

ZEROW HOUSE

Zero Energy Row House

Rice Solar Decathlon 2009
Project Manual
June 2, 2009



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DEVELOPMENT OF CONSTRUCTION DOCUMENTS

The Rice Solar Decathlon team is confidently moving forward with the planning, design, and construction of the ZEROW HOUSE. As our house nears completion, the construction documents for the ZEROW HOUSE have continued to evolve as well. Our drawing set reflects the development of details and connections throughout the house, and all of the design decisions that have been made over the last semester of intense work.

DRAWING SET

- Final documentation of the green wall, shade structure, foundation, and solar PV racking and solar thermal racking systems
- Final documentation of details and connections for the porch and ramping systems, including final foundation footings and handrails
- The organization of the light core has changed substantially to now include two operable doors and a system of awning windows
- Final schedules for doors and windows, appliances, fixtures, interior and exterior finishes, and lighting
- Final design of interiors, including two flexible storage systems in the living room and bedroom, the kitchen, and the bathroom
- Final design of the solar systems on the roof, including a major change in the location of the evacuated tube system
- Final architectural sections and details, including the detailing of connections for the corrugated metal siding
- Development of the assembly and disassembly plan
- Changes to location of on-site vegetation and visual communication

PROJECT MANUAL

- The evolution of our brand and logo elicited a change for the format, graphic quality, and layout of all our documentation and submissions
- Expansion of project specification
- Development of structural calculations to include solar systems
- Summary of unlisted electrical components
- Development of all narratives
- Development of content to meet compliance requirements
- Development of visual communications for our public exhibit on the National Mall

PROJECT SPECIFICATIONS

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SECTION 00 73 19

HEALTH AND SAFETY REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Retractable fall limiter
2. Full-body harness
3. First aid kit

1.2 SUBMITTALS

A. Links to manufacturer's product:

Retractable fall limiter:

<http://www.millerfallprotection.com/fall-protection-products/fall-limiters-self-retracting-lifelines/minilite-fall-limiters>

Full-body harness:

<http://www.millerfallprotection.com/titan-fall-protection-products/body-wear/titan-non-stretch-full-body-harnesses>

First aid kit:

<http://zeemedical.com/zeemedical/NewZee/Catalog2005/index.jsp>

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store product in manufacturer's unopened packaging until ready for use.

PART 1 – PRODUCTS

2.1 MANUFACTURERS

A. Fall limiter and full-body harness:

Miller Fall Protection
1345 15th Street
PO Box 271
Franklin, PA 16323
1 800 873 5242

B. First Aid kit

Zee Medical, Inc.
22 Corporate Park
Irvine, CA 92606
1 800 841 8417

2.2 PRODUCTS

A. MiniLite Fall Limiter FL11-3/11FT

1. 400 lb rating
2. 11 ft self-retracting web lanyard
3. Carabiner and swivel shack connection

B. Titan non-stretch harness T4000/U

1. 400 lb capacity
2. Universal fit
3. Sub-pelvic strap, sliding back D-ring
4. Webbing construction

C. Zee multi-purpose first aid kit, plastic, full (ANSI) 0098

1. Packaged in plastic case with handle

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine products after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The light fixtures shall be installed in accordance with manufacturer's published instructions.

END OF SECTION 00 73 19

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.1 SUMMARY

- A. Project: ZEROW HOUSE: Zero-Energy Rowhouse, Rice University 2009 Solar Decathlon
- B. Owner: Rice University School of Architecture
- C. Architect: Rice University Solar Decathlon Team
- D. Mission: Our team recognizes that for the majority of the house's built lifetime the ZEROW HOUSE will reside in Houston. Thus, the house is designed to withstand the rigors of Houston's high-heat, high-humidity climate. Since the Solar Decathlon entry is based on a specific neighborhood and a specific client base within Row Houses CDC, the house is also designed to meet the needs of low-to-moderate income residents of the Third Ward. The ZEROW HOUSE is designed as a modern re-imagining of the shotgun-style row house which will be able to produce all the energy needed for its operation on-site.

END OF SECTION 01 11 00

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 – ACCESS TO SITE

1.1 Rice University Field

- A. Requirements: Only authorized construction personnel contractors, and Rice University Solar Decathlon team members are allowed on site during construction unless otherwise authorized by the Rice University Solar Decathlon team.
- B. Unauthorized Access: Any persons attempting to access the site without authorization are to be asked to leave in a polite manner. Failure to leave will result in their expulsion (see Criminal Entry).
- C. Criminal Entry: If unauthorized personnel refuse to leave, or if there are visible signs of theft and/or criminal entry, notify the police immediately.

PART 2 – COORDINATION WITH OCCUPANTS

2.1 Rice University Field

- A. Requirements: Rice University Solar Decathlon team members and construction personnel are to comply with any requests made by Rice University. The job site remains the property of Rice University at all times during construction and is to be treated as such.

PART 3 – USE OF SITE

3.1 Rice University Field

- A. Requirements: The site is to be used only for construction of ZEROW HOUSE and storage of related materials unless otherwise authorized. Construction personnel may not sleep overnight in, dwell within, or otherwise occupy the job site without authorization.
- B. Special Events: The site will be used several times during construction to house special events which showcase the ZEROW HOUSE. Construction may be halted during these events. Notification will be given by project management as to the date of such events and their impact on construction.

END OF SECTION 01 14 00

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 – FIELD OFFICES AND SHEDS

1.1 Rice University Field

- A. Available Offices and Storage: The Rice University School of Architecture provides temporary Work Box deployed on the site which will be utilized by the construction management and procurement groups.
- B. Securing Offices and Sheds: The Work Box is to be securely locked at the end of each construction day. The last personnel to leave the site are responsible for securing all doors and locks before leaving.

PART 2 – FIRST AID FACILITIES

2.1 Rice University Field

- A. Requirements: General first aid kits will be made available on site at all times. Personnel are responsible for checking on the condition and quantity of materials in the first aid kits at the beginning of each week during construction.

END OF SECTION 01 52 00

SECTION 01 55 00
VEHICULAR ACCESS AND PARKING

PART 1 – PARKING AREAS

1.1 Definitions

- A. Front (of site): The side facing soccer field and accessible from the road, marked by a gate
- B. Rear: The site opposite to the front gate

1.2 Rice University Field Parking

- A. Requirements: All construction personnel and project visitors should park in available spaces at Rice University for permanent parking (West Lot or Greenbriar Lot). Personnel should avoid parking for longer than necessary along the curb close to the site, as this route will be used for Rice University inner loop public vehicular circulation.
- B. Long Term Parking: The construction site is not meant for long term parking. Rice University, The School of Architecture, Rice University Solar Decathlon Team, and any contractors on site are not responsible for damage to vehicles left on site overnight or after construction has ceased for the day.

PART 2 – TRAFFIC CONTROL

1.1 Moving Vehicles

- A. Requirements: All personnel are required to move their vehicles at the request of the contractor, procurement officers, or any other personnel attempting to navigate delivery trucks into the site.
- B. Unauthorized Vehicles: Vehicles not belonging to Rice University employees, Rice University Solar Decathlon Team, or authorized construction personnel may be towed.
- C. Suspicious Vehicles: Construction personnel should notify the police immediately if any suspicious looking vehicles arrive on or are left at the job site. Personnel should not attempt to approach suspicious vehicles on their own.

1.2 Access Gates

- A. Codes: All personnel will be issued a gate code to enter the construction site. This code is not to be given to anyone not authorized to be on the site.

PART 3 – STAGING AREAS

1.1 Rice University Field Parking

- A. Facilities: Staging facilities will be created at the front of the site marked by front gate and gravel base. All deliveries and trucks are to be directed to the staging area for unloading.

END OF SECTION 01 55 00

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Galvanized Structural Steel Chassis

B. Product Data: Submit Manufacturer's printed product data and specifications

1.2 SUBMITTALS

A. Shop Drawings. Show details for chassis components.

1. Include plans and details of metal fabrication and connections. Show anchorage and accessory items.
2. Indicate compliance with design loads, structural analysis data signed and sealed by the qualified professional engineer responsible for its preparation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Berger Iron Works, Inc.**
1411 Bonner Street
Houston, TX 77007
P.O. Box 7628
Houston, TX 77270-7628
Phone: 1-713-869-7386

END OF SECTION 05 12 00

SECTION 05 52 00
METAL RAILINGS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

- A. Structural Performance: Provide railings capable of withstanding structural loads required by ASCE 7.

1.2 SUBMITTALS

- A. Detailed drawings indicating dimensioning, configuration details and handle height.

PART 2 – PRODUCTS

2.1 METALS

- A. Steel, Extruded Angles and Tubing, sizes indicated in drawings.
- B. Bolts, nuts, and washers.

PART 3 – EXECUTION

3.1 FABRICATION AND INSTALLATION

- A. Assemble railing modules on site
- B. Cut and drill module components, per drawing specification, when needed; verify dimensions in field
- C. Weld railing components in specified locations.
- D. Bolt railing modules in place, to each other, the rails and the deck structure; secure handrail

3.2 FINISHES

- A. Steel Railings: Clean and apply a clear acrylic seal to all raw metal.

END OF SECTION 05 52 00

SECTION 05 59 00
METAL SPECIALTIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Corrugated Metal Exterior Cladding
2. Greenwall Weldmesh
3. Fabricated Steel Planter Box Panels
4. Fabricated Steel Fins
5. Sun Shade Structure

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
2. ASTM C 236 Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
3. ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the specimen
4. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

B. American Iron and Steel Institute (AISI)

1. Specification for the Design of Cold-Formed Steel Structural Members

C. American Institute of Steel Construction (AISC)

1. Code of Standard Practice

D. American Society of Civil Engineers (ASCE)

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

1.3 SYSTEM DESCRIPTION

A. Exterior Cladding Design Requirements:

1. Uninsulated single-skin exposed fastener metal wall panel system.
2. Wall panel system shall be manufactured and installed to withstand specified design loads and maintain performance requirements without defects, damage, or failure.

1.4 SUBMITTALS

- A. Product data, test reports, certifications in accordance with quality assurance and performance requirements specified.
 - 1. MBCI PBC Corrugated Steel
http://www.mbc.com/new/panel_pbc.html
 - 2. McNichols .18" Weldmesh
<http://www.mcnichols.com/products/wiremesh/weldmesh/>
- B. Panel shop drawings consisting of design and erection drawings, finish specifications, and other data. Include, small scale layouts of panels and large-scale details of edge conditions, joints fastener and sealant placement, flashing, penetrations, and special details.
- C. Submit structural design calculations, in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members, for the metal wall panel system.
- D. Custom fabricated items should indicate compliance with design loads, structural analysis data signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be unloaded and stored per the manufacturer's instructions to prevent damage due to handling and weather.

1.6 WARRANTIES

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship for a period of two years from date of shipment.
- B. Paint Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish, in accordance with the paint supplier's standards.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. MBCI Headquarters
14031 West Hardy
P.O. Box 38217
Houston, TX 77238
Toll Free: 1-877-713-6224
Website: <http://www.mbc.com/>

B. McNichols
2402 North Rocky Point Drive Suite 950
Tampa, FL 33607-1421
Phone: 1-813-282-3828 x 2100
Website: <http://www.mcnichols.com/>

C. Campo Sheet Metal Works, Inc.
6811 Lindbergh
Houston TX 77087
Phone: 1-713-645-1567
Website: <http://www.camposheetmetal.com>

2.2 PRODUCTS

- A. MBCI PBC Corrugated Steel Panels with 24 gauge galvalume finish, exposed fasteners
- B. McNichols .18" Weldmesh 5' x 10' trimmed to 4' x 10'
- C. ¼" steel fins, plasma cut and folded with 1-5/8" unistrut pieces
- D. Planter boxes, 18 gauge galvanized steel panels with 1.5" steel angles for riveted to frame
- E. Shade structure, supports, tubes, connections, etc.

3.1 INSTALLATION

- A. Install in accordance to manufacturer detailed assembly procedures required to achieve the structural, thermal, and weathering performance specified.
- B. Metals filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.

END OF SECTION 05 59 00

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Treated Wood Framing Members
2. SYP Wood Framing Members
3. CDX Plywood Sheathing

1.2 SUBMITTALS

- A.** Detailed drawings indicating dimensioning, configuration, and structural notes
- B.** Manufacturer Data including link to Manufacturer Safety Data Sheets and Product Treatment Specification Guide
<http://www.osmosewood.com/micropro/images/MPSSConstructionProductSpecGuide.pdf>

1.3 QUALITY ASSURANCE

- A.** Source Quality: Obtain micronized copper quaternary preservative-treated products from a single approved source
- B.** Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section which has specialized in the treatment of wood similar to that required for this project, licensed by the manufacturer and listed on ICC Evaluation Services, Inc. ESR—1980.
- C.** Quality Mark: All micronized copper quaternary preservative treated wood members shall bear an end tag or permanent ink stamp indicating Osmose Inc., Symbol “Micronized Copper Quaternary Compounds, ESR-1980 AA-696, monitored by a third party inspection Timber Products Inspection

1.4 DELIVERY, STORAGE AND HANDLING

- A.** General: Comply with Product Requirement Sections
- B.** Exposure: Allow materials exposed to incidental moisture to dry thoroughly prior to covering with vapor or moisture-retarding finish materials

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Treated Framing Lumber
 - 1. Osmose, Inc.
P.O. Drawer O
1016 Everree Inn Road
Griffin, GA 30224-0249
Phone: 1-800-241-0240
Website: www.osmose.com

2.2 PRODUCTS

- A. MicroPro “Smart Sense” Preservative-Treated Wood Products
 - 1. Preservative-Treated Materials: AWPALumber, labeled by an inspection agency approved by ALSC’s Board of Review. Waterborne, micronized copper quaternary preservative system meeting the following standards:
 - a. AWPALAnalytical Standards used in the quality control of MicroPro/Smart Sense treated wood
- B. Southern Yellow Pine Wood Framing Members
- C. Plywood Sheathing: Grade CDX
 - 1. Subfloor: ¾” tongue and groove cdx plywood
 - 2. Exterior Wall Sheathing: ½” cdx plywood
 - 3. Roof Deck: 5/8” cdx plywood

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install frame in accordance with manufacturer’s recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
- B. Installer to provide appropriate anchorage device and to securely and rigidly fit frame in place, absolute level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. Install treated wood using hot dipped galvanized steel, stainless steel, or other fasteners and hardware as recommended by the hardware manufacturer and in compliance with codes.
- D. If necessary, adjust hardware for proper operation.
- E. Protect micronized copper quaternary preservative-treated wood from damage due to subsequent construction activity.

- F. Nail plywood to comply with APA recommendations and as shown on drawings.
- G. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.

3.2 ATTACHMENT AND ANCHORAGE

- A. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between the members. Install fasteners without splitting wood; pre-drill as required. Tighten bolts and lag screws at installation and re-tighten as required for tight connections prior to closing in or at completion of all work.

END OF SECTION 06 10 00

SECTION 06 16 00 SHEATHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Cement Board Wall Sheathing

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI A118.9: Specification for Cementitious Backer Units

B. American Society for Testing and Materials:

1. ASTM C 1325: Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Interior Substrate Sheets
2. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
3. ASTM E 119: Test Method for Fire Tests of Building Construction and Materials.
4. ASTM E 1677: Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

1.3 SUBMITTALS

A. Manufacturer link to product data and literature

http://www.usg.com/navigate.do?resource=/USG_Marketing_Content/usg.com/web_files/products/prod_details/DUROCK_Brand_Cement_Board.htm

1.4 QUALITY ASSURANCE

A. Fire Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested in accordance to ASTM E 119 by an independent testing and inspection agency acceptable to authorities having jurisdiction.

1. Fire Resistance Ratings: Indicated by design designations from UL fire Resistance Directory

1.5 DELIVERY, STORAGE AND MAINTENANCE

A. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. Store all DUROCK Brand Cement Board flat. Do not move unless authorized.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. USG Corporation
c/o Corporate Secretary
125 South Franklin
Chicago, IL 60606-4678
Phone: 1-312-606-4000
Technical Questions:
Phone 1-800-874-7968
Email: usg4you@usg.com
Website: www.usg.com

2.2 PRODUCT

- A. Cementitious Fiber-Mat Reinforced Sheathing: ASTM C 1325, ANSI A 118.9, cementitious backer.
 - 1. Product: Subject to compliance with requirements provided by DUROCK Brand Cement Board by United States Gypsum Company.
- B. Fasteners
 - 1. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and application.

2.3 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self adhesive flashing product consisting of a pliable rubberized asphalt compound, bonded to a high density, cross laminated polyethylene film.
- B. Primer for flexible flashing: product recommended by manufacturer of flexible flashing for substrate

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Coordinate wall sheathing installation with flashing and joint sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.1 PROTECTION

- A. Cementitious Fiber-Mat Reinforced Sheathing: A continuous water barrier must be installed over the studs and lap over the flashing. Weeps must be provided to allow water drainage out of the system at all horizontal terminations.

END OF SECTION 06 16 00

SECTION 06 41 16
PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Kitchen cabinetry
2. Bedroom cabinetry
3. Bathroom cabinetry

1.2 SUBMITTALS

Link to manufacturer's product link

Kitchen:

<http://www.ikea.com/us/en/catalog/products/90049403>
<http://www.ikea.com/us/en/catalog/products/S69811889>
<http://www.ikea.com/us/en/catalog/products/S79811799>
<http://www.ikea.com/us/en/catalog/products/S79811884>
<http://www.ikea.com/us/en/catalog/products/80136882>

Bedroom:

<http://www.ikea.com/us/en/catalog/products/50014028>
<http://www.ikea.com/us/en/catalog/products/90103980>
<http://www.ikea.com/us/en/catalog/products/S09847570>

Bathroom:

<http://www.ikea.com/us/en/catalog/products/S29811848>

1.3 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. IKEA

1-800-434-4532

Website: www.ikea.com

2.2 PRODUCTS

A. Kitchen frames: IKEA Akurum

Kitchen cabinet doors: IKEA Applad

1. Wall cabinet dimensions:

- a. W 30x D 12 x H 18 in.
- b. W 18x D 12 x H 18 in.
- c. W 24x D 12 x H 18 in.
- d. W 15x D 12 x H 18 in.
- e. W 24x D 12 x H 24 in.
- f. W 30x D 12 x H 30 in.
- g. W 15x D 12 x H 30 in.

Base cabinet dimensions:

- h. W 23-7/8 x D 24-1/8 x H 30-3/8 in.
- i. W 15 X D 24-1/8 x H 30-3/8 in.

- 2. Frame: Particleboard, melamine foil
- 3. Back: Fiberboard, Acrylic paint
- 4. Door: Fiberboard, polyester paint

B. Bedroom cabinets: IKEA Pax

Bedroom cabinet doors: IKEA Pax Ballstad

1. Bedroom cabinet dimensions:

- a. W 39-3/8 x D 22 x H 79 in.
- b. W 30-3/8 x D 22 X H 27 in.

- 2. Frame: Particleboard, melamine foil
- 3. Back: Fiberboard
- 4. Door: Particleboard, foil

C. Bedroom cabinet: Akurum

- 1. Wall cabinet dimensions: W 29-1/2 x D 12-7/8 x H 14-3/4 in.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine cabinets after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The cabinets shall be installed in accordance with manufacturer's published instructions.

END OF SECTION 06 41 16

SECTION 06 73 00
COMPOSITE DECKING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Exterior Composite Decking

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Deck assembly shall be designed to withstand live and dead loads in accordance with local building codes and calculated loads required for the scope of the project.

1.3 SUBMITTALS

- A. Detailed drawings indicating dimensioning, configuration, and structural notes
- B. Manufacturer Data including link to Manufacturer Safety Data Sheets and Product Treatment Specification Guide
<http://www.trex.com/origins/>

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary decking materials shall be provided by a single manufacturer specializing in composite decking for at least five years.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Trex decking must be supported with dunnage as placed in bundles
- C. When stacking Trex decking, supports should start at each end of the unit and line up vertically and should be supported on a level plane
- D. Trex should not be stacked higher than 6 units or 12' high

1.6 WARRANTIES

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship and against splintering, splitting, checking, rot, decay and termite damage for a period of twenty five years from date of shipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Trex Company, LLC.
245 Capitol Lane
Winchester, VA 22602
Phone: 1-540-542-6300
Website: <http://www.trex.com>

2.2 PRODUCT

- A. Trex Origins Decking
- B. Composite Deck Screws:
 - 1. Fastener with corrosion resistant coating and reverse upper threading.
 - 2. Fasteners must be long enough to penetrate at least 1-1/2 inch into framing members or other solid backing.
- C. Carriage Bolts:
 - 1. Galvanized or stainless steel bolts, nuts and washers.
 - 2. Bolt diameter shall be as necessary to achieve point loading code requirements.
 - 3. Lengths vary based on material thickness.
- D. Hangers, Brackets and Ties:
 - 1. Galvanized or stainless steel hardware fastened with screws of same metal type.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Confirm that the deck framing is square and has a proper slope.
- C. Check all staircase footing locations and depth clearances near doors before installing decking.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Deck boards may be pre-drilled for easier fastening.

3.3 DECKING INSTALLATION

- A. Install decking in accordance with manufacturer's most current application instructions.
- B. Install all blocking, bracing and brackets prior to installing decking.
- C. Whenever possible, position cut edges away from the most common line of sight. Edges may be beveled or routed as necessary to achieve the desired appearance.
- D. Miter cut all ends so decking lands solidly on deck joists. Fasten at every joist using two fasteners. Locate fasteners at least ½" away from the sides of the decking.
- E. Space deck boards 1/8" to ¼" apart to allow for proper drainage and expansion.

3.4 STAIRCASE INSTALLATION

- A. Install stairs in accordance with manufacturer's most current application instructions.
- B. Install all blocking, bracing and brackets prior to install stairs.
- C. Miter cut all ends so treads land solidly on stringers. Fasten into each stringer using two fasteners. Locate fasteners at least ½" away from the sides of the boards.
- D. Install risers so they rest on top of the preceding and below the succeeding tread.
- E. Space treads 1/8" to ¼" apart to allow for proper drainage and expansion.

3.5 RESTORATION

- A. Replace damaged decking and railings before substantial completion.

3.6 CLEANING

- A. Clean up and dispose of excess materials in accordance with all federal, state and local guidelines.

3.7 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION 06 73 00

SECTION 07 13 26
SHEET WATERPROOFING

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Section includes:

1. Weather Barrier House Wrap Membrane

1.2 REFERENCES

A. ASTM International

1. ASTM D 882: Test Method for Tensile Properties of Thin Plastic Sheeting
2. ASTM D 1117; Standard Guide for Evaluating Non-woven Fabrics
3. ASTM E 84; Test Method for Surface Burning Characteristics of Building Materials
4. ASTM E 96; Test Method for Water Vapor Transmission of Materials
5. ASTM E 2178; Test Method for Air Permeance of Building Materials

B. AATCC – American Association of Textile Chemists & Colorists

1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

C. TAPP

1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
2. Test Method T-460; Air Resistance of Paper (Gurley Hill Method)

1.3 SUBMITTALS

A. Product Data: Submit Manufacturer's printed product data and specifications

B. <https://pactivnet.pactiv.com/ProductCatalog/Rooms/DisplayPages/LayoutInitial?ProductCategory=com.webridge.entity.Entity%5B0ID%5B08C43C5D60EBD611A47E0002A5FBF6DF%5D%5D&Product=com.webridge.entity.Entity%5B0ID%5B934DFD6DE5F0D611A4800002A5FBF6DF%5D%5D&Container=com.webridge.entity.Entity%5B0ID%5B2DA706A17A63AC4CB23EB94E057EBADA%5D%5D>

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by weather barrier manufacturer.

1.5 WARRANTY

A. Manufacturer's Warranty

1. Weather barrier manufacturer's warranty for weather barrier for a period of ten years from date of Substantial Completion.
2. Approval by weather barrier manufacturer for warranty is required prior to assembly installation.
3. For warranty details, review manufacturer's published warranty. The foregoing is merely a brief summary of the warranty and manufacturer's obligations are limited to those set out in the warranty document

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. DuPont
4417 Lancaster Pike
Chestnut Run Plaza 728
Wilmington, DE 19805
Phone: 1-800-448-9835
Website: <http://construction.tyvek.com>

2.2 PRODUCTS

- A. DuPont Tyvek ThermaWrap and assembly components

PART 3 – EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
- B. Install weather barrier prior to installation of windows and doors.
- C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap
- D. Install weather barrier silver side facing air space.
- E. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level
- F. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
- G. Window and Door Openings: Extend weather barrier completely over openings.
- H. Overlap weather barrier : Exterior corners: minimum 12 inches. Seams: minimum 6 inches.

END OF SECTION 07 13 26

SECTION 07 21 00
THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Soft Foam insulation and air barrier system

1.2 REFERENCES

- A. ASTM E84 – Surface burning characteristics of building materials
- B. ASTM C518 – Thermal Resistance
- C. ASTM E283 – Air permeability of core foam
- D. ASMT E96 – Water vapor transmission properties

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturer's printed product data and specifications

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Icynene, Inc.
6747 Campobello Road
Mississauga ON
L5N 2L7 Canada
Phone: 1-800-758-7325
Website: <http://www.icynene.com>

2.2 PRODUCTS

- A. Icynene spray formula: ½ pound density free rise, open celled foam insulation

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Applied by spraying liquid components into an open wall, crawl space, or ceiling surface.
- B. Flexible foam will expand to 100 times its volume and fill every crack and crevice; expands in direction of least resistance, so will not expand outward and damage the wall.
- C. Excess material is trimmed off.

END OF SECTION 07 21 00

SECTION 07 42 13
METAL WALL PANELS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Corrugated Metal Exterior Cladding

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
2. ASTM C 236 Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
3. ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the specimen
4. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

B. American Iron and Steel Institute (AISI)

1. Specification for the Design of Cold-Formed Steel Structural Members

C. American Institute of Steel Construction (AISC)

1. Code of Standard Practice

D. American Society of Civil Engineers (ASCE)

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

1.3 SYSTEM DESCRIPTION

A. Exterior Cladding Design Requirements:

1. Uninsulated single-skin exposed fastener metal wall panel system.
2. Wall panel system shall be manufactured and installed to withstand specified design loads and maintain performance requirements without defects, damage, or failure.

1.4 SUBMITTALS

- A. Product data, test reports, certifications in accordance with quality assurance and performance requirements specified.
 - 1. MBCI PBC Corrugated Steel
[http:// www.mbc.com/new/panel_pbc.html](http://www.mbc.com/new/panel_pbc.html)
- B. Panel shop drawings consisting of design and erection drawings, finish specifications, and other data. Include, small scale layouts of panels and large-scale details of edge conditions, joints fastener and sealant placement, flashing, penetrations, and special details.
- C. Submit structural design calculations, in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members, for the metal wall panel system
- D. Custom fabricated items should indicate compliance with design loads, structural analysis data signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be unloaded and stored per the manufacturer's instructions to prevent damage due to handling and weather

1.6 WARRANTIES

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship for a period of two years from date of shipment.
- B. Paint Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish, in accordance with the paint supplier's standards.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. MSCI Headquarters
14031 West Hardy
P.O. Box 38217
Houston, TX 77238
Toll Free: 1-877-713-6224
Website: <http://www.msci.com>

2.2 PRODUCTS

- A. MBCI PBC Corrugated Steel Panels with 26 gauge galvalume finish, exposed fasteners

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install in accordance to manufacturer detailed assembly procedures required to achieve the structural, thermal, and weathering performance specified.
- B. Metals filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.

END OF SECTION 07 42 13

07 54 23 Thermoplastic Membrane Roofing

PART 1 GENERAL

1.01 DESCRIPTION

- A. The project consists of installing Carlisle's Sure-Weld white FleeceBACK membrane adhered with FAST Adhesive as outlined below:

Apply the Sure-Weld FleeceBACK Adhered Roofing System directly to the new plywood roof deck.

1.02 EXTENT OF WORK

- A. Provide all labor, materials, tools, equipment, and supervision necessary to complete the installation of the Sure-Weld FleeceBACK Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details.
- B. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.
- C. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.
- D. Any contractor who intends to submit a bid using a roofing system other than the approved manufacturer must submit for pre-qualification in writing fourteen (14) days prior to the bid date. Any contractor who fails to submit all information as requested will be subject to rejection. Bids stating "as per plans and specs" will be unacceptable.

1.03 SUBMITTALS

- A. Prior to starting work, the roofing contractor must submit the following:

1. Shop drawings showing layout, details of construction and identification of materials.
2. A sample of the manufacturer's Membrane System Warranty.

Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.

4. Certification from the membrane manufacturer indicating the membrane thickness over the reinforcing scrim (top ply membrane thickness) is nominal .015" (15 mil).
5. Certification of the manufacturer's warranty reserve.

- B. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.
- B. Comply with the manufacturer's written instructions for proper material storage.
 - 1. Store Sure-Weld membrane in a dry, cool, shaded area in the original undisturbed plastic. Sure-Weld membrane that has been exposed to the elements for approximately 7 days must be prepared with Sure-Seal Weathered Membrane Cleaner prior to hot air welding.
 - 2. Store curable materials (adhesives and sealants) between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.
 - 3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
- C. Insulation must be on pallets, off the ground and tightly covered with waterproof materials.
- D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.05 WORK SEQUENCE

- A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.
- B. Do not disrupt activities in occupied spaces.

1.07 EXISTING CONDITIONS

If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.09 TEMPORARY FACILITIES AND CONTROLS

- A. Temporary Utilities:
 - 1. Water, power for construction purposes and lighting are available at the site and will

2. Provide all hoses, valves and connections for water from a source designated by the owner when made available.
3. When available, electrical power should be extended as required from the source. Provide all trailers, connections and fused disconnects.

B. Temporary, Sanitary Facilities

Sanitary facilities will not be available at the job site. The roofing contractor shall be responsible for the provision and maintenance of portable toilets or their equal.

C. Building Site:

1. The roofing contractor shall use reasonable care and responsibility to protect the building and site against damages. The contractor shall be responsible for the correction of any damage incurred as a result of the performance of the contract.
2. The roofing contractor shall remove all debris from the job site in a timely and legally acceptable manner so as to not detract from the aesthetics or the functions of the building.

D. Security:

Obey the owner's requirements for personnel identification, inspection and other security measures.

1.10 JOB SITE PROTECTION

- A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide canvas, boards and sheet metal (properly secured) as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.
- B. During the roofing contractor's performance of the work, the building owner will continue to occupy the existing building. The contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary, temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.
- C. Do not overload any portion of the building, by either use of or placement of equipment, storage of debris, or storage of materials.
- D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.
- E. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales

- F. Store moisture susceptible materials above ground and protect with waterproof coverings.
- G. Remove all traces of piled bulk material and return the job site to its original condition upon completion of the work.

1.11 SAFETY

The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.12 WORKMANSHIP

- A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.
- B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.
- C. There shall be a supervisor on the job site at all times while work is in progress.

1.13 QUALITY ASSURANCE

- A. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.
- B. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- C. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.
- D. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and an experienced superintendent on the job at all times roofing work is in progress.
- E. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by written certification on manufacturer's letterhead and presented for the specifier's consideration.
- F. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to

determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

1.14 JOB CONDITIONS, CAUTIONS AND WARNINGS

Refer to Carlisle's Sure-Weld FleeceBACK Adhered Roofing System specification, Part II - Application, for General Job Site Considerations.

- A. Material Safety Data Sheets (MSDS) must be on location at all times during the transportation, storage and application of materials.
- B. Do not apply FAST 100 Adhesive when surface and/or ambient temperatures are below 40°F.

When using FAST 102 Adhesive in heated spray equipment, the adhesive cannot be applied unless surface and/or ambient temperatures are 32°F or warmer. When using FAST 102 Adhesive in non-heated spray equipment, surface and/or ambient temperatures must be 60°F or warmer.

- C. Drums of FAST 100 and FAST 102 Adhesive must be a minimum of 70°F at the time of use. Use drum band heaters when necessary.
- D. The contractor must exercise caution during adhesive spraying to avoid overspray.

Use a non-atomizing spray tip such as the Glas-Craft V-Force or Gusmer Fountain Tip and/or reduce spray pressure to 500 – 800 psi to increase adhesive droplet size and reduce airborne mist. Maintain hand held wind screens on-site for use as necessary.

- E. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.
- F. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.
- G. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.
- H. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.
- I. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

- K. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.15 WARRANTY

- A. Provide manufacturer's (10 year / 15 year) Total System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of (80, 90, 100 or 120 mph) measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.
- B. Pro-rated System Warranties shall not be accepted.
- C. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

PART 2 PRODUCTS

2.01 GENERAL

- A. All components of the specified roofing system shall be products of Carlisle SynTec Incorporated or accepted by Carlisle as compatible.
- B. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

2.02 MEMBRANE

Furnish Sure-Weld white FleeceBACK membrane. Membrane sheets are 12 feet wide and 50' or 100' long.

2.04 ADHESIVES, CLEANERS AND SEALANTS

All products shall be furnished by Carlisle and specifically formulated for the intended purpose.

- A. Foam Adhesive: Sure-Seal FAST• Adhesive
- B. Cleaning Solvent: Weathered Membrane Cleaner
- C. Edge Sealant: Cut-Edge Sealant (only required where reinforcement scrim extends to edge of membrane)

PART 3 EXECUTION

3.01 GENERAL

- A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, job site considerations and weather restrictions.
- B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.03 MEMBRANE PLACEMENT AND BONDING

- A. Position and unroll successive sheets and align to provide a minimum 2 inch overlap (use pre-marked overlap line) along the selvage edge. At end laps (along the width of the sheet), membrane shall be butted together which will be overlaid with 6 inch wide Sure-Weld Reinforced Membrane and hot air welded on all edges.
- B. FleeceBACK Membrane shall be fully adhered to an acceptable substrate with Carlisle FAST Adhesive. The adhesive is spray applied to the substrate only and the membrane is rolled into the wet adhesive once it has foamed up approximately 1/8". Roll the membrane with a weighted (100 - 150 pounds) steel roller to set the membrane into the adhesive.

Note: Exercise care to prevent overspray onto the membrane. If FAST Adhesive should contaminate the splice area, immediately (while the adhesive is still in liquid form) clean with Weathered Membrane Cleaner or allow FAST Adhesive to cure and remove with a paint-type scraper.

3.04 MEMBRANE SPLICING – HOT AIR WELDING

- A. General

The FleeceBACK membrane has a selvage edge (the fleece-backing is discontinued) along the length of the sheet for membrane splicing. Selvage edges are not provided along the width of the membrane; adjoining membrane sheets must be butted together and overlaid with 6 inch wide Sure-Weld Reinforced membrane heat welded on all sides.

- B. Hot Air Welding Procedures

1. Hot air weld the Sure-Weld FleeceBACK membrane using an Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's specifications. At all splice intersections, roll the seam with a silicone roller to ensure a continuous hot air welded seam. (Note: When using .060" thick membrane, all splice intersections shall be overlaid with Sure-Weld non-reinforced flashing)
2. Probe all seams once the hot air welds have thoroughly cooled (approximately 30 minutes).
3. Repair all seam deficiencies the same day they are discovered.

4. Apply Cut Edge Sealant on all cut edges of reinforced membrane (where the scrim reinforcement is exposed) after seam probing is complete. Cut Edge Sealant is not required on vertical splices.

3.05 FLASHING

- A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using Sure-Weld reinforced membrane. Sure-Weld non-reinforced membrane can be used for flashing pipe penetrations, Sealant Pockets, and scuppers, as well as inside and outside corners, when the use of pre-molded accessories is not feasible.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.07 DAILY SEAL

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- B. Use FAST Adhesive or other similar material in accordance with the manufacturer's requirements.

3.08 CLEAN UP

- A. Perform daily clean up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION 07 54 23

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Section includes:

1. Flashing, drip flashing, and accessories
2. Sealants
3. Fastening Devices

1.2 CODES

- A.** Installation procedures should follow all applicable ASTM and IRC codes.
- B.** Installation procedures should follow all applicable manufacturer handling procedures.

1.3 QUALITY ASSURANCE

- A.** Check for manufacturer guarantee
- B.** Warranty should be by manufacturer. Note any handling of product that would make warranty void and follow instructions.

PART 2 – PRODUCTS

2.1 PRODUCTS

- A.** 3/16" Rolled Zinc Flashing panels from sheet metal
- B.** Hardware required for proper installation

2.2 SHEET MATERIALS

- A.** Acceptable flashing material to be used by desired manufacturer.

PART 3 – EXECUTION

3.1 INSPECTIONS

- A.** Inspect products upon arrival for defects.
- B.** Materials should be stored in appropriate place to prevent damage.

3.2 INSTALLATION

- A. Follow all installation instructions provided by manufacturer
- B. Follow all assembly instructions according to IRC.

END OF SECTION 07 62 00

SECTION 07 71 33
MANUFACTURED SCUPPERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Metal Scupper System

1.2 CODES

A. Installation procedures should follow manufacturer details

B. Installation procedures should follow all applicable ASTM and IRC codes

PART 2 – PRODUCTS

2.1 PRODUCTS

A. 3/16" Zinc Scuppers

PART 3 – EXECUTION

3.1 INSPECTIONS

A. Inspect products upon arrival for deficiencies and correct quantity

3.2 INSTALLATION

A. Follow all installation instructions provided by manufacturer.

END OF SECTION 07 71 33

SECTION 08 12 16
ALUMINUM FRAMES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Aluminum framing system, complete with reinforcing, shims, anchors and attachment devices

1.2 SUBMITTALS

- A.** Detailed drawings indicating dimensioning, direction of swing, configuration, typical head jamb, side jambs, sill details, type of glazing material, and handle height
- B.** Product Data including link to manufacturer's literature independently tested data listing performance criteria and Owner's Manual with installation instructions.
http://vistawall.com/dcma/system_html_pages/38h2700_pg2.htm

1.3 DELIVERY, STORAGE AND HANDLING

- A.** Deliver materials to job site in sealed, unopened cartons or crates. Protects units from damage. Store material under cover, protected from weather and construction activities.

1.4 WARRANTY

- A.** Provide manufacturer's standard warranty against defects in materials and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A.** Vistawall Architectural Products
803 Airport Rd
Terrell, Texas 75160
Phone: 1-800-869-4567
Website: <http://vistawall.com>

2.2 PRODUCTS

- A.** Storefronts 1" Glass, HP225 Head Sill Runs Through – 2 ¼" x 7" Front Set Outside Glazed, Clear Anodized Finish

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and applicable provisions of AAMA Aluminum Curtain Wall Design Guide Manual.
- B. Align assemblies plumb and level, free of warp or twist, aligning with adjacent Work.
- C. Tolerances:
 - 1. Limit variations from plumb and level:
 - a. 1/8-inch in 20'-0" vertically and horizontally.
 - b. 1/4-inch in 40'-0" either direction.
 - 2. Limit offsets in theoretical end-to-end and edge-to-edge alignment:
 - a. 1/16-inch where surfaces are flush or less than 1/2 inch out of flush and separated by not more than 2 inches.
 - b. 1/8-inch for surfaces separated by more than 2 inches.
 - 3. Step in face: 1/16-inch maximum.
 - 4. Jog in alignment: 1/16-inch maximum.
 - 5. Location: 1/4-inch maximum deviation of any member at any location.
 - 6. Tolerances are not accumulative.
- D. Provide attachments and shims to permanently fasten system to building structure.
- E. Anchor securely in place, allowing for required movement, including expansion and contraction.
- F. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with protective coating or preformed separators to prevent contact and electrolytic action.
- G. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weather-tight construction.

END OF SECTION 08 12 16

SECTION 08 13 16 ALUMINUM DOORS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Aluminum doors complete with hardware and thresholds

1.2 SUBMITTALS

- A. Detailed drawings indicating dimensioning, direction of swing, configuration, typical head jamb, side jambs, sill details, type of glazing material, and handle height
- A. Product Data including link to manufacturer's literature independently tested data listing performance criteria and Owner's Manual with installation instructions.
http://vistawall.com/dcma/system_html_pages/std_ws500_sa_ohcc_1in.htm

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Protects units from damage. Store material under cover, protected from weather and construction activities.

1.4 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Vistawall Architectural Products
803 Airport Rd
Terrell, Texas 75160
Phone: 1-800-869-4567
Website: <http://vistawall.com>

2.2 PRODUCTS

- A. Entrances Standard Doors with 1" Glass, WS-500 No Frames – Single Acting – Overhead Concealed Closer

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
- B. Installer to provide appropriate anchorage device and to securely and rigidly fit frame in place, absolute level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. If necessary, adjust hardware for proper operation.

END OF SECTION 08 14 00

SECTION 08 51 13
ALUMINUM WINDOWS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Aluminum windows complete with hardware
 - 2. Awning windows, clear anodized finish, with screens

1.2 SUBMITTALS

- A. Detailed drawings indicating dimensioning, direction of swing, configuration, typical head jamb, side jambs, sill details, type of glazing material, and handle height
- B. Product Data including link to manufacturer's literature independently tested data listing performance criteria and Owner's Manual with installation instructions.
<http://www.ramind.com/awningwindows.html>

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Protects units from damage. Store material under cover, protected from weather and construction activities.

1.4 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. RAM Industries, Inc.
13119 Mula Ct.
Stafford, Texas 77477
Phone: 1-281-495-9056
Website: <http://www.ramind.com>

2.2 PRODUCTS

- A. Operable Window System S990 awning windows, clear anodized finish

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
- B. Installer to provide appropriate anchorage device and to securely and rigidly fit frame in place, absolute level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. If necessary, adjust hardware for proper operation.

END OF SECTION 08 51 13

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Interior Gypsum Panels
2. Joint Compound
3. Drywall Screws
4. Joint Tape
5. Drywall Adhesive

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. C 79 – 2001 Standard Specification for Treated Core and Non-treated Core Gypsum Board
2. C 954 – 2004 Specification for Steel Drill Screws for the Application of Gypsum Panel Products
3. C 1280 – 2004 Standard Specification for Application of Gypsum Sheathing
4. C 1396 – 2006 Standard Specification for Gypsum Board
5. E 84 – 2005 Standard Test Method for Surface Burning Characteristics of Building Materials
6. E 119 – 2000 Test Method for Fire Tests of Building Construction and Materials
7. E 1677 – 2005 Standard Specification for an Air Retarder (AR) Material or System For Low-Rise Framed Building Walls

B. Gypsum Association (GA)

1. 253 – Recommended Specification for the Application of Gypsum Sheathing

1.3 SUBMITTALS

- A. Product Data:** detail sheets, for each proposed product type, which provide necessary information to describe the product and its performance.
http://www.usg.com/navigate.do?resource=/USG_Marketing_Content/usg.com/web_files/products/prod_details/SHEETROCK_Brand_Gypsum_Panels.htm
- B. Manufacturer's installation instructions and guidelines,** located in the CUSD Operations and Maintenance Manual
- C. Manufacturer's Owner Manual** outlining recommended care and maintenance procedures, located in the CUSD Operations and Maintenance Manual.

- D. Design Data: Construction document detail drawings. Drawings shall be read before beginning installation and referenced during the installation process.

1.4 QUALITY ASSURANCE

- A. Fire Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested in accordance to ASTM E 119 by an independent testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Fire Resistance Ratings: Indicated by design designations from UL "Fire Resistance Directory".

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Materials shall be delivered to site in manufacturer's unopened bundles, fully identified with name, brand, type and grade.
- B. Acceptance at Site:
 - 1. Inspect bundles upon arrival to site, immediately report any damaged or missing materials directly to the manufacturer.
- C. Storage and Protection
 - 1. All materials shall be delivered in their original unopened packages and stored in a location designated by the Construction Coordinator.
 - 2. All gypsum board should be stored flat.
 - 3. Panels are heavy and can fall over, causing serious injury or death. Do not move unless authorized by Construction Coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. USG Corporation
c/o Corporate Secretary
125 South Franklin
Chicago, IL 60606-4678
Phone: 1-312-606-4000
Technical Questions:
Phone 1-800-874-7968
Email: usg4you@usg.com
Website: <http://usg.com>

2.2 INTERIOR WALL

A. Sheetrock Brand Regular Gypsum Panels:

Gypsum sheathing with water-resistant-treated core and with water repellant paper bonded to core's face, back, and long edges.

1. Type and Thickness: Regular, ½ inch
2. Edge and End configuration: Square
3. Size: 48 by 108 inches (for wall height of 108 inches)
4. Installation: Vertical (stud walls)
5. Frame Spacing: 24 inches o.c. for parallel application
6. Space screws a maximum of 16 inches apart and at least 3/8 inches from ends and edge of panels.

B. Additional Products

1. Application
 - a. 1 ¼ inch Type W Bugle Head Screws
 - b. Galvanized Steel Corner Bead (external corners)
 - c. L-shaped metal trim for ½ inch panels (around doors)
 - d. Paper faced metal bead and trim
2. Finishing
 - a. GreenZip tape
 - b. All Purpose Ready Mixed Joint compound

C. Sheathing, Joint, and Penetration Treatment Materials

1. Apply elastomeric sealant to joints and fasteners. Seal all penetrations and openings with sealant specified in Section 07 92 00 – Joint Sealants

2.3 BATHROOM WALLS

A. Sheetrock Brand Gypsum Panels – Water Resistant

1. Type and Thickness: Regular, ½ inch
2. Edge and End configuration: Square
3. Size: 48 by 108 inches (for wall height of 108 inches)
4. Installation: Vertical (stud walls)
5. Frame Spacing: 24 inches o.c. for parallel application
6. Space screws a maximum of 16 inches apart and at least 3/8 inches from ends and edge of panels.

B. Additional Products

1. Application

- a. 1 ¼ inch Type W Bugle Head Screws
- b. Galvanized Steel Corner Bead (external corners)
- c. L-shaped metal trim for ½ inch panels (around doors)
- d. Paper faced metal bead and trim

2. Finishing

- a. Joint tape
- b. All Purpose Ready Mixed Joint compound

C. Sheathing, Joint, and Penetration Treatment Materials

- 1. Apply elastomeric sealant to joints and fasteners. Seal all penetrations and openings with sealant specified in Section 07 92 00 – Joint Sealants

PART 3 – EXECUTION

3.1 INSTALLATION GENERAL

- D. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- F. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- G. Do not bridge building expansion joints, cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with ASTM C 1280, GA-253 and manufacturer's written instructions located in the CUSD Operations and Maintenance Manual.
- B. Fasten sheathing to wood substrate with screws
 - 1. Install boards with a 3/8 inch gap where non-load-bearing construction abuts structural elements.
 - 2. Install boards with a ¼ inch gap where they abut materials that might retain moisture, to prevent wicking.

3. Space screws maximum of 12 inches apart on ceilings, 16 inches apart on walls and at least 3/8 inches from ends and edges of panels.
- C. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- D. Horizontal installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards

3.3 SHEATHING JOINT AND PENETRATION TREATMENT

- A. Apply elastomeric sealant to joints and fasteners. Seal all penetrations and openings.

3.4 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by flashing manufacturer.
 2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
 4. Lap weather-resistant building paper over flashing at heads of openings.
 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrate.

3.5 PROTECTION

- A. When applied to a structure, sheathing must not be left exposed to the elements for more than one month unless all gaps resulting from cuts, corners, joints and machine-end cuts of the sheathing are filled with an elastomeric sealant at the time of erection to protect the sheathing from water intrusion. This treatment will extend exposure time to six months. Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing barrier securely fastened to framing. Apply covering immediately after installation of sheathing.

END OF SECTION 09 21 16

SECTION 09 34 13
WATERPROOF MEMBRANE CERAMIC TILING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Ceramic tiling

1.2 REFERENCES

- A. ANSI A108.6, 1999 – Specifications for Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and -Grouting Epoxy.
- B. ANSI A118.10, 1999 – Load bearing, Bonded, Waterproof Membranes for Thinset Ceramic Tile and Dimensional Stone.
- C. ANSI A137.1, 1988 – Specifications for Ceramic Tile.

1.3 SUBMITTALS

- A. Product Data: detail sheets, for the proposed product type, which provide necessary information to describe the product and its performance, installation methods, storage handling requirements and recommendations
http://www.arcat.com/sdspeccs/htm04/09_30_00dal.htm
- B. Storage and handling requirements and recommendations
- C. Drawings indicating tile layout, arrangements, and junctions
- D. Maintenance Data: Recommended cleaning methods, cleaning materials, stain removal methods

1.4 QUALITY ASSURANCE

- A. Maintain one copy each of all Referenced standards and specifications on site. Include the TCA Handbook, ANSI A108 Series, ANSI A118 Series ANSI A136.1 and ANSI A137.1 and others as specified under paragraph References.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions. Maintain ambient and substrate temperature of 50 degrees F during installation of materials.

- C. Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. DalTile Corporation
7834 C.F. Hawn Fwy.
P.O. Box 170130
Dallas, TX 75217
Phone: 1-800-933-TILE
1-214-309-4535
Website: <http://www.daltileproducts.com>

2.2 PRODUCT

- A. Daltile Keystone Select Ceramic Tile, moisture absorption 0 to 0.5 percent 1" square, 1/4" thickness, cushioned edges, with trim pieces, at floor
- B. 4"x4" glazed tile with misc. cove and trim at shower walls

2.3 SETTING MATERIALS

- A. Standard Grout: Cement grout as specified in ANSI A118.7

PART 3 – EXECUTION

3.1 INSPECTIONS

- A. Verify that sub-floor surfaces are dust-free, and free of substances which would impair bonding of setting materials to sub-floor surfaces, and are smooth and flat within tolerances specified in ANSI A137.1
- B. Verify that sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

1.3 INSTALLATION

- A. Install tile and grout according to manufacturer's instructions and requirements of ANSI A108.1 through 108.13.
- B. Cut and fit tile to penetrations through tile, leaving sealant joint spaces. Form corners and bases neatly. Align floor joints.

- C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, or excess grout.
- D. Over wood substrates, install in accordance with TCA Handbook Method F142, with standard grout, unless otherwise indicated.
 - 1. Where grout is indicated, install in accordance with TCA Handbook Method F143.
- E. Allow tile to set for a minimum of 48 hours prior to grouting.
- F. Grout tile joints. Use standard grout unless otherwise indicated.
- G. Tiles are to be placed over installed cement backer board.

3.6 SHOWER WALLS

- A. At shower receptor, install in accordance with TCA Handbook Method B412 over units with waterproof membrane.
- B. Grout with standard grout as specified above

END OF SECTION 09 34 13

SECTION 09 62 23
BAMBOO FLOORING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following

1. Bamboo Flooring

1.2 SUBMITTALS

- A. Product Data, certifications and test reports in accordance with quality assurance and performance requirements specified.

http://tomkt.com/html/bamboo/b_specs_so.htm

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Protects units from damage. Store material under cover, protected from weather and construction activities.

1.4 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. To Market
3844 N. W. 8th Street
Oklahoma City, Oklahoma 73107
Phone: 1-866-772-4772

2.2 PRODUCTS

- A. Preserve Bamboo High Density Flooring

3.1 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions.

END OF SECTION 09 62 23

SECTION 09 91 23
INTERIOR PAINTING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Painting and coating for new construction:
 - Interior Primer
 - Interior Wall Paint
 - Interior Trim Paint

1.3 REFERENCES

- A. Green Seal Standard GS-11; May 20, 1993.
- B. MPI (APL) - Master Painters Institute.
- C. SCAQMD 1168 - South Coast Air Quality Management District Rule #1168; October 3, 2003.
- D. SSPC (PM1) - Steel Structures Painting Manual, Vol. 1, Good Painting Practice; Society for Protective Coatings; 1993, Third Edition.
- E. SSPC (PM2) - Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Society for Protective Coatings; 1995, Seventh Edition.
- F. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

1.4 SYSTEM DESCRIPTION

- A. Use low VOC products to minimize impact on indoor air quality

1.5 SUBMITTALS

A. Product Data: product sheet, product description and use

1. Interior Latex Primer Sealer

http://www.benjaminmoore.com/bmpsweb/portals/bmps.portal?_nfpb=true&_windowLabel=contentrender_1_7&contentrender_1_7_actionOverride=%2Fbm%2Fcms%2FContentRenderer%2FrenderContent&contentrender_1_7cnp=public_site%2Farticles%2Fproduct_articles%2Fpa_int_environmentally_friendly&contentrender_1_7np=productcatalog%2Fproduct_pages%2Fpaint%2Fprd_231&_pageLabel=fa_productspecs

2. Interior Latex Flat

http://www.benjaminmoore.com/bmpsweb/portals/bmps.portal?_nfpb=true&_windowLabel=contentrender_1_7&contentrender_1_7_actionOverride=%2Fbm%2Fcms%2FContentRenderer%2FrenderContent&contentrender_1_7cnp=public_site%2Farticles%2Fproduct_articles%2Fpa_int_environmentally_friendly&contentrender_1_7np=productcatalog%2Fproduct_pages%2Fpaint%2Fprd_219&_pageLabel=fa_productspecs

3. Interior Latex Semi-Gloss

http://www.benjaminmoore.com/bmpsweb/portals/bmps.portal?_nfpb=true&_windowLabel=contentrender_1_7&contentrender_1_7_actionOverride=%2Fbm%2Fcms%2FContentRenderer%2FrenderContent&contentrender_1_7cnp=public_site%2Farticles%2Fproduct_articles%2Fpa_int_environmentally_friendly&contentrender_1_7np=productcatalog%2Fproduct_pages%2Fpaint%2Fprd_224&_pageLabel=fa_productspecs

B. Manufacturer's instructions: Indicate special surface preparation procedures.

C. Maintenance Data: Submit data on cleaning, touch-up and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

D. All painting work shall be performed in accordance with manufacturer's instructions.

E. Painting shall only be performed when surface is dry and when weather conditions are satisfactory. Comply with paint manufacture's recommendations for environmental conditions in which paint materials can be applied.

F. Do paint where dust is generated before the coatings are thoroughly dry.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint materials in sealed, labeled containers, indicating manufacturer's name, product name, type of paint and color.
- B. Store paint materials labeled containers in a locked storage area that maintains a minimum ambient temperature of 45 degrees F. Storage shall also be well ventilated to eliminate the build-up of fumes.
- C. Waste Management and Disposal:
 - 1. Comply with local regulations for disposal of all paint materials including paint, stain, wood preservative finishes, solvents, and other related materials.
 - 2. Recycle paint as available in jurisdiction. Separate materials by type. Where paint recycling is not available, materials shall be treated as hazardous waste and disposed in an appropriate manner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Benjamin Moore & Co.
101 Paragon Drive
Montvale, NJ 07645
Phone: 1-800-708-9181
Website: <http://benjaminmoore.com>

2.2 PRODUCT

- A. Interior Primer: One Coat- Eco Spec Interior Latex Primer Sealer #231 (MPI Listed Product, Category 149)
- B. Interior Finish Coat: Two Coats- Eco Spec Interior Latex Flat #219 (MPI Listed Product, Category 143)
- C. Interior Finish Coat: Two Coats- Eco Spec Interior Latex Semi-Gloss #224

PART 3 – EXECUTION

3.1 APPLICATION

- A. Paint or coating – Comply with manufacturer's published recommendation for application
- B. found in the operations manual.
- C. Clean surface before applying primer or first paint coat.
- D. Stir paint thoroughly before use.

- E. Apply one to two coats evenly. The finished work shall show no cloudiness, spotting, holidays, laps, brush marks, runs, curtains, sags, or other imperfections.
- F. Touch up and patch surfaces as required after completion of work by other trades.
- G. Dispose of properly. Dry, empty containers may be recycled in a can recycling program.

3.2 INDOOR AIR QUALITY

- A. Maximize ventilation during application and drying
- B. Painting should be performed prior to the installation of absorbent material such as carpeting and ceiling tile.
- C. Applicators shall wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.
- D. Painting must be completed a minimum of 48 hours prior to occupancy.

END OF SECTION 09 91 23

SECTION 11 28 00
OFFICE EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Materials and methods necessary to install a computer

1.2 SYSTEM DESCRIPTION

A. Personal computer system for data communications.

1.3 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Model number
2. Rough dimensions and utility connections
3. List of maintenance parts
4. installation guide
5. Storage and handling requirements and recommendations

http://h18000.www1.hp.com/products/quickspecs/12768_na/12768_na.PDF

<http://h20000.www2.hp.com/bizsupport/TechSupport/SupportTaskIndex.jsp?lang=en&cc=us&prodTypeId=321957&prodSeriesId=3442856&taskId=115>

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Hewlett-Packard Company

3000 Hanover Street
Palo Alto, CA 94304-1185
Phone: (650) 857-1501
Website: <http://welcome.hp.com>

2.2 PRODUCTS

A. HP Compaq 6820s Notebook PC

1. Dimensions: 15.60 x 11.22 x 1.27 in.

2. Weight: 6.5 lb
3. Display size: 17.0-inch diagonal
4. Hard Drive: 160 GB 5400-rpm ATA
5. Power Supply: 90-watt AC Adapter
6. Battery: 6-cell, 55 WHr Lithium-Ion
7. ENERGY STAR qualified

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine computer immediately after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The computer shall be installed in accordance with manufacturer's published instructions.
- B. Manufacturer's installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 11 28 00

SECTION 11 31 13
RESIDENTIAL KITCHEN APPLIANCES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Range
2. Range Hood
3. Refrigerator
4. Dishwasher
5. Oven

1.2 REFERENCES

A. Environmental Protection Agency (EPA)

1. Energy Star Appliances

1.3 SUBMITTALS

A. Links to manufacturer's published data sheet, including:

1. Owner's Manual
2. Warranty Guides
3. Installation Instructions
4. **Energy Guide**

Range:

http://products.geappliances.com/MarketingObjectRetrieval/Dispatcher?RequestType=PDF&Name=321303_jp202dww_r2.pdf

Range Hood:

<http://www.broan.com/ImageLibrary/broan/pdf/Specifications/99041044.pdf>

Refrigerator:

<http://us.sanyo.com/Large-Apartment-Size/Frost-Free-Apartment-Size-Refrigerator-and-Freezer>

Dishwasher:

http://products.geappliances.com/MarketingObjectRetrieval/Dispatcher?RequestType=PDF&Name=350515_gsmnww_bb_c2.pdf

Oven:

<http://www.ikea.com/us/en/catalog/products/70110496>

1.4 QUALITY ASSURANCE

A. Comply with applicable local codes and regulations.

B. Provide appliances with the EPA Energy Star label where specified.

- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Acceptance at Site

- 1. Inspect appliances upon delivery. Report any damaged or missing components.

B. Packing, Shipping, Handling and Unloading

- 1. Store appliance in manufacturer's packaging until ready for installation.

C. Storage and Protection

- 1. Store packed appliances in a fully enclosed structure that will provide protection from exposure to wind, rain, moisture, and ultraviolet light. The storage surface must be level and sound.

1.6 PROJECT CONDITIONS

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Range

GE Appliance Service
1-800-848-7620
Website: www.hotpoint.com

B. Rangehood

Broan-NuTone, LLC.
P.O. BOX 140
Hartford, WI 53027
Phone: 1-800-558-1711
Website: www.broan.com

C. Refrigerator

SMC General Sales & Online Sales Service
3333 Sanyo Road
Forrest City, Arkansas 72335
Phone: 800-877-5036
Website: <http://us.sanyo.com>

D. Dishwasher

GE Appliance Service
1-800-848-7620
Website: www.geappliances.com

- E. Oven
IKEA
1-800-434-4532
website: www.ikea.com

2.2 PRODUCTS

- A. Range: GE Built-In Electric Cooktop JP202DWW
 - 1. Dimensions: w 21-1/4 x h 3 x d 16-5/8 in.
 - 2. White finish
- B. Range Hood: Broan Under Cabinet Hood 402108
 - 1. Dimensions: w: 24 in
 - 2. 160 CFM
 - 3. White finish
- C. Refrigerator: Frost-free Apartment-Size Fridge and Freezer SANYO SR-1031
 - 1. Dimensions: w 23 5/8 x h 58 5/8 x d 27 in.
 - 2. White finish
 - 3. Capacity: 10.3 cu. Ft. cold storage capacity
- D. Dishwasher: GE Built-In Dishwasher GSM1860NWW
 - 1. Dimensions: w 18 x h 32.5 x d 22.5 in.
 - 2. White finish
 - 3. Capacity: 8 place settings
- E. Oven: Built-in Ikea MUMSIG OBI S50 W
 - 1. Dimensions: w 23-3/8 x h 23-3/8 x d 22-1/4 in.
 - 2. White finish
 - 3. Capacity: 3.1 cu. ft.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's data and installations sheets located in the CUSD Operations manual for additional instruction.

END OF SECTION 11 31 13

SECTION 11 31 23
RESIDENTIAL LAUNDRY APPLIANCES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Stackable washer and dryer front loading unit

1.2 REFERENCES

A. Environmental Protection Agency (EPA)

1. Energy Star Appliances

1.3 SUBMITTALS

A. Links to manufacturer's published data sheet, including:

1. Owner's Manual
 2. Warranty Guides
 3. Installation Instructions
- Energy Guide

Washer:

<http://www.maytag.com/catalog/product.jsp?src=Washers&cat=18&prod=14>

Dryer:

<http://www.maytag.com/catalog/product.jsp?src=Dryers&cat=17&prod=60>

Stacker:

http://www.maytag.com/catalog/accessory_product.jsp?prod=1576&successful_search=MAL2424AXX

1.4 QUALITY ASSURANCE

- A. Comply with applicable local codes and regulations.
- B. Provide appliances with the EPA Energy Star label where specified.
- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Acceptance at Site

1. Inspect appliances upon delivery. Report any damaged or missing components.

B. Packing, Shipping, Handling and Unloading

1. Store appliance in manufacturer's packaging until ready for installation.

C. Storage and Protection

1. Store packed appliances in a fully enclosed structure that will provide protection from exposure to wind, rain, moisture, and ultraviolet light. The storage surface must be level and sound.

1.6 PROJECT CONDITIONS

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Maytag Customer Service
533 Benson Road
Benton Harbor, MI 49022
Phone: (866) 616-2601
Website: www.maytag.com

2.2 PRODUCTS

A. Front-Loader Washer: MAH2400AWW

1. Dimensions: w 23.75 x h 33.25 x d 25.20 in.
2. Capacity: 2.4 cu. Ft.
3. ENERGY STAR qualified
4. Water factor: 5.85
5. White finish

B. Front-Loader Dryer: MDE2400AYW

1. Dimensions: w 23.75 x h 34.00 x d 23.75 in.
2. Capacity: 4.0 cu. Ft.
3. White finish

C. Stacker Kit :MAL2424AXX

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Inspect appliances upon delivery. Report any damaged or missing components.
- B. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sizes and utility requirements.
- C. If substrate preparation is the responsibility of another installer, notify Architect of

unsatisfactory preparation before proceeding.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Remove all packing and shipping bolts before beginning installation. Use the provided wrench to remove the four packing bolts and keep both the wrench and bolts for future use.
- B. Close the holes left by the packing bolts with the supplied caps.
- C. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:
 - 1. Securely mount to substrate. Spacing of 1 inch on all sides of the washer is recommended to reduce noise transfer.
 - 2. Install appliances plumb and level in proper relationship to adjacent construction. Allowable slope under the entire washer is 1 inch
 - 3. Connect appliances to building utility, supply and waste systems as applicable.
 - 4. Test for proper operation and drainage. Adjust until proper operation is achieved.
- D. Refer to manufacturer's data and installation sheets located in the CUSD Operations Manual for additional instruction.

END OF SECTION 11 31 23

SECTION 11 52 00
AUDIOVISUAL EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Materials and methods necessary to install a television.

1.3 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Model number
2. Specification
3. Owner's manual

<http://www.tacp.toshiba.com/televisions/product.asp?model=22lv505>

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The Toshiba Accessory Store

2130 Townline Road

Peoria, IL 61615

Phone: 1-800-350-4105

Website: www.toshiba.com

2.3 PRODUCTS

A. Toshiba LCD HDTV with built-in DVD player 22LV505

1. Screen size: 21.9"
2. Pixel resolution: 1680 x 1050
3. Playable disc types: DVD, DVD-R, DVD-RW, CD, CD-R, CD-RW, VCD
4. High gloss black finish
5. Energy Star Qualified

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine product immediately after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The television shall be installed in accordance with manufacturer's published instructions.
- B. Manufacturer's installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 11 52 00

SECTION 12 36 00

COUNTERTOPS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Laminate countertop

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Technical data

<http://www.ikea.com/us/en/catalog/products/50124116>

1.4 QUALITY ASSURANCE

- A. Coordination drawing shall be prepared, indicating:
 - 1. Plumbing work
 - 2. Electrical work
 - 3. Miscellaneous steel for the general work
 - 4. Location of all walls (rated and non-rated), clocking location and recessed wall item etc.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver no components to project site until areas are ready for installation.
- B. Store components in designated sheltered area prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
- D. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.6 MAINTANANCE

- A. Wipe clean with a damp cloth. Use only water or a non-abrasive detergent.
- B. Wipe dry with a clean cloth.
- C. Light stains can be removed with a damp sponge in water or a mild soapy solution, or a fine sandpaper.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. IKEA Houston
7820 Katy Freeway at Antoine
Houston, TX 77024
Phone: 713 688 7867
Website: www.ikea.com

2.2 PRODUCTS

- A. Prager White Countertop
 - 1. Dimensions: L 49 5/8 x D 25-5/8 x T 1-1/2 in.
 - 2. Melamine laminate; particleboard

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

END OF SECTION 12 36 00

SECTION 21 24 16

DRY-CHEMICAL FIRE-EXTINGUISHING EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Fire extinguisher

1.2 SUBMITTALS

A. Product Data: detail sheets, for the proposed product type, which provide necessary information to describe the product and its performance.

<http://www.kidde.com/utcfs/Templates/Pages/Template-53/0,8062,pageld%3D1201%26siteld%3D384,00.html>

B. Qualification Statement: the product exceeds the minimum UL rating required

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Kiddie Residential and Commercial Division
1016 Corporate Park Drive
Mebane, NC 27302
Phone: 1 919 563 5911
Website: <http://www.kiddie.com>

2.2 PRODUCT

A. FX340GW Kiddie Full Home Fire Extinguisher

PART 3 – EXECUTION

3.1 INSPECTIONS

A. Inspect products upon arrival for damage or misuse.

B. Product should be stored in appropriate locations for easy access.

END OF SECTION 21 24 16

SECTION 22 11 23

DOMESTIC WATER PUMPS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Water pump station
2. Well pump

1.2 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Product details
2. Dimensions and measurements
3. Installation instructions

Water pump station:

<http://www.apricuscanada.com/Downloads/Downloads.html>

<http://www.apricuscanada.com/pumpstation.html>

Well pump:

http://www.sears.com/shc/s/p_10153_12605_08302521000P?mv=rr

1.3 DELIVERY, STORAGE AND HANDLING

A. Acceptance at site:

1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.

B. Packing, Shipping, Handling and Unloading

1. Store product in manufacturer's packaging until ready for installation.

C. Storage and Protection

1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Water pump station:
Apricus Offices
965 West Main Street
Branford, CT 06405, USA
Phone: +1 203 488 8215
Website: www.apricus.com
- B. Well pump: manufactured through SEARS Brands, LLC.
3333 Beverly Rd.
Hoffman Estates, IL 60179
Phone: +1 847 286 2500
Website: www.sears.com

2.2 PRODUCTS

- A. Apricus Pump Station
1. Dimension: h 20.86 x w 11.8 in.
 2. Connections: 1" Male NPT
 3. Maximum pressure: 6 Bar / 87 psi
 4. Maximum operation temperature: 284 F
 5. Maximum stagnation temperature: 320 F
- B. Craftsman Professional ½ hp Shallow Well Pre-Plumbed System

Item Weight: 78.0 lbs.

Dimensions:

Depth: 16 in.

Power:

Fuse Rating: 15 amps

Max Amp At 115V: 8.8

Max Amp At 230V: 4.4

Motor Voltage Convertible: Yes

Motor Voltage Factory Preset: 230 volts

Overload Protection: Built-in thermal overload protection

Product Overview:

General Warranty: 3 year limited

Pump:

Gallons Per Minute Rating: Up to 8.2

Horsepower: ½

Pressure Range: 40/60 psi
Tap Size, Discharge: 1 in.
Tap Size, Suction: 1-1/4 in.

Quality:
Construction: Hydro-Glass®

Performance at 40 PSI:
GPM Discharge at 10 ft. depth: 7.3
GPM Discharge at 15 ft. depth: 6.2
GPM Discharge at 20 ft. depth: 5.0
GPM Discharge at 05 ft. depth: 8.2

Tank:
Captive Air Tank Equivalent: 19 gal.
Pipe Size: 1 in.
Tank Size: 19 gal.
Standard Tank Equivalent: 42 gal.
Tank Style: Horizontal
Tank Drawdown at 20/40 PSI: 6.9
Tank Drawdown at 30/50 PSI: 5.8
Tank Drawdown at 40/60 PSI: 5.0

Dimensions:
Height: 30 in.
Length: 27 in.

Installation Requirements:
Setup: Assembly may be required

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 11 23

SECTION 22 12 00

FACILITY GROUND-MOUNTED POTABLE-WATER STORAGE TANKS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Solaraide HE Solar Tank
 - 2. Vertical polyethylene tank
 - 3. Pillow tank

1.2 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Dimensions and measurements
 - 3. Installation instructions

Solaraide HE Solar Tank:

<http://waterheating.rheem.com/content/resources/documents/specsheets/RHSolaraideHE.pdf>

Vertical polyethylene tank:

<http://www.tank-depot.com/productdetails.aspx?part=TC5670IW>

http://www.interstateproducts.com/all_tanks.htm#sizecap

1.3 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Rheem Water Heating
101 Bell Road
Montgomery, Alabama 36117
Website: www.rheem.com
- B. The Tank Depot, Inc.
641 S.W. 7th Street
Pompano Beach, FL 33060
Phone: +1 954 783 0115
Website: <http://www.tank-depot.com>
- C. Interstate Products, Inc.
3921 Sawyer Rd
Sarasota, FL 34233
1 800 474 7294

2.2 PRODUCTS

- A. Solaraide HE Solar Tank 81V80HE-T
 1. Capacity: 80 gall.
 2. Storage Only
 3. Dimensions: h 58 $\frac{3}{4}$ in x diameter 24 $\frac{1}{2}$ in.
 4. Weight: 222 lb.
 5. R-Factor: R-17.3
- B. Rotonics Guido Green Water Tank
 1. Capacity: 600 gallons
 2. Dimensions: D 72 in x H 42 in.
 3. Storage tanks are seamless with one piece construction
 4. Hard-plumbing of plastic tank is not recommended due to the expansive/contractive characteristics of Polyethylene
 5. Designed for containment of water, 8. Lbs/gal.
 6. FDA approved High Density Linear Polyethylene (ANSI/NSF Standard 61)
 7. Containers are impact and corrosion resistant
 8. Compliant with Local, State, and National standards for Fire Protection
 9. Green opaque water storage tanks blend with the environment, provide additional protection from UV rays and reduce algae growth
 10. Comes with a standard 1-1/2 in. spin weld fill and 2 in. Polupropylene discharge adapter.

- A. Interstate Products Pillow Tank
 - 1. Capacity: 750 gallons
 - 2. Dimensions: L 9.4 ft x W 8.4 ft x H 21 in
 - 3. Constructed of NDF 61 approved fabrics for potable water use.
 - 4. 3 in overlap heat-welded and RF-welded seams.
 - 5. Designed for containment of water, 8 Lbs/gallon.
 - 6. 4"aluminum flange connections
 - 7. UV and chemical resistant.
 - 8. Air vent/pressure relief valve included.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 12 00

SECTION 22 33 13

INSTANTANEOUS ELECTRIC DOMESTIC WATER HEATERS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Whole house electric tankless water heater

1.2 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Product details
2. Dimensions and measurements
3. Installation instructions

<http://www.stiebel-eltron-usa.com/tempra.html>

http://www.stiebel-eltron-usa.com/techdata_tempranew.html

1.3 DELIVERY, STORAGE AND HANDLING

A. Acceptance at site:

1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.

B. Packing, Shipping, Handling and Unloading

1. Store product in manufacturer's packaging until ready for installation.

C. Storage and Protection

1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Steibel Eltron, Inc

17 West Street

West Hatfield, MA 01088

Phone: 1 413 247 3380

Website: <http://www.stiebel-eltron-usa.com>

2.2 PRODUCTS

- A. Tempra 12 Plus: Electric tankless water heater
 - 1. Energy factor: .90
 - 2. Efficiency: 90%
 - 3. Dimensions: 16 5/8 x 14 1/2 x 4 5/8 in.
 - 4. Water fittings: 3/4" male NPT
 - 5. Electrical Requirements:
 - a. Volts: 240
 - b. Kilowatts: 12 kW
 - c. Amps: 50
 - d. Wire Size: 6 gauge (2 conductors & ground)
 - e. Phase: Single

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 33 13

SECTION 22 41 13

RESIDENTIAL WATER CLOSET

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. High efficiency toilet

1.2 REFERENCE STANDARDS

- A. ASME A 112. 19.2
- B. ASME A 112.19.14
- C. CSA B45.0
- D. CSA B45.1
- E. EPA WaterSense

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Dimensions and Measurements
 - 2. Rough in Guide
 - 3. Installation and Care Guide with Service Parts'
 - http://www.us.kohler.com/onlinecatalog/pdf/1087557_4.pdf
 - http://www.us.kohler.com/onlinecatalog/pdf/1087557_1.pdf
 - http://www.us.kohler.com/onlinecatalog/pdf/1087557_2.pdf

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Co. Headquarters
444 Highland Dr.
Kohler, WI 53044
Phone: (920) 457 4441
website: www.kohler.com

2.2 PRODUCTS

- A. Persuade two-piece elongated toilet – K-3654
 - 1. Dimension: 27-5/8 L x 14-3/16 W x 31-1/2 H in.
 - 2. Dual Flush flushing technology
 - 3. 0.8 or 1.6 gallon water consumption options
 - 4. WaterSense label: uses at least 20% less water than standard 1.6-gallon toilets

PART 3 – EXECUTION

3.1 PREPARATION

- A. Clean floor and surrounding areas thoroughly prior to installation.
- B. Install waste drain pipe, roughed in: 12"
- C. Install water supply line

3.2 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 41 13

SECTION 22 41 16

RESIDENTIAL LAVATORIES AND SINKS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Residential lavatories and sinks

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including
 - 1. Product details
 - 2. Dimensions and measurements
 - 3. Installation instructions

Bathroom Sink:

<http://www.ikea.com/us/en/catalog/products/40094582>

Kitchen Sink:

<http://www.ikea.com/us/en/catalog/products/S09847462>

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1.1 MANUFACTURERS

- A. IKEA
 - 1-800-434-4532
 - Website: www.ikea.com

2.2 PRODUCTS

A. IKEA HOLLVIKEN

1. Dimensions: w 22-1/2 x d 17-3/8 x h 6-7/8 in.
2. Material: Ceramic
3. Finish: Colored glaze

B. IKEA BOHOLMEN Inset Sink 1-1/2 bowl

1. Dimensions: w 23-5/8 x d 19-5/8 x h 7-1/8 in
2. Material & finish: stainless steel
3. Contains waste strainer

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 41 16

SECTION 22 41 23

RESIDENTIAL SHOWER RECEPTORS AND BASINS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Shower receptor

1.2 REFERENCE STANDARDS

- A. IAPMO R&T (EPA)
- B. ASME A 112.19.1M
- C. CSA B45

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including
 - 1. Dimensions and measurements
 - 2. Installation instructions
 - 3. Rough in guide

http://www.us.kohler.com/onlinecatalog/pdf/1009404_4.pdf

http://www.us.kohler.com/onlinecatalog/pdf/1009404_2.pdf

http://www.us.kohler.com/onlinecatalog/pdf/1009404_1.pdf

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Co. Headquarters
444 Highland Dr.
Kohler, WI 53044
Phone: (920) 457 4441
Website: www.kohler.com

2.2 PRODUCTS

- A. Kohler Purist Shower Receptor K-9026
 - 1. Dimensions: L 48 x W 36 x D 4 in.
 - 2. Cast iron with Safeguard finish
 - 3. Center drain outlet
 - 4. Drop-in or tile-in installation

PART 3 – EXECUTION

3.1 INSTALLATION

- B. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 41 23

SECTION 22 41 39

RESIDENTIAL FAUCETS, SUPPLIES, AND TRIM

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Bathroom sink faucet
2. Kitchen sink faucet
3. Showerhead

1.2 REFERENCE STANDARDS

Bathroom sink faucet:

- A. ADA
- B. ASME A 112.18.1/CSA B125.1
- C. ICC/ANSI A 117.1
- D. Energy Policy Act of 1992
- E. NSF 61
- F. All applicable US Federal and State material regulations

Showerhead:

- A. ASME 112.18.1/CSA B125
- B. IAPMO/cUPC

1.3 SUBMITTALS

Link to manufacturer's published data sheet, including

1. Product details
2. Dimensions and measurements
3. Installation instructions
4. Rough in guide

Bathroom Sink Faucet:

<http://www.ikea.com/us/en/catalog/products/60144166>

Kitchen Sink Faucet:

http://www.us.kohler.com/onlinecatalog/pdf/1048033_4.pdf

http://www.us.kohler.com/onlinecatalog/pdf/1048033_2.pdf

Showerhead:

http://www.us.kohler.com/onlinecatalog/pdf/1100341_4.pdf

http://www.us.kohler.com/onlinecatalog/pdf/1100341_1.pdf

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. IKEA
1-800-434-4532
website: www.ikea.com
- B. Kohler Co. Headquarters
444 Highland Dr.
Kohler, WI 53044
Phone: (920) 457 4441
Website: www.kohler.com

2.2 PRODUCTS

- A. Bathroom sink faucet: IKEA Dalskar with strainer
 - 1. Cartridge with hard, curable ceramic discs/seals
 - 2. Chrome-plated brass
 - 3. With aerator: 2 gal/min.
- B. Kitchen sink faucet: Kohler Simplice pull-down kitchen sink faucet K-647
 - 1. Metal construction
 - 2. Lower flow aerator options available
 - 3. 2.2 gal/min maximum flow rate
- C. Showerhead: Kohler Purist K-997
 - 1. 1.75 gal/min
 - 2. 5-1/2 in diameter sprayface
 - 3. Dimensions: w 5-1/2 x h 3-15/16 in
 - 4. Polished Chrome finish

PART 3 – EXECUTION

3.1 INSTALLATION

- C. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 22 41 39

SECTION 23 34 00

HVAC FANS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Industrial fan

1.3 SUBMITTALS

A. Link to manufacturer's product:

<http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10051&langId=-1&catalogId=10053&productId=100015874&N=10000003+90008+501492+429492606>

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Hampton Bay at Home Depot
6810 Gulf Freeway
Houston, TX 77087
713 649 1108
Website: <http://www.homedepot.com>

2.2 PRODUCTS

- A. Hampton Bay White Industrial Fan Model #92856
1. Assembled depth: 11.5 in.
 2. Assembled height: 10.2 in.
 3. Assembled width: 28.0 in.
 4. Fan width: 60 in.
 5. Blade length: 25 in.
 6. Assembled weight: 21.2 lbs.
 7. Finish: White
 8. Energy Star Compliant
 9. Single capacitor speed control

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine products after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The fan shall be installed in accordance with manufacturer's published instructions.

END OF SECTION 23 34 00

SECTION 23 56 13

HEATING SOLAR COLLECTORS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Apricus evacuated tube solar collector
 - 2. Apricus heat dissipater

1.2 REFERENCE STANDARDS

- A. ISO 9001:2000

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Technical data
 - 3. Installation and operations manual

Solar collectors:

http://www.apricus.com/html/solar_collector.htm

http://www.apricus.com/html/solar_collector_installation_basics.htm

http://www.apricus.com/html/solar_collector_features.htm

http://www.apricus.com/html/solar_collector_technical_info.htm

Heat dissipater:

http://www.apricus.com/html/solar_heat_dissipator.htm

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Apricus Offices
965 West Main Street
Branford, CT 06405, USA
Phone: +1 203 488 8215
website: www.apricus.com

2.2 PRODUCTS

- A. Apricus Evacuated Tube Solar Collector (Thermal solar heating)
 - 1. Manifold casting material: Aluminum (grade 3A21)
 - 2. Frame material: 1.5 mm 304 Stainless Steel
 - 3. Header pipe material: 99.93% pure Copper & Lead free 45% silver brazing
 - 4. Insulation: Compressed glass wool – $K = 0.043 \text{ W/mK}$
 - 5. Rubber Seals and Rings: HTV grade silicone rubber
 - 6. Maximum Operating Pressure: 8 bar – 116 psi
 - 7. Optimal installation angle: 20-70° Vertical, -5° to +5° Horizontal
 - 8. Optimal flow rate: 0.1 L/min/tube – 0.026 G/min/tube
 - 9. Performance Data (SPF): Conversion factor: $h_o = 0.717$;
Loss Coefficients: $a_1 = 1.52$, $a_2 = 0.0085$
- B. Apricus HD-25 Heat Dissipater
 - 1. >1.3 kW heat dissipation capacity
 - 2. Anodized aluminum fins and outer casing
 - 3. Silver brazed copper piping with ½”M BSP inlet and outlet
 - 4. Easy mounting on exterior wall or in roof space
 - 5. Able to be connected in series for greater heat dissipation capacity
 - 6. Minimal pressure drop

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer’s published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 23 56 13

SECTION 23 72 19

FIXED PLATE AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Fantech energy recovery ventilator

1.2 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Technical data
 - 3. Installation and operations manual<http://www.fantech.net/se704n.pdf>

1.3 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Fantech
10048 Industrial Blvd.
Lenexa, KS 66215
Phone: 1 800 747 1762
Website: www.fantech.net

2.2 PRODUCTS

A. Fantech energy recovery ventilator SE704N

1. Weight: 25 lb.
2. Round Ports: Fits 4 in. ducts
3. Drain Diameter: none
4. Installation: wall bracket
5. Motor speeds: Single speed
6. Electrical supply: 115 V, 60 Hz
7. Power consumption: 40 watts

PART 3 – EXECUTION

3.1 INSTALLATION

- ### A.
- Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 23 72 19

SECTION 23 81 26

SPLIT-SYSTEM AIR CONDITIONING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Indoor units – Wall Mounted Unit
 - 2. Outdoor Unit

1.2 REFERENCE STANDARDS

- A. Units tested by Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label
- B. Wiring in accordance with National Electrical Code (N.E.C.).
- C. AHRI STANDARD 240, AHRI Certification Label
- D. ISO 9001
- E. ISO 14001
- F. System efficiency meets or exceeds 14.5 SEER when part of a 1:1 (indoor/outdoor) system

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Operations manual
 - 2. Service manual
 - 3. Installation manual

http://www.mrslim.com/UploadedFiles/Resource/MSZ-A09~17NA_Op_Manu_SG79Y960H03_12-29-08.pdf

http://www.mrslim.com/UploadedFiles/Resource/MSeries_OB450A.pdf

http://www.mrslim.com/UploadedFiles/Resource/Install_MS_MSZ_MSYA09-17%20.pdf

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store and handle unit according to the manufacturer's recommendations.
- B. Ship the wireless controller inside the carton with the indoor unit. It should be able to withstand 105F storage temperature and 95% relative humidity without adverse effect.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi Electric & Electronics USA, Inc.
HVAC Advanced Products Division
3400 Lawrenceville Suwanee Rd.
Suwanee, Georgia 30024
Phone: 800-433-4822
Website: www.mrslim.com

2.2 PRODUCTS

- A. Indoor Unit—Wall Mounted Unit Mitsubishi MXZ2A20NA Combination:
MSZ-A09NA and MSZ-A12NA
 - 1. General:
 - a. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit shall be charged with dry air before shipment from factory.
 - 2. Unit Cabinet:
 - a. The casing shall have a white finish – Munsell 1.0Y 9.2/0.2.
 - b. Multi directional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining shall be standard.
 - c. There shall be a separate, metal back-plate that secures the indoor unit firmly to the wall. The back plate shall be securely attached to the wall.
 - 3. Fan:
 - a. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
 - b. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.
 - c. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right). Units having capacity greater than

18,000 BTU/h shall have a “Wide Vane” feature to distribute airflow over a wide – 150 degree – angle from right to left to provide comfort over a wider area.

- d. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down.
- e. The indoor fan shall operate at of three (3) selectable speeds: High, Medium, and Low

4. Filter:

- a. Return air shall be filtered by means of easily removed, washable, Catechin, Antioxidant Pre-filter and an Anti-allergy enzyme filter – blue, pleated type.

5. Coil:

- a. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
- b. The tubing shall have inner grooves for high efficiency heat exchange.
- c. All tube joints shall be brazed with phoscopper or silver alloy.
- d. The coils shall be pressure tested at the factory.
- e. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil

6. Electrical:

- a. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
- b. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire connection plus ground.
- c. The indoor unit shall not have any supplemental electrical heat elements.
- d. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor motor control for maximum efficiency.

Indoor Unit Combinations	Cooling Capacity (Btu/h)			Power Usage (W)	Energy Efficiency		Current (A)	
	Heating Capacity (Btu/h)				SEER	HSPF	208V	230V
	Unit A	Unit B	Total					
MSZ-A09NA + MSZ-A12NA	8,500	11,500	20,000	2,150	16.0	8.5	10.66	9.64
	9,500	12,500	22,000	1,780			8.82	7.98

B. Outdoor Unit—Mitsubishi MXZ-2A20NA *5

1. General:

- a. The MXZ Series outdoor units are specifically designed to work with the MSZ indoor units. The outdoor units must have a thermally fused powder

coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

2. Unit Cabinet:

- a. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.

3. Fan:

- a. The unit shall be furnished with a direct drive propeller type fan.
- b. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearing.
- c. The fan motor shall be mounted for quiet operation.
- d. The fan shall be provided with a raised guard to prevent contact with moving parts.
- e. The outdoor unit shall have horizontal discharge airflow.

4. Coil:

- a. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
- b. The coil shall be protected with an integral metal guard.
- c. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, leanier expansion valve.

5. Compressor:

- a. The compressor motor shall be direct current (DC).
- b. The compressor shall be of a high performance hermetic; inverter driven, variable speed, rotary type.
- c. The outdoor unit shall have an accumulator.
- d. The compressor will be equipped with an internal thermal overload.
- e. The outdoor unit must have the ability to operate over the full range with a maximum height difference of 40 feet and have refrigerant tubing length of 65 feet for capacities up to 18,000 BTU/h and a maximum height difference of 50 feet and have refrigerant tubing length of 100 feet for capacities above 18,000 BTU/h between indoor and outdoor units.
- f. There shall be no need for line size changes, traps shall not be used, and no additional refrigerant oil shall be required.
- g. The compressor shall be mounted so as to avoid the transmission of vibration.

6. Electrical:

- a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
- b. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
- c. The outdoor unit shall be controlled by the microprocessor located in the indoor unit and outdoor unit.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description.

END OF SECTION 23 81 26

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

A.1 SUMMARY

- A. Section includes the following:
 - 1. Raceways and Conductors
 - 2. Electrical Identification Materials
 - 3. Support and Anchorage Components

1.2 SUBMITTALS: Not applicable

PART 2 – PRODUCTS

2.1 RACEWAY AND CONDUCTORS

- A. Raceways
 - 1. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
 - 2. FMC: Zinc-coated steel.
 - 3. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
 - 4. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
 - 5. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
 - 6. Raceway Fittings: Specifically designed for raceway type used in Project.
 - 7. MC: Metallic Cable pre-wired flex conduit.
- B. Conductors
 - 1. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
 - 2. Conductors, Larger than No. 10 AWG: Stranded copper.
 - 3. 3. Insulation: Thermoplastic, rated at 75 deg C minimum.
 - 4. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

- A. Raceway Identification Materials
 - 1. Snap-around, color-coding bands; flexible, pre-printed, color-coded acrylic.
 - 2. Self-adhesive, color-coding vinyl tape; flexible, pre-printed, self-adhesive vinyl.
- B. Conductors Identification Materials:
 - 1. Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.

- C. Tape Markers for Wire: Vinyl, self-adhesive, wraparound type with pre-printed numbers and letters.
- D. Warning Labels and Signs: Baked-enamel, pre-printed signs, punched or drilled for fasteners; with colors, legend, and size required for application.
- E. Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.
 - 1. Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers

2.3 SUPPORT AND ANCHORAGE COMPONENTS

- A. Steel Slotted Support Systems: MFMA-3, factory-fabricated components for field assembly.
- B. Raceway and Cable Supports: As described in NECA 1.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings
- D. Pipe Sleeves: Schedule 40, galvanized steel, plain ends.
- E. Mounting, Anchoring, and Attachment Components:
 - 1. Expansion Anchors: Steel, insert-wedge type, for use in concrete.
 - 2. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element
 - 3. Through Bolts: Structural type, hex head, high strength; comply with ASTM A 325.
 - 4. Toggle Bolts: All-steel springhead type.
 - 5. Hanger Rods: Threaded steel.
 - 6. PV Mounting System: Aluminum.
 - 7. PV Clamping System: Aluminum.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION:

- A. Sleeve and Sleeve Seals: Use type and number of sealing elements recommended by manufacturer; comply with NECA 1.

3.2 RACEWAY APPLICATION

- A. Outdoor Installations:
 - 1. Exposed or Concealed: IMC
 - 2. Underground, Single Run: RNC
 - 3. Connection to Vibrating Equipment: LFMC
 - 4. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4
- B. Indoor Installations:
 - 1. Exposed or Concealed: MC
 - 2. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC
 - 3. Damp or Wet Locations: IMC
 - 4. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.

3.3 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- C. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1 inch thick concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- D. Install pull wires in empty raceways.
- E. Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent.
- F. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch maximum length of flexible conduit. Install LFMC in wet or damp locations.

3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- A. Feeders: Type THHN/THWN insulated conductors in raceway.
- B. Underground Feeders and Branch Circuits: Type THWN or single-wire, Type UF insulated conductors in raceway.
- C. Branch Circuits: Type THHN/THWN insulated conductors in raceway.
- D. Branch Circuits: Type THW or THHN/THWN insulated conductors in raceway where exposed. Metal-clad cable where concealed in ceilings and gypsum board partitions.
- E. Branch Circuits: Type THW or THHN/THWN insulated conductors in raceway where exposed. Armored or nonmetallic sheathed cable where permitted by authorities having jurisdiction and where concealed in ceilings and gypsum board partitions.
- F. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.

3.5 APPLICATION OF IDENTIFICATION MATERIALS

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with snap-around color-coding bands:
 - 1. Fire Alarm System: Red.
 - 2. Security System: Blue and yellow
 - 3. Telecommunication System: Green and yellow.
- B. Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.
- C. Locations of Underground Lines: Identify with underground-line warning tape for power lighting, communication, and control wiring.
- D. Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- E. Equipment Identification Labels:
 - 1. Labeling Instructions: Provide a single line of text with 1/2-inch- high letters on 1-1/2-inch high label.
 - 2. Equipment to Be Labeled:
 - a. Panel boards

- b. Electrical switchboard
- c. Transformers
- d. Motor starters
- e. Push-button stations.
- f. Contactors.
- g. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.6 INSTALLATION OF IDENTIFICATION MATERIALS

- A. Verify identity of each item before installing identification products.
- B. System Identification Color Banding for Raceways and Cables: At 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

3.7 INSTALLATION OF SUPPORTS

- A. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.
- B. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated fl or and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 26 05 00

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 SUMMARY

1.2 REFERENCE STANDARDS

A. Comply with NEMA PB 1

B. Comply with NFPA 70

1.3 SUBMITTALS: Not applicable

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Outdoor-mounted, NEMA 3R, Type 1

1. Front: Secured to box with concealed trim clamps.
2. Doors: With concealed hinges, flush catches,
3. Bus: Hard-drawn copper, 98 % conductivity for each phase
4. Extra-Capacity Neutral Bus: Rated 200 % of phase bus, and UL listed as suitable for nonlinear loads
5. Main and Neutral Lugs: Type suitable for use with conductor material.
6. Extra-Capacity Neutral Lugs: Rated 200 % of phase lugs.
7. Equipment Ground Bus: Bonded to box.
8. Feed-through Lugs: Type suitable for use with conductor material.

B. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work."

C. Panelboard Short-Circuit Rating: UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.2. PANELBOARD

A. Panel: Siemens Load Center W3040L1200CU

2.3. MAIN DISCONNECT

A. Disconnect: Cutler Hammer 150A Main Lug Loadcenter, CH2L125RP 120/240V Single Phase.

2.4. COMPONENTS

- A. Molded-Case Circuit Breaker: NEMA AB 1 thermal-magnetic type; UL 489 with series connected rating and interrupting capacity to meet available fault currents.
 - 1. Appropriate for application; Type SWD for switching; Type HACR for heating, air-conditioning, and refrigerating equipment loads.
 - 2. GFCI Circuit Breakers: Single- and two-pole type with 30-mA trip sensitivity.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessory items according to NEMA PB 1.1. Indicate installed circuit loads on a typed circuit directory after balancing panelboard loads.
- B. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 16 Section “Basic Electrical Materials and Methods” for seismic-restraint requirements.
- C. Mount top of trim 74 in. above finished floor, unless otherwise indicated.
- D. More Than Three Current-Carrying Conductors in a Raceway or Cable. Where the number of current-carrying conductors in a raceway or cable exceeds three, or where single conductors or multiconductor cables are stacked or bundled longer than 600 mm (24 in.) without maintaining spacing and are not installed in raceways, the allowable ampacity of each conductor shall be reduced as shown in Table 310.15(B)(2)(a). Each current-carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable Number of Current-Carrying Conductors Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.1 SUMMARY

1.2 REFERENCE STANDARDS

- A. Comply with NFPA 70

1.3 SUBMITTALS: Not applicable

PART 2 – PRODUCTS

2.1 DEVICES

- A. General: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Color: White.
- C. Receptacles: General-Duty grade, NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
- D. Ground-Fault Circuit Interrupter Receptacles: Feed-through type, with integral duplex receptacle complying with UL 498 and UL 943; for installation in a 2-3/4-inch- deep outlet box without an adapter.
- E. Snap Switches: General-duty, quiet type, DSCC W-C-8896F and UL 20.
- F. Wall Plates: Satin-finish stainless steel, fastened with metal screws having heads matching plate color on kitchen backsplash. All other finished areas: white with white screw heads.
- G. Wall Plates, Unfinished Areas: Galvanized steel with metal screws.
- H. Wall Plates, Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet locations.
 - 1. Modular, flush-type, dual-service units suitable for wiring method used.
 - 2. Service Plate: Rectangular, die-cast aluminum with satin finish.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb, level, and square with building lines.
- B. Install unshared neutral conductors on line and load side of dimmers.
- C. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top, unless otherwise indicated. Group adjacent devices under single, multigang wall plates.

END OF SECTION 26 27 26

SECTION 26 31 00

PHOTOVOLTAIC COLLECTORS

PART 1 – GENERAL

3.1 SUMMARY

A. Section includes the following:

1. Photovoltaic panels
2. Photovoltaic panels racking system
3. Photovoltaic AC disconnect

1.2 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Product data sheets
2. Installation and maintenance guide

Solar panels:

<http://www.bp.com/sectiongenericarticle.do?categoryId=9019635&contentId=7036949#7129953>

Photovoltaic panels racking system:

http://www.unirac.com/pdf/sm_datash.pdf

Photovoltaic AC disconnect:

1.3 QUALITY ASSURANCE

A. Certifications:

1. Photovoltaic panels: IEC-61215
2. SolarMount HD: PE certified
3. PV disconnect: UL listed

1.4 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection

1. Store panels in manufacturer's unopened package until ready for installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. BP Solar International, Inc.
630 Solarex Court
Frederick, MD 21703
Phone: 1 301 698 4200
Website: <http://www.bp.com/modularhome.do?categoryId=8050&contentId=7035481>
- B. Unirac, Inc.
1411 Broadway Boulevard NE
Albuquerque, NM 87102
Phone: 505 242 6411
website: <http://www.unirac.com>
- C. GE Consumer and Industrial
Appliance Park
AP3-232
Louisville, KY 40225
1 502 452 7819

2.2 PRODUCTS

- A. BP Solar BP 175B
 - 1. Generals:
 - 1. Dimensions: l 62.8 x w 31.1 x h 1.97 in.
 - 2. Weight: 33.1 lbs
 - 3. Frame: Aluminum
 - 2. Performance under standard test conditions:
 - a. Maximum power (Pmax): 175 Wp
 - b. Open circuit volage (Voc): 44.2 V
 - c. Maximum power point voltage (Vmpp): 35.8 V
 - d. Short circuit current (Isc): 5.40 A
 - e. Maximum power point current (Impp): 4.9 A
 - 3. Component materials:
 - a. Cells per module: 72
 - b. Cell type: silicon nitride multicrystalline
 - c. Cell dimensions: 125 x 125 mm2

4. System integration parameters:
 - a. Maximum system voltage USA NEC: 600 VDC
 - b. Maximum series fuse rating: 15 A
- B. SolarMount, Unirac
 1. Aluminum Extrusion (6105-T5)
 2. SolarMount HD Rails
 3. Mounting clips and clamps
 4. Tilt legs and L-feet
 5. Two-piece standoffs
- C. GE Heavy Duty Disconnect TH6661
 1. Fusible, 240V, 30A, 6 wire
 2. 4-pole
 3. NEMA 3R enclosure

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrate, areas and conditions where installation of solar panels will occur. Verify that substrate and conditions are satisfactory for installation.

3.2 INSTALLATION

- A. Assemble solar panels and install in accordance with manufacturer's instructions and the following:
 1. Securely mount to substrate
 2. Install solar panels plumb and level and in proper relation to adjacent construction
 3. Test for proper operation. Adjust until proper operation is achieved.
 4. Refer to manufacturer's published installation instruction and construction documents for detailed installation instructions.

3.2 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair or replace damaged work.
- B. Clean installed products in accordance with manufacture

END OF SECTION 26 31 00

SECTION 26 51 13

INTERIOR LIGHT FIXTURES, LAMPS, AND BALLASTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Recessed LED lights
2. LED Under cabinet lights
3. LED flexible linear lights
4. LED wall light

1.2 SUBMITTALS

A. Link to manufacturer's product:

1W diode recessed lights:

<http://www.ledproductsusa.com/stdc141-1A.php>

3W diode recessed lights:

<http://www.ledproductsusa.com/stdc141-3.php>

Under cabinet lights:

<http://www.ikea.com/us/en/catalog/products/50119407>

LED flexible linear lights:

<http://www.jescoled.com/web/catalog.aspx>

LED wall light:

<http://www.ledproductsusa.com/stdc150-1.php>

Fluorescent strip light:

<http://www.cooperlighting.com/common/brands.cfm?pg=Detail&id=13760>

1.3 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Recessed LED lights:
Step1 Deziqns
630 Terminal Way
Costa Mesa, Ca. 92627
1 800 822 8427
- B. Under cabinet lights:
IKEA
1 800 434 4532
website: www.ikea.com
- C. LED flexible linear lights:
Jesco Lighting Group
66-25 Traffic Avenue
Glendale, NY 11385
1 800 527 7796
- D. LED wall lights:
Step1 Deziqns
630 Terminal Way
Costa Mesa, Ca. 92627
1 800 822 8427
- E. Fluorescent strip lights:
Cooper Industries
600 Travis, Suite 5600
Houston, TX 77002-1001
1 713 209 8400

2.3 PRODUCTS

- A. 1W diode recessed: STDC141-1A
 - 1. 1x1 watt fixture
 - 2. Output: 3.2 VDC
 - 3. 3000k (warm white) or 5000k (cool white) color temperatures available
 - 4. 50,000 hour life span
 - 5. Cut-out size: 1-1/4 in.
 - 6. Finish: Satin Nickel

- B. 3W diode recessed: STDC141-3
 - 1. 3x1 watt fixture
 - 2. Output: 9.6 VDC
 - 3. 3000k (warm white) or 5000k (cool white) color temperatures available
 - 4. 50,000 hour life span
 - 5. Cut-out size: 2-5/8 in.
 - 6. Finish: Satin Nickel

- C. Under cabinet lights: IKEA Dioder lighting strip
 - 1. Energy consumption: 6.7 W.
 - 2. Light diodes life approximation: 30,000 hours
 - 3. Length: 9-3/4 in.
 - 4. Material: Polycarbonate plastic
 - 5. Can be connected together up to 4 pieces

- D. LED linear lighting strips: DL-FLEX-UP Static Series
 - 1. Voltage input: 24V DC
 - 2. Watts consumed: 0.9 to 1.4 W/section
 - 3. Dry location only
 - 4. UL/cUL

- E. Striplight: Metalux Cricket T5 Micro
 - 1. Fluorescent
 - 2. 2', 3', 4, or 5'inverted Sm strip

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine products after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The light fixtures shall be installed in accordance with manufacturer's published instructions.

END OF SECTION 26 51 13

DL-FLEX-UP Static Series

LED Linear lighting strips for shelves, coves, and lighting effects

Features and Benefits

- Ultra bright surface-mount LEDs available in 4 Colors and 3 Whites.
- Highly flexible material can be applied to most accessible surfaces.
- Low power consumption, heat, voltage.
- Flexible circuit board technology.
- State of the art LED driver technology ensures consistent illumination levels.
- Mounts with 3M Double sided tape.
- Optional Aluminum mounting channel with clear and opaque covers.
- Smooth 120° light distribution.
- Long life LEDs: 50,000-100,000 hours.
- No ultra violet (UV/IR) radiation.
- No Mercury.

Applications

- Cove and contour marking
- Office, store and restaurant architectural features
- Corporate showrooms and exhibition displays
- Residential shelves and counters
- Accenting point-of-purchase display
- Architectural coves
- Display cases and sign applications
- Backlighting of glass and acrylic panels or cutout forms

Brief Specs

- Voltage input: 24V DC
- Watts consumed: 0.9 to 1.4 W/section
- Dry location only (Consult Factory for Wet)
- UL/cUL

DL-FLEX-UP-(Color Output)

Yellow ●

Red ●

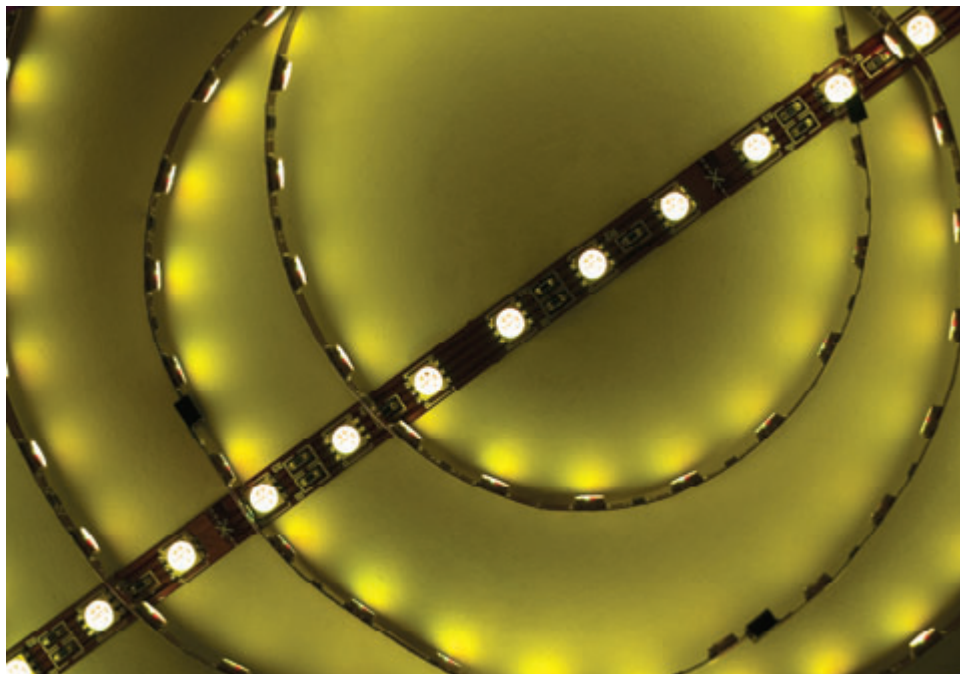
Green ●

Blue ●

3000K ○

4000K ○

6000K ○



Designed originally for jewelry cabinets using 6000K lamps with 120° beam spreads, this new series has expanded rapidly based on the needs of architects, sign-making companies, and display companies. It provides an ease of installation and a quality of output that is currently unequalled.

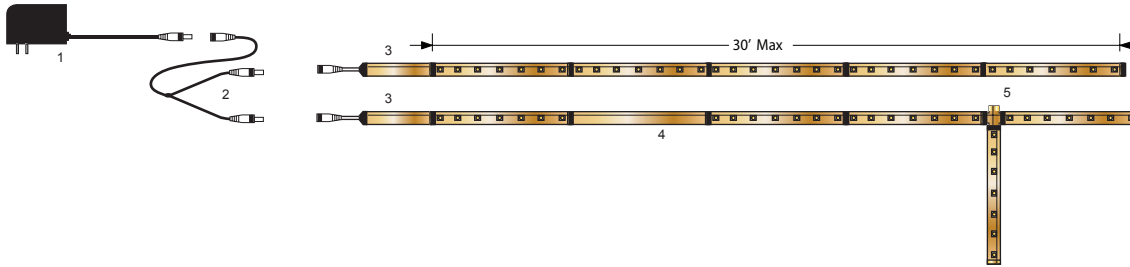
DL-FLEX-UP is a precision lighting system with a sophisticated range of accessories and control options. It packs a surprisingly large punch in a tiny footprint. Created by designers, for designers we have selected the finest quality components for you without compromise in quality. Jesco DL-FLEX-UP is not to be confused with a myriad of look-alikes by others. These product types copy the external design elements of the Jesco product, while missing key details involving long-term performance.

DL-FLEX-UP	
Dimensions (section)	11-3/4"Lx5/16"Wx1/8"H
LED Color	W; Y; R; G; B
Length in Roll	30'
Plug-in Section Length	11-3/4"
LED Spacing	5/8"
No. of LEDs/section	18
Max Watts per Section	1.4W
Maximum Home Run	30'
Maximum Current	54 mA

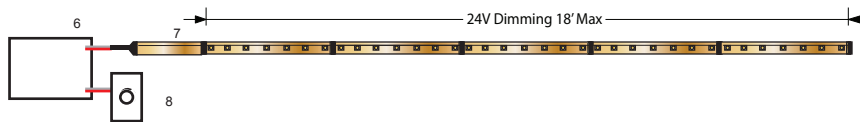
DL-FLEX-UP Static Series

LED Linear lighting strips for shelves, coves, and lighting effects

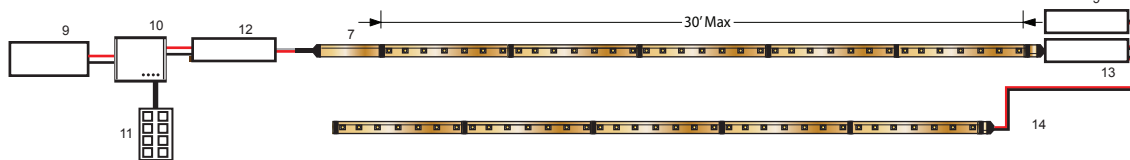
Multiple Run - Plug and Play Power Connection



Single Run - Dimmable Hard-Wire Power Connection



Extended Single Run - Dimmable Hard-Wire Connection with Programmable 8 Button Wallplate



1. DL-PS-24/24WP
2. DL-PS-2Y
3. DL-FLEX-PC
4. DL-FLEX-CC6
5. DL-FLEX-X-CONN
6. DL-PS-25/24-DIM (P.49)
7. DL-PS-PC-HW
8. DL-PS-DS (P.49)
9. DL-PS-XX/XX-HW
10. LC-PC-100 (P.48)
11. DL-LC-KP8-W-8 (P.49)
12. LC-200-INT (P.48)
13. LC-200-RPT (P.48)
14. DL-FLEX-PT-F

Plug and Play Accessories

- | | | |
|---|--------------------|-----------------------------|
| 3 | DL-FLEX-PC | 12" Plug-in power connector |
| | DL-PS-EXT48 | 48" LED driver extension |
| | DL-PS-EXT96 | 96" LED driver extension |
| 2 | DL-PS-2Y | 2-Way split power feed |
| | DL-PS-3Y | 3-Way split power feed |

Plug and Play LED Drivers

- | | | | |
|---|----------------------|-----------|------------------------|
| 1 | DL-PS-WP24/24 | 24W - 24V | LED Driver - Wall Plug |
| | DL-PS-24/24 | 24W - 24V | LED Desktop Driver |
| | DL-PS-36/24 | 36W - 24V | LED Desktop Driver |
| | DL-PS-48/24 | 48W - 24V | LED Desktop Driver |
| | DL-PS-60/24 | 60W - 24V | LED Desktop Driver |

Hard Wire Accessories

- | | | |
|----|-----------------------|--|
| 5 | DL-FLEX-X-CONN | Universal "L", "X" & "T" connector |
| 4 | DL-FLEX-CC6 | 6" Flexible mid-connector |
| 4 | DL-FLEX-CC12 | 12" Flexible mid-connector |
| 7 | DL-PS-PT-M | Male 2-Wire controller input power connector |
| 14 | DL-PS-PT-F | Female 2-Wire controller input power connector |
| 7 | DL-FLEX-PC-HW | 12" Hard-Wire power connector |

Hard Wire LED Drivers

- | | | | |
|---|------------------------|------------|-------------------------|
| 9 | DL-PS-60/24-HW | 60W - 24V | LED Driver - Hard-Wire |
| | DL-PS-60/24-JB | 60W - 24V | LED Driver in J-Box |
| 9 | DL-PS-100/24-HW | 100W - 24V | LED Driver - Hard-Wire |
| | DL-PS-120/24-JB | 120W - 24V | LED Driver in J-Box |
| | DL-PS-150/24 | 150W - 24V | LED Driver - Open Frame |
| | DL-PS-180/24-JB | 180W - 24V | LED Driver J-Box |
| | DL-PS-320/24 | 320W - 24V | LED Driver - Open Frame |

Accessories

- | | |
|-------------------------|--|
| DL-FLEX-CH6 | 6' Mounting channel |
| DL-FLEX-DC6 | 6' Clear dust cover lens |
| DL-FLEX-FL6 | 6' Frosted lens |
| LLMFH-C/C-CH6 | 6' Extruded plastic housing for carpet to carpet |
| LLMFH-C/W-CH6 | 6' extruded plastic housing for carpet to wood |
| DL-FLEX-CH6-CLIP | Mounting Clip for 6' Mounting channel (2 pcs.) |

- For more complex wiring diagrams and further descriptions and specifications please refer to www.jescoled.com.
- Please see Page 48-49 for Lighting Controllers and Dimming Power supplies.
- No connector needed to add the LC-200-RPT to LC-200-INT or LC-180-RF - contractor wiring only.

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. LED ground light
2. LED wall sconce

1.2 REFERENCE STANDARDS

- A. ISO 9001
- B. RoHS (Restriction of Hazardous Substances) Compliant
- C. IP (Ingress Protection) 68 rated

1.3 SUBMITTALS

A. Link to manufacturer's product:

LED ground lights:

<http://www.meteor-lighting.com/images/stories/Spec%20sheet%20for%20SH180%20and%20SH200.pdf>

LED wall sconces:

<http://www.iolighting.com/common/brands.cfm?pg=Detail&brandName=IO&category=wall%20sconce%3A%20cube&id=15178>

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. LED ground lights:

ILOS Corporation
218 Machlin CT., Walnut, CA 91789
213 255 2060
<http://www.meteor-lighting.com>

- B. LED wall sconces:
IO Lighting
1100 Busch PKWY
Buffalo Grove, IL 60089
1 847 777 3900

2.4 PRODUCTS

A. LED Ground Lights SH-200C

1. General:
 - a. Top diameter: 2.7 in.
Bottom diameter: 2.4 in.
Height: 2.2 in.
 - b. Weight: 2.2 in.
 - c. Housing: Stainless steel (SUS304), cast aluminum
 - d. Lens: Bayer super light-permeable PC
 - e. Lighting output: Permanent
 - f. LED pcs: 4
 - g. Optimal rim finish: Brushed/polished stainless steel
2. Operational:
 - a. Switch: Light sensitive auto on/off
 - b. Operation time: Up to 12 hours (direct sunlight) 4~8 hours (overcast)
 - c. Full charge time: 6 hours (direct sunlight)
3. Environmental:
 - a. Compressive strength: 2541 lbs / 1153 kgs (minimum)
 - b. Operating temperature -4F~140F
 - c. Storage temperature: -13F~176F
 - d. Moisture protection: IP68
4. LEDs:
 - a. Lifetime 100,000 hours
 - b. Intensity (mcd): 3000 ~7000 mcd *
 - c. Luminance (lux): 30~300 lux*
 - d. Power consumption: 1.8v~3.3v*
*dependent upon LED color
5. Solar Panel:
 - a. Type: Crystalline panel 2.5v 80mA
 - b. Efficiency: 12% ~15%
 - c. Lifetime: Minimum 2 years
6. Power Storage:
 - a. Type: Ultracapacitor 2.3V 240F
 - b. Lifetime: 10 years
7. Color – White: SH-200C-W: 25 lux (average)

B. LED wall sconce Plane Cube 0-01-C-3K-3K-100-3-0

1. General:
 - a. Body width: 5.9"
Body height: 5.9"
Body depth 2.5"
 - b. Housing: zinc, brushed aluminum
 - c. Lens: polycarbonate, borosilicate glass
 - d. Lighting output: replaceable LED
2. Electrical input
 - a. 120V AC
 - b. 7.5W consumption
3. Color – White- 3000K

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine products after removal from manufacturer's packaging. Report any damaged or missing components directly to the manufacturer.

3.2 INSTALLATION

- A. The light fixtures shall be installed in accordance with manufacturer's published instructions.

END OF SECTION 26 56 00

SECTION 27 20 00

DATA COMMUNICATION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Enphase Envoy Communications Gateway

1.2 REFERENCE STANDARDS

- A. UL 1950, EN 6950
- B. FCC PART 15 CLASS B

1.3 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Dimensions and measurements
 - 3. Installation instructions

http://www.enphaseenergy.com/downloads/Datasheet_Envoy_100308.pdf
<http://www.enphaseenergy.com/support/faqs.cfm>

1.4 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Enphase Energy, Inc.
201 1st Street, Suite 300
Petaluma, CA 94952
Phone: 877 797 4743
Website: www.enphaseenergy.com

2.2 PRODUCTS

- A. Enphase Envoy Communications Gateway
 - 1. AC Outlet: 120 Vac, 60 Hz
 - 2. Power Consumption: 5 Watts
 - 3. Powerline: Enphase Proprietary
 - 4. LAN: 10/100/1000 Auto-sensing, Auto-negotiating
 - 5. Dimensions: w 7.75 x h 5 x d 2.38 in.
 - 6. Weight: 2.0 lbs
 - 7. Cooling: Natural Convection – No Fans
 - 8. Enclosure Environmental Rating: Indoor – NEMA 1

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 27 20 00

SECTION 41 22 13.23

MOBILE CRANES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Mobile Crane

1.2 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Product details
2. Dimensions and measurements

http://www.liebherr.com/at/en/products_at.asp?menuID=106082!3666-0

1.3 DELIVERY, STORAGE AND HANDLING

A. Acceptance at site:

1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
2. Provide appropriate matting material beneath crane feet to comply with required load factors.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Liebherr Cranes, Inc.
4100 Chestnut Ave.
Newport News, VA 23605
United States of America
Phone: +1 757 928 2505
Website: <http://www.liebherr.com>

2.2 PRODUCTS

- A. Liebherr All-Terrain Six-Axle Mobile Crane LTM 1250-6.1
1. Maximum lifting capacity: 585,000 lbs. at 10 ft. radius.
 2. Telescopic boom: 51 feet- 236 feet.

3. Lattice jib: 18 feet- 230 feet.
4. Carrier engine/output: Liebherr, 8-cylinder, turbo-Diesel, 450kW
5. Crane engine/output: Liebherr, 4-cylinder, turbo-Diesel, 180 kW
6. Drive/steering: 12 x 8 x 10
7. Travel speed: 50 mph
8. Operational Weight: 158,730 lbs.
9. Total Counterweight: 214,900 lbs.

PART 3 – EXECUTION

3.1 OPERATION

- A. Assumed weight of assembly to be lifted is 50,000 lbs.
- B. Assumed radius of lift is 74'-0".
- C. Counterweights required total 220,000.
- D. Crane specification to be refined after initial Houston lift has been achieved.

END OF SECTION 41 22 13.23

SECTION 41 65 16

MOBILE GENERATORS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Mobile generator

1.2 SUBMITTALS

A. Link to manufacturer's published data sheet, including:

1. Product details
2. Dimensions and measurements

<http://www.hondapowerequipment.com/products/modeldetail.aspx?page=modeldetail§ion=P2GG&modelname=EB6500&modelid=EB6500XA>

1.3 DELIVERY, STORAGE AND HANDLING

A. Acceptance at site:

1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.

B. Packing, Shipping, Handling and Unloading

1. Store product in manufacturer's packaging until ready for installation.

C. Storage and Protection

1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. American Honda Power Equipment Division

4900 Marconi Dr.

Alpharetta, GA 30005-8847

Phone: +1 770 497 6400

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

2.2 PRODUCTS

A. Honda Generator Model # EB6500XA

1. Engine: Honda GX 390
2. Displacement: 389 cc
3. AC Output: 120/240AV 6500W max. (54.1/ 27.1A) 5500W rated (45.8/22.9A)
4. Receptacles: 20A 125V Duplex (2), 30A 125V Locking Plug, 30A 125/250V Locking Plug
5. DC Output: N/A
6. Starting system: recoil
7. Fuel Tank Capacity: 6.6 gals
8. Run time per Tankful: 5.3 hrs. @ rated load, 10 hrs. @ ½ load
9. Dimensions: L 41.9 x W 27.2 x H 29.2
10. Noise level: 75 dB @ rated load
11. Dry weight: 220 lbs.
12. Residential Warranty: 3 years

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description.

END OF SECTION 41 65 16

SECTION 48 19 16

ELECTRICAL POWER GENERATION INVERTERS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Electrical power generation micro-inverters

1.2 REFERENCE STANDARDS

- A. UL 1741 / IEEE 1547
- B. FCC PART 15 CLASS B

1.2 SUBMITTALS

- A. Link to manufacturer's published data sheet, including:
 - 1. Product details
 - 2. Technical data
 - 3. Installation and operations manual

http://www.enphaseenergy.com/downloads/8261_Datasheet_24_32.pdf

1.2 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at site:
 - 1. Inspect product upon delivery. Report any damaged or missing components directly to the manufacturer.
- B. Packing, Shipping, Handling and Unloading
 - 1. Store product in manufacturer's packaging until ready for installation.
- C. Storage and Protection
 - 1. Store packed product in a safe location as designated by the construction coordinator.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Enphase Energy, Inc.
201 1st Street, Suite 300
Petaluma, CA 94952
Phone: 877 797 4743
Website: <http://www.enphasenergy.com>

2.2 PRODUCTS

- A. Enphase Micro-Inverter: M175-24-240-S01/2
 - 1. General: 24 V Modules: 240 V
 - 2. Dimensions: w 10.5 x h 5.5 x d 1.5 in.
 - 3. Night time power consumption: 580 mW
 - 4. Weight: 4.0 lbs
 - 5. Cooling: Natural Convection – No Fans
 - 6. Enclosure environmental rating: Outdoor – NEMA 6

PART 3 – EXECUTION

3.1 PREPARATION

- A. Clean floor and surrounding areas thoroughly prior to installation.
- B. Install waste drain pipe, roughed in: 12"
- C. Install water supply line

3.2 INSTALLATION

- A. Refer to manufacturer's published installation instructions for detailed installation description. Installation instructions shall be located in the CUSD Operations and Maintenance Manual.

END OF SECTION 48 19 16

RULES COMPLIANCE CHECKLIST

Rule #	Rule Description	Content Requirement(s)	Drawing Sheet(s)	Coordinates
4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	C1.03, C1.04	
4-2	Construction Equipment	Specs for heavy machinery		PM p.133
4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S2.01	
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	S2.03-S2.05	PM p.153
4-5	Generators	Specifications for generators		PM p.135
4-6	Spill Containment	Drawing(s) showing the locations of all equipment, tanks, and pipes that will contain fluids at any point during the event	P1.01-P1.-2	
4-6	Spill Containment	Specifications for all equipment, tanks, and pipes that will contain fluids at any point during the event		PM p.83-90
4-7	Lot Conditions	Calculations showing that structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists		PM p.153
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	S2.03-S2.05	
5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A1.10	
5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	n/a	
6-1	Structural Design Approval	List of, or marking on, all sheets in the complete electronic Construction Documents that have been or will be stamped by the structural engineer in the hard-copy, stamped structural submission; the stamped submission shall consist entirely of sheets or pages that also appear in the complete electronic construction document set		PM p.143
6-2	Maximum Architectural Footprint	Drawing(s) showing all information needed by the Rules Officials to measure the architectural footprint electronically	A1.03	
6-2	Maximum Architectural Footprint	Drawing(s) showing all movable components that may increase the footprint if operated during contest week	n/a	
6-2	Maximum Architectural Footprint	Shading calculations and/or diagrams for components that DO NOT shade the building above its finished floor height between 9 a.m. and 5 p.m. EDT on October 1 (shading calculations and/or diagrams are not necessary for components that are either shorter than finished floor height or obviously do not shade the building)	n/a	
6-3	Minimum Conditioned Space	Drawing(s) showing space conditioning means in primary living spaces	A1.09	

Rule #	Rule Description	Content Requirement(s)	Drawing Sheet(s)	Coordinates
6-4	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	A1.01, A1.11	
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	A1.01	
7-2	Watering Restrictions	Drawings showing the layout and operation of greywater irrigation systems	n/a	
8-1	PV Technology Limitations	Specifications for photovoltaic components		PM p.120
8-1	PV Technology Limitations	Retail price quote for photovoltaic components		PM p.174
8-3	Thermal Energy Storage	Drawing(s) showing the location of thermal energy storage components	M1.01-M1.-2 E1.02-E1.08 P1.01-P1.-4	
8-3	Thermal Energy Storage	Specifications for thermal energy storage components		PM p.83-90, PM p.102
8-3	Thermal Energy Storage	Shading calculations and/or diagrams for thermal energy storage components (if necessary)	P1.01	
8-4	Batteries	Drawing(s) showing the location(s) and quantity of stand-alone, PV-powered devices	n/a	
8-4	Batteries	Specifications for all stand-alone, PV-powered devices	n/a	
8-5	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	n/a	
8-5	Desiccant Systems	Specifications for desiccant system components	n/a	
8-6	Village Grid	Completed Interconnection Application form.		PM p.176
8-6	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	A1.08 E1.02-E1.08	
8-6	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means		PM p.111-122
8-6	Village Grid	One-line electrical diagram	E1.02	
8-6	Village Grid	Calculation of service/feeder net computed load per NEC 220		PM p.171
8-6	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	A.101	
8-6	Village Grid	Elevation(s) showing the terminal box, meter housing, main utility disconnect, and other service equipment	P1.03, E.101 A2.05	

Rule #	Rule Description	Content Requirement(s)	Drawing Sheet(s)	Coordinates
9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	n/a	
9-6	Thermal Mass	Drawing(s) showing the locations of water-based thermal mass systems	n/a	
9-6	Thermal Mass	Specifications for components of water-based thermal mass systems	n/a	
10-2	Event Sponsor Recognition	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	A1.01	PM p.195
10-3	Team Sponsor Recognition	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	A1.01	PM p.195
11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	A1.11	
11-4	Public Exhibit	Drawing(s) showing the dimensions, materials, artwork, and content of the handout		PM p.196
11-4	Public Exhibit	Drawing(s) showing the artwork and content of the team uniform		PM p.197

STAMPED STRUCTURAL DRAWINGS

FASTENER SCHEDULE FOR STRUCTURAL MEMBERS		NUMBER AND TYPE OF FASTENER A, B, C, & D	SPACING OF FASTENERS												
DESCRIPTION OF BUILDING ELEMENTS															
1.	Joint to sill or girder, toe nail	3 - 8d	-----												
2.	Side plate to joist or blocking, toe nail	10 - 4	18" o.c.												
3.	Top or sole plate to stud, end nail	2 - 16d	-----												
4.	Stud to sole plate, toe nail	3 - 8d or 2 - 16d	-----												
5.	Double plate, toe nail	10d	24" o.c.												
6.	Double top plates, toe nail	10d	24" o.c.												
7.	Side plate to joist or blocking at braced wall panels	3 - 16d	18" o.c.												
8.	Double top plates, attachment 48 inch offset of end joints, toe nail is tapered area	8 - 16d	-----												
9.	Blocking between joists or rafters to top plate, toe nail	3 - 8d	-----												
10.	Rifts joist to top plate, toe nail	8d	8" o.c.												
11.	Top plates, tops at corners and intersections, toe nail	2 - 10d	-----												
12.	Ball-up header, two plates with 1/2" spacer	10d	18" o.c. along each edge												
13.	Continuous header, two plates	16d	18" o.c. along each edge												
14.	Cutting joists to plate, toe nail	3 - 8d	-----												
15.	Continuous header to stud, toe nail	4 - 8d	-----												
16.	Cutting joist, tops over partitions, toe nail	3 - 10d	-----												
17.	Cutting joist to parallel rafters, toe nail	2 - 10d	-----												
18.	Rafter to plate, toe nail	2 - 16d	-----												
19.	Ball-up corner studs	10d	24" o.c.												
20.	Ball-up girders and beams, 2-inch lumber layers	10d	Nail each layer as follows: 2" - 16d 2" - 10d 2" - 8d Nail each end of each layer and at each splice.												
21.	2" plates	2 - 16d	At each heading												
22.	Raft rafters to ridge, ceiling or top rafters, toe nail	4 - 16d 2 - 16d toe nail	-----												
23.	Rafter ties to rafters, face	3 - 8d	-----												
<p>NOTE: STRUCTURAL FRAMES, JOIST FLOOR, ROOF AND WALL SHOOKING TO FRAMING ARE PART OF BUILDING WALL SHOOKING TO FRAMING</p> <table border="1"> <tbody> <tr> <td>5/16" - 1/2"</td> <td>8d common nail (see face, web)</td> <td>8</td> <td>12 1/2"</td> </tr> <tr> <td>1/2" - 1"</td> <td>8d common nail</td> <td>8</td> <td>12 1/2"</td> </tr> <tr> <td>1 1/8" - 1 1/4"</td> <td>10d common nail or 8d deformed nail</td> <td>8</td> <td>12"</td> </tr> </tbody> </table>				5/16" - 1/2"	8d common nail (see face, web)	8	12 1/2"	1/2" - 1"	8d common nail	8	12 1/2"	1 1/8" - 1 1/4"	10d common nail or 8d deformed nail	8	12"
5/16" - 1/2"	8d common nail (see face, web)	8	12 1/2"												
1/2" - 1"	8d common nail	8	12 1/2"												
1 1/8" - 1 1/4"	10d common nail or 8d deformed nail	8	12"												

DESCRIPTION OF BUILDING MATERIALS	DESCRIPTION OF FASTENER & FASTENERS	SPACING OF FASTENERS
1/2" galvanized steel deck	1 1/2" galvanized decking nails for common nail, single predrilled 1 1/2" deep, 1 1/4" across, Type W or S	4" @ 8"
5/8" galvanized steel deck	1 3/4" galvanized decking nails for common nail, single predrilled 5/8" deep, 1 1/2" across, Type W or S	4" @ 8"
WOOD STRUCTURAL PANELS, ORIENTATION SEE EXIST. INSTALLMENT TO FRAMING:		
2 1/4" and less	for decked nail or for common nail	12"
2 1/4" - 3"	for decked nail or for common nail	12"
3 1/4" - 4 1/4"	for decked nail and common nail	12"

Source: U.S. Census Bureau, 2000.

[illegible]

3

21. International Building Code with City of Houston amendments.
2009. Solar Technologies Building Code.

1

- [illegible]

1

- [illegible]

Source: *Author's calculations*.

- 管 理 學 報 第 1 卷 第 1 期

1 NAIL SCHEDULE

\$0.01

ZERO
HOUSE

144

Revisions:

Date: 12-16-2008
Drawn by: SLS
Checked by: xj
Approved by: xj

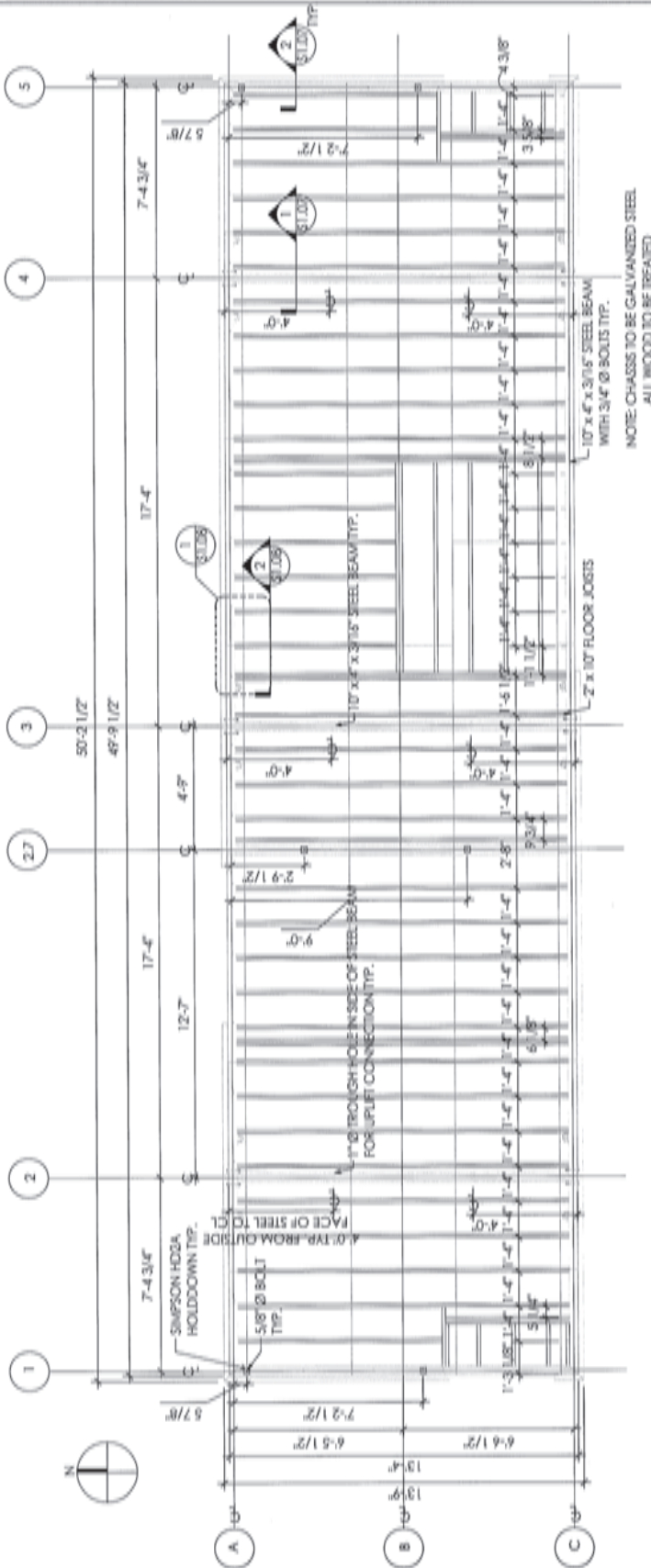
Zero Energy Rowhouse
Rice University
6100 Main St. @ Loop
8 Alumni Drive
Houston, Tx 77005

STRUCTURAL
NOTES

Rice Building Workshop
Zero Energy Rowhouse, 2009 Solar Decathlon
Rice University School of Architecture, MS-50
P.O. Box 1892, Houston TX 77251-1892
SOLAR DECATHLON
NREL



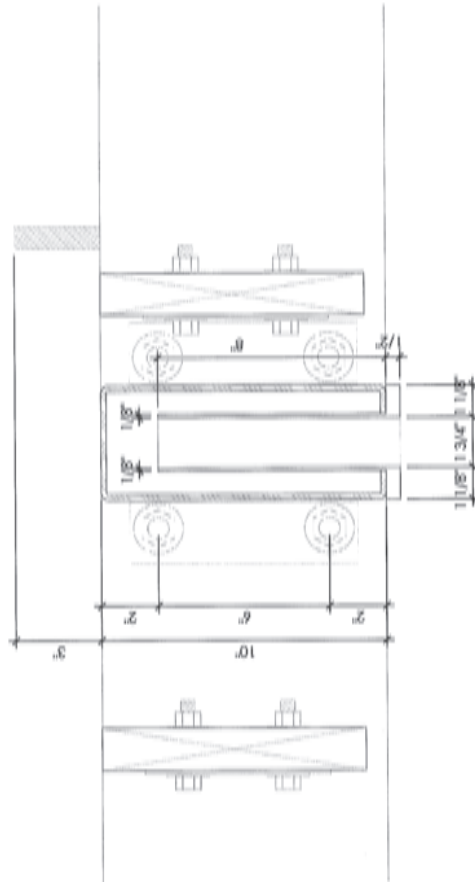
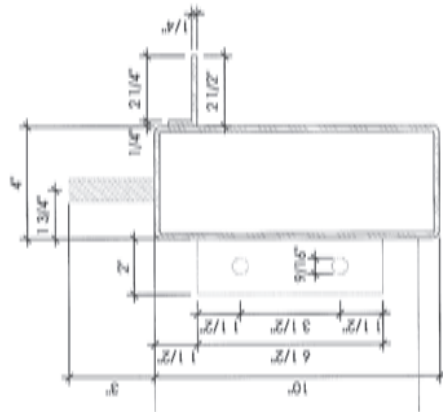
Ernie April
12/12/07



1 FLOOR FRAMING PLAN
1/4"=1'



Christof Spierer
12/01/01



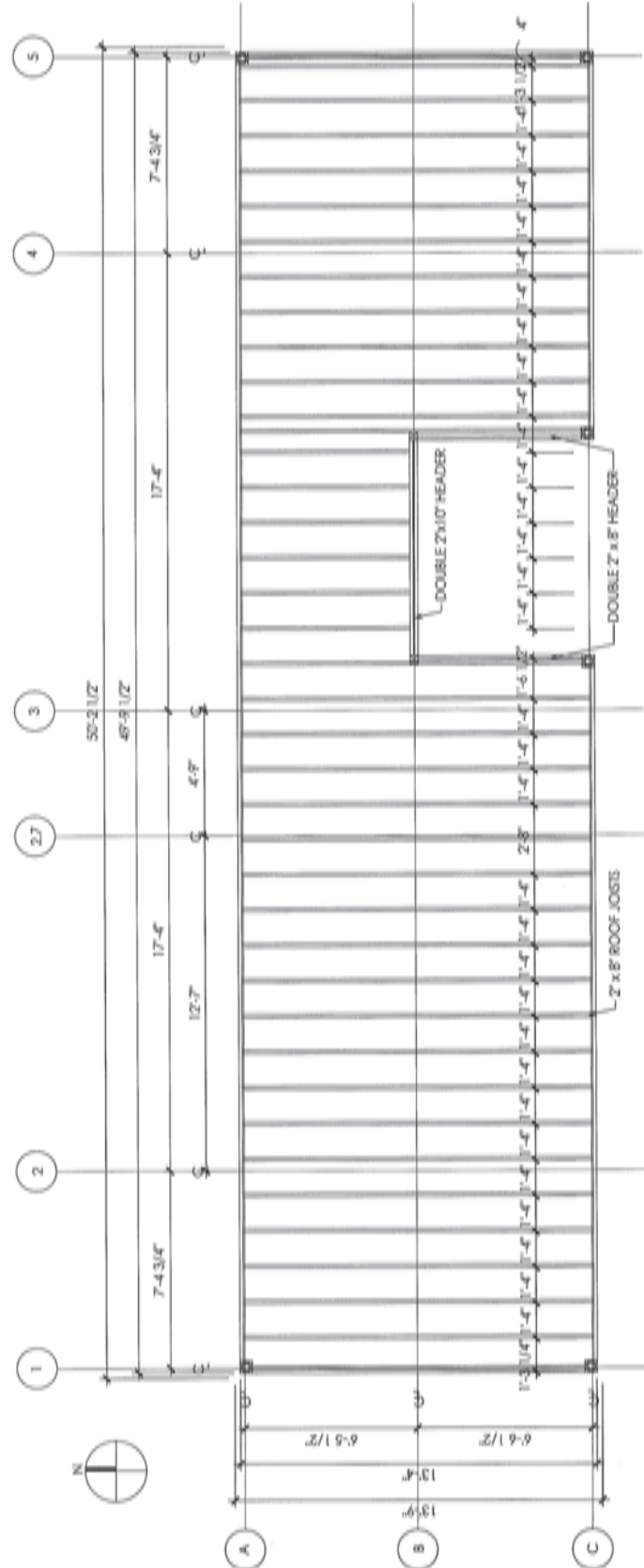
12/10/07
Kermit Spier

Date: Oct 30, 2008
 Drawn by: DD
 Checked by: xx
 Approved by: xx

Zero Energy Rowhouse
Rice University
6100 Main St. @ Loop
8 Alumni Drive
Houston, TX 77025

Scale: 1/4" = 1'-0"

\$1.07



NOTE: ALL WOOD TO BE TREATED



Christof Speller
 Professional Engineer

1 ROOF FRAMING PLAN
 1/4" = 1'

DESIGN CALCULATIONS

Design Calculations

**Ze-Row
2009 Solar Decathlon
Rice University**

**Christof Spieler, P.E.
Morris Architects**

6/1/09



BUILDING CODE

2009 Solar Decathlon Building Code
2006 International Residential Code

LIVE LOADS

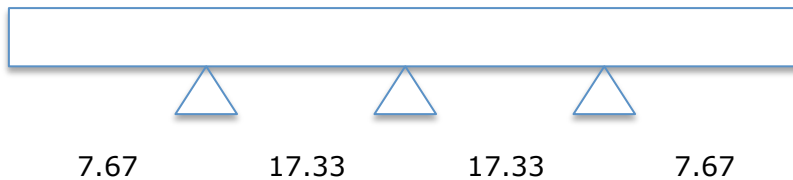
roof	20 psf
floor, ramps	50 psf

DEAD LOADS

total weight	34,139 lb	see attached
--------------	-----------	--------------

EDGE BEAMS

DL	341.38712 plf
trib width	7.5 ft
LL	525 plf
LL roof	150 plf
LL floor	375 plf



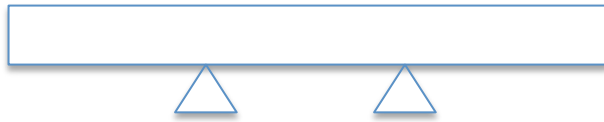
reaction (DL)	5.668	k
reaction (LL)	8.2	k
reaction (LL roof)	2.3	k
reaction (LL floor)	5.9	k

Mmax (DL)	9.7578 k-ft
Mmax (LL)	13.023 k-ft
Mfactored	32.54616 k-ft

use	TS10x4x3
Z	14.586 in ³
Fy	46 ksi
phiMn	50.3217 k-ft

OK

SUPPORT BEAMS



2	11	2
Mmax (DL)	9.7578 k-ft	
Mmax (LL)	14.111 k-ft	
Mfactored	34.28696 k-ft	

use	TS10x4x3
Z	14.586 in ³
Fy	46 ksi
phiMn	50.3217 k-ft

OK

CRANE ATTACHMENT

load	5.668 k
eccentricity	6.75 in
bolt space	5 in
bolt dia	0.625 in

shear in bolt	1.417 k
capacity	15.9 k

tension in bolt	3.8259 k
capacity	29.8 k

unity check	0.2175054	OK
-------------	-----------	-----------

CROSS BM

load	5.668 k
eccentricity	2 in
bolt space	5 in
bolt dia	0.625 in

shear in bolt	1.417 k
capacity	15.9 k

tension in bolt	1.1336 k
capacity	29.8 k

unity check	0.12715977	OK
-------------	------------	-----------

FOUNDATIONS

DL	5.668 k	
LL roof	2.3 k	
LL floor	5.9 k	
gravity load	11.818 k	max of DL+LLr, DL+LLf, DL+.75*(LLr+LLf)
pad width	3 ft	
pad width	3 ft	
pressure	1313.11111 psf	OK
allowable	1500 psf	

TANK BASE PAD

Weight of Polypropylene tank: 80 lbs
Weight of shallow well pump: 78 lbs
Weight of 600 gallons of water: 8.33lb/gal. *600 gal. =4998 lbs
Weight of outbuilding 5/8" plywood decking: $64 \text{ ft}^2 * 1.8 \text{ lb/ft}^2 = 115.2 \text{ lbs}$
Weight of outbuilding 2x4s: 7.75 board-ft * 10 * 1.28 lb/ft = 99.2 lbs
Weight of miscellaneous plumbing components: 15 lbs

Total weight of tank base pad: 5,385.4 lbs

Area of load distribution: $7.75 \text{ ft} * 0.29 \text{ ft} * 10 = 22.6 \text{ ft}^2$

Dead load on soil= $5385.4 \text{ lbs} / 22.6 \text{ ft}^2 = 238.29 \text{ lbs/ft}^2$

$238.29 \text{ psf} < 1500 \text{ psf}$ **OK**

TANK OUBUILDING WALLS AND ROOF BASE

Weight of sawn joists: $16.5 \text{ lbs} * 6 = 99 \text{ lbs}$
Weight of 3/8" plywood roof decking= $81 \text{ ft}^2 * 1.1 \text{ lbs/ft}^2 = 89.1 \text{ lbs}$
Weight of metal roofing: $81 \text{ ft}^2 * 1 \text{ lb/ft}^2 = 81 \text{ lbs}$
Weight of 2x4 studs, headers, and footers: $91.5 \text{ board-ft} * 1.28 \text{ lbs/ft} = 117.12 \text{ lbs}$
Weight of 3/8" plywood wall sheathing: $106 \text{ ft}^2 * 1.1 \text{ lbs/ft}^2 = 116.6 \text{ ft}^2$
Weight of metal siding: $106 \text{ ft}^2 * 1 \text{ lb/ft}^2 = 81 \text{ lbs}$

Total weight of outbuilding walls and roof: 583.82 lbs

Area of load distribution: $0.15 \text{ ft}^2/\text{block} * 6 \text{ blocks} = 0.9 \text{ ft}^2$

Dead load on soil= $583.82 \text{ lbs} / 0.9 \text{ ft}^2 = 648.7 \text{ lbs/ft}^2$

$687.7 \text{ psf} < 1500 \text{ psf}$ **OK**

WASTE WATER PILLOW TANK BASE

Weight of pillow tank: 150 lbs

Weight of 750 gallons of water: $8.33 \text{ lb/gal} * 750 \text{ gal} = 6247.5 \text{ lbs}$

Weight of miscellaneous plumbing components: 20 lbs

Total weight of waste water pillow tank: 6417.5 lbs

Area of load distribution: 78.96 ft^2

Dead load on soil = $6417.5 \text{ lbs} / 78.96 \text{ ft}^2 = 81.28 \text{ lbs/ft}^2$

$81.28 \text{ psf} < 1500 \text{ psf}$ **OK**

HEAT PUMP BASE

Weight of outdoor heat pump: 130 lbs

Weight of miscellaneous HVAC components: 5 lbs

Weight of mounting pad: 20 lbs

Total weight of heat pump assembly: 155 lbs

Area of load distribution: 4 ft^2

Dead load on soil: 38.75 lbs/ft^2

$38.75 \text{ psf} < 1500 \text{ psf}$ **OK**

FLOOR JOISTS

span 13 ft

spacing 16 in

DL 20 psf

LL 50 psf

use 2x10 @16 see Southern Yellow Pine tables

allow. Span 13'7" **OK**

reac 606.666667 lb

bolt capacity 310 lb

$3/4"$ bolt, $1\ 1/2"$ member,
 $1/4"$ steel plate, perp to grain

total cap 1240 lb

OK

ROOF JOISTS

span 13 ft

spacing 16 in

DL		20 psf	
LL		20 psf	
use	2x8@16	see Southern Yellow Pine tables	
allow. Span	14'9"		OK

DECK FOOTINGS

trib width	3 ft	
trib length	7 ft	
dl	10 psf	
ll	50 psf	
reaction	1260 lb	
footing width	1 ft	
load	1260 psf	
allowable	1500 psf	OK

WIND LOADS

speed		60 mph
exposure	C	
mean roof		15 ft
qh		15 psf
GCpf (wind)		0.4
GCpf (lee)		0.29
GCpf (total)		0.69
pressure		10.35
floor to roof		12 ft
roof to ground		3 ft
width		50 ft

SHEAR WALLS

load on roof	3105 lb	
feet of shearw	26 ft	
load on shearw	119.423077 plf	
use	1/2" ply, nails at 6" O.C. edge / 12" field	
allowable	310 plf	OK

OVERTURNING

total load	6210 lb
height	9 ft

overturn mom 55890 lb-ft

spacing btw fc 9.33

weight 34138.712

resist mom 159257.091

overturn F.S. 2.84947381

OK

SLIDING

total load 6210 lb

total weight 34,139 lb

required COF 0.18190493

COF 0.25

F.S. 1.37434428

NAVFAC_DM7_02, Silty sand, gravel or
sand mixed with silt or clay

OK

FOOTINGS FOR WIND LOAD

lateral 1035 lb

turnbuckle strut:

height 24 in

horiz 19.5 in

length 30.9 in

force 1.6413132 k

maximum extension for 18" vert extension

diamater 0.25 in

strength 36 ksi

allowable 23.76 ksi

1.16631627 k

OK

WIND UPLIFT

width 13.75

rafter spacing 1.33

trib width	4.58333333
trib area	63.0208333

30 ft, roof zone 3	33.1
--------------------	------

30 ft, roof zone 3	19.7
adjust for C	1.2
	23.64

governing pre:	33.1
----------------	------

uplift at end of	302.658125 lb
H2.5	415 lb

spacing of bolt	2.66666667
-----------------	------------

uplift each bol	606.833333
-----------------	------------

bolt diameter	0.5 in
yield strength	36 ksi
all	21.6 ksi
	4241.15008 lb

PARAPET TO JOISTS

height	1.5 ft
pressure	20 psf
stud spacing	1.33 ft

load	39.9 lb
moment	318.402 in-lb

nail space	3 in
# nails top and	2

shear each na	53.067
nail strength	211 lb

STEEL CROSS BEAM AT ROOF

moment on hc	25.35 k-ft
height	12 ft

force in memb	2.1125 k
# of bolts	10
force per bolt	211.25 lb

canopy width	8 ft
canopy length	15 ft
load	40 psf
total load	4800 lb
load each end	2400

# bolts	14
force per bolt	171.428571 lb

total load on b	382.678571 lb
capacity	480 lb

BOTTOM OF GREEN WALL

axial	0.3 k
moment	2.356 k-ft
	28.272 k-in
moment arm	5 in
reaction	5.6544 k
bearing area	1.5 in ²
bearing pres.	3.7696 ksi
moment on ta	1.4136 k-in
tab width	3 in
tab thick	0.75 in
Sx	0.28125 in ³
stress	5.02613333 ksi
all	21.6 ksi

bolt shear	5.9544 k
diameter	2 in
area	3.14159265 in ²
stress	1.89534439 in ²

LOAD ON SOLAR PANELS

reactions (gravity)	
RA	0.017

RD	0.045
RE	0.034

total (2 panels	96 lb
total (4 panels	192 lb

per corner	48 lb
------------	-------

reactions (wind) 110mph, exp B

RA	-0.188
RD	-0.579
RE	-0.447

convert speed	0.29752066
---------------	------------

convert expos	1.21
---------------	------

reactions (wind) 60 mph, exposure C

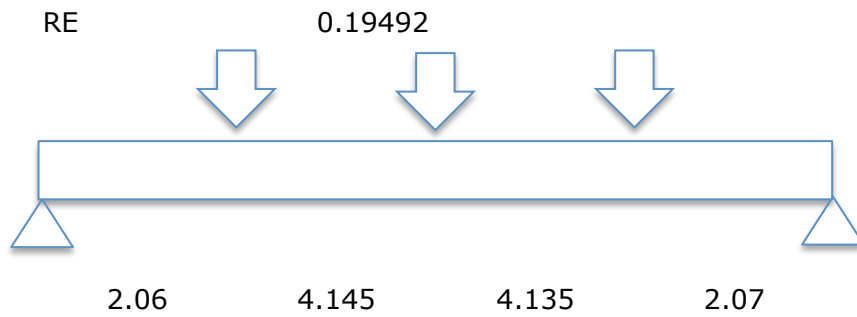
RA	-0.06768
RD	-0.20844
RE	-0.16092

total (2 panels	-437.04 lb
total (4 panels	-874.08 lb

per corner	-218.52 lb
------------	------------

SOLAR PANEL STRUT

RA	0.08468
RD	0.25344



Mmax 1.073 k-ft
 12.876 k-in

use L4x4x1/4

S 1.05 in³

stree 12.2628571 ksi

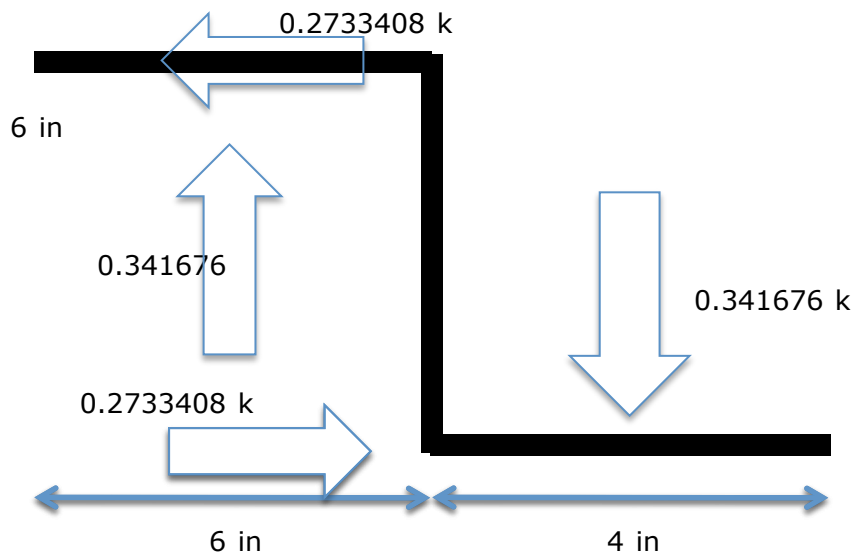
fb 19.68 ksi

OK

CLIP-WIND ACTING DOWNWARDS

total reac on clip

DL	48 lb
WL	218.52 lb
factored	0.341676 k



Mu (max) 0.683352 k-in

width	4 in
thick	0.3125 in
Z	0.09765625
fy	36 ksi
phiMn	3.1640625 k-in

OK

8 lag bolt -- shear	350 lb
pace (par to load)	0
edge (par to load)	1.5
ace (perp to load)	0.5625
dge (perp to load) n/a	
# bolts	4
capacity	1.4 k

perp to grain, SYP, 1/4 pl
perp to grain
per to grain
par to grain

OK

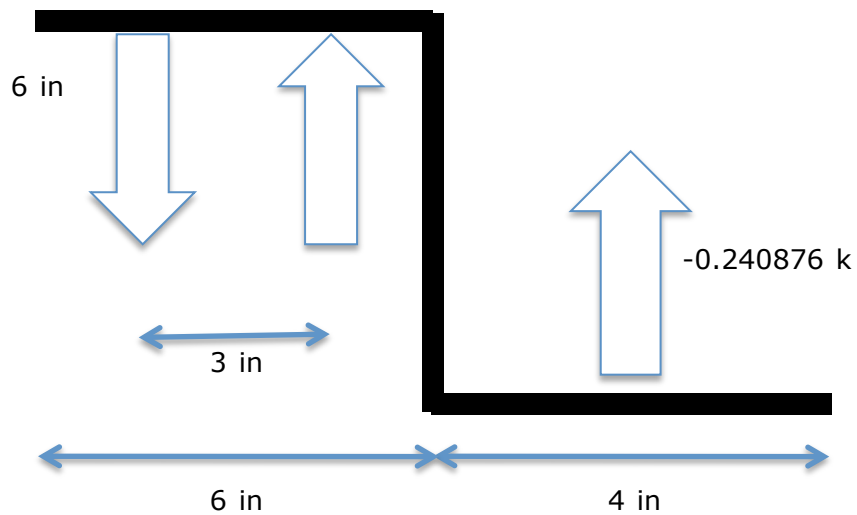
CLIP-WIND ACTING UPWARDS

total reac on clip

DL 48 lb

WL 218.52 lb

factored -0.240876 k



Mu (max) 0.843066 k-in

width 4 in
thick 0.25 in
Z 0.3125
fy 36 ksi
phiMn 10.125 k-in

OK

lag bolt -- tension 538 lb/in
length 3 in

perp to grain, SYP, 1/4 pl

bolts 2
capacity 3228 k

OK

WEIGHT TAKEOFF

Roof					
2"x10	30	13'-8"	410 lin. ft.	2.6 lbs/lin. ft.	1,066
					for model WI 40 Georgia Pacific wood joist
2"x10	7	7'-1"	50 lin. ft.	2.6 lbs/lin. ft.	130
2"x10	1		92 lin. ft.	5 lbs/lin. ft.	460
2"x10	3		153 lin. ft.	5 lbs/lin. ft.	2,295
3/4" F	20	4'x8' Sheets	607 sq. ft.	2.2 lbs/sq. ft.	1,336
					for 6" thick layer
Icyner	648 sq. ft.	0.5 lin. ft.	324 cu. ft.	0.5 lbs./cubic foot	162
					Two Ply Cold Process Modified Bitumen Mineral Surfaced Roofing System. See www.johnsmanville.com
3" Roof			895 sq. ft.	2 lbs/sq. ft.	1790
Shingling			142 lin. ft.	?	?
Roof Parapet					
2"x6" Anchor Plate			143 lin. ft.	3 lbs/lin. ft.	429
2"x6"	115	2 lin. ft.	230 lin. ft.	3 lbs/lin. ft.	690
2"x6" Top Plate			143 lin. ft.	3 lbs/lin. ft.	429
2"x10" Cricket (North)			50 lin. ft.	5 lbs/lin. ft.	1" #
2"x10" Cricket (East and West)			26 lin. ft.	5 lbs/lin. ft.	5" #
1/2" F	9	4'x8' Sheets	288 sq. ft.	1.5 lbs/sq. ft.	432
Ceiling					
Board	15	4'x8' Sheets	482 sq. ft.	2 lbs/sq. ft.	964
Board	2	4'x8' Sheets	64 sq. ft.	2 lbs/sq. ft.	128
Joists	6		25 lin. ft.	2 lbs/lin. ft.	50
					dropped ceiling in bathroom framing for dropped ceiling in bathroom
Floor/Undercarriage					
bfloor	22	4'x8' Sheets	700 sq. ft.	1.5 lbs/sq. ft.	1050
hassis			198 lin. ft.	6.594 lbs/lin. ft.	1305.612
					3.175 mm thick 4"x4" square steel tube
Icyner	700 sq. ft.	0.25 lin. ft.	175 cu. ft.	0.5 lbs./cubic foot	88
					for 3" thick layer
2"x10" TJI Wood Joist			495 lin. ft.	2.6 lbs/lin. ft.	1,287
1/2" Tile Floor			24 sq. ft.	3.5 lbs/sq. ft.	84
					Tile is for bathroom floor
Exterior Walls					
2"x4"	23	8'-10" ≈ 9 lin. ft.	207 lin. ft.	2 lbs/lin. ft.	414
2"x6"	107	8'-10" & (')*+,',	963 lin. ft.	3 lbs/lin. ft.	2,889
2"x6"	2	14 lin. ft.	28 lin. ft.	3 lbs/lin. ft.	84
2"x6"	2	50 lin. ft.	100 lin. ft.	3 lbs/lin. ft.	300
2"x8"	3	50 lin. ft.	150 lin. ft.	4 lbs/lin. ft.	600
1 ends	8	14 lin. ft.	112 lin. ft.	4 lbs/lin. ft.	448
Metal	120'-8" ≈ 121 lin. ft.	13 lin. ft.	1573 sq. ft.	1.58 lbs/sq. ft.	2,485
					24 gauge corrugated metal panel
doors	18 lin. ft.	4 lin. ft.	72 sq. ft.	1.58 lbs/sq. ft.	114
					24 gauge corrugated metal panel
Icyner	1278 sq. ft.	0.5 lin. ft.	639 cu. ft.	0.5 lbs./cubic foot	320
1/2" F	50	4'x8' Sheets	1573 sq. ft.	1.5 lbs/sq. ft.	2,360
doors	3	4'x8' Sheets	72 sq. ft.	1.5 lbs/sq. ft.	108
Moistu	120'-8" ≈ 121 lin. ft.	13 lin. ft.	1573 sq. ft.	0.0194lb/sq. ft.	31
doors	18 lin. ft.	4 lin. ft.	72 sq. ft.	0.0194lb/sq. ft.	2
1/2" C	28	4'x8' Sheets	891 sq. ft.	2 lbs/sq. ft.	1,782

doors	1	4'x8' Sheets	31 sq. ft.	2 lbs/sq. ft.	62
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Doors and Windows

Sliding	2	6'x8'	48 sq. ft.	\$')>828?,-,	(@ for wood framed door with glass insert
Swing	2	4'x8'	32 sq. ft.	\$')>828?,-,	@Afor wood framed door with glass insert
Bathro	1	3'x7'	21 sq. ft.	%,S'')>828?,-,	@Bfor wood framed door with glass insert
Exteri	1	5'x8'	40 sq. ft.	\$')>828?,-,	A# for wood framed door with glass insert
Bedro	1	3'x7'	21 sq. ft.	%,S'')>828?,-,	@Bfor hollow-core wood door
Wash	2	3'x7'	21 sq. ft.	%,S'')>828?,-,	@Bfor hollow-core wood door
Equip	2	3'x8'	48 sq. ft.	%)>828?,-,	\$AA for fiberglass doors
doors	3 lin. ft.	8 lin. ft.	48 sq. ft.	1.58 lbs/sq. ft.	76

Interior Partitions

1/2" C	163'-11" ≈ 164 lin. ft.	9 lin. ft.	1476 sq. ft.	2 lbs/sq. ft.	2,952
doors	6 lin. ft.	2 lin. ft.	12 sq. ft.	2 lbs/sq. ft.	24
doors	4'-7" ≈ 5 lin. ft.	1 lin. ft.	5 sq. ft.	2 lbs/sq. ft.	10
doors	4'-7" ≈ 5 lin. ft.	1 lin. ft.	5 sq. ft.	2 lbs/sq. ft.	10
doors	22 lin. ft.	1 lin. ft.	22 sq. ft.	2 lbs/sq. ft.	44
2"x4"	12	8'-10" ≈ 9 lin. ft.	108 lin. ft.	2 lbs/lin. ft.	216
2"x6"	20	8'-10" ≈ 9 lin. ft.	180 lin. ft.	3 lbs/lin. ft.	540

Equipment

Water	1			?	C
Energy	1			42 lbs	42
Dehur	1			48 lbs	48
Refrig	1			220 lbs	220 for 20 cu. ft. model
Dishw	1			115 lbs	115
Stove,	1			90 lbs	90 for 30" wide electric unit
Wash	1			300 lbs	300 for stacked washer/dryer

Casework/Fixed Furniture

Kitchen	6 lin. ft.			18 lbs/lin. ft.	108 For Maple wood large upper cabinet (30" high)
'range	5 lin. ft.			10 lbs/lin. ft.	50 For Maple wood small upper cabinet (15" high)
Kitchen	4 lin. ft.			16 lbs/lin. ft.	64 For Maple wood base cabinet
Count	1	2' x 6'	12 sq. ft.	2.25 lbs/sq. ft.	27 For 1/4 thick solid surface countertop
Casew	7 lin. ft.			29 lbs/lin. ft.	200 For 9' tall maple cabinet

Interior Finishes

looring			495 sq.ft.	1.6 lbs/sq ft	8.3mm x 7 9/16" x 3' 11 5/8" Tongue & 792 Groove Laminate floor
Walls)	25 lin. ft.	9 lin. ft.	225 sq. ft.	3.5 lbs/sq. ft.	788 Weight is for porcelain tile
plash)	2.5 lin. ft.	9 lin. ft.	22.5 sq. ft.	3.5 lbs/sq. ft.	79 Weight is for porcelain tile

Plumbing & Fixtures

Toilet	1			100 lbs	This weight is for a vitreous china floor mounted toilet.
n Sink	1			60 lbs	This weight is for a vitreous china wall mounted sink.
n Sink	1			20 lbs	This weight is for a double-bowl, stainless steel 20 sink.

Lighting/Electrical

Lights	24			1.6 lbs/light	39
Wiring		400 ft		6.2 lbs/100 ft	25

>B>C4

DEFGDH

TABLE 27 RAFTERS – 20 PSF LIVE LOAD, 20 PSF DEAD LOAD, 240 DEFLECTION, $C_D = 1.15$

HEAVY ROOFING; DRYWALL CEILING; SNOW LOAD

Size inches	Spacing inches on center	Grade									
		Visually Graded				Machine Stress Rated (MSR)			Machine Evaluated Lumber (MEL)		
		SS	No.1	No.2	No.3	2400f - 2.0E	2250f - 1.9E	1950f - 1.7E	M23	M14	M29
2 x 6	12.0	16-1	15-9	14-5	11-2	16-8	16-4	15-9	16-1	15-9	15-9
	16.0	14-7	14-4	12-6	9-8	15-2	14-11	14-4	14-7	14-4	13-11
	19.2	13-9	13-1	11-5	8-10	14-3	14-0	13-6	13-9	13-6	12-8
	24.0	12-9	11-9	10-2	7-11	13-3	13-0	12-6	12-9	12-3	11-4
2 x 8	12.0	21-2	20-10	18-8	14-3	21-11	21-7	20-10	21-2	20-10	20-10
	16.0	19-3	18-1	16-2	12-4	19-11	19-7	18-11	19-3	18-11	18-4
	19.2	18-2	16-6	14-9	11-3	18-9	18-5	17-9	18-2	17-9	16-9
	24.0	16-10	14-9	13-2	10-1	17-5	17-2	16-6	16-10	16-2	15-0
2 x 10	12.0	26-0*	24-9	22-3	16-10	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*
	16.0	24-7	21-5	19-3	14-7	25-5	25-0	24-1	24-7	24-1	23-5
	19.2	23-2	19-7	17-7	13-4	23-11	23-7	22-8	23-2	22-8	21-4
	24.0	21-6	17-6	15-9	11-11	22-3	21-10	21-1	21-6	20-7	19-1
2 x 12	12.0	26-0*	26-0*	26-0*	20-0	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*
	16.0	26-0*	25-7	22-7	17-4	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*
	19.2	26-0*	23-4	20-7	15-10	26-0*	26-0*	26-0*	26-0*	26-0*	26-0
	24.0	25-9	20-11	18-5	14-2	26-0*	26-0*	25-7	26-0*	25-1	23-3

These spans are intended for use in enclosed structures or where the moisture content in use does not exceed 19 percent for an extended period of time unless the table is labeled Wet-Service. Applied loads are given in psf (pounds per square foot). Deflection is limited to the span in inches divided by 360, 240, or 180 and is based on live load only. The load duration factor, C_D , is 1.0 unless shown as 1.15 or 1.25. An asterisk (*) indicates the listed span has been limited to 26'0" based on availability; check sources of supply for lumber longer than 20'. Highlighted sizes/grades are NOT commonly produced.

The Southern Pine Council does not grade or test lumber, and accordingly, does not assign design values to Southern Pine lumber. The design values contained herein are based on the 2002 SPIB Standard Grading Rules for Southern Pine Lumber, published by the Southern Pine Inspection Bureau, and modified as required by the 2001 National Design Specification® (NDS®) for Wood Construction published by the American Forest & Paper Association (AF&PA).

The primary purpose of this publication is to provide a convenient reference for joist and rafter spans for specific grades of Southern Pine lumber. The maximum spans provided herein were determined on the same basis as those in *Span Tables for Joists and Rafters*, published by AF&PA. Accordingly, the Southern Pine Council, its principals and/or members, do not warrant in any way that the design values on which the span tables for Southern Pine lumber contained herein are based are correct, and specifically disclaim any liability for injury or damage resulting from the use of such span tables.

The conditions under which lumber is used in construction may vary widely, as does the quality of the lumber and workmanship. Neither the Southern Pine Council, nor its principals and/or members, have any knowledge of the construction methods, quality of materials and workmanship used on any construction project; and accordingly, cannot and do not, warrant the performance of the lumber used in completed structures.

TABLE 6 FLOOR JOISTS – 50 PSF LIVE LOAD, 20 PSF DEAD LOAD, 360 DEFLECTION

OFFICE SPACE (CONCENTRATED LOAD CHECKS MAY BE REQUIRED; MAXIMUM 1.5 LIGHTWEIGHT CONCRETE)

Size inches	Spacing inches on center	Grade									
		Visually Graded				Machine Stress Rated (MSR)			Machine Evaluated Lumber (MEL)		
		SS	No.1	No.2	No.3	2400f - 2.0E	2250f - 1.9E	1950f - 1.7E	M23	M14	M29
2 x 6	12.0	10-4	10-2	9-11	7-11	10-9	10-6	10-2	10-4	10-2	10-2
	16.0	9-5	9-3	8-10	6-10	9-9	9-7	9-3	9-5	9-3	9-3
	19.2	8-10	8-8	8-1	6-3	9-2	9-0	8-8	8-10	8-8	8-8
	24.0	8-3	8-1	7-2	5-7	8-6	8-4	8-1	8-3	8-1	8-0
2 x 8	12.0	13-8	13-5	13-1	10-0	14-2	13-11	13-5	13-8	13-5	13-5
	16.0	12-5	12-2	11-5	8-8	12-10	12-7	12-2	12-5	12-2	12-2
	19.2	11-8	11-5	10-5	7-11	12-1	11-11	11-5	11-8	11-5	11-5
	24.0	10-10	10-5	9-4	7-1	11-3	11-0	10-8	10-10	10-8	10-7
2 x 10	12.0	17-5	17-1	15-8	11-10	18-0	17-9	17-1	17-5	17-1	17-1
	16.0	15-10	15-1	13-7	10-3	16-5	16-1	15-6	15-10	15-6	15-6
	19.2	14-11	13-10	12-5	9-4	15-5	15-2	14-7	14-11	14-7	14-7
	24.0	13-10	12-4	11-1	8-5	14-4	14-1	13-7	13-10	13-7	13-6
2 x 12	12.0	21-2	20-9	18-5	14-1	21-11	21-7	20-9	21-2	20-9	20-9
	16.0	19-3	18-0	15-11	12-3	19-11	19-7	18-10	19-3	18-10	18-10
	19.2	18-1	16-5	14-6	11-2	18-9	18-5	17-9	18-1	17-9	17-9
	24.0	16-10	14-9	13-0	10-0	17-5	17-1	16-6	16-10	16-6	16-5

These spans are intended for use in enclosed structures or where the moisture content in use does not exceed 19 percent for an extended period of time unless the table is labeled Wet-Service. Applied loads are given in psf (pounds per square foot). Deflection is limited to the span in inches divided by 360, 240, or 180 and is based on live load only. The load duration factor, C_D , is 1.0 unless shown as 1.15 or 1.25. An asterisk (*) indicates the listed span has been limited to 26'0" based on availability; check sources of supply for lumber longer than 20'. Highlighted sizes/grades are NOT commonly produced.

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PV Calculations

BP 175B Specifications at STC:

Open-circuit voltage:	Voc= 44.2 V
Voltage at Pmax:	Vmp=35.8V
Temperature Coefficient of	Voc = $-(160 \pm 20) \text{mV}/^\circ\text{C} = -(0.16 \pm 0.02) \text{V}/^\circ\text{C}$

Enphase M190-72-240-S11/2 Microinverter Specifications:

Reccomended Input Power at STC:	230W
Maximum input DC voltage:	54V
Peak power tracking voltage:	22V - 40V
Max DC short circuit current:	12A
Max input current:	10A

Voc Compliance Calculations

Record low temperature for zip code 20560 (Washington, D.C.): -26.1°C

$$\Delta T = (\text{Record low temperature}) - (\text{Temperature at STC}) = (-26.1^\circ\text{C}) - (25^\circ\text{C}) = -51.1^\circ\text{C}$$

$$\Delta V = (-51.1^\circ\text{C}) * (-0.18 \text{V}/^\circ\text{C}) = 9.198 \text{V}$$

$$\text{Max Voc} = 44.2 \text{V} + 9.198 = 53.398 \text{V}$$

☐ Max Voc=53.398 < 54V=Maximum inverter input voltage

Vmp Compliance Calculations

Highest average temperature for zip code 20560 (Washington, D.C.): 31.11°C

Assume PV module temperature is 30°C than ambient temperature.

$$T \text{ of PV module: } 31.11^\circ\text{C} + 30^\circ\text{C} = 61.11^\circ\text{C}$$

$$\Delta T = (\text{Temperature of PV module}) - (\text{Temperature at STC}) = (61.11^\circ\text{C}) - (25^\circ\text{C}) = 36.11^\circ\text{C}$$

$$\Delta V = (36.11^\circ\text{C}) * (-0.16 \text{V}/^\circ\text{C}) = -5.78 \text{V}$$

$$\text{Minimum Vmp} = (35.8 \text{V}) + (-5.78 \text{V}) = 30.02 \text{V}$$

☐ $30.02 \text{V} < 54 \text{V}$; $22 \text{V} < 30.02 \text{V} < 40 \text{V}$

Fall-Arrest Anchor Point Calculations

For Anchor point detail see S5.04 and C1.05. Fall anchor point are of same construction & detail as PV mounting brackets.

Each anchor point secured by four (4) 3/8 x 3" hot dipped galvanized hex lag screws.
Length of lag screw threading: 2"

Anchor screws secured in 2x6 southern yellow pine headers.

Allowable withdrawal load of 3/8" lag screw in southern yellow pine: 381 lbs/in

Withdrawal load per lag screw: 762 lbs

Withdrawal load per anchor point: 3,048 lbs

Soil Loading Calculations

ZEROW HOUSE Foundation Feet

Total weight of ZE-Row (see structural calculations for takeoff): 39,139 lbs

Areas of each foundation foot pad: 6.25 ft^2

Assumption: Even loading on all six (6) foundation feet

Area of load distribution: $6.25 \text{ ft}^2 \times 6 = 37.5 \text{ ft}^2$

Dead load on soil: 1043.7 lbs/ft^2

$1043.7 \text{ psf} < 1500 \text{ psf}$

Tank Outbuilding: Tank Base Pad

Weight of Polypropylene tank: 80 lbs

Weight of shallow well pump: 78 lbs

Weight of 600 gallons of water: $8.33 \text{ lb/gal.} \times 600 \text{ gal.} = 4998 \text{ lbs}$

Weight of outbuilding 5/8" plywood decking: $64 \text{ ft}^2 \times 1.8 \text{ lb/ft}^2 = 115.2 \text{ lbs}$

Weight of outbuilding 2x4s: $7.75 \text{ board-ft} \times 10 \times 1.28 \text{ lb/ft} = 99.2 \text{ lbs}$

Weight of miscellaneous plumbing components: 15 lbs

Total weight of tank base pad: 5,385.4 lbs

Area of load distribution: $7.75 \text{ ft} \times 0.29 \text{ ft} \times 10 = 22.6 \text{ ft}^2$

Dead load on soil = $5385.4 \text{ lbs} / 22.6 \text{ ft}^2 = 238.29 \text{ lbs/ft}^2$

$238.29 \text{ psf} < 1500 \text{ psf}$

Tank Outbuilding: Independent Walls and Roof

Weight of sawn joists: $16.5 \text{ lbs} \times 6 = 99 \text{ lbs}$

Weight of 3/8" plywood roof decking = $81 \text{ ft}^2 \times 1.1 \text{ lbs/ft}^2 = 89.1 \text{ lbs}$

Weight of metal roofing: $81 \text{ ft}^2 \times 1 \text{ lb/ft}^2 = 81 \text{ lbs}$

Weight of 2x4 studs, headers, and footers: $91.5 \text{ board-ft} \times 1.28 \text{ lbs/ft} = 117.12 \text{ lbs}$

Weight of 3/8" plywood wall sheathing: $106 \text{ ft}^2 \times 1.1 \text{ lbs/ft}^2 = 116.6 \text{ ft}^2$

Weight of metal siding: $106 \text{ ft}^2 \times 1 \text{ lb/ft}^2 = 81 \text{ lbs}$

Total weight of outbuilding walls and roof: 583.82 lbs

Area of load distribution: $0.15 \text{ ft}^2/\text{block} \times 6 \text{ blocks} = 0.9 \text{ ft}^2$

Dead load on soil = $583.82 \text{ lbs} / 0.9 \text{ ft}^2 = 648.7 \text{ lbs/ft}^2$

$648.7 \text{ psf} < 1500 \text{ psf}$

Waste Water Pillow Tank

Weight of pillow tank: 150 lbs

Weight of 750 gallons of water: $8.33 \text{ lb/gal} * 750 \text{ gal} = 6247.5 \text{ lbs}$

Weight of miscellaneous plumbing components: 20 lbs

Total weight of waste water pillow tank: 6417.5 lbs

Area of load distribution: 78.96 ft^2

Dead load on soil = $6417.5 \text{ lbs} / 78.96 \text{ ft}^2 = 81.28 \text{ lbs/ft}^2$

$81.28 \text{ psf} < 1500 \text{ psf}$

Mitsubishi Heat Pump

Weight of outdoor heat pump: 130 lbs

Weight of miscellaneous HVAC components: 5 lbs

Weight of mounting pad: 20 lbs

Total weight of heat pump assembly: 155 lbs

Area of load distribution: 4 ft^2

Dead load on soil: 38.75 lbs/ft^2

$38.75 \text{ psf} < 1500 \text{ psf}$

Service Feeder Net Computed Load

ART 220 CALCULATIONS

SINGLE FAMILY LOAD CALCULATIONS

LIGHTING LOAD (AREA X 3VA) *typically less because light over + not room* → 2035 VA **see 220.12, Table, and 220.12 J**

SMALL APPLIANCE LOAD (1500 VA EACH, MIN 2 CKTS) 4500 VA **see 220.52 (A)** *2 Kitchen 1 Bathroom*

LAUNDRY CIRCUIT (1500 VA) 1500 VA **see 220.52 (B)**

TOTAL 8035 VA VA LINE VA NEUT

FIRST 3000 AT 100% 3000 3000

3001 TO 120,000 AT 35% 1763 1763

120,001 AND UP AT 25% 0 0

APPLIANCE LOAD (FIXED IN PLACE)	
(ADD VA OF EACH)	
1 ST 12000 VA <i>Water heater</i>	
DO NOT INCLUDE 240 V LOADS IN THE NEUTRAL	
2 ND 1800 VA <i>Refrigerator</i>	
3 RD 1080 VA <i>dishwasher</i>	
4 TH 150 VA <i>ERV</i>	
5 TH 100 VA <i>Range hood</i>	
6 TH	
220.53	
TOTAL	15130 VA

*dishwasher
water heater
range hood
~~disposal~~
~~VENT FANS~~
ERV
Refrigerator*

4 OR MORE USE 75% *Less than 4 use 100%* 15130 x .75 11348 (15130 - 1200) x .75 2348

DRYER (USE 220.54, 5000 VA MIN, NEUT AT 70%) 7200 5040

RANGE (USE 220.55, NEUT AT 70%) 9200 6440

AIR CONDITIONING (TABLE 430.148 IF HP)	220.50
HEATING (FULL LOAD)	220.51
	2300 VA

USE LARGEST OF AC AND HEAT **see 220.60** 2300

25% OF LARGEST MOTOR **see 430.24** 575
Typically this is the A.C. compressor

TOTAL LOAD 35386 18591

$\div 240$ $\div 240$
148 = Amps 78 = Amps

ALSO see ANNEX D Examples 310.16 is wire size

Per NEC 220:
VA Line: 148 A
VA Neutral: 78A

Per NEC 310.16
At 90°C:

Line: #1 AWG
Neutral: #4 AWG

WATER BUDGET AND DISCUSSION

ASSUMPTIONS

Hot water draw	16.0 gallons
Clothes washer	12.0 gallons / cycle
Dishwasher	5.8 gallons / cycle
Systems testing	2.0 gallons / day

	Initial Heater Tank Fill	Hot Water Draws	Clothes Washer	Dishwasher	Testing	Daily Total
5-Oct-09	100				2	102
6-Oct-09					2	2
7-Oct-09					2	2
8-Oct-09		32	12.0	5.8	2	51.7625
9-Oct-09		48	24.0		2	73.985
10-Oct-09		32		5.8	2	39.77
11-Oct-09		48			2	50
12-Oct-09		32	24.0		2	57.985
13-Oct-09		48	12.0	5.8	2	67.7625
14-Oct-09		32	24.0	5.8	2	63.755
15-Oct-09		48		5.8	2	55.77
16-Oct-09			24.0		2	25.985
17-Oct-09						0
18-Oct-09						0
19-Oct-09						0
20-Oct-09						0
21-Oct-09						0

Total Water Use (gallons): 592.775

During the ZEROW HOUSE's residence on the National Mall, the house will require roughly 592 gallons of water, supplied by a single 600 gallon storage tank. We will initially fill the tanks with 600 gallons of water, and then draw on the tanks to fill our hot water storage tanks and our supply pipes. Once the plumbing system has been charged and pressurized, we will request a top-off of our tanks to ensure adequate supply. All wastewater will be stored in a 750 gallon pillow tank.

RETAIL PHOTOVOLTAIC PRICE QUOTE

BP 175B PHOTOVOLTAIC PANELS

The BP 175B panels are available from several vendors at competitive market prices. One such vendor, Affordable Solar Group, LLC (<http://affordable-solar.com>), currently sells the BP 175B module to the general public at the following prices:

BP 175 Module: \$620.00

$\$620.00 / 175W = \$3.54 / W$

The screenshot shows the 'affordable solar' website. The top navigation bar includes links for Store, Learn, Residential, Commercial, For installers, and Support, along with a phone number 1.800.810.9939. A search bar and a 'My Account' link are on the left. The main content area displays the 'BP Solar 175B, 175 Watt PV Module' with a price of \$620.00, a list price of \$840.00, and a 'You Save' of \$220.00 (26.19%). The page also includes a 'Shipping Estimate' section with a dropdown for 'United States (US)' and input fields for city and zip code. A sidebar on the left lists various products like Appliances, Batteries & Enclosures, Charge Controllers, etc. The bottom section of the page provides detailed technical specifications for the BP Solar 175B 175 Watt 24 Volt PV Module, including performance, configuration, and electrical characteristics.

BP Solar 175B, 175 Watt PV Module
Item Code : 3076
Our Price : **\$ 620.00**
List Price: ~~\$ 840.00~~
You Save: **\$ 220.00** (26.19 %)
Dollar Per Watt: \$ 3.54
Quantity:
ADD TO CART (+)

Shipping Estimate - estimates are for lower 48 US only
Select Your Country:
Enter Your City:
Enter Your ZipCode:

BP Solar 175B 175 Watt 24 Volt PV Module
High-efficiency photovoltaic module using silicon nitride multicrystalline silicon cells.

Performance
Rated power (Pmax): 175 Watts
Power Tolerance: +3%
Nominal voltage: 24V
Limited Warranty: 25 years

Configuration
175B Bronze frame with output cables and polarized Multicontact (MC3) connectors
175N Silver frame with output cables and polarized Multicontact (MC3) connectors

Electrical Characteristics
Maximum power (Pmax): 175 Watts
Voltage at Pmax: 35.8 Volts
Current at Pmax: 4.9 Amps
Warranted minimum Pmax: 166.3 Watts
Short-circuit current (Isc): 5.4 Amps
Open-circuit voltage (Voc): 44.2 Volts
Temperature coefficient of Isc: (0.065 ±0.015)/°C
Temperature coefficient of Voc: (-160±20)mV/°C
Temperature coefficient of power: (-0.3±0.05)/%°C
NOCT (Air 20°C Sun 0.8kW/m², wind 1m/s): 47 ±2°C

INTERCONNECTION APPLICATION FORM

Solar Decathlon 2009
INTERCONNECTION APPLICATION FORM

Rice University, Lot 105

team name and lot number

PV SYSTEMS

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
BP Solar	16 x BP 175B 175W modules	2800 W
BP Solar	8 x BP 175B 175W modules	1400 W

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

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or kW)	Quantity
Enphase Energy	M175-24-240-S01/2	240V	0.175W	24

Total AC power of all inverters is 4 kVA or kW (in whole numbers).

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Please include the following in the Project Manual:

- 1) One-line electrical schematic – the loads do not have to be detailed.
- 2) Calculations of service/feeder net computed load and neutral load (NEC 220)
- 3) Plan view of the lot showing the house, decks, ramps, tour paths and the service point.
- 4) Elevation view(s) showing the terminal box (contains the service point), meter, and other service equipment (such as the distribution panel or load center).

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Provide the Team's "Electrical Engineer" contact info in the "Team Officer Contact Info" database on the Yahoo Group. See Rule 3-2.

Please see the "Grid Interconnection Process for Teams" file on the Yahoo Group for more details on the interconnection process and the Terminal Box Mounting Panel.

ENERGY ANALYSIS AND DISCUSSION

To analyze the energy use of the ZEROW HOUSE, we first produced a spreadsheet detailing major electrical loads in the house and determined how long each would be in use from the detailed contest week schedule found in the Solar Decathlon Rules and Regulations. Additionally, Greg Tinkler of Redding, Linden, Burr Consulting Engineers developed a model of the ZEROW HOUSE in TRACE 700 v6.1.3. This model allowed us to gain detailed information about monthly kWh required to heat and cool the house, as well as to maintain comfortable humidity levels. This HVAC analysis was performed for both Washington, D.C, and the house's final site in Houston. This HVAC data was incorporated into our Contest Week load spreadsheet to give the following daily electricity demands.

Electrical Loads by Day

Day	kWh Required	Washington, D.C. HVAC (kWh)	kWh Required	Daily kWh Required w/o Clothes Dryer
Thursday (Day 8)	8.88	7.20	16.08	12.48
Friday (Day 9)	11.62	7.20	18.82	11.62
Saturday (Day 10)	4.53	7.20	11.73	11.73
Sunday (Day 11)	4.91	7.20	12.11	12.11
Monday (Day 12)	12.75	7.20	19.95	12.75
Tuesday (Day 13)	8.71	7.20	15.91	12.31
Wednesday (Day 14)	12.92	7.20	20.12	12.92
Thursday (Day 15)	12.96	7.20	20.16	12.96

Design Loads (w/o Clothes Dryer)

Total Contest Load	98.88 kWh
Average Daily Load	12.36 kWh
Max. Daily Load	12.96 kWh
Min. Daily Load	11.62 kWh

Using PVWatts v.2, we modeled our array using the following assumptions: 4.2 kW DC rating, 0.77 derate factor, 15 degree fixed tilt, and 180 degree (South) azimuth. For a data site in ZIP code 20010 (Washington, D.C.) in October, we can expect to produce 12.16 kWh/day from our array. This production closely matched our average daily load without the need for the much-larger PV arrays that have been displayed in past decathlons. It should be noted that this final analysis was performed by excluding the electric clothes dryer. The electric dryer contributes a 3.6 kWh load each time it is used, and we consider this wasteful. On the National Mall we will attempt to dry our towels on a clothes line, and the clothes dryer will only be used to finish drying the towels if it is still necessary.

Additionally, Standard Renewable Energy of Houston performed a residential energy analysis of the ZEROW HOUSE using REM/Rate v12.41. This analysis produced a HERS index for the house. For a house to achieve Energy Star compliance it must have a HERS index of 80 or lower in climate zones 6-8; a net-zero energy home has a HERS index of 0. The ZEROW HOUSE received a HERS index of 6 as designed, attesting to our excellent thermal envelope, use of efficient appliances and HVAC equipment, and strategic placement of glazing.

ARCHITECTURE DESIGN NARRATIVE

The design of the ZEROW HOUSE adopts the row-house typology, specific to the urban fabric of Houston's Third Ward community, as a primary precedent. Our design addresses the small size and limited budget of typical row houses through replication, innovative use of current technologies, local materiality, and an understanding of life-cycle costs.

HOUSTON'S ROW HOUSE

The Row House Community Development Corporation at Project Row Houses is a nonprofit organization dedicated to developing homes, public space, and facilities to preserve and protect the historic character of Houston's Third Ward community. The development of the ZEROW HOUSE is the latest in a long collaboration between Rice Building Workshop and Project Row Houses on affordable housing initiatives based on modern interpretations of the row house. The ZEROW HOUSE is a zero-energy solar home designed specifically for Houston, with a site in the heart of the city at Project Row Houses to come back to after the competition.

The row houses typical to the Third Ward are 19th century high density urban housing, derived from traditional low-income Caribbean-type houses found across the South. Also called shotgun houses, where rooms lead directly into one another in a line, these affordable and small houses are lined up in rows for blocks. These row houses have a beautiful, recognized form that resonates with the historic significance and culture of the Third Ward. The design of the ZEROW HOUSE was based on respecting the character of the existing homes and community, and re-imagining the row-house typology in terms of what it means to be an affordable solar house for Houston that will be able to produce all the energy needed for its operation on site.

RE-THINKING ORGANIZATION

The ZEROW HOUSE is organized around two cores which serve as the basis for the new thinking associated with the design of our row house: the wet core and the light core. The wet core contains all systems associated with water and energy. The light core serves as the primary source for daylighting and as a flexible extension of the living space.

WET CORE

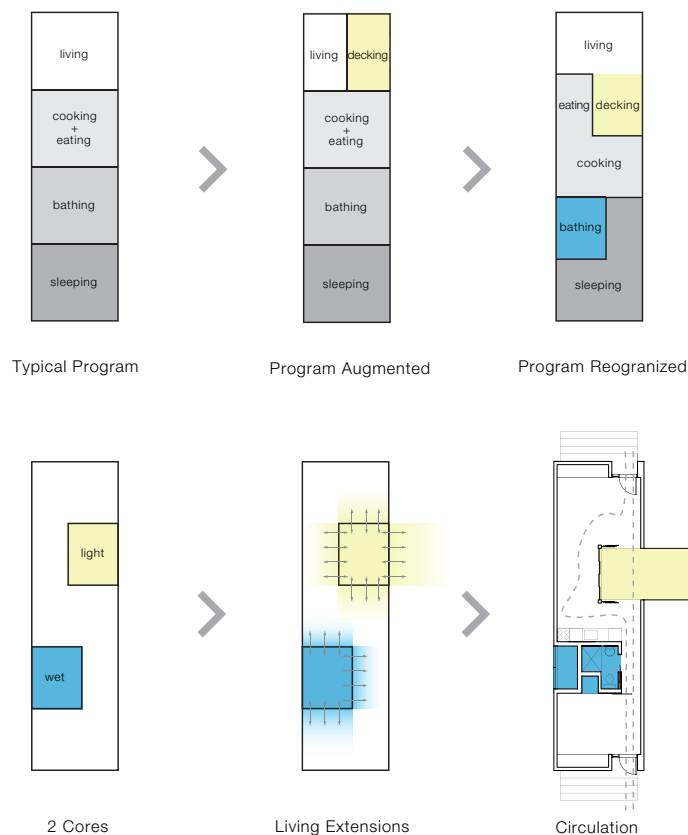
The wet core packages all of the main wiring and mechanical components of the ZEROW HOUSE into one central unit. Physically, it is an 8'x10' space in the house that bundles the kitchen, bathroom, washer and dryer, electrical, plumbing, HVAC, and solar systems. The design of one core to contain all of these functions allows for a significant reduction in cost and materials required for the installation and maintenance of systems that are both traditional and innovative. Designed with prefabrication in mind, the wet core holds promise for building cheaper houses in the future by allowing contractors to bring in the self-contained, pre-assembled unit and build the comparatively inexpensive house frame around it.

LIGHT CORE

As a flexible, exterior space shaded by a cantilevered structure, the light core is a direct extension of the interior living space, blurring the boundary between interior and exterior. It serves as a psychological device that allows for a continuous projection of the indoor living space, without the

need for energy to cool it, as well as a literal part of the living space when opened. Exterior living can be achieved in Houston during a large part of the year because the climate is often pleasant outside of the summer months.

Public and private spaces are created between the placement of these two cores in the rectangular row house footprint, shifting traditional spatial organization. The result is a dynamic re-interpretation of a Houston row house. Interior spaces are integrated seamlessly with the exterior creating larger living areas. The original shotgun-style view maintained through the visual connection that penetrates the house from door to door, through the light core. Circulation throughout the house becomes more engaging, as movement from space to space is no longer restricted to a single linear progression across rooms, but instead establishes itself within the house's more open, usable spaces.



DESIGNED EFFICIENCY | AFFORDABLE, SUSTAINABLE LIVING

Spatial efficiency becomes increasingly important in a home with 520 square feet of conditioned space. An open plan, 9' ceilings, and the exterior living space created by the light core increase comfort and livability. Each space is specifically designed to meet the needs of our future occupants, with affordability, ease of maintenance, and sustainability in mind. Much thought was dedicated to the design of our millwork and storage systems, utilizing IKEA, ELFA, and do-it-yourself products to create a system that is not only affordable and easily accessible to Houston

residents, but that also takes environmental impact into consideration. As a company, IKEA is making a great effort to use materials that are environmentally friendly. They are slowly requiring all of their wood to be Forestry Stewardship Council (FSC) certified. As of 2009, they require their composite wood (used extensively in our cabinetry) to be low in urea formaldehyde.

THE LIVING ROOM houses a flexible shelving system designed with ELFA hardware and painted MDF shelves that can function as a workspace, entertainment area, and storage space for books, movies, magazines, etc. It is integrated with one of the mini-split ductless air conditioning units as one unitized wall system.

THE KITCHEN is a unitized culinary work space that maximizes the amount of storage available along the length of the wet core. IKEA millwork runs to the ceiling, and the careful placement of kitchen appliances allows for maximum space and efficiency in a small kitchen area.

The careful integration of the BATHROOM into the wet core results in a room that utilizes every space possible to function at increased efficiency for its users. This room also contains low-flow fixtures and a simple IKEA medicine cabinet.

Within the BEDROOM are two major systems requiring highly efficient design. The wall of the wet core contains the washer and dryer, as well as the transition from public to private spaces. Ceiling mounted sliding partition doors act as movable wall pieces, nested as a part of the wet core, to conceal the washer and dryer and also provide privacy for the bedroom when desired. The wardrobe provides maximized storage space from floor to ceiling, and is integrated with the second mini-split ductless air conditioning unit to become one unitized wall system.

Product durability was a large factor in the material choices for the ZEROW HOUSE. However, as increased durability many times correlates to an upgrade in both the price and product, what resulted was a careful evaluation of our budget and life-cycle costs. Where funds were available, we were able to use products that had a more expensive price upfront, but longer life cycle. Our bamboo flooring, a natural, fast growing wood, is one example of this; it is slightly more expensive than a less sustainable laminate or VCT flooring, but is also more durable than either of these options. Because the floor itself is a significant feature of the house, as it is unbroken throughout the entire house, the benefits of its natural beauty, durability, and quick growth outweighed the cost.

The exterior decking of the ZEROW HOUSE is also a significant feature, tying back to the original typology of a row house with a front porch. The use of Trex decking further integrates sustainable products into the home, creating exterior areas for gathering.

The palette of the interior spaces became increasingly important to the development of spaces that felt like a home, based on the simplicity and scope of our design. Neutral paint is used for the walls, and warmth is added to the space through the bamboo flooring. Important design aspects are emphasized with accents of color, such as the wet core.

ENVELOPE AND STRUCTURE

The ZEROW HOUSE is clad with a horizontal corrugated steel skin. The modern look of the metal siding provides an interesting contrast to the existing homes in the Third Ward, enhancing the spirited character of the neighborhood. It is a durable exterior that provides aesthetic character for its occupants. The green wall also serves to unite the building with its surroundings, using non-invasive, local plants to provide natural beauty and passive cooling for the house.

The structure of the ZEROW HOUSE is designed for maximum efficiency in terms of heat gain, Houston conditions and climate, energy collection, ease of construction, and long-distance transport to and from Washington, D.C.

The ZEROW HOUSE is just under 14' wide and 50' long, built with 2"x6" wood studs and 2"x10" joists. Using 2"x6" studs not only allows for an increase in the amount of icynene insulation sprayed between the studs, but also creates more structurally sound walls that are capable of withstanding the trip from Houston to Washington D.C. In addition, shear walls protect the house from intense wind loads that may be experienced during hurricane season in Houston. The wooden superstructure sits atop a steel chassis, which is the structural backbone for the house. Foundation footings are located at six points on the chassis, and can be adjusted to meet a desired elevation on an uneven topography. The decking system attaches at the chassis, as does the green wall, eliminating the need for puncturing the metal skin.

MARKET VIABILITY JUSTIFICATION

The ZEROW HOUSE offers a unique zero-energy home that places an emphasis on both solar power and affordability. Our market audience is specifically low- to moderate-income married couples who could benefit from the reduced costs of prefabricated houses compared to the cost of traditionally-built houses. By designing a traditionally recognized row house for a more moderate socio-economic market, we are able to educate and provide a housing solution for people who are usually overlooked in the dialogue over clean energy. In demonstrating the viability of BIPV for this market through the ZEROW HOUSE, we further support the notion that zero-energy houses can be a goal for an average American homeowner.

Location of Permanent Site	Houston, Texas
Housing Type	Single Family (no children)
Number of Occupants	2
Occupant Demographic	Married Couple
Homeowner Annual Income	\$35,000 - \$50,000
Number of Bedrooms / Bathrooms	1 / 1

While interest in solar technologies increases as the cost of energy rises, the reality of owning photovoltaic and evacuated tube systems seems out of reach for the majority of the public due to concerns of cost, lack of education, and ease of access. Additionally, homeownership and the costs associated with it have been pushed to the national stage with recent economic struggles. The ZEROW HOUSE meets the demands of a shifting market and economy, where documented interest in solar energy and good design does not have to be sacrificed for cost, but instead becomes both affordable and accessible to a much larger audience.

SOLAR ENERGY + AFFORDABILITY

With the ZEROW HOUSE, solar power can be seen as a possibility for all people, not only those with high incomes. The ZEROW HOUSE is a well designed, \$99,000 home with a \$40,000 solar electric and hot water system packaged and integrated in a single mechanical core, the wet core.

Homeowner trust in the type of technology they are purchasing and using becomes one of the largest factors to take into consideration in the design of an affordable solar home. The commitment to spend \$40,000 on unfamiliar systems is a large one, and the ZEROW HOUSE addresses this by using established, reliable products that combine low cost with high performance. Both the photovoltaic and hot water systems are manufactured by well-known companies respected world-wide for their innovation in solar energy, allowing the homeowner to be more confident in using solar technologies they may be unfamiliar with. In order to reduce issues caused by a lack of available maintenance and repair, the photovoltaic array and evacuated tubes are some of the most popular types, ensuring that assistance will be readily available.

Although the \$40,000 up-front cost for these solar systems may seem daunting, the solar systems used in the ZEROW HOUSE are some of the most affordable on the market. In order to justify this large initial expense to homeowners, education on the house's performance as a long-term investment becomes important. As the period of use lengthens, cost benefits of the solar systems are high as they will ultimately pay for themselves in 1) saving the homeowners from having to pay

any electric bills, and 2) providing the homeowners with extra income from the energy sold back to the power company.

The first effort to reduce electrical costs lay in reducing the ZEROW HOUSE's electrical loads by utilizing smaller sized, low-energy use appliances and lighting fixtures. An appropriately sized array for this load requires only 4.2 kW DC, and extra cost is eliminated by increasing the system's reliability through energy production monitoring and power-point tracking.

LIVABILITY

The ZEROW HOUSE is a small, yet functional house that contains all that is needed for everyday living with great efficiency: a bedroom, a bathroom, a kitchen, a dining area, and a living room. Each space is specifically designed to meet the needs of our target audience. An open plan, 9' ceilings, and exterior living spaces increase comfort and livability.

The public living areas are integrated seamlessly with the exterior by the light core, which results in great spatial flexibility within a small footprint. By connecting the interior and exterior, a much nicer living environment is achieved overall, increasing the amount of living space and introducing a new way to engage in activities at home. The dining area is also carefully placed to serve as a flexible space, serving as a place to eat and also as a place to gather around for entertainment as an extension of the living room. A wall of operable awning windows allows for natural ventilation, even during light rain.

The light core serves as the primary source of ambient daylight. A shade structure maximizes the amount of direct light blocked from reaching interior spaces, reducing the amount of heat gain and creating a nicer exterior climate for the light core. To supplement natural light, a dimmer LED system is used to control the level of light needed. LED strips are used in the light cove to create a gentle wash of light along the south wall. The homeowner is thus provided with a variety of choices for lighting levels.

To enhance the efficiency of each room, much thought was dedicated to the design of flexible millwork and storage systems found in both public and private spaces resulting in the development of four unitized wall systems in the living room, kitchen, and along two bedroom walls. Each system maximizes the amount of storage available in order to leave the most amount of space possible for activity, and can be re-organized to meet changing needs.

Ease of maintenance was taken into great consideration throughout the house. The product used to light the light cove is a series of LED strips, which can be easily replaced by snapping a new strip into the place of a non-functioning one. The green wall is planted with native Texas vines that require little watering. The planter boxes are located at the level of the chassis, and are designed with the soil exposed to allow for quick and easy drip irrigation when needed. The packaging of all mechanical systems into the wet core results in convenient access to any plumbing or electrical systems when maintenance is needed.

BUILDABILITY

The ZEROW HOUSE is designed using local, low-cost materials and technologies that are affordable for future occupants and appropriate to our Houston climate. We have used standard, off-the-shelf products, such as IKEA cabinetry and typical construction materials, which allows for ease of building because the materials are affordable and easily accessible. We have also focused on replication, an innovative integration of engineering and architecture found in the design of our wet core, and an understanding of life-cycle costs to keep our construction expenditures low.

The careful detail of the construction documents also provide the necessary information for someone in the architecture and construction industry to understand what is being built and how. Not only do our construction documents reflect what will be built on the National Mall, but also document our plans for rebuilding the ZEROW HOUSE at Project Row Houses after the competition. The ease and speed of construction is reflected by our construction timeline, which began in November 2008 and was completed in June 2009.

One unique aspect of the ZEROW HOUSE is the emphasis placed on the reduction of material costs, labor, and time of construction. This has led to the development of the “wet core,” which houses all of the mechanical systems of the house. This one specific location packages the plumbing, electrical, HVAC, and solar systems, in addition to the locations of the kitchen, bathroom, and washer and dryer. Because all of the systems are located in one area, construction of the house was not be postponed because of the inability to have a plumber or electrician come to work on the house. Furthermore, the unique positioning of the wet core results in convenient access to any plumbing or electrical systems one the house has been constructed. Thus, if anything of this type should need to be repaired, the wet core is easily accessed.

Overall, the ease of the construction of ZEROW and its simple rectangular design also holds potential for prefabrication of the house. The wet core allows for a significant reduction in cost and materials required for the installation and maintenance of mechanical systems. The wet core holds promise for building cheaper houses in the future by allowing contractors to bring in the self-contained, pre-assembled unit and build the comparatively inexpensive house frame around it. By selling the ZEROW HOUSE as prefabricated, the target market will be saved the extra costs associated with excess materials, which is typical for on-site production, and excess time because the site will be able to be prepared while the house is being constructed.

The ultimate beauty of the ZEROW HOUSE lies within the definition of its name: Zero Energy Rowhouse. The appeal of using zero energy is strong because of high energy prices and because of general environmental concern. The row-house is a long-honored tradition that has served as a building model for over 100 years. Our slight alteration of this idea allows for ZEROW HOUSE to be seen as a modern look to a continuing tradition.

ENGINEERING DESIGN NARRATIVE

Central to the engineered systems of the ZEROW HOUSE is a spirit of open, replicable design. Our engineering design does not incorporate trade secrets, proprietary designs, or exotic materials; we have chosen to focus on efficient and ingenious incorporation of off-the-shelf components. We consider the U.S. Department of Energy Solar Decathlon a research project for public benefit, and our intent is for homeowners, builders, architects, and engineers to learn from our design and the process that we followed to arrive at it. Indeed, by using easily-accessible products, we hope the visitors to the ZEEROW HOUSE will learn from our designs, improve upon them, and make them their own.

BUILDING ENVELOPE

The envelope of the ZEROW HOUSE is designed to maximize thermal performance through the use of conventional construction methods. All walls are constructed of 2"x6" pine framing with 5 1/2" of icynene insulation; floor joists are also insulated with 5 1/2" of icynene. Glazing has been strategically located and centralized in the Light Core to allow maximum daylighting with reduced glare and heat transfer to conditioned space. A white membrane roof reduces further reduces heat transfer, and our green wall provides a living barrier that prevents heat gain through the walls.

MECHANICAL

The tight envelope of the ZEROW HOUSE significantly reduces heating and cooling loads. The shotgun floor layout maximizes natural ventilation opportunities, and ceiling fans offer additional low-energy ventilation. The conditioned space is actively cooled and heated by a mini-split system; a 3/4 ton unit is located in the bedroom and a 1 ton unit is located in the living room. Additionally, an ERV will allow air exchanges during winter and summer –important in such a well-sealed envelope– without significant change in interior temperature or humidity.

ELECTRICAL

To reduce costs, we have chosen all off-the shelf PV components and we have reduced our electrical loads to the point that we only need a 4.2 kW (DC) array to support them. A great deal of this load reduction comes through our lighting: with the exception of a utility light in the mechanical closet, the entire house is lit with LEDs. We have increased our PV system reliability by decentralizing our inverters into 24 micro-inverters that allow each solar panel to achieve maximum power-point tracking and panel-by-panel energy production monitoring. Our unique racking system is designed to eliminate roof penetrations while allowing the array to reverse its azimuth when the ZEROW HOUSE is installed at its final site in Houston.

WET CORE INTEGRATION

All water and major electric loads in the ZEROW HOUSE are condensed into an 8'x10' space known as the Wet Core; this space includes the mechanical closet, bathroom, and kitchen and laundry utilities. This configuration reduces the length of plumbing and electrical runs, and provides for the easy separation of grey water and black water. By centralizing the ZEROW HOUSE's utilities, we are able to quickly build a simple framed house around it. We wish to showcase the Wet Core as a product that could be efficiently built in a factory and delivered complete to a construction site, reducing labor cost and utility complexity.

LIGHTING DESIGN NARRATIVE

In the design of our lighting system, our team tried to stick as close as possible to the overall guidelines that dictated the design of the ZEROW HOUSE: to be passive, to be efficient and economical, and to be scrappy and opportunistic. The following paragraphs address how we address each of these values in our lighting design.

PASSIVE

Passive daylighting is instrumental to the basic design of the house. Our scheme is a simple, rectangular volume with two insertions: the wet core and the light core. While the wet core is dense block responsible for handling all the plumbing and mechanical functions of the building, the light core acts as its reciprocal – an airy void removed from the building that acts as the organizer of the living spaces. Literally, the light core is a 7' x 8' fully glazed volume of unconditioned space within the rectangular plan of the house that projects out of the house, becoming a porch. The placement of the light core organizes the more public portion of the house into three parts: kitchen, dining, and living. Each of these benefit from natural daylight fed from the light core. Taking into account the harsh summer sun we have in Houston, team members designed a shade structure over the light core that minimizes heat gain during summer sun and allows for deeper penetration of light during cooler winter months.

Additionally, the doors in the two endwalls are glazed to reinforce the fact that this is a contemporary interpretation of a traditional shotgun style house. While the front door is fully transparent and adds more daylight to the living room, our team felt that the more private area of the house, containing the bedroom, should receive less natural light. In the brutal summers of Houston it is often desirable to have a retreat that can be kept dark and cool. Therefore, the door leading out of the house and onto the back porch will have a semi-transparent film that allows natural light in while maintaining a degree of privacy.

EFFICIENCY AND ECONOMY

Working with a local lighting designer, our team tried to find solutions that are current in energy efficiency, but that are also easily available and affordable lighting technologies. Another key consideration was the incorporation of luminaries in a way that complimented both the interior spaces and our approach to daylighting. With the exception of a florescent tube fixture in the mechanical closet, LED lights were used throughout the entire interior and exterior of the ZEROW HOUSE. The use of 1 and 3 watt recessed puck lights distributed throughout the living, sleeping, and bathroom areas provide an even distribution of light and a clean plane over the entire ceiling as ambient light. These fixtures also allow for varied lighting throughout the house through the implementation of zones created by switching, and the fixtures' ability to swivel to provide accent lighting where desired. LED task lighting is provided at the desk and kitchen in addition to ambient light. Recessed strip lighting is built into the kitchen cabinetry to provide optimal task lighting at the countertop. The total wattage for all the interior luminaries and their drivers amounted to less than 250 watts.

Our approach to the exterior lighting was to provide lighting at each of the four entrance points and deck lighting. We concentrated the use of solar powered recessed deck lights at the main

exterior living deck where we see the most use in the evenings. Because of the overall low energy consumption of the luminaries and our goal for an affordable home, we felt we could eliminate automated lighting controls.

OPPORTUNITY

The light cove, which runs along the entire length of the house, is an element of the house that has become a team favorite. This track of recessed lighting is a rather elegant feature that found its way into the house by means of economy. While working on the construction documents of the house cross section, a student noted that the interior dimension was 12'-4". Rather than finishing the ceiling with three full sheets of drywall and a 4" strip, we decided to specify only the full sheets and use the combination of residual space and the up-slope of the roof beyond to insert a series of recessed LED strip lights. These lights, which are dimmable, run the length of the ZEROW HOUSE, reinforcing its shotgun aorganization and washing that entire side of the house with a soft, delicate light.

PUBLIC EXHIBIT

COMMUNICATIONS MATERIALS: ON-SITE SIGNAGE

ZEROW HOUSE

Zero Energy Row House

The ZEROW HOUSE is Rice University's entry in the 2009 Solar Decathlon. Our design addresses the small size and limited budget of a typical Houston row houses through replication, innovative use of current technologies, local materiality, and an understanding of life-cycle costs. The ZEROW HOUSE is a re-imagining of zero-energy living for an affordable solar home for a unique Houston climate and community.

Project Row Houses

rice school of architecture

ENGINEERING

a zero-energy house for Houston

Project Row Houses is a community-based public art project in Houston's Third Ward. It encompasses art and cultural activities, education, social services, historic preservation, and community development.

Project Row Houses

The development of the ZEROW HOUSE is the latest in a long collaboration between Rice Building Workshop and Project Row Houses on affordable housing initiatives. The ZEROW HOUSE is a zero-energy solar home designed specifically for Houston, with a site to come back to in the heart of the city at Project Row Houses where it will be permanently occupied by low-income families.

team ZEROW

Majors in architecture, engineering, economics, and Spanish... Undergraduates and grad students... We now all have construction experience!

The ZEROW HOUSE as a labor of love for

12"

From row houses to ZERO-ENERGY...

20 PV panels producing 4.2 kW of electricity

30 evacuated tubes for your hot water needs

affordable sustainable efficient

material choice: low cost, durable,

passive systems: green wall, shade structure, light core

active systems: pvs, solar hot water, hvac technologies

wet core, flexible interiors, quick construction

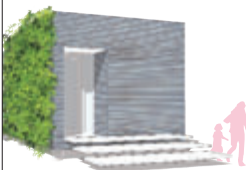
SHADE STRUCTURE

GREEN WALL

36"



COMMUNICATIONS MATERIALS: TRI-FOLD HANDOUT



SOLAR DECATHLON 2009

Every two years, the U.S. Department of Energy hosts the Solar Decathlon competition, where 20 teams from universities in the United States and abroad design and build 800 square foot houses that showcase sustainable and renewable design elements. The solar-powered houses will be on the National Mall in Washington, D.C. in October 2009, where they will be judged in 10 contests and open for public tours.

The ZEROW HOUSE is Rice University's entry in the 2009 Solar Decathlon. The Rice Solar Decathlon team is a student-led project between the Rice Schools of Architecture and Engineering. Members of our team have been preparing for the 2009 Decathlon since January 2006, and we are proud to be the only team to represent the state of Texas in the 2009 competition.



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SOLAR DECATHLON 2009
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 SOLAR DECATHLON 


www.RiceSolarDecathlon.org

**ZEROW
HOUSE**

Zero Energy Row House

8.5"



INNOVATIVE DESIGN



ZEROW SUSTAINABILITY

- Integrated Photovoltaic Array System
- Solar Hot Water System
- Passive Cooling Green Wall
- Natural Daylighting
- Cross Ventilation
- Icynene Spray Foam Insulation
- Low-VOC Interior Paint
- Low Energy Use Appliances
- Low-Flow Plumbing Fixtures
- LED Lighting
- Recycled Materials
- Local Manufacturing

SUSTAINABLE, AFFORDABLE LIVING

PLAN

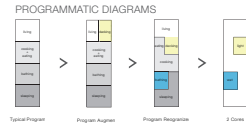
- 01 living
- 02 eating
- 03 outdoor living
- 04 cooking
- 05 bathing
- 06 sleeping

ROW HOUSE RE-IMAGINED

The ZEROW HOUSE adopts the row-house typology, specific to the urban fabric of Houston's Third Ward community, as a primary precedent. Our design addresses the small size and limited budget of typical row houses through replication, innovative use of current technologies, local materiality, and an understanding of life-cycle costs. The ZEROW HOUSE will be able to produce all the energy needed for its operation on-site, using a photovoltaic array and solar hot water system to collect solar energy.

Our basic concept consists of two plug-in components: the WET CORE and the LIGHT CORE. The wet core contains all systems associated with water and energy. The light core serves as the primary source for daylighting and as an exterior extension of the living space.

PROGRAMMATIC DIAGRAMS



AFTER THE COMPETITION

Our house will be transported back to Houston's Third Ward community after the competition in October, where Project Row Houses will operate it as affordable housing in the neighborhood. Project Row Houses is a community-based public art project in Houston's Third Ward. It encompasses art and cultural activities, education, social services, historic preservation, and community development.

Through Rice Building Workshop, long-term plans include developing six of these energy-efficient, single- and multi-family homes on two 50 x 80 foot lots at Project Row Houses.

11"

TEAM UNIFORM

Work T-Shirt: White, recycled-cotton Gildan shirt



Front



Back

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