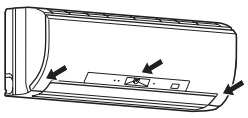
Lorsque le nettoyage ne suffit pas à éliminer la saleté ou l'odeur :

- Remplacer le filtre d'épuration d'air.
- Référence MAC-308FT-E

Panneau frontal



1. Soulevez le panneau frontal jusqu'à ce que vous entendiez un déclic.
2. Maintenez les charnières et tirez sur le panneau pour le retirer comme indiqué sur l'illustration ci-dessus.
   - Essuyez-le avec un chiffon doux et sec ou lavez-le à l'eau.
   - Ne le faites pas tremper dans l'eau pendant plus de deux heures.
   - Faites-le sécher correctement à l'ombre avant de le reposer.
3. Reposez le panneau en suivant la procédure de dépose en sens inverse. Refermez correctement le panneau frontal et appuyez sur les repères indiqués par les flèches.



! Important

- **Nettoyez régulièrement les filtres pour obtenir des performances optimales et réduire votre consommation d'électricité.**
- **Ne touchez pas le capteur "i-see".**
- **Des filtres encrassés peuvent provoquer de la condensation dans le climatiseur, ce qui contribuera à la croissance de certains champignons tels que la moisissure. Il est donc recommandé de nettoyer les filtres à air toutes les 2 semaines.**

EN PRESENCE D'UNE PANNE POTENTIELLE

Suite à la vérification de ces points, si le climatiseur ne fonctionne toujours pas correctement, ne vous en servez plus et consultez votre revendeur.

Symptôme	Explication & points à vérifier
Unité interne	
L'unité ne fonctionne pas.	• Le disjoncteur est-il enclenché ? • La fiche d'alimentation est-elle branchée ? • La minuterie de mise en marche (ON) est-elle programmée ? Page 8
L'ailette horizontale ne bouge pas.	• Les ailettes horizontale et verticale sont-elles installées correctement ? Page 9
L'unité ne peut pas être remise en marche dans les 3 minutes qui suivent sa mise hors tension.	• Cette disposition a été prise pour protéger le climatiseur conformément aux instructions du microprocesseur. Veuillez patienter.
De la buée s'échappe de la sortie d'air de l'unité interne.	• L'air frais pulsé par le climatiseur refroidit rapidement l'humidité présente dans la pièce, et la transforme en buée.
L'oscillation de l'AILETTE HORIZONTALE est suspendue un certain temps, puis restaurée.	• Cela permet l'oscillation correcte de l'AILETTE HORIZONTALE.
La direction de l'air pulsé varie pendant le fonctionnement de l'unité. La télécommande ne permet pas de régler la direction de l'ailette horizontale.	• Lorsque le climatiseur est en mode de REFROIDISSEMENT ou de DESHUMIDIFICATION, s'il fonctionne en continu entre 0,5 et 1 heure avec le flux d'air orienté vers le bas, la direction de l'air pulsé est automatiquement placée en position horizontale afin d'empêcher l'eau de condensation de s'écouler. • En mode de chauffage, si la température de l'air pulsé est trop basse ou si le dégivrage est en cours, l'ailette horizontale se place automatiquement en position horizontale.
Le fonctionnement s'arrête pendant 10 minutes environ en mode de chauffage.	• L'unité extérieure est en cours de dégivrage. Cette opération prend 10 minutes environ, veuillez patienter. (Une température extérieure trop basse et un taux d'humidité trop élevé provoquent une formation de givre.)
L'unité démarre automatiquement lors de la mise sous tension, sans avoir reçu aucun signal de la télécommande.	• Ces modèles sont équipés d'une fonction de redémarrage automatique. Si vous coupez l'alimentation principale sans arrêter le climatiseur avec la télécommande puis remettez sous tension, le climatiseur démarre automatiquement dans le même mode que celui qui avait préalablement été sélectionné à l'aide de la télécommande avant la mise hors tension. Consultez la section "Fonction de redémarrage automatique" Page 6.
Multi-système	
L'unité interne qui ne fonctionne pas chauffe et émet un bruit similaire au bruit de l'eau qui s'écoule.	• Une petite quantité de réfrigérant continue à circuler dans l'unité interne même lorsque celle-ci ne fonctionne pas.
Lorsque le mode de chauffage est sélectionné, le climatiseur ne démarre pas immédiatement.	• Lorsque le climatiseur se met en marche alors que le dégivrage de l'unité externe est en cours, il faut attendre quelques minutes (10 minutes maxi.) pour que l'air pulsé se réchauffe.
Unité externe	
Le ventilateur de l'unité externe ne tourne pas alors que le compresseur fonctionne correctement. Même s'il se met à tourner, le ventilateur s'arrête aussitôt.	• Lorsque la température extérieure est basse, le ventilateur fonctionne de façon intermittente en mode de refroidissement pour maintenir une capacité de refroidissement suffisante.
De l'eau s'écoule de l'unité externe.	• En mode de REFROIDISSEMENT et de DESHUMIDIFICATION, la tuyauterie et les raccords de tuyauterie sont refroidis et un certain degré de condensation peut se produire. • En mode de chauffage, l'eau de condensation présente sur l'échangeur thermique peut goutter. • En mode de chauffage, l'opération de dégivrage fait fondre la glace présente sur l'unité externe et celle-ci se met à goutter.

Symptôme	Explication & points à vérifier
Unité externe	
De la fumée blanche sort de l'unité externe.	• En mode de chauffage, la vapeur générée par l'opération de dégivrage peut ressembler à de la fumée blanche.
Télécommande	
Aucun affichage sur la télécommande ou affichage indistinct. L'unité interne ne répond pas au signal de la télécommande.	• Les piles sont-elles déchargées ? Page 4 • La polarité (+, -) des piles est-elle correcte ? Page 4 • Avez-vous appuyé sur les touches de télécommandes d'autres appareils électriques ?
Le climatiseur ne chauffe ni ne refroidit correctement	
Impossible de refroidir ou de chauffer suffisamment la pièce.	• Le réglage de la température est-il adapté ? Page 6 • Le réglage du ventilateur est-il adapté ? Veuillez régler le ventilateur sur une vitesse plus rapide. Page 7 • Les filtres sont-il propres ? Page 9 • Le ventilateur ou l'échangeur thermique de l'unité interne sont-ils propres ? • L'entrée ou la sortie d'air des unités interne et externe sont-elles obstruées ? • Y a t-il une fenêtre ou une porte ouvertes ?
Le refroidissement de la pièce n'est pas satisfaisant.	• Si vous utilisez un ventilateur ou une gazinière dans la pièce, la charge de refroidissement augmente, et le refroidissement ne peut se faire de manière satisfaisante. • Lorsque la température extérieure est élevée, il se peut que le refroidissement ne se fasse pas de manière satisfaisante.
Le réchauffement de la pièce n'est pas satisfaisant.	• Lorsque la température extérieure est basse, le climatiseur peut ne pas fonctionner de manière satisfaisante pour réchauffer la pièce.
L'air pulsé tarde à sortir du climatiseur en mode de chauffage.	• Veuillez patienter car le climatiseur se prépare à souffler de l'air chaud.
Flux d'air	
L'air qui sort de l'unité interne a une odeur étrange.	• Les filtres sont-il propres ? Page 9 • Le ventilateur ou l'échangeur thermique de l'unité interne sont-ils propres ? • Le climatiseur peut être imprégné de l'odeur d'un mur, d'un tapis, d'un meuble, de vêtements, etc. et la rejeter avec l'air pulsé.
Bruit	
Des craquements se produisent.	• Ce phénomène provient de l'expansion/la contraction du panneau frontal, etc. en raison des variations de température.
Un "murmure" est perceptible.	• Ce bruit est perceptible lorsque de l'air frais pénètre dans le tuyau d'écoulement ; il provient de l'évacuation de l'eau présente dans le tuyau lors de l'ouverture du bouchon ou de la rotation du ventilateur. Ce bruit est également perceptible lorsque de l'air frais pénètre dans le tuyau d'écoulement par vents violents.
Un bruit mécanique provient de l'unité interne.	• Il s'agit du bruit de mise en marche/arrêt du ventilateur ou du compresseur.
Un bruit d'écoulement d'eau se produit.	• Ce bruit peut provenir de la circulation du réfrigérant ou de l'eau de condensation dans le climatiseur.
Un sifflement est parfois perceptible.	• Il s'agit du bruit que fait le réfrigérant à l'intérieur du climatiseur lorsqu'il change de sens.

Dans les cas suivants, arrêtez le climatiseur et consultez votre revendeur.

- Si de l'eau s'écoule ou goutte de l'unité interne.
- Si le témoin de FONCTIONNEMENT clignote.
- Si le disjoncteur saute régulièrement.
- L'unité interne peut ne pas recevoir les signaux de la télécommande dans une pièce dont le système d'éclairage est à lampes fluorescentes (à oscillateur intermittent, etc.).
- Le fonctionnement du climatiseur interfère avec la réception radio ou TV. Il peut s'avérer nécessaire de brancher un amplificateur sur l'appareil concerné.
- Si l'unité émet un bruit anormal.

SI LE CLIMATISEUR DOIT RESTER LONGTEMPS INUTILISE

1 Sélectionnez manuellement le mode de REFROIDISSEMENT et réglez la température la plus élevée ; faites fonctionner le climatiseur entre 3 et 4 heures. Page 6
- Cette opération permet de sécher l'intérieur du climatiseur.
- La présence d'humidité dans la climatisation contribue à créer un terrain favorable à la croissance de certains champignons tels que la moisissure.

2 Appuyez sur ON/OFF pour arrêter le fonctionnement du climatiseur.

3 Débranchez la fiche d'alimentation électrique et/ou coupez le disjoncteur.

4 Retirez toutes les piles de la télécommande.

Lorsque le climatiseur doit être remis en service :

1 Nettoyez le filtre à air. Page 9

2 Veillez à ce que l'entrée et la sortie d'air des unités interne et externe ne soient pas obstruées.

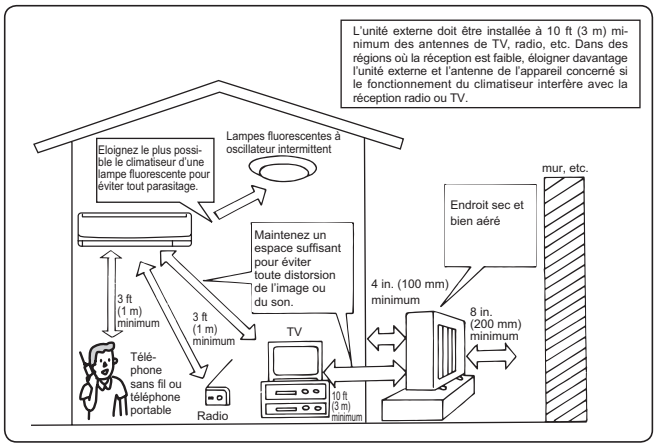
3 Veillez à raccorder correctement le câble de mise à la terre.

4 Reportez-vous à la section "PREPARATIF D'UTILISATION" et suivez les instructions. Page 4

LIEU D'INSTALLATION ET TRAVAUX ELECTRIQUES

Lieu d'installation

Evitez d'installer le climatiseur dans les endroits suivants.
- En présence d'une grande quantité d'huile de machine.
- Dans les régions où l'air est très salin, comme en bord de mer.
- En présence de gaz sulfurique, comme dans les stations thermales.
- Dans des endroits exposés à des projections d'huile ou dont l'atmosphère est chargée d'huile.
- En présence d'équipements haute fréquence ou sans fil.
- Dans un endroit où la sortie d'air de l'unité externe est susceptible d'être obstruée.
- Dans un endroit où le bruit de fonctionnement ou la pulsation d'air chaud risquent de représenter une nuisance pour le voisinage.



Travaux électriques

- Veuillez prévoir un circuit réservé à l'alimentation du climatiseur.
- Veuillez respecter la puissance électrique du disjoncteur.

Dans le doute, veuillez consulter votre revendeur.

FICHE TECHNIQUE

Gamme opérationnelle garantie

		Interne	Externe
Refroidissement	Limite supérieure	90°F (32,2°C) DB	115°F (46,1°C) DB
		73°F (22,8°C) WB	—
	Limite inférieure	67°F (19,4°C) DB	14°F (-10°C) DB
		57°F (13,9°C) WB	—
Chauffage	Limite supérieure	80°F (26,7°C) DB	75°F (23,9°C) DB
		—	65°F (18,3°C) WB
	Limite inférieure	70°F (21,1°C) DB	-13°F (-25°C) DB
		—	-14°F (-25,6°C) WB

DB : Bulbe sec
WB : Bulbe humide

Remarque:

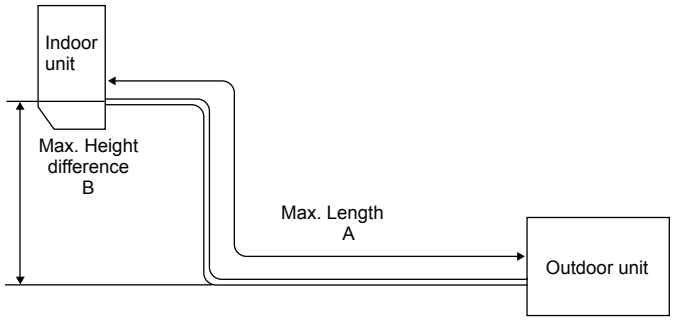
Si la température extérieure est en-dessous de la limite inférieure de la gamme opérationnelle garantie, il se peut que l'unité externe s'arrête jusqu'à ce que la température extérieure dépasse la limite inférieure.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

SG79F408H01

MAX. REFRIGERANT PIPING LENGTH and MAX. HEIGHT DIFFERENCE

Model	Refrigerant piping: ft.		Piping size O.D: in.	
	Max. Length A	Max. Height difference B	Gas	Liquid
MUZ-FE09NA MUZ-FE12NA MUZ-FE12NA1	65	40	3/8	1/4
MUZ-FE18NA	100	50	5/8	3/8



ADDITIONAL REFRIGERANT CHARGE (R410A: oz.)

NOTE: Refrigerant piping exceeding 25 ft. requires additional refrigerant charge according to the calculation.

Model	Outdoor unit precharged	Refrigerant piping length (one way): ft.					
		25	30	40	50	60	65
MUZ-FE09NA MUZ-FE12NA MUZ-FE12NA1	2 lb. 9 oz.	0	1.62	4.86	8.10	11.34	12.96

Calculation: X oz. = 1.08/5 oz. / ft. × (Refrigerant piping length (ft.) - 25)

NOTE: Refrigerant piping exceeding 33 ft. requires additional refrigerant charge according to the calculation.

Model	Outdoor unit precharged	Refrigerant piping length (one way): ft.							
		33	40	50	60	70	80	90	100
MUZ-FE18NA	4 lb. 3 oz.	0	4.14	10.06	15.98	21.90	27.82	33.74	39.66

Calculation: X oz. = 2.96/5 oz. / ft. × (Refrigerant piping length (ft.) - 33)

ENGLISH

MITSUBISHI ELECTRIC

SPLIT-TYPE AIR CONDITIONERS

INSTALLATION MANUAL

JG79A230H03

MSZ-FE09/12NA

When installing multi units, refer to the installation manual of the multi unit for outdoor unit installation.

Required Tools for Installation

Phillips screwdriver	5/32 in. (4 mm) hexagonal wrench
Level	Flare tool for R410A
Scale	Gauge manifold for R410A
Utility knife or scissors	Vacuum pump for R410A
2-9/16 in. (65 mm) hole saw	Charge hose for R410A
Torque wrench	Pipe cutter with reamer
Wrench (or spanner)	

1. BEFORE INSTALLATION

1-1. THE FOLLOWING SHOULD ALWAYS BE OBSERVED FOR SAFETY

- Be sure to read these safety precautions and instructions.
- Be sure to observe the warnings and cautions specified here.
- After reading this manual, be sure to store it with the OPERATING INSTRUCTIONS for future reference.
- Please report to your supply authority or obtain their consent before connecting this equipment to the power supply system.

⚠ WARNING (Could lead to death or serious injury.)

- **Do not install the unit by yourself (user).**
  Improper or incomplete installation could cause fire, electric shock, injury due to the unit falling, or water leakage. Consult a qualified installer or the dealer from whom you purchased the unit.
- **Follow the instructions detailed in the installation manual.**
  Incomplete installation could cause fire or electric shock, injury due to the unit falling, or leakage of water.
- **Install the unit securely in a place that can bear the weight of the unit.**
  If the installation location cannot bear the weight of the unit, the unit could fall causing injury.
- **Perform electrical work according to the installation manual and be sure to use an exclusive circuit. Do not connect other electrical appliances to the circuit.**
  If the capacity of the power circuit is insufficient or there is incomplete electrical work, it could result in a fire or an electric shock.
- **Ground the unit correctly.**
  Do not connect the ground wire to a gas pipe, water pipe, lightning rod or telephone ground. Defective grounding could cause electric shock.
- **Do not damage the wires.**
  Damaged wires could cause fire.
- **Be sure to shut off the main power when setting up the indoor P.C. board or wiring.**
  Failure to do so could cause electric shock.
- **Use the specified wires to securely connect the indoor and outdoor units. Attach the wires firmly to avoid applying stress to the terminal block.**
  Improper connection could cause fire.
- **Do not install the unit in a place where flammable gas may leak.**
  If gas leaks and accumulates around the unit, it could cause an explosion.
- **Do not use intermediate connection of the power cord or the extension cord. Do not connect many devices to one AC outlet.**
  It could cause a fire or an electric shock.
- **Use the parts provided or specified parts for the installation work.**
  The use of defective parts could cause an injury or leakage of water due to a fire, an electric shock, the unit falling, etc.
- **When plugging the power supply plug into the outlet, make sure that there is no dust, blockage, or loose parts both in the outlet and on the plug. Verify that the power supply plug is completely in the outlet.**
  If there is dust, blockage, or loose parts on the power supply plug or the outlet, it could cause electric shock or fire. If loose parts are found on the power supply plug, replace it.
- **Securely attach the electrical cover to the indoor unit and the service panel to the outdoor unit.**
  If the electrical cover of the indoor unit and/or the service panel of the outdoor unit are not attached securely, dust, water, etc. could collect in the unit and could cause a fire or an electric shock.
- **When installing or relocating the unit, make sure that no substance other than the specified refrigerant (R410A) enters the refrigerant circuit.**
  Any foreign substances in the refrigerant circuit can cause abnormal pressure rise or an explosion.
- **Do not discharge the refrigerant into the atmosphere. Check that the refrigerant gas does not leak after installation has been completed. If refrigerant leaks during installation, ventilate the room.**
  If refrigerant comes in contact with a fire, harmful gas could be generated.
  If refrigerant gas leaks indoors, and comes into contact with the flame of a fan heater, space heater, stove, etc., harmful gases will be generated.
- **Use appropriate tools and piping materials for installation.**
  The pressure of R410A is 1.6 times higher than R22. Not using the appropriate tools and materials, or improper installation could cause the pipes to burst causing an injury.
- **When pumping down the refrigerant, stop the compressor before disconnecting the refrigerant pipes.**
  If the refrigerant pipes are disconnected while the compressor is running and the stop valve is open, air could be drawn in and the pressure in the refrigeration cycle could become abnormally high, causing the pipes to burst.
- **When installing the unit, securely connect the refrigerant pipes before starting the compressor.**
  If the compressor is started before the refrigerant pipes are connected and the stop valve is open, air could be drawn in and the pressure in the refrigeration cycle could become abnormally high, causing the pipes to burst.
- **Fasten a flare nut with a torque wrench as specified in this manual.**
  If fastened too tight, a flare nut could break and cause refrigerant leakage.
- **Install the unit according to national wiring regulations.**

⚠ CAUTION (Could lead to serious injury when operated incorrectly.)

- **Depending on the installation area, install a Ground Fault Interrupt (GFI) circuit breaker.**
  If the Ground Fault Interrupt (GFI) circuit breaker is not installed, an electric shock could occur.
- **Perform the drainage/piping work securely according to the installation manual.**
  If there is defect in the drainage/piping work, water could drip from the unit, and damage household items.
- **Do not touch the air inlet or the aluminum fins of the outdoor unit.**
  This could cause injury.
- **Do not install the outdoor unit where small animals may live.**
  If small animals enter the unit and damage its electrical parts, it could cause a malfunction, smoke emission, or fire. Keep the area around the unit clean.

1-2. SELECTING THE INSTALLATION LOCATION

INDOOR UNIT

- Where airflow is not blocked.
- Where cool air spreads over the entire room.
- On a rigid wall to reduce the possibility of vibration.
- Where it is not exposed to direct sunlight.
- Where it can be easily drained.
- At a distance 3 ft. (1 m) or more away from a TV and radio. Operation of the air conditioner may interfere with radio or TV reception. An amplifier may be required for the affected device.
- In a place as far away as possible from fluorescent and incandescent lights (so the infrared remote control can operate the air conditioner normally).
- Where the air filter can be removed and replaced easily.

Note:
Install the indoor unit high on the wall where air can distribute over the entire room.

REMOTE CONTROLLER

- Where it is convenient to operate and easily visible.
- Where children cannot easily touch it.
- Select a position about 4 ft. (1.2 m) above the floor. Check that signals from the remote controller from that position are received by the indoor unit ('beep' or 'beep beep' receiving tone sounds). Then, attach remote controller holder to a pillar or wall and install wireless remote controller.

Note:
In rooms where inverter type fluorescent lamps are used, the signal from the wireless remote controller may not be received.

OUTDOOR UNIT

- Where it is not overly exposed to strong winds.
- Where airflow is good and dustless.
- Where neighbours are not annoyed by operation sound or hot air.
- Where rigid wall or support is available to prevent the increase of operation sound or vibration.
- Where there is no risk of combustible gas leakage.
- If installing the unit in a location high above the ground, be sure to secure the unit legs.
- Where it is at least 10 ft. (3 m) away from the antenna of TV set or radio. Operation of the air conditioner may interfere with radio or TV reception in areas where reception is weak. An amplifier may be required for the affected device.
- Install the unit horizontally.
- Please install it in an area not affected by snowfall or blowing snow. In areas with heavy snow, please install a canopy, a pedestal and/or baffle boards.

Note:

- It is advisable to make a piping loop near outdoor unit so as to reduce vibration.
- For increased efficiency, install the outdoor unit in a location where continuous direct sunlight or excessive water can be avoided as much as possible.

Note:
When operating the air conditioner in low outside temperature, be sure to follow the instructions described below.

- Never install the outdoor unit in a place where its air inlet/outlet side may be exposed directly to wind.
- To prevent exposure to wind, install the outdoor unit with its air inlet side facing the wall and a baffle board on the air outlet side.

Avoid the following places for installation where air conditioner trouble is liable to occur.

- Where flammable gas could leak.
- Where there is an excessive amount of machine oil in the air.
- Salty places such as the seaside.
- Where sulfide gas is generated such as a hot spring.
- Where there is high-frequency or wireless equipment.

1-3. SPECIFICATIONS

1-3-1. POWER SUPPLY AND INDOOR/OUTDOOR WIRE CONNECTION

- Power should be taken from an exclusive branched circuit.
- Wiring work should be based on applicable technical standards.
- Wiring connections should be made following the diagram.
- Securely tighten screws.

Connecting wires and the ground wire

- Use solid conductor AWG14 or stranded conductor AWG14.
- Use double insulated copper wire with 600 V insulation.
- Use copper conductors only.

* Follow local electrical codes.

Power supply cable and ground wire

- Use solid or stranded conductor AWG14.
- Use copper conductors only.

* Follow local electrical codes.

Note:
When the indoor unit is powered from the outdoor unit, depending on local code, a disconnect switch needs to be installed to a power supply circuit.

Electrical specifications

MODEL		MSZ-FE09/12NA
INDOOR UNIT		
Power supply (V, PHASE, Hz)		208/230, 1, 60
Min. Circuit Ampacity (A)		1.0
Fan motor (F.L.A.) (A)		0.76
OUTDOOR UNIT		
Power supply (V, PHASE, Hz)		208/230, 1, 60
Max. Fuse size (time delay) (A)		15
Min. Circuit Ampacity (A)		12
Fan motor (F.L.A.) (A)		0.56
Compressor	(R.L.A) (A)	8.6
	(L.R.A) (A)	10.8
Control voltage		Indoor unit - Remote controller: (Wireless) Indoor unit - Outdoor unit: DC12-24 V (Polar)

1-3-2. REFRIGERANT PIPES

- To prevent condensation, insulate the two refrigerant pipes.
- Refrigerant pipe bending radius must be 4 in. (100 mm) or more.

⚠ CAUTION
Be sure to use the insulation of specified thickness (table on the right). Excessive insulation may cause incorrect installation of the indoor unit, and too little insulation may cause condensate to form.

Pipe	Outside diameter	Minimum wall thickness	Insulation thickness	Insulation material
	inch (mm)			
For liquid	1/4 (6.35)	0.0315 (0.8)	5/16 (8)	Heat resistant foam plastic 0.045 Specific gravity
For gas	3/8 (9.52)	0.0315 (0.8)	5/16 (8)	

- The unit has flared connections on both indoor and outdoor sides.
- Remove the valve cover from the outdoor unit, then connect the pipe.
- Refrigerant pipes are used to connect the indoor and outdoor units.
- Be careful not to crush or over bend the pipe in pipe bending.

Limits	
Pipe length	65 ft. (20 m) max.
Height difference	40 ft. (12 m) max.
No. of bends	10 max.

- Refrigerant adjustment... If pipe length exceeds 25 ft. (7.5 m), additional refrigerant (R410A) charge is required.

(The outdoor unit is charged with refrigerant for pipe length up to 25 ft. [7.5 m])

Pipe length	Up to 25 ft. (7.5 m)	No additional charge is required.
	Exceeding 25 ft. (7.5 m)	Additional charge is required. (Refer to the table below.)
Refrigerant to be added	1.62 oz each 5 ft. (30 g/m)	

1-4. INSTALLATION DIAGRAM

ACCESSORIES
Check the following parts before installation.
<Indoor unit>

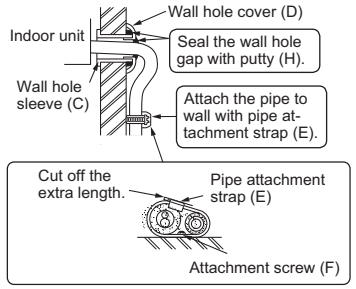
(1)	Installation plate	1
(2)	Attachment screws for the installation plate 4 × 25 mm	5
(3)	Remote controller holder	1
(4)	Screws for the remote controller holder 3.5 × 16 mm (Black)	2
(5)	Battery (AAA) for (6)	2
(6)	Wireless remote controller	1
(7)	Felt tape (For left or left-rear piping)	1
(8)	Anti-Allergy Enzyme Filter	1
(9)	Platinum deodorizing filter	1

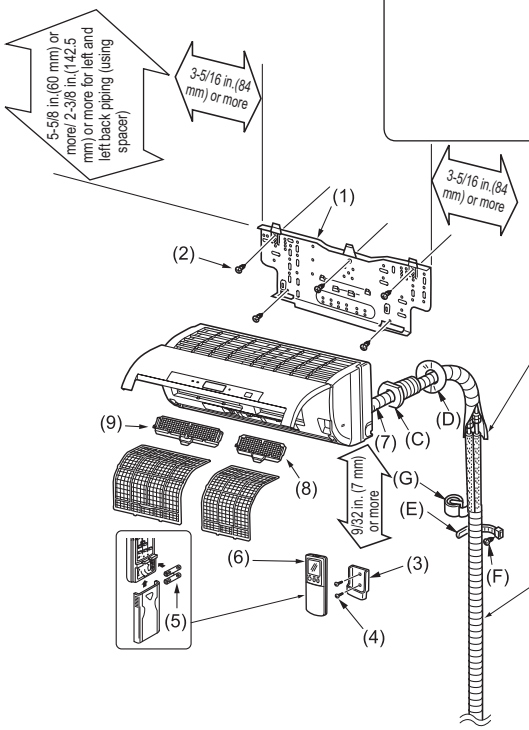
FIELD-SUPPLIED PARTS

(A)	Indoor/outdoor unit connecting wire*	1
(B)	Extension pipe	1
(C)	Wall hole sleeve	1
(D)	Wall hole cover	1
(E)	Pipe attachment strap	2 to 5
(F)	Screw for (E) 4 × 20 mm	2 to 5
(G)	Piping tape	1
(H)	Putty	1
(I)	Drain hose (or soft PVC hose, 19/32 in. [15 mm] inner diameter or hard PVC pipe VP16)	2 to 5
(J)	Refrigerant oil	1
(K)	Power supply cord*	1

*** Note:**
Place indoor/outdoor unit connecting wire (A) and power supply cord (K) at least 3 ft. (1 m) away from the TV antenna wire.

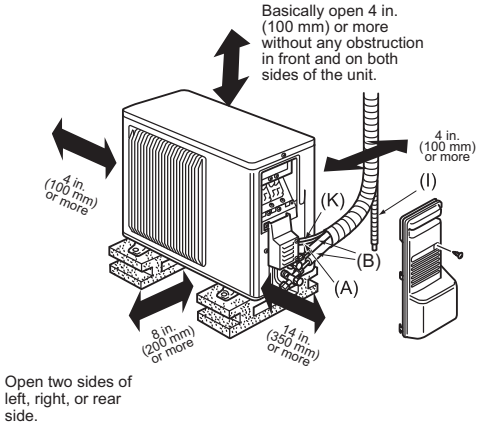
Use the wall hole sleeve (C) to prevent indoor/outdoor connecting wire (A) from contacting metal parts in the wall and to protect the wiring from rodents.



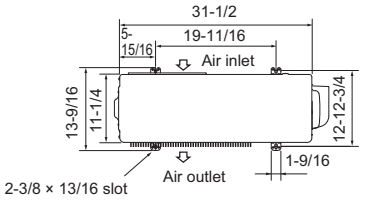


After the leak test, apply insulating material tightly so that there is no gap.

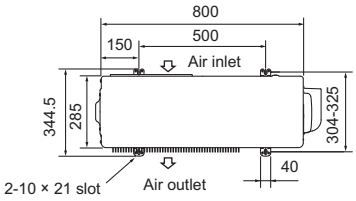
When the piping is to be attached to a wall comprised of tin plate or metal netting, use chemically treated wooden piece 25/32 in. (20 mm) or thicker between the wall and the piping, or wrap insulation vinyl tape 7 to 8 turns around the piping.
To use existing piping, perform COOL operation for 30 minutes and pump down before removing the old air conditioner. Remake flare according to the dimension for new refrigerant.



Unit: inch



Unit: mm



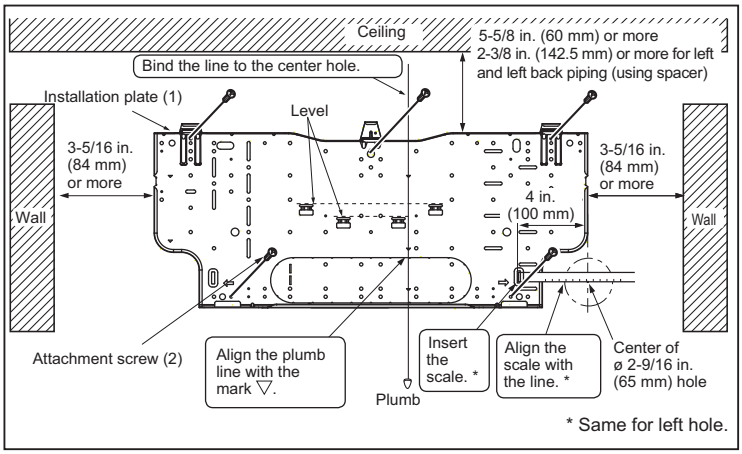
Units should be installed by licensed contractor according to local code requirements.

Drain piping for outdoor unit
Install the unit horizontally.
Do not use drain socket in cold regions. Drain may freeze and make the fan stop.
The outdoor unit produces condensate during the heating operation. Select the installation place to ensure to prevent the outdoor unit and/or the grounds from being wet by drain water or damaged by frozen drain water.

2. INDOOR UNIT INSTALLATION

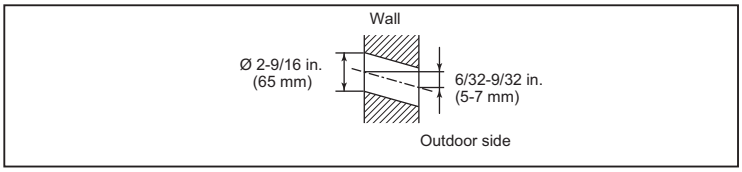
2-1. ATTACHING THE INSTALLATION PLATE

- Find a stud in the wall to attach installation plate (1) horizontally on the wall with screws (2).
- To prevent installation plate (1) from vibrating, be sure to install the attachment screws in the holes indicated in the illustration. For added support, additional screws may also be installed in other holes.
- When the indoor unit is to be attached to a concrete wall using recessed bolts, secure installation plate (1) using 7/16 in. x 13/16 in · 7/16 in. x 1 in. (11 mm × 20 mm · 11 mm × 26 mm) oval hole (17-3/4 in. [450 mm] pitch).
- If the recessed bolt is too long, change it for a shorter one (field-supplied).



2-2. DRILLING

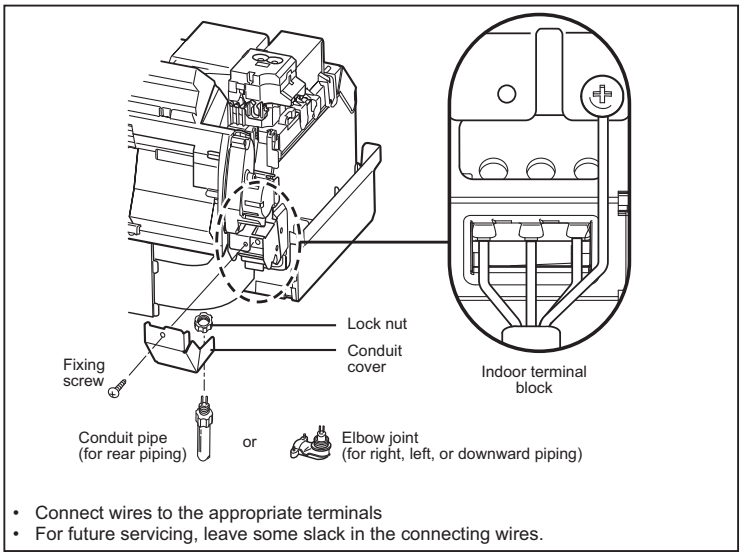
1) Determine where the holes will be located on the wall.
2) Drill a ø 2-9/16 in. (65 mm) hole. The outdoor side should be 6/32 to 9/32 in. (5 to 7 mm) lower than the indoor side.
3) Insert wall hole sleeve (C).



2-3. CONNECTING WIRES FOR INDOOR UNIT

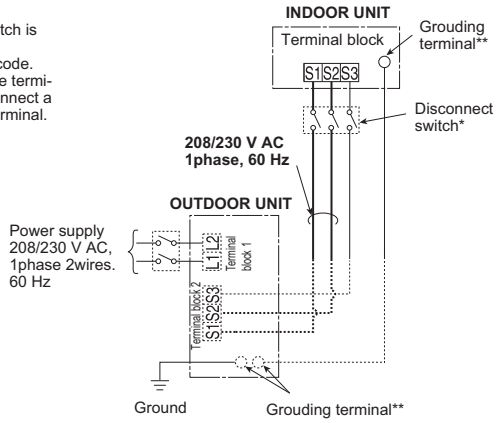
Note:
When the indoor unit is powered from the outdoor unit, depending on local code, a disconnect switch needs to be installed to a power supply circuit.

1) Remove the panel assembly. (Refer to 5-1.)
2) Place the upper part of the indoor unit on the installation plate.
3) Remove corner box and conduit cover.
4) Attach conduit pipe (for rear piping) / elbow joint (for right, left, or downward piping) to conduit cover with lock nut. The thread of the installed conduit pipe / elbow joint appearing inside should be less than 3/8 in. (10 mm). (Fig. 1) Elbow joint should appear less than 1-3/16 in. (30 mm) outside. (Fig. 2)
5) Process the end of ground wire (Fig. 3). Connect it to the ground terminal of electrical parts box.
6) Process the end of indoor/outdoor unit connecting wire (A) (Fig. 3). Attach it to the terminal block. Be careful not to make mis-wiring. Attach the wire to the terminal block securely so that its core cannot be seen, and no external force affects the connecting section of the terminal block.
7) Firmly tighten the terminal screws. After tightening, verify that the wires are tightly fastened.
8) Secure indoor/outdoor unit connecting wire (A) and the ground wire with conduit cover. Never fail to hook the claw of the conduit cover to the electrical box. Attach the conduit cover securely. (Fig. 4)
9) According to the piping direction, remove the shaded part of the left side of box (Fig. 5) or corner box (Fig.6). Reinstall corner box and front panel.



- Connect wires to the appropriate terminals
- For future servicing, leave some slack in the connecting wires.

Remark:
* A disconnect switch is required. Check the local code.
** Use a ring tongue terminal in order to connect a ground wire to terminal.



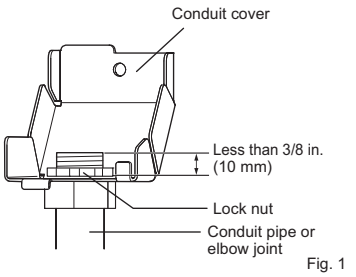


Fig. 1

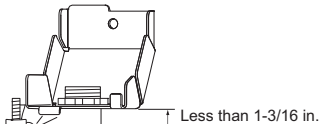
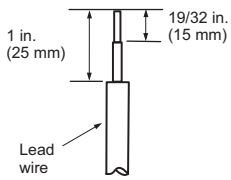


Fig. 2



- Make ground wire a little longer than others. (More than 1-9/16 in. [40 mm])

Fig. 3

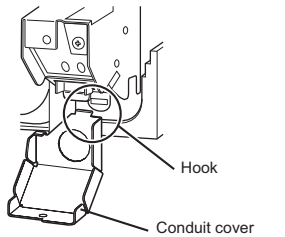


Fig. 4

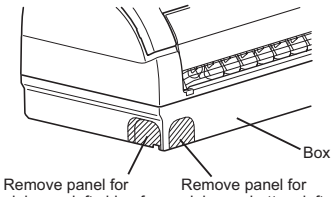


Fig. 5

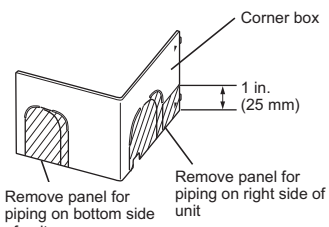


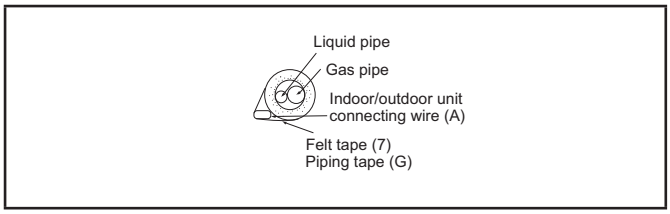
Fig. 6

2-4. PIPE FORMING AND DRAIN PIPING

2-4-1. PIPE FORMING

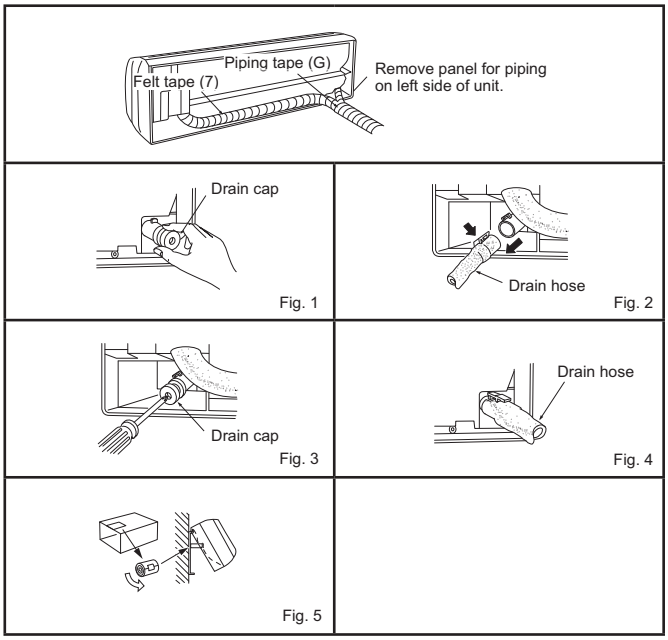
- Place the drain hose below the refrigerant piping.
- Make sure that the drain hose is not crowded or bent.
- Do not pull the hose when applying the tape.
- When the drain hose passes the room, be sure to wrap it with insulation material (field-supplied).

Note:
Make sure not to damage the cover of refrigerant pipe when attaching it back on with screws.

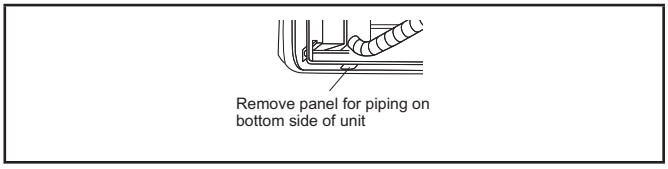


Left or left-rear piping
Note:
Be sure to reattach the drain hose and the drain cap if the piping is being installed on left or bottom left of unit, otherwise, water could drip down from the drain hose.

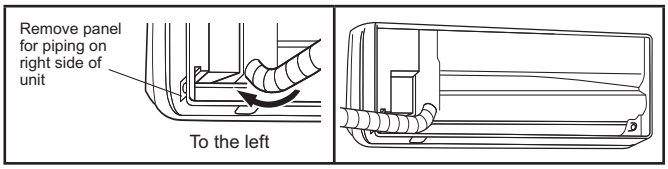
1) Place the refrigerant piping and the drain hose together, then firmly apply felt tape (7) from the end.
   Felt tape (7) overlap width should be 1/3 the tape width. Use a bandage stopper at the end of felt tape (7).
2) Pull out the drain cap at the back right of the indoor unit. (Fig. 1)
   • Hold the convex section at the end and pull the drain cap.
3) Pull out the drain hose at the back left of the indoor unit. (Fig. 2)
   • Hold the claw marked by the arrows and pull out the drain hose forward.
4) Put the drain cap into the section to which the drain hose is to be attached at the rear of the indoor unit. (Fig. 3)
   • Insert a screwdriver into the hole on the cap and insert the cap fully into the drain pan.
5) Insert the drain hose fully into the drain pan at the back right of the indoor unit. (Fig. 4)
   • Check if the hose is hooked securely to the projection of its inserting part at the drain pan.
6) Insert the drain hose into wall hole sleeve (C), and attach the upper part of indoor unit onto the installation plate (1). Then, shift the indoor unit completely to the left to make placing the piping in the back of the unit easier.
7) Cut out a piece of cardboard from the shipping box, roll it up, hook it onto the back rib, and use it as a spacer to lift the indoor unit. (Fig. 5)
8) Connect the refrigerant piping with the extension pipe (B).
9) Attach the lower part of the indoor unit into the installation plate (1).



Rear or bottom piping
1) Place the refrigerant piping and the drain hose together, then firmly apply piping tape (G) from the end.
2) Insert the piping and the drain hose into the wall hole sleeve (C), and attach the upper part of the indoor unit on the installation plate (1).
3) Check if the indoor unit is attached securely on the installation plate (1) by moving the unit to left and right.
4) Attach the lower part of the indoor unit into the installation plate (1).

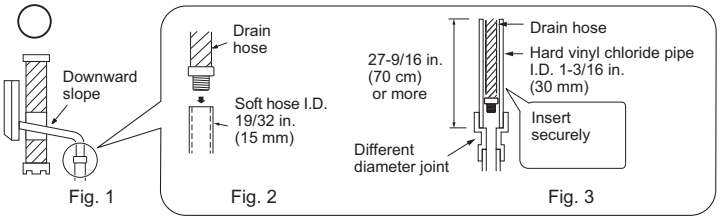


Right piping
Note:
Before performing the following, make sure that wiring is completed, and the conduit cover is installed. (Refer to 2-3.)
1) Place the refrigerant piping and the drain hose together, shift them to left side of the unit, and then firmly apply piping tape (G) from the end.
2) Insert the piping and the drain hose into the wall hole sleeve (C), and attach the upper part of the indoor unit on the installation plate (1).
3) Check if the indoor unit is attached securely on the installation plate (1) by moving the unit to left and right.
4) Attach the lower part of the indoor unit into the installation plate (1).

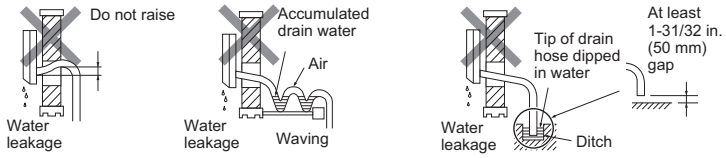


2-4-2. DRAIN PIPING

- If the extension drain hose has to pass through a room, be sure to wrap it with insulation (field-supplied).
- The drain hose should point downward for easy drain. (Fig. 1)
- If the drain hose provided with the indoor unit is too short, connect it with a field-supplied drain hose (I). (Fig. 2)
- When connecting the drain hose to a hard vinyl chloride pipe, be sure to insert it securely into the pipe. (Fig. 3)



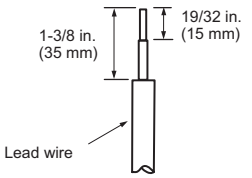
Do not make drain piping as shown below.

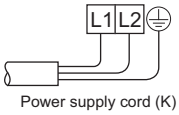


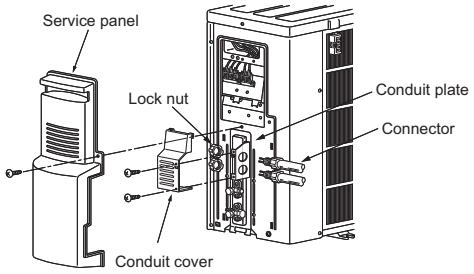
3. OUTDOOR UNIT INSTALLATION

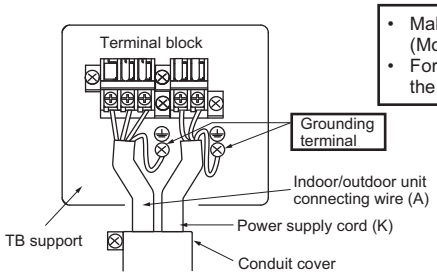
3-1. CONNECTING WIRES FOR OUTDOOR UNIT

1) Remove the service panel.
2) Remove the conduit cover.
3) Attach the conduit connector to conduit plate with lock nut then secure it against unit with screws.
4) Connect ground wires of indoor/outdoor unit connecting wire (A) and power supply cord (K) to the TB support.
5) Loosen the terminal screw, and attach indoor/outdoor unit connecting wire (A) from the indoor unit correctly on the terminal block. Attach the wire to the terminal block securely so that its core cannot be seen, and no external force affects the connecting section of the terminal block.
6) Firmly tighten the terminal screws. After tightening, verify that the wires are tightly fastened.
7) Connect power supply cord (K).
8) Install the conduit cover.
9) Install the service panel securely.









- Make earth wire a little longer than others. (More than 2-3/8 in. [60 mm])
- For future servicing, leave some slack in the connecting wires.

3-2. FLARE CONNECTION

1) Cut the copper pipe as straight as possible with a pipe cutter. (Fig. 1, 2)
2) Remove all burrs from the cut section of the pipe, ensuring that precautions are taken to avoid getting metal shavings into the piping. (Fig. 3)
3) Remove flare nuts attached to indoor and outdoor units, then put them on pipe.
4) Flaring work (Fig. 4, 5). Firmly hold copper pipe in the dimension shown in the table. Select A mm from the table according to the tool you use.
5) Check
   - Compare the flared work with Fig. 6.
   - If flare is defective, cut off the section and repeat procedure.

Pipe diameter inch (mm)	Nut inch (mm)	A inch (mm)			Tightening torque	
		Clutch type tool for R410A	Clutch type tool for R22	Wing nut type tool for R22	N•m	ft•lb (kgf•cm)
ø 1/4 (6.35)	1/4 (17)	0 to 0.02 (0 to 0.5)	0.04 to 0.06 (1.0 to 1.5)	0.06 to 0.08 (1.5 to 2.0)	13.7 to 17.7	10 to 13 (140 to 180)
ø 3/8 (9.52)	3/8 (22)				34.3 to 41.2	25 to 30 (350 to 420)
ø 1/2 (12.7)	1/2 (26)			0.08 to 0.10 (2.0 to 2.5)	49.0 to 56.4	36 to 42 (500 to 575)
ø 5/8 (15.88)	5/8 (29)				73.5 to 78.4	54 to 58 (750 to 800)

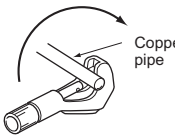


Fig. 1

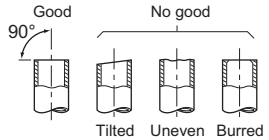


Fig. 2

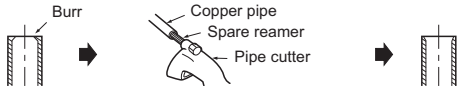


Fig. 3

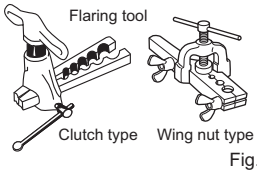


Fig. 4

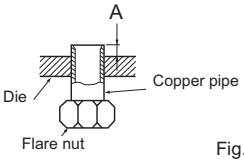


Fig. 5

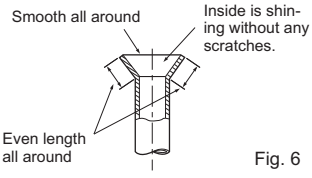


Fig. 6

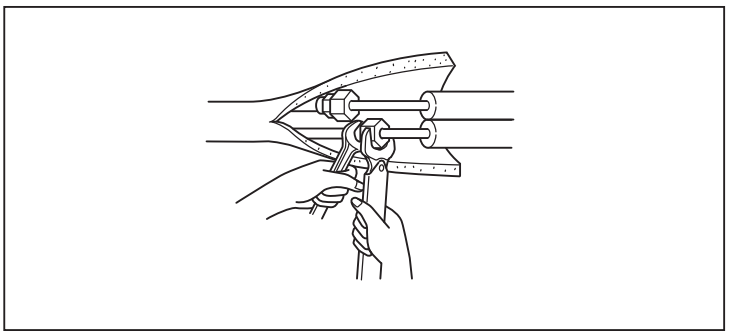
3-3. PIPE CONNECTION

- Fasten flare nut with a torque wrench as specified in the table (refer to 3-2.).
- When fastened too tight, flare nut may eventually break and cause refrigerant leakage.

Indoor unit connection

Connect both liquid and gas pipings to indoor unit.

- Apply a thin coat of refrigerant oil (J) on the seat surface of pipe.
- To connect, first align the center, then tighten the first 3 to 4 turns of flare nut.
- Use tightening torque table above as a guideline for indoor unit side joints, and tighten using two wrenches. Excessive tightening damages the flare section.



Outdoor unit connection

Connect pipes to stop valve pipe joint of the outdoor unit following the same procedure detailed in Indoor unit connection.

- For tightening, use a torque wrench or spanner.

⚠ WARNING

When installing the unit, securely connect the refrigerant pipes before starting the compressor.

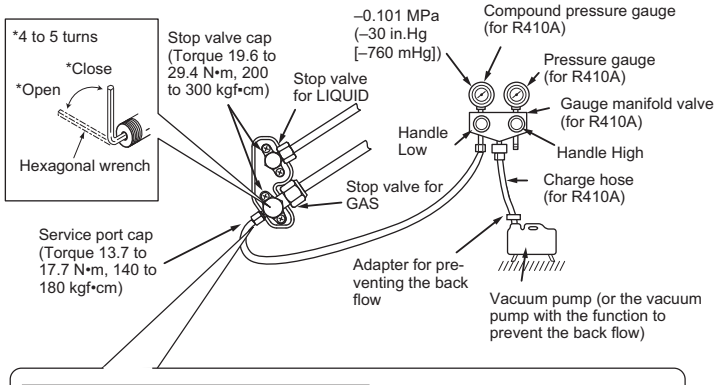
3-4. INSULATION AND TAPING

1) Cover piping joints with pipe cover.
2) For outdoor unit side, insulate the piping, including valves.
3) Apply piping tape (G) starting from the connection on the outdoor unit.
   - When piping has to be installed through a ceiling, closet or where the temperature and humidity are high, use additional field-supplied insulation to prevent condensation.

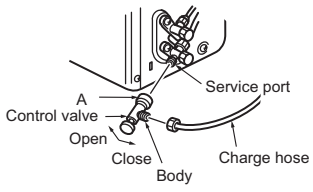
4. PURGING PROCEDURES, LEAK TEST, AND TEST RUN

4-1. PURGING PROCEDURES AND LEAK TEST

1) Remove service port cap of stop valve on the side of the outdoor unit gas pipe.
2) Connect gauge manifold valve and vacuum pump to service port of stop valve on the gas pipe side of the outdoor unit.



Precautions when using the control valve



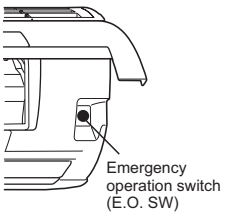
When attaching the control valve to the service port, valve core may deform or loosen if excess pressure is applied. This may cause gas leak.

When attaching the control valve to the service port, make sure that the valve core is in closed position, and then tighten part A. Do not tighten part A or turn the body when valve core is in open position.

3) Run the vacuum pump 15 minutes or more.
4) Check the vacuum with the gauge manifold valve, then close it and shut off the vacuum pump.
5) Leave as it is for one or two minutes. Make sure pointer gauge manifold valve remains in the same position. Confirm that pressure gauge shows –0.101 MPa [Gauge] (–30 in.Hg [–760 mmHg]).
6) Quickly remove gauge manifold valve from service port of stop valve.
7) After refrigerant pipes are connected and evacuated, fully open all stop valves on both sides of gas pipe and liquid pipe. Operating the unit without fully opening the valves lowers the performance and causes problems.
8) Refer to 1-3. SPECIFICATIONS, and charge the prescribed amount of refrigerant if needed. Be sure to charge slowly with liquid refrigerant. Otherwise, composition of the refrigerant in the system may be changed and affect performance of the air conditioner.
9) Tighten cap of service port.
10) Conduct a leak test

4-2. TEST RUN

1) Insert power supply plug into the power outlet and/or turn on the breaker.
2) Press the E.O. SW once. Test run will be performed for 30 minutes. If the power lamp blinks every 0.5 seconds, inspect the indoor/outdoor unit connecting wire (A). After the test run, emergency COOL mode (75ºF [24ºC] COOL) will start.
3) To stop operation, press the E.O. SW several times until all LED lamps turn off. Refer to operating instructions for details.



Checking the remote (infrared) signal reception

Press the ON/OFF button on the remote controller and listen for an audible indicator from the indoor unit. Press the ON/OFF button again to turn the air conditioner off.

- Once the compressor stops, the restart preventive device operates so the compressor will not operate for 3 minutes to protect the air conditioner.

4-3. AUTO RESTART FUNCTION

This product is equipped with an auto restart function. When the power supply is cut off during operation, such as during blackouts, the function automatically starts operation in the previous setting once the power supply is resumed. (Refer to the operating instructions for details.)

Caution:

- After test run or remote signal reception check, turn off the unit with the E.O. SW or the remote controller before turning off the power supply. If this procedure is not performed, the unit will automatically begin operation when power supply is resumed.

To the user

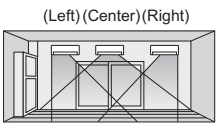
- After installing the unit, explain to the user about auto restart function.
- If auto restart function is unnecessary, it can be deactivated. Consult the service representative to deactivate the function. Refer to the service manual for details.

4-4. REMOTE CONTROLLER SETTING

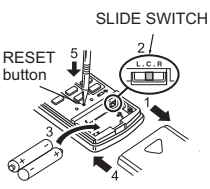
Set the slide switch of the remote controller according to where the indoor unit is installed in the area. If the switch is not set correctly, the air conditioner may not function properly.

Location of unit in area:

Left: Distance to objects (wall, cabinet, etc.) is less than 19-11/16 in. (50 cm) to the left
Center: Distance to objects (wall, cabinet, etc.) is more than 19-11/16 in. (50 cm) to the left and right
Right: Distance to objects (wall, cabinet, etc.) is less than 19-11/16 in. (50 cm) to the right



1) Remove the front lid.
2) Set the slide switch according to the installed position of the indoor unit.
3) Insert two (AAA) batteries.
4) Reattach the front lid.
5) Press the RESET button gently using a thin instrument.



Installation position	Left	Center	Right
Slide switch	L.C.R	L.C.R	L.C.R
Remote controller display			

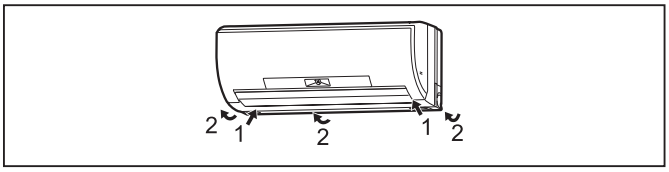
4-5. EXPLANATION TO THE USER

- Using the OPERATING INSTRUCTIONS, explain to the user how to use the air conditioner (the remote controller, removing the air filters, placing or removing the remote controller from the remote controller holder, cleaning methods, precautions for operation, etc.)
- Recommend that the user read the OPERATING INSTRUCTIONS carefully.

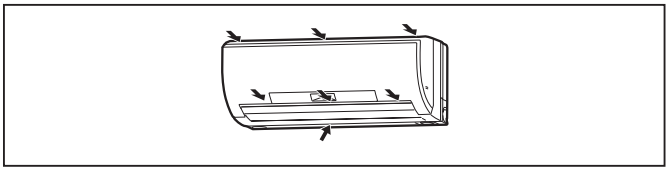
5. RELOCATION AND MAINTENANCE

5-1. REMOVING AND INSTALLING THE PANEL ASSEMBLY

Removal procedure
1) Remove the two screws that attach the panel assembly.
2) Remove the panel assembly. Be sure to remove its bottom end first.

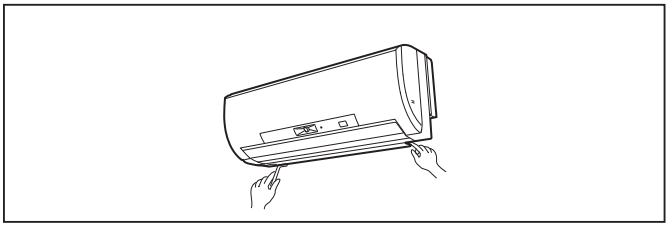


Installation procedure
1) Install the panel assembly following the removal procedure in reverse.
2) Be sure to press the positions as indicated by the arrows in order to attach the assembly completely to the unit.

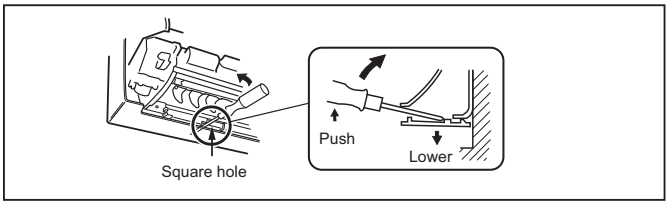


5-2. REMOVING THE INDOOR UNIT

Remove the bottom of the indoor unit from the installation plate.
When releasing the corner part, release both left and right bottom corner part of indoor unit and pull it downward and forward as shown in the figure on the right.



If the above method cannot be used
Remove the front panel. Then, insert hexagonal wrenches into the square holes on the left and right sides of the unit and push them up as shown in the following figure. The bottom of the indoor unit lowers and releases the hooks.



5-3. PUMPING DOWN

When relocating or disposing of the air conditioner, pump down the system following the procedure below so that refrigerant is not released into the atmosphere.
1) Connect the gauge manifold valve to the service port of the stop valve on the gas pipe side of the outdoor unit.
2) Fully close the stop valve on the liquid pipe side of the outdoor unit.
3) Close the stop valve on the gas pipe side of the outdoor unit almost completely so that it can be easily closed fully when the pressure gauge shows 0 MPa [Gauge] (0 lbf/in.^{2} [0 kgf/cm^2]).
4) Start the emergency COOL operation.
   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 E.O. SW once. (The emergency COOL operation can be performed continuously for up to 30 minutes.)
5) 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 [0.5 to 0 kgf/cm^2]).
6) Stop the emergency COOL operation.
   Press the E.O. SW twice to stop the operation.

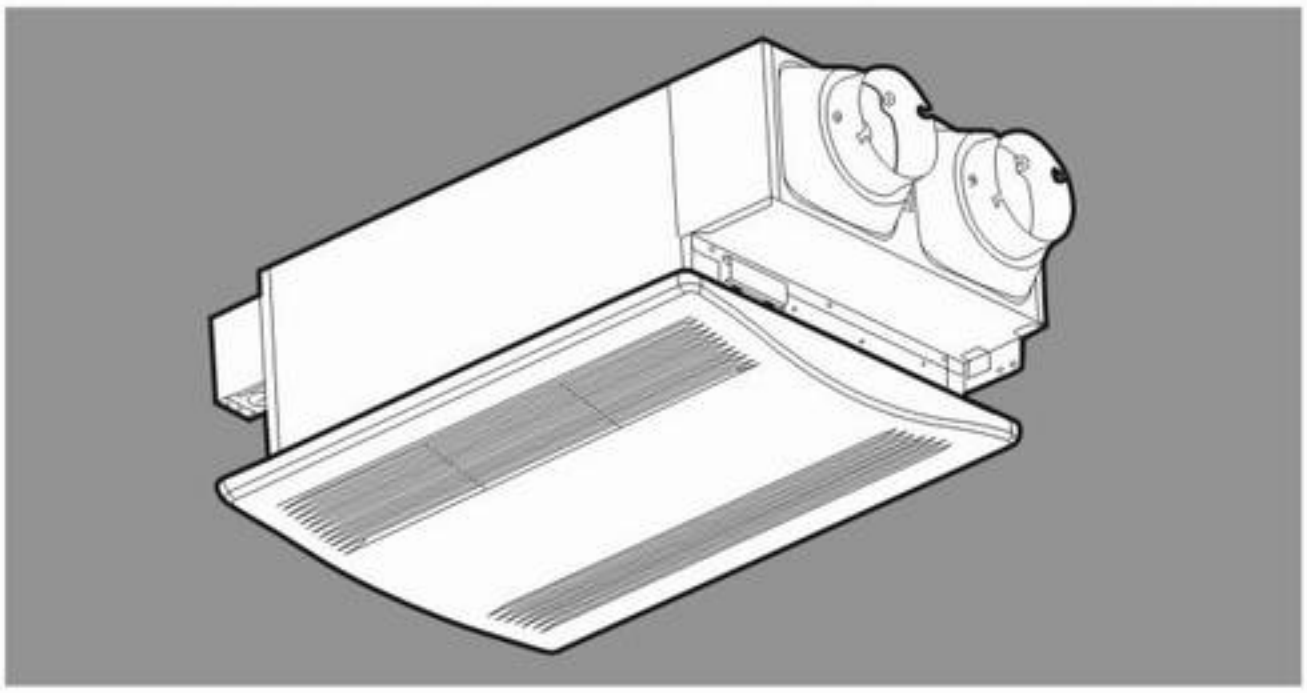
⚠ WARNING

When pumping down the refrigerant, stop the compressor before disconnecting the refrigerant pipes. The compressor may burst if air etc. get into it.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

INSTALLATION INSTRUCTIONS

Spot Energy Recovery Ventilator (ERV) **FV-04VE1**



Panasonic®

READ AND SAVE THESE INSTRUCTIONS.

Please read these instructions carefully before attempting to install, operate or service the Panasonic Spot Energy Recovery Ventilator. Failure to comply with Instructions could result in personal injury and/or property damage. Please retain this booklet for future reference.

Table of Contents

SUPPLIED ACCESSORIES

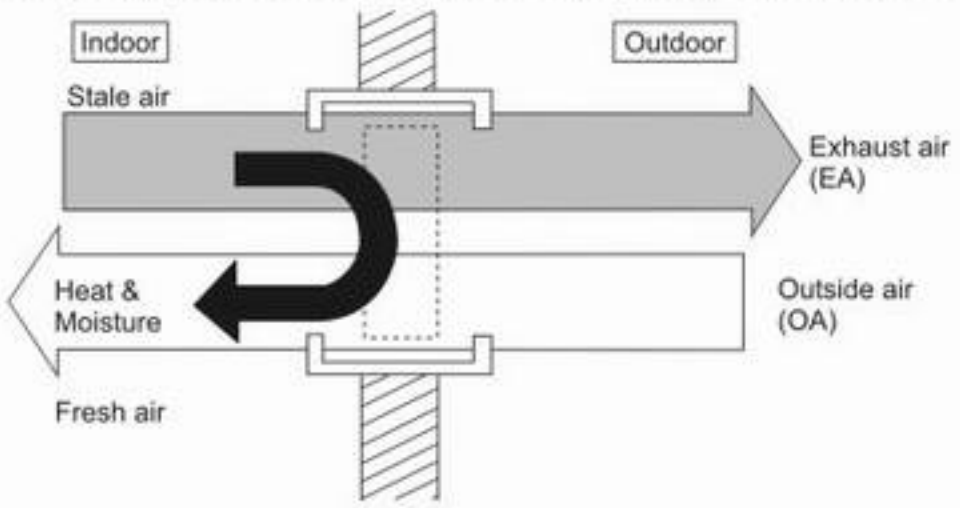
FV-04VE1

Part name	Appearance	Quantity
Grille		1
Suspension bracket Ⅰ		1
Suspension bracket Ⅱ		1
Suspension bracket Ⅲ		1
Screw Ⅰ (ST4.2X12)		1
Screw Ⅱ (ST4.2X10)		1
Long screw (ST4.2X30)		8
Switch Label		1

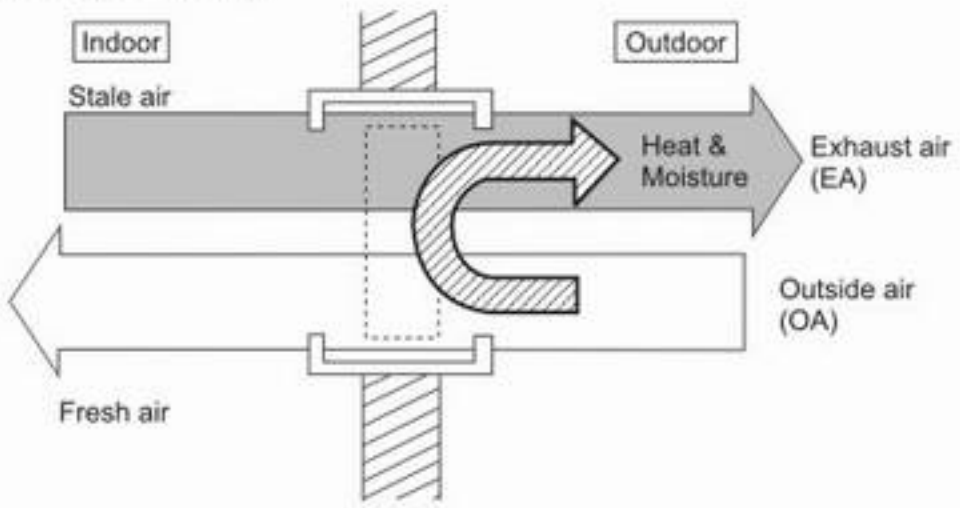
DESCRIPTION

The Panasonic Spot Energy Recovery Ventilator uses two sirocco fans driven by a capacitor motor. The motor is designed to have an extended service life with reduced energy consumption. It also incorporates a thermal-cutoff for safety. The grille covering the main body is a spring-loaded, quick-release type. The exhaust air (EA) duct includes barometric damper to prevent backdrafting. And the outdoor air (OA) duct includes electric damper to prevent backdrafting and control the supply air flow.

Energy Recovery Introduction:Compared to an HRV (Heat Recovery Ventilator), the ERV (Energy Recovery Ventilator) can also transfer humidity and recover energy from that humidity. The ERV can exchange energy between the stale EA and the "fresh" OA, transferring heat and moisture into the incoming cold air in a heating climate and pre-cooling and reducing the humidity of the incoming hot air in a cooling climate. This tempering and treatment of the required ventilation air helps maintain a fresh environment even when the heating or cooling system is not operating.



<Heating Climate>

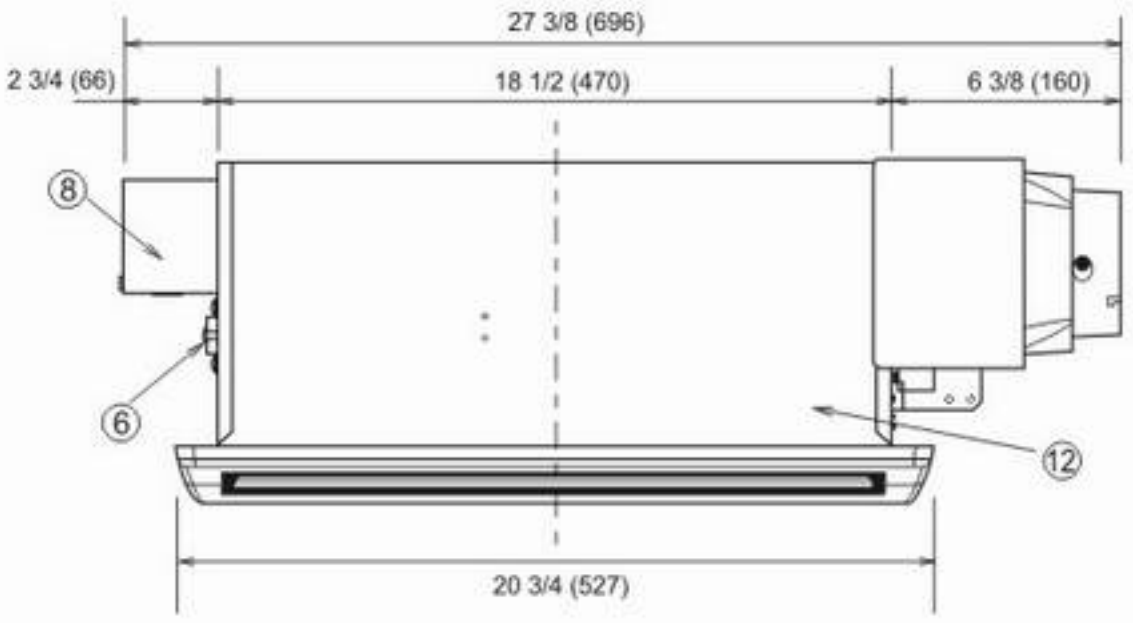


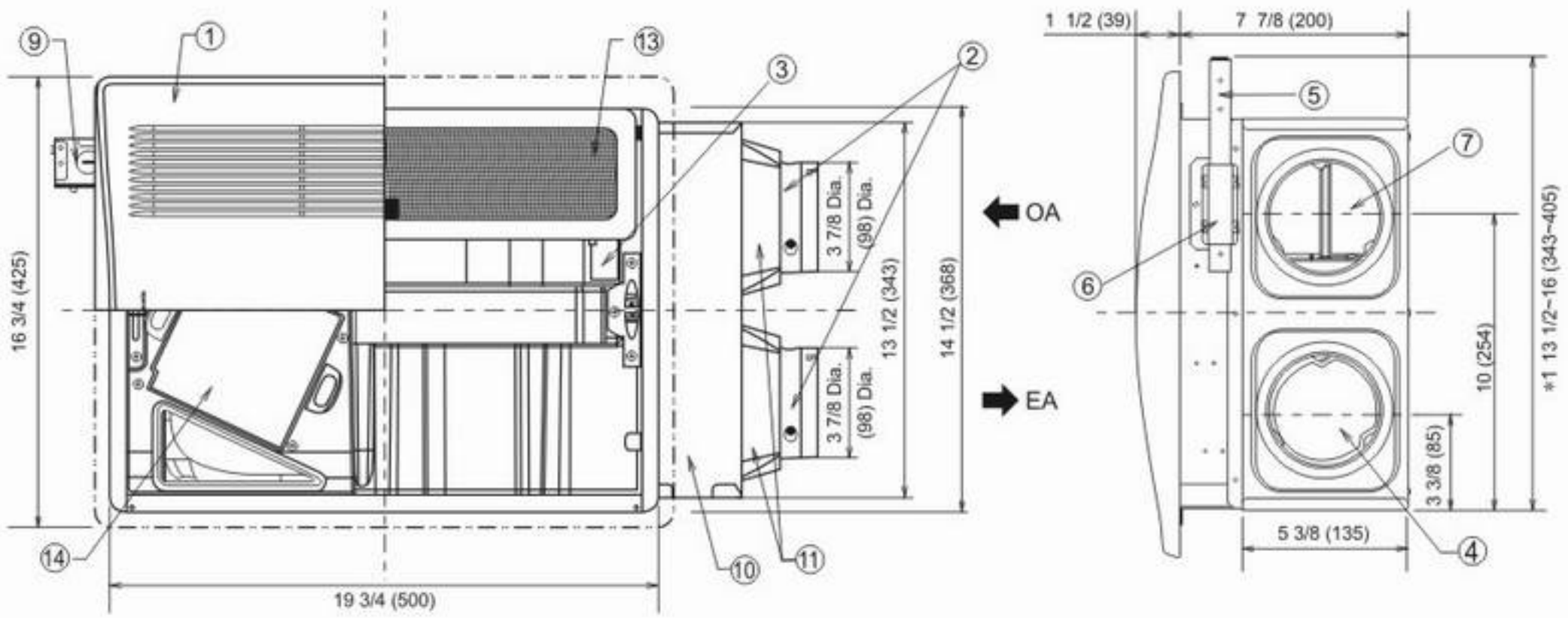
<Cooling Climate>

DIMENSIONS

FV-04VE1

Unit: inches(mm)





No.	Part name	No.	Part name
1	Grille	8	Junction box cover
2	Adaptor	9	Junction box
3	OA Filter	10	Damper box
4	EA Damper	11	Adaptor insulation
5	Suspension bracket I, II, III	12	Fan body
6	Bracket cover	13	RA Filter
7	OA Damper	14	Recovery core

*1 (For 16 inches O.C. joists and 19 inches O.C. joists use suspension bracket I, II & III. Please install the wooden header accordingly in the case of the 24 inches O.C. joists.)

SPECIFICATIONS

<Ventilation Performance>

• Factory setting for 40 CFM

Model	Air Direction	V	Hz	Duct	Speed	Gross Air Deliver at 0.1"WG (cfm)		Power Consumption (W)	Noise (sone)	Weight lb.(kg)
						Exhaust	Supply	Fan Unit		
FV-04VE1	Exhaust & Supply	120	60	4"X2	High	40	30	24	0.8	20.5 (9.3)
					Low	20	20	21	<0.3	

• Optional setting for 20 CFM

Air Direction	V	Hz	Duct	Speed	Gross Air Deliver at 0.1"WG (cfm)		Power Consumption (W)	Noise (sone)
					Exhaust	Supply	Fan Unit	
Exhaust & Supply	120	60	4"X2	High	20	20	21	<0.3
				Low	10	10	17	N/A

Selected only at installation. (Refer to Page 8)

<Energy Performance>

Mode	Supply Temperature		Net Air Flow		Total Recovery Efficiency (%)	Apparent Sensible Effectiveness (%)
	°F	°C	l/S	cfm		
Heating	32	0	14	30	N/A	66
Cooling	95	35	14	29	36	N/A

1. The testing of the ventilation performance is in general accordance with HVI procedures 915 and 916.
2. The testing of the energy performance is in accordance with CSA-C439 standard.

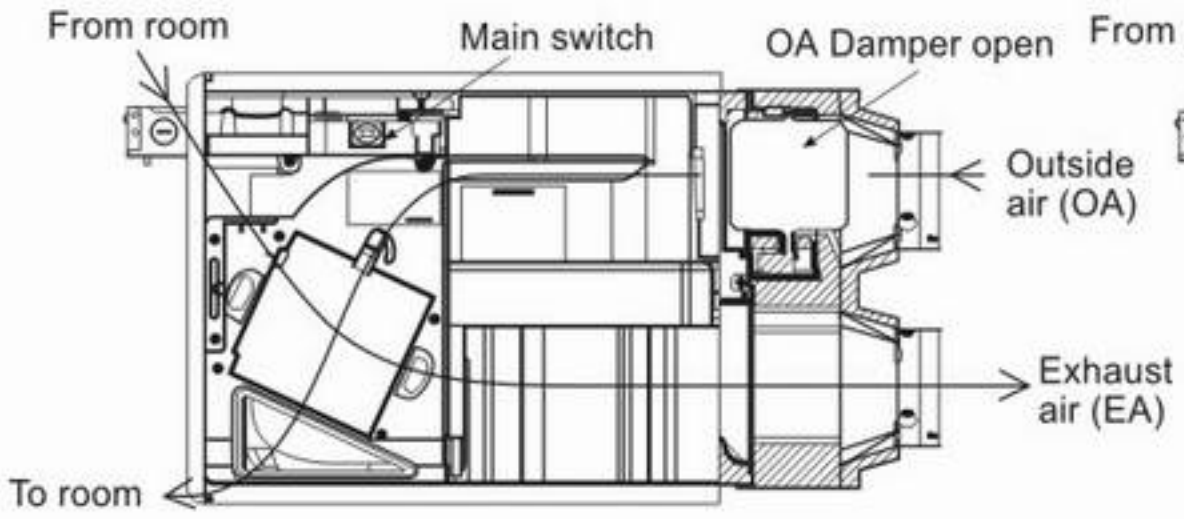
PRODUCT OPERATION

<Main Switch> • Power on/off for unit.
• Turn off the Main Switch when the unit is not in use.

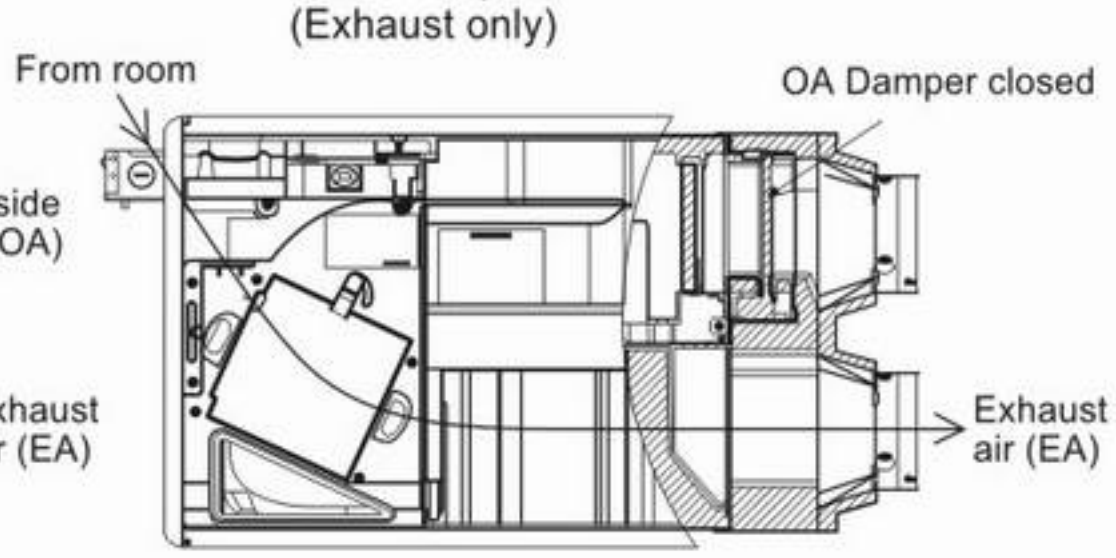
IMPORTANT: Unless you turn off the main switch, the unit will be in standby mode which means it is energized and will consume some electricity.
When turning on or off the main switch, push it completely to the on/off position.

<Operation Mode>

• Normal operation
(Supply and exhaust)



• Defrost operation
• Exhaust operation
(Exhaust only)

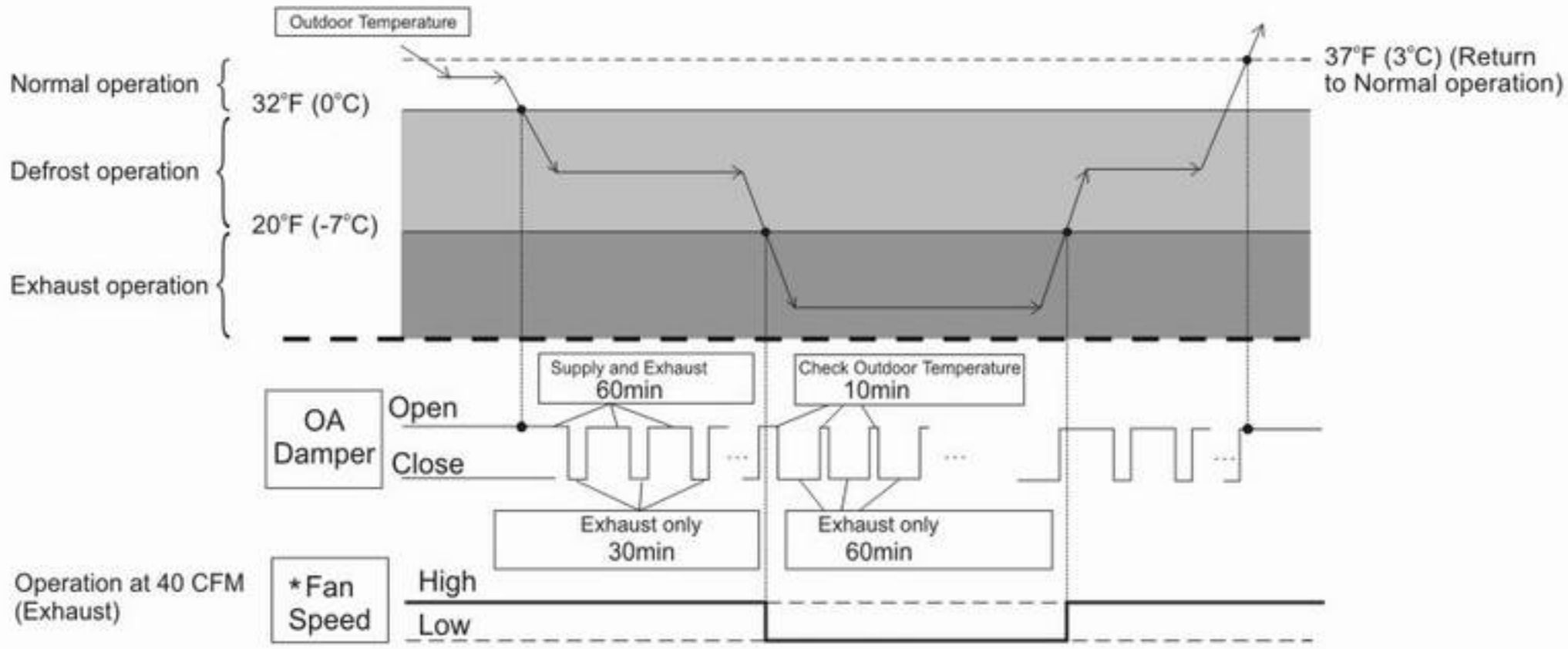


• Defrost operation
When the outside temperature is between 32°F (0°C) and 20°F (-7°C), OA Damper controls Defrost operation. Defrost operation means the damper will open for 60 min. for supply and exhaust and close for 30 min. for exhaust only.

• Exhaust operation
When the outside temperature is under 20°F (-7°C), OA Damper controls Exhaust operation. Exhaust operation means the damper will open for 10 min. to check outside temperature and close for 60 min. for exhaust only.

PRODUCT OPERATION CONTINUED

Introduction of OA Damper's movement



*The High speed is automatically changed to Low speed during Exhaust operation.
Another speed and optional setting (High and Low) are not changed speed during Exhaust operation.

UNPACKING

Unpack and remove unit carefully from carton.
Refer to the Supplied Accessories list to verify that all parts are presented.

GENERAL SAFETY INFORMATION

1. Do not install this ERV where air temperature may exceed 104°F (40°C).
2. Make certain that the electric service supply voltage is 120 V, 60 Hz.
3. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupation Safety and Health Act (OSHA).
4. Always disconnect the power source before working on or near the fan, motor, fixture or junction box.
5. Protect the power cord from sharp edges, oil, grease, hot surfaces, chemicals or other objects.
6. Do not kink the power cord.
7. This unit is recommended for areas where temperature is above 20°F (-7°C). Other areas where temperature fall below 20°F (-7°C), this unit runs on exhaust only.
8. These fans are intended for residential use only.
9. Do not install the unit where ducts are configured as shown in Fig. A.

Fig. A

GENERAL SAFETY INFORMATION CONTINUED

CAUTION:

1. For general ventilating use only. Do not use to exhaust hazardous or explosive materials and vapors.
2. Do not install in cooking area or connect directly to any appliance. (Fig.B)
3. This product must be properly grounded.
4. The unit must be used in a space provided with heated and cooled air, such as a living room, dining room, bedroom, etc.
5. The ducts must be connected directly to the outside.

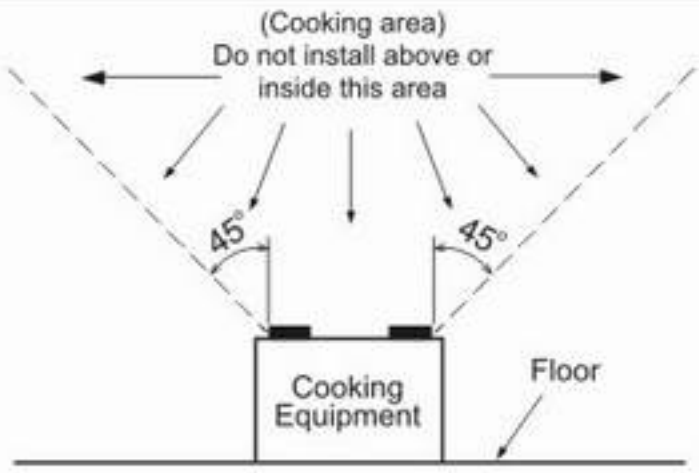


Fig. B

WARNING:

To reduce the risk of fire, electric shock or injury to persons, observe the following:

A. Use this unit only in the manner intended by the manufacturer. If you have any questions, contact the manufacturer.

B. Installation work and electrical wiring must be done by a qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.

C. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent backdrafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating Refrigeration and Air Conditioning Engineers (ASHRAE) and the local code authorities.

D. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.

E. Ducted fans must always be vented to the outdoors.

F. Solid state controls may cause harmonic distortion which can cause motor humming noise. To reduce the risk of fire or electric shock, do not use this unit with any solid-state control device.

G. Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the circuit breaker panel cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

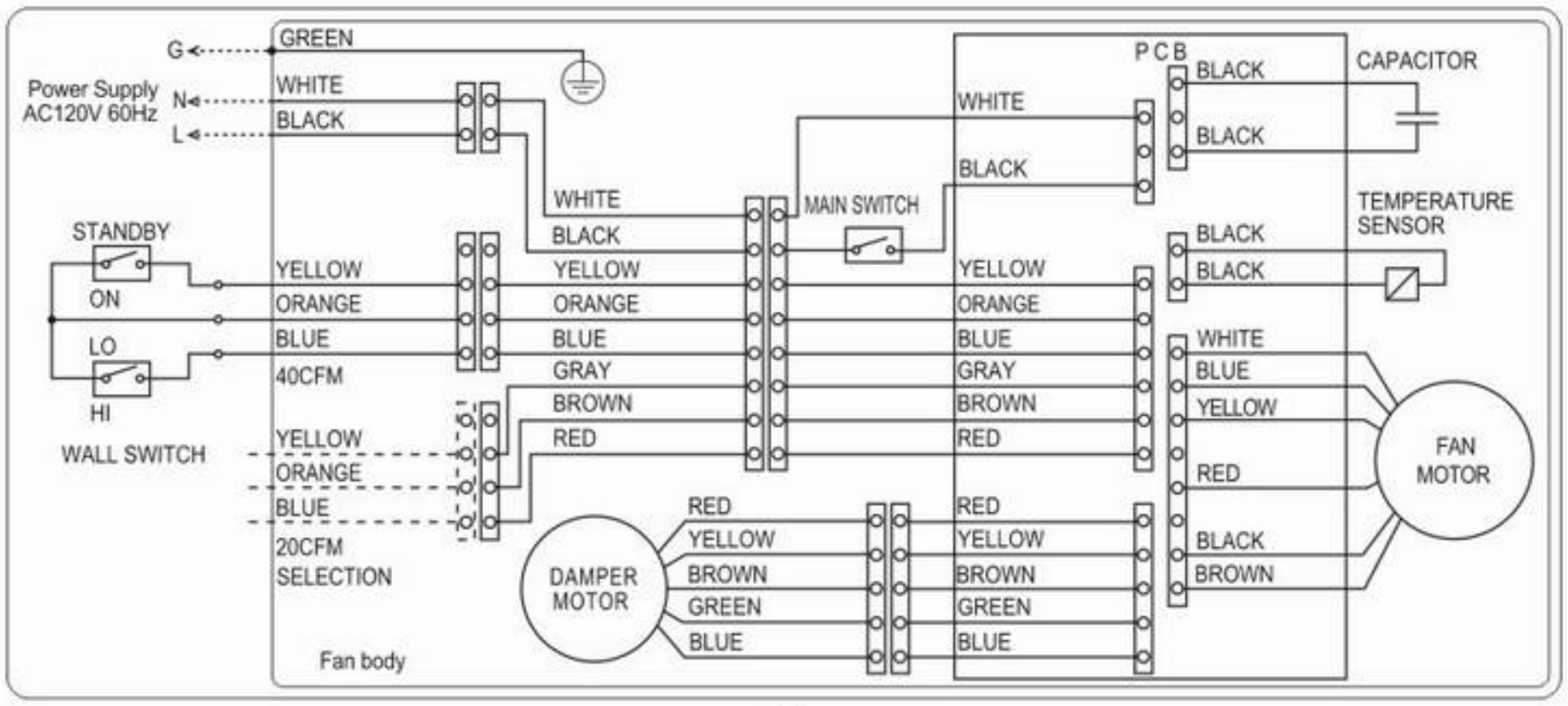
H. Not to be installed in a ceiling thermally insulated to a value greater than R40. (This is required for installation in Canada only.)

I. Never install in the area where the temperature falls below -13°F(-25°C).

J. Never install the unit in a high humidity space, such as a bathroom, kitchen or laundry room.

K. Install the unit in a ceiling where air temperature is above 50°F(10°C) to avoid condensation in unit.

WIRING DIAGRAM



RECOMMENDED ZONES MAP

Recommended zones map

As shown on page 5, this unit has an automatic frost prevention mode, which disables the energy recovery function and allows the unit to work as a normal ventilation fan. (Fresh air will not come into the house during frost prevention mode.) The following map outlines the recommended use zones of the United States and Canada for the Panasonic Spot Energy Recovery Ventilator.

Operation Season

Zone A: Unit can perform optimally throughout the year.

Zone B: Unit can perform optimally between March through November.

Zone C: Unit can perform optimally between April through November.

Zone D: Panasonic does not recommend this unit due to extremely cold year-round weather.

Note:

This map is based on average temperature readings over 10 years from 60 major cities in North America. Actual performance may vary depending on annual temperature differences and varying altitudes.

WIRING CONNECTIONS

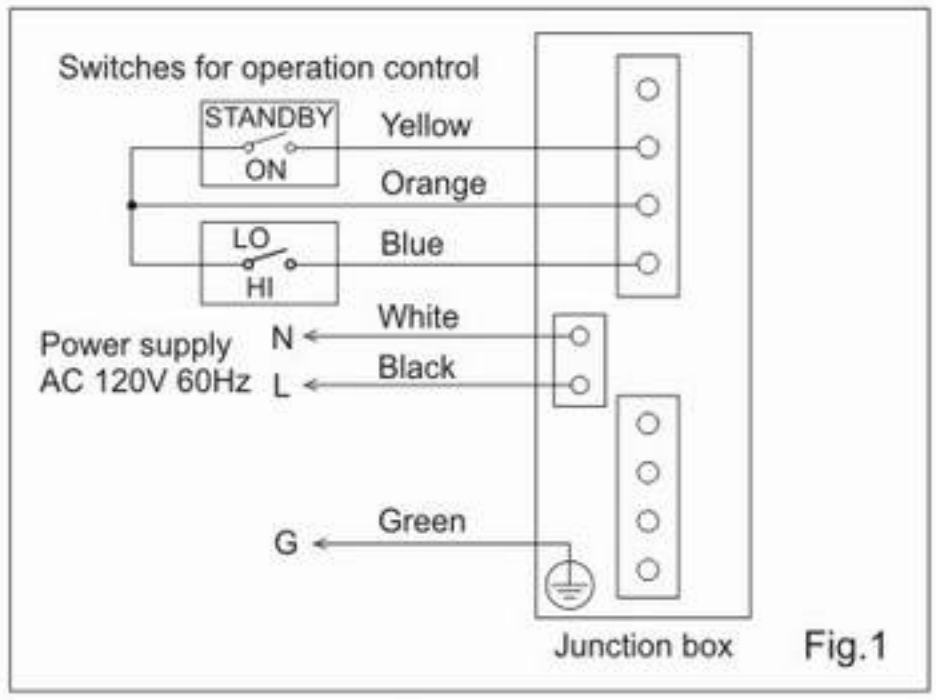


Fig.1

- Optional setting (20 CFM Exhaust):
  If you need to change to 20/10 CFM Exhaust, move the connector to the 20 CFM Exhaust side of the receptacle.
  Note: Selected only at installation (Fig.2).

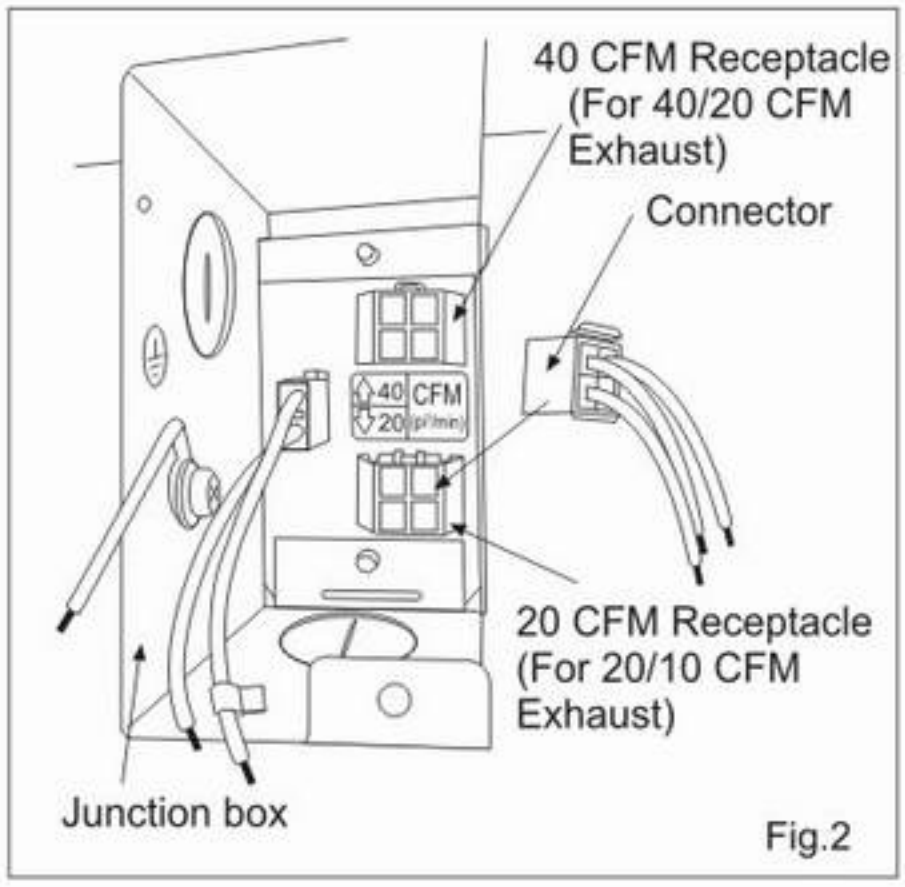
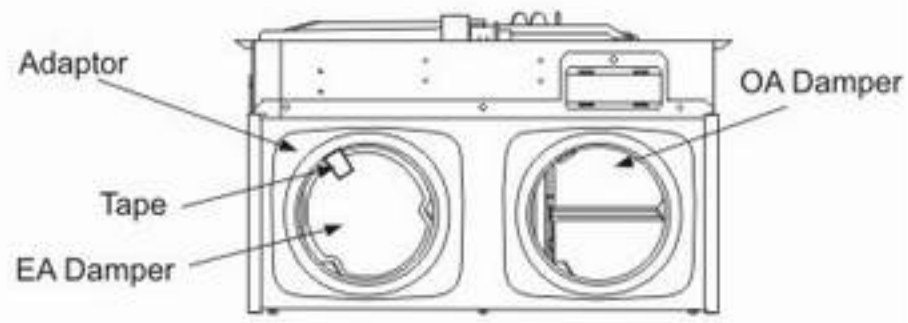


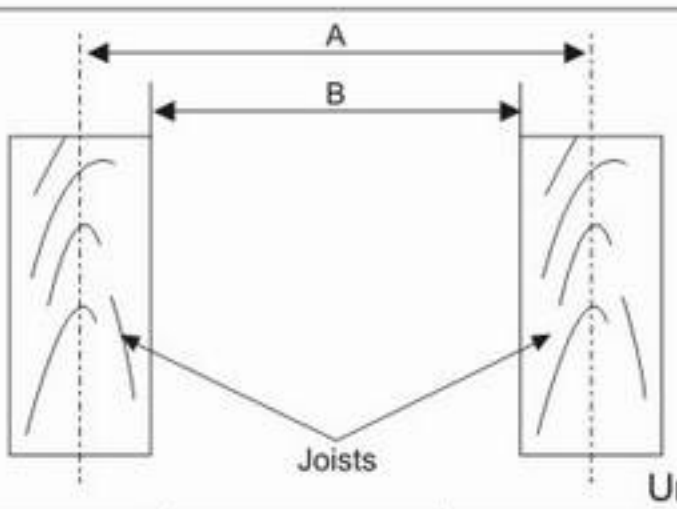
Fig.2

INSTALLATION I (JOIST MOUNTING-I)

IMPORTANT:
Remove the tape as shown below:



1. Insert Suspension bracket I, II, III and adjust the width to fit inside of the joists. (Fig.1)



Unit:inch

A O.C. joists	B	Insert Suspension bracket
16	14 1/2	Refer to Fig. 1
19.2	15.7	
24	22 1/2	Installation II

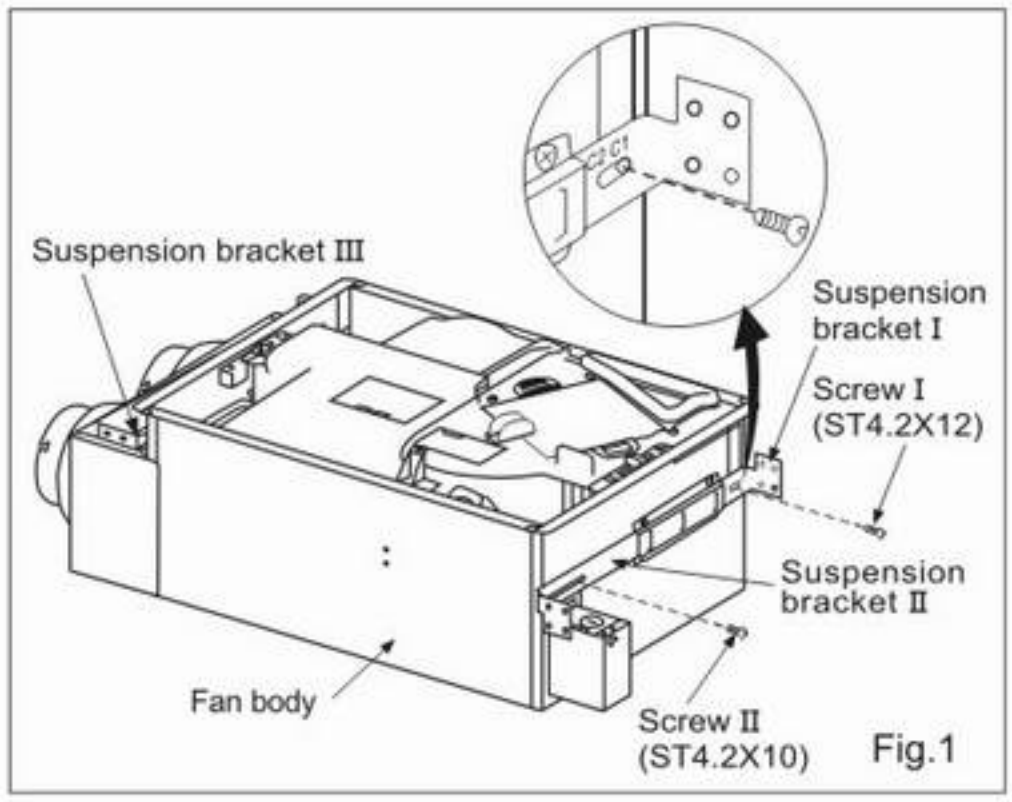


Fig.1

2. Fix screws tentatively to suspension bracket I & II, so that bracket can be adjustable.

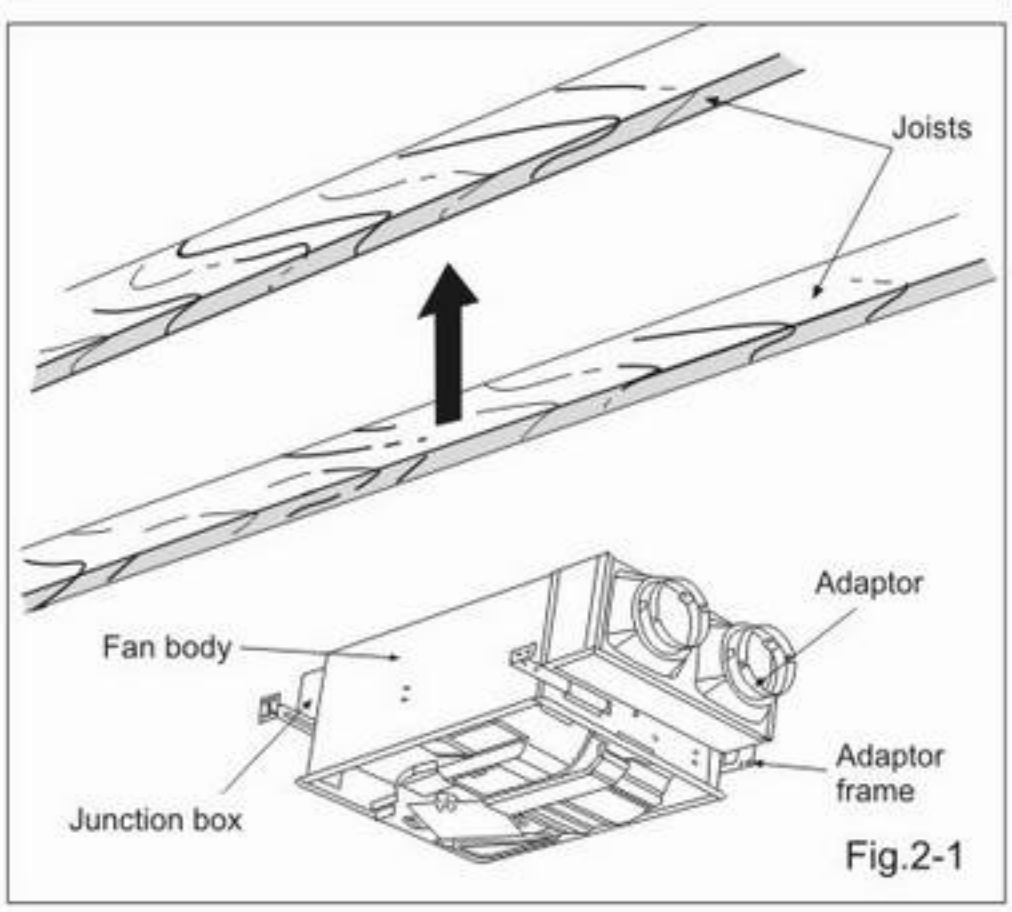
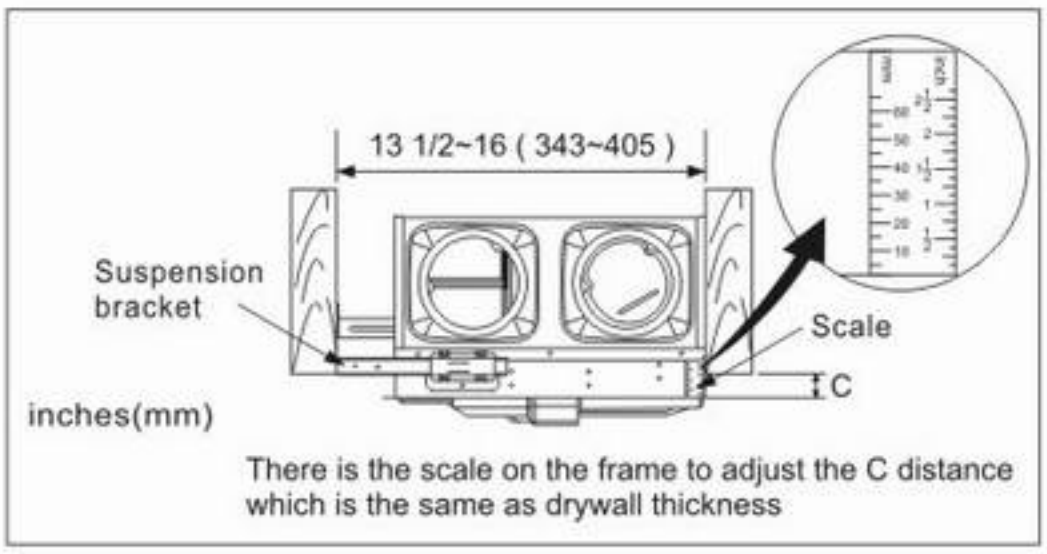


Fig.2-1

INSTALLATION I (JOIST MOUNTING-I) CONTINUED

3. Install the suspension bracket and fix the adaptor frame by using long screws (ST4.2X30) (According to Fig.2-1, Fig.2-2 & Fig.2-3 to install the product.) During installation the distance C (bottom flange) should be kept the same as the drywall thickness.

CAUTION:
If the bottom flange is not the same level as the drywall, the performance of the unit will be affected.



There is the scale on the frame to adjust the C distance which is the same as drywall thickness

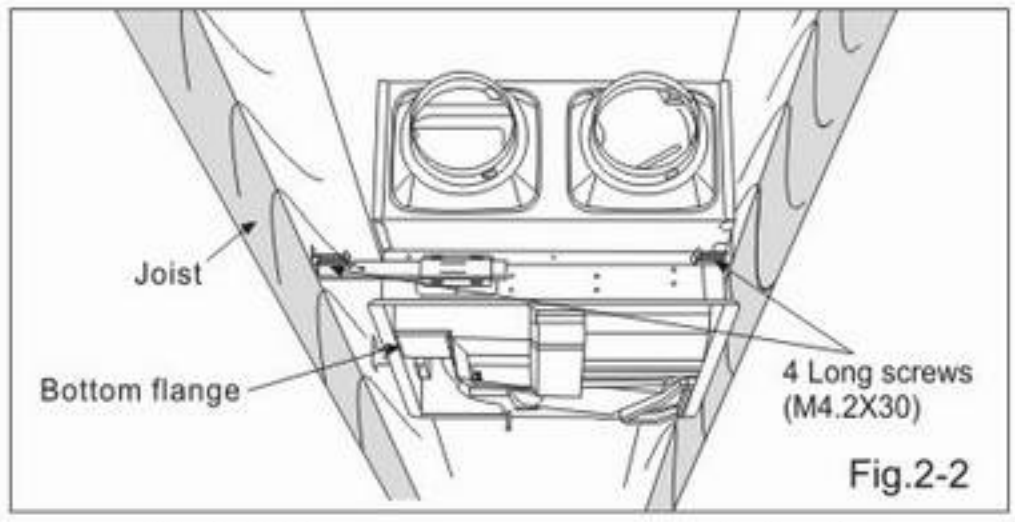


Fig.2-2

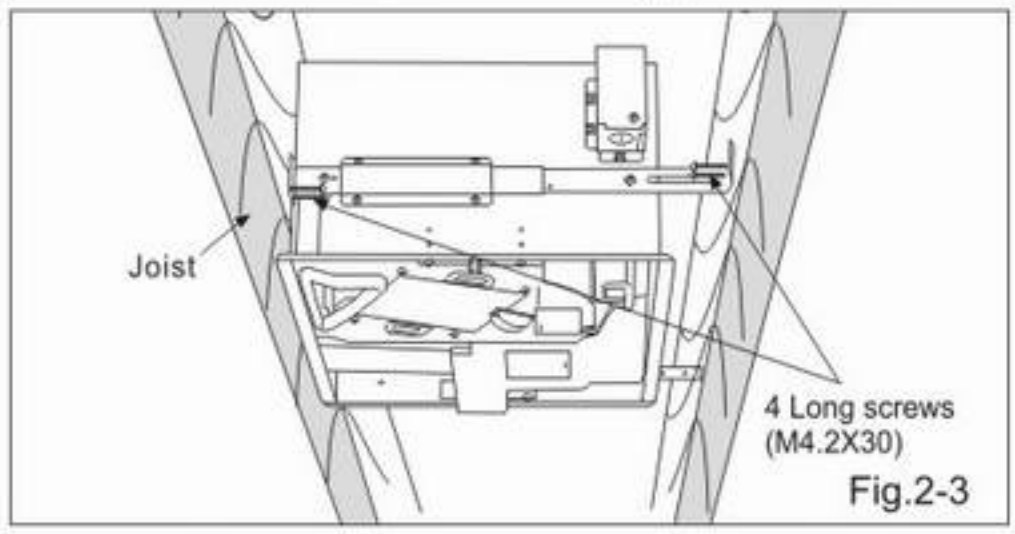


Fig.2-3

4. Fix Screw I & II on suspension bracket I and II firmly.

5. Remove Junction box cover and secure conduit or stress relief to Junction box knock-out hole. (Fig.3)

6. Refer to wiring diagram (Page 6).
Use wire nuts to connect the house power wires to the ERV wires.

CAUTION:
Mount junction box cover carefully so that the lead wires are not pinched.

Optional Air flow setting:
- Factory setting 40/20 CFM Exhaust.
- Remove Connector and change to 20 CFM Exhaust receptacle when selecting 20/10 CFM Exhaust. (Page 8)

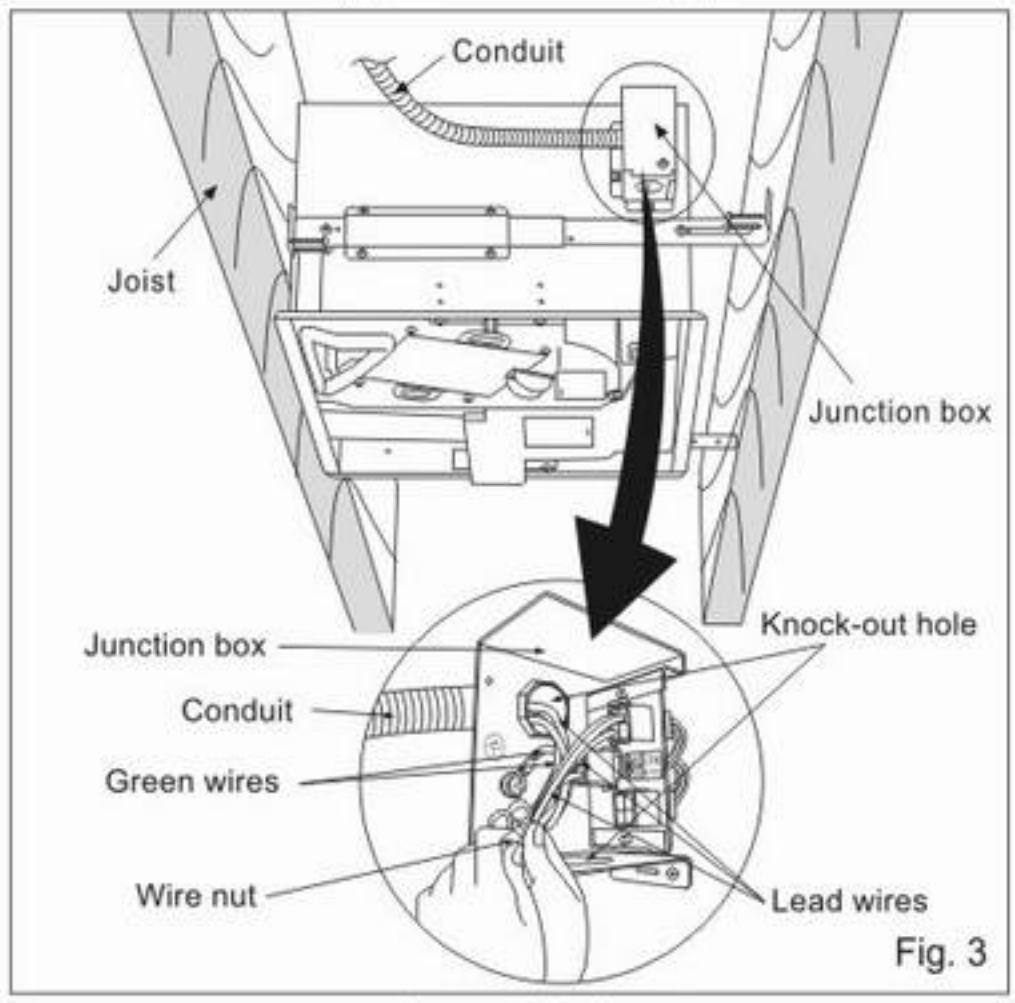


Fig. 3

7. Install insulated ducts and secure them to adaptor with duct tape or clamps. (Fig.4-1)

8. Properly insulate the area around the fan body to minimize building heat loss and gain.
Loose fill or batt insulation can be placed directly over the fan body in the attic. Our cool-running motors do not create enough heat to require special clearance.

CAUTION:
Insulated duct should be used and sealed to adaptor to avoid the water dripping due to condensation.

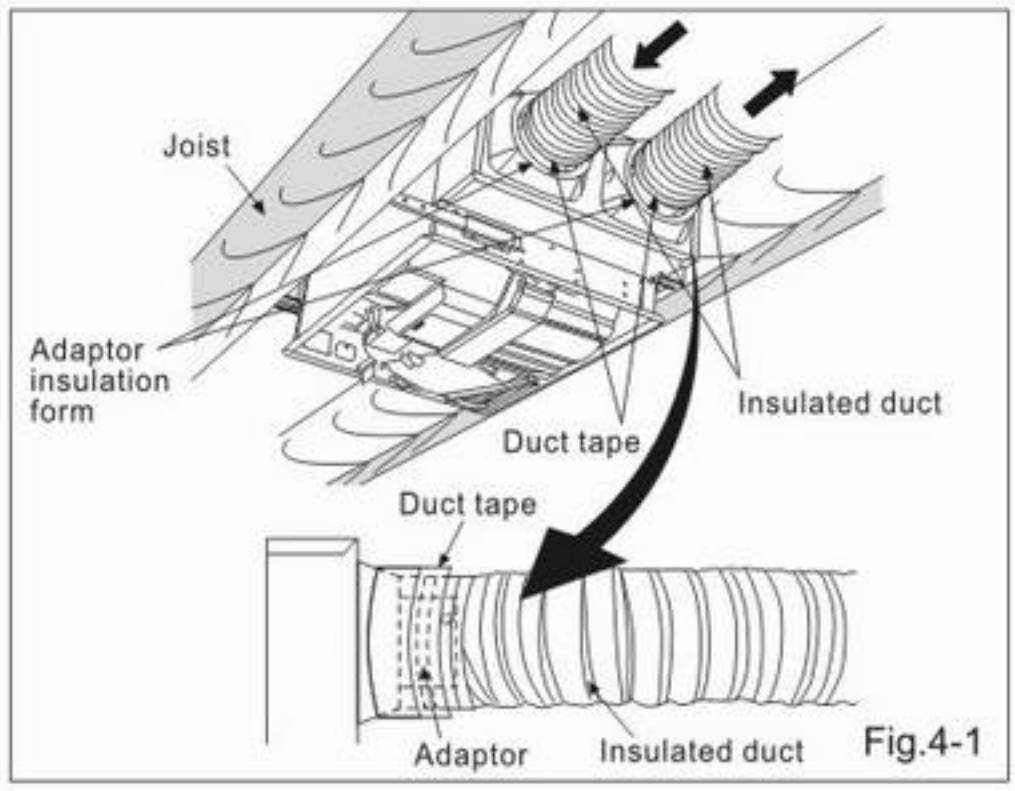


Fig.4-1

INSTALLATION I (JOIST MOUNTING-I) CONTINUED

9. Locate the intake hood and the exhaust hood at least 3' (920mm) away from each other. (Fig.4-2)

CAUTION:
The intake air side duct must be connected to the outside and at least 6' (2m) away from the exhaust of appliances such as furnace, dryer, fuel burning appliances, etc.

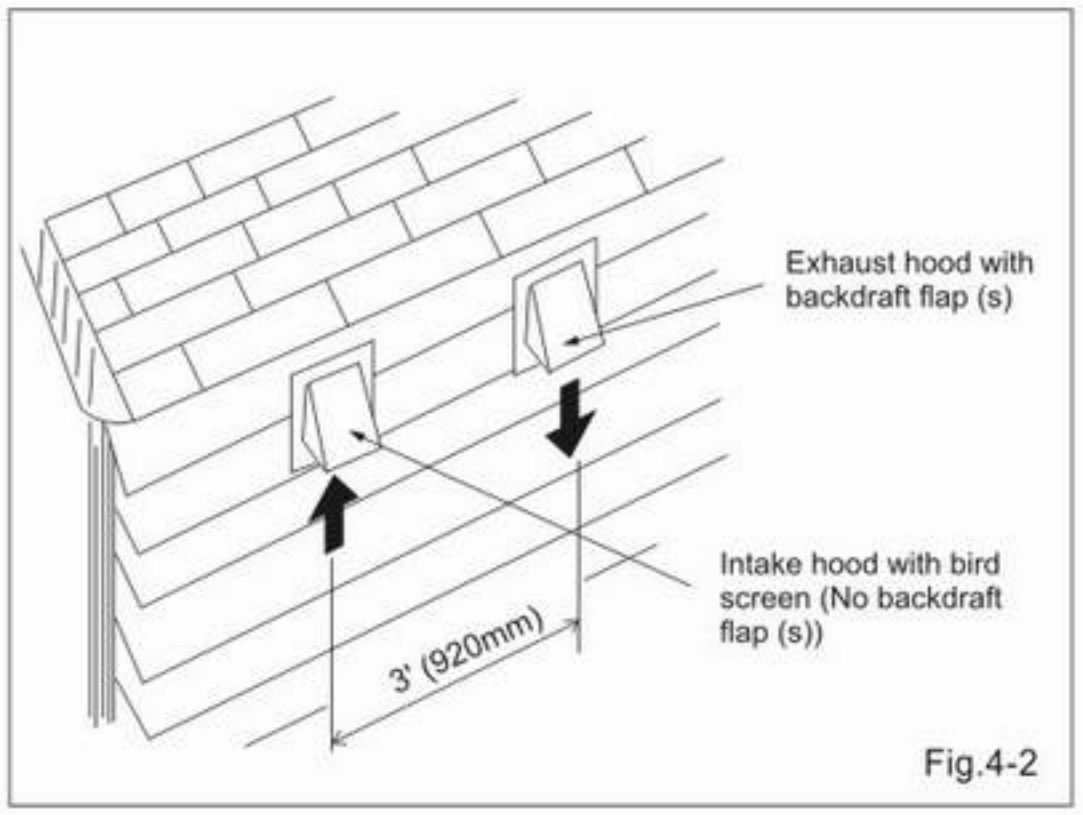


Fig.4-2

10. Finish ceiling work. Ceiling hole should be aligned with the edge of the flange. (Fig.5-1) In attic installation, caulk the body to drywall.

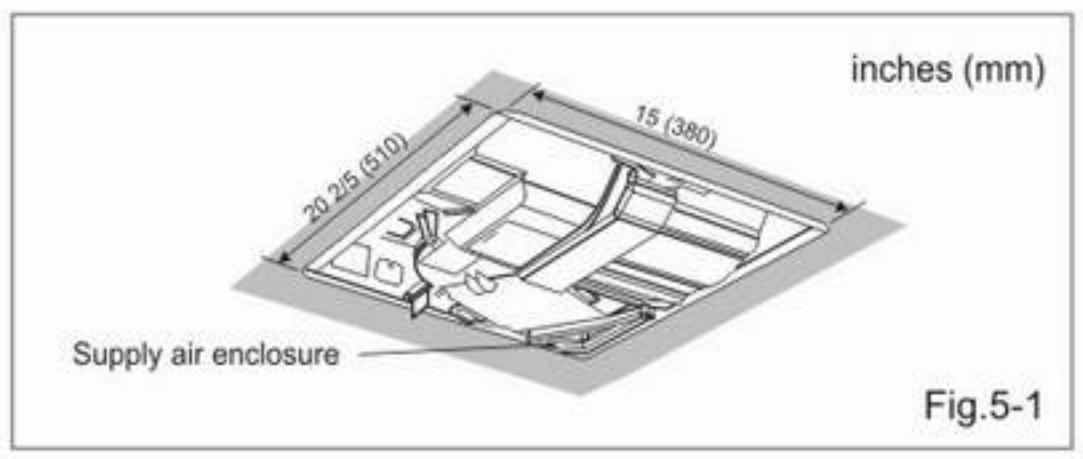


Fig.5-1

11. Turn the grille to the approriate direction to fit the supply air side. Insert mounting springs into slots as shown and mount grille to fan body. During installation of the grille, keep the recovery core to the left and keep the RA filter in front from your position. (Fig. 5-2)

Note: If grille has a gap from the ceiling, adjust the grille position to fit the supply air enclosure on the grille with the one on the fan body and push grille. (Fig. 6-1)

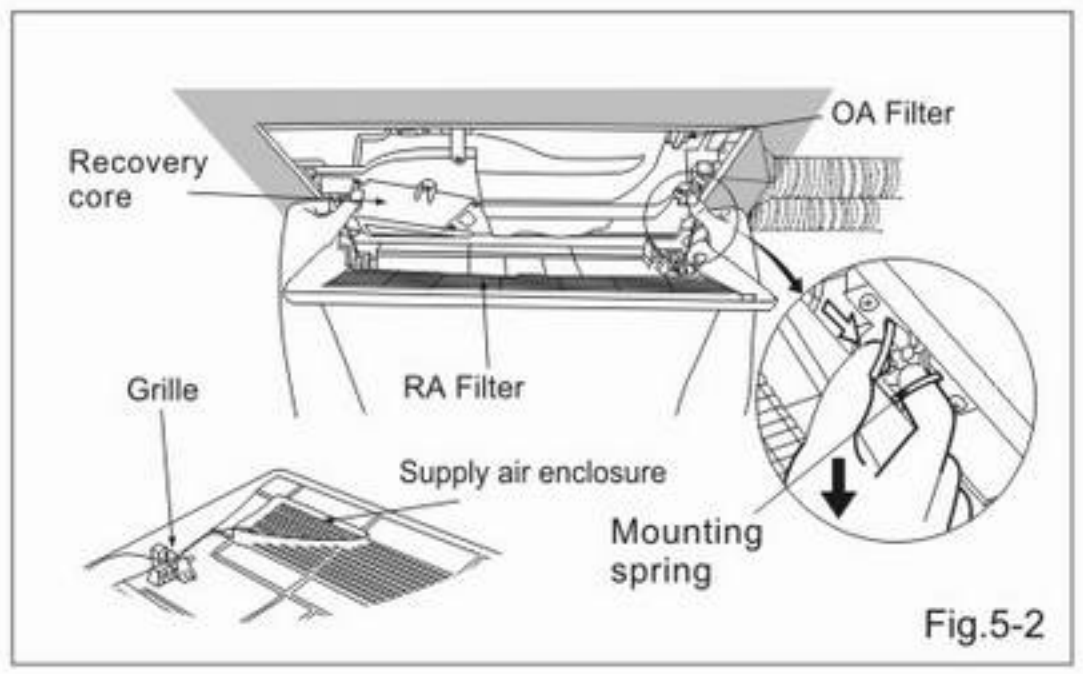


Fig.5-2

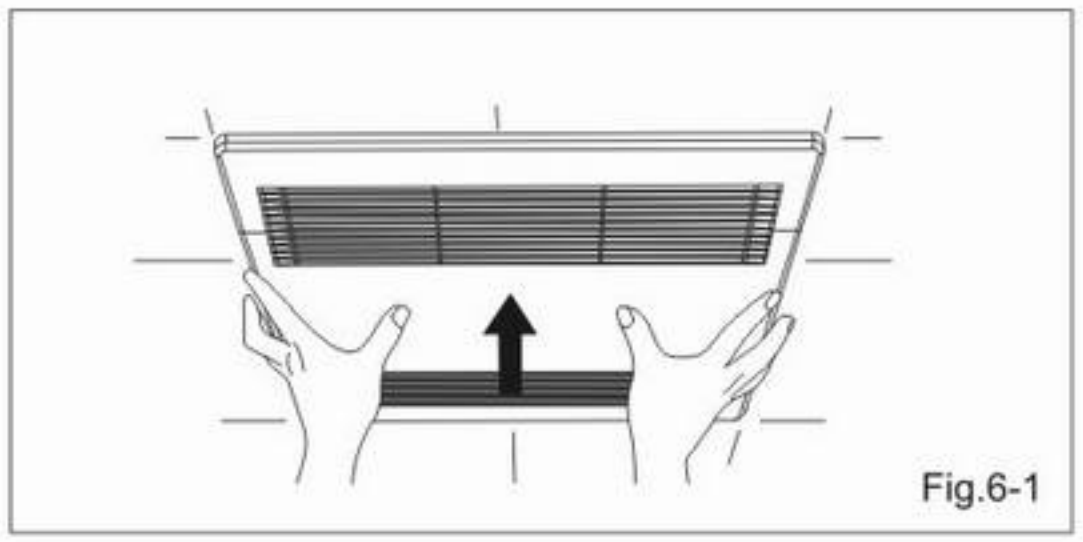


Fig.6-1

INSTALLATION I (JOIST MOUNTING-I) CONTINUED

Note:
If the grille is mounted in the opposite direction, the grille can not be fitted to the ceiling (Fig. 6-2), so then reverse the grille position and try to mount again.

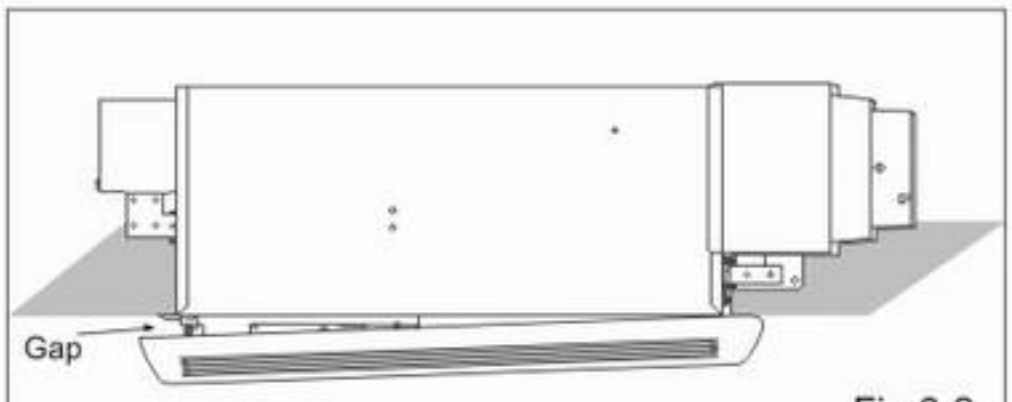
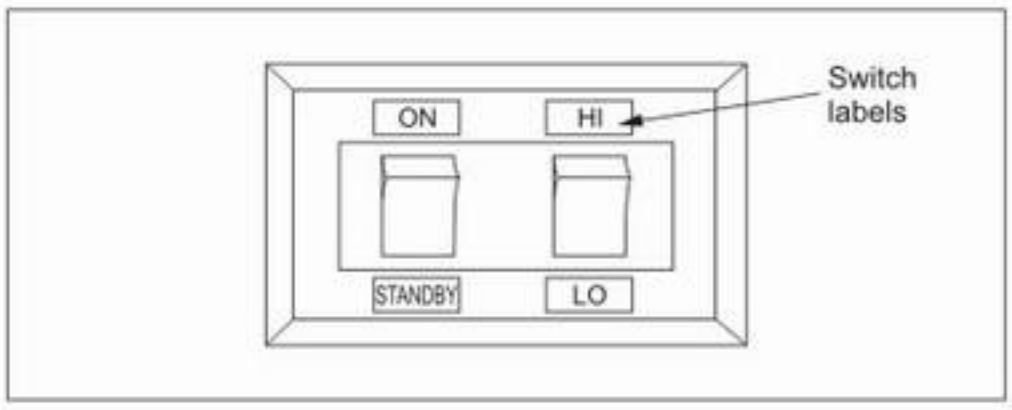


Fig.6-2

[Optional]
Attach the given switch labels (in accessories) on the wall switch (not included) as shown in the diagram for clearer indication.



INSTALLATION II (WOODEN HEADER)

1. Install header between joists by using nails or screws. (Fig.7)
   Insert Suspension bracket I,II,III and adjust the width to fit inside of the joist and header. (Fig.1)
   Insert the fan body between joists and header. Make sure the fan body is horizontal and vertical to the joists. (Fig.7)

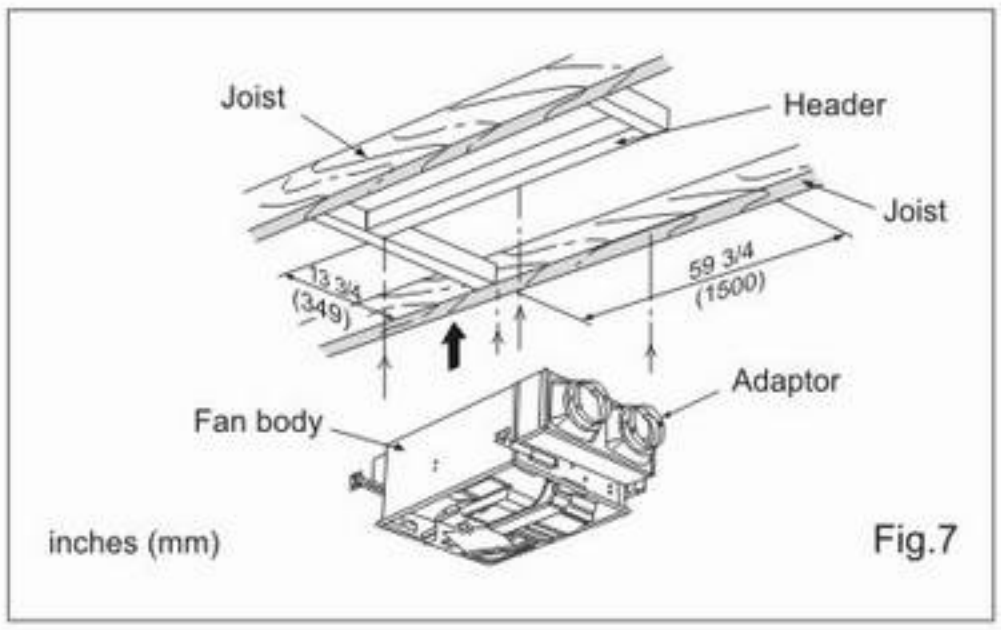


Fig.7

CAUTION:
If the bottom flange is not the same level as the drywall, the performance of the unit will be affected.

2. Follow step 2 to 4 of installation I (Page 8, Page 9) to install the fan body.

3. Follow step 5 to 11 of installation I (Page 9, Page 10) to complete the installation work.

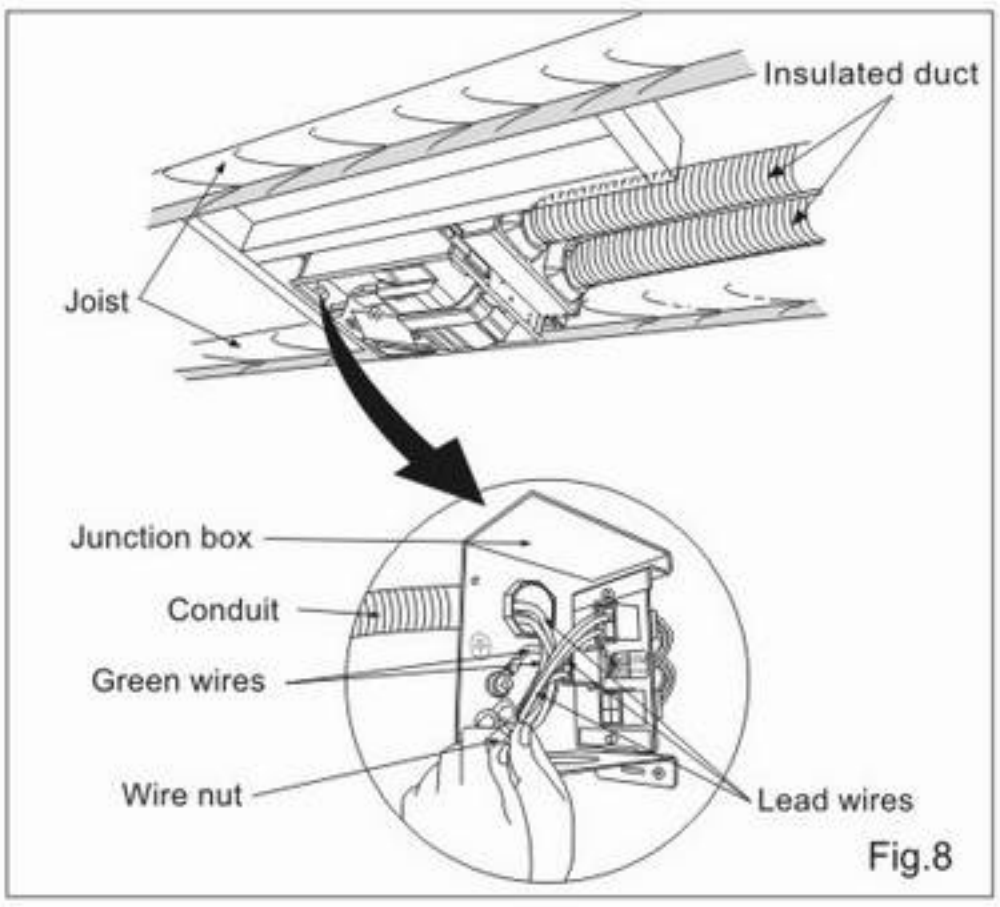


Fig.8

MAINTENANCE (CLEANING)

WARNING:

- Disconnect power source by switching off at service panel before working on unit.

CAUTION:

- Routine maintenance must be done every 2 or 3 months.
- Clogged filters may cause the condensation on the unit due to air flow reduction.

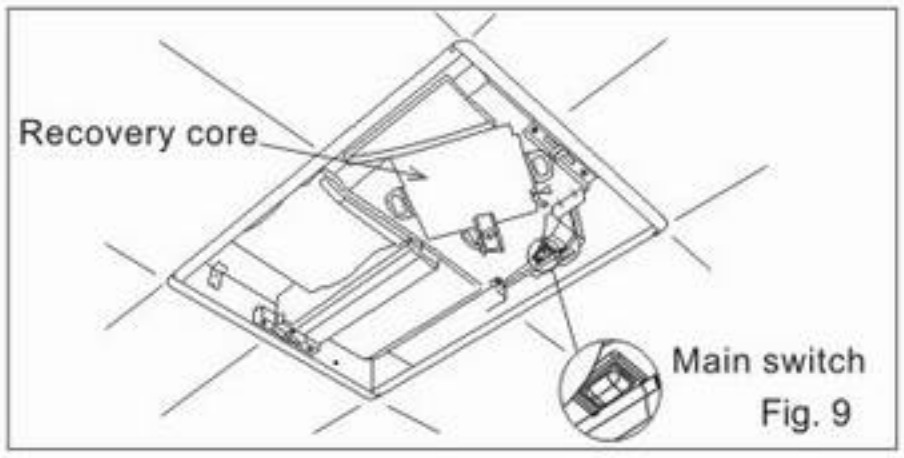


Fig. 9

CAUTION:

1. Never use petrol, benzene, thinner or any other such chemicals for cleaning the ERV.
2. Do not allow water to enter motor.
3. Do not immerse resin parts in water over 60°C.

1. Remove the Grille. (Squeeze mounting spring and pull down carefully.) (Fig.10)

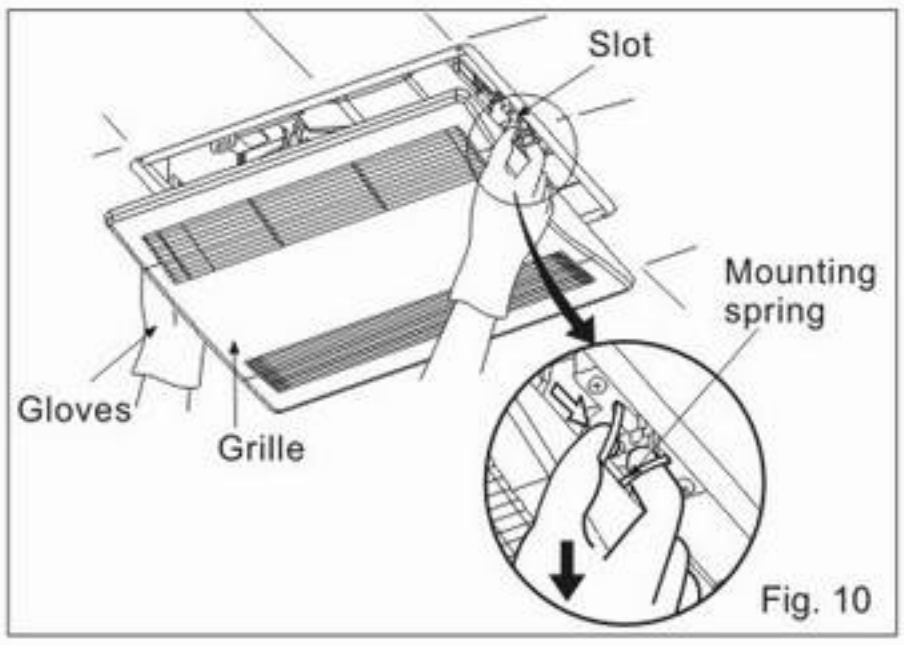


Fig. 10

2. Remove the RA Filter from the Grille. (Fig.11)

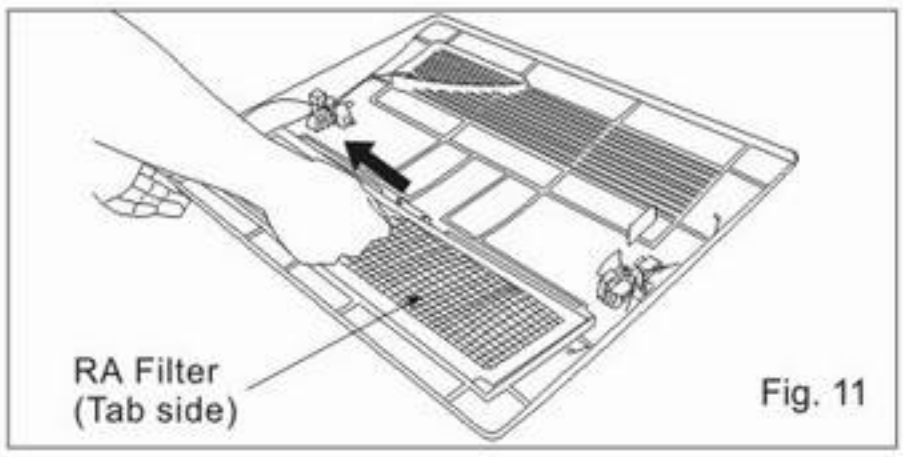


Fig. 11

3. Wash and clean Grille. (Use non-abrasive neutral kitchen detergent, wipe dry with new cloth.) (Fig.12)

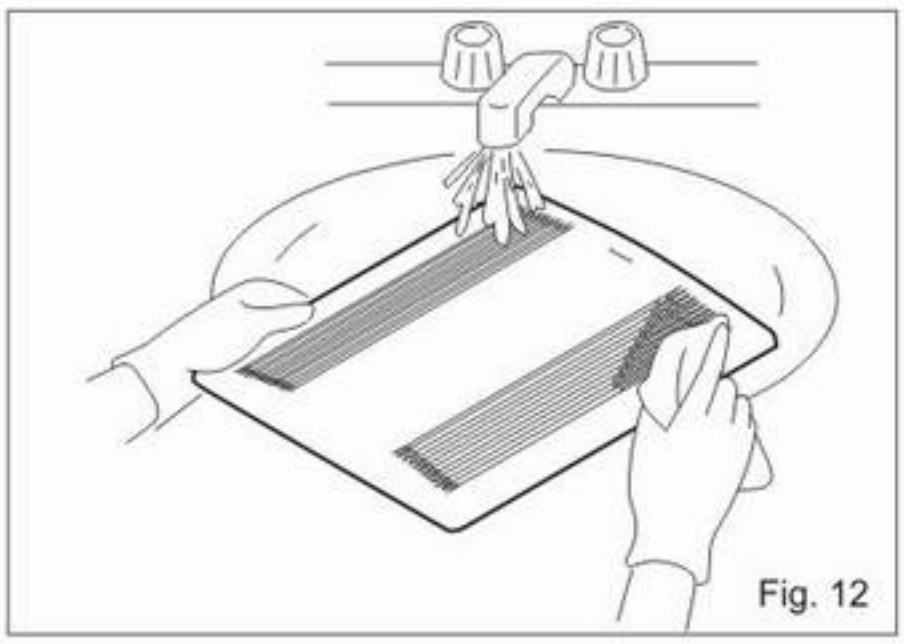


Fig. 12

4. RA Filter cleaning:
   Remove the RA Filter.(Fig.11) And Vacuum-clean. (Fig.13)
   After cleaning, replace the RA Filter.

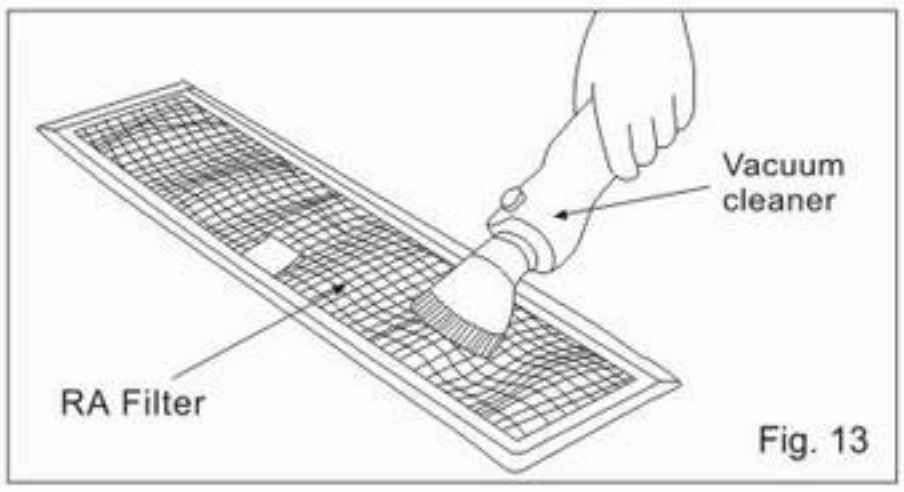


Fig. 13

MAINTENANCE (CLEANING) CONTINUED

5. OA Filter cleaning:
   Remove the OA Filter.(Fig.14) And Vacuum-clean, wash softly within warm water with non-abrasive neutral detergent and allow to air dry. (Fig.15)
   After cleaning, replace the OA Filter according to Filter direction on Fig.14. Make sure the OA Filter has been installed securely.
   The filter can only be installed in one direction.

CAUTION:
Be careful when removing the filter in case condensation water and/or dust has accumulated and may fall out.

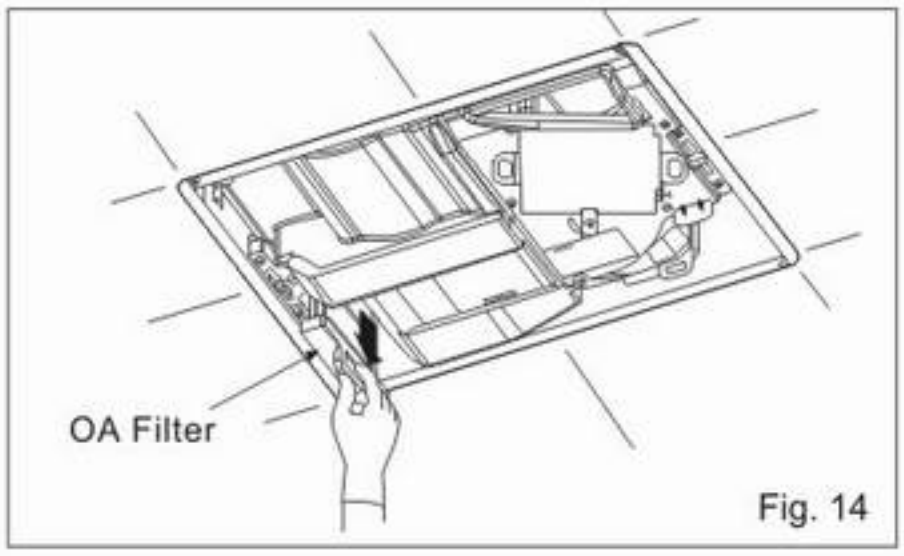


Fig. 14

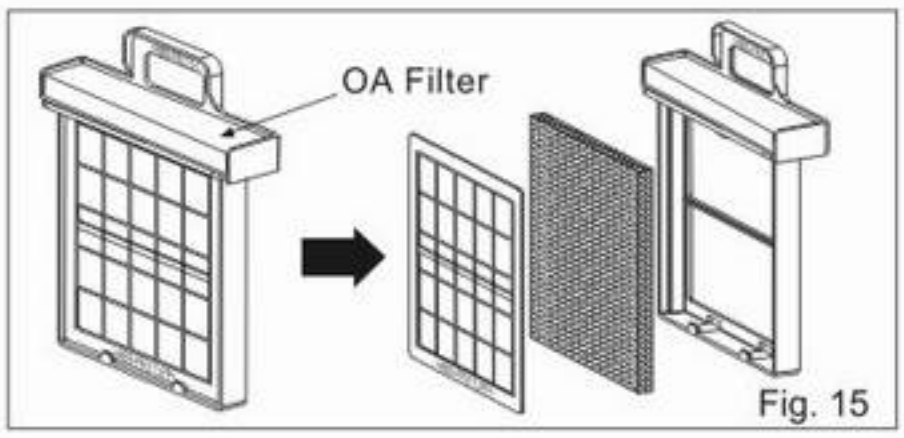


Fig. 15

6. Remove dust and dirt from fan body using a vacuum cleaner. (Fig 16)

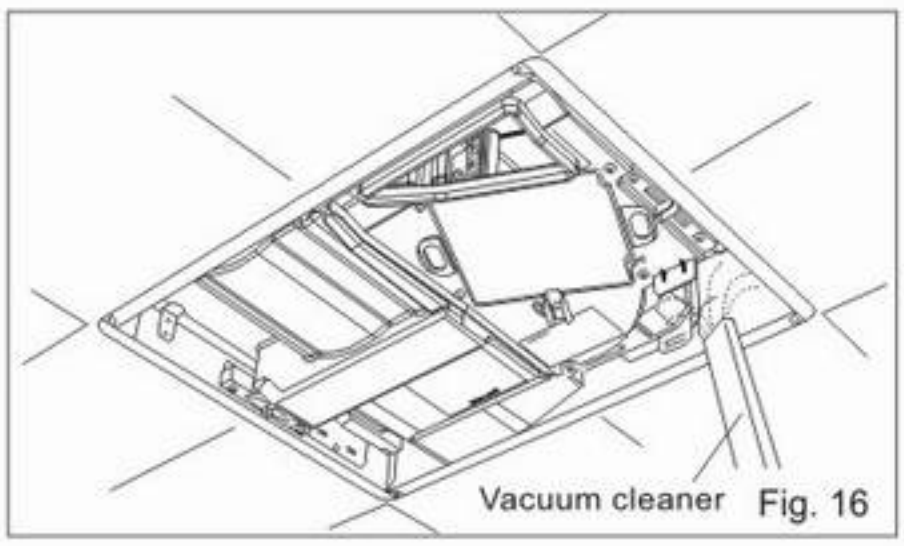


Fig. 16

7. Element cleaning:

   ①Turn the knob to the right.(Fig.17)

   ②Rise up the handles.(Fig.18)

   ③Pull the Recovery core straight down, and slowly remove. (Fig.18)

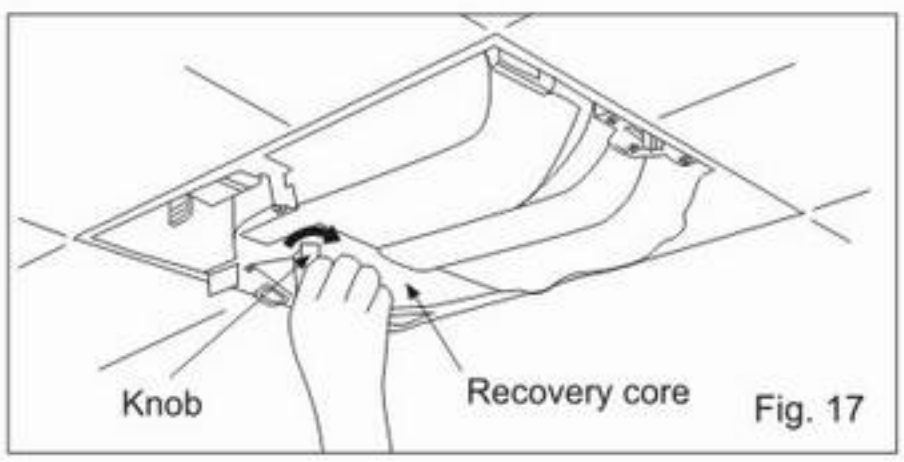


Fig. 17

CAUTION:
Be careful when removing the filter in case condensation water and/or dust has accumulated and may fall out.

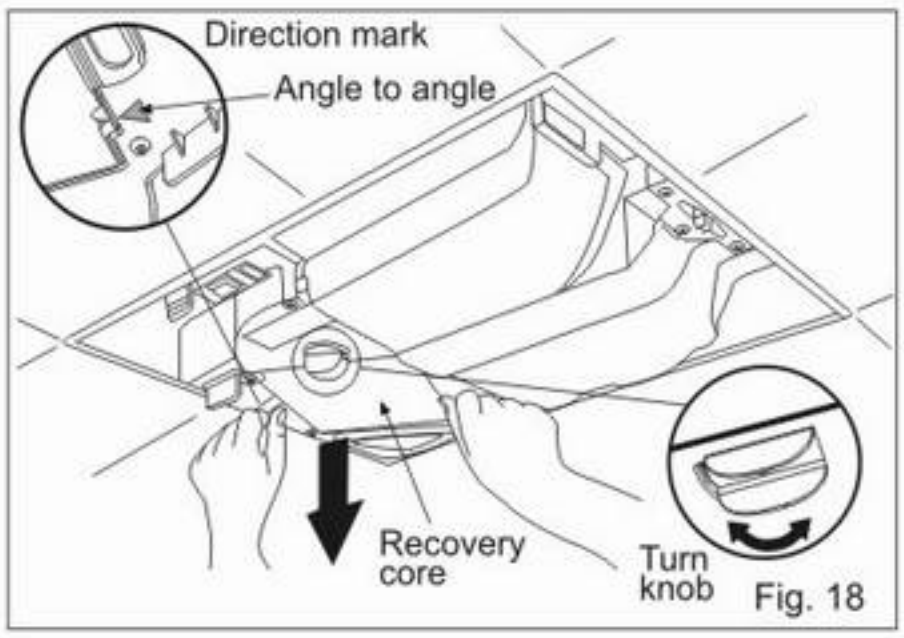


Fig. 18

MAINTENANCE (CLEANING) CONTINUED

④Vacuum-clean carefully. (Fig.19)

IMPORTANT:
When cleaning the recovery core, do not push strongly by the nozzle. It may get damaged.

⑤Replace the recovery core according to the direction mark "△" and turn the knob to lock in place.

CAUTION:
Insert the Recovery core completely then turn the knob to prevent the core dropping.

CAUTION:
- Do not wash the Recovery core to prevent causing damage to the recovery core.
- Make sure that the knob holds the recovery core securely.

8. Turn the grille in the appropriate direction to fit on the air supply side. Insert the mounting springs into the slots, as shown, and mount the grille to the fan body. When installing the grille, keep the recovery core to the left and keep the RA filter in front of your position. (Fig. 20)

CAUTION:
If the grille is mounted in the opposite direction, the grille can not be fitted to the ceiling (Fig. 22), so then reverse the grille position and try to mount again.

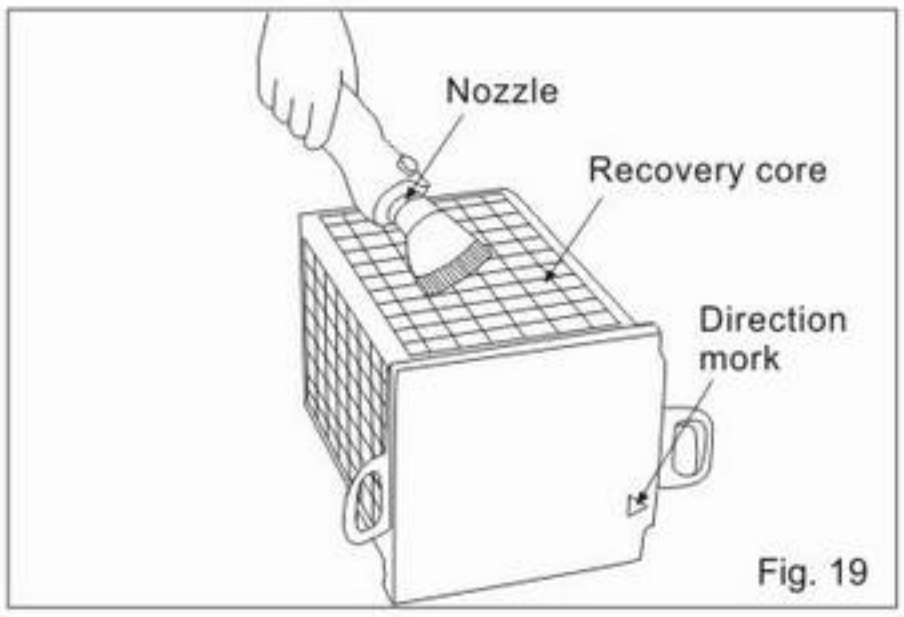


Fig. 19

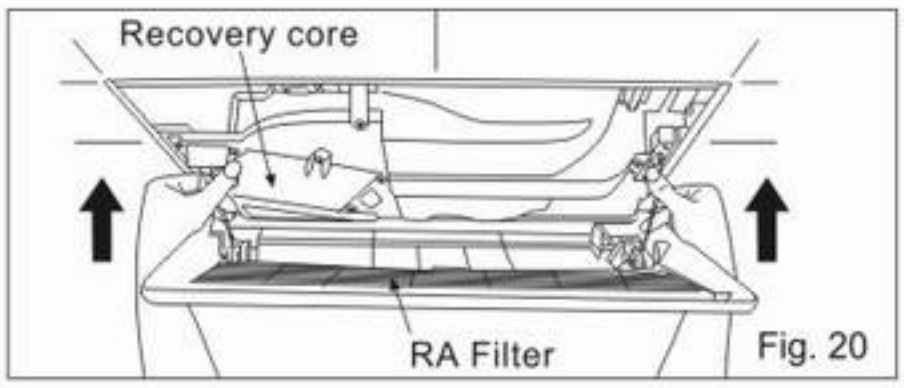


Fig. 20

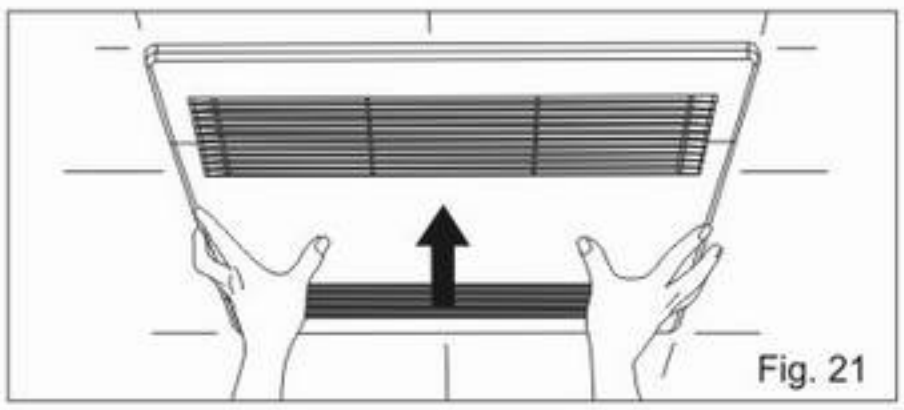


Fig. 21

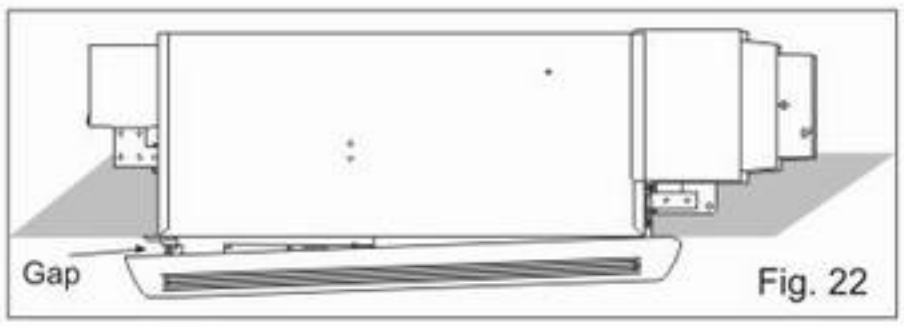


Fig. 22

PRODUCT SERVICE

Warning Concerning Removal of Covers.
The unit should be serviced by a qualified technicians only. No service information is provided for customers. Your product is designed and manufactured to ensure a minimum of maintenance. However, should your unit ever require service, a nationwide system of factory service centers and AUTHORIZED INDEPENDENT SERVICE CENTERS is maintained to support your product's warranty.
(In the U.S.A., call 1-866-292-7292 to Customer call Center.)

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Division of Panasonic Corporation of North America,
One Panasonic Way, Secaucus, NJ 07094

PANASONIC CANADA INC.
5770 Ambler Driver, Mississauga, ON L4W 2T3

www.panasonic.com

X0101-0106 04VE14020A

EZ Boost™ System with BMQE Booster Pump, Tank, and Controller

Product Guide and Installation and operating instructions

Please leave these instructions with the pump for future reference.

Contents

Product Guide

Installation and Operating Instructions

Mission

- to successfully develop, produce, and sell high quality pumps and pumping systems worldwide, contributing to a better quality of life and healthier environment

GBJ - Bjerringbro, Denmark

GMU - Fresno, California

GPU - Olathe, Kansas

GMX - Monterrey, Mexico

GPA - Allentown, Pennsylvania

GCA - Oakville, Ontario, Canada

- One of the 3 largest pump companies in the world
- 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**

EZ BOOST SYSTEM

Introduction

There are many applications within water supply where it is necessary to increase the system pressure. The Grundfos EZ Boost system is the optimum solution for applications requiring:

- Sealless pumps
- Quiet operation and/or
- Maintenance-free operation.

The EZ Boost system offers the following features:

- Dry-running protection
- High efficiency of pump and motor
- Excellent wear resistance
- Soft starter
- Over voltage and under voltage protection
- Overload protection
- Over temperature protection.
- Variable speed
- Electronic control and communication.

Applications

- Pressure boosting.
- Water treatment.

Pumped liquids

Thin, non-explosive liquids not containing abrasive particles or fibers. The liquid must not be able to attack the pump materials chemically or mechanically.

Should the density and/or viscosity of the pumped liquid exceed the density and/or viscosity of water, please contact Grundfos.

BMQE Pump

The pumps used for The Grundfos EZ Boost system are modified SQE submersible pumps. The EZ Boost BMQE pump is an SQE pump with an MSE 3 motor. Pump and motor are centered in the 3" stainless steel sleeve.

BMQE pumps are suitable for both continuous and intermittent operation for a variety of pressure boosting applications.

BMQE Motor

The MSE 3 motors are based on state-of-the-art technology within permanent magnets (PM motor), which accounts for the high motor efficiencies. In addition, the motors have a built-in electronic unit with a frequency converter for variable frequency and soft starting.

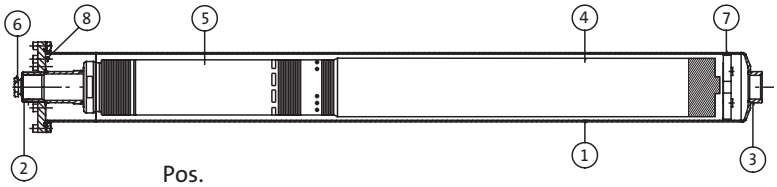
The MSE 3 motors features high efficiency within a wide load range. The high and flat efficiency curve of the PM motor enables the same motor to cover a wide power range as opposed to conventional AC motors. For BMQE pumps, this means fewer motor variants.

EZ Boost Controller

The BMQE pump features variable speed which is offered through frequency control via the EZ Boost controller. As a consequence, the pump can be set to operate in any duty point in the range between the minimum and maximum performance curves of the pump. Each BMQE pump must be connected to its own EZ Boost controller.

It is also possible to operate the BMQE without an EZ Boost controller, though the features offered will be fewer.

BMQE Pump Sectional Drawing



Pos.

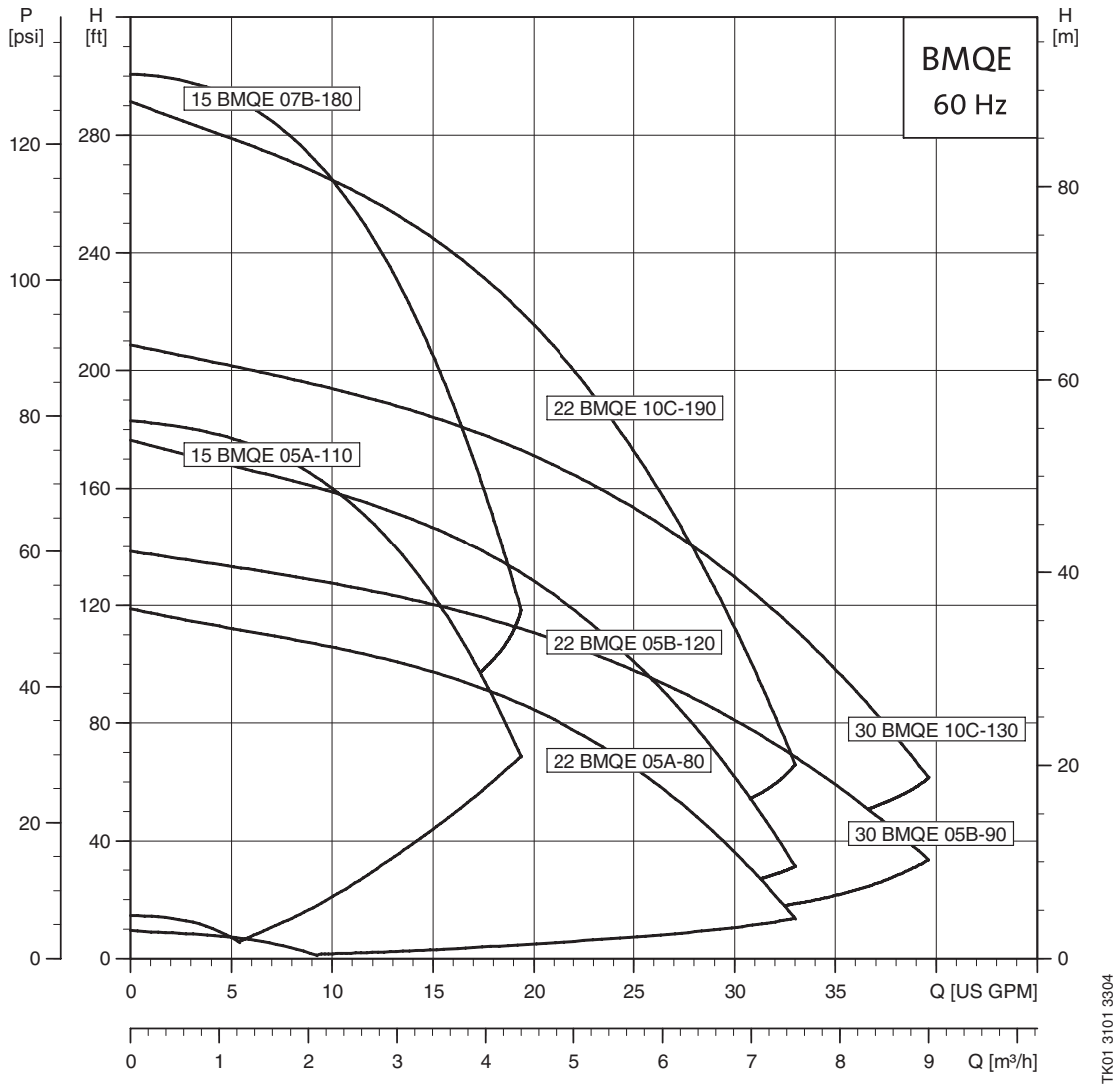
1. Sleeve
2. Discharge connection
3. Suction connection
4. MSE 3 motor
5. SQE pump
6. Cable entry
7. Centering device
8. Air vent screw

Operating conditions

Flow:	Max. 39 US GPM (8.9 m3/h)
Head:	Max. 300 ft (91.4 m)
Temperature:	Max. 95°F (35°C)
Operating pressure:	Max. 145 PSI (10 bar)
Inlet pressure:	Min. 8 PSI (0.55 bar)
Sound-pressure level:	The sound pressure level of the BMQE is lower than 74 db[A] at a distance of 3 feet (1 meter).

It is recommended by Grundfos that the pump be installed with sound and vibration dampening equipment such as flexible piping adapters and anti-vibration mounting. The pump should not be mounted in or adjacent to living quarters. The pump can also be wrapped with sound-proofing insulation to reduce noise (see page 16, EZ Boost System Diagram).

Performance range, 60 Hz



Product range

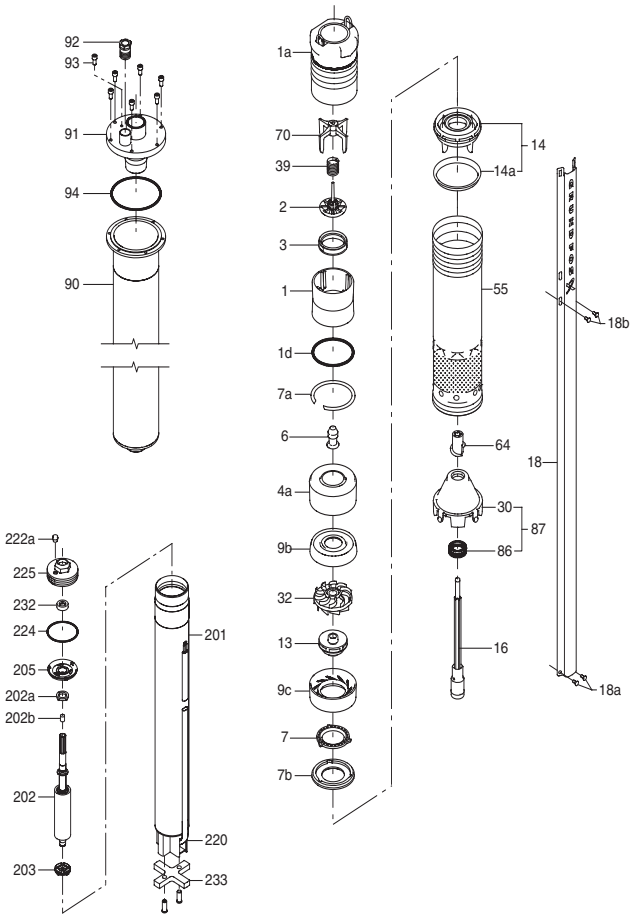
Range	BMQE 15	BMQE 22	BMQE 30
Nominal flow rate [US GPM (m3/h)]	15 (3.4)	22 (5.0)	30 (6.8)
Temperature range	+32 to +95°F (0 to +35°C)		
Maximum working pressure [PSI (bar)]	145 (10)		
Maximum efficiency [%]	57	62	60
Flow range [US GPM (m^3/h)]	0 to 19 (4.3)	0 to 33 (7.5)	0 to 39 (8.8)
Maximum pump pressure [ft (m)/PSI]	300 (91.4)/130	290(88.4)/125	208(63.4)/90
Pipe connection	1.25” NPT inlet / 1” NPT discharge		

Materials BMQ

Sleeve Pos.	Description	Material	AISI
90	Sleeve	Stainless steel	304
91	Flange	Stainless steel	304
92	Cable entry	Stainless steel/ FKM	304
93	Air vent screw	Stainless steel	304
94	O-ring	FKM	

Pump Pos.	Description	Material	AISI
1	Valve casing	Polyamide/PVDF	
1a	Discharge chamber	Stainless steel	304
1d	O-ring	NBR rubber	
3	Valve seat	NBR rubber	
4a	Empty chamber	Polyamide/PVDF	
6	Top bearing	NBR rubber	
7	Neck ring	Polyamide/PVDF	
7a	Lock ring	Stainless steel	310
7b	Neck ring retainer	Polyamide/PVDF	310
9b	Empty chamber	Polyamide/PVDF	
9c	Bottom chamber	Polyamide/PVDF	
13	Impeller with TC bearing	Polyamide/PVDF	
14	Suction interconnector	Polyamide/PVDF	
14a	Ring	Stainless steel	304
16	Shaft with coupling	Stainless steel	304
30	Cone	Polyamide/PVDF	
32	Guide vanes	Polyamide/PVDF	
39	Spring	Stainless steel	316 LN
55	Pump sleeve	Stainless steel	316
64	Priming screw	Polyamide/PVDF	
70	Valve guide	Polyamide/PVDF	
86	Lip seal	NBR rubber	
87	Cone complete	Polyamide/PVDF	

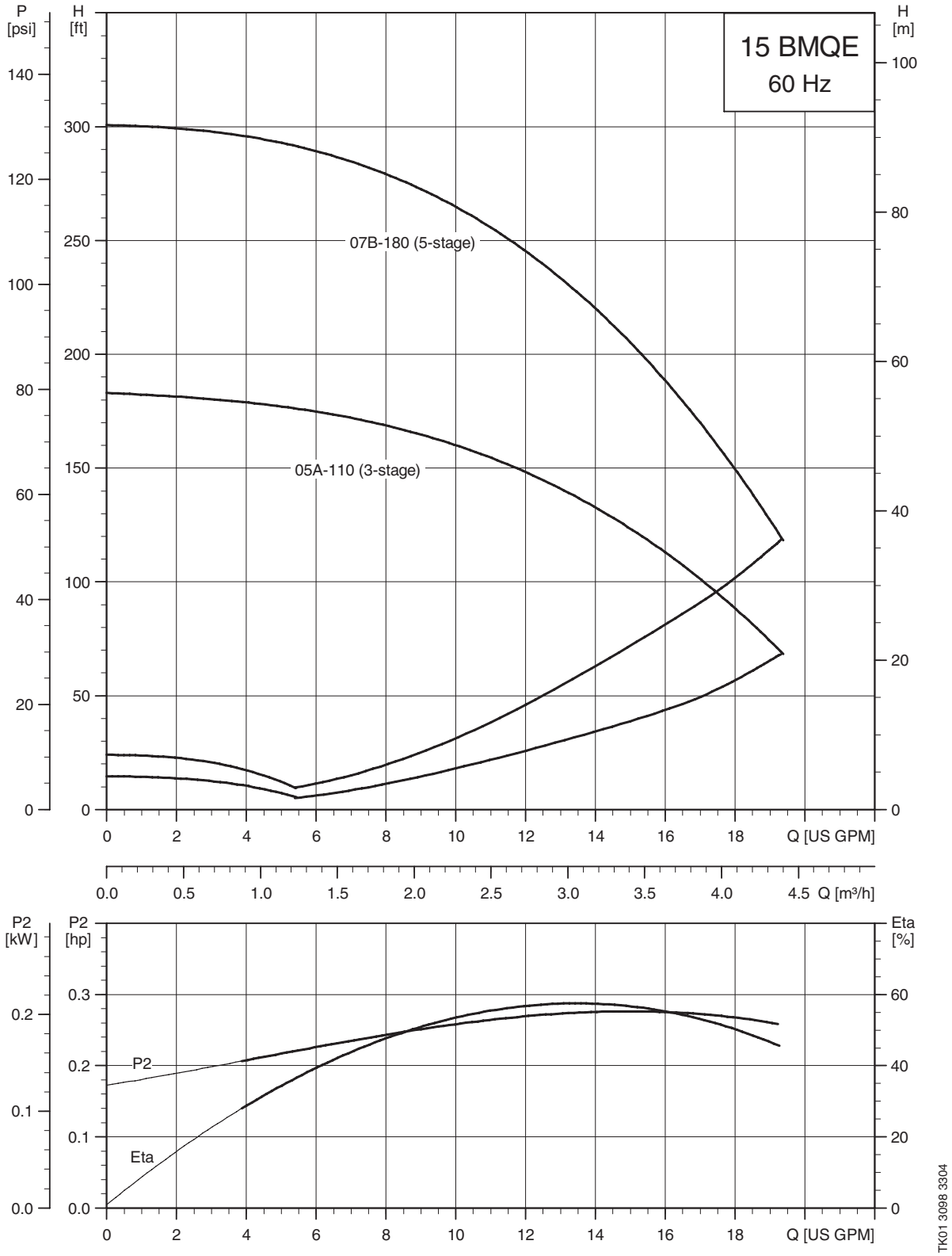
Motor Pos.	Description	Material	AISI
201	Stator	Stainless steel	304
202	Rotor	Stainless steel	304
202a	Stop ring	PP	
202b	Filter	Polyester	
203	Thrust bearing	Carbon	
205	Radial bearing	Ceramic/TC	
220	Motor cable with plug	EPR	
222a	Filling plug	NBR rubber	
224	O-ring	FKM	
225	Top cover	PPS	
232	Shaft seal	NBR rubber	

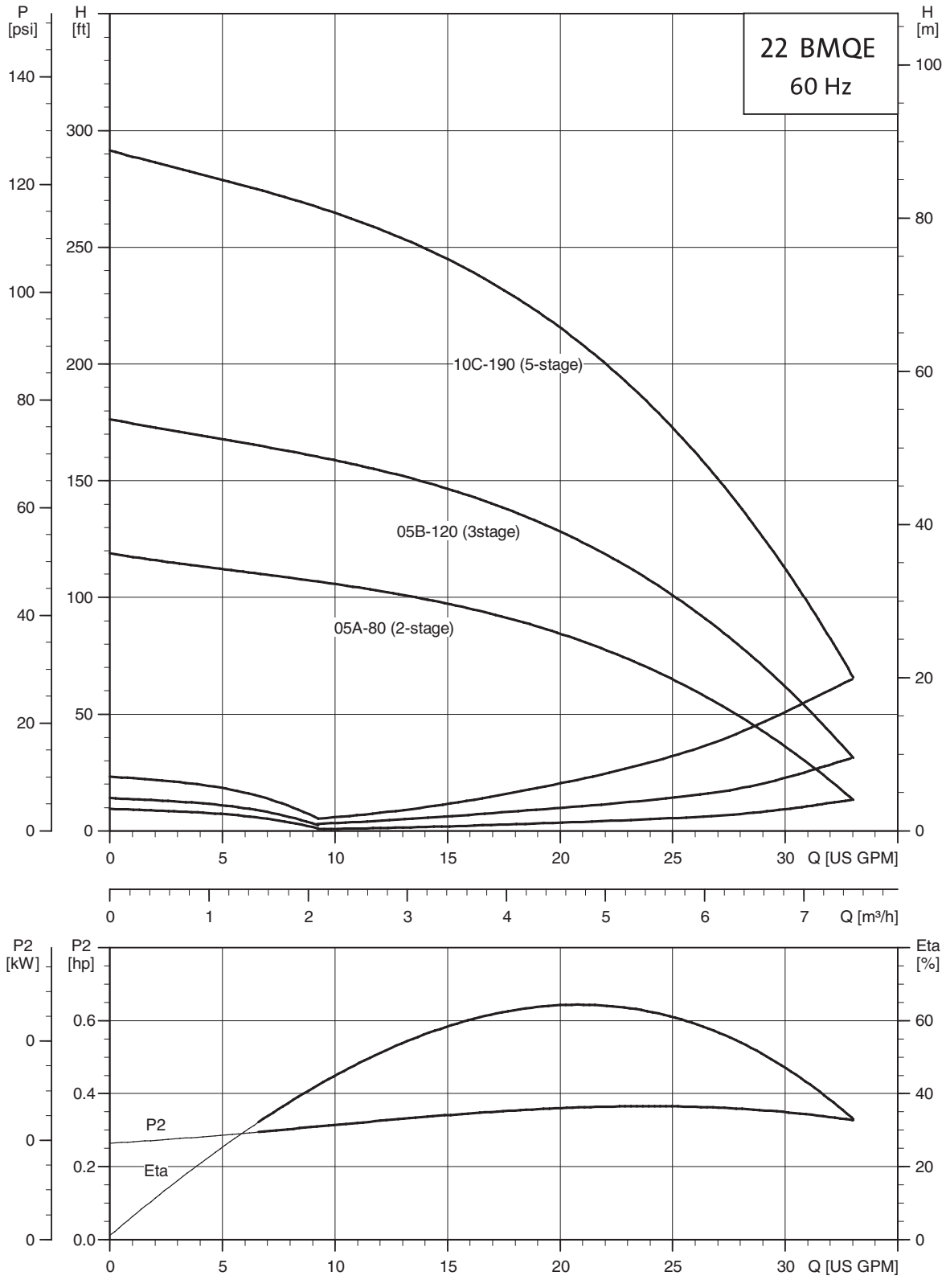


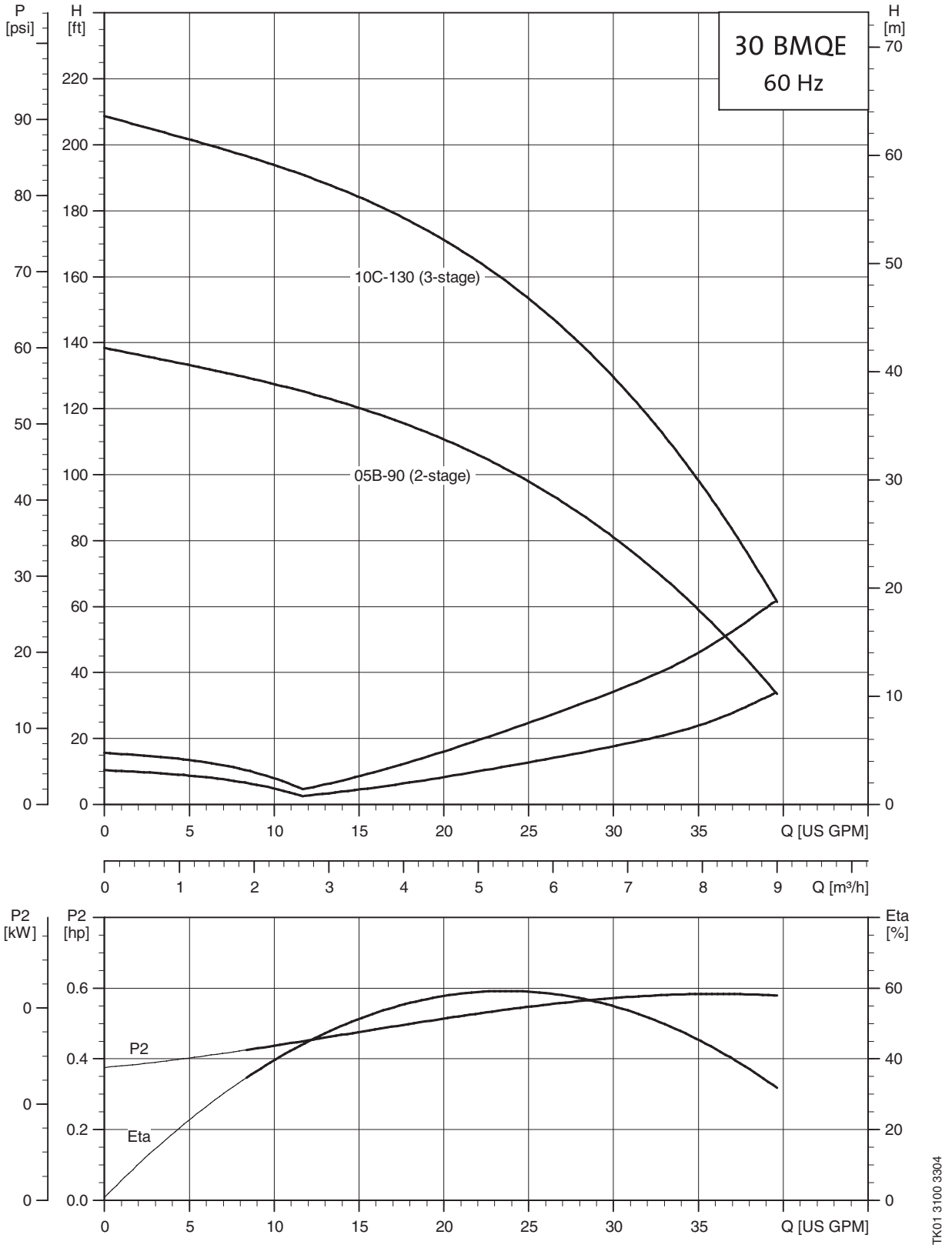
Type key

Example	22	BMQ	E	05B	120

- Rated flow in US GPM
- EZ Boost pump
- Electronically controlled pump via EZ Boost controller
- Motor HP
- Head in feet at rated flow


15 BMQE
60 Hz
P [psi]
H [ft]
H [m]
07B-180 (5-stage)
05A-110 (3-stage)
Q [US GPM]
Q [m³/h]
P2 [kW]
P2 [hp]
Eta [%]
P2
Eta
TK01 3098 3304

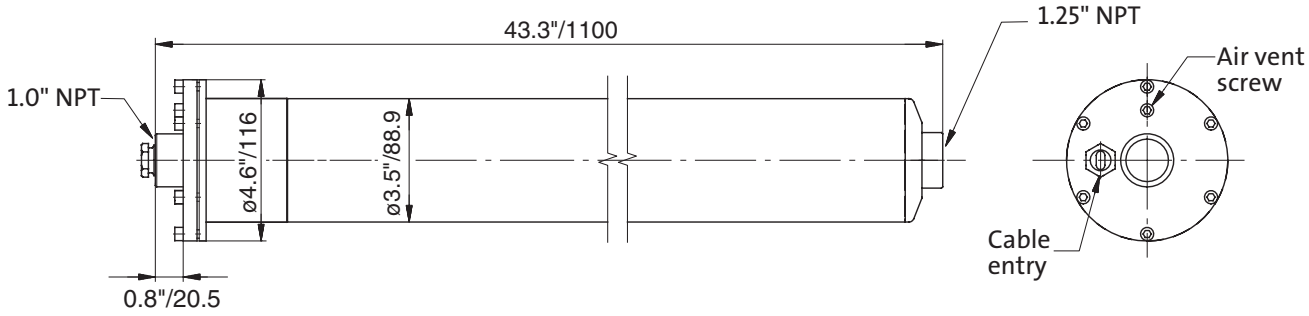

22 BMQE
60 Hz
P [psi]
H [ft]
H [m]
10C-190 (5-stage)
05B-120 (3stage)
05A-80 (2-stage)
Q [US GPM]
Q [m³/h]
P2 [kW]
P2 [hp]
Eta [%]
P2
Eta
Q [US GPM]
TK01 3099 3304


30 BMQE
60 Hz
P [psi]
H [ft]
H [m]
10C-130 (3-stage)
05B-90 (2-stage)
Q [US GPM]
Q [m³/h]
P2 [kW]
P2 [hp]
Eta [%]
P2
Eta
Q [US GPM]
TK01 3100 3304

Weights and electrical data

Model	Material number	Max. motor output [P2]		Rated Voltage	Rated current [A]	Locked rotor current [A]	Shipping weight [lb (kg)]	Shipping volume [ft³ (m³)]
		hp	kW					
15 BMQE 05A-110	91128524	0.845	0.63	110-115	9.2	11.1	26 (11.8)	
22 BMQE 05A-80	91128527	0.845	0.63	110-115	7.8	11.1	26 (11.8)	
15 BMQE 05A-110	91128525	0.845	0.63	200-240	4.6	5.0	26 (11.8)	
15 BMQE 07B-180	91128526	1.408	1.05	200-240	7.1	8.0	29 (13.2)	
22 BMQE 05A-80	91128528	0.845	0.63	200-240	3.9	5.0	26 (11.8)	0.9 (0.025)
22 BMQE 05B-120	91128529	1.408	1.05	200-240	5.6	8.0	29 (13.2)	
22 BMQE 10C-190	91128530	2.320	1.73	200-240	9.9	11.1	31 (14.1)	
30 BMQE 05B-90	91128531	1.408	1.05	200-240	6.0	8.0	31 (14.1)	
30 BMQE 10C-130	91128533	2.320	1.73	200-240	9.5	11.1	31 (14.1)	

Dimensional sketch [in/mm]



Technical data - BMQE pump

Main power supply to pump	1 x 200-240 V –10%/+6%, 60 Hz 1 x 110-115 V –10%/+6%, 60 Hz
Starting	Soft starting.
Stopping	Soft stopping when stopped by the EZ Boost controller
Run-up time	Maximum: 2 seconds. No limitation to the number of starts/stops per hour.
Motor protection	Built into the pump. Protection against: Dry running Over voltage and under voltage 230 V cuts out at < 150 V and > 280 V 115 V cuts out at < 75 V and > 150 V Overload Over temperature
Sound pressure level	The sound pressure level is < 74 db[A] at a distance of 3 feet (1 meter). **It is recommended by Grundfos that the pump be installed with sound and vibration dampening equipment such as; flexible piping adapters and anti-vibration mounting. The pump should not be mounted in or adjacent to living quarters. The pump can also be wrapped with sound proofing insulation to reduce noise. (See page 16, EZ Boost System Diagram.)**
Reset function	BMQE pumps can be reset via EZ Boost controller.
Power factor	PF = 1.
Operation via generator	It is recommended that the generator output is equal to the motor input power P1 [kW] plus 50%; min. P1 +10%, however.
Pipe connection	1.25” NPT inlet / 1” NPT discharge.
Strainer	Holes of the strainer: ø0.09” (2.3 mm)
Marking	UL Listed, CE

EZ Boost Controller

The EZ Boost controller is a control and communication unit especially developed for the BMQE booster pumps in constant pressure applications.

The EZ Boost controller provides:

- Full control of the BMQE pumps
- Two-way communication with the BMQE pumps
- Possibility of adjusting the pressure
- Alarm indication (LED) when service is needed
- The possibility of starting, stopping and resetting the pump simply by means of a push-button

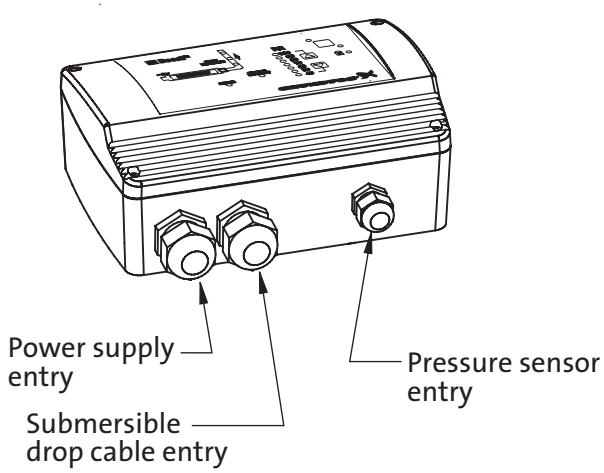
The EZ Boost controller communicates with the pump via power line communication, meaning that no extra cables are required between the EZ Boost controller and the BMQE pump.

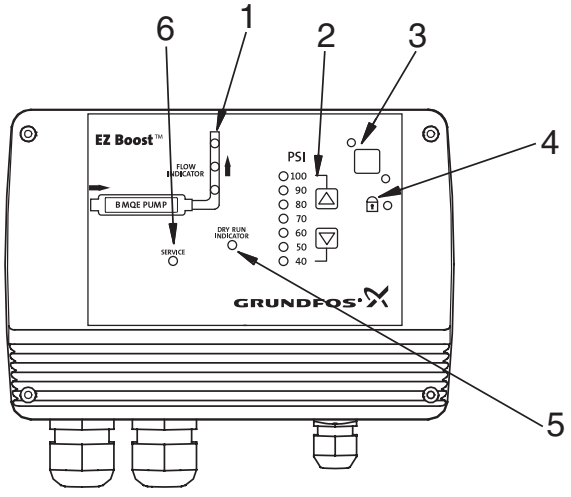
The EZ Boost controller features the following indications (see drawing below):

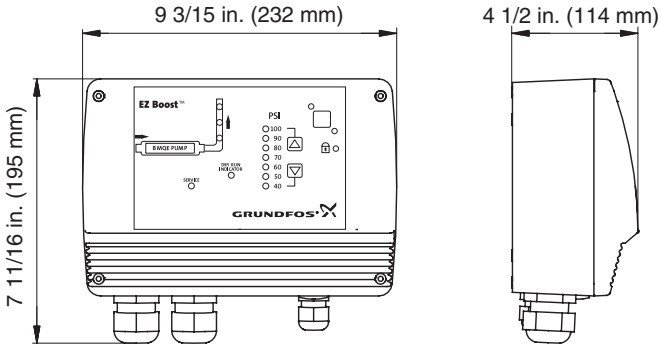
1. Flow indicator
2. System pressure setting
3. System ON/OFF
4. Button lock indicator
5. Dry-running indicator
6. Service needed in case of:
   – No contact to pump
   – Over voltage
   – Under voltage
   – Speed reduction
   – Over temperature
   – Overload
   – Sensor defective

The EZ Boost controller incorporates external signal input for pressure sensor.

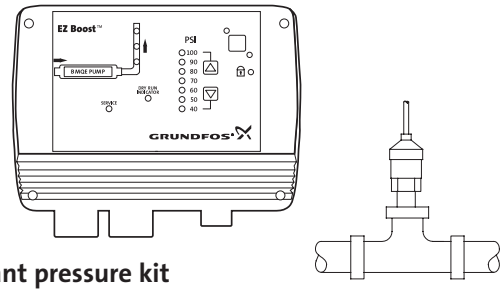
Voltage	1 x 100-240 V –10%/+6%, 60 Hz
Power consumption	5 W
Current consumption	Maximum 130 mA
Enclosure class	NEMA 3R (IP 55)
Ambient temperature	In operation: -22 to +122°F (-30 to +50°C) during storage: -22 to +140°F (-30 to +60°C)
Relative air humidity	95%
Pump cable	Maximum length between EZ Boost controller and pump: 650 ft (198 m).
Back-up fuse	Maximum: 16 A
Marking	UL Listed, CE
Load	Max. 100 mA





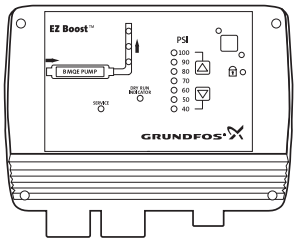


Accessories



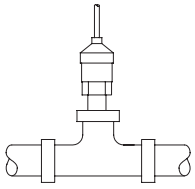
EZ Boost constant pressure kit

Description	Rating	Material number
EZ Boost controller and pressure sensor	40 to 100 PSI setting range	91128636



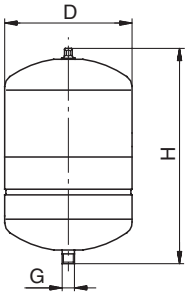
EZ Boost controller

Description	Rating	Material number
EZ Boost controller	40 to 100 PSI setting range	91121987



Sensor

Description	Rating	Material number
Pressure sensor kit for EZ Boost controller	0 to 120 PSI, 1/2” NPT	96437852



Diaphragm tank

Duty range		Materials	
Pre-charge pressure:	40 PSI	Liner:	Polypropylene
Max. operating pressure:	150 PSI	Connection:	Lead-free brass
Max. liquid temperature:	200°F	Tank:	Stainless steel, AISI 304

Description	G connection	D [in (mm)]	H [in (mm)]	Weight [lbs (kg)]	Material number
Diaphragm tank, 2 gallon	3/4” NPT	8 (203)	12.63 (321)	5 (2.3)	91121984

PRE-INSTALLATION

Before beginning installation procedures, these installation and operating instructions should be studied carefully. The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

The sound pressure level of the BMQE is <74 db[A] at a distance of 3 feet (1 meter). **It is recommended by Grundfos that the pump be installed with sound and vibration dampening equipment such as; flexible piping adapters and anti-vibration mounting. The pump should not be mounted in or adjacent to living quarters. The pump can also be wrapped with sound proofing insulation to reduce noise. (See page 16, EZ Boost System Diagram.)**

1. A guide to the EZ Boost System

The EZ Boost Constant Pressure System automatically balances water surges and equalizes flow and pressure according to consumption. In other words, the system maintains a constant water pressure in spite of varying water consumption. The pressure is registered by means of the pressure sensor and transmitted to the controller. The controller adjusts the EZ Boost BMQE pump performance accordingly. The EZ Boost Constant Pressure System features:

- Quick and easy installation: ready-to-use system requiring minimum space
- High user convenience: constant pressure regardless of water consumption
- Easily adjustable pressure level: push button control
- Continuous control and monitoring of pump operation
- Integrated dry-running protection
- Integrated overload protection
- Integrated protection against over voltage and under voltage
- Soft start system

1.1 Function

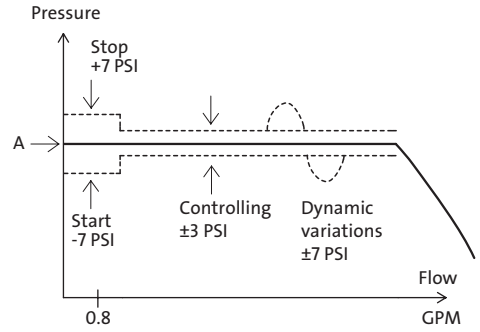
When a tap is opened, the pressure in the tank will start to drop. The system maintains a constant pressure within the maximum pump performance in spite of varying water consumption.

The pressure is registered by means of the pressure sensor, which transmits a signal to the controller. The controller adjusts the pump performance accordingly to maintain constant pressure by changing the pump speed.

At low flow the pressure will drop slowly. When the pressure in the tank is 7 PSI below the setpoint, the pump will start. When the pressure is 7 PSI above the setpoint, the pump will stop.

Even though the EZ Boost controller is controlling the pressure within ±3 PSI, larger pressure variations may occur in the system. If the consumption is suddenly changed, e.g. if a tap is opened, the water must start flowing before the pressure can be made constant again. Such dynamic variations depend on the pipe work, but, typically, they will lie between 7 and 14 PSI. If the desired consumption is higher than the quantity the pump is able to deliver at the desired pressure, the pressure follows the pump curve as illustrated in the far right of fig. 1.

Fig. 1



A = Pressure setting

At large flow rates, the pressure will drop quickly and the pump will start immediately and maintain constant pressure. When the system is running, the EZ Boost controller makes small adjustments to the pressure to detect whether there is consumption. If there is none, the pump will simply refill the tank and stop after a few seconds.

1.2 Power line communication

The communication between the EZ Boost controller and the EZ Boost BMQE pump is via the power supply cable. This communication principle is known as power line communication. Using this principle means that no additional cables to the pump are required. The communication of data is effected by means of a high-frequency signal transmitted to the power supply cable. **In situations where multiple EZ Boost BMQE pump power cables are run parallel in wiring trays or conduit and less than 12 inches apart, the possibility for undesired communication between units exists.** When this occurs, intermittent or continuous NO CONTACT is typically seen. Other unexpected errors may also be seen.

There are two ways to eliminate the possibility of cross communication:

1. Physical separation of the cables – maintain a minimum of 12 inches between pump power cables, and never place more than one cable in a conduit.

2. Use shielded cable – the use of shielded cable prevents cross communication between parallel cables and allows sharing of conduit and cable trays. Tie the cable shield to ground only at the EZ Boost controller panel.

Suitable cables:

Manufacturer	Part number	Gage
Anixter	2A-1403S	14
Anixter	2A-1203S	12
Anixter	2A-1003S	10
Anixter 800-321-1486		

2. Overview of built-in protection

2.1. Run-dry protection

The EZ Boost BMQE pumps are protected against dry-running. In case of dry-run, the BMQE will stop after 30 seconds thus preventing a burnout of the motor. After a dry-running alarm, the pump restarts automatically after 5 min.

2.2. Overload protection

Exposure of the BMQE pump to heavy load causes the current consumption to rise. The motor will automatically compensate for this by reducing the speed. If the speed drops to 30% of the rated speed, the motor will be cut out. If the rotor is being prevented from rotating this will automatically be detected and the power supply cutout. Consequently, no extra motor protection is required.

2.3. Over voltage and under voltage protection

Over voltage and under voltage may occur if the voltage supply is unstable. The integrated protection of the BMQE motor protects the motor if the voltage falls outside the permissible voltage range. With a rated voltage of 200 - 240 V, 60 Hz, the pump will be cut out if voltage falls below 150 V or rises above 280 V. With a rated voltage of 110 - 115 V, 60 Hz, the pump will be cut out if voltage falls below 75 V or rises above 150 V. The motor is automatically cut in when the voltage is again within the permissible voltage range. Therefore, no extra voltage protection relay is required.

3.1. Pumped liquids

The EZ Boost BMQE must not be used for the transfer of flammable liquids such as diesel oil, petrol or similar liquids. The EZ Boost BMQE is designed for pumping thin, clean, non-aggressive, non-explosive liquids, not containing solid particles or fibers. The EZ Boost BMQE is suitable for pressure boosting clean, cool, potable water. The liquid must not attack the pump materials chemically or mechanically.

Liquid temperature: The temperature of the pumped liquid must not exceed +95°F (+35°C).

Delivery and transportation

GRUNDFOS EZ Boost System components are supplied from the factory in proper packaging in which they should remain until they are to be installed. The components are ready for installation.

3.2. Preparation

Before installation, the following checks should be made:

- **Pump type:** Check that the pump type stated on the name-plate fitted to the module sleeve corresponds to order.
- **Electricity supply:** The motor voltage and frequency details stated on the nameplate should be compared with the actual electricity supply available.

3.3. Sound pressure level

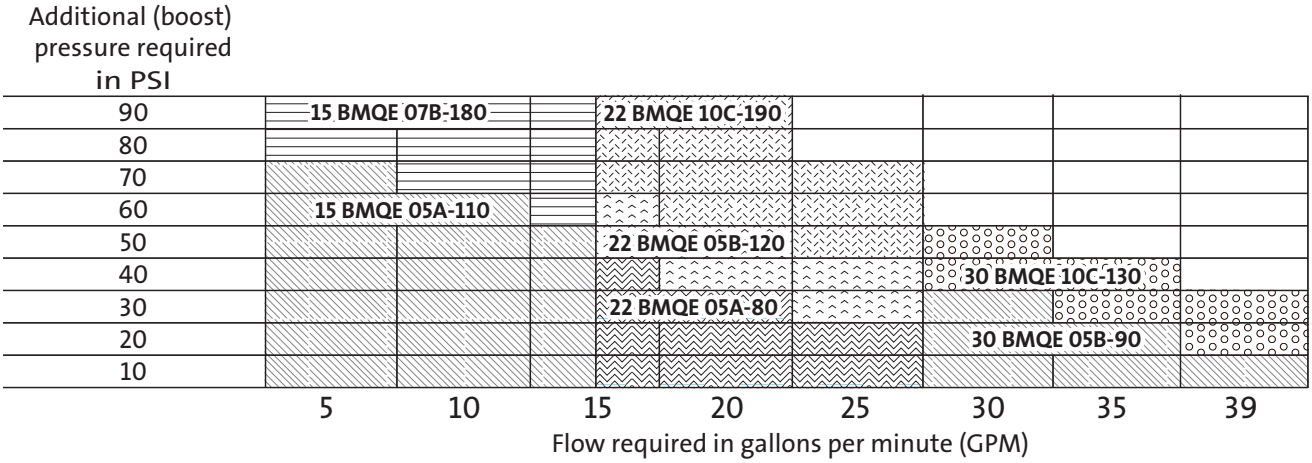
The sound pressure level of the BMQE is <74 db[A] at a distance of 3 feet (1 meter). **It is recommended by Grundfos that the pump be installed with sound and vibration dampening equipment such as; flexible piping adapters and anti-vibration mounting. The pump should not be mounted in or adjacent to living quarters. The pump can also be wrapped with sound proofing insulation to reduce noise.**

4. EZ Boost Quick Guide

4.1. EZ Boost Quick Selection Guide

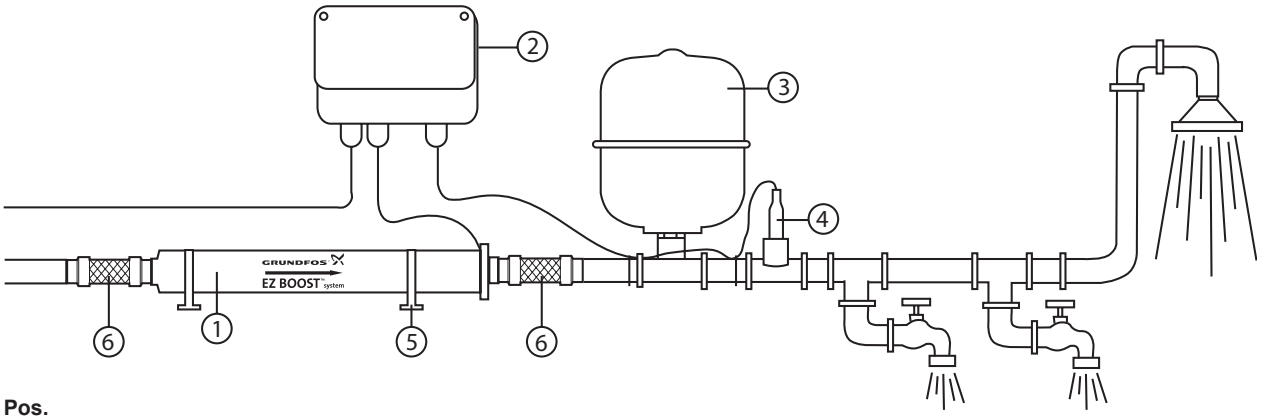
Example:

1. The maximum demand is 15 GPM (3.4 m3/h).
2. The pressure required is 70 PSI system pressure at the taps in the building.
3. The normal minimum inlet pressure (e.g. city pressure) is 20 PSI.
4. The additional boost required is 50 PSI at 15 GPM (3.4 m^3/h).
5. Select a 15 BMQE 05A-110.



4.2. EZ Boost System Diagram

The EZ Boost Constant Pressure System should consist of:

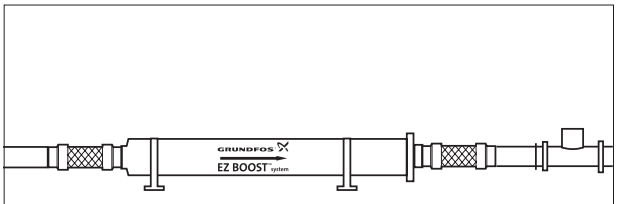


Pos.

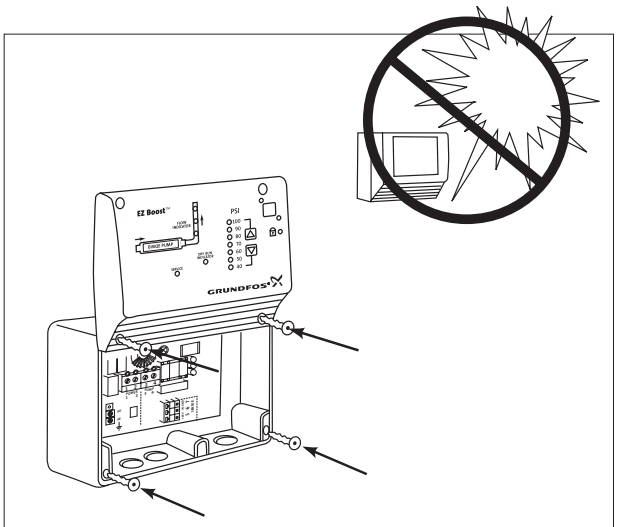
1. EZ Boost BMQE pump
2. EZ Boost controller
3. Diaphragm tank (recommended size 2 U.S. gallons (8 liter)/130 psi)
4. Pressure sensor
5. Mounting brackets
6. Flex connector

4.3. EZ Boost Quick Installation Guide

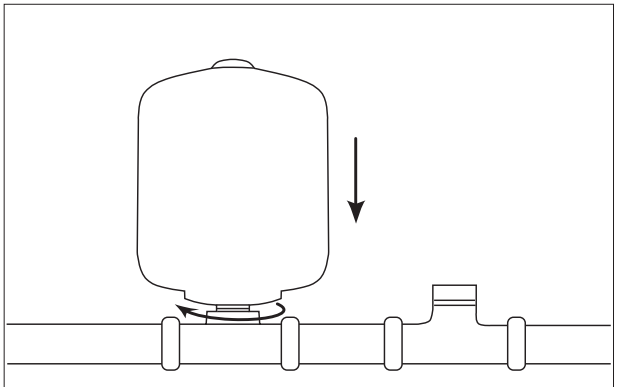
FOR MORE DETAILED INSTALLATION INSTRUCTIONS, PLEASE GO TO SECTION 6.



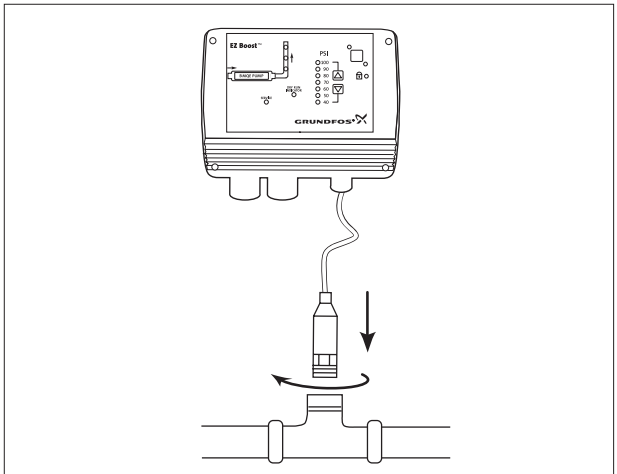
1. Install BMQE pump.



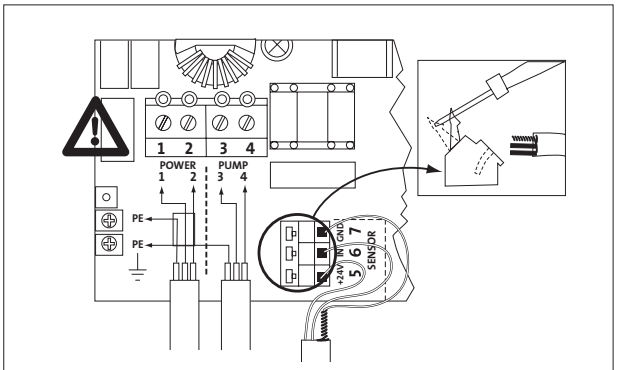
2. Install EZ Boost controller.



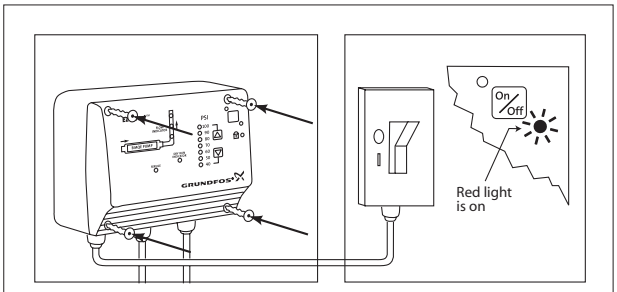
3. Install diaphragm tank.



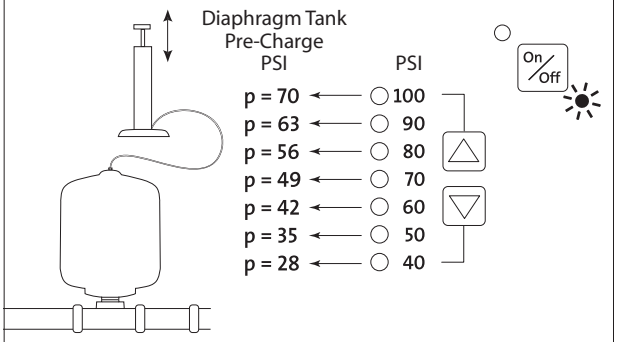
4. Install pressure sensor.



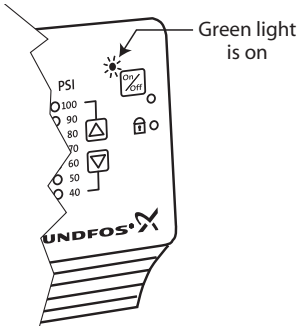
5. Connect incoming power, BMQE pump, and pressure sensor to EZ Boost controller.



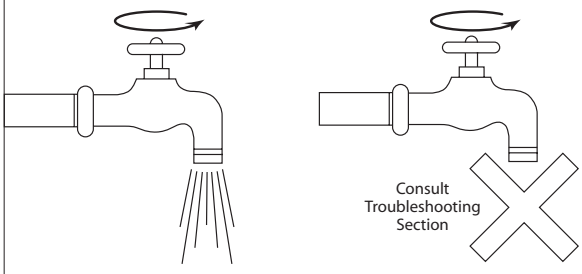
6. Close EZ Boost controller cover.
7. Switch on main power.



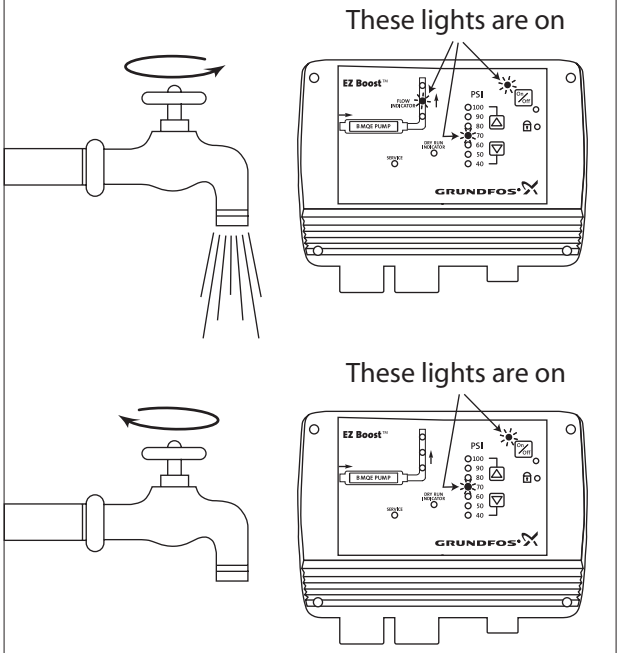
8. Set EZ Boost controller discharge PSI and verify diaphragm pre-charge pressure.



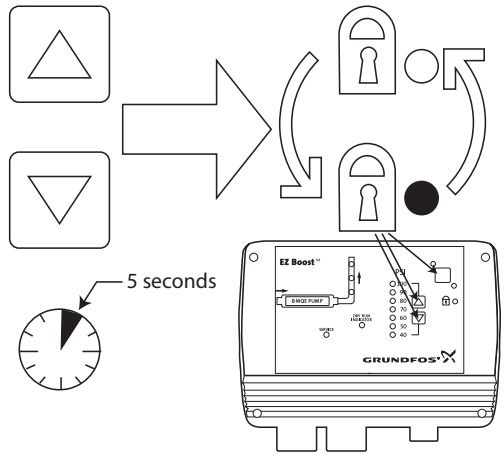
9. Switch on EZ Boost controller.



10. Verify that BMQE pump is operating.



11. Verify that EZ Boost controller is operating.



12. Optional: Lock the buttons.

5. Technical data

Supply voltage:	1 x 200-240 V –10%/+6%, 60 Hz 1 x 110-115 V –10%/+6%, 60 Hz
Fluid temperature:	Max. 95°F (35°C)
Starting current:	The motor starting current is equal to the highest value stated on the EZ Boost BMQE nameplate.
Power factor:	PF = 1.0
Motor cable:	• 2-wire w/ground, 12 AWG Teflon • B: Black (Line, Neutral). • G: Green (Ground).
EZ Boost BMQE inlet/ discharge size:	1.25” NPT inlet / 1” NPT discharge.
EZ Boost BMQE maximum net weights:	31 lbs. (14.1 kg)

5.1. Storage

EZ Boost BMQE storage temperature:	+32°F to +140°F (0°C to +60°C).
EZ Boost controller storage temperature:	-22°F to +140°F (-30°C to +60°C).

5.2. Frost protection

If the BMQE has to be stored after use, it must be stored in a frost-free location or it must be ensured that the motor liquid is frost-proof. The BMQE is shipped from the factory with motor fluid that protects the motor down to -4°F (-20°C). The motor must not be stored without being filled with motor liquid.

6. Installation

6.1.1 Electrical connection

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

Before starting work on the EZ Boost controller or BMQE, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on. The BMQE must be grounded. The EZ Boost controller must be connected in accordance with the local rules and regulations.

IMPORTANT: The on/off button on the EZ Boost controller must not be used as a safety switch when installing and servicing the pump.

Rain-tight or wet location hubs that comply with the requirements in the standard for Fittings for Conduit and Outlet Boxes, UL514B, are to be used. Suitable devices for EZ Boost controller are rated with enclosure type 3, 3R, 3S, 4, 4X, 6 or 6P.

The supply voltage and frequency are marked on the nameplate. Make sure that the EZ Boost controller and BMQE pump are suitable for the electricity supply on which they will be used.

The current consumption can only be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.

All EZ Boost BMQE pumps can be connected to EZ Boost controllers. Each BMQE pump must be connected to its own EZ Boost controller.

CAUTION!

The EZ Boost BMQE must never be connected to a capacitor or to another type of control box than EZ Boost controller.

The EZ Boost BMQE must never be connected to an external frequency converter.

Motor protection: The EZ Boost BMQE incorporates thermal overload protection and requires no additional motor protection.

Connection of motor: The EZ Boost BMQE incorporates a starter device and can therefore be connected directly to the main power supply.

WARNING!

Reduced risk of electric shock during operation of this EZ Boost system requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.

6.1.2. Cable sizing

*** Single-phase 60 HZ maximum cable length motor service to entrance**

Motor rating		Copper wire size (AWG)		
Volts	HP	14	12	10
		Maximum cable length [ft/m]		
115	0.50	100/30.5	160/48.8	250/76.2
230	0.50	400/121.9	650/198.1	650/198.1
	0.75	300/91.4	480/146.3	650/198.1
	1.0	250/76.2	400/121.9	630/192

* The maximum cable length with one EZ Boost Controller is 650' and the maximum wire size is 10 AWG.

In situations where multiple EZ Boost power cables are run parallel in wiring trays or conduit and less than 12 inches apart, the possibility for undesired communication between units exists. When this occurs, intermittent or continuous NO CONTACT is typically seen. Other unexpected errors may also be seen. Refer to section 1.2 and 8.4, #5 for further instructions.

6.2. Positioning the BMQE pump

The GRUNDFOS EZ Boost BMQE pump is supplied with a built-in non-return valve. An arrow on the BMQE sleeve shows the direction of liquid flow through the pump, fig. 3.

The BMQE is suitable for both vertical and horizontal installation, however, the discharge port should never fall below the horizontal plane, see fig. 4.

The BMQE must be installed with the air relief vent in the 12 o'clock position when installed horizontally and when installed in the vertical position, the air vent must be at the top of the unit.

Fig. 3

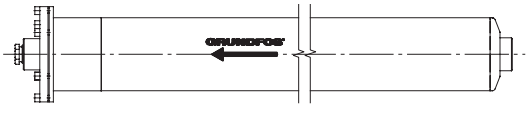
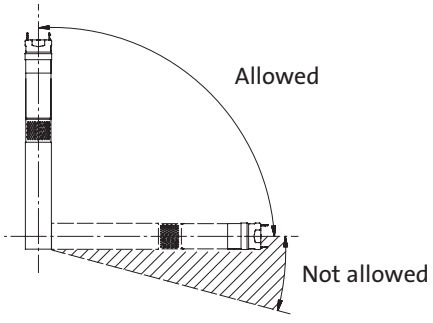


Fig. 4



6.3. EZ Boost controller connection

The EZ Boost controller has two terminal blocks:

- Terminals 1 to 4.
- Terminals 5 to 7.

Furthermore, the EZ Boost controller is equipped with two screw terminals for the ground leads.

6.3.1. Main power supply, POWER, terminals 1, 2 and PE (ground):

Connect terminals 1 and 2 to the line and neutral leads of the main supply. Each terminal can be connected to any of the two leads.

NOTE: Circuit breaker: Maximum 16 A.

IMPORTANT: The main power supply cables must not be connected to terminals 3 and 4 (PUMP).

6.3.2. Motor leads, PUMP, terminals 3, 4 and PE (ground):

Connect terminals 3 and 4 to the line and neutral leads of the pump. Each terminal can be connected to any of the two leads.

6.3.3. NOTES:

Connect one PE terminal to the green ground lead from the pump and one to the ground lead from the main power supply. Each PE terminal must be connected to its own ground lead.

Maximum wire size of the cables to be connected to EZ Boost controller is 10 AWG.

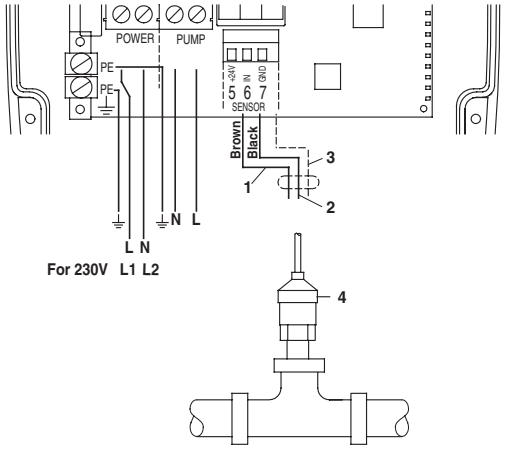
6.4. Positioning the pressure sensor

Pressure losses often cause inconvenience to the user. The EZ Boost controller keeps the pressure constant in the place where the pressure sensor is positioned (see EZ Boost System Diagram on page 16). In the diagram tap 1 is placed close to the pressure sensor. Therefore, the pressure will be kept nearly constant at tap 1, as the friction loss is small. At the shower and tap 2, the friction loss is greater. This, of course, depends on the piping. Therefore, it is recommended that the pressure sensor be positioned as close to the places of consumption as possible. The maximum shielded cable length for the sensor must not exceed 1600 feet.

6.4.1 Connection of the pressure sensor

SENSOR, terminals 5, 6 and 7:

Terminals 5, 6 and 7 (SENSOR) are used for the pressure sensor.



Pos.	Description
1	Standard pressure sensor.+ 24 VDC, brown lead, terminal 5.
2	Standard pressure sensor. Input signal, black lead, terminal 6.
3	Standard pressure sensor. Braid, terminal 7.

Sensor signals:

The pressure sensor to be conected provides a 4-20 mA signal (factory setting).

6.5. Diaphragm Pressure Tank

The EZ Boost controller is designed to work with a 2 gal. diaphragm tank. Install a diaphragm tank to insure that the BMQE will shut off at zero flow. The diaphragm tank must be installed at some point between the BMQE pump and the pressure sensor.

6.5.1 Pre-charge Pressure Setting

The pre-charge pressure of the diaphragm tank must be set to 70% of the pressure setting in order to use the tank to the limit of its capacity.

Use the values in the following table. Pre-charge pressure is measured with 0 PSI in the pipeline:

Setting (PSI)	Pre-charge pressure (PSI)
40	28
50	35
60	42
70	49
80	56
90	63
100	70

Note: If the pre-charge pressure is higher than the pressure setting, the system will have difficulty controlling the pressure.

If the user wants to adjust the pressure without changing the pre-charge pressure of the diaphragm tank, the pre-charge pressure must be equal to the lowest pressure setting used. Failure to follow this instruction will increase pressure fluctuations.

6.6. Pressure Relief Valve

In order to provide protection against the possibility of over pressurization, a pressure relieve valve may be installed down stream of the BMQE. If a relief valve is installed, it is recommended that its discharge be plumbed into an appropriate drainage point.

6.7. Liquid filling and BMQE pump venting

The BMQE is filled with water through the suction port by the water in the piping system.

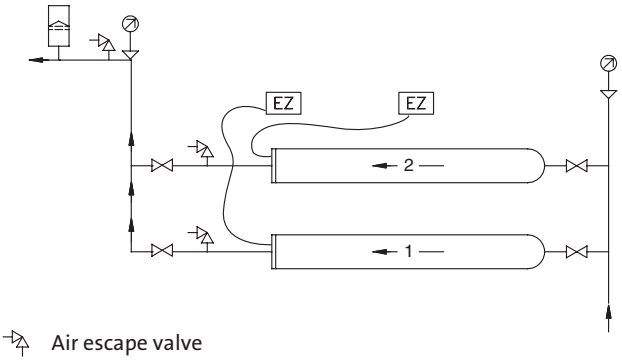
1. The BMQE should be installed with the air relief vent in the 12 o'clock position when installed horizontally and when installed in the vertical position the air vent must be at the top of the unit.
2. Loosen the air vent screw in the BMQE pump.
3. Fill the BMQE with water until it starts running out of the vent hole.
4. Tighten the air vent screw.

6.8. BMQE pumps connected in parallel

6.8.1. When connecting BMQE pumps in parallel as shown in fig. 5, **a separate EZ Boost controller must be used on each BMQE**. Set the pressure on one BMQE 10 PSI lower than the other.

6.8.2. For BMQE pumps connected in parallel, mounted above each other, it is recommended to connect the pipes as shown in fig. 5. This layout ensures that the BMQE pumps are filled with water before starting.

Fig. 5 Booster unit with two BMQE pumps connected in parallel, mounted above each other.



Air escape valve

Diaphragm tank

EZ EZ Boost controller

Isolation valve

Pressure gauge

6.8.3. Notes:

- All BMQE modules are supplied with a non-return valve.
- BMQE modules connected in parallel may also be installed vertically.
- As venting problems may arise in such installations, it is advisable to install suitable air vent devices.
- The BMQE should be positioned with the discharge and air vent at the top when installed vertically.

6.9. Generator Operation

Power may be supplied to BMQE pumps by an adequately sized generator. The generator must be sized 50% above the pumps P1 (input power) values. See following chart.

Motor HP	Minimum generator size	Recommended generator output (watts)
0.33 to 0.50 A	1100	1500
0.50 to 0.75 B	1700	2300
1.0 to 1.5 B	2000	3500

7. Operation

7.1. Starting the BMQE Pump for the First Time

When the BMQE has been connected correctly, it should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Check that the actual inlet pressure is equal to or greater than the previously estimated inlet pressure.

When not being used, all modules should be filled with water as all internal bearings are water lubricated.

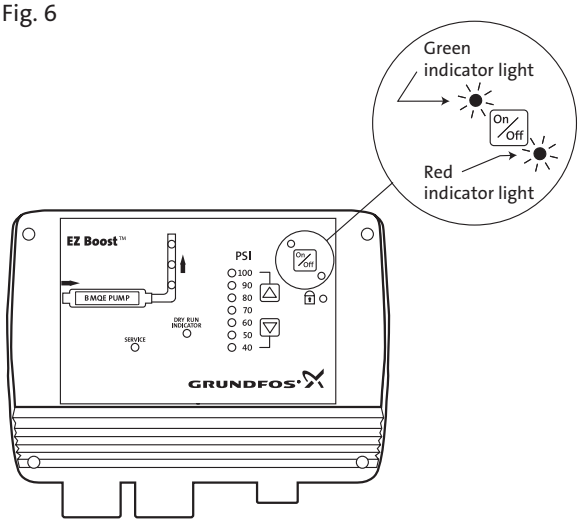
If the BMQE is taken out of operation for a long period, the BMQE should be flushed through with clean water. The modules are then left with clean water until they are to be used again.

7.2. EZ Boost Controller Operating Functions

7.2.1 On/off button

Fig.6 shows the on/off button of the EZ Boost controller.

Fig. 6



The green and red indicator lights in the on/off button indicate pump operating condition as follows:

Indication	Description
Green indicator light permanently on.	The system is operational.
Green indicator light off.	The system is not operational.
Red indicator light permanently on.	Pump has been stopped by means of the On/Off button.*

*If the on/off button has been used to stop the pump, this button must also be used for restarting.

Any alarm indication can be reset by pressing the on/off button.

If the on/off button is pressed for more than 5 seconds, the pump is started, irrespective of any active fault/alarm indications and sensor signals.

When the on/off button is released, the pump will stop, if the alarm still exists.

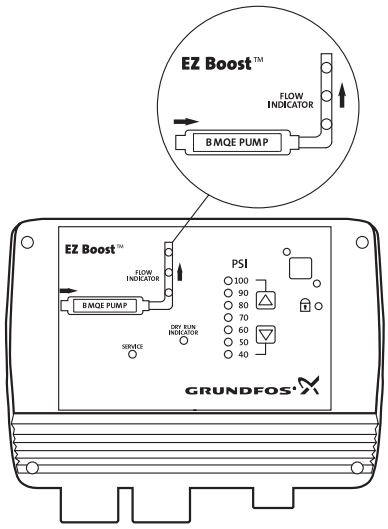
IMPORTANT:

Setting this button to the OFF position DOES NOT remove power from the pump. Before servicing the pump, remove power at the service breaker.

7.2.2. Indication of pump operation

On the graphical illustration on the EZ Boost controller face, the pipe shows run lights when the pump is operating. When the pump is not operating, none of the flow indicator lights are on, see fig. 7.

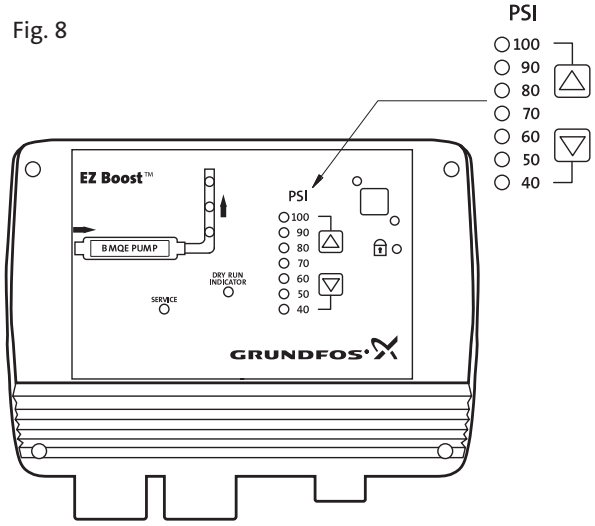
Fig. 7



7.2.3 Pressure setting

The two arrow buttons on the EZ Boost controller front are used for the pressure setting, see fig. 8.

Fig. 8



7.2.3.1 Indication of pressure setting:

The system pressure set is indicated by a yellow indicator light, which is permanently on. Setting range: 40-100 PSI.

7.2.3.2 Arrow-up button:

When this button is pressed, the system pressure setting is increased in steps of 10 PSI.

7.2.3.3 Arrow-down button:

When this button is pressed, the system pressure setting is decreased in steps of 10 PSI.

7.2.3.4. Button locking

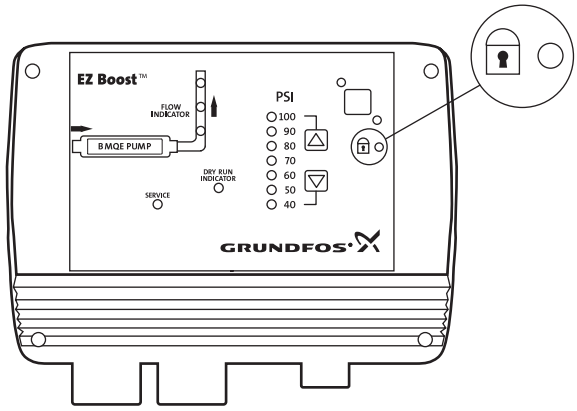
The buttons on the EZ Boost controller can be locked/ unlocked by pressing the two arrow buttons simultaneously for 5 seconds.

NOTE: When the arrow buttons are used for locking, take care not to inadvertently change the pressure setting. When the buttons are locked, the indicator light is permanently on, see fig. 9.

You can use the following procedure:

1. Set the pressure one step up.
2. Press the arrow-down button as the first one when pressing the two buttons.

Fig. 9



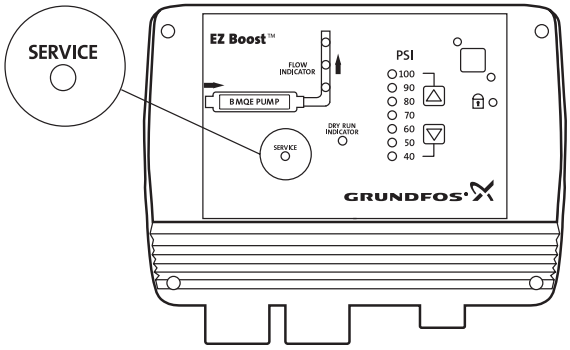
7.3. Alarm Functions

The EZ Boost controller continuously receives operating data from the pump. The alarm functions indicated on the EZ Boost controller front are described in the following sections.

7.3.1. Service alarm

If one or more factory-set alarm values are exceeded, the indicator light for service alarm is permanently on, see fig. 10.

Fig. 10



Possible alarms:

- Sensor defective.
- Overload.
- Over temperature.
- Speed reduction.
- Voltage alarm.
- No contact to pump.

The possible alarms and how to identify them and make the relevant corrections are described in section 8.2 and 8.4, Service.

7.3.2. Dry-running protection

The purpose of the dry-running protection is to protect the pump in case of insufficient water flow.

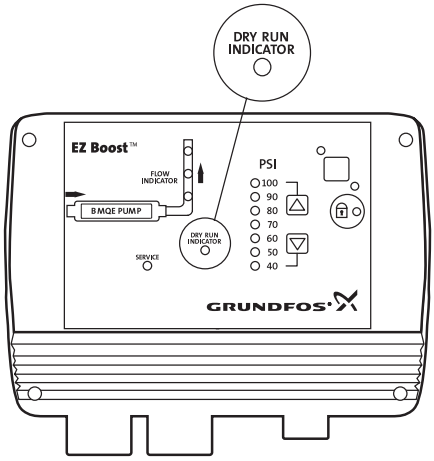
The dry-running protection makes the conventional dry-running protection unnecessary.

No additional cables to the motor are required. The dry run settings shown in section 9, Factory Settings, are built into the pump and automatically transmitted to the EZ Boost controller.

When air enters the pump together with water, the pump power decreases, and pressure drops, causing the motor to increase speed. If the power consumption falls below the dry run setting for an accumulated time of 5 seconds, and the motor speed is within 1000 rpm of the max speed the EZ Boost controller stops the pump and declares a dry run alarm.

When the motor is stopped, the dry-running indicator light is permanently on, see fig. 11.

Fig. 11

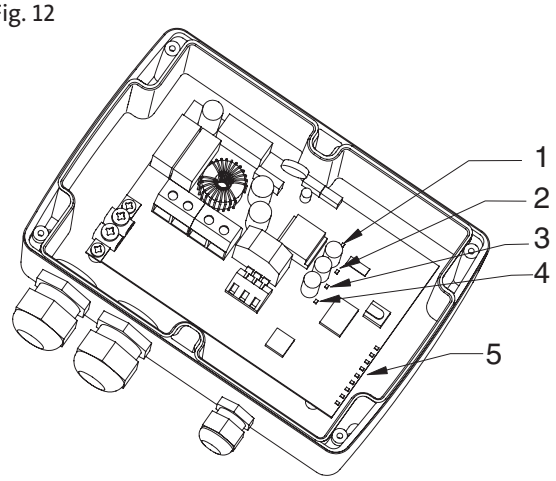


Possible cause	Remedy
The pump performance is too high compared to the inlet yield.	Replace the pump with a smaller one.
In line filter or BMQE screen is blocked.	Filter or BMQE service is required.

Restarting:
After 5 minutes (factory setting), the motor will restart automatically.

7.3.3. Position of LED's

Fig. 12



Pos.	Indication	Description
1	+24 V overload	Permanent red light when the internal 24 VDC supply is overloaded.
2	+24 V	Permanent green light when the internal 24 VDC supply is OK.
3	+10 V	Permanent green light when the internal 10 VDC supply is OK.
4	+5 V	Permanent green light when the internal 5 VDC supply is OK.
5	9 indicator lights:	(see Fig. 14)
	• Control indicator	• Flashing green light when the pump control is working correctly.
	• Min. speed	• Permanent yellow light when the pump is running at minimum speed, 3,000 rpm
	• Max. speed	• Permanent yellow light when the pump is running at maximum speed, 10,700 rpm.
	• Sensor defective	• Permanent red light when the sensor signal is out of signal range.
	• Overload*	• Permanent red light when the motor load exceeds the stop limit, see section 9, Factory Settings.
	• Over temperature*	• Permanent red light when the motor temperature exceeds the stop limit, see section 9, Factory Settings.
	• Speed reduction*	• Permanent red light when the pump speed is reduced, see section 9, Factory Settings.
	• Voltage alarm*	• Permanent red light when the supply voltage is out of range, see section 9, Factory Settings.
	• No contact to pump *	• Permanent red light when communication between the EZ Boost controller and the pump is impossible.

* Press the on/off button to reset the alarm indication.

7.4. EZ Boost BMQE Built-in Protection

The EZ Boost BMQE incorporates an electronic unit which protects the motor in various situations.

- In case of overload, the built-in overload protection will stop the BMQE for 5 minutes. After that period, the booster module will attempt to restart.
- If started without water (dry running), the BMQE will stop after 30 seconds.
- If stopped as a result of dry running, the BMQE will start automatically after 5 minutes.

The motor is protected against the following conditions:

- Dry running
- Voltage surges (up to 4000 V)
- Under voltage
- Over voltage
- Overload
- Over temperature

7.4.1. Restarting the BMQE pump

To reset the EZ Boost BMQE, switch off the electricity supply for 1 minute.

8. EZ Boost System Service

8.1. EZ Boost BMQE Service

For the replacement and repair of parts of the EZ Boost BMQE, please refer to:

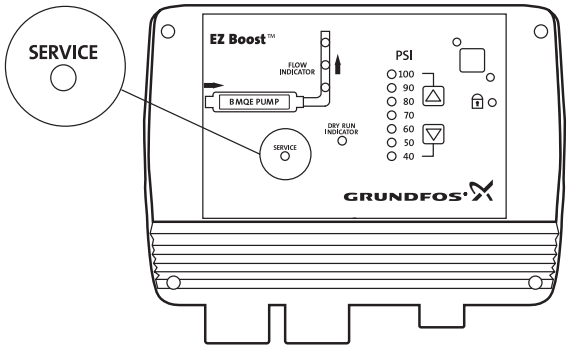
1. Service instructions for SQE pumps describing replacement of motor cable and motor.
2. Parts list for SQE with instructions for dismantling and assembly of pump and motor.

8.2. EZ Boost Controller Service

Before starting any work on the EZ Boost controller, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

The EZ Boost controller continuously receives operating data from the pump. In case of an alarm, the service indicator light is permanently on, see fig. 13.

Fig. 13



The service indicator light will be permanently on if one of the following alarm situations occurs:

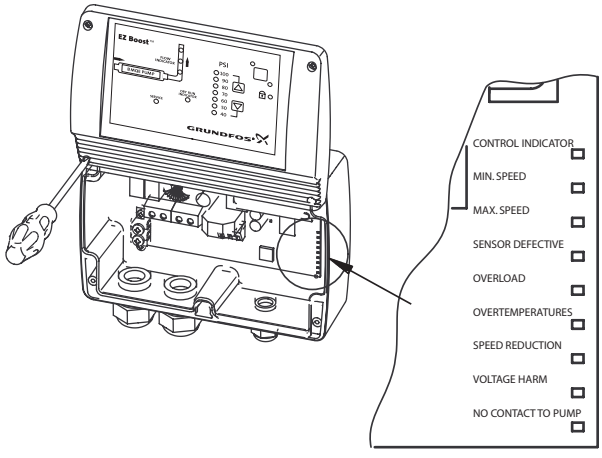
- Sensor defective.
- Over temperature.
- Voltage alarm.
- Overload.
- Speed reduction.
- No contact to pump.

To identify the cause of the service alarm, it is necessary to remove the front cover from the EZ Boost controller. Fit the front cover as shown in fig. 14 to avoid disconnecting the multi-core cable.

A number of LED's are mounted on the supply board inside the EZ Boost controller, see section 7.3.3. Position of LED's.

Fig. 14 shows the LED's and the alarm texts on the supply board.

Fig. 14



8.3. EZ Boost BMQE fault finding chart

Fault	Possible Cause	Remedy
1. The BMQE does not run.	a) The GFI or the voltage-operated GFI has tripped out.	Cut in the circuit breaker.
	b) No electricity supply.	Contact the electricity supply company.
	c) The motor protection has cut off the electricity supply due to over-load.	Check whether the motor/pump is blocked.
	d) The pump/cable is defective.	Repair/replace the pump/cable.
	e) Over voltage has occurred.	Check the electricity supply.
2. The BMQE runs but gives no water.	a) The discharge valve is closed.	Open the valve.
	b) The suction strainer is choked up.	Pull the pump out of the sleeve and clean the strainer.
	c) The pump is defective.	Pull the pump out of the sleeve and repair/ replace the pump.
3. The BMQE runs at reduced capacity.	a) The valves in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves, if necessary.
	b) The discharge pipe is partly choked by impurities.	Clean/replace the discharge pipe.
	c) The pump is partly choked by impurities.	Pull the pump out of the sleeve. Check and clean or replace the pump, if necessary. Clean the pipes.
	d) The pump is defective.	Pull the pump out of the sleeve and repair/ replace the pump.
	e) Leakage in the pipe work.	Check and repair the pipe work.
	f) Under voltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a) The supply voltage is unstable.	Check the electricity supply.
	b) The motor temperature becomes too high.	Check the water temperature.

8.4. EZ Boost controller fault finding chart

Fault	Possible Cause	Remedy
1. No light in the front cover.	a) The ribbon cable connection is loose or defective.	• Is the control indicator LED flashing? If not, the EZ Boost controller is defective. • Check that the ribbon cable connection is secure.
2. The pump does not start. The green indicator light in the on/off button is on. No alarm is indicated.	a) The EZ Boost controller, the pressure sensor or the pump is defective.	Check : • That the control indicator LED is flashing. If not, the EZ Boost controller is defective. • That the system pressure is 7 PSI below the pressure setting. If so, the pump is supposed to start. Open a tap to be sure. If the pump starts, the system is probably OK. The system pressure can be read on the pressure gauge. • Refer to fault 13 to troubleshoot the pressure sensor. If the pump has not started yet, proceed as follows: Press the on/off button for 5 seconds. If the pump starts, the EZ Boost controller or the sensor may be defective. **Note:** The pressure is not controlled and may rise to a high level.
3. The pressure is not constant.	a) The pump is not of the correct type or the pre-charge pressure of the diaphragm tank is incorrect.	Check • That the LED for Max. speed or Min. speed is on. If so, this indicates that the pump has reached a limit. See section 3, EZ Boost Quick Select Guide. Replace the pump, if necessary. • The pre-charge pressure of the diaphragm tank. **Note: Remember to stop and drain the system pressure before the pressure is checked.** • Make sure the diaphragm tank is the 2 gal. size. • Whether the sensor is positioned far away from the tap. If so, the pressure variations may be caused by friction losses, see section 6.4, Positioning the Pressure Sensor.
	b) No contact between BMQE pump and EZ Boost controller.	• Check that the LED for “No contact to pump” is on. If so, go to fault no. 14.

(continued next page)

8.4. EZ Boost controller fault finding chart (continued)

Fault	Possible Cause	Remedy
4.The pump is running continuously.	a) The pump cannot deliver the set pressure. The EZ Boost controller or the sensor is defective.	• Try to lower the pressure setting, see section 7.2.3. Note that the pump may run for about 15 to 20 seconds before it stops. • Check that the control indicator LED is flashing. • Check that the pipe end of the sensor is not blocked. If so, remove the blockage. • Try to stop the pump by means of the on/off button. If this is not possible, the EZ Boost controller is defective. Replace the EZ Boost controller. • Refer to fault 13 to troubleshoot the pressure sensor.
5. The EZ Boost controller indicates "No contact to pump".	a) The pump cable is longer than 650 feet. b) Cable breakage	• Reduce the length of the pump cable. • Switch off the main power supply to the EZ Boost controller. Switch on the main power supply again. The pump is now connected direct to the main power supply without interference from the EZ Boost controller. Does the motor start? **Yes:** The cable is OK. Go to point d). **No:** Switch off the mains supply again. Remove cable and cable plug from the motor and ohm out cable including plug. Is the cable OK? **Yes:** The motor is defective. Replace the motor. **No:** Replace the cable.
	c) Cross communication with adjacent EZ Boost controller.	If another EZ Boost controller is installed: • If pump cables run parallel to each other physically separate them by 12 - 14 inches (305-355 mm) or rewire using shielded cable.
	d) The EZ Boost controller communication part is defective.	Are the three EZ Boost controller supply board LED's in pos. 2, 3 and 4 on and is the control indicator LED flashing? See section 7.3.3. **Yes:** The mains supply is OK. Is the LED "No contact to pump" of the new EZ Boost controller also on? **Yes:** The EZ Boost controller is OK. Go to point e). **No:** The EZ Boost controller which was removed is defective.
	e) The BMQE motor communication part is defective.	• As a consequence of the above mentioned checks, replace the BMQE motor.

(continued next page)

8.4. EZ Boost controller fault finding chart (continued)

Fault	Possible Cause	Remedy
6. Even AFTER replacement, the EZ Boost controller indicates "No contact to pump".	a) Numbering of BMQE pump and EZ Boost controller is different.	• If an BMQE/ EZ Boost controller system has been given a number, this number is stored in both the BMQE and EZ Boost controller. A new EZ Boost controller or BMQE may not have a number corresponding to the number stored in the previous unit. Therefore, "No contact to pump" is indicated even if there is no fault. Give the new system the number used in the previous unit in order to obtain correspondence between the numbering of the BMQE pump and the EZ Boost controller. This requires an R100. **Note:** Two systems on the same main power supply must not have the same number!
7. The EZ Boost controller indicates "Over voltage" or "Under voltage".	a) The supply voltage is unstable or outside the voltage range specified for the installed motor type.	• Check: Possibly over a period of time - that the supply voltage is according to the values in Section 5. **Note:** As the voltage is detected at the motor, allow for the voltage drop in the pump cable.
8. The EZ Boost controller indicates "Dry running".	If the power consumption is lower than the dry-running stop setting and the motor speed is within 1000 rpm of programmed maximum speed, for an accumulated period of 5 seconds, the pump will be stopped.	
	a) The pump performance is too high for the inlet yield.	• Replace the pump with a smaller pump or reduce the pump performance, by lowering maximum speed, or reducing set pressure.
	b) The well screen is blocked.	• Check the well capacity and restore water supply to the well.
9. The EZ Boost controller indicates "Speed reduction" and "Under voltage".	Speed reduction is activated so as to maintain a reduced performance. When the supply voltage falls so low that it can no longer supply the necessary current to maintain 3,000 rpm, the pump will be stopped.	
	a) The supply voltage is unstable or lower than the voltage range specified for the installed motor type.	• Restore correct supply voltage.
	b) The pump is not of the correct type.	• Install correct pump type.
	c) The voltage drop in the pump cable is too great.	• Replace the pump cable with lower gauge wires or reduce cable length.

(continued next page)

8.4. EZ Boost controller fault finding chart (continued)

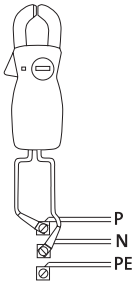
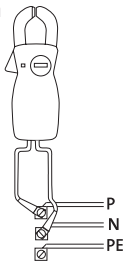
Fault	Possible Cause	Remedy
10. The EZ Boost controller indicates "Speed reduction" and "Overload".	Speed reduction is activated so as to maintain a reduced performance	
	a) The pump is worn or blocked.	• The pump must be serviced.
	b) The pump is too large for the installed motor.	• Replace pump or motor.
11. The EZ Boost controller indicates "Over temperature".	The temperature sensor in the motor is sensing a temperature above the values stated in Section 9, Factory settings:	
	a) Insufficient cooling of the motor.	• Restore correct cooling of the motor. The flow velocity past the motor should be at least 0.5 ft/s (0.15 m/s).
12. The EZ Boost controller indicates "Overload".	a) The pump is worn or blocked.	• The pump must be serviced.
	b) The pump is too large for the installed motor.	• Replace pump or motor.
13. The EZ Boost controller indicates "Sensor defective".	a) The pressure sensor is defective.	• Check that the sensor is wired correctly. If the sensor type is 4-20 mA, measure the DC voltage across the sensor input terminals. If the DC voltage measured at the sensor input terminals is not between 2 and 10 volts the sensor, or wiring is defective. Refer to Section 10, Pressure Sensor Voltage Chart. Replace defective parts. Are the LED "Sensor defective" and the LED, pos. 1, on? See section 7.3.3., Position of LED's. **Yes:** The total load of 24 VDC from terminal 5 is above 100 mA. Disconnect the sensor in order to determine if it is defective. Replace defective sensor. **No:** The load is OK, but the EZ Boost controller sensor input may be defective.
14. The pump is operating on/off.	a) No communication.	• Check that the LED "No contact to pump" is on. If so, the control unit EZ Boost controller starts and stops the pump, based on the sensor signal only. The EZ Boost controller has to be reset after each 250 stop.- see fault no. 5 for remedy

8.5. Instruments not allowed

Note: The use of the following instruments is not allowed during fault finding:

Note: When measuring, use RMS-instruments.

8.6. Checking of motor and cable

1. Supply voltage		Measure the voltage (RMS) between line and neutral. Connect the voltmeter to the terminals at the connection.	When the motor is loaded, the voltage should be within the range specified in section 5, Technical Data. Large variations in supply voltage indicate poor electricity supply, and the BMQE should be stopped until the defect has been remedied.
2. Current consumption		Measure the current (RMS) while the pump is operating at a constant discharge head (if possible, at the capacity where the motor is most heavily loaded). For maximum current, see nameplate.	If the current exceeds the full load current, there are the following possible faults: • Poor connection in leads, possibly in the cable joint. • Too low supply voltage, see item 1.

9. Factory settings

Alarm	200-240 V motors			100-115 V motors
	SQ/SQE/SQE-NE 03A and 05A models	SQ/SQE/SQE-NE05B and 07B models	SQ/SQE/SQE-NE1.0C and 1.5C models	All models
Sensor defective	4-20 mA (the value is stored in the EZ Boost controller)			
Overload	5 A	8 A	11 A	11 A
Over temperature	Stop limit: 149°F (65°C)	Stop limit: 167°F (75°C)	Stop limit: 185°F (85°C)	Stop limit: 185°F (85°C)
	Restart: 131°F (55°C)	Restart: 149°F (65°C)	Restart: 167°F (75°C)	Restart: 167°F (75°C)
Speed reduction	In connection with under voltage or overload			
Over voltage *)	320 VAC	320 VAC	320 VAC	185 VAC
Under voltage	Speed reduction: 190 V Stop limit: 150 V	Speed reduction: 190 V Stop limit: 150 V	Speed reduction: 190 V Stop limit: 150 V	Speed reduction: 190 V Stop limit: 75 V
Dry-running	300 W	680 W	800 W	300 W

*) 200-240 V motors: Operation is guaranteed up to 280 VAC, 100-115 V motors: Operation is guaranteed up to 150 VAC. In order to avoid unnecessary stops, the over voltage stop limit is as stated.

10. Pressure sensor voltage chart

Voltage to pressure chart for EZ Boost pressure sensors. Measure DC voltage between Sensor IN and Sensor Ground. Voltages less than 2 or greater than 10 indicate an incorrectly wired or a faulty sensor.

DC voltage	psi		DC voltage	psi		DC voltage	psi
1.9	0.0		4.5	40.5		7.1	81.0
2.0	0.7		4.6	41.2		7.2	81.7
2.0	1.5		4.6	42.0		7.2	82.5
2.1	2.2		4.7	42.7		7.2	83.2
2.1	3.0		4.7	43.5		7.3	84.0
2.2	3.7		4.8	44.2		7.3	84.7
2.2	4.5		4.8	45.0		7.4	85.5
2.3	5.2		4.8	45.7		7.4	86.2
2.3	6.0		4.9	46.5		7.5	87.0
2.4	6.7		4.9	47.2		7.5	87.7
2.4	7.5		5.0	48.0		7.6	88.5
2.4	8.2		5.0	48.7		7.6	89.2
2.5	9.0		5.1	49.5		7.7	90.0
2.5	9.7		5.1	50.2		7.7	90.7
2.6	10.5		5.2	51.0		7.8	91.5
2.6	11.3		5.2	51.7		7.8	92.2
2.7	12.0		5.3	52.5		7.9	93.0
2.7	12.8		5.3	53.2		7.9	93.7
2.8	13.5		5.4	54.0		8.0	94.5
2.8	14.3		5.4	54.7		8.0	95.2
2.9	15.0		5.5	55.5		8.1	96.0
2.9	15.7		5.5	56.2		8.1	96.7
3.0	16.5		5.6	57.0		8.2	97.5
3.0	17.2		5.6	57.7		8.2	98.2
3.1	18.0		5.7	58.5		8.3	99.0
3.1	18.7		5.7	59.2		8.3	99.7
3.2	19.5		5.8	60.0		8.4	100.5
3.2	20.2		5.8	60.7		8.4	101.3
3.3	21.0		5.9	61.5		8.4	102.0
3.3	21.7		5.9	62.2		8.5	102.8
3.4	22.5		6.0	63.0		8.5	103.5
3.4	23.2		6.0	63.7		8.6	104.3
3.5	24.0		6.0	64.5		8.6	105.0
3.5	24.7		6.1	65.2		8.7	105.8
3.6	25.5		6.1	66.0		8.7	106.5
3.6	26.2		6.2	66.7		8.8	107.3
3.6	27.0		6.2	67.5		8.8	108.0
3.7	27.7		6.3	68.2		8.9	108.8
3.7	28.5		6.3	69.0		8.9	109.5
3.8	29.2		6.4	69.7		9.0	110.3
3.8	30.0		6.4	70.5		9.0	111.0
3.9	30.7		6.5	71.2		9.1	111.8
3.9	31.5		6.5	72.0		9.1	112.5
4.0	32.2		6.6	72.7		9.2	113.3
4.0	33.0		6.6	73.5		9.2	114.0
4.1	33.7		6.7	74.2		9.3	114.8
4.1	34.5		6.7	75.0		9.3	115.5
4.2	35.2		6.8	75.7		9.4	116.3
4.2	36.0		6.8	76.5		9.4	117.0
4.3	36.7		6.9	77.2		9.5	117.8
4.3	37.5		6.9	78.0		9.5	118.5
4.4	38.2		7.0	78.7		9.6	119.3
4.4	39.0		7.0	79.5		9.6	120.0
4.5	39.7		7.1	80.2			

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BE > THINK > INNOVATE >

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Thinking ahead makes it possible
Innovation is the essence

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INSTRUCTIONAL GUIDE

Making ProPEX® Connections

Table of Contents

Making ProPEX® Connections

Uponor ProPEX® F1960 cold-expansion fittings make solid, permanent, manufactured connections without the need for torches, glues, solder, flux or gauges. The unique shape memory of Uponor crosslinked polyethylene (PEX-a) tubing forms a tight seal around the fitting, creating a strong, reliable connection.

This document shows how to make proper ProPEX connections using one of the following tools.

- Milwaukee® M12™ or M18™ Expansion Tools
- ProPEX 201 Corded Expander Tool
- ProPEX Hand Expander Tool

General ProPEX Connection Tips

- If the fitting does not slide into the tubing all the way to the stop, immediately remove it from the tubing and expand the tubing one final time.

  Note: To avoid over-expanding the tubing, do not hold the tubing in the expanded position.

- The number of expansions in **Table 1** is the recommended number of expansions. Experience, technique and weather conditions influence the actual number of expansions. Fewer expansions may be necessary under certain conditions. The correct number of expansions is the amount necessary for the tubing and the shoulder of the fitting to fit snugly together.

- Ensure the ProPEX Ring rests snugly against the fitting shoulder. If there is more than 1/16" (1mm) between the ring and the shoulder of the fitting, square cut the tubing 2" away from the fitting, and make another connection using a new ProPEX Ring and fitting. Brass ProPEX fittings can be disconnected and reused. Engineered polymer (EP) fittings must be discarded. Be sure to follow the recommended minimum distance between ProPEX fittings chart in **Table 2**.

Tubing Size	Milwaukee ProPEX Tool		Uponor ProPEX Tool		
	M12	M18	Manual	100 & 150	201
3/8"	8	9	5	7	—
1/2"	5	6	4	4	—
3/4"	9	8	9	9H	—
1"	13	5	14	7H	—
1 1/4"	—	7	—	7H	—
1 1/2"	—	6	—	8H	—
2"	—	—	—	—	5H

Table 1: Recommended Number of Expansions for 3/8" to 2" Tubing at 73.4°F (23°C)

Note: "H" in the table refers to Uponor H-series expander heads.

Nominal Fitting Size	Cut Length of Pipe
1/2"	2 1/2"
3/4"	3 1/2"
1"	4 1/2"
1 1/4"	5 1/2"
1 1/2"	6 1/2"
2"	7 1/2"

Table 2: Minimum Distance Between ProPEX Fittings

Making ProPEX Connections with Milwaukee ProPEX Expansion Tools

Note: All standard Uponor Expander Heads are compatible with the M12 and M18 tools. Uponor expander heads will not auto-rotate on the Milwaukee tools (only Milwaukee expansion heads will auto-rotate on the M12 and M18). H-heads are not compatible with Milwaukee tools and Milwaukee heads are not compatible with Uponor tools. Milwaukee heads are easily distinguished by color coding and the Milwaukee logo.

Important! Making expansions are slightly different when using a tool that features auto rotation. When making a ProPEX connection, be sure to follow the guidelines for the tool you are using in your application.

1. Square cut the PEX tubing perpendicular to the length of the tubing. Remove all excess material or burrs that might affect the fitting connection.
2. Slide the ProPEX Ring over the end of the tubing until it reaches the stop edge. If using a ProPEX Ring without a stop edge, extend the ring over the end of the tubing no more than 1/16" (1mm).

Important! If making a 3/8" ProPEX Connection, you must first expand each side of the ring before placing it on the tubing. Refer to the "Making 3/8" ProPEX Connections" instructions on **page 8** for further information.

With Auto Rotation (Standard Milwaukee Heads)

3. Milwaukee ProPEX Expansion Tools come with built-in auto rotation. If using a Milwaukee expansion head, simply hold the tubing and tool in place while holding the trigger to expand the tubing. The head will automatically rotate to ensure the tubing is evenly expanded. Continue expanding until the tubing and ring are snug against the shoulder on the expander head. See **Table 1** on **page 1** for the recommended number of expansions for each tubing size.

Without Auto Rotation (Standard Uponor Heads)

4. Press the trigger to expand the tubing.
5. Release the trigger, remove the head from the tubing, rotate it 1/8 turn and slide the head back into the tubing. Continue expanding and rotating until the tubing and ring are snug against the shoulder on the expander head. See **Table 1** on **page 1** for the recommended number of expansions.

Important! Rotating the tool between expansions will provide smooth, even expansion of the tubing. Failure to rotate the tool will cause deep grooves in the tubing which can result in potential leak paths.

Expansion with Milwaukee M12 ProPEX Expansion Tool

ProPEX Fitting Inserted into ½" Uponor PEX Tubing. Make the Fitting with a Milwaukee M12 ProPEX Expansion Tool.

ProPEX Fitting Inserted into 1" Uponor PEX Tubing. Make the Fitting with a Milwaukee M18 ProPEX Expansion Tool.

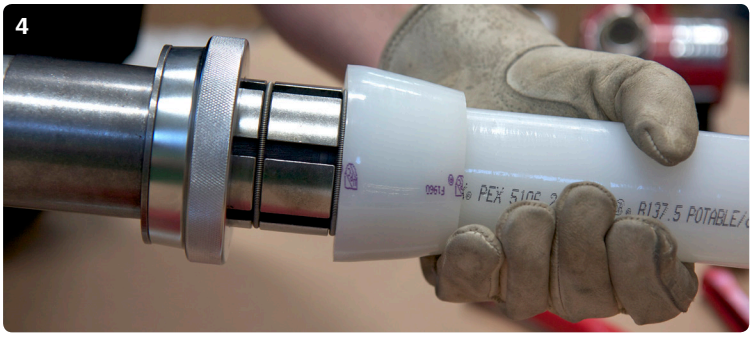
6. After the final expansion, immediately remove the tool and insert the fitting. Ensure the tubing and ring seat against the shoulder of the fitting.

Important! You should feel some resistance as the fitting goes into the tubing. If you do not feel any resistance, the tubing may be over expanded and will require additional time to shrink over the fitting.

Expansion with Milwaukee M18 ProPEX Expansion Tool

Making ProPEX Connections with the ProPEX 201 Corded Expander Tool

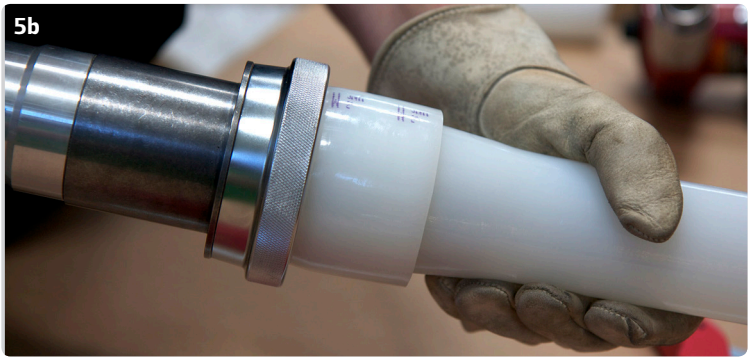
1. Square cut the PEX tubing perpendicular to the length of the tubing. Remove all excess material or burrs that might affect the fitting connection.
2. Slide the ProPEX Ring over the end of the tubing until it reaches the stop edge. If using a ProPEX Ring without a stop edge, extend the ring over the end of the tubing no more than 1/16" (1mm).
3. Slide the expander head into the tubing until it stops. Full expansions are necessary to make a proper connection.
4. Press the trigger to expand the tubing.



5. Release the trigger, remove the head from the tubing, rotate it ⅛ turn and slide the head back into the tubing. Continue expanding and rotating until the tubing and ring are snug against the shoulder on the expander head. See **Table 1** on **page 1** for the recommended number of expansions.

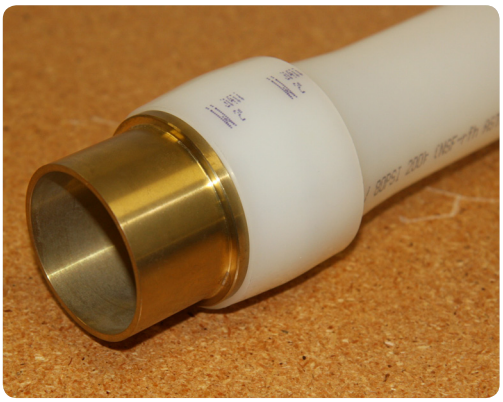
   Important! Rotating the tool between expansions will provide smooth, even expansion of the tubing. Failure to rotate the tool will cause deep grooves in the tubing which can result in potential leak paths.

6. After the final expansion, immediately remove the tool and insert the fitting. Ensure the tubing and ring seat against the shoulder of the fitting.



ProPEX Fitting Inserted into 2" Uponor PEX Tubing

ProPEX Tee Inserted into 2" Uponor PEX Tubing



ProPEX Brass Fitting Inserted into 2" Uponor PEX Tubing

Making ProPEX Connections with the ProPEX Hand Expander Tool

1. Square cut the PEX tubing perpendicular to the length of the tubing. Remove all excess material or burrs that might affect the fitting connection.

2. Slide the ProPEX Ring over the end of the tubing until it reaches the stop edge. If using a ProPEX Ring without a stop edge, extend the ring over the end of the tubing no more than 1/16" (1mm).

   Important! If making a 3/8" ProPEX Connection, you must first expand each side of the ring before placing it on the tubing. Refer to the "Making 3/8" ProPEX Connections" instructions on **page 8** for further information.

Without Auto Rotation

3. When using a ProPEX Hand Expander Tool without the ProPEX Auto Rotation Adapter, brace the free handle of the tool against your hip, or place one hand on each handle. Fully separate the handles and slide the expander head into the tubing until it stops. Full expansions are necessary to make a proper connection. Bring the handles together to expand. Separate the handles, remove the head from the tubing, rotate it 1/8 turn and slide the head back into the tubing. Continue expanding and rotating until the tubing and ring are snug against the shoulder on the expander head. See **Table 1** on **page 1** for the recommended number of expansions for each tubing size.

Important! Rotating the tool between expansions will provide smooth, even expansion of the tubing. Failure to rotate the tool will cause deep grooves in the tubing which can result in potential leak paths.

ProPEX Hand Expander Tool without Auto Rotation Adapter

With Auto Rotation

4. When using a ProPEX Hand Expander Tool with the ProPEX Auto Rotation Adapter, simply hold the tubing and tool in place while separating and closing the handles to expand the tubing. The Auto Rotation Adapter will automatically rotate to ensure the tubing is evenly expanded. Continue expanding until the tubing and ring are snug against the shoulder on the expander head. See **Table 1** on **page 1** for the recommended number of expansions for each tubing size.

5. After the final expansion, immediately remove the tool and insert the fitting. Ensure the tubing and ring seat against the shoulder of the fitting.

   Important! You should feel some resistance as the fitting goes into the tubing. If you do not feel any resistance, the tubing may be over expanded and will require additional time to shrink over the fitting.

ProPEX Hand Expander Tool with Auto Rotation Adapter

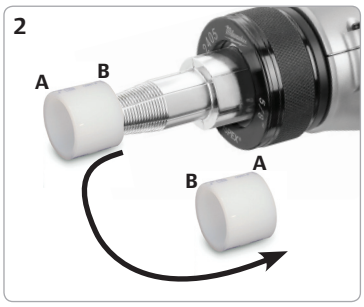
ProPEX Fitting Inserted into ½" Uponor PEX Tubing. Make the Fitting with a ProPEX Hand Expander Tool.

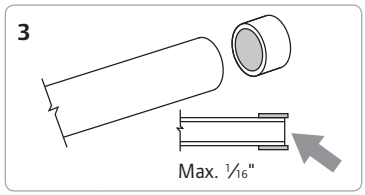
Making ⅜" ProPEX Connections

The ⅜" ProPEX Ring must be expanded once on each side to properly fit over the tubing. Refer to the following instructions to make a ⅜" ProPEX connection.

1. Square cut the PEX tubing perpendicular to the length of the tubing. Remove all excess material or burrs that might affect the fitting connection.
2. Expand each side of the ⅜" ProPEX Ring once.
3. Slide the expanded ring over the end of the tubing. Extend the end of the ring over the end of the tubing no more than 1⁄16" (1mm).
4. After the ring is on the tubing, continue with the regular steps for making a proper connection with your specific tool.

E6081128 Tube Cutter (plastic)





Important Tips for a Proper ⅜" ProPEX Connection

- The thicker ⅜" ProPEX Ring shrinks over the fitting faster than larger-sized rings.
- When the temperature is below 40°F (4.4°C), fewer expansions are required.

Disconnecting a ProPEX Brass Fitting

ProPEX brass and EP fittings are manufactured connections that can be concealed in walls, ceilings and floors. When necessary, ProPEX brass fittings can be disconnected.

Important! EP fittings cannot be reclaimed.

Refer to the following guidelines for disconnecting a ProPEX brass fitting.

1. Ensure the system is not pressurized.
2. Use a utility knife to carefully cut through the ProPEX Ring.

   Important! Do not heat the ring prior to cutting it. Take care to cut only the ring and not the tubing or fitting. Gouges in the fitting may result in leaks. If you accidentally damage the fitting, you must discard it.
3. Remove the ProPEX Ring from the tubing.
4. After removing the ring, apply heat directly around the fitting and tubing connection. Gently work the tubing back and forth while pulling slightly away from the fitting until the tubing separates from the fitting.
5. After removing the fitting, measure 2" (minimum) from the end of the tubing.
6. Square cut the tubing at the 2" marking.
7. Allow the fitting to cool before making the new connection.
8. Use a new ProPEX Ring and follow the steps to make a new connection.

Troubleshooting ProPEX Connections

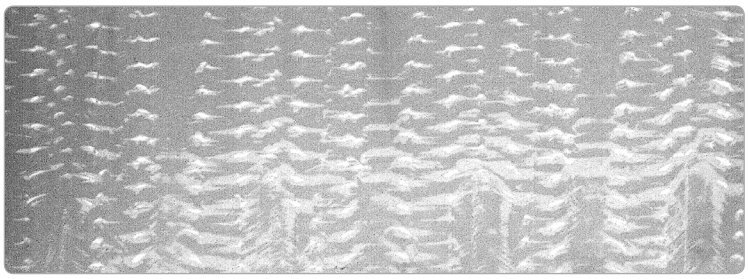
Trouble-free ProPEX installations begin with a tool that is maintained in proper working condition. If the tool or segment fingers are damaged, it is very difficult to make a proper connection. Refer to the following guidelines to assist with challenges in the field.

Fittings Won't Seal

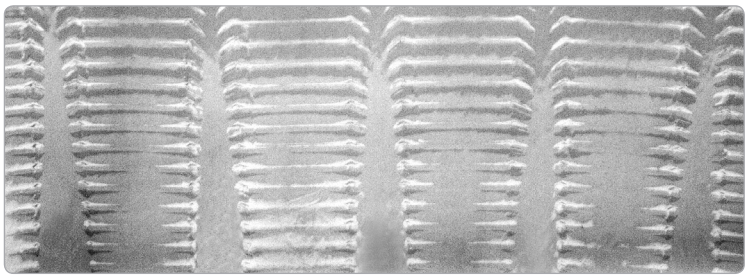
- Make sure the expander head is securely tightened onto the tool.
- Ensure the segment fingers are not bent. If the head does not completely close when the drive unit is fully retracted or the handles of the manual tool are open, replace the head.
- Examine the tool for excess grease on the segment fingers. Remove excess grease prior to making connections.
- Check the fitting for damage. Nicks and gouges will cause the fitting to leak.
- Make sure the internal driver cone is not damaged or bent.
- Make sure the last expansion is not held in the expanded position before the fitting is inserted. You should feel some resistance as the fitting goes into the tubing. If you do not feel any resistance, the tubing may be over expanded and will require additional time to shrink over the fitting.
- Be sure to rotate the tool ⅛ turn after each expansion to avoid deep grooves in the tubing which can result in potential leak paths.

Expansion is Difficult

- Make sure the internal cone is properly greased.



Expansion with Proper Rotation



Expansion without Proper Rotation

Expansion Head Slips Out of Tubing When Making Expansions

- Ensure the tubing and ProPEX Ring are dry.
- Make sure that grease is not getting into the tubing.
- Examine the segment fingers to ensure they are not damaged or bent.

ProPEX Ring Slides Down Tubing During Expansion

- Ensure your hands are clean w hile handling the tubing. Any sweat or oils on your hands can act as a lubricant. Due to the smoothness of PEX, any form of lubricant can cause the ProPEX Ring to slide down the tubing during expansion.
- If you anticipate the ProPEX Ring may possibly slide down, position the ring slightly farther over the end of the tubing and make the first couple of expansions slowly. Once the ring and the tubing begin to expand together, continue with the normal number and type of expansions.
- Place your thumb against the ProPEX Ring to help support it and feel for any movement. If caught early, you can slide the ring up the tubing and expand as described in the previous bullet point.

More Than the Recommended Number of Expansions are Needed to Make a Connection

- Ensure the head is hand-tightened to the expander tool.
- Examine the segment fingers for damage.
- Be sure to completely cycle the tool on each expansion (i.e., close the manual tool handle or release the trigger).

Cold-weather Expansions

- Temperatures affect the time required for the tubing and ring to shrink onto the fitting. The colder the temperature, the slower the contraction time.
- Warming ProPEX fittings and ProPEX Rings reduces contraction time. Put fittings and rings in your pockets prior to installation to keep them warm.
- Make ProPEX connections at temperatures above 5°F (-15°C).
- Fewer expansions are necessary in temperatures below 40ºF (4.4°C).

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uponor

FIRE SAFETY SYSTEMS

IN-LINE FLOW TEST KIT

INSTRUCTION SHEET

In-line Flow Test Kit Assembly Instructions

The Uponor In-line Flow Test Kit performs a flow test on the fire protection system to ensure proper operation and flow.

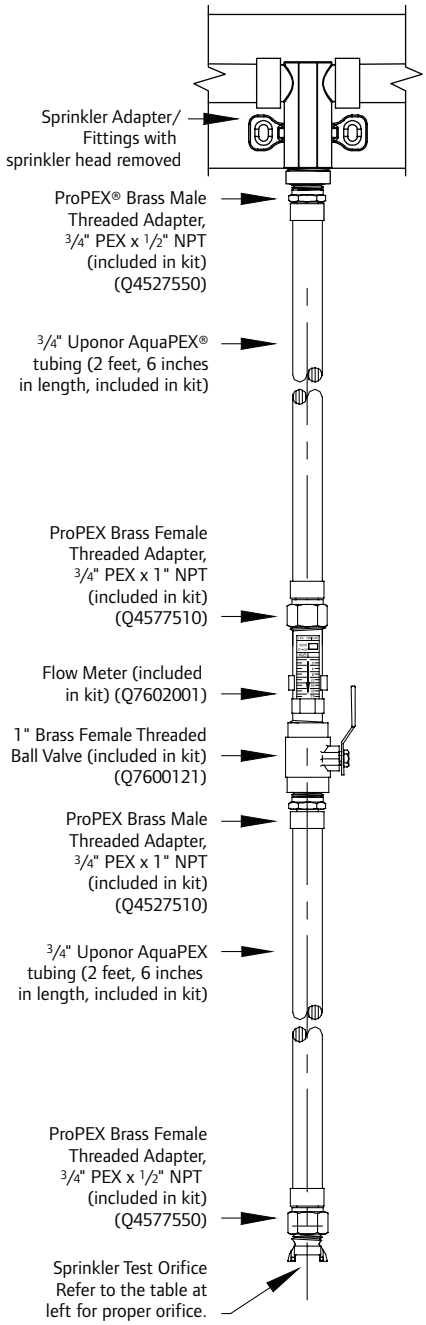
The kit contains the following items.

- Two straight lengths of ¾ Uponor AquaPEX®
- Five test orifices
- One 1" ball valve
- One flow meter
- Assorted hardware
- Assembly and installation instructions

For detailed instructions on performing a proper flow-verification test, refer to the Uponor Fire Safety System Installation Manual.

Per the National Fire Protection Association (NFPA) 13D, Uponor provides both one- and two-head flow calculations. However, Uponor only requires a one-sprinkler flow-verification test. In some instances, the authority having jurisdiction (AHJ) may request a two-sprinkler flow test.

Part Number	Sprinkler Model	K Factor
Q7500030	Test Orifice for F1/Res 30 CCP Concealed and Recessed Pendant Sprinkler	3.0
Q7500040	Test Orifice for F1/Res 40 Recessed Pendant Sprinkler	4.0
Q7500043	Test Orifice for RFC 43 Concealed Sprinkler	4.3
Q7500044	Test Orifice for R1/Res 44 Horizontal Sidewall Sprinkler	4.4
Q7500049	Test Orifice for F1/Res 49 Concealed and Recessed Pendant Sprinkler	4.9



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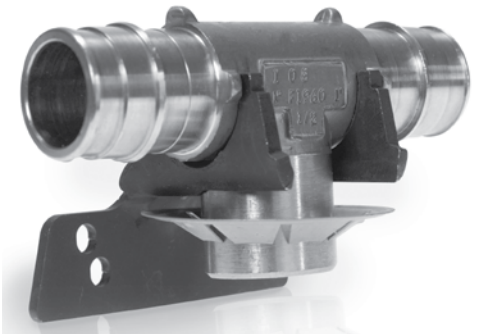
RESIDENTIAL
FIRE SAFETY SYSTEMS

AquaSAFE™
LOOPED SYSTEM

INSTALLATION GUIDE



A Looped, Non-stagnant, Multipurpose Plumbing and Residential Fire Safety System

Uponor AquaSAFE™ Looped System Installation Guide
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The AquaSAFE™ Looped System Installation Guide is a manual published for architects, engineers, building officials, plumbing and fire safety professionals, and Authorities Having Jurisdiction (AHJ). This guide describes the recommendations for installing the Uponor AquaSAFE residential fire sprinkler system in one- and two-family dwellings and manufactured homes, as specified in NFPA 13D.

Always refer to the NFPA 13D Standard, and/or any other applicable codes, standards or ordinances for final determination of installation requirements.

Uponor has taken reasonable efforts in collecting, preparing and providing quality information and material in this document. However, system enhancements may result in modification of features or specifications without notice. For the most current technical information, go to the Uponor website at **www.uponor-usa.com** or **www.uponor.ca**.

Uponor is not liable for installation practices that deviate from this document or are not acceptable practices within the mechanical trades.

Please direct any questions regarding the suitability of an application or a specific design to a local Uponor representative by calling 800.321.4739 (U.S.) or 888.994.7726 (Canada).

Note: Some of the information provided in this installation guide may be pending formal documentation from Underwriters Laboratories (UL).

Table of Contents

Section 1
General Information

Model Code Approvals, Certifications, Ratings and Material Standards

Uponor AquaPEX® tubing and fittings have achieved the following regulatory compliance (model code approvals, standards and certifications).

- UL
- NSF
- UPC
- C-UL
- CSA
- IPC

Uponor AquaPEX tubing and fittings are listed to Underwriters Laboratories (UL) and Canadian Underwriters Laboratories (C-UL) for Multipurpose piping systems of residential occupancies as defined in National Fire Protection Association (NFPA) 13D: Standard for Installation of Sprinkler Systems in One- and Two-family Dwellings and Manufactured Homes. This UL listing was issued to Uponor in June of 2000.

Note: Due to limited space on the fittings, affected Uponor fittings carry the following UL and C-UL designation: c UL us. Please see the UL website, **www.ul.com/database**, for UL documentation for the Uponor system.

Uponor AquaPEX tubing is manufactured in compliance with ASTM F876, ASTM F877, ASTM F1960 and ASTM F2023 as certified by NSF International.

Uponor AquaPEX tubing carries the following maximum pressure and temperature ratings.

- 80 psi at 200°F (5.5 bar at 93.3°C)
- 100 psi at 180°F (6.9 bar at 82.2°C)
- 130 psi at 120°F (8.9 bar at 48.9°C)*
- 160 psi at 73.4°F (11 bar at 23°C)

*This applies to ½", ¾" and 1" Uponor AquaPEX White tubing, in accordance with UL 1821 and ULC/ORD C199P.

The tubing and fittings for multipurpose systems that are not equipped with a fire department connection, are designed to have a working pressure of up to 130 psi (8.9 bar) at a temperature of 120°F (48.9°C).

Uponor AquaPEX tubing carries a standard grade rating recommended by the Plastics Pipe Institute (PPI).

Uponor AquaPEX tubing is listed to NSF International Standard 14, which defines requirements for ingredients, materials, products, quality assurance and marking.

Uponor AquaPEX tubing and Uponor sprinkler adapters are listed to NSF International Standard 61, which defines requirements for toxicity.

Uponor AquaPEX tubing and fittings are certified compliant with

the Canadian Standards Association, CAN/CSA B137.5: Standard for Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.

Handling and Storing Uponor AquaPEX Tubing and Components

Although not comprehensive, the following highlights the most common guidelines and listing requirements when handling Uponor tubing and Uponor Fire Safety system components:

- Install Uponor systems according to the installation instructions of the manufacturer. Not following the instructions and guidelines in the installation guide can result in failure of Uponor systems.
- Do not store sprinkler assemblies or cover plates in areas subject to extreme temperatures (over 100°F/37.7°C).
- Uponor PEX tubing is UL-listed for fire protection systems that do not exceed 130 psi/8.9 bar at 120°F/48.9°C.
- In accordance with the UL and C-UL listings, do not use or store Uponor AquaPEX tubing in areas exposed to direct sunlight for more than 15 days.
- Do not weld, glue or use adhesives or adhesive tape with Uponor AquaPEX tubing.
- Do not apply open flame to Uponor AquaPEX tubing.
- Do not install Uponor AquaPEX tubing within 6" of any gas appliance vents, with the exception of Type B vents.
- Do not install Uponor AquaPEX tubing within 12" of any recessed light fixture unless it is insulated from the PEX line or the PEX line is insulated.
- Do not solder within 18" of Uponor AquaPEX tubing in the same water line. Make sweat connections prior to making the ProPEX® connection.
- Do not use Uponor AquaPEX tubing to convey natural gas.
- Do not use Uponor AquaPEX tubing for an electrical ground.
- Do not expose Uponor AquaPEX tubing to any organic chemicals, strong acids or strong bases.
- Do not install tubing or fittings outdoors.
- Do not use petroleum or solvent-based paints on Uponor AquaPEX tubing.
- Use only approved and appropriate firestop materials with Uponor AquaPEX tubing. Verify firestop compatibility with the firestop manufacturer.

- Do not expose Uponor AquaPEX tubing to rodents, insects or other pests.
  Note: Although PEX tubing does not attract rodents, insects and other pests, these uninvited guests can have detrimental effects on PEX system integrity as well as duct systems, electrical systems and other integrated systems in a home.
- Do not subject Uponor AquaPEX tubing to impact.
- Do not install Uponor AquaPEX tubing in plenums or within 24" of air-return grills or other openings in the ceiling.
- During remodeling or ceiling repair, take appropriate steps to ensure that the tubing and sprinklers are protected from damage.
- Do not install Uponor AquaPEX tubing and fittings in combustible, concealed spaces where sprinklers are required by NFPA 13D Standard and the National Building Code of Canada (as applicable).
- Store Uponor AquaPEX tubing in its carton under cover to avoid dirt accumulation and exposure to direct sunlight. In accordance with the UL and C-UL listings, do not use or store tubing that has been exposed to direct sunlight for more than 15 days. Uponor recommends following these storage and handling guidelines for all Uponor PEX tubing.

Uponor AquaSAFE Fire Safety System Overview and Components

The AquaSAFE Fire Safety system is a cost-effective way to provide reliable and safe home fire protection. This progressive technology combines the plumbing and fire sprinkler systems into an efficient, low cost, Multipurpose system featuring the reputable Uponor AquaPEX tubing.

Uponor AquaSAFE Fire Safety offers two installation design methods:

- Uponor AquaSAFE Looped system
- Uponor AquaSAFE Network system

This guide applies to the Uponor AquaSAFE Looped system. For the Uponor AquaSAFE Network system, please refer to the Uponor AquaSAFE Network System Installation Guide. See **Figures 1-1** and **2-1** for illustrations of the looped system configuration.

In this AquaSAFE Multipurpose system, heat-activated fire sprinklers attach to Uponor sprinkler adapter fittings. Flexible Uponor AquaPEX tubing supplies water to each sprinkler, as well as cold-water plumbing fixtures. Because the plumbing and the fire sprinkler systems are merged into one system, water availability to the sprinklers is verified each time a plumbing fixture is used.

Uponor AquaPEX tubing is made of crosslinked polyethylene (PEX) and designed to withstand temperatures and pressures of 130 psi at 120°F (8.9 bar at 48.9°C) in accordance with UL 1821 and ULC/ORD C199P*.

*This applies to ½", ¾" and 1" Uponor AquaPEX White tubing.

Installation of the AquaSAFE Fire Safety system must comply with:

- National Fire Protection Association 13D (Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes)
- National Building Code of Canada (as applicable)

The Uponor AquaSAFE Looped system uses sprinkler adapter fittings with a ½" NPT outlet to attach the fire sprinkler. Refer to the Uponor Product Catalog for all adapter fittings.

The ProPEX brass tee and multiport tee supply the cold-water fixtures (shown in **Figure 1-1**). Hot water is supplied directly to necessary plumbing fixtures throughout the house in a separate system.

Features and Benefits

- 25-year warranty on Uponor AquaPEX tubing and ProPEX fittings when used together*
- Easily integrates into the plumbing system
- Improves water pressure at all fixtures
- Quickly installed using ProPEX fitting connections
- Verifies fresh water is available to the sprinklers each time an occupant uses a cold-water plumbing fixture

* Must be installed by an Uponor-trained, licensed contractor.

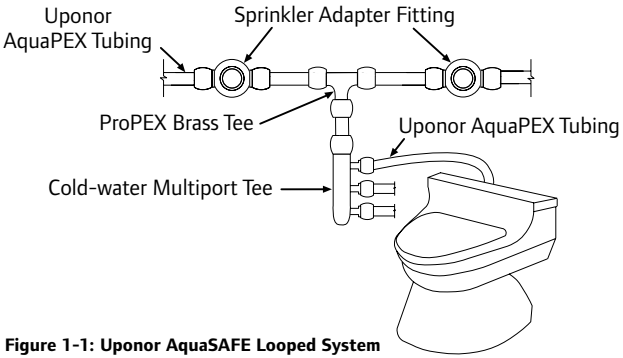


Figure 1-1: Uponor AquaSAFE Looped System

Uponor AquaPEX Tubing

Uponor AquaPEX tubing is an installation-friendly construction product. The flexibility of Uponor AquaPEX allows the installer to eliminate many of the joints normally required with a rigid piping system — saving installation time and expense. Uponor recommends the procedures outlined in this section to simplify installation.

An example of the labeling (print line) on Uponor AquaPEX tubing reads as:

UPONOR AquaPEX® PEX 5006 1.0IN SDR9/ (SP) B137.5 POTABLE/ c(UL)us 130PSI 120°F UL1821/ULC-ORD C199P (NSF) ASTM F876/F877/F2023) (ASTM F1960/ F1807/F2098/F2080)/ICCSR-1099/ICBO ES ER4407/HUD MR1269b (WHI-LISTED CAN/US FS25/SD50)/160PSI 73.4°F/100PSI 180°F/80PSI 200°F UPONOR-PEX-a TUBING UN04950127* xxxxxx**

*USA, Material Type, Extruder No., Year, Month, Day

**Footage marking in increments of three

For an explanation of each marking, refer to **Table 1-1** on the following page.

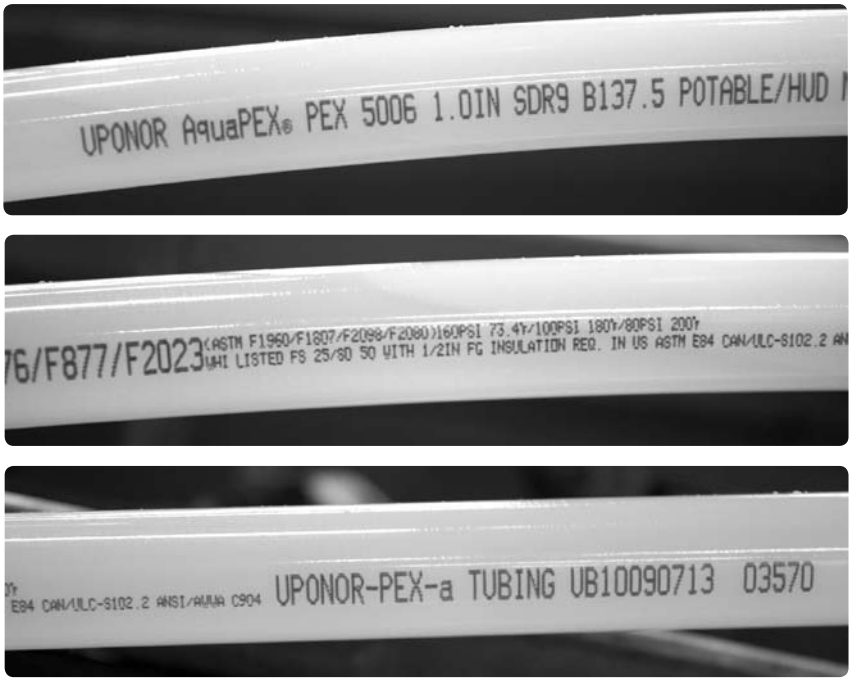


Figure 1-2: Uponor AquaPEX Tubing

Print Stream on Tubing	Explanation
UPONOR AquaPEX	Brand Name
PEX 5006	ASTM F2023 Testing I/A/W ASTM F876
½ IN	Tubing Size (Example: ½")
SDR9	Standard Dimensional Ratio of 9
B137.5 POTABLE	Potable Water Listing by CSA
130PSI 120º F (49º C) UL1821	Rating I/A/W UL 1821 (½", ¾" and 1" only)
ULC-ORD C199P[1]	Canadian Rating I/A/W UL1821 and C199P
ASTM F876/F877/F2023	ASTM Tubing Standards Listed by NSF
ASTM F1960/F2080/F1807	ASTM Fitting Standards Listed by NSF
	IAPMO Reports 3558, 3960
ICC ESR-1099	ICC Evaluation Services Report ESR-1099
ICC ESR1529	ICC Evaluation Services Report ESR 1529
HUD MR1269d	HUD Material Release Report 1269d
WHI-LISTED CAN/US FS25/SD50	Warnock Hersey Listing for 25/50 Plenum Rating
160PSI 73.4ºF (23°C)/100PSI 180ºF (82°C)/80PSI 200ºF (93°C)	Hydrostatic Ratings from PPI in Accordance with ASTM F876
UPONOR PEX-a TUBING	Type of Crosslinking (PEX-a)
UN04950127[2]	Manufacturing Code to Audit Material Source
xxxxxx[3]	Footage Marker in Increments of 3' (three feet)

[1] For ½-inch tubing only
[2] USA, Material Type, Extruder No., Year, Month, Day
[3] Footage marking in increments of three feet (3')

Table 1-1: Print Stream Identification

ProPEX® Sprinkler Adapters and Fittings

Uponor offers sprinkler adapter fittings specifically designed for the AquaSAFE Fire Safety system. These fittings feature ProPEX connections and a standard ½" NPT outlet for connecting fire sprinklers.

Table 1-2 shows the required tubing length needed to approximate the equivalent pressure resistance of the different types of Uponor ProPEX fittings.

Calculated Equivalent Tubing Length

Fitting Type	Tubing Size	
	¾"	1"
Tee - Run	2'	2'
Tee - 90°	6'	6'
90° Elbow	5'	6'
Coupling	2'	2'

Table 1-2: Pressure Resistance (Fittings/Tubing)

Figure 1-3: ProPEX Tee with RFC Sprinkler Head

Figure 1-4: ProPEX Elbow with HSW Sprinkler Head

Uponor ProPEX fittings, used with Uponor AquaPEX ASTM F876 and F877 tubing, are manufactured according to the ASTM F1960 Standard. Uponor offers a complete line of NSF 61-listed ProPEX fittings. ProPEX fittings are made from engineered plastic (EP), stainless steel, or brass for various connection needs.

Connections are made by sliding a ProPEX ring over the PEX tubing and expanding them simultaneously. The expanded tubing and ProPEX ring then slide over the fitting. The connection is made as the PEX tubing shrinks over the fitting due to the unique shape memory of Uponor AquaPEX tubing.

Note: Brass fittings must be used to tee into sprinkler lines.

Refer to the Uponor Product Catalog for a current listing of all ProPEX brass couplings; brass elbows; brass tees; brass reducing tees; brass male threaded adapters; brass female threaded adapters and brass sweat adapters.

Figure 1-5: Uponor Tubing, Ring and ProPEX Brass Tee

Residential Sprinklers

Only National Sanitation Foundation (NSF)-listed residential fire sprinklers are compatible with AquaSAFE Fire Safety systems.

Note: Ensure that all sprinklers are installed within their listing limitations. Additionally, ensure that the Uponor Sprinkler Cabinet that remains in the home contains sprinklers identical to those installed in the system. Do not store sprinklers in areas that may experience excessive heat (over 100°F/37.3°C).

Concealed Sprinklers

A special plate covers the concealed sprinklers. This plate drops away from the sprinkler at 135°F/57.2°C. The sprinkler activates when it senses temperatures greater than 165°F/73.9°C.

Figure 1-6: Concealed Sprinklers

Figure 1-7: Concealed Sprinkler Cover Plates

Caution: Do not paint cover plates. Paint coverage may interfere with the heat sensitivity of the sprinkler.

Note: Concealed sprinklers are compliant with all editions of the NFPA 13D Standard. Do not store sprinklers in areas that may experience excessive heat (over 100°F/37.3°C).

Figure 1-8: Recessed Pendant Sprinkler

Recessed Pendant Sprinklers

Recessed pendant sprinklers are visible in the ceiling and do not use a cover plate. Recessed sprinklers activate when temperatures exceed 155°F/68.3°C. In areas where ambient ceiling temperatures exceed 100°F/37.7°C, intermediate temperature sprinklers are required.

Note: Recessed pendent sprinklers are compliant with all editions of the NFPA 13D Standard. Do not store sprinklers in areas that may experience excessive heat (over 100°F/37.7°C).

Recessed Horizontal Sidewall Sprinklers

Recessed Horizontal Sidewall Sprinklers protrude through the wall of the room, typically between 4" and 6" below the ceiling. The sidewall sprinkler activates when temperatures exceed 155°F/68.3°C. Intermediate temperature sprinklers are required where ambient ceiling temperatures exceed 100°F/37.7°C.

Note: Recessed Horizontal Sidewall Sprinklers are compliant with all editions of NFPA 13D Standard. Do not store sprinklers in areas that may experience excessive heat (over 100°F/37.7°C).

Figure 1-9: Recessed Horizontal Sidewall (HSW) Sprinkler Head

Recessed Escutcheons

Recessed escutcheons include a tension collar, and are available in white or bronze to provide a finished appearance for sprinklers.

Caution: Do not paint over the sprinklers and cover plates. Paint may interfere with the heat sensitivity of the sprinkler, and disturbances may damage the sprinkler.

Figure 1-10: Uponor Recessed Escutcheons

Section 2
Design

Sprinkler Plans

Uponor can supply all needed sprinkler layout design plans. Uponor designers use hydraulic calculation software to create system layouts that provide reliable fire sprinkler protection. This software specifies the proper sprinkler locations, necessary flow rates and pressures. The resulting designs comply with nationally recognized fire codes and standards and meet the requirements of the NFPA 13D Standard and the National Building Code of Canada (as applicable). For more information about Uponor design capabilities, contact your local manufacturer representative.

Certified designers can contact Fire Safety Support at 800.321.4739 (US) or 888.594.7726 (Canada) for more information about integrating our information into their existing sprinkler design software.

Looped Design Example

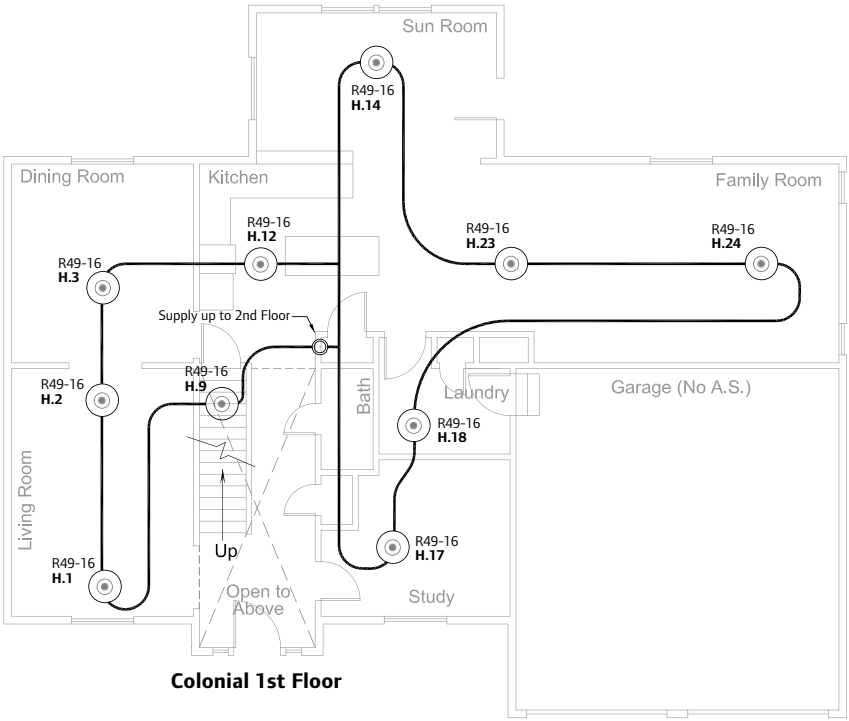
Uponor's Looped Design provides the following information:

- **Model** — Type of sprinkler used.
- **Nominal Orifice Size** — The size of the orifice on the sprinkler
- **Temperature Rating** — The temperature at which the sprinkler will activate
- **k Factor** — A number that describes the size of the hole available for water-flow through the sprinkler
- **Maximum Sprinkler Spacing** — The maximum spacing between the sprinklers (determined by the designer and indicated for each sprinkler on the layout)
- **Maximum Distance to Wall** — The maximum distance the sprinkler may be placed from the wall (equal to ½ the maximum sprinkler spacing designated on the layout).
- **Single Sprinkler** — When performing a single sprinkler flow verification test, the pressure and flow requirements for that sprinkler at various spacing
- **Two or More Sprinklers** — When performing a flow verification test for two or more sprinklers, the pressure and flow requirements for those sprinklers at the selected spacing

Model	Temperature Rating (°F)	Temperature Rating (°C)	K Factor	Maximum Sprinkler Spacing (Feet)	Distance to Wall (Feet)	Minimum Required Sprinkler Discharge			
						Single Sprinkler		Two or More Sprinklers	
						Flow (gpm)	Pressure (psi)	Flow Each (gpm)	Pressure Each (psi)
F1 RES30	155/175	68.3/79.4	3.0	12 x 12	6	8	7.0	8	7.0
(SIN R3511)	155/175	68.3/79.4	3.0	14 x 14	7	10	11.0	10	11.0
1 RES49	155/175	68.3/79.4	4.9	16 x 16	8	13	7.0	13	7.0
(SIN R3516)	155/175	68.3/79.4	4.9	18 x 18	9	17	12.0	17	12.0
	155/175	68.3/79.4	4.9	20 x 20	10	20	16.6	20	16.6
RFC43	165	73.9	4.3	12 x 12	6	12	7.8	12	7.8
(SIN RA0612)	165	73.9	4.3	14 x 14	7	13	9.1	13	9.1
	165	73.9	4.3	16 x 16	8	13	9.1	13	9.1
	165	73.9	4.3	18 x 18	9	18	17.5	18	17.5
	165	73.9	4.3	20 x 20	10	21	23.8	21	23.8
RFC49	165	73.9	4.9	12 x 12	6	13	7.0	13	7.0
(SIN RA0616)	165	73.9	4.9	14 x 14	7	13	7.0	13	7.0
	165	73.9	4.9	16 x 16	8	13	7.0	13	7.0
	165	73.9	4.9	18 x 18	9	17	12.0	17	12.0
	165	73.9	4.9	20 x 20	10	20	16.7	20	16.7
F1 RES44 HSW	155/175	68.3/79.4	4.4	12 x 12	6	12	7.5	12	7.5
(SIN R3516)	155/175	68.3/79.4	4.4	14 x 14	7	14	10.2	14	10.2
Installed	155/175	68.3/79.4	4.4	16 x 16	8	16	13.3	16	13.3
4' – 6'	155/175	68.3/79.4	4.4	16 x 18	8	18	16.8	18	16.8
Below Ceiling	155/175	68.3/79.4	4.4	18 x 18	9	19	18.7	19	18.7
	155/175	68.3/79.4	4.4	16 x 20	8	23	27.4	23	27.4

Table 2-1: Sprinkler Flow Example

Looped Design Layout Example



Colonial 1st Floor

H.#	Sprinkler ID
Sprinkler Node Number	Type of Sprinkler and its Maximum Spacing

Figure 2-1: Example Layout – Loop Design

Section 3
Installation Overview

Important: Ensure a qualified, Uponor-trained AquaSAFE installer is always on the job site during installation.

Recommended Tools

- NFPA 13D Standard
- Installation instructions and spacing guidelines from sprinkler manufacturer
- Uponor manual, battery, or pneumatic expander tool and expander heads
- Compressor and air hose (if using a pneumatic expander tool)
- Appropriate sprinkler wrench (identified on Uponor materials list) and ½" ratchet
- Tube cutter
- Teflon tape
- Screws: #10 x 1½" coarse-thread screws
- Uponor tubing uncoiler
- Drill with drive bits and drill bits (including large bore: 1⅜" to 3")
- Circular saw
- Tape measure
- Hammer
- Wrenches (2) or adjustable pliers
- Speed square
- Level
- Plumb bob and/or chalk string
- Permanent marker
- Heat gun
- Extension cords and portable lighting
- Ladder(s) and/or scaffolding

Product Verification

- Verify quantity and type of sprinkler heads.
- Verify quantity and type of ProPEX sprinkler adapters.
- Verify that appropriate cover plates and/or escutcheons are available to match sprinkler heads.
- Ensure protective caps are available for installation on every sprinkler head.
- Verify enough Uponor tube talons are available for proper support of Uponor AquaPEX tubing.
- Ensure ProPEX plugs are available to plug plumbing rough in for flow test.
- Verify quantity and type of brass ProPEX tees to connect plumbing rough-in and for floor-to-floor connections and same-floor interconnection of sprinkler loops.

Jobsite Verification

To verify that the sprinkler plan is appropriate, walk the entire job prior to installation. Contact the Uponor Design Department at 888.594.7726 to determine if observed changes require a redesign.

- Verify that the sprinkler plans match the layout of the residence. Confirm that walls, beams, ceiling vaults, and other features are consistent with the sprinkler plan and that any other architectural features of the building have not changed.
- Verify adequate water supply. Ensure water supply details match the sprinkler plan, design parameters and confirm appropriate water meter.
- Verify the final elevations match those submitted on the design request form. The sprinkler system was designed with these parameters, and differences can result in flow and pressure inconsistencies.

Mark Sprinkler Head Locations

Spacing from Continuous Obstructions

If obstructions exist that are not shown on the sprinkler plan, refer to NFPA 13D, Section 8.2.5: Obstructions to Residential Sprinklers also refer to the sprinkler manufacturer's installation instructions for proper sprinkler placement. If additional sprinklers are required to avoid obstructions, contact the Uponor Design Department at (888.594.7726) to determine if a redesign is necessary.

Minimum Distances from Heat Sources

The following table provides information from NFPA 13D, Table 7.5.5.3: Minimum Distances for Ordinary Temperature Residential Sprinklers. Use this table to calculate the distance sprinklers should be from any existing heat sources in the building.

Heat Source	Minimum Distance from Edge of Source
Side of open or recessed fireplace	36"
Front of recessed fireplace	60"
Coal- or wood-burning stove	42"
Kitchen range	18"
Wall oven	18"
Hot-air flues	18"
Un-insulated heat ducts	18"
Un-insulated hot water pipes	12"
Side of ceiling- or wall-mounted hot-air diffusers	24"
Front of ceiling- or wall-mounted hot-air diffusers	36"
Hot-water heater or furnace	6"
Light fixture (0 W – 250 W)	6"
Light fixture (250 W – 499 W)	12"

Table 3-1: Minimum Distances from Heat Sources

Floor-to-floor Connection Locations

The sprinkler plan will identify the basic location for floor-to-floor connections of sprinkler loops. Mark these locations at the floor and ceiling, taking into account the sprinkler head and tubing locations.

Note: The floor-to-floor connection may be specified as a different tubing size than the sprinkler loops.

Plumbing Connection Locations

The sprinkler plan will also identify the basic location for plumbing connections to sprinkler loops. Mark the appropriate locations of the plumbing tubing/stub-outs/fixtures with consideration of where the sprinkler tubing will be located.

Dead-end and Arm-over Connections

If any dead ends or arm overs are identified on the sprinkler plans, examine these areas for optimum tubing location to minimize the distance of the dead end runs.

What to do if Changes are Required

If any features or obstructions require the addition or deletion of sprinkler heads, or significant relocation of sprinkler heads, contact the Uponor Design Department to determine if observed changes require a redesign (888.594.7726).

Section 4
Install Sprinkler Adapters

The design printout shows sprinkler placement and spacing. The number after the dash indicates proper sprinkler spacing (in square feet).

Example: R49 -16 signifies a recessed 4.9k sprinkler, designed to cover a 16' x 16' area. The maximum distance off any wall is equal to half the distance of the maximum spacing selected. For example, if the design dictates that the sprinklers are spaced 16 feet apart, do not place farther than eight feet off the wall.

Installation instructions as follows.

1. The design printout should list the type of sprinkler to use in your installation.
2. Use the sprinkler design printout to determine the proper location for installing the sprinkler adapters.

   Caution: Avoid obstructions that may interfere with sprinkler discharge when mounting sprinkler assemblies. Anticipate the use of fans, surface-mounted lighting, beams and slopes. For specific clearance requirements, refer to NFPA 13D: Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes. Vaulted ceilings and obstructions added after the system design is completed can interfere with proper sprinkler operation. Contact the Uponor Design Department (888.594.7726) if ceiling vaults or beams are not shown on the sprinkler plan.

   Note: The sprinkler plan will identify the most hydraulically remote head(s) that will be used for flow-verification testing. To save time during that procedure, make sure these sprinkler locations are clearly defined during installation.
3. Attach the sprinkler-mounting bracket or sprinkler adapter to the structure with two #10 x 1½" coarse-thread screws. If using the lower set of mounting holes, install a third screw in the center hole of the bracket. Refer to the sprinkler plan mounting details for correct placement of brackets and adapters, paying close attention to the ceiling type and sprinkler model.
4. Install sprinkler adapters into mounting brackets, if necessary.
   a. Snap sprinkler adapter into mounting bracket.
   b. Install push-on nut over the threaded portion of the sprinkler adapter.

   Note: The sprinkler adapter and mounting bracket can also be pre-assembled (with or without) the sprinkler head.

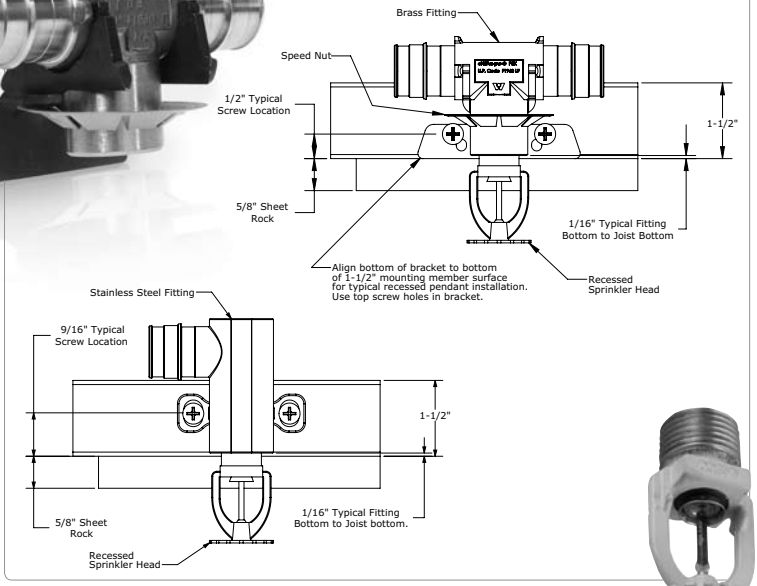


Figure 4-1: Recessed Assembly Sprinkler Placement

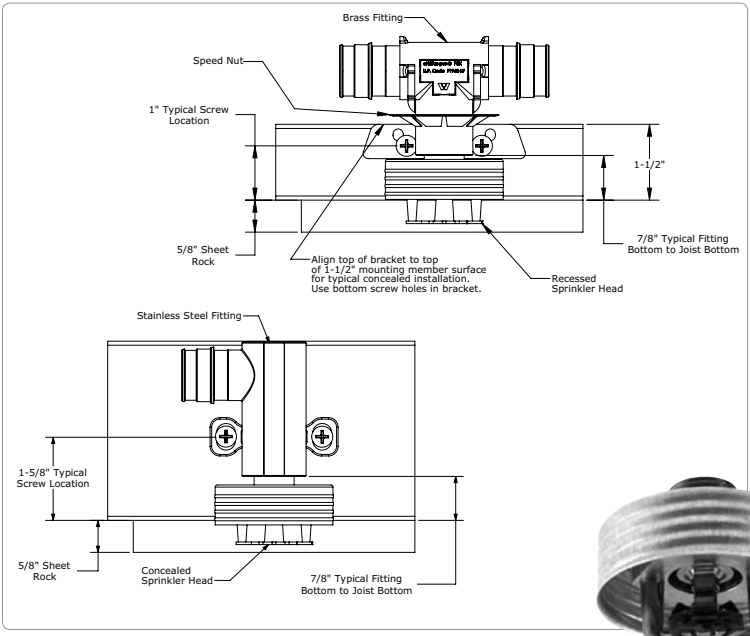


Figure 4-2: Concealed Assembly Sprinkler Placement

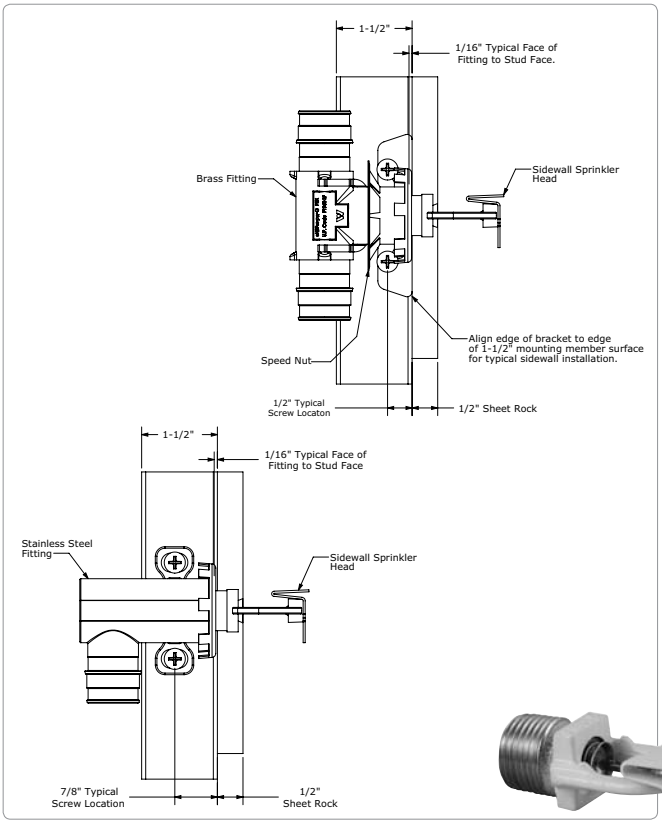


Figure 4-3: Horizontal Sidewall Sprinkler Placement

Note: Dimensions shown are for typical ceiling or wall construction and may not apply in all situations. The sprinkler plans may contain different information based on details supplied on the design request form and/or submitted construction drawings.

When mounting stainless steel sprinkler adapters, certain situations or construction methods may require blocking to support the adapter adequately.

Important: After installing the first mounting bracket or sprinkler adapter, verify the correct placement by temporarily installing all components (sprinkler head, cover plate or escutcheon, and a representation of the ceiling thickness).

Section 5
Install Sprinkler Heads

It is important to follow all installation instructions of the sprinkler manufacturer completely.

1. For pendent or horizontal sidewall sprinklers, thread the tension ring onto the sprinkler head until it bottoms out.
2. Wrap the threads on the sprinkler head with three wraps of Teflon tape when installing the sprinkler head into the sprinkler adapter. Do not use any leak-stopping additives in any fire sprinkler system.
3. Using the appropriate sprinkler wrench (see **Figure 5-1**) and following the sprinkler installation instructions, carefully tighten the sprinkler head into the sprinkler adapter. You should obtain a leak-tight connection with a maximum torque of 14 ft.-lbs. to 21 ft.-lbs. (approximately 2 turns past hand tight). Do not over-tighten.

   Important: Horizontal sidewall sprinkler deflectors must be installed parallel to the plane of the ceiling.

   Note: To save time during flow verification testing, do not fully tighten the sprinkler heads at the most hydraulically remote location(s), as they will be removed during that procedure. Refer to **Section 9: Flow Test** for more details.

Figure 5-1: Sprinkler Wrench Types

4. Install concealed cover plates and/or escutcheons only after the completion of ceiling construction. Leave protective caps on all sprinklers until construction is complete.
5. After the ceiling is finished, install the concealed cover plates by turning the cover clockwise until the flange is in contact with the ceiling. The cover plate assembly provides up to ½" adjustment. There will be a small gap between flange and the ceiling when properly installed. Escutcheons are installed on the tension ring and are pressed into place until the flange is tight against the ceiling. Escutcheons allow for up to ½" adjustment.

Caution: To protect the sprinkler from damage due to finishing work, cover sprinkler head with the plastic cover provided with the sprinkler. Paint and sheetrock can damage a sprinkler if not properly protected. After all finishing work is complete and sheetrock is in place and painted, attach the flat or domed cover plates on the concealed sprinklers or the escutcheon on the recessed or horizontal sidewall sprinklers. The flat cover plate and recessed escutcheon easily slide over the sprinkler using a twisting motion.

Section 6
Install Tubing

- Using proper ProPEX connection procedures, attach the Uponor AquaPEX tubing to the sprinkler adapters.
- To feed plumbing fixtures, install a ProPEX brass tee in the AquaSAFE Looped system. From this tee, you can feed Uponor AquaPEX tubing into a multiport tee to supply multiple fixtures, or you can install a dedicated feed to serve an individual fixture.
- Ensure that you maintain proper spacing between Uponor AquaPEX and uninsulated ducts, can lights, etc.

ProPEX Connections

Making ProPEX Connections

Make strong, reliable connections by using one of the Uponor ProPEX Expander tools (battery, air or hand). The steps are very similar for all three tools — with a slight variation in **step 3** on **page 24**.

1. Make a square cut on the PEX tubing perpendicular to the length of the tubing. Remove all excess material or burrs that might affect the fitting connection.

Figure 6-1

2. Slide the ProPEX ring over the end of the tubing. Make sure the end of the ring extends over the end of the tubing no more than $^{1}/_{16}$" (1.6mm).

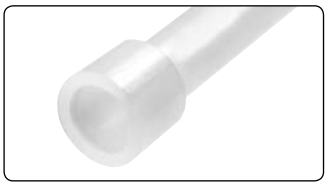


Figure 6-2

3. When using the ProPEX Hand Expander tool, brace the free handle of the tool against your hip, or place one hand on each handle. Fully separate the handles and slide the expander head into the tubing until it stops (See **Figures 6-3** through **6-5**). Full expansions are necessary to make a proper connection. Bring the handles together to expand. Separate the handles, remove the head slightly from the tubing and rotate it one-eighth turn. Slide the tool head into the tubing until it stops in the newly rotated position and expand again.

Figure 6-3

When using the ProPEX Air or Battery Expander tools, slide the expander head into the tubing until it stops. Full expansions are necessary to make a proper connection. Press the trigger to expand. Release the trigger, remove the head slightly from the tubing and rotate it one-eighth turn after each expansion. Slide the tool head into the tubing until it stops in the newly rotated position and expand again.

Figure 6-4

Important: Rotate the tool one-eighth turn in either direction after each expansion to provide smooth and even expansion of the tubing. It is important to reposition the head after each expansion. Otherwise, the segments on the tool head may cause deep grooves in the tubing. These grooves can result in potential leak paths.

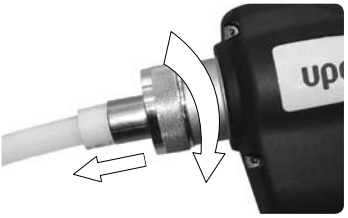


Figure 6-5

Note: It is not necessary to rotate the tool in only one direction. Alternating the turning direction will ease expansion in confined spaces. **Figures 6-6** and **6-7** show enlarged views inside expanded tubing.

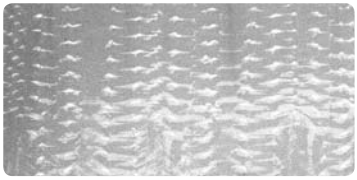


Figure 6-6 Expansion with Proper Rotation

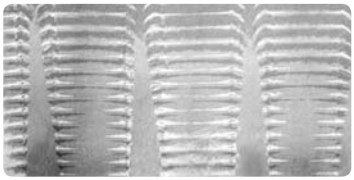


Figure 6-7 Expansion without Proper Rotation

4. Repeat the expansion process until the tubing and ring are snug against the shoulder on the expander head. See **Table 6-1** on **page 27** for the recommended number of expansions for each tubing size.

   Note: The "H" in the chart refers to the H-series expander heads, used only with the ProPEX Battery Expander tools.

5. Immediately remove the ProPEX Expander tool. As you slide the tubing over the fitting, you should feel some resistance. If the tubing reaches the shoulder of the fitting without any resistance, the tubing may be overly expanded and may require additional time to shrink over the fitting completely. Tubing and ProPEX ring should seat against the shoulder of the fitting for a proper connection.

Figure 6-8

Figure 6-9

Important Tips for a Proper ProPEX Connection

- If the fitting does not slide into the tubing all the way to the stop, immediately remove it from the tubing and expand the tubing one final time.

  Note: To avoid overly expanding the tubing, do not hold the tubing in the expanded position.

- The recommended number of expansions is listed in **Table 6-1**. Experience, technique and weather conditions influence the actual number of expansions. Fewer expansions may be necessary under certain conditions. The correct number of expansions is the amount necessary for the tubing and the shoulder of the fitting to fit snugly together.

- Good connections result when the ProPEX ring rests snugly against the stop of the ProPEX

fitting shoulder. If there is more than 1/16" between the ring and the shoulder of the fitting, square-cut the tubing 2" away from the fitting and make another connection using a new ProPEX ring.

The following troubleshooting tips are helpful for making proper ProPEX connections.

If Expansion is Difficult

- Make sure the internal cone is properly greased.

If Expansion Head Slips Out of Tubing During Expansion:

- Ensure the tubing and ProPEX Ring are dry.
- Make sure that grease is not getting into the tubing.
- Examine the segment fingers of the expander head to ensure no fingers are bent.

If ProPEX Ring Slides Down Tubing During Expansion:

- Ensure your hands are clean while handling the tubing. Any sweat or oils on your hands can act as a lubricant. Due to the smoothness of PEX, any form of lubricant can cause the ProPEX ring to slide across the tubing during expansion.
- If you anticipate the ring sliding down, position the ProPEX ring slightly farther over the end of the tubing and make the first couple of expansions slowly. Once the ring and the tubing begin to expand together, you can continue with the normal number and type of expansions.
- Place your thumb against the ProPEX Ring to help support it and feel for any movement. If caught early, you can slide the ring up the tubing and expand as described in the previous bullet point.

If More Expansions Than Recommended Are Needed for a Connection:

- Make sure that the head is hand-tightened to the ProPEX Expander tool.
- Examine the segment fingers of the expander head to ensure that none is bent.
- Be sure to completely cycle the tool on each expansion (i.e., close the hand tool handle or release the battery expander tool trigger).

Using Auto Rotation

Note: Only Uponor or Milwaukee Expansion Tools with Uponor standard heads can use the ProPEX Auto Rotation Adapter (Q6323810). Milwaukee M12 and M18 ProPEX Expander Tools with Milwaukee heads have auto rotation built in.

1. Lightly grease the cone of the ProPEX Expander Tool (hand, air or battery). See **Figure 6-10** on **page 28**.
2. Thread the ProPEX Auto Rotation Adapter (Q6323810) onto the tool. Remove excess oil from adapter cone, then lightly grease cone. See **Figure 6-11** on **page 28**.

3. Select an Uponor standard expander head only. (Uponor H-heads are not compatible.)
4. Thread standard expander head onto the ProPEX Auto Rotation Adapter (Q6323810). See **Figure 6-12** on **page 28**.
5. Square cut the PEX tubing perpendicular to the length of the tubing. See **Figure 6-13** on **page 28**.
6. Slide the ProPEX ring over the end of the tubing. Extend the end of the ring over end of the tubing no more than 1/16". See **Figure 6-14** on **page 28**.
7. Gently slide the expander head into the tubing until it stops. Do not force the expander head into the tubing. See **Figure 6-15** on **page 28**.
8. Perform the expansion and repeat. See **Table 6-1** for the recommended number of expansions. After each expansion, remove the tool from the tubing to allow rotation then reinsert tubing for the next expansion. See **Figure 6-16** on **page 28**.

Tubing Size	Standard Head	H-head
½"	3 – 5	-
¾"	7 – 9	-
1"	12 – 14	6-7

Table 6-1: Recommended Number of Expansions

Note: The recommended expansions are appropriate for both Uponor and Milwaukee ProPEX Expander tools.

9. Expansion is complete when the tubing and ring are snug against the shoulder on the expander head. See Figure **6-17** on **page 28**.
10. Immediately remove the ProPEX Expander tool. You should feel resistance as you insert the fitting. See **Figure 6-18** on **page 28**.

    Note: You do not need to rotate the tubing or the ProPEX Expander tool. The expander head may not rotate after each expansion on 1" tubing. This will not affect the quality of the connection.

Cold-weather Expansions

- Temperature affects the time required for the tubing and ring to shrink onto the fitting — the colder the temperature, the slower the contraction time.
- Warming ProPEX fittings and ProPEX rings reduces contraction time. Put fittings and rings in your pockets prior to installation to keep them warm.
- The temperature must be above 5°F/-15°C to make ProPEX connections.
- Fewer expansions are necessary in temperatures below 40°F/4.4°C.

Note: At colder temperatures (below 40°F/4.4°C), it will take longer for ProPEX connections to seal under pressure. If air leaks are found during pressure tests in cold weather, use a heat gun (with care) to warm up connections all

the way around the circumference of the tubing for about 15 seconds so that the tubing becomes warm to the touch.

Figure 6-10

Figure 6-11

Figure 6-12

Figure 6-13

Figure 6-14

Figure 6-15

Figure 6-16

Figure 6-17

Figure 6-18

Important: Do not let the tubing get hot enough so that it damages the outer polyethylene layer. Never allow direct flame to touch tubing surface. Use continuous movements to avoid over-heating. Even in cold weather, a heat gun is normally not required.

Caution: When warming connections, protect sprinklers and cover plates from excessive heat. Temperatures greater than 155°F/68.3°C will cause the glass bulb of the sprinkler to burst, activating discharge.

Bend Radius and Bend Support

Bending PEX

Refer to **Table 6-2** for the minimum bend radius of Uponor AquaPEX tubing. When making bends less than 12" in diameter, be sure to make the bends slowly and carefully to avoid overly bending or kinking the tubing.

Tubing Size	Bend Radius
½"	3¾"
¾"	5¼"
1"	6¾"

Table 6-2: Uponor AquaPEX Minimum Bend Radius

The following section provides instructions for reforming kinked tubing. Bend supports are available for Uponor AquaPEX tubing and may be used to facilitate 90-degree rigid bends.

Reforming Kinked Tubing

If the tubing kinks and hinders flow, perform the following steps for an easy repair.

1. Straighten the kinked portion of the tubing.
2. Heat the kinked area to approximately 265°F/129.4°C with an electric heat gun (approximately 450 watts of power). Apply the heat evenly until the tubing returns to its original size and shape. Do not use an open flame.

   Caution: Only heat the Uponor AquaPEX tubing long enough to remove the kink. Remove the heat source from the tubing as soon as possible; excessive heat may harm the outer polyethylene layer. Damage to the outer layer is only aesthetic; it does not affect the performance of the tubing.
3. Let the repaired Uponor AquaPEX tubing cool undisturbed to room temperature. When the tubing returns to its original appearance, the repair is complete.

   Caution: The surface temperature of the tubing must not exceed 338°F/170°C. DO NOT apply direct flame to Uponor AquaPEX tubing.

Uponor AquaPEX tubing repaired according to these recommendations will return to its original shape and strength. If Uponor AquaPEX tubing is sliced, punctured or otherwise damaged

beyond the capacity of the crosslinked memory, it is necessary to remove and replace the entire section.

Note: Do not weld PEX or attempt to repair with adhesives.

Caution: When reforming kinked tubing, protect sprinklers and cover plates from excessive heat. These devices are heat sensitive. Excessive temperatures may cause the glass bulb of the sprinkler to burst, activating discharge.

Tubing Support and Tube Talon Guidelines

1. Uponor recommends plastic tubing supports (tube talons) but metal tubing supports designed for plastic tubing are also suitable. Attach metal tubing supports with #10 x 1¼" coarse drywall screws. Ensure proper orientation of the tube talon as shown in **Figure 6-19**.

Figure 6-19: Tube Talon

Figure 6-20: Metal Tubing Supports

2. Do not use supports that will damage the tubing. Inspect metal supports for sharp edges.
3. The linear expansion rate for Uponor AquaPEX tubing is approximately 1.1" per 10°F/12.2°C temperature change for every 100 feet of tubing.
4. Allow ⅛" to 3⁄16" longitudinal clearance per foot of run to accommodate thermal expansion when installing tubing runs. Allow tubing to dip between supports.

   Note: Do not pull tubing tight during installation.
5. Do not rigidly anchor Uponor AquaPEX tubing with supports. Allow enough tubing for freedom of movement to expand and contract.
6. Allow adequate clearance between PEX tubing and the structure (bored holes or sleeves) to allow freedom of movement for thermal expansion and contraction.

Tubing Support Spacing

Anchor Uponor AquaPEX tubing securely enough to support the tubing, yet relaxed enough to allow the tubing to expand and contract.

1. Along horizontal runs, install supports every 32". If horizontal runs are continuously supported, place the tubing supports at 6' intervals. See **Figure 6-21**.

2. Along vertical runs, install supports every 4' to 5' at each floor and at a mid-story guide. See **Figure 6-22**.

Note: In accordance with UL and C-UL listings, provide protection for the tubing and fittings. The minimum protection consists of either:

- One layer of ⅜" (9.5mm) gypsum wallboard
- A suspended membrane ceiling with lay-in panels or tiles weighing greater than 0.35 lbs. per square foot (1.7kg per square meter) when installed with metallic support grids
- ½" (13mm) plywood soffits
- One layer of ½" (13mm) plywood

Note: Do not rough-in the tubing and leave it exposed.

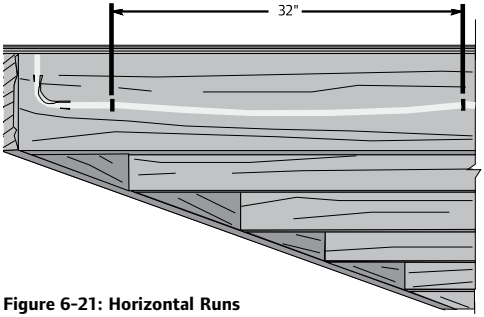


Figure 6-21: Horizontal Runs

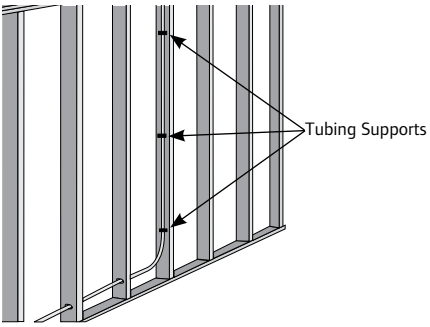


Figure 6-22: Vertical Runs

Purchase an Uponor Select Uncoiler (E6062000), Compact Select Uncoiler (E6063000), Tube Uncoiler (E6061000) or Deluxe Tube Uncoiler (E6061100) for easy, convenient uncoiling of PEX tubing.

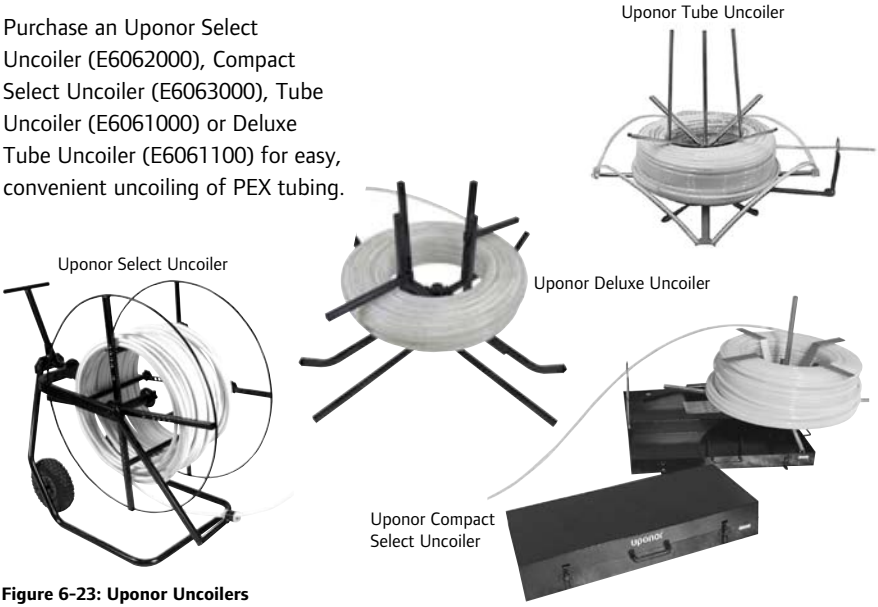


Figure 6-23: Uponor Uncoilers

Extreme Temperature Installations

AquaSAFE Residential Fire Safety systems are often installed in attics or other areas exposed to temperature extremes of heat and/or cold. Follow the recommended extreme weather installation instructions to isolate and protect system components from extreme temperatures. Because this system also delivers domestic cold water directly to plumbing fixtures, Uponor highly recommends that you protect the tubing with adequate insulation in warm weather areas to minimize heating of the cold water supply.

Installation methods include, but are not limited to:

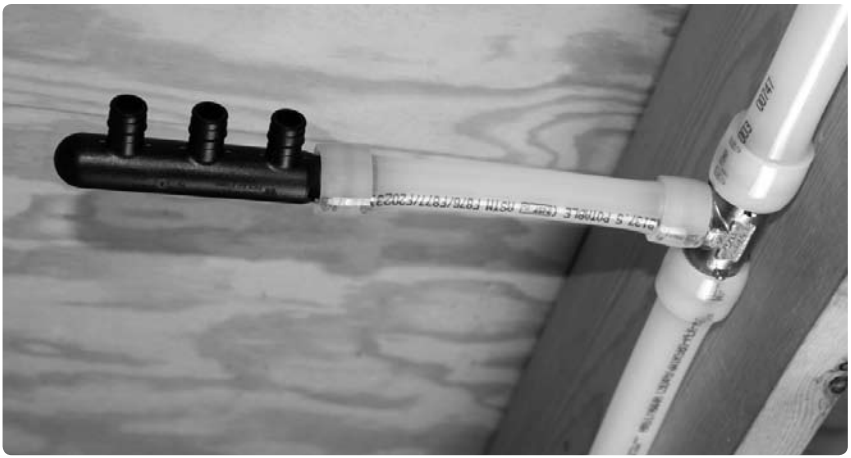
- Tenting over the fire sprinkler piping
- Additional layers of batt insulation
- Increased depth of blown-in insulation

Caution: If you will be installing spray foam insulation, make sure to protect all components during application. Consult with the spray foam manufacturer to ensure compatibility with all products before application.

Consultation with local building officials is encouraged to ensure compliance with local building codes.

Section 7
Connect Plumbing Runs

To feed plumbing fixtures, install a ProPEX brass tee in the AquaSAFE loop. From this tee, you can feed Uponor AquaPEX tubing into a multiport tee to supply cold water to multiple fixtures, or you can install a dedicated run to supply an individual fixture. Ensure plumbing runs have been plugged to allow pressure and flow verification testing.



Section 8
Pressure Test

The NFPA 13D Standard specifies testing at normal operating water pressure. The Uponor AquaSAFE Looped system should be pressure-tested in accordance with the NFPA 13D Standard. If local plumbing code requirements are more stringent, follow your local code.

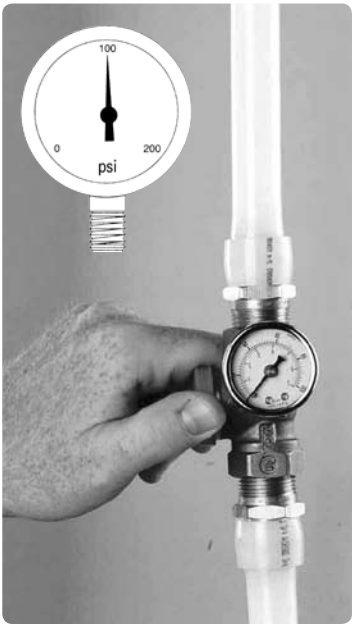


Figure 8-1: Pressure Test at Normal Operating Water Pressure

If you find leaky connections during pressure tests in cold weather, use a heat gun* to warm up connections around the circumference of the tubing for 15 seconds.

*Any 450-watt electric heat gun will work for this purpose.

Note: Ensure that you do not overheat the tubing.

When using the heat gun, protect sprinklers and cover plates from excessive heat. Temperatures greater than 155°F/68.3°C will cause the glass bulb of the sprinkler to burst, activating discharge.

Caution: To protect the sprinkler from damage due to finishing work, cover the head with the plastic cover provided with the sprinkler. Paint and sheetrock can damage a sprinkler if not properly protected. After all finishing work is complete and sheetrock is in place and painted, attach the flat cover plate of the concealed sprinkler or the recessed escutcheon of the recessed sprinkler. The flat cover plate and recessed escutcheon easily slide over the sprinkler using a twisting motion.

Section 9
Flow Test

To ensure the system provides enough water for proper fire sprinkler performance, you should conduct a flow verification test. Trained installers who complete a flow verification test may offer their customers a 25-year limited warranty on Uponor AquaPEX tubing and ProPEX fittings.

For full warranty details, go to **www.uponor-usa.com/warranties** or **www.uponor.ca/warranties**.

Note: The NFPA 13D Installation Standard does not require flow verification.

Before performing a flow verification test, confirm the water pressures by contacting the Water and Sewer Department of your local city. Ensure the available water pressure matches the pressure used in the system design.

Note: The sprinkler plan indicates the most hydraulically remote sprinkler (or pair of sprinklers). For test requirements on other sprinklers, consult your local code.

Note: It is a good idea to notify the fire inspector at least 24 hours prior to performing a flow verification test. This may speed up the inspection process and eliminate the need to repeat the test for the inspector.

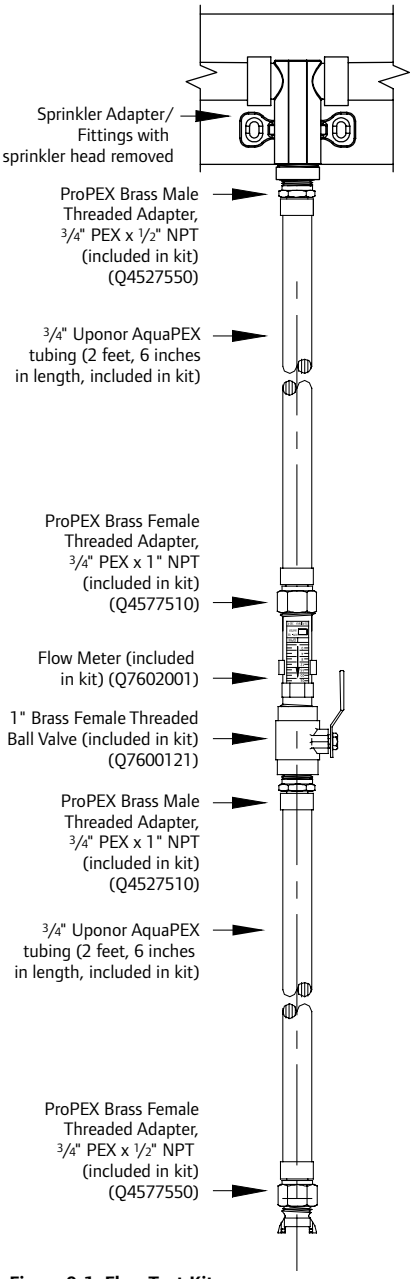


Figure 9-1: Flow Test Kit

Flow Verification Kit

The Flow Verification Kit attaches to the sprinkler adapter for proper flow measurement. The kit contains the following items:

- Flow-control valve
- Uponor flow meter
- Five test orifices
- One ¾" PEX x ½" FNPT threaded adapter
- One ¾" PEX x ½" MNPT threaded adapter
- One ¾" PEX x 1" FNPT threaded adapter
- One ¾" PEX x 1" MNPT threaded Adapter

Performing the Flow Verification Test

All flow-restricting devices (water softener, etc.) must be in place when you perform a flow verification test.

1. Ensure that you have the water turned off.
2. If you have already inserted the sprinkler into the ½" threaded outlet, carefully unscrew the sprinkler from the sprinkler adapter. Place the sprinkler in a safe place to avoid any damage.
3. Assemble the PEX pieces using the threaded fittings. The flow meter must be installed above the control valve. Ensure the arrow on the flow meter is pointing in the direction of the water flow.

4. Install the correct orifice in the bottom of the flow verification kit. Refer to the design printout for the orifice with the appropriate k factor.

5. Attach the flow verification kit to the ½" NPT connection of the sprinkler adapter. Ensure the valve is closed.

   Note: Install a pressure gauge at the manifold location. You must take a pressure reading from this gauge during the flow test.

6. Ensure that you have installed the proper sprinkler orifice adapter to the bottom of the flow verification kit.

7. Pressurize the system to its working pressure.

8. Open the valve and bleed air from the system.

9. Close the valve completely.

10. Record the static pressure reading on the gauge near the manifold.

Figure 9-2: Flow Meter

11. Open the valve until the plunger on the flow meter settles into position. This may take less than one minute. Using the markers on the flow meter, determine the flow through the test device. Record the residual pressure reading on the manifold gauge while the water is flowing.

12. Compare the results with the gallons per minute required on the sprinkler data sheet. Test results must equal or exceed the required flow for proper operation and warranty coverage.

    Note: If the AHJ requires a multiple head test, additional flow verification kits are necessary.

13. Pull all Teflon tape off detached sprinkler.

14. Apply new Teflon tape to the threads of the sprinkler (three wraps).

15. Using the appropriate sprinkler wrench and following the sprinkler installation instructions, carefully tighten the sprinkler head into the sprinkler adapter. You should obtain a leak-tight connection with a maximum torque of 14 ft.-lbs. to 21 ft.-lbs. (approximately 2 turns past hand tight). Do not over-tighten.

16. Once you have verified the proper flow rate, fill out the Flow Test Verification form and fax to Uponor Technical Services Department at 952.997.1731. Keep a copy for your own records. The AHJ may also require a copy.

Performing the Flow Verification Test Without the Flow Meter

The installer can also conduct the flow verification test without the use of the Flow Test Kit, a practice sometimes referred to as the Bucket Test Method, using the following steps.

1. Ensure that you have the water turned off.
2. If you have already inserted the sprinkler into the ½" threaded outlet, carefully unscrew the sprinkler from the sprinkler adapter. Place the sprinkler in a safe place to avoid any damage.
3. Construct a flow test assembly using a 1" full bore ball valve with threaded adapters and ¾" PEX tubing, that threads into the ½" NPT sprinkler adapter and terminates with the correct test orifice.
4. Using a one-gallon container, carefully mark the fill-lines in a large bucket (such as a 20- or 30-gallon garbage container) with a permanent marker. You should mark at the 5-, 8- and 10-gallon levels; then at each gallon up to or exceeding the minimum required flow from the sprinkler (as identified on the sprinkler plan).
5. Attach the flow test assembly to the ½" NPT connection of the sprinkler adapter. Ensure the valve is closed.

   Note: Install a pressure gauge at the manifold location. You must take a pressure reading from this gauge during the flow test.
6. Ensure that you have installed the proper sprinkler orifice adapter to the bottom of the flow test assembly.
7. Pressurize the system to its working pressure.
8. Open the valve and bleed air from the system.
9. Close the valve completely.
10. Record the static pressure reading on the gauge near the manifold.
11. Open the valve and start a timer or stopwatch. Flow water for one minute and record the number of gallons in the bucket. If the minimum volume of water is reached as indicated on the sprinkler plan before one minute has elapsed, the test may be stopped as the flow rate exceeds the requirements.
12. Compare the results with the gallons per minute required on the sprinkler data sheet.

Test results must equal or exceed the required flow for proper operation and warranty coverage.

Note: If the AHJ requires a multiple head test, additional flow test assemblies and buckets are necessary.

13. Pull all Teflon tape off detached sprinkler.
14. Apply new Teflon tape to the threads of the sprinkler (three wraps).
15. Using the appropriate sprinkler wrench and following the sprinkler installation instructions, carefully tighten the sprinkler head into the sprinkler adapter. You should obtain a leak-tight connection with a maximum torque of 14 ft.-lbs. to 21 ft.-lbs. (approximately 2 turns past hand tight). Do not over-tighten.
16. Once you have verified the proper flow rate, fill out the Flow Test Verification form and fax to the Uponor Technical Services Department at 952.997.1731. Keep a copy for your own records. The AHJ may also require a copy.

Troubleshooting Flow Problems

If the number of gallons that flow out of the sprinkler during a flow test is less than the number required by the manufacturer, perform the following checks.

1. Verify the available water pressure.
2. Ensure that you have piped the system according to the design.
3. Verify that you have used the proper test orifice for the flow test.
4. Check to see that all supply valves in the system are open.
5. Ensure that no flow-restricting devices were added after the design was complete.
6. Ensure that you have the properly sized water meter, according to the drawing.
7. Ensure that the water service pipe (i.e., diameter and length) is in accordance with the design.
8. Ensure that the elevations are in accordance with the design. If all of the above are in accordance with the design, contact your Uponor representative.

9. Refer to the following pressure charts for PEX tubing:

Residual Pressure Charts for PEX Tubing

60°F Water

Inlet Pressure: 60 — 3/4" PEX Tube Length (feet)

gpm	25	50	100	150	200	225	275	300	325	ft/s
2.0	59.7	59.5	58.9	58.4	57.9	57.6	57.1	56.8	56.5	1.81
2.5	59.6	59.2	58.4	57.6	56.8	56.4	55.5	55.1	54.7	2.27
3.0	59.4	58.9	57.7	56.6	55.5	54.9	53.8	53.2	52.6	2.72
3.5	59.2	58.5	57.0	55.5	54.0	53.2	51.7	50.9	50.2	3.18
4.0	59.0	58.1	56.1	54.2	52.3	51.3	49.4	48.4	47.4	3.63
4.5	58.8	57.6	55.2	52.8	50.4	49.2	46.8	45.6	44.4	4.08
5.0	58.5	57.1	54.2	51.2	48.3	46.9	43.9	42.5	41.0	4.54
5.5	58.3	56.5	53.0	49.6	46.1	44.3	40.8	39.1	37.4	4.99
6.0	58.0	55.9	51.8	47.7	43.6	41.6	37.5	35.5	33.4	5.44
6.5	57.6	55.3	50.5	45.8	41.0	38.7	33.9	31.5	29.2	5.90
7.0	57.3	54.6	49.1	43.7	38.2	35.5	30.1	27.4	24.6	6.35
7.5	56.9	53.8	47.6	41.5	35.3	32.2	26.0	22.9	19.8	6.80
8.0	56.5	53.0	46.1	39.1	32.1	28.7	21.7	18.2	14.7	7.26
8.5	56.1	52.2	44.4	36.6	28.8	24.9	17.1	13.3	9.4	7.71
9.0	55.7	51.3	42.7	34.0	25.4	21.0	12.4	8.0	3.7	8.17
9.5	55.2	50.4	40.9	31.3	21.7	16.9	7.4	2.6	-	8.62
10.0	54.7	49.5	39.0	28.4	17.9	12.6	2.1	-	-	9.07
10.5	54.2	48.5	37.0	25.4	13.9	8.2	-	-	-	9.53
11.0	53.7	47.4	34.9	22.3	9.8	3.5	-	-	-	9.98
11.5	53.2	46.4	32.7	19.1	5.5	-	-	-	-	10.43
12.0	52.6	45.3	30.5	15.8	1.0	-	-	-	-	10.89
12.5	52.0	44.1	28.2	12.3	-	-	-	-	-	11.34
13.0	51.4	42.9	25.8	8.7	-	-	-	-	-	11.79
13.5	50.8	41.7	23.3	5.0	-	-	-	-	-	12.25

Table 9-1: Residual Pressure (psi) for ASTM F877 ¾" PEX Tubing

60°F Water

Inlet Pressure: 60 — 1" PEX Tube Length (feet)

gpm	25	50	100	150	200	225	275	300	325	ft/s
3.0	59.8	59.7	59.3	59.0	58.7	58.5	58.2	58.0	57.8	1.65
3.5	59.8	59.6	59.1	58.7	58.2	58.0	57.5	57.3	57.1	1.92
4.0	59.7	59.4	58.9	58.3	57.7	57.4	56.9	56.6	56.3	2.20
4.5	59.6	59.3	58.6	57.9	57.2	56.8	56.1	55.7	55.4	2.47
5.0	59.6	59.1	58.3	57.4	56.6	56.1	55.3	54.8	54.4	2.75
5.5	59.5	59.0	57.9	56.9	55.9	55.4	54.3	53.8	53.3	3.02
6.0	59.4	58.8	57.6	56.4	55.2	54.6	53.4	52.8	52.1	3.30
6.5	59.3	58.6	57.2	55.8	54.4	53.7	52.3	51.6	50.9	3.57
7.0	59.2	58.4	56.8	55.2	53.6	52.8	51.2	50.4	49.6	3.85
7.5	59.1	58.2	56.3	54.5	52.7	51.8	50.0	49.0	48.1	4.12
8.0	59.0	57.9	55.9	53.8	51.8	50.7	48.7	47.7	46.6	4.40
8.5	58.8	57.7	55.4	53.1	50.8	49.6	47.3	46.2	45.0	4.67
9.0	58.7	57.4	54.9	52.3	49.8	48.5	45.9	44.7	43.4	4.95
9.5	58.6	57.2	54.3	51.5	48.7	47.3	44.5	43.0	41.6	5.22
10.0	58.4	56.9	53.8	50.7	47.6	46.0	42.9	41.4	39.8	5.50
10.5	58.3	56.6	53.2	49.8	46.4	44.7	41.3	39.6	37.9	5.77
11.0	58.1	56.3	52.6	48.9	45.2	43.3	39.6	37.8	35.9	6.05
11.5	58.0	56.0	52.0	47.9	43.9	41.9	37.9	35.9	33.8	6.32
12.0	57.8	55.6	51.3	46.9	42.6	40.4	36.1	33.9	31.7	6.60
12.5	57.7	55.3	50.6	45.9	41.2	38.9	34.2	31.8	29.5	6.87
13.0	57.5	55.0	49.9	44.9	39.8	37.3	32.2	29.7	27.2	7.15
13.5	57.3	54.6	49.2	43.8	38.3	35.6	30.2	27.5	24.8	7.42
14.0	57.1	54.2	48.4	42.6	36.8	33.9	28.1	25.3	22.4	7.70
14.5	56.9	53.8	47.6	41.5	35.3	32.2	26.0	22.9	19.8	7.97
15.0	56.7	53.4	46.8	40.3	33.7	30.4	23.8	20.5	17.2	8.25
15.5	56.5	53.0	46.0	39.0	32.0	28.5	21.6	18.1	14.6	8.52
16.0	56.3	52.6	45.2	37.8	30.3	26.6	19.2	15.5	11.8	8.80
16.5	56.1	52.2	44.3	36.5	28.6	24.7	16.8	12.9	9.0	9.07
17.0	55.9	51.7	43.4	35.1	26.8	22.7	14.4	10.2	6.1	9.35
17.5	55.6	51.2	42.5	33.7	25.0	20.6	11.9	7.5	3.1	9.62
18.0	55.4	50.8	41.6	32.3	23.1	18.5	9.3	4.7	0.1	9.90
18.5	55.2	50.3	40.6	30.9	21.2	16.4	6.7	1.8	-	10.17
19.0	54.9	49.8	39.6	29.4	19.2	14.2	4.0	-	-	10.45
19.5	54.7	49.3	38.6	27.9	17.2	11.9	1.2	-	-	10.72
20.0	54.4	48.8	37.6	26.4	15.2	9.6	-	-	-	11.00
20.5	54.1	48.3	36.5	24.8	13.1	7.2	-	-	-	11.27
21.0	53.9	47.7	35.5	23.2	11.0	4.8	-	-	-	11.55
21.5	53.6	47.2	34.4	21.6	8.8	2.4	-	-	-	11.82
22.0	53.3	46.6	33.3	19.9	6.5	-	-	-	-	12.09

Table 9-2: Residual Pressure (psi) for ASTM F877 1" PEX Tubing

Bypass Instructions

Flow-restricting devices can have a negative effect on the operation of this system. If any potential flow-restricting devices (such as water softeners, water conditioners, etc.) are part of the plumbing system, notify the system designer prior to initial system design. You can easily modify the system design to accommodate any flow-restricting devices. Refer to the Uponor Domestic Water Bypass Instruction Sheet for more information.

Backflow Prevention Requirements

Because this is a non-stagnant multipurpose fire sprinkler and plumbing system, backflow prevention devices are not required. Check local code for any additional backflow requirements.

Section 10
Homeowner Information

Sprinkler Cabinet

Uponor recommends installing an Uponor Sprinkler Cabinet near the main water shut-off valve. Keep at least one spare sprinkler of each type in the cabinet for easy access to replacements. Check local code requirements for any additional spare sprinkler or cabinet requirements.

Caution: Do not store sprinklers in areas that may experience excessive heat (over 100°F/37.3°C).

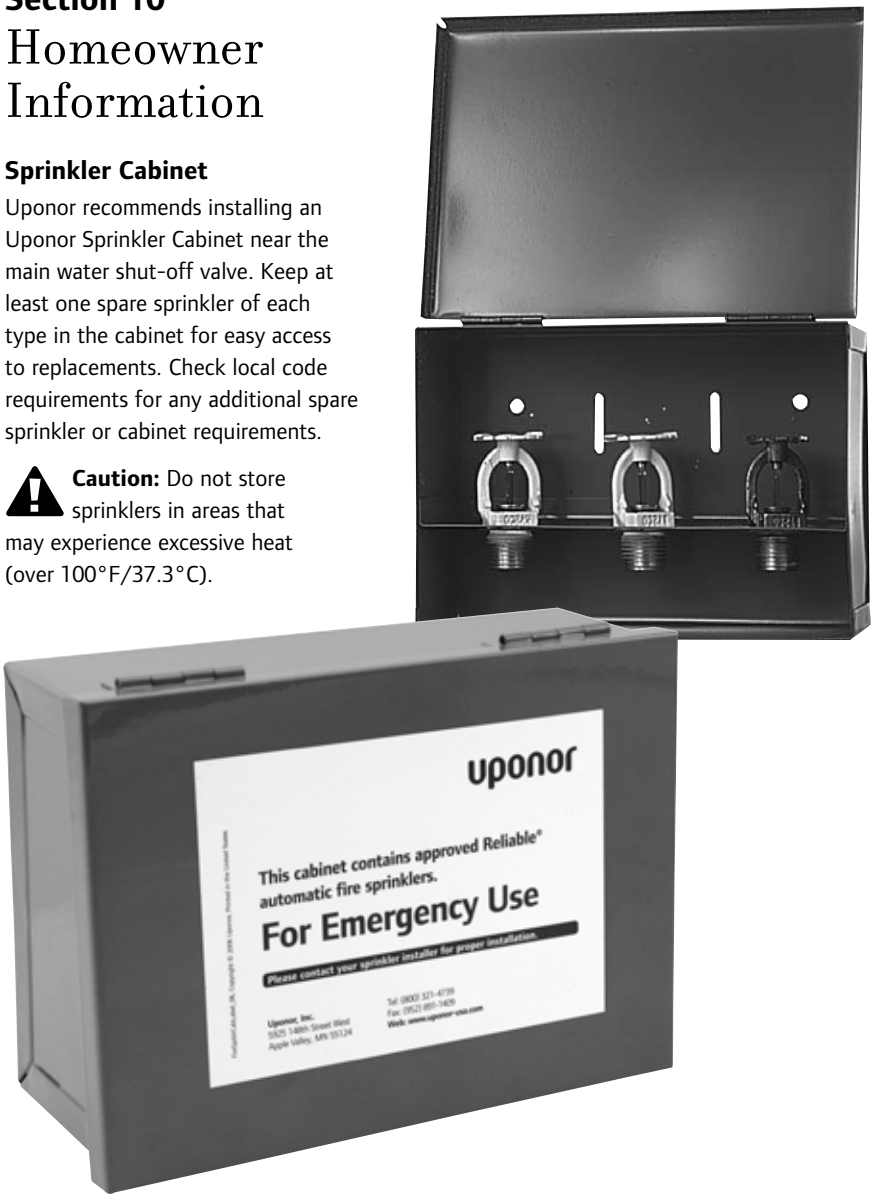


Figure 10-1: Sprinkler Cabinet

Warning Sign

The Uponor AquaSAFE Homeowner Handbook and a red warning sign are provided with the sprinkler design. The red warning label advises the homeowner that modifications to the system should not be made without consulting a fire protection specialist. Leave the homeowner handbook in the home and affix the warning sign adjacent to the primary shutoff valve.

Important: The warning sign must be affixed adjacent to the main shutoff valve per NFPA 13D requirements. If a replacement warning sign is needed, please contact the Uponor Design Department at 888.594.7726.

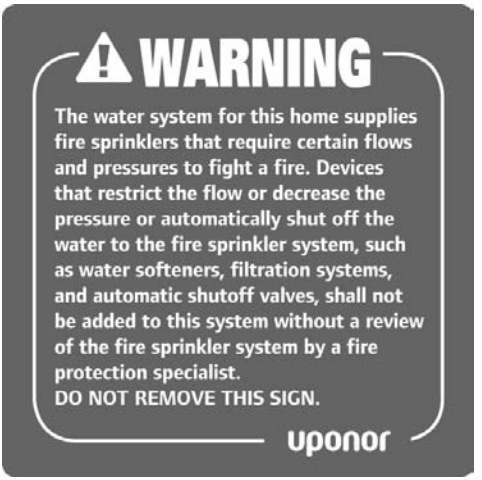


Figure 10-2: Warning Sign

Warranty Information

For warranty information, go to **www.uponor-usa.com/warranties** or **www.uponor.ca/warranties.**

Notes

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