

# SOLAR CAL POLY

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2015

As-Built Phase Project Manual

August 17<sup>th</sup>, 2015

Team Solar Cal Poly's design goal is to explore the balance of passive and active systems, of high and low tech processes, of traditional and digital methods of construction, in pursuit of a project that elicits user interaction and delight.

[calpolysolardecathlon.org](http://calpolysolardecathlon.org)



**Primary Faculty Contact:**

Sandy Stannard, Architect, LEED AP  
Professor of Architecture  
Architecture Department  
California Polytechnic State University  
San Luis Obispo, California 93407  
[stannard@calpoly.edu](mailto:stannard@calpoly.edu)

**Project Managers:**

Lisa-Marie Mueller and Alyssa Parr  
California Polytechnic State University  
San Luis Obispo, California 93407  
[lisa.marie.mueller94@gmail.com](mailto:lisa.marie.mueller94@gmail.com)  
[ahparr@calpoly.edu](mailto:ahparr@calpoly.edu)

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## Summary of Changes

Significant changes to the project manual that have occurred between submissions have been outlined below. The Construction Drawings should also be reviewed for relevant revisions.

### August 17<sup>th</sup>, 2015 Revision

The Project Manual has been updated from the previous issue. Revisions include:

- **Revision 1: Architecture Revisions:**
  - **Exterior:** The redwood screen on our home was adjusted to fit the thermal map of the home. The denser areas of the screen correspond with the hotter areas of the home. Additionally, the sliding screen doors at the bifacial room changed. We now have four 4'x8' doors on the south and two 5'x8' doors on the west. The exterior core cladding material has also changed to Richlite® Rainshadow. For drainage, we are now using four scuppers to direct water into the planters.
  - **Interior:** All flooring is now bamboo. Some of the lighting fixtures have changed to accommodate what was available to our team. The cabinets are now a combination of Resource Furniture prefabricated cabinets and custom cabinets, as noted on the interior elevations.
- **Revision 2: Mechanical System Components**
  - **Return Water:** Parts of infrastructure which were meant to support a possible aquaponics tank were removed.
  - **Plumbing Vents:** Plumbing vents rerouted to avoid excessive drilling in wall spaces.
  - **Fire Sprinklers:** One fire sprinkler has been added to the mechanical room.

- **HVAC:** Placement and size of mechanical room attic vents have been altered to improve airflow.
  
- **Revision 3: Electrical Systems and Components**
  - **Solar PV Modules and Inverter:** The bifacial solar modules incorporated into our canopy system have changed to Sunprime GxB 350W panels. To allow better flexibility in utilizing our production, we have also changed our inverter choice to include the use of both the SMA Sunny Boy 4000TL-US and the SMA Sunny Boy 5000TL-US. Our Sunpower E20/435 panels have also been given a 10 degree tilt, so the racking system was updated to accommodate this.
  
  - **Lighting Layout:** The lighting layout has been modified.
  
  - **Electrical Distribution and Equipment:** Receptacle placement has been altered slightly to better conform to NEC standards, and to allow for versatile use for comfort zones.

## February 12<sup>th</sup>, 2015 Revision

The Project Manual has been updated from the previous issue. Revisions include:

- **Revision 1: Architecture Revisions:**
  - **Wall Thicknesses:** The SIP walls in the private and living modules have changed from 6" to 8".
  
  - **Kitchen:** Kitchen layout has changed by moving the sink and dishwasher to the island eating bar.
  
  - **Bifacial Room:** The bifacial room panels have shifted west to directly line up with the east wall of the living module.

- **Landscaping and Ramps:** Planters and ramps have been added or rearranged to better accommodate the design goals of the outdoor spaces.
- **Casework:** Built in cabinetry at the east and west ends of the living and private modules has been added to create more storage.
- **Windows:** Slight changes to the sizes and spacing of clerestory windows changed for construction purposes. Other windows have moved slightly as a result of added casework.
- **Revision 2: Mechanical System Components**
  - **Water Systems:** Plumbing supply and return lines are changed for the kitchen to reflect the construction of the kitchen island.
  - **Return Water:** The return water system includes an intermediate tank and pump system to ensure that greywater and blackwater reaches the constructed-wetlands and black water tank respectively.

\*Constructed wetlands is a graywater management system in which gray water from the house is diverted for irrigation purposes.
  - **Plumbing Vents:** All plumbing vents are combined to one single vent stack above the washing machine area.
  - **Fire Sprinklers:** Fire sprinklers supply lines run through spacers in the ceiling joists of the public and private modules. Sprinkler heads that are in the kitchen and bath are now wall mounted due to plumbing line consideration. One fire sprinkler is added to the mechanical room.
  - **HVAC:** The ventilation ducts are moved to prevent interference with clearstory windows in bathroom. The HVAC equipment has been changed.

- **PCM:** Independent PCM system with a fan is being developed to stabilize internal temperature.
  
- **Revision 3: Electrical Systems and Components**
  - **Solar PV Modules and Inverter:** The bifacial solar modules being considered for our canopy system have changed to Prism Solar Model B215 solar panels. We have also decided to implement a single dual MPPT inverter, the SMA Sunny Boy 7000TL-US, instead of two separate Fronius string inverters.
  
  - **Lighting Layout:** The lighting layout has changed somewhat. Less strip and bar lights have been specified, and instead mostly single lamps remain on the drawings for the desired lighting.

## November 18<sup>th</sup>, 2014 Revision

The Project Manual has been updated from the previous issue. Revisions include:

- **Revision 1: Architecture Revisions:**
  - Progress in specifying and detailing building systems has led to several architectural changes. First, looking at the general engineering and construction has called for a more modular house. Three separate modules are now defined by height and material. Tweaks to how these come together have influenced the floor plan and spatial adjacencies.
  
  - The kitchen has been consolidated into the bath and mechanical module. The plan has reduced angularity of the hallway and exterior decking.
  
  - Roofs are now flat with a parapet. The central mechanical module roof is raised above the others to work with the mechanical changes and optimize building performance.
  
  - A water capture system has also been developed off of the south-west side of the house.

- **Revision 2: Mechanical System Components**

- The exterior supply and return water tanks reflect the new site layout and updated water budget. These containers are located together in a tank farm for ease of access and convenient shading. The residential water system now includes pumps to compensate for the increased distance between the mechanical room and appliances. This pumping system includes a pump to pressurize supply, two pumps to ensure sanitary waste return, and a thermal loop pump to circulate water between the flat plate collectors on the roof and the thermal storage tank in the mechanical room.
- The interior plumbing layout was changed from a home run system to a trunk and branch system to minimize the total amount of PEX used.
- Additionally, all household appliances were replaced with more efficient and better reviewed models.
- The HVAC system is now run by an air handling unit in the mechanical room rather than the dual minisplit system dispersed throughout the house. This design takes advantage of the ample duct space in the mechanical bar and reduces the overall price of the system. Supply air passing through the HRV is now immediately conditioned to conserve piping and assure air temperature control.

- **Revision 3: Electrical Systems and Components**

- The solar PV configuration for the house now consists of two sections: a rooftop mounted system and a bifacial canopy on the south side of the structure. The rooftop system retains the SunPower E20/435 conventional solar modules used in the previous design; however, they are now configured in 2 strings of 5 for a total of 10 panels (down from 15 in the previous design) at 4.35 kW. The canopy system uses Sanyo HIT 195DA3 bifacial panels, 2 strings of 6 panels, for a total of 12 modules at 2.34 - 3 kW, depending on the amount of reflected light below the canopy.

- The circuits have also been adjusted to better follow NEC guidelines. Outlets have been equipped with AFCI and tamper resistance along with GFCI and weatherproofing where needed, and dedicated circuits have been made for larger appliances such as the stove and washer/dryer. Telecommunication wiring layouts and plans have also been updated for increased system interface with the main control system.
  - Wire information for size and material, particularly in the Site Plan, One-line, and Three-line diagrams have been given more specificity. Along with this, Load Calculations have been filled out more completely as specified by NEC 220.
- **Revision 4: Structural Engineering**
    - Each module that makes up the home has a new layout of flooring and roofing plans. The main change to this was constructing the best floor system to fit the three transporting modules. We looked at the connections of each module and found that the same connections could be done without double beams. Instead of using an extra beam, we will be using temporary supports to hold up the floor joists during the transportation process. Making this adjustment has helped reduce the overall weight, cost, and material use of the home. We used the same idea to take out any double walls between the modules.



## 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	N/A
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	C-101
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	C-101 S-101
Rule 4-5	Generators	Specifications for generators (including sound rating)	N/A
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	H-101 P-101
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	07 45 70 21 00 00 21 12 00 22 00 00 22 14 29 22 41 16 22 30 00 23 56 16
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	A-203 A-204 A-541 S-102
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	A-211 A-212

<b>Rule 5-2</b>	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A-101 A-111 G-201 G-202
<b>Rule 5-2</b>	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
<b>Rule 6-1</b>	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 PM pages 13-80
<b>Rule 6-2</b>	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
<b>Rule 6-2</b>	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
<b>Rule 6-3</b>	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-102 G-103
<b>Rule 7-1</b>	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	A-101 L-101
<b>Rule 7-2</b>	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	P-101 P=104 C-103
<b>Rule 8-1</b>	PV Technology Limitations	Specifications for photovoltaic components	26 00 00 48 14 00
<b>Rule 8-3</b>	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	N/A
<b>Rule 8-3</b>	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A
<b>Rule 8-4</b>	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
<b>Rule 8-4</b>	Desiccant Systems	Specifications for desiccant system components	N/A

Rule 8-5	Village Grid	Completed interconnection application form	PM page 86
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-112 C-103 E-102 E-601
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	26 00 00 48 14 00
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	E-604
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	G-103 A-101 E-401
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	H-101 P-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	H-101 A-101 P-101 P-901
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	PM page 81
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	P-104
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	A-101 A-112 P-101
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	M-104
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	23 30 00 23 82 23

<b>Rule 9-7</b>	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
<b>Rule 9-8</b>		Drawing(s) showing the complete sequence of water delivery and distribution events	P-101 P-102 P-103 P-104 O-101 O-102 O-103 O-104
<b>Rule 9-8</b>	Water Delivery	Specifications for the containers to which water will be delivered	22 12 00
<b>Rule 9-9</b>	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-101 P-102 P-103 P-104 O-101 O-102 O-103 O-104
<b>Rule 9-9</b>	Water Removal	Specifications for the containers from which water will be removed	22 12 00
<b>Rule 11-4</b>	Public Exhibit	Interior and exterior plans showing entire accessible tour	G-102 G-103

**Structural Calculations**

STRUCTURAL CALCULATIONS

*FOR*

2015



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Load Takeoff					
North Module		South Module		Core	
SIP 8 1/4" Roof	3.6 PSF	SIP 8 1/4" Roof	3.6 PSF	Roof Framing	3 PSF
Roof Framing	3 PSF	Roof Framing	3 PSF	2x Low Roof	2 PSF
Solar Panels	0 PSF	Solar Panels	0 PSF	Solar Panels	2 PSF
Roofing	3 PSF	Roofing	3 PSF	Roofing	3 PSF
MEP	0 PSF	MEP	0 PSF	MEP	5 PSF
Gyp Ceiling	2.2 PSF	Gyp Ceiling	2.2 PSF	Gyp Ceiling	2.2 PSF
SIP 8 1/4" Walls	12 PSF	SIP 8 1/4" Walls	12 PSF	2x Stud Walls	12 PSF
Misc	1.2 PSF	Misc	1.2 PSF	Misc	3.8 PSF

Roof Dead Load	13 PSF
Wall Length	61 FT
Wall Height	12.3 FT
Roof Area	338 FT <sup>2</sup>

Roof Dead Load	13 PSF
Wall Length	60 FT
Wall Height	12.25 FT
Roof Area	378.3 FT <sup>2</sup>

Roof Dead Load	21 PSF
Wall Length	70 FT
Wall Height	16 FT
Roof Area	390 FT <sup>2</sup>

North Weight	8878 Lbs
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South Weight	9327 Lbs
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Core Weight	14910 Lbs
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Total Weight	33114.8 Lbs
<b>Total Weight</b>	<b>33.1 Kips</b>

### USGS Summary

Ss = 1.5 g  
 Sds = 1 g  
 Sd1 = 0.56 g  
 I = 1  
 Design Cat: D

### Seismic Base Shear - Light Frame Wood Walls

Ct =	0.02
x =	0.75
height =	14 FT
R =	6.5

T = Ct * height <sup>x</sup> =	0.144752	ASCE 12.8.2.1
Cs (upper) = Sd1/[(T/(R*I))] =	0.590929	ASCE Eq. 12.8-2
Cs (middle) = Sds/(R/I) =	0.153692	ASCE Eq. 12.8-3
Cs (lower) = 0.044*Sds*I =	0.043956	ASCE Eq. 12.8-5

<b>Shear (V) = Cs (middle)*Weight =</b>	<b>5.09 Kips</b>
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**Wind Loading**  
*ASCE 7-10 Ch. 27 Directional Procedure*  
*Part 2: Enclosed Simple Diaphragm Buildings with h < 160 ft*

**Step 1: Risk Category** II

**Step 2: Basic Wind Speed** 110 mph

**Step 3: Wind Load Parameters**

Exposure Category	C
Topographic factor	1
Enclosure Classification	Enclosed

**Step 4: Determine net pressures on walls**  
*ASCE Table 27.6-1*

$$p_h = 25.2 \text{ psf}$$

$$p_o = 25.2 \text{ psf}$$

**Step 5: Determine net roof pressures**  
*Per ASCE Table 27.6-2*

Case	Zone					
	1	2	3	4	5	
$p_z$	1	NA	NA	-23.7	-21.1	-17.3
$p_z$	2	NA	NA	0	0	0

**Step 6: Determine Topographic Factor**  
*Figure 26.8.2*

$$K_{zt} = 1$$

**Step 7: Apply loads to roof and walls simultaneously**

**27.6.2 Parapets**

**Calculate  $p_p$**   
*Figure 27.6-2*

$$p_p = 2.25 \times p_h$$

$$p_p = 2.25 \times 25.2 = 56.7 \text{ psf}$$

**27.6.3**

**Calculate  $p_{ovh}$**   
*Figure 27.6-3*

$$p_{ovh} = 0.75 \times p_3$$

$$p_{ovh} = 0.75 \times -23.7 = -17.78 \text{ psf}$$



REFERENCE	
	<u>WIND LOADING</u>
	<u>MWFRS BASE SHEAR (<math>V_w</math>)</u>
SEE APPENDIX FOR WALL AREA DIAGRAMS	<p>• N-S DIRECTION</p> <p>WINDWARD WALL AREA  <math>A_w = 68^{SF} + 130^{SF} + 100^{SF} + 268^{SF} + 126^{SF} = \underline{692^{SF}}</math></p> <p>WINDWARD PARAPET AREA  <math>A_p = 26^{SF} + 6.5^{SF} = \underline{32.5^{SF}}</math> [1'-0" PARAPET HT.]</p> <p>LEEWARD WALL AREA  <math>A_l = 269^{SF} + 21^{SF} + 300^{SF} = \underline{630^{SF}}</math></p> <p>LEEWARD PARAPET AREA  <math>A_p = 30^{SF} + 49^{SF} = \underline{79^{SF}}</math></p> <p><math>V_w = P_p A_p + 1.66 P_w A_w + 0.34 P_l A_l</math></p> <p>LEEWARD COEFFICIENT &amp; WINDWARD COEFFICIENT</p> <p>L 34.75' B 56'      L/B = 0.62</p> <p>FOR 0.25 ≤ L/B ≤ 1.0 → 0.38</p> <p>FOR 2.0 ≤ L/B ≤ 5.0 → 0.27</p> <p style="text-align: right;">↳ 0.27 LEEWARD 0.73 WINDWARD [REMAINDER]</p> <p><math>V_w = 56.7^{PSF} (79^{SF} + 32.5^{SF}) + 0.73 (25.2^{PSF}) (692^{SF}) + 0.27 (25.2^{PSF}) (630^{SF})</math></p> <p><math>V_w = \underline{23.28^K}</math> (N-S)</p> <p>• E-W DIRECTION</p> <p>WINDWARD WALL AREA  <math>A_w = 130^{SF} + 119^{SF} + 130^{SF} = \underline{379^{SF}}</math></p> <p>LEEWARD WALL AREA  <math>A_l = A_w = \underline{379^{SF}}</math></p> <p>PARAPET AREA  <math>A_p = 34^{SF} + 34^{SF} = 68^{SF}</math></p> <p><math>V_w = 56.7^{PSF} (68^{SF}) + 1.66 (25.2) (379) + 0.34 (25.2) (379) \Rightarrow \underline{V_w = 13.41^K}</math> (E-W)</p> <p>LEEWARD COEFF. &amp; WINDWARD COEFF  L=56' B=34.75' L/B = 1.61</p> <p>FROM INTERPOLATION → 0.34 LEEWARD 0.66 WINDWARD</p>
ASCE 7-10 8-27.	

REFERENCE	
SEE WIND LOADING FOR WIND PRESSURE DETERMINATION	WIND LOADING (CONT...)
	ROOF UPLIFT
	MODULE ①
	UPLIFT PRESSURE: CONSERVATIVELY USE 23.7 <sup>PSF</sup> MAX UPLIFT PRESSURE FOR ENTIRE STRUCTURE
	ROOF AREA: 342 <sup>SF</sup>
	$U_{PLIFT} = 23.7^{PSF} \times 342^{SF} = 8.11^K$
	MODULE ②
	UPLIFT PRESSURE: 23.7 <sup>PSF</sup> 17.78 <sup>PSF</sup> @ OVERHANG
	ROOF AREA: 386 <sup>SF</sup> (60 <sup>SF</sup> @ OVERHANG)
	$U_{PLIFT} = 23.7^{PSF} \times 386^{SF} = 9.15^K$ $= 17.78^{PSF} \times 60^{SF} = 1.07^K$
MODULE ③	
UPLIFT PRESSURE: 23.7 <sup>PSF</sup>	
ROOF AREA: 393 <sup>PSF</sup>	
$U_{PLIFT} = 23.7^{PSF} \times 393^{SF} = 9.31^K$	
OVERHANG	
UPLIFT PRESSURE: 23.7 <sup>PSF</sup> (ABU) 17.78 <sup>PSF</sup> (PLW)	
AREA: 92 <sup>SF</sup>	
$U_{PLIFT} = (23.7 + 17.78) \times 92^{SF} = 3.82^K$	

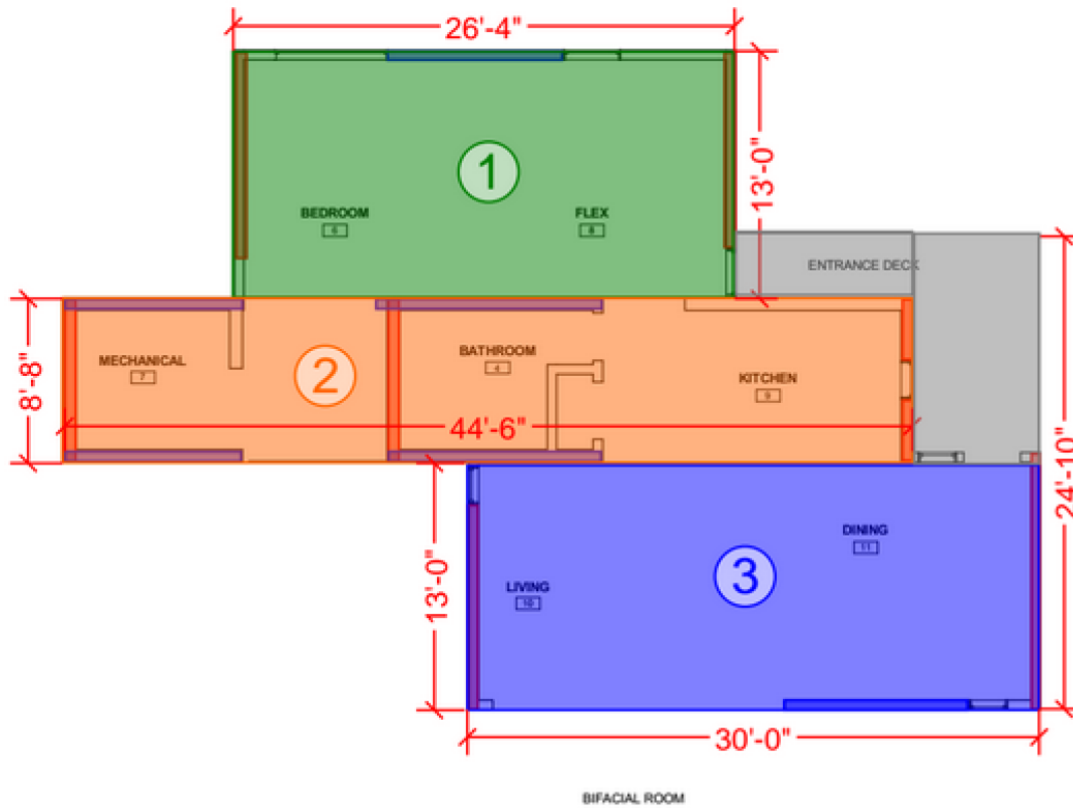
<p>REFERENCE</p>	<p><u>GRAVITY - ROOF BEAM SPLINE</u></p> <p><u>NORTH/SOUTH MODULE</u></p> <p><math>w_D = 13 \text{ psf}</math>   <math>w_L = 20 \text{ psf}</math>   <math>\therefore w_T = 33 \text{ psf}</math></p> <p>SIP ROOF = 8'4"</p> <p>PANEL SPAN (14 ft) = 48 psf allowable</p> <p>MAX SPAN = 13 ft ok ✓</p> <p>33 psf &lt; 48 psf ok ✓</p> <p><u>USE (2) 2x8 DF #2 or BETTER @ 4'-0" C.C.</u></p>
<p>ESR-2233 TABLE 7</p>	
<p>TABLE 1.1</p>	<p><u>CENTER MODULE - CORE</u></p> <p>LONGEST SPAN = 8 ft</p> <p><math>w_D = 21 \text{ psf}</math>   <math>w_L = 20 \text{ psf}</math>   <math>\therefore w_T = 41 \text{ psf}</math></p> <p>Trib width = 2 ft</p> <p><math>w_T = 41 \text{ psf} \times 2 \text{ ft} = 81 \text{ plf}</math></p> <p>SHEAR = <math>81 \text{ plf} \times 8' / 2 = 324 \#</math></p> <p>MOMENT = <math>81 \text{ plf} \times (8')^2 / 8 = 648 \# \cdot \text{ft}</math></p> <p>ALLOWABLE MOMENT FOR DF #2 <math>2 \times b = 737 \# \cdot \text{ft}</math></p> <p><math>M_A = 737 \# \cdot \text{ft} \times C_D^{1.25} = 921 \# \cdot \text{ft} &gt; 648 \# \cdot \text{ft}</math> okay ✓</p> <p><u>USE 2x6 DF #2 or BETTE @ 2'-0" C.C.</u></p>
<p>SIMPSON C-2013 (pg 71)</p>	<p>LUS26 HANGER ALLOWABLE SHEAR = 1070 #</p> <p>1070 # &gt; 324 # okay</p> <p><u>USE LUS26 HANGER @ 2x6 ROOF JOISTS</u></p>

REFERENCE	<u>GRAVITY - FLOOR JOISTS</u>
	$w_b = 10 \text{ psf} \quad w_c = 100 \text{ psf} \quad \therefore w_f = 110 \text{ psf}$ MAX SPAN = 11 ft      Trib Width = 1 ft $\therefore w_f = 110 \text{ plf}$
STEEL - COW 600500-54	$M = \frac{w_e l^2}{8} = \frac{110 \text{ plf} (11')^2}{8} = 1.66 \text{ k-ft}$ FOR 6005162-33 (C6x2in, 16 Gauge) $M_n = 30.4 \text{ in-k}$ $M_n = 30.4 / 12 = 2.53 \text{ k-ft}$ $2.53 \text{ k-ft} > 1.66 \text{ k-ft}$ okay ✓
	<u>USE C6x2, 16 Gauge @ 12" O.C. FLOOR JOISTS</u>

REFERENCE	GRAVITY - DECK JOIST - WORST CASE
	$w_D = 10 \text{ psf}$ $w_L = 100 \text{ psf}$ $\therefore w_T = 110 \text{ psf}$ TRIB WIDTH = 12"
	$w_T (\text{plf}) = 110 \text{ psf} \times 1 \text{ ft} = 110 \text{ plf}$ max span between supports = 4.33'
	$V = wL/2 = (110 \text{ plf})(4.33')/2 = 238 \#$ $M = wL^2/8 = (110 \text{ plf})(4.33')^2/8 = 258 \text{ ft}\#$
	DEFLECTION OK BY INSPECTION
	DF # 2 $F_b = 900 \text{ psi}$ $S = 7.56$ $C_f = 1.3$ $F_v = 180$ $E = 1660000$ FOR 2x6 $b = 1.5 \text{ in}$ $d = 5.5 \text{ in}$ $I = 20.8 \text{ in}^4$
	$V_u = F_v(b)(d)(2/3) = 990\# > 238\#$ okay ✓ $M_u = F_b(S)(C_f)/12 = 737\# \text{ ft} > 258\# \text{ ft}$ okay ✓
	<u>USE 2x6 DF #2 or BETTER @ 12" O.C.</u>

REFERENCE	GRAVITY - PONY WALL UNDER DECK
	<p> <math>w_D = 10 \text{ psf}</math>    <math>w_L = 100 \text{ psf}</math>    <math>\therefore w_T = 110 \text{ psf}</math>                      Trib Width = 4.33'  <math>w_T (\text{plf}) = 110 \text{ psf} (4.33') = 476.3 \text{ plf}</math>                      BASE OF PONY WALL (4x12) FLAT                      BEARING PRESSURE = <math>476.3 \text{ plf} / \left(\frac{11.25}{12}\right) = 508 \text{ psf}</math>                      ALLOWABLE BY COMPETITION = 6000 psf  <math>508 \text{ psf} &lt; 6000 \text{ psf}</math>    OKAY  <u>USE 4x12 FLAT FOR BASE OF PONY WALL</u> </p>

DIAPHRAGM KEY



**Seismic Diaphragm Loads North/South Direction**

*ASCE 7-10 Load Combinations Section 2.4.1*  
**8. 0.6D+0.7E**

DIAPHRAGM: <b>1</b>				GRID <b>2</b> TO <b>6</b>			
	Factor		Cs	LOAD (psf)		DEPTH (ft)	
ROOF	0.7	x	0.154	x	13	x	13 = 18.2 plf
WALLS	0.7	x	0.154	x	12	x	5.5 = 7.11 plf
<b>Total =</b>							<b>25.3 plf</b>

DIAPHRAGM: <b>2</b>				GRID <b>1</b> TO <b>4</b>			
	Factor		Cs	LOAD (psf)		DEPTH (ft)	
ROOF	0.7	x	0.154	x	21	x	8 = 18.1 plf
WALLS	0.7	x	0.154	x	12	x	5.5 = 7.11 plf
<b>Total =</b>							<b>25.2 plf</b>

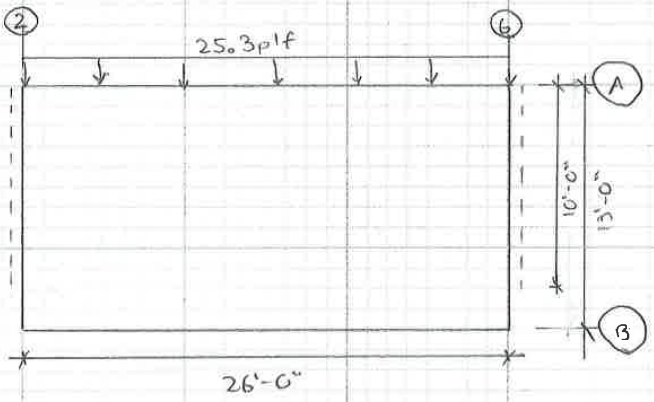


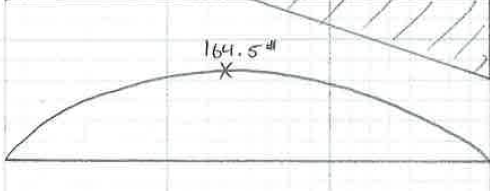
DIAPHRAGM: <b>2</b>				GRID <b>4</b> TO <b>6</b>			
	Factor		Cs	LOAD (psf)		DEPTH (ft)	
ROOF	0.7	x	0.154	x	21	x	8 = 18.1 plf
WALLS	0.7	x	0.154	x	12	x	2 = 2.59 plf
<b>Total =</b>							<b>20.7 plf</b>

DIAPHRAGM: <b>2</b>				GRID <b>6</b> TO <b>7</b>			
	Factor		Cs	LOAD (psf)		DEPTH (ft)	
ROOF	0.7	x	0.154	x	21	x	8 = 18.1 plf
WALLS	0.7	x	0.154	x	12	x	5.5 = 7.11 plf
<b>Total =</b>							<b>25.2 plf</b>

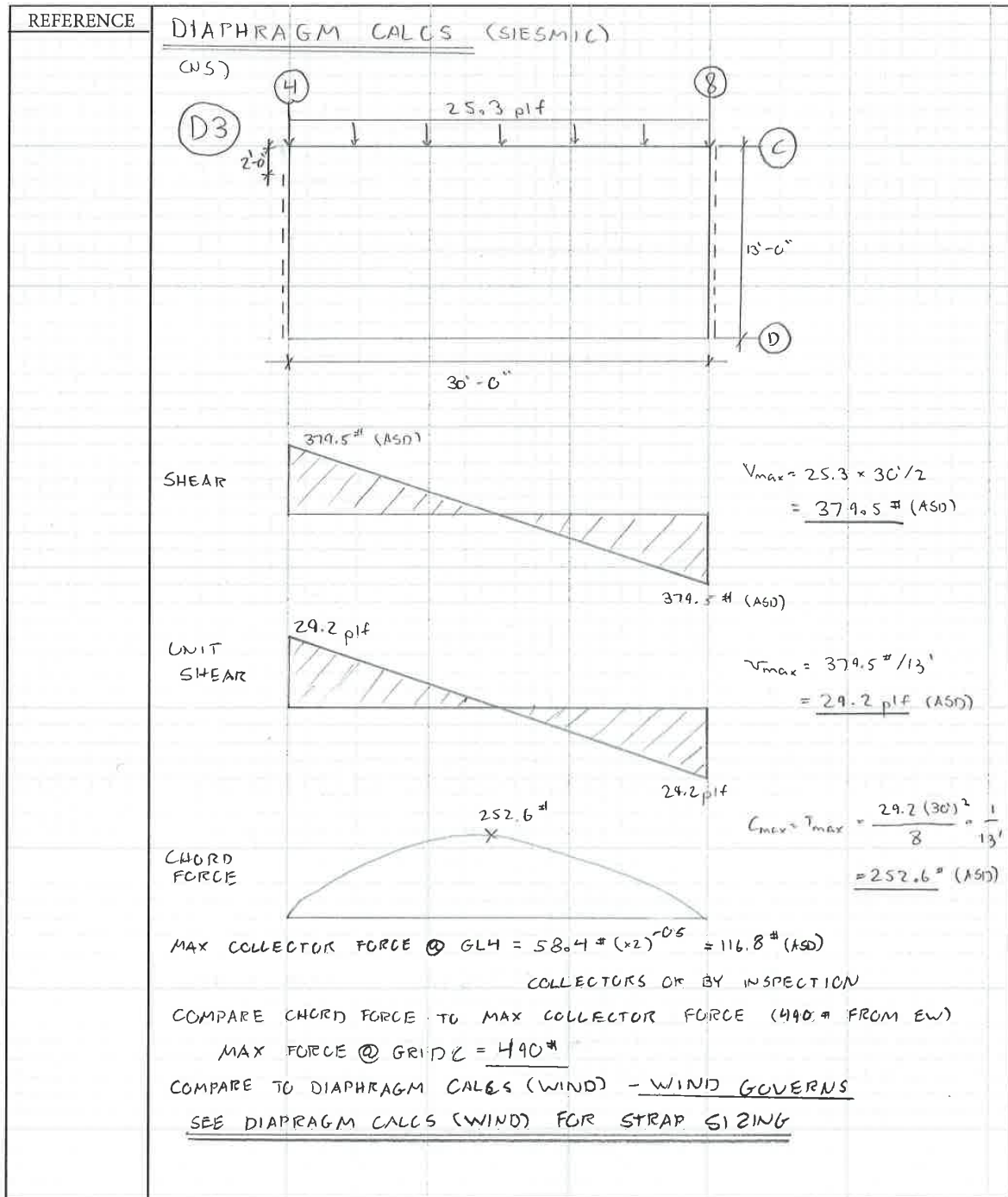
DIAPHRAGM: <b>3</b>				GRID <b>4</b> TO <b>8</b>			
	Factor		Cs	LOAD (psf)		DEPTH (ft)	
ROOF	0.7	x	0.154	x	13	x	13 = 18.2 plf
WALLS	0.7	x	0.154	x	12	x	5.5 = 7.11 plf
<b>Total =</b>							<b>25.3 plf</b>

Notes: ASD Load Factor of 0.7 used for seismic forces. All forces determined from this load determination are factored.



REFERENCE	DIAPHRAGM CALCS (SEISMIC)
	<p>(N-S)</p> <p>(D1)</p>  <p>25.3 plf</p> <p>26'-0"</p> <p>10'-0"</p> <p>13'-0"</p>
SHEAR	 <p>328.9#</p> $V_{max} = 25.3 \# \times 26' / 2$ $= 328.9 \# \text{ (ASD)}$
UNIT SHEAR	 <p>25.3 plf</p> <p>328.9#</p> $v_{max} = 328.9 \# / 13'$ $= 25.3 \text{ plf (ASD)}$
CHORD FORCE	 <p>164.5#</p> $C_{max} = T_{max} = \frac{25.3 (26')^2}{8} \times \frac{1}{13'}$ $= 164.5 \# \text{ (ASD)}$
	<p>MAX COLLECTOR FORCE @ GLB = <math>75.9 \# \times (2)' = 151.8 \#</math></p>
	<p>COLLECTORS OK BY INSPECTION</p>
	<p>COMPARE CHORD FORCE TO MAX COLLECTOR FORCE (221.4# FROM EW)</p>
	<p>MAX FORCE @ GRID A = <u>221.4#</u></p>
	<p>COMPARE TO DIAPHRAGM CALCS (WIND) - <u>WIND GOVERNS</u></p>
	<p><u>SEE DIAPHRAGM CALCS (WIND) FOR STRAP SIZING</u></p>

REFERENCE	DIAPHRAGM CALCS (SEISMIC)
	<p>(NS)</p> <p>155.6#      247.1#</p> <p>SHEAR</p> <p>19.4 plf      30.9 plf</p> <p>UNIT SHEAR</p> <p>87.8# (ASD)      351.8# (ASD)</p> <p>CHORD FORCE</p> <p> <math>V_1 = 18.3 \times 17 / 2 = 155.6 \# \text{ (ASD)}</math>  <math>V_2 = 18.3 \times 27 / 2 = 247.1 \# \text{ (ASD)}</math>  <math>v_1 = 155.6 / 8' = 19.4 \text{ plf (ASD)}</math>  <math>v_2 = 247.1 / 8' = 30.9 \text{ plf (ASD)}</math>  <math>C_{max1} = T_{max1} = \frac{19.4 (17')^2}{8} = 87.8 \# \text{ (ASD)}</math>  <math>C_{max2} = T_{max2} = \frac{30.9 (27')^2}{8} = 351.8 \# \text{ (ASD)}</math> </p> <p>         MAX COLLECTOR FORCE @ GL 7 = 77.25#  <math>77.25 \# \times (2)^{OS} = 154.5 \# \text{ (ASD)}</math>          COLLECTORS OR BY INSPECTION          COMPARE CHORD FORCE TO MAX COLLECTOR FORCE (323.6# FROM EW)          MAX FORCE @ GRID B = 351.8#          COMPARE TO DIAPHRAGM CALCS (WIND) - <u>WIND GOVERNS</u>  <u>SEE DIAPHRAGM CALCS (WIND) FOR STRAP SIZING</u> </p>



**Seismic Diaphragm Loads East/West Direction**

ASCE 7-10 Load Combinations Section 2.4.1  
8.  $0.6D+0.7E$

DIAPHRAGM: 1				GRID A TO B		
	Factor	Cs	LOAD (psf)	DEPTH (ft)		
ROOF	0.7	x 0.154	x 13	x 26	=	36.4 plf
WALLS	0.7	x 0.154	x 12	x 5.5	=	7.11 plf
<b>Total =</b>						<b>43.6 plf</b>

DIAPHRAGM: 2				GRID B TO C		
	Factor	Cs	LOAD (psf)	DEPTH (ft)		
ROOF	0.7	x 0.154	x 21	x 44.5	=	101 plf
WALLS	0.7	x 0.154	x 12	x 7.5	=	9.7 plf
<b>Total =</b>						<b>110 plf</b>

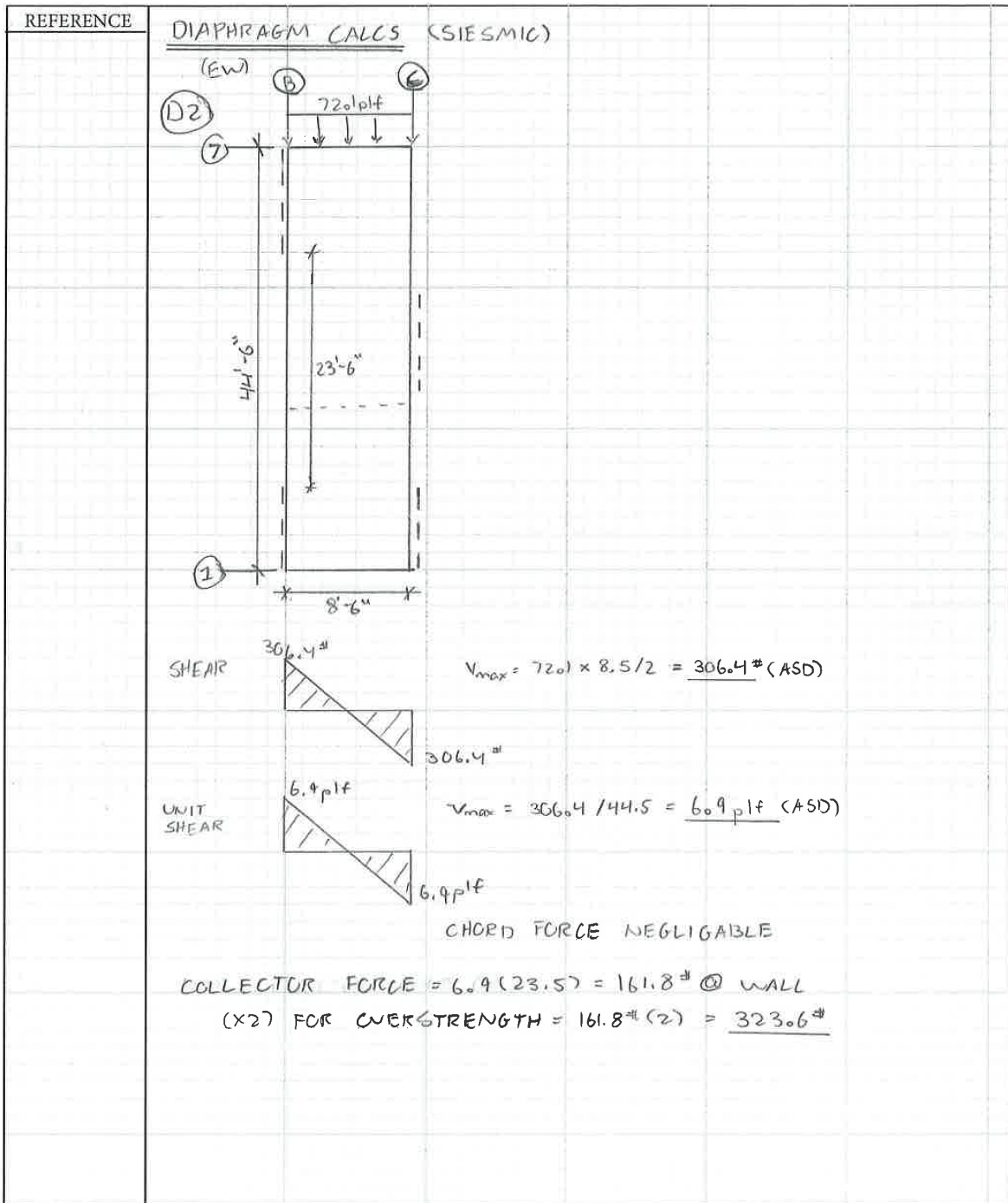
DIAPHRAGM: 3				GRID C TO D		
	Factor	Cs	LOAD (psf)	DEPTH (ft)		
ROOF	0.7	x 0.154	x 13	x 30	=	42 plf
WALLS	0.7	x 0.154	x 12	x 5.5	=	7.11 plf
<b>Total =</b>						<b>49.2 plf</b>

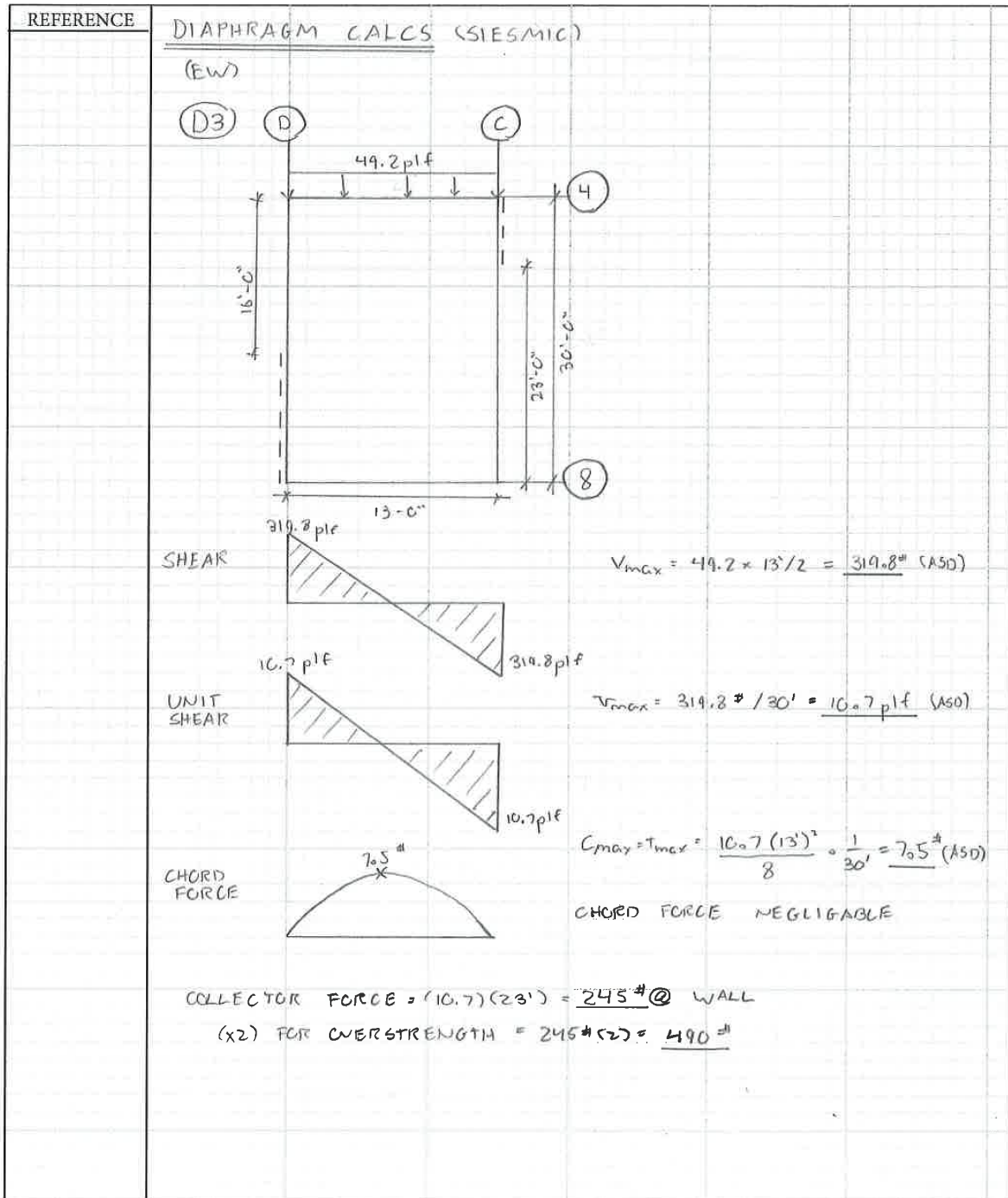
Notes: ASD Load Factor of 0.7 used for seismic forces. All forces determined from this load determination are factored.

521.76923

REFERENCE	DIAPHRAGM CALCS (SEISMIC)
	<p>(EW)</p> <p>319.8#</p> <p>SHEAR</p> <p>UNIT SHEAR</p> <p>12.3 plf</p> <p>12.3 plf</p> <p>BY INSPECTION, CHORD FORCES ARE NEGLIGIBLE</p> <p>COLLECTOR FORCE = 9' x 12.3 = 110.7#</p> <p>(x2) FOR OVERSTRENGTH = 110.7#(2) = 221.4#</p> <p> <math>V_{max} = 49.2 \text{ plf} \times 13' / 2 = 319.8 \# \text{ (ASD)}</math>  <math>V_{max} = 319.8 \# / 26' = 12.3 \text{ plf (ASD)}</math> </p>









**Wind Diaphragm Loads North/South Direction**

ASCE 7-10 Load Combinations Section 2.4.1  
7.  $0.6D+0.6W$

DIAPHRAGM:		1		GRID		2		TO		6	
	Factor		Coeff.		LOAD (psf)		HEIGHT (ft)				
PARAPET	0.6		x		56.7	x	1	=	34	plf	
WINDWARD	0.6	x	0.73	x	25.2	x	5	=	55.2	plf	
LEEWARD	0.6	x	0.27	x	25.2	x	0	=	0	plf	
<b>Total =</b>										<b>89.2</b>	plf

DIAPHRAGM:		2		GRID		1		TO		2	
	Factor		Coeff.		LOAD (psf)		HEIGHT (ft)				
PARAPET	0.6		x		56.7	x	1	=	34	plf	
WINDWARD	0.6	x	0.73	x	25.2	x	7.5	=	82.8	plf	
LEEWARD	0.6	x	0.27	x	25.2	x	7.5	=	30.6	plf	
<b>Total =</b>										<b>147</b>	plf

DIAPHRAGM:		2		GRID		2		TO		4	
	Factor		Coeff.		LOAD (psf)		HEIGHT (ft)				
PARAPET	0.6		x		56.7	x	1	=	34	plf	
WINDWARD	0.6	x	0.73	x	25.2	x	7.5	=	82.8	plf	
LEEWARD	0.6	x	0.27	x	25.2	x	2	=	8.16	plf	
<b>Total =</b>										<b>125</b>	plf

DIAPHRAGM:		2		GRID		4		TO		6	
	Factor		Coeff.		LOAD (psf)		HEIGHT (ft)				
PARAPET	0.6		x		56.7	x	1	=	34	plf	
WINDWARD	0.6	x	0.73	x	25.2	x	2	=	22.1	plf	
LEEWARD	0.6	x	0.27	x	25.2	x	2	=	8.16	plf	
<b>Total =</b>										<b>64.3</b>	plf

DIAPHRAGM:		2		GRID		6		TO		7	
	Factor		Coeff.		LOAD (psf)		HEIGHT (ft)				
PARAPET	0.6		x		56.7	x	1	=	34	plf	
WINDWARD	0.6	x	0.73	x	25.2	x	2	=	22.1	plf	
LEEWARD	0.6	x	0.27	x	25.2	x	7.5	=	30.6	plf	
<b>Total =</b>										<b>86.7</b>	plf

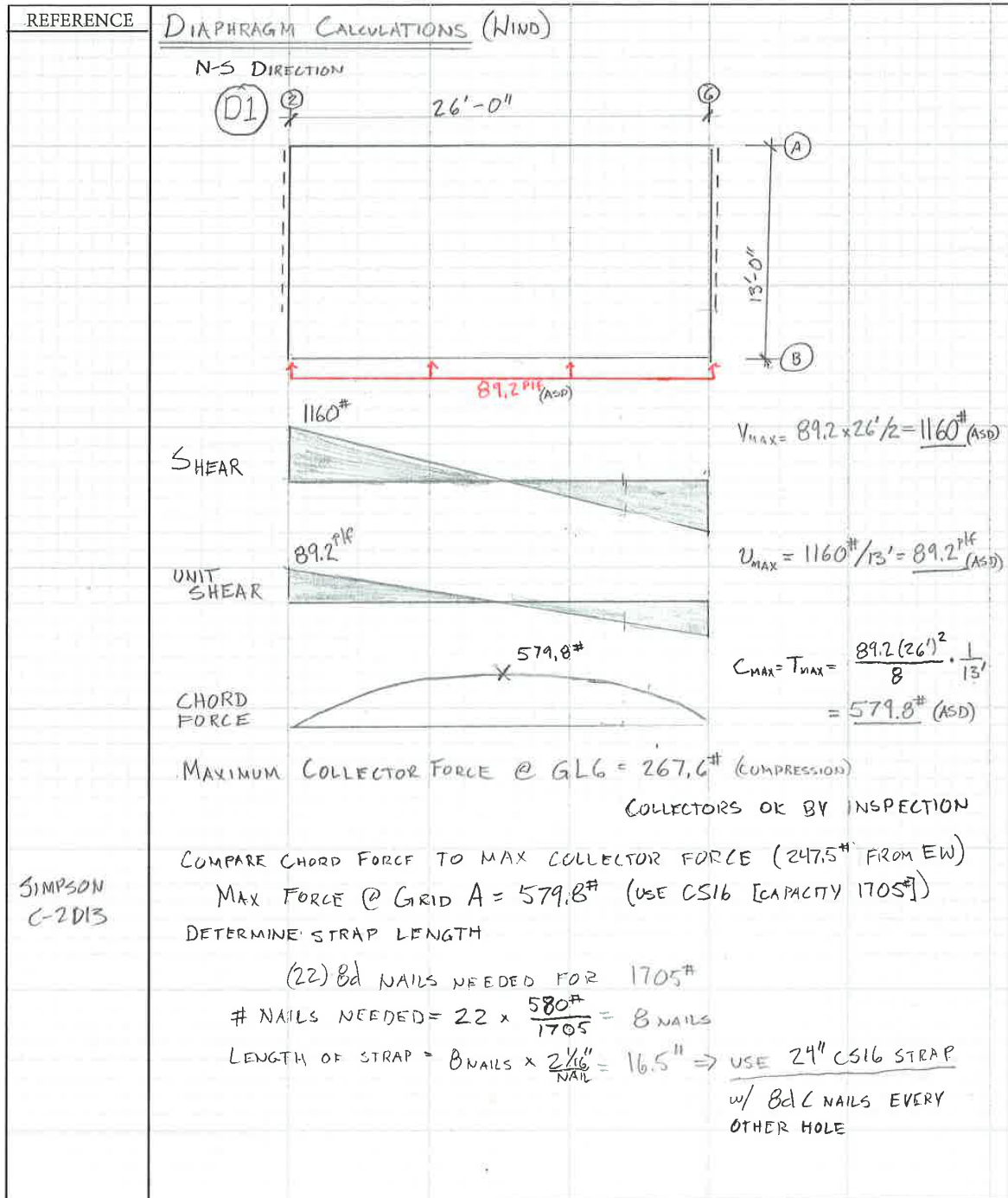
Notes: ASD Load Factor of 0.6 used for wind forces. All forces determined from this load determination are factored.

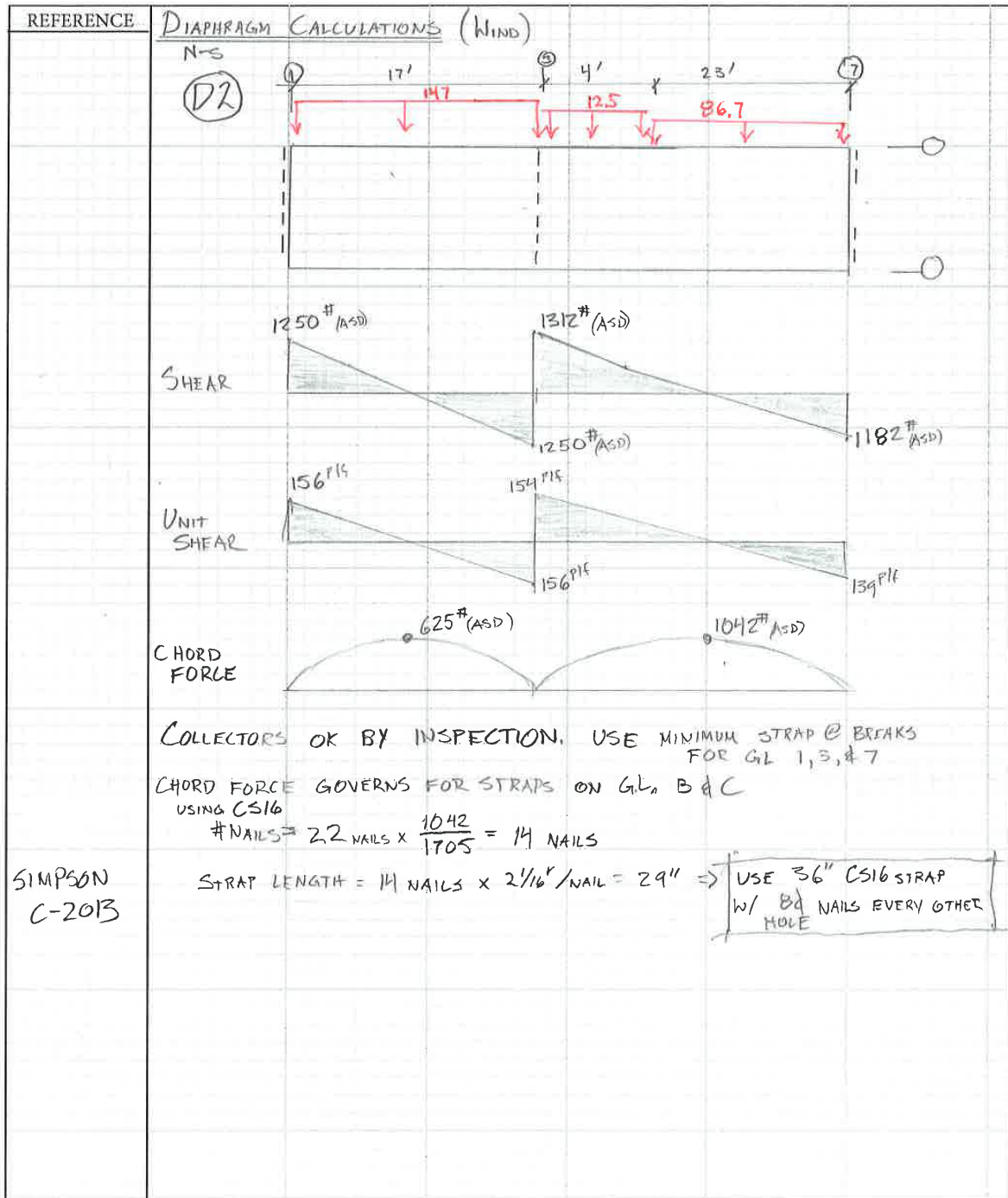
**Wind Diaphragm Loads North/South Direction**

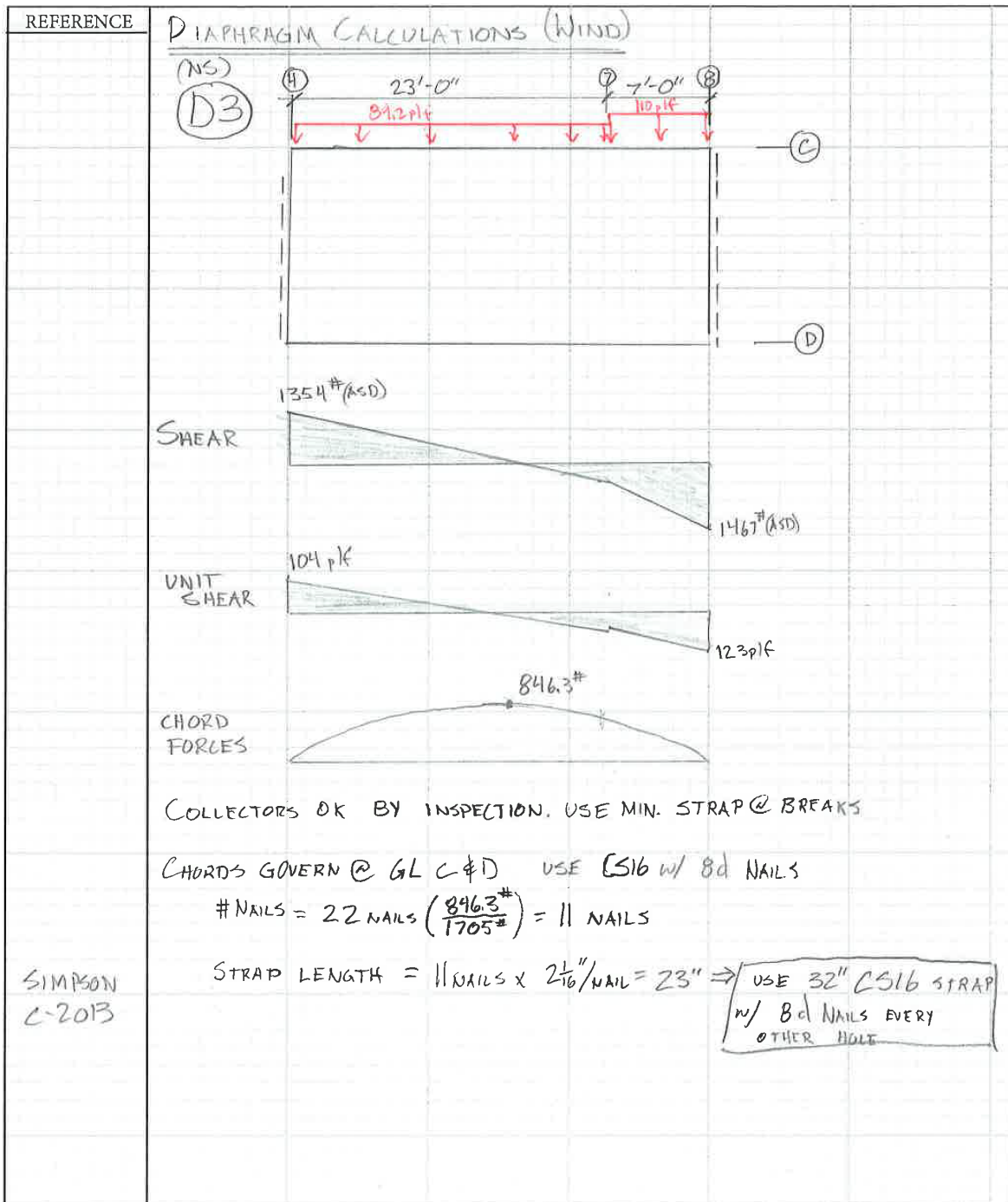
DIAPHRAGM: 3		GRID 4		TO 7	
	Factor	Coeff.	LOAD (psf)	HEIGHT (ft)	
PARAPET	0.6	x	56.7	x 1	= 34 plf
WINDWARD	0.6	x 0.73	x 25.2	x 5	= 55.2 plf
LEEWARD	0.6	x 0.27	x 25.2	x 0	= 0 plf
<b>Total =</b>					<b>89.2 plf</b>

DIAPHRAGM: 3		GRID 7		TO 8	
	Factor	Coeff.	LOAD (psf)	HEIGHT (ft)	
PARAPET	0.6	x	56.7	x 1	= 34 plf
WINDWARD	0.6	x 0.73	x 25.2	x 5	= 55.2 plf
LEEWARD	0.6	x 0.27	x 25.2	x 5	= 20.4 plf
<b>Total =</b>					<b>110 plf</b>

Notes: ASD Load Factor of 0.6 used for wind forces. All forces determined from this load determination are factored.







**Wind Diaphragm Loads East/West Direction**

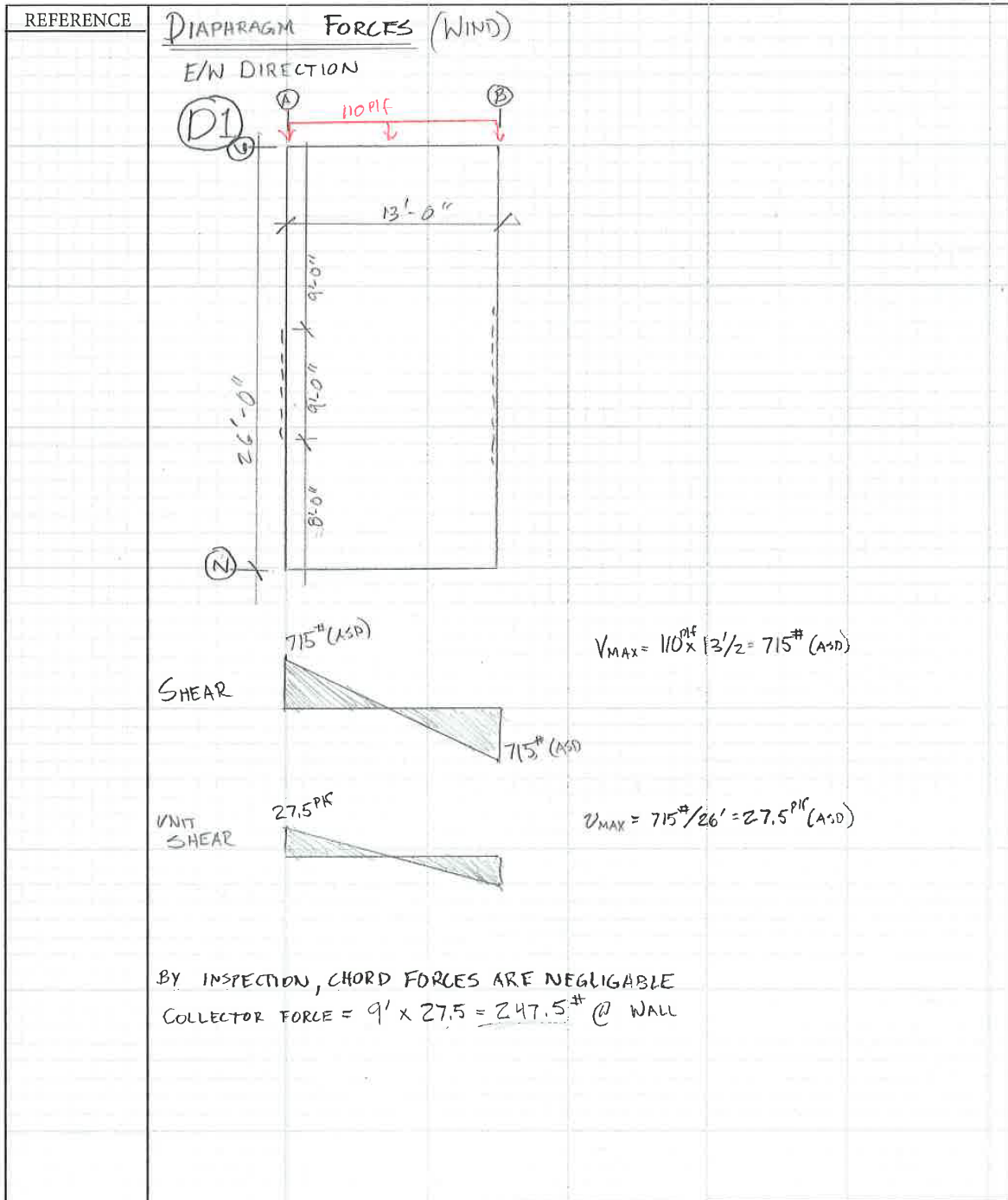
ASCE 7-10 Load Combinations Section 2.4.1  
7. 0.6D+0.6W

DIAPHRAGM: 1		GRID A		TO B	
	Factor	Coeff.	LOAD (psf)		HEIGHT (ft)
PARAPET	0.6	x	56.7	x	1 = 34 plf
WINDWARD	0.6	x 0.66 x	25.2	x	5 = 49.9 plf
LEEWARD	0.6	x 0.34 x	25.2	x	5 = 25.7 plf
<b>Total =</b>					<b>110 plf</b>

DIAPHRAGM: 2		GRID B		TO C	
	Factor	Coeff.	LOAD (psf)		HEIGHT (ft)
PARAPET	0.6	x	56.7	x	1 = 34 plf
WINDWARD	0.6	x 0.66 x	25.2	x	7.5 = 74.8 plf
LEEWARD	0.6	x 0.34 x	25.2	x	7.5 = 38.6 plf
<b>Total =</b>					<b>147 plf</b>

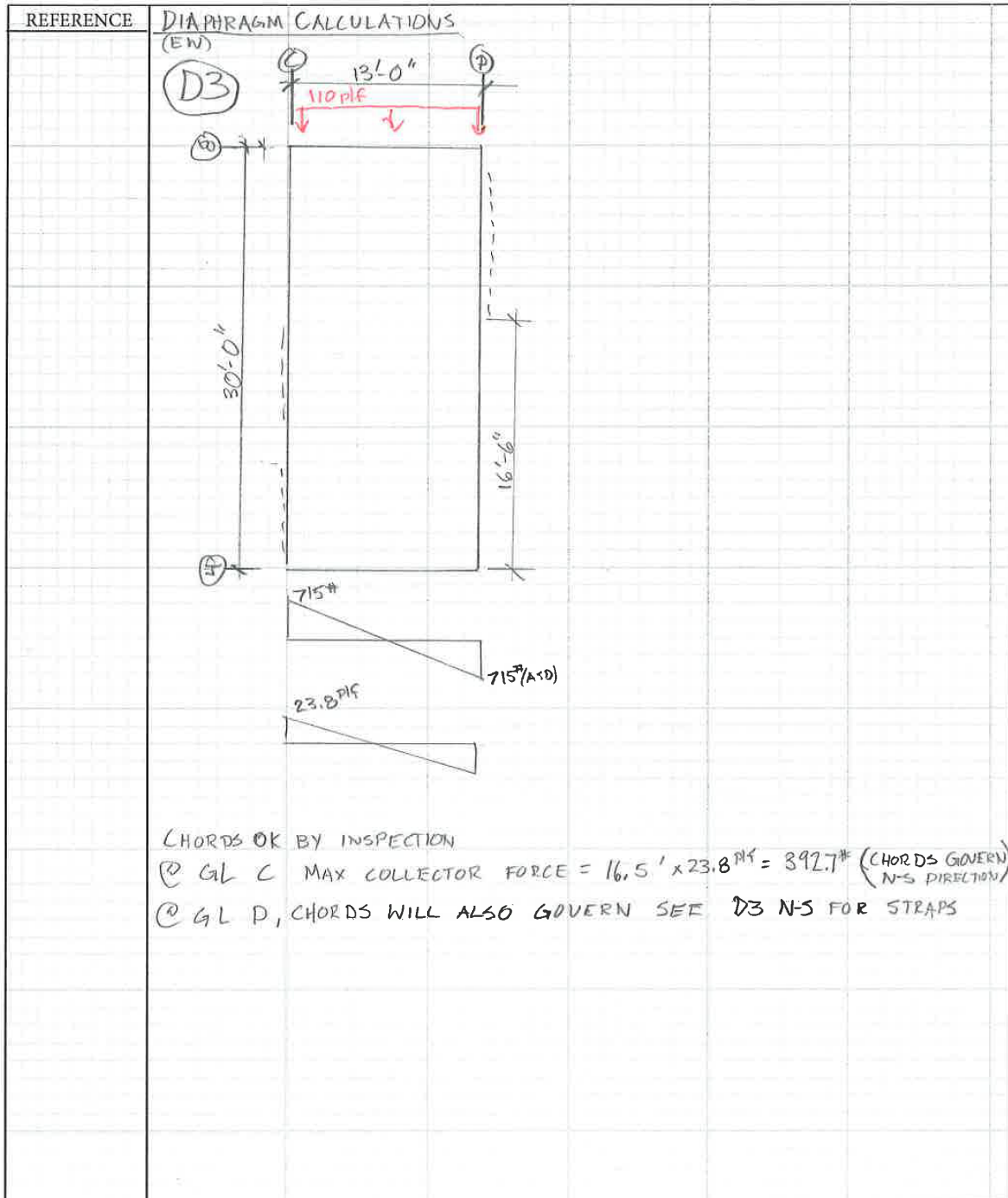
DIAPHRAGM: 3		GRID C		TO D	
	Factor	Coeff.	LOAD (psf)		HEIGHT (ft)
PARAPET	0.6	x	56.7	x	1 = 34 plf
WINDWARD	0.6	x 0.66 x	25.2	x	5 = 49.9 plf
LEEWARD	0.6	x 0.34 x	25.2	x	5 = 25.7 plf
<b>Total =</b>					<b>110 plf</b>

Notes: ASD Load Factor of 0.6 used for wind forces. All forces determined from this load determination are factored.

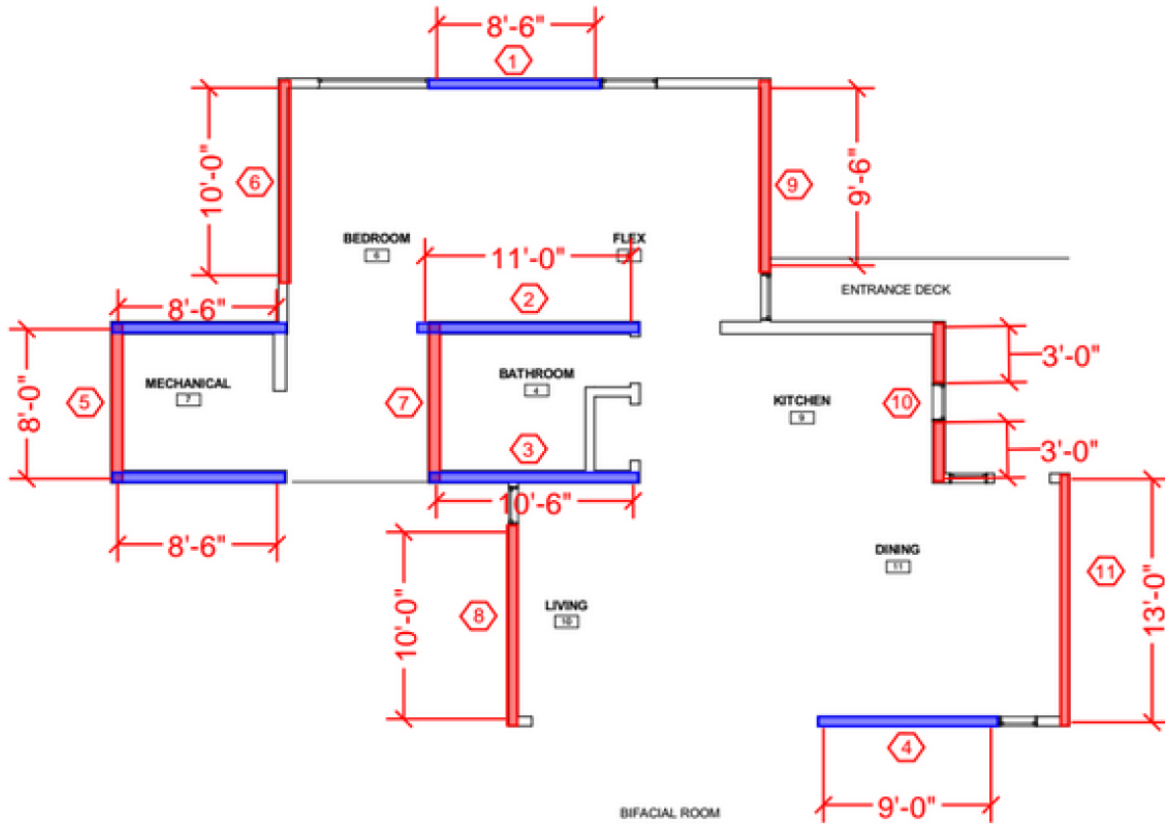


REFERENCE	DIAPHRAGM CALCULATIONS (WIND)
	<p>(D2) (E/W)</p> <p>8'-6"</p> <p>44'-6"</p> <p>6'-2 1/2"</p> <p>SHEAR</p> <p>UNIT SHEAR</p> <p>CHORDS OK BY INSPECTION</p> <p>CHECK COLLECTOR: MAX COLLECT. LENGTH = 23'-6"</p> <p>MAX COLLECT. FORCE = 14# x 23.5' = 329# (NS CHORDS GOVERN. SEE D2 NS FOR STRAPS)</p>





SHEAR WALL KEY



**Wall Loads North/South Direction**

Wall Loads	5 @ MECH		Grid	1
Diaphragm Loads				
	Diaphragm 2			
Grids	1	3		
Type	Seismic	Wind	Seismic	Wind
Load (plf)	25.225	147.42		
Width (ft)	17	17		
Length (ft)	8	8	0	0
Diaphragm Shear (plf)	26.802	156.63	0	0
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	9	" o.c.
Nail Capacity(lbs)	112.64			

**Wall Summary**  
Use 8dC Nails @ 6"oc o/ 7/16" panel one side of Wall  
Use HDU2 Strap to 4x6 #1 post

Wall Calculations		
Length (ft)	11.5	
Load (k)	1.253	
Height (ft)	13	
Wall Wt.	10	
Res. Over	21	
Pt load	0	
Wall Shear	108.9626	
Nailing	8d@6"oc	
Capacity	255	OK
OTM (k-ft)	16.28991	
RM (k-ft)	5.990925	
Uplift (k)	0.936271	
Wall Anchor	HDU2	
Capacity (lbs)	3075	
Stress Ratio	0.304478	
FS	3.284304	OK

Wall Loads	7 @ BATH		Grid	3
Diaphragm Loads				
	Diaphragm 2		Diaphragm 2	
Grids	1	3	3	7
Type	Seismic	Wind	Seismic	Wind
Load (plf)	25.225	147.42	25.2252	86.713
Width (ft)	17	17	27	27
Length (ft)	8	8	8	8
Diaphragm Shear (plf)	26.802	156.63	42.5675	146.33
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	4	" o.c.
Nail Capacity(lbs)	112.64			

**Wall Summary**  
Use 8dC Nails @ 6"oc o/ 7/16" panel one side of Wall  
Use HDU4 Strap to 4x6 #1 post

Wall Calculations		
Length (ft)	8	
Load (k)	2.424	
Height (ft)	13	
Wall Wt. (psf)	10	
Res. Over (plf)	21	
Pt load (K)	0	
Pt load Height (ft)		
Wall Shear (plf)	302.9623	
Nailing	8d@6"oc	
Capacity (plf)	255	OK
OTM (k-ft)	31.50808	
RM (k-ft)	2.8992	
Uplift (k)	3.814517	
Wall Anchor	HDU4	
Capacity (lbs)	4565	
% Stress	84%	
FS	1.20	OK

**Wall Loads North/South Direction**

Wall Loads	8 @ Living Grid				4
ASCE 7-10 Load Combinations Section 2.4.1, Combo 7					
Diaphragm Loads					
	Diaphragm 3				
Grids	4	7			
Type	Seismic	Wind	Seismic	Wind	
Load (plf)	25.333	109.62			
Width (ft)	30	30			
Length (ft)	13	13	0	0	
Diaphragm Shear (plf)	29.23	126.48	0	0	
<b>Wind Governs</b>					
Diaphragm Nailing	8d	@	11	" o.c.	
Nail Capacity(lbs)	112.64				

<b>Wall Summary</b>
Use 8d Common Nails @ 6" oc EA. Side of SIP Panel
Use (2) HDU2 to 4x6 #1 post spline

Wall Calculations		
Length (ft)	10	
Load (k)	1.644	
Height (ft)	10	
Wall Wt. (psf)	8	
Res. Over (plf)	26	
Pt load (K)	0	
Pt load Height (ft)		
Wall Shear (plf)	164.43	
Nailing	8d@6"oc	
Capacity (plf)	510	OK
OTM (k-ft)	16.443	
RM (k-ft)	3.18	
Uplift (k)	1.396105	
Wall Anchor	HDU2	
Capacity (lbs)	3075	
% Stress	45%	
FS	2.20	OK

Wall Loads	11 @ DINING Grid				8
ASCE 7-10 Load Combinations Section 2.4.1, Combo 7					
Diaphragm Loads					
	Diaphragm 2				
Grids	4	7			
Type	Seismic	Wind	Seismic	Wind	
Load (plf)	25.333	109.62			
Width (ft)	30	30			
Length (ft)	13	13			
Diaphragm Shear (plf)	29.23	126.48	0	0	
<b>Wind Governs</b>					
Diaphragm Nailing	8d	@	11	" o.c.	
Nail Capacity(lbs)	112.64				

<b>Wall Summary</b>
Use 8d Common Nails @ 6" oc EA. Side of SIP Panel
Use (2) HDU2 to 4x6 #1 post spline

Wall Calculations		
Length (ft)	13	
Load (k)	1.644	
Height (ft)	10	
Wall Wt. (psf)	8	
Res. Over (plf)	26	
Pt load (K)	0	
Pt load Height (ft)		
Wall Shear (plf)	126.4846	
Nailing	8d@6"oc	
Capacity (plf)	510	OK
OTM (k-ft)	16.443	
RM (k-ft)	5.3742	
Uplift (k)	0.885504	
Wall Anchor	HDU2	
Capacity (lbs)	3075	
% Stress	29%	
FS	3.47	OK

REFERENCE	<h3 style="text-decoration: underline;">SHEAR WALL CALCULATIONS</h3> <p>SHEARWALL @ GL 7 (SHEAR WALL 10)</p> <p>FROM DIAPHRAGM CALCULATIONS WIND GOVERNS FROM D2 NS <math>V_{WALL} = 1182^{\#} ASD</math></p>	
		<p><u>LOADS</u></p> $P_{WALL} = 10^{PSF} \times (13' \times 7' - 2' \times 7') = 770^{\#}$ $P_{PIER} = 10^{PSF} \times 3' \times 7' = 210^{\#}$ $W_D = 21^{PSF} \times 1' = 21^{PIF}$ $W_L = 20^{PSF} \times 1' = 20^{PIF}$ <p><u>WALL VALUES</u></p> <p>7/16" OSB STRUC I w/ 8d NAILS @ 6" OC</p>
NDS 2008 SDPWS T 4.3A	<p><u>SHEAR DEMAND</u></p> $U_{WALL} = \frac{1182^{\#}}{8'} = 147.75^{PIF}$ $U_{PIER} = \left(\frac{1182^{\#}}{2}\right) / 3' = 197^{PIF}$	<p><u>CAPACITY FROM NDS</u></p> $U_5 = 510^{PIF}$ $U_{ASD} = 255^{PIF} \times \frac{2(3')}{7'} = 218.6^{PIF}$ <p>[REDUCTION PER T 4.3.4 NOTE 1]</p> <p style="text-align: center;"><math>U_{PIER} = 197^{PIF} &lt; 218.6^{PIF}</math> (OK)</p>
ASCE 7-10 & 2.4.1	<p><u>OVERTURNING</u></p> <p>LOAD COMBO 7, 0.6D + 0.6W</p> $OTM = \frac{1182^{\#}}{2} \times 7' = 4137^{\#ft}$ $RM = 0.6 \left( \frac{W_D L^2}{2} + \frac{P_L}{2} \right) = 0.6 \left( \frac{21(3)^2}{2} + \frac{210(3)}{2} \right) = 245.7^{\#ft}$ $M_{NET} = 245.7 - 4137^{\#ft} = -3891^{\#ft}$ $T = \frac{3891}{3} = 1297^{\#}$ <p style="text-align: center;">USE NAILING TO POST TO DEVELOPE SHEAR</p> <p style="text-align: center;"><math>1297^{\#} / 112^{\#}_{NAIL} = 11.5 \Rightarrow 12 \text{ NAILS @ } 6" \Rightarrow 70" \text{ NEEDED}</math>  <math>70" = 5.8' \leq 7' \text{ (OK)}</math></p>	

REFERENCE	SHEAR WALL CALCULATIONS
SIMPSON C-2013	<p>SHEAR WALL GL 7 CONT...</p> <p>CHECK GLOBAL OVERTURNING</p> <p>LOAD COMBO 7.0.6D + 0.6W</p> $OTM = 1182^{\#} \times 13' = 15366^{\#ft}$ $RM = 0.6 \left[ \frac{21^{\#} \times 17^2}{2} + \frac{770 \times 7}{2} \right] = 1925.7^{\#ft}$ $M_{NET} = 1925.7 - 15366 = 13440^{\#ft}$ $T = 13440^{\#ft} / 7' = 1920^{\#}$
	<div style="border: 1px solid black; padding: 2px; margin: 5px 0;">USE HDU2 w/ (6) SDS 1/4" x 2 1/2" OUTER POSTS</div> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;">USE CS16 STRAP &amp; BLOCK ACROSS TAB OF WALL PIERS</div> <p>8d NAILS EVERY OTHER HOLE</p>

**Wall Loads East/West Direction**

Wall Loads	1 @ bed		Grid A	
Diaphragm Loads				
	Diaphragm 1			
Grids	A	B		
Type	Seismic	Wind	Seismic	Wind
Load (plf)	43.551	109.62		
Width (ft)	13	13		
Length (ft)	26	26	0	0
Diaphragm Shear (plf)	10.888	27.405	0	0
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	48	" o.c.
Nail Capacity(lbs)	110			

Wall Calculations		
Length (ft)	8.5	
Load (k)	0.713	
Height (ft)	10	
Wall Wt.	8	
Res. Over	42.25	
Pt load	0	
Wall Shear	83.82706	
Nailing	8d@6"oc	
Capacity	510	OK
OTM (k-ft)	7.1253	
RM (k-ft)	2.649769	
Uplift (k)	0.559441	
Wall Anchor	HDU2	
Capacity	3075	
Stress	0.181932	
FS	5.496554	OK

Wall Summary
Use 8d Common Nails @ 6" oc EA. Side of SIP Panel
Use HDU2 Strap to 4x6 #1 post

Wall Loads	2 @ BATH		Grid B	
Diaphragm Loads				
	Diaphragm 1		Diaphragm 2	
Grids	A	B	B	C
Type	Seismic	Wind	Seismic	Wind
Load (plf)	43.551	109.62	110.441	147
Width (ft)	13	13	8	8
Length (ft)	26	26	44	44
Diaphragm Shear (plf)	10.888	27.405	10.0401	13.4
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	32	" o.c.
Nail Capacity(lbs)	110			

Wall Calculations		
Length (ft)	11	
Load (k)	0.713	
Height (ft)	14	
Wall Wt.	10	
Res. Over	84	
Pt load	0.58968	
Pt. Load Ht	10	
Wall Shear	64.77545	
Nailing	8d@6"oc	
Capacity	510	OK
OTM (k-ft)	15.87222	
RM (k-ft)	8.1312	
Uplift (k)	0.73724	
Wall Anchor	HDU2	
Capacity	3075	
Stress	0.239753	
FS	4.170962	OK

Wall Summary
Use 8d Common Nails @ 6" oc EA. Side of SIP Panel
Use HDU2 Strap to 4x6 #1 post

**Wall Loads East/West Direction**

Wall Loads	3 @ Bath		Grid C	
ASCE 7-10 Load Combinations Section 2.4.1, Combo 7				
Diaphragm Loads				
	Diaphragm 2		Diaphragm 3	
Grids	B	C	C	F
Type	Seismic	Wind	Seismic	Wind
Load (plf)	110.44	147.42	49.1568	110
Width (ft)	8	8	13	13
Length (ft)	44	44	30	30
Diaphragm Shear (plf)	10.04	13.402	10.6506	23.8
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	56	" o.c.
Nail Capacity(lbs)	110			

**Wall Summary**  
Use 8dC Nails @ 6"oc o/ 7/16" panel one side of Wall  
Use HDU2 Strap to 4x6 #1 post

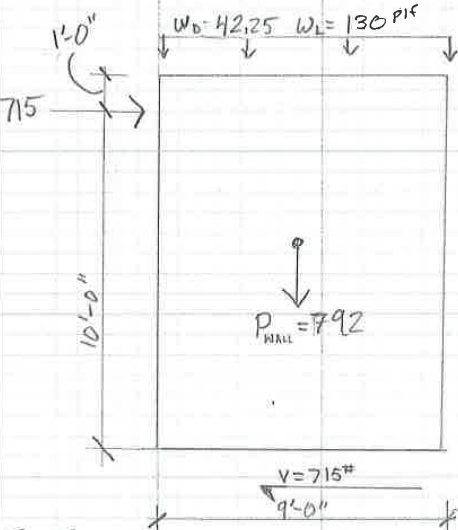
Wall Calculations	
Length (ft)	10.5
Load (k)	0.590
Height (ft)	13
Wall Wt. (psf)	10
Res. Over (plf)	126.25
Pt load (K)	0.71253
Pt load Height (ft)	10
Wall Shear (plf)	56.16
Nailing	8d@6"oc
Capacity (plf)	255 <b>OK</b>
OTM (k-ft)	14.79114
RM (k-ft)	8.475469
Uplift (k)	0.631567
Wall Anchor	HDU2
Capacity (lbs)	3075
% Stress	21%
FS	4.87 <b>OK</b>

Wall Loads	4 @ Dining		Grid D	
ASCE 7-10 Load Combinations Section 2.4.1, Combo 7				
Diaphragm Loads				
	Diaphragm 3			
Grids	C	D		
Type	Seismic	Wind	Seismic	Wind
Load (plf)	49.157	109.62		
Width (ft)	13	13		
Length (ft)	30	30	0	0
Diaphragm Shear (plf)	10.651	23.751	0	0
<b>Wind Governs</b>				
Diaphragm Nailing	8d	@	56	" o.c.
Nail Capacity(lbs)	110			

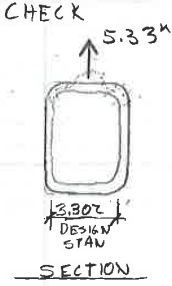
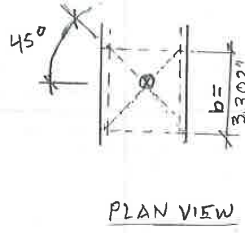
**Wall Summary**  
Use 8d Common Nails @ 6" oc EA. Side of SIP Panel  
Use HDU2 Strap to 4x6 #1 post

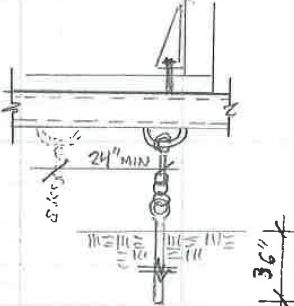
Wall Calculations	
Length (ft)	9
Load (k)	0.713
Height (ft)	10
Wall Wt. (psf)	8
Res. Over (plf)	42.25
Pt load (K)	0
Pt load Height (ft)	0
Wall Shear (plf)	79.17
Nailing	8d@6"oc
Capacity (plf)	510 <b>OK</b>
OTM (k-ft)	7.1253
RM (k-ft)	3.165075
Uplift (k)	0.465909
Wall Anchor	HDU2
Capacity (lbs)	3075
% Stress	15%
FS	6.60 <b>OK</b>



REFERENCE	SHEAR WALL CALCULATIONS
	<p>SAMPLE HAND CALCULATION PROVIDED TO SHOW PROCESS. SEE SPREADSHEET OUTPUT FOR REMAINING WALL DESIGNS.</p> <p>SHEARWALL @ GL "D" (SHEAR WALL 4)</p> <p>FROM DIAPHRAGM CALCULATIONS, WIND GOVERNS.</p> <p>FROM DEW, <math>V_{WALL} = 715 \#</math> (ASD)</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">  </div> <div style="width: 45%;"> <p><u>WALL LOADS</u></p> <p><math>P_{WALL} = 2 \text{ PSF} \times 9' \times 11' = 792 \#</math></p> <p><math>W_D = 13 \text{ PSF} \times 3.25' = 42.25 \text{ pif}</math></p> <p><math>W_L = 20 \text{ PSF} \times \frac{13'}{2} = 130 \text{ pif}</math></p> <p><math>V = 715 \#</math> (ASD)</p> <p><u>WALL VALUES</u></p> <p>7/16" OSB STRUC I w/ 8d NAILS @ 6" OC (2-SIDED FOR SIP WALLS)</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <p><u>SHEAR DEMAND</u></p> <p><math>V_{WALL} = 715 \# / (9' - 0.5') = 84.1 \text{ pif}</math> (ASD)</p> </div> <div style="width: 45%;"> <p><u>CAPACITY</u></p> <p>FROM NDS <math>V_s = 510 \text{ pif}</math> PER SIDE</p> <p><math>V_{ASD} = 255 \text{ pif}</math> PER SIDE</p> <p>o.c. <math>V_{ASD} = 510 \text{ pif}</math></p> </div> </div> <p style="text-align: center; margin-top: 10px;"><math>V_{WALL} = 84.1 \text{ pif} &lt; 510 \text{ pif}</math> (OK)</p>
<p>ASCE 7-10 §2.4.1</p>	<p><u>OVERTURNING</u></p> <p>LOAD COMBINATION 7. 0.6D + 0.6W</p> <p><math>OTM = 715 \# \times 10' = 7150 \# \text{ft}</math></p> <p><math>RM = 0.6 \left( \frac{W_D L^2}{2} + P_{WALL} \times \frac{L}{2} \right) = 0.6 \left( \frac{42.25 (9')^2}{2} + 792 \# \left( \frac{9}{2} \right) \right) = 3165</math></p> <p><math>M_{NET} = 3165 - 7150 = -3985 \# \text{ft}</math></p>
<p>SIMPSON C-2013</p>	<p><math>UPLIFT = M_{NET} / L = 3985 \# \text{ft} / 8.5' = 469 \#</math> UPLIFT</p> <p>USE HDU2 w/ (6) SDS 1/4 x 2 1/2" [CAP. = 3075]</p>

REFERENCE	SHEAR WALL CALCULATIONS
	<p><u>SHEARWALL GL "D" CONTINUED</u></p> <p>CHECK COMPRESSION</p> <p>LOAD COMBINATION 6a. <math>D + 0.75L + 0.75(0.6W) + 0.75L_r</math></p> $OTM_E = 0.75(715\# \times 10') = 5363\#ft$ $OTM_{DHL} = \left(\frac{W_D L^2}{2} + P_{HULL} \frac{L}{2}\right) + \left(\frac{W_r L^2}{2}\right) \times 0.75$ $= \left(\frac{4225(9')^2}{2} + 712\left(\frac{9}{2}\right)\right) + \frac{130(9')^2}{2} \times 0.75 = 9223\#ft$ $C = (5363 + 9223) / (8.5) = 1716\#$ <p>LOAD COMBINATION 5. <math>D + 0.6W</math></p> $OTM_E = 7150\#ft$ $OTM_D = \left(\frac{W_D L^2}{2} + P_{HULL} \frac{L}{2}\right) = 5275\#ft$ $C = (7150 + 5275) / 8.5 = 1462\#$ <p>CHECK <math>F_{c\perp}</math></p> <p>NDS TABLE 4A FROM NDS <math>F_{c\perp} = 625\text{ psi}</math></p> <p>BEARING AREA = <math>1.5' \times 5.5' = 8.25\text{ sq ft}</math> (2x6 NOMINAL)</p> <p>DEMAND <math>f_{c\perp} = 1716\# / 8.25 = 208\text{ psi}</math></p> $F_{c\perp}' = 1.6 \times 625 = 1000\text{ psi} > 208\text{ psi} \quad \text{OK}$

REFERENCE	
	<p><u>WALL ANCHORAGE TO FLOOR FRAME</u></p> <p>MAX UPLIFT: <math>3.81^k \uparrow</math> (ASD) <math>\Rightarrow</math> <math>5.33^k \uparrow</math> (LRFD)</p> <p><u>DESIGN HSS FLANGES FOR BENDING</u></p> <p>USING 4x6 SECTION</p> <p>TRY HSS 6x4 x 3/8</p>
<p>AISC 341-10 T1-11</p>	<p>OVERALL WIDTH = 4" CORNER RADIUS = <math>2t_{dc} = 2(0.349") = 0.698</math> FLEXURAL SPAN = <math>4" - 0.698" = 3.302"</math></p> <p>CHECK</p>  
<p>AISC 341-10 T1-11</p>	<p><u>DEMAND</u></p> $M_u = \frac{PL}{8} = \frac{5.33^k(3.302')}{8} \quad [\text{ASSUMED FIXED-FIXED SUPPORT}]$ $M_u = 2.2 \text{ k-in}$ <p><u>CAPACITY</u></p> $M_n = F_y S_x = 46 \text{ ksi} \times \frac{(3.302')(\frac{3}{8})^2}{6} = 3.56 \text{ k-in}$ $\phi M_n = 0.9(3.56 \text{ k-in})$ $\phi M_n = 3.20 \text{ k-in}$ $M_u = 2.2 \text{ k-in} \geq \phi M_n = 3.20 \text{ k-in} \quad \text{OK}$ <p><u>USE HSS 6x4 x 3/8</u></p>

REFERENCE	<u>SOIL ANCHORAGE</u>
2015 SDC BC §5-5c	<p>PER 2015 SD BUILDING CODE w/ 1" <math>\phi</math> A36 ATR w/ 36" EMBED, CAPACITY UPLIFT = 1250#</p>
	<p>PER SHEAR WALL CALCULATIONS: <u>N/S</u></p>
	<p>WALL 5 &amp; 11 NET UPLIFT &lt; 1250#</p>
	<p>⇒ USE (1) SOIL ANCHOR w/ D-RING &amp; CHAIN BLW HSS @ HOLD DOWNS</p>
	
	<p>WALL 7 &amp; 8 NET UPLIFT &gt; 1250#</p>
@Wall 8	<p>USE (2) SOIL ANCHORS    TO WALL w/ D-RING &amp; CHAIN BLW HSS @ HDs SPACED @ 24" APART MIN</p>
@Wall 7	<p>USE (4) SOIL ANCHORS ⊥ TO WALL w/ D-RING &amp; CHAIN BLW HSS @ HDs SPACED @ 24" APART MIN</p>
<u>E/W</u>	
	<p>ALL E/W WALLS HAVE NET UPLIFT &lt; 1250#</p>
	<p>⇒ USE (1) SOIL ANCHOR w/ D-RING &amp; CHAIN BLW HSS @ HDs</p>

11/10/2014

Design Maps Summary Report

## Design Maps Summary Report

### User-Specified Input

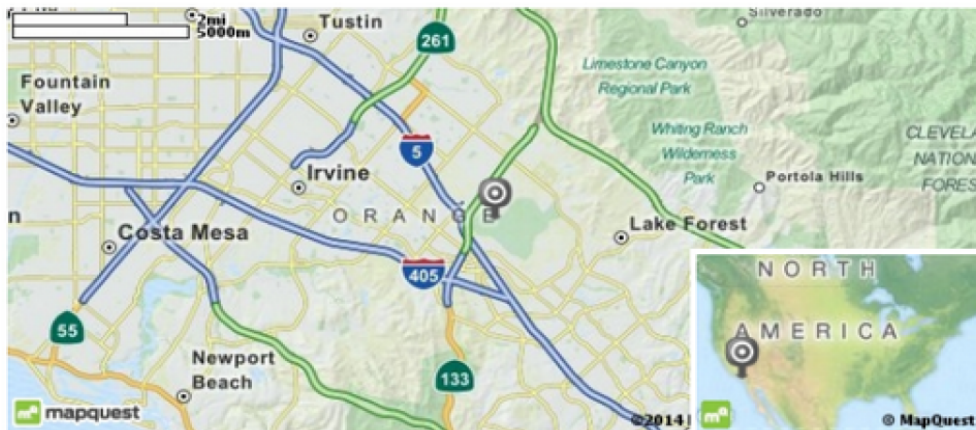
**Report Title** Solar Decathlon  
Tue November 11, 2014 04:41:41 UTC

**Building Code Reference Document** ASCE 7-10 Standard  
(which utilizes USGS hazard data available in 2008)

**Site Coordinates** 33.67368°N, 117.74187°W

**Site Soil Classification** Site Class D - "Stiff Soil"

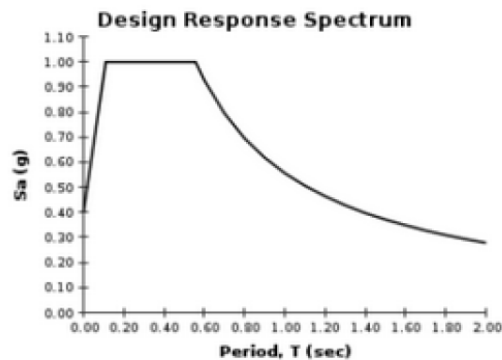
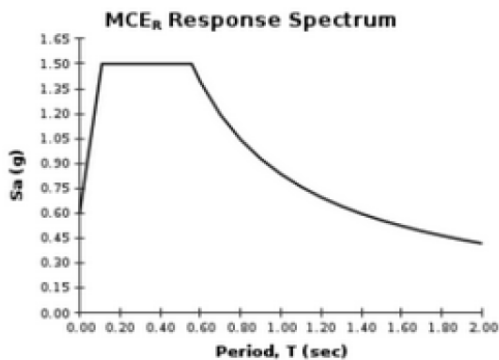
**Risk Category** I/II/III



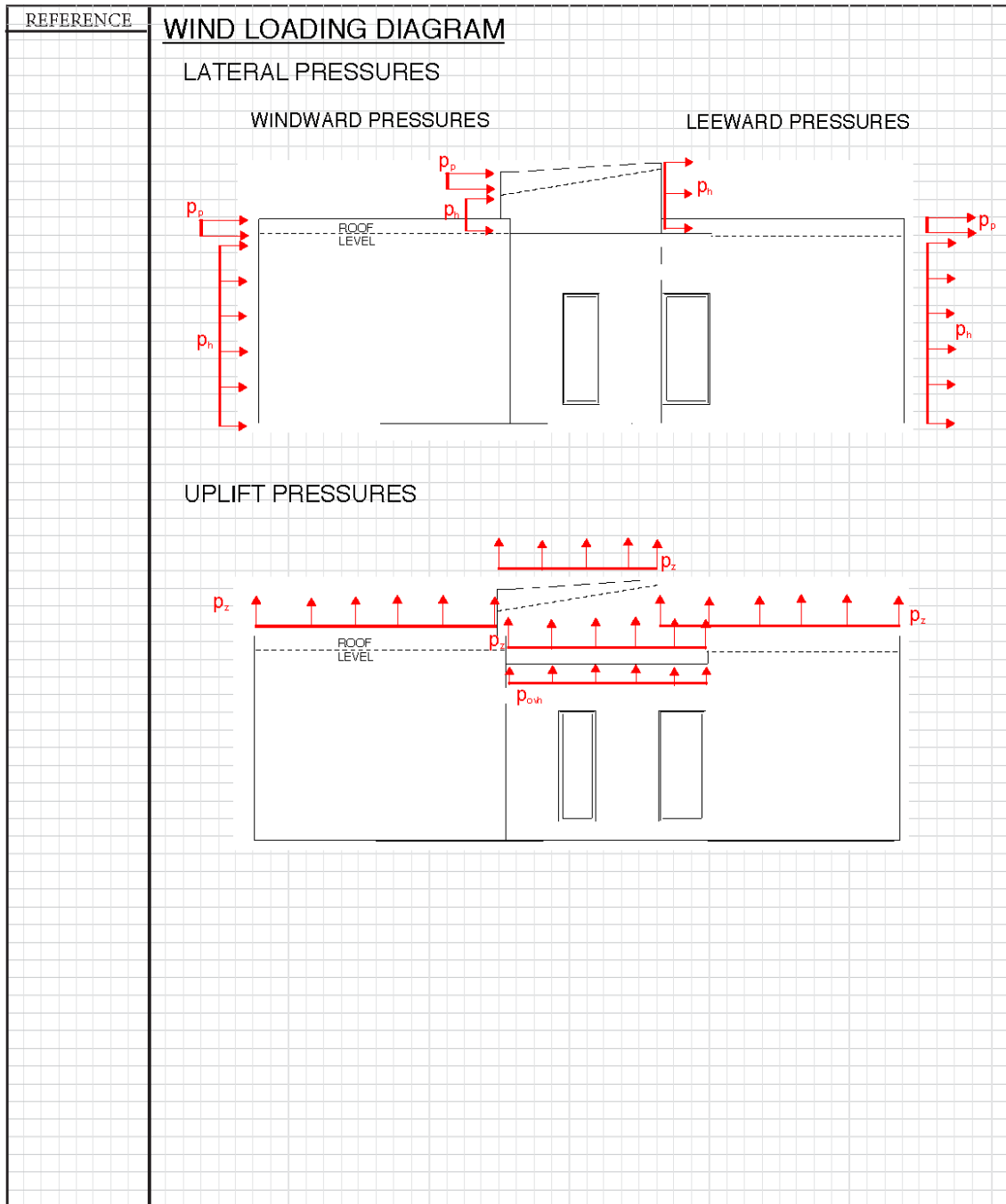
### USGS-Provided Output

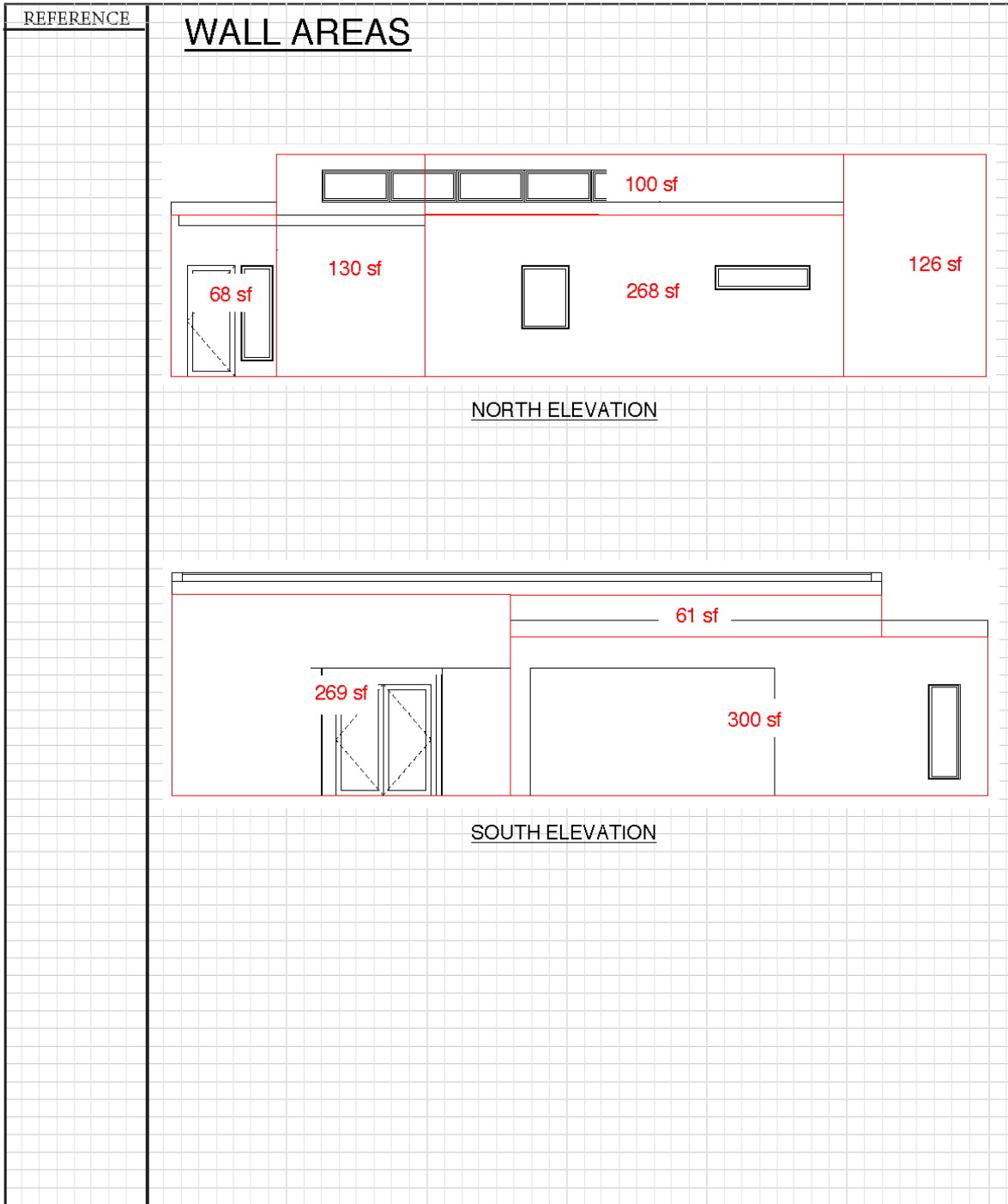
$S_S = 1.499 \text{ g}$	$S_{MS} = 1.499 \text{ g}$	$S_{DS} = 0.999 \text{ g}$
$S_1 = 0.556 \text{ g}$	$S_{M1} = 0.835 \text{ g}$	$S_{D1} = 0.556 \text{ g}$

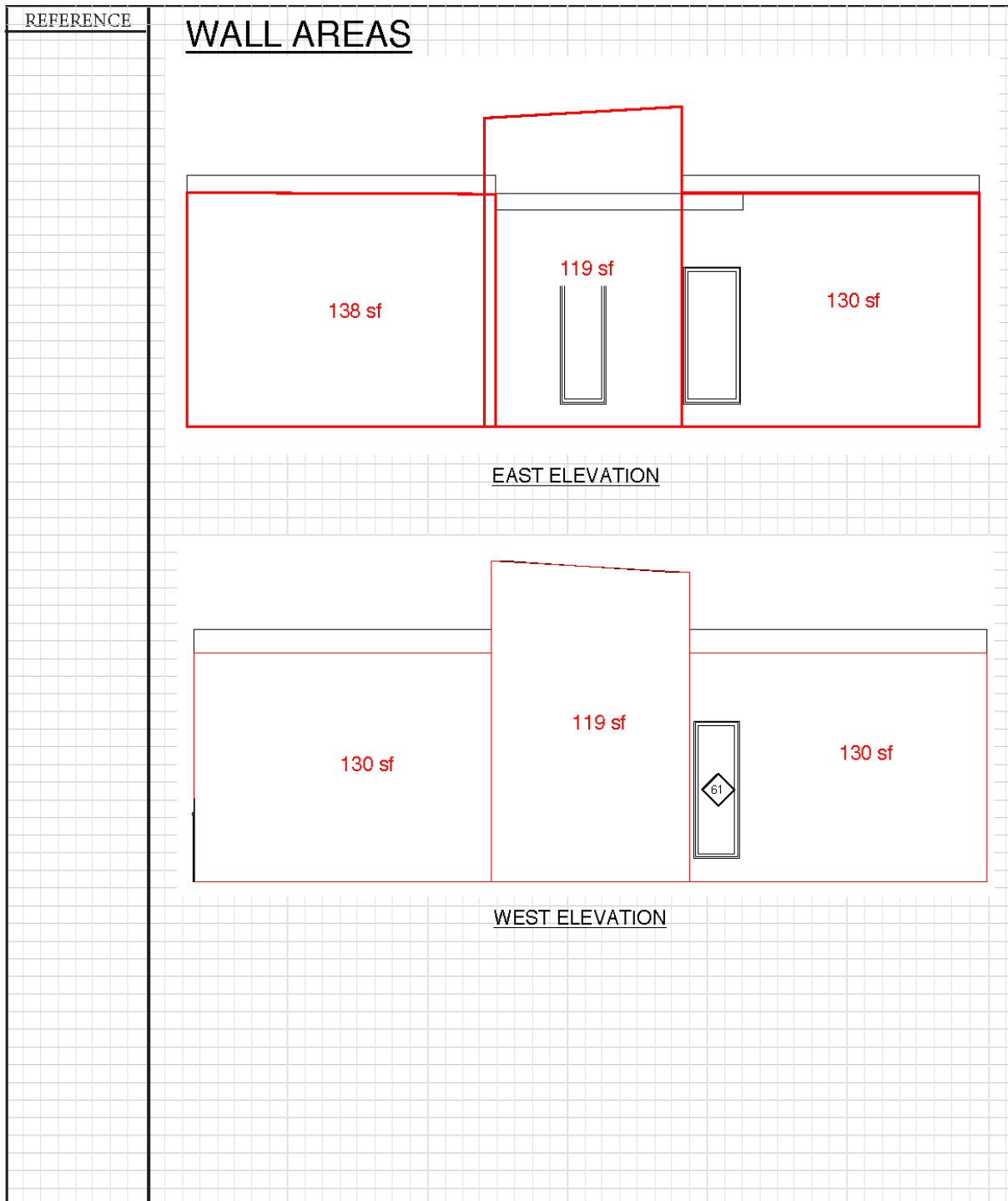
For information on how the  $S_S$  and  $S_1$  values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.



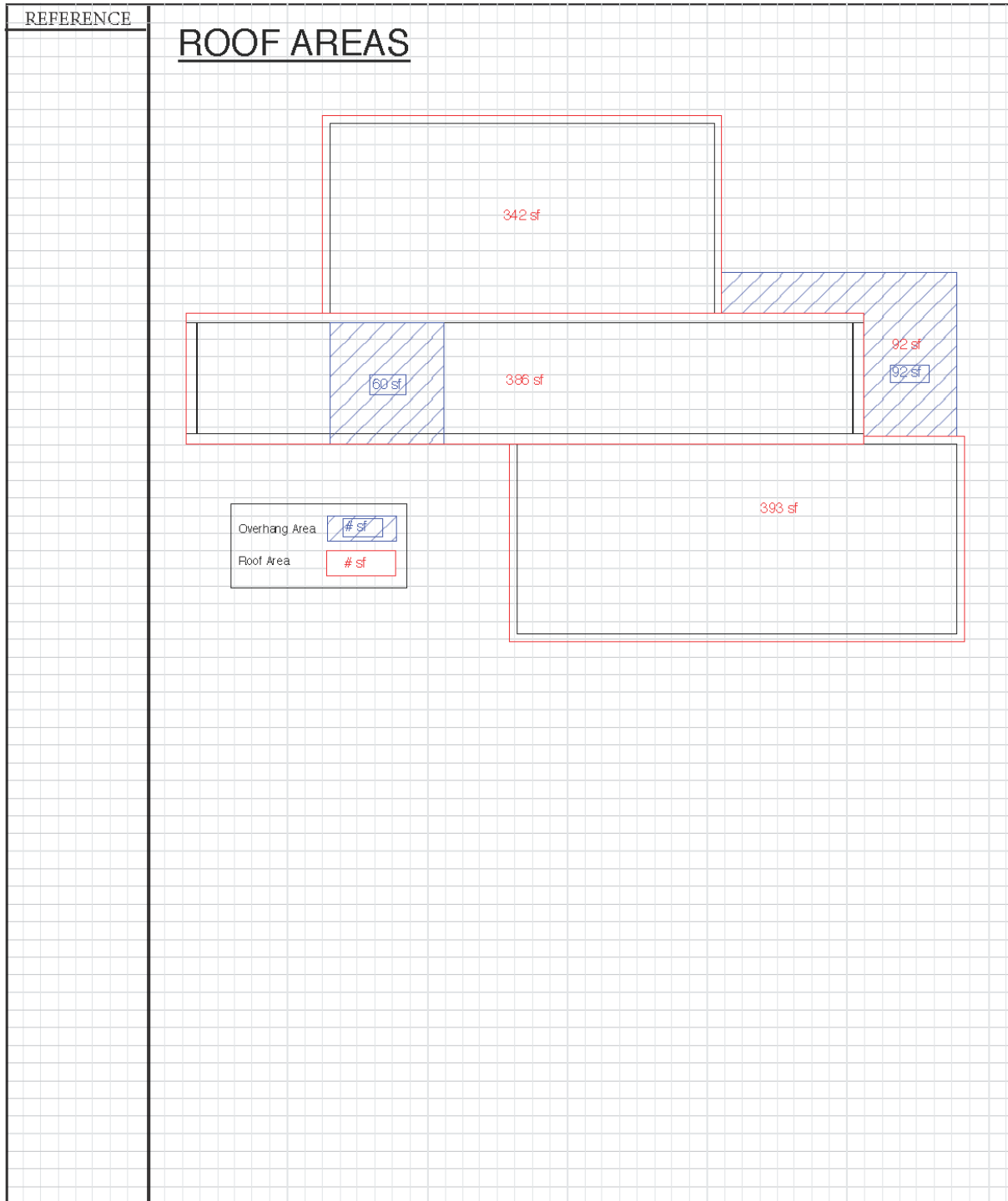
For  $PGA_{hr}$ ,  $T_L$ ,  $C_{RS}$ , and  $C_{R1}$  values, please [view the detailed report](#).











REFERENCE	ICC-ES EVALUATION REPORT, ESR-2233																																																																																																																																																																						
PAGE 6	<p style="text-align: center;"><b>TABLE 3—ALLOWABLE AXIAL LOAD FOR R-CONTROL SIP WALLS<sup>1,2,3,4,5,6</sup> (plf)</b> (See Detail SIP-101c)</p> <table border="1"> <thead> <tr> <th>SIP HEIGHT (ft.)</th> <th>4 1/2 INCH THICK</th> <th>6 1/2 INCH THICK</th> <th>8 1/4 INCH THICK</th> </tr> </thead> <tbody> <tr> <td>8 WAB<sup>7</sup></td> <td>2,300</td> <td>2,400</td> <td>2,400</td> </tr> <tr> <td>8</td> <td>2,750</td> <td>4,000</td> <td>4,000</td> </tr> <tr> <td>10</td> <td>2,500</td> <td>3,500</td> <td>3,500</td> </tr> <tr> <td>12</td> <td>2,000</td> <td>3,000</td> <td>3,000</td> </tr> <tr> <td>14</td> <td>-</td> <td>2,750</td> <td>2,750</td> </tr> <tr> <td>16</td> <td>-</td> <td>2,500</td> <td>2,500</td> </tr> </tbody> </table>	SIP HEIGHT (ft.)	4 1/2 INCH THICK	6 1/2 INCH THICK	8 1/4 INCH THICK	8 WAB <sup>7</sup>	2,300	2,400	2,400	8	2,750	4,000	4,000	10	2,500	3,500	3,500	12	2,000	3,000	3,000	14	-	2,750	2,750	16	-	2,500	2,500																																																																																																																																										
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PAGE 8	<p style="text-align: center;"><b>TABLE 7—ALLOWABLE TRANSVERSE LOAD FOR R-CONTROL SIP, FLOORS AND ROOFS WITH DOUBLE 2x WOOD MEMBER SPLINES<sup>1,2,3,4,5,6</sup> (psf)</b></p> <table border="1"> <thead> <tr> <th rowspan="2">SIP THICKNESS (in.)</th> <th rowspan="2">LIMITS</th> <th colspan="8">PANEL SPAN (ft.)</th> </tr> <tr> <th>10</th> <th>12</th> <th>14</th> <th>16</th> <th>18</th> <th>20</th> <th>22</th> <th>24</th> </tr> </thead> <tbody> <tr> <td rowspan="4">6 1/2</td> <td>L<sub>360</sub></td> <td>53</td> <td>40</td> <td>30</td> <td>24</td> <td>19</td> <td>15</td> <td>—</td> <td>—</td> </tr> <tr> <td>L<sub>240</sub></td> <td>79</td> <td>58</td> <td>45</td> <td>35</td> <td>28</td> <td>22</td> <td>—</td> <td>—</td> </tr> <tr> <td>L<sub>180</sub></td> <td>105</td> <td>79</td> <td>60</td> <td>47</td> <td>37</td> <td>30</td> <td>—</td> <td>—</td> </tr> <tr> <td>Strength</td> <td>105</td> <td>88</td> <td>75</td> <td>66</td> <td>59</td> <td>51</td> <td>—</td> <td>—</td> </tr> <tr> <td rowspan="4">8 1/4</td> <td>L<sub>360</sub></td> <td>89</td> <td>65</td> <td>48</td> <td>37</td> <td>28</td> <td>22</td> <td>—</td> <td>—</td> </tr> <tr> <td>L<sub>240</sub></td> <td>109</td> <td>91</td> <td>72</td> <td>55</td> <td>42</td> <td>33</td> <td>—</td> <td>—</td> </tr> <tr> <td>L<sub>180</sub></td> <td>109</td> <td>91</td> <td>78</td> <td>68</td> <td>57</td> <td>44</td> <td>—</td> <td>—</td> </tr> <tr> <td>Strength</td> <td>109</td> <td>91</td> <td>78</td> <td>68</td> <td>60</td> <td>54</td> <td>—</td> <td>—</td> </tr> <tr> <td rowspan="4">10 1/4</td> <td>L<sub>360</sub></td> <td>150</td> <td>111</td> <td>84</td> <td>65</td> <td>51</td> <td>41</td> <td>33</td> <td>27</td> </tr> <tr> <td>L<sub>240</sub></td> <td>174</td> <td>145</td> <td>124</td> <td>98</td> <td>77</td> <td>61</td> <td>49</td> <td>40</td> </tr> <tr> <td>L<sub>180</sub></td> <td>174</td> <td>145</td> <td>124</td> <td>109</td> <td>87</td> <td>82</td> <td>66</td> <td>54</td> </tr> <tr> <td>Strength</td> <td>174</td> <td>145</td> <td>124</td> <td>109</td> <td>87</td> <td>87</td> <td>79</td> <td>73</td> </tr> <tr> <td rowspan="4">12 1/4</td> <td>L<sub>360</sub></td> <td>177</td> <td>148</td> <td>115</td> <td>89</td> <td>70</td> <td>56</td> <td>45</td> <td>37</td> </tr> <tr> <td>L<sub>240</sub></td> <td>177</td> <td>148</td> <td>127</td> <td>111</td> <td>99</td> <td>84</td> <td>68</td> <td>55</td> </tr> <tr> <td>L<sub>180</sub></td> <td>177</td> <td>148</td> <td>127</td> <td>111</td> <td>99</td> <td>89</td> <td>81</td> <td>74</td> </tr> <tr> <td>Strength</td> <td>177</td> <td>148</td> <td>127</td> <td>111</td> <td>99</td> <td>89</td> <td>81</td> <td>74</td> </tr> </tbody> </table>	SIP THICKNESS (in.)	LIMITS	PANEL SPAN (ft.)								10	12	14	16	18	20	22	24	6 1/2	L <sub>360</sub>	53	40	30	24	19	15	—	—	L <sub>240</sub>	79	58	45	35	28	22	—	—	L <sub>180</sub>	105	79	60	47	37	30	—	—	Strength	105	88	75	66	59	51	—	—	8 1/4	L <sub>360</sub>	89	65	48	37	28	22	—	—	L <sub>240</sub>	109	91	72	55	42	33	—	—	L <sub>180</sub>	109	91	78	68	57	44	—	—	Strength	109	91	78	68	60	54	—	—	10 1/4	L <sub>360</sub>	150	111	84	65	51	41	33	27	L <sub>240</sub>	174	145	124	98	77	61	49	40	L <sub>180</sub>	174	145	124	109	87	82	66	54	Strength	174	145	124	109	87	87	79	73	12 1/4	L <sub>360</sub>	177	148	115	89	70	56	45	37	L <sub>240</sub>	177	148	127	111	99	84	68	55	L <sub>180</sub>	177	148	127	111	99	89	81	74	Strength	177	148	127	111	99	89	81	74
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DESIGNATION-		600S200-54		Specification Sheet SSMA					
Galvanization	G60	Design Thickness	0.0366 in						
Web	6 in	Yield Strength	50 KSI						
Flange	2 in	Mils	54 Mils						
Weight	2.090 Lb/ft	Gauge	16						
<b>Section Properties</b>									
<i>Gross Section Properties</i>									
Cross Sectional Area	A	0.613 in <sup>2</sup>							
Moment of Inertia about the X-X axis	I <sub>xx</sub>	3.319 in <sup>4</sup>							
Radius of Inertia about the X-X axis	R <sub>x</sub>	2.327 in							
Moment of Inertia about the Y-Y axis	I <sub>yy</sub>	0.328 in <sup>4</sup>							
Radius of Gyration about the Y-Y axis	R <sub>y</sub>	0.732 in							
<i>Torsional Section Properties</i>									
Distance from Shear Center to Neutral Axis	X <sub>0</sub>	-1.432 in							
St. Venant Torsion Constant	J x 1000	0.655 in <sup>4</sup>							
Warping Constant	C <sub>w</sub>	2.493 in <sup>6</sup>							
Radius of Gyration	R <sub>0</sub>	2.829 in							
Torsional Flexural Constant	β	0.744							
<i>Effective Section Properties</i>									
Moment of Inertia about the X-X Axis	I <sub>xx</sub>	3.319 in <sup>4</sup>							
Effective Section Modulus about the X-X Axis	S <sub>x</sub>	1.015 in <sup>3</sup>							
Allowable Bending Moment	M <sub>a</sub>	30.400 in-k							
<b>Structural Limiting Heights</b>									
Spacing o.c. (in)	5 psf			15 psf			20 psf		
	L/120	L/240	L/360	L/240	L/360	L/600	L/240	L/360	L/600
12	44' 4"	35' 2"	30' 9"	27' 6"	24' 0"	20' 3"	24' 11"	21' 10"	18' 5"
16	40' 3"	32' 0"	27' 11"	24' 11"	21' 10"	18' 5"	22' 8"	19' 10"	16' 8"
24	35' 2"	27' 11"	24' 5"	21' 10"	19' 1"	16' 1"	19' 2"	17' 4"	14' 7"
Spacing o.c. (in)	25 psf			30 psf			35 psf		
	L/240	L/360	L/600	L/240	L/360	L/600	L/240	L/360	L/600
12	23' 2"	20' 3"	17' 1"	21' 10"	19' 1"	16' 1"	20' 6"	18' 1"	15' 3"
16	21' 0"	18' 5"	15' 6"	19' 2"	17' 4"	14' 7"	17' 9"	16' 5"	13' 10"
24	17' 2"	16' 1"	13' 7"	15' 8"	15' 1"	12' 9"	14' 6"	14' 4"	12' 1"
Spacing o.c. (in)	40 psf			50 psf					
	L/240	L/360	L/600	L/240	L/360	L/600			
12	19' 2"	17' 4"	14' 7"	17' 2"	16' 1"	13' 7"			
16	16' 7"	15' 9"	13' 5"	14' 10"	14' 7"	12' 4"			
24	13' 7"	13' 7"	11' 7"	12' 2"	12' 2"	10' 9"			
<b>Composite Table Notes:</b>									
1. Lateral loads have not been modified for strength checks; full loads are applied.									
2. 15 psf and higher wind pressures have been multiplied by 0.7 for deflection determination, in accordance with footnote "F" of IBC table 1604.3. The 5 psf pressure has not been reduced for deflection checks.									
3. For banding, studs are assumed to be adequately braced to develop full allowable moment.									
4. Stud distortional buckling based on an assumed K <sub>f</sub> = 0.									
5. Web crippling check based on 1 inch end bearing.									
6. Limiting heights are based on steel properties only (non-composite).									
7. End shear and web crippling capacity have not been reduced for punch-outs. Punch-outs are assumed to be in accordance with section C3 of AISI S201.									
8. Moment of inertia for deflection is optimized based on the maximum moment at service loads for the listed spans; therefore, span values may be greater than spans based on an effective moment of inertia listed in section property tables.									

Steel Construction Systems Corporation ("Steel Construction Systems") Disclaimer: All data, specifications and detail contained in this publication are intended as a general guide for using Steel Construction Systems' products. These products should not be used in design or construction without an independent evaluation by a qualified engineer or architect. Steel Construction Systems assumes no liability for failure resulting from the use or misapplication. Steel Construction Systems reserves the right to make modifications and/or change materials of any of their products without prior notice or obligation.

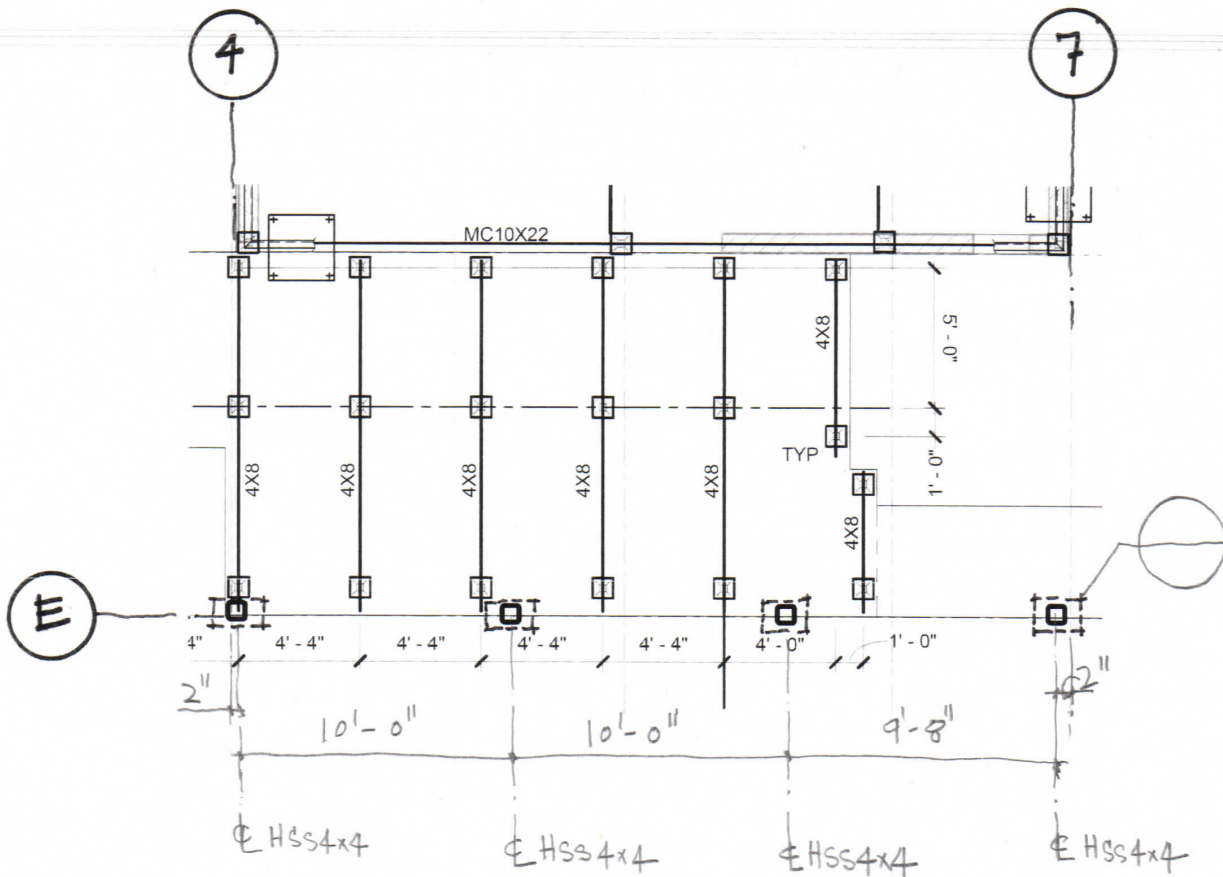
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	<p><i>Table 1.1- Dimensional Lumber Properties and Allowables</i></p> <table border="1"> <thead> <tr> <th>Typ Member Design Parameter (psi)</th> <th><math>F_b</math></th> <th><math>F_v</math></th> <th><math>F_c</math></th> <th>E</th> </tr> </thead> <tbody> <tr> <td>Douglas Fir-Larch #1 (2" &amp; 4")</td> <td>1000</td> <td>180</td> <td>1500</td> <td>1700000</td> </tr> <tr> <td>Douglas Fir-Larch #2 (2" &amp; 4")</td> <td>900</td> <td>180</td> <td>1350</td> <td>1600000</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th rowspan="2">Size</th> <th colspan="2">Dressed size</th> <th>Section Area</th> <th>Section Modulus</th> <th>Moment of Inertia</th> <th><math>C_F</math> Factor</th> <th><math>C_F</math> Factor</th> </tr> <tr> <th>b (in)</th> <th>d (in)</th> <th>A (in<sup>2</sup>)</th> <th>S (in<sup>3</sup>)</th> <th>I (in<sup>4</sup>)</th> <th>for <math>F_b</math></th> <th>for <math>F_c</math></th> </tr> </thead> <tbody> <tr><td>2x4</td><td>1.5</td><td>3.5</td><td>5.25</td><td>3.06</td><td>5.36</td><td>1.5</td><td>1.15</td></tr> <tr><td>2x5</td><td>1.5</td><td>4.5</td><td>6.75</td><td>5.06</td><td>11.39</td><td>1.4</td><td>1.1</td></tr> <tr><td>2x6</td><td>1.5</td><td>5.5</td><td>8.25</td><td>7.56</td><td>20.80</td><td>1.3</td><td>1.1</td></tr> <tr><td>2x8</td><td>1.5</td><td>7.25</td><td>10.875</td><td>13.14</td><td>47.63</td><td>1.2</td><td>1.05</td></tr> <tr><td>2x10</td><td>1.5</td><td>9.25</td><td>13.875</td><td>21.39</td><td>98.93</td><td>1.1</td><td>1</td></tr> <tr><td>2x12</td><td>1.5</td><td>11.25</td><td>16.875</td><td>31.64</td><td>177.98</td><td>1</td><td>1</td></tr> <tr><td>2x14</td><td>1.5</td><td>13.25</td><td>19.875</td><td>43.89</td><td>290.78</td><td>0.9</td><td>0.9</td></tr> <tr><td>4x4</td><td>3.5</td><td>3.5</td><td>12.25</td><td>7.15</td><td>12.51</td><td>1.5</td><td>1.15</td></tr> <tr><td>4x5</td><td>3.5</td><td>4.5</td><td>15.75</td><td>11.81</td><td>26.58</td><td>1.4</td><td>1.1</td></tr> <tr><td>4x6</td><td>3.5</td><td>5.5</td><td>19.25</td><td>17.65</td><td>48.53</td><td>1.3</td><td>1.1</td></tr> <tr><td>4x8</td><td>3.5</td><td>7.25</td><td>25.375</td><td>30.66</td><td>111.15</td><td>1.3</td><td>1.05</td></tr> <tr><td>4x10</td><td>3.5</td><td>9.25</td><td>32.375</td><td>49.91</td><td>230.84</td><td>1.2</td><td>1</td></tr> <tr><td>4x12</td><td>3.5</td><td>11.25</td><td>39.375</td><td>73.83</td><td>415.28</td><td>1.1</td><td>1</td></tr> <tr><td>4x14</td><td>3.5</td><td>13.25</td><td>46.375</td><td>102.41</td><td>678.48</td><td>1</td><td>0.9</td></tr> <tr><td>4x16</td><td>3.5</td><td>15.25</td><td>53.375</td><td>135.66</td><td>1034.42</td><td>1</td><td>0.9</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th rowspan="2">Size</th> <th colspan="4">Douglas Fir-Larch #1</th> <th colspan="4">Douglas Fir-Larch #2</th> </tr> <tr> <th><math>V_s</math></th> 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<tr><td>2x10</td><td>1665</td><td>1961</td><td>20812.5</td><td>168.18</td><td>1665.0</td><td>1765</td><td>18731</td><td>158.29</td></tr> <tr><td>2x12</td><td>2025</td><td>2637</td><td>25312.5</td><td>302.56</td><td>2025.0</td><td>2373</td><td>22781</td><td>284.77</td></tr> <tr><td>2x14</td><td>2385</td><td>3292</td><td>26831.3</td><td>494.32</td><td>2385.0</td><td>2963</td><td>24148</td><td>465.24</td></tr> <tr><td>4x4</td><td>1470</td><td>893</td><td>21131.3</td><td>21.26</td><td>1470.0</td><td>804</td><td>19018</td><td>20.01</td></tr> <tr><td>4x5</td><td>1890</td><td>1378</td><td>25987.5</td><td>45.18</td><td>1890.0</td><td>1240</td><td>23389</td><td>42.53</td></tr> <tr><td>4x6</td><td>2310</td><td>1912</td><td>31762.5</td><td>82.49</td><td>2310.0</td><td>1720</td><td>28586</td><td>77.64</td></tr> <tr><td>4x8</td><td>3045</td><td>3322</td><td>39965.6</td><td>188.95</td><td>3045.0</td><td>2989</td><td>35969</td><td>177.84</td></tr> <tr><td>4x10</td><td>3885</td><td>4991</td><td>48562.5</td><td>392.43</td><td>3885.0</td><td>4492</td><td>43706</td><td>369.34</td></tr> <tr><td>4x12</td><td>4725</td><td>6768</td><td>59062.5</td><td>705.98</td><td>4725.0</td><td>6091</td><td>53156</td><td>664.45</td></tr> <tr><td>4x14</td><td>5565</td><td>8534</td><td>62606.3</td><td>1153.41</td><td>5565.0</td><td>7681</td><td>56346</td><td>1085.56</td></tr> <tr><td>4x16</td><td>6405</td><td>11305</td><td>72056.3</td><td>1758.51</td><td>6405.0</td><td>10175</td><td>64851</td><td>1655.07</td></tr> </tbody> </table>									Typ Member Design Parameter (psi)	$F_b$	$F_v$	$F_c$	E	Douglas Fir-Larch #1 (2" & 4")	1000	180	1500	1700000	Douglas Fir-Larch #2 (2" & 4")	900	180	1350	1600000	Size	Dressed size		Section Area	Section Modulus	Moment of Inertia	$C_F$ Factor	$C_F$ Factor	b (in)	d (in)	A (in <sup>2</sup> )	S (in <sup>3</sup> )	I (in <sup>4</sup> )	for $F_b$	for $F_c$	2x4	1.5	3.5	5.25	3.06	5.36	1.5	1.15	2x5	1.5	4.5	6.75	5.06	11.39	1.4	1.1	2x6	1.5	5.5	8.25	7.56	20.80	1.3	1.1	2x8	1.5	7.25	10.875	13.14	47.63	1.2	1.05	2x10	1.5	9.25	13.875	21.39	98.93	1.1	1	2x12	1.5	11.25	16.875	31.64	177.98	1	1	2x14	1.5	13.25	19.875	43.89	290.78	0.9	0.9	4x4	3.5	3.5	12.25	7.15	12.51	1.5	1.15	4x5	3.5	4.5	15.75	11.81	26.58	1.4	1.1	4x6	3.5	5.5	19.25	17.65	48.53	1.3	1.1	4x8	3.5	7.25	25.375	30.66	111.15	1.3	1.05	4x10	3.5	9.25	32.375	49.91	230.84	1.2	1	4x12	3.5	11.25	39.375	73.83	415.28	1.1	1	4x14	3.5	13.25	46.375	102.41	678.48	1	0.9	4x16	3.5	15.25	53.375	135.66	1034.42	1	0.9	Size	Douglas Fir-Larch #1				Douglas Fir-Larch #2				$V_s$	$M_s$	$P_s$	E'I	$V_s$	$M_s$	$P_s$	E'I	(bxd)	(lbs)	(lb-ft)	(lbs)	(10 <sup>6</sup> ) (lb-in <sup>2</sup> )	(lbs)	(lb-ft)	(lbs)	(10 <sup>6</sup> )	2x4	630	383	9056.3	9.11	630.0	345	8151	8.58	2x5	810	591	11137.5	19.36	810.0	532	10024	18.23	2x6	990	819	13612.5	35.35	990.0	737	12251	33.28	2x8	1305	1314	17128.1	80.98	1305.0	1183	15415	76.22	2x10	1665	1961	20812.5	168.18	1665.0	1765	18731	158.29	2x12	2025	2637	25312.5	302.56	2025.0	2373	22781	284.77	2x14	2385	3292	26831.3	494.32	2385.0	2963	24148	465.24	4x4	1470	893	21131.3	21.26	1470.0	804	19018	20.01	4x5	1890	1378	25987.5	45.18	1890.0	1240	23389	42.53	4x6	2310	1912	31762.5	82.49	2310.0	1720	28586	77.64	4x8	3045	3322	39965.6	188.95	3045.0	2989	35969	177.84	4x10	3885	4991	48562.5	392.43	3885.0	4492	43706	369.34	4x12	4725	6768	59062.5	705.98	4725.0	6091	53156	664.45	4x14	5565	8534	62606.3	1153.41	5565.0	7681	56346	1085.56	4x16	6405	11305	72056.3	1758.51	6405.0	10175	64851	1655.07
Typ Member Design Parameter (psi)	$F_b$	$F_v$	$F_c$	E																																																																																																																																																																																																																																																																																																																												
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Size	Dressed size		Section Area	Section Modulus	Moment of Inertia	$C_F$ Factor	$C_F$ Factor																																																																																																																																																																																																																																																																																																																									
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2x6	1.5	5.5	8.25	7.56	20.80	1.3	1.1																																																																																																																																																																																																																																																																																																																									
2x8	1.5	7.25	10.875	13.14	47.63	1.2	1.05																																																																																																																																																																																																																																																																																																																									
2x10	1.5	9.25	13.875	21.39	98.93	1.1	1																																																																																																																																																																																																																																																																																																																									
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2x14	1.5	13.25	19.875	43.89	290.78	0.9	0.9																																																																																																																																																																																																																																																																																																																									
4x4	3.5	3.5	12.25	7.15	12.51	1.5	1.15																																																																																																																																																																																																																																																																																																																									
4x5	3.5	4.5	15.75	11.81	26.58	1.4	1.1																																																																																																																																																																																																																																																																																																																									
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4x16	3.5	15.25	53.375	135.66	1034.42	1	0.9																																																																																																																																																																																																																																																																																																																									
Size	Douglas Fir-Larch #1				Douglas Fir-Larch #2																																																																																																																																																																																																																																																																																																																											
	$V_s$	$M_s$	$P_s$	E'I	$V_s$	$M_s$	$P_s$	E'I																																																																																																																																																																																																																																																																																																																								
(bxd)	(lbs)	(lb-ft)	(lbs)	(10 <sup>6</sup> ) (lb-in <sup>2</sup> )	(lbs)	(lb-ft)	(lbs)	(10 <sup>6</sup> )																																																																																																																																																																																																																																																																																																																								
2x4	630	383	9056.3	9.11	630.0	345	8151	8.58																																																																																																																																																																																																																																																																																																																								
2x5	810	591	11137.5	19.36	810.0	532	10024	18.23																																																																																																																																																																																																																																																																																																																								
2x6	990	819	13612.5	35.35	990.0	737	12251	33.28																																																																																																																																																																																																																																																																																																																								
2x8	1305	1314	17128.1	80.98	1305.0	1183	15415	76.22																																																																																																																																																																																																																																																																																																																								
2x10	1665	1961	20812.5	168.18	1665.0	1765	18731	158.29																																																																																																																																																																																																																																																																																																																								
2x12	2025	2637	25312.5	302.56	2025.0	2373	22781	284.77																																																																																																																																																																																																																																																																																																																								
2x14	2385	3292	26831.3	494.32	2385.0	2963	24148	465.24																																																																																																																																																																																																																																																																																																																								
4x4	1470	893	21131.3	21.26	1470.0	804	19018	20.01																																																																																																																																																																																																																																																																																																																								
4x5	1890	1378	25987.5	45.18	1890.0	1240	23389	42.53																																																																																																																																																																																																																																																																																																																								
4x6	2310	1912	31762.5	82.49	2310.0	1720	28586	77.64																																																																																																																																																																																																																																																																																																																								
4x8	3045	3322	39965.6	188.95	3045.0	2989	35969	177.84																																																																																																																																																																																																																																																																																																																								
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# SOLAR CAL POLY

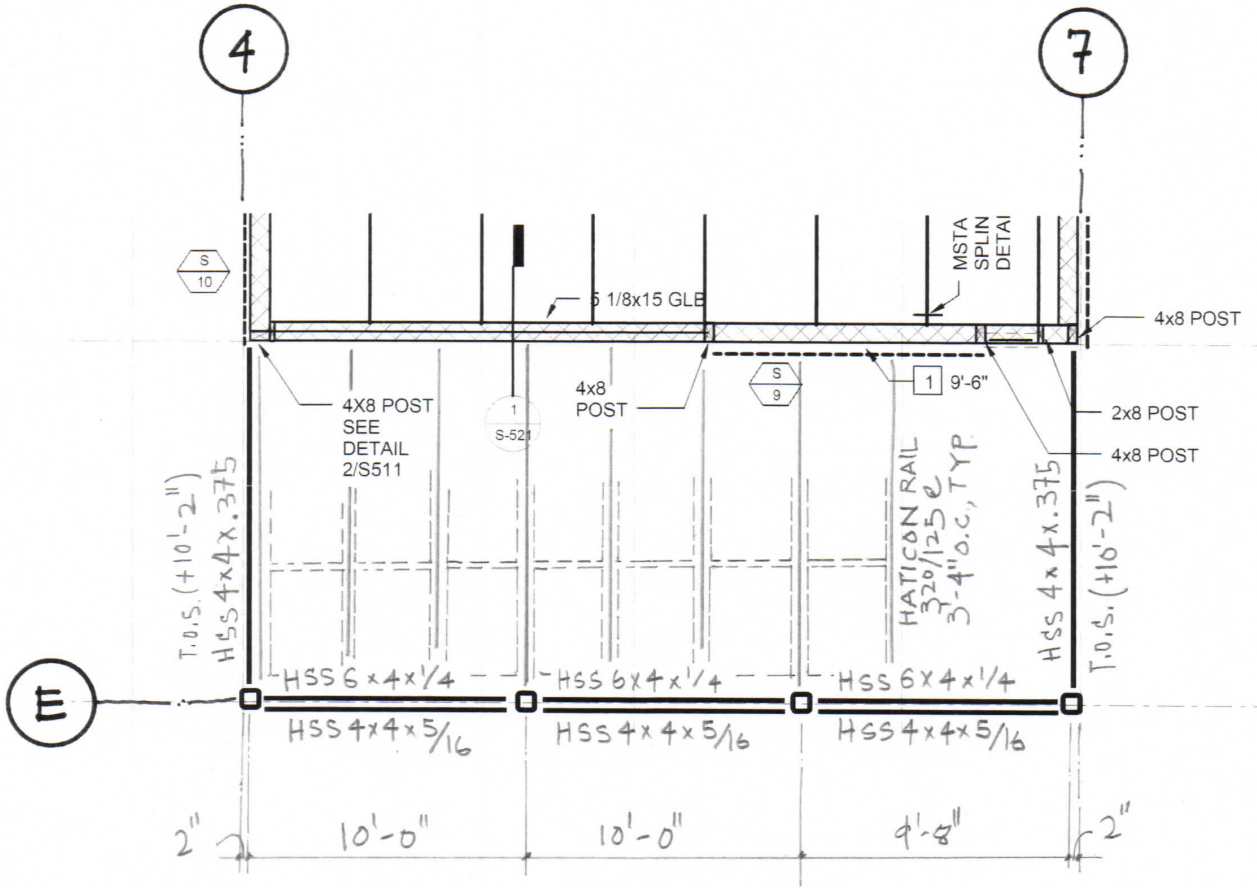
## STRUCTURAL SKETCHES: SKS-1 thru SKS-19 for the 2015



U.S. DEPARTMENT OF ENERGY  
**SOLAR DECATHLON**

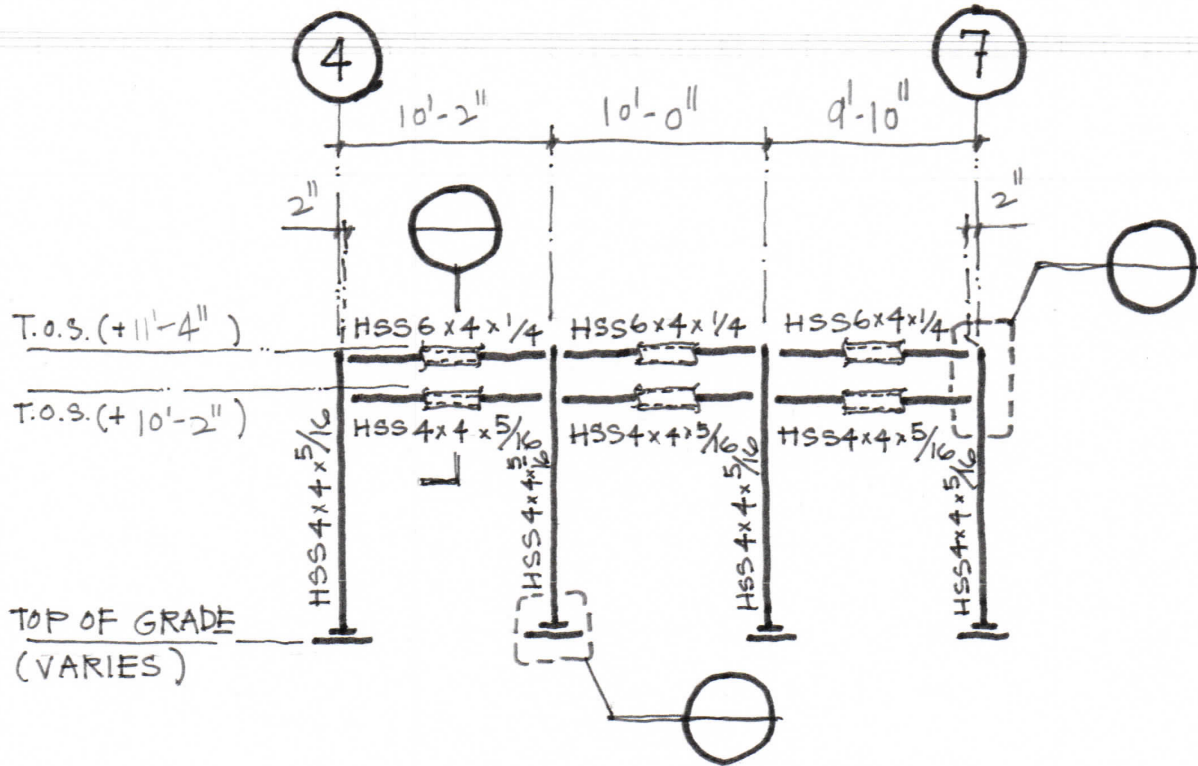


5K5-8 PARTIAL FOUNDATION PLAN  
(Ref: S-101)



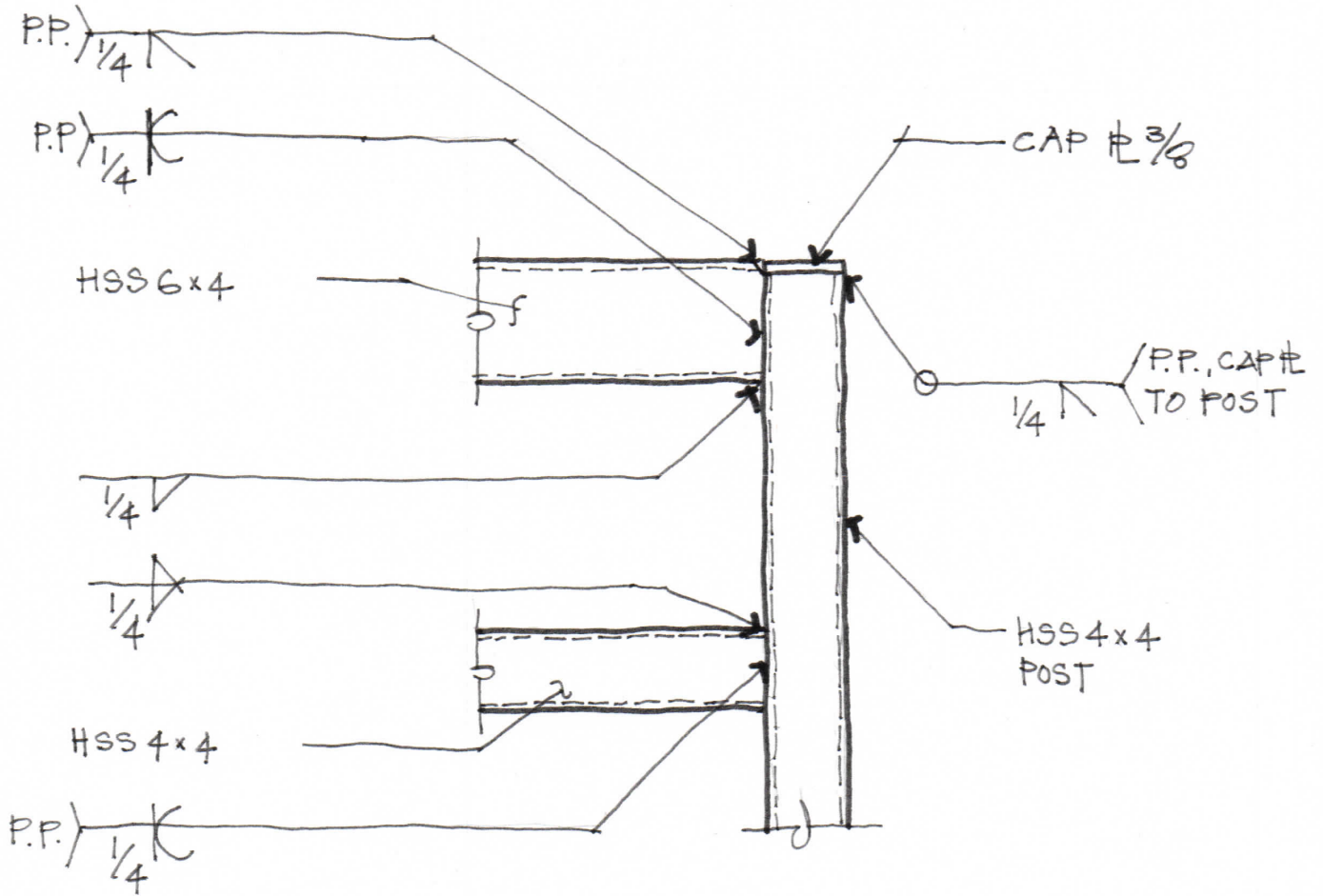
**PARTIAL LOW ROOF FRAMING PLAN**  
(Ref S-103A)

SKS-q

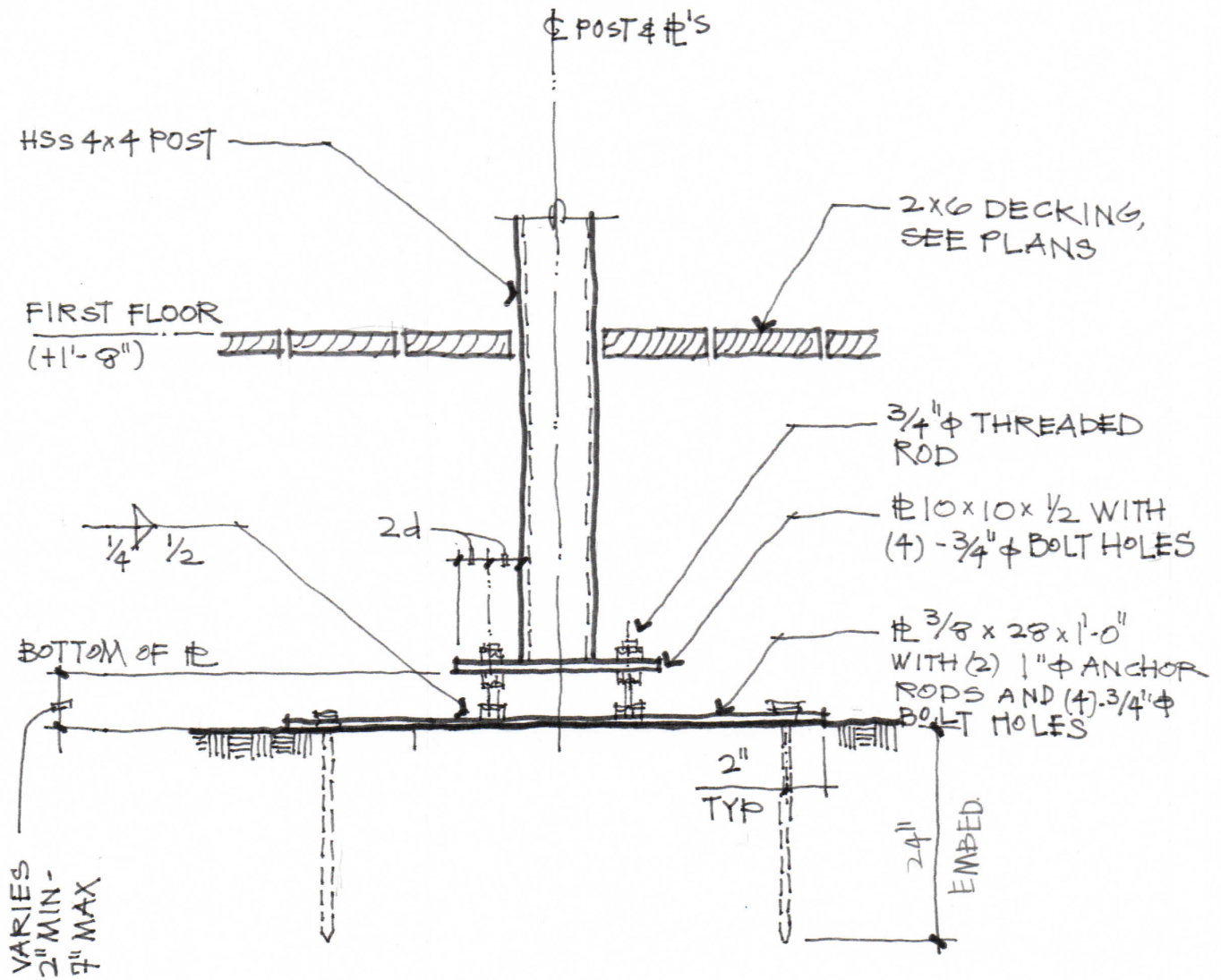


SKS-10 FRAME ELEVATION (BIFACIAL ROOM)



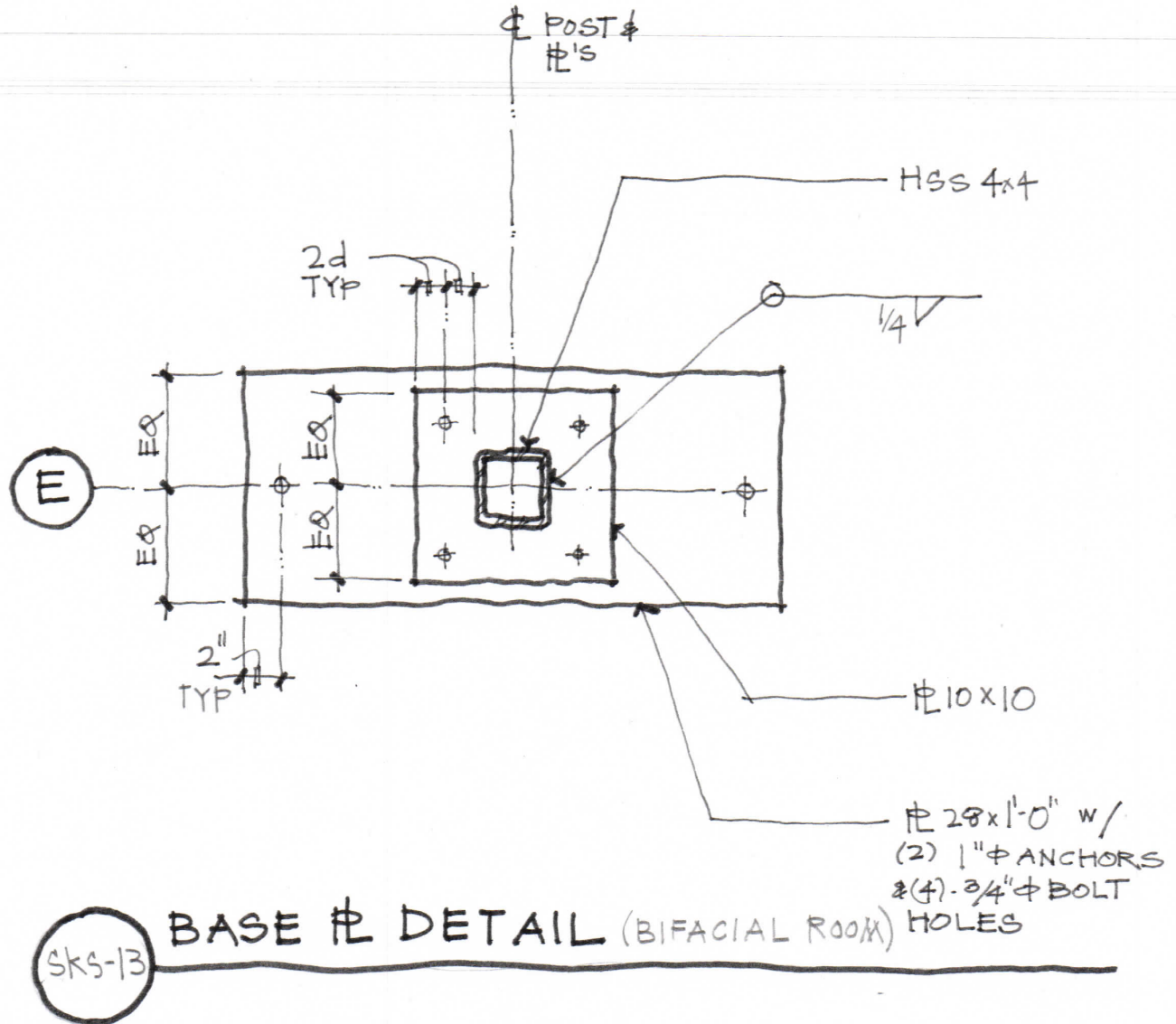


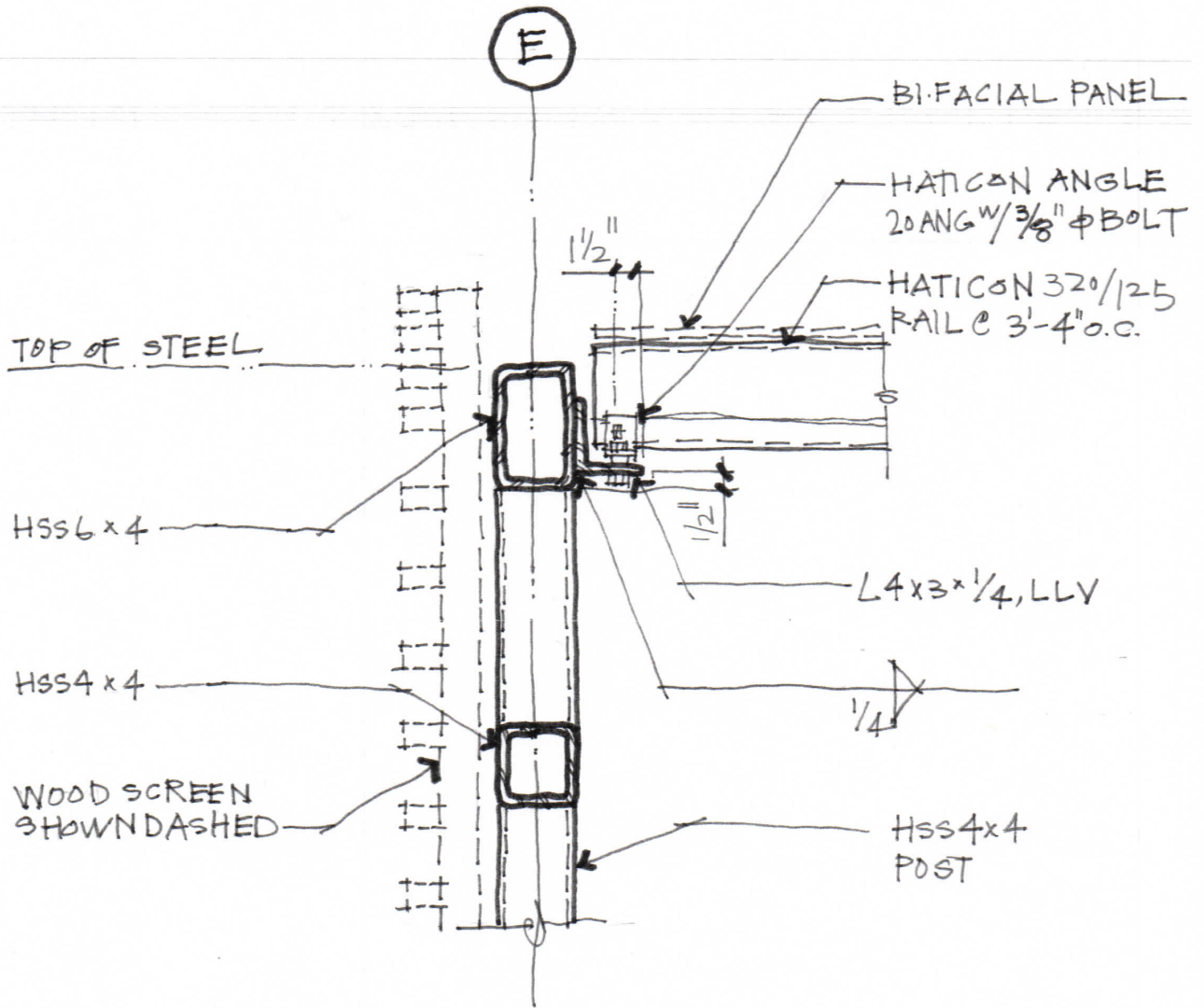
SKS-11 FRAME DETAIL (BIFACIAL ROOM)



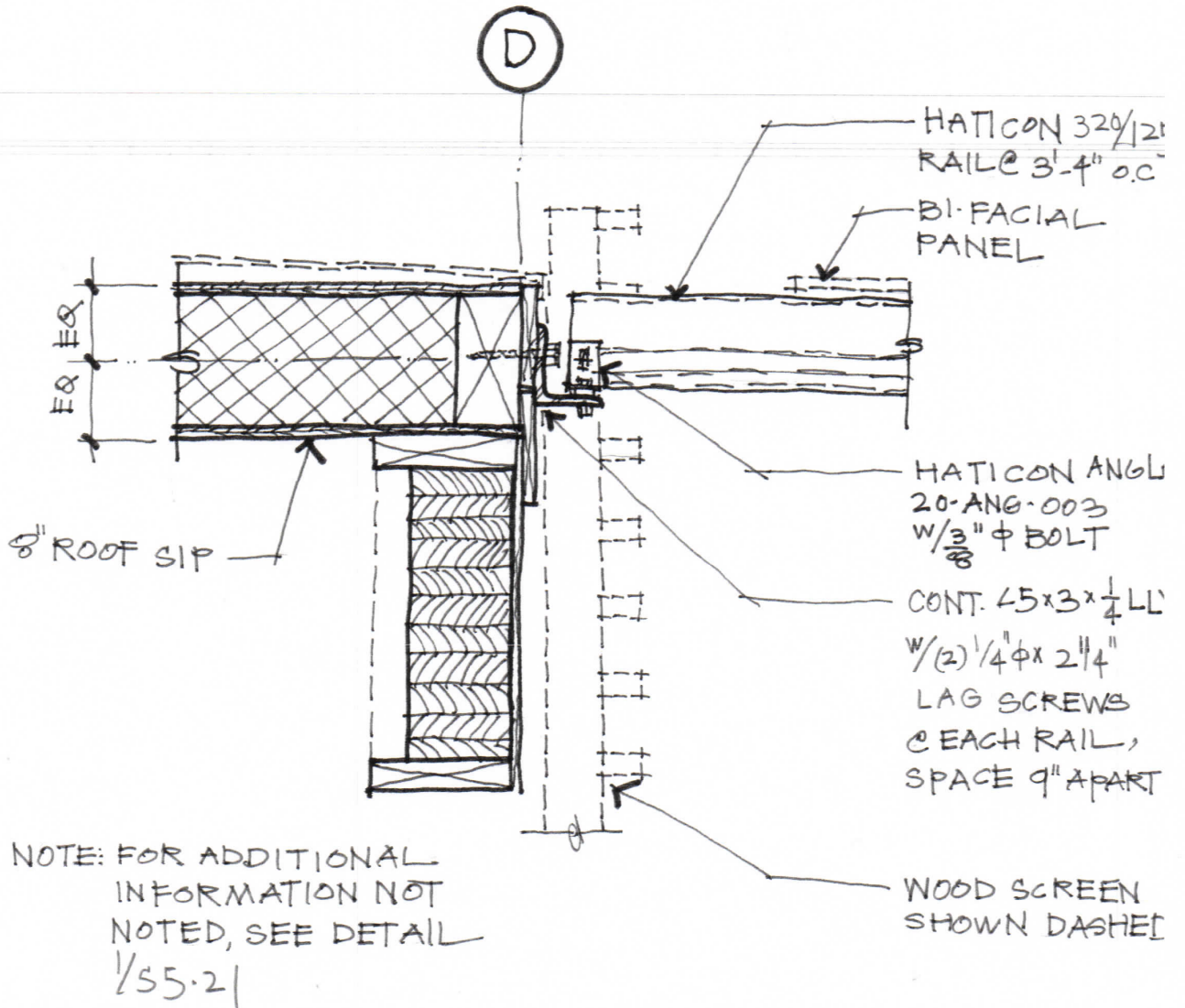
FRAME BASE # DETAIL (BIFACIAL ROOM)

SKS-12

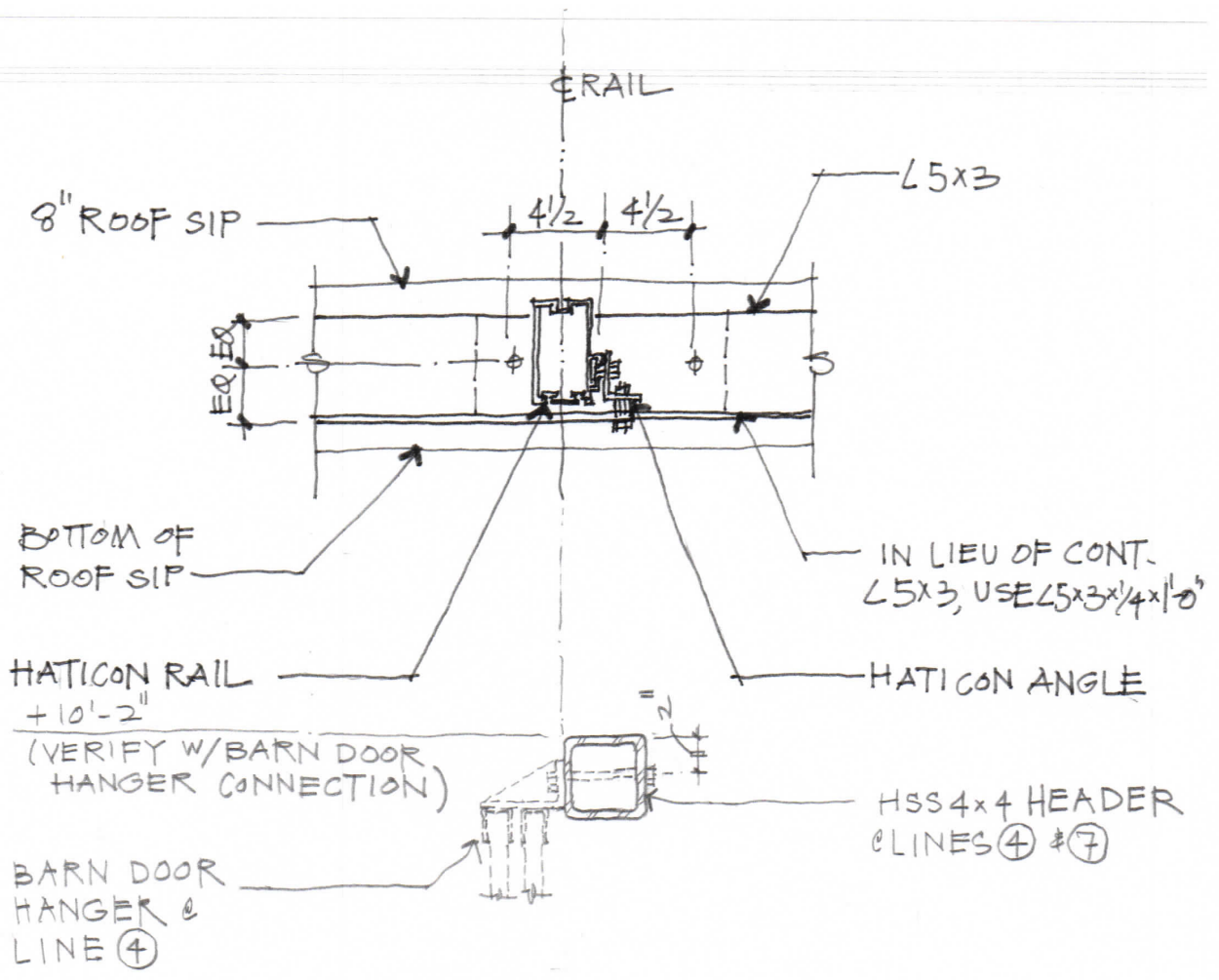




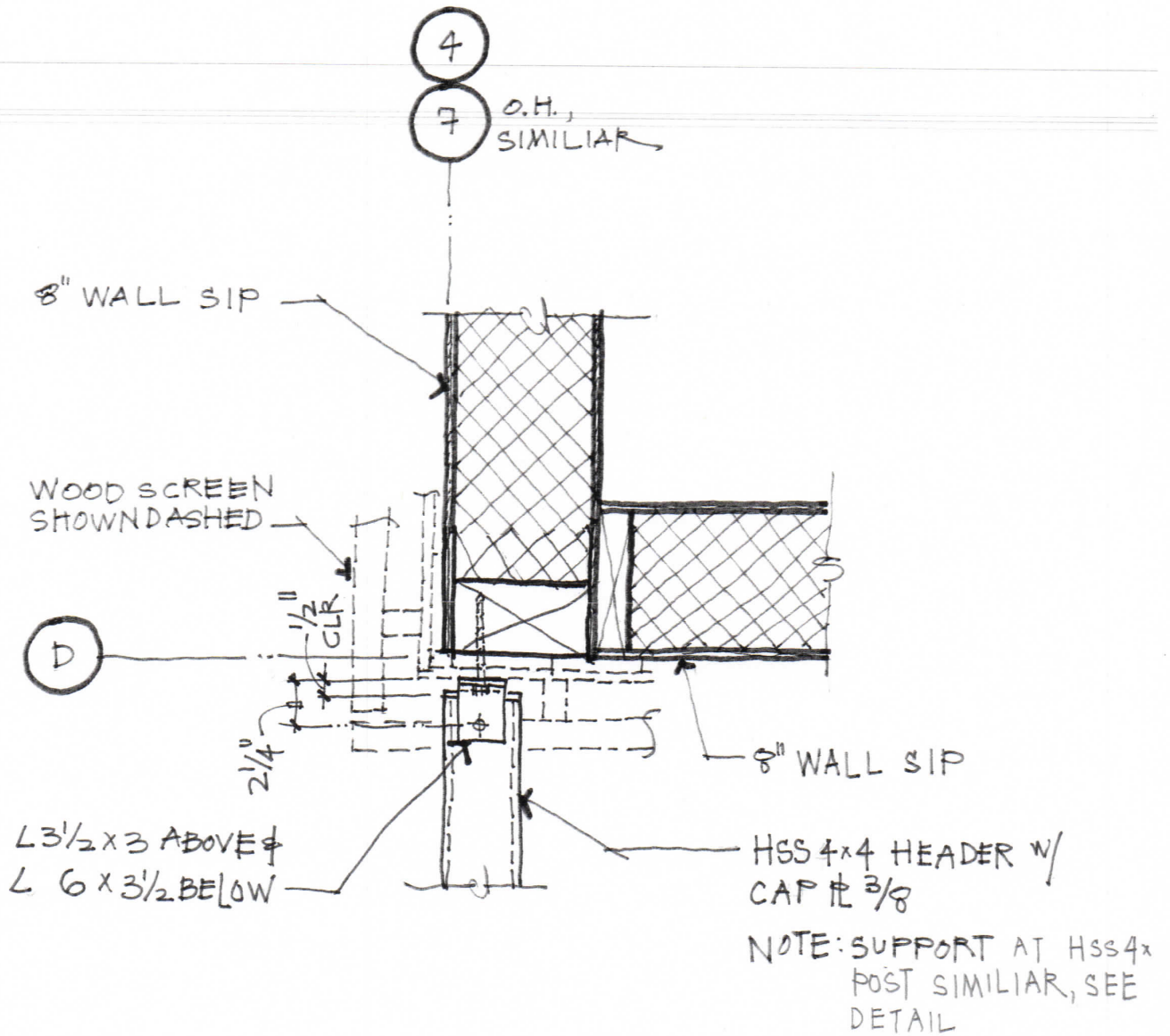
**SKS-14** PANEL / RAIL SUPPORT (BIFACIAL ROOM)



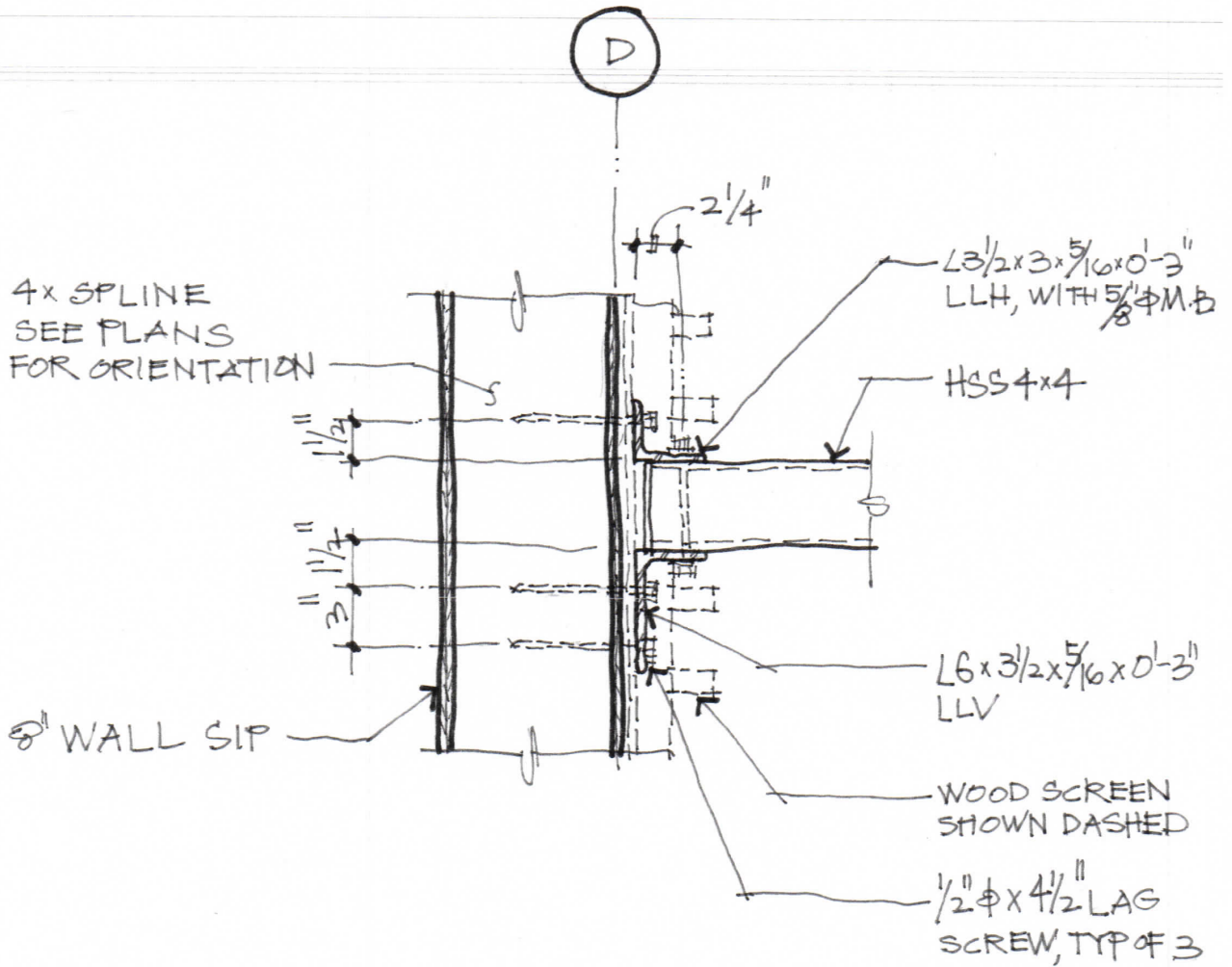
(SKS-15) PANEL/RAIL SUPPORT (BIFACIAL ROOM)



**3KS-16** PANEL / RAIL SUPPORT (BIFACIAL ROOM)

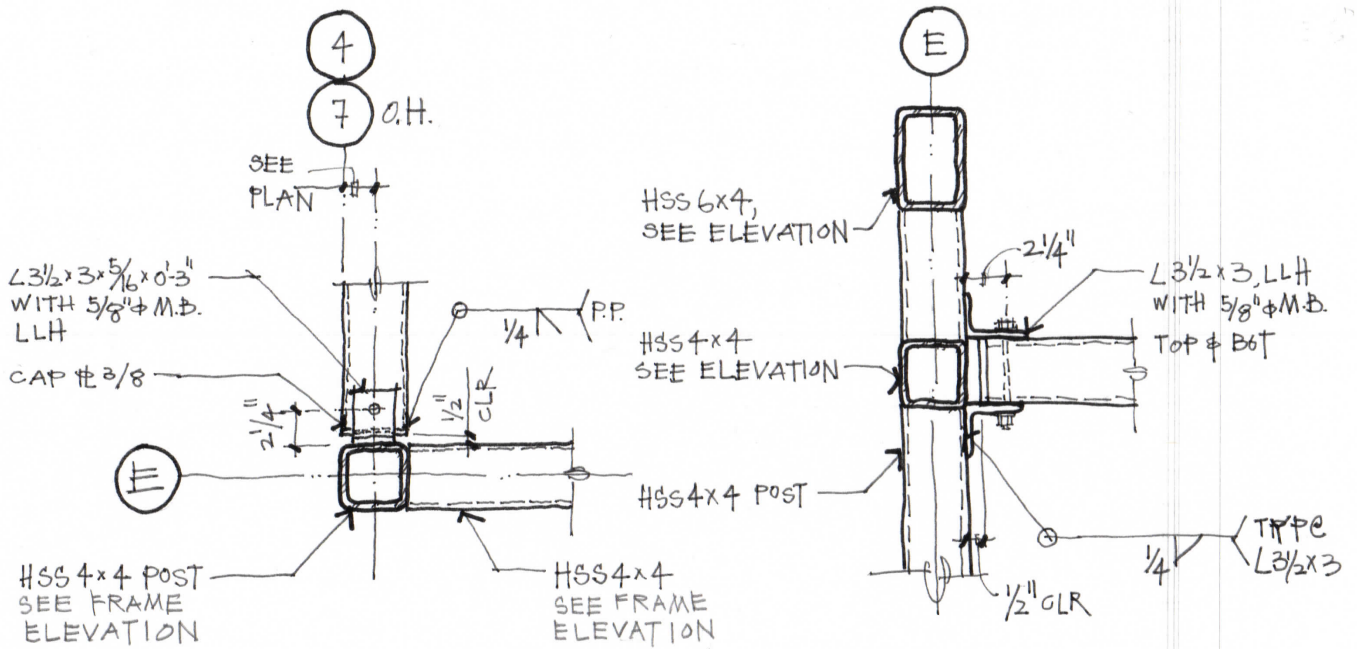


5ks-17 **PLAN-HEADER SUPPORT (BIFACIAL ROOM)**

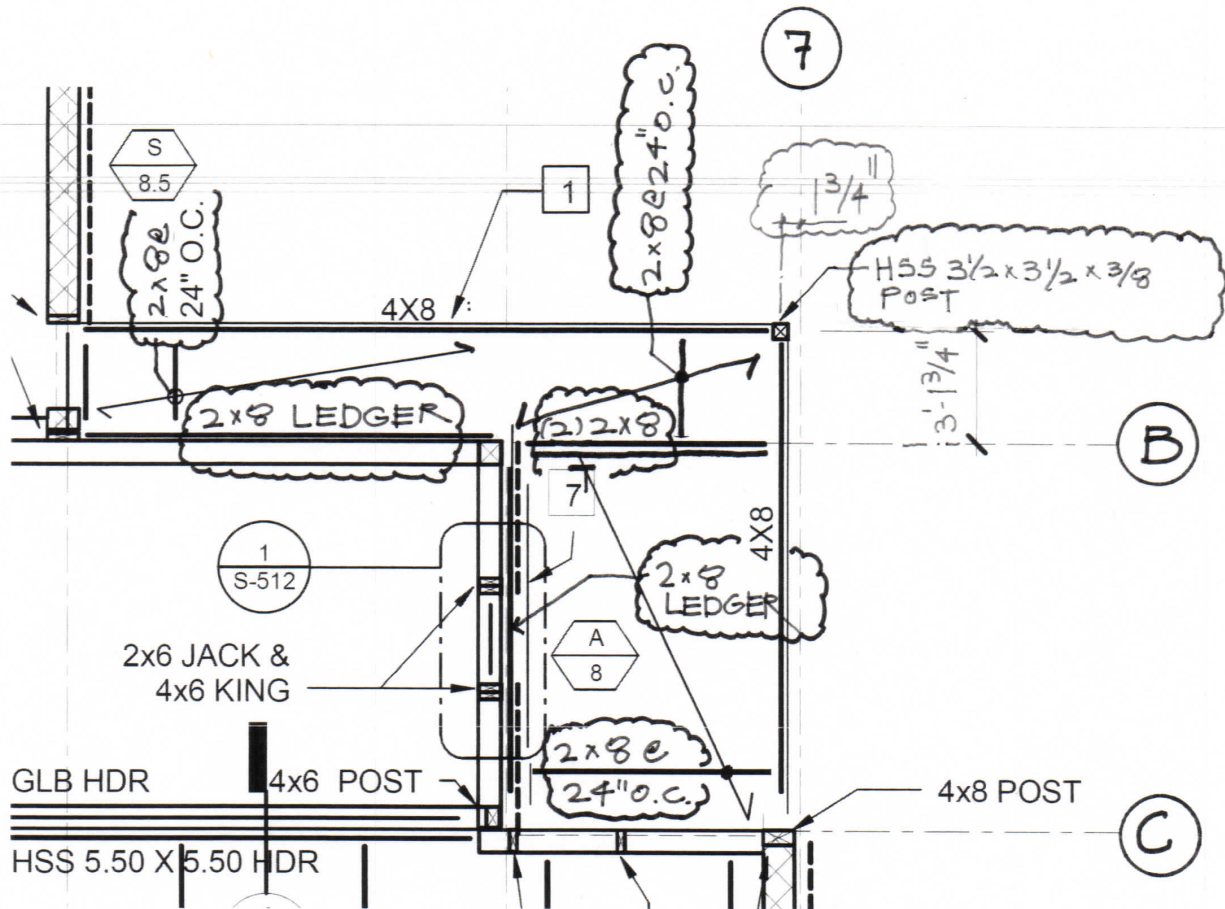


SKS-18 **HEADER SUPPORT-SECTION** (BIFACIAL ROOM)

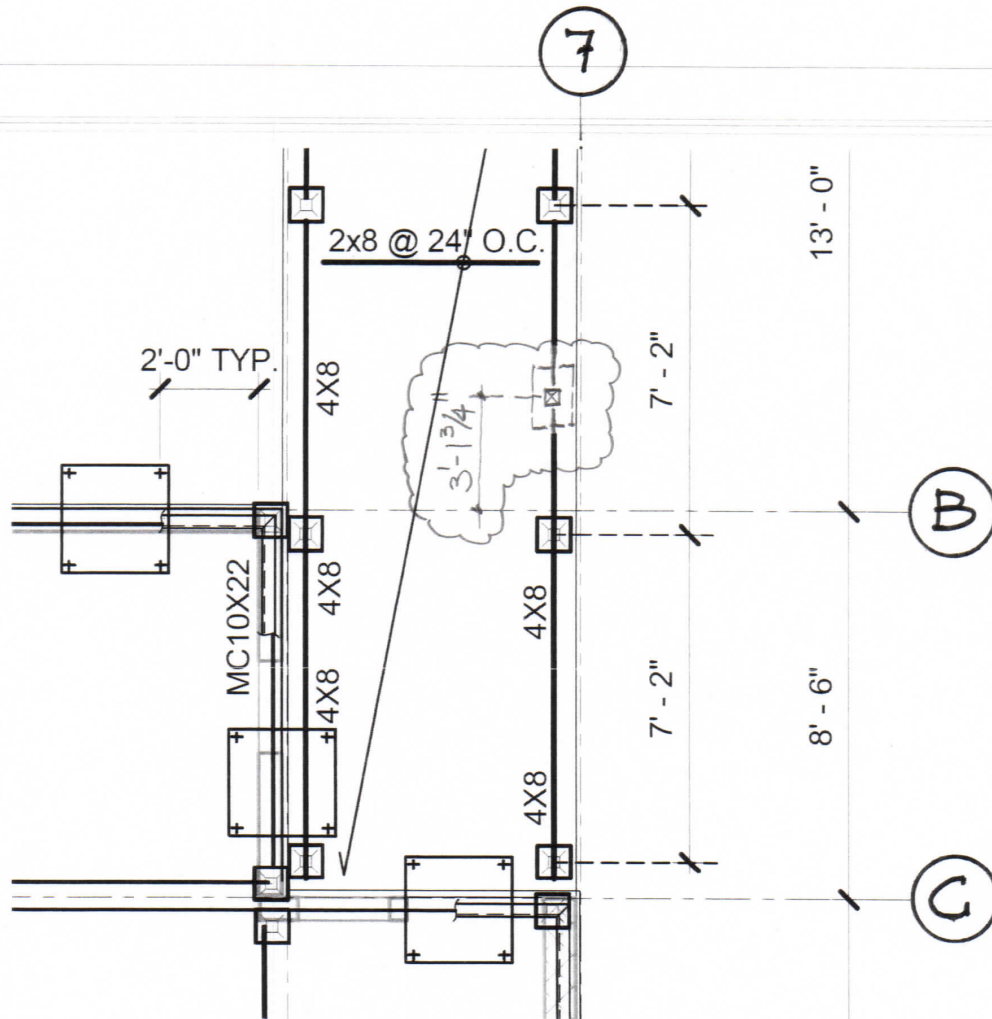




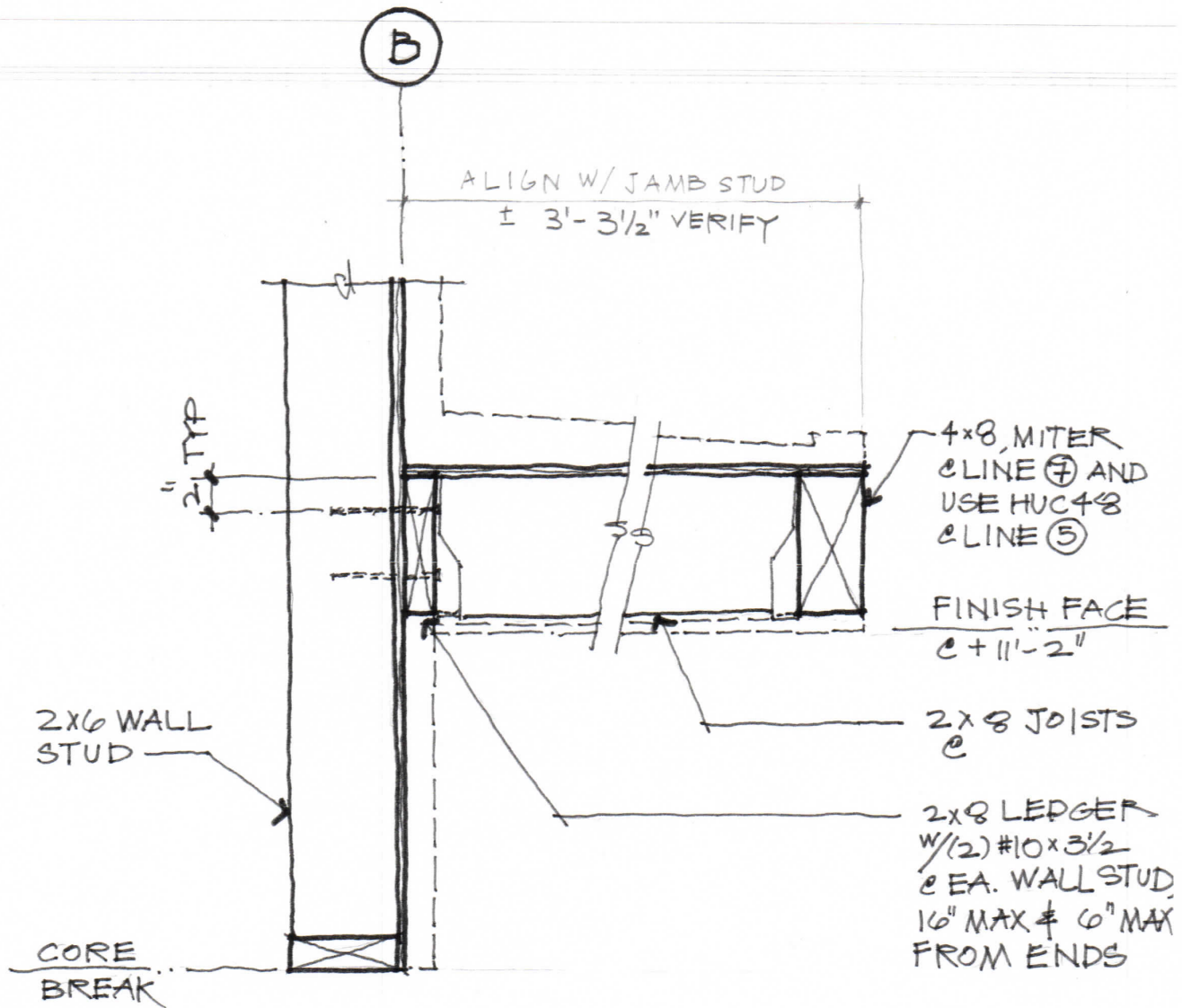
SK5-14 **HEADER SUPPORT & LINE (E)** (BIFACIAL ROOM)



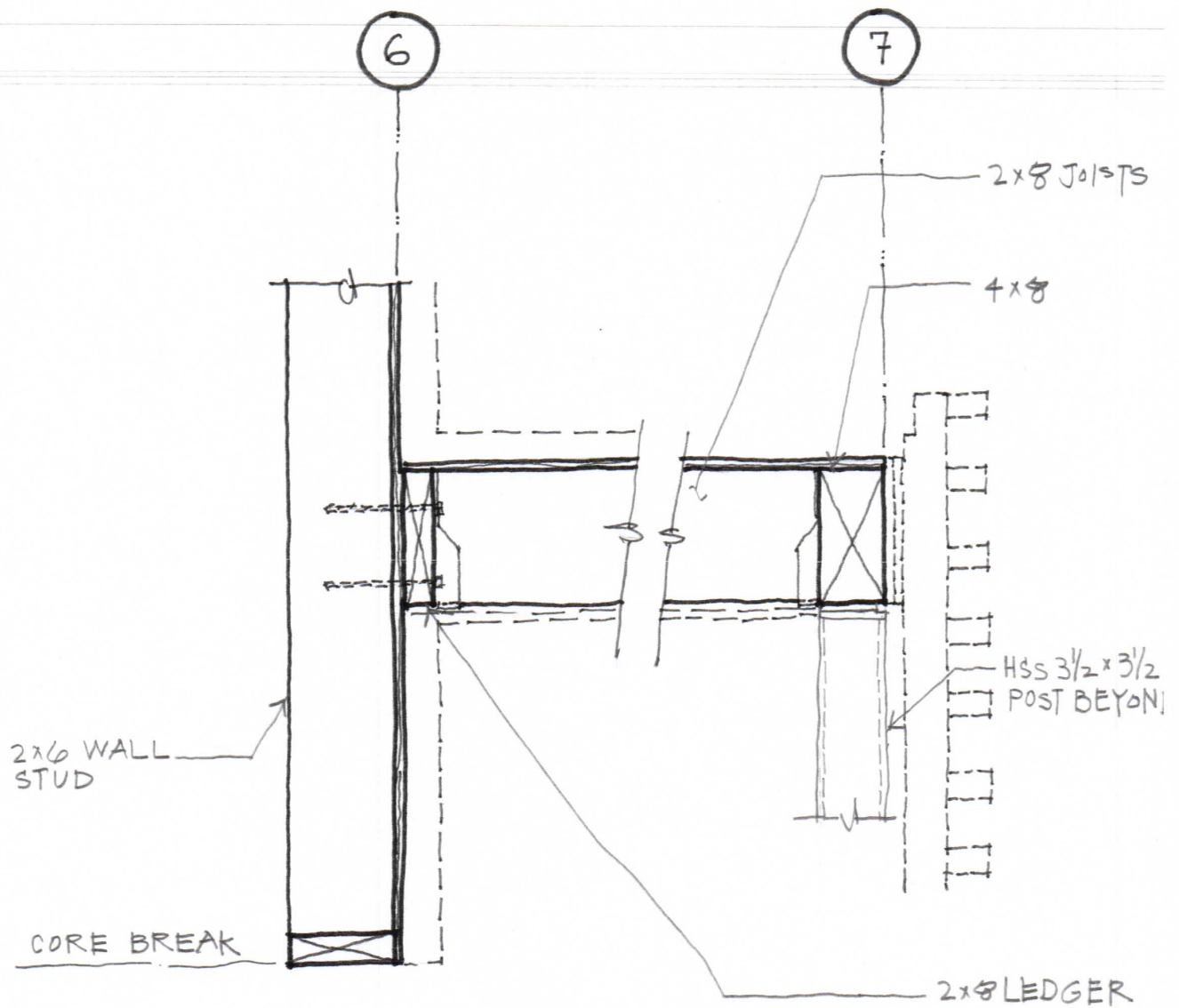
5KS-1 PARTIAL LOW ROOF FRAMING  
(Ref: S. 103A)



5KS-2 PARTIAL FOUNDATION PLAN

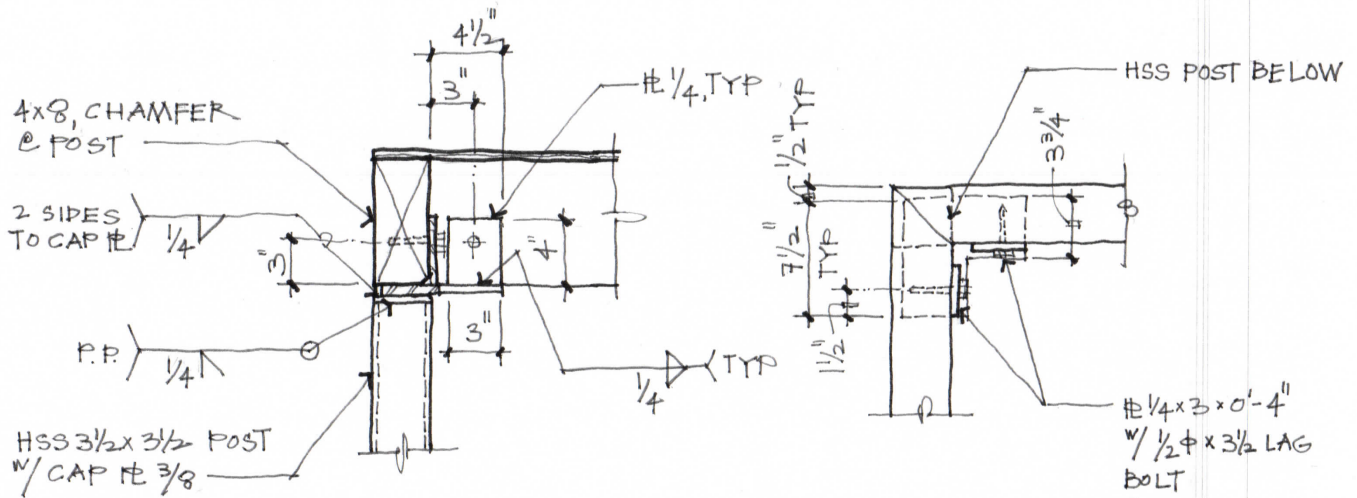


SKS-3 **SECTION (ENTRY OVERHANG)**



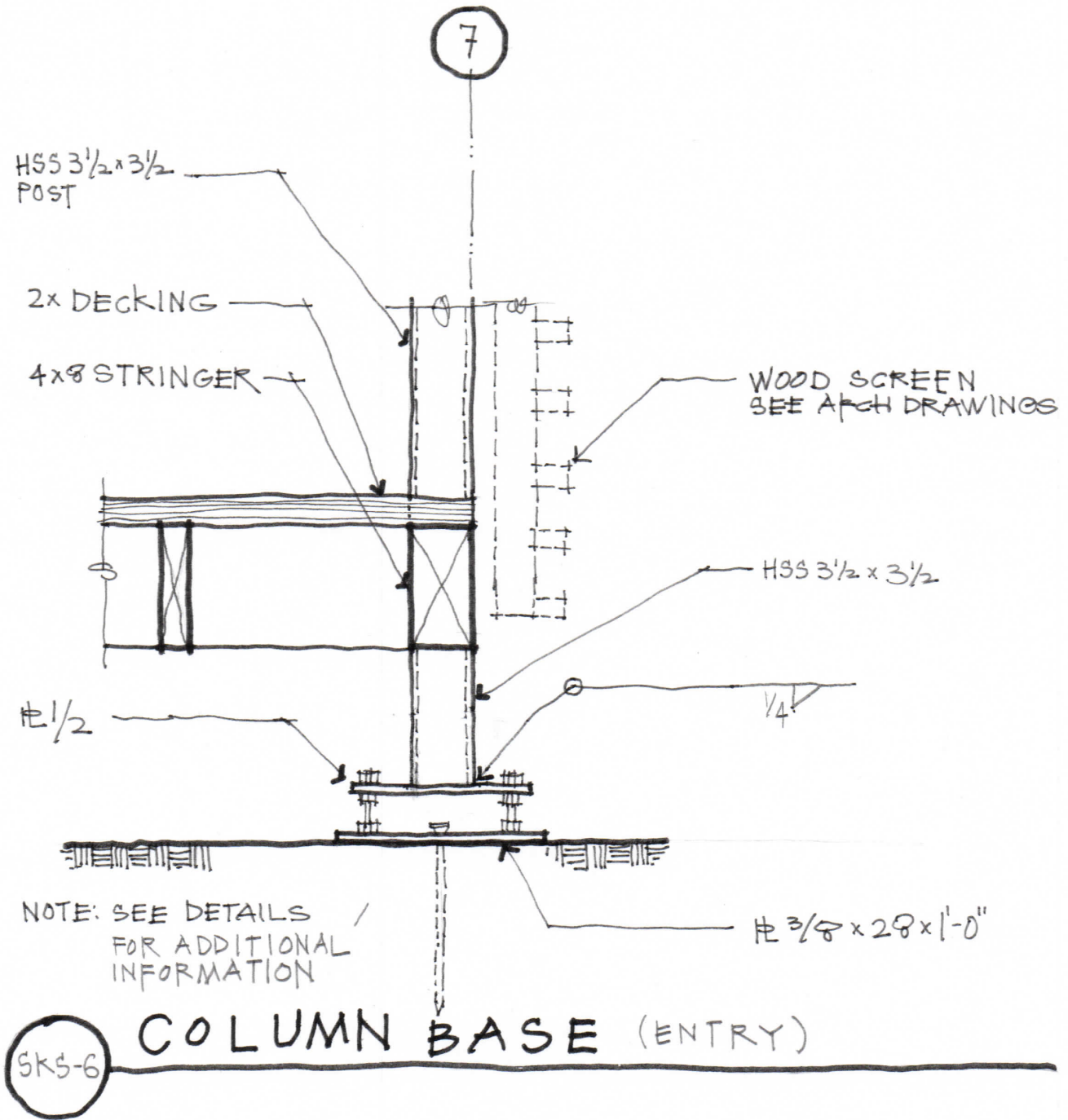
SKS-4

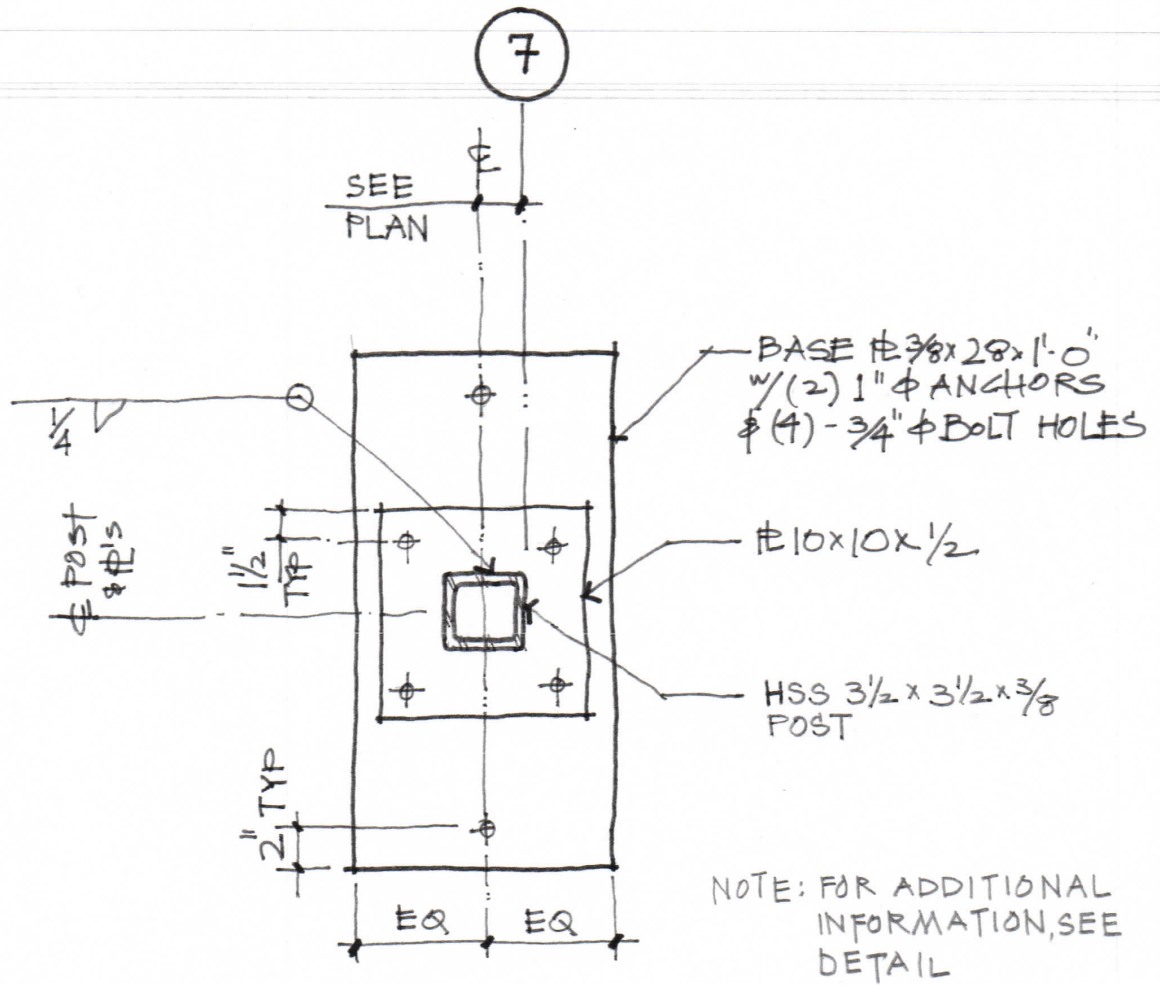
**SECTION (ENTRY OVERHANG)**



SKS-5

**COLUMN CAP DETAIL (ENTRY OVERHANG)**





**SKS-7** COLUMN BASE # @ ENTRY



## Detailed Water Budget

Functions	Water Use (Gallons)	Calculations		Notes
		Gallons	Events	
Hot Water Draws	240	15	16	
Water Vaporization	3	0.6	5	Each event requires 5lb or 2kg of water
Dishwasher	17.78	2.54	7	5 competition events and 2 dinner parties
Clothes Washer	109.36	13.67	8	
Vegetation	50			Constructed Wetlands
Fire Protection	280			
Thermal Storage Tanks	150			
Testing	50			
Solar Thermal Collectors	40			1 - 40 gallon tanks
Safety Factor	100			
<b>TOTAL:</b>	<b>1040.14</b>			

Day	Dish Washer		Hot Water Draws		Clothes Washing		Gray Per Day (Gal)	Black Per Day (Gal)	Total GPD
	Events	GPD	Events	GPD	Events	GPD			
11	1	2.54	0	0	0	0	0	2.54	2.54
12	1	2.54	1	15	1	13.76	28.76	2.54	31.3
13	1	2.54	2	30	1	13.76	43.76	2.54	46.3
14	1	2.54	1	15	1	13.76	28.76	2.54	31.3
15	0	0	3	45	2	27.52	72.52	0	72.52
16	1	2.54	3	45	0	0	45	2.54	47.54
17	0	0	3	45	2	27.52	72.52	0	72.52
18	1	2.54	2	30	0	0	30	2.54	32.54
19	1	2.54	1	15	1	13.76	28.76	2.54	31.3
<b>Total</b>	<b>7</b>	<b>17.78</b>	<b>16</b>	<b>240</b>	<b>8</b>	<b>110.08</b>	<b>350.08</b>	<b>17.78</b>	<b>367.86</b>

## **Summary of Unlisted Electrical Components**

There are no unlisted electrical components in our design.

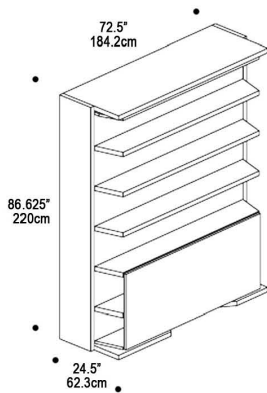
## Summary of Reconfigurable Features

Solar Cal Poly has the following reconfigurable features:

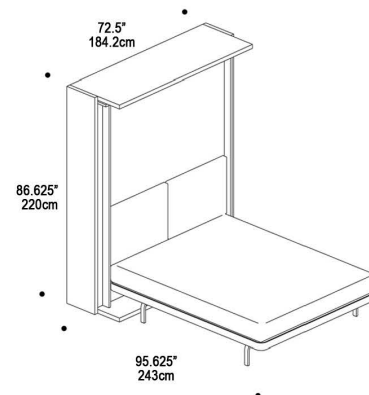
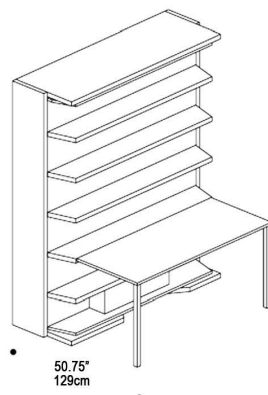
### Resource Furniture Murphy Bed - LGM Tavolo

The LGM Tavolo is a Murphy Bed that has a fold down desk and shelving and can completely fold down into a bed. The bed and desk are operated manually through pivoting joints. Please see the image below for difference in dimensions between each variation. There are no additional safety features that need to be implemented.

LGM Tavolo



Opened



### Bifacial Room Doors

The doors are fastened on a track on which they slide left and right. They are operated manually by pushing them along the track. There are no additional safety features that need to be implemented.

### Blinds on Windows in Bedroom

The blinds in the bedroom will be pleated blinds with standard manual string operation. There are no additional safety features that need to be implemented.

### **Blinds on Windows in Kitchen, Living, and Dining Room**

The blinds in the other rooms will be vertical blinds with equipped with standard sliding and turning operations. They will be manually operated. There are no additional safety features that need to be implemented.

### **Visible Phase Change Art Piece**

In the living room is a art piece consisting of visible phase change material encased in acrylic and attached to an aluminum frame. The frame sits on a track on which is slides left and right. The art piece can be moved by manual pushing it along the track. There are no additional safety features that need to be implemented.

## Interconnection Application Form

Team Name and Lot Number: Cal Poly San Luis Obispo Lot #107

### PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
SunPower	10 Monofacial Panels, 2 Strings of 5	4.35 kW
Sunpreme	14 Bifacial Panels, 2 strings of 7	4.9 kW

Total DC power of all arrays is 9.3 kW (in tenths)

### Inverters

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
SMA	Sunny Boy 5000TL-US	600V	5	1
SMA	Sunny Boy 4000TL-US	600V	4	1

Total AC power of all inverters is 9 kVA or kW (in whole numbers)

### Required Information

Drawing	Location
One-Line Electrical Schematic	E-601
Calculations of service/feeder net computed load and neutral load (NEC 220)	E-604
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	E-401

## Quantity Takeoff of Competition Prototype House

**RSMeans**  
FROM THE GORDIAN GROUP®






















































**Cost Estimate Report**  
RSMeansOnline

Date: 08/12/2015






























































Solar Cal Poly  
Year 2014 Quarter 3  
Unit Detail Report





















Prepared By:  
Erik Pinuelas  
Cal Poly-Solar Decathlon

LineNumber		Description	Quantity	Unit
<b>Division 05 Metals</b>				
05 12 00		Steel for chassis	3.00	Ton
05 19 19		Canopy - bifacial PV overhead	221.00	S.F.
05 45 00		Roof Racking System	266.00	S.F.
05 52 00		1 1/2" x 2" Steel Tube Railings	178.00	L.F.
<b>Division 05 Metals Subtotal</b>				
<b>Division 06 Wood, Plastics, and Composites</b>				
06 10 00		2x6 wood shade screen over fiber cement ext. finish	1,090.00	S.F.
06 11 00		Low roof framing - 2x6	100.00	L.F.
06 11 00		Low roof framing - 4x8	156.00	L.F.
06 11 00		High roof - 2x8	157.00	L.F.
06 12 00		Low roof - 8 1/4" SIPS	732.00	S.F.
06 12 00		8 1/4" SIP w/ splines	943.00	S.F.
06 12 00		1/2" Structural sheathing (x2)w/ 2x6 stud framing, with 3" rigid, spray foam	659.00	S.F.
06 15 00		Decking - 2x6 redwood	853.00	S.F.
06 16 00		Floor sheathing	985.00	S.F.
06 16 00		Roof Sheathing	376.00	S.F.
06 41 00		Upper cabinets, kitchen - custom hardwood	2.50	L.F.
06 41 00		Lower cabinets, kitchen - custom hardwood	9.50	L.F.
06 41 00		Upper cabinets, living room - custom hardwood	12.00	L.F.
06 41 00		Lower cabinets, living room - custom hardwood	9.00	L.F.
06 41 00		Base cabinets in dining room	12.00	L.F.
06 41 00		Upper cabinets in dining room	12.00	L.F.
06 41 00		7' Cabinet in living room	3.00	L.F.
06 41 00		Kitchen island	8.00	L.F.
06 41 00		5' Upper cabinets in bedroom	14.00	L.F.
06 41 00		2'-6" Lower cabinets in bedroom	15.00	L.F.
06 71 13		210x9 1/2 TJI	42.00	Ea.
06 71 13		1/2" plywood	1,068.00	S.F.
06 71 13		2x6 joists	760.00	S.F.

LineNumber				Description	Quantity	Unit
<b>Division 06 Wood, Plastics, and Composites Subtotal</b>						
<b>Division 07 Thermal and Moisture Protection</b>						
07 21 13				1" rigid insulation	1,215.00	S.F.
07 21 13				3" rigid insulation	333.00	S.F.
07 21 29				6" Spray insulation	732.00	S.F.
07 46 00				1/4" pulp-based panel	659.00	S.F.
07 46 46				Exterior wall - 1/4" fiber cement wall cladding	943.00	S.F.
07 50 00				Single-ply vinyl roofing material self-adhered over 1/4" dense rock over rigid insulation	1,107.00	S.F.
07 71 23				Scuppers	4.00	Ea.
07 91 23				Open cell foam	375.00	S.F.
<b>Division 07 Thermal and Moisture Protection Subtotal</b>						
<b>Division 08 Openings</b>						
08 14 00				Flush wood door - 30" x 80"	1.00	Ea.
08 14 73				Sliding wood doors; louvered	202.00	S.F.
08 14 76				Swing door - 36" x 80"	1.00	Ea.
08 35 13				Nana wall 14'-9" x 7'-10"	116.00	S.F.
08 36 00				36" x 84" Integrity Ultrex single lite french door - fiberglass	2.00	Ea.
<b>Division 08 Openings Subtotal</b>						
<b>Division 09 Finishes</b>						
09 29 00				Gypsum board	702.00	S.F.
09 50 00				Sloped core paneled ceiling	207.00	S.F.
09 64 00				Wood floor	900.00	S.F.
09 64 00				Wood base	198.00	L.F.
09 91 00				Wall Paint	1,602.00	S.F.
09 91 00				Ceiling Paint	850.00	S.F.
<b>Division 09 Finishes Subtotal</b>						
<b>Division 10 Specialties</b>						
10 28 00				Toilet tissue dispenser	1.00	Ea.
10 28 00				Towel Bar	1.00	Ea.
<b>Division 10 Specialties Subtotal</b>						
<b>Division 11 Equipment</b>						
11 30 00				Induction Stove	1.00	Ea.
11 30 00				Refrigerator	1.00	Ea.
11 30 00				Clothes washer/dryer	1.00	Ea.
11 30 00				Microwave oven	1.00	Ea.
































































LineNumber				Description	Quantity	Unit
11 30 00				Dishwasher	1.00	Ea.
<b>Division 11 Equipment Subtotal</b>						
<b>Division 12 Furnishings</b>						
12 21 16				Vertical blinds	113.00	S.F.
12 36 00				Kitchen Countertop - composite, solid laminated, 1-1/2" thick	20.00	S.F.
12 36 00				Countertop backsplash	12.00	L.F.
12 36 00				Bathroom Countertop	8.00	S.F.
12 36 00				Bathroom backsplash	4.50	L.F.
12 40 00				Framed mirror - 2x3	6.00	S.F.
<b>Division 12 Furnishings Subtotal</b>						
<b>Division 21 Fire Suppression</b>						
21 13 00				Sprinkler head	8.00	Ea.
21 13 00				Fitting-elbow	4.00	Ea.
21 13 00				Fitting-tee	4.00	Ea.
21 13 00				Pipe-straight 1"	90.00	L.F.
21 13 00				Valve assembly	1.00	Ea.
21 13 00				Pressure release valve	1.00	Ea.
21 13 00				Pump station & controller	1.00	Ea.
<b>Division 21 Fire Suppression Subtotal</b>						
<b>Division 22 Plumbing</b>						
22 05 00				Dishwasher connection	1.00	Ea.
22 07 00				Pipe insulation	100.00	L.F.
22 10 00				Piping manifold	2.00	Ea.
22 10 00				Plumbing supply pipe; PEX	280.00	L.F.
22 10 00				Waste & vent piping; ABS	100.00	L.F.
22 11 23				Drainosaur pump/tank for gray water	1.00	Ea.
22 13 63				Expansion tank	1.00	Ea.
22 13 63				350-gallon gray water tank	1.00	Ea.
22 41 00				Kitchen sink & faucet	1.00	Ea.
22 41 00				Vanity sink & faucet	1.00	Ea.
22 41 00				Shower & mixing valve	1.00	Ea.
22 41 13				Water closet	1.00	Ea.
<b>Division 22 Plumbing Subtotal</b>						
<b>Division 23 Heating, Ventilating, and Air Conditioning (HVAC)</b>						
23 23 00				Refrigeration piping	1.00	Ea.
23 30 00				GRD's	5.00	Ea.
23 33 00				Rigid ductwork	130.00	L.F.























LineNumber			T	Description	Quantity	Unit
23 33 00				PCM duct	1.00	Ea.
23 34 00				Exhaust fan	1.00	Ea.
23 34 23				Energy recovery ventilator	1.00	Ea.
23 56 00				Solar tube collector	2.00	Ea.
23 56 00				Collector controls	1.00	Ea.
23 56 00				Misc valves & fittings	1.00	Ea.
23 71 13				110-gallon thermal storage tank; solar w/electric backup	1.00	Ea.
23 73 00				Air handler	1.00	Ea.
23 81 43				Heat pump; 2-ton outdoor unit	1.00	Ea.

**Division 23 Heating, Ventilating, and Air Conditioning (HVAC) Subtotal**

**Division 26 Electrical**

26 05 00				Service entrance conductors; (3) 2/0 THHN (1) #4 ground	15.00	L.F.
26 05 00				Grounding allowance	1.00	Ea.
26 05 00				Duplex	14.00	Ea.
26 05 00				Double duplex	4.00	Ea.
26 05 00				Single pole switch; 1-gang	2.00	Ea.
26 05 00				Single pole switch; 2-gang	2.00	Ea.
26 05 00				Single pole switch; 3-gang	1.00	Ea.
26 05 00				14-2 NM Cable	1,400.00	L.F.
26 05 00				14-3 NM Cable	240.00	L.F.
26 05 00				12-2 NM Cable	380.00	L.F.
26 05 00				12-3 NM Cable	30.00	L.F.
26 05 00				10-3 NM Cable	80.00	L.F.
26 05 00				6-3 NM Cable	50.00	L.F.
26 05 00				12-2 NM Cable	80.00	L.F.
26 05 00				12-3 NM Cable	360.00	L.F.
26 05 00				10-3 NM Cable	50.00	L.F.
26 05 00				Feeder, 3/4" PVC, #6, 3 wire	150.00	L.F.
26 05 83				Air handler Hookup	1.00	Ea.
26 05 83				Heat pump; 2-ton outdoor unit - hookup	1.00	Ea.
26 05 83				Drainosaur pump/tank for gray water - Connection	1.00	Ea.
26 05 83				110-gallon thermal storage tank; solar w/electric backup - hookup	1.00	Ea.
26 05 83				Energy recovery ventilator - hookup	1.00	Ea.
26 05 83				Exhaust fan - hookup	1.00	Ea.
26 09 23				Occupancy sensor	6.00	Ea.
26 09 23				Ambient Light Sensor	6.00	Ea.
26 09 23				Core/temperature Controller	1.00	Ea.
26 16 00				Electrical meter	1.00	Ea.

LineNumber				Description	Quantity	Unit
26 18 16				Combiner Box and Fuse	2.00	Ea.
26 24 00				Junction box	3.00	Ea.
26 24 16				200A Panel; including AFCI circuit breakers	1.00	Ea.
26 27 26				Ground fault interrupter	7.00	Ea.
26 27 26				Weatherproof ground fault interrupter	9.00	Ea.
26 27 26				30A Dryer outlet	1.00	Ea.
26 27 26				50A Range outlet	1.00	Ea.
26 27 26				30A Vehicle charging station	1.00	Ea.
26 30 00				Data Acquisition System DAS	1.00	Ea.
26 31 00				Sunpreme, Maxima GXB 360W	14.00	Ea.
26 31 00				Sunpower, E20/435	10.00	Ea.
26 35 00				ABB, UNO-8.6-TL-OUTD inverter	1.00	Ea.
26 51 00				6" LED Recessed Can	14.00	Ea.
26 51 00				LED Strip Light	4.00	Ea.
26 51 00				LED Wall Sconce	2.00	Ea.
26 51 00				RGB Downlight	3.00	Ea.
<b>Division 26 Electrical Subtotal</b>						
<b>Division 27 Communications</b>						
27 22 00				Data Opening	6.00	Ea.
27 22 00				TV Opening	4.00	Ea.
27 22 00				8- Port Data Sw	1.00	Ea.
27 22 00				WAP, and modem system	1.00	Ea.
27 30 00				Voice Opening	6.00	Ea.
<b>Division 27 Communications Subtotal</b>						
<b>Division 28 Electronic Safety and Security</b>						
28 31 46				Smoke detector	3.00	Ea.
<b>Division 28 Electronic Safety and Security Subtotal</b>						
<b>Division 31 Earthwork</b>						
31 60 00				Seismic Piers w/ 2'x2'x1" Pad	24.00	Ea.
31 60 00				Decking bearing stand	52.00	Ea.
<b>Division 31 Earthwork Subtotal</b>						
<b>Division 32 Exterior Improvements</b>						
32 71 00				Constructed wetlands	87.00	S.F.
32 93 00				5 gal textural plants	4.00	Ea.
32 93 00				1 gal plants w/ tight habit	6.00	Ea.
32 93 00				1 gal low mounding plants	31.00	Ea.
32 93 00				5 gal plants w/ dense tight habit	9.00	Ea.

LineNumber			T	Description	Quantity	Unit
32 93 00				20 gal succulent plants	16.00	Ea.
32 95 00				Planter box - Northwest	91.00	S.F.
32 95 00				Planter box - North	148.00	S.F.
32 95 00				Planter box - Northeast	60.00	S.F.
32 95 00				Planter box - East central	44.00	S.F.
32 95 00				Planter box - West central	27.00	S.F.
32 95 00				Planter box - Southwest	29.00	S.F.
32 95 00				Planter box - South	73.00	S.F.
<b>Division 32 Exterior Improvements Subtotal</b>						
<b>Division 41</b>						
41 22 13				Crane	1.00	Ea.
41 62 00				Trucking	5.00	Ea.
<b>Division 41 Subtotal</b>						



## **Construction Specifications**

SECTION 06 09 00  
WOOD AND PLASTIC FASTENINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-engineered metal or plastic connectors used to support a wood, plated truss or composite wood, from a concrete, masonry, steel, wood, or composite wood supporting member(s).

1.2 REFERENCES

- A. ASTM A36 – Carbon Structural Steel
- B. ASTM A193 – Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
- C. ASTM A240 – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
- D. ASTM A307 – Carbon Steel Bolts and Studs
- E. ASTM A449 – Hex Cap Screws, Bolts and Studs, Steel, Heat Treated
- F. ASTM A480 – General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
- G. ASTM A493 – Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- H. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- I. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- J. ASTM A706 – Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- K. ASTM A924 – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

- L. ASTM A1011 – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
- M. ASTM D7147 – Standard Specification for Testing and Establishing Allowable Loads of Joist Hangers.
- N. ASTM D2395 – Standard Test Methods for Specific Gravity of Wood and Wood-Based Materials
- O. ASTM F1554 – Anchor Bolts, Steel
- P. ASTM F1575 – Standard Test Method for Determining Bending Yield Moment of Nails
- Q. ASTM F1667 – Driven Fasteners: Nails, Spikes, and Staples
- R. ICC-ES AC13 – Acceptance Criteria for Joist Hangers and Similar Devices
- S. ICC-ES AC116 – Acceptance Criteria for Nails and Spikes
- T. ICC-ES AC118 – Acceptance Criteria for Tapping Screw Fasteners
- U. ICC-ES AC120 – Acceptance Criteria for Wood Screws Used in Horizontal Diaphragms and Vertical Shear Walls
- V. ICC-ES AC155 – Acceptance Criteria for Hold-Downs (Tie-Downs) Attached to Wood Members
- W. ICC-ES AC233 – Acceptance Criteria for Alternate Dowel-Type Threaded Fasteners
- X. ICC-ES AC261 – Acceptance Criteria for Connectors Used with Cold-Formed Steel Structural Members
- Y. ICC-ES AC316 – Acceptance Criteria for Shrinkage Compensating Devices
- Z. ICC-ES AC398 – Acceptance Criteria for Cast-In-Place Cold-Formed Steel Connectors in Concrete for Light-Frame Construction
- AA. ICC-ES AC399 Acceptance Criteria for Cast-In-Place Proprietary Bolts in Concrete for Light-Framed Construction
- BB. AISI 2001 – Cold-Formed Steel Specification

CC. 2005 NDS – National Design Specification

### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.
- B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Simpson Strong-Tie Co., Inc.

### 2.2 MATERIALS

#### A. Steel:

- 1. Sheet: ASTM A36, ASTM A653, ASTM A1011
- 2. Fasteners: ASTM A307, ASTM F1554, ASTM F1667, SAE C1022 (SDS Screws)

#### B. Stainless Steel:

- 1. Sheet: ASTM A240, ATT M A480
- 2. Fasteners: ASTM A493

#### C. Finishes:

- 1. Gray paint
- 2. Hot-dipped galvanized or electro-plated galvanized: G90, G185 (ZMAX or HDG)
- 3. Powder-coated paint
- 4. Electro-galvanized, Zinc dichromate and Double Barrier for SD and SDS screws

### 2.3 FABRICATION

- A. Shop assembly to occur per the manufacturer's approved production drawings.
- B. Fabrication tolerances per manufacturer.



- C. Fabrication requiring welding shall be performed in accordance with the current American Welding Society's standards.
- D. The manufacturer's identification shall be stamped into the metal or wood part and a label may be attached to the part with adhesive.

## 2.4 TESTING

- A. Allowable loads published in manufacturer's catalog to be determined using the minimum load from static and/or cyclic analysis and one or more of the following test methods:
  1. Static load tests in wood assemblies
  2. Static load tests in steel jigs
  3. Static load tests of products embedded in concrete or masonry
- B. Testing to determine allowable loads shall be performed as per the applicable ICC-ES Acceptance Criteria or ASTM standard.
- C. Allowable loads for hangers are determined by a static load test resulting in not more than a 1/8" deflection of the joist relative to the header, or either the lowest of 3 or average of 6 ultimate load divided by 3, or the fastener allowable load as determined by the NDS, whichever is lowest.
- D. Manufacturer to provide code testing data on all products that have been code tested upon request.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Unless otherwise noted in the manufacturer's catalog, allowable loads are for Douglas Fir-Larch under continuously dry conditions. Allowable loads for other species or conditions must be adjusted according to the code. See manufacturer's catalog for additional notes and requirements.
- B. Built up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
- C. Verify that the dimensions of the supporting member are sufficient to receive the specified fasteners.

## 3.2 INSTALLATION

- A. Unless otherwise noted in the manufacturer's catalog, bolts, screws and/or nails shall not be combined.
- B. All nails shall be common unless otherwise noted in the manufacturer's catalog or substituted by the engineer of record with a reduction taken.
- C. Unless otherwise noted in the manufacturer's catalog, bending steel in the field may cause fractures at the bend line. Fractured steel will not carry the allowable load and must be replaced. When bending is allowed or required in the catalog, the connector shall be allowed one cycle bend, one time only.
- D. Galvanized connectors should not be placed in contact with treated wood unless the treated wood is adequately verified to be suitable for such contact. Some wood treatments may accelerate metal deterioration. See the manufacturer's catalog for specific recommendations.
- E. A fastener that splits the wood will not carry the allowable load. Evaluate splits to determine if the connection will perform as required. Dry wood will split more easily and should be evaluated as needed. If wood tends to split, consider pre-boring holes with a diameter not exceeding 0.75 of the nail diameter, for screws in wood with a specific gravity of 0.5 or greater use: 5/32" for SDS, 5/64" for SD9 or SD10, and 1/16" for SD8 (2005 NDS 11.1.4 and 11.1.5.3).
- F. Wood shrinkage will be taken into consideration when designing and installing connections.
- G. Built-up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
- H. Top flange hangers may cause unevenness. Possible remedies should be evaluated by a professional and include using a face mount hanger, routing the beam, or cutting the subfloor to accommodate the top flange thickness.
- I. Do not overload by exceeding the manufacturer's catalog allowable load values.
- J. Unless otherwise noted in the manufacturer's catalog, fill all fastener holes with fastener types as specified in the manufacturer's catalog.
- K. All specified fasteners must be installed according to the instructions in the manufacturer's catalog.

- L. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter (2005 NDS 11.1.2.2).
- M. Install all specified fasteners before loading the connection.
- N. Use proper safety equipment.
- O. Welding shall be in accordance with the Welding Society (AWS) standards.
- P. Welding galvanized steel may produce harmful fumes. Follow proper welding procedures and safety precautions.
- Q. Nail tools with hole-location mechanisms may be used to install connectors, provided the correct quantity and type of nails are properly installed in the nail holes.
- R. The joist shall bear completely on the connector seat the gap between the joist end and the header or back plate of the hanger shall not exceed 1/8".
- S. The installer of ATS systems shall cut rods to length as required.
- T. Anchor bolt nuts should be finger-tight plus 1/3 to 1/2 turn with a wrench. Do not use an impact wrench to tighten nuts on the anchor bolts.
- U. Modifications to products or changes in installation procedures should only be made by a qualified designer. The performance of such modified products or altered installation procedure is the sole responsibility of the designer.

### 3.3 FIELD QUALITY CONTROL

- A. Determine that the proper part is being used in the correct application and has been fabricated by the approved manufacturer by observation of the stamp into the metal part and/or the adhesive label on the product denoting part and manufacturer name.
- B. Before substituting another brand, confirm load capacity based on published testing data and calculations per section 2.4. The engineer/designer of record shall evaluate and give written approval for substitution prior to installation.

END OF SECTION

SECTION 06 10 00  
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Provide rough carpentry.

1.2 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Lumber Standards and Grade Stamps: DOC PS 20, American Softwood Lumber Standard and inspection agency grade stamps.
- C. Construction Panel Standards: DOC PS 1, U.S. Product Standard for Construction and Industrial Plywood; APA PRP-108.
- D. Wood Framing Standards: NFPA House Framing Manual.
1. Exterior Wall Framing: 2 inch by 6-inch nominal (38 mm by 140 mm actual) studs, 24 inches (61 cm) on center.
  2. Exterior Wall Framing: 2 inch by 4-inch nominal (38 mm by 89 mm actual) studs, 16 inches (40 cm) on center.
  3. Interior Wall Framing: 2 inch by 4-inch (38 mm by 89 mm actual) studs, 16 inches (40 cm) on center.

PRESERVATIVE TREATMENT: AWPA C2 for lumber and AWPA C9 for plywood; waterborne pressure treatment. Provide for wood in contact with soil, concrete, masonry, roofing, flashing, dampproofing and waterproofing.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Rough Carpentry Applications:
1. Manufacturers, Dimensional Lumber: [Boise Cascade Company](#); Manufacturers,.
  2. Dimension Lumber:
    - a. Light Framing: Stud, No. 2 or Standard grade.
    - b. Structural Framing: No. 1 grade.
    - c. Species: Any species of grade indicated.
  3. Building Wrap:
    - a. Material: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations;

ASTM E 1677, Type I.

4. Framing Anchors and Fasteners:

- a. Material: Non-corrosive, suitable for load and exposure. Drywall screws are not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- B. Plywood: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial"
- C. Provide nailers, blocking and grounds where required. Set work plumb, level and accurately cut.
- D. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with other work.
- E. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.
- F. Restore damaged components. Protect work from damage.

END OF SECTION

SECTION 06 12 00  
STRUCTURAL INSULATED PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Structural Insulated Panels (SIPs).
- B. Related Sections: Section(s) related to this section include:

1.2 SYSTEM DESCRIPTION

- A. Structural Insulated Panels (SIPs) consist of oriented strand board (OSB) laminated with structural adhesives to an insect resistant EPS insulation core, and SIP Manufacturer supplied connecting splines, sealants, and SIP screws.

1.3 REFERENCES

- A. ACSE 7 - Minimum Loads for Buildings and other Structures.
- B. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- C. ASTM E1803 – Standard Test Method for Determining Structural Capacities of Insulated Panels.
- D. DOC PS2 – Performance Standard for Wood-based Structural-Use Panels.
- E. ICC ES AC04 – Acceptance Criteria for Sandwich Panels.
- F. ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives.
- G. ICC ES AC12 – Acceptance Criteria for Foam Plastic Insulation.
- H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- I. ASTM E1333- Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.

J. EPA - Registered products listing.

## 1.4 SUBMITTALS

### A. Product Data:

1. SIP Code Compliance: Submit a code report / material listing report for SIPs showing evidence of compliance with code requirements as an alternate method of construction. Submit current compliance report from an International Accreditation Service (IAS) Accredited Product Certification Agency that has demonstrated compliance with ISO Guide 65, *General requirements for bodies operating product certification systems*, showing conformance to the International Building Code (IBC) and International Residential Code (IRC).
  - a. Shear Wall use: The submitted code report / material listing report shall include all load cases for transverse, axial and racking shear loading for the SIPs. The report must demonstrate that the SIPs may be used as shear walls in all Seismic Design Categories A, B, C, D, E and F.
2. EPS Code Compliance: Submit ICC ES code report for EPS foam with evidence of compliance with code. Submit current compliance report numbers from ICC ES with conformance to the International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC12.
3. Manufacturer's Instructions: Submit SIP Manufacturer's construction detail book and load design charts.

B. Calculations: Submit structural calculations by a design professional registered in the state the project is being constructed in and qualified to perform the design work.

C. Shop Drawings: Submit shop drawings for SIPs showing layout, elevations, product components and accessories.

### D. Quality Assurance Submittals - Submit the following:

1. SIPs: Submit SIP product certificate showing compliance to Third Party Quality Control program of Underwriters Laboratories, Inc.
2. EPS Core: Submit EPS Insulation manufacturer's certificate showing compliance to Third Party Quality Control program of Underwriters Laboratories, Inc.
3. Labels: Submit a copy of the label approved by the Inspection Agency certifying that manufacture of panels complies with specified performance characteristics and physical properties.
4. SIPA Manufacturer Member in Good Standing: Submit SIPA certificate as evidence showing SIP Manufacturer is a SIPA manufacturing member in good standing.

5. Formaldehyde Emission Rates: Submit evidence that the SIP manufacturer has tested the panels in accordance with ASTM E1333 by and IAS accredited testing laboratory and the result of the testing shows formaldehyde levels below .03 ppm.
- E. Fire Resistant Assemblies - Submit the following:
  1. Submit UL construction number or a code report / material listing report describing each fire-rated assembly.
  2. Submit UL certificate showing flame spread and smoke developed information.
- F. Warranty: Submit SIP manufacturer's standard warranty document.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
- B. Source Limitations: Obtain all SIPs through one manufacturer. All accessories to be furnished or recommended by the SIP manufacturer.
- C. SIP Manufacturer shall be a Manufacturing Member, in good standing, of the Structural Insulated Panel Association (SIPA).

## 1.6 REGULATORY REQUIREMENTS

- A. SIPs shall be recognized for compliance in a current IAS accredited evaluation report or material listing report compliant with the 2009 IBC and 2009 IRC.
- B. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, SIP manufacturer's installation instructions and SIP manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

## 1.7 DELIVERY, STORAGE & HANDLING

- A. Ordering: Comply with SIP manufacturer's ordering instructions and lead time requirements to avoid construction delays.



- B. Delivery: Deliver materials from SIP manufacturer with identification labels or markings intact.
- C. Off-load SIPs from truck and handle using forklift or other means to prevent damage to SIPs.
- D. SIPs shall be fully supported in storage and prevented from contact with the ground. Stack SIPs on pallets or on supports at a maximum of four feet on center.
- E. SIPs shall be fully protected from weather. Protect against exposure to rain, water, dirt, mud, and other residue that may affect SIP performance. Cover stored SIPs with breathable protective wraps. SIPs shall be stored in a protected area.

## 1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: SIP Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
  - 1. Warranty Period: Twenty (20) years from the date of issue of the warranty.

## PART 2 PRODUCTS

### 1.1 MANUFACTURES / SUPPLIERS

- A. Premier SIPs, 1155 Business Park Drive-Bldg "A", Dixon, CA 95620-4303. Phone 707-678-6900

### 1.2 MATERIALS

- A. SIPs consisting of the following:
  - 1. EPS core UL certified for fire and physical properties of ASTM C578 Type I EPS with borate insect resistant treatment. Insulation manufacturer shall provide Third Party UL certificate.
  - 2. OSB identified with APA or PFS performance mark with Exposure I durability rating and performance in accordance with DOC PS-2 span rating 24/16 or greater.
  - 3. Laminating Adhesives shall be in conformance with ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives

### 1.3 ACCESSORIES

- A. Splines: OSB, Premier SIP Spline, or I-beam for use in joining SIPs shall be supplied by SIPs manufacturer.

- B. Fasteners: corrosion resistant SIP screws compatible with SIP system shall be provided by the SIPs manufacturer.
  - 1. Wood Screws for attachment to wood members
  - 2. Heavy Duty Metal Screws for attachment to metal members (16 gauge to 1/4")
  - 3. Light Duty Metal Screws for attachment to metal decks (18 gauge or thinner)
- C. SIP Mastic: Shall be specifically designed for use with SIPs. Mastic must be compatible with all components of the SIP. Mastic shall be provided by the SIP manufacturer.
- D. Dimensional Lumber: Kiln dried DF, #2 or better, or engineered equivalent unless otherwise required by structural drawings.
- E. Vapor Retarder SIP Tape: Tape with an adhesive suitable for indoor use, min. 6 inch wide for use on SIP joints, 18 inch wide for use at roof beams. SIP Tape shall be supplied by the SIP manufacturer.

#### 1.4 FABRICATION

- A. Sizes: SIPs shall be fabricated in accordance with approved Shop Drawings
- B. Thermal Resistance, R-value
  - 1.5 8 1/4" (210 mm) thick SIP with R-value of 29.5 at 75°F and an R-value of 31.8 at 40°F

#### 1.6 PRODUCT SUBSTITUTIONS

- A. Substitutions: No substitutions permitted.

#### 1.7 RELATED MATERIALS

- A. Related Materials: Refer to other sections for related materials as follows:
  - 1. Dimensional Lumber: Kiln dried DF #2 or better or pre-engineered equivalent: Refer to Division 6 Carpentry Sections.

#### 1.8 SOURCE QUALITY

- A. Source Quality Assurance: Each SIP component required shall be supplied by SIP manufacturer and shall be obtained from selected SIP manufacturer or its approved supplier.

1. Each SIP shall be labeled indicating UL or other ISO Guide 65 approved Third Party certification.
2. Provide evidence of UL Third Party inspection and labeling of all insulation used in manufacture of SIPs.
3. SIP manufacturer shall provide Lamination/R-Value Warranty documents for building owner acceptance and execution. Manufacturer's standard forms will be submitted.
4. Provide SIPs with EPS treated for insect resistance. Treatment shall be EPA registered.
5. Dimensional Tolerance - shall comply with values listed in the manufacturer's Quality Control Manual.

B. Source Quality: Obtain SIPs from a single manufacturer.

## PART 3 EXECUTION

### 1.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's ICC-ES or material listing report, Load Design Charts, Detail Book, Shop Drawings, and Product data, including product technical bulletins, for installation.

### 1.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.
1. Verify conditions of foundation/structural system/substrate and other conditions which affect installation of SIPs. Any adverse conditions shall be reported in writing to the SIP manufacturer and the design professional. Do not proceed with installation until adverse conditions are corrected.

### 1.3 INSTALLATION

A. SIP Installation:

1. SIP Supports: Provide level and square foundation/structural system/substrate that support wall and/or roof SIPs. For wall SIPs, hold sill plate back from edge of rim board 1/2" (12 mm) to allow full bearing of OSB skins. Provide 1 1/2" (38 mm) diameter access holes in plating to align with electrical wire chases in SIPs. Provide adequate bracing of SIPs during erection. Remove debris from plate area prior to SIP placement.
2. SIP Fastening: Connect SIPs by nails or staples as shown on drawings. Screws of equal strength

may be substituted for nails and staples as specified by engineer. SIP mastic must be used together with each fastening techniques. Where SIP Screw Fasteners are used, provide a minimum of 1" (25.4 mm) penetration into support. Join SIPs using plates and splines. Secure attachment with nails, staples, or screws, and SIP mastic. Apply SIP mastic following SIP manufacturer recommendations.

3. SIP Tape: Provide SIP Tape at joints between SIP wall panels, roof panels and at intersection of SIP roof and wall panels and as shown in SIP Manufacturer's details.
4. Vapor Retarders: Provide vapor retarders mandated by building code.
5. Thermal Barriers: Interior surfaces of SIPs shall be finished with a minimum 15-minute thermal barrier, such as gypsum wallboard, nominal 1" (25 mm) wood paneling, or other approved materials. Apply code approved thermal barriers according to SIP manufacturer's recommendations.
6. Restrictions: Do not install SIPs directly on concrete. Do not put plumbing in SIPs without consulting SIP manufacturer. Do not over cut skins for field-cut openings and do not cut skins for electrical chases. SIPs shall be protected from exposure to solvents and their vapors that damage the EPS foam core.
7. Remove and replace insulated wall or roof SIPs which have become excessively wet or damaged before proceeding with installation of additional SIPs or other work.

#### 1.4 FIELD QUALITY REQUIREMENTS

- A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

1. Site Visits:

#### 1.5 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction.
  1. Roof SIPs: Protect roof SIPs from weather by roofing materials to provide temporary protection at the end of the day or when rain or snow is imminent.
  2. After installation, cover SIPs to prevent contact with water on each exposed SIP edges and faces.

END OF SECTION

SECTION 06 40 23  
INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

3.2 SUMMARY - Provide interior finish carpentry, architectural woodwork and countertops.

3.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

3.4 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards: Architectural Woodwork Institute (AWI) 'Architectural Woodwork Standards.'
- C. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
  - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
  - 5. Hardwood Plywood and Face Veneers: HPVA HP-1.
- D. Mock-Ups:

PART 4 PRODUCTS

3.1 MATERIALS

- A. Interior Wood Casework:
  - 1. Manufacturers: Calli Bamboo
  - 2. Species for Transparent Finish: Bamboo veneer
  - 3. Species for Transparent Finish:
  - 4. Face Style: Flush overlay.
  - 5. Frame Fabrication: Frameless.
  - 6. Grain Matching: Vertical.

PART 5 EXECUTION

3.1 INSTALLATION

- A. Provide work to sizes, shapes, and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Quality Standard: Install woodwork to comply with AWI standards for the same grade specified for type of woodwork involved.
- C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- D. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.
- E. Repair minor damage, clean and protect.

END OF SECTION

SECTION 07 21 19  
FOAMED IN PLACE INSULATION

PART 1 GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

SUMMARY

Section Includes:  
Open-cell spray polyurethane foam.

ACTION SUBMITTALS

Product Data: For each type of product.

INFORMATIONAL SUBMITTALS

Qualification Data: For Installer.

Product Test Reports: For each product, for tests performed by a qualified testing agency  
Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC

QUALITY ASSURANCE

Installer Qualifications: An authorized representative who is trained and approved by manufacturer. Any repairs by an Icynene licensed contractor.

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.

Fire Resistance Characteristics: As determined by testing identical products (based on a 4 inch (100 mm) minimum thickness) according to ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Fire Resistance Characteristics: As determined by testing identical products according to NFPA 285 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

## DELIVERY, STORAGE, AND HANDLING

Protect spray polyurethane foam components as follows:

Component A and B: store between 60 degrees F (15 degrees C) and 90 degrees F (32 degrees C).

Component B can be frozen but must be protected from overheating over 120 degree F (49 degree C) and prolonged storage over 100 degree F (37 degree C).

Component B: mix thoroughly prior to use.

Components should be a matched set (system) as supplied by the manufacturer.

Use components within their labeled shelf-life.

Use components as supplied with no site alterations or additions.

## WARRANTY

Refer to manufacturer's standard warranty terms (as applicable).

## PRODUCTS

### PERFORMANCE CHARACTERISTICS

Air Material Air Leakage Rate: Maximum material air leakage rate of less than 0.004 cfm/ft<sup>2</sup> under a pressure differential of 0.3 in w.g. (1.6 psf) (0.02 L/m<sup>2</sup> at 75 Pa) per ASTM E 2178 or E 282.

Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Flame-Spread Index: 25 or less.

Smoke-Development Index: 450 or less.

Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

Sustainability Requirements: Provide spray polyurethane foam insulation as follows:

Low Emitting: Insulation tested according to CA/DPH/EHLB/v1.1-2010.

Resistant to fungal growth as per ASTM C1338.

Containing no PBDE.

Basis-of-Design Product: Subject to compliance with requirements, provide Icynene Inc.; Icynene ProSeal or comparable product



## OPEN-CELL SPRAY POLYURETHANE FOAM

Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of 0.5 lb/cu. ft. (8.0 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 3.7 deg F x h x sq. ft./Btu at 75 deg F (0.65 K x sq. m/W at 24 deg C).

Basis-of-Design Product: Subject to compliance with requirements, provide Icynene Inc.; Icynene Classic or comparable product by one of the following:

BASF Corporation.  
Bayer Material Science (Bay Systems)

## EXECUTION

### PREPARATION

Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

### INSTALLATION

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

Spray insulation to envelop entire area to be insulated and fill voids.

Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

Do not apply insulation within 3-inches (76 mm) of heat emitting devices or where the temperature is in excess of 200 degrees F (93 degrees C), as per ASTM C411 or in accordance with applicable codes.

Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

### PROTECTION

Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

Thermal Protection: Protect installed spray polyurethane foam insulation with qualified thermal or ignition barrier per applicable building codes.

## INSTALLATION OF AIR BARRIER COMPONENTS

Install air barrier components – membranes and sealants – as indicated on drawings for spray polyurethane foam as part of an air barrier system.

END OF SECTION

SECTION 07 25 00  
WEATHER BARRIERS  
DuPont™ Tyvek® HomeWrap®

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Weather barrier membrane (DuPont™ Tyvek® HomeWrap®)
- B. Seam Tape (DuPont™ Tyvek® Tape)
- C. Flashing (DuPont™ FlexWrap™, DuPont™ FlexWrap™ NF, DuPont™ StraightFlash™, DuPont™ StraightFlash™ VF, and/or DuPont™ Thru-Wall Flashing)
- D. Fasteners (DuPont™ Tyvek® Wrap Caps)

1.2 REFERENCES

- A. ASTM International
  - 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
  - 2. ASTM C1193; Standard Guide for Use of Joint Sealants
  - 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
  - 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
  - 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
  - 6. ASTM E96; Test Method for Water Vapor Transmission of Materials
  - 7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
  - 8. ASTM E2178; Test Method for Air Permeance of Building Materials
- B. AATCC – American Association of Textile Chemists and Colorists
  - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test
- C. TAPPI
  - 1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
  - 2. Test Method T-460; Air Resistance (Gurley Hill Method)

1.3 SUBMITTALS

B. Product Data: Submit manufacturer current technical literature for each component.

## 1.4 QUALITY ASSURANCE

### A. Qualifications

1. Installer shall have experience with installation of similar weather barrier assemblies under similar conditions.
2. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section [01 60 00 Product Requirements] [insert section number and title].
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by system manufacturer.

## 1.6 SCHEDULING

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURER

DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://www.construction.tyvek.com>

### 2.2 MATERIALS

- A. Basis of Design: spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® HomeWrap® and related assembly components.
- B. Performance Characteristics:
  1. Air Penetration: <.004 cfm/ft<sup>2</sup> at 1.57 psf, when tested in accordance with ASTM E2178. Type I per ASTM E1677.

2. Water Vapor Transmission: 56 perms, when tested in accordance with ASTM E96-05, Method A.
3. Water Penetration Resistance: 250 cm when tested in accordance with AATCC Test Method 127.
4. Basis Weight: 1.8 oz/yd<sup>2</sup>, when tested in accordance with TAPPI Test Method T-410.
5. Air Resistance: 1200 seconds, when tested in accordance with TAPPI Test Method T-460.
6. Tensile Strength: 30/30 lbs/in., when tested in accordance with ASTM D882.
7. Tear Resistance: 8/6 lbs, when tested in accordance with ASTM D1117.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 15, Smoke Developed: 15

## 2.3 ACCESSORIES

- A. Seam Tape: [2] [or] [3] inch wide, DuPont™ Tyvek® Tape as distributed by DuPont Building Innovations.
- B. Fasteners:
  1. (Specifier Note: Steel Frame Construction) DuPont™ Tyvek® Wrap Cap Screws, as distributed by
  2. (Specifier Note: Wood Frame Construction) DuPont™ Tyvek® Wrap Caps, as distributed by DuPont: #4 nails with large 1-inch plastic cap fasteners, or 1-inch plastic cap staples with leg length sufficient to achieve a minimum penetration of 5/8-inch into the wood stud.
2. Provide sealants that comply with ASTM C 920, elastomeric polymer sealant to maintain watertight conditions.
3. Products:
  - a. DuPont™ Residential Sealant
  - b. Sealants recommended by the weather barrier manufacturer.
- C. Adhesive:
  1. Provide adhesive recommended by weather barrier manufacturer.
- D. Flashing
  1. DuPont™ FlexWrap™, as distributed by DuPont: flexible membrane flashing materials for window openings and penetrations.
  2. DuPont™ FlexWrap™ NF, as distributed by DuPont: flexible membrane flashing materials for window openings and penetrations.
  3. DuPont™ StraightFlash™, as distributed by DuPont: straight flashing membrane materials for flashing windows and doors and sealing penetrations, masonry ties, etc.
  4. DuPont™ StraightFlash™ VF, as distributed by DuPont: dual-sided, straight flashing membrane materials for brickmold and non-flanged windows and doors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

### 3.2 INSTALLATION – WEATHER BARRIER

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- B. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- C. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface. Maintain weather barrier plumb and level.
- D. Extend bottom roll edge over sill plate interface 2" to 3" minimum. Seal weather barrier with sealant or tape. Shingle weather barrier over back edge of thru-wall flashings and seal weather barrier with sealant or tape. Ensure weeps are not blocked.
- E. Subsequent layers shall overlap lower layers a minimum of 6 inches horizontally in a shingling manner.
- F. Window and Door Openings: Extend weather barrier completely over openings.
- G. Weather Barrier Attachment:

### 3.3 SEAMING

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

### 3.4 OPENING PREPARATION (for use with flanged windows)

- A. Cut weather barrier in an “I-cut” pattern. A modified I-cut is also acceptable.
  - 1. Cut weather barrier horizontally along the bottom and top of the window opening.
  - 2. From the top center of the window opening, cut weather barrier vertically down to the sill
  - 3. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 8 inches of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

### 3.5 FLASHING

- A. Cut [9-inch] wide DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF a minimum of 12 inches longer than width of sill rough opening. Apply primer as recommended by the manufacturer.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ or DuPont™ FlexWrap™ NF at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges. Mechanical fastening is not required for DuPont™ FlexWrap™ NF.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer’s instructions.
- F. Apply 4-inch wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
- G. Apply 4-inch wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.
- I. Tape head flap in accordance with manufacturer recommendations.
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer’s instructions and ASTM C1193.

### 3.6 PROTECTION

A. Protect installed weather barrier from damage.

END OF SECTION



SECTION 07 42 43  
COMPOSITE AND PLASTIC PANELS

PART 6 GENERAL

3.1 SUMMARY

- A. Provide Exterior wall panels.

3.2 SUBMITTALS

- A. Product Data: Richlite Rain Shadow
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- D. Warranty: Submit manufacturers standard warranty. Include labor and materials to repair or replace defective materials.
  - 1. Warranty Period: 10 years.

3.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 7 PRODUCTS

3.1 MATERIALS

- A. Manufacturers: Paper Composite rainscreen cladding: Richlite Company: [www.richlite.com](http://www.richlite.com).
  - 1. Application: Exterior wall panels, fascia,
- B. Material characteristics
  - 1. Surface Burning Characteristics: Flame spread 30, maximum; smoke developed 30, maximum; when tested in accordance with ASTM E 84.
  - 2. Density: 75.84 pounds per cu ft (1215 kg per cu m).
  - 3. Water Absorption: 0.36 percent for 1 inch (25 mm) thickness, unsealed material, 24 hour fully submerged test.
  - 4. Specific Gravity: 1.213.
  - 5. Thermal Properties:
    - a. Coefficient of Thermal Expansion, X Direction: 5.2 microinches per inch degree F (9.4 microns per mm degree C).

- b. Coefficient of Thermal Expansion, Y Direction: 12.8 microinches per inch degree F (23.0 microns per mm degree C).
  - c. Coefficient of Thermal Expansion, Z Direction: 45.9 microinches per inch degree F (82.7 microns per mm degree C), for span of 73.5 inches (1.87 m).
  - d. Thermal Conductivity: 0.00051 Cal cm/sq cm sec degree C.
6. Tensile Strength:
- a. X Direction: 19,200 psi (132.4 MPa).
  - b. Y Direction: 13,100 psi (90.3 MPa).
7. Compressive Strength:
- a. X Direction: 18,400 psi (126.9 MPa); 7.09 percent strain at failure.
  - b. Y Direction: 15,900 psi (109.6 MPa); 7.15 percent strain at failure.
  - c. Z Direction: 30,000 psi (206.8 MPa); 20 percent strain at failure.
8. Flexural Strength, Face in Tension:
- a. X Direction: 22,000 psi (151.7 MPa).
  - b. Y Direction: 17,300 psi (119.3 MPa).
9. Flexural Strength, Edge in Tension:
- a. X Direction: 20,400 psi (140.6 MPa).
  - b. Y Direction: 16,100 psi (111.0 MPa).
10. Izod Impact, Face Impact:
- a. X Direction: 2.48 ft lb per inch of width (0.046 J/m of width).
  - b. Y Direction: 1.46 ft lb per inch of width (0.027 J/m of width).
11. Izod Impact, Edge Impact:
- a. X Direction: 0.68 ft lb per inch of width (0.013 J/m of width).
  - b. Y Direction: 0.62 ft lb per inch of width (0.012 J/m of width).

C. Description

- 1. Type: Field-assembled panels with exposed fasteners.
- 2. Appearance: opaque as selected.
- 3. Finish: Decorative color or surface as selected.
- 4. Panels: Non-insulated.

## PART 8 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged components and finishes. Clean and protect work from damage.

END OF SECTION

SECTION 07 45 70  
CEMENTITIOUS PANELS

PART 9 GENERAL

3.1 SECTION INCLUDES

- A. Cementitious panel with accessories.

3.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Wood framing and bracing.
- B. Section 06100 - Rough Carpentry: Sheathing.
- C. Section 07210 - Insulation: Exterior wall insulation.

3.3 REFERENCES

3.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Installation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Manufacturer's best practice guide.
  - 4. Technical data sheet.
  - 5. Standard CAD drawings

3.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store siding flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

3.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

3.7 WARRANTY

- A. Manufacturer's Warranty: Provide Hardie HZ5 or HZ10 Reveal Panel Limited Product Warranty,

with 30-year limited product warranty against manufacturing defects.

1. Application Warranty: Application limited warranty for 2 years.

## PART 10 PRODUCTS

### 3.1 MANUFACTURERS

- A. Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Fax: 949-367-4981; Email: [request\\_info \(info@jameshardie.com\)](mailto:request_info(info@jameshardie.com)); Web: [www.jameshardiecommercial.com](http://www.jameshardiecommercial.com)

- B. Requests for approval of equal substitutions will be considered in accordance with provisions of Section 01600.

### 3.2 CLADDING

- A. Cement Cladding Panels: Hardie Reveal Panel as manufactured by James Hardie Building Products, Inc. 5/16 inches thick, 48" wide by 96" inches long.
- B. Code Compliance Requirement for Siding Materials:
  1. Fiber-cement siding, complies with ASTM C 1186 Type A Grade II.
  2. Fiber-cement siding, complies with ASTM E 136 as a noncombustible material.
  3. Fiber-cement siding, complies with ASTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
  4. Fiber-cement siding, complies with ASTM E 119 1 hour and 2 hour fire resistive assemblies listed with Warnock Hersey.
  5. Fiber-cement siding, tested to ASTM E330 for Transverse Loads.
  6. Intertek Warnock Hersey Product Listing.
  7. Manufacturer's Technical Data Sheet.

### 3.3 WEATHER BARRIER

- A. Weather Barrier: Tyvec

### 3.4 FASTENERS

- A. Fasteners: For attaching Hardie Reveal Panel to a rain screen provide the following:
  1. Fasteners shall be of high quality hot dip galv. Box nails
    - a. Alternatives must be approved by the architect. e.g. decorative screws, nails, bugle head screws, etc.

### 3.5 FINISHES

- A. Factory Primer: Provide factory applied universal primer.

1. Primer: Factory applied sealer/primer by James Hardie. Apply flat sheen finishes to panels.
2. Topcoat: Refer to Section 09900 and Exterior Finish Schedule.

## PART 11 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Ensure that drainage plane is intact and all penetrations are sealed.

### 3.3 INSTALLATION

- A. Wood Framing: Nominal 2 inch by 4 inch (51 mm by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
  1. Install water-resistive barriers and claddings to dry surfaces.
  2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
  3. Protect siding from other trades.
- B. Panel Installation: Install materials in strict accordance with manufacturer's installation instructions.
  1. Place fasteners no closer than 3/8 inch from panel edges and 2 inches (51 mm) from panel corners.
  2. Use fasteners as specified in the James Hardie Tech Data sheet Install panel using 1/8 inch spacers at horizontal joints. Leave bottom edge of panel above all horizontal trims exposed, no caulking shall be placed at this overlap of.
  3. Install a kickout flashing to deflect water away from the siding at the roof intersection.
  4. Allow minimum vertical clearance between the bottom edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

5. Maintain clearance between siding and adjacent finished grade.
6. Specific framing and fastener requirements - refer to the applicable building code compliance reports.

#### 3.4 FINISHING

- A. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic exterior flat grade paint with flat finish within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

#### 3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 07 54 00

### MECHANICALLY ATTACHED HEAT-WELDED THERMOPLASTIC SHEET ROOF MEMBRANE SYSTEMS

#### PART 1 – GENERAL

##### System Description

Mechanically attached heat-welded thermoplastic sheet roof membrane systems.

##### 1.1 Regulatory Requirements And Pre-Job Conference

- A. Conform to all applicable building and jurisdictional codes, including roof assembly wind uplift and fire-resistance requirements and slope limitations. GAF recommends at least ¼" (6.3 mm) per foot of slope with proper grading and placement of drainage outlets.
- B. Follow your local jurisdiction requirements for disposing of used or expired adhesives, sealants, and other products subject to disposal regulations.
- C. Potential problems in roofing applications, as well as potential conditions that may be detrimental to installation and performance of the roof system, should be resolved prior to the start of the application. This can best be accomplished by a pre-job meeting with the architect; roofing contractor; general contractor; all other subcontractors whose work will involve the roof system/related systems; and the manufacturer's representative.
- D. The following are common items of discussion at a pre-job conference:
  - 1. Roof deck conditions.
  - 2. Flashing and expansion joint details.
  - 3. Insurance underwriters or building code requirements.
  - 4. Unusual project conditions.
  - 5. Protection of the roof, building, building occupants, and contents during and after application.
  - 6. Application techniques.
  - 7. Coordination and scheduling of other trades that will be working on the project.
  - 8. Designation by the roofing contractor of a qualified person responsible for quality control. This person should be on the project full time during application of the roof system, and should not be replaced without the approval of GAF.
  - 9. Scheduling of material shipments, material storage, and rooftop loading.
  - 10. Submittals of materials, drawings, and project documents.

##### 1.2 Delivery, Storage, And Protection

- A. Deliver products to site in original containers with seals unbroken and labeled with manufacturers' name, product brand name, and type
- B. Store materials in weather-protected environment, clear of the ground and moisture, in accordance with GAF instructions. Store all adhesives, coatings, and sealants/caulks to protect them from freezing. Frozen material must be discarded and replaced. Properly seal

all liquid material containers after use.

C. Outside storage of roofing materials:

1. All materials stored outside must be raised above ground or roof level on pallets and covered with a tarpaulin or other waterproof and "breathable" material. Insulation products should be properly stored and weighted to avoid weather and wind damage.
  2. Factory-installed plastic wrapping is not designed as protective covering for insulation materials and should be removed. Use "breathable" type covers, such as canvas tarpaulins, to allow venting and protection from weather and moisture.
  3. Cover and protect materials at the end of each day's work.
  4. Do not remove any protective tarpaulins until immediately before material will be installed. Extreme heat or cold conditions may require special storage requirements. Reference product data sheets for product storage requirements.
- D. Follow GAF directions and requirements for protection of roofing materials prior to and during installation.
- E. Do NOT use materials that are wet or damaged to the extent that they will no longer serve their intended purposes. All roof insulation that has been wet is considered damaged, even if later dried out. Remove all damaged materials from the job site.
- F. When staging materials on the roof during application, ensure the deck and structure are not temporarily overloaded by the weight of construction materials.
- G. At the job site, no more material should be stored than what will be used within two weeks. For periods longer than two weeks, the materials should be properly warehoused; i.e., dry, ventilated, on pallets, etc. No more material should be stored on the rooftop than can be used within five days. When prolonged inclement weather threatens, i.e., rainy seasons, no more roofing materials should be supplied to the rooftop than can be used within two days.

1.3 Environmental Requirements And Restrictions

- A. Do not apply roofing materials during inclement or threatening weather.
- B. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.
- C. Be aware that high or gusting winds make the installation of some materials more difficult.
- D. Material installation during periods of high ambient temperature and/or humidity levels [typically above 90°F (32°C) and/or 90% relative humidity] can result in poor installation quality due to condensation on the membrane surface or excessively fast adhesive drying rates in hot, dry weather. Do not install materials when moisture, in any form, is present on the roof deck or substrate to which the materials are to be applied.
- E. Material installation during periods of low ambient temperatures, typically below 30°F (0°C), can result in poor installation quality. To avoid these problems:
1. Store accessory materials in a warming box.
  2. Use as soon as possible after removal from warming box.
  3. Allow adhesives to properly cure.
  4. Adjust welder settings to ensure proper welds for applicable ambient conditions.

1.4 Working Environment

- A. Work should only begin when the contractor has decided to his/ her satisfaction that all specifications are workable as specified, and that the contractor can meet project and code requirements.
- B. The contractor should only begin roofing work when the substrates have been prepared as necessary, and are ready to accept the roofing materials installed as specified.
- C. Provide a safe working environment, including, but not limited to, adequate fall protection, restriction of unauthorized access to the work area, and protection of the building and its occupants.
- D. Safe work practices should be followed, including, but not limited to, keeping tools in good operating order; providing adequate ventilation if adhesives are used; and daily housekeeping to remove debris and other hazards. See section 1.07 for further details on safety.
- 1.5 Protect the building, contents, surrounding area, building occupants, and contractor personnel during work. Coordinate all work operations with the building owner and building occupants so that adequate interior protection, as necessary, is provided and disruption to normal building operations is minimized. **Safety Considerations And Warnings**



- A. As with any construction process, safety is a key element. All applicable safety standards and good roofing practices must be followed. Read and understand GAF's Design & Application Guidelines before starting application. Follow all precautions and directions.
- B. Only properly trained and professionally equipped roofing contractors experienced in the installation of each TPO and PVC roofing application should install these systems. Never allow contact between the heated surface of a hot welder or other tool and the applicator's hair, skin, or clothing. Always wear protective gear, including but not limited to: hardhats, goggles, heavy-duty gloves, and snug-fitting clothing.
- C. Solvent-containing accessories may be combustible and should always be kept from heat, flame, or any source of ignition. Empty containers must be disposed of in posted toxic substance landfills in accordance with local, state, and federal regulations.
- D. Thoroughly train all personnel in first-aid procedures, and always comply with all OSHA safety standards and fire codes. Also, use extreme caution when working around equipment, such as gas lines or HVAC units, which have electrical or gas connections.

## 2.1 Membrane

- A. EverGuard® TPO (Smooth Reinforced) Thermoplastic Polyolefin Membrane.

## 2.2 Flashing

- A. EverGuard® membrane flashing should be of the same type and can be used with EverGuardPO membrane for flashing in the same thickness as the field membrane.
- B. EverGuard® TPO and PVC Fleece-Back membranes are optional flashing membranes for all EverGuard® TPO and PVC roofing systems, respectively. These membranes may be a solution when a contaminated substrate is encountered.

## 2.3 Flashing Accessories

- A. EverGuard® preformed flashing accessories must be of the same type as the roofing membrane.
- B. For a full listing and descriptions of the latest EverGuard® TPO and EverGuard Extreme® TPO preformed flashing accessories, see the appropriate Product Data Sheets for the specific membranes you are working with.
- C. All EverGuard® accessories must be stored indoors and protected from moisture and extreme temperatures. See specific instructions on packaging for further details.

## 2.4 Fasteners

- A. Drill-Tec™ membrane fasteners and plates, insulation fasteners and plates, and flashing fasteners and termination bars. Refer to the Insulation Attachment Table and the appropriate Membrane Attachment Table in this Manual for the correct type, length, and diameter of fastener.
- B. Use fasteners that are suitable for the deck type, and ensure the deck is of the required thickness and condition to ensure reliable installation and performance.
- C. Fasteners used in flashings should be dictated by the substrate.

## 2.5 Adhesives, Sealants, And Primers

### A. Adhesives

#### 1. Solvent-based

- a. EverGuard® TPO Bonding Adhesive for TPO smooth-back membranes and insulation.

#### 2. Water-based

- a. EverGuard® WB 181 Water-based Bonding Adhesive for smooth-back TPO membranes, TPO FB membranes, and PVC FB membranes.

## B. Sealants

1. EverGuard<sup>®</sup> 2-Part, urethane-based, Pourable Sealant for use in sealant (pitch) pans. TOPCOAT<sup>®</sup> FlexSeal Caulk Grade, a white, solvent-based synthetic elastomeric sealant for use behind termination bars, stainless steel clamps, drain bowls, and other areas between the substrate and membrane. This includes anywhere at the top edge of flashings where constant pressure is applied on the roof membrane.
2. EverGuard<sup>®</sup> TPO Cut Edge Sealant.

## C. Primers

- EverGuard<sup>®</sup> TPO Primer.

## 2.6 Insulation

- A. The selection of insulation type, thickness, and configuration is the responsibility of the architect, engineer, owner, or roof consultant. GAF reserves the right to accept or reject any roof insulation as an acceptable substrate for GAF roof systems. GAF EnergyGuard<sup>™</sup> insulations must be used in roofing systems to be guaranteed by GAF.
- B. EnergyGuard<sup>™</sup> foam insulations of the types listed below are acceptable. The actual minimum thickness of insulation will depend on flute spacing. Refer to specific Product Data Sheets for further information. Board size can be 4' x 4' or 4' x 8' (1.2 m x 1.2 m or 1.2 m x 2.4 m) panels for mechanical attachment, and 4' x 4' (1.2 m x 1.2 m) for adhered attachment and tapered panels.
1. EnergyGuard<sup>™</sup> Polyisocyanurate Insulation with glass-based facer meeting or exceeding the requirements for ASTM C1289 [min. 16 psi (1.1 kg/cm<sup>2</sup>) compressive strength].
- C. E. DensDeck<sup>®</sup>, DensDeck<sup>®</sup> Prime, and DensDeck<sup>®</sup> DuraGuard Roof Boards (ASTM C1177)

Note: Roof Boards sold and distributed by GAF are acceptable for use in various roof systems as overlay and re-cover boards. Refer to individual GAF Roof System specification sections for limitations on the use of these insulation materials.

## 2.12 Other Accessories

- A. Subject to compliance with requirements, provide the following products:
  1. Wood Nailers: New wood nailers must be #2 or better lumber. Do NOT use asphaltic or creosote-treated lumber.
  2. Roofing Nails: Galvanized or non-ferrous type and size as required to suit application.
  3. Temporary Sealant: Polyurethane foam sealant or similar as required to provide temporary watertight sealing of roofing.

## PART 3 – EXECUTION

### 3.1 Site Conditions

- A. Obtain verification that the building structure can accommodate the added weight of the new roofing system.
- B. Confirm the adequacy of the new roofing system to provide positive slope to drain. Eliminate ponding areas by the addition of drainage locations or by providing additional pitch to the roof surface.
- C. Prepare substrate surfaces thoroughly prior to application of new roofing materials. This is particularly important for re-cover and reroofing applications. Providing a smooth, even, sound, clean, and dry substrate minimizes the likelihood that underlying deficiencies will cause premature deterioration or even failure of the new roofing system.
- D. All defects in the roof deck or substrate must be corrected by the responsible parties before new roofing work commences. Verify that the deck surface is dry, sound, clean, and smooth, and free of depressions, waves, or projections.
- E. Protect building surfaces against damage and contamination from roofing work.
- F. Where work must continue over completed roof areas, protect the finished roofing system from damage.
- G. Deck preparation is the sole responsibility of the building owner or roofing contractor. All defects in the roof deck or substrate must be corrected before roofing work commences.
- H. In addition, for EverGuard Extreme<sup>®</sup> TPO Roof Systems, buildings greater than 100' (30.5 m) in height must have a minimum 3' (0.91 m) parapet wall to be eligible for an extended length Diamond Pledge<sup>™</sup> 25, or 30-year guarantee: A separate counter flashing or cap flashing is required; exposed termination bars are not acceptable.

### 3.2 Preparation Of Roofing Area – New And Tear-off Applications

- A. Remove all existing roofing materials to the roof decking, including flashings, metal edgings, drain leads, pipe boots, and pitch pockets, and clean substrate surfaces of all asphalt and adhesive contaminants.
- B. Confirm quality and condition of roof decking by visual inspection and by fastener pull-out testing by roof fastener manufacturer.
- C. Secure all loose decking. Remove and replace all deteriorated decking.
- D. Remove abandoned equipment and equipment supports.
- E. Confirm that height of equipment supports will allow the installation of full-height flashings.
- F. Air Retarder - EverGuard Extreme<sup>®</sup> TPO Roof Systems

### 3.3 Gypsum Board Installation

- A. General
- B. Gypsum fire barrier board must typically be installed when required by design professional or code authority.
  - 1. Butt gypsum boards together with a 1/4" (6.3 mm) maximum space between adjoining boards. Fit gypsum boards around penetrations and perimeter with a 1/4" (6.3 mm) maximum space between board and penetration.
  - 2. Install gypsum boards in pieces a minimum of 2' x 2' (610 mm x 610 mm) in size.
  - 3. Do NOT use gypsum boards that are wet, warped, or buckled; they must be discarded. Insulation boards that are broken, cracked, or crushed must not be installed unless the damaged area is first removed and discarded.
  - 4. Remove and replace gypsum boards that become wet or damaged after installation.
  - 5. Install no more gypsum board than can be properly covered by the end of each day with roofing membrane.
- C. Securement
  - 1. Mechanical Attachment
    - a. Use appropriate type and length of Drill-Tec<sup>™</sup> fastener for structural deck type. See Insulation Attachment Table in this Manual.
    - b. Install required number of fasteners per board size, and type of roofing system installed. Refer to the construction details at the end of this Manual.
- 3.4 Install fastener so as to firmly imbed the plate to the insulation surface without over-driving.

### 3.5 Membrane Installation

Substrates must be inspected and accepted by the contractor as suitable to receive and hold roof membrane materials.

*NOTE: EverGuard Extreme® has a light-gray backer sheet to distinguish it from regular TPO membrane. It is the contractor's responsibility to install EverGuard Extreme® where specified on the roof; i.e., under highly reflective glass or metal, or wherever the high temperature performance of the membrane is required.*

#### A. Substrate Surface Preparation

1. Prepare substrate surfaces thoroughly prior to application of new roofing materials. This is particularly important for re-cover and reroofing applications.
2. Preparation includes, but is not limited to, removal of existing flashings, replacement of wet/damaged existing roofing materials, removal of loose aggregate, removal of abandoned equipment, supports and penetrations, replacement of damaged decking, etc.
3. Providing a smooth, even, sound, clean, and dry substrate minimizes the likelihood that underlying deficiencies will cause premature deterioration or even failure of the new roofing system.

#### B. Placement

1. Place roof membrane so that wrinkles and buckles are not formed. Remove any wrinkles or buckles from the sheet prior to permanent securement. Roof membrane must be mechanically fastened after it is rolled out, followed by welding to adjacent sheets.
2. Full-width rolls must be installed in the field of the roof.
3. Half-width rolls must be installed in the perimeter region of the roof. Width of the roof perimeter region must be determined in accordance with the Perimeter Half Sheet Table on page 24 of the installation Manual.
4. Overlap roof membrane a minimum of 6" (152 mm) for side laps of mechanically attached systems, and a minimum of 3" (76 mm) for end laps. Membranes are provided with lap lines along the side laps; the inside line is for mechanically attached system overlaps, which are 6" (152 mm) for TPO membranes. For PVC membranes, the solid line (overlap line) is marked on the top ply 5" (127 mm) from the sheet edge. The fastener line is a nominal 2" (51 mm) from the sheet edge, and an "X" is placed between the sheet edge and the field seam overlap line with spacing every 6" (152 mm). TPO fastener spacing marks should resemble a "pyramid" pattern.
5. Best roofing practice is to install membrane so that the laps run across the roof slope lapped toward drainage points. On metal decking, install sheets perpendicular to deck direction so that fasteners will penetrate the top flanges and not the flutes; however, there will be limited areas of the roof (i.e., perimeter areas) where this is not practical. If the deck is running opposite the slope of the roof (flutes running horizontally), then the membrane should run ridge-to-gutter to ensure proper fastening to the top flanges of the deck.
6. All exposed sheet corners must be rounded a minimum of 1" (25 mm).
7. Overlap roof membrane a minimum of 3" (76 mm) for end laps of EverGuard® PVC and TPO membranes. End laps for EverGuard® fleece-back membranes are made by butting adjacent sheets and heat welding an 8" (203 mm) wide EverGuard® TPO reinforced membrane flashing strip over the joints. For PVC membranes, cut a 8" (203 mm) wide flashing strip out of smooth PVC membrane of the same thickness as the field sheet.

#### C. Membrane Securement

1. Roof membrane must be mechanically fastened in the side lap area to the roof deck with fasteners and plates of a type and spacing appropriate to the deck type and as required by the Membrane Attachment Tables in this Manual.
2. The metal plates must be placed within  $\frac{1}{4}$ " -  $\frac{3}{4}$ " (6 mm x 18 mm) of the membrane edge. Plates must not be placed closer than  $\frac{1}{4}$ " (6 mm) to the membrane edge.
3. Fasteners must be installed to achieve the proper embedment depth. Install fasteners vertical to the deck, without lean or tilt. Do not over- or under-drive fasteners. In the corner areas, additional fasteners will also be installed through the perimeter half-width membrane rolls to form a grid pattern, with an 8" (203 mm) wide reinforced membrane flashing strip heat-welded over the additional fasteners. Perimeter cap sheets may overlap one another in the corner areas. Alternatively, the half sheet may be laid out in a "picture frame" manner, burying the fasteners under the half sheets.
4. Mechanically attach membrane with screws and plates to the roof deck at locations of deck slope changes in excess of 1" in 12" (25 mm in 305 mm).

5. Membrane may be heat welded to EverGuard® coated metal flanges.
  - a. Membrane must be secured to the roof deck within 6" (152 mm) of the base of walls and curbs, at the perimeter, and all penetrations with Drill-Tec™ Fasteners of a type and spacing in accordance with in-lap attachment requirements, with a 12" (305 mm) o.c. maximum spacing.
  - b. Alternatively, membrane may be extended vertically 3" up walls and curbs and secured to the wall/curb substrate within 2" (51 mm) of the plane of the roof. Use Drill-Tec™ Fasteners and inverted termination bar of type and spacing in accordance with in-lap attachment requirements, with a 12" (305 mm) o.c. maximum spacing. Vertical attachment with seam plates and fasteners may also be used. This alternative detail, including termination bar, is required to be used for pressurized buildings. Refer to detail drawings at the end of this Manual for specific application methods.
6. Install fasteners so that the plate is drawn down tightly to the membrane surface. Properly installed fasteners will not allow the plate/termination bar to move (underdriving), but will not cause wrinkling of the membrane (overdriving).

#### D. Membrane Surface Preparation for Seaming

1. Membrane must be clean of dirt and contaminants, and free from dew, rain, and other sources of moisture. Factory-fresh membrane typically will not require cleaning prior to automatic welding, provided that welding is performed immediately after placement and securing of the membrane.
2. Membrane that has been exposed for more than 12 hours or has become contaminated will require additional cleaning methods.
3. Light Contamination—Membrane that has been exposed overnight up to a few days to air-borne debris, foot traffic, or dew or light precipitation can usually be cleaned with a white cloth moistened with EverGuard® TPO Cleaner or MEK for PVC. Be sure to wait for solvent to flash off prior to welding.
4. Dirt-Based Contamination—Membrane that is dirt encrusted will require the use of a low-residue cleaner, such as Formula 409®, and a mildly abrasive scrubbing pad to remove the dirt. This must be followed by cleaning with a white cloth moistened with EverGuard® TPO Cleaner or MEK for PVC. Be sure to wait for solvent to flash off prior to welding. Exposure-Based Contamination—Membrane that is weathered or oxidized will require the use of EverGuard® TPO Cleaner or MEK for PVC and a mildly abrasive scrubbing pad to remove the weathered/oxidized top surface layer. This must be followed by cleaning with a white cloth moistened with EverGuard® TPO Cleaner or MEK for PVC. Unexposed membrane left in inventory for a year or more may need to be cleaned as instructed above. Be sure to wait for solvent to flash off prior to welding.
5. Chemical-Based Contamination—Membrane that is contaminated with bonding adhesive, asphalt, flashing cement, grease and oil, and most other contaminants usually cannot be cleaned sufficiently to allow an adequate heat weld to the membrane surface. These membranes should be removed and replaced.
6. If GAF Low Rise Foam Adhesive is accidentally spilled on the surface of the finished roof, use the following procedure to remove the adhesive:
  - a. Carefully scrape off the adhesive without rupturing the underlying roof membrane.
  - b. After removal of the adhesive, cover the affected area with either EverGuard® smooth- or fleece-back TPO membrane.
  - c. Weld the smooth-back edges per specification, or strip in the fleece-back membrane. Use a minimum 6" (152 mm) reinforced smooth-back membrane half on the sheet and half on the roof. End laps for EverGuard® fleece-back membranes are made by butting adjacent sheets and heat welding an 8" (203 mm) wide EverGuard® TPO reinforced membrane flashing strip over the joints. Or, cut a flashing strip of smooth PVC membrane of the same thickness as the field sheet.
  - d. Finish off the process by adding EverGuard® TPO Cut Edge Sealant as needed.

#### E. Field Seaming

1. Fabricate field seams using a current-generation automatic hot-air welding machine and a 10,000-watt voltage-controlled generator minimum. In addition, fabricate detail seams with automated hot-air welders where possible. Outdated welding equipment and inadequate or fluctuating electrical power are the most common causes of poor seam welds.
2. Equipment Settings—The correct speed and temperature settings for automatic welders are determined by preparing test welds at various settings. The welds are tested by application of pressure causing the seam to peel apart. A satisfactory weld will fail by exposing the scrim reinforcement called a "film tearing bond." A deficient weld fails by separating between the two layers of the membrane.

3. Adjustments to Equipment Settings—Many factors will affect the settings: thicker membranes, lower air temperatures, and overcast skies will generally require a slower speed than would be required with thinner membranes, higher air temperatures, and sunny skies. The slower speed provides additional heat energy to compensate for heat-draining conditions. The test weld procedure should be conducted at the beginning of every work period (i.e., morning and afternoon) using bag-fresh material and following a significant change in weather (i.e., air temperature, wind speed, cloud cover).
4. Membrane laps must be heat-welded together. All welds must be continuous, without voids or partial welds. Welds must be free of burns and scorch marks.
5. Weld width must be a minimum 1" (25 mm) to a maximum 1.5" (38 mm) in width for automatic machine welding (robotic welder) for standard GAF guarantees. A minimum welding width of 1.5" (38 mm) is required to comply with FM Global, Miami-Dade County (Florida) and other specifications. In addition, the field seams of all TPO membranes should be made using a robotic welder in the field of the roof.
6. All cut edges of TPO reinforced membranes must be sealed with EverGuard® TPO Cut Edge Sealant.

Cautions and warnings:

1. Any attempt to run a robotic welder at a speed greater than 16 ft (9.6 m)/min. may result in defective seam welds.
2. Setting the speed of the welder too fast can also pose potential problems with the ability of the operator to maintain control of the welder. This is particularly true in reroofing or over uneven substrates.
3. Robotic welders running too fast may not allow the operator to monitor the 1.5" (38 mm) minimum weld and ensure that critical T-joint areas have been correctly creased.
4. The operator must keep in mind the relationship between ambient temperature and robotic welding speed in order to achieve a spec weld.
5. Increasing the speed of the robotic welder can also compromise the appearance of a non-bonded system.

### 3.6 Flashing Installation

Refer to the construction details at the Installation Manual, which depict flashing requirements for typically encountered conditions.

Install flashing materials as shown in the construction details.

#### A. General

1. Flash all perimeter, curb, and penetration conditions with EverGuard® coated metal, membrane flashing, and flashing accessories as appropriate to the site condition.
2. All EverGuard® coated metal and membrane flashing corners must be reinforced with pre-formed corners or non-reinforced membrane.
3. All flashing membranes and accessories are to be heat welded to achieve a minimum 2" (51 mm) wide using a hand welder. When using robotic welders, refer to Section 3.11 E5.
4. All cut edges of reinforced TPO must be sealed with EverGuard® TPO Cut Edge Sealant.
5. When using bonding adhesive, be sure to use adhesive specific to membrane and ambient weather conditions.
6. Minimum flashing height is 8" (203 mm). The maximum distance from the wall that horizontal mechanical attachment is installed is 6" (152 mm). When you must go past 6" (152 mm), move the attachment to the vertical substrate.
7. Installation of EverGuard® PVC flashing membrane over asphalt-based substrates must have a slip sheet or approved insulation boards, metal, wood, etc., under the PVC flashing membrane.
8. EverGuard Extreme® membrane flashings should be of same type, thickness, and color as the roofing membrane.
9. For granulated modified bitumen flashings, a separator sheet must be installed for dry-hung flashings. In adhered applications, a barrier board must also be installed.

#### B. EverGuard® Coated Metal Flashing

1. EverGuard<sup>®</sup> coated metal flashing allows much of the metal-work used in typical roofing applications to benefit from the security of heat-welded membrane seaming, with a corresponding reduction in required metalwork maintenance during the life of the roofing system.
2. EverGuard<sup>®</sup> coated metal must be formed in accordance with construction details and SMACNA guidelines.
3. EverGuard<sup>®</sup> coated metal sections used for roof edging, base flashing, and coping must be butted together with a 1/4" (6 mm) gap to allow for expansion and contraction. Heat weld a 6" (152 mm) wide non-reinforced membrane strip to both sides of the joint. A 2" (51 mm) wide aluminum tape can be installed over the joint as a bond-breaker, to prevent welding in this area.
4. EverGuard<sup>®</sup> coated metal used for sealant pans and scupper inserts, and corners of roof edging, base flashing, and coping, must be overlapped or provided with separate metal pieces to create a continuous flange condition, and pop-riveted securely. PVC- and TPO-coated metal flashings must be stripped in using 6" (152 mm) membranes.
5. EverGuard<sup>®</sup> coated metal base flashings must be provided with min. 4" (102 mm) wide flanges screwed to wood nailers. EverGuard<sup>®</sup> coated metal base flashings must be formed with a 1" (25 mm) cant.
6. Provide a 1/2" (13 mm) hem for all exposed metal edges to provide corrosion protection and edge reinforcement for improved durability.
7. In addition, provide a 1/2" (13 mm) hem for all metal flange edges whenever possible to prevent wearing of the roofing and flashing membranes at the flange edge.
8. EverGuard<sup>®</sup> coated metal flashings are attached to wood nailers or otherwise mechanically attached to the roof deck, or to the wall or curb substrate, in accordance with construction detail requirements.
9. When installing EverGuard<sup>®</sup> coated metal on walls or curbs that completely cover the existing flashing, the flashing does not need to be removed provided that it is in good condition and tightly adhered.

### C. Adhered Reinforced Membrane Flashing - Smooth Surface

1. The thickness of the flashing membrane must be the same as the thickness of the roofing membrane.
2. When using EverGuard® TPO or PVC adhesives, use any one of the following substrates: polyisocyanurate insulation (without foil facer); Blue Ridge Structodek® High Density Fiberboard Roof Insulation; gypsum roof board; cured structural concrete absent of curing and sealing compound; untreated OSB; untreated CDX plywood; Type X gypsum board; and dry, sound masonry absent of curing or sealing compounds.
3. Application of bonding adhesive
  - a. Apply bonding adhesive to both the substrate surface and the underside of the flashing membrane.
  - b. GAF EverGuard® Low VOC Bonding Adhesive for smooth-back TPO membranes features a coverage rate of 500- 600 square feet (47- 56 sq. m) per five gallon (19 liter) bucket. This adhesive features a fast-drying solvent system, which is typically 10-20 minutes at typical application temperatures.
  - c. EverGuard® Solvent-based Bonding Adhesive for TPO and PVC smooth-back membranes features a coverage rate of about 120 sq. ft./gal. (11.2 sq. m/4 liter). This will cover both surfaces, yielding 60 square feet (5.6 sq. m) of finished, mated surface per gallon for standard solvent- based bonding adhesives.
  - d. EverGuard® WB 181 Water-based Bonding Adhesive for smooth-back TPO membranes and TPO and PVC FB membranes is applied at a rate of 200 sq. ft./gal. (7.4 sq. m/liter). Covering both surfaces will yield 100 square feet (9.2 sq. m) of finished, mated surface area per gallon.
4. Apply the adhesive only when the adhesive, substrate, membrane, and outside temperatures are above 40°F (4.4°C) and rising. Application temperatures above 50°F (10°C) are recommended to allow easier adhesive application.
5. Carefully position the membrane flashing prior to application to avoid wrinkles and buckles.
  - a. Please note that solvent-based adhesive must be allowed to dry until tacky to the touch before mating flashing membrane. Water-based adhesive must be allowed to dry completely to the touch. Typically, the flashing should be installed within one hour of applying the water-based adhesive. However, this may vary depending on ambient temperature conditions.
6. Heat-weld all laps in EverGuard® smooth reinforced flashing membrane in accordance with heat-welding guidelines.
7. Porous substrates may require double application of adhesive.
8. For extended-length guarantees, separate counter flashing or cap flashing is required; exposed termination bars are not acceptable.
9. Alternatively, the EverGuard® Freedom™ System can be used for flashings. Consult the EverGuard® Freedom™ Manual for installation instructions. Also available are Corner Curb Wraps, consisting of a pre- formed combination corner and flashing pieces that are 12" (305 mm) in height and can be ordered in various lengths. These pre-fabricated corners can be configured to fit 13.5" x 13.5" (338 mm x 338 mm); 19.5" x 19.5" (500 mm x 500 mm); 25.5" x 25.5" (638 mm x 638 mm); and 31.5" x 31.5" (800 mm x 800 mm) curb flashings. These flashings may be dry hung or fully adhered in place. For fully adhered flashing applications, prime the walls before using adhesive to adhere the membrane.
10. Never use any TPO Primer or TOPCOAT® Surface Seal SB Primer to prime walls to accept adhesives; only use the adhesive you are using for a primer to prime the walls.

### D. Adhered Reinforced Membrane Flashing - Fleece-Back

1. Apply bonding adhesive to the substrate at the rate of 100 sq. ft./gal (9.2 sq. m) for water-based adhesive.
2. The bonding adhesive must remain wet to the touch for one- surface applications.
3. Apply the adhesive only when the outside temperature is above 40°F (4.4°C) and rising. Application temperatures above 50°F (10°C) are recommended to allow easier adhesive application.
4. When installing fleece-back membranes to a vertical surface, the material should be rolled in with hand rollers and should have top edge termination installed immediately to avoid slippage. For best results, flashings may need to be rolled in several times with a hand-held, silicone roller.
5. Non-selvage edge laps in EverGuard® Fleece-Back and EverGuard Extreme® Fleece-Back flashing membrane are made by butting adjacent sheets and heat welding an 8" (203 mm) wide flashing strip of EverGuard® TPO flashing membrane over the joint. End laps for EverGuard® Fleece-Back membranes are made by butting adjacent sheets and heat welding an 8" (203 mm) wide EverGuard® TPO reinforced membrane flashing strip over the joints. Or, cut a flashing strip of smooth PVC membrane of the same thickness as the field sheet. All TPO cut edges on reinforced membranes must be sealed with EverGuard® TPO Cut Edge Sealant.
6. For extended-length guarantees, a counter flashing must be used. Exposed termination bars are not acceptable.

### E. Loose Reinforced Membrane Flashing

1. For extended-length guarantees, a counter flashing must be used. Exposed termination bars are not acceptable.
2. Carefully position the EverGuard® smooth reinforced flashing membrane prior to application to avoid wrinkles and buckles.



3. All laps in EverGuard<sup>®</sup> smooth reinforced flashing membrane must be heat welded in accordance with heat- welding guidelines.
4. Maximum flashing height is 24" (610mm) unless incremental attachment is used.

END OF SECTION

SECTION 08 14 00  
WOOD DOORS

PART 1 GENERAL

SUMMARY

Section Includes:

Entry Doors Specifier Note: Article below should be restricted to statements describing design of performance requirements and functional (not dimensional) tolerances of a complete system. Limit descriptions for composite and operational properties required to link components of a system together and to interface with other systems.

SYSTEM DESCRIPTION

Performance Requirements: Provide products/systems that have been manufactured, fabricated, and installed to the following performance criteria:

U-Factor (NFRC 100) : <.30.>

Solar Heat Gain Coefficient (SHGC) (NFRC 200) : <.30.>

Structural Requirements: Provide products/systems capable of withstanding wind loads based on testing units representative of those indicated for Project that pass AAMA/NWWDA 101/I.S.2/NAFS, Uniform

SUBMITTALS

General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

Product Data: Submit manufacturer's product data and installation guides.

Shop Drawings: Provide drawings indicating direction of operable parts, typical jamb, head and sill conditions, and special mullion reinforcement details.

Color Samples: Submit selection and verification samples, including the following:

Hardware: Submit samples indicating typical finish on window hardware.

Cladding: Submit color Samples of aluminum cladding.

Quality Assurance/Control Submittals: Submit the following:

Performance Data: Provide manufacturer's published performance data for specified products.

Contract Closeout Submittals: Submit the following:

Warranty documents specified herein.

Owner's Manual: Bound manual clearly identified with project name, location, and completion date. Identify type and size of units installed. Provide recommendations for periodic inspections, care, and maintenance. Identify common causes of damage with instructions for temporary repair.

## QUALITY ASSURANCE

Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity. ]

Preinstallation Meetings: conduct meeting prior to installation with architect

## DELIVERY, STORAGE, and HANDLING

Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

Delivery: Deliver materials in manufacturer's original unopened, undamaged containers with identification labels intact.

Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

Store materials and accessories off ground, under cover, and protected from weather and construction activities.

## PROJECT/SITE CONDITIONS

Field Measurements: Verify actual dimensions of openings by field measurements before fabrication. Record measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

Install units in accordance with manufacturer's safety and weather requirements.

## WARRANTY

Project Warranty: Refer to Conditions of the Contract for project Warranty provisions.

Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard limited warranty document. Manufacturer's limited warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

## PRODUCTS

### MANUFACTURER

Provide products from the following manufacturer:

Andersen Eagle Doors

E-mail: [technicalsupport@andersenwindows.com](mailto:technicalsupport@andersenwindows.com).

[www.andersenwindows.com](http://www.andersenwindows.com).

### MANUFACTURED UNITS

Proprietary Products/Systems. Wood outswing doors, including the following:

Andersen® Eagle Doors

Substitutions: No substitutions permitted.

### MATERIALS

Frame and Sash Members: Fabricated from wood species approved in WDMA Industry Standard I.S.8 in the following frame depth:

SPECIFIER NOTE: RETAIN PROJECT REQUIRED FRAME DEPTH SUBPARAGRAPH BELOW AND DELETE SUBPARAGRAPHS NOT REQUIRED.

Frame Depth: 6-9/16 inch (167 mm) wide.

Aluminum Frame Cover: Fabricate from 6063-T5 extruded aluminum in the color specified on the plans

Aluminum Panel Cladding: Fabricate from 0.050 inch (1.3 mm) 6063-T5 aluminum in the color specified on the plans

Weatherstripping: Flexible foam with butt joint corners.

Stops: Clear preservative treated wood.

II: Extruded 6063 aluminum low profile 1/2 inch (13 mm) ADA threshold with compressible bulb weatherstrip in the following finish:

Color: Bronze anodized.

### GLAZING

Clear Insulating Glass Units:

High-Performance™ Low-E4™ Glass, Low SHGC, Argon Filled Insulating Glass Units:

Glass: Tempered insulating glass units consisting of an outboard and inboard lite of clear tempered glass conforming to ASTM C1048, Type 1, Class 1, q3, Kind FT.

Magnetron sputtering vapor deposition (MSVD) TiO<sub>2</sub> coating applied to the No. 1 surface.

High-Performance™ Low-E4™ Glass Coating: Magnetron sputtering vapor deposition (MSVD) Low-E coating applied to the No. 2 surface.

Filling: Fill space between glass lites with argon gas blend.

Protective removable polyolefin film applied to glass surfaces No. 1 and No. 4.

## HARDWARE

Hinges: 4-1/2 inch (114 mm) heavy duty ball bearing hinge with non-removable pin with the following finish:

Finish: Satin Stainless Steel.

Locks: Schlage key way

Provide applied wood interior extension jamb members machined from clear or veneered, clear material approved in ANSI/AAMA/NWWDA 101/I.S.2.

Interior Trim and Casing: Provide wood casing and kerfed jamb extension

Species: Unfinished Pine.

## FABRICATION

Preservative Treatment: Treat wood frame members and interior glazing stops after machining with a water repellent preservative in accordance with WDMA I.S.4.

Frame Components:

Attach extruded aluminum frame cover to wood frame.

Factory-apply fluopolymer coating (1.5 mil primer and 1.5 mil top coat minimum dry film thickness) to exterior exposed surfaces of aluminum components.

Door Panels:

Stiles and Rails: 1-3/4 inch (44 mm) engineered wood cores with laminated veneer interior face and aluminum clad or laminated veneer, exterior face.

Attach stiles to rails using mortise and tenon joints. Reinforce top and bottom rail joints with 5 inch by 3/8 inch (127 mm by 9 mm) diameter lag screws.

Clad exterior door panel surfaces with 0.050 inch (1.3 mm) aluminum cladding.

Factory apply finish paint coating conforming to AAMA 2605 to exterior aluminum frame surfaces.

Weatherstripping: Factory applied flexible foam type weatherstripping to full perimeter of frame.

Glazing: Factory glazed with silicone glazing sealant applied to exterior glazing stops.

## EXECUTION

### MANUFACTURER'S INSTRUCTIONS

Comply with the instructions and recommendations of unit manufacturer.

### EXAMINATION

Site Verification of Conditions: Verify that site conditions are acceptable for installation of units, including the following:

Concrete surfaces are dry and free of excess mortar, rocks, sand, and other construction debris.

Masonry openings are square and dimensions are correct.

Rough openings are square and dimensions are correct.

Sill plates are level.

Wood frame walls are dry, clean, sound, and well nailed or glued, free of voids and without offsets at joints.

Nail heads are driven flush with surfaces in openings and within 3 inches (75 mm) of rough opening.

Do not proceed with installation of units until unacceptable conditions are corrected.

### INSTALLATION

#### General:

Remove unit components, parts, accessories, and installation guides from carton.

Inspect unit components and verify that components are not damaged and that parts are included before disposing of carton.

Shop-assemble multiple units before installation in accordance with manufacturer's installation guides.

Field-assemble multiple units before installation in accordance with manufacturer's installation guides.

#### Interface With Other Work:

Perform installation in accordance with Manufacturer's instructions.

Install units 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.

Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

Install insulation in shim space around unit perimeter to maintain continuity of building insulation. Do not overfill.

Hold back exterior siding or other finish materials from edge of unit to allow for expansion and contraction and installation of proper joint sealant with backing materials. Seal perimeter of unit after exterior finish is applied per requirements of Division 07 "Joint Sealants" Section.

Finish interior units per requirements specified in related sections. Refer to, and comply with, additional requirements in manufacturer's installation guides.

Install optional hardware and unit accessories after cleaning.

Site Tolerances:

Adjust operation, insect screens, hardware, and accessories for a tight fit at contact points and weatherstripping for smooth operation and weathertight closure.

CLEANING

Clean units using cleaning material and methods specifically recommended by window manufacturer.

Remove excess sealants, glazing materials, dirt, and other substances.

Avoid damaging protective coatings and finishes.

Protect unit surfaces from masonry cleaning solution that could damage insulation glass panels or hardware.

Remove debris from work site and properly dispose of debris.

PROTECTION

Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 08 54 13  
CASEMENT/AWNING WINDOW

PART 1 GENERAL

1.1 Section Includes

- A. All Ultrex® Casement/Awning window complete with hardware, glazing, mulling options including PTAC, weather strip, insect screen, grilles-between-the-glass, jamb extension, sheet rock return, j-channel, and standard or specified anchors, trim and attachments.

1.2 References

- A. American Society for Testing and Materials (ASTM):
  - 1. C1036: Standard Specification for Flat Glass.
  - 2. E90-09: Standard Test Method for Laboratory Measurement of airborne Sound Transmission Loss of Building Partitions and Elements.
  - 3. E 283: Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.
  - 4. E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Door by Uniform Static Air Pressure Difference.
  - 5. E 547: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
  - 6. E 2190: Standard Specification for Insulating Glass Unit Performance Evaluation.
  - 7. F 2090-10: Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms.
- B. Insulating Glass Manufacturer's Alliance/Insulating Glass Certification Council (IGMA/IGCC).
- C. American Architectural Manufacturer's Association/Window and Door Manufacturer's Association/Canadian Standards Association (AAMA/WDMA/CSA): (use appropriate specifications depending on certification for each product type).
  - 8. AAMA/WDMA/CSA 101/I.S.2/A440-05: Standard/Specification for windows, doors, and skylights.
  - 9. AAMA/WDMA/CSA 101/I.S.2/A440-08: North American Fenestration Standard/Specification for windows, doors, and skylights.
- D. Window and Door Manufacturer's Association (WDMA): Hallmark Certification Program.
- E. American Architectural Manufacturer's Association (AAMA): 624-10: Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.



F. National Fenestration Rating Council (NFRC): 101: Procedures for Determining Fenestration

1.3 Submittals

- A. Shop Drawings: Submit shop drawings under provision of Section 01 33 23.
- B. Product Data: Submit catalog data under provision of Section 01 33 23.
- C. Samples:
  - 1. Submit corner section under provision of section 01 33 23.
  - 2. Specified performance and design requirements under provisions of Section 01 33 23.
- D. Quality Control Submittals: Certificates: submit manufacturer's certification indicating compliance with specified performance and design requirement under provision of section 01 33 23.

1.4 Quality Assurance

- A. Requirements: consult local code for IBC [International Building Code] and IRC [International Residential Code] adoption year and pertinent revisions for information on:
  - 3. Egress, emergency escape and rescue requirements.
  - 4. Windows fall prevention and/or window opening control device requirements.

1.5 Delivery

- A. Comply with provisions of Section 01 65 00.
- B. Deliver in original packaging and protect from weather.

1.6 Storage and Handling

- A. Store window units in an upright position in a clean and dry storage area above ground to protect from weather under provision of Section 01 66 00.

1.7 Warranty

The following limited warranty is subject to conditions and exclusions. There are certain conditions or applications over which Integrity has no control. Defect or problems as a result of such conditions or applications are not the responsibility of Integrity. For a more complete description of the Integrity limited warranty, refer to the complete and current warranty information is available at <http://www.marvin.com/support/warranty>.

- A. Clear insulating glass with stainless steel spacers is warranted against seal failure caused by manufacturing defects and resulting in visible obstruction through the glass for twenty (20) years from the original date of purchase. Glass is warranted against stress cracks caused by manufacturing defects from ten (10) years from the original date of purchase.
- B. Hardware and other non-glass components are warranted to be free from manufacturing defects for ten (10) years from the original date of purchase.

## PART 2 PRODUCTS

### 2.1 Manufactured Units

- A. Description: All Ultrex® Casement/Awning and related stationary or picture units as manufactured by Integrity Windows and Doors, Roanoke, Virginia.

### 2.2 Frame Description

- A. Interior:
  - 1. Pultruded reinforced fiberglass (Ultrex®), 0.075"-0.077" (2mm) thick wall.
- B. Frame depth:
  - 1. 3 3/32" (79mm).
- C. Jamb Depth:
  - 1. 2" (51mm)
- D. Frame Expander accessory is an insert kit shipped as ready-to-install.
  - 1. Insert kit includes four fabricated frame expander components, including head-jamb, sill and both jamb components.
  - 2. Included in both 1" and 3" frame expander options.

### 2.3 Sash Description

- A. Pultruded reinforced fiberglass (Ultrex®), 0.075"-0.077" (2mm) thick wall.
- B. Composite sash thickness:  
15/16" (24mm)

### 2.4 Glazing

- A. Select quality complying with ASTM C 1036. Insulating glass SIGMA/IGCC when tested in accordance with ASTM E 2190. STC/OITC ratings are tested to the stated performance level in accordance with ASTM E 90-09.
- B. Glazing Method: 11/16" (17mm) insulating glass.
- C. Glass Type: Low E2, E3, or E3/ERS air or Argon Gas.
- D. Glazing Seal: Silicone bead at exterior; interior has glazing boot inserted.
  - 1. Interior accessories: sheetrock return, ¾" receiver, jamb extension (all depths), and frame filler not available factory installed.
  - 2. Exterior accessories: Flush fin not available.

## 2.5 Finish

- A. Exterior: Pultruded fiberglass
  - 1. Factory baked on acrylic urethane.
  - 2. Meets AAMA 624-10 requirements.
- B. Interior: Pultruded fiberglass
  - 1. Factory baked on acrylic urethane.
  - 2. Meets AAMA 624-10 and 00022716 requirements.
- C. Color per schedules

## 2.6 Hardware

- A. Lock: Multipoint locking mechanism is actuated from a single point of operation. The lock mechanism is concealed with only the actuator handle and escutcheon being visible to the interior.
- B. Hinges: Concealed stainless steel track and injection molded shoe.
- C. Handle: Die cast detachable folding handle.
- D. Roto-gear Operator: E-Gard™ coated hinge arm and housing mechanism. Snubber: Pulls the sash tight to the frame and provides engagement to keep the sash in place under structural loads.
- E. Color: Applies to handle and locking hardware:
  - 1. Stone White.

## 2.7 Optional Hardware

## 2.8 Weather Strip

- A. Primary is an extruded TPE foam filled bulb attached to all four sides of the frame by a kerf and provides seal between sash and frame.
- B. Secondary weather strip is an extruded TPE hollow bulb that attaches to a kerf in the sash and provides seal between sash and frame.
- C. Standard weather strip color: black.

## 2.9 Jamb Extension

- A. Standard: 2" (51mm) jambs. Optional factory-installed jamb extension: 4 9/16" (116mm) and 9/16" (167mm). 6

## 2.10 Insect Screen (Remove for fixed windows)

- A. Factory-installed screen
  - 1. Screen mesh, 18 by 16: Charcoal fiberglass.
  - 2. Aluminum frame finish: Stone White.

## 2.11 Not used

# PART 3 EXECUTION

## 3.1 Examination

- A. Verification of Condition: Before installation, verify openings are plumb, square and of proper dimensions as required in Section 01 71 00. Report frame defects or unsuitable conditions to the General Contractor before proceeding.
- B. Acceptance of Condition: Beginning installation confirms acceptance of existing conditions.

## 3.2 Installation

- A. Comply with Section 01 73 00.
- B. Assemble and install window/door unit(s) according to manufacturer's instruction and reviewed shop drawing.
- C. Install sealant and related backing materials at perimeter of unit or assembly in accordance with Section 07 92 00 Joint Sealants. Do not use expansive foam sealant.
- D. Install accessory items as required.
- E. Use finish nails to apply wood trim and moldings.

### 3.3 Cleaning

F. Remove visible labels and adhesive residue according to manufacturer's instruction.

G. Leave windows and glass in a clean condition. Final cleaning as required in Section 01 74 00.

### 3.4 Protecting Installed Construction

H. Comply with Section 07 76 00.

I. Protecting windows from damage by chemicals, solvents, paint or other construction operations that may cause damage.

END OF SECTION

SECTION 09 64 00

WOOD FLOORING

PART 12 GENERAL

3.1 SUMMARY

- A. Provide wood flooring, including and floor preparation and finishing.

3.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Maintenance Data: Submit manufacturer's maintenance data, including maintenance schedule.
- D. Extra Stock: Submit extra stock equal to 2 percent of total used.

3.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Comply with recommendations of National Oak Flooring Manufacturer's Association and the American Parquet Association as applicable.

PART 13 PRODUCTS

3.1 MATERIALS

- A. Wood Strip Flooring for General Use:

1. Manufacturers: Cali Bamboo
2. Species: Bamboo
3. Species:
4. Construction: Laminated wood.
5. Thickness: 5/8" inches nominal.
6. Face Width: As selected.
7. Finish: Factory prefinished.
8. Auxiliary Materials:

- a. Trim, moldings, thresholds, and reducer strips.
- b. Fasteners per manufacturer's installation instructions

PART 14 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

SECTION 09 91 00  
PAINTING

PART 15 GENERAL

3.1 SUMMARY

- A. Provide painting and surface preparation.

3.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.
- C. Extra Stock: Submit 1 unopened gallons of each paint and color used in the project.

3.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Regulations: Compliance with VOC and environmental regulations.
- C. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.
  - 1. Provide 2 foot x 4 foot mock-ups of each type of surface.

PART 16 PRODUCTS

3.1 MATERIALS

- A. Painting:
  - 1. Manufacturers: Benjamin Moore & Co.; Coronado Paint Co.; Kelly-Moore Paints; Miller Paint Co.; PPG Architectural Finishes, Inc. - PPG Paints; Pratt & Lambert Paints; Rodda Paint; Rust-Oleum; Sherwin-Williams.
  - 2. Application: Interior unfinished surfaces.
  - 3. Application: Exterior unfinished surfaces.
  - 4. Primary Coating Type: Zero VOC paints.
  - 5. Primary Paint Systems: Primer plus two finish coat.

PART 17 EXECUTION

3.1 INSTALLATION



- A. Inspect surfaces, report unsatisfactory conditions in writing; beginning work means acceptance of substrate.
- B. Comply with manufacturer's instructions and recommendations for preparation, priming and coating work. Coordinate with work of other sections.
- C. At existing areas to be repainted, remove blistered or peeling paint to sound substrates. Remove chalk deposits and mildew and wash all surfaces with mild detergent. Perform related minor preparation including caulk and glazing compounds. Spot prime bare areas before priming and painting as specified.
- D. Match approved mock-ups for color, texture, and pattern. Re-coat or remove and replace work which does not match or shows loss of adhesion. Clean up, touch up and protect work.

### 3.2 PAINT SCHEDULE

- A. Gypsum Drywall Walls:
  - 1. Gloss:
    - Flat
  - 2. System:
    - a. 1 coat latex primer
  - b. 2 coats latex finish
- B. Gypsum Drywall Walls and Ceilings in Bathrooms, Kitchens and Wet Areas:
  - 1. Gloss:
    - a. Egg shell at bath/kitchen
  - 2. Texture:
    - a. Light stipple
  - 3. System:
    - a. 2 coats latex finish
- C. Gypsum Drywall Ceilings:
  - 1. Gloss:
    - a. Flat
  - 2. System:
    - a. 2 coats latex finish
- D. Wood for Painted Finish:
  - 1. Gloss:
    - a. Semi
  - 2. System:
    - a. 2 coats latex enamel
- E. Exterior Wood for Painted Finish:
  - 1. Gloss:

- a. Eggshell
  - 2. System:
    - a. 2 coats latex enamel
- F. Cementitious wall panels
- 1. Gloss:
    - a. Eggshell
  - 2. System:
    - a. 1 coat latex primer
    - b. 2 coats latex finish
    - c. 2 coats latex finish
- G. Ferrous Metals:
- 1. Gloss:
    - a. Flat
  - 2. System:
    - a. 1 coat rust-inhibiting primer
    - b. 2 coats latex enamel
    - c. 2 coats alkyd enamel

END OF SECTION

SECTION 21 00 00  
FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide fire suppression systems.
- B. Maintain fire alarm system in operation during construction.
- C. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- D. Coordinate location of fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Provide complete sprinkler coverage per NFPA 13D.
- C. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Residential concealed sprinklers shall have a ½" NPT, a nominal K Factor of 4.9, and shall be cULus Listed with an operating temperature of 165°F.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Fire Suppression Systems:
  - 1. Manufacturers, Piping, Valves and Fittings: Sharkbite, Apollo
  - 2. Manufacturers, Fire Suppression Sprinklers: Viking
  - 3. Manufacturers, Alarms, Meters and Gages: Viking, Everbilt
  - 4. Application: Water-based system.
  - 5. Application: Sprinkler system.
  - 6. Sustainable Design: Optimize energy performance.
  - 7. Sustainable Design: Energy efficient equipment and fixtures.
  - 8. Sustainable Design: Commissioning.
  - 9. Type: Fire-suppression sprinkler systems.
    - a. Wet-pipe.
    - b. Sharkbite Model U880W300 (1" Pex piping) Residential concealed pendent sprinkler head.
      - 1. Viking SIN VK457 (Base Part Number 14694A-X)
      - 2. Viking Model 135D4MA/W (White cover plate)
  - 10. Components: Sole Sources
    - a. Waterflow alarm.
      - 1. Viking Model VSRF0100
    - b. Ball valves, check valves, and drain valves.
      - 1. Apollo Model 4ALF-105-A2F (1" Double check valve assembly)
      - 2. Sharkbite Model 22463LF (1" Ball valve)
      - 3. Sharkbite Model 22306-0000LF (1" Ball valve with drain)
    - c. Piping, fittings, and joints.
      - 1. Sharkbite Model UC260LFA (1" Elbow)
      - 2. Sharkbite Model UC374LFA (1" Tee)
      - 3. Sharkbite Model UCF168U (1" PEX x 1/2" FNPT Elbow)
      - 4. Sharkbite Model UC140LFA (1" Male thread adapter)
  - 11. Components: Suitable for service.
    - a. Pipe hangers and supports.
    - b. Meters and gauges

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Fire sprinklers installed in the residential occupancy shall be of a listed residential type.

Residential sprinklers shall be installed in conformance with the manufacturer's installation guidelines and the applicable installation standard. Sprinklers shall be of all brass frame construction with a fusible link type operating element and a metal Belleville spring seal, coated on both sides with Teflon film.

- C. The concealed pendent sprinkler shall be installed with an adapter and a push-on, thread-off cover assembly, with 1/2" of adjustment, and a 2-3/4" or 3-5/16" diameter.
- D. The residential concealed sprinkler will have a white finish cover plate.
- E. Wet type fire sprinkler systems shall be equipped with the means to provide an alarm when a waterflow condition exists. This shall be accomplished through the provision of a vane or paddle type waterflow switch affixed to the system riser. Water vane type switch shall be labeled as to the correct orientation of flow when mounted on system piping. If drilling of the system riser is necessary to mount flow switch, the drilled out disc shall be retrieved and attached to the mounting u-bolt of the flow switch. The vane type flow switch shall be equipped with an adjustable delay of audible alarm initiation and be UL Listed and Factory Mutual Approved for its intended use. Adjustment range shall be from 0 to 90 seconds.
- F. Using the PEX plastic tubing cutters to cut the tubing to length, making sure that you have a good square cut. Slide the correct size Sharkbite® clamp or crimp ring over the tube approximately 2" past the end of the tubing. Push the tubing onto the Sharkbite® barbed fitting until it touches the fitting shoulder. Position the clamp or crimp ring 1/8"-1/4" from the end of the tube. When making clamp connections, position the open jaws of the Clamp Tool over the raised tabs of the Clamp ring and squeeze. Verify the connection is secure by visually checking the clamp tab. Make Crimp connections by placing the jaws of the Crimp Tool over the copper crimp ring and squeezing until the jaws close completely. Verify that the connection is secure using the go/no-go gauge.
- G. The tube shall be inserted into the SharkBite® push-fit fitting in the first stage through a release collar and then through a stainless steel grab ring. The grab ring has teeth that open out and grip onto the tube. At the second stage the tube shall be pushed through an O-ring protector which aligns the tube. A specially formulated EPDM O-ring shall be compressed between the wall of the fitting and the tube before the end of the tube reaches the tube stop. Only when the tube has passed through the O-ring and reached the tube stop shall a secure joint be created. The fitting shall be a SharkBite® push-fit fitting.
- H. System shall be plumbed using SharkBite® Tubing cross-linked polyethylene pipe and all joints shall be made using SharkBite® push-fit fittings or brass Cash Acme barbed fittings with clamps. Tubing and fittings shall be installed as outlined in the SharkBite® PEX installation manual.
- I. Center ceiling-mounted elements in center of ceiling tiles as applicable.

- J. Clearly label all valves and components.
- K. Restore damaged finishes. Test all systems for proper operation in accordance with NFPA 13, 14, and 20. Clean and protect work from damage.
- L. Instruct Owner's personnel in proper operation of systems

END OF SECTION

SECTION 22 00 00  
PLUMBING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide plumbing systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- C. Coordinate location of plumbing systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts, which cannot be resolved.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plumbing Systems:
  - 1. Manufacturers, Piping, Valves and Fittings: Sharkbite, VPC, JM Eagle
  - 2. Type: Plumbing pipes and pumps.
    - a. Sharkbite Model U880B100
    - b. Sharkbite Model U870B100
    - c. Sharkbite Model U860I100
    - d. Sharkbite Model U870R100
    - e. Sharkbite Model U860I100
    - f. JM Eagle Model 57737

- g. VPC Model 1202
- 3. Components: Suitable for service.
  - a. Piping. PART 3

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



SECTION 22 07 00  
PLUMBING INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide insulation for plumbing piping and equipment.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. Plumbing Insulation:
  - 1. Manufacturers: Armacell, Pratt Retail Specialties
  - 2. Application: Secure insulation and protection of PEX piping.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Insulation Materials: Type suitable for service.
  - 6. Fire Performance: Type suitable for service.
  - 7. Vapor Barrier: Type suitable for service. PART 3

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable

regulations and code requirements. Provide proper clearances for servicing.

B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

SECTION 22 12 00  
STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide storage tanks for fresh, grey, and black water.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Data Sheet: Submit data sheet indicating capacity, material characteristics, details of construction, and connections

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Storage Tanks:
  - 1. Fresh Water Storage Tank
    - a. Manufacturers: Norwesco
    - b. Model: Low Profile Tank (N-41392)
    - c. Capacity: 1500 gallons
    - d. Type: Ground.
    - e. Storage: Potable water.
    - f. Materials: Polyethylene
    - g. Type: Factory-fabricated.
  - 2. Black/Grey Water Tank
    - a. Manufacturers: Den Hartog Industries
    - b. Model: Low Profile Tank Ace Roto-Mold (LP0300-RT)
    - c. Capacity: 300 gallons
    - d. Type: Ground.
    - e. Storage: Non-potable water.
    - f. Materials: High Density Polyethylene
    - g. Type: Factory-fabricated.

3. Fresh Water Pressure Tank
  - a. Manufacturers: Water worker
  - b. Model: Pressurized Well Tank (Model # HT20HB)
  - c. Capacity: 20 gallon
  - d. Type: Ground.
  - e. Storage: Potable water.
  - f. Materials: Steel.
  - g. Type: Factory-fabricated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Install assemblies complete with all anchors, inserts, supports and accessories. Test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 22 14 29  
DOMESTIC WATER PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide domestic water pumps for supply, grey, and black water.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Domestic Water Pumps:
  - 1. Grey Water Sump Pump
    - a. Manufacturer: Little Giant
    - b. Model: Drainosaur WRSC-6 (Compact size)
    - c. Mfr Part#: 506065
    - d. Application: Locations indicated.
  - 2. Black Water Drain Pump
    - a. Manufacturer: Saniflo
    - b. Model: Saniswift
    - c. Application: Locations indicated.
  - 3. Plumbing Pump
    - a. Manufacturer: Walrus
    - b. Model: TQ 800-115 Booster Pump
    - c. Application: Locations indicated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 22 41 16  
PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide plumbing fixtures and trim.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards:
  - 1. Materials, Products, and Installation: ASME B31.9.
  - 2. Plastic Piping Components: NSF 14.
- C. Compliance: ANSI A117.1 and local regulations.
- D. Accessibility Requirements: ADAAG and local requirements. PART 2

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plumbing Fixtures:
  - 1. Manufacturers: Oatey, Nibco
  - 2. Application: Return of water from various appliances within the house in question. Secure and safe connection of sections of ABS piping.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Plumbing Fixtures:

- a. Water Closets: Suitable for service required.
- b. Lavatories: Suitable for service required.
- c. Sinks: Suitable for service required.
- d. Showers: Enclosure material, receptor material, shower door, fittings.
- e. Toilet Seats: Compatible with water closet.
- f. Residential/Light Commercial Faucets: Nonmetal underbody faucets.
- g. Bath/Shower Pressure Balance Faucets: Single-lever type.
- h. Bath/Shower Thermostatic Mixing Valve Faucets: Single-lever type.
- i. Shower Receptors: Acrylic coated fiberglass pan
- j. Fittings, Except Faucets: Supplies, stops, traps, wastes, and escutcheons.
- k. Supports: ASME A112.6.1M.
- l. EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- D. Clearly label and tag all components.
- E. Test and balance all systems for proper operation.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



SECTION 23 00 00  
HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide heating, ventilating, and air conditioning systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Heating, Ventilating, and Air Conditioning:
  - 1. Manufacturer: SPEEDI-BOOT
    - a. Square-to-Round Register Vent Boot #SBH-121210 SRA
    - b. Square-to-Round Register Vent Boot #SBH-101010 SRA
  - 2. Sustainable Design: Energy efficient equipment and fixtures.
  - 3. Sustainable Design: Energy modeling.
  - 4. Sustainable Design: Commissioning.
  - 5. Type: HVAC air distribution.
    - a. Air duct accessories. PART 3

EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.

- C. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- D. Clearly label and tag all components.
- E. Test and balance all systems for proper operation.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.
- H. Zinc-coated steel construction.
- I. Use with drop ceilings and wood and metal studs
- J. Extend the telescoping arms and nail or screw them in place for quick, easy installation
- K. Foam gasket helps eliminate air leakage with airtight sealing at installation
- L. Pre-drilled pilot holes for quick, easy vent register installation
- M. Dust and debris cover helps keep dust and debris out of your HVAC system
- N. Mud ring helps prevent boot deformation and gaps between the boot and building envelope
- O. Take only one trip up the ladder for ceiling installation, all you have to do is extended the telescoping arms and nail or screw in place

END OF SECTION

SECTION 23 00 01  
HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide heating, ventilating, and air conditioning systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Heating, Ventilating, and Air Conditioning:
  - 1. Manufacturer: SPEEDI-BOOT
    - a. Square-to-Round Register Vent Boot #SBH-121210 SRA
    - b. Square-to-Round Register Vent Boot #SBH-101010 SRA
  - 2. Sustainable Design: Energy efficient equipment and fixtures.
  - 3. Sustainable Design: Energy modeling.
  - 4. Sustainable Design: Commissioning.
  - 5. Type: HVAC air distribution.
    - a. Air duct accessories. PART

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.

- C. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- D. Clearly label and tag all components.
- E. Test and balance all systems for proper operation.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.
- H. Zinc-coated steel construction
- I. Use with drop ceilings and wood and metal studs
- J. Extend the telescoping arms and nail or screw them in place for quick, easy installation
- K. Foam gasket helps eliminate air leakage with airtight sealing at installation
- L. Pre-drilled pilot holes for quick, easy vent register installation
- M. Dust and debris cover helps keep dust and debris out of your HVAC system
- N. Mud ring helps prevent boot deformation and gaps between the boot and building envelope
- O. Take only one trip up the ladder for ceiling installation, all you have to do is extended the telescoping arms and nail or screw in place

END OF SECTION

SECTION 23 00 02  
HEATING, VENTILATING, AND AIR CONDITIONING  
HEAT PUMP/AIR HANDLER

PART 1 GENERAL

1.1 SUMMARY

- A. Provide vapor-compression cycle for refrigerant piping system.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. HVAC Heat Pump
  1. Manufacturers: Airtemp Heat Pump VT4BE-018K.
  2. Sustainable Design: Energy efficient equipment and fixtures.
  3. Sustainable Design: Energy modeling.
  4. Sustainable Design: Commissioning.
  5. Type: Central HVAC equipment.
    - a. Packaged outdoor HVAC equipment. PART 3

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to VT4BE-018K installation guide for complete instructions for proper outdoor installation.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with

applicable regulations and building code requirements.

- C. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- D. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- E. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- F. Clearly label and tag all components.
- G. Test and balance all systems for proper operation.
- H. Restore damaged finishes. Clean and protect work from damage.
- I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 23 00 03  
HEATING, VENTILATING, AND AIR CONDITIONING  
HEAT RECOVERY VENTILATOR

PART 1 GENERAL

1.1 SUMMARY

- A. Provide heating, ventilating, and air conditioning systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Heat Recovery Ventilator
  1. Manufacturer: Honeywell VNT5150H1000
  2. Application: Provide whole house ventilation
  3. Sustainable Design: Energy efficient equipment and fixtures.
  4. Sustainable Design: Energy modeling.
  5. Sustainable Design: Commissioning.
  6. Type: Central HVAC equipment.
    - a. Air-to-air energy recovery equipment. PART 3

EXECUTION

3.1 INSTALLATION

- A. Refer to Honeywell VNT5150H1000 installation guide for more details.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- C. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical

expansion joints, and anchors.

- D. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- E. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- F. Clearly label and tag all components.
- G. Test and balance all systems for proper operation.
- H. Restore damaged finishes. Clean and protect work from damage.

### 3.2 MAINTENANCE

- A. Clean filters four times per year or as needed, vacuum the filters. Replace filters as needed.
- B. Once a year or as needed, clean the interior of the unit (walls and drain pan) with a mild and nonabrasive soap. It is recommended to use products that are environmentally-friendly.
- C. Once a year or as needed, vacuum the four surfaces, let soak in warm water and mild soap for 15 minutes, then spray rinse and let dry
- D. See additional cleaning steps as needed in installation guide provided.

### 3.3 OPERATION

- A. Refer to installation manual for balancing steps, and control panel use.

END OF SECTION



SECTION 23 09 00  
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Provide instrumentation and control for HVAC.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation Data: Submit manufacturer's operation data, including operating instructions.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Instrumentation and Control for HVAC:
  - 1. Manufacturers: Honeywell YTHX9421R5085WW Prestige Thermostat
  - 2. Application: Provide control for split system with coupled HRV.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Electric Control System Components:
    - a. Valves: Control valves, service valves, terminal unit control valves.
    - b. Dampers: Automatic control dampers, frames, and damper and valve motors.
    - c. Thermostats: Room remote-bulb fire protection low-temperature thermostats.
    - d. Clocks: 7 day, 24 hour type with power backup.
    - e. Sensors: Electronic temperature and relative humidity sensors.
    - f. Controllers: Step, electronic, fan speed, and electric heat current controllers.
    - g. Control Panels: Local control panels, central control panels.
  - 6. Pneumatic Control System Components:
    - a. Air Piping: ASTM B 88 seamless copper tubing.
    - b. Air Piping: ASTM D 2737 polyethylene non-metallic tubing.

- c. Valves: Pneumatic control valves and service valves.
- d. Dampers: Automatic control dampers and frames, and pneumatic operators.
- e. Thermostats: Room and return air thermostats; fire protection thermostats.
- f. Humidistats: Fully proportional type.
- g. Controllers: Temperature, humidity, static pressure and dewpoint controllers.
- h. Sensors: Temperature sensors; humidity sensors; pressure sensors.
- i. Clocks: 7 day, 24 hour type with power backup.
- j. Air Supply Systems: Duplex air compressor.
- k. Air Supply Systems: Single air compressor dryer system.
- l. Air Supply Systems: Single air compressor refrigerator drier system.

## PART 3 EXECUTION

### 3.2 Control Panels: Local control panels, central control panels. INSTALLATION

- A. Refer to Honeywell YTHX9421R5085WW Prestige thermostat installation guide for proper wiring and incorporation with other system modules.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- C. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- D. Clearly label and tag all components.
- E. Test and balance all systems for proper operation.
- F. Restore damaged finishes. Clean and protect work from damage.
- G. Instruct Owner's personnel in proper operation of systems.

### 3.3 OPERATION

- A. Refer to Honeywell YTHX9421R5085WW Prestige Thermostat Owner's Manual for proper operation.

END OF SECTION

SECTION 23 30 00  
HVAC AIR DISTRIBUTION – RD SERIES 10" DAMPER

PART 1 GENERAL

1.1 SUMMARY

- A. Provide HVAC air distribution systems and ductwork.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: DuroDyne
  - 2. Application: Use for air control in heat sink duct.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Metal Ductwork:
    - a. Types: Rectangular, round, and flat-oval metal ducts and plenums.
    - b. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653 G90.

- c. PVC-Coated Galvanized Steel: UL 181 Class 1, ASTM A 653 G90.
  - d. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets.
  - e. Stainless Steel: ASTM A 480, Type 316, with No. 4 finish if exposed.
  - f. Aluminum Sheets: ASTM B 209, Alloy 3003-H14, sheet form, bright finish.
  - g. Duct Liner: NFPA 90A, TIMA AHC-101, ASTM C 1071, Type II.
  - h. Sealing Materials: Joint and seam sealants, tapes and mastics.
  - i. Hangers and Supports: Concrete inserts, powder actuated fasteners.
  - j. Fabrication: SMACNA HVAC Duct construction Standards.
6. Duct Accessories:
- a. Backdraft Dampers: Metal frame, blades, blade seals, and axles.
  - b. Manual Volume Control Dampers: High-performance volume control dampers.
  - c. Fire Dampers: UL 555 with galvanized steel frame, fusible link.
  - d. Ceiling Fire Dampers: UL listed and labeled galvanized steel frame.
  - e. Smoke Dampers: UL 555 and UL 555S, galvanized steel frame.
  - f. Actuators: Damper motors for smooth modulating or 2-position action.
  - g. Duct Silencers: Factory-fabricated rectangular and round units; acoustic fill.
  - h. Turning Vanes: Manufactured and acoustic turning vanes.
  - i. Duct-Mounted Access Doors and Panels: Manufactured units.
  - j. Flexible Connectors: UL 181, Class 1, flame-retardant fabrics.
  - k. Accessory Hardware: Instrument test holes, splitter damper accessories.

END OF SECTION

SECTION 23 30 00  
HVAC AIR DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide HVAC air distribution registers into the room.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: Hart & Cooley
  - 2. Application: Locations indicated.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Metal Ductwork:
    - a. Types: Rectangular, round, and flat-oval metal ducts and plenums.
    - b. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653 G90.
    - c. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets.
    - d. Stainless Steel: ASTM A 480, Type 316, with No. 4 finish if exposed.
    - e. Aluminum Sheets: ASTM B 209, Alloy 3003-H14, sheet form, bright finish.
    - f. Duct Liner: NFPA 90A, TIMA AHC-101, ASTM C 1071, Type II.
    - g. Sealing Materials: Joint and seam sealants, tapes and mastics.
    - h. Firestopping: Fire-resistant sealant.
    - i. Fabrication: SMACNA HVAC Duct construction Standards.
  - 6. Duct Accessories:

- a. Fire Dampers: UL 555 with galvanized steel frame, fusible link.
- b. Ceiling Fire Dampers: UL listed and labeled galvanized steel frame.
- c. Smoke Dampers: UL 555 and UL 555S, galvanized steel frame.
- d. Actuators: Damper motors for smooth modulating or 2-position action.
- e. Duct Silencers: Factory-fabricated rectangular and round units; acoustic fill.
- f. Turning Vanes: Manufactured and acoustic turning vanes.
- g. Duct-Mounted Access Doors and Panels: Manufactured units.
- h. Flexible Connectors: UL 181, Class 1, flame-retardant fabrics.
- i. Accessory Hardware: Instrument test holes, splitter damper accessories.

END OF SECTION

SECTION 23 30 00  
HVAC PCM DUCT

PART 1 GENERAL

1.4 SUMMARY

- A. Provide HVAC air distribution systems and ductwork.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.6 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.2 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: Audubon plumbing supply –
    - a. Trunk duct w/ s-cleat and drives #SBT121212
    - b. Trunk duct w/ s-cleat and drives #SBT481212
  - 2. Application: Phase Change Duct
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Metal Ductwork:
    - a. Types: Rectangular, round, and flat-oval metal ducts and plenums.
    - b. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653 G90.
    - c. PVC-Coated Galvanized Steel: UL 181 Class 1, ASTM A 653 G90.
    - d. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets.
    - e. Stainless Steel: ASTM A 480, Type 316, with No. 4 finish if exposed.
    - f. Aluminum Sheets: ASTM B 209, Alloy 3003-H14, sheet form, bright finish.
    - g. Duct Liner: NFPA 90A, TIMA AHC-101, ASTM C 1071, Type II.

- h. Sealing Materials: Joint and seam sealants, tapes and mastics.
- i. Firestopping: Fire-resistant sealant.
- j. Hangers and Supports: Concrete inserts, powder actuated fasteners.
- k. Fabrication: SMACNA HVAC Duct construction Standards.

## 2.3 CLASSIFIED VENTILATION DUCTS

### A. Performance Standards:

1. All products furnished under this section shall be certified under Underwriters Laboratories, Inc. (UL) category for Fire Resistive Duct Assemblies - Ventilation Ducts and thereby conform to the requirements of ISO-6944 and having fire stops tested in accordance to ANSI/UL 1479. Products shall carry the appropriate UL and classification marks or labels.

Fire resistance ratings for Ventilation Duct shall be applicable to ducts and qualify for a minimum 2 hour fire resistance rating for criteria of duct "Integrity", "Stability" and "Insulation".

2. Alternatively, if hourly fire rating of duct is not needed, then ducts shall be of single wall pressure stack design.

### B. Construction (2 Hour Classified Fire-rated):

1. Ventilation duct sections shall be constructed of an inner and an outer wall with a 3 inches (152 mm) annular insulating space.
2. Inner Material: The inner wall shall be constructed of .035 inch (0.90 mm) thick type 304 stainless steel for diameters 5 inches (127 mm) through 36 inches (914 mm).
3. Inner Material: The inner wall shall be constructed of .035 inch (0.90 mm) thick type aluminized steel for diameters 5 inches (127 mm) through 36 inches (914 mm).
4. Outer Material: The outer wall shall be constructed of .025 inch (0.64 mm) thick aluminized steel for sizes 6 inches (152 mm) through 24 inches (610 mm) and .035 inch (0.90 mm) thick for sizes 26 inches (660 mm) through 36 inches (914 mm).
5. Outer Material: The outer wall shall be constructed of .024 inch (0.61 mm) thick 304 stainless steel for all sizes.
6. Inner and outer walls shall be connected by means of spacer clips, which maintain the concentricity of the annular space.
7. The 3 inches (152 mm) annular insulating space shall be filled with minimum 10 pcf, high-temperature capable, blanket insulation in accordance with the UL fire-rated certifications.
8. Weather Exposure: Aluminized steel outer wall ventilation duct parts exposed to weather shall be protected by one coat of corrosion and heat resistant primer and one coat of heat resistant paint. Paint shall be furnished and applied by installer.
  - a. Where exposed to weather, the outer channel band shall be sealed with P-600 silicone sealant to prevent rainwater from entering the space between the inner and outer walls.



9. Weather Exposure: All ventilation duct parts exposed to the weather shall be 304 stainless steel outer wall.
  - a. Where exposed to weather, the outer channel band shall be sealed with P-600 silicone sealant to prevent rainwater from entering the space between the inner and outer walls.
10. Supports, fan adapters, square to round transitions, hood transitions, drain fittings and adjustable / variable lengths required to install ventilation duct shall be included.
11. Roof penetration pieces shall be either UL listed products of the ventilation duct manufacturer or roof curbs complying with local code.
12. Inner pipe joints shall be held together by means of formed, overlapping V-bands to secure the mating pipe flanges together.
13. Optional: V-bands shall have duct manufacturer's P-600 silicone sealant applied to the V-band groove where duct is under positive pressure.

### PART 3 EXECUTION

#### 3.4 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.5 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### 3.6 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

#### 3.7 DUCT INSTALLATION

- A. The exhaust system shall be installed according to the manufacturer's installation instructions and shall conform to all applicable state and local codes.
- B. Inner pipe joints shall be sealed by use of factory supplied overlapping V bands and sealant.
- C. Roof penetrations shall be suitable for a noncombustible roof and shall be according to the

manufacturer's detail drawings and installation instructions.

- D. When installed according to the manufacturer's installation instructions, the exhaust piping and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.
- E. Provide all supports, guides, expansion joints, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars and flip top terminations as required to provide a complete system.
- F. The entire exhaust system from hood to the termination point, including all accessories, except as noted, shall be from one manufacturer.

### 3.8 CLASSIFIED VENTILATION DUCT INSTALLATION

- A. Store delivered materials inside, out of the weather. Protect materials from accidental damage or vandalism.
- B. Installation shall conform to the manufacturer's installation instructions, UL classification and state or local codes.
- C. Support ventilation duct from building structure using rigid structural shapes for attachment of fixed point supports (Plate Support Assembly). Anchor supports to structure by welding, bolting, steel expansion anchors, or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.
- D. Coordinate installation of dampers or fans. Dampers or fans shall be supported independently from the ventilation duct sections. Protect ventilation duct from twist or movement due to fan torque or vibration.
- E. Protect incomplete ventilation duct installations by attaching temporary closures over open ends of sections.
- F. Clean ventilation duct sections of dust and debris prior to final connection to fans.

### 3.9 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 23 30 00  
HVAC AIR DISTRIBUTION – IN-LINE FAN

PART 1 GENERAL

1.7 SUMMARY

- A. Control air flow to the heat sink duct.

1.8 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.9 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.4 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: Hurricane Afterburner mixed-flow fan model #736140
  - 2. Application: deliver hot or cold air to a custom heat sink duct
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Centrifugal Fans:
    - a. Centrifugal Fans for Indoor Installations: Belt-driven with housing.

PART 3 EXECUTION

3.10 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

B. Test for proper operation, including manufacturer's commissioning.

END OF SECTION

SECTION 23 30 00  
HVAC AIR DISTRIBUTION - REGISTERS

PART 1 GENERAL

1.10 SUMMARY

- A. Provide diffusers and registers for HVAC air distribution system.

1.11 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.12 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.5 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: TruAire.
    - a. 14" x 8" bar-type side wall registers.
    - b. 14" x 8" baseboard return grilles.
  - 2. Application: Locations indicated.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Air Outlets and Inlets:
    - a. Ceiling Air Diffusers: Patterns, dampers, accessories suitable for use.
    - b. Wall Registers and Grilles: Patterns, dampers, accessories suitable for use.

END OF SECTION

SECTION 23 30 00  
HVAC AIR DISTRIBUTION

PART 1 GENERAL

1.13 SUMMARY

- A. Provide HVAC air distribution systems and ductwork.

1.14 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.15 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.6 MATERIALS

- A. HVAC Air Distribution:
  - 1. Manufacturers: Airtemp Air Handler B6EMMX24K-A.
  - 2. Application: Distribute conditioned air to duct system.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Central Station Air-Handling Units:
    - a. Indoor Constant-Volume, Central-Station-Air Handling: ARI 430, NFPA 90A.
    - b. Components: Motors, coils, dampers, filters. PART 3

EXECUTION

3.11 INSTALLATION

- A. Refer to B6EMMX24K-A installation guide for complete instructions for proper installation in upflow configuration.

- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- C. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- D. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- E. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- F. Clearly label and tag all components.
- G. Test and balance all systems for proper operation.
- H. Restore damaged finishes. Clean and protect work from damage.
- I. Instruct Owner's personnel in proper operation of systems.

### 3.12 MAINTENANCE

- A. B6 Series Air Handlers are not supplied with a single air filter when shipped from the factory. It is recommended that the filter be cleaned or replaced monthly. Newly built or recently renovated homes may require more frequent changing until the construction dust has minimized. Filter sizes shown in Table 2 are available at most local retailers
- B. Dirt and lint can create excessive loads on the motor resulting in higher than normal operating temperatures and shortened service life. It is recommended that the blower compartment be cleaned of dirt or lint that may have accumulated in the compartment or on the blower and motor as part of the annual inspection.
- C. Inspect the blower wheel blades for accumulations of dirt and clean if necessary. Inspect mounting nut for tightness when done.
- D. Inspect the blower assembly and motor mounting brackets for tightness and corrosion. Correct deficiencies if necessary. The blower motor contains sealed bearings and under normal operating conditions, no maintenance is necessary for the life of the equipment.

END OF SECTION



SECTION 23 30 00  
HVAC AIR DISTRIBUTION – METAL DUCTWORK

PART 1 GENERAL

1.16 SUMMARY

- A. Provide HVAC air distribution systems and ductwork.

1.17 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.18 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.7 MATERIALS

- A. HVAC Air Distribution:
  - 1. Size:
    - a. 12" round
    - b. 9" round
    - c. 6" round
    - d. 12" round flex
    - e. 9" round flex
    - f. 6" round flex
  - 2. Application: Locations indicated.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Metal Ductwork:
    - a. Types: Rectangular, round, and flat-oval metal ducts and plenums.
    - b. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653 G90.
    - c. PVC-Coated Galvanized Steel: UL 181 Class 1, ASTM A 653 G90.
    - d. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets.
    - e. Stainless Steel: ASTM A 480, Type 316, with No. 4 finish if exposed.
    - f. Aluminum Sheets: ASTM B 209, Alloy 3003-H14, sheet form, bright finish.
    - g. Duct Liner: NFPA 90A, TIMA AHC-101, ASTM C 1071, Type II.
    - h. Sealing Materials: Joint and seam sealants, tapes and mastics.

- i. Firestopping: Fire-resistant sealant.
- j. Hangers and Supports: Concrete inserts, powder actuated fasteners.
- k. Fabrication: SMACNA HVAC Duct construction Standards.

END OF SECTION

SECTION 23 56 16  
PACKAGED SOLAR HEATING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Provide packaged solar hot water systems including solar collectors, heat transfer appliances, and solar storage tanks.

3.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating system controls and schematics, material characteristics, details of construction, weight, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit operation and maintenance data including preventative maintenance procedures and spare parts lists.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Packaged Solar Hot Water Systems:
  - 1. Manufacturers: Heliodyne
  - 2. Type: Residential flat plate solar collector, open loop/indirect hot water system.
    - a. Solar collector array.
    - b. GOBI 406 001

- c. Heat transfer appliances with heat exchangers, pumps and controllers.
  - 1. 51290-D - HPAS 016 012 (Pro Lite w/3 thermistors, Bottom Connect) pump and control unit for tie in to internal heat exchanger tank. Includes: UPS 15-58 Glycol circulator, Delta T Pro Lite differential controller with 3 temperature sensor inputs + remote monitoring capabilities via wifi, vortex flow + temperature sensor for energy and flow readings, 2 x 10K ohm sensors, 150 psi PRV + gauge, fill ports, dual combo valves with 1ea check valve + ball valve + dial thermometer, 2 gallon expansion tank, exp. tank flex hose connector, 120VAC line cord, X-Bracket + self tapping screws for mounting HPAS to side of tank or to wall nearby.
  - 2. 23025 - SENS 000 002 (sensor wire need to be sold in 100' increments)
- d. Collector mounting racks and hardware. 1)
  - 40092-B - RAIL 001 000B
    - 1. 40081-B - RACK 000 001B (4" Pedestal, 47" Leg, Rev B)
- e. Piping System.
  - 1. 50014 - ZZZZ 001 000 (3/4" Dyn-O-Seal Union with Discs)
  - 2. 40155 - ZZZZ 007 000 (Dyno Seal Combo Fitting) (NL), includes well and well thermistor
  - 3. 40212 - ZZZZ 000 008 (Ball Valve Kit)
  - 4. 21896 - ZZZZ 000 019 (360F rated Air Vent 1/2" NPT)
  - 5. 23044 - DFLO 004 004 (Dyn-O-Flo HD 4 single gals glycol) non-toxic, inhibited, high temperature rated propylene glycol concentrate to be used in 50/50 solution with good water.
  - 6. 51418 - Residential Flex Tube Kit 49ft, ZFM, Twin tube and Sensor wire

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation, including manufacturer's commissioning. Repair defects if any, and retest.
- C. Restore damaged components and protect work.

END OF SECTION

SECTION 23 82 23  
CONVECTION HEATING AND COOLING UNITS - THERMASTIX PART 1

GENERAL

1.1 SUMMARY

- A. Provide convection heating and cooling for a localized area in a house.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Convection Heating and Cooling Units:
  - 1. Manufacturers: Phase Change Energy Solutions
  - 2. Application: Use in specified duct for convection air cooling purposes.
  - 3. Sustainable Design: Utility efficient equipment and fixtures.
  - 4. Sustainable Design: Commissioning.
  - 5. Convectors:
    - a. Elements: Aluminum casing, BioPCM material inside aluminum tubes.
    - b. Ends are pinch welded.
  - 6. Dimensions:
    - a. 1 1/12" diameter tubing.
    - b. 11" tubing length.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Clearly label and tag all components.
- C. Test and balance all systems for proper operation.
- D. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 25 00 00  
INTEGRATED AUTOMATION

PAR1 1 GENERAL

1.4 SUMMARY

- A. Install system designed by instrumentation and controls student team.

1.2 SUBMITTALS

- A. Submit installation instructions for each material and product used.

1.2 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
  
- B. Compliance: FCC regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Communications:
  - 1. Application: Communications and monitoring systems.
  - 2. Type: Communications and monitoring systems.
    - a. Temperature and humidity sensor module - provided.
      - ï Single gang box
      - ï Laser-cut face plate
      - ï Arduino Mini PRO
      - ï RHT03 Humidity and Temperature Sensor
    - b. Main Microcontroller - provided.
      - ï Arduino Mega
      - ï Ethernet Shield
      - ï 4 Keystones
    - c. Database and Server - provided.
      - ï Raspberry Pi B+

- d. DC-DC Converter - provided.
  - e. ASUS RT-N66U WIRELESS ROUTER - provided.
3. Components: Suitable for service.
- a. CAT5e cable - provided.

## PART 3 EXECUTION

### 3.4 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

END OF SECTION



SECTION 26 00 00  
PHOTOVOLTAIC PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide power to the grid via photovoltaic (pv) panels.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each type of panel.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Comply with the National Electrical Code and applicable local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Electrical Systems:
  - 1. Manufacturers: SunPower; Sunpreme.
  - 2. Application: Photovoltaic collectors.
  - 3. Type: Facility electrical power generating and storing equipment.
    - a. Photovoltaic collectors.
  - 4. Electrical Standards.
    - a. Code: NFPA 70 National Electrical Code. PART 3

Part 3 EXECUTION

3.1 INSTALLATION OF SUNPOWER E20 435 PANELS

- A. Do not stand on, drop, scratch, or allow objects to fall on modules as it may damage and void the warranty.

- B. There are no user-serviceable parts within the module. Do not attempt to repair any part of the module.
- C. Do not place anything on the modules, even for a moment because resulting residue may damage or stain the glass surface.
- D. If the front glass is broken, or the backsheet is torn, contact with any module surface or module frame can cause electric shock.
- E. Do not install or handle the modules when they are wet or during periods of high wind.
- F. Broken J-boxes or connectors are electrical hazards as well as laceration hazards. Installers should remove any such module from the array and contact SunPower for disposal instructions.
- G. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- H. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- I. Test all systems for proper operation. Clean and protect work from damage.
- J. Ground the frame of the module or array per NEC before wiring the circuit.
- K. SunPower modules must be grounded using grounding hardware that meets requirements for grounding systems in UL 467, UL 1703, or UL 1741; on anodized aluminum frames.
- L. Modules integrated into or mounted over a roofing system must be mounted over a fire-resistant roof covering rated for the application. To reduce soiling, modules should be mounted at a minimum of 10 degrees.
- M. Commercial (silver) module frames have permanently attached stacking pins. Mounting system hardware used with commercial modules must account for the presence of these stacking pins.
- N. For 128-cell modules a minimum of 4" of clearance between the module frames and the structure (or grade) is required.
- O. Do not remove or alter the module frame, and do not create additional mounting holes because doing so may compromise the integrity of the frame.

- P. The modules shall be mounted using one of the following methods:
1. Frame Holes: Secure the module to the structure using the factory mounting holes. Four 1/4" stainless steel bolts, with nuts, washers, and lock washers are recommended per module; tightened to a min. torque of 10 in-lbs. This method has been certified by a third-party organization according to UL 1703. For frame hole mounting, modules must be secured using the holes located at 433mm from the end of the module.
  2. Clamps or Clips: Mount the module with the IFF clips on the longer sides of the module. The centerline of the clips must be 2-16" for G5 frame (6-15" for G3 frame) from the corner of the module. Ensure that the clamps are of sufficient strength to allow for the maximum design pressure of the module. The IFF clip hardware must be tightened to a torque of 35-45 in-lbs.
  3. End Mount: End mounting is the attachment of the shorter side of the module frame to a supporting rail using IFF clips tightened to a torque of 35-45 in-lbs. The centerline of the clips must be 2-10" from the corner of the module. The end-mounting rail and clips or clamps must be of sufficient strength to allow for the maximum design pressure of the module. Verify this capacity before installation.
  4. Everest Solar Mounting System: An Everest Solar Mid or End Clamp can be used to secure the shorter ends of the module. When using Everest Solar mounting hardware. The Everest Solar stainless M-K2 Slot nut is placed in the channel of the aluminum Dome D1000, Dome S1000 or Dome SD mounting component. The WEEB KMC grounding clip is placed under the bottom edge of the module. The Mid or End clamp is placed over the top edge of the module frame and secured to the M-K2 slot nut using a stainless M8 bolt and stainless Belleville washer tightened to a min. of 10.3 ft- lbs. A SunPower IFF clip #509206 may be substituted for the Everest Mid Clamp, but only when the modules are being installed using SunPower's D10 or S10 product. Two clamps must be used on each of the shorter ends of the module.
  5. SunPower-specified or SunPower-supplied mounting systems: Mount modules with strict adherence to SunPower documentation, using hardware systems supplied by or specified by SunPower.
- Q. Use gloves when handling modules. The module glass is sensitive to oils and abrasive surfaces, which may lead to scratches and irregular soiling. Do not place modules such that the glass comes in contact with abrasive surfaces, and minimize any contact with the glass in general. Do not place anything on the modules, even for a moment.
- R. To clean a module, wash its glass surface with potable, non-heated water. Normal water pressure is adequate, but pressurized water (up to 1500 psi) may be used. Some fingerprints, stains, or accumulations of dirt on the glass may be removed with over-the-counter glass cleaners (such as Windex® or equivalent), or with a 3% soap-and-water solution. Do not use harsh industrial-strength cleaning materials such as scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the module glass.

### 3.2 INSTALLATION OF SUNPREME MAXIMA GXB BIFACIAL PANELS

- A. This product meets the certification and standards for UL1703, IEC 61646 & 61730 Application Class A & Safety Class II, for a maximum system voltage of 1000V with maximum overcurrent protection rating of 15A. It is the responsibility of the installer and/or system integrator to ensure compliance with all local electrical codes which may be applicable.
- B. Only authorized qualified and trained personnel shall have access to these modules.
- C. Open circuiting, short circuiting, or opaque covering shall be used to disable an array or portions of an array for installation and service.
- D. Do not touch live terminals with bare hands.
- E. Do not make connections while under load. Do not disconnect under load.
- F. Work only in dry conditions with dry modules and tools.
- G. Use insulated tools for electrical connections.
- H. Systems should be installed by authorized qualified and trained personnel only. The system involves electricity, and can be dangerous if the personnel are not familiar with the appropriate safety procedures.
- I. Do not step or stand on the module, or drop module, or break the glass. Do not disassemble module or junction box. Do not place heavy objects on the surfaces.
- J. Employ a two or more person carry. Do not carry by its wires or junction box.
- K. Wear non-slip, suitable gloves and protective clothing.
- L. Do not install the module where flammable vapors or gases are present. Do not install in corrosive environments. Salt air environments should be avoided.
- M. Care shall be taken during handling and mounting the modules to prevent any impact on front surface, back surface, edges, and corners as this could result in module damage.
- N. A minimum 60mm clearance between the module and the mounting surface (roof, ground, or other solid surface) is required.
- O. A minimum of 10mm spacing must also be maintained between modules to allow for thermal expansion.
- P. Connections to the module other than inter-module connection shall be made by use of

compatible connectors that complies with code requirements.

- Q. Sunprime recommends that all wiring be double insulated with a minimum rating of 90°C, and wiring should use flexible copper conductors where minimum size should be determined by the applicable codes. We recommend a size not less than 4mm<sup>2</sup> cross section (12ga). The insulation type should be appropriate for the type of installation method used and must meet UL1703 and IEC 61730 requirements. The cables and connectors are UV and weather resistant from -40°C to +90°C, and rated for 1000VDC (before de-rating for ambient temperature).

END OF SECTION

SECTION 26 09 23  
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.5 SUMMARY

- A. Install lighting control devices.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.7 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.2 MATERIALS

- A. Lighting Control Devices:
  - 1. Application: Locations indicated.
  - 2. Sustainable Design: Utility efficient equipment and fixtures.
  - 3. Sustainable Design: Commissioning.
  - 4. Lighting Control Equipment Systems:
    - a. Lutron Programmable Lighting Control System
  - 5. Lighting Control Equipment Components:
    - a. Lutron Caseta Wireless System

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Install light switches at uniform height above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close

together as possible and in-line with each other.

- G. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- H. Test all systems for proper operation. Label circuits in electrical panels.
- I. Restore damaged finishes. Clean and protect work from damage.
- J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



SECTION 34 60 13  
AUTOMOTIVE EV CHARGING STATION

PART 1 GENERAL

1.1 SUMMARY

- A. Provides power to charge a BMW i3 via the Wallbox PURE electric car charging station.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturer. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Electric Car Charging Stations:
  - 1. Manufacturers: BMW i3 Wallbox PURE
  - 2. Materials: Suitable for service.
  - 3. Type: Wall mounted charger. PART 3

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with BMW's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Install assemblies complete with all hardware, anchors, inserts, supports and accessories. Test for proper operation. Clean and protect work from damage.
- C. This charging station should be installed, serviced, and maintained only by qualified

personnel.

- D. All pertinent regional, national, and local safety regulations must be observed when installing and using the charging station.
- E. To prevent overheating, only use a supply cable with a cross-section suitable for the rated current used by the charging station.
- F. Do not install the charging station if any damage is observed while unpacking or handling.
- G. If the charging cable is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid any hazard.
- H. Turn off all power supplying this equipment before working on the equipment. Always use an appropriate voltage detection device to confirm the absence of voltage.
- I. When manipulating and wall-mounting the cables, put the cover on and protect the charging station to prevent dust from entering.
- J. The fixing screws must be supplied by the installer and selected according to the charging station weight and the wall type.
- K. The installation must be protected by a circuit breaker and a Residual Current Device 30 mA - Class A, installed in the switchboard. Systems that automatically reset the Residual Current Device are prohibited. An undervoltage remote tripping auxiliary associated with the circuit breaker can be added as an optional protection.
- L. Those electrical protections and the supply cable must be used only for the charging station and must be compliant with the electrical installation standard in force.
- M. Do not commission nor use the charging station if the measured earthing resistance is higher than the threshold specified by the local regulation in force.

END OF SECTION

SECTION 48 14 00  
SOLAR COLLECTOR SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide supports for solar collectors.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Solar Collector Supports, Aluminum Framework:
  1. Manufacturers: SnapNrack
  2. 5-15 degree Tilt Mount
  3. Application: Roof mounted.
  4. Components: Framing, substrate attachment, flashing, collector clips. PART

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. SnapNrack engineered systems should only be used with SnapNrack components and hardware. Any alternate application may void the warranty and structural calculations could become invalid.

- C. If a pilot hole is drilled and a rafter is not found, immediately seal the pilot hole with roofing sealant to avoid water damage.
- D. Do not overtighten hardware.
- E. Always wear fall protection and safety gear.

END OF SECTION

SECTION 48 14 00  
INVERTERS

ART 1 GENERAL

1.1 SUMMARY

- A. Convert the direct current from photovoltaic solar panels into a utility frequency alternating current.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. This device complies with Part 15 of the FCC Rules. PART 2

PRODUCTS

2.1 MATERIALS

- A. Inverter:
  - 1. Manufacturers: SMA America
  - 2. Sustainable Design: Commissioning. PART 3

EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Comply with applicable regulations and code requirements.

- B. Test and balance all systems for proper operation.
- C. All electrical installations must be made in accordance with the local and National Electrical Code ANSI/NFPA 70.
- D. Before working on the inverter, always disconnect the inverter from all voltage sources.
- E. This device may not cause harmful interference.

END OF SECTION