Project Manual

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2011

Team Massachusetts

University of Massachusetts at Lowell

Massachusetts College of Art and Design

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As-Built Deliverable

August 11, 2011

Table of Contents

Summary of Changes
March 22, 2011 Revisions

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

- Rules compliance checklist: Rule 9-2 reference to Manual page 22 33 30.26 – 1 - Deleted
- Interconnection form reflects new inverter and PV panel - Changed
- One-Line Electrical Schematic Diagram – Added
- Three-Line Electrical Schematic Diagram – Removed
- Calculations of Service / Feeder Net Computed Load and Neutral Load Diagram – Added
- Load Center Schematic Diagram - Added
- 05 14 13 – Architecturally Exposed Structural Aluminum Framing - Changed
- 05 50 00 – Wire Rope Decorative Metal Railings – Removed
- 06 16 00 – Sheathing – Changed
- 06 41 16 – Plastic-Laminate-Clad Architectural Cabinets –Changed
- 06 46 00 – Wood Trim - Changed
- 07 21 00 – Thermal Insulation –Changed
- 07 46 46 - Mineral-Fiber Cement Siding –Changed
- 08 14 00 – Wood Doors and Frames - Changed
- 08 52 00 – Wood Windows – Changed
- 08 61 00 – Roof Windows - Changed
- 09 22 16.13 - Non-Structural Metal Stud Framing - Removed
- 09 29 00 – Gypsum Board Panels – Changed
- 09 30 13 – Ceramic Tiling – Removed
- 09 30 33 – Stone Tiling – Added
- 09 93 13.53 – Exterior Finishing – Removed
- 10 06 20 – Interior Specialties - Changed
- 10 22 26.43 – Operable Partitions – Changed
- 12 17 13 – Etched Glass – Removed
- 12 36 00 – Countertops – Changed
- 22 12 19 – Facility Potable Water Storage Tanks - Changed
- 26 31 00 – Photovoltaic Collector System - Changed
- 48 19 16 – Electrical Power Generation Inverters – Changed

May 5, 2011 Revisions

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

- Detailed Water Budget – Changed
- One-Line Electrical Diagram – Changed
- Calculations of Service/Feeder Net Computed Load & Neutral Load (NCE220) – Changed
- Load Center Schematic - Changed
- 01 54 00 – Construction Aids – Changed
- 06 41 16 – Architectural Woodwork – Removed
- 06 82 00 – Glass-Fiber Reinforced Plastic – Added
- 07 13 13 – Bituminous Sheet Waterproofing - Added
- 11 31 00 – Residential Appliances – Changed
- 12 30 00 – Casework - Added
- 21 13 13 – Wet-Pipe Sprinkler Systems – Changed
- 26 05 19 – Low-Voltage Electrical Power Conductors and Cables - Changed
- 26 05 26 – Grounding & Bonding for Electrical Systems - Added
- 26 05 33 – Raceways and Boxes for Electrical Systems – Changed
- 26 24 16 – Panelboards – Changed
- 26 27 00 – Low-Voltage Distribution Equipment – Added
- 26 27 13 – Electricity Metering – Changed
- 26 28 16 – Enclosed Switches and Circuit Breakers – Changed
- 26 31 00 – Photovoltaic Collector System – Changed
- 26 51 00 – Interior Lighting – Changed
- 26 56 00 – Exterior Lighting – Changed

August 11, 2011 Revisions

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

- Interconnection Application Form - Changed
- One-Line Electrical Schematic - Changed
- Calculations of Service / Feeder Net Computed Load and Neutral Load (NCE 220) - Changed
- Plan View of Lot Showing House, Decks, Ramps, Tour Path and Service Point - Changed
- Elevation View Showing Terminal Box with Service Point, meter and Service Equipment - Changed
- 01 54 00 – Construction Aids – Changed
- 01 74 19 – Construction Waste Management and Disposal – Added
- 05 14 13 – Architecturally Exposed Structural Aluminum - Changed
- 05 50 00 – Metal Fabrications - Changed
- 06 05 23 – Wood, Plastic and Composite Fasteners - Changed
- 06 10 00 – Rough Carpentry - Changed
- 06 82 00 – Glass-Fiber Reinforced Plastic - Added
- 07 13 13 – Bituminous Sheet Waterproofing - Removed
- 07 91 00 - Prefromed Joint Seals - changed
- 09 91 23 – Interior Paint - Changed
- 11 31 00 – Residential Appliances - Changed
- 12 21 13.23 – Horizontal Louver Blinds - Removed
- 21 13 13 – Wet-Pipe Sprinkler Systems - Changed
- 22 07 19 – Plumbing Piping Insulation - Removed
- 22 11 16 – Domestic Water Piping - Changed
- 22 12 19 – Facility Potable Water Storage Tanks - Changed
- 22 13 53 – Facility Septic Tanks - Added
- 22 33 30.16 – Residential, Storage Electric Domestic Water Heaters - Changed
- 22 33 30.26 – Residential, Collector-to-Tank, Heat-Exchanger-Coil, Solar-Electric Domestic Water Heaters - Changed
- 23 21 13 – Hydronic Pumps - Removed
- 23 31 13.16 – Round and Flat-Oval Spiral Ducts - Changed
- 23 33 13 – Dampers - Changed
- 23 37 13 – Diffusers, Registers and Grilles - Changed
- 23 72 00 – Air-to-Air Energy Recovery Equipment - Changed
- 23 81 26 – Split-System Air Conditioners - Changed
- 23 84 16 – Dehumidifiers - Changed
- 26 05 19 – Low-Voltage Electrical Power Conductors and Cables - Changed
- 26 05 26 – Grounding and Bonding for Electrical Systems - Changed
- 26 05 33 – Raceway and Boxes for Electrical Systems - Changed
- 26 24 16 – Panelboards - Changed
- 26 27 00 – Low-Voltage Distribution Equipment - Changed
- 26 27 13 – Electricity Metering - Changed
- 26 31 00 – Photovoltaic Collectors - Changed
- 26 51 00 – Interior Lighting – Changed
- 26 56 00 – Exterior Lighting – Changed
- 27 05 13 – Communications Services - Removed
- 27 21 00 – Data Communications Network Equipment - Changed
- 27 21 33 – Data Communications Wireless Access Points - Changed
- 27 22 26 – Data Communications Laptops - Changed

- 27 24 13 – Printers - Removed
- 27 26 16 – Database Development - Removed
- 27 26 19 – Application Development - Removed
- 28 31 00 – Fire Detection and Alarm - Removed
- 28 31 46 – Smoke Detection Sensors - Added
- 28 31 49 – Carbon-Monoxide Detection Sensors - Added

Rules Compliance Checklist

	RULE DESCRIPTION	LOCATION DESCRIPTION	Drawing #	Project Manual Page #
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101,102	
Rule 4-2	Construction Equipment	Specifications for heavy machinery	O-101,102	01 54 00 - 1
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-101	
Rule 4-4	Impact on the Turf	Drawing(s) showing the location, contact area, and soil-bearing pressure of every component resting directly on the turf	S-101	
Rule 4-5	Generators	Specifications for generators	O-101,102	01 54 00 - 1
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	P-101,102,103,104	22 05 00 - 1 22 11 16 - 1 22 12 19 - 1 22 33 30.16 - 1 22 33 30.26 - 3 23 21 13 - 2
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	P-101,102,103,104	01 54 00 -1
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	G-201,202	
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot	S-101	
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	G-201,202	

Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	NA	
Rule 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	S-611	Structural Calculations, 11-24
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101	
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	NA	
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route and the ground surface area that will be covered by organizer-provided walkway material	G-103	
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-101	
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	L-102	
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	E-102,602	26 31 00 - 1
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	NA	
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	NA	NA
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	M-602	
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	M-602	23 84 16 - 1
Rule 8-5	Village Grid	Completed interconnection application form.	E-101,102	
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-101,102	

Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-101,102,603	26 31 00 - 2 48 19 16 - 2 26 05 33 - 2 26 27 13 - 1 26 28 16 - 2
Rule 8-5	Village Grid	One-line electrical diagram	E-601	
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-603	
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	A-101	
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201	
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	P-101	
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. EDT or between 8 a.m. and 4 p.m. solar time on October 1	P-101	
Rule 9-2	Team-Provided Liquids	Quantity, specifications , and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	P-601	
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	NA	
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	P-101,L-102	
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	NA	
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	NA	NA
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	NA	
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	O-603	
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	P-601	23 21 13 - 2 22 12 19 - 1 22 33 30.16 - 1 22 33 30.26 - 3
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and	O-603	

		removal events		
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	P-601	datasheets
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103	

Structural Calculations

Structural Narrative

The unusual stresses of shipping and craning the 4dhome have become dominant factors in the design of our house's structural system. The house will be divided into four modules which are each designed to be independently structurally sound to withstand the rigors of shipping and craning. The Modules will also need to perform in concert as a sound two bedroom home which will be displayed and demonstrated to tens of thousands of visitors during the 2011 Solar Decathlon.

These varied forces have all been taken into account in the design of our 4Dhome. Central Trusses in the roof structure have been designed to handle the dynamic shipping and craning stresses the modules will endure on their journey and during their assembly on the National Mall. The unique stresses on the main modules will be addressed by the insertion of a series of smaller temporary trusses which will stabilize the open sides during delivery and craning and then will be adapted to serve a second purpose as railings for our decks. These horizontal stresses of braking and acceleration while on the trucks as well as the vertical lifting and racking stresses of craning and the eventual live and dead loads while in use have all been addressed and are continuing to be refined.

The use of these trusses in the roof has allowed us to disperse loads evenly throughout the building, and because we are using them in combination with sheathed TJI construction in the walls, floor and roof we have been able to enhance the thermal efficiency of our design by minimizing the costly effects of thermal bridging. We have also managed to keep the central trusses in our design thin enough to remain elegant and maintain a feeling of openness which will be enhanced by a large skylight and gable roof.

This efficient, robust construction has allowed us to address the rigorous structural stresses placed on our design while meeting Passive House insulation and energy use standards in the creation of a pleasant, structurally sound and comfortable home.

Calculation Results

Project Overview

This project manual provided structural calculations and evaluation of atypical construction methods and loading conditions not covered in applicable building codes.
The objective of the structures group is to create a safe and sensible structural design that maximizes efficiency and minimizes thermal bridging.
The shipping aspect is a dominant factor in the design of the house's structural system. The house will be built in four separate modules for shipping. These modules will be craned together for the competition.

Load Summary

The structural design must accommodate multiple phases of loading. Construction is done in a modular building facility. The modules must be able to ship on U.S. highways. The service loads include the three week duration on the National Mall with elevated load criteria and a possible permanent location in Maine, using conservative values. A change in final geographic location will require re-evaluation.

HOME TEAM MASSACHUSETTS

STRUCTURAL CALCULATIONS

ENGINEERING CONSULTANTS

LeMessurier Consultants

6.30.11

U.S. Department of Energy
Solar Decathlon 2011
Date 6/30/2011

Structural Calculations

Submitted By:

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LeM File No.: 31079

U.S. Department of Energy
Solar Decathlon 2011
Date 6/30/2011

Structural Design Loads

Submitted By:

LeMessurier Consultants
675 Massachusetts Avenue, Cambridge, MA 02139
Tel: (617)868-1200 Fax: (617)661-7520

Structural Design Loads – In accordance with ASCE 7-05; Minimum Design Loads for Buildings and Other Structures

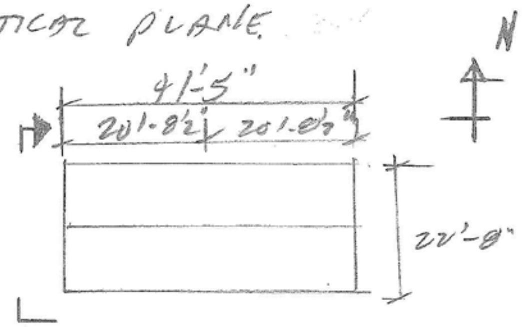
1. Dead Loads
   a. Weight of Permanent Building Components.....As Required
2. Live Loads
   a. First Floor.....100psf
3. Snow Loads
   a. Ground Snow Load.....65psf
   b. Flat Roof Snow Load, P_f.....50psf
   c. Sloped Roof Snow Load, P_s.....50psf
   d. Snow Exposure Factor, C_e.....1.0
   e. Roof Slope Factor, C_s.....1.0
   f. Snow Load Importance Factor, I.....1.0
   g. Thermal Factor, C_t.....1.1
4. Wind Loads
   a. Basic Wind Speed (Boston, MA).....105mph
   b. Importance Factor, I.....1.0
   c. Surface Roughness Category.....B
   d. Exposure Category.....B
   e. Analysis Method.....Method 1 (Simplified Method)
   f. Main Wind Force-Resisting System Design Pressures
      i. Wall Corner.....19.6psf
      ii. Wall Field.....15.7psf
      iii. Roof Corner.....13.5psf
      iv. Roof Field.....10.8psf
   g. Components and Cladding Pressures (based on effective wind area of 20sf)
      i. Interior Roof Zone.....(+)17.6psf/(-)18.8psf
      ii. Roof End/Ridge Zone.....(+)17.6psf/(-)22.2psf
      iii. Roof Corner and Ridge End Zone.....(+)17.6psf/(-)22.2psf
      iv. Wall Interior Zone.....(+)18.9psf/(-)20.6psf
      v. Wall End Zone.....(+)18.9psf/(-)24.8psf

LeM File No.: 31079

LeMessurier Consultants Structural Engineers	By MCG	Date 6/30/11	File No. 31079	Sheet No. 2/
	Subject			

LATERAL WIND LOADS

APPLY PRESSURES NORMAL TO VERTICAL PLANE

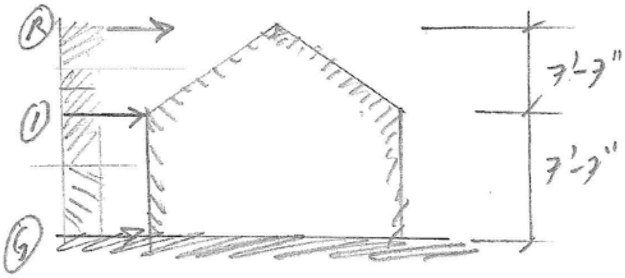


a = 0.1(22'-0") = 2.27'
0.4(15.5') = 6.20'
0.04(22'-0") = 0.91' - MIN
3'-0" ← MIN

a = 3'-0"
2a = 6'-0"

NORTH-SOUTH

TOTAL V_W (EACH SHORT WALL)



F(R) = 6'(0.5 × 7'-7")(13.5 psf) / 1000

+ [(20'-8½") − (6'-0")](0.5 × 7'-7")(10.8 psf) / 1000 ← 14'-8½"

= 0.310^k + 0.602^k = 0.912^k

F(1) = 6'(7'-7")(0.5)(13.5) / 1000

+ 6'(7'-7")(0.5)(19.6) / 1000

+ (14'-8½")(7'-7")(0.5)(10.8) / 1000

+ (14'-8½")(7'-7")(0.5)(15.7) / 1000

= 0.310^k + 0.446^k + 0.602^k + 0.875^k

= 2.23^k

F(G) = 0.446^k + 0.875^k = 1.32^k

V_T = F(R) + F(1) + F(G)
= 0.912^k + 2.23^k + 1.32^k
= 4.46^k E/S

30 by 38 blocks at .25 inches

Nordic Lam™ columns shall be in accordance with the recommendations provided by the manufacturer.

5. Fire-rated assemblies:
Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer (see link above).

6. Limitations:
   a) Nordic Lam™ beams and columns shall be designed in accordance with the code using the design properties specified in this report.
   b) The dimensions of Nordic Lam™ beams and columns shall follow those specified in Table 1.
   c) Nordic Lam™ beams and columns shall be manufactured in accordance with layup combinations specified in APA *Glulam Layup Combinations*, Form Y117 SUP (www.apawood.org/publications) or proprietary Nordic Lam™ manufacturing specifications documented in the in-plant manufacturing standard approved by APA.
   d) Nordic Lam™ is produced at the Nordic Engineered Wood, Chibougamau, Quebec facilities under a quality assurance program audited by APA.
   e) This report is subject to re-examination in one year.

7. Identification:
Nordic Lam™ described in this report is identified by a label bearing the manufacturer's name (Nordic Engineered Wood) and/or trademark, the APA assigned plant number (1057), the product standard (ANSI/AITC A190.1), the APA logo, the combination symbol, the report number PR-L294, and a means of identifying the date of manufacture.

Table 1. Dimensions for Nordic Lam™ layups.

Layup	Minimum width, b (in.)	Maximum width, b (in.)	Minimum depth, H	Maximum depth, h (in.)
20F-E8M1	1-1/2	7-1/2	4 lams	18
20F-ES/CPG	3-1/8[(1)]	3-1/2	4 lams	18
24F-E/ES1M1	1-1/2	7-1/2	4 lams	36[(2)]
24F-ES/NPG	1-1/2	12	4 lams	54[(2)]
ES11	1-1/2	7-1/2	2 lams	15
ES11/NPG	1-1/2	7-1/2	2 lams	15
ES12	1-1/2	7-1/2	2 lams	15
ES12/NPG	1-1/2	12	2 lams	54[(2)]

(1) The minimum width shall be permitted to be 1-1/2 inches when 24F-ES/NPG is trademarked as 20F-ES/CPG.

(2) The maximum depth shall not exceed the tabulated depth or a depth-to-width ratio of 12:1, whichever is smaller.

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APA PRODUCT REPORT®

www.apawood.org

Nordic Lam™
Nordic Engineered Wood

PR-L294
Revised April 12, 2011

Products: Nordic Lam™
Nordic Engineered Wood,
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Montreal, Québec, Canada H3B 2S2
(514) 871-8526
www.nordicewp.com

1. Basis of the product report:
   - 2009 and 2006 International Building Code (IBC): Sections 104.11 Alternative Materials and 2303.1.3 Structural glued laminated timber
   - 2009 and 2006 International Residential Code (IRC): Sections R104.11 Alternative Materials, and R502.1.5, R602.1.2, and R802.1.4 Structural glued-laminated timber
   - ASTM D 3737-07 and D 3737-03 recognized by the 2009 IBC and IRC, and 2006 IBC and IRC, respectively
   - ANSI/AITC A190.1-07 and A190.1-02 recognized by the 2009 IBC and IRC, and 2006 IBC and IRC, respectively
   - APA Reports T2001P-85, T2003P-21, T2003P-85, T2004P-43, T2006P-45, T2008P-91, and T2009P-39, FPInnovations Reports 201003404 and 201003409, and other qualification data

2. Product description:
   Nordic Lam™ is a Black Spruce structural glued laminated timber manufactured in accordance with 20F-E8M1, 20F-ES/CPG, 24F-E/ES1M1, 24F-ES/NPG, ES11, ES11/NPG, ES12, and ES12/NPG layup combinations developed in accordance with the principle of ASTM D 3737. Nordic Lam™ is used as beams, headers, rafters, purlins, columns, studs, and decking, and is manufactured in nominal widths ranging from 1-1/2 to 12 inches, depths up to 54 inches, and lengths up to 80 feet, in accordance with Table 1.

3. Design properties:
   Table 2 lists the design properties for Nordic Lam™ beams. The allowable spans for Nordic Lam™ beams shall be in accordance with the recommendations provided by the manufacturer (www.nordicewp.com/literatures/N-U121NordicLam.pdf), and with EWS Data File: *Glued Laminated Beam Design Tables*, Form S475 (www.apawood.org/publications), as applicable.

   Table 3 lists the design properties for Nordic Lam™ columns. The allowable loads for Nordic Lam™ columns shall be in accordance with the recommendations provided by the manufacturer (www.nordicewp.com/literatures/N-U231Columns.pdf), and with EWS Data File: *Design of Structural Glued Laminated Timber Columns*, Form Y240 (www.apawood.org/publications), as applicable.

4. Product installation:
   Nordic Lam™ beams and columns shall be installed in accordance with the recommendations provided by the manufacturer (www.nordicewp.com/literatures/N-U121NordicLam.pdf) and EWS Technical Note: *Glulam Connection Details*, Form T300 (www.apawood.org/publications). Permissible field notching and drilling of Nordic Lam™ beams shall be in accordance with the recommendations provided by the manufacturer and with EWS Technical Note: *Field Notching and Drilling of Glued Laminated Timber Beams*, Form S560 (www.apawood.org/publications). Permissible field notching and drilling of

LeMessurier Consultants
Structural Engineers

By	Date	File No.	Sheet No.
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Subject

NORDIC BEAM 3½" x 11⅞" NORDIC I-JOIST BEAM

CHECK BENDING STRESS

$$I_{xx} = \frac{3\frac{1}{2}"(11\frac{7}{8}")^3}{12} = 409.4$$

$$S_x = \frac{3\frac{1}{2}"(11\frac{7}{8}")^2}{6} = 82"^3$$

$$M = \frac{115\ psf(10'-7")(16'-10")^2}{8} = 7104^{\#.''} = 85,247^{\#.''}$$

$$f_b = \frac{85,247^{\#.''}}{82"^3} = 1040\ psi$$

$F_b = 2000\ psi$ (LOWER BOUND) $> f_b = 1040\ psi$ ∴ OKAY — SIMPLE BENDING

← FROM TABLE OF DESIGN VALUES

CHECK DEFLECTION

$$w = 100\ psf(10'-7") = 1058^{\#/'}$$

$$\Delta = \frac{5(1058^{\#/'})(16'-10"\times 12"/')^4(1/2"/')}{384(0.8\times 10^6\ psi)(409)} = 0.133" \left(\frac{L}{616}\right)$$ ∴ DEFL. OKAY

CHECK SHEAR

$$R = 115\ psf(10'-7")(16'-10")(0.5) = 4158^{\#}$$

$$f_v = \frac{4158^{\#}}{(3\frac{1}{2}"\times 11\frac{7}{8}")} = 100\ psi < F_v = 175\ psi$$ (LOWER BOUND) ∴ SHEAR OKAY

APA – The Engineered Wood Association is an accredited certification body under ISO 65 by Standards Council of Canada (SCC) and an accredited inspection agency by the International Code Council (ICC) International Accreditation Service (IAS) under ISO/IEC 17020. APA is also an accredited testing organization recognized by IAS and SCC under ISO/IEC 17025. APA is a recognized testing laboratory by Miami-Dade County, and a Product Testing Laboratory, Product Quality Assurance Entity, and Product Validation Entity by the Florida Department of Community Affairs (DCA).

APA – THE ENGINEERED WOOD ASSOCIATION
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Phone: (253) 565-6600 • Fax: (253) 565-7265 • Internet Address: www.apawood.org

PRODUCT SUPPORT HELP DESK
(253) 620-7400 • *E-mail Address*: help@apawood.org

DISCLAIMER

(a) The tabulated values are design values for normal duration of load. All values, except for EI and K, shall be permitted to be adjusted for other load durations as permitted by the code.

(b) The maximum vertical load capacity for Nordic Joist without bearing stiffeners is 2,000 lbf/ft for joists up to 16-inch deep, 1,850 lbf/ft for 18-inch NI-60 and 1,275 lbf/ft for 18-inch NI-80x to 24-inch NI-80x.

(c) Bending stiffness (EI) of the I-joist

(d) Moment capacity (M) of the I-joist, which shall not be increased by any repetitive member use factor.

(e) Shear capacity (V) of the I-joist

(f) Intermediate reaction (IR) of the I-joist for a bearing length of 3-1/2 or 5-1/2 inches with or without web stiffeners in accordance with the bearing stiffener recommendations listed in Table 2.

(g) End reaction (ER) of the I-joist for a bearing length of 1-3/4 and 3-1/2 inches with and without web stiffeners. Higher end reactions are permitted. For a bearing length of 4 inches, the end reaction may be set equal to the tabulated shear value. Interpolation of the end reaction between 1-3/4 and 4-inch bearing length is permitted. For joists up to 16-inch deep with end reaction values greater than 1,550 lbf, web stiffeners are required with the exception of NI-90x, which requires bearing stiffeners when end reaction values exceed 1,885 lbf. For 18-inch NI-60 and 18-inch NI-80x to 24-inch NI-80x with end reactions greater than 1,850 lbf, web stiffeners are required.

(h) Coefficient of shear deflection (K). For calculating uniform load and center-point load deflections of the I-joist in a simple-span application, use Equations 1 and 2.

Uniform Load: $$\delta = \frac{5\omega\ell^4}{384EI} + \frac{\omega\ell^2}{K} \quad [1]$$

Center-Point Load: $$\delta = \frac{P\ell^3}{48EI} + \frac{2P\ell}{K} \quad [2]$$

Where:
δ = calculated deflection (in.)
ω = uniform load (lbf/in.)
P = concentrated load (lbf)
ℓ = design span (in.)
EI = bending stiffness of the I-joist (lbf-in.^{2})
K = coefficient of shear deflection (lbf)

Table 2. Minimum Dimensions for Web Stiffeners [a]

Joist Series	Web Stiffeners		Flange width (in.)
	Thickness (in.)	Width (in.)	
NI-20	1	2-5/16	2-1/2
NI-40	1	2-5/16	2-1/2
NI-40x	1	2-5/16	2-1/2
NI-60	1	2-5/16	2-1/2
NI-70	1-1/2	2-5/16	3-1/2
NI-80	1-1/2	2-5/16	3-1/2
NI-80x	1-1/2	2-5/16	3-1/2
NI-90x	1-1/2	2-5/16	3-1/2

(a) Web stiffener length is 1/8 to 1/4 inch less than the clear distance between flanges. Stiffeners 1-inch thick are wood structural panels and stiffeners 1-1/2-inch thick are SPF lumber (specific gravity of 0.42) or denser lumber.

7. Identification:
The Nordic Joist described in this report is identified by a label bearing the manufacturer's name (Nordic Engineered Wood) and/or trademark, the APA assigned plant number (1052), the I-joist depth and series, the APA logo, the report number PR-L274, and a means of identifying the date of manufacture.

Table 1. Design Properties (Allowable Stress Design) for Nordic Joist™ [a,b]

Joist Depth (in.)	Joist Series	EI[c] (10^6 lbf-in.^{2})	M[d] (lbf-ft)	V[e] (lbf)	IR[f] (lbf)				ER[g] (lbf)				K[h] (10^6 lbf)
					3-1/2 (in.)		5-1/2 (in.)		1-3/4 (in.)		3-1/2 (in.)		
					w/o WS	w/ WS	w/o WS	w/ WS	w/o WS	w/ WS	w/o WS	w/ WS	
7-7/8	NI-40x	138	2,310	880	1,890	NA	NA	NA	880	NA	NA	NA	4.10
	NI-60	147	3,030	880	1,890	NA	NA	NA	880	NA	NA	NA	4.10
	NI-80	204	4,285	880	1,890	NA	NA	NA	880	NA	NA	NA	4.10
9-1/4	NI-20	138	2,510	1,080	1,700	NA	NA	NA	900	NA	NA	NA	4.81
	NI-40x	198	2,810	1,170	2,240	NA	NA	NA	1,120	NA	NA	NA	4.81
	NI-60	217	3,680	1,170	2,240	NA	NA	NA	1,120	NA	NA	NA	4.81
	NI-80	304	5,215	1,170	2,240	NA	NA	NA	1,120	NA	NA	NA	4.81
9-1/2	NI-20	145	2,590	1,120	1,700	NA	NA	NA	900	NA	NA	NA	4.94
	NI-40	193	2,735	1,120	2,160	NA	NA	NA	1,080	NA	NA	NA	4.94
	NI-40x	218	2,900	1,200	2,240	2,620	NA	NA	1,120	NA	NA	NA	4.94
	NI-60	231	3,810	1,200	2,240	2,620	NA	NA	1,120	NA	NA	NA	4.94
	NI-70	304	5,120	1,200	2,240	2,620	NA	NA	1,120	NA	NA	NA	4.94
	NI-80	324	5,385	1,200	2,380	2,790	NA	NA	1,190	NA	NA	NA	4.94
11-1/4	NI-20	222	3,155	1,340	1,800	NA	NA	NA	900	NA	NA	NA	5.85
	NI-40x	313	3,535	1,410	2,750	NA	NA	NA	1,250	NA	NA	NA	5.85
	NI-60	347	4,630	1,410	2,750	NA	NA	NA	1,250	NA	NA	NA	5.85
	NI-80	484	6,560	1,410	2,750	NA	NA	NA	1,330	NA	NA	NA	5.85
11-7/8	NI-20	253	3,355	1,420	1,800	NA	NA	NA	900	NA	NA	NA	6.18
	NI-40	330	3,545	1,420	2,500	NA	NA	NA	1,200	NA	NA	NA	6.18
	NI-40x	371	3,760	1,480	2,750	2,930	NA	NA	1,250	NA	NA	NA	6.18
	NI-60	396	4,935	1,480	2,750	2,930	NA	NA	1,250	NA	NA	NA	6.18
	NI-70	515	6,635	1,480	2,750	2,930	NA	NA	1,250	NA	NA	NA	6.18
	NI-80	547	6,980	1,480	2,900	3,120	NA	NA	1,330	NA	NA	NA	6.18
	NI-90x	615	9,465	2,055	4,170	NA	NA	NA	1,765	NA	NA	NA	6.18
14	NI-40	482	4,270	1,710	2,500	NA	NA	NA	1,200	NA	NA	NA	7.28
	NI-40x	540	4,530	1,730	2,750	3,240	NA	NA	1,250	NA	NA	NA	7.28
	NI-60	584	5,945	1,730	2,750	3,240	NA	NA	1,250	NA	NA	NA	7.28
	NI-70	749	7,990	1,730	2,750	3,240	NA	NA	1,250	NA	NA	NA	7.28
	NI-80	802	8,405	1,730	3,310	3,840	NA	NA	1,330	NA	NA	NA	7.28
	NI-90x	910	11,415	2,210	4,170	NA	NA	NA	1,765	NA	NA	NA	7.28
16	NI-40	657	4,950	1,970	2,500	NA	NA	NA	1,200	NA	NA	NA	8.32
	NI-40x	734	5,250	1,970	2,750	3,240	NA	NA	1,250	NA	NA	NA	8.32
	NI-60	799	6,895	1,970	2,750	3,240	NA	NA	1,250	NA	NA	NA	8.32
	NI-70	1,015	9,265	1,970	2,750	3,240	NA	NA	1,250	NA	NA	NA	8.32
	NI-80	1,092	9,745	1,970	3,310	3,840	NA	NA	1,330	NA	NA	NA	8.32
	NI-90x	1,245	13,100	2,325	4,170	NA	NA	NA	1,765	NA	NA	NA	8.32
18	NI-60	1,019	7,800	2,000	2,800	3,500	3,150	4,100	1,300	1,700	1,520	1,860	9.36
	NI-80x	1,399	10,990	2,360	3,100	3,700	3,250	4,250	1,300	1,900	1,520	2,150	9.36
20	NI-80x	1,771	12,315	2,450	3,100	3,700	3,250	4,250	1,300	2,010	1,520	2,250	10.40
22	NI-80x	2,191	13,645	2,530	3,100	3,700	3,250	4,250	1,300	2,130	1,520	2,350	11.44
24	NI-80x	2,660	14,975	2,600	3,100	3,700	3,250	4,250	1,300	2,250	1,520	2,440	12.48

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 lbf-ft = 1.356 N-m, 1 lbf-in^2 = 0.000287 N-m^2

7/

APA PRODUCT REPORT®

www.apawood.org

Nordic Joist™
Nordic Engineered Wood

PR-L274
Revised May 2, 2011

Products: NI-20, 40, 40x, 60, 70, 80, 80x, and 90x Prefabricated Wood I-Joists

Nordic Engineered Wood,
1100 Avenue des Canadiens-de-Montréal, Suite 504
Montreal, Québec, Canada H3B 2S2
(514) 871-8526
www.nordicewp.com

1. Basis of the product report:
   - 2009 and 2006 International Building Code (IBC): Sections 104.11 Alternative Materials and 2303.1.2 Prefabricated wood I-joists
   - 2009 and 2006 International Residential Code (IRC): Sections R104.11 Alternative Materials and R502.1.4 Prefabricated wood I-joists
   - ASTM D 5055-05 recognized by the 2009 IBC and IRC, and ASTM D 5055-04 recognized by the 2006 IBC and IRC
   - APA Reports T2004P-3, T2004P-21, T2004P-74, T2004P-76, T2005P-30, T2005P-31, T2006P-12, T2006P-13, T2007P-14A, T2007P-76, T2007P-79A, T2007P-81, T2007P-91, T2008P-17, T2010P-20 and other qualification data

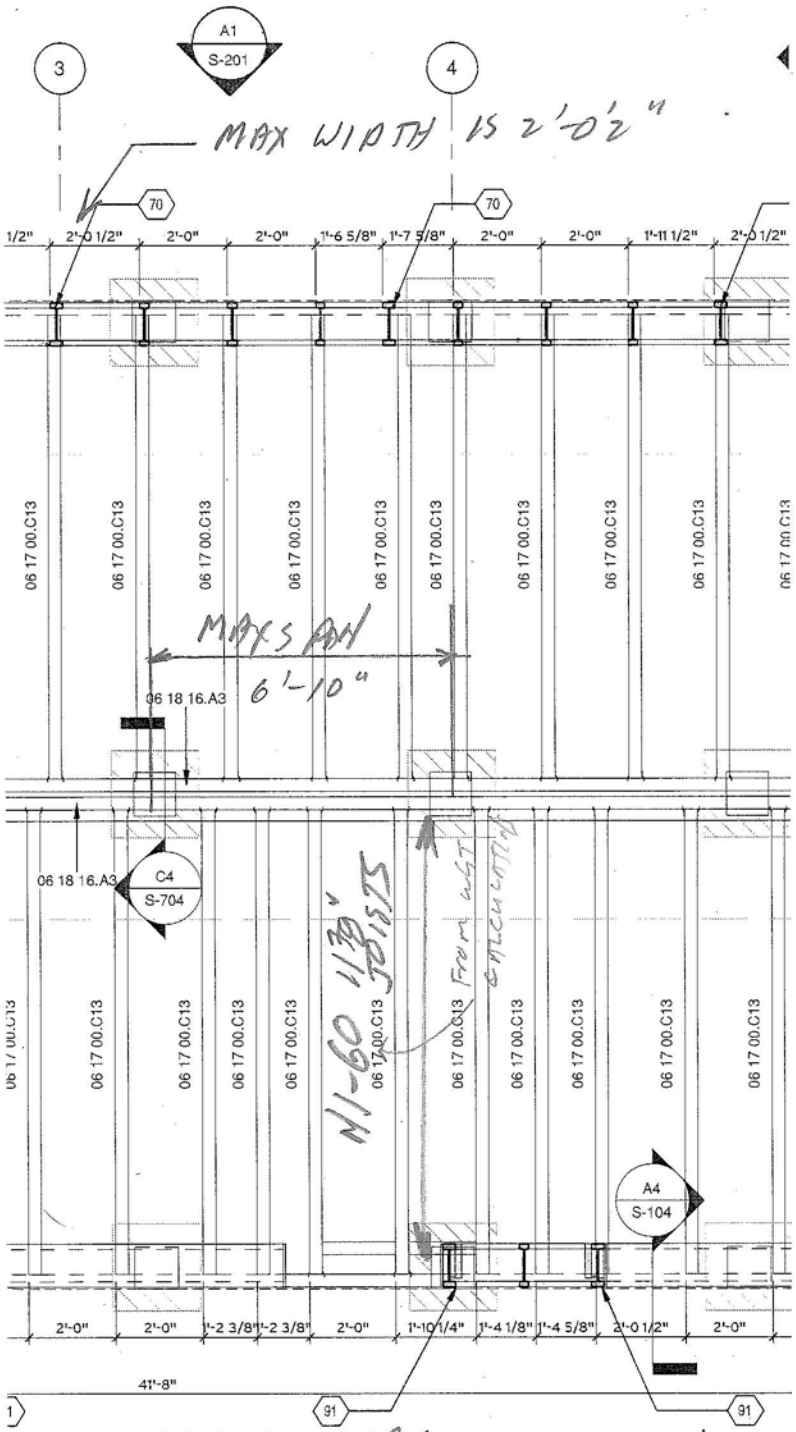
2. Product description:
   Nordic Joist™ is made with lumber flanges and OSB webs in accordance with the in-plant manufacturing standard approved by APA.

3. Design properties:
   Table 1 lists the design properties for Nordic Joist. The allowable spans shall be in accordance with the recommendations provided by the manufacturer (www.nordicewp.com/literature/residential-united-states/).

4. Product installation:
   Nordic Joist shall be installed in accordance with the recommendations provided by the manufacturer (see link above). Permissible web holes, web stiffeners and cantilever reinforcements shall be in accordance with the recommendations provided by the manufacturer.

5. Fire-rated assemblies:
   Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer (see link above), and with APA Design/Construction Guide: Fire-Rated Systems, Form W305 (www.apawood.org/publications).

6. Limitations:
   a) Nordic Joist shall be designed in accordance with the code using the design properties specified in this report.
   b) Nordic Joist is limited to dry service conditions where the average equilibrium moisture content of sawn lumber is less than 16 percent.
   c) Nordic Joist is produced at the Nordic Engineered Wood, Chibougamau, Québec facilities under a quality assurance program audited by APA.
   d) This report is subject to re-examination in one year.



CHECK JOIST STRESS

SAY TRIBUTARY WIDTH IS 2'-0"

DESIGN LIVE = 100 psf

DEAD LOAD = 15 psf

D + L = 115 psf

$w = \frac{115(2'-0")}{1000} = 0.230^{k}$

$M = \frac{0.230^{k}/_{'}(10'-7")^2}{8}$

$= 3,22^{k.'}$

ASD OF N1-60 1 1/2" JO

$M_a = 4.94^{k.'} > M = 3,22^{k}$

∴ JOIST STRESS OK

CHECK DEFLECTION

$\Delta = \frac{5wl^4}{384EI} + \frac{wl^2}{k}$

$w = \frac{100}{115}(0.230^{k}/_{'})(1/12'_{'})$

$= 0,0167^{k}/_{''} \times 1000^{\#}/_{k} =$

From TABLE

$EI = 396 \times 10^6 \ \#/_{''^2}$

$K = 6.18 \times 10^6 \ \#$

$\Delta = \frac{5(16.7^{k}/_{''})(10'-7" \times 12''/_{'})^4}{384(396 \times 10^6)}$

$+ \frac{16.7(10'-7" \times 12''/_{'})^2}{6.18 \times 10^6}$

$= 0.183" <$

CHECK JOIST SHEAR

$R = 0.230^{k}/_{'}(10'-7")/0.5) = 1.22^{k}$

$V_a = 1.40^{k} > R = V = 1.22^{k}$

∴ SHEAR OK

LeMessurier Consultants Structural Engineers	By PCG	Date 6/30/11	File No. 31079	Sheet No. 51
	Subject			

NORTH - SOUTH WIND SHEAR

1ST SIDE $L_i = 22'-0" - (15'+5'-4") = 12.33'$

% FULL HEIGHT $\frac{12.33}{22'-0"} = 54\%$ $C_0 = 0.67$

$V_{WIND} = \frac{0.67(290)(12.33)(x\ 2510\ lb)}{1000\ \#/k} = 9.63^k > V = 4.46^k$

UPLIFT, $R = \frac{4.46^k (7'-7")}{12.33'} = 2.74^k$

2ND SIDE $L_i = 22'-0" - (3'-11" + 3'-6") = 15.25'$

% FULL HEIGHT $\frac{15.25}{22'-0"} = 67\%$ $C_0 = 0.63$

$V_{WIND} = \frac{0.63(290)(15.25)(x\ 2510\ lb)}{1000\ \#/k} = 5.38^k >$
$V = 4.46$

UPLIFT, $R = \frac{4.46^k (7'-7")}{15.25'} = 2.22^k$

LeMessurier Consultants Structural Engineers	By PLG	Date 6/20/11	File No. 31079	Sheet No. 41
	Subject			

CHECK LATERAL SHEAR ON WALL PANEL

$V_{EAST-WEST\ SHEAR\ (TO\ 1\ LONG\ WALL)} = 5.39^k$

$V_{NORTH-SOUTH\ SHEAR\ (TO\ EACH\ WALL)} = 4.46^k$

EAST-WEST WALL SHEAR

$V_{WALL} = (VC_o)\Sigma L_i$

$L_i = 41'-8" - 3(4'-0") = 29.67'$

$\%\ FULL\ HEIGHT = \frac{29.67}{41.67} = 0.71 \quad 71\% \quad C_o = 1.00$

$V_{5/8"\ SHEATHING} = 280\ PLF \leftarrow$ IBC TABLE FOR $15/32$

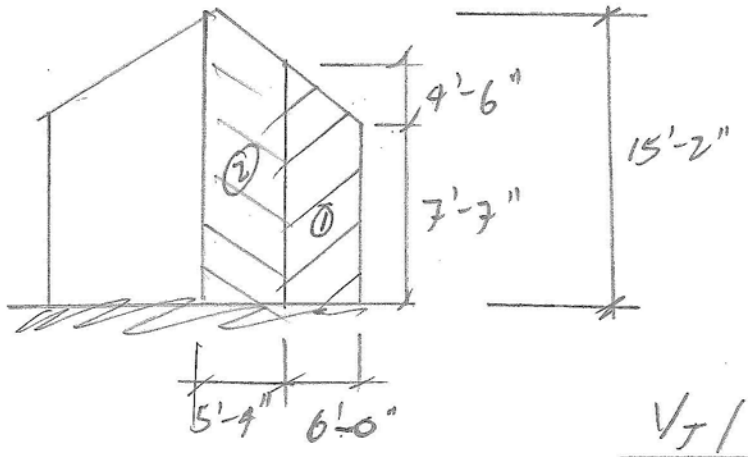
$V_{WALL} = \frac{1.0(280\ PLF)(29.67')}{1000\#/_1} \times 2\ SIDES$ ← WALL SYMMETRICAL $= 16.6^k > V = 5.39^k$

∴ SHEAR OK.

$UPLIFT\ R = \frac{5.39^k(7'-7")}{29.67'} = 1.39^k$

LeMessurier Consultants Structural Engineers	By MCG	Date 6/20/11	File No. 31079	Sheet No. 31
	Subject			

EAST-WEST



$F_{①} = \frac{19.6(12.1')(6')}{1000}$

$= 1.42^{k}$

$F_{②} = \frac{15.7(15.2')(5.33)}{1000}$

$= 1.27^{k}$

V_T (ALL TO 1 SIDE)

$V_T = 2(1.42^{k}) + 2(1.27^{k}) = 5.38^{k}$

CHECK SLIDING

USE 0.6 DEAD

TOTAL DEAD

$P_{ROOF} = \frac{15\ psf\ (1.41)(22'-8")(41'-5")}{1000} = 19.9^{k}$

$D_{FLOOR} = \frac{15\ psf\ (22'8")(41'-5")}{1000} = 14.1^{k}$

$D_{EXT\ WALLS} = \frac{15\ psf\ [(22'8)(2) + 41'-5"/2)](7'-7")}{1000} = 19.6^{k}$

$D_T = 98.6^{k}$

$14.5^{k} = \frac{0.6(D) = 29.2^{k}}{F_S = 2} > V_W = 5.38^{k}$

∴ SLIDING OKAY

CHECK TYPICAL ROOF RAFTER DEFLECTION

$$S = 50\,psf\left(\frac{11'}{13.4'}\right) = 41\,psf$$

$$W_S = 41\,psf\,(2') = 82\,\#/'$$

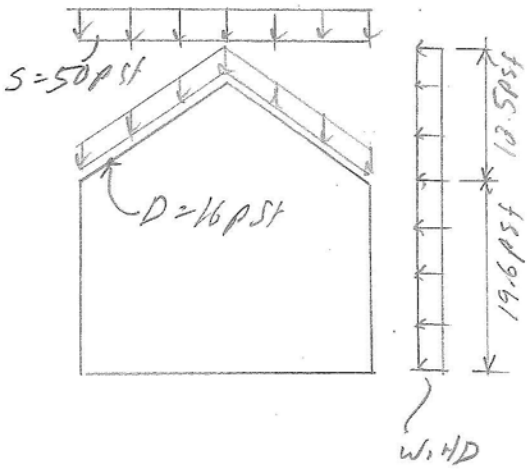
FROM TABLE $EI = 482 \times 10^6\ \#/in^2$

$$\Delta_S = \frac{5(82\,\#/')(1'/12'')(13.4' \times 12'')^4}{384(482\times10^6)} = 0.123'' \left(\frac{L}{1307}\right) \therefore \Delta_S \text{ o.k.}$$

ADD WIND TO ROOF RAFTER

USE $D + 0.75W + 0.75S$

USE CORNER RAFTER



$$TL = 16 + 0.75(13.5)\left(\frac{7.6'}{13.4'}\right) + 0.75(50)\left(\frac{11'}{13.4'}\right)$$

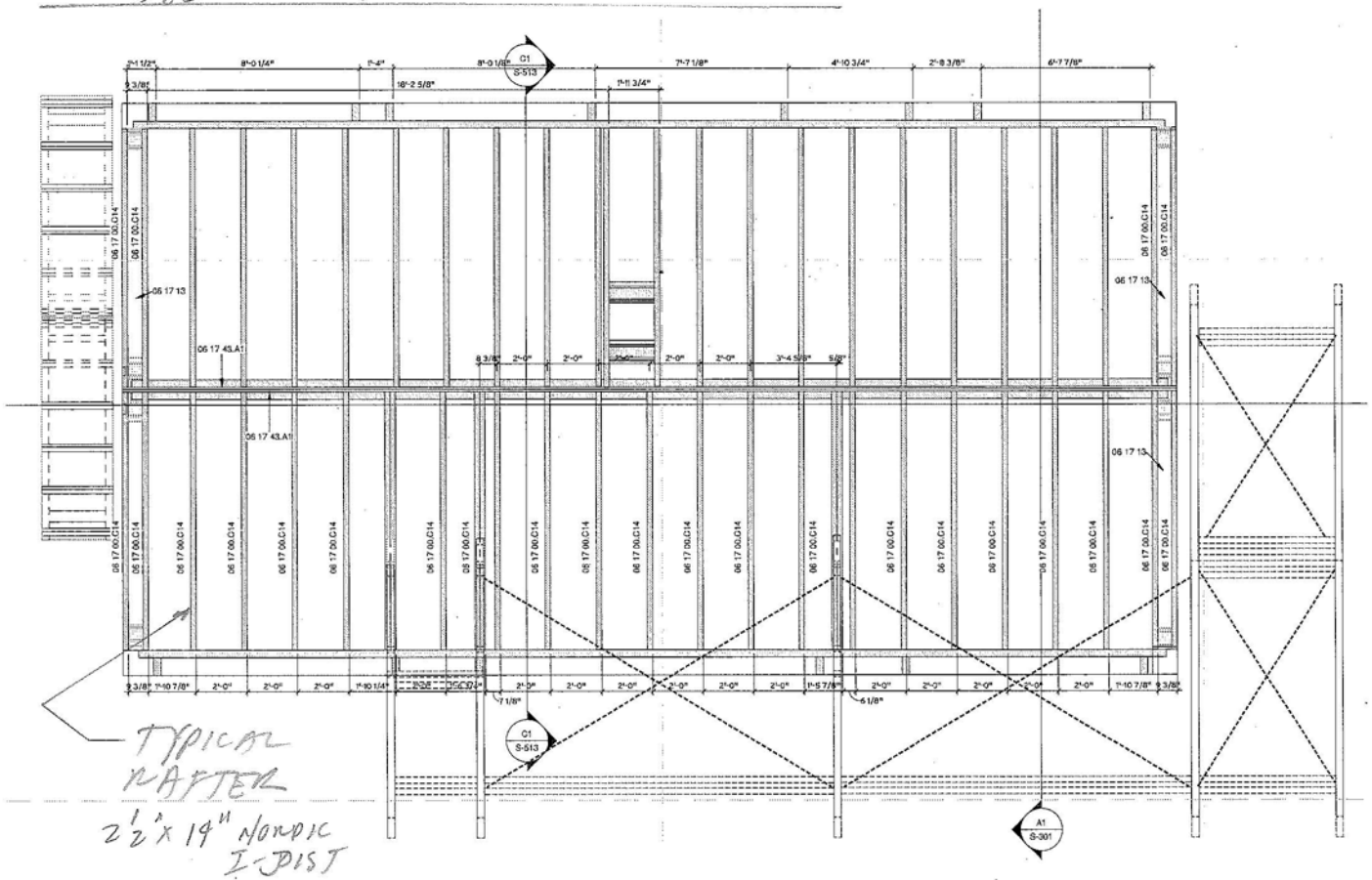
$$= 16 + 5.7 + 30.8$$

$$= 52.5 \quad \text{SAY } 53\,psf$$

BY INSPECTION 53psf < 57 psf FROM GRAVITY ANALYSIS.

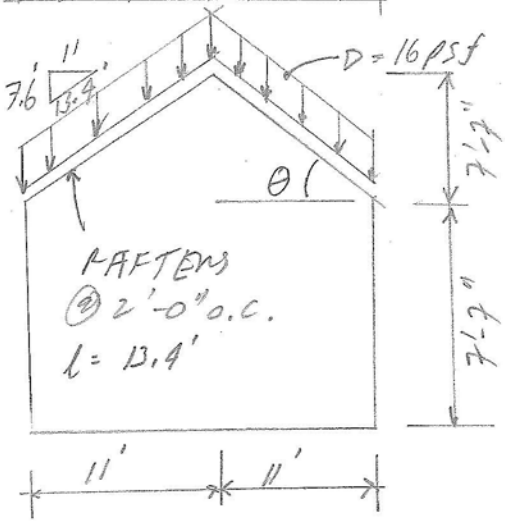
∴ CORNER RAFTER WITH GRAVITY AND WIND O.K.

CHECK ROOF FRAMING



ROOF FRAMING PLAN

N.T.S.



$TL = D + S$

$= 16 + 50\left(\frac{11'}{13.4'}\right)$

$= 57 psf$

$w = 57 psf (2') = 114 \#/'$

$V = \frac{wl}{2} = \frac{114(13.4')}{2} = 764\#$

$M = \frac{wl^2}{8} = \frac{0.114^{k}/'(13.4')^2}{8} = 2.56^{k\cdot'}$

From submitted wsT calculations, joist = NI-90x 14" joist

$M_a = 4.27^{k\cdot'} > M = 2.56^{k\cdot'}$ ∴ ok

$V_a = 1.71^{k} > V = 0.764^{k}$ ∴ ok

APA – The Engineered Wood Association is an accredited certification body under ISO 65 by Standards Council of Canada (SCC) and an accredited inspection agency by the International Code Council (ICC) International Accreditation Service (IAS) under ISO/IEC 17020. APA is also an accredited testing organization recognized by IAS and SCC under ISO/IEC 17025. APA is a recognized testing laboratory by Miami-Dade County, and a Product Testing Laboratory, Product Quality Assurance Entity, and Product Validation Entity by the Florida Department of Community Affairs (DCA).

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DISCLAIMER

Table 3. Design Values Nordic Lam™ Columns for Normal Duration of Load[1]

Combination Symbol	Species[2]	Grade	All Loading			Axially Loaded			Bending about Y-Y Axis				Bending about X-X Axis	
			Modulus of Elasticity[3]		Compression Perpendicular to Grain	Tension Parallel to Grain	Compression Parallel to Grain		Loaded Parallel to Wide Faces of Laminations				Loaded Perpendicular to Wide Faces of Laminations	
									Bending[4]			Shear Parallel to Grain[5,6]	Bending[7]	Shear Parallel to Grain[5]
						2 or More Lams	4 or More Lams	2 or 3 Lams	4 or More Lams	3 Lams	2 Lams		2 Lams to 15 in. Deep	
			E (10^6 psi)	E_{min} (10^6 psi)	$F_{c\perp}$ (psi)	F_t (psi)	F_c (psi)	F_c (psi)	F_{by} (psi)	F_{by} (psi)	F_{by} (psi)	F_{vy} (psi)	F_{bx} (psi)	F_{vx} (psi)
ES 11	ES	C4	1.5	0.79	450	975	1,550	1,350	1,750	1,600	1,400	175	1,350[8]	250
ES 11/NPG	ES	NPG	1.5	0.79	450	975	1,550	1,350	1,750	1,600	1,400	175	1,350	250
ES 12	ES	1.9E6	1.8	0.95	560	1,600	2,300	1,700	2,400	2,400	2,300	175	1,950[8]	250
ES 12/NPG	ES	NPG	1.8	0.95	560	1,600	2,300	1,700	2,400	2,400	2,300	250	2,400	250
Wet-use factors			0.833		0.53	0.8	0.73		0.8			0.875	0.8	0.875

(1) The tabulated design values are for normal duration of loading. For other durations of loading, see applicable building code. The tabulated design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the factors shown at the bottom of the table.

(2) ES = Eastern spruce.

(3) The tabulated E values already include a 5% shear deflection (also known as "apparent E"). The axial modulus of elasticity (E_{axial} and $E_{axial\ min}$) shall be permitted to be calculated by multiplying the tabulated E and E_{min} by 1.05.

(4) The values of F_{by} are based on members 12 inches in depth. For depths less than 12 inches, F_{by} shall be permitted to be increased by multiplying by the size factor, $(12/d)^{1/9}$, where d is the beam depth in inches. When d is less than 3 inches, use the size adjustment factor for 3 inches.

(5) For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the tabulated F_{vx} and F_{vy} values shall be multiplied by 0.72.

(6) The tabulated F_{vy} values are for members of 4 or more lams. The tabulated F_{vy} values shall be multiplied by a factor of 0.95 for 3 lams and 0.84 for 2 lams.

(7) The values of F_{bx} are based on members 5-1/8 inches in width by 12 inches in depth by 21 feet in length. For members with a larger volume, F_{bx} shall be multiplied by a volume factor, C_v, determined in accordance with applicable building code using 1/10 as the exponent.

(8) When the member depth is greater than 15 inches, the tabulated F_{bx} values shall be multiplied by a factor of 0.88.

Table 2. Design Values for Nordic Lam™ Beams for Normal Duration of Load[1]

Symbol	Species[2] Outer/ Core	Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)							Bending About Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)					Axially Loaded		Fasteners	
		Extreme Fiber in Bending[3]		Compression Perpendicular to Grain		Shear Parallel to Grain[4]	Modulus of Elasticity[5]		Extreme Fiber in Bending[6]	Compr. Perpen-dicular to Grain	Shear Parallel to Grain[4]	Modulus of Elasticity[5]		Tension Parallel to Grain	Compr. Parallel to Grain	Specific Gravity for Dowel-Type Fastener Design	
		Bottom of Beam Stressed in Tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Tension Face	Compr. Face											Top or Bottom Face	Side Face
		F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	F_{cLx} (psi)		F_{vx} (psi)	E_x (10^6 psi)	$E_{x\,min}$ (10^6 psi)	F_{by} (psi)	F_{cLy} (psi)	F_{vy} (psi)	E_y (10^6 psi)	$E_{y\,min}$ (10^6 psi)	F_t (psi)	F_c (psi)	SG	
20F-E8M1	ES/ES	2,000	2,000	450	450	250	1.5	0.79	1050	315	175	1.4	0.74	800	1,000	0.41	0.41
20F-ES/CPG	ES/ES	2,000	2,000	450	450	250	1.8	0.95	2,000	450	250	1.8	0.95	800	1,000	0.41	0.41
24F-E/ES1M1	ES/ES	2,400	2,400	560	560	250	1.8	0.95	1,100	300	175	1.5	0.79	1,050	1,150	0.41	0.41
24F-ES/NPG	ES/ES	2,400	2,400	560	560	250	1.8	0.95	2,400	560	250	1.8	0.95	1,600	2,300	0.46	0.46
Wet-use factor		0.8		0.53		0.875	0.833		0.8	0.53	0.875	0.833		0.8	0.73	see NDS	

(1) The tabulated design values are for normal duration of loading. For other durations of loading, see the applicable building code. The tabulated design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the wet-use factors shown at the bottom of the table.

(2) ES = Eastern spruce.

(3) The values of F_{bx} are based on members 5-1/8 inches in width by 12 inches in depth by 21 feet in length. For members with a larger volume, F_{bx} shall be multiplied by a volume factor, C_v, determined in accordance with applicable building code using 1/10 as the exponent.

(4) For non-prismatic members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the F_{vx} and F_{vy} values shall be multiplied by a factor of 0.72.

(5) The tabulated E values already include a 5% shear deflection (also known as "apparent E"). The axial modulus of elasticity, E_{axial} and $E_{axial\,min}$, shall be calculated by multiplying E_y and E_{ymin} by 1.05.

(6) The values of F_{by} are based on members 12 inches in depth. For depths less than 12 inches, F_{by} shall be permitted to be increased by multiplying by the size factor, $(12/d)^{1/9}$, where d is the beam depth in inches. When d is less than 3 inches, use the size adjustment factor for 3 inches.

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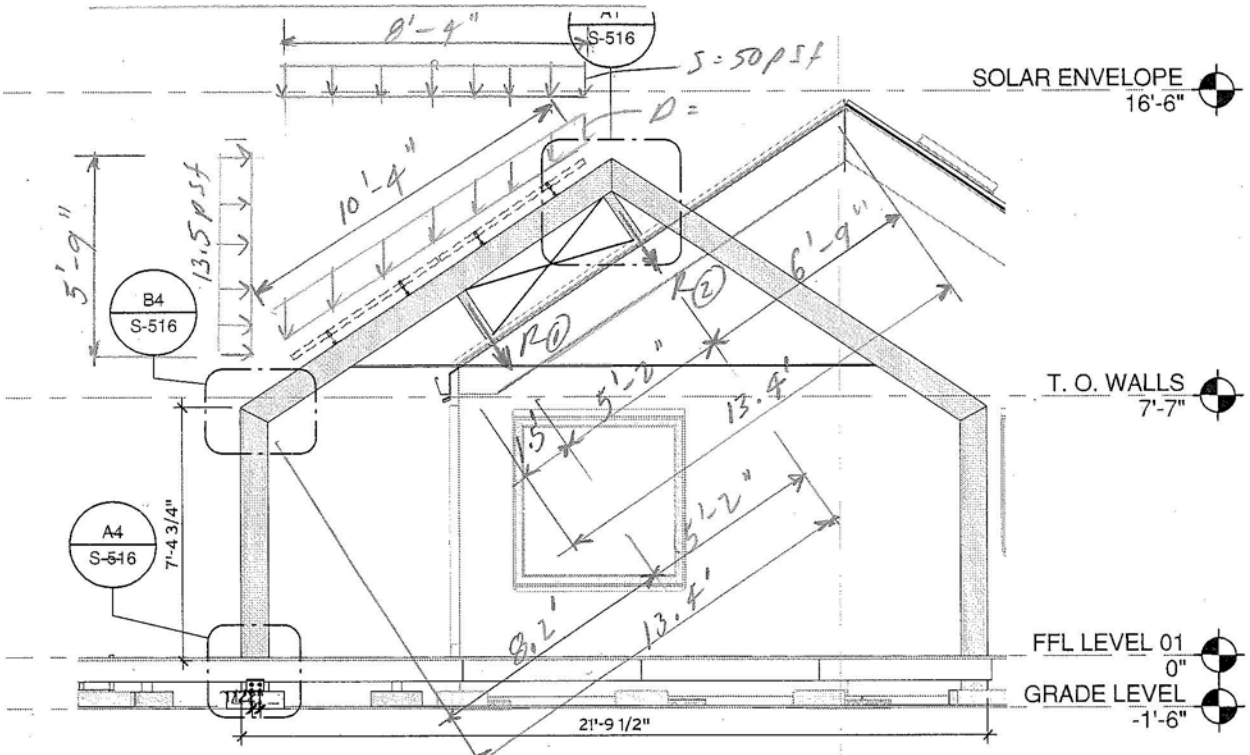
CHECK ROOF RAFTER
W/ TRELLIS LOAD



D4 SOUTH TRELLIS EAST ELEVATION
1/4" = 1'-0"
0 2' 4' 8'

ASSUME PANEL FULL OF WATER

$SAY\left(\frac{13\frac{3}{4}"}{12"}\right)62.4\frac{\#}{ft^3} = 9.1$ SAY 10 psf

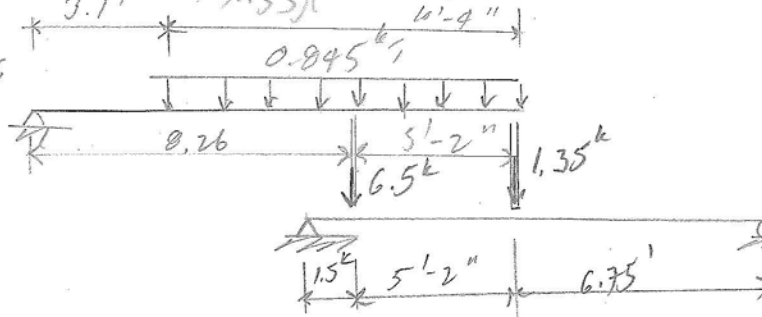
USE 20 psf TO INCLUDE FRAMING

$TL = 20psf + \left(\frac{8.33'}{10.33'}\right)50psf = 60\,psf \leftarrow$ controls

OR

$TL: 20psf + 0.75\left(\frac{8.33'}{10.33'}\right)50psf + 0.75\left(\frac{5.75}{10.33}\right)(13.5psf) = 56\,psf$ (5.6)

$W = \frac{60\,psf\,(14'-1")}{1000} = 0.845^{k}/_{'}$



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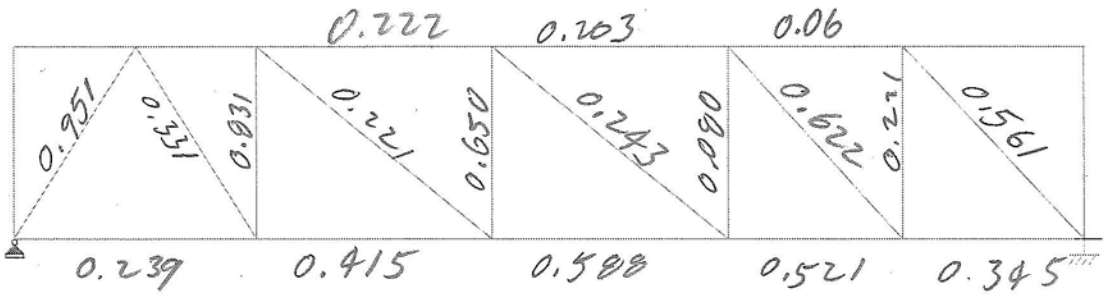
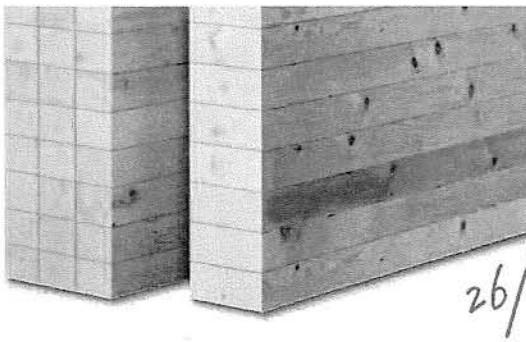
OVERSTRESS RATIOS



NOTE

1. THERE SOME ALL TRUSS MEMBERS OKAY FOR STRESS

Load 3



DESIGN VALUES
FOR NORDIC LAM™

DESIGN STRESSES [1][2]

NORDIC LAM		BEAMS
STRESS GRADE		24F-1.9E
EWS LAYUP COMBINATION		24F-E/ES1M1
Bending About X-X Axis *(Loaded Perpendicular to Wide Face of Laminations)*		
Extreme Fiber in Bending [3][4]	F_{bx}	2400 psi
Shear Parallel to Grain [5]	F_{vx}	250 psi
Compression Perpendicular to Grain	F_{cpx}	560 psi
Shear-Free Modulus of Elasticity	E_x	1.9×10^6 psi
Apparent Modulus of Elasticity [6]	$E_{x,\,app.}$	1.8×10^6 psi
Bending About Y-Y Axis *(Loaded Parallel to Wide Face of Laminations)*		
Extreme Fiber in Bending [7]	F_{by}	1100 psi
Shear Parallel to Grain [5]	F_{vy}	175 psi
Compression Perpendicular to Grain	F_{cpy}	300 psi
Shear-Free Modulus of Elasticity	E_y	1.6×10^6 psi
Apparent Modulus of Elasticity [6]	$E_{y,\,app.}$	1.5×10^6 psi
Axially Loaded		
Compression Parallel to Grain	F_c	1150 psi
Tension Parallel to Grain	F_t	1050 psi
Modulus of Elasticity	E_a	1.6×10^6 psi

(1) The tabulated design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the wet service factors, C_M (NDS-05, 5.3.3).

(2) The tabulated design values are for normal duration of loading. For other durations of loading, see applicable building code.

(3) Nordic Lam bending members are symmetrical throughout the depth of the member (balanced layups).

(4) The tabulated design values in bending (F_{bx}) shall be multiplied by a volume effect factor, C_v. The volume factor formula is: $C_v = (12/d)^{1/19} \times (5.125/b)^{1/10} \times (21/L)^{1/10} \leq 1.0$, where d = beam depth (in.), b = beam width (in.), and L = beam length (ft).

(5) For notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS-05 3.4.3.3), the design value for shear (F_v) shall be multiplied by a factor of 0.72.

(6) The tabulated "apparent E" values already include a 5% shear deflection.

(7) The values of F_{by} shall be permitted to be increased by multiplying by the size factor, $(12/d)^{1/9}$, where d is the beam depth in inches.

(8) Design of glulam members shall be in accordance to National Design Specification, 2005 Edition.

(9) The specific gravity for dowel-type fastener design is 0.41. Member weight shall be based on density of 35 pcf.

Refer to the *Nordic Lam Design/Construction Guide* for more information.

NORDIC ENGINEERED WOOD

Nordic Sustainable Wood Solutions

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info@nordicewp.com • www.nordicewp.com
T. 514.633.9661 • F. 514.633.0833

$F'_c = F_c C_m C_F C_D = 1150(0.8)(1.1)(1.0) = 1012$ psi

$f_c = \frac{P}{A} = \frac{13,300 \text{ lbf}}{(14")(3.5")} = 271$ psi $< F'_c = 1012$ psi

$\frac{f_c}{F'_c} = \frac{271}{1012} = 0.268 < 1.0$

ADD BENDING TERM

$M = 36,200$ lbf-in

$S = \frac{3.5(14)^2}{6} = 114.3 \text{ in}^3$

$f_b = \frac{36,200}{114.3} = 317$ psi

$F'_b = 0.8(1.1)(2400 \text{ psi}) = 2112$ psi

$\frac{f_b}{F'_b} = \frac{317}{2112} = 0.150$

OVERSTRESS RATIO

OVR $= 0.268^2 + 0.150 = 0.222 < 1.0$ ∴ TOP CHORD STRESS OKAY

CHECK TRUSS MEMBERS

TOP CHORD: AXIAL + BENDING

$F_c = 1150$ psi
$E_{MIN} = 1.6 \times 10^6$ psi
$C_D = 1.0$ $C_t = 1.0$ $C_i = 1.0$

$C_M = 0.80$ compression MEMBER
$= 0.90$ MODULUS OF ELASTICITY

$C_F = 1.1$ compression MEMBER

$k_e = 1.0$

$\frac{k_e l_1}{d_1} = \frac{1.0(8.67')(12''/')}{14''} = 7.43$ STRONG ← GOVERNS

$\frac{k_e l_2}{d_2} = \frac{1.0(2')(12''/')}{3\frac{1}{2}''} = 6.85$ WEAK

$E'_{min} = E_{min} C_M = 1.6 \times 10^6 (0.9) = 1.44 \times 10^6$ psi

$F_c^* = F_c C_M C_F = 1150 \text{ psi} (0.8)(1.1) = 1012$ psi

$F_{cE1} = \frac{0.822(1.44 \times 10^6 \text{ psi})}{(7.43)^2} = 21,442$ psi

$F' = \frac{F_{cE1}}{F_c^*} = \frac{21,442 \text{ psi}}{1012 \text{ psi}} = 21.2$

$c = 0.9$ STRUCTURAL LUM

$C_p = \frac{1+F'}{2c} - \sqrt{\left(\frac{1.0+F'}{2c}\right)^2 - \frac{F'}{c}} = \frac{1+21.2}{2(0.9)} + \sqrt{\left(\frac{1+21.2}{2(0.9)}\right)^2 - \frac{21.2}{2(0.9)}}$

$= 0.995$ USE $C_D = 1.0$

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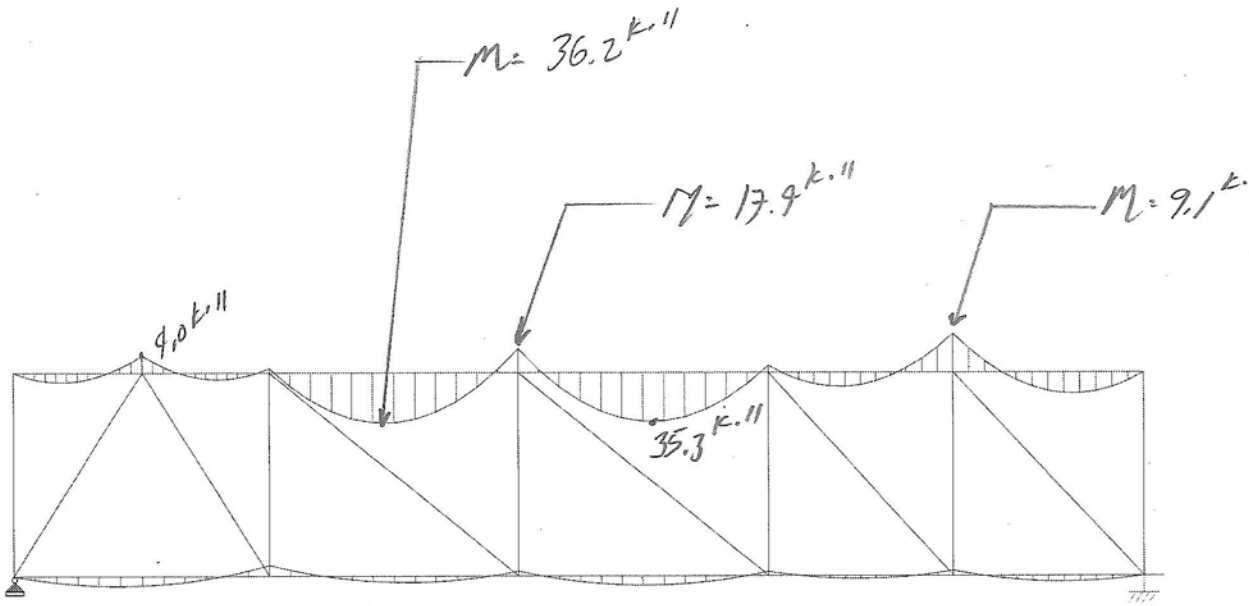
COMBINATION = DEAD + LIVE

BENDING MOMENT



X

Load 3 : **Bending Z**

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	Part		
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	By	Date 16-Dec-08	Chd
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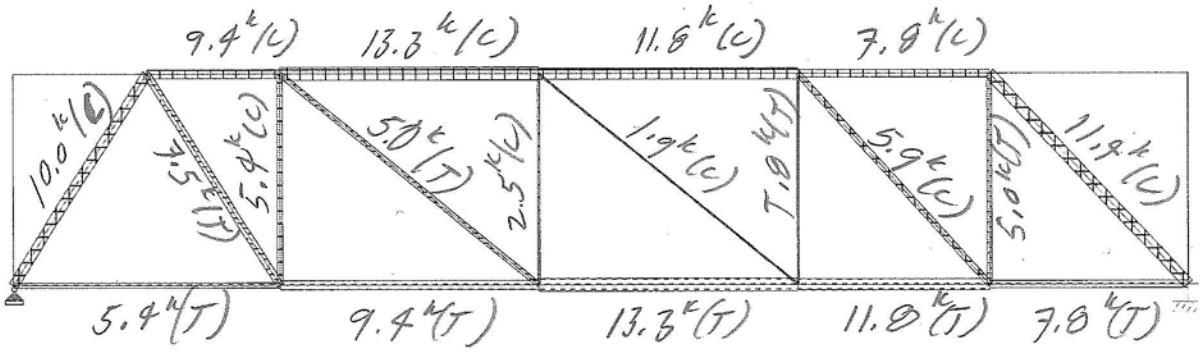
COMBINATION: DEAD + LIVE

AXIAL FORCES



MAX AXIAL

TOP CHORD (3½"x14"): 13.3k(C)

BOT CHORD (3½"x7"): 13.3k(T)

DIAGONAL/VERTICAL (3½"SQ): 10.0k(C)
7.5k(T)

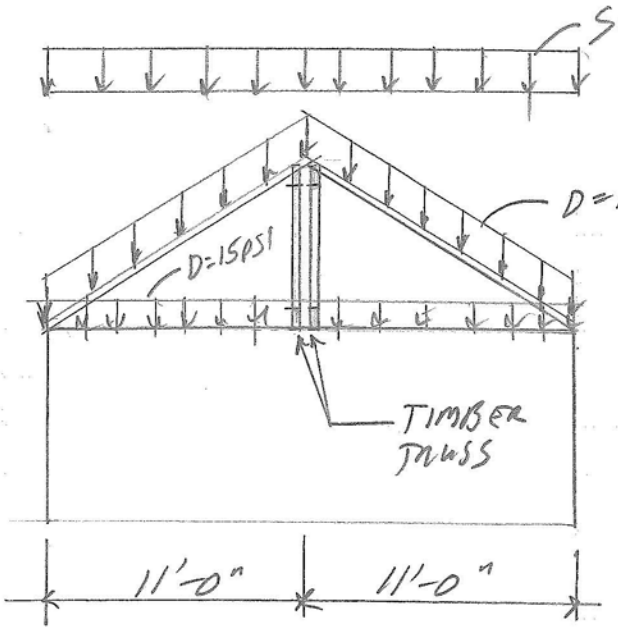
(3½"x7½"): 11.4k(C)

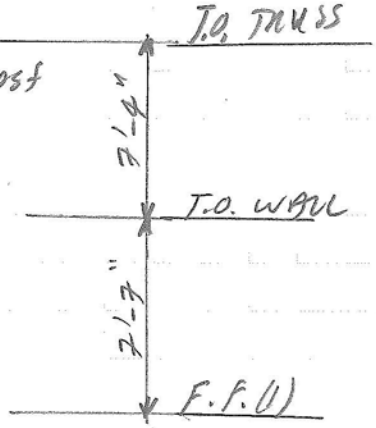
X

Load 3 : **Axial Force**

LeMessurier Consultants Structural Engineers	By TCG	Date	File No.	Sheet No. 21
	Subject			

RIDGE TRUSS ANALYSIS





TOP COND LOAD

CALCULATE RIDGE LOAD

$L_{RAFTER} = (7.33^2 + 11^2)^{0.5} = 13.2'$

$TL = 16\ psf\left(\frac{13.2'}{11'}\right) + 50\ psf = 69.2\ psf$

19.2 psf

$S/D = \frac{19.2}{69.2} = 0.280$

$R_{RAFTER} = \frac{69.2\ psf\ (11')}{2\ (1000)} = 0.381^{k}/_{'}$

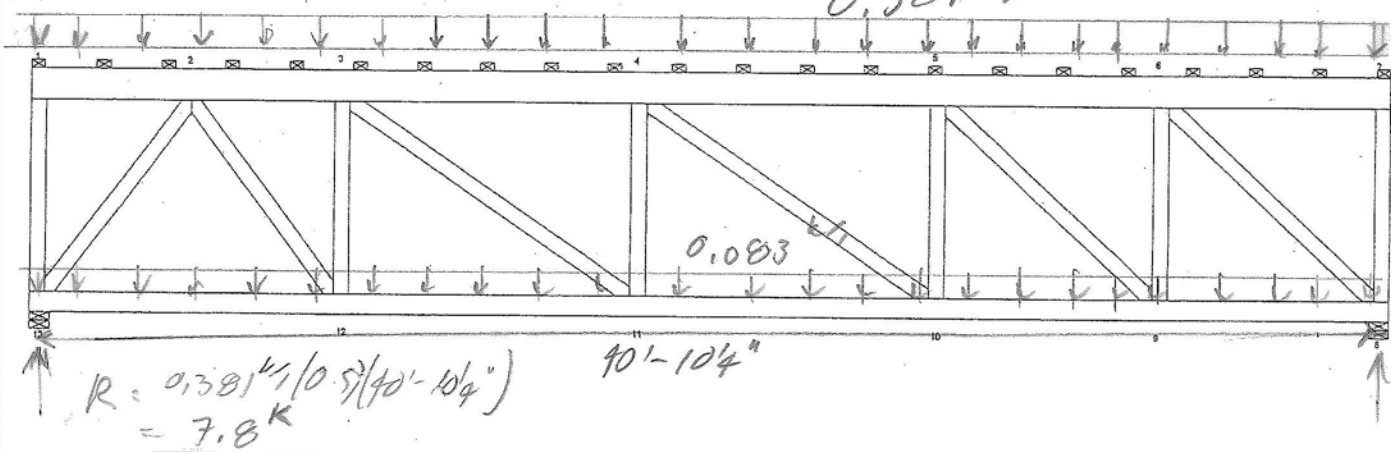
(2) TRUSS @

L: 0.273
D: 0.106

$0.381^{k}/_{'}$

BOT. COND LOAD

$\frac{11'(0.5)(15\ psf)}{1000} = 0.083^{k}/_{'}$



$R = 0.381^{k}/_{'}(0.5)(40'-10\frac{1}{4}")$

$= 7.8^{k}$

Job	Truss	Truss Type	Qty	Ply	Nordic Engineered Wood
1106-033 SOLAR DECATHLON	RG1	FLAT	1	1	20/

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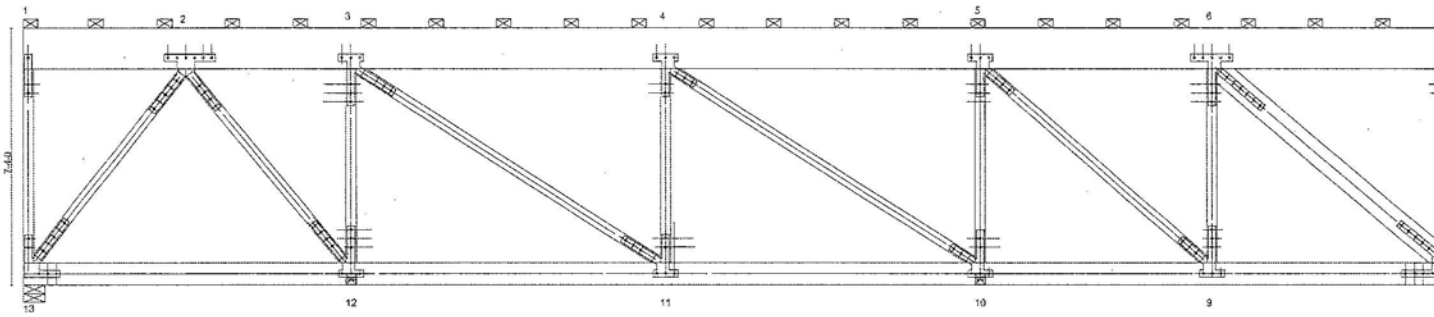
4-7-4	9-3-12	18-3-6	27-3-0	33-10-4	40-10-4
4-7-4	4-8-8	8-11-10	8-11-10	6-7-4	7-0-0



9-3-12	18-3-6	27-3-0	33-10-4	40-10-4
9-3-12	8-11-10	8-11-10	6-7-4	7-0-0

LOADING (psf)		SPACING	5-5-11	CSI		DEFL	in	(loc)	l/defl	L/d
TCLL	90.0	Bolt Increase	1.15	TC	0.48	Vert(LL)	-0.29	10-11	>999	240
TCDL	25.0	Lumber Increase	1.15	BC	0.97	Vert(TL)	-0.53	10-11	>915	180
BCLL	0.0	Rep Stress Incr	NO	WB	1.00	Horz(TL)	0.16	8	n/a	n/a
BCDL	10.0	Code IBC2009		(Matrix)						

Plates are 1/4" thick ASTM A 36 steel
Bolts are 3/4" full diameter with a bending yield strength of 45,000 psi

LUMBER
TOP CHORD Nordic 24F 3.5" x 14"
BOT CHORD Nordic 24F 3.5" x 7.5"
WEBS Nordic 24F 3.5" x 3.5" except
6-8: 2X4 Nordic 24F 3.5" x 7.5"

BRACING
TOP CHORD 2-0-0 oc purlins (6-0-0 max.), except end verticals

BOT CHORD Braces at joints 10 and 12
Attach 4x4 lateral brace with (2)
3/8" x 9" lag screws through truss
bottom chord and into end grain of 4x4 brace.

REACTIONS (lb/size) 13=13877/0-7-4 (min. 0-2-7), 8=13877/0-7-4 (min. 0-2-7)
Max Uplift13=-1862(LC 3), 8=-1862(LC 3)

FORCES (lb) - Maximum Compression/Maximum Tension
TOP CHORD 1-13=-1147/196, 1-2=-68/4, 2-3=-15435/2060, 3-4=-21869/2936, 4-5=-19458/2611, 5-6=-12814/1718, 6-7=-51/5, 7-8=-1671/291
BOT CHORD 12-13=-1195/8703, 11-12=-2060/15435, 10-11=-2936/21869, 9-10=-2611/19458, 8-9=-1718/12814
WEBS 2-13=-15182/2095, 3-12=-8674/1349, 3-11=-1079/7924, 5-10=-106/2157, 6-8=-17522/2352, 4-10=-2969/400, 6-9=-751/6854, 5-9=-9286/1248, 2-12=-1466/11416, 4-11=-4185/783

NOTES
1) 3/4" bolts (ASTM A-307) shall be placed in maximum 13/16" and minimum 25/32" diameter holes. Holes shall be accurately aligned in main members and side plates.
Bolts shall not be forcibly driven. All bolts shall have a full nut with full thread contact.
Do not over tighten bolts. Tighten bolts to snug fit plus quater turn maximum.
2) This truss has been checked for uniform roof live load only, except as noted.
3) Wind: ASCE 7-05; 120mph; TCDL=6.0psf; BCDL=6.0psf; h=25ft; Cat. II; Exp C; enclosed; MWFRS (low-rise); Lumber DOL=1.60 plate grip DOL=1.60
4) Provide mechanical connection (by others) of truss to bearing plate capable of withstanding 1862 lb uplift at joint 13 and 1862 lb uplift at joint 8.
5) This truss is designed in accordance with the 2009 International Building Code.
6) 3/4" bolts shall be spaced at 3" c/c in a row.
End distance shall be 5.25" from center line of last bolt to end of member.
1/4" plate shall be a minimum of 2.5" wide. Plate end shall be 1.25" from center line of last bolt.
Center line of bolts in the top chord and bottom chord shall be 3.75 up from the bottom edge of the top and bottom chords. Center line of bolts in all webs and end verticals shall be center line of the members.
1/4" thick steel gusset plates are drawn to scale.

STATE OF MAINE
PHILLIP E. ROBBINS
LICENSED
PROFESSIONAL ENGINEER

7/20/11

19

Job	Truss	Truss Type	Qty	Ply	Nordic Engineered Wood
1106-033 SOLAR DECATHLON	RG1	FLAT	1	1	

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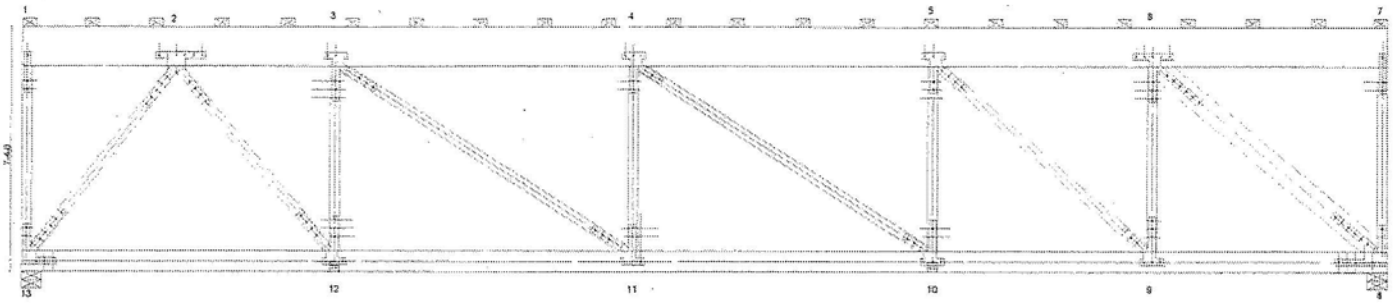

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COMMONWEALTH OF MASSACHUSETTS
CARL A. DEMETER
STRUCTURAL
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REGISTERED PROFESSIONAL ENGINEER

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11757 W. KEN CARYL AVE., UNIT F, #121
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303-972-6512

7-20-11

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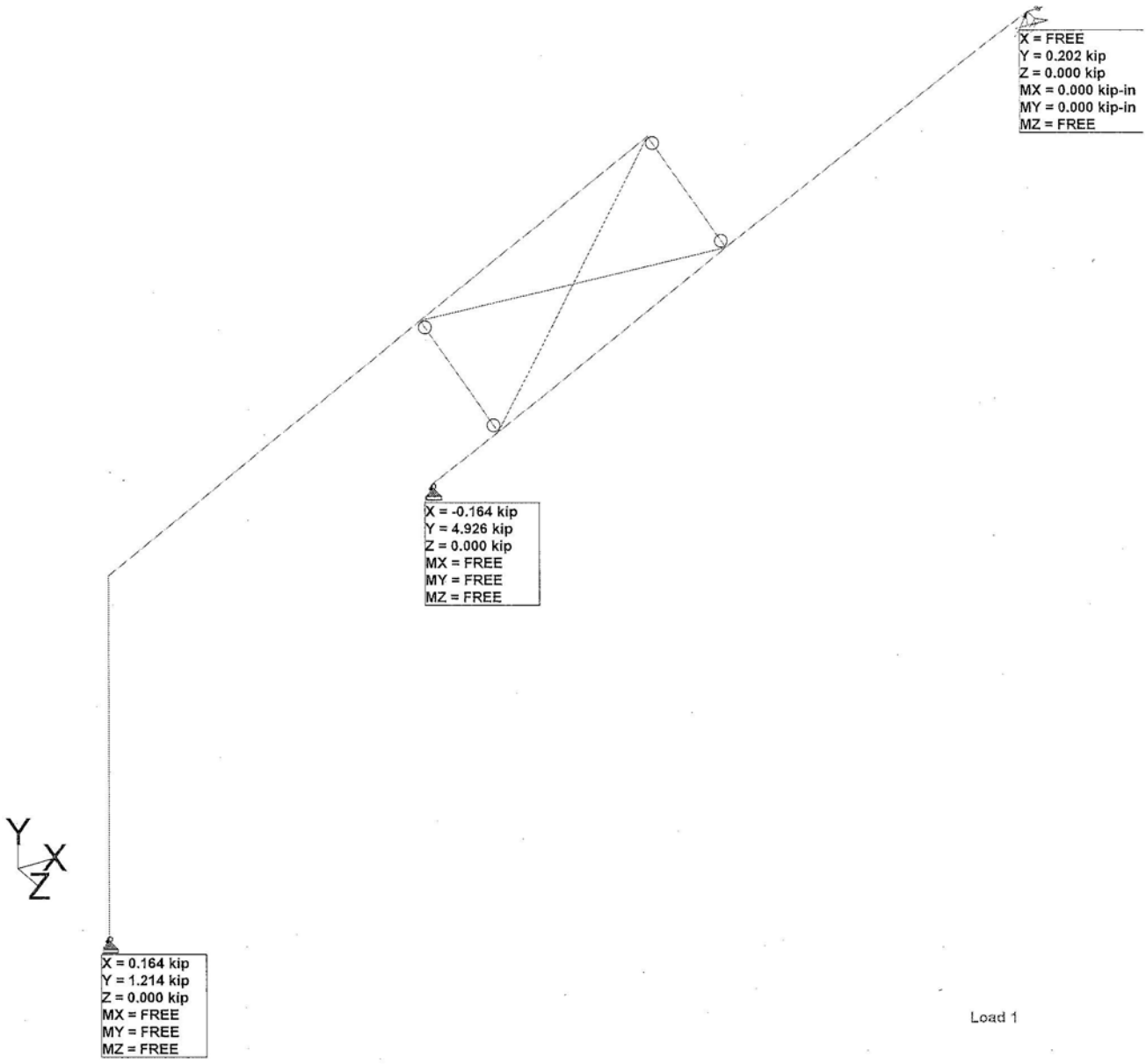

Load 1

Software licensed to	Job No	Sheet No 1	Rev 3/
	Part		
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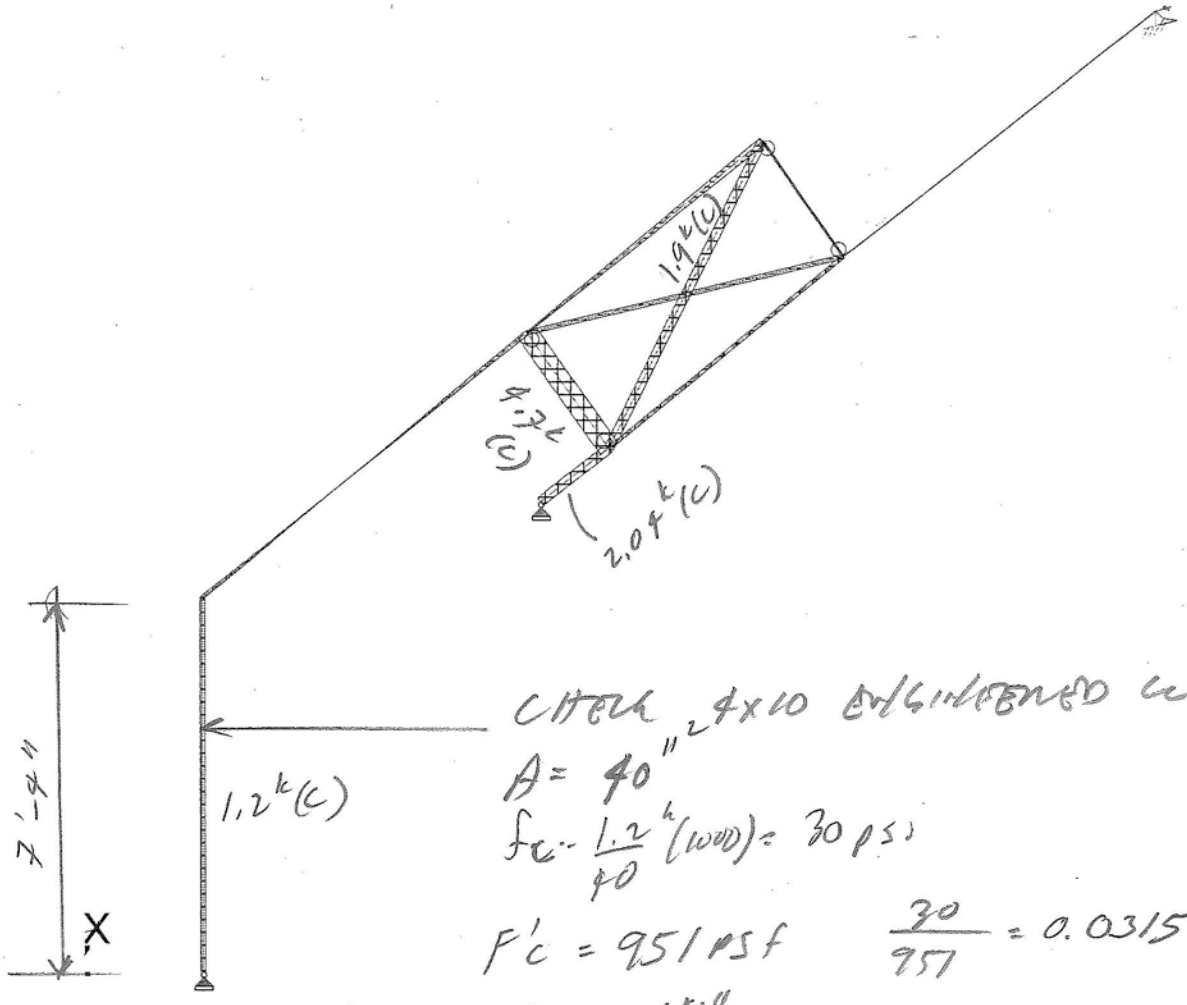
Client	File trellis corner.std		Date/Time 02-Aug-2011 09



CHECK 4x10 ENGINEERED GLULAM

$A = 40''^2$

$f_c = \frac{1.2^k}{40}$ (WOOD) = 30 psi

$F'_c = 951$ psf $\quad \frac{30}{951} = 0.0315$

$M = 14.4^{k\cdot''}$

$S = 66.7^{in^3}$ $\rightarrow$ $f_b = 216$ psi

$F'_b = 2112$ psf

Load 1 : Axial Force

$\frac{216}{2112} = 0.102$

INTERACTION

$0.0315 + 0.102 = 0.1037 < 1$

$\therefore$ OKAY

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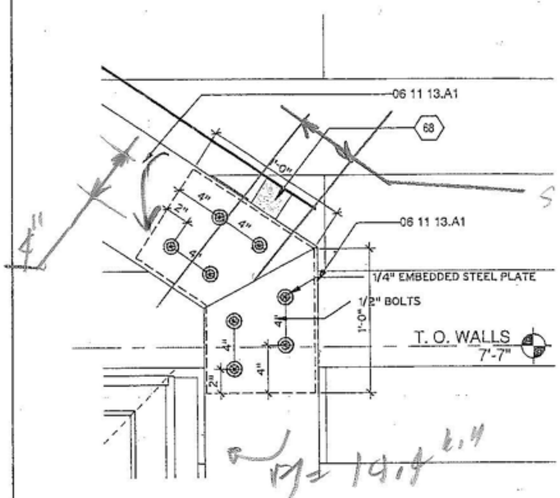
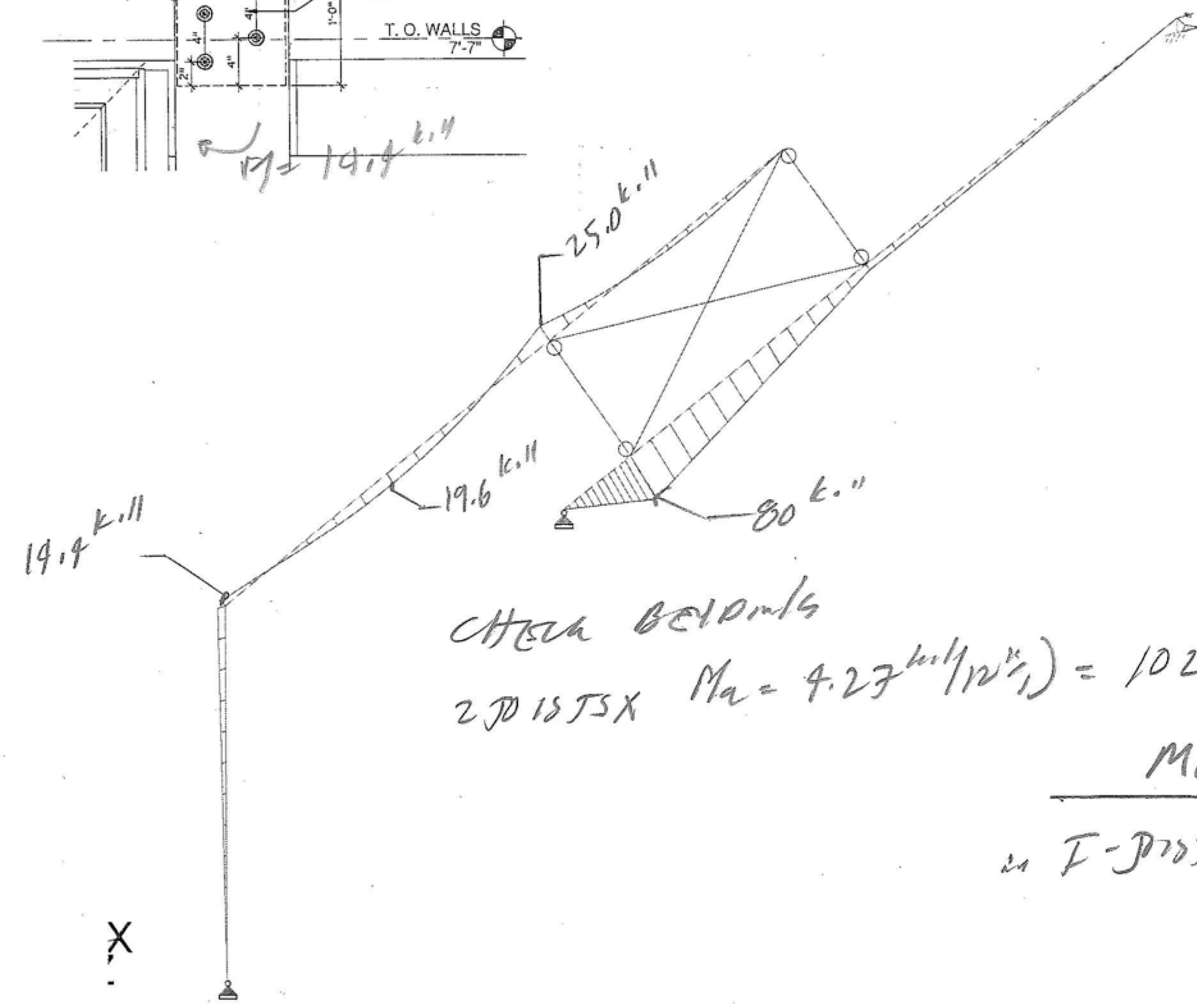


$V_{BOLT} = \frac{14.4^{k\cdot''}}{4''(2\ BOLTS)} = 1.8^{k}/BOLT$

$\frac{V_A}{\Omega}\ \frac{1}{2}''\phi = 24\,ksi(0.2'') = 4.8^{k}/BOLT$

∴ BOLTS OKAY



CHECK BENDING

2JD 15JSX $M_a = 4.27^{k\cdot'}(12''/') = 102.4 > M_u = 80^{k\cdot''}$

∴ I-JOIST OKAY

Load 1 : **Bending Z**

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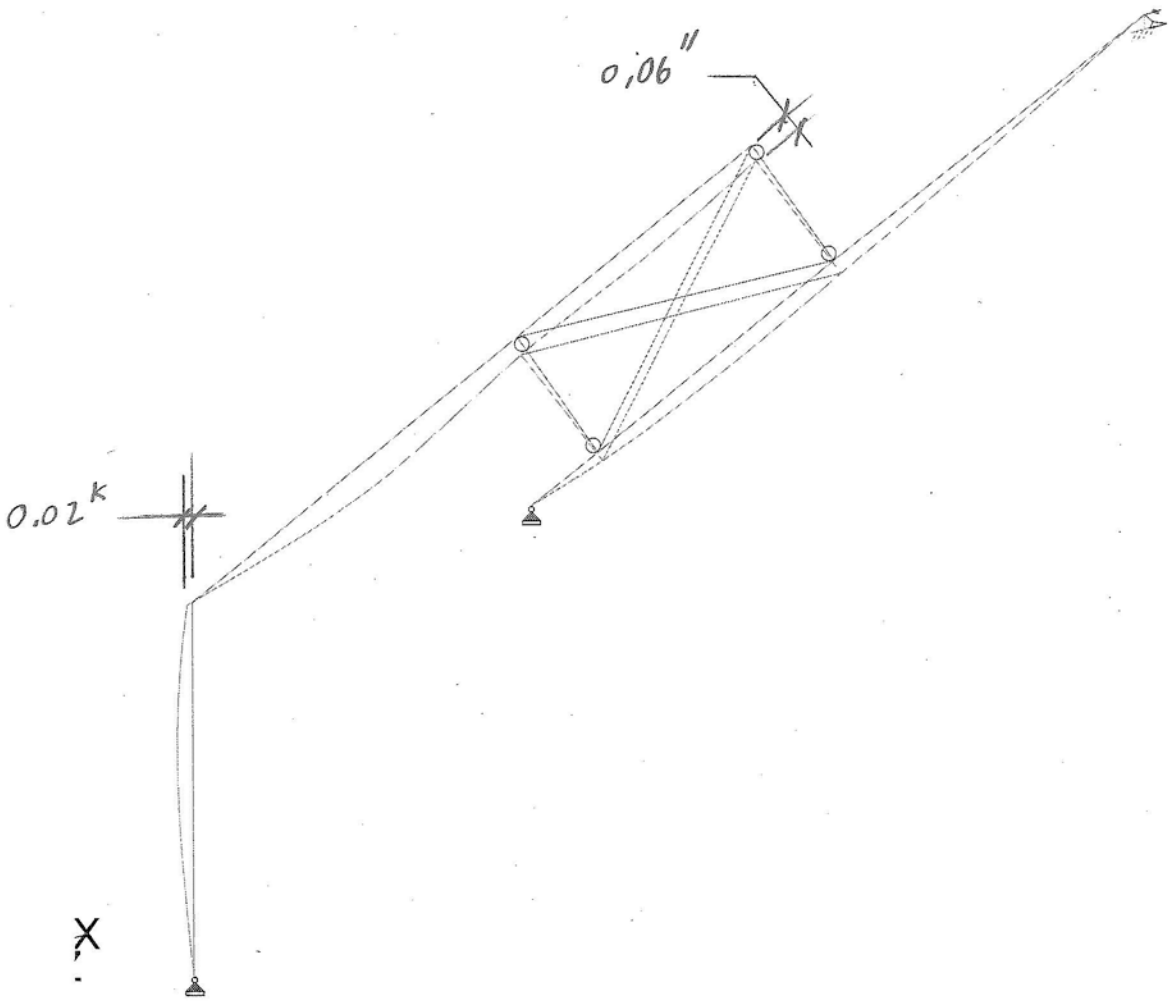

Load 1 : Displacement

Software licensed to	Job No	Sheet No 1	Rev
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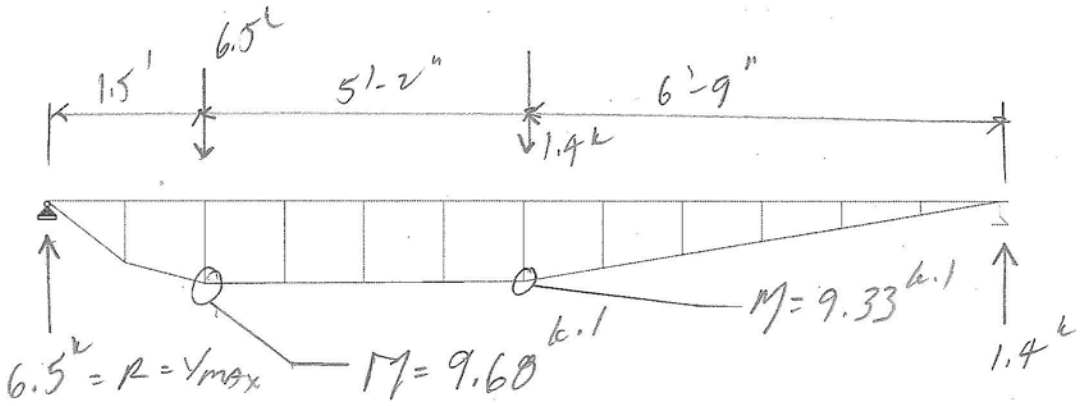
Job Title	Ref		
	By	Date 16-Dec-08	Chd
Client	File trellis 2xroof rafter suppor	Date/Time 13-Jul-2011 14:	

OF RAFTERS REQ'D = $\frac{M = 9.60^{k\cdot l}}{M_a = 4.27^{k\cdot l}} = 2.27$ say (3)



X

Load 1 : **Bending Z**

A1

P. E. Robbins, Inc.
1777 State Route 167
Victoria, IL 61485

6/17/2011

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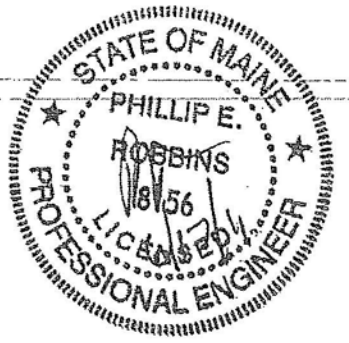
Nordic

Model # : **Solar Decathalon**

Job Number: **1106-033**

Page #	Sheet
1	Index
2	Worst Case Loading for Wall I-joist
3	11-7/8" NI-40x I-Joist Calculation for Worst Case
4	Wind Load Supplement
5	Snow Load Supplement



U.S. Department of Energy
Solar Decathlon 2011
Date 6/30/2011

Appendix

LeMessurier Consultants Structural Engineers	By MCG	Date 6/30/11	File No.	Sheet No. 34
	Subject			

CHECK FOOTING BEARING ASSUME 2000 PSF BEARING

INTERIOR FOOTING:

CENTER BEAM REACTION $R = 4.2^k \times 2 = 8.4^k$

MIN FTG SIZE $= \frac{8.4^k}{2^{ksf}} = 4.2\ SF \rightarrow$ 2'-0" SQ

EXTERIOR FOOTING:

$R = 4.2^k + 3.6^k$ (WALL I-JOIST) $= 7.8^k$

MIN FTG SIZE $= \frac{7.8^k}{2^{ksf}} = 3.9\ SF \rightarrow$ 2'-0" SQ

A 11

WIND LOAD (Method 1)

Basic Wind Speed	V_{3s}	=	110 mph	
Importance Factor	I	=	1	
Exposure Category		=	B	
Case A	A	=	3'x9'x21.6lbx.7=	408.24 lb
	B	=	3'x4.5'x14.8x.7=	139.86 lb
	C	=	39'x4.5'x17.2lbx.7=	2113.02 lb
	D	=	39'x9'x11.8lbx.7=	2899.26 lb
	E	=	3'x11'x1.7lbx.7=	39.27 lb
	F	=	3'x11'x-13.1lbx.7=	-302.61 lb
	G	=	39'x11'x0.6lbx0.7=	180.18 lb
	H	=	39'x11'x-11.3lbx0.7=	-3393.39 lb

=

Footings

Footing Type A	Wall 1	2.75 ft x	11.5 ft x	14.57 psf=	460.7763		
(corner)	Wall 2	3.4 ft x	8 ft x	14.57 psf=	396.304		
2'x2'	Floor	2.75 ft x	3.4 ft x	114.0 psf=	1066.087		
	Roof Dead	3.45 ft x	3.4 ft x	15.78 psf=	185.0408		
	Roof Live	3.4 ft x	2.75 ft x	30 psf=			
					2108.208	lbs/	4 ft= 527.052
Footing Type B	Wall	6.8 ft x	8 ft x	14.57 psf=	792.608		
(S and N wall)	Floor	6.8 ft x	5.5 ft x	114 psf=	4263.6		
2.5'x2.5'	Roof Live	6.8 ft x	11 ft x	30 psf=	2244		
	Roof Dead	6.8 ft x	13.8 ft x	15.78 psf=			
					7300.208	lbs/	6.25 ft= 1168.03328
Footing Type C	Wall	5.5 ft x	11.5 ft x	14.57 psf=	921.5525		
(E and W wall)	Floor	5.5 ft x	6.6 ft x	114 psf=	4138.2		
2'x2'	Roof Live	5.5 ft x	6.6 ft x	30 psf=			
	Roof Dead	6.6 ft x	6.6 ft x	15.78 psf=	687.159		
					5746.912	lbs/	6.25 ft= 919.50584
Footing Type D	Floor	6.9 ft x	11 ft x	114 psf=	8652.6		
(Center spine)					8652.6	lbs/	6.25 ft= 1384.416
2'x2'							

A9

Roof Joists	14" NI-40x	
	Sloped Length	14'
	Slope	33.69 Degrees
	Spacing	24"OC
	Allowable load	117plf
Roof weighs	45.8 psf or	91.55 plf on joists
Floor Joists	11 7/8"NI-80	
	Span	10'
	Spacing	24"OC
	Allowable load	227plf
Floor weighs	114.0 psf or	228.04 plf on joist
Wall Joists	Are being calculated by Nordic	

By Sections
Shell Load

Level 2	Section A (Roof Section) Area (sf)	Flat Load (psf)	Glazing (sf)	Weight (lbs.)	Section B (Roof Section) Area (sf)	Flat Load (psf)	Weight (lbs.)
Roof	539.5	15.775	-4.52	8439.31	539.5	15.775	8510.6125
Floor	0	14.0		0	0	14.0	0
Exterior Walls	70	14.57		1019.9	70	14.57	1019.9
Glazing	4.52	8		36.16			
				9495.37			9530.5125

Level 1	Section C (Ground Section) Area (sf)	Flat Load (psf)	Glazing (sf)	Weight (lbs.)	Section D (Ground Section) Area (sf)	Flat Load (psf)	Glazing (sf)	Weight (lbs.)
Roof	0	15.775		0	0	15.775		0
Floor	456.5	14.0		6400.13	456.5	14.0		6400.13
Exterior Walls	444.5	14.57	-61.51	5580.164	444.5	14.57	-165.33	4067.5069
Glazing	61.51	8		492.08	165.33	8		1322.64
				12472.37				11790.2769

Glazing Area	A	B	C	D
	4.52		4.84	9.57
			4.84	25.43
			4.84	3.85
			20.44	8.53
			8.13	22.03
			13.13	7.2
			5.29	20.62
				25.43
				9.67
				3.85
				8.53
				20.62
	4.52		61.51	165.33

A7

Trellis Roof		
Solar Panels	Sun Power	2.64 psf
Bracing	Clamps	2 psf
Timbers	Dual 2X6 Douglas Fir Timbers 8' O.C.	0.57 psf
		5.21 psf
		30 psf
Solar Water	1 Sun Drum Panel	26 Pounds

Deck		
Primary Member	Pressure Treated 4X4s 4' O.C.	0.85 psf
Secondaries	Pressure Treated 2X4s 16" O.C.	1.66 psf
Decking	Pressure Treated 1X4s	2.5 psf
Detailing	Douglas Fir 1X4's 4' O.C.	0.24 psf
		5.25 psf

A6

Gravity Loads

Roof		
Roofing	Standing Seam Metal	1.5 psf
Strapping	2.5X3/4" Fir Strapping 18" O.C.	0.8 psf
Sheathing	ZIP System 5/8" OSB	2 psf
Framing	NI-40x 14" Joists	1.575 psf
Insulation	10" Fiberglass	1.4 psf
Sheathing	5/8" OSB	2 psf
Chaseway framing	3"X2"Pine Strapping 18" O.C.	1 psf
Insulation	4 layers Urethane foam (w/skin)	2 psf
Ceiling	5/8" Gypsum	2 psf
Incedentials		1.5 psf
Dead Load		15.775 psf (16)
Live Load		30.0 psf ← Not Shown
Floors		
Finish	Hardwood flooring	4 psf
Subflooring	1/2" OSB	1.9 psf
Framing	NI-60 11 7/8" Joists	1.5 psf
Insulation	4 layers Urethane foam (w/skin)	2 psf
Insulation	8" Fiberglass	1.12 psf
Sheathing	Zip System 5/8" OSB	2 psf
Incedentials		1.5 psf
Dead Load		14.0 psf (14)
Live Load		100.0 psf

Exterior Walls		
Exterior Finish	8" Cambia planks 1/2" thick	2 psf
Rain Screen	2X2 Straping 24 O.C.	1.05 psf
Sheathing	Zip System 5/8" OSB	2 psf
Insulation	4 layers Urethane foam (w/skin)	0.4 psf
Insulation	8" Fiberglass	1.12 psf
Framing	NI-60 11 7/8" Joists	1.5 psf
Sheathing	5/8" OSB	2 psf
Chaseway Framing	3"X2" Pine Strapping 18" O.C.	1 psf
Interior Finish	5/8" Gypsum	2 psf
Incedentials		1.5 psf
Dead Load		14.57 psf (15)

Interior Walls		
Finish	5/8" Gypsum X 2 Sides	2 psf
Framing	2X4 Framing	1.25 psf
Incedentals		1.5 psf
Dead Load		4.75 psf (5)

Gravity Loads (Continued)

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6/17/2011

CLIENT: Nordic
SUBJECT: Solar Decathalon
Job: 1106-033
DESIGNER: TAR

ASCE 7-05 SNOW LOADS

Snow Loads for Hip and Gable Roofs

Flat Roof Snow Load (Pf):
Pf = 0.7(Ce)(Ct)(I)(pg) (psf)

Exposure Factor (Ce):	1.0	Table 7-2 ASCE 7-05 page 92
Thermal Factor (Ct):	1.0	Table 7-3 ASCE 7-05 page 93.
Importance Factor (I):	1.0	Table 7-4 ASCE 7-05 page 93
Ground Snow Load (pg):	90.0	
Horizontal Distance Eave to Ridge (W)	11.0	feet
Roof Surface type:	1	ASCE 7-05 Section 7.4 page 81 and 82:
Enter Roof Slope:	8	/12
Roof Slope in degrees:	33.7	
(S):	1.5	

Flat Roof Snow Load Pf = 63.0 psf Section 7.3 and 7.3.4 minimums page 81

Sloped-Roof Snow Loads (Ps): Roof Slope Factor (Cs): 0.90774831
Ps = (Cs)(Pf) (psf)

Sloped Roof Snow Load Ps = 57.2 psf

Unbalanced Snow Load: 1.5pf/Ce for roof slope <= 5 degrees — Figure 7-5 page 89
1.5ps/Ce for roof slope > 5 degrees and < 70 degrees — Figure 7-5 page 89
Each Building slope <=20 ft in width

Unbalanced Snow Load for W <= 20 = 90.0 psf Rafter System Only

Note: unbalanced snow loads need not be considered for slope > 70 degrees or slope < larger 0f 2.38 degrees and 70/W + 0.5
NA = Not Applicable

Unbalanced Snow Load for All Other Roofs or Rafters > 20 ft.

Windward unbalanced load = 17.2 psf

Leeward Drift unbalanced load = 109.1 psf for 8.6 ft. from ridge

Leeward unbalanced load = 57.2 psf from 8.6 to 11.0 from ridge

A4

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Victoria, IL 61485

6/17/2011

Tel: (309) 879-3258
Fax: (309) 879-3256

Basic Wind Load Design Criteria

Client: Nordic
Client's SN: Solar Decathalon
JOB NUMBER: 1106-033

Roof Slope:	8	/12		
Wind Speed:	120	MPH (3 sec. Gust)		
Exposure:	C			
Mean Roof Height:	15.0	ft	Adjustment Factor:	1.21
1st Floor Mean Wall Height	15.0	ft	Adjustment Factor:	1.21
Topographical Factor Kzt:	1.00			
Importance Factor I:	1.00			

ASCE 7-05 Simplified Design Procedure Method 1
Enclosed Building Internal Pressure Coefficient Gcpi = +/-0.18
Positive loads act towards the surface and negative loads act away from the surface
MWFRS Design Pressures (Net):

Horizontal Roof Pressures			Vertical Roof Pressures		
End zone of Roof (B):	21.3	psf	End zone of Windward (E):	12.0	psf
Interior zone of Roof (D):	16.9	psf	End zone of Leeward (F):	-18.9	psf
			Interior zone of Windward (G):	10.4	psf
			Interior zone of Leeward (H):	-16.2	psf
1st Floor Horizontal Pressure					
End zone of Wall (A):	31.1	psf	End Overhang (Eoh):	-12.5	psf
Interior zone of Wall (C):	24.7	psf	Interior Overhang (Goh):	-10.9	psf

Component and Cladding Design Pressures (Net):

	Design Load (psf) sf = 10			Design Load (psf) sf = 20			Design Load (psf) sf =50		
Roof Interior (1):	28.7	-31.3	psf	27.8	-29.8	psf	26.9	-27.6	psf
Roof Edge (2):	28.7	-36.7	psf	27.8	-35.1	psf	26.9	-32.9	psf
Roof Corner (3):	28.7	-36.7	psf	27.8	-35.1	psf	26.9	-32.9	psf
Overhang Edge (2):	-53.1	psf		-51.5	psf		-49.4	psf	
Overhang Corner (3):	-53.1	psf		-51.5	psf		-49.4	psf	
1st Floor									
Wall Interior (4):	31.3	-34.0	psf	29.9	-32.5	psf	28.1	-30.7	psf
Wall Corner (5):	31.3	-42.0	psf	29.9	-39.2	psf	28.1	-35.5	psf
Roof\Gable									
Wall Interior (4):	31.3	-34.0	psf	29.9	-32.5	psf	28.1	-30.7	psf
Wall Corner (5):	31.3	-42.0	psf	29.9	-39.2	psf	28.1	-35.5	psf

A3

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6/17/2011

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I-Joist used as beam-column

Member				Loading				
11-7/8 NI-40x	OK			W_b =	0	plf	0.0	plf
F_b =	1950	psi		W_d =	14.8	plf	177.6	plf
F_t =	1200	psi		Axial load =	3560	lbs		
F_v =	135	psi		Compression				
F_c =	1800	psi		C_d =	1.0			
E =	1700000	psi		L/	360			
E_{min} =	881302	psi	= $\frac{E[1 - 1.645 * 0.1) * 1.03}{1.66}$					

Dimension

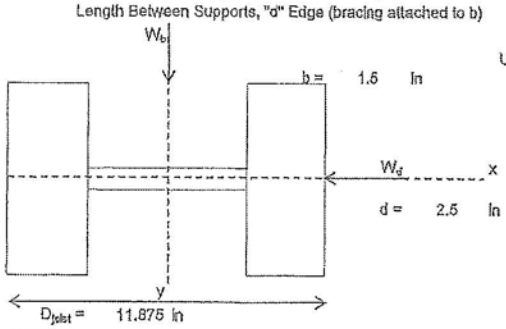
Bending Span Length L = 91 in

Length Between Supports, "b" Edge (bracing attached to d) L_b = 0.001 in (about x)

Length Between Supports, "d" Edge (bracing attached to b) L_d = 91 in (about y)

K_e = 1.0

Use 0.001 for continous support



I_x = 3.91 in^4 = $2\frac{bd^3}{12}$

c_x = 1.25 in

A = 7.5 = 2bd

EIy = 3.71E+08 lb*in^2

K_y = 6.18E+06 lb

D_{joist} = 11.875 in

Bending

L_x =	0.001	in	L_{ex} =	0.00206	in	R_{bx} =	0.05	OK	
L_y =	91	in	L_{ey} =	155.83	in	R_{by} =	6.115489	OK	
F'_{bx} =	1950	psi	F_{bEx} =	5.E+08	psi	F_{bEx}/F'_{bx} =	2.37E+05	C_{Lx} =	1.00
F'_{by} =	1950	psi	F_{bEy} =	3.E+04	psi	F_{bEy}/F'_{by} =	1.45E+01	C_{Ly} =	1.00

M_x = 0 in*lbs = $\frac{W_d L^2}{8}$ f_{b1} = 0 psi = $\frac{M_x c_x}{I_x}$

M_y = 15319.85 in*lbs = $\frac{W_d L^2}{8}$ M_{joist} = 45120 in*lbs

Shear

V_x = 0 lbs = $\frac{W_b L}{2}$ f_{vx} = 0.0 psi = $\frac{3V_x}{2bd}$ OK = if($F_v C_d$>= f_{vx} , OK , No good)

V_y = 673 lbs = $\frac{W_d L}{2}$ V_{joist} = 1480 lbs OK = if(V_{joist}>= V_y , OK , No good)

Deflection

Δ_{Limit} = 0.253 in

Δ_x = 0.000 in = $\frac{5W_b L^4}{384EI_x}$ OK = if(Δ_{Limit}>= Δ_x , OK , No good)

Δ_y = 0.055 in = $\frac{5W_d L^4}{384EIy} + \frac{W_d L^2}{K_y}$ OK = if(Δ_{Limit}>= Δ_y , OK , No good)

Compression

P = 3560 lbs f_c = 473 psi F'_c = 1800 psi

L_{ex} = 0.001 in = $K_e L_b$ 0.0004 in = L_{ex} / d OK

L_{ey} = 91 in = $K_e L_d$ 7.663158 in = L_{ey} / D_{joist} OK

~~F_{cE1} = 4.53E+12 F_{cE1}/F'_c = 2.52E+09 F_{cE}/F'_c = 2.52E+09~~

~~F_{cE2} = 1.23E+04 F_{cE2}/F'_c = 6.853435 C_p = 1.00 = $\frac{1 + F_{cE}/F_c}{1.8} - \sqrt{\left[\frac{1 + F_{cE}/F_c}{1.8}\right]^2 - \frac{F_{cE}/F_c}{0.9}}$~~

F'_c = 1800 psi OK = if(F'_c>= f_c , OK , No good)

Tension

f_t = 473 psi 0.734 = $\frac{f_t}{F't} + \frac{f_{b1}}{F_{bx}} + \frac{M_y}{M_{joist}}$ OK

$F't$ = 1200 psi 0.0968 = $\frac{f_{b1} - f_t}{F_b C_d} + \frac{M_y}{M_{joist}}$ OK

Bending and Axial Compression

F_{cE1} = 4.53E+12 OK

F_{cE2} = 1.23E+04 OK 0.35 = $\frac{f_c}{F'_c}^2 + \frac{f_{b1}}{F_b C_d C_{Lx}[1 - f_c / F_{cE1}]} + \frac{M_y}{M_{joist}[1 - f_c / F_{cE2} - (f_{b1} / F_{bE})^2]}$

F_{bE} = 5.46E+04 OK OK

Required F_{cp} Bearing Capacity = 473 psi

PE ROBBINS INC

1777 State Route 167 • Victoria, Illinois 61485

Solar Decathalon Loading - Worst Case

Wind → 120 mph, Exposure C

Snow → 90 psf ground snow load

Roof Dead → 20 psf

Rafter Exterior Bearing Wall Load

$(90 + 20)\left(\frac{11.33 \text{ ft}}{2}\right) = 623 \text{ plf}$

Wall Pressure = 31.1 plf

For A 9'-4 3/4" Opening

$$\text{Axial load} = (623)\left[\frac{(9.396')}{2} + \frac{(2')}{2}\right] = 3550 \text{ lbs}$$

$$\text{Bending} = (31.1 \text{ plf})\left(\frac{9.396}{2} + 2\right) = 177.2 \text{ plf}$$

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Josh Johnson Email: josh@perobbins.com

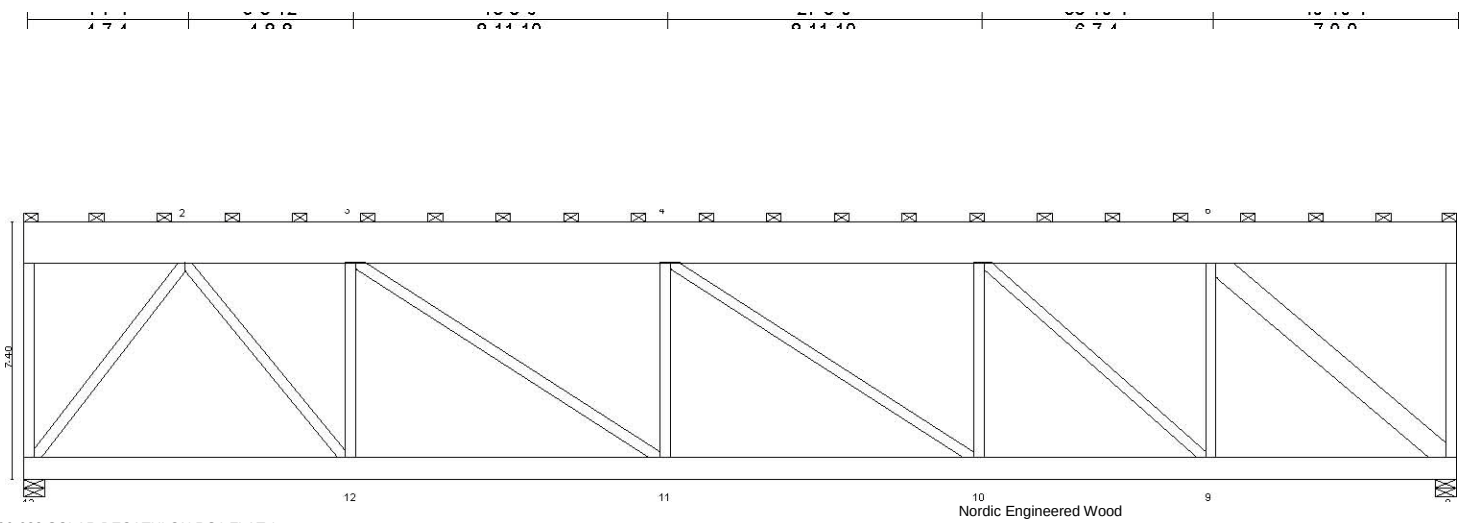
Customer _____

Job # _____

Truss Calculations

Job Truss Truss Type Qty

Ply



1106-033 SOLAR DECATHLON RG1 FLAT 1

1

P.E. Robbins, Inc., Victoria, IL 61485 7.220 e Dec 29 2009 MiTek Industries, Inc. Wed Jul 06 23:22:47 2011 Page 1

4-7-4

9-3-12 18-3-6 27-3-0 33-10-4 40-10-4

9-3-12	18-3-6	27-3-0	33-10-4	40-10-4
9-3-12	8-11-10	8-11-10	6-7-4	7-0-0

LOADING(psf) TCLL TCDL BCLL BCDL 90.0 25.0 0.0 20.0	**SPACING** Plates Increase Lumber Increase Rep Stress Incr Code 5-5-11 1.15 1.15 NO IBC2009/TPI2007	**CSI** TC BC WB (Matrix) 0.17 0.48 1.00	**DEFL** Vert(LL) Vert(TL) Horz(TL)	in -0.29 - 0.53 0.16 (loc) 10- 11 10-11	l/def l >99 9 >91	L/d 240 180 n/a	**PLATES** Weight: 1140 lb **GRIP**

4-7-4 4-8-8 8-11-10 8-11-10 6-7-4 7-0-0

BRACING
TOP CHORD Nordic 24F 3.5" x 14" TOP CHORD 2-0-0 oc purlins (6-0-0 max.), except end verticals [P] BOT CHORD Nordic 24F 3.5" x 7.5" WEBS Nordic 24F 3.5" x 3.5" except BOT CHORD Braces at joints 10 an
12
6-8: 2X4 Nordic 24F 3.5" x 7.5"

REACTIONS (lb/size) 13=14988/0-7-4 (min. 0-3-8), 8=14988/0-7-4 (min. 0-3-8) Max
Uplift13=-1529(LC 3), 8=-1529(LC 3)

FORCES (lb) - Maximum Compression/Maximum Tension TOP CHORD 1-13=-1150/195, 1-2=-85/0, 2-3=-16695/1682, 3-4=-23606/2411, 4-5=-21055/2148, 5-6=-13558/1381, 6-7=-94/5, 7-8=-1908/319 BOT CHORD
12-13=-1004/9340, 11-12=-1682/16695, 10-11=-2411/23606, 9-10=-2148/21055, 8-9=-1381/13558 WEBS 2-13=-16273/1768, 3-12=-8976/1259, 3-11=-897/8512, 5-10=0/2735, 6-8=-18486/1888, 4-10=-3142/324, 6-
502/7977, 5-9=-10477/1073,
2-12=-1150/12472, 4-11=-4049/824

P. E. Robbins, Inc.
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7/7/2011

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Top Chord
Description: Tension Check
Description:
Model #: Solar Decathlon
Job: 1106-033

Member: 24Fb 3 1/2" x 14"
Member Axially Loaded in: Tension
.7 Deflection Check Load: yes for C/C wind loads

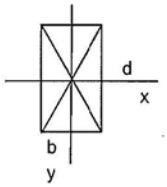
Column check = **OK**

Loading

W_{bwall}=	57.53	pli
Wd_{wall}=	0	pli
Axial load =	2382	lbs

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



Conditions

Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 108 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 108 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 24 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 2 x 4 #2 SYP
Bearing member F_{cp} (psi) 565

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 14"	2400	1050	250	560	1150	1.6E+10	3.5	14	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 49
Ix= 800.33 Sx = 114.33 M_{b_max} = 83878.74 f_{b1} = 734 psi L_{ub} = 24 L_{eb} = 49
Iy= 50.02 Sy = 28.58 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 108 L_{ed} = 218
R_{Bx} = 7.5 OK F_{bx}* = 2400.0 F_{bEb} = 124134036 F_{bEx}/F_{bx}*= 51722.52 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 2.0 OK F_{by}* = 2400 F_{bEd} = 1.80E+09 F_{bEy}/F_{by}*= 750588.5 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 3106.62 f_{vb} = 95.100612 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.45 Allowed = 0.45

Column

Axial Load (lb) = 2382 f_c = 48.6 psi F_c* = 1150
L_{eb} = 24 L_{eb}/d = 1.714286 greater = 30.8571429 OK F_{cE1} = 1.6349.E+09
L_{ed} = 108 L_{ed}/b = 30.85714 F_{cE2} = 5.0459E+06
F_{cE} = 5.05E+06 F_{cE}/F_c* = 4387.757 C_p = 0.99997721 F_c' = 1149.97 OK

Combined Bending and Axial Tension

f_t = 49 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.351978 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.351978 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.31 OK

Bearing

Bearing member F_{cp}' (psi) 565 OK
F_c = 48.6

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7/6/2011

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Top Chord
Description: Compression Check
Description:
Model #: Solar Decathlon
Job: 1106-033

Member: 24Fb 3 1/2" x 14"
Member Axially Loaded in: Compression
.7 Deflection Check Load: yes for C/C wind loads

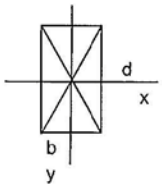
Column check = **OK**

Loading

W_{bwall}= 57.53 pli
Wd_{wall}= 0 pli
Axial load = 23307 lbs

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



Conditions

Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 108 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 108 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 24 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 2 x 4 #2 SYP
Bearing member F_{cp} (psi) 565

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E_r
24Fb 3 1/2" x 14"	2400	1050	250	560	1150	1.6E+10	3.5	14	0.9	1	3.5	5.84E

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 49
Ix= 800.33 Sx = 114.33 M_{b_max} = 83878.74 f_{b1} = 734 psi L_{ub} = 24 L_{eb} = 49.
Iy= 50.02 Sy = 28.58 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 108 L_{ed} = 218
R_{Bx} = 7.5 OK F_{bx}* = 2400.0 F_{bEb} = 124134036 F_{bEx}/F_{bx}*= 51722.52 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 2.0 OK F_{by}* = 2400 F_{bEd} = 1.80E+09 F_{bEy}/F_{by}*= 750588.5 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 3106.62 f_{vb} = 95.100612 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.45 Allowed = 0.45

Column

Axial Load (lb) = 23307 f_c = 475.7 psi F_c* = 1150
L_{eb} = 24 L_{eb}/d = 1.714286 greater = 30.8571429 OK F_{cE1} = 1.6349.E+09
L_{ed} = 108 L_{ed}/b = 30.85714 F_{cE2} = 5.0459E+06
F_{cE} = 5.05E+06 F_{cE}/F_c* = 4387.757 C_p = 0.99997721 F_c' = 1149.97 OK

Combined Bending and Axial Tension

f_t = 476 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.758683 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.758683 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{c\alpha 2}) - (f_{b1}/F_{bE})^2]\}$ = 0.48 OK

Bearing

Bearing member F_{cp}' (psi) 565 OK
F_c = 475.7

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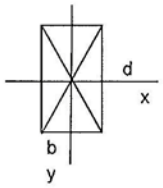
2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: **Bottom Chord**
Description: **Tension Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

Member: **24Fb 3 1/2" x 7 1/2"**
Member Axially Loaded in: **Tension**
.7 Deflection Check Load: **yes** for C/C wind loads
Column check = **OK**

Loading
W_{bwall}= 4 pli
Wd_{wall}= 0 pli
Axial load = 23307 lbs

Load Factors
Load Duration (C_D) = **1.15**
Repetitive Member Factor C_r = **1.15**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = **1**

DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: **490.25** IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= **215.25** IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= **215.25** IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: **no** Yes; C_L= 1.0 see note
Bearing Member **2 x 4 #2 SYP**
Bearing member F_{cp} (psi) 565

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 7 1/2"	2400	1050	250	560	1150	1.6E+10	7.5	7.5	0.9	1	7.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 56.25
Ix= 263.67 Sx = 70.31 M_{b_max} = 120172.531 f_{b1} = 1709 psi L_{ub} = 215.25 L_{eb} = 373.
Iy= 263.67 Sy = 70.31 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 215.25 L_{ed} = 373.
R_{Bx} = 7.1 OK F_{bx}* = 3174.0 F_{bEb} = 140895677 F_{bEx}/F_{bx}*= 44390.57 C_{Lx} = 1.0000 F_{bx}' = 31
R_{By} = 7.1 OK F_{by}* = 3174 F_{bEd} = 1.41E+08 F_{bEy}/F_{by}*= 44390.57 C_{Ly} = 1.0000 F_{by}' = 31

Bending Shear

V_x = 980.5 f_{vb} = 26.146667 F_{vb}' = 287.5 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 287.5 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 2.04270833 Allowed = 2.04270833

Column

Axial Load (lb) = 23307 f_c = 414.3 psi F_c* = 1322.5
L_{eb} = 215.25 L_{eb}/d = 28.7 greater = 28.7 **OK** F_{cE1} = 5.8329.E+06
L_{ed} = 215.25 L_{ed}/b = 28.7 F_{cE2} = 5.8329E+06
F_{cE} = 5.83E+06 F_{cE}/F_c* = 4410.546 C_p = 0.99997732 F_c' = 1322.47 **OK**

Combined Bending and Axial Tension

f_t = 414 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.881619 **OK**
F_t' = 1207.5 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.881619 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.64 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 565 **OK**
F_c = 414.3

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2005 NDS Combined Bending and Axial Loading

CLIENT: **Nordic**
Description: **Bottom Chord**
Description: **Compression Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

Member: **24Fb 3 1/2" x 7 1/2"**
Member Axially Loaded in: **Compression**
.7 Deflection Check Load: **yes** for C/C wind loads

Column check = **OK**

Loading

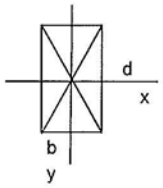
W_{bwall}=	4	pli
Wd_{wall}=	0	pli
Axial load =	2382	lbs

Conditions

Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = **1**

Load Factors

Load Duration (C_D) = **1.00**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: **215.25** IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= **215.25** IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= **215.25** IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: **no** Yes; C_L= 1.0 see note
Bearing Member **2 x 4 #2 SYP**
Bearing member F_{cp} (psi) 565

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 7 1/2"	2400	1050	250	560	1150	1.6E+10	7.5	7.5	0.9	1	7.5	5.84

(F_t, E, E_{min}) C_t = 1
(F_b, F_v, F_c, F_{cp}) C_t = 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 56.25
Ix= 263.67 Sx = 70.31 M_{b_max} = 23166.2813 f_{b1} = 329 psi L_{ub} = 215.25 L_{eb} = 373.
Iy= 263.67 Sy = 70.31 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 215.25 L_{ed} = 373.
R_{Bx} = 7.1 **OK** F_{bx}* = 2400.0 F_{bEb} = 140895677 F_{bEx}/F_{bx}*= 58706.53 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 7.1 **OK** F_{by}* = 2400 F_{bEd} = 1.41E+08 F_{bEy}/F_{by}*= 58706.53 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 430.5 f_{vb} = 11.48 F_{vb}' = 250 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.896875 Allowed = 0.896875

Column

Axial Load (lb) = 2382 f_c = 42.3 psi F_c* = 1150
L_{eb} = 215.25 L_{eb}/d = 28.7 greater = 28.7 **OK** F_{cE1} = 5.8329.E+06
L_{ed} = 215.25 L_{ed}/b = 28.7 F_{cE2} = 5.8329E+06
F_{cE} = 5.83E+06 F_{cE}/F_c* = 5072.128 C_p = 0.99998028 F_c' = 1149.98 **OK**

Combined Bending and Axial Tension

f_t = 42 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.177612 **OK**
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.177612 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.14 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 565 **OK**
F_c = 42.3

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 1-13 3-12 4-11 5-10 6-9 7-8
Description: Compression Check
Description:
Model #: Solar Decathalon
Job: 1106-033

Loading

W_{bwall}= 10 pli
Wd_{wall}= 0 pli
Axial load = 9368 lbs

Conditions

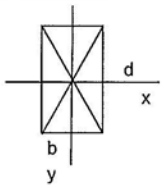
Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Member: 24Fb 3 1/2" x 3 1/2"
Member Axially Loaded in: Compression
.7 Deflection Check Load: no for C/C wind loads

Column check = **OK**

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.10



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 73 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 73 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 73 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	8.29

(F_t, E, E_{min}) C_t = 1
(F_b, F_v, F_c, F_{cp}) C_t = 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 6661.25 f_{b1} = 932 psi L_{ub} = 73 L_{eb} = 129
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 73 L_{ed} = 129
R_{Bx} = 6.1 OK F_{bx}* = 2400.0 F_{bEb} = 269034907 F_{bEx}/F_{bx}*= 112097.9 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 6.1 OK F_{by}* = 2400 F_{bEd} = 2.69E+08 F_{bEy}/F_{by}*= 112097.9 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 365 f_{vb} = 44.693878 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.30416667 Allowed = 0.30416667

Column

Axial Load (lb) = 9368 f_c = 764.7 psi F_c* = 1150
L_{eb} = 73 L_{eb}/d = 20.85714 greater = 20.8571429 OK F_{cE1} = 1.5673.E+07
L_{ed} = 73 L_{ed}/b = 20.85714 F_{cE2} = 1.5673E+07
F_{cE} = 1.57E+07 F_{cE}/F_c* = 13628.87 C_p = 0.99999266 F_c' = 1149.99 OK

Combined Bending and Axial Tension

f_t = 765 psi $f_t/F_t' + f_{b1}/F_{bb}$* = 1.11673 OK
F_t' = 1050 psi $f_t/F_t' + f_{b1}/F_{b1}$* + f_{b2}/F_{b2}*= 1.11673 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.83 OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 764.7

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2005 NDS Combined Bending and Axial Loading

CLIENT: **Nordic**
Description: **Webs 1-13 3-12 4-11 5-10 6-9 7-8**
Description: **Tension Check**
Description:
Model #: **Solar Decathalon**
Job: **1106-033**

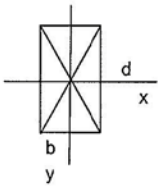
Loading
W_{bwall}= 9 pli
Wd_{wall}= 0 pli
Axial load = 8163 lbs

Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = **1**

Member: **24Fb 3 1/2" x 3 1/2"**
Member Axially Loaded in: **Tension**
.7 Deflection Check Load: no for C/C wind loads

Column check = **OK**

Load Factors
Load Duration (C_D) = **1.00**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.10**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: 73 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 73 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 73 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E_r
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	8.29

(F_t, E, E_{min}) C_t = 1
(F_b, F_v, F_c, F_{cp}) C_t = 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 5995.125 f_{b1} = 839 psi L_{ub} = 73 L_{eb} = 129
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 73 L_{ed} = 129
R_{Bx} = 6.1 OK F_{bx}* = 2400.0 F_{bEb} = 269034907 F_{bEx}/F_{bx}*= 112097.9 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 6.1 OK F_{by}* = 2400 F_{bEd} = 2.69E+08 F_{bEy}/F_{by}*= 112097.9 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 328.5 f_{vb} = 40.22449 F_{vb}' = 250 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.30416667 Allowed = 0.30416667

Column

Axial Load (lb) = 8163 f_c = 666.4 psi F_c* = 1150
L_{eb} = 73 L_{eb}/d = 20.85714 greater = 20.8571429 **OK** F_{cE1} = 1.5673.E+07
L_{ed} = 73 L_{ed}/b = 20.85714 F_{cE2} = 1.5673E+07
F_{cE} = 1.57E+07 F_{cE}/F_c* = 13628.87 C_p = 0.99999266 F_c' = 1149.99 **OK**

Combined Bending and Axial Tension

f_t = 666 psi $f_t/F_t' + f_{b1}/F_{bb}$* = 0.984206 **OK**
F_t' = 1050 psi $f_t/F_t' + f_{b1}/F_{b1}$* + f_{b2}/F_{b2}*= 0.984206 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK**
$f_{b1} < F_{bE}$ **OK**

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.69 **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 666.4

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7/6/2011

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2005 NDS Combined Bending and Axial Loading

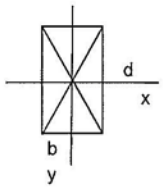
CLIENT: **Nordic**
Description: **Webs 2-13**
Description: **Tension Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

Loading
W_{bwall}= 0 plf
Wd_{wall}= 0 plf
Axial load = 1746 lbs

Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = 1

Member: **24Fb 3 1/2" x 3 1/2"**
Member Axially Loaded in: **Tension**
.7 Deflection Check Load: **no** for C/C wind loads
Column check = **OK**

Load Factors
Load Duration (C_D) = **1.15**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: **92.8** IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= **92.8** IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= **92.8** IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: **no** Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 92.8 L_{eb} = 161
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 92.8 L_{ed} = 161
R_{Bx} = 6.8 **OK** F_{bx}* = 2760.0 F_{bEb} = 151756553 F_{bEx}/F_{bx}*= 54984.26 C_{Lx} = 1.0000 F_{bx}' = 27
R_{By} = 6.8 **OK** F_{by}* = 2760 F_{bEd} = 1.52E+08 F_{bEy}/F_{by}*= 54984.26 C_{Ly} = 1.0000 F_{by}' = 27

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 287.5 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 287.5 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.38666667 Allowed = 0.38666667

Column

Axial Load (lb) = 1746 f_c = 142.5 psi F_c* = 1322.5
L_{eb} = 92.8 L_{eb}/d = 26.51429 greater = 26.5142857 **OK** F_{cE1} = 6.8343.E+06
L_{ed} = 92.8 L_{ed}/b = 26.51429 F_{cE2} = 6.8343E+06
F_{cE} = 6.83E+06 F_{cE}/F_c* = 5167.688 C_p = 0.99998065 F_c' = 1322.47 **OK**

Combined Bending and Axial Tension

f_t = 143 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.118038 **OK**
F_t' = 1207.5 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.118038 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.01 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 142.5

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2005 NDS Combined Bending and Axial Loading

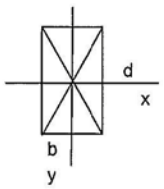
CLIENT: **Nordic**
Description: **Webs 2-13**
Description: **Compression Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

Loading
W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 15891 lbs

Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = 1

Member: **24Fb 3 1/2" x 3 1/2"**
Member Axially Loaded in: **Compression**
.7 Deflection Check Load: **no** for C/C wind loads
Column check = **OK**

Load Factors
Load Duration (C_D) = **1.15**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.10**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: **92.8** IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= **92.8** IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= **92.8** IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: **no** Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	8.29

(F_t, E, E_{min}) C_t 1 — Wet service Factor C_M
(F_b, F_v, F_c, F_{cp}) C_t 1

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00 C_{fu} 1
(F_{cp}) C_i = 1.00

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 92.8 L_{eb} = 161
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 92.8 L_{ed} = 161
R_{Bx} = 6.8 **OK** F_{bx}* = 2760.0 F_{bEb} = 215358980 F_{bEx}/F_{bx}*= 78028.62 C_{Lx} = 1.0000 F_{bx}' = 27
R_{By} = 6.8 **OK** F_{by}* = 2760 F_{bEd} = 2.15E+08 F_{bEy}/F_{by}*= 78028.62 C_{Ly} = 1.0000 F_{by}' = 27

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 287.5 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 287.5 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.38666667 Allowed = 0.38666667

Column

Axial Load (lb) = 15891 f_c = 1297.2 psi F_c* = 1322.5
L_{eb} = 92.8 L_{eb}/d = 26.51429 greater = 26.5142857 **OK** F_{cE1} = 9.6986.E+06
L_{ed} = 92.8 L_{ed}/b = 26.51429 F_{cE2} = 9.6986E+06
F_{cE} = 9.70E+06 F_{cE}/F_c* = 7333.509 C_p = 0.99998636 F_c' = 1322.48 **OK**

Combined Bending and Axial Tension

f_t = 1297 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 1.074306 **OK**
F_t' = 1207.5 psi $f_t/F_t'+f_{b1}/F_{b1}*+f_{b2}/F_{b2}$*= 1.074306 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{c\alpha 2}) - (f_{b1}/F_{bE})^2]\}$ = 0.96 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 1297.2

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2005 NDS Combined Bending and Axial Loading

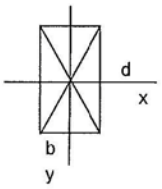
CLIENT: **Nordic**
Description: **Webs 2-12**
Description: **Tension Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

Loading
W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 12631 lbs

Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = 1

Member: **24Fb 3 1/2" x 3 1/2"**
Member Axially Loaded in: **Tension**
.7 Deflection Check Load: no for C/C wind loads
Column check = **OK**

Load Factors
Load Duration (C_D) = **1.00**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: 91.1 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 91.1 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 91.1 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1 — Wet service Factor C_M
(F_b, F_v, F_c, F_{cp}) C_t 1

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00 C_{fu} 1
(F_{cp}) C_i = 1.00

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 91.1 L_{eb} = 158
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 91.1 L_{ed} = 158
R_{Bx} = 6.7 **OK** F_{bx}* = 2400.0 F_{bEb} = 154401433 F_{bEx}/F_{bx}*= 64333.93 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 6.7 **OK** F_{by}* = 2400 F_{bEd} = 1.54E+08 F_{bEy}/F_{by}*= 64333.93 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.37958333 Allowed = 0.37958333

Column

Axial Load (lb) = 12631 f_c = 1031.1 psi F_c* = 1150
L_{eb} = 91.1 L_{eb}/d = 26.02857 greater = 26.0285714 **OK** F_{cE1} = 7.0917.E+06
L_{ed} = 91.1 L_{ed}/b = 26.02857 F_{cE2} = 7.0917E+06
F_{cE} = 7.09E+06 F_{cE}/F_c* = 6166.708 C_p = 0.99998378 F_c' = 1149.98 **OK**

Combined Bending and Axial Tension

f_t = 1031 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.982002 **OK**
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.982002 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.80 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 1031.1

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2005 NDS Combined Bending and Axial Loading

CLIENT: **Nordic**
Description: **Webs 2-12**
Description: **Compression Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

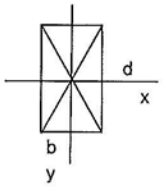
Loading
W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 1175 lbs

Conditions
Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Member: **24Fb 3 1/2" x 3 1/2"**
Member Axially Loaded in: **Compression**
.7 Deflection Check Load: no for C/C wind loads

Column check = **OK**

Load Factors
Load Duration (C_D) = **1.00**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 91.1 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 91.1 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 91.1 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 91.1 L_{eb} = 158
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 91.1 L_{ed} = 158
R_{Bx} = 6.7 OK F_{bx}* = 2400.0 F_{bEb} = 154401433 F_{bEx}/F_{bx}*= 64333.93 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 6.7 OK F_{by}* = 2400 F_{bEd} = 1.54E+08 F_{bEy}/F_{by}*= 64333.93 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.37958333 Allowed = 0.37958333

Column

Axial Load (lb) = 1175 f_c = 95.9 psi F_c* = 1150
L_{eb} = 91.1 L_{eb}/d = 26.02857 greater = 26.0285714 OK F_{cE1} = 7.0917.E+06
L_{ed} = 91.1 L_{ed}/b = 26.02857 F_{cE2} = 7.0917E+06
F_{cE} = 7.09E+06 F_{cE}/F_c* = 6166.708 C_p = 0.99998378 F_c' = 1149.98 OK

Combined Bending and Axial Tension

f_t = 96 psi $f_t/F_t' + f_{b1}/F_{bb}$* = 0.091351 OK
F_t' = 1050 psi $f_t/F_t' + f_{b1}/F_{b1}$* $+ f_{b2}/F_{b2}$*= 0.091351 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.01 OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 95.9

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7/6/2011

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 3-11 4-10
Description: Compression Check
Description:
Model #: Solar Decathlon
Job: 1106-033

Loading

W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 3175 lbs

Conditions

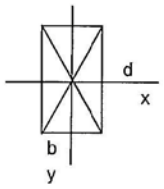
Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Member: 24Fb 3 1/2" x 3 1/2"
Member Axially Loaded in: Compression
.7 Deflection Check Load: no for C/C wind loads

Column check = **OK**

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 130.2 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 130.2 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 130.2 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 130.2 L_{eb} = 222.
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 130.2 L_{ed} = 222.
R_{Bx} = 8.0 OK F_{bx}* = 2400.0 F_{bEb} = 110219494 F_{bEx}/F_{bx}*= 45924.79 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 8.0 OK F_{by}* = 2400 F_{bEd} = 1.10E+08 F_{bEy}/F_{by}*= 45924.79 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.5425 Allowed = 0.5425

Column

Axial Load (lb) = 3175 f_c = 259.2 psi F_c* = 1150
L_{eb} = 130.2 L_{eb}/d = 37.2 greater = 37.2 OK F_{cE1} = 3.4719.E+06
L_{ed} = 130.2 L_{ed}/b = 37.2 F_{cE2} = 3.4719E+06
F_{cE} = 3.47E+06 F_{cE}/F_c* = 3019.035 C_p = 0.99996687 F_c' = 1149.96 OK

Combined Bending and Axial Tension

f_t = 259 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.246842 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.246842 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.05 OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 259.2

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1777 State Route 167
Victoria IL 61485

7/6/2011

Tel: 309-879-3258

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 3-11 4-10
Description: Tension Check
Description:
Model #: Solar Decathlon
Job: 1106-033

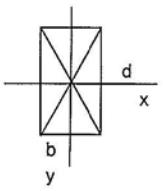
Member: 24Fb 3 1/2" x 3 1/2"
Member Axially Loaded in: Tension
.7 Deflection Check Load: no for C/C wind loads
Column check = OK

Loading

W_{bwall}=	0	pli
Wd_{wall}=	0	pli
Axial load =	8535	lbs

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



Conditions

Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 130.2 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 130.2 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 130.2 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 130.2 L_{eb} = 222.
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 130.2 L_{ed} = 222.
R_{Bx} = 8.0 OK F_{bx}* = 2400.0 F_{bEb} = 110219494 F_{bEx}/F_{bx}*= 45924.79 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 8.0 OK F_{by}* = 2400 F_{bEd} = 1.10E+08 F_{bEy}/F_{by}*= 45924.79 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.5425 Allowed = 0.5425

Column

Axial Load (lb) = 8535 f_c = 696.7 psi F_c* = 1150
L_{eb} = 130.2 L_{eb}/d = 37.2 greater = 37.2 OK F_{cE1} = 3.4719.E+06
L_{ed} = 130.2 L_{ed}/b = 37.2 F_{cE2} = 3.4719E+06
F_{cE} = 3.47E+06 F_{cE}/F_c* = 3019.035 C_p = 0.99996687 F_c' = 1149.96 OK

Combined Bending and Axial Tension

f_t = 697 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.663557 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.663557 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.37 OK
$f_{b1} < F_{bE}$ OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 696.7

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7/6/2011

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 5-9
Description: Tension Check
Description:
Model #: Solar Decathalon
Job: 1106-033

Member: 24Fb 3 1/2" x 3 1/2"
Member Axially Loaded in: Tension
.7 Deflection Check Load: no for C/C wind loads
Column check = OK

Loading

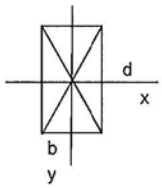
W_{bwall}=	0	pli
Wd_{wall}=	0	pli
Axial load =	1102	lbs

Conditions

Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 110.5 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 110.5 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 110.5 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 110.5 L_{eb} = 190
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 110.5 L_{ed} = 190
R_{Bx} = 7.4 OK F_{bx}* = 2400.0 F_{bEb} = 128787068 F_{bEx}/F_{bx}*= 53661.28 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 7.4 OK F_{by}* = 2400 F_{bEd} = 1.29E+08 F_{bEy}/F_{by}*= 53661.28 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.46041667 Allowed = 0.46041667

Column

Axial Load (lb) = 1102 f_c = 90.0 psi F_c* = 1150
L_{eb} = 110.5 L_{eb}/d = 31.57143 greater = 31.5714286 OK F_{cE1} = 4.8202.E+06
L_{ed} = 110.5 L_{ed}/b = 31.57143 F_{cE2} = 4.8202E+06
F_{cE} = 4.82E+06 F_{cE}/F_c* = 4191.462 C_p = 0.99997614 F_c' = 1149.97 OK

Combined Bending and Axial Tension

f_t = 90 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.085675 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.085675 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.01 OK
$f_{b1} < F_{bE}$ OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 90.0

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7/7/2011

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 5-9
Description: Compression Check
Description:
Model #: Solar Decathlon
Job: 1106-033

Loading

W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 10840 lbs

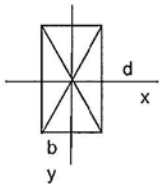
Conditions

Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Member: 24Fb 3 1/2" x 3 1/2"
Member Axially Loaded in: Compression
.7 Deflection Check Load: no for C/C wind loads
Column check = **OK**

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 110.5 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 110.5 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 110.5 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 3 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	3.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 12.25
Ix= 12.51 Sx = 7.15 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 110.5 L_{eb} = 190
Iy= 12.51 Sy = 7.15 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 110.5 L_{ed} = 190
R_{Bx} = 7.4 **OK** F_{bx}* = 2400.0 F_{bEb} = 128787068 F_{bEx}/F_{bx}*= 53661.28 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 7.4 **OK** F_{by}* = 2400 F_{bEd} = 1.29E+08 F_{bEy}/F_{by}*= 53661.28 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.46041667 Allowed = 0.46041667

Column

Axial Load (lb) = 10840 f_c = 884.9 psi F_c* = 1150
L_{eb} = 110.5 L_{eb}/d = 31.57143 greater = 31.5714286 **OK** F_{cE1} = 4.8202.E+06
L_{ed} = 110.5 L_{ed}/b = 31.57143 F_{cE2} = 4.8202E+06
F_{cE} = 4.82E+06 F_{cE}/F_c* = 4191.462 C_p = 0.99997614 F_c' = 1149.97 **OK**

Combined Bending and Axial Tension

f_t = 885 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.84276 **OK**
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.84276 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK** $[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.59 **OK**
$f_{b1} < F_{bE}$ **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 884.9

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1777 State Route 167
Victoria IL 61485

7/7/2011

Tel: 309-879-3258

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2005 NDS Combined Bending and Axial Loading

CLIENT: **Nordic**
Description: **Webs 6-8**
Description: **Tension Check**
Description:
Model #: **Solar Decathlon**
Job: **1106-033**

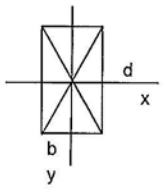
Loading
W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 1840 lbs

Conditions
Moisture Condition **Dry**
Temperature **T ≤ 100**
Plies = 1

Member: **24Fb 3 1/2" x 7 1/2"**
Member Axially Loaded in: **Tension**
.7 Deflection Check Load: **no** for C/C wind loads

Column check = **OK**

Load Factors
Load Duration (C_D) = **1.00**
Repetitive Member Factor C_r = **1.00**
K_e = **1.0**
Incised? **no**
COV_E **0.25**



DEFLECTION LIMIT = L/ **240** IN
Span Length Bending Member: **110.5** IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= **110.5** IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= **110.5** IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: **no** Yes; C_L= 1.0 see note
Bearing Member **24Fb 3 1/2" x 14"**
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 7 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	7.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 26.25
Ix= 123.05 Sx = 32.81 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 110.5 L_{eb} = 202
Iy= 26.80 Sy = 15.31 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 110.5 L_{ed} = 202
R_{Bx} = 11.1 **OK** F_{bx}* = 2400.0 F_{bEb} = 56541134 F_{bEx}/F_{bx}*= 23558.81 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 3.6 **OK** F_{by}* = 2400 F_{bEd} = 5.56E+08 F_{bEy}/F_{by}*= 231810.4 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' **OK**
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' **OK**

Deflection

$Deflection_b$ = 0.000 **OK** $Deflection_d$ = 0.000 **OK**
Allowed = 0.46041667 Allowed = 0.46041667

Column

Axial Load (lb) = 1840 f_c = 70.1 psi F_c* = 1150
L_{eb} = 110.5 L_{eb}/d = 14.73333 greater = 31.5714286 **OK** F_{cE1} = 2.2133.E+07
L_{ed} = 110.5 L_{ed}/b = 31.57143 F_{cE2} = 4.8202E+06
F_{cE} = 4.82E+06 F_{cE}/F_c* = 4191.462 C_p = 0.99997614 F_c' = 1149.97 **OK**

Combined Bending and Axial Tension

f_t = 70 psi $f_t/F_t' + f_{b1}/F_{bb}$* = 0.066757 **OK**
F_t' = 1050 psi $f_t/F_t' + f_{b1}/F_{b1}$* $+ f_{b2}/F_{b2}$*= 0.066757 **OK**

Combined Bending and Axial Compression

$F_c < F_{cE1}$ **OK**
$F_c < F_{cE2}$ **OK**
$f_{b1} < F_{bE}$ **OK**

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.00 **OK**

Bearing

Bearing member F_{cp}' (psi) 560 **OK**
F_c = 70.1

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1777 State Route 167
Victoria IL 61485

7/6/2011

Tel: 309-879-3258

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2005 NDS Combined Bending and Axial Loading

CLIENT: Nordic
Description: Webs 6-8
Description: Compression Check
Description:
Model #: Solar Decathalon
Job: 1106-033

Loading

W_{bwall}= 0 pli
Wd_{wall}= 0 pli
Axial load = 17897 lbs

Conditions

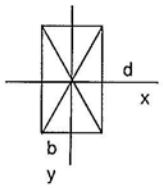
Moisture Condition Dry
Temperature T ≤ 100
Plies = 1

Member: 24Fb 3 1/2" x 7 1/2"
Member Axially Loaded in: Compression
.7 Deflection Check Load: no for C/C wind loads

Column check = **OK**

Load Factors

Load Duration (C_D) = 1.00
Repetitive Member Factor C_r = 1.00
K_e = 1.0
Incised? no
COV_E 0.25



DEFLECTION LIMIT = L/ 240 IN
Span Length Bending Member: 110.5 IN
DISTANCE BETWEEN LATERAL SUPPORT ON BREADTH EDGE b (lb)= 110.5 IN (enter 0.001 for continuous support)
DISTANCE BETWEEN LATERAL SUPPORT ON DEPTH EDGE d (ld)= 110.5 IN (enter 0.001 for continuous support)
Beam Stability Factor C_L override: no Yes; C_L= 1.0 see note
Bearing Member 24Fb 3 1/2" x 14"
Bearing member F_{cp} (psi) 560

Member Properties	F_b (psi)	F_t (psi)	F_v (psi)	F_{cp} (psi)	F_c (psi)	E (psi)	b (in)	d (in)	c	Plys	Effective b	E
24Fb 3 1/2" x 7 1/2"	2400	1050	250	560	1150	1.6E+10	3.5	7.5	0.9	1	3.5	5.84

(F_t, E, E_{min}) C_t 1
(F_b, F_v, F_c, F_{cp}) C_t 1
(E, E_{min}) C_i = 1.00
(F_b, F_t, F_c, F_v) C_i = 1.00
(F_{cp}) C_i = 1.00

Wet service Factor C_M

F_b	F_t	F_v	F_{cp}	F_c	E and E_{min}
1	1	1	1	1	1

C_{fu} 1

Bending Flexure

Area = 26.25
Ix= 123.05 Sx = 32.81 M_{b_max} = 0 f_{b1} = 0 psi L_{ub} = 110.5 L_{eb} = 202
Iy= 26.80 Sy = 15.31 M_{d_max} = 0 f_{b2} = 0 psi L_{ud} = 110.5 L_{ed} = 202
R_{Bx} = 11.1 OK F_{bx}* = 2400.0 F_{bEb} = 56541134 F_{bEx}/F_{bx}*= 23558.81 C_{Lx} = 1.0000 F_{bx}' = 24
R_{By} = 3.6 OK F_{by}* = 2400 F_{bEd} = 5.56E+08 F_{bEy}/F_{by}*= 231810.4 C_{Ly} = 1.0000 F_{by}' = 24

Bending Shear

V_x = 0 f_{vb} = 0 F_{vb}' = 250 fvb<Fvb' OK
V_y = 0 f_{vd} = 0 F_{vd}' = 250 fvd<Fvd' OK

Deflection

$Deflection_b$ = 0.000 OK $Deflection_d$ = 0.000 OK
Allowed = 0.46041667 Allowed = 0.46041667

Column

Axial Load (lb) = 17897 f_c = 681.8 psi F_c* = 1150
L_{eb} = 110.5 L_{eb}/d = 14.73333 greater = 31.5714286 OK F_{cE1} = 2.2133.E+07
L_{ed} = 110.5 L_{ed}/b = 31.57143 F_{cE2} = 4.8202E+06
F_{cE} = 4.82E+06 F_{cE}/F_c* = 4191.462 C_p = 0.99997614 F_c' = 1149.97 OK

Combined Bending and Axial Tension

f_t = 682 psi $f_t/F_t'+f_{b1}/F_{bb}$* = 0.649324 OK
F_t' = 1050 psi $f_t/F_t'+f_{b1}/F_{b1}$*$+f_{b2}/F_{b2}$*= 0.649324 OK

Combined Bending and Axial Compression

$F_c < F_{cE1}$ OK
$F_c < F_{cE2}$ OK
$f_{b1} < F_{bE}$ OK

$[f_c/F_c']^2 + f_{b1}/\{F_{b1}'[1-(f_c/F_{cE1})]\} + f_{b2}/\{F_{b2}'[1-(f_c/F_{ce2}) - (f_{b1}/F_{bE})^2]\}$ = 0.35 OK

Bearing

Bearing member F_{cp}' (psi) 560 OK
F_c = 681.8

Detailed Water Budget

Function	Events	Gallons per Event	Water Used (Gallons)	Notes
Hot water Draws	16	20	320	15 gallon requirement plus 5 gals extra for “warm up”, if necessary, to reach 110 F
Water Vaporization	5	0.75	3	
Dishwasher	5	3	15	3 gallons per use from Manufacturer's Specifications
Laundry Washer	8	11	88	11 gallons per use from Manufacturer's Specifications
Hot Water Storage Tanks	1	135	135	80 gallon Solar Thermal Tank, 50 gallon Backup Tank, and Circulation line
Initial System Fill	1	45	45	Initial water system bleed and pipe fill
Irrigation	15	5	75	5 gallons per day for 15 days, for flowers
Fire Protection	N/A	N/A	500	Sprinkler system discharge
Testing	N/A	N/A	100	Testing of domestic hot water system prior to start
Safety Factor	N/A	N/A	193	15% of total water use
Water Required			**1479**	Total water used over Decathlon Competition

Summary of Unlisted Electrical Components

We have no unlisted electrical components. All electrical components carry an approved testing agency's listing per section 6-7 of the SD2011 Building Code.

Summary of Reconfigurable Features

Storage Wall

The storage walls are effortlessly slid into the hallway expanding the dining and living rooms to provide more flexibility for the family. They are offset from each other, allowing them to be in the open position simultaneously or one at a time. The walls are connected to a track along a truss, which carries a portion of the load. There are also casters along the bottom of the wall, which run along a minimal steel track in the floor and carry the majority of the load. The storage walls are engineered to slide along the track safely and effortlessly.

For the public tours, the house will be configured in its primary layout, however, we will demonstrate the movable components to the jurors during their guided tour. The west storage wall will be moved to expand the dining room for the dinner party and allow the table and chairs to be reconfigured to comfortably seat eight. For movie night the east storage wall will be moved to the open position allowing the living room furniture to be reconfigured.

REF: DRAWING: A-603 MOVABLE COMPONENT DIAGRAM

Operable External Blinds

The windows on the south, east and west facades of the 4Dhome are all shaded by exterior horizontal blinds. These products are all commercially available and produced by Hella. The blinds are operated by electronic controls from the interior of the house allowing the user to control the tilt angle and total window coverage. They can be used to mitigate both solar heat gain and daylight.

The blinds will be used in the competition to supplement the passive cooling strategy for the 4dhome. During peak cooling load hours, the blinds will be used to reduce the solar heat gain coefficient of the respective glazing they are covering. The blinds will be retracted as necessary to optimize passive cooling throughout the day.

At night the blinds will be fully retracted to allow views to the interior from outside. During juried walkthroughs the full spectrum of configurations will be demonstrated.

Interconnection Application Form

Team Massachusetts, Lot 401

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
SUNPOWER	Twenty-eight E-19/240 modules; arranged in two arrays, each array having two strings of seven panels each.	6720 W [28 panels rated 240 W]

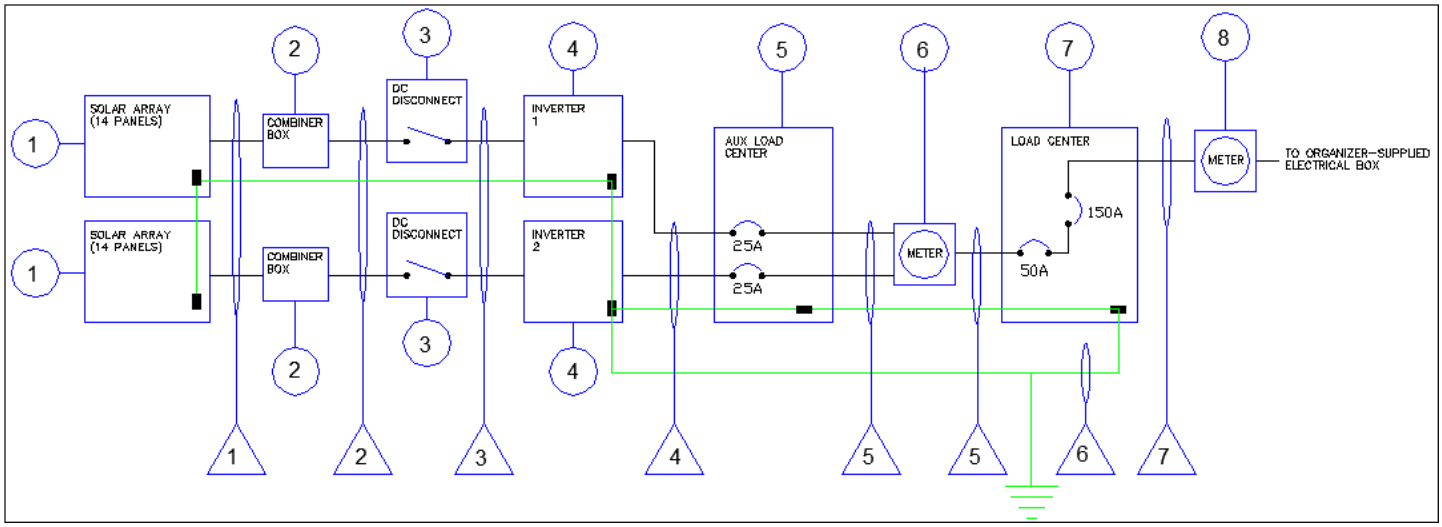
Total DC power of all arrays is _____6.7_____ kW (in tenths)

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
SOLECTRIA	PVI 4000	240 VAC	4.0 KW	2

Total AC power of all inverters is ____8____ kW (in whole numbers)

One-Line Electrical Schematic



O	PV SYSTEM EQUIPMENT SCHEDULE				
TAG	COMPONENTS	NO.	MANUFACTURER	MODEL	NOTES
1	PV MODULE	28	SUNPOWER	E19 / 240	4 STRINGS OF 7 MODULES PER STRING
2	COMBINER BOX	2	WILEY ELECTRONICS	ACE-2P	NEMA 3R ENCLOSURE
3	DC DISCONNECT	2	SQUARE D	HU362RB	3-POLE UNFUSED, 60A, 600VDC, NEMA 3R ENCLOSURE, 200KA MAX SHORT CIRCUIT RATING
4	DC/AC INVERTER	2	SOLECTRIA	PVI 4000	NOT CAPABLE OF BACK-FEEDING CURRENTS, NEMA 4/IP 65 ENCLOSURE
5	AUX LOAD CENTER	1	SQUARE D	QO612L100RB	100A MAIN LUG LOAD CENTER, OUTDOOR RATED, 1Ø 120/240VAC 3W, 12 CIRCUITS 6 SPACES, 10 KA MAX SHORT CIRCUIT RATING
6	METER	1	GE	I-210+C	
7	MAIN LOAD CENTER	1	SQUARE D	HOM1632L200TC	240V, 200A, 1 PHASE, 16 SP, 10 KA MAX SHORT CIRCUIT RATING
8	METER	1	N/A	N/A	ORGANIZER SUPPLIED METER

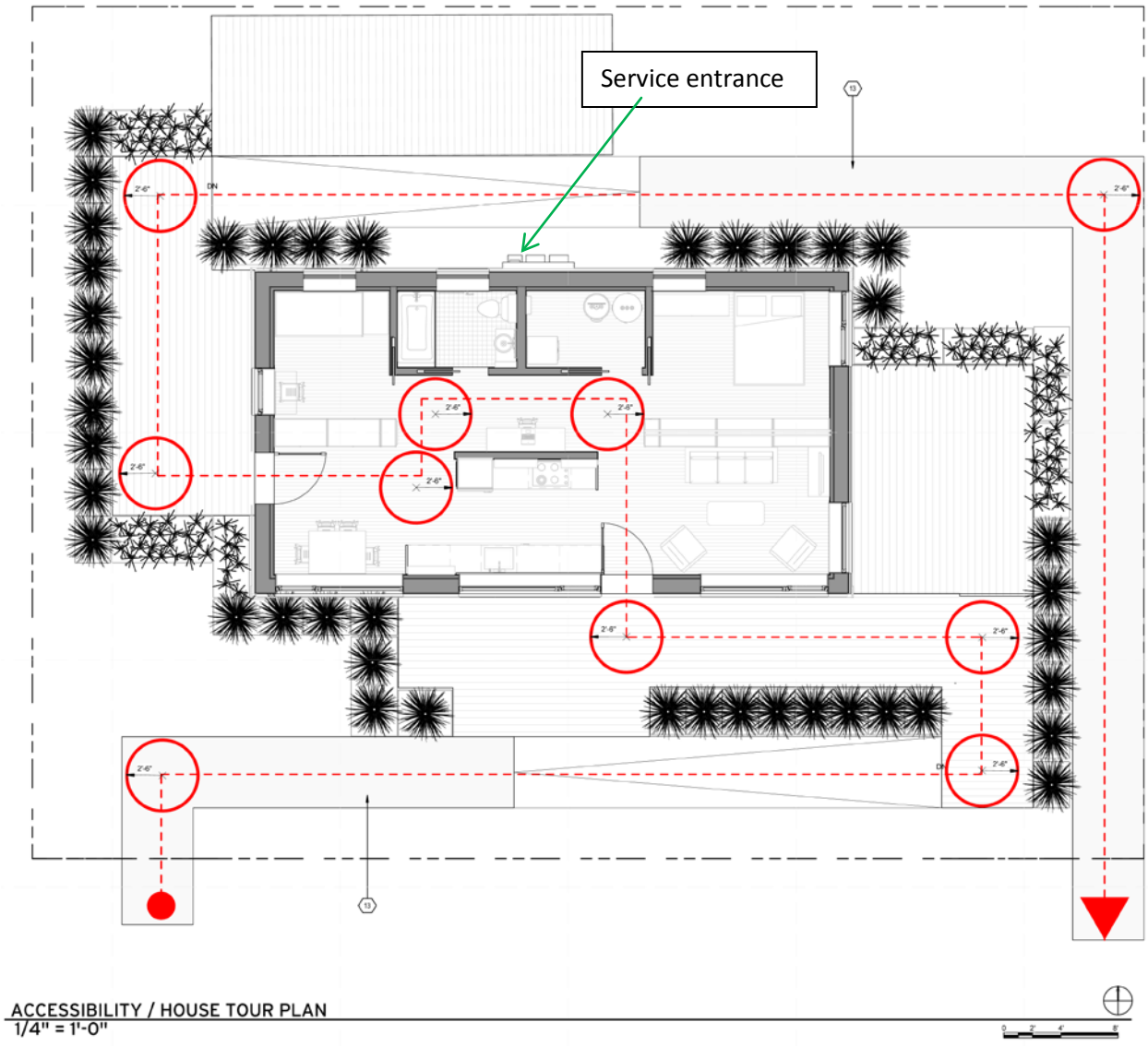
Δ	CONDUCTOR AND CONDUIT SCHEDULE				
TAG	DESCRIPTION OR CONDUCTOR TYPE	CONDUCTOR GAUGE	#/COLOR OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
1	USE-2	10 AWG	4/BLACK,4/BLACK W/WHITE TERMINAL MARKINGS	FREE AIR	N/A
	EQUIP. GROUNDING CONDUCTOR (EGC)	10 AWG	2/BARE CU	FREE AIR	N/A
2 & 3	THWN-2	10 AWG	1/BLACK, 1/WHITE PER CONDUIT	2/EMT	3/4''
	INSULATED EGC	10 AWG	1/GREEN PER CONDUIT		
4	THWN-2	10 AWG	2/RED, 2/BLACK, 2/WHITE PER CONDUIT	2/EMT	3/4''
	INSULATED EGC	10 AWG	1/GREEN PER CONDUIT		
5	THWN-2	4 AWG	1/BLACK, 1/RED, 1/WHITE	EMT	1.5"
	INSULATED EGC	10 AWG	1 BARE CU		
6	GROUNDING ELECTRODE CONDUCTOR (GEC)	4 AWG	1 BARE CU	N/A	N/A
7	THWN-2	2/0 AWG	2/BLACK, 1/WHITE	1/EMT	1"

Calculations of service/feeder net computed load and neutral load (NCE 220)

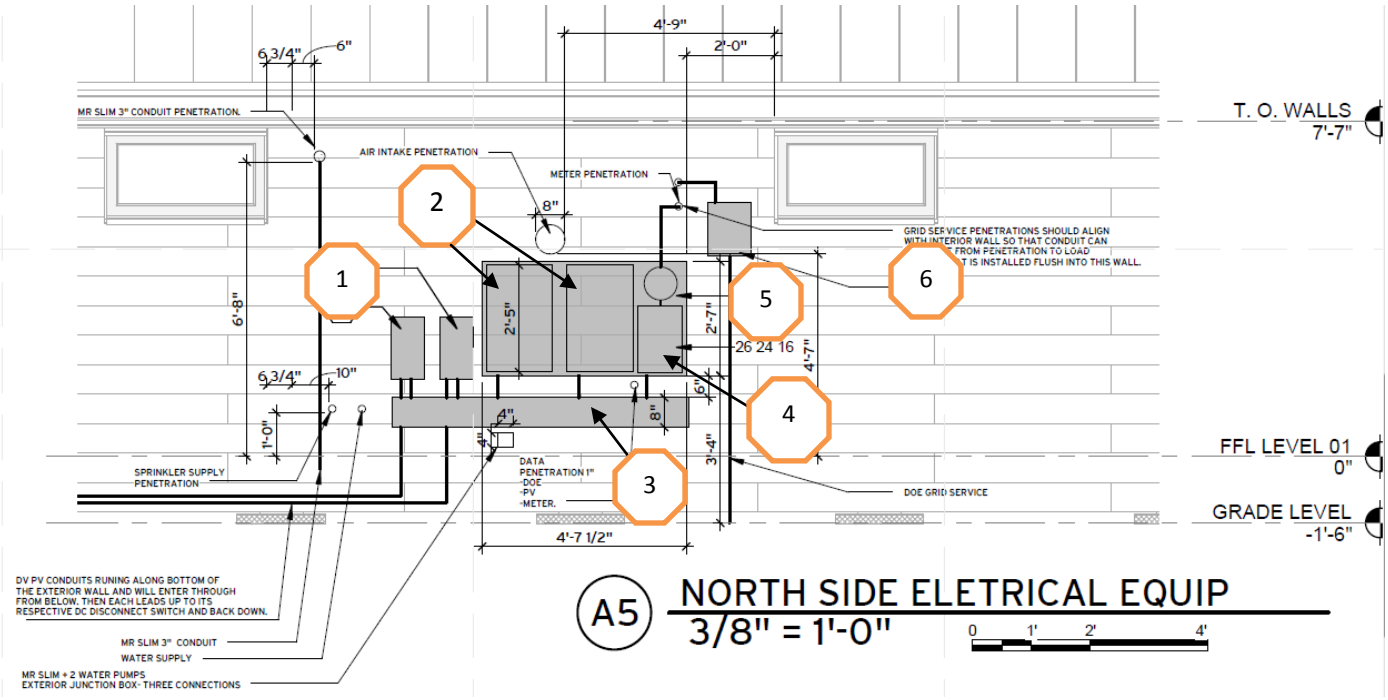
LOAD CALCULATIONS			
REFERENCES	LOAD	VALUE	UNIT
220.82 (B) (1)	GENERAL LIGHTING LOAD (3 VA/SQ FT*945 SQ FT)	2835	VA
220.82 (B) (2)	TWO 20 AMP SMALL APPLIANCE CIRCUIT (2X1500)	3000	VA
220.82 (B) (2)	LAUNDRY CIRCUIT	1500	VA
220.82(B) (3)	REFRIGERATOR	1800	VA
220.82(B) (3)	COOK TOP	7700	VA
220.82(B) (3)	COOKTOP HOOD	240	VA
220.82(B) (3)	DISHWASHER	1800	VA
220.82(B) (3)	MICROWAVE	1800	VA
220.82(B) (3)	HRV	96	VA
220.82(B) (3)	AIR SOURCE HOT WATER HEATER	1440	VA
220.82(B) (3)	50 GAL HOT WATER TANK	6000	VA
220.82(B) (3)	DEHUMIDIFIER	624	VA
220.82(B) (3)	WATER SUPPLY PUMP	1500	VA
220.82(B) (3)	DRYER	5000	VA
	TOTAL, GENERAL LOAD:	35335	VA
	FIRST 10KVA AT 100%	10000	VA
	REMAINDER AT 40% (0.4*25335)	10134	VA
	SUBTOTAL GENERAL LOAD	20134	
220.82 (C) (2)	MR. SLIM HEAT PUMP (AIR CONDITIONING)	1500	VA
	TOTAL:	21634	VA
	CALCULATED LOAD FOR SERVICE: (TOTAL/240V)	90	A
	DECATHLON GRID SERVICE & HOUSE LOAD CENTER MAIN BREAKER	150	A
	TOTAL AMPACITY FOR PV INVERTER CIRCUITS (2*25)	50	A
	TOTAL AMPACITY OF CIRCUITS SUPPLYING POWER TO LOAD CENTER	200	A
	MAIN LOAD CENTER RATING	200	A
690.64 (B)(2)	ALLOWABLE AMPACITY FOR CIRCUITS SUPPLYING POWER (1.2*200)	240	A
THEREFORE, DECATHLON GRID SERVICE SUPPLIES ENOUGH CURRENT TO MEET LOAD REQUIREMENT (90< 150A), AND TOTAL OF INPUT CIRCUITS IS LESS THAN 120% OF LOAD CENTER CAPACITY (150+50 < 240)			

NEUTRAL LOAD CALCULATIONS		
	Value	Unit
GENERAL LIGHTING LOAD (3VA/ft2)	2835	VA
20 AMP SMALL BRANCH CIRCUIT (2X1500)	3000	VA
Sub Total	5835	VA
3000 VA @ 100%	3000	VA
5835VA-3000VA = 2835 @ 35%	992.3	VA
Sub Total	3992	VA
Microwave and cooktop 9740 VA X 70% for neutral load	6818	VA
Clothes washer dryer 5000 VA X 70%	3500	VA
Dishwasher	1800	VA
Sub total	12118	VA
Total Load	16110	VA
Calculated for neutral = 16110 / 240V	67.13	A

Plan view of the lot showing the house, decks, ramps, tour paths and the service point



Elevation view showing the terminal box (contains the service point), meter and other service equipment



1: DC Disconnect Switches

2: Inverters

3: Conduit Trough

4: Aux Load Center

5: PV Meter

6: Organizer Meter

Energy Analysis Results and Discussion

Table of Contents

1. INTRODUCTION

The results of the Solar Decathlon are not only a showcase of cutting edge homes designed by students, the homes are the embodiment of the ideas of the future where sustainability will help save nations from their dependence on fossil fuels and the earth from climate change. One emerging idea is Passive House, which aims in the design of a home that uses 90% less energy than a conventional home. Passive house standards were formulated at the first Earth Summit in 1992 and aim for a specific energy use equal to or less than 4.75 kBtu/ft^2/yr. This value is regarded as the most amount of energy humanity can afford to spend in each new and retrofitted home in order to maintain and save our climate.

Team Massachusetts has decided to design to Passive House standards. The design methodology leads to a final product where highly insulated walls, superior air tightness, and passive solar and internal gains allow a home to be ultra-efficient. Only after an efficient building envelope is designed, are the photovoltaics then implemented to mitigate electrical loads.

The adoption of Passive House principles has informed the 4Dhome's building envelope to the highest degree; including window placements, wall constructions, and the mitigation of thermal bridging. The Passive House Planning Package (PHPP) has given Team Massachusetts the ability to make quick changes to the envelope design and to see the subsequent effects on an annual steady state energy balance.

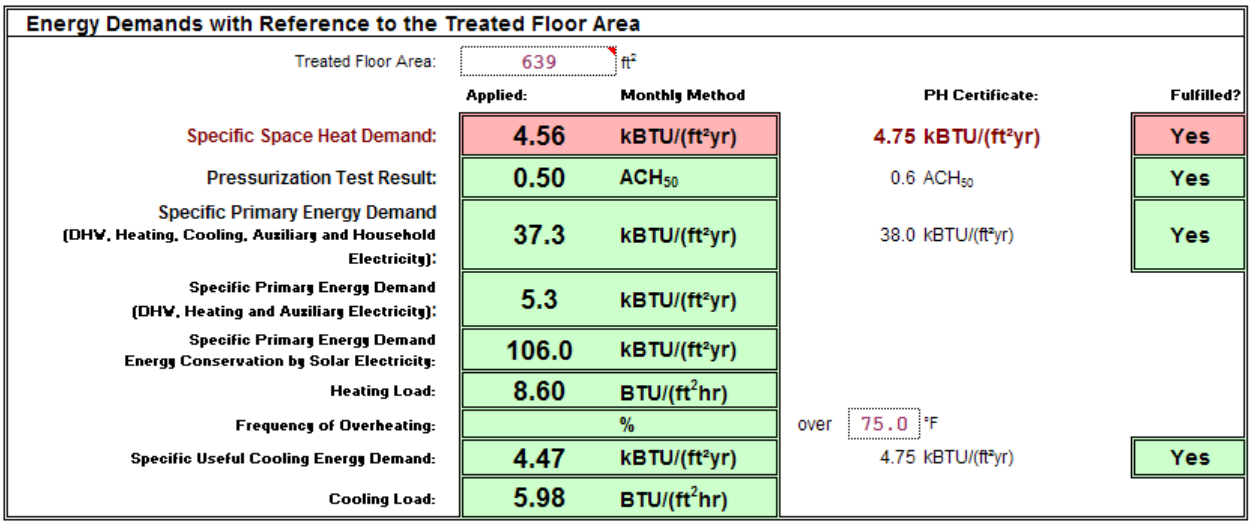
To further investigate the dynamic behavior of the mechanical systems, the 4Dhome has been simulated using Matlab's Simulink, a fully customizable graphical user interface. The dynamic model was successful in simulating the solar decathlon events, something that could not have been simulated using the PHPP. The results showed the mechanical systems in place will satisfy the 4Dhome's needs during climate extremes and most importantly, the rigors of the Solar Decathlon Competition. The results of the PHPP analysis, the HVAC design, the active and passive systems, and the results from dynamic model are explained in the subsequent sections.

2. ENERGY EFFICIENT DESIGN

2.1. PHPP as Design Tool

The basis for all design considerations began with output from the PHPP. The results from the PHPP model are culminated together on a verification page, so as changes are made to the whole house model, the verification page can be reviewed to see whether a design change improved the overall energy balance. Figure 2.1 is a screen shot of the verification page for the 4Dhome.

Most parameters on the verification page are based on the treated floor area (TFA). In brief, the TFA is all area inside the home not including area underneath the footprint of the walls. The TFA also considers rooms with limited use like mechanical rooms to contribute only 60% of their floor area to the TFA total. The heating load and the cooling load are useful to size the mechanical systems for environmental extremes. The specific space heating and specific space cooling energy demands inform how much energy will be required to heat and cool each space on an annual basis.



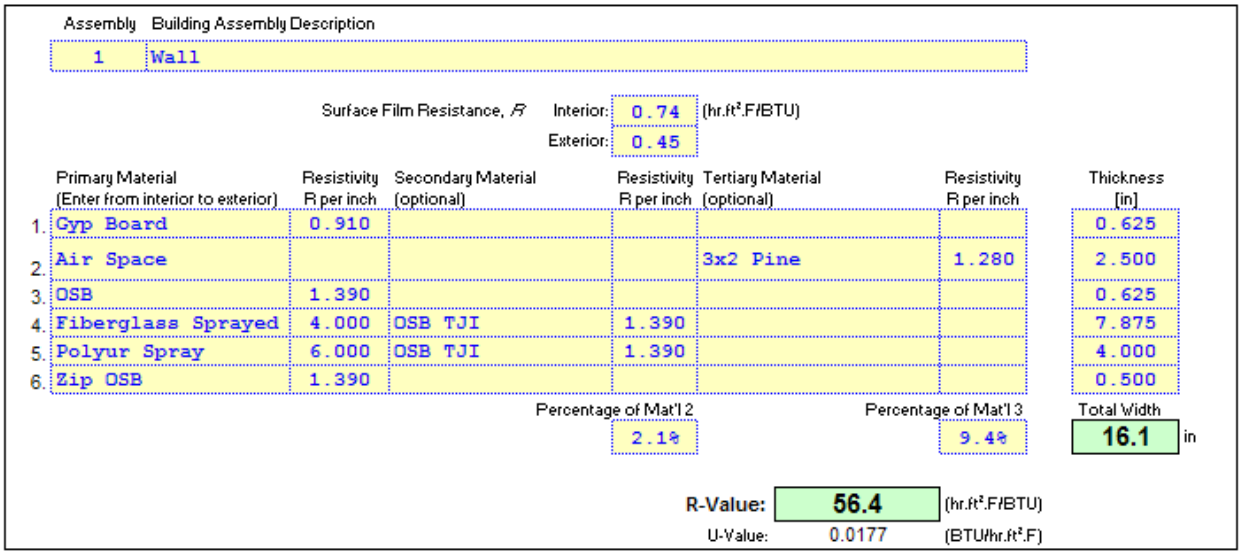
Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 639 ft²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	4.56	kBTU/(ft²yr)	4.75 kBTU/(ft²yr)	Yes
Pressurization Test Result:	0.50	ACH_{50}	0.6 ACH_{50}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	37.3	kBTU/(ft²yr)	38.0 kBTU/(ft²yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	5.3	kBTU/(ft²yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	106.0	kBTU/(ft²yr)		
Heating Load:	8.60	BTU/(ft²hr)		
Frequency of Overheating:		%	over 75.0 °F	
Specific Useful Cooling Energy Demand:	4.47	kBTU/(ft²yr)	4.75 kBTU/(ft²yr)	Yes
Cooling Load:	5.98	BTU/(ft²hr)		

Figure 2.1: Screen Shot of PHPP Verification

The building envelope, the skin of the 4Dhome, is a very important membrane that stops heat exchange between interior and exterior environments. PHPP allows for the construction of different wall, ceiling, and floor types and then for quick implementation into the steady state model. Figure 2.2 shows an example of a wall with an 11.875'' TJI wall stud, 24'' on center aside a 2.5'' utility chase.



Assembly 1 — Building Assembly Description: Wall

Surface Film Resistance, R — Interior: 0.74 (hr.ft².F/BTU); Exterior: 0.45

	Primary Material (Enter from interior to exterior)	Resistivity R per inch	Secondary Material (optional)	Resistivity R per inch	Tertiary Material (optional)	Resistivity R per inch	Thickness [in]
1.	Gyp Board	0.910					0.625
2.	Air Space				3x2 Pine	1.280	2.500
3.	OSB	1.390					0.625
4.	Fiberglass Sprayed	4.000	OSB TJI	1.390			7.875
5.	Polyur Spray	6.000	OSB TJI	1.390			4.000
6.	Zip OSB	1.390					0.500

Percentage of Mat'l 2: 2.1% — Percentage of Mat'l 3: 9.4% — Total Width: 16.1 in

R-Value: 56.4 (hr.ft².F/BTU)

U-Value: 0.0177 (BTU/hr.ft².F)

Figure 2.2: Screen Shot of Wall Element R-Value Calculation

After the walls are modeled, the windows can be assigned to each wall with their own specific orientation, size, solar heat gain coefficients, thermal properties, and overhangs. A way PHPP informed us in glazing application was to help determine the proper amount of glazing area required on the southern façade. The current glazing area is significantly higher than the conceptual design glazing area. The area of the windows needed to be increased so the sun could passively heat the home in the winter time. The PHPP also verified that the addition of more windows would mean a larger heat loss coefficient for the entire home, thus increasing the heating and cooling demand throughout the year. Using the verification page and the windows worksheet in tandem, the window area could be optimized. This trial and error method was not only the method for weighing the energy costs of different windows and their sizes, but also helped in the design of window overhangs, wall R-values, ventilation schemes, and thermal bridges.

After the entire building envelope is constructed in the PHPP, including walls, windows, doors, and thermal bridges, the heat loss of different components of the building envelope can be interpreted. Figure 2.3 shows the percentage of heat

loss transported through each building element. Notice the flux through the thermal bridges is negative; this means with respect to the original PHPP inputs, the thermal bridge analysis increased the accuracy of the model by eliminating redundancies in the heat loss calculations when they were made with respect to exterior dimensions.

Group #	Area Group	Area	Unit	Average R-Value [(hr.ft².F)/BTU]	H-Value: U × A [BTU/hr.F]	Fraction of Transmission Heat Losses	Average R-Value [(hr.ft².F)/BTU]
1	Treated Floor Area	638.6	ft²				
2	North Windows	26.7	ft²	4.3	6.2	6%	4.3
3	East Windows	46.3	ft²	5.6	8.3	8%	5.6
4	South Windows	192.4	ft²	5.7	33.8	31%	5.7
5	West Windows	39.8	ft²	5.2	7.7	7%	5.2
8	Exterior Wall - Ambient	1110.1	ft²	56.6	19.6	18%	56.6
10	Roof/Ceiling - Ambient	2077.2	ft²	60.8	34.2	31%	60.8
21	Thermal Bridges Ambient	277.8	ft	——	-1.0	-1%	——
Total Thermal Envelope		3493	ft²	32.2	108.6	100%	32.159
Envelope-Area-to-Treated-Floor-Area Ratio				5.5			

Figure 2.3: Screen Shot of Summary of Heat Loss through Each Building Element

2.2. Thermal Bridge Analysis and PHPP

Since PHPP models the building envelope with respect to exterior dimensions, there is some redundancy and sometimes a conservative heat loss calculation at any façade intersection. THERM by Lawrence Berkeley National Laboratory was used to model thermal bridges and to calculate their UA-Value for implementation into the PHPP model. For example, Figure 2.4 shows the peak of the home during a design and development stage as it was modeled through PHPP.

First, exterior dimensions are input into the PHPP, notice Figure 2.4, block 1, there is overlap between each element; this is what PHPP first assumes because of its one dimensional data input. To further show this, the elements are split up in block 2. The red lines indicate the overlapping boundaries of the separate entities. If PHPP were to calculate the UA of the building envelope with these overlapping entities, in cases where a thermal bridge free connection was designed, would yield a conservative heat loss calculation. Using THERM, the entities are combined into one by modeling the actual construction of the roof peak. The new heat loss coefficient for the thermal bridge determined in THERM is entered in place of the overlapping entities in PHPP, resulting in a more accurate heat loss model. Using THERM method ensures a precise building heat loss coefficient, like those needed for Passive House standards.

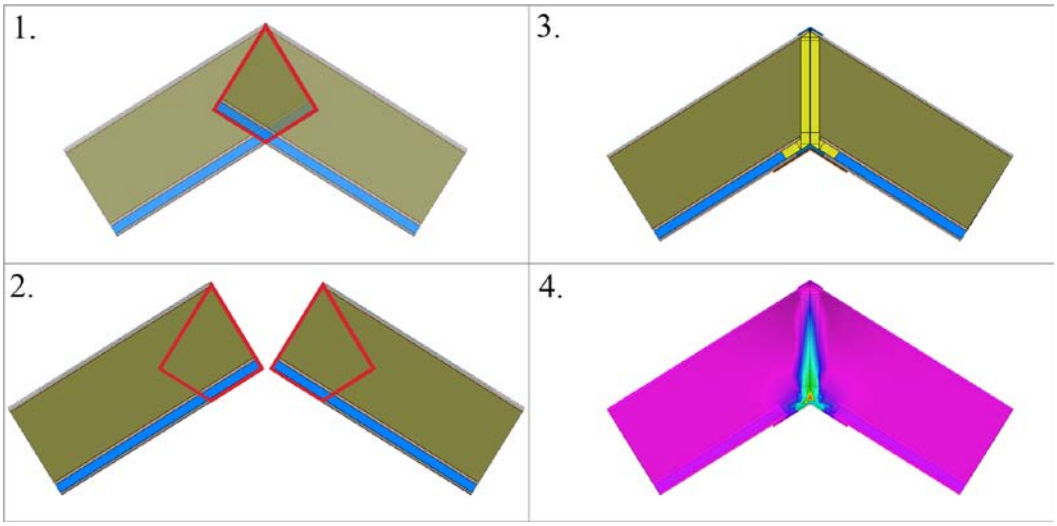


Figure 2.4: Eliminating Heat Loss Calculation Redundancies in PHPP with Thermal Bridge Calculations

2.3. PHPP Results for Boston

Great results from the PHPP near the Boston location were one of the main priorities because this is where the home will eventually reside. As the verification page was shown previously, the home meets PHPP standards in Boston, pending the blower door test which will determine the final air tightness of the home. The design heating load is 5495 BTU/hr and the design cooling load is just under one third of a ton, or 3820 BTU/hr. To put the heating use into perspective for the 4Dhome, it would take an 85% efficient furnace only 18 gallons of #2 fuel oil to heat the 4Dhome for one year!

Out of the total heat required for the home, the passive solar heating and internal gains will account for 83% of the total required heat. Window overhangs, window reveals, and shading reduction factors were designed for the Boston location in order to bring the specific cooling demand within acceptable levels.

2.4. PHPP Results for Washington DC

There is not much the PHPP can reveal about the competition in Washington for the short time the 4Dhome is there, but it can shed some light onto the difference of climate in Washington. For example, the design heating load is reduced to 1329 BTU/hr and design cooling load is reduced to 3386 BTU/hr. Although the design cooling load is reduced compared to Boston, the total annual cooling demand is increased to 7.73 kBTU/ft^2/yr. This indicates Boston is prone to higher climactic extremes than Washington, but Washington is a warmer location throughout the year. If the home was placed in Washington year round, 92% of the annual required heating energy would be satisfied by solar and internal gains alone. The dynamic simulation yielded the best results as to how the 4Dhome will perform in the Washington DC climate during the rigors of the competition.

3. HVAC SYSTEM

The mechanical systems have been designed to be highly efficient and to recover heat, to work seamlessly within the HVAC system as a whole while maintaining autonomy, and to provide comfort and convenience in an affordable and reliable design that will function for decades to come. Off-the-shelf components have been used which are accessible to the consumer, coupling them together in an innovative and yet simple and efficient configuration.

3.1. Heating & Cooling

The 4Dhome is heated and cooled with a highly efficient ducted heat pump. Meeting Passive House criteria has permitted the use of a small 9,000 BTU Mitsubishi unit, which is ducted to the main living space and each bedroom. In this split heat pump, a refrigerant is pumped between an outdoor and indoor unit; this fluid can absorb heat from interior air and transfer it outside (which cools the home), or can absorb heat from the outside air and transfer it inside (which heats the home). Unlike conventional electric heaters that use electricity to create heat inside the house, a heat pump uses electricity simply to transfer heat, making it much more efficient.

In addition, unlike conventional heat pumps, this unit is driven by an inverter which adjusts the compressor speed, allowing a varied output based on demand to save energy when possible. The heat pump used in the 4Dhome home transfers 2.9 times more heat energy than electricity it consumes, making it nearly 3 times more efficient than a conventional electric resistance heater.

3.2. Dehumidification

A dehumidifier is needed during hot summer months in Boston, and the Simulink energy model confirms the need for dehumidification in Washington DC in September. The 4Dhome has a 65 pint Honeywell dehumidifier ducted into the HVAC system. The dehumidifier has a dedicated return from the main living space in the hallway, and feeds into the existing main supply duct for the heat pump. With an energy factor of 2.11, this unit is one of the most efficient

residential dehumidifiers available. Because it is installed in the attic space and equipped with a drain line, the homeowner doesn't have to empty out the condensate from a tray, or trip over a large plug-in unit sitting in the middle of a room.

3.3. Ventilation

A Passive House is much more airtight than the conventional home, and so mechanical ventilation is very important. The 4D Home employs a heat recovery ventilator (HRV), which ventilates stale interior air through a heat exchanger, using it to pre-heat or pre-cool the incoming fresh air. The Nu-Air HRV unit in the 4D Home is Energy Star rated and captures up to 85% of the energy from the exhausted air. It requires small 5" penetrations in the roof for the fresh air intake and exhaust, and feeds into the main supply duct to the house.

3.4. Indoor Air Quality

Smoke and airborne debris from cooking contribute to poor air quality in the home. In addition to ventilation, a ductless range hood with separate filtering stages for grease, odors, and smoke was chosen to filter cooking fumes before they enter the conditioned space. This allows the occupants of the home to enjoy the benefits of cooking with a range hood without creating an additional penetration in the envelope. Since the hood does not vent to the outside, there is no cost associated with conditioning the make-up air, resulting in significant energy savings when there is a large temperature difference between the outside and conditioned space.

Heating and cooling loads have been minimized by meeting Passive House criteria, which has allowed the use of small and few mechanical components. It is still crucial, however, to design the HVAC system to be highly efficient to minimize electrical consumption and remain net-zero, without adding costly PV panels to our array. The mechanical components must operate under the extreme climate conditions of the area, and work with the other HVAC equipment efficiently, to ensure comfort for the homeowner throughout all seasons.

4. SOLAR THERMAL SYSTEM

Capturing energy from the sun and converting it to electricity via photovoltaic panels is a very clean way to generate electrical energy. However, PV panels are currently not that efficient in converting the sun's energy, most having efficiencies between 10-20% (ours are 19.3% efficient). A much more efficient means of capturing solar energy is through the use of solar thermal collectors, which capture the heat from the sunlight and transfer it to a fluid, which in turn can be used for any number of applications, including heating domestic hot water or space conditioning. Thermal collectors have efficiencies of 50% or higher, thus are anywhere from 3-5 times more efficient at capturing solar energy than PV panels. In previous Solar Decathlon events, several teams heated their hot water with efficient heat pumps and skipped a solar thermal system altogether. Team Massachusetts decided early on that solar thermal system technology, as a vital part of the greater solar energy industry, was too vital not to use on the 4Dhome.

For the 4Dhome, with its Passive House inspired design and super-efficient heat pump, we decided to use solar thermal for our domestic hot water (DHW). Though we could have used it for both heating and cooling the air, we decided the benefits did not outweigh the extra complication and cost.

In brief, this system uses solar thermal collectors and a heat exchanger in closed loop to pre-heat water in an 80 gallon "solar tank". The water in the 80 gallon tank then serves as preheated inlet water for the 50 gallon "backup" tank. If needed, the water is further heated to the set temperature of 125°F by a modern, efficient electric heat pump that is mounted on top of the 50 gallon tank. An electric element in the 50 gallon tank serves as a backup heating source. See a schematic of this system in Figure 4.1.

4.1. Sizing the System

The first step in sizing any DHW system is to determine the load on the system. How much hot water will the home's residents use during a typical day? What is the possible maximum load that the system may face? "Load" can be thought of as the gallons used per day at the hot water set point temperature. Two loads had to be considered; one for just the decathlon contests, and one for the home's permanent location here in Massachusetts. For the decathlon, the load is based off the hot water draws and the dishwasher runs (Team Massachusetts plans to use cold water for clothes washing). The contest hot water load is in Table 4.1.

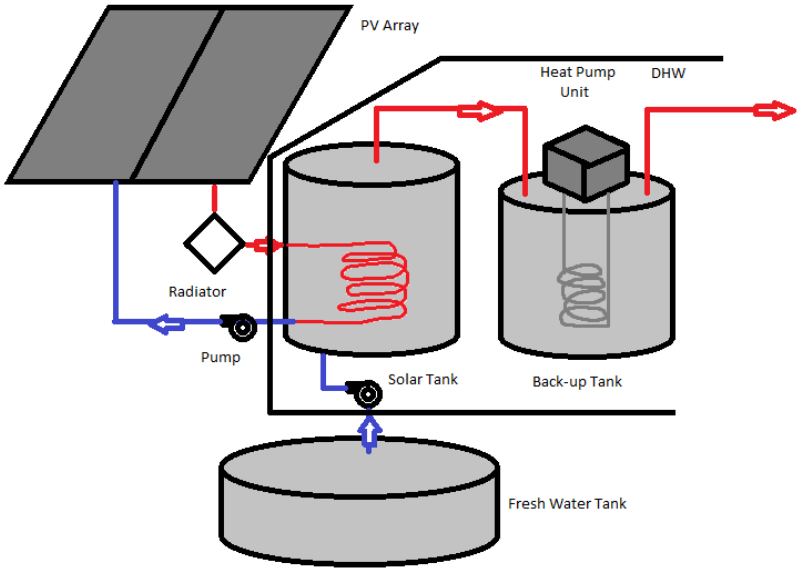


Figure 4.1: Schematic of DHW

Table 4.1: Hot Water Contest Loads per Day for the 2011 Decathlon

Day	Hot Water Draws	Gallons	Dishwasher Runs	Gallons	Total Gallons/Day	Liters
8	2	30	1	2.9	32.9	124.4
9	0	0	0	0	0	0.0
10	2	30	0	0	30	113.4
11	2	30	1	2.9	32.9	124.4
12	2	30	0	0	30	113.4
13	1	15	0	0	15	56.7
14	3	45	1	2.9	47.9	181.1
15	2	30	1	2.9	32.9	124.4
16	2	30	1	2.9	32.9	124.4
Total	*16*	*240*	*5*	*14.5*	*254.5*	962.0
				Average	31.8	120.3
				Maximum	47.9	181.1

For the annual load after the home is rebuilt in Boston, the industry standard of 20 gallons per person per day, or 60 gallons per day for the three person household was used (an independent analysis resulted in a 57 gal/day load for the 4Dhome). 60 gallons per day is nearly double the average requirement for the decathlon. Therefore, our initial question was should the solar thermal system be sized to meet the higher load in Boston or the lower load for the competition. Other factors to be considered included system cost; that back-up water heater was a very efficient electric heat pump

which itself would consume little energy; and finally, the weather conditions for the decathlon (DC in September) were much more favorable for solar hot water heating than the conditions the system would be exposed to in Boston through an entire year. The team turned to two modeling methods to help with this decision—using the publically available Retscreen and an analytical method carried out by using MathCAD. A screen shot of the analysis from Retscreen showing the use of Boston annual data, 120˚F water temp, and a demand of 60 gal/day is shown in Figure 4.2.

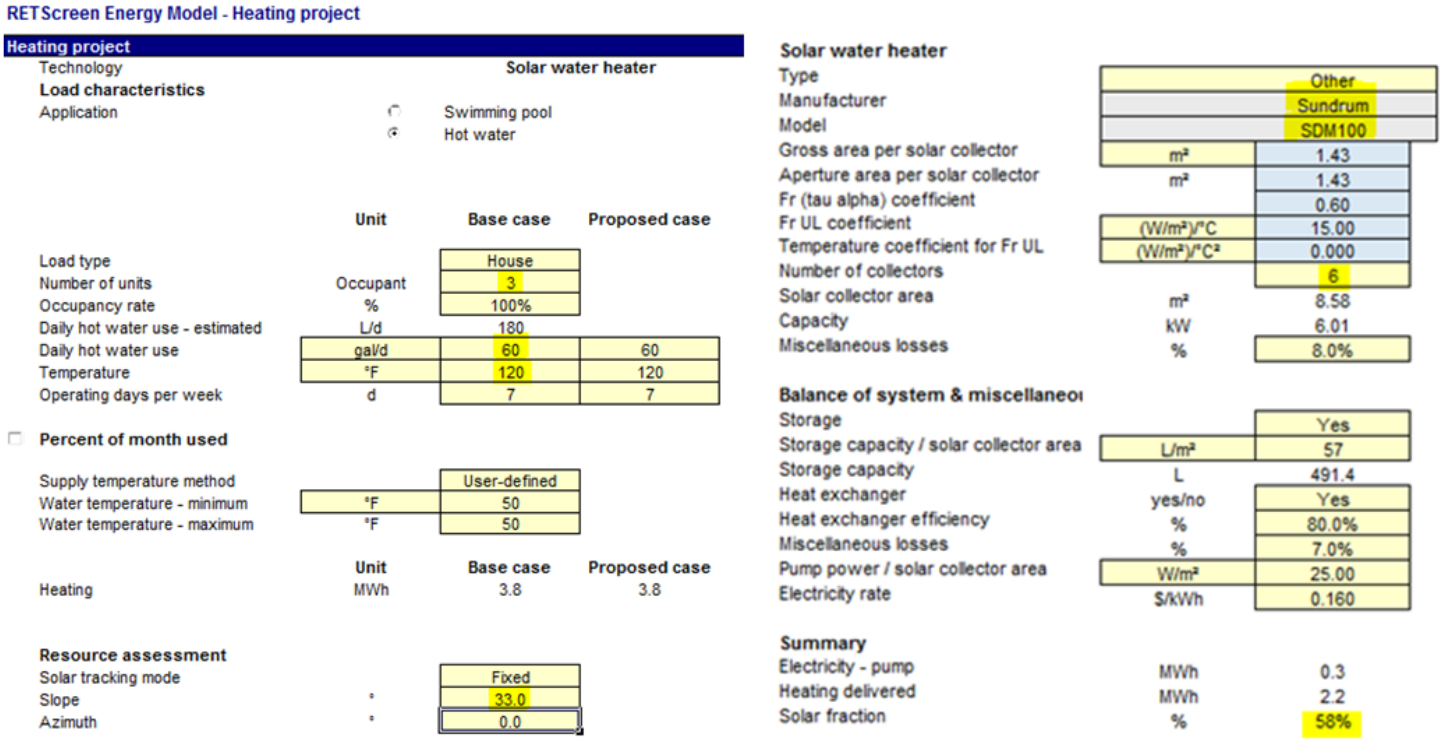


Figure 4.2: Screen Shot of Retscreen Modeling Software used to Calculate the Solar Fraction

The second method allowed the team to take an analytical approach to the problem. Several important calculations were achieved using MathCAD, including:

- Determining the available solar energy (the monthly average (for Boston) or daily (for the decathlon) irradiation on a tilted surface
- Converting the load from gallons per day into energy required per day, calculating the energy lost through the storage tank walls, and then combining these two to determine the total energy load (per day for the decathlon, per month for Boston)
- Using the "f-chart" method where a series of equations are used to determine the solar fraction, using the same parameters for the SunDrum panels as were used in Retscreen

Table 4.2 includes the results from 9 runs in MathCAD, using the same scenarios used in Retscreen. Both models yield similar results. To reach a relatively high solar fraction in Boston (73% average), a system using eight SunDrum panels is required. However, for the much smaller load and more favorable conditions of the decathlon, only six panels would provide 94% of our DHW load. In result, the 4Dhome will be using six panels during the competition, whereby the solar thermal system should be able to supply nearly the entire contest load. The final owner of the home could always add two additional SunDrum panels for a relatively low cost during the rebuild, if they desired a higher solar fraction for their home.

Table 4.2: Comparison of Results between Retscreen and Analytical Method

Specific Parameters						Solar Fraction Per Analysis Method		
Simulation Number	Climate Data Location	Duration	Hot Water Temperature (˚F)	Load (gal/day)	# of SunDrum Panels	Retscreen	Analytical	Average
1	DC	9 days	120	31.8	4	68%	82%	75%
2	DC	9 days	120	31.8	6	100%	92%	96%
3	DC	9 days	130	31.8	4	59%	75%	67%
4	DC	9 days	130	31.8	6	100%	87%	94%
5	Boston	year	120	60	4	29%	44%	37%
6	Boston	year	120	60	6	58%	59%	59%
7	Boston	year	130	60	4	23%	38%	31%
8	Boston	year	130	60	6	47%	51%	49%
9	Boston	year	130	60	8	82%	63%	73%

4.2. The SunDrum Collector

Finally, the SunDrum Panels were chosen over traditional flat plat or evacuated tube collectors for their innovative hybrid technology. Unlike other solar thermal collectors which are mounted separately from a PV system, SunDrum's panels are very thin and mount directly behind the surface of the PV modules. As a PV panel's temperature increases from exposure to sunlight, the temperature difference between the panel and the cooler liquid flowing in planer flow inside the SunDrum panel (water for the competition, a glycol solution to prevent freezing once rebuilt in Massachusetts) causes heat to transfer from the panel to the liquid. Thus, part of the sun's energy that would ordinarily have been wasted is captured by the hybrid panel, and used to heat DHW. A secondary effect is that the PV panel's temperature is lowered during this process, and therefore its efficiency is increased slightly compared to an un-paired panel. Figure 4.3 shows a SunDrum panel mounted in a PV panel. The relative thinness of the panel is evident.

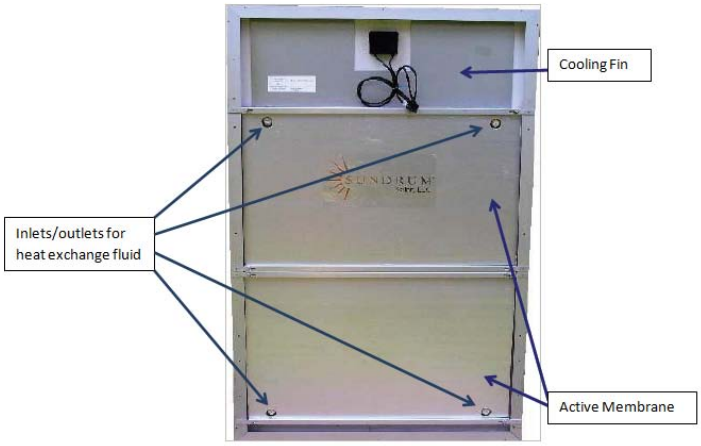


Figure 4.3: SunDrum Panel Installed in its Mated PV panel

Each panel is made of two thin sheets of sandwiched metal, a thin sheet of insulation, and a frame. In this system, there aren't cylindrical pipes underneath the PV that carry the water; it instead flows between two thin sheets of metal. These sheets have perforations that direct this planar flow along a serpentine path. The hybrid panels will have inlet and outlet pipes (PEX tubing) feeding into and from the bottom (connected to other panels in series). The inlet and outlet ports are located at the top and bottom corners. Using hybrid panels frees up more roof space for additional PV panels (if required), and captures more energy per square foot of installed panel.

5. SOLAR ELECTRIC SYSTEM

5.1. The Modules

The decision to use SunPower monocrystalline modules was based on several factors; the extremely high efficiency and competitive temperature rating of the panel, and the company's locality. The SunPower E19/240 panels are 19.3% efficient, and have a temperature rating of over 90% (ratio of the rated power at PTC, to the rated power at STC). A module's rating at PTC is a more accurate reflection of the real life performance of the panel than is the STC. The high efficiency of this panel is largely attributed to the use of monocrystalline material, and the all-back contact design. Because our trellis design imposes size constraints for the PV array, it is necessary to use a highly efficient panel with a large power output per area, to ensure the entire electrical load of the home is met with the particular array area available.

5.2. The Array

The photovoltaic system is sized to meet the entire annual electrical load of the 4Dhome when in Boston, Massachusetts. The main array is comprised of twenty-eight SunPower E19/240 panels, having a total DC rating of 6664 W. Because of the size of the array necessary, and the temperature conditions of Massachusetts, proper string sizing requires us to have two arrays, each having two strings of seven panels. Each array connects to a Solectria PVI 4000 string inverter. This configuration allows the user to determine if the PV system is working correctly; each array should produce an equal amount of power, so a malfunction in one array will be easily detectable. All twenty-eight panels are mounted on a south-facing trellis; the PV panels act as an overhang and provide summer shading. The trellis sits above the roof and allows for natural convective cooling of the panels.

5.3. Optimal Tilt Angle

Using an analytical method and TMY3 data, it was found the optimal PV array tilt angle for a non-shaded site in Boston, Massachusetts is 36.5 degrees. This is nearly 6 degrees less than the latitude of 42.4 degrees. Figure 5.1 shows changing the tilt angle from the optimal slope will result in a loss of electricity produced over the 30 year lifetime of the array; the farther away the array is installed from the optimal tilt angle, the losses become more significant. In the design of the 4Dhome's roof and trellis, the optimal tilt angle was considered. Weighing aesthetics and minimal predicted losses in performance, the angle of the roof and trellis is 33 degrees. An array at 33 degrees receives 99.9% the incident energy of an array at the optimal angle.

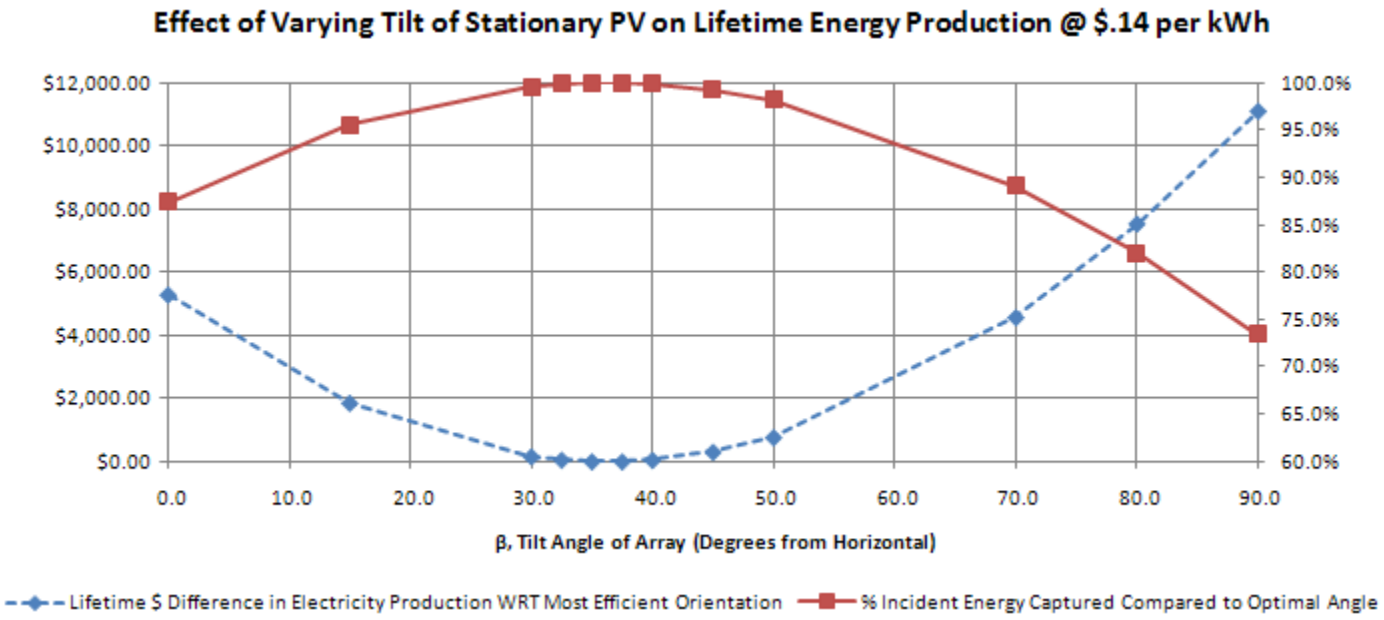


Figure 5.1: Effects of Tilt Angle on Annual PV Output for the 4Dhome

5.4. Electrical Load

The total electrical energy use of the 4Dhome is a sum of the appliance, lighting, domestic hot water, and HVAC loads. The power usage and operation schedule of the appliances, lighting, DHW, and the air heat pump are known but the electricity demand of the HVAC system required a more detailed analysis. A dynamic model constructed in Matlab's Simulink will aid in calculating the electrical energy use of all HVAC equipment for both Boston and the competition in Washington DC. The characteristics of the annual electrical load are in Figure 5.2 for Boston.

The predicted annual energy usage of the 4Dhome in Boston, Massachusetts is 6900 kWh. The expected annual energy production of the PV system is over 130% of this load, as predicted by PVWatts. The "extra" energy will ensure that the home will be net-zero even if the eventual owners add more loads, and will also help the home achieve success during the Decathlon Energy Balance event.

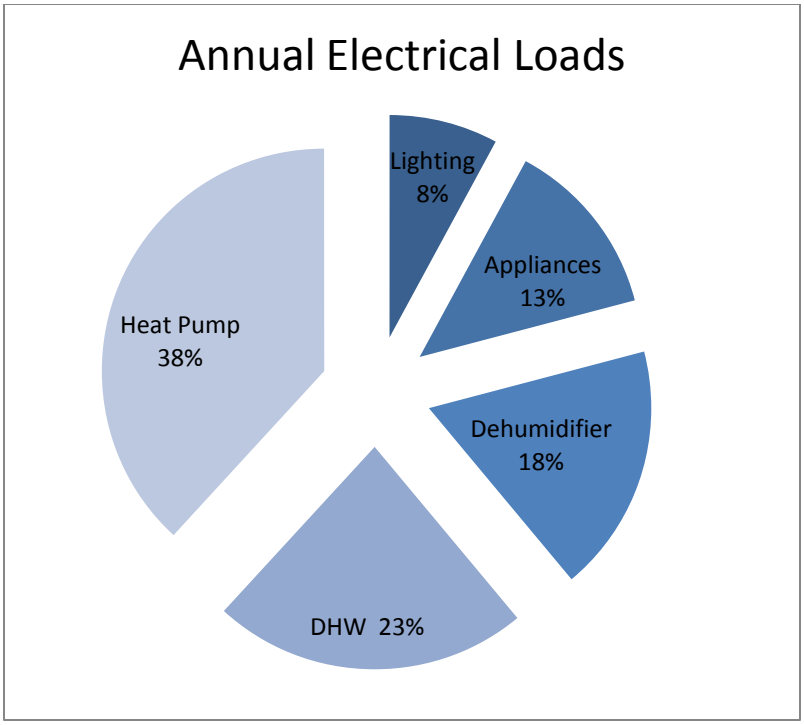


Figure 5.2: Annual Electrical Load for the 4Dhome in Boston

6. DYNAMIC MODEL IN SIMULINK

6.1. Description

Simulink is a mathematical modeling environment within Matlab with a block-diagram graphical user interface used to simulate dynamic systems. Simulink contains a vast library of predefined and customizable functions, or "blocks", and offers tight integration with the rest of the Matlab environment. Simulink was the preferred modeling environment because of its robustness and accessibility, which allowed accurate and fully customizable simulations of the 4Dhome's energy systems during a Solar Decathlon competition period.

The primary goals of the Simulink modeling effort were to verify initial HVAC equipment sizing calculations and develop a tool for simulating various energy related design considerations in competition scenarios.

6.2. Modeling Philosophy

The transport of energy in any home is incredibly complex. Many simplifications must be made to simulate the energy performance of a home in a practical fashion. For the purposes of this model, many energy interactions did not need to be considered. The energy systems that were simulated were building envelope, moisture and carbon dioxide concentration inside the home, PV, DHW, solar thermal, and HVAC systems. Figure 6.1 shows a flow chart of these various systems and their interactions.

Since the competition schedule is known, it was possible to build an input load schedule. These loads represent thermal, moisture and CO_2 concentration gains to the living space of the house that are then used as inputs for the model.

TMY data was used for all ambient conditions. Because of the statistical nature of TMY data it was important to use a wide range of data to establish meaningful results. Competition performance was simulated using various TMY data sets to gain insight into the typical performance variations.

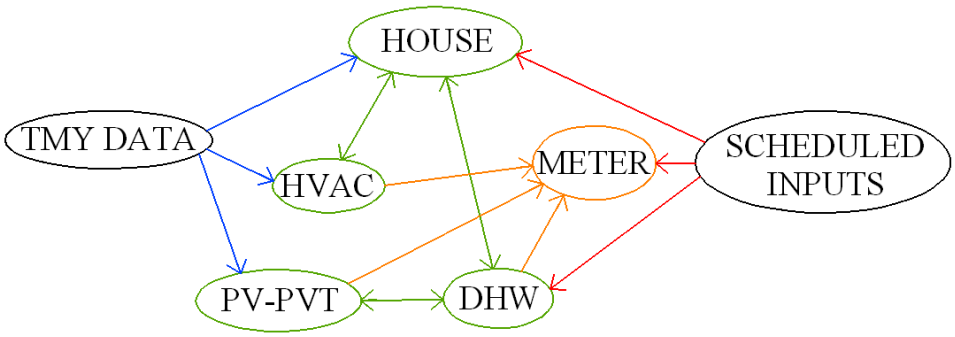
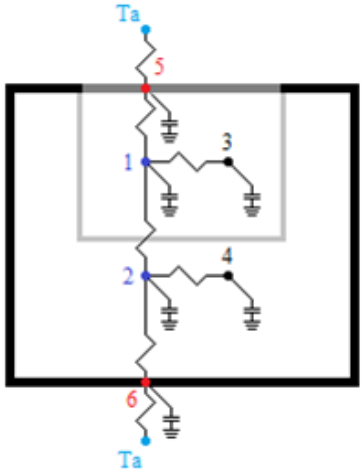


Figure 6.1: Interactions between the Dynamic Systems of the Home

6.3. Modeling the Building Envelope

Equations describing the flow of energy in the home and DHW system were cast into state space representations for ease of modeling. The equations (1st order, ODEs) describe the change in state (temperature) in a particular "thermal zone" with respect to time, as a function of the other states and inputs. The state space formulation provides a convenient scheme for representing coupled systems, implementing controlled and uncontrolled inputs, and computing relevant outputs. Certain inputs (such as a variable mass flow rates) result in mildly non-linear systems. This was dealt with by recasting the state space equations within the simulation for changes in such inputs, as they were infrequent. With initial conditions and environmental inputs, the temperature of each thermal zone can be determined through time integration of the state space equations. The home is represented by six coupled nodes and is shown in Figure 6.2 in the form of a thermal network model. The house model uses ambient temperature and heat gains to the mechanical room and living space as inputs, and then outputs the temperature at each node over the simulation period.



Node	Description
1	Air in the Mechanical Room
2	Air in the Living Space
3	Thermal Mass in Mechanical Room
4	Thermal Mass in Living Space
5	Thermal Mass in Exterior Wall/Floor/Ceiling of Mechanical Room
6	Thermal Mass of Exerior Wall/Floor/Ceiling of Living Space

Figure 6.2: Thermal Network of Home and Description of Nodes

6.4. Modeling Moisture and CO_2

Simplified moisture and CO_2 concentration models were used. Air infiltration and HRV ventilation provide mechanisms for moisture and CO_2 exchange through the building envelope. Moisture is also produced within the house from occupants, appliances and equipment. Saturation pressure data was embedded in the model to compute relative humidity. The only source of CO_2 production in the house is the occupants. The CO_2 concentration in the home is a good indicator of the overall air quality and is used to control the operation of the HRV.

6.5. Modeling DHW

The tank temperatures in the DHW system were simulated with a state space model. The tanks are exposed to the air in the mechanical room, causing them to lose heat to the home. The DHW model outputs the temperatures of the tanks, the heat given to the mechanical room from the tanks, and the heat removed from the air by the heat pump.

6.6. Modeling Solar

A modified Hottel-Whillier model was used to model the SunDrum hybrid solar-thermal panels, which extends the conventional thermal analysis of flat plate solar water collector to include a coupled PV panel. This extended model by Florshuetz allows the use of the usual parameters of the conventional Hottel-Whillier model, such as the collector heat removal factor and heat loss factor and modify them with factors that describe the PV reference efficiency and the decrease in PV efficiency with temperature.

Therefore, the Hottel-Whillier equations can be used for useful thermal output, simply by replacing the parameters with the modified parameters for a hybrid system. Then the useful electrical output of the PV panels that are coupled with SunDrum's hybrid panels can be found by subtracting the useful thermal energy and the overall thermal loss of the system from the total solar energy collected by the surface. The electrical energy produced by the remaining 22 PV panels that are not coupled with hybrid collectors was then simply summed and de-rated according to the system efficiency.

6.7. Modeling HVAC

Heat Pump – The output of the mini-split heat pump is modeled with a tuned PID controller, designed to simulate the unit in cooling mode. The system rise time, settling time, and overshoot were calibrated within Simulink with a built in PID tuner. The set point temperature for the heat pump controller is 23^{o}C.

HRV – The HRV is modeled in its nominal mode of operation and is controlled by a CO_2 sensor located in the living space. The HRV set point is 300ppm higher than the ambient concentration. The HRV facilitates the exchange of air between the home and the environment. When the HRV switches on, the CO_2 concentration in the home falls towards the ambient concentration. The HRV turns off when the concentration in the home is within 10% of the ambient concentration.

Dehumidifier – The electric dehumidifier is modeled in its nominal mode of operation and is controlled by a relative humidity (RH) sensor located in the living space. The dehumidifier operates independently and is not coupled to any other HVAC equipment. The dehumidifier turns on when the RH in the living space reaches 60% and off when it reaches 40%.

6.8. Inputs

The competition schedule was used to tabulate the following sets of scheduled inputs for the model at 15 minute intervals:

Electrical Draws - Includes electrical draws from appliances and lighting, [W]

Heat Gains - Includes heat gains associated with scheduled electrical usage and occupants, [W]

Moisture Gains - Includes moisture gains associated with occupant perspiration, appliances (cooktop and dishwasher), and shower use, [kg/hr]

CO_2 - Includes CO_2 gains from scheduled number of occupants at a "low" activity level, [g/hr]

DHW Draw - Includes DHW draws from the shower and dishwasher, [L/hr]

Doors - Includes schedule of door states [open, closed] used to determine natural air exchange rate with the environment.

TMY data (hourly intervals) - TMY3 data was used to for atmospheric conditions. Information on temperature, humidity, and irradiation were pre-processed for our needs and used as inputs to the model. Because of the random nature of the data and relatively short duration of the competition, the house model was simulated with several different TMY3 data sets, from various locations and time frames surrounding the competition site and duration.

The following Figures, 6.3 through 6.8, show various inputs to this dynamic model, both TMY data and scheduled inputs.

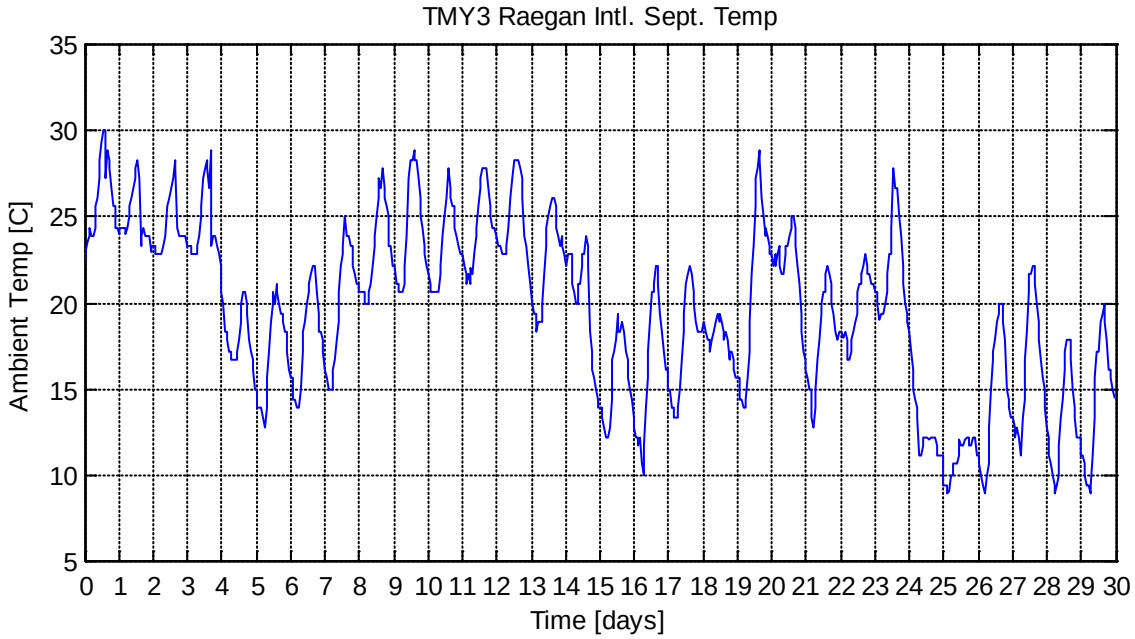


Figure 6.3: Use of TMY Temperature Data Surrounding Competition Period

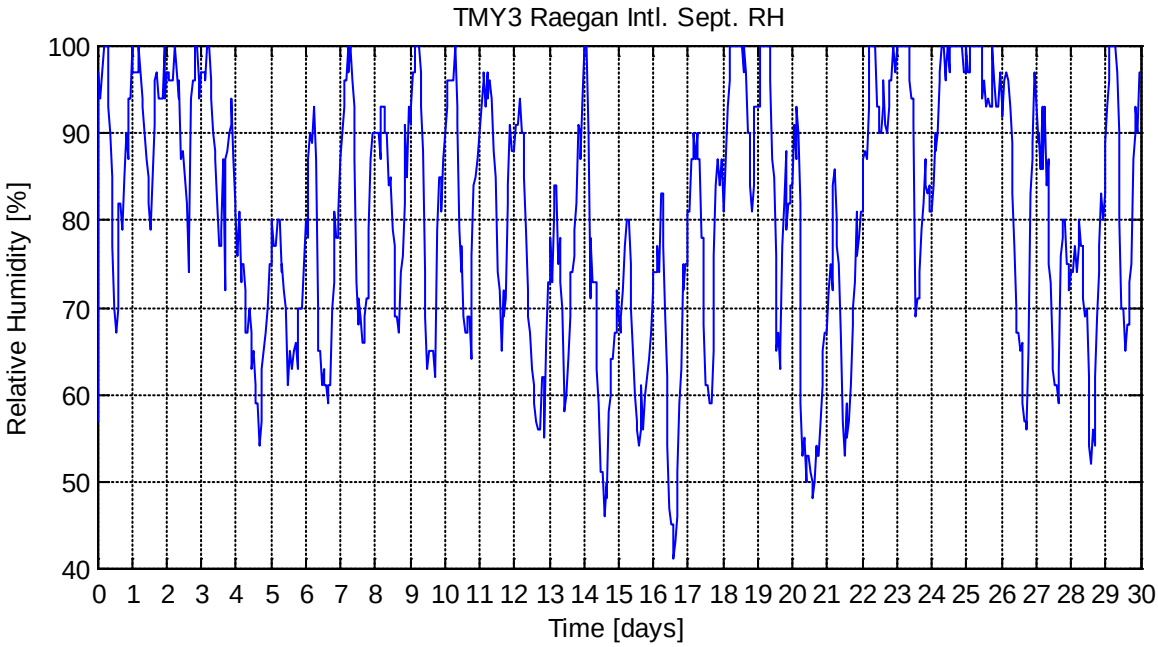


Figure 6.4: Use of TMY Relative Humidity Data Surrounding Competition Period

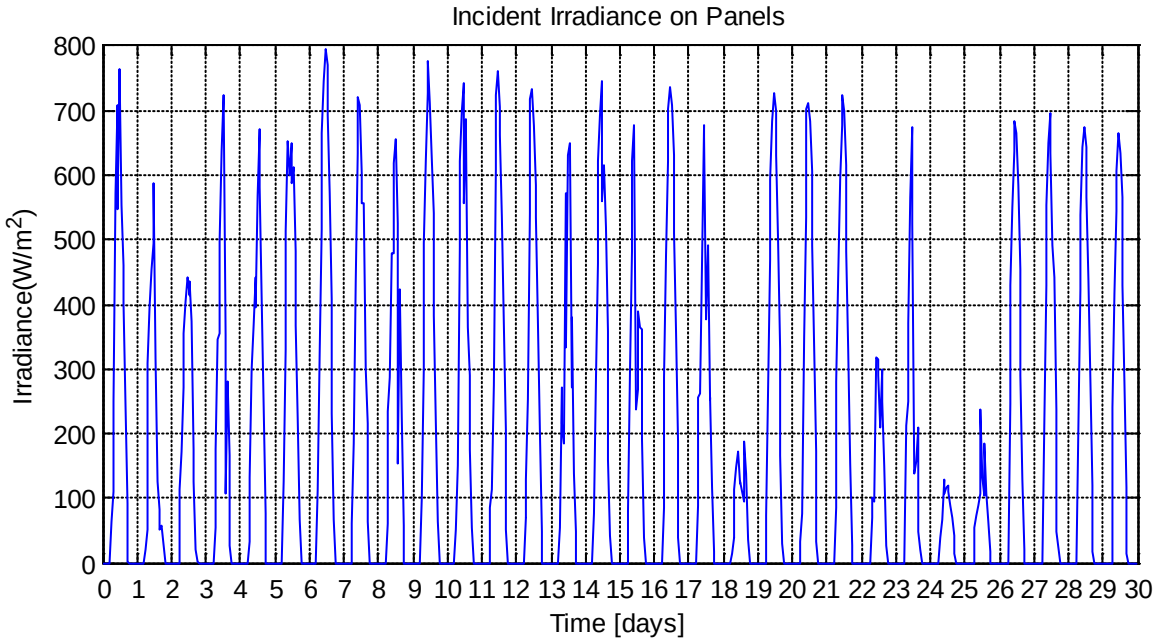


Figure 6.5: A Predicted Schedule of Incident Irradiation

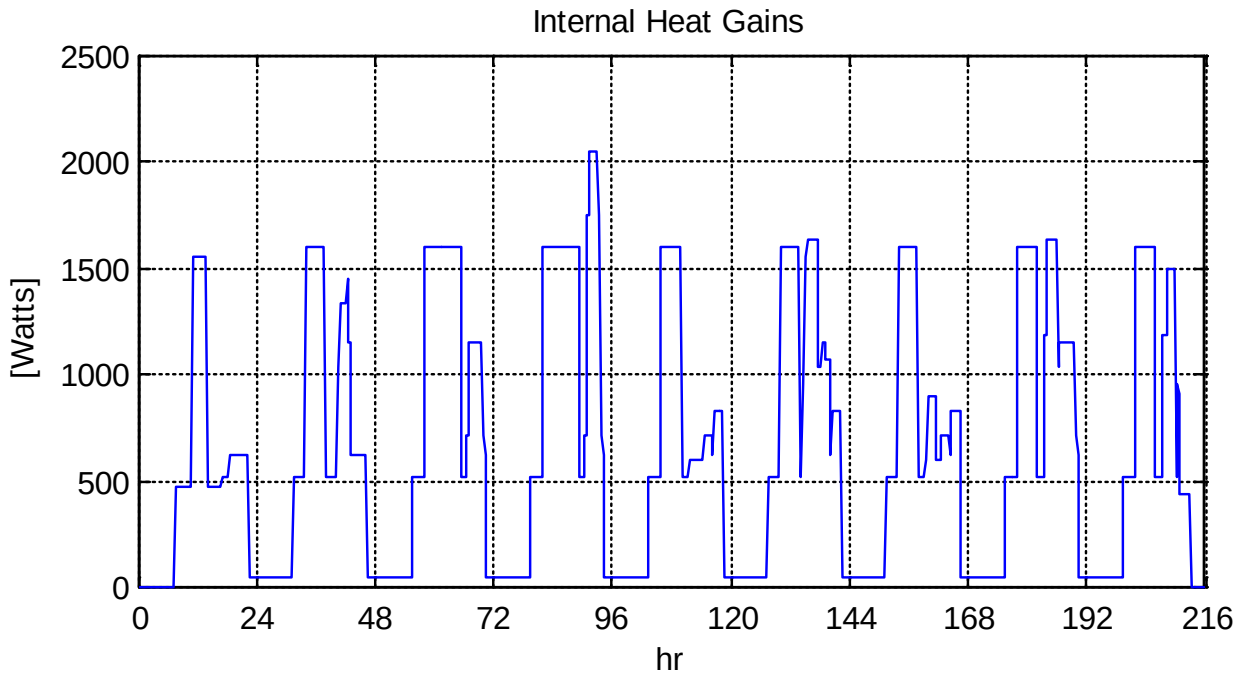


Figure 6.6: A Predicted Schedule of Internal Heat Gains during Competition Period

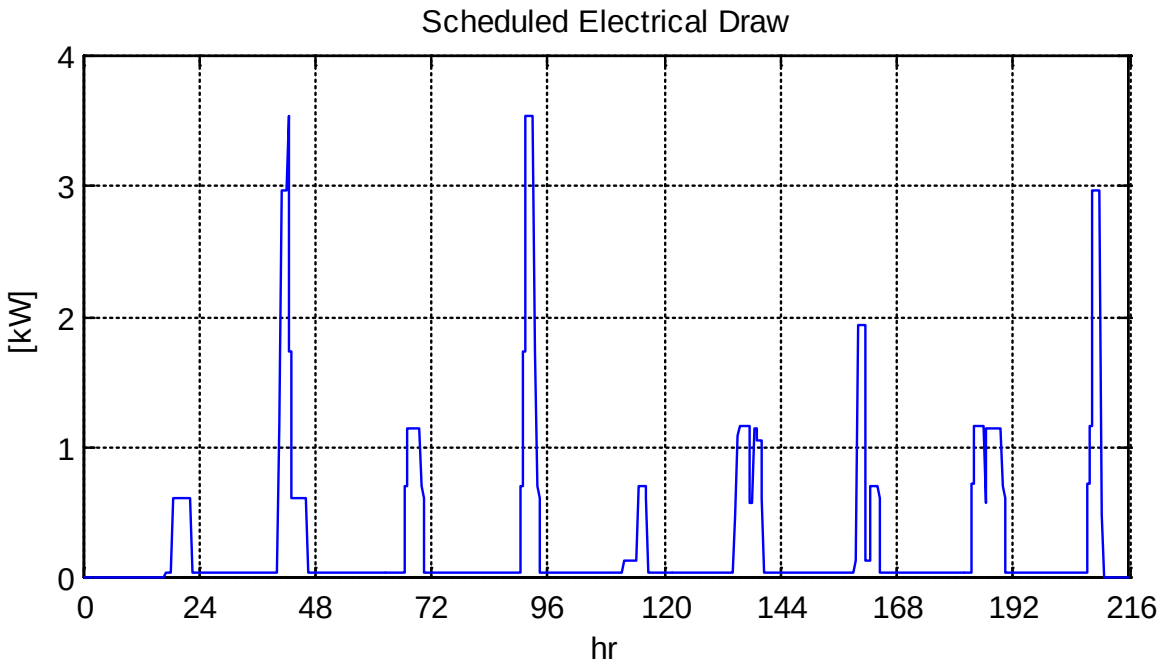


Figure 6.7: A Predicted Schedule of Electric Demand during Competition Period

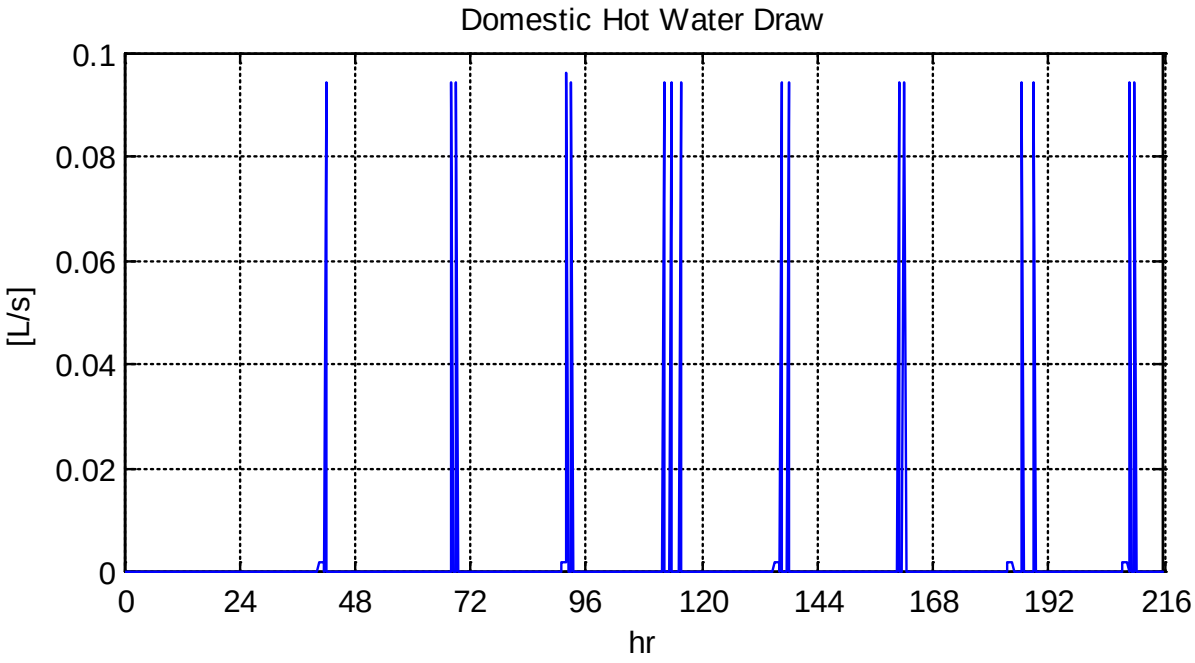


Figure 6.8: A Predicted Schedule of Intermittent Hot Water Draws during Competition Period

6.9. Initial conditions

The model's initial conditions were simply set to be within their controlled ranges. This was preferred to simulating pre-competition days for ease of modeling and post processing. Both approaches showed negligible differences in predicted performance.

House - All house zone temperatures are initially set to 23°C.

DHW – The backup tank is initially set to 55°C.

CO_2 – The initial CO_2 concentration in the house is the average ambient concentration of about 550 ppm (by mass).

RH – The initial relative humidity inside the home is about 55%.

7. DYNAMIC MODEL RESULTS

For the purposes of this section, a "typical" sample simulation was used to generate data and figures to be analyzed in detail. The time frame corresponding to September 13th through 21st from the Reagan Intl TMY3 data was used because it allowed us to use a more conservative estimation of irradiance.

The results show the temperature and relative humidity in the living space remaining within the comfort zone (between 22.2 and 24.4°C and below 60% RH) outside of touring hours. The air temperature in the mechanical room is very sensitive to the operation of the air-to-water heat pump. This will reduce the cooling load over the competition period, but it will be recommended to install ducting for the unit to increase the home's performance during the winter months in its final location. The thermal mass in the home and exterior walls, floor, and ceiling, helps stabilize the air temperatures, especially during times with large temperature swings. The model also shows the HRV is able to handle the CO_2 removal load through ventilation, ensuring fresh air for the occupants.

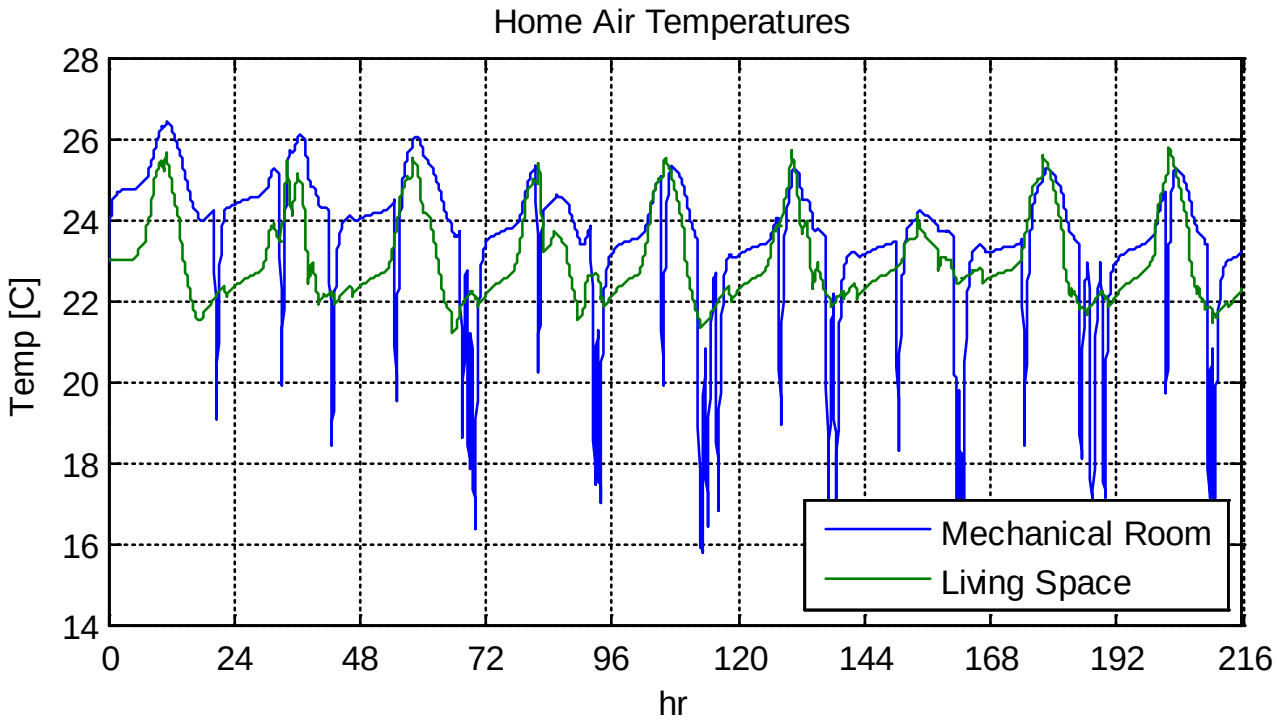


Figure 7.1: Interior Air Temperatures of the Mechanical Room and Living Space over the Sample Simulation.

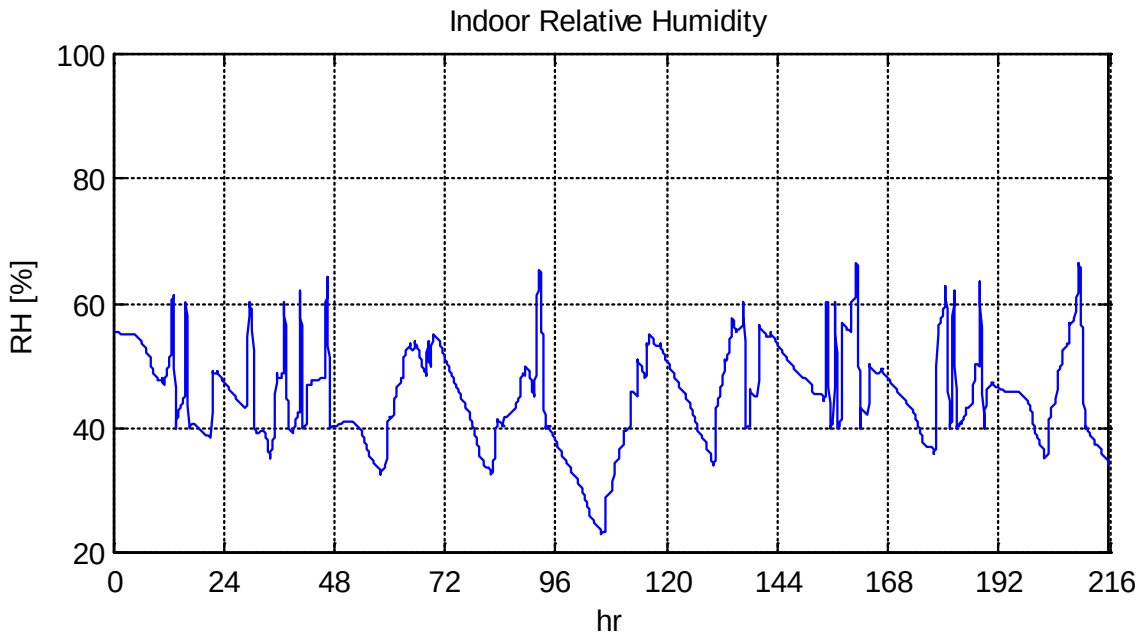


Figure 7.2: Relative Humidity in the living space.

The DHW tank temperature results shows the backup tank being maintained at acceptable levels during the competition draws. This simulation predicted that the solar-thermal system produces about 60% of the domestic hot water load over the simulated competition period. Although this system was sized to meet 80 to 90% of the DHW load over the course of a year, the competition DHW draws do not represent the hot water use of a typical family. When the draws are dispersed over day, this percentage is much higher.

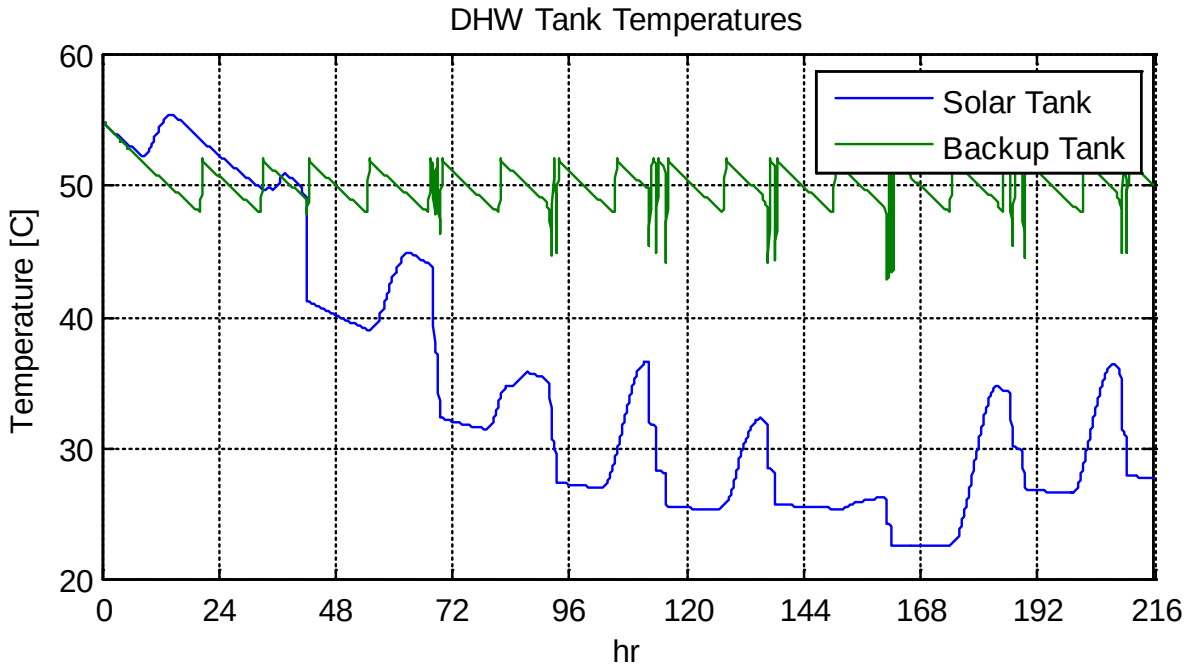


Figure 7.3: DHW Tank Temperatures During Competition.

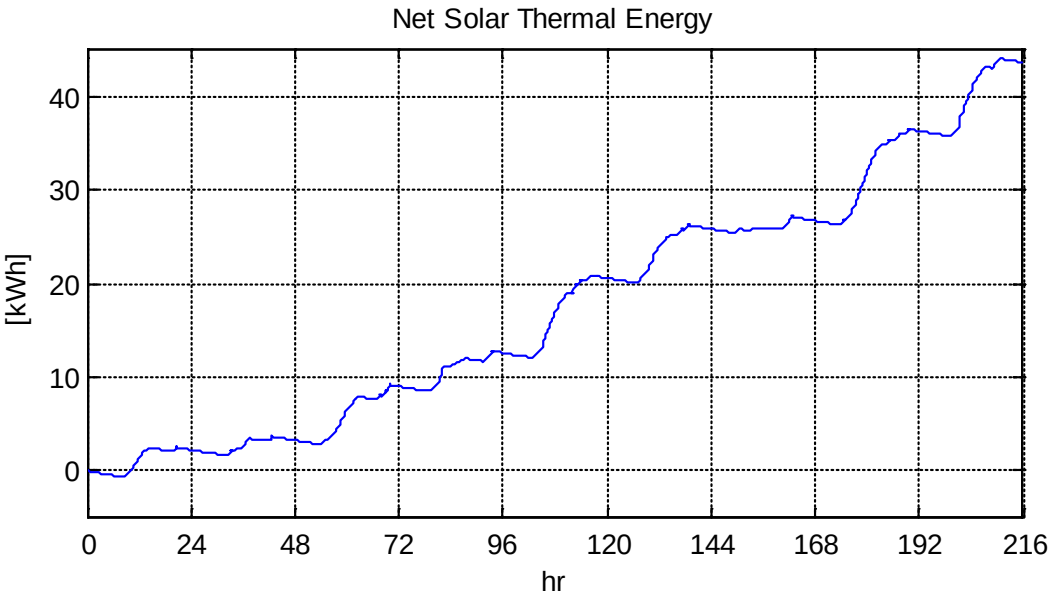


Figure 7.4: Net Thermal Energy Includes Useful Heat from Solar Thermal System and Heat Losses to Mechanical Room.

The simulation results show the 4Dhome performing better than net-zero over the competition period, while meeting comfort zone and fresh air requirements. Over the various time frames simulated, a range of ± 15kWh on this metric is expected.

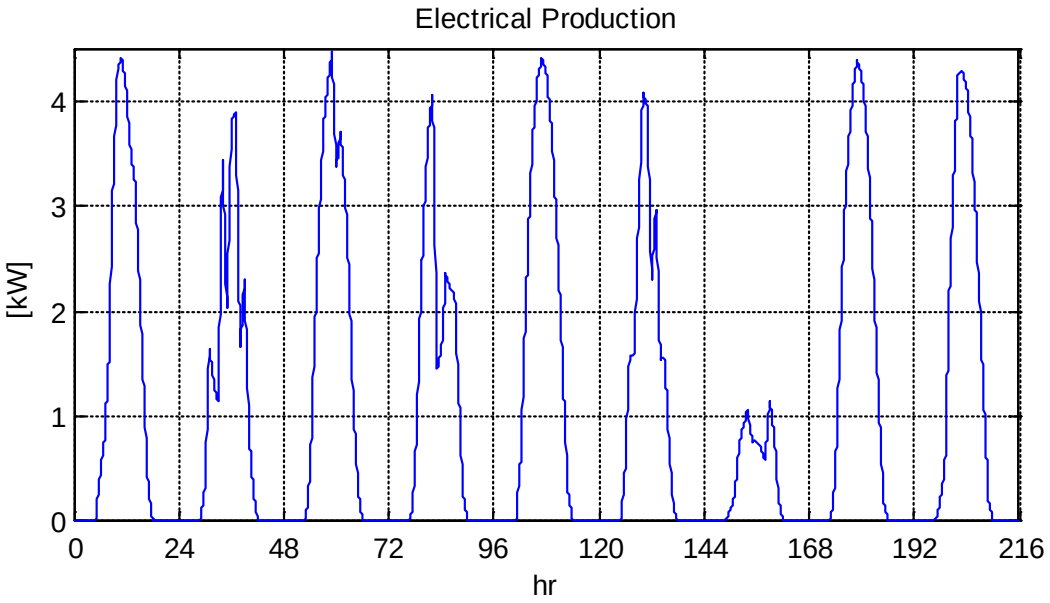


Figure 7.5: Electrical energy production rate from PV and PVT systems.

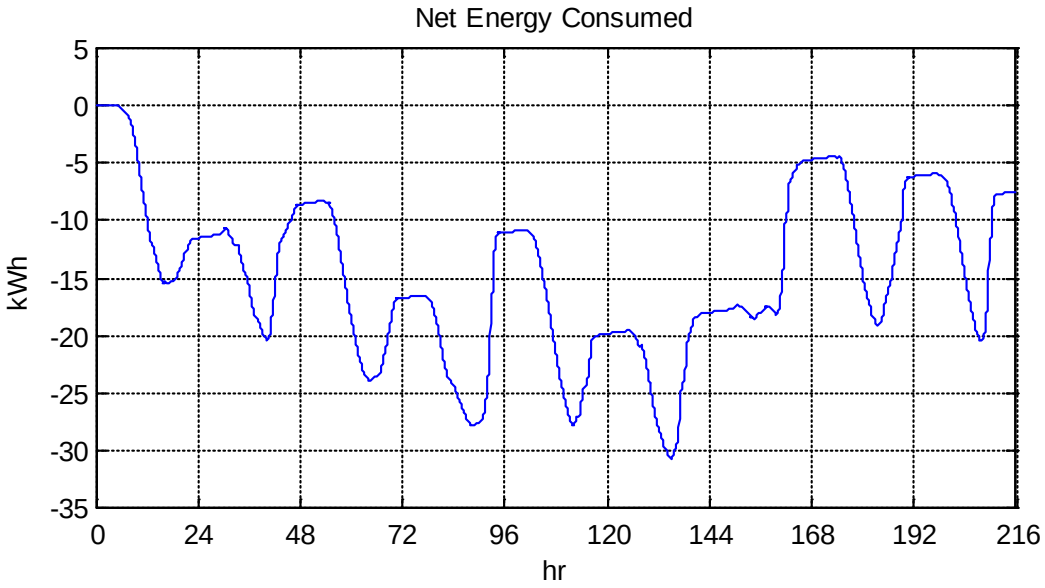


Figure 7.6: Net energy consumed over sample competition period.

The most influential parameters on the model performance seem to be the local irradiance, swinging temperatures and high humidity. These results show the culmination of many energy conscious design decisions. Efficient appliance and equipment selection significantly reduced the electrical load compared to a conventional house (approximately 80% reduction compared to similarly-sized conventional home). Net-zero is not an easy metric to achieve under the competition loads and comfort zone requirements, but with careful planning and a conservative modeling approach we believe we have designed an affordable home-energy system with exceptional performance.

8. 4DHome ENERGY MONITORING

8.1. Philosophy

The modern lifestyle of a working couple with a young child may not allow time for actively monitoring the energy usage of the 4Dhome, unless the activity of doing so is easy, interesting and accessible. The only time typical households are able to evaluate their energy consumption is when they receive their utility bill. With only a monthly bill to review, the detail required to pinpoint energy overuse is not present. The energy monitoring system of the 4Dhome makes understanding energy use easy by explaining energy in forms familiar to the average homeowner. It also actively monitors specific circuits and appliances in the home, giving the home owners a much more detailed picture than from a utility bill.

8.2. Real Time Energy Monitoring

The power consumption at the individual circuit level is measured and logged into the energy monitoring system at one second intervals. This data is then averaged to one minute intervals and transmitted over the internet to an offsite server. The power consumption data is then accessible in real time with any device with a browser (computer, laptop, smart phone, etc.). This interface is called the dashboard and an example of this real time monitoring is in Figure 8.1.

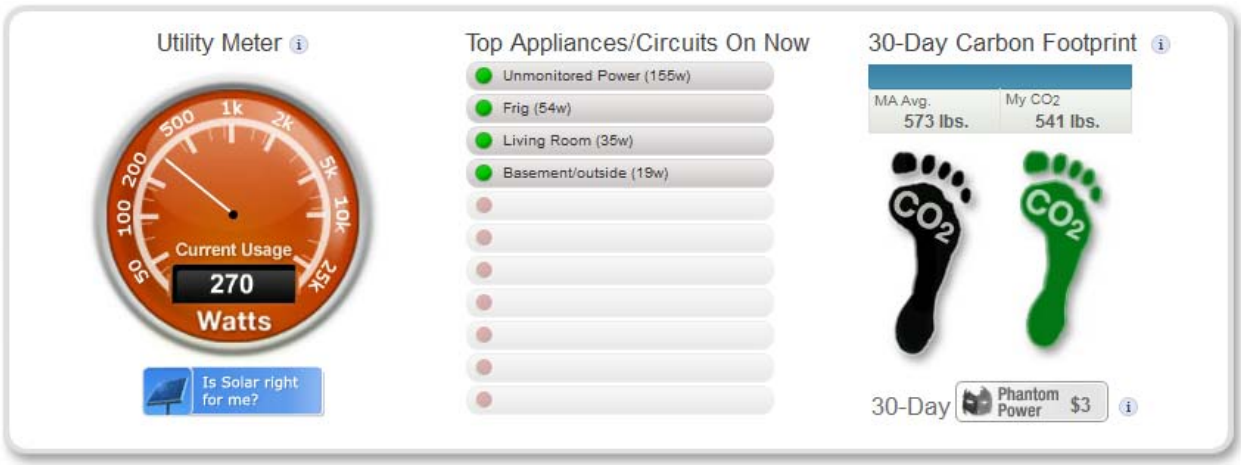


Figure 8.1: Instantaneous Power Consumption Meter

8.3. Energy Usage Analysis

The easy accessibility of this system will allow the 4Dhome owners to observe their consumption habits and create lifestyle adjustments to save energy, whether it is on a daily, weekly, or monthly basis. Figure 8.2 shows an example screen shot of the electricity consumption timeline by day (graph on the left) and by the minute (graph on the right). The system is precise enough so that it is possible to see energy spikes from appliances as small as clock radios and compact fluorescent lights.

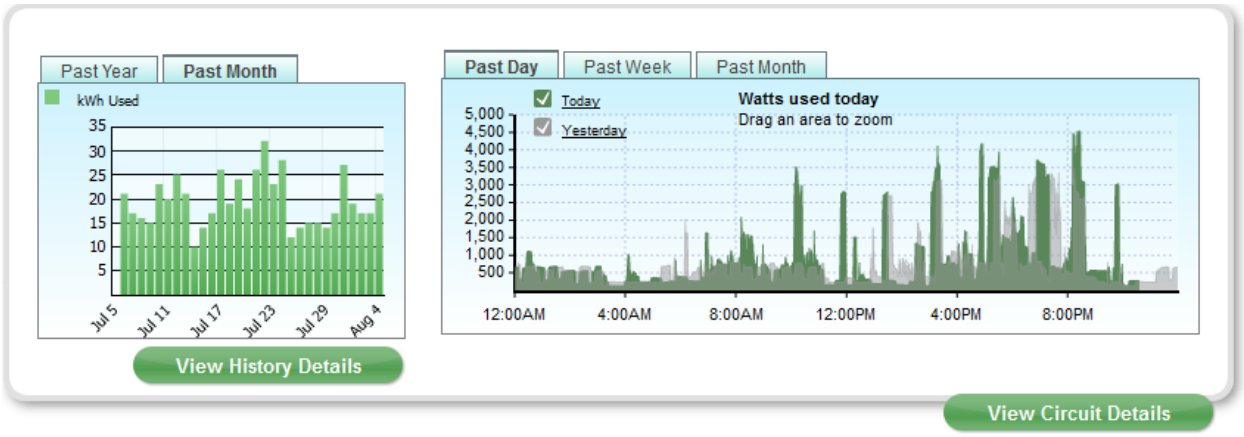


Figure 8.2: The Electricity Consumption Time Line

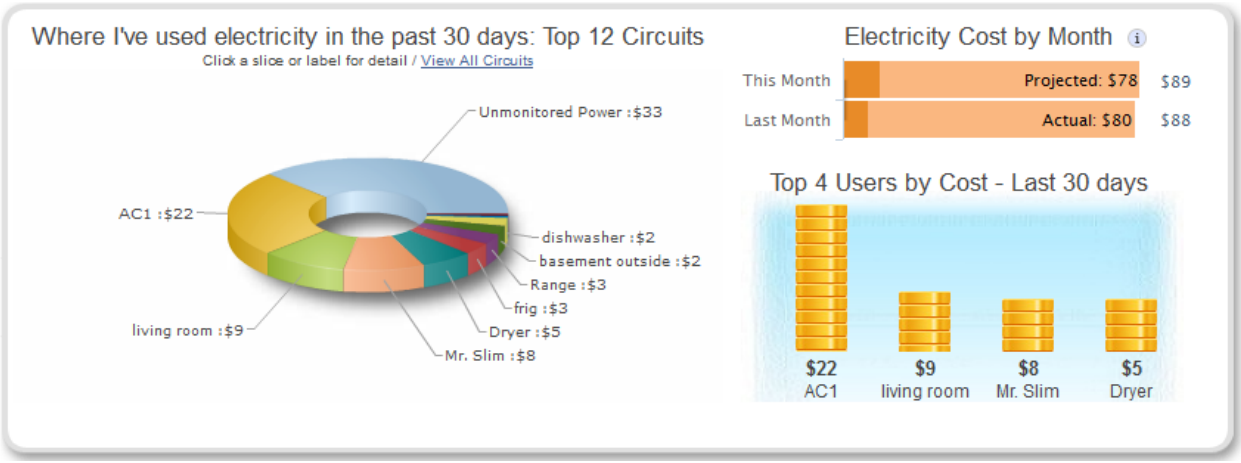


Figure 8.3: Total Electricity Consumed per Month by Each Electric Circuit

The dashboard makes understanding energy use easy, interesting and accessible all the time. The daily, weekly and monthly average home energy consumption is always displayed in parameters that are intuitive and easily understood. The instantaneous energy consumption display can alert the family via text or email if there is unexpected usage and gives a sense of magnitude of appliance and circuit (room) energy consumption. Additionally, as shown in Figure 8.3, this system translates energy use into dollars, thereby aiding the family's understanding of how they can save money through better energy management. Thus, we believe the dashboard will serve as an active promoter to decrease energy consumption by effectively informing the 4Dhome's inhabitants of their energy use.

9. CONCLUSION

Team Massachusetts has designed an efficient solar powered home optimized for both its permanent home in Boston and the Solar Decathlon competition site. Through steady state modeling with the Passive House Planning Package, independent analysis using Retscreen, PVWatts, and various analytical methods including performing an in depth dynamic simulation, Team Massachusetts is confident the 4Dhome can be net-zero at both sites. The energy analyses have enabled considerations that will allow the 4Dhome to be both competitive and prepared for its final resting place.Construction Specifications

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22 05 00	Common Work Results for Plumbing
22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
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22 33 30.16	Residential, Storage Electric Domestic Water Heaters
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Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)

23 31 13.16	Round and Flat-Oval Spiral Ducts
23 33 13	Back Draft Dampers
23 37 13	Diffusers, Registers and Grilles
23 40 00	Super Ultra-Low Penetration Filtration
23 72 00	Air to Air Recovery Equipment
23 81 26	Split System Air Conditioner
23 84 16	Dehumidifiers

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Division 26 – Electrical

26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 33	Raceway and Boxes for Electrical Systems
26 24 16	Panelboards
26 27 13	Electricity Metering
26 28 16	Enclosed Switches and Circuit Breakers
26 31 00	Photovoltaic Collector System
26 51 00	Interior Lighting
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Division 27 – Communications

27 21 00	Data Communication Network Equipment
27 21 33	Data Communication Wireless Access Points
27 22 26	Data Communications Laptop

Division 28 – Electronic Safety and Security

Divisions 31 – Earthwork

31 05 00 Soils for Earthwork

Division 32 – Exterior Improvements

32 90 00 Planting

Division 33 – Utilities

Division 34 – Transportation

Division 35 – Waterway and Marine Construction

Division 40 – Process Integration

Division 41 – Material Processing and Handling Equipment

Division 42 – Process, Heating, Cooling, and Drying Equipment

Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment

Division 44 – Pollution Control Equipment

Division 45 – Industry-Specific Manufacturing Equipment

Division 48 – Electrical Power Generation

48 19 16 Electrical Power Generation Inverters

SECTION 01 10 00
SUMMARY

PART 1 – GENERAL

1.01 PROJECT INFORMATION

A. Project: Team Massachusetts 4D Home entry, 2011 US Solar Decathlon

1. Location: National Mall, Washington, DC

B. Architect: Team Massachusetts - Massachusetts College of Art and Design

C. Engineer: Team Massachusetts - University of Massachusetts, Lowell

D. Work Consists of: Design, construction, transportation and assembly of a 1000 sq.ft. house

1.02 INTENT

A. Drawings and specifications are intended to provide the basis for the proper completion of the Project suitable for the intended use of the Owner.

B. Items not expressly set forth but which are reasonably implied or necessary for the proper performance of this work shall be included.

1.03 CUTTING AND PATCHING

A. Provide cutting and patching work to properly complete the Project

B. Do not remove or alter structural components without written approval

C. Cut with tools appropriate for materials to be cut

D. Patch with materials and methods to produce patch which is not visible from a distance of three feet

E. Do not cut and patch in manner that would result in a failure of the work to perform as intended, decrease fire performance, decrease acoustical performance, decrease energy performance, decrease operational life, or decrease safety factors

1.04 PROJECT MEETINGS

A. Arrange for a preconstruction conference prior to start of construction. Meeting shall be attended by Owner, Architect, Engineer, Construction Manager, Contractor, Health and Safety Officer and major subcontractors

B. Arrange for progress meetings once a month during construction, prior to application for payment. Record minutes and distribute promptly.

1.05 SUBMITTALS

A. Submit a project schedule and update at least monthly. Submit for approval all submittals listed in individual sections with the following number of copies: Shop Drawings, reviewed and annotated by the Contractor, 3 copies; product data, 3 copies; samples, 3 sets plus range samples where applicable; test reports, 3 copies; warranties, 3 copies; other submittals, 3 copies

B. Include details of construction and adjacent construction in shop drawings. Clearly indicate any deviations from requirements of the contract documents. Fabricate materials from approved shop drawings only.

1.06 QUALITY ASSURANCE

A. Comply with applicable codes, regulations, ordinances and requirements of authorities having jurisdiction, including accessibility guidelines where applicable. Submit copies of inspection reports, notices and similar documents to Construction Manager

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years unless otherwise approved by Architect or Engineer

C. Use experienced installers. Furnish evidence of experience if requested.

D. Deliver, handle, and store materials in strict accordance with manufacturer’s instructions.

E. Use of any supplier or subcontractor is subject to Owners approval.

F. Engage and pay for testing agencies as required. Refer to individual sections for additional requirements.

1.08 TEMPORARY FACILITIES

A. Provide temporary facilities and connections as required for the proper completion of the project.

B. Provide and maintain temporary utility services

C. Owner will pay for temporary utility service. Do not waste.

D. Provide temporary protection for adjacent areas to prevent contamination by construction dust and debris.

E. Provide temporary barricades as necessary to ensure protection of the public.

F. Provide suitable waste disposal units and empty regularly. Do not permit accumulation of trash and waste materials.

G. Maintain egress within and around construction areas.

H. Maintain fire alarm systems in operation during construction

I. Provide fire extinguishers in work areas during construction.

J. Provide temporary protection for adjacent construction. Promptly repair any damage at no additional cost to the Owner.

1.09 PRODUCTS AND SUBSTITUTIONS

A. Provide products and materials specified. Request Architects selection of colors and accessories in sufficient time to avoid delaying progress of work.

B. Submit requests for substitutions shall be in writing, including reasons. Submit sufficient information for Architect or Engineer to evaluate proposed substitution.

C. Remove and replace work which does not conform to the contract documents at no additional expense to the Owner.

1.10 INSTALLATION

A. Inspect substrates and report any unsatisfactory conditions in writing.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.

D. Install materials inexact accordance with manufacturer’s instruction and approved submittals.

E. Install materials in proper relation with adjacent construction and with proper appearance.

F. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.

G. Refer to additional installation requirements and tolerances specified under individual specification sections.

1.11 CLOSEOUT

A. Prepare punchlist for remaining work for review by the Architect, Project Manager or Construction Manager

B. Complete punchlist items promptly at no additional expense to the Owner.

C. Submit accurate record documents of building and site.

D. Submit operating manuals, maintenance manuals, and warranty information

E. Obtain and submit copies of occupancy permits.

F. Train Owner in use of building systems

G. Remove temporary facilities and provide final cleaning and touch up.

H. Restore portions of building, site improvements, landscaping and other items damaged by construction operations to the satisfaction of the Architect, Project Manager or Construction Manger at no additional expense to the Owner

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION 01 10 00

SECTION 01 54 00
CONSTRUCTION AIDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary Generator

B. Temporary Crane

C. Temporary Scaffolding

D. Temporary Barricades

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. NPS noise regulation 36CFR2.12, NCCCO

1.04 SUBMITTALS

A. Generator: Proof of compliance with NPS 36CFR2.12

B. Crane: Proof of operator NCCCO certification

PART 2 – PRODUCTS

2.01 GENERATOR

A. Honda EU6500iSA

1. hondapowerequipment.generator spec

B. Plastic Tray

1. Liquid Volume Capacity Greater Than Liquid Contents in Generator

2. Compliance with All Codes Regarding Spill Containment

2.02 CRANE

A. 100 Ton Hydraulic Crane

1. Operator provided by crane owner

2. Set crew: Mod-Set, Inc., 29 Trufant Lane, Topsham, ME 04086, 207-725-0959

2.03 SCAFFOLDING

A. BAKER STYLE SCAFFOLDING

1. Adjustable 6 foot to 12 foot

2.04 TEMPORARY BARRICADES

A. Cones

B. Yellow Caution Tape

C. Signal Flags

PART 3 – EXECUTION

3.01 Install provided temporary protection to prevent damage to turf grass surfaces

END OF SECTION 01 54 00

SECTION 02 05 19.13
GEOTEXTILES FOR EXISTING CONDITIONS

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Filter Fabric for Temporary Foundations

1.02 RELATED SECTIONS

05 50 00 Metal Fabrications

31 05 00 Soils for Earthwork

1.03 REFERENCE STANDARDS

A. ASTM D 5261, D 4632, D 4533, D 4833, D 3786, D 4491, and D 4751

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 GEOTEXTILES

A. US Construction Fabrics: Geotextile SKAPS W200

1. Material: Woven polypropylene

2. Roll Dimensions (W x L) – ft: 12.5 x 432 / 17.5 x 309

3. Square Yards per Roll: 600

PART 3- EXECUTION

3.01 INSTALLATION

A. Geotextile fabric must be placed on ground before sand is used for leveling footings

B. Geotextile fabric must be wrapped around leveling sand the top must be closed by placing footing Foamglas and steel plate material on top to ensure sand will not erode from underneath footings due to wind or rain

END OF SECTION 02 05 19.13

SECTION 05 14 13
ARCHITECTURALLY-EXPOSED STRUCTURAL ALUMINUM

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Photovoltaic mounting system

1. Structural aluminum

2. Stainless steel hardware

1.02 RELATED SECTIONS

A. Section 26 31 00 - Photovoltaic Collector System

1.03 REFERENCE STANDARDS

A. ANSI/AF&PA NDS-2005, UL 467

1.04 SUBMITTALS

A. Product datasheets from manufacturer

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializes in manufacturing the products specified in this section with minimum 10 years' experience.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. IronRidge

2.02 COMPONENTS

A. XRS Rail

1. Extruded, anodized 6105-T5 aluminum, clear.

2. 16’ long sections and 7’ sections cut to size.

B. Mounting Accessories

1. Aluminum, mill

a. Internal rail splice – Joins two rails

b. Adjustable L-foot – Attaches rails to wooden trellis frame

c. Center clamp – Type F, 2.5’’, clamps inside edges of PV panels to rails

d. End clamp – Type F, 1.81’’, clamps outer edges of PV panels to rails

2. Stainless steel hardware

a. Self-drilling, self tapping screw (10-16 x ½’’) – Fastens rails and splice; Eight per splice.

b. Hex cap bolt (3/8-16 x 1’’) – One per L-foot.

c. Flange nut (3/8’’-16) – One per L-foot bolt.

d. Hex cap bolt (1/4-20 x 2.50’’) – One per center clamp

e. Flange nut (1/4-20) – One per center clamp, one per end clamp

f. Hex cap bolt (1/4-20 x 1.81’’) – One per end clamp

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Tools and instructions required for assembly; IronRidge installation manual

1. Wrenches – open-end, box-end, or socket drive with sockets to support the following size hex heads:

a. 3/8’’, used for ¼ cap-end screws, ¼ bolts

b. ¼’’, used for 3/8 cap-end screws, 3/8 bolts

2. Torque values for dry bolts

a. Required torque of 84 in-lbs for bolt size of ¼-20

b. Required torque of 144 in-lbs for bolt size of 5/16-18

c. Required torque of 180 in-lbs for bolt size of 3/8-16

END OF SECTION 05 14 13

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Steel plate for temporary footings

1.02 RELATED REQUIREMENTS

A. 31 05 00 Soils for Earthwork

B. 02 05 19.13 Geotextiles for Existing Conditions

1.03 REFERENCE STANDARDS

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

PART 2 - PRODUCTS

2.01 METAL FABRICATIONS

A. General: Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges.

B. Dimensions

1. 2 foot x 2 foot x 1/2 inch – Quantity: 18

2. 2 foot 6 inch x 2 foot 6 inch x 1/2 inch – Quantity: 6

3. 2 foot x 2 foot 4 inches x 1/2 inch - Quantity: 1

2.03 STEEL AND IRON FINISHES

A. Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3, “Power Tool Cleaning,” and paint with a fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

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

C. Apply bituminous paint to concealed surfaces of units set into concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Fit exposed connections accurately together to form hairline joints.

END OF SECTION 05 50 00

SECTION 06 05 23

WOOD, PLASTIC AND COMPOSITE FASTENINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Metal Plates

B. Metal Connectors

C. Bolts, Washers and Nuts

D. Threaded Rod

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ICC-ES ESR-2105 / ESR-2523 / ESR-2604 / ESR-2523

PART 2 – PRODUCTS

2.01 METAL PLATES

A. Simpson Strong-Tie: Architectural products group, The Specialty Collection

1. Custom Fabricated Truss Plates

2. Custom Fabricated Trellis Plates

3. Finish: Factory Primed Grey, Field Painted

2.02 METAL CONNECTORS

A. Manufacturer: Simpson Strong-Tie

1. DTT2Z - Module Connectors, Quantity: 56

2. HL37 - Trellis Angle Connectors, Quantity: 36

3. LUS28 - Deck Joist Hanger, Quantity: 25

4. LUS26 - Deck Joist Hanger, Quantity: 240

5. ABA44Z - Deck Post Base, Quantity: 36

6. IUS 3 1/2 inch x 11 7/8 inch - Floor Joist, Quantity: 138

7. A34 Angle - Hall Ceiling Connection, Quantity: 20

8. HL53 - House Footings L Bracket, Quantity: 40

9. CMST - Coil Strap

10. U24 - Ceiling Joist Hanger, Quantity: 17

B. Metal Fabrication

1. L Bracket, East Trellis Column: 3 1/2 inch x 3 1/2 inch x 1/4 inch, Qty: 4

2. L Bracket, East Trellis Column: 3 1/2 inch x 4 3/4 inch x 1/4 inch, Qty: 4

2.03 BOLTS, WASHERS AND NUTS

A. Manufacturer: Simpson Strong-Tie

1. Lag Bolt

a. 6 inch x 1/4 inch - Decks and Ramps, Quantity: 102

b. 4 inch x 1/4 inch - Decks and Ramps, Quantity: 42

c. 8 inch x 1/2 inch - Decks and Ramps, Quantity: 42

d. 4 inch x 3/4 inch - Truss, Quantity: 200

e. 10 inch x 3/4 inch - Truss, Quantity: 26

f. 4 inch x 1/2 inch - Trellis, Quantity: 328

2. Eye Bolt

a. 6 inch x 1/2 inch - Trellis, Quantity: 36

2.04 THREADED ROD

A. 11 1/2 inch - Module Connectors

B. 15 inch - Module Connectors

PART 3 – EXECUTION

3.01 EXECUTION

A. Steel washers, flat to be used where bolt head or hex nut in direct contact with wood

END OF SECTION 06 05 23

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Engineered Wood Products

B. Dimensional Lumber

1.02 RELATED REQUIREMENTS

A. Reinforcing and Framing Schedules S-601

B. Column and Beam Schedules S-602

1.03 REFERENCE STANDARDS

A. Dimensional lumber: AWPA C24; ALSC Board of Review; IRC 2009

B. Engineered lumber: ICC ES ESR-1387, HUD MR 925; ICC ES ESR-1153

C. Fasteners: CABO NER-272; CABO NER-272; ASTM A 563; ASTM A 563; ASTM A 153/A153M; ASTM A 307, Grade A

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Nordic Engineered Wood, www.nordicewp.com

2.02 ENGINEERED WOOD PRODUCTS

A. Nordic Joist

1. Floor Joists: Nordic NI80, 11 7/8 inches

2. Plates and Studs: Nordic NI40x, 11 7/8 inches

3. Rafters: Nordic NI40x, 14 inches

4. Nordic Joist Data Sheets

B. Nordic Lam

1. Columns: 1 3/4 inch x 9 1/2 inch

2. Columns at Module Marriage Line: 4 inch x 8 inch

3. Roof and Deck Beams: 3 1/2 inch x 11 7/8 inch

4. Beam and Header Data Sheets

5. Column Data Sheets

C. Nordic EnviroWall

1. Module Mating Line Keyway: 2 inch x 4 inch

2. Module Mating Line Keyway: 2 inch x 6 inch

3. Envirowall Data Sheets

2.02 DIMENSIONAL LUMBER

A. S4S

B. Spruce, Pine, Fir

C. 2 inch x 4 inch

D. 2 inch x 6 inch

2.03 FASTENERS

A. Power Drive Fasteners

B. Steel bolts, hex nuts and flat washers

PART 3 – EXECUTION

3.01 INSTALLATION

A. Locate nailers, blocking and similar supports to comply with requirements for attaching other Construction.

B. Securely attach rough carpentry to substrates

C. Provide preservative-treated materials for all exterior rough carpentry unless otherwise indicated.

D. Where rough carpentry is exposed to weather, in ground contact, or in areas of high relative humidity, provide fasteners with hot-dip zinc coating or of type 304 stainless steel.

E. Steel washers, flat to be used where bolt head or hex nut in direct contact with wood

F. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent

END OF SECTION 06 10 00

SECTION 06 16 00
SHEATHING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Combination Wall Sheathing, Water-resistive Barrier and Air Barrier

B. Combination Roof Sheathing and Roof Underlayment

C. Self-Adhering Flexible Flashing

D. Subflooring Material

E. Interior Sheathing

1.02 RELATED REQUIREMENTS

A. 09 60 00 Flooring

B. 10 22 26.43 Operable Partitions

1.03 REFERENCE STANDARDS

A. US DOC PS-2, 2009 IRC, CABO NER-272

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Huber Engineered Woods, 800-933-9220, www.huberwood.com

2.02 EXTERIOR SHEATHING

A. Exterior Wall Sheathing

1. ZIP System, 1/2 inch Oriented Strand Board Wall Sheathing with Integral Water-Resistive Barrier, Exposure I Sheathing.

2. Dimensions: 1/2 inch, 4 foot x 8 foot panels

B. Roof Sheathing

1. ZIP System, 5/8 inch Oriented Strand Board Roof Sheathing with Integral Water-Resistive Barrier, Exposure I, Structural I Sheathing

2. Dimensions: 5/8 inch, 4 foot x 8 foot panels

3. Edge: Tongue and Groove

C. Self-Adhering Flexible Flashing

1. ZIP System Self-Adhering Tape: Pressure Sensitive, Self-Adhering, Cold-Applied, Proprietary Seam Tape Consisting of Polyolefin Film with Acrylic Adhesive

2. 3 1/2 inch flashing tape

3. 6 inch flashing tape

2.03 SUBFLOORING

A. Underlayment

1. Advantech (AT-Series) Engineered Flooring Panels

2. Not less than 23/32 inch x 4 feet x 8 feet, 24 oc

3. Edge Detail: Tongue and Groove

2.04 INTERIOR SHEATHING

A. Walls

1. Oriented-Strand-Board Sheathing

2. Dimensions: 5/8 inch, 4 foot x 8 foot panels

3. Performance Standard: DOC PS2 and ICC-ES ESR-1785

B. Ceiling

1. Oriented-Strand-Board Sheathing

2. Dimensions: 5/8 inch, 4 foot x 8 foot panels

3. Performance Standard: DOC PS2 and ICC-ES ESR-1785

PART 3 – EXECUTION

3.01 INSTALLATION

A. Securely attach to substrates

B. All Subflooring, Wall and Roof Sheathing to be glued and nailed to wood framing.

C. Furnish tape gun for Zip System flashing tapes

END OF SECTION 06 16 00

SECTION 06 20 00
Finish Carpentry

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Lumber

B. Interior Trim

C. Exterior Trim

D. Fasteners

1.02 RELATED REQUIREMENTS

A. 06 10 00 Rough Carpentry

B. 06 41 16 Architectural Woodwork

1.03 REFERENCE STANDARDS

A. DOC PS 20, American Lumber Standards Committee Board and Review

1.04 SUBMITTALS

A. Certification Requirements

PART 2 – PRODUCTS

2.01 LUMBER

A. Dimensional lumber: S4S Spruce, Pine or Fir

2.02 INTERIOR STANDING AND RUNNING TRIM

A. Trim: Kiln dried, #1 clear pine

2.02 EXTERIOR STANDING AND RUNING TRIM

A. Trim: Kiln dried, #1 Clear Western Red Cedar

2.03 FASTENERS

A. Hardware: Stainless-steel, hot-dip galvanized or aluminum.

B. Glue: Aliphatic-resin, polyurethane or resorcinol wood glue recommended by the manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install standing and running trim with minimum number of joints practical, using full length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Cope at returns and miter at corners.

B. Use waterproof glue for exterior applications.

END OF SECTION 06 20 0

SECTION 06 46 00
WOOD TRIM

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Door and Window Casings

B. Base Board

1.02 RELATED REQUIREMENTS

A. 06 20 00 Finish Carpentry

B. 06 41 16 Architectural Woodwork

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 DOOR AND WINDOW TRIM

A. Finish Grade Plywood

B. 10 inch x 3/4 inch nominal

C. Finish: Natural satin finish, water based acrylic

2.02 BASE BOARD

A. Clear Pine or Poplar

B. 1 inch x 6 inch nominal, square profile

C. Finish: Painted same color as walls

PART 3 – EXECUTION (Not Used)

END OF SECTION 06 46 00

SECTION 06 82 00
GLASS-FIBER REINFORCED PLASTIC

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary Footing Materials

1.02 RELATED REQUIREMENTS

A. 05 50 00 Metal Fabrications

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Pittsburgh Corning US, www.foamglas.us/foamglas specs

2.02 TEMPORARY FOOTINGS

A. Foamglas Flat Block– 18 inch x 24 inch x 3 inch thick

PART 3- EXECUTION (Not Used)

END OF SECTION 06 82 00

SECTION 07 21 00
THERMAL INSULATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Sprayed Insulation

B. Blown Fiberglass Insulation

1.02 RELATED REQUIREMENTS

A. 06 10 00 Rough Carpentry

B. 06 16 00 Sheathing

1.03 REFERENCE STANDARDS

A. ICC-ES; IBC/IRC; ASTM E 84; ASTM E 96; ASTM E 283; ASTM C 518; ASTM C 687; ASTM C 177; ASTM C 764 Type I; ASTM C 1338; ASTM D 1621; ASTM D 1622; ASTM D1623; ASTM D 2126; ASTM D 2842; ASTM E 136

B. Federal Regulation 16 CFR 1209, 16 CFR 1404, 16 CFR 460. ASTM C-739, ASTM E-84, Smoke Developed Index <450. ICC-ES ESR-1996 Report

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. CertainTeed Corp., Insulation Group: 750 E. Swedesford Rd. P. O. Box 860; Valley Forge, PA 19482-0860; Toll Free Tel: 800-233-8990, www.certainteed.com

2.02 SPRAYED INSULATION

A. CertaSpray Polyurethane Closed Cell Foam

B. Roof, Floor and Walls: 3,000 square feet at a depth of 4 inches

2.02 BLOWN FIBERGLASS INSULATION

A. Optima Blown Fiberglass Insulation

B. Roof: 1,250 square feet at a depth of 10 inches

C. Floor and Walls: 1,850 square feet at a depth of 8 inches

PART 3 – EXECUTION

A. Confirm completion of work in writing for all trades requiring access to interior of wall before application.

3.01 INSTALLATION

END OF SECTION 07 21 0

SECTION 07 41 13
METAL ROOF PANELS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Standing Seam Corrugated Metal Roof Panels

B. Trim

1.02 RELATED REQUIREMENTS

A. 06 16 00 SHEATHING

1.03 REFERENCE STANDARDS

A. UL 263 Fire Resistance Rating; UL 2218 Class 4 Impact Resistance; UL 790 Class A Fire Resistance Rating; ASTM E-283 Air Infiltration Approved; ASTM E-331 Water Penetration Approved CEGS-07416 US Army Corps of Engineers Rated-ASTM E-1592; UL 580 Class 90 Wind Uplift; ASTM 2112-07 5.13; ASTM D 226

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 STEEL ROOFING PANELS

A. Manufacturer: Drexel Metals, Inc., 204 Railroad Dr., Ivyland, PA 18974, drexmet.com

B. Galvanized steel sheet metal roofing panels, 24” width, 26 gage.

1. Exposed seam

2. 1/2 inch rib height

2.02 TRIM

A. Eave Drip Edge

B. Rake Drip Edge

C. Ridge Cap

PART 3 – EXECUTION

END OF SECTION 07 41 13

SECTION 07 46 46
MINERAL FIBER CEMENT SIDING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Mineral fiber cement siding

1.02 RELATED REQUIREMENTS

A. 06 16 00 SHEATHING

1.03 REFERENCE STANDARDS

A. ASTM C 920; ASTM C 1185; ASTM C 1186; ASTM E 72; ASTM E 84; ASTM E 96; ASTM E 136; ASTM E 228; ASTM G 26

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. CertainTeed Corporation, Siding Products Group, P.O. Box 860, Valley Forge, Pennsylvania 19482. (800) 233-8990, www.certainteed.com

2.02 FIBER CEMENT SIDING

A. CertainTeed ColorMax Prefinished Smooth Lap

B. Size: 8 1/4 inch x 12 foot

PART 3 – EXECUTION

END OF SECTION 07 46 46

SECTION 07 71 23
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Gutters

B. Downspouts

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 GUTTERS

A. Aluminum Gutters

1. 4 inch

2. Style: Box Gutter, Square

3. Aluminum Gutter Hangers

2.02 DOWNSPOUTS

A. Aluminum Downspout

1. 3 inch

2. Aluminum Strapping

PART 3 – EXECUTION (Not Used)
END OF SECTION 07 71 23

SECTION 07 91 00
PREFORMED JOINT SEALS

1.01 SECTION INCLUDES

A. Module Joint Seals

B. Window Joint Seals

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. CE EN 14909, ASTM E2112

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Tremco - Illbruck

2.02 Joint Seal

A. Illbruck 2112 Insulation Tape

B. willseal product info

PART 3 – EXECUTION

END OF SECTION 07 91 00

SECTION 08 14 00
WOOD DOORS AND FRAMES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pocket Doors

B. Prefinished Wood Doors

C. Door Hardware

1.02 RELATED REQUIREMENTS

A. 08 06 10 Door Schedule

1.03 REFERENCE STANDARDS

A. Passive House Certification

B. Glazing: IRC 308.6

1.04 SUBMITTALS

A. Passive House Certification

B. Schematic Drawings

PART 2 – PRODUCTS

2.01 POCKET DOORS

A. Johnson Hardware, www.johnsonhardware.com

1. 2060 Pocket Door Frame

2. Frame compatible with 2inch x 6 inch interior wall

B. Jeld-Wen, www.jeld-wen.com

1. Flush All Panel Interior Door

2. Solid Core

.

2.02 EXTERIOR DOORS

A. Front Door, South elevation

1. Model: Makrowin 88G2

2. Passive House Certified

3. Finish: Mahogany

A. Patio Door, West elevation

1. Model: Makrowin 88G2

2. Passive House Certified

3. Finish: Mahogany

2.02 DOOR GLAZING

A.Triple Glazed Low E Insulated with Warm-Edge Spacer System – Swisspacer V, Ug-value of 0.105, SHGC of 0.5 and VT of 0.71

2.03 Hardware: Secustic Melbourne F9-2

A. Aluminum Steel Matte textured

PART 3 – EXECUTION

END OF SECTION 08 14 00

SECTION 08 52 00
WOOD WINDOWS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Manufactured Windows

B. Window Hardware

1.02 RELATED REQUIREMENTS

A. 08 06 50 Window Schedule

1.03 REFERENCE STANDARDS

A. Passive House Certification, IRC 308.6

1.04 SUBMITTALS

A. Passive House Certification

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Makrowin, European Architectural Supply, 100 Todd Pond Rd, Lincoln, MA, 781-647-4432, www.eas-usa.com

2.02 WINDOW

A. Profile: Makrowin 88G2

B. Glazing: Triple Glazed Low E Insulated with Warm-Edge Spacer System – Swisspacer V, Ug value of 0.105, SHGC of 0.5 and VT of 0.71

2.03 Hardware: Secustic Melbourne F9-2

A. Aluminum Steel Matte textured

B. Fully perimeter locking with 2 security closures and safety lock

PART 3 – EXECUTION (Not Used)

END OF SECTION 08 52 00

SECTION 08 61 00
ROOF WINDOWS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Skylight

1.02 RELATED REQUIREMENTS

A. 08 06 60 Skylight Schedule

1.03 REFERENCE STANDARDS

A. IRC 308.6

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Roto-Frank, European Architectural Supply, 100 Todd Pond Rd, Lincoln, MA, 781-647-4432, www.eas-usa.com

2.02 SKYLIGHT

A. Model: WDF Design R8 – Top Hinged

B. Frame: Wood Profile

C. Glazing: 9A 3 Pane, Tempered, Ug 0.08, Uw 0.14, SHGC 30%, VT 45%

PART 3 – EXECUTION

END OF SECTION 08 61 00

SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Gypsum Board Wall Panels

B. Mold and Mildew Resistant Gypsum

C. Gypsum Board Ceiling Panels

1.02 RELATED REQUIREMENTS

A. 09 06 20 Schedule for Gypsum

1.03 REFERENCE STANDARDS

A. ASTM C 473; ASTM C 475; ASTM C 514; ASTM C 665; ASTM C 840; ASTM C 954; ASTM C 1002; ASTM C 1047: ASTM C 1396: ASTM C 1629: ASTM D 3273; GA-214; GA-216; GA-231; GA-238 Federal Specification SS-L-30D Type III (Grade X); GREENGUARD Children & Schools Certified

1.05 SUBMITTALS

1.06 QUALITY ASSURANCE

A. Provide Products Manufactured in North America Only

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. CertainTeed Gypsum, Inc.; 4300 West Cypress Street, Suite 500, Tampa, FL 33607; 1-800-233-8990 (1-866-427-2872); www.certainteed.com

2.02 GYPSUM BOARD WALL PANELS

A. REGULAR GYPSUM BOARD: Gypsum core panel solid set core enclosed in paper. Complying with ASTM C1396.

1. ProRoc® Regular, manufactured by CertainTeed Gypsum, Inc.

2. Thickness: 1/2 inch

3. Width: 48 inches

4. Length: 8 feet

B. MOISTURE AND MOLD RESISTANT GYPSUM BOARD: Moisture and Mold Resistant Gypsum Board: Gypsum core panel with enhanced core formulated for resistance to moisture and mold; surfaced with moisture/mold resistant paper on front, back, and long edges. Complying with ASTM C1396

1. ProRoc® Moisture and Mold Resistant With M2TECH™ Gypsum Board by CertainTeed Gypsum, Inc.

2. Thickness: 1/2 inch

3. Width: 48 inches

4. Length: 8 feet

2.03 GYPSUM BOARD CEILING PANELS

A. REGULAR GYPSUM CEILING BOARD: Gypsum Core panel with enhanced sag resistant core. Complying with ASTM C 1396.

1. ProRoc® Interior Ceiling, manufactured by CertainTeed Gypsum, Inc.

2. Thickness: 1/2 inch

3. Width: 48 inches

4. Length: 8 feet

PART 3 – EXECUTION (Not Used)

END OF SECTION 09 29 00

SECTION 09 30 33
CERAMIC TILING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Concrete Tile

B. Grout

C. Tile Backing Board

1.02 RELATED REQUIREMENTS

A. 09 06 30 Schedule for Tiling

1.03 REFERENCE STANDARDS

A. Ceramic Tile: ANSI A137.1.1988, ANSI- A137.1, ANSI A108.13, , TCA Installation Handbook recommendations

B. Grout: ANSI A118.7, ANSI A108.10

C. Tile Backing Board: ANSI A118.9, UL

1. Bonding Material: ANSI A118.4, ANSI A118.11

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 CONCRETE TILE

A. 6 inch x 6 inch

2.02 GROUT

A. Color to match tile color

2.03 TILE BACKING BOARD

A. WonderBoard 1/2 inch

B. 36 inch x 60 inch x 1/2 inch

C. FlexBond Crack Prevention Mortar

PART 3 – EXECUTION (Not Used)

END OF SECTION 09 30 33

SECTION 09 64 29
WOOD STRIP AND PLANK FLOORING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pre-finished, tongue and groove wood flooring

1.02 RELATED REQUIREMENTS

A. 06 16 00 Sheathing

1.03 REFERENCE STANDARDS

A. NOFMA grading rules for species, grade, and cut.

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 SOLID-WOOD STRIP FLOORING

A. Maple

B. Tongue and grooved

C. 3/4 inch

D. 3-1/4 inch

E. Random Lengths 9 to 84 inch

F. Pre-Finished

PART 3 – EXECUTION

3.01 Installation

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."

B. Solid-wood, Strip flooring: nail down on or above grade

END OF SECTION 09 64 29

SECTION 09 91 23
INTERIOR PAINTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Interior Paint

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. Conformance Standards: AIM; CARB; LADCO; OTC; SCQAMD; Low VOC; MPI

1.04 SUBMITTALS

A. Color Sample

PART 2 – PRODUCTS

2.01 LATEX PAINT

A. Benjamin Moore, EcoSpec Interior Latex Flat 219

B. Color: Pure White

C. Low VOC, low odor

PART 3 – EXECUTION

3.01 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.

C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

D. General surface preparation indicated by manufacturer.

1. Gypsum Wallboard: Nails or screws should be countersunk, and they along with any indentations should be mudded flush with the surface, sanded smooth and cleaned to remove any dust, then prime with a high quality latex primer prior to painting the substrate.

2. Wood: Unpainted wood or wood in poor condition should be sanded smooth, wiped clean, then primed. Any knots or resinous areas must be primed before painting. Countersink all nails, putty flush with surface, then prime with a high quality latex primer.

E. Provide materials that are compatible with one another and with substrates

3.02 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces, unless otherwise indicated.

1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint the backside of access panels.

4. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, or other surface imperfections. Cut in sharp lines and color breaks.

D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.03 CLEANING

A. Washing Instructions: Wait at least 14 days after painting before cleaning the surface with a non-abrasive mild cleaner.

B. Clean up: Wipe up spills immediately with damp cloth or sponge. Wash brushes, rollers and other painting tools with soap and water immediately after use.

END OF SECTION 09 91 23

SECTION 10 06 10
SCHEDULES FOR INFORMATION SPECIALTIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Exterior Signage

B. Interior Signage

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 - PRODUCTS

2.01 TBD

PART 3 - EXECUTION

3.01 TBD

END OF SECTION 10 06 10

SECTION 10 06 20
INTERIOR SPECIALTIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Towel Racks

B. Soap Dishes

C. Shower Curtain

D. Toilet Paper holder

1.02 RELATED REQUIREMENTS

A. 09 30 13 Ceramic Tiling

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 TOWEL BAR

A. IKEA Grundtal: Rail

1. Stainless Steel Rail, 20 7/8”, model 900.113.96, cost $6.99, quantity 1

2.02 SOAP DISHES

A. Ceramic Tile Soap Dishes

B. Product Description: Glazed Ceramic Soap Dish Tiles for the bathroom

2.03 SHOWER CURTAIN

A. Water Resistant Shower Curtain and Shower Rod

B. Product Description: Water resistant fabric/plastic shower curtain, curtain rod, curtain rings, and mounting hardware.

2.04 TOILET ROLL HOLDER

A. IKEA Grundtal

1. Toilet Paper Roll Holder, Stainless Steel, model 200.478.98 ,cost $4.99, quantity 1

2. Wall mounted, wood

PART 3 – EXECUTION

END OF SECTION 10 06 20

SECTION 10 22 26.43
OPERABLE PARTITIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Hardware for moveable walls

B. Plywood

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. CARB Phase 2

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 OVERHEAD TRACK

A. 2610F Wall Mount Door Hardware

1. Part #: 2610F

2. Johnson Hardware: http://johnsonhardware.com track

2.02 WHEELS

A. Hamilton Caster

1. XC70D Duralast Wheel ; 6inch x 3 inch ; 3/4 BB

2. Model : W-630-DB70-3/4

3. http://hamiltoncaster.com XC70D wheel

2.03 PLYWOOD

A. Finish Grade

B. Birch

C. Formaldehyde free

PART 3 – EXECUTION

END OF SECTION 10 22 26.43

SECTION 10 44 16
FIRE EXTINGUISHER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Fire Extinguisher

1.02 RELATED REQUIREMENTS

A. 21 13 13 Wet Pipe Sprinkler System

1.03 REFERENCE STANDARDS

A. Mets NFPA requirements, UL rated 2-A:10-B:C, UL listed

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 KIDDE model FX210R

A. Type 2A-10BC

B. Part # 21002770

B. http://www.kidde.com fire extinguisher

PART 3 – EXECUTION

END OF SECTION 10 44 16

SECTION 10 71 13.13
EXTERIOR SHUTTERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Exterior Shutters, Motorized

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 EXTERIOR SHUTTERS, MOTORIZED

A. Manufacturer: HELLA

B. Model: AR 63 ZM

C. http://www.hella.info outdoor blinds

PART 3 – EXECUTION

END OF SECTION 10 71 13.13

SECTION 11 31 00

RESIDENTIAL APPLIANCES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

B. Laundry appliances.

C. Entertainment equipment.

1.02 RELATED REQUIREMENTS

A. Division 22 – Plumbing Piping: Plumbing connections for appliances

B. Division 26 – Equipment Wiring: Electrical connections for appliances

1.03 REFERENCE STANDARDS

A. UL – Underwriters Laboratories Inc.; ENERGY STAR

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 KITCHEN APPLIANCES

A. Refrigerator/Freezer combination

1. Manufacturer & Model: Whirlpool GB9FHDXWS

2. Type: bottom freezer

3. Size: 18.5 cubic feet

4. Specifications: To view this product's technical data, CLICK HERE.

B. Dishwasher

1. Manufacturer & Model: Fisher & Paykel DD24SCX6

2. Type: compact, single drawer

3. Specifications: To view this product's technical data, CLICK HERE.

C. Cooktop

1. Manufacturer & Model: BOSCH NET5054UC 500 Series

2. Type: built-in

3. Size: 4-burner

4. Specifications: To view this product's technical data, CLICK HERE.

D. Microwave-Convection Oven combination

1. Manufacturer & Model: GE Monogram Built-In Oven ZSC1201NSS

2. Type: built-in

3. Size: 1.6 CU FT

4. Specifications: To view this product's technical data, CLICK HERE.

E. Range Hood

1. Manufacturer & Model: BROAN 413004

2. Specifications: To view this product's technical data, CLICK HERE.

2.02 LAUNDRY APPLIANCES

A. Clothes Washer/Dryer combination

1. Manufacturer & Model: LG WM3455HW

2. Type: compact

3. Size: 2.7 cubic feet

4. Specifications: To view this product's technical data, CLICK HERE.

2.03 ENTERTAINMENT EQUIPMENT

A. Television

1. Manufacturer & Model: Panasonic TC-L42D2

2. Type: LED

3. Size: 42 inches

4. Energy: Power Rating 0.105 kW

5. Specifications: To view this product's technical data, CLICK HERE.

B. Home Theater

1. Manufacturer & Model: Sony BDV-E770W

2. Type: Includes blu-ray player, audio-video receiver & speakers

3. Energy: Power Rating 0.12 kW

4. Specifications: To view this product's technical data, CLICK HERE.

PART 3 – EXECUTION

END OF SECTION 11 31 00

SECTION 12 30 00

CASEWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Kitchen Cabinets

B. Bathroom Cabinets

1.02 RELATED REQUIREMENTS

A. 12 36 13 Countertops

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. IKEA

2.02 KITCHEN CABINETS

A. IKEA Akurum: Frame: White; Front: Abstrakt High Gloss White

1. Upper Cabinet, model 298.695.04, cost $84.00, quantity 2

2. Base Cabinet, 2+2 Drawers, model 098.692.70, cost $270.96, quantity 1

3. Base Cabinet, 2 Drawers / 2 Doors, model 398.693.44, cost $223.98, quantity 3

4. Base Cabinet, Sink, model 998.692.61, cost $ 119.00, quantity 1

5. Base Cabinet, Drawer / Door, model 998.693.22, cost $124.99, quantity 1

6. Drawer Base Cabinet, 3 Drawer, model 098.692.89, cost $175.97, quantity 1

7. www.ikea.com akurum cabinets

2.03 BATHROOM CABINETS

A. IKEA Freden

1. Mirror Cabinet, model 801.411.81, cost $99.99, quantity 1

2. Sink Cabinet, model 298.627.34, cost $279.00, quantity 1

3. www.ikea.com freden cabinets

PART 3 – EXECUTION (Not Used)

END OF SECTION 12 30 00

SECTION 12 36 00
COUNTERTOPS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quartz Composite Countertop

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Caesarstone, 6840 Hayvenhurst Ave. Suite 100, Van Nuys, CA 91406 (877)978-2789, caesarstoneus.com

2.02 COUNTERTOP

A. Color: Concrete 2003

B. Edge: Radius

C. Thickness: 3/4 inch

PART 3 – EXECUTION

3.02 INSTALLATION

END OF SECTION 12 36 00

SECTION 12 58 00
RESIDENTIAL FURNITURE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Custom Fabricated Residential Furniture

1. Desktop Work Space

2. Dining Table and chairs

3. Residential Chairs

4. Coffee Table

5. Side Tables

6. Storage Bench Seating

7. Couches and Loveseats

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 RESIDENTIAL FURNITURE

A. Desktop Workspace: Desktop is a collapsible work surface that can easily be folded up and relocated. Desktop consists primarily of wood and metal.

B. Dining Table: The dining table is designed to seat up to 10 guests, contain storage for house wares and be reconfigured to accommodate various dining arrangements. The table is comprised primarily of wood and metal.

C. Multi-use Chairs: These chairs are intended to service the dining room table, both desktop workspaces, and casual seating throughout the house. The primary materials used will be wood and metal.

D. Coffee Table: The coffee table will be made up of wood and metal, and will incorporate a storage element.

E. Side Tables: The side tables will be flexible furniture pieces that can be used either as night side tables or end tables for living room seating. The tables will be fabricated out of wood and metal.

F. Storage Bench Seating: The bench seating will be reconfigurable to accommodate various dining arrangements, and will incorporate a storage component. The bench seating will consist of wood and metal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The installation of all furniture will be in accordance with the architectural drawings provided by team Massachusetts.

B. The installation of all furniture will take place after the 4D house is assembled and the interior finishes are complete.

END OF SECTION 12 58 00

SECTION 12 58 29
BEDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Bed – Master Bedroom

B. Bed – Child Bedroom

1.02 RELATED REQUIREMENTS

A. 12 45 00 Bedroom Furnishings

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 Master Bed

2.02 Child Bed

PART 3 – EXECUTION (Not Used)

END OF SECTION 12 58 29

SECTION 12 58 36
NIGHTSTANDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Nightstands – Master Bedroom

B. Nightstands – Child Bedroom

1.02 RELATED REQUIREMENTS

A. 12 43 00 Portable Lamps

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 Master Bedroom Nightstands

2.02 Child Bedroom Nightstands

PART 3 – EXECUTION (Not Used)

END OF SECTION 12 58 36

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES
- A. Tubing
- B. Rings
- C. Supports
- D. Tees
- E. Valves
- F. Finishes
- G. Sprinkler Assemblies
- H. Cabinet
- I. Adapters
- J. Tools

1.02 RELATED REQUIREMENTS

A. 10 44 16 Fire Extinguishers

1.03 REFERENCE STANDARDS

A. UPC, IPC, NSPC, NPC

B.B137.5, ASTM F1960

C. ANSI/NSF 14/61, ICC ESR 1099, IAPMO 3558

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 PIPING AND FITTINGS

A. Manufacturer: Uponor Inc., 5925 148th Street West, Apple Valley, MN 55124 www.uponor-usa.com

B. AquaPEX Tubing, White

1. 1/2 inch, Quantity: 100 foot

2. 3/4 inch, Quantity: 10 foot

3. 1 inch, Quantity: 200 foot

C. ProPEX Rings

1. Ring with Stop -1/2 inch, Quantity: 8

2. Ring with Stop - 3/4 inch, Quantity: 2

3. Ring - 1 inch, Quantity: 28

D. Supports

1. Tube Talon

a. 1/2 inch, Quantity: 100

b. 5/8 inch, Quantity: 100

c. 3/4 inch, Quantity: 100

d. 1 inch, Quantity: 100

2. PEX Wall Support Bracket

a. 1/2 inch, Quantity: 3

b. 3/4 inch, Quantity: 3

3. Plastic Bend Support - 1/2 inch, Quantity: 4

E. Tees

1. ProPEX LF Brass Tee

a. 1inch PEX x 1 inch PEX x 1 inch PEX, Quantity: 1

b. 1 inch PEX x 3/4 inch PEX x 1 inch PEX, Quantity: 1

c. 1 inch PEX x 1 inch PEX x 1/2 inch PEX, Quantity: 1

2. EP Multi-port Tee

a. 3/4 inch EP Branch Opposing Multi-port Tee- 3 Outlets, Quantity: 1

F. Valves

1. ProPEX EP Angle Stop Valve for 1/2 inch PEX, Quantity: 3

2. UL/FM Ball Valve Full Port 1 inch, Quantity: 1

G. Finishes

1. Concealed Flat Cover Plate - White, Quantity: 10

2. ProPEX LF Copper Tub Ell - 1/2 inch PEX x 1/2 inch Copper (3 inch x 4 inch), Quantity: 1

3. ProPEX Escutcheon for 1/2 inch PEX (11/16 inch O.D.) White, Quantity: 3

H. Sprinkler Assembly

1. RFC43 (165oF) Flat Concealed Sprinkler, Quantity: 10 inch

I. Cabinet

1. Sprinkler Cabinet without Sprinkler Heads, Quantity: 1

J. Adapters

1. ProPEX LF Brass Sweat Adapter -1 inch PEX x 1 inch Copper, Quantity: 1

2. Fire Sprinkler Adapter Push-On Nut, Quantity: 25

3. Fire Sprinkler Adapter Mounting Bracket

a. 3/4 inch, Quantity: 10

b. 1 inch, Quantity: 10

4. ProPEX LF Brass Fire Sprinkler Adapter Tee - 1 inch PEX x 1 inch PEX x 1/2 inch FNPT, Quantity: 10

K. Tools

1. In-Line Flow Test Kit, Quantity: 1

2. Concealed Sprinkler Wrench for RFC43 Heads, Flat, Quantity: 1

3. Cover Plate, Quantity: 1

PART 3 – EXECUTION (Not Used)

END OF SECTION 21 13 13

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.01 SECTION INCLUDES:
A. Piping
B. Miscellaneous

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
A. NSF Standard 61 Drinking Water System Components - Health Effects

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 PIPING
A. Copper; Type L
B. Cross-linked Polyethylene (PEX)
C. PVC

2.02 GROUT

PART 3 – EXECUTION

3.01 GENERAL PIPING INSTALLATION
A. Install piping free of sags and bends.
B. Install Fittings for changes in direction and branch connections.

3.02 GENERAL EQUIPMENT INSTALLATIONS
A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
C. 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.
D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 22 05 00

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 – GENERAL

1.01 SECTION INCLUDES:
- A. Piping
- B. Fittings
- C. Joining Materials

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
- A. NSF-61 - health requirements
- B. ASTM F876 - dimensions and
- C. ASTM F877- ability to withstand pressure and temperature
- D. SDR 9 - Standard Dimension Ratio

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 PIPING AND FITTINGS
- A. Hard Copper Tubing: Type L
  - 1. Joining Material: lead-free flux
- B. Soft Copper Tubing: Type L
  - 1. Joining Material: lead-free flux
- C. Wirsbo PEX Tubing and Fittings

PART 3 – EXECUTION

3.01 PREPARATION
- A. Make sure that the pipe is clean and clear of debris.

3.02 INSTALLATION
- A. Install domestic water piping without pitch for horizontal piping and plumb for vertical piping.

3.03 INSPECTING

A. Inspect all pipe as follows:

1. Fill domestic water. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered extended, or repaired.

END OF SECTION 22 11 16

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. Specialty Items

1.02 RELATED REQUIREMENTS

A. 22 11 16 Domestic Water Piping

1.03 REFERENCE STANDARDS

A. ASSE 1015
B. AWWA C510
C. ASTM F877
D. ASTM F1960
E. ANSI B18.18
F. NSF 61-8

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 MANUFACTURED UNITS

A. Reduced-Pressure Backflow Preventers
B. Laundry Outlet Boxes
C. Stop-and-Waste Drain Valves

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install backflow preventer at main water-supply connection.
B. Install Cloths Washer Box To wall and connect pipes as specified by Manufacturer.
C. Install Stop-and-Waste Drain Valves as specified by Manufacturer.

END OF SECTION 22 11 19

SECTION 22 12 19
FACILITY POTABLE WATER STORAGE TANKS

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. Water Tanks
B. Fresh Water Transfer Pump
C. Pressure Regulating Tank

1.02 RELATED REQUIREMENTS

A. 22 33 30.16 Residential, Storage Electric Domestic Water Heaters

B. 22 33 30.26 Residential, Collector-to-Tank, Solar-Electric Domestic Water Heater

1.03 REFERENCE STANDARDS

A. PPI 63101-016H
B. XR3 FDA/NSF-61
C. C-UL

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 DOMESTIC WATER STORAGE TANK

A. Manufacturer: Aire Industrial, Model#: 951-015002
B. Size: 1500 Gallon Fresh Water Bladder Tank, Dimensions 9' (W) x 13' (L) x 18" (H)
C. One 4 inch PVC Fill Fitting/Scotty Cap and one 1-1/2" PVC Flange Fitting with PVC Ball Valve
D. Bladder Tanks are manufactured using XR3 FDA/NSF-61 approved materials, which are specifically engineered for the storage of consumable fluids
E. To view this product's technical data, CLICK HERE

2.02 FRESH WATER TRANSFER PUMP

A. Manufacturer: Craftsman model Professional 3/4 hp Hydro-Glass® Shallow Well Jet Pump
B. Description: Used to provide a constant pressure to domestic water lines
C. Motor: 3/4 Hp, Capacitor Start, Dual voltage 115 or 230

D. Tap Size: Discharge Two 1 inch, Suction 1-1/4 inches

E. Pressure Rating: 40/60 PSI

F. To view this product's technical data, CLICK HERE

2.03 PRESSURIZATION TANK

A. Manufacturer: Amtrol, Model WX-202P

B. Description: Holds pressure in tank to reduce the amount of times the pump is needed. When pressure is dropped below a certain rating the pump will recharge the tank.

C. Size: 20 Gallon 32-1/8" (H) x 15-3/8 (D)

D. Pressure Rating: Pre-charge 38 PSI, Working Pressure 125 PSI

E. Inlet/Outlet: 1" NPTF Stainless Steel

F. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION

A. There must be an accessible area around openings for filling and emptying the tank of no less than 12 inches

END OF SECTION 22 12 19

SECTION 22 13 16
SANITARY WASTE PIPING AND VENT PIPING

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. Piping
B. Fittings
C. Joining Material

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM D 1784 - Rigid Vinyl Compounds
B. ASTM D 1785 - PVC Plastic Pipe, Schedule 40
C. ASTM D 2466 - PVC Plastic Fittings, Schedule 40
D. ASTM D 2564 - Solvent Cements for PVC Pipe and Fittings
E. NSF Standard 14- Plastic Piping Components and Related Materials
F. NSF Standard 61 - Drinking Water System Components - Health Effects

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 PIPING
A. Polyvinyl Chloride (PVC)
B. Polyvinyl Chloride Fittings
1. 1. Coupler
2. 90 degrees
3. 45 degrees
4. Tee

2.03 Joining Materials
A. Primer
B. Cement

PART 3 – EXECUTION

3.01 PREPARATION

A. Prepare pipe by reaming burrs.

B. Remove scale dirt on inside and outside of pipe.

C. Prepare piping fittings.

3.02 INSTALLATION

A. Cut pipe to desired length.

B. Support pipe with hangers every 5 feet

C. Add Primer and Cement to pipe and fitting then press together holding for several seconds till cement has cured.

END OF SECTION 22 13 16

SECTION 22 13 53
FACILITY SEPTIC TANKS

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. Water Tank

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM D 751

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 GRAY WATER STORAGE TANK

A. Manufacturer: Aire Industrial, Model#: 951-010001

B. Size: 1000 Gallon Fresh Water Bladder Tank, Dimensions 9' (W) x 12' (L) x 16" (H)

C. One 4 inch PVC Fill Fitting/Scotty Cap and one 1-1/2" PVC Flange Fitting with PVC Ball Valve

D. Bladder Tanks are manufactured using rugged 22 oz. reinforced PVC fabrics, which are specifically engineered for the storage of gray water

E. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION

A. There must be an accessible area around openings for filling and emptying the tank of no less than 12 inches

END OF SECTION 22 13 53

22 33 30.16
RESIDENTIAL, STORAGE ELECTRIC DOMESTIC WATER HEATERS

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. 50 Gallon Back-Up DHW Storage Tank

B. Heat Pump used to augment solar thermal system

1.02 RELATED REQUIREMENTS

A. 22 33 30.26 Residential, Collector-to-Tank, Heat-Exchanger-Coil, Solar-Electric Domestic Water Heaters

B. 22 11 23 Domestic Water Pumps

C. 22 05 00 Common Work Results for Plumbing

1.03 REFERENCE STANDARDS

A. ANSI STANDARD 61 DRINKING WATER SYSTEM COMPONENTS

1.04 SUBMITTALS

A. DHW system schematic

B. Mechanical room layout drawing

PART 2 – PRODUCTS

2.01 BACK-UP HOT WATER STORAGE TANK

A. Manufacturer: State Water Heaters

B. Description: This 50-gallon tank (designated the back-up hot water tank) stores the DHW at the desired set point of 120 degrees F. Its cold water inlet is connected to the 80-gallon solar hot water tank, and its hot water outlet is connected to the hot water piping for the home. This tank's water is heated primarily by the Green Star heat pump mounted on top of it, but also has a built-in electric element to augment the heat pump.

C. Equipment:

1. State Water Heaters model ES6 50 DOCS
   a. Weight: 155
   b. Warranty: 10 years
   c. Substitutions: any 50 gallon electric hot water tank.
   d. To view this product's technical data, CLICK HERE

2.02 HOT WATER HEAT PUMP

A. Manufacturer: USI Green Energy

B. Description: This heat pump operates by transferring heat from the surrounding air to the water stored in the tank on which it is attached. This technology is a relatively new application to an old idea, and is more than twice as efficient as traditional electric water heaters. A copper coil is inserted into the tank, through which the heat transfer fluid circulates. The heat pump should be able to keep the water at the desired set point for most loads. At high loads, the back-up electric element build into the tank will activate and augment the heat pump.

C. Equipment

1. Green Star Model WH 270
   a. Weight: 48 lbs
   b. Warranty: 1 year labor, 6 year parts
   c. Substitutions: a 50-gallon hot water tank with a built-in electric heat pump could replace this heat pump along with the 50-gallon tank on which it sits.
   d. To view this product's spec sheet, CLICK HERE.

PART 3 – EXECUTION

END OF SECTION 22 33 30.16

22 33 30.26
RESIDENTIAL, COLLECTOR-TO-TANK, HEAT-EXCHANGER-COIL, SOLAR-ELECTRIC DOMESTICWATER HEATERS

PART 1 – GENERAL

1.01 SECTION INCLUDES:

A. SunDrum Hybrid Solar Collector System
B. Solar-heated hot water tank storage tank

1.02 RELATED REQUIREMENTS

A. 22 33 30.16 Residential, Storage Electric Domestic Water Heaters
B. 22 11 23 Domestic Water Pumps
C. 22 05 00 Common Work Results for Plumbing

1.03 REFERENCE STANDARDS

A. ANSI Standard 61 Drinking Water System Components
B. Solar Rating & Certification Corporation (SRCC) Standards

1.04 SUBMITTALS

A. Solar hot water system schematic

PART 2 – PRODUCTS

2.01 SOLAR THERMAL SYSTEM

A. Manufacturers
    1. Solar thermal panels: SunDrum Solar
    2. Controller: Steca Elektronik GmBh
    3. Expansion tank: Amtrol, Inc.
    4. Circulator pump: Grundfos

B. Description: The closed-loop system used is the SDM300-6-B, consisting of two strings of three panels connected in parallel. This is a hybrid system that not only provides heat to the DHW system, but also helps cool the PV array. Each of the six panels is mounted directly underneath a PV panel, and hence will not be visible. While the sun is shining, heat from the PV panels is transferred to the fluid flowing through the

SunDrum panels. This fluid is pumped to the 80 Gallon solar water tank, where it flows through a heat exchanger coil inside the tank. The heat is transferred to the water in the tank, and thus the fluid leaving the coil is cooler than the fluid exiting from the collectors. This cooler fluid then circulates back to the collectors and the process repeats. There is a temperature sensor in one of the collectors, and another in the water tank. A preprogrammed controller is connected to these two sensors. It activates a circulator pump when it detects a collector temperature 16° F higher than tank temperature and will shut the pump off when collector temperature drops to within 8° F higher than tank temperature. The heat transfer fluid is distilled water.

C. Equipment

1. Six (6) SunDrum SDM100 solar thermal collector panels.
   a. Dry weight: 22 lbs. Installed weight: 26 lbs.
   b. Operating temperature range: -40° C to +90° C
   c. Warranty: 10 years
   d. Substitutions: none. All components listed make up one complete system and are all provided by SunDrum Solar, LLC, per MOU with Team Massachusetts.
   d. For this product's tech data, CLICK HERE.

2. Six (6) SDM100 Connection Kits
   a. Each kit includes 2-3/8 inch barbs, 2 plugs, 2 stainless steel hose clamps, 5 feet of industrial hose, and 5 feet of UV resistant insulation.

3. One (1) HK-2 Header Kit
   a. x inch diameter copper piping
   b. Air expansion valve
4. Controller
   a. Steca Solar TR0301U
   b. For this product's data sheet, CLICK HERE.
5. Pump Station: pump and check valve
   a. Grundfos Alpha pump
   b. For this product's data sheet, CLICK HERE.

6. Expansion tank
   a. Amtrol Extrol Rx-15
   b. For this product's data sheet, CLICK HERE.

7. Five Gallons of Distilled Water

2.02 SOLAR HOT WATER TANK

A. Manufacturer: Heat Transfer Products, Inc.

B. Description: This is a Heat Transfer Contender SSC-80SE 80 Gallon Water Tank that includes a built-in heat exchanger coil used for a solar thermal system. The water in this tank serves two purposes: as a "heat sink" to absorb heat from the solar thermal system; and as "pre-heat" tank for the "cold" water entering the back-up, 50 gallon hot water tank (see section 22 33 30.26). This tank will not be connected to power so that the electrical heating

element in this tank will never turn on. The solar thermal system controller will control the water temperature in this tank.

C. Equipment
   1. Manufacturer: Heat Transfer Products, Inc.
   2. Model: Contender SSC-80SE .
   3. For this product's data sheet, CLICK HERE.

2.03 DISTILLED WATER - 5 gallons

PART 3 – EXECUTION

3.01 INSTALLATION

A. Special Techniques

   1. Follow SunDrum Solar SDM300 Series Installation Manual.

A. Interface with Other Work

   1. The solar thermal panel installation must be coordinated with the installation of the PV system, since the panels are mounted directly into six PV panels. Exact location of the six chosen PV panels in the PV array must be confirmed, so that SunDrum solar panels are placed correctly.

3.02 SYSTEMS START-UP

A. This closed loop solar thermal system must be charged differently than most solar thermal systems. Follow steps in SunDrum Solar SDM300 Series Installation Manual starting under the heading "System Startup and Shutdown".

END OF SECTION 22 33 30.26

23 31 13.16
ROUND AND FLAT-OVAL SPIRAL DUCTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork

B. Duct fittings

1.02 RELATED SECTIONS

A. Section 23 33 13 – Back Draft Dampers

B. Section 23 37 13 – Diffusers, Registers, and Grilles

C. Section 23 72 00 – Air to Air Energy Recovery Equipment

D. Section 23 81 26 – Split System Air Conditioner

1.03 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA) 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

B. American Society for Testing and Materials (ASTM) A653, Standard specifications for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy Coated (Galva-nealed) by the hot-dip process.

C. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) – HVAC Duct Construction Standards (DCS) – Metal and Flexible

1.04 SUBMITTALS

A. Construction Drawings, Ductwork

B. Product datasheets from manufacturer

1.05 QUALITY ASSURANCE

A. Qualifications

1. Company specializing in manufacturing the type of products used here should have a minimum of three years of documented experience.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Fantech

B. The Duct Shop

2.02 MATERIALS

A. Ductwork

1. Rigid ducts are hot dipped galvanized steel, ASTM A653/A653M FS type B, with G60/Z180 coating.

2. 5'', 8'', and 10'' circular ductwork is used.

3. Minimal amounts of flexible round insulated ductwork will be used.

B. Duct fittings

1. Saddle taps on round – The Duct Store

a. 6" saddletap to fit on 10" round; for supply run off to secondary bedroom.

b. 6" saddletap to fit on 8" round; for fresh air supply run off to HRV.

c. 26 gauge galvanized steel

2. Reducer – Fantech

a. Fantech CKR Series (Model CKR 54); 5" to 4"

b. Use to reduce 5" HRV return to 4" for bathroom return

c. Length in line: 3 ¼"

3. Reducer – The Duct Shop

a. (2) 10" to 6"; reduce 10" main line to 6" bedroom registers

b. (2) 6" to 5"; (1) expand 5" HRV supply collar to 6" to use the 6" saddletap on the 8" fresh air supply duct, and (1) expand 5" HRV exhaust collar to 6" to then expand to 8", for the combined 8" exhaust duct.

c. (1) 6" to 8"; expand 6" HRV exhaust section to 8" for 8" combined exhaust.

d. 26 gauge galvanized steel

4. Elbows – The Duct Shop

a. 45 degree adjustable elbow; 8”, 5”, 4”

b. 90 degree adjustable elbow, 10”, 8”, 5”, 4”

c. 26 gauge galvanized steel

5. Wye adapters – The Duct Shop

a. 10 x 10 x 8”; used to connect dehumidifier supply to main 10” supply.

b. 10 x 10 x 10”; to split heat pump supply.

c. 8 x 8 x 8”; used to branch the dehumidifier exhaust into the combined exhaust.

d. 26 gauge galvanized steel

C. Exterior Vents, weather hoods – Fantech

1. Roof cap (Model RC 8), 8”, with damper flap closure, duct connection and screened exhaust opening.

a. Total height from bottom of collar to top of bend: 11 ¾”

2. Supply outdoor weather hood (Model FML 8, UPC # 24118), 8”, single unit

D. Duct accessories – Fantech

1. Stabilizing mounting clamps (5’’, 8’’, 10’’) – two inch wide galvanized steel bands lined with neoprene

2. Inlet guards (8’’) – Wire ring, zinc chromate plated steel. Used at fresh air intake.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Special instructions

1. Minimize flexible ductwork.

2. A rectangular to round transition is required to connect the Mr. Slim unit.

3. Use fittings that minimize head loss.

4. Maintain access to volume dampers and backflow dampers for airflow tuning and maintenance.

END OF SECTION 23 31 13.16

SECTION 23 33 13
BACK DRAFT DAMPERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Back draft dampers

B. Volume dampers

1.02 RELATED SECTIONS

A. Section 23 31 13.16 – Round and Flat-Oval Spiral Ducts

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. Construction Drawings, Ductwork

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializes in manufacturing the products specified in this section with minimum 10 years' experience.

1.05 SYSTEM DESCRIPTION

A. Back draft dampers are used where backflow could occur.

B. Supplies from air-to-air heat pump, HRV, and dehumidifier are combined to form a single supply duct. Returns from house and from bathroom combine before entering the HRV. A single fresh air and single exhaust house penetration serve both the dehumidifier and HRV. Back draft dampers are needed in the house supply and exhaust lines, mainly where duct runs join together.

C. Not included in this section are back draft dampers installed at the diffuser/register collar. See Section 23 37 13 – Diffusers, Registers, and Grilles.

D. Volume dampers are used to control the airflow to/from equipment and the house.

E. Volume dampers are needed in the return line to the house to the dehumidifier, in the supply from the house to the dehumidifier, and at the combined supply to the house and to each bedroom.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Fantech

2.02 MATERIALS

A. Back draft damper

1. RSK back draft dampers, models RSK 8 and RSK 10 (UPC # 69080 and 69100)
2. 8”diameter and 3 1/8” wide, 10” diameter and 3” wide
3. Galvanized Steel Collar and Lightweight Aluminum Damper Blades
4. Spring loaded for positive closure

B. Volume damper

1. Iris Damper, models IR 6, IR 8, and IR10 (UPC # 63060, 63080, 63100)
2. 6”diameter and 2” wide, 8” diameter and 2 ¼” wide, 10” diameter and 2 3/4” wide
3. Include calibrated airflow measuring device.

PART3 – EXECUTION

3.01 INSTALLATION

A. Install back draft dampers in locations to eliminate backflow.

B. Install volume dampers in locations where air tuning is required.

C. Follow manufacturer’s instructions for ductwork installation, and follow measures for maximizing efficiency.

END OF SECTION 23 33 13

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Diffusers

B. Registers

C. Dampers installed at diffuser collar

1.02 RELATED SECTIONS

A. Section 23 31 13.16 – Round and Flat-Oval Spiral Ducts

1.03 REFERENCE STANDARDS

A. ANSI/ ASHRAE Standard 70-2006.

1.04 SUBMITTALS

A. Product datasheet from manufacturer.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Fantech

B. Hart and Cooley

2.02 PRODUCTS

A. Supply and exhaust grilles

1. Fantech DG Series exhaust grille (Model DG 4, UPC # 67940)

a. Low profile, fixed circular plastic.

b. Used in bathroom ceiling; return from bathroom to HRV.

c. For use with 4” duct; duct connections are 1/8” smaller than duct size.

d. Matching diameter galvanized mounting collar with nailing strip is included.

e. Total length: 3 ¾", grille outer diameter: 4 7/8"

2. Hart and Cooley CBPS/CBPR T-bar curved-blade perforated supply/return diffuser, steel

a. Used at each 6" diameter bedroom supply, at the 8" dehumidifier hallway return, and at the 10" combined hallway supply.

b. Dimension: 23-¾" x 23-¾"

c. Perforated steel face, white finish

d. Available in 6", 8", 10", 12", 14", and 16"diameter necks.

e. 2" high collar permits easy flex connections

f. Individually adjusted pattern deflectors can be field-adjusted for 1, 2, 3-way air patterns.

3. Hart and Cooley T-bar accessories

a. 5400 Series Collar Ring; 2" high collar permits easy flex connections.

b. 3800 Series adjustable damper; for use with 5400 series collar.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Follow manufacturer's instructions for installation

END OF SECTION 23 37 13

SECTION 23 40 00
SUPER ULTRA-LOW PENETRATION FILTRATION

PART1 – GENERAL

1.01 SECTION INCLUDES

A. Super Ultra-Low Penetration Air-filters

1.02 RELATED SECTIONS

A. Section 23 37 13 – Diffusers, registers, and grilles

1.03 SUBMITTALS

A. Product datasheet from manufacturer.

PART2 – PRODUCTS

2.1 MANUFACTURERS

A. Flanders Corporation

2.2 Materials

A. Flanders Precisionaire 2 inch LEED MERV 13 Filters

B. Actual filter face size for 12 inch x 24 inch and 24 inch x 24 inch filters is 5/8 inch under on height and width Actual face size on all other sizes is 1/2 inch under on height and width

C. Actual filter depth is 1/4 inch under for these nominal 2 inch deep filters

PART3 – EXECUTION (Not Used)

END SECTION 23 40 00

SECTION 23 72 00
AIR TO AIR ENERGY RECOVERY EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Ventilation Equipment

1.02 RELATED SECTIONS

A. Section 23 31 13.16 - Round and Flat-oval Spiral Ducts

1.03 REFERENCE STANDARDS

A. HVI, CSA C22.2

1.04 SUBMITTALS

A. Product datasheet from manufacturer

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializes in manufacturing the products specified in this section with minimum 10 years' experience.

B. Memberships & Certification: CSA, Air-Conditioning, Heating and Refrigeration Institute (AHRI), NRTL/C, Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), Home Ventilating Institute (HVI), Canadian Home Builders Association (CHBA).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Nu-Air Ventilation Inc.

2.02. COMPONENTS

A. Heat Recovery Ventilator (HRV), Model ES100

B. Housing/Core

1. Painted 0.032 Aluminum casing with a white enamel finish

2. Cabinet insulation is 1-inch polyurethane

3. Core is a cross-flow heat exchanger

C. Characteristics

1. Defrosting system for outdoor conditions below -5 degrees Celsius.

2. Polyester Air Filters: MERV rating of 9

3. Expanded Polystyrene Insulation

4. 24 V circuit protection with self resetting fuse

D. Specifications

1. Airflow: 104-129 CFM at 0.4 in wg

2. Electrical: 120V/1 /60 Hz, 0.7 A, 84 W

E. To view this product's technical data, CLICK HERE.

PART 3 – EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly prior to installation. Remove all debris and confirm structural support for connections and supporting elements.

B. Verify all clearances and requirements as specified by manufacturer.

3.02 INSTALLATION

A. Follow manufacturer's instructions for handling and installation, and follow measures for maximizing efficiency in the duct layout.

B. Install units with adequate spacing to access heat recovery coils and filters for maintenance.

C. To view this product's technical data, CLICK HERE.

END OF SECTION 23 72 00

SECTION 23 81 26
SPLIT SYSTEM AIR CONDITIONER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Indoor and outdoor units of split-ducted air-conditioning system

B. Refrigerant piping

C. Controls

D. Fan

1.02 RELATED SECTIONS

A. Section 23 31 13.16 - Round and Flat-oval Spiral Ducts

1.03 REFERENCE STANDARDS

A. Comply with ASHRAE 15, EPA, AHRI, UL, ETL and ISO Standards

1.04 SUBMITTALS

A. Product datasheet from manufacturer

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Mitsubishi Electric

2.02 COMPONENTS

A. Mr. Slim Concealed Duct Mini Split Heat Pump System

1. Includes (1) SEZKD09NA4 Indoor unit and (1) SUZKA09NA Outdoor condensing unit
2. External finish: Galvanized-steel sheets
3. Built-in drain mechanism for condensate removal
4. Polypropylene Honeycomb Air filter included with indoor unit

5. Cooling capacity: 8100 BTU, Cooling capacity range: 3,800 – 10,900 BTU

6. Heating capacity: 10,900 BTU, Cooling capacity range: 4,800 – 14,100 BTU

7. Total Input: 670 W Cooling and 1,020 W heating

8. Power Supply: 1-phase, 60 Hz, 208/230V

9. Air Flow, Lo-Med-Hi: 194-247-317 CFM (dry), 174-222-285 CFM (wet)

10. Weight: 42 lb (indoor unit), 66 lb (outdoor unit)

11. Dimensions [W x D x H]: 31-1/8'' x 27-9/16'' x 7-7/8'' (Indoor unit), 31-1/2'' x 11-1/4'' x 21-5/8'' (outdoor unit).

B. Refrigerant

1. R410A refrigerant

2. Piping: Insulated Copper tubing size at gas side 3/8 inch and liquid side 1/4 inch

C. Controls

1. PAR-21 MAA wired remote controller included

2. Indoor unit powered from outdoor unit using A-Control

3. Automatic fan speed control

4. Auto restart following a power outage

D. Fan

1. Two Sirocco Fans

2. Direct-driven DC Brushless Motor

3. Motor Output: 96W

E. To view these products technical data, CLICK HERE.

PART 3 – EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly prior to installation

B. Mount the indoor unit into a ceiling strong enough to withstand the weight of the unit

3.02 INSTALLATION

A. Perform the installation securely referring to the product installation manual.

B. Be sure to install the unit level

C. Use an exclusive circuit as accordance to NFPA 90B.

D. To view this product's technical data, CLICK HERE.

END OF SECTION 23 81 26

SECTION 23 84 16
DEHUMIDIFIER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Dehumidifier

1.02 RELATED SECTIONS

A. Section 23 31 13.16 – Round and Flat-oval Spiral Ducts

1.03 REFERENCE STANDARDS

A. ETL listed, UL 474

1.04 SYSTEM DESCRIPTION

A. Ducted, with dedicated return to main supply.

1.05 SUBMITTALS

A. Product datasheet from manufacturer.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Honeywell International Inc.

2.02 COMPONENTS

A. Honeywell TrueDRY DR65 ventilating dehumidification system

1. Energy performance: 2.22 liters (4.7 pints) per kilowatt hour.
2. Dimensions (L x W x H) / weight: 28.5” x 12” x 12” / 55 lbs (length includes duct collars)
3. Electrical: 120V AC, 60HZ, 5.2 Amps
4. Blower: 160 CFM @ 0.0 inches WG
5. Capacity at 60% RH: 21 pints/day (60 F), 42 pints/day (70 F), 65 pints/day (80 F)
6. Drain connection: ¾’’ threaded female NPT, with attached ¾’’ threaded male NPT.

7. Refrigerant: R-410A

8. Filter: standard MERV-11, 1'' (D) x 9'' (H) x 11'' (W)

9. Duct connections: 8'' duct collars for inlet and outlet, ABS plastic

10. For this product's data sheet, CLICK HERE.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation must conform to NEC, ANSI/NFPA 70 and National Fuel Gas Code ANSI Z223.1

B. Install in accordance with manufacturer's instructions.

C. Use backdraft damper immediately before connection of dehumidifier outlet to main supply.

C. Allow for adequate clearances for servicing and proper operation.

END OF SECTION 23 84 16

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SUMMARY

A. Wire and cable for 600 volts and less.

B. Wiring connectors and connections.

1.02 RELATED SECTIONS

A. Section 26 05 33 – Raceway and Boxes for Electrical Systems

1.03 REFERENCE STANDARDS

A. NECA 1 – Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.

B. NFPA 70 – National Electric Code; National Fire Protection Association; 2008.

1.04 SUBMITTALS

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer qualifications: Company specializing in manufacturing the products specified in this section with a minimum of 10 years experience.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Southwire

B. General Cable

C. Belden

2.02 MATERIALS

A. Southwire CU-USE wire

1. Type USE-2 copper conductor

2. Insulation voltage rating: 600V

3. Cross-linked polyethylene insulation

B. Southwire Simpull THWN-2 wire

1. Type THWN-2 copper conductor

2. Insulation voltage rating: 600V

3. Thermoplastic insulation/SIM nylon sheath

C. Southwire bare copper wire

D. Southwire Romex wire

E. General Cable, Carol Brand 18-3 thermostat wire

1. 150V

2. Type CL2

F. Belden RG6/U cable

1. Quad shielded

2. Coaxial

D. Wiring Connectors

1. In accordance with UL and NEC.

2. Branch Circuits 10 AWG and smaller:

a. Connectors shall be solderless, screw-on, pressure cable type, 600 volt, 105 degrees C, with integral insulation; approved for copper and aluminum conductors, and reusable.

b. Integral Insulator: Must have skirt to completely cover stripped wires.

c. Comply with manufacturer's listing/labeling as to the number, size, and combination of conductors that may be joined.

3. Feeder Circuits: Connectors shall be indent, hex screw, or bolt-clamp type. Material shall be highly conductive and corrosion resistant.

2.03 WIRING REQUIREMENTS

A. See “Conductor and Conduit Schedule” on page E-602 (Three-line diagram) of Construction Documents for required wire gauges/colors.

B. Concealed Dry Interior Locations: Use only building wire in raceway, nonmetallic-sheathed cable, armored cable, or metal clad cable.

C. Exposed Dry Interior Locations: Typically, use only building wire in raceway.

1. At equipment rooms use building wire in raceway, nonmetallic-sheathed cable, armored cable, or metal clad cable.

D. Wet or Damp Interior Locations: Use only building wire in raceway, direct burial cable, armored cable with jacket, or metal clad cable.

E. Exterior Locations: Use only building wire in raceway, direct burial cable, service-entrance cable, armored cable with jacket, or metal clad cable.

F. Underground Installations: Use only building wire in raceway, direct burial cable, or service-entrance cable.

G. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

H. Use stranded conductors for control circuits.

I. Use minimum of 12 AWG conductors for power and lighting circuits.

J. Use minimum of 16 AWG conductors for control circuits.

K. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 meters (75 feet).

L. Use 10 AWG conductors for 20 ampere, 240 volt branch circuits longer than 60 meters (200 feet).

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that any mechanical work likely to damage wire and cable has been completed.

B. Verify that raceway installation is completed and supported.

3.02 PREPARATION

A. Swab raceway before installing wire.

B. Clean conductor surfaces before installing lugs and connectors.

3.03 INSTALLATION

A. Install wire and cable securely and neatly, as in NECA 1.

B. Route wire and cable as required to meet project conditions.

1. Wire and cable routing indicated is approximate unless dimensioned.

C. Pull all conductors into raceway at same time.

D. Protect exposed cable from damage.

E. Neatly train and lace wiring inside boxes, equipment, and panelboards.

F. Trench and backfill for direct burial cable installation. Install warning tape along entire length of direct burial cable, within 75 millimeters (3 inches) of grade.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Ground rod kit

B. Washer Electrical Equipment Bond (WEEB) hardware

1.02 RELATED SECTIONS

A. Section 05 14 13 – Architecturally-exposed structural aluminum

1.03 REFERENCE STANDARDS

A. UL 467, CSA C22.2#41 2007

1.04 SUBMITTALS

A. Product datasheet from manufacturer

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Wiley Electronics LLC

2.02 MATERIALS

A. Copper Bonded Grounding Rod 5/8 inch x 8/ feet

B. Bronze Clamps

C. Conductor

D. Ground Rod Connector

E. Drive Sleeve

F. WEEB-DMC Compression Clip

G. WEEBL-6.7 Grounding Lug

H. WEEB Bonding Jumper-6.7

I. To view these products' technical data, CLICK HERE.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. WEEBs are single use only.

C. WEEB clip and lug assembly: Tighten fasteners to 10 ft-lb / 13.5 N-m using general purpose anti-seize compound on threads.

D. WEEB lug assembly: Lay in equipment grounding conductor and tighten bolt to 7 ft-lb / 10 N-m.

E. WEEB bonding jumper assembly: Torque to 10 ft-lb / 13.5 N-m using general purpose anti-seize compound on threads.

END OF SECTION 26 05 26

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. RACEWAY

B. CONDUITS

1.02 RELATED SECTIONS

A. 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

1.03 REFERENCE STANDARDS

A. UL 797 – Electrical Metallic Tubing.

B. UL 514B Conduit, Tubing and Cable Fittings.

C. UL 6 –Electrical Rigid Metal Conduit – Steel

D. ANSI C80.1 – Electrical Rigid Steel Conduit

E. ANSI C80.3 – Steel Electrical Metallic Tubing.

F. ANSI B1.20.1 – Pipe Threads, General Purpose.

G. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2003.

H. NFPA 70 – National Electrical Code; National Fire Protection Association; 2008.

1.04 SUBMITTALS

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70

B. Manufacturer qualifications: Company specializing in manufacturing the products specified in this section with a minimum of 10 years experience.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Allied Electrical Group

B. JM Eagle

2.02 MATERIALS

A. Allied Kwik-Fit EMT (Electrical Metallic Tubing) for indoors, 1-1/4 inch Trade Size

1. Nominal outside diameter: 1.510 inch

2. Nominal wall thickness: 0.065 inch

3. Approximate weight per 100 Feet: 101 pounds

4. Bundle: 840 feet, approx. 720 pounds

5. To view this product's technical data, CLICK HERE

B. Allied Rigid Steel Conduit, hot-dip galvanized steel, exterior, 1-1/2 inch Trade Size

1. Nominal outside diameter: 1.900 inch

2. Nominal wall thickness: 0.138 inch

3. Approximate weight per 100 Feet: 263 pounds

4. Bundle: 800 feet

5. Allied RIGID is recognized as an equipment grounding conductor by NEC Article 250.

6. To view this product's technical data, CLICK HERE

C. JM Eagle Electrical Conduit

1. PVC/non-metallic

2. ANSI/UL 651 conforming

3. NEMA TC-2 conforming

4. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 05 33

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 SUMMARY

A. CIRCUIT BREAKERS

B. LOAD CENTERS

1.02 SUBMITTALS

A. Construction Drawings: Wiring diagram

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric

2.02 PRODUCTS

A. Homeline Load Center HOM1632L200TC, single phase, indoor main lugs, ground bar included.

1. 32 branch circuits

2. 200 Amp Mains Rating

3. To view this product's technical data, CLICK HERE

B. QO Load Center QO612L100RB, single phase, outdoor main lugs, ground bar sold separately

1. 12 branch circuits

2. 100 Amp Mains Rating

3. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 24 16

SECTION 26 27 00

LOW-VOLTAGE DISTRIBUTION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Wall Receptacles

B. Switches

1.02 RELATED SECTIONS

A. 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

1.03 REFERENCE STANDARDS

A. UL 2003

B. UL 943

C. UL 1472

D. CSA C22.2 184.1

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Hubbell

B. Leviton

2.02 MATERIALS

A. Hubbell Tamper-Proof Receptacle RRD15SWTR

1. 15A/125V

2. Self-Grounding

3. To view this product's technical data, CLICK HERE

B. Hubbell Tamper-Proof Receptacle DR20WHITR

1. 20A/125V

2. 3-Wire Grounding

3. To view this product's technical data, CLICK HERE

C. Leviton Single-Pole Switch 5601-2W

1. 15A/120V

2. To view this product's technical data, CLICK HERE

D. Leviton 3-Way Switch 5603-2W

1. 15A/120V

2. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION 26 27 00

SECTION 26 27 13

ELECTRICITY METERING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Construction Drawings.

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.

C. Coordinate with utility companies for services and components they furnish.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

C. Meter Sockets: Comply with requirements of electrical power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with disconnect device, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below:

1. Comply with requirements of utility company for meter center.

2. Housing: NEMA 250, Type 3R enclosure.

3. Minimum Short-Circuit Rating: 10,000 Amp symmetrical at rated voltage.

4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.

5. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house loadcenters and panelboards that have 10,000-Amp interrupting capacity.

a. Identification: Provide legend identifying tenant's address.

b. Physical Protection: Tamper resistant, with hasp for padlock.

6. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.

2.02 MANUFACTURERS

A. Landis & Gyr

B. General Electric

2.03 MATERIALS

A. Landis & Gyr Meter Socket UAT-4

1. Single phase, 200A

2. OH/UG Service feeder location

3. Standard 4-jaw, ringless

4. NEMA 3R, rainproof enclosure

5. To view this product's technical data, CLICK HERE

B. GE Singlephase Meter I-210+c

1. ANSI C12.1, C12.10, C12.20, C37.90.1 conforming

2. To view this product's technical data, CLICK HERE

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

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.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

END OF SECTION 26 27 13

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.01 SUMMARY

A. NONFUSIBLE SWITCHES

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. UL98, Standard for Safety, Enclosed and Dead Front Switches. UL Listed under File E2875, or E154828.

B. NEMA Standards Publication KS1, Enclosed Switches.

C. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 V maximum); National Electric Manufacturers Association; 2001 (R2006).

D. NFPA 70 – National Electric Code; National Fire Protection Association; 2008.

1.04 SUBMITTALS

A. Construction Documents: Electrical wiring diagram.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years experience.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric

2.02 COMPONENTS

A. Square D DC Disconnect Switch, model HU362RB, 3-pole, unfused.

1. Product Data

    a. Current Rating: 60 Amp

    b. Voltage Rating: 600 Volt DC

    c. Weight: 6 pounds

    d. Dimensions: (H D W): 17.5 inch x 10.5 inch x 7.25 inch

    e. To view this product's technical data, CLICK HERE

PART 3 - EXECUTION (Not Used)

END OF SECTION 26 28 16

SECTION 26 31 00

PHOTOVOLTAIC COLLECTOR SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Photovoltaic Modules, Frame, Junction Box, and Cables

B. Transition Box

1.02 RELATED SECTIONS

A. Section 26 27 17 – Equipment Wiring: Connection to facility power distribution.

B. Section 48 19 16 – Electrical Power Generation Inverters

1.03 REFERENCE STANDARDS

A. Photovoltaic modules

1. ASTM E 1799 – Standard Practice for Visual Inspections of Photovoltaic Modules.

2. UL 1703 – Flat Plate Photovoltaic Modules and Panels; 2002.

3. UL 4703 – Photovoltaic Cable.

4. IEC 61215 – Crystalline Silicon Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval; 2005; ed. 2.

5. IEC 61730 – Photovoltaic (PV) Module Safety Qualification; 2004; Class A.

6. UL Fire Safety Class C.

B. Combiner Box

1. CAN/CSA C22.2 No. 107.1-01 General Use Power Supplies; 2001.

2. CAN/CSA C22.2 No. 0.4-04 Bonding of Electrical Equipment; 2004.

3. CAN/CSA C22.2 No. 0.12-M1985 Wiring Space and Wiring Banding Space in Enclosures for Equipment Rated 760 V or Less.

4. CAN/CSA-C22.2 No. 0-M91 General Requirements – Canadian Electrical Code, Part II.

1.04 SUBMITTALS

A. Construction Drawings: Wiring diagram

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Sunpower

B. Wiley Electronics

2.02 MATERIALS

A. SunPower E19/240 Photovoltaic Modules

1. Description: 72 silicon solar cells in frame, factory assembled with junction box, series interconnection cables, bypass diodes located in junction box; IEC 61215 compliant, UL 1703 listed.

2. Maximum System Voltage (UL): 600 Volt

3. Rated Power: 240 Watt

4. Rated MPP Voltage: 40.5 Volt

5. Rated MPP Current: 5.93 Amp

6. Open Circuit Voltage: 48.6 Volt

7. Short Circuit Current: 6.30 Amp

8. Series Fuse Rating: 20 Amp

9. To view this product's technical data, CLICK HERE

B. Wiley Electronics ACE-2P Pass-through Box

1. Description: 2-string, unfused, with anodized aluminum mounting bracket.

2. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide DC and AC lightning protection devices to protect inverter and PV modules.

C. Provide minimum clearance of 7mm (1/4 inch) between PV panels to allow for thermal expansion of the frames.

D. Note: SunPower modules are positively grounded. See installation manual for grounding requirements.

3.02 SAFETY

A. Install according to manufacturer's handling, installation, and fire safety requirements and recommendations.

3.03 INSPECTION

A. Provide the services of manufacturer-training personnel to inspect and commission the system:

1. Energy Efficiency: Verify equipment is properly installed, connected, and adjusted. Verify that equipment is operating as specified.

2. Renewable Energy: Verify proper operation in all modes of system operation by testing. Verify proper operation under a wide range of conditions to verify energy delivery as calculated for those conditions.

a. Solar Energy Systems: Comply with ASTM E1799 – Standard Practice for Visual Inspections of Photovoltaic Modules.

END OF SECTION 26 31 00

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. LED LIGHTING

B. FLUORESCENT

1.02 RELATED REQUIREMENTS

A. 26 06 50 Schedules for Lighting

1.03 REFERENCE STANDARDS

A. UL listed, ETL listed

1.04 SUBMITTALS

A. Product Data

PART 2 – PRODUCTS

2.01 LED

A. BKSSL

1. BQL-LED-E22-WHP-D, SL Brickstar Louvered 8 watt, e22 lamp, 2 Fixtures

B. USAI

1. 3140-10-S-LSTA4-8420-C1-20W-30-30-NC-120-DIML3, R1 BeveLED Adjustable 40 degree, 5 Fixtures

C. ALKCO

1. ARIS-21-40-120-PRL-HWC/AJC6, L1 LED Task Light, 4 Fixtures

2. ARIS 41-40-120-PRL-HWC/AJC6, L2 LED Task Lamp, 1 Fixture

D. Amerlux

1. CNTRV22-12-LED-E—WT-C-120-NF-3000-DIM, R3 Canopy, 4 Fixtures

E. Insight

1. 3140-10-S-LSTA4-8420-C1-20W-30-30-NC-120-DIML3, R1 BeveLED Adjustable 40 degree, 4 Fixtures

F. Philips

1. PW01L30SAU-LED-6W-3000K-120+SG02L, S1 Wall Mount, 2 Fixtures

2.02 FLUORESCENT

A. ADA

1. CSS2030-1-FC12T9-32W / 835-14, 1/2 inch to 3 inch, S2, 1 Fixture

B. ALKO

1. TAB125-ASY-120-BA/AL-CL+LS, F1 Surface Mount, 8 Fixtures

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 51 00

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Exterior House Lighting

1.02 RELATED REQUIREMENTS

A. 26 06 50 Schedules for Lighting

1.03 REFERENCE STANDARDS

A.UL listing

1.04 SUBMITTALS (Not Used)

PART 2 – PRODUCTS

2.01 HOUSE LIGHTING

A. Lumiere

1. 904-12WLEDN-3000K-12-BK-NBR, T2 Canopy, 9 Fixtures

2. 213-12WLEDW-3000K-12-BK-NBR, T1 Canopy, 2 Fixtures

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 56 00

SECTION 27 21 00
DATA COMMUNICATION NETWORK EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. DATA LOGGING EQUIPMENT
B. RELATED SYSTEMS

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. NFPA 70, Article 100, 2008 NEC

1.04 SUBMITTALS

A. Product datasheets

PART 2 – PRODUCTS

2.01 Manufacturers

A. Powerhouse Dynamics

B. Solectria Renewables

2.02 Dataloggers

A. eMonitoring System for energy consumption monitoring and logging.

B. Solrenview for PV production monitoring and logging, with revenue grade and weather station options.

C. For technical data on these products, CLICK HERE.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with product installation manual and related NEC codes
B. Connect the device to all the monitored sensors and systems

END OF SECTION 27 21 00

SECTION 27 21 33
DATA COMMUNICATION WIRELESS ACCESS POINTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. WIRED DATA CONNECTIVITY EQUIPMENT
B. WIRELESS DATA CONNECTIVITY EQUIPMENT

1.02 RELATED REQUIREMENTS

A. Data communication modem and switch

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 Manufacturer

A. DLink

2.02 DIR-632 8 Port Wireless n Router

A. 802.3z, 10/100/1000 Mbps wired network access
B. 802.11n, for wireless standard
C. For datasheet on this product, CLICK HERE.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with product installation manual and related NEC codes
B. Service is used by all the devices connect to the Ethernet port and WIFI

END OF SECTION 27 21 33

SECTION 27 22 26

DATA COMMUNICATION LAPTOP

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. PERSONAL COMPUTER

1.02 RELATED REQUIREMENTS

REFERENCE STANDARDS

A. Electrical Components, Devices and Accessories Listed and labeled as defined in NFPA 70, Article 100

1.04 SUBMITTALS

A. Product datasheet: Manufacture specification sheets for all the products listed under products

PART 2 – PRODUCTS

2.01 Manufactures

A. Hewlett-Packard

2.02 Laptop

A. HP Pavilion dv7 Notebook PC

B. To view this product's datasheet, CLICK HERE.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with product installation manual and related NEC codes

B. Connect the device to the communication network device

END OF SECTION 27 22 26

SECTION 28 31 46
SMOKE DECTION SENSORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Smoke detectors

1.02 RELATED SECTIONS

A. 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

1.03 REFERENCE STANDARDS

A. UL 268, National Fire Alarm Code, NFPA 72, Article 760 NEC

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 ALARM-INITIATING DEVICES

A. Kidde Firex i5000 Smoke detectors: UL-listed, 120 - Vac with 9-Vdc back-up, ionization type, hardwired.

1. For this product's technical data, CLICK HERE.

2.02 NOTIFICATION APPLIANCES

A. Built-in piezoelectric horn rated at 85 decibels at 10 feet.

2.03 WIRE AND CABLING

A. General: UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install and test systems per manufacturer's instructions, NFPA 72 and NEC Article 760.

B. Wiring Method: Install wiring interior to walls and ceilings as indicated in schematics.

C. Wire all alarms to a single, continuous (non-switched) power line, not protected by a ground fault interrupter.

END OF SECTION 28 31 46

SECTION 28 31 49
CARBON MONOXIDE DETECTION SENSORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Carbon monoxide detector

1.02 RELATED SECTIONS

A. 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

1.03 REFERENCE STANDARDS

A. UL 268, National Fire Alarm Code, NFPA 72, Article 760 NEC

1.04 SUBMITTALS

PART 2 – PRODUCTS

2.01 ALARM-INITIATING DEVICES

A. First Alert C05120BN Carbon Monoxide Alarm

1. For this product's technical data, CLICK HERE.

2.02 NOTIFICATION APPLIANCES

A. Built-in piezoelectric horn rated at 85 decibels at 10 feet.

2.03 WIRE AND CABLING

A. General: UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-voltage Circuits: No. 16 AWG, minimum.

2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install and test systems per manufacturer's instructions, NFPA 72 and NEC Article 760.

B. Wiring Method: Install wiring interior to walls and ceilings as indicated in schematics.

C. Wire all alarms to a single, continuous (non-switched) power line, not protected by a ground fault interrupter.

END OF SECTION 28 31 49

SECTION 31 05 00
SOILS FOR EARTHWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Sand for Temporary Footings

1.02 RELATED SECTIONS

A. 02 05 19.13 Geotextiles for Existing Conditions
B. 05 50 00 Metal Fabrications

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

PART 2 – PRODUCTS

A. Quikrete 50 pound All Purpose Sand

PART 3 – EXECUTION

END OF SECTION 31 05 00

SECTION 32 90 00
PLANTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Plants
B. Planters

1.02 RELATED REQUIREMENTS

A. 32 06 90 Schedules for Planting
B. 26 56 00 Exterior Lighting

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. Care and Maintenance Instructions

PART 2 – PRODUCTS

2.01 PLANTS

A. Blue Sedge
B. Feather Reed Grass
C. Maiden Pink

2.02 PLANTERS

A. Custom, mobile style to be determined

PART 3 – EXECUTION

3.01 INSTALL

A. Furnish appropriate soil and nutrient mixtures for plantings

END OF SECTION 32 90 00

SECTION 48 19 16

ELECTRICAL POWER GENERATION INVERTERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Photovoltaic inverter system

1.02 RELATED SECTIONS

A. Section 26 31 00 – Photovoltaic Generation

1.03 REFERENCE STANDARDS

A. UL 1741 – Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources; 2007.

1.04 SUBMITTALS

A. Electrical wiring diagram.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years experience.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Solectria Renewables

2.02 COMPONENTS

A. Solectria inverter model PVI 4000

1. Product Data

a. DC Specifications

1. Continuous Power: 4100 Watt

2. Recommended Maximum PV Array Power, STC rating: 4900 Watt DC

3. Maximum Input Voltage: 600 Volt

4. Maximum Input Current: 20 Amp

b. AC Specifications

1. Continuous Power: 3900 Watt

2. Nominal Voltage: 240/208 Volt

3. Continuous Current (Max.): 16.5 Amp

4. Frequency: 60 Hz; ±1 percent

5. Distortion Factor (THD): <3 percent

6. Maximum Efficiency: 96.7 percent

c. Mechanical Specifications

1. Aluminum housing, NEMA 3R, rainproof enclosure.

2. Dimensions (L W H): 28.8 inch x 17.75 inch x 6.75 inch

3. Weight: 50.7 pounds

4. Ambient Temperature Range (full power operation): −13 degrees F to +131 degrees F

d. To view this product's technical data, CLICK HERE

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide fire-resistive plywood backing as necessary to support the power conditioning unit.

B. Solectria Installation Manual: PVI4000 Installation Manual

END OF SECTION 48 19 16

Appendix Product Data Sheets

Division 11 – Residential Appliances

Refrigerator/Freezer

Whirlpool

Whirlpool Gold® Resource Saver™ ENERGY STAR® Qualified 19 cu. ft. Bottom Mount Refrigerator

GB9FHDXWS Write the first review

why you'll love it...

Built-In Sensors Inside Help Keep Conditions Cool and Your Food Fresh

Smart, built-in sensors enabled by 6th Sense™ technology do the thinking for you and adjust conditions inside helping keep your food fresh and cold.

Adustable Storage Gives You Flexibility and Adaptability

Arrange your fresh and frozen food exactly how you want it. Adjustable door bins, slide-out shelves, and more make it easy to find what you need.

Resource Saver™ Refrigerator

Whirlpool

This Resource Saver™ bottom mount refrigerator exceeds the minimum federal energy standard by 50% and uses less energy each year than a 60-watt light bulb.

specifications...

Energy and Eco-Friendly
Energy Star® Qualified: Yes

Style and Extras

Lighting: 1 - 40 Watt Blue	Shelves: Spillproof	Refrigerator Pantry Door: 13" Standard
Icemaker Type: Factory Installed	Control Type: Electronic 1-7	

Capacity

Total Capacity: 18.5 Cu. Ft.	Refrigerator Capacity: 12.9 Cu. Ft.	Freezer Capacity: 5.6 Cu. Ft.

Dimensions

Depth: 33 3/8	Depth Closed Including Handles: 33 3/8	Depth Radius: 59 Width: 29 5/8
Height To Top Of Cabinet: 65 1/2	Height: 66 15/16	

Description Specifications

Description

18.5 Cu. Ft. Bottom Freezer Refrigerator (Color: Stainless Steel) ENERGY STAR

- ENERGY STAR® qualified
- Electronic temperature controls: easily navigate with just a touch to instantly adjust refrigerator and freezer temperatures
- Factory installed automatic ice maker
- Freezer light illuminates the freezer compartment for easier access to all your frozen items
- Lower wire freezer basket
- Smooth door finish
- Reversible door swing allows door swing to be changed to accommodate user preference
- Resource Saver™ refrigerator exceeds the minimum federal energy standard by 50% and uses less energy each year than a 60-watt light bulb
- Adaptive Defrost System (ADS): depending upon usage, ADS models can have fewer defrosts, saving energy and preserving food more efficiently
- Accu-Chill™ Temperature Management System
- Humidity-controlled crispers helps you preserve the freshness of your favorite fruits and vegetables with controlled humidity levels in the clear, extra-deep crisper
- Half-width adjustable slide-out shelves
- Adjustable door bins (1 gallon size) give you the flexibility to store beverages anywhere in the refrigerator door by moving bins where and when you need them
- Drawer freezer door: generous storage baskets in the drawer slide out for easy access to items in the back
- Upper slide-out freezer basket makes it even easier to quickly spot and grab what you're looking for

Specifications

Appliance Color/Finish	Stainless steel	CEE Tier Qualified	CEE Tier III
Dispenser Options	N/A	Height to Top of Case (Inches)	65.5
Child Safety Locks	No	Height to Top of Door Hinge (Inches)	66.9375
Water Filter Indicator	No	Width (Inches)	29.625
Door Alarm	No	Depth (Including Handles) (Inches)	33.375
Dispenser Light	No	Freezer Capacity (Cu. Feet)	5.6
Ice Maker	Single	Depth (Excluding Handles) (Inches)	30.875
Space-Saving In-Door Ice	No	Depth (Less Door) (Inches)	28.125
Air Filtration	No	Depth with Door Open (Inches)	59.0

Dual Evaporator Cooling System	No	Cabinet Color	Black
Refrigerator Interior Lighting	Incandescent	Door Handle(s) Color	Stainless steel
Overall Capacity (Cu. Feet)	18.5	Manufacturer Color/Finish	Stainless steel
Electronic Temperature Control	Yes	Toe Grille Color	Black
Shelf Options	Glass shelves	Reversible Door	Yes
Temperature Controlled Drawer	Yes	Custom Door Kit Compatible	No
Snack/Deli Drawer	Yes	Lowe's Exclusive	No
Pantry Drawer	No	Door Finish	Smooth
Door Shelves	3.0	Manufacturer's Warranty (Labor)	Limited 1-year
Gallon Door Storage	Yes	Manufacturer's Warranty (Parts)	Limited 1-year
Humidity-Controlled Crispers	2	Color/Finish Family	Steel-Stainless
Freezer Door Bins	0	CSA Safety Listing	No
Freezer Door Shelves	0	ETL Safety Listing	No
Refrigerator Capacity (Cu. Feet)	12.9	UL Safety Listing	Yes
Freezer Baskets	2	Door Style	Flat
Freezer Shelves	0	Hidden Hinge	No
Freezer Door Style	Pull-out drawer	Handle Type	Standard
Frost-Free	Yes	Water Filtration	No
ENERGY STAR Qualified	Yes		

PERFORMANCE DATA SHEETS

Interior Water Filtration System

Model UKF8001AXX-750 Capacity 750 Gallons (2839 Liters)

System tested and certified by NSF International against NSF/ANSI Standard 42 for the reduction of Chlorine Taste and Odor, Particulate Class I*; and against NSF/ANSI Standard 53 for the reduction of Lead, Mercury, Atrazine, Benzene, p-Dichlorobenzene, Carbofuran, Toxaphene, Cysts, Turbidity, Asbestos, Tetrachloroethylene and Lindane.

This system has been tested according to NSF/ANSI Standards 42 and 53 for the reduction of the substances listed below. The concentration of the indicated substances in water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI Standards 42 and 53.

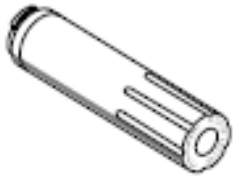
Substance Reduction Aesthetic Effects	NSF Reduction Requirements	Average Influent	Influent Challenge Concentration	Maximum Effluent	Average Effluent	Minimum% Reduction	Average% Reduction
Chlorine Taste/Odor	50% reduction	2.00 mg/L	2.0 mg/L ± 10%	0.06 mg/L	0.050625 mg/L	97.00%	97.52%
Particulate Class I*	85% reduction	14,000,000 #/mL	At least 10,000 particles/mL	370,000 #/mL**	196,666 #/mL	97.40%	99.00%
Contaminant Reduction	**NSF Reduction Requirements**	**Average Influent**	**Influent Challenge Concentration**	**Maximum Effluent**	**Average Effluent**	**Minimum% Reduction**	**Average% Reduction**
Lead: @ pH 6.5	0.010 mg/L	0.150 mg/L†	0.15 mg/L ± 10%	< 0.001 mg/L	< 0.001 mg/L	>99.30%	>99.30%
Lead: @ pH 8.5	0.010 mg/L	0.150 mg/L†	0.15 mg/L ± 10%	< 0.001 mg/L	< 0.001 mg/L	>99.30%	>99.30%
Mercury: @ pH 6.5	0.002 mg/L	0.006 mg/L	0.006 mg/L ± 10%	0.0005 mg/L	0.0003 mg/L	91.70%	95.00%
Mercury: @ pH 8.5	0.002 mg/L	0.0059 mg/L	0.006 mg/L ± 10%	0.0018 mg/L	0.00073 mg/L	69.20%	88.10%
Benzene	0.005 mg/L	0.0133 mg/L	0.015 mg/L ± 10%	0.0005 mg/L	0.0005 mg/L	96.10%	96.30%
p-Dichlorobenzene	0.075 mg/L	0.210 mg/L	0.225 mg/L ± 10%	< 0.0005 mg/L	< 0.0005 mg/L	>99.80%	>99.80%
Carbofuran	0.040 mg/L	0.0753 mg/L	0.08 mg/L ± 10%	0.027 mg/L	0.008 mg/L	64.60%	73.46%
Toxaphene	0.003 mg/L	0.015 mg/L	0.015 ± 10%	< 0.001 mg/L	< 0.001 mg/L	>93.3%	>93.3%
Atrazine	0.003 mg/L	0.0102 mg/L	0.009 mg/L ± 10%	0.0027 mg/L	0.00105 mg/L	76.30%	89.40%
Asbestos	>99%	126.5 MF/L	10^7 to 10^9 fibers/L**	< 0.17 MF/L	< 0.17 MF/L	>99.99%	>99.99%
Live Cysts‡	>99.95%	122,500 #/L	50,000/L min.	< 1 #/L‡	< 1 #/L‡	>99.99%	>99.99%
Turbidity	0.5 NTU	10.5 NTU	11 ± 1 NTU	0.30 NTU	0.125 NTU	97.30%	98.80%
Lindane	0.0002 mg/L	0.0019 mg/L	0.002 ± 10%	< 0.00016 mg/L	0.000035 mg/L	91.80%	97.90%
Tetrachloroethylene	0.005 mg/L	0.015 mg/L	0.015 mg/L ± 10%	< 0.0005 mg/L	< 0.0005 mg/L	>96.6%	>96.6%

Test Parameters: pH = 7.5 ± 0.5 unless otherwise noted. Flow = 0.78 gpm (2.9 Lpm). Pressure = 60 psig (413.7 kPa). Temp. = 68°F ± 5°F (20°C ± 3°C).

- It is essential that operational, maintenance, and filter replacement requirements be carried out for the product to perform as advertised.
- The disposable water filter should be replaced at least every 6 months.
- The filter monitor system measures the amount of water that passes through the filter and alerts you to replace the filter. When 90% of the filter's rated life is used, the yellow (Order) light comes on. When 100% of the filter's rated life is used, the red (Replace) light comes on, and it is recommended that you replace the filter. For models without filter status lights, replace the filter every 6 months. Use replacement filter model UKF8001AXX-750. 2011 suggested retail price of $44.99 U.S.A./$49.95 Canada. Prices are subject to change without notice.
- The product is for cold water use only.
- Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used on disinfected waters that may contain filterable cysts.
- Refer to the "Water Filtration System" section for the Manufacturer's name and telephone number.
- Refer to the "Warranty" section for the Manufacturer's limited warranty.

Application Guidelines/Water Supply Parameters

Water Supply	City or Well
Water Pressure	35 - 120 psi (241 - 827 kPa)
Water Temperature	33° - 100°F (1° - 38°C)
Service Flow Rate	0.78 gpm (2.9 L/min.) @ 60 psi



*Class I particle size: >0.5 to <1 um

**Test requirement is at least 100,000 particles/mL of AC Fine Test Dust.

†These contaminants are not necessarily in your water supply. Performance may vary based on local water conditions.

**Fibers greater than 10 um in length

‡Based on the use of Cryptosporidium parvum oocysts

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Fisher&Paykel

Dishwashing

Single DishDrawer®

DD24SCX6V2 EZKleen Stainless Steel Single

Key Features

- Flow through detergent dispenser
- Folding tines
- Key lock and child lock option
- Three stage flood protection

Dimensions

H 16 3/32 x W 23 9/16 x D 22 7/16

Product Info

We imagined the ideal dishwasher...and the concept of the DishDrawer was born. Years of research and refinement have created an appliance that offers a compelling blend of form and function. Each drawer is independently operated, allowing you to wash small loads as economically as large ones. DishDrawer lets you match the wash programme to the contents, so dishes are better cared for.

Finishes

-  EZKleen Stainless Steel

Consumption Data

- Energy RatingENERGY STAR rated

Features

- Quiet operation

Performance Features

- 163° F temperature in final rinse
- Choice of wash programmes9
- Economical eco option
- Flow through detergent dispenser
- Heating element in each drawer
- Rinse aid dispenser
- Uses as little as 1.95 gallons of water per drawer

Usability Features

- Accomodates long stemmed wine glasses
- Easy to use, primary and secondary (concealed) control panels with single touch programming
- End of cycle beeps
- Energy saving, delay start option - up to 12 hours
- Flexible racking system
- Flood protection built in
- Folding tines
- Fully adjustable racking system
- Holds 6 place settings
- Holds plates up to 11 1/2 inches
- Intelligent load sensing for optimum performance
- Key lock and child lock option
- Rinse aid indicator light
- Self diagnostics for servicing

- Smart Drive intelligent technology
- Three stage flood protection
- Wash progress and time remaining display

Warranty

- 1 year parts & labor warranty

Wash Programmes

- Delicate
- Delicate Eco
- Fast
- Fast Eco
- Heavy
- Heavy Eco
- Normal
- Normal Eco
- Rinse

Dimensions

- A- Overall Height of product16 3/32
- B- Overall Width of Product23 9/16
- C- Overall Depth of Product22 7/16
- D- Depth of Draw (open)20 1/2

Contact Details

Fisher & Paykel Appliances Inc.
5900 Skylab Road

Huntington Beach CA 92647
USA
Phone: 1.888.936.7872
Fax: 1.800.547.1971

Continued on next page..

Description

23.6-Inch Drawer Dishwasher (Color: Stainless Steel) ENERGY STAR

- Single drawer offers perfect ergonomics - no more bending
- Nine cycles for every washing need
- Superior washing performance incorporates the world's first flow through detergent dispenser detergent burn so your dishes last longer
- The drawer is a carbon impregnated polymer tub which is seamless, stain resistant, and odor resistant

Specifications

Lowe's Exclusive	No	Rinse and Hold Cycle	No
Removable Top Rack	No	Unique or Exclusive Cycle	The first dishwasher with variable water pressure. "Scrub" clean on the heavy duty and wash gently on the delicate cycle
Fold-Down Tines	Lower rack only		
Removable Silverware Basket	Yes		
Silverware Basket Covers	No		
Stemware Holder	Yes		
Air Dry	Yes		
Automatic Temperature Control	Yes		
Direct Feed	Yes		
Number of Drawers	1.0		
Hi-Temp Wash Option	No		
NSF Certified Sanitization Option	No	Number of Cycles	9.0
Self-Cleaning Filter	No	Number of Wash Levels	1.0
Steam Option	No	Number of AHAM Place Settings	5.0
Targeted Scouring Module	No	Sound Rating (Decibels)	47.5
Targeted Silverware Wash Module	No	Cycle Status Lights	Yes
Wash System	The world's first variable water pressure and flow through detergent dispenser and 163 F sanitizing temperature	Rinse Aid Dispenser Indicator	Yes
		Control Panel Color	Stainless
		Control Panel Style	Hidden
		CEE Tier Qualified	CEE Tier I
		Control Type	Electronic
		Custom Door Panel Color	N/A
		Custom Door Panels	No
		Tub Height	Standard
		Height (Inches)	16.1

Wash System Type	Direct feed	Width (Inches)	23.6
Water Filtration	No	Depth - Door Shut (w/ Handle) (Inches)	24.1
Control Lock/Child Lock	Yes	Depth - Door Shut (w/o Handle) (Inches)	24.1
Manufacturer Color/Finish	Stainless Steel	Depth with Door Open (Inches)	44.1
		Fill and Drain Hose Included	Yes
Hard Food Disposer or Filtration	Filtration	Rack Material	PVC
Sensor Wash Cycle	Yes	Power Cord Included	Yes
Advanced Sensor Wash Cycle	No	Manufacturer's Warranty (Labor)	Full 1-year
Gentle Wash Cycle	Yes	Manufacturer's Warranty (Parts)	Full 1-year
Heated/Hi-Temp Dry	No	Color/Finish Family	Steel-Stainless
Heavy/Pots and Pans Cycle	Yes		
Normal Cycle	Yes	ETL Safety Listing	No
Pre-Soak Cycle	No	CSA Safety Listing	No
Quick Rinse Cycle	Yes	UL Safety Listing	Yes
Quick Wash Cycle	Yes	Tub Material	Gray plastic
ENERGY STAR Qualified	Yes	Adjustable Upper Rack	No
		Rack Options	Culinary and utility racks

TO GO BACK, CLICK HERE

NET5054UC
500 Series
30" Stainless Steel Electric Cooktop with Touch Control

BOSCH

Features and Benefits

Appearance

- Sleek Touch Control Panel Offers a Choice of 17 Settings for Unprecedented Temperature Control. Features PreciseSelect™: Touch Controls with Direct Cooking Selection.
- Front and Back Stainless Steel Strip for a Premium Look

Performance

- Bridge Element Accomodates Oblong Pans and Multiple Diameter Sized Cookware
- Dual Element Offers the Capability to use Multiple Pan Sizes

Convenience

- Clean Lock - Prevents Unwanted Changing of Settings while Cleaning Spill-Overs.
- Keep Warm function allows meals to remain ready to serve

Safety

- 2-Level Heat Indicator - Warns if Cooktop is Warm or Hot
- ChildLock - Prevents the Cooktop from Being Accidentally Switched on. Locks Temperature Settings if in Use.

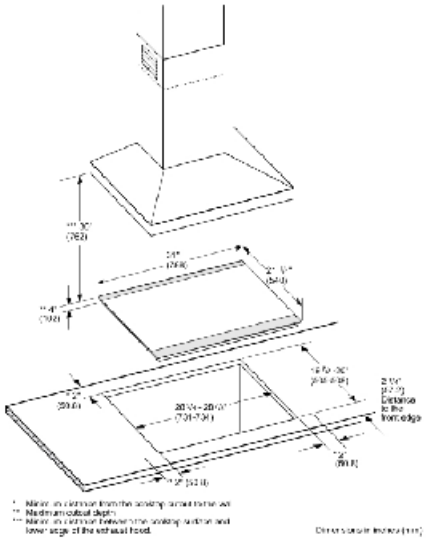
Notes: All height, width and depth dimensions are shown in inches. *Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice.Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be foundin a ccompanying product literature or you may contact your account manager for further details.

For more information on our entire line of products, go to boschappliances.com or call 1-800-944-2904.

Litho Date: 08/2009

NET5054UC
500 Series
30" Stainless Steel Electric Cooktop with Touch Control

BOSCH



Features	
Knob Material	
Sealed Burners	No
Burners with booster	
Type of grate	
Natural Gas Connection Rating (BTU)	
LP Gas Connection Rating (BTU)	
Dimension of 1st heating element (in)	7"
Power of 1st heating element (kW)	1.8 ; 4
Power of 1st burner (BTU)	
Dimension of 2nd heating element (in)	7"
Power of 2nd heating element (kW)	1.8
Power of 2nd burner (BTU)	
Dimension of 3rd heating element (in)	
Power of 3rd heating element (kW)	1.1 ; 2.5
Power of 3rd burner (BTU)	
Dimension of 4th heating element (in)	9"6"
Power of 4th heating element (kW)	1.2
Power of 4th burner (BTU)	
Dimension of 5th heating element (in)	6"
Power of 5th heating element (kW)	
Power of 5th burner (BTU)	
Dimension of 6th heating element (in)	

Technical Specification	
UPC code	825225867623
Main color of product	Black
Energy source	Electric
Gas type	
Alternative gas type	
Watts (W)	7700
Current (A)	32
Volts (V)	240/208
Frequency (Hz)	60
Approval certificates	CUL
Power cord length (in)	
Plug type	No plug
Required cutout size (HxWxD) (in)	4" x 27 7/8" x 20"
Minimum distance from counter front (in)	2 1/4"
Minimum distance from rear wall (in)	2"
Overall appliance dimensions (HxWxD) (in)	1/4"+4" x 31" x 21 1/4"
Product packaging dimensions (HxWxD) (in)	7.87 x 24.21 x 37.40
Net weight (lbs)	30
Gross weight (lbs)	35

Notes: All height, width and depth dimensions are shown in inches. *Please refer to installation instructions prior to making cutout. BSH reserves the absolute and unrestricted right to change product materials and specifications, at any time, without notice.Consult the product's installation instructions for final dimensional data and other details. Applicable product warranty can be foundin a ccompanying product literature or you may contact your account manager for further details.

For more information on our entire line of products, go to boschappliances.com or call 1-800-944-2904.

Litho Date: 08/2009

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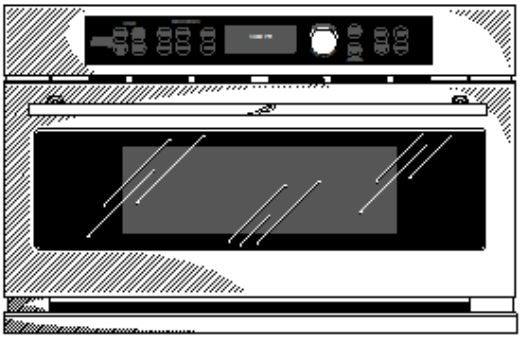
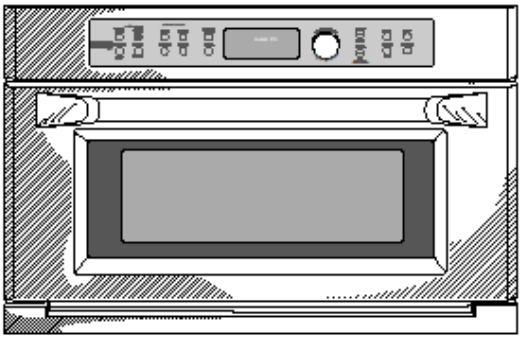
ZSC1201NSS/ZSC1202NSS
GE Monogram® Built-In Advantium® 120 Oven

Features and Benefits

- Remarkable Versatility – Multiple cooking options create four ovens in one—Speedcook, True European convection, sensor microwave and warming ovens—to bake, broil, brown, roast and warm and proof foods
- Speedcook Technology – Halogen light system combines with microwaves and speedcooks your favorite foods to delicious perfection in minutes, with no preheating
- Powerful Performance – Oven-quality foods cook up to four times faster than a conventional oven, with no preheating required
- Spacious Interior – Large 1.7-cu.-ft rounded oven cavity with 16" turntable allow full and continual rotation of a 9" x 13" casserole dish; removable oven rack offers the convenience of multi-level cooking
- Installation Flexibility – Ovens can be installed in 30" wall cabinet and can also be installed below a countertop or below a GE Monogram electric radiant or gas-on-glass cooktop—models ZEU36R, ZEU30R and ZEU36K
- Sophisticated Styling – Integrated models make a singular architectural impression with sleek, horizontal lines set off by a tubular handle and stainless steel control knob
- Professional Styling - Professional models exude power with a premium-grade stainless steel exterior, chamfered edges and a die-cast control knob
- Model ZSC1201NSS – Integrated stainless steel
- Model ZSC1202NSS – Professional stainless steel
- Optional Accessory Storage Drawer - ZX2201NSS (for use with ZSC1201NSS only)



Integrated



Professional

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at ge.com or call GE Answer Center® service, 800.626.2000.

imagination at work

Specification Created 11/08 130316

Continued on next page

ZSC1201NSS/ZSC1202NSS
GE Monogram® Built-In Advantium® 120 Oven

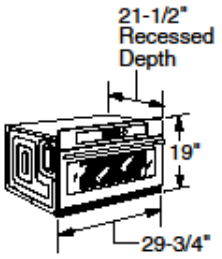
Dimensions and Installation Information (in inches)

Installation Flexibility

The Monogram Advantium 120 built-in oven can be installed directly into a wall, or a 30" wide wall oven cabinet. Install it alone, with a wall oven, a microwave oven or a warming drawer.

- This oven may be installed below a cooktop or below a countertop
- Two Advantium 120 ovens may be installed side-by-side
- Two Advantium 120 ovens may be installed, stacked, one over the other

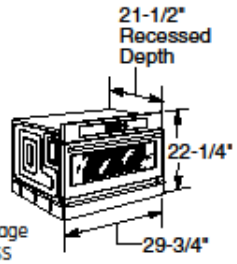
Always refer to each specific product installation instructions for details.



Electrical Requirements

Product rating is 120-volt, 60 Hz, 15 amp circuit and draws 1.8 kilowatts. It must be connected to a supply circuit of the proper voltage and frequency and protected by a time-delay fuse or circuit breaker.

- An Advantium 120 oven installed in combination with any other appliance must be supplied with separate electrical connections.

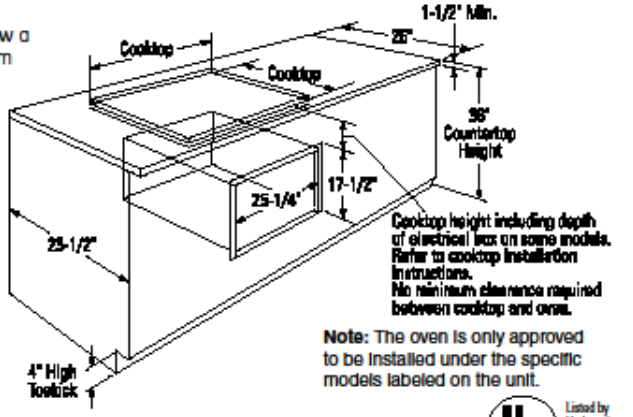


with optional storage drawer ZX2201NSS

Installation Information – before installing, consult installations instructions packed with the product and available on-line at www.monogram.com for current dimensional date.

Installation below a 30" or 36" cooktop

This Advantium 120V oven can be installed below a countertop or beneath a 30 or 36" GE Monogram electric radiant or gas-on-glass cooktop. Models include ZEU36R, ZEU30R and ZEU36K. Install the oven in a 36" or wider base cabinet.



Note: The oven is only approved to be installed under the specific models labeled on the unit.

For answers to your Monogram,® GE Profile™ or GE® appliance questions, visit our website at ge.com or call GE Answer Center® service, 800.626.2000.

imagination at work

Listed by Underwriters Laboratories

Specification Created 11/08 130316

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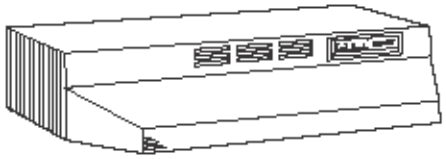
BROAN

SPECIFICATION SHEET

41000 SERIES TWO-SPEED NON-DUCTED RANGE HOOD



Broan's most economical non-ducted hood with filtration of airborne cooking contaminants.

FEATURES

- Rocker-type fan and light switches
- Polymeric blade and light lens (accepts up to 75W bulb)
- Non-ducted filter – effective non-ducted filtration system removes smoke and odors
- Mitered sides and hemmed bottom for safety and good looks
- Contemporary styling in White, Almond, Black and Stainless Steel
- Available in 24", 30", 36", and 42" widths
- Special Order Size: 21"

SPECIFICATIONS

VOLTS	AMPS	RPM
120	2.0	2850

TYPICAL SPECIFICATION

Range hood shall be Broan Model 41000.

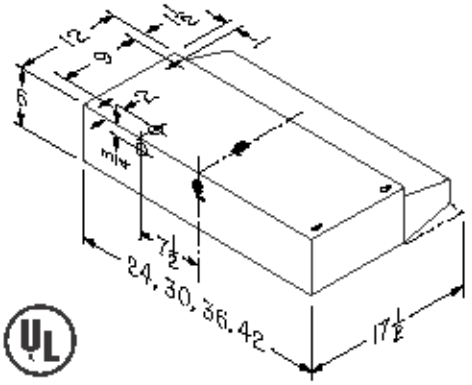
Unit shall be non-ducted and have a non-ducted filter.

Motor to be permanently lubricated. RPM not to exceed 2850.

Unit shall have a two-speed fan switch and separate light switch.

Sides shall be mitered and bottom edge hemmed – with no sharp edges.

Unit shall be U.L. listed.



Broan-NuTone LLC, 926 West State Street, Hartford, Wisconsin 53027 (1-800-637-1453)

REFERENCE	QTY.	REMARKS	Project
			Location
			Architect
			Engineer
			Contractor
			Submitted by Date

50H 99041055K

TO GO BACK, CLICK HERE

LAUNDRY

WM3455HW
WM3455HS

Front Load Compact Washer/Dryer Combo

HIGHLIGHTS
Ventless Condensing Dryer
SenseClean™
LoDecibel™ Quiet Operation

FEATURES

- 2.7 cu.ft. Capacity (IEC)
- Direct Drive Motor (10 year Warranty)
- 1300 RPM
- LoDecibel™ Quiet Operation
- Highly Energy and Water Efficient
- SenseClean™
- 9 Washing Cycles
- 6 Drying Cycles
- 5 Temperature Levels
- Sanitary Cycle
- Delay Wash (up to 19 hours)
- Upfront Electronic Control Panel with LED Display and Dial-A-Cycle™
- Chrome Rimmed Door with Glass
- Ventless Condensing Drying System

IS IT A WASHER? OR SOMETHING BETTER?

LG's all-in-one washer and dryer combo does it all in just one machine. It's great for those who want to be able to do laundry at home but do not have an external venting source which conventional dryers require. Perfect for homes, apartments, businesses and vacation homes where space is valuable.

Available colors:

○ White ● Silver

Continued on next page

LAUNDRY

WM3455HW
WM3455HS

Front Load Compact Washer/Dryer Combo

CAPACITY	
Capacity*	IEC 2.7 cu.ft.
APPEARANCE	
Design Look	Front Control
Intelligent Electronic Controls with LED Display	•
Dial-A-Cycle™	•
ENERGY	
Energy Star Compliant	•
WASH/DRY PROGRAMS	
9 Wash Cycles	Cotton/Normal, Perm. Press, Delicates, Hand Wash/Wool, Drain & Spin, Baby Wear, Speed Wash, Sanitary, Bulky/Large
6 Dry Cycles	Speed Dry, Sanitary, Cotton/Normal, Perm. Press, Baby Wear, Drain & Spin
5 Wash/Rinse Temps	Extra Hot/Cold, Hot/Cold, Warm/Warm, Warm/Cold, Cold/Cold
Spin Speeds	Extra High (1300 max), High, Medium, Low, No Spin
No. of Water Levels	Automatically adjusts to size of load
9 Options	Prewash, Extra Rinse, Stain Cycle, Rinse & Spin, Water Plus, Tub Clean, Delay Wash (up to 19 hours), Child Lock , Custom Program
FABRIC CARE FEATURES	
Ventless Condensing Drying System	•
SenseClean™ System	•
Sensor Dry	•
CONVENIENCE FEATURES	
3 Tray Dispenser	Prewash, Main Wash, Softener
LoDecibel™ Quiet Operation	•
End of Cycle Beeper	•
Child Lock	•
Auto Suds Removal	•
Forced Drain System	•
Status Indicator(s)	•
Internal Water Heater (1000W)	•
Leveling Legs	4 Adjustable Legs
MOTOR AND AGITATOR	
Motor Type	Direct Drive Motor
Motor Speed	Variable
Axis	Horizontal
MATERIALS AND FINISHES	
NeveRust™ Stainless Steel Drum	•
Cabinet	Painted Steel
Control Panel	Plastic
Top Plate	LPM Board
Transparent Door Glass	•
Door Rim	Chrome
Available Colors	White (W), Silver (S)
POWER SOURCE	
Ratings	CSA Listed
Electrical Requirements / Type	120V, 12 Amps / Electric
DIMENSIONS	
Product (WxHxD)	24" x 33 1/2" x 25 1/4" (45"D with door open)
Carton (WxHxD)	26"x 35 3/4"x 27 3/4"
Weight: Product / Shipping	159 lbs. / 168 lbs.

WARRANTY		
1 Year Parts and Labor, 10 Years Motor, Lifetime on Drum		
UPC CODES		
WM3455HW	Combo Washer & Dryer – White	048231 010818
WM3455HS	Combo Washer & Dryer – Silver	048231 011327

Control Panel

www.LG.com

LG Electronics U.S.A., Inc.
1000 Sylvan Avenue Englewood Cliffs, NJ 07632
Customer Service and Technical Support: (800) 243-0000

Dimensions and weights are approximate. Design, features and specifications subject to change without notice.

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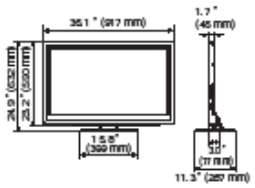
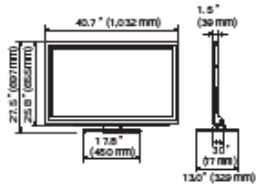
Specifications

		TC-L37D2	TC-L42D2
Power Source		AC 110-127 V, 60 Hz	
Power Consumption	Maximum	130 W	137 W
	Standby condition	0.3 W	0.3 W
Display panel	Aspect Ratio	16:9	
	Visible screen size	37" class (37.0 inches measured diagonally)	42" class (42.0 inches measured diagonally)
	(W × H × Diagonal)	32.2 " × 18.1 " × 37.0 " (819 mm × 460 mm × 940 mm)	36.6 " × 20.6 " × 42.0 " (930 mm × 523 mm × 1,067 mm)
	(No. of pixels)	2,073,600 (1,920 (W) × 1,080(H)) [5,760 × 1,080 dots]	
Sound	Speaker	1-way 2 speakers slim under SP System	
	Audio Output	20 W [10 W + 10 W] (10 % THD)	
PC signals		VGA, SVGA, XGA, WXGA, SXGA Horizontal scanning frequency 31 - 69 kHz Vertical scanning frequency 59 - 86 Hz	
Channel Capability - ATSC/NTSC (Digital/Analog)		VHF/ UHF: 2 - 69, CATV: 1 - 135	
Operating Conditions		Temperature: 32 °F – 95 °F (0 °C – 35°C) Humidity: 20 % – 80 % RH (non-condensing)	
Connection Terminals	VIDEO IN 1-2	VIDEO: RCA PIN Type × 1 1.0 V[p-p] (75 Ω) AUDIO L - R: RCA PIN Type × 2 0.5 V [rms]	
	COMPONENT IN	Y: 1.0 V [p-p] (including synchronization) PB, PR: ±0.35 V [p-p] AUDIO L-R: RCA PIN Type × 2 0.5 V [rms]	
	HDMI 1-3	TYPE A Connector × 3 ● This TV supports "HDAVI Control 5" function.	
	PC	D-SUB 15PIN: R,G,B / 0.7 V [p-p] (75 Ω) HD, VD / 1.0 - 5.0 V [p-p] (high impedance)	
	Dock for iPod	DC 5V 500mA MAX	
	Card slot	SD CARD slot × 1	
	DIGITAL AUDIO OUT	PCM / Dolby Digital, Fiber Optic	
FEATURES		3D Y/C FILTER, CLOSED CAPTION, V-Chip, HDAVI Control 5 Vesa compatible, VIERA IMAGE VIEWER	
Dimensions (W × H × D)	Including TV stand	36.1 " x 24.9 " x 11.3 " (917 mm x 632 mm 287 mm)	40.7 " x 27.5 " x 13.0 " (1,032 mm x 697 mm x 329 mm)
	TV Set only	36.1 " x 23.2 " x 1.7 " (3.0 ") (917 mm x 590 mm x 45 mm (77 mm))	40.7 " x 25.8 " x 1.5 " (3.0 ") (1,032 mm x 655 mm x 39 mm (77 mm))
Mass	Including TV stand	38.6 lb. (17.5 kg) NET	47.4 lb. (21.5 kg) NET
	TV Set only	32.0 lb. (14.5 kg) NET	40.8 lb. (18.5 kg) NET

[TC-L37D2]



[TC-L42D2]



Note

● Design and Specifications are subject to change without notice. Mass and Dimensions shown are approximate.

19) An outside antenna system should not be located in the vicinity of overhead power lines, other electric light, power circuits, or where it can fall into such power lines or circuits. When installing an outside antenna system, extreme care should be taken to keep from touching such power lines or circuits as contact with them might be fatal.
20) Unplug this LCD TV from the wall outlet and refer servicing to qualified service personnel under the following conditions:
   a. When the power cord or plug is damaged or frayed.
   b. If liquid has been spilled into the LCD TV.
   c. If the LCD TV has been exposed to rain or water.
   d. If the LCD TV does not operate normally by following the operating instructions.
      Adjust only those controls that are covered by the operating instructions as improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the LCD TV to normal operation.
   e. If the LCD TV has been dropped or the cabinet has been damaged.
   f. When the LCD TV exhibits a distinct change in performance – this indicates a need for service.
21) When replacement parts are required, be sure the service technician uses replacement parts specified by the manufacturer that have the same characteristics as the original parts. Unauthorized substitutions may result in fire, electric shock, or other hazards.
22) **WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPARATUS TO RAIN, MOISTURE, DRIPPING OR SPLASHING.**
DO NOT PLACE LIQUID CONTAINERS (FLOWER VASES, CUPS, COSMETICS, ETC.) ABOVE THE SET (INCLUDING ON SHELVES ABOVE, ETC.).
23) **WARNING: SMALL PARTS CAN PRESENT CHOKING HAZARD IF ACCIDENTALLY SWALLOWED. KEEP SMALL PARTS AWAY FROM YOUNG CHILDREN.**
DISCARD UNNEEDED SMALL PARTS AND OTHER OBJECTS, INCLUDING PACKAGING MATERIALS AND PLASTIC BAGS/SHEETS TO PREVENT THEM FROM BEING PLAYED WITH BY YOUNG CHILDREN, CREATING THE POTENTIAL RISK OF SUFFOCATION.
24) **CAUTION:** The Power switch on this unit will not completely shut off all power from AC outlet. Since the power cord serves as the main disconnect device for the unit, you will need to unplug it from the AC outlet to shut down all power. Therefore, make sure the unit has been installed so that the power cord can be easily unplugged from AC outlet in case of an accident. To avoid fire hazard, the power cord should also be unplugged from the AC outlet when left unused for a long period of time (for example, when on vacation).
25) **CAUTION:** TO PREVENT ELECTRIC SHOCK, DO NOT USE THIS PLUG WITH A RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE.
26) **CAUTION:** USE WITH OTHER STAND MAY RESULT IN INSTABILITY POSSIBLY CAUSING INJURY.
27) **CAUTION:** DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE.
28) **CAUTION: This LCD TV is for use only with the following optional accessory. Use with any other type of optional accessories may cause instability which could result in the possibility of injury.**
(All of the following accessories are manufactured by Panasonic Corporation)
• Wall-hanging bracket: TY-WK3L2RW
Always be sure to ask a qualified technician to carry out set-up.

NOTE: This equipment is designed to operate in North America and other countries where the broadcasting system and AC house current are exactly the same as in North America.

FCC STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Caution:
To assure continued compliance, follow the attached installation instructions and use only shielded interface cables when connecting to computer or peripheral devices. Any changes or modifications not expressly approved by Panasonic Corp. of North America could void the user's authority to operate this device.

FCC Declaration of Conformity
Model No. TC-L37D2, TC-L42D2

Responsible Party:	Panasonic Corporation of North America One Panasonic Way, Secaucus, NJ 07094
Contact Source:	Panasonic Consumer Electronics Company 1-877-95-VIERA (958-4372)
email:	consumerproducts@panasonic.com

Safety Precautions (Continued)

⚠WARNING

CEA CHILD SAFETY NOTICES: Flat panel displays are not always supported on the proper stands or installed according to the manufacturer's recommendations. Flat panel displays that are inappropriately situated on dressers, bookcases, shelves, desks, speakers, chests or carts may fall over and may cause personal injury or even death.

The consumer electronics industry (of which Panasonic is a member) is committed to making home entertainment enjoyable and safe. To prevent personal injury or death, be sure to follow the following safety guidelines:

TUNE INTO SAFETY:

- One size does NOT fit all. Follow the manufacturer's recommendations for the safe installation and use of your flat panel display.
- Carefully read and understand all enclosed instructions for proper use of this product.
- Don't allow children to climb on or play with furniture and television sets.
- Don't place flat panel displays on furniture that can easily be used as steps, such as a chest of drawers.
- Remember that children can become excited while watching a program, especially on "larger than life" flat panel displays. Care should be taken to install the display where it cannot be pushed, pulled over, or knocked down.
- Care should be taken to route all cords and cables connected to the flat panel display so that they cannot be pulled or grabbed by curious children.

WALL MOUNTING: IF YOU DECIDE TO WALL MOUNT YOUR FLAT PANEL DISPLAY, ALWAYS:

- Use a mount that has been recommended by the display manufacturer and/or listed by an independent laboratory (such as UL, CSA, ETL).
- Follow all instructions supplied by the display and wall mount manufacturers.
- If you have any doubts about your ability to safely install your flat panel display, contact your retailer about professional installation.
- Make sure the wall where you are mounting the display is appropriate. Some wall mounts are not designed to be mounted to walls with steel studs or old cinder block construction. If you are unsure, contact a professional installer.
- A minimum of two people are required for installation. Flat panel displays can be heavy.

The American Academy of Pediatrics discourages television viewing for children younger than two years of age.

This product incorporates the following software:
(1) software developed independently by or for Panasonic Corporation,
(2) software owned by a third party and licensed to Panasonic Corporation,
(3) software licensed under the GNU General Public License, Version 2 (GPL v2),
(4) software licensed under the GNU LESSER General Public License (LGPL) and/or,
(5) open source software other than software licensed under the GPL and/or LGPL

For the software categorized as (3) or (4), please refer to the terms and conditions of GPL v2 and LGPL, as the case may be at http://www.gnu.org/licenses/old-licenses/gpl-2.0.html and http://www.gnu.org/licenses/old-licenses/lgpl-2.1.html In addition, software categorized as (3) or (4) is copyrighted by several individuals and/or entities. Please refer to the copyright notice of those individuals at http://www.am-linux.jp/dl/DTV10UT/.

GPL/LGPL SOFTWARE IS DISTRIBUTED IN THE HOPE THAT IT WILL BE USEFUL, BUT WITHOUT ANY WARRANTY, EXPRESS, IMPLIED OR STATUTORY, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
For at least three (3) years from delivery of products, Panasonic will give to anyone who contacts us at the address provided below, for a charge of no more than our cost of physically performing source code distribution, a complete machine-readable copy of the corresponding source code covered under GPL v2/LGPL
Contact Information
cdrequest@am-linux.jp
Source code is also freely available to you and any other member of the public via our website below.
http://www.am-linux.jp/dl/DTV10UT/

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SONY
make.believe

BDV-E770W

Blu-ray Disc™ Player Home Entertainment System

Experience Full HD 1080p and powerful 5.1channel HD surround sound featuring wireless rear speakers with the Sony® BDV-E770W 3D Blu-ray Disc™ Home Theater System.[1] Connect to the Internet and wirelessly stream a wide variety of online and personal entertainment.[2]

Bullets

- 1000 watt 5.1 channel surround sound (167Wx5+165Wx)[3]
- Wireless Rear Speakers eliminate wire clutter
- BRAVIA® Internet Video: Access movies, music, videos & more[4]
- Wi-Fi® Enabled & 3D Blu-ray Disc™ playback capability[5]
- Quick Start/Load to watch movies faster than ever
- iPod music playback via front USB slot[6]
- DLNA® wireless streaming of photos, videos and music[7]
- Access detailed movie information w/ Gracenote®[8]
- Cross Search for easy searching of BRAVIA® Internet Video[9]
- Enjoy music, photos and video via front USB slot[6]
- Plays Blu-ray Disc™ movies in Full HD 1080p[10]
- Dolby® True-HD and dts® HD Enhanced Audio Codecs[11]

Features

BRAVIA® Internet Video

Instantly stream a wide variety of movies, TV episodes, videos and music from a large selection of entertainment apps including: Netflix®, YouTube™, Pandora, Slacker® - the list goes on and on.[4]

Wireless Rear Speakers

Enjoy 5.1 channel surround sound without needing to run wires across the room to the rear speakers.

Wi-Fi® Enabled

Connect to your home wireless broadband network.[5]

3D Blu-ray Disc™ Full HD 1080p playback

Enjoy 3D Blu-ray Disc™ movies in Full HD 1080p. Also supports standard Blu-ray Disc movies in high definition and upscales DVDs to near HD quality.[1]

Quick Start/Quick Load

Begin enjoying your entertainment faster than ever.

Share Personal Entertainment (DLNA®)

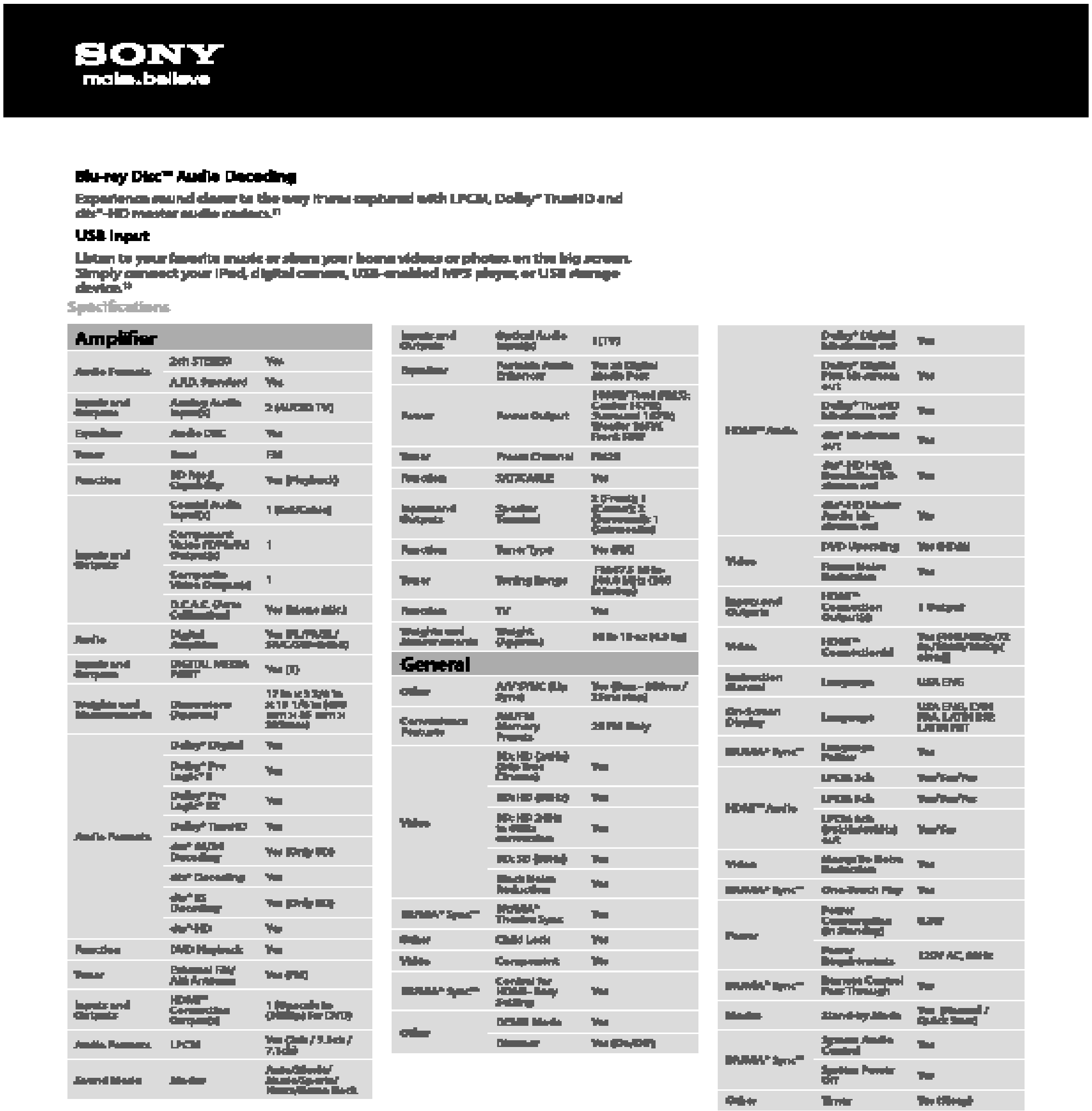
Stream music, videos and photos from compatible DLNA® devices (like a PC) using your home network.[7]

Gracenote™ Metadata Service

Instantly gives you access to detailed information about the movies you are watching[8].

Cross Search

Easily search select BRAVIA® Internet Video partners for entertainment or information related to the disc that you are enjoying.[9]


SONY
make.believe

Blu-ray Disc™ Audio Decoding

Experience sound closer to the way it was captured with LPCM, Dolby® TrueHD and dts®-HD master audio codecs.[1]

USB Input

Listen to your favorite music or share your home videos or photos on the big screen. Simply connect your iPod, digital camera, USB-enabled MP3 player, or USB storage device.[2]

Specifications

Amplifier

General

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Fresh Water Storage Tank

Product Description: 1,500 Gallon Potable Water Tank

Manufacturer: AIRE Industrial Products

Bladder Width	**9**	**ft**	**Package Contents:**
Bladder Length	**13**	**ft**	**One (1) Bladder**
Height	**18**	**inches**	**One (1) Basic Repair Kit**
Valves			**One (1) Ground Pad**
Tie Down Points	**4**	**ea.**	
Gal. Capacity	**1500**	**gal.**	**Mfg Part #**
Pad Area	**117**	**Sq Ft**	**950-026500**
Fabric	**22 oz PVC**		**MFG Cage Code**
Bladder Weight	**70**	**lbs**	**1MDS4**

Valve Upgrades available

TO GO BACK, CLICK HERE

Fresh Water Transfer Pump

Product Description

3/4 hp Hydro-Glass®, Craftsman Professional Shallow Well Water Pump capable of pumping up to 10.9 GPM. Performance is based on depth to water of 20 ft. or less and a 40/60 pressure rating.

Built-in Check Valve - prevents pumped water from returning to source

Built-in shallow well jet - eliminates additional purchase

Dual voltage (115 or 230)

Capacitor start motor - more efficient motor start

Dual discharge - simplifies hookup

Draincock - simplifies draining and winterization

Limited 3 year warranty

Added on February 12, 2009

Specifications

DIMENSIONS:

PRODUCT OVERVIEW:

POWER:

INSTALLATION REQUIR

QUALITY:

PUMP:

PERFORMANCE AT 40

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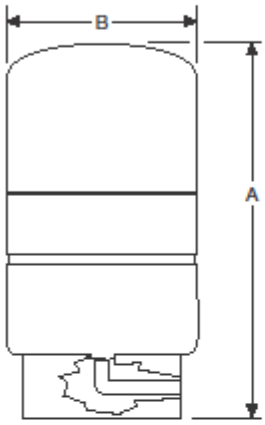
AMTROL

WELL-X-TROL® PRO Access®

Pre-pressurized diaphragm-type well tanks
Stainless steel system connection piped to he stand



Stand Models

Model No.	Tank Vol. Lit.	Tank Vol. Gal	Max. Accept. Factor	A Height mm	A Height Ins.	B Diameter mm	B Diameter Ins.	Sys. Conn. Ins.	Factory Pre-charge PSIG	Working Pressure PSIG[1]	Ship Wt. kg	Ship Wt. lbs.
WX-202P	76	20.0	0.57	803	31 1/4	390	15 3/8	1	38	125	15.0	33
WX-202XLP	98.4	26.0	0.44	971.5	38 1/4	390.5	15 3/8	1	38	125	16.3	36
WX-203P	121	32.0	0.35	1181	46 1/2	390	15 3/8	1	38	125	20.0	43
WX-205P	129	34.0	1.00	752	29 5/8	559	22	1 1/4	38	125	28.0	61
WX-250P	167	44.0	0.77	914	36	559	22	1 1/4	38	125	31.0	69
WX-251P	235	62.0	0.55	1187	46 3/4	559	22	1 1/4	38	125	41.0	92
WX-255P	306.6	81.0	0.41	1432	56 3/8	558.8	22	1 1/4	38	125	38.4	103
WX-302P	326	86.0	0.54	1200	47 1/4	660	26	1 1/4	38	125	56.0	123
WX-350P	450	119.0	0.39	1572	61 7/8	660	26	1 1/4	38	125	75.0	166

[1] 125 PSIG is 862 kPa.

Max. Operating Conditions

Operating Temperature	200° F (93° C)
Working Pressure	125 PSIG (862 kPa)

NSF

Complies with Low Lead Plumbing Law

Specifications

Description	Standard Construction
Shell	Steel
Diaphragm	Butyl
Liner	Polypropylene
System Connection	Stainless Steel NPTF

Job Name _____

Location _____

_____

_____

Engineer _____

Contractor _____

Contractor P.O. No. _____

Sales Representative _____

Model No. Ordered _____

Pump Cut-In _____ PSI Pump Cut-Out _____ PSI

Pump GPM _____ PSI

Rev. 03/10
P/N 4400-003

Submittal data sheets can ONLY be ordered as a "Submittal Data Sheet Pack", using MC# 4400. They are not available to order on an individual basis, however each data sheet is available on the AMTROL Web Site and can be downloaded and printed for use as needed. For the most updated technical specifications, please download sheet at www.amtrol.com

3

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Husky 1000 Gallon Potable Water Bladder Tank

Bladder tanks have unlimited practical uses including:

Providing drinking water storage for disaster area victims
Additional fresh water for boats or RV
Waste water containment
Rain Water Collection for Irrigation Systems
Pesticides and insecticides
Nurseries
Farming, watering livestock or treating with insecticides
Fuel storage,diesel,gas,jet,etc.
Gray water storage for pressure washing systems
Fire Fighting
Black Water (sewage)
Flatbed Truck Tanks
Railcar Tanks
•Materials NSF-61 Approved (potable water)
•25-75 gal. comes with a 3/4" Flange and Ball Valve
•1 1/2" Flange and Ball Valve Standard on Sizes 100-1000 gal.
•4" Fill Cap or 7" Diameter Fill Sleve
•Easy to Handle, Folds down for Compact Storage

Part Number: HPC-BT-1000PW
Capacity: 1000 Gallons
Size: 108"L x 132"W x 16"H
Weight: 60 lbs.

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RESIDENTIAL

SELECT® High Efficiency

High-Efficiency Residential Electric Water Heaters

New, Higher Energy Factor of .93, meets efficiency requirements for most electric utility rebate programs – 2-1/2"-thick CFC-free foam insulation, heat trap nipples and other features produce performance that meets Energy Star Home Program recommendations.

Diffuser Dip Tube – Helps reduce lime and sediment buildup, maximizes hot water output. Made of State PEXAN,™ a cross-link PEX polymer that can withstand long-term exposure to water temperatures up to 400ºF.

Aluminum Anode Rod – Helps protect against corrosion for longer life.

Durable Tamper-Resistant Brass Drain Valve

Glass-Lined Tank – For long-lasting protection against rust and corrosion.

Upgrade Tank Warranty to 10 Years – See details on page 2.

Certified and Rated Side-Mounted T&P Relief Valve – Top-Mounted T&P Relief Valve availiable as an option on some models.

6-Year Limited Tank and Parts Warranty

Code Compliance - meets or exceeds federal minimum energy standards according to the latest edition of the National Appliance Energy Conservation Act (NAECA). Also complies with ASHRAE 90.1-2004 and current editions of ICC Codes and HUD Standards.

For more information on Select® contact:
State Water Heaters
500 Tennessee Waltz Parkway, Ashland City, TN 37015
800-365-0024 Toll-free USA
www.statewaterheaters.com

SRESS00606 March 2008R

SOLID. STATE.

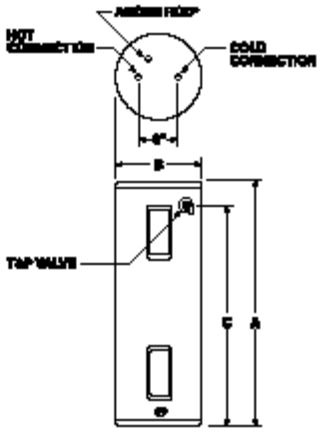
state WATER HEATERS

SELECT® High Efficiency

High-Efficiency Residential Electric Water Heaters

MODEL NUMBER	PEAK DEMAND OUTPUT (1st Hour Rating Gallons)	ENERGY FACTOR	GALLON CAPACITY	ELEMENT WATTAGE 240 VAC		RECOVERY 90°F RISE	R VALUE	DIMENSIONS IN INCHES			APPROX. SHIPPING WEIGHT (LBS)
				STANDARD	MAXIMUM			A HEIGHT	B DIAMETER	C	
TALL MODELS											
ES6 40 DOCT	54	.93	40	4500	6000	21	20	60	19	53-1/2	120
ES6 52 DOCT *	60	.93	50	4500	6000	21	20	56-1/2	21-1/2	47-1/2	135
ES6 66 DOCT	76	.92	66	4500	6000	21	20	61	23	53	180
ES6 80 DOCT *	87	.93	80	4500	6000	21	20	61-1/2	25	52	210
MEDIUM MODEL											
ES6 50 DOCS	62	.93	50	4500	6000	21	20	49	23	40-1/2	155

Recoveries are rounded to nearest gallon
Water Connections – 3/4" male NPT on all models
For 10-Year Tank Warranty, change "6" to "X" in Model Number (ES X40DOCT)
*Models not available with top-mounted T&P Valve



*Location for optional top-mounted T&P Valve, if available and ordered from factory.

For complete information on limited warranties, consult written warranty, or contact the State Customer Care Center, 1-800-365-0024.

State Industries, Inc. reserves the right to make product changes or improvements without prior notice.

For more information on Select® contact:
State Water Heaters
500 Tennessee Waltz Parkway, Ashland City, TN 37015
800-365-0024 Toll-free USA
www.statewaterheaters.com

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USI GREEN ENERGY

GREEN STAR Water Heater

Affordable, High Efficiency Water Heater

Features and Benefits

Highest Efficiency Water Heater
Instead of burning fuel, a **Green Star** Water Heater uses a heat pump to transfer solar heat from the surrounding air into your water tank. While the best fuel burning water heaters have a maximum efficiency of less than 95%, in warmer climates the efficiency of a heat pump water heater can exceed 300%. Even in 32°F air **Green Star** Water Heaters have an efficiency of 166%.

Retrofit for Existing Water Heater
A **Green Star** is mounted on top of or near an existing water heater and the its heat condenser is inserted into the heater tank. Green Star Water Heaters transfer solar heat from the surrounding air to the heat condenser which transfers the heat to the water in your tank.

Simplified Heat Control
Green Star heaters use a simple in-tank thermometer to directly measure the tank water temperature and maintain the water at the set temperature.

Low Cost & High Reliability
The simple, elegant design of the **Green Star** heater does not use any pumps, pump controllers or heat controllers making **Green Star** the most affordable, highest reliability water heater available – surpassing other type of solar water heaters which are much more expensive to buy and install.

Easy to Install
A **Green Star** heater can be easily installed using basic pipe fitting skills.

Low Maintenance
Green Star water heaters are virtually maintenance free, thousands have been installed.

Quiet
At 52dB a **Green Star** heater is quieter than a small window air conditioner.

Dehumidification & Air Conditioning
Green Star™ removes moisture and cools air as it moves heat from the air to the water in the water heater tank.

Making Your Water Heater Very Energy Efficient

Green Star water heaters replace the fuel burning heater in your water tank with a pump which uses solar heat in the air to heat your water. They produce more hot water per hour safely and more efficiently than other types of water heaters. According to Solar Energy International: *"Heat Pump technology, when applied to the water heating industry, provides the highest energy efficient water heaters in the country."*

In addition to heating water, **Green Star** heaters emit cool, dry air which can providing additional savings by cooling your home in the summer (kit sold separately). **Green Star** heaters run on standard 110V and consume about as much energy as two coffee machines.

Compared to standard electric water heaters, **Green Star** heaters provide operating cost savings up to 70% while heating up to 29% more water per hour.

Utilities and other customers as well as articles such as Duke University's recently published article[1] on HPWH all conclude that the superior **Green Star** heater design makes it today's leading Heat Pump Solar Water Heater.

[1] *Manufacturing Climate Solutions Carbon-Reducing Technologies and U.S. Jobs*
Chapter 6 Electric Heat Pump Water Heaters

Specifications

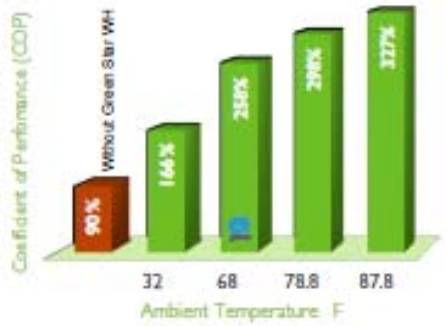
	WH 270	WH 320	
Max Water Temperature	135 (10 between open and close)		°F
Efficiency	258	211	%
Energy Factor	2.11	2.11	
1st Hour Rating (40 gal tank)	50+	53+	Gallon
Output	7000	12000	BTU
Dimensions[1]	18x14x14	19x15x14	inches
Weight	48	64	lbs
Noise Level	52	52	dB
AC Power	115	115	Volts
Current			
Operating	6	10	Amps
Startup	12	20	Amps
Phase	1	1	
Frequency	60	60	Hz

[1] Minimum 5 inches clearance required above 14" height

All measurements made using DOE testing standards at ambient temperature of 68°F.

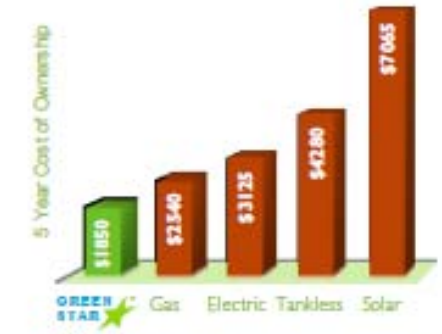
Installation indoors near a drain (high humidity results in up to a quart of condensate daily) where ambient temperatures are above 35°F is recommended.

Green Star™ Water Heater Efficiency



By comparison, standard water heaters have 65–95% COP

Estimated 5 Year Cost of Ownership



Includes purchase, installation, 5 years maintenance & fuel

Green Star is a trademark of USI Green Energy

D1005140A

USI GREEN ENERGY
960 Bridle Path Rd, Allentown PA 18103

ENERGY STAR PARTNER

Phone: 610.439.2122
Fax: 610.439.8242
www.usigreenenergy.com

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SunDrum® Solar SDM100-10, -21, & -30 Collector Assembly Guide, Rev 004

SDM100 - 10

SDM100 - 21

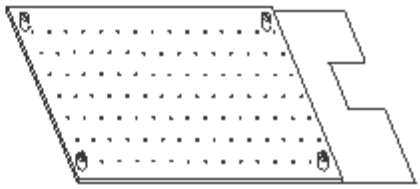
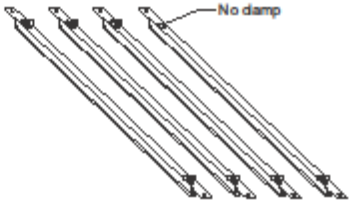
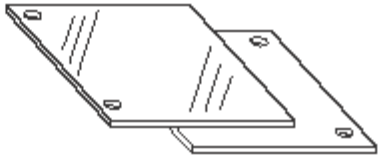
SDM100 - 30

Hybrid Solar Collector

Assembly Guide

Revision #	Description	Date	Author	Approved
001	Original Document	10/14/08	MGI	
002	Release to Publication	11/6/08	MGI	
003	Prepublication Format	11/6/08	MDS	
004	Added SDM100-21, Clarified step 15 and added stacking warning	2/11/09	MGI	PR

PARTS LIST:

QTY	Description	Image
1	SDM100-10, -21, or -30 Collector	
4	Brackets with clamps (3 with 2 clamps per bracket, and 1 with only one clamp)	
2	Foil-Backed Insulation Panels	
2	Stainless Steel Compression Wedges (SDM100-10 only)	
1	Hardware kit: SDM100-10 & -30: #10-32 lock nut, #10 star washer, ¼"-20 bolt and nut, ¼" star washer SDM100-21: #10-32 bolt, 2 10-32 lock nuts, #10-32 star washer	

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Steca Elektronik GmbH | 87700 Memmingen | Germany | Fon +49 (0) 8331 8558-0 | Fax +49 (0) 8331 8558-132 | www.steca.com

Steca TR 0301 U

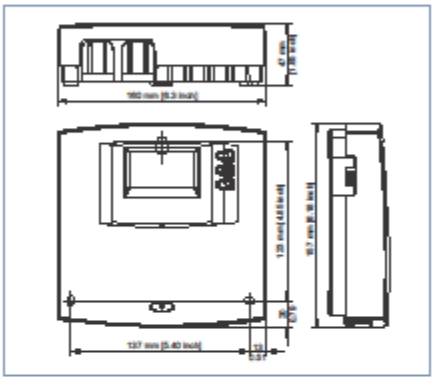
3 inputs,
1 output

The Steca TR 0301 U controller was specially developed for the North American market based on the Steca TR 0301 basic controller. With its special certification (ETL label) from a Nationally Recognized Testing Laboratory (NRTL) in the US, the controller meets the safety standards and minimum requirements of the North American market.

A feature of the Steca TR 0301 series of controllers is the animated graphic display, which offers a complete visualisation of the solar energy system's operating status and solar circuit.

The clearly arranged display ensures easy operation using pictograms. The controller was jointly designed with an internationally renowned design centre. The controller is used for monitoring and controlling solar thermal systems with one collector array and one storage tank. In addition, the controller performs important system monitoring and safety functions to ensure safe and long-lasting operation of the entire system. The numerous additional functions of the Steca TR 0301 U also include a maximum storage tank temperature function, a tube collector function, an anti-freeze function, a holiday and storage recool function as well as a choice of temperature indications in either degrees Celsius (°C) or Fahrenheit (°F). The operational safety of the system is supported by a sophisticated fault diagnosis. The multi-coloured LCD backlighting ensures quick and safe location of occurring errors and facilitates quick troubleshooting.

The Steca TR 0301 U controller is supplied with a pre-fitted US mains connection cable and a preinstalled, pluggable pump output.



Product features

- Compact, multipart designer casing
- Maximum storage tank temperature
- High level of operational safety through fault diagnosis
- Temperature display °C / °F
- Collector overtemperature disconnection
- Spring clamp terminals allow rapid and easy installation

Displays

- Graphical LCD display with backlighting
- Animated representation of the systems and operating states

Operation

- Non-verbal menu navigation
- Side switch for manual, auto, off

Functions

- Holiday (storage tank recooling)
- Interval / tube collector
- Anti-freeze
- Display storage tank top

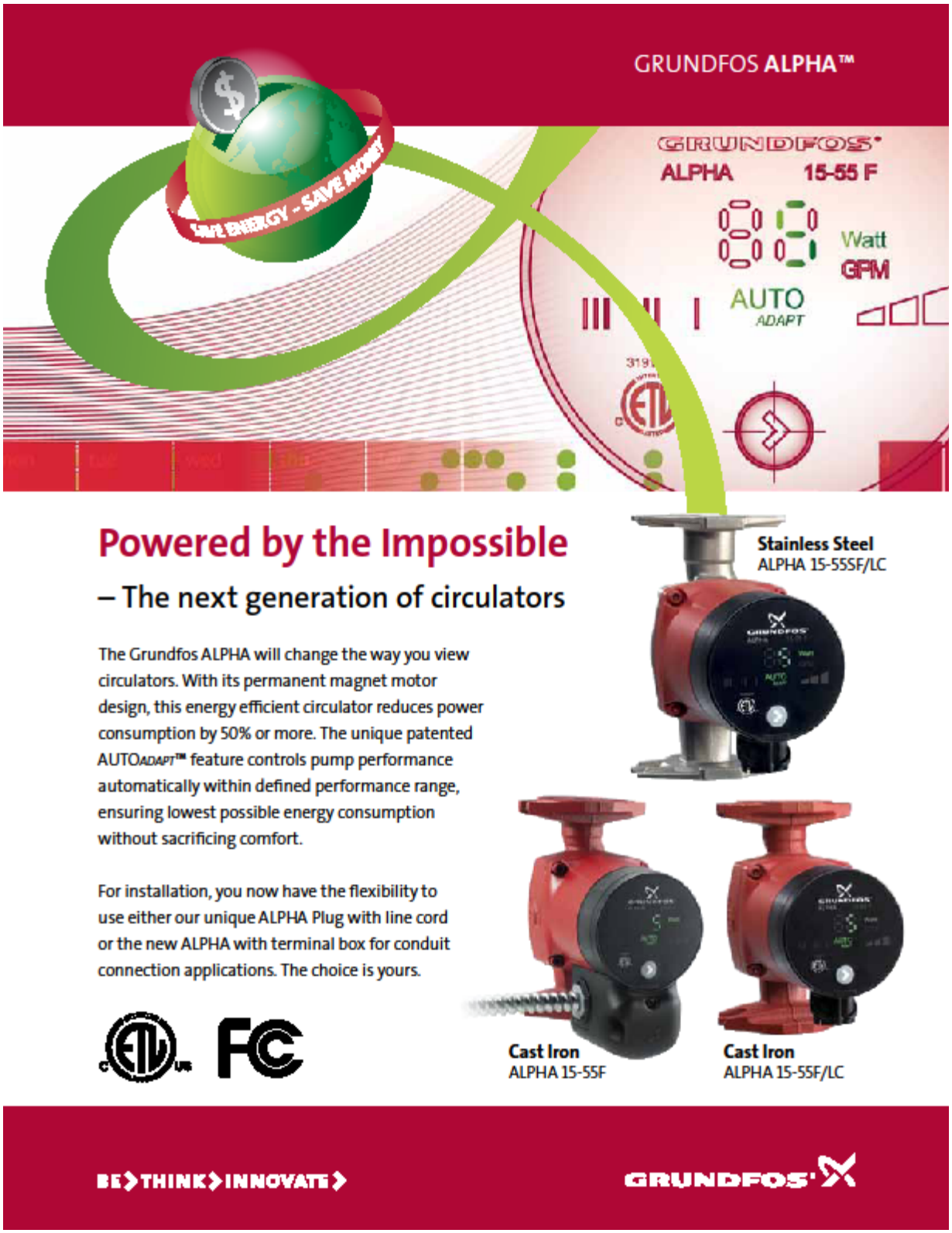
	TR 0301 U
System voltage	120 V AC, 60 Hz optional 240 V AC, 60 Hz
Own consumption	≤ 1 W [≤ 0.001 HP]
Inputs	3 3 x temperature (Pt1000)
Output	1 1 x switch output relay (R1), max. 400 W / 0.5 HP (120 V AC) or 800 W / 1 HP (240 V AC)
Line cord	75 inch, 3 x 18 AWG at 221 °F
Turn-on temperature difference	16 F
Turn-off temperature difference	8 F
Ambient temperature	0 °C [+32 °F] ... +45 °C [+113 °F]
Degree of protection	IP 20 / DIN 40050
Dimensions (X x Y x Z)	160 x 157 x 47 mm [6.3 x 6.18 x 1.85 inch]
Weight	350 g [12.35 oz]
Temperature sensors 2 x Pt1000	1.5 m [59 inch] silicone cable with bushing (Measuring range up to + 180 °C [+356 °F])

technical data at 25 °C / 77 °F

System type
1 collector array

Internal heat exchanger, intelligent pump control

areas of application | inputs/outputs


GRUNDFOS ALPHA™
SAVE ENERGY - SAVE MONEY
GRUNDFOS
ALPHA 15-55 F
Watt
GPM
AUTO
ADAPT
Powered by the Impossible
– The next generation of circulators
The Grundfos ALPHA will change the way you view circulators. With its permanent magnet motor design, this energy efficient circulator reduces power consumption by 50% or more. The unique patented AUTOADAPT™ feature controls pump performance automatically within defined performance range, ensuring lowest possible energy consumption without sacrificing comfort.
For installation, you now have the flexibility to use either our unique ALPHA Plug with line cord or the new ALPHA with terminal box for conduit connection applications. The choice is yours.
Stainless Steel
ALPHA 15-55SF/LC
Cast Iron
ALPHA 15-55F
Cast Iron
ALPHA 15-55F/LC
BE THINK INNOVATE
GRUNDFOS

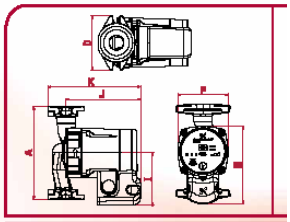
Technical Data:

Flow Range:	0 to 21 GPM
Head Range:	0 to 19 Feet
Motor:	1X115V
Min. Fluid Temperature:	36°F (2°C)
Max. Fluid Temperature:	230°F (110°C)
Max. Working Pressure:	150 PSI
Watts:	5-45W
Amps:	0.65A

Product Offering:

Model	Desc
ALPHA 15-55F	Cast iron flange
ALPHA 15-55FR	Cast iron rotated fla
ALPHA 15-55SF	Stainless flange
ALPHA 15-55F/LC	Cast iron flang
ALPHA 15-55FR/LC	Cast iron rotated f
ALPHA 15-55SF/LC	Stainless flang
	Service Kit
	Service Kit -

Dimensional Drawing:



A	B	C	D	E	F
6-1/2	6-3/16	4-15/16	3-13/16	2-3/8	3-7/1

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Advanced Heating and Hot Water Systems

P.O. Box 429 120 Braley Road East Freetown, MA 02717 508-763-8071 Fax: 508-763-3780

SSC Solar Water Heater Submittal Sheet

SuperStor Contender Solar Water Heaters with Boiler (SB Series) or Electric (SE Series) Back-Up

JOB NAME:

LOCATION:

ARCH./ENGR.:

WHOLESALER:

MECH. CONTRACTOR:

MODEL NUMBER:

BACK-UP WATER HEATING SYSTEM:

High Efficiency Solar Heat Exchanger

- **Specially formulated Enamel Flow Coated steel solar heat exchanger provides maximum heat transfer of solar energy to domestic water and corrosion resistance**
- **Low pressure drop**
- **Gasketless heat exchanger design**
- **1" NPT solar heat exchanger outlet size – all models**

Glass-Lined Tank

- **Specially formulated Enamel Flow Coat guarantees 100% tank coverage, ensuring no exposed welds**
- **Insulated with environmentally safe, CFC free, water-blown, extra thick foam insulation.**
- **Allows less than ½ degree Fahrenheit per hour heat loss**
- **Outer shell constructed of grey finished durable plastic for rust and impact resistance**
- **¾" NPT inlet and outlet domestic connection size for 50 gallon models – 1 ½" NPT for 80 and 119 gallon models**
- **Included temperature and pressure relief valve**
- **Surface mounted sensor for accurate current temperature measurement inside vessel**

SB Series Solar Water Heaters

- **Back-up Boiler Heat Exchanger – provides back-up water heating from the boiler if the solar system fails to keep up with domestic hot water demand**
- **Specially formulated Enamel Flow Coated steel heat exchanger provides maximum heat transfer of boiler energy to domestic water and corrosion resistance**
- **Gasketless heat exchanger design**
- **1" NPT boiler heat exchanger outlet size – all models**
- **Tank mounted boiler thermostat to control back-up operation**

SE Series Solar Water Heaters

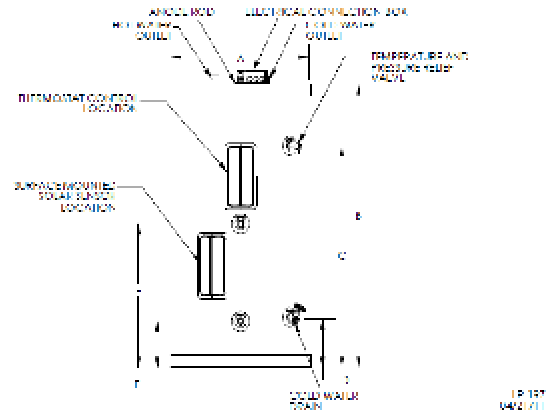
- **Back-up Electric Element – 4500W / 240V electric element provides back-up water heating if solar system fails to keep up with domestic hot water demand**
- **Surface-mounted control provides accurate temperature measurement to timely activate the back-up electric element**

Additional Features

- **Oversized anode rod protects tank from corrosion**
- **Limited warranty – 7 years residential and 5 years commercial coverage**
- **SRCC OG-300 Certified – applies to Federal Tax Credit when connected to a solar collector**
- **May qualify for additional State and Local incentives – ask your installer for more information**

LP-197.sub
Rev. 5.11.11

CONTENDER SE SERIES SOLAR WATER HEATER
(with BACK-UP ELECTRIC ELEMENT)



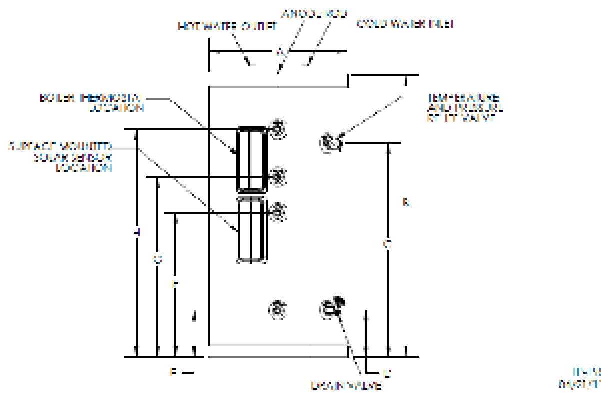
CONTENDER SOLAR WATER HEATER DIMENSIONS & SPECS

MODEL #	GAL.	A	B	C	D	E	F	HEAT EXCHANGER OUTLET SIZE	INLET/OUTLET SIZE	SHIPPING WEIGHT (lbs)
[illegible]	50	23"	46-1/2"	36-1/2"	5"	7-3/4"	23-1/2"	1" NPT	3/4" NPT	175
[illegible]	80	23"	71-1/2"	60-1/4"	6"	7-3/4"	33-1/2"	1" NPT	1-1/2" NPT	237
[illegible]	119	27"	64"	51"	10-1/2"	10"	27"	1" NPT	1-1/2" NPT	336

CONTENDER SOLAR GLASS LINED SE SERIES

MODEL	SOLAR HX VOLUME GALLONS	HEATED WATER VOLUME OF BACK UP	RECOVERY OF BACK UP IN MINUTES 65° RISE	RECOVERY OF BACK UP IN MINUTES 90° RISE	FIRST DRAW* 65° RISE	FIRST DRAW* 90° RISE
[illegible]	2 GAL	15 GAL	38 MIN	53 MIN	20 GAL	14 GAL
[illegible]	2 GAL	67 GAL	[illegible] MIN	100 MIN	58 GAL	38 GAL
[illegible]	9 GAL	67 GAL	141 MIN	126 MIN	73 GAL	47 GAL

CONTENDER SB SERIES SOLAR WATER HEATER
(with BACK-UP HEAT EXCHANGER)



CONTENDER SOLAR WATER HEATER DIMENSIONS & SPECS

MODEL #	GAL.	A	B	C	D	E	F	G	H	HEAT EXCHANGER OUTLET SIZE	INLET/OUTLET SIZE	SHIPPING WEIGHT (lbs)
[illegible]	50	23"	46 1/2"	36 1/2"	5"	7 3/4"	23 1/2"	30"	37 3/4"	1" NPT	3/4" NPT	187
[illegible]	80	23"	71-1/2"	60-1/4"	6"	7-3/4"	33-1/2"	40"	55-1/2"	1" NPT	1-1/2" NPT	266
[illegible]	119	27"	64"	51"	10 1/2"	10"	27"	36"	47 1/4"	1" NPT	1 1/2" NPT	367

CONTENDER GLASS LINED SOLAR SB SERIES

MODEL	HX VOLUME GALLONS SOLAR	HX VOLUME GALLONS BOILER	HEATED WATER VOLUME OF BACK UP	RECOVERY OF BACK UP IN MINUTES 65° RISE	RECOVERY OF BACK UP IN MINUTES 90° RISE	BOILER OUTPUT FOR TEST RECOVERY	FIRST DRAW* 65° RISE	FIRST DRAW* 90° RISE
[illegible]	2 GAL	1.5 GAL	6 GAL	12 MIN	17 MIN	[illegible] BTU/HR	30 GAL	14 GAL
[illegible]	2 GAL	1.5 GAL	37 GAL	17 MIN	24 MIN	90,000 BTU/HR	58 GAL	38 GAL
[illegible]	9 GAL	1.5 GAL	67 GAL	29 MIN	31 MIN	100,000 BTU/HR	73 GAL	46 GAL

* AMOUNT OF WATER DRAWN OUT OF STORAGE TANK WITHOUT ANY ENERGY INPUT
ALL DIMENSIONS ARE APPROXIMATE
[illegible]
[illegible]
For questions, please consult the factory.

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Heat Recovery Ventilator

nu-air
Sustainability Through Innovation

Model: ES100

VENTILATION PERFORMANCE

EXT. STATIC PRESSURE	NET SUPPLY AIR FLOW	GROSS AIR FLOW SUPPLY	GROSS AIR FLOW EXHAUST
In wg (Pa)	cfm (l/s)	cfm (l/s)	cfm (l/s)
0.1 (25)	147 (69)	150 (71)	172 (81)
0.2 (50)	131 (61)	134 (63)	153 (72)
0.3 (75)	118 (56)	121 (57)	135 (64)
0.4 (100)	104 (49)	107 (50)	123 (58)
0.5 (125)	91 (43)	93 (44)	111 (52)
0.6 (150)	76 (36)	78 (37)	92 (43)
0.7 (175)	64 (30)	66 (31)	79 (37)
0.8 (200)	52 (24)	53 (25)	64 (30)

ENERGY PERFORMANCE

SUPPLY TEMP.	NET AIR FLOW	POWER CONSUMED	SENSIBLE RECOVERY	APPARENT SENSIBLE
°F (°C)	cfm (l/s)	Watts	EFFICIENCY	EFFECTIVENESS
+32 (0)	55 (26)	48	70	79
+32 (0)	66 (31)	52	68	76
+32 (0)	40 (86)	72	65	73
13 (-25)	64 (30)	58	56	80

CABINET/CORE: The case is constructed of 0.032 painted aluminum with a white enamel finish. The cabinet is fully insulated with 1-inch polyurethane. The unit is equipped with a cross-flow heat exchange core.

ELECTRICAL: 120V/1/60 Hz. 84W, 0.7A

BLOWERS: Two backward curve impellers using PSC motors and permanently sealed bearings.

CERTIFICATION: HVI, CSA C22.2

REVERSIBLE: internal components can be accessed **front or back**

ADDITIONAL FEATURES:

- Built in furnace interlock options: commands furnace blower when HRV is on or just on high speed.
- Intelligent defrost adjusts to outdoor conditions below -5º C (23º F)
- Independent speed adjustment of either supply or exhaust motor in BOTH high and low speed
- 24V circuit protection with self resetting fuse
- Drain, hanger kit, polyester air filters included
- 12 VDC **AND/OR** 24 V connection for remote control with mechanical switch or the following Nu-Air controls:

ES Series: Unlimited numbers. Series or parallel.	**WINDSOR Series**
ES-M1: Off/ Stby/ Lo/ Hi **ES-M2**: Off/ Stby/ Lo/ 20 Lo-40 Stby **ES-M3**: Off/ Stby/ Lo/ 20 Lo—40 Recirculation **ES-T1**: 20-40-60-minute timer	**DSTAT-1**: Humidity control **Win-1**: Humidity control/ OFF/ STBY/ Continuous/ Intermittent/ Full-time high speed **WIN-20**: 20-minute timer (up to 6)

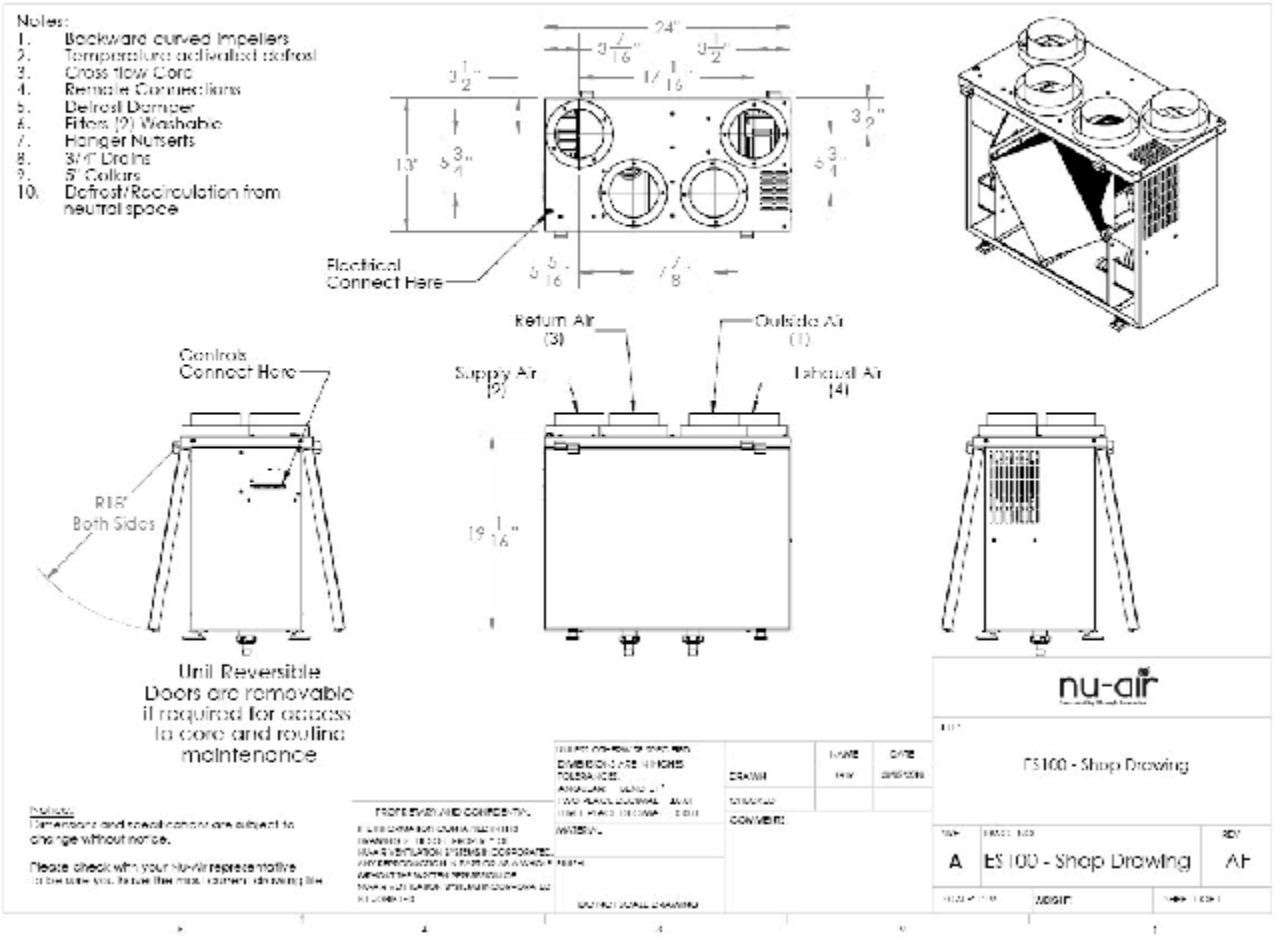
Defrost: When outdoor temperature is below -5º C (23º F), a defrost cycle is initiated for a fixed duration. The fresh air motor will go to high speed and the exhaust air motor will go to low speed. A damper will shut off the cold supply port, directing ambient air through the core for defrosting. The unit will resume normal operation for a fixed duration, then the processor will read outdoor temperature and initiate defrost as necessary. Defrost times and intervals will vary according to temperature below -5º C (23º F).

Warranty: There is a 5-year warranty on all internal components. The heat recovery core has a lifetime warranty.

Notes:
This product earned the ENERGY STAR® by meeting strict energy efficiency guidelines set by Natural Resources Canada and the US EPA. It meets ENERGY STAR requirements only when used in Canada.

Nu-Air Ventilation Systems Inc. reserves the right to change specifications without notice.

Model: ES100



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MITSUBISHI ELECTRIC

Mr. SLIM
Split-ductless A/C and Heat Pumps

SUBMITTAL DATA: SEZ-KD09NA & SUZ-KA09NA

9,000 BTU/H HORIZONTAL-DUCTED HEAT-PUMP SYSTEMS

Job Name: Location: Date:

Purchaser: Engineer:

Submitted to: For ☐ Reference ☐ Approval ☐ Construction

System Designation: Schedule No.:

GENERAL FEATURES

- Horizontal-ducted indoor unit for residential applications
- Ultra thin body: 7-7/8" high
- Built-in drain mechanism for condensate removal; lifts to 21-11/16"
- Air filter is included with indoor unit
- Quiet operation — as low as 23 dBA
- PAR-21MAA wired remote controller is included
- Indoor unit powered from outdoor unit using A-Control
- Automatic fan speed control
- Auto restart following a power outage
- Limited warranty: five years on parts and defects and seven years on compressors

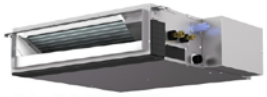
OPTIONAL ACCESSORIES

Indoor Unit

- M-NET Control Adapter (MAC-399IF)
- External Heat Adapter (PAC-YU25HT)
- CN24 Relay Kit (CN24RELAY-KIT-CM)
- Three-pole Disconnect Switch (TAZ-MS303)

Outdoor Unit

- Drain Pan Heater (MAC-640BH-U)
- Drain Socket (MAC-860DS)



Indoor Unit: SEZ-KD09NA

Remote Controller: PAR-21MAA

Outdoor Unit: SUZ-KA09NA

Cooling*
Rated Capacity . . . . . 8,100 Btu/h
Capacity Range . . . . . 3,800 - 10,900 Btu/h
SEER 15.0
Total Input . . . . . 670 W

Heating at 47°F*
Rated Capacity . . . . . 10,900 Btu/h
Capacity Range . . . . . 4,800 - 14,100 Btu/h
HSPF 10.0
Total Input . . . . . 1,020 W

Heating at 17°F*
Rated Capacity . . . . . 6,700 Btu/h
Rated Total Input . . . . . 810 W
Maximum Capacity . . . . . 7,300 Btu/h
Maximum Total Input . . . . . 1,000 W

* Rating Conditions (Cooling) - Indoor: 80°F (27°C) DB, 67°F (19°C) WB; Outdoor: 95°F (35°C) DB, 75°F (24°C) WB.
(Heating at 47°F) - Indoor: 70°F (21°C) DB, 60°F (16°C) WB; Outdoor: 47°F (8°C) DB, 43°F (6°C) WB.
(Heating at 17°F) - Indoor: 70°F (21°C) DB, 60°F (16°C) WB; Outdoor: 17°F (-8°C) DB, 15°F (-9°C) WB.

Electrical Requirements
Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
Breaker Size . . . . . 15 A

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . DC 12-24V
Indoor - Remote Controller . . . . . DC 12V

OPERATING RANGE

		Indoor Intake Air Temp.	Outdoor Intake Air Temp.
Cooling	Maximum	90°F (32°C) DB, 73°F (23°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F (14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F (19°C) WB	75°F (24°C) DB, 65°F (18°C) WB
	Minimum	70°F (21°C) DB, 60°F (16°C) WB	-4°F (-20°C) DB, -5°F (-21°C) WB

Indoor Unit
MCA . . . . . 1 A
Fan Type x Quantity . . . . . Sirocco Fan x 2
Fan Motor Type . . . . . Direct-driven DC Brushless Motor
Fan Motor Output . . . . . 96 W
Fan Motor . . . . . 0.51 F.L.A.
Airflow (Lo - Med - Hi) . . . . . 194 - 247 - 317 Dry CFM
174 - 222 - 285 Wet CFM
Air Filter . . . . . Polypropylene Honeycomb
External Static Pressure . . . . . 0.02 - 0.06 - 0.14 - 0.20"WG
Sound Pressure Level (Lo - Med - Hi) . . . . . 23 - 26 - 30 dB(A)

DIMENSIONS	UNIT INCHES / MM
W	31-1/8 / 790
D	27-9/16 / 700
H	7-7/8 / 200

Weight . . . . . 42 lbs. / 19 kg
External Finish . . . . . Galvanized-steel Sheets
Field Drainpipe Size O.D. . . . . 1-1/4" / 32 mm
Wall-mounted Remote Controller PAR-21MAA
(see Data Submittal Sheet)

Outdoor Unit
Compressor . . . . . DC Inverter-driven
MCA . . . . . 12 A
MOCP . . . . . 15 A
Fan Motor . . . . . 0.50 F.L.A.
Sound Pressure Level
Cooling . . . . . 46 dB(A)
Heating . . . . . 50 dB(A)

DIMENSIONS	INCHES / MM
W	31-1/2 / 800
D	11-1/4 / 285
H	21-5/8 / 550

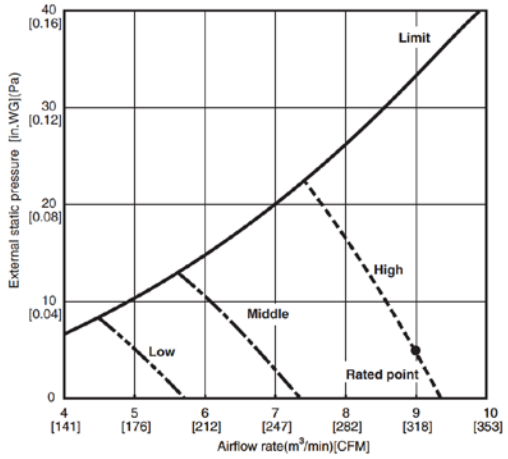
Weight . . . . . 66 lbs. / 30 kg
External Finish . . . . . Munsell No. 3Y 7.8 / 1.1
Refrigerant Type R410A
Refrigerant Pipe Size O.D.
Gas Side . . . . . 3/8" / 9.52 mm
Liquid Side . . . . . 1/4" / 6.35 mm
Max. Refrigerant Pipe Length . . . . . 65' / 19 m
Max. Refrigerant Pipe Height Difference . . . . . 40' / 12 m
Connection Method . . . . . Flared

R410A INVERTER

SEZ-KD09NA INDOOR FAN PERFORMANCE AND CORRECTED AIR FLOW CHARTS

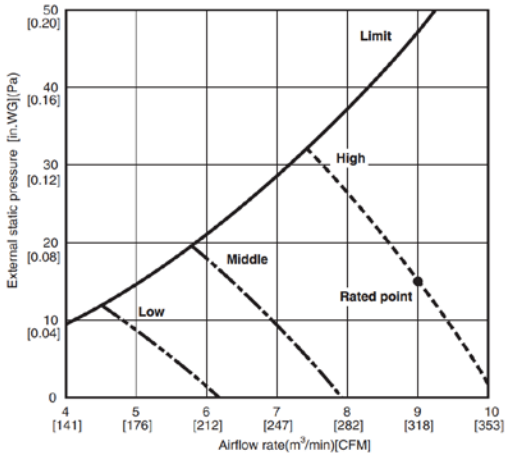
SEZ-KD09NA

(External static pressure 0.02[in.WG](5Pa)) 208/230V 60Hz



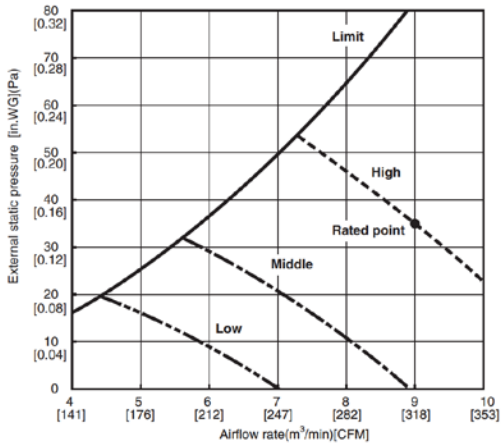
SEZ-KD09NA

(External static pressure 0.06[in.WG](15Pa)) 208/230V 60Hz



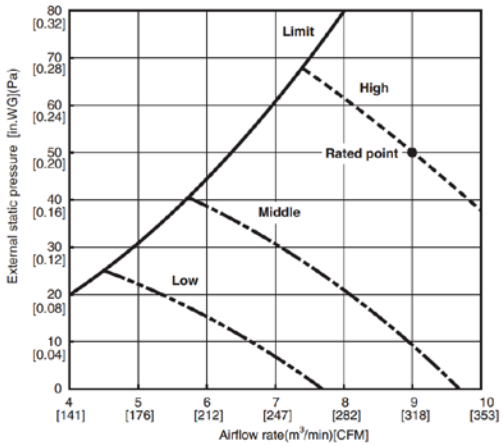
SEZ-KD09NA

(External static pressure 0.14[in.WG](35Pa)) 208/230V 60Hz



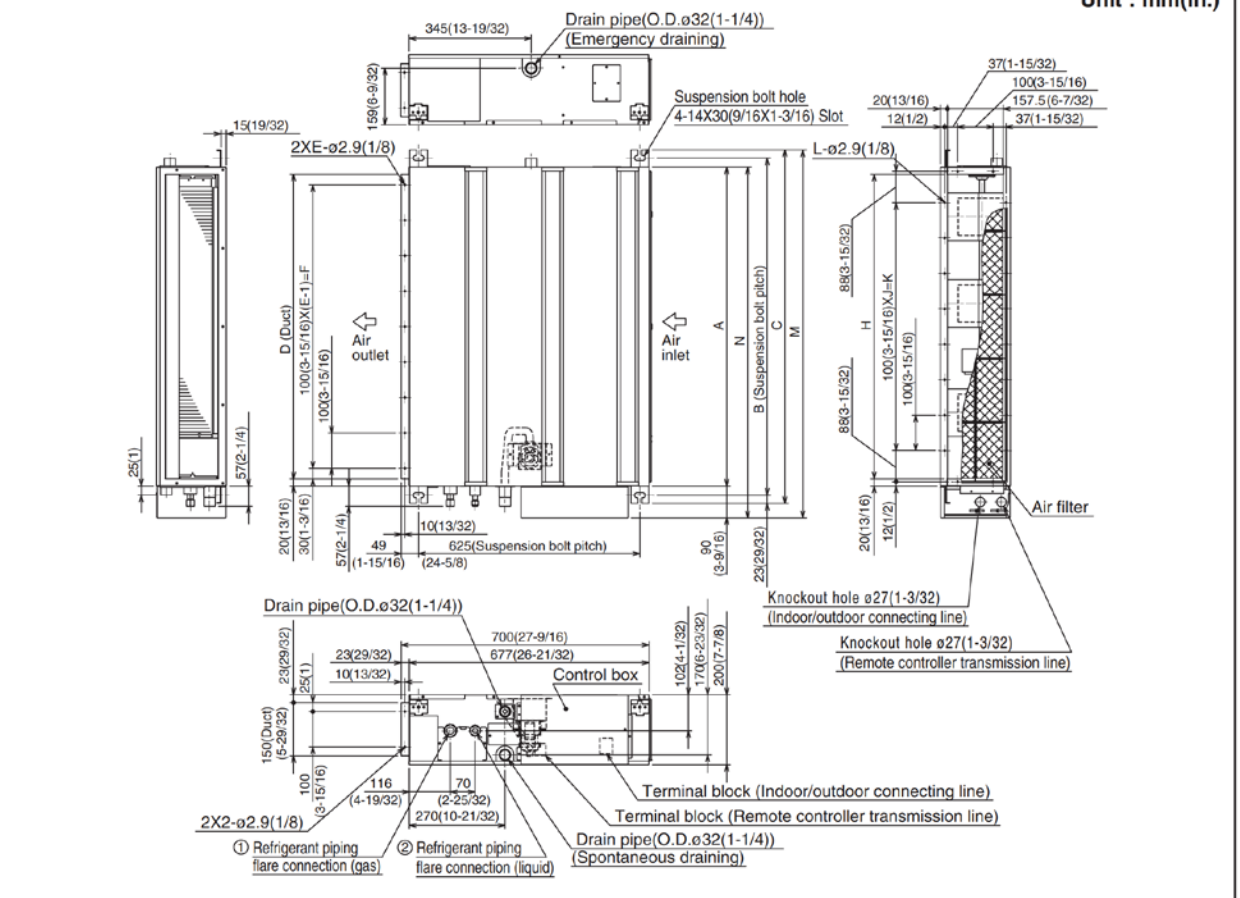
SEZ-KD09NA

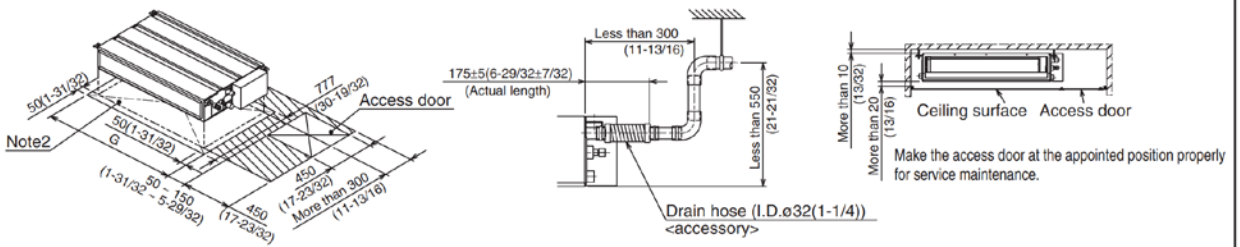
(External static pressure 0.20[in.WG](50Pa)) 208/230V 60Hz



DIMENSIONS: SEZ-KD09NA

Unit : mm(in.)





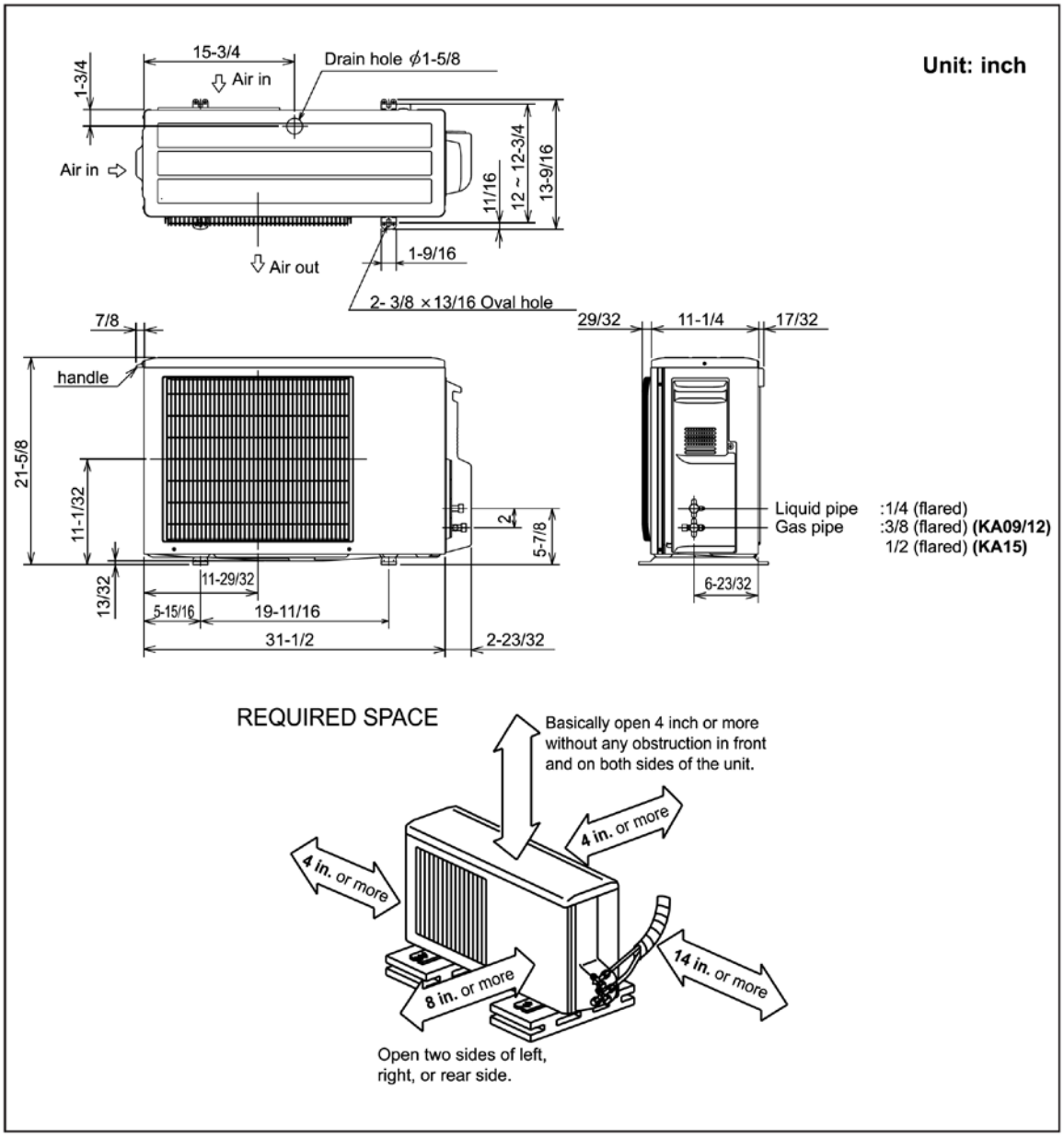
Required space for service and maintenance

mm(in.)

Model	A	B	C	D	E	F	G	H	J	K	L	M	N	① Gas pipe	②Liquid pipe
SEZ-KD09NA	700 (27-9/16)	752 (29-5/8)	798 (31-7/16)	660 (26)	7	600 (23-5/8)	800 (31-1/2)	660 (26)	5	500 (19-11/16)	16	839 (33-1/16)	790 (31-1/8)	ø9.52(3/8)	ø6.35(1/4)
SEZ-KD12NA	900 (35-7/16)	952 (37-1/2)	998 (39-5/16)	860 (33-7/8)	9	800 (31-1/2)	1000 (39-3/8)	860 (33-7/8)	7	700 (27-9/16)	20	1039 (40-29/32)	990 (39)		
SEZ-KD15NA														ø12.7(1/2)	
SEZ-KD18NA	1100 (45-5/16)	1152 (45-3/8)	1198 (47-3/16)	1060 (41-3/4)	11	1000 (39-3/8)	1200 (47-1/4)	1060 (41-3/4)	9	900 (35-7/16)	24	1239 (48-25/32)	1190 (46-7/8)		

Note1.Use M10 screw for the suspension bolt (field supply).
2.Keep the service space for the maintenance at the bottom.
3.This chart indicates for SEZ-KD15NA model,which has 3 fans.
SEZ-KD09,12NA models have 2 fans.
SEZ-KD18NA models have 4 fans.
4.In case an inlet duct is used,remove the air filter(supply with the unit), then install the filter(field supply) at suction side.

DIMENSIONS: SUZ-KA09NA



AHRI CERTIFIED www.ahridirectory.org Unitary Small HP AHRI Standard 210/240

ETL LISTED

ENERGY STAR PARTNER

MITSUBISHI ELECTRIC

HVAC Advanced Products Division
3400 Lawrenceville Suwanee Rd
Suwanee, GA 30024
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Toll Free: 800-433-4822 (#3)
www.mehvac.com

Specifications are subject to change without notice.

TO GO BACK, CLICK HERE

About the TrueDRY™ DR65 Dehumidifier

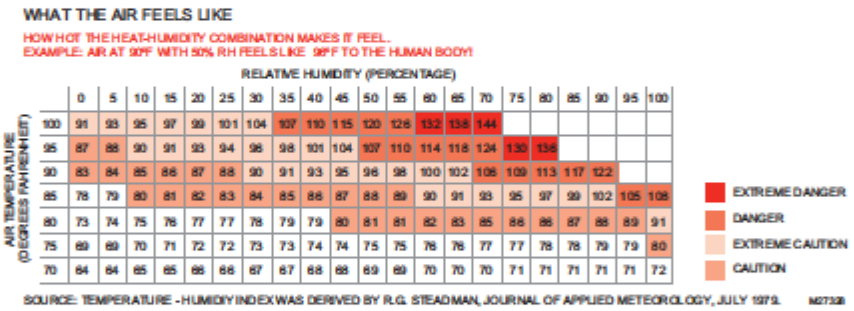
The Honeywell TrueDRY DR65 ensures the home is maintained at proper humidity levels through its high performance and efficiency.

Benefits

- Removes up to 65 pints (30.8 l) of water per day from the indoor air.
- Built-in humidity control requires no additional wiring to an external control. Just plug in and go! Choice of external control options also available for centrally ducted control.
- Feedback on operation and maintenance provided via intuitive on-board LED light interface.

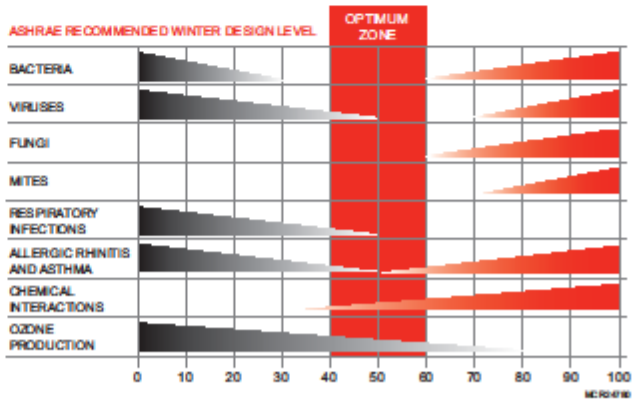
Maintaining Ideal Humidity

Dew points and relative humidity (RH) affect the way your body senses heat. Higher humidity levels cause the air to feel much hotter than the actual temperature. When maintained properly, your cooling equipment may not run as much because dehumidified air feels cooler.



Ideal humidity is defined by industry experts* as being between 40-60% on an average annual basis. When indoor humidity exceeds 60%, the home is more susceptible to mold and mildew growth. TrueDRY DR65 safeguards against excessive humidity in the home year-round.

***American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).**



Specifications

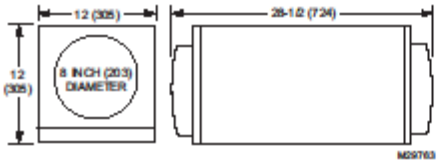
Install TrueDRY DR65 according to National Electric Codes.

Dry-Bulb Temp	Intake Humidity	Capacity (Pints/Day)
80°F (26.7°C)	60% RH	65
70°F (21.1°C)	60% RH	42
60°F (15.6°C)	60% RH	21

Home Size (square ft)	Dehumidifier Capacity Required to Maintain Desired Indoor RH*		
	60% RH Indoor (pints/day)	50% RH Indoor (pints/day)	40% RH Indoor (pints/day)
2080	49–54	55–58	71–78
2600	61–68	65–72	90–97
3120	75–82	79–86	95–110

* Based on extreme climates where outdoor humidity is 70-90% RH. For less extreme climates, larger homes can be adequately served with less capacity. Actual requirements may vary.

Dimensions in inches and (mm):



Airflow versus external static pressure (0–1 in. water pressure) with collars attached

0 in.	160 CFM
0.2 in.	140 CFM
0.4 in.	120 CFM
0.6 in.	100 CFM

Product weight: 55 lb (25 kg)
Shipping weight: 65 lb (30 kg)
Shipping dimensions: 16 in. H x 15 in. W x 31 in. L
Media Filter: MERV 11, 9 in. H x 11 in. W x 1 in. D
Drain connection: 3/4-in. threaded female NPT connection, with attached 3/4-in. male connection.
Duct connections: 8-in. round inlet and outlet. ABS plastic, compatible for connection to rigid or flexible ducting with sheet metal screws and/or tape.
Cabinet: 20 gauge galvanized steel powder-coat painted.
Insulation: R value 1
Compressor: Rotary-style, 5.8 KBTU
Refrigerant: R-410A, 15 oz.
Operating Temp Range (outside cabinet): 34°F to 135°F (1.1°C to 57.2°C)
Operating Humidity Range: 0-99% RH

Input ratings

- Electrical input voltage: 120 VAC, 60 Hz nominal
- Input current: 5.2 A

Output ratings

- Power transformer to R/C terminals: 24 VAC, 0.85 A
- Energy Performance: 2.22 liters (4.7 pints) per kilowatt hour (KWH)

Standards and approval body requirements

ETL Tested per standard UL 474 ducted dehumidifier.

ENERGY STAR rated.

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Published 03/22/2011

Grounding Rods

ERITECH®

ERITECH® Copperbonded Ground Rods

In a grounding system, the ground electrode provides the physical connection to the earth and is the instrument used to dissipate current into it. There are two main types of electrodes.

"Natural" electrodes are intrinsic to the facility and include metal underground water pipe, the metal frame of the building (if effectively grounded), and reinforcing bar in concrete foundations.

"Made" electrodes are installed specifically to improve the performance of the grounding system and include wire meshes, metallic plates, buried copper conductor and rods or pipe driven into the ground.

The ground rod is the most widely used grounding electrode. ERICO® is the world's largest manufacturer of ground rods and offers a complete line of rods and accessories to meet the needs of every user.

Features

Copperbonded Ground Rods

- Resist corrosion better than galvanized rods allowing for a 30-year service life in most soils
- State of the art manufacturing process ensures uniform plating thickness
- Average tensile strength of 80,000 psi and straightness tolerance of .010" per linear foot
- Exceed the requirements of ANSI®/UL® 467-1984, CSA®, and ANSI/NEMA® GR-1

Pointed Copperbonded Ground Rods

- Manufactured of high strength 1035 cold drawn steel
- The ERICO preferred ground rod

Compression Couplers for Pointed Rods

- For use when coupling pointed rods

Sectional Copperbonded Ground Rods

- For use when it is necessary to deep-drive rods
- Cold-rolled threads - stronger than cut threads

Threaded Couplers for Sectional Rods

- For use when coupling sectional rods

Drive Studs for Sectional Rods

- Screws into threaded coupler while rod is being driven

Applications

ERICO has a complete line of ground rods and accessories to meet the needs of every user.

More Information

View product information by region: North & Latin America · Europe · Asia & Australia

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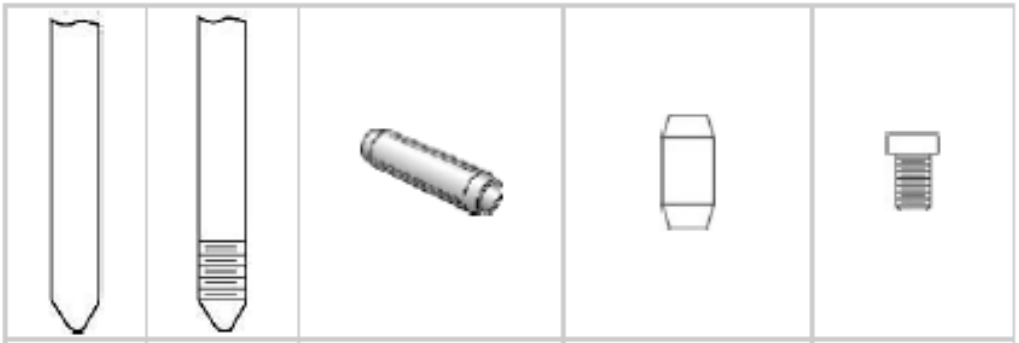
Product Information - North & Latin America Return to Top



Pointed Ground Rod	Sectional Ground Rod	Compression Coupler for Pointed Rods	Threaded Coupler for Sectional Rods	Drive Stud for Sectional Rods

Pointed Copperbonded Ground Rods

Part No.	Plating Thickness (mil)	Diameter (in)	Length (ft)	Standard Package	Weight per 100
613852	5	3/8	5	5	160
613862	5	3/8	6	5	198
613880	10	3/8	8	5	270
611255	5	1/2	5	5	296
611265	5	1/2	6	5	310
611285	5	1/2	8	5	482
611380*	10	1/2	8	5	553
611205	5	1/2	10	5	557
611300*	10	1/2	10	5	738
615850	10	5/8	5	5	420
615860	10	5/8	6	5	509
615880*	10	5/8	8	5	680
615883*	13-REA	5/8	8	5	680
615800*	10	5/8	10	5	844
615803*	13-REA	5/8	10	5	844
615812*	10	5/8	12	5	1000
615815*	10	5/8	15	5	1275
613460	10	3/4	6	5	750
613480*	10	3/4	8	5	1000
613483*	13	3/4	8	5	1000
613400*	10	3/4	10	5	1240
613412*	10	3/4	12	5	1480
613415*	10	3/4	15	5	1850
614400*	10	1	10	5	2204

** UL Listed*

TO GO BACK, CLICK HERE

Note: the following listing document applies to all of the WEEB devices in this project manual.

Intertek

AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:	Wiley Electronics, LLC	**Manufacturer:**	Same As Applicant
Address:	44 Peoples Rd Saugerties, NY 12477	**Address:**	
Country:	USA	**Country:**	
Contact:	Maggie Dulka / Mr. Brian Wiley	**Contact:**	
Phone:	845-247-4708	**Phone:**	
FAX:	845-247-7438	**FAX:**	
Email:	paul@we-llc.com	**Email:**	

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Lake Forest, CA

Control Number: 3098177 **Authorized by:** Patricia Greaves for William T. Starr, Certification Manager

C ETL LISTED US
Intertek

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3851 or 607-753-6711 Fax 607-756-6699

Standard(s):	UL Standard for Safety for Grounding and Bonding Equipment, UL 467, 9th Edition and Grounding and Bonding Equipment, CSA C22.2 #41, 5th Edition, September 2007
Product:	Bonding Devices
Models:	Bonding Devices Model numbers WEEB-9.5, WEEB-9.5NL, WEEB-CL, WEEBL-6.7, WEEBL-8.2, WEEBL-8.0, WEEB-DMC, WEEB-PMC, WEEB-CMC, WEEB-SMC, WEEB-Bonding Jumper-6.7, WEEB-Bonding Jumper-8.0, WEEB-Bonding Jumper-8.2, WEEB-KMC, WEEB-UGC2, WEEB-UMC, WEEB-DPF, WEEB-11.5, WEEB-WMC, WEEB-CSG, Double Wedge Solar Giant, WEEB-SSF, WEEB-JJR, WEEB-WMR1, WEEB-WMR2, WEEB-UIR.

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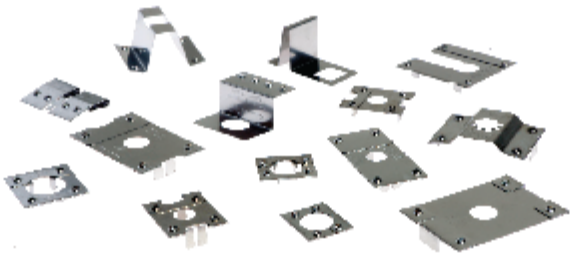
ED 8.9.4 (8-Jan-10) Mandatory

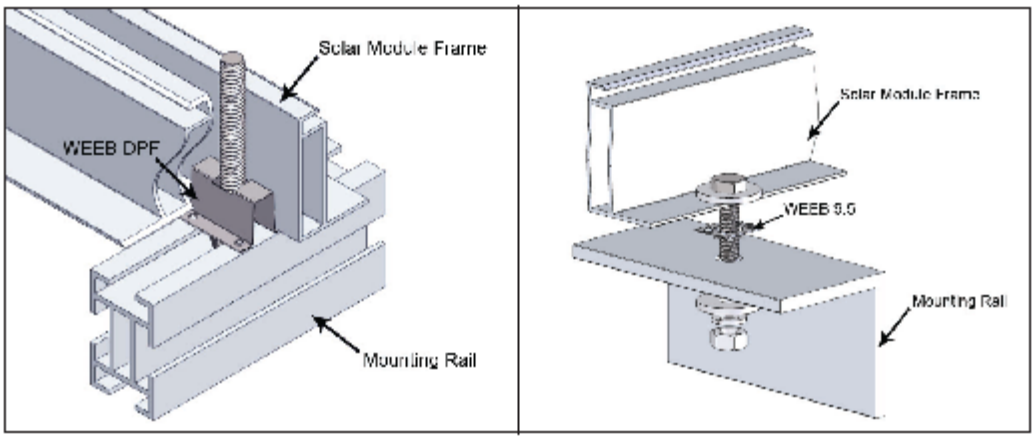
Published 03/22/2011

WEEB Washer, Electrical Equipment Bond

The WEEB line of products is designed to bond solar PV modules to mounting structures and create an electrical path to ground. WEEBs eliminate the need for older, more costly grounding methods and greatly reduce the amount of labor and materials used in installations. The innovative WEEB design removes the need to run ground wire to each individual module and eliminates the need for surface preparation on anodized aluminum components. To install, WEEBs are placed between PV modules and mounting rails at clamping points or at bolted connections. When anti-seize is applied and the hardware is tightened down to the appropriate torque spec, the WEEBs' specialized teeth embed into anodized aluminum, galvanized steel, or any electrically conductive metal to establish a gas tight electrical connection.



- Material: 304 stainless steel
- Listed to ANSI-UL 467 by Intertek ETL for use in Canada and the USA
- Maximum electrical equipment ground conductor size when used with 2 WEEBs contacting each module in an assembly: 6 AWG
- Outdoor rated



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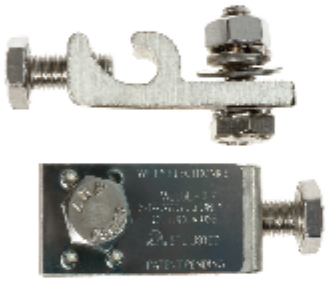
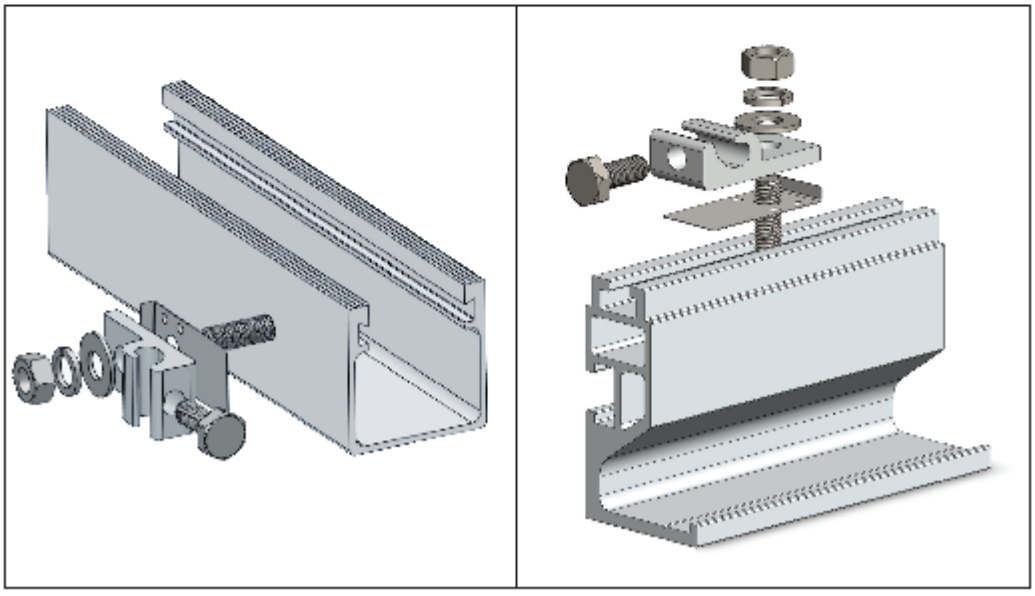
Advancing Renewable Technology

WEEB Lug

The WEEB Lug consists of a WEEB (Washer, Electrical Equipment Bond), lay-in lug, and hardware. It is used with one solid or stranded copper wire (6AWG to 14AWG), or two copper wires (10AWG to 12AWG) to provide a continuous ground on roof or ground mounted solar systems. Unlike traditional lay-in lugs, the WEEB Lug does not require surface preparation on rail or module to install. The WEEB Lug is installed using a 1/4-20 stainless steel screw which tightens the WEEB, allowing the specialized teeth to embed into anodized aluminum, galvanized steel, or any electrically conductive metal to establish a gas tight electrical connection. The tin-plated Lug assures minimum contact resistance and protection against corrosion. The copper wire is clamped by a 1/4-28 stainless steel screw, which is horizontal to the tang for easy access when mounted under a PV module. The low profile of the WEEB Lug allows it to be installed in a variety of positions and comes with hardware to mount it to a rail or through a 1/4 inch clearance hole.



- Material: 304 stainless steel, tin-plated copper, outdoor rated
- Low profile design
- Multiple equipment ground conductor allowance:
  One 14 AWG to 6 AWG or two 10 AWG, two 12 AWG
- Listed to ANSI/UL 467 by Intertek ETL



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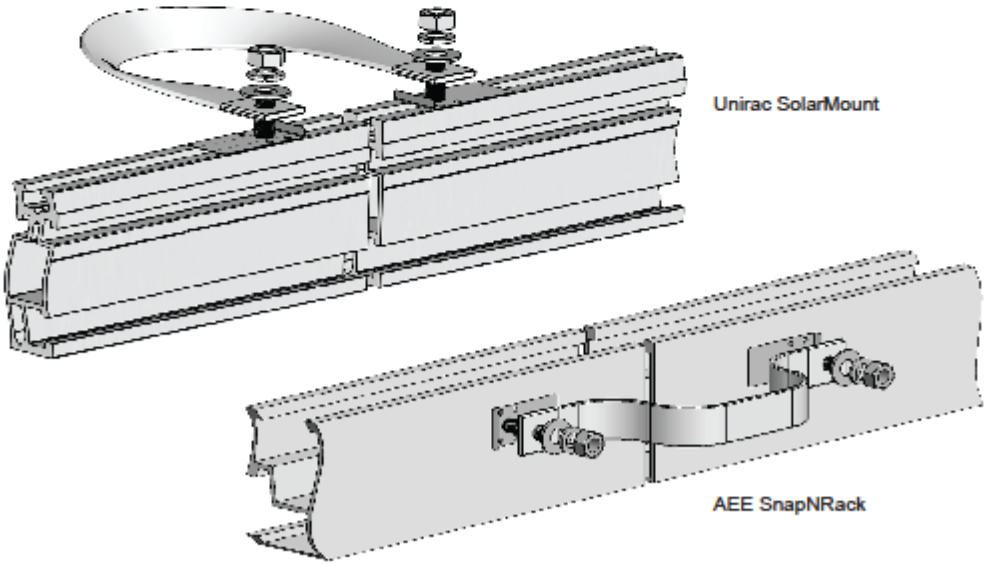
Advancing Renewable Technology

WEEB Bonding Jumper

The WEEB Bonding Jumper is used to create an electrical connection between two pieces of anodized aluminum, galvanized steel, or any electrically conductive metal which has been mechanically spliced. Long spans of mounting rails are sometimes constructed from two shorter rail sections. Manufacturers may recommend that a floating splice be used to allow for thermal expansion. A floating splice is rigidly attached to only one rail, and allows the rails to expand and contract in line with each other. In such cases, via NEC code, it is also necessary to make an electrical splice, which can be done with a WEEB Bonding Jumper. The Bonding Jumper is constructed of tin plated, braided copper wire with a WEEB attached at each end of the Jumper. The WEEBs provide a reliable, gas tight electrical connection, and the braided copper wire allows for thermal expansion. The examples below illustrate two ways to install the WEEB Bonding Jumper.



Unirac SolarMount

AEE SnapNRack

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ALLIED KWIK-FIT® EMT

New available in Trade Sizes 1 1/4 & 1 1/2

For Faster, Easier Installation...
Make It Kwik-Fit® EMT

KWIK-FIT® EMT is manufactured from high quality steel with a BUILT-IN set-screw coupling, eliminating the need to purchase, inventory, and install separate couplings.

On the job site, installation is much faster and you've reduced both material and labor costs.
Even clean-up after installation is easier – no clutter of extra couplings and empty boxes!

Patent No. US 7,404,582 B2

- No separate couplings to purchase, store, carry or install
- High grade durable and ductile steel for long life
- Corrosion Resistant exterior and interior finishes
- UL listed and manufactured in accordance with ANSI C80.3
- Available in trade sizes 1 1/4 – 4

No separate couplings to purchase, store, carry or install! You always have the right type and size coupling with you – attached at the end of the EMT!

Contact your local Allied Tube & Conduit electrical distributor, or visit www.alliedeg.com.

ALLIED ELECTRICAL™ Group

Electrical Infrastructure Solutions™

www.alliedeg.com

ALLIED KWIK-FIT® EMT

allied TUBE & CONDUIT®

KWIK-FIT® EMT Specifications

KWIK-FIT® SIGNIFICANTLY REDUCES INSTALLATION COST

Each 10' length of KWIK-FIT EMT has an integral steel set-screw coupling. These built-in couplings significantly reduce installation time, and eliminate the need to purchase, store, and install separate couplings. Simply insert the plain end of the KWIK-FIT into the coupling end and tighten the set-screws.

SUPERIOR STRENGTH & CONSTRUCTION

KWIK-FIT EMT is all steel for superior strength, performance and excellent ground return path. Allied EMT is hot galvanized using Allied's patented in-line Flo-Coat® process. This process combines zinc, a conversion coating, and a clear organic polymer top-coat to form a triple layer of protection against corrosion and abrasion.

The interior of KWIK-FIT EMT is protected with Allied's superior EZ PULL® coating. This interior coating makes wire-pulling even easier with a 30% lower coefficient of static friction.

AVAILABLE SIZES

KWIK-FIT EMT is available in 10' lengths, trade sizes from 1 1/4 – 4.

UL LISTED & APPROVED

KWIK-FIT EMT is listed to UL Standard 797 *Electrical Metallic Tubing – Steel*, and to UL 514B *Conduit, Tubing and Cable Fittings*. KWIK-FIT EMT is manufactured in accordance with ANSI Standard C80.3.

WEIGHTS AND DIMENSIONS FOR KWIK-FIT EMT

Trade Size Designator		Approx. Wt. Per 100 Ft. (30.5M)		Nominal Outside Diameter[1]		Nominal Wall Thickness		Master Bundles			
								Quantity		Approx. Wt.	
U.S.	Metric	lb.	kg	in.	mm	in.	mm	ft.	m	lb.	kg
1 1/4	35	101	45.8	1.510	38.4	0.065	1.65	840	256.0	720.0	326.6
1 1/2	31	116	52.6	1.740	44.2	0.065	1.65	720	219.4	812.0	368.3
2	53	148	67.1	2.197	55.8	0.065	1.65	500	152.4	706.0	320.2
2 1/2	63	216	98.0	2.875	73.0	0.072	1.83	350	106.8	756.0	343.0
3	78	263	119.3	3.500	88.9	0.072	1.83	300	91.5	789.0	357.9
3 1/2	91	349	158.3	4.000	101.6	0.083	2.11	250	76.3	872.5	395.8
4	103	393	178.2	4.500	114.3	0.083	2.11	250	76.3	982.5	445.5

[1]Outside diameter tolerances: +/- .006 in. (.13mm) for trade size 2 (53); +/- .010 in. (.25mm) for trade size 2 1/2 (63); +/- .015 in. (.38mm) for trade size 3 (78); +/- .020 in. (.51mm) for trade sizes 3 1/2 (91) and 4 (103mm).
NOTE: Length = 10 ft. (3.0m) with a tolerance of ± .25 in. (6.35mm).

• Allied Tube & Conduit - Electrical
16100 S. Lathrop Avenue, Harvey, IL 60426 Tel. 708-339-1610 800-882-5543 Fax 708-339-0615

ALLIED ELECTRICAL™ Group www.alliedeg.com

• Allied Tube & Conduit • AFC Cable Systems® • Power-Strut® Metal & Fiberglass Framing • Cope® Cable Tray

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ALLIED RIGID STEEL CONDUIT

allied TUBE & CONDUIT®

Quality Long Lasting GRC (Rigid) Steel Conduit...

Allied Rigid Steel Conduit is precision manufactured for dependable, long-lasting value and ultimate protection for electrical conductors. Highly resistant to damage from impact, it can be installed in all occupancies and in all locations, including Class I Division 1 hazardous locations.

Rigid steel conduit, covered by Article 344 in the National Electric Code® (NEC), is recognized as an equipment grounding conductor in Article 250-118 of the NEC and also provides excellent shielding from electromagnetic fields.

- **Hot-dip galvanized to inhibit white rust and increase corrosion resistance**
- **High strength ductile steel for long life and easy bending**
- **Provides smooth, continuous raceways for fast wire-pulling**
- **UL listed to UL 6, manufactured in accordance with ANSI C80.1**
- **Available in trade sizes 1/2 – 6**

Kwik-Couple® for Faster Installations

Get the Kwik-Couple® Connection

Innovation from the conduit leaders at Allied.

Allied's patented* Kwik-Couple rigid steel conduit cuts threaded conduit installation time and cost significantly. Kwik-Couple comes installed right on the conduit or elbows, right where you need it.

Just line up the ends, spin the coupling forward onto the next piece and wrench tighten. It's that easy! Trade sizes 2-1/2 – 4.

Contact Allied for details.

* U.S. Patent Numbers 4258936,4547004.

Contact your local Allied Tube & Conduit electrical distributor, or visit www.alliedeg.com.

Electrical Infrastructure Solutions®

www.alliedeg.com

ALLIED RIGID STEEL CONDUIT

allied TUBE & CONDUIT

Allied Rigid Steel Conduit Specifications

FULL ELECTRICAL SYSTEM PROTECTION

Manufactured from high-strength steel, Allied RIGID combines damage-resistant strength with ductility to assure easy bending, cutting and joining. It also provides smooth, continuous raceways for fast wire-pulling. No need to worry about damage to the conduit system even when pulling through multiple 90° bends.

Allied RIGID is hot-dipped galvanized inside and out. It's top-coated with a compatible organic layer to inhibit white rust and increase corrosion resistance. It is impact and crush resistant for maximum conductor protection.

The 3/4" taper NPT threads (ANSI B1.20.1) are full cut and hot galvanized after cutting. Color-coded end-cap thread protectors keep the threads clean, sharp and also provide instant trade size recognition. Trade sizes are color-coded blue, 1/2 trade sizes black, and 1/4 trade sizes red.

EMI SHIELDING

Allied RIGID is very effective in reducing electromagnetic field levels for encased power distribution circuits, shielding computers and other sensitive electronic equipment from the effects of electro-magnetic interference. Visit www.steelconduit.org/gemi.htm to obtain the GEMI (Grounding and Electro-magnetic Interference) software analysis program.

FULL CODES & STANDARDS COMPLIANCE

Allied RIGID is covered by article 344 of the National Electrical Code. It is listed to Underwriters Laboratories Safety Standard UL 6. and is manufactured to ANSI C80.1, both of which have been adopted as Federal Specifications in lieu of WWC 581. Allied RIGID is recognized as an equipment grounding conductor by NEC Article 250.

Installation of Rigid Metal Conduit shall be in accordance with the National Electrical Code and UL General Information card #DYIX. Master bundles conform to NEMA standard RN2.

SPECIFICATION DATA

RIGID Metal Conduit shall be hot-dip galvanized steel equal to that manufactured by Allied Tube & Conduit Corporation. Threads shall be hot galvanized after cutting. RIGID shall be produced in accordance with UL Safety Standard #6 and ANSI C80.1 and shall be listed by a nationally recognized testing laboratory with follow-up service. Where **Kwik-Couple® Rigid** is used it shall also meet UL Safety Standard 514-B. It is noted that these UL standards have been adopted by the federal government and separate military specifications no longer exist.

Weights and Dimensions for Galvanized Rigid Tubing

Trade Size Designator		Approx. Wt.* Per 100 Ft. (30.5M)		Nominal Outside Diameter[1]		Nominal Wall Thickness		Quantity in Master Bundle	
U.S.	Metric	lb.	kg	in.	mm	in.	mm	ft.	m
1/2	16	82	37.2	0.840	21.3	0.104	2.60	2500	762.5
3/4	21	109	49.4	1.050	26.7	0.107	2.70	2000	610.0
1	27	161	73.0	1.315	33.4	0.126	3.20	1250	381.3
1-1/4	35	218	98.9	1.660	42.2	0.133	3.40	900	274.5
1-1/2	41	263	119.3	1.900	48.3	0.138	3.50	800	244.0
2	53	350	158.7	2.375	60.3	0.146	3.70	600	183.0
2-1/2	63	559	253.5	2.875	73.0	0.193	4.90	370	112.9
3	78	727	329.7	3.500	88.9	0.205	5.20	300	91.5
3-1/2	91	880	399.1	4.000	101.6	0.215	5.50	250	76.3
4	103	1030	467.1	4.500	114.3	0.225	5.70	200	61.0
5	129	1400	634.9	5.563	141.3	0.245	6.20	150	45.8
6	155	1840	834.5	6.625	168.3	0.266	6.80	100	30.5

[1] For more information only; not a spec requirement.

NOTE: Length = 10 ft. (3.05m) with a tolerance of +/- .25 in. (6.35mm).
* NEMA Standard

Weights and Dimensions for Kwik-Couple® Rigid

Trade Size Designator		Approx. Wt. Per 100 Ft. (30.5M)		Nominal Outside Diameter[1]		Nominal Wall Thickness		Quantity in Master Bundle	
U.S.	Metric	lb.	kg	in.	mm	in.	mm	ft.	m
2-1/2	63	559	253.5	2.875	73.0	0.193	4.90	400	122.0
3	78	727	329.7	3.500	88.9	0.205	5.20	300	91.5
3-1/2	91	880	399.1	4.000	101.6	0.215	5.50	250	76.3
4	103	1030	467.1	4.500	114.3	0.225	5.70	200	61.0

[1]Outside diameter tolerances: +/- .025 in. (.64mm) [2]For information only; not a spec requirement.

For more information, contact Allied at
(800) 882-5543,
or visit our website at **www.alliedeg.com**

• **Allied Tube & Conduit® - Electrical**
16100 S. Lathrop Avenue, Harvey, IL 60426 Tel. 708-339-1610 800-882-5543 Fax 708-339-0615

Electrical & Support Division www.alliedeg.com

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ELECTRICAL CONDUIT

JM Eagle — Building essentials for a better tomorrow

SUBMITTAL AND DATA SHEET

SCHEDULE 40 AND SCHEDULE 80 CONDUIT NSF NRTL* ANSI/UL 651 AND NEMA TC-2

RIGID NON-METALLIC CONDUIT FOR USE IN BOTH ABOVE GROUND AND UNDERGROUND INSTALLATIONS

SCHEDULE 40 CONDUIT — Rated for 90°C Conductors

SIZE	AVERAGE O.D.	NOM. I.D.	MIN. T.	APPROX. WT/100 FT
1/2	0.840	0.622	0.109	18
3/4	1.050	0.824	0.113	24
1	1.315	1.049	0.133	33
1-1/4	1.660	1.380	0.140	45
1-1/2	1.900	1.610	0.145	56
2	2.375	2.067	0.154	76
2-1/2	2.875	2.469	0.203	126
3	3.500	3.068	0.216	163
3-1/2	4.000	3.548	0.226	197
4	4.500	4.026	0.237	234
5	5.563	5.047	0.258	319
6	6.625	6.065	0.280	411
8 ::	8.625	7.942	0.322	622

Schedule 40 is furnished in standard 10' lengths with one bell end.
20' lengths are available upon request.
:: Non-UL or -NSF listed

SCHEDULE 80 CONDUIT — Rated for 90°C Conductors

SIZE	AVERAGE O.D.	NOM. I.D.	MIN. T.	APPROX. WT/100 FT
1/2	0.840	0.546	0.147	22
3/4	1.050	0.742	0.154	30
1	1.315	0.957	0.179	42
1-1/4	1.660	1.278	0.191	60
1-1/2	1.900	1.500	0.200	72
2	2.375	1.939	0.218	98
2-1/2	2.875	2.323	0.276	160
3	3.500	2.900	0.300	213
3 1/2	4.000	3.364	0.318	256
4	4.500	3.826	0.337	310
5	5.563	4.813	0.375	430
6	6.625	5.761	0.432	590

Schedule 80 is furnished in standard 10' lengths with one bell end.
20' lengths are available upon request.

* NATIONAL RECOGNIZED TESTING LABORATORY (NRTL) BY OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION (OHSA)

Published 03/22/2011

Product Data Sheet

HOM1632L200TC

LOADCTR HOM MLO 240V 200A 1PH 16SP NEMA1

SQUARE D by Schneider Electric

List Price $357.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Ampere Rating	200A
Bus Material	Tin Plated Aluminum
Enclosure Type	Indoor
Box Number	9
Enclosure Rating	NEMA 1
Grounding Bar	Factory Installed
Maximum Single Pole Circuits	32
Application	Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.
Short Circuit Current Rating	10kA
Maximum Tandem Circuit Breakers	16
Approvals	UL Listed
Main Type	Convertible - Factory Installed main lugs
Cover Type	Combination Flush/Surface
Marketing Trade Name	Homeline
Phase	1-Phase
Depth	3.75 Inches
Height	29.86 Inches
Spaces	16
Voltage Rating	120/240VAC
Wire Size	#4 to 250 AWG/kcmil (Al/Cu)
Wiring Configuration	3-Wire
Width	14.25 Inches

Shipping and Ordering

Category	00045 - Load Centers, Type HOM 12 - 42 Circuit, NEMA1 Indoor
Discount Schedule	DE3C
GTIN	00785901309338
Package Quantity	1
Weight	27.2 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	US

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

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Schneider Electric

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Product Data Sheet

QO612L100RB

LOAD CENTER QO MLO 240V 100A 1PH 6SP

SQUARE D by Schneider Electric

List Price $143.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Short Circuit Current Rating	10kA
Main Type	Fixed - Factory Installed main lugs
Maximum Single Pole Circuits	12
Maximum Tandem Circuit Breakers	6
Phase	1-Phase
Spaces	6
Ampere Rating	100A
Voltage Rating	120/240VAC
Wire Size	#8 to 1 AWG(Al/Cu)
Wiring Configuration	3-Wire
Application	Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.
Depth	4.27 Inches
Approvals	UL Listed
Height	12.65 Inches
Cover Type	Surface
Width	8.88 Inches
Bus Material	Tin Plated Aluminum
Enclosure Type	Outdoor/Rainproof
Box Number	2R
Enclosure Rating	NEMA 3R
Grounding Bar	Order separately

Notes:
70A (max) branch circuit breaker and 70A (max) back fed main circuit breaker.

Shipping and Ordering

Category	00101 - Load Centers, 1 Phase, NEMA1 & 3R, 2 - 8 Circuit, Type QO
Discount Schedule	DE3A
GTIN	00785901785590
Package Quantity	1
Weight	9.68 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

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Schneider Electric

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It's all about SAFETY. HUBBELL SAFE.
Tamper-Resistant Receptacles
—the new standard in electrical safety.
Spring-loaded shutter mechanism allows plugs to enter—but resists access to single-pronged items like keys, hairpins, or nails.
The NEC® 2008 code:
NEC Article 406.11 requires tamper-resistant receptacles for dwelling units. "In all areas specified in 210.52, all 125 volt 15- and 20-ampere receptacles shall be listed tamper-resistant receptacles." Article 210.52 specifies where receptacles shall be installed.
What this means to you:
All 15- and 20-amp, 125 volt residential receptacles must be of a type classified and listed as Tamper-Resistant (TR). This includes duplexes, GFCIs, single receptacles, clock hangers, floor boxes, and other specialty products with outlets. Receptacles, even if dedicated to a specific use and not readily accessible, must be tamper-resistant.
This affects all new construction and major renovations for single- and multi-family homes. In some instances, hotel rooms and college dormitories are classified as dwelling units.
homeSELECT

homeSELECT www.homeselect.net

Why Tamper-Resistant?

The tamper-resistant code requirement is all about safety.

- Approximately 2,400 children per year suffer electrical outlet related injuries.
- For years, the design and use of tamper-resistant receptacles have been proven effective in pediatric areas and hospital installations nationwide. It makes sense to have them in homes.
- The additional cost per device is minimal and well worth it.
- Required by states that adopt 2008 NEC®.

Tamper-Resistant Receptacles

	 Standard Duplex Self-Grounding 15A 125V	 Standard Duplex Quick Thread 15A 125V	 Decorator Duplex Self-Grounding 15A 125V	 Standard Duplex Cut Ears 15A 125V	 Standard Single Receptacle 15A 125V	 Standard Single Receptacle 20A 125V
Almond	RR15SALTR	RR15QALTR	RRD15SALTR	RR15KALTR	RR151ALTR	RR201ALTR
Black	RR15SBKTR	RR15QBKTR	RRD15SBKTR	RR15KBKTR	RR151BKTR	RR201BKTR
Brown	RR15STR	RR15QTR	RRD15STR	RR15KTR	RR151TR	RR201TR
Gray	–	–	RRD15SGYTR	–	RR151GYTR	RR201GYTR
Ivory	RR15SITR	RR15QITR	RRD15SITR	RR15KITR	RR151ITR	RR201ITR
Light Almond	RR15SLATR	RR15QLATR	RRD15SLATR	RR15KLATR	RR151LATR	RR201LATR
White	RR15SWTR	RR15QWTR	RRD15SWTR	RR15KWTR	RR151WTR	RR201WTR

	 Decorator Single Receptacle 15A 125V	 Decorator Single Receptacle 20A 125V	 Standard Combo SP Switch 15A 120V Receptacle 15A 125V	 Standard Combo 3W Switch 15A 120V Receptacle 15A 125V	 Decorator Combo SP Switch 15A 120V Receptacle 15A 125V	 Decorator Combo 3W Switch 15A 120V Receptacle 15A 125V
Almond	RRD151ALTR	RRD201ALTR	RC108ALTR	RC306ALTR	RCD108ALTR	RCD308ALTR
Black	RRD151BKTR	RRD201BKTR	–	–	RCD108BKTR	RCD308BKTR
Brown	RRD151TR	RRD201TR	RC108TR	RC306TR	–	–
Gray	RRD151GYTR	RRD201GYTR	–	–	RCD108GYTR	RCD308GYTR
Ivory	RRD151ITR	RRD201ITR	RC108ITR	RC306ITR	RCD108ITR	RCD308ITR
Light Almond	RRD151LATR	RRD201LATR	RC108LATR	RC306LATR	RCD108LATR	RCD308LATR
White	RRD151WTR	RRD201WTR	RC108WTR	RC306WTR	RCD108WTR	RCD308WTR

Setting the standard, wire to wire.

Increasing awareness of child electrical safety

The National Electrical Manufacturers Association has developed a program titled *Real Safety* that identifies the dangers electrical receptacles may pose to children, educating users about tamper-resistant receptacle function. *Real Safety* targets electrical professionals, inspectors, distributors, builders and new homeowners. For more information visit the website at www.childoutletsafety.org.

Tamper-Resistant GFCIs and Specialty Items

	 GFCI Duplex 15A 125V	 GFCI Duplex 20A 125V	 GFCI Combo SP Switch 15A 120V Receptacle 15A 125V	 JLOAD™ Multimedia Outlet 15A & Jacks	 JLOAD™ Multimedia Outlet 20A & Jacks
Almond	GFTR15AL	GFTR20AL	GFSP15TRAL	RJ650ALTR	RJ620ALTR
Black	GFTR15BK	GFTR20BK	GFSP15TRBK	RJ650BKTR	RJ620BKTR
Brown	GFTR15	GFTR20	GFSP15TR	–	–
Gray	GFTR15GY	GFTR20GY	GFSP15TRGY	RJ650GYTR	RJ620GYTR
Ivory	GFTR15I	GFTR20I	GFSP15TRI	RJ650ITR	RJ620ITR
Light Almond	GFTR15LA	GFTR20LA	GFSP15TRLA	RJ650LATR	RJ620LATR
White	GFTR15W	GFTR20W	GFSP15TRW	RJ650WTR	RJ620WTR

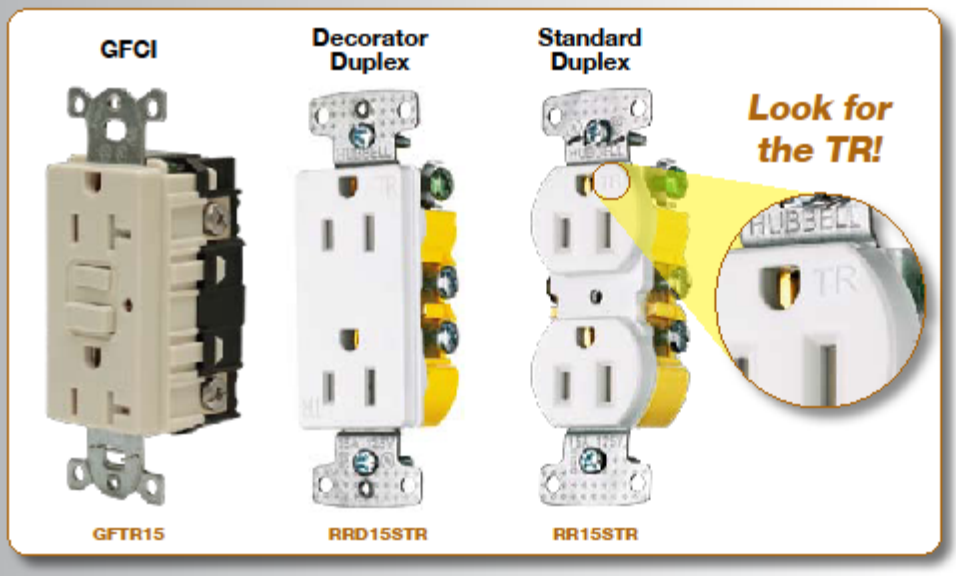
	 Clock Hanger 15A 125V	 Single Receptacle Floor Box 15A 125V	 Duplex Receptacle Floor Box Metal 15A 125V	 Duplex Receptacle Floor Box Slab-on-grade 15A 125V	 Drop-in Floor Box 15A 125V
Almond	–	–	RF515AL	RF406AL*	–
Black	–	–	RF515BK	RF406BK*	–
Brown	–	–	RF515BN	–	–
Ivory	RR151CHITR	–	–	–	–
White	RR151CHWTR	–	–	–	–
Brass	RR151CHBSTR	RF151TR	RF515BS	RF406BS*	RF151R*
Stainless	RR151CHSSTR	–	RF515SS	–	–

* Not CSA Approved

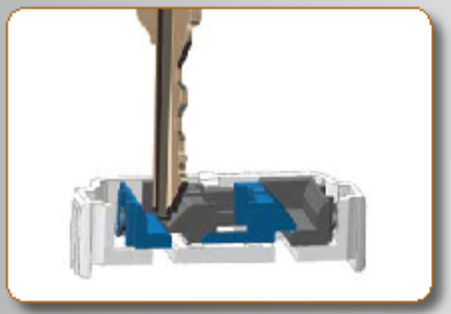
homeSELECT www.homeselect.net

Residential Tamper-Resistant Performance

Protection is always there with the tamper-resistant receptacles. It is reliable, automatic and permanent. With attention to design and performance, Hubbell has developed a new shutter mechanism to enable tamper-resistance to be built into standard and decorator duplexes, single receptacles, floor boxes and other power devices. At Hubbell, performance is our history, safety is our goal—now for your home.

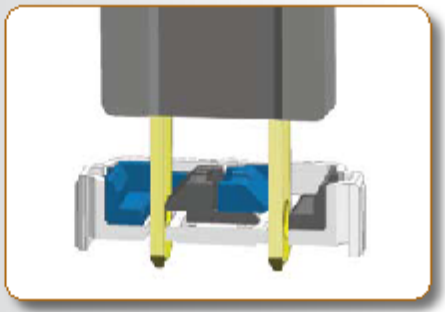


Built-In Safety Action



Spring-loaded shutter mechanism restricts access to an object in any one side of the receptacle.

Power When Needed



Insertion of a two or three bladed plug will open the shutters, allowing electrical contact.

Hubbell Wiring Device-Kellems • Hubbell Incorporated (Delaware) • 185 Plains Road • Milford, CT 06461-2420
Phone (800) 288-6000 • FAX (800) 255-1031 • www.homeselect.net
Hubbell Canada LP • 870 Brock Road South • Pickering, Ontario L1W 1Z8
Phone (800) 263-4622 • (905) 839-1138 • FAX (905) 839-9108 • www.hubbell-canada.com

HS127

Wiring Systems

Residential Grade
Decora AC Quiet Rocker Switches

LEVITON
Building a Connected World

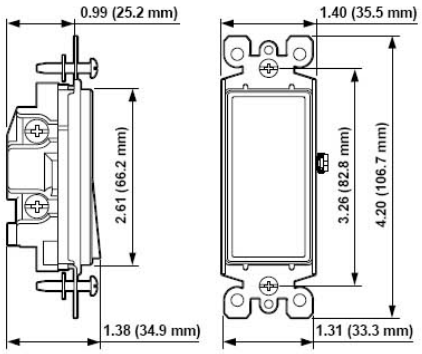
15 AMP Quickwire Push-In and Side Wired 120/277V AC

DESCRIPTION	CAT. NO.	ROCKER/FRAME COLOR*
Single-Pole	5601	Mahogany
	5601-I	Ivory
	5601-W	White
	5601-2A	Almond
	5601-2E	Ebony
	5601-2GY	Gray
Double-Pole	5602-2	Mahogany
	5602-2I	Ivory
	5602-2W	White
	5602-2GY	Gray
	5602-2A	Almond
	5602-2E	Ebony
Three-Way	5603	Mahogany
	5603-I	Ivory
	5603-W	White
	5603-2A	Almond
	5603-2E	Ebony
	5603-2GY	Gray
Four-Way	5604-2	Mahogany
	5604-2I	Ivory
	5604-2W	White
	5604-2A	Almond
	5604-2E	Ebony
	5604-2GY	Gray

Note: To order Decora rocker switches with grounding screw add suffix -2 (e.g. 5601-2I)
All devices are UL Listed and CSA Certified.


5601-I in 80301-I


5601-2GY in 80301-GY



DECORA AC QUIET ROCKER SWITCHES
Cat. Nos. 5601, 5602, 5603, 5604

SPECIFICATIONS & FEATURES
- Switch frame shields against dust and fits in wallplate to prevent rocker binding
- Side Wire and Quickwire (No.12 or No.14 copper or copper-clad wire) push-in terminal wiring options
- Sturdy construction for long service life
- Full rated current capacity with tungsten, fluorescent or resistive loads. Motor capacity is 80% of switch rating
- Conform to all NEMA standard specifications

TESTING & CODE COMPLIANCE
- UL Listed (File #E-7458)
- CSA Certified (File #LR-3413)
- NOM Certified (#057)
- Backed by a Limited Two-Year Warranty

*COLOR
Rocker/Frame colors available as listed.

HORSE POWER
15A
½ @ 120V
2 @ 240V

MATERIAL CHARACTERISTICS
Environmental: Flammability UL-94, V2 Rating
Operating Temperature: -40°C to 120°C

For more information regarding matching wallplates, colors, materials, single and multi-gang, refer to Wallplates, section G.

For answers to technical questions, call Leviton's Techline at 1-800-824-3005 ....*Building a Connected World*

A6

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Published 03/22/2011

LANDIS & GYR

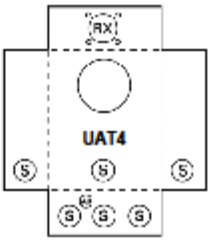
Product Schedule 410

TYPE UAT4 200A RESIDENTIAL METER MOUNTING DEVICES

Common Features

- OH/UG construction
- 200A continuous duty rated
- 250A max rated
- Quad ground on all devices
- Lay-in 350 kcmil max lugs
- Steel or aluminum construction
- Glass filled polyester block construction
- Ring or ringless style
- Horn bypass available

UAT417-XPQG



KNOCKOUTS (inches):

S:	1, 1-1/4, 1-1/2, 2, 2-1/2
AB:	1/4, 1/2, 7/8
RX:	Ø2.750 HUB OP

Cover Style	Service	Terminal Connector	Bypass	Dimension W	H	D	Hub Opening	Barrel Lock Prov.	5th Jaw Kit #	Catalog Number Aluminum	Steel
Ringless	OH/UG	#14-2/0	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	-	UAT411-XG ⑧
Ringless	OH/UG	#14-2/0	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	-	UAT411-XVZ ⑧
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Opening	N/A	H659-0121	UAT434-0G	UAT414-0G ⑦
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	Blank Top	N/A	H659-0121	UAT434-PG	-
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Opening	N/A	H659-0121	UAT437-0G	UAT417-0G
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Opening	N/A	H659-0121	UAT437-0GF	UAT417-0GF ①
Ringless	OH	#6-350 kcmil	None	11.0	14.0	4.5	2" Hub Installed	N/A	H659-0121	-	UAT417-DG
Ringless	OH	#6-350 kcmil	None	11.0	14.0	4.5	2.5" Hub Installed	N/A	H659-0121	-	UAT417-EG
Ringless	UG	#6-350 kcmil	None	11.0	14.0	4.5	Blank Top	N/A	H659-0121	UAT437-PG	UAT417-PG
Ringless	UG	#6-350 kcmil	None	11.0	14.0	4.5	Blank Top	N/A	H659-0121	UAT437-PGF	UAT417-PGF ①
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	UAT437-XG	UAT417-XG
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	UAT437-XGF	UAT417-XGF ①
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	UAT457-XG	-
Ringless	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	7/16"	Factory Installed	-	UAT417-X0XA
Ringless	UG	#6-350 kcmil	None	11.0	14.0	4.5	Blank Top	7/16"	Factory Installed	-	UAT417-P0XA
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Opening	N/A	H659-0121	-	UAT417-0PZ
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Opening	N/A	H659-0121	-	UAT417-0PQG
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Cl. Plate	7/16" or 7/8"	Factory Installed	-	UAT417-XQ ③
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Cl. Plate	7/8"	Factory Installed	-	UAT417-XFP
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Cl. Plate	7/8"	Factory Installed	-	UAT417-XFP ②
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Cl. Plate	N/A	Factory Installed	-	UAT417-XVZ ②
Ringless	OH/UG	#6-350 kcmil	Horn	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	-	UAT417-XPQG
Ringless	UG	#6-350 kcmil	Horn	11.0	14.0	4.5	Blank Top	N/A	H659-0121	-	UAT417-PPQG
Ring	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Opening	N/A	H659-0121	-	UAT427-0G ⑤
Ring	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	-	UAT427-XG ⑤
Ring	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	H659-0121	-	UAT427-XGSP ④
Ring	OH/UG	#6-350 kcmil	None	11.0	14.0	4.5	RX Cl. Plate	N/A	Factory Installed	-	UAT427-XMWR⑤
Ring	UG	#6-350 kcmil	None	11.0	14.0	4.5	Blank Top	N/A	Factory Installed	-	UAT427-PB ⑤

① Includes stainless steel latch and hasp.
② Includes cardboard meter opening cover.
③ Includes concentric 7/8" and 7/16" barrel lock K.O.
④ Cover attaches via 2 brackets with screws behind meter.
⑤ Cover attaches via slider latch behind meter.
⑥ Catalog numbers listed include KO and bracket for barrel lock.
⑦ De-rated to160 amps continuous.
⑧ De-rated to125 amps continuous.

6

LANDIS & GYR

Product Schedule 410

CUSTOMIZED CATALOG NUMBER:

1) Select cover style and enclosure material
2) Select hub style
3) Select options

UAT4 - ____ ____ ____ ____

1 = Ringless, Steel
2 = Ring Type, Steel
3 = Ringless, Aluminum
5 = Ringless, Ptd Aluminum

1 = 125 Amp continuous rated
4 = 160 Amp continuous rated
7 = 200 Amp continuous rated

A = 1" Hub Installed
B = 1.25" Hub Installed
C = 1.50" Hub Installed
D = 2" Hub Installed
E = 2.5" Hub Installed
O = No Hub Installed
X = Cover Plate Installed
P = No Hub Opening

C = 7/16" B.L. KO
D = 7/16" B.L. KO w/Bracket
E = 7/8" B.L. KO
F = 7/8" B.L. KO w/Bracket
I = Inhibitor
M = 5th Jaw Installed 9:00
P = Horn Bypass
V = Horn Bypass w/5th Jaw
Z = Meter Opening Cover

Consult the factory for other available options such as, but not limited to insulated 5th terminals, alternate jaw guide configuration, alternate hasp material and special labeling.

GENERAL INFORMATION:

Capacity:	200 ampere continuous, 600 volts a.c.
Application:	Single phase, 3 wire, self-contained convertible to 5 terminal.
Enclosures:	All enclosures shown here are ringless, NEMA Type 3R. All enclosures are available in either 16 gauge painted steel .063 aluminum in natural finish. (For painted aluminum enclosures, consult factory.)
Block Assembly:	Block assemblies are arc and track resistant thermoset.
Terminals:	Lay-in style, tin-plated, extruded aluminum 6061-T6.
UL:	All sockets are UL listed unless otherwise indicated.
ANSI-C12.7:	All sockets meet or exceed ANSI-C12-7 standards.
Stud-Type:	Optional stud-type connectors are available, consult factory.
Hubs:	Hubs conform to ANSI standard. 2.5" hub maximum.
Barrel Lock Prov.:	Includes bracket and knockout.

TO GO BACK, CLICK HERE

SmartSynch®
we create smart grids™

I-210+c® SmartMeter

SmartSynch's residential smart metering solution features a communications module that is integrated into the GE I-210+c electricity meter. The I-210+c SmartMeter communicates over an existing cellular network with the SmartSynch Transaction Management System™ (TMS) or other C12.21 head-end system (such as MV-90) and complies with ANSI C12.19 protocols for data storage and transmission.

The I-210+c SmartMeter is a single-phase electronic watt-hour meter for use in residential and light commercial service locations. The I-210+c's key features include Time of Use, Demand and Load Profile, Remote Connect/Disconnect, and C12.22/C12.21 compatibility. The I-210+c SmartMeter also includes an optional ZigBee® wireless component for in-premise communications and an optional Badger ORION® wireless component for gas and water reads.

Functions & Features

Wireless Communications

- GPRS
- ZigBee®
- Badger ORION®

Advanced Metering Functionality

- Remote Disconnect/Reconnect
- Flexible Two-Way Data Retrieval
- Scheduled & On-Demand Reads
- Interval Reads (5, 15, 30, 60 minutes)
- Real-Time Interval Reads
- Automated Register, Self-Read & TOU
- Demand Resets
- Real-Time Meter Event & Alarm Retrieval
- Real-Time Power Outage & Restoration
- Service Diagnostics & Tamper Detection
- Tilt Detection
- Meter Clock Synchronization
- SmartMeter Status Display
- Automated Meter Registration
- Secure & Encrypted Data Transmissions
- Bi-Directional Metering
- Over-The-Air SmartMeter Module Firmware Upgrade

Supported Meter Forms

- Class 20: 3S, 4S
- Class 100: 1S
- Class 200: 2S, 12S, 25S
- Class 320: 2S
- See back page for Supported Forms with Remote Disconnect

Hardware Components

- Remote Disconnect/Reconnect
- Radio Control Module Board (RCM)
- Capacitor Storage Bank (CSB)
- GSM/GPRS Modem
- ZigBee Transceiver
- Badger ORION Receiver
- Internal Antenna

Operating Ranges

Temperature

- Operating: [-40°C, +85°C]
- Transmission (GPRS): [-40°C, +85°C]

Humidity

- 0% to 95% non-condensing

Accuracy

- Meets ANSI 12.20 for accuracy class 0.5%

Regulatory & Industry Specifications

- FCC Part 15 Class B
- ANSI C37.90.1 – 1989: (SWC)
- ANSI C12.20 (Class 0.5) – 1998
- PTCRB Certified
- Network Carrier Certified
- Measurement Canada Certified

SmartSynch, Inc.
4400 Old Canton Road
Jackson, Mississippi 39211
1-888-362-1780

www.smartsynch.com

Hardware Specifications

Hardware Component	Description
Radio Control Module Board (RCM)	32-bit ARM processor, 256K RAM, 512K flash
Capacitor Storage Bank (CSB)	Supplies peak power for data transmissions and all functions during power outages – no batteries required
GSM/GPRS Modem	GSM modem communicates with head-end using GPRS and SMS services
ZigBee Transceiver	Wireless component for in-premise two-way communications
Badger ORION Receiver	Wireless component for receiving gas and water reads
Internal Antenna	Flexible dual frequency GSM antenna for the modem

Temperature Ranges

Operating: [-40°C, +85°C]

Transmission (wireless): [-40°C, +85°C]

Humidity Range

0% to 95% non-condensing

Accuracy

Meets ANSI 12.20 for accuracy class 0.5%

Supported Meter Forms

Class 20: 3S, 4S
Class 100: 1S
Class 200: 2S, 12S, 25S
Class 320: 2S

With Disconnect

Class 100: 1S
Class 200: 2S, 12S, 25S
Class 320: 25S

Regulatory & Industry Certifications

FCC Part 15 Class B
ANSI C37.90.1 – 1989: Surge Withstand Capability (SWC)
ANSI C12.20 (Class 0.5) – 1998
PTCRB Certified
Measurement Canada Certified
Network Carrier Certified

Input/Output Signal or Interface	Definition/Values
Module Power Input Voltage	120 - 240 VAC
Meter Serial Interface	3.3V / TTL compatible asynchronous

Integration

The SmartMeter module is a fully integrated, under-the-cover option inside the I-210+c meter. The I-210+c SmartMeter is shipped as one complete unit, ready for field deployment.

Version and Compatibility Information

I-210+c Meter Hardware:	Supported meter forms, classes, and types, equipped with battery
I-210+c Meter Firmware:	Latest fully supported
SmartModule:	I-210+c GPRS SmartMeter Module
SmartSynch TMS:	Version 6.0 or higher

About SmartSynch: Headquartered in Jackson, Miss., SmartSynch has been developing successful Smart Grid Intelligence solutions for the utility industry since 2000. The company's clean-tech innovations in the two-way delivery of real-time energy usage data over cellular networks (AT&T, Rogers, etc.), in lieu of private network build-outs, have to date simplified SmartMeter deployments for 150 major North American utilities, while enabling green-energy initiatives and delivering significantly higher Returns on Resources.

Unlike proprietary, closed-architecture solutions, SmartSynch's SmartMeters represent future-proof investments in technology. The standards-based IP connectivity enabled in every SmartMeter deployed makes them adaptable and remotely upgradable to support today's sensor and communications needs, as well as tomorrow's opportunities, better than any alternative.

Product Data Sheet

DU322RB

Safety Switch , 60A, Non-Fusible, 3-Pole

SQUARE D by Schneider Electric

List Price $443.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Number of Poles	3-Pole
Terminal Type	Lugs
Type of Duty	General Duty
Maximum Voltage Rating	240VAC
Wire Size	#10 to #2 AWG(Al) - #14 to #2 AWG(Cu)
Depth	3.75 Inches
Height	9.63 Inches
Action	Single Throw
Ampere Rating	60A
Width	7.25 Inches
Approvals	UL Listed File Number E2875
Enclosure Rating	NEMA 3R
Enclosure Type	Rainproof and Sleet/Ice proof (Indoor/Outdoor)
Factory Installed Neutral	No
Disconnect Type	Non-Fusible
Mounting Type	Surface

Shipping and Ordering

Category	00106 - Safety Switch, General Duty, 30 - 200 Amp, NEMA3R
Discount Schedule	DE1A
GTIN	00785901491767
Package Quantity	1
Weight	4.78 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

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Schneider Electric

SUNPOWER

E19 / 240 SOLAR PANEL

MAXIMUM EFFICIENCY AND PERFORMANCE

BENEFITS

Highest Efficiency
SunPower™ Solar Panels are the most efficient photovoltaic panels on the market today.

More Power
Our panels produce more power in the same amount of space—up to 50% more than conventional designs and 100% more than thin film solar panels.

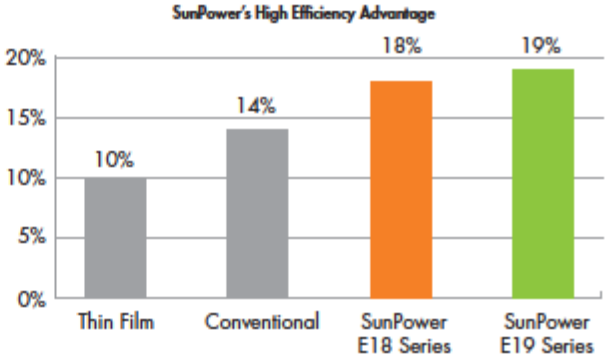
Reduced Installation Cost
More power per panel means fewer panels per install. This saves both time and money.

Reliable and Robust Design
Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations.

E19 SERIES

The SunPower™ 240 Solar Panel provides today's highest efficiency and performance. Utilizing 72 all back-contact solar cells, the SunPower 240 delivers a total panel conversion efficiency of 19.3%. The panel's reduced voltage-temperature coefficient, anti-reflective glass and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.

SPR-240E-WHT-D



SUNPOWER

E19 / 240 SOLAR PANEL

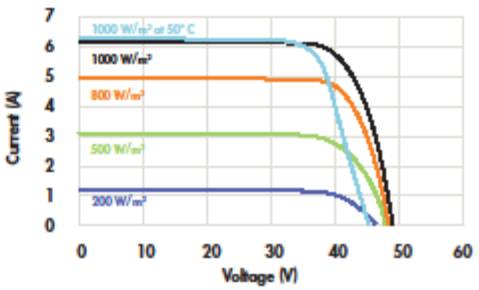
MAXIMUM EFFICIENCY AND PERFORMANCE

Electrical Data

Measured at Standard Test Conditions (STC): Irradiance of 1000W/m², AM 1.5, and cell temperature 25° C

Peak Power (+5/-3%)	P_{max}	240 W
Efficiency	η	19.3 %
Rated Voltage	V_{mpp}	40.5 V
Rated Current	I_{mpp}	5.93 A
Open Circuit Voltage	V_{oc}	48.6 V
Short Circuit Current	I_{sc}	6.30 A
Maximum System Voltage	UL	600 V
Temperature Coefficients	Power (P)	-0.38% / K
	Voltage (V_{oc})	-132.5mV / K
	Current (I_{sc})	3.5mA / K
NOCT		45° C +/-2° C
Series Fuse Rating		20 A

I-V Curve



Current/voltage characteristics with dependence on irradiance and module temperature.

Mechanical Data

Solar Cells	72 SunPower all-back contact monocrystalline
Front Glass	High transmission tempered glass with anti-reflective (AR) coating
Junction Box	IP-65 rated with 3 bypass diodes Dimensions: 32 x 155 x 128 (mm)
Output Cables	1000mm length cables / MultiContact (MC4) connectors
Frame	Anodized aluminum alloy type 6063 (black)
Weight	33.1 lbs. (15.0 kg)

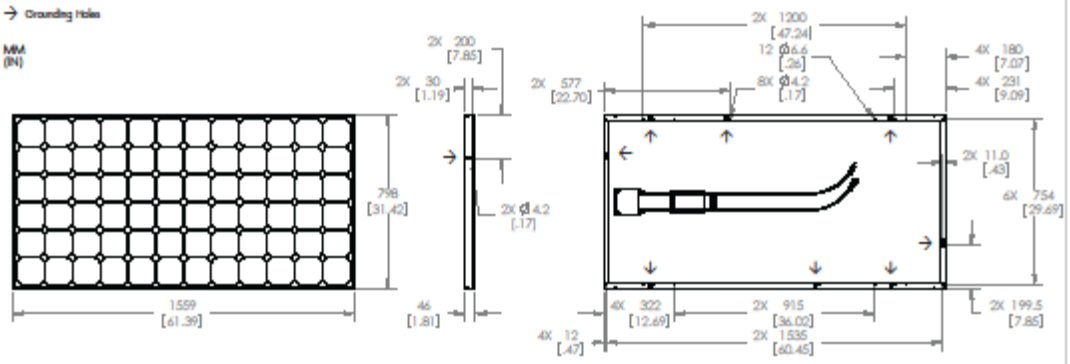
Tested Operating Conditions

Temperature	-40° F to +185° F (-40° C to + 85° C)
Max load	113 psf 550kg/m² (5400 Pa) front – e.g. snow; 50 psf 245kg/m² (2400 Pa) front and back – e.g. wind
Impact Resistance	Hail 1 in (25 mm) at 52mph (23 m/s)

Warranties and Certifications

Warranties	25 year limited power warranty
	10 year limited product warranty
Certifications	Tested to UL 1703. Class C Fire Rating

Dimensions



CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Visit sunpowercorp.com for details

sunpowercorp.com

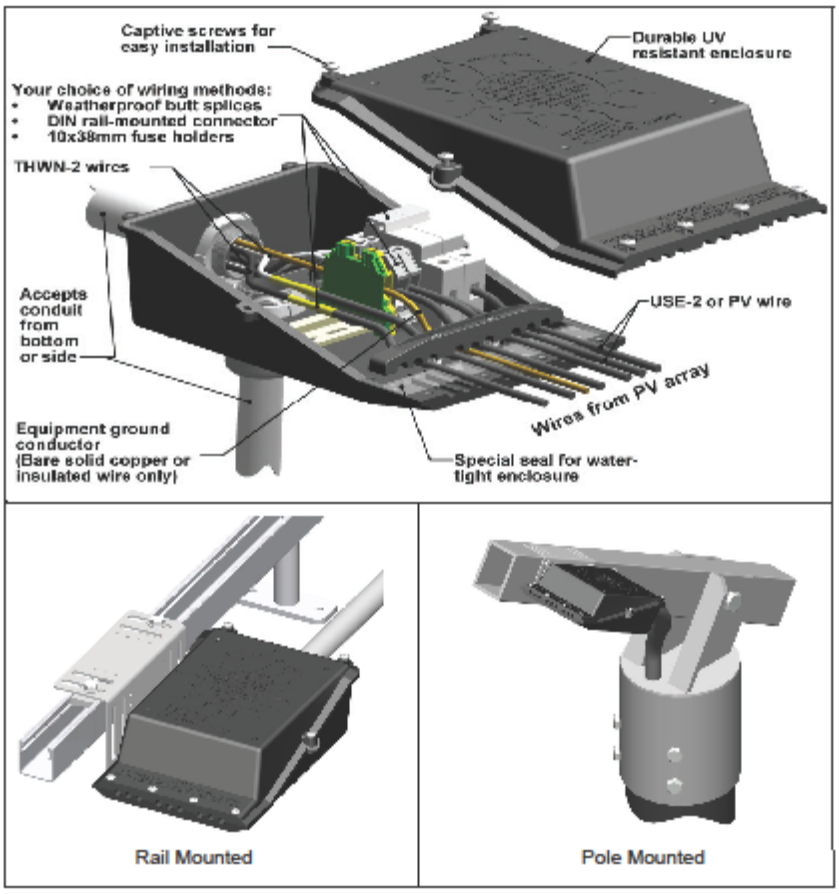
Document #001-65327 Rev** / LTR_EN

TO GO BACK, CLICK HERE

wiley
Advancing Renewable Technology

ACE Acme Conduit Entry Box

The ACE makes quick and simple transitions from USE-2 or PV array wire to conduit protected THWN-2 wire. The box features a compact two-piece UV resistant, NEMA3R rated, enclosure that allows ample wiring space and is compatible with any conduit type. The unique wire entry seals the enclosure even if entry slots are unused. Convenient side and bottom conduit drill out allow for easy conduit routing. The cover comes with captive screws for hassle-free assembly.



Contact us at: 845.247.4708 www.we-llc.com

Published 03/22/2011

Specifications

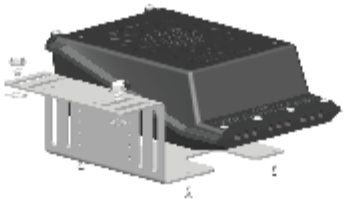
Input Wire Diameter Range	5.0 - 6.8 [0.20 -0.27in] 10-12 AWG USE-2/PV V
Maximum number of Input Conductor Slots	9
Maximum number of PV strings	4
Maximum number of Combined Strings	4
Equipment Ground Conductor Type	Bare solid or jacketed only
Equipment Ground Conductor Diameter Range	4.0-6.8mm [0.16-0.27 in]
Acceptable Conduit Sizes	19.05mm, 25.4mm [0.75in, 1.0in]
Internal Volume	1840cm [112 in]
Internal Height	72.0mm[2.83 in]
Drill Out	Side, Bottom

Configurations

ACE Part Number	ACE Configuration	Terminal Block	Terminal Block Internal Bus	Fuse Holder	Fuse Combiner Bus	Grounding Terminal	DIN Rail
ACE-PT	Pass-Through using Butt Splices/Wire Nuts	N/A	N/A	N/A	N/A	N/A	N/A
ACE-1P	1-String Pass-through	2	N/A	N/A	N/A	1	1
ACE-2P	2-String Pass-through	4	N/A	N/A	N/A	1	1
ACE-3P	3-String Pass-through	6	N/A	N/A	N/A	1	1
ACE-4P	4-String Pass-through	8	N/A	N/A	N/A	1	1
ACE-2C	2-Strings Combiner	4	2X 2-Pole	Not required for 2-string combiner	N/A	1	1
ACE-3C	3-Strings Combiner	3	1X 3-Pole	3	1X 3-Pole	1	1
ACE-4C	4-Strings Combiner	4	1X 4-Pole	4	1X 4-Pole	1	1

Mounting Bracket is included with the purchase of the ACE. It is made of lightweight, corrosion resistant, anodized aluminum. The mounting bracket assembly includes:

1X ACE Mounting Bracket
4X Mounting Screws
2x Bonding Washers



Contact us at: 845.247.4708 www.we-llc.com

AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:	WILEY ELECTRONICS, LLC	**Manufacturer:**	WILEY ELECTRONICS, LLC
Address:	P.O. Box 361 SAUGERTIES, NY 12477	**Address:**	1131 Kings Hwy SAUGERTIES, NY 12477
Country:	USA	**Country:**	USA
Contact:	Mr. Brian Wiley	**Contact:**	Mr. Brian Wiley
Phone:	(845) 247-2875	**Phone:**	(845) 247-2875
FAX:	(845) 246-0189	**FAX:**	(845) 246-0189
Email:	btw@we-llc.com	**Email:**	btw@we-llc.com

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY

Control Number: 3098177 **Authorized by:** for Michelle Lake
William T. Starr, Certification Manager

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3851 or 607-753-6711 Fax 607-756-6699

Standard(s):	UL Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, UL 1741. First Edition, May 7th 1999, Including Revisions through November 7, 2005.).
Product:	PV Combiner boxes
Brand Name:	N/A
Models:	ACE-PT, ACE-1P, ACE-2P, ACE-3P, ACE- 4P, ACE-2C, ACE-3C,AND ACE-4C

TO GO BACK, CLICK HERE

Division 27 – Communications

emonitor™

eMonitor™ Version 2.0

Installation Guide

Rev 1.2

TLA Number: 950-000008 Rev:E
Serial: **EM1A1 6144 7E3C**
MAC Address: **00-90-C2-E0-7E-3C**

Published 03/22/2011

1. Getting Started

NOTE: Installation should not be started until the qualified installer has read this entire Installation Guide.

Important Safety Information

The eMonitor is one of the first home energy management solutions that monitors all of the circuits in your home independently, and therefore is able to provide you with a detailed view of your electricity usage. In order to do this, sensors need to be installed on each circuit breaker inside your electrical panel. The installation is very straightforward, and every effort has been made to provide for the safe, secure installation of the eMonitor. However, the installation of the eMonitor requires the cover of the main electrical circuit breaker panel to be removed.

When this is done, there is the potential hazard of shock, burn, or even electrocution.

Even when the Main Circuit Breaker has been turned to the "OFF" position, there may still be areas within the circuit breaker panel that are electrified, or "hot". **Installation should be performed by a licensed electrician.**

This model of the eMonitor is suitable for installation with 120/240V single-phase 60Hz service, normally found in North America (USA, Canada, Mexico and portions of the Caribbean). It is not suitable for 3-phase service, or for 230V 50Hz service commonly found in other regions of the world.

All wiring in the United States must be installed in accordance with the latest adopted edition of the National Electrical Code (ANSI/NFPA 70, NEC) and state or local requirements. All wiring in Canada must be installed in accordance with the latest adopted edition of the Canadian Electrical Code (CSA C22.2 CEC, Part I) and any provincial or local requirements.

A typical installation of a 24-channel eMonitor unit should take approximately one hour.

One of my appliances is using a lot less power than I would have expected

- The first thing to check is whether the sensor that is attached to the circuit that has that appliance is tightly connected to the eMonitor
- If that is not the problem, it is possible that your circuit panel had the wrong label, and the eMonitor is not monitoring the appliance you think it is. The way to check that is to turn off the breaker which has the associated label, and see if the appliance turns off. If not, you will need to perform a little trial and error to find the correct circuit and channel.
- NOTE: before turning the breaker off, be sure to turn off any computers or medical devices on that circuit to avoid damage to them.

E. Specifications for the eMonitor

Communication Protocols

TCP-IP via Ethernet (802.3) 10/100base-T

Wireless ZigBee® (802.15) mesh networking

Local via high speed Serial port

Power Requirements

120 VAC Power, 60 Hz

Calibrated Adapter:

Input 120 VAC 60 Hz 7W

Output: 12VAC 1000mA

Dimensions

L x H x W: 8.80" x 4.25" x 1.75"

Hardware features

Scans circuit and outlet power consumption every second, records average every minute

Backlit display (128 x 64 graphics dot Matrix LCD)

3 LED status lights

4 button membrane keypad

Embedded Web server provides local data access

8MB memory supports 1 day of data storage

Firmware remotely upgradable

Environmental conditions

Operating Temperature: –10°C to +60°C (14°F to +140°F)

- When the product exhibits a distinct change in performance – this indicates a need for service.

Replacement Parts – When replacement parts are required, be sure the service technician has used replacement parts specified by the manufacturer or that have the same characteristics as the original part. Unauthorized substitutions may result in fire, electric shock, or other hazards and voiding of warranties.

Safety Check – Upon completion of any service or repairs to this product, ask the service technician to perform safety checks to determine that the product is in proper operating condition.

Heat – The product should be situated away from heat sources such as radiators, heat registers, stoves, or other products that produce heat.

FC eMonitor 24
Version 1.6
Tested to comply with FCC standards for Home or Office Use

Declaration of Conformity:

FCC Class B approval

Warranty

Powerhouse Dynamics warrants this eMonitor unit against defects in materials and workmanship for the length of the initially contracted monitoring service. For the first two (2) years from the date of purchase, Powerhouse Dynamics will replace any defective product at no charge. Thereafter, if applicable, there will also be a $125 re-stocking charge for replaced products. The defective product must be returned to PowerHouse dynamics; please ensure that the unit is properly packed before shipping. Powerhouse Dynamics will not provide reimbursement for shipping, removal, or reinstallation.

This Warranty does not cover damage from accident, misuse or abuse, incorrect installation, installation at environmental conditions outside the specifications, lack of reasonable care, or the fixing of any attachment that did not come with the product or is not specifically authorized by Powerhouse Dynamics. Powerhouse Dynamics will not provide reimbursement for any non-approved repair services or for any damage caused by such services, which would invalidate this Warranty.

THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. UNDER NO CIRCUMSTANCES WILL POWERHOUSE DYNAMICS BE RESPONSIBLE FOR ANY INDIRECT, CONSEQUENTIAL, SPECIAL OR INCIDENTAL DAMAGES, OR PROPERTY LOSS OR INJURY.

WEB-BASED MONITORING

SOLRENVIEW

FEATURES

- Inverter direct & revenue grade monitoring
- Performance charting
- Real-time status notifications
- Detailed system data
- Reliable, safe & secure data storage

OPTIONS

- Sub-array monitoring (SolZone)
- Weather station
- Kiosk View (Flash View)
- Automated agency reporting
- Sun Spec alliance compatible

WEB-BASED MONITORING

Solectria Renewables' SolrenView web-based monitoring solution is available for use with any residential, commercial or SMARTGRID Inverters, allowing for real-time, seamless recording and reporting of PV system production. The SolrenView gateway hardware provides data via Ethernet (standard) or cellular modem. The SolrenView hardware comes standard and fully-integrated within all commercial and SMARTGRID inverters and is available for residential use with LCD or LITE gateway systems. The complete SolrenView series features inverter direct monitoring, revenue grade monitoring, agency reporting, SolZone sub-array monitoring, Kiosk View (flash view) system and a weather station.

Built for the real world

Published 03/22/2011

SolrenView™ Inverter Direct

STANDARD DATA MONITORING PACKAGE

SolrenView™ Inverter Direct monitoring allows customers to see detailed inverter data (DC and AC) using a web browser. This standard package allows customers to view daily, weekly and monthly graphs up to 5 years in the past viewing single events or long-term performance trends. The package includes e-mail and cell phone alerts with detailed descriptions of system issues and a recommended course of action. This service is only available for the industry-leading Solectria PVI and SGI series inverters.

SolrenView™ Revenue Grade Energy Production

OPTIONAL MONITORING PACKAGE

SolrenView™ Revenue Grade Energy Production monitoring package option keeps an accurate count of every kWh produced by a customer's PV system. The energy produced is automatically reported to a solar program agency for convenience, if the agency reporting option is chosen. This package option also includes e-mail alarms with detailed descriptions of system problems and a recommended course of action. This package option is available for systems 1kW – multi-MW utilizing any inverter make and model.

SolrenView™ Weather Station

OPTION

The real-time weather package allows customers to view accurate readings for crucial environmental information. The weather station comes standard with a solar irradiance sensor as well as temperature sensors for ambient and module measurements. Wind speed and wind direction sensors are options that may be added to the weather station. This is a great educational tool and a must for PPAs.

Viewable Measurements:

- Solar Irradiance
- Ambient Temperature
- Module Temperature
- Wind Speed (optional)
- Wind Direction (optional)

SolrenView™ SolZone™ Sub-Array Monitoring

OPTION

While SolrenView™ provides to the customer the ability to view the total system performance, SolZone™ provides an extra level of granularity to see multiple sub-array DC currents.

SolZone™ has the ability to compare individual PV zones against each other based on the number of sub-array fuses or "zones" built into a Solectria factory-installed DC sub-combiner. Each sub-array zone may be monitored and compared against each other. The data collected, monitored and displayed via web browser is viewable in various modes. SolZone™ is also compatible with many third party monitoring systems.

SolrenView™ Agency Reporting

OPTION

The SolrenView™ Agency Reporting is an ideal option for customers that require Revenue Grade reporting to be sent to an agency such as PTS, SCE, CCSE and PGE. A report is generated from SolrenView™ Revenue Grade outputs and sent directly to the agency of choice.

SolrenView™ Kiosk View *(Flash View)*

OPTION

The Kiosk View (Flash View) option provides customers with a clean, simple view and quick, easy access to a customer's PV system performance. This is a great tool for advertising and public viewing. This option includes custom Flash Programming only. The Kiosk View must be ordered in addition to a SolrenView™ service package. This option requires a dedicated computer and monitor, purchased elsewhere (not available for purchase through Solectria Renewables).

SOLECTRIA RENEWABLES www.solren.com | inverters@solren.com | 978.683.9700

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D-Link

DIR-632

WHAT THIS PRODUCT DOES

Create a wireless network to share high-speed Internet access with computers, game consoles, and media players from greater distances around your home.

BENEFITS OF A WIRELESS N ROUTER

This Wireless N 8-Port Router uses powerful 802.11n technology with multiple intelligent antennas to maximize the speed and range of your wireless signal to significantly outperform previous-generation Wireless G MIMO devices[1]. The antennas on the Wireless N 8-Port Router make use of your home's environment by bouncing multiple wireless signals off walls and ceilings to work around obstructions and help eliminate dead spots.

YOUR NETWORK SETUP

TECHNICAL SPECIFICATIONS

STANDARDS
- IEEE 802.11n
- IEEE 802.11g
- IEEE 802.3
- IEEE 802.3u

DEVICE INTERFACE
- 8 10/100 LAN Ports
- 1 10/100 WAN Port

SECURITY
- Wi-Fi Protected Access (WPA, WPA2)*

ADVANCED FIREWALL FEATURES
- Network Address Translation (NAT)
- Stateful Packet Inspection (SPI)
- VPN Pass-through / Multi-sessions PPTP / L2TP / IPSec

DEVICE MANAGEMENT
- Internet Explorer® v7 or Later; Mozilla Firefox® v3.0 or Later; or other Java-enabled Browsers

LEDs
- Power
- WLAN (Wireless Connection)
- LAN (10/100)
- Internet Status

CERTIFICATIONS
- FCC Class B
- IC
- Wi-Fi®
- IPv6 Gold

DIMENSIONS
- Item (WxDxH): 9.1" x 5.9" x 1.3" (230mm x 150mm x 33mm)
- Packaging (WxDxH): 10.9" x 2.6" x 8.1" (276.8mm x 65mm x 205.8mm)

WEIGHT
- Item: 0.6 lbs (272.2 grams)
- Packaging: 2.0 lbs (907.2 grams)

WARRANTY
- 1-Year Limited*

RECOMMENDED SYSTEM REQUIREMENTS
For Optimal Wireless Performance, use with:
- Wireless N 300 USB Adapter (DWA-131, DWA-121, or DWA-140)

MINIMUM SYSTEM REQUIREMENTS
Computer with:
- Windows® 7, Windows Vista®, Windows® XP (SP2), or Mac OS® X (v10.4)+
- Internet Explorer 7 or Mozilla Firefox 3.0
- CD-ROM Drive
- Network Interface Card

For Internet Access:
- Cable or DSL Modem
- Subscription with an Internet Service Provider (ISP)

PACKAGE CONTENTS
- Wireless N 8-Port Router
- CAT 5 Ethernet Cable
- Power Adapter
- CD-ROM with
  - Installation Wizard
  - Product Documentation

* Maximum wireless signal rate derived from IEEE Standard 802.11 specifications. Actual data throughput will vary. Network conditions and environmental factors, including volume of network traffic, building materials and construction, and network overhead, lower actual data throughput rate. Environmental factors will adversely affect wireless signal range. Wireless range and speed rates are D-Link 802.11n/g performance measurements based on the wireless range and speed rates of a standard Wireless G product from D-Link. Maximum throughput based on D-Link Wireless N clients.
* 1-Year Limited Warranty available only in the USA and Canada.
* Computer must adhere to Microsoft's recommended System Requirements.
* The software included with this product is not Mac-compatible.
* Latest software and documentation now available at http://support.dlink.com.

All references to speed and range are for comparison purposes only. Product specifications, size, and shape are subject to change without notice, and actual product appearance may differ from that depicted herein.

Hardware Version A1

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HP Pavilion dv7t series

Processors Intel 2nd gen Core
Usage Business
Type THE ultimate entertainment and performance machine.
Battery Life Up to 5.25 hours of battery life (6 cell)+++
Memory card reader Multi-Format Digital Media Card Reader
Accessible memory slots 2
Maximum Memory Expansion 8GB
Ports 4 USB (2 USB 2.0 and 2 SuperSpeed USB 3.0), HDMI, VGA
Additional Ports RJ-45, HDMI
Chassis aluminum chassis in dark umber color (metal)
Hard Drive Protection HP ProtectSmart protects the hard drive & data
Audio Beats(TM) audio + HP Triple Bass Reflex Subwoofer
ENERGY STAR Qualified Yes
DLNA Certified Yes
Adapter 120W AC
Dimensions 16.38" (W) x 10.83" (D) x 1.24" (min H)/1.42" (max H)
Thinness 1.24"
Weight 6.72 lbs
Network Card 10/100/1000 Gigabit Ethernet LAN (RJ-45 connector)
Optical Drive Internal
Blu-ray Drive Optional
Webcam HP TrueVision HD Webcam
Fingerprint Reader Included
CoolSense Included
Security SW Norton Internet Security 60-day subscription
Included SW HP Games, Windows Live
Warranty 2-year hardware limited warranty

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Division 28 – Electronic Safety and Security

Kidde

FIREX

120V AC Wire-In Smoke Alarm

Slide Load Front Battery Door, Alkaline Battery, 10 Yr Warranty

Model i5000

- Ionization Sensing Technology
- Battery Backup (batteries included)
- Hush® Button
- Alarm Memory Indicator
- New 360° Mounting Plate with Tamper Resistance
- Front Load Battery Door

Description

The Kidde i5000 is an AC/DC powered, ionization smoke alarm that operates on a 120V power source with 9V alkaline battery backup.

This alarm uses ionization sensing technology. Ionization sensing alarms may detect invisible fire particles (associated with flaming fires) sooner than photoelectric alarms. Photoelectric sensing alarms may detect visible particles (associated with smoldering fires) sooner than ionization alarms.

Kidde strongly recommends that both ionization and photoelectric smoke alarms be installed to help insure maximum detection of the various types of fire that can occur within the home.

The front-loading battery door allows user to change the battery without removing the alarm from the mounting bracket making battery replacement easy and convenient. This smoke alarm is available in a 6-piece cut case with tray for easy display as well as a 6-piece bulk pack for contractors and property owners. This unit is a UL Listed product with a 10-year limited warranty.

Install Confidence:

Easy Installation
- Front battery pull tab allows battery activation without removing alarm from mounting bracket.
- Large mounting base makes mounting easier, protects surface paint from dirt and covers imperfections.
- Pre-stripped wiring harness with easy off cap does not require stripper tool. Tinned strands increase conductivity and wire nut grip.

Fewer Callbacks
- Large centrally located Test/Hush® alarm control button.
- Dust cover protects sensor from contaminates during construction reducing nuisance alarms.

User-Friendly Features
- Easy access front loading battery door.
- Battery backup provides protection in case of power failure.
- Interconnectable with up to 24 devices (of which 18 can be initiating) including smoke, CO and heat alarms. See user's guide for complete instructions.

10 YEAR LIMITED WARRANTY

SIGNALING UL LISTED

120V AC Wire-In Smoke Alarm
Slide Load Front Battery Door

Model I5000

Architectural and Engineering Specifications

The smoke alarm shall be Kidde Model I5000 or approved equal. It shall be powered by a 120VAC, 60Hz source along with a 9V alkaline battery backup. The unit shall incorporate an ionization sensor with nominal sensitivity of 0.50 to .92%/ft. The temperature operating range shall be between 40°F and 100°F (4°C and 38°C) and the humidity operating range shall be up to 85% relative humidity.

The smoke alarm can be installed on any standard single gang electrical box, up to a 4" octagon junction box. The electrical connection (to the alarm) shall be made with a plug-in connector. A maximum of 24 Kidde devices can be interconnected in a multiple station arrangement. The interconnect system must not exceed the NFPA (National Fire Protection Association) limit of 18 initiating devices, of which 12 can be smoke alarms. With 18 initiating devices (Smoke, heat, CO, etc), interconnected, it is still possible to interconnect 6 strobe lights and/or relay modules. The alarm shall provide optional tamper resistance that deters removal of the unit from the wall or ceiling. No additional pieces shall be required to activate this feature.

The alarm shall include an easy access battery compartment that is opened and closed by sliding the battery door. The 9V battery carrier will ensure proper battery backup protection by not allowing the battery door to close if the battery is placed in the unit incorrectly or if a battery is not present.

The unit shall include a piezoelectric horn that is rated at 85 decibels at 10 feet. The unit shall include the Smart Hush™ feature that silences the unit for approximately 8 minutes if a nuisance condition occurs.

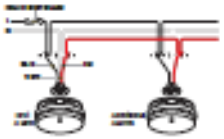
The unit shall incorporate red and green LED indicators. The green LED (when illuminated) indicates the presence of AC power. The red LED (located under the TEST/Hush button) has four modes of operation:

Standby Condition: The red LED will flash every 30-40 seconds to indicate that the smoke alarm is operating properly. **Alarm Condition:** When the alarm senses products of combustion and goes into alarm the red LED will flash one flash per second. The flashing LED and pulsating alarm will continue until the air is cleared. When units are interconnected, only the red LED of the alarm that senses the smoke or is being tested (the originating unit) will flash. All other units in the interconnected system will sound an alarm but their red LED's will NOT flash. **Alarm Memory:** This smoke alarm is equipped with an alarm memory, which provides a visual indication when an alarm has been activated. The red LED will illuminate for about 1.5 seconds every 16 seconds to indicate the memory condition. **Smart Hush™ Mode:** The red LED will illuminate for 1.5 seconds every 8 seconds, indicating the smoke alarm is in the Smart Hush™ Mode.

The unit shall at a minimum meet the requirements of UL217, NFPA72, and (chapter 11), The State of California Fire Marshall, NFPA101 (One and two family dwellings), Federal Housing Authority (FHA), Housing and Urban Development (HUD).

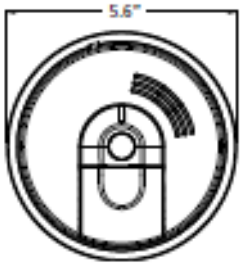
Installation of Smoke Alarm

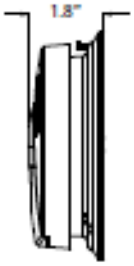
The smoke alarm should be installed to comply with all local codes having jurisdiction in your area, Article 760 of the National Electric Code, and NFPA 72. Make certain all alarms are wired to a single, continuous (non-switched) power line, which is not protected by a ground fault interrupter. A maximum of 1000 ft. of wire can be used in the interconnect system. Use standard UL listed household wire as required by code.



Technical Specifications

Model:	I5000
UPC:	0-47871-07582-9
Power Source:	120VAC (80mA Max)
Sensor:	Ionization
Audio Alarm:	85dB at 10ft
Temperature Range:	40°F (4.4°C) to 100°F (37.8°C)
Humidity Range:	Up to 85% relative humidity (RH)
Size:	5.6" in diameter x 1.8" depth
Weight:	.5lbs
Interconnects:	Up to 24 Kidde devices
LED:	Green, receiving ac power Red, 4 modes of operation
Warranty:	10 year limited





Ordering Information

	Ordering Number	UPC	I2F5	Pack Quantity	Dimensions (w x d x h inches)	Weight	Skid
I5000	21007582	0-47871-07582-9	100-47871-07582-6	Cut Case (6 units)	6.63 x 13.25 x 6.25	3 lbs	1008

Not for sale by individual unit

Kidde

FIREX

1016 Corporate Park Drive
Mebane NC 27302
1-800-880-6788
www.Kidde.com

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BRK ELECTRONICS®

Cat. No. CO5120B

CARBON MONOXIDE ALARM

AC/DC USES STANDARD 9V BATTERY

NEW! CO5120B Series Carbon Monoxide Alarm

- **Easier—Less time to install**
- **Sleek, low profile design**

Features	Benefits
Centered "Quick-Connect" wiring harness.	Provides quick and easy connection to AC power.
Universal Mounting Bracket.	Center mounts to any standard electrical junction box up to 4" octagonal without screw removal. Large opening for wiring connects to unit every 60 degrees for easy alignment and quick installation. Does not warp due to drywall imperfections. Same size footprint as other BRK Electronics® smoke alarms.
Easy-opening, pivoting side-load 9V battery compartment.	No need to remove the unit from the ceiling to replace the 9V battery
9V battery is pre-installed.	Just pull the mylar tab from the battery drawer and the battery is connected.
Interconnectable—up to 12 multiple station CO5120B alarms	Unit that detects carbon monoxide identifies itself, and sends alarm signal to other units connected in series.
3rd Generation electronic CO sensing circuit	Low power consumption — .085 amps standby, .087 amps in alarm Reduces nuisance alarms
Operates on 120VAC with 9V battery back-up.	Red LED indicates which power supply is active — AC or DC
Latching alarm indicator.	The latching alarm feature indicates which unit(s) in an interconnected series has(have) detected alarm levels of CO.
Single Test/Silence button.	Dual Function: • Tests all functions by electronically simulating the presence of CO • Silences the alarm while the occupant(s) respond to an alarm. After the initial silence period, if levels of CO present still indicate a potentially dangerous situation, the alarm will sound again.

ISO 9002

5 YEAR LIMITED WARRANTY

Published 03/22/2011

Cat. No. CO5120B

CARBON MONOXIDE ALARM 9V BATTERY POWERED

APPLICATION

BRK Electronics® Model CO5120B is a 120V, hard wired carbon monoxide alarm with 9V-battery backup. It can be operated as a single station unit or interconnected to other BRK Electronics® Carbon Monoxide Alarms. A latching alarm indicator shows which alarm(s) in an interconnected series detected alarm levels of carbon monoxide. These models also have a dual function test/silence button: during testing it will electronically simulate the presence of carbon monoxide, causing the unit to alarm; during an alarm it will temporarily silence the horn while residents take corrective action.

The CO5120B has been fully tested and complies with Underwriters Laboratories, Inc. Safety Standard 2034 for single and multiple station carbon monoxide alarms, and with model building codes published by ICBO, SBCCI, BOCA and CABO. The CO5120B has a repeating temporal horn pattern - 4 beeps, pause, 4 beeps, pause. The alarm has been specifically designed for residential and institutional applications including single family homes, multi family homes, sleeping rooms of hospitals, hotels, motels, dormitories, and other mixed occupancy dwellings as defined in standard NFPA 101. The sensor is a third generation metal oxide type. It is adjusted not to detect CO levels below 30 PPM. This unit will not alarm when exposed to a constant level of 30 PPM for 30 days. It will alarm at the following levels under 30% to 70% relative humidity (RH):

- 400 PPM CO between 4 and 15 minutes
- 150 PPM CO between 10 and 50 minutes
- 70 PPM CO between 60 and 240 minutes

According to Underwriters Laboratories Inc. UL 2034 section 1.2: "Carbon monoxide alarms covered by these requirements are intended to respond to the presence of Carbon Monoxide from sources such as, but not limited to, exhaust from internal combustion engines, abnormal operation of fuel-fired appliances, and fireplaces. CO alarms are intended to alarm at Carbon Monoxide levels below those that could cause a loss of ability to react to the dangers of Carbon Monoxide exposure." This CO alarm monitors the air, and is designed to alarm before CO levels become life-threatening. This allows you precious time to leave the house and correct the problem. This is only possible if the alarms are located, installed, and maintained as described in the user's manual.

The Consumer Products Safety Commission (CPSC) recommends the use of at least one CO alarm per household, located near the sleeping area. For additional protection, install additional CO alarms on every level of the home, in each separate bedroom, and near each separate sleeping area. It is recommended that Model CO5120B CO alarms be interconnected. Refer to the Model CO5120B User's Manual for more information on the proper location, placement, and installation of the CO5120B.

ARCHITECTURAL AND ENGINEERING SPECIFICATIONS

The Carbon Monoxide Alarm shall be BRK Electronics Model CO5120B or approved equal and shall provide, at a minimum, the following features and functions:

1. A third generation sensor calibrated to meet UL 2034 October 1, 1998.
2. The unit should be 120V hard wired with 9V-battery back up.
3. In battery-back-up mode, the battery must last for 8 hr. minimum in standby and then 12 hour minimum in alarm.
4. The unit should be self-diagnostic and have a visual and audible alert to indicate a malfunction.
5. The alarm unit must have a button that will test the alarm by simulating CO, and silence any nuisance alarm.
6. A solid state Piezo alarm horn rated 85dB at 10 ft. that provides a temporal pattern: 4 beeps, pause, 4 beeps, pause.
7. The alarm unit will have a red LED to indicate the status of the power supply (AC or DC).
8. The CO alarm will have a latched LED that will indicate which CO alarm(s) in the series detected alarm levels of CO. Latch is manually reset.
9. The CO alarm shall have an internal gasket to prevent the intrusion of outside air that might otherwise infiltrate the unit and clean carbon monoxide from the sensing chamber.
10. The unit shall be capable of operating between 40°F and 100° F (4°-38°C) and relative humidity of 30% to 70%.
11. The CO alarm will be interconnectable with up to 12 units of its own type.

TECHNICAL SPECIFICATIONS

Alarm Circuit	100% Solid State
Operating Voltage	120VAC; 9V DC back-up
Operating Ambient Temp. Range	40°F(4°C) to 100°F(38°C)
Operating Humidity Range	30% to 70% RH
Alarm Horn Rating	85dB at 10FL
Alarm Reset	Automatic when CO clears
Single Test/Silence Button	Tests all functions by electronically simulating the presence of CO. Resets the latch feature. Silences the alarm while the occupant(s) respond to an alarm. After the initial silence period, if levels of CO present still indicate a potentially dangerous situation, the alarm will sound again.
Alarm Status Indicators	
Battery Status Indicator	Red LED flashes approx. once per minute when unit is operating on battery power only. Horn "chirps" once per minute when battery becomes low.
Service Status Indicator	If unit is not operating properly, Red LED flashes three times in rapid succession (every minute); horn chirps simultaneously.
CO Alarm Status Indicator	Red LED flashes rapidly; horn sounds in repeating pattern (4 beeps, pause, 4 beeps, pause) when the unit has detected enough CO to trigger an alarm.
Unit Dimensions	5 ⅜"Dia x 1 ⅞"H (w/ bracket)
Unit Weight	.7 lbs.
NAED #	05617
Units Per Case	12 units

MANUFACTURED BY:

BRK Electronics®
3901 Liberty Street Road
Aurora, IL 60504-8122

Printed in USA

DISTRIBUTED BY:

FOR TECHNICAL HELP OR REPRESENTATIVE NEAREST YOU PHONE 1-800-323-9005

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PVI 4000 Inverters

STRING INVERTERS

PVI 3000
PVI 4000
PVI 5000
PVI 5300
PVI 6500
PVI 7500

FEATURES
- 96% CEC efficiency
- Wide input operating voltage window
- 208 VAC, 240 VAC or 277 VAC
- Fully-integrated design
- Detachable wiring box
- Standard 10 year warranty
- RS232/RS485 communications
- User interactive LCD display

OPTIONS
- Integrated panel assembly
- Web-based monitoring

SOLECTRIA RENEWABLES

STRING INVERTERS

At 96% CEC efficiency, the Solectria Renewables string inverter series, ranging from 3.0 kW to 7.5 kW, is the most efficient transformer isolated string inverter on the market. The PVI 3000-PVI 7500 series of inverters consist of six power ratings to optimally match your grid-tied PV system, and boasts fully-integrated DC and AC disconnects, an LCD display, and a 3, 4, or 5 fuse string combiner all contained within a detachable wiring box. This feature allows for a clean, simple, and safe installation with easy serviceability. The integrated panel assembly option allows for this inverter series to be pre-wired and mounted on an industrial grade aluminum panel with kWh meter and optional AC visible-blade disconnect or circuit breakers on a two-inverter panel assembly.

Built for the real world

SPECIFICATIONS		PVI 3000	PVI 4000	PVI 5000	PVI 5300	PVI 6000	PVI 7600
DC Input							
Absolute Maximum Input Voltage		600 VDC					
MPPT Input Voltage Range		200-550 VDC				230-500 VDC	
Maximum Operating Input Current		16 A	20 A	25 A	25 A	25 A	25 A
AC Output							
Nominal Output Voltage		208 or 240 VAC				208, 240 or 277 VAC	
AC Voltage Range (Standard)		-12%/+10%					
Continuous Output Power	208 VAC	2700W	3400W	4300W	4600W	6000 W	7500 W
	240 VAC	2900W	3900W	4900W	5300W	6000 W	7500 W
	277 VAC	--				6000 W	7500 W
Continuous Output Current	208 VAC	13 A	16.3 A	20.7 A	22.1 A	31.3 A	36.1 A
	240 VAC	13 A	16.3 A	20.7 A	22.1 A	27.1 A	31.3 A
	277 VAC	--				23.5 A	27.1 A
Maximum Backfeed Current		0 A					
Nominal Output Frequency		60 Hz					
Output Frequency Range		59.3-60.5 Hz					
Power Factor		Unity, >0.99					
Total Harmonic Distortion (THD)		<3%					
Efficiency							
Peak Efficiency	208 VAC	96.4%	96.5%	96.4%	96.2%	96.0%	96.2%
	240 VAC	96.7%	96.7%	96.7%	96.4%	96.3%	96.5%
	277 VAC	--				96.7%	96.7%
CEC Efficiency	208 VAC	95.5%	95.5%	96.0%	95.5%	95.5%	
	240 VAC	96.0%	96.0%	96.0%	96.0%	96.0%	
	277 VAC	--				96.0%	
Tare Loss		0.5 W					
Integrated String Combiner							
Fused String Inputs		3	4	4	4	5	5
Temperature							
Ambient Temperature Range (full power)		-13°F to +131°F (-25°C to +55°C)					-13°F to +122°F (-25°C to +50°C)
Storage Temperature Range		-13°F to +131°F (-25°C to +55°C)				-13°F to +149°F (-25°C to +65°C)	
Relative Humidity (non-condensing)		5-95%					
Monitoring Options							
Web-based Monitoring (Inverter Direct)		SolrenView					
Revenue Grade Monitoring		External					
Third Party Compatibility		Standard via RS232/RS485					
Testing & Certifications							
Safety Listings & Certifications		UL 1741/IEEE 1547, IEEE 1547.1, CSA C22.2#107.1, FCC part 15 B					
Testing Agency		ETL					
Warranty							
Standard		10 year					
Enclosure							
AC/DC Disconnects		Standard, fully-integrated (Internal)					
Dimensions (H x W x D)		28.8 in x 17.9 in x 6.9 in (732 mm x 454 mm x 175 mm)		28.8 in x 17.9 in x 8.3 in (732 mm x 454 mm x 210 mm)		28.8 in x 17.3 in x 8.2 in (732 mm x 438 mm x 208 mm)	
Weight		47 lbs (21.4 kg)	48 lbs (21.8 kg)	58.5 lbs (26.6 kg)	60 lbs (27.4 kg)	88.9 lbs (40.4 kg)	
Enclosure Rating		NEMA 3R					
Enclosure Finish		Painted aluminum					

SOLECTRIA RENEWABLES www.solren.com | inverters@solren.com | 978.683.9700

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