



RADIANT HOUSE

PROJECT MANUAL

US DEPARTMENT OF ENERGY
SOLAR DECATHLON 2013
SANTA CLARA UNIVERSITY



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SUMMARY OF CHANGES

SUMMARY OF CHANGES

OCTOBER 11, 2012

The first draft of the Project Manual was submitted.

NOVEMBER 20, 2012 REVISION

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

- Changed Logo
- Added summary of Rules Compliant checklist and linked content locations
- Removed duplicate drawings and MasterSpec references
- Added Structural Narrative
- Updated and added Structural Calculations
- Added Radiant System Narrative
- Added Quantity Takeoff
- Added or updated MasterSpec sections:
 - 05 52 00 Metal Railings
 - 06 15 33 Wood Patio Decking
 - 06 43 00 Wood Stairs and Railings
 - 07 21 29 Sprayed Insulation
 - 07 53 23 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
 - 07 62 00 Sheet Metal Flashing and Trim
 - 10 28 00 Toilet, Bath, and Laundry Accessories
 - 11 31 23 Residential Laundry Appliances
 - 22 05 10 Plumbing Valves
 - 22 41 16 Residential Lavatories and Sinks
 - 22 41 23 Residential Showers
 - 22 41 39 Residential Faucets, Supplies, and Trim
 - 22 80 08 Domestic Hot Water
 - 23 09 13 Sensors and Transmitters
 - 23 71 00 Thermal Storage
 - 23 81 16 Radiant Heating Panels
 - 23 84 16 Dehumidifier
 - 25 13 00 Integrated Automation Control & Monitoring Network
 - 26 05 19 Low-Voltage Power Connectors & Conductors
 - 26 05 26 Grounding and Bonding for Electrical Systems
 - 26 05 33 Raceway and Boxes for Electrical Systems
 - 26 09 23 Lighting Control Devices
 - 26 24 16 Panelboards
 - 26 27 26 Wiring Devices
 - 26 09 23 Lighting Control Devices
 - 26 31 00 Photovoltaic Collectors
 - 26 32 13 Engine Generators

- 26 33 13 Batteries
- 26 50 00 Lighting
- 32 93 00 Plants
- 41 22 13 Mobile Crane
- 41 23 23 Boom Lift
- 41 62 23 Fork Lifts
- 48 19 16 Electrical Power Generation Inverters

FEBRUARY 14, 2013 REVISION

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

- Moved 4-7 Lot Conditions 1 to Structural Calculations
- Updated 6-1 Structural Narrative to reference Stamped Drawing Set and Stamped Structural Calculations
- Removed 9-2 Team Provided Liquids – replaced with reference to relevant MasterSpec sections
- Removed 9-6 Thermal Mass
- Removed 9-8 Water Delivery drawing - moved to Drawing Set
- Removed 9-9 Water Removal drawing - moved to Drawing Set
- Revised and Updated Structural Calculations
- Revised Structural Narrative
- Revised Bamboo Structural Bamboo Structural Systems Narrative
- Updated Detailed Water Budget
- Revised and updated Energy Analysis Results and Discussion
- Updated Quantity Takeoff
- Added or updated MasterSpec sections:
 - 06 15 33 Wood Patio Decking
 - 06 16 00 Sheathing
 - 07 21 29 Sprayed Insulation
 - 07 42 13 Metal Wall Panels
 - 07 53 23 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
 - 08 14 16 Interior Wood Doors
 - 08 14 17 Interior Wood Pocket Doors
 - 08 14 20 Exterior Metal Doors
 - 08 33 00 Sliding Glass Doors
 - 08 52 00 Windows
 - 09 29 00 Drywall
 - 09 65 19 Tile Flooring
 - 09 69 00 Access Flooring
 - 09 74 10 Tile Wall Coverings
 - 11 31 13 Residential Kitchen Appliances
 - 11 31 23 Residential Laundry Appliances
 - 12 36 40 Stone Countertops

- 21 10 00 Water-based Fire Suppression Systems
- 21 11 00 Water-based Fire Suppression Pumps
- 22 05 00 Common Work Results for Plumbing
- 22 05 10 Plumbing Valves
- 22 05 19 Meter and Gauges for Plumbing Piping
- 22 05 23 General-Duty
- 22 07 00 Plumbing Insulation
- 22 11 13 Facility Water Distribution Piping
- 22 11 16 Domestic Water Piping
- 22 11 23 Domestic Water Pumps
- 22 12 00 Facility Potable-Water Storage Tanks
- 22 13 00 Facility Sanitary Sewage and Vent Piping
- 22 13 53 Facility Septic Tanks
- 22 41 39 Residential Faucets, Supplies, and Trim
- 23 09 13 Sensors and Transmitters
- 23 31 00 HVAC Ducts and Casings
- 23 84 17 Refrigerant
- 25 13 00 Integrated Automation Control & Monitoring Network
- 26 09 23 Lighting Control Devices
- 32 93 00 Plants
- Removed MasterSpec sections
 - 06 15 13 Wood Floor Decking
 - 06 46 00 Wood Trim
 - 08 14 73 Sliding Wood Doors
 - 09 64 29 Wood Strip & Plank Flooring
 - 22 05 23 General-Duty Valves for Plumbing Piping
 - 23 71 00 Thermal Mass

APRIL 5, 2013 REVISION

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

- Updated Rules Compliant checklist and linked content locations
- Updated the Quantity Takeoff
- Updated 9-9 to include information on access to grey water tanks for water removal and corrected misleading wording
- Updated Structural Calculations
- Updated Construction Budget
- Updated Total Project Budget
- Added or updated MasterSpec sections:
 - 00 31 00 Available Project Information
 - 05 52 00 Metal Railings
 - 06 15 33 Wood Patio Decking
 - 07 72 00 Roof Accessories

- 08 13 20 Exterior Metal Doors
- 08 13 73 Sliding Metal Doors
- 08 53 13 Windows
- 09 65 15 Primed MDF Base Moulding
- 12 32 13 Manufactured Wood-Veneer-Faced Casework
- 21 30 00 Fire Pumps
- 22 05 19 Meter and Gauged for Water-Based Piping
- 22 05 23 General-Duty Valves for Water-Based Piping
- 22 12 00 Facility Potable-Water Storage Tanks
- 22 13 53 Facility Greywater Tanks
- 23 23 23 Refrigerant
- 23 83 16 Radiant-Heating Hydronic Piping
- 23 83 33 Electric Radiant Heaters
- 25 13 10 Integrated Automation Control & Monitoring Network Cabling
- 25 13 20 Integrated Automation Control & Monitoring Network Server
- 26 32 13 Engine Generators
- 26 50 00 Lighting
- 41 20 00 Crane and Hoists
- Removed MasterSpec sections
 - 06 20 23 Interior Finish Carpentry
 - 06 43 00 Wood Stairs and Railings
 - 06 46 00 Wood Trim
 - 08 14 20 Exterior Metal Doors
 - 08 33 00 Sliding Glass Doors
 - 08 52 00 Windows
 - 11 28 13 Computers
 - 12 35 30.13 Kitchen Casework
 - 21 11 00 Water-Based Fire Suppression Pumps
 - 22 05 10 Plumbing Valves
 - 22 05 19 Meter and Gauges for Plumbing Piping
 - 22 05 23 General-Duty Valves for Plumbing Piping
 - 22 13 53 Facility Septic Tanks
 - 23 81 16 Radiant Heating Panels
 - 23 81 43 Air to Water Heat Pump
 - 23 85 17 Refrigerant
 - 41 22 13 Mobile Crane

MAY 9, 2013 REVISION

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

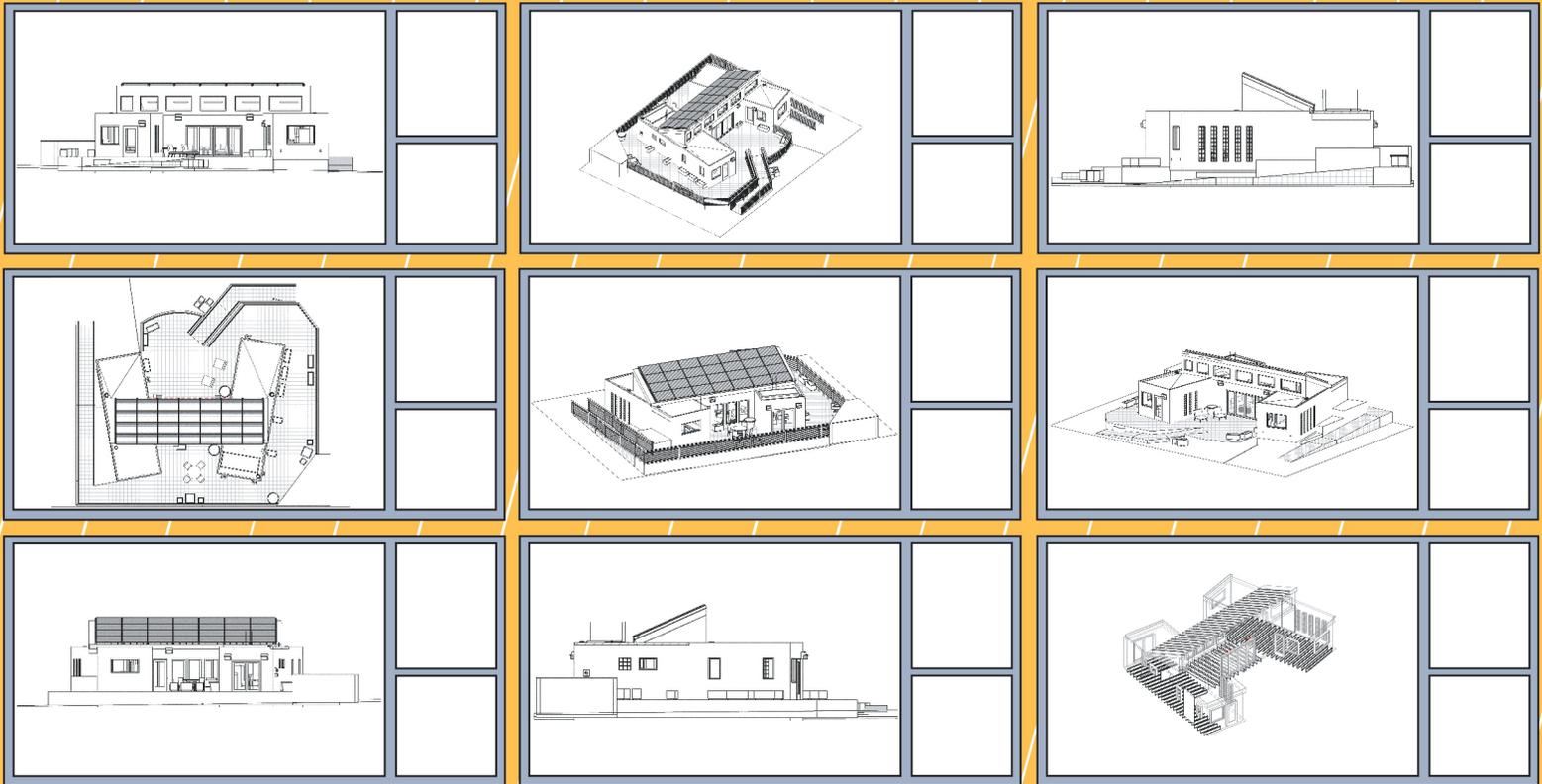
- Updated the Quantity Takeoff
- Updated MasterSpec sections
 - 26 05 33 Raceway and Boxes for Electrical Systems
 - 26 31 00 Photovoltaic Collectors

AUGUST 22, 2013 REVISION

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

- Changed the main title page design and all subsequent section title page designs
- Updated the locations in the Rules Compliance Checklist
- Updated the structural calculations page location and construction drawings page numbering in 6-1 Structural Design Approval
- Updated and added Structural Calculations including the Structural Narrative and Bamboo Structural Systems Narrative
- Revised and updated Energy Analysis Results and Discussion
- Updated the Quantity Takeoff
- Added or updated MasterSpec sections:
 - 00 31 00 Available Project Information
 - 01 10 00 Summary
 - 05 21 00 Structural Steel
 - 05 52 00 Metal Railings
 - 06 15 33 Wood Patio Decking
 - 07 21 29 Insulation
 - 07 42 13 Metal Wall Panels
 - 07 54 23 Thermoplastic Roofing Membrane (TPO)
 - 07 62 00 Sheet Metal Flashing and Trim
 - 07 72 00 Roof Accessories
 - 08 13 20 Exterior Metal Doors
 - 08 13 21 Exterior Fiberglass Doors
 - 08 13 73 Sliding Metal Doors
 - 08 14 16 Interior Wood Doors
 - 08 14 17 Interior Wood Pocket Doors
 - 08 53 13 Windows
 - 09 29 00 Drywall
 - 09 64 00 Wood Flooring
 - 09 65 15 Baseboard
 - 10 73 13 Awnings
 - 11 31 23 Residential Laundry Appliances
 - 11 52 00 Audio-Visual Equipment
 - 12 32 13 Manufactured Wood-Veneer-Faced Casework
 - 22 05 00 Common Work Results for Plumbing
 - 22 05 23 General-Duty Valves for Water-Based Piping
 - 22 11 13 Facility Water Distribution Piping
 - 22 11 16 Domestic Water Piping
 - 22 11 23 Water Pumps
 - 22 13 00 Facility Sanitary Sewage and Vent Piping
 - 22 13 53 Facility Greywater Tanks
 - 22 80 08 Domestic Hot Water Tanks

- 22 81 81 Phase Change Material
- 23 09 13 Sensors and Transmitters
- 23 31 00 HVAC Ducts and Casings
- 23 37 13 Diffusers, Registers, and Grilles
- 23 56 13 Solar Thermal Collectors
- 23 72 15 Heat Recovery Ventilator (HRV)
- 23 83 33 Air to Water Heat Pump
- 25 13 20 Integrated Automation Control and Monitoring
- 26 05 19 Low-Voltage Electrical Power Conductors and Cables
- 26 05 20 Controls Wiring
- 26 05 26 Grounding and Bonding for Electrical Systems
- 26 05 33 Raceway and Boxes for Electrical Systems
- 26 05 83 Wiring Connections
- 26 09 23 Lighting Control Devices
- 26 27 26 Wiring Devices
- 26 28 16 Enclosed Switches and Circuit Breakers
- 26 50 00 Lighting
- 26 50 01 Bathroom Exhaust Fan and Light
- 32 93 00 Plants
- Removed MasterSpec sections
 - 07 53 23 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing
 - 09 65 15 Primed MDF Base Moulding
 - 09 69 00 Access Flooring
 - 25 13 10 Integrated Automation Control & Monitoring Network Cabling



RULES COMPLIANCE

RULES COMPLIANCE CHECKLIST

Rule #	Rule Name	Content Description	Location
4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101
4-2	Construction Equipment	Specifications for heavy machinery	41 20 00 41 23 23 41 62 23
4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-101
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-108
4-5	Generators	Specifications for generators (including sound rating)	26 32 13
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	P-102 P-103 P-104 P-901 P-902 M-102 M-103 H-101 FP-01
4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain liquids at any point during the event	21 10 00 22 05 00 22 11 13 22 11 16 22 11 23 22 12 00 22 13 00 22 13 53 22 41 16 22 41 23 22 80 08 23 23 23 23 83 16 23 83 33
4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (30.48 cm) of vertical elevation change exists	Pg. 50
4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (30.48 cm) of vertical elevation change exists on the lot	S-501
5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	G-201 G-202

5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that have been or 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	Pg. 15
6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
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
6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-103
7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-101
7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	N/A
8-1	PV Technology Limitations	Specifications for photovoltaic components	26 31 00 48 19 16
8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	F-101 E-105 T-102
8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	26 33 13
8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	N/A
8-4	Desiccant Systems	Specifications for desiccant system components	N/A
8-5	Village Grid	Completed interconnection application form	Pg. 115
8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-103 E-201 E-401

8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	26 05 19 26 05 26 26 05 33 26 05 83 26 24 16 26 27 26 26 28 16 26 31 00 48 19 16
8-5	Village Grid	One-line electrical diagram	E-611
8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-601
8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	G-103
8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201
9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	P-102 P-103 P-104
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-103 P-901
9-2	Team-Provided Liquids	Quantity, characteristics, and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	N/A
9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	N/A
9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	N/A
9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	H-101
9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	N/A
9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	P-101
9-8	Water Delivery	Specifications for the containers to which water will be delivered	22 12 00
9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-101
9-9	Water Removal	Specifications for the containers from which water will be removed	22 12 00 22 13 53

11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103 X-101
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6-1 STRUCTURAL DESIGN APPROVAL

The following is a list of the sheets and pages that are stamped in the hard copy by Dr. Mark Aschheim, PE. The sheets and pages can be found in the Construction Drawings and Project Manual at the locations listed below, or in a separate, but attached Stamped Drawing Set and Stamped Structural Calculations.

- Structural Calculations, pages 19-95 of the Project Manual
- Construction drawings, including:
 - S-001 Structural Notes and Symbols
 - S-101 Foundation Plan
 - S-102 Module Separation
 - S-103 Floor Framing Plan
 - S-104 Wall Framing Plan
 - S-105 Lower Roof Framing
 - S-106 Upper Roof Module Framing Plan
 - S-107 Deck Framing Plan
 - S-108 Bearing Pressure Plan
 - S-109 South Awning Plan
 - S-201 Module A Wall Framing
 - S-202 Module A Wall Framing
 - S-203 Module B Wall Framing
 - S-204 Module C Wall Framing
 - S-205 Module C Wall Framing
 - S-206 Roof Elevation
 - S-303 Roof Module Section
 - S-311 Deck Section
 - S-401 Awning Large Scale Plan
 - S-501 Pier Details
 - S-502 Pier Plate Details
 - S-512 Bamboo Gravity Wall Details
 - S-521 I-Joist Details
 - S-531 Connection Details
 - S-532 Timber to Steel Connections
 - S-541 Railing Details
 - S-551 Awning Details
 - S-601 Schedules
- S.O.S. Steel Co. Shop drawings, including:
 - D1
 - D2
 - D3
 - D4
 - D4.1
 - D5
 - D5.1

D6
D7
D8
D9
D10
D11
E1
E1.1
E2
E3
E4

9-8 WATER DELIVERY 1

Stage 1

- Water Truck pulls up to Radiant House on south side.

Stage 2

- Awaiting Team members move hose from truck and attach it to storage tank.
- When tank is full, water is turned off and the hose is prepped for the next lot.

Stage 3

- Water Truck moves to the next lot.

9-9 WATER REMOVAL 1

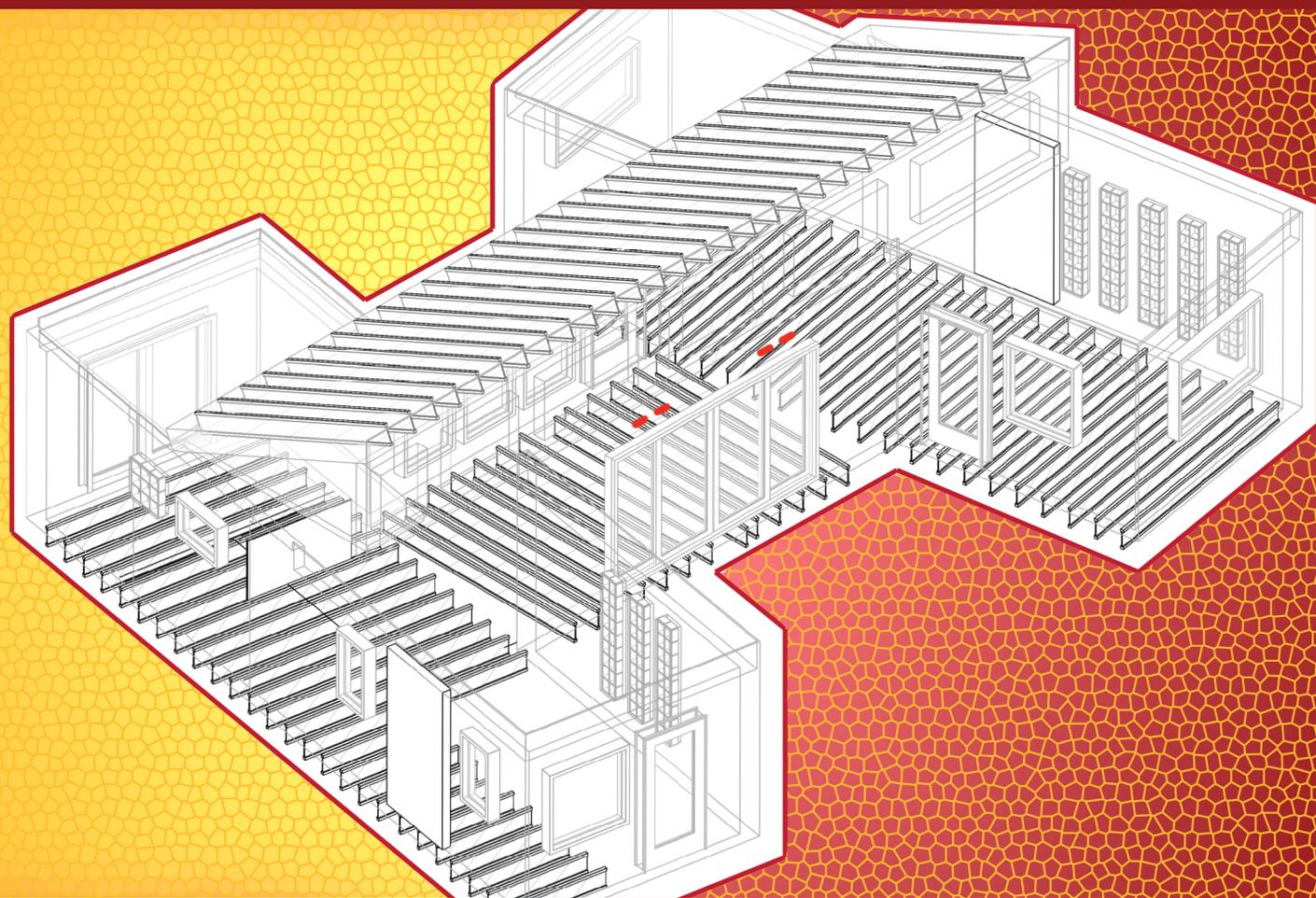
Stage 1

- Water Truck pulls up to Radiant House on south side.
- Awaiting team members move hose from truck and attach it to storage tanks (water has already been removed from radiant and sprinkler system).
- Excess water is removed from storage tanks.
- Hose is placed back in truck and made ready to move to stage 2.

Stage 2

- Water truck moves to stage 2.
- Team members grab hose and attach it to the greywater tank via bottom outlet which will be located flush with the outside perimeter of the deck for easy access.
- Wastewater is removed from greywater tank.
- Hose is placed back in truck and made ready to move.

*Reversed if the water truck is coming in from the other side.



STRUCTURAL CALCULATIONS

STRUCTURAL CALCULATIONS

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STRUCTURAL NARRATIVE

The 2013 Radiant House is the realization of Santa Clara's goal to design a strong, efficient, and innovative symbol of sustainability. Utilizing a conventional system of joists, beams, studs, and shear walls, we implemented an innovative and original design to resist and transfer dead, live, wind, and seismic loads to the foundation.

The approach of our team is to substitute an initial conventional softwood design with one that makes use of a bamboo structural system. Research conducted at Santa Clara University has yielded results affirming bamboo's suitability as a substitute for bamboo joists and gravity walls. The bamboo will be incorporated into the design as a primary structural component of Radiant House.

Radiant House will be composed of three base modules and an additional roof module. A perimeter structural steel channel or angle will serve as the backbone to each of these modules, serving to collect all gravity and lateral loads and distribute them into the foundation, which will consist of a series of seismic and standard piers. Roof gravity loads will be collected by bamboo joists and transferred through bamboo gravity walls into the steel channel. While lateral loads at the roof level will transfer through the roof diaphragm into the shear walls and into the perimeter steel channel. The floor joists will be hung such that a minimum clearance of 1- 9/16 inch will be maintained above the bottom of the steel channel. Lateral loads will be collected by floor diaphragms and transferred into the steel perimeter channel.

The sloped roof module consists of a structural steel angle base that transmits roof diaphragm loads into the top plates of the base modules. The roof angle is 24 degrees and is supported on the low side by the above mentioned structural steel angle and a vierendeel truss at the high end of the slope. The vierendeel truss is created by vertical structural steel channels running between the base angle and a top horizontal steel angle. The vertical steel channels are placed at strategic locations to carry and transfer shear loading due to wind and seismic in the East-West directions and gravity loads, while still allowing windows for natural lighting. The roof slopes from the top steel at the north wall to the base steel on the south side in order to create a slope optimal for solar collection.

As Radiant House will be transported by truck from Santa Clara to Irvine, our greatest concern is maintaining the structural integrity of the completed house during transportation. The significant wind loads expected to act on the house's modules during transportation will require thorough consideration during both the design and transportation phases in order to preserve structural stability. For example, steel beams will be placed parallel to the floor joists and flush with the bottom of the perimeter channel to support and transfer the gravity load to the truck bed during transportation.

Santa Clara's 2013 Radiant House demonstrates the importance of structural engineering's role in sustainable development and design. With its frugal and efficient design and its pioneering use of sustainable products, the structural engineering of Radiant House reaffirms Santa Clara's enduring commitment to sustainability.

BAMBOO STRUCTURAL SYSTEMS NARRATIVE

Santa Clara seeks to implement a bamboo structural system in our 2013 Solar Decathlon house. We will provide a conventional softwood design and then, where sufficient capacity is demonstrated, will propose substitution of the following bamboo structural components:

- *Bamboo gravity walls:* Wall panels will be prefabricated, with hollow section bamboo culms at 16 inches on center, mounted to 4 ft. by 8 ft. woven bamboo panels. The assembly will have an integral bottom plate positioned to allow the wall panel be dropped in place on top of a field-installed bottom plate. Similarly, the lower of two top plates will be preinstalled in the panel assembly. Once the wall panel is in place, the upper of the two top plates will be field installed as a means to integrate the wall panels into the structural system. See Figure 18.
- *Bamboo joists:* Representing our third innovation in this category, our I-shaped bamboo joists consist of a woven bamboo sheet product used as a web, with solid section bamboo culms attached to the web to form flanges. See Figure 17.

These components are being developed in our laboratory in collaboration with a bamboo fabricator in Vietnam. Acceptance criteria for each component has been approved and quality assurance/quality control protocols for each component has also been approved to ensure the bamboo components used in construction adhere to design expectations.

- *Bamboo stud walls:* Stud walls were subjected to axial compression testing to establish design values and determine behavior under loading.
- *Bamboo joists:* Shear and bending tests are underway to establish design values.

Results obtained through testing have been compared to behavior displayed by conventional softwood components and to required demand loads to determine the suitability of bamboo as a substitute for components in Radiant House's structural system. Santa Clara hopes to provide innovation in Radiant House with this bamboo structural system.

See S-512 and S-521 for relevant drawings.

MATERIAL PROPERTIES

Steel

Channels	$f_y = 36$ ksi
Angles	$f_y = 36$ ksi
HSS beams	$f_y = 46$ ksi
W beams	$f_y = 36$ ksi

Connections

Welds	E70XX
High Strength Bolts	A490
Machine Bolts	A307

Wood Framing

Sawn Lumber

Horizontal Framing:

2x6	D.F.	No.2
4x6	D.F.	No.2
6x6	D.F.	No.1
2x12	D.F.	No.1
4x12	D.F.	No.1

Vertical Framing:

2x studs	D.F.	No.2
4x posts	D.F.	No.2

Mudsills & Ledgers:

D.F.	No.2
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GRAVITY LOADS

Flat Roof over the Mech Room			
Roofing	TPO Roofing	1.5	psf
Sheathing	3/4" T&G Plywood	2.2	psf
Framing	TJI 230 Joists @ 24" O.C.	2.1	psf
Insulation	ICYNENE MD-R-200	1.5	psf
Solar Thermal	Free Hot Water	3.3	psf
MEP	Messana Panels	2.8	psf
Parapet		1.7	psf
Misc.		0.9	psf
Dead Load		16.0	psf
Live Load		20	psf
Flat Roof Not over the Mech Room			
Roofing	TPO Roofing	1.5	psf
Sheathing	3/4" T&G Plywood	2.2	psf
Framing	TJI 230 Joists @ 16" O.C.	2.1	psf
Insulation	ICYNENE MD-R-200	1.1	psf
MEP	Messana Panels	2.8	psf
Parapet		1.7	psf
Misc.		0.6	psf
Dead Load		12.0	psf
Live Load		20	psf
Slope Roof			
PV Panels	Bosch Solar Module c-Si M 60	3.0	psf
Racking System	Sunplanter	1.0	psf
Roofing	TPO Roofing	1.5	psf
Sheathing	3/4" T&G Plywood	2.2	psf
Framing	TJI 230 Joists @ 16" O.C.	2.1	psf
Insulation	ICYNENE MD-R-200	1.5	psf
MEP	Messana Panels	2.8	psf
Misc.		0.9	psf
Dead Load		15.0	psf
Live Load		20	psf
Floors			
Finish	Tate ConCore 1500 Posilock	8.8	psf
Sheathing	3/4" T&G Plywood	2.2	psf
Framing	TJI 230 Joists @ 16" O.C.	2.1	psf
Insulation	ICYNENE MD-R-200	1.1	psf
MEP	Conduit, Ducting, and Piping	1	psf
Misc		0.8	psf
Dead Load		16.0	psf

Live Load 50 psf

Exterior Wall

Exterior Finish	Siding	4	psf
Sheathing	15/32" Str1 Plywood	1.7	psf
Studs	2 x 4 @ 16" staggered	2.7	psf
Interior Finish	5/8" EcoRock Gyp	2.5	psf
Insulation	ICYNENE MD-R-200	1.1	psf
Glazing	Windows and Mullion	2	psf
Misc.		1	psf

Dead Load 15 psf

Exterior Side Wall Of Top Module

Exterior Finish	Siding	4	psf
Sheathing	15/32" Str1 Plywood	1.7	psf
Studs	2 x 4 @ 16" staggered	2.7	psf
Interior Finish	5/8" EcoRock Gyp	2.5	psf
Insulation	ICYNENE MD-R-200	1.1	psf
Misc.		1	psf

Dead Load 13 psf

Interior Wall

Finish	(2) 5/8" EcoRock Gyp	5	psf
Framing	2 x 4 @ 16" single stud	1	psf
Misc.		2	psf

Dead Load 8 psf

Other Loads

Steel Foundation Track	33.9	plf
Mechanical Equipment	2000	lb

SEISMIC DESIGN BASE SHEAR

Santa Clara seismic conditions govern over Irvine

Zip Code = 95053

Spectral Response Accelerations S_s and S_1

S_s and S_1 = Mapped Spectral Acceleration Values

Site Class B - $F_a = 1.0$, $F_v = 1.0$

Data are based on a 0.01 deg grid spacing

Period (sec)	Centroid S_a (g)	
0.2	1.500	(S_s) , Site Class D
1.0	0.600	(S_1) , Site Class D
Period (sec)	Maximum S_a (g)	
0.2	1.500	(S_s) , Site Class D
1.0	0.600	(S_1) , Site Class D
Period (sec)	Minimum S_a (g)	
0.2	1.500	(S_s) , Site Class D
1.0	0.600	(S_1) , Site Class D

Occupancy Category	=	II	(ASCE/SEI 7-10, Table 1.5-1)
I	=	1	
h_x	=	18 ft	
R	=	6.5	Light Framed Walls w/ Panels For Shear Resistance
C_t	=	0.02	
X	=	0.75	
T_a	= $C_t * (h)^x$	= 0.175	
S_s	=	1.5 g	
S_1	=	0.6 g < 0.6g	
F_a	=	1	
F_v	=	1.5	
S_{MS}	= $F_a * S_s$	= 1.5 g	
S_{M1}	= $2 * S_{MS}/3$	= 0.9 g	
S_{DS}	= $F_v * S_1$	= 1 g > 0.50	Seis. Design Cat.: D
S_{D1}	= $2 * S_{M1}/3$	= 0.6 g	
C_s	= $S_{ds}/(R/I)$	= 0.154	(ASCE/SEI 7-10, Eq 12.8-2)
$C_{s \text{ max}}$	= $S_{d1}/T_a(R/I)$	= 0.528	(ASCE/SEI 7-10, Eq 12.8-3)
$C_{s \text{ min}}$	= $.044 S_{DS} * I$	= 0.044	(ASCE/SEI 7-10, Eq 12.8-5)
C_s	=	0.154	(Controls)
V	= $C_s * W$	= 0.154 W	
ρ	=	1.300	
E	= $\rho * V$	= 0.200 W	

SEISMIC DESIGN BASE SHEAR

Santa Clara seismic conditions govern over Irvine

Zip Code = 92618

Spectral Response Accelerations S_s and S_1

S_s and S_1 = Mapped Spectral Acceleration Values

Site Class B - $F_a = 1.0$, $F_v = 1.0$

Data are based on a 0.01 deg grid spacing

Period (sec)	Centroid S_a (g)	
0.2	1.470	(S_s) , Site Class D
1.0	0.520	(S_1) , Site Class D
Period (sec)	Maximum S_a (g)	
0.2	1.500	(S_s) , Site Class D
1.0	0.546	(S_1) , Site Class D
Period (sec)	Minimum S_a (g)	
0.2	1.401	(S_s) , Site Class D
1.0	0.498	(S_1) , Site Class D

Occupancy Category	=	II	(ASCE/SEI 7-10, Table 1.5-1)
I	=	1	
h_x	=	18 ft	
R	=	6.5	Light Framed Walls w/ Panels For
C_t	=	0.02	Shear Resistance
x	=	0.75	
T_a	=	$C_t * (h)^x$	
S_s	=	1.5 g	
S_1	=	0.546 g < 0.6g	
F_a	=	1	
F_v	=	1.5	
S_{MS}	=	$F_a * S_s$	
S_{M1}	=	$2 * S_{ms}/3$	
S_{DS}	=	$F_v * S_1$	
S_{D1}	=	$2 * S_{m1}/3$	
C_s	=	$S_{ds}/(R/I)$	(ASCE/SEI 7-10, Eq 12.8-2)
$C_s \text{ max}$	=	$S_{d1}/T_a(R/I)$	(ASCE/SEI 7-10, Eq 12.8-3)
$C_s \text{ min}$	=	$.044 S_{DS} * I$	(ASCE/SEI 7-10, Eq 12.8-5)
C_s	=	0.154	(Controls)
V	=	$C_s * W$	
ρ	=	1.300	
E	=	$\rho * V$	
		0.200 W	
		1 g > 0.50	Seis. Design Cat.: D

MODULE A

Building Weight:

Level	N-S Seismic Load			E-W Seismic Load		
	Area (sf)	Flat Load (psf)	Weight (lbs.)	Area (sf)	Flat Load (psf)	Weight (lbs.)
Sloped Roof	144	15	2160	144	15	2160
Roof	257	12	3084	257	12	3084
Floor	388	16	6208	388	16	6208
Ext. Wall (N)	117	15	1755	117	15	1755
Ext. Wall (S)	117	15	1755	117	15	1755
Ext. Wall (E)	315	15	4729	315	15	4729
Ext. Wall (W)	210	15	3154	210	15	3154
Roof Side Wall (W)	42	13	540	42	13	540
Roof Wall (N)	70	15	1055	70	15	1055
Top Steel			1171			1171
Total Wt.			25609			25609

E = 5121.9 lbs. 5121.9 lbs.

MODULE A

Force Distribution:

Level	h _x ^k (ft)	N-S Seismic Load				E-W Seismic Load			
		w _x (lbs)	w _x *h _x ^k	$\frac{w_x * h_x^k}{S(w_i * h_i)}$	F _x (lbs)	w _x (lbs)	w _x *h _x ^k	$\frac{w_x * h_x^k}{S(w_i * h_i)}$	F _x (lbs)
Roof	18.0	13593	244668	0.89064	4562	13593	244668	0.89064	4562
Ground	2.5	12017	30041	0.10936	560	12017	30041	0.10936	560
Total		25609	274710	1	5122	25609	274710	1	5122

MODULE B

Building Weight:

Level	N-S Seismic Load			E-W Seismic Load		
	Area (sf)	Flat Load (psf)	Weight (lbs)	Area (sf)	Flat Load (psf)	Weight (lbs)
Sloped Roof	247	15	3703	247	15	3703
Floor	228	16	3648	228	16	3648
Ext. Wall (N)	199	15	2991	199	15	2991
Ext. Wall (S)	161	15	2421	161	15	2421
Roof Wall (N)	146	15	2196	146	15	2196
Steel			1030			1030
Total Wt.			15989			15989

E = 3197.9 lbs 3197.9 lbs

Module B

Force Distribution:

Level	h _x ^k (ft)	N-S Seismic Load				E-W Seismic Load			
		w _x (lbs)	w _x *h _x ^k	$\frac{w_x * h_x^k}{S(w_i * h_i)}$	F _x (lbs)	w _x (lbs)	w _x *h _x ^k	$\frac{w_x * h_x^k}{S(w_i * h_i)}$	F _x (lbs)
Roof	18.0	9523	171414	0.91382	2922	9523	171414	0.91382	2922
Ground	2.5	6466	16166	0.08618	276	6466	16166	0.08618	276
Total		15989	187580	1	3198	15989	187580	1	3198

MODULE C

Building Weight:

Level	N-S Seismic Load			E-W Seismic Load		
	Area (sf)	Flat Load (psf)	Weight (lbs)	Area (sf)	Flat Load (psf)	Weight (lbs)
Sloped Roof	144	15	2160	144	15	2160
Roof with water	108	16	1728	108	16	1728
Roof	197	12	2364	197	12	2364
Floor	436	16	6976	436	16	6976
Ext. Wall (N)	117	15	1755	117	15	1755
Ext. Wall (S)	117	15	1755	117	15	1755
Ext. Wall (E)	354	15	5314	354	15	5314
Ext. Wall (W)	319	15	4778	319	15	4778
Interior Walls	276	8	2211	276	8	2211
Roof Side Wall (E)	42	13	540	42	13	540
Mech Room			2000			2000
Roof Wall (N)	70	15	1055	70	15	1055
Bathroom			1200			1200
Steel			1171			1171
Total Wt.			35005			35005

E = 7001.0 lbs 7001.0 lbs

MODULE C

Force Distribution:

Level	h _x ^k (ft)	N-S Seismic Load				E-W Seismic Load			
		w _x (lbs)	w _x *h _x ^k	$\frac{w_x \cdot h_x^k}{\sum(w_i \cdot h_i)}$	F _x (lbs)	w _x (lbs)	w _x *h _x ^k	$\frac{w_x \cdot h_x^k}{\sum(w_i \cdot h_i)}$	F _x (lbs)
Roof	18.0	16811	302592	0.87688	6139	16811	302592	0.87688	6139
Ground	2.5	16995	42486	0.12312	862	16995	42486	0.12312	862
Total		33805	345079	1	7001	33805	345079	1	7001

WIND LOAD

Per ASCE 7-10

Wind conditions for Santa Clara and Irvine are the same.

Basic Wind Speed	V	=	85	mph
Importance Factor	I	=	1.0	
Exposure Category		=	C	
Velocity Pressure Exposure Coefficient	K _z	=	0.9	
Velocity Pressure Exposure Coefficient	K _h	=	0.85	
Topographic Factor	K _{zt}	=	1	
Wind Directionality Factor	K _d	=	0.85	
Gust Effect Factor	G	=	0.85	
Enclosure Classification		=	Enclosed	
Internal Pressure Coefficient	GC _{pi}	=	0.18	
	GC _{pi}	=	-0.18	
Wall External Pressure Coefficients	C _p	=	0.8	Windward Wall
			-0.25	Leeward Wall
			-0.7	Side Wall
Roof External Pressure Coefficients	C _p	=	-0.9	Windward Wall
			-0.5	Leeward Wall
Velocity Pressure	$q_z = (0.00256)(K_z)(K_{zt})(K_d)(V^2)(I) =$		14.15	
Velocity Pressure	$q_h = (0.00256)(K_h)(K_{zt})(K_d)(V^2)(I) =$		13.36	
Design Wind Load	$p = qGC_p - q_i(GC_{pi}) =$		12.027	psf

Module A

Width. N-S	=	32.33	ft
Width. E-W	=	12	ft
Height	=	18.00	ft
Vwind.N-S	=	2598	lbs Seismic Governs
Vwind.E-W	=	7000	lbs Wind Governs

Module B

Width. N-S	=	12	ft
Width. E-W	=	21.10	ft
Height	=	18.00	ft
Vwind.N-S	=	4569	lbs Seismic Governs
Vwind.E-W	=	2598	lbs Wind Governs

Module C

Width. N-S	=	36.33	ft
Width. E-W	=	12	ft
Height	=	18.00	ft
Vwind.N-S	=	2598	lbs Seismic Governs
Vwind.E-W	=	7866	lbs Wind Governs

SHEAR WALLS

MODULE A

E-W Wind Load on Shear Walls

Shear Wall	Wall Type	Fx (lbs)	Px = Fx/1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
A	Segmented	605	432.3	2.84	9.46	3.326	152.0	475	15/32 Str 1	10d @ 6
B	Segmented	605	432.3	2.84	9.46	3.326	152.0	475	15/32 Str 1	10d @ 6
C	Segmented	485	346.5	2.84	9.46	3.326	121.9	475	15/32 Str 1	10d @ 6
D	Segmented	485	346.5	2.84	9.46	3.326	121.9	475	15/32 Str 1	10d @ 6
H&I	Collector A	2530	1806.9	-	-	-	-	-	-	-
K	Collector B	2289	1635.3	-	-	-	-	-	-	-

N-S Seismic Load on Shear Walls

Shear Wall	Wall Type	Fx (lbs)	Px = Fx/1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
E	Segmented	1225	874.9	2.75	9.46	3.439	318.1	340	15/32 Str 1	10d @ 6
F	Segmented	3340	2386.0	7.50	9.46	1.261	318.1	340	15/32 Str 1	10d @ 6
G	Segmented	2281	1629.2	12.00	9.46	0.788	135.8	340	15/32 Str 1	10d @ 6

MODULE B

E-W Seismic Load on Shear Walls

Shear Wall	Wall Type	Fx (lbs)	Px = Fx/1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
H	Segmented	3477	2483.3	4.00	9.46	2.365	620.8	665	15/32 Str 1	10d @ 3
I	Segmented	3477	2483.3	4.00	9.46	2.365	620.8	665	15/32 Str 1	10d @ 3
K	Collector B	1461	1043.7	-	-	-	-	-	-	-

N-S Wind Load on Shear Walls

Shear Wall	Wall Type	Fx (lbs)	Px = Fx/1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
E&F		2284.38	1631.7	-	-	-	-	-	-	-
N,O&P		2284.38	1631.7	-	-	-	-	-	-	-

MODULE C

E-W Wind Load on Shear Walls

Shear Wall	Wall Type	Fx (lbs)	Px = Fx/1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
J	Segmented	1643	1173.8	2.71	9.46	3.492	433.4	510	15/32 Str 1	10d @ 4
K	Perforated	6323	4516.1	-	-	-	-	-	-	-
L	Segmented	344	245.6	2.84	9.46	3.326	86.4	475	15/32 Str 1	10d @ 6
M	Segmented	344	245.6	2.84	9.46	3.326	86.4	475	15/32 Str 1	10d @ 6
H&I	Collector A	2963	2116.1	-	-	-	-	-	-	-

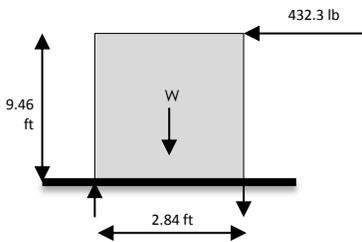
N-S Seismic Load on Shear Walls

Shear Wall	Wall Type	F _x (lbs)	P _x = F _x /1.4	b (ft)	h(ft)	Aspect Ratio (h:b)	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
N	Segmented	1784.6	1274.7	4.00	9.46	2.365	318.7	340	15/32 Str 1	10d @ 6
O	Segmented	1784.6	1274.7	4.00	9.46	2.365	318.7	340	15/32 Str 1	10d @ 6
P	Segmented	1784.6	1274.7	4.00	9.46	2.365	318.7	340	15/32 Str 1	10d @ 6
Q	Segmented	3069.5	2192.5	7.67	9.46	1.234	286.0	340	15/32 Str 1	10d @ 6

Perforated Shear Walls

Shear Wall	∑L _i (ft)	L _{total} (ft)	Opening Height Ratio	Percent Full-Height Sheathing	C _o	v (ASD) (plf)	v. allow (plf)	Plywood (in.)	Edge Nailing (in.)
K	0.00	8.04	h/3	0.75	1	0.0	561.58	15/32 Str 1	10d @ 4

SHEAR WALL - A :



Check Loads:

P_x = 432.3 lbs
 W* = 0 lbs
 M_{ot} = 4088.7 lb-ft
 T_{asd} = 1437.79 lbs

Check Holddown:

HDU2 SDS2.5

Ta.hd= 3075 lbs OK

Check Overturning

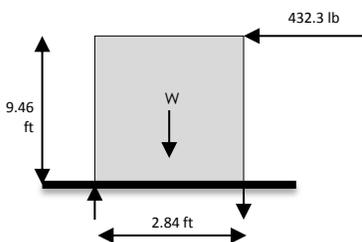
W = 0 lbs
 M_r = 8744.5 lb-ft
 M_{ot} = 4088.7 lb-ft
 M_r > M_{ot} OK

Clips to Top Plate

Clip A35
 Capacity 695 lbs
 Number Req'd 2
 Req'd Spacing 27 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - B :



Check Loads:

P_x = 432.3 lbs
 W* = 0 lbs
 M_{ot} = 4088.7 lb-ft
 T_{asd} = 1437.79 lbs

Check Holddown:

HDU2 SDS2.5

Ta.hd= 3075 lbs OK

Check Overturning

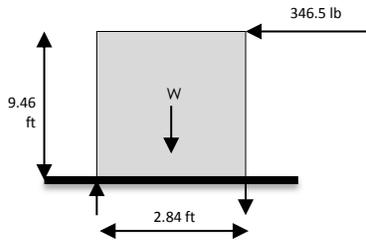
W = 0 lbs
 M_r = 8744.5 lb-ft
 M_{ot} = 4088.7 lb-ft
 M_r > M_{ot} OK

Clips to Top Plate

Clip A35
 Capacity 695 lbs
 Number Req'd 2
 Req'd Spacing 27 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - C :



Check Loads:

P_x	=	346.5	lbs
W^*	=	0	lbs
M_{ot}	=	3277.5	lb-ft
T_{asd}	=	1152.51	lbs

Check Holddown:

$T_{a,hd}$	=	3075	lbs	OK
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Check Overturning

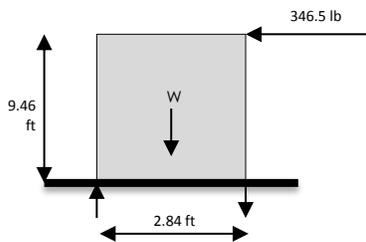
W	=	0	lbs
M_r	=	8744.5	lb-ft
M_{ot}	=	3277.5	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		27 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - D :



Check Loads:

P_x	=	346.5	lbs
W^*	=	0	lbs
M_{ot}	=	3277.5	lb-ft
T_{asd}	=	1152.51	lbs

Check Holddown:

$T_{a,hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

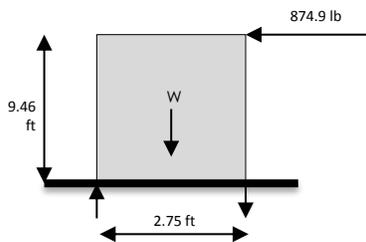
W	=	0	lbs
M_r	=	8744.5	lb-ft
M_{ot}	=	3277.5	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		27 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - E :



Check Loads:

P_x	=	874.9	lbs
W^*	=	0	lbs
M_{ot}	=	8274.9	lb-ft
T_{asd}	=	3009.04	lbs

Check Holddown:

$T_{a,hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

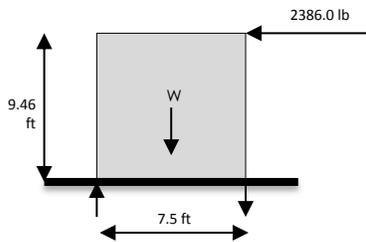
W	=	0	lbs
M_r	=	8456.3	lb-ft
M_{ot}	=	8274.9	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		26 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - F :



Check Loads:

P_x	=	2386.0	lbs
W^*	=	0	lbs
M_{ot}	=	22567.8	lb-ft
T_{asd}	=	3009.04	lbs

Check Holddown:

$T_{a.hd}$	=	3075	lbs	OK
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Check Overturning

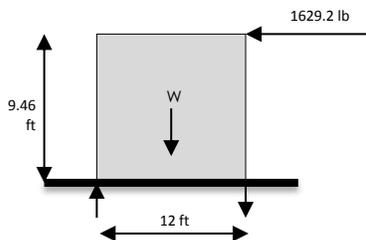
W	=	0	lbs
M_r	=	23062.5	lb-ft
M_{ot}	=	22567.8	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		4
Req'd Spacing		30.00 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - G :



Check Loads:

P_x	=	1629.2	lbs
W^*	=	0	lbs
M_{ot}	=	15409.5	lb-ft
T_{asd}	=	1284.12	lbs

Check Holddown:

$T_{a.hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

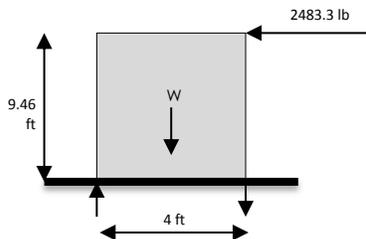
W	=	0	lbs
M_r	=	36900.0	lb-ft
M_{ot}	=	15409.5	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		3
Req'd Spacing		48 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - H :



Check Loads:

P_x	=	2483.3	lbs
W^*	=	0	lbs
M_{ot}	=	23488.3	lb-ft
T_{asd}	=	5872.07	lbs

Check Holddown:

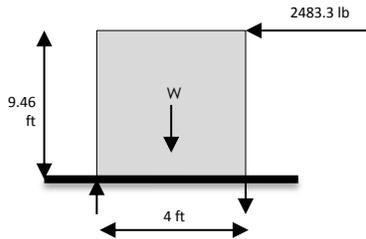
$T_{a.hd}$	=	6970	lbs	OK
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Check Overturning

W	=	0	lbs
M_r	=	27880.0	lb-ft
M_{ot}	=	23488.3	lb-ft
M_r	>	M_{ot}	OK

* Assume weight of wall is 0 to be conservative

SHEAR WALL - I :



Check Loads:

P_x	=	2483.3	lbs
W^*	=	0	lbs
M_{ot}	=	23488.3	lb-ft
T_{asd}	=	5872.07	lbs

Check Holddown: HDU8 SDS2.5

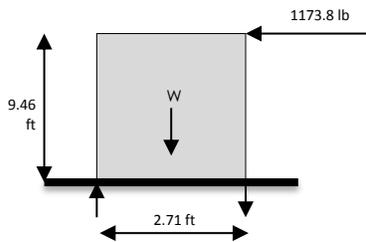
$T_{a.hd}$	=	6970	lbs	OK
------------	---	------	-----	----

Check Overturning

W	=	0	lbs
M_r	=	27880.0	lb-ft
M_{ot}	=	23488.3	lb-ft
M_r	>	M_{ot}	OK

* Assume weight of wall is 0 to be conservative

SHEAR WALL - J :



Check Loads:

P_x	=	1173.8	lbs
W^*	=	0	lbs
M_{ot}	=	11102.6	lb-ft
T_{asd}	=	4099.42	lbs

Check Holddown: HDU4 SDS2.5

$T_{a.hd}$	=	4565	lbs	OK
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Check Overturning

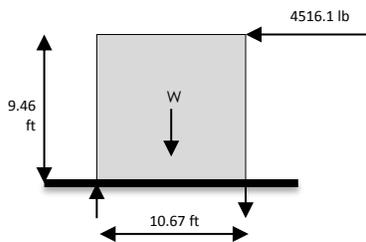
W	=	0	lbs
M_r	=	12363.5	lb-ft
M_{ot}	=	11102.6	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		30 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - K :



Check Loads:

P_x	=	4516.1	lbs
T_{asd}	=	V_h	lbs
		$Co \sum L_i$	lb-ft
T_{asd}	=	5400.00	lbs

Check Holddown: HDU5 SDS2.5

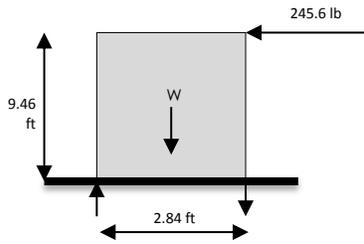
$T_{a.hd}$	=	5645	lbs	OK
------------	---	------	-----	----

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		7
Req'd Spacing		21.00 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - L:



Check Loads:

P_x	=	245.6	lbs
W^*	=	0	lbs
M_{ot}	=	2323.4	lb-ft
T_{asd}	=	817.0	lbs

Check Holdown:

$T_{a.hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

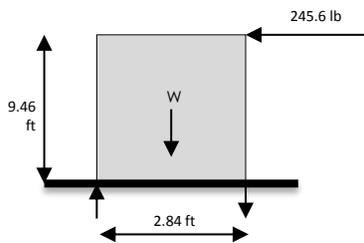
W	=	0	lbs
M_r	=	8744.5	lb-ft
M_{ot}	=	2323.4	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		26 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - M :



Check Loads:

P_x	=	245.6	lbs
W^*	=	0	lbs
M_{ot}	=	2323.4	lb-ft
T_{asd}	=	817.00	lbs

Check Holdown:

$T_{a.hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

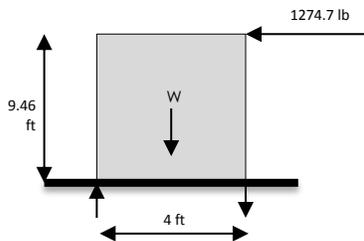
W	=	0	lbs
M_r	=	8744.5	lb-ft
M_{ot}	=	2323.4	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		26 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - N :



Check Loads:

P_x	=	1274.7	lbs
W^*	=	0	lbs
M_{ot}	=	12056.9	lb-ft
T_{asd}	=	3014.24	lbs

Check Holdown:

$T_{a.hd}$	=	3075	lbs	OK
------------	---	------	-----	----

Check Overturning

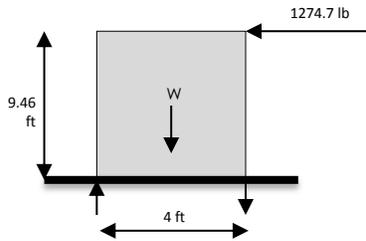
W	=	0	lbs
M_r	=	0.0	lb-ft
M_{ot}	=	12056.9	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip		A35
Capacity		695 lbs
Number Req'd		2
Req'd Spacing		24 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - O :



Check Loads:

P_x	=	1274.7	lbs
W^*	=	0	lbs
M_{ot}	=	12056.9	lb-ft
T_{asd}	=	3014.24	lbs

Check Holdown: HDU2 SDS2.5

Ta.hd=	3075	lbs	OK
--------	------	-----	----

Check Overturning

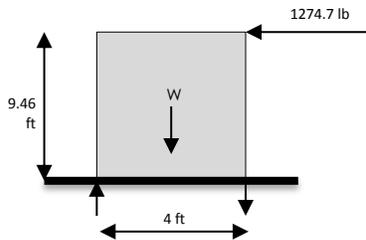
W	=	0	lbs
M_r	=	12300.0	lb-ft
M_{ot}	=	12056.9	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip	A35
Capacity	695 lbs
Number Req'd	2
Req'd Spacing	24 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - P :



Check Loads:

P_x	=	1274.7	lbs
W^*	=	0	lbs
M_{ot}	=	12056.9	lb-ft
T_{asd}	=	3014.24	lbs

Check Holdown: HDU2 SDS2.5

Ta.hd=	3075	lbs	OK
--------	------	-----	----

Check Overturning

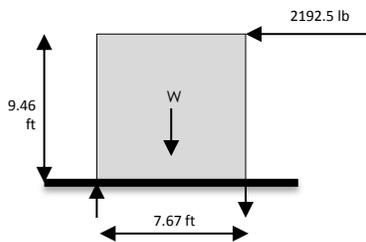
W	=	0	lbs
M_r	=	12300.0	lb-ft
M_{ot}	=	12056.9	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip	A35
Capacity	695 lbs
Number Req'd	2
Req'd Spacing	24 in.

* Assume weight of wall is 0 to be conservative

SHEAR WALL - Q :



Check Loads:

P_x	=	2192.5	lbs
W^*	=	0	lbs
M_{ot}	=	20737.6	lb-ft
T_{asd}	=	2704.91	lbs

Check Holdown: HDU2 SDS2.5

Ta.hd=	3075	lbs	OK
--------	------	-----	----

Check Overturning

W	=	0	lbs
M_r	=	23575.0	lb-ft
M_{ot}	=	20737.6	lb-ft
M_r	>	M_{ot}	OK

Clips to Top Plate

Clip	A35
Capacity	695 lbs
Number Req'd	3
Req'd Spacing	30 in.

* Assume weight of wall is 0 to be conservative

FLAT ROOF DIAPHRAGM

MODULE A

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	12.00	ft
N-S	Dead Load	D_L	12.00	psf
	Length of Building	L_{B1}	12.33	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	144.32	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	29.60	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	865.95	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	177.60	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	70.21	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	14.40	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	140.42	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	28.80	plf
Direction 2	Height of Story	H_1	12.00	ft
E-W	Dead Load	D_L	12.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	12.33	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	144.32	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	28.80	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	890.00	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	177.60	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	74.17	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	14.80	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	148.33	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	29.60	plf

***Use 3/4" T&G, 8d nails @ 6 inch edge nail spacing**

***Use 15 gauge staples @ 12 inches for field stapling**

FLAT ROOF DIAPHRAGM

MODULE C

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	12.00	ft
N-S	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	16.50	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	144.32	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	52.80	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	865.95	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	316.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	52.48	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	19.20	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	104.96	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	38.40	plf
Direction 2	Height of Story	H_1	12.00	ft
E-W	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	16.50	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	144.32	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	38.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	1190.68	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	316.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	99.22	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	26.40	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	198.45	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	52.80	plf

***Use 3/4" T&G, 8d nails @ 6 inch edge nail spacing**

***Use 15 gauge staples @ 12 inches for field stapling**

FLOOR DIAPHRAGM

MODULE A

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	8.00	ft
N-S	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	32.33	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	103.47	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	577.30	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	620.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	17.85	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	19.20	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	35.71	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	38.40	plf
Direction 2	Height of Story	H_1	8.00	ft
E-W	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	32.33	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	38.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	1555.50	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	620.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	129.62	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	51.73	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	259.25	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	103.47	plf
Load with cut panel sections				
	Diaphragm Edge Shear	$V_{wdnom}\cdot L_{B2}$	8382.39	lbs
	Length with cut panels	L_{B3}	28.33	ft
	V_{wdnom}	$V_{wdnom}\cdot L_{B2}$	295.85	plf
	Diaphragm Edge Shear	$V_{sdnom}\cdot L_{B2}/L_{B3}$	3345.42	lbs
	V_{sdnom}	$V_{sdnom}\cdot L_{B2}/L_{B3}$	118.07	plf

*Use 3/4" T&G, 10d nails @ 6 inch edge nail spacing

*Use 15 gauge staples @ 12 inches for field stapling

FLOOR DIAPHRAGM

MODULE B

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	8.00	ft
E-W	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	21.50	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	68.80	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	577.30	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	412.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	26.85	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	19.20	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	53.70	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	38.40	plf
Direction 2	Height of Story	H_1	8.00	ft
N-S	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	21.50	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	38.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	1034.32	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	412.80	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	86.19	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	34.40	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	172.39	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	68.80	plf
Load with cut panel sections				
	Diaphragm Edge Shear	$V_{wdnom}\cdot L_{B2}$	2068.65	lbs
	Length with cut panels	L_{B3}	8.00	ft
	V_{wdnom}	$V_{wdnom}\cdot L_{B2}$	258.58	plf
	Diaphragm Edge Shear	$V_{sdnom}\cdot L_{B2}/L_{B3}$	825.60	lbs
	V_{sdnom}	$V_{sdnom}\cdot L_{B2}/L_{B3}$	103.20	plf

*Use 3/4" T&G, 10d nails @ 6 inch edge nail spacing

*Use 15 gauge staples @ 12 inches for field stapling

FLOOR DIAPHRAGM

MODULE C

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	8.00	ft
N-S	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	36.33	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	116.27	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	577.30	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	697.60	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	15.89	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	19.20	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	31.78	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	38.40	plf
Direction 2	Height of Story	H_1	8.00	ft
E-W	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	36.33	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	96.22	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	38.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	1747.93	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	697.60	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	145.66	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	58.13	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	291.32	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	116.27	plf
Load with cut panel sections				
	Diaphragm Edge Shear	$V_{wdnom}\cdot L_{B2}$	10584.67	lbs
	Length with cut panels	L_{B3}	32.33	ft
	V_{wdnom}	$V_{wdnom}\cdot L_{B2}$	327.36	plf
	Diaphragm Edge Shear	$V_{sdnom}\cdot L_{B2}/L_{B3}$	4224.36	lbs
	V_{sdnom}	$V_{sdnom}\cdot L_{B2}/L_{B3}$	130.65	plf

*Use 3/4" T&G, 10d nails @ 6 inch edge nail spacing

*Use 15 gauge staples @ 12 inches for field stapling

TJI ® 230 JOISTS PROVIDED INFORMATION

TJI Depth = 9 1/2 "

ROOF JOISTS

40 PSF Live Load/20 PSF Dead Load > 20 PSF Live Load/16 PSF Dead Load **OK**

L/480 Live Load Deflection

40 PSF Live Load/20 PSF Dead Load			
Spacing	Allowable Span		
16" o.c.	16'-8"	>11'	OK

L/360 Live Load Deflection (Minimum criteria per code)

40 PSF Live Load/20 PSF Dead Load			
Spacing	Allowable Span		
16" o.c.	18'-1"	>11'	OK

FLOOR JOISTS

$$\Delta = \frac{22.5wL^4}{EI} + \frac{2.67wL^2}{d \times 10^5} = 0.1583 \text{ in.}$$

w = uniform live load in pounds per linear foot = 66.67

L = span in feet = 11.625

d = out-to-out depth of the joist in inches = 9.5

EI = 206 x 10⁶ in²-lb

L/480 = 0.2906 in.

L/360 = 0.3875 in.

L/480 & L/360 > Δ **OK**

FLAT ROOF JOIST CALCULATIONS

2x12 Trimmed Joist - DFL No. 1

Length	138 in
Depth	9.75 in
Width	1.5 in
Area	14.63 in ²
S _x	23.77 in ³
I _x	115.86 in ⁴

Reference Design Values

F _b	1000 psi
F _v	180 psi
E	1700000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _M	C _t	C _F	C _i	C _r
1	1	1	1.075	1	1.15

Structural Analysis :

Dead load	20 psf
Live load	25 psf
W: D+L	60 plf
M _{load}	11902.5 lb-in

O.C. spacing	16 in
--------------	-------

Design Calculations

Bending Check

Depth _{nominal}	10.5 in	
Width _{nominal}	2 in	
D _n /W _n :	5.25	* Block @ 16" o.c. with TJI
C _L	1	
F' _b	$F_b * C_M * C_t * C_D * C_r * C_F * C_i * C_L$	
F' _b	1236.25 psi	
f _b : M/S	500.8 psi	
f _b < F' _b ?	OK	

Deflection Check

Length/360	0.383 in.
L	2.778 lb/in
Δ	$5 * L * \text{Length}^4 / (384 * E * I)$
Δ	0.067 in
Δ < Length/360?	OK

Shear Check

F' _v	$F_v * C_D * C_M * C_t * C_i$
F' _v	180 psi
V: wL/2	345 lb
f _v : 3V/2A	35.4 psi
f _v < F' _v ?	OK

FLOOR JOIST CALCULATIONS

DFL No. 2 - 2x4 Floor Joists in Module B from Lines 2-2.5 and 4.5-5

Length	42 in
Depth	3.5 in
Width	1.5 in
Area	5.25 in ²
S _x	3.06 in ³
I _x	5.36 in ⁴

Reference Design Values

F _b	900 psi
F _v	180 psi
E	1600000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _M	C _t	C _F	C _i	C _r
1	1	1	1	1	1.15

Structural Analysis

Dead Load	16 psf
Live Load	50 psf
W: D+L	66 psf
W	94.29 plf
M _{load} :	1732.5 in-lb

Worst Case Tributary Area:

5 ft²

Design Calculations

Bending Check

Depth _{nominal}	4 in
Width _{nominal}	2 in
D _n /W _n :	2 OK
C _L	1
F' _b	F _b *C _M *C _t *C _D *C _r *C _F *C _i *C _L
F' _b	1035 psi
f _b : M/S	565.7 psi
f _b <F' _b ?	OK

Deflection Check

Length/360	0.117 in.
L	5.556 lb/in
Δ	5*L*Length ⁴ / (384*E*I)
Δ	0.026 in
Δ < Length/360?	OK

Shear Check

F' _v	F _v *C _D *C _M *C _t *C _i
F' _v =	180 psi
V: wL/2	165 lb
f _v : 3V/2A	47.1 psi
f _v <F' _v ?	OK

FOUNDATIONS

MODULE A

DIMENSIONS	LENGTH:	32.33	FT	
	HEIGHT:	18	FT	(AT HIGHEST POINT)
	WIDTH:	12	FT	
	WIND:	12.027	PSF	

GRAVITY

DEAD LOAD

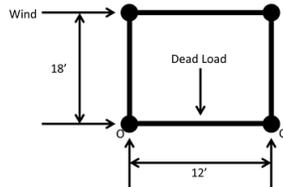
TOTAL MODULE 25609 LBS

LIVE LOAD

FLOOR	50	PSF	19400	LBS
ROOF	20	PSF	8020	LBS
			27420	LBS

1500 PSF BEARING PRESSURE REQUIRES: 19 SQ FT FOR FOOTINGS

LATERAL - FOR IRVINE, CA



WIND: 3028 LBS
DEAD: 27420 LBS

Mo = 0 =>

$$c = [(WIND)(18') + (DEAD)(12'/2)]/12'$$

c = 18251.4 LBS

1500 PSF BEARING PRESSURE REQUIRES: 12.2 SQ FT FOR FOOTINGS PER SIDE

EAST:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	3	1.8	SQ FT
	13.33	SQ FT	PROVIDED

WEST:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	3	1.8	SQ FT
	13.33	SQ FT	PROVIDED

26.7	TOTAL SQ FT PROVIDED
1369	PSF PER FOOTING

FOUNDATIONS

MODULE B

DIMENSIONS	LENGTH:	21.17	FT	
	HEIGHT:	18	FT	(AT HIGHEST POINT)
	WIDTH:	12	FT	
	WIND:	12.027	PSF	

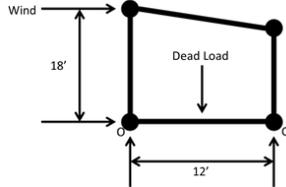
GRAVITY

DEAD LOAD	TOTAL MODULE	15989	LBS
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LIVE LOAD	FLOOR	50	PSF	11400	LBS
	ROOF	20	PSF	4937	LBS
				<hr/>	
				16337	LBS

1500 PSF BEARING PRESSURE REQUIRES: 11 SQ FT FOR FOOTINGS

LATERAL - FOR IRVINE, CA



WIND:	4159	LBS
DEAD:	16337	LBS

Mo = 0 =>

$$c = \frac{[(WIND)(18') + (DEAD)(12'/2)]}{12'}$$

c = 14407.2 LBS

1500 PSF BEARING PRESSURE REQUIRES: 9.6 SQ FT FOR FOOTINGS PER SIDE

NORTH:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	1	1.8	SQ FT
	9.78	SQ FT	PROVIDED

SOUTH:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	1	1.8	SQ FT
	9.78	SQ FT	PROVIDED

19.6	TOTAL SQ FT PROVIDED
1473	PSF PER FOOTING

FOUNDATIONS

MODULE C

DIMENSIONS	LENGTH:	36.33	FT	
	HEIGHT:	18	FT	(AT HIGHEST POINT)
	WIDTH:	12	FT	
	WIND:	12.027	PSF	

GRAVITY

DEAD LOAD

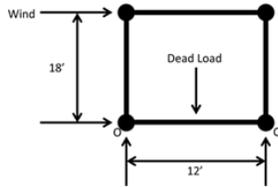
TOTAL MODULE 35005 LBS

LIVE LOAD

FLOOR	50	PSF	21800	LBS
ROOF	20	PSF	8980	LBS
			30780	LBS

1500 PSF BEARING PRESSURE REQUIRES: 21 SQ FT FOR FOOTINGS

LATERAL - FOR IRVINE, CA



WIND: 4760 LBS
DEAD: 30780 LBS

Mo = 0 => $c = [(WIND)(18') + (DEAD)(12'/2)]/12'$
c = 22529.5 LBS

1500 PSF BEARING PRESSURE REQUIRES: 15.0 SQ FT FOR FOOTINGS PER SIDE

EAST:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	5	1.78	SQ FT
	16.89	SQ FT	PROVIDED

WEST:

SEISMIC PIERS	2	4	SQ FT
STANDARD PIERS	5	1.78	SQ FT
	16.89	SQ FT	PROVIDED

33.8	TOTAL SQ FT PROVIDED
1334	PSF PER FOOTING

ANCHORAGE

SEISMIC ANCHOR LOADS

Shear Load (lb) Allowable Design Level			
Module	A	B	C
N-S	4890	-	6017
E-W	1558	4968	6181

Assumed Pullout Design Capacity (per Solar Decathlon rules)
1250 lbs

Shear Load (lb) per Seismic Pier Allowable Design Level			
Module	A	B	C
(lbs)	1223	1242	1545

Assumed Shear Design Capacity (per Solar Decathlon rules)
1500 lbs

Shear Load per Anchor Allowable Design Level			
Module	A	B	C
(lbs)	1223	1242	773

ALLOWABLE SHEAR STRENGTH OF THREADED ROD ANCHOR

AS PER THE DOE, USE A 1" DIAMETER ANCHOR

$$R_n = F_n A_b / \Omega \quad \text{where } \Omega = 2$$

$$F_n = F_{nv} = 20.772 \text{ ksi for A36}$$

$$A_b = 0.785 \text{ in}^2$$

$$R_n = 8157 \text{ lbs per anchor}$$

8157 lbs > 1500 lbs **OK**

8157 lbs > 1242 lbs **OK**

PULLOUT STRENGTH - THREADED ROD ANCHOR IN CONCRETE

$$\text{Embedment length} = 36 \text{ in.}$$

$$\text{Pullout Surface Area} = \pi * 1.4142 * H^2 = 5758 \text{ in}^2$$

$$\text{Shear Strength of Concrete} = 800 \text{ psi}$$

$$\text{Force (lbs)} = 4606336.85 \text{ lbs}$$

4606337 lbs > 1250 lbs **OK**

GRADE VARIABILITY

Standard Piers, fabricated by Central Piers Inc., serve as the footings required to comply with the allowable bearing capacity. See S-101 for the foundation plan and bearing plan. Central Piers Inc. supplies various sized piers for varying ground heights. Central Piers Inc. stocks seismic piers that range from 7"-10" up to 19"-33". Each Standard Pier has a height adjustment of 2". Santa Clara plans to bring a set of all of the available sized piers listed on the Footing Adjustability Schedule on S-601 if shimming is needed. Therefore, no additional structural calculations are needed for our method of pier adjustability because an appropriately sized pier will be used where piers are needed.

MOMENT STABILITY

Overturning Moment = wind * height
Resisting Moment = weight * base/2

MODULE A

Overturning Moment = 29519 lb-ft
Resisting Moment = 153656 lb-ft
OM < RM OK

Factor of Safety = 5.2052659 >1.67 OK

MODULE B

Overturning Moment = 40550 lb-ft
Resisting Moment = 140988 lb-ft
OM < RM OK

Factor of Safety = 3.4768858 >1.67 OK

MODULE C

Overturning Moment = 46407 lb-ft
Resisting Moment = 210031 lb-ft
OM < RM OK

Factor of Safety = 4.5258548 >1.67 OK

ROOF MODULE

Overturning Moment = 24312 lb-ft
Resisting Moment = 95548 lb-ft
OM < RM OK

Factor of Safety = 3.9301247 >1.67 OK

WALL POST DESIGN

Member Information: 4 x 6, No. 1 DF-L

Length	100.75 in
Depth	5.5 in
Width	3.5 in
Area	19.25 in ²

Reference Design Values

F _c	1500 psi
E	1700000 psi
E _{min}	620000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _{M,C}	C _t	C _F	C _i	C _{M,E}	C _{M,Fc}	C _T
1	1	1	1.1	1	1	1	1

Design Calculations

Compression Check

P _{load}	1300 lbs	<i>*Worst Case Scenario: Column at A2 or A5</i>
E' _{min}	$E_{min} * C_{M,E} * C_t * C_i * C_T$	620000 psi
F _{cE}	$0.822 * E'_{min} / ((L/width)^2)$	615 psi
F _c *	$F_c * C_D * C_{M,Fc} * C_t * C_F * C_i$	1650 psi
C _P	0.338	
F' _c	$F_c * C_D * C_M * C_t * C_F * C_i * C_P$	558.0 psi
f _c	P _{load} /Area	67.53 psi
f_c < F'_c	OK	

WALL STUD DESIGN

Member Information: 2 x 4, No. 2 DF-L

Length	100.75 in
Depth	3.5 in
Width	1.5 in
Area	5.25 in ²

Reference Design Values

F _c	1350 psi
E	1600000 psi
E _{min}	580000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _{M,C}	C _t	C _F	C _i	C _{M,E}	C _{M,Fc}	C _T
1	1	1	1.15	1	1	1	1

Design Calculations

P _{load}	288 lbs	<i>*Worst Case Scenario: Between A5 & A6</i>
E' _{min}	$E_{min} * C_{M,E} * C_t * C_i * C_T$	580000 psi
F _{cE}	$0.822 * E'_{min} / ((L/width)^2)$	106 psi
F _c *	$F_c * C_D * C_{M,Fc} * C_t * C_F * C_i$	1552.5 psi
C _P	0.067	
F' _c	$F_c * C_D * C_M * C_t * C_F * C_i * C_p$	104.2 psi
f _c	P _{load} /Area	54.9 psi
f _c < F' _c	OK	

HEADER CALCULATIONS

Header - 4 x 6 DFL No. 1

Length	72 in.
Depth	5.5 in.
Width	3.5 in.
Area	19.25 in ²
S _x	17.65 in ³
I _x	48.53 in ⁴

Reference Design Values

F _b	900 psi
F _v	180 psi
E	1600000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _M	C _t	C _F	C _i	C _r
1	1	1	1.3	1	1

Structural Analysis

Dead Load	16 psf
Live Load	20 psf
W: D+L	36 psf
W	220 plf
M	11880 in-lb

Trib. Area of roof over header	36 ft ²
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*(plus 4 plf for 2 - 2x6 plates above header)

Design Calculations

Bending Check

Depth _{nominal}	6 in.
Width _{nominal}	4 in.
D _n /W _n	1.5 OK
C _L	1
F' _b	$F_b * C_M * C_t * C_D * C_r * C_F * C_i * C_L$
F' _b	1170 psi
f _b : M/S	673.25 psi
f _b < F' _b ?	OK

Deflection Check

Length/360	0.2 in.
L	1.667 lb/in
Δ	$5 * L * \text{Length}^4 / (384 * E * I)$
Δ	0.007511 in.
Δ < Length/360?	OK

Shear Check

F' _v	$F_v * C_D * C_M * C_t * C_i$
F' _v	180 psi
V: wL/2	660 lb
f _v : 3V/2A	51.43 psi
f _v < F' _v ?	OK

* USE 4X6 HEADERS ON OPENINGS BETWEEN 4-6 ft

HEADER CALCULATIONS

Header - 2 x 6 DFL No. 2

Length	48 in.
Depth	5.5 in.
Width	1.5 in.
Area	8.25 in ²
S _x	7.56 in ³
I _x	20.80 in ⁴

Reference Design Values

F _b	900 psi
F _v	180 psi
E	1600000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _M	C _t	C _F	C _i	C _r
1	1	1	1.3	1	1

Structural Analysis

Dead Load	16 psf
Live Load	20 psf
W: D+L	36 psf
W	220 plf
M	5280 in-lb

Trib. Area of roof over header	24 ft ²
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*(plus 4 plf for 2 - 2x6 plates above header)

Design Calculations

Bending Check

Depth _{nominal}	6 in.
Width _{nominal}	2 in.
D _n /W _n	3 OK
C _L	1
F' _b	$F_b * C_M * C_i * C_D * C_t * C_F * C_i * C_L$
F' _b	1170 psi
f _b : M/S	698.18 psi
f _b < F' _b ?	OK

Deflection Check

Length/360	0.13 in.
L	1.667 lb/in
Δ	$5 * L * \text{Length}^4 / (384 * E * I)$
Δ	0.003462 in.
Δ < Length/360?	OK

Shear Check

F' _v	$F_v * C_D * C_M * C_i * C_i$
F' _v	180 psi
V: wL/2	440 lb
f _v : 3V/2A	80.00 psi
f _v < F' _v ?	OK

* USE 2X6 HEADERS ON OPENINGS LESS THAN 4 ft

STEEL

BOTTOM STEEL CHANNEL : C15X33.9

SUPPORTS AT : 0', 6', 14', 22.33', 30.33', & 36.33'

LOADS

D+L 330.0 plf

PROPERTIES

W	33.9	lb/ft	S _x	42	in ³
A	10	in ²	I _x	315	in ⁴
d	15	in	I	36.33	ft
b	3.375	in	E	29000000	psi
t	0.625	in	F _y	36	ksi

DEFLECTION

$\Delta_{\text{allowable}}$	=	l/480	=	0.076'
Δ_{max}	=	0.009'		OK

Max Allowable Uniform Load	=	91.3	klf
Actual Uniform Load	=	0.33	klf
		Max > Actual	OK

FLEXURE

Yielding

M _n	=	91.3	kip-ft
M _{max}	=	2.074	kip-ft OK

SHEAR

V _n	=	77.6	kips
V _{max}	=	1.888	kips OK

STEEL

BOTTOM SHORT EDGE STEEL CHANNEL- MODULE B : C8X11.5

SUPPORTS AT : 0', 6', & 12'

LOADS

D + L 216.0 plf

PROPERTIES

W	11.5	lb/ft	S _x	8.14	in ³
A	3.37	in ²	I _x	32.5	in ⁴
d	8	in	l	6	ft
b	2.25	in	E	29000000	psi
t	0.375	in	F _y	36	ksi

DEFLECTION

Δ_{\max}	=	0.007'	=	OK
$\Delta_{\text{allowable}}$	=	1/480	=	0.013'

Max Allowable Uniform Load	=	17.3	klf
Actual Uniform Load	=	0.216	klf
		Max > Actual	OK

FLEXURE

Yielding

M _n	=	17.3	kip-ft	
M _{max}	=	1.024	kip-ft	OK

SHEAR

V _n	=	22.8	kips	
V _{max}	=	0.832	kips	OK

STEEL

BOTTOM STEEL: HSS 8X3X3/8

LOADS

$$\text{Point load during transportation} = 2143.2 \text{ lbs}$$

PROPERTIES

$$\begin{aligned} b/t &= 5.6 \\ h/t &= 19.9 \\ \text{Cantilevered Length} &= 18.6875" \\ &\text{Need to check yielding, flange local buckling, and web local buckling} \end{aligned}$$

DEFLECTION

$\Delta_{\text{allowable}}$	=	1/480	=	0.039"
Δ_{max}	=	0.0033"	=	OK

FLEXURE

Yielding

M_n	=	61.72	kip-ft	
M_{max}	=	3.34	kip-ft	OK

SHEAR

$$V_n = 0.6F_y A_w C_v \quad A_w = 5.4375 \text{ in}^2 \quad C_v = 1 \quad F_y = 46 \text{ ksi}$$

V_n	=	89.87	kips	
V_{max}	=	2.14	kips	OK

FLANGE LOCAL BUCKLING

$$1.12 \sqrt{E/F_y} = 28.12 > b/t \quad \text{FLB DOES NOT APPLY}$$

WEB LOCAL BUCKLING

$$2.42 \sqrt{E/F_y} = 60.76 > h/t \quad \text{WLB DOES NOT APPLY}$$

STEEL

STEEL COLUMNS : HSS 3.5X3.5X5/16

LOADS

$$\text{Point Load} = 3 \text{ kips}$$

PROPERTIES

W	12.7 lb/ft	S _x	3.34 in ³	r	1.29 in
A _g	3.52 in ²	I _x	5.84 in ⁴	b/t	9.03
d	3.5 in	E	29000000 psi	KL/r	81.77
I	8.79 ft	F _y	46 ksi		

Need check local buckling and flexural buckling

FLEXURAL BUCKLING

When $KL/r < 4.71\sqrt{E/F_y}$:

$$F_{cr} = [0.658^{F_y/F_e}] F_y$$

$$\text{where } F_e = \frac{\pi^2 E}{(KL/r)^2} = 42.81 \text{ ksi}$$

$$F_{cr} = 29.34 \text{ ksi}$$

$$P_n = 0.9F_{cr}A_g = 92.94 \text{ kips} > 3 \text{ kips} \quad \text{OK}$$

LOCAL BUCKLING

$$1.4\sqrt{E/I} = 59.07 > b/t \quad \text{NONSLENDER - LB DOES NOT APPLY}$$

STEEL

TOP MODULE CONNECTOR BEAM : W5X19

LOADS

$$D + L = 300.0 \text{ plf}$$

PROPERTIES

W	16	lb/ft	S_x	10.2	in ³	L	21.25	ft
A	5.56	in ²	I_x	26.3	in ⁴	L_b	11.583	ft
A_w	2.24	in ²	I_y	9.13	in ⁴	Z_x	9.63	in ³
d	5.125	in	E	29000000	psi	r_y	1.28	in.
b_f	5	in	F_y	50	ksi	C_v	1	
t_w	0.4375	in	J_c	0.316	in ⁴	C_b	1.14	
h_o	4.72	in.						

Need to check yielding and lateral torsional buckling.

DEFLECTION

$\Delta_{\text{allowable}}$	=	$I_b/480$	=	0.024'
Δ_{max}	=	0.0133'	=	OK

Max Allowable Uniform Load	=	91.3	klf
Actual Uniform Load	=	0.33	klf
		Max > Actual	OK

FLEXURE

Yielding

M_n	=	481.5	kip-in
M_{max}	=	60.4	kip-in OK

SHEAR

$$V_n = 0.6F_y A_w C_v$$

V_n	=	67.27	kips
V_{max}	=	1.738	kips OK

LATERAL - TORSIONAL BUCKLING

$$\begin{aligned}
 L_p &= 1.76r_y \sqrt{E/F_y} = 54.25 \text{ in} \\
 L_b &= 139 \text{ in} \\
 L_r &= 1.95r_{ts} \sqrt{E/0.7F_y} \sqrt{\{(J_o/S_x h_o) + v[(J_o/S_x h_o)^2 + 6.76(0.7F_y/E)^2]\}} \\
 r_{ts}^2 &= I_y h_o / 2S_x \rightarrow r_{ts} = 1.453 \\
 L_r &= 276.25 \text{ in.}
 \end{aligned}$$

When $L_p < L_b < L_r$:

$$M_n = C_b \{M_p - [M_p - 0.7F_y S_x] * [(L_b - L_p) / (L_r - L_p)]\} \leq M_p$$

$$M_n = 339.4 \text{ k-in} \leq M_p \quad \text{OK}$$

$$M_n > M_{max} \quad \text{OK}$$

STEEL

LATERAL COLLECTOR BEAM : W5X19

LOADS

$$\text{E-W Seismic and Wind Loads} = 7.1 \text{ kips}$$

PROPERTIES

b/t	5.85	E	29000 ksi	L	141.81 in
A _g	5.56 in ²	F _y	50 ksi	r _y	1.26 in.
C _w	50.9 in ⁶	I _x	26.3 in ⁴	I _y	9.13 in ⁴
J	0.316 in ⁴	G	11200 ksi	KL/r	112.55

Need to check flexural buckling and torsional buckling.

FLEXURAL BUCKLING

When $KL/r < 4.71\sqrt{E/F_y}$:

$$F_{cr} = [0.658^{F_y/F_e}] F_y$$

$$\text{where } F_e = \frac{\pi^2 E}{(KL/r)^2} = 22.59 \text{ ksi}$$

$$F_{cr} = 19.80 \text{ ksi}$$

$$P_n = 0.9F_{cr}A_g = 99.09 \text{ kips} \geq 7.1 \text{ kips} \quad \mathbf{OK}$$

TORSIONAL BUCKLING

For doubly symmetric members:

$$F_e = [\pi^2 EC_w / (K_z L)^2 + GJ] * 1 / (I_x + I_y)$$

$$F_e = 120.34 \text{ ksi}$$

$$F_{cr} = 42.02 \text{ ksi}$$

$$P_n = 0.9F_{cr}A_g = 210.26 \text{ kips} \geq 7.1 \text{ Kips} \quad \mathbf{OK}$$

STEEL

W5x19 TO COLUMN PLATE CONNECTION

LOADS

W_{wind}	5244	lb	
$W_{seismic}$	5783	lb	* (Seismic Governs)

(2) 1/2" A307 threaded bolt

ALLOWABLE SHEAR STRENGTH

F_{nv}	27	ksi	
A_b	0.196	in ²	
ϕ	0.75		
$R_n = \phi * F_{nv} * A_b$	3976.08	lbs	
$2 * R_n$	7952.16	lbs	
7952.16	>	5783.00	OK

AVAILABLE TENSILE STRENGTH

f_{tv}	13.4	ksi	(WIND LOAD)
F'_{nt}	28.83	≤	45
$R_n = \phi * F'_{nt} * 2A_b =$	8490	lbs	OK

STEEL

W5X19 SPLICE CONNECTION

(Details 2 & 3 on SOS E2)

$$A_n \cdot U = A_e$$

$$\phi A_e \cdot F_v \geq 7.87^k$$

$$A_e = 0.5625 \text{ in}^2$$

$$F_v = 21.6 \text{ ksi}$$

$$\phi A_e \cdot F_v = 9.1125 \text{ kips} \geq 7.87^k \quad \mathbf{OK}$$

1/2" A325 bolts

$$F_n A_b = R_n = 10.60 \text{ kips}$$

$$\phi R_n = 7.95 \text{ kips} \geq 7.87^k \quad \mathbf{OK}$$

STEEL

C15X33.9 to C8X11.5 MODULE CONNECTION

MODULE A TO B Detail 4 on SOS E2

LOADS

$W_{wind.}$	5122	lb	* (Wind Governs)
$W_{seismic}$	4569	lb	

1" A307 threaded bolt

ALLOWABLE SHEAR STRENGTH

F_{nv}	27	ksi	
A_b	0.785	in ²	
ϕ	0.75		
$R_n = \phi * F_{nv} * A_b$	15904.31	lbs	
15904.31	>	5122.00	OK

AVAILABLE TENSILE STRENGTH

f_{tv}	6.5	ksi	(WIND LOAD)
F'_{nt}	44.01	≤	45
$R_n = \phi * F'_{nt} * A_b =$	25923	lbs	OK

STEEL

C15x33.9 to C8x11.5 MODULE CONNECTION

MODULE B TO C Detail 4 on SOS E2

LOADS

$W_{wind.}$	7866	lb	* (Wind Governs)
$W_{seismic}$	7001	lb	

1" A307 threaded bolt

ALLOWABLE SHEAR STRENGTH

F_{nv}	27	ksi	
A_b	0.785	in ²	
ϕ	0.75		
$R_n = \phi * F_{nv} * A_b$	15904.31	lbs	
15904.31	>	7866.00	OK

AVAILABLE TENSILE STRENGTH

f_{tv}	10.0	ksi	(WIND LOAD)
F'_{nt}	36.24	≤	45
$R_n = \phi * F'_{nt} * A_b =$	21349	lbs	OK

STEEL

TEMPORARY BRACING : L2X2X1/4

For Transportation

Design Load : 20 kips in tension or compression

TENSION

A_g 0.944 in²

$A_e = 0.75A_g$ 0.708 in²

Available Strength in Axial Tension

Yielding

$\phi_t P_n$ 30.6 kips > 20 kips

Rupture

$\phi_t P_n$ 30.8 kips > 20 kips

COMPRESSION

$0.45\sqrt{E/F_y}$ 12.77

b/t 8

$b/t < 0.45\sqrt{E/F_y} \rightarrow$ nonslender

$P_n = F_{cr} A_g$

KL/r 261.47

$4.71\sqrt{E/F_y}$ 133.68

$KL/r > 4.71\sqrt{E/F_y} \rightarrow F_{cr} = 0.877 F_e$

F_{cr} 3.672 ksi

P_n 3.466 kips Per brace

→ **Need 6 braces per module B to take 20 kips load in compression and tension**

→ **Add bracing in other modules for additional support to their existing shear walls**

CONNECTIONS

DTT2Z-SDS2.5 HOLDOWN CONNECTION

NORTH SIDE

LOAD

$(12.027 \text{ PSF}) \cdot (7\frac{1}{2}) \cdot (41.5\frac{1}{2}) =$	873.46	LBS
$(12.027 \text{ PSF}) \cdot (9.2\frac{1}{2}) \cdot (21.1\frac{1}{2}) =$	583.67	LBS
	<hr/>	
Σ	1457.13	LBS

HOLDOWN:

DTT2Z-SDS2.5

2145 LBS > 1457.13 LBS **OK**

SOUTH SIDE

LOAD

$(12.027 \text{ PSF}) \cdot (7) \cdot (41.5\frac{1}{2}) =$	1746.92	LBS
$(12.027 \text{ PSF}) \cdot (7\frac{1}{2}) \cdot (16.8\frac{1}{2}) =$	353.59	LBS
	<hr/>	
Σ	2100.52	LBS

PERCENT THAT GOES TO HOLDOWN : 51.3%

HOLDOWN:

DTT2Z-SDS2.5

2145 LBS > 1077.56 LBS **OK**

ROOF MODULE

STEEL

ROOF BOTTOM STEEL ANGLE : L8X4X1/2

SUPPORTS AT : 0.1667', 9.75', 31.21', 40.79'

LOADS

$W_{Live\ Load}$	20 psf	120 plf		
$W_{Dead\ Load}$	15.5 psf		Tributary Width	6 ft
D + L	35.5 psf	212.7 plf	Average Wall Height	6.083 ft

PROPERTIES

W	19.6 lb/ft	S_x	7.48 in ²
A	5.8 in ²	I_x	38.6 in ⁴
d	4 in	l	0.1667 ft
b	8 in	E	29000000 psi
t	0.5 in	Fy	36 ksi

DEFLECTION

Beam	$\Delta_{allowable}$	=	l/480	=	0.537 in
	$\Delta_{max(21.46' span)}$	=	0.272 in	=	OK

Cantilever	$\Delta_{allowable}$	=	l/480	=	0.004 in
	$\Delta_{max(0.1667' span)}$	=	0.000 in	=	OK

FLEXURE

Yielding

M_y	215.42 kip-in			
M_n	=	1.5*M _y	=	26.93 kip-ft
M_{max}	=	7.63	kip-ft	OK

SHEAR

$h/t_w = b/t$	18.7	<	63.58	
V_n	=	.6F _y b*t*C _v	=	57.6 kips
V_{max}	=	2.542	kips	OK

LATERAL TORSIONAL BUCKLING

Continuous Lateral Support - N/A

LEG LOCAL BUCKLING

Compact Section - N/A

CHECK INTERNAL BENDING

Load (1' span)

$$\begin{aligned} P &= (35.5 \text{ psf} * \cos(24) + 12.027 \text{ psf}) * 11.25 \text{ ft}^2 = 500.15 \text{ lb} \\ l &= 8 \text{ in} \\ b &= 5.625 \text{ in} \end{aligned}$$

$$\begin{aligned} M_{\max} &= P * b = 234.45 \text{ lb-ft} \quad \mathbf{OK} \\ M_{\text{allowable}} &= 0.8 S_x F_y = 2585088 \text{ lb-ft} \end{aligned}$$

$$\begin{aligned} \Delta_{\text{allowable}} &= l/360 = 0.0222 \text{ in} \\ \Delta_{\max} &= (P b^2 / 6EI)(3l - b) = 0.0201 \text{ in} \quad \mathbf{OK} \end{aligned}$$

STEEL

ROOF BOTTOM STEEL ANGLE : L8X4X1/2

SUPPORTS AT : 0.1667', 9.75', 31.21', 40.79'

LOADS

$W_{\text{Live Load}}$	120	plf		
$W_{\text{Dead Load}}$	114.8	plf	Tributary Width	6 ft
D + L	234.8	plf	Average Wall Height	6.083 ft

PROPERTIES

W	19.6	lb/ft	S_x	7.48	in ²
A	5.8	in ²	I_x	38.6	in ⁴
d	4	in	l	0.1667	ft
b	8	in	E	29000000	psi
t	0.5	in	Fy	36	ksi

DEFLECTION

Beam	$\Delta_{\text{allowable}}$	=	l/480	=	0.537
	$\Delta_{\text{max (21.46' span)}}$	=	0.356	=	OK

Cantilever	$\Delta_{\text{allowable}}$	=	l/480	=	0.004
	$\Delta_{\text{max(0.1667' span)}}$	=	0.000	in.	OK

FLEXURE

Yielding

M_y	215.42	kip-in			
M_n	=	1.5* M_y	=	26.93	kip-ft
M_{max}	=	8.19	kip-ft	OK	

SHEAR

$h/t_w = b/t$	18.7	<	63.58		
V_n	=	$.6F_y b t C_v / \Omega$	=	57.6	kips
V_{max}	=	2.73	kips	OK	

LATERAL TORSIONAL BUCKLING

Continuous Lateral Support - N/A

LEG LOCAL BUCKLING

Compact Section - N/A

CHECK INTERNAL BENDING

Load (1' span)

$$\begin{aligned} P &= (35.5 \text{ psf} * \cos(24) + 12.027 \text{ psf}) * 11.25 \text{ ft}^2 = 500.15 \text{ lb} \\ l &= 8 \text{ in} \\ b &= 5.625 \text{ in} \end{aligned}$$

$M_{\max} = P * b = 234.45 \text{ lb-ft}$	OK
$M_{\text{allowable}} = 0.8 S_x F_y = 2585088 \text{ lb-ft}$	

$\Delta_{\text{allowable}} = l/360 = 0.0222 \text{ in}$	
$\Delta_{\max} = (P b^2 / 6EI)(3l - b) = 0.0201 \text{ in}$	OK

STEEL

NORTH WALL ROOF STEEL COLUMNS : C3X3.5

LOADS

$W_{wind\ E-W}$	12.027	psf	144.32	plf	Tributary Width	12.00	ft
$W_{seismic}$	7499.52	lb	308.20	plf	Beam Length	6.083	ft
$W_{seismic}$	1874.88	lb per column	* (Seismic Governs)				

SECTION PROPERTIES

Weight	3.5	lb/ft	Weight	85.167	lb per column		
A	1.09	in	I_x	1.57	in ⁴	E	29000000 psi
d	3	in	Z_x	1.24	in ³	F_y	36 ksi
b_f	1.37	in	S_x	1.04	in ³	F_u	58 ksi
t_w	0.132	in	r_x	1.2	in	b/t	5.02
t_f	0.273	in	L	6.0833	ft	h/ t_w	14.5

DEFLECTION

$\Delta_{allowable}$	=	$l/480$	=	0.152	in	
$\Delta_{max\ (21.46'\ span)}$	=	$5wL^4/(384EI)$	=	0.0024	in	OK

FLEXURE

Yielding $\Omega_b = 1.67$

$M_n = M_p/\Omega = F_y Z_x/\Omega =$	26.73	k-in	=	2.228	k-ft
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SHEAR

$V_n = .6F_y A_w C_v/\Omega =$	5.7024	kips		
$V_{max} =$	0.93744	kips	OK	

$\Omega = 1.5$ $k_v = 5$ $C_v = 1$

LATERAL TORSIONAL BUCKLING

$$L_p = 147.929 \text{ in}$$

$$L_b = 6.083 \text{ in}$$

$$L_b \leq L_p$$

→ NO LATERAL TORSIONAL BUCKLING

$M_{\max} = w l^2 / 12 = 0.95 \text{ kip-ft}$	OK
$M_p = 2.23 \text{ kip-ft}$	

TENSION

$$P_{\max} = 0.1259 \text{ kips} \quad \mathbf{OK}$$

Yielding

$P_n = F_y A_g / \Omega = 23.50 \text{ kips}$

Rupture

$P_n = F_u A_e / \Omega = 33.27 \text{ kips}$

NORTH WALL ROOF - TIMBER FRAMING

DOUG FIR LARCH 2X6 STUDS

LOADS

$W_{Live\ Load}$	20	psf	120	plf		
$W_{Dead\ Load}$	18	psf	108	plf	$f_c = P/A$	126.7 psi
$V_{wind\ N-S}$	12.027	psf	55.1	plf	$fb = M/S$	404.6 psi
D + L + W	50.027	psf	283.1	plf		
					M	254.99 lb-ft

SECTION PROPERTIES

b	1.5	in	W	1.9	plf	219.213	lb
d	5.5	in	E	1600000	psi	5.219	plf over northwall
A	8.25	in ²	E_{min}	580000	psi		
S_x	7.563	in ³	F_b	900	psi		
I_x	20.8	in ⁴	F_c	1350	psi		
S_y	2.063	in ⁴	F_v	180	psi		
I_y	1.547	in ⁴					
			Grav Tributary Width	6	ft		
			Wind Tributary Width	4.58	ft		MAX TRIB LENGTH
			Average Wall Height = l	6.08	ft		

BEAM COLUMN ANALYSIS

$$(f_c/F_c)^2 + (F_{b1}/(F_{b1}*(1-(f_c/F_{cE1})))) + (f_{b2}/(F_{b2}*(f_c/F_{cE2})-(f_{b1}/F_{bE})^2)) \leq 1.0$$

Adjustment Factors:

C_D	1.6	C_{fu}	1.0
$C_{F_{Fc}}$	1.1	C_T	1.0
$C_{F_{Fb}}$	1.3	C_i	1.0
C_t	1.0	$C_{M_{Fb}}$	1.0
C_r	1.0	C_{M_E}	1.0
$C_{M_{Fc}}$	1.0		

STRUCTURAL ANALYSIS

Major Axis Bending

M_{x_Max}	1309.7	lb-ft	(Simple Assumed)
F_{b1}	2078.0	psi	

Minor Axis Bending

F_{b1}	0	psi	(Concentric Axial Force)
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Axial Load

P_{axial}	1722.33	lb
F_c	208.77	psi

MEMBER CAPACITIES

Axial Capacity

F'_c	$F'_c = F_c C_D C_M C_t C_F C_i C_P$	1743.95 psi
E'_{min}	$E'_{min} = E_{min} C_M C_t C_i C_T$	580000 psi
F_{cE}	$.822(E'_{min})/(l_e/d)^2$	2706.32 psi
	$K_e = 1$	$l_e = 6.083$
	$l_e/d = 13.27$	OK
F^*_c	$F^*_c = F_c C_D C_M C_t C_F C_i$	2376 psi
	$\rightarrow C_p = 0.734$	

Flexural Capacity

F'_b	$F'_b = F_b C_D C_M C_t C_L C_F C_i C_{tu} C_r$	1872 psi
--------	---	----------

CHECK

$$(f_c/F'_c)^2 + (F_{b1}/(F'_{b1} * (1 - (f_c/F_{cE1})))) + (f_{b2}/(F'_{b2} * (f_c/F_{cE2}) - (f_{b1}/F_{bE}))) \leq 1.0$$

0.232	≤	1.0	OK
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TJI ® 230 JOISTS PROVIDED INFORMATION

TJI Depth = 9 1/2 "

ROOF JOISTS

40 PSF Live Load/20 PSF Dead Load > 20 PSF Live Load/16 PSF Dead Load **OK**

L/480 Live Load Deflection

40 PSF Live Load/20 PSF Dead Load			
Spacing	Allowable Span		
16" o.c.	16'-8"	>13'	OK

L/360 Live Load Deflection (Minimum criteria per code)

40 PSF Live Load/20 PSF Dead Load			
Spacing	Allowable Span		
16" o.c.	18'-1"	>13'	OK

ROOF CHORD FORCES

$$\text{Chord Force} = M/d = T = C$$

LOADS

$W_{\text{Live Load}}$	0 psf	0 plf		
$W_{\text{Dead Load}}$	18 psf		Chord Depth (d) =	12 ft
D + L	18 psf	216 plf	Length (l) =	43.00 ft

CHORD FORCE ANALYSIS

$$M = Wl^2/8 = 49923 \text{ lb-ft}$$

$$M/d = 4.16025 \text{ kips}$$

MEMBER ALLOWABLE

A36 - L8X4X1/2 - Braced Column Analysis

$$T_{\text{allow}} = 188 \text{ kips (Table 5-2) AISC Steel Construction Manual}$$

$$C_{\text{allow}} = 34.6 \text{ kips (Table 4-11) AISC Steel Construction Manual}$$

$$\text{Chord Force}_{\text{Capacity}} = 34.6 > \text{Chord Force}_{\text{Demand}} = 4.16025 \quad \mathbf{OK}$$

SLOPED ROOF DIAPHRAGM

ROOF MODULE

Unblocked Diaphragm Design

Direction 1	Height of Story	H_1	6.00	ft
N-S	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	41.06	ft
		L_{B2}	12.00	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	72.16	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	131.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	432.97	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	788.38	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	10.54	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	19.20	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	21.09	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	38.40	plf
Direction 2	Height of Story	H_1	6.00	ft
E-W	Dead Load	D_L	16.00	psf
	Length of Building	L_{B1}	12.00	ft
		L_{B2}	41.06	ft
Applied Load	Wind	$W_L=(12.027\text{psf})\cdot H_1$	72.16	plf
	Seismic	$W_S=0.2\cdot D_L\cdot L_{B1}$	38.40	plf
V_{max}	Wind	$V_{wmax}=W_L\cdot L_{B2}/2$	1481.55	lb
	Seismic	$V_{smax}=W_S\cdot L_{B2}/2$	788.38	lb
V_{wd}	Wind	$V_{wd}=V_{wmax}/L_{B1}$	123.46	plf
V_{sd}	Seismic	$V_{sd}=V_{smax}/L_{B1}$	65.70	plf
Nominal Capacities	Ω		2	
	V_{wdnom}	$V_{wdnom}=V_{wd}\cdot\Omega$	246.92	plf
	V_{sdnom}	$V_{sdnom}=V_{sd}\cdot\Omega$	131.40	plf

***Use 3/4" T&G, 8d nails @ 6 inch edge nail spacing**

***Use 15 gauge staples @ 12 inches for field stapling**

CONNECTIONS

REFER TO PAGE S-531

C15X33.9 TO C8X11.5 INTERMODULAR CONNECTION

LOADS

W_{wind}	3146	lb	* (Wind Governs)
$W_{seismic}$	1857.6	lb	

1/2" A307 threaded bolt

ALLOWABLE SHEAR STRENGTH

F_{nv}	27	ksi	
A_b	0.196	in ²	
ϕ	0.75		
$R_n = \phi * F_{nv} * A_b$	3976.08	lbs	
3976.08	>	3146.07	OK

AVAILABLE TENSILE STRENGTH

f_{rv}	16.0	ksi	(WIND LOAD)
F'_{nt}	22.89	≤	45
$R_n = \phi * F'_{nt} * A_b =$	3371	lbs	OK

NORTH WALL TIMBER STUDS

Simpson Strong-Tie A34 Connection Framing Angle

Max Load =	490	psf	>	50.03	psf	OK
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JOIST HANGER CONNECTION

Simpson Strong-Tie LSSU135 Sloped Hanger

Max Load =	1275	psf	>	38	psf	OK
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C3X3.5 TO L8X4X1/2 : TOP & BOTTOM CONNECTION

LOADS

$W_{wind.N-s}$	3146.07	lb	73.164396	plf	*(Wind Governs)
$W_{seismic}$	1857.6	lb	43.2	plf	

Tributary Width	12.00	ft
Wall Height = 'Beam Length'	6.083	ft

Industry Designed Filet Welded Connection

SUNPLANTER

(2) 5/16" Ceramic Coated lag screw

UPLIFT

SA	=	546	ft ²	
WIND _{lat}	=	12.027	psf	
WIND _{perp}	=	12.027tan(24)	=	5.34 psf
	=	21.86	lb	
UPLIFT	=	2915.64	lb	over whole roof
UPLIFT	=	208.26	lb	per column end
GRAVITY	=	96.6	lb	per column end

CAPACITY

TENSION	=	893	lb		per bolt		
SHEAR	=	432	lb		per bolt		
T&S	=	447	lb		per bolt		
		893	lb	>	208	lb	OK
		431	lb	>	21.86	lb	OK

DECK

DECK GIRDER CALCULATIONS

DFL No. 2 - 4x6

Length	96 in
Depth	5.5 in
Width	3.5 in
Area	19.25 in ²
S _x	17.65 in ³
I _x	48.53 in ⁴

Reference Design Values

F _b	900 psi
F _v	180 psi
E	1600000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _{M,b}	C _t	C _F	C _i	C _r	C _{M,v}
1	0.85	1	1.3	1	1	0.97

Structural Analysis

Dead Load	1.96 psf
Live Load	100 psf
W: D+L	135.95 plf
M _{load} :	13050.88 lb-in

O.C. spacing

16 in

Design Calculations

Bending Check

Depth _{nominal}	4 in
Width _{nominal}	2 in
D _n /W _n :	2 OK
C _L	1
F' _b	$F_b * C_M * C_t * C_D * C_r * C_F * C_i * C_L$
F' _b	994.5 psi
f _b : M/S	739.6 psi
f _b < F' _b ?	OK

Deflection Check

Length/360	0.267 in.
L	11.111 lb/in
Δ	$5 * L * \text{Length}^4 / (384 * E * I)$
Δ	0.158 in
Δ < Length/360?	OK

Shear Check

F _v	$F_v * C_D * C_M * C_t * C_i$
F' _v =	174.6 psi
V: wL/2	543.79 lb
f _v : 3V/2A	42.4 psi
f _v < F' _v ?	OK

DECK JOIST CALCULATIONS

DFL No. 2 - 2x6

Length	48 in
Depth	5.5 in
Width	1.5 in
Area	8.25 in ²
S _x	7.56 in ³
I _x	20.80 in ⁴

Reference Design Values

F _b	900 psi
F _v	180 psi
E	1600000 psi

Adjustment Factors - NDS Table 4.3.1

C _D	C _{M,b}	C _t	C _F	C _i	C _r	C _{M,v}
1	0.85	1	1.3	1	1.15	0.97

Structural Analysis

Dead Load	1.96 psf
Live Load	100 psf
W: D+L	135.95 plf
M _{load} :	3262.72 lb-in

O.C. spacing

16 in

Design Calculations

Bending Check

Depth _{nominal}	6 in
Width _{nominal}	2 in
D _n /W _n :	3 OK
C _L	1
F' _b	$F_b * C_M * C_t * C_D * C_r * C_F * C_i * C_L$
F' _b	1143.675 psi
f _b : M/S	431.4 psi
f _b < F' _b ?	OK

Deflection Check

Length/360	0.133 in.
L	11.111 lb/in
Δ	$5 * L * \text{Length}^4 / (384 * E * I)$
Δ	0.023 in
Δ < Length/360?	OK

Shear Check

F' _v	$F_v * C_D * C_M * C_t * C_i$
F' _v	174.6 psi
V: wL/2	271.89 lb
f _v : 3V/2A	49.4 psi
f _v < F' _v ?	OK

DECK SLATS

TIGER DECK

Length	16 in
Depth	3.44 in
Width	0.94 in
Area	3.2336 in ²
S _x	1.85 in ³
I _x	3.19 in ⁴

Bending Strength (psi @ 12%)	16620
Max Crushing Strength (psi @ 12%)	10320
Weight (lb/cu.ft.)	77

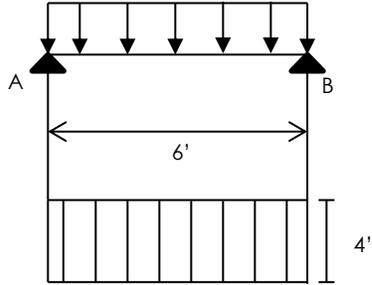
JOIST SPACING (in)	ALLOWABLE LOAD (psf)	MAX DEFLECTION	MAX FLEXURAL STRESS (psi)	Δ
12	40	0.00022	37	L/54096
16	40	0.0007	66	L/22822
19.2	40	0.00145	95	L/13207
24	40	0.00355	148	L/6762
12	60	0.00033	58	L/38085
16	60	0.00105	99	L/15215
19.2	60	0.00218	143	L/6805
24	60	0.00532	224	L/4508
12	90	0.0005	84	L/24043
16	90	0.00158	149	L/10143
19.2	90	0.00327	215	L/5870
24	90	0.00799	335	L/3005
16	100	0.00176	165.6	L/9090

THROUGH EXTRAPOLATION:

FLEXURE	165.6 psi	<	335 psi	OK
DEFLECTION	L/9090	<	L/360	OK

DECK FOUNDATION

<u>D</u>	<u>L</u>	<u>Total</u>	<u>Trib B</u>	<u>w</u>
(psf)	(psf)	(psf)	(ft)	(plf)
20.00	100	120.00	4.00	480



w =	480	plf
L =	8.00	ft
$R_A = R_B =$	1920	LBS

AT 1500_{PSF} BEARING PRESSURE THIS REQUIRES: 1.3 SQ FT FOR FOOTINGS

A:		QTY	AREA	
	SEISMIC PIERS	0	4	SQ FT
	STANDARD PIERS	2	1.8	SQ FT
		3.6	SQ FT	PROVIDED
		533.3	PSF PER FOOTING	

AT 1500_{PSF} BEARING PRESSURE THIS REQUIRES: 1.3 SQ FT FOR FOOTINGS

B:		QTY	AREA	
	SEISMIC PIERS	0	4	SQ FT
	STANDARD PIERS	2	1.8	SQ FT
		3.6	SQ FT	PROVIDED
		533.3	PSF PER FOOTING	

DECK

DECK CONNECTIONS

SLAT TO JOIST:

STANDARD: (2) No. 8 screws per slat per supporting joist

JOIST TO GIRDER:

16 penny nails

NOTE: Blocking at ~ 4' intervals for rigidity

GIRDER TO SUPPORT:

Simpson Strong Tie: GLS & GLT

HOUSE LEDGER:

N/A – self supported deck via piers

SUPPORT TO PIER:

Central Piers: Marriage Top (201) to 4x6 In Place Girder

AWNINGS

DESIGN WIND LOAD

ASCE 7-02 6.4.2.2: WIND DESIGN METHOD I

$$P_{net} = \lambda * I * P_{net}^{*30}$$

BASIC WIND LOAD

Angle (<7°) 4.5 °

Table 6.3 for permeable components & cladding (6.4.3)

I 1

λ 1.21

Basic Wind Speed 90 mph

P_{net30} -19.8 psf

(For Zone 2 @ 100 ft²)

P_{net30} -10 psf

(Minimum allowed per 6.4.2.2.1)

Approximate Effective Area 400 ft²

$P_{net30} =$ -19.8 psf

AWNINGS

MEMBER A (114 IN): HSS 2X2X1/8

PROPERTIES - AISC Shapes Database

A_g	0.84 in ²	Z	0.584 in ³	r	0.761 in
d	2 in	I	0.486 in ⁴	KL/r	149.8 in/in
L_{Member}	9.5 ft	E	29000000 psi	Ω	1.67
		F_y	46 ksi		

EFFECTIVE AREA

Effective Width	50 in	WIND	-19.8 psf
Effective Length	114 in	<i>(ASCE 7-02 Wind Design Method I, section 6.4.2.2)</i>	
A _{eff}	39.6 ft ²		

EFFECTIVE WIND LOAD

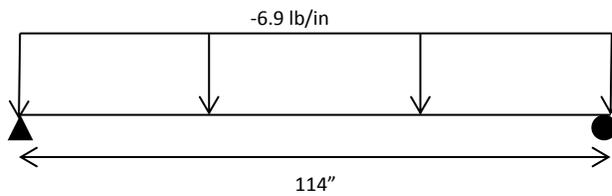
1/2 tributary area of wind load (assume aspect ratio 2:1)

WIND _{eff} = A _{eff} *WIND	=	-783.8 lb
W = WIND _{eff} /Member L	=	-6.875 lb/in

DEFLECTION CHECK

Δ _{allowable}	=	L/80	1.43 in	<i>(conservative)</i>	
Δ _{max}	=	5WL ⁴ /(384EI)	1.07 in		
		Δ _{max}	<	Δ _{allowable}	OK

FLEXURE



Yielding

M _n	=	F _y *Z	=	26.9 kip-in	
M _{allow}	=	M _n /Ω	=	1.3 kip-ft	
M _{max}	=	WL ² /8	=	0.9 kip-ft	
		M _{max}	<	M _{allow}	OK

FLEXURAL BUCKLING -

Due to tension of shade fabric on beams distributed as axial load on Member A

Assume: Fabric weight << than tension & wind loads

75 lb tension/gromet (gromets attached @ 6" O.C. on fabric and weaved into beams)

Tension Force	=	150	plf
Length of Fabric	=	139	in
Length of Beam	=	114	in
Intermediate Braces, Member A	=	3	members
Total Axial Load on Member A	=	579	lb
F_{actual}	=	0.689	ksi

When $KL/r > 4.71 \sqrt{E/F_y} = 118.3$ in/in

$F_{cr} = 0.877 F_e$

where $F_e = \frac{\pi^2 E}{(KL/r)^2} = 12.8$ ksi

$F_{cr} = 11.19$ ksi

$F_n = F_{cr} / \Omega = 6.7$ ksi

F_n	=	6.7	ksi
F_{actual}	=	0.689	ksi
F_{actual}	<	F_n	OK

AWNINGS

TRUSS BRACE STIFFENER (186 IN): HSS 2X2X1/8

PROPERTIES

A_g	0.84	in ²	I	0.486	in ⁴	r	0.761	in
d	2	in	E	29000000	psi	KL_{eff}/r	122.2	in/in
Member L	15.5	ft	F_y	46	ksi	Ω	1.67	
L_{eff}	7.75	ft						

EFFECTIVE AREA

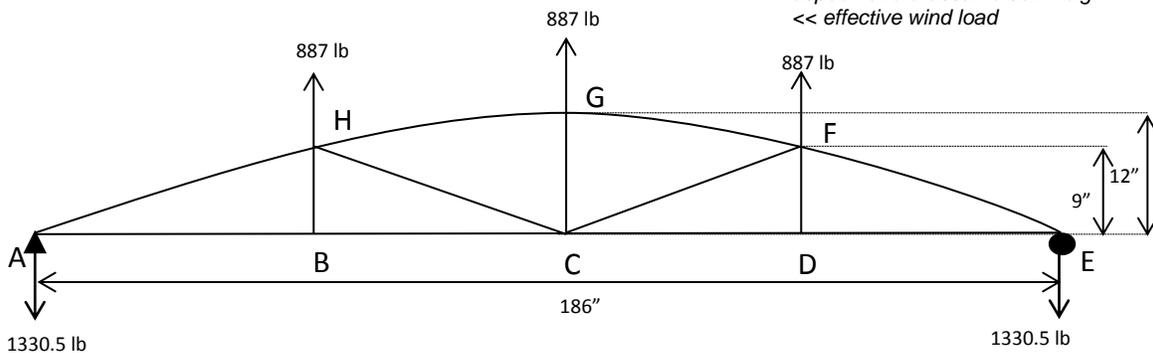
Effective Width ₁	47	in	WIND	19.8	psf
Effective Width ₂	57	in			(NOTE: Positive for upward direction)
Member L	186	in			(ASCE 7-02 Wind Design Method I, section 6.4.2.2)
A_{eff}	134.3	ft ²			

EFFECTIVE WIND LOAD

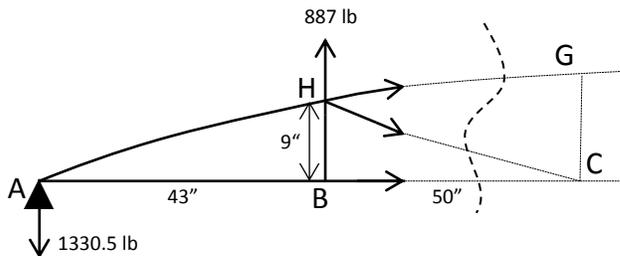
1/2 tributary area of wind load (assume aspect ratio 2:1)

$$WIND_{eff} = A_{eff} * WIND = 2660 \text{ lb}$$

NOTE: Conservative for assumed aspect ratio & assume self-weight << effective wind load



Using the method of sections,



Due to Symmetry, end reactions are equal.

$$A_y = B_y = (3 * 887) / 2 = 1330.50 \text{ lb}$$

Axial Load in bottom chord of truss:

$$\Sigma F_x = 0 = HG + HC_x + BC$$

$$\Sigma M_H = 0 = BC (9") + A (43") = BC (9") + (1330.5\text{lb}) (43")$$

$$BC = -(43"/9") * 1330.5\text{lb}$$

$$F_{axial} = BC = -6356.83 = 6357 \text{ lb (compression)}$$

FLEXURAL BUCKLING

Due to axial force from uplift

$$\text{When } KL/r > 4.71\sqrt{E/F_c} = 118.3 \text{ in/in}$$

$$F_{cr} = 0.877F_e$$

$$\text{where } F_e = \frac{\pi^2 E}{(KL/r)^2} = 19.2 \text{ ksi}$$

$$F_{cr} = 16.81 \text{ ksi}$$

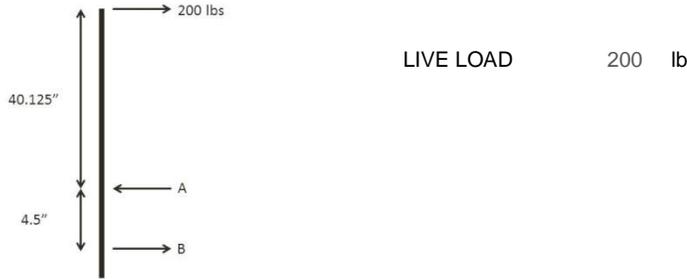
F_n	=	F_{cr} / Ω	=	10.1 ksi
F_{actual}	=	F_{axial} / A_g	=	7.57 ksi
$F_{\text{actual}} < F_n$				OK

RAILINGS

DESIGN BOLT STRENGTH FOR TYPICAL GUARDRAIL POST

(2) 3/8" A307 threaded bolt

DEMAND TENSILE STRENGTH



$$\sum M_A = 0 \Rightarrow B = [\text{LOAD} \times 40.125"] / 4.5"$$

Bolt_B = 1961.1 lb

$$\sum F_x = 0 \Rightarrow A = B + \text{LOAD}$$

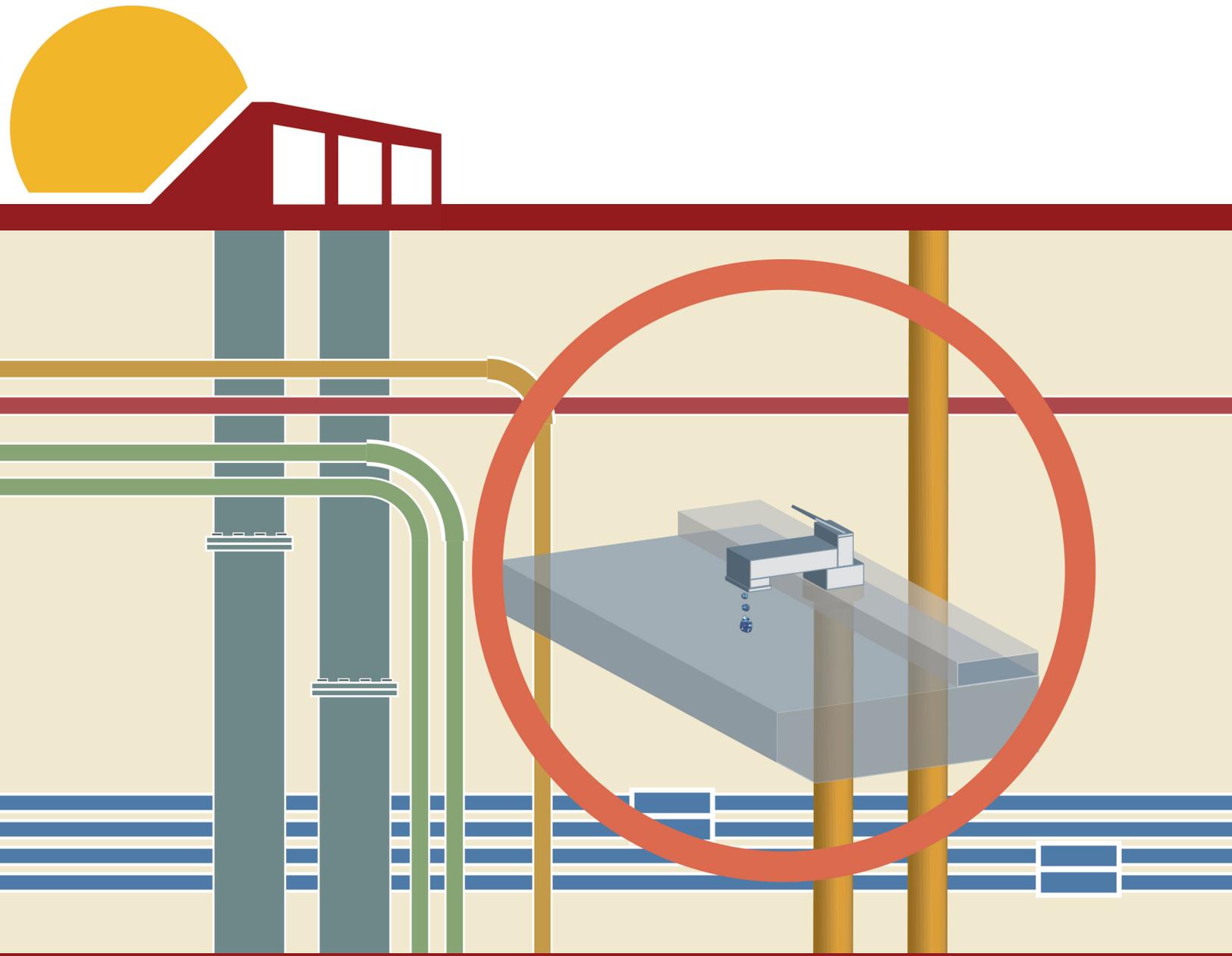
Bolt_A = 2161.1 lb

ALLOWABLE TENSILE STRENGTH

F _{nt}	45 ksi		(NOMINAL TENSILE STRENGTH)
A _b	0.110 in ²		
Ω	2.00		
R_n = F_{nt} * A_b / Ω	2485.05	lb	

(AISC Steel Construction Manual EQ. J3-1)

Check	R _n	>	Demand		
2485 lb		>	1961 lb	Bolt _B	OK
2485 lb		>	2161 lb	Bolt _A	OK



DETAILED WATER BUDGET

Dishwasher	3.47
Cooking	1
Hot Water	15
Subtotal	31.398
Minimum Gallons of Water for Competition	358.8

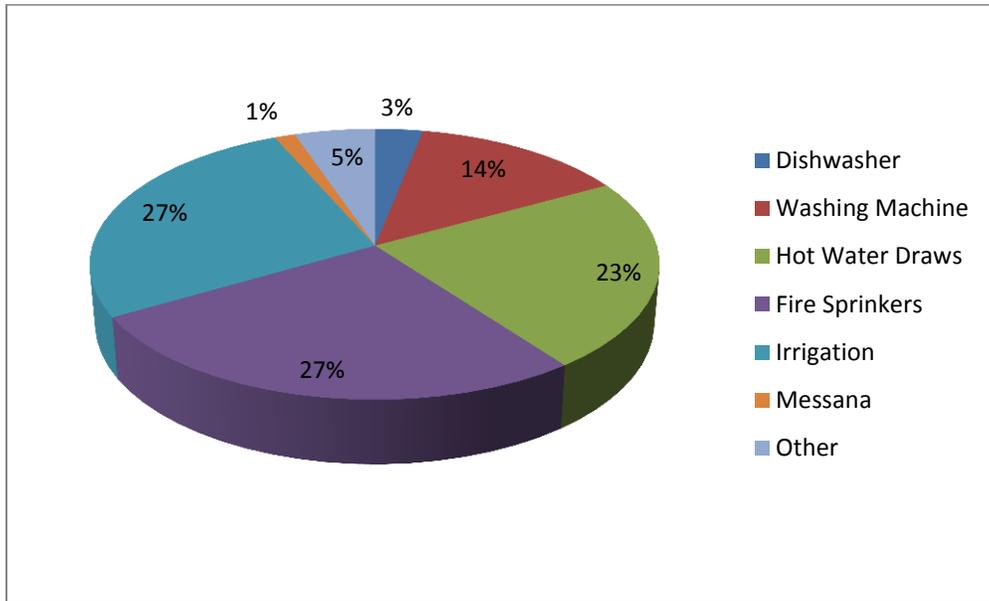
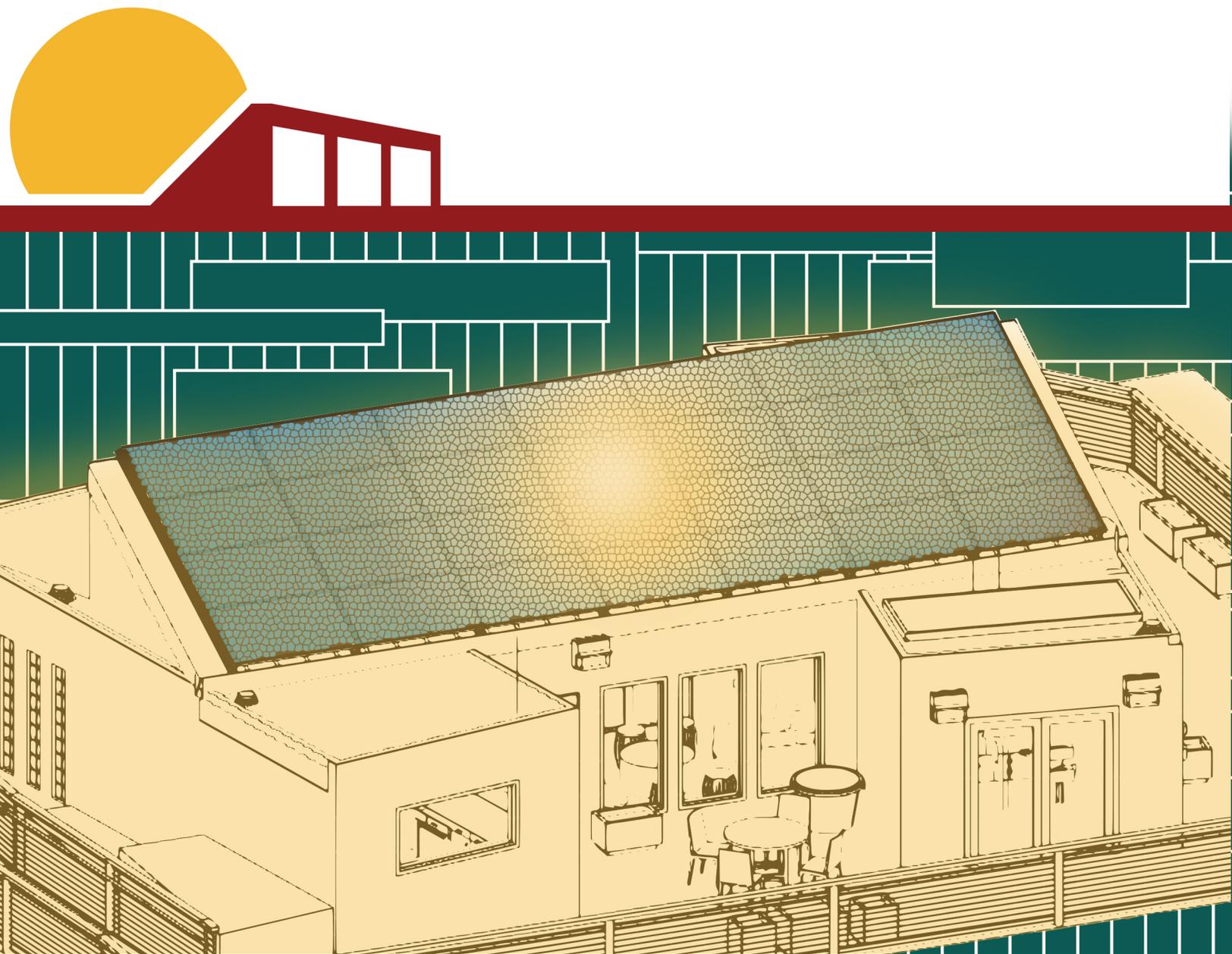


Figure 1: Water budget breakdown



ENERGY ANALYSIS RESULTS & DISCUSSION

ENERGY ANALYSIS RESULTS & DISCUSSION

This energy analysis will provide a comprehensive account of all the energy to be produced and consumed by Radiant House during the 2013 Solar Decathlon Competition. It will also supply detailed descriptions of the executions of contests that deal with energy consumption and the corresponding components used for each of these contests.

HVAC

Radiant House will use Messana Ray Magic radiant heating and cooling in conjunction with a split-system Daikin Altherma heat pump as its HVAC system. The Messana Ray Magic system provides radiant heating and cooling from the ceiling to create a comfortable interior temperature. The radiant system can provide up to 23,351 Btu/h of cooling when running at 45°F performance; however, the typical cooling capacity of the system is approximately 18,000 Btu/h. The system runs more efficiently when the supply water temperature is 55° F. The standard heating capacity of the system is 16,384 Btu/h when the supply temperature is 100° F. By covering 75% of the ceiling space in Messana panels, the supply water can be run at a temperature closer to the room temperature, which allows for increased efficiency within the system. This system will be supported by an under-floor air distribution (UFAD) system which will be coupled with a heat recovery ventilator (HRV) and a Messana dehumidification system. The ventilation system distributes air throughout the house by collecting air near the ceiling and routing it through the ducting located beneath the finished floor. Minimal ducting is required because of the low air flow (110 CFM) necessary for an air distribution system used for circulation purposes only.

The heating and cooling loads for Radiant House were calculated using two different approaches in order to obtain an accurate estimate of the load requirements during the competition. The first method gives a rough estimate based on the ambient temperature, the desired indoor temperature, the R-values and the thicknesses of the insulation, the total surface area of the floor, roof, and walls of the house, as well as the square footage of the windows and their respective R-values. The calculations take into account the internal heat gains of the house in order to get an accurate worst-case scenario for the heating loads. The internal gain included in the calculations is the heat generated by people, appliances, and lighting. When calculating the heat losses, the calculations ignore the internal heat gains of the house so as to get a worse-case scenario for the cooling load. The weather data (ambient temperature) is based on above-average temperatures of typical October weather in El Toro, CA.

The heating and cooling loads were also calculated using the energy analysis program, HAP (Hourly Analysis Program), an engineering software program designed to calculate heating and cooling loads of a house along with the energy consumption and the monetary cost of running standard HVAC systems. For this project, only the heating and cooling load data were utilized due to the nonstandard HVAC system. Spaces are defined within the program (i.e., Kitchen, Dining Room, Living Room, etc.) based on their geometry and orientation. The inputs for the spaces include R-values for the walls, roof, and floor space as well as the square footage of windows. The walls and ceiling were assumed to have an R-value of 26 and 43, respectively.

The windows were assigned R-values of 3.3. Lighting and thermostat schedules were created based on their respective competition schedules. The weather data is from an internal weather database and uses warmer-than-average temperatures when determining the outside air temperature. The results of both analyses appear in the following tables. Additionally, the energy consumption of the heat pump HVAC system is provided below by Hydronic Heat Pumps and details the energy consumption on a monthly and yearly basis.

Table 1: Design Heating and Cooling Loads for Radiant House in Irvine, CA

DESIGN COOLING				DESIGN HEATING		
COOLING DATA AT Jun 1300				HEATING DATA AT DES HTG		
COOLING OA DB / WB 92.1 °F / 68.1 °F				HEATING OA DB / WB 38.0 °F / 31.9 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	445 ft²	13168	-	445 ft²	-	-
Wall Transmission	1151 ft²	834	-	1151 ft²	1169	-
Roof Transmission	903 ft²	1524	-	903 ft²	673	-
Window Transmission	445 ft²	1976	-	445 ft²	4539	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	21 ft²	328	-	21 ft²	290	-
Floor Transmission	811 ft²	575	-	811 ft²	254	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	44 ft²	369	-	44 ft²	155	-
Overhead Lighting	0 W	205	-	0	0	-
Task Lighting	0 W	170	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	7	1310	1130	0	0	0
Infiltration	-	152	-49	-	359	12
Miscellaneous	-	263	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	20874	1081	-	7440	12
Zone Conditioning	-	20545	1081	-	6818	12
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1682 CFM	0	-	1682 CFM	0	-
Ventilation Load	0 CFM	0	0	0 CFM	0	0
Supply Fan Load	1682 CFM	0	-	1682 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	20545	1081	-	6818	12
Central Cooling Coil	-	24402	1130	-	0	0
Central Heating Coil	-	-3857	-	-	6818	-
>> Total Conditioning	-	20545	1130	-	6818	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Table 2: Sample heating and cooling loads for a typical day in October in Irvine, CA.

Time	OA Temp.	Zone Temp.	Sensible Load	Zone Cond.
Hour	(°F)	(°F)	(BTU/hr)	(BTU/hr)
0	70.1	73.2	5089.5	5815.4
100	68.8	73.5	4336.6	4406.2
200	67.5	73.1	3640.4	4498.7
300	66.4	73.4	3000.7	3131.9
400	65.7	73.4	2431.6	2593.1
500	65.4	73.2	1966.6	2403
600	65.9	73	2611.4	3427.7
700	67.2	73.4	5605.4	5600.2
800	69.6	73.8	8539.1	7803.8
900	72.9	73.4	10790	10912.4
1000	76.8	73.9	12482.8	11378.6
1100	81.3	73.5	13817	13645
1200	85.4	73.6	15376.2	14969.8
1300	88.5	74.2	17180.2	15663.6
1400	90.6	74	18507.9	17542
1500	91.4	74	18642.6	17590.2
1600	90.6	74	16609.1	15572.3
1700	88.8	74	13819.2	12852.1
1800	85.9	73.9	11866.2	11226.8
1900	82.6	73.9	11187	10579
2000	79.2	73.8	9904.1	9530.9
2100	76.3	73.5	8747.6	8870.6
2200	73.7	73.7	7690.7	7522.6
2300	71.6	73.3	6335.6	6969.4

Table 3: HVAC Equipment Energy Consumption

Use	Manufacturer	Model	kW	Hours Used	Total kWh
Heat Pump	Daikin	EKHBX054BA3VJU	-	-	15.75
DHW	Daikin	EKHWS050BA3VJU	-	-	5.80
Pump (Solar Thermal)	Grundfos	ALPHA 15-55	0.045	80	3.60
Pump (Messana Panels)	Grundfos	ALPHA 15-55	0.045	54	2.43
Pressure Pump	Grundfos	MQ3-35 B	0.900	10	9.00
Mixing Valve	Belimo	LRB24-SR-T	0.001	10	0.01
Recirculation Pump	Grundfos	UP15-29SU	0.045	25	1.13
Pump (PCM Tank)	Grundfos	ALPHA 15-55	0.045	50	2.25
Dehumidifier	Messana	HI250	0.290	22.5	6.53
HRV	Messana	RR250	0.100	22.5	2.25
HVAC Control	Messana	Control Magic	0.010	180	1.80
Total:					50.55 kWh

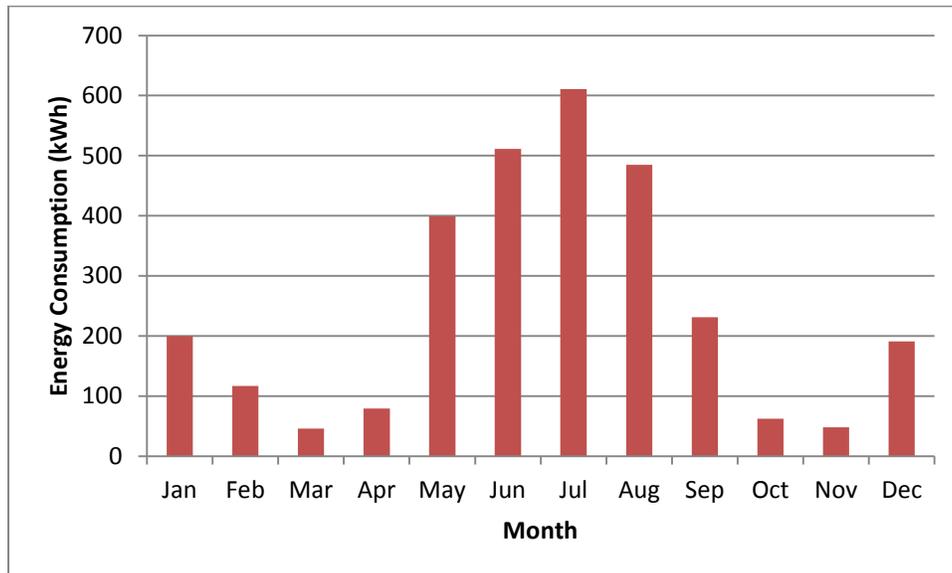


Figure 2: Daikin Split-System Heat Pump Monthly Energy Consumption

Table 4: Daikin Split-System Heat Pump Yearly Energy Consumption

Yearly energy consumption (heating)	602 kWh
Yearly energy consumption (cooling)	2379 kWh
Total yearly energy consumption (heat/cool)	2981 kWh

RADIANT SYSTEM

The Messina Ray Magic product is a radiant distribution system that provides heating and cooling throughout the house. The radiant panels are 4 x 8 foot drywall panels that contain plastic tubing and a thin aluminum sheet to increase the effective radiant surface area. Radiant heating and cooling provides a more comfortable living environment by eliminating harsh bursts of warm or cool air. The panels also provide additional insulation to the house and are more sound proof than standard drywall. Easy to install, the panels feature laser engraving to mark where they can be attached to ceiling joists without damaging the water delivery tubes. Installation is made even easier by the snap connections that join the ends of PEX piping in adjacent panels.

WATER

Water will be stored in multiple storage tanks on site, including a 1500 gallon storage tank and two 500 gallon waste water tanks, for the entirety of the competition. The 1500 gallon storage tank has ample room for the expected 1119 gallons of water to be used during the competition. Waste water, including discharges from hot water draws and laundry cycles, will be stored in the two 500 gallon tanks. The total amount of waste water is expected to be approximately 448 gallons. All tanks are designed to hold more water than expected in order to account for unforeseen additional water draws. Each tank is located for easy removal at the conclusion of the competition.

Water usage for Radiant House can be divided into 4 systems: HVAC, hot water, cold water, and fire suppression. Water from the 1500 gallon storage tank will be directed via two different pumps to either the fire suppression system or to a manifold in the mechanical room dedicated to the hot and cold water distribution. Water for the radiant system will be contained within a closed loop that must be filled separately from the 1500 gallon storage tank.

PEX piping will be used for the majority of the water distribution throughout Radiant House because the material is cheap, easily available, and easy to install due to its flexibility. Flexibility is important in designing the plumbing system because of the need for quick connections between the four modules of the house.

Hot water will be provided by a 50-gallon domestic hot water tank. The tank will be heated primarily by a solar thermal collector with supplemental heat provided by a Daikin heat pump and an electrical booster heater located within the tank itself.

The solar thermal collector will be connected directly to the hot water tank by a solar thermal kit and will provide most of the heating during the course of the day, while the heat pump and booster heater within the tank will provide the necessary heating during the nighttime hours. Over the course of the competition there will be 16 hot water draws of 15 gallons each, which must be at a temperature of 110°F. This will be handled primarily by the 12.4 KWh/day solar thermal collector with any additional heating provided by the heat pump.

APPLIANCES

Table 5: Appliance Energy Consumption

Appliance	Manufacturer	Model	Retail Price	kWh/hour or kWh/cycle	Hrs or Cycles Used	Total kWh
Clothes Dryer	Bosch	WTV6100US	\$895	2	8	16
Clothes Washer	Bosch	WAS2016UC	\$850	0.24	8	1.94
Dishwasher	Bosch	SHX2AR55UC	\$699	1.3	5	6.5
Induction Stove	Bosch	NIT3065UC	\$1,699	2.8	10	28.0
Oven	Bosch	HBL3350UC	\$1,449	2	1	2
Refrigerator	Sun Frost	RF12	\$2,849	0.012	216	2.59
Vent	Bosch	DHD3014UC	\$1,199	n/a	0	n/a
Internal Blower	Bosch	DHG601DUC	\$499	n/a	0	n/a

Appliances featured in Radiant House were chosen with aesthetics and energy efficiency in mind. During the 10 days of competition, the Sun Frost refrigerator will operate in the range of 34°F and 40°F and the freezer will operate between -20°F and 5°F, using a total of 2.59 kWh. Over this 10 day period, both the Bosch clothes washer and dryer will run through 6 cycles and use 0.24 kWh/cycle and 2.00 kWh/cycle, totaling to 1.94 kWh and 16 kWh respectively. The Bosch induction stove will be used to boil water and to cook for two dinner parties, resulting in approximately 10 hours of stove use, for a total of 28.0 kWh. The Bosch oven will be used to prepare food for one dinner party, using a total of 2 kWh. The Bosch dishwasher will run through 5 cycles, each time reaching 120°F during the cycle and consuming a total of 6.5 kWh. The total energy used by the appliances during the 10 day competition will be 57.03 kWh. The following pie chart demonstrates the energy consumption of each appliance used by Radiant House.

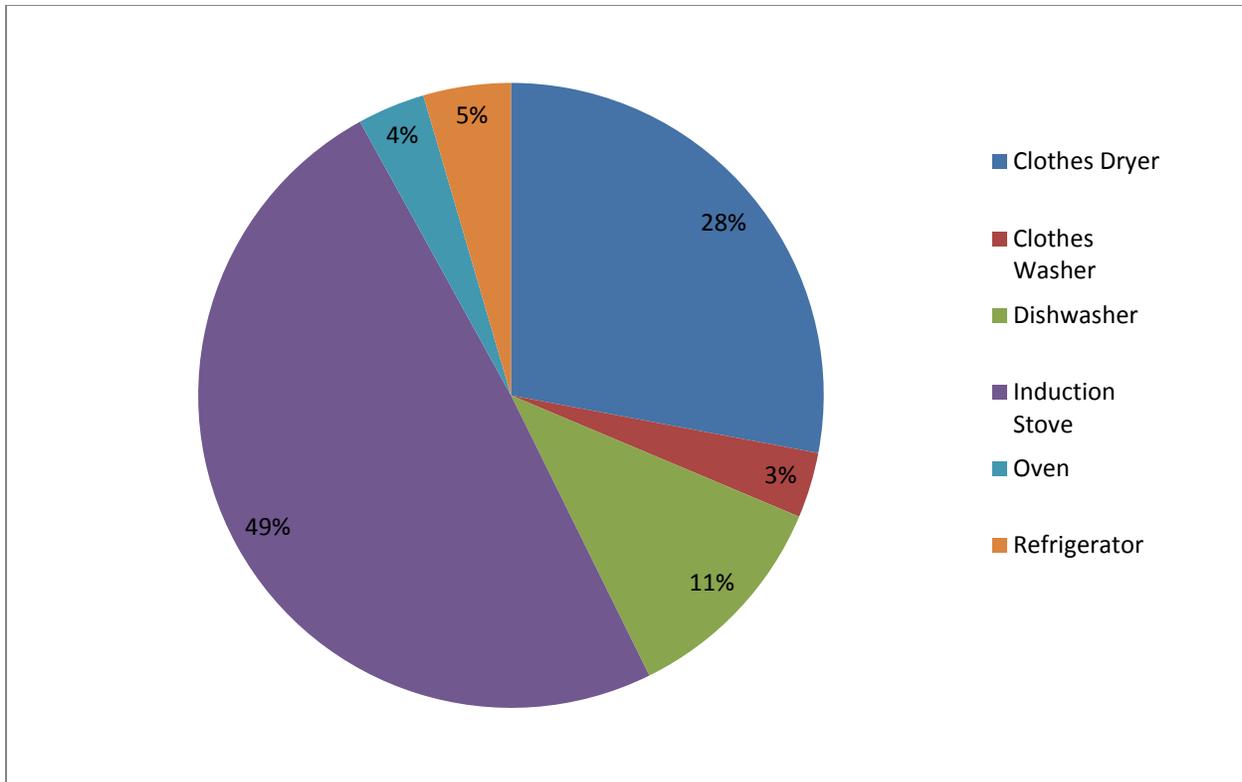


Figure 3: Appliance energy usage of Radiant House during the competition in Irvine, CA.

LIGHTING

Santa Clara’s Radiant House will use lighting design to establish an inviting, comfortable, and peaceful atmosphere for its residents. This will be accomplished by balancing natural and artificial light, taking full advantage of the 300-plus annual days of California sun. Three main factors will be considered in the design process: clear connections between indoor and outdoor space, the development of a simple yet intelligent control system that residents can intuitively understand and use, and cost, in order to maintain the affordability of the house.

Radiant House will showcase cutting-edge LED lights in all living spaces except for the bathroom. 2-inch LED linear and down lights will be recessed into the radiant heating and cooling panels for a seamless design. LED pendant lights and under cabinet lighting will serve as accent lighting to warm the work space in the kitchen. Unique to all LED lights featured in Radiant House is the color temperature changing feature that mimics the natural warm light generated by incandescent light bulbs when dimming. These lights dim not only in intensity, but in color as well. Overall, the indoor lighting design will serve to promote the comfort of the residents in Radiant House while remaining energy efficient.

Exterior lights will connect interior and exterior spaces by providing seamless transitions between the two spaces. Solar powered rope lights will highlight the entrance and exit ramps,

guiding residents to and from the house. Additional small, circular lights placed in the south-side exterior deck will create an intimate, private setting. Radiant House will be a welcoming home even at night, as these features will softly light the house and its most distinguishing features.

The lighting control system will also establish an inviting and comfortable living atmosphere for residents. Lights will be dimmable in the kitchen, bedroom, living, and dining rooms in order to create a smooth transition from natural light during the day to artificial light after the sun sets. The high clerestory windows along the roof line will also help to smooth the transition from daylight to artificial light as the setting sun will strike the vaulted ceiling with natural light through the windows and reflect downward into the great room.

Cost is an integral factor in Radiant House's lighting schematic. While LED lights can often be expensive, we are confident in our decisions and believe that these lights are economic and cut many energy costs. Accent lights will be kept to a minimum to take advantage of the ample natural light and to reduce cost.

The following table includes all lighting used throughout Radiant House. Lighting will consume approximately 32.5 kWh during the competition.

Table 6: Lighting energy consumption for Radiant House during the competition in Irvine, CA.

Function	Manufacturer	Model	Watts (per ft./ fixture)	Hours Used	Total Energy (kW)
<i>Interior</i>					
Bedroom LED Down Lights (qty. 5)	EST	DL 2 BL	10	35	1.75
Bedroom Table Lamps (qty. 2)	Lamps Plus	84182	60	35	4.20
Closet LED Linear Light (4 ft)	EST	M110	5	35	0.70
Bathroom Vanity Light (qty. 1)	Oxygen Lighting	Zenith Vanity	28	35	0.98
Bathroom Fan Light (qty. 1)	NuTone	769RL	100	35	3.50
Living Room LED Linear Lighting (32 ft)	EST	M109	5	35	5.60
Dining Room LED Down Lights (qty. 6)	EST	DL 2 BL	10	35	2.10
Kitchen LED Down Lights (qty. 4)	EST	DL 2 BL	8	35	1.12
Kitchen Under Cabinet Lights (14 ft)	EST	M109	5	35	2.45
Kitchen Pendants (qty. 3)	EST	P 38	5	35	0.53
<i>Exterior</i>					
Hardwired LED Deck Lights (3 sets of 8)	Hampton Bay	667 347	10	35	1.05
Hard Wired Door Lights (qty. 7)	Possini	R7825	35	35	8.56
TOTAL ENERGY:					32.5 kWh

ENERGY BUDGET AND RESULTS

Radiant House's 28 panel array is rated at a peak of 7.14 kW. Referencing historical data for Irvine, CA, and PV Watts Calculator Version 2, the average insolation during the month of October is 5.23 kWh/m²/day. Combined with the 24° angle of the roof and a de-rate factor of 0.82, we estimate about 281 kWh of energy will be produced by the solar array during the length of the competition, averaging to about 28.1 kWh per day. We plan to consume an average of 16.7 kWh energy per day, which is well under our projected production.

Over the course of a year in Irvine, CA, Radiant House's solar array is projected to produce 10,979 kWh. Based upon a utility energy cost of \$0.13/kWh provided by Southern California Edison, Radiant House produces approximately \$1,647 worth of usable household energy per year. With an estimated installation cost of \$18,000 for the solar system, the homeowner will see a return on investment in 11 years.

Below is a breakdown of projected energy consumption by various appliances and equipment during the competition.

Table 7: Appliance and Equipment Energy Consumption for Contest Week

Appliance	kW/hour or kW/cycle	Hours Used/ Total Cycles	Total Energy (kWh)
Induction Stove	2.80	6	28.20
Oven	2.00	4	8.00
Dishwasher	1.30	5	6.50
Fridge/Freezer	0.02	203	3.95
Clothes Washer	0.24	8	1.94
Clothes Dryer	2.00	8	16.00
Entertainment (TV, DVD, Surround Sound)	0.07	100	7.00
Computer	0.11	34	3.74
Lighting	-	35	32.50
Heat Pump	-	-	15.75
Hot Water Tank	-	-	5.80
Pressure Pump	0.90	10	9.00
Dehumidifier	0.29	23	6.67
ERV	0.10	23	2.30
Solar Thermal Pump	0.05	80	4.00
Other Mechanical Equipment (Mixing Valve, PCM Tank, Recirculation Pump)	-	-	7.61

Total Energy Use during Competition: **167 kWh**

Average Energy Use per Day: **16.7 kWh**

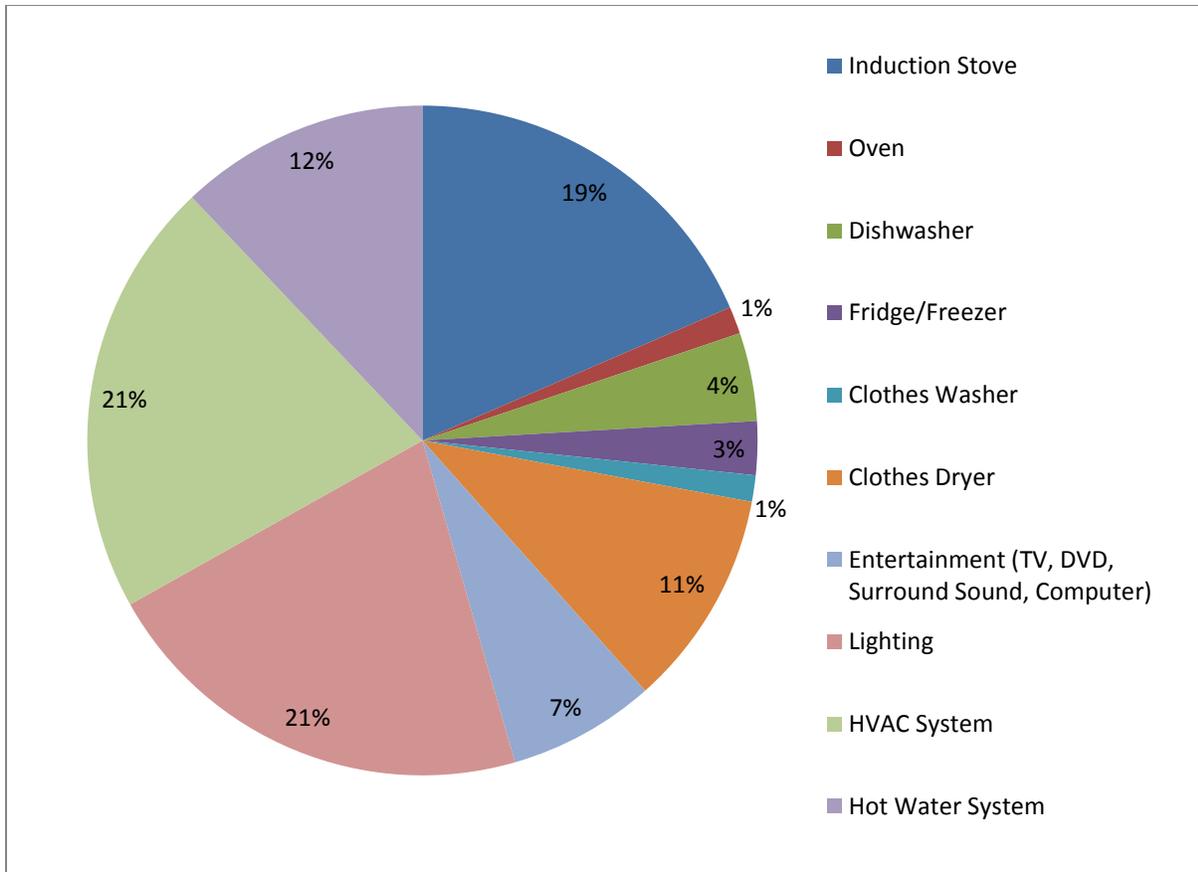
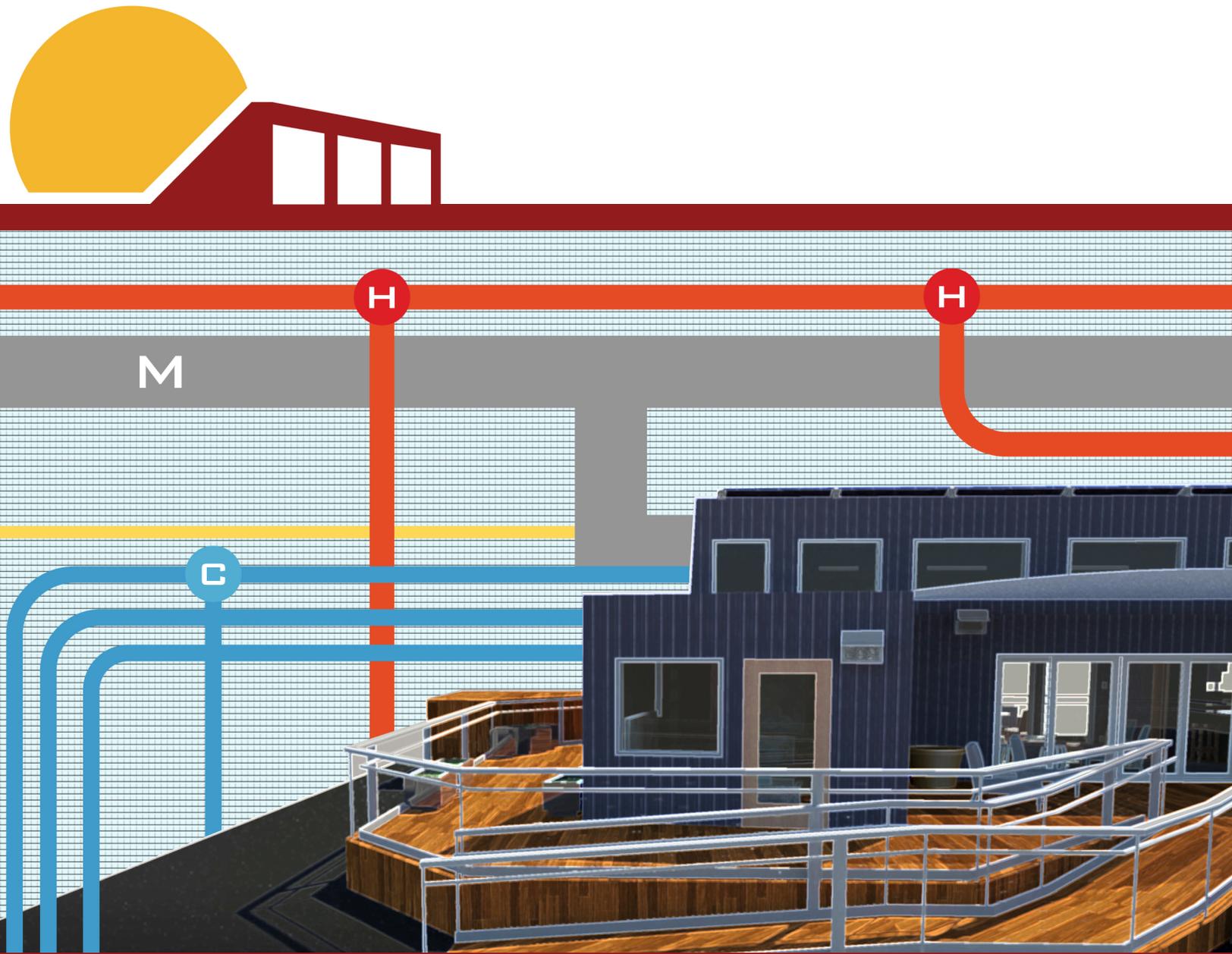


Figure 4: Projected appliance and equipment energy consumption during the competition.

Table 8: Annual Radiant House solar energy production for Irvine, CA (Data provided by PV Watts Calculator Version 2 with a tilt angle 24 degrees and de-rate factor of 0.82).

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)	Energy Value (\$)
January	4.08	692	103.84
February	4.75	735	110.23
March	5.42	918	137.66
April	6.31	1,022	153.36
May	6.41	1,064	159.60
June	6.45	1,037	155.62
July	6.99	1,142	171.29
August	6.97	1,125	168.70
September	6.14	973	145.99
October	5.23	871	130.69
November	4.46	730	109.53
December	3.96	669	100.42
Annual	5.60	10,979	\$ 1,647



SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

Electric Clothes Dryer Modification

The clothes dryer for Radiant House will be modified through the inclusion of a simple cross flow heat exchanger inside the dryer housing and below the drum. Hot exhaust air is channeled through the tubes of a compact heat exchanger on the way to the vent. The ambient air is drawn over the heated tubes before passing over the heating coils on the way to the dryer drum. Through this simple process of pre-heating the incoming air, we have found that the energy needed to dry a set of six towels can be reduced by about 10-20%. We have also begun studies in which dryer air is drawn from ducting underneath the solar panels, which has an even higher energy savings potential.

Design of the compact heat exchanger was accomplished so that the net air flow through the dryer was minimally affected. Studies have shown that reduced airflow (commonly due to clogged lint screens) is the leading cause of dryer fires. No other potential risk factors are anticipated with this design innovation.



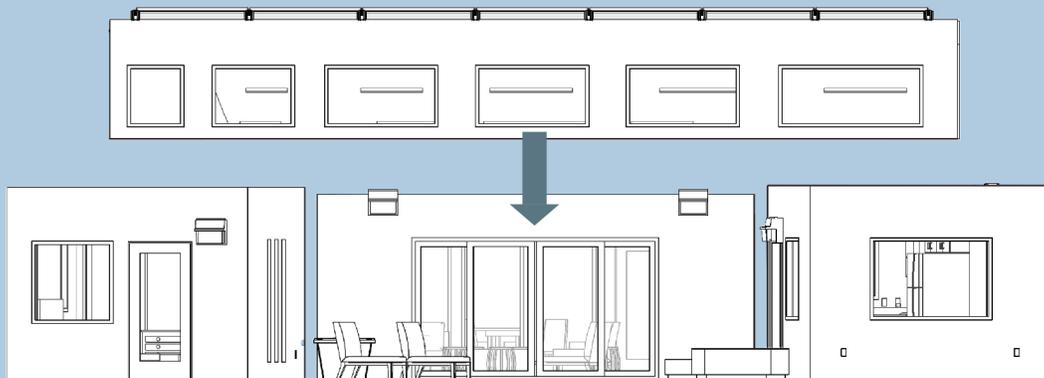
Figure 5: Prototype heat exchanger unit (HEX)



1



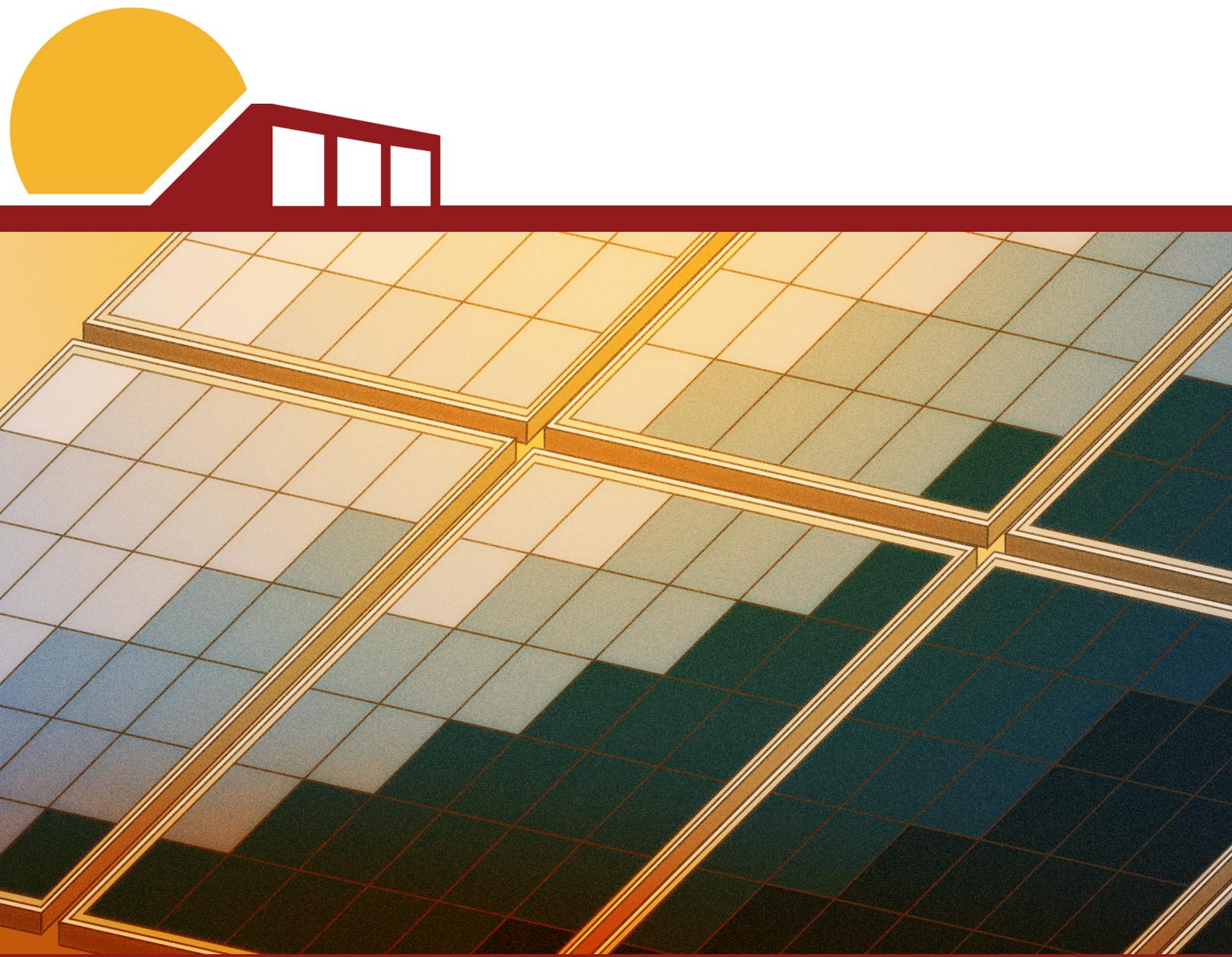
2



SUMMARY OF RECONFIGURABLE FEATURES

SUMMARY OF RECONFIGURABLE FEATURES

Radiant House does not currently include reconfigurable features.



INTERCONNECTION APPLICATION FORM

INTERCONNECTION APPLICATION FORM

Lot #118

Table 7: PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array
Bosch c-Si M 60 NA 30119	We will have 4 parallel strings. Each string will have 7 panels in series. Each string will have three Tigo MM-2ES units and one Tigo MM-ES unit to prevent module mismatch and increase panel efficiency.	28 panels rated at 255 Watts each 7.14 kW

Total DC power of all arrays is **7.14kW**.

Table 8: Inverters

Inverter Manufacturer	Model Number	Max DC Voltage	Max DC Power	Quantity
Sunny Boy	8000TL - US	600 V	8.3 kW	1

Total AC power of all inverters is **8 kW**.

Notes:

- One-Line Electrical diagram can be found on E-611 of the drawing set.
- Calculations of service/feeder net computer load and neutral load are described in the chart on the following page.
- A plan view of the lot showing the house, decks, ramps, tour paths, and terminal box can be found on G-103 of the drawing set.

Contacts:

Santa Clara's Electrical Engineer is Margaret Jones. Her contact information can be found in the Team Officer Contact Information database on the Solar Decathlon Yahoo Group.



QUANTITY TAKE-OFF

QUANTITY TAKE-OFF

Quantity Take-off				
<u>System</u>	<u>Element</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>
Foundation	Seismic pier	7"	3	Ea
		11"	9	Ea
	Standard pier	6"	4	Ea
		8"	5	Ea
		10"	4	Ea
		12"	4	Ea
		14"	2	Ea
		16"	3	Ea
Steel	Steel C-channel	C15x33.9	222	LF
		C8x11.5	24	LF
		C3x4.1 (6 posts, upper roof framing)	30	LF
	Steel hollow structural sections (HSS)	HSS8x3x3/8 (9 beams)	105	LF
		HSS3 1/2x3 1/2x5/16 (12 posts, vertical framing)	105	LF
	Wide flange steel beam	W5x19 (lower roof framing)	86	LF
	Steel angle	L8x4x1/2 (upper roof framing)	147	LF
	Steel plate	PL1/4x4 (11.5" length)	12	Ea
		PL1/4x5 (8" length)	12	Ea
	Steel stud	1/2 o x studs; 1.5" length	96	Ea
		1/2 o x studs; 3.5" length (lower roof)	36	Ea
		1/2 o x studs; 2" length (lower roof)	62	Ea
		1/2 o x studs; 1" length (lower roof)	19	Ea
		1/2 o x studs; 3" length (base)	40	Ea
		1/2 o x studs; 3.5" length (base framing)	69	Ea
		1/2 o x studs; 2.5" length (base framing)	69	Ea
		1/2 o x studs; 1" length (upper roof)	12	Ea
		1/2 o x studs; 3.5' length (upper roof)	12	Ea
		1/2 o x studs; 2.5" length (upper roof)	48	Ea
	Field bolt	1/2 o x M.B.; 1.5" length	32	Ea
		1/2 o x M.B.; 1.5" length (lower roof)	24	Ea

		3/4 o x M.B.; 1.5" length (lower roof)	18	Ea
		1 o x M.B.; 2.5" length (base framing)	12	Ea
		1/2 o x M.B.; 1.5" length (upper roof)	22	Ea
	Steel plates	PL 3/8x3 11/16; 5" length (lower roof)	2	Ea
		PL 3/8x3 1/2; 1'-1/2" length (lower roof)	4	Ea
		PL 3/8x3; 1'-1 15/16" length (base framing)	15	Ea
		PL 3/8x3; 6.5" length (base framing)	18	Ea
	Erection brace (for TRANSPORTATION ONLY)	L2x2x1/4 (6 braces)	76	LF
Structure	Rim joist	2x10 lumber	221	LF
		4x12 (roof)	82	LF
	Steel beam joist	2x4 lumber (stacked pair)	256	LF
	Bamboo joist	133" each; made using: 1" bamboo culms (4/joist), 1/2" woven bamboo plywood webs	36	Ea
	Joist	133" each; TJI 1230 Trus joist	15	Ea
	Joist hanger	10" IUS 2.37/9.5 Simpson Strong Tie joist hanger	102	Ea
		8" LUS 210 Simpson Strong Tie joist hanger	8	Ea
	Nailer	2x6 lumber	199	LF
		2x4 lumber, stacked pair (module B, ends)	46	LF
	Blocking	2x4 lumber (16 blocks)	43	LF
	Wall blocking	2x4 around perimeter	149	LF
	Blocking hanger	USP JPF24 Simpson	36	Ea
	Blocking connector	D1045 Simpson	32	Ea
	Bolt blocking	2x4; (10 blocks; 16" each)	14	LF
	Vertical nailer	2x6; 2/post	210	LF
		2x4; 1/post	105	LF
	Support for horizontal nailer	2x4	199	LF
	Bamboo joist	150" each (roof)	24	Ea
	Joist	150" each; TJI230 Trus joist (roof)	5	Ea
	Plywood decking	3/4" tongue and groove	1051	SF
	Sloped roof sheathing	1/2" plywood (sides)	298	SF
		3/4" plywood (top)	528	SF

	Rim joist (roof)	2x10	249	LF
	Rim joist connectors	LTP4	41	Ea
Module C, flat roof framing	Joist	136" each; TJI230 Trus joist	6	Ea
	Bamboo joist	136" each	7	Ea
	Lumber	6x6	23	LF
		4x4	23	LF
		2x10 lumber	31	LF
	Hangers	ITS2.37/9.5	16	Ea
		A35 clips	24	Ea
		LUS2.10	4	Ea
		LSSUI35	16	Ea
		IUS2.37/9.5 joist hanger	26	Ea
	Blocking	2x4	50	LF
	Sheathing	1/2" plywood	348	SF
	Parapet	2x4	272	LF
Module C, North Wall framing	Lumber (16 OC)	4x6	36	LF
		6x6	8	LF
		2x6	92	LF
		2x4	16	LF
	6x6 hangers	HUC66	2	Ea
	Hold downs	HDU2 Simpson	1	Ea
		HDU4 Simpson	2	Ea
	Connectors	3" square USP	4	Ea
	Sheathing	1/2" plywood	77	SF
Module C, East Wall framing	Lumber (16 OC)	2x4 (bamboo culms)	71	LF
		2x4 lumber	184	LF
		2x6	300	LF
		2x12	10	LF
		4x8 bamboo gravity wall	1	Ea
	Hold downs	HDU2 Simpson	2	Ea
	Connectors	3" square USP	10	Ea
	Sheathing	1/2" plywood	296	SF
Module C, South Wall framing	Lumber (16 OC)	4x6	40	LF
		6x6	6	LF
		2x6	56	LF
		2x4	16	LF
	6x6 hangers	HUC66	2	Ea
	Hold downs	HDU2 Simpson	4	Ea
	Connectors	3" square USP	4	Ea

	Sheathing	1/2" plywood	113	SF
Module C, West Wall framing	Lumber (16 OC)	2x4	120	LF
		2x6	171	LF
		4x6	64	LF
	Hold downs	HDU7	7	Ea
		DTT2Z SDS2.5	2	Ea
	Connectors	3" square USP	8	Ea
	Sheathing	1/2" plywood	183	SF
Module B, South Wall framing	Lumber (16 OC)	2x6	208	LF
		6x6	14	LF
	Connectors	3" square USP	4	Ea
	Sheathing	1/2" plywood	93	SF
Module A, flat roof framing	Joist	136" TJI230 Trus joist	5	Ea
	Bamboo joist	136"	5	Ea
	Lumber	6x6	23	LF
		4x4	23	LF
		2x10	29	LF
	Hangers	ITS2.37/9.5	16	Ea
		LSSUI35	16	Ea
		A35 clips	26	Ea
		IUS2.37/9.5 joist hanger	20	Ea
		LUS2.10	4	Ea
	Blocking	2x4	50	LF
	Sheathing	1/2" plywood	255	SF
	Parapet	2x4	262	LF
Module A, East Wall framing	Lumber (16 OC)	2x4	94	LF
		2x6	78	LF
		4x6	48	LF
		6x6	8	LF
	Hold downs	HDU2	5	Ea
		DTT2Z SDS2.5	2	Ea
	Connectors	3" square USP	6	Ea
	Sheathing	1/2" plywood	163	Ea
Module A, South Wall framing	Lumber (16 OC)	2x4	98	LF
		2x6	52	LF
		4x6	40	LF
		6x6	6	LF
	6x6 hangers	HUC66	2	Ea

	Hold downs	HDU2	4	Ea
	Sheathing	1/2" plywood	97	SF
Module A, West Wall framing	Lumber (16 OC)	2x4	144	LF
		2x4 (bamboo culms)	39	LF
		2x6	241	LF
		4x6	32	LF
		4x8 bamboo gravity wall	1	Ea
	Hold downs	HDU2	2	Ea
	Connectors	3" square USP	8	Ea
	Sheathing	1/2" plywood	251	SF
Module A, North Wall framing	Lumber (16 OC)	2x4	70	LF
		2x6	46	LF
		4x6	32	LF
		6x6	6	LF
	6x6 hangers	HUC66	2	Ea
	Hold downs	HDU2	4	Ea
	Connectors	3" square USP	21	Ea
	Sheathing	1/2" plywood	96	SF
Module B, North Wall framing	Lumber (16 OC)	2x4	76	LF
		2x6	70	LF
		4x6	33	LF
		6x6	12	LF
	Connectors	3" square USP	6	Ea
	Hold downs	HDU8	4	Ea
	6x6 hangers	HUC66	2	Ea
	Sheathing	1/2" plywood	121	SF
Roof Module, East End framing	Lumber	2x4	62	LF
Roof Module, North Face framing	Lumber	2x4	54	LF
		2x6	303	LF
Roof Module, West End framing	Lumber	2x4	62	LF
Interior bedroom wall framing	Lumber	2x4	116	LF
		4x6	10	LF
Interior bathroom wall framing	Lumber	2x4	58	LF
Interior hallway wall framing	Lumber	2x4	102	LF
		2x6	7	LF

Interior hallway pony wall framing	Lumber	2x4	54	LF
		2x6	7	LF
Interior mechanical room wall framing	Lumber	2x4	9	LF
		2x6	91	LF
		4x6	17	LF
		6x6	12	LF
	Hold downs	HDU5	2	LF
Drywall	Gypsum board	Gold Bond 8' x 4' x 5/8" drywall panel; model number: GB99500800	500	SF
		Gold Bond 8' x 4' x 1/2" high strength lite gypsum board; model number: GB00090800	1800	SF
Wall Finishes	Tile wall coverings	Fireclay Quickship recycled ceramic tile	200	SF
		Yukon Cliff Brick 10 1/2" x 11 3/4" glass and travertine mosaic wall tile	97	SF
	Paint	Dunn-Edwards Everest, 0 VOC	1800	SF
	Clay	American Clay wall finish	568	SF
	Backerboard	James Hardie HardieBacker 1/2" Ceramic Tile Backer Board; model number: 220023	476	SF
Entertainment	TV wall mount	Sanus full motion wall mount for 32"-47" flat-panel TV; model number: VMF220-B1	1	Ea
Casework	Wood casework	Northern Contour custom cabinets: spectrum series metro, black walnut; 3/4" core	98	SF
Countertops	Stone countertops	ECO by Consentino, Polar Cap	60	SF
Flooring	Lumber	2x6 - module C	387	LF
		2x6 - module A	315	LF
		2x6 - module B	208	LF
		2x4	11	LF
	Sheathing	5/8" plywood	1051	SF
	Finished floor	Plyboo flat grain bamboo flooring; model number: FL-5872UN-NAUF/FSC	1051	SF

		Kelly Moore alkyd QD sanding sealer; model: 2164 EZ SAND	1051	SF
	Baseboard	Plyboo base shoe; model number: QRD-100PN	210	LF
	Tile flooring - Bathroom	Fireclay Quickship recycled ceramic tile	35	SF
Exterior doors		Masonite flush series prehung veneered flush birch door, 36x80	1	Ea
		Masonite flush series veneered flush birch pocket door, 36x80	2	Ea
		Masonite 36x80 full lite fiberglass entry door; SKU: 476575	3	Ea
		Masonite 72x80 full lite steel patio door; SKU: 511213	1	Ea
Windows	Picture window	Milgard 920 TB PW, argon fill; 3060 rough opening	3	Ea
		Milgard 920 TB PW, argon fill; 4030 RO	1	Ea
		Milgard 920 TB PW, argon fill; 7030 RO	1	Ea
		Milgard 920 TB PW, argon fill; 2930 RO	1	Ea
	Single hung window	Milgard 1520 TB SH, argon fill; 2036 RO	2	Ea
	Half vent window	Milgard 1120 TB HV, argon fill; 3740 RO	1	Ea
		Milgard 1120 TB HV, argon fill; 6030 RO	1	Ea
		Milgard 1120 TB HV, argon fill; 4040 RO	1	Ea
		Milgard 1120 TB HV, argon fill; 3020 RO	1	Ea
		Milgard 1120 TB HV, argon fill; 6040 RO	1	Ea
	Full awning window	Milgard 920 TV FA, argon fill; 5630 RO	3	Ea
	Glass blocks	Pittsburgh Corning premiere IceScapes glass blocks; model number: 110504; 8" x 8" x 4"	6	Ea
		Pittsburgh Corning premiere IceScapes glass blocks; model number: 110351; 6" x 8" x 4"	144	Ea
	Sliding glass door	Masonite sliding patio door; finished slider 143 1/2" x 82 1/2"; 4 panel; lowe tempered E II with Argon	1	Ea

Roofing	TPO roofing	Carlisle 45mil TPO roofing system	1030	SF
	Parapet drain	Thunderbird TPO-clad inside-wall parapet drain	24	LF
	Roof drain	Bottom outlet roof drain with overflow	48	LF
	Tapered installation board	2 degree incline	575	SF
	Underlayment	Grace Ultra self-adhered roofing underlayment for high temperature applications; MFG model #: 5003000	446	SF
	Flashing	JM Permaflash system	67	LF
	Box gutter	Galvanized steel	18	LF
Weatherproofing		Grace Ultra self-adhered underlayment for high temperature applications; MFG model #: 5003000	1633	SF
Lighting	Interior lighting	Energy Savings Technology, LLC, M 109 UC LED Light, M 109; part number: M 109-S-2735-60-2-012-3, length: 5'	1	Ea
		EST M 109 UC LED Light, M 109; part number: M 109-S-2735-50-01-XX-01, length: 6'	1	Ea
		EST CCF-109 Connector cable; part number: CCF-109-10; length: 10'	1	Ea
		EST CCF-109 Connector cable; part number: CCF-109-15, length: 15'	1	Ea
		EST PCU UC Power supply; part number: PCU 109 100	1	Ea
		EST DL 2 BL 2" downlight; part number: DL 2 BL MP	4	Ea
		EST PCU DL power supply; part number: PCU DL 100	1	Ea
		EST P38 pendant light; part number: DL 2 BL MP	3	Ea
		EST PCU P38 power supply; part number: PCU P38 100	1	Ea
		EST DL 2 BL 2" downlight; part number: DL 2 BL MP	6	Ea

		EST PCU DL power supply; part number: PCU DL 100	1	Ea
		EST M 109 LED linear light; part number: M 109-S-2735-60-W-012-3, length: 5'	1	Ea
		EST M 109 LED linear light; part number: M 109-S-2735-48-W-012-3, length: 4'	3	Ea
		EST M 109 LED linear light; part number: M 109-S-2735-36-W-012-3, length: 3'	4	Ea
		EST M 109 LED linear light; part number: M 109-S-2735-24-W-012-3, length: 2'	2	Ea
		EST M 109 housing LED linear light; part number: M 109-H-60, length: 5'	1	Ea
		EST M 109 housing LED linear light; part number: M 109-H-48, length: 4'	3	Ea
		EST M 109 housing LED linear light; part number: M 109-H-36, length: 3'	4	Ea
		EST M 109 housing LED linear light; part number: M 109-H-24, length: 2'	2	Ea
		EST CCF 109-20; part number: CCF 109-20, length: 20'	10	Ea
		EST CCF 109-F-20; part number: CCF 109-F-20, length: 20'	10	Ea
		EST PCU UC Power supply; part number: PCU 109 100	3	Ea
		EST DL 2 BL 2" downlight; part number: DL 2 BL MP	5	Ea
		EST PCU DL power supply; part number: PCU DL 100	1	Ea
		EST M 110 closet LED light; part number: M 110-S-2735-48-W-012-3, length: 4'	1	Ea
		EST PCU power supply; part number: PCU 110 60	1	Ea

		NuTone 70 CFM fan/light with transparent polymeric lens and resin grille; model number: 769RLF	1	Ea
		Y Lighting zenith vanity light; item number: OXY-ZENITH-VANITY, model: 2-5142	1	Ea
		Lamps Plus matte silver up and down wall light; style number: R7830	2	Ea
	Exterior lighting	Hampton Bay 12V low voltage LED 8 piece stainless steel deck light kit; model number: HD28101BS8	24	Ea
		Possini hard wired door lights; model number: R7825	7	Ea
	Lighting control devices	WattStopper 0-10V fluorescent architectural dimmer; model number: ADF-120277	6	Ea
		SainSmart DC controlled relay board; model number: 20-018-102	4	Ea
Electrical	Wiring	Romex 12/3	250	LF
		Romex 10/3	250	LF
		Romes 12/2	1000	LF
		Romex 14/2	500	LF
		Romex 8/3	115	LF
		Romex 14/3	100	LF
		THHN12 blue strand	500	LF
		THHN12 red strand	500	LF
		THHN12 green strand	500	LF
		THHN12 black strand	500	LF
		THHN12 white strand	500	LF
		THHN10 white strand	500	LF
		THHN10 red strand	500	LF
		Southwire 6 solid bare copper; model number: 10638502	80	LF
		Shoals 2000V AWG 10 PV wire	15	LF
		Tamper resistant AFCI receptacles; ALFR1-W	20	Ea
		Duplex GFCI convenience receptacles; model number: S7899-GY	9	Ea
		Wall plates; model	25	Ea

		number: PJ26-W		
		Raintight and weather resistant wall plates; model number: 4992	4	Ea
	Conduit	3/4" electrical metallic tubing (EMT) conduit; model number: 873044	55	LF
		3/4" liquidtight flexible metal conduit (LFMC)	5	LF
		3/4" LFMC 90 degree elbow	2	Ea
		3/4" EMT conduit clamp	22	Ea
		3/4" EMT screw clip	25	Ea
		3/4" EMT screw corner	25	Ea
	Boxes	Greenfield 1-gang weatherproof electrical box; model number: CBPS, internet model number: 202188604	2	Ea
		Thomas & Betts Carlon 1-gang 21 cubic in. adjustable electrical box; model number: B121ADJ	20	Ea
		Thomas & Betts Carlon 2-gang 34 cubic in. adjustable switch and outlet box; model number: B234ADJC	14	Ea
		Thomas & Betts Carlon 1-gang 18 cubic in. zip switch and outlet box; model number: B118A, internet model number: 100404124	30	Ea
		RACO 1-gang 6 cubic in round ceiling pan	7	Ea
		Steel handy box; 1.5" depth	5	Ea
	Panelboard	Eaton 200A single-phase main lug loadcenter; model number: BR3040L200	1	Ea
	Metering	Siemens MC0816B1200 ESN meter-load center combo	1	Ea
	Circuit breaker	Milbank U3832 30A fusible disconnect	1	Ea
		Eaton 20A; BR2020	8	Ea
		Eaton 40/20A; BQ240220	2	Ea
		Eaton 30/15A; BQ230215	2	Ea
		Eaton 20A; BR120AF	4	Ea
		Eaton 15A; BR115AF	2	Ea

		Eaton 20A/20A; BR2020	8	Ea
		Eaton 15/30A; BQ215230	1	Ea
		Eaton 20/40A; BQ220240	4	Ea
		Eaton 20/30A; BQ220230	1	Ea
	PV grounding	Burndy WEEB-lug-8.0; item number: 30020111	10	Ea
		Burndy WEEB DPF	112	Ea
	Solar panels	Bosch mono-crystalline photovoltaic module for electricity generation, c-Si M 60 NA42117 (255 Wp)	28	Ea
	Module maximizer	Tigo Energy MM-ES50	28	Ea
	Maximizer management unit	Tigo	1	Ea
	Energy gateway	Tigo	1	Ea
	Inverter	SMA Sunny Boy; model number: 8000TL-US	1	Ea
	PV racking	Sunplanter aluminum rails; 150"x6"	10	Ea
Controls		Arduino UNO microcontroller board; store code: A000066, microcontroller ATmega328	1	Ea
		Arduino MEGA microcontroller board; store code: A000067, microcontroller ATmega2560	4	Ea
		Arduino ethernet shield	1	Ea
		Raspberry Pi assembled board; manufacturer part number: RASPBERRY- MODB-512M	1	Ea
		Cisco 16-port small business desktop switch, 100 series; model number: SF100D-16-NA	1	Ea
	Motors	Autoslide motor system for sliding door, SlideRight AS011	2	Ea
		Somfy Sonesse 30 shade stepper motor for window blinds	5	Ea
		Somfy dry contact motor interface	5	Ea
		Marvel power window system; model number: 4290	1	Ea
		Rollertrol tubular motor; reference number: TMDC- 12-25-15-28-NR	3	

	Solar radiation sensor	Davis instruments 6450 solar radiation sensor; SKU: 6450	1	Ea
	Weather station	Campbell Scientific RM Young wind sentry set; model number: 03002	1	Ea
	Temperature and humidity sensor	Viasala HMP60 humidity and temperature probe for volume applications	1	Ea
	Cabling	Jameco jacketed, braided Cat 5e ethernet cable; manufacturer number: 10X5-804TH-100VP	600	LF
		Jameco wire hook-up solid 22 AWG; black, red	400	LF
		C2G Cat5 modular plug for round stranded cable	4	ea
		Southwire 22-4 CL3R shielded security cable; model number: 56910544	400	LF
		GE 14-gauge speaker wire; model number: 87649	400	LF
		GE RG-6 coaxial cable; model number: 73287	60	LF
		Aurum Ultra series high-speed HDMI extension cable; Amazon standard identification number: B009EAGMW2	75	LF
HVAC	Ducting	JPL class 1 air duct; 4" round insulated wire ducting	18	LF
		OC McDonald Co., Inc. 10x4 sheet metal ducting	15	LF
		OC McDonald 10x4 to 4" round sheet metal reducer	1	Ea
		OC McDonald 4" round to 10x2 boot	1	Ea
		OC McDonald 7x4 sheet metal	36	LF
		Acosta 5" round wire flex duct	20	LF
	Register	Reggio register metal grill square design; model number: G412, no holes	4	Ea
	Messana	Ray Magic Panel, part number: RM1051; 4'x8'x2"	20	Ea
		Ray Magic blank filler panel, part number: RM1623; 4'x8'x2"	12	Ea

		Pre-insulated backbone pipe, part number: RM1625; 5/8" pert-al-pert 8'	3	Ea
		Snap-in magic coupling, part number: RM1158	30	Ea
		Snap-in magic adapter, part number: RM1159	24	Ea
		Snap-in magic cap, part number: RM1514	20	Ea
		Magic 3-way fitting, part number: RM1161	12	Ea
		Fit-in coupling, part number: RM1165; 5/8"	4	Ea
		Fit-in 90 degree elbow, part number: RM1163; 5/8"	16	Ea
		Fit-in tee, part number: RM1166; 5/8"	22	Ea
		Fit-in 90 degree 5/8"x5/8" male, part number: RM1599	10	Ea
		Fit-in plug, part number: RM1167; 5/8"	4	Ea
		Magic cover gypsum plate, part number: RM1169	20	Ea
		Manifold snap-in cap, part number: RM1336	2	Ea
		Pre-insulated manifold, part number: RM1597; 10 loop	1	Ea
		Pre-insulated PEX-AL-PEX, part number: RM1157; 5/8"	320	LF
		Thermal hydronic actuator, part number: RM1152	10	Ea
		Control Magic electronic climate control unit, part number: CM1317	1	Ea
		SoLFWare Magic home, part number: CM1319	1	Ea
		Sense Magic humidity and temperature room sensor, part number: CM1456	3	Ea
		Sense Magic dial humidity and temperature room sensor, part number: CM1611	1	Ea
		Sense magic installation kit, part number: CM1627	4	Ea
		PT1000 temperature sensor, part number: CM1346	2	Ea

		Power supply 110V-24V DC 15W, part number: CM1350	1	Ea
		Isolatable fuse carrier, part number: CM1656; Schneider 15646	1	Ea
		6A fuse, part number: CM1659	10	Ea
		Relay socket, part number: CM1661	1	Ea
		24V 6A miniature relay, part number: CM1662	1	Ea
		Enclosure 4x18 DIN, part number: CM1693	1	Ea
		Air Magic HI250 neutral temperature dehumidifier, part number: AM1686	1	Ea
		Air Magic RR250 HRV module for HI250, part number: AM1687	1	Ea
		Air Magic 250 inlet adapter, part number: AM1313	1	Ea
		Air Magic 250 outlet adapter, part number: AM1314	1	Ea
	Refrigerant	Homewerks Worldwide R-410a refrigerant	5	lb
	Insulation	Rhino Linings DuraTite 2.0 closed-cell spray foam insulation; part numberL DT20 SET	3104	SF
		Icynene LD-R-50 open-cell spray foam insulation	1051	SF
		Green Guard certified unfaced fiberglass insulation	1400	SF
DHW system	Tank	American Solar Technics SoLFank kit	1	Ea
	Phase-change material	PureTemp phase change material; PureTemp48	9.8	Kg
		PureTemp phase change material; PureTemp53	4.7	Kg
	Piping	Everhot 1/2" PEX tubing with oxygen barrier	100	LF
	Controller	SHEM32 differential controller	1	Ea
	Pumps	Grundfos UPS15-58FC 3-speed circulator pump; model number: 59896341	1	Ea
	Heat exchanger	Mueller streamline 1/2" 363 PSI coil copper pipe; model number: D 08050PSE	10	LF

	Structure	Stainless rectangle 316/316L annealed; .125"x.75"	4	LF
		Stainless rectangle 316/316L annealed; .5"x1"	4	LF
		Cold finish stainless round 316/316L; .3125"	7	LF
	Washers	Flat nylon washers; FW0283A	750	Ea
	Solar thermal panel	Free Hot Water 4x10 flat collector, 8000 series; item code: FHWFC1005	1	Ea
Plumbing	Piping	SharkBite PEX Cold water pipe, blue 1/2" PEX	90	LF
		1/2" PEX plastic elbows	50	Ea
		SharkBite PEX hot water pipe with insulation, clear 1/2" PEX	97	LF
		Genova products 1 1/2" schedule 40 ABS	43	LF
		Genova products 2" schedule 40 ABS	49	LF
		1" type L copper piping	40	LF
		1/4" copper tubing	20	LF
		5/8" copper tubing	20	LF
		3/4" type L copper piping	1	LF
	Sanitary piping	2" PEX	10	LF
	Connection	Oatey 2" WMOB Quadro box with 1/4 turn brass hammer ball valves, copper sweat standard pack	1	Ea
		Oatey plastic icemaker box with 1/4 turn low lead brass hammer valve, copper sweat standard pack	1	Ea
	Water meter	Badger E-series water meter; 5/8" (ESM-T-01)	1	Ea
	Manifold	Nibco 6-port manifold; MSC part #: 75924340, manufacturer number: PX01120; inlet size: 3/4," outlet size: 1/2"	1	Ea
	Heat pump	Daikin Altherma split type heat pump, outdoor unit; model number: ERLQ018BAVJU	1	Ea

		Daikin Altherma hydrobox, indoor unit; model number: EKHBX030BA3VJU	1	Ea
	Pumps	Grundfos Alpha 15-55F; model number: 59896877	1	Ea
		Grundfos MQ3-35 pressure boosting pump; model number: 96860172	1	Ea
		Water Ace R5V sump pump; model number: 27496D500	1	Ea
	Tanks	Loomis Tank custom fabricated potable-water 1500 gallon storage tank; model number: LNW1500W	1	Ea
		Polyethylene greywater tank; 500 gal	2	Ea
		Daikin domestic hot water tank; model number: EKHWS050BA3VJU	1	Ea
Plumbing fixtures	Toilet tissue holder	Kohler Purist horizontal toilet tissue holder; model number: K-14377-CP	1	Ea
	Towel bar	Kohler Purist 24" single towel bar; model number: K-14436-CP	1	Ea
	Grab bar	Kohler Purist 32" grab bar; model number: K-11894-S	1	Ea
	Sinks	23" semi-pedestal bathroom sink with single faucet hole and shroud; model number: K-5150-1-0	1	Ea
		Kohler Lawnfield ; top-mount, single bowl sink; model number: K-5832	1	Ea
		Kohler Simplice pull-down kitchen sink faucet; model number: K-596	1	Ea
		Escale bathroom sink overflow cap; model number: K-4061-CP	1	Ea
		3/8" NPT angle supplies with stop, cross handle, and annealed vertical tube; model number: K-7605-P-CP	2	Ea
		Kohler bathroom sink grid drain with overflow; model number: K-7129-A-CP	1	Ea
		Kohler duostrainer manual sink strainer with tailpiece; model number: K-8801-VS	1	Ea

		Purist tall single-hold bathroom sink faucet with straight lever handle; model number: K-14404-4A-CP	1	Ea
	Lavatory	Kohler Saile one-piece elongated with dual flush technology; model number: K-3564-0	1	Ea
	Shower	Kohler Maax Evidence 6034M wall-mount shower base; model number: 105738-R-000-001-103	1	Ea
		Kohler Maax Evidence walk-in enclosure, right; model number: 137346-900-084-002	1	Ea
		Kohler Maax Evidence wood drip-tray accessory	1	Ea
		Kohler Forte Essentials performance shower package; model number: K-10827-4-CP	1	Ea
		Kohler Rite-temp 1/2" pressure-balancing valve with PEX expansion connections; model number: K-304-UX-NA	1	Ea
		Kohler round shower drain; model number: K-9132-CP	1	Ea
Appliances	Oven	Bosch 30" single wall oven; model number: HBL3350UC	1	Ea
	Dishwasher	Bosch 24" bar handle dishwasher; model number: SHX2AR55UC	1	Ea
	Refrigerator and freezer	Sun Frost refrigerator and freezer; model number: RF12	1	Ea
	Stove	Bosch induction stove cooktop; model number: NIT5065UC	1	Ea
	Stove hood	Bosch 30" downdraLF ventilation; model number: DHD3014UC	1	Ea
		Bosch 600 CFM internal blower; model number: DHG601DUC	1	Ea
	Clothes dryer	Bosch 24" compact venter dryer; model number: WTV76100US	1	Ea
	Clothes washer	Bosch 24" compact washer; model number: WAS20160UC	1	Ea

Fire suppression	Piping	1 1/4" CPVC sprinkler pipe	105	LF
		1" CPVC sprinkler pipe	1000	LF
		CPVC coupling	60	Ea
		1" CPVC elbow	35	Ea
		1 1/4" CPVC sprinkler pipe	15	Ea
		1 1/4" x 1" bushing	1	Ea
		1" x 1/2" reducer	12	Ea
		1" tee	11	Ea
	Accessories	CPVC pipe strap	10	Ea
		CPVC steel adapter	1	Ea
		Lag bolts	100	Ea
		CPVC screws	100	Ea
		CPVC hangers	100	Ea
		1 5/8" strut	10	LF
		2 1/2" flexible coupling	1	Ea
		2 1/2" rigid coupling	1	Ea
		2 1/2" copper coupling	1	Ea
		1 1/4" copper elbow	1	Ea
		Dielectric NIP groove thread 2 1/2"	1	Ea
		Dielectric union 1"	1	Ea
	Manifold	Tyco central 2 1/2" riser manifold	1	Ea
		2 1/2" riser clamp	1	Ea
	Gauges	Gauge kit	1	Ea
	Valves	Nibco T301W 1 1/4" angle valve	1	Ea
		2" butterfly valve with tamper	1	Ea
	Fire meter	Badger Meter Recordall FireSeries Meter FSMA 3"	1	Ea
	Smoke alarm	NNI Inc. System Sensor 2WTA-B	2	Ea
	Sprinkler head	Tyco Fire Production rapid response series LFII residential flat plate concealed pendant 4.9K-factor sprinklers; TY3596	12	Ea
	Pump	Talco LSF-150SP: motor, pump, controls; 40 GPM @ 50 PSI	1	Ea
Awning	Support straps	Simpson Strong-Tie 20-Gauge Strap; model number: ST2215	6	Ea
	Structure	Gatorshield 16-gauge 2" square steel	300	LF

	Fabric	AwnTex 160 #EF5 60" 36x16 winter wheat; item number: 863400	420	SF
Siding	Metal siding	Metal Sales US 24-gauge steel soffit panel; 12"	1800	SF
	Sheet metal flashing and trim	Metal Sales US 24-gauge steel flashing and trim	180	LF
Railings	Metal railings	Powder coated steel posts	125	LF
		Stainless steel tube railing	250	LF
Deck	Wood patio decking	Tigerwood decking by TigerDeck; 1"x6"	1480	SF
	Deck foundations	Standard pier	141	Ea
		4x6 lumber - girders, 8' OC	1480	SF
	Deck framing	2x6 lumber; 16" O.C.	1480	SF
Plants		Deer Grass	10	Ea
		Windmill Palm	1	Ea
		Lavender	11	Ea
		Bush Monkey Flower	2	Ea
		Golden Goddess Bamboo	5	Ea
		Rosemary	6	Ea
		Lenonotis Leonurus Lion's Tail	3	Ea
		Scarlet Bugler	5	Ea
		Kangaroo Paws	20	Ea
		Aloe Cameronii	3	Ea
		Bush Marigold	5	Ea
		Clysto Cactus Strausii	1	Ea
		Aloe Striata	5	Ea
		Dyckia Fosterana Hybrid	5	Ea
		Aloe Plicatillis	5	Ea
		Aeonium ZorcoLF	5	Ea
Soil		6" Soil Base	100	SF
Planter Boxes		Constructed from bamboo I-joists (see "Structure")	178	LF

CONSTRUCTION SPECIFICATIONS

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SECTION 00 31 00

Available Project Information

PART 1 – GENERAL

1.1 PRELIMINARY PHASE SCHEDULE

A. Schematic Design Phase	January 2012 – April 2012
B. Design Development Phase	May 2012 – October 2012
C. Construction Documents Phase	October 2012 – February 2013
D. Construction Phase	January 2013 – June 2013
E. System and Building Testing Phase	June 2013 – August 2013
F. Competition Phase	September 22, 2013 – October 18, 2013

1.2 PROJECT BUDGET INFORMATION

- A. Construction Budget: \$340,000.00
- B. Total Project Budget: \$950,000.00

1.3 CONSTRUCTION FACILITY

- A. The SCU Solar Decathlon 2013 House will be constructed in a contained area provided by Santa Clara University
 - 1. 500 El Camino Real
Santa Clara, CA 95053

END OF SECTION 00 31 00

SECTION 01 10 00

Summary

PART 2 - GENERAL

1.1 PROJECT INFORMATION

- A. Project Identification: Radiant House, Santa Clara University's 2013 Solar Decathlon.
- B. Project Location: Santa Clara University
500 El Camino Real
Santa Clara, CA 95053
- C. Owner: Santa Clara University
- D. Architect: The Santa Clara University Solar Decathlon Team
- E. Project Manager: Jake Gallau
(408) 806-9392
jgallau@gmail.com
- F. Project description: Radiant House is the Santa Clara University entry for the 2013 Solar Decathlon. Utilizing highly efficient materials and technologies, cutting-edge photovoltaics, and fully integrated control systems, Radiant House will blend elegance, efficiency, and economy in a truly revolutionary way.
- G. Mission: The vision of Santa Clara's Radiant House is a vision of a brighter future, a future of energy independence and environmental integrity. Our goal is to expand and enable the accessibility of solar energy, demonstrating that a sustainable lifestyle is not something that must wait until the future, but is something that can be achieved today. As a team, Santa Clara combines the expertise of undergraduate students from a variety of disciplines to bring an original perspective not only to the quantitative building elements, but also the qualitative relations of space and utility. Incorporating the three E's of our philosophy – Efficiency, Economy, and Elegance – we have created a home that strikes a balance between comfort, aesthetics, and technological innovation. It is

because of our commitment to the Jesuit values of competence, conscience, and compassion that we have built an extensive outreach program and have conducted thorough ethical examinations of each team decision. Together, these elements represent more than just a house; they define a vision for a greener and healthier tomorrow, available and amenable to everyone.

END OF SECTION 01 10 00

SECTION 05 21 00

Structural Steel

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the steel structure, foundations, and framing

1.2 SECTION REQUIREMENTS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. SOS Steel Co.

1160 Richard Ave

Santa Clara, CA 95050

Phone: 408.727.6363

Website: www.sossteelco.com

- B. Central Piers Inc.

284 North Thorne Ave

Fresno, CA 93706

Phone: 1.800.653.0387

Website: www.centralpiers.com

2.2 PRODUCTS

- A. SOS steel C-channels

- 1. Types:

- a. C15x33.9

- b. C8x11.5

- c. C3x4.1

- B. SOS steel hollow structural sections

1. Types:

- a. HSS8x3x3/8
- b. HSS3 1/2x3 1/2x5/16

C. SOS steel wide flange steel beams

1. Types:

- a. W5x19

D. SOS steel angles

1. Types:

- a. L8x4x1/2

E. SOS steel plates

1. Types:

- a. PL1/4x4, 11.5"
- b. PL1/4x5, 8"
- c. PL3/8x3 11/16, 5"
- d. PL3/8x3 1/2, 1'-1/2"
- e. PL3/8x3, 1'-1 15/16"
- f. PL3/8x3, 6.5"

F. Central Pier seismic pier

- 1. Model number: SPA 30-5F
- 2. Heights:
 - a. 7"
 - b. 11"
- 3. See manufacturer's specifications for further information:

<http://www.centralpiers.com/piers.html>

G. Central Pier standard pier

- 1. Heights:

- a. 6"
 - b. 8"
 - c. 10"
 - d. 12"
 - e. 14"
 - f. 16"
2. See manufacturer's specifications for further information:
- <http://www.centralpiers.com/piers.html>

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 05 21 00

SECTION 05 52 00

Metal Railings

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes metal railings

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Heinzen Manufacturing International (HMI)

405 Mayock St.

Gilroy, CA 95020

Phone: 408.842.7233

Website: www.heinzen.com

2.2 Products

- A. Powder Coated Steel Posts
- B. Stainless Steel Tube Railing

2.3 FABRICATION

- A. Assemble railing systems in shop to the greatest extent possible
- B. Use connections that maintain structural value of joined pieces
- C. Form changes in direction of railing members by use of prefabricated fittings
- D. Fabricate railing systems and handrails for connecting members with concealed mechanical fasteners and fittings

PART 3 - EXECUTION

3.1 INSTALLATION

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

- B. Set railings accurately in location, alignment, and elevation and free of rack
- C. Coat concealed surfaces of aluminum that will be in contact with cementations materials or dissimilar metals, with a heavy coat of bituminous paint
- D. Anchor posts to structural base and blocking of the exterior wood deck

END OF SECTION 05 52 00

SECTION 06 15 33

Wood Patio Decking

PART 1 – GENERAL

1.1 SUMMARY

- A. Tiger Deck to be used for wood patio decking

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Tiger Deck

31244 N Spirit Dr.

Spirit Lake, ID

Phone: 503.625.1747

Website: <http://www.tigerdeck.com/>

2.2 PRODUCTS

- A. Tiger Deck

1. Location: Outside Patio and Decking
2. Nominal Size: 1" X 6"
3. See manufacturer's specifications for further information:

<http://www.tigerdeck.com/technical-data/>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted
- B. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction

- C. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction" unless otherwise indicated
- D. Securely attach work to substrates, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners
 - 2. Published requirements of metal framing anchor manufacturer
 - 3. Tiger Deck resurfacing guide on their website
- E. Secure decking to framing with concealed decking fasteners or secure paver grid to the deck surface with approved fasteners
- F. Secure stair treads and risers by gluing and nailing screwing to carriages
- G. Countersink fastener heads, fill flush, and sand filler
- H. Extend treads over carriages and finish with bullnose edge

END OF SECTION 06 15 33

SECTION 06 16 00

Sheathing

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the sheathing of Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pinecone Lumber
 - 895 E Evelyn Ave.
 - Sunnyvale, CA 94086
 - Phone: 408.736.5491
 - Website: <http://www.pineconelumber.com/>

2.2 PRODUCTS

- A. Wood Panel Products, General
 - 1. Plywood: DOC PS 1.
 - 2. See manufacturer's specifications for further information:
<http://www.pineconelumber.com/>
- B. Treated Plywood
 - 1. Preservative-Treated Plywood: AWPA C9.
 - 2. Use treatment containing no arsenic or chromium
 - 3. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- C. Wall Sheathing
 - 1. Structural 1 Plywood Wall Sheathing
 - 2. Thickness: 15/32" Structural 1

3. See manufacturer's specifications for further information:

<http://www.pineconelumber.com/>

D. Roof Sheathing

1. Plywood Roof Sheathing: Structural Sheathing
2. Thickness: 3/4" Tongue and Groove
3. See manufacturer's specifications for further information:

<http://www.pineconelumber.com/>

E. Subflooring and Underlayment

1. Plywood Floor Sheathing: Structural Sheathing
2. Thickness: 3/4" Tongue and Groove and 5/8" Tongue and Groove
3. See manufacturer's specifications for further information:

<http://www.pineconelumber.com/>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasteners

1. General: Provide fasteners of size and type that comply with International Building Code, International Residential Code, Wood Frame Construction Manual, and National Design Specification

B. Fastening Methods:

1. Wall, Floor and Roof Sheathing:
 - a. Nail to wood framing

C. Install products in accordance with manufacturer's recommendations

END OF SECTION 06 16 00

SECTION 07 21 29

Insulation

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specifications for the polyurethane spray foam insulation

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Rhino Linings

9151 Rehco Road

San Diego, CA 92121

Phone: 858.450.0441

Website: <http://www.rhino linings.com/home>

- B. Owens Corning

1 Owens Corning Pkwy

Toledo, OH 43659

Phone: 419.248.8000

Website: <http://www.owenscorning.com/>

- C. ICYNENE

6747 Campobello Road

Mississauga, ON

L5N 2L7 Canada

Phone: 1.800.758.7325

Website: <http://www.icynene.com/>

2.2 PRODUCT

A. DuraTite 2.0 Closed-Cell Spray Foam Insulation

1. R-value of 6.3 per inch
2. 3% bio-based content
3. 3% pre-consumer recycled content
4. See manufacturer's specifications for further information:

http://rhinoliningsindustrial.com/products/spray_polyurethane_foams/duratite%E2%84%A2_2.0/48/233

B. R-13 EcoTouch PINK FIBERGLAS Insulation with PureFiber Technology

1. R-value of 13 per 3 1/2"
2. 99% natural ingredients
3. 58% total recycled content
4. See manufacturer's specifications for further information:

<http://insulation.owenscorning.com/homeowners/renovation/products/r-13-fiberglas-insulation/>

C. ICYNENE LD-R-50 Open Cell Spray Foam Insulation

1. R-value of 3.7 per inch
2. Made with environmentally friendly and renewable castor oil
3. See manufacturer's specifications for further information:

<http://www.icynene.com/builders/products/product-portfolio/ld-r-50-spray-foam-insulation>

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, under which work is to be performed
- B. Do NOT proceed until unsatisfactory conditions have been corrected

1. Review placement area to determine final location will not be within 3 inches of any heat source where the temperature will exceed 180 degrees °F per ASTM C 411 or in accordance with authorities having jurisdiction

3.2 PREPARATION

- A. Clean substrates and cavities of loose materials capable of interfering with placement

3.3 APPLICATION

- A. Site Mix liquid components supplied by Icyene and installed by Independent Icyene Licensed Dealer
- B. Apply insulation to substrates in compliance with manufacturer's written instructions
- C. Apply insulation to produce thickness require for indicated R Value
- D. Extend insulation thickness indicated to envelop entire area to be insulated
- E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is places on warm side of insulation encapsulates piping

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes
- B. Provide temporary coverings where insulation is subject to abuse

END OF SECTION 07 21 29

SECTION 07 42 13

Metal Wall Panels

PART 1 – GENERAL

1.3 SUMMARY

- A. This section includes specifications on metal wall panels

1.4 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Metal Sales U.S.

545 South 3rd Street, Suite 200

Louisville, KY 40202

Phone: 1.800.406.7387

Website: <http://www.metalsales.us.com/home/>

2.2 PRODUCTS

- A. 24 Gauge Steel Soffit Panel
 - 1. Dimensions: 12"
 - 2. Location: Exterior Siding
 - 3. See manufacturer's specifications for further information:

<http://www.metalsales.us.com/panel/soffit-panel/>

PART 3 – EXECUTION

3.2 INSTALLATION

- A. Install siding according to manufacturer's instructions.

END OF SECTION 07 42 13

SECTION 07 53 23

Thermoplastic Roofing Membrane (TPO)

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes TPO Roofing

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Distributed by:

Alliance Roofing

1250 Campbell Ave.

San Jose, CA 95126

Phone: 408.261.2595

Website: <http://www.alliancerroofingcal.com/>

2.2 PRODUCTS

- A. Thermoplastic Roofing Membrane (TPO)

1. Test Method: ASTM D4637
2. Type: Type I
3. Reinforcement: Non-reinforced
4. Thickness: 45 mils (1.1 mm)
5. See Manufacturer's Specifications for Further Information:

http://starringworldlw.en.alibaba.com/product/490289244-212617355/Waterproof_Membrane_TPO_Thermoplastic_Roofing_.html?domain_name=starringworldlw.en.alibaba.com

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install EPDM sheet according to roofing system manufacturer's instructions
- B. Seams: Clean splices and prime splices areas for applying splice tape; firmly roll side and end laps of overlapping sheets
- C. Seal exposed edges of sheet terminations
- D. Install sheet flashings and preformed flashing accessories and adhere to substrates
- E. Apply coatings to membrane roofing or base flashings according to manufacturer's written recommendations

END OF SECTION 07 53 23

SECTION 07 62 00

Sheet Metal Flashing and Trim

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes sheet metal flashing and trim

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Metal Sales U.S.

545 South 3rd Street, Suite 200

Louisville, KY 40202

Phone: 1.800.406.7387

Website: <http://www.metalsales.us.com/home/>

2.2 PRODUCTS

- A. 24 Gauge Steel Flashing and Trim

1. Location: Exterior Siding
2. See manufacturer's specifications for further information:

<http://www.metalsales.us.com/panel/soffit-panel/>

- B. Aluminum Roof Flashing

1. Material: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, not less than 0.032 inch (0.8 mm) thick

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install around exterior joints and seems according to manufacturer's specifications

END OF SECTION 07 62 00

SECTION 07 72 00

Roof Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes roof accessories

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Thunderbird Products

1148 North Marshall Avenue

El Cajon, CA 92020

Phone: 619.448.3567

Website: www.thunderbirdproducts.com

2.2 PRODUCTS

- A. TPO-clad inside-wall parapet drain

- 1. Model number: TPO-PDND2NH

- 2. Location: roof

- 3. Dimensions: 12" x 7" x 5"

- 4. Features:

- a. Includes aluminum dome strainer

- 5. See manufacturer's specifications for further information:

- http://www.thunderbirdproducts.com/products/images/tpo_inside_wall_pd.pdf

- B. Bottom outlet roof drain with overflow

- 1. Model number: RDCB2TA

- 2. Location: roof

3. Features:

- a. 2" male thread drain and overflow
 - b. Heavy duty ABS Cyclac dome strainer
 - c. 20 oz. seamless copper basin
4. See manufacturer's specifications for further information:

http://www.thunderbirdproducts.com/products/images/c_bottom_outlet_rd_wof.pdf

C. Thermoplastic membrane roof drain

D. Tapered installation board

1. Features:

- a. Two degree incline

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 07 72 00

SECTION 08 13 20

Exterior Metal Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes all metal exterior doors for Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Masonite Co

1 North Dale Mabry Hwy

Suite 950

Tampa, FL 33809

Phone: 1.800.895.2723

Website: www.masonite.com

- 1. Available at Home Depot

2435 Lafayette St.

Santa Clara, CA 95050

Phone: 408.492.9600

2.2 PRODUCT

- A. Masonite 72" x 80" Full Lite Steel Patio Door

- 1. SKU: 511213
- 2. Rough Opening: 72" x 80"
- 3. Finished Door: 71.25" x 78.25"
- 4. Material: Painted steel

5. Type: prehung outswing French door
6. See manufacturer's specifications for further information:
<http://www.homedepot.com/p/202888039>

2.3 ACCESSORIES

- A. Door hardware

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 08 13 20

SECTION 08 13 21

Exterior Fiberglass Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes all fiberglass exterior doors for Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Masonite Co

1 North Dale Mabry Hwy

Suite 950

Tampa, FL 33809

Phone: 1.800.895.2723

Website: www.masonite.com

- 1. Available at Home Depot

2435 Lafayette St.

Santa Clara, CA 95050

Phone: 408.492.9600

2.2 PRODUCT

- A. Masonite 36" x 80" Full Lite Entry Door

- 1. SKU: 476575

- 2. Location: South patio

- 3. Rough Opening: 37.5" x 81.5"

- 4. Finished Door: 36" x 80"

5. Material: Belleville Smooth Fiberglass
6. Type: :Prehung, outswing, entry door with Full Lite clear glass rectangle
7. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Masonite-Full-Lite-Primed-Smooth-Fiberglass-Entry-Door-with-Brickmold-46248/202896282#.Ug0RvVdAeUI>

B. Masonite 36" x 80" Full Lite Entry Door

1. SKU: 476575
2. Location: Exterior bedroom
3. Rough Opening: 37.5" x 81.5"
4. Finished Door: 36" x 80"
5. Material: Belleville Smooth Fiberglass
6. Type: :Prehung, outswing entry door with 1/2 Lite clear glass rectangle and 1 panel
7. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Masonite-Vent-Lite-Primed-Smooth-Fiberglass-Entry-Door-with-No-Brickmold-27277/202518481#.Ug0ScVdAeUI>

C. Masonite 36" x 80" Full Lite Entry Door

1. SKU: 476575
2. Location: Front entrance
3. Rough Opening: 37.5" x 81.5"
4. Finished Door: 36" x 80"
5. Material: Belleville Smooth Fiberglass
6. Type: :Prehung, inswing entry door with 1/2 Lite clear glass rectangle and 1 panel
7. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Masonite-Vent-Lite-Primed-Smooth-Fiberglass-Entry-Door-with-No-Brickmold-27277/202518481#.Ug0ScVdAeUI>

2.3 ACCESSORIES

A. Door hardware

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's recommendations

END OF SECTION 08 13 21

SECTION 08 13 73

Sliding Metal Doors

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the sliding glass doors used in the Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Masonite Co
 - 1 North Dale Mabry Hwy
 - Suite 950
 - Tampa, FL 33809
 - Phone: 1.800.895.2723
 - Website: www.masonite.com

2.2 PRODUCTS

- A. Sliding Patio Door
 - 1. Finished Slider: 143 1/2" X 82 1/2"
 - 2. Lowe tempered E II with Argon

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions

END OF SECTION 08 13 73

SECTION 08 14 16

Interior Wood Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes all wood doors for interior spaces of Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Masonite Co

1 North Dale Mabry Hwy

Suite 950

Tampa, FL 33809

Phone: (800) 895-2723

Website: www.masonite.com

- 1. Available at Home Depot

2435 Lafayette St.

Santa Clara, CA 95050

Phone: 408.492.9600

2.2 PRODUCT

- A. Masonite Flush Series Prehung Veneered Flush Birch Door

- 1. Location: Bedroom

- 2. Rough Opening: 37.5" x 81.69"

- 3. Finished Door: 36" x 80"

- 4. Thickness: 1-3/8"

5. See manufacturer's specifications for further information:

[http://www.homedepot.com/p/Masonite-Smooth-Flush-Hardwood-Hollow-Core-](http://www.homedepot.com/p/Masonite-Smooth-Flush-Hardwood-Hollow-Core-Birch-Veneer-Composite-Prehung-Interior-Door-17729/202872493#.Ug0JMVdAeUJ)

[Birch-Veneer-Composite-Prehung-Interior-Door-](http://www.homedepot.com/p/Masonite-Smooth-Flush-Hardwood-Hollow-Core-Birch-Veneer-Composite-Prehung-Interior-Door-17729/202872493#.Ug0JMVdAeUJ)

[17729/202872493#.Ug0JMVdAeUJ](http://www.homedepot.com/p/Masonite-Smooth-Flush-Hardwood-Hollow-Core-Birch-Veneer-Composite-Prehung-Interior-Door-17729/202872493#.Ug0JMVdAeUJ)

2.3 ACCESSORIES

- A. Door hardware

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 08 14 16

SECTION 08 14 17

Interior Wood Pocket Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes all wood pocket doors for interior spaces of Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Masonite Co

1 North Dale Mabry Hwy

Suite 950

Tampa, FL 33809

Phone: 1.800.895.2723

Website: www.masonite.com

- 1. Available at Home Depot

2435 Lafayette St.

Santa Clara, CA 95050

Phone: (408) 492-9600

2.2 PRODUCT

- A. Masonite Flush Series Veneered Flush Birch Pocket Door

- 1. Location: Bathroom and Closet

- 2. Rough Opening: 37.5" x 81.69"

- 3. Finished Door: 36" x 80"

- 4. Thickness: 1-3/8"

5. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Masonite-Smooth-Flush-Hardwood-Hollow-Core->

[Birch-Veneer-Composite-Prehung-Interior-Door-](#)

[17729/202872493#.Ug0JMVdAeUJ](#)

2.3 ACCESSORIES

- A. Door hardware

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 08 14 17

SECTION 08 53 13

Windows

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the windows and window accessories used in the Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Milgard

1010 54th Ave East

Tacoma, WA 98424

Phone: 1.800.645.4273

Website: www.milgard.com

- B. Pittsburgh Corning

800 Presque Isle Dr.

Pittsburgh, PA 15239

Phone: 724.327.6100

Website: www.pittsburghcorning.com

2.2 PRODUCTS

- A. Milgard Picture Windows

1. Model: 920 TB PW

2. Glass O/Is:

a. TX/2C

b. M2/C2

3. Rough opening dimensions:

- a. 3060
 - b. 4030
 - c. 7030
 - d. 2930
4. Features:
- a. 1/8 Sun coat Max
 - b. 1/8 clear temp
 - c. Fill: Argon
 - d. See manufacturer's specifications for further information:
<http://www.milgard.com/catalog/windows/style/picture/series/thermally-improved-aluminum/picture.asp>

B. Milgard Single-hung Window

- 1. Model: 1520 TB SH
- 2. Glass O/I: TX/2C
- 3. Rough opening dimension: 2036
- 4. Features:
 - a. 1/8 Sun coat Max
 - b. 1/8 clear temp
 - c. Horizontal set: 21
 - d. Fill: Argon
 - e. See manufacturer's specifications for further information:
<http://www.milgard.com/catalog/windows/style/single-hung/series/thermally-improved-aluminum/single-hung.asp>

C. Milgard Half Vent Windows

- 1. Model: 1120 TB HV

2. Glass O/Is:
 - a. TX/2C
 - b. M2/C2
3. Rough opening dimensions:
 - a. 3740
 - b. 6030
 - c. 4040
 - d. 3020
 - e. 6040
4. Features:
 - a. 1/8 Sun coat Max
 - b. 1/8 clear temp
 - c. Fill: Argon
 - d. See manufacturer's specifications for further information:

<http://www.milgard.com/catalog/windows/style/horizontal-slider/series/thermally-improved-aluminum/horizontal-slider.asp>

D. Milgard Full Awning Window

1. Model: 920 TV FA
2. Glass O/I: M2/C2
3. Rough opening dimension: 5630
4. Features:
 - a. 1/8 Sun coat Max
 - b. 1/8 clear temp
 - c. Fill: Argon

d. See manufacturer's specifications for further information:

<http://www.milgard.com/catalog/windows/style/awning/series/thermally-improved-aluminum/awning.asp>

E. Pittsburgh Corning Premiere IceScapes Glass Blocks

1. Model number: 110504

2. R-value: 1.96

3. Material: glass

4. Dimensions: 8" x 8" x 4"

5. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-Premiere-8-in-x-8-in-x-4-in-IceScapes-Glass-Blocks-8-Pack-110504/100540309#.Uq0dZ8rqpgM>

F. Pittsburgh Corning Premiere Decora Glass Blocks

1. Model number: 110351

2. R-value: 1.96

3. Material: glass

4. Dimensions: 6" x 8" x 4"

5. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-Premiere-6-in-x-8-in-x-4-in-Decora-Glass-Block-9-Pack-110351/100268806#.Ug0e7MrqpgM>

G. Pittsburgh Corning Glass-Block Expansion Strips

1. Model number: 120951

2. Material: plastic foam

3. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-Glass-Block-Expansion-Strips-12-Pack->

[120951/100318673?keyword=pittsburgh+corning+glass+block+expansion+strips#.Ug0dSsrqpqM](http://www.homedepot.com/p/Pittsburgh-Corning-ProVantage-Vertical-Spacer-10-Pack-104004/100538687?keyword=Zoom+Videos+Pittsburgh+Corning+Provantage+Vertical+Spacer#.Ug0dkMrqpqM)

H. Pittsburgh Corning ProVantage Vertical Spacer

1. Model number: 104004
2. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-ProVantage-Vertical-Spacer-10-Pack-104004/100538687?keyword=Zoom+Videos+Pittsburgh+Corning+Provantage+Vertical+Spacer#.Ug0dkMrqpqM>

I. Pittsburgh Corning ProVantage 15lb. Grout Mix

1. Model number: 114006
2. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-ProVantage-15-lb-Grout-Mix-114006/100542568?keyword=Pittsburgh+Corning+ProVantage+15+lb.+Grout+Mix#.Ug0eq8rqpqM>

J. Pittsburgh Corning Premiere Perimeter Channels for Premiere Glass Blocks

1. Model number: 120919
2. Material: PVC
3. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-Premiere-Perimeter-Channels-for-Premiere-Glass-Blocks-4-Pack-120919/100318670?keyword=Pittsburgh+Corning+Premiere+Perimeter+Channels+for+Premiere#.Ug0fdcrqpqM>

K. Pittsburgh Corning ProVantage Horizontal Spacers

1. Model number: 124005

2. Material: PVC

3. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-ProVantage-Horizontal-Spacers-4-Pack-124005/100577242#.Ug0fysrgpqM>

L. Pittsburgh Corning Glass Block Sealant

1. Model number: 102133

2. See distributor's specifications for further information:

<http://www.homedepot.com/p/Pittsburgh-Corning-Glass-Block-Sealant-4-Pack-102133/100318675#.Ug0gFMrgpqM>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions

END OF SECTION 08 53 13

SECTION 09 29 00

Drywall

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the drywall used in Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Gold Bond by National Gypsum
 - 2001 Rexford Road
 - Charlotte, North Carolina 28211
 - Phone: 704.365.7300
 - Website: <http://nationalgypsum.com/index.htm>

2.2 Products

- A. Gold Bond 5/8" Drywall Panel
 - 1. Model Number: GB99500800
 - 2. Made with Type X, fire-resistant gypsum core
 - 3. See manufacturer's specifications for further information:
http://www.lowes.com/pd_11737-272-GB99500800_0_?productId=3009508&Ntt=11737&pl=1¤tURL=%3FNtt%3D11737&facetInfo=
- B. Gold Bond 1/2" Drywall Panel
 - 1. Model Number: GB00090800
 - 2. See manufacturer's specifications for further information:

http://www.homedepot.com/p/Gold-Bond-1-2-in-x-4-ft-x-8-ft-High-Strength-Lite-Gypsum-Board-GB00090800/202809177#.UHL_T1dAeUJ

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions.

END OF SECTION 09 29 00

SECTION 09 64 00

Wood Flooring

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wood flooring.

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Plyboo by Smith & Fong Company

475 Sixth Street

San Francisco, CA 94103

Phone: 866.835.9859

Website: www.plyboo.com

- B. Kelly-Moore Paint Company Inc.

987 Commercial St.

San Carlos, CA 94070

Phone: 1.888.677.2468

Website: www.kellymoore.com

2.2 PRODUCTS

- A. Plyboo Unfinished Flat Grain Bamboo Flooring

1. Model Number: FL-5872UN-NAUF/FSC

2. Material: 100% bamboo

3. Dimensions: 5/8" x 3 5/8" x 72"

4. Hardness:

- a. ASTM D1037, Janka Ball Hardness Test

- b. 1800 lb.
- 5. Finish Rating
 - a. ASTM D4060, CS17 wheel, taber abrasion and ASTM D3359 adhesion
 - b. 23500 rotations, 4B adhesion rating
- 6. See Manufacturer's Specifications for Further Information:
<http://www.plyboo.com/products/plyboo-flat-grain-bamboo-flooring>

B. Kelly Moore Alkyd QD Sanding Sealer

- 1. Model: 2164 EZ SAND
- 2. Resin type: Alkyd
- 3. Color range: Clear
- 4. Finish: Semi-Gloss, MPI gloss level 5
- 5. VOC: <540 grams per liter
- 6. See Manufacturer's Specifications for Further Information:
<http://www.kellymoore.com/userfiles/file/pdfs/2164tds.pdf>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation

- 1. Install according to manufacturer's recommendations

END OF SECTION 09 64 00

SECTION 09 65 15

Baseboard

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the baseboard

1.2 SUBMITTALS

- A. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Plyboo by Smith & Fong Company

475 Sixth Street

San Francisco, CA 94103

Phone: 866.835.9859

Website: www.plyboo.com

2.2 PRODUCTS

- A. Plyboo Base Shoe

1. Model number: QRD-100PN
2. Location: Kitchen
3. Finish: Prefinished, Natural
4. Dimensions: 7/16" x 3/4" x 72"
5. Features:

- a. See manufacturer's specifications for further information:

<http://www.plyboo.com/downloads/flooring-accessories>

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 09 65 15

SECTION 09 65 19

Tile Flooring

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the tile used in Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Clay Tile

495 West Julian Street

San Jose, CA 95110

Phone: 408.275.1182

Website: www.fireclaytile.com

2.2 Products

- A. Quickship Recycled Ceramic Tile

1. Finish: Horizon
2. 6"x6"
3. 70% recycled materials (including post-consumer waste)
4. Made in California

END OF SECTION 09 65 19

SECTION 09 74 10

Tile Wall Coverings

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the tile used in Radiant House

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Fire Clay Tile

495 West Julian Street

San Jose, CA 95110

Phone: 408.275.1182

Website: www.fireclaytile.com

- B. Jeffrey Court

620 Parkridge Avenue

Norco, CA 92860

Phone: 951.340.3383

Website: www.jeffreycourt.com

2.2 Products

- A. Quickship Recycled Ceramic Tile

- 1. Fire Clay

- 2. Location: Bathroom

- 3. Finish: Horizon

- 4. 6"x6"

- 5. 70% recycled materials (including post-consumer waste)

6. Made in California
- B. Yukon Cliff Brick 10-1/2" x 11-3/4" glass and travertine mosaic wall tile
1. Jeffrey Court
 2. Location: Kitchen
 3. Smooth unglazed surface of glass combination with stone

END OF SECTION 09 74 10

SECTION 10 28 00

Toilet, Bath, and Laundry Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the toilets, showers, and laundry accessories.

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Kitchen and Bath Plumbing Fixtures

Kohler Co.

444 Highland Drive

Kohler, WI 53044

Phone: 920.457.4441

Website: <http://www.us.kohler.com/us/>

2.2 PRODUCTS

- A. Kohler Purist Horizontal Toilet Tissue Holder

- 1. Model Number: K-14377-CP

- 2. Location: Bathroom

- 3. Finish: Polished Chrome

- 4. Features:

- a. Pivoting holder makes changing toilet tissue quick and simple

- b. Premium metal construction for durability

- c. Kohler Finished resist corrosion and tarnish

- B. Kohler Purist 24" Single Towel Bar

- 1. Model Number: K-14436-CP

2. Location: Bathroom
3. Finish: Polished Chrome
4. Features:
 - a. Solid Brass Configuration
 - b. KOHLER finishes resist corrosion and tarnish

C. Kohler Purist 32" Grab Bar

1. Model Number: K-11894-S
2. Location: Bathroom
3. Finish: Polished Stainless Steel
4. Features:
 - a. Metal construction
 - b. See manufacturer's specifications for further information:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1097577_4.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Tools Required: an adjustable wrench, pliers, sealant tape, wax seal, level, hammer, tape measure, pencil, screw driver, drill.
- B. Install fixtures in accordance with manufacturer's recommendations.

1. Bathroom toilet:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1087557_2.pdf

2. Toilet tissue holder:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1087639_2.pdf

3. Towel bar:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1087638_2.pdf

4. Toilet seat:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1133011_2.pdf

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1160682_2.pdf

END OF SECTION 10 28 00

SECTION 10 73 13

Awnings

PART 1 – GENERAL

1.5 SUMMARY

- B. This section includes the back awning and awning structure

1.6 SECTION REQUIREMENTS

- B. Product data

PART 2 – PRODUCTS

2.3 MANUFACTURERS

- A. Trivantage

1831 North Park Ave

Glen Raven, NC 27217

Phone: 800.786.1876

Website: www.trivantage.com

2.4 DEVICES

- H. Trivantage AwnTex 160 #EF5 awning fabric

- 1. Item number: 863400

- 2. Dimensions: 60" 36x16

- 3. Color: Winter Wheat

- 4. See manufacturer's specifications for further information:

- <http://www.trivantage.com/webapp/wcs/stores/servlet/en/tri->

- [us/AwnTex+160+EF5+60+36x16+Winter+Wheat+Standard+Pack+30+Yards+86340](http://www.trivantage.com/webapp/wcs/stores/servlet/en/tri-us/AwnTex+160+EF5+60+36x16+Winter+Wheat+Standard+Pack+30+Yards+86340)

- [0](#)

- I. Gatorshield steel awning structure

- 1. Dimensions: 2" square

- 2. Gauge: 16

3. See manufacturer's specifications for further information:

<http://www.usw.com/images/uploads/literature/goutdoor.pdf>

PART 3 – INSTALLATION

3.1 INSTALLATION

- B. Install according to manufacturer's instructions

END OF SECTION 10 73 13

SECTION 11 31 13

Residential Kitchen Appliances

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the residential kitchen appliances

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bosch Design Center

17911 Von Karman, Suite 100

Irvine, CA 92614

Phone: 1.800.944.2904

Website: <http://www.bosch-home.com/us/>

- B. Sun Frost Refrigerator Systems

Sun Frost

P.O. Box 1101

Arcata, CA 95518

Phone: 707.822.9095

Website: <http://www.sunfrost.com/index.html>

2.2 PRODUCTS

- A. Bosch 30" Single Wall Oven

1. Model Number: HBL3350UC

2. Location: Kitchen

3. Capacity: 4.7 Cubic Feet

4. Material: 300 Series - Stainless Steel

5. See manufacturer's specifications for further information:

<http://www.bosch-home.com/us/products/built-in-wall-ovens/single-ovens/HBL3350UC.html?a=b>

B. Bosch 24" Bar Handle Dishwasher

1. Model number: SHX2AR55UC
2. Location: Kitchen
3. Efficiency: 279 kwh/yr. Energy Star®
4. Material: Ascenta Series – Stainless Steel
5. See manufacturer's specifications for further information:

<http://www.bosch-home.com/us/products/built-in-dishwashers/bar-handle/SHX2AR55UC.html?source=search>

C. Sun Frost Refrigerator and Freezer

1. Model number: RF12
2. Location: Kitchen
3. Single Compressor Refrigerator and Freezer with a Passive (No Fans) Cooling System
4. ENERGY STAR® Qualified Model
5. See manufacturer's specifications for further information:

http://www.sunfrost.com/refrigerator_specs.html

D. Bosch Induction Stove Cooktop

1. Model Number: NIT5065UC
2. Location: Kitchen
3. Finish: Black top with Front and back Stainless Steel Strips
4. Features:
 - a. 30" Induction Cooktop
 - b. 4 Cooktop Burners

- c. 11" Heating Element with Powerful 3600W
 - d. Touch Control
 - e. Direct Cooking Level Surface
 - f. Built-In-Timers
 - g. Fast Heat Mode Boils Water Twice as Fast as Conventional Electric
5. See manufacturer's specifications for further information:

<http://www.bosch-home.com/us/products/cooktops/induction-cooktops/NIT5065UC.html?a=b>

E. Bosch 30" Downdraft Ventilation

- 1. Model Number: DHD3014UC
- 2. Location: Kitchen
- 3. Finish: Stainless Steel
- 4. Features:
 - a. 31" x 3 3/4"
 - b. 600 CFM Blower Options (Sold Separately)
 - c. Duct Blower Left, Right, or Straight Down
- 5. See manufacturer's specifications for further information:

<http://www.bosch-home.com/us/products/ventilation/downdrafts/DHD3014UC.html?source=search>

F. Bosch 600 CFM Internal Blower

- 1. Model Number: DHG601DUC
- 2. Location: Kitchen
- 3. Finish: Stainless Steel
- 4. Features:
 - a. 15 1/8" x 14 3/8" x 6 3/4"
 - b. Ducted Operating Mode

- c. Internal Blowers are installed under the countertop with the downdraft
- 5. See manufacturer's specifications for further information:
<http://www.bosch-home.com/us/products/ventilation/downdrafts/DHG601DUC.html?source=search>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Requirements

1. Kitchen Oven

- a. Watts: 5,800 W
- b. Current: 30; 25 A
- c. Volts: 240/208 V
- d. Frequency: 60 Hz
- e. Plug Type: Fixed Connection, No Plug
- f. Energy Source: Electric

2. Kitchen Dishwasher

- a. Watts: 1,400 W
- b. Current: 12 A
- c. Volts: 120 V
- d. Frequency: 160 Hz
- e. Tub Type: Tall Tub
- f. Plug Type: Fixed Connection

3. Kitchen Fridge/Freezer: N/A

4. Kitchen Induction Stove Cooktop

- a. Watts: 7,200W
- b. Current: 40A

- c. Volts: 208-240V
 - d. Frequency: 60 Hz
 - e. Energy Source-Electric
 - f. No Plug Required
5. Kitchen Stove Hood
- a. Watts: 580W
 - b. Volts: 110V
 - c. Frequency: 60 Hz
 - d. Requires a 120V-3 Prong Plug
- B. Install products in accordance with manufacturer's recommendations via instructions provided with unit.
- 1. Kitchen Oven: N/A
 - 2. Kitchen Dishwasher: N/A
 - 3. Kitchen Fridge/Freezer: N/A
 - 4. Kitchen Induction Stove Cooktop: N/A
 - 5. Kitchen Stove Hood: N/A

END OF SECTION 11 31 13

SECTION 11 31 23

Residential Laundry Appliances

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the residential laundry appliances.

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bosch Design Center
 - 17911 Von Karman, Suite 100
 - Irvine, CA 92614
 - Phone: 1.800.944.2904
 - Website: <http://www.bosch-home.com/us/>

3.2 PRODUCTS

- A. Bosch 24" Compact Vented Dryer
 - 1. Model Number: WTV76100US
 - 2. Location: Closet
 - 3. Capacity: 3.9 Cubic Feet
 - 4. Finish: Axxis - White
 - 5. Features:
 - a. Moisture Sensor-Controlled Automatic Drying Programs Prevents Wasted Energy and Over drying
 - b. 110 CFM High Air Flow
 - c. 4 Temperature Settings
 - d. See manufacturer's specifications for further information:

<http://www.bosch-home.com/us/products/compact-washers-dryers/compact-dryers/WTV76100US.html?source=search>

B. 24" Compact Washer

1. Model Number: WAS20160UC
2. Location: Closet
3. Capacity: 2.2 Cubic Feet
4. Finish: Axxis - White
5. Features:
 - a. Energy Star® Qualified
 - b. Exceed Energy Star Requirements by up to 63%
 - c. Internal Water Heater Heats Water Quickly and Efficiently
 - d. Wash Up to 17.6 lbs.
 - e. See manufacturer's specifications for further information:

<http://www.lg.com/us/dryers/lg-DLEX3470V-electric-dryer>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Requirements:

1. Washer:
 - a. Current: 10 A
 - b. Volts: 120 V
 - c. Energy Source: Electric
2. Dryer:
 - a. Current: 30 A
 - b. Volts: 240 V
 - c. Energy Source: Electric

END OF SECTION 11 31 23

SECTION 11 52 00

Audio-Visual Equipment

PART 1 - GENERAL

1.1 SUMMARY

- B. This section includes the audio-visual equipment

1.2 SUBMITTALS

- B. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- B. Samsung

85 Challenger Road

Ridgefield Park, NJ 07660

Phone: 1.800.726.7864

Website: www.samsung.com

Available at:

1. Best Buy
2. Target

- C. Sanus

6436 City West Parkway

Eden Prairie, MN 55344

Phone: 651.484.7988

Website: www.sanus.com

Available at:

1. Best Buy

2.2 PRODUCTS

- A. Samsung 46" LED Smart HDTV

1. Model number: UN46EH5300
2. Resolution: 1080p
3. TV Type: LED flat-panel
4. Screen refresh rate: 60 Hz
5. Features:

- a. See distributor's specifications for further information:

<http://www.bestbuy.com/site/46%22+Class--+LED--+1080p--+60Hz--+Smart--+HDTV/5372883.p?id=1218637213786&skuld=5372883&st=samsung#tab=overview>

B. Samsung Wi-Fi Blu Ray Player

1. Model number: BD-E5400/ZA
2. Resolution: HD – 1080p
3. Features:

- a. See distributor's specifications for further information:

http://www.target.com/p/samsung-wifi-blu-ray-player-black-bd-e5400-za/-/A-14291344#prodSlot=medium_1_2&term=samsung+blu-ray+player

C. Sanus Full Motion Wall Mount for 32"-47" Flat-Panel TV

1. Model number: VMF220-B1
2. Dimensions: 19 1/2" x 21 1/4" x 3 7/8"
3. Weight: 24.9 lbs.
4. Mount type: Full Motion
5. Features:

- a. See distributor's specifications for further information:

<http://www.bestbuy.com/site/Full-Motion+Wall+Mount+for+Most+32%22--+47%22+Flat-Panel+TVs+->

[+Extends+20%22/9967112.p?id=1218204943793&skuld=9967112&st=sanus#ta
b=specifications](#)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 11 52 00

SECTION 12 32 13

Manufactured Wood-Veneer-Faced Casework

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wood casework.

1.2 SUBMITTALS

- A. Product Data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Northern Contours

1355 Mendota Heights Rd.

Suite 100

St. Paul, MN 55120

Phone: 651.695.1698

Website: www.northerncontours.com

2.2 PRODUCTS

- A. Northern Contour Custom Cabinets

1. Spectrum Series Metro
2. Location: Kitchen
3. Material: Quartered Black Walnut
4. Core: 3/4"
5. Features:

- a. See manufacturer's specifications for further information:

<http://www.northerncontours.com/Products/Detail/SPEMET>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation

1. Install according to manufacturer's instructions

END OF SECTION 12 32 13

SECTION 12 36 40

Stone Countertops

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the stone countertops used in Radiant House.

1.2 SUBMITTALS

- A. Product Data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ECO by Cosentino

Cosentino USA

13124 Trinity Street

Stafford, TX

Phone: 800-268-6837

Website: ecobycosentino.com/usa/

2.2 Products

- A. ECO by Cosentino

- 1. Finish: Polar Cap

- 2. Features:

- a. 20 mm thick
 - b. 75% of recycled materials
 - c. 25% of natural stones ecological resin
 - d. 94% of water used in manufacturing process is re-used

END OF SECTION 12 36 40

SECTION 21 05 19

Fire Suppression System Meters & Gauges

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the meters and gauges that will be used in Radiant House's fire suppression system

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. NNI Inc.

N & N International

667 N.W. 118th Street

Miami, FL 33168-2540

Phone: 305-687-3330

Website: <http://nni.8m.com/index.html>

- B. Badger Meter

4545 W Brown Deer Rd.

Milwaukee, WI 53223

Phone: 414.355.0400

Website: www.badgermeter.com

2.2 PRODUCTS

- A. NNI Inc. System Sensor 2WTA-B

1. Electrical: 2-wire 8.5-35V 50uA (130uA alarm), 14-22 AWG wires.
2. Physical: 4-inch-square back box with paster ring directly mounted to ceiling.

3. See manufacturer's specifications for further information:

http://nni.8m.com/smoke_alarm_i3.html

B. Badger Meter Recordall FireSeries Meter FSMA 3"

1. Size: 3"
2. GPM: 6 to 550
3. See manufacturer's specifications for further information:

<http://www.badgermeter.com/getdoc/d2f1e6ed-b57a-432c-ae4d-c3622002acbe/Fire-Service-Meters.aspx>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions
- B. Install according to:
 1. Compliance with IRC (International Residential Code)
 2. Compliance with IFC (International Fire Code)

END OF SECTION 21 05 19

SECTION 21 10 00

Water-Based Fire Suppression Systems

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes water-based fire suppression systems

1.2 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product performance requirements
 - 2. Product data for pipe and fittings
 - 3. Product data for sprinklers

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydraulically design sprinkler systems according to NFPA 13D.
- B. Comply with NFPA 13D and NFPA 70.
- C. UL-listed and -labeled and FM-approved pipe and fittings.

2.2 PRODUCTS – PIPE AND FITTINGS

- A. CPVC Plastic Pipe
 - 1. ASTM F 442
 - 2. UL 1821
 - 3. Rating: 175-psig
 - 4. Approvals:
 - a. UL
 - b. FM
 - c. C-UL
 - d. NSF
 - e. LPCB

- f. MEA
 - g. City of Menlo Park Fire Department
5. Include "Listed" and "CPVC Sprinkler Pipe" marks on pipe.
- B. Copper Tube
- 1. Drawn temper
- C. CPVC Plastic Pipe Fittings
- 1. ASTM F 438 for NPS 3/4 to NPS 3
 - 2. ASTM F 439 for NPS 2
 - 3. UL listed
 - 4. Rating: 175-psig
 - 5. Include "Listed" and "CPVC Sprinkler Fitting" marks on fittings
 - 6. Various types of adapters available to meet metallic fittings
 - 7. All female pipe thread adapters to have brass inserts for durability
 - 8. Grooved adapters connect directly to grooved end valves and metallic pipe, with flexible grooved end couplings

2.3 PRODUCTS – SPRINKLERS

- A. Automatic sprinklers:
- 1. Manufacturer:
Tyco Fire Products
PO Box 2806
Lubbock, TX 79408-2806
Phone: 714.993.6111
Website: www.tyco-fire.com
 - 2. Tyco Rapid Response Series LFII Residential Flat Plate Concealed Pendant Sprinkler
 - a. Model number: TY3596

- b. Features:
 - i. K-Factor: 4.9K
 - ii. Fast-response
 - iii. Certified under UL 1626, for Residential Systems
 - iv. Certified under UL 1767, for Rapid Response Enabled Systems
 - v. Maximum working pressure: 175 psi
 - vi. Discharge coefficient: 4.9 GPM/psi^{1/2}
 - vii. Temperature Rating: 160° F (Sprinkler), 139°F (Cover Plate)
 - viii. Vertical Adjustment/Orifice: 1/2 inch
 - ix. Spacing Requirements: Min 8 feet, not to exceed length of coverage area
- c. Components and Composition:
 - i. Body: Brass
 - ii. Cap: Bronze
 - iii. Saddle: Brass
 - iv. Sealing Assembly: Beryllium Nickel w/Teflon
 - v. Soldered Link Halves: Nickel
 - vi. Lever: Bronze
 - vii. Compression Screw: Brass
 - viii. Deflector: Copper or Brass
 - ix. Guide Pin Housings: Bronze
 - x. Guide Pins: Stainless Steel or Bronze
 - xi. Support Cup: Stainless Steel
 - xii. Cover Plate: Copper
 - xiii. Retainer Cover Plate: Bronze
 - xiv. Ejection Spring: Stainless Steel

- B. Sprinkler Types and Categories: Nominal 1/2-inch orifice for NFPA 13D standard temperature classification rating unless otherwise indicated or required by application.
- C. Sprinkler types include the following:
 - 1. Upright, pendent, and sidewall sprinklers.
 - 2. Extended coverage sprinklers.
 - 3. Quick-response sprinklers.
 - 4. Pendent and sidewall, dry-type sprinklers.
- D. Sprinkler Guards: Wire-cage type, including fastening device.
- E. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench, suitable for wall mounting

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to external tank for service entrance to building
- B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service

3.2 PIPING INSTALLATION

- C. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve
- D. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes
- E. Install ball drip valves to drain piping between fire department connections and check valves
- F. Drain to floor drain or outside building
- G. Install alarm devices in piping systems and connect to fire-alarm system
- H. Protect piping from earthquake damage as required by NFPA 13D
- I. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe

- J. Install gages to permit removal, and install where they will not be subject to freezing
- K. Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections
- L. Where there is more than one control valve, provide permanently marked identification signs indicating portion of system controlled by each valve
- M. Install check valve in each water supply connection
- N. Install backflow preventers in potable-water supply sources
- O. Install alarm check valves for proper direction of flow, including bypass check valve and retard chamber drain line connection

3.3 PIPING

- P. Install shutoff valve, check valve, pressure gage, drain, and other accessories indicated at connection to water service piping

3.4 TESTING

- Q. Flush, test, and inspect sprinkler piping systems according to NFPA 13D

END OF SECTION 21 10 00

SECTION 21 30 00

Fire Pumps

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the pumps used in the water based fire suppression system

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 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.
- B. Comply with UL 778 for motor-operated water pumps.

2.2 MANUFACTURERS

- A. Talco Fire Systems
6040 NE 112th Ave.
Portland, OR 97220
Phone: 800 878 8055
<http://www.talcofire.com/index.html>

2.3 Products

- A. Talco LSF-150SP
 1. Casing: Cast Iron.
 2. Impeller: Plastic.
 3. Impeller Material: ASTM B 584, cast bronze or stainless steel.
 4. Shaft and Shaft Sleeve: Steel shaft with copper-alloy shaft sleeve or cast iron.

5. Seal: Mechanical; with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Motor:
 - a. 1.5 horsepower electric
 - b. 230 Volt, 10.9 Amp
 - c. Single Phase

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
- B. Motor Sizes: Minimum size as indicated.
- C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 262913 "Enclosed Controllers."

2.5 CONTROLS

- A. Timers: Electric, for control of minimum run time of pump.
 1. Type: Programmable, clock with manual override on-off switch.
- B. Switches: Electric for changing pump settings.
 1. HOA Toggle switch (Hand, Off, Auto)
 2. 40/60 Pressure switch

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so weight of piping is not supported by pump volute.
- D. Install electrical connections for power, controls, and devices.

- E. Suspend in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers. Fabricate brackets or supports as required for pumps.
- F. Install vertical in-line pumps on concrete bases.
- G. Connect piping with valves that are at least the same size as piping connecting to pumps.
- H. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- I. Install shutoff valve and strainer on suction side of pumps.
- J. Install non-slam check valve and throttling valve on discharge side of pumps.
- K. Install thermostats in hot-water return piping.
- L. Install pressure gages on suction and discharge of each pump. Install at integral pressure gauge tapings where provided.

END OF SECTION 21 30 00

SECTION 22 05 00

Common Work Results for Plumbing

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes common work results for plumbing

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Uponor

5925 148th Street West

Apple Valley, MN 55124

Phone: 800.321.4739

Website: <http://www.uponor-usa.com/>

2.2 PRODUCTS

- A. Uponor plastic bend support
 - 1. Model number: A5250500
- B. Uponor tube talon
 - 1. Sizes:
 - a. 1/2"
 - b. 5/8"
 - c. 3/4"
 - d. 1"

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install piping according to manufacturer's instructions

1. Install piping free of sags and bends
 2. Install fittings for changes in direction and branch connections
 3. Install sleeves for pipes passing through walls and concrete floors and roof slabs
 4. Install unions at final connection to each piece of equipment
- B. Install general equipment according to safety standards and to manufacturer's instructions
1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated
 2. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated
 3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations
 4. Install equipment to allow right of way for piping installed at required slope
- C. Install bases, supports, and anchorages according to seismic codes and to manufacturer's instructions
1. Construct concrete bases of dimensions indicated, but not less than 100 mm larger in both directions than supported unit
 2. Install dowel rods on 450-mm centers around the full perimeter of the base to connect concrete base to concrete floor
 3. Place and secure anchorage devices
- D. Install hangers and supports in accordance with MSS SP-69 and MSS SP-89
1. Install building attachments within concrete or to structural steel
 2. Install hangers and supports to allow controlled thermal and seismic movement of piping systems

3. Install hangers and supports to piping live and dead loading and stresses from movement will not be transferred to connected equipment
- E. For horizontal piping hangers and supports, install the following types:
1. Pipe hangers: MSS Type 5
 1. For suspension of pipes DN 15 to DN 100 to allow off-center closure for hanger installation before pipe erection
 2. Pipe hangers: MSS Type 10
 - a. For suspension of non-insulated stationary pipes DN 15 to DN 50
- F. For vertical piping clamps, install the following types:
1. Extension pipe or riser clamps: MSS Type 8
 - a. For support of pipe risers DN 20 to DN 500
 2. Carbon or alloy steel riser camps: MSS Type 42
 - a. For support of pipe risers DN 20 to DN 500
- G. Comply with the PHCC National Standard Plumbing Code and manufacturer's recommendations

END OF SECTION 22 05 00

SECTION 22 05 19

Meter and Gauges for Water-Based Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes meters and gauges for plumbing piping

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Badger Meter

4545 W Brown Deer Rd.

Milwaukee, WI 53223

Phone: 414.355.0400

Website: www.badgermeter.com

2.2 PRODUCTS

- A. Badger E-Series water meter

1. Size: 5/8" (15 mm)
2. Maximum pressure: 175 PSI
3. Maximum flow: 25 gpm
4. Measured temperature range: 34 – 140 F
5. See manufacturer's specifications for further information:
<http://badgermeter.com/Water/Water-Meters/E-Series.aspx>

PART 3 - EXECUTION

- A. General: Comply with owner's manual and the PHCC National Standard Plumbing Code and manufacturer's recommendations.

END OF SECTION 22 05 19

SECTION 22 05 23

General-Duty Valves for Water-Based Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes plumbing valves

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Homewerks Worldwide, LLC.

500 Bond Street

Lincolnshire, Illinois 60069

Phone: 224.543.1500

Website: <http://www.homewerksww.com/>

- B. Honeywell

101 Columbia Road

Mailstop – M6/LM

Norristown, NJ 07962

Phone: 1.877.841.2840

Website: <https://honeywell.com/Pages/Home.aspx>

- C. Matco-Norca

PO Box 27 Route 22

Brewster, New York 10509

Phone: 845.278.7570

Website: <http://www.matco-norca.com/>

- D. Belimo

43 Old Ridgebury Road

Danbury, CT 06810

Phone: 1.800.543.9038

Website: <http://www.belimo.us/ishop/cms/sh/index.shtml>

2.2 PRODUCTS

A. Brass Full-Port Ball Valve

1. Model: VBVFPSB5B
2. Location: Mechanical Room
3. Material: Brass
4. Dimensions [L x W x H]: 2.25" x 5.5" x 3.25"
5. Weight: 1.2 lb
6. Valve inlet diameter: 1"
7. Valve outlet diameter: 1"
8. Rating: 200 psi
9. Minimum working temperature: 40 F
10. Maximum working temperature: 180 F

B. Sweat Union Mixing Valve

1. Model: AM102-US-1
2. Location: Mechanical Room
3. Material: Nickel plated Brass
4. Valve inlet diameter: 1" threaded
5. Valve outlet diameter: 1" threaded
6. Max pressure: 150 psi
7. Minimum working temperature: 70 F
8. Maximum working temperature: 145 F

C. Bronze In-Line Check Valve

1. Model: 525C05
2. Location: Mechanical Room
3. Material: Bronze
4. Valve inlet diameter: 1"
5. Valve outlet diameter: 1"

D. Belimo Mixing Valve

1. Model: B317+LRB24-SR-T
2. Location: Mechanical Room
3. Valve diameter: 3/4"

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 22 05 23

SECTION 22 07 00

Plumbing Insulation

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the plumbing insulation

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. SharkBite

2727 Paces Ferry Rd. SE

Suite 1750, Building Two

Atlanta, GA 30339

Phone: 1.877.700.4242

Website: www.sharkbite.com

2.2 PRODUCTS

- A. SharkBite PEX pipe with insulation

1. Model number: U860I100
2. Inside diameter: 1/2"
3. Outside diameter: 3/4"
4. See manufacturer's specifications for further information:

http://www.homedepot.com/h_d1/N-5yc1v/R-203316941/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=pex+insulation&storeId=10051#.US03-oZvZ8E

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install around PEX piping ensuring a snug fit

END OF SECTION 22 07 00

SECTION 22 11 13

Facility Water Distribution Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes facility water distribution piping, the non-radiant portion of hydronic piping for the radiant system

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Genova Products

7034 East Court St.

Box 309

Davison, MI 48423-0309

Phone: 810.744.4500

Website: www.genovaproducts.com

2.2 PRODUCTS

- A. Copper piping for hydronic use

- 1. Sizes:

- a. 1/2"

- b. 3/4"

- c. 1"

- d. 1 1/4"

- 2. Type: L

- B. Genova Products DWV CC ABS pipe

- 1. Dimensions: 2"x10"

C. Genova Products ABS coupling

1. Model number: 80120
2. Diameter: 2"

D. Genova Products sanitary street ABS elbow

1. Model number: 82926
2. Diameter: 2"

E. Genova Products ABS sanitary tee

1. Model number: 81120
2. Diameter: 2"

F. Genova Products ABS vent cap

1. Diameter: 2"

G. Genova Products ABS wye

1. Model number: 81020
2. Diameter: 2"

H. Genova Products ABS pipe

1. Dimensions: 2"x10"

1.3 ACCESSORIES

A. NPT fittings

1. Diameter: less than or equal to 1 1/2"
2. ANSI B16.22 & B16.18

PART 3 – EXECUTION

3.1 INSTALLATION

A. Copper pipe installation

1. All water and glycol systems with operating temperatures of 40°F to 210°F: Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 1.5" and smaller, above ground, within building

2. Install air vents at high points in the system, heat transfer coils, and elsewhere as required for system air venting

B. ABS pipe installation

1. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping installation requirements.
2. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.
3. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
4. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
5. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
6. Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 80 and smaller; 1 percent downward in direction of flow for piping DN 100 and larger
7. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
8. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
9. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

10. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
11. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
12. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
13. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure unless otherwise indicated.
14. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for pipe hanger and support devices.

END OF SECTION 22 11 13

SECTION 22 11 16

Domestic Water Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes domestic water piping

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Uponor

5925 148th Street West

Apple Valley, MN 55124

Phone: 800.321.4739

Website: <http://www.uponor-usa.com/>

- B. SharkBite

2727 Paces Ferry Rd. SE

Suite 1750, Building Two

Atlanta, GA 30339

Phone: 1.877.700.4242

Website: www.sharkbite.com

- C. BrassCraft Manufacturing Company

39600 Orchard Hill Place

Novi, MI 48375-6000

Phone: 248.305.6000

Website: www.brasscraft.com

- D. Nibco

1516 Middlebury St.

Elkhart, IN 46516-4740

Phone: 800.234.0227

Website: www.nibco.com

Distributed by: www.mscdirect.com

2.2 PRODUCTS

A. Nibco Manifold

1. MSC part #: 75924340
2. Manufacturer part #: PX01120
3. Location (in house): Mechanical room
4. Inlet size: 3/4"
5. Outlet size: 1/2"
6. Features:
 - a. 6 outlet ports
7. See distributor's specifications for further information:
<http://www.mscdirect.com/product/75924340>

B. Uponor PEX piping

1. SKU: F1040500
2. Diameters:
 - a. 1/2"
 - b. 3/4"
 - c. 1"
3. Complies with:
 - a. DIN4726
 - b. ASTM F877
 - c. NSF

4. See distributor's specifications for further information:

<http://www.pexsupply.com/Wirsbo-Uponor-F1040500-1-2-AQUAPEX-100-ft-coil-2173000-p>

C. SharkBite rings

1. Model number: 23103CP25
2. Diameters:
 - a. 3/8"
 - b. 1"
 - c. 2"
 - d. 4"
3. See manufacturer's specifications for further information:

http://www.homedepot.com/h_d1/N-5yc1v/R-202032916/h_d2/ProductDisplay?catalogId=10053&langId=-1&keyword=PEX+rings&storeId=10051#.US1DQIZvZ8E

D. SharkBite tees

1. Model number: UC326LFA
 - a. Size: 1/2"
2. Model number: UC374A
 - a. Size: 1"
3. See manufacturer's specifications for further information:
 - a. <http://www.homedepot.com/webapp/catalog/servlet/Search?storeId=10051&langId=-1&catalogId=10053&keyword=pex+tees&Ns=None&Ntp=1&Ntpc=1&selectedCategory=Search+All>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install Wirsbo AQUAPEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook
- B. Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures
- C. Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline
- D. Make sweat connections prior to making PEX connections
- E. Do not expose PEX tubing to direct sunlight for more than 30 days
- F. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer
- G. Protect PEX tubing with sleeves where abrasion may occur
- H. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail
- I. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- J. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers

3.2 INSPECTION AND CLEANING

- A. Inspect and test piping systems as follows:
 - 1. Fill domestic water piping
 - 2. Check components to determine that they are not air bound and that piping is full of water
 - 3. 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 mg/L of chlorine
- C. Isolate with valves and allow to stand for 24 hours

- D. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time

END OF SECTION 22 11 16

SECTION 22 11 23

Water Pumps

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes domestic water and greywater pumps

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Grundfos Pumps Corporation

17100 W. 118th Terrace

Olathe, Kansas 66061

Phone: 913.227.3400

Website: <http://us.grundfos.com/>

- B. Ace Pump Corporation

1650 Channel Ave.

Memphis, TN 38113

Phone: 901.948.8514

Website: <http://www.acepumps.com/>

2.2 PRODUCTS

- A. Grundfos Alpha 15-55F

1. Model Number: 59896877
2. Description: Cast iron with terminal box
3. 1 x 115V, 60 Hz
4. See manufacturer's specifications for further information:

<http://www.pexsupply.com/Grundfos-59896832-ALPHA-15-55-F-LC-Cast-Iron-Circulator-Pump>

B. Grundfos MQ3-35 Pressure Boosting Pump

1. Model Number: 96860172
2. 115V
3. See manufacturer's specifications for further information:

<http://www.pexsupply.com/Grundfos-96860172-MQ3-35-Pressure-Boosting-Pump-115V>

C. Grundfos UPS15-58FC 3-Speed Circulator Pump

1. Model Number: 59896341
2. 115V, 1/25 HP
3. See manufacturer's specifications for further information:

<http://www.pexsupply.com/Grundfos-59896341-UPS15-58FC-3-Speed-Circulator-Pump-1-25-HP-115-volt-4701000-p>

D. Grundfos UP15-29SU Circulator Pump

1. Model Number: 4VZJ6
2. 115 V, 1/12 HP
3. See manufacturer's specifications for further information:
4. http://www.grainger.com/Grainger/GRUNDFOS-Circulator-Pump-4VZJ6?gclid=CKnmmbjq-rgCFUFyQgodZxwAjQ&cm_mmc=PPC:%20Google%20Catalog-_-Pumps%3EHot%20Water%20Circulating%20Pumps-_-Grundfos%3EHot%20Water%20Circulating%20Pumps%3EPhrase-_-UP15-29SU&ef_id=UgpdWwAAAS4EYer0:20130813162251:s

E. Water Ace R5V Sump Pump

1. Model Number: 27496D500

2. 1 1/4" – 1 1/2" discharge
3. 115v
4. See manufacturer's specifications for further information:

http://www.waterace.com/sump_3.html

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Comply with HI 1.4
- B. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories
- C. Support pumps and piping so weight of piping is not supported by pump volute.
- D. Install electrical connections for power, controls, and devices
- E. Suspend in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers
- F. Fabricate brackets or supports as required for pumps
- G. Install vertical in-line pumps on concrete bases
- H. Connect piping with valves that are at least the same size as piping connecting to pumps
- I. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles
- J. Install shutoff valve and strainer on suction side of pumps
- K. Install non-slam check valve and throttling valve on discharge side of pumps
- L. Install thermostats in hot-water return piping
- M. Install pressure gauges on suction and discharge of each pump. Install at integral pressure gauge tapings where provided

END OF SECTION 22 11 23

SECTION 22 12 00

Facility Potable-Water Storage Tanks

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes facility potable-water storage tanks

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Loomis Tank Center

2610 Ramada Drive

Paso Robles, CA 93446

Phone: 805.239.2279

Website: www.loomistank.com

2.2 PRODUCTS

- A. Loomis Tank custom fabricated potable-water storage tank

1. Capacity: 1500 gal.
2. Model Number: LNW1500W
3. Material: polyethylene
4. Features:
 - a. Single-chamber
 - b. Molded
 - c. HDPE or PE construction
 - d. 95in D X 58 in H
 - e. Top Fitting: 1.5" D and 16.5" D
 - f. Bottom Fitting: 2" D

5. See manufacturer's specifications for further information:

http://shop.loomistank.com/product/1003201.1008797.1008800.0.0/LNW1500W/_/NW_1500_WTR_95D_X_58H

2.3 ACCESSORIES

A. PEX pipes and fittings

1. See Section 22 11 16

B. Cleanouts

1. ASME A112.36.2M, with round, flanged, cast-iron housing; and secured, scoriated, medium-duty loading class, cast-iron cover
2. Includes cast-iron ferrule and countersunk brass cleanout plug

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install potable-water storage tanks level

B. Install polyethylene potable-water storage tanks according to guidelines

1. Accessibility, ease of maintenance, and removal should be taken into consideration when installing tanks
2. Adequately support all pipes and valves
3. Do not apply excess weight on water tanks
4. Tanks are not designed for storage of fluid in vacuum conditions or higher pressure above atmospheric
5. Use caution when handling all tanks

C. Fill potable-water storage tank with water

END OF SECTION 22 12 00

SECTION 22 13 00

Facility Sanitary Sewage and Vent Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes facility sanitary sewage and vent piping

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Genova Products

7034 East Court Street

Box 309

Davison, MI 48423-0309

Phone: 810.744.4500

Website: www.genovaproducts.com

2.2 PRODUCTS

- A. Genova Products ABS p-trap

1. Product number: various
2. Size: various"

- B. PVC Plastic and ABS Pipe and Fittings:

1. ASTM D 2665,
2. Plain ends with PVC socket-type.
3. Diameter 1 1/2" and 2"

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Comply with requirements in Division 22 Section “Common Work Results for Plumbing” for basic piping installation requirements
- B. Install wall penetration system at each pipe penetration through foundation wall
- C. Make installation watertight
- D. Comply with requirements in Division 22 Section “Common Work Results for Plumbing” for wall penetration systems
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends
- F. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical
- G. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe
- H. Straight tees, elbows, and crosses may be used on vent lines
- I. Do not change direction of flow more than 90 degrees
- J. Use proper size of standard increasers and reducers if pipes of different sizes are connected
- K. Reducing size of drainage piping in direction of flow is prohibited
- L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 80 and smaller; 1 percent downward in direction of flow for piping DN 100 and larger
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack
- M. Install PVC soil and waste drainage and vent piping according to ASTM D 2665
- N. Install underground PVC soil and waste drainage piping according to ASTM D 2321

- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction
- P. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction

END OF SECTION 22 13 00

SECTION 22 13 53

Facility Greywater Tanks

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the waste water tanks used for bathroom and kitchen shower and sink water

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 SEPTIC TANKS

- A. Polyethylene Greywater Tanks: Two single-chamber, molded, HDPE or PE construction; fabricated for greywater tank application.
 - 1. Capacity: 500 gal.
 - 2. See <http://www.ryanherco.com/> for fabricator

2.2 SIPHONS

- A. Automatic Siphons: Manufactured siphon assembly of molded HDPE trap, pipe, and bell, with PVC vent piping and stainless-steel bolts.
 - 1. Unit Size: min. 4 inches diameter.

2.3 DISTRIBUTION PIPES AND FITTINGS

- A. ABS Sewer Pipe and Fittings: ASTM D 2751, SDR 35, for solvent-cement or elastomeric gasket joints.
 - 1. Solvent Cement: ASTM D 2235.
 - 2. Gaskets: ASTM F 477, elastomeric seal.

PART 3 - EXECUTION

3.1 GREYWATER TANK INSTALLATION

- A. Install greywater tanks level

B. Install polyethylene greywater tanks according to guidelines.

C. Fill septic tank with water.

END OF SECTION 22 13 53

SECTION 22 41 16

Residential Lavatories and Sinks

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the sinks for the Bathroom and Kitchen

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Kitchen and Bath Plumbing Fixtures

Kohler Co.

444 Highland Drive

Kohler, WI 53044

Phone: 920.457.4441

Website: <http://www.us.kohler.com/us/>

2.2 PRODUCTS

- A. 23" semi-pedestal bathroom sink with single faucet hole and shroud

1. Model Number: K-5150-1-0
2. Location: Bathroom
3. Features:
 - a. Finish: White and Polished Chrome
 - b. Dimensions: L: 23-5/8" W:18-5/16" H: 16-5/32"
 - c. Single Faucet Hole
 - d. Deep, V shape basin
 - e. Coordinates with other products in Reve Suite

4. See manufacturer's specifications for further information:

<http://www.us.kohler.com/us/R%C3%A4ve%E2%84%A2-23-semi-pedestal-bathroom-sink-with-single-faucet-hole-and-shroud/productDetail/Wall-mount-Sinks/427399.htm?brandId=651438&skuld=405496&categoryId=651434&hash=id%3Dfilters%26startIndex%3D20%26scrollTop%3D0>

B. Escal Bathroom Sink Overflow Caps

1. Model Number: K-4061-CP
2. Location: Bathroom
3. Features:
 - a. Finish: Polished Chrome
 - b. Overflow cap attractively conceals drain while still allowing water to exit the sink
4. See manufacturer's specifications for further information:

<http://www.us.kohler.com/us/Escale-bathroom-sink-overflow-caps/productDetail/Non-Catalog/426432.htm?brandId=651438>

C. Pair 3/8" NPT angle supplies with stop, cross handle and annealed vertical tube

1. Model Number: K-7605-P-CP
2. Location: Bathroom
3. Features:
 - a. Finish: Polished Chrome
 - b. Pair of angle supplies with stop
 - c. Annealed vertical tube
 - d. 3/8" NPT
 - e. Four-arm handle
4. See manufacturer's specifications for further information:

<http://www.us.kohler.com/us/Pair-3-8-NPT-angle-supplies-with-stop.-cross-handle--and-annealed-vertical-tube/productDetail/Non-Catalog/419889.htm?brandId=651438>

D. Kohler Bathroom Sink Grid Drain with Overflow

1. Model Number: K-7129-A-CP
2. Location: Bathroom
3. Features
 - a. Finish: Polished Chrome
 - b. Solid brass construction ensures durability and reliability
 - c. Kohler finished resist corrosion and tarnishing
 - d. For use in overflow applications
4. See manufacturer's specifications for further information:
http://www.us.kohler.com/us/Bathroom-sink-grid-drain-with-overflow/productDetail/Bathroom-Fittings/424162.htm?skuld=389504&brandId=909034&pageName=null&_requestid=944783#

E. Kohler Lawnfield Under-Mounted Large/Medium Double Bow

1. Model Number: K-5841-4U-FE
2. Location: Kitchen
3. Features
 - a. Finish: Frost
 - b. Dimensions: L: 33" W: 22" H: 9-5/8"
 - c. KOHLER cast iron
 - d. Drop-in or under-mount installation
4. See manufacturer's specifications for further information:
http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1148646_4.pdf

F. Kohler Duostrainer Manual sink strainer with tailpiece

1. Model Number: K-8801-VS
2. Location: Kitchen

3. Features

- a. Finish: Vibrant Stainless
- b. Fits sinks with standard 3-1/2" or 4" outlet
- c. 1-1/2" connection and 4" tailpiece

4. See manufacturer's specifications for further information:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/105248_4.pdf

G. Saile one-piece elongated with dual flush technology

1. Model Number: K-3564-0

2. Location: Bathroom

3. Features

- a. Finish: White
- b. One-piece toilets integrate the tank and bowl into a seamless, easy-to-clean design
- c. Compact elongated bowl offers added comfort while occupying the same space as a round-front bowl
- d. Top-mounted 2 button flush offers a choice of 0.8 or 1.6 gpf
- e. Saile Quiet-Close seat with Quick-Release functionality allows seat to close quietly and quickly unlatch from the toilet for easy removal and convenient cleaning

4. See manufacturer's specifications for further information:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1086323_4.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all items with manufacturer's recommendations.

1. Kohler Bathroom Sink and Accessories

- a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1114335_2.pdf

- b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1107910_2.pdf
- 2. Kohler Kitchen Sink and Accessories
 - a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1068591_2.pdf
 - b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1084071_2.pdf
- 3. Kohler Lavatory
 - a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1086323_1.pdf
 - b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1087602_2.pdf

END OF SECTION 22 41 16

SECTION 22 41 23

Residential Showers

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the necessary parts for the residential shower

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Kitchen and Bath Plumbing Fixtures

MAAX Bath Inc.,

160 St. Joseph Blvd

Lachine, QC H8S2L3

Phone: 800.328.2531

Website: <http://www.maax.com/en/main%20navigation/contact/contact%20us.aspx>

2.2 PRODUCTS

- A. Maax Evidence 6034 M Wall-Mount Shower Base

- 1. Model Number: 105738-R-000-001-103

- 2. Location: Bathroom

- 3. Features:

- a. Finish: White Base

- b. Dimensions: W: 60" D: 34" H:3 ¼"

- c. See manufacturer's product description for optional accessories:

- [http://menards.inserts2online.com/main/plumbing/bath/bathing/shower-](http://menards.inserts2online.com/main/plumbing/bath/bathing/shower-bases/evidence-6034-m-wall-mount-shower-base/p-1708966.htm)

- [bases/evidence-6034-m-wall-mount-shower-base/p-1708966.htm](http://menards.inserts2online.com/main/plumbing/bath/bathing/shower-bases/evidence-6034-m-wall-mount-shower-base/p-1708966.htm)

- 4. See manufacturer's specifications for further information:

- <http://www.maax.com/en/utilitypages/productdetail.aspx?productID={E48C0BB7->

- [85D5-469B-B1B3-343833024582](http://www.maax.com/en/utilitypages/productdetail.aspx?productID={E48C0BB7-85D5-469B-B1B3-343833024582)

B. Maax Evidence Walk-In Enclosure Right

1. Model Number: 137346-900-084-002
2. Location: Bathroom
3. Features:
 - a. Finish: Chrome Clear
 - b. Glass Enclosure Only
 - c. Wall mount installation – 3 stationary glass panels
 - d. Made with thick 8mm clear safety glass
 - e. Dimensions: W: 60" D: 36" H: 84" Opening 23"
4. See Manufacturer's Product Description for Optional Accessories:
<http://menards.inserts2online.com/main/plumbing/bath/bathing/shower-bases/evidence-6034-m-wall-mount-shower-base/p-1708966.htm>

C. Maax Evidence Wood Drip-Tray Accessory

1. Model Number: 10024772-185
2. Location: Bathroom
3. Features
 - a. Finish: Teak
 - b. Only Available for the 60 x 34" Evidence Shower Base
 - c. Material composed of strong birch wood which is heat-treated to resist water
 - d. Dimensions: W: 21-1/4 D: 28-3/4" H: 1-1/2"
 - e. See Manufacturer's Product Description for Optional Accessories:
<http://menards.inserts2online.com/main/plumbing/bath/bathing/shower-bases/evidence-6034-m-wall-mount-shower-base/p-1708966.htm>

D. Kohler Forte Essentials Performance Shower Package

1. Model Number: K-10827-4-CP
2. Location: Bathroom

3. Features

- a. Finish: Polished Chrome
- b. Hand shower, Showerhead, Shower arm with Diverter, Shower Hose, Slidebar Kit, Rite-Temp Valve Trim
- c. Single lever handle provides on/off activation and temperature setting
- d. 2.5 gallons per minute flow rate from the showerhead and hand shower
- e. See manufacturer's Specifications for Further Information

4. See manufacturer's specifications for further information:

- a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1039077_4.pdf
- b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/087753_4.pdf
- c. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1012741_4.pdf

E. Kohler Rite-Temp ½" Pressure-Balancing Valve with PEX Expansion Connections

1. Model Number: K-304-UX-NA

2. Location: Bathroom

3. Features

- a. Brass valve bodies
- b. High-temperature limit setting for added safety
- c. Mixing valve from "cold" to "hot"
- d. Rite-Temp pressure balancing diaphragm design valve

4. See manufacturer's specifications for further information:

- a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1110626_4.pdf

F. Kohler Round Shower Drain

1. Model Number: K-9132-CP

2. Location: Bathroom

3. Features

- a. Finish: Polished Chrome

- b. Intended for installations with 2" caulk connection
 - c. Perforated strainer
4. See manufacturer's specifications for further information:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/105266_4.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tools Required: Electric drill, 1/4" ceramic drill bit, File and utility knife, Cutting pliers, Measuring tape, Pencil, Screwdriver, Level, Safety glasses, 1/8" and 5/32" Allen keys, Square, and Hack saw

B. Install all items in accordance with manufacturer's recommendations.

1. Maax Shower Base and Accessories

http://menards.inserts2online.com/main/store/20090519001/items/media/Plumbing/Maax/Install_Instruct/install_EVm-Pnls1of2.pdf

2. Kohler Shower Accessories:

- a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1046145_2.pdf
- b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1016117_2.pdf
- c. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1110626_2.pdf
- d. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1114755_2.pdf

END OF SECTION 22 41 23

SECTION 22 41 39

Residential Faucets, Supplies, and Trim

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the necessary parts for the bathroom faucet

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Kitchen and Bath Plumbing Fixtures

Kohler Co.

444 Highland Drive

Kohler, WI 53044

Phone: 920.457.4441

Website: www.us.kohler.com/us/

2.2 PRODUCTS

- A. Purist Tall Single-Hole Bathroom Sink Faucet with Straight Lever Handle

- 1. Model Number: K-14404-4A-CP

- 2. Location: Bathroom

- 3. Features:

- a. Finish: Polished Chrome

- b. Dimensions: L: 6/14" W: 2-1/4" H: 12"

- c. Single Faucet Hole

- d. Solid brass construction for durability and reliability

- e. Single-control operation allows faucet to be turned on and off at any temperature setting

- f. High temperature limit stop allows comfortable maximum temperature preset
 - g. 6-1/4" spout
 - h. WaterSense-labeled faucet – uses at least 30% less water than the standard faucets
4. See manufacturer's specifications for further information:

http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1104904_4.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all items in accordance with manufacturer's recommendations.

- 1. Kohler Faucet
 - a. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1202231_2.pdf
 - b. http://www.us.kohler.com/webassets/kpna/catalog/pdf/en/1032026_2.pdf

END OF SECTION 22 41 39

SECTION 22 80 08

Domestic Hot Water Tanks

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specifications for the domestic hot water tank

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Daikin Industries

1645 Wallace Dr., Suite 110

Carrollton, TX 75006

Phone: 972.245.1510

Website: www.daikin.com

- B. American Solartech

P.O. Box 882

Searsport, ME 04974

Phone: 888.866.8970

Website: <http://americansolartech.com/index.html>

2.2 PRODUCTS

- A. Domestic hot water tank

1. Model number: EKHWS050BA3VJU
2. Location: Mechanical room
3. Dimensions: [Height X Diameter]: 45-3/8" x 22-7/8"
4. Capacity: 50 gal
5. Weight: 99.2 lbs.

B. Softank Heat Storage Tank

1. Dimensions: [Height X Diameter]: 48" x 46"
2. Capacity: 200 gal
3. See manufacturer's specifications for more information:

<http://americansolartechnics.com/softank.html>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendation

END OF SECTION 22 80 08

SECTION 22 81 81

Phase Change Material

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes phase change material that will be used to store thermal energy from Radiant House's solar thermal panel

1.2 RELATED SECTIONS

- A. 22 80 08 Domestic Hot Water Tanks

1.3 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Pure Temp
151 Chesire Lane, Suite 400
Plymouth, MN 55441
Phone: 952.941.0306
Website: <http://puretemp.com/index.html>

2.2 PRODUCTS

- A. Pure Temp 48 and Pure Temp 53 Vegetable Based Phase Change Material
 1. Non-toxic, renewable, and biodegradable PCM
 2. See manufacturer's specifications for further information:
<http://puretemp.com/technology.html>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The phase change material will be installed in coils in the Softank domestic water tank.

END OF SECTION 22 81 81

SECTION 23 09 13

Sensors and Transmitters

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes sensors and transmitters

1.2 SECTION REQUIREMENTS

- A. Product data

PART 2 – PRODUCTS

2.5 MANUFACTURERS

- B. Davis Instruments

3465 Diablo Ave

Hayward, CA 94545

Phone: 800.678.3669

Website: www.davisnet.com

- C. Campbell Scientific

815 West 1800 North

Logan, UT 84321

Phone: 435.227.9090

Website: www.cambellsci.com

- D. Viasala

6980 Santa Teresa Blvd

San Jose, CA 95119

Phone: 408.578.3670

Website: www.viasala.com

2.6 PRODUCTS

- A. Davis Instruments 6450 Solar Radiation Sensor

1. SKU: 6450

2. See distributor's specifications for further information:

<http://www.rainmanweather.com/site/products/6450-Solar-Radiation-Sensor>

B. Campbell Scientific R.M. Young Wind Sentry Set

1. Model number: 03002

2. See manufacturer's specifications for further information:

<http://s.campbellsci.com/documents/us/manuals/03002.pdf>

C. Viasala HMP60 Humidity and Temperature Probe for Volume Applications

1. See manufacturer's specifications for further information:

<http://www.vaisala.com/Vaisala%20Documents/User%20Guides%20and%20Quick%20Ref%20Guides/HMP60%20HMP110%20HMP110T%20User%27s%20Guide%20in%20English.pdf>

PART 3 – INSTALLATION

3.1 INSTALLATION

C. Install according to manufacturer's instructions

END OF SECTION 23 09 13

SECTION 23 23 23

Refrigerant

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the refrigerant used in the heat pump and compressor for the Messana system

1.2 RELATED SECTIONS

- A. Section 23 81 43 Air to Water Heat Pump

1.3 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Homewerks Worldwide, LLC.
500 Bond Street
Lincolnshire, Illinois 60069
Phone: 224-543-1500
Website: <http://www.homewerksww.com/>

2.2 PRODUCTS

- A. R-410a Refrigerant
 1. Model: R-410a
 2. Location: Mechanical Room & Outside Enclosure (Used in Heat Pump & Compressor)
 3. Product specs:
 - a. Density: 67.87 lb/ft³ (@ 68°F)
 - b. Melting Point: -247°F
 - c. Boiling Point: -55.3°F

PART 3 - EXECUTION

3.1 INSTALLATION

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

END OF SECTION 23 23 23

SECTION 23 31 00

HVAC Ducts and Casings

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specifications for all ducting elbows, joints, and casings

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. O.C. McDonald Co
 - 1150 W San Carlos St
 - San Jose, CA 95126
 - Phone: 408-295-2182
 - <http://www.ocmcdonald.com/>
- B. Acosta Sheet Metal Manufacturing Company, Inc.
 - 930 Remillard Ct
 - San Jose, CA 95122
 - Phone: 408-275-6370
 - <http://www.acostamfg.com/>

2.2 PRODUCTS

- A. O.C. McDonald 10x4, 7x4, 12x3, 5x4 Rectangular Straight Ducting
 - 1. Location: Mechanical Room/Hallway/Great Room
 - 2. Material: 24 Gauge Galvanized Steel - Snaplock Seam
- B. O.C. McDonald 4x7, 4x5, 5x4 Rectangular Elbow Ducting
 - 1. Location: Mechanical Room/Hallway/Great Room
 - 2. Material: 24 Gauge Galvanized Steel - Snaplock Seam

C. Acosta 5" Round Spiral Pipe

1. Location: Mechanical Room
2. Material: Prime G-90

D. Acosta 4" Round Wire Flex Duct

1. Location: Hallway/Bedroom
2. Material: wireflex
3. Insulation: R value - 4.2

E. Acosta 90 Degree Elbow

1. Location: Mechanical Room
2. Material: Prime G-90

F. Acosta F-13 90 Degree Angle Boot

1. Location: Bedroom
2. Material: Prime G-90
3. Dimensions: 4" Diameter to 12" x 3.5"

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Requirements:

1. Install according to manufacturer's specifications.

SECTION 23 31 00

SECTION 23 37 13

Diffusers, Registers, and Grilles

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes specifications for all diffusers, registers, and grilles

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. The Reggio Register Co.
 - 31 Jytek Road
 - Leominster, MA 01453
 - Phone: 1.800.880.3090
 - Website: <http://www.reggioregister.com/>

2.2 PRODUCTS

- A. Reggio Register Metal Grill Square Design
 - 1. Model Number: G412 no holes
 - 2. Inside Dimensions: 10" x 2¼"
 - 3. Outside Dimensions: 12" x 3½"

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendation

END OF SECTION 23 31 00

SECTION 23 56 13

Solar Thermal Collectors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the flat plate solar thermal collectors

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Free Hot Water

2146 Bering Drive

San Jose, CA 95131

Phone: 408.432.9900

Website: <http://www.freehotwater.com/>

2.2 PRODUCTS

- B. 4' x 10' 8000 Series Flat Collector

- 1. Dimensions: 120' X 48" X

- 2. Glazed Large Flat Panel

- 3. See manufacturer's specifications for further information:

- <http://shop.freehotwater.com/collectors/fhwfc1005/4x10-flat-collector-8000-series-40-sqft/>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 23 56 13

SECTION 23 72 15

Heat Recovery Ventilator (HRV)

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the HRV, part of the Messina Radiant Heating and Cooling system

1.2 SUBMITTALS

- A. Product Data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Messina Air-Ray Conditioning LLC

2224 Albert Ln

Capitola, CA 95010

Phone: 1.855.729.6244

Website: www.raymagic.com

2.2 PRODUCTS

- A. Messina Air-Magic RR250 HRV

1. Part number: AM1687
2. 110V, 60Hz
3. Blower: 120 cfm
4. Dimensions: 20 1/2" x 10" x 28"
5. Weight: 55 lbs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 11 31 13

SECTION 23 83 16

Radiant-Heating Hydronic Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes specifications for the radiant heating panels used throughout the house

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Messana Air-Ray Conditioning LLC
2224 Albert LN
Capitola, CA 95010
Phone: 855-729-6244
Website: www.raymagic.com

2.2 PRODUCT

- A. Ray Magic Panel
 1. Model: Standard
 2. Location: In ceiling throughout house
 3. Dimensions [L x W x H]: 8' x 4' x 2"
 4. Weight (dry): 2.63 lbs./ft³
 5. Radiant Tubing: PEOC Dowtex
 - a. Diameter: 7/16" o.d. – 5/16" i.d.
 - b. Spacing: 2 5/8"
 - c. 61 ft. per circuit (two circuits per panel with 0.12 gal of water each)
 6. Heat Output:

- a. Typical: 32.5 Btu/h/ft²
- b. Max: 78.7 Btu/h/ft²
- 7. Cooling Output:
 - a. Typical: 24.7 Btu/h/ft²
 - b. Max: 38.4 Btu/h/ft²

B. Manifold

- 1. Model: Standard
- 2. Location: Mechanical Room
- 3. Product Specs:
 - a. Dimensions [L x W x D]: 8" x 2" x 8"
 - b. Inlet Port Size: 1" or 1-1/4"
 - c. Outlet Port Size: 5/8"
 - d. Flow Rate: Max of 0.4 GPM

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendation

END OF SECTION 23 83 16

SECTION 23 83 33

Air to Water Heat Pump

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes specifications for the HVAC system in the house

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Daikin Industries

1645 Wallace Dr., Suite 110

Carrollton, TX 75006

Phone: 972.245.1510

Fax: 972.245.1038

Website: www.daikin.com

2.2 PRODUCTS

- A. Daikin Altherma split type heat pump outdoor unit

- 1. Model number: ERLQ018BAVJU

- 2. Product Specs:

- a. Dimensions [H x W x D]: 28 9/10" x 32 1/2" x 11 8/10"

- b. Weight (gross): 134 lbs.

- c. EER [efficiency]: 10.41

- d. Nominal heating capacity: 19,620 Btu/hr.

- e. Nominal cooling capacity: 24,570 Btu/hr.

- A. Daikin Altherma Hydrobox indoor unit

- 1. Model number: EKHBX030BA3VJU

2. Product Specs:

- a. Dimensions [H x W x D]: 36 5/16" x 19 3/4" x 14 7/32"
- b. Weight (gross): 130 lbs.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendation

END OF SECTION 23 83 33

SECTION 23 84 16

Dehumidifier

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the radiant dehumidifier used in the Radiant House.

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Messana Air-Ray Conditioning LLC

2224 Albert Ln

Capitola, CA

Phone: 855.729.6244

Website: www.raymagic.com

2.2 PRODUCTS

- A. Ray Magic Panel

1. Model Number: HI 250
2. Location: TBD
3. Dimensions [L x W x H]: 25.59" x 19.84" x 9.8"
4. Weight: 63.93 lbs.
5. Thermal Specifications
 - a. Condensed Humidity: 6.34 gallons/day
 - b. Refrigeration Power Consumption: 800 W
 - c. Air Flow: 367.86 CFM
 - d. Static Pressure Available:
 - i. Maximum: 0.0201 feet of head

- ii. Medium: 0.0184 feet of head
 - iii. Minimum: 0.0100 feet of head
 - e. Water Flow Rate: 63.40 gallons/hour
 - f. Water Circuit Head Loss: 1.6728 feet of head
 - g. Refrigerant Gas R134a: 0.4189 lbs.
 - h. Sound Power Level: 41 dB(A)
 - i. Sound Pressure Level: 33 dB(A)
6. Electrical Specifications
- a. Rated Power Consumption: 290 W
 - b. Max. Power Consumption (Compressor + Speed 3): 320 W
 - c. Rated Amps. Absorbed: 1.7 A
 - d. Max. Amps. Absorbed: 1.9 A
 - e. Production Rating: IP 44
 - f. Power Supply: 230 Vac / 1 + N Ph / 50 Hz

PART 3 - EXECUTION

3.1 INSTALLATION

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

END OF SECTION 23 84 16

SECTION 25 13 10

Integrated Automation Control & Monitoring Network Cabling

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes information regarding the data logger and its adjacent systems, including the monitoring network and automation devices that will be in direct communication with the central processor.

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Jameco ValuePro

1355 Shoreway Road

Belmont, CA 94002

Phone: 1.800.831.4242

Website: <https://www.jameco.com>

- B. Cable To Go

3555 Kettering Blvd

Moraine, OH 45439

Phone: 1.800.506.9607

Website: <http://www.cablestogo.com/>

2.2 PRODUCTS

- A. Cat 5e Ethernet Cable

1. Model Description: Jacketed, braided Cat 5e cable
2. See manufacturer's specifications for further information:

https://www.jameco.com/webapp/wcs/stores/servlet/Product_10001_10001_644615_-1

B. Copper Cable (Black)

1. Model Description: Solid copper 22AWG insulated wire
2. See manufacturer's specifications for further information:

https://www.jameco.com/webapp/wcs/stores/servlet/Product_10001_10001_367_92_-1

C. Copper Cable (Red)

1. Model Description: Solid copper 22AWG insulated wire
2. See manufacturer's specifications for further information:

https://www.jameco.com/webapp/wcs/stores/servlet/Product_10001_10001_368_56_-1

D. RJ45 Plug

1. Model Description: Modular Plug for Cat 5 RJ45 – 100pk.
2. See manufacturer's specifications for further information:

<http://www.newegg.com/Product/Product.aspx?Item=N82E16812999268>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 25 13 10

SECTION 25 13 20

Integrated Automation Control & Monitoring Network

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes information regarding the control system and its adjacent systems, including the monitoring network and automation devices that will be in direct communication with the central processor

1.2 SUBMITTALS

- A. Product data

PART 2 – Products

2.1 MANUFACTURERS

- A. Arduino

Calle Huelva 2 - Ed.Villapalma

18690 Almunecar (GR) - Spain

Website: <http://arduino.cc/en/>

- B. Marvel via Alco Service and Supply Co.

11578 K-Tel Dr.

Minnetonka, MN 55343

Phone: 800.328.6019

Website: www.alcosupply.com

- C. RollerTrol

Website: www.rollertrol.com

- D. Autoslide Pty Ltd

3/413 Victoria St

Wetherill Park, NSW 2164 Australia

Phone: 1.866.967.3669

Website: www.autoslide.com

E. Jameco Electronics

1355 Shoreway Rd

Belmont, CA

Phone: 1.800.831.4242

Website: www.jameco.com

F. Cables To Go (C2G)

3555 Kettering Blvd

Moraine, OH 45439

Phone: 800.506.9607

Website: www.cablestogo.com

G. Raspberry Pi

Website: www.raspberrypi.org

H. Cisco

170 West Tasman Dr.

San Jose, CA 95134

Phone: 1.800.553.6387

Website: www.cisco.com

2.2 PRODUCTS

A. Arduino UNO

1. Arduino Store Code: A000066
2. Microcontroller: ATmega328
3. Operating voltage: 5V
4. Input voltage: 7-12V
5. Flash memory: 32 KB
6. Clock speed: 16 MHz

7. See manufacturer's specifications for further information:

<http://www.arduino.cc/en/Main/ArduinoBoardUno>

B. Arduino MEGA

1. Arduino Store Code: A000067
2. Microcontroller: ATmega2560
3. Operating voltage: 5V
4. Input voltage: 7-12V
5. Flash memory: 256 KB
6. Clock speed: 16 MHz
7. See manufacturer's specifications for further information:

<http://arduino.cc/en/Main/ArduinoBoardMega2560>

C. Marvel Power Window System

1. Model number: 4290
2. See distributor's specifications for further information:

<http://www.alcosupply.com/products/marvel-power-window-system-129.cfm>

D. RollerTrol Tubular Motor

1. Reference number: TMDC-12-25-15-28-NR
2. Operating voltage: 12V DC
3. See manufacturer's specifications for further information:

<http://rollertrol.com/store/en/12v-tubular/14-projector-screen-motor.html>

E. Autoslide Sliding Door Motor

1. See manufacturer's specifications for further information: <http://www.autoslide.com>

F. Jameco Cat 5e Ethernet Cable

1. Manufacturer number: 10X5-804TH-100VP
2. See manufacturer's specifications for further information:

<https://www.jameco.com/Jameco/Products/ProdDS/644615.pdf>

G. Jameco Wire Hook-up Solid 22 AWG (Black)

1. Manufacturer number: 9313-0-R
2. See manufacturer's specifications for further information:

<https://www.jameco.com/Jameco/Products/ProdDS/36792.pdf>

H. Jameco Wire Hook-up Solid 22 AWG (Red)

1. Manufacturer number: 9313-2-R
2. See manufacturer's specifications for further information:

<https://www.jameco.com/Jameco/Products/ProdDS/36856.pdf>

I. C2G Cat5 Modular Plug for Round Stranded Cable

1. Model number: 11381
2. Plug type: RJ45
3. See distributor's specifications for further information:

<http://www.newegg.com/Product/Product.aspx?Item=N82E16812999268>

J. Raspberry Pi Assembled Board

1. Manufacturer part number: RASPBERRY-MODB-512M
2. See distributor's specifications for further information:

<http://www.newark.com/raspberry-pi/raspbrry-modb-512m/model-b-assembled-board-only/dp/43W5302>

K. Cisco Small Business Desktop Switch

1. Series: 100
2. Model number: SF100D-16-NA
3. Ports: 16
4. See distributor's specifications for further information:

<http://www.newegg.com/Product/Product.aspx?Item=N82E16833150148&Tpk=sf-100d-16>

PART 3 – INSTALLATION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions

END OF SECTION 25 13 20

SECTION 26 05 19

Low-Voltage Power Connectors & Conductors

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specifications for low-voltage power connectors & conductors

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Belden

401 Pennsylvania Parkway, #200

Indianapolis, IN 46280

Phone: 510.438.9071

Website: <http://www.belden.com/>

2.2 PRODUCTS

- A. Belden AWG #20 gage

1. 4 Conductor stranded
2. Shielded gray copper
3. CMR 75C
4. See manufacturer's specifications for further information:

http://www.belden.com/products/catalogs/mastercatalog/brilliance/upload/20New_Generation_Cables.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Maybe be used for both exposed and concealed work in normal dry locations at temperatures not exceeding 90°C.

- B. Primarily used in residential wiring as branch circuits for outlets, switches, and other loads.
- C. Copper conductors are annealed copper.
- D. Stranded conductors are compressed stranded.

END OF SECTION 26 05 19

SECTION 26 05 20

Controls Wiring

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wiring for the control systems

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Southwire

9199 Cleveland Ave.

Suite 100

Rancho Cucamonga, CA 91730

Phone: 919.989.2888

Website: www.southwire.com

Available at:

1. Home Depot

- B. GE

3135 Easton Turnpike

Fairfield, CT 06828

Phone: 203.373.2211

Website: www.ge.com

Available at:

1. Home Depot

- C. Aurum Cables via Amazon.com

2.2 PRODUCTS

A. Southwire 22-4 CL3R Shielded Security Cable

1. Model Number: 56910544
2. Rating: 300 Volts
3. Length: 500'
4. Features:
 - a. PVC jacket with flame-retardant PVC insulation
 - b. Solid bare copper conductors
 - c. UL listed
 - d. See distributor's specifications for further information:

<http://www.homedepot.com/p/Southwire-500-ft-22-4-CL3R-Shielded-Security-Cable-56910544/202316269#.UgrR2VfgpqN>

B. Southwire 24/4 CAT5e Riser Cable

1. Model Number: 56917945
2. Length: 500'
3. Features:
 - a. Low-smoke PVC jacket
 - b. 24-gauge cord
 - c. Soft annealed copper conductors
 - d. See distributor's specifications for further information:

<http://www.homedepot.com/p/Southwire-500-ft-24-4-CAT5e-Riser-Cable-Gray-56917945/202316244#.UgrSeVfgpqN>

C. GE 14-Gauge Speaker Wire

1. Model Number: 87649
2. Length: 100'
3. Features:
 - a. Extra-thick PVC insulation

- b. See distributor's specifications for further information:

<http://www.homedepot.com/p/GE-100-ft-14-Gauge-Speaker-wire-clear-style-87649/202788268#.UgrTA1fgpqN>

D. GE RG-6 Coaxial Cable

- 1. Model Number: 73287
- 2. Length: 100'
- 3. Features:
 - a. F-connectors on each end for easy screw-on installation
 - b. See distributor's specifications for further information:

<http://www.homedepot.com/p/GE-100-ft-RG-6-Coaxial-Cable-White-73287/202698864#.UgrTaFfgpqN>

E. Aurum Ultra Series High Speed HDMI Extension Cable

- 1. Amazon Standard Identification Number: B009EAGMW2
- 2. Length: 35'
- 3. Features:
 - a. 1080 audio return channel
 - b. 24k gold-plated connectors with braided thick 26 AWG cable core
 - c. ROHS compliant
 - d. See distributor's specifications for further information:

http://www.amazon.com/gp/product/B009EAGMW2/ref=oh_details_o05_s00_i01?ie=UTF8&psc=1

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 26 05 20

SECTION 26 05 26

Grounding and Bonding for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the grounding and bonding for electrical systems

1.2 SUBMITTALS

- A. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Burndy

47 e Industrial Park Drive

Manchester, NH 03109

Phone: 800.346.4175

Website: www.burndy.com

- B. Southwire

9199 Cleveland Ave.

Suite 100

Rancho Cucamonga, CA 91730

Phone: 919.989.2888

Website: www.southwire.com

Available at:

1. Home Depot

2.2 PRODUCTS

- A. Burndy WEEB-Lug

1. Catalog: WEEB-LUG-8.0

2. Item number: 30020111

3. Dimensions: 1.6" x 0.87" x 0.47"
4. Features:
 - a. See manufacturer's specifications for further information:
<http://www.we-llc.com/pdf/weeblugtearsheet8-22-12.pdf>

B. Burndy WEEB DPF

1. Material: 304 stainless steel
2. Features:
 - a. ETL listed to UL 467
 - b. UL recognized to Subject Standard 2703
 - c. Outdoor rated
 - d. See manufacturer's specifications for further information:
<http://www.we-llc.com/pdf/weebcutsheet.pdf>

C. Southwire 6 Solid Bare Copper

1. Model number: 10638502
2. Rating: 600 volts
3. Gauge: 6
4. Length: 315 ft.
5. Features:
 - a. 1-UL listed
 - b. See distributor's specifications for further information:
<http://www.homedepot.com/p/Southwire-315-ft-6-Solid-BareCopper-Cable-10638502/202316341#.UgukhlfqpgN>

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 26 05 26

SECTION 26 05 33

Raceway and Boxes for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specifications for the electrical housings, including raceways, conduits, boxes, and meter housing

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allied Tube and Conduit available via Home Depot

Website: <http://www.alliedeg.us/>

- B. Southwire

9199 Cleveland Ave.

Suite 100

Rancho Cucamonga, CA 91730

Phone: 919.989.2888

Website: www.southwire.com

Available at: Home Depot

- C. Thomas & Betts

8155 T&B Boulevard

Memphis, TN 38125

Phone: 901.252.5000

Website: <http://www.tnb.com/pub/>

- D. Greenfield Industries, Inc.

99 Doxsee Drive

Freeport, NY 11520-4782

Phone: 516.623.9230

Website: <http://www.greenfieldny.com/>

E. Halex

23901 Aurora Road

Cleveland, OH 44146

Phone: 1.800.749.3261

Website: <http://www.halexco.com/>

F. RACO

3902 West Sample Street

South Bend, IN 46619

Phone: 1.800.722.6437

Website: <http://www.hubbell-raco.com/default.aspx>

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70, "National Electrical Code."

2.2 PRODUCTS

- A. Allied 3/4" Electrical Metallic Tubing Conduit

1. Model Number: 873044
2. Material: Galvanized steel
3. See manufacturer's specifications for further information:

http://www.homedepot.com/p/Allied-Tube-Conduit-3-4-in-x-5-ft-Electrical-Metallic-Tubing-EMT-Conduit-873044/203022617?N=1z117wbZ1z113da%20-%20.Uf_YfpKG14c#specifications

- B. Southwire 3/4' Liquidtight Flexible Metal Conduit (LFMC)

1. Titan – Type UL Conduit
2. See manufacturer's specifications for further information:

<http://www.southwire.com/products/TitanTypeUL.htm>

C. Thomas & Betts REDDOT 17 cubic in 1-Gang Old Work Metal. Electrical Box

1. Model Number: 72239
2. UL listed and approved for outdoor use
3. See manufacturer's specifications for further information:

<http://www.lowes.com/ProductDisplay?partNumber=72239-53911-S105E-RL&langId=-1&storeId=10151&productId=3419602&catalogId=10051&cmRelshp=req&rel=noFollow&cld=PDIO1>

D. Greenfield 1-Gang Weatherproof Electrical Box

1. Model Number: CBPS
2. Internet Model Number: 202188604
3. See manufacturer's specifications for further information:

http://www.homedepot.com/p/Greenfield-1-Gang-Weatherproof-Electrical-Box-Blank-Cover-Gray-CBPS/202188604?MERCH=REC--NavPLPHorizontal1-1--NA--202188604--N#.Uf_ef5KG14c

E. Thomas & Betts Carlon 1-Gang 21 cubic in. Adjustable Electrical Box

1. Model Number: B121ADJ
2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Carlon-1-Gang-21-cu-in-Adjustable-Electrical-Box-B121ADJ/202077339#.Ugu62ldAeUJ>

F. Thomas & Betts Carlon 2-Gang 34 cubic in. Adjustable Switch and Outlet Box

1. Model Number: B234ADJC
2. Internet Model Number: 100315472
3. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Carlson-2-Gang-34-cu-in-Non-Metallic-Adjustable-Switch-and-Outlet-Box-B234ADJC/100315472?N=2dq#.Ugu8X1dAeUJ>

G. Thomas & Betts Carlson 1-Gang 18 cubic in. Zip Switch and Outlet Box

1. Model Number: B118A
2. Internet Model Number: 100404124
3. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Carlson-1-Gang-18-cu-in-Zip-Box-Blue-Non-Metallic-Switch-and-Outlet-Box-Case-of-100-B118A/100404124?N=2dq#.Ugu9Y1dAeUJ>

H. RACO 1- Gang 6 cubic in. Round Ceiling Pan

1. Model Number: 8293
2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Raco-1-Gang-6-0-cu-in-Round-Ceiling-Pan-8293/100574367#.Ugu911dAeUJ>

2.3 ACCESSORIES

A. Thomas & Betts Superstrut 3/4" Conduit Clamp

1. Model Number: Z703 3/4EG-25
2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Superstrut-3-4-in-Conduit-Clamp-Z703-3-4EG-25/202077399#.Ugu0WldAeUJ>

B. Thomas & Betts Superstrut 1-5/8" Metal Framing Channel

1. Model Number: ZB14HS10PG
2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Superstrut-1-5-8-in-x-10-ft-Metal-Framing-Channel-ZB14HS10PG/100183826#.Ugu1FIdAeUJ>

C. Halex 3/4" Type LB Threaded Aluminum Conduit Body

1. Model Number: 58607

2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Halex-3-4-in-Type-LB-Threaded-Aluminum-Conduit-Body-58607/100146504#.Ugu1dVdAeUJ>

D. Raco 3/4" Steel EMT Set-Screw Connector

1. Model Number: 2003B5
2. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Raco-3-4-in-Steel-EMT-Set-Screw-Connector-5-Pack-2003B5/203671402?N=1z115w7#.Ugu191dAeUJ>

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install outdoor raceways according to:

1. Exposed or Concealed: IMC.
2. Underground, Single Run: RNC.
3. Connection to Vibrating Equipment: LFMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4.

B. Install indoor raceways according to:

1. Exposed or Concealed: EMT.
2. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC.
3. Damp or Wet Locations: IMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.

C. Install raceways and conduits according to manufacturer's instructions

1. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
2. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

3. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch- (25-mm-) thick concrete cover.
4. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
5. Space raceways laterally to prevent voids in concrete.
6. Install conduit larger than 1-inch (27-mm) trade size, parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
7. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
8. Raceways Embedded in Slabs:
 - a. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - b. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
9. Install pull wires in empty raceways.
10. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch (1830-mm) maximum length of flexible conduit.
11. Install raceways and cables concealed within finished walls, ceilings, and floors unless otherwise indicated.
12. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
13. Installation of Hangers and Supports:

- a. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in this article.
 - b. 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.
14. Raceway Support Methods: In addition to methods described in NECA 1, [EMT] [IMC] [and] [RMC] may be supported by openings through structure members, as permitted in NFPA 70.
15. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.
16. Strength of Support[and Seismic-Restraint] Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static[and seismic] loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
17. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated or required by Code:
- a. To Wood: Fasten with lag screws or through bolts.
 - b. To New Concrete: Bolt to concrete inserts.
 - c. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - d. To Existing Concrete: Expansion anchor fasteners.
 - e. To Steel:[Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts] [Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69]

18. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

END OF SECTION 26 05 33

SECTION 26 05 83

Wiring Connections

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wiring connections

1.2 SUBMITTALS

- A. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Shoals Technologies Group

1400 Shoals Way

Portland, TN 37148

Phone: 615.451.1400

Website: www.shoals.com

2.2 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
- B. Comply with NFPA-70

2.3 PRODUCTS

- A. Shoals Interconnect System Y-Joints

1. Model number: STG.ICY.10.12

2. Maximum voltage: 1000V

3. Maximum DC current: 20 (12AWG)/30A (10AWG, 8AWG)

4. Certifications:

- a. UL9703 for 600V and 1000V systems

5. Features:

- a. Resistance welded joints
- b. See manufacturer's specifications for further information:

http://shoals.com/wp-content/downloads/STG_PC_W12.pdf

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 26 05 83

SECTION 26 09 23

Lighting Control Devices

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wall mounted switches and high-voltage relays for light control

1.2 SECTION REQUIREMENTS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACUTERERS

- A. WattStopper

2800 De La Cruz Blvd.

Santa Clara, CA 95050

Phone: 408.988.5331

Website: <http://www.wattstopper.com/>

- B. SainSmart

5251 West 16th Place, Suite 200

Leawood, Kansas 66211

Phone: 323.372.3043

Website: <http://www.sainSMART.com/>

2.2 PRODUCTS

- A. WattStopper 0-10V Fluorescent Architectural Dimmer

- 1. Model Number: ADF-120277

- 2. See manufacturer's specifications for further information:

- <http://www.wattstopper.com/products/wallbox-dimmers/architectural-dimmers/adf-120277.aspx#.Ug1bxFdAeUI>

- B. SainSmart DC Controlled Relay Board

1. Model Number: 20-018-102
2. See manufacturer's specifications for further information:

<http://www.sainsmart.com/arduino-compatibles-1/relay/8-channel-dc-5v-relay-module-for-arduino-pic-arm-dsp-avr-msp430-ttl-logic.html>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install all products according to manufacturer's instructions

END OF SECTION 26 09 23

SECTION 26 24 16

Panelboards

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes panelboards

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric

Phone: 888.778.2733

Website: <http://www.schneider-electric.com/site/home/index.cfm/us/>

2.2 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.
- B. Comply with NEMA PB 1.

2.3 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush and Surface-mounted cabinets; NEMA 250, Type 1.
 - 1. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- B. Incoming Mains Location: Side
- C. Phase, Neutral, and Ground Buses: Tin-plated aluminum.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated copper.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.

- E. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Mains: Circuit breaker
- B. Branch Overcurrent Protective Devices: For circuit-breaker frame sizes 125 A and smaller: plug-in circuit breakers .
- C. Main Service Panel
 1. Service panel for connecting grid, PV array, and house sub-panels.
 2. Schneider Electric NF3000G3, 200A mains breaker rating
 3. See manufacturer's specifications for further information:
<http://products.schneider-electric.us/products-services/products/lighting-control/powerlink/3000-level-system/3000-level-g3-controller/>

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground- fault protection (6-mA trip).
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

C. Surge Breakers

1. Protect house electric system from voltage spikes
2. Schneider Electric
3. See manufacturer's specifications for further information:

<http://ecatalog.squared.com/fulldetail.cfm?partnumber=QO2175SB>

B. Arc Fault Breaker

1. Schneider Electric QO120CAFIC
2. See manufacturer's specifications for further information:

<http://ecatalog.squared.com/fulldetail.cfm?partnumber=QO120CAFIC>

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Referenced NECA and NEMA standards in first paragraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations.
- B. Receive, inspect, handle, store and install panelboards and accessories according to
- C. NECA 407 and NEMA PB 1.1.
- D. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."
- E. Ensure that, whatever height is retained for top of trim in first paragraph below, the operating handle of top-most switch or circuit breaker, in on position, is not higher than
- F. 79 inches (2000 mm) above finished floor or grade.
- G. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- H. Arrange conductors into groups; bundle and wrap with wire ties.
- I. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.

END OF SECTION 26 24 16

SECTION 26 27 13

Electricity Metering

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the electricity metering devices
- 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.

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric

North American Division

1415 Roselle Road

Palatine, IL 60067

Phone: 1.888.788.2733

Website: <http://www.schneider-electric.com/site/home/index.cfm/ww/>

2.2 PRODUCTS

- A. Square D Meter Socket by Schneider Electric

1. Model Number: UTRS202B Meter Socket

2. See manufacturer's specifications for further information:

http://www.schneider-electric.com/products/us/en/51500-metering-equipment/51510-metering-equipment/7969-individual-meter-sockets/?p_url=http://www.ops-ecat.schneider-electric.com/ecatalogue/browse.do%3fconf=US%26el_typ=product%2

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

END OF SECTION 26 27 13

SECTION 26 27 26

Wiring Devices

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the wiring devices

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Southwire

9199 Cleveland Ave.

Suite 100

Rancho Cucamonga, CA 91730

Phone: 919.989.2888

Website: www.southwire.com

Available at:

1. Home Depot

- B. Shoals Technologies Group

1400 Shoals Way

Portland, TN 37148

Phone: 615.451.1400

Website: www.shoals.com

- C. Leviton Mfg. Company Inc.

201 North Service Rd.

Melville, NY 11747

Phone: 1.800.323.8920

Website: <http://www.leviton.com>

2.2 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
- B. Comply with NFPA-70

2.3 PRODUCTS

A. Southwire 14/2 BX/AC-90 Cable

- 1. Model number: 61029323
- 2. Length: 100 ft.
- 3. Materials:
 - a. Soft-drawn copper
 - b. Moisture-resistant, flame retardant paper covering
 - c. Exterior aluminum armor
- 4. Certifications:
 - a. UL listed
 - b. CSA certified
- 5. See distributor's specifications for further information:

<http://www.homedepot.com/p/Southwire-14-2-X-100-ft-BX-AC-90-Cable-61029323/202819634#.Uguxf1fgpqM>

B. Southwire 12/2 BX/AC-90 Cable

- 1. Model number: 61023101
- 2. Length: 250 ft.
- 3. Rating: 600V
- 4. Certifications:
 - a. UL listed

- b. CSA certified
 - 5. See distributor's specifications for further information:
<http://www.homedepot.com/p/Southwire-12-2-X-250-ft-BX-AC-90-Cable-61023101/202562780#.Uguy9lfqpqM>
- C. Southwire 10/3 MC Stranded Electrical Cable
- 1. Model number: 69118805
 - 2. Length: 125 ft.
 - 3. Rating: 600V
 - 4. Certifications:
 - a. UL listed
 - 5. See distributor's specifications for further information:
<http://www.homedepot.com/p/Southwire-10-3-X-125-ft-MC-Stranded-Electrical-Cable-69118805/202250422#.Ugu0H1fgpqM>
- D. Southwire 10/2 BX/AC-90 Cable
- 1. Model number: 61029805
 - 2. Length: 125 ft.
 - 3. Certifications:
 - a. UL listed
 - b. CSA certified
 - 4. See distributor's specifications for further information:
<http://www.homedepot.com/p/Southwire-10-2-X-125-ft-BX-AC-90-Cable-61029805/202967353#.Ugu09VfgpqM>
- E. Southwire Black 6-3 Romex NM-B W/G Wire
- 1. Model number: 63950002
 - 2. Length: 125 ft.
 - 3. Rating: 600V

4. Certifications:
 - a. 1-UL listed
 - b. CSA certified
5. See distributor's specifications for further information:
<http://www.homedepot.com/p/Southwire-125-ft-Black-6-3-Romex-NM-B-W-G-Wire-63950002/202316279#.Ugu1gVfgpqM>

F. Shoals 2000V AWG 10 PV Wire

1. Ratings:
 - a. UL listed as 2000V type PV
 - b. UL listed as RHH?RHW-2
 - c. 90C temperature rating
 - d. UL subject 4703
 - e. Meets the requirement of UL 854 for TYPE USE-2
 - f. NEC Article 690 standards
2. See manufacturer's specifications for further information:
<http://shoals.com/products/pv-wire/2000v-pv-wire>

G. Leviton feed-through, tamper resistant AFCI receptacles

1. Model number: AFTR1-W (Arc Fault Circuit Interrupter receptacles)
2. Product specs:
 - a. 125 V, 15A
 - b. Complies with: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498
3. See manufacturer's specifications for further information:
http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber= AFTR1-W§ion=55035&minisite=10251

H. Leviton duplex GFCI convenience receptacles

1. Model number: S7899-GY (Ground Fault Circuit Interrupter receptacles)
 2. Product specs:
 - a. 125 V, 15A
 - b. straight blade, feed-through type
 - c. Complies with: NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
 3. See manufacturer's specifications for further information:
http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber=S7899-GY§ion=42318&minisite=10251
- I. Leviton wall plates, finished areas
1. Model number: PJ26-W
 2. Product specs:
 - a. Smooth, high-impact thermoplastic fastened with metal screws having matching plate color
 - b. Complies with CSA, UL524
 3. See manufacturer's specifications for further information:
http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber=PJ26-W§ion=42938&minisite=10251
- J. Leviton wall plates, damp locations
1. Model number: 4992 (Raintight and Weather Resistant Wallplate)
 2. Product specs:
 - a. Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet locations
 - b. Complies with CSA, UL524
 3. See manufacturer's specifications further information:
http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber=4992§ion=429

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Install devices and assemblies plumb, level, and square with building lines.
- C. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- D. Install unshared neutral conductors on line and load side of dimmers.
- E. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

END OF SECTION 26 27 26

SECTION 26 28 16

Enclosed Switches and Circuit Breakers

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the enclosed switches and circuit breakers

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Milbank

4801 Deramus

Kansas City, MO 64120

Phone: 877.483.5314

Website: www.milbankmfg.com

- B. Eaton

1111 Superi Avenue

Cleveland, OH 44114

Phone: 216.523.5000

Website: www.eaton.com

2.2 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.

2.3 PRODUCTS

- A. Milbank U3832 30A Fusible disconnect

- 1. Features:

- a. 240 VAC
- b. 30 amp
- c. Power rating: 3 HP
- d. NEMA 3R
- e. UL listed
- f. See manufacturer's specifications for further information:

<http://www.milbankworks.com/catalogs/CO.pdf>

B. Eaton Single-Phase Main Lug Loadcenter

- 1. Model number: BR3040L200
- 2. Features:
 - a. Main ampere rating: 200
 - b. Spaces: 30
 - c. Circuits: 40
 - d. 1 phase/3 wire
 - e. See manufacturer's specifications for further information:

http://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/ol01_tab01.pdf

C. Eaton Circuit Breakers

- 1. Types:
 - a. 15A single-pole
 - b. 20A single-pole
 - c. 30A double-pole
 - d. 20A double-pole
 - e. 15A double-pole

2. See manufacturer's specifications for further information:

[http://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/vol01
_tab01.pdf](http://www.eaton.com/ecm/groups/public/@pub/@electrical/documents/content/vol01_tab01.pdf)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated
- B. Install fuses in fusible devices
- C. Comply with NECA 1

END OF SECTION 26 28 16

SECTION 26 31 00

Photovoltaic Collectors

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes photovoltaic collectors

1.2 SUBMITTALS

- A. Product data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Bosch

Robert-Bosch -Straße 1

99310 Arnstadt

Germany

Phone: 49.0.3628.664.0

Website: http://www.bosch-solarenergy.com/en/bosch_se_online/home_1.html

- B. Tigo Energy

420 Blossom Hill Rd

Los Gatos, CA 95032

Phone: 408.402.0802

Website: <http://www.tigoenergy.com/>

- C. Sunplanter

Website: <http://www.sunplanter.com/en/index.php>

- D. Silverback Solar

327 Coral Street

Santa Cruz, CA 95060

877.765.2759

Website: www.silverbacksolar.com

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 “National Electrical Code”
- B. Meets UL 1703 requirements and the ASTM standards applied to photovoltaic panels

2.3 DEVICES

A. Modules

- 1. Manufacturer: Bosch
- 2. Mono-crystalline photovoltaic module for electricity generation
- 3. Bosch Solar Module c-Si M 60 NA42117 (255Wp)
- 4. See manufacturer’s specifications for further information:

http://www.bosch-solarenergy.com/media/bosch_se_online/alle_pdfs/technische_dokumente_1/datenblaetter/kristalline_module/m_60_na42117/Bosch_Solar_Module_c_Si_M_60_NA42117_englisch_USA_US.pdf

B. Accessories

- 1. Module Maximizers
 - a. Manufacturer: Tigo Energy
 - b. Model number MM-ES50
 - c. Maximizer to extract the maximum power from each solar module
 - d. See manufacturer’s specifications for further information:

http://www.tigoenergy.com/sites/default/files/attachments/mm_es_datasheet.pdf

2. Maximizer Management Unit

- a. Manufacturer: Tigo Energy
- b. Communicator between the Panel Maximizers and the inverter
- c. See manufacturer’s specifications for further information:

http://tigoenergy.com/sites/default/files/attachments/mmu_datasheet.pdf

3. Energy Gateway

a. Manufacturer: Tigo Energy

b. Provides robust and scalable wireless communications with each optimizer.

This solution provides clear, concise communication with the optimizers on the array.

c. See manufacturer's specifications for further information:

http://www.tigoenergy.com/sites/default/files/attachments/gateway_datasheet_en_0.pdf

4. Roof Mounting

a. Manufacturer: Sunplanter

b. Aluminum rails act as roof support and as PV racking system

c. Product sheets not disclosed: patent pending technology

5. Module Bonding Clips, Tek Screws, and WEEBS

a. Manufacturer: Silverback Solar

b. Aluminum clip attached to solar panel mounting rails fastened with self-drilling tek screws.

c. See manufacturer's specifications for further information:

http://www.silverbacksolar.com/docs/silverback_WEEB.PDF

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation

1. Install solar modules and maximizers in accordance with manufacturer's written recommendations and reference drawings for location.

2. Set modules level and true to line and anchor securely to Sunplanter rails to meet torque pressures required in manufacturer's instructions.

3. Repair or replace any solar modules, mountings, or maximizers damaged during transportation or installation.

END OF SECTION 26 31 00

SECTION 26 32 13

Engine Generators

PART 1-GENERAL

1.1 SUMMARY

- A. This section includes the generators used to power tools and lights for assembling and disassembling the house.

1.2 SUBMITTALS

- A. Product data

PART 2 - PRODUCTS

2.1 GENERATOR REQUIREMENTS

- A. Sound Rating: No more than 60 dB at 50 ft.
- B. Must be UL listed.
- C. Will not leak liquids onto the construction site.

2.2 GENERATOR ASSEMBLY

- A. Honda Inverter Generator - EU6500iS
 - 1. 389cc Gasoline Powered Engine
 - 2. Run Time: 4.7 hours (rated load), 14 hours (1/4 rated load)
 - 3. Outputs:
 - a. 20A 125V Duplex
 - b. 30A 125V Locking Plug
 - c. 30A 125/250V Locking Plug
 - 4. Maximum Output: 6500 Watts (54.1A @ 120V / 27.1A @ 240V) F. Rated Output: 5500 Watts (45.8 @ 120V / 22.9A @ 240V)
 - 5. Operating Noise: 60 dB(A) (rated load), 52 dB(A) (1/4 load) at 7m using the (A) scale

6. See manufacturer's specifications for further information:

<http://powerequipment.honda.com/generators/models/eu6500is>

PART 3-EXECUTION

3.1 INSTALLATION

- A. Wheel outside to use as needed. Store when not in use.
- B. Use caution while filling the generator in order to prevent spills.
- C. Wear hearing protection when within 50 feet to prevent hearing loss.

END OF SECTION 26 32 13

SECTION 26 33 13

Batteries

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes batteries for smoke detector battery backup and for the television remote control

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Duracell

Berkshire Corporate Park

Bethel, CT 06801

Phone: 1.800.551.2355

Website: <http://www.duracell.com/en-US/index.jsp>

2.2 BATTERIES FOR SMOKE DETECTOR BATTERY BACK UP

- A. Product: Duracell CopperTop 9 Volt

1. Classification: Alkaline
2. Chemical System: a. Cathode: Zinc
 - 2.1 Anode: Manganese Dioxide
 - 2.2 Electrolyte: Potassium Hydroxide
 - i. Designation: ANSI-1604A, IEC-6LR61
 - ii. Nominal Voltage: 9 Volts

2.3 BATTERIES FOR TELEVISION REMOTE CONTROL

- A. Product: Duracell CopperTop AA

1. Classification: Alkaline
2. Chemical System:
 - a. Cathode: Zinc

- b. Anode: Manganese Dioxide
- c. Electrolyte: Potassium Hydroxide
 - i. Designation: ANSI-15A, IEC-LR6
 - ii. Nominal Voltage: 1.5 Volts

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install batteries in equipment according to the instruction manual.

END OF SECTION 26 33 13

SECTION 26 50 00

Lighting

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the house lighting

1.2 SUBMITTALS

- A. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Energy Savings Technology, LLC

562 East Weddell Drive, Suite 7

Sunnyvale, CA 94089

Phone: 408.744.1602

Website: www.est-es2.com

- B. Broan-NuTone LLC

926 W State St.

Hartford, WI 53027

Phone: 262.673.4340

Website: www.nutone.com

- C. Y Lighting LLC

1850 Mt. Diablo Blvd

Walnut Creek, CA 94596

Phone: 866.428.9289

Website: www.ylighting.com

- D. Lamps Plus Inc.

20250 Plummer St

Chatsworth, CA 91311

Phone: 818.886.5267

Website: www.lampsplus.com

E. Hampton Bay

Available at:

1. Home Depot

2.2 PRODUCTS

A. EST Lighting LED 2" Linear Down light

1. Model: M109 D
2. See manufacturer's specifications for further information:
<http://www.est-es2.com/data/M109%20Data%20Sheet%20-%20Spec%20DATA%20-%20V2.2.3.pdf>

B. EST Lighting LED 2" Recessed Down light

1. Model: DL 2 BL
2. See manufacturer's specifications for further information:
<http://www.est-es2.com/index.php>

C. EST LED Pendant light

1. Model: P38
2. See manufacturer's specifications for further information: <http://www.est-es2.com/index.php>

D. NuTone 70 CFM Fan/Light with Transparent Polymeric Lens and Resin Grille

1. Model number: 769RFT
2. Location: Bathroom
3. Material and finish:
 - a. Housing: galvanized steel
 - b. Grille: white polymeric

4. Motor: 115vAC, 60Hz, 1.1 amp
5. Electrical rating: 120V, 60Hz, 1.3A
6. See manufacturer's specifications for further information:

<http://www.nutone.com/common/productDigitalAssehandler.ashx?id=fc258f95-2e43-45c1-8f82-77a10ddb7a8>

E. Y Lighting Zenith Vanity Light

1. Item number: OXY-ZENITH-VANITY
2. Model: 2-5142
3. Dimensions: 47.6" x 2.88" x 3.1"
4. See manufacturer's specifications for further information:

<http://www.ylighting.com/oxy-zenith.html>

F. Lamps Plus Matte Silver Up and Down Wall Light

1. Style number: R7830
2. Dimensions: 6 3/4" x 2 1/2" x 3 3/4"
3. See manufacturer's specifications for further information:

http://www.lampsplus.com/products/matte-silver-up-and-down-wall-light_r7830.html

G. Hampton Bay 12V Low Voltage LED 8 Piece Stainless Steel Deck Light Kit

1. Model number: HD28101BS8
2. Certifications:
 - a. 1-UL listed
 - b. CSA listed
3. See distributor's specifications for further information:

http://www.homedepot.com/p/Hampton-Bay-12V-Low-Voltage-LED-8-Piece-Stainless-Steel-Deck-Light-Kit-HD28101BS8/202883263#.UqvtMH_n-71

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's recommendations

END OF SECTION 26 50 00

SECTION 26 50 01

Bathroom Exhaust Fan and Light

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes the exhaust fan for the bathroom

1.2 SUBMITTALS

- A. Product Data

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. NuTone

9825 Kenwood Rd., Ste. 301

Cincinnati, OH 45242

Phone: 1.888.336.3948

Website: www.nutone.com

2.2 PRODUCTS

- A. NuTone 70 CFM Ceiling Exhaust Fan with Light

1. Model Number: QTN110LE
2. Location (in house): Bathroom
3. Dimensions [L x W x H]: 10.5" x 11.375" x 7.625"
4. Weight: 10.6 lbs.
5. Wattage: 18 W
6. See manufacturer's specifications for further information:

http://www.homedepot.com/p/NuTone-70-CFM-Ceiling-Exhaust-Fan-with-Light-White-Grille-and-13w-Fluorescent-Bulb-769RFT/100490317?keyword=769rft#.Uf_bpVdAeUJ

2.3 ACCESSORIES

A. Broan Roof Vent Kit

1. Model Number: RVK1A
2. Weight: 3 lbs.
3. See manufacturer's specifications for further information:

<http://www.homedepot.com/p/Broan-Roof-Vent-Kit-RVK1A/100344509#specifications>

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install NuTone 70 CFM Ceiling Exhaust Fan with Light according to manufacturer's instructions

END OF SECTION 26 50 01

SECTION 32 93 00

Plants

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the exterior plants

1.2 Submittals

- A. Product data

PART 2 - PRODUCTS

2.1 PLANTING MATERIALS

- A. Shrub, Grass, and Flower Species Used: Listed by common name, Latin name. Nursery grown with healthy root systems, healthy structure, and free of insects, eggs, larvae, defects, and disfigurement.

1. Deer Grass (*Muhlenbergia rigens*)
2. Windmill Palm (*Trachycarpus fortunei*)
3. Lavender (*Lavandula*)
4. Bush Monkey Flower (*Mimulus aurantiacus*)
5. Golden Goddess (*Bambusa multiplex*)
6. Rosemary (*Rosmarinus officinalis*)
7. Lion's Tail (*Leonotis leonurus*)
8. Scarlet Bugler (*Penstemon barbatus*)
9. Kangaroo Paws (*Anigozanthos bicolor*)
10. Aloe Cameronii
11. Bush Marigold (*Tagetes lemmonii*)
12. Cylsto Cactus Strausii
13. Aloe Striata
14. Dyckia Fosterana Hybrid

15. Aloe Plicatillis

16. Aeonium Zorcoft

B. Tree Species Used: Listed by common name, Latin name, size (W x H). Nursery grown, with healthy root systems, well-shaped, fully branched, healthy, and free of insects, eggs, larvae, defects, and disfigurement.

1. Windmill Palm, *Trachycarpus Fortunei*, 1 ft / 10-15 ft (trunk width/ foliage width) x 30-60 ft (height)

C. Ground Covers Used: N/A – Install as desired in future

PART 3 - EXECUTION

3.1 PREPARATION

A. Planting Bed Establishment: Loosen subgrade to a depth of 6 inches. Remove stones sticks, roots, and rubbish. Spread planting soil mixture to a depth of 6 inches, but not less than required to meet finish grades. Work first layer into top of loosened subgrade.

B. Trees and Shrubs: Excavate pits with sides sloped inward and with bottom of excavation slightly raised at center to assist drainage. Excavate approximately three times as wide as ball diameter. Scarify sides of plant pit smeared or smoothed during excavation.

1. Set trees and shrubs plumb and in center of pit with top of ball flush with 1 inch adjacent finish grades.

2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Carefully remove root balls from containers without damaging root ball or plant. Do not use planting stock if ball is cracked or broken before or during planting operation.

3. Place planting soil mix around ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water

- thoroughly before placing remainder of backfill. Water again after placing and tamping final layer of planting soil mix.
4. Prune, thin, and shape trees and shrubs after planting.
 - i. Ground Cover, Grasses, and Flowers:
 5. Dig holes large enough to allow root spread, obeying directions written on plant label for spacing and arrangement.
 6. Plant stock working soil around roots and leaving a slight saucer around plants to hold water. Obey grower and other directions on soil type and amendments needed/watering patterns needed, and amend soil/watering patterns accordingly
 7. Water after planting. Do not cover plant crowns with wet soil.
 8. Fertilize and feed plants according to directions as needed
- C. Edgings: Install edgings and anchor with stakes driven below top elevation of edging.

3.2 MAINTENANCE

- A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Install support stakes to combat the effects of high wind and/or inclement weather
1. Maintain trees and shrubs until established, but not less than six months.
- B. Ground, Grass, and Flower Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.
1. Maintain ground covers and plants until established, but not less than six months.

END OF SECTION 32 93 00

SECTION 41 20 00

Crane and Hoists

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification includes the requirements, terms of use, and product data of a mobile crane used to unload and load the modules of the house for the competition.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Terex

106 12th Street SE

Waverly, IA 50677

Phone: +1 877 794 5284

Fax: +1 855 891 3089

2.2 MODEL

- A. T-340-1 Truck Crane

- B. See manufactures specifications at:

http://www.terex.com/main.php?obj=prod&action=VIEW&id=d65db72ae72987e738c2ee4044594260&nav=prod&cid=487c16c8ff14_5d0843f57512eafb8592

2.3 GENERAL NOTES

- A. Rated loads as shown on Lift Charts pertain to this machine as originally manufactures and equipment. Modifications to the machine or use of optional equipment other than that specified can result in reduction of Capacity.
- B. Construction equipment can be hazardous if improperly operated or maintained. Operation and maintenance of this machine shall be in compliance with the information in the operator's Parts and Safety Manuals supplied with this machine. If these manuals are missing, order replacements from the manufacture through your distributor.

- C. These warnings do not constitute all of the operating conditions for the crane. The operator and job site supervision must read the operators manual, CIMA safety manual, and applicable OSHA regulations. And ASME safety standards for cranes.
- D. This crane and its load ratings are in accordance with per crane and shovel association, standard no. 4 SAE crane load stability test code J765A, SAE method of test for crane structure J1603 and applicable safety code for cones , derricks and hoists, ASME/ANSI b30.5

2.4 CAPACITIES

- A. Maximum Lifting Capacity: 40 t (36.36 mt)
- B. Maximum Boom Length: 30 - 94 ft (9.23 - 28.49 m)
- C. Elevation Degree (min to max.): -4 to 77 degrees
- D. Standard Jib Length: 32-49 ft (9.75-14.86m)
- E. Optional Jib Length: 32 ft (9.75m)
- F. Maximum Tip Height with Jib:147 ft (44.81m)
- G. Drive/Steer: 6X4X2
- H. Engine Model: Cummins ISC 300
- I. Horsepower: 300 hp (224 kW)
- J. Max Speed: 60 mph (96 km/h)
- K. Max Gradeability: 56%
- L. Overall Length: 26 ft 4 in (8.03m)
- M. Overall Width: 8 ft (2.46m)
- N. Overall Height: 10 ft 8.75 in (3.27m)
- O. Lightest Gross Vehicle Weight: (minimum counterweight) 47,101 lb. (21,365 kg.)
- P. Gross Vehicle Weight Typical Equipment: (maximum counterweight) 57,275 lbs. (25,979 kg)

PART 3-EXECUTION

3.1 SETUP

- A. Crane load ratings are based on the crane being leveled and standing on a firm, uniform supporting surface.
- B. Crane load ratings on outriggers are based on all outrigger beams being fully extended or in the case of partial extension ratings mechanically pinned in the appropriate position, and the tires free of the supporting surface.
- C. Crane load ratings on tires depend on appropriate inflation pressure and the tire conditions. Caution must be exercised when increasing air pressures in tires. Consult Operator's Manual for precautions.
- D. Use of jibs, lattice-type boom extensions, or fourth section pullouts extended is not permitted for pick and carry operations.
- E. Consult appropriate section of the Operator's and Service Manual for more exact description of hoist line reeving.
- F. The use of more parts of line than required by the load may result in having insufficient rope to allow the hook block to reach the ground.
- G. Properly maintained wire rope is essential for safe crane operation. Consult Operator's Manual for proper maintenance and inspection requirements.
- H. When spin-resistant wire rope is used, the allowable rope loading shall be the breaking strength divided by five (5), unless otherwise specified by the wire rope manufacturer.
- I. Do not elevate the boom above 60° unless the boom is positioned in-line with the crane's chassis or the outriggers are extended. Failure to observe this warning may result in loss of stability.

3.2 – OPERATION

- A. Crane load ratings must not be exceeded. Do not attempt to top the crane to determine allowable loads.

- B. When either radius or boom length, or both, are between listed values, the smaller of the two listed load ratings shall be used.
- C. Do not operate at longer radii than those listed on the applicable load rating chart (cross hatched areas shown on range diagrams).
- D. The boom angles shown on the Capacity Chart give an approximation of the operating radius for a specified boom length. The boom angle, before loading, should be greater to account for boom deflection. It may be necessary to retract the boom if maximum boom angle is insufficient to maintain rated radius.
- E. Power telescoping boom sections must be extended equally.
- F. Rated loads include the weight of hook block, slings, and auxiliary lifting devices. Their weights shall be subtracted from the listed rated load to obtain the net load that can be lifted. When lifting over the jib the weight of any hook block, slings, and auxiliary lifting devices at the boom head must be added to the load. When jibs are erected but unused add two (2) times the weight of any hook block, slings, and auxiliary lifting devices at the jib head to the load.
- G. Rated loads do not exceed 85% on outriggers or 75% on tires, of the tipping load as determined by SAE Crane Stability Test Code J765a. Structural strength ratings in chart are indicated with an asterisk (*).
- H. Rated loads are based on freely suspended loads. No attempt shall be made to drag a load horizontally on the ground in any direction.
- I. The user shall operate at reduced ratings to allow for adverse job conditions, such as: Soft or uneven ground, out of level conditions, high winds, side loads, pendulum action, jerking or sudden stopping of loads, hazardous conditions, experience of personnel, two machine lifts, traveling with loads, electric wires, etc., (side pull on boom or jib is hazardous). Derating of the cranes lifting capacity is required when wind speed exceeds 20 MPH. the center of the lifted load must never be allowed to move more than 3* feet

off the center line of the base boom section due to the effects of wind, inertia, or any combination of the two. Use 2 feet off the center line of the base boom for a two section boom, 3 feet for a three section boom, or 4 feet for a four section boom.”

- J. The maximum load which can be telescoped is not definable, because of variations in loadings and crane maintenance, but it is permissible to attempt retraction and extension if load ratings are not exceeded.
- K. Load ratings are dependent upon the crane being maintained according to manufacturer’s specifications.
- L. It is recommended that load handling devices, including hooks, and hook blocks, be kept away from boom head at all times.
- M. 360° capacities apply only to machines equipped with a front outrigger jack and all five (5) out- rigger jacks properly set. If the front (5th) outrigger jack is not properly set, the work area is restricted to the over side and over rear areas as shown on the Crane Working Positions diagram. Use the 360° load ratings in the overside work areas.
- N. Do not lift with outrigger beams positioned between the fully extended and intermediate (pinned) positions.
- O. Truck Cranes not equipped with equalizing (bogie) beams between the rear axles may not be used for lifting “on tires”. Truck Cranes equipped with equalizing beams and rear air suspension should “dump” the air before lifting “on tires”.

3.3 SPECIAL RESTRICTIONS

1. Crane may not leave access road when on the National Mall. Crane is not allowed to travel on any of the grass on the mall.
2. Crane must wait aside the National mall for Solar Decathlon Operations Director to approve site access.

END OF SECTION 41 20 00

SECTION 41 23 23

Boom Lift

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes the terms of use, requirements, and product data for a boom lift to be used during the assembly and disassembly of the house.

1.2 STANDARDS OF COMPLIANCE

- A. ANSI A92.5
- B. CSA B354.4
- C. CE Compliance
- D. AS 1418.10

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Genie

2.2 PRODUCTS

- A. Z-34/22 DC
 - 1. Measurements
 - a. Working Height Maximum: 40.5 ft
 - b. Platform Height Maximum: 34.5 ft
 - c. Horizontal reach Maximum: 22.25 ft
 - d. Up and Over Clearance: 14.9 ft
 - e. Platform Length: 2.5 ft
 - f. Platform Width: 4.5 ft
 - g. Height – Stowed: 6.5 ft
 - h. Length – Stowed: 18.5 ft
 - i. Storage Height: 7.5 ft

- j. Storage Length: 13.5 ft
 - k. Wheelbase: 6 ft
 - l. Ground clearance – center: 6 in
2. Productivity
- a. Lift Capacity: 500 lbs.
 - b. Platform Rotation: 180 Degrees
 - c. Vertical Jib Rotation: 139 Degrees
 - d. Drive Speed – Stowed: 4 mph
 - e. Drive Speed-Raised: .68 mph
 - f. Gradeability stowed: 30%
 - g. Turning Radius- Inside: 5ft 9 in
 - h. Turning Radius-Outside: 13 ft 1 in
 - i. Controls: 24V DC proportional
 - j. Drive: 2WD
 - k. Jib: 4 ft boom
 - l. Tires: Air Filled
3. Power
- a. Power source: 48V DC (eight 6V batteries 315 Ah capacity)
 - b. Auxiliary Power Unit: 24V DC
 - c. Hydraulic Tank Capacity: 4 gal
4. Weight
- a. 11,000 lbs.

PART 3 - EXECUTION

3.1 Safety and Implementation

- A. All operators must comply with all safety standards and regulations set forth for by the Solar Decathlon.

- B. All operators must be certified to operate equipment and carry certification card at all times during operation.
- C. Boom lift must only travel on pads provided to protect the grass of the National Mall.

END OF SECTION 41 23 23

SECTION 41 62 23

Fork Lifts

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes the terms of use, requirements, and product data for the fork lifts needed for assembly and disassembly of the house.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Gradall
- B. Toyota

2.2 PRODUCTS

- A. 534D10-45 Telescopic Forklift
 - 1. Dimensions
 - a. Length to fork face: 19.7 ft
 - b. Width Over Tires: 8.2 ft
 - c. Overall Height: 7.7 ft
 - d. Wheelbase: 11.2 ft
 - e. Ground Clearance: 19.3 ft
 - f. Turning Radius Outside Tires: 14.6 ft
 - 2. Lift
 - a. Max Lift Height: 45 ft
 - b. Max Forward Reach: 31.5 ft
 - c. Max Lift Capacity: 10000 lb
 - d. Max Load at Max Reach: 3000 lb
 - 3. Engine
 - a. Power: 114 hp

- b. Torque: 2500 rpm
 - c. Displacement: 274.6 cu in
 - d. Cylinders: 4
4. Operational
- a. Weight: 25300 lb
 - b. Fuel Capacity: 38 gal
 - c. Hydraulic System Fluid Capacity: 40 gal
 - d. Operating Voltage: 12V
 - e. Alternator Supplied Amperage: 65 A
 - f. Drawbar Pull: 21000 lb
 - g. Tire Size: 14x24-12PR
 - h. Max Speed: 19 mph
5. Manufacturer specifications for Gradall Forklift can be found at:

<http://www.ritchiespecs.com/specification?type=Lifting+%26+Material+Handling&category=Telescopic+Forklift&make=Gradall&model=534D10-45&modelid=94431>

B. 8FGU15 Internal Combustion Pneumatic Warehouse Forklift

1. Performance
- a. 2007 EPA/CARB certified engine with closed loop 3-way catalytic muffler system
 - b. Toyota 136 cu. in., 4-cylinder, OHV gasoline engine (4Y-ECS)
 - c. Toyota 152 cu. in., 4-cylinder, OHV diesel engine (1DZ-II)
 - d. Electronic fuel injection (gasoline only)
 - e. UL "G" gasoline engine
 - f. UL "D" diesel engine
 - g. One-way automatic fork leveling
 - h. Independent brake & inching pedals

- i. Integrated monitoring system – includes
 - i. Digital hour meter display
 - ii. Engine coolant temperature gauge
 - iii. Fuel gauge (gasoline only)
 - iv. Check engine light
 - v. Sedimentor warning light (diesel only)
 - vi. Glow indicator light (diesel only)
 - vii. Engine oil pressure warning light
 - viii. Battery charge warning light
 - ix. OPSS activation light
 - x. SAS/OPSS warning light
 - xi. 2-stage limited free lift mast (V)
 - xii. Adjustable headlights with guards
 - xiii. Foot-activated parking brake
 - xiv. Alternator with built-in regulator
 - xv. Transistorized ignition assembly
 - xvi. Automatic transmission with oil cooler
 - xvii. Full floating powertrain
 - xviii. Hydraulic valve lifters
 - xix. Integrated head light and turn signal lever
 - xx. Electric shift control
 - xxi. Durability
- j. Control Area Network (CAN-bus) communication
- k. Fully-stamped steel side panels
- l. Moisture resistant electric connectors
- m. High cooling capacity radiator with fan shroud

- n. Low maintenance battery
 - o. Large capacity engine cooling fan
 - p. 7" cyclone air cleaner with high positioned external air-intake (6" diameter on 8FGCU15.18.S20)
 - q. Plate iron front fenders
 - r. Anti-restart ignition key switch
 - s. Stamped steel engine hood
 - t. Fully-sealed air-intake system
 - u. Self-adjusting brakes
 - i. Load and Capacities
 - A. Load Capacity: 3000 lb
 - B. Engine HP/rpm: 51/2570
 - C. Max Travel Speed: 11.5 mph
 - D. Maximum Lift Speed Full Load (f.p.m.): 131
 - E. Maximum Gradeability Full Load (%): 45
 - F. Basic Tilt Angle Stack (in): 92.1
 - G. Turning Radius: 76 in
 - H. Dimensions
 - 2. Width: 42.1 in
 - 3. Length: 87.8 in
 - 4. Height: 81.9 in
5. Manufacturer specifications for Toyota Pneumatic Forklift can be found at:
<http://www.directindustry.com/prod/toyota-industrial-equipment/electric-forklift-truck-14115-27200.html>

PART 3 - EXECUTION

3.1 Safety and Implementation

- A. All operators must comply with all safety standards and regulations set forth for by the Solar Decathlon.
- B. All operators must be certified to operate equipment and carry certification card at all times during operation.
- C. Forklifts must only travel on protective pads provided to protect the grass of the National Mall.

END OF SECTION 41 62 23

SECTION 48 19 16

Electrical Power Generation Inverters

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Product Data

1.2 RELATED SECTIONS

- A. Section 26 31 00 – Photovoltaic Collectors

PART 2 – PRODUCTS

2.1 PRODUCT PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70, “National Electrical Code”

2.2 DEVICES

- A. Inverter

1. SMA Sunny Boy 8000TL-US
2. DC to AC transformer-less grid-tie inverter for up to a 8000 watt photovoltaic array.
3. See manufacturer’s specifications for further information:

<http://files.sma.de/dl/10707/SUNNYBOY6-11TLUS-DUS122510W.pdf>

PART 3 – EXECUTION

3.1 EXECUTION

- A. Installation

1. Measure service entrance conductors to confirm AC service at the site.
2. Install in accordance with manufacturer’s recommendations.

END OF SECTION 48 19 16