

U.S. DEPARTMENT OF ENERGY

SOLAR DECATHLON 2013



Team aSUNm Project Manual

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## CONSTRUCTION SPECIFICATIONS CONTENTS:

01 51 13 - Temporary Electricity  
01 54 23 - Temporary Scaffolding and Platforms  
03 40 00 - Precast concrete  
05 00 00 – Metals  
05 05 23 - Metal Fastenings  
05 12 00 - Structural steel framing  
05 17 00 - Structural Rod Assemblies  
05 40 00 – Cold-Formed Metal Framing  
05 50 00 - Metal Fabrications  
05 54 00 - Metal Floorplate  
05 75 00 - Architectural Metalwork  
06 00 00 - Wood, Plastic, and Composites  
06 05 23 - Wood, Plastic, and Composite Fastenings  
06 10 00 - Rough Carpentry  
06 11 00 - Wood Framing  
06 16 00 - Sheathing  
06 16 23 – Subflooring  
06 22 00 - Millwork  
06 40 13 - Exterior Architectural Woodwork  
06 40 23 - Interior Architectural Woodwork  
06 73 00 - Composite decking  
07 00 00 - Thermal and Moisture Protection  
07 13 00 - Sheet waterproofing  
07 14 00 – Fluid-Applied Waterproofing  
07 20 00 – Thermal Protection  
07 21 13 - Board Insulation  
07 21 19 - Foamed-In-Place Insulation  
07 27 00 – Air Barriers  
07 44 56 - Mineral-fiber-reinforced Cementitious panels  
07 46 23 –Wood Siding  
07 62 00 - Sheet metal flashing and trim  
07 71 23 - Manufactured gutters and downspouts  
07 71 26 – Reglets  
07 90 00 – Joint Protection  
08 11 16 - Aluminum doors and frames  
08 14 16 - Flush wood doors  
08 33 23 - Overhead coiling doors  
08 35 13.13 - Accordion folding doors  
08 51 13 - Aluminum windows  
08 71 00 - Door hardware  
08 78 00 - Special Function Hardware  
08 80 00 – Glazing  
08 95 00 – Vents  
09 21 00 - Plaster and Gypsum Assemblies  
09 25 26 - Natural clay plastering  
09 29 00 - Gypsum Board  
09 60 00 - Flooring  
09 91 23 - Interior painting  
10 22 23.23 - Operable partition system  
11 00 00 - Equipment



- 11 31 13 - Residential Kitchen appliances
- 11 31 23 - Residential Laundry appliances
- 11 52 00 - Audio-visual equipment
- 11 52 13 - Projection screens
- 11 52 16.19 - Overhead projectors
- 12 36 00 – Countertops
- 12 93 43.13 – Site Seating
- 13 30 00 - Special Structures
- 13 42 00 - Building Modules
- 21 13 13 - Wet-Pipe Sprinkler System
- 22 11 16 - Domestic Water Piping
- 22 11 23 - Domestic Water Pumps
- 22 12 00 - Facility-potable water storage tank
- 22 14 00 - Facility storm drainage
- 22 14 13 - Facility storm drainage piping
- 22 33 00 - Electrical Domestic Water Heaters
- 22 41 00 - Residential Plumbing Fixtures
- 22 41 13 - Residential water closets, urinals, and bidets
- 22 41 16 - Residential lavatories and sinks
- 22 41 23 - Residential shower receptors and basins
- 22 41 39 - Residential faucets, supplies, and trim
- 23 01 00 - Operation and Maintenance of HVAC Systems
- 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- 23 09 13 - Instrumentation and control devices for HVAC
- 23 21 13 – Hydronic Piping
- 23 21 23 - Hydronic Pumps
- 23 31 00 - HVAC Ducts and Casings
- 23 37 13 - Diffusers, registers, and grilles
- 23 38 00 - Ventilation hoods
- 23 57 00 - Heat exchangers for HVAC
- 23 64 23 - Scroll Water Chillers
- 23 71 00 - Thermal storage
- 23 72 19 - Fixed Plate air-to-air energy recovery equipment
- 23 80 00 - Decentralized HVAC Equipment
- 23 82 19 - Fan coil units
- 23 83 16 - Radiant-heating hydronic piping
- 25 35 16 - Integrated Automation Sensors and Transmitters
- 26 05 00 - Common Work Results for electrical
- 26 05 83 - Wiring Connections
- 26 09 23 - Lighting control devices
- 26 22 00 - Low-Voltage Transformers
- 26 24 16 - Panelboards
- 26 27 13 –Electricity metering
- 26 27 26 - Wiring Devices
- 26 28 00 - Low-Voltage Circuit Protective Devices
- 26 29 13 – Enclosed Controllers
- 26 31 00 - Photovoltaic Collectors
- 26 51 00 - Interior Lighting
- 26 56 00 - Exterior lighting
- 27 20 00 - Data communications
- 28 31 46 - Smoke detection sensors
- 31 66 00 – Special Foundations
- 32 00 00 - Exterior Improvements
- 32 14 13 - Precast Concrete Unit Paving





- 32 35 00 - Screening Devices
- 32 91 16.19 - Netting Planting Soil Stabilization
- 32 93 00 - Plants
- 32 94 33 - Planters
- 33 79 00 - Site Grounding
- 48 19 16 - Electrical power generation inverters



## Summary of Changes

Significant changes to the aSUNm project manual and construction drawings that have occurred between submissions have been outlined below.

### Tuesday, November 20<sup>th</sup> 2012 Revisions

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

- **COMPLETION OF RULES COMPLIANCE CHECKLIST**
- **ADDITION OF TARGET CLIENT CHARACTERISTICS AND REQUIREMENTS**
- **STRUCTURAL AND SEISMIC CALCULATION REVISIONS AS PER ASCE 7-10**  
Design narrative added
- **WATER BUDGET**  
Total water budget increased from 979.83 gallons to 1330.73 gallons. This is a result of an increase of water use for fire protection from 25 to 344 gallons.
- **ELECTRICAL REVISIONS:**  
PV panels changed from Bosch to Sunpower E19 240  
Inverter changed from Sunny Boy to Power One 5000  
Tigo optimizers have been removed
- **ADDITION OF WRITTEN DESCRIPTION OF SUMMARY OF RECONFIGURABLE FEATURES**
- **ENERGY ANALYSIS RESULTS AND DISCUSSION**  
SD Building code content and compliance added
- **SPECIFICATION REVISIONS**

#### **SPECIFICATIONS ADDED**

Section 01 51 13 - Temporary Electricity  
Section 07 00 00 - Thermal and Moisture Protection  
Section 07 13 26 - Self-Adhering Sheet Waterproofing  
Section 07 26 00 – Vapor Retarders  
Section 07 62 00 - Sheet Metal Flashing and Trim  
Section 08 11 16 – Aluminum Doors  
Section 08 33 23 - Overhead Coiling Doors  
Section 08 35 13.13 – Accordion Folding Doors  
Section 08 51 13 - Aluminum Windows



Section 09 29 00 – Gypsum  
Section 09 62 23 – Bamboo Flooring  
Section 09 94 23 – Interior Painting  
Section 11 31 13 - Residential Kitchen Appliances  
Section 11 31 23 - Residential Laundry Appliances  
Section 11 52 16.19 – Overhead Projectors  
Section 12 35 30 – Residential Casework  
Section 12 36 00 – Counters  
Section 21 13 13 – Wet-Pipe Sprinkler System (Added As Per NFPA 13d Standard)  
Section 22 14 00 - Facility Storm Drainage  
Section 22 41 13 - Residential Water Closets, Urinals, And Bidets  
Section 22 41 16 - Residential Lavatories And Sinks  
Section 22 41 23 - Residential Shower Receptors And Basins  
Section 22 41 39 - Residential Faucets, Supplies, And Trim  
Section 23 01 00 - Operation And Maintenance Of HVAC Systems  
Section 23 23 00 – Refrigerant Piping  
Section 23 57 00 - Heat Exchangers For HVAC  
Section 23 64 23 - Scroll Water Chillers  
Section 23 82 19 – Fan Coil Units  
Section 26 27 26 - Wiring Devices  
Section 26 22 00 - Low-Voltage Transformers  
Section 26 24 16 – Panelboards  
Section 26 27 13 - Electricity Metering  
Section 26 31 00 - Photovoltaic Collectors  
Section 26 51 00 - Interior Lighting  
Section 32 91 16.19 - Netting Planting Soil Stabilization

#### **SPECIFICATIONS UPDATED**

Section 01 54 19 - Temporary Cranes  
Section 06 05 23 - Wood, Plastics, And Composites  
Section 06 16 00 - Sheathing  
Section 06 16 23 - Subflooring  
Section 06 70 00 - Structural Composites  
Section 07 13 26 - Self-Adhering Sheet Waterproofing  
Section 07 21 19 - Thermal Insulation  
Section 07 44 56 – Mineral-Fiber-Reinforced Cementitious Panels  
Section 08 14 16 - Flush Wood Doors  
Section 08 71 00 - Door Hardware  
Section 08 80 00 – Glazing  
Section 09 25 26 – Natural Clay Plastering



Section 10 22 23.23 - Operable Panel System  
Section 11 52 00 - Audio Visual Equipment  
Section 221116 - Domestic Water Piping  
Section 22 11 23 – Domestic Water Pumps  
Section 22 12 00 - Facility-Potable Water Storage Tank  
Section 22 33 00 – Electrical Domestic Water Heater  
Section 22 41 00 - Residential Plumbing Fixtures  
Section 23 21 23 - Hydronic Pumps  
Section 23 31 00 - HVAC Ducts And Casings  
Section 23 37 13 - Diffusers, Registers, And Grilles  
Section 23 38 00 – Ventilation Hood  
Section 23 71 00 - Thermal Storage  
Section 23 72 19 – Fixed Plate Air-To-Air Energy Recovery Equipment  
Section 23 80 00 - Decentralized HVAC Equipment  
Section 23 83 16 – Radiant-Heating Hydronic Piping  
Section 26 09 23 - Lighting Control Devices  
Section 26 56 00 – Exterior Lighting  
Section 27 00 00 - Data Communication  
Section 28 31 46 – Smoke Detection Sensors  
Section 32 93 00 – Plants  
Section 32 94 33 – Planters  
Section 33 79 00 – Grounding  
Section 48 19 16 - Electrical Power Generation Inverters

**SPECIFICATIONS REMOVED**

Section 08 10 00 – Doors And Frames  
Section 08 14 00 – Wood Doors  
Section 08 35 13 – Folding Doors  
Section 08 36 13 – Sectional Doors  
Section 08 50 00 – Windows  
Section 09 60 00 – Flooring  
Section 11 31 00 – Residential Appliances  
Section 11 52 16 – Projectors  
Section 23 34 00 – HVAC Fans  
Section 23 64 00 – Packaged Water Chillers  
Section 26 31 00 – Photovoltaic  
Section 26 50 00 – Lighting  
Section 32 14 00 – Unit Paving  
Section 33 70 00 – Electrical Utilities



- **CONSTRUCTION DOCUMENTATION SHEET REVISIONS**

**A-Series – Interior Wall Reveal**

Interior reveal wrapping around the core- kitchen, east wall in bedroom, bathroom, and west wall in flex space added. 4" reveal on upper wall and lower wall.

**A –Series- Mechanical Shaft**

The mechanical shaft in the bathroom was expanded in the east/west axis.

**A-Series- Bathroom Material Changes**

Shower pan was recessed into the subfloor structure to allow a bamboo, slat, roll-on floor-surface. Bamboo slats will wrap up the walls and onto the ceiling of the shower space. A soffit has been added over the sink and toilet space in the bathroom (ceiling lowered 6").

**A-Series- Water Management**

Water-hogs moved from the north wall of the bedroom to the north wall of the mechanical room.

**A-Series- Water Management**

Reduced number of Water-hogs to 8 units.

**A-Series- Roof Drainage**

North Module roof changed to drain water onto the Mechanical Module roof. Mechanical Module roof cricketed to send water to a drain-pipe that is connected to Water-Hogs in series on north wall.

**A-Series- Rain Screen Assembly**

Building skin and rain screen assembly integrated into a single, panelized system utilizing 14-gauge steel and metal angles as structural support. Fiber-cement board backing screwed directly into dimensional lumber rain screen.

**A-Series- Interior Bathroom Doors**

Doors flanking the bathroom on east and west side changed from pocket doors to sliding barn doors.

**A-Series- Kitchen Soffit**

Kitchen soffit changed to panelized bamboo system.

**A-201, 202- Solar Canopy**

Solar Canopy angle changed to 22 degrees.

**F-102- Fire Protection**

Fire protection drawings replaced with drawings from Jason Grantham, engineer at "Eagle Automatic."

**S-104- Deck Framing**

Deck framing designed to resist seismic using Bison-Bracing. Allows for load transfer into moment frame and shear walls.

**S-104- Deck Framing**



Private deck outside of bedroom pulled back 2' from west to account for solar envelope. Exterior "wing-wall" pulled back 2' from west as well.

**S-102- First Floor Framing**

Shower framing to be framed as a separate unit with 2"x4" joists @ 8" o.c. to allow for recessed shower pan.

**P-103- Domestic Return**

Drainpipes changed to 3" diameter.

**P-Series- Condensate**

Addition of condensate drains to capture condensate from mechanical equipment.

**E-101- Interior Electrical**

Revised electrical switch and outlet plan; addition of GFCI and AFI outlets.

**E-102- Low Voltage Transformer**

LVT transformer moved from inside mechanical room to inside bike storage module.

**E-103- Solar Panel Configuration**

Solar panels changed to 6 rows of 7 panels.

**L-101 Site Conditions**

An addition of boulders was made to the northeast planters and rock garden on southwest corner of deck.

**M-Series- Energy Recovery Ventilator**

ERV sized as EV-200. Updated specifications included in project manual.

**M-Series- Air Handler**

AHU changed to fan-coil unit: Johnson Controls FHX-25; specifications updated in project manual.

**M-Series- Duct Work**

Revised supply and return ductwork.

**M-Series-Hot Water**

Changed to heat pump water heater, updated specifications to reflect.

**M-Series- Thermal Mass**

47 cubic foot ice-storage unit added to mechanical room for use with radiant cooling system.



## Thursday, February 14<sup>th</sup> 2013 Revisions

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

- **RULES COMPLIANCE UPDATED**  
Team supplied liquids schedule updated  
Spill containment plan (Sheet H-101 & H-601)  
Transportation Plan, Materials safety and removal plans (Submitted prior (02/2013), pending approval)
- **STRUCTURAL AND SEISMIC CALCULATION REVISIONS AS PER ASCE 7-10**
- **WATER BUDGET**  
Total water budget increased from 1330.73 gallons to 1337.33 gallons
- **ELECTRICAL REVISIONS:**  
PV panels changed from Sunpower E19 240 to SolarWorld SW 245 mono black
- **ENERGY ANALYSIS RESULTS AND DISCUSSION UPDATED**
- **QUANTITY TAKEOFFS UPDATED**
- **SD BUILDING CODE CONTENT AND COMPLIANCE**  
Listed referenced codes, standards, and references and removed unnecessary quoted text
- **SPECIFICATION REVISIONS**

### **SPECIFICATIONS ADDED**

Section 01 54 23 - Temporary Scaffolding and Platforms  
Section 03 40 00 – Precast Concrete  
Section 05 05 23 – Metal Fastenings  
Section 05 17 00 - Structural Rod Assemblies  
Section 05 50 00 – Metal Fabrications  
Section 05 54 00 – Metal Floorplate  
Section 05 75 00 – Architectural Metalwork  
Section 06 00 00 - Wood, Plastic, and Composites  
Section 06 10 00 – Rough Carpentry  
Section 06 40 13 - Exterior Architectural Woodwork  
Section 06 40 23 - Interior Architectural Woodwork  
Section 06 42 13 - Solid Lumber Paneling  
Section 07 13 00 – Sheet Waterproofing  
Section 07 21 13 – Board Insulation  
Section 07 27 00 – Air Barriers  
Section 07 46 23 –Wood Siding  
Section 07 71 26 – Reglets  
Section 08 78 00 – Special Function Hardware



Section 09 21 00 – Plaster and Gypsum Assemblies  
Section 11 52 13 – Projection Screens  
Section 22 14 13 - Facility Storm Drainage Piping  
Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC  
Section 26 05 00 - Common Work Results for electrical  
Section 26 05 83 - Wiring Connections  
Section 31 66 00 – Special Foundations  
Section 32 14 13 - Precast Concrete Unit Paving  
Section 32 35 00 – Screening Devices

#### **SPECIFICATIONS UPDATED**

All specifications have been updated

#### **SPECIFICATIONS REMOVED**

Section 06 70 00 – Structural Composites  
Section 07 10 00 – Dampproofing and Waterproofing  
Section 07 13 26 - Self-Adhering Sheet Waterproofing  
Section 07 26 00 – Vapor Retarders  
Section 07 53 00 - Elastomeric membrane roofing  
Section 08 14 76 – Bifolding Wood Doors  
Section 13 48 00 – Sound, Vibration, and Seismic Control  
Section 22 33 13 – Instantaneous Electric Domestic Water Heaters

#### • **CONSTRUCTION DOCUMENTATION SHEET REVISIONS**

##### **A-Series – Exterior Finish**

The Spandrel above the window/ door on the exterior envelope changed to black lacquered finish on fiber cement board.

##### **A –Series- Mechanical Shaft**

The North wall at mechanical shaft removed. Minor reduction in framing. Also toe wall adjacent to the mechanical shaft removed from the bathroom. Minor reduction in framing and finish bamboo surface.

##### **A-Series- Bathroom Material and Wall Changes**

Recessed Shower pan detail has been revised to allow easier grey water collection. Revised and reduced bamboo slats that wrap up the walls. The soffit over the sink and toilet space in the bathroom has been revised again (ceiling @ soffit lowered from 6" to 1'). This soffit has built in access panel to the fan coil unit. Relocate the Fan coil unit from its previous location on the roof of the south module to its current location in the soffit. Reductions in duct length from ERV to the fan coil and the supply duct from the fan coil on the DOAS side of HVAC.

##### **A-Series- Water Management**

Water-hogs moved from the north wall of the bedroom to the north wall of the mechanical room. Reduced in numbers from 8 to 5 units.





**A-Series- Rain Screen Assembly**

Further Improvement of the panelized integrated rain screen/ building skin assembly. The mounting detail improved by introducing Z clips and reduction in Angle profiles.

**A-Series- Interior Bathroom Doors (A-402)**

Doors flanking the bathroom on east and west side changed from pocket doors to face flush sliding doors.

**A-Series- Kitchen Soffit**

Panelized bamboo system at the Kitchen soffit revised with 2/3 reduction in the quantity of bamboo slats by changing orientation from vertical on edge to horizontal on face application.

**A-201, 202- Solar Canopy**

Solar Canopy angle changed to 19 degrees.

**S-104- Deck Framing**

Revised deck foundation from previously specified Bison Vers-adjust composite concrete paver decking and footing system to more economical central piers seismic Jack stand footings with pressure treated wood.

**A-101 and A-513- Ramp**

Revised railing detail at the ramp.

**E-103- Solar Panel Configuration**

Solar panels changed to 6 rows of 7 (42 panels) to 6 rows of 6 (36 panels).

**M-Series- Air Handler**

Fan-coil unit: Johnson Controls FHX-25; specifications has been updated to more economical TRANE compact concealed model 'P' type 'C-300'.

**M-Series- Duct Work**

Revised supply and return ductwork- reduced lengths.

**A 101**

Planter benches on sheet A-101 not part of the contract.

**A-402, A-404**

Framing revised from 2x8 to 2x4 for the plumbing core wall.

**A-301, A-302, A-303, A-311, A-312, A-313 - Revised Footings**

Revised footing to comply with the seismic - Central pier Jack Stands.

**S-501, S-522**

Canopy structure revised.



**H-101, M-101B**

Revised access to couplings and Hydronic pipes for the BEKA capillary mats. Total surface area of BEKA radiant capillary mats reduced.

**L-103**

Revision of Down lighting fixtures

## Friday, April 5<sup>th</sup> 2013 Revisions

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

- **INTERCONNECTION APPLICATION FORM UPDATED**  
Changed sheet reference from E-201 to E-106
- **TARGET CLIENT CHARACTERISTICS AND REQUIREMENTS EDITED**  
Target market narrowed from two to a single example
- **PHOTOVOLTAIC NARRATIVE EDITED**  
Scalability portion of photovoltaic narrative removed
- **SPECIFICATION REVISIONS**

**SPECIFICATIONS ADDED**

Section 26 28 00 - Low-Voltage Circuit Protective Devices

**SPECIFICATIONS UPDATED**

Section 22 12 00 - Facility-Potable Water Storage Tank

Section 20 05 00 – Common Work Results for Electrical

Section 26 05 83 – Wiring Connections

Section 26 22 00 – Low-Voltage Transformers

**SPECIFICATIONS REMOVED**

Section 26 18 00 – Medium-Voltage Circuit Protection Devices

- **CONSTRUCTION DOCUMENTATION SHEET REVISIONS**

**G-011**

Modularity section removed

**H-101**

Added annotations 3 and 4 to distinguish supply and waste tanks



**H-601**

Updated schedule

**L-101, L-103**

Element outside of solar envelope removed

**S-514**

2' separation between anchors verified

**A-111**

Addressed title

**A-112**

Element outside of solar envelope deleted

**A-513**

Added 12" extensions and height dimensions to handrail. Length dimension added.

**P-101**

Updated plumbing

**P-102, P-103**

Addressed pipe sizing

**P-601**

Updated pipe sizing and revised schedule

**P-901**

Updated isometric to incorporate 500 gallon supply tank

**P-902**

Updated isometric to incorporate 500 gallon return tank

**M-001**

Addressed scale

**E-Series**

AFCI outlets added per code and drawings labeled

**E-102**

Added circuit number for home runs

**E-104**

Added circuit number for lighting and home runs



**E-106**

Added sheet 106 as referenced on electrical interconnection application form

**E-107**

Revised PV calculations

**E-201**

Sheet added to show panel and meter elevations

**E-601**

One-line diagram revised

**E-603**

Three-line diagram revised

**E-604**

Revised panel schedule

**E-605**

Revised feeder and neutral calculations

**E-606**

Sheet added

**T-601**

Revised HVAC control systems

**T-602**

Revised master control schematic

**O-101, O-102**

Revised crane logistics



## Thursday, August 22nd 2013 Revisions

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

- **PHOTOVOLTAIC NARRATIVE REMOVED**
- **UPDATED TEAM-SUPPLIED LIQUIDS SCHEDULE**
- **UPDATED DETAILED WATER BUDGET**
- **SPECIFICATION REVISIONS**

### **SPECIFICATIONS ADDED**

Section 05 40 00 – Cold-Formed Metal Framing  
Section 06 22 00 – Millwork  
Section 07 20 00 – Thermal Protection  
Section 11 00 00 – Equipment  
Section 23 21 13 – Hydronic Piping  
Section 26 29 13 – Enclosed Controllers

### **SPECIFICATIONS UPDATED**

All divisions have been revised and updated for manufacturer and product information

### **SPECIFICATIONS REMOVED**

Section 01 51 13 – Temporary Electricity  
Section 06 42 13 – Solid Lumber Paneling  
Section 07 72 00 – Roof Accessories  
Section 09 23 00 – Gypsum Plastering  
Section 09 62 23 – Bamboo Flooring  
Section 12 35 30 – Residential Casework  
Section 23 23 00 – Refrigerant Piping  
Section 23 32 33 – Air Distribution Ceiling Plenums  
Section 23 83 16 – Radiant Heating Hydronic Piping

- **CONSTRUCTION DOCUMENTATION SHEET REVISIONS**

#### **A-Series**

Decreased depth of spray-in insulation in wall, roof, floor assemblies and removed insulation from parapet walls  
Removed carport canopy structure  
Removed southwest planter  
Added seating bench  
Simplified brise soleil rain screen.



Revised planter module structure to use less material  
Revised material and detailing of interior soffit conditions  
Finalized millwork

**S-series**

Modified canopy structure for transportation

**L-Series**

Simplified landscape strategy and decreased quantity of plants

**P-series**

Revised supply and return system for efficiencies

**O-Series**

Revised transportation operations and logistics: removal of crane use

**M-Series**

Revised Mechanical equipment: Chiller

**T-Series**

Updated

**E-Series**

Updated



## 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-201 O-202 O-301 O-601 O-602
Rule 4-2	Construction Equipment	Specifications for heavy machinery	Div 01 51 13 Div 11 00 00
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-100
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	S-102
Rule 4-5	Generators	Specifications for generators (including sound rating)	Div 01 51 13
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 H-601 Page 22
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	Div 21 13 13 Div 22 11 16 Div 22 11 23 Div 22 12 00 Div 22 14 00 Div 22 14 13 Div 22 33 00 Div 22 41 00 Div 23 21 13 Div 23 21 23 Div 23 57 00 Div 23 64 23 Div 23 71 00 Div 23 80 00 Div 23 82 19
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	S-511 S-513 S-514 S-515 S-521 S-524 Page 23 Div 31 66 00



Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	S-511 S-513 S-514 S-515 S-521 S-524 Div 31 66 00
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A-201 A-202
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	S-series Page 23-128 (See separate documentation for stamped drawings and calculations)
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-102 G-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-Series
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	N/A
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	Div 26 22 00 Div 26 24 16 Div 26 27 13 Div 26 31 00 Div 33 79 00 Div 48 19 16
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A





Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	N/A
Rule 8-5	Village Grid	Completed interconnection application form	Page 134
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-Series A-102
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	Div 26 24 16 Div 26 27 13 Div 26 31 00 Div 33 79 00 Div 48 19 16
Rule 8-5	Village Grid	One-line electrical diagram	E-603
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-Series
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	E-Series A-102 G-102 G-103
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-Series A-102
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	H-101
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on October 1	P-101 P-102 L-101 G-601
Rule 9-2	Team-Provided Liquids	Quantity, specifications , and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	H-601 Page 22
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	N/A
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	A-112
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	M-series M-101A M-101B M-201
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	Div 23 71 00



Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	P-101 P-102 P-901
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	Div 22 12 00
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-101 P-102 P-902
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	Div 22 12 00 Div 22 41 00
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-102 G-103

### Team-Supplied Liquids Schedule

The following is a list of all team-supplied liquids:

Information about team-supplied liquids					
Liquid	Quantity	Purpose	Specification	Delivery Date*	Notes
<b>Water-graphite mixture</b>	45 gallons water-graphite mixture	Thermodynamic system: thermal storage	23 71 00	9/21/13	Graphite and water will be premixed and sealed before competition, will remain sealed and will not circulate
<b>Propylene glycol<sup>+,#</sup></b>	22 gallons	Thermodynamic system: thermal storage	23 71 00	9/21/13	Dynalene, will be mixed with water to approx. 30%

\*Team-supplied liquids will be delivered with the rest of Team ASUNM's supplies and equipment. The planned date for arrival of trucks is 9/21/13; however, delivery date is approximate only due to the possibility of shipping delays.  
 + see SD Organizer approved "Request for Approval for the use of Propylene Glycol during Solar Decathlon 2013", 2/18/13  
 # MSDS for Propylene glycol can be found in the Health and Safety Plan



## Structural Calculations

### Structural Design Narrative

#### STRUCTURAL DESIGN NARRATIVE

##### **GENERAL DESCRIPTION:**

The SHADE home is a custom-designed single-family residence. SHADE's two main interior modules are comprised of shop fabricated steel frames with integrated chassis' which support gravity loads and transfers this loading into the foundation system. Roof diaphragms, floor diaphragms and shear walls are integral with the steel frame and resist lateral forces.

The solar canopy module supports the solar array and is a moment frame which resists gravity and lateral forces.

The mechanical unit is traditionally framed using cold-formed steel and transfers lateral forces using roof diaphragms, floor diaphragms and shear walls.

##### **FOUNDATIONS:**

The design of the adjustable "Central Piers" seismic piers and footings will comply with limitations on differential movement appropriate to the competition duration and variability of surface strata.

It is anticipated that uplift and overturning forces will be entirely resisted by the building weight; shear forces will be resisted by ground embedded 1" diameter by 42" long steel stakes.

##### **SUPERSTRUCTURE:**

The design of the superstructure was driven by several factors most importantly constructability, but also the necessity for accuracy and tolerance over repeated assemblies and disassemblies.

##### **SUPERSTRUCTURE DETAIL**

Gravity loads will primarily be resisted by shop-fabricated steel frame of hot-rolled members.

Roof framing will be affixed through steel joist tabs welded directly to the steel frame to create desired roof configurations.

Roof diaphragms will consist of cold-formed steel rafters fastened directly to 15/32" APA rated O.S.B.

Floor framing will be affixed through steel joist tabs welded directly of the steel frame to create desired floor configurations.

Floor diaphragms will consist of cold-formed steel joists fastened directly to 1-1/8" T&G APA rated plywood.



The lateral system utilizes exterior shear walls for bracing.

#### **LOAD PATH:**

Lateral forces are resisted by shear walls, roof diaphragms, floor diaphragms and ground embedded steel stakes as well as a moment frame in the case of the solar canopy. Lateral forces which act on the roof diaphragm are transferred through the roof O.S.B into blocking at the diaphragm edge via #8 PPSD screw at 6" o.c., force is then transferred to the top plate of the shear walls via a Simpson A35 connection, shear wall plywood is connected to the top plate and studs by 1-1/2" bugle head "GypFast" nail at 6" o.c.; load continues through cold-formed steel tracks and studs, the bottom plate is attached to the hot-rolled steel (part of the overall steel frame assembly) at floor level via 5/8" ASTM A307 shear studs at 32" o.c. When necessary, shear walls resist overturning utilizing Simpson S/HDs. From the bottom W, M and MC shaped beams, load is transferred to the ground through a bolted connection to Central Piers 7" seismic piers which are affixed 1/2" plywood pads. The lateral loads are then transferred into the ground via 1" diameter by 42" long steel stakes directly through the seismic piers. Ample anchorage is employed to resist lateral forces in all directions.

#### STRUCTURAL DESIGN GUIDELINES

##### **APPLICABLE CODES AND STANDARDS**

The following codes and standards are specified:

2013 Solar Decathlon Building Code (SDBC)

2009 International Residential Code (IRC)

ASCE 7-05, Minimum Design Loads for Buildings and Other Structures

The following structural design codes will be followed as specified by the governing codes and standards:

NDS, National Design Specification for Wood Construction (NDS)

AISC 230 Specification for Structural Steel Buildings

##### **STRUCTURAL LOADING**

Uniformly Distributed Live Loading



The following values are specified by the applicable codes and standards or are higher values selected for use on this project.

**WIND:**

Competition: 85 mph (3-second gust), exposure category C – No Overturning, uplifting, or sliding with a safety factor of 2.

Permanent: 90 mph (3-second gust), exposure category C

**SEISMIC PARAMETERS:**

IRC Seismic Design Category (SDC) D<sub>2</sub> (See IRC R301.2.2) is used to calculate the design forces. The design base shear is found using the equivalent lateral force procedure with the following factors:

Short period map value ( $S_{DS}$ ): 0.968 g

Assumed Site Class (Soil Factor): D

**RAILINGS:**

200 lb (890 N) concentrated load applied in any direction at any point at the top of the rail.

**INTERIOR FLOOR, DECKS, RAMPS:**

50 psf (2.39 kPa) live load

**EXTERIOR FLOOR, DECKS RAMPS USED FOR TOUR STAGING AND EGRESS PURPOSES:**

100 psf (4.79 kPa) live load.

**ROOF:**

20 psf (0.958 kPa) live load

**TEMPORARY PAVED SURFACE:**

3,000 psf (143 kPa) maximum load-bearing pressure

**MATERIAL SPECIFICATIONS:**

Structural Steel: ASTM A572,  $F_y = 50$  ksi

Bolts & Plain Anchors: ASTM A307

Welding: E70XX electrodes



### **NON-STRUCTURAL COMPONENTS:**

Provisions for the support of non-structural components are as follows:

Seismic provisions of the 2009 IBC require minimum detailing requirements for non-load bearing walls, supports for mechanical, electrical, plumbing equipment, etc.

### **FUTURE USE AND EXPANSION PROVISIONS**

No provisions for future changes in use or expansion will be included in the structural design.

## **Weight Calculations**

WEIGHT CALCULATIONS FOR MODULES, MECHANICAL ROOM AND EXTERNAL STORAGE:



**NORTH  
MODULE**

<b>STEEL FRAME</b>	<b>WEIGHT (PLF)</b>	<b>LENGTH (FT.)</b>	<b>WEIGHT (#)</b>
COLUMNS (HSS 3x3x3/16)	6.87	86.82	596.4534
HIGH ROOF BEAMS (HSS 3x2x1/8)	5.59	99.49	556.1491
LOW ROOF BEAMS (HSS 8x3x1/4)	17.32	36.54	632.8728
LOW ROOF BEAMS (HSS 6x3x1/4)	13.91	62.96	875.7736
CEILING BEAM (HSS 4x3x5/16)	12.7	36.54	464.058
AXLE BEAMS (W 12x14)	14	29.29	410.06
AXLE CROSS BEAM (W 12x22)	22	26.85	590.7
FRONT AND BACK RAILS (MC 12x10.6)	10.6	27.375	290.175
EDGE BEAMS (M 12x11.8)	11.8	73.08	862.344
CROSS BEAMS (M 12x11.8)	11.8	26.83	316.594
<b>TOTAL</b>			<b>5595.1799</b>

<b>ROOF JOISTS AND RAFTERS (NORTH)</b>	<b>WEIGHT (PLF)</b>	<b>LENGTH (FT.)</b>	<b>WEIGHT (#)</b>
800S162-54 @ 24" O.C.	2.28	250.8	571.824
600S162-54 @24" O.C.	1.89	237.85	449.5365
<b>TOTAL</b>			<b>1021.3605</b>

<b>ROOF (NORTH)</b>	<b>WEIGHT (PSF)</b>	<b>AREA (FT^2)</b>	<b>WEIGHT (#)</b>
1/2" PLYWOOD	1.7	459.67	781.439
RIGID FIBERGLASS / 6" THICK	9	459.67	4137.03
HEAT LOC SOY SPRAY INSULATION / 8" THICK	1.47	459.67	675.7149
1/2" DUROCK CEMENT BOARD	2.4	459.67	1103.208
1/2" PLASTER	5	459.67	2298.35



SPRAY INSULATION / 1" THICK	0.185	459.67	85.03895
M,E,P	6	459.67	2758.02
<b>TOTAL</b>	<b>25.755</b>		<b>11838.80085</b>

FLOOR JOISTS (NORTH)	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
600S200-54 @ 12" O.C.	2.09	432.5	903.925
<b>TOTAL</b>			<b>903.925</b>

FLOOR (NORTH)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
1 1/8" O.S.B.	3.6	470.38	1693.368
1/2" BAMBOO FLOORING	2	470.38	940.76
HEAT LOC SOY SPRAY INSULATION / 6" THICK	1.1	470.38	517.418
T-111 3/8" THICK	1.1	470.38	517.418
MISC.	2	470.38	940.76
<b>TOTAL</b>	<b>9.8</b>		<b>4609.724</b>

WALLS (EXTERIOR)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
362S162-54 @ 24" O.C.	0.75	441.48	331.11
162S125-33 @ 24" O.C.	0.25	441.48	110.37
HEAT LOC SOY SPRAY INSULATION / 7.25" THICK	1.33	441.48	587.1684
1/2" GYPSUM	2.2	441.48	971.256
1/2" PLYWOOD	1.7	441.48	750.516
FIBER CEMENT CLADDING	3	441.48	1324.44





MISC.	2.8	441.48	1236.144
CLAY SKIM FINISH	0.5	441.48	220.74
<b>TOTAL</b>	<b>12.53</b>		<b>5531.7444</b>

PARAPET WALL	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
250S162-54 @ 24" O.C.	0.61	96.68	58.9748
1/2" PLYWOOD (INSIDE)	1.7	96.68	164.356
FIBER CEMENT CLADDING	3	96.68	290.04
1/2" PLYWOOD (OUTSIDE)	1.7	96.68	164.356
HEAT LOC SOY SPRAY INSULATION / 2.5" THICK	0.46	96.68	44.4728
<b>TOTAL</b>	<b>7.47</b>		<b>722.1996</b>

WALLS (INTERIOR)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
550S162-54 @ 16" O.C.	1.8	282	507.6
1/2" GYPSUM	2.2	282	620.4
1/2" GYPSUM	2.2	282	620.4
HEAT LOC SOY SPRAY INSULATION / 5.5" THICK	1	282	282
MISC.	2.8	282	789.6
<b>TOTAL</b>	<b>10</b>		<b>2820</b>

EXTERIOR DOOR / WINDOWS	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
GLASS, FRAME, SASH	8	153.2	1225.6
<b>TOTAL</b>	<b>8</b>		<b>1225.6</b>



INTERIOR HOLLOW CORE DOORS	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
DOOR, FRAME	4	172	688
<b>TOTAL</b>	<b>4</b>		<b>688</b>

EQUIPMENT	WEIGHT (#)
DW (N)	81
REFRIGERATOR (N)	605
DRYER (N)	185
WASHER (N)	185
<b>TOTAL</b>	<b>1056</b>

FAÇADE SCREENS	WEIGHT EACH	NUMBER	WEIGHT (#)
	181.15	4	724.6
<b>TOTAL</b>			<b>724.6</b>

M,E,P MISC.			1000
<b>TOTAL</b>			<b>1000</b>

<u>NORTH</u>				
<u>MODULE</u>				
<u>TOTAL</u>				37737.13425

	STEEL FRAME	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
<i>SOUTH</i>				



MODULE

COLUMNS (HSS 3x3x3/16)	6.87	90.76	623.5212
HIGH ROOF BEAMS (HSS 3x2x1/8)	5.59	95.48	533.7332
LOW ROOF BEAMS (6x3x1/4)	13.91	95.48	1328.1268
AXLE BEAMS (W 12x14)	14	29.3	410.2
AXLE CROSS BEAM (W 12x22)	22	22.83	502.26
FRONT AND BACK RAILS (MC 12x10.6)	10.6	23.38	247.828
EDGE BEAMS (M 12x11.8)	11.8	73.08	862.344
CROSS BEAMS (M 12x11.8)	11.8	22.83	269.394
<b>TOTAL</b>			<b>4777.4072</b>

ROOF RAFTERS (SOUTH)	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
800S162-54 @16" O.C.	2.28	250.8	571.824
<b>TOTAL</b>			<b>571.824</b>

ROOF (SOUTH)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
1/2" PLYWOOD	1.7	386.67	657.339
RIGID FIBERGLASS / 6" THICK	9	386.67	3480.03
HEAT LOC SOY SPRAY INSULATION / 8" THICK	1.47	386.67	568.4049
1/2" DUROCK CEMENT BOARD	2.4	386.67	928.008
1/2" PLASTER	5	386.67	1933.35
SPRAY INSULATION / 1" THICK	0.185	386.67	71.53395
M,E,P	6	386.67	2320.02
<b>TOTAL</b>	<b>25.755</b>		<b>9958.68585</b>



FLOOR JOISTS (SOUTH)	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
600S200-54 @ 12" O.C.	2.09	396.46	828.6014
<b>TOTAL</b>			<b>828.6014</b>

FLOOR (SOUTH)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
1 1/8" O.S.B.	3.6	309.875	1115.55
1/2" BAMBOO FLOORING	2	309.875	619.75
HEAT LOC SOY SPRAY INSULATION / 6" THICK	1.1	309.875	340.8625
T-111 3/8" THICK	1.1	309.875	340.8625
MISC.	2	309.875	619.75
<b>TOTAL</b>	<b>9.8</b>		<b>3036.775</b>

WALLS (EXTERIOR)	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
362S162-54 @ 24" O.C.	0.75	414.91	311.1825
162S125-33 @ 24" O.C.	0.25	414.91	103.7275
HEAT LOC SOY SPRAY INSULATION / 7.25" THICK	1.33	414.91	551.8303
1/2" GYPSUM	2.2	414.91	912.802
1/2" PLYWOOD	1.7	414.91	705.347
FIBER CEMENT CLADDING	3	414.91	1244.73
MISC.	2.8	414.91	1161.748
CLAY SKIM FINISH	0.5	414.91	207.455
<b>TOTAL</b>	<b>12.53</b>		<b>5198.8223</b>



PARAPET WALL	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
250S162-54 @ 24" O.C.	0.61	97.48	59.4628
1/2" PLYWOOD (INSIDE)	1.7	97.48	165.716
FIBER CEMENT CLADDING	3	97.48	292.44
1/2" PLYWOOD (OUTSIDE)	1.7	97.48	165.716
HEAT LOC SOY SPRAY INSULATION / 2.5" THICK	0.46	97.48	44.8408
<b>TOTAL</b>	<b>7.47</b>		<b>728.1756</b>

EXTERIOR DOOR / WINDOWS	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
GLASS, FRAME, SASH	8	177	1416
<b>TOTAL</b>	<b>8</b>		<b>1416</b>

EQUIPMENT		WEIGHT (#)
OVEN (S)		171
COOKTOP (S)		33
<b>TOTAL</b>		<b>204</b>

CASEWORK		WEIGHT (#)
CABINETS		500
COUNTERTOPS		1000
<b>TOTAL</b>		<b>1500</b>

ROCK GARDEN	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
PAN	3	32.9	98.7



ROCK 2"	16	32.9	526.4
<b>TOTAL</b>	<b>19</b>		<b>625.1</b>
<b>OUTDOOR DECK</b>	<b>WEIGHT (PSF)</b>	<b>AREA (FT^2)</b>	<b>WEIGHT (#)</b>
CONCRETE PAVER	20	53.6	1072
<b>TOTAL</b>	<b>20</b>		<b>1072</b>
<b>FAÇADE SCREENS</b>	<b>WEIGHT EACH</b>	<b>NUMBER</b>	<b>WEIGHT (#)</b>
	181.15	4	724.6
<b>TOTAL</b>			<b>724.6</b>

<u>SOUTH</u>				
<u>MODULE</u>				
<u>TOTAL</u>				30641.99135

CANOPY	STRUCTURE	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
	COLUMNS (HSS 5x5x3/8)	15.62	67.67	1057.0054
	HIGH CANTILEVERED BEAM (HSS 10x5x1/4)	24.1	46.58	1122.578
	E-W FLITCH BEAM	11.44	46.75	534.82
	N-S FLITCH BEAMS	11.44	200	2288



AXLE BEAMS (W 12x14)	14	8	112
AXLE CROSS BEAM (W 12x22)	22	41.33	909.26
FRONT AND BACK RAILS (MC 12x10.6)	10.6	20	212
EDGE BEAMS (M 12x11.8)	11.8	93	1097.4
CROSS BEAMS (M 12x11.8)	11.8	40	472
FRONT COLLUMN SUPPORT BEAM (W6x12)	12	42.25	507
PV RACKING	7.1	238	1689.8
CROSS BRACING (DF 2x4)	1.28	92	117.76
600S200-54 @ 12" O.C.	2.09	331.32	692.4588
FLITCH COLUMNS	25	47.5	1187.5
RIGID 2x6 BEAMS	2	180	360
MISC.			500

<b>TOTAL</b>			<b>12859.5822</b>
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SHADING	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
PV PANELS	7	680	4760
SCREEN	7	240	1680

<b>TOTAL</b>			<b>6440</b>
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FLOOR	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
DECKING	2.29	232	531.28
CORRUGATED METAL DECKING	2.5	96	240
PAVERS (8)			700
ROCK 2"	16	55	880



<b>TOTAL</b>				<b>2351.28</b>
<b>MISC.</b>				<b>WEIGHT (#)</b>
SHADE SCREENS (5)				500
PLANTERS				600
BENCH				390.5
MISC. ELECTRICAL				500
<b>TOTAL</b>				<b>1990.5</b>

<u>CANOPY</u>				
<u>TOTAL</u>				23641.3622

*MECHANICAL  
UNIT*

STRUCTURE	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
M12x11.8	11.8	35.34	417.012
MISC. STRUCTURE			200
<b>TOTAL</b>			<b>617.012</b>

ROOF RAFTERS	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
600S162-54 @16" O.C.	1.89	45.83	86.6187
<b>TOTAL</b>			<b>86.6187</b>

ROOF	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
5/8" GYPSUM	2.2	45.83	100.826





1/2" O.S.B.	1.7	45.83	77.911
RIGID FIBERGLASS / 1.5" THICK AVERAGE	2.25	45.83	103.1175
HEAT LOC SOY SPRAY INSULATION / 4" THICK	0.734	45.83	33.63922
M,E,P	6	45.83	274.98
<b>TOTAL</b>	<b>12.884</b>		<b>590.47372</b>

FLOOR JOISTS	WEIGHT (PLF)	LENGTH (FT.)	WEIGHT (#)
600S162-54 @16" O.C.	1.89	31.5	59.535
<b>TOTAL</b>			<b>59.535</b>

FLOOR	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
1 1/8" O.S.B.	3.6	55.125	198.45
HEAT LOC SOY SPRAY INSULATION / 4" THICK	0.734	55.125	40.46175
MISC.	2.1	55.125	115.7625
<b>TOTAL</b>	<b>6.434</b>		<b>354.67425</b>

WALL	WEIGHT (PSF)	AREA (FT^2)	WEIGHT (#)
362S162-54 @ 12" O.C.	1.5	298.4	447.6
5/8" GYPSUM	2.2	117.96	259.512
FIBER CEMENT BOARD	3	298.4	895.2
1/2" PLYWOOD	1.7	298.4	507.28
HEAT LOC SOY SPRAY INSULATION / 3" THICK	0.55	298.4	164.12



DOOR	4	33.34	133.36
MISC.	4	298.4	1193.6
SCREEN			400

<b>TOTAL</b>			<b>3553.072</b>
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<b>EQUIPMENT</b>			<b>WEIGHT (#)</b>
MCB PANEL			35
INVERTERS			120
AC DISCONNECT MLO PANEL			8.05
LINE RELAY / DISCONNECT PANEL			4
METER ENCLOSURE			13.12
CONTROLS SYSTEM			20
METALIC CONDUIT			30
HEAT PUMP 80 GAL. WATER HEATER			254
ENERGY RECOVERY VENTILATOR			36
THERMAL STORAGE			626
HEAT EXCHANGER			11.02
CIRCULATING PUMPS			22.8
CONTROL VALVES / PIPING CONTROLS			21
FIRE SUPRESSION PUMP			60
PIPING MANIFOLD			20

<b>TOTAL</b>			<b>1280.99</b>
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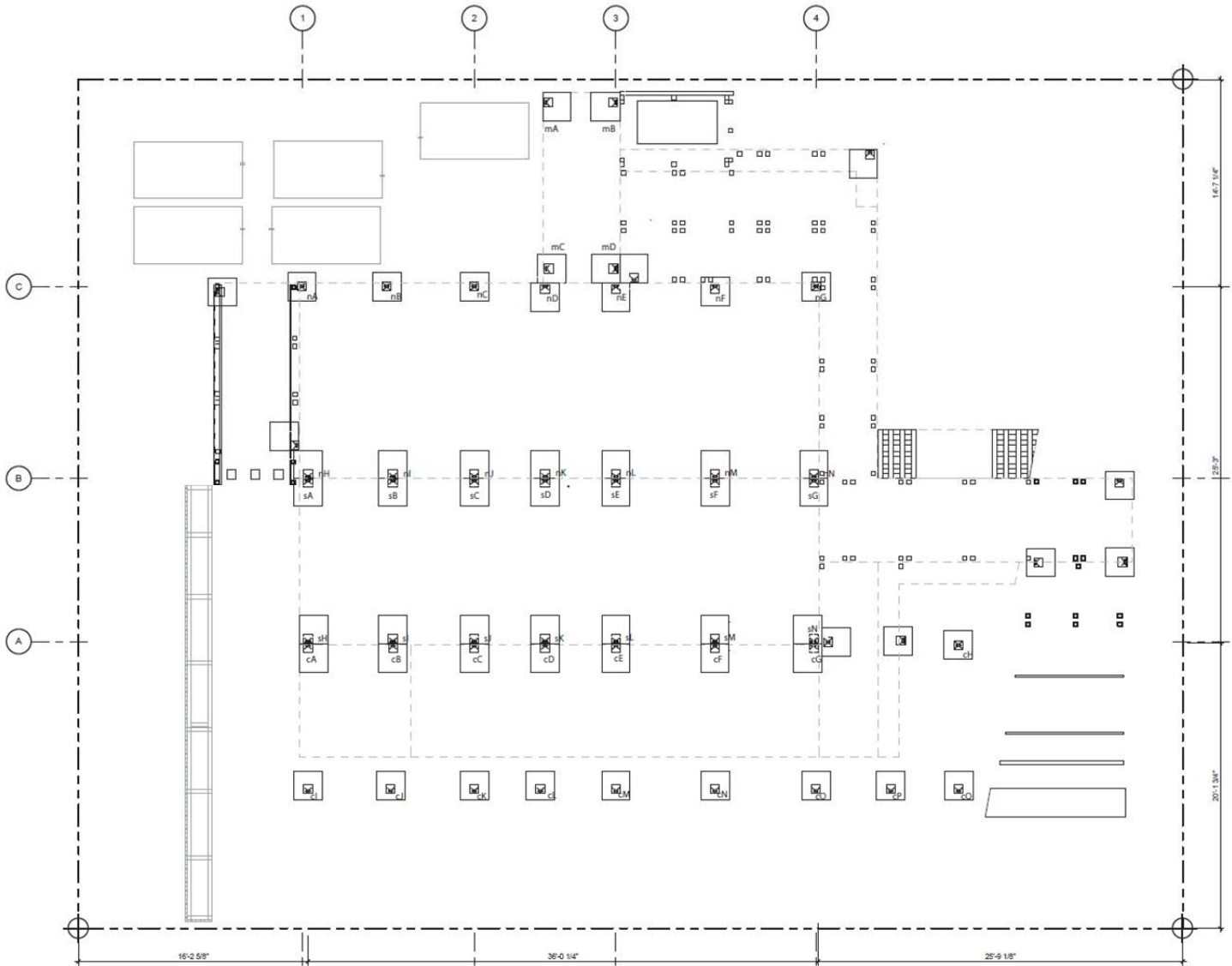
<b>TOTAL</b>			<b>6542.37567</b>
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TOTAL MODULES WEIGHT				98562.86347
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# Foundation Loading Calculations

## DECK / CANOPY CALCULATIONS





ARIZONA STATE UNIVERSITY/ UNIVERSITY OF NEW MEXICO (TEAM aSUNm)  
The Design School, Attn: Solar Decathlon 2013 PO Box 871605, Tempe, AZ 85287-1605

SCHEMATIC	AREA	LENGTH (FT)	WIDTH (FT)	WEIGHT (LBS)	HEIGHT (FT)	WEIGHT (LBS)	HEIGHT (FT)	WEIGHT (LBS)	HEIGHT (FT)	WEIGHT (LBS)	HEIGHT (FT)	WEIGHT (LBS)	HEIGHT (FT)	WEIGHT (LBS)	HEIGHT (FT)
SECTIONS	SECTION 1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 2	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 3	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 6	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 8	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SECTION 10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
WALLS	WALL 1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 2	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 3	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 6	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 8	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	WALL 10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
FLOORING	FLOOR 1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 2	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 3	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 6	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 8	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	FLOOR 10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
CEILING	CEILING 1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 2	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 3	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 6	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 7	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 8	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	CEILING 10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0









SOLUTIONS REPORT *Level, Floor: Flush Beam*  
 Current Solution: 1 piece(s) 2 x 8 Douglas Fir-Larch No. 2

**PASSED**  
 DECK AND RAMP RIM JOISTS

Overall Length: 6' 7"



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDf
Member Reaction (lbs)	710 @ 2"	2109 (2.25")	Passed (34%)	--
Shear (lbs)	534 @ 5' 8 1/4"	1305	Passed (41%)	1.00
Moment (Ft-lbs)	1088 @ 3' 3 1/2"	1183	Passed (92%)	1.00
Live Load Defl. (in)	0.090 @ 3' 3 1/2"	0.156	Passed (L/832)	--
Total Load Defl. (in)	0.100 @ 3' 3 1/2"	0.313	Passed (L/747)	--

System : Floor  
 Member Type : Flush Beam  
 Building Use : Residential  
 Building Code : IBC  
 Design Methodology : ASD

All Product Solutions			
Depth	Series	Plies	Wood Volume
7 1/4"	2 x Douglas Fir-Larch No. 2	1	17.40

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

Forte Software Operator	Job Notes
ASU { } jpurcel@gmail.com	

8/21/2013 10:29:48 PM  
 Forte v4.0, Design Engine: V5.6.1.203





SOLUTIONS REPORT

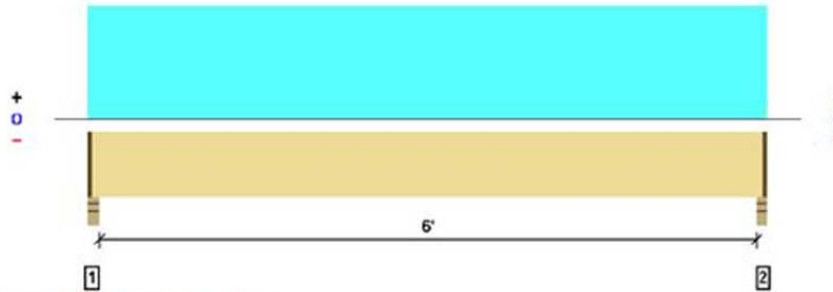
Level, Floor: Joist

PASSED

Current Solution: : 1 piece(s) 2 x 6 Douglas Fir-Larch No. 2 @ 12" OC

DECK AND RAMP JOISTS

Overall Length: 6' 7"



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	351 @ 2 1/2"	2109 (2.25")	Passed (17%)	--
Shear (lbs)	280 @ 5' 10"	990	Passed (28%)	1.00
Moment (Ft-lbs)	523 @ 3' 3 1/2"	848	Passed (62%)	1.00
Live Load Defl. (in)	0.098 @ 3' 3 1/2"	0.154	Passed (L/757)	--
Total Load Defl. (in)	0.108 @ 3' 3 1/2"	0.308	Passed (L/688)	--
TJ-Pro™ Rating	N/A	N/A	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC  
 Design Methodology : ASD

All Product Solutions						
Depth	Series	Plies	Spacing	TJ-Pro™ Rating	Wood Volume	
5 1/2"	2 x Douglas Fir-Larch No. 1	1	12"	N/A	1.17	
5 1/2"	2 x Douglas Fir-Larch No. 2	1	12"	N/A	1.10	

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

Forste Software Operator	Job Notes
ASU ( ) jpurcel@gmail.com	

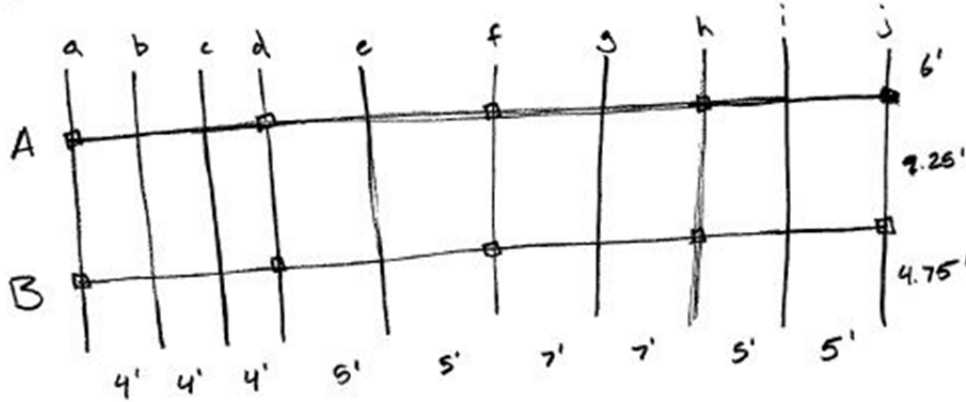
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Page 1 of 1

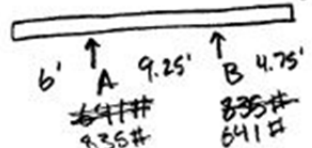


FLITCH BEAM ASSEMBLIES					
S'	plate steel	1/8"	3/16"	1/4"	5/16"
wood	size				
2x4	1.5x3.5	10.4628571428571	12.632	14.8017142857143	16.9708571428571
2x6	1.5x5.5	25.8384727272727	31.1952	36.5519272727273	41.9086545454545
2x8	1.5x7.25	44.8969379310345	54.205075862069	63.5129379310345	72.8208
2x10	1.5x9.25	73.0845837837838	88.2363675675676	103.387935135135	118.539718918919
2x12	1.5x11.25	108.105422222222	130.517511111111	152.9296	175.341866666667
	2x	1/8"	3/16"	1/4"	5/16"
lo	1.5				
	3.5	5.359	7.592	11.388	15.185
	5.5	20.7969	29.462	44.193	58.924
	7.25	47.6347	67.482	101.224	134.965
	9.25	98.9316	140.153	210.23	280.306
	11.25	177.9785	252.136	378.204	504.272
I'	steel plate	1/8"	3/16"	1/4"	5/16"
wood					
2x4	1.5x3.5	18.31	22.106	25.903	29.699
2x6	1.5x5.5	71.0558	85.7868	100.5178	115.2488
2x8	1.5x7.25	162.7514	196.4934	230.2344	263.9754
2x10	1.5x9.25	338.0162	408.0932	478.1692	548.2462
2x12	1.5x11.25	608.093	734.161	860.229	986.298

CANOPY



a)



6' ↑ A 9.25' B 4.75'

#4## 835#  
#3## 641#

4x8 DF #1  
S = 30.66  
I = 111.1

64.5 TW = 2'  
DL = 7psf  
10.5 plf  
LL = 20psf

W = 27psf (2') + 10 plf  
= 64.5 plf

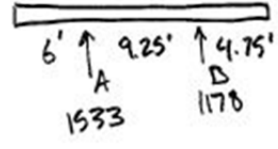
2-2x6 w 5/16" steel  
S = 41.908  
I = 115.24

- or -

2x10 DF #2  
S = 21.39  
I = 98.93

→ 2-2x6 w 1/4" steel  
S = 36.95  
I = 100.517

b)



6' ↑ A 9.25' B 4.75'

#4## 1533  
#3## 1178

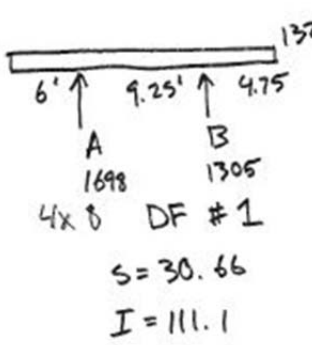
4x8 DF #1  
S = 30.66  
I = 111.1

118.5 TW = 4'  
DL = 7psf  
10.5 plf  
LL = 20psf

W = 27psf (4') + 10.5 plf  
= 118.5 plf

→ 2-2x6 w 5/16" steel  
S = 41.908  
I = 115.24

d)

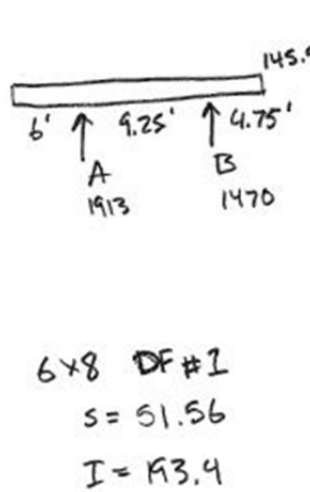


$TW = 4.5'$   
 $DL = 7 \text{ psf}$   
 $10.5 \text{ plf}$   
 $LL = 20 \text{ psf}$   
 $W = 27 \text{ psf}(4.5) + 10.5 \text{ plf}$   
 $= 132 \text{ plf}$

$4 \times 8 \text{ DF \#1}$   
 $S = 30.66$   
 $I = 111.1$

$\rightarrow 2 - 2 \times 6 \text{ w/ } 5/16'' \text{ steel}$   
 $S = 41.908$   
 $I = 115.24$

e, i)

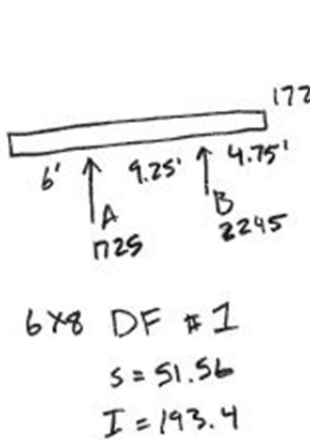


$TW = 5'$   
 $DL = 7 \text{ psf}$   
 $10.5 \text{ plf}$   
 $LL = 20 \text{ psf}$   
 $W = 27(5') + 10.5 \text{ plf}$   
 $= 145.5$

$6 \times 8 \text{ DF \#1}$   
 $S = 51.56$   
 $I = 193.4$

$\rightarrow 2 - 2 \times 8 \text{ w/ } 3/16'' \text{ steel}$   
 $S = 54.205$   
 $I = 196.49$

f, h)

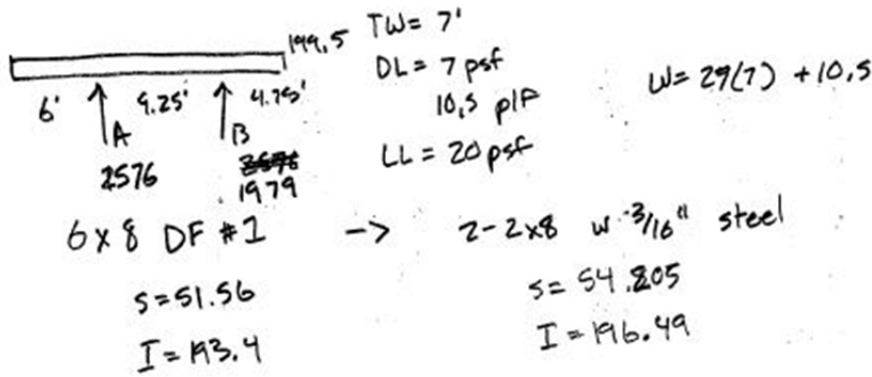


$TW = 6'$   
 $DL = 7 \text{ psf}$   
 $10.5 \text{ plf}$   
 $LL = 20 \text{ psf}$   
 $W = 27(6) + 10.5$   
 $= 172.5$

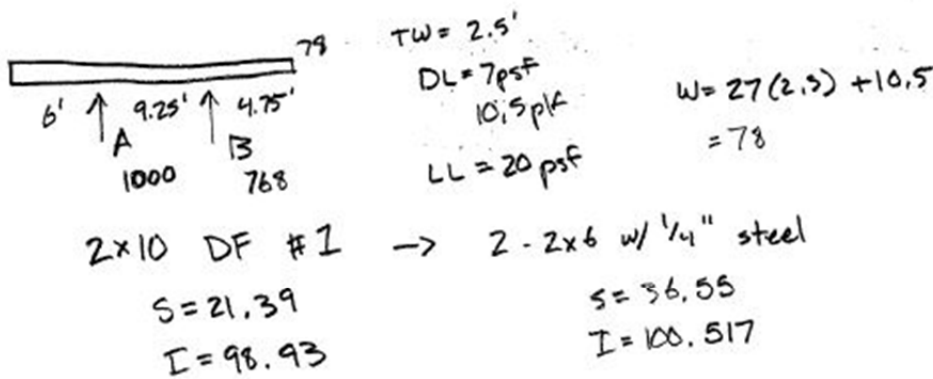
$6 \times 8 \text{ DF \#1}$   
 $S = 51.56$   
 $I = 193.4$

$\rightarrow 2 - 2 \times 8 \text{ w } 3/16'' \text{ steel}$   
 $S = 54.205$   
 $I = 196.49$

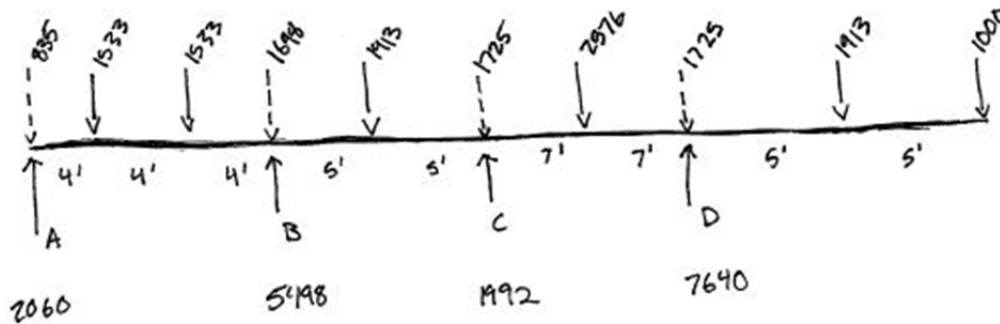
g)



j)



A)



$M = 19881$

$1200 \text{ psi} > \frac{19888(12)}{S}$   
 $S > 118.88$

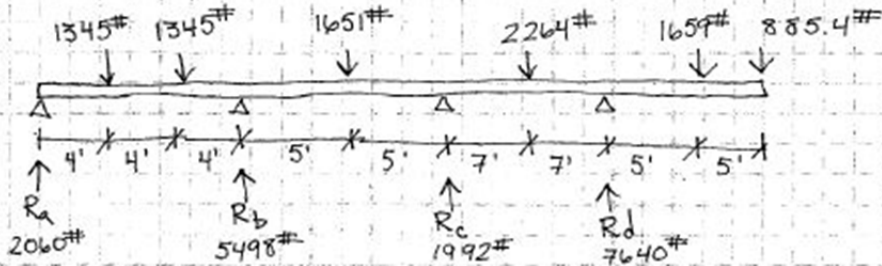
X





Concrete Reinforcing Steel Institute  
 933 North Plank Grove Road  
 Schaumburg, Illinois 60173  
 p: 847.517.1200 | f: 847.517.1266  
 www.crsi.org

Project a SUNM SOLAR DECATHLON		Sheet No. of
Made By KC	Checked By	Date
Subject CANOPY CANTILEVER BEAM		Project No.



$$M_{MAX} = 19.88 \text{ K} \cdot \text{FT} \left( 12 \frac{\text{IN}}{\text{FT}} \right) = 238.56 \text{ K} \cdot \text{IN}$$

$$F_b > f_b$$

$$F_b = 30.36 > \frac{238.56 \text{ K} \cdot \text{IN}}{S}$$

$$S = 7.858 \text{ IN}^3$$

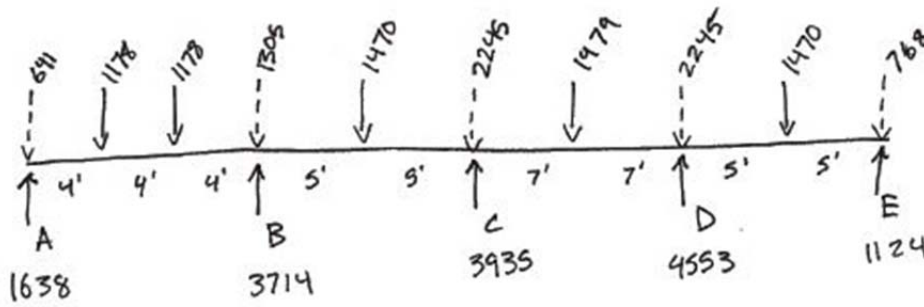
$$\therefore \text{TRY HSS } 7 \times 3 \times \frac{5}{16}$$

$$S = 9.00$$

✓ DEFLECTION

$$\Delta_{ALLOWED} =$$

B)



6x8 DF #1 → 2- 2x8 w 3/16" steel  
 $S = 51.56$                        $S = 54.705$   
 $I = 193.4$                          $I = 196.49$

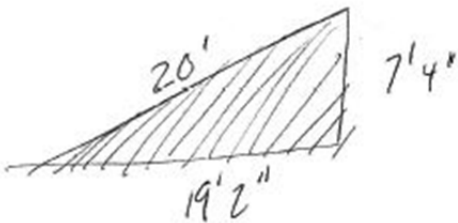
Wind AT TOP OF COLUMNS (9'7")  
 N+S



$A = 337.318$

$V_{base} = 15 \text{ psf} (337.318) = 5059.77 \#$

E+W



$A = 70.274$

$V_{base} = 15 \text{ psf} (70.274) = 1054 \#$



ARIZONA STATE UNIVERSITY/ UNIVERSITY OF NEW MEXICO (TEAM aSUNm)  
 The Design School, Attn: Solar Decathlon 2013 PO Box 871605, Tempe, AZ 85287-1605

	I	I/sumI	% of V	Vbase (kips)	#/ch	3 x 3 x 3/16						
Aa	22.8	0.154628687690743	782.385595116989	7.49525400122075	width	0.625	r	1.22474487139159				
Ad	22.8				height	6	K/r	187.725893389903	Fa:			
Af	22.8				length	9.58	fa	0.607936666666666		4.23	0.14351457940519	
Ah	22.8				area	7.5	fb	11.8346115608749		33	0.35862459335684	
Ba	11.25	0.076297049847406	388.045523906409	3.6983161190234	I	11.25					0.50213917176804	
Bd	11.25				p	4.553						
Bf	11.25				S	3.75						
Bh	11.25											
Bj	11.25											
total	147.45				HSS	5x5x3/8						
					width	5	r	1.86146328340795				
					height	5	K/r	116.553486709941	Fa:			
					length	9.04	fa	1.16109422462401		10.91	0.10642476855368	
					area	6.58	fb	26.1578947368421		33	0.79266347687400	
					I	22.8					0.89608824542799	
					p	7.94						
					S	9.12						
					M	19.88						

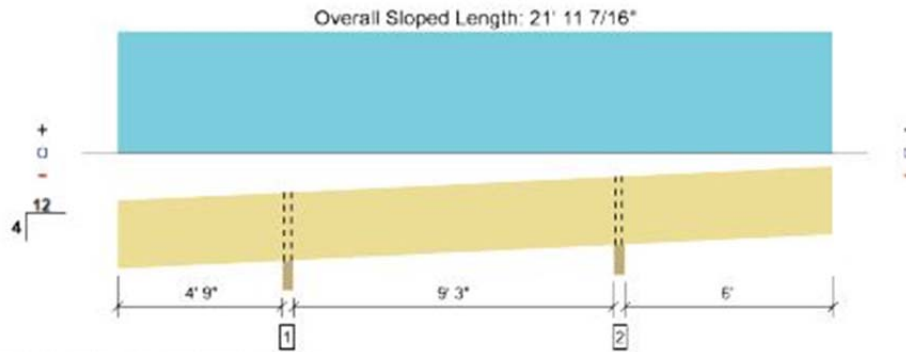




SOLUTIONS REPORT Level, Roof: Flush Beam

Current Solution: : 1 piece(s) 2 x 10 Douglas Fir-Larch No. 2

a



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	835 @ 14' 5 1/4"	3459 (3.50")	Passed (24%)	--
Shear (lbs)	378 @ 15' 3 3/4"	1499	Passed (25%)	0.90
Moment (Ft-lbs)	-1354 @ 14' 5 1/4"	1588	Passed (85%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.385 @ 20' 7"	0.648	Passed (2L/404)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pitch : 4:12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	▲	▲	▲	▲	▲	▲
Maximum Down (lbs) / LDF	--	641/0.90	--	835/0.90	--	--
Critical Down (lbs) / LDF	--	641/0.90	--	835/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50'	--	3.50'	--	--
Support Fc-perp (psi)	--	625	--	625	--	--
Required unbraced length	180.26"	180.26"	260.36"	89.06"	89.06"	89.06"

### 1.0 Dead (LDF = 0.9)

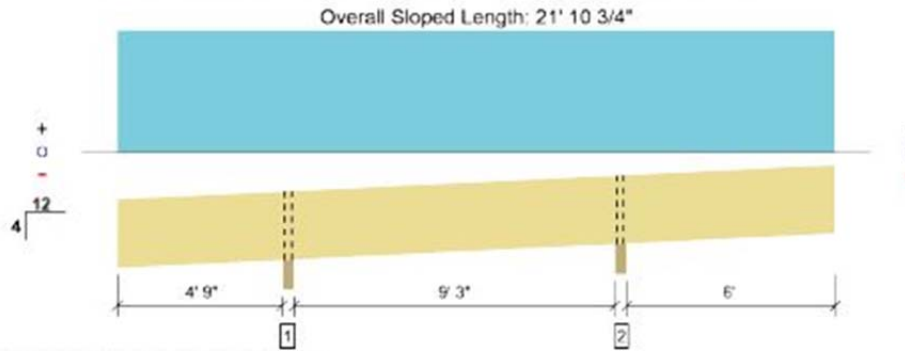
Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	▲	▲	▲	▲	▲	▲
Member Reaction (lbs)	--	641	--	835	--	--
Loads to Supports (lbs)	--	641	--	835	--	--
Shear used for design (lbs)	--	-288 227	--	-331 378	--	--
Shear at support node (lbs)	--	-351 290	--	-394 441	--	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (Ft-lbs)	0	-859	-272	-1354	0	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	0.00"
Total Load Deflection (in)	0.20"	--	-0.06"	--	0.38"	0.38"



SOLUTIONS REPORT *Level, Roof: Flush Beam*

**Current Solution: : 1 piece(s) 4 x 8 Douglas Fir-Larch No. 2**

**b**



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1533 @ 14' 5 1/4"	8070 (3.50")	Passed (19%)	--
Shear (lbs)	715 @ 15' 1 7/8"	2741	Passed (26%)	0.90
Moment (Ft-lbs)	-2487 @ 14' 5 1/4"	2691	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.629 @ 20' 7"	0.648	Passed (2L/248)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pitch : 4:12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"
	▲	▲	▲	▲	
Maximum Down (lbs) / LDF	--	1178/0.90	--	1533/0.90	--
Critical Down (lbs) / LDF	--	1178/0.90	--	1533/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Bearing Length	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	--	625	--	625	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.9)

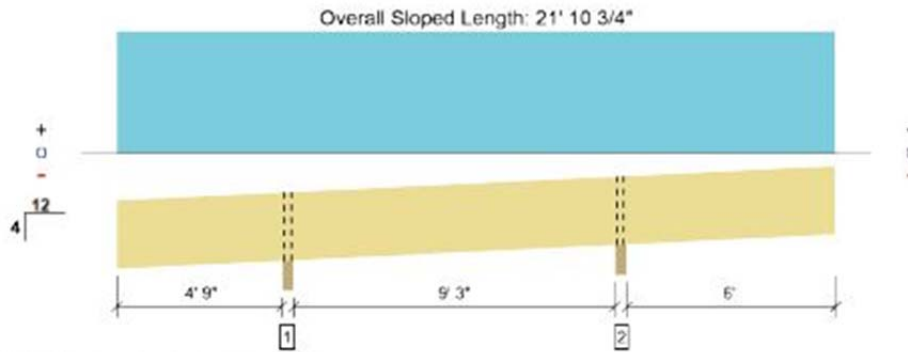
Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"
	▲	▲	▲	▲	
Member Reaction (lbs)	--	1178	--	1533	--
Loads to Supports (lbs)	--	1178	--	1533	--
Shear used for design (lbs)	--	-550 438	--	-629 715	--
Shear at support node (lbs)	--	-645 533	--	-723 809	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (Ft-lbs)	0	-1578	-500	-2487	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.32"	--	-0.10"	--	0.63"



SOLUTIONS REPORT Level, Roof: Flush Beam

Current Solution: : 1 piece(s) 4 x 8 Douglas Fir-Larch No. 1

d



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1698 @ 14' 5 1/4"	8070 (3.50")	Passed (21%)	--
Shear (lbs)	792 @ 15' 1 7/8"	2741	Passed (29%)	0.90
Moment (Ft-lbs)	-2756 @ 14' 5 1/4"	2989	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.656 @ 20' 7"	0.648	Passed (2L/238)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pitch : 4:12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Maximum Down (lbs) / LDF		1305/0.90		1698/0.90		
Critical Down (lbs) / LDF	--	1305/0.90	--	1698/0.90	--	
Maximum Uplift (lbs) / LDF		0/1.00		0/1.00		
Critical Uplift (lbs) / LDF		0/1.00		0/1.00		
Beaming Length		3.50"		3.50"		
Support Fr. perp (psi)		625		625		
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"	

1.0 Dead (LDF = 0.9)

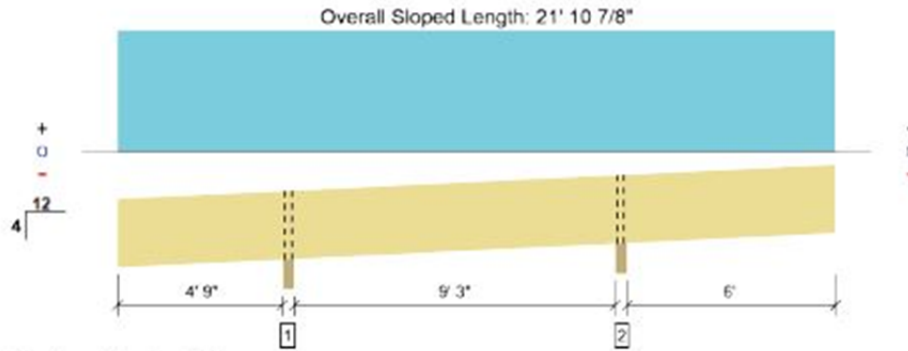
Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Member Reaction (lbs)	--	1305	--	1698	--	
Loads to Supports (lbs)	--	1305	--	1698	--	
Shear used for design (lbs)		-609   486		-697   792		
Shear at support node (lbs)		-714   591		-802   897		
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	
Moment (Ft-lbs)	0	-1749	553	-2756	0	
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	
Total Load Deflection (in)	0.34"	--	-0.10"	--	0.00"	



SOLUTIONS REPORT *Level, Roof: Flush Beam*

**Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1**

e



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1913 @ 14' 5 1/4"	12682 (3.50")	Passed (15%)	--
Shear (lbs)	889 @ 15' 2 1/8"	4208	Passed (21%)	0.90
Moment (ft-lbs)	-3105 @ 14' 5 1/4"	4641	Passed (67%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.451 @ 20' 7"	0.648	Passed (2L/344)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pnch : 4/12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Maximum Down (lbs) / LDF		1470/0.90		1913/0.90		
Critical Down (lbs) / LDF	--	1470/0.90	--	1913/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50"	--	3.50"	--	--
Support Fc perp (psi)	--	625	--	625	--	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"	260.36"

### 1.0 Dead (LDF = 0.9)

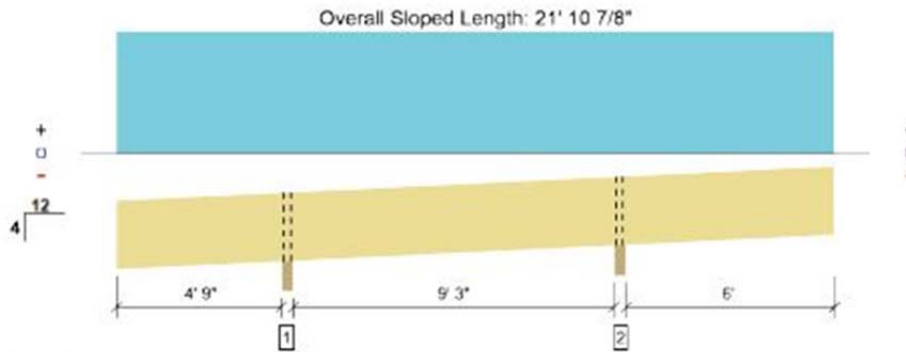
Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Member Reaction (lbs)	--	1470	--	1913	--	--
Loads to Supports (lbs)	--	1470	--	1913	--	--
Shear used for design (lbs)		-683 544		-782 889		
Shear at support node (lbs)		-805 665		-903 1010		
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (ft-lbs)	0	-1970	625	-3105	0	
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	
Total Load Deflection (in)	0.23"	--	-0.02"	--	0.45"	



SOLUTIONS REPORT Level, Roof: Flush Beam

Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1

f



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDf
Member Reaction (lbs)	2245 @ 14' 5 1/4"	12682 (3.50")	Passed (18%)	--
Shear (lbs)	1043 @ 15' 2 1/8"	4208	Passed (25%)	0.90
Moment (Ft-lbs)	-3642 @ 14' 5 1/4"	4641	Passed (78%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.529 @ 20' 7"	0.648	Passed (2L/294)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pnch : 4/12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"
	▲	▲	▲	▲	
Maximum Down (lbs) / LDF	--	1725/0.90	--	2245/0.90	--
Critical Down (lbs) / LDF	--	1725/0.90	--	2245/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Bearing Length	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	--	625	--	625	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"

### 1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"
	▲	▲	▲	▲	
Member Reaction (lbs)	--	1725	--	2245	--
Loads to Supports (lbs)	--	1725	--	2245	--
Shear used for design (lbs)	--	-802 638	--	-917 1043	--
Shear at support node (lbs)	--	-944 781	--	-1060 1185	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (Ft-lbs)	0	-2311	-731	-3642	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.27"	--	-0.08"	--	0.53"

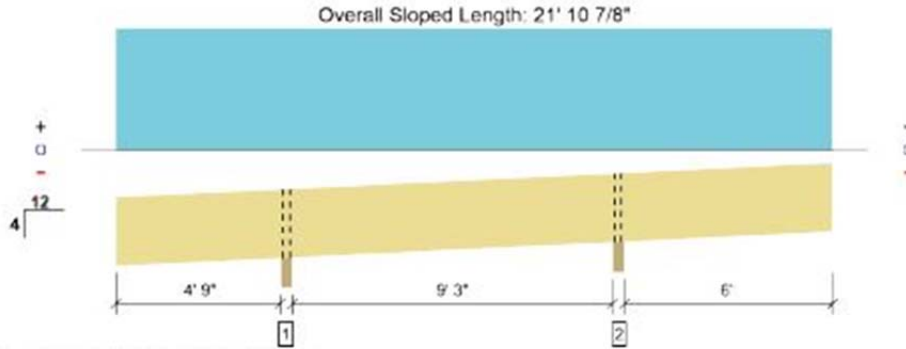




SOLUTIONS REPORT *Level, Roof: Flush Beam*

**Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1**

8



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	2576 @ 14' 5 1/4"	12682 (3.50")	Passed (20%)	--
Shear (lbs)	1197 @ 15' 2 1/8"	4206	Passed (28%)	0.90
Moment (Ft-lbs)	-4180 @ 14' 5 1/4"	4641	Passed (90%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.607 @ 20' 7"	0.648	Passed (2L/256)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Pitch : 4:12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"	9' 6 1/2"	6' 1 3/4"
Maximum Down (lbs) / LDF	--	1979/0.90	2576/0.90
Critical Down (lbs) / LDF	--	1979/0.90	2576/0.90
Maximum Uplift (lbs) / LDF	--	0/1.00	0/1.00
Critical Uplift (lbs) / LDF	--	0/1.00	0/1.00
Bearing Length	--	3.50"	3.50"
Support Fc-perp (psi)	--	625	625
Required unbroed length	260.36"	260.36"	260.36"

### 1.0 Dead (LDF = 0.9)

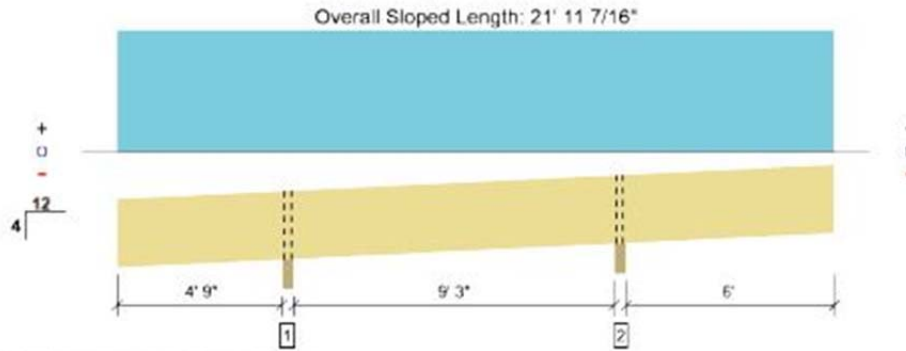
Loading On All Spans	4' 10 3/4"	9' 6 1/2"	6' 1 3/4"
Member Reaction (lbs)	--	1979	2576
Loads to Supports (lbs)	--	1979	2576
Shear used for design (lbs)	--	-920   732	-1052   1197
Shear at support node (lbs)	--	-1083   896	-1216   1360
Shear at span point load (lbs)	N/A	--	N/A
Moment (Ft-lbs)	0	-2652	-4180
Live Load Deflection (in)	0.00"	--	0.00"
Total Load Deflection (in)	0.31"	--	0.61"



SOLUTIONS REPORT Level, Roof: Flush Beam

Current Solution: : 1 piece(s) 2 x 10 Douglas Fir-Larch No. 1

j



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1000 @ 14' 5 1/4"	3459 (3.50")	Passed (29%)	--
Shear (lbs)	453 @ 15' 3 3/4"	1499	Passed (30%)	0.90
Moment (ft-lbs)	-1623 @ 14' 5 1/4"	1765	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.434 @ 20' 7"	0.648	Passed (2L/358)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IRC  
Design Methodology : ASD  
Member Size : 4x12

### Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"
	▲	▲	▲	▲	▲
Maximum Down (lbs) / LDF	--	768/0.90	--	1000/0.90	--
Critical Down (lbs) / LDF	--	768/0.90	--	1000/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Beaming Length	--	3.50"	--	3.50"	--
Support Fc perp (psi)	--	625	--	625	--
Required unbraced length	159.11"	159.11"	159.11"	61.41"	61.41"

### 1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		4' 1 3/4"
	▲	▲	▲	▲	▲
Member Reaction (lbs)	--	768	--	1000	--
Loads to Supports (lbs)	--	768	--	1000	--
Shear used for design (lbs)	--	-345   272	--	-397   453	--
Shear at support node (lbs)	--	-421   348	--	-472   528	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (ft-lbs)	0	-1030	376	-1623	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.22"	--	-0.02"	--	0.41"



FULL DETAIL REPORT Level, Roof: Flush Beam

A

**1 piece(s) 6 x 12 Douglas Fir-Larch No. 2**

Summary of Loads to Supports

All load groups / combinations / patterns								
	12'		10'		14'		10'	
Maximum Down (lbs) / LDF	2060/0.90	--	5498/0.90	--	1992/0.90	--	7640/0.90	--
Critical Down (lbs) / LDF	2060/0.90	--	5498/0.90	--	1992/0.90	--	7640/0.90	--
Maximum Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--
Bearing Length	2.25"	--	3.50"	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	625	--	625	--	625	--	625	--
Required unbraced length	N/A	552.75"	552.75"	552.75"	552.75"	6.00"	6.00"	6.00"

1.0 Dead (LDF = 0.9)

Loading On All Spans											
	12'		10'		14'		10'				
Member Reaction (lbs)	1225	--	5498	--	1992	--	7640	--			
Loads to Supports (lbs)	2060	--	5498	--	1992	--	7640	--			
Shear used for design (lbs)	N/A	1206	--	-2054	1747	--	-328	-59	--	-2861	3056
Shear at support node (lbs)	N/A	1224	--	-3733	1765	--	-2033	-41	--	-4567	3073
Shear at span point load (lbs)	--	-1968	--		1687	--		-2727	--		2996
Moment (Ft-lbs)	--	-5039	--	-5661	2682	--	1015	-19120	--	-19881	-5214
Live Load Deflection (in)	--	0.00"	--		0.00"	--		0.00"	--		0.00"
Total Load Deflection (in)	--	0.10"	--		0.03"	--		-0.19"	--		2.08"





FULL DETAIL REPORT Level, Roof: Flush Beam

1 piece(s) 6 x 8 Douglas Fir-Larch No. 1

B

Summary of Loads to Supports

All load groups / combinations / patterns										
	12'		10'		14'		10' 1 1/2"			
Maximum Down (lbs) / LDF	1638/0.90	--	3714/0.90	--	3935/0.90	--	4553/0.90	--	1124/0.90	
Critical Down (lbs) / LDF	1638/0.90	--	3714/0.90	--	3935/0.90	--	4553/0.90	--	1124/0.90	
Maximum Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	
Critical Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	
Bearing Length	2.25"	--	3.50"	--	3.50"	--	3.50"	--	3.50"	
Support Fc-perp (psi)	625	--	625	--	625	--	625	--	625	
Required unbraced length	N/A	556.25"	556.25"	556.25"	556.25"	556.25"	556.25"	556.25"	556.25"	N/A

1.0 Dead (LDF = 0.9)

Loading On All Spans														
	12'		10'		14'		10' 1 1/2"							
Member Reaction (lbs)	997	--	3714	--	3935	--	4553	--	1124					
Loads to Supports (lbs)	1638	--	3714	--	3935	--	4553	--	1124					
Shear used for design (lbs)	N/A	988	-1521	916	--	-718	1031	--	-1153	1213	--	-551	N/A	
Shear at support node (lbs)	N/A	996	--	-2790	924	--	-2896	1039	--	-3331	1221	--	-1122	N/A
Shear at span point load (lbs)	--	-1442	--	873	--	-1011	--	1171	--					
Moment (Ft-lbs)	--	3742	-3543	-2315	--	-2797	4060	--	-3829	1953	--			
Live Load Deflection (in)	--	0.00"	--	0.00"	--	0.00"	--	0.00"	--	0.00"	--			
Total Load Deflection (in)	--	0.25"	--	-0.04"	--	0.23"	--	0.06"	--					

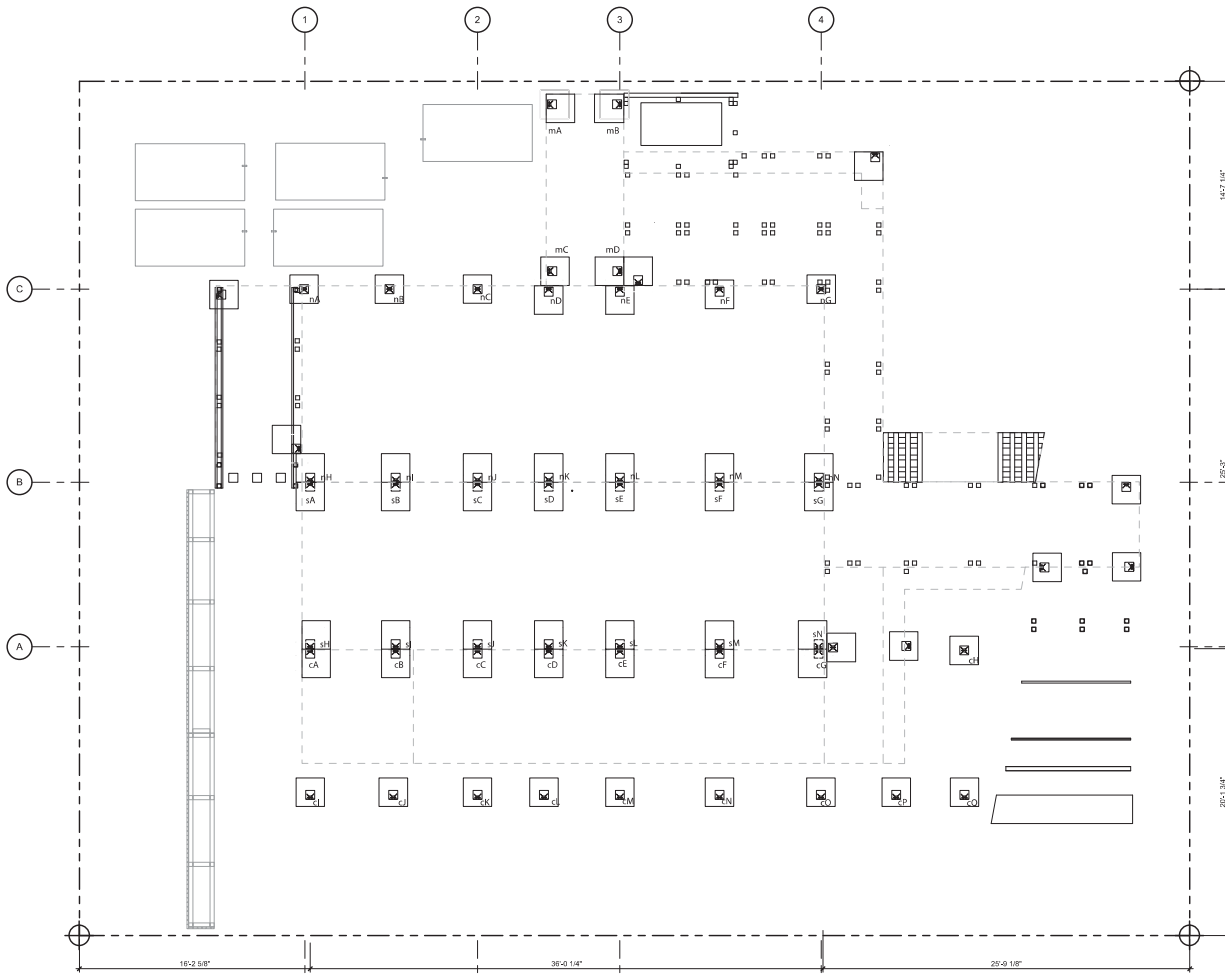








Table with columns for Item, Qty, Unit, Weight, Length, Area, Volume, and other metrics. Includes categories like Structure, Mechanical, Electrical, and Plumbing. Total weight is 179.87 tons.



## Considerations for Gravity Forces

SEE ATTACHED PAGES FROM SSMA TECHNICAL CATALOG AS REFERENCE

<b>TYPICAL FLOOR JOIST</b>
LL: 50 PSF
DL: 10 PSF
L: 11' 0"
FROM SSMA TECHNICAL CATALOG PG. 43
USE 600S200-54 @12" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION

<b>S. MODULE ROOF RAFTER</b>
LL: 20 PSF
DL: 35 PSF
L: 11.2083'
FROM SSMA TECHNICAL CATALOG PG. 42
USE 800S162-54 @16" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION

<b>N. MODULE ROOF RAFTER</b>
LL: 20 PSF
DL: 20 PSF
L: 13.2083'
FROM SSMA TECHNICAL CATALOG PG. 38
USE 800S162-54 @24" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION



<b>N. MODULE CEILING JOIST</b>
LL: 4 PSF
DL: 15 PSF
L: 13.2083'
FROM SSMA TECHNICAL CATALOG PG. 36
USE 600S162-54 @24" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION

<b>MECH. UNIT FLOOR JOIST</b>
LL: 100 PSF
DL: 20 PSF
L: 4.5'
FROM SSMA TECHNICAL CATALOG PG. 44
USE 600S162-54 @16" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION

<b>MECH. UNIT ROOF RAFTER</b>
LL: 20 PSF
DL: 20 PSF
L: 4.5
FROM SSMA TECHNICAL CATALOG PG. 38
USE 600S162-54 @16" O.C.
SINGLE-SPAN
L/360 LIVE LOAD DEFLECTION



<b>MECH. ROOM WALL VERTICAL LOADS</b>
TRIB. WIDTH=2.47'(35 PSF)=86.45 PLF
FROM SSMA TECHNICAL CATALOG PG. 25
USE 362S162-54 @ 12" O.C.
15 PSF LATERAL LOAD
12' WALL HEIGHT
ALLOWABLE AXIAL LOAD: 2.1 K
<b>WEST PATIO CANOPY BEAMS</b>
L: 12.5'
DL: 20 PSF
LL: 6 PSF
w= 3'(26 PSF) = 78 PLF
v= 78 PLF (12.5') = 975#/2 = 487.5#
M= (975#/2) (6.25') (1/2) = 1523.4 PF
Fb>fb
1200 PSI > (1523.4 (12"/FT)/S)
S= 15.23 in <sup>2</sup>
THEREFORE USE 2 - 2x8 DF #1
S= 13.14 in <sup>2</sup> (2) = 26.28 in <sup>2</sup>
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [140"/240 = 0.625"$
$\Delta_{\text{actual}} = [5(78)(12.5'^4)(1728)]/[384(1800000)(95.26)] = 0.25"$

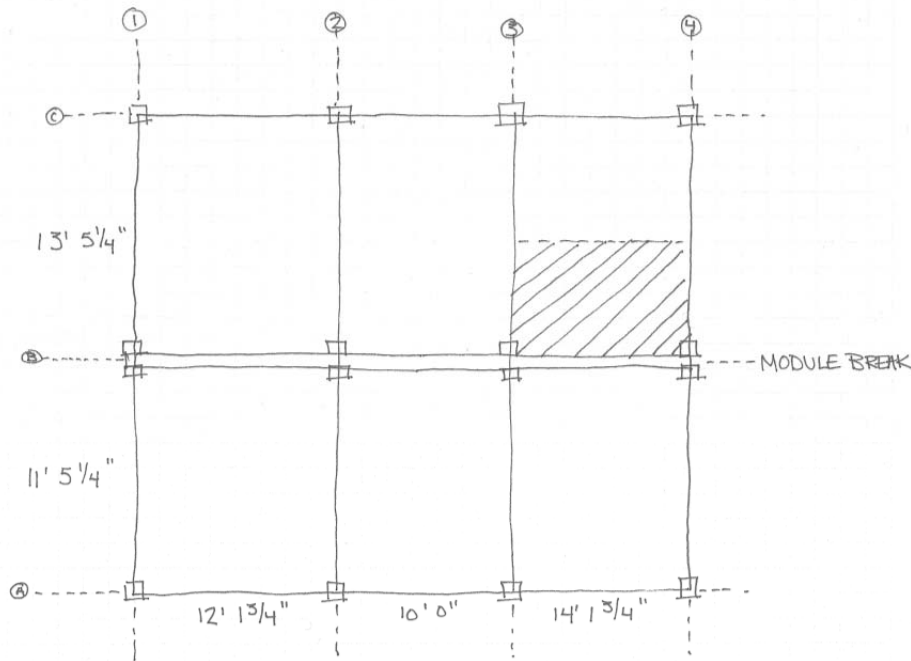
HOT-ROLLED STEEL FRAME CALCULATIONS

REFERENCE SHEETS S-102 & S-103





Project a SUNM SOLAR DECATHLON		Sheet No. G6 of
Made By KC	Checked By	Date
Subject HSS STEEL FRAME		Project No.



THE DESIGN OF ALL ROOF AND FLOOR BEAMS IS BASED OFF THE TRIBUTARY WIDTH & LENGTH OF THE WORST CASE LOADING SCENARIO AT B BETWEEN 3 AND 4 IN ABOVE FRAMING PLAN, EXCEPTION, C ROOF BEAMS ARE CALCULATED SEPARATELY.



<b>FLOOR BEAM</b>
L: 13.42'
TW: 10.469'
DL: 20 PSF
LL: 50 PSF
$w = (10.469' * 70 \text{ PSF}) = 732.83 \text{ PLF} = 0.733 \text{ KLF}$
$M = [0.733(13.42'^2)]/8 = 16.5 \text{ k*ft} (12"/\text{ft}) = 198.0 \text{ k*in}$
$v = [0.733(13.42)]/2 = 4.92 \text{ k}$
Fb > fb
$Fb = 30.36 > 198.0 \text{ k*in/s}$
$s = 6.46 \text{ in}^3$
THEREFORE, USE W12x22, FROM AISC MANUAL PG. 1-28
$s(\text{allowable}) = 25.4 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [13.42'(12)]/240 = 0.671"$
$\Delta_{\text{actual}} = [5(0.733)(13.42'^4)(1728)]/[384(29,000)(156)] = 0.118"$



<b>FLOOR BEAM</b>
L: 13.42'
TW: 9.94'
DL: 20 PSF
LL: 50 PSF
$w = (9.94' * 70 \text{ PSF}) = 695.8 \text{ PLF} = 0.696 \text{ KLF}$
$M = [0.696(13.42'^2)]/8 = 15.67 \text{ k*ft} (12''/\text{ft}) = 188.0 \text{ k*in}$
$v = [0.696(13.42)]/2 = 4.67 \text{ k}$
Fb > fb
$F_b = 30.36 > 188.0 \text{ k*in/s}$
$s = 6.19 \text{ in}^3$
THEREFORE, USE M12x11.8, FROM AISC MANUAL PG. 1-34
$s(\text{allowable}) = 12.0 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [13.42'(12)]/240 = 0.671''$
$\Delta_{\text{actual}} = [5(0.696)(13.42'^4)(1728)]/[384(29,000)(71.9)] = 0.244''$



<b>FLOOR EDGE BEAM (EAST &amp; WEST)</b>
L: 13.42'
TW: 1.67'
DL: 20 PSF
LL: 50 PSF
$w = (1.67' * 70 \text{ PSF}) = 116.9 \text{ PLF} = 0.117 \text{ KLF}$
$M = [0.117(13.42'^2)]/8 = 2.64 \text{ k*ft} (12''/\text{ft}) = 31.6 \text{ k*in}$
$v = [0.117(13.42)]/2 = 0.79 \text{ k}$
Fb > fb
$Fb = 30.36 > 31.6 \text{ k*in/s}$
$s = 1.04 \text{ in}^3$
THEREFORE, USE MC12x10.6, FROM AISC MANUAL PG. 1-42
$s(\text{allowable}) = 9.23 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [13.42'(12)]/240 = 0.671''$
$\Delta_{\text{actual}} = [5(1.04)(13.42'^4)(1728)]/[384(29,000)(55.4)] = 0.472''$



<b>FLOOR GIRDER BEAMS (NORTH &amp; SOUTH) (MOST CONSERVATIVE)</b>
L: 7.07'
$\sum M_A = 0 = 4,674\#(0.75') - 7.07F_B$
$F_B = 495.89\#$
$F_A = 4,178.71\#$
$F_b > f_b$
$F_b = 30.36 > 37.56 \text{ k}^*\text{in}/\text{s}$
$s = 1.25 \text{ in}^3$
THEREFORE, USE MC12x10.6, FROM AISC MANUAL PG. 1-42
$s(\text{allowable}) = 9.23 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [7.07'(12)]/240 = 0.3535''$
$\Delta_{\text{actual}} = [5(0.66)(7.07'^4)(1728)]/[384(29,000)(55.4)] = 0.023''$



<b>N. MODULE ROOF BEAM (MOST CONSERVATIVE)</b>
L: 14.146'
TW: 6.72'
DL: 20 PSF
LL: 20 PSF
$w = (6.72' * 40 \text{ PSF}) = 268.8 \text{ PLF} = 0.269 \text{ KLF}$
$M = [0.269(14.146'^2)]/8 = 6.73 \text{ k*ft} (12''/\text{ft}) = 80.74 \text{ k*in}$
$v = [0.269(14.146)]/2 = 1.9 \text{ k}$
Fb > fb
$Fb = 30.36 > 80.74 \text{ k*in/s}$
$s = 2.66 \text{ in}^3$
THEREFORE, USE HSS 6x3x1/4, FROM AISC MANUAL PG. 1-102
$s(\text{allowable}) = 5.98 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [14.146'(12)]/240 = 0.71''$
$\Delta_{\text{actual}} = [5(0.269)(14.146'^4)(1728)]/[384(29,000)(17.9)] = 0.47''$



<b>N. MODULE NORTH ROOF BEAM (MOST CONSERVATIVE)</b>
L: 14.146'
TW: 6.72'
DL: 35 PSF
LL: 20 PSF
$w = (6.72' * 55 \text{ PSF}) = 369.6 \text{ PLF} = 0.370 \text{ KLF}$
$M = [0.370(14.146'^2)]/8 = 9.26 \text{ k*ft} (12''/\text{ft}) = 111.06 \text{ k*in}$
$v = [0.370(14.146)]/2 = 2.62 \text{ k}$
Fb > fb
$F_b = 30.36 > 111.06 \text{ k*in/s}$
$s = 3.66 \text{ in}^3$
THEREFORE, USE HSS 8x3x1/4, FROM AISC MANUAL PG. 1-101
$s(\text{allowable}) = 9.40 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [14.146'(12)]/240 = 0.71''$
$\Delta_{\text{actual}} = [5(0.370)(14.146'^4)(1728)]/[384(29,000)(37.6)] = 0.306''$



<b>N. MODULE CEILING BEAM</b>
L: 14.146'
TW: 6.72'
DL: 15 PSF
LL: 4 PSF
$w = (6.72' * 19 \text{ PSF}) = 127.68 \text{ PLF} = 0.127 \text{ KLF}$
$M = [0.127(14.146'^2)]/8 = 3.18 \text{ k*ft} (12''/\text{ft}) = 38.12 \text{ k*in}$
$v = [0.127(14.146)]/2 = 0.90 \text{ k}$
Fb > fb
$Fb = 30.36 > 38.12 \text{ k*in/s}$
$s = 1.26 \text{ in}^3$
THEREFORE, USE HSS 4x3x5/16, FROM AISC MANUAL PG. 1-103
$s(\text{allowable}) = 3.72 \text{ in}^3$
CHECK DEFLECTION
$\Delta_{\text{allowed}} = [14.146'(12)]/240 = 0.71''$
$\Delta_{\text{actual}} = [5(0.127)(14.146'^4)(1728)]/[384(29,000)(7.45)] = 0.53''$





<b>N., S. MODULE COLUMNS (MOST CONSERVATIVE)</b>
ROOF LOADING:
DL: 20 PSF
LL: 20 PSF
CEILING LOADING:
DL: 15 PSF
LL: 4 PSF
TOTAL LOADING: 59 PSF
81.1FT <sup>2</sup> (59 PSF) = 4784.9# OR 4.78 k (ACTUAL)
THEREFORE, USE HSS 3x3x3/16 (9' EFFECTIVE LENGTH)
FROM COLUMN TABLE, AISC MANUAL PG. 3-43
ALLOWABLE AXIAL LOAD: 31 k

<b>HANDRAIL</b>
200# LOAD IN ANY DIRECTION AT TOP OF RAIL
2 - 2x4 DF #1
$f_b' = (500\text{psi})(1.3)(1.65) = 1072.5\text{psi}$
$A = 2(5.25\text{in}^3) = 10.5\text{in}^3$
$S_x = 2(3.06) = 6.12$
$M_{MAX} = 200\#(3.5') = 700 \text{ #FT}$
$M_{ALLOW} = f_b'(S_x) = 1072.5\text{psi}(10.5\text{in}^3) = 11261.25\text{#IN} = 938.43 \text{ #FT}$
THEREFORE, USE 2 - 2x4 DF#1 FOR HANDRAIL SUPPORT



SOLUTIONS REPORT

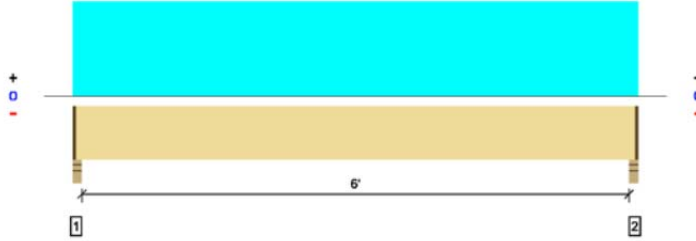
Level, Floor: Joist

PASSED

Current Solution: : 1 piece(s) 2 x 6 Douglas Fir-Larch No. 2 @ 12" OC

DECK AND RAMP JOISTS

Overall Length: 6' 7"



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	351 @ 2 1/2"	2109 (2.25")	Passed (17%)	--
Shear (lbs)	280 @ 5' 10"	990	Passed (28%)	1.00
Moment (Ft-lbs)	523 @ 3' 3 1/2"	848	Passed (62%)	1.00
Live Load Defl. (in)	0.098 @ 3' 3 1/2"	0.154	Passed (L/757)	--
Total Load Defl. (in)	0.108 @ 3' 3 1/2"	0.308	Passed (L/688)	--
TJ-Pro™ Rating	N/A	N/A	--	--

System : Floor  
 Member Type : Joist  
 Building Use : Residential  
 Building Code : IBC  
 Design Methodology : ASD

All Product Solutions					
Depth	Series	Plies	Spacing	TJ-Pro™ Rating	Wood Volume
5 1/2"	2 x Douglas Fir-Larch No. 1	1	12"	N/A	1.17
5 1/2"	2 x Douglas Fir-Larch No. 2	1	12"	N/A	1.10

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

Forte Software Operator	Job Notes
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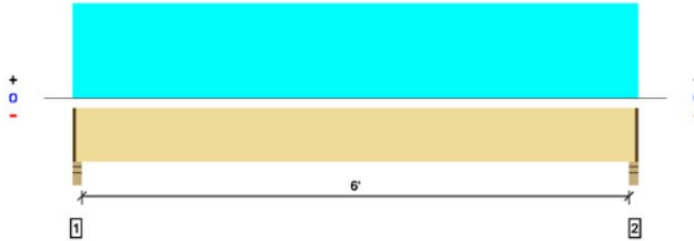


SOLUTIONS REPORT *Level, Floor: Flush Beam*  
 Current Solution: : 1 piece(s) 2 x 8 Douglas Fir-Larch No. 2

PASSED

DECK AND RAMP RIM JOISTS

Overall Length: 6' 7"



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	710 @ 2"	2109 (2.25")	Passed (34%)	--
Shear (lbs)	534 @ 5' 8 1/4"	1305	Passed (41%)	1.00
Moment (Ft-lbs)	1088 @ 3' 3 1/2"	1183	Passed (92%)	1.00
Live Load Defl. (in)	0.090 @ 3' 3 1/2"	0.156	Passed (L/832)	--
Total Load Defl. (in)	0.100 @ 3' 3 1/2"	0.313	Passed (L/747)	--

System : Floor  
 Member Type : Flush Beam  
 Building Use : Residential  
 Building Code : IBC  
 Design Methodology : ASD

All Product Solutions			
Depth	Series	Plies	Wood Volume
7 1/4"	2 x Douglas Fir-Larch No. 2	1	17.40

The purpose of this report is for product comparison only. Load and support information necessary for professional design review is not displayed here. Please print an individual Member Report for submittal purposes.

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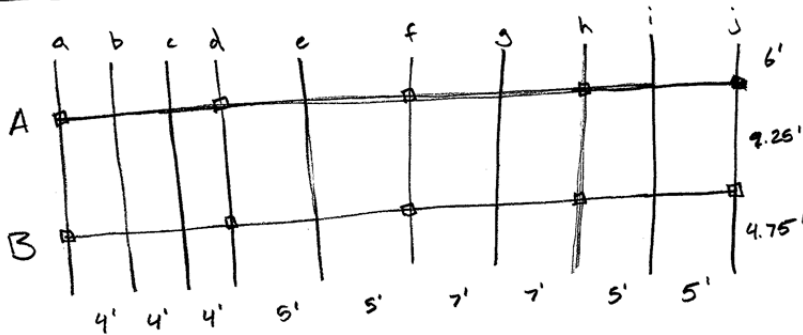
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FLITCH BEAM ASSEMBLIES						
S'	plate steel	1/8"	3/16"	1/4"	5/16"	
wood	size					
2x4	1.5x3.5	10.4628571428571	12.632	14.8017142857143	16.9708571428571	
2x6	1.5x5.5	25.8384727272727	31.1952	36.5519272727273	41.9086545454545	
2x8	1.5x7.25	44.8969379310345	54.205075862069	63.5129379310345	72.8208	
2x10	1.5x9.25	73.0845837837838	88.2363675675676	103.387935135135	118.539718918919	
2x12	1.5x11.25	108.105422222222	130.517511111111	152.9296	175.341866666667	
	2x	1/8"	3/16"	1/4"	5/16"	
lo	1.5					
	3.5	5.359	7.592	11.388	15.185	18.981
	5.5	20.7969	29.462	44.193	58.924	73.655
	7.25	47.6347	67.482	101.224	134.965	168.706
	9.25	98.9316	140.153	210.23	280.306	350.383
	11.25	177.9785	252.136	378.204	504.272	630.341
I'	steel plate	1/8"	3/16"	1/4"	5/16"	
wood						
2x4	1.5x3.5	18.31	22.106	25.903	29.699	
2x6	1.5x5.5	71.0558	85.7868	100.5178	115.2488	
2x8	1.5x7.25	162.7514	196.4934	230.2344	263.9754	
2x10	1.5x9.25	338.0162	408.0932	478.1692	548.2462	
2x12	1.5x11.25	608.093	734.161	860.229	986.298	

CANOPY



a)

6' ↑ A 9.25' B 4.75'

~~641#~~ 835# 641#

4x8 DF #1

S = 30.66

I = 111.1

64.5 TW = 2'

DL = 7 psf

10.5 p/f

LL = 20 psf

W = 27 psf (2') + 10 p/f

= 64.5 p/f

2-2x6 w 5/16" steel

S = 41.908

I = 115.24

- or -

2x10 DF #2 → 2-2x6 w/ 1/4" steel

S = 21.39      S = 36.85

I = 98.93      I = 100.517

b)

6' ↑ A 9.25' B 4.75'

1533 1178

4x8 DF #1

S = 30.66

I = 111.1

118.5 TW = 4'

DL = 7 psf

10.5 p/f

LL = 20 psf

W = 27 psf (4') + 10.5 p/f

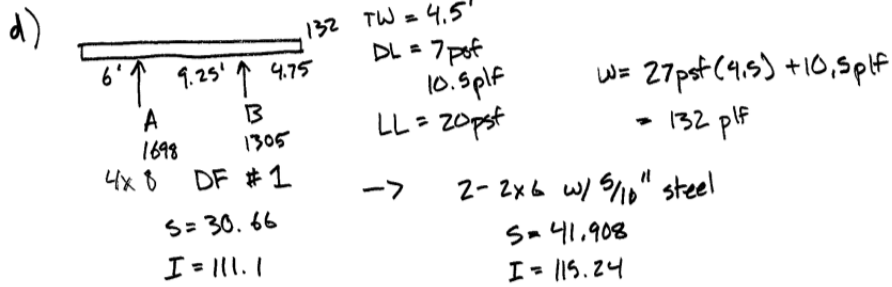
= 118.5 p/f

2-2x6 w 5/16" steel

S = 41.908

I = 115.24

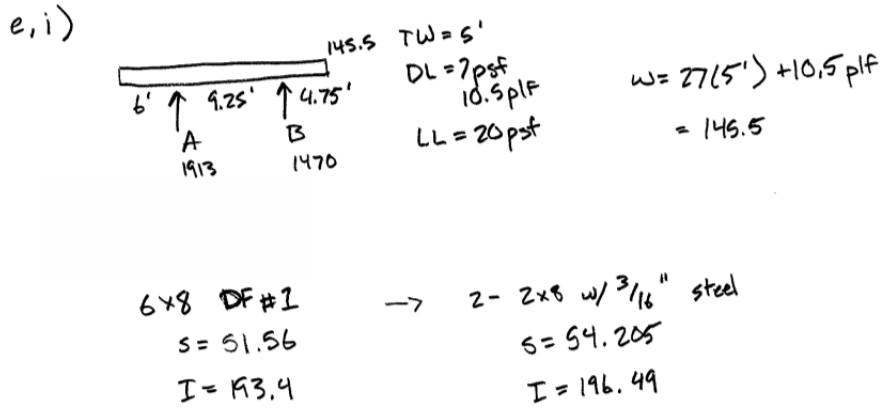
d)



$TW = 4.5'$   
 $DL = 7psf$   
 $10.5plf$   
 $LL = 20psf$   
 $W = 27psf(4.5) + 10.5plf = 132 plf$   
 $\rightarrow 2- 2x6 w/ 5/16'' steel$   
 $S = 41.908$   
 $I = 115.24$

$6'$   $1.25'$   $4.75'$   $132$   
 A B  
 $1698$   $1305$   
 $4x8 DF \#1$   
 $S = 30.66$   
 $I = 111.1$

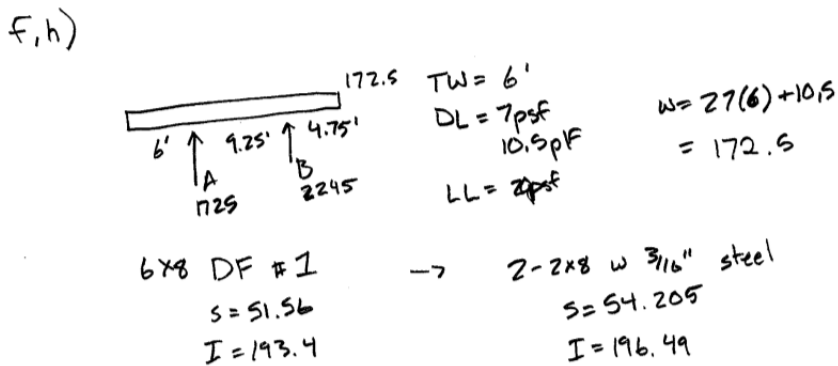
e, i)



$TW = 5'$   
 $DL = 7psf$   
 $10.5plf$   
 $LL = 20psf$   
 $W = 27(5') + 10.5plf = 145.5$   
 $\rightarrow 2- 2x8 w/ 3/16'' steel$   
 $S = 54.205$   
 $I = 196.49$

$6'$   $1.25'$   $4.75'$   $145.5$   
 A B  
 $1913$   $1470$   
 $6x8 DF \#1$   
 $S = 51.56$   
 $I = 193.4$

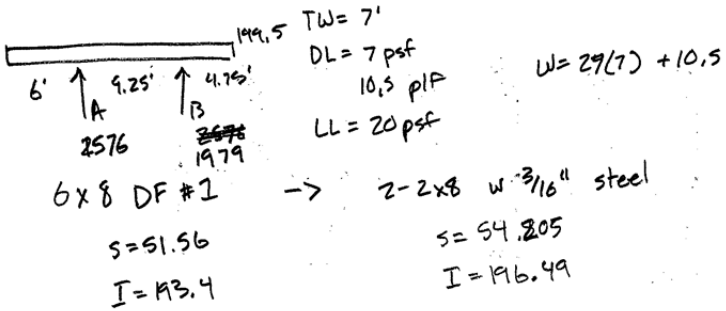
f, h)



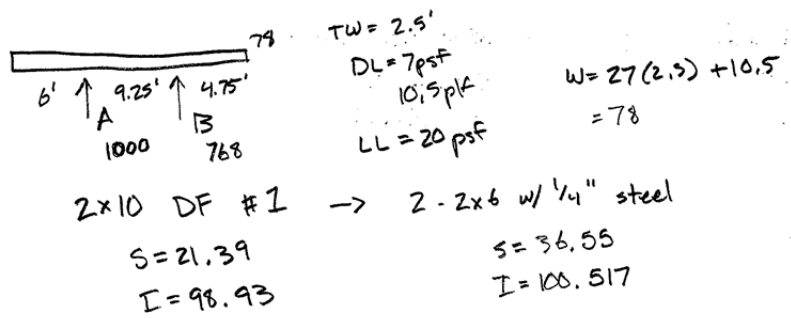
$TW = 6'$   
 $DL = 7psf$   
 $10.5plf$   
 $LL = 2psf$   
 $W = 27(6) + 10.5 = 172.5$   
 $\rightarrow 2- 2x8 w 3/16'' steel$   
 $S = 54.205$   
 $I = 196.49$

$6'$   $1.25'$   $4.75'$   $172.5$   
 A B  
 $1725$   $2245$   
 $6x8 DF \#1$   
 $S = 51.56$   
 $I = 193.4$

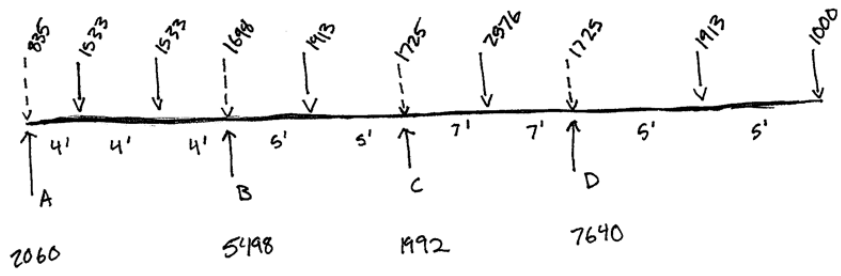
g)



j)



A)

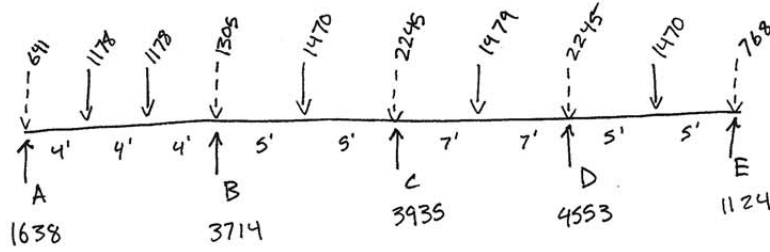


$M = 19881$

$1200$  psi  $> \frac{19888(12)}{S}$   
 $S > 198.88$

X

B)



6x8 DF #1 → 2- 2x8 w 3/16" steel  
 $S = 51.56$   $S = 54.205$   
 $I = 193.4$   $I = 196.49$

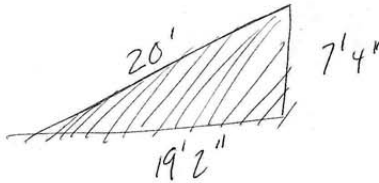
Wind AT TOP OF COLUMNS (9'7")  
 N+S



$A = 337.318$

$V_{base} = 15 \text{ psf} (337.318) = 5059.77 \#$

E+W



$A = 70.274$   
 $V_{base} = 15 \text{ psf} (70.274) = 1054 \#$



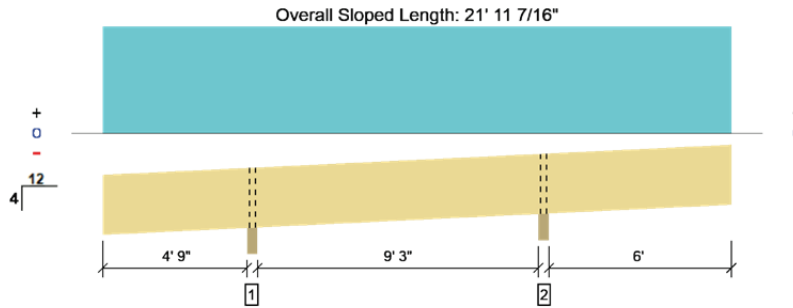


	I	Isuml	% of V	Vbase (kips)		fitch	3 x 3 x 3/16		r				
Aa	22.8	0.154628687690743	782.385595116889	7.49525400122075		width	0.625		r				
Ad	22.8					height	6		Kl/r				
Af	22.8					length	9.59		fa				4.23 0.143514578408191
Ah	22.8					area	7.5		fb				33 0.35862459335984
Ba	11.25	0.076297049847406	386.0455239806409	3.6983161190234		I	11.25						0.50213917176804
Bd	11.25					P	4.553						
Bf	11.25					S	3.75						
Bh	11.25												
Bi	11.25												
total	147.45					HSS	5x5x3/8		r				
						width	5		r				
						height	5		Kl/r				
						length	9.04		fa				10.91 0.106424768553981
						area	6.58		fb				33 0.79266347687400
						I	22.8						0.89908924542799
						P	7.64						
						S	9.12						
						M	19.88						



SOLUTIONS REPORT *Level, Roof: Flush Beam*  
Current Solution: : 1 piece(s) 2 x 10 Douglas Fir-Larch No. 2

a



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	835 @ 14' 5 1/4"	3459 (3.50")	Passed (24%)	--
Shear (lbs)	378 @ 15' 3 3/4"	1499	Passed (25%)	0.90
Moment (Ft-lbs)	-1354 @ 14' 5 1/4"	1588	Passed (85%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.385 @ 20' 7"	0.648	Passed (2L/404)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Maximum Down (lbs) / LDF	--	641/0.90	--	835/0.90
Critical Down (lbs) / LDF	--	641/0.90	--	835/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Bearing Length	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	--	625	--	625	--
Required unbraced length	180.26"	180.26"	260.36"	89.06"	89.06"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Member Reaction (lbs)	--	641	--	835
Loads to Supports (lbs)	--	641	--	835	--
Shear used for design (lbs)	--	-288    227	--	-331    378	--
Shear at support node (lbs)	--	-351    290	--	-394    441	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (Ft-lbs)	0	-859	-272	-1354	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.20"	--	-0.06"	--	0.38"

Forte Software Operator	Job Notes
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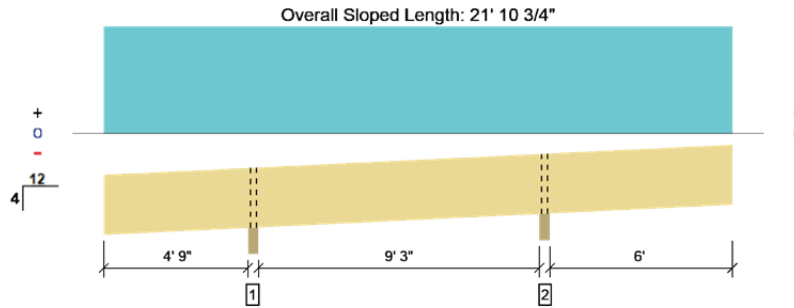
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SOLUTIONS REPORT Level, Roof: Flush Beam  
Current Solution: : 1 piece(s) 4 x 8 Douglas Fir-Larch No. 2

b



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1533 @ 14' 5 1/4"	8070 (3.50")	Passed (19%)	--
Shear (lbs)	715 @ 15' 1 7/8"	2741	Passed (26%)	0.90
Moment (Ft-lbs)	-2487 @ 14' 5 1/4"	2691	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.629 @ 20' 7"	0.648	Passed (2L/248)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	Maximum Down (lbs) / LDF	--	1178/0.90	--	1533/0.90	--
Critical Down (lbs) / LDF	--	1178/0.90	--	1533/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50"	--	3.50"	--	--
Support Fc-perp (psi)	--	625	--	625	--	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.90)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	Member Reaction (lbs)	--	1178	--	1533	--
Loads to Supports (lbs)	--	1178	--	1533	--	--
Shear used for design (lbs)	--	-550 438	--	-629 715	--	--
Shear at support node (lbs)	--	-645 533	--	-723 809	--	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (Ft-lbs)	0	-1578	-500	-2487	0	--
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	--
Total Load Deflection (in)	0.32"	--	-0.10"	--	0.63"	--

Forte Software Operator	Job Notes
ASU ( ) - jjpurcel@gmail.com	

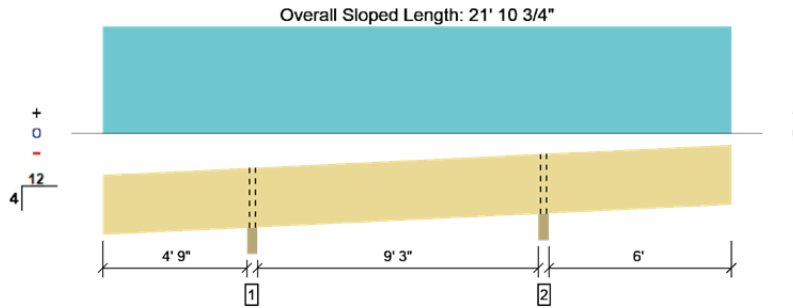
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Forte v4.0, Design Engine: V5.6.1.203

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SOLUTIONS REPORT Level, Roof: Flush Beam  
Current Solution: : 1 piece(s) 4 x 8 Douglas Fir-Larch No. 1

d



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1698 @ 14' 5 1/4"	8070 (3.50")	Passed (21%)	--
Shear (lbs)	792 @ 15' 1 7/8"	2741	Passed (29%)	0.90
Moment (Ft-lbs)	-2756 @ 14' 5 1/4"	2989	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.656 @ 20' 7"	0.648	Passed (2L/238)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Maximum Down (lbs) / LDF	--	1305/0.90	--	1698/0.90
Critical Down (lbs) / LDF	--	1305/0.90	--	1698/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Bearing Length	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	--	625	--	625	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Member Reaction (lbs)	--	1305	--	1698
Loads to Supports (lbs)	--	1305	--	1698	--
Shear used for design (lbs)	--	-609   486	--	-697   792	--
Shear at support node (lbs)	--	-714   591	--	-802   897	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (Ft-lbs)	0	-1749	-553	-2756	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.34"	--	-0.10"	--	0.66"

Forte Software Operator	Job Notes
ASU ( ) - jjpurcel@gmail.com	

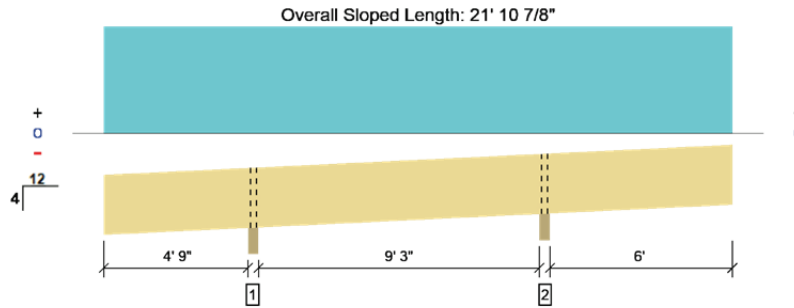
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SOLUTIONS REPORT Level, Roof: Flush Beam  
Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1

e



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1913 @ 14' 5 1/4"	12682 (3.50")	Passed (15%)	--
Shear (lbs)	889 @ 15' 2 1/8"	4208	Passed (21%)	0.90
Moment (Ft-lbs)	-3105 @ 14' 5 1/4"	4641	Passed (67%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.451 @ 20' 7"	0.648	Passed (2L/344)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Maximum Down (lbs) / LDF	--	1470/0.90	--	1913/0.90	--	--
Critical Down (lbs) / LDF	--	1470/0.90	--	1913/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50"	--	3.50"	--	--
Support Fc-perp (psi)	--	625	--	625	--	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
Member Reaction (lbs)	--	1470	--	1913	--	--
Loads to Supports (lbs)	--	1470	--	1913	--	--
Shear used for design (lbs)	--	-683   544	--	-782   889	--	--
Shear at support node (lbs)	--	-805   665	--	-903   1010	--	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (Ft-lbs)	0	-1970	-624	-3105	0	--
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	--
Total Load Deflection (in)	0.23"	--	-0.07"	--	0.45"	--

Forte Software Operator	Job Notes
ASU ( ) - jjpurcel@gmail.com	

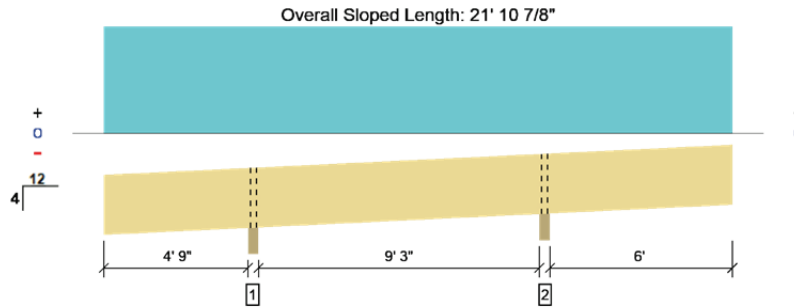
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SOLUTIONS REPORT *Level, Roof: Flush Beam*  
Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1

f



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	2245 @ 14' 5 1/4"	12682 (3.50")	Passed (18%)	--
Shear (lbs)	1043 @ 15' 2 1/8"	4208	Passed (25%)	0.90
Moment (Ft-lbs)	-3642 @ 14' 5 1/4"	4641	Passed (78%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.529 @ 20' 7"	0.648	Passed (2L/294)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	Maximum Down (lbs) / LDF	--	1725/0.90	--	2245/0.90	--
Critical Down (lbs) / LDF	--	1725/0.90	--	2245/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50"	--	3.50"	--	--
Support Fc-perp (psi)	--	625	--	625	--	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	Member Reaction (lbs)	--	1725	--	2245	--
Loads to Supports (lbs)	--	1725	--	2245	--	--
Shear used for design (lbs)	--	-802 638	--	-917 1043	--	--
Shear at support node (lbs)	--	-944 781	--	-1060 1185	--	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (Ft-lbs)	0	-2311	-731	-3642	0	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	0.00"
Total Load Deflection (in)	0.27"	--	-0.08"	--	0.53"	0.53"

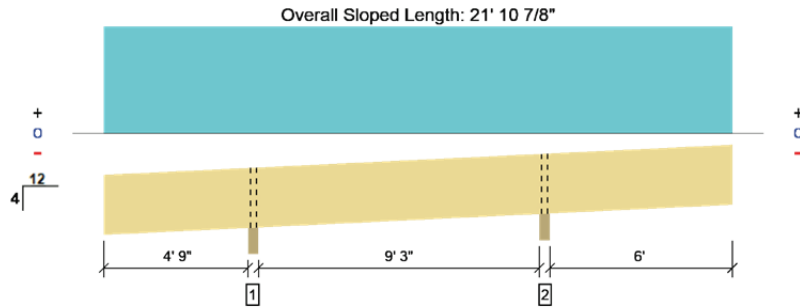
Forte Software Operator	Job Notes
ASU ( ) - jipurcel@gmail.com	

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SOLUTIONS REPORT Level, Roof: Flush Beam  
Current Solution: : 1 piece(s) 6 x 8 Douglas Fir-Larch No. 1

8



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	2576 @ 14' 5 1/4"	12682 (3.50")	Passed (20%)	--
Shear (lbs)	1197 @ 15' 2 1/8"	4208	Passed (28%)	0.90
Moment (Ft-lbs)	-4180 @ 14' 5 1/4"	4641	Passed (90%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.607 @ 20' 7"	0.648	Passed (2L/256)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Maximum Down (lbs) / LDF	--	1979/0.90	--	2576/0.90
Critical Down (lbs) / LDF	--	1979/0.90	--	2576/0.90	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--
Bearing Length	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	--	625	--	625	--
Required unbraced length	260.36"	260.36"	260.36"	260.36"	260.36"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"    ▲    9' 6 1/2"    ▲    6' 1 3/4"				
	Member Reaction (lbs)	--	1979	--	2576
Loads to Supports (lbs)	--	1979	--	2576	--
Shear used for design (lbs)	--	-920    732	--	-1052    1197	--
Shear at support node (lbs)	--	-1083    896	--	-1216    1360	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A
Moment (Ft-lbs)	0	-2652	-839	-4180	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	0.31"	--	-0.09"	--	0.61"

Forte Software Operator	Job Notes
ASU ( ) - jipurcel@gmail.com	

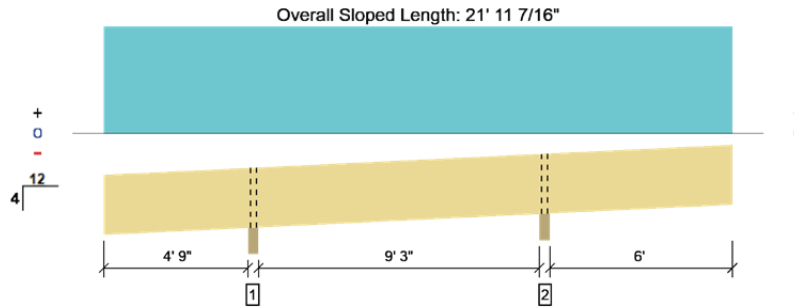
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**SOLUTIONS REPORT** Level, Roof: Flush Beam  
**Current Solution: : 1 piece(s) 2 x 10 Douglas Fir-Larch No. 1**

j



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.; Drawing is Conceptual

Design Results	Actual @ Location	Allowed	Result	LDF
Member Reaction (lbs)	1000 @ 14' 5 1/4"	3459 (3.50")	Passed (29%)	--
Shear (lbs)	453 @ 15' 3 3/4"	1499	Passed (30%)	0.90
Moment (Ft-lbs)	-1623 @ 14' 5 1/4"	1765	Passed (92%)	0.90
Live Load Defl. (in)	0.000 @ 0	0.344	Passed (2L/999+)	--
Total Load Defl. (in)	0.434 @ 20' 7"	0.648	Passed (2L/358)	--

System : Roof  
Member Type : Flush Beam  
Building Use : Residential  
Building Code : IBC  
Design Methodology : ASD  
Member Pitch : 4/12

Summary of Loads to Supports

All load groups / combinations / patterns	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	▲	▲	▲	▲	▲	▲
Maximum Down (lbs) / LDF	--	768/0.90	--	1000/0.90	--	--
Critical Down (lbs) / LDF	--	768/0.90	--	1000/0.90	--	--
Maximum Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Critical Uplift (lbs) / LDF	--	0/1.00	--	0/1.00	--	--
Bearing Length	--	3.50"	--	3.50"	--	--
Support Fc-perp (psi)	--	625	--	625	--	--
Required unbraced length	159.11"	159.11"	260.36"	61.41"	61.41"	61.41"

1.0 Dead (LDF = 0.9)

Loading On All Spans	4' 10 3/4"		9' 6 1/2"		6' 1 3/4"	
	▲	▲	▲	▲	▲	▲
Member Reaction (lbs)	--	768	--	1000	--	--
Loads to Supports (lbs)	--	768	--	1000	--	--
Shear used for design (lbs)	--	-345 272	--	-397 453	--	--
Shear at support node (lbs)	--	-421 348	--	-472 528	--	--
Shear at span point load (lbs)	N/A	--	N/A	--	N/A	--
Moment (Ft-lbs)	0	-1030	-326	-1623	0	0
Live Load Deflection (in)	0.00"	--	0.00"	--	0.00"	0.00"
Total Load Deflection (in)	0.22"	--	-0.07"	--	0.43"	0.43"

Forte Software Operator	Job Notes
ASU ( ) - jjpurcel@gmail.com	

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**FORTE** FULL DETAIL REPORT *Level, Roof: Flush Beam*  
**1 piece(s) 6 x 12 Douglas Fir-Larch No. 2**

**A**

Summary of Loads to Supports

All load groups / combinations / patterns	12'		10'		14'		10'	
	▲	▲	▲	▲	▲	▲	▲	▲
Maximum Down (lbs) / LDF	2060/0.90	--	5498/0.90	--	1992/0.90	--	7640/0.90	--
Critical Down (lbs) / LDF	2060/0.90	--	5498/0.90	--	1992/0.90	--	7640/0.90	--
Maximum Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--
Critical Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--
Bearing Length	2.25"	--	3.50"	--	3.50"	--	3.50"	--
Support Fc-perp (psi)	625	--	625	--	625	--	625	--
Required unbraced length	N/A	552.75"	552.75"	552.75"	552.75"	6.00"	6.00"	6.00"

1.0 Dead (LDF = 0.9)

Loading On All Spans	12'		10'		14'		10'	
	▲	▲	▲	▲	▲	▲	▲	▲
Member Reaction (lbs)	1225	--	5498	--	1992	--	7640	--
Loads to Supports (lbs)	2060	--	5498	--	1992	--	7640	--
Shear used for design (lbs)	N/A	1206	--	-2054	1747	--	-328	-59
Shear at support node (lbs)	N/A	1224	--	-3733	1765	--	-2033	-41
Shear at span point load (lbs)	--	-1968	--	1687	--	-2727	--	2996
Moment (Ft-lbs)	--	-5039	--	-5661	2682	1015	-19120	-19881
Live Load Deflection (in)	--	0.00"	--	0.00"	--	0.00"	--	0.00"
Total Load Deflection (in)	--	0.10"	--	0.03"	--	-0.19"	--	2.08"



**FORTE** FULL DETAIL REPORT *Level, Roof: Flush Beam*  
**1 piece(s) 6 x 8 Douglas Fir-Larch No. 1**

**B**

Summary of Loads to Supports

All load groups / combinations / patterns										
	12'		10'		14'		10' 1 1/2"			
Maximum Down (lbs) / LDF	1638/0.90	--	3714/0.90	--	3935/0.90	--	4553/0.90	--	1124/0.90	
Critical Down (lbs) / LDF	1638/0.90	--	3714/0.90	--	3935/0.90	--	4553/0.90	--	1124/0.90	
Maximum Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	
Critical Uplift (lbs) / LDF	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	--	0/1.00	
Bearing Length	2.25"	--	3.50"	--	3.50"	--	3.50"	--	3.50"	
Support Fc-perp (psi)	625	--	625	--	625	--	625	--	625	
Required unbraced length	N/A	556.25"	556.25"	556.25"	556.25"	556.25"	556.25"	556.25"	N/A	

1.0 Dead (LDF = 0.9)

Loading On All Spans														
	12'		10'		14'		10' 1 1/2"							
Member Reaction (lbs)	997	--	3714	--	3935	--	4553	--	1124					
Loads to Supports (lbs)	1638	--	3714	--	3935	--	4553	--	1124					
Shear used for design (lbs)	N/A	988	--	-1521	916	--	-718	1031	--	-1153	1213	--	-551	N/A
Shear at support node (lbs)	N/A	996	--	-2790	924	--	-2896	1039	--	-3331	1221	--	-1122	N/A
Shear at span point load (lbs)	--	-1442	--	873	--	-1011	--	1171	--					
Moment (Ft-lbs)	--	3742	--	-3543	-2315	--	-2797	4060	--	-3829	1953	--		
Live Load Deflection (in)	--	0.00"	--	0.00"	--	0.00"	--	0.00"	--	0.00"	--			
Total Load Deflection (in)	--	0.25"	--	-0.04"	--	0.23"	--	0.06"	--					



RAM SBeam v3.0  
 Solar D - ASU - Solar Canopy  
 Cantilver HSS  
 Licensed to: RAM International

08/21/13 16:28:32

**Gravity Beam Design**

**STEEL CODE: ASD 9th Ed.**

**SPAN INFORMATION (ft): I-End (0.00,0.00) J-End (24.00,0.00)**

Beam Size (User Selected) = HSS10X5X1/4 Fy = 50.0 ksi  
 Total Beam Length (ft) = 24.00  
 Cantilever on right (ft) = 10.00

**POINT LOADS (kips):**

Dist (ft)	DL	LL	Flange Bracing	
			Top	Bottom
7.000	1.13	1.13	Yes	Yes
19.000	0.83	0.83	Yes	Yes
23.997	0.45	0.45	Yes	Yes

**LINE LOADS (k/ft):**

Load	Dist (ft)	DL	LL
1	0.000	0.023	0.000
	14.000	0.023	0.000
2	14.000	0.023	0.000
	24.000	0.023	0.000

**SHEAR: Max V (DL+LL) = 2.79 kips fv = 0.60 ksi Fv = 20.00 ksi**

**MOMENTS:**

Span	Cond	Moment kip-ft	@ ft	Lb ft	Cb	Tension Flange		Compr Flange	
						fb	Fb	fb	Fb
Center	Max +	3.6	7.0	7.0	1.75	2.50	33.00	2.50	33.00
	Max -	-18.4	14.0	7.0	1.50	12.85	33.00	12.85	33.00
Right	Max -	-18.4	14.0	5.0	1.00	12.85	33.00	12.85	33.00
Controlling		-18.4	14.0	7.0	1.50	12.85	33.00	---	---

**REACTIONS (kips):**

	Left	Right
DL reaction	0.03	2.93
Max +LL reaction	0.57	2.46
Max -LL reaction	-0.62	0.00
Max +total reaction	0.59	5.39
Max -total reaction	-0.59	2.93

**DEFLECTIONS:**

**Center span:**

Dead load (in)	at	8.68 ft =	0.036	L/D =	4669
Live load (in)	at	8.68 ft =	0.075	L/D =	2243
Net Total load (in)	at	8.68 ft =	0.111	L/D =	1515

**Right cantilever:**

Dead load (in)	=	-0.386	L/D =	621
Pos Live load (in)	=	-0.444	L/D =	540
Neg Live load (in)	=	0.096	L/D =	2492
Pos Total load (in)	=	-0.831	L/D =	289



### Considerations for Lateral Forces

<b>WIND</b>
COMPETITON: IRVINE, CA
85 MPH (3 SECOND GUST)
EXPOSURE: C
PERMANENT: PHOENIX, AZ
90 MPH (3 SECOND GUST)
EXPOSURE: C
THEREFORE, USE PHOENIX VALUES, MORE CONSERVATIVE
$q=0.025KV^2I_W C_D$
$q=0.025(0.90)(90^2)(1.0)(0.80) = 14.58 \text{ PSF (ROUND TO 15 PSF)}$
SOUTH FACE, MODULES
AREA= 720.09 FT <sup>2</sup>
$V_{BASE}=15.0 \text{ PSF}(720.09)=10.8 \text{ K}$
NORTH FACE, MODULES
AREA= 720.09 FT <sup>2</sup>
$V_{BASE}=15.0 \text{ PSF (720.09)}=10.8 \text{ K}$
EAST FACE, MODULES
AREA= 574.165 FT <sup>2</sup>
$V_{BASE}=15.0 \text{ PSF (574.165)}= 8.61 \text{ K}$
WEST FACE, MODULES
AREA= 574.165 FT <sup>2</sup>
$V_{BASE}=15.0 \text{ PSF (574.165)}= 8.61 \text{ K}$
WEST PATIO CANOPY (CONSERVATIVE AREA)
AREA= 62.4FT <sup>2</sup>
$V_{BASE}=15.0 \text{ PSF (62.4)}= 936\#$



## Design Maps Summary Report

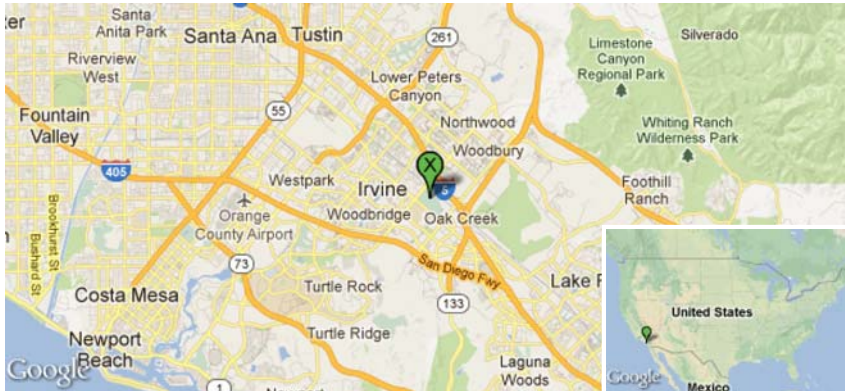
### User-Specified Input

**Building Code Reference Document** 2006/2009 International Building Code  
(which makes use of 2002 USGS hazard data)

**Site Coordinates** 33.68027°N, 117.77152°W

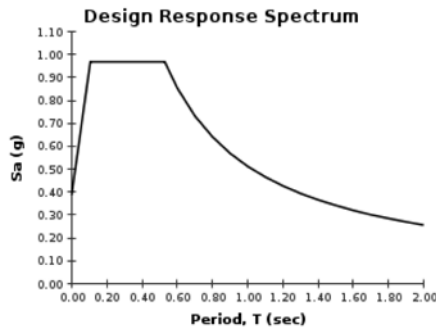
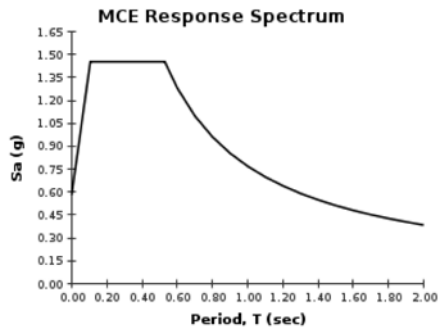
**Site Soil Classification** Site Class D – “Stiff Soil”

**Occupancy Category** Occupancy Category I



### USGS-Provided Output

$S_s = 1.453 \text{ g}$        $S_{MS} = 1.453 \text{ g}$        $S_{Ds} = 0.968 \text{ g}$   
 $S_1 = 0.512 \text{ g}$        $S_{M1} = 0.769 \text{ g}$        $S_{D1} = 0.512 \text{ g}$



Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.



<b>SEISMIC</b>
IRC DESIGN CATEGORY: D <sub>2</sub>
SEE IRC SECTION R301.2.2
OCCUPANCY CATEGORY: II
S <sub>DS</sub> (FOR IRVINE, CA): 0.968g (SOIL CLASSIFICATION D)
R= 7.0 (LIGHT FRAMED SHEAR WALL)
SEE ASCE 7 12.2-1
$C_s = (S_{DS}(1))/R = (0.968(1))/7.0 = 0.138$

<b>SEISMIC MODULES</b>
$v=C_s(W)$
W= 98.56 K (N., S. MODULES, SOLAR CANOPY, MECH. UNIT)
$v=0.138(98.56 K) = 13.601 K$
THEREFORE, SEISMIC CONTROLS LATERAL FORCES FOR N., S. MODULES, SOLAR CANOPY, MECH. UNIT
<b>SEISMIC WEST PATIO CANOPY</b>
$v=C_s(W)$
W= 1524#
$v=0.138(1524\#) = 210.31\#$
THEREFORE, WIND CONTROLS LATERAL FORCES FOR WEST PATIO CANOPY



<b>NORTH + SOUTH MODULES   ROOF DIAPHRAGM SHEAR RESISTANCE</b>
$N=(v/L)$
v ACTING AT ROOF DIAPHRAGM
$v=C_s(W)$
$v=0.138(49.78 K) = 6.87 K$
$N_x= 6870\#/36.68'(4) = 46.82 \text{ PLF IN X-DIRECTION}$
$N_y= 6870\#/25.54'(2) = 134.5 \text{ PLF IN Y-DIRECTION}$
THEREFORE, USE LP TECH SHIELD, APA RATED EXPOSURE 1 O.S.B.
FASTENED WITH #8 PPSD SCREW
SCREW SPACING: 6" MAX. ON ALL SUPPORTED EDGES
MAX SHEAR STRENGTH: 615 PLF

<b>NORTH + SOUTH MODULES   FLOOR DIAPHRAGM SHEAR RESISTANCE</b>
$N=(v/L)$
v ACTING AT FLOOR DIAPHRAGM
$v=C_s(W)$
$v=0.138(18.6 K) = 2.57 K$
$N_x= 2570\#/122.04' = 21.06 \text{ PLF IN X-DIRECTION}$
$N_y= 2570\#/25.54'(2) = 50.31 \text{ PLF IN Y-DIRECTION}$
THEREFORE, USE 1-1/8" STRUCTURAL 1 RATED O.S.B.
FASTENED WITH #10 PPSD SCREW
SCREW SPACING: 6" MAX. ON ALL SUPPORTED EDGES
MAX SHEAR STRENGTH: 615 PLF

<b>MECH. ROOM   ROOF DIAPHRAGM SHEAR RESISTANCE</b>
$N=(v/L)$
v ACTING AT ROOF DIAPHRAGM
$v=C_s(W)$
$v=0.138(4.22 K) = 0.58 K$
$N_x= 582.36\#/4.58' = 127.15 \text{ PLF IN X-DIRECTION}$



$N_y = 582.36\#/20' = 29.118$ PLF IN Y-DIRECTION
THEREFORE, USE LP TECH SHIELD, APA RATED EXPOSURE 1 O.S.B.
FASTENED WITH #8 PPSD SCREW
SCREW SPACING: 6" MAX. ON ALL SUPPORTED EDGES
MAX SHEAR STRENGTH: 615 PLF

<b>MECH. ROOM   ROOF DIAPHRAGM SHEAR RESISTANCE</b>
$N = (v/L)$
v ACTING AT FLOOR DIAPHRAGM
$v = C_s(W)$
$v = 0.138(2.32 K) = 0.32 K$
$N_x = 320.16\#/4.58' = 69.9$ PLF IN X-DIRECTION
$N_y = 320.16\#/20' = 16.00$ PLF IN Y-DIRECTION
THEREFORE, USE 1-1/8" STRUCTURAL 1 RATED O.S.B.
FASTENED WITH #10 PPSD SCREW
SCREW SPACING: 6" MAX. ON ALL SUPPORTED EDGES
MAX SHEAR STRENGTH: 615 PLF
THEREFORE, SEISMIC CONTROLS LATERAL FORCES FOR N., S. MODULES, SOLAR CANOPY, MECH UNIT

REFER TO S-600 FOR SHEAR WALL LOCATIONS

SHEAR WALL CALCULATIONS						
NORTH + SOUTH MODULES						
WALL	LENGTH (FT)	I	% OF TOTAL	SHEAR (v) IN #	SHEAR (v) IN PLF	CONCLUSION (APA RATED SHEATHING)
EW1	7.79	26.39 40435 9	0.2061 20175	993.4992431	127.5352045	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
EW2	6.52	15.47	0.1208	582.5027161	89.34090738	15/32" APA RATED STRUCTURAL 1 PLY.





		52026 1	51186			FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
EW3	2.5	0.872 39583 3	0.0068 12839	32.83788621	13.13515448	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
EW4	8.37	32.73 93407 9	0.2556 72786	1232.342827	147.2333127	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
EW5	9.75	51.74 96484 4	0.4041 30824	1947.910572	199.7856997	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
EW6	2.45	0.821 09197 9	0.0064 1219	30.90675579	12.61500237	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
TOTAL		128.0 51723 3	1	4820		
<b>WALL</b>	<b>LENGTH (FT)</b>	<b>I</b>	<b>% OF TOTAL</b>	<b>SHEAR (v) IN #</b>	<b>SHEAR (v) IN PLF</b>	<b>CONCLUSION (APA RATED SHEATHING)</b>
NS1	7.36	22.26 00942 9	0.1314 7194	633.6947504	86.09983021	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
NS2	2.31	0.688 22349 8	0.0040 64766	19.59217296	8.481460155	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
NS3	13.13	126.3 82730 7	0.7464 38113	3597.831705	274.0161238	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 4" o.c., V MAX: 380#
NS4	7.1	19.98 33641 7	0.1180 25181	568.8813713	80.1241368	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
TOTAL		169.3 14412 7	1	4820		
<b>MECHANICAL UNIT</b>						
<b>WALL</b>	<b>LENGTH (FT)</b>	<b>I</b>	<b>% OF TOTAL</b>	<b>SHEAR (v) IN #</b>	<b>SHEAR (v) IN PLF</b>	<b>CONCLUSION (APA RATED SHEATHING)</b>
EW1	4.6	2.757 85333 3	1	486.94	105.8565217	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
TOTAL		2.757	1	486.94		



		85333 3				
<b>WALL</b>	<b>LENGTH (FT)</b>	<b>I</b>	<b>% OF TOTAL</b>	<b>SHEAR (v) IN #</b>	<b>SHEAR (v) IN PLF</b>	<b>CONCLUSION (APA RATED SHEATHING)</b>
NS1	13.25	65.90 90885 4	0.9334 95535	454.556316	34.30613706	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
NS2	5.31	4.242 10324 5	0.0600 82525	29.25658458	5.50971461	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
NS3	2.52	0.453 41856	0.0064 2194	3.127099385	1.240912454	15/32" APA RATED STRUCTURAL 1 PLY. FASTENER: RAMSET GYPFAST, SPACING: 6" o.c., V MAX: 253#
<b>TOTAL</b>		70.60 46103 5	1	486.94		

LOCAL OVERTURNING CALCULATIONS											
NORTH + SOUTH MODULES											
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
EW1	8.5	8444.743566	7.22	141.512	101.15	242.662	7362.862537	1081.881029	1622.821544	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW2	8.5	4951.273087	7.22	141.512	101.15	242.662	5157.829342	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW3	8.5	279.1220328	7.22	141.512	101.15	242.662	758.31875	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW4	9	11091.08544	5.81	107.485	107.1	214.585	7516.579943	3574.505499	5361.758248	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW5	9	17531.19515	5.81	107.485	107.1	214.585	10199.49328	7331.701866	10997.5528	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW6	9	278.1608022	5.81	107.485	107.1	214.585	644.0232313	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
NS1	8.5833	5439.192151	18.34	359.464	102.14127	461.60527	12502.48642	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS2	8.972	175.7809758	18.34	359.464	106.7668	466.2308	1243.927086	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS3	8.75	31481.02742	18.34	359.464	104.125	463.589	39960.65324	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855



NS4	9	5119.932342	18.34	339.29	107.1	446.39	11251.25995	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
<b>MECHANICAL UNIT</b>	<b>MECHANICAL UNIT</b>										
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	
EW1	8.5	4138.99	13.56	145.77	86.7	232.47	2459.5326	1679.4574	2519.1861	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	
NS1	8.5	3863.728686	2.76	29.67	86.7	116.37	10215.10406	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS2	8.5	248.6809689	2.76	29.67	86.7	116.37	1640.590079	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS3	8.5	26.58034477	2.76	29.67	86.7	116.37	369.498024	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855



<b>UPLIFT</b>
NORTH, SOUTH MODULES, MECH. UNIT
ASCE 7, FIGURE 27.4-4
MONOSLOPE FREE ROOFS
WIND DIRECTION: 180 DEGREES
LOAD CASE: A
OBSTRUCTED WIND FLOW
$C_{NW} = -0.5$
$q = 0.0025K V^2 I_w C_{NW}$
$q = 0.0025(0.90)(90^2)(1.0)(-0.5)$
$q = -9.11 \text{ PSF}$
ROOF DEAD LOAD:
25.8 PSF (NORTH)
25.8 PSF (SOUTH)
12.9 PSF (MECH. UNIT)
THEREFORE, NO NET UPLIFT
SOLAR CANOPY MODULE
$q = -29 \text{ PSF (COMPONENT AND CLADDING)}$
$29 \text{ PSF (337 FT}^2) = 9773\#$
THEREFORE, RESIST UPLIFT WITH 20 SIMPSON H2.5A (2 PER EACH N-S BEAM)
<b>MODULES ANCHORING FOR SHEAR RESISTANCE WITH SAFETY FACTOR</b>
$V_{TOTAL} = 13.6 \text{ K}$
$SHEAR/ANCHOR = V_{TOTAL}/14$
$13600\#/14 = 971.5\#/ANCHOR$
THEREFORE, USE (14) 1" DIAMETER, 42" LONG DOUBLE HEAD STEEL TENT STAKES AS PRODUCED BY HOGAN COMPANY, INC. EMBEDDED 36" INTO TARMAC COMPOSITION WITH ASSUMED SHEAR RESISTANCE OF 1,500# TO RESIST SHEAR IN X AND Y DIRECTIONS.
REFER TO S-100 FOR ANCHOR LOCATIONS
<b>WEST PATIO CANOPY ANCHORING FOR SHEAR RESISTANCE WITH SAFETY FACTOR</b>



$$V_{TOTAL} = 936 \#$$

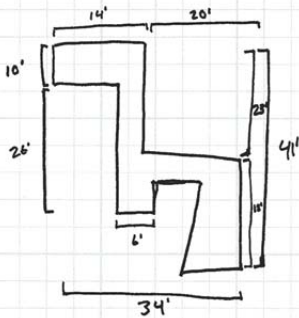
$$SHEAR/ANCHOR = V_{TOTAL}/2$$

$$936\#/2 = 468\#/ANCHOR$$

THEREFORE, USE (2) 1" DIAMETER, 42" LONG DOUBLE HEAD STEEL TENT STAKES AS PRODUCED BY HOGAN COMPANY, INC. EMBEDDED 36" INTO TARMAC COMPOSITION WITH ASSUMED SHEAR RESISTANCE OF 1,500# TO RESIST SHEAR IN X AND Y DIRECTIONS.

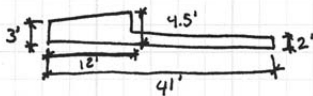


Project <b>ASUNM SOLAR DECATHLON</b>		Sheet No. of
Made By <b>JP</b>	Checked By	Date
Subject <b>OVERTURNING + UPLIFT DECK</b>		Project No.



DL = 10 psf  
 A = 472 ft<sup>2</sup>  
 TW = 4.72 K

$q_{\text{UPLIFT}} = 9.11 \text{ psf} < 10 \text{ psf} \checkmark$   
 No UPLIFT



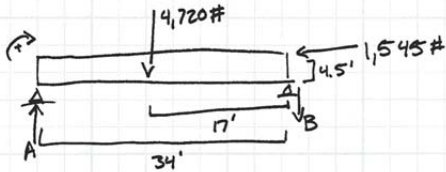
A = 103 ft<sup>2</sup>

SEISMIC:  $C_s = .138$

$V_{\text{BASE}} = .138(4.72 \text{ K})$   
 = .651 K or 651 #

WIND:  $q = 15 \text{ psf}$

$V_{\text{BASE}} = 15 \text{ psf}(103 \text{ ft}^2)$   
 = 1,545 #



$\sum M_A = 0 = 4,720(17') + B(34') - 1,545(4.5')$   
 $B = -2,155.5 \#$  or  $2,155.5 \uparrow$   
 No HOLD DOWN NECESSARY

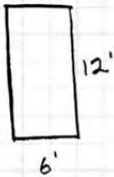
$V_{\text{TENT STAKE}} = 1500 \#$

AT LEAST 2 STAKES NEEDED

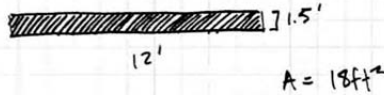


Project aSUNm SOLAR DECATHLON		Sheet No. L24 of
Made By JP	Checked By	Date
Subject OVERTURNING + UPLIFT DECK		Project No.

WEST DECK



DL = 23 psf  
 TW = 1656



SEISMIC:  $C_s = .138$

$$V_{base} = .138(1656\#)$$

$$= 228.528 \#$$

UPLIFT:

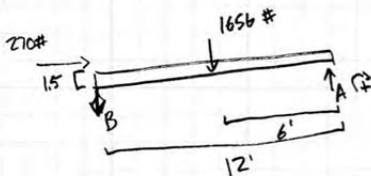
$$q_{uplift} = 9.11 \text{ psf} < 23 \text{ psf}$$

No uplift

WIND:  $q = 15 \text{ psf}$

$$V_{base} = 15 \text{ psf} (18 \text{ ft}^2)$$

$$= 270 \#$$



$$\sum M_A = 0 = 270\#(1.5') - 1656\#(6') - B(12')$$

$$B = -794.25$$

or  
 794.25  $\uparrow$  No HOLD DOWN NEEDED

$$\sqrt{\text{TENT STAKE}} = 1500\# > 270\#$$

> 1 STAKE NEEDED IN EACH DIRECTION





ARIZONA STATE UNIVERSITY/ UNIVERSITY OF NEW MEXICO (TEAM aSUNm)  
The Design School, Attn: Solar Decathlon 2013 PO Box 871605, Tempe, AZ 85287-1605

LOCAL OVERTURNING CALCULATIONS											
NORTH + SOUTH MODULES											
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
EW1	8.5	8444.743566	7.22	141.512	101.15	242.662	7362.862537	1081.881029	1622.821544	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW2	8.5	4951.273087	7.22	141.512	101.15	242.662	5157.829342	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW3	8.5	279.1220328	7.22	141.512	101.15	242.662	758.31875	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW4	9	11091.08544	5.81	107.485	107.1	214.585	7516.579943	3574.505499	5361.758248	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW5	9	17531.19515	5.81	107.485	107.1	214.585	10199.49328	7331.701866	10997.5528	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
EW6	9	278.1608022	5.81	107.485	107.1	214.585	644.0232313	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
NS1	8.5833	5439.192151	18.34	359.464	102.14127	461.60527	12502.48642	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS2	8.972	175.7809758	18.34	359.464	106.7668	466.2308	1243.927086	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS3	8.75	31481.02742	18.34	359.464	104.125	463.589	39960.65324	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855

NS4	9	5119.932342	18.34	339.29	107.1	446.39	11251.25995	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
MECHANICAL UNIT	MECHANICAL UNIT										
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
EW1	8.5	4138.99	13.56	145.77	86.7	232.47	2459.5326	1679.4574	2519.1861	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
WALL	HEIGHT (FT)	OVERTURNING MOMENT	SHEAR TRIBUTARY LENGTH (FT)	WEIGHT RESISTING (ROOF) IN #	WEIGHT RESISTING (WALL) IN PLF	SUM OF RESISTING FORCE (IN PLF)	TOTAL RESISTING FORCE (IN #)	NECESSARY FORCE TO HOLD DOWN (IN #)	WITH SAFETY FACTOR (*1.5) IN #	CONCLUSION	ALLOWABLE TENSION LOAD IN #
NS1	8.5	3863.728686	2.76	29.67	86.7	116.37	10215.10406	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS2	8.5	248.6809689	2.76	29.67	86.7	116.37	1640.590079	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855
NS3	8.5	26.58034477	2.76	29.67	86.7	116.37	369.498024	0	0	SIMPSON S/HD8S, 17 - #14 STUD FASTENERS, 7/8" ANCHOR BOLT, BOUNDARY MEMBER: 2-54mil	8855





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**DIVISION: 05—METALS**  
**Section: 05090—Metal Fastenings**

**DIVISION: 06—WOOD AND PLASTICS**  
**Section: 06090—Wood and Plastic Fastenings**

**RAMSET PLYWOOD FASTENERS FOR PLYWOOD  
PANEL SHEAR WALLS AND DIAPHRAGMS ATTACHED  
TO STEEL FRAMING**

**ITW RAMSET**  
**700 HIGH GROVE BOULEVARD**  
**GLENDALE HEIGHTS, ILLINOIS 60139**

#### 1.0 SUBJECT

Ramset Plywood Fasteners for Plywood Panel Shear Walls and Diaphragms Attached to Steel Framing.

#### 2.0 DESCRIPTION

##### 2.1 General:

Ramset Plywood fasteners are pneumatically or gas power driven fasteners used to attach plywood structural panels to light-gage steel framing for shear wall and horizontal diaphragm applications. Fasteners are limited to locations not exposed to the weather or damp environments.

##### 2.2 Materials:

**2.2.1 Ramset Plywood Fasteners:** The fasteners are manufactured from AISI C 1030 steel, heat-treated to a Rockwell C hardness of 45 to 50, or AISI C 1060 steel, heat-treated to a Rockwell C hardness of 44 to 48. Minimum tensile strength is 210 ksi (1,447 MPa). The fasteners have a tapered helical point and annular threading on the shank. The fasteners have a shank diameter of 0.120 inch (3 mm) and are available with a length of either 1.5 or 1.75 inches (38.1 or 44.5 mm). The fastener head is either a 0.275-inch-diameter (6.9 mm) flat head or 0.312-inch-diameter (7.9 mm) bugle head. Fasteners with a flat head are zinc-plated with a chromate finish, and fasteners with a bugle head have a cathodic-epoxy electro-coating over a electro plated zinc coating.

**2.2.2 Plywood Sheathing:** Plywood panels must comply with UBC Standard 23-2, and be capable of supporting vertical loads in accordance with the panel span rating shown in the code. Plywood panels used for walls must have span ratings appropriate for the spacing of the wall framing.

**2.2.3 Steel Framing:** In this report, gage numbers for steel framing members refer to the following minimum base-metal thicknesses:

- No. 14 gage : 0.0747 inch (1.9 mm)
- No. 16 gage : 0.0598 inch (1.5 mm)
- No. 18 gage : 0.0478 inch (1.2 mm)
- No. 20 gage : 0.0359 inch (0.9 mm)
- No. 22 gage : 0.0299 inch (0.8 mm)

Steel studs for shear walls must be C-shaped, with a minimum depth of  $3\frac{3}{8}$  inches (92 mm) and a minimum flange width of  $1\frac{3}{8}$  inches (41 mm), except No. 22 gage studs have a minimum flange width of  $1\frac{1}{4}$  inches (32 mm). Steel studs must have a minimum yield strength of 33 ksi (228 kPa) and a minimum tensile strength of 52 ksi (359 kPa).

Steel joists for diaphragms must comply with the code and must be suitable for the direct support of floors and roof decks. The Ramset Plywood fasteners are limited for use with diaphragms framed with cold-formed framing members complying with Division VII, Chapter 22, of the 1997 *Uniform Building Code*™ (UBC). Recognition of the fasteners for use with heavier steel, common to open-web steel joists referenced in Section 3, Division IX, Chapter 22, of the UBC, is beyond the scope of this report.

##### 2.3 Design:

**2.3.1 General:** Allowable pull-out and lateral loads for the Buildex fasteners attaching wood-based structural sheathing to light-gage steel framing members are specified in Table 1.

##### 2.3.2 Shear Walls:

**2.3.2.1 Wind Resistance:** Allowable shear for shear walls using Buildex fasteners to attach wood-based structural panels to light-gage studs is shown in Table 3 for wind forces. Maximum shear-wall height-to-width is  $3\frac{1}{2}$ :1 for panels fastened along all edges, and 2:1 where blocking is omitted at intermediate joints. The deflection of blocked panel shear walls uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a$$

For SI:

$$\Delta = \frac{2000vh^3}{3EAb} + \frac{vh}{Gt} + 2.46he_n + d_a$$

\*Revised January 2009

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where:

- A = Area of boundary element cross section (vertical member at shear wall boundary), square inches (mm<sup>2</sup>).
- b = Wall width, feet (mm).
- d<sub>a</sub> = Deflection due to anchorage details (rotation and slip at tie-down bolts).
- E = Elastic modulus of boundary element (vertical member at shear wall boundary), pounds per square inch (N/mm<sup>2</sup>).
- e<sub>n</sub> = Fastener deformation, inches (mm). (See Table 2.)
- G = Modulus of rigidity of plywood, pounds per square inch (N/mm<sup>2</sup>). (See Table 23-2-J of UBC Standard 23-2.)
- h = Wall height, feet (mm).
- t = Effective thickness of plywood sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2.)
- v = Maximum shear due to design loads at the top of the wall, pounds per lineal foot (N/mm).
- Δ = The calculated deflection, inches (mm).

**2.3.2.2 Seismic Resistance:** Shear walls are constructed as follows:

1. Sheathing: Sheathing is Structural 1 plywood complying with UBC Standard 23-2, with the long dimension parallel to stud framing, and is nominally <sup>15</sup>/<sub>32</sub> inch thick, or thicker. All panel edges must be fully blocked.
2. Framing: Studs must have minimum dimensions of 1<sup>5</sup>/<sub>8</sub> inches (41 mm) by 3<sup>1</sup>/<sub>2</sub> inches (89 mm), with a <sup>3</sup>/<sub>8</sub>-inch (9.5 mm) return lip. Track must have minimum dimensions of 1<sup>1</sup>/<sub>4</sub> inches (32 mm) by 3<sup>1</sup>/<sub>2</sub> inches (89 mm). Both studs and track must have a minimum uncoated base-metal thickness of 0.033 inch (0.084 mm), must not have a base-metal thickness greater than 0.0747 inch (1.90 mm), and must be ASTM A 653, SS, Grade 33. Stud spacing is a maximum of 24 inches (610 mm). Doubled studs are required at vertical edges of sheathing panels.
3. Fasteners: Framing screws must be No. 8 by <sup>5</sup>/<sub>8</sub>-inch (16 mm), wafer-head self-drilling screws. Sheathing fasteners are Buildex fasteners, spaced 2 inches (51 mm) on center around all plywood edges. Fasteners in the field of the panel must be installed at 12 inches (305 mm) on center. Edge distance is <sup>3</sup>/<sub>8</sub> inch (9.5 mm) for plywood and framing.

Additional design and wall construction requirements are in Section 2219 of the UBC. In addition, supplemental requirements in Section 2220 of the UBC apply to shear walls located in Seismic Zone 3 or 4.

The nominal shear strength of the wall is 780 pounds per foot. Design shear values are determined in accordance with Section 2219.3 of the UBC. The maximum inelastic response displacement is <sup>3</sup>/<sub>4</sub> inch (19.1 mm). The design level response displacement is determined in accordance with Section 2.3.2.1.

**2.3.3 Diaphragms:** Allowable shear for wind or seismic forces is shown in Table 4 for diaphragms using Ramset Plywood fasteners to attach plywood structural sheathing to steel framing members. The maximum span-to-width ratio of the diaphragm is 4:1. The deflection of blocked

panel diaphragms uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

For SI:

$$\Delta = \frac{52vL^3}{EAb} + \frac{vL}{4Gt} + 0.614Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

where:

- A = Area of chord cross section, square inches (mm<sup>2</sup>).
- b = Diaphragm width, feet (mm).
- E = Elastic modulus of chords, pounds per square inch (N/mm<sup>2</sup>).
- e<sub>n</sub> = Fastener deformation, inches (mm). See Table 2.
- G = Modulus of rigidity of sheathing, pounds per square inch (N/mm<sup>2</sup>). (See Table 23-2-J of UBC Standard 23-2 for values of G.)
- L = Diaphragm length, feet (mm).
- t = Effective thickness of wood-based sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2 for values of t for plywood).
- v = Maximum shear due to design loads in the direction under consideration, pounds per lineal foot (N/mm).
- Δ = Calculated deflection, inches (mm).

Σ(Δ<sub>c</sub>X) = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance from the nearest support.

**2.4 Installation:**

Fasteners are installed using pneumatic or gas powered tools recommended by ITW Ramset. Installation must be in accordance with this report and the published manufacturer's installation instructions. The fasteners are installed in such a manner that they pierce the wood-based panels being fastened and the knurl of the fastener protrudes through the steel framing members a minimum of <sup>1</sup>/<sub>4</sub> inch (6.4 mm). The fasteners must be installed with the heads flush to the panel surface. If overdriving occurs, no more than 20 percent of the fasteners are permitted to be overdriven more than <sup>1</sup>/<sub>16</sub> inch (1.6 mm).

**2.5 Identification:**

The Ramset Plywood fasteners are identified on the carton by the manufacturer's name and product name, and identified on the head of each fastener by one of the following logos:



Flat Head



Bugle Head

**3.0 EVIDENCE SUBMITTED**

Reports of shear wall tests, cyclic tests, and individual fastener pull-out and pull-through tests; and descriptive literature.

**4.0 FINDINGS**

**That the Ramset Plywood fasteners described in this report, comply with the 1997 Uniform Building Code™, subject to the following conditions:**



- |  |   |
|--|---|
| <p>4.1 Fasteners are manufactured, identified and installed in accordance with this report.</p> <p>4.2 Individual fastener allowable values for attachment of wood-based panels to light-gage steel are limited to the values noted in Table 1.</p> <p>4.3 Allowable shear values for shear walls intended to resist wind loads and horizontal diaphragms are limited to the values noted in Tables 3 and 4.</p> | <p>4.4 Shear walls intended to resist seismic forces comply with Section 2.3.2.2.</p> <p>4.5 Limitations based on deflections of shear walls and horizontal diaphragms must be considered in design.</p> <p>This report is subject to re-examination in one year.</p> |
|--|---|

**TABLE 1—ALLOWABLE WITHDRAWAL AND LATERAL LOADS  
FOR A RAMSET PLYWOOD FASTENER USED TO ATTACH STRUCTURAL PLYWOOD PANELS  
TO STEEL FRAMING MEMBERS<sup>1,2,3</sup>**

MINIMUM STEEL THICKNESS (gage) <sup>4</sup>	MINIMUM THICKNESS OF STRUCTURAL PANELS				MINIMUM THICKNESS OF STRUCTURAL PANELS			
	<sup>3</sup> / <sub>8</sub> inch	<sup>15</sup> / <sub>32</sub> inch	<sup>19</sup> / <sub>32</sub> inch	<sup>23</sup> / <sub>32</sub> inch	<sup>3</sup> / <sub>8</sub> inch	<sup>15</sup> / <sub>32</sub> inch	<sup>19</sup> / <sub>32</sub> inch	<sup>23</sup> / <sub>32</sub> inch
	Withdrawal Loads (pounds)				Lateral Loads (pounds)			
14	90	90	95	120	135	160	190	215
16	90	90	90	110	135	160	165	185
18	90	90	90	90	135	160	160	160
20	70	70	70	70	110	130	130	130
22	50	50	50	50	110	110	110	110

For SI: 1 inch = 25.4 mm, 1 pound = 4.448 N.

<sup>1</sup>Tabulated values are for loads due to wind or earthquake, and must be reduced by 25 percent for other applications.

<sup>2</sup>Tabulated values allow for no more than 20 percent of the fasteners to be overdriven more than <sup>1</sup>/<sub>16</sub> inch.

<sup>3</sup>Minimum edge distance and spacing are <sup>3</sup>/<sub>8</sub> inch and 3 inches, respectively.

<sup>4</sup>Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

**TABLE 2—e<sub>n</sub> VALUES<sup>1,2,3</sup>**

GAGE OF STRUCTURAL STEEL MEMBER	MAXIMUM LOAD (lb/fastener)	e <sub>n</sub>
14	235	0.031
16	180	0.021
18	125	0.016
20	80	0.031
22	135	0.031

For SI: 1 pound = 4.448 N.

<sup>1</sup>These load values include a one-third increase for short-term loading and must not be exceeded. The maximum load per fastener must not be exceeded. Lower values may be used with the e<sub>n</sub> values noted in the table.

<sup>2</sup>The load per fastener is determined by dividing the shear per foot by the number of fasteners per foot.

<sup>3</sup>Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

**TABLE 3—ALLOWABLE SHEAR FOR WIND FORCES FOR STRUCTURAL PLYWOOD SHEAR WALLS  
ATTACHED TO LIGHT GAGE STEEL STUDS WITH RAMSET PLYWOOD FASTENERS<sup>1,2,3</sup> (pounds per foot)**

PANEL TYPE	MINIMUM PANEL THICKNESS (inch)	FRAMING		FASTENER SPACING <sup>4,5</sup> (inches on center)			
		Minimum Gage <sup>6</sup>	Spacing (inches on center)	6	4	3	2
Structural I or Rated Sheathing and Siding	<sup>3</sup> / <sub>8</sub>	22	16	180	270	360	459
	<sup>3</sup> / <sub>8</sub>		24	144	216	288	367
	<sup>15</sup> / <sub>32</sub>	20	16 or 24	170	255	340	433
	<sup>3</sup> / <sub>8</sub>		16	180	270	360	459
	<sup>3</sup> / <sub>8</sub>	18	24	144	216	288	367
	<sup>15</sup> / <sub>32</sub>		16 or 24	208	313	417	531
	<sup>3</sup> / <sub>8</sub>	16	16	214	321	428	546
	<sup>3</sup> / <sub>8</sub>		24	171	257	342	437
	<sup>15</sup> / <sub>32</sub>	14	16 or 24	253	380	506	645
	<sup>19</sup> / <sub>32</sub>		16 or 24	259	389	518	661
	<sup>23</sup> / <sub>32</sub>	16	16 or 24	259	389	518	661
	<sup>19</sup> / <sub>32</sub>		16 or 24	266	399	532	679
	<sup>23</sup> / <sub>32</sub>	14	16 or 24	296	445	593	756
	<sup>19</sup> / <sub>32</sub>		16 or 24	304	456	608	776
	<sup>23</sup> / <sub>32</sub>	14	16 or 24	345	517	690	879
	<sup>23</sup> / <sub>32</sub>		16 or 24	345	517	690	879

For SI: 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.



**TABLE 3—ALLOWABLE SHEAR FOR WIND FORCES FOR STRUCTURAL PLYWOOD SHEAR WALLS ATTACHED TO LIGHT GAGE STEEL STUDS WITH RAMSET PLYWOOD FASTENERS<sup>1,2,3</sup> (pounds per foot) (Continued)**

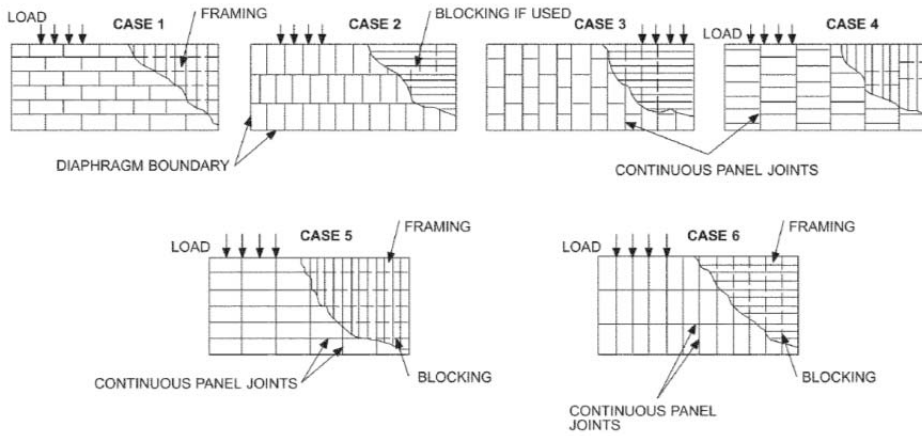
<sup>1</sup>These values are for short-term loads due to wind and must be reduced 25 percent for normal loading. See Table 1.  
<sup>2</sup>The pin must be long enough to penetrate through the metal framing a minimum of 1/4 inch.  
<sup>3</sup>Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than 1/16 inch.  
<sup>4</sup>All panel edges must be blocked with minimum nominal 2-inch framing. Panels are permitted to be installed either horizontally or vertically. Fasteners must be spaced a maximum of 6 inches on center along intermediate framing members for 3/8-inch-thick panels installed on framing spaced 24 inches on center, and 12 inches on center for framing 16 inches on center or thicker panels.  
<sup>5</sup>Tabulated values are for structural plywood panels applied to one side of a wall. Values cannot be increased for panels attached to both sides of a wall.  
<sup>6</sup>Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

**TABLE 4—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES FOR STRUCTURAL PLYWOOD HORIZONTAL DIAPHRAGMS SUPPORTED BY LIGHT-GAGE STEEL FRAMING ATTACHED WITH RAMSET PLYWOOD FASTENERS<sup>1</sup> (pounds per foot)**

SHEATHING PANEL	MINIMUM PANEL THICKNESS (inch)	SUPPORTING STEEL MEMBER FLANGE DIMENSIONS		BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
		Width (inches)	Minimum Gage <sup>6</sup>	Fastener Spacing at Diaphragm Boundaries (all cases), at Continuous Panel Edges Parallel to Load (Cases 3 and 4) and at All Panel Edges (Cases 5 and 6) <sup>2,3,4,5</sup>				Nails Spaced 6 Inches Maximum at Supported Edges	
				6	4	2 1/2	2	Case 1 (no unblocked edges or continuous joints to load)	All Other Cases (Cases 2 through 6)
		Fastener Spacing at Other Panel Edges							
				6	6	4	3		
Structural I or Rated sheathing	3/8	1.5	22	202	270	405	459	180	135
	3/8	2.5		227	303	455	515	202	152
	15/32	1.5		191	255	382	433	170	127
	15/32	2.5		215	286	430	487	191	143
	3/8	1.5	20	202	270	405	459	180	135
	3/8	2.5		227	303	455	515	202	152
	15/32	1.5		234	313	469	531	208	156
	15/32	2.5		263	351	527	597	234	176
	3/8	1.5	18	241	321	481	546	214	160
	3/8	2.5		270	361	541	613	240	180
	15/32	1.5		285	380	569	645	253	190
	15/32	2.5		320	426	640	725	284	213
	19/32	1.5		292	389	583	661	259	194
	19/32	2.5		328	437	655	743	291	218
	23/32	1.5		292	389	583	661	259	194
	23/32	2.5		328	437	655	743	291	218
Structural I or Rated sheathing	19/32	1.5	16	300	399	599	679	266	200
	19/32	2.5		337	449	673	763	299	224
	23/32	1.5		333	445	667	756	296	222
	19/32	2.5		375	500	749	849	333	250
	19/32	1.5	14	342	456	685	776	304	228
	19/32	2.5		385	513	769	872	342	256
	23/32	1.5		388	517	776	879	345	259
	19/32	2.5		436	581	872	988	388	291

For SI: 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.

<sup>1</sup>These values are for short-term loads due to wind or earthquake, and must be reduced 25 percent for normal loading.  
<sup>2</sup>The pin must be long enough to penetrate through the metal framing a minimum of 1/4 inch.  
<sup>3</sup>Fasteners are spaced a maximum of 12 inches on center along intermediate framing members.  
<sup>4</sup>Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than 1/16 inch.  
<sup>5</sup>Framing is permitted to be oriented in either direction for diaphragms, provided sheathing is designed for vertical loads.  
<sup>6</sup>Section 2.2.3 describes minimum base-metal thicknesses associated with gages.



**NOTE:** Framing may be oriented in either direction for diaphragms provided sheathing is properly designed for vertical loading.





## Combined Axial and Lateral Loads

		5 psf Lateral Load (Interior Walls)														
Wall Height (ft)	Spacing (in) oc.	600S137					600S162					600S200				
		33 ksi		50 ksi			33 ksi		50 ksi			33 ksi		50 ksi		
		33	43	54	68	97	33	43	54	68	97	33	43	54	68	97
8	12	1.77	2.51	3.81	5.05	7.54	2.42	3.40	5.61	7.45	11.39	2.86	4.31	7.46	9.97	15.65
	16	1.73	2.47	3.78	5.02	7.52	2.37	3.35	5.57	7.41	11.35	2.81	4.26	7.41	9.93	15.60
	24	1.65	2.39	3.72	4.96	7.46	2.28	3.27	5.49	7.33	11.28	2.72	4.16	7.31	9.83	15.51
9	12	1.74	2.47	3.78	5.02	7.52	2.38	3.36	5.57	7.41	11.35	2.80	4.23	7.31	9.79	15.39
	16	1.69	2.43	3.74	4.98	7.48	2.32	3.30	5.52	7.36	11.31	2.74	4.16	7.25	9.73	15.33
	24	1.59	2.33	3.66	4.90	7.41	2.20	3.19	5.42	7.26	11.21	2.62	4.03	7.12	9.61	15.20
10	12	1.70	2.44	3.75	4.99	7.49	2.33	3.31	5.53	7.37	11.31	2.73	4.13	7.14	9.58	15.07
	16	1.63	2.37	3.70	4.94	7.44	2.25	3.24	5.46	7.30	11.25	2.65	4.05	7.05	9.50	14.99
	24	1.51	2.25	3.59	4.83	7.36	2.10	3.11	5.33	7.17	11.12	2.50	3.88	6.89	9.35	14.83
12	12	1.60	2.34	3.66	4.90	7.41	2.17	3.15	5.35	7.25	11.19	2.55	3.88	6.67	9.00	14.21
	16	1.51	2.25	3.59	4.82	7.34	2.06	3.05	5.25	7.15	11.09	2.44	3.76	6.55	8.89	14.09
	24	1.33	2.07	3.43	4.67	7.21	1.85	2.85	5.05	6.95	10.89	2.22	3.53	6.31	8.66	13.85
14	12	1.48	2.22	3.55	4.79	7.31	1.95	2.91	4.93	6.77	10.96	2.32	3.56	6.07	8.26	13.08
	16	1.36	2.09	3.44	4.67	7.20	1.81	2.78	4.80	6.63	10.80	2.17	3.40	5.91	8.10	12.91
	24	1.11	1.85	3.21	4.45	7.00	1.54	2.51	4.53	6.35	10.49	1.89	3.09	5.59	7.79	12.58
16	12	1.34	2.07	3.40	4.63	7.15	1.71	2.62	4.41	6.10	9.89	2.05	3.18	5.38	7.38	11.74
	16	1.18	1.90	3.24	4.46	7.00	1.53	2.45	4.24	5.91	9.68	1.87	2.98	5.18	7.17	11.52
	24	0.87 <sup>3</sup>	1.59	2.95	4.16	6.71	1.20 <sup>4</sup>	2.12	3.91	5.57	9.28	1.52	2.61	4.79	6.79	11.09

		5 psf Lateral Load (Interior Walls)														
Wall Height (ft)	Spacing (in) oc.	800S137					800S162					800S200				
		33 ksi		50 ksi			33 ksi		50 ksi			33 ksi		50 ksi		
		43	54	68	97	43	54	68	97	118	43	54	68	97	118	
8	12	2.43	3.57	4.74	7.21	3.35	5.43	7.25	11.25	14.30	4.47	7.74	10.29	15.98	20.46	
	16	2.40	3.55	4.72	7.19	3.32	5.40	7.22	11.23	14.28	4.44	7.71	10.25	15.95	20.43	
	24	2.35	3.50	4.68	7.16	3.26	5.35	7.16	11.17	14.23	4.36	7.64	10.19	15.88	20.37	
9	12	2.40	3.55	4.73	7.20	3.33	5.41	7.22	11.23	14.28	4.44	7.71	10.26	15.95	20.43	
	16	2.37	3.52	4.70	7.17	3.29	5.37	7.19	11.20	14.25	4.39	7.67	10.21	15.91	20.39	
	24	2.30	3.47	4.65	7.12	3.21	5.30	7.12	11.13	14.19	4.30	7.57	10.13	15.83	20.31	
10	12	2.38	3.53	4.71	7.18	3.30	5.38	7.19	11.20	14.26	4.41	7.68	10.22	15.92	20.40	
	16	2.34	3.49	4.67	7.15	3.25	5.33	7.15	11.16	14.22	4.35	7.62	10.17	15.87	20.35	
	24	2.26	3.43	4.61	7.09	3.15	5.24	7.06	11.07	14.14	4.23	7.50	10.06	15.76	20.25	
12	12	2.32	3.48	4.66	7.13	3.22	5.31	7.13	11.14	14.20	4.32	7.59	10.14	15.84	20.32	
	16	2.26	3.43	4.61	7.09	3.15	5.24	7.06	11.07	14.14	4.23	7.50	10.06	15.76	20.24	
	24	2.14	3.33	4.51	7.00	3.00	5.11	6.93	10.94	14.03	4.06	7.32	9.90	15.60	20.08	
14	12	2.25	3.42	4.60	7.08	3.13	5.22	7.04	11.05	14.12	4.16	7.36	9.96	15.72	20.20	
	16	2.16	3.35	4.53	7.01	3.03	5.13	6.94	10.95	14.03	4.04	7.24	9.84	15.61	20.09	
	24	2.00	3.21	4.40	6.88	2.83	4.94	6.76	10.76	13.87	3.80	6.99	9.61	15.38	19.86	
16	12	2.16	3.34	4.52	7.00	3.02	5.11	6.93	10.93	14.01	3.93	6.95	9.45	15.15	19.78	
	16	2.05	3.25	4.43	6.91	2.89	4.98	6.80	10.80	13.89	3.77	6.78	9.30	15.00	19.62	
	24	1.83	3.06	4.25	6.74	2.62	4.72	6.54	10.53	13.66	3.46	6.46	9.00	14.68	19.29	

		15 psf Lateral Load															
Wall Height (ft)	Spacing (in) oc.	350S162			362S137			362S162			362S200						
		33 ksi		50 ksi	33 ksi		50 ksi	33 ksi		50 ksi	33 ksi		50 ksi				
		33	43	54	68	33	43	54	68	33	43	54	68				
8	12	1.37	2.10	3.56	4.66	1.09	1.72	2.95	3.98	1.44	2.20	3.74	4.96	1.77	2.79	4.71	6.22
	16	1.16	1.89	3.36	4.46	0.91	1.53	2.77	3.80	1.23	1.99	3.55	4.76	1.55	2.56	4.49	6.01
	24	0.78	1.49	2.99	4.08	0.56 <sup>4</sup>	1.16	2.43	3.44	0.85	1.59	3.17	4.38	1.13	2.13	4.06	5.58
9	12	1.13	1.82	3.14	4.16	0.90	1.49	2.64	3.59	1.21	1.93	3.35	4.47	1.51	2.47	4.21	5.60
	16	0.90	1.57	2.91	3.92	0.68	1.26	2.43	3.37	0.97	1.68	3.12	4.23	1.25	2.19	3.94	5.34
	24	0.46 <sup>3</sup>	1.11 <sup>4</sup>	2.48	3.48	0.28 <sup>3</sup>	0.83 <sup>4</sup>	2.03	2.94	0.53 <sup>3</sup>	1.21	2.68	3.77	0.77 <sup>4</sup>	1.68	3.44	4.84
10	12	0.90	1.53	2.71	3.63	0.70 <sup>4</sup>	1.25	2.31	3.16	0.97	1.64	2.94	3.94	1.25	2.13	3.69	4.95
	16	0.64 <sup>3</sup>	1.25	2.45	3.37	0.46 <sup>3</sup>	0.99 <sup>4</sup>	2.07	2.91	0.71 <sup>4</sup>	1.36	2.67	3.66	0.95	1.82	3.38	4.65
	24	0.17 <sup>3</sup>	0.74 <sup>3</sup>	1.99 <sup>4</sup>	2.88	-	0.51 <sup>3</sup>	1.62 <sup>3</sup>	2.44 <sup>4</sup>	0.23 <sup>3</sup>	0.84 <sup>3</sup>	2.18 <sup>4</sup>	3.15	0.42 <sup>3</sup>	1.25 <sup>4</sup>	2.83	4.09
12	12	0.47 <sup>3</sup>	0.98 <sup>3</sup>	1.90 <sup>4</sup>	2.62	0.33 <sup>3</sup>	0.78 <sup>3</sup>	1.63 <sup>4</sup>	2.30	0.53 <sup>3</sup>	1.08 <sup>4</sup>	2.10	2.88	0.74 <sup>3</sup>	1.46	2.65	3.66
	16	0.18 <sup>2</sup>	0.67 <sup>3</sup>	1.62 <sup>3</sup>	2.33 <sup>4</sup>	-	0.48 <sup>3</sup>	1.36 <sup>3</sup>	2.02 <sup>4</sup>	0.24 <sup>2</sup>	0.76 <sup>3</sup>	1.81 <sup>3</sup>	2.58 <sup>4</sup>	0.41 <sup>3</sup>	1.11 <sup>3</sup>	2.32 <sup>4</sup>	3.32
	24	-	0.13 <sup>2</sup>	1.13 <sup>2</sup>	1.81 <sup>3</sup>	-	-	0.89 <sup>2</sup>	1.51 <sup>3</sup>	-	0.20 <sup>2</sup>	1.29 <sup>3</sup>	2.03 <sup>3</sup>	-	0.49 <sup>3</sup>	1.73 <sup>3</sup>	2.72 <sup>3</sup>
14	12	0.13 <sup>2</sup>	0.53 <sup>3</sup>	1.27 <sup>3</sup>	1.83 <sup>3</sup>	-	0.38 <sup>2</sup>	1.08 <sup>3</sup>	1.60 <sup>3</sup>	0.18 <sup>2</sup>	0.61 <sup>3</sup>	1.42 <sup>3</sup>	2.03 <sup>3</sup>	0.32 <sup>2</sup>	0.90 <sup>3</sup>	1.82 <sup>3</sup>	2.61 <sup>4</sup>
	16	-	0.22 <sup>2</sup>	1.00 <sup>2</sup>	1.54 <sup>3</sup>	-	-	0.82 <sup>2</sup>	1.31 <sup>3</sup>	-	0.29 <sup>2</sup>	1.14 <sup>3</sup>	1.73 <sup>3</sup>	-	0.54 <sup>2</sup>	1.49 <sup>3</sup>	2.28 <sup>3</sup>
	24	-	-	0.53 <sup>1</sup>	1.04 <sup>2</sup>	-	-	0.35 <sup>1</sup>	0.82 <sup>2</sup>	-	-	0.64 <sup>1</sup>	1.19 <sup>2</sup>	-	-	0.92 <sup>2</sup>	1.69 <sup>2</sup>
16	12	-	0.20 <sup>1</sup>	0.82 <sup>2</sup>	1.26 <sup>3</sup>	-	-	0.68 <sup>2</sup>	1.07 <sup>2</sup>	-	0.26 <sup>2</sup>	0.93 <sup>2</sup>	1.41 <sup>3</sup>	-	0.46 <sup>2</sup>	1.22 <sup>3</sup>	1.85 <sup>3</sup>
	16	-	-	0.57 <sup>1</sup>	0.98 <sup>2</sup>	-	-	0.42 <sup>1</sup>	0.80 <sup>2</sup>	-	-	0.66 <sup>1</sup>	1.12 <sup>2</sup>	-	0.12 <sup>1</sup>	0.91 <sup>2</sup>	1.53 <sup>2</sup>
	24	-	-	0.13 <sup>1</sup>	0.51 <sup>1</sup>	-	-	-	0.34 <sup>1</sup>	-	-	0.19 <sup>1</sup>	0.62 <sup>1</sup>	-	-	0.38 <sup>1</sup>	0.97 <sup>1</sup>

If no note, deflection meets L/720

<sup>1</sup>Deflection meets L/120

<sup>2</sup>Deflection meets L/240

<sup>3</sup>Deflection meets L/360

<sup>4</sup>Deflection meets L/600

See Table Notes on page 24.



## Floor Joist Spans

10 psf Dead Load and 20 psf Live Load													
Section	Fy (ksi)	L/360 Live Load Deflection						L/480 Live Load Deflection					
		Single Span			Double Span			Single Span			Double Span		
		Spacing (in) on center			Spacing (in) on center			Spacing (in) on center			Spacing (in) on center		
		12	16	24	12	16	24	12	16	24	12	16	24
600S162-33	33	14' 6"	12' 7"	10' 3"	14' 6"	12' 7"	10' 1"	14' 4"	12' 7"	10' 3"	14' 6"	12' 7"	10' 1"
600S200-33	33	15' 6"	13' 5"	10' 11"	15' 6"	13' 3"	10' 5"	15' 0"	13' 5"	10' 11"	15' 6"	13' 3"	10' 5"
600S162-43	33	17' 2"	15' 6"	12' 8"	17' 11"	15' 6"	12' 8"	15' 7"	14' 2"	12' 5"	17' 6"	15' 6"	12' 8"
600S200-43	33	18' 0"	16' 0"	13' 1"	18' 6"	16' 0"	13' 1"	16' 5"	14' 11"	13' 0"	18' 5"	16' 0"	13' 1"
600S250-43	33	18' 11"	16' 5"	13' 5"	19' 0"	16' 5"	13' 5"	17' 2"	15' 7"	13' 5"	19' 0"	16' 5"	13' 5"
600S162-54	50	18' 5"	16' 9"	14' 7"	20' 8"	18' 9"	16' 5"	16' 9"	15' 2"	13' 3"	18' 9"	17' 1"	14' 11"
600S200-54	50	19' 4"	17' 7"	15' 4"	21' 9"	19' 9"	17' 3"	17' 7"	16' 0"	14' 0"	19' 9"	17' 11"	15' 8"
600S250-54	50	20' 3"	18' 5"	16' 1"	22' 9"	20' 8"	17' 10"	18' 5"	16' 9"	14' 8"	20' 8"	18' 10"	16' 5"
600S162-68	50	19' 9"	17' 11"	15' 8"	22' 2"	20' 2"	17' 7"	17' 11"	16' 4"	14' 3"	20' 2"	18' 4"	16' 0"
600S200-68	50	20' 9"	18' 10"	16' 6"	23' 4"	21' 2"	18' 6"	18' 10"	17' 2"	15' 0"	21' 2"	19' 3"	16' 10"
600S250-68	50	21' 9"	19' 9"	17' 3"	24' 5"	22' 3"	19' 5"	19' 9"	18' 0"	15' 8"	22' 3"	20' 2"	17' 8"
600S162-97	50	21' 11"	19' 11"	17' 4"	24' 7"	22' 4"	19' 6"	19' 11"	18' 1"	15' 9"	22' 4"	20' 3"	17' 9"
600S200-97	50	23' 1"	20' 11"	18' 4"	25' 11"	23' 6"	20' 7"	20' 11"	19' 0"	16' 8"	23' 6"	21' 4"	18' 8"
600S250-97	50	24' 3"	22' 0"	19' 3"	27' 2"	24' 8"	21' 7"	22' 0"	20' 0"	17' 6"	24' 8"	22' 5"	19' 7"
600S162-118	50	23' 1"	21' 0"	18' 4"	25' 11"	23' 7"	20' 7"	21' 0"	19' 1"	16' 8"	23' 7"	21' 5"	18' 9"
600S200-118	50	24' 5"	22' 2"	19' 4"	27' 5"	24' 11"	21' 9"	22' 2"	20' 2"	17' 7"	24' 11"	22' 7"	19' 9"
600S250-118	50	25' 8"	23' 4"	20' 4"	28' 9"	26' 2"	22' 10"	23' 4"	21' 2"	18' 6"	26' 2"	23' 9"	20' 9"
800S162-33	33	16' 9"	14' 6"	11' 10"	15' 8"	13' 0"	9' 10"	16' 9"	14' 6"	11' 10"	15' 8"	13' 0"	9' 10"
800S200-33	33	18' 0"	15' 7"	12' 8"	16' 6"	13' 8"	10' 3"	18' 0"	15' 7"	12' 8"	16' 6"	13' 8"	10' 3"
800S162-43	33	20' 2"	17' 6"	14' 3"	20' 2"	17' 6"	13' 11"	19' 6"	17' 6"	14' 3"	20' 2"	17' 6"	13' 11"
800S200-43	33	21' 7"	18' 8"	15' 3"	21' 7"	18' 8"	15' 3"	20' 7"	18' 8"	15' 3"	21' 7"	18' 8"	15' 3"
800S250-43	33	22' 2"	19' 2"	15' 8"	22' 2"	19' 2"	15' 6"	21' 5"	19' 2"	15' 8"	22' 2"	19' 2"	15' 6"
800S162-54	50	23' 3"	21' 1"	18' 4"	26' 0"	23' 5"	19' 1"	21' 1"	19' 2"	16' 9"	23' 8"	21' 6"	18' 9"
800S200-54	50	24' 4"	22' 1"	19' 4"	27' 4"	24' 10"	20' 5"	22' 1"	20' 1"	17' 6"	24' 10"	22' 6"	19' 8"
800S250-54	50	25' 4"	23' 1"	20' 2"	28' 6"	25' 6"	20' 10"	23' 1"	20' 11"	18' 3"	25' 10"	23' 6"	20' 6"
800S162-68	50	24' 11"	22' 8"	19' 9"	28' 0"	25' 5"	22' 3"	22' 8"	20' 7"	18' 0"	25' 5"	23' 1"	20' 2"
800S200-68	50	26' 1"	23' 9"	20' 9"	29' 4"	26' 8"	23' 3"	23' 9"	21' 7"	18' 10"	26' 8"	24' 2"	21' 2"
800S250-68	50	27' 3"	24' 9"	21' 8"	30' 7"	27' 10"	24' 3"	24' 9"	22' 6"	19' 8"	27' 10"	25' 3"	22' 1"
800S162-97	50	27' 8"	25' 2"	22' 0"	31' 1"	28' 3"	24' 8"	25' 2"	22' 10"	20' 0"	28' 3"	25' 8"	22' 5"
800S200-97	50	29' 0"	26' 5"	23' 1"	32' 7"	29' 7"	25' 11"	26' 5"	24' 0"	20' 11"	29' 7"	26' 11"	23' 6"
800S250-97	50	30' 4"	27' 7"	24' 1"	34' 1"	30' 11"	27' 1"	27' 7"	25' 1"	21' 11"	30' 11"	28' 2"	24' 7"
800S162-118	50	29' 4"	26' 7"	23' 3"	32' 11"	29' 11"	26' 1"	26' 7"	24' 2"	21' 1"	29' 11"	27' 2"	23' 9"
800S200-118	50	30' 9"	27' 11"	24' 5"	34' 6"	31' 5"	27' 5"	27' 11"	25' 5"	22' 2"	31' 5"	28' 6"	24' 11"
800S250-118	50	32' 2"	29' 3"	25' 6"	36' 1"	32' 10"	28' 8"	29' 3"	26' 7"	23' 2"	32' 10"	29' 10"	26' 1"
1000S162-43	33	22' 4"	19' 4"	15' 10"	22' 3"	18' 10"	14' 8"	22' 4"	19' 4"	15' 10"	22' 3"	18' 10"	14' 8"
1000S200-43	33	24' 1"	20' 11"	17' 1"	23' 5"	19' 9"	15' 4"	24' 1"	20' 11"	17' 1"	23' 5"	19' 9"	15' 4"
1000S250-43	33	24' 10"	21' 6"	17' 6"	24' 5"	20' 6"	15' 10"	24' 10"	21' 6"	17' 6"	24' 5"	20' 6"	15' 10"
1000S162-54	50	27' 7"	25' 0"	21' 2"	29' 11"	25' 11"	21' 2"	25' 2"	22' 10"	19' 11"	28' 2"	25' 6"	21' 2"
1000S200-54	50	28' 10"	26' 2"	22' 9"	32' 2"	27' 10"	22' 2"	26' 4"	23' 10"	20' 9"	29' 5"	26' 8"	22' 2"
1000S250-54	50	30' 3"	27' 6"	23' 4"	33' 1"	28' 8"	23' 1"	27' 6"	25' 0"	21' 10"	30' 10"	28' 1"	23' 1"
1000S162-68	50	30' 0"	27' 2"	23' 8"	33' 6"	30' 5"	25' 0"	27' 3"	24' 9"	21' 7"	30' 7"	27' 9"	24' 2"
1000S200-68	50	31' 3"	28' 5"	24' 9"	35' 0"	31' 9"	26' 9"	28' 5"	25' 10"	22' 7"	31' 11"	28' 11"	25' 3"
1000S250-68	50	32' 6"	29' 7"	25' 10"	36' 6"	33' 2"	27' 6"	29' 7"	26' 10"	23' 5"	33' 2"	30' 2"	26' 4"
1000S162-97	50	33' 4"	30' 4"	26' 6"	37' 5"	34' 0"	29' 9"	30' 4"	27' 6"	24' 1"	34' 0"	30' 11"	27' 0"
1000S200-97	50	34' 10"	31' 8"	27' 8"	39' 1"	35' 6"	31' 0"	31' 8"	28' 9"	25' 1"	35' 6"	32' 3"	28' 2"
1000S250-97	50	36' 3"	32' 11"	28' 9"	40' 9"	37' 0"	32' 4"	32' 11"	29' 11"	26' 2"	37' 0"	33' 7"	29' 4"
1000S162-118	50	35' 4"	32' 1"	28' 0"	39' 8"	36' 0"	31' 6"	32' 1"	29' 2"	25' 6"	36' 0"	32' 9"	28' 7"
1000S200-118	50	36' 11"	33' 7"	29' 4"	41' 6"	37' 8"	32' 11"	33' 7"	30' 6"	26' 8"	37' 8"	34' 3"	29' 11"
1000S250-118	50	38' 6"	35' 0"	30' 7"	43' 2"	39' 3"	34' 4"	35' 0"	31' 9"	27' 9"	39' 3"	35' 8"	31' 2"

"e" web stiffeners required at ends.

Web stiffeners required at interior supports for double span conditions.

See Table Notes on page 35.



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## Floor Joist Spans

10 psf Dead Load and 30 psf Live Load													
Section	Fy (ksi)	L/360 Live Load Deflection						L/480 Live Load Deflection					
		Single Span			Double Span			Single Span			Double Span		
		Spacing (in) on center			Spacing (in) on center			Spacing (in) on center			Spacing (in) on center		
		12	16	24	12	16	24	12	16	24	12	16	24
600S162-33	33	12'7"	10'11"	8'11"	12'7"	10'10"	8'5"	12'6"	10'11"	8'11"	12'7"	10'10"	8'5"
600S200-33	33	13'5"	11'7"	9'6"	13'3"	11'2"	8'8"	13'2"	11'7"	9'6"	13'3"	11'2"	8'8"
600S162-43	33	15'0"	13'5"	11'0"	15'6"	13'5"	11'0"	13'8"	12'5"	10'10"	15'4"	13'5"	11'0"
600S200-43	33	15'9"	13'10"	11'4"	16'0"	13'10"	11'4"	14'4"	13'0"	11'4"	16'0"	13'10"	11'4"
600S250-43	33	16'5"	14'3"	11'7"	16'5"	14'3"	11'7"	15'0"	13'7"	11'7"	16'5"	14'3"	11'7"
600S162-54	50	16'1"	14'7"	12'9"	18'1"	16'5"	14'4"	14'7"	13'3"	11'7"	16'5"	14'11"	13'0"
600S200-54	50	16'11"	15'4"	13'5"	19'0"	17'3"	15'1"	15'4"	14'0"	12'2"	17'3"	15'8"	13'8"
600S250-54	50	17'9"	16'1"	14'1"	19'11"	18'1"	15'6"	16'1"	14'8"	12'9"	18'1"	16'5"	14'4"
600S162-68	50	17'3"	15'8"	13'8"	19'4"	17'7"	15'4"	15'8"	14'3"	12'5"	17'7"	16'0"	14'0"
600S200-68	50	18'2"	16'6"	14'5"	20'4"	18'6"	16'2"	16'6"	15'0"	13'1"	18'6"	16'10"	14'8"
600S250-68	50	19'0"	17'3"	15'1"	21'4"	19'5"	16'11"	17'3"	15'8"	13'9"	19'5"	17'8"	15'5"
600S162-97	50	19'1"	17'4"	15'2"	21'6"	19'6"	17'0"	17'4"	15'9"	13'9"	19'6"	17'9"	15'6"
600S200-97	50	20'2"	18'4"	16'0"	22'7"	20'7"	17'11"	18'4"	16'8"	14'6"	20'7"	18'8"	16'4"
600S250-97	50	21'2"	19'3"	16'9"	23'9"	21'7"	18'10"	19'3"	17'6"	15'3"	21'7"	19'7"	17'2"
600S162-118	50	20'2"	18'4"	16'0"	22'8"	20'7"	18'0"	18'4"	16'8"	14'7"	20'7"	18'9"	16'4"
600S200-118	50	21'4"	19'4"	16'11"	23'11"	21'9"	19'0"	19'4"	17'7"	15'4"	21'9"	19'9"	17'3"
600S250-118	50	22'5"	20'4"	17'9"	25'2"	22'10"	20'0"	20'4"	18'6"	16'2"	22'10"	20'9"	18'2"
800S162-33	33	14'6"	12'7"	10'3"	13'0"	10'9"	8'0"	14'6"	12'7"	10'3"	13'0"	10'9"	8'0"
800S200-33	33	15'7"	13'6"	11'0"	13'8"	11'2"	8'2"	15'7"	13'6"	11'0"	13'8"	11'2"	8'2"
800S162-43	33	17'6"	15'2"	12'4"	17'6"	14'11"	11'9"	17'1"	15'2"	12'4"	17'6"	14'11"	11'9"
800S200-43	33	18'8"	16'2"	13'3"	18'8"	16'2"	12'11"	18'0"	16'2"	13'3"	18'8"	16'2"	12'11"
800S250-43	33	19'2"	16'7"	13'7"	19'2"	16'7"	13'0"	18'9"	16'7"	13'7"	19'2"	16'7"	13'0"
800S162-54	50	20'3"	18'5"	16'0"	22'8"	20'3"	16'6"	18'5"	16'9"	14'7"	20'8"	18'9"	16'4"
800S200-54	50	21'3"	19'4"	16'10"	23'10"	21'7"	17'8"	19'4"	17'6"	15'4"	21'8"	19'8"	17'2"
800S250-54	50	22'2"	20'2"	17'7"	24'11"	22'1"	18'1"	20'2"	18'3"	16'0"	22'7"	20'6"	17'11"
800S162-68	50	21'9"	19'9"	17'3"	24'5"	22'3"	19'5"	19'9"	18'0"	15'8"	22'3"	20'2"	17'8"
800S200-68	50	22'10"	20'9"	18'1"	25'7"	23'3"	20'4"	20'9"	18'10"	16'5"	23'3"	21'2"	18'6"
800S250-68	50	23'10"	21'8"	18'11"	26'9"	24'3"	21'2"	21'8"	19'8"	17'2"	24'3"	22'1"	19'3"
800S162-97	50	24'2"	22'0"	19'2"	27'2"	24'8"	21'7"	22'0"	20'0"	17'5"	24'8"	22'5"	19'7"
800S200-97	50	25'4"	23'1"	20'2"	28'6"	25'11"	22'7"	23'1"	20'11"	18'4"	25'11"	23'6"	20'6"
800S250-97	50	26'6"	24'1"	21'0"	29'9"	27'1"	23'7"	24'1"	21'11"	19'1"	27'1"	24'7"	21'6"
800S162-118	50	25'7"	23'3"	20'4"	28'9"	26'1"	22'10"	23'3"	21'1"	18'5"	26'1"	23'9"	20'9"
800S200-118	50	26'10"	24'5"	21'4"	30'2"	27'5"	23'11"	24'5"	22'2"	19'5"	27'5"	24'11"	21'9"
800S250-118	50	28'1"	25'6"	22'4"	31'7"	28'8"	25'1"	25'6"	23'2"	20'3"	28'8"	26'1"	22'9"
1000S162-43	33	19'4"	16'9"	13'8"	18'10"	15'10"	12'2"	19'4"	16'9"	13'8"	18'10"	15'10"	12'2"
1000S200-43	33	20'11"	18'1"	14'9"	19'9"	16'6"	12'7"	20'11"	18'1"	14'9"	19'9"	16'6"	12'7"
1000S250-43	33	21'6"	18'7"	15'2"	20'6"	17'1"	13'0"	21'6"	18'7"	15'2"	20'6"	17'1"	13'0"
1000S162-54	50	24'1"	21'10"	18'4"	25'11"	22'6"	18'2"	22'0"	19'11"	17'4"	24'7"	22'3"	18'2"
1000S200-54	50	25'2"	22'10"	19'9"	27'10"	23'8"	18'9"	23'0"	20'10"	18'2"	25'8"	23'3"	18'9"
1000S250-54	50	26'5"	24'0"	20'3"	28'8"	24'9"	19'6"	24'0"	21'10"	19'1"	27'0"	24'6"	19'6"
1000S162-68	50	26'2"	23'9"	20'8"	29'3"	26'6"	21'8"	23'9"	21'7"	18'10"	26'8"	24'2"	21'1"
1000S200-68	50	27'4"	24'10"	21'7"	30'7"	27'9"	23'2"	24'10"	22'7"	19'8"	27'10"	25'3"	22'0"
1000S250-68	50	28'5"	25'10"	22'7"	31'11"	29'0"	23'10"	25'10"	23'5"	20'6"	29'0"	26'4"	23'0"
1000S162-97	50	29'2"	26'6"	23'1"	32'8"	29'9"	26'0"	26'6"	24'1"	21'0"	29'9"	27'0"	23'7"
1000S200-97	50	30'5"	27'8"	24'2"	34'2"	31'0"	27'1"	27'8"	25'1"	21'11"	31'0"	28'2"	24'8"
1000S250-97	50	31'8"	28'9"	25'2"	35'7"	32'4"	28'3"	28'9"	26'2"	22'10"	32'4"	29'4"	25'8"
1000S162-118	50	30'10"	28'0"	24'6"	34'8"	31'6"	27'6"	28'0"	25'6"	22'3"	31'6"	28'7"	25'0"
1000S200-118	50	32'3"	29'4"	25'7"	36'3"	32'11"	28'9"	29'4"	26'8"	23'3"	32'11"	29'11"	26'1"
1000S250-118	50	33'7"	30'7"	26'8"	37'9"	34'4"	29'11"	30'7"	27'9"	24'3"	34'4"	31'2"	27'3"

"e" web stiffeners required at ends.

Web stiffeners required at interior supports for double span conditions.

See Table Notes on page 35.



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## Floor Joist Spans

10 psf Dead Load and 50 psf Live Load													
Section	Fy (ksi)	L/360 Live Load Deflection						L/480 Live Load Deflection					
		Single Span			Double Span			Single Span			Double Span		
		Spacing (in) on center			Spacing (in) on center			Spacing (in) on center			Spacing (in) on center		
		12	16	24	12	16	24	12	16	24	12	16	24
600S162-33	33	10' 3"	8' 11"	7' 3"	10' 1"	8' 5"	6' 5"	10' 3"	8' 11"	7' 3"	10' 1"	8' 5"	6' 5"
600S200-33	33	10' 11"	9' 6"	7' 9"	10' 5"	8' 8"	6' 7"	10' 11"	9' 6"	7' 9"	10' 5"	8' 8"	6' 7"
600S162-43	33	12' 8"	11' 0"	9' 0"	12' 8"	11' 0"	8' 10"	11' 6"	10' 5"	9' 0"	12' 8"	11' 0"	8' 10"
600S200-43	33	13' 1"	11' 4"	9' 3"	13' 1"	11' 4"	9' 0"	12' 1"	11' 0"	9' 3"	13' 1"	11' 4"	9' 0"
600S250-43	33	13' 5"	11' 7"	9' 6"	13' 5"	11' 7"	9' 2"	12' 8"	11' 6"	9' 6"	13' 5"	11' 7"	9' 2"
600S162-54	50	13' 7"	12' 4"	10' 9"	15' 3"	13' 10"	12' 0"	12' 4"	11' 2"	9' 9"	13' 10"	12' 7"	11' 0"
600S200-54	50	14' 3"	13' 0"	11' 4"	16' 0"	14' 7"	12' 2"	13' 0"	11' 9"	10' 3"	14' 7"	13' 3"	11' 7"
600S250-54	50	14' 11"	13' 7"	11' 10"	16' 9"	15' 3"	12' 6"	13' 7"	12' 4"	10' 9"	15' 3"	13' 10"	12' 1"
600S162-68	50	14' 7"	13' 3"	11' 7"	16' 4"	14' 10"	13' 0"	13' 3"	12' 0"	10' 6"	14' 10"	13' 6"	11' 9"
600S200-68	50	15' 4"	13' 11"	12' 2"	17' 2"	15' 7"	13' 8"	13' 11"	12' 8"	11' 0"	15' 7"	14' 2"	12' 5"
600S250-68	50	16' 1"	14' 7"	12' 9"	18' 0"	16' 4"	14' 4"	14' 7"	13' 3"	11' 7"	16' 4"	14' 10"	13' 0"
600S162-97	50	16' 2"	14' 8"	12' 10"	18' 1"	16' 5"	14' 4"	14' 8"	13' 4"	11' 8"	16' 5"	14' 11"	13' 1"
600S200-97	50	17' 0"	15' 5"	13' 6"	19' 1"	17' 4"	15' 2"	15' 5"	14' 0"	12' 3"	17' 4"	15' 9"	13' 9"
600S250-97	50	17' 10"	16' 3"	14' 2"	20' 0"	18' 2"	15' 11"	16' 3"	14' 9"	12' 10"	18' 2"	16' 6"	14' 5"
600S162-118	50	17' 0"	15' 6"	13' 6"	19' 1"	17' 4"	15' 2"	15' 6"	14' 1"	12' 3"	17' 4"	15' 9"	13' 9"
600S200-118	50	18' 0"	16' 4"	14' 3"	20' 2"	18' 4"	16' 0"	16' 4"	14' 10"	13' 0"	18' 4"	16' 8"	14' 7"
600S250-118	50	18' 11"	17' 2"	15' 0"	21' 3"	19' 3"	16' 10"	17' 2"	15' 7"	13' 7"	19' 3"	17' 6"	15' 4"
800S162-33	33	11' 10"	10' 3"	7' 11"	9' 10"	8' 0"	5' 9"	11' 10"	10' 3"	7' 11"	9' 10"	8' 0"	5' 9"
800S200-33	33	12' 8"	11' 0"	7' 11"	10' 3"	8' 2"	5' 10"	12' 8"	11' 0"	7' 11"	10' 3"	8' 2"	5' 10"
800S162-43	33	14' 3"	12' 4"	10' 1"	13' 11"	11' 9"	9' 2"	14' 3"	12' 4"	10' 1"	13' 11"	11' 9"	9' 2"
800S200-43	33	15' 3"	13' 3"	10' 10"	15' 3"	12' 11"	10' 0"	15' 2"	13' 3"	10' 10"	15' 3"	12' 11"	10' 0"
800S250-43	33	15' 8"	13' 7"	11' 1"	15' 6"	13' 0"	10' 0"	15' 8"	13' 7"	11' 1"	15' 6"	13' 0"	10' 0"
800S162-54	50	17' 1"	15' 6"	13' 6"	19' 1"	16' 6"	13' 5"	15' 7"	14' 1"	12' 4"	17' 5"	15' 10"	13' 5"
800S200-54	50	17' 11"	16' 3"	14' 3"	20' 1"	17' 8"	14' 5"	16' 3"	14' 9"	12' 11"	18' 3"	16' 7"	14' 5"
800S250-54	50	18' 8"	17' 0"	14' 9"	20' 10"	18' 1"	14' 8"	17' 0"	15' 5"	13' 6"	19' 1"	17' 4"	14' 8"
800S162-68	50	18' 4"	16' 8"	14' 7"	20' 7"	18' 9"	15' 10"	16' 8"	15' 2"	13' 3"	18' 9"	17' 0"	14' 10"
800S200-68	50	19' 3"	17' 6"	15' 3"	21' 7"	19' 7"	17' 2"	17' 6"	15' 11"	13' 10"	19' 7"	17' 10"	15' 7"
800S250-68	50	20' 1"	18' 3"	15' 11"	22' 7"	20' 6"	17' 3"	18' 3"	16' 7"	14' 6"	20' 6"	18' 7"	16' 3"
800S162-97	50	20' 5"	18' 6"	16' 2"	22' 11"	20' 10"	18' 2"	18' 6"	16' 10"	14' 9"	20' 10"	18' 11"	16' 6"
800S200-97	50	21' 5"	19' 5"	17' 0"	24' 0"	21' 10"	19' 1"	19' 5"	17' 8"	15' 5"	21' 10"	19' 10"	17' 4"
800S250-97	50	22' 4"	20' 4"	17' 9"	25' 1"	22' 10"	19' 11"	20' 4"	18' 5"	16' 1"	22' 10"	20' 9"	18' 1"
800S162-118	50	21' 7"	19' 7"	17' 2"	24' 3"	22' 0"	19' 3"	19' 7"	17' 10"	15' 7"	22' 0"	20' 0"	17' 6"
800S200-118	50	22' 8"	20' 7"	18' 0"	25' 5"	23' 1"	20' 2"	20' 7"	18' 8"	16' 4"	23' 1"	21' 0"	18' 4"
800S250-118	50	23' 8"	21' 6"	18' 10"	26' 7"	24' 2"	21' 2"	21' 6"	19' 7"	17' 1"	24' 2"	22' 0"	19' 2"
1000S162-43	33	15' 10"	13' 8"	11' 2"	14' 8"	12' 2"	9' 1"	15' 10"	13' 8"	11' 2"	14' 8"	12' 2"	9' 1"
1000S200-43	33	17' 1"	14' 9"	12' 1"	15' 4"	12' 7"	9' 4"	17' 1"	14' 9"	12' 1"	15' 4"	12' 7"	9' 4"
1000S250-43	33	17' 6"	15' 2"	12' 5"	15' 10"	13' 0"	9' 7"	17' 6"	15' 2"	12' 5"	15' 10"	13' 0"	9' 7"
1000S162-54	50	20' 4"	18' 4"	15' 0"	21' 2"	18' 2"	14' 2"	18' 6"	16' 10"	14' 7"	20' 8"	18' 2"	14' 2"
1000S200-54	50	21' 3"	19' 3"	16' 1"	22' 2"	18' 9"	14' 7"	19' 4"	17' 7"	15' 3"	21' 8"	18' 9"	14' 7"
1000S250-54	50	22' 4"	20' 3"	16' 6"	23' 1"	19' 6"	15' 1"	20' 3"	18' 5"	16' 1"	22' 9"	19' 6"	15' 1"
1000S162-68	50	22' 1"	20' 0"	17' 5"	24' 8"	21' 8"	17' 8"	20' 1"	18' 3"	15' 11"	22' 6"	20' 5"	17' 8"
1000S200-68	50	23' 0"	20' 11"	18' 3"	25' 9"	23' 2"	18' 11"	20' 11"	19' 0"	16' 7"	23' 6"	21' 4"	18' 7"
1000S250-68	50	24' 0"	21' 9"	19' 0"	26' 11"	23' 10"	19' 5"	21' 9"	19' 9"	17' 3"	24' 5"	22' 3"	19' 5"
1000S162-97	50	24' 7"	22' 4"	19' 6"	27' 7"	25' 1"	21' 11"	22' 4"	20' 3"	17' 9"	25' 1"	22' 9"	19' 11"
1000S200-97	50	25' 8"	23' 4"	20' 4"	28' 10"	26' 2"	22' 10"	23' 4"	21' 2"	18' 6"	26' 2"	23' 9"	20' 9"
1000S250-97	50	26' 9"	24' 3"	21' 2"	30' 0"	27' 3"	23' 10"	24' 3"	22' 1"	19' 3"	27' 3"	24' 9"	21' 8"
1000S162-118	50	26' 0"	23' 8"	20' 8"	29' 3"	26' 7"	23' 2"	23' 8"	21' 6"	18' 9"	26' 7"	24' 1"	21' 1"
1000S200-118	50	27' 3"	24' 9"	21' 7"	30' 7"	27' 9"	24' 3"	24' 9"	22' 6"	19' 7"	27' 9"	25' 3"	22' 0"
1000S250-118	50	28' 4"	25' 9"	22' 6"	31' 10"	28' 11"	25' 3"	25' 9"	23' 5"	20' 5"	28' 11"	26' 3"	22' 11"

*"e" web stiffeners required at ends.*

*Web stiffeners required at interior supports for double span conditions.*

*See Table Notes on page 35.*



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## Floor Joist Spans

10 psf Dead Load and 50 psf Live Load													
Section	Fy (ksi)	L/360 Live Load Deflection						L/480 Live Load Deflection					
		Single Span			Double Span			Single Span			Double Span		
		Spacing (in) on center			Spacing (in) on center			Spacing (in) on center			Spacing (in) on center		
		12	16	24	12	16	24	12	16	24	12	16	24
1200S162-54	50	22' 10"	19' 9"	16' 1"	22' 5"	18' 9"	14' 2"	21' 4"	19' 4"	16' 1"	22' 5"	18' 9"	14' 2"
1200S200-54	50	24' 4"	21' 4"	17' 5"	23' 2"	19' 3"	14' 6"	22' 3"	20' 2"	17' 5"	23' 2"	19' 3"	14' 6"
1200S250-54	50	25' 4"	22' 1"	18' 0"	23' 5"	19' 6"	14' 8"	23' 1"	21' 0"	18' 0"	23' 5"	19' 6"	14' 8"
1200S162-68	50	25' 6"	23' 1"	19' 2"	27' 1"	23' 6"	19' 2"	23' 3"	21' 1"	18' 4"	25' 11"	23' 6"	19' 2"
1200S200-68	50	26' 6"	24' 1"	20' 7"	29' 2"	25' 3"	20' 4"	24' 2"	21' 11"	19' 1"	27' 1"	24' 6"	20' 4"
1200S250-68	50	27' 7"	25' 0"	21' 3"	30' 1"	25' 9"	20' 5"	25' 2"	22' 10"	19' 10"	28' 1"	25' 6"	20' 5"
1200S162-97	50	28' 8"	26' 1"	22' 9"	32' 2"	29' 3"	24' 10"	26' 1"	23' 8"	20' 8"	29' 3"	26' 7"	23' 3"
1200S200-97	50	29' 10"	27' 1"	23' 8"	33' 6"	30' 5"	26' 7"	27' 1"	24' 8"	21' 6"	30' 5"	27' 8"	24' 2"
1200S250-97	50	31' 0"	28' 2"	24' 7"	34' 9"	31' 7"	27' 5"	28' 2"	25' 7"	22' 4"	31' 7"	28' 9"	25' 1"
1200S162-118	50	30' 5"	27' 7"	24' 2"	34' 2"	31' 0"	27' 1"	27' 7"	25' 1"	21' 11"	31' 0"	28' 2"	24' 7"
1200S200-118	50	31' 8"	28' 9"	25' 2"	35' 7"	32' 4"	28' 3"	28' 9"	26' 2"	22' 10"	32' 4"	29' 4"	25' 8"
1200S250-118	50	32' 11"	29' 11"	26' 1"	36' 11"	33' 7"	29' 4"	29' 11"	27' 2"	23' 9"	33' 7"	30' 6"	26' 8"
1200S300-118	50	34' 0"	30' 11"	27' 0"	38' 3"	34' 9"	30' 4"	30' 11"	28' 1"	24' 7"	34' 9"	31' 7"	27' 7"
1200S350-118	50	35' 8"	32' 5"	28' 4"	40' 1"	36' 5"	31' 10"	32' 5"	29' 5"	25' 9"	36' 5"	33' 1"	28' 11"
1400S162-54	50	24' 1"	20' 10"	17' 0"	22' 9"	18' 7"	13' 8"	24' 0"	20' 10"	17' 0"	22' 9"	18' 7"	13' 8"
1400S200-54	50	26' 2"	22' 8"	18' 6"	23' 4"	19' 0"	13' 10"	25' 0"	22' 8"	18' 6"	23' 4"	19' 0"	13' 10"
1400S250-54	50	27' 2"	23' 7"	19' 3"	23' 7"	19' 2"	13' 11"	25' 11"	23' 6"	19' 3"	23' 7"	19' 2"	13' 11"
1400S300-54	50	27' 10"	24' 1"	19' 7"	23' 9"	19' 3"	14' 0"	26' 9"	24' 1"	19' 7"	23' 9"	19' 3"	14' 0"
1400S350-54	50	31' 2"	27' 1"	19' 7"	25' 3"	20' 3"	14' 6"	28' 7"	25' 11"	19' 7"	25' 3"	20' 3"	14' 6"
1400S162-68	50	28' 8"	24' 11"	20' 4"	28' 9"	24' 11"	20' 1"	26' 3"	23' 9"	20' 4"	28' 9"	24' 11"	20' 1"
1400S200-68	50	29' 11"	26' 11"	22' 0"	31' 1"	26' 10"	20' 11"	27' 3"	24' 9"	21' 6"	30' 5"	26' 10"	20' 11"
1400S250-68	50	31' 0"	27' 11"	22' 10"	31' 11"	27' 0"	21' 0"	28' 4"	25' 8"	22' 4"	31' 7"	27' 0"	21' 0"
1400S300-68	50	32' 0"	28' 7"	23' 4"	32' 4"	27' 3"	21' 3"	29' 3"	26' 6"	23' 0"	32' 4"	27' 3"	21' 3"
1400S350-68	50	33' 11"	30' 10"	26' 1"	35' 11"	30' 1"	23' 1"	30' 10"	28' 0"	24' 6"	34' 7"	30' 1"	23' 1"
1400S162-97	50	32' 9"	29' 8"	25' 10"	36' 7"	32' 8"	26' 8"	29' 9"	27' 0"	23' 7"	33' 4"	30' 3"	26' 4"
1400S200-97	50	34' 0"	30' 10"	26' 10"	38' 0"	34' 6"	28' 7"	30' 10"	28' 1"	24' 6"	34' 8"	31' 5"	27' 5"
1400S250-97	50	35' 2"	31' 11"	27' 10"	39' 5"	35' 9"	29' 7"	31' 11"	29' 0"	25' 4"	35' 11"	32' 7"	28' 5"
1400S300-97	50	36' 3"	33' 0"	28' 9"	40' 8"	36' 11"	30' 4"	33' 0"	29' 11"	26' 2"	37' 0"	33' 8"	29' 4"
1400S350-97	50	37' 11"	34' 6"	30' 1"	42' 7"	38' 8"	33' 5"	34' 6"	31' 4"	27' 4"	38' 8"	35' 2"	30' 9"
1400S162-118	50	34' 9"	31' 7"	27' 7"	39' 0"	35' 5"	30' 11"	31' 7"	28' 8"	25' 1"	35' 5"	32' 2"	28' 1"
1400S200-118	50	36' 1"	32' 9"	28' 8"	40' 6"	36' 10"	32' 2"	32' 9"	29' 9"	26' 0"	36' 10"	33' 5"	29' 2"
1400S250-118	50	37' 4"	33' 11"	29' 8"	41' 11"	38' 1"	33' 4"	33' 11"	30' 10"	26' 11"	38' 1"	34' 8"	30' 3"
1400S300-118	50	38' 7"	35' 1"	30' 7"	43' 4"	39' 4"	34' 4"	35' 1"	31' 10"	27' 10"	39' 4"	35' 9"	31' 3"
1400S350-118	50	40' 4"	36' 8"	32' 0"	45' 4"	41' 2"	36' 0"	36' 8"	33' 4"	29' 1"	41' 2"	37' 5"	32' 8"
1600S162-68	50	30' 2"	26' 1"	21' 4"	30' 2"	26' 1"	20' 3"	29' 1"	26' 1"	21' 4"	30' 2"	26' 1"	20' 3"
1600S200-68	50	32' 8"	28' 4"	23' 2"	32' 8"	27' 5"	20' 11"	30' 3"	27' 5"	23' 2"	32' 8"	27' 5"	20' 11"
1600S250-68	50	34' 1"	29' 6"	24' 1"	33' 0"	27' 7"	21' 0"	31' 4"	28' 5"	24' 1"	33' 0"	27' 7"	21' 0"
1600S300-68	50	35' 1"	30' 4"	24' 9"	33' 4"	27' 10"	21' 2"	32' 4"	29' 4"	24' 9"	33' 4"	27' 10"	21' 2"
1600S350-68	50	37' 1"	33' 8"	27' 9"	36' 1"	29' 10"	22' 5"	33' 10"	30' 8"	26' 9"	36' 1"	29' 10"	22' 5"
1600S162-97	50	36' 6"	33' 1"	28' 2"	39' 10"	34' 6"	28' 2"	33' 4"	30' 3"	26' 4"	37' 2"	33' 8"	28' 2"
1600S200-97	50	37' 10"	34' 4"	29' 10"	42' 3"	37' 1"	30' 3"	34' 6"	31' 4"	27' 3"	38' 7"	35' 0"	30' 3"
1600S250-97	50	39' 2"	35' 6"	30' 11"	43' 9"	38' 7"	31' 6"	35' 8"	32' 5"	28' 2"	39' 11"	36' 2"	31' 6"
1600S300-97	50	40' 4"	36' 7"	31' 11"	45' 1"	39' 7"	32' 4"	36' 9"	33' 4"	29' 1"	41' 2"	37' 4"	32' 4"
1600S350-97	50	42' 2"	38' 3"	33' 4"	47' 2"	42' 9"	35' 5"	38' 5"	34' 10"	30' 5"	43' 0"	39' 0"	34' 0"
1600S162-118	50	39' 0"	35' 6"	30' 11"	43' 9"	39' 8"	32' 10"	35' 6"	32' 3"	28' 2"	39' 10"	36' 2"	31' 7"
1600S200-118	50	40' 5"	36' 9"	32' 1"	45' 5"	41' 2"	35' 1"	36' 9"	33' 4"	29' 2"	41' 3"	37' 6"	32' 9"
1600S250-118	50	41' 9"	37' 11"	33' 2"	46' 11"	42' 7"	36' 6"	37' 11"	34' 6"	30' 2"	42' 7"	38' 9"	33' 10"
1600S300-118	50	43' 1"	39' 1"	34' 2"	48' 4"	43' 11"	37' 6"	39' 1"	35' 6"	31' 0"	43' 11"	39' 11"	34' 10"
1600S350-118	50	44' 11"	40' 10"	35' 8"	50' 6"	45' 10"	40' 0"	40' 10"	37' 1"	32' 5"	45' 10"	41' 8"	36' 5"

"e" web stiffeners required at ends.

Web stiffeners required at interior supports for double span conditions.

See Table Notes on page 35.



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## Floor Joist Spans

15 psf Dead Load and 125 psf Live Load													
Section	Fy (ksi)	L/360 Live Load Deflection						L/480 Live Load Deflection					
		Single Span			Double Span			Single Span			Double Span		
		Spacing (in) on center			Spacing (in) on center			Spacing (in) on center			Spacing (in) on center		
		12	16	24	12	16	24	12	16	24	12	16	24
600S162-33	33	6'9"	5'10"	4'7"	5'9"	4'8"	3'4"	6'9"	5'10"	4'7"	5'9"	4'8"	3'4"
600S200-33	33	7'2"	6'2"	4'7"	5'11"	4'9"	3'4"	7'2"	6'2"	4'7"	5'11"	4'9"	3'4"
600S162-43	33	8'4"	7'2"	5'10"	8'1"	6'9"	5'2"	8'4"	7'2"	5'10"	8'1"	6'9"	5'2"
600S200-43	33	8'7"	7'5"	6'1"	8'2"	6'10"	5'3"	8'7"	7'5"	6'1"	8'2"	6'10"	5'3"
600S250-43	33	8'9"	7'7"	6'3"	8'4"	7'0"	5'4"	8'9"	7'7"	6'3"	8'4"	7'0"	5'4"
600S162-54	50	10'0"	9'1"	7'10"	11'1"	9'5"	7'4"	9'1"	8'3"	7'3"	10'2"	9'3"	7'4"
600S200-54	50	10'6"	9'7"	8'1"	11'2"	9'5"	7'4"	9'7"	8'8"	7'7"	10'9"	9'5"	7'4"
600S250-54	50	11'0"	10'0"	8'3"	11'5"	9'8"	7'6"	10'0"	9'1"	7'11"	11'3"	9'8"	7'6"
600S162-68	50	10'9"	9'9"	8'6"	12'0"	10'11"	8'11"	9'9"	8'10"	7'9"	10'11"	9'11"	8'8"
600S200-68	50	11'3"	10'3"	8'11"	12'8"	11'6"	9'3"	10'3"	9'4"	8'2"	11'6"	10'5"	9'2"
600S250-68	50	11'10"	10'9"	9'5"	13'3"	11'5"	9'1"	10'9"	9'9"	8'6"	12'1"	10'11"	9'1"
600S162-97	50	11'11"	10'10"	9'5"	13'4"	12'1"	10'7"	10'10"	9'10"	8'7"	12'1"	11'0"	9'7"
600S200-97	50	12'6"	11'4"	9'11"	14'1"	12'9"	11'2"	11'4"	10'4"	9'0"	12'9"	11'7"	10'2"
600S250-97	50	13'2"	11'11"	10'5"	14'9"	13'5"	11'9"	11'11"	10'10"	9'6"	13'5"	12'2"	10'8"
600S162-118	50	12'7"	11'5"	10'0"	14'1"	12'10"	11'2"	11'5"	10'4"	9'1"	12'10"	11'8"	10'2"
600S200-118	50	13'3"	12'0"	10'6"	14'10"	13'6"	11'10"	12'0"	10'11"	9'7"	13'6"	12'3"	10'9"
600S250-118	50	13'11"	12'8"	11'1"	15'8"	14'2"	12'5"	12'8"	11'6"	10'0"	14'2"	12'11"	11'3"
800S162-33	33	6'9"	5'1"	3'5"	5'0"	3'11"	2'8"	6'9"	5'1"	3'5"	5'0"	3'11"	2'8"
800S200-33	33	6'9"	5'1"	3'5"	5'1"	3'11"	2'8"	6'9"	5'1"	3'5"	5'1"	3'11"	2'8"
800S162-43	33	9'4"	8'1"	6'7"	8'4"	6'10"	5'1"	9'4"	8'1"	6'7"	8'4"	6'10"	5'1"
800S200-43	33	10'0"	8'8"	7'1"	9'0"	7'4"	5'4"	10'0"	8'8"	7'1"	9'0"	7'4"	5'4"
800S250-43	33	10'3"	8'11"	7'3"	9'0"	7'4"	5'4"	10'3"	8'11"	7'3"	9'0"	7'4"	5'4"
800S162-54	50	12'6"	10'10"	8'10"	12'3"	10'4"	8'1"	11'5"	10'4"	8'10"	12'3"	10'4"	8'1"
800S200-54	50	13'2"	11'7"	9'5"	13'4"	11'2"	8'7"	12'0"	10'11"	9'5"	13'4"	11'2"	8'7"
800S250-54	50	13'8"	11'10"	9'8"	13'5"	11'3"	8'8"	12'6"	11'4"	9'8"	13'5"	11'3"	8'8"
800S162-68	50	13'6"	12'4"	10'4"	14'8"	12'8"	10'1"	12'4"	11'2"	9'9"	13'10"	12'7"	10'1"
800S200-68	50	14'2"	12'11"	11'3"	15'11"	14'0"	11'3"	12'11"	11'8"	10'3"	14'5"	13'2"	11'3"
800S250-68	50	14'10"	13'5"	11'4"	16'0"	13'10"	11'0"	13'5"	12'3"	10'8"	15'1"	13'9"	11'0"
800S162-97	50	15'0"	13'8"	11'11"	16'11"	15'4"	12'8"	13'8"	12'5"	10'10"	15'4"	13'11"	12'2"
800S200-97	50	15'9"	14'4"	12'6"	17'8"	16'1"	14'1"	14'4"	13'0"	11'4"	16'1"	14'7"	12'9"
800S250-97	50	16'6"	15'0"	13'1"	18'6"	16'10"	14'8"	15'0"	13'7"	11'11"	16'10"	15'3"	13'4"
800S162-118	50	15'11"	14'5"	12'7"	17'10"	16'3"	14'2"	14'5"	13'2"	11'6"	16'3"	14'9"	12'11"
800S200-118	50	16'8"	15'2"	13'3"	18'9"	17'0"	14'11"	15'2"	13'9"	12'0"	17'0"	15'6"	13'6"
800S250-118	50	17'6"	15'10"	13'10"	19'7"	17'10"	15'7"	15'10"	14'5"	12'7"	17'10"	16'2"	14'2"
1000S162-43	33	10'4"	8'11"	6'0"	8'1"	6'5"	4'6"	10'4"	8'11"	6'0"	8'1"	6'5"	4'6"
1000S200-43	33	11'2"	8'11"	6'0"	8'3"	6'6"	4'7"	11'2"	8'11"	6'0"	8'3"	6'6"	4'7"
1000S250-43	33	11'6"	8'11"	6'0"	8'5"	6'7"	4'7"	11'6"	8'11"	6'0"	8'5"	6'7"	4'7"
1000S162-54	50	13'10"	12'0"	9'10"	12'10"	10'7"	7'11"	13'7"	12'0"	9'10"	12'10"	10'7"	7'11"
1000S200-54	50	14'11"	12'11"	10'6"	13'3"	10'10"	8'0"	14'2"	12'10"	10'6"	13'3"	10'10"	8'0"
1000S250-54	50	15'4"	13'3"	10'10"	13'8"	11'2"	8'2"	14'11"	13'3"	10'10"	13'8"	11'2"	8'2"
1000S162-68	50	16'2"	14'2"	11'7"	16'5"	14'2"	11'2"	14'9"	13'5"	11'7"	16'5"	14'2"	11'2"
1000S200-68	50	16'11"	15'2"	12'5"	17'6"	14'10"	11'8"	15'5"	14'0"	12'2"	17'3"	14'10"	11'8"
1000S250-68	50	17'8"	15'7"	12'9"	18'0"	15'7"	12'4"	16'1"	14'7"	12'9"	18'0"	15'7"	12'4"
1000S162-97	50	18'1"	16'5"	14'4"	20'4"	18'2"	14'9"	16'5"	14'11"	13'1"	18'6"	16'9"	14'8"
1000S200-97	50	18'11"	17'2"	15'0"	21'3"	19'3"	15'8"	17'2"	15'7"	13'8"	19'3"	17'6"	15'4"
1000S250-97	50	19'8"	17'11"	15'8"	22'1"	20'1"	16'11"	17'11"	16'3"	14'2"	20'1"	18'3"	15'11"
1000S162-118	50	19'2"	17'5"	15'3"	21'6"	19'7"	16'7"	17'5"	15'10"	13'10"	19'7"	17'9"	15'6"
1000S200-118	50	20'1"	18'3"	15'11"	22'6"	20'5"	17'8"	18'3"	16'7"	14'5"	20'5"	18'7"	16'3"
1000S250-118	50	20'11"	19'0"	16'7"	23'5"	21'4"	18'7"	19'0"	17'3"	15'1"	21'4"	19'4"	16'11"

*"e" web stiffeners required at ends.*

*Web stiffeners required at interior supports for double span conditions.*

*See Table Notes on page 35.*



Holdowns & Tension Ties

**S/HDs & S/HDB Holdowns**



The S/HD series of holdowns is designed for installation with either screws or bolts into the studs or column. The S/HDs series installs with #14 screws and has been designed to utilize fewer fasteners to reduce installation time. The S/HDB series is ideal for bolt-on applications where the cold-formed stud manufacturer can pre-punch the bolt holes.

**MATERIAL:** See table

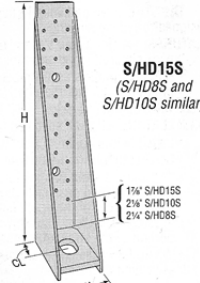
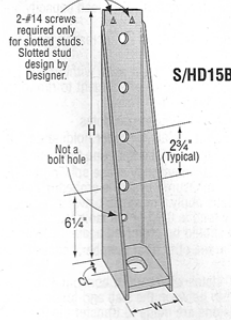
**FINISH:** Simpson Strong-Tie gray paint. Hot-dip galvanized is available; see Corrosion-Information, page 12-13.

**INSTALLATION:** • Use all specified fasteners; some models have extra fastener holes. See General Notes.

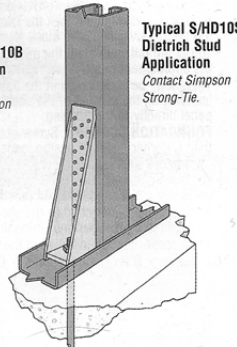
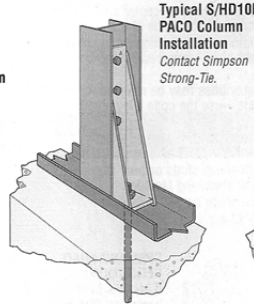
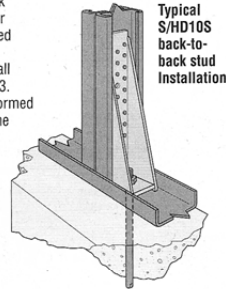
- Anchor bolt washer is not required.
- Standard washers are required on stud bolt nuts for model S/HDB.
- Thin wall socket (OD=2" maximum) is required for S/HD15 to tighten the 1" anchor bolt.
- Stud bolts – use A307.
- Boundary members (*back-to-back studs*) design shall be by Designer.

• S/HDs and S/HDB holdowns can be welded per Designer's recommendation and specification. To tie back-to-back stud members together, the Designer must determine the fasteners required to bind members to act as one unit. Welders and welding procedures shall be qualified as specified in AWS D1.3. Welded connections used for cold-formed steel structural members in which the thickness of the thinnest connected part is 0.18 inch or less shall comply to 2001 AISI N95 Specification Section E2.

**CODE:** See page 8 for Code Listing Key Chart.



Holdowns & Tension Ties



Available with additional corrosion protection. Check with Simpson Strong-Tie.

Model	H	Fasteners		Stud Member Thickness mil (ga) <sup>4</sup>	ASD		LRFD		Nominal Tension Load <sup>7</sup>	Code Ref
		Found. Anchor Diameter <sup>1</sup>	Stud Fasteners		Tension Load	Deflection at ASD Load <sup>6</sup>	Tension Load	Deflection at LRFD Load <sup>6</sup>		
S/HD8S	11	3/8	17 - #14	2-33 (2-20ga)	7335	0.120	11715	0.204	13720	FC1
				2-43 (2-18ga)	8750	0.086	13975	0.146	21435	
				2-54 (2-16ga)	8855	0.106	14145	0.162	21700	
				Steel Fixture	10840	0.053	17335	0.072	32525	
S/HD10S	13 1/2	3/8	22 - #14	2-33 (2-20ga)	7400	0.122	11815	0.192	13835	
				2-43 (2-18ga)	11120	0.112	17755	0.124	20795	
				2-54 (2-16ga)	12220	0.096	19520	0.145	29940	
				Steel Fixture	12375	0.043	19820	0.061	33535	
S/HD15S	17	1	30 - #14	2-43 (2-18ga)	12110	0.096	19340	0.164	22645	
				2-54 (2-16ga)	13500	0.110	21565	0.130	33075	
				Steel Fixture	15810	0.043	25320	0.065	42845	
				2-33 (2-20ga)	3895	0.081	5620	0.144	8645	
S/HD8B	11	3/8	2 - 3/4 Dia	2-43 (2-18ga)	5345	0.098	7710	0.146	11865	
				2-54 (2-16ga)	8950	0.082	14280	0.141	20310	
				Steel Fixture	9080	0.069	14545	0.104	22975	
				2-33 (2-20ga)	5840	0.070	8430	0.124	12970	
S/HD10B	13 1/2	3/8	3 - 3/4 Dia	2-43 (2-18ga)	8015	0.087	11565	0.120	17795	
				2-54 (2-16ga)	12090	0.125	19720	0.230	28050	
				Steel Fixture	15635	0.102	24955	0.123	35495	
				2-43 (2-18ga)	10690	0.118	15425	0.179	22165	
S/HD15B	17	1	4 - 3/4 Dia	2-54 (2-16ga)	16020	0.090	25565	0.121	36360	
				Steel Fixture	18690	0.104	29825	0.139	42425	

1. Designer shall specify the foundation anchor material type, length, embedment and configuration. Tabulated loads may exceed anchor bolt ASTM A36 or A307 tension capacities.  
2. See pages 26-30 for anchor bolt options.  
3. See page 21 for anchor bolt retrofit options.  
4. Stud design by Specifier. Tabulated loads are based on a minimum studs thickness for fastener connection.  
5. 3/8" self-drilling screws can be substituted for #14.

6. Deflection at ASD and LRFD Loads includes fastener slip, holdown elongation and anchor bolt elongation (L-4).  
7. Nominal Tension Load is based on the average ultimate (peak) load from tests. AISI Lateral Design standard requires holdown to have nominal strength to resist lesser of amplified seismic load or what the system can deliver.

Simpson Strong-Tie® Fastening Systems

**QUIK DRIVE® – Collated Screws**



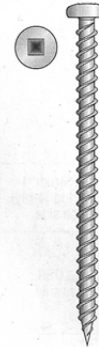
**PHSS Screw**

Common Application: Wood to wood

**FEATURES:**

- Pan head
- #2 square drive  
(Driver bit in each box; replacement bit model BIT2S)
- Twin threads
- Sharp point
- Yellow-zinc coating
- Curved collation

Length (in.)	Shank Size	Carton Quantity	Model No.	PRO 250	PRO 300S
2	#8	2000	PHSS2S	✓	✓
2½	#8	1500	PHSS212S	✓	✓



**PPSD Screw**

Common Application: Subfloor/sheathing to cold-formed steel  
(#8 – maximum thickness: 54 mils/16 ga.; #10 – maximum thickness: 97 mils/12 ga.)

**FEATURES:**

- Flat head with nibs for easy countersinking
- #3 square drive  
(Driver bit in each box; replacement bit model BIT3S)
- Fine threads
- Pilot point
- Yellow-zinc coating
- Curved collation
- 0.315" head diameter meets AISI lateral design standard

Length (in.)	Shank Size	Point Size	Threads Per Inch	Carton Quantity	Model No.	PRO 200	PRO 200S	PRO 250	PRO 300S
1½	#8	2	18	2000	PPSD11516S0818	✓	✓	✓	✓
1¾	#10	3	16	2000	PPSD134S1016	✓	✓	✓	✓
3	#10	3	16	1000	PPSD3S1016				✓



**Allowable Withdrawal Loads in Steel Connections (lbs)**

Model No.	Size	Load Description	Steel Thickness: mil (ga)			
			27 (22)	33 (20)	43 (18)	54 (16)
PPSD11516	#8 x 1½"	ASD	56	69	89	162
		LRFD	84	104	134	243
		Nominal Strength	169	206	270	485

1. The tabulated values are based on calculations with Section E4 of the AISI S100-07.
2. Values are based on cold-formed steel (CFS) members with a minimum yield strength,  $F_y$  of 33 ksi and minimum tensile strength,  $F_u$  of 45 ksi for 43 mil (18 ga) to 27 mil (22 ga), and a minimum yield strength,  $F_y$  of 50 ksi and minimum tensile strength,  $F_u$  of 65 ksi for 54 mils (16 ga).
3. For design purposes, steel sheet thicknesses are 0.0283" for 27 mil (22 ga), 0.0346" for 33 mil (20 ga), 0.0451" for 43 mil (18 ga), and 0.0566" for 54 mil (16 ga). The actual sheet thickness shall not be less than 95% of these design thickness as specified in AISI/COFS/GP 2001 Section A5.1.
4. A minimum of three exposed screw threads are required to achieve loads in table.
5. See page 183 for information on screw strength.

For information on corrosion, materials and coatings, see pages 10-13.



Simpson Strong-Tie® Fastening Systems

**QUICK DRIVE® – Collated Screws**

**SIMPSON**  
**Strong-Tie**

**PPSD Screw (cont.)**

**Nominal Shear Strength (Rn) for Shear Walls (Seismic) (lbs/ft)**

Assembly Description	Max. Aspect Ratio (h/w)	Fastener Spacing at Panel Edges <sup>2</sup> (in.)				Designation Thickness <sup>5,6</sup> of Stud, Track and Blocking <sup>8</sup> (mils)
		6	4	3	2	
½" Struct. 1 Sheathing (4-ply), one side	2:1 <sup>3</sup>	780	990	•	•	33 or 43
	2:1	890	1330	1775	2190	43 or 54
¾" OSB, one side	2:1 <sup>3</sup>	700	915	•	•	33
	2:1 <sup>3</sup>	825	1235	1545	2060	43 or 54
	2:1	940	1410	1760	2350	54

- Nominal strength shall be multiplied by the resistance factor ( $\phi = 0.6$ , LRFD) to determine design strength or divided by the safety factor ( $\Omega = 2.5$ , ASD) to determine allowable strength.
- Screws in the field of the panel shall be installed 12" (305 mm) on center (o.c.) unless otherwise shown.
- Shear wall height to width aspect ratio (h/w) greater than 2:1, but not exceeding 4:1, shall be permitted provided the nominal strength values are multiplied by 2w/h.
- Wall studs and track shall be of ASTM A1003 Structural Grade 33 (Grade 230) Type H steel for members with a designation thickness of 33 and 43 mils, and A1003 Structural Grade 50 (Grade 340) Type H steel for members with a designation thickness equal to or greater than 54 mils.
- For wood structural panel sheathed shear walls, tabulated Rn values applicable for short-term load duration (seismic loads). For other in-plane lateral loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table for wood structural panel sheathed shear walls shall be multiplied by 0.63 (normal) or 0.56 (permanent).
- All sheathing edges shall be attached to framing or 1½" width 33 mil blocking.
- Maximum stud spacing 24" o.c.
- Table based on Table C2.1-3 AISI Standard "North American Standard for Cold-Form Steel Framing-Lateral Design 2007 Edition with Supplement No. 1 and Commentary".
- See General Load Table on page 183 for screw strength.

**Nominal Shear Strength (Rn) for Shear Walls (Wind) (lbs/ft)**

Assembly Description	Max. Aspect Ratio (h/w)	Fastener Spacing at Panel Edges <sup>2</sup> (in.)			
		6	4	3	2
½" Struct. 1 Sheathing (4-ply), one side	2:1	1065	•	•	•
¾" rated sheathing (OSB), one side	2:1	910	1025 <sup>9</sup>	1425 <sup>9</sup>	1825 <sup>9</sup>

- Nominal strength shall be multiplied by the resistance factor ( $\phi = 0.65$ , LRFD) to determine design strength or divided by the safety factor ( $\Omega = 2.0$ , ASD) to determine allowable strength.
- Screws in the field of the panel shall be installed 12 inches (305 mm) on center (o.c.).
- Shear wall height to width aspect ratio (h/w) greater than 2:1, but not exceeding 4:1, shall be permitted provided the nominal strength values are multiplied by 2w/h.
- For wood structural panel sheathed shear walls, tabulated Rn values applicable for short-term load duration (wind loads). For other in-plane lateral loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above for wood structural panel sheathed shearwalls shall be multiplied by 0.63 (normal) or 0.56 (permanent).
- Maximum stud spacing 24" o.c.
- Stud, track and blocking (if applicable) shall be a minimum of 33 mils.
- All sheathing edges shall be attached to framing or 1½" width 33 mil blocking.
- Table based on Table C2.1-1 AISI Standard "North American Standard for Cold-Form Steel Framing-Lateral Design 2007 Edition with Supplement No. 1 and Commentary".
- See General Load Table on page 183 for screw strength.

**Nominal Shear Strength (Rn) for Diaphragms with Wood Sheathing<sup>2</sup> (lbs/ft)**

Membrane Material	Thickness (in.)	Blocked				Unblocked	
		Screw Spacing at Diaphragm Boundary Edges and All Continuous Panel Edges (in.)				Screws Spaced Maximum of 6" on All Supported Edges	
		6	4	2.5	2	Load Perpendicular to Unblocked Edges and Continuous Panel Joints	All Other Configurations
Structural 1	¾"	768	1022	1660	2045	685	510
	7/16"	768	1127	1800	2255	755	565
	½"	925	1232	1970	2465	825	615
C-D, C-C and other graded wood structural panels <sup>2</sup>	¾"	690	920	1470	1840	615	460
	7/16"	760	1015	1620	2030	680	505
	½"	832	1110	1770	2215	740	555

- Framing members shall have a designated thickness between 33-54 mils.
- Wood structural panels shall conform to DOC PS-1 and PS-2.
- For wood structural panel sheathed diaphragms, tabulated Rn values shall be applicable for short-term load duration (wind or seismic loads). For other in-plane lateral loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above for wood structural panel sheathed diaphragms shall be multiplied by 0.75 (normal) or 0.67 (permanent).
- Nominal strength shall be multiplied by the resistance factor ( $\phi = 0.60$ , LRFD Seismic,  $\phi = 0.65$ , LRFD Wind) or divided by the safety factor ( $\Omega = 2.5$  ASD Seismic,  $\Omega = 2.0$  ASD Wind) to determine allowable strength.
- Length to width ratio of blocked wood diaphragms shall not exceed 4:1 and 3:1 for unblocking diaphragms.
- Screws installed in the field of the panel shall be spaced at a maximum of 12" on center (o.c.)
- Shear values are permitted for use in seismic design where the seismic response modification factor, R, taken to or less than 3.
- Where diaphragms are blocked, all panel edges must be attached to framing or blocking. Blocking shall be a minimum thickness of 33 mils with a minimum width of 1½".
- Maximum joist spacing 24" o.c.
- Table based on Table D2.1 AISI Standard "North American Standard for Cold-Form Steel Framing-Lateral Design 2007 Edition with Supplement No. 1 and Commentary".
- Screws installed in the field of the panel shall be installed at 12" o.c.
- For open-front structures, see AISI standard for additional information.
- See page 183 for information on screw strength.

C-F511 ©2011 SIMPSON STRONG-TIE COMPANY INC. C-F511 ©2011 SIMPSON STRONG-TIE COMPANY INC.

Straps & Ties

**H/TSP** Seismic & Hurricane Ties



Simpson Strong-Tie® hurricane ties provide a positive connection between truss/rafter and the wall of the structure to resist wind and seismic forces. New additions to the line provide even more options.

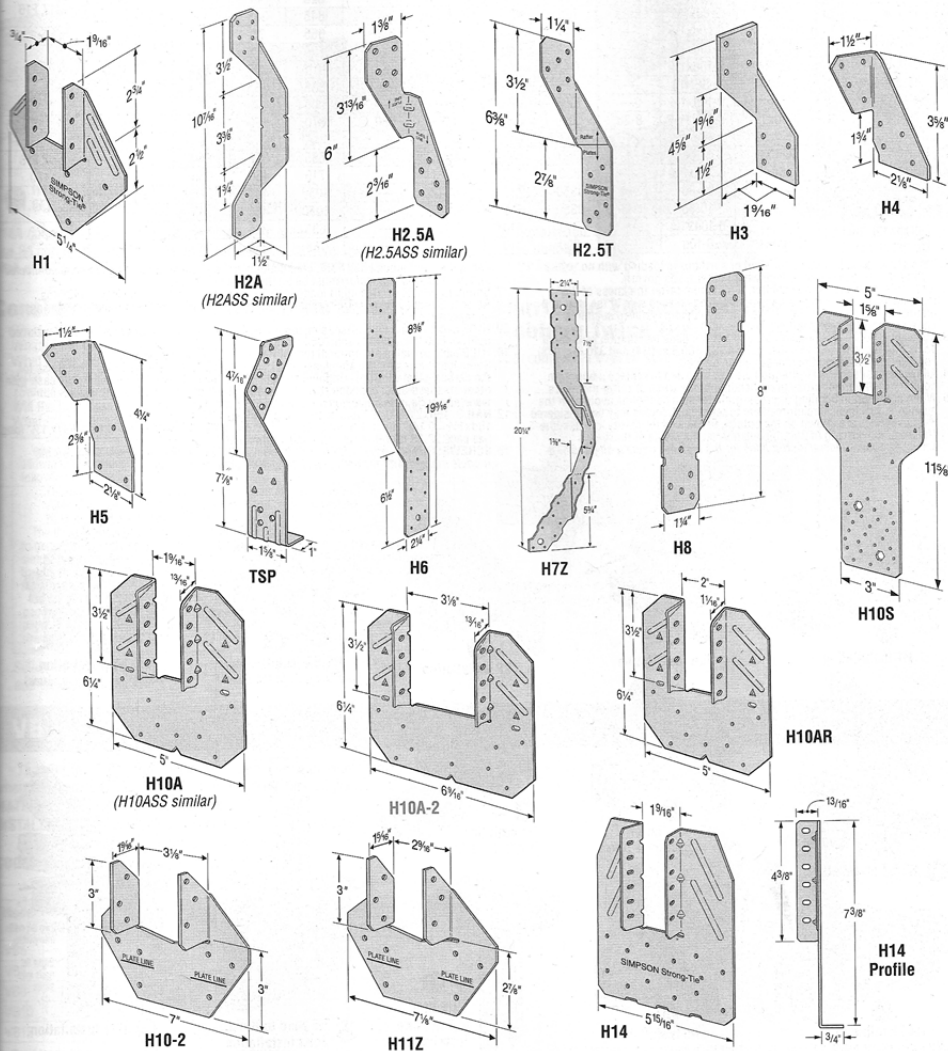
- H10AR – The heavy-duty design of the H10A available with a 2" wide throat to accommodate rough lumber
- H10A-2 – The H10A design with a 3" throat for double 2x members
- H2ASS, H2.5ASS and H10ASS – Popular ties now available in stainless steel.

**MATERIAL:** See table.  
**FINISH:** Galvanized. H7Z and H11Z—ZMAX® coating. Some models available in stainless steel or ZMAX; see Corrosion Information, page 14-15 or visit [www.strongtie.com](http://www.strongtie.com).

**INSTALLATION:** • Use all specified fasteners. See General Notes.

- H1 can be installed with flanges facing inward (*reverse of H1 installation drawing; number 1*).
- H2.5T, H3, H4, H5 and H6 ties are shipped in equal quantities of right and left versions (*right versions shown*).
- Hurricane ties do not replace solid blocking.
- When installing ties on plated trusses (*on the side opposite the truss plate*) do not fasten through the truss plate from behind. This can force the truss plate off of the truss and compromise truss performance.
- H10A optional nailing to connect shear blocking, use 8d nails. Slots allow maximum field bending up to a pitch of 6:12, use H10A sloped loads for field bent installation.

**CODES:** See page 13 for Code Reference Key Chart.



Straps & Ties



Straps & Ties

**H/TSP** Seismic & Hurricane Ties



These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

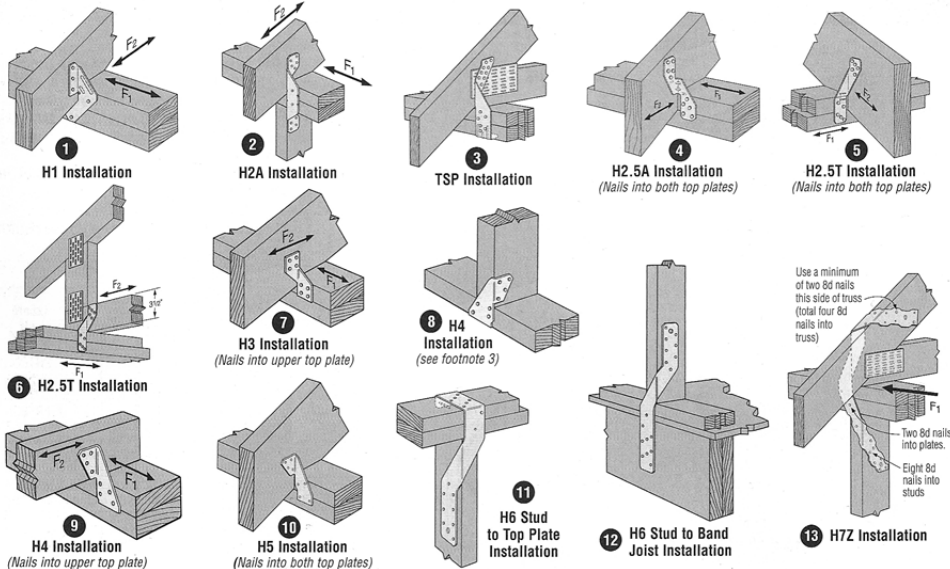
These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 27 for more information.

Model No.	Ga	Fasteners			DF/SP Allowable Loads			Uplift with 8dx1½ Nails (160)	SPF/HF Allowable Loads			Uplift with 8dx1½ Nails (160)	Code Ref.
		To Rafter/Truss	To Plates	To Studs	Uplift (160)	Lateral (160) F <sub>1</sub>	Lateral (160) F <sub>2</sub>		Uplift (160)	Lateral (160) F <sub>1</sub>	Lateral (160) F <sub>2</sub>		
H1	18	6-8dx1½	4-8d	—	585	485	165	455	400	415	140	370	I17, L6, F16
H2A	18	5-8dx1½	2-8dx1½	5-8dx1½	575	130	55	—	495	130	55	—	IP1, L18, F25
H2ASS	18	5-SS8d	2-SS8d	5-SS8d	400	130	55	400	345	130	55	345	170
H2.5A	18	5-8d	5-8d	—	600	110	110	575	535	110	110	495	I17, F16
H2.5ASS	18	5-SS8d	5-SS8d	—	440	75	70	365	380	75	70	310	170
H2.5T	18	5-8d	5-8d	—	545	135	145	425	545	135	145	425	IP1, L18, F25
H3	18	4-8d	4-8d	—	455	125	160	415	320	105	140	290	—
H4	20	4-8d	4-8d	—	360	165	160	360	235	140	135	235	I17, L6, F16
H5	18	4-8d	4-8d	—	455	115	200	455	265	100	170	265	—
H6	16	—	8-8d	8-8d	950	—	—	—	820	—	—	—	I17, F16
H7Z	16	4-8d	2-8dx1½	8-8d	985	400	—	—	845	345	—	—	—
H8	18	5-10dx1½	5-10dx1½	—	745	75	—	630	565	75	—	510	L10, F26
H10A Sloped	18	9-10dx1½	9-10dx1½	—	855	590	285	—	760	505	285	—	—
H10A	18	9-10dx1½	9-10dx1½	—	1140 <sup>1</sup>	590	285	—	1015	505	285	—	I17, L18, F25
H10ASS	18	9-SSN10	9-SSN10	—	970	565	170	—	835	485	170	—	170
H10AR	18	9-10dx1½	9-10dx1½	—	1050	490	285	—	905	420	285	—	—
H10S <sup>10</sup>	18	8-8dx1½	8-8dx1½ <sup>10</sup>	8-8d	1010	660	215	550	870	570	185	475	IP1, L18, F25
H10A-2	18	9-10dx1½	9-10dx1½	—	1245	815	260	—	1070	700	225	—	F25
H10-2	18	6-10d	6-10d	—	760	455	395	—	655	390	340	—	I17, F16
H11Z	18	6-16dx2½	6-16dx2½	—	830	525	760	—	715	450	655	—	170
H14	18	1 12-8dx1½	13-8d	—	1350 <sup>7</sup>	515	265	—	1050	480	245	—	IP1, L18, F25
		2 12-8dx1½	15-8d	—	1350 <sup>7</sup>	515	265	—	1050	480	245	—	
TSP	16	9-10dx1½	6-10dx1½	—	740	310	190	—	635	265	160	—	F26
		9-10dx1½	6-10d	—	890	310	190	—	765	265	160	—	

- Loads have been increased for wind or earthquake loading with no further increase allowed; reduce where other loads govern.
- Allowable loads are for one anchor. A minimum rafter thickness of 2½" must be used when framing anchors are used on each side of the joist and on the same side of the plate (exception: connectors installed such that nails on opposite side don't interfere).
- Allowable DF/SP uplift load for stud to bottom plate installation (see detail 15) is 390 lbs. (H2.5A); 265 lbs. (H2.5ASS); 360 lbs. (H4) and 310 lbs. (H8). For SPF/HF values multiply these values by 0.86.
- Allowable loads in the F<sub>1</sub> direction are not intended to replace diaphragm boundary members or cross grain bending of the truss or rafter members.
- When cross-grain bending or cross-grain tension cannot be avoided in the members, mechanical reinforcement to resist such forces may be considered.
- Hurricane Ties are shown on the outside of the wall for clarity and assume a minimum overhang of 3½". Installation on the inside of the wall is acceptable (see General Instructions for the Installer notes u on page 17).

- For uplift Continuous Load Path, connections in the same area (i.e. truss to plate connector and plate to stud connector) must be on the same side of the wall.
- Southern Pine allowable uplift loads for H10A = 1340 lbs. and for the H14 = 1465 lbs.
- Refer to Simpson Strong-Tie® technical bulletin T-HTIEBEARING for allowable bearing enhancement loads.
- H10S can have the stud offset a maximum of 1" from rafter (center to center) for a reduced uplift of 860 lbs. (DF/SP) and 765 lbs. (SPF).
- H10S nails to plates are optional for uplift but required for lateral loads.
- Some load values for the stainless-steel connectors shown here are lower than those for the carbon-steel versions. Ongoing test programs have shown this to also be the case with other stainless-steel connectors in the product line that are installed with nails. Visit [www.strongtie.com/corrosion](http://www.strongtie.com/corrosion) for updated information.
- NAILS:** 16dx2½" = 0.162" dia. x 2½" long, 10d = 0.148" dia. x 3" long, 10dx1½" = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½" = 0.131" dia. x 1½" long. See page 22-23 for other nail sizes and information.
- SCREWS:** Strong-Drive® SD #9x1½" (model SD9112) = 0.131" dia. x 1½" long (for the models marked with the orange flag only). Full table loads apply.

Straps & Ties



Straps & Ties

**LTP4/LTP5/A34/A35 Framing Angles & Plates**

**SIMPSON**  
**Strong-Tie**

The larger LTP5 spans subfloor at the top of the blocking or rim joist. The embossments enhance performance.

The LTP4 Lateral Tie Plate transfers shear forces for top plate-to-rim joist or blocking connections. Nail holes are spaced to prevent wood splitting for single and double top plate applications. May be installed over plywood sheathing.

The A35 anchor's exclusive bending slot allows instant, accurate field bends for all two- and three-way ties. Balanced, completely reversible design permits the A35 to secure a great variety of connections.

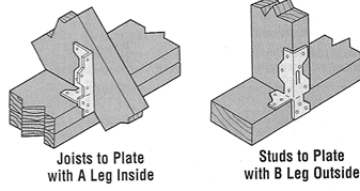
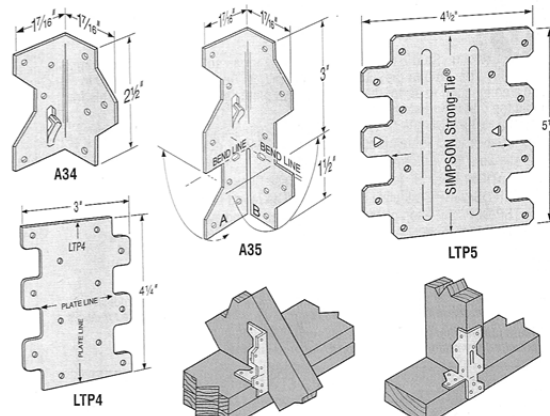
**MATERIAL:** LTP4/LTP5—20 gauge; all others—18 gauge  
**FINISH:** Galvanized. Some products available in stainless steel or ZMAX® coating; see Corrosion Information, page 14-15.

**INSTALLATION:** • Use all specified fasteners. See General Notes.  
• A35—Bend one time only.

**CODES:** See page 13 for Code Reference Key Chart.

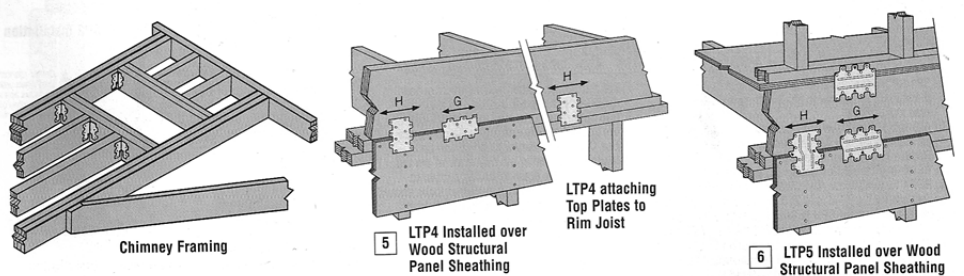
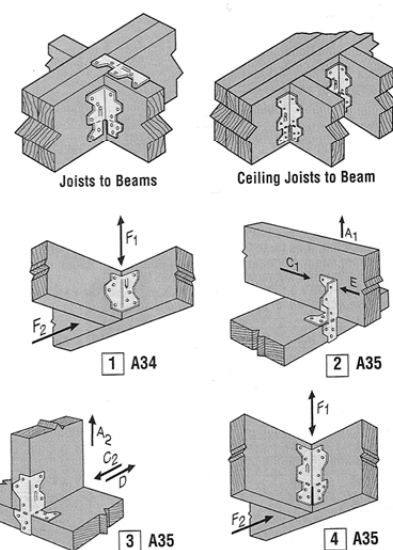
These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

These products are approved for installation with the Strong-Drive SD Structural-Connector screw. See page 27 for more information.



Model No.	Type of Connection	Fasteners	Direction of Load	DF/SP Allowable Loads			SPF/HF Allowable Loads			Code Ref.
				Floor (100)	Roof (125)	(160)	Floor (100)	Roof (125)	(160)	
A34	1	8-8dx1½	F <sub>1</sub>	395	485	515	340	415	445	IP1, L5, L18, F13
			F <sub>2</sub> <sup>6</sup>	395	455	455	340	390	390	
A35	2	9-8dx1½	A <sub>1</sub> , E	295	365	395	255	315	340	
			C <sub>1</sub>	210	210	210	180	180	180	
	3	12-8dx1½	A <sub>2</sub>	295	365	380	255	315	325	
			C <sub>2</sub>	295	365	370	255	315	320	
4	12-8dx1½	D	F <sub>1</sub>	595	695	670	510	575	600	
			F <sub>2</sub> <sup>6</sup>	595	670	670	510	575	575	
LTP4	5	12-8dx1½	G	515	645	670	445	555	575	I14, L5, F13
			H	515	645	670	445	555	575	
LTP5	6	12-8dx1½	H	585	620	620	505	535	535	IP1, L18, F25
				545	545	545	470	470	470	

- Allowable loads are for one anchor. When anchors are installed on each side of the joist, the minimum joist thickness is 3".
- Some illustrations show connections that could cause cross-grain tension or bending of the wood during loading if not reinforced sufficiently. In this case, mechanical reinforcement should be considered.
- LTP4 can be installed over ¾" wood structural panel sheathing with 8dx1½ nails and achieve 0.72 of the listed load, or over ½" and achieve 0.64 of the listed load. 8d commons will achieve 100% load.
- The LTP5 may be installed over wood structural panel sheathing up to ½" thick using 8dx1½ nails with no reduction in load.
- Connectors are required on both sides to achieve F<sub>2</sub> loads in both directions.
- NAILS:** 8dx1½ = 0.131" dia. x 1½" long.  
See page 22-23 for other nail sizes and information.



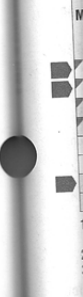
Straps & Ties  
**RBC**

The RBC and transfer... The locator... can be used... pitches from...  
**MATERIAL:**...  
**INSTALLATION:**...  
• Field...  
• See fill... and...  
**CODES:** See...  
The RB... and late... Code re...  
• IRC...  
• IBC...  
Blockin... Code r...  
• IRC...  
• IBC...

Model No.	Code
RBC	

- Allowab...
- RBC ca...
- Allowab... increas...
- When a...
- RBC in... (F<sub>1</sub>) loa...
- RBC m...
- NAILS:**

**A**  
Our...  
**MATER**  
**FINISH**  
**INSTALL**  
**CODES**





## Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	
Water Vaporization	3.6	0.6	6	
Dishwasher	50	10	5	Assume 10 gal. per cycle, high estimate
Clothes Washer	160	20	8	Assume 20 gal. per cycle, in the high range of washing machines
Vegetation	150	50	3	50 gallons per week for all landscape, 3 weeks
Fire Protection	344	344	1	Based on 35 gpm at 40 psi for ten minutes
Thermal Storage Tank	110	110	1	110 gallons of water for filling thermal storage tank
Testing	115	115	1	Includes test hot water draw
Initial Systems Fill	100	100	1	For chiller reservoirs for cooling/heating loops
TSU/FCU hydronic loop	10	10	1	Filling supply and return lines of TSU/FCU/chiller hydronic loop
Hydronic piping, radiant	9	9	1	Filling supply, return, and manifold piping of radiant ceiling system
Radiant Ceiling	4	4	1	Filling capillary tubes of radiant ceiling
Safety Factor	130.16			
<b>WATER REQUIRED</b>	<b>1431.76</b>	gallons		

**NOTE:**

WATER BUDGET BASED ON KNOWN FACTORS, ESTIMATES FOR UNKNOWN QUANTITIES, ASSUMPTIONS STATED WHERE APPLICABLE



## Summary of Unlisted Electrical Components

ALL ELECTRICAL COMPONENTS CARRY AN APPROVED TESTING AGENCY'S LISTING PER SECTION 6-7 OF THE SOLAR DECATHLON 2013 BUILDING CODE.



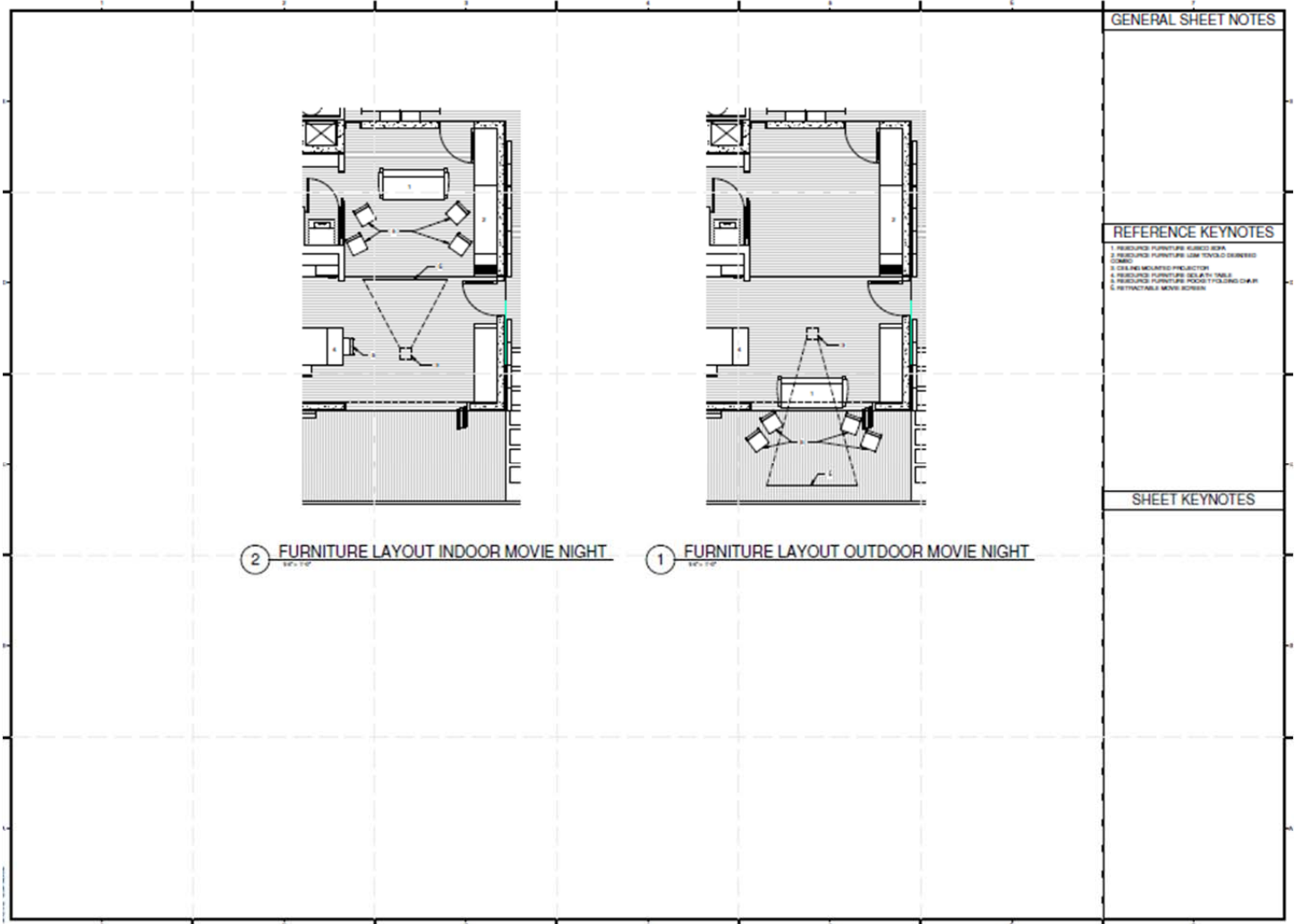
## Target Client Characteristics and Requirements

Characteristic or Requirement	Example
Location of permanent site	Phoenix, AZ
Housing type	Suburban house
# of occupants	2
Client demographic	Older, retired couple
Client annual income	\$60,000
# of bedrooms	1









PLEASE REFERENCE SHEET A-604

**WALK THROUGH NARRATIVE:**

Upon entering shade jurors will observe the flex room configured according to drawing C5 on sheet A-603. The jurors will continue on into the kitchen and progress into the bedroom where the furniture will be displayed according to drawings A2 and A4 of sheet A-603. Following a walk through the bathroom the jurors will re-enter the flex space to find it in the configuration found in C3 of sheet a-603, team aSUNm will then demonstrate the reconfiguration of the furniture by transitioning to the layout of drawing C1 of sheet a-603 and drawings C2 and C4 of sheet A-604. The jurors will then proceed with the remainder of the tour.



## Interconnection Application Form

Arizona State University & University of New Mexico – Lot Number 117

### PV Systems

#### DISCLAIMERS:

[1] PV panel information below is tentative and will be finalized when a formal agreement with a PV vendor will be reached.

[2] Number of PV panels specified in the table below is the actual target number to be used. The drawings will be updated to reflect the correct and final PV module count after a formal agreement with a PV module vendor is reached.

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
SolarWorld SW 245 mono black	Mono-crystalline, 36 modules total (9 modules connected in series, 2 strings in parallel per inverter. Two 5kW inverters total)	8820 W, STC conditions

Total DC power of all arrays is   8.82   kW (in tenths)

### INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
Power One	PVI 5000	240V AC	5kW	2

Total AC power of all inverters is   10   kVA or kW (in whole numbers)

### REQUIRED INFORMATION

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

	Location
<b>One-Line Electrical Schematic</b>	E601
<b>Three-Line Electrical Schematic</b>	E602
<b>PV and Wire Size Calculations</b>	E603
<b>Calculations of service/feeder net computed load and neutral load (NEC 220)</b>	E604, E605
<b>Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center</b>	E106



## Energy Analysis Results and Discussion

### INTRODUCTION

One of the intended goals of SHADE's design and construction is to implement technologies and building approaches that result in a residence with a lower energy demand than a conventionally constructed house. This kind of design approach, coupled with the PV array to generate electricity will result in a net-zero residence. The final decisions about which technologies, materials, and methods used were reached based on the combined considerations of energy efficiency, demand reduction, affordability, availability to Team ASUNM based on purchase price and sponsorship, applicability for current and future markets, and innovation. This last criterion was given large weight since the design and construction of SHADE represents an opportunity to experiment with systems and approaches that are not yet widely adopted, but may become so if adequate demonstration can be made of their efficacy.

SHADE is designed for the Phoenix climate, which is characterized by high average air temperatures year-round, very high summer temperatures, low relative humidity, and high insolation. Major constraints on the design include finding a balance between affordable construction, low energy demands for cooling and heating, and appropriate use of daylight for tasks and ambiance.

The purpose of this report is to present the analyses that informed the design and implementation of SHADE. These have included parametric analyses of envelope components and constructions, orientation and geometrical studies, and simulations of energy generation and use. A brief overview is given of some of the tools used for these energy analyses. A general description is then given of the house geometry, construction, and systems. This is followed by an overview of some of the results that informed the design process, especially related to structural and envelope choices. The results of simulations of the effects of natural ventilation, the freezing of the thermal storage unit, and the expected PV electricity production are presented. The quantitative contributions of some final construction choices to SHADE's energy use are shown. Finally, a summary of the expected annual energy consumption of SHADE is given.

### METHODS AND TOOLS

A variety of software application and analysis tools have been used at various points throughout the design and construction process of SHADE. Some of these are briefly described below.

eQuest: This application is available as a free download from the US Department of Energy. It is a valuable tool for quickly and easily estimating cooling and heating loads, as well as evaluating the effects of changing envelope parameters such as size and placement of windows, and R-values of walls. However, eQuest does not currently easily incorporate radiant cooling into its simulations.



Homer: This is a modeling software that can be used to model an entire home's loads including basic electrical loads and PV generation along with other loads such as wind and battery storage loads. For this analysis, Homer was used to model SHADE's PV production in both Irvine for the competition and Phoenix for the remaining life of the home on an hourly basis. Homer can account for the weather and temperature for different geographical areas, as well as design constraints such as the size of the PV system and the angle of the PV array.

MATLAB: MATLAB is a numerical computing environment with many capabilities. It was used in this context to simulate the freezing of the thermal storage unit with varying inlet temperatures and flow rates.

PVWatts: PVWatts is a modeling software that uses data from NREL to give a monthly estimated PV output based on geographical location, and design constraints on a PV system such as size of the PV system and the tilt angle. PVWatts is widely used by PV professionals to estimate the output of a PV system for their customers and will model production on a monthly basis. Results from PVWatts were compared with and used alongside those from Homer.

Spreadsheet software: Calculation spreadsheets were created in both Microsoft Excel and Open Office Calculation to quickly evaluate many aspects of energy analysis, from cooling load calculations to PV array sizing, to analysis of experimental data. Calculation spreadsheets have the advantage of being easy to learn and understand while also remaining capable of analyzing large data sets and carrying out some complicated calculations.

TRNSYS: TRNSYS is a building energy modeling application capable of evaluating transient effects. It offers a great degree of user control, and can evaluate highly complex building systems. While this software is capable of carrying out complex analyses, learning to use its full capabilities is also complex. Team ASUNM has used the basic features of TRNSYS to evaluate the contribution of building envelope elements and shading features to heating and cooling loads.

## GEOMETRY AND SYSTEMS

SHADE is roughly rectangular, and travels in two modules that are attached along the East-West axis of the house. There is one fixed window and a large sliding door in the South wall, which is shaded by the structure that supports the PV array. There are four smaller glass doors located in the envelope of the house: two on the West wall, one on the North wall, and one on the East wall. In addition to the glass door, there are two narrow windows on the North wall. Shading structures are an integral part of the building envelope. Their use is important not just to control direct solar gain, but also to expand the living space, in order to take advantage of the often-pleasant climate of Phoenix.

The South side of the house contains the kitchen area and living/flex space, and has the largest window, with some direct solar gain in the winter to assist with the moderate space heating needs in Phoenix. The North side of the house contains the bedroom, bathroom, and part of the living/flex space, which can be configured to be a guest bedroom or home office. There are outdoor living areas on all sides of the house; these spaces have shade structures to ensure that the occupants get the maximum enjoyment and use out of them.

### *Systems*

The systems of SHADE fall into three primary categories: heating, ventilation, and cooling; solar energy; and controls. A brief overview is given of each.



### Heating, ventilation, and cooling

Capillary mats made of plastic are laid underneath the plastered ceiling. Chilled or heated water is pumped through these mats; this radiant delivery system provides the primary heating and cooling needs of the house. Humidity control and additional peak cooling are provided by a minimal air system consisting of a fan coil unit with a chilled water coil and an energy-recovery ventilation unit. Heating is also provided via the radiant ceiling, with additional capacity from the air system; however, additional heating is not projected to be necessary for typical operation in Phoenix. The radiant delivery system was chosen to maximize thermal comfort while minimizing energy use for HVAC. Radiant cooling provides superior thermal comfort compared to forced air systems, even at higher indoor ambient temperatures. This effect is primarily due to the mean radiant temperature of the room being lower than that of an air-cooled space. Since water has a much higher heat capacity than air, it is more efficient to move heat around a living space using water than air. This efficiency translates to less energy required for both the circulating pump and the fan for the supplementary air system than for the fan alone for an all-air system.

The cooling system includes a small thermal storage unit. Energy storage in the form of latent energy, or phase change energy, will be implemented to satisfy part of the cooling load. A thermal storage system consisting of an insulated tank, internal energy storage containers that hold water for freezing/ice, a circulating pump, and a 30% mixture of propylene glycol will be used to store energy and offset the peak cooling load. During the cooling season, a chiller will operate at night to circulate very cold working fluid to the ice bags, freezing them and storing the day's peak cooling requirement. This nightly cycle will allow the chiller to operate at a lower ambient temperature compared to daytime operation, improving its ability to reject heat efficiently.

While thermal storage systems are in use for commercial systems, the residential market for this product remains under-served. This form of energy storage will help to reduce peak electricity demand in regions such as Phoenix, where air-conditioning makes up a dominant part of the electricity demand. Shifting some of the cooling load to thermal storage smoothes peak electricity demand, and allows consumers to take better advantage of off-peak electricity rates.

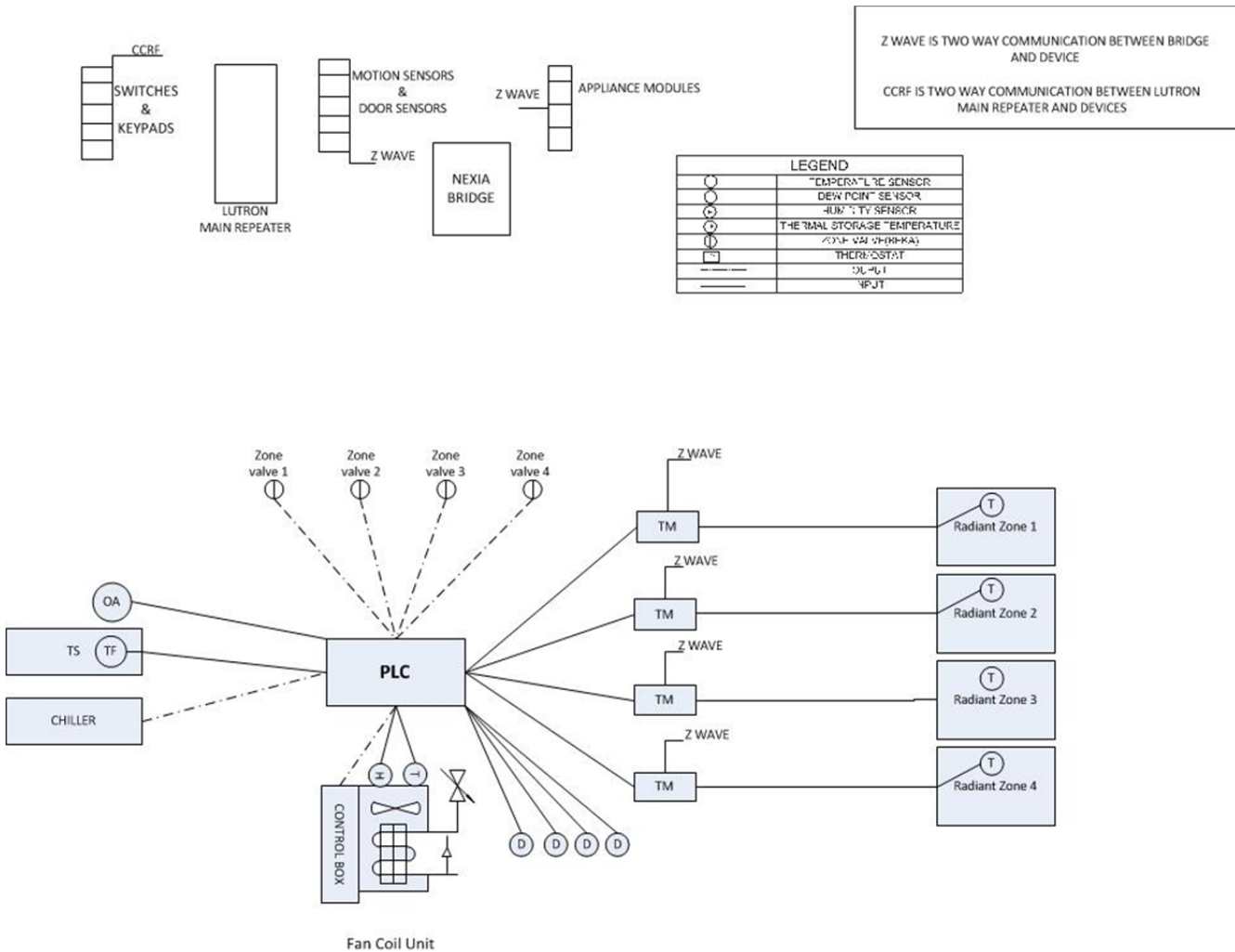
A dedicated heat-pump water heater serves as the primary source for domestic hot water. In addition, the water chiller for the radiant, air, and thermal storage system also acts as a domestic hot water pre-heater. Water to be used for laundry, bathing, or other household tasks passes through a bath located inside the chiller cabinet. The hot refrigerant line also passes through this bath, rejecting its heat to this bath and preventing the condenser fan from needing to run as much.

### Solar Energy System

Photovoltaic panels are mounted on the South-facing detached shade structure and convert sunlight into electricity while shading the South-facing windows from most direct summer sunlight. The PV system is made up of 36 SolarWorld 265 PV panels for a total system size of 9.54 kW DC. Two PowerOne PVI 5000 inverters are used.

Control system

A combination of wired and wireless equipment is used to coordinate the controls of the indoor and outdoor lighting, security system, HVAC equipment, and household appliances. The goal of the integrated control system is to maximize the usability of the controls system for the home occupant while providing opportunities for energy conservation and remote access. A schematic of the overall controls systems is shown in Figure 1.



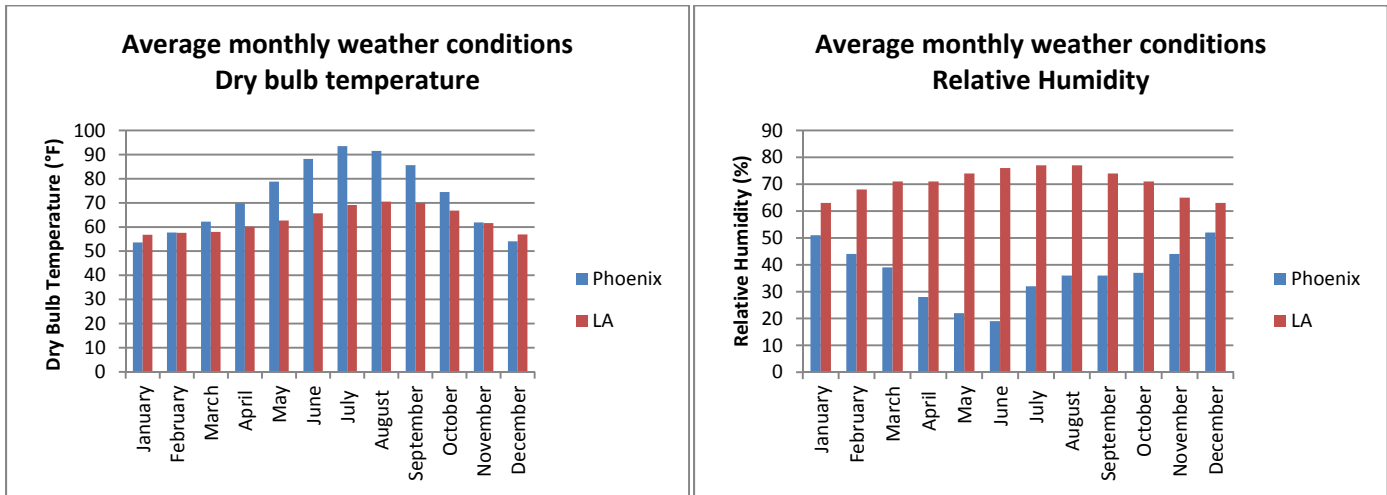
**Figure 1:** Schematic of SHADE's control system

**ENVELOPE DESIGN ANALYSIS AND LOAD CALCULATION RESULTS**

One of the first steps towards designing energy efficient buildings involves examining the climate in which the building will operate. Another important step involves closely examining the effects of envelope components on the energy consumption of the building. In most detached residences, envelope loads constitute the largest single component of cooling and heating loads.

*Weather data and outdoor design conditions*

Average weather data for Phoenix are available in many forms, including as Typical Meteorological year (TMY) Data, which are useful for building energy simulation software, and as tabulated average weather data such as those presented in the NREL Blue and Red Books. While TMY data are the most suitable for detailed energy analysis and simulation, the Red Book and Blue book data are presented as monthly averages, which is convenient for an overall idea of the climate of a location; however, there is some concern that the Blue and Red book data are outdated due to changing climates. Average weather data for dry bulb temperature and relative humidity are given in Figure 2.



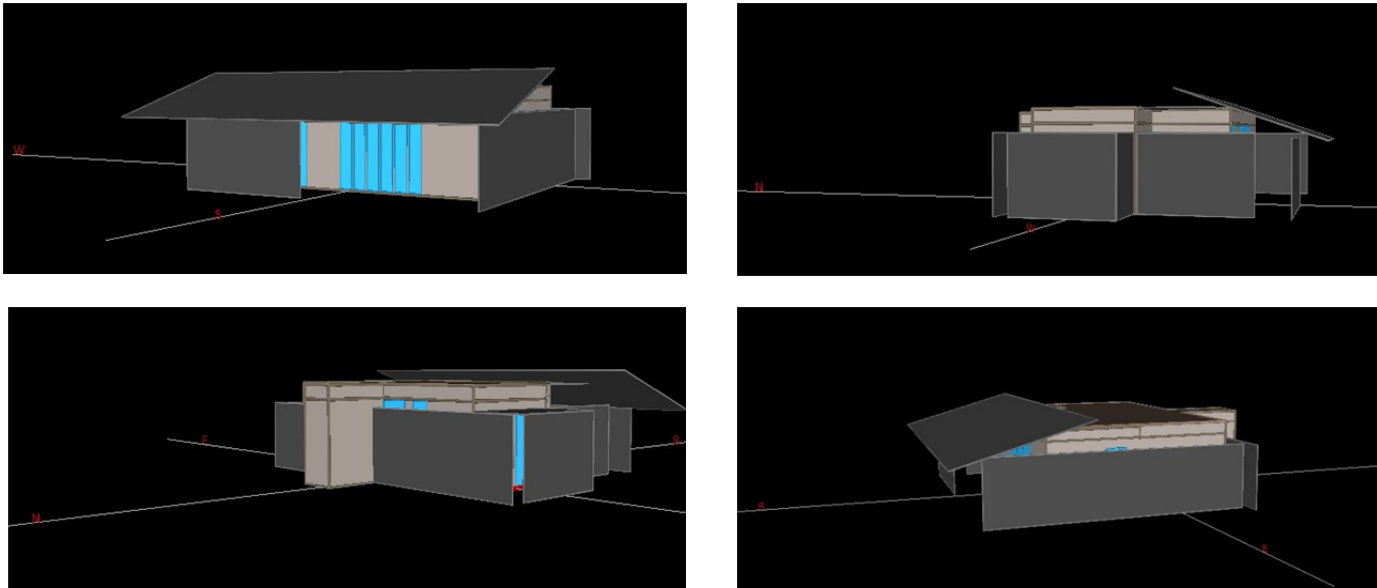
**Figure 2:** Average weather conditions for Phoenix, AZ and Los Angeles, CA.

It can be seen that the climate of Phoenix is characterized by high ambient temperatures with the highest temperatures occurring in the months of June, July, and August. There is low relative humidity throughout most of the year, with the highest average relative humidity occurring in the winter months and some during the summer monsoon. On the other hand, the climate of the competition location is characterized by relatively constant ambient temperatures and high relative humidity year-round. The latent cooling load in Phoenix is relatively low; however a system that will provide adequate dehumidification for the contest site will be necessary.

The Phoenix climate is also characterized by ambient temperatures within the comfort envelope (70 -75 °F) during days in the spring and fall, and some nights in the early summer.

### *Heating and cooling load analysis*

The main contribution to cooling load was found to be the size, placement, and shading of windows. Samples of results can be seen in Figure 3, showing the influence of window area and shading structures. The results of this energy modeling helped guide the architectural design team in the placement and sizing of glazing and shading features. The effect of envelope R-value was known to be important during the design process. These effects were explored quantitatively.

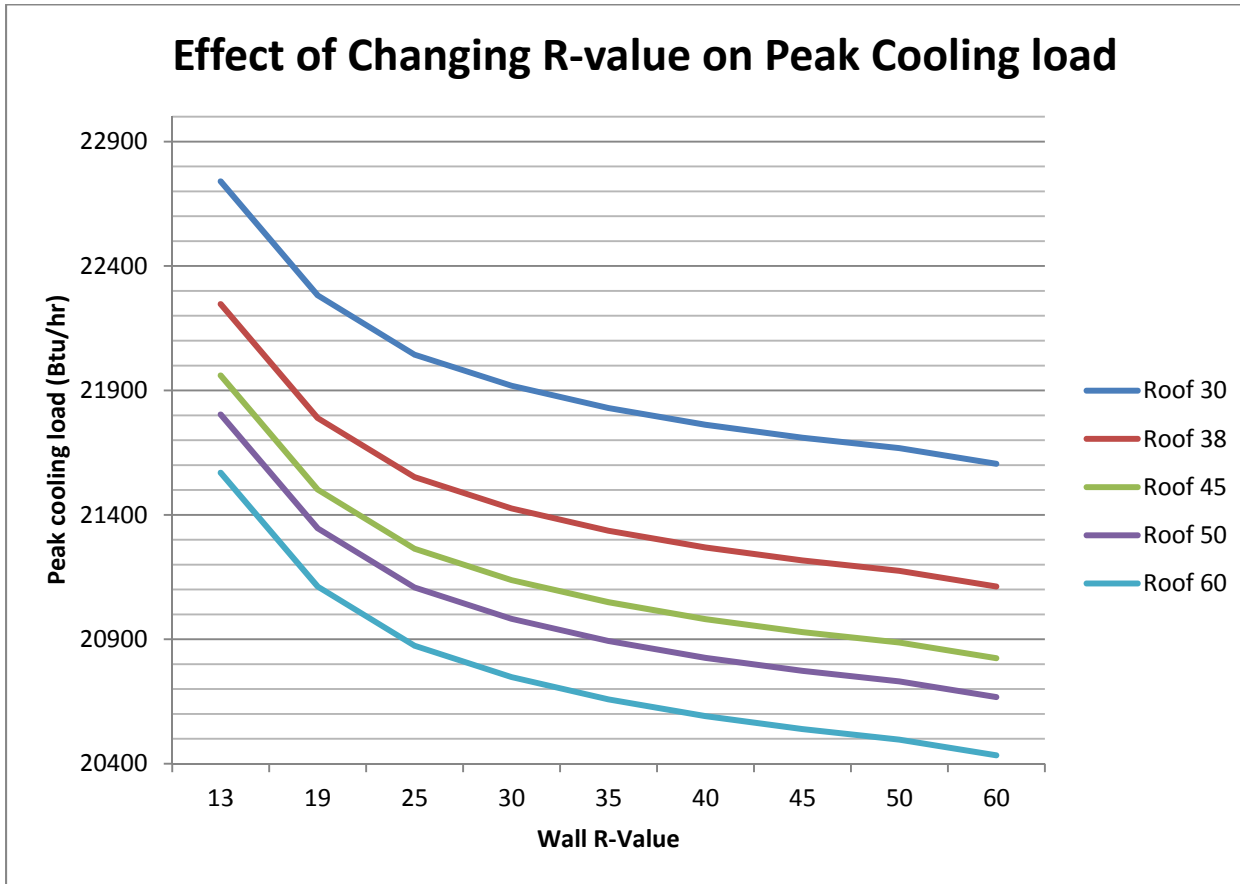


**Figure 3:** Simplified renderings of the contest prototype, produced in eQuest and showing shade structures. Clockwise from above left, South, West, East and North.

In addition to software energy modeling, analyses of building cooling loads were carried out using the ASHRAE CLTD method for residential heating and cooling load calculations, using a spreadsheet. A comparison was made of peak cooling load based on varying the R-values of the walls and roof. This analysis was carried out using a building design that is slightly modified compared to the final design of SHADE. Therefore, the value of the peak load is higher than the final peak cooling load for SHADE. However, the trend still holds true. This analysis compared the cooling loads for R-values ranging from the minimum of 13 required by the IRC to 60, a high R-value. It can be seen from Figure 4 that there is a large reduction in cooling load going from a wall R-value of 13 to 19 or 30; however, the slope of the curve flattens out above thirty, indicating a diminishing return. For a wall R-value of 30, there is a fairly small decrease in cooling load moving from a roof R-value of 38 to 45.

The walls of SHADE have an R-value of 40 in the walls and over R-60 in the roof. While a site-built house may not have insulation underneath a poured slab, SHADE will benefit from insulating the subfloor to prevent excessive heat gain from the tarmac.

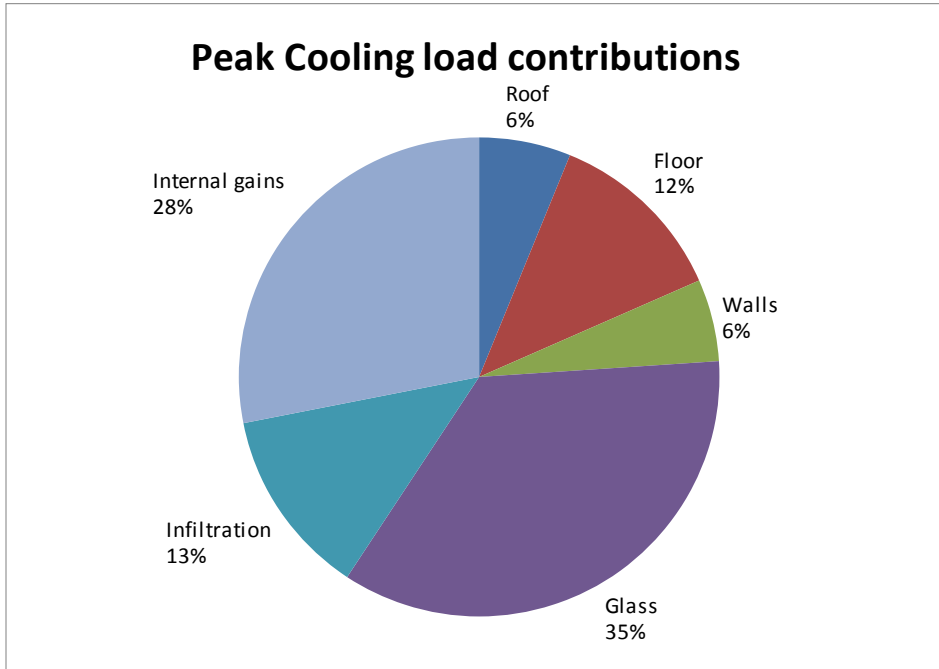




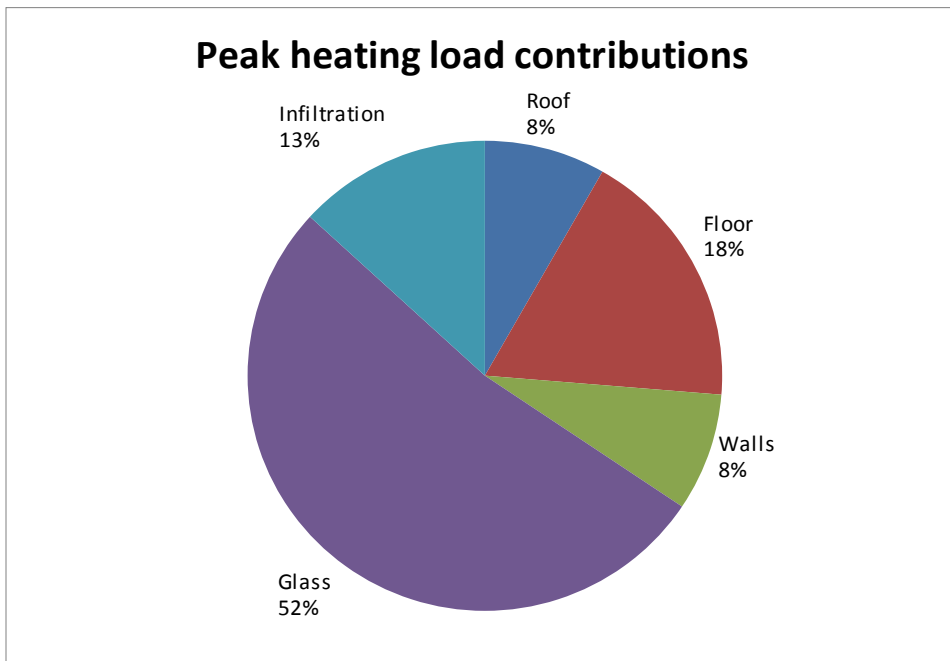
**Figure 4:** Parametric analysis of effect of R-value for wall and roof on peak cooling load.

*Peak cooling and heating loads results*

The final design, including exterior structures and envelope R-values gives a peak cooling load of approximately 1.2 tons and a peak heating load of around 9000 Btu/h. The contributions of individual components to these loads are shown below, in Figures 5 and 6. These results were found using the CLTD method.



**Figure 5:** Example calculations of heating and cooling loads, obtained with eQuest.



**Figure 6:** Contributions of components to peak heating load.

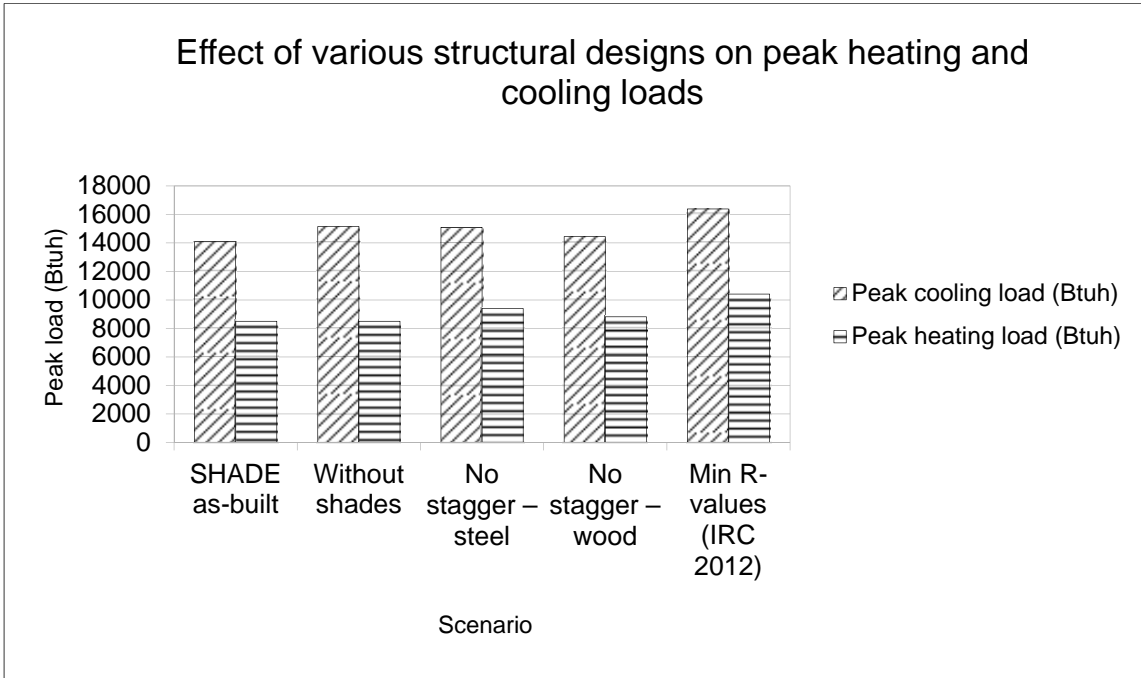


The loads were calculated for four zones: the Flex Space South, the Flex Space North, the Bathroom, and the Bedroom. Although SHADE has an open floor plan, the surface area of the ceiling determines the cooling capacity of each room's radiant array. The sensible load not met by the radiant ceiling and the required latent load are met by the chilled water fan coil unit.

There are several key features of SHADE's physical construction that implement this demand reduction approach. These include external constructions that shade glazed areas on the East, South, and West sides of the house, a staggered stud construction for the external walls, and a highly insulated envelope. Most of these features are non-standard compared to conventional residential construction.

External structures to shade glazed areas are common in the Southwest; however, in many residential applications they are added by residents as secondary features to house construction. The external structures of SHADE are integral to its design. Conventionally homes are typically constructed of structural members which provide thermal bridging between the ambient and internal conditions. Staggering, or offsetting the framing members of a wall results in an overall increase of the wall's thermal resistance by increasing the thermal resistance of each path for heat conduction.

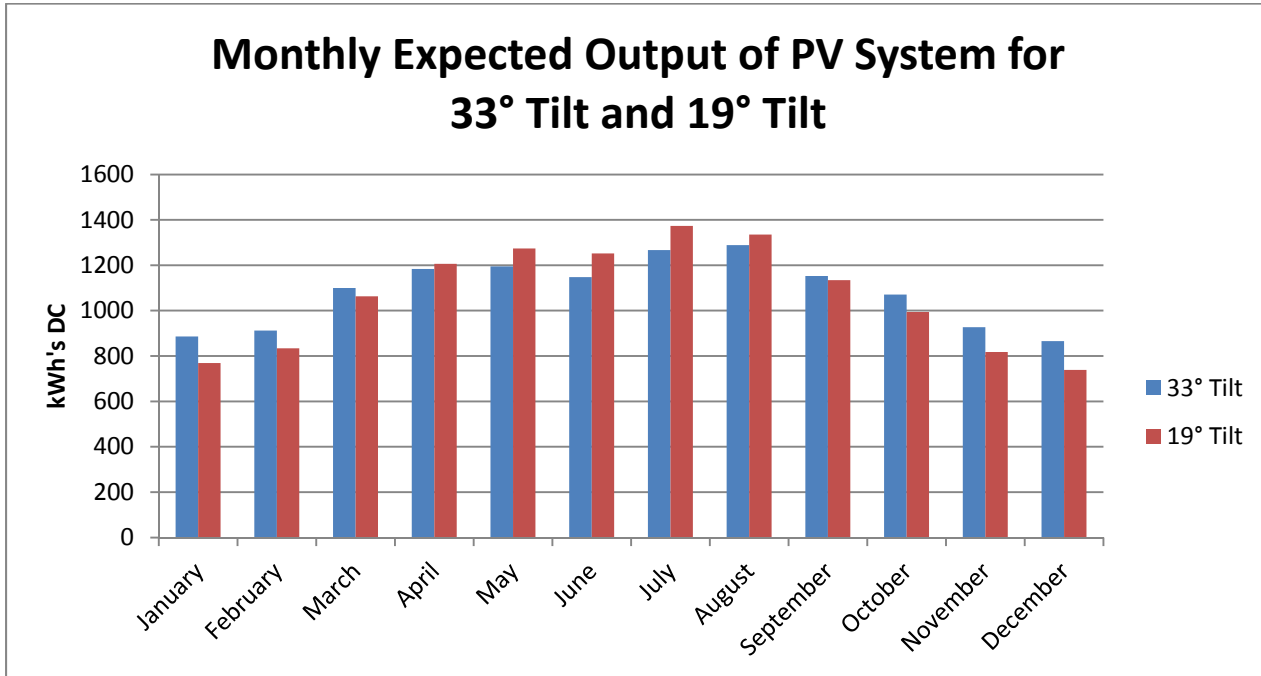
The reduction in cooling load due to these modifications can be quantified by comparing peak cooling and heating load calculations for SHADE with and without them. This parametric analysis was carried out by varying input values to the CLTD spreadsheet used for peak cooling and heating load calculations. The results are shown below, in Figure 7. It can be seen that the R-value of the wall contributes more to reducing the cooling load than any other feature. It can also be seen that the staggered steel stud construction performs better than a non-staggered construction using either steel or wood. The reduction in cooling load for SHADE compared to conventional construction approaches varies from 8 to almost 16%.



**Figure 7:** Impact of envelope and structural design options on peak heating and cooling loads

#### PV SYSTEM OUTPUT

Phoenix homes experience extreme electrical demands in the summer due to high cooling loads. It was thus decided to find a way to increase production of the PV system in the summer months. This can easily be done by lowering the tilt angle of the PV array. A shallower tilt angle increases production in the summer at the expense of decreased production in the winter. The height of the bottom of the PV canopy above the occupied space also influenced the decision of the final tilt angle. Through modeling in PVWatts and Homer, it was found that if the typical tilt for the PV system, which is close to the latitude of the locality, was roughly divided by two, the production gained in the summer months would outweigh the loss in the winter months and give favorable conditions in both summer and winter. A typical tilt for the Phoenix area is 33°. The final tilt for SHADE’s PV canopy was determined to be 19°. A comparison of the expected monthly output of SHADE’s PV array is shown in Figure 8. The added production in the hotter months of April through August is 357 kWh higher than at the typical tilt of 33 degrees. It should also be noted that the annual production was only affected by 207 kWh.



**Figure 8:** Comparison of monthly PV production for typical Phoenix tilt and SHADE’s PV array tilt.

The effect of the shallower tilt angle on the PV production during the contest was investigated, using data for Irvine, California. It can be seen in Figure 9 that the production during the Energy Balance contest period is less at an angle of 19° than if the PV array were at 33°; however, the added summertime benefit of the shallower angle, the architectural and aesthetic appeal of the PV canopy, and the minimum height requirement for the occupied space influenced the final tilt angle decision.

#### COMPARISON OF ELECTRICITY DEMAND AND PV PRODUCTION

Hourly demands were estimated based on expected scheduling for typical residential use of SHADE. This comparison was carried out using a spreadsheet input with all of the electrical loads of SHADE whose contribution to demand was evaluated room-by-room and an hourly basis. The effects of capacity control of fans, pumps, and the compressor can be evaluated, as can the estimated contribution of items such as clothes dryers to SHADE’s overall energy use. It bears mentioning that the unit of time of an hour may overestimate the total energy of the compressor, since it will be cycling, even with capacity control measures. On the other hand, when compressors cycle their efficiencies drop, leading to an increased electricity consumption for the start-up period.

It can be seen in Figure 9 that the maximum contribution to the household electricity demand is due to the Mechanical Room, to which the compressor is attributed. Regardless of whether thermal storage is used, the compressor dominates the electricity load. An hourly load profile used to generate this room-by-room contribution is shown in Figure 10. In the case of thermal storage, there is a baseline load at night due to the compressor running to make the ice. This profile is determined based on the outdoor temperature profiles typical of Phoenix in the hottest part of the summer and

SHADE's peak cooling load. These two profiles are shown together in Figure 11. In the case without thermal storage the compressor is expected to cycle more to meet load. In the case with thermal storage, there is no compressor load during the hottest part of the day when the ice is being melted for cooling. The scheduling to freeze and melt ice can be seen plotted with the dry bulb temperature in the summer of Phoenix.

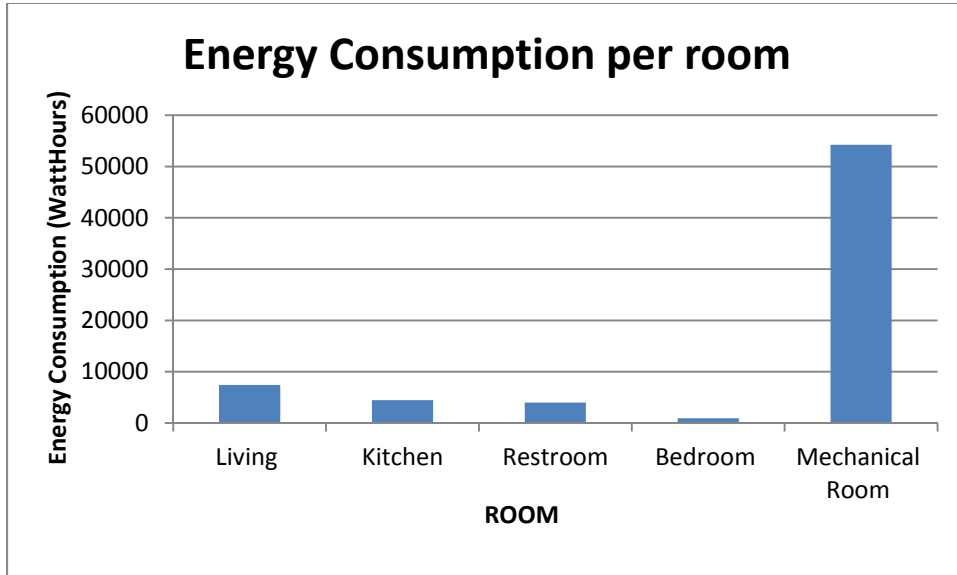


Figure 9: Room-by-room energy consumption for SHADE in summer, with thermal storage.

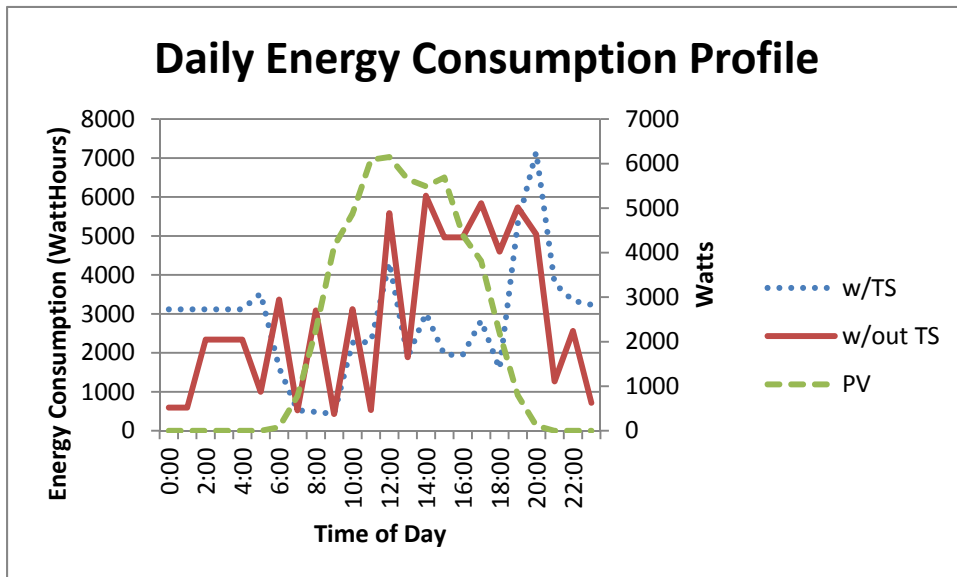
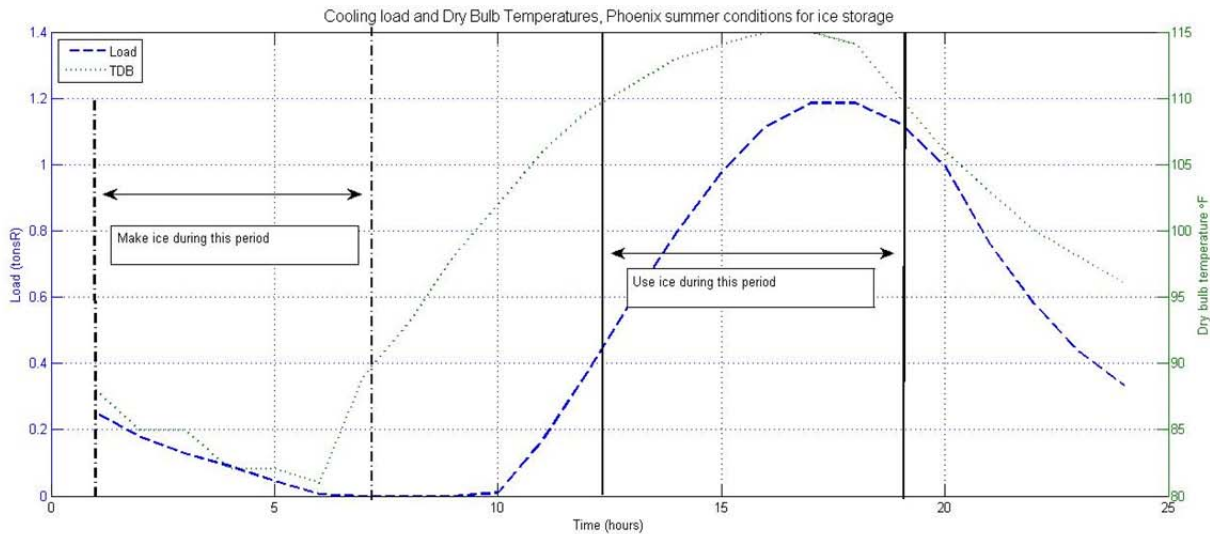


Figure 10: Whole house daily energy consumption profile for summer, with and without thermal storage. PV output is also shown.

It can also be seen in Figure 10 that the PV output is lower than the nominal array rating, by almost 40%. The hourly PV data come from Homer, which can take temperature effects into account. The hot ambient conditions and intense insolation in Phoenix reduce the efficiency and output of the PV array.



**Figure 11:** Peak cooling load profile and outdoor dry bulb temperature for Phoenix.

Using thermal storage in this way shifts the electricity usage from peak use time to off-peak. This may result in energy savings, since the compressor will be more efficient at lower ambient temperatures. In the scenario shown in Figure 10 there is a reduced energy consumption of 3.5% using thermal storage vs. not. However, as the evaporator temperature drops in order to cool the working fluid enough to make ice, compressor efficiency will also drop. Due to this effect, the use of thermal storage for cooling is predicted to produce slight energy savings, or be energy neutral compared to the case without thermal storage. Additional savings include monetary savings due to time of use rates, which can be up to three times higher than off-peak rates; as well as making viable options available for distributed energy storage to increase penetration of renewable energy into the grid.

The same spreadsheet approach that was used to calculate hourly and daily loads was used to estimate annual electricity demand. While this kind of estimate is subject to error based on assumptions of scheduling and the limitations of hourly inputs, it provides a starting point for estimated annual use of a residence. The annual estimated electricity demand for many of the large appliances is shown in Table 1.

The estimated annual output of the PV array, given by Homer, is 15740 kWh. This shows that based on assumptions of scheduling and performance of equipment, SHADE should be net positive or net zero. While this also indicates that a smaller PV array could be used the decision to size up is based on the desire to perform well in the Energy Balance contest.



<b>Table 1: Estimated annual electricity consumption</b>	
<b>Appliance</b>	<b>Annual Estimated Energy Demand (kWh)</b>
Lights	365
Washer	443.11
Dryer	1136.975
Oven	175.2
Refrigerator	539.835
Dishwasher	287.985
Laptop	840.96
TV	654.81
Range Hood	75.92
Water Heater	1204.5
Estimated HVAC	6950.33
<b>Total:</b>	
per year	12674.63
per week	243.74
per month	1056.22
per day	34.73





## FEATURES WHOSE CONTRIBUTION IS DIFFICULT TO QUANTIFY

Some of the features implemented in SHADE contribute to energy savings in ways that have proven to be difficult to quantify. For example, some of the interior walls feature a clay finish that passively absorbs and desorbs humidity from the air. Passive humidity control reduces the latent load needing to be satisfied mechanically; however, the extent to which this translates to reduced fan electricity consumption is difficult to quantify without extensive testing or complex simulation.

Another example is the Phase Change Materials placed in the floor, above the ceiling, and in the walls. This material is meant to behave in a way similar to thermal mass; its effect is to slow down temperature changes and lower the overall peak temperature. These effects can be quantified somewhat and expected values are given by the manufacturer; however, the behavior in individual applications with varying ratios of mass to surface or volume defy simple analysis. Furthermore, as with the analysis of the thermal storage unit, the process of phase change and its modeling or simulation introduce complications not well approximated with simple models.

Many of the building modeling packages available have a broad range of application for conventional buildings: those using forced-air systems and standard construction methods. However, most of them only apply with great caution, or difficulty, or both, to a building with unconventional features such as a radiant ceiling or envelope-incorporated phase change materials. While this poses a challenge to those seeking to justify the use of unconventional features quantitatively, it also presents an opportunity for improvement and expansion of modeling and simulation packages.

## CONCLUSION

The major elements contributing to the energy analysis of SHADE have been presented and discussed. The major systems contributing to energy production, consumption, and management include the cooling, heating, ventilation, PV, and controls systems. The effect of envelope construction and geometry was investigated, and it was seen that the envelope features employed in the construction of SHADE reduced its energy usage compared to conventional construction methods. The effect of a shallower tilt angle for the PV array compared to standard practice was investigated and this arrangement was found to give higher outputs in summer, when the largest electricity demands occur due to high cooling loads. Estimates of annual electricity use were generated based on real data from the equipment in SHADE and assumptions about scheduling based on typical residential usage patterns. SHADE is predicted to be net positive for the year in Phoenix, and net zero for the contest in Irvine. Finally, there are several aspects of SHADE's construction whose contributions to energy savings are expected to be noticeable, but which are difficult to accurately quantify and analyze. These aspects contribute to the innovation of SHADE, which can serve as an example for sustainable residential construction for the American Southwest and provide research and testing opportunities for these and other cutting edge approaches.



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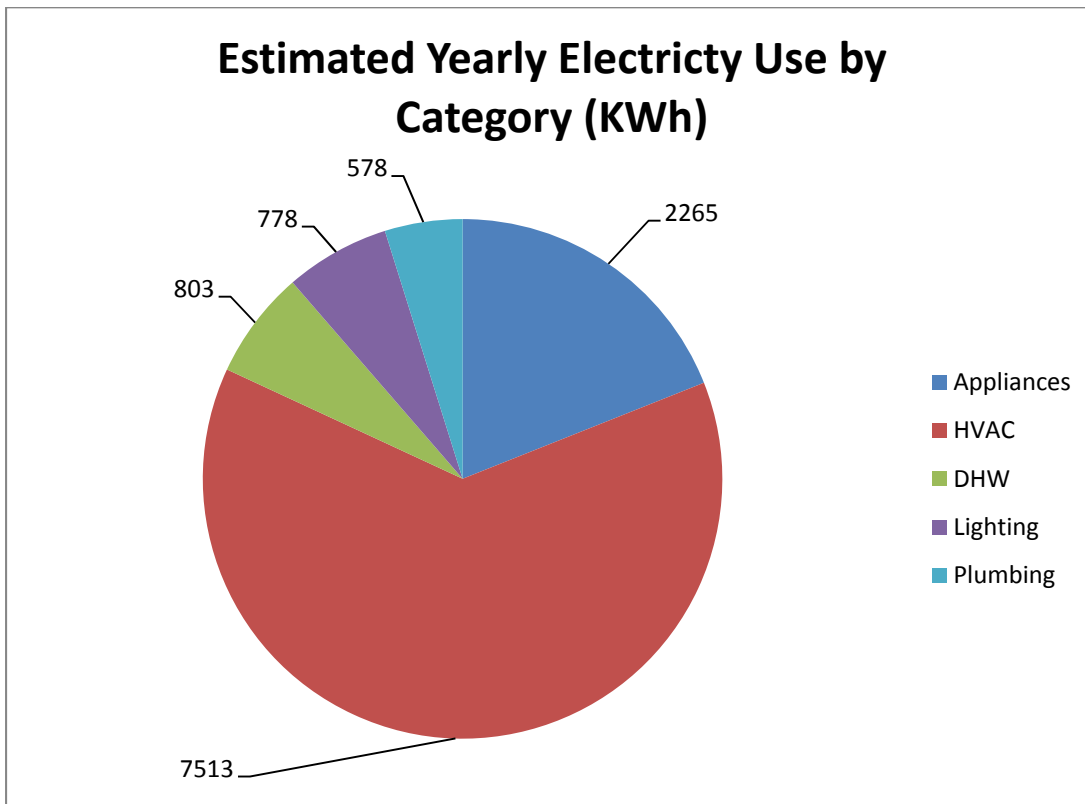
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## House Energy Demand and Appliances



Estimated annual electricity use by end-use category



## Quantity Takeoff of Competition Prototype House

### QUANTITY TAKEOFFS FOR ASUMN SOLAR DECATHLON 2013

Specification Number	Brief Description	Detailed Description	Qty	Unit
Division 01 General Requirements				
01 51 13	Temporary Electricity	Generators	2	Each
Division 03 Concrete				
03 40 00	Precast Concrete	Bathroom Sink	1	Each
Division 05 Metals				
05 00 00	Metals	Steel Angles	27	L.F.
05 05 23	Metal Fastenings	Z-girts and hat channels that will hold the fiber cement board to the exterior of the building	-	-
05 05 23	Metal Fastenings	2" Z-Furring @ 54 mil 3'4"	13	Each
05 05 23	Metal Fastenings	2" Z-Furring @ 54 mil 11'6"	11	Each
05 05 23	Metal Fastenings	2" Z-Furring @ 54 mil 10'6"	19	Each
05 05 23	Metal Fastenings	7/8" Furring Channel @ 54 mil 10'6"	13	Each
05 05 23	Metal Fastenings	7/8" Z-Furring @ 54 mil 10'6"	6	Each
05 05 23	Metal Fastenings	7/8" Furring Channel @ 54 mil 11'0"	12	Each
05 05 23	Metal Fastenings	7/8" Z-Furring @ 54 mil 11'0"	3	Each
05 05 23	Metal Fastenings	7/8" Furring Channel @ 54 mil 11'6"	5	Each
05 05 23	Metal Fastenings	7/8" Z-Furring @ 54 mil 11'6"	1	Each
05 12 00	Structural steel framing	HSS steel beams and columns, structural steel angle steel plates at foundations	-	-
05 12 00	Structural steel framing	Columns (HSS 3x3x3/16)	178	L.F.
		Columns (HSS 5x5x3/8)	68	L.F.
05 12 00	Structural steel framing	High Roof Beams (HSS 3x2x1/8)	195	L.F.
05 12 00	Structural steel framing	Low Roof Beams (6x3x1/4)	159	L.F.
05 12 00	Structural steel framing	Low Roof Beams (8x3x1/4)	37	
05 12 00	Structural steel framing	Axle Beams (W 12x14)	67	L.F.
05 12 00	Structural steel framing	Axle Cross Beam (W 12x22)	92	L.F.
05 12 00	Structural steel framing	Front and Back Rails (MC 12x10.6)	71	L.F.
05 12 00	Structural steel framing	Edge Beams (M 12x11.8)	239	L.F.
05 12 00	Structural steel framing	Cross Beams (M 12x11.8)	90	L.F.



05 12 00	Structural steel framing	High cantilevered beam (HSS 10x5x1/4)	47	L.F.
05 17 00	Structural Rod Assemblies	1"x42" double headed tent stakes for seismic performance.	20	Each
05 40 00	Cold-Formed Metal Framing	Roof Joists - 800S162-54 @ 24" O.C.	251	S.F.
05 40 00	Cold-Formed Metal Framing	Roof Joists - 600S162-54 @24" O.C.	238	S.F.
05 40 00	Cold-Formed Metal Framing	Floor Joists - 600S200-54 @ 12" O.C.	433	S.F.
05 40 00	Cold-Formed Metal Framing	Floor Joists - 600S200-54 @ 12" O.C.	397	S.F.
05 40 00	Cold-Formed Metal Framing	Exterior wall studs - 362S162-54 @ 24" O.C.	442	S.F.
05 40 00	Cold-Formed Metal Framing	Exterior wall studs - 162S125-33 @ 24" O.C.	442	S.F.
05 40 00	Cold-Formed Metal Framing	Exterior wall studs - 362S162-54 @ 24" O.C.	415	S.F.
05 40 00	Cold-Formed Metal Framing	Exterior wall studs - 162S125-33 @ 24" O.C.	415	S.F.
05 40 00	Cold-Formed Metal Framing	Parapet walls - 250S162-54 @ 24" O.C.	97	S.F.
05 40 00	Cold-Formed Metal Framing	Parapet walls - 250S162-54 @ 24" O.C.	98	S.F.
05 40 00	Cold-Formed Metal Framing	Interior studs - 550S162-54 @ 16" O.C. @ 16" O.C.	282	S.F.
05 40 00	Cold-Formed Metal Framing	Roof Rafters - 800S162-54 @16" O.C.	251	S.F.
05 50 00	Metal Fabrications	600S200-54 @ 12" O.C.	332	L.F.
		10 Flitch Columns	48	L.F.
		11 Flitch Beams	247	L.F.
05 54 00	Metal floorplate	Rock pan at south deck	1 @ 33	S.F.
05 75 00	Architectural Metalwork	18 guage sheet metal	104	S.F.
<b>Division 06 Wood, Plastics and Composites</b>				
06 00 00	Wood, Plastic, and Composites	Plastic landscaping stakes	32	Each
06 10 00	Rough Carpentry	Blocking, furring, general spacings and fastening	-	As Needed
06 11 00	Wood Framing	Dimensional Lumber	9,352	L.F.
06 16 00	Sheathing	Exterior sheathing	3,780	S.F.
06 22 00	Millwork	Cabinetry (kitchen, bathroom shelves)	130	S.F.
06 40 13	Exterior Architectural Woodwork	Shade screens	13	Unit
06 40 23	Interior Architectural Woodwork	Bamboo for shower finish and soffit	781	S.F.
06 73 00	Composite decking	Trex decking	850	S.F.



Division 07		Thermal and Moisture Protection			
07 14 00	Fluid-applied waterproofing	Elastomeric paint on roof	1,00	S.F.	
07 20 00	Thermal Protection	BioPCM	1,600	S.F.	
07 21 13	Board Insulation	Rigid insulation	900	S.F.	
07 21 19	Foamed-In-Place Insulation	Heat-Loc thermal Insulation (4")	2,768	S.F.	
07 21 19	Foamed-In-Place Insulation	Thermal insulation at roof	847	S.F.	
07 27 00	Air Barriers	Fluid-applied water resistive weather barriers on walls	1,891	S.F.	
07 44 56	Mineral-fiber-reinforced cementitious panels	Exterior cladding/ interior finish at core wall	3,520	S.F.	
07 62 00	Sheet metal flashing and trim	Flashing at roof	158	L.F.	
07 71 23	Manufactured gutters and downspouts	Rainwater scuppers	4	Each	
07 71 26	Reglets	At corner terminations	840	L.F.	
07 90 00	Joint Protection	Building module seams	88	L.F.	
Division 08		Openings			
08 11 16	Aluminum doors and frames	Exterior Doors	4	Each	
08 11 16	Aluminum doors and frames	Exterior Doors	172	S.F.	
08 14 16	Flush wood doors	Interior face flush wood doors	2	Each	
08 14 16	Flush wood doors	Privacy Door	1	Each	
08 14 16	Flush wood doors	Pivot slide door	1	Each	
08 14 16	Flush wood doors	Interior panel door	6	Panels	
08 33 23	Overhead coiling doors	Mechanical room door	1	Each	
08 35 13.13	Accordion folding doors	Exterior panel door	1	Each	
08 51 13	Aluminum windows	Window Frames/glazing. Approx. sizes 36"x96", 54"x96", 18"x96", 36"x106"	4	Unit	
08 71 00	Door hardware	Pivot door system	1	Each	
08 71 00	Door hardware	Flushed panel door	2	Each	
08 71 00	Door hardware	Track panel door	1	Each	
08 80 00	Glazing	Exterior Window Glazing	331	S.F.	
08 95 00	Vents	Vents	9	Each	
Division 09		Finishes			
09 21 00	Plaster and Gypsum Assemblies	Fire-rated gypsum to receive clay on ceiling	800	S.F.	
09 25 26	Natural clay plastering	Clay finish system interior walls (two coats)	900	S.F.	
09 29 00	Gypsum Board	Fire-rated gypsum	1500	S.F.	
09 60 29	Marmoleum Flooring	Marmoleum Striato petrified wood 3577	800	S.F.	
09 94 23	Interior painting	Paint/Primer	300	S.F.	



Division 10		Specialties		
10 22 23.23	Moveable partition system	Interior partition wall	1	Each
Division 11		Equipment		
11 00 00	Equipment	Heavy equipment in construction	2	Each
11 31 13	Residential Kitchen appliances	Residential appliances - Range, Cook-top, Dishwasher, Refridgerator	4	Unit
11 31 23	Residential Laundry appliances	Residential appliances - Stackable Dryer/Washing Machine	2	Unit
11 52 00	Audio-visual equipment	Audio-visual equip (speakers system)	5	Each
11 52 13	Projection screens	Prodisplay projection screen/film	1	Each
11 52 16.19	Overhead projectors	Projector	1	Each
Division 12		Furnishings		
12 36 00	Countertops	Kitchen counters	51	S.F.
Division 13		Special Construction		
13 30 00	Special Structures	Unirac system - solar mount	560	L.F.
13 42 00	Building Modules	Building modules	3	Each
Division 21		Fire Suppression		
21 13 13	Wet-Pipe Sprinkler System	Sprinkler system	850	SF/living
Division 22		Plumbing		
22 11 16	Domestic Water Piping	Plumbing pipes (supply and return)	225	L.F.
22 11 23	Domestic Water Pumps	Water pump	1	Each
22 12 00	Facility-potable water storage tank	Potable water storage tank	3	Each
22 14 00	Facility storm drainage	Water hogs storage tanks	6	Each
22 14 13	Facility storm drainage piping	Roof drain/overflow drain	3	Each
22 33 00	Electrical Domestic Water Heaters	Hot water tank	1	Each
22 41 00	Residential Plumbing Fixtures	Drainage pans	3	Unit
22 41 13	Residential water closets, urinals, and bidets	Toilet	1	Each
22 41 16	Residential lavatories and sinks	Fixtures (lavatories/ sinks)	2	Unit
22 41 23	residential shower receptors and basins	Shower receptors and basins	1	Each
22 41 39	Residential faucets, supplies, and trim	Shower fixtures	1	Each



Division 23		Heating, Ventilating, and Air-Conditioning		
23 05 29	Hangers and supports for HVAC piping and equipment	Hangers and Supports for HVAC Piping and Equipment	-	As Needed
23 09 13	Instrumentation and control devices for HVAC	HVAC control devices	1	Each
23 09 13	Instrumentation and control devices for HVAC	ACI A/RH5-D	1	Each
23 09 13	Instrumentation and control devices for HVAC	Divelbiss PCS-101	1	Each
23 09 13	Instrumentation and control devices for HVAC	Divelbiss HDIO 24P	3	Each
23 09 13	Instrumentation and control devices for HVAC	Honeywell HSS-DPS	4	Each
23 09 13	Instrumentation and control devices for HVAC	Honeywell T775	2	Each
23 09 13	Instrumentation and control devices for HVAC	Honeywell 500721579	2	Each
23 09 13	Instrumentation and control devices for HVAC	Kele UAT-1	1	Each
23 09 13	Instrumentation and control devices for HVAC	Mamac Systems TE213BC21B3	1	Each
23 09 13	Instrumentation and control devices for HVAC	Mamac Systems TE213F1B3	1	Each
23 09 13	Instrumentation and control devices for HVAC	RCS RTS3	4	Each
23 09 13	Instrumentation and control devices for HVAC	TZ45R	4	Each
23 21 13	Hydronic Piping	Beka 20 mm pipe	216	Each
23 21 13	Hydronic Piping	Beka 20 mm 90's	30	Each
23 21 13	Hydronic Piping	Beka 20 mm couplers	24	Each
23 21 13	Hydronic Piping	Beka 20 mm caps	12	Each
23 21 13	Hydronic Piping	Beka 20 mm T's	2	Each
23 21 13	Hydronic Piping	Aquatherm 20 mm 1/2" MNPT fitting	3	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm pipe	20	L.F.
23 21 13	Hydronic Piping	Aquatherm 32 pipe	14	L.F.
23 21 13	Hydronic Piping	Copper pipe, 3/4"	30	L.F.
23 21 13	Hydronic Piping	Copper nipple, 3/4" x 2 1/2"	8	Each
23 21 13	Hydronic Piping	Aquatherm T's 3/4" to 1"	8	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm 90's	4	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm T's	2	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm unions	8	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm ball valve	10	Each
23 21 13	Hydronic Piping	Aquatherm 25 to 20 mm couplers	10	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm FNPT fittings	8	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm MNPT fittings	9	Each
23 21 13	Hydronic Piping	Aquatherm 25 mm couplers	2	Each





23 21 13	Hydronic Piping	Aquatherm 32 mm 45's	2	Each
23 21 13	Hydronic Piping	Aquatherm 32 mm 90's	8	Each
23 21 13	Hydronic Piping	Aquatherm 32 mm ball valve	4	Each
23 21 13	Hydronic Piping	Aquatherm 32 mm union	4	Each
23 21 13	Hydronic Piping	Aquatherm 32 mm threaded T	4	Each
23 21 13	Hydronic Piping	Webstone Fill & Purge	2	Each
23 21 13	Hydronic Piping	Webstone Expansion tank valve	2	Each
23 21 13	Hydronic Piping	Webstone Air Separator	2	Each
23 21 13	Hydronic Piping	2.1 Gallon Expansion tank	2	Each
23 21 13	Hydronic Piping	Y-strainer	1	Each
23 21 13	Hydronic Piping	Check valve	1	Each
23 21 13	Hydronic Piping	Plast-o-matic 3/4" ball valve	4	Count
23 21 13	Hydronic Piping	Push lok 3/4" hose	4	Each
23 21 13	Hydronic Piping	Push lok 3/4" MNPT fittings	4	Each
23 21 13	Hydronic Piping	Honeywell VCZMR7100	2	Each
23 21 13	Hydronic Piping	Honeywell VC8114ZZ11	2	Each
23 21 13	Hydronic Piping	Honeywell VBN3AF3	1	Each
23 21 13	Hydronic Piping	Honeywell VBN3AH3	1	Each
23 21 13	Hydronic Piping	Honeywell V8043E1145/U	4	Each
23 21 13	Hydronic Piping	Griswold Quickset	6	Each
23 21 23	Hydronic Pumps	Circulating pump	1	Each
23 21 23	Hydronic Pumps	Grundfos Magna 32-100N	1	Count
23 21 23	Hydronic Pumps	Bell&Gossett Eco Vario	1	Count
23 23 00	Refrigerant Piping	refrigerant piping for between thermal storage and chiller	20	L.F.
23 31 00	HVAC Ducts and Casings	ductwork, including flex duct	45	L.F.
23 31 00	HVAC Ducts and Casings	Duct, rect, 20" x 7"	4	L.F.
23 31 00	HVAC Ducts and Casings	Duct, rect, 19" x 8"	1	L.F.
23 31 00	HVAC Ducts and Casings	6" round duct	40	L.F.
23 31 00	HVAC Ducts and Casings	6" round dampers	3	Each
23 31 00	HVAC Ducts and Casings	Field fabricated fittings/cans	10	Lbs.
23 31 00	HVAC Ducts and Casings	6" insulated flex duct	10	L.F.
23 31 00	HVAC Ducts and Casings	6" duct insulation/vapor barrier	30	L.F.
23 32 33	Air-Distribution Ceiling Plenums	Plenums	4	Each
23 37 13	Diffusers, registers, and grilles	Supply diffusers	1	Each
23 37 13	Diffusers, registers, and grilles	Return grille	3	Each
23 37 13	Diffusers, registers, and grilles	Supply grille	1	Each
23 37 13	Diffusers, registers, and grilles	Titus FL30	1	Each
23 37 13	Diffusers, registers, and grilles	Titus MLR	4	Each
23 38 00	Ventilation hoods	Ventilated hoods	1	Each



23 57 00	Heat exchangers for HVAC	Heat exchanger for Beka system; Bell&Gossett BPN410-20	1	Each
23 64 23	Scroll Water Chillers	Chillking water chiller/heat pump	1	Each
23 71 00	Thermal storage	Thermal storage	1	Each
23 72 19	Fixed Plate air-to-air energy recovery equipment	Air-to-air energy recovery equipment	1	Each
23 80 00	Decentralized HVAC Equipment	BEKA Capillary Mat System (radiant cooling)	546	S.F.
23 82 19	Fan coil units	Air Handling Unit /Fan Coil; JCI HLP/FHP 020	1	Unit
23 83 16	Radiant-heating hydronic piping	Capillary hydronic tubing	800	S.F.
<b>Division 25 Integrated Automation</b>				
25 35 16	Integrated Automation Sensors and Transmitters	Data logger	1	Unit
25 35 16	Integrated Automation Sensors and Transmitters	Enclosure dew point sensor	4	Each
	Integrated Automation	Controls	1	Unit
<b>Division 26 Electrical</b>				
26 09 23	Lighting control devices	Lighting controls	1	Each
26 22 00	Low-Voltage Transformers	Transformer for landscape lighting	1	Each
26 24 16	Panelboards	Including main electrical distribution	2	Each
26 27 13	Electricity metering	Meter housing	1	Each
26 31 00	Photovoltaic Collectors	Photovoltaic panels	36	Each
26 31 00	Photovoltaic Collectors	Photovoltaic panels	680	S.F.
26 51 00	Interior Lighting	Interior Lighting	11	Each
26 56 00	Exterior lighting	Exterior landscape and walkway lighting; LED Lighting	7	Each
26 56 00	Exterior lighting	Exterior landscape and walkway lighting; FB Frère Bébé	20	Each
<b>Division 27 Communications</b>				
27 20 00	Data communications	Data communications	150	L.F.
<b>Division 28 Electronic Safety and Security</b>				
28 31 46	Smoke detection sensors	Smoke detectors	2	Each
<b>Division 31 Earthwork</b>				
31 66 00	Special Foundations	Foundation Piers	110	Each



Division 32		Exterior Improvements		
32 00 00	Exterior Improvements	Benches	3	Each
32 14 13.13	Precast Concrete Unit Paving	1 3/4 precast concrete paver (in rock bed), decking pavers	14 @ 54	Each
32 35 00	Screening Devices	Green screens	9	Each
32 91 16.19	Netting Planting Soil Stabilization	Mesh for mulch	1,072	S.F.
32 93 00	Plants	Plants	169	Each
32 94 33	Planters	Planters	1,072	S.F.
Division 33		Utilities		
33 79 00	Site Grounding	Site Grounding	1	N/A
Division 48		Electrical Power Generation		
48 19 16	Electrical power generation inverters	Inverters	2	Each



## **SD Building Code Content and Compliance**

### **CODES, STANDARDS, AND REFERENCES USED**

Americans with Disabilities Act - ADA  
International Code Council - ICC A117.1  
International Building Code (IBC)  
International Residential Code (IRC)  
Solar Decathlon Design Code (SDC)  
American Society of Civil Engineers - ASCE 07-10  
APA – The Engineered Wood Association  
National Fire Protection Association (NFPA)  
National Electric Code (NEC)  
American Society for Testing and Materials - ASTM E84



## Construction Specifications

**NOTE:**

THE SPECIFICATIONS IN THE FOLLOWING SECTION ARE COMPLETED TO THE BEST OF OUR KNOWLEDGE TO DATE. SPECIFICATIONS MAY REMAIN IN A GENERALIZED TEMPLATE FORM AS PLACEHOLDERS UNTIL EDITED WITH FURTHER DETAILS AND UPDATES ACCORDINGLY UP TO AND THROUGH COMPLETION OF COMPETITION HOUSE PROTOTYPE.



**Division 00 – Procurement and Contracting Requirements**

SECTION NOT USED AT THIS TIME



## Division 01 - General Requirements

### SECTION 01 51 13 - TEMPORARY ELECTRICITY

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes: portable generators

##### 1.02 SUBMITTALS

- A. Product data: For each type of product
  1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, components, and performance
  2. Operation and maintenance data

##### 1.03 STORAGE AND HANDLING

- A. As per manufacturer's instructions

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
  1. Sacred Power Corporation, 1501 12th St. NW, Albuquerque, NM 87104  
Phone: (505) 242-2292, Fax: (505) 247-4616, E-mail: [info@sacredpowercorp.com](mailto:info@sacredpowercorp.com), Website: <http://www.sacredpowercorp.com>
    - a) Model: SP 800 Hybrid generator

##### 2.02 PERFORMANCE REQUIREMENTS

- A. Sound rating: Low tone muffler or other for operation below 85 dBa
- B. Rated Watts: 800



## 2.03 COMPONENTS

A. Components for PV hybrid generators will include any of the following:

1. Photovoltaic PV array: 1000 peak watts/hr
2. Dual-axis tracker
3. Gel Cell batteries
4. Cool cell battery box
5. Wind turbine

## 2.04 MOTORS

A. All motors shall comply with ANSI/NEMA MG 1-2011, temperature rating, service factor, and efficiency requirements for motors.

1. Enclosure: Totally enclosed, fan cooled or totally enclosed, air over.
2. Enclosure Materials: Cast aluminum or Rolled steel.
3. Electrical Characteristics:
  - a) Power Output: 2kVA
  - b) Voltage Output: 120 VAC
  - c) Current Output: 17 Amps AC
  - d) PV Output: 800 W
  - e) Battery Capacity: 200Ah@24V

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine equipment before use.
- B. Reject equipment that is damaged.

### 3.02 APPLICATION





A. Exterior use only

END OF SECTION 01 51 13



## SECTION 01 54 23 - TEMPORARY SCAFFOLDING AND PLATFORMS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Temporary scaffolding and working platforms

#### 1.02 REFERENCES

- A. Occupational Safety and Health Act (OSHA): OSHA Part 1910, Subpart D, 1910.28

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:

1. Werner
2. BIL-JAX
3. Other

#### 2.02 COMPONENTS

- A. System components:

1. Platform guard railings and toe board assemblies
2. Scaffold plank units
3. Scaffold frame units
4. Cross braces
5. Outriggers
6. Leveling jack
7. Pins and fastenings



## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Occupational Safety and Health Act (OSHA): OSHA Part 1910, Subpart D, 1910.28. Comply with 29 CFR 1910.28 for use of scaffolding.

### 3.02 ERECTION

- A. Equipment Installation: Install scaffolding as per manufacturer's instructions

### 3.03 FIELD QUALITY CONTROL

- A. Inspections: Engage a competent person knowledgeable in OSHA Part 1910, Subpart D to perform inspections before use.

END OF SECTION 01 54 23



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The Design School, Attn: Solar Decathlon 2013 PO Box 871605, Tempe, AZ 85287-1605

**Division 02 – Existing Conditions**

SECTION NOT USED AT THIS TIME



## Division 03 – Concrete

### SECTION 03 40 00 – PRECAST CONCRETE

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes: Concrete sink

##### 1.02 RELATED SECTIONS

- A. Section 22 11 16 – Domestic water piping

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store and dispose of Solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- B. Comply with manufacturers written instructions for storage, handling and protection prior to and during installation.

##### 1.04 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.

#### PART 2 - PRODUCTS

##### 2.01 STAINLESS CONCRETE VANITY SINK

- A. Manufacturer: Hard Goods, 2111 S Industrial Park Ave, Tempe, AZ 85282
- B. Type: Single bowl sink
- C. Product: GFRC "Yuma" concrete sink
- D. Size: 36" x 25" x 3"
- E. Color: Natural

#### PART 3 - EXECUTION



### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

### 3.02 PREPARATION

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

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
  - 1. Cleaner: Clean spills promptly with a low Ph cleaner. Longer exposure to spills may result in a stain.
  - 2. Seal prior to use with Dry Treat Stain Proof stone sealer.

### 3.04 PROTECTION

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

END OF SECTION 03 40 00



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**Division 04 – Masonry**

SECTION NOT USED AT THIS TIME



## Division 05 – Metals

### SECTION 05 00 00 - METALS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes: Design and installation of the non-structural steel angles.
- B. Related Sections:
  - 1. Section 05 12 00 - Structural Steel Framing
  - 2. Section 05 54 00 - Metal Floorplate

##### 1.02 SUBMITTALS

- A. Product Data

#### PART 2 - PRODUCTS

##### 2.01 STEEL ANGLES

- A. Manufacturer: To be determined
  - 1. System to be installed per drawing using appropriate fastening and hardware.
  - 2. Angles will serve as a material boundary in the rock pans in the exterior landscaping
  - 3. 3" x 3" x 3/16" steel angles

##### 2.02 FINISHES

- A. Mill finish, typical for all structural applications

#### PART 3 - EXECUTION

##### 3.01 INSTALLATION





- A. Prepare angles by removing projections.
- B. Set angles level without warp or rack of angle and panels and anchor securely to module beams.
- C. Fasten steel angles securely in place with 1/4" bolt to module beams.
- D. Correct deficiencies and reinstall any steel angles that do not comply with structural requirements.

END OF SECTION 05 00 00



## SECTION 05 05 23 – METAL FASTENINGS

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

#### 1.02 SUMMARY

- A. Section Includes: Hat channels, “V” channels, clips, and connectors to receive fiber cement exterior cladding.
- B. Related Requirements:
  - 1. Division 07 44 56 Section "Mineral-Fiber-Reinforced Cementitious Panels"

#### 1.03 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

#### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings: Provide shop drawings prepared by manufacturer.
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - 3. For cold-formed metal framing indicated to comply with design loads, include structural analysis and detailed shop drawings signed and sealed by a qualified professional engineer, who shall be licensed in the State in which the Project is located and responsible for their preparation.

#### 1.05 QUALITY CONTROL

- A. Codes and Standards:
  - 1. AISI North American Specification [NASPEC] 2001 Supplement
  - 2. ASTM C645 and C955



## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products manufactured by ClarkDietrich Building Systems specified in other Part 2 articles, or comparable products from other manufacturers.
  - 1. ClarkDietrich; 9100 Centre Pointe Dr, Suite 210, West Chester, OH 45069; Phone: 513-870-110; Fax: 513-870-1300
    - a) Furring/ Hat channel
    - b) V Chanel
    - c) Support clips and connections
  - 2. McMaster-Carr; 9630 Norwalk Blvd, Santa Fe Springs, CA 90670-2932; Phone: 562-692-5911
  - 3. Copper State Bolt & Nut Co.; copperstate.com

### 2.02 PRODUCT REQUIREMENTS

- A. Delegated Design: Design system to provide for tolerances for movement of exterior cladding material.

### 2.03 FURRING/ HAT AND "V" CHANNELS:

- A. Manufacturer's standard length; 10 feet & 20 feet.
  - 1. Basis-of-Design Product: ClarkDietrich Building Systems; Product Name: 087F125-54 (33ksi, G60).
  - 2. Size: 7/8 inch
  - 3. Depth: 0.875 inch
  - 4. Width: 1.250 inch
  - 5. Minimum Base-Metal Thickness: 54 mils (16 gauge)
  - 6. Finish: G60
- B. "V" Channel
  - 1. Depth: 1", 2"

### 2.04 SCREWS

- A. Manufacturer: Copper State Bolt & Nut Co.



## 1. Products

- a) #8x1/2" Flat head Phillips sheet metal screw type A
  - i) Material: Zinc
- b) #8x3" Bugle head Phillips Deck Screw Sharp Point
  - i) Material: Yellow Zinc
- c) Ultracon Masonry Fasteners 1/4 x 1 1/4" blue Phillips flat head
- d) Pro-Twist Marker 10 x 3 1/2" GS312; coarse yellow

## 2.05 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade 36, Grade 55, threaded carbon-steel bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated.
- E. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- G. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- H. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - a)Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- I. Welding Electrodes: Comply with AWS standards.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
- B. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- C. Install cold-formed steel channels and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
- D. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Erection Tolerances: Install cold-formed steel channels level, plumb, and true to line to a maximum allowable tolerance variation.

END OF SECTION 05 05 23



## SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes: Structural steel beams, columns and angles.

#### 1.02 SECTION REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate and install structural steel framing and weld elements to withstand structural loads required by International Residential Code 2009 and all applicable codes.

B. Submittals: Shop Drawings.

C. References: All structural steel work shall conform to the following governing standards:

1. American Society for Testing and Materials: ASTM Specifications for Structural Steel
2. American Welding Society: AWS Structural Welding Code, AWS Specifications for Welding Rods and Bare Electrodes
3. Industrial Fasteners Institute: IFS Handbook on Bolt, Nut and Rivet Standards

### PART 2 - PRODUCTS

#### 2.01 PRE-FABRICATED STRUCTURAL STEEL FRAMING

A. Suppliers: Shuff Steel Company, 420 S. 19th Avenue, Phoenix, AZ 85009, (602) 252-7787

B. Structural Steel Members:

1. M 12x11.8
2. MC 12x10.6
3. W 12x22
4. W12x14



5. HSS 3x3x3/16
6. HSS 5x5x3/8
7. HSS 8x3x1/4
8. HSS 3x2x1/8
9. HSS 6x3x1/4
10. HSS 6x3x3/8
11. HSS 4x3x5/16
12. HSS 10x5x1/4
13. L 3x3x1/4

## 2.02 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator. Comply with applicable provisions of the following:
  1. AISC 303
  2. AISC 341 and AISC 341s1
  3. AISC 360
  4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

## 2.03 STRUCTURAL STEEL PRODUCTS

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

## 2.04 ACCESSORIES

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



- B. Primer: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.

## 2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality and methods used for correctly welding.

## PART 3 - EXECUTION

### 3.01 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- C. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- D. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
- E. Correct deficiencies in or remove and reinstall any steel framing that does not comply with requirements.
- F. Repair, refinish, or replace aluminum extrusions and connecting hardware damages during installation, as directed by Architect.

END OF SECTION 05 12 00





## SECTION 05 17 00 – STRUCTURAL ROD ASSEMBLIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes steel stakes for seismic.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements American Society for Testing and Materials ASTM - 7. Available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Pioneer Tool & Forge Inc. Part # 2836WH, 1 x 36 w/2" Head

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: tent stake shall withstand the effects of earthquake motions determined according to IBC 2009 at least 1500lb sheer capacity.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine tent stakes before installation. Reject tent stakes that are warped or damaged.

#### 3.02 INSTALLATION

- A. As per manufacturer's instructions.

END OF SECTION 05 17 00



## SECTION 05 40 00 – COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes:

1. Cold-formed metal framing for walls.
2. Cold-formed metal framing for floors.
3. Cold-formed metal framing for roofs.

B. Related sections

1. Section 05 00 00 - Metals.
2. Section 05 05 23 - Metal Fastenings.
3. Section 05 12 00 - Structural Steel Framing.
4. Section 06 05 23 – Wood, Plastic, and Composite Fastenings.
5. Section 06 16 00 – Sheathing.
6. Section 07 21 19 – Foamed-In-Place Insulation.
7. Section 09 21 00 – Plaster and Gypsum Assemblies.
8. Section 09 29 00 – Gypsum Board.

#### 1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
3. ASTM A 1003 - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
4. ASTM B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
5. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel



Products or Metal Plaster Bases to Steel Studs from 0.033 inches to 0.112 inches in thickness.

6. ASTM C 955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
  7. ASTM C 1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
  8. ASTM C 1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- B. AISI - Standard for Cold-Formed Steel Framing General Provisions.
- C. AISI - North American Specification for the Design of Cold-Formed Steel Structural Members.
- D. AWS D.1.3 - Structural Welding Code - Sheet Steel.

#### 1.03 DESIGN REQUIREMENTS

- A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.
- B. Design loads: As indicated on the Structural Drawings.
- C. Design framing systems to withstand design loads without deflections greater than the following:
- D. Exterior Walls: Lateral deflection of: L/240.
- E. Interior Load-Bearing Walls: Lateral deflection of: L/240.
- F. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).
- G. Design framing system to accommodate deflection of primary building structure and construction tolerances.
- H. Design exterior non-load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.

#### 1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature, data sheets and installation recommendations for specified products.
- B. Manufacturers certification of product compliance with codes and standards.
- C. Structural Calculations: Submit structural calculations prepared by manufacturer for approval. Submittal shall be sealed by a professional engineer registered in the state of the project.



1. Description of design criteria.
2. Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
3. Selection of framing components, accessories and welded connection requirements.
4. Verification of attachments to structure and adjacent framing components.
5. Engineer shall have a minimum of 5 years experience with projects of similar scope.

D. Shop Drawings:

1. Submit shop drawings prepared by the cold-formed metal framing manufacturer showing plans, sections, elevations, layouts, profiles and product component locations, including anchorage, bracing, fasteners, accessories and finishes.
2. Show connection details with screw types and locations, weld lengths and locations, and other fastener requirements.
3. Where prefabricated or pre-finished panels are to be provided, provided drawings depicting panel configurations, dimensions and locations.
4. Shop Drawings shall be signed and sealed by a registered PE (professional cold-formed specialty engineer) registered in the state of the project.

1.05 QUALITY ASSURANCE

- A. Contractor shall provide effective, full time quality control over all fabrication and erection complying with the pertinent codes and regulations of government agencies having jurisdiction.
- B. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
- C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.
- D. Welding Standards: Comply with applicable provisions AWS D1.1 "Structural Welding Code – Steel" and AWS D1.3 "Structural Welding Code-Sheet Steel."
- E. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

1.06 DELIVERY, STORAGE, AND HANDLING

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



- B. Protect and store materials protected from exposure to rain, snow or other harmful weather conditions. Products to be handled per AISI's "Code of Standard Practice" .

## 1.07 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.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer, Metal Framing: United Metal Products, 4337 West Filmore St. Phoenix, AZ, 85043. Tel: (602) 272-6179. Fax: (602) 272-6183. Web: <http://www.unitedmetalproducts.info>.
- B. Substitutions: Not permitted.

### 2.02 COMPONENTS

- A. Structural Studs: Cold-formed galvanized steel C-studs
  1. Size: 1-5/8 inch (41 mm) flange width, 1/2 inch (12.7 mm) returns, and web depth as indicated on drawings;
  2. Size: 3 inch (76 mm) flange width, 5/8 inch (15.9 mm) returns, and web depth as indicated on drawings;
  3. Sizes: As indicated on drawings.
  4. Minimum Yield Strength: 50 ksi (345 MPa) for 16 gauge and heavier.
  5. Minimum Delivered Thickness: 16 gauge, 0.0538 inch (1.37 mm).
- B. Structural Runner Track: Cold formed galvanized steel sheet.
  1. Flange Length: 1 1/2 inch (38 mm).
  2. Minimum Yield Strength: 33 ksi (227 MPa) for 18 gauge and lighter.
  3. Material thickness to match stud/joist thickness unless design dictates heavier thickness.

### 2.03 MATERIALS

- A. Cold-Formed Steel Sheet: Complying with ASTM A 1003/A 1003M; unless indicated otherwise.
- B. Galvanized Coating: G60 coating weight minimum, complying with ASTM C 955.



1. Where required: G90 coating weight minimum, complying with ASTM C955.

## 2.04 FABRICATION

- A. General: Framing components may be pre-assembled into panels prior to erecting.
- B. Fabricate panels square, with components attached in a manner so as to prevent racking or distortion.
- C. Cut all framing components squarely for attachment to perpendicular members, or as required for an angular fit against abutting members. Hold members positively in place until properly fastened.
- D. Provide insulation as specified elsewhere in all double jamb studs and double header members, which will not be accessible to the insulation contractor.
- E. Axially Loaded Studs:
  1. Install studs to have full bearing against inside track web (1/8 inches (3.2 mm) maximum gap) prior to stud and track attachment.
  2. Splices in axially loaded studs are not permitted.
- F. Fasteners: Fasten components using self-tapping screws or welding.
- G. Welding: Welding is permitted on 18 gauge or heavier material only.
  1. Specify welding configuration and size on the Structural Calculation submittal.
  2. Qualify welding operators in accordance with Section 6.0 of AWS D.1.3.
  3. Touch up all welds with zinc-rich paint in compliance with ASTM A 780.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 ERECTION

- A. General Erection Requirements:
  1. Install cold-formed framing in accordance with requirements of ASTM C1007.



2. Weld in compliance with AWS D.1.3.
3. Install in compliance with applicable sections of the AISI's Standard for Cold-Formed Steel Framing General Provisions.

B. Wall Systems:

1. Erect framing and panels plumb, level and square in strict accordance with approved shop drawings.
2. Handle and lift prefabricated panels in a manner so as not to cause distortion in any member.
3. Anchor runner track securely to the supporting structure as shown on the erection drawings. Install concrete anchors only after full compressive strength has been achieved. Provide a sill sealer or gasket barrier between all concrete and steel connections.
4. Butt all track joints. Securely anchor abutting pieces of track to a common structural element, or butt-weld or splice them together.
5. Align and plumb studs, and securely attach to the flanges or webs of both upper and lower tracks except when vertical movement is specified.
6. Install jack studs or cripples below window sills, above window and door heads, at freestanding stair rails and elsewhere to furnish support, securely attached to supporting members.
7. Attach wall stud bridging in a manner to prevent stud rotation. Space bridging rows according to manufacturer's recommendations.
8. Frame wall openings to include headers and supporting studs as shown in the drawings.
9. Provide temporary bracing until erection is completed.
10. Provide stud walls at locations indicated on plans as "shear walls" for frame stability and lateral load resistance.
11. Where indicated in the drawings, provide for structural vertical movement using a vertical slide clip or other means in accordance with manufacturer's recommendations.

C. Steel Joists:

1. Locate joists directly over bearing studs within 3/4 inch (19 mm) or provide a suitable load distribution member at the top track.
2. Provide web stiffeners at reaction points where indicated in drawings.



3. Provide joist bridging as shown in drawings.
4. Provide end blocking where joist ends are not otherwise restrained from rotation.

### 3.03 FIELD QUALITY CONTROL

- A. Inspection: Periodic special inspections are required by local code authorities.
  1. Owner will hire and pay inspection agency.
  2. Submit schedule showing when the following activities will be performed and resubmit schedule when timing changes.
  3. Notify inspection agency not less than 3 days before the start of any of the following activities.
  4. Inspections are required during welding operations, screw attachment, bolting, anchoring and other fastening of components within the force resisting structural system, including struts, braces, and hold-downs.

### 3.04 PROTECTION

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

END OF SECTION 05 40 00





## SECTION 05 50 00 – METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Flitch Columns
- B. Related Sections:
  - 1. Section 06 40 13 - Exterior Architectural Woodwork

#### 1.02 ACTION SUBMITTALS

- A. Shop Drawings:
  - 1. Include plans, elevations, sections, and supporting details.
  - 2. Include details of material assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of architectural metalwork.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by supplier

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store in dry, protected, well-ventilated area and protect from damage.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Saguaro Steel - 5/8" sheet steel



B. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. Saguaro Steel

## 2.02 FABRICATION

- A. Shop Assembled

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine all products specified above before installation. Reject any products that are wet, moisture damaged, scratched, or damaged.
- B. Notify Architect of unsatisfactory conditions.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best results.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install materials level, plumb, sure, true and straight.
- C. Adjust as necessary to ensure tight fitment.

### 3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION 05 50 00



## SECTION 05 54 00 – METAL FLOORPLATE

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes metal fabrications for the following applications:

1. Rock pan in planting modules
2. Rock pan on decking

#### 1.02 RELATED SECTIONS

- A. Section 05 00 00 - Metals.
- B. Section 06 11 00 - Wood framing
- C. Section 32 14 13 - Precast Concrete Unit Paving.
- D. Section 32 91 13.26 - Planting Beds.
- E. Section 32 94 33 - Planters

#### 1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM): ASTM A 240 -Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- B. American Society for Testing and Materials (ASTM): ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM Metal Finishes Manual for Architectural and Metal Finishes.

#### 1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Description of materials, finishes, and construction.
3. Storage and handling requirements and recommendations.
4. Installation methods.
5. Maintenance methods.



6. Cleaning methods.

- B. Shop Drawings: Submit shop drawings showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.
- C. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

1.05 QUALITY ASSURANCE

- A. Mock-Up: Provide a mock-up for evaluation of application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship and materials are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Western States Decking

2.02 APPLICATIONS

- A. Rock pan in planting modules
  - 1. Mill-finished steel: Apply mechanical finish on fabricated work in the locations scheduled, with texture and reflectivity to match architects sample. Protect with PVC covering.
  - 2. Textured Pattern: Pattern as manufactured by Western States Decking, with 7/8 inch corrugated galvanized (16 gauge) thickness and mill finish.
- B. Rock pan on decking



1. Mill-finished steel: Apply mechanical finish on fabricated work in the locations scheduled, with texture and reflectivity to match architects sample. Protect with PVC covering.
2. Textured Pattern: Pattern as manufactured by Magnum Companies, 2439 South 49<sup>th</sup> Avenue, Phoenix, Arizona 85043 (602) 272-3600, with 0.25 inch (6.35 mm) (3 gauge) thickness and mill finish.

### 2.03 MATERIALS

- A. Mill finished steel: Provide materials with standard blemishes and discoloration as manufactured. Provide manufacturer's recommended alloy, strength, and thickness for application and finish indicated. Protect finish from damage during shipping, handling, storage, and installation with strippable film.
  1. Finish: No. 2B Mill finish
  2. Thickness: As required by application.

## PART 3 - EXECUTION

### 3.01 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.

### 3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install ornamental formed metal materials plumb, square, and rigidly coupled and adequately anchored, maintaining uniformed clearances and accurate alignment.
- C. Restore damaged finishes that require field cutting, welding, or grinding.

### 3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION 05 54 00



## SECTION 05 75 00 – ARCHITECTURAL METALWORK

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Sheet metalwork for shade screens
- B. Related Sections:
  - 1. Section 06 40 13 - Exterior Architectural Woodwork

#### 1.02 ACTION SUBMITTALS

- A. Shop Drawings:
  - 1. Include plans, elevations, sections, and supporting details.
  - 2. Include details of material assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of architectural metalwork.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by supplier

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store in dry, protected, well-ventilated area and protect from damage.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Magnum - custom cut 18 gauge sheet steel



B. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. Magnum located at 2439 South 49<sup>th</sup> Avenue, Phoenix, Arizona 85043; Toll Free Tel. 800-827-8002; Tel. 602-272-3600; Web: <http://magnumcompanies.net/>

## 2.02 FABRICATION

- A. Shop Assembled

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine all products specified above before installation. Reject any products that are wet, moisture damaged, scratched, or damaged.
- B. Notify Architect of unsatisfactory conditions.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best results.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install materials level, plumb, sure, true and straight.
- C. Adjust as necessary to ensure tight fitment.

### 3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION 05 75 00



## Division 06 – Wood, Plastics, and Composites

### SECTION 06 00 00 - WOOD, PLASTICS, AND COMPOSITES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Section Includes: Landscape stakes.

##### B. RELATED SECTIONS

1. Section 320000 – Exterior Improvements.
2. Section 329300 – Plants.

##### 1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

##### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

##### 1.04 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.

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

A. Acceptable Manufacturer: Liberty Hardware Mfg. Corp., which is located at: 140 Business Park Drive, Winston-Salem, NC 27107; Toll Free Tel: 800.542.3789; Tel: 336.769.4077; Fax: 336.769.1839; Email: [request info \(http://www.libertyhardware.com/support/contact/\)](mailto:requestinfo@libertyhardware.com); Web: <http://www.libertyhardware.com>

B. Substitutions: Allowed if meets project requirements and has been approved by architect.

##### 2.02 APPLICATIONS

A. Landscape planter benches:

1. Use 7" plastic landscape stakes in planter soil to secure bench surface.
2. Product: 267594 Vortex Outdoor Solutions 4-Pack 7" Plastic Landscape Stakes as manufactured by Liberty Hardware Mfg. Corp.





### PART 3 - EXECUTION

#### 3.01 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.

#### 3.02 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.

#### 3.03 INSTALLATION

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

#### 3.04 PROTECTION

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

END OF SECTION 06 00 00



## SECTION 06 05 23 - WOOD, PLASTIC, AND COMPOSITE FASTENINGS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Fasteners, face mount joist hangers for sawn lumber, hold-downs, framing angles, and seismic and hurricane ties.

#### 1.02 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

### PART 2 - PRODUCTS



## 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Simpson Strong-Tie, 120 E Corporate Place #6; Chandler, AZ 85225. Tel: (480) 855-7360. Fax: (480) 963-3052. Web: [www.strongtie.com](http://www.strongtie.com)
- B. Substitutions: Not permitted.

## 2.02 COMPONENTS

- A. Sheathing Nails: 8d common nails, 16d common nails.
- B. Simpson Strong-Tie Company Inc.
  - 1. Face mount joist hangers for sawn lumber which may include: Simpson HU26, Simpson HU28, Simpson HU210
  - 2. Source: Simpson Strong-Tie Company, Inc.
  - 3. [www.strongtie.com](http://www.strongtie.com)
- C. Simpson Strong-Tie Company Inc.
  - 1. Framing angles: Simpson A35, Simpson A34
  - 2. Source: Simpson Strong-Tie Company, Inc.
  - 3. [www.strongtie.com](http://www.strongtie.com)
- D. Simpson Strong-Tie Company Inc.
  - 1. Holdowns for shear walls which may include: Simpson HD3B, Simpson HD9B
  - 2. Source: Simpson Strong-Tie Company, Inc.
  - 3. [www.strongtie.com](http://www.strongtie.com)
- E. Simpson Strong-Tie Company Inc.
  - 1. Seismic and hurricane ties: Simpson H3
  - 2. Source: Simpson Strong-Tie Company, Inc.
  - 3. [www.strongtie.com](http://www.strongtie.com)
- F. Threaded Studs: ½" Threaded studs with nuts and lock washers.

## 2.03 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, ATTM 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

## 2.04 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.

## 2.05 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

### 3.01 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.

### 3.02 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.

END OF SECTION 06 05 23



## SECTION 06 10 00 – ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

##### B. Section Includes: Execution and completion of Rough Carpentry in accordance with the Specifications and Drawings including but not limited to;

1. Blocking, furring, general spacing and fastening

#### 1.02 Related Sections:

- A. Division 01 Section "General Requirements."
- B. Division 01 Section "Special Procedures."
- C. Division 01 Section "Construction Waste Management".
- D. Division 06 Section "Finish Carpentry".

#### 1.03 REFERENCES

##### A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

##### B. ASTM International.

- C. American Wood Preservers Association (AWPA).
- D. Douglas Fir Protection Association (DFPA).
- E. National Fire Protection Association (NFPA).

#### 1.04 SUBMITTALS

##### A. Submit under provisions of Divisions 01 Section "General Requirements" and "Special Procedures."

- B. Certificate: Provide certificate from each manufacturer stating that material is first quality, meets or exceeds the properties of specified materials as specified herein, and is suitable for intended use on this Project. Where recycled lumber materials are used for structural applications or where otherwise noted, include lumber certification and quality grading.

#### 1.05 QUALITY ASSURANCE

- A. Inspection: Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is completed to the point where this installation may properly commence.
- B. Discrepancies: In the event of discrepancy, immediately notify the Project Manager. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.



- C. Lumber may be rejected by the Project Manager, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Materials shall be properly packed and handled while in transit so as to arrive at the job site in undamaged condition. Manufactured materials shall be delivered in suitable containers plainly marked with brand and manufacturer's name.
  - B. Storage arrangements shall be subject to Project Manager's approval and shall afford every access for inspection and identification of each item. Lumber shall be piled off the ground, on skids, in a manner which prevents twisting or warping and affords proper ventilation, drainage and protection from termites and decay, rain and excessive sun. Plywood shall be protected from dampness. Material shall be protected from the elements and from damage or deterioration.
  - C. Damaged or deteriorated materials or assemblies shall not be used in the work and shall be replaced at no extra cost to University.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. General: Material shall conform to these specifications and to the applicable current editions of the Standard Specifications of ASTM and CBC. [The source of new lumber shall be certified sustainable harvested lumber.]
- B. Lumber Grading:
  - 1. Douglas Fir: "Standard Grading and Dressing Rules,"
  - 2. Redwood: "Standard Specifications for Grades of Redwood Lumber"
- C. Lumber Grade Marking: Each piece of lumber shall bear the official grade mark of the appropriate inspection bureau of the American Lumber Association.
- D. Lumber Size and Patterns: Surface four sides, dress sizes to UBC Chapter 23; work to sizes shown. Sizing and surfacing shall be as required and approved for the particular location. Framing shall be sized and where exposed shall be surfaced.
- E. MDF Board:
  - 1.  $\frac{1}{2}$ " and  $\frac{3}{4}$ "

### 2.02 LUMBER FASTENINGS (except for preservative pressure treated lumber fastenings)

- A. Nails and Spikes: Common Wire unless otherwise noted
  - 1. Nailing of wood members shall conform to Uniform Building Code and/or as indicated.
  - 2. Penetration: half-length of nail into piece receiving point.
  - 3. To connect pieces 2 inches (25 mm) net in thickness, 16d nails may be used.
  - 4. Do not drive nails closer together than half their length, nor closer to edge of piece of lumber or timber than  $\frac{1}{4}$  their length.
  - 5. Spacing and size of nails to be such that splitting will not occur. Pre-bore holes for nails wherever necessary to prevent splitting. Bore diameter of holes smaller than diameter of nail or spike ( $\frac{3}{4}$  dia.).
  - 6. For plywood nailing, barbed plywood nails, size and spacing as indicated. Nails shall have edge distances of not less than  $\frac{3}{8}$  inch (9.5 mm).
  - 7. Use galvanized nails where exposed to weather or where members are built-in to roofing.
- B. Screws: Bright steel wood screws:



1. Screws are to be turned into place, not driven. Self-tapping where required for fastening to metal framing.
  2. Countersink where heads will interfere or as required.
  3. Screw bolt holes the same diameter and depth as shank; bore holes for threaded portion of screws with bit no larger than base of thread.
  4. Use galvanized or cadmium plated screws on fastenings exposed to weather or where members are built-in to roofing.
- C. Bolts: Standard mild steel, square or hex head machine bolts with square nuts and malleable iron or steel plate washers, conforming to ASTM A307.
1. To be installed in drilled holes the diameter of the bolt, 1/32 inch (0.8 mm) to 1/16-inch (1.6 mm) over size.
  2. Bolting of wood members shall conform to CBC requirements and as called for on the drawings.
  3. Washers: Provide bolts bearing on wood, unless noted otherwise on the drawings, with malleable iron, or steel plate washers under heads and nuts. Do no final bolting until structure has been properly aligned.
  4. Use galvanized bolts, nuts and washers where exposed to weather or where members are built-in to roofing.
- D. Lag Screws: Conform to "National Design Specification for Stress Graded Lumber and Its Fastenings," NFPA, latest edition.
1. Lag screws shall be screwed and not driven into place. Penetration in each timber shall not be less than 2/3 of the length of the lag screw.
  2. Hole shall be bored the same diameter and depth as the shank, after which the hole shall be continued to a depth equal to the length of the lag screw with a diameter no larger than 3/4 of the shank diameter.
  3. Washers: Provide lag screws bearing on wood with malleable iron or steel plate washers under heads.
  4. Use galvanized lag screws and washers where exposed to weather or where members are built-in to roofing.
- 2.03 ROUGH HARDWARE (except for preservative pressure treated lumber fastenings)
- A. Provide rough hardware related to carpentry work which is not specifically called out under other headings. This shall include, but not be limited to, the following:
1. General: Fastenings, devices, and other rough hardware not specifically indicated on drawings or specified herein shall be submitted for approval prior to installation. Conform to ASTM A7 or A36.
  2. Framing clips, hangers, etc.: Standard products of Simpson.
  3. Sheet metal straps: Galvanized sheet steel of gauges and designs indicated.
  4. Expansion anchors shall have a current ICC evaluation report and be size, number and type shown, installed as described in the evaluation report.
  5. Powder Driven Fasteners: shall have a current ICC evaluation report and be size, number and type shown, installed as described in the evaluation report.

## PART 3 - EXECUTION

### 3.01 WORKMANSHIP





- A. General: Rough carpentry shall produce joints true, tight, and well nailed with members assembled in accordance with the Drawings and with pertinent codes and regulations.
  - B. Selection of lumber pieces: Carefully select members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.
- 3.02 SITE-APPLIED WOOD TREATMENT
- A. Brush apply two coats of preservative treatment on site cut ends and site cut wood in contact with other wood surfaces.
  - B. Apply preservative treatment in accordance with manufacturer's instructions.
  - C. Allow preservative to cure prior to erecting members.
- 3.03 INSTALLATION - LUMBER AND DECKING
- A. Secure decking perpendicular to framing members with ends staggered over firm bearing where possible.
  - B. Maintain deck joints of 1/16 inch (1.6 mm).
  - C. Surface Flatness: +/- 1/4-inch (6 mm) in 10 feet (3 m) maximum.
- 3.04 FRAMING
- A. Install framing in strict accordance with the requirements of CBC Chapter 23 unless more stringent requirements are specified herein or shown on the Drawings.
  - B. Optimum Value Engineering: Where indicated on drawings or, with prior approval by the Project Manager, the following framing techniques may be employed. Nothing in this Section shall supercede requirements of CBC Chapter 23 as modified by Division 01 Section "Lateral Force Procedures", or other requirements in the Drawings or Specifications.
    - 1. Wall studs spaced at 24 inches (600 mm) on center with horizontal staggering (Verify with Project Manager and ensure that wall finish materials can meet spans)
    - 2. Built up headers may be used in lieu of solid lumber.
    - 3. Frame corners with two studs and framing clips.
    - 4. Use blocking for attachments in lieu of continuous stud.
    - 5. Delete headers at non-load bearing walls.
    - 6. Layout framing to take advantage of sheathing or siding dimensions.
- 3.05 CLEANUP
- A. At the end of each shift and upon completion of the work, remove debris, rubbish and surplus materials from the site which resulted from work under this section. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill. Take positive measures to ensure that saw dust and wood shavings do not enter the storm drainage system.
- 3.06 WASTE MANAGEMENT
- A. Conform with Division 01 Section "Construction Waste Management."
  - B. Separate wood waste in accordance with the Waste Management Plan.
  - C. Separate stained, painted and treated lumber from clean lumber and place in designated area for hazardous materials.
  - D. Separate and store separately in a clean and dry location the following categories for salvage or re-use on site:
    - 1. Sheet materials larger than 2 square feet (1.19 m).
    - 2. Framing members larger than 16 inches (400 mm).



3. Multiple offcuts of sizes larger than 12 inches (300 mm).
- E. The following categories may be re-used in the manufacture of particle board or MDF.
  1. Composite wood, (for example, plywood, OSB, LVL, I-Joist, parallel strand, MDF, particleboard).
  2. Clean dimensional lumber.
- F. Set aside damaged wood for acceptable alternative uses, for example use as bracing, blocking, cripples, or ties.
- G. Do not burn in an open fire, wood stove, fireplace or other non-industrial incinerator lumber that is less than a year old or wood treated with creosote, pentachlorophenol, CCA, ACA, or other pressure treatment.
- H. Separate the following categories for disposal and place in designated areas for hazardous materials: treated, stained, painted, or contaminated wood.
  - I. Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

END OF SECTION 06 10 00



## SECTION 06 11 00 - WOOD FRAMING

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Wood stud wall framing
- B. Floor joists
- C. Roof rafters
- D. Exterior decking joists and framing: Pressure-treated lumber

#### 1.02 RELATED SECTIONS

- A. Section 05 00 00 - Metals.
- B. Section 05 05 23 - Metal Fastenings.
- C. Section 05 12 00 - Structural Steel Framing.
- D. Section 06 05 23 – Wood, Plastic, and Composite Fastenings.
- E. Section 06 16 00 – Sheathing.
- F. Section 07 21 19 – Foamed-In-Place Insulation.
- G. Section 09 21 00 – Plaster and Gypsum Assemblies.
- H. Section 09 29 00 – Gypsum Board.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Technical data indicating compliance with specifications and standards.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Certification: Submit certification that the decking size specified will meet the specified design wind pressure and snow loads.
- C. Selection Samples: For each finish product specified, two complete sets of finish samples of the manufacturer's standard stain colors on the specified species and with the specified pattern, size, texture, and finish.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in providing products of the type specified in this section, with minimum of 5 years documented experience with products in use.
- B. Labeling Requirements: Each length of lumber shall be stamped at the mill indicating certification mark, mill identification, grade name, and inspection certificate. All labels shall be placed on surfaces where it will not be



exposed to view when installed.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.06 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.

### PART 2 - PRODUCTS

#### 2.01 LUMBER

##### A. Dimensional Lumber:

- 1. Maximum Moisture Content: 19%
- 2. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3
- 3. Framing Other Than Non-Load-Bearing Interior Partitions: Douglas Fir/Larch: WCLIB or WWPA
- 4. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics on exposed surfaces and edges that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
  - A. Species:
    - 1) Rafters and joists: Southern Yellow Pine
    - 2) Beams, Girders, and Headers: Southern Yellow Pine
    - 3) Studs and Plates: Southern Yellow Pine
  - a) Pressure-treated lumber shall be used for all exterior applications

##### B. Timbers 5-Inch Nominal (117-mm Actual) Size and Thicker:

- 1. Species:
  - A. Douglas fir-larch
  - B. Douglas fir-larch (north)
  - C. Douglas fir-south
  - D. NLGA, WCLIB, or WWPA

##### C. Miscellaneous Lumber:

- 1. Standard, Stud, or No. 3 grade with 19% maximum moisture content of any species
- 2. Provide for nailers, blocking, and similar members.



PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install deck with tongue up on all sloped surfaces.

END OF SECTION 06 11 00



SECTION 06 16 00 - SHEATHING  
PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Section includes sheathing for the following applications:

1. Wall Sheathing
2. Roof Sheathing
3. Subflooring

1.02 RELATED SECTIONS

- A. Section 05 05 23 Metal Fastenings
- B. Section 05 40 00 Cold-Formed Metal Framing
- C. Section 06 11 00 - Wood framing
- D. Section 06 16 23 - Subflooring

PART 2 - PRODUCTS.

2.01 WALL SHEATHING

- A. 15/32" Plywood Wall Sheathing: Exposure 1, Structural I sheathing.
- B. Cementitious Backer Units: ASTM C 1325, Type A.
  1. USG Corporation; DUROCK Cement Board.

2.04 ROOF SHEATHING

- A. LP TechShield Radiant Barrier
  1. APA Exposure 1 rated OSB

2.05 SUBFLOORING AND UNDERLAYMENT

- A. Subflooring:
  1. Oriented-Strand-Board Subflooring: Exposure 1, Structural sheathing



a) 1 1/8" T & G

## PART 3 - EXECUTION

### 3.01 INSTALLATION

#### A. Fastening Methods:

##### 1. Subflooring and Roof Sheathing:

a) Screwed to light gauge steel framing

##### 2. Wall Sheathing:

a) Nail to light gauge steel frame.

END OF SECTION 06 16 00



## SECTION 06 16 23 – SUBFLOORING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Subfloor panels
- B. Related Requirements:
  - 1. Division 06 10 00 Section “Rough Carpentry”

#### 1.02 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Capable of demonstrating that all wood procurement operations are conducted in accordance with procedures and policies of the Sustainable Forestry Initiative (SFI) Program.
- B. Code Compliance: Comply with requirements of the following:
- C. International Code Council Evaluation Service, ICC-ES ESR-1785.
- D. Voluntary Product Standard, DOC PS2-10, “Performance Standard for Wood-Based Structural-Use Panels”.

#### 1.03 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of flooring and sheathing system that fail due to manufacturing defects within specified warranty period.
  - 1. For subflooring and roof and wall sheathing applications, manufacturer shall warrant that the panels will not delaminate nor require sanding due to moisture absorption during installation within 300 days of purchase. Verify available warranties and warranty periods.
  - 2. Warranty Period: 50 year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Huber Engineered Woods: AdvanTech Sheathing





## 2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine sheathing before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- B. Examine floors and roofs for suitable conditions where sheathing will be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Chapter 23 in ICC's "International Building Code".
  - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings".
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.



### 3.03 PROTECTION

- A. Remove and replace sheathing panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 06 16 23



## SECTION 06 22 00 - MILLWORK

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Cabinet boxes
2. Cabinet doors & drawers
3. Shelves
2. Hinges
3. Undermount drawer slides

#### 1.02 ACTION SUBMITTALS

##### A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendation.
2. Storage and handling requirements and recommendations.
3. Installation methods.

##### B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
2. Include details of utility spaces.
3. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
4. Include coordinated dimensions for laboratory equipment specified in other Sections.

##### C. Selection Samples: For each finished product specified, one complete set of color chips representing manufacturer's full range of available colors and patterns.

1. One set of casework samples indicating full range of finishes for casework specified.

#### 1.03 QUALITY ASSURANCE

##### A. Installer Qualifications: As indicated by fabricator of products.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until project conditions are ready for installation.
- B. Store in dry, protected, well-ventilated area and protect from damage.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

##### A. Products: Subject to compliance with requirements, provide the following:

1. Cabinet boxes



- a. Dimension
  1. See drawings.
- b. Finish
  1. ¾" Melamine
2. Cabinet doors & drawer fronts
  - a. Doors
    1. Dimension: See drawings.
    2. Finish: White gloss rigid thermofoil (RTF)
  - b. Drawer fronts
    - 1) Dimension: See drawings
    - 2) Finish: White gloss rigid thermofoil (RTF)
3. Blum undermount soft close drawer slides (Blumotion)
  - a. Quantity: 7
4. Blum insert soft close hinges
  - a. Quantity: 11
5. Shelves
  - a. Dimension: See drawings.
  - b. Finish: Sherwin Williams' Chem Aqua- latex based lacquer
6. Drawer boxes
  - a. Prefinished Birch plywood
7. Sheet material
  - a. MDF

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acceptable Manufacturer: Superior Hardwoods, which is located at: 616 S. 55<sup>th</sup> Ave, Phoenix, AZ. Tel 602-353-8008; Web: <http://www.superiorhardwoods.com/>
2. Acceptable Manufacturer: Northern Contours, which is located at: 305 S. Brooks, Mesa, AZ. Tel 480-214-8240; Web: <http://www.northerncontours.com/>
3. Acceptable Manufacturer: Sherwin Williams, which is located at: 6150 Dixie Hwy, Fairfield, OH. Tel 513-829-8677; Web: [http://www.sherwin-williams.com/?WT.mc\\_id=SW\\_Store1797](http://www.sherwin-williams.com/?WT.mc_id=SW_Store1797)
4. Acceptable Manufacturer: Wurth Louis and Company, which is located at: 2110 E. Raymond Ave. B-2, Phoenix, AZ 85040. Tel 602-243-0242; Web: <http://www.blum.com/us/en/index.php>

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Examine products specified above before installation. Reject any products that are wet, moisture damaged, or mold damaged.

END OF SECTION 06 22 00



## SECTION 06 40 13 – EXTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Woodwork for exterior vertical shade structures
- B. Related Sections
  - 1. Section 05 75 00 - Architectural metalwork

#### 1.02 CERTIFICATION OF WOOD STANDARDS

- A. Grades of exterior architectural woodwork shall comply with AWI's "Architectural Woodwork Standards."
- B. Submittals: Product Data.

### PART 2 - PRODUCTS

#### 2.01 LUMBER

- A. Dimensional Lumber:
  - 1. AWI 100.
  - 2. Nominal Sizes: 2"x4" and 2"x6"
  - 3. Wood Species and Grade: Douglas Fir, select clear.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install as per drawings.

END OF SECTION 06 40 13



## SECTION 06 40 23 – INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section includes:

1. Bamboo shower finish
2. Bamboo bathroom soffit
3. Bamboo kitchen soffit

#### 1.02 ACTION SUBMITTALS

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

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

##### B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of finishes and soffits.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

##### C. Include diagrams for power, signal, and control wiring.

##### D. Samples: For each exposed product and for each color and texture specified.

#### 1.03 QUALITY ASSURANCE

##### A. Installer Qualifications: Qualified worker

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

##### A. Products: Subject to compliance with requirements, provide the following:



1. Terra Firma Bamboo Plywood
  - a) ¾" x 48" x 96"
  - b) Finish: medium dark
2. Terra Firma Bamboo Counter Tops
  - a) 1 ½" x 26" x 96"
  - b) Finish: medium dark

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acceptable Manufacturer: Terra Firma, which is located at Portland, OR, USA; Tel 971-207-4830; Web: [www.terrafirmafloorings.com](http://www.terrafirmafloorings.com)

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine products specified above before installation. Reject any products that are wet, moisture damaged, or mold damaged.

#### 3.02 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.

#### 3.03 INSTALLATION

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

#### 3.04 PROTECTION

- A. Precaution shall be taken during installation to ensure that product is not damaged. Do not install damaged goods. Damaged components shall be replaced.

END OF SECTION 06 40 23



## SECTION 06 73 00 – COMPOSITE DECKING

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Outdoor Raised Deck Floor System.

#### 1.02 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E72-98 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Shop Drawings:
  - 1. Indicate slat layout, patterns, color arrangement, perimeter conditions, and junctions with dissimilar materials, thresholds, and setting details
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer specializing in the work of this section with minimum five years experience.





- B. Installer Qualifications: Company specializing in performing similar work to the work of this section with minimum two years experience.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Mock-up shall consist of a minimum of 4 underlayment panels and associated components.
  - 3. Do not proceed with remaining work until workmanship is approved by Architect.
  - 4. Refinish mock-up area as required to produce acceptable work.
  - 5. Accepted mock-ups shall be comparison standard for remaining Work

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Deliver materials in manufacturer's unopened containers, fully identified with name, brand, type, and grade.
- C. Store adhesives out of direct sunlight at temperatures 40-75 degrees. Some adhesives require special handling and storage. Follow manufacturer's written instructions for storage and handling of all products.
- D. Protect materials from contamination in accordance with manufacturer's instructions.
- E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.06 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

#### 1.07 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.
- B. Deck supports specified are to be for used with pedestrian traffic only.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Trex ; Phone: 1-800-289-8739
- B. Substitutions: Of equal quality and product.

### 2.02 PRODUCTS

- A. Trex Transcend High Performance composite decking
  - 1. Color: Rope Swing
  - 2. Weatherability: Moisture/temperature resistant.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Establish accurate lines, levels and pattern.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Substrate surface that will underlayment panels shall be structurally capable of carrying the dead and live loads anticipated.
- E. Substrate surface that will receive the deck supports must be well compacted or structurally capable of carrying the dead and live loads anticipated.



- F. Substrate must be clean and free of projections and debris that could impair the performance of the total deck system.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install deck materials, pattern, grid layout, and finished elevation as indicated on the Drawings.
- C. Establish starting point and the finished elevation of the deck surface and mark around the perimeter with an acceptable leveling device.
- D. Mark off and square all outside edges with control. Install two lines that are perpendicular to each other across the deck area. Continue to mark a grid of lines in both directions marking the location of each pedestal. Use the control lines as references to periodically check the layout during installation.
- E. Place in orientation or pattern indicated.
- F. Spacing 1/16 inch to 1/8 inch (16 mm to 32 mm) with drainage between paver joints and thru panel.
- G. No joint fillers required.

### 3.03 PROTECTION

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

END OF SECTION 06 73 00



## Division 07 – Thermal and Moisture Protection

### SECTION 07 00 00 – THERMAL PROTECTION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- a) Section includes 3M™ Scotchmate™ Reclosable Fasteners SJ3571 and SJ3572 Family. Scotchmate Reclosable Fasteners consist of nylon fabric with hooks or loops.
- b) Related Sections:
  - i) Section 32 94 33 – Planters

##### 1.02 ACTION SUBMITTALS

- a) Product Data:
  - i) Temperature down to -40°F (-40°C) increases the typical closure strengths. The adhesive on Scotchmate reclosable fasteners SJ3571 and SJ3572 has been formulated to withstand typical outdoor temperature, humidity and ultraviolet exposure conditions.
  - ii) Closure strength of nylon hook and loop fasteners decreases after prolonged exposure to water due mainly to water absorption by the cut nylon ends for hook products. Closure strength is regained when dried.
  - iii) The nylon components resist occasional attack by most common solvents and alkaline solutions. Acid solutions may cause deterioration of the fastener

##### 1.03 INFORMATIONAL SUBMITTALS

- a) Coordination Drawings: Sheet L-502 and L-503 show details of how VHB Tape will be used to assemble the planter modules, drawn to scale, and coordinated with each other, using input from installers of the items involved.

##### 1.04 WARRANTY

- a) Unless stated otherwise in 3M's product literature, packaging inserts or product packaging for individual products, 3M warrants that each 3M product meets the applicable specifications at the time 3M ships the product. Individual products may have additional or different warranties as stated on product literature, package inserts or product packages. 3M makes no other warranties, express



or implied, including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose or any implied warranty arising out of a course of dealing, custom or usage of trade. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's application. If the 3M product is defective within the warranty period, your exclusive remedy and 3M's and seller's sole obligation will be, at 3M's option, to replace the product or refund the purchase price.

- i) Warranty Period: 2 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- a) Products: User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of application. The materials to be bonded with the product, the surface preparation of these materials, the products selected for use, the conditions in which the product is used, and the time and environmental conditions in which the product is expected to perform are among the many factors that can affect the use and performance of a 3M product.
- b) 3M™; Scotchmate™ Reclosable Fasteners SJ3571 and SJ3572.

## PART 3 - EXECUTION

### 3.01 CONNECTIONS

- a) See sheet L-502 and L-503 for proper connection details
- b) Mechanical attachment of Scotchmate Reclosable Fasteners SJ3571 and SJ3572 family of products may also be secured using staples, screws, rivets and similar methods for difficult to adhere to surfaces such as textured plastics and wood. This may reduce the possibility of edge lifting. The head of the mechanical fastener should be flat and large enough to resist pull through when the fastener is disengaged. The head of the fastener should also be recessed as much as possible below the surface of the hook or loop to prevent interference with (dis)engagement properties.

### 3.02 IDENTIFICATION

- a) These hook and loop fasteners are coated on the backside with a high temperature acrylic pressure sensitive adhesive designed to function over a range of temperatures and humidity. This adhesive is especially suited for attachment to bare metals and a variety of high surface energy adherents.



3.03 3M™ Scotchmate™ Reclosable Fasteners SJ3571 and SJ3572 SCHEDULE

- a) 200 linear feet of SJ3571 and SJ3572, 1in wide

END OF SECTION 07 00 00



## SECTION 07 13 00 - SHEET WATERPROOFING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Self-adhered sheet membrane waterproofing and accessory products.
- B. Related Sections:
  - 1. Section 06 10 00 – Rough Carpentry
  - 2. Section 06 11 00 – Wood Framing
  - 3. Section 06 16 23 – Subflooring
  - 4. Section 06 40 23 – Interior Architectural Woodwork
  - 5. Section 08 14 00 – Wood Doors
  - 6. Section 09 21 00 – Plaster and Gypsum Board Assemblies
  - 7. Section 09 25 26 – Natural Clay Plastering
  - 8. Section 09 29 00 – Gypsum Board
  - 9. Section 09 62 23 – Bamboo Flooring
  - 10. Section 22 11 16 – Domestic Water Piping
  - 11. Section 22 41 23 – Residential Shower Receptors and Basins
  - 12. Section 22 41 39 – Residential Faucets, Supplies, and Trim

#### 1.02 REFERENCES

- A. American Society of Testing and Materials (ASTM):
  - 1. ASTM C 272 Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.
  - 2. ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 3. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - 4. ASTM C 836 Standard Test Methods for Crack Cycling at -32 C.
  - 5. ASTM D 36 Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus).
  - 6. ASTM D 92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester.
  - 7. ASTM D 412 Standard Test Method for Tensile Strength.
  - 8. ASTM D 570 Standard Test Method for Water Absorption.
  - 9. ASTM D 751 Standard Test Method for Resistance to Hydrostatic Head.



10. ASTM D 882 Standard Test Method for Tensile Strength, Film.
11. ASTM D 896 Standard Practice for Resistance of Adhesive Bonds to Chemical Reagents.
12. ASTM D 903 Standard Test Method for Peel Resistance.
13. ASTM D 1621 .Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
14. ASTM D 1876 Standard Test Method for Lap Adhesion.
15. ASTM D 1970 Standard Test Method for Flexibility at Cold Temperature.
16. ASTM D 1970 Standard Test Method for Crack Cycling at -32 C.
17. ASTM D 5385 Standard Test Methods for Resistance to Hydrostatic Head
18. ASTM D 5601 Standard Test Methods for Tear Resistance.
19. ASTM D 5602 Standard Test Methods for Static Puncture.
20. ASTM D 5957 Standard Guide for Flood Testing Horizontal Waterproofing Installations.
21. ASTM E 96(B) Standard Test Method for Water Vapor Permeance.
22. ASTM E 154 Standard Test Method for Puncture Resistance.
23. ASTM D 5385 Standard Test Methods for Resistance to Hydrostatic Head.

B. International Organization for Standardization (ISO) 9001:2000 Quality Standard.

### 1.03 DEFINITIONS

A. Waterproofing Terminology: Refer to the following publications for terms related to waterproofing work not otherwise defined in this section.

1. ASTM D 1079: Definitions of Terms Relating to Waterproofing, Roofing, and Bituminous Materials.
2. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.
3. Roof Consultants Institute Glossary of Terms.

### 1.04 SUBMITTALS

- A. Product Data: Include physical properties of the specified materials and explanations about product installation, including installation techniques, restrictions, limitations and manufacturer recommendations.
- B. Warranty: Certification that all components of the waterproofing assembly are being supplied and warranted by a single manufacturer. Provide a specimen warranty from the manufacturer that includes all components of the waterproofing installation.
- C. Shop Drawings: Include detailing for all assemblies, including walls, curbs, drains, penetrations, edges, and expansion and control joints. Include installation details of waterproofing, flashing, fastening and insulation as applicable.

### 1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. The installer shall demonstrate its qualification to perform the work of this section by providing written evidence from the manufacturer providing the single-source warranty that the installer is an applicator in good standing and is authorized to install the specified waterproofing system on the project.
2. Documentation of the installer's qualifications shall be written on the manufacturer's letterhead, include the name and address of the installer and the full name and physical address of the





waterproofing installation in the body of the letter, and shall be signed by an authorized representative of the membrane manufacturer.

B. Manufacturer Qualifications:

1. Shall have a minimum of 10-year experience manufacturing waterproofing membrane systems.
2. Provide a warranty upon satisfactory installation of the waterproofing system.

1.06 PRE-INSTALLATION CONFERENCE

A. Convene no less than five days prior to commencing Work at a time and location to be determined.

1. All parties responsible for Work of this section shall be required to attend including the Architect, Owner, Contractor and any other trades affected by the waterproofing Work.
2. Review installation procedures and coordination required with related work.
3. Inspect and make notes of job conditions prior to installation:
  - a. Minutes shall be taken at the conference and provided to all parties present.
  - b. All outstanding issues shall be noted in writing designating the responsible party for follow-up action and the timetable for completion.
  - c. Application of waterproofing system shall not take place until all outstanding issues are resolved to the satisfaction of the Building Owner.

1.07 QUALITY CONTROL

- A. Warranty shall be issued upon approval of the installation.
- B. Inspections shall be performed by a Technical Representative employed full-time by the Manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the Manufacturer only.
- C. A final inspection report from the Technical Representative, certifying that the waterproofing system has been satisfactorily installed according to the project specifications, Approved Details and good general waterproofing practice, shall be provided.

1.08 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.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original unopened containers of packaging clearly labeled with manufacturer's name, brand name, instruction for use and all identifying numbers.
- B. Store all materials in protected and well-ventilated areas. Only materials to be used the same day shall be removed from this location. Special care shall be required at temperatures below 40 degree F (4.5 degree C). Keep all materials away from open flame or welding sparks.
- C. Pails of materials shall be carefully stored and adequately protected in accordance with the manufacturer's



recommendations.

- D. Store all adhesives at temperatures between 60 degree F (15.5 degree C) and 80 degree F (26.6 degree C).

#### 1.10 WARRANTY

- A. Sheet Membrane Waterproofing: Upon completion of work, the contractor shall supply the Owner with a single-source warranty issued by the manufacturer of the waterproofing assembly.
  - 1. Warranty Period: 10 years.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Schluter Systems L.P., which is located at: 194 Pleasant Ridge Road; Plattsburgh, NY 12901-5841; Toll Free Tel: 800-472-4588; Email: info@schluter.com; Web: www.schluter.com
- B. Substitutions: Not permitted unless approved by Architect.

#### 2.02 SELF-ADHERED SHEET MEMBRANE WATERPROOFING

- A. Furnish and install a complete vertical and/or horizontal waterproofing assembly including a self-adhered sheet waterproofing membrane with a drainage / protection course. To ensure total system compatibility all products shall be purchased from a single-source manufacturer.
- B. Sheet Membrane Waterproofing:
  - 1. Product: Kerdi-Board
  - 2. A multifunctional tile substrate and building panel, which can also be used for creating bonded waterproofing assemblies with tile coverings. It consists of an extruded polystyrene foam panel, with a special reinforcement material on both sides and fleece webbing for effective anchoring in thin-set mortar. The membrane shall have a total thickness of ¾ inches. Provide appropriate sheathing behind and on top of Kerdi-Board during installation. No special adhesive or heat shall be required to form laps.
  - 3. Thickness: 3/4 inches.

### PART 3 - EXECUTION

#### 3.01 SURFACE INSPECTION

- A. Do not begin installation until substrates have been properly prepared.
- B. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify Contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are completed.

#### 3.02 SURFACE PREPARATION

- A. Surfaces shall be structurally sound and free of voids, spalled areas, looser aggregate and sharp protrusions. Remove contaminates such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone



and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

### 3.03 KERDI-BOARD INSTALLATION

- A. Remove all surface contaminants from the substrate that may weaken the bond.
- B. Apply thin-set mortar to the substrate and/or onto KERDI-BOARD with a notched trowel. The mortar must bond to the substrate and mechanically anchor the fleece on the KERDI-BOARD surface.
- C. Apply the panels to the wall and firmly press them in place to ensure full coverage.
- D. Tightly abut the individual panels and align them appropriately.
- E. The tiles can be installed immediately using unmodified thin-set mortar. Choose a notched trowel to match the tile format, and back-butter the tiles, if necessary, to attain full coverage. Note: If the bond between the thin-set mortar and substrate is questionable, additional mechanical attachment with the Schluter®-KERDI-BOARD-ZSD anchors or Schluter®-KERDI-BOARDZT washers and corresponding screws is required. Fasteners are installed after the thin-set mortar has hardened.
- F. Where waterproofing is desired, the joints and corners of Schluter®-KERDI-BOARD in the area must be sealed with Schluter®-KERDI-BAND using unmodified thin-set mortar. The KERDI-BAND must overlap panel joints by at least 2" (50 mm). KERDI-BAND is also suitable for sealing connections to fixed building elements such as door and window frames. Where these surfaces will not accept a bond to unmodified thin-set mortar, use Schluter®-KERDI-FIX to bond KERDI-BAND. Separate KERDI-BOARD above the existing movement joints and structural joints and cover the joints with Schluter®-KERDI-FLEX using unmodified thin-set mortar, ensuring a minimum 2" (50 mm) overlap. Fastener penetrations may be sealed with
- G. KERDI-BAND using unmodified thin-set mortar.
- H. Please refer to the Schluter®-Shower System Installation Handbook for guidelines on waterproofing showers, steam showers, and tub surrounds.
- I. Note: Certain glass tiles may not be compatible with bonded waterproofing applications and/or may require special setting materials. Consult glass tile manufacturer and Schluter®-Systems for more information.
- J. Certain moisture-sensitive stones, e.g., green marble, or resin-backed tiles may not be appropriate for use in wet areas or may require special setting materials. Consult stone supplier and Schluter®-Systems for more information.
- K. If installing bathroom fixtures such as grab bars in showers, wall-mounted toilets, or other heavy objects, the fixtures must be anchored in the structure or solid blocking behind KERDI-BOARD.
- L. Note: Reinforcement may be required behind the entire footprint of the object. For example, place solid blocking behind the base of a wall-mounted toilet installed over KERDI-BOARD on stud framing.

### 3.04 PROTECTION AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.



- B. Clean spillage and debris from adjacent construction using cleaning agents and procedures recommended by membrane manufacturer of affected construction.

END OF SECTION 07 13 00



## SECTION 07 14 00 – FLUID-APPLIED WATERPROOFING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.02 SUMMARY

A. This Section includes the following:

1. Materials and installation methods for fluid-applied, vapor permeable air barrier membrane system located in the non-accessible part of the wall.

2. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly.

B. Related Sections include the following:

1. Section 06 16 00 - Sheathing

2. Section 07 62 00 – Sheet Metal Flashing and Trim

3. Section 07 92 00 – Joint Protection

#### 1.03 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

#### 1.04 QUALITY ASSURANCE

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:



1. It must be continuous, with all joints made airtight.
2. It shall have an air permeability not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.02 L/s. x sq. m. @ 75 Pa), when tested in accordance with ASTM E2178.
3. It shall have an air permeability not to exceed 0.04 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/s. x sq. m. @ 75 Pa), when tested in accordance with ASTM E2357.
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable.
5. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
  - a. Foundation and walls
  - b. Walls and windows or doors
  - c. Different wall systems
  - d. Wall and roof
  - e. Wall and roof over unconditioned space
  - f. Walls, floor and roof across construction, control and expansion joints
  - g. Walls, floors and roof to utility, pipe and duct penetrations
6. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

#### 1.05 REFERENCES

- A. The following standards and publications are applicable to the extent referenced in the text. The most recent version of these standards is implied unless otherwise stated.
- B. American Society for Testing and Materials (ASTM)
  1. ASTM C836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
  2. ASTM C1193 Guide for Use of Joint Sealants
  3. ASTM D412 Standard Test Methods for Rubber Properties in Tension
  4. ASTM D570 Test Method for Water Absorption of Plastics
  5. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds



6. ASTM D1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
7. ASTM D1876 Test Method for Peel Resistance of Adhesives
8. ASTM D1938 Test Method for Tear Propagation Resistance of Plastic Film and Sheeting
9. ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
10. ASTM D4258 Practice for Surface Cleaning Concrete for Coating
11. ASTM D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
12. ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
13. ASTM E96 Test Methods for Water Vapor Transmission of Materials
14. ASTM E154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
15. ASTM E1186 Practice for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems
16. ASTM E2178 Standard Test Method for Air Permeance of Building Materials
17. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

#### 1.06 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
1. Include details of interfaces with other materials that form part of air barrier
  2. Include details of mockups
- C. Samples: Submit representative samples of the following for approval:
1. Fluid-Applied membrane
  2. Self-Adhered Transition Membrane
  3. Self-Adhered Through Wall Flashing
- D. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.



- E. Qualification Data: For Applicator.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers, submit certified test report showing compliance with requirements specified for ASTM E2178.
- G. Warranty: Submit a sample warranty identifying the terms and conditions stated in Article 1.10.

#### 1.07 QUALITY ASSURANCE

- A. Manufacturer: Air barrier systems shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of waterproofing and air barriers. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.
- B. Source Limitations: Obtain primary air-barrier material and through wall flashing through one source from a single manufacturer. Should project require a vapor permeable and a vapor impermeable air barrier on same project, obtain vapor-permeable and vapor impermeable air barrier and through wall flashing from one source from a single manufacturer. See specification Section 07270 for fully-adhered vapor impermeable air barrier.
- C. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- D. Mockups: Before beginning installation of air barrier, provide air barrier work for exterior wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
- E. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed
- F. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved
- G. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Preinstallation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include but not be limited to the following:
  - H. Review of submittals
  - I. Review of surface preparation, minimum curing period and installation procedures
  - J. Review of special details and flashings
  - K. Sequence of construction, responsibilities and schedule for subsequent operations
  - L. Review of mock-up requirements
  - M. Review of inspection, testing, protection and repair procedures

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather,





excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

- B. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
- C. Protect fluid-applied membrane components from freezing and extreme heat.
- D. Sequence deliveries to avoid delays, but minimize on-site storage.

## 1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a wet substrate or during snow, rain, fog, or mist.

## PART 2 PRODUCTS

### 2.01 FLUID-APPLIED, VAPOR PERMEABLE MEMBRANE AIR BARRIER

- A. FLUID-APPLIED AIR BARRIER MEMBRANE: Perm-A-Barrier® VPO, as manufactured by Grace Construction Products, 62 Whittemore Avenue, Cambridge, MA; a fluid-applied, vapor permeable, acrylic membrane that provides continuous air tightness and water protection throughout the wall assembly. The membrane is dark-colored and designed for exposure to indirect and intermittent sunlight, such as behind open joint rain screen systems. Product shall have the following minimum physical properties:
  - B. Membrane Air Permeance: ASTM E2178: Not to exceed 0.0004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.002 L/s. x sq. m. @ 75 Pa)
  - C. Assembly Performance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.0008 cfm/sq. ft. of surface area under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.004 L/s. x sq. m. of surface area at 75 Pa) when tested in accordance with ASTM E2357.
  - D. Membrane Vapor Permeance: ASTM E96, Method B: 11.2 perms
  - E. Peel Adhesion: ASTM D903: min. 5 pli or substrate failure to glass faced wall board, min. 20 pli to concrete/CMU
  - F. Pull Adhesion: ASTM D4541: min. 50 psi or substrate failure to glass faced wall board, min. 200 psi to concrete/CMU
  - G. Weather resistance: Maintain physical properties after 84 daily cycles of UV
  - H. Neil Sealability: ASTM D1970: Pass
    - I. Low temperature flexibility and crack bridging: ASTM C836: Pass at -15F (-26C)
    - J. Color: Blackish green
  - K. TRANSITION MEMBRANE: Perm-A-Barrier Detail Membrane manufactured by Grace Construction Product; a 0.9 mm (36 mils) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (4 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:
    - L. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/Pa s. sq. m.) max.
  - M. Air Permeance at 75 Pa (0.3 in. water) pressure difference: 0.0006 L/s. sq. m (0.00012 cfm/ sq. ft.) max.
  - N. Puncture Resistance: ASTM E154: 178 N (40 lbs.) min.
  - O. Lap Adhesion at -4°C (25°F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
  - P. Low Temperature Flexibility: ASTM D1970: Unaffected to -43°C (-45°F)
  - Q. Tensile Strength: ASTM D412, Die C Modified: min. 2.7 MPa (400 psi)



- R. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%
- S. FLEXIBLE MEMBRANE WALL FLASHING: Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products; a 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:
  - T. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/ Pa s. sq. m.) max.
  - U. Water Absorption: ASTM D570: max. 0.1% by weight
  - V. Puncture Resistance: ASTM E154: 356 N (80 lbs.) min.
- W. Tear Resistance
  - X. Initiation ASTM D1004: min. 58 N (13.0 lbs.) M.D.
  - Y. Propagation ASTM D1938: min. 40 N (9.0 lbs.) M.D.
  - Z. Lap Adhesion at -4°C (25°F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
- AA. Low Temperature Flexibility: ASTM D1970: Unaffected to -43°C (-45°F)
- BB. Tensile Strength: ASTM D412, Die C Modified: min. 5.5 MPa (800 psi)
- CC. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%
- DD. [Spec. Note: Perm-A-Barrier Aluminum Flashing is not to be used when materials that could cause corrosion of aluminum, such as stucco, are to be in direct contact with the aluminum facing of the Perm-A-Barrier Aluminum Flashing]
- EE. FLEXIBLE MEMBRANE ALUMINUM FLASHING: Perm-A-Barrier Aluminum flashing manufactured by Grace Construction Products; a 0.9 mm (35 mils) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (5 mil) of aluminum film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:
  - FF. Water Absorption: ASTM D570: max 0.1% by weight
  - GG. Puncture Resistance: ASTM E154: 355N (80 lbs) min.
  - HH. Lap Adhesion at -4°C (25°F): ASTM D1876 Modified: 880 N/m (5.0 lbs./in.) of width
    - II. Low Temperature Flexibility: ASTM D1970 Modified: Unaffected to -26°C (-15°F)
  - JJ. Tensile Strength: ASTM D412, Die C Modified: min. 4.1 MPa (600 Psi)
- KK. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C Modified: min. 200%

## 2.02 PRIMERS

Primer for Self-adhered air barrier membrane: Perm-A-Barrier Primer Plus manufactured by Grace Construction Products; a water-based primer which imparts an aggressive, high tack finish on the treated substrate. Product shall have the following minimum physical properties:

1. Color: Milky White (wet), Clear (dry)
2. Weight: 8.25 lbs./gal.
3. Solids Content (by wt.): 53-57%
4. Solvent Type: Water
3. VOC Content: Not to exceed 1 g/L
4. Application Temperature: 4°C (40°F) and above



Wall Primer for Self-adhered transition membrane and Self-adhered flexible membrane wall flashing: Perm-A-Barrier WB Primer manufactured by Grace Construction Products; a water-based primer which imparts an aggressive, high tack finish on the treated substrate.

Flash Point: No flash to boiling point

VOC Content: Not to exceed 10 g/L

Application Temperature: -4°C (25°F) and above

Freezing point (as packaged): -7°C (21°F)

### 2.03 PENETRATIONS & TERMINATION SEALANT

Liquid Membrane for Details and Terminations: Bituthene Liquid Membrane manufactured by Grace Construction Products; a two-part, elastomeric, trowel grade material designed for use with fluid-applied membranes, self-adhered membranes and tapes. 10 g/L max. VOC content.

Substrate Patching Membrane: Bituthene Liquid Membrane manufactured by Grace Construction Products; a two-part, elastomeric, trowel grade material designed for use with fluid-applied membranes, self-adhered membranes and tapes. 10 g/L max. VOC content.

Joint Sealant: Refer to sealant manufacturer's recommendations.

## PART 3 EXECUTION

### 3.01 EXAMINATION

Verify that substrates and conditions are ready to accept the Work of this section. Notify [engineer] [architect] [consultant] in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.

All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full-flush.

Curing compounds or release agents used in concrete construction must be resin based without oil, wax or pigments.

### 3.02 SURFACE PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the fluid-applied air barrier assembly.

B. Exterior sheathing panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Pre-treat all board joints with 50 – 75 mm (2-3 in.) wide, manufacturer's recommended mesh-



style wallboard tape. Gaps greater than 6 mm (1/4 in.) should be filled with mastic or caulk, allowing sufficient time to fully cure before application of the mesh-style wallboard tape and fluid applied air barrier system.

- C. Masonry Substrates: Apply air and vapor barrier over concrete block and brick with smooth trowel-cut mortar joints, struck full and flush. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or parge coat.
- D. Related Materials: Treat construction joints and install flashing as recommended by manufacturer.
- E. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- F. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- G. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- J. At changes in substrate plane, apply sealant or Bituthene Liquid Membrane at sharp corners and edges to form a smooth transition from one plane to another.
- K. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

### 3.03 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.

1. Prime substrate as required.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant according to ASTM C1193 and with air barrier manufacturer's written instructions. Apply mesh-style wallboard tape to joint prior to installing fluid air barrier membrane.

### 3.04 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.



C. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable Membrane Air Barrier: 90-mil (2.4-mm) wet film thickness, 42~45-mil (1.2-mm) dry film thickness.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

### 3.05 TRANSITION MEMBRANE INSTALLATION

A. Install strips, transition membrane, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Apply primer to substrates to receive transition membrane at required rate and allow to dry. Limit priming to areas that will be covered by transition tape in same day. Re-prime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing not covered with air membrane material with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition membrane to substrate with termination sealant.

E. Apply joint sealants forming part of air barrier assembly within sealant manufacturer's recommended application temperature ranges. Consult sealant manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition membrane so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates.

1. Transition Membrane: Roll firmly to enhance adhesion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Repair punctures, voids, and deficient lapped seams in strips and transition membrane. Slit and flatten fish-mouths and blisters. Patch with transition membrane extending 6 inches (150 mm) beyond repaired areas in strip direction.



### 3.06 FIELD QUALITY CONTROL

A. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements by Architect. Inspections may include the following:

Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes

Continuous structural support of air barrier system has been provided

Site conditions for application temperature and dryness of substrates have been maintained

Maximum exposure time of materials to UV deterioration has not been exceeded

Laps in strips and transition membrane have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish-mouths

Termination sealant has been applied on cut edges

Strips and transition membrane have been firmly adhered to substrate

Compatible materials have been used

Transitions at changes in direction and structural support at gaps have been provided.

Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal

All penetrations have been sealed

C. Remove and replace deficient air barrier components and retest as specified above.

### 3.07 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace main air barrier material exposed for more than 180 days.

C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Remove masking materials after installation.

END OF SECTION 07 14 00



## SECTION 07 20 00 – THERMAL PROTECTION

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Bio-based phase change materials encapsulated in flame retardant, super- engineered poly-film.
- B. Related Sections:
  - 1. Section 05 12 00 – Structural Steel Framing
  - 2. Section 06 11 00 – Wood Framing
  - 3. Section 06 16 00 – Sheathing
  - 4. Section 07 21 13 – Board Insulation
  - 5. Section 07 21 19 – Foamed-in-place Insulation

#### 1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
    - a) UL 723
    - b) NFPA 255
    - c) UBC 8-1
  - 2. ASTM E 96 - Standard Test Method for Water Vapor Transmission of Materials.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Product test reports performed by a qualified independent testing agency evidencing compliance of products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.



4. Installation methods: Indicate special procedures, substrate and perimeter conditions requiring special treatment.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: As per manufacturer.

#### 1.05 REGULATORY REQUIREMENTS

- A. Conform to minimum SD Building Code requirements for flame and smoke ratings and non-combustibility as applicable.
- B. Fire-Test-Response Characteristics: Provide materials specified as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  1. Surface-Burning Characteristics: ASTM E 84.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers written instructions for storage, handling and protection prior to and during installation.
- B. All materials shall be kept clean and dry prior to their installation.
- C. When stored outside or on a job site, materials shall be kept off the ground and adequately covered with tarpaulins.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Phase Change Energy Solutions; 120 E Pritchard St. Ashedboro, North Carolina 27203; 1-800-283-7887; [www.phasechange.com](http://www.phasechange.com); info@phasechange.com.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Do not proceed with installation until substrates have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
  1. All surface materials must be solid, clean, dry, meet applicable code requirements, be properly installed, and suitable for use with bioPCM prior to installation.





2. Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.
3. Comply with manufacturer's written installation instructions for preparing cavities indicated to receive bioPCM mats to be free of any foreign material that will impede application.
4. Verify that other work on and within spaces to be insulated is complete prior to application.

### 3.02 APPLICATION

- A. Cover as much of the ceiling as possible by cutting the material to fit the available space. Do not cut into the bioPCM pockets. Side laps of the material may overlap.
- B. Locations and Fasteners:
  1. Ceiling: Materials shall be installed rolled out over the ceiling between joists with the flat side of the poly-film coming into contact with the ceiling.
  2. Floor: Materials shall be installed rolled out under the subfloor between joists with the flat side of the poly-film coming into contact with the floor.
- C. The laps of materials shall then be fastened into place with staples. Do not cut into the pockets holding the bioPCM.
- D. Typical installations will have roughly 80% coverage.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect application for proper fastening and possible bioPCM pocket punctures.

### 3.04 CLEANING

- A. Plan and coordinate to minimize the generation of offcuts and waste. Reuse bioPCM mat scraps.
- B. Separate and recycle waste materials in accordance with the Waste Management.

### 3.05 PROTECTION

- A. Do not permit subsequent work to disturb applied bioPCM mats.
- B. Protect installed bioPCM mats from damage due to harmful weather exposures, physical abuse, punctures and other causes. Provide temporary coverings where bioPCM mats is subject to abuse.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 20 00



## SECTION 07 21 13 – BOARD INSULATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. HCFC FREE Polyiso Rigid board type roof insulation(s) for thermal protection as part of roofing assemblies.
2. Recover board Polyiso roof insulation.

##### B. Related Sections:

1. Section 05 12 00 – Structural Steel Framing
2. Section 05 40 00 – Metal Framing
3. Section 06 10 00 – Rough Carpentry
4. Section 06 11 00 – Wood Framing
5. Section 06 16 00 – Sheathing
6. Section 07 21 19 – Foamed-in-place Insulation

#### 1.02 REFERENCES

- A. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Insulation Board.
- B. ASTM D 312 - Standard Specification for Asphalt Used in Roofing.
- C. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
- D. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- E. FM 4450 - Approval Standard - Class I Insulated Steel Roof Decks.
- F. FM 4470 - Approval Standard - Class I Roof Covers.
- G. FS HH-I-1972/1 - Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on Both Sides of the Foam.
- H. FS HH-I-1972/2 - Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Asphalt/Organic Felt, Asphalt/Asbestos Felt, or Asphalt/Glass Fiber Felt on Both Sides of the Foam.
- I. FS HH-I-1972/3 - Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Perlite Insulation Board on One Side and Asphalt/Organic Felt or Asphalt/Glass Fiber Felt on the Other.



### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Product test reports performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.
  - 4. Installation methods: Indicate special procedures, substrate and perimeter conditions requiring special treatment.

### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Company with minimum three years experience manufacturing specified products.
- B. Installer Qualifications: As per manufacturer.

### 1.05 REGULATORY REQUIREMENTS

- A. Conform to minimum SD Building Code requirements for flame and smoke ratings and non-combustibility as applicable.
- B. Fire-Test-Response Characteristics: Provide materials specified as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers written instructions for storage, handling and protection prior to and during installation.
- B. Deliver insulation in packages labeled with material name, thermal value and product code.
- C. When stored outdoors, stack insulation on pallets above ground or roof deck and cover with tarpaulin or other suitable waterproof coverings. Slit or remove manufacturer's packaging before covering with waterproof covering
- D. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
- E. Use only those components that are supplied by the Manufacturer for the specified product.



## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Atlas Roofing Corporation; 2000 RiverEdge Pkwy, Suite 800; Atlanta, GA 30328; Phone: 770.952.1442; Fax: 770.952.3170.
- B. Substitutions: Not permitted.
- C. Provide polyiso roof board insulation from a single manufacturer.

### 2.02 MATERIALS

- A. Polyiso Roof Board Insulation: Provide products that comply with the following:
  - 1. ASTM standards specified.
  - 2. Factory Mutual (FM) approvals specified.
  - 3. Underwriters Laboratories Inc. (UL) classifications specified.
  - 4. Metro-Dade County, Florida Product Control.
  - 5. California State Insulation Quality Standards and Title 25 Foam Flammability Criteria.
  - 6. BOCA National Building Code Section on Foam Plastic Insulation
  - 7. ICBO Uniform Building Code Section on Foam Plastic Insulation.
  - 8. SBCCI Standard Building Code Section on Foam Plastic Insulation.
  - 9. Canadian Compliance: CAN/ULC and CCMC.
- B. AC Foam-II, -III, and -IV: Closed-cell HCFC FREE "Green" polyisocyanurate foam core manufactured using [HCFC] [ACUltra Hydrocarbon] blowing agent and integrally laminated to heavy non-asphaltic fiber-reinforced felt facers; FM [1-60] [1-90] wind uplift classification; compressive strength - [20 psi] [25 psi].
- C. LTTR - Insulation "R" Value: 4-7 Long-term thermal resistance values of the foam were determined in accordance with CAN/ULC-S770. All test samples were third-party selected and tested by an accredited materials testing laboratory.
- D. Related Materials:
  - 1. Fasteners: Factory Mutual approved
  - 2. Base Ply: As recommended by membrane manufacturer.
  - 3. Fasteners: For Nail Base and Vented-R: Atlas Nail Base Fasteners.



4. Asphalt Bitumen: Comply with ASTM D 312, Type III (steep) or Type IV. USE ONLY ON APPROVED BOARD INSULATION TYPES.
  - a) Provide with labels indicating flash point, softening point, finished blowing temperature, and equiviscous temperature.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Do not proceed with installation until substrates have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
  1. Review placement area to determine final location will not be within 3 inches (76 mm) of any heat source where the temperature will exceed 200 degrees F (93 degrees C) per ASTM C 411 or in accordance with authorities having jurisdiction.
  2. Mask and protect adjacent surfaces from overspray or damage.
  3. Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.
  4. Comply with manufacturer's written installation instructions for preparing cavities indicated to receive insulation to be free of any foreign material that will impede application.
  5. Verify that other work on and within spaces to be insulated is complete prior to application.

#### 3.02 APPLICATION

- A. Apply insulation in accordance with manufacturer's written application instructions. Apply insulation to a uniform thickness without voids.
- B. Apply to minimum cured thickness as indicated on the Drawings or as scheduled at the end of this Section.
- C. Apply to minimum cured thickness as scheduled on Drawings.
- D. Seal plumbing stacks and electrical wiring to control air leakage.
- E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- F. Where building is designed to meet the specific air tightness standards apply insulation as recommended by manufacturer to provide airtight construction. Apply transition membranes and sealant to joints between air barrier components as specified in Division 7.



3.03 FIELD QUALITY CONTROL

- A. Inspect application for insulation thickness and density.

3.04 CLEANING

- A. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Reuse insulation scraps to the maximum extent feasible.
- B. Separate and recycle waste materials in accordance with the Waste Management Plan and to the extent economically feasible.

3.05 PROTECTION

- A. Do not permit subsequent work to disturb applied insulation.
- B. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 21 13



## SECTION 07 21 19 – FOAMED-IN-PLACE INSULATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes spray-in-place rigid closed cell polyurethane foam insulation in various assemblies, to provide an air barrier and improved thermal resistance within interior walls, ceiling, roof, and floor of structure.

B. Related Sections:

1. Section 05 12 00 – Structural Steel Framing
2. Section 05 40 00 – Metal Framing
3. Section 06 11 00 – Wood Framing
4. Section 06 10 00 – Rough Carpentry
5. Section 06 16 00 – Sheathing
6. Section 07 14 00B – Fluid-Applied Waterproofing
7. Section 07 20 00 – Thermal Protection
8. Section 07 21 13 – Board Insulation
9. Section 09 21 00 – Plaster and Gypsum Board Assemblies
10. Section 09 29 00 – Gypsum Board

#### 1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
3. ASTM D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
4. ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.



5. ASTM D 1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
7. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
8. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
9. ASTM E 413 - Classification for Rating Sound Insulation.

B. International Code Council – International Residential Code:

1. Section 103.7 - Alternate Materials and Methods.
2. 2012 IRC Section R316 - Foam Plastic Insulation.
3. Section 806.4 – Unvented Attic Assemblies.

C. International Code Council – International Building Code:

1. Section 104.11 Alternative materials, design and methods of construction and equipment.
2. Section 2603 Foam Plastic Insulation.

### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Seismic Qualification Certificates: For accessories and components, from manufacturer.

### 1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Before commencing work, submit in accordance with local code.
  1. Submit technical data sheets and samples as required by local code officials.
  2. Submit the technical data sheet from the manufacturer showing the test results from the ASTM E84 (Surface Burning Characteristics).
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.





2. Storage and handling requirements and recommendations.
3. Installation methods.

#### 1.05 QUALITY ASSURANCE

##### A. Installer Qualifications:

1. Contractor performing work under this section shall be trained by DEMILEC (USA) LLC® in the art of applying spray polyurethane foam insulation.
2. Provide current DEMILEC (USA) LLC® Authorized Contractor Certification.
3. Provide InSeal Right® Quality Assurance Program Certificate of Compliance.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered in manufacturer's original containers clearly labeled with manufacturer's name, product identification, safety information, net weight of contents and expiration date.
- B. Material shall be stored in a safe manner and where the temperatures are in the limits specified by the material manufacturer.
- C. Empty containers shall be removed from site on a daily basis.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.07 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.
- B. Ventilate area to receive insulation to maintain safe working conditions.
- C. Protect workers as recommended by standards and manufacturer's recommendations.
- D. Protect adjacent surfaces, windows, equipment, and site areas from damage of overspray.



## 1.08 WARRANTY

- A. Manufacturer's Warranty: DEMILEC (USA) LLC® warrants spray-in-place urethane foam insulation, when installed by certified contractors using factory-trained applicators and applied in accordance to the Product Specification, will perform as stated in the Product Technical Data Sheet.
1. This warranty is in effect throughout the life of the building provided the original purchaser registers with the Warranty Department of the Manufacturer within thirty days of occupancy.
  2. Manufacturer's sole responsibility under this Limited Lifetime Warranty shall be to repair or replace any defective Product at the cost of the material only.
  3. Manufacturer shall not be responsible for labor cost or any other costs whatsoever related to, or in connection with the removal or installation of either the original or replacement product.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: DEMILEC (USA) LLC®; 2925 Galleria Dr, Arlington, TX 76011. ASD. Toll Free Tel: (877) DEMILEC. Tel: (817) 640-4900. Fax: (817) 633-2000. Email: specs@demilecusa.com. Web: <http://www.demilecusa.com>
- B. Substitutions: Equivalent as judged by Architect
1. Contact DEMILEC (USA)'s Engineering Department for product comparison data
    - a) 817-640-4900
    - b) specs@demilecusa.com

### 2.02 SPRAY FOAM INSULATION

- A. Spray Applied Rigid Polyurethane Foam Insulation System:
1. Product: HEATLOK SOY® 200 Manufactured by DEMILEC (USA) LLC®, Arlington, TX
  2. Product Approval:
    - a) International Code Council Evaluation Services Report #3210
    - b) Approved for non-structural walls in building types I, II, III, IV, and V construction under IBC and dwellings for IRC.
    - c) Approved for exterior walls in building types I, II, III, and IV construction.
    - d) Passed AC 377 Appendix X compliant NFPA 286.



### 3. Installation:

- a) Application with a prescriptive Thermal Barrier:
  - i) Up to 9-1/4 inches (235 mm) for wall cavities and 11-1/4 inches (286mm) in floors or ceilings with 1/2 inch gypsum wall board or equivalent 15 minute thermal barrier in accordance with IBC 2603.4 or IRC R316.4.
- b) Application without a Thermal or Ignition Barrier (exposed foam)
  - i) Up to 9-1/4 inches (235mm) in walls and 11-1/4 inches (286mm) in floors and ceilings with all foam surfaces covered with 4 dry mils (0.10mm) [7 wet mils (0.18mm)] of Blazelok TB™ 200 primer then covered with 8 dry mils (0.20mm) [14 wet mils (0.36mm)] of Blazelok TB™ 200 intumescent coating.
- c) Use as Water-resistive Barrier:
  - i) Minimum 1-1/2 inches (38mm) continuous layer applied to suitable exterior substrate. Refer to ESR # 3210 Section 4.5
- d) One-hour Fire-resistance-rated Wall Assembly: Nonload-bearing:
  - i) Refer to ESR #3210 Section 4.6

### 4. Physical Properties:

- a) Density (ASTM D 1622): 2.1 lb/cf (0.034 gm/cu. cm).
- b) Thermal Resistance (ASTM C 518):
  - i) Aged R value at 1 inch (180 days at 76 degrees F (23 degrees C)) – R-7.4 (sf.h degree F/BTU), refer to ESR 3210 for R-value table
- c) Water Vapor Permeance @ 1.5" (ASTME 96-05): 0.79 perms (is a vapor barrier per IBC Section 202 definitions at 1.2")
- d) Air Permeance @ 75 Pa @ 1" (ASTME 2178-03): 0.004 L/sm<sup>2</sup>
- e) Air Leakage of Air Barrier Assembly (static loading to 600 Pa and gust loading to 1,200 PA) Complies with ABAA requirements (ASTME 2357-05): <0.0022L/sm<sup>2</sup>
- f) Compressive Strength (ASTM D 1621): 20.6 psi (142 kPa).
- g) Tensile Strength (ASTM D 1623): 45.4 psi (313 kPa)
- h) Off Gassing Test (VOC Emissions) (CGSB 51.23-92): Pass (no toxic vapor).



- i) Surface Burning Characteristics (ASTM E 84) 4 inches: Class I. Flame Spread Index 20, Smoke Developed Index 400.
  - j) Closed Cell Content (ASTM D2856) : >92%.
  - k) Bio-based Solid Content (ASTM D 6866): 3%
  - l) Oxygen Index (ASTM D 2863): 23%
  - m) Water Absorption % by Volume (ASTM D 2842): 0.3%
  - n) Bio-based Content (ASTMD 6866-08): 3%
5. Equipment used to apply the foam insulation shall have fixed ratio positive displacement pumps and approved by foam manufacturer.

## 2.03 ACCESSORY PRODUCTS

### A. Water Based Fire Protection:

- 1. Product: BLAZELOK TB™ 200 with BLAZELOK™ TB 200 Primer, Distributed by DEMILEC (USA) LLC®, Manufactured by TPR2.
- 2. Application: Install primer first, then intumescent coating. Follow manufacturer's application recommendations.
- 3. Physical Properties:
  - a) BLAZELOK™ TB 200 Primer
    - i) Approval: Complies with the 2009 IBC® 2603.9 and 803.2; 2009 IRC® 302.9.4 and 316.6; 2006 IRC® 314.6 and 315.4 and the NFPA 101 paragraph 10.2.3.7.2 for use without a prescriptive thermal barrier.
    - ii) Surface Burning Characteristics (ASTM E 84): Class I. Flame Spread Index 0, Smoke Developed Index 20.
    - iii) Expands up to 2000 percent.
    - iv) Flash Point: None
    - v) Volatility/VOC: < 50 g/L
    - vi) Non-toxic, drain safe, water based, non-fuming.
    - vii) Color: Gray
  - b) BLAZELOK™ TB 200



- i) Approval: Complies with the 2009 IBC® 2603.9 and 803.2; 2009 IRC® 302.9.4 and 316.6; 2006 IRC® 314.6 and 315.4 and the NFPA 101 paragraph 10.2.3.7.2 for use without a prescriptive thermal barrier.
  - ii) Surface Burning Characteristics (ASTM E 84): Class I. Flame Spread Index 5, Smoke Developed Index 20.
  - iii) Expands up to 2000 percent.
  - iv) Flash Point: None
  - v) Volatility/VOC: < 50 g/L
  - vi) Non-toxic, drain safe, water based, non-fuming.
  - vii) Color: Dull Flat white
- I) Do not add tint
- II) Wait minimum 24 hours prior to top coating with quality latex paint. Verify dryness with moisture meter.

#### B. Water Based Fire Protection

1. Product: No-Burn® Plus XD, Manufactured by No-Burn Inc.
2. Approval: Complies with 2006 IRC 314.6, 2009 IRC 316.6, IBC 2603.9 and AC 377 over vertical surfaces of SEALECTION® 500 and SEALECTION Agribalance®.
3. Application: Follow manufacturer's application recommendations.
4. Physical Properties:
  - a) Flash Point: None
  - b) Volatility/VOC: 18 g/L
  - c) Clean-up with soap and water.
5. Color:
  - a) Opaque/White or as specified.

#### C. Water Based Fire Protection:

1. Product: Andek Fireguard, manufactured by Andek Corporation.
2. Application: Follow manufacturer's application recommendations.



3. Approval: Complies with 2006 IRC 314.6, 2009 IRC 316.6, IBC 2603.9 and AC 377 over vertical surfaces of SEALECTION® 500.
4. Physical Properties:
  - a) Surface Burning Characteristics (ASTM E 84): Class I. Flame Spread Index 5, Smoke Developed Index 30.
  - b) Flash Point: None
  - c) Volatility/VOC: < 50 g/L
  - d) Non-toxic, drain safe, water based, non-fuming.
  - e) Color:
    - i) 26 standard colors including black, white and custom tints.

## PART 3 - EXECUTION

### 3.01 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.
- C. Commencement of work outlined in this section shall be deemed as acceptance of existing work and conditions.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Apply as recommended by manufacturer to thickness as indicated on drawings.



- B. Protection: Except as provided in Section 314.5 and Section 314.6 of the 2006 International Residential Code, Section 316.5 and Section 316.6 of the 2009 International Residential Code and Section 2603.4.1 and Section 2603.9 of the International Building Code, all plastic insulation shall be separated from the interior of the building by an approved thermal barrier of 1/2 inch (13 mm) gypsum wallboard or equivalent thermal barrier material. Code compliant fire protection may be achieved with the use of BLAZELOK™ IB, BLAZELOK™ TB, BLAZELOK™ TB 200 with BLAZELOK™ TB 200 Primer, Andek Fire Guard, and/or NO-Burn Plus XD depending on the details of the application. Refer to 2.3 ACCESSORY PRODUCTS for more information or contact DEMILEC (USA) LLC®'s Engineering Department for assistance, 817-640-4900.

#### 3.04 PROTECTION

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

END OF SECTION 07 21 19



SECTION 07 27 00 – AIR BARRIERS  
PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Water--resistive weather barrier for exterior walls
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry
  - 2. Section 07 21 13 - Board Insulation

1.02 QUALITY ASSURANCE

- A. Single Source: Provide water-resistive weather barrier and accessories that are recommended for use by a single manufacturer.
- B. Manufacturer Qualifications: Approved manufacturer of products with minimum 5 years experience in manufacture of similar products.

1.03 ACTION SUBMITTALS

- A. Product data: Provide manufacturer's standard installation instructions and details for water-resistive weather barrier and supporting products.

PART 2 - PRODUCTS

2.01 WATER-RESISTIVE WEATHER BARRIER

- A. Water-Resistive Weather Barrier: Water-resistive weather barrier consisting of multiple layers of UV stabilized spun-bonded polypropylene.
  - 1. Water Vapor Permeance tested to ASTM E 96 Method B: 212 perms (12180ng/Pa.s.m2)
  - 2. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage.
  - 3. Tensile Strength tested to ASTM D 882: 25 lbf/inch (43.8 N/mm), machine direction; 20 lbf/inch(35.0 N/mm), cross-machine direction
  - 4. Surface Burning Characteristics tested to ASTM E 84: Class A, Flame-spread index of less than 25,
  - 5. Smoke-development index of less than 450
  - 6. Application Temperature: No temperature restrictions
  - 7. Allowable UV Exposure Time: 270 days





8. Physical Dimensions: 0.020 inches (0.51 mm) thick, 59 inches (1.45 m) wide and 5 oz per sq. yd.
9. (17 g/sq. m.)
10. Color: black

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Examine substrate with Installer present for compliance with requirements and other conditions that would adversely affect installation or performance of water-resistive weather barrier. Correct deficient conditions prior to proceeding with water-resistive barrier installation.
- B. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean and dry substrate for breathable membrane application.

### 3.02 INSTALLATION

- A. General: Install water-resistive weather barrier in accordance with manufacturer's instructions over exterior ridged insulation. Secure water-resistive barrier to substrate to prevent damage prior to installation of cladding
- B. Window and Louver Openings
  1. Install lap strip water-resistive weather barrier around jambs, extending along wall surface a minimum of 9 inches (230 mm).
  2. Secure prefabricated water-resistive weather barrier corners at head of opening.
  3. Install lap strip of water-resistive weather barrier across head of opening, extending horizontally beyond corners minimum of 6 inches (150 mm).
  4. Cut water-resistive weather barrier along leading edge of header 2 inches (50 mm) beyond jamb to allow insertion of window nailing flange behind water-resistive weather barrier.
- C. Door Openings
  1. Install water-resistive weather barrier lap strip around jambs, extending along wall surface a minimum of 9 inches (230 mm).
  2. Secure prefabricated water-resistive weather barrier corners at head of opening.
  3. Install lap strip of water-resistive weather barrier across head of opening, extending horizontally beyond corners minimum of 6 inches (150 mm).



4. Cut water-resistant weather barrier along leading edge of header 2 inches (50 mm) beyond jamb to allow insertion of door nailing flange behind weather barrier.

#### D. Pipe and Conduit Penetrations

1. Install manufactured penetration sleeves sized for penetration and installed as recommended by sleeve manufacturer.
2. Prepare water-resistant weather barrier skirt with minimum 12 inches (300 mm) of fabric on all sides at counter-flashed penetrations. Make multiple cuts to form a star-shaped opening in fabric and place over penetration. Extend skirt fabric along penetrating item and seal to penetrating item.

#### E. Water-Resistive Weather Barrier

1. Begin water-resistant weather barrier installation at bottom of wall, mechanically fastening water resistant weather barrier at bottom and top at 24 inches (600 mm) o.c. Seal bottom edge of water-resistant weather barrier to substrate in continuous bead of non-skinning butyl sealant or butyl tape.
2. Install water-resistant weather barrier at overlapped lap strips and penetration skirts. Overlap at vertical laps minimum of 6 inches (150 mm) with taped joints or 12 inches (300 mm) without tape. Overlap at horizontal laps minimum of 6 inches (150 mm). Insert water-resistant weather barrier under bottom edge of lap strips and penetration skirts; do not tape bottom edge of skirts and lap strips.
3. Extend water-resistant weather barrier 6 inches (150 mm) over corners.
4. Shingle subsequent courses of water-resistant weather barrier. Do not place vertical laps above openings.
5. Use additional mechanical fasteners in field of sheet and tape joints if water-resistant weather barrier will be left exposed prior to installation of cladding.

#### F. Exposed Rainscreen Water-Resistive Weather Barrier

1. Use manufacturer's recommended UV-resistant black-surfaced water-resistant weather barrier material or UV-resistant black tape at open joints in spaced rainscreen cladding systems.

### 3.03 PROTECTING AND CLEANING

- G. Protect installed water-resistant weather barrier from damage due to construction activities, and extended exposure to weather.
- H. Inspect exposed water-resistant weather barrier prior to installation of cladding. Remove water-resistant weather barrier materials that have been damaged and replace. Patch damaged areas as recommended by manufacturer.



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END OF SECTION 07 27 00



## SECTION 07 44 56 – MINERAL-FIBER-REINFORCED CEMENTITIOUS PANELS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes fiber reinforced cement panel siding system.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry.
  - 2. Section 06 16 00 - Sheathing.
  - 3. Section 07 21 19 - Foamed-In-Place Insulation
  - 4. Section 07 90 00 - Joint Protection.

#### 1.02 REFERENCES

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures
- B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
- C. ASTM C 1186 - Standard Specification for Flat Non-Asbestos Fiber-Cement Sheets.
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure.

#### 1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
  - 1. Design and size components to withstand live loads caused by pressure of wind acting normal to plane of wall as calculated in accordance with ANSI/ASCE 7, and as measured in accordance with ANSI/ASTM E330.
  - 2. Deflection: Provide system capable of withstanding wind loading within the following limitations:
    - a. No permanent deformation is acceptable.
  - 3. Design system to accommodate, without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; and deflection of structural support framing.
  - 4. Design to accommodate vertical inter-story movement and provide an allowance for the following tolerances:



- a. Structural creep.
  - b. Thermally induced expansion and contraction of framing members.
  - c. Fabrication and erection tolerances.
  - d. Design ultimate load capacity of anchor components to withstand 2.0 times "Design Wind Load" without failure.
5. Maintain continuous air and vapor barrier throughout assembly.

#### 1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods, including fastening patterns.
- B. Shop Drawings: Provide shop drawings and erection plans for review including the following:
  1. Layout of furring, weather barrier, finished sheets and fastener pattern.
  2. Details at base and top of walls, corners, at window and door trim and at other openings and connections.
  3. Shop drawings prepared and stamped by a structural engineer licensed in the state where the project is located.
- C. Calculations: Provide wind load calculations, engineering calculations and substantiating data to validate wind resistance of roof system.
- D. Product certificates including Research//Evaluation report or Code Authority approval of the system use for intended application.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 3 inches by 6 inches (76 mm by 150 mm) square, representing actual product, color, and patterns.
- G. Manufacturer's Certificates: Certify materials and accessory component products meet or exceed specified requirements.
- H. Manufacturer's warranties. Executed by manufacturer and installer.



#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installer with not less than three years of experience with products similar to those specified.
- B. Pre-Installation Conference:
  - 1. Prior to any panel application, the Contractor shall convene a pre-installation conference.
  - 2. Coordinate conference scheduling with the Architect. Conference shall be attended by the Contractor, Architect, personnel directly responsible for the installation of panels, flashing and sheet metal work and other trades interfacing with the panel work.
  - 3. Provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.
  - 4. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cement panels to site until job is ready for their installation.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store materials off the ground, flat and under cover in a dry place until erection.
- D. Keep materials dry and protect from freezing.
- E. Store materials in such a way to accommodate easy inspection of the materials prior to installation.

#### 1.07 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.

#### 1.08 WARRANTY

- A. Installed material shall have a manufacturer's warranty for the following period:
  - 1. 5 years.
- B. Warranty includes the repair or replacement of siding that does not comply with requirements or that fails within specified warranty period. Failures include, but are not limited to, cracking, deforming or otherwise deteriorating beyond normal weathering.

### PART 2 - PRODUCTS



## 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Omniroc
- B. Substitutions: Not permitted.

## 2.02 MATERIALS

- A. Prefinished Cement Board Siding Panels: SIL-LEED siding sheets, fiber reinforced, cement based product conforming to ASTM C 1186 and manufactured of cement sand, cellulose fibers and fillers.
  - 1. Panel Size:
    - a. 5/16 inch 4 feet by 8 feet. (6 mm by 1219 mm by 2438 mm).
  - 2. Colors:
    - a. Natural colors (non-treated material):
      - 1) Ash - Natural.
  - 3. Mechanical fasteners: External tamper proof screws, stainless steel, torx head fasteners.
    - a. Screws shall be length as required by the panel manufacturer for the furring material used.
    - b. Wood screws: Size: #10 by 1-1/2 inch (38 mm).
    - c. Steel Screws: Size: #12 by 1-1/8 inch (29 mm).
  - 4. Continuous cushions of black EPDM rubber, 1-1/4 inch (32 mm) and 3-1/2 inch (95 mm) as required.

## 2.03 ACCESSORIES

- A. Trim: PVC, composite and stainless steel trim shapes suitable for trim conditions.
- B. Sheet Metal Flashing: Minimum 26 gauge hot-dipped galvanized steel sheet, or stainless steel.
- C. Wood furring materials shall conform to the requirements specified in Section 06 10 00.
- D. Rigid insulation between furring channels shall comply with Section 07 21 13. Thickness of insulation shall be as indicated on the Drawings.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Ensure that framing is completed and that electrical rough-in, windows, doors, and \_\_\_\_\_ in place before proceeding with work of this section.



C.If substrate preparation is the responsibility of another installer, notify Architect of preparation before proceeding. unsatisfactory

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Repair as necessary any substrate conditions that would be detrimental to proper 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 all dust, dirt, fingerprints and all other foreign marks on the material are removed prior to installation of the panels.

### 3.03 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions and the approved shop drawings.
- B. Panel Cutting:
  - 1. Cut panels using a high speed circular saw with a segmented diamond blade.
  - 2. Cut panels from the front side and protect the face from being damaged during cutting.
  - 3. For incidental cuts, cut panels from the front side using a jigsaw with a carbide tip blade.
  - 4. Provide adequate ventilation during cutting. Use of a dust extractor is recommended.
- C. Drilling:
  - 1. Drilling of holes must be done from the front of the panel using a carbide tip drill bit.
  - 2. Holes are recommended to be done using a universal drill.
  - 3. Larger holes, or cut-outs on the panel, can be made by a jig saw with a carbide blade or a hole saw with a diamond blade.
- D. Prepare structural backing with studs, backer board, weather barrier and furring as required to meet the performance requirements specified. Install fiber reinforced panels over a properly prepared support system in accordance with the manufacturer's installation instructions and approved shop drawings.
- E. Install weather barrier over prepared substrate.
- F. Fiber reinforced cement panel siding shall be installed over an impervious weather barrier, on furring strips with black EPDM rubber strips, and with an air cavity behind the face panel to allow ventilation of the substrate.
- G. Panels shall be attached to furring using the attachment pattern and fasteners indicated in the manufacturer's installation instructions and approved shop drawings.





- H. Install black EPDM rubber strips to each furring member.
- I. Pre-drill holes in cement boards in pattern indicated in the manufacturers installation instructions and approved shop drawings. Holes shall be of size as specified by the panel manufacturer for the fasteners being used.
- J. Fasten fiber cement board to furring as per vendor's details with approved stainless steel fasteners.

#### 3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Inspect walls for any damage. Replace panels that are damaged. Do not attempt to repair.
- C. Ensure all dirt, dust, fingerprints and all foreign marks are immediately removed from the face of the material to avoid from permanent damage.
- D. Replace damaged products before Substantial Completion.

END OF SECTION 07 44 56



## SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Roof Flashing and Accessories
- B. Related Sections:
  - 1. Section 05 40 00 – Metal Framing
  - 2. Section 06 10 00 – Rough Carpentry
  - 3. Section 07 14 00A – Fluid Applied Waterproofing
  - 4. Section 07 21 19 – Foamed-In-Place Insulation
  - 5. Section 07 21 13 – Board Insulation
  - 6. Section 07 21 19 – Thermal Insulation
  - 7. Section 07 71 23 – Manufactured Gutters and Downspouts
  - 8. Section 07 72 00 – Roof Accessories
  - 9. Section 07 90 00 – Joint Protection
  - 10. Section 22 14 13 – Facility Storm Drainage Piping.

#### 1.02 REFERENCES

- A. NRCA Roofing and Waterproofing Manual.
- B. ASTM International (ASTM): ASTM A 653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

#### 1.03 SUBMITTALS

- A. Manufacturer's data sheets on each product to be installed, including model number, material, color, finish and installation instructions.
- B. Verification Samples: Two representative samples of each type of product to be installed.
- C. Shop Drawings: Manufacturer's engineered layout chart based on roof material, code snow load, roof slope and sheathing thickness.
- D. Manufacturer's Certification: Manufacturer's standard warranty stating in writing that systems and layout have been engineered for project conditions and location and are suitable for use.

#### 1.04 QUALITY ASSURANCE



- A. Convene a pre-installation conference prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of layout and installation details.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.06 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.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Products: Subject to compliance with requirements, provide the information listed in Part 1.
- B. Substitutions: Allowed if approved by Architect.

#### 2.02 ROOF FLASHING

- A. Products: Subject to compliance with project requirements, provide the information listed in Part 1 after consultation with Architect.

#### 2.03 ACCESSORIES

##### A. Cant Strip

- 1. Products: Subject to compliance with project requirements, provide the information listed in Part 1 after consultation with Architect.

##### B. Termination Bar

- 1. Products: Subject to compliance with project requirements, provide the information listed in Part 1 after consultation with Architect.

##### C. Flashing Tape

- 1. Product: Grace Vycor Plus Self-Adhered Flashing Tape
- 2. Manufacturer: Grace Construction Products located at 62 Whittemore Avenue; Cambridge, MA 02140; Tel: (866) 333-(3726); Fax: (617) 498-4311; [www.graceconstruction.com](http://www.graceconstruction.com)

##### D. Cap Flashing

- 1. Product: Typical cap flashing custom fabricated on site or in shop according to shop drawings



prepared by sub-contractor as according to Construction Documents by Architect.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Do not begin installation until roofing work is complete in the area in which products will be installed.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.02 ROOF FLASHING INSTALLATION

- A. Install roof flashing in accordance with manufacturer's application requirements and all current building code requirements. If the manufacturer's recommendations and local building codes are in conflict, the more restrictive application shall be performed.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.
- E. A vapor retarder / temporary roof may be applied to protect the inside of the structure prior to the roof system installation.

#### 3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Repair or replace damaged products before Substantial Completion.

END OF SECTION 07 62 00



## SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes:

1. Gutters and Downspouts.
2. Related Accessories.

B. RELATED SECTIONS

1. Section 05 40 00 – Metal Framing
2. Section 06 10 00 – Rough Carpentry
3. Section 07 14 00A – Fluid Applied Waterproofing
4. Section 07 21 13 – Board Insulation
5. Section 07 21 19 – Foamed-In-Place Insulation
6. Section 07 27 00 – Air Barriers
7. Section 07 62 00 – Sheet Metal Flashing and Trim
8. Section 07 90 00 – Joint Protection
9. Section 22 14 13 – Facility Storm Drainage Piping

#### 1.02 REFERENCES

- A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. SMACNA - Architectural Sheet Metal Manual.
- C. IRC – International Residential Code
- D. SD Building Code – Solar Decathlon Building Code

#### 1.03 DESIGN / PERFORMANCE REQUIREMENTS

- A. Conform at minimum to SD Building Code and IRC for size and method of rain water discharge.
- B. American Architectural Manufacturers Association (AAMA) Specification 1405.1 "Specification for Aluminum Raincarrying Systems".
- C. FHA Minimum Property Standard 4900.1 for One- and Two-Family Dwellings.
- D. FHA Minimum Property Standard 4910.1 for Multi-Family Dwellings.



#### 1.04 SUBMITTALS

- A. Product Data: Manufacturer's catalog data, detail sheets, and specifications.
- B. Shop Drawings: Prepared specifically for this project; showing dimensions of metal gutters and accessories, fastening details and connections and interface with other products.
- C. Manufacturers warranties.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Certified and approved installer of the Architect.
- B. Perform Work in accordance with SMACNA Manual or CDA Handbook.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products to prevent twisting, bending, and abrasion. Provide ventilation. Slope stored materials to drain.
- C. During storage prevent contact with materials capable of causing discoloration, staining, or other damage.

#### 1.07 PROJECT CONDITIONS

- A. Coordinate installation with installation of adjacent roofing, siding and related materials.

#### 1.08 WARRANTY

- A. Provide the Manufacturer's Limited 20-Year, pro-rated and non-transferable Warranty covering labor materials.

#### 1.09 COORDINATION

- A. Coordinate Work with other operations and installation of finish materials to avoid damage to installed underlayment and membrane materials.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Englert, Inc., which is located at: 1200 Amboy Ave. ; Perth Amboy, NJ 08861; Toll Free Tel: 800-364-5378; Tel: 732-826-8614; Email: c.mcguire@englertinc.com; Web: www.englertinc.com
- B. Substitutions: Allowed with approval from Architect.

#### 2.02 COMPONENTS

- A. Gutters: Aluminum sheet, ASTM B 209, Alloy 3105-H24. Minimum tensile strength 26,000 psi, minimum yield strength 25,000 psi or equivalent. Continuous and seamless sheet aluminum, roll formed.



1. Thickness:
  - a) 0.027 inch (0.69 mm).
- B. Downspouts: Aluminum sheet, ASTM B 209, Alloy 3105-H24. Minimum tensile strength 26,000 psi, minimum yield strength 25,000 psi or equivalent.
  1. Thickness:
    - a) 0.019 inch (0.48 mm).
  2. Size:
    - a) 2 inches by 3 inches (51 mm by 76 mm).
- C. Endcaps: Aluminum sheet, ASTM B 209, Alloy 3105-H24, thickness 0.027 inch (0.69 mm).
- D. Inside and Outside Mitres: Aluminum sheet, ASTM B 209, Alloy 3105-H24, thickness 0.027 inch (0.69 mm).
- E. Gutter Hangers and Anchors: Aluminum sheet, ASTM B 209, Alloy 3105-H24, thickness 0.063 inch (1.60 mm). Provide types required to suit project requirements.
- F. Downspout Anchors: Aluminum. Provide types required to suit project requirements.
- G. Elbows: Aluminum sheet, ASTM B 209, Alloy 3105-H24. Minimum tensile strength 26,000 psi, minimum yield strength 25,000 psi or equivalent.
  1. Thickness:
    - a) 0.019 inch (0.48 mm).
  2. Size: To match downspouts.
- H. Aluminum Finish: CastleClad, two-coat system applied in a continuous baked-on process in a single operation, comprising of an acid-based primer and baked-on high performance linear polyester topcoat on exposed surfaces. Concealed surfaces finished with a polyester gold backer or wash coat.
  1. Color (Best available color to be chosen):
    - a) Light Gray.
    - b) Dark Gray.
- I. Sealant: Provide as specified in Section 07 90 00.
- J. Fasteners: Same material and finish as gutters and downspouts.

## 2.03 FABRICATION



- A. Continuously form seamless gutters to the profiles and sizes specified.
- B. Form downspouts of profiles and sizes specified.
- C. Hem exposed edges of metal.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify governing dimensions at building.
- C. Verify surfaces are ready to receive gutters and downspouts.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Clean and repair if necessary any adjoining work on which this work is in any way dependent for its proper installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install gutters using appropriate hangers to allow normal expansion and contraction.
- C. Install gutter hangers using two 1-1/4 inch (32 mm) screw shank nails and fastened into solid lumber.
- D. All gutters shall be in continuous length for each elevation (run). No end laps are allowed.
- E. Exercise care in placing aluminum in contact with other dissimilar metals or materials that are not compatible with aluminum.
- F. Providing adequate insulation/separation where ever necessary, such as by painting or otherwise protecting when they are in contact with aluminum or when drainage from them passes over aluminum surfaces.
- G. Install sealants where indicated to clean dry surfaces only without skips or voids.

#### 3.04 PROTECTION

- A. Protect installed products until completion of project.





- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 71 23



## SECTION 07 71 26 - REGLETS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes: Reglets

1. Cembonit Fiber Cement Panels
2. Gypsum Board Systems
3. Kerdi Board
4. Rough Carpentry

##### B. Related Sections

1. Section 06 10 00 – Rough Carpentry
2. Section 07 13 00 – Sheet Waterproofing
3. Section 07 44 56 – Mineral-Fiber Reinforced Cementitious Panels
4. Section 09 29 00 – Gypsum Board

#### 1.02 SUBMITTALS

##### A. Shop Drawings: Submit complete shop drawings indicating quantities, finishes, dimensions and attachment relationships

##### B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Mark manufacturer's brochures to include only those products proposed for use.

##### C. Detail Drawings:

1. Submit approved plan, section, elevation or isometric drawings which detail the appropriate methods for all termination conditions found on the project.
2. Coordinate approved drawings with locations found on the Contract Drawings.

#### 1.03 QUALITY ASSURANCE



A. Applicable standards; standards of the following, as referenced herein:

1. Aluminum Association (AA).
2. American Society for Testing and Materials (ASTM).

B. Allowable tolerances in horizontal planes:

1. Variation from level: +1/8" in 12'-0".

C. Allowable tolerances in framed vertical construction.

1. Position: +1/4" maximum variation from design position.
  
2. Alignment: 1/8" in 8'-0"; 1/4" maximum in any continuous wall, line or surface.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack accessories off floor on pallets or similar platforms providing continuous support for accessories to prevent sagging. Stack accessories so that long lengths are not over short lengths.
- B. Do not overload floor systems.
- C. Handle components to avoid racking, twisting, denting or scratching of finished surfaces.
- D. Handle materials to prevent damage to surfaces, edges and ends of sheet metal items. Reject and remove damaged material from site.

1.05 WARRANTY

- A. Provide manufacturers' warranty against defects in material and workmanship for a period of one year.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Fry Reglet Corporation, located at 12342 Hawkins St. Santa Fe Springs, CA, 90670. Phone 800-237-9773. Fax 800-200-4397. [www.fryreglet.com](http://www.fryreglet.com)
- B. Substitutions: Allowed with verification by Architect that substituted product meets project requirements.

2.02 MATERIALS AND FINISH:

- A. Anodized finish: Architectural 200R1 medium etch (AA-M32c10A21), clear color.

2.03 PROFILES

- A. Inside Corner
  1. Acceptable product: Number FCP – Inside Corner
- B. Outside Corner



1. Acceptable product: Number FCP – Outside Corner

C. Vertical Retainer

1. Acceptable product: Number FCP – Vert Ret

D. Horizontal Trim

1. Acceptable product: Number FCP - Horizontal

#### 2.04 SCOPE / APPLICATION

A. Exterior Skin System: Provide a termination cap for 5/16 " Cembonit Panels

B. Interior Cladding System: Provide a termination cap for Fiber-Reinforced Cement Panels.

C. Interior Finishing: Provide a transition point between Fiber-Reinforced Cement Panels and any surrounding interior finishes.

#### 2.05 FABRICATION

A. Aluminum framing components to be factory mitered and welded to form subassemblies including 2-way, 3-way and 4-way intersections, inside and outside corners and custom intersections as detailed in manufacturer's shop drawings. Wall cladding system shall be capable of providing either a fineline joint, or a 1/4" reveal joint, with an anodized aluminum exposed element bordering each panel horizontally, vertically or in both directions in accordance with Architectural drawings. All other details, including base, head, corners, intersections etc. shall be fabricated in accordance with the Architectural drawings.

B. Infill panels shall be installed in a non-progressive manner and must be point accessible. Panels shall be affixed to framework with co-extruded clips having an independent lab certification pullout loading of 10 pounds per inch of attachment.

#### 2.06 ACCESSORIES

A. Refer to the following Sections:

1. Section 05 05 23 – Metal Fastenings

2. Section 07 44 56 – Mineral-Fiber Reinforced Cementitious Panels

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

A. Do not begin installation until panels are verified as dry, flat, and rigid.

B. If panel installation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify dimensions of wall panels prior to installation to assure compatibility with job-site conditions.



### 3.02 INSTALLATION

- A. 5/16" Fiber Cement Panels: Install panel accessories in accordance with panel manufacturer's supplemental installation details for commercial applications and as follows:
  - 1. Inside and outside corner trim: Install at designated corners.
  - 2. Vertical retainer: Install between 5/16" fiber cement panels.
  - 3. Horizontal Trim: Install at horizontal joints as indicated on drawings.

### 3.03 CLEANING AND PROTECTION

- A. Visually inspect all exposed surfaces for scratches or blemishes. Protection of components and coupled wall panels by other trades after installation shall be the responsibility of the General Contractor.
- B. Protect accessories from damage until date of Substantial Completion. Replace accessories which become damaged.

END OF SECTION 07 71 26



## SECTION 07 90 00 - JOINT PROTECTION

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes:

1. Clear sealant
2. Caulking

B. Related Sections:

1. Section 07 44 56 - Mineral-fiber-reinforced Cementitious Panels
2. Section 07 46 25 - Siding
3. Section 07 50 00 - Membrane Roofing
4. Section 07 53 00 - Elastomeric Membrane Roofing
5. Section 08 51 13 - Aluminum Windows
6. Section 08 80 00 - Glazing

#### 1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM C 661 - Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
2. ASTM C679 - Standard Test Method for Tack-Free Time of Elastomeric Sealants.
3. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
4. ASTM C794 - Standard Test Method for Tack-Free Time of Elastomeric Sealants.
5. ASTM C920 - Elastomeric Joint Sealants.
6. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
7. ASTM C1193 - Standard Guide for Use of Joint Sealants.
8. ASTM C1248 - Standard Test Method for Staining Porous Substrate by Joint Sealants.



9. ASTM C1330 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
10. ASTM D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
11. ASTM D2202 - Standard Test Method for Slump of Sealants.
12. ASTM E119 (UL 263) - Standard Test Method for Fire Tests of Building Construction and Materials.

B. Government Services Administration (GSA), Commercial Item Descriptions (CID):

1. GSA CID A-A-272A - Sealing Compound: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures).
2. GSA CID A-A-1556 - Sealing Compound Elastomeric Type, Single Component (For Caulking, Sealing, and Glazing in Buildings and Other Structures).

C. International Maritime Organization (IMO/MED).

### 1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Product data for silicone sealant, primer, joint backing, and other accessories. Include material safety data sheets (MSDSs) and certifications showing compliance with specified standards.
2. Shop drawings detailing sealant joints and indicating joint dimensions, materials, sealant profile, and size limitations.
3. Manufacturer's color chart for selection by Architect.
4. Manufacturer's instructions for installation and field quality control testing.
5. Copy of warranties specified in Paragraph 1.5 for review by Architect.

B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

### 1.04 QUALITY ASSURANCE

A. Perform work in accordance to project specifications.



## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
  - 1. 790 Silicone Building Sealant.
  - 2. Dow Corning.
  - 3. Sealant color.
  - 4. Sealant batch or lot number.
  - 5. Sealant use-before date.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
  - 1. Store materials in a clean, dry area indoors in accordance with manufacturer's instructions.
  - 2. Store sealants within temperature range in accordance with manufacturer's instructions.
  - 3. Keep containers sealed until ready for use.
  - 4. Do not use materials after manufacturer's use-before date.

## 1.06 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.
  - 1. Do not apply sealants to surfaces that are wet, damp, or contain frost.
  - 2. Do not apply sealants when air or surface temperature is below 35 degrees F.
  - 3. Use caution when applying sealants when air or surface temperature is above 120 degrees F.

## PART 2 - PRODUCTS





## 2.01 MANUFACTURERS

- A. Dow Corning Corporation, P.O. Box 994, Midland, MI 48686-0994; (800) 248-2481;  
[www.dowcorning.com/construction](http://www.dowcorning.com/construction).
- B. Substitutions: Allowed if meets project requirements and has been approved by architect.

## 2.02 SEALANT

- A. Type: One-component, ultra-low modulus, neutral-cure silicone rubber sealant; *Dow Corning*® 790 Silicone Building Sealant, as manufactured by Dow Corning Corporation.
- B. Compliance: Sealant shall meet or exceed requirements of these standards:
  - 1. ASTM C920, Type S, Grade NS, Class 100/50, Use T, NT, G, M, A, and O.
  - 2. GSA CID A-A-272A.
  - 3. GSA CID A-A-1556.
- C. Color: [Adobe tan] [Black] [Bronze] [Blue spruce] [Charcoal] [Dusty rose] [Gray] [Natural stone] [Precast white] [Rustic brick] [Sandstone] [\_\_\_\_\_] [Custom color as designated by Architect].
- D. Shelf life: 12 months.
- E. Application temperature range: Minus 20 to plus 120 degrees F.
- F. Tack-free time: 1 hour at 50 percent relative humidity, tested in accordance with ASTM C679.
- G. Working time: 10 to 20 minutes.
- H. Curing time at 3/8-inch depth: 7 to 14 days at 77 degrees F and 50 percent relative humidity.
- I. Flow, sag, or slump in 3 inches wide joint: None, when tested in accordance with ASTM D2202.
- J. Volatile organic compound (VOC) content: 43 grams/liter maximum.
- K. Cured sealant properties after 21 days at 77 degrees F and 50 percent relative humidity.
  - 1. Joint movement capability: Plus 100 percent extension and 50 percent compression, tested in accordance with ASTM C719.
  - 2. Hardness: 15-durometer hardness, Shore A, tested in accordance with ASTM C661.



3. Properties tested in accordance with ASTM D412:
  - a. Ultimate tensile strength: [100 psi] [0.07 kg per square mm].
  - b. Ultimate elongation: 1,600 percent.
4. Minimum peel strength: [15 ppi] [2.67 kg/cm], tested in accordance with ASTM C794.
5. Properties, tested in accordance with ASTM C1135:
  - a. Adhesion at 25 percent extension: 15 psi.
  - b. Adhesion at 50 percent extension: 20 psi.
6. Weathering after 22,400 hours, tested in accordance with ASTM C1135 using QUV Weatherometer:
  - a. At 25 percent extension: 30 psi.
  - b. At 50 percent extension: 40 psi.
7. Staining after 14 days at 50 percent compression, 158 degrees F: None on concrete, granite, limestone, and brick, when tested in accordance with ASTM C1248.

### 2.03 CAULKING

- A. Caulking shall be formulated one component, moisture cure exhibiting high tensile strength, permanently elastic, low modulus and a paintable surface after cure.
  1. Heat Resistance: Long term exposure to temperatures greater than 194 degrees F will decrease tensile strength over time. Do not use in applications where the temperatures will continuously exceed 194 degrees F.

### 2.04 ACCESSORIES

- A. Substrate primer: As recommended for project conditions and provided by silicone sealant manufacturer.
- B. Sealant backing: Provide backing complying with ASTM C1330
  1. Size: Greater than joint opening by 25 percent minimum.
- C. Bond breaker tape: Provide tape to prevent adhesion to joint fillers or joint surfaces at back of joint and allow sealant movement.
  1. Type: Polyethylene or other plastic tape recommended by sealant manufacturer.



- D. Masking tape: Non-staining, non-absorbent type compatible with silicone sealant and adjacent surfaces.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Prepare substrates and apply silicone sealant in accordance with manufacturer's instructions.
- B. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDSs).
1. Do not use silicone sealant for:
  2. Below-grade applications.
  3. Surfaces to be immersed in water for prolonged time.
  4. Brass and copper surfaces.
  5. Materials bleeding oils, plasticizers, and solvents.
  6. Structural glazing and adhesive.
  7. Surfaces to be painted.
  8. Surfaces in direct contact with food.
- C. Medical and pharmaceutical applications. Do not apply in totally confined spaces without ventilation for curing.

#### 3.02 PREPARATION

- A. Inspect existing joints to be repaired. Ensure surfaces are clean, dry, and free of frost, dust, dirt, grease, oil, curing compounds, form release agents, laitance, efflorescence, mildew, and previous films and coatings.
- B. Adhesion test: Apply silicone sealant to small area and perform adhesion test in accordance with ASTM C1193, Method A, to determine if primer is required to achieve adequate adhesion. If necessary, apply primer at rate and in accordance with manufacturer's instructions. Allow primer to dry.
- C. Masking: Apply masking tape as required to protect adjacent surfaces and to ensure straight bead line and facilitate cleaning.

#### 3.03 INSTALLATION



- A. Sealant backing: Install without gaps, twisting, stretching, or puncturing backing material. Use gage to ensure uniform depth to achieve correct profile, coverage, and performance.
- B. Bond breaker: Install on backside of joint where backing is not feasible.
- C. Sealant:
  - 1. Use sealant-dispensing equipment to push sealant bead into opening. Fill joint opening to full and proper configuration. Apply in continuous operation.
  - 2. Before skinning or curing begins, tool sealant with metal spatula. Provide concave, smooth, uniform, sealant finish. Eliminate air pockets and ensure complete contact on both sides of joint opening. Tool joints in one continuous stroke.
- D. Complete horizontal joints prior to vertical joints. Lap vertical sealant over horizontal joints.
- E. Cleaning: Remove masking tape and excess sealant.

### 3.04 FIELD QUALITY CONTROL

- A. Perform adhesion tests in accordance with manufacturer's instructions and ASTM C1193, Method A, Field-Applied Sealant Joint Hand-Pull Tab.
  - 1. For sealants applied between dissimilar materials, test both sides of joint.
- B. Sealants failing adhesion test shall be removed, substrates cleaned, sealants re-installed, and re-testing performed.
- C. Maintain test log and submit report to Architect indicating tests, locations, dates, results, and remedial actions.

### 3.05 PROTECTION

- A. Protect sealants in joints from damage until fully cured.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 90 00



## Division 08 – Openings

### SECTION 08 11 16 - ALUMINUM DOORS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes: Aluminum Framed Doors
- B. Related Requirements:
  - 1. Division 08 80 00 – Glazing
  - 2. Division 08 71 00 - Door Hardware

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products:
  - 1. Western Window Systems; Series 900 Thermally Broken In-swing Hinged Door
  - 2. Western Window Systems; Series 900 Thermally Broken Out-swing Hinged Door

##### 2.02 MATERIALS

- A. Frames:
  - 1. Commercial quality 6063-T5 alloy and temper extruded aluminum.
  - 2. 2.79” Narrow Stile with 2.90” top rail and 4.18” bottom rail.
- B. Finishes:
  - 1. Bronzed Anodized Finish
- C. Hardware:
  - 1. Hardware shall be black/bronzed.
  - 2. All doors shall use .5” Commercial threshold to comply with ADA Standards.



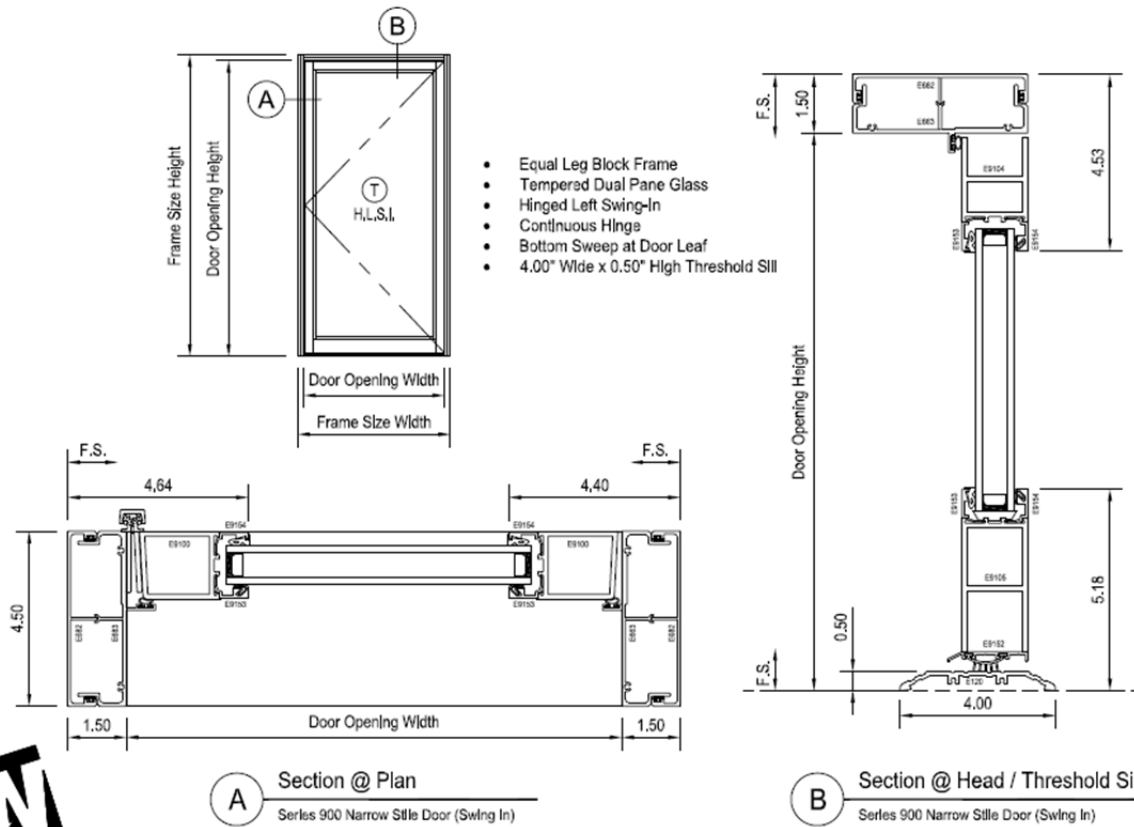
## 2.03 CONSTRUCTION

- A. Door frame members shall be neatly fitted and mechanically joined at the corners using plated or stainless steel screws.
- B. Door rails shall be designed to nest with stiles to eliminate daylight and shine at cut edge.
- C. Door Panel stiles and rails shall be full-hollow (tubular) extrusions with a nominal thickness of .125".
- D. Glazing will be secured with extruded aluminum snap-in stops that can be removed for re-glazing.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation shall be in accordance with published techniques from Western Window Systems.



**Series 900: Hinged Door - Narrow Stile**  
 Equal Leg Block Frame - (HLSI) - 0.50" High Threshold Sill w/ Sweep

END OF SECTION 08 11 16



## SECTION 08 14 16 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Flush wood doors.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

##### A. PRODUCTS:

- 1. Graham Doors; Flush Wood Earth Door

##### B. MATERIALS

- 1. Finishes: White Oak

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Site verification of substrate conditions, which have been previously completed are acceptable for the product installation instructions in accordance with manufacturer's specifications.
- B. Verify that door frame openings are constructed plumb, true and level before beginning installation process. Select fasteners of adequate type, number and quality to perform the intended functions.
- C. Remove protective packaging just prior to installation. Installer shall be experienced in performing work required and shall be specialized in the installation of work similar to that required for this project. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product packaging instructions for installation.

END OF SECTION 08 14 16





## SECTION 08 33 23 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Full Weather Sealed Rolling Service Door.

#### 1.02 WARRANTY

- A. Door Warranty: Provide one year written warranty from date of installation against deficiencies due to defects in materials or workmanship. Installer agrees to repair or replace any defects in materials or workmanship.
- B. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products:
  - 1. Cookson Doors.; Push-up Counter Door

#### 2.02 MATERIALS

- A. Ferrous Metal
  - 1. To receive a factory applied coat of primer and if zinc or cadmium coated a pre-paint treatment is to be applied to the primer.
- B. Non-Ferrous Metal
  - 1. To be Finished as noted on drawings
- C. Corrosion Resistant-Steel
  - 1. To be Finished as noted on drawings

#### 2.03 CURTAIN

- A. Interlocking Slat
  - 1. To be Configuration, Thickness, and Material shown on Cookson drawings.



B. Grille Section

1. To be constructed to the pattern, material, and spacing as noted on Cookson drawings.

2.04 LOCKING DEVICES

- A. Non-locking Tubular Bolt Mounted within bottom bar. Operable from one side only.

2.05 GUIDES

- A. Guide Sections to be extruded aluminum to be the configuration and gauge as shown on Cookson drawings.

2.06 BRACKETS

- A. To be made of mill steel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that dimensions are correct and project conditions are in accordance with manufacturer's installation instructions; do not proceed with installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Ensure that units are installed plumb and true, free of warp or twist, and within tolerances specified by manufacturer for smooth operation.

3.03 FIELD TESTING

- A. Test doors for regular operation.

3.04 DEMONSTRATION

- A. Instruct the Owner's personnel in correct operation and maintenance of units.

3.05 ADJUST AND CLEAN



- A. Clean units in accordance with manufacturer's instructions.
  
- B. Restore slight blemishes in finishes in accordance with manufacturer's instructions to match original finish.  
Remove and provide new units where repairs are not acceptable to the Architect.

END OF SECTION 08 33 23



## SECTION 08 35 13.13 – ACCORDIAN FOLDING DOORS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Bi-Folding Doors
- B. Related Requirements:
  - 1. Division 08 80 00 – Glazing
  - 2. Division 08 71 00- Door Hardware

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products:
  - 1. Western Window Systems; Series 9500 Bi-Folding Door Thermally Broken Out-swing

#### 2.02 MATERIALS

- A. Frames
  - 1. Commercial quality 6063-T5 alloy and temper extruded aluminum.
  - 2. 4.5" Frame width 2.25"x 3.5" Stile with 1.5" threshold
- B. Finishes
  - 1. Dark Bronzed Anodized Finish
- C. Hardware
  - 1. Door frame shall use Centor E3 Hardware.
  - 2. Door Hardware shall be Black/Bronzed

#### 2.03 CONSTRUCTION

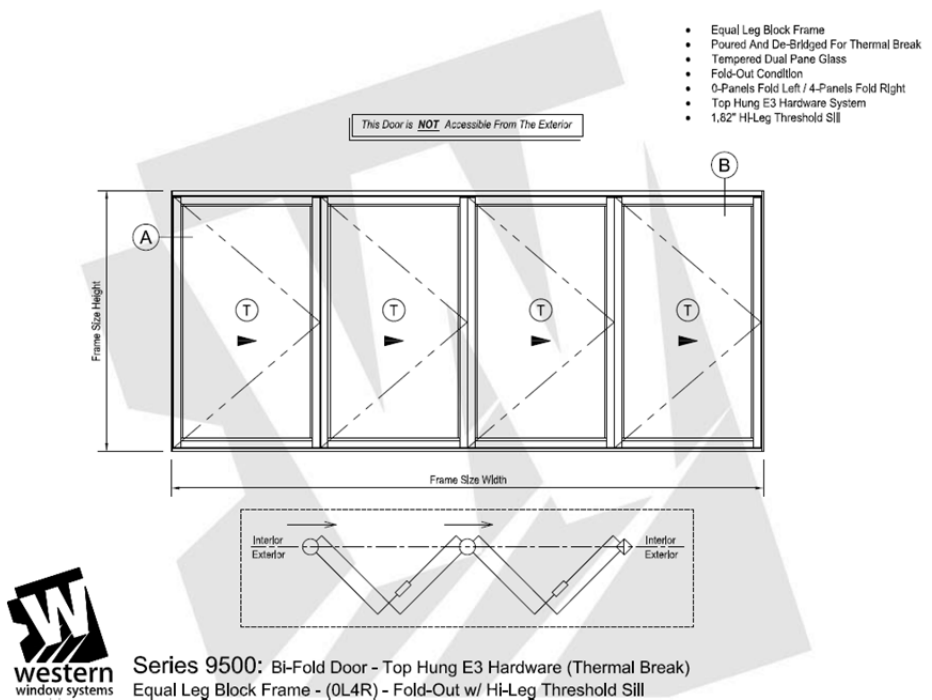
- A. Door Frame members shall be neatly fitted and mechanically joined at the corners using plated or stainless steel screws.

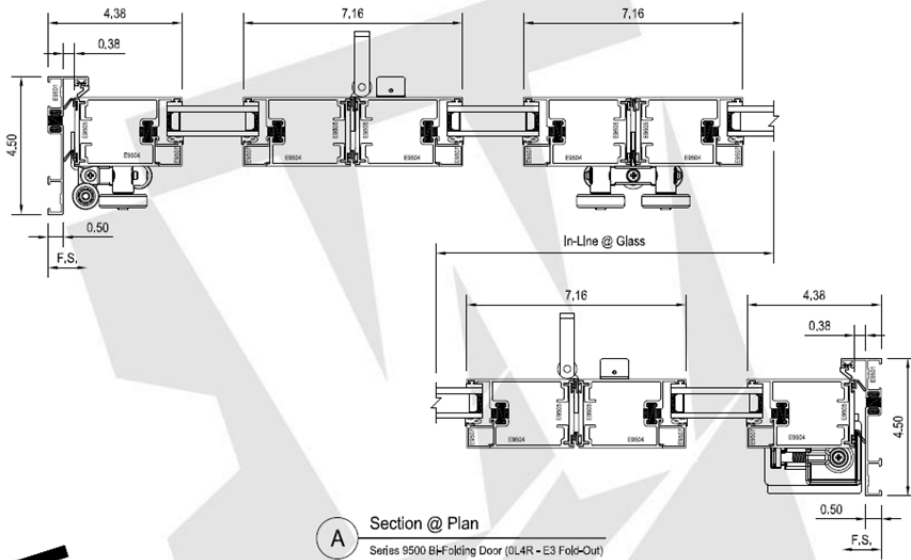
- B. Door stiles shall be fabricated to achieve an interlock system that engages the rails and is secured with a tie rod assembly to ensure a permanent rigid connection at the top and bottom corners of the door panel.
- C. Glazing will be secured with extruded aluminum snap-in stops that can be removed for re-glazing.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with published techniques from Western Window Systems.

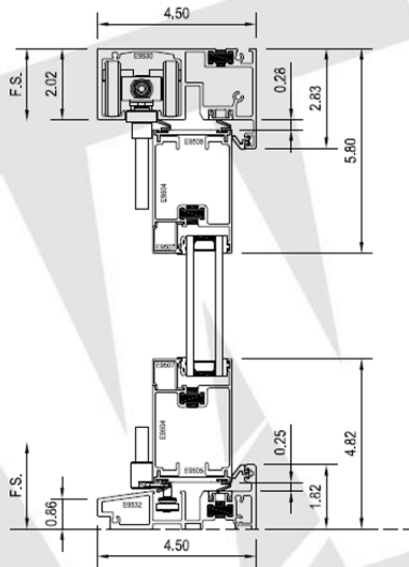




**A** Section @ Plan  
Series 9500 Bi-Folding Door (0L4R - E3 Fold-Out)



Series 9500: Bi-Fold Door - Top Hung E3 Hardware (Thermal Break)  
Equal Leg Block Frame - (0L4R) - Fold-Out w/ Hi-Leg Threshold Sill



**B** Section @ Head / Threshold Sill  
Series 9500 Bi-Folding Door (E3 Fold-Out)



Series 9500: Bi-Fold Door - Top Hung E3 Hardware (Thermal Break)  
Equal Leg Block Frame - (0L4R) - Fold-Out w/ Hi-Leg Threshold Sill



END OF SECTION 08 35 13.13



## SECTION 08 51 13 - ALUMINUM WINDOWS

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes: Aluminum framed windows.

B. Related Requirements:

1. Division 08 80 00 – Glazing
2. Division 08 71 00- Door Hardware

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

A. Products

1. Western Window Systems; Series 700 Thermally broken fixed window.

#### 2.02 MATERIALS

A. FRAMES

1. Commercial quality 6063-T5 alloy and temper extruded aluminum.

B. FINISHES

1. Dark Bronzed Anodized Finish

#### 2.03 CONSTRUCTION

- A. All frame and sash members shall be mitered and mechanically joined with crimped aluminum corner keys and sealed with a high grade silicone sealant
- C. Casement sash corners shall also be welded when the frame width exceeds 30".
- D. Structural frame and sash members shall be full-hollow (tubular) extrusions.

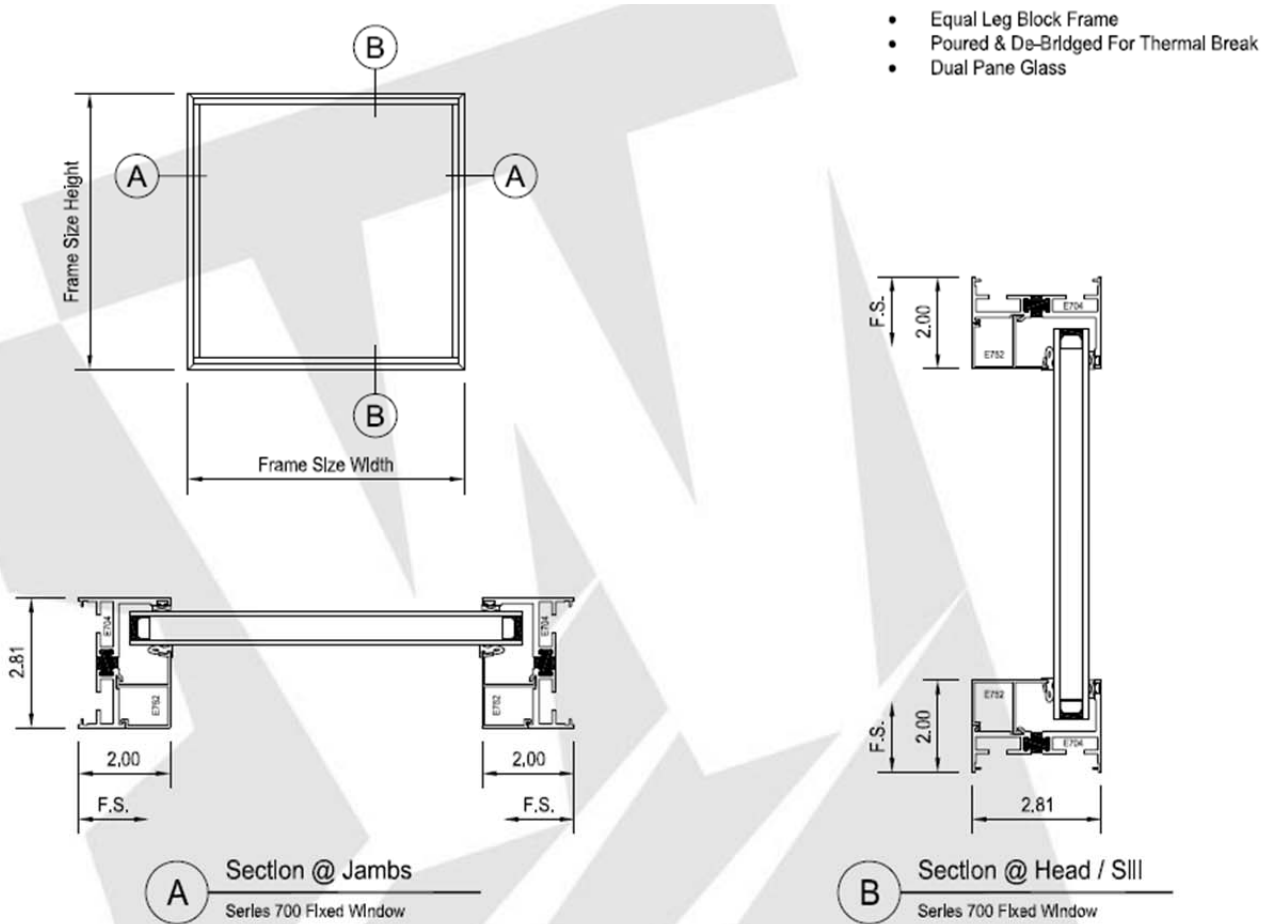


E. Glazing will be secured with extruded aluminum snap-in stops that can be removed for re-glazing.

PART 2 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with published techniques from Western Window Systems.



**Series 700: Fixed Window (Thermal Break)**  
 Equal Leg Block Frame - (O)

END OF SECTION 08 51 13



## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section includes:

1. Concealed residential door hinges.
2. Lever sets for standard duty interior use.
3. Top hung sliding door systems
4. Straight and curved track sliding doors.
5. Straight and curved track sliding walls and partitions.
6. Multiple panel, straight track folding doors and walls.

##### B. Related Requirements:

1. Section 05 12 00 – Structural Steel: Track supports.
2. Section 08 12 00 – Aluminum Doors and Frames
3. Section 08 21 10 – Flush Wood Doors
4. Section 08 71 00 – Door Hardware: Cylinder locks, pulls.

#### 1.02 ACTION SUBMITTALS

##### A. Submit under provisions of Section 01 30 00.

##### B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

##### C. Shop Drawings:

1. Include plans, elevations, sections, and supporting details.



2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Detail fabrication and assembly of door and track installations.
  4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  5. Include diagrams for power, signal, and control wiring.
- D. Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and finishes.
- E. Component Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by hardware supplier.

### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store in dry, protected, well-ventilated area and protect from damage.

### 1.05 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace TECTUS TE 240 3D, Seattle TER46Q, and HAWA Junior 80/Z that fail(s) in materials or workmanship within specified warranty period.
1. Warranty Period: Hafele HAWA Junior 80/Z - 2 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
1. Hafele HAWA Junior 80/Z Sliding Door Assembly



- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ; Archdale, NC 27263; Toll Free Tel: 888-437-7477; Tel: 336-434-8136; Email: request info (Info\_us@hafeleamericas.com); Web: www.hafele.com/us
  2. Substitutions: Not permitted.

## 2.02 SLIDING AND FOLDING DOOR AND WALL HARDWARE

- A. Hardware for Sliding Wood Doors and Walls: Hawa Junior; top track, two-wheeled trolleys with high-density nylon wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.
- B. Opening and Closing Force: Not more than 5.2 pounds force (23 n) to ADA requirement certified by independent testing laboratory.
- C. Floor Guide: Surface mounted, running in groove in bottom of door.
- D. Stops: Wall mounted rubber bumpers; track stop for each panel, with adjustable catch.
- E. Locks: Hawa Silent-Stop, with bolt locking into top track, thumbturns both sides at approximately 36 inches (915 mm) above floor; mortised into edge of door.
- F. Accessories: Provide all components recommended by hardware manufacturer or required to achieve a complete installation.
- G. Fasteners: Provide all fasteners required, of type recommended by hardware manufacturer.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine all products specified above before installation. Reject any products that are wet, moisture damaged, mold damaged, scratched, damaged, or non-functional.
- B. Do not begin installation until support and floor substrates have been properly completed.
- C. Verify that structural supports are level and of adequate strength to support the applied loads.
- D. Verify opening dimensions prior to fabrication and assembly.
- E. Notify Architect of unsatisfactory conditions.



### 3.02 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.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install hardware level, plumb, sure, true and straight.
- C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.
- D. Clean track and hardware surfaces before hanging sliding doors.

### 3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION 08 71 00



SECTION 08 78 00 – SPECIAL FUNCTION HARDWARE  
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Straight and curved track for sliding partitions.
2. Straight track for top hung sliding door system.

B. Related Sections:

1. Section 05 12 00 – Structural Steel Framing
2. Section 08 11 16 – Aluminum Doors and Frames

1.02 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at project site in Tempe, AZ.

1.03 ACTION SUBMITTALS

- A. Submit under provisions of Section 01 31 00.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparations instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

- C. Shop Drawings: Submit drawings that document layout, profiles, product components, anchorage details, track mounting and support, and adjoining interface construction.

- D. Samples: For each exposed product and for each color and texture specified.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.05 WARRANTY



- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of product(s) that fail(s) in materials or workmanship within specified warranty period.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products the following:

1. Hafele Single running track for Slido Classic Door, pre-drilled 940-43-931

- a) 1.22" x 1.3" (W x H)
- b) Length: 9' 10 1/8"
- c) Material: Aluminum
- d) Finish: Bright

2. Hafele Top hung sliding track

- a) Height: 2 9/16"
- b) Material: Aluminum
- c) Finish: Anodized

- B. Manufacturers: Subject to compliance with requirements, provide products by the following:

- C. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ; Archdale, NC 27263; Toll Free Tel: 888-437-7477; Tel: 336-434-8136; Email: request info (Info\_us@hafeleamericas.com); Web: www.hafele.com/us

### 2.02 ACCESSORIES

- A. Hafele Mounting bracket with screw nut for single track 940-42-061

- 1. Material: Steel
- 2. Finish: Galvanized

- B. Hafele Clip panel for single track 940-43-130

- 1. Height: 2.67"
- 2. Length: 9' 10 1/8"



3. Material: Aluminum
4. Finish: Silver colored, anodized

C. Hafele Standard floor guide

1. Length: 9' 10 1/8"

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine products specified above before installation. Reject any products that are wet, moisture damaged, or mold damaged.
- B. Do not begin installation until support and floor substrates have been properly completed.
- C. Verify that structural supports are level and of adequate strength to support the applied loads.
- D. Verify opening dimensions prior to fabrication and assembly.
- E. Notify Architect of unsatisfactory conditions.

#### 3.02 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.

#### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install hardware level, plumb, sure, true and straight.
- C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.
- D. Clean track and hardware to ensure smooth, quiet, and effortless operation and safety.

#### 3.04 PROTECTION

- A. Hardware and track components shall be protected from damage and stored in a dry, well-ventilated area. Immediately report any damaged material to carrier that made the delivery and note such damage on the carrier's freight bill of lading.





- B. Precautions shall be taken during construction to ensure that hardware is not damaged. Do not install damaged goods. Damaged components shall be replaced.

END OF SECTION 08 78 00



## SECTION 08 80 00 - GLAZING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Glazing
- B. Related sections:
  - 1. Division 08 11 16 Section "Aluminum Doors:
  - 2. Division 08 35 13.13 Section "Accordion folding doors"
  - 3. Division 08 51 13 Section "Aluminum Windows"

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products:
  - 1. Western Window Systems; DUO-PANE glass

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics:
  - 1. Glazing shall have solar ban 70.
  - 2. Shall conform to ASTM E774-97 Specification for Sealed Insulated Glass.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Installed by manufacturer

END OF SECTION 08 80 00



## SECTION 08 95 00 – VENTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes intake and exhaust grilles for the hot water heater and the energy recovery ventilation located in the mechanical room. This section also includes intake and exhaust diffusers for interior vents.

### PART 2 - PRODUCTS

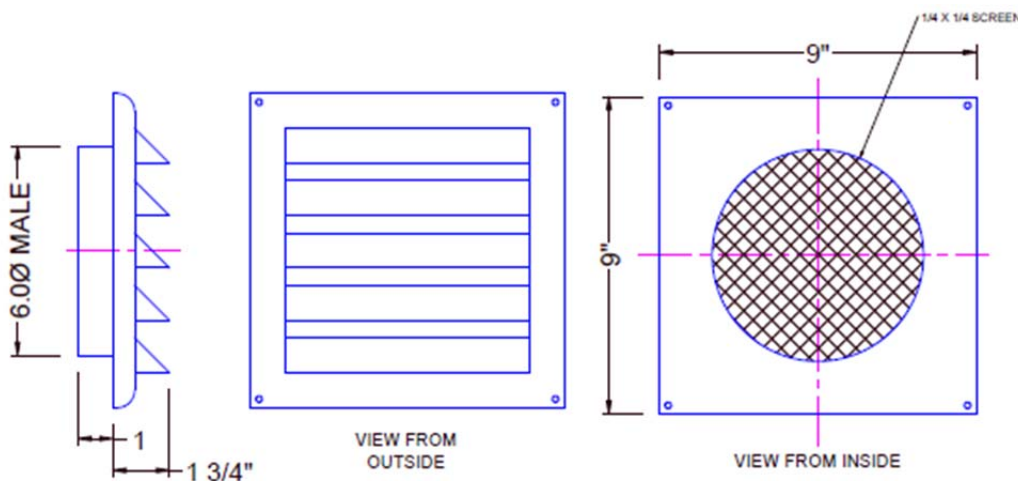
#### 2.01 MANUFACTURERS

- A. The following products may be purchased by RenewAire (4510 Helgesen Drive Madison, WI 53718; 800-627-4499; [renewaire.com](http://renewaire.com)):
  1. 6" Louvered Wall Cap, Model: VB106/VW106
- B. The following products may be purchased by Lowe's or equivalent:
  1. Accord 24" x 6" White Return Grille, Model: ABRGWH246
- C. Titus;
  1. Flowbar; FL-30
  2. MLR-39 1-Slot
  3. MLR-39 4-Slot
  4. MLR-38 1-Slot

#### 2.02 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Hot Water Heater Intake Grille
  1. Description: Horizontal louvered intake grille with a cleanable metal screen that can accommodate a 250 cfm volumetric flow rate
  2. Model: ABRGWH246
  3. Area: equivalent to 1 ft<sup>2</sup>
  4. Material: all steel construction
  5. Finish: white
  6. Duct Connection: 6" diameter
- C. Hot Water Heater Exhaust Grille
  1. Description: Horizontal louvered exhaust grille with a cleanable metal screen
  2. Model: ABRGWH246
  3. Area: equivalent to 1 ft<sup>2</sup>
  4. Material: all steel construction
  5. Finish: white
  6. Duct Connection: 6" diameter
- D. Energy Recovery Ventilation Intake Grille

1. Description: Louvered intake grille with a cleanable metal screen that can accommodate a 90 cfm volumetric flow rate
  2. Model: VB106/VW106
  3. Dimensions: 9" by 9"
  4. Material: Vinyl
  5. Finish: White
  6. Duct Connection: 6" diameter
- E. Energy Recovery Ventilation Exhaust Grille
1. Description: Louvered exhaust grille with a cleanable metal screen
  2. Model: VB106/VW106
  3. Dimensions: 9" by 9"
  4. Material: Vinyl
  5. Finish: White
  6. Duct Connection: 6" diameter



- F. Air Handler Intake
1. Description: Vent opening for air intake to Air Handler.
  2. Model: Flowbar; FL-30
  3. Dimension: 22" x 6"
  4. Material: Steel
- G. Air Handler Diffuser
1. Description: Vent diffuser for air intake to Air Handler.
  2. Model: MLR 39: 4 Slots
  3. Dimension: 22" x 6"
  4. Material: Steel
- H. Air Handler Diffuser
1. Description: Vent diffuser for air intake to Air Handler.



2. Model: MLR 39: 1 Slots
  3. Dimension: 12" x 2- 3/8"
  4. Material: Steel
- I. Air Handler Diffuser
1. Description: Vent diffuser for air intake to Air Handler.
  2. Model: MLR 38: 1 Slots
  3. Material: Steel
- J. Accessories
1. Installation Components
  2. ¼" Protective Mesh
  3. Winter Bypass Valve

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install intake and exhaust grilles level and plumb of sizes indicated on plans and air outlet schedules.
- B. Install intake and exhaust grilles of the sizes and mounting types indicated on the plans and outlet schedule.
- C. Wall-Mounted intake and exhaust grilles: Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practical. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. After installation, adjust grilles to air patterns indicated, or as directed, before starting air balancing.
- E. All grilles shall be performance tested as a composite assembly in full accordance with ASHRAE Standard 70.

END OF SECTION 08 95 00



## Division 09 – Finishes

### SECTION 09 21 00 – GYPSUM AND PLASTER ASSEMBLIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. This Section includes the following:

1. Gypsum Plaster on Gypsum board.

B. Related Sections include the following:

1. Section 09 29 00 – Gypsum Board

##### 1.02 REFERENCES

A. American Society for Testing and Materials:

1. ASTM C 28: Specification for Gypsum Plaster.
2. ASTM C 472: Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete.
3. ASTM C 631: Specification for Bonding Compounds for Interior Gypsum Plastering.
4. ASTM C 645: Specification for Nonstructural Steel Framing Members.
5. ASTM C 665: Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
6. ASTM C 841: Specification for Installation of Interior Lathing and Furring.
7. ASTM C 842: Specification for Application of Interior Gypsum Plaster.
8. ASTM C 919: Practice for Use of Sealants in Acoustical Applications.
9. ASTM E 90: Test Method for laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
10. ASTM E119: Test Method for Fire Tests of Building Construction and Materials.

##### 1.03 SUBMITTALS

A. General: Submit in accordance with Section 23 80 00.

B. Product Data: Review specification and manufacturers data before assembly.

##### 1.04 QUALITY ASSURANCE

A. Fire Resistance Rated Assembly Characteristics: For gypsum plaster assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire Resistance Ratings: Indicated by design designations from UL Fire Resistance Directory.



B. Sound Transmission Characteristics: For gypsum plaster assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 by a qualified independent testing agency.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. All materials, except water and sand, shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the site.

#### 1.06 PROJECT CONDITIONS

A. Comply with ASTM C 842 requirements or gypsum plaster manufacturer's written recommendations, whichever are more stringent.

### PART 2 - PRODUCTS

#### 2.01 BASE PLASTER

A. Fire rated gypsum plaster base, General: Complies with requirements of ASTM C 587 Standard Specification for Gypsum Veneer Plaster.

B. Manufacturer by Western Blended Products:

1. Headquarters and Material Provider: California One Kote: Sacramento Stucco Co. 1550 Parkway Blvd, West Sacramento, CA 955691. Telephone: (916) 372-7442. Fax: (916) 372-4836. Website: <http://www.westernblended.com>
2. Application: of  $\frac{3}{4}$ " thick plaster, premixed mixture, just add water.
  - a. Application: bonded to gypsum board.
  - b. Mixture must be applied in 40 minutes.

#### 2.02 FINISH PLASTER

A. Finish Plaster. Complies with requirements of ASTM C 587 Standard Specification for Gypsum Veneer Plaster.

#### 2.03 ONE COAT GYPSUM PLASTER

A. Veneer Plaster. Complies with requirements of ASTM C 587 Standard Specification for Gypsum Veneer Plaster.

#### 2.04 ACCESSORIES

A. General: Comply with ASTM C 841 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Zinc and Zinc-Coated (Galvanized) Accessories:



1. Cornerite: Fabricated from expanded-metal lath with manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.
2. Striplath: Fabricated from expanded-metal lath with manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.
3. Corner Beads: Fabricated from zinc or zinc-coated (galvanized) steel.
  - a. Small nose corner bead with expanded flanges; use unless otherwise indicated.
  - b. Bull nose corner bead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.
4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated on Drawings.

## 2.05 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Bonding Compound: ASTM C 631.

## 2.06 FINISH COAT PLASTER MATERIALS

A. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gauged, interior finish.

B. High-Strength Gypsum Gauging Plaster: ASTM C 28, with a minimum, average, dry compressive strength of 5000 psi per ASTM C 472 for a neat mix.

## 2.07 PLASTER MIXES

A. General: Comply with ASTM C 842 and manufacturer's written instructions for applications indicated.

B. Finish Coat Mix for Smooth-Troweled Finishes: [1 part California One Kote gypsum plaster to 2 parts water]  
[Gypsum ready-mixed finish plaster] .





C. Finish Coat Mix for Sprayed Finishes: Gypsum ready-mixed finish plaster.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including roof framing and substrate assembly, for compliance with requirements and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

### 3.03 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- B. STC-Rated Assemblies: Must be compliant with STC rating for staggered stud, between 46-47. Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
  - 1. Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations.
  - 2. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

#### C. For Plaster Bonding agent (Brown Coat): Surface Preparation

- 1. Surfaces to receive Bonding material on BEKA system MUST BE STRUCTURALLY SOUND AND CLEAN, free from loose material, dust, dirt, oil, grease, wax, loose paint, mildew, rust, laitance, or efflorescence. Form release agents, curing compounds, hardeners, and sealers.

### 3.04 INSTALLING STEEL FRAMING, GENERAL

- A. General: Comply with requirements in ASTM C 841 for applications indicated.
  - 1. Comply with ASTM C 754 for installation of items not addressed in ASTM C 841.
- B. Install supplementary framing, blocking, and bracing at terminations in plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.



1. Comply with details indicated on Drawings and with plaster manufacturer's written recommendations.

### 3.05 INSTALLING PLASTER WELD

#### A. Application

1. Application of bonding agent: Apply California One Coat or California Kwik Patch with a hawk and trowel. Press firmly into place making sure to imbed the plaster into gypsum. Do not apply more than  $\frac{3}{4}$ " in one pass.
2. If additional thickness is needed, leave the first coat with a rough surface. Apply the second coat only when the first coat is sufficiently hard so as not to be damaged by the additional application of material. Do not build the second coat to greater than  $\frac{1}{4}$ " in thickness.
3. California One Coat may be feathered to a thin edge to blend patches.
4. The following characteristics are based on moderate humidity and an ambient temperature of 70°F / 21°C:
5. California One Coat will be workable for about 45 minutes. California Kwik Patch will have an open time of about 20 minutes
6. Inspection of bonding agent: Prior to applying plaster, inspect bonding agent application to assure a continuous pink film over the entire bonding surface.

#### B. Application One-Coat Plaster

1. Apply a white skim coat of plaster  $\frac{1}{4}$  to  $\frac{3}{4}$  inch thick over Brown Coat direct to gypsum board on ceilings (the mixing, application and finishing of white coat shall be as specified for regular white finish coat). At contractor's option. [allow 1 hour] or delayed a week to 10 days with no effect on bond.)

#### C. Application of Plaster over Electric Heating Cable: Also suitable for BEKA matts

1. Contact Larsen Products for Guide Specifications.
2. Patch Plaster Over California One Kote following work of other trades.

### 3.06 INSTALLING ACCESSORIES

- A. Apply bottom course first, with face out, long dimension at right angles to stud with joints butted together.
- B. Cut lath to fit neatly around electrical outlets and openings.
- C. Place end joints between studs, staggered in successive courses.
- D. Align and support lath ends with clips at top, center and bottom of each joint.
- E. Secure lath to studs using two screws per stud, each located 2 inches from lath edge.

### 3.07 INSTALLING ACCESSORIES

- A. General: Install according to ASTM C 841.



B. Corner Beads: Install at external corners.

C. Casing Beads: Install at terminations of plasterwork, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or frames act as casing beads.

D. Control Joints: Install control joints at locations indicated on drawings.

### 3.08 PLASTER APPLICATION

A. General: Comply with ASTM C 842.

1. Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.

2. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases. Will have to add to adhere to BEKA mats.

C. Finish Coats:

1. Provide troweled finish where indicated.

2. Provide float finish where indicated.

3. Provide sprayed finish where indicated.

4. Provide textured finish where indicated.

5. Textured Finish: Match Architect's sample.

END OF SECTION 09 21 00



## SECTION 09 25 26 – NATURAL CLAY PLASTERING

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. SECTION INCLUDES

- A. Clay veneer plaster for interior application.
- B. Primers.
- C. Additional substrate coats.
- D. Sealers and waxes.
- E. Plaster binders.
- F. Textural additives.
- G. Lime putty.
- H. Accessories.

##### B. RELATED SECTIONS

- A. Section 09 21 00 – Plaster and gypsum board assemblies

#### 1.02 SUBMITTALS

##### A. PRODUCT DATA

- A. Submit manufacturer's literature for each product specified.

##### B. SELECTION SAMPLES

- A. Provide samples of manufacturer's standard colors for color selection.
- B. Provide samples of standard textured finishes.

##### C. VERIFICATION SAMPLES

- A. Submit sample for each color and textured finish specified in minimum 12" by 12" sample. Prepare sample to show appropriate application process. In addition to verification of aesthetic qualities, the sample should also be used to demonstrate compatibility and application process.



#### D. QUALIFICATION DATA

- A. Intended for qualified and certified installer.

#### 1.03 QUALITY ASSURANCE

##### A. INSTALLER QUALIFICATIONS

- A. An installer who is an American Clay Artisan applicator.

##### B. FINISH MOCKUPS

- A. Apply mockups of at least 100 st. ft. in a surface area or as shown on Drawings to demonstrate aesthetic effects and set quality standards for materials and execution.
- B. Apply mockups at location indicated on Drawings or as directed by Architect.
- C. Apply mockups for the following applications.
  - a. Walls and partitions.
  - b. Ceilings.
- D. Simulate finished lighting conditions for review of mockups.
- E. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

##### C. TECHNICAL DATA

- A. Fade Resistance; Color Pigments
  - a. ASTM D4303-03
- B. Flame Spread
  - a. ASTM E-84; NFPA Class A; UBC Class 1.
- C. Mold Resistance
  - a. ASTM D3272; 10 Rating (10: no mold growth).
- D. Permeability
  - a. ASTM E-96; 45.76 perms; 16.91 grains/hr-ft<sup>2</sup>.
- E. Sound
  - a. ASTM 423-07; SAA: 0.09; NRC: 0.10.
  - b. ASTM 90-04; STC: 31

#### 1.04 DELIVERY, STORAGE AND HANDLING

##### A. STORAGE

- A. Cover mixed plaster during breaks to retain moisture.
- B. Store materials in clearly marked containers in location not subject to direct moisture; protect from freezing.
- C. Clay veneer plaster mixed with PlasterPlus
  - a. Store in cool location in container for not more than seven days. After seven days, dry mixture thoroughly on plastic sheet, and store dried material in a covered, airtight container.
- D. Clay veneer plaster mixed with Mud Glue



- a. Store in cool location in container with loose lid (not airtight) for no more than five days. After five days, dry mixture thoroughly on plastic sheet.

#### B. WASTE MANAGEMENT AND DISPOSAL

- A. Surplus clay veneer plaster and clean clay veneer plaster may be used as touch-up materials and extra material for Owner. Clearly mark container as “waste recycled – clay veneer plaster”.
- B. Wet clay veneer plaster should be dried thoroughly on plastic sheet and stored in clearly marked container.

### 1.05 PROJECT CONDITIONS

#### A. ROOM TEMPERATURE

- A. Maintain temperatures at not less than 50 degrees Fahrenheit or greater than 90 degrees Fahrenheit for at least 3 days before application of clay veneer plaster, continuously during application, and for 3 days after completing application.
- B. Bring materials into room 24 hours before mixing to acclimate them to ambient temperature.

#### B. VENTILATION

- A. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
- B. Maintain relative humidity levels for prevailing ambient temperature that produces normal drying conditions. Humidity levels should be not more than 50% relative humidity. Use mechanical means to reduce humidity levels if necessary.
- C. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application.
- D. Upon completion of plaster application, natural or mechanical ventilation may be utilized if specified temperature and humidity levels are maintained.

### 1.06 EXTRA MATERIALS

#### A. PRODUCT

- A. Provide owner with ten percent of clay veneer plaster applied in each color and texture specified.



## PART 2 - PRODUCTS

### 1.01 PLASTER

#### A. CLAY VENEER PLASTER FOR INTERIOR APPLICATION

- A. Proprietary dry blend of clay, fine aggregates, and pigments with mold growth inhibiting natural additives.

#### B. MANUFACTURER

- A. American Clay Enterprises, LLC  
8724 Alameda Park Drive NE, Suite F  
Albuquerque, New Mexico 87102  
505-243-5300 or 1-866-404-1634.

#### C. PRODUCT

##### A. First coat

- a. American Clay Earth Plaster Loma
- b. Packaging: 50 lbs bags
- c. Coverage: 180-220 sq. feet per 50 lb bag (per coat)

##### B. Second coat (if upgrading)

- a. American Clay Earth Plaster Lomalina.
- b. Packaging: 50 lb bags
- c. Coverage: 200-250 sq feet per 50 lb bag (per coat)

##### C. Color additives

- a. Standard American Clay color pigment.
- b. Custom American Clay color pigment to match Architect's sample.

##### D. Properties

- a. Fire-resistant: non-combustible; non-toxic: non-chemical materials; fade resistant; mold resistant; dust resistant; non-dusting; breathable; paintable and stainable.

##### E. Aggregate

- a. Calcium carbonate and mica.

##### F. Color Pigment



a. Natural oxides and mineral pigments.

G. Recycled content by weight

a. 72% post-industrial.

H. Water

a. Potable water.

## 1.02 PRIMERS

### A. TEXTURED PRIMER

A. Mixture of sand aggregates and paint primer

a. American Clay Primer Sand mixed with a multipurpose, transitional or stain-blocking paint primer.

b. American Clay Sanded Primer Elite.

### B. MANUFACTURER

A. American Clay Enterprises, LLC  
8724 Alameda Park Drive NE, Suite F  
Albuquerque, New Mexico 87102  
505-243-5300 or 1-866-404-1634.

### C. OTHER PRIMERS

A. Water-borne primer acceptable to clay veneer plaster manufacturer to be used where indicated in systems below.

## 1.03 SEALERS AND WAXES

### A. GENERAL

A. Sealer must be compatible with clay veneer plaster.

B. VOC content must meet or exceed the VOC and chemical component limits of Green Seal requirements.

### B. ACRYLIC MASONRY SEALER

A. American Clay Penetrating Sealer / Gloss Sealer.





- B. AFM Safecoat “Watershield” or “Mexi-seal”.
- C. Or equal product.

C. FURNITURE OR PASTE WAX

- A. Bioshield “Floor and Furniture Hardwax.”
- B. Or equal product.

D. OIL

- A. AFM “Natural Clear Penetrating Oil.”
- B. Bioshield “Penetrating Sealer.”
- C. Or equal product.

E. LIQUID POTASSIUM OR “WATER GLASS”

- A. AFM Safecoat “Penetrating WaterStop”.
- B. Anco Industries Inc. “Stucco Cure”.
- C. Or equal product.

1.04 PLASTER BINDERS

A. PLASTERPLUS

- A. Proprietary dry blend of aggregates and polymers.

B. MANUFACTURER

- A. American Clay Enterprises, LLC  
8724 Alameda Park Drive NE, Suite F  
Albuquerque, New Mexico 87102  
505-243-5300 or 1-866-404-1634.

C. MUD GLUE

- A. Highly alkaline natural binder; proprietary blend of aggregates, polymers and silicates.

D. MANUFACTURER

- A. American Clay Enterprises, LLC  
8724 Alameda Park Drive NE, Suite F  
Albuquerque, New Mexico 87102  
505-243-5300 or 1-866-404-1634.



## 1.05 ACCESSORIES

### A. JOINT REINFORCING MATERIALS

- A. Trim accessories
  - a. As specified in Section 09260 "Gypsum Board Assemblies."
- B. Filler
  - a. Multi-purpose joint compound; do not use multipurpose lightweight or lightweight topping compounds under clay veneer plasters.

## PART 3 - EXECUTION

### 1.01 GROUNDWORK

#### A. EXAMINATION

- A. Confirm that substrate is ready to accept primer and clay veneer plaster finish.
- B. Surfaces should be dry.
- C. Correct substrate conditions prior to clay veneer plaster application process.

#### B. PREPARATION

- A. General preparation for all substrate categories
  - a. Scrape off loose or flaking paint or other surface material until a well-bonded surface is exposed.
  - b. Knock down high points or protrusions of more than 1/16" with a wide putty knife, scraper or drywall sanding screen.
  - c. Clean and fill any mortar joints and depressions deeper than 1/32", for Lomalina finish coat, with filler that bonds to the substrate.
  - d. Lightly sand any high gloss or glossy sealed surface with 150 grit sandpaper to provide a "tooth" for the primer; test existing paint for lead content prior to sanding; if paint contains lead, follow OSHA procedures.
  - e. Remove any dust with a vacuum or clean with 10% water based sealer and 90% water.
  - f. Clean surfaces to remove dirt, grease, oil, and other foreign matter and deposits that could impair bond with plaster; wash sooty or greasy surfaces with a Tri-Sodium Phosphate (TSP) or equal paint preparation cleaner.
  - g. Knock down high points of 1/32" for a Lomalina finish coat.
  - h. Allow surface to dry.
  - i. Mask adjacent surfaces with painter's tape. Leave tape 1/8" from edge of plaster surface area so that the tape will pull off cleanly.

### 1.02 GENERAL APPLICATION

#### A. APPLICATION THICKNESS



- A. American Clay Earth Plaster Loma
  - a. 1<sup>st</sup> coat; 0.035" (as thin as a credit card)
- B. American Clay Earth Plaster Lomalina
  - a. 2<sup>nd</sup> coat; a bit less than 0.035" (a bit thinner than a credit card)

### 1.03 TRIM ACCESSORY AND JOINT REINFORCEMENT INSTALLATION

#### A. TRIM ACCESSORIES

- A. Prime with textured primer.

#### B. JOINT REINFORCEMENT

- A. Tape and bed
  - a. Level 2 for hand application; Gypsum Association GA-214.
  - b. Level 3 for spray application; Gypsum Association GA-214.
- B. Corner bead
  - a. Prime with two coats of textured primer.
  - b. Joints or repairs must be completely dry prior to primer application.

### 1.04 PRIMER APPLICATION

#### A. ADDITIONAL SUBSTRATE PREPARATION

- A. Apply primer and allow application to dry prior to clay plaster veneer application.
  - a. Stir primer completely, scraping the bottom of the container so that all sand is integrated into the primer. The sand is critical because it enables the plaster to bond to the wall.
  - b. Brush primer along edges of wall, then roll or brush primer on the remaining surfaces. Ensure that all surfaces are coated thoroughly to provide proper plaster bond.
  - c. Spray textured primer and then back roll.
- B. Let primer dry for 3 hours or until sand "bites back" when hand is rubbed against wall.
- C. Double prime outside corners and over exterior corners which are more vulnerable to nicks and dings.
- D. Finished corners should have slight radius.

### 1.05 MIXING CLAY VENEER PLASTER

#### A. GENERAL

- A. Prior to adding water, loosely mix dry clay plaster to even the mix after settling during shipping.
- B. Add ½ bag of plaster and binder to water and evenly mix.
- C. Prior to adding color pigment to plaster, mix color pigment with water in a solution to prevent color starrng.



- D. Add remaining plaster and additional water if needed and mix; mixture consistency should resemble conventional lime or gypsum plasters, typically something similar to soft-serve ice cream. Total water content will vary between 2 to 2 ½ gallons.
- E. Allow plaster to stand for a minimum of 30 minutes before use (the longer it sits, the better it becomes); clay mixture can be mixed as much as 30 days before application and will remain workable as long as the mixture remains wet.
- F. If thickening occurs or mixture has completely dried, add water to bring mixture to a workable consistency.

## 1.06 CLAY VENEER PLASTER APPLICATION

### A. GENERAL

- A. Do not apply clay veneer plaster on damp surfaces.
- B. Using a hawk and trowel apply the Loma first plaster coat; as thin as 1 credit card. When applying plaster make sure to do so in vertical strips with irregular edges by maintaining a wet edge at all times. Make sure you go from one edge of the wall to the other without breaking. Allow it to completely dry, typically 2 to 8 hours depending on humidity levels; do not completely smooth the first coat in order to provide adequate keying of the second coat. (Thickness: 1 credit card = 0.89mm = 0.035"; 1 business card = 0.44mm = 0.017")
- C. Mist wall lightly before applying second coat because it will give more working time by slowing the plaster's drying speed. Avoid over-wetting plaster.
- D. Apply the second coat of Porcelina, as thin as a business card and allow to dry.
- E. If necessary, apply an additional coat to achieve an extremely smooth surface or to hide drywall screws and other surface blemishes. Previous coats should be completely dry and shrinkage complete prior to application of the next coat.
- F. Adjust the texture: when wall is "leather hard" you may smooth the wall by hard troweling, remove trowel marks with a dry sponge, or create an evenly rough surface by rubbing the entire surface with a dry sponge.
- G. For each plaster coat, finish complete walls, panels or ceilings in one operation to avoid the effects of possible variation in color.
- H. On a plastic sheet, layout leftover material that remains wet longer than three days and allow it to dry completely prior to reuse.

## 1.07 APPLICATION SYSTEMS

### A. TRADITIONAL SYSTEM

- A. Description
  - a. Typically, a three-step application system consisting of textured primer, one base coat of American Clay Earth Plaster Loma (first coat) and one finish coat of American Clay Earth Plaster Lomalina (second coat).
- B. Application
  - a. Apply in accordance with complete manufacturer's instructions.



## 1.08 FINISHING AND TEXTURING

### A. TEXTURING (DURING FINISH COAT APPLICATION)

- A. Trowel; matte finish (harder and smoother finish)
  - a. Allow surface to dry completely; surface should be dry to the touch and is set enough that a finger pressed into the surface no longer leaves an impression.

### B. FINISHING

- A. Smooth-troweled finish
  - a. Begin finish when final veneer coat is set or dry; the clay veneer plaster should be resistant to light press of finger but does not leave an impression; if the surface has dried, wet the surface with water using a hand pump sprayer and rework the surface as required.
  - b. To prevent surface cracking, do not over-work.
- B. Smooth finish
  - a. Continue to lightly wet final veneer coat with water and trowel smooth with stainless steel or plastic trowel.
- C. Concluding notes
  - a. Allow veneer plaster to dry completely, a minimum of 12 hours prior to applying sealer.
  - b. Where clay veneer plaster abuts metal doorframes, windows, and other units in veneer plaster, groove finish coat to eliminate spalling; caulk exposed edges.

## 1.09 COMPRESSING THE FINISH COAT

### A. COMPRESSION METHOD

- A. Trowel; matte finish (harder and smoother finish)
  - a. Lightly mist surface, after second coat of plaster, so that it is evenly damp but no water is running down the wall. Trowel with a stainless steel trowel or a plastic trowel.

## 1.010 SEALERS AND COLOR ENHANCERS

### A. SEALER APPLICATION

- A. Apply 2 coats of sealer
  - a. Wax sealer; apply wax directly to the surface with a rag and work into the surface.
  - b. Oil sealer; brush or rag-apply in accordance with sealer manufacturer's instructions for porous substrates.
  - c. Acrylic masonry sealer; spray-apply in accordance with sealer manufacturer's instructions for porous substrates.
  - d. Liquid potassium or "Water Glass" sealer; spray-apply in accordance with sealer manufacturer's instructions for porous substrates.

### B. COLOR ENHANCER APPLICATION



- A. Black soap color enhancer
  - a. Apply warm from squeeze bottle and trowel onto surface; remove excess soap with rag.
  - b. The first coat may dry unevenly; continue to add coats until the soap dries evenly.
  - c. Pigment may be added to soap to create special effects.

#### 1.011 CLEANING AND PROTECTION

##### A. CLEANING CLAY VENEER PLASTER

- A. Unsealed surfaces
  - a. Clean with barely damp sponge and water; do not use cleansers.
- B. Sealed surfaces
  - a. Clean with damp sponge and water; do not use cleansers.

##### B. PROTECTING CLAY VENEER PLASTER

- A. Protect surfaces from construction damage.
- B. Repair damaged areas, remove protection, and clean prior to Substantial Completion.

#### 1.012 REPAIR AND MAINTENANCE

##### A. TOUCH UP REPAIRS

- A. Clay veneer plaster layer
  - a. If veneer plaster is still evident underneath affected area, lightly wet the area with a sponge and water.
- B. Bonding failure
  - a. If patch is necessary due to a lack of bonding agent on the substrate, apply more primer and then apply the clay veneer plaster.
  - b. After the veneer plaster has set, use a sponge along the build seam between the patch and original material; blend the seam with a circular motion.
  - c. Smooth the seam with the appropriate tool for the final surface desired and allow patch to dry; if during the smoothing process, there are sponge marks (light streaky areas), use a very damp sponge to remove the streaks.
- C. Cracks larger than 1/16"
  - a. Create a barrier between the crack and patch to keep the crack from translating to the surface.
  - b. Remove veneer plaster down to the substrate and repair crack; prime the repaired area as required and complete the repair as indicated above.

##### B. MAINTENANCE

- A. Surface stains and marks
  - a. Lightly wipe with a clean damp sponge or cloth to remove; do not use harsh cleaners or abrasive cloths.



- B. Surface cracks
  - a. Mist area with vinegar water (1 to 4 ratio of vinegar to water) and smooth with sponge or trowel.
- C. Settling cracks or areas larger than 1/16"
  - a. Fill with new material as specified in "Touch Up Repairs" article above.

#### 1.013 SCHEDULE

##### A. LOCATION 1

- A. System
  - a. Traditional System.
- B. Colors
  - a. Arden.
- C. Finishes
  - a. Lomalina.
- D. Sealers and waxes
  - a. Please specify sealers and/or waxes used.

END OF SECTION 09 25 26



SECTION 09 29 00 – GYPSUM BOARD  
PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Gypsum Board

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05 40 00 Cold-Formed Metal Framing for wall stud construction and assembly.
- B. Section 09 25 26 Natural Clay Plastering for outer wall interior wall finish.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions with project conditions and materials clearly identified or detailed for each required system.

1.4 SYSTEM REQUIREMENTS

- A. Performance Requirements: Fabricate and install systems as indicated but not less than that required to comply with ASTM C754 under the following conditions:
  - 1. Interior suspended ceilings and soffits: Maximum deflection of  $l/360$  of distance between supports.
  - 2. Exterior soffits: Withstand minimum positive and negative pressure of 20 psf with maximum deflection of  $l/360$  of distance between supports.
  - 3. Nonstructural components that are permanently attached to structures and their support attachments in the Project Manual shall be designed and constructed to resist the effects of earthquake motions in accordance to local jurisdiction.
- B. Fire Resistance Ratings: Where fire resistance classifications are indicated, provide materials and application procedures identical to those listed by UL or tested according to ASTM E119 for type of construction shown.

1.5 QUALITY ASSURANCE

- A. Reference Standards:
  - 1. Applicable requirements of ASTM C754 for installation of steel framing.





2. Install gypsum board in accordance with applicable requirements and recommendations of Gypsum Association GA 216, "Recommended Specifications for the Application and Finishing of Gypsum Board" except for more stringent requirements of manufacturer.
3. Apply acoustical sealant in accordance with applicable requirements of ASTM C919.

#### 1.6 DELIVERY, STORAGE AND HANDLING

##### A. Delivery:

1. Deliver material to site promptly without undue exposure to weather.
2. Deliver in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.

##### B. Storage:

1. Store above ground in dry, ventilated space.
2. Protect materials from soiling, rusting and damage.
3. Store board to be directly applied to masonry walls at 70°F for 24 hours prior to installation.

#### 1.7 PROJECT CONDITIONS

##### A. Environmental Requirements:

1. Do not install gypsum board when ambient temperature is below 40°F.
2. For adhesive attachment of gypsum board, and for finishing of gypsum board, maintain ambient temperature above 55°F from one week prior to attachment or joint treatment, and until joint treatment is complete and dry.

#### 1.8.1 ALTERNATE CONSTRUCTION WASTE DISPOSAL

##### A. Reuse:

1. Separate clean waste drywall pieces from contaminants for landfilling or recycling. Do not include vinyl-faced, mold-resistant or asphalt impregnated gypsum boards. Pulverize and apply to site soil in accordance to landscape specifications. Protect scrapes and pulverized material from moisture and contamination. Alternate to on-site soil amendment, work to supply local farming granular material for their use.

##### B. Recycle:

1. Separate clean waste drywall pieces from contaminants for landfilling or reuse. Working with local waste hauler and local drywall manufacturer, provide proper storage of waste for pickup and return. Protect scrapes material from moisture and contamination.

#### PART 2 - PRODUCTS



## 2.1 PRODUCTS AND MANUFACTURERS

- A. Gypsum Board and Accessories: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL.
- B. Steel Framing and Furring: Company acceptable to installer.
- C. Grid Suspension Assemblies: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL.

## 2.2 BOARD MATERIALS

- A. Gypsum Board:
  - 1. ASTM C1396 (Section 5), X fire-resistant type.
  - 2. Edges: Tapered.
  - 3. SHEETROCK® brand MOLD TOUGH™ AR gypsum panels were designed and tested to offer greater resistance to surface indentation and impact damage than standard SHEETROCK gypsum panels. These abuse-resistant gypsum panels are a low-cost alternative to other systems for partitions that require greater impact resistance. SHEETROCK MOLD TOUGH AR gypsum panels have a noncombustible, moisture- and mold-resistant core that is encased in moisture- and mold-resistant, 100 percent recycled green face and brown back papers. The face paper is folded around the long edges to reinforce and protect the core, and the ends are square cut and finished smooth. Long edges of panels are tapered, allowing joints to be reinforced and concealed with a USG joint treatment system.
  - 4. Thickness: 1/4 [3/8] [½] [5/8] [3/4] inch, unless otherwise indicated.
    - a. Where curved gypsum board construction is indicated, use 1/4 inch thick flexible facing board.
  - 5. Acceptable products:
    - a. Typical partitions and ceilings: Equivalent to SHEETROCK® brand SW, FIRECODE® or FIRECODE® "C" Core gypsum panels by USG.
    - b. OR [depends on edge condition option]: Equivalent to SHEETROCK® brand Regular, FIRECODE® or FIRECODE® "C" Core gypsum panels by USG.
    - c. Acceptable product for fire-rated walls: Equivalent to ULTRACODE® Core, 3/4 inch thick, by USG.
    - d. SHEETROCK® brand MOLD TOUGH™ FIRECODE® and FIRECODE® C Core gypsum panels have a noncombustible, moisture- and mold-resistant gypsum core that is encased in moisture- and mold-resistant, 100 percent recycled green face and brown back papers. The panels feature tapered long edges for easy finishing. The



5/8" FIRECODE and 1/2" FIRECODE C Core panels are UL Classified for fire resistance (Type X).

e. Acceptable product for curved walls: 1/4" Flexible Gypsum Panels.

B. Ceiling Board:

1. ASTM C1396 (Section 12), non-sag type.
2. Thickness: ½ inch.
3. Acceptable product: Equivalent to Interior Gypsum Ceiling Board by USG.

C. Moisture & Mold Resistant:

1. ASTM C1396 (Section 5), regular type except where Type X fire-resistant type is indicated or required to meet UL assembly types.
2. Edges: Tapered.
3. Thickness: [1/2] [5/8] [3/4] inch.
4. Acceptable products: Sheetrock® brand Mold Tough™ Firecode (Type X), Firecode® C Core or ULTRACODE® Core gypsum panels by USG.
5. SHEETROCK® brand MOLD TOUGH™ AR gypsum panels were designed and tested to offer greater resistance to surface indentation and impact damage than standard SHEETROCK gypsum panels. These abuse-resistant gypsum panels are a low-cost alternative to other systems for partitions that require greater impact resistance. SHEETROCK MOLD TOUGH AR gypsum panels have a noncombustible, moisture- and mold-resistant core that is encased in moisture- and mold-resistant, 100 percent recycled green face and brown back papers. The face paper is folded around the long edges to reinforce and protect the core, and the ends are square cut and finished smooth. Long edges of panels are tapered, allowing joints to be reinforced and concealed with a USG joint treatment system.

## 2.3 METAL FRAMING AND FURRING MATERIALS

A. Metal Studs and Runners:

1. ASTM C645, "C" shaped, gauge:
  - a. Provide gauge as indicated for studs; runner gauge as recommended by stud manufacturer.
  - b. Provide 25 gauge studs, except as otherwise indicated or specified. Provide heavier gauge if required.
  - c. At door [and borrowed light] frames, provide (2) 25 gage minimum studs at each jamb. Where wall is indicated or specified to be typically framed with 20 gauge studs, provide (2) 20 gauge studs at each jamb.



- d. Provide 20 gauge studs at walls to receive cement backer board [,] [and] water resistant gypsum board with ceramic tile facing.
- e. Provide runner gauge as recommended by stud manufacturer.
2. Depth of sections: As indicated.
3. Corrosion protection: G40 hot-dipped galvanized coating per ASTM A525.

## 2.4 CEILING AND SOFFIT SUPPORT MATERIALS

- A. Hanger Anchorage Devices: Screws, clips, bolts or other devices compatible with indicated structural anchorage for ceiling hangers and whose suitability has been proven through standard construction practices or by certified test data.
  
- D. Hangers:
  1. Steel wire or rods, sizes to comply with requirements of ASTM C754 for ceiling or soffit area and loads to be supported.
  2. Wire: ASTM A 641, soft, Class 1 galvanized.
  3. Rods and flats:
    1. Mild steel components.
    2. Finish: Galvanized or painted with rust-inhibitive paint for interior work; galvanized for exterior work.
  
- E. Framing System:
  1. Main runners:
    1. Cold-rolled, "C" shaped steel channels, 16 gauge minimum.
    2. Finish: Galvanized with G40 hot-dip galvanized coating per ASTM A525 [for exterior work]; galvanized or painted with rust-inhibitive paint for other interior work.
    3. Form to required radius at curved ceilings.

## 2.5 ACCESSORIES

- A. Metal Trim for Gypsum Board:
  1. Conform to profile and dimensions indicated.
  2. Material for interior work: Galvanized steel, 26 gauge minimum.
  3. Corner beads: Equivalent to Dur-A-Bead No. 103 [104] [800] [900] by USG.
  4. Casing beads (edge beads): Equivalent to 200A [200B] [401] [402] [P-1] [701-B] [801-A] [801-B] by USG.
  5. Control joints:
    - a. Roll-formed zinc with perforated flanges.
    - b. Size: 1-3/4 inch wide, with ¼ inch wide center channel.
    - c. Provide with removable tape strip over channel.
    - d. Acceptable product: Equivalent to No. 093 by USG.



- D. Trim for Exterior Soffits: Rolled zinc complying with ASTM C1047.
- E. Special Trim and Reveals: Extruded aluminum alloy 6063-T5, profiles as indicated.
- H. Hanger Wire Sound Isolators: Provide where indicated for sound-rated suspended ceilings.
- I. Adhesives and Joint Treatment Materials:
  - 1. Conform to requirements of ASTM C475.
  - 2. Joint compounds:
    - a. Drying-type (ready-mixed): Equivalent to SHEETROCK® brand taping joint compound and topping joint compound, or SHEETROCK® all purpose joint compound [or ready-mixed lightweight all purpose joint compound by USG.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and adjoining construction and conditions under which work is to be installed. Do not proceed with work until unsatisfactory conditions are corrected.

#### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install in accordance with reference standards and manufacturer's instructions [and as required to comply with seismic requirements].
- B. Tolerances:
  - 1. Do not exceed 1/8 inch in 8'-0" variation from plumb or level in exposed lines of surface, except at joints between gypsum board units.
  - 2. Do not exceed 1/16 inch variation between planes of abutting edges or ends.
  - 3. Shim as required to comply with specified tolerances.
- C. Install framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.



- D. Install supplementary framing, blocking and bracing at terminations in gypsum board assemblies to support fixtures, equipment, heavy trim, grab bars, toilet accessories, furnishings or similar construction.

### 3.3 METAL SUPPORT INSTALLATION

- A. Metal Runners:
  - 1. Align and secure runner tracks accurately to partition layout at both floor and ceiling.
  - 2. Provide fasteners appropriate to substrate construction as recommended by manufacturer.
  
- B. Metal Studs:
  - 1. Position metal studs vertically in the runners, spaced as indicated.
  - 2. Place studs so that flanges face in same direction.
  - 3. Cut studs  $\frac{1}{2}$  inch short of full height to provide perimeter relief.
  - 4. Align and plumb partition framing accurately.
  - 5. Where partitions abut ceiling or deck construction or vertical structural elements, provide slip or cushion type joint between partition and structure as recommended by stud manufacturer to prevent transfer of structural loads or movements to partitions, and to provide lateral support.
  - 6. Provide horizontal bracing where necessary for lateral support.
  
- C. [Hat Channel Furring:
  - 1. Attach hat-shaped furring channels either vertically or horizontally with fasteners through alternate wing flanges (staggered).
  - 2. Space furring channels at 24 inches on center, unless otherwise indicated. Where furring is indicated to receive backer board, water resistant gypsum board with ceramic tile, or veneer plaster, space at 16 inches on center.
  - 3. Install furring channels within 4 inches of floor line and ceiling line.]
  
- E. [Ceiling and Soffit Support Systems:
  - 1. Secure hangers or rods to structural support by connecting directly to structure where possible; otherwise connect to inserts, clips or other anchorage devices or fasteners indicated.
  - 2. Space main runners, hangers and furring according to requirements of ASTM C754, except as otherwise indicated.
  - 3. Where spacing of structural members, or width of ducts or other equipment, prevents regular spacing of hangers, provide supplemental hangers and suspension members and reinforce nearest affected hangers to span extra distance.

### 3.4 BOARD INSTALLATION



- A. [Single Layer Gypsum Board on Metal Studs:
1. Loosely butt gypsum board joints together and neatly fit.
  2. [Do not place butt ends against tapered edges.]
  3. Maximum allowable gap at end joints: 1/8 inch.
  4. Stagger joints on opposite sides of partitions.
  5. Apply ceiling boards first where gypsum board ceilings and wall occur.
  6. Cut openings in gypsum board to fit electrical outlets, plumbing, light fixtures and piping snugly and small enough to be covered by plates and escutcheons. Cut both face and back paper.
  7. Screw board in place securely with screws spaced according to manufacturer's recommendations.]
- B. Water-Resistant Gypsum Board:
1. Complete plumbing rough-in before gypsum board panels are erected.
  2. Separate gypsum panels from rough-in and fixtures by 1/4 inch space.
  3. Make necessary cut-outs and seal cut or exposed panel edges with thinned-down ceramic tile adhesive or with waterproof flexible sealant, as recommended by gypsum board manufacturer.
  4. Install water-resistant board horizontally.
  5. Do not place water-resistant board directly over vapor retarder.
  6. [Prior to tile application, fill openings around pipes, fittings, fixtures, interior angles and other penetrations with waterproof flexible sealant, as recommended by gypsum board manufacturer. Do not fill 1/4 inch gap at bottom of panels.]]

### 3.7 ACCESSORY INSTALLATION

- A. Trim:
1. Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
  2. Install metal corner beads at external corners.
  3. Install metal casing bead trim whenever edge of gypsum board would otherwise be exposed or semi-exposed.
- B. Control Joints:
1. Install control joints at junction of gypsum board partitions with walls or partitions of other finish material.
  2. Install control joints within long runs of partitions, ceilings or soffits at approximately 30'-0" on center or as indicated.
  3. Where gypsum board is vertically continuous, as at stairwells, provide horizontal control joints at each floor level.



- C. Special Trim: Install as indicated on drawings and in accordance with manufacturer's instructions.

### 3.8 FINISHING

- A. Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214, "Recommended Specification: Levels of Gypsum Board Finish".
  - 1. Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
  - 2. Level 2: Gypsum board substrate at tile [stone], except remove tool marks and ridges.
  - 3. Level 3: Gypsum board surfaces, where textured finishes or heavy vinyl wall papering will be used [High-build Primer required as specified in Section 09911 or USG First Coat primer].
  - 4. Level 4: Gypsum board surfaces, except where another finish level is indicated [High-build Primer required as specified in Section 09911 or USG First Coat primer].
  - 5. Level 5: Gypsum board surfaces requiring extra smooth surface for critical light, where indicated using spray-applied Primer-Surfacer, TUFF-HIDE [or watered-down joint compound skim coat over whole surface and High-build Primer required as specified in Section 09911 or SHEETROCK® First Coat primer].
    - a. Surface Preparation: Complete gypsum board surface to Level 2 before applying KILZ® Pro X Primer and Natural Clay Finish.
- B. Interior Gypsum Board:
  - 1. [Prefill:
    - a. Use setting-type joint compound. Mix joint compound according to manufacturer's directions.
    - b. Fill joints between boards flush to top of eased or beveled edge.
    - c. Fill joints of gypsum board above suspended ceilings in fire-rated partitions.
    - d. Wipe off excess compound and allow compound to harden.]
  - 2. Taping (Level 1):
    - a. Use taping or all purpose [conventional weight, lightweight or midweight] compound.
    - b. Butter taping compound into inside corners and joints.
    - c. Center tape over joints and press down into fresh compound.
    - d. Remove excess compound.
    - e. Tape joints of gypsum board above suspended ceilings.
  - 3. First coat (Level 2):
    - a. Use taping or all-purpose [conventional weight, lightweight or midweight] drying-type compound, or setting-type joint compound.
    - b. Immediately after bedding tape, apply skim coat of compound over body of tape and allow to dry completely in accordance with manufacturer's instructions.
    - c. Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
  - 4. Second coat (Level 3): Use all purpose or topping (conventional weight, lightweight or midweight) drying type joint compound. After first coat treatment is dried, apply second





- coat of compound over tape and trim, feathering compound 2 inches beyond edge of first coat.
5. Third coat (Level 4):
    - a. Use all purpose or topping [conventional weight, lightweight or midweight] drying type joint compound.
    - b. After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2 inches beyond edge of second coat.
    - c. Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
  6. [Skim coat (Level 5):
    - a. Apply skim coat of all-purpose (conventional weight) drying-type compound or spray-applied Primer-Surfacer, TUFF-HIDE over exposed surfaces of gypsum board.
    - b. After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.]
- C. Water-Resistant Gypsum Board: Treat fastener heads and joints with setting-type joint compound.
1. [For joints to be covered with tile, apply tape and joint compound bedding coat and skim coat only; do not apply finish coats.
    - a. Do not crown joints or leave excess compound on panels.
    - b. Remove tool marks and ridges.
    - c. For fastener heads to be covered with tile, apply one coat of joint compound.]
- G. Joint Compound:
1. After skim coat sets, apply finish coat of compound feathering 3 to 4 inches beyond tape edges.
  2. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.
  3. Allow joint compound to completely set before applying veneer plaster finish.
- H. Trim:
1. Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
  2. Install metal corner beads at external corners.
  3. Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi-exposed, and where gypsum base terminates against dissimilar material.



- I. Control Joints: Install where indicated and specified.
  
- J. Special Trim and Reveal Joints: Install as indicated on drawings and in accordance with manufacturer's instructions.

### 3.10 ADJUSTING

- A. Correct damage and defects which may telegraph through finish work.
  
- B. Leave work smooth and uniform.

END OF SECTION 09 29 00



## SECTION 09 60 00 – FLOORING

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes: Forbo Flooring - Marmoleum® linoleum flooring for the Solar Decathlon SHADE home. Prefinished natural and recycled material striated and pre-engineered linoleum flooring installed by [glued down method].

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry

#### 1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM F 2034 Standard Specification for Linoleum Sheet Floor Covering.
2. ASTM F 1861 Standard Specification for Resilient Wall Base.
3. ASTM F 1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.
4. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
5. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
6. ASTM E 492 Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine.
7. ASTM E 989 Standard Classification for Determination of Impact Insulation Class (IIC).

B. National Fire Protection Association (NFPA):

1. NFPA 258 Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

C. International Standards and Training Alliance (INSTALL):

1. INSTALL Resilient Certification



### 1.03 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- B. Specifier Note: Article below includes submittal of relevant data to be furnished by Contractor either before, during, or after construction. Coordinate this article with Architect's and Contractor's duties and responsibilities in "Conditions of the Contract" and Division 1 Submittal Procedures Section.

### 1.04 ACTION SUBMITTALS

#### A. Product Data:

- 1. Flooring: Include Petrified Wood Striato [3577] color, adhesive used in manufacturing of flooring planks and finish data.
- 2. Accessories.
- 3. Installation adhesive.

B. Shop drawings: Include direction of flooring, fastening method, flooring patterns, and scaled sectional details of accessories and transitions to adjoining materials.

#### C. Quality Assurance/Control Submittals:

- 1. Qualifications: Proof of manufacturer and installer qualifications.
- 2. Test Reports: Reports for specified Physical Property Performance Requirements.
- 3. Manufacturers Installation Instructions.

D. Closeout Submittals: Submit the following items:

A. Maintenance data.

B. Letter of Warranty.

### 1.04 QUALITY ASSURANCE

#### A. Installer Qualifications:

- 1. Spectra Contract Flooring, official installer of Forbo Flooring products.

#### B. Regulatory Requirements:

- 1. Fire Performance Characteristics: Provide resilient linoleum sheet flooring with the following fire performance characteristics as determined by testing products in accordance with ASTM method indicated below by a certified testing laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - a. Critical Radiant Flux: Class 1 Rating per NFPA 253 (ASTM E 648) (0.45 watts/cm<sup>2</sup> or greater).
  - b. Smoke Density: Less than 450 per NFPA 258 (ASTM E 662).



Specifier Note: Retain paragraph below for erected assemblies (either on-site or off-site) required for review of construction, coordination of work of several sections, testing, or observation of operation. Mock-ups, when accepted or approved, establish standards by which work will be judged. Coordinate below with Division 1 Quality Control (Mock-Up Requirements) Section.

- C. Pre-instillation Meetings: Conduct conference at Accelerated Construction Technologies in Phoenix, Arizona. Conference will consist of decathletes and installer of the Marmoleum® flooring.

#### 1.06 WARRANTY

- A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

Specifier Note: Coordinate paragraph below with manufacturer's warranty requirements.

- 1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial Completion.

Specifier Note: Coordinate article below with Division 1 Closeout Submittals (Maintenance Materials) Section.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  - 1. Material should be stored in areas that are fully enclosed and weathertight. The permanent HVAC should be fully operational, controlled and set at a minimum of 68° F (20° C) for at least 48 hours prior to the installation.

#### 1.08 MAINTENANCE

- A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals (Maintenance Materials) Section.

Specifier Note: Revise paragraph below specifying size and percentage as required for project.

- 1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.



2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

## PART 2 - PRODUCTS

### 2.01 RESILIENT LINOLEUM SHEET FLOORING [PRODUCT TYPE]

#### A. Manufacturer: Forbo Flooring, Inc.

Specifier Note: Paragraph below is an addition to CSI SectionFormat and a supplement to MANU-SPEC<sup>®</sup>. Retain or delete paragraph below per project requirements and specifier's practice.

1. Contact: 8 Maplewood Dr., Humboldt Industrial Park, P.O. Box 667, Hazleton, PA 18202; Telephone +800 842 7839 or +570 459 0771; Fax + 570 450 0258

Specifier Note: Paragraph below is an addition to CSI SectionFormat and a supplement to MANU-SPEC<sup>®</sup>. Retain or delete paragraph below per project requirements and specifier's practice.

2. Representative Contact: [Specify representative contact information.]

#### B. Proprietary Product(s): Marmoleum<sup>®</sup> [Striato] Linoleum Sheet and Linoleum Adhesive.

1. Description: Homogeneous sheet linoleum of primarily natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendered onto natural jute backing. Pattern and color shall extend throughout total thickness of material.
2. Width: 2 Meters (79")
3. Length: 32 Meters (105 Linear Feet)
4. Gauge: 2.5mm (1/10")
5. Backing: Jute
6. Pattern and Color: Petrified Wood [3577]
7. Adhesive: Forbo Flooring, Inc., L 885 Adhesive
8. Heat Welding Rod: Forbo Flooring, Inc., Marmoweld<sup>®</sup> color-matched [solid color] [multi-color] welding rod.
9. Topshield<sup>™</sup> finish

#### C. Proprietary Product(s): Marmoleum<sup>®</sup> Decibel Linoleum Sheet and Linoleum Adhesive.

1. Description: Homogeneous sheet linoleum of primarily natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendered onto natural jute backing with an applied polyolefin comfort layer. Pattern and color shall extend throughout total thickness of material.
2. Width: 2 Meters (79")
3. Length: 27 Meters (89 Linear Feet)
4. Gauge: 3.5mm (0.137")
5. Backing: Jute/Polyolefin Foam
6. Pattern and Color: Petrified Wood [3577]
7. Adhesive: Forbo Flooring, Inc., L 885 Adhesive
8. Heat Welding Rod: Forbo Flooring, Inc., Marmoweld<sup>®</sup> color-matched [solid color] [multi-color] welding rod.
9. Topshield<sup>™</sup> finish



- D. Proprietary Product(s): Marmoleum<sup>®</sup> Composition Sheet (MCS) Linoleum Sheet and Linoleum Adhesive.
1. Description: Homogeneous sheet linoleum of primarily natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendered onto natural jute backing. Pattern and color shall extend throughout total thickness of material.
  2. Width: 2 Meters (79")
  3. Length: 32 Meters (105 Linear Feet)
  4. Gauge: 2.0mm (0.080")
  5. Backing: Jute
  6. Pattern and Color: Petrified Wood [3577]
  7. Adhesive: Forbo Flooring, Inc., L 885 Adhesive
  8. Heat Welding Rod: Forbo Flooring, Inc., Marmoweld<sup>®</sup> color-matched [solid color] [multi-color] welding rod.
  9. Topshield<sup>™</sup> finish
- E. Proprietary Product(s): Marmoleum<sup>®</sup> Sport Linoleum Sheet and Linoleum Adhesive.
1. Description: Homogeneous sheet linoleum of primarily natural materials consisting of linseed oil, wood flour, and rosin binders, mixed and calendered onto natural jute backing. Pattern and color shall extend throughout total thickness of material.
  2. Width: 2 Meters (79")
  3. Length: 28 Meters (92 Linear Feet)
  4. Gauge: 3.2mm (1/8")
  5. Backing: Jute
  6. Pattern and Color: Petrified Wood [3577]
  7. Adhesive: Forbo Flooring, Inc., L 885 Adhesive
  8. Heat Welding Rod: Forbo Flooring, Inc., Marmoweld<sup>®</sup> color-matched [solid color] [multi-color] welding rod.

## 2.02 MATERIALS

- A. Related Materials: Refer to other sections for related materials as follows:
1. Underlayment and Patching Compound: Refer to Division 3 Concrete Sections for portland cement based underlayments and patching compounds.
  2. Resilient Flooring Accessories: Refer to Division 9 Finishes Sections for resilient flooring accessories.
  3. Expansion Joint Covers: Refer to other specification section for expansion joint covers to be used with resilient flooring.

## PART 3 - EXECUTION

### 3.01 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 (i.e. moisture tests, bond test, pH test, etc.).



- B. **Material Inspection:** In accordance with manufacturer's installation requirements, visually inspect materials prior to installation. Material with visual defects shall not be installed and shall not be considered as a legitimate claim.

### 3.02 PREPARATION

- A. **Adjacent Surfaces Protection:** Protect adjacent work areas and finish surfaces from damage during product installation.
- B. **Surface Preparation:**
  - 1. **General:** Prepare floor substrate in accordance with manufacturer's instructions.
  - 2. **Floor Substrate:** Floors shall be sound, smooth, flat, permanently dry, clean, and free of all foreign materials including, but not limited to, dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt and old adhesive residue.
- C. **Wood Subfloors:** Wood floors should be double construction with a minimum total thickness of 1 inch. Wood floors must be rigid, free from movement and have at least 18" of well-ventilated air space below. Forbo floor coverings should not be installed over wooden subfloors built on sleepers over on or below grade concrete floors without first making sure that adequate precautions have been taken to ensure the structural integrity of the system, and to prevent moisture migration from the concrete slab.
  - 1. Refer to Division 6 Carpentry sections for wood subfloor construction.
  - 2. **Reference Standard:** Comply with ASTM F 1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring

Specifier Note: Coordinate article below with manufacturer's recommended installation details and requirements.

### 3.03 INSTALLATION

- A. **Adhesive Flooring Installation:** Cut required length of linoleum flooring from roll, allowing enough material to extend up the wall 4 to 6 inches at either end. Apply adhesive and lay sheet flooring into wet adhesive and roll with a 100 pound roller. Install sheet flooring square with room axis.
  - 1. [Adhesive, Seamless Flooring Installation: Rout out seams and heat weld together with complementary colored heat welding rod of complimentary composition in accordance with resilient flooring manufacturer's recommendations.]
  - 2. **Adhesive Flooring and Flash Coved Base Installation:** Extend flooring up the wall in a flash-coved method to a height of [4] [6] inches ([102] [152] mm), as indicated.
  - 3. **Adhesive Material Installation:** Use trowel as recommended by flooring manufacturer for specific adhesive. Spread at a rate of approximately 150 ft<sup>2</sup>/gallon, as recommended by flooring manufacturer.
- B. **Installation Techniques:**
  - 1. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
  - 2. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures and built-in furniture, including pipes, outlets, edgings, thresholds, nosings, and cabinets.





3. Extend flooring into toe spaces, door reveals, closets, and similar openings.
4. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
5. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to other specification sections for expansion joint covers.
6. Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed installation.
  - a. Use adhesive applied to substrate in compliance with flooring manufacturer's recommendations, including those for trowel notching, adhesive mixing, and adhesive open and working times.
7. Roll resilient flooring as required by resilient flooring manufacturer.

C. Finish Flooring Patterns: As selected by Architect.

Specifier Note: Coordinate article below with Division 1 Quality Assurance and Quality Control Sections.

### 3.04 CLEANING

- B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
  1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer.
  2. Sweep and vacuum floor after installation.
  3. Do not wash floor until after time period recommended by flooring manufacturer.
  4. Damp mop flooring to remove black marks and soil.

Specifier Note: Coordinate article below with Division 1 Execution Requirements Section.

### 3.05 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

Specifier Note: Add or delete article below to suit project requirements.

### 3.06 INITIAL MAINTENANCE PROCEDURES

- C. General: Include in Contract Sum Amount cost for initial maintenance procedures, and execute procedures after flooring installation as recommended by flooring manufacturer.
- D. Initial maintenance "Starter Kit" supplied by manufacturer. Initial maintenance to be conducted by flooring contractor.
- E. Drying Room Yellowing: Expose installed linoleum to either natural or artificial light to allow "drying room yellowing" (the film is a natural occurrence of the oxidation of the linseed oil in linoleum products) on installed linoleum flooring to disappear prior to initiating temporary protection procedures.



Specifier Note: Retain article below to suit project requirements. CSI PageFormat allows for Schedules, Forms, and Tables to be located at the end of a section. Article may be used to described specific criteria requirements of similar products or equipment.

END OF SECTION 09 60 00



## SECTION 09 91 23 – INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes Interior primer and paint systems for the interior mechanical core unit. Primer will be used for sealing the drywall and will be behind fiber cement panels.

#### 1.2 ACTION SUBMITTALS

- B. Product Data: Manufacturer's data sheets on each paint and coating product should include:
  1. Product characteristics
  2. Surface preparation instructions and recommendations
  3. Primer requirements and finish specification
  4. Storage and handling requirements and recommendations
  5. Application methods

#### 1.3 DELIVERY, STORAGE, AND HANDLING

- C. Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information:
  1. Product name and type (description)
  2. Application & use instructions
  3. Surface preparation
  4. VOC content.
  5. Environmental issues
- D. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.
- E. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.
- F. Testing Agency Qualifications: Member company of NETA or an NRTL.
- G. Warranty. If this product is found to be defective upon inspection by its representative, Masterchem Industries LLC will, at its option, either furnish an equivalent amount of new product or refund the purchase price to the original consumer purchaser of this product upon proof of purchase. Masterchem Industries will not be liable for any representations or warranties made by any retail seller or applicator of this product. This warranty excludes (1) labor or cost of labor for the removal of this product or any other product, the repair or replacement of substrates to which this product is applied or the application of replacement product and (2) any incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you



specific rights and you may also have other rights which vary from state to state. This warranty is not transferable. To make a warranty claim, write to Technical Service, Masterchem Industries LLC, 3135 Old Highway M, Imperial, MO 63052-2834, or email Technical Service at [techservice@masterchem.com](mailto:techservice@masterchem.com). †WARNING! If you scrape, sand or remove old paint, you may release lead dust. LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE. Wear a NIOSH-approved respirator to control lead exposure. Clean up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Hotline at 1-800-424-LEAD or log on to [www.epa.gov/lead](http://www.epa.gov/lead).

#### 1.4 PROJECT CONDITIONS

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacture
  - 1. KILZ  
Masterchem Industries  
3135 Old Hwy M  
Imperial, MO 63052  
<http://www.kilz.com>  
1-866-977-3711
- B. Substitutions: Requests for substitutions will be considered. When submitting request for substitution, provide complete product data specified above under Submittals, for each substitute product.

#### 2.2 APPLICATION/SCOPE

- C. Surfaces to be coated
  - 1. Drywall
  - 2. MDF bracing for fiber cement panels, refer to section (?)

#### 2.3 MATERIALS – GENERAL REQUIREMENTS

- D. Primers:
  - 1. Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.



## 2.4 ACCESSORIES

- E. A Coating Application Accessories: 1 Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.
- F.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared. Notify Architect of unsatisfactory conditions before proceeding.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

### 3.2 SURFACE PREPARATION

- D. Cover all nail and screw heads with joint compound according to directions and sand to smooth surface.
- E. Tape drywall and apply joint compound and allow to fully cure according to directions prior to priming.
- F. Sand to smooth surface before priming.
- G. Wipe off dust with a damp cloth and allow to dry before applying the primer. The surface must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

### 3.3 VOC CONTENT

- A. Content: <50 g/L. The addition of colorant may add VOCs.

### 3.4 INSTALLATION

- H. Apply all coatings and materials with manufacture specifications in mind. Mix and thin coatings according to manufacture recommendation.
- I. Must be wearing proper PPE, eye protection is recommended.
- J. Use only when temperatures are between 50°F (10°C) and 90°F (32°C).



- K. Coverage is approximately 300-400 square feet per gallon depending on the surface porosity.
- L. May be tinted with up to 2 ounces of universal colorant per gallon.
- M. Glossy surfaces: not recommended. KILZ PREMIUM® and KILZ 2® primers are recommended for use over properly prepared glossy surfaces.
- N. Do not apply to wet or damp surfaces.
  - 1. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
  - 2. Test new concrete for moisture content.
  - 3. Wait until wood is fully dry after rain, fog or dew.
- O. Apply coatings using methods recommended by manufacturer.
- P. Masonry, brick, stucco and plaster: not recommended. KILZ PREMIUM® and KILZ 2® are recommended for use over properly prepared masonry surfaces.
- Q. Stainblocking: Not formulated to block stains. For stainblocking, use KILZ ORIGINAL®, KILZ ODERLESS®, KILZ COMPLETE®, KILZ PREMIUM® Primer.
- R. Primer will not be used underneath Natural Clay Plaster Finish, Section 09 25 26.
- S. Inspection: The coated surface must be inspected and approved by the Architect or Engineer just 09 91 23 Interior Paints & Coatings 26 prior to each coat.

### 3.5 PROTECTION

- T. Protect finished coatings from damage until completion of project.
- U. Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 09 91 23



## Division 10 – Specialties

### SECTION 10 22 23.23 - MOVEABLE PANEL SYSTEMS

#### PART 1- GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Single panel partitions, 1 3/8" - 2" (35 mm - 50 mm) thick panels.
- B. Related Sections:
  - 1. Section 05 40 00 – Metal Framing
  - 2. Section 08 14 16 – Flush Wood Doors
  - 3. Section 09 21 00 – Plaster and Gypsum Assemblies
  - 4. Section 11 52 13 – Projection screens

##### 1.02 REFERENCES

- A. ASTM E 557 - Standard Practice for the Installation of Operable Partitions.

##### 1.03 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this project.
- B. Preparation of Opening: Conform to ASTM E 557.

##### 1.05 DELIVERY, STORAGE, AND HANDLING



- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's instructions and as required to prevent damage.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

- A. Acceptable Manufacturer: Häfele America Co., which is located at: 3901 Cheyenne Drive; Archdale, N.C. 27263; Toll Free Tel: 1-800-423-3531; Corporate Tel: 1-336-434-2322; Web: <http://www.hafele.com/us/index.htm>
- B. No Substitutions.

### 2.02 SINGLE PANEL PARTITIONS, 1 3/8" - 2" (35 mm - 50 mm) THICK PANELS

- A. Product: HAWA – Aperto 60/H Sliding Interior Partitions by Häfele America Co., manually operated individual flat panels, top supported with lower guide channel.  
Final Closure:
  - 1. Refer to Häfele Product Catalog pgs. 258 - 259.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Do not begin installation until supports and substrates have been properly prepared.
- B. Notify Architect in writing of unsatisfactory preparation prior to installation. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and ASTM E 557 installation procedures. Test for proper operation and make necessary adjustments until satisfactory results are obtained.

### 3.03 PROTECTION

- A. Protect installed products until completion of project.

Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 22 23.23





## Division 11 – Equipment

### SECTION 11 00 00 – EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Section Includes: The use and preparation for heavy equipment including trucks and fork lifts

##### 1.02 PREINSTALLATION

A. Pre-installation Conference: Conduct conference at build site and assembly site

##### 1.03 QUALITY ASSURANCE

A. Licensed and experienced with heavy equipment that is being operated

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

A. Products: Open

##### 2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified.

#### PART 3 - EXECUTION

##### 3.01 EXAMINATION

A. Visually examine all trucks, forklifts and any other heavy equipment before use.

1. Reject and contact Project manager if any problems or discrepancies occur

##### 3.02 PREPARATION

A. Make sure any lift made and trip made is securely fastened with straps to ensure no movement that could cause harm to operator and others in the area.

END OF SECTION 11 00 00



## SECTION 11 31 13 - RESIDENTIAL KITCHEN APPLIANCES

### PART 1- GENERAL

#### 1.01 SUMMARY

##### A. Section Includes: Residential Appliances

1. Refrigeration.
2. Cooking products.
3. Dishwashers.

##### B. Related Sections

1. Section 05 40 00 – Metal Framing
2. Section 06 22 00 – Millwork
3. Section 12 36 00 – Countertops
4. Section 22 11 16 – Domestic Water Piping
5. Section 22 41 16 – Residential Lavatories and Sinks

#### 1.02 REFERENCES

- A. International Residential Code
- B. ANSI A117.1 - Guidelines for Accessible and Useable Buildings and Facilities.
- C. EPA - Energy Star Appliances.
- D. Public Law 101-336 - Americans with Disabilities Act.

#### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Model number and selected options for each appliance.
  2. Preparation instructions and recommendations.
  3. Storage and handling requirements and recommendations.
  4. Installation methods.
  5. List of maintenance parts.

#### 1.04 QUALITY ASSURANCE



- A. Regulatory Requirements: Comply with referenced standards and the Americans with Disabilities Act as applicable for fixtures for the disabled.
- B. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.
- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.06 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.

#### 1.07 WARRANTY

- A. Provide manufacturer's standard written limited one-year warranty for each type of appliance specified.
- B. Provide manufacturer's standard written limited parts warranty for each type of appliance specified.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Fisher & Paykel Appliances Inc., which is located at: 5900 Skylab Road ; Huntington Beach, CA 92647; Tel: 1.888.936.7872; Email: through Contact on website; Web: [www.fisherpaykel.com/us](http://www.fisherpaykel.com/us)
- B. Acceptable Manufacturer: IKEA USA, which is located at: 420 Alan Wood Road; Conshohocken, PA 19428; Toll Free Tel: 1.800.434.4532; Web: [www.ikea.com](http://www.ikea.com)
- C. Acceptable Manufacturer: Frigidaire, which is located at: 2715 Washington Road; Augusta, GA 30909; Toll Free Tel: 1.800.374.4432; Web: [www.frigidaire.com](http://www.frigidaire.com)

#### 2.02 REFRIGERATION

- A. Refrigerators and Freezers: As manufactured by Fisher & Paykel.
  - 1. ActiveSmart™ Fridge - 17 cu. ft. Counter Depth French Door; Model No RF170ADX1
  - 2. Appearance: Stainless steel.

#### 2.03 COOKING PRODUCTS

- A. Ovens: Models, standard accessories/kits and custom accessories/kits as manufactured by IKEA USA.
  - 1. Slide-In Electric Oven: 29 3/4 inch (75.6 cm) IKEA Nutid Slide-In Convection Oven, article no. 101.423.39.



2. Appearance: White

B. Cooktops: Models, standard accessories/kits and custom accessories/kits as manufactured by IKEA USA.

1. Glass Ceramic Cooktop: 30 3/8 inch (77 cm) IKEA Nutid Drop-In Glass Ceramic Cooktop, article no. 701.826.19.

2. Appearance: White

#### 2.04 DISHWASHERS

A. Dishwashers: Models, standard accessories/kits and custom accessories/kits as manufactured by IKEA USA.

1. Built-In Dishwashers: 24 inch (61 cm) IKEA Nutid Built-In Dishwasher with Tall Tub, article no. 401.423.71.

2. Appearance: Stainless steel.

### PART3 - EXECUTION

#### 3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.02 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.

#### 3.03 INSTALLATION

A. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:

1. Securely mount to substrate.
2. Install appliances plumb and level and in proper relationship to adjacent construction.
3. Connect appliances to building utility, supply and waste systems as applicable.
4. Test for proper operation and drainage. Adjust until proper operation is achieved.

#### 3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

#### 3.05 APPLIANCE DATA SHEETS



- A. Refer to the manufacturer's data sheets supplied by manufacturer or lookup on manufacturer's website for required features and additional requirements.

END OF SECTION 11 31 13



## SECTION 11 31 23 - RESIDENTIAL LAUNDRY APPLIANCES

### PART 1- GENERAL

#### 1.01 SUMMARY

A. Section Includes: Residential Laundry Appliances

1. 11 31 23 A – Clothes Dryer
2. 11 31 23 B – Clothes Washer

#### 1.02 REFERENCES

- A. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
- C. NAECA: Provide residential appliances that comply with NAECA standards.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Model number and selected options for each appliance.
  2. Preparation instructions and recommendations.
  3. Storage and handling requirements and recommendations.
  4. Installation methods.
  5. List of maintenance parts.

#### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with referenced standards.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.06 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.

#### 1.07 WARRANTY

- A. Provide manufacturer's standard written limited one-year warranty for each type of appliance specified.
- B. Provide manufacturer's standard written limited parts warranty for each type of appliance specified.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- D. Acceptable Manufacturer: Frigidaire, which is located at: 2715 Washington Road; Augusta, GA 30909; Toll Free Tel: 1.800.374.4432; Web: [www.frigidaire.com](http://www.frigidaire.com)

#### 2.02 CLOTHES WASHER

- A. Frigidaire Affinity 3.9 Cu. Ft. Front Load Washer featuring Ready Steam™
- B. Product Number: FAFS4174NW
- C. Capacity: 3.9 Cu. Ft.
- D. Ready Steam™
- E. <http://www.frigidaire.com/FAFS4174NW.aspx?productCode=FFHT2126LW>

#### 2.03 CLOTHES DRYER

- A. Frigidaire Affinity 7.0 Cu. Ft. Electric Dryer featuring Ready Steam™
- B. Product Number: FASE7073NW
- C. Capacity: 7.0 cu. ft.
- D. Ready Steam™
- E. <http://www.frigidaire.com/products/Laundry/Dryers/FASE7073NW.aspx>

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:
  - 1. Securely mount to substrate.
  - 2. Install appliances plumb and level and in proper relationship to adjacent construction.



3. Connect appliances to building utility, supply and waste systems as applicable.
4. Test for proper operation and drainage. Adjust if necessary.

### 3.02 PROTECTION

- A. Protect installed products until completion of project.

Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 11 31 23





## SECTION 11 52 00 - AUDIO VISUAL EQUIPMENT

### PART 1- GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Interior/Exterior Speaker Systems and Receiver
- B. Related Sections:
  - 1. Section 11 52 16.19 – Overhead Projectors

### PART 2- PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Outdoor Speaker Depot, which is located at 775 Columbia St., Brea, CA 92821; Toll Free Tel: 888-779-4968; Tel: 562-697-2600; Web: <http://www.outdoorspeakerdepot.com>
- B. Acceptable Manufacturer: Starpower, which is located at: 7077 E. Mayo Blvd.; Phoenix, AZ 85054; Toll Free Tel: 888-206-1160; Tel: 480-538-1700; Email: [customerservice@star-power.com](mailto:customerservice@star-power.com); Web: <http://www.star-power.com/>

#### 2.02 INTERIOR SPEAKERS

- A. Outdoor Speaker Depot
- B. Product Number: IW620
- C. Dimensions: 8-5/8" H X 12" W
- D. <http://www.outdoorspeakerdepot.com/mibuseinwasp.html>

#### 2.03 EXTERIOR SPEAKERS

- A. Yamaha 130w All Weather Speaker System
- B. Product Number: NSAW390WH
- C. Dimensions: 11 1/16" H x 7 3/32" D x 7 5/16" W
- D. <http://www.star-power.com/home-theater-audio/audio/speakers/NSAW390WH/>

#### 2.04 RECEIVER

- A. Yamaha 5.1 Channel Receiver



- B. Product Number: RXV375BL
- C. Dimensions: 6" H x 12 3/8" D x 17 1/8" W
- D. <http://www.star-power.com/home-theater-audio/audio/receivers/RXV375BL/>

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
- B. All wiring shall be installed in accordance with NFPA 70, the National Electrical Code.

END OF SECTION 11 52 00



## SECTION 11 52 13 – PROJECTION SCREENS

### PART 1- GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Manually operated, ceiling mounted, dual projection screens.

#### 1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: PRODISPLAY USA, which is located at: 63 Via Pico Plaza Suite 104; San Clemente CA 92672; Toll Free Tel: 800-348-1704; Fax: 949-218-5709; Web: <http://www.prodisplayus.com/>

#### 2.02 MANUALLY OPERATED, CEILING MOUNTED, DUAL PROJECTION SCREENS

- A. PRODISPLAY 360° (2)
- B. 60" Dual projection, roll-up screen
- C. Flexible optical film
- D. <http://www.prodisplayus.com/360.html>

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install front projection screens with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

Test manually operated units to verify that screen operating components are in optimum functioning condition

**PRODISPLAY™ USA**

www.prodisplayus.com | info@prodisplayus.com | (800) 348-1704



**360°™**

This unique projection screen produces a perfectly viewable image on both sides at the same time with 180° angle of visibility, creating the world's first 360° projection surface.

360° is another high gain screen material which performs well in areas of high ambient light.

This material can either be used as either a front or rear projection solution, offering increased flexibility for installs with space challenges.

360° is available in four standard formats to match your application:

- Roll Film & Adhesive Backed Film
- Portable Presenter
- Rigid Clear Acrylic Screen
- Electric Roll-Up with Remote

**Features**

- High Gain: 5.7
- Perfect Color Reproduction
- Viewing Angle: 180°
- Thickness: 120 microns (film)
- Color: Off White

**Benefits**

- 360° Dual Projection Surface
- Front or Rear Projection
- Sizes to 100" Diagonal 4:3 Aspect
- Sizes to 120" Diagonal 16:9 Aspect
- Film width 63"
- Custom Shapes & Sizes

**Applications**

- Window Displays
- POP/POS Displays
- Outdoor Events
- Exhibit & Trade Shows
- Club and Hospitality Venues
- Advertising Displays

**Accessories**

- Cable Suspension System
- Weighted Suspension System
- Extrusion Bars
- Aluminum Frames
- Portable & Fixed Stands
- Sound Pod Audio

www.prodisplayus.com • 63 Via Pico Plaza • Suite 104 • San Clemente CA 92672 • (800) 348-1704 • Fax (949) 218-5709 • info@prodisplayus.com

END OF SECTION 11 52 13



## SECTION 11 52 16.19 – OVERHEAD PROJECTORS

### PART 1- GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Short Throw Overhead Projector
- B. Related Sections:
  - 1. Section 11 52 00 – Audio-Visual Equipment

### PART 2- PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: BenQ, which is located at: 15375 Barranca Suite A205; Irvine, CA 92618; Tel: 949-255-9500; Fax: 949-255-9600; Web: <http://www.benq.us/home.cfm>

#### 2.02 SHORT THROW OVERHEAD PROJECTOR

- A. BenQ W1080ST
- B. Product Number: W1080ST
- C. Contrast Ratio: 10,000:1
- D. Throw Ratio: 65.7" @ 1 M
- E. Dimensions: 12.2" x 4.09" x 9.6"
- F. <http://www.benq.us/product/projector/w1080st/>

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Comply with manufacturer's instructions for installation of audio systems.
- B. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
- C. All wiring shall be installed in accordance with NFPA 70, the National Electrical Code.

END OF SECTION 11 52 16.19



## Division 12 – Furnishings

### SECTION 12 35 30 – RESIDENTIAL CASEWORK

END OF SECTION 12 35 30



## SECTION 12 36 00 – COUNTERTOPS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes countertops for fabricated millwork.

#### 1.02 RELATED SECTIONS

- A. Section 06 22 00 – Millwork for cabinetry (in kitchen, bathroom shelves).

#### 1.03 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
  - 4. MSDS for finish sealer.
- B. Shop Drawings:
  - 1. Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- C. Installation Instructions: Manufacturer's installation instructions and recommendations.
- D. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.
- E. Industry Standards:
  - 1. ASTM D2583: 60-70
  - 2. ASTM C880: 5000-13000
  - 3. ASTM C97: 0.03
  - 4. NEMA LD3-3.3: No Effect
  - 5. ANIZ Z-124.6: No Effect
  - 6. ASTM E84: Class 1
  - 7. ASTM c484: Passes 5 cycles

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

#### 1.05 WARRANTY



#### A. Manufacturer's Warranty

1. This warranty does not cover any conditions or damages resulting from accidents, alterations, misuse, abuse, excessive humidity, excessive heat and temperature, fading, patina, or discoloration over time. MSI surfaces are a paper-composite material and will patina over time.
2. This warranty does not apply to conditions caused by normal wear and tear upon the product.
3. To obtain warranty service, contact the dealer from whom you purchases the product. Your dealer will work with their regional distributor and MSI to promptly repair or replace any defective pieces. Warranty claims must be accompanied by proof of purchase, as well as details regarding the nature of the problem, location of the product, etc.
4. In no event shall MSI or its distributors be liable or responsible for incidental or consequential damages or for any other direct or indirect damage, loss, cost, expense or fee.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the following:

1. MSI: Premium Natural Quartz

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acceptable Manufacturer: Premium Natural Quartz from MSI: Orange Natural Quartz Countertop Facility. Address: 2095 N.Batavia Street, Orange, CA 92865. Phone: (714)685-7500. Fax: (714)685-7600. Email: [msi\\_ca@msistone.com](mailto:msi_ca@msistone.com).
2. Substitutions: Not permitted.

#### 2.02 ASSEMBLY DESCRIPTION

A. Countertop Assemblies for MSI: Premium Natural Quartz Stone.

1. Flat Sheet Thickness: 2mm minimum.
2. Sinks and Bowls: Separate units for under mounting.
3. Cutouts and Drain Grooves: As shown on drawings.
4. Finish on Exposed Surfaces: Gloss finish
5. Color: Arctic White.
6. Exposed Edge Treatment: 2" thickness.
  - a. Profile: Square edge.
  - b. Profile: As indicated on drawings.

#### 2.03 MATERIALS

A. MSI Premium Natural Quartz

1. Natural Quartz Sheets: Natural Arctic White stone.





2. Adhesives: Chemical resistant two-part epoxy waterproof adhesive as recommended by manufacturer.
3. Joint Sealant:
  - a. Sealant Type: Mildew-resistant silicone
  - b. Sealant Type: Silicone.

## PART 3 - EXECUTION

### 3.01 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.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### 3.02 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.

### 3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.
- C. Where indicated use cove molding.
- D. Where applied cove molding is not indicated use specified sealant.

### 3.04 CLEANING AND PROTECTION

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

END OF SECTION 12 36 00



## SECTION 12 93 43.13 – SITE SEATING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Exterior Benches.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- C. Manufacturer's warranties.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until conditions are ready for installation.

#### 1.05 COORDINATION

- A. Coordinate work with other operations and installation of benches/decking to avoid damage to installed materials.

### PART 2 - PRODUCTS

#### 2.02 BENCHES

- A. Wood and Concrete Planter Benches.
  - 1. Custom planter bench.
    - a. Height: 18 inches.
    - b. Width: 18 inches.
    - c. Length: Site Specific. Reference sheet L-101.
    - d. Seat: Wood material (2x4)
    - e. Sidewall: 16 ga Mill Finished Steel



## PART 3 – EXECUTION

### 3.01 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.

### 3.02 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.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Surface mounting. Location and drilling of holes for inserts included. Anchor bolts and inserts provided by others.

### 3.04 PROTECTION

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

END OF SECTION 12 93 43.13



## Division 13 – Special Construction

### SECTION 13 30 00 - SPECIAL STRUCTURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Section includes: PV array racking system.

##### 1.02 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference with the racking system vendor.

##### 1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sheet A551 “PV mounting details”

B. Seismic Qualification Certificates: Obtain PV Array racking structure, accessories, and components, from manufacturer.

C. Welding certificates. Obtain from manufacturer.

D. Material test reports. Obtain from manufacturer.

E. Product test reports. Obtain from manufacturer.

F. Research reports. Obtain from manufacturer.

G. Source quality-control reports. Obtain from manufacturer.

H. Field quality-control reports. Obtain from manufacturer

I. Sample warranty. Obtain from manufacturer

##### 1.04 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, An authorized representative who is trained and approved by manufacturer.

C. Testing Agency Qualifications: Qualified according to [ASTM C 1021] [ASTM C 1093] for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC Standard 17025.



D. Testing Agency Qualifications: Member company of NETA or an NRTL.

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## 1.05 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of PV array racking structure that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Insert number year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements: Sunframe

1. Unirac; 1411 Broadway Boulevard NE, Albuquerque NM, 87102-1545; Phone: 505-242-6411; Fax: 505-242-6412; Website: unirac.com

### 2.02 ASSEMBLY DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 2 - EXECUTION

### 3.01 INSTALLATION

A. Assembly: Comply with manufacturer's instructions for installation of PV array racking.

B. Comply with NECA 1.

C. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

END OF SECTION 13 30 00



## SECTION 13 42 00 - BUILDING MODULES

### PART 1 - GENERAL

#### 1. SUMMARY

- A. Section includes: Information transporting, caring and handling for building modules.
- B. Submittals: Shop Drawings.

### PART 2 - PRODUCTS

#### A. FABRICATED MODULES

##### 1. Constructed Modules

- a. South module size: 38'-8"x14' and North Module size: 28'-8"x12'

#### B. FINISHES

- 1. Complete construction to be finished on site.

### PART 3 - EXECUTION

#### A. PREPERATION

- 1. Prepare individual modules by wrapping exterior with padding and securing materials within modules for shipping.
- 2. Apply waterproof plastic to exterior.
- 3. Rail modules into place with proper safety precautions. See documents for railing diagram.

#### B. TRANSPORTATION

- 1. Fees for \$30 per day in Arizona and travel permit for California required.
- 2. Proper signage per Arizona DOT and California DOT. The lettering shall be a 10-inch minimum height with a 1-5/8-inch minimum brush stroke, and a minimum 1-inch margin all around. All signs shall be black letters on a yellow background, mounted at least 18 inches above the road surface front and rear. Signs shall be



neat, clean, legible, mounted securely and visible from straight ahead or behind and to 45-degree either side thereof.

3. Yellow Route in California requires 1 pilot vehicle for loads from 12'-14'6". If loads wider than one lane, 2 pilot vehicles are required.
4. Transporting module within greater Los Angeles city limits is not permitted.

#### C. CONNECTION

1. Remove waterproofing transportation membrane and prep for setup.
2. Position module chassis into correct location at site.
3. Remove wheels and axels once in place.
4. Place south module first and attached properly to jack pads.
5. Locate location for north module with jack pads and rail north module into place.
6. Attached modules together at steel angles on module beams at floor and ceiling.
7. Remove structural bracing once adequate connections for both modules have been made and comply with California seismic load requirements.
8. See additional specs regarding finishes.

END OF SECTION 13 42 00



## Division 14 – Conveying Equipment

SECTION NOT USED





## Division 21 – Fire Suppression

### SECTION 21 13 13 – WET-PIPE SPRINKLER SYSTEM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes: Tyco Rapid Response LFII Residential pendant sprinkler

##### 1.2 SCOPE OF WORK

- A. Design, installation and testing shall be in accordance with NFPA 13D 2010 Edition.
- B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation.

##### 1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, and location and size of each field connection.
- C. Delegated-Design Submittal: For Tyco Rapid Response LFII Residential Sprinkler.

##### 1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Certificates: For Tyco Rapid Response LFII Residential Sprinkler, accessories, and components, from manufacturer.
- C. Product test reports.
- D. Research reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample warranty.



1.07 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Operation and maintenance data.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace Tyco Rapid Response LFII Residential Sprinkler that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 10 year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the following:

1. Tyco Rapid Response LFII Residential Sprinkler.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings Tyco Rapid Response LFII Residential Sprinkler or a comparable product by one of the following:

1. Tyco.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design Fire Suppression system.

B. Seismic Performance: Tyco Rapid Response LFII Residential Sprinkler shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Component Importance Factor is 1.0.

C. Capacities and Characteristics:

1. Maximum working pressure 175 psi, Temperature Rating Sprinkler 160 deg F Cover Plate 139 deg F.



## 2.3 PIPING & FITTINGS

- A. CPVC piping and fittings as in accordance with NFPA 13D. Other types listed acceptable in NFPA 13D must be approved before using.

## 2.4 VALVES

- A. Valves in accordance with NFPA 13D.

## 2.5 SPRINKLERS

- A. All sprinklers shall be Tyco brand and UL approved.
- B. Temperature Ratings: In accordance with NFPA 13D.

## 2.6 SPRINKLER CABINET

Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser.

## 2.7 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

## 2.8 SWITCHES:

- A. Water flow Alarm Switches: Shall be UL listed.

## 2.9 GAUGES

Provide gauges as required by NFPA 13D.

## 2.10 PIPE HANGERS AND SUPPORTS

Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13D. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13D, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.



## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine Tyco Rapid Response LFII Residential Sprinkler before installation. Reject Tyco Rapid Response LFII Residential Sprinkler that are wet, moisture damaged, or mold damaged.

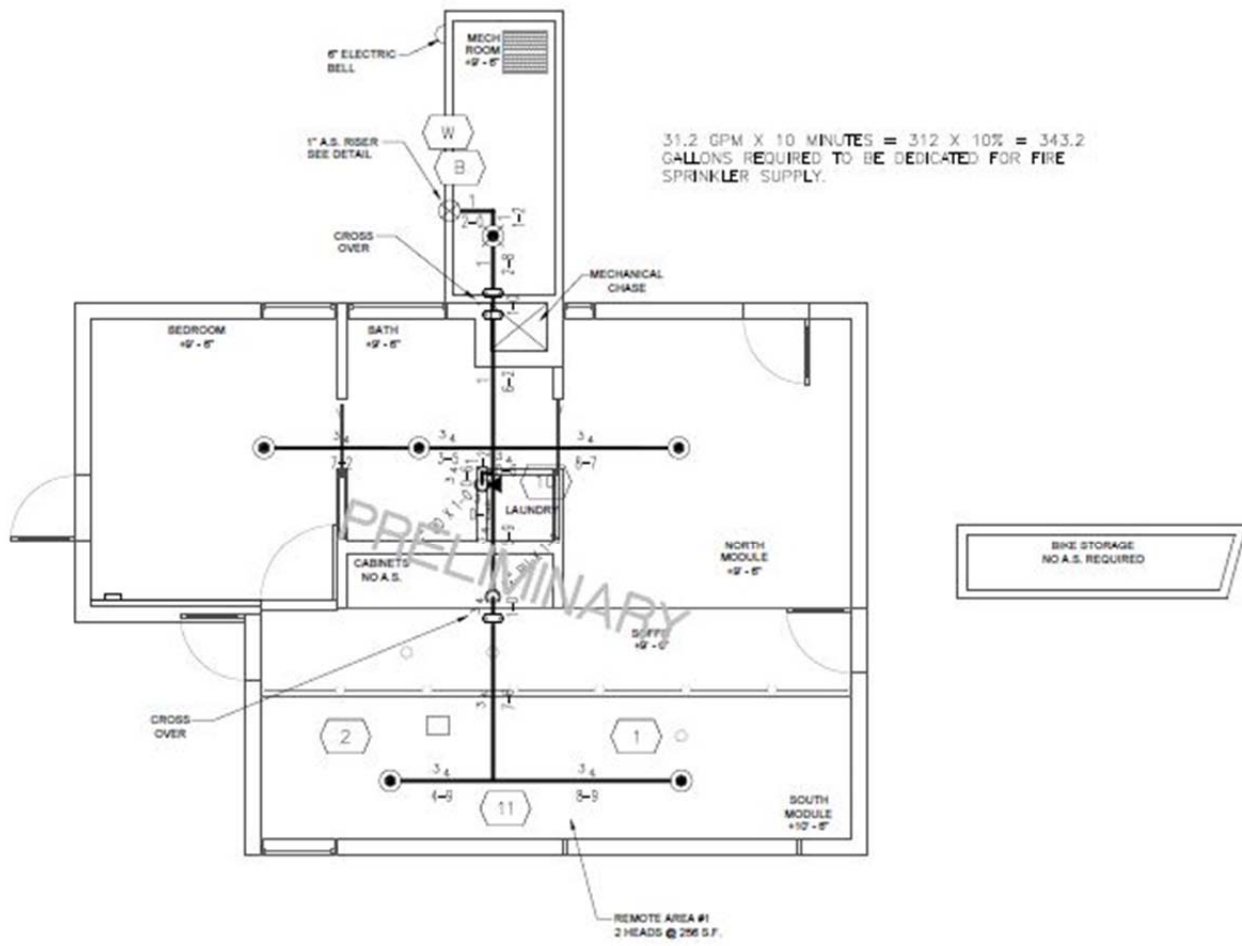
### 3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings.
- C. Drains: Pipe drains to discharge at safe points outside of the building.
- D. Inspector's Test Connection: Install and supply in conformance with NFPA 13D, locate in a secured area, and discharge to the exterior of the building or use listed on riser inspector's test valve.
- E. Firestopping shall comply with the firestopping Section.
- F. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- G. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the owner.
- H. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.
- J. Comply with NECA 1



### 3.2 INSPECTION AND TEST

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative.
  
- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13D, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.



SCALE: 3/16" = 1'-0"



SHADE PROJECT

Drawing Date:11/16/12

11/16/12 11: 1

HYDRAULIC DESIGN INFORMATION SHEET

Job Name: SHADE PROJECT

Location: TEAM: aSUNM

Drawing Date: 11/16/12

Remote Area Number: 1

Contractor: EAGLE AUTOMATIC  
GLENDLAE, AZ

Telephone:480-232-3601

Designer: J. GRANTHAM

Calculated By:SprinkCAD

www.sprinkcad.com  
451 N. Cannon Ave.  
Lansdale, PA 19446

Construction: COMBUSTIBLE

Occupancy:SINGLE FAMILY HOME

Reviewing Authorities:PLAN REVIEW

SYSTEM DESIGN

Code:NFPA 13D

Hazard:RES

System Type:WET

Area of Sprinkler Oper.	sq ft	Sprinkler or Nozzle
Density (gpm/sq ft)	RES	Make: TYCO
Area per Sprinkler	256.0 sq ft	Model: LFII
Hose Allowance Inside	5 gpm	K-Factor: 4.90
Hose Allowance Outside	0 gpm	Temperature Rating: 160

CALCULATION SUMMARY

2 Flowing Outlets

gpm Required: 31.2 psi Required: 35.0 @ PUMP DISCHARGE

WATER SUPPLY

	Pump Data
Date of Test	Rated Capacity 35 gpm
Static Pressure 0 psi	Rated Pressure 40 psi
Residual Pres 0 psi	
At a Flow of 0 gpm	Make: SPEC
Elevation 0"	Model:

Location: AT PUMP DISCHARGE

Source of Information: SPEC

SYSTEM VOLUME 2 Gallons

Notes: 31.2 GPM X 10 MINUTES = 312 X 10% = 343.2  
GALLONS REQUIRED TO BE DEDICATED FOR FIRE  
SPRINKLER SUPPLY.





SHADE PROJECT

Drawing Date:11/16/12

11/16/12 11: 1

HYDRAULIC CALCULATION DETAILS

QTY	DESCRIPTION	LENGTH	C	HYDRAULIC ID	FLOW gpm	LOSS psi	TOTALS
	Hydr Ref W	Required at Hyd Area 1			26		20.6 psi
1	1" CPVC 90 Ell TOP OF RISER	5'	120	1.049	26	1.4	
1	Pipe 1" PVx15 CPVC PIPE	9'	150	1.109	26	1.0	
1	1" CPVC Tee RUN TEE	1'	120	1.049	26	0.3	
1	1" Thrd Check Valve	5'	120	1.049	26	1.1	
1	1" Thrd Other Valve FLOW SWITCH	CHART LOSS			26	3.0	
1	1" CPVC 90 Ell BOTTOM OF RISER	5'	120	1.049	26	1.4	
	Fixed Flow DOMESTIC USAGE				5 gpm		
	Elevation Change 9'0"					3.9	
	Total Loss for	TOTAL LOSS FOR RISER					11.9 psi
	Hydr Ref B	Required at AT BASE OF RISER			31		32.5 psi
1	1" Thrd Ball Valve SHUT OFF VALVE	2'	120	1.049	31	0.6	
1	Pipe 1 1/4" Wx100 APEX WRISBO	10'	150	1.054	31	1.9	
	Total Loss for	TOTAL LOSS FOR UG					2.5 psi
	Hydr Ref S	Required at PUMP DISCHARGE			31		35.0 psi
	Water Source 40.0 psi static,	0 psi residual @		35 gpm	31 gpm		39.2 psi
	SAFETY PRESSURE						4.2 psi

Available Pressure of 39.2 psi Exceeds Required Pressure of 35.0 psi  
 This is a safety margin of 4.2 psi or 11 % of Supply

Maximum Water Velocity is 14.2 fps





FITTING NAME TABLE

ABBREV.	NAME
C	Coupling
E	90' Standard Elbow
F	45' Elbow
S	Straight Flow Thru Tee
T	90' Flow Thru Tee
V	Valve

LEGEND

- HYD REF Hydraulic reference. Refer to accompanying flow diagram.
- K FACTOR Flow factor for open head or path where  $Flow (gpm) = K \times \sqrt{P}$
- Qa Flow added or subtracted
- Qt Total flow
- DIA Actual internal diameter of pipe
- C Hazen Williams pipe roughness factor
- Pf/ft Friction loss per foot of pipe
- PIPE Length of pipe
- FTNG'S Number of fittings. See table above.
- TOTAL Total length (PIPE + FTNG'S)
- Pt Total pressure (psi) at fitting
- Pe Pressure due to change in elevation  
where  $Pe = 0.433 \times \text{change in elevation}$
- Pf Friction loss (psi) to fitting  
where  $Pf = 1 \times 4.52 \times (Q/C)^{1.85} / ID^{4.87}$
- Pv Velocity pressure (psi)  
where  $Pv = 0.001123 \times Q^2 / ID^4$
- Pn Normal pressure (psi), where  $Pn = Pt - Pv$

NOTES:

- Pressures are balanced to 0.01 psi. Pressures are listed to 0.1 psi. Addition may vary by 0.1 psi due to accumulation of round off.
- Calculations conform to NFPA 13.
- Velocity Pressures are not considered in these Calculations



NODE NUMBER	ELEVATION (FT)	SPRINKLER K-FACTOR (GPM/ (PSI <sup>1/2</sup> ))	PRESSURE (PSI)	ACTUAL FLOW (GPM)	MINIMUM FLOW (GPM)	ACTUAL DENSITY (GPM/SQ.FT)
1	11.00		7.4			
1S	10.50	4.90	7.0	13.0	13.0	0.05
2	11.00		7.7			
2S	10.50	4.90	7.3	13.2	13.0	0.05
10	10.00		18.5			
11	11.00		9.0			
W	10.00		20.6			

Max velocity of 14.15 occurs in the pipe from 11 TO 10

Nodes with "S" indicate a node at the top of a sprig or bottom of drop pendent. The node without an "S" is on the branch.



SHADE PROJECT

Drawing Date: 11/16/12  
 Tyco Fire Products

11/16/12 11: 1

Page 5

HYD. REF POINT	Qa Qt	DIA. "C" Pf/ft	FITTING TYPES	PIPE FTNG'S TOTAL	Pt Pe Pf	Pt Pv Pn	***** NOTES *****
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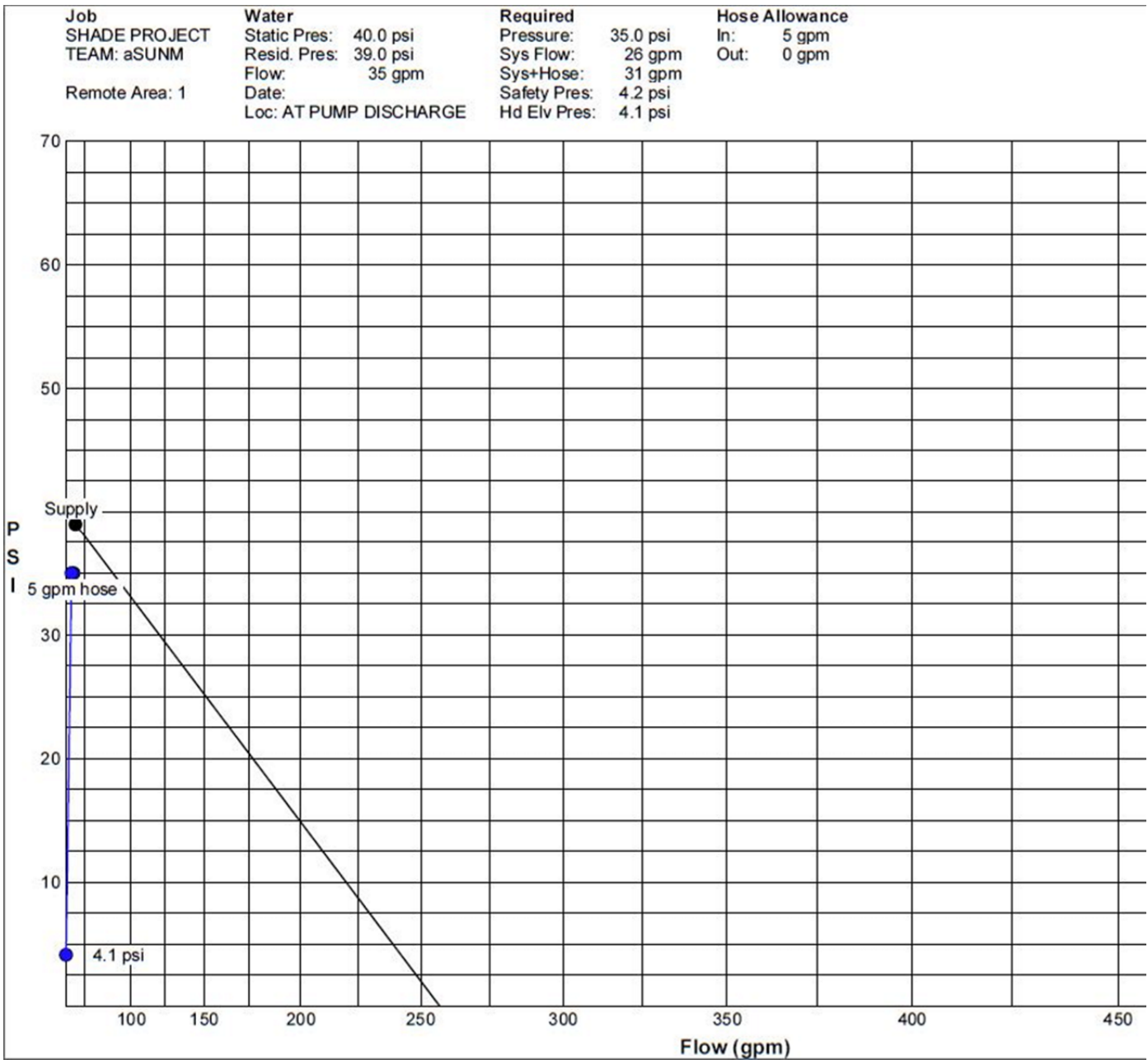
**PATH 1 FROM HYDRAULIC REFERENCE 1 TO W (PRIMARY PATH)**

1S	12.96	0.874 C=150	1E	0.50 5.60	7.0 -0.2	7.0 0.0	K = 4.90
	12.96	0.094		6.10	0.6	7.0	Vel = 7.00
1		0.874 C=150	1T	8.73 8.40	7.4 0.0	7.4 0.0	EqK = 4.78
	12.96	0.094		17.13	1.6	7.4	Vel = 7.00
11	13.24	0.874 C=150	2E	15.29 11.20	9.0 0.4	9.0 0.0	See PATH 2
	26.20	0.345		26.49	9.1	9.0	Vel = 14.15
10		1.101 C=150	1E	14.17 3.83	18.5 0.0	18.5 0.0	
	26.20	0.112		18.00	2.0	18.5	Vel = 8.92
W	26.20				20.6		K = 5.78

**PATH 2 FROM HYDRAULIC REFERENCE 2 TO 11**

2S	13.24	0.874 C=150	1E	0.50 5.60	7.3 -0.2	7.3 0.0	K = 4.90
	13.24	0.098		6.10	0.6	7.3	Vel = 7.15
2		0.874 C=150	1T	4.76 8.40	7.7 0.0	7.7 0.0	EqK = 4.78
	13.24	0.098		13.16	1.3	7.7	Vel = 7.15
11	13.24				9.0		K = 4.42

UNITS - DIAMETER (INCH)      LENGTH (FOOT)      FLOW (GPM)      PRESSURE (PSI)



END OF SECTION 21 13 13



## Division 22 – Plumbing

### SECTION 22 11 16 - DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Related Sections:

1. Division 22 11 23 “Domestic Water Pumps”
2. Division 22 33 00 “Electric Domestic Water Heaters”
3. Division 22 41 00 “Residential Plumbing Fixtures”

###### B. Section includes plumbing pipes, fittings, T’s and elbow connectors.

1. Product Data: For transition fittings and dielectric fittings.
2. Product for solvent cements and adhesive primers, documentation including printed statement of VOC content.

##### 1.02 SECTION REQUIREMENTS

###### A. Comply with NSF 14 for plastic, potable domestic water piping and components.

###### B. Comply with NSF 61 for potable domestic water piping and components.

###### C. Plastic piping shall be marked with “NSF-pw”.

#### PART 2 - PRODUCTS

##### 2.01 PIPE AND FITTING

###### A. Hard Copper Tubing: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper with wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

1. Copper Unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.

###### B. Soft Copper Tubing: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper with copper pressure fittings, cast-copper-alloy or wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

1. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.

###### C. Galvanized-Steel Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe, with ASME B16.4, Class 125, galvanized, standard pattern gray-iron, threaded fittings.

###### D. CPVC Piping: ASTM F 441/F 441M, Schedule 40 pipe with ASTM F 438, CPVC Schedule 40 socket-type fittings.

###### E. PEX Tube and Fittings: ASTM F 877, SDR 9 PEX tubing and ASTM F 1807, metal insert-type fittings with copper or stainless-steel crimp rings.

1. Manifold: ASTM F 877 plastic or corrosion-resistant-metal assembly, with a plastic or corrosion-resistant-metal valve for each outlet.

###### F. PVC Piping: ASTM D 1785, Schedule 40 pipe with ASTM D 2466, Schedule 40, socket-type fittings.

###### G. Special-Duty Valves:

1. Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
2. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.



3. PVC Union Ball Valves: MSS SP-122, with full-port ball, threaded detachable end connectors, and pressure rating not less than [125 psig (860 kPa)] [150 psig (1035 kPa)] at [73 deg F (23 deg C)].
  4. PVC Non-Union Ball Valves: MSS SP-122, with full- or reduced-port ball, socket or threaded ends, and pressure rating not less than [125 psig (860 kPa)] [150 psig (1035 kPa)] at 73 deg F (23 deg C).
  5. PVC Butterfly Valves: With lever handle and pressure rating not less than [150 psig (1035 kPa) at 73 deg F (23 deg C)]
  6. PVC Check Valves: Swing or ball-check design and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).
- H. Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.
- I. Flexible Connectors: Stainless-steel, corrugated-metal tubing with wire-braid covering. Working-pressure rating a minimum of [200 psig (1380 kPa)] [250 psig (1725 kPa)].

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with requirements in Section 22 05 00 "Common Work Results for Plumbing" for basic piping installation requirements.
- B. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for wall penetration systems.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for pressure gages and Section 221119 "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install domestic water piping with 0.25 percent slope downward toward drain for horizontal piping and plumb for vertical piping.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- F. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for basic piping joint construction.
  1. Soldered Joints: Comply with procedures in ASTM B 828 unless otherwise indicated.
- G. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for pipe hanger and support devices.
  1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
    - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
    - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
    - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
    - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
    - e. Support vertical piping at each floor.
  2. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:





- a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
  - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
  - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
  - d. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
3. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
- a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
  - b. Install hangers for vertical PEX piping every 48 inches (1200 mm).
4. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
- a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
  - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
  - c. Install supports for vertical PVC piping every 48 inches (1200 mm).
- H. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

### 3.02 INSPECTING AND CLEANING

#### A. Inspect and test piping systems as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

B. Clean and disinfect potable domestic water piping by filling system with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

### 3.03 PIPING SCHEDULE

A. Aboveground Distribution Piping: Pex piping

B. Mechanical Room Piping: Copper pipe

### 3.04 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Install gate valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated.

C. Install gate or ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.



- D. PVC ball, butterfly, and check valves may be used in matching piping materials.
- E. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.
- F. Install swing check valve on discharge side of each pump and elsewhere as indicated.
- G. Install ball valves in each hot-water circulating loop and discharge side of each pump.

END OF SECTION 22 11 16





## SECTION 22 11 23 – DOMESTIC WATER PUMPS

### PART 1 - GENERAL

#### A. SUMMARY

1. Section Includes: Diaphragm Pump Premium Demand Delivery Pump w/Splash-Proof Motor.

#### B. ACTION SUBMITTALS

1. Product Data: For each type of product.
2. Shop Drawings:
  - a. Include plans, elevations, sections, and mounting details.
  - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - c. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - d. Include diagrams for power, signal, and control wiring.

### PART 2 - PRODUCTS

#### 1.01 MANUFACTURERS

##### A. Goulds Technology

- ##### B. Basis-of-Design Product: Subject to compliance with requirements, provide GT irrigator self priming centrifugal pump; 60 hz – GT 153; PSI 40. Model: P63FZZ - 4418

#### 1.02 MOTORS

- ##### A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified.

1. Enclosure: Totally enclosed
2. Variable speed motor: MAKE Nidec Motor Corporation
3. Volts: 208-230/460
4. HP: 1 ½
5. RPM: 3450



6. AMPS: 5.0
7. INS Class B

## PART 3 - EXECUTION

### 1.01 EXAMINATION

- A. Examine Pump before installation. Reject Pumps that are damaged.

### 1.02 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces. Conceal raceway and cables when exposed to open air.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Prepare test and inspection reports.
- F. Motor must be grounded in accordance with local and national electric code. Component cover must be in place before and during operation.

END OF SECTION 22 11 23



## SECTION 22 12 00 - FACILITY-POTABLE WATER STORAGE TANK

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes 500 Gallon Intermediate Bulk Container (IBC) Tote.

#### 1.02 ACTION SUBMITTALS

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

#### 1.03 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace 500 Gallon IBC Tote that fail(s) in materials or workmanship within specified warranty period.

- 1. Warranty Period: 1 year(s) from date of Substantial Completion.

#### 1.04 MANUFACTURERS

- A. Product: Subject to compliance with requirements, provide 500 Gallon Tote with Butterfly Valve, Steel Pallet, or a comparable product.

#### 1.05 ACCESSORIES

- A. Ball Valve, Ball Valve Dust Cap, Fill Cap
- B. Adapters as Required by Installation

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1. 500 Gallon IBC Tote
- 2. Grainger; Storage Tank, Rectangular.



3. Other

2.02 SYSTEM DESCRIPTION

A. Mechanical Properties: The minimum for the properties of the material shall be as follows based on molded parts:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>	<u>UNITS</u>
Density	D1505	59 (0.937-0.942)	#/ft <sup>3</sup> (gm/cc)
ESCR Spec. Thickness			
125 mils F-50	D1693	1000	Hrs.
Tensile Strength	D638		
Ultimate 2"/min.	Type IV Spec.	2600	PSI
Elongation at break	D638		
2"/min.	Type IV Spec.	450	%
Vicat Softening Temp.	D1525	240	Deg. F
Brittleness Temp.	D746	-180	Deg. F
Flexural Modulus	D790	100,000-110,000	PSI

2.03 PERFORMANCE REQUIREMENTS

A. Low Temperature Impact: Low temperature impact is determined by using a 30 lb. falling dart at -20 F.

<u>Wall thickness in. (mm)</u>	<u>ft-lb. (J) to fail, min.</u>
Less than & including 0.25 in. (6.6 mm)	90 (122.0)
0.26 in. (6.6 mm) to & including 0.50 in. (12.9 mm)	100 (135.5)
0.51 in. (12.9 mm) to & including 0.75 in. (19.3 mm)	150 (203.2)
0.76 in. (19.3 mm) to & including 1.00 in. (25.4 mm)	200 (271.0)

B. Perfect Gel: For cross-linked polyethylene – The percent gel level is determined by using the test method found in ASTM D1998. The percent gel level for cross-linked tanks on the inside 0.125 in. (3.2 mm) of the wall shall be a minimum of 60%.

C. Capacities and Characteristics:

1. Appearance: The finished surface of the tank shall be free as commercially practicable from visual defect such as foreign inclusions, air bubbles, pin holes, craters, crazing and cracking that will impair the serviceability of the tank.
2. Cut Edges: All edges cut out i.e., open top flanges, manways, shall be trimmed to have smooth edges.
3. Dimensions and Tolerances: All Dimensions will be taken with the tank in its proper, usable position and unfilled. Tank dimensions will represent the exterior measurements.
  - a. Outside diameter – The tolerance for the outside diameter including out of roundness shall be +/- 3%



b. Shell wall and head thickness – The tolerance for thickness shall be +/-20% of the design thickness. The total amount of an area on the low side of the tolerance shall not exceed 10% of the total area and individual area shall not exceed 1 ft. 2 (.09m<sup>2</sup>) in size.

D. Markings:

1. The tank is marked to identify the producer – Chem-Trainer Inc., date (month and year) of manufacture, capacity and serial number.
2. The proper caution and/or warning signs are affixed to the tank.
3. Tank capacities should be based on total tank volume.

## 2.04 MATERIALS

A. Linear Polyethylene: A high quality, chemically resistant plastic with high stress crack and impact resistance. Linear polyethylene is translucent and exhibits properties that are ideal for applications that are exposed to low temperatures and/or high impact. Unlike thermosets, linear polyethylene is weldable, thus allowing for greater flexibility when designing modification to our standard tanks. The plastic complies with USDA and FDA regulations for storage and processing of food. Linear polyethylene is fully recyclable and thereby provides a convenient method of disposal.

B. Cross-linked Polyethylene: High density cross-linked polyethylene has excellent low temperature impact and environmental stress-crack resistance. This polyethylene is a thermoset, thus does not permit the utilization of welded tank connections. Cross-linked polyethylene does not have USDA or FDA compliance for storage of processing edibles and is not recyclable.

C. Ultra violet light stabilizers and fillers: The plastic does not contain a minimum of 0.25 to a maximum of 0.50 long term U.V. stabilizer. It does not contain any fillers.

D. Pigment: Pigment can be added at purchaser'

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine Portable Water Storage Tank before installation. Reject Portable Water Storage Tank that are moisture damaged, mold damaged, or broken.

### 3.02 PREPARATION: PACKING AND SHIPPING

A. All fittings and flange faces shall be protected from damage by covering with suitable plywood, hard-board or plastic securely fastened. Tanks shall be positively vented at all times.

B. Pipe and tubing, fittings and miscellaneous small parts shall be packaged. Loose items which may scratch the interior surface shall not be placed inside the tank during shipment. Additional protection, such as battens, end wrapping, cross bracing, or other interior fastenings may be required to assure each individual equipment pieces are not damaged in transit.



- C. Upon the arrival at the destination, the purchaser is advised to inspect for damage in transit. If damage has occurred, a claim should be filled with the carrier by the purchaser. The supplier should be notified if the damage is not first repaired by the fabricator prior to the product being put into service. The purchaser accepts all future responsibility for the effect of the tank failure resulting from damage.
- D. It is recommended that the tank be hydrostacially tested at the time of installation.

### 3.03 INSTALLATION

- A. Comply with applicable standards
- B. Equipment Installation: Install as per manufacturer's instructions. Comply with requirements for seismic-restraint devices.
- C. Provide connections, fittings and accessories as required by the system.

### 3.04 PROTECTION

- A. When installing Portable Water Storage Tank, wear personal protective equipment (PPE) as referred to in the Health and Safety Manual.

END OF SECTION 22 12 00



## SECTION 22 14 00 - FACILITY STORM DRAINAGE

### PART 1 GENERAL

#### A. SUMMARY

- a. Section includes Rainwater HOGs, modular rainwater harvesting tanks.

#### B. ACTION SUBMITTALS

- a. Product Data: Invented by architectural designer Sally Dominguez in 2004, the Rainwater HOG has won more than 5 awards and accolades for its groundbreaking design. Rainwater HOG is the original flat-walled, hole-braced plastic water tank. HOG is the only water tank that can work horizontally, vertically, or on its side, without compromise.
- b. Samples: HOG Olive Green is standard. Custom colors available.
- c. Delegated-Design Submittal: For Rainwater HOG.
  - 1) Storing and reusing your rainwater is simple with HOGs. They are easy to handle, easy to install and you can add additional **50 gallon/190 liter HOGs** to your existing installation at any time. HOGs work equally well vertically, horizontally or on their sides. The robust 1/4inch (6mm) wall thickness of the HOG tank means you can use HOGs over and over to suit your changing needs. The key to successful rainwater re-use is understanding your monthly rainfall, and your monthly water needs, and using a robust tank that is UV-stabilized and impervious to light. If you want to use the rainwater with a pump, or bring it inside a building to flush toilets or wash clothes, we recommend a first flush diverter in addition to our Inlet Filter. We are also happy to help you select pumps, hose fittings, level indicators and other useful rainwater fittings. HOGs are in use all over the world, watering vegetables, irrigating gardens, flushing toilets and washing laundry.

#### C. INFORMATIONAL SUBMITTALS

- a. Coordination Drawings: Sheet L-101 explains the placements of the water hogs in plan, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- b. Material test reports.
  - 1) Food-grade polyethylene (MDPE) complies with AS2070, FDA and HPB Regulatory standards for food contact. Brass and nylon threaded fittings
- c. Product test reports.
  - 1) Rainwater HOG has won a prestigious Spark Award for Design, the Eco Product Award from California H+D, and was named in Greenspec's Top 10 Green Building Products for 2008.



D. QUALITY ASSURANCE

- a. Installer Qualifications: Please consult a qualified plumber if unsure about correct installation procedure. Rainwater HOGs must be installed in accordance with these instructions. Rainwater HOG LLC takes no responsibility for any loss or damage caused by the use of the HOG and/or accessories. In the interests of continuing product improvement, specification may change without notice.

PART 2 PRODUCTS

A. MANUFACTURERS

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) HOG Works Pty Ltd; Rainwater HOG.
- b. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

PART 3 EXECUTION

A. INSTALLATION

- a. Comply with Vertical (on wall) for installation of Rainwater HOG.
- b. Equipment Installation:
  - 1. Place Wall Channels horizontally at center height of 35½" (900mm) from base level and fix to wall using appropriate fixings (not supplied). Ensure the HOGs are sitting on a firm, stable and level surface.
  - 2. Position Spring Nuts 19½" (500mm) apart between HOGs and 9 ¾" (250mm) from edge.
  - 3. Saw the top off the inlet HOG nub along the ridged line to form a 3½ inch opening.
  - 4. Attach Elbow Vents to the top holes and attach Connectors and Outlet to bottom holes.
  - 5. Attach and direct overflow hose (see 'Plumbing').
  - 6. Place Inlet Screen over inlet opening under downspout (see Plumbing).
  - 7. Stand HOG in position and bolt the Plate through the HOG into the Spring Nut.

END OF SECTION 22 14 00





## SECTION 22 14 13 – FACILITY STORM DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. This section includes roof drain and overflow drain.

B. Related Sections:

1. Division 22 14 00 "Facility Storm Drainage"

#### 1.02 INFORMATIONAL SUBMITTALS

A. Definition: The roof drainage piping is designed to connect to the water hog storage tanks in order to harvest all the rainwater that is captured by our house.

B. Performance Requirements: The system must be free of leaks to prevent water from escaping the system and leaking into the ground.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

A. Exterior Storm Water Piping

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

A. Refer to the drawings for the payout and slope of the pipes.

END OF SECTION 22 14 13



## SECTION 22 33 00 – ELECTRICAL DOMESTIC WATER HEATER

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes: ATI80 AirTap Hybrid Water Heater.

#### 1.02 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for ATI80.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Warranties: Submit a written warranty executed by manufacturer agreeing to repair or replace water heaters that fail in materials or workmanship within 10 years from date of Substantial Completion. Failures include, but are not limited to, tanks and elements. Limited lifetime warranty on tank only.

#### 1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: See M-602 and P-102 on which the following items are shown coordinated with each other, using input from installers of the items involved:

1. Domestic water heater, scroll water chiller, domestic water piping

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

A. Comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.

#### 2.02 WATER HEATERS, GENERAL

A. Insulation: Suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.



B. Anode Rods: Factory installed, magnesium.

C. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

D. Drain Valve: Factory or field installed.

## 2.03 ELECTRIC WATER HEATERS

A. Products: Subject to compliance with requirements, provide the following:

1. AirGenerate AT180 AirTap Hybrid Water Heater

B. Household, Storage, Electric Water Heaters: UL 174, 80 gal. capacity; steel with 150-psig working-pressure rating. Two electric, screw-in, immersion-type heating elements with adjustable thermostat for each element and wiring arrangement for non-simultaneous operation with maximum 30-A circuit.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Connect rigid piping to temperature and pressure relief valves and extend to closest floor drain.

B. Install vacuum relief valves in cold-water-inlet piping.

C. Install shutoff valves and unions at hot- and cold-water piping connections.

D. Make piping connections with dielectric fittings where dissimilar piping materials are joined.

E. Electrically ground units according to authorities having jurisdiction.

END OF SECTION 22 33 00



## SECTION 22 41 00 - RESIDENTIAL PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Drainage and condensate pan for washer/dryer, Fan Coil, ERV, Chiller, Pumps and Heaters.

B. Related Requirements

1. Section 22 11 16 - DOMESTIC WATER PIPING
2. Section 23 71 00 - THERMAL STORAGE
3. Section 23 57 00 - HEAT EXCHANGERS FOR HVAC
4. Section 23 64 23 - SCROLL WATER CHILLERS
5. Section 23 23 00 - REFRIGERANT PIPING.
6. Section 11 31 23 - RESIDENTIAL LAUNDRY APPLIANCES
7. Section 23 82 19 - FAN COIL UNITS

#### 1.02 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: Include furnished specialties, accessories, and color charts for cabinet finishes.
2. Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within five nyears from date of Substantial Completion.

C. Condensate drain piping materials can be cast iron, galvanized polybutylene, polyethylene, ABS, CPVC or PVC pipe or tubing piping shall be at least 3/4" in diameter and shall not decrease in size throughout its run from the condensate drain pan to its final disposal destination - no constructions by diameter

D. Horizontal runs of condensate drain piping slope at least 1/8" per foot in the direction of discharge. There is also a requirement for "uniform slope" and "uniform alignment".

#### 1.03 RELEVANT CODES

A. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's Accessibility Guidelines, ICC A117.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."



C. ICC Building Code, Section 307: Condensate Disposal Regulations & Recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: With built-in Condensate Pan that needs to be connected to drainage as per Section 22 11 16 and with complete compliance to relevant codes and Manufacturers guidelines.
- B. JOHNSTONE DIVERSITECH - 6M3030, MODEL # B98-946 26 gauge seamless pan with rolled edges, includes drain and anchoring fittings and two outlets with outer dimensions 30" X 30" or equivalent model from DIVERSITECH 6-3263L & 6-2748L as required on site.
- C. AQUAGUARD GOLIATH Drain Pans Mfg # AG-G 28X69 OR equivalent from the series B91-882, B98-769, B98-771, B98 - 768, B98 - 770 complete with relevant model Float Switch.
- D. EDENTON COLLECTION SINGLE-HANDLE VESSEL FAUCET; MIRWSED100CP with Quarter-turn ceramic disc cartridge

2.02 BASIS OF DESIGN

- A. PANS must comply with all or most relevant of the following, - Use in horizontal application, no seams, rust or leakage, reinforced corners, 3/4" PVC/ABS/Copper Drainage Fittings attached to the pan, Self Extinguishing and non-combustible, with 275 F temp rating, and for Fan Coil, Chiller secondary drain must support up to 450 lbs, and must comply with ASTM-E-84-05 and UL-94 5VA.
- B. Float Switch must include drain plugs and rubber isolators.

2.03 ACCESSORIES

- A. ACCUFIT MIR3001 valve
  - 1. Ceramic disc shower valve 1/2" MIP & SWT
  - 2. Pressure balance valve with integral stops
  - 3. Adjustable temperature limit stop
  - 4. 6.26 GPM flow rate at 60 psi
  - 5. cUPC Approved
  - 6. Meets or exceeds ASSE 1016-P standards

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.



- B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- D. Verify that accessories required have been furnished and installed.
- E. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices.
- F. Comply with requirements for pipe hangers and supports.
- G. Comply with requirements for general-duty valves and switches.

END OF SECTION 22 41 00



## SECTION 22 41 13 - RESIDENTIAL WATER CLOSETS, URINALS, AND BIDETS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: water closet, seat and associated valves, drains, and fittings.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: Product Data for each type of plumbing fixture, including trim, fittings, accessories, appliances, appurtenances, equipment, and supports.

B. Shop Drawings:

1. Include plans, elevations, sections, and [mounting] [attachment] details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

- C. Samples: For each exposed product and for each color and texture specified.

D. INFORMATIONAL SUBMITTALS

1. Product certificates.
2. Field quality-control reports.
3. Sample warranty.

E. CLOSEOUT SUBMITTALS

1. Maintenance data.
2. Operation and maintenance data.

F. QUALITY ASSURANCE

1. Installer Qualifications: Fabricator of products.



2. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
3. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

#### G. WARRANTY

1. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of Residential Water Closet that fail(s) in materials or workmanship within specified warranty period
  - a. Warranty Period: 1 year(s) from date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide Mirabelle Winter Haven Wall-Mounted Toilet Product Code MIRWH220WH or a comparable product:

1. Mirabelle

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act";] for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Capacities and Characteristics:
  1. Vitreous China Construction
  2. Washdown Bowl with Seat and Cover
  3. Concealed Tank, Dual Flush Option
  4. ADA Compliant





## 2.03 WATER CLOSET

- A. Vitreous-China Water Closet: Elongated, wall hung siphon-jet, wall hanging, back outlet with close-coupled, gravity-type tank, one-piece bowl and tank, flushometer valve.
  - 1. Manufacturers: Mirabelle
  - 2. Materials: Vitreous China Construction
  - 3. Flush Volume: 1.6 / 0.8 GPF - 6.0 / 3.0 LPF
  - 4. Meets or exceeds the WaterSense® HET and ASME A112.19.2 specifications when installed in combination with appropriate matching fixture.
  - 5. ADA compliant when installed according to ADA guidelines

## 2.04 TOILET SEAT

- A. Toilet Seat: Elongated, solid closed front with cover with bumpers and hardware, Residential class.
  - 1. Manufacturers: Mirabelle
  - 2. Materials: Vitreous China Construction

## 2.05 COMPONENTS

- A. Concealed Tank
- B. Bowl with Seat and Cover
- C. Dual Flush Option

## 2.06 ACCESSORIES

- A. As required for installation
  - 1. Geberit Model No. 111.728.00.1

## 2.07 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled equipment[, by a qualified testing agency,] according ASME. Water Closet meets ASME Standard: A112.19.2M

## PART 3 EXECUTION



### 3.01 EXAMINATION

- A. Examine water closet before installation. Reject products that are cracked, rusted, or defective.

### 3.02 INSTALLATION

- A. Install fitting insulation kits on fixtures for people with disabilities.
- B. Install fixtures with flanges and gasket seals.
- C. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- D. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- E. Fasten wall-mounted fittings to reinforcement built into walls.
- F. Fasten counter-mounting plumbing fixtures to casework.
- G. Secure supplies to supports or substrate within pipe space behind fixture.
- H. Set shower receptors and mop basins in leveling bed of cement grout.
- I. Install individual supply inlets, supply stops, supply risers, and tubular brass traps with cleanouts at fixture.
- J. Install water-supply stop valves in accessible locations.
- K. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes unless otherwise indicated.
- L. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.
- M. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install [in sink deck] [on countertop at sink] <Insert location>. Connect inlet hose to dishwasher and outlet hose to disposer.
- N. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- P. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.
- Q. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.



- R. Ground equipment.
- S. Comply with ASME Standard A112.19.2

### 3.03 CONNECTIONS

- A. Coordinate installations and specialty arrangements with Drawings and with requirements specified in system

### 3.04 FIELD QUALITY CONTROL

- A. Sinks and lavatories will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION 22 41 13



## SECTION 22 41 16 - RESIDENTIAL LAVATORIES AND SINKS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Related Sections:

1. Division 22 11 00 "Domestic Water Piping"

B. This section includes the kitchen sink.

#### 1.02 ACTION SUBMITTALS

A. Product Data: Submit samples for all finishes as selected by Architect.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver items in manufacturer's original unopened protective packaging.

B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

C. Handle so as to prevent damage to finished surfaces.

#### 1.04 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of the one that fail(s) in materials or workmanship within specified warranty period upon receipt of notice from Buyer.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

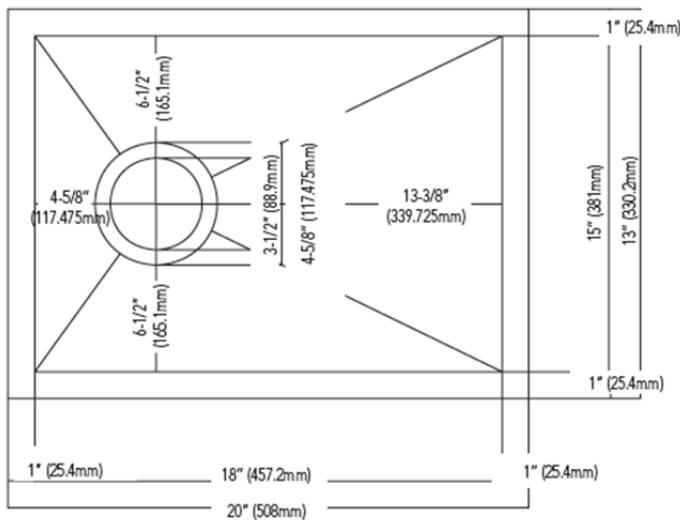
A. The following products may be purchased by Mirabelle.

1. One-Bowl Undermount Sink, Model: MIRUC1520Z

#### 2.02 SYSTEM DESCRIPTION

A. Kitchen Sink

1. Material: #16 gauge, type 304 (18-8) stainless steel
2. Undermount
3. Bowl Depth: 10"
4. Covered Corners: Approximately 5/8"
5. Finish: Exposed surfaces have a brushed finish
6. Underside: Fully protected by heavy duty Sound Guard undercoating to reduce condensation and dampen sound
7. Drain Opening: 3-1/2"
8. Note: all Mirabelle undermount sinks are designed to attach to the underside of any solid surface countertop.



## B. Optional Accessories

1. Disposal flange with stopper: MB132974
2. Basket strainer: MB132975
3. Bottom grid: MIRG1813



## 2.03 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled equipment, by a qualified testing agency, according ASME. Sink complies with ASME A112.19.3.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine sink before installation. Reject products that are cracked, rusted, or defective.

### 3.02 INSTALLATION

- A. Reference drawings for configuration and locations.
- B. Use concealed fasteners wherever possible.
- C. Provide anchors, bolts and other necessary fasteners, and attach accessories securely to walls and partitions in locations as shown or directed.
- D. Install exposed mounting devices and fasteners finished to match the accessories.
- E. Mounting heights shall be as recommended for handicapped access and at the locations indicated on drawings.
- F. Fasten counter-mounting plumbing fixtures to casework.
- G. Secure supplies to supports or substrate within pipe space behind fixture.
- H. Install water-supply stop valves in accessible locations.
- I. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.
- J. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.
- K. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.



- L. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.

### 3.03 FIELD QUALITY CONTROL

- A. Sinks and lavatories will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION 22 41 16



## SECTION 22 41 23 - RESIDENTIAL SHOWER RECEPTORS AND BASINS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes custom shower floor and receptor.
- B. Related sections:
  - A. Division 06 40 23 Section "Interior Architectural Woodwork"

### PART 2 PRODUCTS

#### 2.01 SHOWER FLOOR

- A. Bamboo Shower Floor: Bamboo floor is custom made in shop.
  - 1. 1x4 Bamboo lumber that is reinforced with deflection beams. Lumber placed ¼ apart for water drainage.
  - 2. Finished floor resting on wood support around shower basin perimeter.

#### 2.02 SHOWER RECEPTORS

- A. Membrane Receptor
  - 1. Slope of receptor is angled to allow for return waste to be drained in return waste pipe.
  - 2. Receptor is resting on ½" plywood. Supporting overall by 2x2 floor joists @ 8" O.C. All meet load requirements.

### PART 3 EXECUTION

#### 1.01 INSTALLATION

- A. Install water barrier below shower receptor before installation of receptor and before the installation of steel angles for bamboo floor.
- B. Install receptor and angles. Rest shower floor on steel angles.

#### 1.02 CONNECTIONS

- A. Connect return waste pipe to main return waste pipe during the installation of shower receptor.





END OF SECTION 22 41 23



## SECTION 22 41 39 - RESIDENTIAL FAUCETS, SUPPLIES, AND TRIM

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Related Sections:

1. Division 22 11 00 "Domestic Water Piping"

- B. This section includes the diverter shower valve, on-wall hand shower, bathroom faucet, kitchen faucet, shower valve, and shower head.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: Submit samples for all finishes as selected by Architect.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items in manufacturer's original unopened protective packaging.
- B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.
- C. Handle so as to prevent damage to finished surfaces.

#### 1.04 WARRANTY

- A. Provide standard manufacturer's warranty for each product listed.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

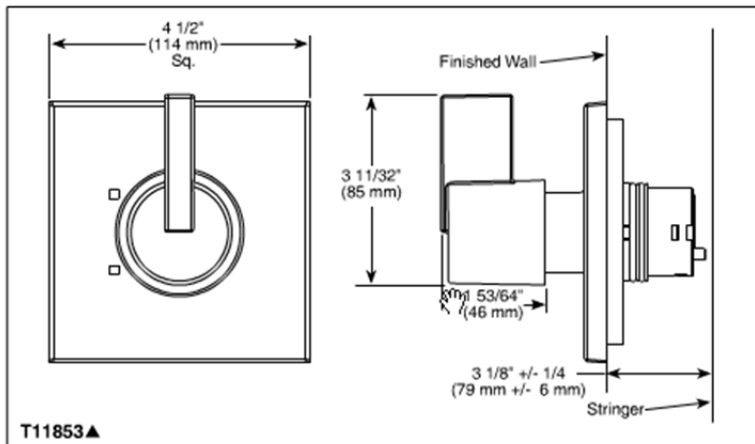
- A. The following products may be purchased by Kohler ([pfisterfaucets.com](http://pfisterfaucets.com))

1. Kohler – 8" Contemporary round rain showerhead
  - a. 2.5 gallons per minute flow rate
  - b. Solid brass construction

#### 2.02 SYSTEM DESCRIPTION

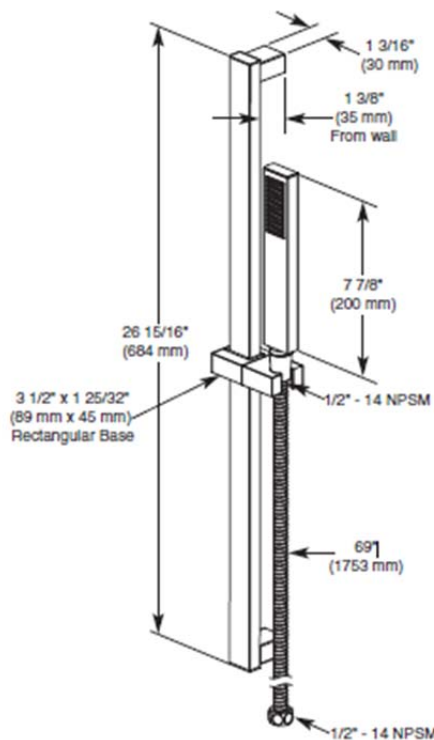
##### A. Diverter Shower Valve

1. Finish: Chrome
2. Construction: Brass
3. Width: 4-1/2"
4. Three function diverter trim with 2 individual positions, 1 shared position
5. Accessory: 1/2" rough-in (R11000)



### B. On-Wall Hand Shower

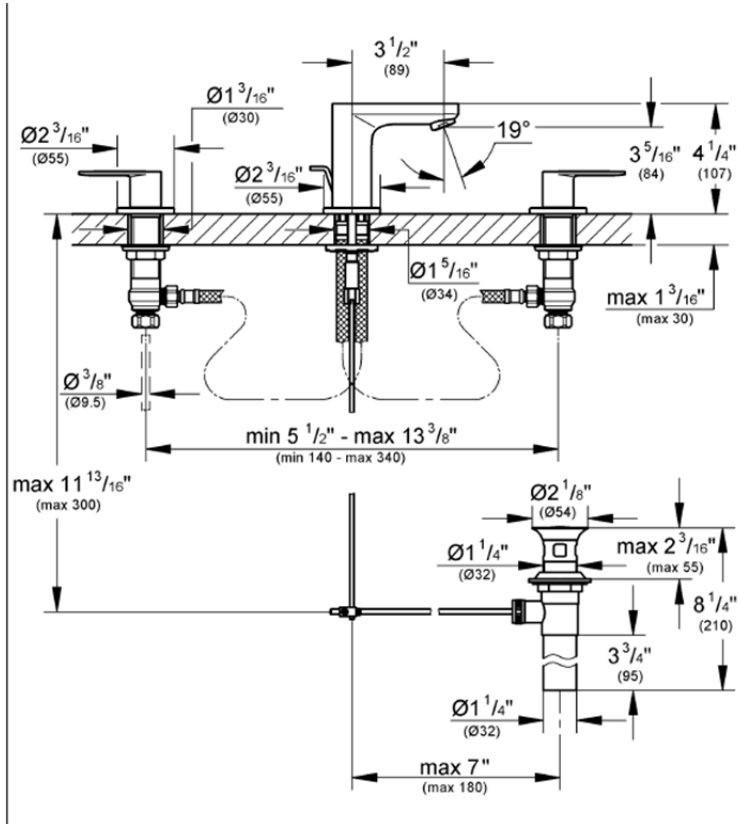
1. Hand shower with full spray pattern and touch clean nubs
2. Certified dual check valves
3. 2.5 gpm @ 80 psi
4. 69" flexible plastic hose in matching finish



### C. Bathroom Faucet

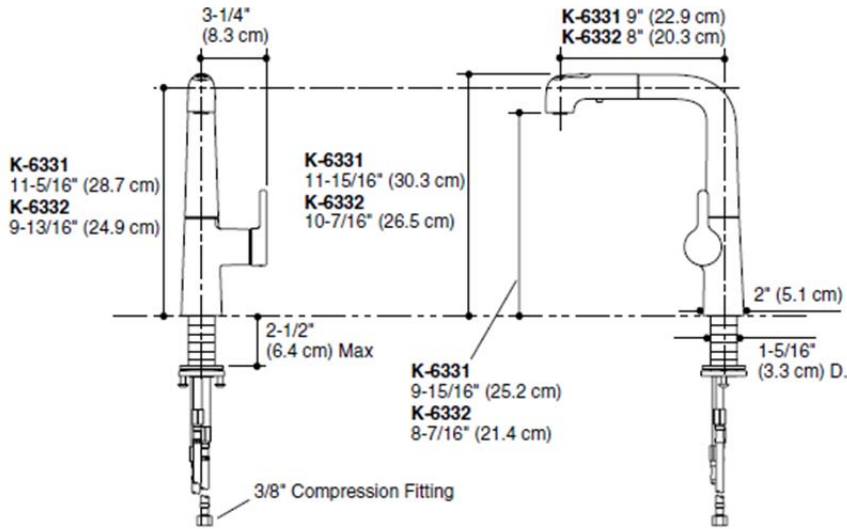
1. GROHE WaterCare technology 1.5 gpm spout with SpeedClean low control
2. GROHE StarLight chrome finish
3.  $\frac{1}{2}''$  ceramic cartridges (90 degree turn)

4. 1-1/4" pop-up waste set
5. GROHE QuickFix installation system with centering support
6. Pressure resistant flexible connection hoses
7. Union nut with 7/16" drilling



#### D. Kitchen Faucet

1. Metal construction
2. One-piece, self-contained ceramic disc valve allows both volume and temperature control
3. Temperature memory allows faucet to be turned on and off at any temperature setting
4. High-temperature limit setting for added safety
5. Three-function sprayhead with spray, aerated stream, and pause settings
6. Promotion technology with nylon hose and ball joint for easy operation
7. ADA compliant lever handle
8. 360 degree spout rotation
9. (2.2) Gallons per minute maximum flow rate
10. Polished chrome finish

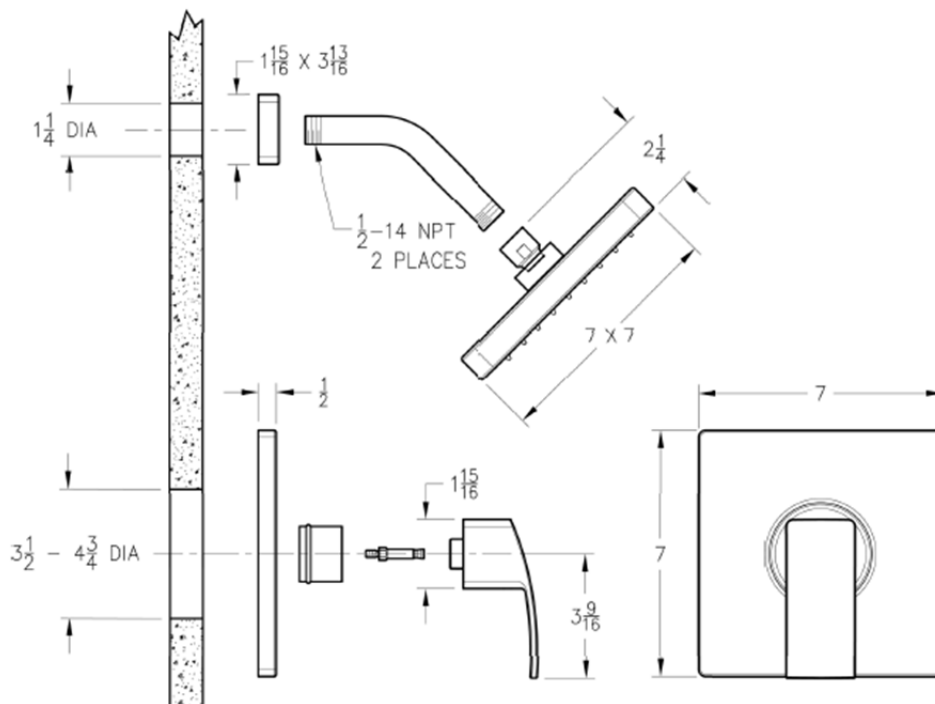


#### E. Shower Head

1. Polished chrome finish
2. 2.5 gpm
3. Self-cleaning

#### F. Shower Valve

1. 1-Handle, Valve Only Trim
2. Polished chrome finish





## 2.03 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled equipment, by a qualified testing agency, according ASME. Sink complies with ASME A112.19.3-2008 / CSA B45.4-08, lavatory ASME A112.19.2/CSA B45.1.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine sink before installation. Reject products that are cracked, rusted, or defective.

### 3.02 INSTALLATION

- A. Reference drawings for configuration and locations.
- B. Use concealed fasteners wherever possible.
- C. Install per manufacturer's instruction manuals.
- D. Secure bathroom accessories in accordance with manufacturer's instructions for each item and each type of substrate.
- E. Provide anchors, bolts and other necessary fasteners, and attach accessories securely to walls and partitions in locations as shown or directed.
- F. Install exposed mounting devices and fasteners finished to match the accessories.
- G. Mounting heights shall be as recommended for handicapped access and at the locations indicated on drawings.
- H. Fasten counter-mounting plumbing fixtures to casework.
- I. Secure supplies to supports or substrate within pipe space behind fixture.
- J. Install water-supply stop valves in accessible locations.
- K. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.
- L. Install piping connections between plumbing fixtures and piping systems and plumbing equipment. Install insulation on supplies and drains of fixtures for people with disabilities.

### 3.03 FIELD QUALITY CONTROL

- A. Sinks and lavatories will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION 22 41 39



## Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)

### SECTION 23 01 00 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Operation and maintenance of HVAC
- B. Related Requirements:
  - 1. Division 23 05 93 Section “TESTING, ADJUSTING, AND BALANCING FOR HVAC”.

#### PART 2 PRODUCTS

##### 2.01 PERFORMANCE REQUIREMENTS

- A. Operation and maintenance of all HVAC equipment should be performed by qualified persons.
- B. Manipulation of refrigerant circuits should be performed by a licensed HVAC technician.

##### 2.02 MATERIALS

- A. For all devices, components, appliances, and systems, require operation and maintenance manual.

#### PART 3 EXECUTION

##### 3.01 TESTING

- A. Testing performed by qualified technician as per manufacturer’s instructions.

END OF SECTION 23 01 00



## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 – GENERAL

#### 1.01 SECTION REQUIREMENTS

- A. Submittals:
  - 1. Certified TAB reports.
  - 2. Documentation of work performed per ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
  - 3. Documentation of work performed per ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
- B. TAB Firm Qualifications: [AABC] [NEBB] [or] [TABB] certified.
- C. TAB Report Forms: Standard TAB contractor's forms approved by Architect.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

### PART 2 – PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. As per manufacturer's specifications

### PART 3 – EXECUTION

#### 3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- F. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.





- G. Examine automatic temperature system components to verify the following:
1. Dampers, valves, and other controlled devices are operated by the intended controller.
  2. Dampers and valves are in the position indicated by the controller.
  3. Integrity of dampers and valves for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
  4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  6. Sensors are located to sense only the intended conditions.
  7. Sequence of operation for control modes is according to the Contract Documents.
  8. Controller set points are set at indicated values.
  9. Interlocked systems are operating.
  10. Changeover from heating to cooling mode occurs according to indicated values.
- H. Report deficiencies discovered before and during performance of test and balance procedures.

### 3.02 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.03 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare schematic diagrams of systems' "as-built" duct layouts.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check for airflow blockages.



- F. Check condensate drains for proper connections and functioning.
- G. Check for proper sealing of air-handling unit components.
- H. Check for proper sealing of air duct system.

#### 3.04 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data; number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  - 1. Open all manual valves for maximum flow.
  - 2. Check liquid level in expansion tank.
  - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
  - 4. Set system controls so automatic valves are wide open to heat exchangers.
  - 5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

#### 3.05 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
  - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

END OF SECTION 23 05 93



## SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Instrumentation and control devices for HVAC.

#### 1.02 ACTION SUBMITTALS

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

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Product Components: Subject to compliance with requirements, provide the following
  1. Dew point Sensors- Honeywell
  2. Supply voltage 24 Vac/Vdc 20%
  3. Power consumption < 10 mA (ac) / < 3 mA (dc)
  4. Switch-points
  5. RH > 90% ± 3% contact "open"
  6. RH < 90% ± 3% contact "closed"
  7. Switching hysteresis 5% RH
  8. Output potential-free relay with
  9. changeover contact
  10. Switching voltage max. 24 Vac/dc
  11. Switching current max. 1 A
  12. Response time at change of < 3 min
  13. pipe/wall temperature
  14. Response time at change of < 25 s
  15. relative humidity
  16. Weight approx. 60 g
  17. Operation temperature 0...50 °C (32...122 °F)
  18. Storage temperature -20...70 °C (-4...158 °F)
  19. Humidity 10...100% RH
  20. Status indication LED, red
  21. Dust protection by special coating (permeable for water vapor)
  22. Housing protection class IP40
  23. Housing material PC, fire resistant according
  24. UL94-V0



25. 2. Temperature and Humidity Sensors- TRANE
  - 1) Sensor operating temperature From -20°F to 140°F (-29°C to 60°C)
26. Storage temperature From -85°F to 158°F (-65°C to 70°C)
27. Operating humidity range From -40°F to 185°F (-40°C to 85°C)
28. Storage/operating humidity range 99% relative humidity (RH), noncondensing
29. Accuracy  $\pm 3\%$  RH over 20% to 95% RH at 77°F (25°C) and includes hysteresis, linearity, and repeatability
30. Hysteresis Less than 1% RH
31. Repeatability 0.5% RH
32. Sensitivity 0.1% RH
33. Thermistor resistance 10 k $\Omega$  at 77°F
34. Temperature accuracy  $\pm 0.36^\circ\text{F}$  ( $\pm 0.2^\circ\text{C}$ )
35. Supply voltage 18 to 36 Vdc
36. Output characteristics 4-20 mA for 0% to 100% RH
37. Drift rate Less than 1% per year
38. Sensing element Polymer capacitive
39. Mounting fits a standard 2 in. by 4 in. junction box (vertical mount only). Mounting holes are spaced 3.2 in. (83mm) apart on vertical center line. Includes mounting screws for junction box or wall anchors for sheetrock walls. Overall dimensions: 2.9 in (74 mm) by 4.7 in. (119 mm)

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- C. Label time switches and contactors with a unique designation.
- D. Verify actuation of each sensor and adjust time delays.

END OF SECTION 23 09 13



## SECTION 23 21 13 – HYDRONIC PIPING

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Piping for radiant heating/cooling ceiling mats, fan coil unit.
- B. Related Requirements:
  - 1. Section 23 80 00 - Decentralized Hvac Equipment
  - 2. Division 23 82 19 - Fan Coil Units

#### 1.02 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-A, M-101-B, M-102, M-901, T-601 drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- B. Heat exchanger, supply and return hydronic piping, circulating pump, valves, HVAC control devices.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Beka Pipes, Supply Lines, and Fittings.
    - a. Outer diameter: 20 mm
    - b. Polypropylene, random copolymer
  - 2. PEX piping
    - a. Outer diameter 5/8" for use with Fan coil unit.

#### 2.02 PERFORMANCE REQUIREMENTS

- a. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- 2. Temperature Change: 120 deg F, ambient.



- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Combustion Characteristics: ASTM E 136.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine walls, floors, and ceilings for suitable conditions where hydronic piping will be installed.

### 3.02 INSTALLATION

- A. Comply with manufacturer's instructions for installation of Beka Pipes, Supply Lines, and Fittings.
- B. Comply with manufacturer's instructions for installation of PEX piping for hydronic systems.
- C. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- E. Comply with requirements for general-duty valves specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- F. Heat-fuse all joints of Beka Pipes, Supply Lines, and fittings as per 2012 IRC Table M2101.1.
- G. Before operating test at no less than 100 psi (690 kPa) for no less than 15 minutes.

### 3.03 STARTUP SERVICE

- A. Perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Pressure tested with 100 psi for a time of 15 minutes.

END OF SECTION 23 21 13



## SECTION 23 21 23 - HYDRONIC PUMPS

### PART 1 GENERAL

#### 1. SUMMARY

- a. Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1) Dual-temperature heating and cooling water piping.
  - 2) Glycol cooling-water piping.
  - 3) Condensate-drain piping.
  - 4) Air-vent piping.
  - 5) Safety-valve-inlet and – outlet piping.
  
- b. Related Requirements:
  - 1) Section 23 21 23 "HYDRONIC PUMPS".
  - 2) Section 23 57 00 "HEAT EXCHANGERS FOR HVAC".
  - 3) Section 23 64 23 "SCROLL WATER CHILLERS".
  - 4) Section 23 71 00 "THERMAL STORAGE".
  - 5) Section 23 80 00 "DECENTRALIZED HVAC EQUIPMENT".
  - 6) Section 23 82 19 "FAN COIL UNITS".

#### 2. INFORMATIONAL SUBMITTALS

- a. Coordination Drawings: See drawings M-101-A, M-101-B, M-102, M-901, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1) Heat exchanger, decentralized HVAC equipment, supply and return hydronic piping, circulating pump, valves, HVAC control devices.

#### 3. DEFINITIONS

- a. PP: Polypropylene
- b. PEX: Cross-linked polyethylene.

#### 4. PERFORMANCE REQUIREMENTS

- a. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:



- 1) Dual-Temperature Heating and Cooling Water Piping: 70 psig at 140 deg F.
- 2) Glycol Cooling-Water Piping: 70 psig at 140 deg F .
- 3) Condensate-Drain Piping: 120 deg F.
- 4) Air-Vent Piping: 120 deg F.
- 5) Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

5. ACTION SUBMITTALS

- a. Product Data: For each type of the following:

- 1) PP pipe and socket welded fittings.
- 2) Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
- 3) Air control devices.
- 4) Hydronic specialties.

6. CLOSEOUT SUBMITTALS

- a. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

7. MAINTENANCE MATERIAL SUBMITTALS

- a. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 PRODUCTS

1. COPPER TUBE AND FITTINGS

- a. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
  - b. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
  - c. DWV Copper Tubing: ASTM B 306, Type DWV.
  - d. Wrought-Copper Fittings: ASME B 75.
  - e. Cast Copper Alloy Fittings: CDA C89833, UL Water Quality Mark, NSF61.
- 1) Basis-of-Design Product: Subject to compliance with requirements, provide Grinnell Mechanical Products, a TYCO International Company; Fig. 640 Rigid Couplings or a comparable product by one of the following:





- a) Anvil International, Inc.
- b) S. P. Fittings; a division of Star Pipe Products.
- c) Victaulic Company.

f. Wrought-Copper Unions: ASME B16.22.

## 2. PLASTIC PIPE AND FITTINGS

- a. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- b. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- c. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- d. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
- e. PP Plastic Pipe: Pipe shall be manufactured from PP-R resin. Wall thickness shall meet short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11..
- f. PP Plastic Fittings: Fittings shall be manufactured from PP-R resin meeting short-term properties and long-term strength requirements of ASTM F 2389.
- g. PEX Plastic Pipe: All PEX tubing shall be 5 layer PEX.
- h. PEX to metal fittings: PEX fittings shall be crimp or compression type.

## 3. SYNTHETIC RUBBER PIPING

- a. Push-lok hose
- b. Push-lok fittings

## 4. JOINING MATERIALS

- a. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1) ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated or supplied by manufacturer.
    - a) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.



- b) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - b. Grooved Couplings, Flange Bolts, and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
    - 1) Hex Nuts: ASTM A 563, Grade A.
    - 2) Bolts and Nuts: Zinc electroplated.
  - c. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
  - d. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
  - e. Solvent Cements for Joining Plastic Piping:
    - 1) PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - f. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.
5. TRANSITION FITTINGS
- a. Plastic-to-Metal Transition Fittings:
    - 1) Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a) Aquatherm.
      - b) Beka.
  - b. Plastic-to-Metal Transition Unions:
    - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a) Charlotte Pipe and Foundry Company.
      - b) IPEX Inc.
      - c) KBi.
      - d) NIBCO INC.
6. DIELECTRIC FITTINGS
- a. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  - b. Dielectric Unions:
    - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:



- a) Capitol Manufacturing Company.
- b) Central Plastics Company.
- c) Hart Industries International, Inc.
- d) Jomar International Ltd.
- e) Matco-Norca, Inc.
- f) McDonald, A. Y. Mfg. Co.
- g) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- h) Wilkins; a Zurn company.

2) Description:

- a) Standard: ASSE 1079.
- b) End Connections: Solder-joint copper alloy and threaded ferrous.

c. Dielectric Flanges:

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a) Capitol Manufacturing Company.
- b) Central Plastics Company.
- c) Matco-Norca, Inc.
- d) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e) Wilkins; a Zurn company.

2) Description:

- a) Standard: ASSE 1079.
- b) Factory-fabricated, bolted, companion-flange assembly.
- c) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

d. Dielectric Nipples:

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a) Elster Perfection.
- b) Matco-Norca, Inc.
- c) Precision Plumbing Products, Inc.
- d) Victaulic Company.

2) Description:

- a) Pressure Rating: 300 psig at 225 deg F .
- b) End Connections: Grooved.
- c) Lining: Inert and noncorrosive.



7. VALVES

- a. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230913 "Instrumentation and Control Devices for HVAC."
- b. Plastic Ball Valves:
  - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a) Aquatherm.
    - b) Beka USA.
    - c) Plast-O-Matic Valves, Inc.
  - 2) Body: One-, two-, or three-piece PP to match piping.
  - 3) Ball: Full-port PP to match piping.
  - 4) Seats: PP.
  - 5) Seals: EPDM.
  - 6) End Connections: NPT or socket fusion welded.
  - 7) Handle Style: Tee shape.
  - 8) CWP Rating: Equal to piping service.
  - 9) Maximum Operating Temperature: Equal to piping service.
- c. Brass, Venturi, Circuit Balancing Valves:
  - 1) Basis-of-Design Product: Subject to compliance with requirements, provide Griswold Controls Quicksets or a comparable product by one of the following:
    - a) Armstrong Pumps, Inc.
    - b) Bell & Gossett Domestic Pump; a division of ITT Industries.
    - c) Flow Design Inc.
    - d) Gerand Engineering Co.
    - e) Taco.
  - 2) Body: Forged Brass, ASTM B283-06.
  - 3) Ball valve: Nickel-plated brass ball, full port.
  - 4) Venturi: Brass.
  - 5) O-ring: EPDM.
  - 6) End Connections: NPT.
  - 7) Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 8) Handle Style: Memory Stop with graduated markings.
  - 9) Pressure/temperature rating: 400 psig/ 250 deg F.
- d. Mixing Valves:
  - 1) Products: Subject to compliance with requirements, provide the following in quantities and model numbers indicated on drawings:
    - a) Honeywell VBN3 series mixing valves with actuators
  - 2) Body: Forged brass.
  - 3) End connections: FNPT.



- 4) O-ring: EPDM.
- 5) VBN3 series three-way valves shall be capable of mixing and diverting applications.
- 6) Minimum close-off pressure: 40 psi at not more than 0.01% of Cv seat leakage on all ports.
- 7) Actuator: Shall accept analog modulating, floating, or two-position signal as indicated in the control sequence. Shall provide minimum torque required for full valve shutoff position. Shall be removable for service/replacement without disconnecting valve body from piping.

e. Three-way valves:

- 1) Products: Subject to compliance with requirements, provide the following in quantities and model numbers indicated on drawings:
  - a) Honeywell VC series three-way valves with actuators
- 2) Body: Forged brass.
- 3) End connections: FNPT.
- 4) Actuator: Shall accept analog modulating, floating, or two-position signal as indicated in the control sequence. Shall provide minimum torque required for full valve shutoff position. Shall be removable for service/replacement without disconnecting valve body from piping.

f. Zone and fan coil valves:

- 1) Products: Subject to compliance with requirements, provide the following in quantities and model numbers indicated on drawings:
  - a) Honeywell V8043 zone valves
- 2) Body: Forged brass.
- 3) End connections: FNPT or sweat.
- 4) Normally closed.
- 5) Two-position, 24 VAC control.

8. AIR CONTROL DEVICES

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Amtrol, Inc.
- 2) Armstrong Pumps, Inc.
- 3) Bell & Gossett Domestic Pump; a division of ITT Industries.
- 4) Taco.
- 5) Johnson Controls.
- 6) Flexcon.
- 7) Webstone.

b. Manual Air Vents:

- 1) Body: Bronze.
- 2) Internal Parts: Nonferrous.
- 3) Operator: Screwdriver or thumbscrew.



- 4) Inlet Connection: NPS 1/2.
- 5) Discharge Connection: NPS 1/8.
- 6) CWP Rating: 150 psig.
- 7) Maximum Operating Temperature: 225 deg F.

c. Diaphragm -Type Expansion Tanks:

- 1) Tank: Welded steel, rated for 100-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 2) Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
- 3) Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

d. Air Purgers:

- 1) Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
- 2) Maximum Working Pressure: 150 psig.
- 3) Maximum Operating Temperature: 250 deg F.

9. CHEMICAL TREATMENT

- a. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

10. HYDRONIC PIPING SPECIALTIES

- a. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Amtrol, Inc.
- 2) Armstrong Pumps, Inc.
- 3) Bell & Gossett Domestic Pump; a division of ITT Industries.
- 4) Taco.
- 5) Johnson Controls.
- 6) Flexcon.
- 7) Webstone.
- 8) Zurn Wilkins.

- b. Y-Pattern Strainers:

- 1) Supply sizes and quantities indicated on drawings.
- 2) Body: Low-lead bronze.
- 3) End Connections: FNPT.
- 4) Strainer Screen: Stainless steel screen, Size 20 mesh.



- 5) Maximum pressure: 300 psig.
- c. Swing check valve
- 1) Supply sizes and quantities indicated on drawings.
  - 2) Body: Brass.
  - 3) End Connections: FNPT.
  - 4) Maximum water pressure: 200 psig.
- d. Purge & Fill Valve
- 1) Supply sizes and quantities indicated on drawings.
  - 2) Body: Brass.
  - 3) End Connections: FNPT.
- e. Expansion tank valve
- 1) Supply sizes and quantities indicated on drawings.
  - 2) Body: Brass.
  - 3) End Connections: FNPT.

## PART 3 EXECUTION

### 1. PIPING APPLICATIONS

- a. Dual-temperature heating and cooling water piping, aboveground, NPS 2 and smaller, shall be the following as indicated in drawings:
- 1) Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2) PP pipe and socket-welded joints.
  - 3) PEX pipe and compression or crimp joints.
  - 4) Push-lok hose and fittings.
- b. Glycol cooling-water piping, aboveground, NPS 2 and smaller, shall be the following as indicated in drawings:
- 1) Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2) PP pipe and socket-welded joints.
  - 3) PEX pipe and compression or crimp joints.



- 4) Push-lok hose and fittings.
  - c. Condensate-Drain Piping: DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
  - d. Air-Vent Piping:
    - 1) Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
    - 2) Outlet: Type K , annealed-temper copper tubing with soldered or flared joints.
  - e. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. VALVE APPLICATIONS
- a. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
  - b. Install balancing valves in the return pipe of each heating or cooling terminal.
  - c. Install check valves at each pump discharge and elsewhere as required to control flow direction.
  - d. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
3. PIPING INSTALLATIONS
- a. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
  - b. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
  - c. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.
  - d. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
  - e. Install piping to permit valve servicing.





- f. Install piping at indicated slopes.
  - g. Install piping free of sags and bends.
  - h. Install fittings for changes in direction and branch connections.
  - i. Install piping to allow application of insulation.
  - j. Follow manufacturer's specifications for minimum bend radii.
  - k. Select system components with pressure rating equal to or greater than system operating pressure.
  - l. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
  - m. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
  - n. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
  - o. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
  - p. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
  - q. Install strainers as indicated. Match size of strainer blowoff connection for strainers smaller than NPS 2.
  - r. Install sleeves for piping penetrations of walls, ceilings, and floors.
4. HANGERS AND SUPPORTS
- a. Install the following pipe attachments:
    - 1) Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
    - 2) On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
  - b. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
    - 1) NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
    - 2) NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
    - 3) NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - c. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
  - d. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.



## 5. PIPE JOINT CONSTRUCTION

- a. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- b. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- c. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- d. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1) Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2) Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- e. Fusion welded joints: Use socket-fusion, electrofusion, or butt-fusion as applicable for fitting or joint type. Follow pipe and fitting manufacturer's recommendations for welder temperature, depth of weld, and welding times.
- f. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1) Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2) CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3) PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 4) PVC Nonpressure Piping: Join according to ASTM D 2855.
- g. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

## 6. HYDRONIC SPECIALTIES INSTALLATION

- a. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- b. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- c. Install expansion tanks on the floor or with designated expansion tank valve. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.
  - 1) Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.



7. TERMINAL EQUIPMENT CONNECTIONS

- a. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- b. Install control valves in accessible locations close to connected equipment or as indicated in drawings.
- c. Install ports for pressure gages and thermometers at locations indicated in drawings.

8. CHEMICAL TREATMENT

- a. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
- b. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:
  - 1) Dual-Temperature Heating and Cooling Water Piping: Minimum 20 percent propylene glycol.
  - 2) Glycol Cooling-Water Piping: Minimum 30 percent propylene glycol.

9. FIELD QUALITY CONTROL

- a. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1) Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2) Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3) Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4) Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5) Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- b. Perform the following tests on hydronic piping:
  - 1) Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2) While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3) Isolate expansion tanks and determine that hydronic system is full of water.
  - 4) Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."



- 5) After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6) Prepare written report of testing.
- c. Perform the following before operating the system:
- 1) Open manual valves fully.
  - 2) Inspect pumps for proper rotation.
  - 3) Set makeup pressure-reducing valves for required system pressure.
  - 4) Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  - 5) Set temperature controls so all coils are calling for full flow.
  - 6) Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  - 7) Verify lubrication of motors and bearings.

END OF SECTION 23 21 23



## SECTION 23 31 00 - HVAC DUCTS AND CASINGS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: HVAC Ducts and Casings.
- B. Related Sections:
  - 1. Section 23 37 13 – Diffusers, Registers, and Grilles
  - 2. Section 23 72 19 - Fixed Plate Air-To-Air Energy Recovery Equipment
  - 3. Section 23 82 19 - Fan Coil Units

#### 1.02 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-A, M-901, and T-601, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. ERV, Fan Coil Unit, HVAC Control Devices.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Ductwork and supports shall conform to the “HVAC Duct Construction Standards, Metal and Flexible, Third Edition, 2005”. Where fittings of configurations not shown in the HVAC-DCS are shown on the contract drawings, they shall be constructed as though they were therein.

#### 2.02 DUCTS

- A. Duct dimensions
  - 1. Duct dimensions shown in the contract drawings include space for acoustical linings where necessary. Ducts requiring acoustical linings are indicated on contract drawings.
- B. Duct Pressure Class



1. Duct pressure classes are to be identified on the contract drawings.

C. Duct Seal Class

1. Ducts shall be sealed as specified in the HVAC-DCS.

D. Duct liner

1. Metal nosing shall be used on leading edges of each piece of lined duct when the velocity exceeds 4000 fpm (20.3 m/s), otherwise, it shall be used on the leading edge of any lined duct section that is preceded by unlined duct.

## 2.03 ACCESSORIES

A. Volume Dampers and Control Dampers: Single-blade and multiple opposed-blade dampers, standard leakage rating, and suitable for horizontal or vertical applications; factory fabricated and complete with required hardware and accessories.

B. Fire Dampers: Rated and labeled according to UL 555 by an NRTL; factory fabricated and complete with required hardware and accessories.

C. Ceiling Fire Dampers: Labeled according to UL 555C by an NRTL and complying with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory." Provide factory-fabricated units complete with required hardware and accessories.

D. Smoke Dampers: Labeled according to UL 555S by an NRTL. Combination fire and smoke dampers shall also be rated and labeled according to UL 555. Provide factory-fabricated units complete with required hardware and accessories.

E. Flexible Connectors: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

F. Flexible Ducts: Corrugated aluminum complying with UL 181, Class 1. Where the specifications for connecting and supporting these in the HVAC-DCS are more stringent or restrictive, they shall supersede.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine all components of ducts and casings before installation. Reject parts that are moisture damaged, or mold damaged.



### 3.02 INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. Conceal ducts from view in finished and occupied spaces.
- C. Avoid passing through electrical equipment spaces and enclosures.
- D. Use fabric isolation at all connection points between fan coil unit and rigid duct.
- E. Use flex duct at all connections between ERV and rigid duct.
- F. Supply duct from ERV to fan coil unit shall be insulated with a minimum of R-6.
- G. Support ducts to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Hangers and Supports."
- H. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- I. Install volume and control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- J. Clean new duct system(s) before testing, adjusting, and balancing.

### 3.03 TESTING, ADJUSTING, AND BALANCING

- A. Balance airflow within distribution systems, including submains, branches, and terminals to indicated quantities.

END OF SECTION 23 31 00



## SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. This section includes supply, return, and exhaust registers.
- B. Show duct connections, shapes, face sizes, patterns, dampers, etc., on Drawings or in a schedule.

#### 1.02 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-A and M-901, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. HVAC Ducts
  - 2. Fan Coil Unit
  - 3. ERV

### PART 2 PRODUCTS

#### 2.01 DIFFUSERS, REGISTERS, AND GRILLES

- A. Basis-of-Design Product: Titus Flowbar and Modulinear Return or comparable products from one of the following:
  - 1. Price
  - 2. Trane

#### 2.02 SYSTEM DESCRIPTION

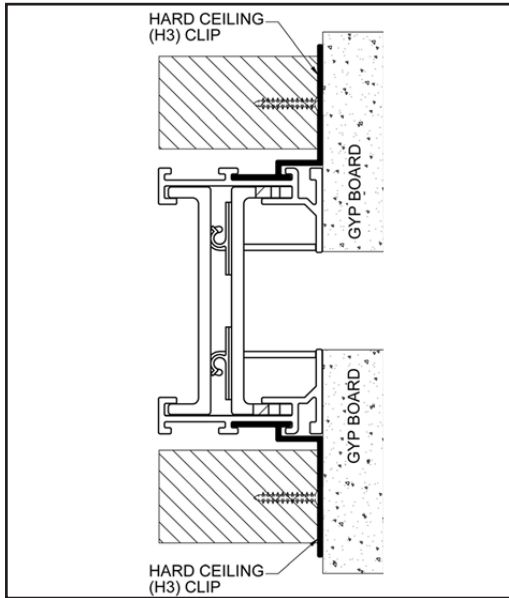
- A. See Diffuser schedule for model numbers and finish details for all diffusers.

### PART 3 EXECUTION

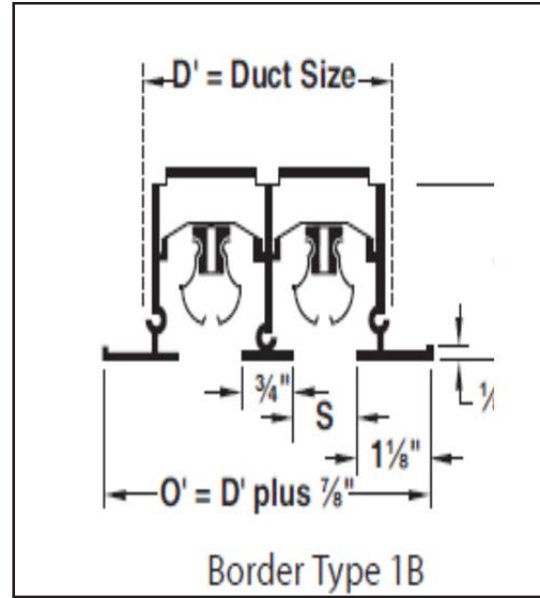
#### 3.01 INSTALLATION

- A. Install diffusers level and plumb in plenum assembly of sizes indicated on plans and air outlet schedules.
- B. Install supply/return diffusers of the sizes and mounting types indicated on the plans and outlet schedule.
- C. Wall-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practical. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.





Side Wall – Exposed flange – Border 11



Side Wall – Return/exhaust Border 1B

END OF SECTION 23 37 13



## SECTION 23 38 00 – VENTILATION HOODS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Kitchen island ventilation hood and blower.
- B. Related Requirements
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections.

#### 1.02 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 and ASTM C 1093 for testing indicated.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Ikea 30" Island Canopy Range Hood

#### 2.02 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Kitchen Island Ventilation Hood
  - 1. Material: Stainless Steel
  - 2. Size: 30" long



- C. Kitchen Island Ventilation Blower
  - 1. Capacities and Characteristics:
    - a. Blower: 400 CFM
    - b. Power Consumption: 490 W Maximum
    - c. Enclosure: Open, externally ventilated
    - d. Volts: 120
    - e. Phase: Single
    - f. Hertz: 60
    - g. Full-Load Amperes: 4.1 A

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Comply with NECA 1.
- B. Safety Instructions
  - 1. For residential use only.
  - 2. To reduce the risk of fire or electric shock, do not use this fan with any Solid-State Speed Control Device.
  - 3. To reduce the risk of fire and to properly exhaust air, be sure to duct air outside. Do not vent exhaust air into spaces within walls or ceilings or into attics, crawl spaces, or garages.
  - 4. For general ventilating use only. Do not use to exhaust hazardous or explosive materials and vapors.
  - 5. To avoid motor bearing damage and noise and/or unbalanced impellers, keep drywall spray, construction dust, etc. off power unit.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces and materials using the methods recommended by the manufacturer.

### 3.03 INSTALLATION

- A. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
- B. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
- C. Install hood in recirculation mode.



- D. This unit must be grounded.
- E. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- H. In addition to the previously stated installation requirements, follow the step-by-step Installation Instructions provided by the manufacturer and attached in this Project Manual.

END OF SECTION 23 38 00



## SECTION 23 57 00 - HEAT EXCHANGERS FOR HVAC

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes Brazed Plate Heat Exchanger for HVAC.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for Bell & Gossett BP410-20.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-B, M-602, and M-901, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Beka KS15 mats, Fan coil units, supply and return hydronic piping, circulating pump, and valves.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, Bell & Gossett BP410-20.

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics:
  - 1. Total heat exchanged: 16000 Btu/h
    - a. Hot side
      - 1) Fluid name: Water-Propylene Glycol 10%
      - 2) Inlet temperature: 65 deg F
      - 3) Flow rate: 7.00 gpm
      - 4) Pressure drop, calculated: 1.85 PSI



b. Cold Side

- 1) Fluid name: Water 50% propylene glycol
- 2) Inlet temperature: variable
- 3) Flow rate: 8.00 gpm
- 4) Pressure drop, calculated: 3.21 PSI

2.03 MATERIALS

- A. Bell & Gossett BPN410-20
- B. Capacities and Characteristics:
  1. Brazed plate heat exchanger, plate material 316L SS, Brazing material Cu.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine walls, floors, and ceilings for suitable conditions where Heat Exchanger will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrate and tools for installation according to manufacturer's instructions.

3.03 INSTALLATION

- A. Equipment Installation: Install Heat Exchanger using mounting hole/bracket provided by manufacturer.
- B. Insulation: After installation and pressure testing, insulate Heat Exchanger with a minimum of R-6.

3.04 STARTUP SERVICE

- A. Pressure test manifold assembly with 100 psi for a time of 15 minutes.

END OF SECTION 23 57 00



## SECTION 23 64 23 - SCROLL WATER CHILLERS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes: Scroll Water Chiller.
- B. Related Sections:
  - 1. Division 22 33 00 – Electrical Domestic Water Heaters
  - 2. Division 23 21 13 Hydronic Piping.
  - 3. Division 23 71 00 - Thermal Storage.
- C. Action Submittals:
  - 1. Product Data. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

#### 1.01 INFORMATIONAL SUBMITTALS

- 1. Coordination Drawings: See drawings M-602, M-901, T-601 on which the following items are shown and coordinated with each other, using input from installers of the items involved: Chiller, Heat Exchanger, Controls, Electric Water Heater, Thermal Storage Unit.

#### 1.01 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.

#### 2.02 WATER CHILLERS

- A. Manufacturers: Chilling



- B. Description: Water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- C. Cabinet:
1. Base, Frame, and Casing: Galvanized steel with corrosion resistant powder coating.
  2. Acoustical compressor enclosure.
- D. Compressors:
1. Description: Scroll Compressor
    - a. Model: Copeland ZPS40K4E
    - b. Capacity Control: Ultra-Tech capacity control, plus hot-gas bypass.
  2. Description: Scroll Compressor
    - a. Model: Copeland ZP16K5E
- E. Refrigeration:
1. Refrigerant: R410a
  2. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant bypass from thermal-expansion valve, suction filter, liquid line filter/dryer, sight glass, charging connections.
- F. Evaporator: Chilling coiled copper
1. UL listed
- G. Air-Cooled Condensers:
1. Fans: Direct-drive propeller type arranged for vertical air discharge.
  2. Cooling condenser fan motor: US motors K55HXDSW-1212.
  3. Heating condenser fan motor: MFE-71TVAL
- H. Controls: Manufacturer supplied chiller controls interface with field-supplied control system; unit mounted, and factory wired with a single-point power connection and separate control circuit.
1. 24 VAC compressor control signal.
  2. Digital control interface for setpoint input.
- I. Insulation: 3/4 inch closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials, factory-applied over cold surfaces of water chiller components.
- J. Water Chiller Characteristics and Capacities:
1. First stage cooling capacity: 16000 BTUH
  2. Second stage cooling capacity: 40000 BTUH (STC)
    - a. Second stage cooling used for low-temperature cooling for thermal storage.
  3. Heat pump capacity: 16000 BTUH
  4. Full-Load Efficiency:





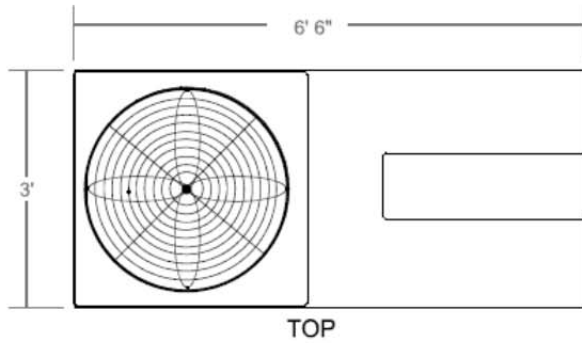
- a. COP: 2.12
5. Number of Refrigeration Circuits: Two.
6. Compressor Rated Load Amperes: 24.
7. Compressor Locked-Rotor Amperes: 96.
8. Controls:
  - a. Power Connection: Internal transformer.
  - b. Controls Electrical Characteristics: 24 VAC, single phase, 60 Hz.
  - c. Field-selectable setpoints for first and second stage cooling.
9. Chiller Minimum Circuit Ampacity: 37 A.
10. Chiller Maximum Overcurrent Protection Device: 58 A.
11. Chiller Electrical Characteristics: 208/230 V ac, single phase, 60 Hz.
12. Insulated 20 gallon tank for domestic hot water preheating
  - a. Hot gas line passes through bath.
  - b. Coil plumbed to water heater passes through bath.
  - c. Condenser fan activated by pressure switch linked to setpoint of DHW heat recovery bath, maximum 120 deg F.

## PART 3 EXECUTION

### 3.01 INSTALLATION

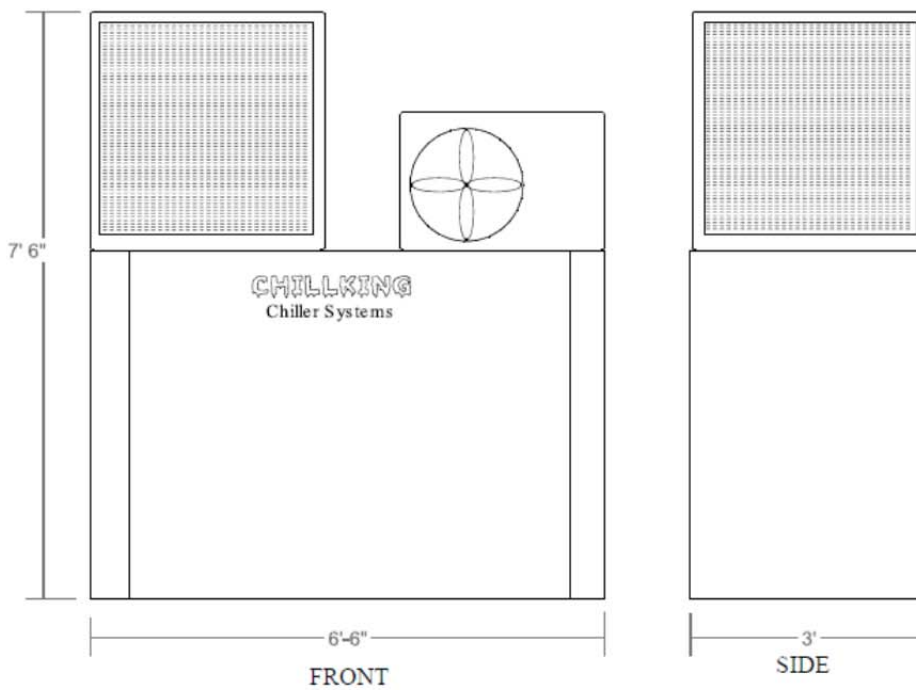
- A. Install chillers level and plumb, and anchor to base. Maintain recommended clearances.
- B. Install flexible pipe connections for chillers mounted on vibration isolators.
- C. Install shutoff valves at chiller inlet and outlet connections.
- D. Install electrical devices, including remote flow switches and remote chiller control panel. Comply with NFPA 70.

# CHILLKING Chiller Systems



#### SPECIFICATIONS

- Electrical 208/230 , 60Hz single phase
- Minimum Circuit Ampacity 37A
- Maximum Fuse Size 58A
- 410A refrigerant
- Dimensions 36" Wide, 78" Long, 90" Tall



P.O. Box 1696 Bastrop, Texas 78602 Tel 512-303-1529

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

END OF SECTION 23 64 23



## SECTION 23 71 00 - THERMAL STORAGE

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes Thermal Storage Unit.
- B. Related Requirements:
  - 1. Section 23 21 23 "HYDRONIC PUMPS" for Hydronic pumps
  - 2. Section 23 57 00 "HEAT EXCHANGERS FOR HVAC " for Brazed Plate Heat Exchanger.
  - 3. Section 23 64 23 " SCROLL WATER CHILLERS" for Water Chiller.
- C. Shop Drawings:
  - 1. See U.S. Patent application 61,841,877 filed July 1, 2013 for construction details of internal heat exchanger for thermal storage unit.

#### 1.02 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-B, M-602, M-901, T-601 drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Chiller, Heat exchanger, Hydronic pumps, HVAC controls.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics:
  - 1. Stainless steel tank containing sealed polypropylene bags filled with Phase Change Material (PCM) made of a water and graphite mixture. Working fluid (30% propylene glycol – 70% water) circulates through tank and on to the cooling delivery system.
  - 2. Total PCM volume is 50 gallons.
  - 3. Thermal storage unit freezes at night and melts during the day.



4. Tank is insulated with to at least R-25 with a combination of denim insulation and reflective/radiant barrier wrap.
5. Thermal Storage unit is used for cooling only; diverting valve installed at inlet prevents circulation of heated water through tank.
6. Tank characteristics
  - a. Ghidi VCT 400 L
  - b. Two 1.5" tri-clover fittings with butterfly valves, two tri-clover MNPT nipples, associated gaskets and clamps.

## 2.03 FABRICATION

- A. See U.S. Patent application 61,841,877 filed July 1, 2013 for fabrication details of internal heat exchanger.

## PART 3 EXECUTION

### 3.01 EXAMINATION

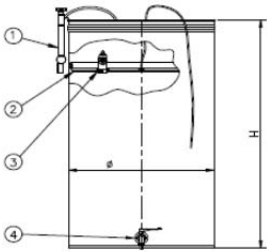
- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for Thermal Storage piping to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, roofs for suitable conditions where Thermal Storage unit will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION.

- A. Equipment Installation: Install Thermal Storage Unit level on surface or substrate adequate to support entire weight of filled unit.
- B. Locate tank in final location. Lay tank on its side and fill with heat exchanger components.
- C. Carefully set tank upright.
- D. Provide a minimum of 6" clearance on all sides of tank for insulation.
- E. Connect thermal storage unit to hydronic piping. Fill and visually inspect for leaks. Repair or eliminate any leaks before operation.
- F. Do not pressurize thermal storage unit. Isolate thermal storage unit during pressure testing of hydronic system.

- G. Once unit is leak free, insulate tank.
- H. Do not transport Thermal Storage unit full. If transportation is required, drain working fluid and remove internal heat exchanger. Recover working fluid safely and in compliance with local ordinances concerning propylene glycol.

### FLAT BOTTOM VARIABLE CAPACITY TANKS

TANK MOD. FPP FOR WINE PNEUMATIC SYSTEM STAINLESS STEEL AISI 304						
		CODE WITHOUT DOOR	CODE WITH DOOR	L.	Ø	H
		*****	*****	***	***	***
		*****	*****	***	***	***
		*****	*****	***	***	***
		40100	*****	100	410	750
		40150	*****	150	510	750
		40200	*****	200	510	1000
		40300	*****	300	620	1000
		40400	40407	400	720	1000
		40500	40507	500	720	1250
POS.	STANDARD EQUIPMENT	40600	40607	600	720	1500
1	PNEUMATIC AIR KIT	40800	40807	800	920	1250
2	PNEUMATIC FLOAT	41000	41007	1000	920	1500
3	VALVE REGULATING PRESSURE/DEPRESSURE	41500	41507	1500	1160	1500
4	VALVE GHIDI 1" INOX	42000	42007	2000	1310	1500
<b>SPECIAL FITTINGS: SUPPORT INOX (SEE SPARE PARTS PAGE)</b>						

END OF SECTION 23 71 00



## SECTION 23 72 19 – FIXED PLATE AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Energy Recovery Ventilation (ERV) unit.

#### 1.02 SECTION REQUIREMENTS

- A. Submittals:
  - 1. Product Data: Include rated capacities, operating characteristics, furnished specialties, accessories, and color charts for cabinet finishes.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-A, M-102, M-901, T-601 drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Fan coil unit, ductwork, HVAC controls.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.05 WARRANTY

- A. Renewaire Warranty: The RenewAire 90-Series ERV's are protected by a 10 year warranty on the ERV core and a 5 year warranty on all other parts.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Renewaire EV 90.



- B. Cabinet: 22 gauge steel, insulated with 1 inch expanded polystyrene foam insulation.
- C. Core: cross flow ERV core
- D. Cabinet Finish: Textured, powder coat paint.
- E. Accessories:
  - 1. Permanently lubricated, motorized impeller blowers, sealed bearings.
  - 2. Filters: disposable 1" MERV 8.
- F. Basic Unit Controls:
  - 1. Control interface to be used with field-supplied control system.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics:
  - 1. Air flow range: 40-110 cfm.
  - 2. Sensible recovery efficiency: 72%
  - 3. Net moisture transfer: 37%
  - 4. Total recovery efficiency: 46%

## 2.03 CONTROLS AND SAFETIES

- A. Safety interlock switch turns off the unit when the door is opened.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install ERV level and plumb, following construction drawings.
- B. Comply with NECA 1.
- C. Ensure that duct work is correctly installed and sealed, filters are in place, and controls are connected. Shut and latch door.
- D. Apply insulation and vapor barrier on supply and exhaust ductwork as per manufacturer's instructions.

END OF SECTION 23 72 19



## SECTION 23 80 00 - DECENTRALIZED HVAC EQUIPMENT

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Beka KS15 Radiant heating and cooling ceiling mats.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and dimensions of individual components and profiles for Beka KS15 mats.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Product Schedule: See drawings M-601.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-B, M-602, M-901, T-601 drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Heat exchanger, supply and return hydronic piping, circulating pump, valves, HVAC control devices.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For Beka KS15 mats to include in operation and maintenance manuals, provided in hard copy or as electronic document.
- B. Sample Warranty: "BEKA products are made of high-quality materials and are subject to strict control in purchase, manufacture and delivery. All BEKA products undergo quality controls during the manufacturing process in line with operational standards. BeKa Heiz- und Kühlmatten GmbH gives a warranty for all its products, if expertly assembled, of 15 years as of the date of the transfer of risks. For consequential and third-party damages, a product liability insurance with a coverage of 5 million Euros has been taken out with a leading German insurance company."

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
- B. Pressure tested at factory to 10 bar for 10 hours.





Installer Qualifications: An authorized representative who is trained and approved by manufacturer. Additional pressure test required post-installation.

#### 1.06 FIELD CONDITIONS

- A. Pressurize mats prior to plastering; repair leaks or replace defective mats prior to plastering.

#### 1.07 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.

Pressure tested at factory to 10 bar for 10 hours.

#### 1.08 WARRANTY

- B. BEKA Warranty: BEKA agrees to repair or replace BEKA mats that fail in materials or workmanship within specified warranty period. workmanship within specified warranty period.
- C. Warranty Period: 15 years as of the date of the transfer of risks.
  - 1. Coverage: For consequential and third-party damages, a product liability insurance with a coverage of 5 million Euros has been taken out with a leading German insurance company.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Beka KS15 mats of sizes and quantities listed in schedules.

#### 2.02 2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Combustion Characteristics: ASTM E 136.
- C. Capacities and Characteristics:
  - 1. Cooling capacity at defined conditions: 24 Btu/h sq. ft.
  - 2. Filled weight: 1.842 oz/sq. ft.
  - 3. Allowable heating water temperature: 140 deg. F
  - 4. Operating pressure: 58 psi



5. Connections: Welded plastic

2.03 MATERIALS

A. BEKA, KS15 mats

1. Material: Polypropylene Random-Copolymer Type 3 DIN 8078
2. Color: as supplied by factory.

2.04 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Finish products after assembly.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas conditions, with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls, floors, and ceilings for suitable conditions where Beka KS15 mats will be installed.
- C. Examine roughing-in for Beka KS15 mats piping to verify actual locations of piping connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrate and tools for installation according to manufacturer's instructions.

3.03 INSTALLATION

- A. Equipment Installation: Install Beka KS15 mats according to manufacturer instructions.
- B. Drawings indicate general arrangement of mats and piping. Make final locations where indicated, as much as practical. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.



3.04 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions. Pressure test with 100 psi for a time of 15 minutes.

END OF SECTION 23 80 00



## SECTION 23 82 19 – FAN COIL UNITS

### PART 2 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Johnson Controls Fan Coil Unit.

#### 1.02 SECTION REQUIREMENTS

##### A. Submittals:

- 1. Product Data: Include rated capacities, operating characteristics, furnished specialties, accessories, and color charts for cabinet finishes.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See drawings M-101-A, M-602, M-901, and T-601, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Heat exchanger, supply and return hydronic piping, circulating pump, valves, HVAC control devices.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 90A, by a qualified testing agency, and marked for intended location and application.

#### 2.02 FACTORY-ASSEMBLED UNITS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Johnson Controls HLP/FHP 020 4 rows cooling/2 rows heating



- B. Description: Factory-packaged and -tested units rated according to AHRI 440-97, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: closed cell insulation complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
  - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Main and Auxiliary Drain Pans: Main drain pan positively sloped in every plane and insulated with closed-cell insulation.
- E. Chassis: Galvanized steel where exposed to moisture.
- F. Cabinet: Galvanized steel.
  - 1. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain.
  - 2. Stack Unit Discharge and Return Grille: Return grille shall provide maintenance access to fan-coil unit.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 300 psig and a maximum entering-water temperature of 200 deg F. Include manual air vent and drain valve.
- H. Cabinet Finish: Galvanized steel.
- I. Accessories:
  - 1. Permanently lubricated, multispeed motor, resiliently mounted on motor board.
  - 2. Keyslot hanger holes for suspending from joists.
  - 3. Filters: either 1-inch throwaway or 1" MERV 8.
- J. Basic Unit Controls:
  - 1. Control interface to be used with field-supplied control system.
  - 2. Unit-mounted control box contains relay board which includes a line voltage to 24-volt transformer and an optional disconnect switch.
  - 3. Unit-mounted fan speed switch.
  - 4. Two-way and three-way modulating valves are rated for a maximum pressure differential across the valves of 50 psig.
- K. Capacities and Characteristics:
  - 1. Fan:
    - a. Airflow: 260 cfm.
    - b. External Static Pressure: 0.05 inches wg .
    - c. Motor Horsepower: 0.33.
    - d. ECM 2.3 module
  - 2. Cooling Capacity:



- a. Total: 8800 Btu/h .
  - b. Sensible: 6000 Btu/h .
  - c. Entering-Air Dry-Bulb Temperature: 80 deg F .
  - d. Entering-Air Wet-Bulb Temperature: 67 deg F .
3. Chilled-Water Coil:
- a. Water Flow 1.6 gpm .
  - b. Water-Side Pressure Loss: 2.5 feet wg.
  - c. Entering-Water Temperature: 45 deg F .
4. Heating Capacity:
- a. Output: 15,700 Btu/h.
  - b. Entering-Air Temperature: 70 deg F.
  - c. Air-Temperature Rise: 30 deg F.
5. Hot-Water Heating Coil:
- a. Water Flow: 0.8 gpm.
  - b. H Water-Side Pressure Loss: 0.9 feet wg.
  - c. Entering-Water Temperature: 180 deg F.
6. Electrical Characteristics:
- a. Volts: 115.
  - b. Phase: Single
  - c. Hertz: 60.
  - d. Full-Load Amperes: 5.
  - e. Maximum Overcurrent Protection: 15 A.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install fan-coil units to comply with NFPA 90A.
- B. Install unit level and plumb and firmly anchored.
- C. Connect to supply and return piping with shutoff valve and union at each connection.
- D. Connect units to wiring systems and to ground.
- E. Connect to field-supplied control system.

END OF SECTION 23 82 19



## Division 25 – Integrated Automation

### SECTION 25 35 16 - INTEGRATED AUTOMATION SENSORS AND TRANSMITTERS

#### PART 1 GENERAL

##### 1.03 SUMMARY

- A. Section Includes: Instrumentation and control devices for HVAC.

##### 1.04 ACTION SUBMITTALS

- E. Product Data: For each type of product.

##### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. System Components: Subject to compliance with requirements, provide each of the following in quantities indicated in drawings:

1. CR1000
2. NEXIA BRIDGE
3. Aurora logger residential

- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Power One
2. Campbell Scientific
3. Nexia

- C. PERFORMANCE REQUIREMENTS

1. Campbell Scientific Cr 1000 data logger.

1. Maximum Scan Rate: 100 Hz
2. Analog Inputs: 16 single-ended or 8 differential individually configured
3. Pulse Counters: 2
4. Switched Excitation Channels: 3 voltage
5. Digital Ports: 8 I/Os or 4 RS-232 COM2
6. Communications/Data Storage Ports: 1 CS I/O, 1 RS-232, 1 parallel peripheral



7. Switched 12 Volt: 1
8. Input Voltage Range:  $\pm 5$  Vdc
9. Analog Voltage Accuracy:  $\pm(0.06\%$  of reading + offset),  $0^\circ$  to  $40^\circ\text{C}$
10. Analog Resolution:  $0.33 \mu\text{V}$
11. A/D Bits: 13
12. Temperature Range: Standard:  $-25^\circ$  to  $+50^\circ\text{C}$ , Extended:  $-55^\circ$  to  $+85^\circ\text{C}$
13. Memory: 2 MB Flash (operating system), 4 MB (CPU usage, program storage, and data storage)
14. Power Requirements: 9.6 to 16 Vdc
15. Current Drain: 0.7 mA typical; 0.9 mA max. (sleep mode), 1 to 16 mA typical (w/o RS-232 communication), 17 to 28 mA typical (w/RS-232 communication)

## 2.02 MANUFACTURERS

### A. Products: Subject to compliance with requirements,

#### A. Campbell Scientific Cr 1000 data logger

1. Maximum Scan Rate: 100 Hz
2. Analog Inputs: 16 single-ended or 8 differential individually configured
3. Pulse Counters: 2
4. Switched Excitation Channels: 3 voltage
5. Digital Ports: 8 I/Os or 4 RS-232 COM2
6. Communications/Data Storage Ports: 1 CS I/O, 1 RS-232, 1 parallel peripheral
7. Switched 12 Volt: 1
8. Input Voltage Range:  $\pm 5$  Vdc
9. Analog Voltage Accuracy:  $\pm(0.06\%$  of reading + offset),  $0^\circ$  to  $40^\circ\text{C}$
10. Analog Resolution:  $0.33 \mu\text{V}$
11. A/D Bits: 13
12. Temperature Range: Standard:  $-25^\circ$  to  $+50^\circ\text{C}$ , Extended:  $-55^\circ$  to  $+85^\circ\text{C}$
13. Memory: 2 MB Flash (operating system), 4 MB (CPU usage, program storage, and data storage)
14. Power Requirements: 9.6 to 16 Vdc
15. Current Drain: 0.7 mA typical; 0.9 mA max. (sleep mode), 1 to 16 mA typical (w/o RS-232 communication), 17 to 28 mA typical (w/RS-232 communication)

#### B. Nexia Bridge

- a. Product height: 4.8", width: 4.0", Product weight 7oz, Product depth: 1.4"
- b. Input voltage : 120V, Battery operated 9v.
- c. Ethernet port provided for setting up gateway.
- d. Online programming is enabled through the Nexia Web interface.

#### C. Aurora Data logger

- a. Serial Port Interface: (2) RS-485 + (2) RS-232
- b. Maximum Devices per Serial Port : Physical limitation of 32 (reduced by poll rate, inverter data set size, and logger type)





- c. Fieldbus Cable : RS-485 Shielded twisted pair. Recommend Belden # 1120A cable or # 3106A for 3 conductors
- d. Ethernet Port 0 : firewall protected Ethernet WAN port for internet connection
- e. Ethernet Port 1 : Local LAN with static Ip address
- f. Ethernet Connections : RJ-45 Ethernet 10/100 base-T (LAN/WAN)
- g. Plant Fieldbus Protocols : Aurora, Modbus RTU, SunSpec
- h. LAN/WAN Protocols : HTTP, dHCp, SSL, SSH, XML
- i. Data Sampling rate: High frequency data sampling - 1 minute average
- j. Local Storage : Log data for 30 days based on 15-minute intervals. (days logged reduced by intervals shorter than 15-minute)
- k. Upgradeability : field upgradable over the Internet or locally via USB memory stick
- l. DC Power Supply Input : 100 - 240 VAC
- m. DC Power Supply output : 12VdC, 1A
- n. Ambient Temperature range : 0 to 40C
- o. Environmental Protection rating : Ip20
- p. relative Humidity : <85% Non-condensing
- q. Dimensions : H x W x D 1" x 5.5" x 5.25" ( .03m x .14m x .13m)
- r. Weight : 2 lbs (0.91kg)
- s. Mounting System : Screws through flanges
- t. Emission : fCC part 15 Class B, CISpR 22, EN 55022 Conducted and Radiated Emission
- u. Immunity : EN55024

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Inspect locations for suitable conditions Devices will be installed. Suitable conditions include freedom from excessive dust or moisture.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- D. Connect sensors to controllers according to manufacturer's wiring instructions.

END OF SECTION 25 35 16



## Division 26 – Electrical

### SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

#### PART 1 - GENERAL

##### 1.01 SUMMARY

###### A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Silicone sealants.

##### 1.02 RELATED DOCUMENTS

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

##### 1.03 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

#### PART 2 – PRODUCTS

##### 2.01 SLEEVES

###### A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- ###### B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

###### C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
  - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be



0.138 inch (3.5 mm).

## 2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Advance Products & Systems, Inc. b. CALPICO, Inc.
    - c. Metraflex Company (The). d. Allstate approved equal.
  2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel.
  4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Presealed Systems.
    - b. Allstate approved equal.

## 2.04 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multi-component, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.



### PART 3 - EXECUTION

#### 3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors. D. Sleeves for

#### Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

- 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
- 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

#### 3.02 SLEEVE-SEAL-SYSTEM INSTALLATION



- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.03 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 00



## SECTION 26 05 83 – WIRING CONNECTIONS

### PART 1 GENERAL

#### 1.01 SUMMARY

A. Section Includes: Low voltage cable connectors. To be used as a modular solution for connecting the mechanical room to the main house. The purpose is for safe and repeatable connection and disconnection of our electrical branch circuits.

B. Related Sections:

1. Division 26 28 00 Section “Low-voltage circuit protective devices”:

#### 1.02 SUBMITTALS

A. Product Data

#### 1.03 QUALITY ASSURANCE

A. UL Listed

#### 1.04 DELIVERY, STORAGE, HANDLING

A. Inspect materials upon delivery to assure that specified products have been received. Keep damaged material identified as damaged and removed from the worksite.

B. Store materials in safe area, away from construction traffic; store under cover and off ground, protected from moisture. Keep materials in original packaging until ready for installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Products: Quick-CEB and SnapPhase, Coupler/Splice device

1. Tyco Electric; Website: [www.te.com](http://www.te.com)
2. Other

#### 2.02 PRODUCT CHARACTERISTICS

- A. Product type: cable splice
- B. Product series: NM-1
- C. Strain relief and housing material: Polycarbonate
- D. Electrical characteristics: 20A rating
- E. Wire range (mm[AWG]): 2.00-3.00<sup>2</sup> [14-12]
- F. Mounting bracket material: Pre-galvanized carbon steel
- G. Contact base material: copper alloy
- H. Contact plating, mating area, material: tin



- I. Configuration features: Number of wires is two (2) plus ground

## 2.03 HUBBEL TWIST LOCK DEVICES

- A. safety shroud twist lock 30amp 125 volt, nema I5-30r flush mount receptacle. Cat # hbl 2620sr
- B. safety shroud male plug 30amp 125 volt, nema I5-30 cat # hbl 2611s
- C. safety shroud twist lock 50amp 125 volt flush-mount receptacle cat #cs6370
- D. safety shroud twist lock 50amp 125 volt plug; cat#cs6361c

## 2.04 STANDARDS

- A. RoHS/ELV Compliant; ELV compliant
- B. Lead free

## PART 3 EXECUTION

### 3.01 PREPARATION

- 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.

### 3.02 INSTALLATION

- A. Comply with manufacturer's installation instructions
- B. Comply with local building codes and regulations, including but not limited to the NEC Building Code
- C. Wiring method: All wire will be twisted clockwise and installed under the receptacle screw terminal. Flush mount receptacles will be covered in accordance with NEC requirements for trim plating. 30 and 50 amp plugs will be mounted to the wall with strain relief measures. All 12awg cabling will be dressed and labeled neatly and installed per the manufacturer's directions

### 3.02 PROTECTION

- A. Protect installed cable and quick connections by properly dressing and strapping the cable. All Cable and quick connections to be labeled clearly as live electrical parts.
- B. Test Procedure: ohm meter testing before and meter testing after energizing by qualified electrician.

END OF SECTION 26 05 83



## SECTION 26 09 23 - LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Lighting Control Devices

#### 1.02 SECTION REQUIREMENTS

- B. Submittals: Product Data.

### PART 2 PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2.02 DEVICES

- 1. Products: Lutron Radio RA - Main repeater
  - a. Main/Auxiliary Repeater: 9 V 300 mA
  - b. Input 120V- 60Hz 6.5W
  - c. Main Repeater: 3.1 W. Test conditions: One LED on, Ethernet cable plugged in, powered by 9v, adapter supplied. Auxillary Repeater : 0.6W. Test Conditions: One LED on, powered by 9v adapter supplied
  - d. Regulatory Approvals: DC adapter: UL listed for US and CANADA, NOM . Main repeater: FCC,IC,COFETEL
  - e. Environment: Ambient operating temperature: 32F to 104F. 0 to 90% humidity, non-condensing . Indoor use only.
  - f. Low voltage wire type: two pair-one pair 18AWG, One pair 22AWG to 18AWG twisted shield.
  - g. Communications: Repeaters communicate with system through RF. All devices must be located within 30ft of a repeater. All repeaters must be places within 60ft of other repeaters.





- h. ESD Protection: Tested to withstand electrostatic discharge without damage or memory loss, in accordance with IEC 61000-4-2
- i. Surge Protection: Tested withstand surge voltages without damage or loss of operation, in accordance with IEEE C62.41-1991. Recommended practice on surge voltages in low voltage AC power circuits.
- j. Power failure: Power failure memory: should power be interrupted, the repeater will be return to its previous state when power is restored.
- k. Mounting: mount on a wall, ceiling , or level surface using the two #6 screws provided
- l. Connections : Main repeater: Ethernet, RS232, RS485 and USB
- m. Warranty: 1 year limited warranty.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install and aim repeaters in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

END OF SECTION 26 09 23



## SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: px lighting control, low voltage transformer for landscape lighting

#### 1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site in Irvine, California.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

1. 300W FX Luxor Transformer for low-voltage landscape lighting

- B. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

- C. Basis-of-Design Product: Subject to compliance with requirements, provide [Drawing: L-501][reference key note (1) for Light Fixture, and reference key note (2) for transformer] FX Luminare; FB Frère Béb  or a comparable product by one of the following:

1. FX Luminare lighting controller.
2. Product Data:
  - a. Number of controllers: 1
  - b. Output capacity: 300 Watt
  - c. Input Voltage: 120V
  - d. Output voltage: <24 v
  - e. Height:13.5"
  - f. Width:7.5"
  - g. Depth:6"
  - h. Finishes: Flat Black Finish
  - i. Casing: stainless steel

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Wall-mounted transformers shall be constructed and adequately anchored and braced to withstand seismic forces at the location where installed.
- B. Enclosure: Totally enclosed, non-ventilated, NEMA 250, Type 3R
- C. Core and coil shall be encapsulated within resin compound, sealing out moisture and air

#### 2.03 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in [Division 11 Section "Common Motor Requirements for Equipment."]

1. Electrical Characteristics:
  - a. Watts: 300w

#### 2.04 ACCESSORIES



- A. Timer
- B. Photocell

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Examine FX Luminaire controller before installation. Reject controller that are wet, moisture damaged, or mold damaged, or dented.

#### 3.02 INSTALLATION

- A. Refer to Drawing sheet L-501 for installation details for fixtures and transformer.
- B. Fasten transformers securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.
- C. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
- D. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounting transformers as specified in Section 260500 "Common Work Results for Electrical."
- E. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions
- F. Wiring Method: manufacturer installed whip for power, pipe to exterior of building, low voltage direct burial wire to lights.
  - 1. There will be 160 ft of low voltage electrical wiring

END OF SECTION 26 22 00



## SECTION 26 24 16 – PANELBOARDS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Main Distribution Panelboard
- B. System Description: Square d HOMELINE 200amp 240vac load center single phase 3 wire

#### 1.02 1.02 PERFORMANCE REQUIREMENTS

- A. Performance: 200amp uniform load and 10000 maximum short circuit current rating concentrated load.
- B. Engineering design of Justin Armstrong by Contractor.

#### 1.03 1.03 QUALITY ASSURANCE

- A. Quality Standard: UL listed
- B. Square D homeline load center

#### 1.04 1.04 WARRANTY

- A. Square D warrants its single phase load centers, in a residential application, to be free from defects in material and workmanship under normal care and proper usage for a period of 10 years from the date of installation for HOMELINE load centers; and lifetime for QO load centers, when used with the appropriate Square D HOMELINE or QO branch circuit breakers. See attached residential warranty for QO and HOM circuit breakers for more information. For an application other than residential, the standards Terms and Conditions of Sale apply

#### 1.05 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

### PART 2 – PRODUCTS

#### 2.01 PRODUCTS

- A. 200 amp main disconnect, 240vac
  - 1. B. Main neutral lug
  - 2. Main grounding lug



3. Neutral bar
4. Grounding bar
5. Bonding screw
6. Labels
7. Dead front and lockable cover
8. Controls and Safeties: all installers have been properly trained on electrical safety and will be supervised by a qualified electrician. Loto will be employed when work is done on any branch circuits or equipment. The dead front will be installed before the panel is energized. All branch circuits will be ohm tested before energizing.

## 2.02 SOURCE QUALITY CONTROL

- A. Testing: UL tested, listed, and labeled

## PART 3 - EXECUTION

### 3.03 INSTALLATION

- A. Installation Method: load center will be hung in an area in accordance with NEC working space requirements, with proper lighting, with a main disconnect height not to exceed 6'7" aff
- B. Wiring Method: all circuit breakers will be single lugged using copper wire listed and rated for the amperage provided by each circuit breaker. The wires will be installed in a workmanlike manner. All grounded white wires will be landed on the neutral bar, all green grounding wires will be landed on the ground bar. All penetrations into the cabinet will be through provided knockouts with approved bushings.

### 3.04 FIELD QUALITY CONTROL

- A. Testing: By qualified electrician with a category three or higher field suitable meter
- B. Test Procedure: ohm meter testing before and meter testing after energizing by qualified electrician

END OF SECTION 26 24 16



## SECTION 26 27 13 - ELECTRICITY METERING

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Square D Metering Devices
- B. System Description: 200 amp meter socket, ct monitoring strip

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Performance: METER SOCKET phase 600vac 10000 rms short circuit rating nema 3r
- B. Performance: CT MONITORING STRIP 42 space capacity to monitor interior branch circuits
- C. Engineering design of Justin Armstrong by Contractor.

#### 1.03 QUALITY ASSURANCE

- A. Quality Standard: UL listed

#### 1.04 WARRANTY

- A. Meter socket 5years
- B. Ct monitoring strip 15 years

#### 1.05 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

### PART 2 PRODUCTS

#### 2.01 PRODUCTS

- A. Individual Meter Socket with ring (single phase 600 vac 200 amp, nema 3 enclosure, 10000rms short circuit rating, bonded neutral)
- B. Bcpm ct monitoring strip (42 space)



C. Controls and Safeties: All installers have been properly trained on electrical safety and will be supervised by a qualified electrician. Wiring will be ohm tested before energized. Box will be locked and secured by a qualified electrician after energizing.

## 2.02 SOURCE QUALITY CONTROL

A. Testing: UL tested, listed, and labeled

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Installation Method: The center of the meter socket will be at 5'6" or higher (at eye level).

B. Wiring Method: All feeder cable will be copper and rated for 200 amps. The sheathing around the cable will be within 1/4" of the main lugs, no copper shall stick out above the main lugs. All lugs will be hand tightened until secure and then turned another quarter turn. All wires entering the enclosure shall enter through provided knockouts and secured with approved locknuts and bushings.

### 3.02 FIELD QUALITY CONTROL

A. Testing: By qualified electrician with a category three or higher field suitable meter

B. Test Procedure: Ohm meter testing before and meter testing after energizing by qualified electrician

END OF SECTION 26 27 13



## SECTION 26 27 26 – WIRING DEVICES

### PART 1 GENERAL

#### 1.02 SUMMARY

- A. Section Includes: Receptacles
- B. System Description: Three and four wire straight blade receptacles

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Performance: 15-50amp listed devices
- B. Engineering design of Justin Armstrong by Contractor.

#### 1.02 QUALITY ASSURANCE

- A. Quality Standard: UL listed

#### 1.02 WARRANTY

- A. 5 year limited warranty (Cooper)

#### 1.02 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

### PART 2 PRODUCTS

#### 2.02 PRODUCTS

- A. 30 amp 4 prong dryer plug (1)
- B. 50 amp 4 prong range plug (2)
- C. 20 amp tamper resistant gfci receptacle (10)
- D. 20 amp tamper resistant/weather resistant gfci (8)





- E. 20 amp single use receptacle (2)
- F. 15 amp tamper resistant decora receptacles (20)
- G. 15 amp tamper resistant smart receptacles for Home Automation System (z wave) (10)
- H. Controls and Safeties: All installers have been properly trained on electrical safety and will be supervised by a qualified electrician. Loto will be employed when work is done on any branch circuits or equipment if the panelboard is energized. All cable will be meter tested before installing receptacles.

## 2.02 2.02 SOURCE QUALITY CONTROL

- A. Testing: UL tested, listed, and labeled

## PART 3 EXECUTION

### 3.02 INSTALLATION

- A. Installation Method: All receptacles will be installed in accordance with ADA height requirements.
- B. Wiring Method: All wire will be twisted clockwise and installed under the receptacle screw terminal

### 3.02 FIELD QUALITY CONTROL

- A. Testing: By qualified electrician with a category three or higher field suitable meter
- B. Test Procedure: Ohm meter testing before and meter testing after energizing by qualified electrician

END OF SECTION 26 27 26



## SECTION 26 28 00 - LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Circuit breakers
- B. System Description: Overcurrent protection for Shade house.

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Performance: 15-60 amp uniform load and 10000 instant trip concentrated load.
- B. Engineering design of Justin Armstrong by Contractor.

#### 1.03 QUALITY ASSURANCE

- A. Quality Standard: UL listed
- B. Square D homeline circuit breakers

### PART 2 PRODUCTS

#### 2.01 WARRANTY

- A. Square D warrants its single phase load centers, in a residential application, to be free from defects in material and workmanship under normal care and proper usage for a period of 10 years from the date of installation for HOMELINE load centers; and lifetime for QO load centers, when used with the appropriate Square D HOMELINE or QO branch circuit breakers. See attached residential warranty for QO and HOM circuit breakers for more information. For an application other than residential, the standards Terms and Conditions of Sale apply

#### 2.02 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

#### 2.03 MATERIALS

- A. Unused circuit breakers



## 2.04 COMPONENTS

- A. 20 amp single pole homeline circuit (8)
- B. 20 amp combination style arc fault breakers (10)
- C. 50 amp 240 volt circuit breaker (2)
- D. 30 amp 240 volt circuit breaker (1)
- E. 60 amp 240 volt circuit breaker (3)
- F. Operators: electrical safety trained personnel
- G. Controls and Safeties: all installers have been properly trained on electrical safety and will be supervised by a qualified electrician. Loto will be employed when work is done on any branch circuits or equipment.

## PART 3 EXECUTION

### 1.01 SOURCE QUALITY CONTROL

- A. Testing: UL tested, listed, and labeled

### 3.02 INSTALLATION

- A. Installation Method: snap in
- B. Wiring Method: all circuit breakers will be single lugged using copper wire listed and rated for the amperage provided by each circuit breaker. The wires will be installed in a workmanlike manner

### 3.03 FIELD QUALITY CONTROL

- A. Testing: By qualified electrician with a category three or higher field suitable meter
- B. Test Procedure: ohm meter testing before and meter testing after energizing by qualified electrician

END OF SECTION 26 28 00



## SECTION 26 29 13 – ENCLOSED CONTROLLERS

### PART 1 GENERAL

#### 1. SECTION REQUIREMENTS

- a. Submittals: Product Data.

#### 1.2 WARRANTY

- A. Schneider Electric USA inc warrants equipment manufactured by it and sold through authorized sales channels to be free from defects in materials and workmanship for eighteen months from date of service.

### PART 2 PRODUCTS

#### 1. PERFORMANCE REQUIREMENTS

- a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2. CONTROLLERS AND ACCESSORIES

- a. Schneider Load Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- b. Energy monitoring and control for 120Vac or 120/240Vac 60A or less load using a 1 or 2 pole, 15 to 60A, QOPLILC circuit breaker
- c. Enclosures: NEMA 3R Housing, non-metallic, surface mounting enclosure, installable in any location where a branch circuit breaker or disconnect switch is normally used.
- d. UL 489 Canadian Standard FCC, Class B, part 15 Radio Emissions IEC 61000-4 Electromagnetic Compatibility

### PART 3 EXECUTION

#### 1. INSTALLATION

- a. Comply with all applicable sections of NEC and IBC for installation of Schneider Load controller.
- b. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible in accordance with Section 26 05 00 - Common Work Results for Electrical.



- c. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

END OF SECTION 26 29 13



## SECTION 26 31 00 - PHOTOVOLTAIC COLLECTORS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Photovoltaic (PV) collector panels
- B. Related Sections: Division 13 30 00 "Section Special Structures" for PV racking system

#### 1.02 QUALITY ASSURANCE

- A. Quality Standard: Per manufacturer
- B. Products: UL listed

#### 1.03 WARRANTY

- A. Warranty Period: 25 year performance, 10 year product

#### 1.04 SOURCE QUALITY CONTROL

- A. Testing: By Manufacturer

#### 1.05 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, and mounting details.
- B. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Include diagrams for power, signal, and control wiring.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Product: Sunmodule SW 265 mono black; Version 2.5 frame (39.41in x 65.94in x 1.22in)
  - 1. Acceptable Manufacturer: SolarWorld; 4650 Adohr Lane, Camarillo, CA 93012; Phone: 855-467-6527; Website: [www.solarworld-usa.com](http://www.solarworld-usa.com)



2. Substitutions: Not permitted

2.02 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 PERFORMANCE

- A. Fire Rating: Class C
- B. Operating Temperature: -40°C to 85°C
- C. Weight: 46.7 lbs (21.2 kg)
- D. Electrical Characteristics:
  - 1. Module efficiency: 15.81%
  - 2. Maximum power: 265 Wp
  - 3. Short circuit current: 8.82A
  - 4. Maximum power point voltage: 31.9V
  - 5. Maximum power point current: 8.33A
  - 6. Open circuit voltage: 38.1V

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's requirements
- B. Installation Method: Mount on racking system
- C. Wiring Method: Install cables in raceways when applicable. Conceal cables except in accessible indoor spaces where possible.
- D. Comply with NECA 1 and NEC



3.02 FIELD QUALITY CONTROL

- A. Special Inspections: A qualified special inspector to perform inspections.

END OF SECTION 26 31 00





## SECTION 26 51 00 - INTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SUMMARY

A. Section includes: Interior light fixtures, including lamps, of the following types:

1. Interior Surface Mount Fixtures
  - a. Flush Mount
  - b. Cove Lighting
  - c. Pendant Fixtures
  - d. Chandelier Fixture

#### B. Related Sections

1. Section 26 09 23 – Lighting control devices.
2. Section 26 18 00 – Medium-voltage circuit protection devices
3. Section 26 27 26 – Wiring devices.
4. Section 26 56 00 – Exterior lighting.

#### 1.02 REFERENCES

- A. National Fire Protection Association (NFPA): NFPA 70, National Electrical Code.
- B. Underwriters Laboratories (UL): UL 1598 - Luminaires.
- C. Canadian Underwriters Laboratories (cUL): cUL 1598 - Luminaires

#### 1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. NFPA 70 - National Electrical Code.
2. Underwriters' Laboratories labeling.
3. Canadian Underwriters' Laboratories labeling.

B. Fixture Schedule: Manufacturer's standard fixture schedule, coordinated with project requirements and the fixture schedule on the Drawings.

C. Verification Samples: Full size unit of each fixture type, including lamps, ballasts and supports.

D. Operation and Maintenance Data: For each fixture and component, including lamps.

#### 1.04 QUALITY ASSURANCE

A. Compliance: Provide fixtures that comply with the following and additional local regulations.



1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging, out of extreme heat or direct sunlight, until ready for installation.

#### 1.06 PROJECT CONDITIONS

- A. Coordinate locations of lighting fixtures with ceilings, ceiling mounted components, fire protection and mechanical components, and partitions.
- B. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

### PART 2- PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Lithonia Lighting, which is located at: PO Box A, Conyers, GA 30012; Tel: 800-858-7763; Web: [www.lithonia.com](http://www.lithonia.com)
- B. Acceptable Manufacturer: Cooper Lighting, which is located at: 600 Travis Street, Suite 5600, Houston, Texas 77002-1001; Tel: 713-209-8400; Web: [www.cooperindustries.com](http://www.cooperindustries.com)
- C. Acceptable Manufacturer: Ferguson, which is located at: 1 Coates Drive, Goshen, New York 10924; Tel: 800-638-8875; E-mail: [info@shop.ferguson.com](mailto:info@shop.ferguson.com); Web: [shop.ferguson.com](http://shop.ferguson.com)
- D. Acceptable Manufacturer: Tech Lighting, which is located at: 7400 Linder Avenue, Skokie, IL 60077; Tel: 847-410-4400; E-mail: [cswest@techlighting.com](mailto:cswest@techlighting.com); Web: [www.techlighting.com](http://www.techlighting.com)
- E. Acceptable Manufacturer: Design Within Reach, which is located at: 711 Canal St., 3rd floor, Stamford, CT 06902; Tel: 800-944-2233; Web: [www.dwr.com](http://www.dwr.com)
- F. Substitutions: Allowed with verification from architect.

#### 2.02 INTERIOR RECESSED FIXTURES

- A. Flush Mount
  1. **Product:** Lithonia Lighting Versi Lite 7 in. White LED Mini Flush Mount as manufactured by Lithonia Lighting.
    - a. **Description:** Flush ceiling mount. All fixtures are 7.31 inches deep/wide and 1.75 inches high.
    - b. **Fixture Finish:** Matte White (Standard).
    - c. **Fixture/track material:** Cast aluminum with acrylic diffuser.
    - d. **Product weight:** 1 lb.
    - e. **Power:** 15 W. Refer to Fixture Schedule.
    - f. **Certifications:** CSA Listed.
    - g. **Light source:** LED
    - h. **Trim included**
      - 1) **Size:** 5 inches model:



- 2) Model LK5BPMW LED M4: (1) 15W LED lamp.

## 2.03 INTERIOR SURFACE MOUNT FIXTURES

### A. Cove Lighting

1. Product: LC32 - Light Level 1 as manufactured by Cooper Lighting.
  - a. Description: Surface mount within small niches, architectural coves, and valences. Sheet metal tabs on each side of the luminaire provide two structural mounting locations. Fixture is 2.43inches (62mm) in height and 2.74in (70mm) in width.
  - b. Finish: Aluminum
  - c. Power: 8.9 W. Refer to Fixture Schedule.
  - d. Integral Dimmable Driver
  - e. Light source: LED
  - f. Mounting: Must be Specified.
    - 1) Model LC32 – Light Level: (1) 8.9W LED lamp.

### B. Pendant Fixtures

1. Product: Tech Lighting Piper Pendant Track Light as manufactured by Ferguson.
  - a. Description: Chrome LED pendant light. The fixture is 2.5 inches in width and 10 inches in height.
  - b. Finish: Chrome
  - c. Product weight: 3 lb.
  - d. Power: 6W / 12V. Refer to Fixture Schedule.
  - e. Wire length: 12"
  - f. Light source: LED
  - g. Mounting: Must be specified.
    - 1) Size: 2.5 inches length, 2.5 inches width, 10 inches height:
    - 2) Model TL700MOPPRCCLED: (1) 6W LED lamp.
2. Product: Pod Head as manufactured by Tech Lighting.
  - a. Description: Modern head surrounded by a translucent glass orb. Head rotates 360°, pivots 260° to direct the beam. LED MR16 lamp of up to 50 watts (not included).
  - b. Finish: Clear
  - c. Product weight: 0.56lb
  - d. Mounting: Must be specified with FJ - Freejack
    - 1) Size: 2.5 inches (63 mm) length models.

### C. Chandelier Fixture

1. Product: Nelson Saucer Pendant Lamp for surface mounted installation as manufactured by Design Within Reach.
  - a. Description: Surface mounted chandelier down light. Fixture is 36 inches in width.
  - b. Finish: Plastic polymer; steel frame.
  - c. Refer to Fixture Schedule.
  - d. Light source: LED Bulb



- e. Power: 150 W / 120 V max
- f. Mounting: Must be specified.
  - 1) Size: 36 inches in diameter
  - 2) Model 0316: (1)

### PART 3 - EXECUTION

#### 3.01 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.

#### 3.02 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.

#### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions including the following:
  - 1. Install fixtures in proper relationship with adjacent construction and ceiling grid and components.
  - 2. Install fixtures with clearances recommended by manufacturer.
  - 3. Install lamps and test for proper operation.

#### 3.04 PROTECTION

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

END OF SECTION 26 51 00



## SECTION 26 56 00 – EXTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SUMMARY

- a. Section Includes: FX Luminare LED Landscape Lighting.

#### 1.02 RELATED SECTIONS

- A. Section 06 40 13 – Architectural Woodwork
- B. Section 07 00 00 – Thermal and Moisture Protection
- C. Section 25 00 00 – Integrated Automation
- D. Section 26 05 83 – Wiring Connections
- E. Section 26 09 23 – Lighting Control Devices
- F. Section 26 22 00 – Low Voltage Transformers
- G. Section 26 27 26 – Wiring Devices
- H. Section 32 94 33 - Planters

#### 1.03 PREINSTALLATION MEETINGS

- a. Pre-Installation Conference: Conduct conference at Project site in Irvine, California.

### PART 2 PRODUCTS



## 2.01 MANUFACTURERS

- a. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
  - 1) FX Luminare; FB Frère Béb .
- b. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- c. Basis-of-Design Product: Subject to compliance with requirements, provide [Drawing: L-501][reference key note (1) for Light Fixture, and reference key note (2) for transformer] FX Luminare; FB Fr re B b  or a comparable product by one of the following:
  - 1) FX Luminare LED Landscape Lighting.
  - 2) Product Data:
    - a) Number of LEDs: 1
    - b) Halogen Lumen Output Equivalent: 10 Watt
    - c) Useful LED Life (170): 50,000 Hours of Average.
    - d) Input Voltage: 15V
    - e) VA Total: 2.4
    - f) Watts Used: 2.0
    - g) Max Lumens: 60
    - h) Fixture Diameter: 2.0"
    - i) Fixture Height: 7.5"
    - j) Finishes: Flat Black Finish

## 2.02 MOTORS

- b. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in [Division 11 Section "Common Motor Requirements for Equipment."]
  - 3) Electrical Characteristics:
    - a) Watts: [150] [300]: 150

## 2.03 ACCESSORIES

- c. Super Slot Spiker: 2"x10"
- d. LED Filters: Color Filters



## PART 3 EXECUTION

### 3.01 EXAMINATION

- a. Examine FX Luminare; FB Frère Béb  before installation. Reject FX Luminare; FB Frère B b  that are wet, moisture damaged, or mold damaged.

### 3.02 INSTALLATION

- d. Refer to Drawing sheet L-501 for installation details for fixtures and transformer.
- b. Wiring Method: Install cables in Planters and cable lines.
  - 1) There will be 160 ft of low voltage electrical wiring, and

END OF SECTION 26 56 00



## Division 27 – Communications

### SECTION 27 00 00 - DATA COMMUNICATIONS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- a. Section includes: Linksys Wi-Fi Router.

##### 1.02 ACTION SUBMITTALS

- b. Product Data: For each type of product.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Linksys; Tel: 877-959-7467; Web: <https://www.linksys.com/en-us/home>

##### 2.02 SHORT THROW OVERHEAD PROJECTOR

- A. Linksys N900 SMART Wi-Fi Wireless Router
- B. Product Number: EA4500
- C. Speed: Up to 450 Mbps
- D. Bands: Simultaneous 2.4 GHz and 5 GHz
- E. Package Dimensions: 12 " W x 9.25" H x 2.88" D
- F. [http://store.linksys.com/Routers/Linksys-EA4500-Dual-Band-N900-Router-with-Gigabit-USB\\_stcVVproductId145330245VVcatId551966VVviewprod.htm](http://store.linksys.com/Routers/Linksys-EA4500-Dual-Band-N900-Router-with-Gigabit-USB_stcVVproductId145330245VVcatId551966VVviewprod.htm)

##### 3.01 INSTALLATION

- A. Per manufacturer's instructions

END OF SECTION 27 00 00





## Division 28 – Electronic Safety and Security

### SECTION 28 31 46 – SMOKE DETECTION SENSORS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes: Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm.

##### 1.02 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at ASU.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring
- C. Samples: For each exposed product and for each color and texture specified.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected Ceiling Plan, drawn to scale, and coordinated with each other, using input from installers of the items involved.

##### 1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Operation and maintenance data.

##### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.



## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

1. Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm .

### 2.02 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor is 1.5.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm before installation. Reject Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm that are wet, moisture damaged, or mold damaged.

### 3.02 INSTALLATION

A. Per National Fire Protection Association (NFPA) standards: Comply with NFPA for installation of Kidde Dual Sensor, 120V AC with Battery Backup Smoke Alarm.

B. Comply with NECA 1.

1. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - a. Install plenum cable in environmental air spaces, including plenum ceilings.



- b. Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."
- c. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes for Electrical Systems."

- 2. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- 3. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.03 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 28 31 46



## Division 31 - Earthwork

### SECTION 31 66 00 – SPECIAL FOUNDATIONS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Seismic and Adjustable Piers

##### 1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used including:
  - 1. Preparation instruction and recommendations
  - 2. Storage and handling requirements and recommendations
  - 3. Installation methods
- B. Shop Drawings: Submit shop drawings detailing installation methods. Coordinate placement with locations noted on the contract drawings

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following
  - 1. Central Piers; Seismic Pier
  - 2. Central Piers; Standard Pier
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Central Piers; 284 North Thorne Ave, Fresno, CA 93706; Phone: 800-653-0387; Website: [centralpiers.com](http://centralpiers.com)

##### 2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: seismic pier shall withstand the effects of earthquake motions determined according to ASCE 7.



## 2.03 MATERIALS

### A. Structural Steel:

1. Shall conform to ASTM A36  $F_y=36$  KSI minimum
2. Shall be fabricated according to AISC Specifications
3. Shall be welded according to AWS specifications:
  - a. Electrodes: E70
  - b. Plates: ASTM A36
  - c. Bolts: Standard ASTM A307
  - d. Threaded Rod: Cold drawn low carbon weldable
4. All metal Components including nails and screw are to be protective coated

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared
- B. Verify all elevations

### 3.02 PREPARATION

- A. Footings are to be supported by either firm, unsaturated, undisturbed soil or compacted fill, asphalt or concrete footings are designed for 1000 psf bearing capacity and shall be compatible with local soil conditions. All footings shall be founded in accordance with HCD guidelines and title 25 or prepare sub-grade per soil report, when available.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturers' instruction

END OF SECTION 31 66 00



## Division 32 – Exterior Improvements

### SECTION 32 00 00 – EXTERIOR IMPROVEMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wood and Concrete Planter Benches.
- B. RELATED SECTIONS
  - 1. Section 32 91 16.19 - Netting Planting Soil Stabilization
  - 2. Section 32 93 00 - Plants

##### 1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Selection Samples: Color selections shall be made from the manufacturer's brochure representing manufacturer's full range of available colors and patterns.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- D. Manufacturer's warranties.

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until conditions are ready for installation.

##### 1.04 COORDINATION

- A. Coordinate Work with other operations and installation of benches to avoid damage to installed materials.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Kornegay Design., which is located at: 212 South 18th Street, Phoenix, Arizona 85034; Toll Free Tel: 877-252-6323; Tel:602-252-6323; Web: [www.kornegaydesign.com](http://www.kornegaydesign.com)
- B. Substitutions: Allowed with verification from architect.

##### 2.02 BENCHES

- A. Wood and Concrete Planter Benches.
  - 1. Custom planter bench.
    - a. Height: 15 inches (381 mm).



- b. Width: 20 inches (508 mm).
- c. Length: 60 inches (1524 mm).
- d. Concrete thickness of planter mold at top: 2 inches (50.8 mm)
- e. Concrete thickness of planter mold at bottom: 4 inches (101.6 mm)
- f. Seat: Wood material (2x4), 40 inches in width that sits on top of concrete planter mold.
- g. Plants will sit in concrete planter mold.
- h. Colors: As selected by the Architect from manufacturer, Davis Colors standard concrete mix:  
Sandstone 5237

### PART 3 EXECUTION

#### 3.01 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.

#### 3.02 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.

#### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Surface mounting. Location and drilling of holes for inserts included. Anchor bolts and inserts provided by others.

#### 3.04 PROTECTION

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

END OF SECTION 32 00 00



## SECTION 32 14 13 – PRECAST CONCRETE UNIT PAVING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes: Fiber reinforced concrete pavers.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. 36"x18"x2" Fiber reinforced concrete paver
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Kornegay Design Inc.

#### 2.02 - MATERIALS

- A. Concrete
  - 1. Portland Cement: Type 1 portland cement Grey
  - 2. Sand: Silica Sand
  - 3. Glass Fibers: Alkali resistant fiber specifically produced for glass fiber reinforcing
  - 4. Water: potable, free from foreign materials in amounts harmful to concrete
  - 5. Polymer admixture: Utilize standard mix designs incorporating admixtures which facilitate the workability, curing strength of the mix.
- B. Characteristics
  - 1. Imprinted eucalyptus leaf fossil pattern

### PART 3 – EXECUTION

- A. Install as per manufacturer's instructions

END OF SECTION 32 14 13





## SECTION 32 35 00 – SCREENING DEVICES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Cable trellis assembly.

#### 1.01 RELATED SECTIONS

- A. Section 05 75 00 - Architectural Metalwork
- B. Section 06 10 00 - Rough Carpentry
- C. Section 32 93 00 - Plants

#### 1.01 REFERENCES

- A. American Iron and Steel Institute (AISI) - Steel Product Manual; Stainless and Heat Resisting Steel.
- B. ASTM International (ASTM):
  - 1. ASTM A 276 - Stainless and Heat-Resisting Steel Bars and Shapes.
  - 2. ASTM A 380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.
  - 3. ASTM A 492 - Specification for Stainless Steel Rope Wire.
  - 4. ASTM A 555 - Stainless Steel Wire.
  - 5. ASTM A 582 - Specification for Free-Machining Stainless and Heat-Resisting Steel Bars.
  - 6. ASTM B 912 - Specification for Passivation of Stainless Steels Using Electropolishing.
  - 7. ASTM F 1145 - Specification for Turnbuckles, Swaged, Welded, Forged.
- C. MIL-C-5688 - Pre-Stretching and Proof-Testing of Wire Rope Assemblies.

#### 1.01 DESIGN / PERFORMANCE REQUIREMENTS

- A. Structural Requirements: Provide stainless steel trellis systems capable of withstanding the effects of gravity and applied loads and stresses within limits and under conditions indicated on the Drawings:
  - 1. Components: Design and size to withstand dead and live loads of components, plants, rain, snow and ice and loads caused by positive and negative wind pressure acting normal to plane of trellis as calculated in accordance with applicable code.
- B. Trellis systems shall accommodate expansion and contraction of metal components without causing undue stress, buckling, opening of joints, and distortion.
- C. Supports and hardware shall withstand loads encountered without excessive deflection or distortion when cables are tensioned to required amounts required to conform to applicable building codes.

#### 1.01 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards. Provide list of fittings being provided with descriptions, load capabilities, and either photographs or drawings for each type. Manufacturer's data sheets on each product



to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

#### 1.01 QUALITY ASSURANCE

##### A. Manufacturer Qualifications:

1. Company specializing in manufacturer of stainless steel wire rope, fittings, and other stainless steel components with 10 years minimum successful experience.

##### B. Installer Qualifications: Experienced in performing work of this section that has specialized in installation of work similar to that required for this project.

##### C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Locate in areas designated by Architect.
2. Size: Minimum of 10 square feet (1 sm).
3. Do not proceed with remaining work until workmanship is approved by Architect.
4. Rework mock-up as required to produce acceptable work.
5. Retain mock-up during construction as quality standard.
6. Remove and legally dispose of mock-up when no longer needed.
7. Incorporate mock-up into final construction.

#### 1.01 DELIVERY, STORAGE, AND HANDLING

##### A. Store products in manufacturer's unopened packaging until ready for installation.

##### B. Handle and store products according to manufacturer's recommendations. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

##### C. Exercise care not to scratch, mark, dent, or bend metal components during delivery, storage, and installation.

#### 1.01 PROJECT CONDITIONS

##### A. Verify actual openings by field measurements before fabrication; show recorded measurements on shop drawings.

##### B. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

##### A. Acceptable Manufacturer: Seco South Railing & Cable Assemblies, which is located at: 2111 34th Way ; Largo, FL 33771; Tel: 727-536-1924; Email: request info (sales@secosouth.com); Web: www.secosouth.com

##### B. Acceptable Manufacturer: Jakob Inc., which is located at 955 NW 17<sup>th</sup> Ave., Suite B, Delray Beach, FL 33445;



Toll Free Tel: 1-866-215-1421; Email: [info@jakob-usa.com](mailto:info@jakob-usa.com); Web: <http://www.jakob-usa.com/>

- C. Substitutions: Allowed with verification by Architect that substituted product meets project requirements.

## 2.01 CABLE TRELIS SYSTEM

- A. Provide stainless steel climbing plant trellis structures and mounting as indicated on the Drawings. Manufacturer/Contractor shall engineer and fabricate components and assemblies for installation.

- B. Trellis Systems:

Product: System 2000-65 (Heavy Duty Trellis) as manufactured by Seco South Inc.

1. System: Rectangular grid of cables supported by wall mounted stand-offs and secured by cross clamps to support vegetation screening.
2. Cable: 3/16 inch (4.8 mm) diameter with swage studs at each end of the cable.
  - a. Stainless Steel Wire: ASTM A 492 Type 316.
3. Swage Stud: Model 553 Short Swage Stud Terminal - Model 553-3/16-5/16.
4. Wall Mounted Stand Off: 5 inch (127 mm) length off the wall.
  - a. Cable Size 3/16 inch (4.8 mm).
5. Cable Cross Clamp: Fixes the 90 degree intersection of cables to be fixed by locking the cables in the barrel of the clamp with a threaded set screw.
  - a. Cable Size 3/16 inch (4.8 mm).
6. Product: G1.3 Famoos as manufactured by Jakob, Inc.
  - a. System: Rectangular grid of cables supported by wall mounted stand-offs and secured by cross clamps to support vegetation screening.

## 2.01 FINISH

- A. After fabrication, clean and de-scale stainless steel wire rope, fittings, and other components in accordance with ASTM A 380.
- B. Finish components with AISI No. 4 brushed satin finish in accordance with ASTM B 912.

## 2.01 FABRICATION

- A. Tolerances: Verify dimensions on site prior to shop fabrication.
- B. Fabricate stainless steel in accordance with AISI Steel Product Manual and the manufacturer's requirements.
- C. Shop fabricate to designs indicated on Drawings and to meet performance requirements specified. Shop fabricate fittings, interfacing parts and assemblies so that field cutting adjustments are not necessary.
- D. Coordinate requirements, dimensions and spacings of trellis system to ensure required factory drilled holes in supporting framework are correctly located.
- E. Make exposed joints butt, flush, and hairline.



- F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Before beginning installation, verify that conditions installed under other sections are acceptable for installation of cable trellis systems in accordance with manufacturer's installation instructions.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.
- C. Verify supporting system for stainless steel wire rope trellis is prepared for attachment of anchors, fittings, wire rope, and wire netting and transfer of calculated loads.
- D. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.01 PREPARATION

- A. Verify alignment, support dimensions, and tolerances are correct.
- B. Inventory components to ensure all required items are available for installation. Inspect components for damage. Remove damaged components from site and replace.

#### 3.01 INSTALLATION

- A. Install wire rope trellis system in accordance with manufacturer's instructions and the approved shop drawings.
- B. Provide anchorage devices and fittings to secure to in-place construction; including threaded fittings for concrete inserts, toggle bolts and through-bolts.
- C. Install infill plumb, level, square, and rigid without kinks or sags.
- D. Anchor trellis system to mounting surfaces as indicated on the Drawings.
- E. Separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.
- F. Use manufacturer's supplied cable hardware.
- G. Ensure cables are clean, parallel to each other, and without kinks or sags.
- H. Tension cable with hand or hydraulic equipment so that no slack is visible.
- I. After final adjustment provide tamper resistant lock tight materials on all fittings.

#### 3.01 ADJUSTING AND CLEANING

- A. Adjust wire rope tension and connecting hardware.



- B. Remove temporary coverings and protection of adjacent work areas. Clean installed products in accordance with manufacturer's instructions before owner's acceptance.
- C. Do not use abrasive cleaners.
- D. Remove from project site and legally dispose of construction debris associated with this work.

### 3.01 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Protect installed products and finished surfaces from damage during construction.
- D. Replace defective or damaged components as directed by Architect.

END OF SECTION 32 35 00



## SECTION 32 91 16.19 - NETTING PLANTING SOIL STABILIZATION

### PART 1 GENERAL

#### 1. SUMMARY

- a. Section includes Netting Plant Soil Stabilization.
  - 1) Netting plant soil stabilization is for containing mulch in exterior planting modules.
- b. Related Requirements:
  - 1) Division 32 94 33 Planter Modules.

### PART 2 PRODUCTS

#### 1. MANUFACTURERS

- a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to:
  - 1) Coolaroo; 6 ft. x 15 ft. Shade Cloth Heritage Green (90% UV Block).

#### 2. MATERIALS

- a. 6' x 15' single roll at 0.03125 inches thick.
- b. Breathable cloth with knitted construction to prevent fraying and tearing.

### PART 3 EXECUTION

#### 1. EXAMINATION

- a. Examine Coolaroo shade cloth before installation. Reject Coolaroo Shade Cloth that is moisture damaged, mold damaged, or torn.

#### 2. INSTALLATION

- a. Coolaroo shade cloth will be cut to appropriate size according to individual planter module. Holes will then be cut in the shade cloth according to plant location and diameter within the planting module. Shade cloth must then be stapled on to the 2" x 4" framed module on the interior face and bottom edge of the 2" x 4" while providing enough grab for mulch.



3. PROTECTION

- a. When installing Coolaroo shade cloth, wear personal protective equipment (PPE) as referred to in the Health and Safety Manual.

END OF SECTION 32 91 16.19



## SECTION 32 93 00 – PLANTS

### PART 1 GENERAL

#### 1. SUMMARY

- a. Section includes plant material used within the landscape.
- b. Related Requirements:
  - 1) Division 32 94 33 Section "Planters" for enclosing the plant material around the house.

#### 2. ACTION SUBMITTALS

- a. Delegated-Design Submittal: For plant material design and placement refer to sheet L-101.

#### 3. INFORMATIONAL SUBMITTALS

- a. Coordination Drawings: Sheets L-101, L-104, L-502, L-503 and L-601 explain all of the different plant material scenarios and locations, drawn to scale, and coordinated with each other, using input from installers of the items involved.

#### 4. CLOSEOUT SUBMITTALS

- a. Maintenance data.
  - 1) The plant material will require to be watered once a week with a total of 50 gallons of water sourced from the water hogs on site using a generic hose. The plants will be supplemented with nutrients from the mulch that is on top of the planters and will thus not need any other sort of maintenance other than water.

### PART 2 PRODUCTS

#### 1. MANUFACTURERS

- a. Products: Subject to compliance with requirements, California Department of Food and Agriculture (CDFA) Sections 3271, 3250, 3280, 3282 and Federal Regulations Subparts 301.45, 301.50, 301.80, 301.81, 301.85.
  - 1) V&P Nurseries; Plant Material.
  - 2) Mountain States Wholesale Nursery; Plant Material.





- b. **Manufacturers:** Subject to compliance with requirements, V&P Nursery is responsible for compliance with Federal and CDFA Law for transporting plants into California and using proper soil mixtures and plant material that will be in compliance with both Federal and State Regulations.

### PART 3 EXECUTION

#### 1. EXAMINATION

- a. Examine Plant Material before installation. Reject Plants that are not in compliance with CDFA Regulations, dead, have root rot, or weevil damaged.

#### 2. INSTALLATION

- a. The Plant Materials will be delivered on an enclosed trunk provided and driven by V&P Nurseries with all the soil and plants in their respective pots already cleared by the CDFA at the California Arizona border. The plants will be removed from the truck by nursery employees and will then be placed in their appropriate spaces on site by SD Decathletes. Some potted plants will have to stand on 2x4 generic crates that will have been set up before plant installation. The final step will be to enclose the potted plants with the modular planter encasements that will visually tie all of the plants together and make them seamless in appearance.

#### 3. SCHEDULE

PLANT SCHEDULE					
MARK	SCIENTIFIC NAME	COMMON NAME	TYPE	QUANTITY	POT SIZE
1	PACHYCEREUS MARGINATUS	MEXICAN FENCE POST	CACTUS	3	5 GAL
2	PEDILANTHUS MACROCARPUS	LADY'S SLIPPER	SUCCULENT	6	5 GAL
3	PORTULACARIA AFRA	ELEPHANT'S FOOD	SUCCULENT	6	5 GAL
4	MUHLENBERGIA CAPILLARIS	PINK MUHLY	GRASS	6	5 GAL
5	CARNEGIA GIGANTEA	SAGUARO	CACTUS	1	5 GAL
6	ECHINOCACTUS GRUSSONII	GOLDEN BARREL	CACTUS	5	3 GAL



7	AGAVE GEMINIFLORA	TWIN-FLOWERED AGAVE	AGAVE	3	5 GAL
8	AGAVE PARRYI	PARRY'S AGAVE	AGAVE	2	5 GAL
9	ALOE X 'BLUE ELF'	BLUE ELF ALOE	SUCCULENT	7	5 GAL
10	SETCREASEA PALLIDA	PURPLE HEART	PERENNIAL	7	1 GAL
11	PEDILANTHUS BRACTEATUS	SLIPPER PLANT	SUCCULENT	6	5 GAL
12	ENCELIA FARINOSA	BRITTLEBUSH	SHRUB	6	5 GAL
13	BOUGAINVILLEA SPECTABILIS	BOUGAINVILLEA	VINE	9	15 GAL
14	LARREA TRIDENTATA	CREOSOTE BUSH	SHRUB	6	5 GAL
15	MUHLENBERGIA RIGENS	DEER GRASS	GRASS	8	15 GAL
16	TECOMA SPARKLETTE	SPARKLETTE	SHRUB	4	15 GAL
17	TECOMA STANS 'GOLD STAR'	ARIZONA YELLOW BELLS	SHRUB	6	15 GAL
18	TECOMA X 'SPARKY'	SPARKY	SHRUB	6	15 GAL
19	HESPERALOE FUNIFERA	GIANT HESPERALOE	SUCCULENT	6	15 GAL
20	PENSTEMON BACCHARIFOLIUS	ROCK PENSTEMON	PERENNIAL	4	5 GAL
21	JUSTICIA SPICIGERA	MEXICAN HONEYSUCKLE	SHRUB	6	5 GAL
22	HYMENOXYIS ACAULIS	ANGELITA DAISY	SHRUB	12	1 GAL
23	CALLIANDARA CALIFORNICA	BAJA FAIRY DUSTER	SHRUB	10	5 GAL
24	PROSOPIS X 'RIO SALADO'	RIO SALADO MESQUITE	TREE	1	36" BOX



25	SIMMONDSIA CHINENSIS	JOJOBA	SHRUB	10	5 GAL
PRODUCTIVE GARDEN SCHEDULE					
MARK	SCIENTIFIC NAME	COMMON NAME	TYPE	QUANTITY	POT SIZE
26	BRASSICA OLERACEA CAPITATA	CABBAGE	VEGETABLE	3	1 GAL
27	CITRULLUS LANATUS	WATERMELON	FRUIT	3	1 GAL
28	ERUCA VESICARIA SATAVA	ARUGULA	VEGETABLE	3	1 GAL
29	DAUCUS CAROTA SATIVUS	CARROT	VEGETABLE	3	1 GAL
30	BRASSICA OLERACEA ACEPHALA	COLLARD GREENS	VEGETABLE	3	1 GAL
31	LACTUCA SATIVA	LETTUCE	VEGETABLE	3	1 GAL
32	LYCOPERSICON ESCULENTUM	TOMATO	FRUIT	3	1 GAL
33	SPINACIA OLERASEA	SPINACH	VEGETABLE	3	1 GAL

END OF SECTION 32 93 00



## SECTION 32 94 33 – PLANTERS

### PART 1 GENERAL

#### 1.01 SUMMARY

- a. Section includes Planter Panels. There are different panel types creating a screening system that houses all of the plant material on site. They are constructed out of various materials that are described in L-502 and L-503. The modules are used as an exterior skin to house the plants that lay on the tarmac. The modules do not have any horizontal load against them. The loads of the plants are carried within their respected gallon pots or boxes. Mulch fills the top of the modules creating a continuous surface throughout all the module breaks. There are two different module heights that are reflected in the details within L-502.
- b. Related Sections:
  - 1) Section 07 00 00 - Thermal and Moisture Protection.
  - 2) Section 26 56 00 – Exterior Lighting.
  - 3) Section 32 91 16.19 - Netting Planting Soil Stabilization.
  - 4) Section 32 93 00 - Plants.

#### 1.02 INFORMATIONAL SUBMITTALS

- a. Coordination Drawings: Sheets L-104, L-502 and L-503 explain the different panel types and their placement on site and joint details. Drawings are to scale and coordinated with each other, using input from installers of the items involved.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- a. Products: Planter Modules
  - 1) Solar Decathlon Decathletes; Custom Fabrication.
- b. Manufacturers: Subject to compliance with requirements



## 2.02 Planter Modules Assembly Description

- 1) The plant material will have to be placed on site in their appropriate locations before the planter panels can be assembled. The planter panels will be attached to each other on site using a 2x4 hung from joist hangers attached to the panels tying them together to create one continuous surface.

## 2.03 MATERIALS

### b. DF Stud Grade 2x2 and 2x4

- 2) Surface free of knots, solid stock of species indicated

### c. Plywood

- 1) 3/4in free of defects
- 2) Manufacturer: Generic. Architect to determine if suitable during fabrication.

### d. Simpson StrongTie – 2x4 Joist Hanger

- 1) Manufacturer: Simpson StrongTie

### e. Shade Cloth Netting

- 1) See Section 32 91 16.19 - Netting Planting Stabilization

### f. Mulch

- 1) Mulch will be a mix of compost and high clay content particulate that will hold water and provide nutrients for the plant material
- 2) Manufacturer: Generic. To be determined by architect during fabrication on site.

### g. Natural Canvas Fabric

- 1) Unbleached, Natural colored fabric to be attached to plywood panel.

### h. Adhesive Velcro

- 1) Manufacturer: 3M
- 2) Substitutions: To be approved by architect during fabrication.

### i. Screws

- 1) Distributed by Copper State or Home Depot.

### j. Plant Material



- 1) 32 94 33 Plants, The plants housed within the planter modules will all be placed according to the landscape plan on L-101.

k. Capacities and Characteristics:

- 1) The Planter panel system does not hold any horizontal loads from the plant materials and are not physically tied to any mechanical or electrical equipment to make them comply with any particular standard. They do shade certain elements on site such as the water storage tanks and the landscape lighting fixtures, but do not distribute any of their vertical loads to make the planters comply with any seismic standards. The planters are designed to carry their own weight and distribute the load of the mulch it carries through its 2x4 stud grade footings.
- 2) There will not be any physical attachment of the modules to the decking or structure of the house making them truly independent, so it will not affect structural calculations of either element. To ensure they will not move and to make them structurally stable and uniform all of the modules will be connected to their neighboring panel using a generic 2x4 wood brace, so that the mulch that lies between each module will not fall through the module breaks and visually tie the entire landscape together.

## 2.04 FABRICATION

- c. Shop Assembly: The modules will be pre-fabricated off site by Solar Decathlon decathletes from Team ASUNM using sheets L-104, L-502 and L-503 as guidelines for construction.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- a. Examine each planter module for stability and structural integrity before installation. Reject planter modules that do not display structural stability.

END OF SECTION 32 94 33



## Division 33 – Utilities

### SECTION 33 79 00 – SITE GROUNDING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes: Site grounding method.
- B. Related requirements: Reference Sheet E-602, E-603

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. To be determined (grounding rod, ground wire and ground rod clamp)

##### 2.02 ASSEMBLY DESCRIPTION

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

##### 2.03 PERFORMANCE REQUIREMENTS

- C. Delegated Design: Engage a qualified professional electrical engineer

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. Comply with requirements as per NEC

END OF SECTION 33 79 00



## Division 48 – Electrical Power Generation

### SECTION 48 19 16 - ELECTRICAL POWER GENERATION INVERTERS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Power-One Aurora Uno PVI-5000-OUTD-US.

##### 1.02 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Follow installation drawings of mechanical room (sheets M-201 and E-201), drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Certificates: For of Power-One Aurora Uno PVI-5000-OUTD-US, accessories, and components, from manufacturer.
- C. Certificate of Conformity CSA-C22.2 N.107.1-01 UL Std N.1741
- D. 10-Year Limited Warranty. See attached document for further information on warranty terms.

##### 1.03 CLOSEOUT SUBMITTALS

- A. See manufactures Installation and Operator’s Manual for information on proper maintenance.
- B. See manufactures Installation and Operator’s Manual for information on operations.

##### 1.04 WARRANTY

- A. 10-Year Limited Warranty: Manufacturer agrees to repair or replace components of Power-One Aurora Uno PVI-5000-OUTD-US inverter that fail(s) in materials or workmanship within specified warranty period.
- B. Warranty Period: 10 years from date of Substantial Completion.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Power-One Aurora Uno PVI-5000-OUTD-US inverter.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following: Power-One





- C. Basis-of-Design Product: Subject to compliance with requirements, provide Power-One; PVI-5000-OUTD-US.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Aurora Uno PVI-5000-OUTD-US shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Temperature Change: Operating ambient temperature, -13 deg F (-25 deg C) to 140 deg F (60 deg C),
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

## 2.03 MANUFACTURED UNITS

- A. Power-One Aurora Uno PVI-5000-OUTD-US: Solar photovoltaic inverter.
1. Products: Subject to compliance with requirements, provide the following:
    - a) Power-One Aurora Uno PVI-5000-OUTD-US
  2. Manufacturers: Subject to compliance with requirements, provide products by the following: Power-One

## 2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled equipment according to UL 1741, IEEE 1547, NEMA 4X, and CSA C22.2 N. 107.1-0.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Comply with all applicable sections of NEC and IBC for installation of Power-One Aurora Uno PVI-5000-OUTD-US.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible in accordance with section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL.



D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.02 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. The inverter will be connected to the DC side of the PV array and will each be connected to an AC disconnect switch.

END OF SECTION 48 19 16



END OF DOCUMENT