BEAUSOLEIL
Louisiana Solar Home UL LAFAYETTE SoAD
BeauSoleilHome.org

# PROJECT MANUAL

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## SUMMARY OF CHANGES

This is the first approved and reviewed submittal, therefore there is no need for a summary of changes.

| 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 | Assembly: O-101 – O-106 | |
| 4-2 | Construction Equipment | Specs for heavy machinery | Project Manual Div. 01 54 00 | |
| 4-3 | Ground Penetration | Drawing(s) showing the locations and depths of all ground penetrations on the competition site | S-105 | |
| 4-4 | Impact on the Turf | Drawing(s) showing the location, contact area, and soil bearing pressure of every component resting directly on the turf | S-106 | |
| 4-5 | Generators | Specifications for generators | Project Manual Div 01 54 00 | |
| 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 | Subsets P and M | |
| 4-6 | Spill Containment | Specifications for all equipment, tanks, and pipes that will contain fluids at any point during the event | Subset P REF Subset M REF | |
| 4-7 | Lot Conditions | Calculations showing that structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists | Project Manual: Structural Calculations | |
| 4-7 | Lot Conditions | Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot | S-108 | |
| 5-2 | Solar Envelope Dimensions | Drawing(s) showing the location of all house and site components relative to the solar envelope | C-101 – C501, A-114-001 - A-114-002 | |
| 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 | Project Manual: Structural Calculation | |
| 6-2 | Maximum Architectural Footprint | Drawing(s) showing all information needed by the Rules Officials to measure the architectural footprint electronically | A-111, A-116 | |
| 6-2 | Maximum Architectural Footprint | Drawing(s) showing all movable components that may increase the footprint if operated during contest week | A-113 | |
| 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) | A-114-001, A-114-002 | |
| 6-3 | Minimum Conditioned Space | Drawing(s) showing space conditioning means in primary living spaces | A-116 | |

| 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 | C-101, X-102 | |
| 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 | Subsection L | |
| 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 | Project Manual Div 26 31 00 | |
| 8-1 | PV Technology Limitations | Retail price quote for photovoltaic components | | |
| 8-3 | Thermal Energy Storage | Drawing(s) showing the location of thermal energy storage components | n/a | |
| 8-3 | Thermal Energy Storage | Specifications for thermal energy storage components | n/a | |
| 8-3 | Thermal Energy Storage | Shading calculations and/or diagrams for thermal energy storage components (if necessary) | n/a | |
| 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. | Project Manual | |
| 8-6 | Village Grid | Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means | E-101, E-105, E-106 | |
| 8-6 | Village Grid | Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means | Project Manual Div 26 31 00 | |
| 8-6 | Village Grid | One-line electrical diagram | E-605 | |
| 8-6 | Village Grid | Calculation of service/feeder net computed load per NEC 220 | E-605 | |
| 8-6 | Village Grid | Site plan showing the house, decks, ramps, tour paths, and terminal box | C-101, X-102 | |
| 8-6 | Village Grid | Elevation(s) showing the terminal box, meter housing, main utility disconnect, and other service equipment | A-212, C-201 | |
| 9-4 | Rainwater Collection | Drawing(s) showing the layout and operation of rainwater collection systems | n/a | |

| Rule # | Rule Description | Content Requirement(s) | Drawing Sheet(s) | Coordinates |
|---|---|---|---|---|
| 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 | X-203 – X-205 | |
| 10-3 | Team Sponsor Recognition | Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage | X-203 – X-205 | |
| 11-4 | Public Exhibit | Interior and exterior plans showing entire accessible tour route | X-102 | |
| 11-4 | Public Exhibit | Drawing(s) showing the dimensions, materials, artwork, and content of the handout | X-201 | |
| 11-4 | Public Exhibit | Drawing(s) showing the artwork and content of the team uniform | X-202 | |

CODE COMPLIANCE CHECKLIST

Not Required.

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# Construction Specifications

2009 Solar Decathlon
BeauSoleil Louisiana Solar Home
University of Louisiana

# SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.

1.2 SUMMARY

A. This section includes the following temporary facilities and controls:

1. Forklift
2. Mobile Crane
3. Electric Scissor Lift
4. Generator

1.3 SUBMITTALS

A. General: Adhere to shop drawings detailing erection of building indicated. Include plans, elevations, sections, and details and their connections. Show accessory items.

1.4 QUALITY ASSURANCE

A. Operator Qualifications: Workers experienced in successfully operating the forklift, crane, scissors, and generator may be used for this Project. They must possess significant experience with sufficient production capacity to produce required results without causing delay in the Work. (Refer to Health and Safety Plan)

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of building components before operating machinery.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed.

1.6 COORDINATION

A. Coordinate component installation and operation of machinery. Furnish setting drawings, templates, and directions. Deliver all necessary items to Project site in time for installation.

## PART 2 - PRODUCTS

2.1 FORKLIFT

A. Manufacturer

1. Yale North America

B. Product Information

1. Yale Veracitor™ VX Value truck
GP040-070VX
http://northamerica.yale.com/yna_product_details.asp?product=GP040-070VX&page=yna_pneumatic_tire_trucks.asp

2.2 MOBILE CRANE

A. Manufacturer

1. Link Belt

B. Product Information

2. LTM 1080/1L
100 ton Liebherr
http://www.gatwoodcrane.com/truck_cranes.htm
or
http://www.cranenetwork.com/crane_details.htm?recordID=18915

2.3 SCISSOR LIFT

A. Manufacturer

1. JLG Industries, Inc.
1-877-JLG-LIFT

B. Product Information

3. LE Series 3369L
http://www.jlg.com/en-US/Specification.html?ProductLineNodeId=e696c6eb-8162-4f4f-808e-6241623918c1&BaseProductLineNodeId=c662180a-b3fa-45f8-b066-07980981e2ba&ModelId=2359ddc4-d59f-4dae-b70b-0b1a65e256a6&GroupProductLineNodeId=8bd26ee3-3859-42f1-89a4-aff7038fc89c&ProductRootMenuId=d39badf6-70c2-4fa3-a03c-268cb1f085d7

2.4 GENERATOR

A. Manufacturer

1. Briggs and Stratton

B. Product Information

1. 30209 - Elite Series 5500 Watt Portable Gas Generator
http://www.everygenerator.com/Briggs-and-Stratton-030209-BAS1004.html#ProdDetails

## PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate all temporary facilities and controls on site.

3.2 INSTALLATION, GENERAL

A. General: Install building components to comply with requirements of items being installed, including manufacturers' written instructions and requirements indicated on Shop Drawings.

END OF SECTION 01 50 00

# SECTION 05 12 23 – STRUCTURAL STEEL FOR BUILDINGS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all materials, labor, equipment and incidental services necessary for the fabrication, painting and erection of all structural steel and incidental steel framing included in the Contract.

B. Fabricate and erect all structural steel in conformance with the latest edition of the Specification for Structural Steel for Buildings - Allowable Stress Design and Plastic Design by the American Institute of Steel Construction (AISC), except that references to the AISC Code of Standard Practice shall apply only to dimensional tolerances and quality of work for fabrication and erection. Other provisions of the AISC Code of Standard Practice may be voluntarily adopted by the Contractor as a basis for fabrication and erection subcontracts, but these other provisions are <u>not</u> part of this project specification.

C. All references herein to standards of the American Institute of Steel Construction (AISC) and the American Society for Testing Materials (ASTM) and the American Welding Society (AWS) apply to the latest revision thereof.

D. If structural framing depends on dimensions, member sizes, and arrangement of existing construction, Contractor shall field verify arrangement, sizes, and dimensions and include accurate, existing conditions on the shop drawings.

I. Splices and connections not shown on the Drawings shall be designed by the Contractor to develop the full strength of the largest connecting member. Such connections shall be submitted for review separately from the shop drawings. Fully descriptive sketches and a written request for review shall be submitted by the Contractor.

J. If foreign steel is used on any part of the Project, it shall be certified by Supplier as complying with all applicable ASTM, AWS, and AISC requirements herein specified.

## PART 2 - PRODUCTS

2.1 All materials shall be new and undamaged.

2.2 Channels, and shapes shall conform to ASTM A36.

2.3 Steel plates and angles shall conform to ASTM A36.

2.4 Square and rectangular structural tubes shall conform to ASTM A500 Grade B.

2.5 Bolts shall be heavy hexagon structural bolts conforming to ASTM A-325 Type 1 for interior locations and Type 3 for exterior locations.

2.6 If twist-off type tension control bolts are used, bolts shall conform to ASTM F1852 Type 1 for interior locations and Type 3 for exterior locations.

# PART 3 - EXECUTION

## 3.1 WELDING

A. Materials and processes used, and details of all joints shall comply with the American Welding Society Code for Arc and Gas Welding in Building Construction.

B. Use AWS A5.1 or A5.5 E70XX electrodes for manual arc welding and AWS A5.17 F7X-EXXX electrodes for submerged arc welding.

C. All welders shall be qualified according to AWS Standards for the type of welding that they perform on this Project. Welders shall carry their certification papers and show them to the Owner's representatives upon request.

## 3.2 HIGH STRENGTH BOLTING

A. High strength bolted joints, where called for on Drawings, shall be assembled in accordance with "Specification for Structural Joints using ASTM A-325 or A490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation and endorsed by the AISC.

## 3.3 ERECTION

A. The steel framing system described in these drawings and specifications is designed for strength and serviceability as a completed and functioning structure under loads prescribed by the governing codes. The strength and stability of the incomplete steel framing system will vary throughout construction and will depend on the means, methods, and sequence of construction selected by the Contractor.

B. The lateral load resisting system for the building is not complete until all framing is aligned, fully connected and secured in final position, all floor decks are fully fastened to supporting members, all floor slabs are poured and cured for seven days, all roof decks are fastened in final position and all bearing walls and designated shear walls are complete and connected to the structural frame(s).

C. The Contractor has sole authority and responsibility for the means, methods, sequence and safety of construction. The Contractor shall, at all times, provide temporary shoring, bracing and tie-down anchorage consistent with the Contractor’s selected means, methods and sequence of construction and such temporary supports shall be adequate to assure stability and to prevent movement or collapse of the steel framing, or any portion thereof, during erection and throughout construction.

D. Anchor bolts and other anchorage devices are designed for loads required by governing codes after the project is complete. The Contractor is responsible for independent structural analysis to verify the safety of these bolts and devices under loads which may be imposed during erection and construction.

E. Erect all steel in accordance with standards and specifications of the AISC. Locate anchor bolts accurately and install into connecting work in advance. Install base plates true to line and level and set solid in non-shrinking grout.

F. Do not enlarge shop-made bolt holes by flame cutting in the field. If shop-fabricated components do not assemble properly in the field, do not modify them in any manner without first obtaining the approval of the Architect.

G. Light gage, cold formed purlins and girts shall be installed in accordance with recommendations of the American Iron and Steel Institute and the Light Gage Structural Institute. Purlins and girts shall be installed with the manufacturer’s standard long lap splices to assure continuity at all interior supports. Sag rods or strap bracing shall be installed at all

span quarter points unless the light gage manufacturer provides satisfactory supporting data demonstrating that less bracing points will comply with the standards referenced above and the specified U.L. roof classification.

3.4 PAINTING

A. This section applies to steel which does not receive finished painting. See other documents for finished painting requirements.

B. Paint all structural steel in the shop after fabrication is completed. After erection, paint all field connections, all welded areas and touch up all abrasions, damaged or defective paint and rust areas and remove all dirt, mud, mortar, debris, etc., from all steel surfaces.

C. Immediately before painting, thoroughly prepare the steel surface in compliance with the Steel Structures Painting Council Specifications SP-3. Remove all oil and grease, loose mill scale, loose rust, loose paint and other detrimental foreign matter from the steel surface.

D. Apply paint with brush, roller or spray; or dip in accordance with manufacturer's specifications.

E. For shop painting and touch up painting of steel joists use a primer conforming to Steel Structures Painting Council Specification Paint 15. Dry film thickness shall be 1.0 - 1.4 mils.

F. For shop painting of and touch up field painting of hot rolled steel shapes, a primer conforming to Steel Structures Painting Council Paint System No. 1. Dry film thickness shall be 1.7 - 2.0 mils.

G. Where called for on Drawings, galvanizing shall conform to ASTM A 123 and A 153. The Contractor shall consult with the galvanizer to assure that fabricated components will not warp during the galvanizing process. Subassemblies which are warped beyond normal tolerances will not be installed and will be replaced at Contractor's expense.

## END OF SECTION 05 12 23

# SECTION 05 41 00 - COLD-FORMED METAL FRAMING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Types of cold-formed metal framing units include the following:

1. Steel framing for soffits

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold -formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As follows:

a. Dead Loads: Weight of materials and construction.

2. Deflection Limits:

a. Interior Load Bearing Framing: Horizontal deflection of L/600 of the wall height.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 3/4 inch.

5. Cold-Formed Steel Framing, General: Design according to AISI's "Standards for Cold-Formed Steel Framing - General Provisions."

a. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product data for each type of cold-formed metal framing product and accessory indicated.

1.5 QUALITY ASSURANCE

A. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel

Framing - General Provisions."

B. Welding Standards: Use qualified welders and comply with American Welding Society (AWS) D1.1, "Structural Welding Code - Steel" and AWS D1.3 "Structural Welding Code - Sheet Steel."

C. Coordination of Work: Coordinate layout and installation of suspension system components for suspended ceilings with other work supported by or penetrating through ceiling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

2.1 METAL STUD FRAMING

A. System Components: Manufacturers' standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base Metal Thickness: 0.0329 inch (20 gage).
2. Flange Width: 2 inch.

B. Materials and Finishes:

1. Fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.
2. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

C. Accessories: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

D. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base Metal Thickness: 0.0329 inch (20 gage).
2. Flange Width: 1-1/4 inch.

E. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

2.2 ANCHORS AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36 (ASTM A36M), zinc coated by the hot-dip process according to ASTM A 123.

B. Bolts and Studs: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers. Zinc coated by the hot-dip process according to ASTM A 153.

C. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

2.3 MISCELLANEOUS MATERIALS

A. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.4 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating jointed members by not less than 3 exposed screw threads.

B. Install framing members in one piece lengths, unless splice connections are indicated for track or tension members.
C. Provide temporary bracing and leave in place until framing is permanently stabilized.

D. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
E. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
F. Fabrication and Erection Tolerances: Fabricate and erect assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements, including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FURRING, GENERAL

A. Standards: Comply with ML/SFA 920, "Guide Specifications for Metal Lathing and Furring," and with requirements of ASTM C 1063.
B. Isolation: Where metal support systems abuts building structure horizontally sufficiently isolate from structural movement to prevent transfer of loading from building structure.

1. Frame both sides of control joints independently and do not bridge joints with furring and lathing or accessories.

C. Install additional framing and furring members as required to form openings and frames for other work as indicated. Coordinate support systems for proper support of framed work that is not indicated to be supported independently of metal furring and lathing system.

3.3 INSTALLATION OF METAL STUDS

A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.
B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges unless otherwise indicated.
D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.

E. Set studs plumb, at spacing indicated on Drawings, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

1. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Fill opening of stud with solid wood blocking. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
I. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
K. Installation of Horizontal Members: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2-inch end bearing.

1. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by manufacturer.
2. Where required, reinforce at interior supports with single short length of metal framing section located directly over interior support, snap-on shoe, 30 percent side-piece lapped reinforcement, or other method recommended by manufacturer.
3. Secure to interior support systems to prevent lateral movement of bottom flange.
4. Install steel framing components for suspended ceilings so that members are level to within 1/8 inch in 10 feet as measured both lengthwise on each member and transversely between parallel members.
5. Wire-tie or clip furring members to main supports as indicated.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and

Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion

END OF SECTION 05 41 00

# SECTION 05 50 00 – METAL FABRICATIONS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the following metal fabrications:

1. Steel framing and supports for countertops
2. Steel framing and supports for sectional doors.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Rough hardware.
5. Miscellaneous structural shapes.
6. Solar Water Heater System components
7. Steel connections for wood framing members.
8. Steel shapes for drainage components.
9. Checkered steel plates at bottom of ramp
10. Aluminum Water Storage Tanks
11. Prefabricated Adjustable Steel Piers http://www.centralpiers.com/anchorpier.html
12. Photovoltaic Rack System
13. Prefabricated Steel Shutters
14. Perforated Aluminum Wall Panels
15. Soffits and Grates

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 06 Section "Rough Framing" for anchorage and support of concealed framing members.
2. Division 06 Section "Finish Carpentry" for anchorage and support of exposed framing members.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

C. Samples representative of materials and finished products as may be requested by Architect.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firms experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.

C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

1. Galvanized finish for exterior installations and where indicated.

2.2 FERROUS METALS

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

B. Steel Tubing: Product type (manufacturing method) and as follows:

1. Cold Formed Steel Tubing: ASTM A 500, grade as indicated below:

a. Grade B, unless otherwise indicated or required for design loading.

C. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel complying with ASTM A 653, with G90 coating; 0.108-inch.

D. Concrete or Masonry Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

E. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

F. Stair Brackets www.goproconstruction.com

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

B. Aluminum Perforated Plate and Sheet
http://www.begno.com/

C. Aluminum Extrusions and Tubing: ASTM B 221, Alloy 6063-T6.

D. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6.

E. Aluminum Castings: ASTM B 26, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless steel fasteners for fastening aluminum. Select fasteners for the type, grade, and class required.

B. Steel Bolts and Nuts: Carriage head type, ASTM A 307, Grade A with hex nuts on non-exposed side, ASTM A 563, and flat washers where applicable.

C. Stainless Steel Bolts and Nuts: Carriage head annealed stainless-steel bolts, nuts and flat washers where applicable; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

D. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dipped or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489, stainless steel.

F. Machine Screws: ANSI B18.6.3, cadmium plated steel.

G. Plain Washers: Round, ANSI B18.22.1.

H. Lock Washers: Helical, spring type, ASME B18.21.1.

I. Expansion Anchors: Anchor bolts and sleeve assemblies of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593ASTM F 738M and nuts complying with ASTM F 594ASTM F 836M.

J. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
B. Shop Primers: Provide primers that comply with Division 9 painting Sections.

1. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
2. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.

C. Fabricate supports from operable doors from continuous steel members of sizes indicated with attached bearing plates, anchors, and braces as shown. Drill bottom flanges to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports at all exterior locations.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.9 METAL FLOOR PLATES

A. Fabricate from aluminum plate of thickness and configuration as indicated on Drawings.

1. Provide smooth surface with manufacturer's standard perforated pattern..

B. Provide with welded on cast-in lugs.

2.10 METAL NOSINGS AND THRESHOLDS

A. Extruded Units: Aluminum, with checkered. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

1. Threshold: Beveled units, full depth of ramp with flush transition to grade level and elevation for start of ramp.

2.11 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting and for anchoring or securing work to concrete or other structures.

B. Furnish embeds or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for lifting and permanently supporting

tilt-up concrete wall panels.

C. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

2.14 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

## PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts,

wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable components securely to and rigidly brace from building structure.

3.4 ADJUSTING AND CLEANING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

## END OF SECTION 05 50 00

# SECTION 05 52 13 – PIPE AND TUBE RAILINGS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel pipe and tube railings at ramp and stairs.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses on railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding the allowable design working stress of materials for handrails, railings, anchors, and connections:

1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

a. Load above need not be assumed to act concurrently with loads on top rails

in determining stress on guards.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

C. Field Measurements: Where components are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.5 COORDINATION

A. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of materials and finish as supported rails, unless otherwise indicated.

2.2 STEEL AND IRON

A. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
B. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

1. Galvanized in compliance with ASTM A 653, G60 coating, ground smooth.

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

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select

fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

D. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

E. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

H. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.4 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FABRICATION

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Configuration: 1-1/4-inch round top rails, 1-1/4-inch round posts, 1-1/4-inch round handrails and 1-inch round pickets spaced so that not more than 4 inches clear exists between any point.

B. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

C. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting railings and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

D. Connect railing posts to stair framing by a welded ¼" thick baseplate bolted to stair and deck frame.

E. Assemble railings in the shop to the greatest extent possible to minimize field splicing and assembly.

F. Cut drill and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

G. Connections that will be exposed to weather shall exclude water. Provide weep holes where water may accumulate.

H. Welded Connections: Where welding is necessary,cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Non-Welded Connections: Connect members with concealed mechanical fasteners and fittings for smooth top rail members and with exposed 'tees' and 'elbows" connections for all other locations.

J. Form changes in direction as follows:

1. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

## 2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## 2.7 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and

environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.
B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

### 3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

### 3.4 ANCHORING POSTS

A. Anchor posts to substrate surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
2. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

## END OF SECTION 05 52 13

# SECTION 06 10 00 – ROUGH CARPENTRY

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Framing in bathroom ceiling and walls with dimension lumber.
2. Roof equipment bases and support curbs.
3. Wood stripping
4. Wood furring, bridging, sleepers, grounds, nailers, and blocking.
5. Wood blocking at shelves and wall cabinet locations.
6. Subfloor Sheathing.
7. Cypress skirting
8. IPE decking

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 06 Section "Structural Insulated Panels."
2. Division 06 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.
3. Division 10 and 11 Sections for wall and ceiling mounted components.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.5 SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Product data fr wood-t-preservative and fire retardant treated materials.

1.6 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

## PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. SPIB - Southern Pine Inspection Bureau.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

E. Engineered Wood Products: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Do not use chemicals containing chromium or arsenic.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates installed over concrete slabs directly in contact with earth.
4. Plywood panels used as permanent decking for concrete slabs and decks.

2.3 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.

1. Maximum Moisture Content: 15 percent.
2. Grade: No. 2 or better.
3. Species: Douglas fir: WCLIB or Yellow pine; SPIB.
4. Extreme Fiber in Bending: 1300 psi
5. Compression Parallel to grain: 1250 psi
6. Modulus of Elasticity: 1700 ksi.

2.4 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.

1. Extreme Fiber Stress in Bending, Edgewise: 2900-psi for 12-inch nominal-depth members, unless noted otherwise.

B. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

1. Manufacturer: Provide products by same manufacturer as I-joists.
2. Material: All veneer product, glued-laminated wood, or product made from any combination of solid wood, wood strands, and veneers. Provide rim boards made without urea formaldehyde.
3. Thickness: 1-1/4 inches.

2.5 BOARDS

A. Concealed Boards: Where boards will be concealed by other work, provide lumber with 19 percent maximum moisture content and of following species and grade:

1. Species and Grade: Mixed southern pine, No. 2 per SPIB rules.

2.6 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGR of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.7 CONCEALED PERFORMANCE-RATED STRUCTURAL-USE PANELS

A. General: Where structural-use panels are indicated for the following concealed types of applications, provide APA-performance-rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail (where applicable).

1. Thickness: Provide panels meeting requirements specified but not less than thickness indicated.
2. Span Ratings: Provide panels with span ratings required to meet "Code Plus" provisions of APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial."

B. Plywood Subfloor Sheathing: APA-rated sheathing, low-VOC adhesive.

1. Exposure Durability Classification: Exterior.
2. Span Rating: As required to suit support spacing indicated.
3. Edge Detail: Tongue and groove.
4. Sturdi-Flor, or approved equivalent

C. Plywood Mechanical Deck Sheathing: APA-rated sheathing.

1. Exposure Durability Classification: Exterior.
2. Span Rating and Thickness: As indicated and required to suit stud spacing indicated.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
2. Where rough carpentry is preservative treated with chemical containing ammonia or copper, provide fasteners of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF--105.
C. Power-Driven Fasteners: CABO NER-272.
D. Wood Screws: ASME B18.6.1.
E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)
F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
G. Expansion Anchors: Anchor bolts and sleeve assembly of material indicated below with

capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Carbon steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Where secured into or through preservative treated materials containing ammonia or copper, provide stainless steel units with bolts and nuts complying with ASTM F 593 and ASTM F594, Alloy Group 1 or 2.

2.9 METAL FRAMING ANCHORS

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:

1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

C. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.

1. Thickness: 0.050 inch.

D. Wall Bracing: Flat bracing made for anchoring studs together, 1-1/8 inches (29 mm) wide by 9/16 inch (14 mm) deep by 0.034 inch (0.85 mm) thick with hemmed edges.

E. Hold-Downs: Brackets for bolting through wall studs and securing roof to base framing system and foundation supports with anchor bolts or hold-down with threaded rods and designed to accommodate design wind uplift considerations.

F. Stair Bracket System: Go Pro Construction Solutions Go Pro Universal Stair Bracket System as manufactured by Go Pro Construction Solutions, L.L.C. 18800 Cochran Avenue, Cleveland , OH. 1-877-577-4142.
http://store01.prostores.com/servlet/gopro/the-Universal-Stair-Bracket/Categories

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Asphalt-saturated organic felt complying with ASTM D 226, Type II (No. 30 asphalt felt), unperforated.

## PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
E. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
F. Metal Framing Anchors: Install metal framing to anchors to comply with manufacturer's written instructions.
G. Do not splice structural members between supports, unless otherwise indicated.
H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

    1. Fire block concealed spaces of wood-frames walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal-thickness.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

    1. NES NER-272 for power-driven fasteners.
    2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code."
    3. Published requirements of metal framing anchor manufacturer.
    4. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction."

J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
K. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
L. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
M. Countersink nail heads on exposed carpentry work and fill holes with wood filler.
N. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

## 3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
B. Provide solid wood blocking between supports at all wall hung cabinets and other wall hung items.

C. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Where possible, anchor to formwork before concrete placement.
D. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.
E. Blocking in conjunction with steelwork that is either parallel to the vertical face of the steel or is hanging from the steel shall be set and anchored with bolts, washers, and nuts. Attachment of blocking with powder actuated fasteners at these conditions shall not be permitted.

3.3 WOOD FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 WOOD FRAMING, GENERAL

A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
B. Install framing members of size and at spacing indicated.
C. Do not splice structural members between supports.

3.5 WALL AND PARTITION FRAMING

A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction, unless otherwise indicated.

1. For interior partitions and walls, provide wood studs spaced 16 inches (406 mm) o.c., except where otherwise indicated or required.

a. Refer to “P-Types” indicated on drawings for actual stud sizes.

2. Provide continuous horizontal blocking at mid-height of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with 3 or more studs. Provide miscellaneous blocking and framing as shown and as required to support facing materials, fixtures, specialty items, and trim.
C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs with headers not less than 4-inch nominal (89-mm actual) depth for openings 36 inches (900 mm) and less in width, and not less than 6-inch nominal (140-mm actual) depth for wider openings.
2. For load-bearing walls, Unless indicated otherwise, provide double-jamb studs for openings 72 inches (1800 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth shown or, if not shown, as recommended by

AFPA's "Manual for Wood Frame Construction."

3.6 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of members with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated, or if not indicated, by using metal joist hangers.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers, and trimmers where span of header exceeds 48 inches.

C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist; one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.

D. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

E. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2 inch nominal thickness by depth of joist over supports.

F. Provide solid blocking between joists under jamb studs for openings.

G. Under load bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

H. Provide bridging of type indicated below at intervals of 96 inches o.c., between joists.

1. Diagonal wood bridging formed from bevel cut, 1x3 inch nominal size lumber, double crossed and nailed at both ends to joists.

3.7 INSTALLATION OF STRUCTURAL-USE PANELS

A. General: Comply with applicable recommendations contained in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

1. Fastening Methods: Fasten panels as indicated below:

a. Subflooring and Sheathing: Glue and nail to wood framing.

1) Space panels 1/8 inch apart at edges and ends.

2. Plywood Backing Panels: Nail or screw to supports.

## END OF SECTION 06 10 00

# SECTION 06 12 00 – STRUCTURAL PANELS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes Structural Insulated Panels (SIP).
B. Related Sections include the following:

1. Section 06100 – Rough Carpentry

1.3 SUBMITTALS

A. Product Data: SIP manufacturer's product literature including structural properties and installation instructions.
B. Shop Drawings: Show fully dimensioned fabrication and installation details for SIPs. Shop drawings shall be prepared under the supervision of a Professional Engineer.
C. Warranty: Warranty Document.

1.4 QUALITY ASSURANCE

A. Source limitations: Obtain all SIPs for each construction unit through one source. All accessories as recommended by the SIP manufacturer.
B. Structural Design: A Professional Engineer shall perform a structural analysis and design of the SIP assemblies in accordance with the design loads.
C. Installation Contractor must have experience on projects of similar size and scope.
D. Conduct pre-installation meetings to verify project requirements, foundation, structural system, substrate conditions, SIP manufacturer's installation instructions and SIP manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. SIPs shall be kept dry and protected with waterproof covering during transportation and storage
B. Exercise care to prevent crushing of SIP edges with cargo hold down straps during transportation.
C. Carefully load and unload SIPs from trucks to prevent damage to the panels.
D. Store SIPs elevated off of the ground on sleepers.
E. Take care in handling SIPs to prevent delamination. Do not lift panels by the top skin.

1.6 COORDINATION

A. Time delivery and installation of SIPs to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow the installation of SIPs.

## PART 2 – PRODUCTS

2.1 MANUFACTURER / SUPPLIER

A. WindGuard Eco-Panels 6261 Hwy 31, St. Martinville, LA 70582

HTTP://WWW.LASBHOMES.COM/SIP.NXG

2.2 MATERIALS USED TO FABRICATE SIPS

A. Oriented Strand Board (OSB): 7/16" thick minimum.
B. Expanded Polystyrene (EPS) core shall comply with ASTM C578 and shall have a minimum density of 0.9. pcf.
C. Adhesive: ASTM D2559

2.3 LUMBER

A. Grade and Species: Visually graded dimension lumber No. 2 or better of any of the following species:

1. Southern Pine; SPIB

B. Lumber shall be kiln dried to not more than 19% moisture content.
C. Lumber shall be clearly marked with grade stamp of grading agency.
D. Engineered wood products shall be used where required for structural adequacy.

1. Laminated Veneer Lumber (LVL)

2.4 FASTENERS

A. Common Nails: ASTM F1667.
B. Panel Screws: screws with pancake head, minimal thread diameter 0.255 inches, minimum shank diameter 0.190 inches and a minimum head diameter 0.625 inches.

2.5 FABRICATION

A. Cut SIPs to accurate lengths, angles, and sizes to comply approved Shop Drawings.
B. Thermal Resistance, R-value:

1. 6 ½" thick SIP with R-value = 24.2 at 75°F
2. 8 ¼" thick SIP with R-value = 30.9 at 75°F

C. Provide electrical wiring chases in foam core where required.

## PART 3 – EXECUTION

3.1 PREPARATION

A. Examine foundations, sills, framing and other surfaces to receive SIPs and verify that conditions are suitable for the installation of SIPs. Report any unsatisfactory conditions to the Contractor. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hoist SIPs in place by lifting equipment suited to size of panels. Exercise care to prevent damage to SIPs.
B. Install SIPs plumb, square and true to line.
C. Fill all panel joints with expanding urethane foam or seal by other approved method.
D. Repair or replace all damaged SIPs.
E. Remove debris from project site and legally dispose of debris.

END OF SECTION 06 12 00

# SECTION 06 17 13 – LAMINATED VENEER LUMBER

## PART 1 – GENERAL

1.1 DESCRIPTION

A. Work in this section includes, but is not limited to:
Laminated Veneer Lumber (LVL) beams and headers
B. Related work specified elsewhere
Rough carpentry

1.2 SUBMITTALS

Submit manufacturer's descriptive literature indicating material composition, thicknesses, dimensions, loading and fabrication details.
A. Shop drawings:
Submit manufacturer's literature indicating installation details. Include locations and details of bearing, blocking, bridging, and cutting for work by others.

1.3 QUALITY ASSURANCE

A. Certify that materials meet specified requirements.
B. Regulatory Requirements:
GP Lam LVL is listed with major building codes. Contact BlueLinx for most current code compliance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in manufacturer's original packaging, containers and bundles with manufacturer's identification intact and legible.
B. Store and handle materials to protect against contact with damp and wet surfaces, exposure to weather, breakage, and damage. Provide air circulation under covering and around stacks of materials.

1.5 LIMITATIONS:

A. Cutting:
Except for cutting to length, GP Lam LVL beams and headers shall not be cut, drilled or notched, except as noted in manufacturer's literature.
B. Moisture conditions:
GP Lam LVL is for use in covered, dry conditions.

## PART 2 – PRODUCTS

2.1 PREFABRICATED WOOD BEAMS AND HEADERS

A. Acceptable products

1. Georgia-Pacific Corporation, GP Lam LVL Floor and Roof Beams
http://www.gp.com/build/product.aspx?pid=1392

B. Characteristics:

1. Construction:

1 ¾" thick pressure bonded, lap-jointed wood veneers, with grain of veneers running parallel in the long direction.

2. Beam depths:
   As required for loading, deflection, and span
3. Beam Length:
   As required for span and bearing.

2.2 ACCESSORIES

A. Fasteners:
   16d common nails, approved screws or ½" bolts.

B. Hangers: http://www.strongtie.com/products/connectors/IUS-IUT-MIU.asp

   1. IUS1.81/11.88

C. Straps: http://www.strongtie.com/products/connectors/HRS-ST-PS-HST-LSTA.asp

   1. MSTA24

## PART 3 – EXECUTION

3.1 GENERAL

A. Provide GP Lam LVL beams and headers where indicated on drawings using hangars and accessories specified.

3.2 ACCESSORIES

A. Install accessories where indicated and in accordance with beam and header manufacturer's instructions.

## END OF SECTION 06 17 13

# SECTION 06 20 00 – FINISH CARPENTRY

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior wood planters
2. Porch decking
3. Exterior standing and running trim and ornamental trim.
4. Interior door frames and baseboards
5. Cypress Rain Screen Cladding
6. Wood mouldings

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 06 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Division 06 Section “Interior Architectural Woodwork" for interior woodwork not specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed finish carpentry similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
B. Fire-Test Characteristics: Test molded units per ASTM E84 for Class A requirement by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
C. Sample Installation: Before complete installation of composite moldings and components, provide materials and construction indicated for the completed work in a sample wall section from sill to soffit, to verify selections made and to demonstrate aesthetic effects. Obtain Owner’s and Architects’s approval of finish texture, pattern, and workmanship standards.

1. Mock-up sample may be incorporated into the final work if accepted by Architect.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of solid wood boards to avoid extended on-site storage and to avoid delaying the Work.
B. Do not deliver finish carpentry until environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installing exterior finish carpentry only when existing and

forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

B. Environmental Limitations: Do not deliver or install interior finish carpentry until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through the remainder of construction period.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," for lumber and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. SPIB - Southern Pine Inspection Bureau

### 2.2 EXTERIOR STANDING AND RUNNING TRIM

A. Provide finished lumber complying with the following requirements including those of the grading agency listed with species:

1. Species: New Growth Cypress.
2. Texture: Surfaced (smooth).
3. Lumber for Painted Finish: Solid lumber stock.

### 2.3 STANDING AND RUNNING TRIM APPLICATIONS

A. Lumber Trim, Interior Applications; for Transparent Finish:

1. White Oak at interior, new growth cypress at exterior
2. Pattern: As indicated on Drawings.

B. Porch Flooring and Decking:

1. Exterior Areas (where indicated on Drawings): Ipe (Tabebuis Lapacho Group - Bignoniaceae).
http://www.ironwoods.com/ironwoods_ipe.html

a. Size: As indicated on drawings.

### 2.4 WOOD SHUTTERS

A. Quality Standard: Comply with AWI Section shutters.
B. Grade: Custom.
C. Wood Species: Spanish Cedar.
D. Hardware: Standard galvanized steel barn door track and roller system for size and weight of panels as selected by Architect for wall anchorage at hold-open position.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails of the following materials, in sufficient length to penetrate minimum of 1-1/2 inches (38 mm) into substrate, unless otherwise recommended by manufacturer.

1. Hot-dip galvanized steel.

B. Glue: Aliphatic- or phenolic-resin wood glue recommended by manufacturer for general carpentry use.

C. Sealants: Comply with requirements of Division 7 Section "Joint Sealants" for materials required for sealing siding work.

D. Screen Fabric: Glass-fiber mesh fabric; 18-by-16 mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh resistant to corrosion. Shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM 33656.

1. Mesh Color: Black.

2.6 FABRICATION

A. Wood Moisture Content: Comply with requirements of specified inspection agencies and manufacturer's recommendations for moisture content of finish carpentry on relative humidity conditions existing during time of fabrication and in installation areas.

B. Exterior standing and running trim wider than 5 inches (125 mm).

1. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius.
2. Ease edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and performance of finish carpentry. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Condition finish carpentry to average prevailing humidity conditions in installation areas before installation, for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

C. Prime and back prime lumber for painted finish exposed on the exterior. Comply with requirements for surface preparation and application in Division 9 Section "Painting."

3.3 INSTALLATION, GENERAL

A. Do not use finish carpentry materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

1. Where treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.

C. Countersink nails, fill surface flush, and sand where face nailing is unavoidable.

D. Install finish carpentry plumb, level, true, and aligned with adjacent materials. Use concealed shims where required for alignment.

1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Countersink nails, fill surface flush, and sand where face nailing is unavoidable.
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) for plumb and level. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
4. Coordinate finish carpentry with materials and systems in or adjacent to standing and running trim and rails. Provide cutouts for mechanical and electrical items that penetrate exposed surfaces of trim and rails

E. Refer to Division 09 Sections for final finishing of finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints, if required.

B. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

C. Fit exterior joints to exclude water. Apply flat grain lumber with bark side exposed to weather.

3.5 ADJUSTING

A. Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean finish carpentry on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure finish carpentry is without damage or deterioration at the time of Substantial Completion.

## END OF SECTION 06 20 00

# SECTION 06 40 23 – INTERIOR ARCHITECTURAL WOODWORK

## PART 1 - GENERAL

1.1 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction prior to woodwork installation.

1.2 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
B. Installer Qualifications: Arrange for interior architectural woodwork installation by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this Project.
C. Quality Standard: Except as otherwise indicated, comply with the following standard:

1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:

1. Particleboard: ANSI A208.1, Grade M-2.

a) Recycled Content: Provide products with an average recycled content so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 50 percent.

2. Softwood Plywood: PS 1.
3. Hardwood Plywood and Face Veneers: HPVA HP-1 / AHA A 135.4.

B. Particleboard: ANSI A208.1, Grade M-2 made with binder containing no urea formaldehyde.
C. Wood Species:

1. Cabinets: New Growth Cypress

2. Countertops: Ipe (Tabebuis Lapacho Group - Bignoniaceae).
a) Size: As indicated on drawings.

3. Interior Trim, White Oak

2.2 CABINET HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

2.3 INSTALLATION MATERIALS

A. Furring, Blocking, Studs, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.

C. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide interior woodwork complying with the referenced quality standard and of the following grade:

1. Grade: Custom.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

2.5 WOOD CABINETS (MILLWORK) FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 400 requirements for wood cabinets.

1. Grade: Premium as indicated for laminated face boards.

B. AWI Type of Cabinet Construction: Flush.
C. Wood Species: As indicated.

1. Matching of Veneer Leaves: Book match, as close as possible.
2. Veneer Matching Within Panel Face: Balance match.
3. Coloration Within Exposed Faces of Panel Surfaces: Free of dark or irregular colored fields.

D. Semi-exposed and Concealed Surfaces: Provide surface materials indicated below:

1. Surfaces Other than Drawer Bodies: Fabricators standard species closely resembling face panels.
2. Drawer Sides and Backs: Solid hardwood lumber, species closely matching exposed surfaces, shop finished.
3. Drawer Bottoms: Hardwood plywood, shop finished.

2.6 SOLID-WOOD COUNTERTOPS

A. Grade: Premium.
B. Type of Top: Solid wood, butcherblock configuration, sealed.
C. Fabricate tops in one piece, unless otherwise indicated. Comply with fabricator's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with loose backsplashes for field applications.

D. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches for plumb and level (including tops).
C. Standing and Running Trim and Cabinet Edges: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Do not use pieces less than 36 inches long, except where necessary. Stagger joints in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.

1. Install standing and running trim with no more than 1/8 inch in 96-inch variation from a straight line.

D. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

2. Maintain veneer sequence matching of cabinets with transparent finish.

E. Countertops: Anchor securely to base units and other support systems as indicated.

1. Align countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Secure backsplashes to walls with adhesives.
4. Calk space between backsplash and wall with specified sealant.

F. Refer to Division 9 Sections for final finishing of installed architectural woodwork.

3.2 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
B. Clean, lubricate, and adjust hardware.
C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.3 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

## END OF SECTION 06 40 23

# SECTION 06 64 00 – PLASTIC PANELING

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 6 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Polycarbonate Sheets

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
B. Schedule: Use same designations indicated on Drawings.
C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
D. Maintenance Data: For each product to include in maintenance manuals.
E. Warranties: Manufacturers warranty applies
.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain items through one source from a single manufacturer.

Provide products from same manufacturer for each type of collector/invertor required.
To the greatest extent possible, provide collectors and invertors by a single manufacturer for entire Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Store materials in a clean, dry, ventilated, weather tight, secure location. Protect materials from soiling, abuse, loss, and moisture damage.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Polygal
P.O. Box 410592, Charlotte, NC 28241 USA
Toll Free: 1(800) 537-0095
Fax: 1(704)588-7400
http://www.polygal-northamerica.com/

2.2 Polycarbonate Sheets

A. 8mm, 48” W, Polycarbonate Multi-Wall Sheets, Standard, Light Transmission = ICE

http://www.polygal-northamerica.com/standard_grade.php

B. 8mm x 4' x 16' PolyCarbonate sheets, Standard Grade – CLEAR
http://www.polygal-northamerica.com/standard_grade.php

C. 8mm x 4' x 16' Polycarbonate sheet, Polycoolite with Anti-fog
http://www.polygal-northamerica.com/polycoolite.php

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Examine area to verify actual locations of connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

### 3.3 CLEANING AND PROTECTION

A. Clean and protect each sheet to insure prevention of damage to sheets.
B. Verify that accessories and connections required have been furnished and installed.
C. Remove packing material from polycarbonate sheets and leave items in clean condition, ready for operation.

## END OF SECTION 06 64 00

# SECTION 07 13 26 – Self-Adhering Sheet Waterproofing

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   a. Self-adhering polymer modified underlayment

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
B. Samples: For the following products:

   1. 12-by-12-inch square of underlayment sheet.
   2. Warranties: Special warranties

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store rolls according to manufacturer's written instructions.
B. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Apply underlayment within the reach of ambient and substrate temperatures recommended by manufacturer. Do not apply underlayment to a damp or wet substrate.

   1. Do not apply underlayment in snow, rain, fog, or mist.

## PART 2 – PRODUCTS

2.1 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

   1. Thermal Stability: Stable after testing at 240 deg. F; ASTM D 1970.
   2. Low-Temperature Flexibility: Passes after testing at minus 20 deg. F; ASTM D 1970.
   3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - Grace Construction Products; a unit of Grace, W.R. & Co.; Ultra

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements and other conditions affecting performance.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean and dry substrate for underlayment application.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches Roll laps with roller. Cover underlayment within 14 days.

B. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

3.4 PROTECTING AND CLEANING

A. Protect installed underlayment from damage due to ultraviolet light, and other causes.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures

## END OF SECTION 07 13 26

# SECTION 07 21 00 – THERMAL INSULATION

## PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Spray Application SEALECTION Agribalance to provide insulation and air seal (roof of extension modules)

1.2 REFERENCES

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

1. ASTM C518; Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM D2863, Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (oxygen index)
3. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials
4. ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
5. ASTM E96, Test Method for Water Vapor Transmission Rate of Building Materials.
6. ASTM E283, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Difference Across the Specimen.
7. International Code Council – International Residential Code

a. Section 103.7 Alternate Materials and Methods
b. Section R314 Foam Plastic Insulation
c. Section 806.4 Conditioned Attic Assemblies

1.3 SUBMITTALS

A. Product Data: Provide data on materials, describing insulation properties, surface burning characteristics, etc.
B. LEED Information: Indicate percentage of waste materials by weight diverted from landfill and recycled.
C. Manufacturer's installation instructions: Indicate special procedures, perimeter conditions requiring special treatment.
D. Manufacturer's Certificate: certify that products meet or exceed specified requirements

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum of three years documented experience.
B. Applicator: Company specializing in performing the work of this section

1.5 REGULATORY REQUIREMENTS

A. Conform to UL Assembly Design
B. Conform to applicable code for flame and smoke ratings

1.6 ENVIRONMENTAL GUIDELINES:

A. Toxicity/Hazardous Materials:

1. Out gassing/Reactivity

a. Formaldehyde: Products contained urea-formaldehyde will not be permitted.
b. Chlorofluorocarbons (CFCs)/HCFCs: Products and equipment requiring or using CFCs or HCFCs during the manufacturing process will not be permitted.

B. Air tightness: Meet specific standards of the Energy Star Program of 1.5 Air Changes/Hour at 50 Pa.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
B. Store materials in an area protected from freezing and overheating damage and in accordance with manufacturers instructions.
C. Protect materials during handling and application to prevent damage and contamination.

## PART 2 – PRODUCTS

2.1 MANUFACTURER: www.demilecusa.com

A. Demilec USA
2925 Galleria Drive
Arlington, TX 76011
P: 817.640.4900
F: 817.633.2000
info@demilicusa.com

2.2 MATERIALS

A. Spray Applied Semi Rigid Polyurethan Foam Insulation System
B. Product: SEALECTION Agribalance Manufactured by DEMILEC (USA) LLC, Arlington, TX
http://www.demilecusa.com/Default.aspx?ip=3&sip=46

2.3 EQUIPMENT

A. Equipment used to apply the foam insulation shall have fixed ratio positive displacement pumps and approved by foam manufacturer.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that substrate is free of any foreign materials that will impede application.
C. Verify that other work on and within spaces to be insulated in compete prior to application
D. Notify Architect of conditions that would adversely affect the application.
E. Beginning of installation means applicator accepts existing conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for preparing substrates indicated to receive insulation.
B. Mask and protect adjacent surfaces from overspray or damage.

C. Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.

3.3 APPLICATION

A. Apply insulation in accordance with manufacturer's written application instructions.
B. Apply insulation to a reasonable uniform monolithic density without voids.
C. Apply insulation in all necessary areas as indicated by drawings.

| Location | Recommended Thickness | R-Value of Insulation |
|---|---|---|
| Exterior Walls | 3.5-5.5 inches | 14-22 |
| Pony and Hip Walls | 3.5-5.5 inches | 14-22 |
| Attic Assembly | 3.5-10 inches | 14-40 |

Note: Recommended thickness is dependent on the type of wall construction 2"x4" vs. 2"x6"

3.4 FIELD QUALITY CONTROL

A. Inspect application for insulation thickness and density

3.5 PROTECTION OF FINISHED WORK

A. Do not permit subsequent work to disturb applied insulation.

## END OF SECTION 07 21 00

# SECTION 07 27 00 – AIR BARRIERS

## PART 1 – GENERAL

1.1 SUMMARY

A. This Section provides for the exterior wall, breathable membrane
B. Related sections include the following:

1. Division 6 Section "Rough Carpentry" for exterior sheathing
2. Division 6 Section "Finish Carpentry" for cypress rain screen cladding
3. Division 7 Section "Metal Siding" for wall membrane
4. Division 13 Section "Pre-Engineered Buildings" for metal siding and roofing

1.2 REFERENCES

A. American Association of Textile Chemists and Colorist [AATCC]
B. American Society for Testing and Materials [ASTM]
C. International Code Council Acceptance Criteria [CC-ES-AC]

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions, technical data, and tested physical and performance properties of breathable membrane.
B. Shop Drawings: Provide 1-1/2" scale drawings (or larger) showing relationship of membrane to:

1. Framing or blocking members
2. SIPS
4. Sheathing
5. All exterior cladding and corner conditions
6. Door or window frames
7. Rain Screen Battens / Cavity Design
8. Pipe, Conduit and Duct penetrations

C. Samples:

1. 8-1/2-x-11 inch square of breathable membrane sheet
2. Tapes (Single & Double-Sided)
3. Factory fabricated window opening corners
4. 12" long section of sill pan
5. Sample of Batten 6" long x ½" depth
6. Provide materials and fasteners for mock-up

D. Manufacturer's Instructions: Provide manufacturer's instructions showing the recommended procedures and sequence of installation of breathable membrane in rain screen installation. Please see our website www.VaproShield.com for downloadable installation instructions.

1.4 QUALITY ASSURANCE

A. Membrane manufacturer shall have an on-going quality control program with inspections by a nationally recognized independent organization and shall be so labeled.
B. Source Limitations: Obtain all breathable membrane through one source from a single manufacturer.
C. Preinstallation Conference: Conduct conference at project site to comply with requirements in

Division 1 Section "Project Management and Coordination." Review requirements for membrane, including surface preparation specified under other Sections, substrate condition and pretreatment, temporary weather protection, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original containers with seals unbroken, wrapped in a polythene sleeve, labeled with manufacturer's name, and product brand name.
B. Store rolls under cover, on a clean, level surface, either flat or upright.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following products:

1. Spun Bonded Polypropylene: Membrane shall be furnished in standard rolls of 59" high (1-1/2 meters) and 164 feet (50 meters) long http://www.vaproshield.com/products/wrapshield/

a. WrapShield –Black for open joint rain screen applications, distributed by VaproShield LLC, Phone (866) 731-7663, www.vaproshield.com
b. Others as may be approved by Addendum.

2.2 UNDERLAYMENT PHYSICAL PROPERTIES

A. Color: Exterior Black to weather side, White on interior.
B. Thickness and Weight: 0.020 inches thick and 5.014 oz. / sq. yd.
C. Tensile Strength: ASTM D882, Pass
D. Dry Breaking Force: ASTM D5034, Pass
E. Water Resistance (control and weathered specimens): AATCC 127, Pass
F. Water Resistance (Ponding): ASTM D779, Pass
G. Water Vapor Transmission: ASTM E96, Pass
H. Low Temperature Bend: AC38, Pass
I. Air Permeance of Building Materials: ASTM 2178, Pass
J. Air Leakage through Wall Systems: ASTM E 283, Pass
K. Air Retarder Materials & Systems: ASTM 1677, Pass
L. Flamespread Index: ASTM E-84, Pass
M. Smoke Development Index: ASTM E-84, Pass
N. Water Resistance (UBC Flashing Requirements): ASTM 2112, Pass Accessories provided by VaproShield include a complete systems approach by offering prefabricated sill pans and a batten system, which can be utilized in a simple rain screen system 4" VaproTape (Single-Sided) 35 mil, Black is available for open joint applications.

2.3 BUILDING OFFICIAL APPROVALS

A. ICC: International Code Council, ICC Certificate #ESR-1916 (Approved).

2.4 AUXILIARY MATERIALS, distributed by VaproShield LLC Phone (866) 731-7663

A. VaproSillSaver™

1. Window Sill Pan – VaproSillSaver

a. 1-5/8”, 2”, 2-3/8”, 3-1/8” Sill Pan for flanged windows with end dams and spacers for field modification and installation

2. Sliding Door Sill Pan

a. 3-1/8” Sill Pan for flanged sliding doors with end dams and spacers for field modification and installation

B. VaproVent™ Strips (Rain Screen Construction)

1. For a breathable drainage cavity:

a. VaproVent top and bottom venting protection strips
b. Others as may be approved by Addendum

C. Tape

1. Single-Sided Tape:

a. 3” VaproTape™ (Single-Sided) 20 mil., for use to secure WrapShield to itself and to substrates
b. Others as may be approved by Addendum

2. Double-Sided Sealing Tape

a. 1” VaproTape™ (Double-Sided) 30 mil., for use to seal WrapShield to itself and to substrates
b. One inch wide butyl rubber tape, subject to approval of the Architect.
c. Others as may be approved by Addendum.

D. Caulks and Sealant

1. As approved and recommended by membrane manufacturer.

E. Fasteners

1. Wood Sheathing Substrate Application: Fasteners are dictated by the ICBO Their approval provides no minimum frequency for the fasteners. It states, “The underlayment shall be fastened only as necessary to hold in place, except in areas subject to basic (fastest mile) wind speeds in excess of 90 miles per hour (for UBC) or 3 second gust wind speeds in excess of 110 miles per hour (for IRC).” Since the underlayment will be held down by cladding, many specifiers do not mention detailed information about the fasteners
a. Minimum No. 12-gage [.0129-inch-shank-diameter (2.11mm)] corrosion-resistant steel or stainless steel nails having a minimum 3/8-inch diameter (9.5mm) head,

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements and other conditions affecting performance.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean and dry substrate for breathable membrane application.

3.3 PENETRATIONS

A. Pipes and Conduit: Install manufactured penetration sleeves sized for the penetration and installed as recommended by the manufacturer.

B. Windows:

1. Secure prefabricated VaproFlashing and Factory Formed Corners at window sill ends.
2. Next, lay strip of breathable membrane across sill. Secure with tape or mechanical fasteners so that the membrane used for the wall can be slipped underneath the corners and sill, allowing for a minimum lap of 6 inches.
3. Wrap a strip of breathable membrane around jambs extending horizontally along walls a minimum of 9 inches.
4. Secure VaproShield Factory Formed Corners at ends of window head.
5. Next, lay strip of breathable membrane across the opening, extending horizontally beyond the corners a minimum of 6 inches.

   a. Cut membrane along the leading edge of the header an inch or two beyond each jamb, so that the nailing flange of the window may side up behind the membrane.

C. Doors:

1. Wrap a strip of breathable membrane around jambs, extending horizontally along walls a minimum of 9 inches.

   a. Secure VaproShield Factory Formed Corners at ends of door head.
   b. Next, lay strip of breathable membrane across the opening, extending horizontally beyond the corners a minimum of 6 inches.
   c. Cut membrane along the leading edge of the header, an inch or two beyond each jamb, so that the nailing flange of the door may side up behind the membrane.

3.4 BREATHABLE UNDERLAYMENT APPLICATION

A. Install membranes in accordance with manufacturer’s instructions over [exterior sheathing or metal purlins]. Secure the membrane so that the subsurface is protected from weather until cladding can be installed.

1. First, wrap penetrations as specified and detailed.
2. Next, starting from the bottom, unroll the membrane, Orange side out (or black for open joint rain screen applications), mechanically fastening top and bottom, 2’-0” o.c.
3. Seal against jambs of openings with 1” VaproTape (Double-Sided).
4. Vertical laps shall be a minimum of 6” with taped joints or 12” without tape. Horizontal laps shall be a minimum of 6”.

3.5 INSTALLATION INSTRUCTIONS

A. Step 1 – Begin Flashing Penetrations

1. Cut a piece of WrapShield to act as a “skirt” around counter flashed penetrations i.e. Ducts/housings or pipes. Distance from penetration to edge of barrier “skirt” minimum of 12”.
2. Make four cuts to form a star shape and place over penetration snugly.

3. Extend “ears” of material along vertical penetration and seal with VaproTape (Single-Sided).
4. Tape top edge of “skirt” to wall using VaproTape (Single-Sided). Do not tape bottom edge.

B. Step 2 – Attach Water Resistive/Air Barrier

1. Starting at base of wall, unroll WrapShield horizontally across wall. Best Practice: place a continuous bead of non-skinning butyl sealant or butyl tape on foundation wall and seal WrapShield to it.
2. Extend 6” over starting corner.
3. Fasten at top and bottom of roll at 2” from edge of WrapShield to center of fasteners.
4. Fasten at maximum of 2’0” on center.
5. Shingle next layers of WrapShield, ensuring minimum 6” horizontal and minimum 12” vertical laps. Ensure minimum 6” horizontal and minimum 6” vertical laps if taped with VaproTape (Single-Sided) at vertical laps. Do not place vertical laps above windows.
6. For delayed installation of siding/masonry determine fasteners and reduced fastener spacing for wind exposure (i.e. cap nails).

C. Step 3 – Finish Flashing Penetrations

1. Ensure WrapShield is slipped under bottom edge of penetration “skirt” and shingled over taped top edge.
2. Seal top and sides with VaproTape (Double-Sided).
3. Ensure whole “skirt” assembly is flashed appropriately with metal.

D. Step 4 – Install Siding/Masonry

1. Cladding boards – per cladding system installation requirements. For information on use of Black WrapShield in open joint applications refer to www.vaproshield.com.
2. Masonry - wall ties/mechanical fasteners/veneer anchors as per building code requirements.

E. Air Barrier Application

1. Install WrapShield between sill plate and foundation gasket and seal to foundation wall with a bead of non-skinning butyl or butyl tape (VaproTape Double-Sided).
2. Method A: Flash penetrations and install WrapShield according to water resistive barrier installation instructions.*
3. Fasteners to be a maximum 6” on vertical and maximum 16” on horizontal centers. Increase fasteners where air barrier bridges openings in sheathing board.
4. Method B: Install continuous furring strips vertically along stud lines, vertical fasteners at 12”. Best Practice: fasteners at maximum 6” on vertical and maximum 16” on horizontal.
5. Tape all vertical and horizontal laps using VaproTape “AB” (air barrier) or VaproTape Single-Sided.
6. Overlap WrapShield and ceiling air barrier and seal with VaproTape “AB” (air barrier) or use VaproTape (Single-Sided).

G. Open Joint Applications

1. Requires double layer of membrane material at open joint, due to UV exposure.

3.6 PROTECTING AND CLEANING

A. Protect installed breathable membrane from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Manufacturer suggests a maximum of nine (9) months UV exposure.

1. Repair torn breathable membrane as follows:

a. Insert a full height piece of membrane extending 12 inches horizontally beyond the damage and extend up and under the membrane above. Mechanically attach membrane to substrate top and bottom.

B. Remove mud and similar marks with a water only scrub. If chemicals have been spilled on membrane, treat as a tear and repair as stated above.

## END OF SECTION 07 27 00

# SECTION 07 41 00 – METAL WALL PANELS

## PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All exterior metal wall panels and associated flashing, [insulation], [subgirts], [profile louvers], sealants, and fasteners necessary to form the exterior metal wall panel system shown on the contract drawings and/or specified herein.

B. Related Sections:

1. 06120 Structural Panels
2. 07600 Flashing & Sheet Metal
3. 07900 Joint Sealers

1.2 REFERENCES

A. General: Reference latest edition of applicable codes and standards.

B. 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 Box1
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 Specimen1
4. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

C. American Iron and Steel Institute (AISI):

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

D. American Institute of Steel Construction (AISC):

1 . Code of Standard Practice

E. American Society of Civil Engineers (ASCE):

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

F. International Code Council (ICC

1. International Building Code (IBC)

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Design wind loads shall be as specified below, acting normal to the plane of the wall, or as indicated on the contract drawings.
2. Wall panels shall be designed for maximum deflection as indicated in the drawings.
3. Air infiltration of the wall panel system shall be limited to 0.06 CFM/ft2 at a positive pressure differential of 1.57 psf when tested in accordance with ASTM E 283.3a

4. There shall be no uncontrolled water penetration to the building interior when the wall panel system is tested per ASTM E 331 at a positive pressure differential of 6.24 psf or 20% of the design wind pressures whichever is greater. The test pressure need not exceed 12 psf.
5. Wall panel system shall be tested for thermal transmittance in accordance with ASTM C 236. Thermal transmittance, corrected to 15 mph wind outside and still air inside, shall not exceed measurements as indicated in drawings.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: The manufacturer shall have had a minimum of ten (10) years experience in the successful completion of projects employing similar materials, applications, and performance requirements.
   1. Manufacturer shall provide a list of five (5) similar completed projects with addresses of the project location, architect, and owner.

B. Installers Qualifications: The wall systems contractor shall have had a minimum of ten (10) years experience in the successful completion of projects employing similar materials, applications, and performance requirements.

   1. The wall systems contractor shall provide a list of five (5) similar completed projects with addresses of the project location, architect, and owner.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 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 (2) years from date of shipment.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. MBCI Headquarters
Houston, Texas
Main Phone: 281-445-8555
Toll Free: 877-713-6224

B. Substitutions: Materials, accessories, and testing specified shall establish the minimum level of quality, performance, dimension, and appearance required of any substitution.

   1. No substitution will be considered unless, written request for approval has been received by the specifying architect at least ten (10) days prior to the bid date. Request shall include evidence submitted to demonstrate equivalency to the products and performance levels specified.

      a. A complete description of the substitution including details referenced to the wall conditions shown on the contract drawings.
      b. Independent test reports verifying compliance with specified performance requirements.

c. Calculations certified by a professional engineer, registered in the state where the project is located, verifying that the proposed substitution meets the specified loading requirements.
d. A detailed listing of each specification item with which the substitution does not fully comply.

2. The manufacturer or wall systems contractor proposing the substitute shall pay the costs of any other subcontractor affected by the proposed substitute.

2.2 MATERIALS

A. PBC Corrugated Steel Panel and Trim

1. http://www.mbci.com/new/panel_pbc.html

C. All exterior flashing and trim shall be fabricated in the same material, gage, finish, and color as the exterior profile, unless otherwise noted.

1. Extrusions shall be 6063-T5 aluminum with exposed surfaces painted to match wall panels.

2.3 FINISHES

A. Galvalume

2.4 CORNERS

A. Reference Drawings

2.5 ACCESSORIES

A. Wall panel system fasteners shall be #14 minimum diameters, self-tapping, with hex head.

1. Exposed fasteners shall be 300 series stainless steel with 5/8" bonded neoprene and stainless steel washers coated to match the exterior panel color. 14 Unless specified otherwise, painted Profile Louvers shall receive a standard backside finish consisting of a 0.2 mil primer and 0.3 mil backer coat. Profile Louvers designed as part of a screen wall application shall receive a backside finish matching the specified exterior finish system.

C. Sealants:

1. Hidden sealant at all side laps, end laps, and flashing details shall be gun grade non-curing butyl or polymeric non-skinning butyl tape to ensure weather tightness.
2. Exposed sealant shall be one-part moisture curing, gun grade polyurethane.

2.6 FABRICATION

A. Wall panel system components shall be fabricated in the factory for field assembly to the greatest extent possible.

## PART 3 - EXECUTION

3.1 INSPECTION

A. Wall panel systems contractor shall check the alignment of the structural supports. Alignment exceeding tolerances defined in the AISC Code of Standard Practice shall be corrected prior to proceeding with the installation of the wall panel system.
B. Wall panel systems contractor shall inspect installation of vapor permeable air and water barrier for compliance with manufacturer's installation instructions. Corrections necessary to ensure specified performance shall be made prior to wall panel installation.

3.2 INSTALLATION

A. Manufacturer shall provide detailed instructions covering the tools, fasteners, sealants, and assembly procedures required to achieve the structural, thermal, and weathering performance specified.
B. Metal filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.
C. The wall panel systems contractor shall coordinate work with other trades as required to insure proper flashing and seals with adjoining construction.

3.3 DAMAGED MATERIAL AND CLEANING

A. Damage caused by the manufacturer or wall panel systems contractor shall be repaired or replaced.
B. The general contractor shall inspect and approve each completed wall area and be responsible for protecting finished work from damage by other trades.
C. The wall panel systems contractor shall remove all protective materials and labels from the wall components as they are installed.
D. The general contractor shall be responsible for final cleaning of the wall panel system due to any conditions that occur after the wall panel systems contractor has completed an area. Cleaning is to be done in accordance with the manufacturer's instructions.

## END OF SECTION 07 41 00

# SECTION 07 61 13 – STANDING SEAM SHEET METAL ROOFING

## PART 1 – GENERAL

1.1 SUMMARY

A. General

1. Furnish all labor, material, tools, equipment, and services for all preformed roofing as indicated, in accordance with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements

B. Related Work Specified Elsewhere:

1. 051000: Structural Steel
2. 076000: Flashing and Sheet Metal

1.2 QUALITY ASSURANCE

A. Applicable Standards

1. SMACNA: "Architectural Sheet Metal Manual", Sheet Metal and Air Conditioning Contractors National Association, Inc.
2. LGSI: "Light Gage Structural Institute"
3. AISC: "Steel Construction Manual", American Institute of Steel Construction.
4. AISI: "Cold Form Steel Design Manual", American Iron and Steel Institute (1996 Edition).
5. UL58: "Tests for Uplift Resistance of Roof Assembles", Underwriters Laboratories, Inc.
6. UL2218: Class 4 Impact Resistance Rating
7. ASTM E 282-84: "Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen", American Society for Testing and Materials.
8. ASTEM E 331-83: "Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference," American Society for Testing and Materials.
9. ASTM E 1514-93: "Standard Specification for Structural Standing Seam Steel Roof Panel Systems", American Society for Testing and Materials
10. ASTM E 1592-95: "Standard Testing Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference," American Society for Testing and Materials.

NOTICE: Contact MBCI for the proper combination of panel gauge, clip type, clip spacing and substructure to achieve a UL-90 rated system.

11. ASTM A 792-83-AZ50 (Painted) & ASTM A792-83-AZ55 (Bare Galvalume Plus): "Specifications for Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process, General Requirements (Galvalume)", American Society for Testing and Materials.

12. ASTM E 408-71: Standard Test Method for Total Normal Emittance of Surfaces Using Inspection – Meter Techniques. (Energy Star for Roof Products)
13. ASTM E 903-96: Standard Test Method for Solar Absorbance, Using Integrating Spheres. (Energy Star for Roof Products)

B. Manufacturer's Qualifications:

1. Manufacturer has a minimum of five years experience in manufacturing metal roof systems of this nature. Panels specified in this section shall be producing in a factory environment (not with a portable roll form with fixed-base roll forming equipment) and in line leveling assuring the highest level of quality control. A letter from the manufacturer certifying compliance will accompany the product material submittals.

C. Installation Contractor's Qualifications:

1. Installation contractor shall be an approved installer, certified by the manufacturer before the beginning of installation of the metal roof system, specifically for MBCI's LokSeam metal roof system, Certification by manufacturer must include the following:

    a. Maintain $250,000 minimum general liability insurance coverage.
    b. Maintain statutory limits of worker's compensation coverage as mandated by law.
    c. Have no viable claims pending regarding negligent acts or defective workmanship on previously performed or current projects.
    d. Has not filed for protection from creditors under any state or federal insolvency or debtor relief statutes or codes.
    e. Project foreman is the person having received certification by the manufacturer specific training in the proper installation of the selected metal roof system and will be present to supervise whenever material is being installed. Specific certified installer program shall include the following:

2. The instructor must have a minimum of 10 years experience in the application of metal roof systems.
3. A formal syllabus for the classroom and hands-on training.
4. Classroom instruction with review and thorough understanding of the specific product's technical manual
5. Hands-on mock-up instruction with a review and thorough understanding of the specific product's details.
6. The installation contractor must pass a written and oral exam.

    a. Provide five references from five different architects or building owners for projects that have been in services for a minimum of 2 years, stating satisfactory performance by the installation contractor.
    b. Provide certification letter than installation contractor has a minimum of three years of metal product installation experience immediately preceding the date upon which work is to commence.

D. Pre-Installation Conference:

1. Prior to installation of roofing system, conduct a pre-installation conference at the project side.
2. Attendance: Owner, Architect, Contractor, Project Superintendent, and Certified Installer.
3. Agenda:

    a. Roofing details and agenda

b. Critical work sequencing and review of phasing plan
c. Inspection sequencing

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Performance Testing:

1. Metal roof system must be tested in accordance with Underwriters Laboratories, Inc. (UL) Test Method 580 “Tests for Uplift Resistance of Roof Assemblies.”
2. Metal roof system must be installed in accordance with UL Construction method.
3. Metal roof system must be tested in accordance with ASTM E 1592-95 for negative loading when AISI specifications do not apply. Determine panel bending and clip-to-panel strength by testing in accordance with ASTM E 1592-95. Capacity for gauge, span or loading other than those tested may be determined by interpolating test values only.
4. Metal roof system must meet the air infiltration requirements of ASTEM E 283-84 when testing with a 6.24 PSF pressure differential with no uncontrollable water leakage when five gallons per hour of water is sprayed per square foot of roof area.
5. Metal roof system must meet the water penetration requirements of ASTEM E 331-83 when tested with a 6.24 PSF pressure differential with no uncontrollable water leakage when five gallons per hour of water is sprayed per square foot of roof area.
6. Metal Roof Panels shall be high reflectance and high emittance in accordance with Energy Star. Initial Reflectance (Galvalume Only) shall be at least .68 when tested with ASTM – E 1918 (Measured as Solar Reflectivity, not visible reflectance)

1.4 DESIGN REQUIREMENTS

A. Roof Design Loads

1. Design Criteria shall be in accordance with the most current version of IBC.
2. Dead Loads:

a. The dead load shall be the weight of the SSMR system, Collateral loads, such as sprinklers, mechanical and electrical systems, and ceiling shsall not be attached to the panels.

3. Live Loads

a. The panels and concealed anchor clips shall be capable of supporting a minimum of uniform live load of 20 psf.

4. Roof Snow Loads

a. The design roof snow loads shall be as shown on the contract drawings.

5. Wind Loads

a. The design wind uplift pressure for the roof system shall be as shown on the contract drawings. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when calculating fastener design loads.

i. Single fastener in each connection : 3.00
ii. Two or more fasteners in each connection: 2.25

6. Thermal Loads

a. Roof panels shall be free to move in response to the expansion and contraction forces resulting for a total temperature range of 50 degrees F during the life of the structure.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit complete shop drawings and erection details, approved by the metal roofing manufacturer, to the architect for review. Do not proceed with manufacture of roofing materials prior to review of shop drawings and field verification of all dimensions. Do not use drawings prepared by the architect (owner) for shop and erection drawings.
2. Shop drawings show methods of erection, roof and wall panels layout, sections and details, anticipated loads, flashings, sealants, interfaces with all materials not supplied and proposed identification of component parts and their finishes.

B. Performance Tests:

1. Submit certified test results by a recognized testing laboratory or manufacturers lab (witnessed by a professional engineer) in accordance with specified test methods for each panel system.

C. Calculations:

1. Submit engineering calculations defining all cladding loads for all roof areas based on design criteria listed in Para 1.04 Design Requirements, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure.
2. Compute uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading.

a. Calculate holding strength of fasteners in accordance with submitted test data provided by the fastener manufacturer based on length of embedment and properties of materials
b. Submit thermal calculations and details of floating clip, flashing attachments, and accessories certifying the free movement in response to the expansion/contraction forces resulting from a total temperature differential of 110 degrees F.

D. Samples:

1. Submit samples and color chips for all proposed finishes.

a. Submit one 8-inch long sample of panel, including chips.
b. Submit two 3 inches x 5 inch color chip samples in color selected by the architect (owner)

E. Warranties:
Metal roof system manufacturer shall submit a specimen copy of the warranty upon final acceptance of the project. Provide one of the following warranties:

1. Finish

a. Covering bare metal against rupture, structural failure and perforation due to normal atmospheric corrosion exposure for a period of 20 years.

2. Weathertightness
Metal roof system manufacturer shall submit a specimen copy of manufacturer's weathertightness warranty, including evidence of application for warranty and manufacturer's acceptance of the applicator and warranty conditions.

a. Single Source Warranty

F. Test Reports:

1. Submit Test Reports showing that metal panels have been tested in accordance with the Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference of ASTM E 1592-95.
2. Metal roof system must meet the air infiltration requirements of ASTM E 283-84 when tested with a 6.24 PSF pressure differential. The resulting air infiltration leakage rate will be a minimum of 12" LokSeam.
3. Submit Test Reports showing that metal panels meet the water penetration requirements of ASTM E 331-83 when tested with a 12.00 PSF pressure differential with no uncontrollable water leakage when five gallons per hours of water is sprayed per square foot of roof area.

G. Metal Roof System Fabrication Certification:

1. Submit a letter from the metal roof system manufacturer certifying the LokSeam panels have been produced in a factory environment (not job site roll formed) with fixed-based roll forming equipment in line leveling.

H. Certified Installers Qualifications:

1. Submit certificate from manufacturer certifying that installer of the metal roof system has met all of the criteria outlined in "1.02 C. Installer's qualifications and is an authorized installer certified by the manufacturer.
2. Submit the formal syllabus for the classroom and hands-on training.
3. Submit five references from five different architects or building owners for projects that have been services for a minimum of two years, stating satisfactory performance by the installation contractor.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.7 WEATHERTIGHTNESS WARRANTIES

A. Single Source Warranty

1. For a period of 20 years from the date of substantial completion, the roofing manufacturer WARRANTS to the Building Owner : to furnish roof panels, flashing and related items used to fasten the roof panels and flashing including roof jack and curb attachments to the roof structure, will not allow intrusion of water from the exterior of the roofing manufacturer's Roof System into the buildings envelope when exposed to ordinary weather conditions and ordinary wear and usage. The Date of Substantial Completion is the date that is certified by Architect, Owner, or Owner's Representative, when the roofing manufacturer's Roofing System is completed and accepted by or on behalf of the Owner.
2. Manufacturer's Field Service:

a. During installation, provide for two on-site inspections of roof application by

qualified technical representative of the manufacturer.

b. Upon completion of installation, provide final inspection by a technical representative of roofing manufacturer to confirm that roofing system has been installed in accordance with manufacturer's requirements.

3. The roofing manufacturer shall have the SOLE and EXCLUSIVE obligation for all warranty work commencing on the date of substantial completion and under all circumstances terminates on the 20 year anniversary of the date certified as Substantial Completion of the roofing manufacturer's Roof System. During the period in which the roofing manufacturer has any warranty obligation, the roofing manufacturer shall take appropriate actions necessary to cause the non-performing portions of the Roof System to perform their proper functions.
4. The total liability of the roofing manufacturer under Single Source Warranty is Single Source I, limited solely to two times the cost of the roofing manufacturer's roof system as invoiced to the roofing manufacturer's customer.

## PART 2 - PRODUCTS

2.1 MANUFACTURER

A. MBCI Headquarters
Houston, TX
P: 281.445.8555
Toll Free: 877.713.6224
http://www.mbci.com/new/contact.html

2.2 MATERIALS

A. Metal Roof System Profile

1. 1-3/4" high rib x 12" wide panel
http://www.mbci.com/panel_lokseam12.html

B. Panel Style

1. Narrow rib, vertical leg, concealed fastener, positive snap lock standing seam, utilizing male and female rib configurations, with factory applied hot melt mastic in female rib.

C. Gauge

1. 24 Gauge

D. Finish

1. Galvalun

E. Substrate

1. Galvalume steel sheet, .5 ounces/ sq ft, minimum yield of 50,000 psi.

F. Clip

1. UL 90

G. Other manufacturers desiring approval must comply with section 01630

H. Acceptable Curb and Equipment Support Units:

1. LMCurbs – Longview, TX

2.3 MISCELLANEOUS MATERIALS

A. Fasteners

1. All self-tapping/self-drilling fasteners, bolts, nuts, self-locking rivets and other suit able fasteners shall be designed to withstand specified design loads.
2. Use long life fasteners for all interior and exterior metal roof system applications.
3. Provide fasteners with a factory applied coating in a color to match metal roof system application.
4. Provide neoprene washers under heads of exposed fasteners.
5. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

B. Accessories

1. Provide all components required per the metal roof system manufacturer's approved shop drawings for a complete metal roof system to include panels, panel clips, trim/flashing, fascias, ridge, closures, sealants, fillers, and any other required items.

a. All outside closures will be fabricated from Galvalume Plus or Pre-Painted Galvalume sheet steel of the same gauge, finish, and color as the panels.
b. All tape seal is to be a pressure senstivie, 100 percent solids, polyisobutylene compound sealing tape with a release paper backing. Provide permanently elastic, non-sagging, non-toxic, non-staining tape seal approved by the metal roof system manufacturer.
c. All joint sealant is to be a one-part elastomeric polyurethane sealant approved by the metal roof system manufacturer.

2.4 FABRICATION

A. Material shall be in-line leveled prior to roll forming the panel profile.
B. Where possible, roll form panels in continuous lengths, full length of detailed runs.
C. Standard panel length shall be no more than 40 feet long for 22 gauge and 24 gauge. (For longer length available contact manufacturer.
D. Fabricate trim/flashing and accessories to detailed profiles.
E. Fabricate trim/flashing from same material as panel.

2.5 PREFABRICATED CURES AND EQUIPMENT SUPPORTS

A. Comply with loading and strength requirements as indicated where units support work of other trades.
B. Fabricate curbs of structural quality aluminum (min .08 in thickness for mechanical gear up to 1000 lbs and 2000 lbs; use a two curb system per the manufacturer above 2000 lbs.), factory primed and prepared for painting with mitered and welded corner joints. Provide integral cap cells and water diverter crickets. The upper flange of the curb must be a minimum of 18" above the water diverter crickets. The upper flange of the curb must be a minimum of 18" above the water diverter. (This allows 12" of free area after the panel is lapped over the flange on the high side._ Curbs shall be designed to install under metal roof system on the high side and over metal roof system on the low side.
C. Minimum height of prefabricated curb will be 8 inches above the finished metal roof system.

D. Curbs shall be constructed to match the configuration of the metal roof panels and extend to a panel rib on each side. Minimum distance between curb wall and panel rib is 6”.
E. Curb flanges must be constructed to match the configuration of the metal roof panels and extend to a panel rib on each side. Minimum distance between curb wall and panel rib is 6”.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

A. Examinations

1. Inspect installed work of other trades and verify that such work is complete to a point where this work may continue.
2. Verify that installation may be made in accordance with approved shop drawings and manufacturer’s instructions. This specifically includes verifying that secondary structural members and/or decking are installed to meet UL and building code requirements. Coordinate with metal roof system manufacturer to insure that reduced clip spaces at eave, rake, ridge, and corner areas are accommated.

B. Discrepancies

1. In event of discrepancy, notify the architect (owner).
2. Do not proceed with installation until discrepancies have been resolved.

### 3.2 INSTALLATION

A. Install metal roof system so that it is weathertight, without waves, warps, buckles, fastening stresses, or distortion, allowing for expansion and contraction.
B. Install metal roof system in accordance with manufacturers instructions and shop drawings.
C. Provide concealed anchors at all panel attachment locations.
D. Install panels plumb, level, and straight with seams and ribs parallel, conforming to design as indicated.

### 3.3 ROOF CURB INSTALLATION

A. Comply with metal roof system manufacturer’s shop drawings, instructions, and recommendations for installation of roof curbs. Refer to metal roof system manufacturer’s standard installation details.
B. Anchor curbs securely in place with provisions for thermal and structural movement.

### 3.4 CLEANING, PROTECTION

A. Dispose of excess materials and remove debric from site.
B. Clean work in accordance with manufacturer’s recommendation.
C. Protect work against damage until final acceptance. Replace or repair to the satisfaction of the architect (owner) any work that becomes damaged prior to final acceptance.
D. Touch up minor scratches and abrasions with touch up paint supplied by the metal roof system manufacturer.
E. Do not allow panels or trim to come in contact with dissimilar metals such as copper, lead, or graphite. Water run-off from these materials is also prohibited. This specifically includes condensate from roof top unites A/C units.

## END OF SECTION 07 41 00

# SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:

1. Exposed trim and fascia.
2. Copings.
3. Soffit panels.
4. Metal flashing.
5. Formed roof drainage sheet metal fabrications.
6. Stainless Steel Sinks

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 07 Section “Metal Roof and Wall Panel” for flashing and roof accessories as part of sheet metals roofing work.
2. Division 07 Section "Joint Sealants" for elastomeric sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing, trim, and wall panels to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for applicable wind zone.
C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change Range: 120 degree F , ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.
D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or

more units showing the full range of variations expected.

1. 8-inch- (200-mm-) square Samples of specified sheet materials to be exposed as finished surfaces.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Work of this Section shall conform to the requirements of NRCA Roofing and Waterproofing Manual, SMACNA Architectural Sheet Metal Manual, and the manufacturer's instructions.
B. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

## PART 2 - PRODUCTS

2.1 METALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ-50 coating, Grade 40, structural quality.
2. Surface: Smooth, flat.
3. Color: Match color of roof panels.

B. Galvanized Steel Sheet: ASTM A 526, G90 (ASTM A 526M, Z 275), commercial quality, or ASTM A 527, G 90 (ASTM A 527M, Z 275), lock-forming quality, hot-dip galvanized steel sheet with 0.20 percent copper; not less than 0.0396 inch (1.0 mm) thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder: ASTM B 32, Grade Sn50, used with rosin flux.
B. Fasteners: Same metal as sheet metal flashing or other non-corrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
C. Paper Slip Sheet: 5-lb/square (0.244 kg/sq. m) red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.
D. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.
E. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, nondrying, non-migrating sealant.

F. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
G. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.
I. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
E. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 ROOF SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
B. Roof Edge Flashing and Fascia Cap: fabricate in minimum 96-inch long but not exceeding 10-foot long sections. Furnish with 6-inch wide joint cover plates.

1. Joint Style: Butt with 12-inch wide, concealed backup plate and 6-inch-wide, exposed cover plate.

2. Fabricate with scuppers spaced 10 feet apart, of dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tap3ered strip into field of roof.
3. Fabricate from the following materials:

   a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

C. Copings: Fabricate from the following material:

1. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.

D. Base Flashing (Where exposed to view): Fabricate from the following material:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

E. Base Flashing (Where not exposed to view): Fabricate from the following material:

1. Galvanized Steel: 0.028 inch thick.

F. Counterflashing: Fabricate from the following material:

1. Aluminum-Zinc Alloy-Coated Steel(where exposed to view): 0.022 inch thick.
2. Galvanized Steel (where not exposed to view): 0.022 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic

sealant (concealed within joints).

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.

E. Do not solder the following metals:

1. Metallic coated steel sheet.

F. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

G. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

1. Use joint adhesive for nonmoving joints specified not to be soldered.

H. Seams: Fabricate nonmoving seams in sheet metal with single lock flat seams at locations indicated. Tin edges to be seamed, form seams, and solder.

I. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

J. Install reglets to receive counterflashing according to the following requirements:

K. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches (50 mm) and bed with sealant.

## 3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.

2. Anchor interior leg of coping with screw fasteners and washers at 20-inch centers.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of anchor and washer at 36-inch centers.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

## END OF SECTION 07 62 00

# SECTION 07 92 00 – JOINT SEALANTS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this Section.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage to moisture, high or low temperatures, contaminants, or other causes.

1.3 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg F (4.4 deg C).
2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

## PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealer indicated or, if not otherwise indicated, as selected by Architect from manufacturer's full range of standard colors for products of type indicated.

C. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA method 24):

1. Architectural Sealants: 250g/L.
2. Sealant Primers for Nonporous Surfaces: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class and Uses.

B. One-part Nonsag Urethane Sealant: Type S; Grade NS; Class 25.

C. One-Part Nonacid-Curing Silicone Sealant: Type S; Grade NS; Class 25.

D. One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25, formulated with fungicide.

E. Multi-Part Pourable Urethane Sealant for Use T: Type M, Grade P, Class 25.

2.3 LATEX JOINT SEALANTS

A. Acrylic-Emulsion Sealant: Manufacturer's standard one part, nonsag, mildew-resistant, silicone-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior involving joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.

2.4 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
B. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer - substrate tests and field tests.
B. Cleaners for Nonporous Surfaces: Provide non-staining, chemical cleaners of type which are acceptable to manufacturer of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
C. Masking Tape: Provide non-staining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.
D. Joint Filler Material: Bituminous fiber joint filler strips consisting of asphalt saturated fiberboard, complying with ASTM D 1751.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers.
B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALERS:

A. General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint

sealants as applicable to materials, applications, and conditions present.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint filler to provide support of sealant during application and at position required to produce the cross-sections shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

## END OF SECTION 07 92 00

# SECTION 08 14 33 – STILE AND RAIL WOOD DOORS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior stile and rail wood doors.
2. Fitting stile and rail wood doors to frames.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 6 Section "Finish Carpentry" for door frames in conjunction with stile and rail doors.
2. Division 6 Section “Plastic Paneling” for polycarbonate infill panels.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product data for each type of door, including details of construction, glazing, and factory-finishing specifications.
C. Shop drawings indicating location and size of each door; elevation of each kind of door; construction details not covered in product data, including those for stiles, rails, panels, and moldings (sticking); location and extent of hardware cutouts; fire ratings; and other pertinent data.
D. Samples for verification in the form of a corner section, 12 inches (300 mm) square, showing edges, faces, joinery, and material qualities of typical stile, rail, molding, and panel for each exposed material, door type, and finish required; and as follows:

1. Doors for Transparent Finish: Door faces with typical range of color and grain for each veneer and lumber species required.

1.4 QUALITY ASSURANCE

A. Quality Standard: Comply with the following standard:

1. NWWDA Quality Standard: I.S.6, "Industry Standard for Wood Stile and Rail Doors," of the National Wood Window and Door Association.
2. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grade of door, construction, finish, and other requirements.

B. Single-Source Responsibility: Obtain doors form one source and by a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's instructions.
B. Comply with WIC Technical Bulletin 420-R for delivery, storage, and handling of doors.
C. Identify each door with individual opening numbers as designated on shop drawings, using temporary, removable, or concealed markings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with the following requirements applicable to Project's geographical location:

1. AWI quality standard Section 100-S-11 "Relative Humidity and Moisture Content."

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship , or have warped (bow, cup, or twist) more than 1/4 inch in a 42-by 84-inch section.

1. Warranty shall be in effect during the following period of time from date of Substantial Completion:

a. Interior Doors: Life of Installation.

## PART 2 - PRODUCTS

2.1 STILE AND RAIL DOORS OF SPECIAL DESIGN AND CONSTRUCTION

A. Interior Doors: Comply with the following requirements:

1. Grade of Doors for Transparent Finish: Premium.

B. Wood Species and Cut for Transparent Finish: TideWater Red Cypress, plain sliced.
C. Stile and Rail Dimensions: Comply with the following:

1. Widths: As indicated.

D. Thickness: 1-3/4 inches (45 mm).
E. Molding Profile: Manufacturer's standard.
F. Design: Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect’s approval.
G. Polycarbonate Panels: Provided by Owner for field installation by Contractor.

2.2 FABRICATION

A. Fabricate stile and rail wood doors to comply with the following requirements:

1. In sizes indicated for job-site fitting.

B. Glazed Openings: Trim openings indicated for glazing with solid wood molding of profile indicated, with one side removable. Miter wood moldings at corner joints.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installed door frames prior to hanging door:

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation see Division 8 Section "Door Hardware."
B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced quality standard and as indicated.
C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide 1/8 inch at heads and jambs, 1/16 inch per leaf at meeting stiles for pairs of doors. Provide ½ inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 3/8 inch from bottom of door to top of threshold.
2. Bevel non-fire rated doors, 1/8 inch in 2 inches at lock and hinge edges.

3.3 ADJUSTING AND PROTECTION

A. Operation: Rehang or replace doors that do not swing or operate freely.
B. Finished Doors: Refinish or replace doors damaged during installation.
C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.

## END OF SECTION 08 14 33

# SECTION 08 36 13 – SECTIONAL DOORS

## PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Overhead doors

1.2 RELATED SECTIONS

A. Section 05 50 00 – Metal Fabrications

1.3 REFERENCES

A. AS 1170.2:2002 - Structural Design Actions - General Principles.
B. AS4100-1990 - SAA Steel Structures Code.
C. AS 1288 – Glass in Buildings – Selection and Installation
D. AA-6063-T6 – Standards for Aluminum Alloy and Temper
E. ASTM A513, Type 1 – Steel Tubes
F. ASTM A1008 – Sheet steel for Covers
G. ASTM A36 – Steel Bars
H. ASTM a36 – Sheet Steel for Tracks/Channels

1.4 PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code as shown in drawings.

B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00
B. Product Data: Manufacturer's data sheets on each product to be used, including:

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

C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, accessories and anchors, jamb details, connection details, anchorage spacing, hardware locations, and installation details
D. Selection Samples: For each finish product specified, two complete sets of colors chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) squre, representing actual product, color, and patterns.
F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
G. Operation and Maintenance Data
H. Submit written agreement in manufacturer's standard form signed by manufacturer and installer agreeing to repair or replace defective doors that are warped, twisted, bowed, or

damaged as a result of defective product.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in
B. this section with minimum five years documented experience.
C. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. Acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Store materials in a clean, dry, ventilated, weathertight, secure location. Protect materials from soiling, abuse, loss, and moisture damage.

1.8 PROJECT CONDITIONS

A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
B. Environmental Conditions: Prior to and during installation, environmental conditions shall be in accordance with door manufacturers latest published recommendations for temperature, rain, wind, humidity, ventilation, and illumination.

1.9 WARRANTY

A. Manufacturer warrants to the original purchaser within one year from date of installation, if a product sold under this warranty proves to be defective in material or workmanship through normal use and service according to maintenance and operations instructions, as verified by inspection by persons authorized by Renlita Overhead Doors, Renlita Overhead Doors will replace or repair (at Renlita Overhead Doors option) the defective product.
B. Manufacturer warrants the steel frame against rust, in painted non-damaged condition for a period of two years from original purchase. This warranty does not apply to scratched, dented, damaged or corroded areas of the frame.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Renlita Doors North America, LLC, which is located at: P. O. Box B ; Bonham, TX 75418; Tel: 903-583-7500; Fax: 903-583-7544; Email: request info; Web: www.renlitadoors.com

2.2 OVERHEAD DOORS

A. Two Leaf Hinged Stacking Overhead Doors: Two horizontal panels hinged together, weather lapped at horizontal joint; rising vertically on roller and track system fixed to building structure to stack in a folded position under lintel.

1. Approved Product: Series 3000, Foldaway Doors. http://www.renlitadoors.com/products_series3000_foldaway_doors.htm

B. Framework: Welded construction fabricated from rolled hollow section steel members with minimum wall thickness of 0.063 inch (1.6 mm). Beams shall be designed for maximum

dead load deflection of 1/300th part of the span.

C. Counter Balancing: Counterweight system with enclosed counterweights suspended by 6/19 flexible multi-strand steel cables with minimum safety factor of 6:1. Cable shall be bedded in steel sheaves with a minimum sheave to cable diameter ratio of 19:1. Sheaves shall be capable of carrying design loads.

D. Construct steel door sections from carbon steel hot rolled tube complying with ASTM A-513 Type 1 and ASTM A-36.

E. Counterweight Covers: Counterweights shall be protected and covered with a removable pressed sheet.

F. Manual Operation: As indicated on the Drawings and Door Schedule.

1. Provide a manual operating handle and safety device to be used to manually open/close the door and to be stored in operating channel when door is in open position acting as a safety device preventing accidental closure of the door.
2. Door shall be equipped with keyed slide bar locking device located at lower panel adjacent to operating channel.

G. Size:

1. As indicated on Drawings.

H. Locking:

1. Internal padbolts, unless otherwise specified.

2.3 GLAZING AND CLADDING

A. Glazing: Glazed in accordance with AS1288.

1. Glass: LoE3-366

2.4 FINISHES

A. Finish, Ferrous Metals: All surfaces except working machine parts shall receive the following factory applied finish:

1. Powder coating.

B. Finish, Aluminum: Provide the following factory applied finish:

1. Powder coating.

C. Finish, Color:

1. As selected from manufacturer's full range of available colors.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until openings have been properly prepared.
B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
C. Verify electric power is available and of correct characteristics.
D. If 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. Inserts and Anchorages: Furnish inserts and anchoring devices suitable for the installation of the units and consistent with the manufacturer's installation requirements. Coordinate delivery with other work to avoid delay.
B. Install overhead doors, operating equipment, hardware, seals, stops, anchors, inserts, supports and track in accordance with approved shop drawings and the manufacturer's printed instructions.
C. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
D. Anchor assembly to wall construction and building framing without distortion or stress.

E. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
F. Fit and align door assembly including hardware.
G. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 CLEANING AND ADJUSTING

A. Lubricate, test and adjust door assembly to smooth operation free from warp twist or distortion and in full contact with weatherstripping.
B. Clean doors, frames and glass.
C. Remove temporary labels and visible markings.

3.5 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
B. Protect installed products until completion of project.
C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

3.6 MAINTENANCE

A. Post Installation Maintenance:

1. Contractor and installer shall provide Owner with complete company name, address phone number, fax number and assigned contact for emergency repairs and scheduled maintenance for the installed door(s).

B. Training/Instruction for Owner for Operation and System Maintenance:

1. Manufacturer shall instruct Owner's representative in regular tenant provided maintenance and operation of installed doors.

## END OF SECTION 08 36 13

# SECTION 08 41 13 – Aluminum-Framed Entrances and Storefronts

## PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Individual panel aluminum and glass door system, including aluminum frame, tracks, threshold, sliding panels, swing panels, sliding L frame panels with incorporated swing doors, stacking bays, sliding/swinging and locking hardware, weather stripping, glass and glazing; designed to provide an opening glass wall or storefront, with sizes and configurations as shown on drawings and specified herein, with the HSW50 NanaWall®, the Thermally Broken Aluminum Framed Individual Panel Sliding System as supplied by NanaWall Systems, Inc.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 611.98, Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603.02, Voluntary Specifications, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 1303.5, Voluntary Specifications for Forced Entry Resistant Aluminum Sliding Glass Doors.

B. American National Standards Institute (ANSI):

1. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings.

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

1. ASTM E 283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
2. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
3. ASTM E 547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.

D. Consumer Product Safety Commission (CPSC):

1. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials.

E. National Fenestration Rating Council (NFRC):

1. NFRC 100, Procedure for Determining Fenestration Product Thermal Materials.
2. NFRC 200, Procedure for Determining Solar Heat Gain Coefficient.

1.3 SUBMITTALS

A. Shop Drawings: Indicate dimensioning, configuration, swing panels, stacking bay layout, typical head jamb, side jambs and sill details, type of glazing material and handle height.
B. Product Data: Manufacturer's literature including independently tested data listing performance criteria and Owner's Manual with installation instructions.
C. Contract Closeout Submittal: Submit Owner's Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.

1.4 QUALITY ASSURANCE

A. Manufacturer: Provide complete, precision built, engineered, pre-fitted unit by a single source manufacturer with at least 15 years experience in the sale of folding/sliding door systems for large openings in the North American market.
B. Performance Requirements: Unit to comply with applicable manufacturer's independently certified testing results. Testing results include air infiltration in accordance with ASTM E 283, water penetration in accordance with ASTM E 547, structural loading in accordance with ASTM E 330, and forced entry in accordance with AAMA 1303.5 and CAWM 300-96.
C. Thermal Performance: Unit to comply with the U value, simulated in accordance with NFRC 100, shown in manufacturer's latest published data for the glazing specified.
D. Solar Heat Gain Coefficient: Unit to comply with the solar heat gain coefficient, simulated in accordance with NFRC 200, shown in manufacturer's latest published data for the glazing specified.
E. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least 3 projects of similar scale and complexity successfully completed in the last 3 years. Provide project names, locations, completion dates, names and telephone numbers of General Contractor and Owner's contact person.

1.5 WARRANTY

A. Provide manufacturer's standard warranty against defects in materials and workmanship.
B. Warranty Period: Ten years for roller and for seal failure of insulated glass supplied. For all other components, one year (two years if unit is installed by manufacturer's certified trained installer) from date of delivery by manufacturer.

1.6 SITE CONDITIONS, DELIVERY, STORAGE, AND HANDLING

A. In addition to general delivery, storage and handling requirements specified in Section 01600, comply with the following:

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

## Part 2 – PRODUCTS

2.1 Supplier

A. NANA WALL SYSTEMS, INC.
707 Redwood Highway, Mill Valley, California 94941
Toll Free (800) 873-5673
Telephone: (415) 383-3148
Fax: (415) 383-0312
Website: www.nanawall.com
Email: info@nanawallsystems.com

2.2 Materials

A. Frame and Panels: From manufacturer's standard profiles, provide head jamb, side jambs, sliding panels, swing panels, sliding L frame panels with incorporated swing panels, with dimensions shown on drawings. Provide standard bottom rail. Provide dark bronze anodized flush sill. Provide unit with standard one lite.
http://www.nanawall.com/products/Info_HSW50.asp

1. Aluminum: Extrusions with nominal thickness of .098” (2.5mm). Alloy specified as AlMgSi 0.5 with strength ratedas 6063-T5 or F-22 (European standard). Panels thermally broken with 9/16” (14 mm) Polyamide plastic reinforced with glass fibers. Head jamb thermally broken with cover plates on both sides.
2. Finish: Powder coated as selected from standard color.

B. Glass: Provide manufacturer’s standard glass and glazing 15/16” insulating Low-E safety

C. Locking Hardware and Handles: Provide manufacturer’s standard flat handle on inside only and concealed two point locking hardware operated by 180º turn of handle as needed on system.

D. Sliding & Swinging Hardware: Provide manufacturer’s standard hardware.

1. For each sliding panel, provide 2 two wheeled, toughened Polyamide covered stainless steel uni-directional sliding door carriers. Carrying capacity of each carrier to be 220 lbs.
2. Provide on all four corners of sliding panels, sliding L frame panels and swing panels, thermally broken, die cast zinc multi-functional corner fittings with carrier connectors, male and female locking receptacles, hinges and hinge pins as required. Finish: Powder coated, closest match to finish of frame and panels.
3. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks.

E. Other Components:

1. Weather stripping: Provide manufacturer’s standard double layer APTK at both the inner and outer edge of door panels or on frame for vertical sealing between panels and between panels and frame. Provide brush seals with flexible plastic web for all horizontal sealing.
2. Provide machine screws for connecting frame components.

2.3 Fabrication

A. Use extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.
B. Sizes and Configurations: See drawings for selected number and size of panels, location of swing panels, and location of tracks and stacking bays.

2.4 Accessories (Edit for project requirements.)

A. Provide corner posts.

## Part 3 – EXECUTION

3.1 Erection

A. Because of the large dimensions involved and the weight and movement of the panels, verify the structural integrity of the header such that the maximum deflection with the live load is limited to be the ©2006 Nana Wall Systems Specifications subject to change without notice 4 lesser of l/720 of the span and 1/4”. Similar structural support is needed for the stacking bay(s) and any upper track leading to it.
B. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square, with no unevenness, bowing, or bumps on floor.

C. Installation of units constitutes acceptance of existing conditions.

3.2 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 anchorage devices and to securely and rigidly fit frame in place, absolutely level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
C. If necessary, provide drain connections from lower track.
D. Install panels, handles and lock set in accordance with manufacturer's recommendations and Installation instructions.
E. If necessary, adjust hardware for proper operation.

END OF SECTION 08 41 13

# SECTION 08 52 00 – METAL-CLAD WOOD WINDOWS AND DOORS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section includes the following wood window types:

1. Aluminum clad windows.

B. This Section includes the following wood door types:

1. Aluminum single panel clad swinging doors.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide wood windows and doors engineered, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading without failure, as demonstrated by testing manufacturer's standard window and door assemblies representing types, grades, and sizes required for this Project according to test methods indicated.

B. Standards: Performance requirements for operating force, air infiltration, water penetration, structural performance, and forced-entry resistance for wood window and doors are those specified in NWWDA I.S. 2, "Industry Standard for Wood Window Units."

C. Test Criteria: Testing shall be performed by a qualified independent testing agency based on the following criteria:

1. Design wind velocity at Project site is 60 mi./hr.
2. Test Procedures: Test window and door units according to ASTM E 283 for air infiltration, ASTM E 547 for water penetration, and ASTM E 330 for structural performance.

D. Performance Requirements: Testing shall demonstrate compliance with requirements indicated in NWWDA I.S. 2 for water penetration, and structural performance for the type and performance grade of window and door units required. Where required design pressure exceeds the minimum for the specified window grade, comply with requirements of NWWDA I.S. 2, Article 6, "Optional Performance Classifications," for higher than minimum performance grades.

1. Air-Infiltration Rate for Doors: Not more than 0.15 cfm/sq. ft. for an inward test pressure of 1.57 lbf/sq. ft. (75 Pa).
2. Air-Infiltration Rate for Windows: Not more than 0.05 cfm/sq. ft. for an inward test pressure of 6.24 lbf/sq. ft. (295 Pa).
3. Water Penetration for Doors: No water penetration as defined in the test method at a static pressure of 4.16 p.s.f. after 15 minutes with water applied at a rate of five gallons per hour per square foot.
4. Water Penetration for Windows: No water penetration as defined in the test method at a static pressure of 12 p.s.f. after 15 minutes with water applied at a rate of five gallons per hour per square foot.
5. Structural Performance: No failure or permanent deflection in excess of 0.4 percent of any member's span after removing the imposed load, for a positive (inward) and negative (outward) test pressure of 22.5 lbf/sq. ft. (1077 Pa).

1.3 QUALITY ASSURANCE

A. Safety Glass Standard: Provide products complying with testing requirements of 16 CFR, Part 1201 for Category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with the certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

B. Glazing Standards: Comply with recommendations of GANA's "Glazing Manual" and "Sealant Manual," unless more stringent requirements are indicated.

C. Insulating-Glass Certification Program: Provide insulating-glass units permanently marked on spacers or at least on one component pane of units with the appropriate certification label of the inspecting agency indicated below:

1. Insulating Glass Certification Council.
2. Associated Laboratories, Inc.
3. National Certification Testing Laboratories.

1.4 PROJECT CONDITIONS

A. Field Measurements: Check window and door openings by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating wood windows and doors without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.
2. Coordinate size of doors panels to accommodate A.D.A. accessibility requirements for appropriate clearances above thresholds.

B. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide Kolbe and Kolbe Ultra Series, or a comparable product by one of the following:

1. Aluminum-Clad Wood Door Units (Acceptable for A.D.A. outswinging unit):

a. Jeld Wen Windows and Doors Company, Inc., adaptable for A.D.A. entrance door threshold requirements.

2. Aluminum-Clad Wood Window Units:

a. Jeld Wen Windows and Doors Company, Inc..

B. Performance Rating for Units: High performance rated.

2.2 GLASS AND GLAZING MATERIALS

A. General: Provide manufacturer's standard 5/8" Argon filled Low-E sealed clear insulating glass units complying with the following minimum requirements:

1. Provide tempered or laminated glass insulated units for all locations.

a. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
b. Outdoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
c. Total Unit “U” Factor: 0.34
d. Shading Coefficient: 0.50

B. Glazing Seal: Provide manufacturer's standard extruded, vinyl, or butyl glazing gasket providing weathertight seal.
C. Safety Glazing: Provide tempered or laminated glass insulating units at doors and other locations immediately adjacent to doors and walking paths.

2.3 HARDWARE

A. General: Provide manufacturer’s standard hardware, necessary to operate, tightly close, limit travel, and to securely lock windows which are operable. Do not use aluminum in frictional contact with other metals.

1. Provide hardware with a special coating finish and plated steel or brass/bronze operating bars and rods in finish as selected by Architect.

B. Handles and escutcheon plates: Active handle, inactive handle, interior and exterior escutcheon plates are made of solid brass with protective lacquer.
C. Gaskets: Black Neoprene.
D. Locking hardware shall have a 1 inch (25mm) throw deadbolt with Schlageâ key lock cylinder.

1. Color: Brushed aluminum

E. Locking System Options: All components are corrosion resistant.

1. Five Point: On primary active panels of High Performance units. Made of stainless steel.
2. Head and sill strike plates are made of Light Bronze Anodized aluminum.

a. Color: Brushed aluminum with aluminum strike.

3. Two Point Flush Bolt: On secondary active panel. Top and bottom threaded shoot rods are made of steel and die cast parts. Lever Face Plate has a lacquer coated Bright Brass finish. Head and sill strike plates are made of Light Bronze anodized aluminum.

F. Hinges: Commercial grade hinges, 4-1/2” x 4-1/2” ball bearing square corner with non-removable pin in satin nickel finish.
G. Weatherstripping: Manufacturers standard to comply with performance requirements specified.

2.4 ACCESSORIES

A. General: Muntins (simulated-divided lites) are intended for use on all windows of this project, except where noted otherwise.
B. Grilles (False Muntins): Provide grilles in designs shown, for application to the inside and outside of each sash light where true divided light components are not scheduled.

1. Material: Aluminum-Clad wood outside/ wood inside.
2. Design: 1-1/8" Traditional Special Muntins inside and outside.
3. Color: Custom to match window.

2.5 WINDOWS

A. Window Types: As indicated on drawings

1. Performance Grades and Class: LC 35
2. Clad Wood Casement
http://www.jeld-wen.com/windows/wood/premium/product.cfm/product_id/28

B. Fixed units may be manufacturer's standard casement type units secured in fixed position without operating mechanism.

C. Condensation Resistance Factor (CRF): Provide wood windows tested for thermal performance according to AAMA 15003, showing a CRF of 45 minimum.

2.6 DOORS

A. Door Types: As indicated on drawings

1. Swinging Patio Doors
http://www.jeld-wen.com/windows/wood/custom/product.cfm/product_id/23

2.7 FABRICATION

A. General: Fabricate wood window and door units to comply with indicated standards. Include a complete system for assembly of components and anchorage of window and door units.

1. Comply with requirements of NWWDA I.S. 2 , I.S. 610, and I.S. 620 for moisture content of lumber at time of fabrication.

B. Fabricate window and doors to produce units that are reglazable without dismantling sash framing. Provide openings and mortises precut, where possible, to receive hardware and other items.

1. Provide weatherstripping at perimeter of each operating sash.
2. Factory-Glazed Window and Door Units: Except for light sizes in excess of 100 united inches (2500 mm width plus length), glaze window and door units in the shop before delivery, unless factory glazing is not available from manufacturer. Comply with requirements of Division 8 Section "Glazing" of these Specifications and NWWDA I.S. 2.

C. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to the Project site, to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullion and cover plates capable of withstanding design loads of window units.

E. Glazing Stops: Provide nailed or snap-on type clad glazing stops, coordinated with indicated profiles and arrangement as indicated on Drawings.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installing window and door

units, hardware, operators, accessories, and other components of the Work.

B. Set window and door units plumb, level, true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.

C. Set sill members and installation fins in a bed of sealant or with joint fillers or gaskets, as indicated, to provide weathertight construction.

D. Install waterproof tape over the installation fin and onto the wall sheathing. Seal securely to provide additional water protection.

E. Metal Protection: Separate aluminum and other corrodible surfaces form sources of corrosion or electrolytic action at points with other materials by complying with requirements specified in “Dissimilar Materials” Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.2 ADJUSTING

A. Adjust operating sash and hardware to provide a tight fit at contact points and weatherstripping for smooth operation and a weathertight closure. Lubricate hardware and moving parts.

3.3 CLEANING

A. Clean interior and exterior surfaces immediately after installation. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealants, dirt, and other substances.

B. Clean glass of factory-glazed units immediately after installing windows and doors. Wash and polish glass on both faces before Substantial Completion. Comply with manufacturer’s recommendations for final cleaning and maintenance. Remove nonpermanent labels from glass surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.

3.4 PROTECTION

A. Protect window and door units from damage or deterioration until the time of Substantial Completion.

## END OF SECTION 08 52 00

# SECTION 08 83 00 - MIRRORS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of silvered flat glass mirrors.

1. Annealed monolithic glass mirrors.

1.3 DEFINITIONS

A. Deterioration of Mirrors: Defects developed from normal use that are attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1.4 PERFORMANCE REQUIREMENTS

A. Provide mirrors that will not fail under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with the following published recommendations:

1. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

## PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRROR MATERIALS

A. Clear Glass Mirrors: ASTM C 1503, Mirror Glazing Quality.

B. Nominal Thickness: 6.0 mm.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
C. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

2.4 FABRICATION

A. Mirror Edge Treatment: Flat polished edge.
B. Seal edges of mirrors after edge treatment to prevent chemical or atmospheric penetration of glass coating.
C. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance.
B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
C. Proceed with mirror installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
C. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

3.3 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
B. Do not permit edges of mirrors to be exposed to standing water.
C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION 08 83 00

# SECTION 09 20 00 – GYPSUM BOARD

## PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Glass-mat faced, moisture resistant gypsum board.
B. Related Sections:

1. Section 06 10 00 Rough Carpentry.
2. Section 09 21 16 Gypsum Board Assemblies.

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
3. ASTM C630 Standard Specification for Water-Resistant Gypsum Backing Board.
4. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.
5. ASTM C1396 Standard Specification for Gypsum Board.
6. ASTM C1658 Standard Specification for Glass Mat Gypsum Panels.
7. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
8. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Gypsum Association (GA): GA-214 Recommended Levels of Gypsum Board Finish.

1.3 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Provide products that comply with the following limits for surface burning characteristics when tested per ASTM E84:

1. Flame spread: Refer to drawings
2. Smoke developed: Refer to drawings

B. Provide products that have been GREENGUARD Indoor Air Quality Certified by the GREENGUARD Environmental Institute under the GREENGUARD Standard for Low Emitting Products and GREENGUARD for Children & Schools product certification program.

1.5 WARRANTY

A. Provide products that offer six months of coverage against in-place exposure damage (delamination, deterioration and decay).

B. Manufacturer's Warranty: Three years against manufacturing defects.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Georgia-Pacific Gypsum LLC:

1. Fire-Rated Fiberglass-Mat Faced Gypsum Board: DensArmor Plus Fireguard.
2. Regular 5/8" Type Gypsum Board

2.2 MATERIALS

A. 5/8 Inch Fire-Rated Fiberglass-Mat Faced Gypsum Board:

1. Thickness: 5/8 inch.
2. Width: 4 feet.
3. Length: 8 feet.
4. Weight: 2570 pounds per M square feet.
5. Edges: Tapered.
6. Surfacing: Coated fiberglass mat on face, back, and long edges.
7. Flexural Strength, Parallel (ASTM C473, ASTM C1658): Not less than 100 lbf.
8. Flexural Strength, Perpendicular (ASTM C473, ASTM C1658): Not less than 140 lbf.
9. R-Value (ASTM C518): Not less than 0.67.
10. Nail Pull Resistance (ASTM C473, ASTM C1658): Not less than 90 lbf.
11. Humidified Deflection (ASTM C473, ASTM C1658): Not more than 1/8 inch.
12. Hardness, Core, Edges, and Ends (ASTM C473, ASTM C1396): Not less than
13. Water Absorption (ASTM C630, ASTM C1396, ASTM C1658): Less than 5 percent of weight.
14. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
15. Acceptable Products:

    a. 5/8 Inch DensArmor Plus Fireguard Interior Guard Type X, Georgia-Pacific Gypsum.
    b. Regular 5/8" Type Gypsum Board

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General: In accordance with ASTM C840 and the manufacturer's recommendations.

1. Manufacturer's Recommendations:

    a. Current "Product Catalog", Georgia-Pacific Gypsum.

3.2 APPLICATION

A. Primer and Paint Application:

1. Use a high quality, high build drywall primer/surfacer. Comply with application instructions of the primer manufacturer as stated on the container.
2. Apply high build primer at a sufficient wet film thickness to ensure a dry film thickness that will produce acceptable results.

3. Apply finish coats of paint per the paint manufacturer's label instructions.

3.3 PROTECTION

A. Protect gypsum board installations from damage and deterioration until the date of Substantial Completion.

END OF SECTION 09 20 00

# SECTION 09 30 00 - TILING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Types of tile work in this section include the following:

1. Glazed wall tile.
2. Glazed floor tile.
3. Crack Isolation Membrane

B. Related Sections include the following:

1. Division 9 Section “Gypsum Board Assemblies” for gypsum board

1.3 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
B. Product data for each type of product specified.
C. Samples for verification purposes of each item listed below:

1. Each type and composition of tile and grout for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
2. Full-size units of each type of trim and accessory for each color required.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility for Tile: Provide materials obtained from one source for each type and color of tile.
B. Single Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in materials, design, and to extent indicated for Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
B. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.
C. Store liquid materials in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
C. Maintain temperatures at not less than 50°F (10 C) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.

## PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.

1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.

B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
C. Colors, Textures and Patterns: For tile, grout and other products requiring selection of colors, surface textures or other appearance characteristics, provide products or materials complying with the following requirements.

1. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.
2. Note that Architect may select up to four different colors for use in the field of the wall and up to two different colors at the floor tiles.

D. Provide tile trim and accessories which match one of the selected colors and finish of adjoining flat tile.
E. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match

approved samples.

F. Mounting: Where factory-mounted tile is required provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

1. Where tile is installed at shower, do not use back- or edge-mounted tile assemblies unless the tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

2.2 TILE PRODUCTS

A. Glazed Ceramic Wall Tile: Provide factory-mounted flat tile complying with the following requirements:

1. Composition: Porcelain
2. Nominal Facial Dimensions: 1-3/4x3-1/4, 2x2, 2x6, 13x13
3. Nominal Thickness: 1/4".
4. Face: Plain edges.
5. Product: Complying Example - American Olean
6. Price Group: Full color range.
7. Glass Tiles

B. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:

a. Base for Thin set Mortar Installations: Coved.
b. Wainscot cap for Thin set Mortar Installations: Surface bullnose.
c. External Corners for Thin set Installations: Surface bullnose.
d. Internal Corners: Field-butted square corners, except use coved base and cap angle pieces designed to member with stretcher shapes.

2.3 CRACK ISOLATION MEMBRANE

A. General: Manufacturer’s standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicate. Include reinforcement and accessories recommended by manufacturer.

B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16 inch nominal thickness:

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

a. Schluter Systems L.P.; DITRA

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar for Floor Tile: ANSI A118.4, composition as follows:

1. Latex additive (water emulsion) of type described below, serving as replacement for part or all of gaging water, combined at job site with prepackaged dry mortar mix

supplied or specified by latex additive manufacturer.

a. Latex Type: Manufacturer's standard, low VOC type.

B. Water-Cleanable Epoxy Grout: ANSI A118.3
C. Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1mm) thick.
D. Organic Adhesive for Wall and Ceiling Tile: ANSI A136.1, Type I, with a VOC content of 65g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118.6, color as selected

1. Latex additive (water emulsion) serving as replacement for part or all of gauging water, added at job site with dry grout mixture, with type of latex and dry grout mix as follows:

a. Latex Type: Manufacturer's standard, low VOC type.

B. Dry Grout Mixture: Dry-set grout specified or supplied by latex additive manufacturer. Use latex additive without retarder with dry-set grout.

1. Application: Use dry-set grout combined with latex additive for grouting joints in glazed wall tile.

C. Color: As selected by Architect from standard color selections from one of the following manufacturers:

1. American Olean.
2. C-Cure Corporation.
3. Mapei Corporation.

2.6 MISCELLANEOUS MATERIALS:

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
B. Temporary Protective Coating: Provide either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout, is compatible with tile and mortar/grout products and is easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined, tasteless, odorless, containing at least 0.5 percent oil with a melting point of 120 degrees F (49 degrees C) to 140 degrees F (60 degrees C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specifically formulated and recommended for use as a temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers. Manufactures standard Low VOC type.
D. Grout Sealer: Manufacturer’s standard silicone product for sealing grout joints that does not

change color or appearance of grout. Manufactures standard Low VOC type.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers for accurately proportioning of materials, water or additive content, mixing equipment and mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that surfaces for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installation indicated.

   a. Verify that surfaces that received a steel trowel finsih have been mechanically scarified.

3. Verify the installation of mechanical units and similar items located in or behind tile has been completed before installing tile.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, waxes, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI series of tile installation standard for installations indicated.

1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile

units taken from one package show the same range in colors as those taken from other packages and match approved samples. if not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:

1. Petroleum paraffin wax or grout release.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".

B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

C. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

1. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

1. When recessed items occur at tile wainscot and extend above top of wainscot, extend one wall tile around top portion and trim with bullnose edge.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tile.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants".

H. Grout tile to comply with the requirements of the following installation standards:

1. For ceramic tile grouts (sand-portland cement, dry set, commercial portland cement and latex-portland cement grouts), comply with ANSI A108.10.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

3.5 FLOOR INSTALLATION METHODS

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards, setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:

1. Latex Portland Cement Mortar: ANSI A108.5.
2. Grout: Latex-portland cement , except use epoxy grout at all wet areas.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6mm)
2. Glazed Floor Tile: 1/4 inch ( 6.3mm)

C. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.6 WALL TILE INSTALLATION METHODS

A. Install types of tile designated for wall applications to comply with requirements indicated below for setting-bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

B. Organic Adhesive: ANSI A108.4.

1. Solid Backing, Interior: TCA W223.
2. Grout: Latex-portland cement , except use epoxy grout at all wet areas..

C. Joint Widths: Install tile on wall with the following joint widths:

1. Wall Tile: 1/16 inch (1.6mm).

3.7 FLOOR TILE INSTALLATION SCHEDULE

A. Tile Installation at Shower Receptor (Floors): Interior shower receptor installation over waterproofing.

1. Tile Type: Glazed ceramic mosaic.
2. Grout: Polymer modified unsanded grout , except use epoxy grout at all wet areas..

3.8 WALL TILE INSTALLATION SCHEDULE

A. Tile Installation at Other Locations: Interior wall installation over cementitious backer units; organic adhesive; TCA W245 and ANSI A 108.5.

1. Tile Type: Unglazed ceramic mosaic.
2. Grout: Polymer modified unsanded grout , except use epoxy grout at all wet areas..

3.9 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Unglazed tile may be cleaned with acid solution only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

1. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

## END OF SECTION 09 30 00

# SECTION 09 64 00 – WOOD FLOORING

## PART 1 - GENERAL

1 .1 RELATED DOCUMENTS

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

1 .2 SUMMARY

A. This Section includes field-finished wood flooring.
B. Related Sections include the following:

1. Division 07 Sections for waterproofing membranes.

1 .3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show installation details including location and layout of each type of wood flooring and accessory.
C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes available for wood flooring.

1 .4 QUALITY ASSURANCE

A. Mockups: Install mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1 .5 DELIVERY, STORAGE, AND HANDLING

A. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.

1 .6 PROJECT CONDITIONS

A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
B. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F18 and 24 deg C and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.

C. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.

1. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
2. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

## PART 2 - PRODUCTS

2.1 WOOD FLOORING MATERIALS, GENERAL

A. Solid-Wood, Strip Flooring: Kiln dried to 6 to 9 percent maximum moisture content, tongue and groove, and with backs channeled (kerfed) for stress relief.
B. Species and Grade: #1 White Oak
C. Cut: Plain sawn.
D. Thickness: As indicated on Drawings.
E. Face Width: As indicated on Drawings.
F. Lengths: Random-length strips complying with applicable grading rules

2.2 Urethane Finish System: Complete water -based system of compatible components that is recommended by finish manufacturer for application indicated.

A. VOC Content: When calculated according to 40 CFR 59, Subpart D (EPA Method 24), as follows:

1. Finish Coats and Floor Sealers: Not more than 350 g/L.
2. Stains: Not more than 250 g/L.

B. Finish Coats: Formulated for multi-coat application on wood flooring.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BonaKemi USA Inc.
b. Hillyard, Inc.

C. Floor Sealer: Pliable, penetrating type.
D. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.3 ACCESSORY MATERIALS

A. Wood Sleepers and Subfloor: As specified in Division 06 Section "Rough Carpentry."
B. Asphalt-Saturated Felt: ASTM D 4869, Type II.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
B. Verify that substrates comply with tolerances and other requirements specified in other Sections.
C. Substrate Moisture Testing, General: Perform tests recommended by manufacturer or, if none, comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
D. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch deviation in any direction when checked with a 10-foot straight edge.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
C. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
D. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
B. Wood Sleepers and Subfloor: Install according to requirements in Division 06 Section "Rough Carpentry."
C. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch.
D. Vapor Retarder:

1. Wood Flooring Nailed to Sleepers: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.

E. Solid-Wood, Strip Flooring: Blind nail or staple flooring to substrate.

1. For flooring of face width more than 3 inches, do the following:

a. Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
b. Install no fewer than 2 countersunk nails at each end of each piece, spaced not more than 16 inches along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

3.4 FIELD FINISHING

A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
B. Comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
C. Fill and repair wood flooring seams and defects.
D. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats.
E. Apply stains to achieve an even color distribution matching approved Samples.
F. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.5 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
B. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

## END OF SECTION 09 64 00

# SECTION 09 91 00 - PAINTING

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron work, exposed ductwork and electrical conduits, underside of metal roof panels, exposed roof trusses and primed metal surfaces of mechanical and electrical equipment.
2. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: Manufacturer’s technical information, label analysis, and application instructions for each material proposed for use.
B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect of problems anticipated using the materials specified.

C. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples.

D. Provide full-coat finish samples on at least 100 sq. ft. of surface until required sheen, color and texture are obtained; simulate finished lighting conditions for review of in-place work.

1. Final acceptance of colors will be from job-applied samples.
2. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface in accordance with the schedule or as specified. After finishes are accepted, this room or surface will be used for evaluation of coating systems of a similar nature.

E. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or the exclude equal products of other manufacturers.
2. Federal specifications establish a minimum quality level for paint materials, except where other product identification is used. Provide written certification from the manufacturer that materials provided meet or exceed these criteria.

F. VOC Content of all Paint Products: E Range of E1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during

application and drying periods.

D. Multiple Colors: Note that Architect may select up to six colors for use at the interior areas of the Project and up to three colors for use at the exterior areas of the Project.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish not less than 1 additional gallon of each materials and color applied.

## PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Colors: Provide color selections made by the Architect.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

a. Flat Paints and Coatings: VOC content of not more than 50 g/L.
b. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
c. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Wood: 15 percent.
b. Gypsum Board: 12 percent.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
C. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods r3ecommended in writing by paint manufacturer.
E. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
2. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
3. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

F. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

1. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

G. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

H. Gypsum Board Substrates: Do not begin painting application until finishing compound is dry and sanded smooth.

I. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and , if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.3 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

1. Paint colors, surface treatments, and finishes are indicated in "schedules."
2. Provide finish coats that are compatible with Prime Coat used.
3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with only before final installation of equipment.
7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.

8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
11. Sand lightly between each succeeding enamel or varnish coat.
12. Omit primer on metal surfaces that have been shop-primed and touch up painted.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

E. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been primed by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

1. Verify prime coating requirements and limitations with supplier of glass fiber reinforced gypsum panels.

F. Stipple Enamel finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

H. Transparent (Clear Finishes): Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

## 3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

## 3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.

B. Ferrous Metal: Provide the following system over ferrous metal. Primer is not required on shop-primed items.

1. Quick-Drying Enamel System: MPI EXT 5.1A.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Quick-drying enamel matching topcoat.
c. Topcoat: Quick-drying enamel semigloss.

C. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:

1. Latex Over Water-Based Primer System: MPI EXT 5.3H.

a. Prime Coat: Waterborne galvanized-metal primer.
b. Intermediate Coat: Exterior latex matching topcoat.
c. Topcoat: Exterior latex semigloss.

D. Wood Surfaces (as indicated in Finish Schedules): Provide the following components over exposed wood.

1. Latex System: MPI EXT 6.3L

a. Prime Coat: Exterior latex wood primer.
b. Intermediate Coat: Exterior latex matching topcoat.
c. Topcoat: Exterior latex semigloss.

3.7 INTERIOR PAINT SCHEDULE

A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.

B. Woodwork and Hardboard: Provide the following paint finish systems over new, interior wood surfaces:

1. Latex System: MPI INT 6.3T.

a. Prime Coat: Interior latex-based wood primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex semigloss.

C. Wood-Finishing Materials: Provide the manufacturer's recommended factory-formulated, wood-finishing materials that are compatible with the substrate and undercoats indicated.

a. Waterborne Clear Acrylic System: MPI INT 6.3Q.

1) Three Finish Coats: Waterborne clear acrylic satin.

D. Wood Countertops: Provide the manufacturer's recommended factory-formulated, wood-finishing materials that are compatible with the substrate indicated.

1. Lacquer Over Sealer System: MPI INT 6.3H.

a. Seal Coat: Lacquer sanding sealer.
b. Two Finish Coats: Lacquer, clear satin.

E. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Latex System: MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex flat at ceiling areas and satin finish elsewhere.

F. Ferrous Metal: Provide the following finish systems over interior ferrous metal. Primer is not required on shop-primed items.

1. High-Performance Architectural Latex System: MPI INT 5.1R.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex satin.

G. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated (galvanized) metal surfaces:

1. Latex Over Waterborne Primer System: MPI INT 5.3J.

a. Prime Coat: Waterborne galvanized-metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex satin.

END OF SECTION 09 91 00

# SECTION 10 28 00 – TOILET, BATH, AND LAUNDRY ACCESSORIES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes accessories as scheduled.
B. Related Sections include the following:

1. Division 08 Section "Mirrors" for frameless mirrors.

1.3 SUBMITTALS

A. Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.
B. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.
C. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.
D. Maintenance instructions including replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

## PART 2 - PRODUCTS

2.1 ACCESSORIES

A. ALLOWANCE:

1. Toilet and Bath Accessory Allowance: Allow the following sum indicated for toilet and Bath Accessories throughout the Project. The listed amount shall include the FOB job costs with proper adjustment made to the actual price. The allowance shall not

include tax, uncrating, storage, or installation, or any additional costs for special items; include those costs in the price bid at no additional costs to the Owner.

a. Allow the sum of $1000.00.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units in accordance with manufacturers' written instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

1. Comply with ADAAG and ANSI A 117.1 for all locations and mounting heights of all toilet and bath accessories.

B. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
B. Remove temporary labels and protective coverings.
C. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

## END OF SECTION 10 28 00

# Section 10 44 00 - Fire Protection Specialties

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Fire Extinguishers.

1.3 SUBMITTALS

A. Product data for each type of product specified.

1. Fire Extinguishers: Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Samples for verification purposes of each type of metal finish required, prepared on metal samples of same thickness and alloy indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain fire extinguishers and cabinets from one source from a single manufacturer.
B. Coordination:

C. UL-Listed Products: Fire extinguishers UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.
D. FM-Listed Products: Fire extinguishers approved by Factory Mutual Research Corporation for type, rating, and classification of extinguisher and carry appropriate FM marking.

E. NFPA Requirements: Provide new portable fire extinguishers which comply with the requirements of NFPA 10 "Portable Fire Extinguishers."

# PART 2 - PRODUCTS

## 2.1 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, which comply with requirements of governing authorities.

B. Fill and service extinguishers to comply with requirements of governing authorities and manufacturer.

C. Abbreviations indicated below identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

D. Multipurpose Dry Chemical Type for all Locations: UL-rated 2A-10 BC nominal capacity, in enameled steel container, with monoammonium phosphate-based dry chemical in enameled-steel container.

## 2.2 ACCESORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

## 3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection

cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch-up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance,. Use only materials and procedures recommended or furnished by fire protection cabinets ane mounting bracket manufacturers.

END OF SECTION 10 44 00

# SECTION 10 81 16 – INSECT CONTROL DEVICES

## PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Electrically or Manually operated, roll-up, retractable screens in [recessed] [surface mounted] housing with [recessed] [surface mounted] side tracks.

1.2 SUBMITTALS

A. Reference Section 01330-Submittal Procedures; submit following items:

1. Product Data including paint color samples.
2. Shop Drawings:

a. Plan showing screen location and location of controls and specified accessories.
b. Elevations showing screen seams, if any, and power receptacle locations, if any.
c. Head, jamb, and sill details.
d. Schematic control drawing.

3. Samples:

a. Minimum 12 inch by 12 inch (300 mm by 300 mm) piece of screen material.
b. Schematic control drawing.

4. Quality/Assurance/Control Submittals:

a. Qualifications: Proof of manufacturer and installer qualifications.
b. Manufacturer's Installation Instructions.

B. Closeout Submittals: Reference Section 01780-Closeout Submittals; submit following items:

1. Operating and Maintenance Instructions.
2. Special warranties and registration form.
3. Obtain Architect's approval prior to beginning installation of other units

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Minimum five years experience in producing retractable screens.
2. Installer Qualifications: Must be a manufacturer authorized installer.
3. Product Qualifications: CSA and UL Approval; CSA standard C22.2 No.247, UL standard 325.

B. Pre-Installation Meeting:

1. Convene meeting at project site within one week of scheduled start of installation with representatives of the following in attendance: Owner, Architect, General Contractor, and Phantom Screens Representative.

2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.
3. Keep minutes of meeting including responsibilities of various parties and deviations from specifications and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's instructions.
B. Special Instructions: Store packaged units in a horizontal position, evenly supported, and without top loading.

1.5 SCHEDULING

A. Coordinate with Phantom Representative regarding installation schedule for recessed components.

1.6 WARRANTY

A. Special Warranties:

1. Limited Lifetime Material Warranty on Aluminum Components:

a. Warrant materials to withstand normal weather elements and against breakage under normal use conditions.
b. Warranty shall not cover claims originating from faulty installation, hail, flood, fire, harmful chemicals and fumes ,misuse, abuse, fading, chalking, oxidization, erosion of paint, acts of God, or causes beyond control of the manufacturer.

2. 5 Year Warranty on Electric Motors and Manually Operated Gears:

a. Warrant against failure under normal use conditions.
b. Warranty shall be void if electric motors are exposed to water, acts of God, or abnormal conditions.

3. 1 Year Warranty on Electronic Components:

a. Warrant against failure under normal use conditions.
b. Warranty shall be void if electronic components are exposed to water, acts of God, or abnormal conditions.

4. Registration: Installation registration form shall be signed by Owner or Owner's Representative and returned to manufacturer.
5. Limitations:

a. Manufacturer shall not be responsible for indirect, punitive, special, incidental, or consequential damages or losses suffered or incurred in connection with the product or its use.
b. Warranties implied by, including those of merchantability and fitness for use or for particular purpose shall be limited to materials only in duration of 1 year.
c. Warranty shall not cover incidental damage to screen mesh.
d. Warranty shall not cover cost, removal cost, and shipping cost of materials covered in above special warranties.
e. Warranties shall apply to original owner only.

## PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Phantom Mfg. (Int'l) Ltd
P.O. Box 2310
Abbotsford, B.C. V2T 4X2
Canada
Tel: (888) 444-4142
Fax: (604) 855-7834
E-mail: phantom@phantomscreens.com
Website: http://www.phantomscreens.com/

1. Phantom Representative

B. Model:

1. Executive I [5 1/2" housing, 139.70 mm]
http://www.phantomscreens.com/content/execspecs.php

C. Substitutions: Reference Section 01630-Product Substitution Procedures.

2.2 MATERIALS

A. Aluminum Components:

1. Extruded Shapes: ASTM B 221, alloy 6063-T6, 6060-T61, 6063-T5, 6060-T51, 6063-T6.
2. Extruded Tubes: ASTM B 429, alloy 6005A-T61
3. Die Cast Standard Housing End Caps: ASTM B85-92a, alloy ADC-12 or 383 ANSI / AA 383.

B. Sealant: As specified in 07920 – Joint Sealants.

2.3 COMPONENTS

A. Housing Back, Top, and Cover: Recessed, extruded aluminum, three piece.

1. Fabricate surface mounted housings and covers to be the same size.

B. Motor: Simu®, Inc., T5 tubular type, 120v AC, 60 Hz, with 6 ft (2 m) grounded plug-in power cord; model as recommended by screen manufacturer based on screen size.
D. Roller Assembly: Extruded aluminum, outside diameter as specified by manufacturer based on screen size.
E. Mounting Angle: Extruded aluminum.
F. Sidetrack and Cover: [Recessed] [Surface mounted], extruded aluminum.
G. Screen Mesh:

1. Size and Type: Oversized I
2. Color: Phantom Black

H. Slide Bar: Extruded aluminum.
I. Bottom Seal: [1.75 inch (44 mm)] [4 inch (102 mm)] [6 inch (152 mm)] grey vinyl.
J. Zipper: No. 5 nylon, color coordinated to screen mesh.
K. Control System:

1. Programmable handheld single channel remote. Provide [2 units]
2. Building Automation System Interface
3. Other miscellaneous items typically provided by manufacturer as required to complete installation.

2.4 FINISH

A. Semigloss Weather Resistant Powder Coat: Akzo Nobel Polyester Base (AAMA 2603) [Signature color offering].
B. Color: As selected by Architect.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which screen components will be installed.

1. Verify that cavities for recessed housings are properly sized, include a mounting subtrate, are free of unrelated penetrations.
2. Verify that screen opening compiles with manufacturer's requirements for being square, plumb, and level.
3. Verify that electrical work is correctly located.

B. Coordinate with responsible entity to correct unsatisfactory conditions.
C. Commencement of work by installer is acceptance of substrate conditions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's installation instructions.
B. Install sealant in joints between screen members and adjacent construction as shown on drawings.

3.3 FIELD QUALITY CONTROL

A. Inspection:

1. Verify that Slide Bar moves freely up and down without restriction.
2. Verify that Slide Bar is parallel to housing when retracted.
3. Verify that Bottom Seal creates a seal all along floor.

B. Site Tests:

1. Verify that electrical or manual operation works properly, and that motor or gear limits are set correctly.

3.4 CLEANING

A. Reference Section 01740-Cleaning.
B. Clean soiled components to "like new" condition.

3.5 DEMONSTRATION

A. Demonstrate operation to Owner's Representative.
B. Review maintenance requirements with Owner's Representative.
C. Remind Owner's Representative to complete and submit warranty registration form.

3.6 PROTECTION

A. Provide protection to prevent damage to screen components until [Substantial Completion] [Final Acceptance by the Owner].

B. Coordinate with Owner's Representative to determine if protection should remain in place following [Substantial Completion] [Final Acceptance by the Owner] and who will be responsible for final removal.

## END OF SECTION 10 81 16

# SECTION 11 31 00 – RESIDENTIAL APPLIANCES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cooking equipment including:

a. Electric ranges.

2. Ventilation

a. Range hoods.

3. Undercounter refrigerator
4. Undercabinet refrigerator/freezers.
5. Cleaning appliances:

a. Dishwashers.
b. Stackable clothes washer and dryer.

6. Home Entertainment

a. Sony 32" Class BRAVIA M Series LCD HD
b. Dell Inspiron laptop PC

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
B. Appliance Schedule: For appliances; use same designations indicated on Drawings.
C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
D. Maintenance Data: For each product to include in maintenance manuals.
E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain residential appliances through one source from a single manufacturer.

1. Provide products from same manufacturer for each type of appliance required.
2. To the greatest extent possible, provide appliances by a single manufacturer for entire Project.

B. Regulatory Requirements: Comply with provisions of the following product certifications:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and

marked for intended use.

2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.
3. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. Basis-of-Design Product: The design for each residential appliance is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 APPLIANCES

A. Range:

1. Kitchenaid:KESS908SPS
http://www.kitchenaid.com/catalog/product.jsp?src=ModelNumberLookup&productId=1789

B. Exhaust Hood:

1. Opus:FDF 367 WXS Wall Mount
http://www.ajmadison.com/cgi-bin/ajmadison/FDF367WXS.html?brand_store=1

a. Franke Consumer Products, Inc. 3050 Campus Dr., Suite 500 Hatfield, PA 19440 Telephone: 800-626-5771

C. Undercabinet Refrigerator /Freezer:

1. Perlick Corporation: H2FR-S
http://www.bringperlickhome.com/pdf-files/48_FINAL.pdf

D. Dishwasher:

1. Kitchenaid: KUDH03DTSS
http://www.kitchenaid.com/catalog/product.jsp?src=Drawer+Dishwashers&cat=887&prod=1713

E. Electric Dryer

1. Whirlpool WED7500V
http://laundry.manualsonline.com/manuals/mfg/whirlpool/wed7500v.html

F. Front Loading Washer

1. Whirlpool WFC7500V

http://www.retrevo.com/s/Whirlpool-WFC7500V-Washers-review-manual/id/19051ag218/t/1-2/

G. Laptop

1. Dell Inspiron 8600
Model Number PP02X

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.
B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 CLEANING AND PROTECTION

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
B. Verify that accessories required have been furnished and installed.
C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

## END OF SECTION 11 31 00

# SECTION 12 00 00– FURNISHINGS

## PART 1 – GENERAL

1.1 GENERAL

A. Interior furnishings, accessories and art

## PART 2 – PRODUCTS

2.1 FURNISHINGS

A. Product Names, Model, and Hyperlink

1. Sofa : West Elm 89-5125208
http://www.westelm.com/online/store/ProductDisplay?partNumber=WE-PRODf038&storeId=17001&langId=-1&catalogId=17002&viewSetCode=E&parentId=WE-SH1FRNSAC&retainNav=true&cmsrc=WE-SH1FRNSAC

2. Side Chair : West Elm 89-9775388
http://www.westelm.com/online/store/ShoppingBasketDisplayView?orderId=3328463&storeId=17001&cancelUrl=&catalogId=17002&langId=-1
3. Dining Chair Euro Style Olga Chair 03320
http://www.gotoeurostyle.com/prod_detail.asp?product_id=488
4. Bar Stools
http://www.target.com/Bradley-Barstool-Silver-30/dp/B001PGRLRI/sr=1-1/qid=1243487303/ref=sr_1_1/181-0063481-3848477?ie=UTF8&frombrowse=0&index=target&rh=k%3ABRADLEY%20BARSTOOL&page=1

B. Custom Fabricated Furniture

1. Dining Table - $3,500.00
2. Side Tables/Coffee Tables - $1,200.00
3. Murphy Bed - $1,587.00

C. Allowances

1. Furniture = $2,936.78
2. Custom Fab. Furniture = $5,700.00

2.2 ACCESSORIES

A. Kitchen
B. Living Room
C. Bedroom
D. Window Blinds
E. Allowances:

1. Kitchen Accessories: $1,500.00
2. Living Room $ 500.00
3. Bedroom $ 500.00
4. Window Blinds $ 882.29

2.3 ART

A. Framed Paintings
B. Sculptures
C. Allowances (Paintings and Scultpture) : $20,000.00

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Follow manufacturer's recommendations for installation.

## END OF SECTION 12 00 00

# SECTION 12 35 30 - RESIDENTIAL CASEWORK

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Kitchen cabinets.
2. Bedroom Storage Cabinets.

B. Related Sections include the following:

1. Division 6 Section "Interior Architectural Woodwork" for wood countertops.
2. Division 11 Section "Residential Appliances" for appliances.
3. Division 15 Section "Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.3 DEFINITIONS

A. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
B. Semi-exposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semi-exposed."
C. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

1.4 SUBMITTALS

A. Product Data:

1. Cabinets:
2. Cabinet hardware.

B. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.
C. Samples for Initial Selection: For each type of material exposed to view.

1.5 QUALITY ASSURANCE

A. Source Limitations for Cabinets: Obtain cabinets through one source from a single manufacturer.
B. Product Options: Drawings indicate size, configurations, and finish material of cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' cabinets of similar sizes and door and drawer configurations, same finish material, and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."
C. Quality Standards: Unless otherwise indicated, comply with the following standards:

1. Cabinets: KCMA A161.1.

D. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location of each unit and showing compliance with the above standard.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.
C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

1.7 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.
B. Coordinate locations of utilities that will penetrate countertops or backsplashes.

## PART 2 - PRODUCTS

2.1 CABINET MATERIALS

A. General:

1. Adhesives: Do not use adhesives that contain urea formaldehyde.
2. Hardwood Lumber: Kiln dried to 7 percent moisture content.
3. Softwood Lumber: Kiln dried to 10 percent moisture content.
4. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
5. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
6. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

2.2 CABINET HARDWARE

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.
B. Pulls: Back-mounted decorative pulls.
C. Hinges: Concealed European-style self-closing hinges.
D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091.

2.3 CABINETS

A. Available Products: Subject to compliance with requirements, cabinets that may be incorporated into the Work include, but are not limited to, the following:

1. IKEA Drawer and Cabinet Pulls
   http://www.ikea.com/us/en/catalog/categories/departments/kitchen/series

2. Custom Cypress Cabinetry

B. Cabinet Style: Aluminum Frame with Glass Panel
C. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
B. Install cabinets without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.
C. Install cabinets and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.
D. Fasten cabinets to adjacent units and to backing.
E. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

### 3.2 ADJUSTING AND CLEANING

A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
B. Clean casework on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

## END OF SECTION 12 35 30

# SECTION 22 07 00 – PLUMBING INSULATION

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
B. Shop Drawings:

1. Detail application of product.

C. Qualification Data: For qualified Installer.
D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed..
E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.
B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

## PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Flexible elastomeric thermal insulation is not suitable for temperatures lower than minus 70 deg F (minus 57 deg C) and higher than 220 deg F (104 deg C). Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-

sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
3. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation

to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIELD QUALITY CONTROL

A. Inspections in this article are destructive. Retain if workmanship quality is an important requirement. Architect should be prepared to reject all work if defective work is discovered in sample inspection.
B. Perform tests and inspections.
C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 6 (DN 25) and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot and Re-circulated Hot Water:

1. NPS 6 (DN 32) and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch (13 mm) thick.

b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

F. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.

G. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

END OF SECTION 22 07 00

# SECTION 22 11 10– FACILITY WATER DISTRIBUTION

## PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Furnish and install sanitary drainage and vent piping systems, and domestic water piping, including valves and fittings.

B. Furnish and install miscellaneous apparatus attached to plumbing piping systems.

1.2 REFERENCES

A. ASME A112.26.1M - Water Hammer Arresters.
B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DMV.
E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
F. ASSE 1011 - Hose Connection Vacuum Breakers.
G. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
H. ASSE 1019 - Wall Hydrants, Frost-Proof Automatic Draining Anti-Backflow Types.
I. ASTM A 47 - Ferritic Malleable Iron Castings.
J. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
K. ASTM A 74 - Cast Iron Soil Pipe and Fittings.
L. ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
M. ASTM B 32 - Solder Metal.
N. ASTM B 88 - Seamless Copper Water Tube.
O. ASTM B 306 - Copper Drainage Tube (DWV).
P. ASTM C 564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
Q. AWS A5.8 - Brazing Filler Metal.
R. AWWA C111 - Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
S. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
T. AWWA C606 - Grooved and Shouldered Joints.
U. MSS SP-110 - Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
V. PDI WH-201 - Water Hammer Arresters.

1.3 SUBMITTALS

A. Include data on pipe materials, pipe fittings, and special fabricated items.
B. Include component sizes, rough-in requirements, service sizes and finishes for specialties.
C. Provide operation and maintenance manual.

1.4 QUALITY ASSURANCE

A. For each product specified, provide components by same manufacturer throughout project.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS: Provide products from the following lists of preferred manufacturers.

A. Valves:

1. Hammond.
2. Crane.
3. Apollo.
4. Nibco.
5. Stockham.

B. Floor Drains:

1. Tyler/Wade.
2. Josam.
3. Jay R. Smith.
4. Zurn.
5. Watts.

C. Cleanouts:

1. Tyler/Wade.
2. Josam.
3. Jay R. Smith.
4. Zurn.

D. Backflow Preventers:

1. Rockwell.
2. FEBCO.

E. Water Hammer Arresters:

1. Precision Plumbing Products.
2. Sioux Chief.
3. Watts.

F. Hose Bibbs/Hydrants:

1. Woodford.
2. Jay R. Smith.
3. Josam.
4. Chicago.
5. Zurn.

G. Water Tanks:

1. Silicon Solar

2.2 SANITARY SEWER AND VENT PIPING

A. Above Grade:

1. Schedule 40 solid wall PVC Piping with solvent welded fittings.

2.3 WATER PIPING

A. http://www.viega.net/288.htm

B. Above Deck:

1. Pipe 1 Inches and Smaller; Copper Tubing: ASTM B 88, Type L, hard drawn or soft

tubing.

a. Fittings: ASME B16.18, cast bronze, or ASME B16.22 wrought copper and bronze, or Tee-drill application.
b. Joints: ASTM B 32, solder, Grade 95TA (lead free).

2. Pex flexible tubing with manufactured fittings.

2.4 VALVES

A. Gate Valves:

1. 2 Inches and Smaller: Bronze body, 125 psi steam, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.
2. Over 2 Inches: Iron body, 125 psi steam, bronze trim, OS&Y rising stem, handwheel, wedge, flanged or grooved ends.

B. Ball Valves:

1. 2 Inches and Smaller: Bronze body, full port, chrome plated brass/bronze ball, eflon seats, separate packnut with adjustable stem packing, rated 150 psi steam and 600 WOG, solder or threaded ends. Valve ends shall have full depth ANSI threads or extended solder connections and be comply with MSS SP-110. Provide with balancing stops on hot water return line.
2. Over 2 Inches: Cast steel body, Class 150 stainless steel ball and stem, teflon seat and stuffing box seals, lever handle, flanged ends.

C. Swing Check Valves:

1. 2 Inches and Smaller: Rate 200 psi WOG minimum water pressure, brass or bronze construction, bronze disc, threaded or soldered connections.
2. Over 2 Inches: Rated 200 psi WOG minimum water pressure, iron body, brass mounted, flanged connections.

2.5 DRAINS (See Plans)

2.6 ESCUTCHEONS

A. Provide escutcheons at finished surfaces where bare or insulated piping exposed to view passes through floors, walls or ceilings, except in boiler, utility or equipment rooms. Fasten securely to pipe or pipe covering. Provide satin finish, corrosion resisting steel, polished chromium-plated zinc alloy or polished chromium-plated copper alloy of the one-piece or split-pattern held in place by internal spring tension or setscrew.

2.7 WATER HAMMER ARRESTERS

A. ASME A112.26.1M; sized in accordance with PDI WH-201, factory precharged suitable for operation in temperature range of minus 33 to 300 degrees F and maximum 250 psig working pressure; Sioux Chief.
B. 12” tall air chamber in supply piping to fixture.

2.8 WATER HEATER RELIEF LINES

A. These shall be Government Type “L” hard copper.

2.9 EQUIPMENT DRAIN LINES

A. These shall be Government Type "L" hard copper, schedule 40 PVC, or DWV copper.

2.10 HOT WATER TANK

A. Manufacturer

1. Silicon Solar Inc.
http://www.siliconsolar.com/
Silicon Solar Inc 2917 State HW 7
Bainbridge, NY 13733
607-563-7865

B. Product Information

1. Silicon Solar http://solarhotwater.siliconsolar.com/solar-storage-tanks-40gallon.php
http://solarhotwater.siliconsolar.com/pdfs/SHW-GIB-005-solar-storage-tanks.pdf
2. Description: 50gal Polyurethane insulated tank. Insulation: 2" polyurethane R22

2.11 BLADDER EXPANSION TANK

A. Manufacturer:

1. AMTROL, Inc.
Corporate Office
1400 Division Road
West Warwick, R.I. 02893
Phone: (401) 884-6300
Fax: (401) 884-4773
Email: info@amtrol.com

B. Product Information:

1. Extrol Expansion Tank For Closed Hydronic Heating, Radiant & Chilled Water Systems
http://www.amtrol.com/pdf/extrolbrochure.pdf

## PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. Coordinate forming of floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
B. Route piping in orderly manner and maintain gradient.
C. Install piping to conserve building space and not interfere with use of space.
D. Group piping whenever practical at common elevations.
E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F. Provide clearance for installation of insulation and access to valves.
G. Provide access where valves and fittings are not exposed.
H. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
I. Establish invert elevations, slopes for drainage to 1/8-inch per foot (nominally 1 percent)

minimum. Maintain gradients.

J. Install hub and plain end pipe with hub end upstream.
K. Install valves with stems upright or horizontal, not inverted.
L. Install unions downstream of valves and at equipment or apparatus connections.
M. Install brass male adapters each side of valves in copper pipe system. Sweat solder adapters to pipe.
N. Install ball valves for shut-off and to isolate equipment, or part of systems.
O. Install ball valves for throttling, bypass, or manual flow control services.
P. Provide spring loaded check valves on discharge of water pumps.
Q. Slope water piping and arrange to drain at all low points.
R. Install piping parallel with or at right angles to walls unless otherwise shown on drawings.
S. Conceal piping above ceiling, in walls or chases, etc., unless otherwise noted on the drawings.
T. Bending of rigid piping is not permitted, only ells shall be utilized for a change in direction.
U. Temporarily plug or cap open ends of pipe at the end of each work day.
V. Install specialties in accordance with manufacturer's instructions to permit intended performance.
W. Ensure clearance at cleanout for rodding of drainage system.
X. Install water hammer arresters sized in accordance with APDI@ or 12 high air chambers on all hot and cold water lines at the end of each plumbing fixture.

END OF SECTION 22 11 10

# SECTION 22 11 20 – PLUMBING PIPING AND PUMPS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:

1. Close-coupled, horizontally mounted, in-line centrifugal pumps.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.
B. Protect bearings and couplings against damage.
C. Comply with pump manufacturer's written rigging instructions for handling.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CLOSE COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS (COLD WATER BOOSTER SYSTEM)

A. Available Manufacturers:

1. Tigerflow Housecat Simplex. http://www.tigerflow.com/housecat.html

2. Description: Pre-fabricated and factory tested, single source responsibility pump package shall include a 1 HP closed coupled pump and motor with stainless steel pump construction, mechanical seal, TEFC-3600 RPM motor, built-in thermal overload protection for 120 or 230 volt single phase 60 hertz electrical service, pre-pressurized bladder tank with 14 gallon capacity, 150# non-code tank, NSF-61 certified bladder with vertical construction, suction globe style non-slam check valve, adjustable relief valve, type "L" copper piping (1" NPT), discharge system pressure gauge, auto system pressure switch (30-50#). The system shall have a third party system certification complying with OSHA and Federal regulations 29CFR1910.303, 29CFR1910.399, NFPA 70 (National Electric Code) article 90-7. The system shall be UL/C-UL listed packaged pumping system label "QCZJ". The system capacity ratings shall be 30 GPM at 20 PSI boost pressure, 17 GPM at 40 PSI boost pressure, 7 GPM at 55 PSI boost pressure and 0 GPM at 68 PSI boost pressure.

2.3 CLOSE COUPLED, HORIZONTALLY MOUNTED, CLOSED-LOOP GLYCOL CIRCULATION 1 PUMPS

A. Manufacturers:

1. Taco, Inc.
1160 Cranston St.
Cranston, RI 02920
Phone: (401) 942-8000
FAX: (401) 942-2360

B. Product Information

1. Model 007 Cartridge Circulator
http://www.taco-hvac.com/uploads/FileLibrary/100-1.8.pdf

2. Description: Pre-fabricated circulator pump designed specifically for hyronic and solar applications. The 1/25hp pumps has a minimum fluid temperature of 40 degrees and a maximum fluid temperature of 240 degrees Fahrenheit. The pump is a cartridge style, maintenance free, wet-rotor, in-line, single stage circulator pump. It is designed for quiet operation in Hydronic heating, Radiant heating, Hydro-Air fan coils, Indirect water heaters, Chilled fresh water, and Domestic Water Recirculation systems. Available in Cast Iron, Bronze or Stainless Steel construction with universal flanged connections. The unique replaceable cartridge contains all of the moving parts and allows the circulator to be easily serviced instead of replacing the entire unit. Ideal for a wide range of applications.

2.4 DIFFERENTIAL PUMP CONTROLS

A. Manufacturer:

1. Resol Sales Department
Hattingen, Germany

Email: export@resol.de
Phone Number: +49 (0) 23 24 / 96 48-735

B. Product Information:

1. DeltaSol BS
http://www.resol-gmbh.de/index/produktdetail/kategorie/1/sprache/en/id/3

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
C. Install close-coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.

3.3 CONTROL INSTALLATION

A. Install immersion-type thermostats in hot-water return piping.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to pumps to allow service and maintenance.
C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Close-coupled, horizontally mounted, in-line centrifugal pumps.

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps.

D. Ground equipment according to Grounding and Bonding requirements.
E. Connect wiring according to electrical requirements.
F. Connect thermostats to pumps that they control.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written

instructions.

2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain controls and pumps.

## END OF SECTION 22 11 20

# SECTION 22 41 00 – RESIDENTIAL PLUMBING FIXTURES

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. All Residential Plumbing Fixtures

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
B. Schedule: For fixtures; use same designations indicated on Drawings.
C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
D. Maintenance Data: For each product to include in maintenance manuals.
E. Warranties: Manufacturers warranty applies.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fixtures through one source from a single manufacturer.

Provide products from same manufacturer for each type of fixture required.
To the greatest extent possible, provide fixtures by a single manufacturer for entire Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Store materials in a clean, dry, ventilated, weather tight, secure location. Protect materials from soiling, abuse, loss, and moisture damage.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. LCR Corporation
LAFAYETTE, LA
3201 AMBASSADOR CAFFERY PKWY
337/981-7860

2.2 FIXTURES

A. Kitchen Sink:

1. Purist® widespread lavatory faucet K-14406-4-CP (Polished Crome)
http://www.us.kohler.com/onlinecatalog/pdf/1106616_4.pdf

C. Shower Faucet

1. Purist Multifunction Handshower K-978
http://www.us.kohler.com/onlinecatalog/detail.jsp?item=12255702&section=2&category=8&subcategory=50

D. Water Closet

Highline® Comfort Height® elongated 1.1 gpf toilet
http://www.us.kohler.com/onlinecatalog/pdf/1054185_4.pdf

E. Lavatory Sink

Inscribe® 16-1/2" cast iron Wading Pool® K-2388-96 lavatory
http://www.us.kohler.com/onlinecatalog/pdf/1091071_4.pdf

F. Showerhead

1. Purist Showerhead K-997
http://www.us.kohler.com/onlinecatalog/detail.jsp?item=13323902&section=2&category=8&subcategory=50

G. Toilet Seat

1. Cachet® Quiet-Close™ toilet seat with Quick-Release™ functionality - K-4636
http://www.us.kohler.com/onlinecatalog/pdf/1035808_4.pdf

H. Water Heater (Tankless)

1. Stiebel-Eltron Tempra Tankless water heater with microprocessor-based thermostatic temperature control (flow rate and temperature modulating) with thermal hi-limit cut-out switch monitoring each module. Unit shall be ETL Listed and meet ANSI/UL 499 standards. Unit shall have 12.0 KW total heating capacity at 240/1/60 electric service.
http://www.stiebel-eltron-usa.com/tempra.html

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Examine areas to verify actual locations of connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

### 3.3 CLEANING AND PROTECTION

A. Test each item of residential fixtures to verify proper operation. Make necessary adjustments.
B. Verify that accessories required have been furnished and installed.

C. Remove packing material from residential fixtures and leave units in clean condition, ready for operation.

END OF SECTION 22 41 00

# SECTION 23 00 00 – INSTRUMENTATION AND CONTROL FOR HVAC

## PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

A. The heat pump air conditioning system shall be a Mitsubishi Electric MXZ-A variable capacity multi-zone series. The system shall consist of three (3) slim silhouette, compact, wall mounted indoor fan coil sections with digital wired controller and a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven heat pump design.

B. Indoor unit models shall be two (2) models MSZA09NA and one (1) model MSZA12NA. Outdoor unit model number shall be MXZ3A30NA (3:1).

1.2 QUALITY ASSURANCE

A. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 / 240 and bear the ARI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).

E. A dry air holding charge shall be provided in the indoor section.

F. System efficiency shall meet or exceed 13 SEER when part of a multi system (3:1)

.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored inside and carefully handled according to the manufacturer's recommendations.

B. The wired controller shall be shipped inside the carton and packaged with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

1.4 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have an extended warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.

B. Manufacturer shall have over 25 years of continuous experience in the U.S. market.

## PART 2 – PRODUCTS

2.1 INDOOR UNIT

A. General:

1. The indoor unit shall be fully factory assembled, wired and run tested prior to shipment. Contained within the indoor unit shall be all factory wiring, piping, control circuit board, fan, and fan motor. The unit shall have a self-diagnostic function, 3-minute restart time delay mechanism, an auto restart function, an emergency / test operation. Indoor unit shall be charged with dry air before shipment from factory.

MSZ-A09NA (x2) and MSZ-A12NA
http://www.mehvac.com/products/itemDetail.asp?ProductSubCategoryID=141&ProductCategoryID=24&ProductID=1503

B. Unit Cabinet:

1. The casing shall have a white finish.
2. Multi directional drain and refrigerant piping, offering three (3) direction pipe alignment for all refrigerant piping and two (2) direction pipe alignment for condensate draining shall be standard.
3. There shall be a separate back plate that secures the indoor unit firmly to the wall.

C. Fan:

1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
2. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearing.
3. A manual adjustable guide vane shall be provided with the ability to change the horizontal airflow from side to side (left to right).
4. A integral, motorized, multi-position, vertical air sweep flow louver shall provide for uniform air distribution. Louver position shall be selectable from the remote controller
5. The indoor fan motor shall be capable of three (3) speed operation: High, Medium and Low.

D. Filter:

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

E. Coil:

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The refrigerant tubing shall have inner groves for high efficiency heat exchange.
3. All tube joints shall be brazed with phoscopper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.

F. Electrical:

1. The indoor unit electrical power shall be 208 / 230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system allowing each indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated , by-directional, digital control signal without additional connections.
3. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

G. Control:

1. Each indoor unit shall be provided with a field installed hard-wired digital, wall mounted remote controller to perform all input functions necessary to operate the system.
2. The remote controller shall provide a Power On/Off switch, Mode Selector – Cool-Dry-Heat, Temperature Setting, 24 Hour Clock / Timer Control, Fan Speed Select and

Auto Vane selector.
3. Operating mode for all units in the multi-zone system shall be determined by the first indoor unit to request Heat or Cool function.

4. The indoor unit shall perform Self-diagnostic Function and be equipped with Test Run switching and Check Mode switching.
5. Temperature changes shall be by 1°F increments with a range of 61-88°F.
6. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired digital remote controller, providing emergency operation and controlling the outdoor unit.
7. The indoor units shall be capable of working with both single-zone or multi-zone outdoor units.
8. The system shall be capable of automatically restarting, at all previous settings, when the power is restored after power interruption.
9. The digital remote controller shall control the operation of the motorized, vertical, air sweep louver for Auto (position determined by control program), Manual (four controller selectable positions) or Sweep (continuous motion). The louver shall drive to the closed position when the indoor unit is turned off.

## 2.2 OUTDOOR UNITS

### A. General

1. The MXZ outdoor units shall be specifically designed to work with the MSZ family of indoor units. The units must have a fused powder coated finish in a Munsell 5Y 8/1 color. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory prior to shipment.
MXZ-3A30NA
http://www.mehvac.com/products/itemDetail.asp?ProductSubCategoryID=141&ProductCategoryID=24&ProductID=1503

### B. Unit Cabinet

1. All casing and cabinet components shall be fabricated of galvanized steel, bonderized finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for durable, corrosion resistant surface protection.

### C. Fan

1. The unit shall be furnished with a direct drive, high performance propeller type fan.
2. The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings.
3. Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.
4. The fan motor shall be mounted with vibration isolation for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.

### D. Coil

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil shall be protected with an integral guard.
3. Refrigerant flow from the outdoor unit shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.

### E. Compressor:

1. The compressor motor shall be direct current (DC) type designed for variable speed operation.
2. The compressor shall be a high performance, hermetic, inverter driven, variable speed, rotary type.
3. The outdoor unit shall be equipped with a suction side refrigerant accumulator.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

F. Manifold:

The outdoor unit shall have manifold connections providing a separate set of flared fittings for each indoor unit per the table below:

| Port Connections | A | B | C |
|---|---|---|---|
| | | | |
| MXZ3A30NA | ¼ " Liquid : 1/2" Gas | ¼ " Liquid : 3/8" Gas | ¼ " Liquid : 3/8" Gas |
| | | | |

[Some indoor unit combinations may require port adaptors for proper connection]

G. Piping Requirements:

The outdoor unit must have the ability to operate within the following refrigerant piping and height limitations without the need for line size changes, traps or additional oil.

Piping Lengths:

| Refrigerant Piping Data | Length to each indoor unit | Total piping length |
|---|---|---|
| | | |
| MXZ3A30NA | 82 feet (Max) | 230 feet (Max) |
| | | |

Height Differential:

| Model | Indoor unit above outdoor unit | Indoor unit below outdoor unit |
|---|---|---|
| | | |
| MXZ3A30NA | 49 feet (Max) | 33 feet (Max) |
| | | |

H. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
3. The outdoor unit shall be controlled by the microprocessors located in the indoor unit and in the outdoor unit communicating system status, operation, and instructions digitally over A-Control wiring.
4. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

## PART 3 – EXECUTION

3.1 Each system shall perform in accordance with the ratings shown in the tables below.

3.2 Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 23.9°C WB) for the outdoor unit at rated frequency: A09-50Hz, A12-76Hz, A15-77Hz, A17-79Hz, A24-110Hz.

3.3 Heating performance shall be based on 70ºF DB, 60 ºF WB (21.1ºC DB, 15.6ºC WB) for the indoor unit and 47 º F DB, 43º F WB (8.3 º C DB, 6.1º C WB) for the outdoor unit at rated frequency: A09-61Hz, A12-76Hz, A15-78Hz, A17-88Hz, A24-101Hz.

## END OF SECTION 23 00 00

# SECTION 23 07 00 – HVAC INSULATION

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
B. Shop Drawings:

1. Detail application of products for each type of insulation.
2. Detail application of field-applied jackets.
3. Detail field application for each insulation type.

C. Qualification Data: For qualified Installer.
D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Flexible elastomeric thermal insulation is not suitable for temperatures lower than minus 70 deg F (minus 57 deg C) and higher than 220 deg F (104 deg C).

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

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it self and to surfaces to be insulated, unless otherwise indicated.
B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.4 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches(75 mm).
3. Thickness: 6.5 mils(0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches(50 mm).
3. Thickness: 3.7 mils(0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:

    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches(38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm)o.c.
    4. For below ambient services, apply vapor-barrier mastic over staples.
    5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

M. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles. Where pipe expansion is anticipated, detail expansion compensation for insulation on Drawings and indicate intervals for its occurrence. See MICA's "National Commercial & Industrial Insulation Standards," Plate No. 41A.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

E. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

F. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

## 3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD QUALITY CONTROL

A. Inspections in this article are destructive. Retain if workmanship quality is an important requirement. Architect should be prepared to reject all work if defective work is discovered in sample inspection.
B. Perform tests and inspections.
C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded

valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed outdoor air.
2. Indoor, concealed return air.
3. Indoor, concealed exhaust.

3.9 INDOOR DUCT INSULATION SCHEDULE

A. Concealed, round, return-air, exhaust-air, and outside-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm)thick and (12-kg/cu. m)1.5-lb/cu. ft. (24-kg/cu. m)nominal density.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F(16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch (19 mm)thick.
b. Flexible elastomeric thickness is limited to 1 inch (25 mm) to meet a flame-spread index of 25 and a smoke-developed index of 50. Condensation control and energy efficiency are limited by thickness.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches (50 mm) thick.

END OF SECTION 23 07 00

# SECTION 23 30 00 – AIR DISTRIBUTION

## PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Ductwork and Ductwork Accessories.
B. Diffusers, Registers, and Grilles.

1.2 SUBMITTALS

A. Submit product data and shop drawings.
B. Include brochures describing air diffusers, registers and grilles.

1.3 REGULATORY REQUIREMENTS

A. Construct Ductwork to recommendations in SMACNA Duct Construction Manual, and to the requirements of NFPA 90A and NFPA 96.

## PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Sheet Steel for Ducts: ASTM A 525 and ASTM A 527 galvanized sheet steel, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A 90.
B. Galvanized Steel Hot Dipped After Fabrication: ASTM A 123.
C. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

2.2 LOW PRESSURE DUCTS: All ducts on the project are low pressure as defined by SMACNA.

A. General: Construction, metal gauge, and reinforcements shall conform with NFPA 90A and SMACNA LPDCS. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Construct ductwork of galvanized steel.
B. Curved Elbows: Make curved elbows with a centerline radius not less than 1-1/2 times the width or diameter of the duct.
C. Joints and Laps: Make substantially airtight. Make laps at joints in the direction of air flow. Button-punch or bolt-connection in standing seams shall be spaced at fixed centers not greater than 6 inches. "Button Punch Snap-Lock" may be used instead of Pittsburgh Lock.
D. Fittings: Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, flexible connections and access door shall conform with Section II, SMACNA LPDCS.

2.3 INSULATED FLEXIBLE DUCTS

A. General: Interlocking spiral of galvanized steel construction, rated to 2 inches wc positive and 1.5 inches wc negative for low pressure duct and 10 inches wc positive or negative for medium or high pressure ducts. Ducts shall be factory insulated with flexible glass fiber insulation, having maximum 0.23 K value at 75 degrees F., enclosed by seamless aluminum pigmented vapor barrier jacket. Flexible duct shall not exceed 8 feet in length and total bends shall not exceed 90 degrees.

2.4 DUCTWORK ACCESSORIES

A. Flexible Connections: Flexible connections shall be provided between air conditioning units or fan housings and the duct with which they are connected. The material used shall be wire-reinforced glass fabric of suitable weave and weight, and shall be rendered practically air tight in an approved manner. The necessary angles, bolts, clips, or other fastening for securing the flexible material to the equipment and ducts shall be furnished.

B. Turning Vanes: Turning vanes shall consist of double thickness curved metal blades or vanes rigidly mounted in a runner, arranged so as to permit the air to make the abrupt turns without appreciable turbulence, shall be the manufacturer's standard products and shall be quiet and free from vibration when the system is in operation.

C. Duct Access Doors: Doors shall be rigid and airtight. Provide insulated access doors in ducts at fire dampers, and smoke dampers. Doors shall have a continuous neoprene gasket on the perimeter, hinged, and positive locking devices. Doors shall be of adequate size to service the dampers and equipment located inside ducts but less than 12" x 12" and shall be Ruskin Type ADC1, or approved equal.

2.5 DAMPERS

A. Balance Dampers: Multi-louvered, butterfly, and splitter dampers shall be constructed of galvanized steel sheets not less than 20 gauge thickness. Dampers shall be designed to offer minimum to the flow of air.

B. Control Dampers: Provide at locations on Plans pneumatic control dampers to provide low leakage shut off of air. The damper shall be constructed of aluminum with aluminum airfoil blades. Leakage shall not exceed 6 CFM/SQ. FT. at 4" W.G. unit shall be AMCA certified and equal to Ruskin CD-50.

2.6 DIFFUSERS, REGISTERS, GRILLES

A. Ceiling Exhaust and Return Air Grilles: Grilles shall be as indicated in schedules on drawings and shall be as manufactured by Nailor, Titus, Anemostat, Price, Metal Aire, or approved equal.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Installation shall conform with NFPA and SMACNA. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors and dampers. Install ductwork accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

B. Ductwork: Install airtight. When air distribution systems are operated, there shall be no chatter, vibration, or dust marks.

C. Dampers: When installed on ducts to be thermally insulated, equip each damper-operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of the insulation.

D. Turning Vanes: Provide turning vanes in all square elbows.

E. Access Doors: Provide for automatic dampers, volume dampers, fire dampers, duct coils, and other concealed apparatus requiring service and inspection in the duct system.

F. Duct Sleeves: Install for all ducts passing through walls, partitions, floors, roofs and ceilings. This contractor shall be responsible for the proper size and location of the sleeves. Allow 1-inch clearance between duct and opening or between insulation and opening on insulated ducts except at grilles, registers, and diffusers. Pack opening between sleeve and duct or insulation with mineral fiber.

G. Duct Supports: Ducts shall be supported by not less than two 1-inch wide by 1/16-inch thick galvanized strap of sheet steel hangers located one on each side of duct, spaced. Attach supports only to structural framing members and concrete slabs.

H. Gauge Markings: Fabricate ducts so that the gauge markings are on the outside the duct.

END OF SECTION 23 30 00

# SECTION 23 37 13.60 – DIFFUSERS, REGISTERS, AND GRILLES

## PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Diffusers, Registers, and Grilles.

1.2 SUBMITTALS

A. Submit product data and shop drawings.
B. Include brochures describing air diffusers, registers and grilles.

## PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS, GRILLES

A. Ceiling Exhaust and Return Air Grilles: Grilles shall be as indicated in schedules on drawings and shall be as manufactured by Nailor, Titus, Anemostat, Price, Metal Aire, or approved equal.

B. Products

1. Anodized Aluminum Register for Dehumidifier Supply

## PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Installation shall conform with NFPA and SMACNA. Provide mounting and supporting of diffusers, registers, and grilles. Install diffusers, registers, and grilles accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

## END OF SECTION 23 37 13.60

# SECTION 23 80 00 – DECENTRALIZED HVAC EQUIPMENT

## PART 1 – GENERAL

1.1 SECTION INCLUDES:

A. Exhaust Fans and Accessories.
B. De-Humidifier unit.

1.2 QUALITY ASSURANCE:

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
B. Fan Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
C. Fan Fabrication: Conform to AMCA 99 and/or ARI 430.

1.3 SUBMITTALS:

A. Submit product data and shop drawings.
B. Submit manufacturer's installation instruction.

## PART 2 - PRODUCTS

2.1 EXHAUST FANS AND ACCESSORIES:

A. General: This Contractor shall furnish and install BROAN model QTX110SL and shall be complete with all accessories and specials scheduled. Fans shall be rated in accordance with AMCA Standards and shall be AMCA labeled. All fractional horsepower motors shall be provided with internal overload protections.

2.2 DE-HUMIDIFIER UNIT:

A. Furnish and install Therma-Stor model Ultra-Aire 65H Part #4027170 De-Humidification unit complete with MERV 11 filter, Outside air motor operated damper, drain hose, and digital wall mounted controller (model DEH 3000).
http://www.conditionedair.com/iaq.html
B. Unit capacities shall be 190 CFM at 0.0” w.g., 680 watts at 80 degrees F and 60% relative humidity, 120/1/60 electric service, and 5.50 amps 65 pints per day.

## PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install equipment in accordance with manufacturer's installation instruction.
B. Coordinate installation with architectural, structural, mechanical, and electrical work.
C. Pipe condensate to drain.
D. Clean and flush system before placing in operation.
E. Verify that the proper utilities are connected and ready for use before operation of equipment.

## END OF SECTION 23 80 00

# SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.
B. NBR: Acrylonitrile butadiene rubber.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: 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. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast in place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 -PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Aluminum and Copper Conductors: Comply with NEMA WC 70.
B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN THWN.
C. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type MC mineral insulated, metal sheathed cable, Type NM and Type SO.

2.2 CONNECTORS AND SPLICES

A. Description: Factory fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN THWN, single conductors in raceway.
B. Exposed Feeders: Type THHN THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN THWN, single conductors in raceway or NM cable for residential areas as allowed by local code.
D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN THWN, single conductors in raceway or NM cable .
E. Branch Circuits Concealed in Concrete, below Slabs on Grade, and Underground: Type THHN THWN, single conductors in raceway.
F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire mesh, strain relief device at terminations to suit application.
G. Control Circuits: Type THHN THWN, in raceway or Power limited cable, concealed in building finishes.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. Use manufacturer approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
C. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips, that will not damage cables or raceway.
D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

# SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. ENT: Electrical nonmetallic tubing.
C. EPDM: Ethylene propylene diene terpolymer rubber.
D. FMC: Flexible metal conduit.
E. IMC: Intermediate metal conduit.
F. LFMC: Liquidtight flexible metal conduit.
G. LFNC: Liquidtight flexible nonmetallic conduit.
H. NBR: Acrylonitrile butadiene rubber.
I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged cover enclosures, and cabinets.
B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: 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. Comply with NFPA 70.

## PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.
B. Aluminum Rigid Conduit: ANSI C80.5.
C. IMC: ANSI C80.6.
D. PVC Coated Steel Conduit: PVC coated rigid steel conduit IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.
F. FMC: Zinc coated steel or aluminum.
G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: set screw or compression type.
3. Coating for Fittings for PVC Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. ENT: NEMA TC 13.
B. RNC: NEMA TC 2, Type EPC 40 PVC, unless otherwise indicated.
C. LFNC: UL 1660.
D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 12 3R, unless otherwise indicated.
C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
D. Wireway Covers: Screw cover type.
E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless steel screws and oil resistant gaskets.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap on covers. Manufacturer's standard enamel finish in color selected by Architect Prime coating, ready for field painting.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard custom colors.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Butler Manufacturing Company; Walker Division.
b. Enduro Systems, Inc.; Composite Products Division.
c. Hubbell Incorporated; Wiring Device Kellems Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
C. Cast Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
F. Nonmetallic Floor Boxes: Nonadjustable, round.
G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
H. Cast Metal Access, Pull, and Junction Boxes: NEMA FB 1,galvanized, cast iron with gasketed cover.
I. Hinged Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio frequency resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel, EMT or EPC-40-PVC conduit .
2. Concealed Conduit, Aboveground: Rigid steel conduit, EMT or RNC, Type EPC 40 PVC.
3. Underground Conduit: RNC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor Driven Equipment): LFMC .
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R .

B. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

### 3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
B. Complete raceway installation before starting conductor installation.
C. Arrange stub ups so curved portions of bends are not visible above the finished slab.
D. Install no more than the equivalent of three 90 degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
E. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

### 3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

# SECTION 26 24 16 - PANELBOARDS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Load Centers

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. Comply with NEMA PB 1.
E. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## PART 2 - PRODUCTS

2.1 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Load Centers: Comply with UL 67.
C. Mains: Circuit breaker.
D. Branch Overcurrent Protective Devices: Plug in circuit breakers, replaceable without disturbing adjacent units.
E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Eaton Electrical Inc.; Cutler Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Fused Switch: NEMA KS 1, Type GD; clips to accommodate specified fuses; lockable handle.

1. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.3 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Current Technology; a subsidiary of Danahar Corporation.
2. Eaton Electrical Inc.; Cutler Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for over current protective device test, inspection, maintenance, and operation.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panel boards according to NECA 407 .
B. Examine panel boards before installation. Reject panel boards that are damaged or rusted or have been subjected to water saturation.
C. Examine elements and surfaces to receive panel boards for compliance with installation tolerances and other conditions affecting performance of the Work.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panel boards and accessories according to manufactures requirements.
B. Mount panel board cabinet plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish and mating with back box.
C. Install over current protective devices and controllers not already factory installed.
D. Install filler plates in unused spaces.

E. Stub four 1-inch empty conduits from panel board into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
G. Comply with NECA 1.

3.3 IDENTIFICATION

A. Create a directory to indicate installed circuit loads after balancing panel board loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

B. Panel boards will be considered defective if they do not pass tests and inspections.

## END OF SECTION 26 24 16

# SECTION 26 27 26 – WIRING DEVICES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall switch and exterior occupancy sensors.
3. Communications outlets.
4. Pendant cord connector devices.
5. Cord and plug sets.
6. Floor service outlets, poke through assemblies, service poles, and multioutlet assemblies.
7. Lighting Controls

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch circuit conductor.
D. RFI: Radio frequency interference.
E. TVSS: Transient voltage surge suppressor.
F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.
D. Field quality control test reports.
E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5 20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221 2 (single pole), 1222 2 (two pole), 1223 2 (three way), 1224 2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221 PLR for 120 V, 1221 7PLR for 277 V.

d. Pass & Seymour; PS20AC1 PLR for 120 V.

2. Description: Single pole, with neon lighted handle, illuminated when switch is "ON."

D. Key Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221 2L.
d. Pass & Seymour; PS20AC1 L.

2. Description: Single pole, with factory supplied key in lieu of switch handle.

2.5 WALL BOX DIMMERS

A. Dimmer Switches: Modular, full wave, solid state units with integral, quiet on off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider ; with single pole or three way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square law dimming curve. On off switch positions shall bypass dimmer module.

1. Provide wattage to next load requirements of circuit.

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low end dimming; dimmer ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 FAN SPEED CONTROLS

A. Modular, 120 V, full wave, solid state units with integral, quiet on off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable slider , 5 A 1.5 A.
2. Three speed adjustable slider , 1.5 A.

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high impact thermoplastic 0.035-inch- thick..
3. Material for Unfinished Spaces: Smooth, high impact thermoplastic.
4. Material for Damp Locations: Cast aluminum with spring loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather resistant , die cast aluminum with lockable cover.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

2.9 DIMMER

A. Manufacturer

1. Wattstopper
Wells-Keown Associates, Inc.
Harahan, LA
Tel: 504-733-0301
Fax: 504-733-3675

B. Product Information

1. RD-200 Passive Infrared (PIR) Dimming Wall Switch Vacancy Sensor
http://www.wattstopper.com/products/details.html?id=225

2.10 TIME SWITCHES

A. Manufacturer

1. Wattstopper
Wells-Keown Associates, Inc.
Harahan, LA
Tel: 504-733-0301
Fax: 504-733-3675

B. Product Information

1. RT – 50 AND RT – 100 Time Switches
www.wattstopper.com/getdoc/2017/22903%20RT-50,%20RT-100%20cut.pdf

2.11 VACANCY SENSORS

A. Manufacturer

1. Wattstopper
Wells-Keown Associates, Inc.
Harahan, LA
Tel: 504-733-0301
Fax: 504-733-3675

B. Product Information

1. RS – 250 N Series Passive Infrared (PIR) Universal Application Wall Switch Vacancy Sensors
www.environmentalhomecenter.com/inc/pdf/RS_250_350.pdf

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

B. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15 or 20 A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal to metal contact.

C. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up , and on horizontally mounted receptacles to the right .
2. Install hospital grade receptacles in patient care areas with the ground pin or neutral blade at the top.

D. Device Plates: Do not use oversized or extra deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

E. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

## END OF SECTION 26 27 26

# SECTION 26 28 13 - FUSES

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches .

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let through current curves for fuses with current limiting characteristics.
3. Time current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let through current curves for fuses with current limiting characteristics.
b. Time current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ferraz Shawmut, Inc.
2. Little Fuse.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
B. End Caps: End caps shall be capable of being tested if fuse is blown.
C. Indicating Feature: Fuse shall have an indicating feature which clearly indicates when fuse is blown.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Service Entrance: Class RK1, time delay .
B. Motor Branch Circuits: Class RK1 , time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
B. Install spare fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

## END OF SECTION 26 28 13

# SECTION 26 31 00 – PHOTOVOLTAIC COLLECTORS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Photovoltaic Collectors
2. BiFacial Photovoltaic Collectors

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
B. Schedule: Use same designations indicated on Drawings.
C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
D. Maintenance Data: For each product to include in maintenance manuals.
E. Warranties: Manufacturers warranty applies
.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain items through one source from a single manufacturer.

Provide products from same manufacturer for each type of collector/invertor required.
To the greatest extent possible, provide collectors and invertors by a single manufacturer for entire Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Store materials in a clean, dry, ventilated, weather tight, secure location. Protect materials from soiling, abuse, loss, and moisture damage.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. SANYO Energy USA Corp.
2600 Netwok Blvd., Suite 600
Frisco, TX 75034, U.S.A
E-mail: solar@sec.sanyo.com
http://us.sanyo.com/Consumer

2.2 Photovoltaic Collectors

A. HIT Photovoltaic Module Power 205

1. HIP-205BA19
http://us.sanyo.com/dynamic/product/Downloads/HITPower205DataSheet-35558646.pdf

B. BiFacial Photovoltaics HIT Double 195

1. HIP-195DA3
http://us.sanyo.com/dynamic/product/Downloads/HIT%20Double%20195%20Data%20Sheet-9628861.pdf

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Examine area to verify actual locations of connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

### 3.3 CLEANING AND PROTECTION

A. Test each item to verify proper operation. Make necessary adjustments.
B. Verify that accessories required have been furnished and installed.
C. Remove packing material from solar collectors and leave units in clean condition, ready for operation.

## END OF SECTION 26 31 00

# SECTION 26 51 00 – INTERIOR LIGHTING

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Lighting fixture supports.

1.3 DEFINITIONS

A. BF: Ballast factor.
B. CRI: Color-rendering index.
C. CU: Coefficient of utilization.
D. HID: High-intensity discharge.
E. LER: Luminaire efficacy rating.
F. Luminaire: Complete lighting fixture, including ballast housing if provided.
G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Qualification Data: For agencies providing photometric data for lighting fixtures.
B. Field quality-control test reports.
C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: 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. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified. If prior approval is indicated, contractor to submit for prior approval seven days prior to bidding.

B. Wattstopper
2800 De La Cruz Blvd.
Santa Clara, CA 95050
Phone: 408.988.5331
Fax: 408.988.5373
www.wattstopper.com

2.2 LIGHTING CONTROLS

A. LightSaver LS-101 Daylighting Controller:
http://www.wattstopper.com/products/details.html?id=180

B. EN Outdoor Motion Sensor
http://www.wattstopper.com/getdoc/1252/OutdoorBroch.pdf

C. BZ 100 Dual Voltage Power Pack
http://www.wattstopper.com/products/details.html?id=98

D. CX-100 Series Passive Infrared Ceiling/Wall Sensors
http://www.wattstopper.com/products/details.html?id=16

2.3 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
B. Metal Parts: Free of burrs and sharp corners and edges.
C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage. Coordinate first paragraph below with Drawings to identify humid spaces.
B. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage
C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
D. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.5 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Refer to Fixture Schedule for fixture requirements.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. Adjust aimable lighting fixtures to provide required light intensities.

## END OF SECTION 26 51 00

# SECTION 31 66 00 SPECIAL FOUNDATIONS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the following metal fabrications:

1. Prefabricated Adjustable Steel Piers

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

C. Samples representative of materials and finished products as may be requested by Architect.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firms experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Installer Qualifications: Arrange for installation of piers specified in this section by same firm that fabricated them.

C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of piers and site topography before laying out piers.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with installation of piers.

1.6 COORDINATION

A. Coordinate installation of piers. Furnish setting drawings, templates, and directions for installing piers. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

2.1 FOUNDATION PIERS

A. Manufacturer

1. Central Piers Inc.
284 North Thorne Ave.
Fresno Ca. 93706
800.653.0387
centralpiers@sbcglobal.net

B. Product Information

1. CP Anchor Pier
SPA 30-9F
http://www.centralpiers.com/30-9F%20CBC2007.pdf

## PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish piers, setting drawings, diagrams, templates, instructions, and directions for installation of piers. Coordinate delivery of such items to project site.

3.2 INSTALLATION, GENERAL

A. General: Install piers to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

A. Touch-Up Painting: Immediately after erection, clean and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.

## END OF SECTION 31 66 00

# SECTION 32 90 00 - PLANTING

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of landscape development work is shown on drawings and in schedules.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site
B. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
C. Do not remove container grown stock from containers. Plants will be set in planters in the pots.

1.4 JOB CONDITIONS

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
B. Utilities: Determine location and depth of underground utilities and perform work in a manner a will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned
C. Planting Time: Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

1.5 PLANT MATERIAL

A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 “American Standard for Nursery Stock.”

## PART 2 - PRODUCT

2.1 PREPARATION

A. Layout individual tree and shrub locations and areas for planting. Make final plant location decisions at this time prior to irrigation installation and mulching.

2.2 PLANTS

A. Refer to drawing A1.13 for detailed plant listing

## PART 3 - EXECUTION

3.1 PLANTING AND MULCHING

A. Mulch voids between plant containers and planter; place not less than 3” thick to conceal planting containers.

3.2 MAINTENANCE

A. Begin maintenance immediately after planting.
B. Maintain all trees, shrubs, and other plants by pruning, cultivating, fertilizing, mulching, and weeding as required for healthy grown.

3.3 CLEANUP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.
B. Protect landscape work and materials from damage due to landscape orientations, operations by other contractors and trades and trespassers. Maintain protection during installation and 2 periods. Treat, repair or replace damaged landscape work as directed.
C. Protect existing lawns from damage as required by covering, raking, watering, etc…

3.4 INSPECTION AND ACCEPTANCE

A. When landscape work is completed, the Landscape Architect will, upon request, make an inspection to determine acceptability.

## END OF SECTION 32 90 00

# SECTION 48 19 16 – ELECTRICAL POWER GENERATION INVERTORS

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Xantrex Inverters

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
B. Schedule: Use same designations indicated on Drawings.
C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
D. Maintenance Data: For each product to include in maintenance manuals.
E. Warranties: Manufacturers warranty applies
.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain items through one source from a single manufacturer.

Provide products from same manufacturer for each type of collector/invertor required.
To the greatest extent possible, provide collectors and invertors by a single manufacturer for entire Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.
B. Store materials in a clean, dry, ventilated, weather tight, secure location. Protect materials from soiling, abuse, loss, and moisture damage.

## PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Xantrex Technology Inc.
8999 Nelson Way
Burnaby, BC
Canada V5A 4B5
General Tel: 604.422.8595
General Fax: 604.420.1591

2.2 Xantrex Invertor

A. GT Series Grid Tie Solar Invertors

1. Single Phase Invertor
http://www.xantrex.com/web/id/172/p/2604/pt/25/product.asp

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Examine area to verify actual locations of connections before equipment installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

A. Test each item to verify proper operation. Make necessary adjustments.
B. Verify that accessories required have been furnished and installed.
C. Remove packing material from invertors and leave units in clean condition, ready for operation.

## END OF SECTION 48 19 16

# STRUCTURAL CALCULATIONS

**FOR**

# BEAUSOLEIL

# UNIVERSITY OF LOUISIANA
## AT LAFAYETTE

## LAFAYETTE, LOUISIANA

Engineering Calculations Provided by:
**E. R. Desormeaux, PE**
**Randall J. Hebert, PE**

Project: BeauSoliel
Location: LVL 1.75 x 11.875 Multi-Span Floor Beam - 10' between supports
Multi-Span Floor Beam
[2006 International Building Code(2005 NDS)]
1.75 IN x 11.875 IN x 30.0 FT (10 + 10 + 10)
2.0E-2900F - APA EWS LVL Stress Classes
Section Adequate By: 14.0%
Controlling Factor: Shear

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**DEFLECTIONS**

| | Left | | Center | | Right | |
|---|---|---|---|---|---|---|
| Live Load | 0.12 | IN L/1014 | 0.08 | IN L/1486 | 0.12 | IN L/1014 |
| Dead Load | 0.06 | in | 0.00 | in | 0.06 | in |
| Total Load | 0.18 | IN L/659 | 0.09 | IN L/1403 | 0.18 | IN L/659 |

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

**REACTIONS**

| | A | B | C | D |
|---|---|---|---|---|
| Live Load | 1519 lb | 4050 lb | 4050 lb | 1519 lb |
| Dead Load | 1050 lb | 2888 lb | 2888 lb | 1050 lb |
| Total Load | 2569 lb | 6938 lb | 6938 lb | 2569 lb |
| Bearing Length | 1.96 in | 5.29 in | 5.29 in | 1.96 in |

**BEAM DATA**

| | Left | Center | Right |
|---|---|---|---|
| Span Length | 10 ft | 10 ft | 10 ft |
| Unbraced Length-Top | 0 ft | 0 ft | 0 ft |
| Unbraced Length-Bottom | 0 ft | 0 ft | 0 ft |
| Floor Duration Factor | 0.90 | | |
| Notch Depth | 0.00 | | |

**MATERIAL PROPERTIES**

2.0E-2900F - APA EWS LVL Stress Classes

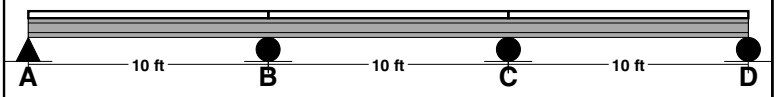
| | Base Values | Adjusted |
|---|---|---|
| Bending Stress: | Fb = 2900 psi | Fb' = 2613 psi |
| | *Cd=0.90 CF=1.00* | |
| Shear Stress: | Fv = 285 psi | Fv' = 257 psi |
| | *Cd=0.90* | |
| Modulus of Elasticity: | E = 2000 ksi | E' = 2000 ksi |
| Comp. ⊥ to Grain: | Fc - ⊥ = 750 psi | Fc - ⊥' = 750 psi |

**Controlling Moment:** -6563 ft-lb
Over right support of span 1 (Left Span)
Created by combining all dead loads and live loads on span(s) 1, 2

**Controlling Shear:** 3117 lb
At a distance d from left support of span 3 (Right Span)
Created by combining all dead loads and live loads on span(s) 2, 3

| **Comparisons with required sections:** | Req'd | Provided |
|---|---|---|
| Section Modulus: | 30.14 in3 | 41.13 in3 |
| Area (Shear): | 18.23 in2 | 20.78 in2 |
| Moment of Inertia (deflection): | 88.9 in4 | 244.21 in4 |
| Moment: | -6563 ft-lb | 8957 ft-lb |
| Shear: | 3117 lb | 3554 lb |

**LOADING DIAGRAM**




**FLOOR LOADING**

| | | Left | Center | Right |
|---|---|---|---|---|
| Floor Live Load | FLL = | 50 psf | 50 psf | 50 psf |
| Floor Dead Load | FDL = | 38 psf | 38 psf | 38 psf |
| Floor Tributary Width Side One | TW1 = | 0 ft | 0 ft | 0 ft |
| Floor Tributary Width Side Two | TW2 = | 6.8 ft | 6.8 ft | 6.8 ft |
| Wall Load | WALL = | 0 plf | 0 plf | 0 plf |

**BEAM LOADING**

| | Left | Center | Right |
|---|---|---|---|
| Reduced Floor Live Load | 50 psf | 50 psf | 50 psf |
| Total Live Load | 338 plf | 338 plf | 338 plf |
| Total Dead Load | 257 plf | 257 plf | 257 plf |
| Beam Self Weight | 6 plf | 6 plf | 6 plf |
| Total Load | 600 plf | 600 plf | 600 plf |

**NOTES**

Design Loads
30,000 lb weight - 18,000 per beam, 364 plf
supplied by BeauSoliel team
50 psf - LL

Total Load - 667 psf

Project: BeauSoliel
Location: LVL 1.75 x 11.875 Multi-Span Floor Beam - 10' between supports
Multi-Span Floor Beam
[2006 International Building Code(2005 NDS)]
1.75 IN x 11.875 IN x 30.0 FT (10 + 10 + 10)
2.0E-2900F - APA EWS LVL Stress Classes
Section Adequate By: 14.0%
Controlling Factor: Shear

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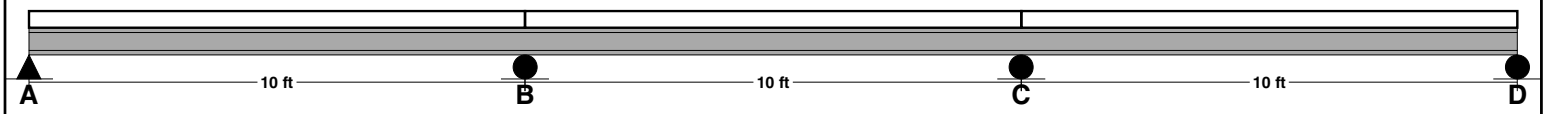
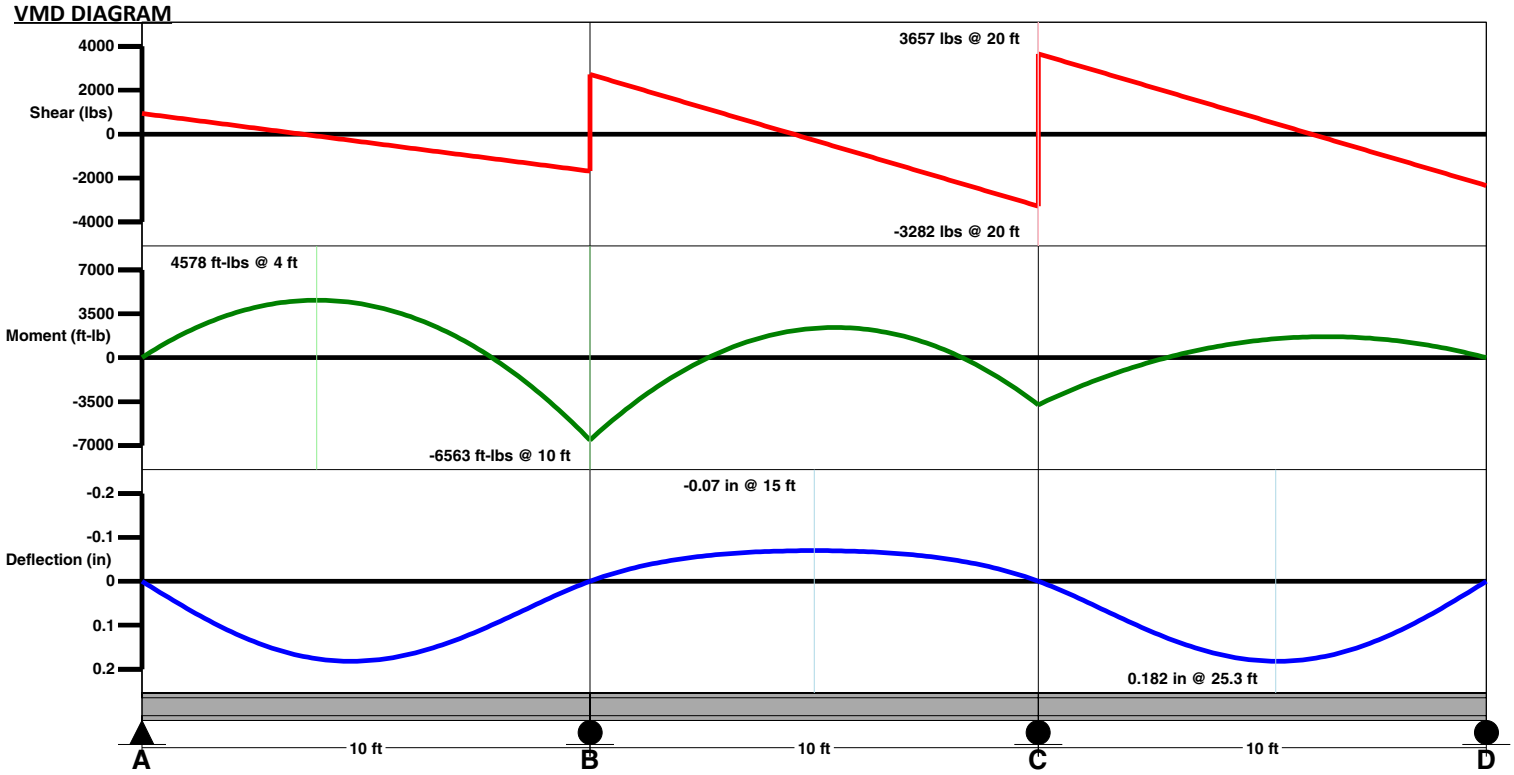
## LOADING DIAGRAM




## VMD DIAGRAM



Project: BeauSoliel
Location: LVL 1.75 x 11.875 Single Span Floor Beam - 10' between support
Uniformly Loaded Floor Beam
[2006 International Building Code(2005 NDS)]
1.75 IN x 11.875 IN x 10.0 FT
2.0E-2900F - APA EWS LVL Stress Classes
Section Adequate By: 35.7%
Controlling Factor: Moment

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**DEFLECTIONS**

| | Center | |
|---|---|---|
| Live Load | 0.15 | IN L/789 |
| Dead Load | 0.12 | in |
| Total Load | 0.27 | IN L/444 |

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

**REACTIONS**

| | A | | B | |
|---|---|---|---|---|
| Live Load | 1650 | lb | 1650 | lb |
| Dead Load | 1284 | lb | 1284 | lb |
| Total Load | 2934 | lb | 2934 | lb |
| Bearing Length | 2.24 | in | 2.24 | in |

**BEAM DATA**

| | Center | |
|---|---|---|
| Span Length | 10 | ft |
| Unbraced Length-Top | 0 | ft |
| Floor Duration Factor | 1.00 | |
| Notch Depth | 0.00 | |

**MATERIAL PROPERTIES**

2.0E-2900F - APA EWS LVL Stress Classes

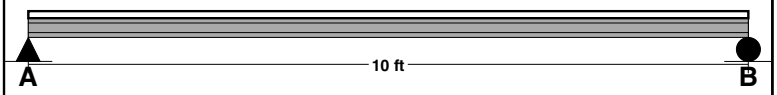
| | Base Values | | Adjusted | |
|---|---|---|---|---|
| Bending Stress: | Fb = 2900 | psi | Fb' = 2904 | psi |
| | *Cd=1.00 CF=1.00* | | | |
| Shear Stress: | Fv = 285 | psi | Fv' = 285 | psi |
| | *Cd=1.00* | | | |
| Modulus of Elasticity: | E = 2000 | ksi | E' = 2000 | ksi |
| Comp. ⊥ to Grain: | Fc - ⊥ = 750 | psi | Fc - ⊥' = 750 | psi |

**Controlling Moment:** 7336 ft-lb
5.0 ft from left support
Created by combining all dead and live loads.

**Controlling Shear:** 2406 lb
At a distance d from support.
Created by combining all dead and live loads.

| **Comparisons with required sections:** | Req'd | | Provided | |
|---|---|---|---|---|
| Section Modulus: | 30.32 | in3 | 41.13 | in3 |
| Area (Shear): | 12.66 | in2 | 20.78 | in2 |
| Moment of Inertia (deflection): | 132.02 | in4 | 244.21 | in4 |
| Moment: | 7336 | ft-lb | 9953 | ft-lb |
| Shear: | 2406 | lb | 3948 | lb |

**LOADING DIAGRAM**




**FLOOR LOADING**

| | | Side 1 | | Side 2 | |
|---|---|---|---|---|---|
| Floor Live Load | FLL = | 50 | psf | 0 | psf |
| Floor Dead Load | FDL = | 38 | psf | 0 | psf |
| Floor Tributary Width | FTW = | 6.6 | ft | 0 | ft |
| Wall Load | WALL = | 0 | plf | | |

**BEAM LOADING**

| | | | |
|---|---|---|---|
| Beam Total Live Load: | wL = | 330 | plf |
| Beam Total Dead Load: | wD = | 251 | plf |
| Beam Self Weight: | BSW = | 6 | plf |
| Total Maximum Load: | wT = | 587 | plf |

**NOTES**

Project: BeauSoliel
Location: LVL 1.75 x 11.875 Single Span Floor Beam - 10' between support
Uniformly Loaded Floor Beam
[2006 International Building Code(2005 NDS)]
1.75 IN x 11.875 IN x 10.0 FT
2.0E-2900F - APA EWS LVL Stress Classes
Section Adequate By: 35.7%
Controlling Factor: Moment

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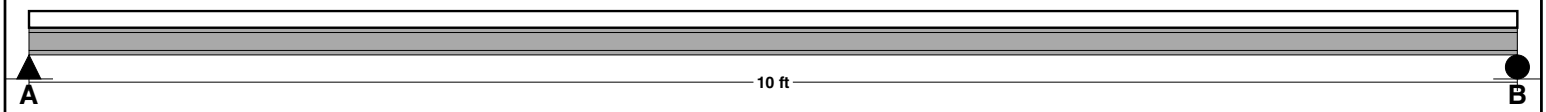
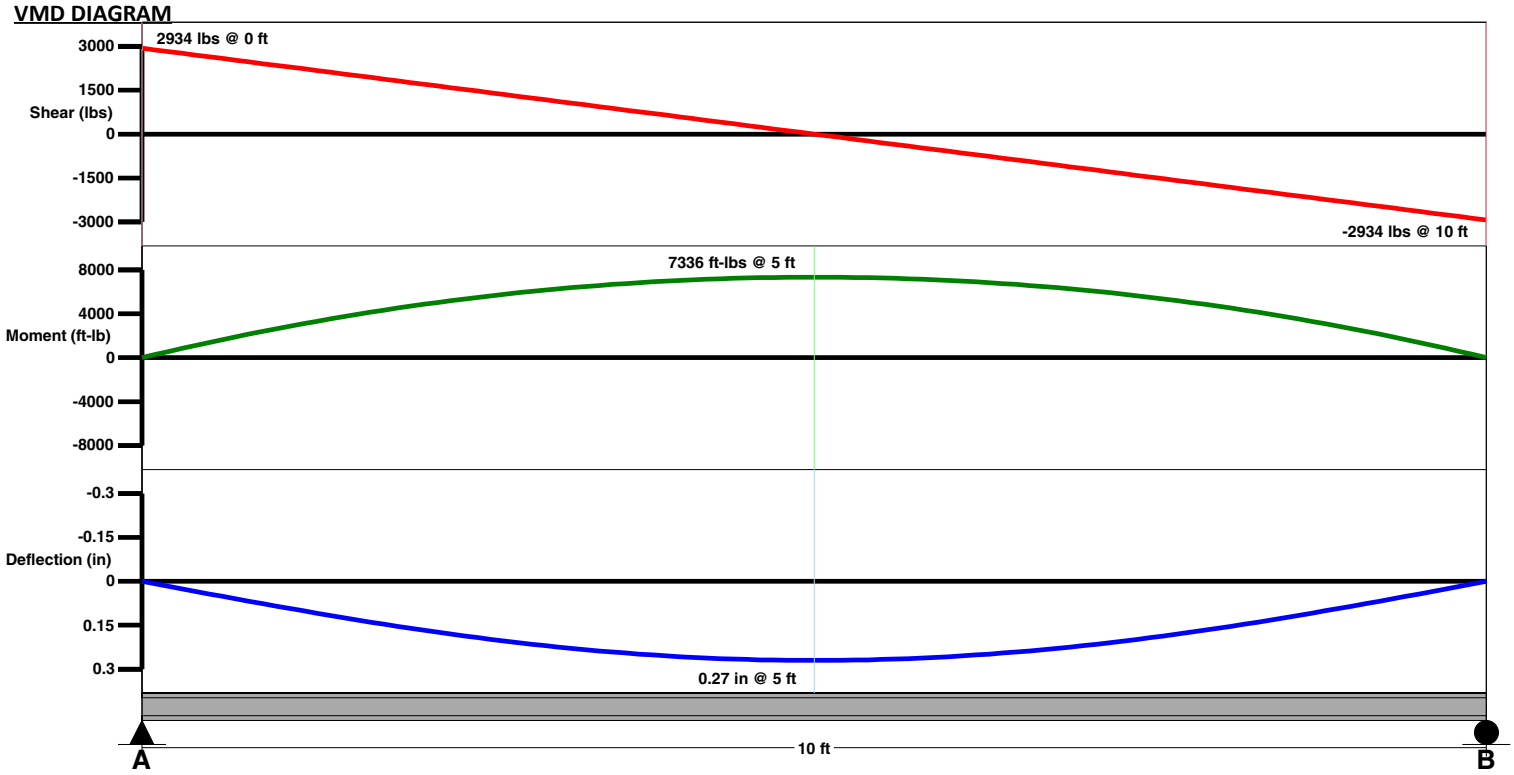
**LOADING DIAGRAM**




**VMD DIAGRAM**



Project: BeauSoliel
Location: Floor Joist 2 x12 at 12 o.c.
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 11.25 IN x 13.19 FT @ 12 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 39.0%
Controlling Factor: Moment

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**DEFLECTIONS**

| | Center | |
|---|---|---|
| Live Load | 0.08 | IN L/2065 |
| Dead Load | 0.06 | in |
| Total Load | 0.13 | IN L/1174 |

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/360

**REACTIONS**

| | A | | B | |
|---|---|---|---|---|
| Live Load | 330 | lb | 330 | lb |
| Dead Load | 251 | lb | 251 | lb |
| Total Load | 580 | lb | 580 | lb |
| Bearing Length | 0.68 | in | 0.68 | in |

**BEAM DATA**

| | Center | |
|---|---|---|
| Span Length | 13.19 | ft |
| Unbraced Length-Top | 0 | ft |
| Unbraced Length-Bottom | 0 | ft |

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 0.90

**MATERIAL PROPERTIES**

#2 - Southern Pine

| | Base Values | | Adjusted | |
|---|---|---|---|---|
| Bending Stress: | Fb = 975 | psi | Fb' = 1009 | psi |
| | *Cd=0.90 CF=1.00 Cr=1.15* | | | |
| Shear Stress: | Fv = 175 | psi | Fv' = 158 | psi |
| | *Cd=0.90* | | | |
| Modulus of Elasticity: | E = 1600 | ksi | E' = 1600 | ksi |
| Min. Mod. of Elasticity: | E_min = 580 | ksi | E_min' = 580 | ksi |
| Comp. ⊥ to Grain: | Fc - ⊥ = 565 | psi | Fc - ⊥' = 565 | psi |

**Controlling Moment:** 1914 ft-lb
6.59 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
**Controlling Shear:** -499 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

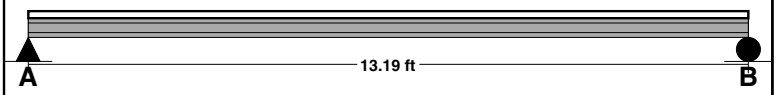
| **Comparisons with required sections:** | Req'd | | Provided | |
|---|---|---|---|---|
| Section Modulus: | 22.76 | in3 | 31.64 | in3 |
| Area (Shear): | 4.75 | in2 | 16.88 | in2 |
| Moment of Inertia (deflection): | 85.18 | in4 | 277.67 | in4 |
| Moment: | 1914 | ft-lb | 2661 | ft-lb |
| Shear: | -499 | lb | 1772 | lb |

**Decking Information**

Plywood Thickness: T = 1 1/8 in
Plywood Is Glued:
Moment of Inertia Calculations For Glued Floor:

| | | | |
|---|---|---|---|
| Joist Area: | A-joist = | 16.88 | IN2 |
| Plywood Area: | A-ply = | 3.08 | IN2 |
| Section Centroid: | C = | 7 | IN ABOVE BASE |
| Moment of Inertia (deflection): | I-comb = | 278 | IN4 |

**LOADING DIAGRAM**




**JOIST LOADING**

| **Uniform Floor Loading** | | Center | |
|---|---|---|---|
| Live Load | LL = | 50 | psf |
| Dead Load | DL = | 38 | psf |
| Total Load | TL = | 88 | psf |
| TL Adj. For Joist Spacing | wT = | 88 | plf |

**NOTES**

Span is calculated between LVL Beams, inside dimensions

Project: BeauSoliel
Location: Floor Joist 2 x12 at 12 o.c.
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 11.25 IN x 13.19 FT @ 12 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 39.0%
Controlling Factor: Moment

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**LOADING DIAGRAM**

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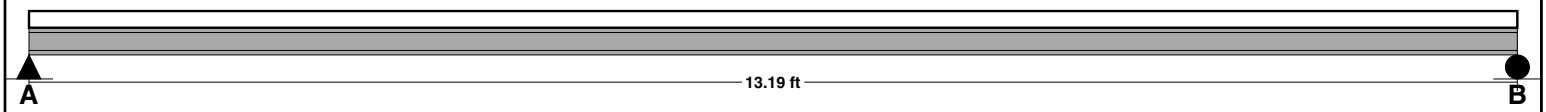
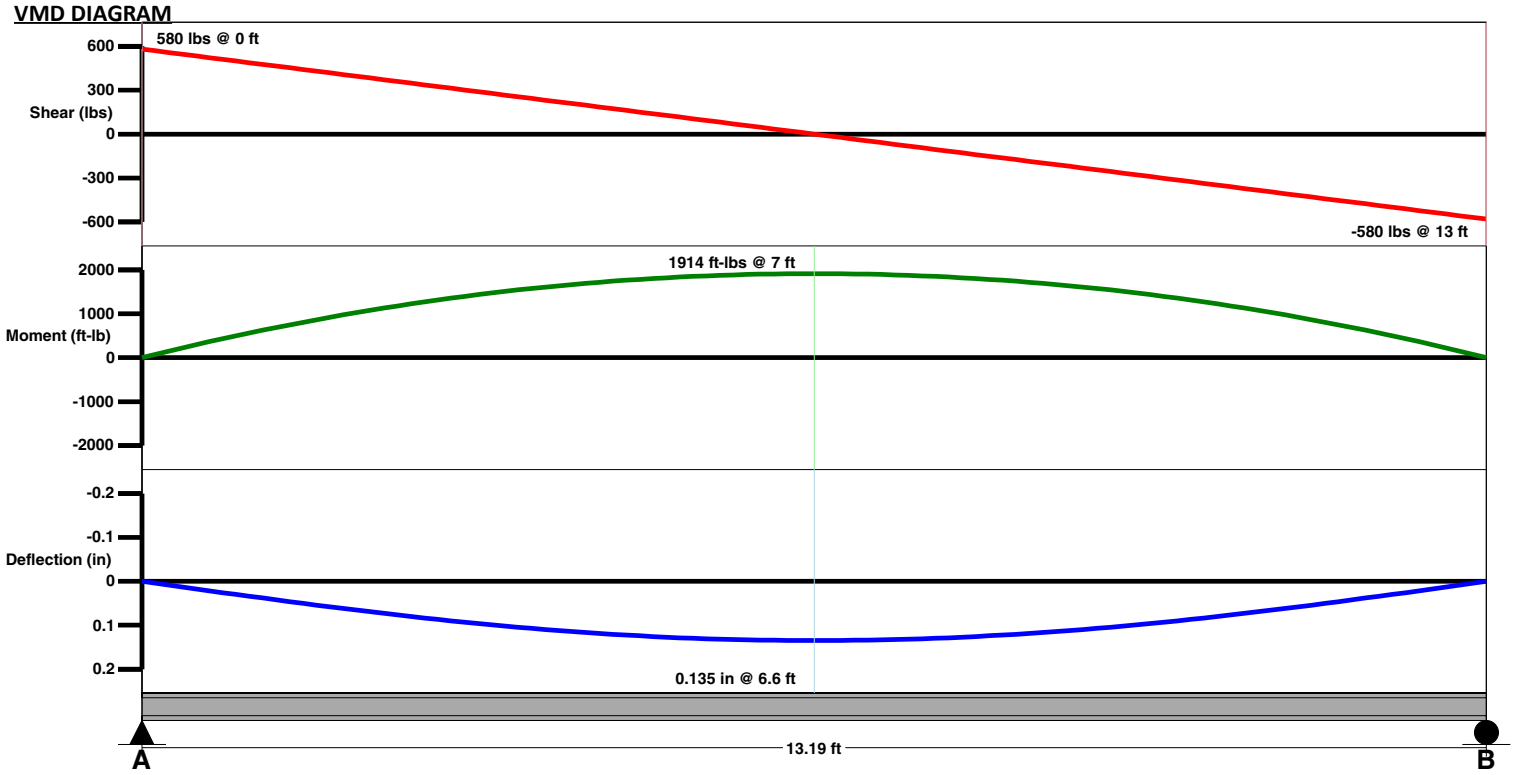



**VMD DIAGRAM**



Project: BeauSoliel
Location: Deck Framing 2 x 6 (short spans - longest span calculations)
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 5.5 IN x 6.333 FT @ 16 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 9.2%
Controlling Factor: Deflection

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**DEFLECTIONS** Center

| | | |
|---|---|---|
| Live Load | 0.15 | IN L/524 |
| Dead Load | 0.01 | in |
| Total Load | 0.16 | IN L/476 |

Live Load Deflection Criteria: L/480 Total Load Deflection Criteria: L/360

**REACTIONS**

| | A | | B | |
|---|---|---|---|---|
| Live Load | 422 | lb | 422 | lb |
| Dead Load | 42 | lb | 42 | lb |
| Total Load | 464 | lb | 464 | lb |
| Bearing Length | 0.55 | in | 0.55 | in |

**BEAM DATA** Center

| | | |
|---|---|---|
| Span Length | 6.33 | ft |
| Unbraced Length-Top | 0 | ft |
| Unbraced Length-Bottom | 0 | ft |

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 0.90

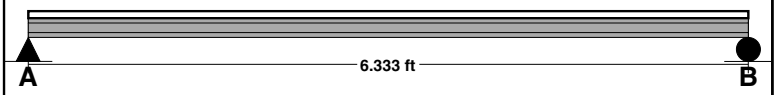
**MATERIAL PROPERTIES**
#2 - Southern Pine

| | Base Values | | | Adjusted | | |
|---|---|---|---|---|---|---|
| Bending Stress: | Fb = | 975 | psi | Fb' = | 1294 | psi |
| | *Cd=0.90 CF=1.28 Cr=1.15* | | | | | |
| Shear Stress: | Fv = | 175 | psi | Fv' = | 158 | psi |
| | *Cd=0.90* | | | | | |
| Modulus of Elasticity: | E = | 1600 | ksi | E' = | 1600 | ksi |
| Min. Mod. of Elasticity: | E_min = | 580 | ksi | E_min' = | 580 | ksi |
| Comp. ⊥ to Grain: | Fc - ⊥ = | 565 | psi | Fc - ⊥' = | 565 | psi |

**Controlling Moment:** 735 ft-lb
3.17 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
**Controlling Shear:** 399 lb
At a distance d from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

| **Comparisons with required sections:** | Req'd | | Provided | |
|---|---|---|---|---|
| Section Modulus: | 6.82 | in3 | 7.56 | in3 |
| Area (Shear): | 3.8 | in2 | 8.25 | in2 |
| Moment of Inertia (deflection): | 19.05 | in4 | 20.8 | in4 |
| Moment: | 735 | ft-lb | 815 | ft-lb |
| Shear: | 399 | lb | 866 | lb |

**LOADING DIAGRAM**




**JOIST LOADING**

| **Uniform Floor Loading** | | Center | |
|---|---|---|---|
| Live Load | LL = | 100 | psf |
| Dead Load | DL = | 10 | psf |
| Total Load | TL = | 110 | psf |
| TL Adj. For Joist Spacing | wT = | 146.7 | plf |

**NOTES**

Joists for the exterior decking has several different lengths. The joist with the longest span was evalulted, since all joists sizes are the same.

Project: BeauSoliel
Location: Deck Framing 2 x 6 (short spans - longest span calculations)
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 5.5 IN x 6.333 FT @ 16 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 9.2%
Controlling Factor: Deflection

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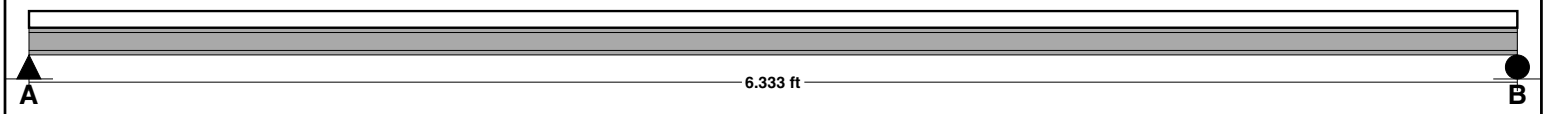
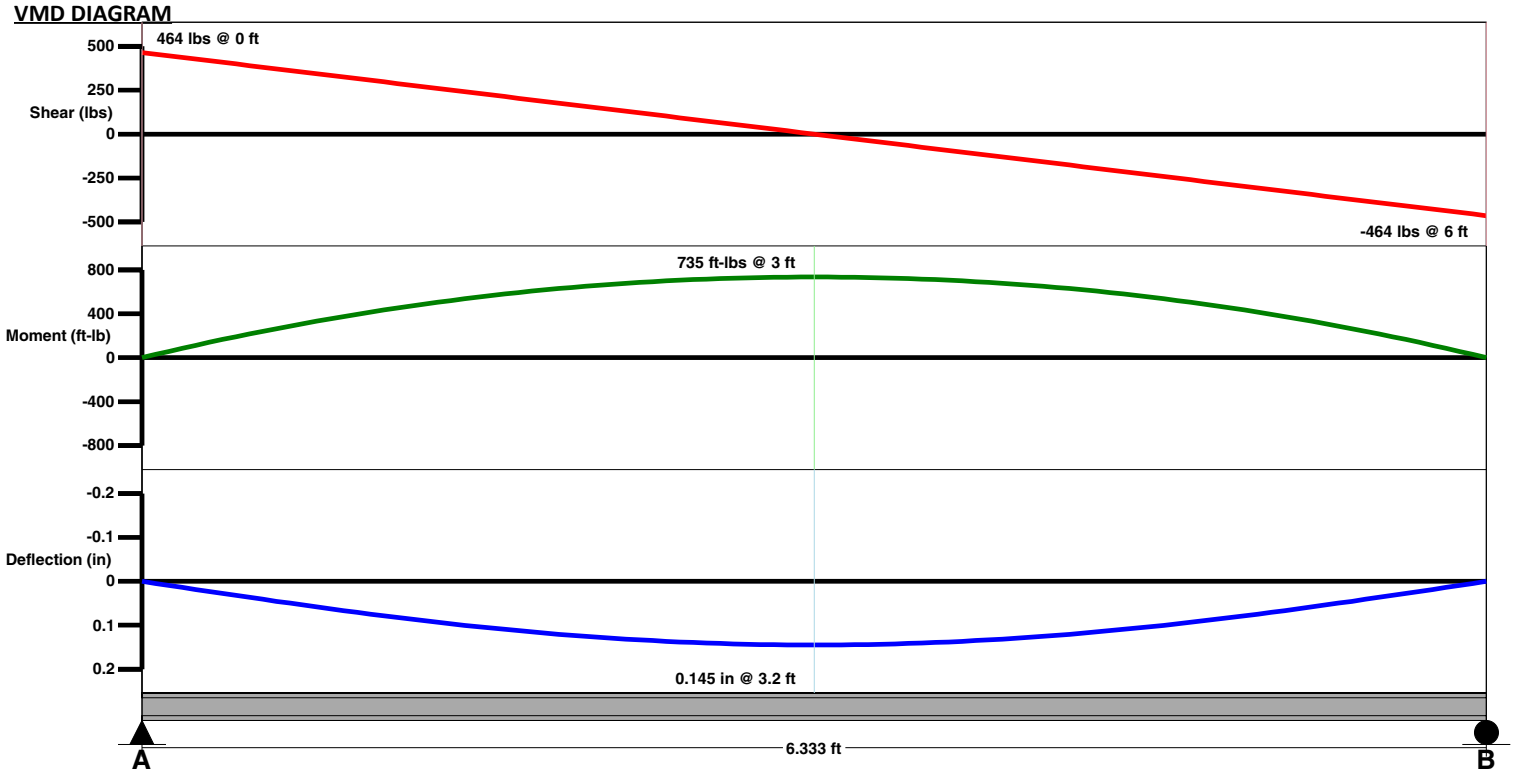
**LOADING DIAGRAM**




**VMD DIAGRAM**



Project: BeauSoliel
Location: Floor Joist 2 x 12 at 12 o.c.
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 11.25 IN x 13.19 FT @ 12 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 39.0%
Controlling Factor: Moment

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**DEFLECTIONS** Center

| | | |
|---|---|---|
| Live Load | 0.08 | IN L/2065 |
| Dead Load | 0.06 | in |
| Total Load | 0.13 | IN L/1174 |

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/360

**REACTIONS**

| | A | | B | |
|---|---|---|---|---|
| Live Load | 330 | lb | 330 | lb |
| Dead Load | 251 | lb | 251 | lb |
| Total Load | 580 | lb | 580 | lb |
| Bearing Length | 0.68 | in | 0.68 | in |

**BEAM DATA** Center

| | | |
|---|---|---|
| Span Length | 13.19 | ft |
| Unbraced Length-Top | 0 | ft |
| Unbraced Length-Bottom | 0 | ft |

Floor sheathing applied to top of joists-top of joists fully braced.
Floor Duration Factor 0.90

**MATERIAL PROPERTIES**
#2 - Southern Pine

| | Base Values | | Adjusted | |
|---|---|---|---|---|
| Bending Stress: | Fb = 975 | psi | Fb' = 1009 | psi |
| | *Cd=0.90 CF=1.00 Cr=1.15* | | | |
| Shear Stress: | Fv = 175 | psi | Fv' = 158 | psi |
| | *Cd=0.90* | | | |
| Modulus of Elasticity: | E = 1600 | ksi | E' = 1600 | ksi |
| Min. Mod. of Elasticity: | E_min = 580 | ksi | E_min' = 580 | ksi |
| Comp. ⊥ to Grain: | Fc - ⊥ = 565 | psi | Fc - ⊥' = 565 | psi |

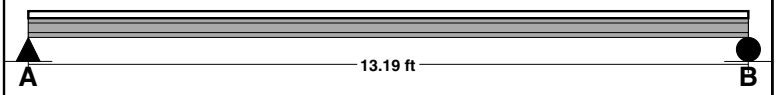
**Controlling Moment:** 1914 ft-lb
6.59 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
**Controlling Shear:** -499 lb
At a distance d from right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

| **Comparisons with required sections:** | Req'd | | Provided | |
|---|---|---|---|---|
| Section Modulus: | 22.76 | in3 | 31.64 | in3 |
| Area (Shear): | 4.75 | in2 | 16.88 | in2 |
| Moment of Inertia (deflection): | 85.18 | in4 | 277.67 | in4 |
| Moment: | 1914 | ft-lb | 2661 | ft-lb |
| Shear: | -499 | lb | 1772 | lb |

**Decking Information**
Plywood Thickness: T = 1 1/8 in
Plywood Is Glued:
Moment of Inertia Calculations For Glued Floor:

| | | | |
|---|---|---|---|
| Joist Area: | A-joist = | 16.88 | IN2 |
| Plywood Area: | A-ply = | 3.08 | IN2 |
| Section Centroid: | C = | 7 | IN ABOVE BASE |
| Moment of Inertia (deflection): | I-comb = | 278 | IN4 |

**LOADING DIAGRAM**




**JOIST LOADING**

| **Uniform Floor Loading** | | Center | |
|---|---|---|---|
| Live Load | LL = | 50 | psf |
| Dead Load | DL = | 38 | psf |
| Total Load | TL = | 88 | psf |
| TL Adj. For Joist Spacing | wT = | 88 | plf |

**NOTES**
Span is calculated between LVL Beams, inside dimensions

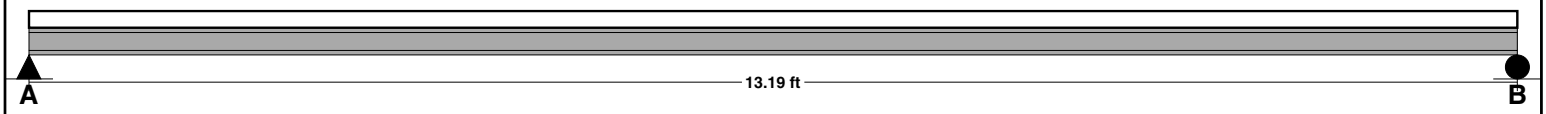
Project: BeauSoliel
Location: Floor Joist 2 x 12 at 12 o.c.
Floor Joist
[2006 International Building Code(2005 NDS)]
1.5 IN x 11.25 IN x 13.19 FT @ 12 O.C.
#2 - Southern Pine - Dry Use
Section Adequate By: 39.0%
Controlling Factor: Moment

E.R. DesOrmeaux
E.R. DesOrmeaux, Inc.
1454 Surrey St.
Lafayette, LA 70501

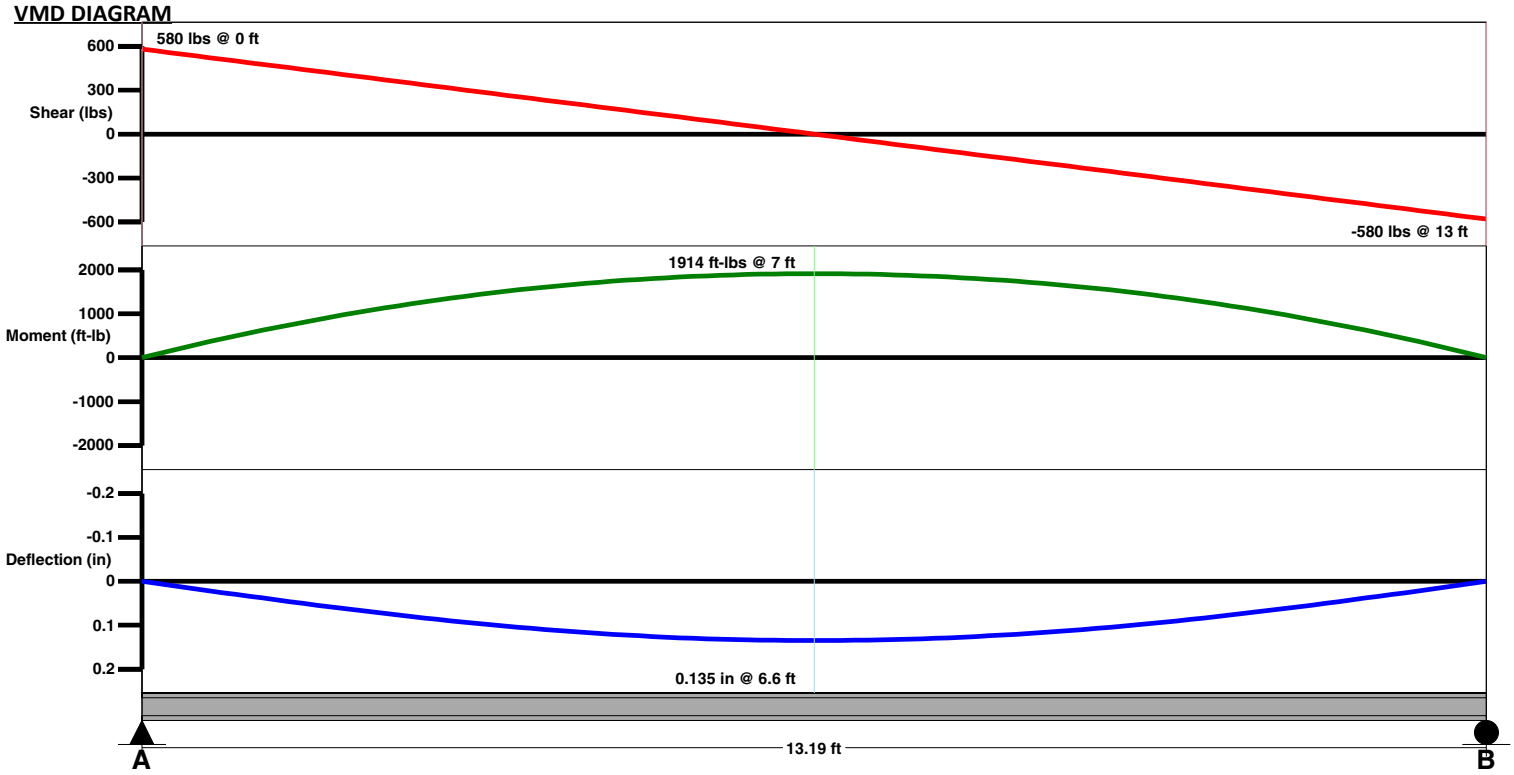


**LOADING DIAGRAM**

StruCalc Version 8.0.97.0 12/14/2008 4:00:52 PM




**VMD DIAGRAM**



Project: BeauSoliel
Location: Footing 1
Footing
[2006 International Building Code(2005 NDS)]
Footing Size: 2.5 FT x 2.5 FT x 12.00 IN
Reinforcement: #5 Bars @ 7.00 IN. O.C. E/W / (4) min.
Section Footing Design Adequate

E.R. DesOrmeaux
E.R. DesOrmeaux, Inc.
1454 Surrey St.
Lafayette, LA 70501



**FOOTING PROPERTIES**

| | | | |
|---|---|---|---|
| Allowable Soil Bearing Pressure: | Qs = | 1500 | psf |
| Concrete Compressive Strength: | F'c = | 3500 | psi |
| Reinforcing Steel Yield Strength: | Fy = | 40000 | psi |
| Concrete Reinforcement Cover: | c = | 3 | in |

**FOOTING SIZE**

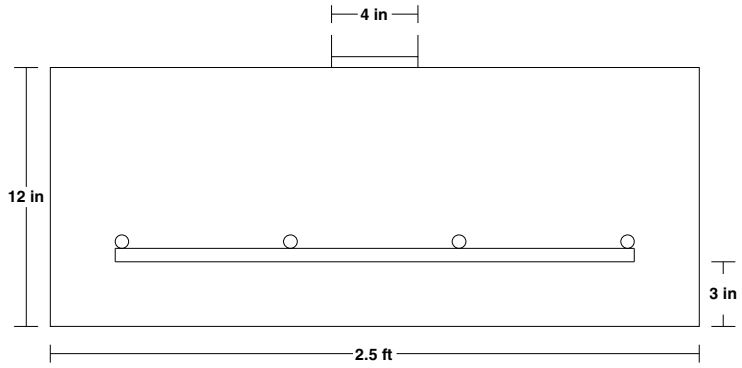
| | | | |
|---|---|---|---|
| Width: | W = | 2.5 | ft |
| Length: | L = | 2.5 | ft |
| Depth: | Depth = | 12 | in |
| Effective Depth to Top Layer of Steel: | d = | 8.06 | in |

**COLUMN AND BASEPLATE SIZE**

| | | | |
|---|---|---|---|
| Column Type: | Steel | | |
| Column Width: | m = | 4 | in |
| Column Depth: | n = | 4 | in |
| Baseplate Width: | bsw = | 4 | in |
| Baseplate Length: | bsl = | 4 | in |

**LOADING DIAGRAM**

StruCalc Version 8.0.97.0 12/14/2008 4:00:52 PM




**FOOTING LOADING**

| | | | |
|---|---|---|---|
| Live Load: | PL = | 4669 | lb |
| Dead Load: | PD = | 2535 | lb |
| Total Load: | PT = | 7204 | lb |
| Ultimate Factored Load: | Pu = | 10512 | lb |

**FOOTING CALCULATIONS**

**Bearing Calculations:**

| | | | |
|---|---|---|---|
| Ultimate Bearing Pressure: | Qu = | 1153 | psf |
| Effective Allowable Soil Bearing Pressure: | Qe = | 1350 | psf |
| Required Footing Area: | Areq = | 5.34 | sf |
| Area Provided: | A = | 6.25 | sf |

**Baseplate Bearing:**

| | | | |
|---|---|---|---|
| Bearing Required: | Bear = | 10512 | lb |
| Allowable Bearing: | Bear-A = | 61880 | lb |

**Beam Shear Calculations (One Way Shear):**

| | | | |
|---|---|---|---|
| Beam Shear: | Vu1 = | 1730 | lb |
| Allowable Beam Shear: | Vc1 = | 21464 | lb |

**Punching Shear Calculations (Two Way Shear):**

| | | | |
|---|---|---|---|
| Critical Perimeter: | Bo = | 48.25 | in |
| Punching Shear: | Vu2 = | 8813 | lb |
| Allowable Punching Shear (ACI 11-35): | vc2-a = | 103565 | lb |
| Allowable Punching Shear (ACI 11-36): | vc2-b = | 149892 | lb |
| Allowable Punching Shear (ACI 11-37): | vc2-c = | 69043 | lb |
| Controlling Allowable Punching Shear: | vc2 = | 69043 | lb |

**Bending Calculations:**

| | | | |
|---|---|---|---|
| Factored Moment: | Mu = | 29610 | in-lb |
| Nominal Moment Strength: | Mn = | 343873 | in-lb |

**Reinforcement Calculations:**

| | | | |
|---|---|---|---|
| Concrete Compressive Block Depth: | a = | 0.55 | in |
| Steel Required Based on Moment: | As(1) = | 0.10 | in2 |
| Min. Code Req'd Reinf. (Shrink./Temp. (ACI-10.5.4): | As(2) = | 1.21 | in2 |
| Controlling Reinforcing Steel: | As-reqd = | 1.21 | in2 |
| Selected Reinforcement: | #5's @ 7.0 in. o.c. e/w (4) Min. | | |
| Reinforcement Area Provided: | As = | 1.23 | in2 |

**Development Length Calculations:**

| | | | |
|---|---|---|---|
| Development Length Required: | Ld = | 15 | in |
| Development Length Supplied: | Ld-sup = | 10 | in |

Note: Plain concrete adequate for bending, therefore adequate development length not required.

**NOTES**

**Randall J. Hebert & Associates, Inc.**
105 Fanny St. — Lafayette, LA 70508-4115 Voice 337-261-1976 Fax 337-261-1977

Project: BENSOLEIL
Client: UL - ERD
Engineer: R.H.
Date: 12.10.08 Sheet: ____ Of: ____

Remarks:

MOMENT DIVERTION AT BLDG EAVE

M = 0.85 [illegible] = 42.96 in lb

WALL = 6" ROOF = 8"

$T_W = \frac{42.96}{6} = 716$ # @ WALL SHEATHING

$T_R = \frac{42.96}{8} = 537$ # @ ROOF SHEATHING

CHECK 1/4" Φ LAG SCREW $F_u = 10$ ksi

SCREW CAPACITY $= A_b \times F_u = \frac{(0.25)^2 \pi}{4} \times 10$

$= 0.49$ K $= 490$ #

SCREW CAPACITY IN WOOD IS 65 # EA REF 5-26

ROOF $\frac{537}{65} = 8.5$ USE 9 SCREWS

WALL $\frac{716}{65} = 11.4$ USE 12 SCREWS

THESE VALUES ARE FOR 1 FOOT

**Randall J. Hebert & Associates, Inc.**
105 Fanny St. — Lafayette, LA 70508-4115 Voice 337-261-1976 Fax 337-261-1977

Project: [illegible]
Client: DC - [illegible]
Engineer: RH
Date: 12.10.0X Sheet: ____ Of: ____

Remarks:

BEARING AT [illegible] = 1.2F[illegible] × 0.105 × 0.25 =

$F_b$ = 1.2(58)(0.105)(0.25) = 1.87k 1870# > 65

USE [illegible] TOP & BOTTOM OF [illegible]

PEAK CONVECTION

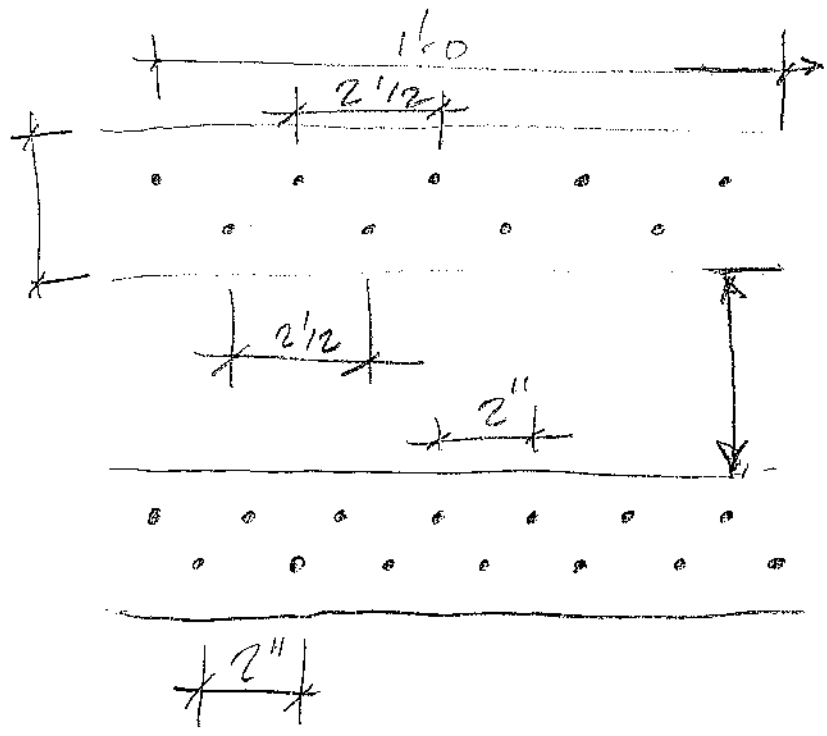
M = 0.235 × 12000 = 2820

$TR_{PEAK}$ = $\frac{2820}{8}$ = 353 #

[illegible] 353#/ft = 5.6 USE 6 PER FOOT

SUMMARY

ROOF @ EAVE
TOP & BOTTOM




WALL @ EAVE
TOP & BOTTOM

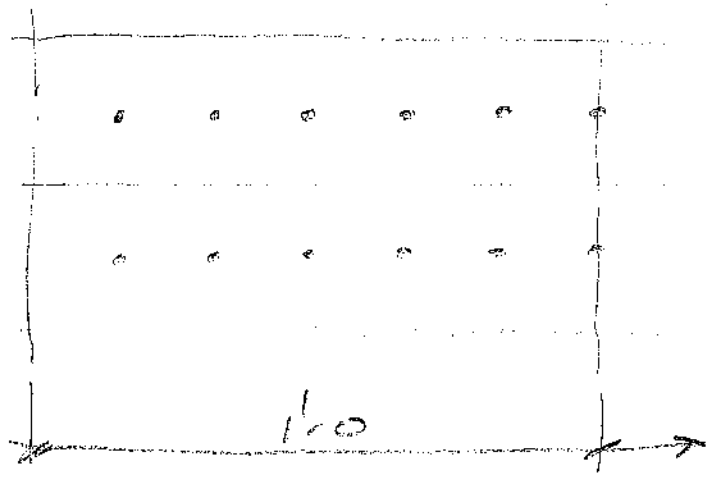
Randall J. Hebert & Associates, Inc.
105 Fanny St. — Lafayette, LA 70508-4115
Voice 337-261-1976 Fax 337-261-1977

Project: BLEAU SOLEIL
Client: UL - ERD
Engineer: RH
Date: 12.10.08 Sheet: Of:

Remarks:

ROOF @ PEAK

TOP & BOTTOM



Randall J. Hebert & Associates, Inc.
105 Fanny St. — Lafayette, LA 70508-4115 Voice 337-261-1976 Fax 337-261-1977

Project: BENSOLEIL
Client: H.L. - EDTD
Engineer: RH
Date: 12.10.06 Sheet: Of:

Remarks:

POST BASE

M = 600 FT # 7200 IN LB

SLEEVE DIMS

BOLT SPACING 2.5 IN

BOLT DIA 0.44 IN

$A_b = 0.152 \text{ in}^2$

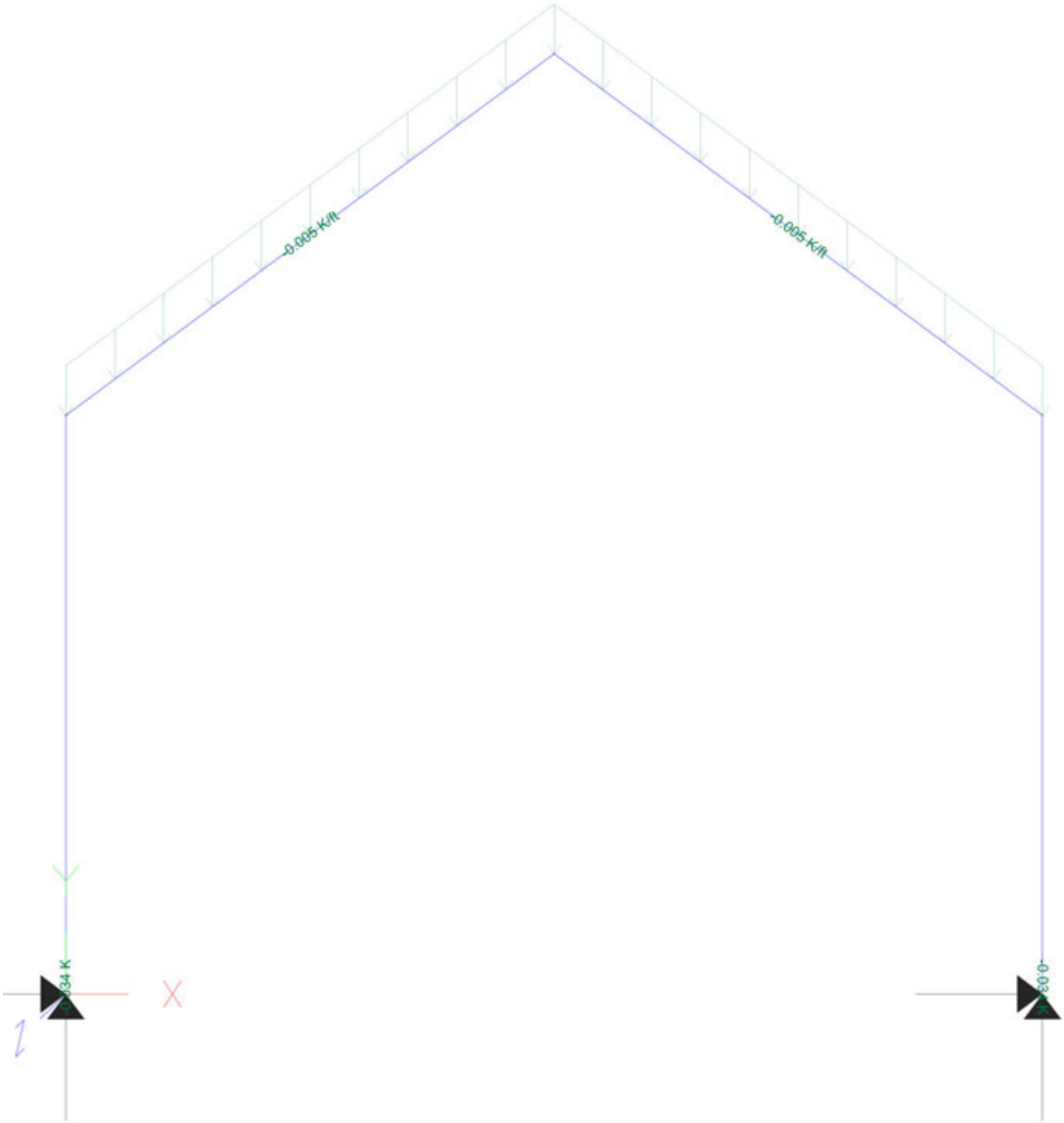
BOLT TENSION = $F_t \times A_b$ = 20 ksi × 0.152

= 3.04 k = 3040 #

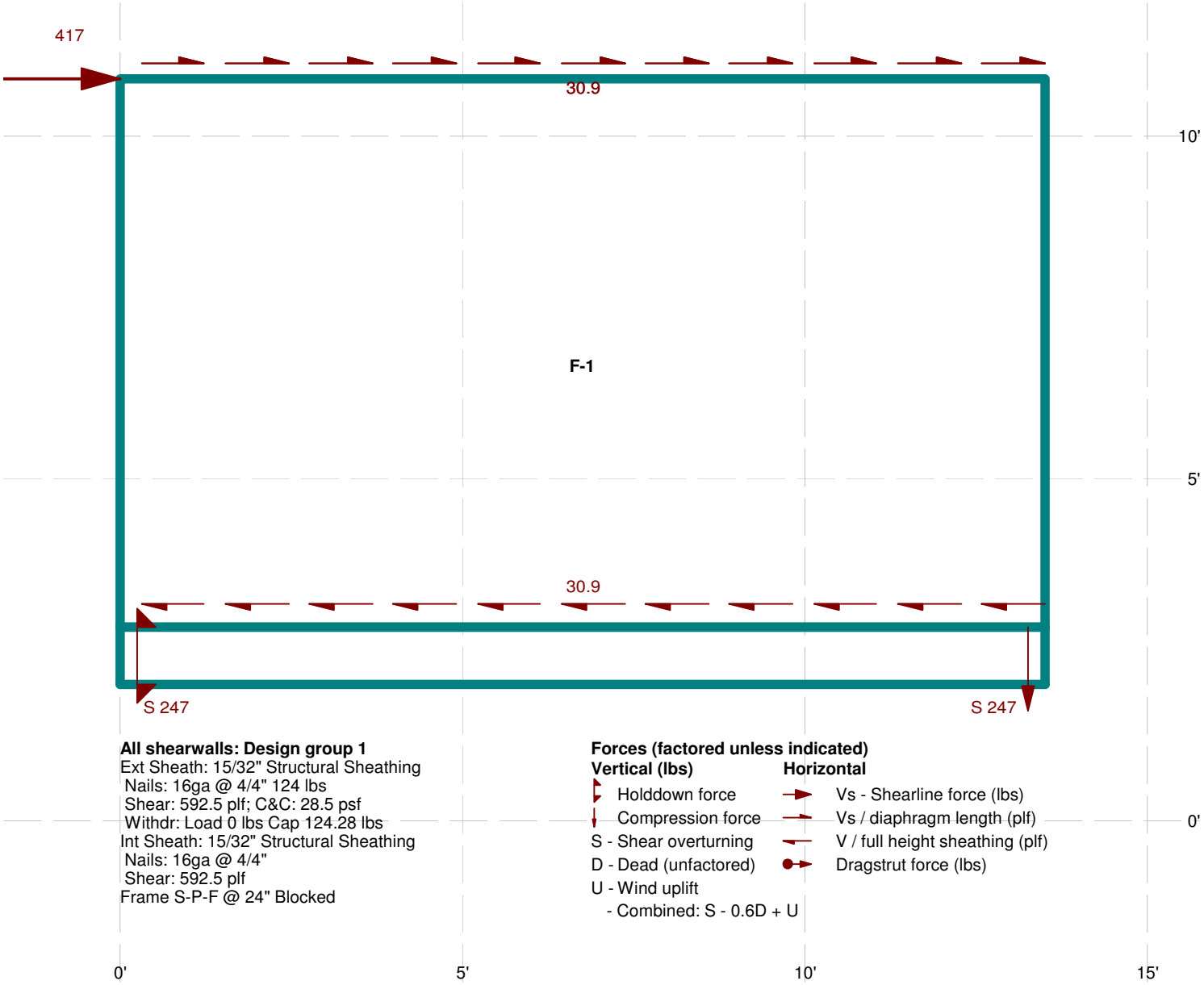
$T = \frac{7200}{2.5}$ = 2880 FOR 2 BOLTS

1440 PER BOLT < 3040 ok

BeauSoleil Project: frame.vap
Randall J. Hebert & Assoc. Inc., Randall J. Hebert
E R Desormeaux P.E.
Dec 11, 2008; 01:58 PM
Load Case: D
IES VisualAnalysis 6.00.0109



**Elevation View**
**Shearline F, at Y = 49.5 ft, Level 1.**
**Flexible Diaphragm Wind Design.**




**All shearwalls: Design group 1**
Ext Sheath: 15/32" Structural Sheathing
Nails: 16ga @ 4/4" 124 lbs
Shear: 592.5 plf; C&C: 28.5 psf
Withdr: Load 0 lbs Cap 124.28 lbs
Int Sheath: 15/32" Structural Sheathing
Nails: 16ga @ 4/4"
Shear: 592.5 plf
Frame S-P-F @ 24" Blocked

**Forces (factored unless indicated)**

**Vertical (lbs)**
- Holddown force
- Compression force
- S - Shear overturning
- D - Dead (unfactored)
- U - Wind uplift
- Combined: S - 0.6D + U

**Horizontal**
- Vs - Shearline force (lbs)
- Vs / diaphragm length (plf)
- V / full height sheathing (plf)
- Dragstrut force (lbs)

# BeauSoleil Project

VisualAnalysis 6.00 Report
Company: Randall J. Hebert & Assoc. Inc. Engineer: Randall J. Hebert - E R Desormeaux P.E.
Project File: frame.vap
Folder: M:\EngE-K\ERD\BeauSoleil\

# Project Notes

Analysys is based upon a one (1) foot width and is analyzed as a rigid frame, low rise building
This analysis is specified as a 60mph 3-sec gust definition with Exposure Category C IRC 2006

# Load Combination Summary

Equation Combination: 16-10Lr
Combination: D + Lr + H*0 + F*0
Contributing Cases & Source
D (D)
Lr (Lr)
Equation Combination: 16-10R
Combination: D + R*0 + H*0 + F*0
Contributing Cases & Source
D (D)
Equation Combination: 16-11Lr
Combination: D + 0.75L*0 + 0.75Lpa*0 + 0.75Lr + H*0 + F*0 + 0.75T*0
Contributing Cases & Source
D (D)
Lr (Lr)
Equation Combination: 16-12W »+X
Combination: D + H*0 + F*0 + 1.50Fa*0 + W+X
Contributing Cases & Source
D (D)
W+X (W+X)
Equation Combination: 16-13W+Lr »+X
Combination: D + 0.75L*0 + 0.75Lpa*0 + 0.75Lr + H*0 + F*0 + 1.50Fa*0 + 0.75W+X
Contributing Cases & Source
D (D)
Lr (Lr)
W+X (W+X)
Equation Combination: 16-13W+R »+X
Combination: D + 0.75L*0 + 0.75Lpa*0 + 0.75R*0 + H*0 + F*0 + 1.50Fa*0 + 0.75W+X
Contributing Cases & Source
D (D)
W+X (W+X)
Equation Combination: 16-14 »+X
Combination: 0.60D + H*0 + 1.50Fa*0 + W+X
Contributing Cases & Source
D (D)
W+X (W+X)
Equation Combination: 16-14 »+X+Y
Combination: 0.60D + H*0 + 1.50Fa*0 + W+X+Y*0
Contributing Cases & Source
D (D)
Equation Combination: D+L
Combination: D + L*0 + Lpa*0
Contributing Cases & Source
D (D)
Equation Combination: Live
Combination: L*0 + Lpa*0 + Lr
Contributing Cases & Source
Lr (Lr)
Equation Combination: Wind
Combination: D*0 + L*0 + Lpa*0 + Lr*0 + R*0 + S*0 + H*0 + F*0 + Fa*0 + T*0 + W+X + W-X*0 + W+Y*0 + W-Y*0 + W+Z*0 + W-Z*0 + W+X+Y*0 + W+X-Y*0 + W-X+Y*0 + W-X-Y*0 + W+Y+Z*0 + W+Y-Z*0 + W-Y+Z*0 + W-Y-Z*0 + W+Z+X*0 + W+Z-X*0 + W-Z+X*0 + W-Z-X*0 + E+X*0 + E-X*0 + E+Y*0 + E-Y*0 + E+Z*0 + E-Z*0 + Other*0
Contributing Cases & Source
W+X (W+X)

# Nodes

| Node | X ft | Y ft | Fix DX | Fix DY | Fix RZ |
|---|---|---|---|---|---|
| N001 | 0.00 | 0.00 | Yes | Yes | No |
| N002 | 0.00 | 9.25 | No | No | No |
| N003 | 6.75 | 13.00 | No | No | No |
| N004 | 13.50 | 9.25 | No | No | No |
| N005 | 13.50 | 0.00 | Yes | Yes | No |

# Material Properties

| Material | Strength Ksi | Elasticity Ksi | Poisson | Density K/in^3 | Therm. Coeff. in/in/deg-F |
|---|---|---|---|---|---|
| Spruce-P | -NA- | 1100.00 | 0.362 | 0.00 | 2.00e-006 |

# Member Elements

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Rz1 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|
| COL001 | sips | Spruce-Pi | N001 | N002 | 9.250 | 0.030 | Fix | Fix | Normal |
| COL002 | sips | Spruce-Pi | N004 | N005 | 9.250 | 0.030 | Fix | Fix | Normal |
| V001 | sips | Spruce-Pi | N002 | N003 | 7.722 | 0.025 | Fix | Fix | Normal |
| V002 | sips | Spruce-Pi | N003 | N004 | 7.722 | 0.025 | Fix | Fix | Normal |

# Section Properties

| Section | Theta deg | Ax in^2 | Iz in^4 | Sz(+y) in^3 | Sz(-y) in^3 |
|---|---|---|---|---|---|
| sips | 0.000 | 12.312 | 91.643 | 30.549 | 30.549 |

# Member Uniform Loads

| Load Case | Member | Direction | Offset ft | End Offset ft | Force K/ft | Moment ft-K/ft |
|---|---|---|---|---|---|---|
| D | V001 | DY | 0.00 | 7.72 | -0.01 | -NA- |
| D | V002 | DY | 0.00 | 7.72 | -0.01 | -NA- |
| Lr | V001 | DY | 0.00 | 7.72 | -0.02 | -NA- |
| Lr | V002 | DY | 0.00 | 7.72 | -0.02 | -NA- |
| W+X | COL001 | DX | 0.00 | 9.25 | 0.00 | -NA- |
| W+X | COL002 | DX | 0.00 | 9.25 | 0.00 | -NA- |
| W+X | V001 | dy | 0.00 | 7.72 | 0.01 | -NA- |
| W+X | V002 | dy | 0.00 | 7.72 | 0.00 | -NA- |

# Member Local Displacements

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-10Lr | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.028 | -0.000 | 0.014 | > 2000 |
| COL001 | 16-10Lr | 2.056 | -0.000 | 0.028 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-10Lr | 3.083 | -0.001 | 0.040 | > 2000 |
| COL001 | 16-10Lr | 4.111 | -0.001 | 0.050 | > 2000 |
| COL001 | 16-10Lr | 5.139 | -0.001 | 0.057 | 1932.662 |
| COL001 | 16-10Lr | 6.167 | -0.001 | 0.062 | 1801.854 |
| COL001 | 16-10Lr | 7.194 | -0.002 | 0.062 | 1796.638 |
| COL001 | 16-10Lr | 8.222 | -0.002 | 0.057 | 1936.995 |
| COL001 | 16-10Lr | 9.250 | -0.002 | 0.048 | > 2000 |
| COL001 | 16-10R | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10R | 1.028 | -0.000 | 0.004 | > 2000 |
| COL001 | 16-10R | 2.056 | -0.000 | 0.008 | > 2000 |
| COL001 | 16-10R | 3.083 | -0.000 | 0.012 | > 2000 |
| COL001 | 16-10R | 4.111 | -0.000 | 0.015 | > 2000 |
| COL001 | 16-10R | 5.139 | -0.000 | 0.017 | > 2000 |
| COL001 | 16-10R | 6.167 | -0.000 | 0.018 | > 2000 |
| COL001 | 16-10R | 7.194 | -0.001 | 0.018 | > 2000 |
| COL001 | 16-10R | 8.222 | -0.001 | 0.017 | > 2000 |
| COL001 | 16-10R | 9.250 | -0.001 | 0.014 | > 2000 |
| COL001 | 16-11Lr | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-11Lr | 1.028 | -0.000 | 0.012 | > 2000 |
| COL001 | 16-11Lr | 2.056 | -0.000 | 0.023 | > 2000 |
| COL001 | 16-11Lr | 3.083 | -0.001 | 0.033 | > 2000 |
| COL001 | 16-11Lr | 4.111 | -0.001 | 0.041 | > 2000 |
| COL001 | 16-11Lr | 5.139 | -0.001 | 0.047 | > 2000 |
| COL001 | 16-11Lr | 6.167 | -0.001 | 0.051 | > 2000 |
| COL001 | 16-11Lr | 7.194 | -0.001 | 0.051 | > 2000 |
| COL001 | 16-11Lr | 8.222 | -0.001 | 0.047 | > 2000 |
| COL001 | 16-11Lr | 9.250 | -0.002 | 0.039 | > 2000 |
| COL001 | 16-12W »+X | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-12W »+X | 1.028 | -0.000 | -0.014 | < -2000 |
| COL001 | 16-12W »+X | 2.056 | -0.000 | -0.027 | < -2000 |
| COL001 | 16-12W »+X | 3.083 | -0.000 | -0.040 | < -2000 |
| COL001 | 16-12W »+X | 4.111 | -0.000 | -0.052 | < -2000 |
| COL001 | 16-12W »+X | 5.139 | -0.000 | -0.064 | -1740.452 |
| COL001 | 16-12W »+X | 6.167 | -0.000 | -0.074 | -1494.006 |
| COL001 | 16-12W »+X | 7.194 | -0.000 | -0.084 | -1323.996 |
| COL001 | 16-12W »+X | 8.222 | -0.000 | -0.092 | -1201.552 |
| COL001 | 16-12W »+X | 9.250 | -0.000 | -0.100 | -1110.527 |
| COL001 | 16-13W+Lr »+X | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-13W+Lr »+X | 1.028 | -0.000 | -0.002 | < -2000 |
| COL001 | 16-13W+Lr »+X | 2.056 | -0.000 | -0.004 | < -2000 |
| COL001 | 16-13W+Lr »+X | 3.083 | -0.000 | -0.006 | < -2000 |
| COL001 | 16-13W+Lr »+X | 4.111 | -0.001 | -0.009 | < -2000 |
| COL001 | 16-13W+Lr »+X | 5.139 | -0.001 | -0.013 | < -2000 |
| COL001 | 16-13W+Lr »+X | 6.167 | -0.001 | -0.019 | < -2000 |
| COL001 | 16-13W+Lr »+X | 7.194 | -0.001 | -0.026 | < -2000 |
| COL001 | 16-13W+Lr »+X | 8.222 | -0.001 | -0.035 | < -2000 |
| COL001 | 16-13W+Lr »+X | 9.250 | -0.001 | -0.046 | < -2000 |
| COL001 | 16-13W+R »+X | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-13W+R »+X | 1.028 | -0.000 | -0.009 | < -2000 |
| COL001 | 16-13W+R »+X | 2.056 | -0.000 | -0.018 | < -2000 |
| COL001 | 16-13W+R »+X | 3.083 | -0.000 | -0.027 | < -2000 |
| COL001 | 16-13W+R »+X | 4.111 | -0.000 | -0.036 | < -2000 |
| COL001 | 16-13W+R »+X | 5.139 | -0.000 | -0.044 | < -2000 |
| COL001 | 16-13W+R »+X | 6.167 | -0.000 | -0.051 | < -2000 |
| COL001 | 16-13W+R »+X | 7.194 | -0.000 | -0.058 | -1901.643 |
| COL001 | 16-13W+R »+X | 8.222 | -0.000 | -0.065 | -1704.925 |
| COL001 | 16-13W+R »+X | 9.250 | -0.000 | -0.072 | -1552.441 |
| COL001 | 16-14 »+X | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-14 »+X | 1.028 | -0.000 | -0.015 | < -2000 |
| COL001 | 16-14 »+X | 2.056 | -0.000 | -0.030 | < -2000 |
| COL001 | 16-14 »+X | 3.083 | -0.000 | -0.045 | < -2000 |
| COL001 | 16-14 »+X | 4.111 | -0.000 | -0.058 | -1908.363 |
| COL001 | 16-14 »+X | 5.139 | -0.000 | -0.070 | -1574.874 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-14 »+X | 6.167 | 0.000 | -0.081 | -1362.156 |
| COL001 | 16-14 »+X | 7.194 | 0.000 | -0.091 | -1219.127 |
| COL001 | 16-14 »+X | 8.222 | 0.000 | -0.099 | -1120.438 |
| COL001 | 16-14 »+X | 9.250 | 0.000 | -0.105 | -1052.182 |
| COL001 | 16-14 »+X+Y | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X+Y | 1.028 | -0.000 | 0.002 | > 2000 |
| COL001 | 16-14 »+X+Y | 2.056 | -0.000 | 0.005 | > 2000 |
| COL001 | 16-14 »+X+Y | 3.083 | -0.000 | 0.007 | > 2000 |
| COL001 | 16-14 »+X+Y | 4.111 | -0.000 | 0.009 | > 2000 |
| COL001 | 16-14 »+X+Y | 5.139 | -0.000 | 0.010 | > 2000 |
| COL001 | 16-14 »+X+Y | 6.167 | -0.000 | 0.011 | > 2000 |
| COL001 | 16-14 »+X+Y | 7.194 | -0.000 | 0.011 | > 2000 |
| COL001 | 16-14 »+X+Y | 8.222 | -0.000 | 0.010 | > 2000 |
| COL001 | 16-14 »+X+Y | 9.250 | -0.000 | 0.008 | > 2000 |
| COL001 | D | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.028 | -0.000 | 0.004 | > 2000 |
| COL001 | D | 2.056 | -0.000 | 0.008 | > 2000 |
| COL001 | D | 3.083 | -0.000 | 0.012 | > 2000 |
| COL001 | D | 4.111 | -0.000 | 0.015 | > 2000 |
| COL001 | D | 5.139 | -0.000 | 0.017 | > 2000 |
| COL001 | D | 6.167 | -0.000 | 0.018 | > 2000 |
| COL001 | D | 7.194 | -0.001 | 0.018 | > 2000 |
| COL001 | D | 8.222 | -0.001 | 0.017 | > 2000 |
| COL001 | D | 9.250 | -0.001 | 0.014 | > 2000 |
| COL001 | D+L | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | D+L | 1.028 | -0.000 | 0.004 | > 2000 |
| COL001 | D+L | 2.056 | -0.000 | 0.008 | > 2000 |
| COL001 | D+L | 3.083 | -0.000 | 0.012 | > 2000 |
| COL001 | D+L | 4.111 | -0.000 | 0.015 | > 2000 |
| COL001 | D+L | 5.139 | -0.000 | 0.017 | > 2000 |
| COL001 | D+L | 6.167 | -0.000 | 0.018 | > 2000 |
| COL001 | D+L | 7.194 | -0.001 | 0.018 | > 2000 |
| COL001 | D+L | 8.222 | -0.001 | 0.017 | > 2000 |
| COL001 | D+L | 9.250 | -0.001 | 0.014 | > 2000 |
| COL001 | Live | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | Live | 1.028 | -0.000 | 0.010 | > 2000 |
| COL001 | Live | 2.056 | -0.000 | 0.020 | > 2000 |
| COL001 | Live | 3.083 | -0.000 | 0.028 | > 2000 |
| COL001 | Live | 4.111 | -0.001 | 0.035 | > 2000 |
| COL001 | Live | 5.139 | -0.001 | 0.041 | > 2000 |
| COL001 | Live | 6.167 | -0.001 | 0.044 | > 2000 |
| COL001 | Live | 7.194 | -0.001 | 0.044 | > 2000 |
| COL001 | Live | 8.222 | -0.001 | 0.041 | > 2000 |
| COL001 | Live | 9.250 | -0.001 | 0.034 | > 2000 |
| COL001 | Wind | 0.000 | 0.000 | -0.000 | -NA- |
| COL001 | Wind | 1.028 | 0.000 | -0.018 | < -2000 |
| COL001 | Wind | 2.056 | 0.000 | -0.035 | < -2000 |
| COL001 | Wind | 3.083 | 0.000 | -0.052 | < -2000 |
| COL001 | Wind | 4.111 | 0.000 | -0.067 | -1659.035 |
| COL001 | Wind | 5.139 | 0.000 | -0.081 | -1378.288 |
| COL001 | Wind | 6.167 | 0.000 | -0.092 | -1203.01 |
| COL001 | Wind | 7.194 | 0.000 | -0.102 | -1089.698 |
| COL001 | Wind | 8.222 | 0.000 | -0.109 | -1017.504 |
| COL001 | Wind | 9.250 | 0.000 | **-0.114** | -975.320 |
| COL002 | 16-10Lr | 0.000 | 0.002 | 0.048 | > 2000 |
| COL002 | 16-10Lr | 1.028 | 0.002 | 0.057 | 1935.446 |
| COL002 | 16-10Lr | 2.056 | 0.002 | 0.062 | 1795.472 |
| COL002 | 16-10Lr | 3.083 | 0.001 | 0.062 | 1800.848 |
| COL002 | 16-10Lr | 4.111 | 0.001 | 0.057 | 1931.698 |
| COL002 | 16-10Lr | 5.139 | 0.001 | 0.050 | > 2000 |
| COL002 | 16-10Lr | 6.167 | 0.001 | 0.040 | > 2000 |
| COL002 | 16-10Lr | 7.194 | 0.000 | 0.028 | > 2000 |
| COL002 | 16-10Lr | 8.222 | 0.000 | 0.014 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL002 | 16-10Lr | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-10R | 0.000 | 0.001 | 0.014 | > 2000 |
| COL002 | 16-10R | 1.028 | 0.001 | 0.017 | > 2000 |
| COL002 | 16-10R | 2.056 | 0.001 | 0.018 | > 2000 |
| COL002 | 16-10R | 3.083 | 0.000 | 0.018 | > 2000 |
| COL002 | 16-10R | 4.111 | 0.000 | 0.017 | > 2000 |
| COL002 | 16-10R | 5.139 | 0.000 | 0.015 | > 2000 |
| COL002 | 16-10R | 6.167 | 0.000 | 0.012 | > 2000 |
| COL002 | 16-10R | 7.194 | 0.000 | 0.008 | > 2000 |
| COL002 | 16-10R | 8.222 | 0.000 | 0.004 | > 2000 |
| COL002 | 16-10R | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-11Lr | 0.000 | 0.002 | 0.039 | > 2000 |
| COL002 | 16-11Lr | 1.028 | 0.001 | 0.047 | > 2000 |
| COL002 | 16-11Lr | 2.056 | 0.001 | 0.051 | > 2000 |
| COL002 | 16-11Lr | 3.083 | 0.001 | 0.051 | > 2000 |
| COL002 | 16-11Lr | 4.111 | 0.001 | 0.047 | > 2000 |
| COL002 | 16-11Lr | 5.139 | 0.001 | 0.041 | > 2000 |
| COL002 | 16-11Lr | 6.167 | 0.001 | 0.033 | > 2000 |
| COL002 | 16-11Lr | 7.194 | 0.000 | 0.023 | > 2000 |
| COL002 | 16-11Lr | 8.222 | 0.000 | 0.012 | > 2000 |
| COL002 | 16-11Lr | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-12W »+X | 0.000 | 0.001 | 0.120 | 927.640 |
| COL002 | 16-12W »+X | 1.028 | 0.001 | 0.116 | 956.321 |
| COL002 | 16-12W »+X | 2.056 | 0.000 | 0.110 | 1013.173 |
| COL002 | 16-12W »+X | 3.083 | 0.000 | 0.100 | 1107.585 |
| COL002 | 16-12W »+X | 4.111 | 0.000 | 0.088 | 1258.095 |
| COL002 | 16-12W »+X | 5.139 | 0.000 | 0.074 | 1503.260 |
| COL002 | 16-12W »+X | 6.167 | 0.000 | 0.057 | 1934.505 |
| COL002 | 16-12W »+X | 7.194 | 0.000 | 0.039 | > 2000 |
| COL002 | 16-12W »+X | 8.222 | 0.000 | 0.020 | > 2000 |
| COL002 | 16-12W »+X | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-13W+Lr »+X | 0.000 | 0.002 | 0.118 | 937.029 |
| COL002 | 16-13W+Lr »+X | 1.028 | 0.001 | **0.122** | 912.207 |
| COL002 | 16-13W+Lr »+X | 2.056 | 0.001 | 0.119 | 928.873 |
| COL002 | 16-13W+Lr »+X | 3.083 | 0.001 | 0.112 | 987.675 |
| COL002 | 16-13W+Lr »+X | 4.111 | 0.001 | 0.101 | 1100.401 |
| COL002 | 16-13W+Lr »+X | 5.139 | 0.001 | 0.086 | 1297.475 |
| COL002 | 16-13W+Lr »+X | 6.167 | 0.001 | 0.067 | 1655.023 |
| COL002 | 16-13W+Lr »+X | 7.194 | 0.000 | 0.046 | > 2000 |
| COL002 | 16-13W+Lr »+X | 8.222 | 0.000 | 0.024 | > 2000 |
| COL002 | 16-13W+Lr »+X | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-13W+R »+X | 0.000 | 0.001 | 0.093 | 1190.721 |
| COL002 | 16-13W+R »+X | 1.028 | 0.001 | 0.091 | 1216.522 |
| COL002 | 16-13W+R »+X | 2.056 | 0.000 | 0.087 | 1280.500 |
| COL002 | 16-13W+R »+X | 3.083 | 0.000 | 0.080 | 1393.302 |
| COL002 | 16-13W+R »+X | 4.111 | 0.000 | 0.070 | 1577.389 |
| COL002 | 16-13W+R »+X | 5.139 | 0.000 | 0.059 | 1880.419 |
| COL002 | 16-13W+R »+X | 6.167 | 0.000 | 0.046 | > 2000 |
| COL002 | 16-13W+R »+X | 7.194 | 0.000 | 0.031 | > 2000 |
| COL002 | 16-13W+R »+X | 8.222 | 0.000 | 0.016 | > 2000 |
| COL002 | 16-13W+R »+X | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-14 »+X | 0.000 | 0.000 | 0.114 | 972.871 |
| COL002 | 16-14 »+X | 1.028 | 0.000 | 0.109 | 1014.963 |
| COL002 | 16-14 »+X | 2.056 | 0.000 | 0.102 | 1084.735 |
| COL002 | 16-14 »+X | 3.083 | 0.000 | 0.093 | 1193.385 |
| COL002 | 16-14 »+X | 4.111 | 0.000 | 0.082 | 1361.765 |
| COL002 | 16-14 »+X | 5.139 | 0.000 | 0.068 | 1632.356 |
| COL002 | 16-14 »+X | 6.167 | 0.000 | 0.053 | > 2000 |
| COL002 | 16-14 »+X | 7.194 | 0.000 | 0.036 | > 2000 |
| COL002 | 16-14 »+X | 8.222 | 0.000 | 0.018 | > 2000 |
| COL002 | 16-14 »+X | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | 16-14 »+X+Y | 0.000 | 0.000 | 0.008 | > 2000 |
| COL002 | 16-14 »+X+Y | 1.028 | 0.000 | 0.010 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL002 | 16-14 »+X+Y | 2.056 | 0.000 | 0.011 | > 2000 |
| COL002 | 16-14 »+X+Y | 3.083 | 0.000 | 0.011 | > 2000 |
| COL002 | 16-14 »+X+Y | 4.111 | 0.000 | 0.010 | > 2000 |
| COL002 | 16-14 »+X+Y | 5.139 | 0.000 | 0.009 | > 2000 |
| COL002 | 16-14 »+X+Y | 6.167 | 0.000 | 0.007 | > 2000 |
| COL002 | 16-14 »+X+Y | 7.194 | 0.000 | 0.005 | > 2000 |
| COL002 | 16-14 »+X+Y | 8.222 | 0.000 | 0.002 | > 2000 |
| COL002 | 16-14 »+X+Y | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | D | 0.000 | 0.001 | 0.014 | > 2000 |
| COL002 | D | 1.028 | 0.001 | 0.017 | > 2000 |
| COL002 | D | 2.056 | 0.001 | 0.018 | > 2000 |
| COL002 | D | 3.083 | 0.000 | 0.018 | > 2000 |
| COL002 | D | 4.111 | 0.000 | 0.017 | > 2000 |
| COL002 | D | 5.139 | 0.000 | 0.015 | > 2000 |
| COL002 | D | 6.167 | 0.000 | 0.012 | > 2000 |
| COL002 | D | 7.194 | 0.000 | 0.008 | > 2000 |
| COL002 | D | 8.222 | 0.000 | 0.004 | > 2000 |
| COL002 | D | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | D+L | 0.000 | 0.001 | 0.014 | > 2000 |
| COL002 | D+L | 1.028 | 0.001 | 0.017 | > 2000 |
| COL002 | D+L | 2.056 | 0.001 | 0.018 | > 2000 |
| COL002 | D+L | 3.083 | 0.000 | 0.018 | > 2000 |
| COL002 | D+L | 4.111 | 0.000 | 0.017 | > 2000 |
| COL002 | D+L | 5.139 | 0.000 | 0.015 | > 2000 |
| COL002 | D+L | 6.167 | 0.000 | 0.012 | > 2000 |
| COL002 | D+L | 7.194 | 0.000 | 0.008 | > 2000 |
| COL002 | D+L | 8.222 | 0.000 | 0.004 | > 2000 |
| COL002 | D+L | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | Live | 0.000 | 0.001 | 0.034 | > 2000 |
| COL002 | Live | 1.028 | 0.001 | 0.041 | > 2000 |
| COL002 | Live | 2.056 | 0.001 | 0.044 | > 2000 |
| COL002 | Live | 3.083 | 0.001 | 0.044 | > 2000 |
| COL002 | Live | 4.111 | 0.001 | 0.041 | > 2000 |
| COL002 | Live | 5.139 | 0.001 | 0.035 | > 2000 |
| COL002 | Live | 6.167 | 0.000 | 0.028 | > 2000 |
| COL002 | Live | 7.194 | 0.000 | 0.020 | > 2000 |
| COL002 | Live | 8.222 | 0.000 | 0.010 | > 2000 |
| COL002 | Live | 9.250 | 0.000 | 0.000 | -NA- |
| COL002 | Wind | 0.000 | -0.000 | 0.106 | 1049.640 |
| COL002 | Wind | 1.028 | -0.000 | 0.099 | 1117.836 |
| COL002 | Wind | 2.056 | -0.000 | 0.091 | 1213.306 |
| COL002 | Wind | 3.083 | -0.000 | 0.082 | 1350.369 |
| COL002 | Wind | 4.111 | -0.000 | 0.071 | 1553.907 |
| COL002 | Wind | 5.139 | -0.000 | 0.059 | 1873.831 |
| COL002 | Wind | 6.167 | -0.000 | 0.046 | > 2000 |
| COL002 | Wind | 7.194 | -0.000 | 0.031 | > 2000 |
| COL002 | Wind | 8.222 | -0.000 | 0.016 | > 2000 |
| COL002 | Wind | 9.250 | -0.000 | 0.000 | -NA- |
| V001 | 16-10Lr | 0.000 | -0.042 | 0.021 | > 2000 |
| V001 | 16-10Lr | 0.858 | **-0.043** | 0.009 | > 2000 |
| V001 | 16-10Lr | 1.716 | -0.043 | -0.006 | < -2000 |
| V001 | 16-10Lr | 2.574 | -0.043 | -0.021 | < -2000 |
| V001 | 16-10Lr | 3.432 | -0.043 | -0.037 | < -2000 |
| V001 | 16-10Lr | 4.290 | -0.043 | -0.051 | -1833.095 |
| V001 | 16-10Lr | 5.148 | -0.043 | -0.062 | -1493.867 |
| V001 | 16-10Lr | 6.006 | -0.043 | -0.071 | -1312.916 |
| V001 | 16-10Lr | 6.864 | -0.043 | -0.076 | -1222.659 |
| V001 | 16-10Lr | 7.722 | -0.043 | -0.078 | -1195.039 |
| V001 | 16-10R | 0.000 | -0.012 | 0.006 | > 2000 |
| V001 | 16-10R | 0.858 | -0.012 | 0.003 | > 2000 |
| V001 | 16-10R | 1.716 | -0.012 | -0.002 | < -2000 |
| V001 | 16-10R | 2.574 | -0.013 | -0.006 | < -2000 |
| V001 | 16-10R | 3.432 | -0.013 | -0.011 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| V001 | 16-10R | 4.290 | -0.013 | -0.015 | < -2000 |
| V001 | 16-10R | 5.148 | -0.013 | -0.018 | < -2000 |
| V001 | 16-10R | 6.006 | -0.013 | -0.021 | < -2000 |
| V001 | 16-10R | 6.864 | -0.013 | -0.022 | < -2000 |
| V001 | 16-10R | 7.722 | -0.013 | -0.023 | < -2000 |
| V001 | 16-11Lr | 0.000 | -0.035 | 0.018 | > 2000 |
| V001 | 16-11Lr | 0.858 | -0.035 | 0.007 | > 2000 |
| V001 | 16-11Lr | 1.716 | -0.035 | -0.005 | < -2000 |
| V001 | 16-11Lr | 2.574 | -0.035 | -0.018 | < -2000 |
| V001 | 16-11Lr | 3.432 | -0.035 | -0.030 | < -2000 |
| V001 | 16-11Lr | 4.290 | -0.035 | -0.042 | < -2000 |
| V001 | 16-11Lr | 5.148 | -0.035 | -0.051 | -1814.259 |
| V001 | 16-11Lr | 6.006 | -0.035 | -0.058 | -1594.579 |
| V001 | 16-11Lr | 6.864 | -0.035 | -0.062 | -1484.993 |
| V001 | 16-11Lr | 7.722 | -0.035 | -0.064 | -1451.45 |
| V001 | 16-12W »+X | 0.000 | 0.087 | -0.049 | -1901.196 |
| V001 | 16-12W »+X | 0.858 | 0.087 | -0.054 | -1705.332 |
| V001 | 16-12W »+X | 1.716 | 0.087 | -0.059 | -1564.58 |
| V001 | 16-12W »+X | 2.574 | 0.087 | -0.063 | -1463.253 |
| V001 | 16-12W »+X | 3.432 | 0.087 | -0.067 | -1391.544 |
| V001 | 16-12W »+X | 4.290 | 0.087 | -0.069 | -1343.541 |
| V001 | 16-12W »+X | 5.148 | 0.087 | -0.070 | -1315.602 |
| V001 | 16-12W »+X | 6.006 | 0.087 | -0.071 | -1305.659 |
| V001 | 16-12W »+X | 6.864 | 0.087 | -0.071 | -1313.11 |
| V001 | 16-12W »+X | 7.722 | 0.087 | -0.069 | -1338.191 |
| V001 | 16-13W+Lr »+X | 0.000 | 0.040 | -0.024 | < -2000 |
| V001 | 16-13W+Lr »+X | 0.858 | 0.040 | -0.035 | < -2000 |
| V001 | 16-13W+Lr »+X | 1.716 | 0.040 | -0.048 | -1936.215 |
| V001 | 16-13W+Lr »+X | 2.574 | 0.040 | -0.060 | -1533.897 |
| V001 | 16-13W+Lr »+X | 3.432 | 0.040 | -0.072 | -1285.405 |
| V001 | 16-13W+Lr »+X | 4.290 | 0.040 | -0.082 | -1127.147 |
| V001 | 16-13W+Lr »+X | 5.148 | 0.040 | -0.090 | -1026.841 |
| V001 | 16-13W+Lr »+X | 6.006 | 0.040 | -0.096 | -967.197 |
| V001 | 16-13W+Lr »+X | 6.864 | 0.040 | -0.099 | -939.314 |
| V001 | 16-13W+Lr »+X | 7.722 | 0.039 | -0.099 | -938.695 |
| V001 | 16-13W+R »+X | 0.000 | 0.062 | -0.035 | < -2000 |
| V001 | 16-13W+R »+X | 0.858 | 0.062 | -0.040 | < -2000 |
| V001 | 16-13W+R »+X | 1.716 | 0.062 | -0.045 | < -2000 |
| V001 | 16-13W+R »+X | 2.574 | 0.062 | -0.049 | -1887.812 |
| V001 | 16-13W+R »+X | 3.432 | 0.062 | -0.053 | -1760.021 |
| V001 | 16-13W+R »+X | 4.290 | 0.062 | -0.055 | -1671.363 |
| V001 | 16-13W+R »+X | 5.148 | 0.062 | -0.057 | -1614.941 |
| V001 | 16-13W+R »+X | 6.006 | 0.062 | -0.058 | -1586.547 |
| V001 | 16-13W+R »+X | 6.864 | 0.062 | -0.058 | -1584.409 |
| V001 | 16-13W+R »+X | 7.722 | 0.062 | -0.058 | -1608.157 |
| V001 | 16-14 »+X | 0.000 | 0.092 | -0.051 | -1809.67 |
| V001 | 16-14 »+X | 0.858 | 0.092 | -0.055 | -1673.96 |
| V001 | 16-14 »+X | 1.716 | 0.092 | -0.059 | -1583.563 |
| V001 | 16-14 »+X | 2.574 | 0.092 | -0.061 | -1524.489 |
| V001 | 16-14 »+X | 3.432 | 0.092 | -0.062 | -1488.321 |
| V001 | 16-14 »+X | 4.290 | 0.092 | -0.063 | -1470.237 |
| V001 | 16-14 »+X | 5.148 | 0.092 | -0.063 | -1467.373 |
| V001 | 16-14 »+X | 6.006 | 0.092 | -0.063 | -1478.212 |
| V001 | 16-14 »+X | 6.864 | 0.092 | -0.062 | -1502.467 |
| V001 | 16-14 »+X | 7.722 | 0.092 | -0.060 | -1540.636 |
| V001 | 16-14 »+X+Y | 0.000 | -0.007 | 0.004 | > 2000 |
| V001 | 16-14 »+X+Y | 0.858 | -0.007 | 0.002 | > 2000 |
| V001 | 16-14 »+X+Y | 1.716 | -0.007 | -0.001 | < -2000 |
| V001 | 16-14 »+X+Y | 2.574 | -0.008 | -0.004 | < -2000 |
| V001 | 16-14 »+X+Y | 3.432 | -0.008 | -0.006 | < -2000 |
| V001 | 16-14 »+X+Y | 4.290 | -0.008 | -0.009 | < -2000 |
| V001 | 16-14 »+X+Y | 5.148 | -0.008 | -0.011 | < -2000 |
| V001 | 16-14 »+X+Y | 6.006 | -0.008 | -0.012 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| V001 | 16-14 »+X+Y | 6.864 | -0.008 | -0.013 | < -2000 |
| V001 | 16-14 »+X+Y | 7.722 | -0.008 | -0.014 | < -2000 |
| V001 | D | 0.000 | -0.012 | 0.006 | > 2000 |
| V001 | D | 0.858 | -0.012 | 0.003 | > 2000 |
| V001 | D | 1.716 | -0.012 | -0.002 | < -2000 |
| V001 | D | 2.574 | -0.013 | -0.006 | < -2000 |
| V001 | D | 3.432 | -0.013 | -0.011 | < -2000 |
| V001 | D | 4.290 | -0.013 | -0.015 | < -2000 |
| V001 | D | 5.148 | -0.013 | -0.018 | < -2000 |
| V001 | D | 6.006 | -0.013 | -0.021 | < -2000 |
| V001 | D | 6.864 | -0.013 | -0.022 | < -2000 |
| V001 | D | 7.722 | -0.013 | -0.023 | < -2000 |
| V001 | D+L | 0.000 | -0.012 | 0.006 | > 2000 |
| V001 | D+L | 0.858 | -0.012 | 0.003 | > 2000 |
| V001 | D+L | 1.716 | -0.012 | -0.002 | < -2000 |
| V001 | D+L | 2.574 | -0.013 | -0.006 | < -2000 |
| V001 | D+L | 3.432 | -0.013 | -0.011 | < -2000 |
| V001 | D+L | 4.290 | -0.013 | -0.015 | < -2000 |
| V001 | D+L | 5.148 | -0.013 | -0.018 | < -2000 |
| V001 | D+L | 6.006 | -0.013 | -0.021 | < -2000 |
| V001 | D+L | 6.864 | -0.013 | -0.022 | < -2000 |
| V001 | D+L | 7.722 | -0.013 | -0.023 | < -2000 |
| V001 | Live | 0.000 | -0.030 | 0.015 | > 2000 |
| V001 | Live | 0.858 | -0.030 | 0.006 | > 2000 |
| V001 | Live | 1.716 | -0.030 | -0.004 | < -2000 |
| V001 | Live | 2.574 | -0.030 | -0.015 | < -2000 |
| V001 | Live | 3.432 | -0.030 | -0.026 | < -2000 |
| V001 | Live | 4.290 | -0.030 | -0.036 | < -2000 |
| V001 | Live | 5.148 | -0.030 | -0.044 | < -2000 |
| V001 | Live | 6.006 | -0.030 | -0.050 | -1858.202 |
| V001 | Live | 6.864 | -0.030 | -0.054 | -1730.278 |
| V001 | Live | 7.722 | -0.030 | -0.055 | -1691.171 |
| V001 | Wind | 0.000 | 0.100 | -0.055 | -1687.791 |
| V001 | Wind | 0.858 | 0.100 | -0.057 | -1629.008 |
| V001 | Wind | 1.716 | 0.100 | -0.057 | -1612.918 |
| V001 | Wind | 2.574 | 0.100 | -0.057 | -1626.597 |
| V001 | Wind | 3.432 | 0.100 | -0.056 | -1661.666 |
| V001 | Wind | 4.290 | 0.100 | -0.054 | -1712.468 |
| V001 | Wind | 5.148 | 0.100 | -0.052 | -1774.427 |
| V001 | Wind | 6.006 | 0.100 | -0.050 | -1843.699 |
| V001 | Wind | 6.864 | 0.100 | -0.048 | -1917.166 |
| V001 | Wind | 7.722 | 0.100 | -0.046 | -1992.863 |
| V002 | 16-10Lr | 0.000 | 0.043 | -0.078 | -1195.582 |
| V002 | 16-10Lr | 0.858 | 0.043 | -0.076 | -1223.15 |
| V002 | 16-10Lr | 1.716 | 0.043 | -0.071 | -1313.393 |
| V002 | 16-10Lr | 2.574 | 0.043 | -0.062 | -1494.37 |
| V002 | 16-10Lr | 3.432 | 0.043 | -0.051 | -1833.678 |
| V002 | 16-10Lr | 4.290 | 0.043 | -0.037 | < -2000 |
| V002 | 16-10Lr | 5.148 | 0.043 | -0.021 | < -2000 |
| V002 | 16-10Lr | 6.006 | 0.043 | -0.006 | < -2000 |
| V002 | 16-10Lr | 6.864 | 0.043 | 0.009 | > 2000 |
| V002 | 16-10Lr | 7.722 | 0.043 | 0.021 | > 2000 |
| V002 | 16-10R | 0.000 | 0.013 | -0.023 | < -2000 |
| V002 | 16-10R | 0.858 | 0.013 | -0.022 | < -2000 |
| V002 | 16-10R | 1.716 | 0.013 | -0.021 | < -2000 |
| V002 | 16-10R | 2.574 | 0.013 | -0.018 | < -2000 |
| V002 | 16-10R | 3.432 | 0.013 | -0.015 | < -2000 |
| V002 | 16-10R | 4.290 | 0.013 | -0.011 | < -2000 |
| V002 | 16-10R | 5.148 | 0.013 | -0.006 | < -2000 |
| V002 | 16-10R | 6.006 | 0.013 | -0.002 | < -2000 |
| V002 | 16-10R | 6.864 | 0.013 | 0.003 | > 2000 |
| V002 | 16-10R | 7.722 | 0.012 | 0.006 | > 2000 |
| V002 | 16-11Lr | 0.000 | 0.035 | -0.064 | -1452.251 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| V002 | 16-11Lr | 0.858 | 0.035 | -0.062 | -1485.717 |
| V002 | 16-11Lr | 1.716 | 0.035 | -0.058 | -1595.284 |
| V002 | 16-11Lr | 2.574 | 0.035 | -0.051 | -1815.00 |
| V002 | 16-11Lr | 3.432 | 0.035 | -0.042 | < -2000 |
| V002 | 16-11Lr | 4.290 | 0.035 | -0.030 | < -2000 |
| V002 | 16-11Lr | 5.148 | 0.035 | -0.018 | < -2000 |
| V002 | 16-11Lr | 6.006 | 0.035 | -0.005 | < -2000 |
| V002 | 16-11Lr | 6.864 | 0.035 | 0.007 | > 2000 |
| V002 | 16-11Lr | 7.722 | 0.035 | 0.018 | > 2000 |
| V002 | 16-12W »+X | 0.000 | **0.105** | 0.038 | > 2000 |
| V002 | 16-12W »+X | 0.858 | 0.105 | 0.040 | > 2000 |
| V002 | 16-12W »+X | 1.716 | 0.105 | 0.043 | > 2000 |
| V002 | 16-12W »+X | 2.574 | 0.105 | 0.046 | > 2000 |
| V002 | 16-12W »+X | 3.432 | 0.105 | 0.049 | 1875.311 |
| V002 | 16-12W »+X | 4.290 | 0.105 | 0.053 | 1756.962 |
| V002 | 16-12W »+X | 5.148 | 0.105 | 0.056 | 1666.749 |
| V002 | 16-12W »+X | 6.006 | 0.105 | 0.058 | 1608.084 |
| V002 | 16-12W »+X | 6.864 | 0.105 | 0.058 | 1585.791 |
| V002 | 16-12W »+X | 7.722 | 0.105 | 0.058 | 1607.851 |
| V002 | 16-13W+Lr »+X | 0.000 | 0.105 | -0.019 | < -2000 |
| V002 | 16-13W+Lr »+X | 0.858 | 0.105 | -0.016 | < -2000 |
| V002 | 16-13W+Lr »+X | 1.716 | 0.105 | -0.011 | < -2000 |
| V002 | 16-13W+Lr »+X | 2.574 | 0.105 | -0.003 | < -2000 |
| V002 | 16-13W+Lr »+X | 3.432 | 0.105 | 0.007 | > 2000 |
| V002 | 16-13W+Lr »+X | 4.290 | 0.105 | 0.017 | > 2000 |
| V002 | 16-13W+Lr »+X | 5.148 | 0.104 | 0.029 | > 2000 |
| V002 | 16-13W+Lr »+X | 6.006 | 0.104 | 0.040 | > 2000 |
| V002 | 16-13W+Lr »+X | 6.864 | 0.104 | 0.049 | 1878.926 |
| V002 | 16-13W+Lr »+X | 7.722 | 0.104 | 0.056 | 1649.106 |
| V002 | 16-13W+R »+X | 0.000 | 0.082 | 0.022 | > 2000 |
| V002 | 16-13W+R »+X | 0.858 | 0.082 | 0.024 | > 2000 |
| V002 | 16-13W+R »+X | 1.716 | 0.082 | 0.027 | > 2000 |
| V002 | 16-13W+R »+X | 2.574 | 0.082 | 0.030 | > 2000 |
| V002 | 16-13W+R »+X | 3.432 | 0.082 | 0.033 | > 2000 |
| V002 | 16-13W+R »+X | 4.290 | 0.082 | 0.037 | > 2000 |
| V002 | 16-13W+R »+X | 5.148 | 0.082 | 0.040 | > 2000 |
| V002 | 16-13W+R »+X | 6.006 | 0.082 | 0.043 | > 2000 |
| V002 | 16-13W+R »+X | 6.864 | 0.082 | 0.044 | > 2000 |
| V002 | 16-13W+R »+X | 7.722 | 0.082 | 0.045 | > 2000 |
| V002 | 16-14 »+X | 0.000 | 0.100 | 0.047 | 1987.240 |
| V002 | 16-14 »+X | 0.858 | 0.100 | 0.049 | 1905.549 |
| V002 | 16-14 »+X | 1.716 | 0.100 | 0.051 | 1820.503 |
| V002 | 16-14 »+X | 2.574 | 0.100 | 0.053 | 1741.237 |
| V002 | 16-14 »+X | 3.432 | 0.100 | 0.055 | 1674.157 |
| V002 | 16-14 »+X | 4.290 | 0.100 | 0.057 | 1623.789 |
| V002 | 16-14 »+X | 5.148 | 0.100 | 0.058 | 1593.896 |
| V002 | 16-14 »+X | 6.006 | 0.100 | 0.058 | 1588.530 |
| V002 | 16-14 »+X | 6.864 | 0.100 | 0.057 | 1613.884 |
| V002 | 16-14 »+X | 7.722 | 0.100 | 0.055 | 1679.600 |
| V002 | 16-14 »+X+Y | 0.000 | 0.008 | -0.014 | < -2000 |
| V002 | 16-14 »+X+Y | 0.858 | 0.008 | -0.013 | < -2000 |
| V002 | 16-14 »+X+Y | 1.716 | 0.008 | -0.012 | < -2000 |
| V002 | 16-14 »+X+Y | 2.574 | 0.008 | -0.011 | < -2000 |
| V002 | 16-14 »+X+Y | 3.432 | 0.008 | -0.009 | < -2000 |
| V002 | 16-14 »+X+Y | 4.290 | 0.008 | -0.006 | < -2000 |
| V002 | 16-14 »+X+Y | 5.148 | 0.008 | -0.004 | < -2000 |
| V002 | 16-14 »+X+Y | 6.006 | 0.008 | -0.001 | < -2000 |
| V002 | 16-14 »+X+Y | 6.864 | 0.008 | 0.002 | > 2000 |
| V002 | 16-14 »+X+Y | 7.722 | 0.007 | 0.004 | > 2000 |
| V002 | D | 0.000 | 0.013 | -0.023 | < -2000 |
| V002 | D | 0.858 | 0.013 | -0.022 | < -2000 |
| V002 | D | 1.716 | 0.013 | -0.021 | < -2000 |
| V002 | D | 2.574 | 0.013 | -0.018 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| V002 | D | 3.432 | 0.013 | -0.015 | < -2000 |
| V002 | D | 4.290 | 0.013 | -0.011 | < -2000 |
| V002 | D | 5.148 | 0.013 | -0.006 | < -2000 |
| V002 | D | 6.006 | 0.013 | -0.002 | < -2000 |
| V002 | D | 6.864 | 0.013 | 0.003 | > 2000 |
| V002 | D | 7.722 | 0.012 | 0.006 | > 2000 |
| V002 | D+L | 0.000 | 0.013 | -0.023 | < -2000 |
| V002 | D+L | 0.858 | 0.013 | -0.022 | < -2000 |
| V002 | D+L | 1.716 | 0.013 | -0.021 | < -2000 |
| V002 | D+L | 2.574 | 0.013 | -0.018 | < -2000 |
| V002 | D+L | 3.432 | 0.013 | -0.015 | < -2000 |
| V002 | D+L | 4.290 | 0.013 | -0.011 | < -2000 |
| V002 | D+L | 5.148 | 0.013 | -0.006 | < -2000 |
| V002 | D+L | 6.006 | 0.013 | -0.002 | < -2000 |
| V002 | D+L | 6.864 | 0.013 | 0.003 | > 2000 |
| V002 | D+L | 7.722 | 0.012 | 0.006 | > 2000 |
| V002 | Live | 0.000 | 0.030 | -0.055 | -1691.171 |
| V002 | Live | 0.858 | 0.030 | -0.054 | -1730.278 |
| V002 | Live | 1.716 | 0.030 | -0.050 | -1858.202 |
| V002 | Live | 2.574 | 0.030 | -0.044 | < -2000 |
| V002 | Live | 3.432 | 0.030 | -0.036 | < -2000 |
| V002 | Live | 4.290 | 0.030 | -0.026 | < -2000 |
| V002 | Live | 5.148 | 0.030 | -0.015 | < -2000 |
| V002 | Live | 6.006 | 0.030 | -0.004 | < -2000 |
| V002 | Live | 6.864 | 0.030 | 0.006 | > 2000 |
| V002 | Live | 7.722 | 0.030 | 0.015 | > 2000 |
| V002 | Wind | 0.000 | 0.092 | 0.060 | 1537.812 |
| V002 | Wind | 0.858 | 0.092 | 0.062 | 1495.764 |
| V002 | Wind | 1.716 | 0.092 | 0.063 | 1463.619 |
| V002 | Wind | 2.574 | 0.092 | 0.064 | 1444.884 |
| V002 | Wind | 3.432 | 0.092 | 0.064 | 1442.125 |
| V002 | Wind | 4.290 | 0.092 | 0.064 | 1458.017 |
| V002 | Wind | 5.148 | 0.092 | 0.062 | 1495.822 |
| V002 | Wind | 6.006 | 0.092 | 0.059 | 1560.075 |
| V002 | Wind | 6.864 | 0.092 | 0.056 | 1657.939 |
| V002 | Wind | 7.722 | 0.092 | 0.051 | 1800.092 |

# Member Min/Max Displacements

| Extreme Item | Member | Result Case Name | Offset ft | Dy in |
|---|---|---|---|---|
| Max Dy | COL002 | 16-13W+Lr »+X | 1.11 | **0.122** |
| Min Dy | COL001 | Wind | 9.25 | **-0.114** |

# Member Min/Max Forces

| Extreme Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Mz K-ft |
|---|---|---|---|---|---|---|
| Max Axial | COL001 | Wind | 0.00 | **0.052** | 0.026 | 0.000 |
| Max Mz | V002 | 16-10Lr | 0.77 | -0.042 | -0.002 | **0.278** |
| Max Vy | V001 | 16-10Lr | 0.00 | -0.137 | **0.173** | -0.331 |
| Min Axial | COL001 | 16-10Lr | 0.00 | **-0.282** | -0.036 | -0.000 |
| Min Mz | V002 | 16-10Lr | 7.72 | -0.137 | -0.173 | -0.331 |
| Min Vy | V002 | 16-10Lr | 7.72 | -0.137 | **-0.173** | **-0.331** |

# Member Min/Max Stresses

| Extreme | Item | Member | Result Case Name | Offset ft | fa Ksi | fby(+z) Ksi | fby(-z) Ksi | fbz(+y) Ksi | fbz(-y) Ksi |
|---|---|---|---|---|---|---|---|---|---|
| Max | fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | 0.000 | -0.000 |
| Max | fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | 0.000 | -0.000 |
| Max | fbz(+y) | V002 | 16-10Lr | 7.72 | -0.011 | 0.000 | -0.000 | **0.130** | **-0.130** |
| Max | fbz(-y) | V002 | 16-10Lr | 0.77 | -0.003 | 0.000 | -0.000 | -0.109 | 0.109 |
| Max | fx | COL001 | Wind | 0.00 | **0.004** | 0.000 | -0.000 | -0.000 | 0.000 |
| Min | fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | 0.000 | -0.000 |
| Min | fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | 0.000 | -0.000 |
| Min | fbz(+y) | V002 | 16-10Lr | 0.77 | -0.003 | 0.000 | -0.000 | **-0.109** | **0.109** |
| Min | fbz(-y) | V002 | 16-10Lr | 7.72 | -0.011 | 0.000 | -0.000 | 0.130 | -0.130 |
| Min | fx | COL001 | 16-10Lr | 0.00 | **-0.023** | **0.000** | **-0.000** | 0.000 | -0.000 |

# Nodal Displacements

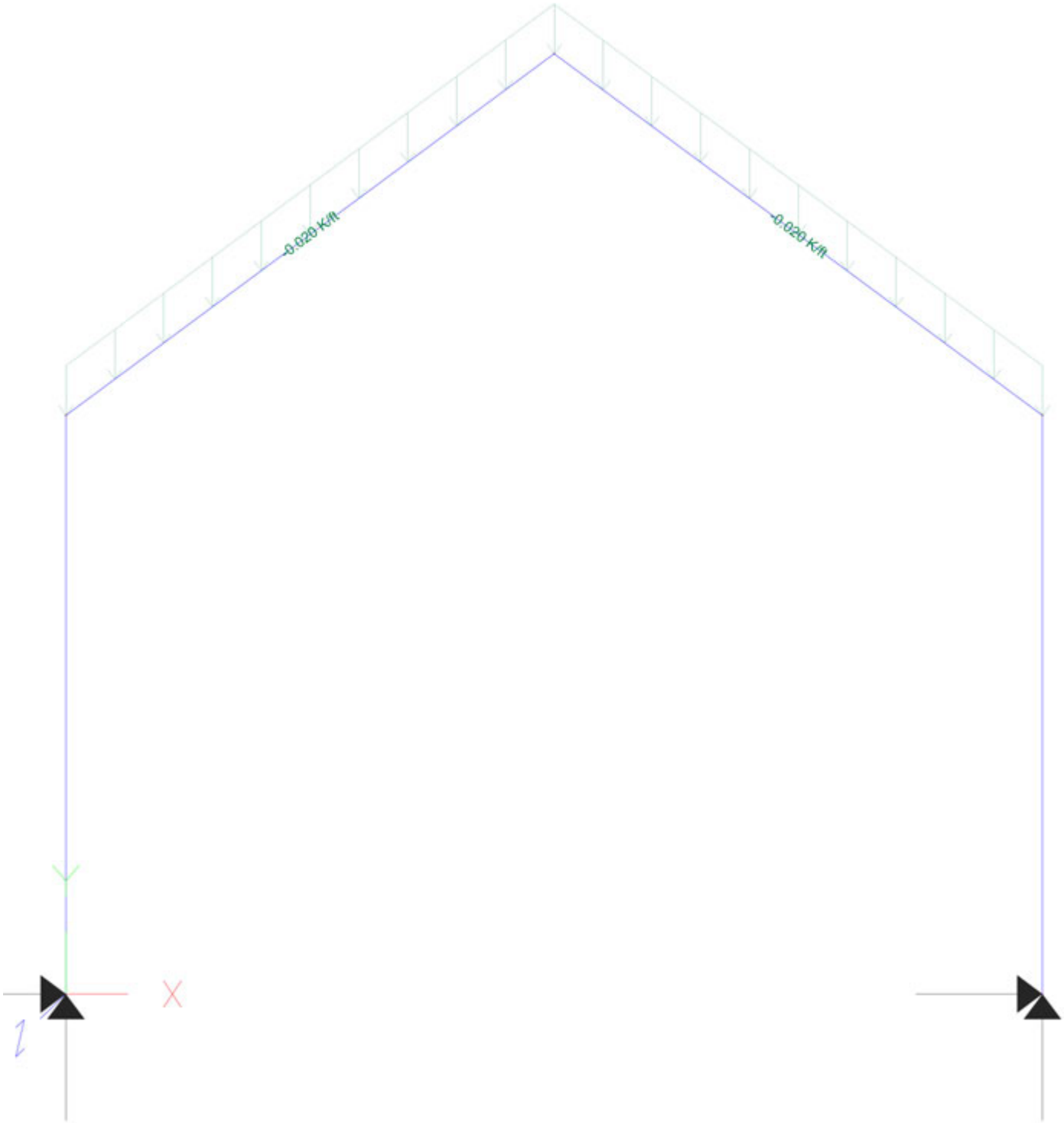
| Node | Result Case Name | DX in | DY in | RZ deg |
|---|---|---|---|---|
| N001 | 16-10Lr | -0.000 | -0.000 | **0.066** |
| N001 | 16-10R | -0.000 | -0.000 | 0.019 |
| N001 | 16-11Lr | -0.000 | -0.000 | 0.055 |
| N001 | 16-12W »+X | 0.000 | -0.000 | -0.064 |
| N001 | 16-13W+Lr »+X | -0.000 | -0.000 | -0.008 |
| N001 | 16-13W+R »+X | 0.000 | -0.000 | -0.043 |
| N001 | 16-14 »+X | 0.000 | -0.000 | -0.072 |
| N001 | 16-14 »+X+Y | -0.000 | -0.000 | 0.012 |
| N001 | D | -0.000 | -0.000 | 0.019 |
| N001 | D+L | -0.000 | -0.000 | 0.019 |
| N001 | Live | -0.000 | -0.000 | 0.047 |
| N001 | Wind | 0.000 | 0.000 | -0.083 |
| N002 | 16-10Lr | **-0.048** | -0.002 | -0.059 |
| N002 | 16-10R | -0.014 | -0.001 | -0.017 |
| N002 | 16-11Lr | -0.039 | -0.002 | -0.048 |
| N002 | 16-12W »+X | 0.100 | -0.000 | -0.033 |
| N002 | 16-13W+Lr »+X | 0.046 | -0.001 | -0.060 |
| N002 | 16-13W+R »+X | 0.072 | -0.000 | -0.029 |
| N002 | 16-14 »+X | 0.105 | 0.000 | -0.026 |
| N002 | 16-14 »+X+Y | -0.008 | -0.000 | -0.010 |
| N002 | D | -0.014 | -0.001 | -0.017 |
| N002 | D+L | -0.014 | -0.001 | -0.017 |
| N002 | Live | -0.034 | -0.001 | -0.042 |
| N002 | Wind | 0.114 | 0.000 | -0.016 |
| N003 | 16-10Lr | 0.000 | **-0.089** | -0.000 |
| N003 | 16-10R | 0.000 | -0.026 | -0.000 |
| N003 | 16-11Lr | 0.000 | -0.073 | -0.000 |
| N003 | 16-12W »+X | 0.110 | -0.018 | 0.010 |
| N003 | 16-13W+Lr »+X | 0.082 | -0.067 | 0.007 |
| N003 | 16-13W+R »+X | 0.082 | -0.020 | 0.007 |
| N003 | 16-14 »+X | 0.110 | -0.008 | 0.010 |
| N003 | 16-14 »+X+Y | 0.000 | -0.016 | -0.000 |
| N003 | D | 0.000 | -0.026 | -0.000 |
| N003 | D+L | 0.000 | -0.026 | -0.000 |
| N003 | Live | 0.000 | -0.063 | 0.000 |
| N003 | Wind | 0.110 | **0.008** | 0.010 |
| N004 | 16-10Lr | 0.048 | -0.002 | 0.059 |
| N004 | 16-10R | 0.014 | -0.001 | 0.017 |
| N004 | 16-11Lr | 0.039 | -0.002 | 0.048 |
| N004 | 16-12W »+X | **0.120** | -0.001 | -0.010 |
| N004 | 16-13W+Lr »+X | 0.118 | -0.002 | 0.028 |
| N004 | 16-13W+R »+X | 0.093 | -0.001 | -0.003 |
| N004 | 16-14 »+X | 0.114 | -0.000 | -0.017 |
| N004 | 16-14 »+X+Y | 0.008 | -0.000 | 0.010 |

| Node | Result Case Name | DX in | DY in | RZ deg |
|---|---|---|---|---|
| N004 | D | 0.014 | -0.001 | 0.017 |
| N004 | D+L | 0.014 | -0.001 | 0.017 |
| N004 | Live | 0.034 | -0.001 | 0.042 |
| N004 | Wind | 0.106 | 0.000 | -0.027 |
| N005 | 16-10Lr | 0.000 | -0.000 | -0.066 |
| N005 | 16-10R | 0.000 | -0.000 | -0.019 |
| N005 | 16-11Lr | 0.000 | -0.000 | -0.055 |
| N005 | 16-12W »+X | 0.000 | -0.000 | -0.093 |
| N005 | 16-13W+Lr »+X | 0.000 | -0.000 | **-0.110** |
| N005 | 16-13W+R »+X | 0.000 | -0.000 | -0.075 |
| N005 | 16-14 »+X | 0.000 | -0.000 | -0.085 |
| N005 | 16-14 »+X+Y | 0.000 | -0.000 | -0.012 |
| N005 | D | 0.000 | -0.000 | -0.019 |
| N005 | D+L | 0.000 | -0.000 | -0.019 |
| N005 | Live | 0.000 | -0.000 | -0.047 |
| N005 | Wind | 0.000 | 0.000 | -0.074 |

# Nodal Reactions

| Node | Result Case Name | FX K | FY K | MZ K-ft |
|---|---|---|---|---|
| N001 | 16-10Lr | **0.04** | **0.28** | -NA- |
| N001 | 16-10R | 0.01 | 0.13 | -NA- |
| N001 | 16-11Lr | 0.03 | 0.24 | -NA- |
| N001 | 16-12W »+X | -0.02 | 0.08 | -NA- |
| N001 | 16-13W+Lr »+X | 0.01 | 0.20 | -NA- |
| N001 | 16-13W+R »+X | -0.01 | 0.09 | -NA- |
| N001 | 16-14 »+X | -0.02 | 0.03 | -NA- |
| N001 | 16-14 »+X+Y | 0.01 | 0.08 | -NA- |
| N001 | D | 0.01 | 0.13 | -NA- |
| N001 | D+L | 0.01 | 0.13 | -NA- |
| N001 | Live | 0.03 | 0.15 | -NA- |
| N001 | Wind | -0.03 | **-0.05** | -NA- |
| N005 | 16-10Lr | -0.04 | 0.28 | -NA- |
| N005 | 16-10R | -0.01 | 0.13 | -NA- |
| N005 | 16-11Lr | -0.03 | 0.24 | -NA- |
| N005 | 16-12W »+X | -0.04 | 0.11 | -NA- |
| N005 | 16-13W+Lr »+X | **-0.05** | 0.23 | -NA- |
| N005 | 16-13W+R »+X | -0.03 | 0.12 | -NA- |
| N005 | 16-14 »+X | -0.03 | 0.06 | -NA- |
| N005 | 16-14 »+X+Y | -0.01 | 0.08 | -NA- |
| N005 | D | -0.01 | 0.13 | -NA- |
| N005 | D+L | -0.01 | 0.13 | -NA- |
| N005 | Live | -0.03 | 0.15 | -NA- |
| N005 | Wind | -0.03 | -0.02 | -NA- |

BeauSoleil Project: frame.vap
Randall J. Hebert & Assoc. Inc., Randall J. Hebert
E R Desormeaux P.E.
Dec 11, 2008; 01:59 PM
Load Case: Lr
IES VisualAnalysis 6.00.0109



## Moment Connection Design For sips panel

### Eave Condition

Try 12Ga Plate Bent to fit the connection

Try 3/8" Lag Screws; (preliminary calculations on ¼" proved to require too many)

Lag Screw Length 2" into 2X Blocking

Moment at Eave = 0.331 Ft-K  or  0.331 x 12,000 = 3972 inch-lbs per foot of wall

Wall = 6"  Roof = 8"

Tw = 3972 / 6  = 662# per foot of wall

Tr =  3972 / 8  = 496.5 or 497# per foot of wall

Screw Shear Capacity = Ab x Fv  or  ($0.375^2$ x pi /4) x 10 ksi

= 1.1 k  or 1100 #

Screw Capacity in Wood w/ Steel Plate 3/8" = 100# AITC p 5-26

Wall Leg of Clip # of Screws = 662/100 = 6.6 or 7 fasteners per foot of wall

Roof Leg of Clpi # of Screws = 497/100 = 4.9 or 5 fasteners per foot of wall

### Peak Condition

Moment at peak = 0.278Ft-K  or  0.278 x 12,000 = 3336 in-lb per foot of roof

Tr = 3336 / 8 = 417# per foot of roof

No. Fasteners (Screws) = 417/100 = 4.14 or 5 per foot of roof

Check Connector Plate (12 Ga)  t = 0.105"

Fp = 1.2 Fu = 1.2 x 58 ksi x 0.105 x .375 = 2.74 ksi >100 ok

## Rail Post Base Sleeve Connection to Deck Structure

Moment = 200 x 36" = 7200 in-lb

Sleeve bolt spacing = 2.5"

Bolt Dia = 0.44"  Ab = 0.152 $in^2$

Bolt Tension = 7200 in-lb /2.5 in = 2880 #

Per Bolt = 2880 / 2 = 1440#

Ft = 20ksi x 0.152 = 3.04 or 3040# > 1440# OK

## Strap to connect Sips Panel to Base Structure

For Uplift to be  negated by Dead load Simpson Clip MSTA24

Dead Load per foot of wall = 0.13k or 130#

Uplift per foot of wall = -0.05k  (  or 50# Uplift)

Strap Load Req'd: 130-50=80# per foot of wall x 2 = 160#

Strap Provides 1225# >>160# OK

Strap Also Meets Requirements of Jamb Uplift 1225# > 542# OK

## Floor Joist Hanger

Floor Live+Dead Reaction From Printout = 580#

Hanger Selected is Simpson IUS1.81-11/88 with a capacity of 1010# (Floor Loads) OK

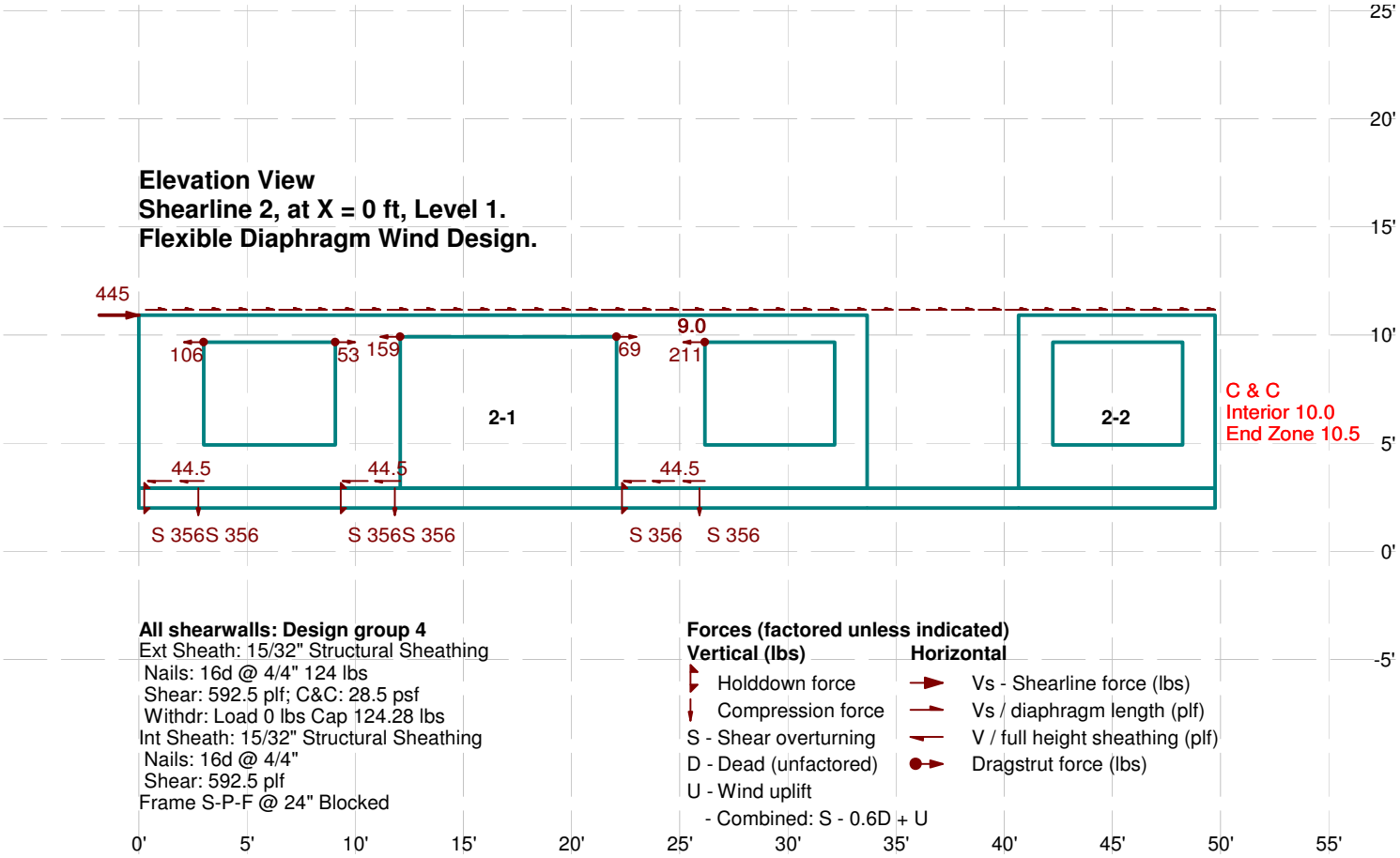
## PV Panel Tiedown

Uplift on a panel is 16.4psf x 4.5 x 3 = 221#

Allowable on one fastener is 900# > 221#/4 or 55# actual uplift per fastener  OK

# WoodWorks® Shearwalls SOFTWARE FOR WOOD DESIGN

**shearwalldesign.wsw** **WoodWorks® Shearwalls 7.01** **Dec. 9, 2008 12:30:52**




**All shearwalls: Design group 4**
Ext Sheath: 15/32" Structural Sheathing
Nails: 16d @ 4/4" 124 lbs
Shear: 592.5 plf; C&C: 28.5 psf
Withdr: Load 0 lbs Cap 124.28 lbs
Int Sheath: 15/32" Structural Sheathing
Nails: 16d @ 4/4"
Shear: 592.5 plf
Frame S-P-F @ 24" Blocked

**Forces (factored unless indicated)**

**Vertical (lbs)**
- Holddown force
- Compression force
- S - Shear overturning
- D - Dead (unfactored)
- U - Wind uplift
- Combined: S - 0.6D + U

**Horizontal**
- Vs - Shearline force (lbs)
- Vs / diaphragm length (plf)
- V / full height sheathing (plf)
- Dragstrut force (lbs)

# Rail Post

VisualAnalysis 6.00 Report
Company: Randall J. Hebert & Assoc. Inc.  Engineer: Randall J. Hebert - E R Desormeaux PE
Project File: Rail Post.vap
Folder: M:\EngE-K\ERD\BeauSoleil\

# Project Notes

Rail Post is analyzed for a 200 lb point load at the top

# Load Combination Summary

Equation Combination: 16-10Lr
   Combination: D + Lr*0 + H*0 + F*0
   Contributing Cases & Source
   D (D)
Equation Combination: 16-11Lr
   Combination: D + 0.75L + 0.75Lpa*0 + 0.75Lr*0 + H*0 + F*0 + 0.75T*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: 16-14 »+X
   Combination: 0.60D + H*0 + 1.50Fa*0 + W+X*0
   Contributing Cases & Source
   D (D)
Equation Combination: 16-9
   Combination: D + L + Lpa*0 + H*0 + F*0 + T*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: D+L
   Combination: D + L + Lpa*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: Live
   Combination: L + Lpa*0 + Lr*0
   Contributing Cases & Source
   L (L)

# Nodes

| Node | X ft | Y ft | Fix DX | Fix DY | Fix RZ |
|---|---|---|---|---|---|
| N001 | 0.00 | 0.00 | Yes | Yes | Yes |
| N002 | 0.00 | 3.00 | No | No | No |

# Material Properties

| Material | Strength Ksi | Elasticity Ksi | Poisson | Density K/in^3 | Therm. Coeff. in/in/deg-F |
|---|---|---|---|---|---|
| ASTM A50 | -NA- | 29000.00 | 0.290 | 0.00 | 6.39e-006 |

# Member Elements

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Rz1 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|
| COL001 | HSS1.66 | ASTM A500 | N001 | N002 | 3.000 | 0.006 | Fix | Fix | Normal |

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Rz1 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|

# Section Properties

| Section | Theta deg | Ax in^2 | Iz in^4 | Sz(+y) in^3 | Sz(-y) in^3 |
|---|---|---|---|---|---|
| HSS1.66 | 0.000 | 0.625 | 0.184 | 0.222 | 0.222 |

# Areas

This item is empty. Check the selection state, or report properties.

# Member Uniform Loads

This item is empty. Check the selection state, or report properties.

# Member Local Displacements

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-10Lr | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-11Lr | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-11Lr | 0.333 | -0.000 | -0.008 | < -2000 |
| COL001 | 16-11Lr | 0.667 | -0.000 | -0.030 | -1195.555 |
| COL001 | 16-11Lr | 1.000 | -0.000 | -0.065 | -555.833 |
| COL001 | 16-11Lr | 1.333 | -0.000 | -0.110 | -325.986 |
| COL001 | 16-11Lr | 1.667 | -0.000 | -0.165 | -218.195 |
| COL001 | 16-11Lr | 2.000 | -0.000 | -0.227 | -158.810 |
| COL001 | 16-11Lr | 2.333 | -0.000 | -0.294 | -122.495 |
| COL001 | 16-11Lr | 2.667 | -0.000 | -0.365 | -98.729 |
| COL001 | 16-11Lr | 3.000 | -0.000 | -0.437 | -82.346 |
| COL001 | 16-14 »+X | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-9 | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-9 | 0.333 | -0.000 | -0.011 | < -2000 |
| COL001 | 16-9 | 0.667 | -0.000 | -0.040 | -896.666 |
| COL001 | 16-9 | 1.000 | -0.000 | -0.086 | -416.875 |
| COL001 | 16-9 | 1.333 | -0.000 | -0.147 | -244.490 |
| COL001 | 16-9 | 1.667 | -0.000 | -0.220 | -163.646 |
| COL001 | 16-9 | 2.000 | -0.000 | -0.302 | -119.107 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-9 | 2.333 | -0.000 | -0.392 | -91.872 |
| COL001 | 16-9 | 2.667 | -0.000 | -0.486 | -74.046 |
| COL001 | 16-9 | 3.000 | -0.000 | -0.583 | -61.759 |
| COL001 | D | 0.000 | **-0.000** | **0.000** | -NA- |
| COL001 | D | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | D+L | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | D+L | 0.333 | -0.000 | -0.011 | < -2000 |
| COL001 | D+L | 0.667 | -0.000 | -0.040 | -896.666 |
| COL001 | D+L | 1.000 | -0.000 | -0.086 | -416.875 |
| COL001 | D+L | 1.333 | -0.000 | -0.147 | -244.490 |
| COL001 | D+L | 1.667 | -0.000 | -0.220 | -163.646 |
| COL001 | D+L | 2.000 | -0.000 | -0.302 | -119.107 |
| COL001 | D+L | 2.333 | -0.000 | -0.392 | -91.872 |
| COL001 | D+L | 2.667 | -0.000 | -0.486 | -74.046 |
| COL001 | D+L | 3.000 | -0.000 | -0.583 | -61.759 |
| COL001 | L | 0.000 | 0.000 | -0.000 | -NA- |
| COL001 | L | 0.333 | 0.000 | -0.011 | < -2000 |
| COL001 | L | 0.667 | 0.000 | -0.040 | -896.666 |
| COL001 | L | 1.000 | 0.000 | -0.086 | -416.875 |
| COL001 | L | 1.333 | 0.000 | -0.147 | -244.490 |
| COL001 | L | 1.667 | 0.000 | -0.220 | -163.646 |
| COL001 | L | 2.000 | 0.000 | -0.302 | -119.107 |
| COL001 | L | 2.333 | 0.000 | -0.392 | -91.872 |
| COL001 | L | 2.667 | 0.000 | -0.486 | -74.046 |
| COL001 | L | 3.000 | 0.000 | **-0.583** | -61.759 |
| COL001 | Live | 0.000 | 0.000 | -0.000 | -NA- |
| COL001 | Live | 0.333 | 0.000 | -0.011 | < -2000 |
| COL001 | Live | 0.667 | 0.000 | -0.040 | -896.666 |
| COL001 | Live | 1.000 | 0.000 | -0.086 | -416.875 |
| COL001 | Live | 1.333 | 0.000 | -0.147 | -244.490 |
| COL001 | Live | 1.667 | 0.000 | -0.220 | -163.646 |
| COL001 | Live | 2.000 | 0.000 | -0.302 | -119.107 |
| COL001 | Live | 2.333 | 0.000 | -0.392 | -91.872 |
| COL001 | Live | 2.667 | 0.000 | -0.486 | -74.046 |
| COL001 | Live | 3.000 | 0.000 | -0.583 | -61.759 |

# Member Min/Max Displacements

| Extreme | Item | Member | Result Case Name | Offset ft | Dy in |
|---|---|---|---|---|---|
| Max | Dy | COL001 | D | 0.00 | **0.000** |
| Min | Dy | COL001 | L | 3.00 | **-0.583** |

# Member Min/Max Forces

| Extreme | Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Mz K-ft |
|---|---|---|---|---|---|---|---|
| Max | Axial | COL001 | 16-14 »+X | 3.00 | **0.000** | -0.000 | 0.000 |
| Max | Mz | COL001 | L | 3.00 | 0.000 | 0.200 | 0.000 |

| Extreme Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Mz K-ft |
|---|---|---|---|---|---|---|
| Max Vy | COL001 | L | 0.00 | 0.000 | **0.200** | **-0.600** |
| Min Axial | COL001 | D | 0.00 | **-0.006** | **-0.000** | **0.000** |
| Min Mz | COL001 | L | 0.00 | 0.000 | 0.200 | -0.600 |
| Min Vy | COL001 | D | 0.00 | -0.006 | -0.000 | 0.000 |

# Member Min/Max Stresses

| Extreme Item | Member | Result Case Name | Offset ft | fa Ksi | fby(+z) Ksi | fby(-z) Ksi | fbz(+y) Ksi | fbz(-y) Ksi |
|---|---|---|---|---|---|---|---|---|
| Max fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fbz(+y) | COL001 | L | 0.00 | 0.000 | 0.000 | -0.000 | **32.432** | **-32.432** |
| Max fbz(-y) | COL001 | L | 3.00 | 0.000 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fx | COL001 | 16-14 »+X | 3.00 | **0.000** | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fbz(+y) | COL001 | L | 3.00 | 0.000 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fbz(-y) | COL001 | L | 0.00 | 0.000 | 0.000 | -0.000 | 32.432 | -32.432 |
| Min fx | COL001 | D | 0.00 | **-0.01** | **0.000** | **-0.000** | **-0.000** | **0.000** |

# Nodal Displacements

| Node | Result Case Name | DX in | DY in | RZ deg |
|---|---|---|---|---|
| N001 | 16-10Lr | 0.000 | -0.000 | 0.000 |
| N001 | 16-11Lr | 0.000 | -0.000 | -0.000 |
| N001 | 16-14 »+X | 0.000 | -0.000 | 0.000 |
| N001 | 16-9 | 0.000 | -0.000 | -0.000 |
| N001 | D | **0.000** | **-0.000** | **0.000** |
| N001 | D+L | 0.000 | -0.000 | -0.000 |
| N001 | L | 0.000 | 0.000 | -0.000 |
| N001 | Live | 0.000 | 0.000 | -0.000 |
| N002 | 16-10Lr | 0.000 | -0.000 | 0.000 |
| N002 | 16-11Lr | 0.437 | -0.000 | -1.044 |
| N002 | 16-14 »+X | 0.000 | -0.000 | 0.000 |
| N002 | 16-9 | 0.583 | -0.000 | -1.392 |
| N002 | D | 0.000 | -0.000 | 0.000 |
| N002 | D+L | 0.583 | -0.000 | -1.392 |
| N002 | L | **0.583** | 0.000 | **-1.392** |
| N002 | Live | 0.583 | 0.000 | -1.392 |

# Nodal Reactions

| Node | Result Case Name | FX K | FY K | MZ K-ft |
|---|---|---|---|---|
| N001 | 16-10Lr | 0.00 | 0.01 | 0.00 |
| N001 | 16-11Lr | -0.15 | 0.01 | 0.45 |
| N001 | 16-14 »+X | 0.00 | 0.00 | 0.00 |
| N001 | 16-9 | -0.20 | 0.01 | 0.60 |
| N001 | D | **0.00** | **0.01** | **0.00** |
| N001 | D+L | -0.20 | 0.01 | 0.60 |
| N001 | L | **-0.20** | **0.00** | **0.60** |
| N001 | Live | -0.20 | 0.00 | 0.60 |

# Design Group Results

Steel Design, per AISC ASD (2005)
Design Group: Steel_Column_G01, Group Report, Designed As: HSS1.660x.140

SIZE CONSTRAINTS: none
BRACING INFORMATION:
Weak(y) Bracing: Unbraced
Strong(z) Bracing: Unbraced

COLUMN INFORMATION:
Automatic Kz (no sidesway) = varies; See 'Member K Factors' table.
Automatic Ky (no sidesway) = varies.

Fy = 42.00Ksi
Design checks assume a 2nd order analysis was performed. (No B1, B2 factors needed.)
Combined Stresses Check:

| Member Name | Result Case# | Offset ft | Pu K | Muz K-ft | Pn/Ω K | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| COL001 | 19.01 | 0.00 | -0.01 | -0.45 | 11.99 | 0.64 | H1-1b | 0.70 |
| COL001 | 21.01 | 0.00 | -0.01 | -0.60 | 11.99 | 0.64 | H1-1b | 0.94 |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| COL001 | 19.01 | 0.00 | -0.45 | 3.00 | 1.60 | 0.64 | F8-1 | 0.70 |
| COL001 | 21.01 | 0.00 | -0.60 | 3.00 | 1.60 | 0.64 | F8-1 | 0.94 |

# Rail Post

VisualAnalysis 6.00 Report
Company: Randall J. Hebert & Assoc. Inc.  Engineer: Randall J. Hebert  Billing: E Ray Desormeaux PE
Project File: Rail Post.vap
Folder: M:\EngE-K\ERD\BeauSoleil\

# Project Notes

Rail Post is analyzed for a 200 lb point load at the top

# Load Combination Summary

Equation Combination: 16-10Lr
   Combination: D + Lr*0 + H*0 + F*0
   Contributing Cases & Source
   D (D)
Equation Combination: 16-11Lr
   Combination: D + 0.75L + 0.75Lpa*0 + 0.75Lr*0 + H*0 + F*0 + 0.75T*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: 16-14 »+X
   Combination: 0.60D + H*0 + 1.50Fa*0 + W+X*0
   Contributing Cases & Source
   D (D)
Equation Combination: 16-9
   Combination: D + L + Lpa*0 + H*0 + F*0 + T*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: D+L
   Combination: D + L + Lpa*0
   Contributing Cases & Source
   D (D)
   L (L)
Equation Combination: Live
   Combination: L + Lpa*0 + Lr*0
   Contributing Cases & Source
   L (L)

# Nodes

| Node | X ft | Y ft | Fix DX | Fix DY | Fix RZ |
|---|---|---|---|---|---|
| N001 | 0.00 | 0.00 | Yes | Yes | Yes |
| N002 | 0.00 | 3.00 | No | No | No |

# Material Properties

| Material | Strength Ksi | Elasticity Ksi | Poisson | Density K/in^3 | Therm. Coeff. in/in/deg-F |
|---|---|---|---|---|---|
| ASTM A50 | -NA- | 29000.00 | 0.290 | 0.00 | 6.39e-006 |

# Member Elements

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Rz1 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Rz1 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|
| COL001 | HSS1.66 | ASTM A500 | N001 | N002 | 3.000 | 0.006 | Fix | Fix | Normal |

# Section Properties

| Section | Theta deg | Ax in^2 | Iz in^4 | Sz(+y) in^3 | Sz(-y) in^3 |
|---|---|---|---|---|---|
| HSS1.66 | 0.000 | 0.625 | 0.184 | 0.222 | 0.222 |

# Areas

This item is empty. Check the selection state, or report properties.

# Member Uniform Loads

This item is empty. Check the selection state, or report properties.

# Member Local Displacements

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-10Lr | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-10Lr | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-11Lr | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-11Lr | 0.333 | -0.000 | -0.008 | < -2000 |
| COL001 | 16-11Lr | 0.667 | -0.000 | -0.030 | -1195.555 |
| COL001 | 16-11Lr | 1.000 | -0.000 | -0.065 | -555.833 |
| COL001 | 16-11Lr | 1.333 | -0.000 | -0.110 | -325.986 |
| COL001 | 16-11Lr | 1.667 | -0.000 | -0.165 | -218.195 |
| COL001 | 16-11Lr | 2.000 | -0.000 | -0.227 | -158.810 |
| COL001 | 16-11Lr | 2.333 | -0.000 | -0.294 | -122.495 |
| COL001 | 16-11Lr | 2.667 | -0.000 | -0.365 | -98.729 |
| COL001 | 16-11Lr | 3.000 | -0.000 | -0.437 | -82.346 |
| COL001 | 16-14 »+X | 0.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | 16-14 »+X | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | 16-9 | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | 16-9 | 0.333 | -0.000 | -0.011 | < -2000 |
| COL001 | 16-9 | 0.667 | -0.000 | -0.040 | -896.666 |
| COL001 | 16-9 | 1.000 | -0.000 | -0.086 | -416.875 |
| COL001 | 16-9 | 1.333 | -0.000 | -0.147 | -244.490 |
| COL001 | 16-9 | 1.667 | -0.000 | -0.220 | -163.646 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy |
|---|---|---|---|---|---|
| COL001 | 16-9 | 2.000 | -0.000 | -0.302 | -119.107 |
| COL001 | 16-9 | 2.333 | -0.000 | -0.392 | -91.872 |
| COL001 | 16-9 | 2.667 | -0.000 | -0.486 | -74.046 |
| COL001 | 16-9 | 3.000 | -0.000 | -0.583 | -61.759 |
| COL001 | D | 0.000 | **-0.000** | **0.000** | -NA- |
| COL001 | D | 0.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 0.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.000 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 1.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.000 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.333 | -0.000 | 0.000 | -NA- |
| COL001 | D | 2.667 | -0.000 | 0.000 | -NA- |
| COL001 | D | 3.000 | -0.000 | 0.000 | -NA- |
| COL001 | D+L | 0.000 | -0.000 | -0.000 | -NA- |
| COL001 | D+L | 0.333 | -0.000 | -0.011 | < -2000 |
| COL001 | D+L | 0.667 | -0.000 | -0.040 | -896.666 |
| COL001 | D+L | 1.000 | -0.000 | -0.086 | -416.875 |
| COL001 | D+L | 1.333 | -0.000 | -0.147 | -244.490 |
| COL001 | D+L | 1.667 | -0.000 | -0.220 | -163.646 |
| COL001 | D+L | 2.000 | -0.000 | -0.302 | -119.107 |
| COL001 | D+L | 2.333 | -0.000 | -0.392 | -91.872 |
| COL001 | D+L | 2.667 | -0.000 | -0.486 | -74.046 |
| COL001 | D+L | 3.000 | -0.000 | -0.583 | -61.759 |
| COL001 | L | 0.000 | 0.000 | -0.000 | -NA- |
| COL001 | L | 0.333 | 0.000 | -0.011 | < -2000 |
| COL001 | L | 0.667 | 0.000 | -0.040 | -896.666 |
| COL001 | L | 1.000 | 0.000 | -0.086 | -416.875 |
| COL001 | L | 1.333 | 0.000 | -0.147 | -244.490 |
| COL001 | L | 1.667 | 0.000 | -0.220 | -163.646 |
| COL001 | L | 2.000 | 0.000 | -0.302 | -119.107 |
| COL001 | L | 2.333 | 0.000 | -0.392 | -91.872 |
| COL001 | L | 2.667 | 0.000 | -0.486 | -74.046 |
| COL001 | L | 3.000 | 0.000 | **-0.583** | -61.759 |
| COL001 | Live | 0.000 | 0.000 | -0.000 | -NA- |
| COL001 | Live | 0.333 | 0.000 | -0.011 | < -2000 |
| COL001 | Live | 0.667 | 0.000 | -0.040 | -896.666 |
| COL001 | Live | 1.000 | 0.000 | -0.086 | -416.875 |
| COL001 | Live | 1.333 | 0.000 | -0.147 | -244.490 |
| COL001 | Live | 1.667 | 0.000 | -0.220 | -163.646 |
| COL001 | Live | 2.000 | 0.000 | -0.302 | -119.107 |
| COL001 | Live | 2.333 | 0.000 | -0.392 | -91.872 |
| COL001 | Live | 2.667 | 0.000 | -0.486 | -74.046 |
| COL001 | Live | 3.000 | 0.000 | -0.583 | -61.759 |

# Member Min/Max Displacements

| Extreme | Item | Member | Result Case Name | Offset ft | Dy in |
|---|---|---|---|---|---|
| Max | Dy | COL001 | D | 0.00 | **0.000** |
| Min | Dy | COL001 | L | 3.00 | **-0.583** |

# Member Min/Max Forces

| Extreme | Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Mz K-ft |
|---|---|---|---|---|---|---|---|
| Max | Axial | COL001 | 16-14 »+X | 3.00 | **0.000** | -0.000 | 0.000 |

| Extreme Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Mz K-ft |
|---|---|---|---|---|---|---|
| Max Mz | COL001 | L | 3.00 | 0.000 | 0.200 | 0.000 |
| Max Vy | COL001 | L | 0.00 | 0.000 | **0.200** | **-0.600** |
| Min Axial | COL001 | D | 0.00 | **-0.006** | **-0.000** | **0.000** |
| Min Mz | COL001 | L | 0.00 | 0.000 | 0.200 | -0.600 |
| Min Vy | COL001 | D | 0.00 | -0.006 | -0.000 | 0.000 |

# Member Min/Max Stresses

| Extreme Item | Member | Result Case Name | Offset ft | fa Ksi | fby(+z) Ksi | fby(-z) Ksi | fbz(+y) Ksi | fbz(-y) Ksi |
|---|---|---|---|---|---|---|---|---|
| Max fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fbz(+y) | COL001 | L | 0.00 | 0.000 | 0.000 | -0.000 | **32.432** | **-32.432** |
| Max fbz(-y) | COL001 | L | 3.00 | 0.000 | 0.000 | -0.000 | -0.000 | 0.000 |
| Max fx | COL001 | 16-14 »+X | 3.00 | **0.000** | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fby(+z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fby(-z) | COL001 | D | 0.00 | -0.01 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fbz(+y) | COL001 | L | 3.00 | 0.000 | 0.000 | -0.000 | -0.000 | 0.000 |
| Min fbz(-y) | COL001 | L | 0.00 | 0.000 | 0.000 | -0.000 | 32.432 | -32.432 |
| Min fx | COL001 | D | 0.00 | **-0.01** | **0.000** | **-0.000** | **-0.000** | **0.000** |

# Nodal Displacements

| Node | Result Case Name | DX in | DY in | RZ deg |
|---|---|---|---|---|
| N001 | 16-10Lr | 0.000 | -0.000 | 0.000 |
| N001 | 16-11Lr | 0.000 | -0.000 | -0.000 |
| N001 | 16-14 »+X | 0.000 | -0.000 | 0.000 |
| N001 | 16-9 | 0.000 | -0.000 | -0.000 |
| N001 | D | **0.000** | **-0.000** | **0.000** |
| N001 | D+L | 0.000 | -0.000 | -0.000 |
| N001 | L | 0.000 | 0.000 | -0.000 |
| N001 | Live | 0.000 | 0.000 | -0.000 |
| N002 | 16-10Lr | 0.000 | -0.000 | 0.000 |
| N002 | 16-11Lr | 0.437 | -0.000 | -1.044 |
| N002 | 16-14 »+X | 0.000 | -0.000 | 0.000 |
| N002 | 16-9 | 0.583 | -0.000 | -1.392 |
| N002 | D | 0.000 | -0.000 | 0.000 |
| N002 | D+L | 0.583 | -0.000 | -1.392 |
| N002 | L | **0.583** | 0.000 | **-1.392** |
| N002 | Live | 0.583 | 0.000 | -1.392 |

# Nodal Reactions

| Node | Result Case Name | FX K | FY K | MZ K-ft |
|---|---|---|---|---|
| N001 | 16-10Lr | 0.00 | 0.01 | 0.00 |
| N001 | 16-11Lr | -0.15 | 0.01 | 0.45 |
| N001 | 16-14 »+X | 0.00 | 0.00 | 0.00 |
| N001 | 16-9 | -0.20 | 0.01 | 0.60 |
| N001 | D | **0.00** | **0.01** | **0.00** |
| N001 | D+L | -0.20 | 0.01 | 0.60 |
| N001 | L | **-0.20** | **0.00** | **0.60** |
| N001 | Live | -0.20 | 0.00 | 0.60 |

| Node | Result Case Name | FX K | FY K | MZ K-ft |
|---|---|---|---|---|

# Design Group Results

Steel Design, per AISC ASD (2005)
Design Group: Steel_Column_G01, Group Report, Designed As: HSS1.660x.140

SIZE CONSTRAINTS: none
BRACING INFORMATION:
Weak(y) Bracing: Unbraced
Strong(z) Bracing: Unbraced

COLUMN INFORMATION:
Automatic Kz (no sidesway) = varies; See 'Member K Factors' table.
Automatic Ky (no sidesway) = varies.

Fy = 42.00Ksi
Design checks assume a 2nd order analysis was performed. (No B1, B2 factors needed.)

Combined Stresses Check:

| Member Name | Result Case# | Offset ft | Pu K | Muz K-ft | Pn/Ω K | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| COL001 | 19.01 | 0.00 | -0.01 | -0.45 | 11.99 | 0.64 | H1-1b | 0.70 |
| COL001 | 21.01 | 0.00 | -0.01 | -0.60 | 11.99 | 0.64 | H1-1b | 0.94 |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| COL001 | 19.01 | 0.00 | -0.45 | 3.00 | 1.60 | 0.64 | F8-1 | 0.70 |
| COL001 | 21.01 | 0.00 | -0.60 | 3.00 | 1.60 | 0.64 | F8-1 | 0.94 |

# Restroom Framing

VisualAnalysis 6.00 Report
Company: Randall J. Hebert & Assoc. Inc.  Engineer: Randall J. Hebert
Project File: Restroom Framing.vap
Folder: M:\EngE-K\ERD\BeauSoleil\

## Project Notes

Tube Framing for Restroom Extension from Sidewall

## Nodes

| Node | X ft | Y ft | Z ft | Fix DX | Fix DY | Fix DZ | Fix RX | Fix RY | Fix RZ |
|---|---|---|---|---|---|---|---|---|---|
| N001 | 0.00 | 0.00 | 0.00 | Yes | Yes | Yes | No | No | No |
| N002 | 0.00 | 9.75 | 0.00 | Yes | Yes | Yes | No | No | No |
| N003 | 2.50 | 0.00 | 0.00 | No | No | No | No | No | No |
| N004 | 2.50 | 9.75 | 0.00 | No | No | No | No | No | No |
| N005 | 0.00 | 0.00 | 6.75 | Yes | Yes | Yes | No | No | No |
| N006 | 0.00 | 9.75 | 6.75 | Yes | Yes | Yes | No | No | No |
| N007 | 2.50 | 0.00 | 6.75 | No | No | No | No | No | No |
| N008 | 2.50 | 9.75 | 6.75 | No | No | No | No | No | No |

## Member Elements

| Member | Section | Material | (1)Node | (2)Node | Length ft | Weight K | Ry1 | Rz1 | Ry2 | Rz2 | One Way |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BmZ001 | HSS2x2x | ASTM A50 | N006 | N002 | 6.75 | 0.02 | Fix | Fix | Fix | Fix | Normal |
| BmX001 | HSS2x2x | ASTM A50 | N006 | N008 | 2.50 | 0.01 | Fix | Fix | Fix | Fix | Normal |
| BmX002 | HSS2x2x | ASTM A50 | N002 | N004 | 2.50 | 0.01 | Fix | Fix | Fix | Fix | Normal |
| BmZ002 | HSS2x2x | ASTM A50 | N005 | N001 | 6.75 | 0.02 | Fix | Fix | Fix | Fix | Normal |
| BmX003 | HSS2x2x | ASTM A50 | N001 | N003 | 2.50 | 0.01 | Fix | Fix | Fix | Fix | Normal |
| BmZ003 | HSS2x2x | ASTM A50 | N007 | N003 | 6.75 | 0.02 | Fix | Fix | Fix | Fix | Normal |
| BmX004 | HSS2x2x | ASTM A50 | N005 | N007 | 2.50 | 0.01 | Fix | Fix | Fix | Fix | Normal |
| BmZ004 | HSS2x2x | ASTM A50 | N008 | N004 | 6.75 | 0.02 | Fix | Fix | Fix | Fix | Normal |
| COL001 | HSS2x2x | ASTM A50 | N001 | N002 | 9.75 | 0.03 | Fix | Fix | Fix | Fix | Normal |
| COL001-- | HSS2x2x | ASTM A50 | N007 | N008 | 9.75 | 0.03 | Fix | Fix | Fix | Fix | Normal |
| COL001-0 | HSS2x2x | ASTM A50 | N003 | N004 | 9.75 | 0.03 | Fix | Fix | Fix | Fix | Normal |
| COL001-1 | HSS2x2x | ASTM A50 | N005 | N006 | 9.75 | 0.03 | Fix | Fix | Fix | Fix | Normal |

## Material Properties

| Material | Strength Ksi | Elasticity Ksi | Poisson | Density K/in^3 | Therm. Coeff. in/in/deg-F |
|---|---|---|---|---|---|
| ASTM A50 | -NA- | 29000.00 | 0.290 | 0.00 | 6.39e-006 |

## Section Properties

| Section | Beta deg | Theta deg | Ax in^2 | J in^4 | Iy in^4 | Iz in^4 | Sz(+y) in^3 | Sz(-y) in^3 | Sy(+z) in^3 | Sy(-z) in^3 |
|---|---|---|---|---|---|---|---|---|---|---|
| HSS2x2x | 0.00 | 0.00 | 0.84 | 0.80 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 |

## Member Uniform Loads

| Load Case | Member | Direction | Offset ft | End Offset ft | Force K/ft | Moment ft-K/ft |
|---|---|---|---|---|---|---|
| D | BmZ003 | DY | 0.00 | 6.75 | -0.01 | -NA- |
| D | BmZ004 | DY | 0.00 | 6.75 | -0.01 | -NA- |
| Lr | BmZ003 | DY | 0.00 | 6.75 | -0.13 | -NA- |
| Lr | BmZ004 | DY | 0.00 | 6.75 | -0.05 | -NA- |
| W+X | COL001-- | DX | 0.00 | 9.75 | -0.07 | -NA- |
| W+X | COL001-0 | DX | 0.00 | 9.75 | -0.07 | -NA- |
| W+Z | COL001-- | DZ | 0.00 | 9.75 | -0.07 | -NA- |
| W+Z | COL001-0 | DZ | 0.00 | 9.75 | -0.07 | -NA- |

# Member Local Displacements

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ001 | 16-10Lr | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-10Lr | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-10Lr | 0.28 | 0.00 | -0.03 | -1100.254 | -0.00 | -NA- |
| BmX001 | 16-10Lr | 0.56 | 0.00 | -0.06 | -518.656 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 0.83 | 0.00 | -0.09 | -330.436 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 1.11 | 0.00 | -0.13 | -239.637 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 1.39 | 0.00 | -0.16 | -187.451 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 1.67 | 0.00 | -0.19 | -154.310 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 1.94 | 0.00 | -0.23 | -131.980 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 2.22 | 0.00 | -0.26 | -116.363 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 2.25 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-10Lr | 2.50 | 0.00 | -0.29 | -105.260 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 3.00 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 3.75 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 4.50 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-10Lr | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ001 | 16-10R | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-10R | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-10R | 0.28 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-10R | 0.56 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-10R | 0.83 | 0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX001 | 16-10R | 1.11 | 0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX001 | 16-10R | 1.39 | 0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ001 | 16-10R | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-10R | 1.67 | 0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX001 | 16-10R | 1.94 | 0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX001 | 16-10R | 2.22 | 0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ001 | 16-10R | 2.25 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-10R | 2.50 | 0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ001 | 16-10R | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 4.50 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-10R | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ001 | 16-11Lr | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-11Lr | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-11Lr | 0.28 | 0.00 | -0.02 | -1378.944 | -0.00 | -NA- |
| BmX001 | 16-11Lr | 0.56 | 0.00 | -0.05 | -650.050 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 0.83 | 0.00 | -0.07 | -414.165 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX001 | 16-11Lr | 1.11 | 0.00 | -0.10 | -300.373 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 1.39 | 0.00 | -0.13 | -234.973 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 1.67 | 0.00 | -0.16 | -193.440 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 1.94 | 0.00 | -0.18 | -165.455 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 2.22 | 0.00 | -0.21 | -145.884 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 2.25 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-11Lr | 2.50 | 0.00 | -0.23 | -131.969 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 4.50 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-11Lr | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ001 | 16-12W »+X | 0.00 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 0.28 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 0.56 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 0.83 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 1.11 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 1.39 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 1.67 | -0.00 | -0.02 | -1692.821 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 1.94 | -0.00 | -0.03 | -1100.506 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 2.22 | -0.00 | -0.04 | -759.613 | -0.00 | < -2000 |
| BmZ001 | 16-12W »+X | 2.25 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-12W »+X | 2.50 | -0.00 | -0.05 | -548.089 | -0.00 | < -2000 |
| BmZ001 | 16-12W »+X | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 4.50 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-12W »+X | 6.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-12W »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-12W »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-12W »+Z | 0.28 | 0.00 | -0.01 | < -2000 | -0.02 | -1770.54 |
| BmX001 | 16-12W »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.04 | -815.959 |
| BmZ001 | 16-12W »+Z | 0.75 | 0.00 | 0.00 | > 2000 | -0.03 | < -2000 |
| BmX001 | 16-12W »+Z | 0.83 | 0.00 | -0.02 | -1718.889 | -0.06 | -511.436 |
| BmX001 | 16-12W »+Z | 1.11 | 0.00 | -0.02 | -1247.632 | -0.08 | -366.636 |
| BmX001 | 16-12W »+Z | 1.39 | 0.00 | -0.03 | -976.802 | -0.11 | -284.638 |
| BmZ001 | 16-12W »+Z | 1.50 | 0.00 | 0.00 | > 2000 | -0.04 | < -2000 |
| BmX001 | 16-12W »+Z | 1.67 | 0.00 | -0.04 | -804.805 | -0.13 | -233.345 |
| BmX001 | 16-12W »+Z | 1.94 | 0.00 | -0.04 | -688.907 | -0.15 | -199.389 |
| BmX001 | 16-12W »+Z | 2.22 | 0.00 | -0.05 | -607.830 | -0.17 | -176.174 |
| BmZ001 | 16-12W »+Z | 2.25 | 0.00 | -0.00 | < -2000 | -0.03 | < -2000 |
| BmX001 | 16-12W »+Z | 2.50 | 0.00 | -0.05 | -550.152 | -0.19 | -160.226 |
| BmZ001 | 16-12W »+Z | 3.00 | 0.00 | -0.00 | < -2000 | -0.01 | < -2000 |
| BmZ001 | 16-12W »+Z | 3.75 | 0.00 | -0.01 | < -2000 | 0.01 | > 2000 |
| BmZ001 | 16-12W »+Z | 4.50 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-12W »+Z | 5.25 | 0.00 | -0.01 | < -2000 | 0.04 | > 2000 |
| BmZ001 | 16-12W »+Z | 6.00 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-12W »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-13W+Lr »+X | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+Lr »+X | 0.28 | -0.00 | -0.02 | -1692.743 | -0.00 | -NA- |
| BmX001 | 16-13W+Lr »+X | 0.56 | -0.00 | -0.04 | -784.669 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 0.83 | -0.00 | -0.06 | -490.644 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 1.11 | -0.00 | -0.09 | -348.336 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 1.39 | -0.00 | -0.11 | -266.150 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX001 | 16-13W+Lr »+X | 1.67 | -0.00 | -0.14 | -213.450 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 1.94 | -0.00 | -0.17 | -177.251 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 2.22 | -0.00 | -0.20 | -151.198 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 2.25 | 0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmX001 | 16-13W+Lr »+X | 2.50 | -0.00 | -0.23 | -131.771 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 4.50 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| BmZ001 | 16-13W+Lr »+X | 6.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+Lr »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-13W+Lr »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-13W+Lr »+Z | 0.28 | 0.00 | -0.02 | -1377.753 | -0.01 | < -2000 |
| BmX001 | 16-13W+Lr »+Z | 0.56 | 0.00 | -0.05 | -649.499 | -0.03 | -1087.536 |
| BmZ001 | 16-13W+Lr »+Z | 0.75 | 0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| BmX001 | 16-13W+Lr »+Z | 0.83 | 0.00 | -0.07 | -413.819 | -0.04 | -681.666 |
| BmX001 | 16-13W+Lr »+Z | 1.11 | 0.00 | -0.10 | -300.124 | -0.06 | -488.674 |
| BmX001 | 16-13W+Lr »+Z | 1.39 | 0.00 | -0.13 | -234.780 | -0.08 | -379.384 |
| BmZ001 | 16-13W+Lr »+Z | 1.50 | 0.00 | 0.00 | > 2000 | -0.03 | < -2000 |
| BmX001 | 16-13W+Lr »+Z | 1.67 | 0.00 | -0.16 | -193.282 | -0.10 | -311.018 |
| BmX001 | 16-13W+Lr »+Z | 1.94 | 0.00 | -0.18 | -165.320 | -0.11 | -265.759 |
| BmX001 | 16-13W+Lr »+Z | 2.22 | 0.00 | -0.21 | -145.764 | -0.13 | -234.816 |
| BmZ001 | 16-13W+Lr »+Z | 2.25 | 0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| BmX001 | 16-13W+Lr »+Z | 2.50 | 0.00 | -0.23 | -131.860 | -0.14 | -213.559 |
| BmZ001 | 16-13W+Lr »+Z | 3.00 | 0.00 | -0.00 | < -2000 | -0.01 | < -2000 |
| BmZ001 | 16-13W+Lr »+Z | 3.75 | 0.00 | -0.01 | < -2000 | 0.01 | > 2000 |
| BmZ001 | 16-13W+Lr »+Z | 4.50 | 0.00 | -0.01 | < -2000 | 0.02 | > 2000 |
| BmZ001 | 16-13W+Lr »+Z | 5.25 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-13W+Lr »+Z | 6.00 | 0.00 | -0.01 | < -2000 | 0.02 | > 2000 |
| BmZ001 | 16-13W+Lr »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 0.00 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 0.28 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 0.56 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 0.83 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 1.11 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 1.39 | -0.00 | -0.02 | -1921.022 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 1.67 | -0.00 | -0.02 | -1329.306 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 1.94 | -0.00 | -0.03 | -959.002 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 2.22 | -0.00 | -0.04 | -715.937 | -0.00 | < -2000 |
| BmZ001 | 16-13W+R »+X | 2.25 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-13W+R »+X | 2.50 | -0.00 | -0.05 | -549.230 | -0.00 | < -2000 |
| BmZ001 | 16-13W+R »+X | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 4.50 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+X | 6.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-13W+R »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-13W+R »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-13W+R »+Z | 0.28 | 0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmX001 | 16-13W+R »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.03 | -1087.921 |
| BmZ001 | 16-13W+R »+Z | 0.75 | 0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| BmX001 | 16-13W+R »+Z | 0.83 | 0.00 | -0.02 | -1720.878 | -0.04 | -681.901 |
| BmX001 | 16-13W+R »+Z | 1.11 | 0.00 | -0.02 | -1249.062 | -0.06 | -488.839 |
| BmX001 | 16-13W+R »+Z | 1.39 | 0.00 | -0.03 | -977.915 | -0.08 | -379.510 |
| BmZ001 | 16-13W+R »+Z | 1.50 | 0.00 | 0.00 | > 2000 | -0.03 | < -2000 |
| BmX001 | 16-13W+R »+Z | 1.67 | 0.00 | -0.04 | -805.719 | -0.10 | -311.121 |
| BmX001 | 16-13W+R »+Z | 1.94 | 0.00 | -0.04 | -689.690 | -0.11 | -265.847 |
| BmX001 | 16-13W+R »+Z | 2.22 | 0.00 | -0.05 | -608.523 | -0.13 | -234.894 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ001 | 16-13W+R »+Z | 2.25 | 0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| BmX001 | 16-13W+R »+Z | 2.50 | 0.00 | -0.05 | -550.783 | -0.14 | -213.630 |
| BmZ001 | 16-13W+R »+Z | 3.00 | 0.00 | -0.00 | < -2000 | -0.01 | < -2000 |
| BmZ001 | 16-13W+R »+Z | 3.75 | 0.00 | -0.01 | < -2000 | 0.01 | > 2000 |
| BmZ001 | 16-13W+R »+Z | 4.50 | 0.00 | -0.01 | < -2000 | 0.02 | > 2000 |
| BmZ001 | 16-13W+R »+Z | 5.25 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-13W+R »+Z | 6.00 | 0.00 | -0.01 | < -2000 | 0.02 | > 2000 |
| BmZ001 | 16-13W+R »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 0.00 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 0.28 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 0.56 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 0.83 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 1.11 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 1.39 | -0.00 | 0.00 | > 2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 1.67 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 1.94 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 2.22 | -0.00 | -0.02 | -1511.995 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 2.25 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X | 2.50 | -0.00 | -0.03 | -908.445 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 3.00 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 3.75 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 4.50 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X | 6.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 0.28 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 0.56 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 0.83 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 1.11 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 1.39 | 0.00 | -0.02 | -1635.446 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 1.67 | 0.00 | -0.02 | -1347.457 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 1.94 | 0.00 | -0.03 | -1153.415 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 2.22 | 0.00 | -0.03 | -1017.685 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 2.25 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | 16-14 »+X+Y | 2.50 | 0.00 | -0.03 | -921.140 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 3.00 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 3.75 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 4.50 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | 16-14 »+X+Y | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ001 | 16-14 »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | 16-14 »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | 16-14 »+Z | 0.28 | 0.00 | -0.00 | < -2000 | -0.02 | -1770.588 |
| BmX001 | 16-14 »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.04 | -815.980 |
| BmZ001 | 16-14 »+Z | 0.75 | 0.00 | 0.00 | > 2000 | -0.03 | < -2000 |
| BmX001 | 16-14 »+Z | 0.83 | 0.00 | -0.01 | < -2000 | -0.06 | -511.449 |
| BmX001 | 16-14 »+Z | 1.11 | 0.00 | -0.01 | < -2000 | -0.08 | -366.645 |
| BmX001 | 16-14 »+Z | 1.39 | 0.00 | -0.02 | -1623.079 | -0.11 | -284.645 |
| BmZ001 | 16-14 »+Z | 1.50 | 0.00 | 0.00 | > 2000 | -0.04 | < -2000 |
| BmX001 | 16-14 »+Z | 1.67 | 0.00 | -0.02 | -1337.296 | -0.13 | -233.351 |
| BmX001 | 16-14 »+Z | 1.94 | 0.00 | -0.03 | -1144.714 | -0.15 | -199.394 |
| BmX001 | 16-14 »+Z | 2.22 | 0.00 | -0.03 | -1009.984 | -0.17 | -176.178 |
| BmZ001 | 16-14 »+Z | 2.25 | 0.00 | 0.00 | > 2000 | -0.03 | < -2000 |
| BmX001 | 16-14 »+Z | 2.50 | 0.00 | -0.03 | -914.128 | -0.19 | -160.230 |
| BmZ001 | 16-14 »+Z | 3.00 | 0.00 | -0.00 | < -2000 | -0.01 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ001 | 16-14 »+Z | 3.75 | 0.00 | -0.01 | < -2000 | 0.01 | > 2000 |
| BmZ001 | 16-14 »+Z | 4.50 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-14 »+Z | 5.25 | 0.00 | -0.01 | < -2000 | 0.04 | > 2000 |
| BmZ001 | 16-14 »+Z | 6.00 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ001 | 16-14 »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | D | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | D | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | D | 0.28 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | D | 0.56 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | D | 0.83 | 0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX001 | D | 1.11 | 0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX001 | D | 1.39 | 0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ001 | D | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | D | 1.67 | 0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX001 | D | 1.94 | 0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX001 | D | 2.22 | 0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ001 | D | 2.25 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | D | 2.50 | 0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ001 | D | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 4.50 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | D | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | D+L | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ001 | D+L | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | D+L | 0.28 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | D+L | 0.56 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 0.75 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | D+L | 0.83 | 0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX001 | D+L | 1.11 | 0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX001 | D+L | 1.39 | 0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ001 | D+L | 1.50 | 0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX001 | D+L | 1.67 | 0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX001 | D+L | 1.94 | 0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX001 | D+L | 2.22 | 0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ001 | D+L | 2.25 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX001 | D+L | 2.50 | 0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ001 | D+L | 3.00 | 0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 3.75 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 4.50 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 5.25 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 6.00 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmZ001 | D+L | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ001 | Live | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX001 | Live | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX001 | Live | 0.28 | 0.00 | -0.02 | -1361.00 | -0.00 | -NA- |
| BmX001 | Live | 0.56 | 0.00 | -0.05 | -641.490 | -0.00 | < -2000 |
| BmZ001 | Live | 0.75 | 0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmX001 | Live | 0.83 | 0.00 | -0.07 | -408.627 | -0.00 | < -2000 |
| BmX001 | Live | 1.11 | 0.00 | -0.10 | -296.284 | -0.00 | < -2000 |
| BmX001 | Live | 1.39 | 0.00 | -0.13 | -231.716 | -0.00 | < -2000 |
| BmZ001 | Live | 1.50 | 0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmX001 | Live | 1.67 | 0.00 | -0.16 | -190.710 | -0.00 | < -2000 |
| BmX001 | Live | 1.94 | 0.00 | -0.18 | -163.081 | -0.00 | < -2000 |
| BmX001 | Live | 2.22 | 0.00 | -0.21 | -143.759 | -0.00 | < -2000 |
| BmZ001 | Live | 2.25 | 0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmX001 | Live | 2.50 | 0.00 | -0.23 | -130.023 | -0.00 | < -2000 |
| BmZ001 | Live | 3.00 | 0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmZ001 | Live | 3.75 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmZ001 | Live | 4.50 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmZ001 | Live | 5.25 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ001 | Live | 6.00 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| BmZ001 | Live | 6.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | 16-10Lr | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-10Lr | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-10Lr | 0.28 | 0.00 | -0.03 | -1100.254 | 0.00 | -NA- |
| BmX002 | 16-10Lr | 0.56 | 0.00 | -0.06 | -518.656 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 0.75 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 0.83 | 0.00 | -0.09 | -330.436 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 1.11 | 0.00 | -0.13 | -239.637 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 1.39 | 0.00 | -0.16 | -187.451 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 1.50 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 1.67 | 0.00 | -0.19 | -154.310 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 1.94 | 0.00 | -0.23 | -131.980 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 2.22 | 0.00 | -0.26 | -116.363 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 2.25 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-10Lr | 2.50 | 0.00 | -0.29 | -105.260 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 3.00 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 3.75 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 4.50 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 5.25 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 6.00 | 0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-10Lr | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-10R | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | 16-10R | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-10R | 0.28 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-10R | 0.56 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-10R | 0.83 | 0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX002 | 16-10R | 1.11 | 0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX002 | 16-10R | 1.39 | 0.00 | -0.03 | -981.268 | 0.00 | -NA- |
| BmZ002 | 16-10R | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-10R | 1.67 | 0.00 | -0.04 | -808.474 | 0.00 | -NA- |
| BmX002 | 16-10R | 1.94 | 0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX002 | 16-10R | 2.22 | 0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ002 | 16-10R | 2.25 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-10R | 2.50 | 0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ002 | 16-10R | 3.00 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 3.75 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 4.50 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-10R | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-11Lr | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-11Lr | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-11Lr | 0.28 | 0.00 | -0.02 | -1378.944 | 0.00 | -NA- |
| BmX002 | 16-11Lr | 0.56 | 0.00 | -0.05 | -650.050 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 0.75 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 0.83 | 0.00 | -0.07 | -414.165 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 1.11 | 0.00 | -0.10 | -300.373 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 1.39 | 0.00 | -0.13 | -234.973 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 1.50 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 1.67 | 0.00 | -0.16 | -193.440 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 1.94 | 0.00 | -0.18 | -165.455 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 2.22 | 0.00 | -0.21 | -145.884 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 2.25 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-11Lr | 2.50 | 0.00 | -0.23 | -131.969 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 3.00 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 3.75 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 4.50 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 5.25 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 6.00 | 0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-11Lr | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-12W »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ002 | 16-12W »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-12W »+X | 0.28 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 0.56 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 0.83 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 1.11 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 1.39 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 1.67 | -0.00 | -0.02 | -1692.821 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 1.94 | -0.00 | -0.03 | -1100.506 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 2.22 | -0.00 | -0.04 | -759.613 | 0.00 | > 2000 |
| BmZ002 | 16-12W »+X | 2.25 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-12W »+X | 2.50 | -0.00 | -0.05 | -548.089 | 0.00 | > 2000 |
| BmZ002 | 16-12W »+X | 3.00 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 3.75 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 4.50 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-12W »+X | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-12W »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-12W »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-12W »+Z | 0.28 | -0.00 | -0.01 | < -2000 | -0.02 | -1770.779 |
| BmX002 | 16-12W »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.04 | -816.064 |
| BmZ002 | 16-12W »+Z | 0.75 | 0.00 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-12W »+Z | 0.83 | -0.00 | -0.02 | -1734.929 | -0.06 | -511.500 |
| BmX002 | 16-12W »+Z | 1.11 | -0.00 | -0.02 | -1259.162 | -0.08 | -366.682 |
| BmX002 | 16-12W »+Z | 1.39 | -0.00 | -0.03 | -985.774 | -0.11 | -284.673 |
| BmZ002 | 16-12W »+Z | 1.50 | 0.00 | -0.01 | < -2000 | -0.04 | < -2000 |
| BmX002 | 16-12W »+Z | 1.67 | -0.00 | -0.04 | -812.177 | -0.13 | -233.373 |
| BmX002 | 16-12W »+Z | 1.94 | -0.00 | -0.04 | -695.219 | -0.15 | -199.413 |
| BmX002 | 16-12W »+Z | 2.22 | -0.00 | -0.05 | -613.417 | -0.17 | -176.195 |
| BmZ002 | 16-12W »+Z | 2.25 | 0.00 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-12W »+Z | 2.50 | -0.00 | -0.05 | -555.240 | -0.19 | -160.245 |
| BmZ002 | 16-12W »+Z | 3.00 | 0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmZ002 | 16-12W »+Z | 3.75 | 0.00 | -0.00 | < -2000 | 0.01 | > 2000 |
| BmZ002 | 16-12W »+Z | 4.50 | 0.00 | -0.00 | < -2000 | 0.03 | > 2000 |
| BmZ002 | 16-12W »+Z | 5.25 | 0.00 | 0.00 | > 2000 | 0.04 | > 2000 |
| BmZ002 | 16-12W »+Z | 6.00 | 0.00 | 0.00 | > 2000 | 0.03 | > 2000 |
| BmZ002 | 16-12W »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+Lr »+X | 0.28 | -0.00 | -0.02 | -1692.743 | 0.00 | -NA- |
| BmX002 | 16-13W+Lr »+X | 0.56 | -0.00 | -0.04 | -784.669 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 0.75 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 0.83 | -0.00 | -0.06 | -490.644 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 1.11 | -0.00 | -0.09 | -348.336 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 1.39 | -0.00 | -0.11 | -266.150 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 1.50 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 1.67 | -0.00 | -0.14 | -213.450 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 1.94 | -0.00 | -0.17 | -177.251 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 2.22 | -0.00 | -0.20 | -151.198 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 2.25 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | 16-13W+Lr »+X | 2.50 | -0.00 | -0.23 | -131.771 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 3.00 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 3.75 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 4.50 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 5.25 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 6.00 | 0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmZ002 | 16-13W+Lr »+X | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+Lr »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-13W+Lr »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-13W+Lr »+Z | 0.28 | -0.00 | -0.02 | -1380.137 | -0.01 | < -2000 |
| BmX002 | 16-13W+Lr »+Z | 0.56 | -0.00 | -0.05 | -650.601 | -0.03 | -1088.495 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ002 | 16-13W+Lr »+Z | 0.75 | 0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| BmX002 | 16-13W+Lr »+Z | 0.83 | -0.00 | -0.07 | -414.511 | -0.04 | -682.250 |
| BmX002 | 16-13W+Lr »+Z | 1.11 | -0.00 | -0.10 | -300.621 | -0.06 | -489.084 |
| BmX002 | 16-13W+Lr »+Z | 1.39 | -0.00 | -0.13 | -235.166 | -0.08 | -379.698 |
| BmZ002 | 16-13W+Lr »+Z | 1.50 | 0.00 | -0.02 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-13W+Lr »+Z | 1.67 | -0.00 | -0.15 | -193.598 | -0.10 | -311.274 |
| BmX002 | 16-13W+Lr »+Z | 1.94 | -0.00 | -0.18 | -165.590 | -0.11 | -265.978 |
| BmX002 | 16-13W+Lr »+Z | 2.22 | -0.00 | -0.21 | -146.003 | -0.13 | -235.010 |
| BmZ002 | 16-13W+Lr »+Z | 2.25 | 0.00 | -0.03 | < -2000 | -0.02 | < -2000 |
| BmX002 | 16-13W+Lr »+Z | 2.50 | -0.00 | -0.23 | -132.078 | -0.14 | -213.737 |
| BmZ002 | 16-13W+Lr »+Z | 3.00 | 0.00 | -0.03 | < -2000 | -0.01 | < -2000 |
| BmZ002 | 16-13W+Lr »+Z | 3.75 | 0.00 | -0.03 | < -2000 | 0.01 | > 2000 |
| BmZ002 | 16-13W+Lr »+Z | 4.50 | 0.00 | -0.02 | < -2000 | 0.02 | > 2000 |
| BmZ002 | 16-13W+Lr »+Z | 5.25 | 0.00 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ002 | 16-13W+Lr »+Z | 6.00 | 0.00 | -0.01 | < -2000 | 0.02 | > 2000 |
| BmZ002 | 16-13W+Lr »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 0.28 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 0.56 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 0.83 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 1.11 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 1.39 | -0.00 | -0.02 | -1921.022 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 1.67 | -0.00 | -0.02 | -1329.306 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 1.94 | -0.00 | -0.03 | -959.002 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 2.22 | -0.00 | -0.04 | -715.937 | 0.00 | > 2000 |
| BmZ002 | 16-13W+R »+X | 2.25 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-13W+R »+X | 2.50 | -0.00 | -0.05 | -549.230 | 0.00 | > 2000 |
| BmZ002 | 16-13W+R »+X | 3.00 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 3.75 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 4.50 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-13W+R »+X | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-13W+R »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-13W+R »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-13W+R »+Z | 0.28 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmX002 | 16-13W+R »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.03 | -1088.109 |
| BmZ002 | 16-13W+R »+Z | 0.75 | 0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| BmX002 | 16-13W+R »+Z | 0.83 | -0.00 | -0.02 | -1732.908 | -0.04 | -682.015 |
| BmX002 | 16-13W+R »+Z | 1.11 | -0.00 | -0.02 | -1257.709 | -0.06 | -488.919 |
| BmX002 | 16-13W+R »+Z | 1.39 | -0.00 | -0.03 | -984.644 | -0.08 | -379.572 |
| BmZ002 | 16-13W+R »+Z | 1.50 | 0.00 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-13W+R »+Z | 1.67 | -0.00 | -0.04 | -811.248 | -0.10 | -311.171 |
| BmX002 | 16-13W+R »+Z | 1.94 | -0.00 | -0.04 | -694.424 | -0.11 | -265.890 |
| BmX002 | 16-13W+R »+Z | 2.22 | -0.00 | -0.05 | -612.713 | -0.13 | -234.932 |
| BmZ002 | 16-13W+R »+Z | 2.25 | 0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| BmX002 | 16-13W+R »+Z | 2.50 | -0.00 | -0.05 | -554.599 | -0.14 | -213.665 |
| BmZ002 | 16-13W+R »+Z | 3.00 | 0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmZ002 | 16-13W+R »+Z | 3.75 | 0.00 | -0.00 | < -2000 | 0.01 | > 2000 |
| BmZ002 | 16-13W+R »+Z | 4.50 | 0.00 | -0.00 | < -2000 | 0.02 | > 2000 |
| BmZ002 | 16-13W+R »+Z | 5.25 | 0.00 | 0.00 | > 2000 | 0.03 | > 2000 |
| BmZ002 | 16-13W+R »+Z | 6.00 | 0.00 | 0.00 | > 2000 | 0.02 | > 2000 |
| BmZ002 | 16-13W+R »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-14 »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-14 »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 0.28 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 0.56 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 0.83 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 1.11 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX002 | 16-14 »+X | 1.39 | -0.00 | 0.00 | > 2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 1.67 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 1.94 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 2.22 | -0.00 | -0.02 | -1511.995 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 2.25 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X | 2.50 | -0.00 | -0.03 | -908.445 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 3.00 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 3.75 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 4.50 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 0.28 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 0.56 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 0.83 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 1.11 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 1.39 | 0.00 | -0.02 | -1635.446 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 1.67 | 0.00 | -0.02 | -1347.457 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 1.94 | 0.00 | -0.03 | -1153.415 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 2.22 | 0.00 | -0.03 | -1017.685 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 2.25 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | 16-14 »+X+Y | 2.50 | 0.00 | -0.03 | -921.140 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 3.00 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 3.75 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 4.50 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | 16-14 »+X+Y | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | 16-14 »+Z | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | 16-14 »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | 16-14 »+Z | 0.28 | -0.00 | -0.00 | < -2000 | -0.02 | -1770.731 |
| BmX002 | 16-14 »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.04 | -816.043 |
| BmZ002 | 16-14 »+Z | 0.75 | 0.00 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-14 »+Z | 0.83 | -0.00 | -0.01 | < -2000 | -0.06 | -511.488 |
| BmX002 | 16-14 »+Z | 1.11 | -0.00 | -0.01 | < -2000 | -0.08 | -366.673 |
| BmX002 | 16-14 »+Z | 1.39 | -0.00 | -0.02 | -1648.003 | -0.11 | -284.666 |
| BmZ002 | 16-14 »+Z | 1.50 | 0.00 | -0.01 | < -2000 | -0.04 | < -2000 |
| BmX002 | 16-14 »+Z | 1.67 | -0.00 | -0.02 | -1357.774 | -0.13 | -233.368 |
| BmX002 | 16-14 »+Z | 1.94 | -0.00 | -0.03 | -1162.249 | -0.15 | -199.409 |
| BmX002 | 16-14 »+Z | 2.22 | -0.00 | -0.03 | -1025.504 | -0.17 | -176.191 |
| BmZ002 | 16-14 »+Z | 2.25 | 0.00 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX002 | 16-14 »+Z | 2.50 | -0.00 | -0.03 | -928.262 | -0.19 | -160.242 |
| BmZ002 | 16-14 »+Z | 3.00 | 0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmZ002 | 16-14 »+Z | 3.75 | 0.00 | -0.00 | < -2000 | 0.01 | > 2000 |
| BmZ002 | 16-14 »+Z | 4.50 | 0.00 | 0.00 | > 2000 | 0.03 | > 2000 |
| BmZ002 | 16-14 »+Z | 5.25 | 0.00 | 0.00 | > 2000 | 0.04 | > 2000 |
| BmZ002 | 16-14 »+Z | 6.00 | 0.00 | 0.00 | > 2000 | 0.03 | > 2000 |
| BmZ002 | 16-14 »+Z | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | D | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | D | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | D | 0.28 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | D | 0.56 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | D | 0.83 | 0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX002 | D | 1.11 | 0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX002 | D | 1.39 | 0.00 | -0.03 | -981.268 | 0.00 | -NA- |
| BmZ002 | D | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | D | 1.67 | 0.00 | -0.04 | -808.474 | 0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX002 | D | 1.94 | 0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX002 | D | 2.22 | 0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ002 | D | 2.25 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | D | 2.50 | 0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ002 | D | 3.00 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 3.75 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 4.50 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | D | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ002 | D+L | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | D+L | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX002 | D+L | 0.28 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | D+L | 0.56 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 0.75 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | D+L | 0.83 | 0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX002 | D+L | 1.11 | 0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX002 | D+L | 1.39 | 0.00 | -0.03 | -981.268 | 0.00 | -NA- |
| BmZ002 | D+L | 1.50 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX002 | D+L | 1.67 | 0.00 | -0.04 | -808.474 | 0.00 | -NA- |
| BmX002 | D+L | 1.94 | 0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX002 | D+L | 2.22 | 0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ002 | D+L | 2.25 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX002 | D+L | 2.50 | 0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ002 | D+L | 3.00 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 3.75 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 4.50 | 0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 5.25 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 6.00 | 0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmZ002 | D+L | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | Live | 0.00 | 0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmZ002 | Live | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX002 | Live | 0.28 | 0.00 | -0.02 | -1361.00 | 0.00 | -NA- |
| BmX002 | Live | 0.56 | 0.00 | -0.05 | -641.490 | 0.00 | > 2000 |
| BmZ002 | Live | 0.75 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmX002 | Live | 0.83 | 0.00 | -0.07 | -408.627 | 0.00 | > 2000 |
| BmX002 | Live | 1.11 | 0.00 | -0.10 | -296.284 | 0.00 | > 2000 |
| BmX002 | Live | 1.39 | 0.00 | -0.13 | -231.716 | 0.00 | > 2000 |
| BmZ002 | Live | 1.50 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmX002 | Live | 1.67 | 0.00 | -0.16 | -190.710 | 0.00 | > 2000 |
| BmX002 | Live | 1.94 | 0.00 | -0.18 | -163.081 | 0.00 | > 2000 |
| BmX002 | Live | 2.22 | 0.00 | -0.21 | -143.759 | 0.00 | > 2000 |
| BmZ002 | Live | 2.25 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX002 | Live | 2.50 | 0.00 | -0.23 | -130.023 | 0.00 | > 2000 |
| BmZ002 | Live | 3.00 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | Live | 3.75 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | Live | 4.50 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmZ002 | Live | 5.25 | 0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| BmZ002 | Live | 6.00 | 0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| BmZ002 | Live | 6.75 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ003 | 16-10Lr | 0.00 | -0.00 | -0.29 | -283.598 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-10Lr | 0.28 | -0.00 | -0.03 | -1097.685 | -0.00 | -NA- |
| BmX003 | 16-10Lr | 0.56 | -0.00 | -0.06 | -517.489 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 0.75 | -0.00 | -0.35 | -233.799 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 0.83 | -0.00 | -0.09 | -329.714 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 1.11 | -0.00 | -0.13 | -239.124 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 1.39 | -0.00 | -0.16 | -187.056 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 1.50 | -0.00 | -0.41 | -197.037 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 1.67 | -0.00 | -0.19 | -153.987 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 1.94 | -0.00 | -0.23 | -131.703 | -0.00 | < -2000 |
| BmX003 | 16-10Lr | 2.22 | -0.00 | -0.26 | -116.118 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 2.25 | -0.00 | -0.46 | -174.863 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX003 | 16-10Lr | 2.50 | -0.00 | -0.29 | -105.036 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 3.00 | -0.00 | **-0.49** | -164.621 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 3.75 | 0.00 | -0.49 | -164.621 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 4.50 | 0.00 | -0.46 | -174.863 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 5.25 | 0.00 | -0.41 | -197.037 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 6.00 | 0.00 | -0.35 | -233.799 | -0.00 | < -2000 |
| BmZ003 | 16-10Lr | 6.75 | 0.00 | -0.29 | -283.598 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 0.00 | -0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmX003 | 16-10R | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-10R | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-10R | 0.56 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ003 | 16-10R | 0.75 | -0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |
| BmX003 | 16-10R | 0.83 | -0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX003 | 16-10R | 1.11 | -0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX003 | 16-10R | 1.39 | -0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ003 | 16-10R | 1.50 | -0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmX003 | 16-10R | 1.67 | -0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX003 | 16-10R | 1.94 | -0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX003 | 16-10R | 2.22 | -0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 2.25 | -0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmX003 | 16-10R | 2.50 | -0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 3.00 | -0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 3.75 | 0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 4.50 | 0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 5.25 | 0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 6.00 | 0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |
| BmZ003 | 16-10R | 6.75 | 0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 0.00 | -0.00 | -0.23 | -355.603 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-11Lr | 0.28 | -0.00 | -0.02 | -1375.917 | -0.00 | -NA- |
| BmX003 | 16-11Lr | 0.56 | -0.00 | -0.05 | -648.675 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 0.75 | -0.00 | -0.27 | -294.627 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 0.83 | -0.00 | -0.07 | -413.314 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 1.11 | -0.00 | -0.10 | -299.768 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 1.39 | -0.00 | -0.13 | -234.507 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 1.50 | -0.00 | -0.33 | -249.185 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 1.67 | -0.00 | -0.16 | -193.059 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 1.94 | -0.00 | -0.18 | -165.129 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 2.22 | -0.00 | -0.21 | -145.595 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 2.25 | -0.00 | -0.37 | -221.610 | -0.00 | < -2000 |
| BmX003 | 16-11Lr | 2.50 | -0.00 | -0.23 | -131.705 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 3.00 | -0.00 | -0.39 | -208.830 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 3.75 | 0.00 | -0.39 | -208.830 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 4.50 | 0.00 | -0.37 | -221.610 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 5.25 | 0.00 | -0.33 | -249.185 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 6.00 | 0.00 | -0.27 | -294.627 | -0.00 | < -2000 |
| BmZ003 | 16-11Lr | 6.75 | 0.00 | -0.23 | -355.603 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 0.00 | -0.00 | -0.05 | -1504.866 | -0.00 | < -2000 |
| BmX003 | 16-12W »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 0.56 | -0.00 | -0.02 | -1386.794 | -0.00 | -NA- |
| BmZ003 | 16-12W »+X | 0.75 | -0.00 | -0.06 | -1352.568 | -0.00 | < -2000 |
| BmX003 | 16-12W »+X | 0.83 | -0.00 | -0.03 | -925.162 | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 1.11 | -0.00 | -0.04 | -709.692 | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 1.39 | -0.00 | -0.05 | -593.894 | -0.00 | -NA- |
| BmZ003 | 16-12W »+X | 1.50 | -0.00 | -0.07 | -1217.832 | -0.00 | < -2000 |
| BmX003 | 16-12W »+X | 1.67 | -0.00 | -0.06 | -531.049 | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 1.94 | -0.00 | -0.06 | -504.720 | -0.00 | -NA- |
| BmX003 | 16-12W »+X | 2.22 | -0.00 | -0.06 | -510.478 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 2.25 | -0.00 | -0.07 | -1126.281 | -0.00 | < -2000 |
| BmX003 | 16-12W »+X | 2.50 | -0.00 | -0.05 | -557.358 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 3.00 | -0.00 | -0.07 | -1081.111 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 3.75 | 0.00 | -0.07 | -1081.111 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ003 | 16-12W »+X | 4.50 | 0.00 | -0.07 | -1126.281 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 5.25 | 0.00 | -0.07 | -1217.832 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 6.00 | 0.00 | -0.06 | -1352.568 | -0.00 | < -2000 |
| BmZ003 | 16-12W »+X | 6.75 | 0.00 | -0.05 | -1504.866 | -0.00 | < -2000 |
| BmX003 | 16-12W »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ003 | 16-12W »+Z | 0.00 | **0.19** | -0.05 | -1499.148 | 0.00 | > 2000 |
| BmX003 | 16-12W »+Z | 0.28 | -0.00 | -0.01 | < -2000 | -0.02 | -1770.54 |
| BmX003 | 16-12W »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.04 | -815.959 |
| BmZ003 | 16-12W »+Z | 0.75 | 0.19 | -0.09 | -950.282 | -0.03 | < -2000 |
| BmX003 | 16-12W »+Z | 0.83 | -0.00 | -0.02 | -1718.889 | -0.06 | -511.436 |
| BmX003 | 16-12W »+Z | 1.11 | -0.00 | -0.02 | -1247.632 | -0.08 | -366.636 |
| BmX003 | 16-12W »+Z | 1.39 | -0.00 | -0.03 | -976.802 | -0.11 | -284.638 |
| BmZ003 | 16-12W »+Z | 1.50 | 0.19 | -0.10 | -824.301 | -0.04 | < -2000 |
| BmX003 | 16-12W »+Z | 1.67 | -0.00 | -0.04 | -804.805 | -0.13 | -233.345 |
| BmX003 | 16-12W »+Z | 1.94 | -0.00 | -0.04 | -688.907 | -0.15 | -199.389 |
| BmX003 | 16-12W »+Z | 2.22 | -0.00 | -0.05 | -607.830 | -0.17 | -176.174 |
| BmZ003 | 16-12W »+Z | 2.25 | 0.19 | -0.10 | -839.132 | -0.03 | < -2000 |
| BmX003 | 16-12W »+Z | 2.50 | -0.00 | -0.05 | -550.152 | -0.19 | -160.226 |
| BmZ003 | 16-12W »+Z | 3.00 | 0.19 | -0.08 | -960.497 | -0.01 | < -2000 |
| BmZ003 | 16-12W »+Z | 3.75 | 0.19 | -0.07 | -1219.424 | 0.01 | > 2000 |
| BmZ003 | 16-12W »+Z | 4.50 | 0.19 | -0.05 | -1679.861 | 0.03 | > 2000 |
| BmZ003 | 16-12W »+Z | 5.25 | 0.19 | -0.04 | < -2000 | 0.04 | > 2000 |
| BmZ003 | 16-12W »+Z | 6.00 | 0.19 | -0.04 | < -2000 | 0.03 | > 2000 |
| BmZ003 | 16-12W »+Z | 6.75 | 0.19 | -0.05 | -1485.41 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.23 | -356.137 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-13W+Lr »+X | 0.28 | -0.00 | -0.03 | -1161.139 | -0.00 | -NA- |
| BmX003 | 16-13W+Lr »+X | 0.56 | -0.00 | -0.05 | -553.855 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 0.75 | -0.00 | -0.27 | -294.993 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 0.83 | -0.00 | -0.08 | -357.676 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 1.11 | -0.00 | -0.11 | -263.552 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 1.39 | -0.00 | -0.14 | -209.960 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 1.50 | -0.00 | -0.32 | -249.447 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 1.67 | -0.00 | -0.17 | -176.541 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 1.94 | -0.00 | -0.19 | -154.844 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 2.22 | -0.00 | -0.21 | -140.661 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 2.25 | -0.00 | -0.37 | -221.817 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+X | 2.50 | -0.00 | -0.23 | -131.903 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 3.00 | -0.00 | -0.39 | -209.014 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 3.75 | 0.00 | -0.39 | -209.014 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 4.50 | 0.00 | -0.37 | -221.817 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 5.25 | 0.00 | -0.32 | -249.447 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 6.00 | 0.00 | -0.27 | -294.993 | -0.00 | < -2000 |
| BmZ003 | 16-13W+Lr »+X | 6.75 | 0.00 | -0.23 | -356.137 | -0.00 | < -2000 |
| BmX003 | 16-13W+Lr »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ003 | 16-13W+Lr »+Z | 0.00 | 0.14 | -0.23 | -355.896 | 0.00 | > 2000 |
| BmX003 | 16-13W+Lr »+Z | 0.28 | -0.00 | -0.02 | -1374.731 | -0.01 | < -2000 |
| BmX003 | 16-13W+Lr »+Z | 0.56 | -0.00 | -0.05 | -648.127 | -0.03 | -1087.536 |
| BmZ003 | 16-13W+Lr »+Z | 0.75 | 0.14 | -0.29 | -275.889 | -0.02 | < -2000 |
| BmX003 | 16-13W+Lr »+Z | 0.83 | -0.00 | -0.07 | -412.970 | -0.04 | -681.666 |
| BmX003 | 16-13W+Lr »+Z | 1.11 | -0.00 | -0.10 | -299.521 | -0.06 | -488.674 |
| BmX003 | 16-13W+Lr »+Z | 1.39 | -0.00 | -0.13 | -234.315 | -0.08 | -379.384 |
| BmZ003 | 16-13W+Lr »+Z | 1.50 | 0.14 | -0.35 | -232.402 | -0.03 | < -2000 |
| BmX003 | 16-13W+Lr »+Z | 1.67 | -0.00 | -0.16 | -192.901 | -0.10 | -311.018 |
| BmX003 | 16-13W+Lr »+Z | 1.94 | -0.00 | -0.18 | -164.995 | -0.11 | -265.759 |
| BmX003 | 16-13W+Lr »+Z | 2.22 | -0.00 | -0.21 | -145.476 | -0.13 | -234.816 |
| BmZ003 | 16-13W+Lr »+Z | 2.25 | 0.14 | -0.38 | -211.144 | -0.02 | < -2000 |
| BmX003 | 16-13W+Lr »+Z | 2.50 | -0.00 | -0.23 | -131.597 | -0.14 | -213.559 |
| BmZ003 | 16-13W+Lr »+Z | 3.00 | 0.14 | -0.39 | -205.277 | -0.01 | < -2000 |
| BmZ003 | 16-13W+Lr »+Z | 3.75 | 0.14 | -0.38 | -212.509 | 0.01 | > 2000 |
| BmZ003 | 16-13W+Lr »+Z | 4.50 | 0.14 | -0.35 | -233.167 | 0.02 | > 2000 |
| BmZ003 | 16-13W+Lr »+Z | 5.25 | 0.14 | -0.30 | -268.580 | 0.03 | > 2000 |
| BmZ003 | 16-13W+Lr »+Z | 6.00 | 0.14 | -0.26 | -316.095 | 0.02 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ003 | 16-13W+Lr »+Z | 6.75 | 0.14 | -0.23 | -355.311 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 0.00 | -0.00 | -0.05 | -1501.691 | -0.00 | < -2000 |
| BmX003 | 16-13W+R »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 0.56 | -0.00 | -0.02 | -1579.495 | -0.00 | -NA- |
| BmZ003 | 16-13W+R »+X | 0.75 | -0.00 | -0.06 | -1350.003 | -0.00 | < -2000 |
| BmX003 | 16-13W+R »+X | 0.83 | -0.00 | -0.03 | -1046.639 | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 1.11 | -0.00 | -0.04 | -796.014 | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 1.39 | -0.00 | -0.05 | -658.925 | -0.00 | -NA- |
| BmZ003 | 16-13W+R »+X | 1.50 | -0.00 | -0.07 | -1215.752 | -0.00 | < -2000 |
| BmX003 | 16-13W+R »+X | 1.67 | -0.00 | -0.05 | -580.881 | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 1.94 | -0.00 | -0.06 | -541.354 | -0.00 | -NA- |
| BmX003 | 16-13W+R »+X | 2.22 | -0.00 | -0.06 | -532.301 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 2.25 | -0.00 | -0.07 | -1124.501 | -0.00 | < -2000 |
| BmX003 | 16-13W+R »+X | 2.50 | -0.00 | -0.05 | -556.182 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 3.00 | -0.00 | -0.08 | -1079.472 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 3.75 | 0.00 | -0.08 | -1079.472 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 4.50 | 0.00 | -0.07 | -1124.501 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 5.25 | 0.00 | -0.07 | -1215.752 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 6.00 | 0.00 | -0.06 | -1350.003 | -0.00 | < -2000 |
| BmZ003 | 16-13W+R »+X | 6.75 | 0.00 | -0.05 | -1501.691 | -0.00 | < -2000 |
| BmX003 | 16-13W+R »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ003 | 16-13W+R »+Z | 0.00 | 0.14 | -0.05 | -1497.417 | 0.00 | > 2000 |
| BmX003 | 16-13W+R »+Z | 0.28 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmX003 | 16-13W+R »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.03 | -1087.921 |
| BmZ003 | 16-13W+R »+Z | 0.75 | 0.14 | -0.08 | -1025.138 | -0.02 | < -2000 |
| BmX003 | 16-13W+R »+Z | 0.83 | -0.00 | -0.02 | -1720.878 | -0.04 | -681.901 |
| BmX003 | 16-13W+R »+Z | 1.11 | -0.00 | -0.02 | -1249.062 | -0.06 | -488.839 |
| BmX003 | 16-13W+R »+Z | 1.39 | -0.00 | -0.03 | -977.915 | -0.08 | -379.510 |
| BmZ003 | 16-13W+R »+Z | 1.50 | 0.14 | -0.09 | -895.617 | -0.03 | < -2000 |
| BmX003 | 16-13W+R »+Z | 1.67 | -0.00 | -0.04 | -805.719 | -0.10 | -311.121 |
| BmX003 | 16-13W+R »+Z | 1.94 | -0.00 | -0.04 | -689.690 | -0.11 | -265.847 |
| BmX003 | 16-13W+R »+Z | 2.22 | -0.00 | -0.05 | -608.523 | -0.13 | -234.894 |
| BmZ003 | 16-13W+R »+Z | 2.25 | 0.14 | -0.09 | -895.131 | -0.02 | < -2000 |
| BmX003 | 16-13W+R »+Z | 2.50 | -0.00 | -0.05 | -550.783 | -0.14 | -213.630 |
| BmZ003 | 16-13W+R »+Z | 3.00 | 0.14 | -0.08 | -986.686 | -0.01 | < -2000 |
| BmZ003 | 16-13W+R »+Z | 3.75 | 0.14 | -0.07 | -1179.673 | 0.01 | > 2000 |
| BmZ003 | 16-13W+R »+Z | 4.50 | 0.14 | -0.05 | -1492.894 | 0.02 | > 2000 |
| BmZ003 | 16-13W+R »+Z | 5.25 | 0.14 | -0.04 | -1862.366 | 0.03 | > 2000 |
| BmZ003 | 16-13W+R »+Z | 6.00 | 0.14 | -0.04 | -1943.902 | 0.02 | > 2000 |
| BmZ003 | 16-13W+R »+Z | 6.75 | 0.14 | -0.05 | -1487.114 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 0.00 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 0.56 | -0.00 | -0.02 | -1743.95 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X | 0.75 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X | 0.83 | -0.00 | -0.03 | -1177.496 | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 1.11 | -0.00 | -0.03 | -917.496 | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 1.39 | -0.00 | -0.04 | -783.598 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X | 1.50 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X | 1.67 | -0.00 | -0.04 | -720.302 | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 1.94 | -0.00 | -0.04 | -712.605 | -0.00 | -NA- |
| BmX003 | 16-14 »+X | 2.22 | -0.00 | -0.04 | -766.950 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X | 2.25 | -0.00 | -0.04 | -1885.088 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X | 2.50 | -0.00 | -0.03 | -934.196 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X | 3.00 | -0.00 | -0.04 | -1809.179 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 3.75 | 0.00 | -0.04 | -1809.179 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 4.50 | 0.00 | -0.04 | -1885.088 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 5.25 | 0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 6.00 | 0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X | 6.75 | 0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X+Y | 0.00 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X+Y | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX003 | 16-14 »+X+Y | 0.28 | -0.00 | -0.00 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 0.56 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 0.75 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X+Y | 0.83 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 1.11 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 1.39 | -0.00 | -0.02 | -1635.446 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 1.50 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+X+Y | 1.67 | -0.00 | -0.02 | -1347.457 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 1.94 | -0.00 | -0.03 | -1153.415 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 2.22 | -0.00 | -0.03 | -1017.685 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 2.25 | -0.00 | -0.04 | -1865.329 | -0.00 | -NA- |
| BmX003 | 16-14 »+X+Y | 2.50 | -0.00 | -0.03 | -921.140 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 3.00 | -0.00 | -0.05 | -1790.972 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 3.75 | 0.00 | -0.05 | -1790.972 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 4.50 | 0.00 | -0.04 | -1865.329 | -0.00 | -NA- |
| BmZ003 | 16-14 »+X+Y | 5.25 | 0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X+Y | 6.00 | 0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmZ003 | 16-14 »+X+Y | 6.75 | 0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmX003 | 16-14 »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ003 | 16-14 »+Z | 0.00 | 0.19 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX003 | 16-14 »+Z | 0.28 | -0.00 | -0.00 | < -2000 | -0.02 | -1770.588 |
| BmX003 | 16-14 »+Z | 0.56 | -0.00 | -0.01 | < -2000 | -0.04 | -815.980 |
| BmZ003 | 16-14 »+Z | 0.75 | 0.19 | -0.06 | -1325.666 | -0.03 | < -2000 |
| BmX003 | 16-14 »+Z | 0.83 | -0.00 | -0.01 | < -2000 | -0.06 | -511.449 |
| BmX003 | 16-14 »+Z | 1.11 | -0.00 | -0.01 | < -2000 | -0.08 | -366.645 |
| BmX003 | 16-14 »+Z | 1.39 | -0.00 | -0.02 | -1623.079 | -0.11 | -284.645 |
| BmZ003 | 16-14 »+Z | 1.50 | 0.19 | -0.07 | -1133.21 | -0.04 | < -2000 |
| BmX003 | 16-14 »+Z | 1.67 | -0.00 | -0.02 | -1337.296 | -0.13 | -233.351 |
| BmX003 | 16-14 »+Z | 1.94 | -0.00 | -0.03 | -1144.714 | -0.15 | -199.394 |
| BmX003 | 16-14 »+Z | 2.22 | -0.00 | -0.03 | -1009.984 | -0.17 | -176.178 |
| BmZ003 | 16-14 »+Z | 2.25 | 0.19 | -0.07 | -1198.598 | -0.03 | < -2000 |
| BmX003 | 16-14 »+Z | 2.50 | -0.00 | -0.03 | -914.128 | -0.19 | -160.230 |
| BmZ003 | 16-14 »+Z | 3.00 | 0.19 | -0.05 | -1495.014 | -0.01 | < -2000 |
| BmZ003 | 16-14 »+Z | 3.75 | 0.19 | -0.04 | < -2000 | 0.01 | > 2000 |
| BmZ003 | 16-14 »+Z | 4.50 | 0.19 | -0.02 | < -2000 | 0.03 | > 2000 |
| BmZ003 | 16-14 »+Z | 5.25 | 0.19 | -0.01 | < -2000 | 0.04 | > 2000 |
| BmZ003 | 16-14 »+Z | 6.00 | 0.19 | -0.01 | < -2000 | 0.03 | > 2000 |
| BmZ003 | 16-14 »+Z | 6.75 | 0.19 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmZ003 | D | 0.00 | -0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmX003 | D | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | D | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | D | 0.56 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ003 | D | 0.75 | -0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |
| BmX003 | D | 0.83 | -0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX003 | D | 1.11 | -0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX003 | D | 1.39 | -0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ003 | D | 1.50 | -0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmX003 | D | 1.67 | -0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX003 | D | 1.94 | -0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX003 | D | 2.22 | -0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ003 | D | 2.25 | -0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmX003 | D | 2.50 | -0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ003 | D | 3.00 | -0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | D | 3.75 | 0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | D | 4.50 | 0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmZ003 | D | 5.25 | 0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmZ003 | D | 6.00 | 0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |
| BmZ003 | D | 6.75 | 0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmZ003 | D+L | 0.00 | -0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmX003 | D+L | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | D+L | 0.28 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmX003 | D+L | 0.56 | -0.00 | -0.01 | < -2000 | -0.00 | -NA- |
| BmZ003 | D+L | 0.75 | -0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX003 | D+L | 0.83 | -0.00 | -0.02 | -1726.872 | -0.00 | -NA- |
| BmX003 | D+L | 1.11 | -0.00 | -0.02 | -1253.371 | -0.00 | -NA- |
| BmX003 | D+L | 1.39 | -0.00 | -0.03 | -981.268 | -0.00 | -NA- |
| BmZ003 | D+L | 1.50 | -0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmX003 | D+L | 1.67 | -0.00 | -0.04 | -808.474 | -0.00 | -NA- |
| BmX003 | D+L | 1.94 | -0.00 | -0.04 | -692.049 | -0.00 | -NA- |
| BmX003 | D+L | 2.22 | -0.00 | -0.05 | -610.611 | -0.00 | < -2000 |
| BmZ003 | D+L | 2.25 | -0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmX003 | D+L | 2.50 | -0.00 | -0.05 | -552.684 | -0.00 | < -2000 |
| BmZ003 | D+L | 3.00 | -0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | D+L | 3.75 | 0.00 | -0.08 | -1074.583 | -0.00 | < -2000 |
| BmZ003 | D+L | 4.50 | 0.00 | -0.07 | -1119.198 | -0.00 | < -2000 |
| BmZ003 | D+L | 5.25 | 0.00 | -0.07 | -1209.555 | -0.00 | < -2000 |
| BmZ003 | D+L | 6.00 | 0.00 | -0.06 | -1342.365 | -0.00 | < -2000 |
| BmZ003 | D+L | 6.75 | 0.00 | -0.05 | -1492.248 | -0.00 | < -2000 |
| BmZ003 | Live | 0.00 | -0.00 | -0.23 | -350.142 | -0.00 | < -2000 |
| BmX003 | Live | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmX003 | Live | 0.28 | -0.00 | -0.02 | -1357.071 | -0.00 | -NA- |
| BmX003 | Live | 0.56 | -0.00 | -0.05 | -639.707 | -0.00 | < -2000 |
| BmZ003 | Live | 0.75 | -0.00 | -0.29 | -283.107 | -0.00 | < -2000 |
| BmX003 | Live | 0.83 | -0.00 | -0.07 | -407.523 | -0.00 | < -2000 |
| BmX003 | Live | 1.11 | -0.00 | -0.10 | -295.501 | -0.00 | < -2000 |
| BmX003 | Live | 1.39 | -0.00 | -0.13 | -231.112 | -0.00 | < -2000 |
| BmZ003 | Live | 1.50 | -0.00 | -0.34 | -235.380 | -0.00 | < -2000 |
| BmX003 | Live | 1.67 | -0.00 | -0.16 | -190.217 | -0.00 | < -2000 |
| BmX003 | Live | 1.94 | -0.00 | -0.18 | -162.659 | -0.00 | < -2000 |
| BmX003 | Live | 2.22 | -0.00 | -0.21 | -143.385 | -0.00 | < -2000 |
| BmZ003 | Live | 2.25 | -0.00 | -0.39 | -207.243 | -0.00 | < -2000 |
| BmX003 | Live | 2.50 | -0.00 | -0.23 | -129.682 | -0.00 | < -2000 |
| BmZ003 | Live | 3.00 | -0.00 | -0.42 | -194.402 | -0.00 | < -2000 |
| BmZ003 | Live | 3.75 | 0.00 | -0.42 | -194.402 | -0.00 | < -2000 |
| BmZ003 | Live | 4.50 | 0.00 | -0.39 | -207.243 | -0.00 | < -2000 |
| BmZ003 | Live | 5.25 | 0.00 | -0.34 | -235.380 | -0.00 | < -2000 |
| BmZ003 | Live | 6.00 | 0.00 | -0.29 | -283.107 | -0.00 | < -2000 |
| BmZ003 | Live | 6.75 | 0.00 | -0.23 | -350.142 | -0.00 | < -2000 |
| BmZ004 | 16-10Lr | 0.00 | 0.00 | -0.29 | -284.202 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-10Lr | 0.28 | -0.00 | -0.03 | -1097.685 | 0.00 | -NA- |
| BmX004 | 16-10Lr | 0.56 | -0.00 | -0.06 | -517.489 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 0.75 | 0.00 | -0.30 | -267.020 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 0.83 | -0.00 | -0.09 | -329.714 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 1.11 | -0.00 | -0.13 | -239.124 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 1.39 | -0.00 | -0.16 | -187.056 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 1.50 | 0.00 | -0.33 | -248.510 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 1.67 | -0.00 | -0.19 | -153.987 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 1.94 | -0.00 | -0.23 | -131.703 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 2.22 | -0.00 | -0.26 | -116.118 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 2.25 | 0.00 | -0.35 | -234.632 | 0.00 | > 2000 |
| BmX004 | 16-10Lr | 2.50 | -0.00 | -0.29 | -105.036 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 3.00 | 0.00 | -0.36 | -227.438 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 3.75 | -0.00 | -0.36 | -227.438 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 4.50 | -0.00 | -0.35 | -234.632 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 5.25 | -0.00 | -0.33 | -248.510 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 6.00 | -0.00 | -0.30 | -267.020 | 0.00 | > 2000 |
| BmZ004 | 16-10Lr | 6.75 | -0.00 | -0.29 | -284.202 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 0.00 | 0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |
| BmX004 | 16-10R | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-10R | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-10R | 0.56 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ004 | 16-10R | 0.75 | 0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmX004 | 16-10R | 0.83 | -0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX004 | 16-10R | 1.11 | -0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX004 | 16-10R | 1.39 | -0.00 | -0.03 | -981.268 | 0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ004 | 16-10R | 1.50 | 0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmX004 | 16-10R | 1.67 | -0.00 | -0.04 | -808.474 | 0.00 | -NA- |
| BmX004 | 16-10R | 1.94 | -0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX004 | 16-10R | 2.22 | -0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 2.25 | 0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmX004 | 16-10R | 2.50 | -0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 3.00 | 0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 3.75 | -0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 4.50 | -0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 5.25 | -0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 6.00 | -0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmZ004 | 16-10R | 6.75 | -0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 0.00 | 0.00 | -0.23 | -356.316 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-11Lr | 0.28 | -0.00 | -0.02 | -1375.917 | 0.00 | -NA- |
| BmX004 | 16-11Lr | 0.56 | -0.00 | -0.05 | -648.675 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 0.75 | 0.00 | -0.24 | -333.888 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 0.83 | -0.00 | -0.07 | -413.314 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 1.11 | -0.00 | -0.10 | -299.768 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 1.39 | -0.00 | -0.13 | -234.507 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 1.50 | 0.00 | -0.26 | -310.109 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 1.67 | -0.00 | -0.16 | -193.059 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 1.94 | -0.00 | -0.18 | -165.129 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 2.22 | -0.00 | -0.21 | -145.595 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 2.25 | 0.00 | -0.28 | -292.408 | 0.00 | > 2000 |
| BmX004 | 16-11Lr | 2.50 | -0.00 | -0.23 | -131.705 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 3.00 | 0.00 | -0.29 | -283.266 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 3.75 | -0.00 | -0.29 | -283.266 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 4.50 | -0.00 | -0.28 | -292.408 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 5.25 | -0.00 | -0.26 | -310.109 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 6.00 | -0.00 | -0.24 | -333.888 | 0.00 | > 2000 |
| BmZ004 | 16-11Lr | 6.75 | -0.00 | -0.23 | -356.316 | 0.00 | > 2000 |
| BmZ004 | 16-12W »+X | 0.00 | 0.00 | -0.05 | -1479.839 | -0.00 | < -2000 |
| BmX004 | 16-12W »+X | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 0.56 | -0.00 | -0.02 | -1386.794 | 0.00 | -NA- |
| BmZ004 | 16-12W »+X | 0.75 | 0.00 | -0.06 | -1332.316 | -0.00 | < -2000 |
| BmX004 | 16-12W »+X | 0.83 | -0.00 | -0.03 | -925.162 | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 1.11 | -0.00 | -0.04 | -709.692 | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 1.39 | -0.00 | -0.05 | -593.894 | 0.00 | -NA- |
| BmZ004 | 16-12W »+X | 1.50 | 0.00 | -0.07 | -1201.39 | -0.00 | < -2000 |
| BmX004 | 16-12W »+X | 1.67 | -0.00 | -0.06 | -531.049 | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 1.94 | -0.00 | -0.06 | -504.720 | 0.00 | -NA- |
| BmX004 | 16-12W »+X | 2.22 | -0.00 | -0.06 | -510.478 | 0.00 | > 2000 |
| BmZ004 | 16-12W »+X | 2.25 | 0.00 | -0.07 | -1112.203 | -0.00 | < -2000 |
| BmX004 | 16-12W »+X | 2.50 | -0.00 | -0.05 | -557.358 | 0.00 | > 2000 |
| BmZ004 | 16-12W »+X | 3.00 | 0.00 | -0.08 | -1068.134 | -0.00 | < -2000 |
| BmZ004 | 16-12W »+X | 3.75 | -0.00 | -0.08 | -1068.134 | -0.00 | < -2000 |
| BmZ004 | 16-12W »+X | 4.50 | -0.00 | -0.07 | -1112.203 | -0.00 | < -2000 |
| BmZ004 | 16-12W »+X | 5.25 | -0.00 | -0.07 | -1201.39 | -0.00 | < -2000 |
| BmZ004 | 16-12W »+X | 6.00 | -0.00 | -0.06 | -1332.316 | -0.00 | < -2000 |
| BmZ004 | 16-12W »+X | 6.75 | -0.00 | -0.05 | -1479.839 | -0.00 | < -2000 |
| BmX004 | 16-12W »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ004 | 16-12W »+Z | 0.00 | 0.19 | -0.05 | -1485.41 | 0.00 | > 2000 |
| BmX004 | 16-12W »+Z | 0.28 | 0.00 | -0.01 | < -2000 | -0.02 | -1770.779 |
| BmX004 | 16-12W »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.04 | -816.064 |
| BmZ004 | 16-12W »+Z | 0.75 | 0.19 | -0.04 | < -2000 | -0.03 | < -2000 |
| BmX004 | 16-12W »+Z | 0.83 | 0.00 | -0.02 | -1734.929 | -0.06 | -511.500 |
| BmX004 | 16-12W »+Z | 1.11 | 0.00 | -0.02 | -1259.162 | -0.08 | -366.682 |
| BmX004 | 16-12W »+Z | 1.39 | 0.00 | -0.03 | -985.774 | -0.11 | -284.673 |
| BmZ004 | 16-12W »+Z | 1.50 | 0.19 | -0.04 | < -2000 | -0.04 | < -2000 |
| BmX004 | 16-12W »+Z | 1.67 | 0.00 | -0.04 | -812.177 | -0.13 | -233.373 |
| BmX004 | 16-12W »+Z | 1.94 | 0.00 | -0.04 | -695.219 | -0.15 | -199.413 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmX004 | 16-12W »+Z | 2.22 | 0.00 | -0.05 | -613.417 | -0.17 | -176.195 |
| BmZ004 | 16-12W »+Z | 2.25 | 0.19 | -0.05 | -1679.861 | -0.03 | < -2000 |
| BmX004 | 16-12W »+Z | 2.50 | 0.00 | -0.05 | -555.240 | -0.19 | -160.245 |
| BmZ004 | 16-12W »+Z | 3.00 | 0.19 | -0.07 | -1219.424 | -0.01 | < -2000 |
| BmZ004 | 16-12W »+Z | 3.75 | 0.19 | -0.08 | -960.497 | 0.01 | > 2000 |
| BmZ004 | 16-12W »+Z | 4.50 | 0.19 | -0.10 | -839.132 | 0.03 | > 2000 |
| BmZ004 | 16-12W »+Z | 5.25 | 0.19 | -0.10 | -824.301 | 0.04 | > 2000 |
| BmZ004 | 16-12W »+Z | 6.00 | 0.19 | -0.09 | -950.282 | 0.03 | > 2000 |
| BmZ004 | 16-12W »+Z | 6.75 | 0.19 | -0.05 | -1499.148 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 0.00 | 0.00 | -0.23 | -355.782 | -0.00 | < -2000 |
| BmX004 | 16-13W+Lr »+X | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-13W+Lr »+X | 0.28 | -0.00 | -0.03 | -1161.139 | 0.00 | -NA- |
| BmX004 | 16-13W+Lr »+X | 0.56 | -0.00 | -0.05 | -553.855 | 0.00 | > 2000 |
| BmZ004 | 16-13W+Lr »+X | 0.75 | 0.00 | -0.24 | -333.419 | -0.00 | < -2000 |
| BmX004 | 16-13W+Lr »+X | 0.83 | -0.00 | -0.08 | -357.676 | 0.00 | > 2000 |
| BmX004 | 16-13W+Lr »+X | 1.11 | -0.00 | -0.11 | -263.552 | 0.00 | > 2000 |
| BmX004 | 16-13W+Lr »+X | 1.39 | -0.00 | -0.14 | -209.960 | 0.00 | > 2000 |
| BmZ004 | 16-13W+Lr »+X | 1.50 | 0.00 | -0.26 | -309.704 | -0.00 | < -2000 |
| BmX004 | 16-13W+Lr »+X | 1.67 | -0.00 | -0.17 | -176.541 | 0.00 | > 2000 |
| BmX004 | 16-13W+Lr »+X | 1.94 | -0.00 | -0.19 | -154.844 | 0.00 | > 2000 |
| BmX004 | 16-13W+Lr »+X | 2.22 | -0.00 | -0.21 | -140.661 | 0.00 | > 2000 |
| BmZ004 | 16-13W+Lr »+X | 2.25 | 0.00 | -0.28 | -292.049 | -0.00 | < -2000 |
| BmX004 | 16-13W+Lr »+X | 2.50 | -0.00 | -0.23 | -131.903 | 0.00 | > 2000 |
| BmZ004 | 16-13W+Lr »+X | 3.00 | 0.00 | -0.29 | -282.928 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 3.75 | -0.00 | -0.29 | -282.928 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 4.50 | -0.00 | -0.28 | -292.049 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 5.25 | -0.00 | -0.26 | -309.704 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 6.00 | -0.00 | -0.24 | -333.419 | -0.00 | < -2000 |
| BmZ004 | 16-13W+Lr »+X | 6.75 | -0.00 | -0.23 | -355.782 | -0.00 | < -2000 |
| BmX004 | 16-13W+Lr »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ004 | 16-13W+Lr »+Z | 0.00 | 0.14 | -0.23 | -356.022 | 0.00 | > 2000 |
| BmX004 | 16-13W+Lr »+Z | 0.28 | 0.00 | -0.02 | -1377.105 | -0.01 | < -2000 |
| BmX004 | 16-13W+Lr »+Z | 0.56 | 0.00 | -0.05 | -649.225 | -0.03 | -1088.495 |
| BmZ004 | 16-13W+Lr »+Z | 0.75 | 0.14 | -0.22 | -361.730 | -0.02 | < -2000 |
| BmX004 | 16-13W+Lr »+Z | 0.83 | 0.00 | -0.07 | -413.659 | -0.04 | -682.250 |
| BmX004 | 16-13W+Lr »+Z | 1.11 | 0.00 | -0.10 | -300.016 | -0.06 | -489.084 |
| BmX004 | 16-13W+Lr »+Z | 1.39 | 0.00 | -0.13 | -234.699 | -0.08 | -379.698 |
| BmZ004 | 16-13W+Lr »+Z | 1.50 | 0.14 | -0.24 | -340.730 | -0.03 | < -2000 |
| BmX004 | 16-13W+Lr »+Z | 1.67 | 0.00 | -0.16 | -193.216 | -0.10 | -311.274 |
| BmX004 | 16-13W+Lr »+Z | 1.94 | 0.00 | -0.18 | -165.264 | -0.11 | -265.978 |
| BmX004 | 16-13W+Lr »+Z | 2.22 | 0.00 | -0.21 | -145.714 | -0.13 | -235.010 |
| BmZ004 | 16-13W+Lr »+Z | 2.25 | 0.14 | -0.26 | -312.870 | -0.02 | < -2000 |
| BmX004 | 16-13W+Lr »+Z | 2.50 | 0.00 | -0.23 | -131.813 | -0.14 | -213.737 |
| BmZ004 | 16-13W+Lr »+Z | 3.00 | 0.14 | -0.28 | -290.078 | -0.01 | < -2000 |
| BmZ004 | 16-13W+Lr »+Z | 3.75 | 0.14 | -0.29 | -276.767 | 0.01 | > 2000 |
| BmZ004 | 16-13W+Lr »+Z | 4.50 | 0.14 | -0.30 | -274.459 | 0.02 | > 2000 |
| BmZ004 | 16-13W+Lr »+Z | 5.25 | 0.14 | -0.28 | -284.538 | 0.03 | > 2000 |
| BmZ004 | 16-13W+Lr »+Z | 6.00 | 0.14 | -0.26 | -310.025 | 0.02 | > 2000 |
| BmZ004 | 16-13W+Lr »+Z | 6.75 | 0.14 | -0.23 | -356.610 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 0.00 | 0.00 | -0.05 | -1482.922 | -0.00 | < -2000 |
| BmX004 | 16-13W+R »+X | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 0.56 | -0.00 | -0.02 | -1579.495 | 0.00 | -NA- |
| BmZ004 | 16-13W+R »+X | 0.75 | 0.00 | -0.06 | -1334.814 | -0.00 | < -2000 |
| BmX004 | 16-13W+R »+X | 0.83 | -0.00 | -0.03 | -1046.639 | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 1.11 | -0.00 | -0.04 | -796.014 | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 1.39 | -0.00 | -0.05 | -658.925 | 0.00 | -NA- |
| BmZ004 | 16-13W+R »+X | 1.50 | 0.00 | -0.07 | -1203.421 | -0.00 | < -2000 |
| BmX004 | 16-13W+R »+X | 1.67 | -0.00 | -0.05 | -580.881 | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 1.94 | -0.00 | -0.06 | -541.354 | 0.00 | -NA- |
| BmX004 | 16-13W+R »+X | 2.22 | -0.00 | -0.06 | -532.301 | 0.00 | > 2000 |
| BmZ004 | 16-13W+R »+X | 2.25 | 0.00 | -0.07 | -1113.944 | -0.00 | < -2000 |
| BmX004 | 16-13W+R »+X | 2.50 | -0.00 | -0.05 | -556.182 | 0.00 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ004 | 16-13W+R »+X | 3.00 | 0.00 | -0.08 | -1069.739 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 3.75 | -0.00 | -0.08 | -1069.739 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 4.50 | -0.00 | -0.07 | -1113.944 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 5.25 | -0.00 | -0.07 | -1203.421 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 6.00 | -0.00 | -0.06 | -1334.814 | -0.00 | < -2000 |
| BmZ004 | 16-13W+R »+X | 6.75 | -0.00 | -0.05 | -1482.922 | -0.00 | < -2000 |
| BmX004 | 16-13W+R »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ004 | 16-13W+R »+Z | 0.00 | 0.14 | -0.05 | -1487.114 | 0.00 | > 2000 |
| BmX004 | 16-13W+R »+Z | 0.28 | 0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| BmX004 | 16-13W+R »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.03 | -1088.109 |
| BmZ004 | 16-13W+R »+Z | 0.75 | 0.14 | -0.04 | -1943.902 | -0.02 | < -2000 |
| BmX004 | 16-13W+R »+Z | 0.83 | 0.00 | -0.02 | -1732.908 | -0.04 | -682.015 |
| BmX004 | 16-13W+R »+Z | 1.11 | 0.00 | -0.02 | -1257.709 | -0.06 | -488.919 |
| BmX004 | 16-13W+R »+Z | 1.39 | 0.00 | -0.03 | -984.644 | -0.08 | -379.572 |
| BmZ004 | 16-13W+R »+Z | 1.50 | 0.14 | -0.04 | -1862.366 | -0.03 | < -2000 |
| BmX004 | 16-13W+R »+Z | 1.67 | 0.00 | -0.04 | -811.248 | -0.10 | -311.171 |
| BmX004 | 16-13W+R »+Z | 1.94 | 0.00 | -0.04 | -694.424 | -0.11 | -265.890 |
| BmX004 | 16-13W+R »+Z | 2.22 | 0.00 | -0.05 | -612.713 | -0.13 | -234.932 |
| BmZ004 | 16-13W+R »+Z | 2.25 | 0.14 | -0.05 | -1492.894 | -0.02 | < -2000 |
| BmX004 | 16-13W+R »+Z | 2.50 | 0.00 | -0.05 | -554.599 | -0.14 | -213.665 |
| BmZ004 | 16-13W+R »+Z | 3.00 | 0.14 | -0.07 | -1179.673 | -0.01 | < -2000 |
| BmZ004 | 16-13W+R »+Z | 3.75 | 0.14 | -0.08 | -986.686 | 0.01 | > 2000 |
| BmZ004 | 16-13W+R »+Z | 4.50 | 0.14 | -0.09 | -895.131 | 0.02 | > 2000 |
| BmZ004 | 16-13W+R »+Z | 5.25 | 0.14 | -0.09 | -895.617 | 0.03 | > 2000 |
| BmZ004 | 16-13W+R »+Z | 6.00 | 0.14 | -0.08 | -1025.138 | 0.02 | > 2000 |
| BmZ004 | 16-13W+R »+Z | 6.75 | 0.14 | -0.05 | -1497.417 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 0.00 | 0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmX004 | 16-14 »+X | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 0.56 | -0.00 | -0.02 | -1743.95 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X | 0.75 | 0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmX004 | 16-14 »+X | 0.83 | -0.00 | -0.03 | -1177.496 | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 1.11 | -0.00 | -0.03 | -917.496 | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 1.39 | -0.00 | -0.04 | -783.598 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X | 1.50 | 0.00 | -0.04 | -1993.345 | -0.00 | < -2000 |
| BmX004 | 16-14 »+X | 1.67 | -0.00 | -0.04 | -720.302 | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 1.94 | -0.00 | -0.04 | -712.605 | 0.00 | -NA- |
| BmX004 | 16-14 »+X | 2.22 | -0.00 | -0.04 | -766.950 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X | 2.25 | 0.00 | -0.04 | -1845.981 | -0.00 | < -2000 |
| BmX004 | 16-14 »+X | 2.50 | -0.00 | -0.03 | -934.196 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X | 3.00 | 0.00 | -0.05 | -1773.128 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 3.75 | -0.00 | -0.05 | -1773.128 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 4.50 | -0.00 | -0.04 | -1845.981 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 5.25 | -0.00 | -0.04 | -1993.345 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 6.00 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X | 6.75 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmZ004 | 16-14 »+X+Y | 0.00 | 0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX004 | 16-14 »+X+Y | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 0.28 | -0.00 | -0.00 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 0.56 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 0.75 | 0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| BmX004 | 16-14 »+X+Y | 0.83 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 1.11 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 1.39 | -0.00 | -0.02 | -1635.446 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 1.50 | 0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| BmX004 | 16-14 »+X+Y | 1.67 | -0.00 | -0.02 | -1347.457 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 1.94 | -0.00 | -0.03 | -1153.415 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 2.22 | -0.00 | -0.03 | -1017.685 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 2.25 | 0.00 | -0.04 | -1865.329 | 0.00 | -NA- |
| BmX004 | 16-14 »+X+Y | 2.50 | -0.00 | -0.03 | -921.140 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 3.00 | 0.00 | -0.05 | -1790.972 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 3.75 | -0.00 | -0.05 | -1790.972 | 0.00 | -NA- |
| BmZ004 | 16-14 »+X+Y | 4.50 | -0.00 | -0.04 | -1865.329 | 0.00 | -NA- |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ004 | 16-14 »+X+Y | 5.25 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| BmZ004 | 16-14 »+X+Y | 6.00 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| BmZ004 | 16-14 »+X+Y | 6.75 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX004 | 16-14 »+Z | 0.00 | 0.00 | -0.00 | -NA- | -0.00 | -NA- |
| BmZ004 | 16-14 »+Z | 0.00 | 0.19 | -0.03 | < -2000 | 0.00 | > 2000 |
| BmX004 | 16-14 »+Z | 0.28 | 0.00 | -0.00 | < -2000 | -0.02 | -1770.731 |
| BmX004 | 16-14 »+Z | 0.56 | 0.00 | -0.01 | < -2000 | -0.04 | -816.043 |
| BmZ004 | 16-14 »+Z | 0.75 | 0.19 | -0.01 | < -2000 | -0.03 | < -2000 |
| BmX004 | 16-14 »+Z | 0.83 | 0.00 | -0.01 | < -2000 | -0.06 | -511.488 |
| BmX004 | 16-14 »+Z | 1.11 | 0.00 | -0.01 | < -2000 | -0.08 | -366.673 |
| BmX004 | 16-14 »+Z | 1.39 | 0.00 | -0.02 | -1648.003 | -0.11 | -284.666 |
| BmZ004 | 16-14 »+Z | 1.50 | 0.19 | -0.01 | < -2000 | -0.04 | < -2000 |
| BmX004 | 16-14 »+Z | 1.67 | 0.00 | -0.02 | -1357.774 | -0.13 | -233.368 |
| BmX004 | 16-14 »+Z | 1.94 | 0.00 | -0.03 | -1162.249 | -0.15 | -199.409 |
| BmX004 | 16-14 »+Z | 2.22 | 0.00 | -0.03 | -1025.504 | -0.17 | -176.191 |
| BmZ004 | 16-14 »+Z | 2.25 | 0.19 | -0.02 | < -2000 | -0.03 | < -2000 |
| BmX004 | 16-14 »+Z | 2.50 | 0.00 | -0.03 | -928.262 | -0.19 | -160.242 |
| BmZ004 | 16-14 »+Z | 3.00 | 0.19 | -0.04 | < -2000 | -0.01 | < -2000 |
| BmZ004 | 16-14 »+Z | 3.75 | 0.19 | -0.05 | -1495.014 | 0.01 | > 2000 |
| BmZ004 | 16-14 »+Z | 4.50 | 0.19 | -0.07 | -1198.598 | 0.03 | > 2000 |
| BmZ004 | 16-14 »+Z | 5.25 | 0.19 | -0.07 | -1133.21 | 0.04 | > 2000 |
| BmZ004 | 16-14 »+Z | 6.00 | 0.19 | -0.06 | -1325.666 | 0.03 | > 2000 |
| BmZ004 | 16-14 »+Z | 6.75 | 0.19 | -0.03 | < -2000 | -0.00 | < -2000 |
| BmZ004 | D | 0.00 | 0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |
| BmX004 | D | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | D | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | D | 0.56 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ004 | D | 0.75 | 0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmX004 | D | 0.83 | -0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX004 | D | 1.11 | -0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX004 | D | 1.39 | -0.00 | -0.03 | -981.268 | 0.00 | -NA- |
| BmZ004 | D | 1.50 | 0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmX004 | D | 1.67 | -0.00 | -0.04 | -808.474 | 0.00 | -NA- |
| BmX004 | D | 1.94 | -0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX004 | D | 2.22 | -0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ004 | D | 2.25 | 0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmX004 | D | 2.50 | -0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ004 | D | 3.00 | 0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | D | 3.75 | -0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | D | 4.50 | -0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmZ004 | D | 5.25 | -0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmZ004 | D | 6.00 | -0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmZ004 | D | 6.75 | -0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |
| BmZ004 | D+L | 0.00 | 0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |
| BmX004 | D+L | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | D+L | 0.28 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmX004 | D+L | 0.56 | -0.00 | -0.01 | < -2000 | 0.00 | -NA- |
| BmZ004 | D+L | 0.75 | 0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmX004 | D+L | 0.83 | -0.00 | -0.02 | -1726.872 | 0.00 | -NA- |
| BmX004 | D+L | 1.11 | -0.00 | -0.02 | -1253.371 | 0.00 | -NA- |
| BmX004 | D+L | 1.39 | -0.00 | -0.03 | -981.268 | 0.00 | -NA- |
| BmZ004 | D+L | 1.50 | 0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmX004 | D+L | 1.67 | -0.00 | -0.04 | -808.474 | 0.00 | -NA- |
| BmX004 | D+L | 1.94 | -0.00 | -0.04 | -692.049 | 0.00 | -NA- |
| BmX004 | D+L | 2.22 | -0.00 | -0.05 | -610.611 | 0.00 | > 2000 |
| BmZ004 | D+L | 2.25 | 0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmX004 | D+L | 2.50 | -0.00 | -0.05 | -552.684 | 0.00 | > 2000 |
| BmZ004 | D+L | 3.00 | 0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | D+L | 3.75 | -0.00 | -0.08 | -1074.583 | 0.00 | > 2000 |
| BmZ004 | D+L | 4.50 | -0.00 | -0.07 | -1119.198 | 0.00 | > 2000 |
| BmZ004 | D+L | 5.25 | -0.00 | -0.07 | -1209.555 | 0.00 | > 2000 |
| BmZ004 | D+L | 6.00 | -0.00 | -0.06 | -1342.365 | 0.00 | > 2000 |
| BmZ004 | D+L | 6.75 | -0.00 | -0.05 | -1492.248 | 0.00 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| BmZ004 | Live | 0.00 | 0.00 | -0.23 | -351.063 | 0.00 | > 2000 |
| BmX004 | Live | 0.00 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| BmX004 | Live | 0.28 | -0.00 | -0.02 | -1357.071 | 0.00 | -NA- |
| BmX004 | Live | 0.56 | -0.00 | -0.05 | -639.707 | 0.00 | > 2000 |
| BmZ004 | Live | 0.75 | 0.00 | -0.24 | -333.324 | 0.00 | > 2000 |
| BmX004 | Live | 0.83 | -0.00 | -0.07 | -407.523 | 0.00 | > 2000 |
| BmX004 | Live | 1.11 | -0.00 | -0.10 | -295.501 | 0.00 | > 2000 |
| BmX004 | Live | 1.39 | -0.00 | -0.13 | -231.112 | 0.00 | > 2000 |
| BmZ004 | Live | 1.50 | 0.00 | -0.26 | -312.771 | 0.00 | > 2000 |
| BmX004 | Live | 1.67 | -0.00 | -0.16 | -190.217 | 0.00 | > 2000 |
| BmX004 | Live | 1.94 | -0.00 | -0.18 | -162.659 | 0.00 | > 2000 |
| BmX004 | Live | 2.22 | -0.00 | -0.21 | -143.385 | 0.00 | > 2000 |
| BmZ004 | Live | 2.25 | 0.00 | -0.27 | -296.868 | 0.00 | > 2000 |
| BmX004 | Live | 2.50 | -0.00 | -0.23 | -129.682 | 0.00 | > 2000 |
| BmZ004 | Live | 3.00 | 0.00 | -0.28 | -288.499 | 0.00 | > 2000 |
| BmZ004 | Live | 3.75 | -0.00 | -0.28 | -288.499 | 0.00 | > 2000 |
| BmZ004 | Live | 4.50 | -0.00 | -0.27 | -296.868 | 0.00 | > 2000 |
| BmZ004 | Live | 5.25 | -0.00 | -0.26 | -312.771 | 0.00 | > 2000 |
| BmZ004 | Live | 6.00 | -0.00 | -0.24 | -333.324 | 0.00 | > 2000 |
| BmZ004 | Live | 6.75 | -0.00 | -0.23 | -351.063 | 0.00 | > 2000 |
| COL001 | 16-10Lr | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-10Lr | 1.08 | -0.00 | -0.07 | -1727.495 | 0.02 | > 2000 |
| COL001 | 16-10Lr | 2.17 | -0.00 | -0.08 | -1376.845 | 0.02 | > 2000 |
| COL001 | 16-10Lr | 3.25 | -0.00 | -0.07 | -1774.447 | 0.03 | > 2000 |
| COL001 | 16-10Lr | 4.33 | -0.00 | -0.02 | < -2000 | 0.02 | > 2000 |
| COL001 | 16-10Lr | 5.42 | -0.00 | 0.02 | > 2000 | 0.02 | > 2000 |
| COL001 | 16-10Lr | 6.50 | -0.00 | 0.07 | 1787.589 | 0.01 | > 2000 |
| COL001 | 16-10Lr | 7.58 | -0.00 | 0.08 | 1382.973 | 0.00 | > 2000 |
| COL001 | 16-10Lr | 8.67 | -0.00 | 0.07 | 1732.994 | 0.00 | > 2000 |
| COL001 | 16-10Lr | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-10R | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-10R | 1.08 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-10R | 2.17 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-10R | 3.25 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-10R | 4.33 | -0.00 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-10R | 5.42 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-10R | 6.50 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-10R | 7.58 | -0.00 | 0.02 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-10R | 8.67 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-10R | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-11Lr | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-11Lr | 1.08 | -0.00 | -0.05 | < -2000 | 0.01 | > 2000 |
| COL001 | 16-11Lr | 2.17 | -0.00 | -0.07 | -1725.924 | 0.02 | > 2000 |
| COL001 | 16-11Lr | 3.25 | -0.00 | -0.05 | < -2000 | 0.02 | > 2000 |
| COL001 | 16-11Lr | 4.33 | -0.00 | -0.02 | < -2000 | 0.02 | > 2000 |
| COL001 | 16-11Lr | 5.42 | -0.00 | 0.02 | > 2000 | 0.01 | > 2000 |
| COL001 | 16-11Lr | 6.50 | -0.00 | 0.05 | > 2000 | 0.01 | > 2000 |
| COL001 | 16-11Lr | 7.58 | -0.00 | 0.07 | 1733.143 | 0.00 | > 2000 |
| COL001 | 16-11Lr | 8.67 | -0.00 | 0.05 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-11Lr | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-12W »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-12W »+X | 1.08 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-12W »+X | 2.17 | -0.00 | -0.05 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-12W »+X | 3.25 | -0.00 | -0.05 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-12W »+X | 4.33 | -0.00 | -0.05 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-12W »+X | 5.42 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-12W »+X | 6.50 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-12W »+X | 7.58 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-12W »+X | 8.67 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-12W »+X | 9.75 | 0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-12W »+Z | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-12W »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001 | 16-12W »+Z | 2.17 | -0.00 | -0.02 | < -2000 | -0.01 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001 | 16-12W »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001 | 16-12W »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001 | 16-12W »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-12W »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-12W »+Z | 7.58 | -0.00 | 0.02 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-12W »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-12W »+Z | 9.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+Lr »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+Lr »+X | 1.08 | -0.00 | -0.07 | -1725.501 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+X | 2.17 | -0.00 | -0.09 | -1272.827 | 0.02 | > 2000 |
| COL001 | 16-13W+Lr »+X | 3.25 | -0.00 | -0.08 | -1398.415 | 0.02 | > 2000 |
| COL001 | 16-13W+Lr »+X | 4.33 | -0.00 | -0.05 | < -2000 | 0.02 | > 2000 |
| COL001 | 16-13W+Lr »+X | 5.42 | -0.00 | -0.02 | < -2000 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+X | 6.50 | -0.00 | 0.02 | > 2000 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+X | 7.58 | -0.00 | 0.04 | > 2000 | 0.00 | > 2000 |
| COL001 | 16-13W+Lr »+X | 8.67 | -0.00 | 0.04 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-13W+Lr »+X | 9.75 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-13W+Lr »+Z | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+Lr »+Z | 1.08 | -0.00 | -0.05 | < -2000 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+Z | 2.17 | -0.00 | -0.07 | -1723.169 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+Z | 3.25 | -0.00 | -0.05 | < -2000 | 0.01 | > 2000 |
| COL001 | 16-13W+Lr »+Z | 4.33 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-13W+Lr »+Z | 5.42 | -0.00 | 0.02 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-13W+Lr »+Z | 6.50 | -0.00 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-13W+Lr »+Z | 7.58 | -0.00 | 0.07 | 1735.930 | -0.01 | < -2000 |
| COL001 | 16-13W+Lr »+Z | 8.67 | -0.00 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-13W+Lr »+Z | 9.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+R »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+R »+X | 1.08 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-13W+R »+X | 2.17 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-13W+R »+X | 3.25 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-13W+R »+X | 4.33 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-13W+R »+X | 5.42 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-13W+R »+X | 6.50 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-13W+R »+X | 7.58 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-13W+R »+X | 8.67 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-13W+R »+X | 9.75 | 0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-13W+R »+Z | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-13W+R »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-13W+R »+Z | 2.17 | -0.00 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001 | 16-13W+R »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001 | 16-13W+R »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001 | 16-13W+R »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-13W+R »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-13W+R »+Z | 7.58 | -0.00 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-13W+R »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-13W+R »+Z | 9.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-14 »+X | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-14 »+X | 1.08 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X | 2.17 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X | 3.25 | -0.00 | -0.05 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X | 4.33 | -0.00 | -0.05 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X | 5.42 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X | 6.50 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X | 7.58 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X | 8.67 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X | 9.75 | 0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-14 »+X+Y | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-14 »+X+Y | 1.08 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X+Y | 2.17 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X+Y | 3.25 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X+Y | 4.33 | -0.00 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001 | 16-14 »+X+Y | 5.42 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001 | 16-14 »+X+Y | 6.50 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X+Y | 7.58 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X+Y | 8.67 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | 16-14 »+X+Y | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | 16-14 »+Z | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | 16-14 »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001 | 16-14 »+Z | 2.17 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001 | 16-14 »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001 | 16-14 »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001 | 16-14 »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-14 »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-14 »+Z | 7.58 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001 | 16-14 »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001 | 16-14 »+Z | 9.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | D | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | D | 1.08 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | D | 2.17 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001 | D | 3.25 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | D | 4.33 | -0.00 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001 | D | 5.42 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001 | D | 6.50 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | D | 7.58 | -0.00 | 0.02 | > 2000 | -0.00 | < -2000 |
| COL001 | D | 8.67 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | D | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | D+L | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | D+L | 1.08 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | D+L | 2.17 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001 | D+L | 3.25 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001 | D+L | 4.33 | -0.00 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001 | D+L | 5.42 | -0.00 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001 | D+L | 6.50 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | D+L | 7.58 | -0.00 | 0.02 | > 2000 | -0.00 | < -2000 |
| COL001 | D+L | 8.67 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001 | D+L | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001 | Live | 0.00 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001 | Live | 1.08 | -0.00 | -0.05 | < -2000 | 0.01 | > 2000 |
| COL001 | Live | 2.17 | -0.00 | -0.07 | -1701.859 | 0.02 | > 2000 |
| COL001 | Live | 3.25 | -0.00 | -0.05 | < -2000 | 0.02 | > 2000 |
| COL001 | Live | 4.33 | -0.00 | -0.02 | < -2000 | 0.02 | > 2000 |
| COL001 | Live | 5.42 | -0.00 | 0.02 | > 2000 | 0.02 | > 2000 |
| COL001 | Live | 6.50 | -0.00 | 0.05 | > 2000 | 0.01 | > 2000 |
| COL001 | Live | 7.58 | -0.00 | 0.07 | 1711.230 | 0.01 | > 2000 |
| COL001 | Live | 8.67 | -0.00 | 0.05 | > 2000 | 0.00 | > 2000 |
| COL001 | Live | 9.75 | -0.00 | -0.00 | -NA- | 0.00 | -NA- |
| COL001-- | 16-10Lr | 0.00 | **-0.29** | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-10Lr | 1.08 | -0.29 | -0.07 | -1734.959 | -0.06 | < -2000 |
| COL001-- | 16-10Lr | 2.17 | -0.29 | -0.08 | -1382.002 | -0.08 | -1388.838 |
| COL001-- | 16-10Lr | 3.25 | -0.29 | -0.07 | -1780.78 | -0.09 | -1333.175 |
| COL001-- | 16-10Lr | 4.33 | -0.29 | -0.02 | < -2000 | -0.07 | -1576.248 |
| COL001-- | 16-10Lr | 5.42 | -0.29 | 0.02 | > 2000 | -0.05 | < -2000 |
| COL001-- | 16-10Lr | 6.50 | -0.29 | 0.07 | 1794.017 | -0.03 | < -2000 |
| COL001-- | 16-10Lr | 7.58 | -0.29 | 0.08 | 1388.176 | -0.00 | < -2000 |
| COL001-- | 16-10Lr | 8.67 | -0.29 | 0.07 | 1740.506 | 0.01 | > 2000 |
| COL001-- | 16-10Lr | 9.75 | -0.29 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-10R | 0.00 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-10R | 1.08 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-10R | 2.17 | -0.05 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001-- | 16-10R | 3.25 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-10R | 4.33 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-10R | 5.42 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-10R | 6.50 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-10R | 7.58 | -0.05 | 0.02 | > 2000 | 0.01 | > 2000 |
| COL001-- | 16-10R | 8.67 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-- | 16-10R | 9.75 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-11Lr | 0.00 | -0.23 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-11Lr | 1.08 | -0.23 | -0.05 | < -2000 | -0.04 | < -2000 |
| COL001-- | 16-11Lr | 2.17 | -0.23 | -0.07 | -1733.638 | -0.06 | -1807.16 |
| COL001-- | 16-11Lr | 3.25 | -0.23 | -0.05 | < -2000 | -0.07 | -1745.503 |
| COL001-- | 16-11Lr | 4.33 | -0.23 | -0.02 | < -2000 | -0.06 | < -2000 |
| COL001-- | 16-11Lr | 5.42 | -0.23 | 0.02 | > 2000 | -0.04 | < -2000 |
| COL001-- | 16-11Lr | 6.50 | -0.23 | 0.05 | > 2000 | -0.02 | < -2000 |
| COL001-- | 16-11Lr | 7.58 | -0.23 | 0.07 | 1740.922 | -0.00 | < -2000 |
| COL001-- | 16-11Lr | 8.67 | -0.23 | 0.05 | > 2000 | 0.01 | > 2000 |
| COL001-- | 16-11Lr | 9.75 | -0.23 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-12W »+X | 0.00 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-12W »+X | 1.08 | -0.05 | 0.06 | 1982.241 | -0.00 | < -2000 |
| COL001-- | 16-12W »+X | 2.17 | -0.05 | 0.15 | 792.667 | -0.01 | < -2000 |
| COL001-- | 16-12W »+X | 3.25 | -0.05 | 0.23 | 507.047 | -0.00 | < -2000 |
| COL001-- | 16-12W »+X | 4.33 | -0.05 | 0.28 | 412.258 | -0.00 | < -2000 |
| COL001-- | 16-12W »+X | 5.42 | -0.05 | **0.29** | 399.365 | 0.00 | > 2000 |
| COL001-- | 16-12W »+X | 6.50 | -0.05 | 0.26 | 457.972 | 0.00 | > 2000 |
| COL001-- | 16-12W »+X | 7.58 | -0.05 | 0.18 | 651.204 | 0.01 | > 2000 |
| COL001-- | 16-12W »+X | 8.67 | -0.05 | 0.08 | 1382.959 | 0.00 | > 2000 |
| COL001-- | 16-12W »+X | 9.75 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-- | 16-12W »+Z | 0.00 | -0.05 | -0.00 | < -2000 | -0.19 | -624.957 |
| COL001-- | 16-12W »+Z | 1.08 | -0.05 | -0.01 | < -2000 | -0.27 | -435.957 |
| COL001-- | 16-12W »+Z | 2.17 | -0.05 | -0.02 | < -2000 | -0.37 | -320.529 |
| COL001-- | 16-12W »+Z | 3.25 | -0.05 | -0.01 | < -2000 | -0.45 | -262.667 |
| COL001-- | 16-12W »+Z | 4.33 | -0.05 | -0.00 | < -2000 | **-0.49** | -239.338 |
| COL001-- | 16-12W »+Z | 5.42 | -0.05 | 0.00 | > 2000 | -0.49 | -241.103 |
| COL001-- | 16-12W »+Z | 6.50 | -0.05 | 0.01 | > 2000 | -0.44 | -268.490 |
| COL001-- | 16-12W »+Z | 7.58 | -0.05 | 0.02 | > 2000 | -0.35 | -331.920 |
| COL001-- | 16-12W »+Z | 8.67 | -0.05 | 0.01 | > 2000 | -0.26 | -452.814 |
| COL001-- | 16-12W »+Z | 9.75 | -0.05 | -0.00 | < -2000 | -0.19 | -624.881 |
| COL001-- | 16-13W+Lr »+X | 0.00 | -0.23 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-13W+Lr »+X | 1.08 | -0.23 | -0.00 | < -2000 | -0.04 | < -2000 |
| COL001-- | 16-13W+Lr »+X | 2.17 | -0.23 | 0.05 | > 2000 | -0.06 | -1802.786 |
| COL001-- | 16-13W+Lr »+X | 3.25 | -0.23 | 0.13 | 899.820 | -0.07 | -1746.727 |
| COL001-- | 16-13W+Lr »+X | 4.33 | -0.23 | 0.20 | 594.600 | -0.06 | < -2000 |
| COL001-- | 16-13W+Lr »+X | 5.42 | -0.23 | 0.24 | 497.024 | -0.04 | < -2000 |
| COL001-- | 16-13W+Lr »+X | 6.50 | -0.23 | 0.23 | 499.409 | -0.02 | < -2000 |
| COL001-- | 16-13W+Lr »+X | 7.58 | -0.23 | 0.19 | 615.205 | -0.00 | < -2000 |
| COL001-- | 16-13W+Lr »+X | 8.67 | -0.23 | 0.11 | 1086.369 | 0.01 | > 2000 |
| COL001-- | 16-13W+Lr »+X | 9.75 | -0.23 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-- | 16-13W+Lr »+Z | 0.00 | -0.23 | -0.00 | < -2000 | -0.14 | -833.572 |
| COL001-- | 16-13W+Lr »+Z | 1.08 | -0.23 | -0.05 | < -2000 | -0.24 | -483.801 |
| COL001-- | 16-13W+Lr »+Z | 2.17 | -0.23 | -0.07 | -1727.278 | -0.33 | -350.333 |
| COL001-- | 16-13W+Lr »+Z | 3.25 | -0.23 | -0.05 | < -2000 | -0.40 | -294.389 |
| COL001-- | 16-13W+Lr »+Z | 4.33 | -0.23 | -0.02 | < -2000 | -0.42 | -277.604 |
| COL001-- | 16-13W+Lr »+Z | 5.42 | -0.23 | 0.02 | > 2000 | -0.40 | -290.187 |
| COL001-- | 16-13W+Lr »+Z | 6.50 | -0.23 | 0.05 | > 2000 | -0.35 | -336.097 |
| COL001-- | 16-13W+Lr »+Z | 7.58 | -0.23 | 0.07 | 1734.511 | -0.27 | -433.307 |
| COL001-- | 16-13W+Lr »+Z | 8.67 | -0.23 | 0.05 | > 2000 | -0.19 | -613.104 |
| COL001-- | 16-13W+Lr »+Z | 9.75 | -0.23 | -0.00 | < -2000 | -0.14 | -832.879 |
| COL001-- | 16-13W+R »+X | 0.00 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-13W+R »+X | 1.08 | -0.05 | 0.04 | > 2000 | -0.00 | < -2000 |
| COL001-- | 16-13W+R »+X | 2.17 | -0.05 | 0.11 | 1096.593 | -0.01 | < -2000 |
| COL001-- | 16-13W+R »+X | 3.25 | -0.05 | 0.17 | 688.356 | -0.00 | < -2000 |
| COL001-- | 16-13W+R »+X | 4.33 | -0.05 | 0.21 | 552.651 | -0.00 | < -2000 |
| COL001-- | 16-13W+R »+X | 5.42 | -0.05 | 0.22 | 529.725 | 0.00 | > 2000 |
| COL001-- | 16-13W+R »+X | 6.50 | -0.05 | 0.19 | 600.936 | 0.00 | > 2000 |
| COL001-- | 16-13W+R »+X | 7.58 | -0.05 | 0.14 | 843.191 | 0.01 | > 2000 |
| COL001-- | 16-13W+R »+X | 8.67 | -0.05 | 0.07 | 1755.490 | 0.00 | > 2000 |
| COL001-- | 16-13W+R »+X | 9.75 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-- | 16-13W+R »+Z | 0.00 | -0.05 | -0.00 | < -2000 | -0.14 | -833.293 |
| COL001-- | 16-13W+R »+Z | 1.08 | -0.05 | -0.01 | < -2000 | -0.20 | -577.692 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-- | 16-13W+R »+Z | 2.17 | -0.05 | -0.02 | < -2000 | -0.28 | -424.941 |
| COL001-- | 16-13W+R »+Z | 3.25 | -0.05 | -0.01 | < -2000 | -0.34 | -348.961 |
| COL001-- | 16-13W+R »+Z | 4.33 | -0.05 | -0.00 | < -2000 | -0.37 | -318.728 |
| COL001-- | 16-13W+R »+Z | 5.42 | -0.05 | 0.00 | > 2000 | -0.36 | -321.867 |
| COL001-- | 16-13W+R »+Z | 6.50 | -0.05 | 0.01 | > 2000 | -0.33 | -359.314 |
| COL001-- | 16-13W+R »+Z | 7.58 | -0.05 | 0.02 | > 2000 | -0.26 | -445.197 |
| COL001-- | 16-13W+R »+Z | 8.67 | -0.05 | 0.01 | > 2000 | -0.19 | -607.668 |
| COL001-- | 16-13W+R »+Z | 9.75 | -0.05 | -0.00 | < -2000 | -0.14 | -833.157 |
| COL001-- | 16-14 »+X | 0.00 | -0.03 | 0.00 | > 2000 | 0.00 | -NA- |
| COL001-- | 16-14 »+X | 1.08 | -0.03 | 0.06 | 1824.148 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X | 2.17 | -0.03 | 0.15 | 759.662 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X | 3.25 | -0.03 | 0.24 | 496.408 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X | 4.33 | -0.03 | 0.29 | 409.613 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X | 5.42 | -0.03 | 0.29 | 401.879 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X | 6.50 | -0.03 | 0.25 | 467.012 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X | 7.58 | -0.03 | 0.17 | 675.307 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X | 8.67 | -0.03 | 0.08 | 1471.961 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X | 9.75 | -0.03 | 0.00 | > 2000 | -0.00 | -NA- |
| COL001-- | 16-14 »+X+Y | 0.00 | -0.03 | 0.00 | > 2000 | 0.00 | -NA- |
| COL001-- | 16-14 »+X+Y | 1.08 | -0.03 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X+Y | 2.17 | -0.03 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X+Y | 3.25 | -0.03 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X+Y | 4.33 | -0.03 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | 16-14 »+X+Y | 5.42 | -0.03 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X+Y | 6.50 | -0.03 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X+Y | 7.58 | -0.03 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X+Y | 8.67 | -0.03 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | 16-14 »+X+Y | 9.75 | -0.03 | -0.00 | < -2000 | -0.00 | -NA- |
| COL001-- | 16-14 »+Z | 0.00 | -0.03 | -0.00 | < -2000 | -0.19 | -624.942 |
| COL001-- | 16-14 »+Z | 1.08 | -0.03 | -0.01 | < -2000 | -0.27 | -439.227 |
| COL001-- | 16-14 »+Z | 2.17 | -0.03 | -0.01 | < -2000 | -0.36 | -322.744 |
| COL001-- | 16-14 »+Z | 3.25 | -0.03 | -0.01 | < -2000 | -0.44 | -263.811 |
| COL001-- | 16-14 »+Z | 4.33 | -0.03 | -0.00 | < -2000 | -0.49 | -239.689 |
| COL001-- | 16-14 »+Z | 5.42 | -0.03 | 0.00 | > 2000 | -0.49 | -240.748 |
| COL001-- | 16-14 »+Z | 6.50 | -0.03 | 0.01 | > 2000 | -0.44 | -267.305 |
| COL001-- | 16-14 »+Z | 7.58 | -0.03 | 0.01 | > 2000 | -0.36 | -329.577 |
| COL001-- | 16-14 »+Z | 8.67 | -0.03 | 0.01 | > 2000 | -0.26 | -449.339 |
| COL001-- | 16-14 »+Z | 9.75 | -0.03 | -0.00 | < -2000 | -0.19 | -624.896 |
| COL001-- | D | 0.00 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | D | 1.08 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | D | 2.17 | -0.05 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001-- | D | 3.25 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | D | 4.33 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | D | 5.42 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | D | 6.50 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | D | 7.58 | -0.05 | 0.02 | > 2000 | 0.01 | > 2000 |
| COL001-- | D | 8.67 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | D | 9.75 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | D+L | 0.00 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | D+L | 1.08 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | D+L | 2.17 | -0.05 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001-- | D+L | 3.25 | -0.05 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-- | D+L | 4.33 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | D+L | 5.42 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | D+L | 6.50 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | D+L | 7.58 | -0.05 | 0.02 | > 2000 | 0.01 | > 2000 |
| COL001-- | D+L | 8.67 | -0.05 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-- | D+L | 9.75 | -0.05 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-- | Live | 0.00 | -0.23 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-- | Live | 1.08 | -0.23 | -0.05 | < -2000 | -0.05 | < -2000 |
| COL001-- | Live | 2.17 | -0.23 | -0.07 | -1703.392 | -0.08 | -1499.951 |
| COL001-- | Live | 3.25 | -0.23 | -0.05 | < -2000 | -0.08 | -1410.927 |
| COL001-- | Live | 4.33 | -0.23 | -0.02 | < -2000 | -0.07 | -1615.117 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-- | Live | 5.42 | -0.23 | 0.02 | > 2000 | -0.05 | < -2000 |
| COL001-- | Live | 6.50 | -0.23 | 0.05 | > 2000 | -0.03 | < -2000 |
| COL001-- | Live | 7.58 | -0.23 | 0.07 | 1712.780 | -0.01 | < -2000 |
| COL001-- | Live | 8.67 | -0.23 | 0.05 | > 2000 | 0.00 | > 2000 |
| COL001-- | Live | 9.75 | -0.23 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-0 | 16-10Lr | 0.00 | -0.29 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-10Lr | 1.08 | -0.29 | -0.07 | -1734.959 | 0.06 | > 2000 |
| COL001-0 | 16-10Lr | 2.17 | -0.29 | -0.08 | -1382.002 | 0.08 | 1388.838 |
| COL001-0 | 16-10Lr | 3.25 | -0.29 | -0.07 | -1780.78 | **0.09** | 1333.175 |
| COL001-0 | 16-10Lr | 4.33 | -0.29 | -0.02 | < -2000 | 0.07 | 1576.248 |
| COL001-0 | 16-10Lr | 5.42 | -0.29 | 0.02 | > 2000 | 0.05 | > 2000 |
| COL001-0 | 16-10Lr | 6.50 | -0.29 | 0.07 | 1794.017 | 0.03 | > 2000 |
| COL001-0 | 16-10Lr | 7.58 | -0.29 | 0.08 | 1388.176 | 0.00 | > 2000 |
| COL001-0 | 16-10Lr | 8.67 | -0.29 | 0.07 | 1740.506 | -0.01 | < -2000 |
| COL001-0 | 16-10Lr | 9.75 | -0.29 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-10R | 0.00 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-10R | 1.08 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-10R | 2.17 | -0.05 | -0.02 | < -2000 | 0.01 | > 2000 |
| COL001-0 | 16-10R | 3.25 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-10R | 4.33 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-10R | 5.42 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-10R | 6.50 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-10R | 7.58 | -0.05 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-0 | 16-10R | 8.67 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-10R | 9.75 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-11Lr | 0.00 | -0.23 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-11Lr | 1.08 | -0.23 | -0.05 | < -2000 | 0.04 | > 2000 |
| COL001-0 | 16-11Lr | 2.17 | -0.23 | -0.07 | -1733.638 | 0.06 | 1807.160 |
| COL001-0 | 16-11Lr | 3.25 | -0.23 | -0.05 | < -2000 | 0.07 | 1745.503 |
| COL001-0 | 16-11Lr | 4.33 | -0.23 | -0.02 | < -2000 | 0.06 | > 2000 |
| COL001-0 | 16-11Lr | 5.42 | -0.23 | 0.02 | > 2000 | 0.04 | > 2000 |
| COL001-0 | 16-11Lr | 6.50 | -0.23 | 0.05 | > 2000 | 0.02 | > 2000 |
| COL001-0 | 16-11Lr | 7.58 | -0.23 | 0.07 | 1740.922 | 0.00 | > 2000 |
| COL001-0 | 16-11Lr | 8.67 | -0.23 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001-0 | 16-11Lr | 9.75 | -0.23 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-12W »+X | 0.00 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-12W »+X | 1.08 | -0.05 | 0.06 | 1982.241 | 0.00 | > 2000 |
| COL001-0 | 16-12W »+X | 2.17 | -0.05 | 0.15 | 792.667 | 0.01 | > 2000 |
| COL001-0 | 16-12W »+X | 3.25 | -0.05 | 0.23 | 507.047 | 0.00 | > 2000 |
| COL001-0 | 16-12W »+X | 4.33 | -0.05 | 0.28 | 412.258 | 0.00 | > 2000 |
| COL001-0 | 16-12W »+X | 5.42 | -0.05 | 0.29 | 399.365 | -0.00 | < -2000 |
| COL001-0 | 16-12W »+X | 6.50 | -0.05 | 0.26 | 457.972 | -0.00 | < -2000 |
| COL001-0 | 16-12W »+X | 7.58 | -0.05 | 0.18 | 651.204 | -0.01 | < -2000 |
| COL001-0 | 16-12W »+X | 8.67 | -0.05 | 0.08 | 1382.959 | -0.00 | < -2000 |
| COL001-0 | 16-12W »+X | 9.75 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-0 | 16-12W »+Z | 0.00 | -0.05 | 0.00 | > 2000 | -0.19 | -624.881 |
| COL001-0 | 16-12W »+Z | 1.08 | -0.05 | -0.01 | < -2000 | -0.26 | -452.814 |
| COL001-0 | 16-12W »+Z | 2.17 | -0.05 | -0.02 | < -2000 | -0.35 | -331.920 |
| COL001-0 | 16-12W »+Z | 3.25 | -0.05 | -0.01 | < -2000 | -0.44 | -268.490 |
| COL001-0 | 16-12W »+Z | 4.33 | -0.05 | -0.00 | < -2000 | -0.49 | -241.103 |
| COL001-0 | 16-12W »+Z | 5.42 | -0.05 | 0.00 | > 2000 | -0.49 | -239.338 |
| COL001-0 | 16-12W »+Z | 6.50 | -0.05 | 0.01 | > 2000 | -0.45 | -262.667 |
| COL001-0 | 16-12W »+Z | 7.58 | -0.05 | 0.02 | > 2000 | -0.37 | -320.529 |
| COL001-0 | 16-12W »+Z | 8.67 | -0.05 | 0.01 | > 2000 | -0.27 | -435.957 |
| COL001-0 | 16-12W »+Z | 9.75 | -0.05 | 0.00 | > 2000 | -0.19 | -624.957 |
| COL001-0 | 16-13W+Lr »+X | 0.00 | -0.23 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-13W+Lr »+X | 1.08 | -0.23 | -0.00 | < -2000 | 0.04 | > 2000 |
| COL001-0 | 16-13W+Lr »+X | 2.17 | -0.23 | 0.05 | > 2000 | 0.06 | 1802.786 |
| COL001-0 | 16-13W+Lr »+X | 3.25 | -0.23 | 0.13 | 899.820 | 0.07 | 1746.727 |
| COL001-0 | 16-13W+Lr »+X | 4.33 | -0.23 | 0.20 | 594.600 | 0.06 | > 2000 |
| COL001-0 | 16-13W+Lr »+X | 5.42 | -0.23 | 0.24 | 497.024 | 0.04 | > 2000 |
| COL001-0 | 16-13W+Lr »+X | 6.50 | -0.23 | 0.23 | 499.409 | 0.02 | > 2000 |
| COL001-0 | 16-13W+Lr »+X | 7.58 | -0.23 | 0.19 | 615.205 | 0.00 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-0 | 16-13W+Lr »+X | 8.67 | -0.23 | 0.11 | 1086.369 | -0.01 | < -2000 |
| COL001-0 | 16-13W+Lr »+X | 9.75 | -0.23 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-0 | 16-13W+Lr »+Z | 0.00 | -0.23 | 0.00 | > 2000 | -0.14 | -832.879 |
| COL001-0 | 16-13W+Lr »+Z | 1.08 | -0.23 | -0.05 | < -2000 | -0.15 | -763.536 |
| COL001-0 | 16-13W+Lr »+Z | 2.17 | -0.23 | -0.07 | -1727.272 | -0.20 | -573.054 |
| COL001-0 | 16-13W+Lr »+Z | 3.25 | -0.23 | -0.05 | < -2000 | -0.26 | -444.077 |
| COL001-0 | 16-13W+Lr »+Z | 4.33 | -0.23 | -0.02 | < -2000 | -0.31 | -378.487 |
| COL001-0 | 16-13W+Lr »+Z | 5.42 | -0.23 | 0.02 | > 2000 | -0.33 | -357.360 |
| COL001-0 | 16-13W+Lr »+Z | 6.50 | -0.23 | 0.05 | > 2000 | -0.31 | -374.057 |
| COL001-0 | 16-13W+Lr »+Z | 7.58 | -0.23 | 0.07 | 1734.518 | -0.27 | -436.370 |
| COL001-0 | 16-13W+Lr »+Z | 8.67 | -0.23 | 0.05 | > 2000 | -0.20 | -572.863 |
| COL001-0 | 16-13W+Lr »+Z | 9.75 | -0.23 | 0.00 | > 2000 | -0.14 | -833.572 |
| COL001-0 | 16-13W+R »+X | 0.00 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-13W+R »+X | 1.08 | -0.05 | 0.04 | > 2000 | 0.00 | > 2000 |
| COL001-0 | 16-13W+R »+X | 2.17 | -0.05 | 0.11 | 1096.593 | 0.01 | > 2000 |
| COL001-0 | 16-13W+R »+X | 3.25 | -0.05 | 0.17 | 688.356 | 0.00 | > 2000 |
| COL001-0 | 16-13W+R »+X | 4.33 | -0.05 | 0.21 | 552.651 | 0.00 | > 2000 |
| COL001-0 | 16-13W+R »+X | 5.42 | -0.05 | 0.22 | 529.725 | -0.00 | < -2000 |
| COL001-0 | 16-13W+R »+X | 6.50 | -0.05 | 0.19 | 600.936 | -0.00 | < -2000 |
| COL001-0 | 16-13W+R »+X | 7.58 | -0.05 | 0.14 | 843.191 | -0.01 | < -2000 |
| COL001-0 | 16-13W+R »+X | 8.67 | -0.05 | 0.07 | 1755.490 | -0.00 | < -2000 |
| COL001-0 | 16-13W+R »+X | 9.75 | -0.05 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-0 | 16-13W+R »+Z | 0.00 | -0.05 | 0.00 | > 2000 | -0.14 | -833.157 |
| COL001-0 | 16-13W+R »+Z | 1.08 | -0.05 | -0.01 | < -2000 | -0.19 | -607.668 |
| COL001-0 | 16-13W+R »+Z | 2.17 | -0.05 | -0.02 | < -2000 | -0.26 | -445.197 |
| COL001-0 | 16-13W+R »+Z | 3.25 | -0.05 | -0.01 | < -2000 | -0.33 | -359.314 |
| COL001-0 | 16-13W+R »+Z | 4.33 | -0.05 | -0.00 | < -2000 | -0.36 | -321.867 |
| COL001-0 | 16-13W+R »+Z | 5.42 | -0.05 | 0.00 | > 2000 | -0.37 | -318.728 |
| COL001-0 | 16-13W+R »+Z | 6.50 | -0.05 | 0.01 | > 2000 | -0.34 | -348.961 |
| COL001-0 | 16-13W+R »+Z | 7.58 | -0.05 | 0.02 | > 2000 | -0.28 | -424.941 |
| COL001-0 | 16-13W+R »+Z | 8.67 | -0.05 | 0.01 | > 2000 | -0.20 | -577.692 |
| COL001-0 | 16-13W+R »+Z | 9.75 | -0.05 | 0.00 | > 2000 | -0.14 | -833.293 |
| COL001-0 | 16-14 »+X | 0.00 | -0.03 | 0.00 | > 2000 | -0.00 | -NA- |
| COL001-0 | 16-14 »+X | 1.08 | -0.03 | 0.06 | 1824.148 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X | 2.17 | -0.03 | 0.15 | 759.662 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X | 3.25 | -0.03 | 0.24 | 496.408 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X | 4.33 | -0.03 | 0.29 | 409.613 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X | 5.42 | -0.03 | 0.29 | 401.879 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X | 6.50 | -0.03 | 0.25 | 467.012 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X | 7.58 | -0.03 | 0.17 | 675.307 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X | 8.67 | -0.03 | 0.08 | 1471.961 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X | 9.75 | -0.03 | 0.00 | > 2000 | 0.00 | -NA- |
| COL001-0 | 16-14 »+X+Y | 0.00 | -0.03 | 0.00 | > 2000 | -0.00 | -NA- |
| COL001-0 | 16-14 »+X+Y | 1.08 | -0.03 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X+Y | 2.17 | -0.03 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X+Y | 3.25 | -0.03 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X+Y | 4.33 | -0.03 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | 16-14 »+X+Y | 5.42 | -0.03 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X+Y | 6.50 | -0.03 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X+Y | 7.58 | -0.03 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X+Y | 8.67 | -0.03 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | 16-14 »+X+Y | 9.75 | -0.03 | -0.00 | < -2000 | 0.00 | -NA- |
| COL001-0 | 16-14 »+Z | 0.00 | -0.03 | 0.00 | > 2000 | -0.19 | -624.896 |
| COL001-0 | 16-14 »+Z | 1.08 | -0.03 | -0.01 | < -2000 | -0.26 | -449.339 |
| COL001-0 | 16-14 »+Z | 2.17 | -0.03 | -0.01 | < -2000 | -0.36 | -329.577 |
| COL001-0 | 16-14 »+Z | 3.25 | -0.03 | -0.01 | < -2000 | -0.44 | -267.305 |
| COL001-0 | 16-14 »+Z | 4.33 | -0.03 | -0.00 | < -2000 | -0.49 | -240.748 |
| COL001-0 | 16-14 »+Z | 5.42 | -0.03 | 0.00 | > 2000 | -0.49 | -239.689 |
| COL001-0 | 16-14 »+Z | 6.50 | -0.03 | 0.01 | > 2000 | -0.44 | -263.811 |
| COL001-0 | 16-14 »+Z | 7.58 | -0.03 | 0.01 | > 2000 | -0.36 | -322.744 |
| COL001-0 | 16-14 »+Z | 8.67 | -0.03 | 0.01 | > 2000 | -0.27 | -439.227 |
| COL001-0 | 16-14 »+Z | 9.75 | -0.03 | 0.00 | > 2000 | -0.19 | -624.942 |
| COL001-0 | D | 0.00 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-0 | D | 1.08 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D | 2.17 | -0.05 | -0.02 | < -2000 | 0.01 | > 2000 |
| COL001-0 | D | 3.25 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D | 4.33 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D | 5.42 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D | 6.50 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D | 7.58 | -0.05 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-0 | D | 8.67 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D | 9.75 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D+L | 0.00 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D+L | 1.08 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D+L | 2.17 | -0.05 | -0.02 | < -2000 | 0.01 | > 2000 |
| COL001-0 | D+L | 3.25 | -0.05 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D+L | 4.33 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | D+L | 5.42 | -0.05 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D+L | 6.50 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D+L | 7.58 | -0.05 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-0 | D+L | 8.67 | -0.05 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-0 | D+L | 9.75 | -0.05 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-0 | Live | 0.00 | -0.23 | 0.00 | > 2000 | -0.00 | < -2000 |
| COL001-0 | Live | 1.08 | -0.23 | -0.05 | < -2000 | 0.05 | > 2000 |
| COL001-0 | Live | 2.17 | -0.23 | -0.07 | -1703.392 | 0.08 | 1499.951 |
| COL001-0 | Live | 3.25 | -0.23 | -0.05 | < -2000 | 0.08 | 1410.927 |
| COL001-0 | Live | 4.33 | -0.23 | -0.02 | < -2000 | 0.07 | 1615.117 |
| COL001-0 | Live | 5.42 | -0.23 | 0.02 | > 2000 | 0.05 | > 2000 |
| COL001-0 | Live | 6.50 | -0.23 | 0.05 | > 2000 | 0.03 | > 2000 |
| COL001-0 | Live | 7.58 | -0.23 | 0.07 | 1712.780 | 0.01 | > 2000 |
| COL001-0 | Live | 8.67 | -0.23 | 0.05 | > 2000 | -0.00 | < -2000 |
| COL001-0 | Live | 9.75 | -0.23 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-10Lr | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-10Lr | 1.08 | -0.00 | -0.07 | -1727.495 | -0.02 | < -2000 |
| COL001-1 | 16-10Lr | 2.17 | -0.00 | -0.08 | -1376.845 | -0.02 | < -2000 |
| COL001-1 | 16-10Lr | 3.25 | -0.00 | -0.07 | -1774.447 | -0.03 | < -2000 |
| COL001-1 | 16-10Lr | 4.33 | -0.00 | -0.02 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-10Lr | 5.42 | -0.00 | 0.02 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-10Lr | 6.50 | -0.00 | 0.07 | 1787.589 | -0.01 | < -2000 |
| COL001-1 | 16-10Lr | 7.58 | -0.00 | 0.08 | 1382.973 | -0.00 | < -2000 |
| COL001-1 | 16-10Lr | 8.67 | -0.00 | 0.07 | 1732.994 | -0.00 | < -2000 |
| COL001-1 | 16-10Lr | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-10R | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-10R | 1.08 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-10R | 2.17 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-10R | 3.25 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-10R | 4.33 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-10R | 5.42 | -0.00 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-10R | 6.50 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-10R | 7.58 | -0.00 | 0.02 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-10R | 8.67 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-10R | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-11Lr | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-11Lr | 1.08 | -0.00 | -0.05 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-11Lr | 2.17 | -0.00 | -0.07 | -1725.924 | -0.02 | < -2000 |
| COL001-1 | 16-11Lr | 3.25 | -0.00 | -0.05 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-11Lr | 4.33 | -0.00 | -0.02 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-11Lr | 5.42 | -0.00 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-11Lr | 6.50 | -0.00 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-11Lr | 7.58 | -0.00 | 0.07 | 1733.143 | -0.00 | < -2000 |
| COL001-1 | 16-11Lr | 8.67 | -0.00 | 0.05 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-11Lr | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-12W »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-12W »+X | 1.08 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-12W »+X | 2.17 | -0.00 | -0.05 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-12W »+X | 3.25 | -0.00 | -0.05 | < -2000 | -0.00 | < -2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-1 | 16-12W »+X | 4.33 | -0.00 | -0.05 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-12W »+X | 5.42 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-12W »+X | 6.50 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-12W »+X | 7.58 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-12W »+X | 8.67 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-12W »+X | 9.75 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-12W »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-12W »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-12W »+Z | 2.17 | -0.00 | -0.02 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-12W »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-12W »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-12W »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-12W »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-12W »+Z | 7.58 | -0.00 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-12W »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-12W »+Z | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+Lr »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-13W+Lr »+X | 1.08 | -0.00 | -0.07 | -1725.501 | -0.01 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 2.17 | -0.00 | -0.09 | -1272.827 | -0.02 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 3.25 | -0.00 | -0.08 | -1398.415 | -0.02 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 4.33 | -0.00 | -0.05 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 5.42 | -0.00 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 6.50 | -0.00 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 7.58 | -0.00 | 0.04 | > 2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+Lr »+X | 8.67 | -0.00 | 0.04 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-13W+Lr »+X | 9.75 | -0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+Lr »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+Lr »+Z | 1.08 | -0.00 | -0.05 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 2.17 | -0.00 | -0.07 | -1728.688 | -0.03 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 3.25 | -0.00 | -0.05 | < -2000 | -0.04 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 4.33 | -0.00 | -0.02 | < -2000 | -0.03 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 5.42 | -0.00 | 0.02 | > 2000 | -0.03 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 6.50 | -0.00 | 0.05 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 7.58 | -0.00 | 0.07 | 1730.365 | -0.01 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 8.67 | -0.00 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+Lr »+Z | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+R »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-13W+R »+X | 1.08 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+R »+X | 2.17 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+R »+X | 3.25 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+R »+X | 4.33 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+R »+X | 5.42 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-13W+R »+X | 6.50 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-13W+R »+X | 7.58 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-13W+R »+X | 8.67 | -0.00 | -0.00 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-13W+R »+X | 9.75 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+R »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-13W+R »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 2.17 | -0.00 | -0.02 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 7.58 | -0.00 | 0.02 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.00 | < -2000 |
| COL001-1 | 16-13W+R »+Z | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-14 »+X | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-14 »+X | 1.08 | -0.00 | -0.03 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X | 2.17 | -0.00 | -0.04 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X | 3.25 | -0.00 | -0.05 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X | 4.33 | -0.00 | -0.05 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X | 5.42 | -0.00 | -0.04 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X | 6.50 | -0.00 | -0.03 | < -2000 | 0.00 | > 2000 |

| Member | Result Case Name | Offset ft | Dx in | Dy in | Span/Dy | Dz in | Span/Dz |
|---|---|---|---|---|---|---|---|
| COL001-1 | 16-14 »+X | 7.58 | -0.00 | -0.02 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X | 8.67 | -0.00 | -0.01 | < -2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X | 9.75 | 0.00 | 0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-14 »+X+Y | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | 16-14 »+X+Y | 1.08 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X+Y | 2.17 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X+Y | 3.25 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X+Y | 4.33 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-1 | 16-14 »+X+Y | 5.42 | -0.00 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X+Y | 6.50 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X+Y | 7.58 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X+Y | 8.67 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | 16-14 »+X+Y | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-14 »+Z | 0.00 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | 16-14 »+Z | 1.08 | -0.00 | -0.01 | < -2000 | -0.01 | < -2000 |
| COL001-1 | 16-14 »+Z | 2.17 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-14 »+Z | 3.25 | -0.00 | -0.01 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-14 »+Z | 4.33 | -0.00 | -0.00 | < -2000 | -0.02 | < -2000 |
| COL001-1 | 16-14 »+Z | 5.42 | -0.00 | 0.00 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-14 »+Z | 6.50 | -0.00 | 0.01 | > 2000 | -0.02 | < -2000 |
| COL001-1 | 16-14 »+Z | 7.58 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-14 »+Z | 8.67 | -0.00 | 0.01 | > 2000 | -0.01 | < -2000 |
| COL001-1 | 16-14 »+Z | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | D | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | D | 1.08 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D | 2.17 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D | 3.25 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D | 4.33 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D | 5.42 | -0.00 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D | 6.50 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D | 7.58 | -0.00 | 0.02 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D | 8.67 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | D+L | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | D+L | 1.08 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D+L | 2.17 | -0.00 | -0.02 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D+L | 3.25 | -0.00 | -0.01 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D+L | 4.33 | -0.00 | -0.00 | < -2000 | -0.00 | < -2000 |
| COL001-1 | D+L | 5.42 | -0.00 | 0.00 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D+L | 6.50 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D+L | 7.58 | -0.00 | 0.02 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D+L | 8.67 | -0.00 | 0.01 | > 2000 | 0.00 | > 2000 |
| COL001-1 | D+L | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |
| COL001-1 | Live | 0.00 | -0.00 | 0.00 | -NA- | 0.00 | -NA- |
| COL001-1 | Live | 1.08 | -0.00 | -0.05 | < -2000 | -0.01 | < -2000 |
| COL001-1 | Live | 2.17 | -0.00 | -0.07 | -1701.859 | -0.02 | < -2000 |
| COL001-1 | Live | 3.25 | -0.00 | -0.05 | < -2000 | -0.02 | < -2000 |
| COL001-1 | Live | 4.33 | -0.00 | -0.02 | < -2000 | -0.02 | < -2000 |
| COL001-1 | Live | 5.42 | -0.00 | 0.02 | > 2000 | -0.02 | < -2000 |
| COL001-1 | Live | 6.50 | -0.00 | 0.05 | > 2000 | -0.01 | < -2000 |
| COL001-1 | Live | 7.58 | -0.00 | 0.07 | 1711.230 | -0.01 | < -2000 |
| COL001-1 | Live | 8.67 | -0.00 | 0.05 | > 2000 | -0.00 | < -2000 |
| COL001-1 | Live | 9.75 | -0.00 | -0.00 | -NA- | -0.00 | -NA- |

# Member Min/Max Forces

| Extreme Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Vz K | Mx K-ft | My K-ft | Mz K-ft |
|---|---|---|---|---|---|---|---|---|---|
| Max Axial | COL001-0 | 16-13W+Lr »+Z | 9.75 | **0.19** | -0.07 | **-0.20** | -0.00 | -0.19 | -0.36 |
| Max My | BmZ001 | 16-12W »+Z | 0.00 | -0.00 | 0.03 | -0.12 | -0.00 | **0.40** | -0.07 |

| Extreme Item | Member | Result Case Name | Offset ft | Fx K | Vy K | Vz K | Mx K-ft | My K-ft | Mz K-ft |
|---|---|---|---|---|---|---|---|---|---|
| Max Mz | COL001-- | 16-13W+Lr »+X | 0.00 | -0.06 | -0.31 | -0.04 | 0.00 | 0.20 | **0.69** |
| Max Torsion | BmX003 | 16-10Lr | 0.00 | -0.09 | 0.37 | 0.00 | **0.10** | -0.00 | -0.46 |
| Max Vy | BmZ003 | 16-10Lr | 0.00 | 0.04 | **0.47** | -0.00 | -0.00 | -0.00 | -0.37 |
| Max Vz | COL001-0 | 16-13W+Lr »+Z | 9.75 | 0.19 | -0.07 | -0.20 | -0.00 | -0.19 | -0.36 |
| Min Axial | BmX004 | 16-12W »+X | 0.00 | **-0.33** | 0.26 | -0.00 | -0.01 | 0.00 | -0.12 |
| Min My | COL001-0 | 16-13W+Lr »+Z | 0.00 | 0.16 | -0.07 | **0.27** | -0.00 | **-0.53** | 0.36 |
| Min Mz | BmZ003 | 16-13W+Lr »+Z | 6.75 | 0.04 | -0.45 | -0.09 | 0.00 | -0.30 | **-0.55** |
| Min Torsion | BmX004 | 16-13W+Lr »+Z | 0.00 | 0.01 | 0.29 | 0.24 | **-0.14** | -0.30 | -0.36 |
| Min Vy | BmZ003 | 16-10Lr | 6.75 | 0.04 | **-0.47** | -0.00 | -0.00 | -0.00 | -0.37 |
| Min Vz | BmX004 | 16-12W »+X | 0.00 | -0.33 | 0.26 | -0.00 | -0.01 | 0.00 | -0.12 |

# Member Min/Max Stresses

| Extreme Item | Member | Result Case Name | Offset ft | fa Ksi | fby(+z) Ksi | fby(-z) Ksi | fbz(+y) Ksi | fbz(-y) Ksi |
|---|---|---|---|---|---|---|---|---|
| Max fby(+z) | COL001-0 | 16-13W+Lr »+Z | 0.00 | 0.19 | **13.08** | **-13.08** | -8.97 | 8.97 |
| Max fby(-z) | BmZ001 | 16-12W »+Z | 0.00 | -0.00 | -9.78 | 9.78 | 1.75 | -1.75 |
| Max fbz(+y) | BmZ003 | 16-13W+Lr »+Z | 6.75 | 0.04 | 7.33 | -7.33 | **13.54** | **-13.54** |
| Max fbz(-y) | COL001-- | 16-13W+Lr »+X | 0.00 | -0.07 | -5.05 | 5.05 | -17.15 | 17.15 |
| Max fx | COL001-0 | 16-13W+Lr »+Z | 9.75 | **0.22** | 4.60 | -4.60 | 8.95 | -8.95 |
| Min fby(+z) | BmZ001 | 16-12W »+Z | 0.00 | -0.00 | **-9.78** | **9.78** | 1.75 | -1.75 |
| Min fby(-z) | COL001-0 | 16-13W+Lr »+Z | 0.00 | 0.19 | 13.08 | -13.08 | -8.97 | 8.97 |
| Min fbz(+y) | COL001-- | 16-13W+Lr »+X | 0.00 | -0.07 | -5.05 | 5.05 | **-17.15** | **17.15** |
| Min fbz(-y) | BmZ003 | 16-13W+Lr »+Z | 6.75 | 0.04 | 7.33 | -7.33 | 13.54 | -13.54 |
| Min fx | BmX004 | 16-12W »+X | 0.00 | **-0.40** | -0.00 | 0.00 | 2.95 | -2.95 |

# Nodal Displacements

| Node | Result Case Name | DX in | DY in | DZ in | RX deg | RY deg | RZ deg |
|---|---|---|---|---|---|---|---|
| N001 | 16-10Lr | -0.00 | -0.00 | -0.00 | 0.09 | 0.00 | -0.43 |
| N001 | 16-10R | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.08 |
| N001 | 16-11Lr | -0.00 | -0.00 | -0.00 | 0.07 | 0.00 | -0.35 |
| N001 | 16-12W »+X | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.17 |
| N001 | 16-12W »+Z | -0.00 | -0.00 | -0.00 | -0.03 | **0.26** | -0.08 |
| N001 | 16-13W+Lr »+X | -0.00 | -0.00 | -0.00 | 0.07 | 0.00 | -0.42 |
| N001 | 16-13W+Lr »+Z | -0.00 | -0.00 | -0.00 | 0.04 | 0.20 | -0.35 |
| N001 | 16-13W+R »+X | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.15 |
| N001 | 16-13W+R »+Z | -0.00 | -0.00 | -0.00 | -0.02 | 0.20 | -0.08 |
| N001 | 16-14 »+X | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.14 |
| N001 | 16-14 »+X+Y | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.05 |
| N001 | 16-14 »+Z | -0.00 | -0.00 | -0.00 | -0.04 | 0.26 | -0.05 |
| N001 | D | **-0.00** | **-0.00** | **-0.00** | 0.01 | **0.00** | -0.08 |
| N001 | D+L | -0.00 | -0.00 | -0.00 | 0.01 | 0.00 | -0.08 |
| N001 | Live | -0.00 | -0.00 | -0.00 | 0.08 | 0.00 | -0.35 |
| N002 | 16-10Lr | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.43 |
| N002 | 16-10R | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.08 |
| N002 | 16-11Lr | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.35 |
| N002 | 16-12W »+X | -0.00 | 0.00 | 0.00 | 0.01 | -0.00 | 0.01 |
| N002 | 16-12W »+Z | -0.00 | -0.00 | -0.00 | 0.06 | 0.26 | -0.08 |
| N002 | 16-13W+Lr »+X | -0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.28 |
| N002 | 16-13W+Lr »+Z | -0.00 | -0.00 | -0.00 | 0.04 | 0.20 | -0.35 |
| N002 | 16-13W+R »+X | -0.00 | 0.00 | 0.00 | 0.01 | -0.00 | -0.01 |
| N002 | 16-13W+R »+Z | -0.00 | -0.00 | -0.00 | 0.05 | 0.20 | -0.08 |
| N002 | 16-14 »+X | -0.00 | 0.00 | 0.00 | 0.01 | -0.00 | 0.04 |
| N002 | 16-14 »+X+Y | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.05 |
| N002 | 16-14 »+Z | -0.00 | -0.00 | -0.00 | 0.05 | 0.26 | -0.05 |

| Node | Result Case Name | DX in | DY in | DZ in | RX deg | RY deg | RZ deg |
|---|---|---|---|---|---|---|---|
| N002 | D | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.08 |
| N002 | D+L | 0.00 | -0.00 | 0.00 | 0.01 | -0.00 | -0.08 |
| N002 | Live | 0.00 | -0.00 | 0.00 | -0.00 | -0.00 | -0.35 |
| N003 | 16-10Lr | -0.00 | **-0.29** | -0.00 | **0.33** | 0.00 | -0.43 |
| N003 | 16-10R | -0.00 | -0.05 | -0.00 | 0.03 | 0.00 | -0.08 |
| N003 | 16-11Lr | -0.00 | -0.23 | -0.00 | 0.26 | 0.00 | -0.35 |
| N003 | 16-12W »+X | -0.00 | -0.05 | -0.00 | 0.03 | 0.00 | 0.13 |
| N003 | 16-12W »+Z | -0.00 | -0.05 | **-0.19** | -0.20 | 0.26 | -0.08 |
| N003 | 16-13W+Lr »+X | -0.00 | -0.23 | -0.00 | 0.26 | 0.00 | -0.19 |
| N003 | 16-13W+Lr »+Z | -0.00 | -0.23 | -0.14 | 0.08 | 0.20 | -0.35 |
| N003 | 16-13W+R »+X | -0.00 | -0.05 | -0.00 | 0.03 | 0.00 | 0.07 |
| N003 | 16-13W+R »+Z | -0.00 | -0.05 | -0.14 | -0.14 | 0.20 | -0.08 |
| N003 | 16-14 »+X | -0.00 | -0.03 | -0.00 | 0.02 | 0.00 | **0.16** |
| N003 | 16-14 »+X+Y | -0.00 | -0.03 | -0.00 | 0.02 | 0.00 | -0.05 |
| N003 | 16-14 »+Z | -0.00 | -0.03 | -0.19 | -0.21 | 0.26 | -0.05 |
| N003 | D | -0.00 | -0.05 | -0.00 | 0.03 | 0.00 | -0.08 |
| N003 | D+L | -0.00 | -0.05 | -0.00 | 0.03 | 0.00 | -0.08 |
| N003 | Live | -0.00 | -0.23 | -0.00 | 0.30 | 0.00 | -0.35 |
| N004 | 16-10Lr | 0.00 | -0.29 | 0.00 | 0.08 | -0.00 | -0.43 |
| N004 | 16-10R | 0.00 | -0.05 | 0.00 | 0.03 | -0.00 | -0.08 |
| N004 | 16-11Lr | 0.00 | -0.23 | 0.00 | 0.07 | -0.00 | -0.34 |
| N004 | 16-12W »+X | -0.00 | -0.05 | 0.00 | 0.03 | -0.00 | -0.29 |
| N004 | 16-12W »+Z | -0.00 | -0.05 | -0.19 | 0.26 | 0.26 | -0.08 |
| N004 | 16-13W+Lr »+X | -0.00 | -0.23 | 0.00 | 0.07 | -0.00 | **-0.50** |
| N004 | 16-13W+Lr »+Z | -0.00 | -0.23 | -0.14 | 0.24 | 0.20 | -0.34 |
| N004 | 16-13W+R »+X | -0.00 | -0.05 | 0.00 | 0.03 | -0.00 | -0.24 |
| N004 | 16-13W+R »+Z | -0.00 | -0.05 | -0.14 | 0.21 | 0.20 | -0.08 |
| N004 | 16-14 »+X | -0.00 | -0.03 | 0.00 | 0.02 | -0.00 | -0.26 |
| N004 | 16-14 »+X+Y | 0.00 | -0.03 | 0.00 | 0.02 | -0.00 | -0.05 |
| N004 | 16-14 »+Z | -0.00 | -0.03 | -0.19 | 0.25 | 0.26 | -0.05 |
| N004 | D | 0.00 | -0.05 | 0.00 | 0.03 | -0.00 | -0.08 |
| N004 | D+L | 0.00 | -0.05 | 0.00 | 0.03 | -0.00 | -0.08 |
| N004 | Live | 0.00 | -0.23 | 0.00 | 0.05 | -0.00 | -0.35 |
| N005 | 16-10Lr | -0.00 | -0.00 | 0.00 | -0.09 | -0.00 | -0.43 |
| N005 | 16-10R | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.08 |
| N005 | 16-11Lr | -0.00 | -0.00 | 0.00 | -0.07 | -0.00 | -0.35 |
| N005 | 16-12W »+X | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.17 |
| N005 | 16-12W »+Z | 0.00 | -0.00 | -0.00 | -0.06 | 0.26 | -0.08 |
| N005 | 16-13W+Lr »+X | -0.00 | -0.00 | 0.00 | -0.07 | -0.00 | -0.42 |
| N005 | 16-13W+Lr »+Z | 0.00 | -0.00 | -0.00 | -0.11 | 0.20 | -0.35 |
| N005 | 16-13W+R »+X | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.15 |
| N005 | 16-13W+R »+Z | 0.00 | -0.00 | -0.00 | -0.05 | 0.20 | -0.08 |
| N005 | 16-14 »+X | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.14 |
| N005 | 16-14 »+X+Y | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.05 |
| N005 | 16-14 »+Z | 0.00 | -0.00 | -0.00 | -0.05 | 0.26 | -0.05 |
| N005 | D | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.08 |
| N005 | D+L | -0.00 | -0.00 | 0.00 | -0.01 | -0.00 | -0.08 |
| N005 | Live | -0.00 | -0.00 | 0.00 | -0.08 | -0.00 | -0.35 |
| N006 | 16-10Lr | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.43 |
| N006 | 16-10R | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.08 |
| N006 | 16-11Lr | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.35 |
| N006 | 16-12W »+X | -0.00 | 0.00 | -0.00 | -0.01 | 0.00 | 0.01 |
| N006 | 16-12W »+Z | 0.00 | -0.00 | -0.00 | 0.03 | 0.26 | -0.08 |
| N006 | 16-13W+Lr »+X | -0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.28 |
| N006 | 16-13W+Lr »+Z | 0.00 | -0.00 | -0.00 | 0.02 | 0.20 | -0.35 |
| N006 | 16-13W+R »+X | -0.00 | 0.00 | -0.00 | -0.01 | 0.00 | -0.01 |
| N006 | 16-13W+R »+Z | 0.00 | -0.00 | -0.00 | 0.02 | 0.20 | -0.08 |
| N006 | 16-14 »+X | -0.00 | 0.00 | -0.00 | -0.01 | 0.00 | 0.04 |
| N006 | 16-14 »+X+Y | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.05 |
| N006 | 16-14 »+Z | 0.00 | -0.00 | -0.00 | 0.04 | 0.26 | -0.05 |
| N006 | D | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.08 |
| N006 | D+L | 0.00 | -0.00 | -0.00 | -0.01 | 0.00 | -0.08 |
| N006 | Live | 0.00 | -0.00 | -0.00 | 0.00 | 0.00 | -0.35 |

| Node | Result Case Name | DX in | DY in | DZ in | RX deg | RY deg | RZ deg |
|---|---|---|---|---|---|---|---|
| N007 | 16-10Lr | -0.00 | -0.29 | 0.00 | -0.33 | -0.00 | -0.43 |
| N007 | 16-10R | -0.00 | -0.05 | 0.00 | -0.03 | -0.00 | -0.08 |
| N007 | 16-11Lr | -0.00 | -0.23 | 0.00 | -0.26 | -0.00 | -0.35 |
| N007 | 16-12W »+X | -0.00 | -0.05 | 0.00 | -0.03 | -0.00 | 0.13 |
| N007 | 16-12W »+Z | 0.00 | -0.05 | -0.19 | -0.26 | 0.26 | -0.08 |
| N007 | 16-13W+Lr »+X | -0.00 | -0.23 | 0.00 | -0.26 | -0.00 | -0.19 |
| N007 | 16-13W+Lr »+Z | 0.00 | -0.23 | -0.14 | **-0.43** | 0.20 | -0.35 |
| N007 | 16-13W+R »+X | -0.00 | -0.05 | 0.00 | -0.03 | -0.00 | 0.07 |
| N007 | 16-13W+R »+Z | 0.00 | -0.05 | -0.14 | -0.21 | 0.20 | -0.08 |
| N007 | 16-14 »+X | -0.00 | -0.03 | 0.00 | -0.02 | -0.00 | 0.16 |
| N007 | 16-14 »+X+Y | -0.00 | -0.03 | 0.00 | -0.02 | -0.00 | -0.05 |
| N007 | 16-14 »+Z | 0.00 | -0.03 | -0.19 | -0.25 | 0.26 | -0.05 |
| N007 | D | -0.00 | -0.05 | 0.00 | -0.03 | -0.00 | -0.08 |
| N007 | D+L | -0.00 | -0.05 | 0.00 | -0.03 | -0.00 | -0.08 |
| N007 | Live | -0.00 | -0.23 | 0.00 | -0.30 | -0.00 | -0.35 |
| N008 | 16-10Lr | 0.00 | -0.29 | -0.00 | -0.08 | 0.00 | -0.43 |
| N008 | 16-10R | 0.00 | -0.05 | -0.00 | -0.03 | 0.00 | -0.08 |
| N008 | 16-11Lr | 0.00 | -0.23 | -0.00 | -0.07 | 0.00 | -0.34 |
| N008 | 16-12W »+X | -0.00 | -0.05 | -0.00 | -0.03 | 0.00 | -0.29 |
| N008 | 16-12W »+Z | 0.00 | -0.05 | -0.19 | 0.20 | 0.26 | -0.08 |
| N008 | 16-13W+Lr »+X | -0.00 | -0.23 | -0.00 | -0.07 | 0.00 | -0.50 |
| N008 | 16-13W+Lr »+Z | 0.00 | -0.23 | -0.14 | 0.10 | 0.20 | -0.35 |
| N008 | 16-13W+R »+X | -0.00 | -0.05 | -0.00 | -0.03 | 0.00 | -0.24 |
| N008 | 16-13W+R »+Z | 0.00 | -0.05 | -0.14 | 0.14 | 0.20 | -0.08 |
| N008 | 16-14 »+X | -0.00 | -0.03 | -0.00 | -0.02 | 0.00 | -0.26 |
| N008 | 16-14 »+X+Y | 0.00 | -0.03 | -0.00 | -0.02 | 0.00 | -0.05 |
| N008 | 16-14 »+Z | 0.00 | -0.03 | -0.19 | 0.21 | 0.26 | -0.05 |
| N008 | D | 0.00 | -0.05 | -0.00 | -0.03 | 0.00 | -0.08 |
| N008 | D+L | 0.00 | -0.05 | -0.00 | -0.03 | 0.00 | -0.08 |
| N008 | Live | 0.00 | -0.23 | -0.00 | -0.05 | 0.00 | -0.35 |

# Nodal Reactions

| Node | Result Case Name | FX K | FY K | FZ K | MX K-ft | MY K-ft | MZ K-ft |
|---|---|---|---|---|---|---|---|
| N001 | 16-10Lr | 0.19 | 0.39 | 0.01 | -NA- | -NA- | -NA- |
| N001 | 16-10R | 0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N001 | 16-11Lr | 0.15 | 0.32 | 0.01 | -NA- | -NA- | -NA- |
| N001 | 16-12W »+X | 0.35 | 0.29 | 0.00 | -NA- | -NA- | -NA- |
| N001 | 16-12W »+Z | 0.27 | 0.12 | **0.32** | -NA- | -NA- | -NA- |
| N001 | 16-13W+Lr »+X | **0.39** | **0.46** | 0.01 | -NA- | -NA- | -NA- |
| N001 | 16-13W+Lr »+Z | 0.33 | 0.33 | 0.25 | -NA- | -NA- | -NA- |
| N001 | 16-13W+R »+X | 0.27 | 0.24 | 0.00 | -NA- | -NA- | -NA- |
| N001 | 16-13W+R »+Z | 0.21 | 0.11 | 0.24 | -NA- | -NA- | -NA- |
| N001 | 16-14 »+X | 0.34 | 0.25 | 0.00 | -NA- | -NA- | -NA- |
| N001 | 16-14 »+X+Y | 0.02 | 0.06 | 0.00 | -NA- | -NA- | -NA- |
| N001 | 16-14 »+Z | 0.26 | 0.08 | 0.32 | -NA- | -NA- | -NA- |
| N001 | D | 0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N001 | D+L | 0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N001 | Live | 0.15 | 0.30 | 0.01 | -NA- | -NA- | -NA- |
| N002 | 16-10Lr | -0.19 | 0.39 | **-0.01** | -NA- | -NA- | -NA- |
| N002 | 16-10R | -0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N002 | 16-11Lr | -0.15 | 0.32 | -0.01 | -NA- | -NA- | -NA- |
| N002 | 16-12W »+X | 0.28 | -0.09 | -0.00 | -NA- | -NA- | -NA- |
| N002 | 16-12W »+Z | 0.20 | 0.08 | 0.31 | -NA- | -NA- | -NA- |
| N002 | 16-13W+Lr »+X | 0.09 | 0.18 | -0.01 | -NA- | -NA- | -NA- |
| N002 | 16-13W+Lr »+Z | 0.03 | 0.30 | 0.23 | -NA- | -NA- | -NA- |
| N002 | 16-13W+R »+X | 0.20 | -0.05 | -0.00 | -NA- | -NA- | -NA- |
| N002 | 16-13W+R »+Z | 0.14 | 0.08 | 0.23 | -NA- | -NA- | -NA- |
| N002 | 16-14 »+X | 0.30 | **-0.13** | -0.00 | -NA- | -NA- | -NA- |

| Node | Result Case Name | FX K | FY K | FZ K | MX K-ft | MY K-ft | MZ K-ft |
|---|---|---|---|---|---|---|---|
| N002 | 16-14 »+X+Y | -0.02 | 0.06 | -0.00 | -NA- | -NA- | -NA- |
| N002 | 16-14 »+Z | 0.21 | 0.04 | 0.32 | -NA- | -NA- | -NA- |
| N002 | D | -0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N002 | D+L | -0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N002 | Live | -0.15 | 0.30 | -0.01 | -NA- | -NA- | -NA- |
| N005 | 16-10Lr | 0.19 | 0.39 | -0.01 | -NA- | -NA- | -NA- |
| N005 | 16-10R | 0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N005 | 16-11Lr | 0.15 | 0.32 | -0.01 | -NA- | -NA- | -NA- |
| N005 | 16-12W »+X | 0.35 | 0.29 | -0.00 | -NA- | -NA- | -NA- |
| N005 | 16-12W »+Z | -0.20 | 0.08 | 0.31 | -NA- | -NA- | -NA- |
| N005 | 16-13W+Lr »+X | 0.39 | 0.46 | -0.01 | -NA- | -NA- | -NA- |
| N005 | 16-13W+Lr »+Z | -0.03 | 0.30 | 0.23 | -NA- | -NA- | -NA- |
| N005 | 16-13W+R »+X | 0.27 | 0.24 | -0.00 | -NA- | -NA- | -NA- |
| N005 | 16-13W+R »+Z | -0.14 | 0.08 | 0.23 | -NA- | -NA- | -NA- |
| N005 | 16-14 »+X | 0.34 | 0.25 | -0.00 | -NA- | -NA- | -NA- |
| N005 | 16-14 »+X+Y | 0.02 | 0.06 | -0.00 | -NA- | -NA- | -NA- |
| N005 | 16-14 »+Z | -0.21 | 0.04 | 0.32 | -NA- | -NA- | -NA- |
| N005 | D | 0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N005 | D+L | 0.04 | 0.10 | -0.00 | -NA- | -NA- | -NA- |
| N005 | Live | 0.15 | 0.30 | -0.01 | -NA- | -NA- | -NA- |
| N006 | 16-10Lr | -0.19 | 0.39 | 0.01 | -NA- | -NA- | -NA- |
| N006 | 16-10R | -0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N006 | 16-11Lr | -0.15 | 0.32 | 0.01 | -NA- | -NA- | -NA- |
| N006 | 16-12W »+X | 0.28 | -0.09 | 0.00 | -NA- | -NA- | -NA- |
| N006 | 16-12W »+Z | -0.27 | 0.12 | 0.32 | -NA- | -NA- | -NA- |
| N006 | 16-13W+Lr »+X | 0.09 | 0.18 | 0.01 | -NA- | -NA- | -NA- |
| N006 | 16-13W+Lr »+Z | **-0.33** | 0.33 | 0.25 | -NA- | -NA- | -NA- |
| N006 | 16-13W+R »+X | 0.20 | -0.05 | 0.00 | -NA- | -NA- | -NA- |
| N006 | 16-13W+R »+Z | -0.21 | 0.11 | 0.24 | -NA- | -NA- | -NA- |
| N006 | 16-14 »+X | 0.30 | -0.13 | 0.00 | -NA- | -NA- | -NA- |
| N006 | 16-14 »+X+Y | -0.02 | 0.06 | 0.00 | -NA- | -NA- | -NA- |
| N006 | 16-14 »+Z | -0.26 | 0.08 | 0.32 | -NA- | -NA- | -NA- |
| N006 | D | -0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N006 | D+L | -0.04 | 0.10 | 0.00 | -NA- | -NA- | -NA- |
| N006 | Live | -0.15 | 0.30 | 0.01 | -NA- | -NA- | -NA- |

# Design Group Results

Steel Design, per AISC ASD (2005)
Design Group: Steel_Beam X_G01, Group Report, Designed As: HSS2x2x1/8

SIZE CONSTRAINTS: none
BRACING INFORMATION:
Lateral Top(+y) Bracing: Unbraced
Lateral Bottom(-y) Bracing: Unbraced
Fy = 46.00Ksi

Combined Stresses Check:

| Member Name | Result Case# | Offset ft | Pu K | Muz K-ft | Muy K-ft | Pn/Ω K | Mnz/Ω K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|
| BmX001 | 26.01 | 0.00 | 0.09 | -0.46 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.34 |
| BmX001 | 27.01 | 0.00 | 0.02 | -0.09 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.07 |
| BmX001 | 28.01 | 0.00 | 0.07 | -0.36 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.27 |
| BmX001 | 29.01 | 2.50 | -0.30 | -0.36 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.27 |
| BmX001 | 30.01 | 0.00 | 0.13 | -0.09 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.36 |
| BmX001 | 31.01 | 0.00 | -0.16 | -0.34 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.26 | | | | | | | | | | |
| | BmX001 | 32.01 | 0.00 | 0.16 | -0.36 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.50 | | | | | | | | | | |
| | BmX001 | 33.01 | 2.50 | -0.22 | -0.25 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.19 | | | | | | | | | | |
| | BmX001 | 34.01 | 0.00 | 0.11 | -0.09 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.29 | | | | | | | | | | |
| | BmX001 | 35.01 | 2.50 | -0.31 | -0.39 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.30 | | | | | | | | | | |
| | BmX001 | 36.01 | 0.00 | 0.01 | -0.05 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.04 | | | | | | | | | | |
| | BmX001 | 37.01 | 0.00 | 0.13 | -0.05 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.34 | | | | | | | | | | |
| | BmX002 | 26.01 | 0.00 | 0.09 | -0.46 | 0.00 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.34 | | | | | | | | | | |
| | BmX002 | 27.01 | 0.00 | 0.02 | -0.09 | 0.00 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.07 | | | | | | | | | | |
| | BmX002 | 28.01 | 0.00 | 0.07 | -0.36 | 0.00 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.27 | | | | | | | | | | |
| | BmX002 | 29.01 | 2.50 | -0.30 | -0.36 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.27 | | | | | | | | | | |
| | BmX002 | 30.01 | 0.00 | -0.10 | -0.09 | -0.40 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.36 | | | | | | | | | | |
| | BmX002 | 31.01 | 0.00 | -0.16 | -0.34 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.26 | | | | | | | | | | |
| | BmX002 | 32.01 | 0.00 | -0.01 | -0.36 | -0.30 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.49 | | | | | | | | | | |
| | BmX002 | 33.01 | 2.50 | -0.22 | -0.25 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.19 | | | | | | | | | | |
| | BmX002 | 34.01 | 0.00 | -0.07 | -0.09 | -0.30 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.29 | | | | | | | | | | |
| | BmX002 | 35.01 | 2.50 | -0.31 | -0.39 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.30 | | | | | | | | | | |
| | BmX002 | 36.01 | 0.00 | 0.01 | -0.05 | 0.00 | 23.14 | 1.34 | 1.34 | H1-1b |
| 0.04 | | | | | | | | | | |
| | BmX002 | 37.01 | 0.00 | -0.11 | -0.05 | -0.40 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.34 | | | | | | | | | | |
| | BmX003 | 26.01 | 0.00 | -0.09 | -0.46 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.34 | | | | | | | | | | |
| | BmX003 | 27.01 | 0.00 | -0.02 | -0.09 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.07 | | | | | | | | | | |
| | BmX003 | 28.01 | 0.00 | -0.07 | -0.36 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.27 | | | | | | | | | | |
| | BmX003 | 29.01 | 2.50 | -0.33 | 0.53 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.40 | | | | | | | | | | |
| | BmX003 | 30.01 | 0.00 | -0.13 | -0.09 | -0.40 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.36 | | | | | | | | | | |
| | BmX003 | 31.01 | 2.50 | -0.31 | 0.69 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.53 | | | | | | | | | | |
| | BmX003 | 32.01 | 0.00 | -0.16 | -0.36 | -0.30 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.50 | | | | | | | | | | |
| | BmX003 | 33.01 | 2.50 | -0.26 | 0.42 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.32 | | | | | | | | | | |
| | BmX003 | 34.01 | 0.00 | -0.11 | -0.09 | -0.30 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.29 | | | | | | | | | | |
| | BmX003 | 35.01 | 2.50 | -0.33 | 0.49 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.38 | | | | | | | | | | |
| | BmX003 | 36.01 | 0.00 | -0.01 | -0.05 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.04 | | | | | | | | | | |
| | BmX003 | 37.01 | 0.00 | -0.13 | -0.05 | -0.40 | 20.84 | 1.34 | 1.34 | H1-1b |
| 0.34 | | | | | | | | | | |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| BmX001 | 26.01 | 0.00 | -0.46 | 2.50 | 2.17 | 1.34 | F7-1 | 0.34 |
| BmX001 | 27.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BmX001 | 28.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX001 | 29.01 | 2.50 | -0.36 | 2.50 | 1.57 | 1.34 | F7-1 | 0.27 |
| BmX001 | 30.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX001 | 31.01 | 0.00 | -0.34 | 2.50 | 1.70 | 1.34 | F7-1 | 0.25 |
| BmX001 | 32.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX001 | 33.01 | 2.50 | -0.25 | 2.50 | 1.48 | 1.34 | F7-1 | 0.18 |
| BmX001 | 34.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX001 | 35.01 | 2.50 | -0.39 | 2.50 | 1.69 | 1.34 | F7-1 | 0.29 |
| BmX001 | 36.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX001 | 37.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX002 | 26.01 | 0.00 | -0.46 | 2.50 | 2.17 | 1.34 | F7-1 | 0.34 |
| BmX002 | 27.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX002 | 28.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX002 | 29.01 | 2.50 | -0.36 | 2.50 | 1.57 | 1.34 | F7-1 | 0.27 |
| BmX002 | 30.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.06 |
| BmX002 | 31.01 | 0.00 | -0.34 | 2.50 | 1.70 | 1.34 | F7-1 | 0.25 |
| BmX002 | 32.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX002 | 33.01 | 2.50 | -0.25 | 2.50 | 1.48 | 1.34 | F7-1 | 0.18 |
| BmX002 | 34.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX002 | 35.01 | 2.50 | -0.39 | 2.50 | 1.69 | 1.34 | F7-1 | 0.29 |
| BmX002 | 36.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX002 | 37.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX003 | 26.01 | 0.00 | -0.46 | 2.50 | 2.17 | 1.34 | F7-1 | 0.34 |
| BmX003 | 27.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX003 | 28.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX003 | 29.01 | 2.50 | 0.53 | 2.50 | 2.08 | 1.34 | F7-1 | 0.39 |
| BmX003 | 30.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX003 | 31.01 | 2.50 | 0.69 | 2.50 | 2.26 | 1.34 | F7-1 | 0.52 |
| BmX003 | 32.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX003 | 33.01 | 2.50 | 0.42 | 2.50 | 2.16 | 1.34 | F7-1 | 0.31 |
| BmX003 | 34.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX003 | 35.01 | 2.50 | 0.49 | 2.50 | 1.99 | 1.34 | F7-1 | 0.37 |
| BmX003 | 36.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX003 | 37.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |

Axial Check:

| Member Name | Result Case# | Offset ft | Pu K | KL/r | FeFB Ksi | FeFTB Ksi | Q | Fcr Ksi | Pn/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BmX001 | 29.01 | 0.00 | -0.30 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX001 | 30.01 | 0.00 | 0.13 | 39.44 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| BmX001 | 31.01 | 0.00 | -0.16 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX001 | 32.01 | 0.00 | 0.16 | 39.44 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| BmX001 | 33.01 | 0.00 | -0.22 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX001 | 35.01 | 0.00 | -0.31 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX001 | 37.01 | 0.00 | 0.13 | 39.44 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| BmX002 | 29.01 | 0.00 | -0.30 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX002 | 31.01 | 0.00 | -0.16 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX002 | 33.01 | 0.00 | -0.22 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX002 | 35.01 | 0.00 | -0.31 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX002 | 37.01 | 0.00 | -0.11 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX003 | 29.01 | 0.00 | -0.33 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.02 |
| BmX003 | 30.01 | 0.00 | -0.13 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | | |

```
E3-2FB        0.01
      BmX003       31.01    0.00   -0.31   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.01
      BmX003       32.01    0.00   -0.16   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.01
      BmX003       33.01    0.00   -0.26   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.01
      BmX003       34.01    0.00   -0.11   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.01
      BmX003       35.01    0.00   -0.33   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.02
      BmX003       37.01    0.00   -0.13   39.44  184.00 9439.32        1.00   41.43   20.84
E3-2FB        0.01
```

Flexure Check (Weak Bending):

| Member Name | Result Case# | Offset ft | Muy K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|
| BmX001 | 30.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX001 | 32.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX001 | 34.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX001 | 37.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX002 | 30.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX002 | 32.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX002 | 34.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX002 | 37.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX003 | 30.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX003 | 32.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX003 | 34.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX003 | 37.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |

Shear Check (Strong Axis):

| Member Name | Result Case# | Offset ft | Vuy K | ~h/tw | Vny/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmX001 | 26.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmX001 | 27.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX001 | 28.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX001 | 29.01 | 2.50 | -0.12 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX001 | 30.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX001 | 31.01 | 0.00 | 0.15 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX001 | 32.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX001 | 33.01 | 2.50 | -0.08 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX001 | 34.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX001 | 35.01 | 2.50 | -0.15 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX001 | 36.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX001 | 37.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 26.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmX002 | 27.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 28.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX002 | 29.01 | 2.50 | -0.12 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX002 | 30.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 31.01 | 0.00 | 0.15 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX002 | 32.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX002 | 33.01 | 2.50 | -0.08 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 34.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 35.01 | 2.50 | -0.15 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmX002 | 36.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX002 | 37.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX003 | 26.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmX003 | 27.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX003 | 28.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX003 | 29.01 | 0.00 | 0.26 | 14.24 | 6.33 | G2-1 | 0.04 |
| BmX003 | 30.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX003 | 31.01 | 0.00 | 0.44 | 14.24 | 6.33 | G2-1 | 0.07 |
| BmX003 | 32.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX003 | 33.01 | 0.00 | 0.22 | 14.24 | 6.33 | G2-1 | 0.03 |
| BmX003 | 34.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BmX003 | 35.01 | 0.00 | 0.23 | 14.24 | 6.33 | G2-1 | 0.04 |
| BmX003 | 36.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX003 | 37.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |

Shear Check (Weak Axis):

| Member Name | Result Case# | Offset ft | Vuz K | Aw in^2 | Vnz/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmX001 | 30.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX001 | 32.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX001 | 34.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX001 | 37.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX002 | 30.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX002 | 32.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX002 | 34.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX002 | 37.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX003 | 30.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX003 | 32.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX003 | 34.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX003 | 37.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |

Warning: Possible warping stresses were not checked.
Maximum torsional moment, T, is 0.10 K-ft. St. Venant shear (fv = T*t/J) is included in the shear checks, warping normal stress is not considered.
Steel Design, per AISC ASD (2005)
Design Group: Steel_Beam X_G02, Group Report, Designed As: HSS2x2x1/8

SIZE CONSTRAINTS: none
BRACING INFORMATION:
Lateral Top(+y) Bracing: Unbraced
Lateral Bottom(-y) Bracing: Unbraced
Fy = 46.00Ksi

Combined Stresses Check:

| Member Name | Result Case# | Offset ft | Pu K | Muz K-ft | Muy K-ft | Pn/Ω K | Mnz/Ω K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|
| BmX004 | 26.01 | 0.00 | -0.09 | -0.46 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.34 |
| BmX004 | 27.01 | 0.00 | -0.02 | -0.09 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.07 |
| BmX004 | 28.01 | 0.00 | -0.07 | -0.36 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.27 |
| BmX004 | 29.01 | 2.50 | -0.33 | 0.53 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.40 |
| BmX004 | 30.01 | 0.00 | 0.10 | -0.09 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.36 |
| BmX004 | 31.01 | 2.50 | -0.31 | 0.69 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.53 |
| BmX004 | 32.01 | 0.00 | 0.01 | -0.36 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.49 |
| BmX004 | 33.01 | 2.50 | -0.26 | 0.42 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.32 |
| BmX004 | 34.01 | 0.00 | 0.07 | -0.09 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.29 |
| BmX004 | 35.01 | 2.50 | -0.33 | 0.49 | -0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.38 |
| BmX004 | 36.01 | 0.00 | -0.01 | -0.05 | 0.00 | 20.84 | 1.34 | 1.34 | H1-1b | 0.04 |
| BmX004 | 37.01 | 0.00 | 0.11 | -0.05 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.34 |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| BmX004 | 26.01 | 0.00 | -0.46 | 2.50 | 2.17 | 1.34 | F7-1 | 0.34 |
| BmX004 | 27.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BmX004 | 28.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX004 | 29.01 | 2.50 | 0.53 | 2.50 | 2.08 | 1.34 | F7-1 | 0.39 |
| BmX004 | 30.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.06 |
| BmX004 | 31.01 | 2.50 | 0.69 | 2.50 | 2.26 | 1.34 | F7-1 | 0.52 |
| BmX004 | 32.01 | 0.00 | -0.36 | 2.50 | 2.18 | 1.34 | F7-1 | 0.27 |
| BmX004 | 33.01 | 2.50 | 0.42 | 2.50 | 2.16 | 1.34 | F7-1 | 0.31 |
| BmX004 | 34.01 | 0.00 | -0.09 | 2.50 | 2.20 | 1.34 | F7-1 | 0.07 |
| BmX004 | 35.01 | 2.50 | 0.49 | 2.50 | 1.99 | 1.34 | F7-1 | 0.37 |
| BmX004 | 36.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |
| BmX004 | 37.01 | 0.00 | -0.05 | 2.50 | 2.20 | 1.34 | F7-1 | 0.04 |

Axial Check:

| Member Name | Result Case# | Offset ft | Pu K | KL/r | FeFB Ksi | FeFTB Ksi | Q | Fcr Ksi | Pn/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BmX004 | 29.01 | 0.00 | -0.33 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.02 |
| BmX004 | 31.01 | 0.00 | -0.31 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX004 | 33.01 | 0.00 | -0.26 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.01 |
| BmX004 | 35.01 | 0.00 | -0.33 | 39.44 | 184.00 | 9439.32 | 1.00 | 41.43 | 20.84 | E3-2FB | 0.02 |

Flexure Check (Weak Bending):

| Member Name | Result Case# | Offset ft | Muy K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|
| BmX004 | 30.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmX004 | 32.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX004 | 34.01 | 0.00 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmX004 | 37.01 | 0.00 | -0.40 | 1.34 | F7-1 | 0.30 |

Shear Check (Strong Axis):

| Member Name | Result Case# | Offset ft | Vuy K | ~h/tw | Vny/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmX004 | 26.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmX004 | 27.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX004 | 28.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX004 | 29.01 | 0.00 | 0.26 | 14.24 | 6.33 | G2-1 | 0.04 |
| BmX004 | 30.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX004 | 31.01 | 0.00 | 0.44 | 14.24 | 6.33 | G2-1 | 0.07 |
| BmX004 | 32.01 | 0.00 | 0.29 | 14.24 | 6.33 | G2-1 | 0.05 |
| BmX004 | 33.01 | 0.00 | 0.22 | 14.24 | 6.33 | G2-1 | 0.03 |
| BmX004 | 34.01 | 0.00 | 0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX004 | 35.01 | 0.00 | 0.23 | 14.24 | 6.33 | G2-1 | 0.04 |
| BmX004 | 36.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmX004 | 37.01 | 0.00 | 0.04 | 14.24 | 6.33 | G2-1 | 0.01 |

Shear Check (Weak Axis):

| Member Name | Result Case# | Offset ft | Vuz K | Aw in^2 | Vnz/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmX004 | 30.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| BmX004 | 32.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX004 | 34.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| BmX004 | 37.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |

Warning: Possible warping stresses were not checked.
Maximum torsional moment, T, is 0.14 K-ft. St. Venant shear (fv = T*t/J) is included in the shear checks, warping normal stress is not considered.
Steel Design, per AISC ASD (2005)
Design Group: Steel_Beam Z_G03, Group Report, Designed As: HSS2x2x1/8

SIZE CONSTRAINTS: none
BRACING INFORMATION:
Lateral Top(+y) Bracing: Unbraced

Lateral Bottom(-y) Bracing: Unbraced
Fy = 46.00Ksi

Combined Stresses Check:

| Member Name | Result Case# | Offset ft | Pu K | Muz K-ft | Muy K-ft | Pn/Ω K | Mnz/Ω K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|
| BmZ001 | 30.01 | 0.00 | -0.00 | -0.07 | 0.40 | 13.43 | 1.34 | 1.34 | H1-1b | 0.35 |
| BmZ001 | 32.01 | 0.00 | -0.00 | -0.06 | 0.30 | 13.43 | 1.34 | 1.34 | H1-1b | 0.26 |
| BmZ001 | 34.01 | 0.00 | -0.00 | -0.05 | 0.30 | 13.43 | 1.34 | 1.34 | H1-1b | 0.26 |
| BmZ001 | 37.01 | 0.00 | -0.00 | -0.07 | 0.40 | 13.43 | 1.34 | 1.34 | H1-1b | 0.35 |
| BmZ002 | 26.01 | 3.38 | 0.00 | 0.05 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.04 |
| BmZ002 | 28.01 | 3.38 | 0.00 | 0.04 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ002 | 30.01 | 6.75 | 0.00 | -0.07 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.35 |
| BmZ002 | 31.01 | 3.38 | 0.00 | 0.04 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ002 | 32.01 | 0.00 | 0.00 | 0.08 | 0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.28 |
| BmZ002 | 34.01 | 6.75 | 0.00 | -0.05 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.26 |
| BmZ002 | 37.01 | 6.75 | 0.00 | -0.07 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.35 |
| BmZ003 | 26.01 | 3.38 | 0.04 | 0.43 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.32 |
| BmZ003 | 27.01 | 3.38 | 0.01 | 0.05 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ003 | 28.01 | 3.38 | 0.04 | 0.34 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.25 |
| BmZ003 | 29.01 | 3.38 | 0.01 | 0.05 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ003 | 30.01 | 6.75 | 0.01 | -0.39 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.59 |
| BmZ003 | 31.01 | 3.38 | 0.04 | 0.34 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.25 |
| BmZ003 | 32.01 | 6.75 | 0.04 | -0.55 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.63 |
| BmZ003 | 33.01 | 3.38 | 0.01 | 0.05 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ003 | 34.01 | 6.75 | 0.01 | -0.31 | -0.30 | 23.14 | 1.34 | 1.34 | H1-1b | 0.45 |
| BmZ003 | 35.01 | 3.38 | 0.00 | 0.03 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.02 |
| BmZ003 | 36.01 | 3.38 | 0.00 | 0.03 | -0.00 | 23.14 | 1.34 | 1.34 | H1-1b | 0.02 |
| BmZ003 | 37.01 | 6.75 | 0.00 | -0.38 | -0.40 | 23.14 | 1.34 | 1.34 | H1-1b | 0.58 |
| BmZ004 | 26.01 | 0.00 | -0.04 | -0.21 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b | 0.16 |
| BmZ004 | 27.01 | 3.38 | -0.01 | 0.05 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ004 | 28.01 | 0.00 | -0.04 | -0.17 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b | 0.12 |
| BmZ004 | 29.01 | 3.38 | -0.01 | 0.05 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b | 0.03 |
| BmZ004 | 30.01 | 0.00 | -0.01 | -0.39 | 0.40 | 13.43 | 1.34 | 1.34 | H1-1b | 0.59 |
| BmZ004 | 31.01 | 0.00 | -0.04 | -0.17 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b | 0.12 |
| BmZ004 | 32.01 | 0.00 | -0.04 | -0.43 | 0.30 | 13.43 | 1.34 | 1.34 | H1-1b | 0.54 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| BmZ004 | 33.01 | 3.38 | -0.01 | 0.05 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b 0.03 |
| BmZ004 | 34.01 | 0.00 | -0.01 | -0.31 | 0.30 | 13.43 | 1.34 | 1.34 | H1-1b 0.45 |
| BmZ004 | 35.01 | 3.38 | -0.00 | 0.03 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b 0.02 |
| BmZ004 | 36.01 | 3.38 | -0.00 | 0.03 | 0.00 | 13.43 | 1.34 | 1.34 | H1-1b 0.02 |
| BmZ004 | 37.01 | 0.00 | -0.00 | -0.38 | 0.40 | 13.43 | 1.34 | 1.34 | H1-1b 0.58 |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| BmZ001 | 26.01 | 3.38 | 0.01 | 6.75 | 1.26 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 27.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 28.01 | 3.38 | 0.01 | 6.75 | 1.24 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 29.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 30.01 | 0.00 | -0.07 | 6.75 | 2.15 | 1.34 | F7-1 | 0.05 |
| BmZ001 | 31.01 | 3.38 | 0.01 | 6.75 | 1.24 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 32.01 | 0.00 | -0.06 | 6.75 | 2.16 | 1.34 | F7-1 | 0.04 |
| BmZ001 | 33.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 34.01 | 0.00 | -0.05 | 6.75 | 2.09 | 1.34 | F7-1 | 0.04 |
| BmZ001 | 35.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 36.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ001 | 37.01 | 0.00 | -0.07 | 6.75 | 2.24 | 1.34 | F7-1 | 0.05 |
| BmZ002 | 26.01 | 3.38 | 0.05 | 6.75 | 1.04 | 1.34 | F7-1 | 0.04 |
| BmZ002 | 27.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ002 | 28.01 | 3.38 | 0.04 | 6.75 | 1.05 | 1.34 | F7-1 | 0.03 |
| BmZ002 | 29.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ002 | 30.01 | 6.75 | -0.07 | 6.75 | 2.04 | 1.34 | F7-1 | 0.05 |
| BmZ002 | 31.01 | 3.38 | 0.04 | 6.75 | 1.05 | 1.34 | F7-1 | 0.03 |
| BmZ002 | 32.01 | 0.00 | 0.08 | 6.75 | 1.53 | 1.34 | F7-1 | 0.06 |
| BmZ002 | 33.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ002 | 34.01 | 6.75 | -0.05 | 6.75 | 2.01 | 1.34 | F7-1 | 0.04 |
| BmZ002 | 35.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ002 | 36.01 | 3.38 | 0.01 | 6.75 | 1.21 | 1.34 | F7-1 | 0.01 |
| BmZ002 | 37.01 | 6.75 | -0.07 | 6.75 | 2.09 | 1.34 | F7-1 | 0.05 |
| BmZ003 | 26.01 | 3.38 | 0.43 | 6.75 | 1.29 | 1.34 | F7-1 | 0.32 |
| BmZ003 | 27.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ003 | 28.01 | 3.38 | 0.34 | 6.75 | 1.29 | 1.34 | F7-1 | 0.25 |
| BmZ003 | 29.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ003 | 30.01 | 6.75 | -0.39 | 6.75 | 2.18 | 1.34 | F7-1 | 0.29 |
| BmZ003 | 31.01 | 3.38 | 0.34 | 6.75 | 1.29 | 1.34 | F7-1 | 0.25 |
| BmZ003 | 32.01 | 6.75 | -0.55 | 6.75 | 1.76 | 1.34 | F7-1 | 0.41 |
| BmZ003 | 33.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ003 | 34.01 | 6.75 | -0.31 | 6.75 | 2.17 | 1.34 | F7-1 | 0.23 |
| BmZ003 | 35.01 | 3.38 | 0.03 | 6.75 | 1.31 | 1.34 | F7-1 | 0.02 |
| BmZ003 | 36.01 | 3.38 | 0.03 | 6.75 | 1.31 | 1.34 | F7-1 | 0.02 |
| BmZ003 | 37.01 | 6.75 | -0.38 | 6.75 | 2.19 | 1.34 | F7-1 | 0.28 |
| BmZ004 | 26.01 | 0.00 | -0.21 | 6.75 | 1.60 | 1.34 | F7-1 | 0.15 |
| BmZ004 | 27.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ004 | 28.01 | 0.00 | -0.17 | 6.75 | 1.57 | 1.34 | F7-1 | 0.12 |
| BmZ004 | 29.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ004 | 30.01 | 0.00 | -0.39 | 6.75 | 2.25 | 1.34 | F7-1 | 0.29 |
| BmZ004 | 31.01 | 0.00 | -0.17 | 6.75 | 1.57 | 1.34 | F7-1 | 0.12 |
| BmZ004 | 32.01 | 0.00 | -0.43 | 6.75 | 2.20 | 1.34 | F7-1 | 0.32 |
| BmZ004 | 33.01 | 3.38 | 0.05 | 6.75 | 1.31 | 1.34 | F7-1 | 0.03 |
| BmZ004 | 34.01 | 0.00 | -0.31 | 6.75 | 2.23 | 1.34 | F7-1 | 0.23 |
| BmZ004 | 35.01 | 3.38 | 0.03 | 6.75 | 1.31 | 1.34 | F7-1 | 0.02 |
| BmZ004 | 36.01 | 3.38 | 0.03 | 6.75 | 1.31 | 1.34 | F7-1 | 0.02 |
| BmZ004 | 37.01 | 0.00 | -0.38 | 6.75 | 2.28 | 1.34 | F7-1 | 0.28 |

Flexure Check (Weak Bending):

| Member Name | Result Case# | Offset ft | Muy K-ft | Mny/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| BmZ001 | 30.01 | 0.00 | 0.40 | 1.34 | F7-1 | 0.30 |
| BmZ001 | 32.01 | 0.00 | 0.30 | 1.34 | F7-1 | 0.22 |
| BmZ001 | 34.01 | 0.00 | 0.30 | 1.34 | F7-1 | 0.22 |
| BmZ001 | 37.01 | 0.00 | 0.40 | 1.34 | F7-1 | 0.30 |
| BmZ002 | 30.01 | 6.75 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmZ002 | 32.01 | 6.75 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmZ002 | 34.01 | 6.75 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmZ002 | 37.01 | 6.75 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmZ003 | 30.01 | 6.75 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmZ003 | 32.01 | 6.75 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmZ003 | 34.01 | 6.75 | -0.30 | 1.34 | F7-1 | 0.22 |
| BmZ003 | 37.01 | 6.75 | -0.40 | 1.34 | F7-1 | 0.30 |
| BmZ004 | 30.01 | 0.00 | 0.40 | 1.34 | F7-1 | 0.30 |
| BmZ004 | 32.01 | 0.00 | 0.30 | 1.34 | F7-1 | 0.22 |
| BmZ004 | 34.01 | 0.00 | 0.30 | 1.34 | F7-1 | 0.22 |
| BmZ004 | 37.01 | 0.00 | 0.40 | 1.34 | F7-1 | 0.30 |

Shear Check (Strong Axis):

| Member Name | Result Case# | Offset ft | Vuy K | ~h/tw | Vny/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmZ003 | 26.01 | 0.00 | 0.47 | 14.24 | 6.33 | G2-1 | 0.07 |
| BmZ003 | 27.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ003 | 28.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmZ003 | 29.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ003 | 30.01 | 6.75 | -0.16 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmZ003 | 31.01 | 0.00 | 0.37 | 14.24 | 6.33 | G2-1 | 0.06 |
| BmZ003 | 32.01 | 6.75 | -0.45 | 14.24 | 6.33 | G2-1 | 0.07 |
| BmZ003 | 33.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ003 | 34.01 | 6.75 | -0.13 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmZ003 | 37.01 | 6.75 | -0.14 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmZ004 | 26.01 | 0.00 | 0.22 | 14.24 | 6.33 | G2-1 | 0.03 |
| BmZ004 | 27.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ004 | 28.01 | 0.00 | 0.18 | 14.24 | 6.33 | G2-1 | 0.03 |
| BmZ004 | 29.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ004 | 30.01 | 0.00 | 0.16 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmZ004 | 31.01 | 0.00 | 0.18 | 14.24 | 6.33 | G2-1 | 0.03 |
| BmZ004 | 32.01 | 0.00 | 0.26 | 14.24 | 6.33 | G2-1 | 0.04 |
| BmZ004 | 33.01 | 0.00 | 0.05 | 14.24 | 6.33 | G2-1 | 0.01 |
| BmZ004 | 34.01 | 0.00 | 0.13 | 14.24 | 6.33 | G2-1 | 0.02 |
| BmZ004 | 37.01 | 0.00 | 0.14 | 14.24 | 6.33 | G2-1 | 0.02 |

Shear Check (Weak Axis):

| Member Name | Result Case# | Offset ft | Vuz K | Aw in^2 | Vnz/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| BmZ001 | 30.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ001 | 32.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ001 | 34.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ001 | 37.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ002 | 30.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ002 | 32.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ002 | 34.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ002 | 37.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ003 | 30.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ003 | 32.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ003 | 34.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ003 | 37.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ004 | 30.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |
| BmZ004 | 32.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ004 | 34.01 | 0.00 | -0.09 | 0.38 | 6.33 | G2-1 | 0.01 |
| BmZ004 | 37.01 | 0.00 | -0.12 | 0.38 | 6.33 | G2-1 | 0.02 |

Steel Design, per AISC ASD (2005)
Design Group: Steel_Column_G04, Group Report, Designed As: HSS2x2x1/8

SIZE CONSTRAINTS: none
BRACING INFORMATION:

```
   Weak(y) Bracing: Unbraced
   Strong(z) Bracing: Unbraced

COLUMN INFORMATION:
   Automatic Kz (no sidesway) = varies; See 'Member K Factors' table.
   Automatic Ky (no sidesway) = varies.

   Fy = 46.00Ksi
   Design checks assume a 2nd order analysis was performed. (No B1, B2 factors needed.)
Combined Stresses Check:
      Member      Result  Offset      Pu     Muz     Muy    Pn/Ω  Mnz/Ω   Mny/Ω        Code   Unity
        Name       Case#      ft       K    K-ft    K-ft       K    K-ft    K-ft        Ref.
Check
      COL001       26.01    0.00   -0.01    0.46   -0.07    9.02    1.34    1.34       H1-1b
0.39
      COL001       27.01    0.00   -0.01    0.09   -0.01    9.02    1.34    1.34       H1-1b
0.08
      COL001       28.01    0.00   -0.01    0.36   -0.05    9.02    1.34    1.34       H1-1b
0.31
      COL001       29.01    0.00   -0.01    0.12   -0.01    9.02    1.34    1.34       H1-1b
0.10
      COL001       30.01    9.75    0.01   -0.09    0.03   23.14    1.34    1.34       H1-1b
0.09
      COL001       31.01    0.00   -0.01    0.39   -0.05    9.02    1.34    1.34       H1-1b
0.33
      COL001       32.01    0.00   -0.01    0.36   -0.04    9.02    1.34    1.34       H1-1b
0.30
      COL001       33.01    0.00   -0.01    0.11   -0.01    9.02    1.34    1.34       H1-1b
0.09
      COL001       34.01    9.75    0.01   -0.09    0.02   23.14    1.34    1.34       H1-1b
0.08
      COL001       35.01    0.00   -0.01    0.08   -0.01    9.02    1.34    1.34       H1-1b
0.07
      COL001       36.01    0.00   -0.01    0.05   -0.01    9.02    1.34    1.34       H1-1b
0.05
      COL001       37.01    9.75    0.01   -0.05    0.02   23.14    1.34    1.34       H1-1b
0.06
   COL001--1       26.01    0.00    0.11    0.46    0.26   23.14    1.34    1.34       H1-1b
0.54
   COL001--1       27.01    0.00   -0.01    0.09    0.03    9.02    1.34    1.34       H1-1b
0.09
   COL001--1       28.01    0.00    0.08    0.36    0.20   23.14    1.34    1.34       H1-1b
0.43
   COL001--1       29.01    0.00   -0.20    0.53    0.03    9.02    1.34    1.34       H1-1b
0.43
   COL001--1       30.01    9.75   -0.09   -0.09   -0.47    9.02    1.34    1.34       H1-1b
0.42
   COL001--1       31.01    0.00   -0.06    0.69    0.20    9.02    1.34    1.34       H1-1b
0.67
   COL001--1       32.01    9.75    0.03   -0.36   -0.46   23.14    1.34    1.34       H1-1b
0.62
   COL001--1       33.01    0.00   -0.16    0.42    0.03    9.02    1.34    1.34       H1-1b
0.35
   COL001--1       34.01    9.75   -0.06   -0.09   -0.36    9.02    1.34    1.34       H1-1b
0.34
   COL001--1       35.01    0.00   -0.20    0.49    0.02    9.02    1.34    1.34       H1-1b
0.39
   COL001--1       36.01    0.00   -0.01    0.05    0.02    9.02    1.34    1.34       H1-1b
0.05
   COL001--1       37.01    9.75   -0.10   -0.05   -0.45    9.02    1.34    1.34       H1-1b
0.38
    COL001-0       26.01    0.00    0.11    0.46   -0.26   23.14    1.34    1.34       H1-1b
0.54
    COL001-0       27.01    0.00   -0.01    0.09   -0.03    9.02    1.34    1.34       H1-1b
0.09
    COL001-0       28.01    0.00    0.08    0.36   -0.20   23.14    1.34    1.34       H1-1b
0.43
```

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COL001-0 | 29.01 | 0.00 | -0.20 | 0.53 | -0.03 | 9.02 | 1.34 | 1.34 | H1-1b | 0.43 |
| COL001-0 | 30.01 | 0.00 | 0.09 | 0.09 | -0.47 | 23.14 | 1.34 | 1.34 | H1-1b | 0.41 |
| COL001-0 | 31.01 | 0.00 | -0.06 | 0.69 | -0.20 | 9.02 | 1.34 | 1.34 | H1-1b | 0.67 |
| COL001-0 | 32.01 | 0.00 | 0.16 | 0.36 | -0.53 | 23.14 | 1.34 | 1.34 | H1-1b | 0.67 |
| COL001-0 | 33.01 | 0.00 | -0.16 | 0.42 | -0.03 | 9.02 | 1.34 | 1.34 | H1-1b | 0.35 |
| COL001-0 | 34.01 | 0.00 | 0.06 | 0.09 | -0.36 | 23.14 | 1.34 | 1.34 | H1-1b | 0.33 |
| COL001-0 | 35.01 | 0.00 | -0.20 | 0.49 | -0.02 | 9.02 | 1.34 | 1.34 | H1-1b | 0.39 |
| COL001-0 | 36.01 | 0.00 | -0.01 | 0.05 | -0.02 | 9.02 | 1.34 | 1.34 | H1-1b | 0.05 |
| COL001-0 | 37.01 | 0.00 | 0.10 | 0.05 | -0.45 | 23.14 | 1.34 | 1.34 | H1-1b | 0.38 |
| COL001-1 | 26.01 | 0.00 | -0.01 | 0.46 | 0.07 | 9.02 | 1.34 | 1.34 | H1-1b | 0.39 |
| COL001-1 | 27.01 | 0.00 | -0.01 | 0.09 | 0.01 | 9.02 | 1.34 | 1.34 | H1-1b | 0.08 |
| COL001-1 | 28.01 | 0.00 | -0.01 | 0.36 | 0.05 | 9.02 | 1.34 | 1.34 | H1-1b | 0.31 |
| COL001-1 | 29.01 | 0.00 | -0.01 | 0.12 | 0.01 | 9.02 | 1.34 | 1.34 | H1-1b | 0.10 |
| COL001-1 | 30.01 | 0.00 | -0.01 | 0.09 | 0.03 | 9.02 | 1.34 | 1.34 | H1-1b | 0.09 |
| COL001-1 | 31.01 | 0.00 | -0.01 | 0.39 | 0.05 | 9.02 | 1.34 | 1.34 | H1-1b | 0.33 |
| COL001-1 | 32.01 | 0.00 | -0.01 | 0.36 | 0.07 | 9.02 | 1.34 | 1.34 | H1-1b | 0.32 |
| COL001-1 | 33.01 | 0.00 | -0.01 | 0.11 | 0.01 | 9.02 | 1.34 | 1.34 | H1-1b | 0.09 |
| COL001-1 | 34.01 | 0.00 | -0.01 | 0.09 | 0.02 | 9.02 | 1.34 | 1.34 | H1-1b | 0.08 |
| COL001-1 | 35.01 | 0.00 | -0.01 | 0.08 | 0.01 | 9.02 | 1.34 | 1.34 | H1-1b | 0.07 |
| COL001-1 | 36.01 | 0.00 | -0.01 | 0.05 | 0.01 | 9.02 | 1.34 | 1.34 | H1-1b | 0.05 |
| COL001-1 | 37.01 | 0.00 | -0.01 | 0.05 | 0.02 | 9.02 | 1.34 | 1.34 | H1-1b | 0.06 |

Flexure Check (Strong Bending):

| Member Name | Result Case# | Offset ft | Muz K-ft | Lu ft | Cb | Mnz/Ω K-ft | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|
| COL001 | 26.01 | 0.00 | 0.46 | 9.75 | 2.17 | 1.34 | F7-1 | 0.34 |
| COL001 | 27.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001 | 28.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001 | 29.01 | 0.00 | 0.12 | 9.75 | 2.10 | 1.34 | F7-1 | 0.09 |
| COL001 | 30.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001 | 31.01 | 0.00 | 0.39 | 9.75 | 2.15 | 1.34 | F7-1 | 0.29 |
| COL001 | 32.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001 | 33.01 | 0.00 | 0.11 | 9.75 | 2.11 | 1.34 | F7-1 | 0.08 |
| COL001 | 34.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001 | 35.01 | 0.00 | 0.08 | 9.75 | 1.86 | 1.34 | F7-1 | 0.06 |
| COL001 | 36.01 | 0.00 | 0.05 | 9.75 | 2.17 | 1.34 | F7-1 | 0.04 |
| COL001 | 37.01 | 0.00 | 0.05 | 9.75 | 2.17 | 1.34 | F7-1 | 0.04 |
| COL001--1 | 26.01 | 0.00 | 0.46 | 9.75 | 2.17 | 1.34 | F7-1 | 0.34 |
| COL001--1 | 27.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.06 |
| COL001--1 | 28.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001--1 | 29.01 | 0.00 | 0.53 | 9.75 | 1.93 | 1.34 | F7-1 | 0.39 |
| COL001--1 | 30.01 | 9.75 | -0.09 | 9.75 | 2.21 | 1.34 | F7-1 | 0.06 |
| COL001--1 | 31.01 | 0.00 | 0.69 | 9.75 | 2.23 | 1.34 | F7-1 | 0.52 |
| COL001--1 | 32.01 | 0.00 | 0.36 | 9.75 | 2.21 | 1.34 | F7-1 | 0.27 |
| COL001--1 | 33.01 | 0.00 | 0.42 | 9.75 | 2.00 | 1.34 | F7-1 | 0.31 |
| COL001--1 | 34.01 | 9.75 | -0.09 | 9.75 | 2.21 | 1.34 | F7-1 | 0.06 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| COL001--1 | 35.01 | 0.00 | 0.49 | 9.75 | 1.84 | 1.34 | F7-1 | 0.37 |
| COL001--1 | 36.01 | 0.00 | 0.05 | 9.75 | 2.17 | 1.34 | F7-1 | 0.04 |
| COL001--1 | 37.01 | 9.75 | -0.05 | 9.75 | 2.22 | 1.34 | F7-1 | 0.04 |
| COL001-0 | 26.01 | 0.00 | 0.46 | 9.75 | 2.17 | 1.34 | F7-1 | 0.34 |
| COL001-0 | 27.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.06 |
| COL001-0 | 28.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001-0 | 29.01 | 0.00 | 0.53 | 9.75 | 1.93 | 1.34 | F7-1 | 0.39 |
| COL001-0 | 30.01 | 0.00 | 0.09 | 9.75 | 2.21 | 1.34 | F7-1 | 0.06 |
| COL001-0 | 31.01 | 0.00 | 0.69 | 9.75 | 2.23 | 1.34 | F7-1 | 0.52 |
| COL001-0 | 32.01 | 0.00 | 0.36 | 9.75 | 2.21 | 1.34 | F7-1 | 0.27 |
| COL001-0 | 33.01 | 0.00 | 0.42 | 9.75 | 2.00 | 1.34 | F7-1 | 0.31 |
| COL001-0 | 34.01 | 0.00 | 0.09 | 9.75 | 2.21 | 1.34 | F7-1 | 0.06 |
| COL001-0 | 35.01 | 0.00 | 0.49 | 9.75 | 1.84 | 1.34 | F7-1 | 0.37 |
| COL001-0 | 36.01 | 0.00 | 0.05 | 9.75 | 2.17 | 1.34 | F7-1 | 0.04 |
| COL001-0 | 37.01 | 0.00 | 0.05 | 9.75 | 2.21 | 1.34 | F7-1 | 0.04 |
| COL001-1 | 26.01 | 0.00 | 0.46 | 9.75 | 2.17 | 1.34 | F7-1 | 0.34 |
| COL001-1 | 27.01 | 0.00 | 0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001-1 | 28.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001-1 | 29.01 | 0.00 | 0.12 | 9.75 | 2.10 | 1.34 | F7-1 | 0.09 |
| COL001-1 | 30.01 | 9.75 | -0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001-1 | 31.01 | 0.00 | 0.39 | 9.75 | 2.15 | 1.34 | F7-1 | 0.29 |
| COL001-1 | 32.01 | 0.00 | 0.36 | 9.75 | 2.17 | 1.34 | F7-1 | 0.27 |
| COL001-1 | 33.01 | 0.00 | 0.11 | 9.75 | 2.11 | 1.34 | F7-1 | 0.08 |
| COL001-1 | 34.01 | 9.75 | -0.09 | 9.75 | 2.17 | 1.34 | F7-1 | 0.07 |
| COL001-1 | 35.01 | 0.00 | 0.08 | 9.75 | 1.86 | 1.34 | F7-1 | 0.06 |
| COL001-1 | 36.01 | 0.00 | 0.05 | 9.75 | 2.17 | 1.34 | F7-1 | 0.04 |
| COL001-1 | 37.01 | 9.75 | -0.05 | 9.75 | 2.18 | 1.34 | F7-1 | 0.04 |

Axial Check:

| Member Name | Result Case# | Offset ft | Pu K | KL/r | FeFB Ksi | FeFTB Ksi | Q | Fcr Ksi | Pn/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COL001--1 | 26.01 | 9.75 | 0.14 | 118.32 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| COL001--1 | 29.01 | 0.00 | -0.20 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |
| COL001--1 | 30.01 | 0.00 | -0.12 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.01 |
| COL001--1 | 31.01 | 0.00 | -0.06 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.01 |
| COL001--1 | 33.01 | 0.00 | -0.16 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |
| COL001--1 | 34.01 | 0.00 | -0.09 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.01 |
| COL001--1 | 35.01 | 0.00 | -0.20 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |
| COL001--1 | 37.01 | 0.00 | -0.11 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.01 |
| COL001-0 | 26.01 | 9.75 | 0.14 | 118.32 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| COL001-0 | 29.01 | 0.00 | -0.20 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |
| COL001-0 | 30.01 | 9.75 | 0.12 | 118.32 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| COL001-0 | 31.01 | 0.00 | -0.06 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.01 |
| COL001-0 | 32.01 | 9.75 | 0.19 | 118.32 | -1.00 | -1.00 | 1.00 | 46.00 | 23.14 | D2-1 | 0.01 |
| COL001-0 | 33.01 | 0.00 | -0.16 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |
| COL001-0 | 35.01 | 0.00 | -0.20 | 118.32 | 20.44 | 9201.72 | 1.00 | 17.94 | 9.02 | E3-2FB | 0.02 |

Flexure Check (Weak Bending):

| Member | Result | Offset | Muy | Mny/Ω | Code | Unity |
|---|---|---|---|---|---|---|

| Name | Case# | ft | K-ft | K-ft | Ref. | Check |
|---|---|---|---|---|---|---|
| COL001 | 26.01 | 0.00 | -0.07 | 1.34 | F7-1 | 0.05 |
| COL001 | 27.01 | 0.00 | -0.01 | 1.34 | F7-1 | 0.01 |
| COL001 | 28.01 | 0.00 | -0.05 | 1.34 | F7-1 | 0.04 |
| COL001 | 29.01 | 0.00 | -0.01 | 1.34 | F7-1 | 0.01 |
| COL001 | 30.01 | 9.75 | 0.03 | 1.34 | F7-1 | 0.02 |
| COL001 | 31.01 | 0.00 | -0.05 | 1.34 | F7-1 | 0.04 |
| COL001 | 32.01 | 9.75 | 0.04 | 1.34 | F7-1 | 0.03 |
| COL001 | 33.01 | 0.00 | -0.01 | 1.34 | F7-1 | 0.01 |
| COL001 | 34.01 | 9.75 | 0.02 | 1.34 | F7-1 | 0.02 |
| COL001 | 35.01 | 0.00 | -0.01 | 1.34 | F7-1 | 0.01 |
| COL001 | 36.01 | 0.00 | -0.01 | 1.34 | F7-1 | 0.01 |
| COL001 | 37.01 | 9.75 | 0.02 | 1.34 | F7-1 | 0.02 |
| COL001--1 | 26.01 | 0.00 | 0.26 | 1.34 | F7-1 | 0.19 |
| COL001--1 | 27.01 | 0.00 | 0.03 | 1.34 | F7-1 | 0.03 |
| COL001--1 | 28.01 | 0.00 | 0.20 | 1.34 | F7-1 | 0.15 |
| COL001--1 | 29.01 | 0.00 | 0.03 | 1.34 | F7-1 | 0.03 |
| COL001--1 | 30.01 | 9.75 | -0.47 | 1.34 | F7-1 | 0.35 |
| COL001--1 | 31.01 | 0.00 | 0.20 | 1.34 | F7-1 | 0.15 |
| COL001--1 | 32.01 | 9.75 | -0.46 | 1.34 | F7-1 | 0.35 |
| COL001--1 | 33.01 | 0.00 | 0.03 | 1.34 | F7-1 | 0.03 |
| COL001--1 | 34.01 | 9.75 | -0.36 | 1.34 | F7-1 | 0.27 |
| COL001--1 | 35.01 | 0.00 | 0.02 | 1.34 | F7-1 | 0.02 |
| COL001--1 | 36.01 | 0.00 | 0.02 | 1.34 | F7-1 | 0.02 |
| COL001--1 | 37.01 | 9.75 | -0.45 | 1.34 | F7-1 | 0.34 |
| COL001-0 | 26.01 | 0.00 | -0.26 | 1.34 | F7-1 | 0.19 |
| COL001-0 | 27.01 | 0.00 | -0.03 | 1.34 | F7-1 | 0.03 |
| COL001-0 | 28.01 | 0.00 | -0.20 | 1.34 | F7-1 | 0.15 |
| COL001-0 | 29.01 | 0.00 | -0.03 | 1.34 | F7-1 | 0.03 |
| COL001-0 | 30.01 | 0.00 | -0.47 | 1.34 | F7-1 | 0.35 |
| COL001-0 | 31.01 | 0.00 | -0.20 | 1.34 | F7-1 | 0.15 |
| COL001-0 | 32.01 | 0.00 | -0.53 | 1.34 | F7-1 | 0.40 |
| COL001-0 | 33.01 | 0.00 | -0.03 | 1.34 | F7-1 | 0.03 |
| COL001-0 | 34.01 | 0.00 | -0.36 | 1.34 | F7-1 | 0.27 |
| COL001-0 | 35.01 | 0.00 | -0.02 | 1.34 | F7-1 | 0.02 |
| COL001-0 | 36.01 | 0.00 | -0.02 | 1.34 | F7-1 | 0.02 |
| COL001-0 | 37.01 | 0.00 | -0.45 | 1.34 | F7-1 | 0.34 |
| COL001-1 | 26.01 | 0.00 | 0.07 | 1.34 | F7-1 | 0.05 |
| COL001-1 | 27.01 | 0.00 | 0.01 | 1.34 | F7-1 | 0.01 |
| COL001-1 | 28.01 | 0.00 | 0.05 | 1.34 | F7-1 | 0.04 |
| COL001-1 | 29.01 | 0.00 | 0.01 | 1.34 | F7-1 | 0.01 |
| COL001-1 | 30.01 | 0.00 | 0.03 | 1.34 | F7-1 | 0.02 |
| COL001-1 | 31.01 | 0.00 | 0.05 | 1.34 | F7-1 | 0.04 |
| COL001-1 | 32.01 | 0.00 | 0.07 | 1.34 | F7-1 | 0.05 |
| COL001-1 | 33.01 | 0.00 | 0.01 | 1.34 | F7-1 | 0.01 |
| COL001-1 | 34.01 | 0.00 | 0.02 | 1.34 | F7-1 | 0.02 |
| COL001-1 | 35.01 | 0.00 | 0.01 | 1.34 | F7-1 | 0.01 |
| COL001-1 | 36.01 | 0.00 | 0.01 | 1.34 | F7-1 | 0.01 |
| COL001-1 | 37.01 | 0.00 | 0.02 | 1.34 | F7-1 | 0.02 |

Shear Check (Strong Axis):

| Member Name | Result Case# | Offset ft | Vuy K | ~h/tw | Vny/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| COL001 | 26.01 | 0.00 | -0.09 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001 | 28.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001 | 31.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001 | 32.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 26.01 | 0.00 | -0.09 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 28.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 29.01 | 0.00 | -0.33 | 14.24 | 6.33 | G2-1 | 0.05 |
| COL001--1 | 31.01 | 0.00 | -0.31 | 14.24 | 6.33 | G2-1 | 0.05 |
| COL001--1 | 32.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 33.01 | 0.00 | -0.26 | 14.24 | 6.33 | G2-1 | 0.04 |
| COL001--1 | 35.01 | 0.00 | -0.33 | 14.24 | 6.33 | G2-1 | 0.05 |
| COL001-0 | 26.01 | 0.00 | -0.09 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 28.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 29.01 | 0.00 | -0.33 | 14.24 | 6.33 | G2-1 | 0.05 |

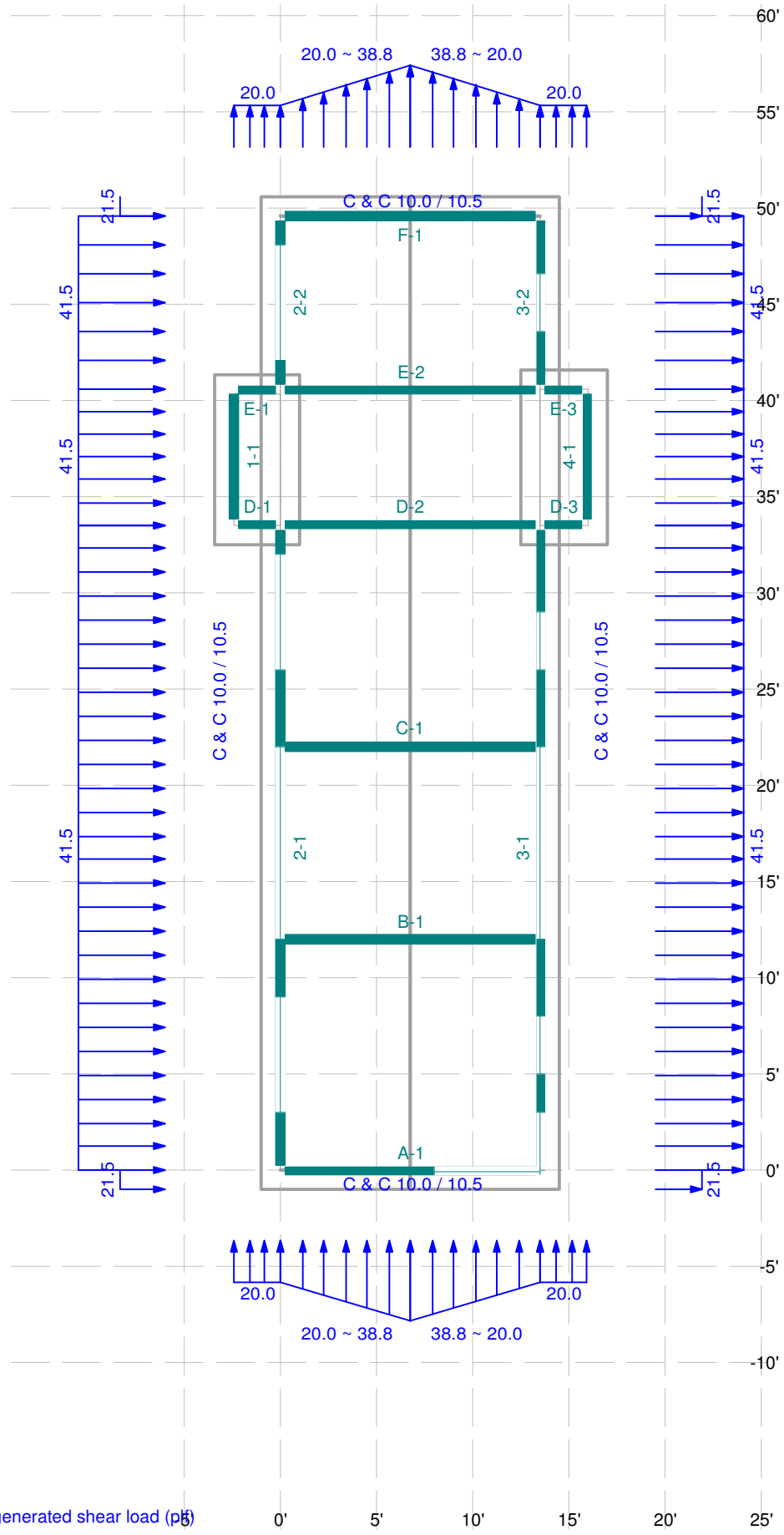
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| COL001-0 | 31.01 | 0.00 | -0.31 | 14.24 | 6.33 | G2-1 | 0.05 |
| COL001-0 | 32.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 33.01 | 0.00 | -0.26 | 14.24 | 6.33 | G2-1 | 0.04 |
| COL001-0 | 35.01 | 0.00 | -0.33 | 14.24 | 6.33 | G2-1 | 0.05 |
| COL001-1 | 26.01 | 0.00 | -0.09 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-1 | 28.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-1 | 31.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |
| COL001-1 | 32.01 | 0.00 | -0.07 | 14.24 | 6.33 | G2-1 | 0.01 |

Shear Check (Weak Axis):

| Member Name | Result Case# | Offset ft | Vuz K | Aw in^2 | Vnz/Ω K | Code Ref. | Unity Check |
|---|---|---|---|---|---|---|---|
| COL001--1 | 26.01 | 0.00 | -0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 28.01 | 0.00 | -0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 30.01 | 9.75 | -0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| COL001--1 | 31.01 | 0.00 | -0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001--1 | 32.01 | 9.75 | -0.27 | 0.38 | 6.33 | G2-1 | 0.04 |
| COL001--1 | 34.01 | 9.75 | -0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| COL001--1 | 37.01 | 9.75 | -0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| COL001-0 | 26.01 | 0.00 | 0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 28.01 | 0.00 | 0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 30.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |
| COL001-0 | 31.01 | 0.00 | 0.04 | 0.38 | 6.33 | G2-1 | 0.01 |
| COL001-0 | 32.01 | 0.00 | 0.27 | 0.38 | 6.33 | G2-1 | 0.04 |
| COL001-0 | 34.01 | 0.00 | 0.24 | 0.38 | 6.33 | G2-1 | 0.04 |
| COL001-0 | 37.01 | 0.00 | 0.32 | 0.38 | 6.33 | G2-1 | 0.05 |

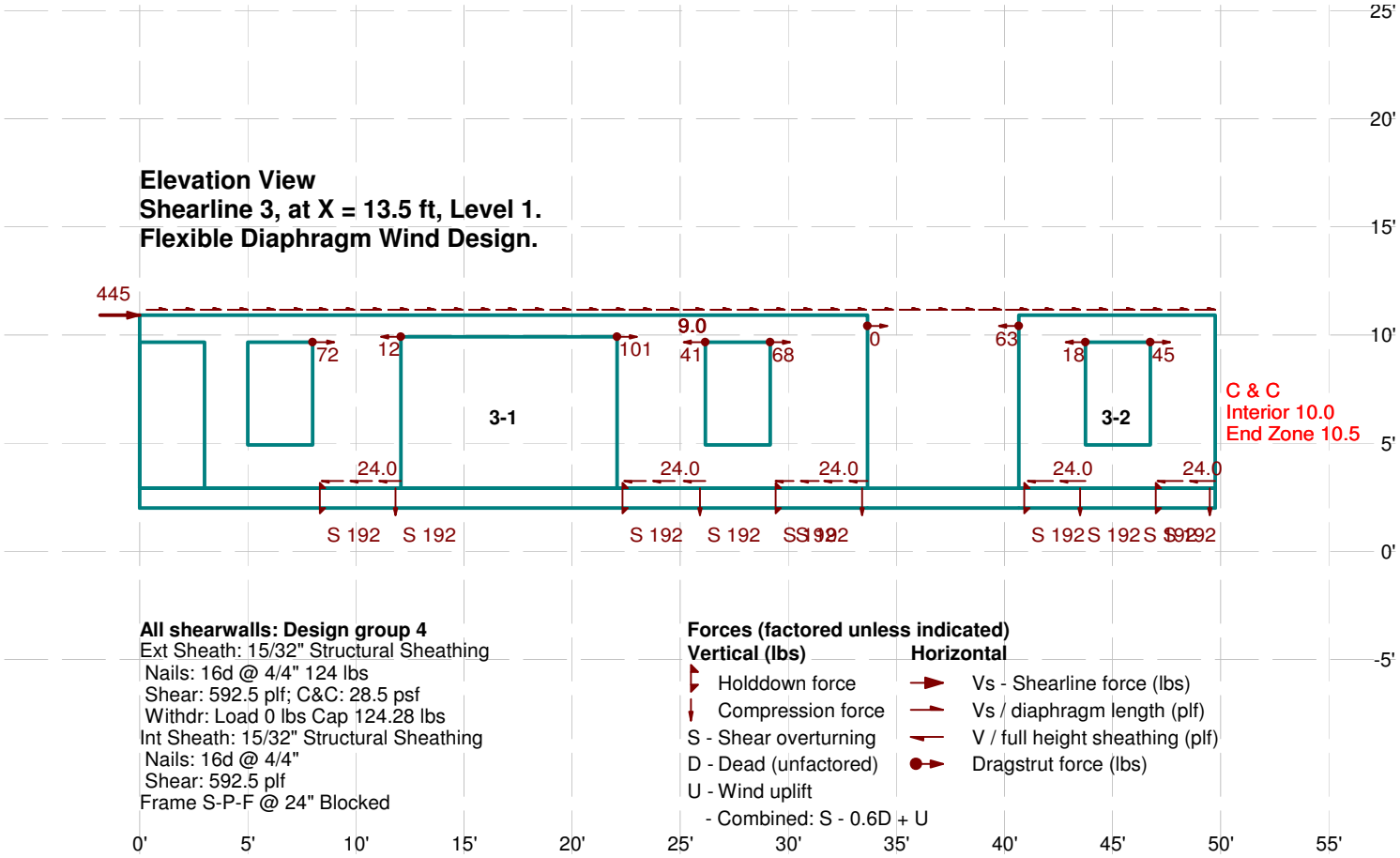
WoodWorks® Shearwalls 7.01 Dec. 9, 2008 12:09:15

Level 1 of 1



# WoodWorks® Shearwalls SOFTWARE FOR WOOD DESIGN

**shearwalldesign.wsw** **WoodWorks® Shearwalls 7.01** **Dec. 9, 2008 12:30:52**




**All shearwalls: Design group 4**
Ext Sheath: 15/32" Structural Sheathing
Nails: 16d @ 4/4" 124 lbs
Shear: 592.5 plf; C&C: 28.5 psf
Withdr: Load 0 lbs Cap 124.28 lbs
Int Sheath: 15/32" Structural Sheathing
Nails: 16d @ 4/4"
Shear: 592.5 plf
Frame S-P-F @ 24" Blocked

**Forces (factored unless indicated)**

**Vertical (lbs)**
- Holddown force
- Compression force
- S - Shear overturning
- D - Dead (unfactored)
- U - Wind uplift
- Combined: S - 0.6D + U

**Horizontal**
- Vs - Shearline force (lbs)
- Vs / diaphragm length (plf)
- V / full height sheathing (plf)
- Dragstrut force (lbs)

# WoodWorks® Shearwalls — SOFTWARE FOR WOOD DESIGN

**WoodWorks® Shearwalls 7.01**

**shearwalldesign.wsr** — **Dec. 11, 2008 14:30:39**

## Project Information

### COMPANY AND PROJECT INFORMATION

| Company | Project |
|---|---|
| Randall J Hebert & Associates, Inc.<br>Randall J Hebert PE<br>E Ray Desormeaux PE<br>Lafayette, LA | BeauSoleil<br>University of Louisiana - Lafayette |

### DESIGN SETTINGS

| Design Code | Wind Standard | Seismic Standard |
|---|---|---|
| IBC 2003 | ASCE 7-02 All heights | ASCE 7-02 |

| Wind Capacity Increase | | Load Combinations | Building Code Capacity Reduction | |
|---|---|---|---|---|
| Shear | C&C Panels | | Wind | Seismic |
| 1.40 | 1.60 | 0.70 Seismic<br>1.00 Wind | 1.00 | 1.00 |

| Nail Withdrawal Modification | | | | Max Shearwall Offset [ft] | |
|---|---|---|---|---|---|
| Duration Factor | Temperature Range | Moisture Content Fabrication | Moisture Content Service | Plan (within story) | Elevation (between stories) |
| 1.60 | T<=100F | Dry | Dry | 0.50 | - |

| Maximum Height-to-width Ratio | | | | | | |
|---|---|---|---|---|---|---|
| Plywood | | Fiberboard | Lumber | | Gypsum | |
| Wind | Seismic | | Wind | Seismic | Blocked | Unblocked |
| 3.5 | 3.5 | - | - | - | 2.0 | 1.5 |

| | |
|---|---|
| **Shearwall Relative Rigidity:** | Designed capacity using flexible distribution |
| **Hold-down Forces:** | Based on applied shearline force |
| **Seismic Materials:** | Include gypsum on exterior walls |
| **Case 2 rigid diaphragm load distribution:** | 75% loads, torsional moment |

### SITE INFORMATION

| IBC Occupancy | ASCE 7 Equivalent |
|---|---|
| Category II - All others | Category II - All others |

| Wind | Seismic |
|---|---|
| ASCE 7-02 General analytic method for all bldgs | ASCE 7-02 Equivalent lateral force procedure |

| | | | |
|---|---|---|---|
| **Design Wind Speed** | 60mph | **Use Group** | I |
| **Exposure** | Exposure C | **Design Category** | A |
| **Enclosure** | Enclosed | **Site Profile Class** | D |

**Topographic Information [ft]**

| Shape | Height | Length |
|---|---|---|
| - | - | - |

**Site Location:** -

-
-

**Spectral Response Acceleration**

**S1:** 0.400g **Ss:** 0.750g

| Fundamental Period | E-W | N-S |
|---|---|---|
| T Used | 0.088s | 0.088s |
| Approximate Ta | 0.088s | 0.088s |
| Maximum T | 0.105s | 0.105s |
| Response Factor R | 2.00 | 2.00 |

## Structural Data

### STORY INFORMATION

| | Story Elev [ft] | Floor/Ceiling Depth [in] | Wall Height [ft] |
|---|---|---|---|
| **Ceiling** | 10.83 | 0.0 | |
| **Level 1** | 2.83 | 10.0 | 8.00 |
| **Foundation** | 2.00 | | |

### BLOCK and ROOF INFORMATION

| Block Dimensions [ft] | | | Roof Panels Face | Type | Slope | Overhang [ft] |
|---|---|---|---|---|---|---|
| **Block 1** | 1 Story | N-S Ridge | | | | |
| Location X,Y = | 0.00 | 0.00 | **North** | Gable | 90.0 | 1.00 |
| Extent X,Y = | 13.50 | 49.50 | **South** | Gable | 90.0 | 1.00 |
| Ridge X Location, Offset | 6.75 | 0.00 | **East** | Side | 30.0 | 1.00 |
| Ridge Elevation, Height | 14.73 | 3.90 | **West** | Side | 30.0 | 1.00 |
| **Block 2** | 1 Story | E-W Ridge | | | | |
| Location X,Y = | 13.50 | 33.50 | **North** | Side | 0.0 | 1.00 |
| Extent X,Y = | 2.50 | 7.00 | **South** | Side | 0.0 | 1.00 |
| Ridge Y Location, Offset | 37.00 | 0.00 | **East** | Gable | 0.0 | 1.00 |
| Ridge Elevation, Height | 10.83 | 0.00 | **West** | Joined | 0.0 | 1.00 |
| **Block 3** | 1 Story | E-W Ridge | | | | |
| Location X,Y = | -2.40 | 33.50 | **North** | Side | 0.0 | 1.00 |
| Extent X,Y = | 2.40 | 6.75 | **South** | Side | 0.0 | 1.00 |
| Ridge Y Location, Offset | 36.88 | 0.00 | **East** | Joined | 0.0 | 1.00 |
| Ridge Elevation, Height | 10.83 | 0.00 | **West** | Gable | 0.0 | 1.00 |

**MATERIALS by WALL GROUP**

| Wall | | Sheathing [in] | | | Fasteners | | Spcg [in] | | Framing Members [in] | | | | Apply |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grp | Surf | Material | Thick | Orient | Size | Type | Edg | Fld | Blkg | Species | G | Spc | Notes |
| 1 | Ext | Struct Shthg | 15/32 | Vert | 16d | Nail | 4 | 4 | yes | S-P-F | 0.42 | 24 | 1,2 |
| | Int | Struct Shthg | 15/32 | Vert | 16ga | Nail | 4 | 4 | yes | S-P-F | 0.42 | 24 | |
| 2 | Both | Struct Shthg | 15/32 | Vert | 16ga | Nail | 4 | 7 | yes | S-P-F | 0.42 | 16 | 1,2 |
| 3 | Both | Gyp SB 4'x8' | 1/2 | Horz | 11ga | Nail | 4 | 4 | yes | S-P-F | 0.42 | 12 | |
| 4 | Both | Struct Shthg | 15/32 | Vert | 16ga | Nail | 4 | 4 | yes | S-P-F | 0.42 | 24 | 1,2 |
| 5 | Both | Struct Shthg | 15/32 | Vert | 16d | Nail | 4 | 4 | yes | S-P-F | 0.42 | 24 | 1,2 |

*Grp - Wall Design Group; Surf - Exterior or interior surface of exterior wall; Spcg - Edge or field nail spacing; Blkg - Blocked; G - Specific gravity; Spc - Wall stud spacing*

*Notes:*

*1. Capacity has been reduced according to IBC specific gravity adjustment.*

*2. Framing at adjoining panel edges must be 3" nominal or wider with staggered nailing.*

**SHEARLINE, WALL and OPENING DIMENSIONS**

| North-South Shearlines | Type | Wall Group(s) | Location X [ft] | Extent [ft] Start | Extent [ft] End | Length [ft] | FHS [ft] | Height [ft] |
|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line 1, Level 1 | Seg | 4 | -2.40 | 33.50 | 40.50 | 7.00 | 7.00 | 8.00 |
| Wall 1-1 | Seg | 4 | -2.40 | 33.50 | 40.50 | 7.00 | 7.00 | |
| **Line 2** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line 2, Level 1 | Seg | 5 | 0.00 | 0.00 | 49.50 | 49.50 | 10.00 | 8.00 |
| Wall 2-2 | Seg | 5 | 0.00 | 40.50 | 49.50 | 9.00 | 0.00 | |
| Opening 1 | | | | 42.00 | 48.00 | 6.00 | | 4.75 |
| Wall 2-1 | Seg | 5 | 0.00 | 0.00 | 33.50 | 33.50 | 10.00 | |
| Opening 1 | | | | 3.00 | 9.00 | 6.00 | | 4.75 |
| Opening 2 | | | | 12.00 | 22.00 | 10.00 | | 7.00 |
| Opening 3 | | | | 26.00 | 32.00 | 6.00 | | 4.75 |
| **Line 3** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line 3, Level 1 | Seg | 5 | 13.50 | 0.00 | 49.50 | 49.50 | 18.50 | 8.00 |
| Wall 3-2 | Seg | 5 | 13.50 | 40.50 | 49.50 | 9.00 | 6.00 | |
| Opening 1 | | | | 43.50 | 46.50 | 3.00 | | 4.75 |
| Wall 3-1 | Seg | 5 | 13.50 | 0.00 | 33.50 | 33.50 | 12.50 | |
| Opening 1 | | | | 0.00 | 3.00 | 3.00 | | 6.75 |
| Opening 2 | | | | 5.00 | 8.00 | 3.00 | | 4.75 |
| Opening 3 | | | | 12.00 | 22.00 | 10.00 | | 7.00 |
| Opening 4 | | | | 26.00 | 29.00 | 3.00 | | 4.75 |
| **Line 4** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line 4, Level 1 | Seg | 4 | 15.90 | 33.50 | 40.50 | 7.00 | 7.00 | 8.00 |
| Wall 4-1 | Seg | 4 | 15.90 | 33.50 | 40.50 | 7.00 | 7.00 | |

| East-West Shearlines | Type | Wall Group(s) | Location Y [ft] | Extent [ft] Start | Extent [ft] End | Length [ft] | FHS [ft] | Height [ft] |
|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line A, Level 1 | Seg | 1 | 0.00 | 0.00 | 13.50 | 13.50 | 8.00 | 8.00 |
| Wall A-1 | Seg | 1 | 0.00 | 0.00 | 13.50 | 13.50 | 8.00 | |
| Opening 1 | | | | 8.00 | 13.50 | 5.50 | | 6.75 |
| **Line B** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line B, Level 1 | Seg | 2 | 12.00 | 0.00 | 13.50 | 13.50 | 13.50 | 8.00 |
| Wall B-1 | Seg | 2 | 12.00 | 0.00 | 13.50 | 13.50 | 13.50 | |
| **Line C** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line C, Level 1 | Seg | 2 | 22.00 | 0.00 | 13.50 | 13.50 | 13.50 | 8.00 |
| Wall C-1 | Seg | 2 | 22.00 | 0.00 | 13.50 | 13.50 | 13.50 | |
| **Line D** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line D, Level 1 | Seg | 3 | 33.50 | -2.40 | 15.90 | 18.30 | 13.50 | 8.00 |
| Wall D-3 | Seg | 3 | 33.50 | 13.50 | 15.90 | 2.40 | 0.00 | |
| Wall D-1 | Seg | 3 | 33.50 | -2.40 | 0.00 | 2.40 | 0.00 | |
| Wall D-2 | Seg | 3 | 33.50 | 0.00 | 13.50 | 13.50 | 13.50 | |
| **Line E** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line E, Level 1 | Seg | 3 | 40.50 | -2.40 | 15.90 | 18.30 | 13.50 | 8.00 |
| Wall E-3 | Seg | 3 | 40.50 | 13.50 | 15.90 | 2.40 | 0.00 | |
| Wall E-1 | Seg | 3 | 40.50 | -2.40 | 0.00 | 2.40 | 0.00 | |
| Wall E-2 | Seg | 3 | 40.50 | 0.00 | 13.50 | 13.50 | 13.50 | |
| **Line F** | | | | | | | | |
| **Level 1** | | | | | | | | |
| Line F, Level 1 | Seg | 1 | 49.50 | 0.00 | 13.50 | 13.50 | 13.50 | 8.00 |
| Wall F-1 | Seg | 1 | 49.50 | 0.00 | 13.50 | 13.50 | 13.50 | |

*Type - Seg = segmented, prf = perforated, NSW = non-shearwall; Location - dimension perp. to wall; FHS - length of full-height sheathing; Wall Group(s) - refer to Materials by Wall Group table, refer to Shear Results tables for each design case if more than one group*

## Loads

**WIND SHEAR LOADS (overlapping loads combined)**

| Level 1 Block | F | Element | Load Case | Wnd Dir | Surf Dir | Prof | Location [ft] Start | Location [ft] End | Magnitude [lbs,plf,psf] Start | Magnitude [lbs,plf,psf] End | Trib Ht [ft] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Accum. | W | | 2 | W->E | Wind | Line | 33.50 | 40.50 | 17.2 | | |
| Accum. | W | | 1 | W->E | Wind | Line | 33.50 | 40.50 | 41.5 | | |
| Accum. | W | | 1 | W->E | Wind | Line | 40.50 | 49.50 | 41.5 | | |
| Accum. | W | | 2 | W->E | Wind | Line | 40.50 | 49.50 | 17.2 | | |
| Accum. | E | | 1 | W->E | Lee | Line | 33.50 | 40.50 | 41.5 | | |
| Accum. | E | | 2 | W->E | Lee | Line | 33.50 | 40.50 | 19.4 | | |
| Accum. | E | | 2 | W->E | Lee | Line | 40.50 | 49.50 | 19.4 | | |
| Accum. | E | | 1 | W->E | Lee | Line | 40.50 | 49.50 | 41.5 | | |
| Accum. | W | | 1 | E->W | Lee | Line | 33.50 | 40.50 | 41.5 | | |
| Accum. | W | | 2 | E->W | Lee | Line | 33.50 | 40.50 | 19.4 | | |
| Accum. | W | | 1 | E->W | Lee | Line | 40.50 | 49.50 | 41.5 | | |
| Accum. | W | | 2 | E->W | Lee | Line | 40.50 | 49.50 | 19.4 | | |
| Accum. | E | | 1 | E->W | Wind | Line | 33.50 | 40.50 | 41.5 | | |
| Accum. | E | | 2 | E->W | Wind | Line | 33.50 | 40.50 | 17.2 | | |
| Accum. | E | | 2 | E->W | Wind | Line | 40.50 | 49.50 | 17.2 | | |
| Accum. | E | | 1 | E->W | Wind | Line | 40.50 | 49.50 | 41.5 | | |
| Accum. | S | | 2 | S->N | Wind | Line | 0.00 | 6.75 | 13.6 | 26.3 | |
| Accum. | S | | 1 | S->N | Wind | Line | 0.00 | 6.75 | 20.0 | 38.8 | |
| Accum. | S | | 1 | S->N | Wind | Line | 13.50 | 15.90 | 20.0 | | |
| Accum. | S | | 2 | S->N | Wind | Line | 13.50 | 15.90 | 13.6 | | |
| Accum. | N | | 1 | S->N | Lee | Line | 0.00 | 6.75 | 20.0 | 38.8 | |
| Accum. | N | | 2 | S->N | Lee | Line | 0.00 | 6.75 | 3.7 | 7.1 | |
| Accum. | N | | 2 | S->N | Lee | Line | 13.50 | 15.90 | 4.4 | | |
| Accum. | N | | 1 | S->N | Lee | Line | 13.50 | 15.90 | 20.0 | | |
| Accum. | S | | 1 | N->S | Lee | Line | 0.00 | 6.75 | 20.0 | 38.8 | |
| Accum. | S | | 2 | N->S | Lee | Line | 0.00 | 6.75 | 3.7 | 7.1 | |
| Accum. | S | | 1 | N->S | Lee | Line | 13.50 | 15.90 | 20.0 | | |
| Accum. | S | | 2 | N->S | Lee | Line | 13.50 | 15.90 | 4.4 | | |
| Accum. | N | | 1 | N->S | Wind | Line | 0.00 | 6.75 | 20.0 | 38.8 | |
| Accum. | N | | 2 | N->S | Wind | Line | 0.00 | 6.75 | 13.6 | 26.3 | |
| Accum. | N | | 2 | N->S | Wind | Line | 13.50 | 15.90 | 13.6 | | |
| Accum. | N | | 1 | N->S | Wind | Line | 13.50 | 15.90 | 20.0 | | |
| Block 1 | W | | 2 | W->E | Wind | Line | -1.00 | 0.00 | 3.7 | | |
| Block 1 | W | | 1 | W->E | Wind | Line | -1.00 | 0.00 | 21.5 | | |
| Block 1 | W | | 2 | W->E | Wind | Line | 0.00 | 33.50 | 17.2 | | |
| Block 1 | W | | 1 | W->E | Wind | Line | 0.00 | 33.50 | 41.5 | | |
| Block 1 | W | | 1 | W->E | Wind | Line | 49.50 | 50.50 | 21.5 | | |
| Block 1 | W | | 2 | W->E | Wind | Line | 49.50 | 50.50 | 3.7 | | |
| Block 1 | E | | 2 | W->E | Lee | Line | -1.00 | 0.00 | 11.0 | | |
| Block 1 | E | | 1 | W->E | Lee | Line | -1.00 | 0.00 | 21.5 | | |
| Block 1 | E | | 2 | W->E | Lee | Line | 0.00 | 33.50 | 19.4 | | |
| Block 1 | E | | 1 | W->E | Lee | Line | 0.00 | 33.50 | 41.5 | | |
| Block 1 | E | | 2 | W->E | Lee | Line | 49.50 | 50.50 | 11.0 | | |
| Block 1 | E | | 1 | W->E | Lee | Line | 49.50 | 50.50 | 21.5 | | |
| Block 1 | W | | 1 | E->W | Lee | Line | -1.00 | 0.00 | 21.5 | | |
| Block 1 | W | | 2 | E->W | Lee | Line | -1.00 | 0.00 | 11.0 | | |
| Block 1 | W | | 2 | E->W | Lee | Line | 0.00 | 33.50 | 19.4 | | |
| Block 1 | W | | 1 | E->W | Lee | Line | 0.00 | 33.50 | 41.5 | | |
| Block 1 | W | | 2 | E->W | Lee | Line | 49.50 | 50.50 | 11.0 | | |
| Block 1 | W | | 1 | E->W | Lee | Line | 49.50 | 50.50 | 21.5 | | |
| Block 1 | E | | 2 | E->W | Wind | Line | -1.00 | 0.00 | 3.7 | | |
| Block 1 | E | | 1 | E->W | Wind | Line | -1.00 | 0.00 | 21.5 | | |
| Block 1 | E | | 1 | E->W | Wind | Line | 0.00 | 33.50 | 41.5 | | |
| Block 1 | E | | 2 | E->W | Wind | Line | 0.00 | 33.50 | 17.2 | | |
| Block 1 | E | | 1 | E->W | Wind | Line | 49.50 | 50.50 | 21.5 | | |
| Block 1 | E | | 2 | E->W | Wind | Line | 49.50 | 50.50 | 3.7 | | |
| Block 1 | S | | 2 | S->N | Wind | Line | 6.75 | 13.50 | 26.3 | 13.6 | |
| Block 1 | S | | 1 | S->N | Wind | Line | 6.75 | 13.50 | 38.8 | 20.0 | |
| Block 1 | N | | 2 | S->N | Lee | Line | 6.75 | 13.50 | 7.1 | 3.7 | |
| Block 1 | N | | 1 | S->N | Lee | Line | 6.75 | 13.50 | 38.8 | 20.0 | |
| Block 1 | S | | 2 | N->S | Lee | Line | 6.75 | 13.50 | 7.1 | 3.7 | |
| Block 1 | S | | 1 | N->S | Lee | Line | 6.75 | 13.50 | 38.8 | 20.0 | |
| Block 1 | N | | 1 | N->S | Wind | Line | 6.75 | 13.50 | 38.8 | 20.0 | |
| Block 1 | N | | 2 | N->S | Wind | Line | 6.75 | 13.50 | 26.3 | 13.6 | |

**WIND SHEAR LOADS (overlapping loads combined)**
**( continued)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Block 3 | S | 2 | S->N | Wind | Line | -2.40 | 0.00 | 13.6 |
| Block 3 | S | 1 | S->N | Wind | Line | -2.40 | 0.00 | 20.0 |
| Block 3 | N | 2 | S->N | Lee | Line | -2.40 | 0.00 | 4.4 |
| Block 3 | N | 1 | S->N | Lee | Line | -2.40 | 0.00 | 20.0 |
| Block 3 | S | 2 | N->S | Lee | Line | -2.40 | 0.00 | 4.4 |
| Block 3 | S | 1 | N->S | Lee | Line | -2.40 | 0.00 | 20.0 |
| Block 3 | N | 1 | N->S | Wind | Line | -2.40 | 0.00 | 20.0 |
| Block 3 | N | 2 | N->S | Wind | Line | -2.40 | 0.00 | 13.6 |

*Block - Block used in load generation, Accum. = loads from one block combined with another, Manual = user-entered loads (so no block); F - Building face (north, south, east or west); Element - building surface on which loads generated or entered; Load Case - ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal; Surf Dir - Windward or leeward side of the building; Prof - Profile (distribution); Location - start and end points on building element; Magnitude - Start = intensity of uniform and point loads or leftmost intensity of trapezoidal load, end = right intensity of trap load; Trib Ht - Tributary height of user-applied area loads only*
*Loads on the North, East, South, West face(s) based on 10 psf minimum wind pressure as per ASCE 7-02 Section 6.1.4.1.*

**WIND C&C LOADS**

| Block | Building Face | Level | Magnitude [psf] Interior | End Zone |
|---|---|---|---|---|
| Block 1 | West | 1 | 10.0 | 10.5 |
| Block 1 | East | 1 | 10.0 | 10.5 |
| Block 1 | South | 1 | 10.0 | 10.5 |
| Block 1 | North | 1 | 10.0 | 10.5 |
| Block 2 | East | 1 | 10.0 | 10.0 |
| Block 2 | South | 1 | 10.0 | 10.0 |
| Block 2 | North | 1 | 10.0 | 10.0 |
| Block 3 | West | 1 | 10.0 | 10.0 |
| Block 3 | South | 1 | 10.0 | 10.0 |
| Block 3 | North | 1 | 10.0 | 10.0 |

**BUILDING MASSES**

| Level 1 Force Dir | Building Element | Block | Wall Line | Profile | Location [ft] Start | Location [ft] End | Magnitude [lbs,plf,psf] Start | Magnitude [lbs,plf,psf] End | Trib Width [ft] |
|---|---|---|---|---|---|---|---|---|---|
| E-W | Roof | Block 1 | 2 | Line | -1.00 | 50.50 | 77.5 | 77.5 | |
| E-W | Roof | Block 1 | 3 | Line | -1.00 | 50.50 | 77.5 | 77.5 | |
| E-W | Roof | Block 2 | 3 | Line | 32.50 | 41.50 | 12.5 | 12.5 | |
| E-W | Roof | Block 2 | | Line | 32.50 | 41.50 | 22.5 | 22.5 | |
| E-W | Roof | Block 3 | 1 | Line | 32.50 | 41.25 | 22.0 | 22.0 | |
| E-W | Roof | Block 3 | 2 | Line | 32.50 | 41.25 | 12.0 | 12.0 | |
| N-S | Roof | Block 1 | A | Line | -1.00 | 14.50 | 257.5 | 257.5 | |
| N-S | Roof | Block 1 | F | Line | -1.00 | 14.50 | 257.5 | 257.5 | |
| N-S | Roof | Block 2 | D | Line | 13.50 | 17.00 | 45.0 | 45.0 | |
| N-S | Roof | Block 2 | E | Line | 13.50 | 17.00 | 45.0 | 45.0 | |
| N-S | Roof | Block 3 | D | Line | -3.40 | 0.00 | 43.8 | 43.8 | |
| N-S | Roof | Block 3 | | Line | -3.40 | 0.00 | 43.8 | 43.8 | |
| N-S | L Gable | Block 1 | A | Line | 0.00 | 6.75 | 37.5 | 0.0 | |
| N-S | R Gable | Block 1 | A | Line | 6.75 | 13.50 | 0.0 | 37.5 | |
| N-S | R Gable | Block 1 | F | Line | 0.00 | 6.75 | 37.5 | 0.0 | |
| N-S | L Gable | Block 1 | F | Line | 6.75 | 13.50 | 0.0 | 37.5 | |
| Both | Wall 1-1 | n/a | 1 | Line | 33.50 | 40.50 | 40.0 | 40.0 | |
| Both | Wall 2-1 | n/a | 2 | Line | 0.00 | 33.50 | 40.0 | 40.0 | |
| Both | Wall 2-2 | n/a | 2 | Line | 40.50 | 49.50 | 40.0 | 40.0 | |
| Both | Wall 3-1 | n/a | 3 | Line | 0.00 | 33.50 | 40.0 | 40.0 | |
| Both | Wall 3-2 | n/a | 3 | Line | 40.50 | 49.50 | 40.0 | 40.0 | |
| Both | Wall 4-1 | n/a | 4 | Line | 33.50 | 40.50 | 40.0 | 40.0 | |
| Both | Wall A-1 | n/a | A | Line | 0.00 | 13.50 | 40.0 | 40.0 | |
| Both | Wall D-1 | n/a | D | Line | -2.40 | 0.00 | 40.0 | 40.0 | |
| Both | Wall D-3 | n/a | D | Line | 13.50 | 15.90 | 40.0 | 40.0 | |
| Both | Wall E-1 | n/a | E | Line | -2.40 | 0.00 | 40.0 | 40.0 | |
| Both | Wall E-3 | n/a | E | Line | 13.50 | 15.90 | 40.0 | 40.0 | |
| Both | Wall F-1 | n/a | F | Line | 0.00 | 13.50 | 40.0 | 40.0 | |

*Force direction - Direction in which the mass is used for seismic load generation, E-W, N-S, or Both; Building element - Roof, gable end, wall or floor area used to generate mass, wall line for user-applied masses, Floor D# - refer to plan view for floor area number; Wall line - For generated masses, shearline that equivalent line load is assigned to, or line that user-applied mass is applied to - Location - Start and end points of equivalent line load on wall line; Trib Width. - for user applied area loads only*

**SEISMIC LOADS**

| Level 1 Force Dir | Profile | Location [ft] Start | Location [ft] End | Mag [lbs,plf,psf] Start | Mag [lbs,plf,psf] End |
|---|---|---|---|---|---|
| E-W | Line | -1.00 | 0.00 | 46.5 | 46.5 |
| E-W | Point | 0.00 | 0.00 | 238 | 238 |
| E-W | Line | 0.00 | 32.50 | 70.5 | 70.5 |
| E-W | Line | 32.50 | 33.50 | 91.2 | 91.2 |
| E-W | Point | 33.50 | 33.50 | 58 | 58 |
| E-W | Line | 33.50 | 40.50 | 91.2 | 91.2 |
| E-W | Point | 40.50 | 40.50 | 58 | 58 |
| E-W | Line | 40.50 | 41.25 | 91.2 | 91.2 |
| E-W | Line | 41.25 | 41.50 | 81.0 | 81.0 |
| E-W | Line | 41.50 | 49.50 | 70.5 | 70.5 |
| E-W | Point | 49.50 | 49.50 | 238 | 238 |
| E-W | Line | 49.50 | 50.50 | 46.5 | 46.5 |
| N-S | Line | -3.40 | -2.40 | 26.3 | 26.3 |
| N-S | Point | -2.40 | -2.40 | 84 | 84 |
| N-S | Line | -2.40 | -1.00 | 50.3 | 50.3 |
| N-S | Line | -1.00 | 0.00 | 204.8 | 204.8 |
| N-S | Point | 0.00 | 0.00 | 510 | 510 |
| N-S | Line | 0.00 | 6.75 | 178.5 | 201.0 |
| N-S | Line | 6.75 | 13.50 | 201.0 | 178.5 |
| N-S | Point | 13.50 | 13.50 | 510 | 510 |
| N-S | Line | 13.50 | 14.50 | 205.5 | 205.5 |
| N-S | Line | 14.50 | 15.90 | 51.0 | 51.0 |
| N-S | Point | 15.90 | 15.90 | 84 | 84 |
| N-S | Line | 15.90 | 17.00 | 27.0 | 27.0 |

*Loads in table can be accumulation of loads from several building masses, so they do not correspond with a particular building element. Location - Start and end of load in direction perpendicular to seismic force direction*
*All loads entered by the user or generated by program are specified (unfactored) loads.The program will apply a load factor of 0.70 and reliability/redundancy factor to seismic loads before distributing them to the shearlines.*

## Flexible Diaphragm Wind Design

**SHEAR RESULTS**

| North-South Shearlines | W Gp | For Dir | Ld. Case | Shear Force [plf] V [lbs] | V/L | V/FHS | Allowable Shear [plf] Int | Ext | Co | C | Total | V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | |
| Ln1, Lev1 | 4 | Both | 1 | 48 | 6.9 | 6.9 | 592 | 592 | 1.00 | X | 1185 | 8295 | 0.01 |
| **Line 2** | | | | | | | | | | | | | |
| Ln2, Lev1 | 5 | Both | 1 | 445 | 9.0 | 44.5 | 592 | 592 | 1.00 | X | 1185 | 11850 | 0.04 |
| Wall 2-2 | 5 | Both | 1 | | - | | 592 | 592 | 1.00 | | 1185 | 0.0 | - |
| Wall 2-1 | 5 | Both | 1 | 445 | - | 44.5 | 592 | 592 | 1.00 | | 1185 | 11850 | 0.04 |
| **Line 3** | | | | | | | | | | | | | |
| Ln3, Lev1 | 5 | Both | 1 | 445 | 9.0 | 24.0 | 592 | 592 | 1.00 | X | 1185 | 21922 | 0.02 |
| Wall 3-2 | 5 | Both | 1 | 144 | - | 24.0 | 592 | 592 | 1.00 | | 1185 | 7110 | 0.02 |
| Wall 3-1 | 5 | Both | 1 | 300 | - | 24.0 | 592 | 592 | 1.00 | | 1185 | 14812 | 0.02 |
| **Line 4** | | | | | | | | | | | | | |
| Ln4, Lev1 | 4 | Both | 1 | 48 | 6.9 | 6.9 | 592 | 592 | 1.00 | X | 1185 | 8295 | 0.01 |

| East-West Shearlines | W Gp | For Dir | Ld. Case | Shear Force [plf] V [lbs] | V/L | V/FHS | Allowable Shear [plf] Int | Ext | Co | C | Total | V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | |
| LnA, Lev1 | 1 | Both | 1 | 542 | 40.1 | 67.7 | 592 | 592 | 1.00 | X | 1185 | 9480 | 0.06 |
| **Line B** | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | Both | 1 | 914 | 67.7 | 67.7 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.06 |
| **Line C** | | | | | | | | | | | | | |
| LnC, Lev1 | 2 | Both | 1 | 893 | 66.2 | 66.2 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.06 |
| **Line D** | | | | | | | | | | | | | |
| LnD, Lev1 | 3 | Both | 1 | 769 | 42.0 | 56.9 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.16 |
| Wall D-3 | 3 | Both | 1 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-1 | 3 | Both | 1 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-2 | 3 | Both | 1 | 769 | - | 56.9 | 175 | 175 | 1.00 | | 350 | 4725 | 0.16 |
| **Line E** | | | | | | | | | | | | | |
| LnE, Lev1 | 3 | Both | 1 | 665 | 36.3 | 49.2 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.14 |
| Wall E-3 | 3 | Both | 1 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-1 | 3 | Both | 1 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-2 | 3 | Both | 1 | 665 | - | 49.2 | 175 | 175 | 1.00 | | 350 | 4725 | 0.14 |
| **Line F** | | | | | | | | | | | | | |
| LnF, Lev1 | 1 | Both | 1 | 417 | 30.9 | 30.9 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.03 |

*W Grp - Wall group as listed in Materials table; For Dir - force direction, always "both" ; H/W factor - Factor due to shearwall height-to-width ratio for interior and exterior wall sheathing; V - Factored shear force applied to entire line and amount taken by each wall; V/L - Diaphragm shear force = factored shearline force divided by length of shearline;*
*Following values marked with * means that value for shearline is the one for wall with critical design response on line; V/FHS* - Design shear force = factored shear force per unit full height sheathing, Int* - Unit shear capacity of interior sheathing; Ext* - Unit shear capacity of exterior sheathing Co* - Perforation factor; C - Sheathing combination rule, A = Add capacities, S = Strongest side only, X = Strongest side or twice weakest; Total* - Combined unit shear capacity inc. perforation factor and H/W factor; V - Combined shear capacity of wall or total capacity of shearline ; Crit Resp* - Critical response = Vapp/FHS/Vcap = design shear force/unit shear capacity*

**DRAGSTRUT AND HOLDDOWN FORCES**

| Level 1 Line-Wall | Position on Wall or Opening | Location [ft] X | Location [ft] Y | Ld. Case | Tensile Holddown Force [lbs] Shear | Dead | Uplift | Cmb'd | Dragstrut Force [lbs] |
|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | |
| 1-1 | Left Wall End | -2.40 | 33.75 | 1 | 55 | | | 55 | |
| 1-1 | Right Wall End | -2.40 | 40.25 | 1 | 55 | | | 55 | |
| **Line 2** | | | | | | | | | |
| 2-1 | Right Opening 2 | 0.00 | 22.25 | 1 | 356 | | | 356 | |
| 2-1 | Left Wall End | 0.00 | 0.25 | 1 | 356 | | | 356 | |
| 2-1 | Left Opening 1 | 0.00 | 2.75 | 1 | 356 | | | 356 | |
| 2-1 | Right Opening 1 | 0.00 | 9.25 | 1 | 356 | | | 356 | |
| 2-1 | Left Opening 2 | 0.00 | 11.75 | 1 | 356 | | | 356 | |
| 2-1 | Left Opening 3 | 0.00 | 25.75 | 1 | 356 | | | 356 | |
| 2-1 | Left Opening 1 | 0.00 | 3.00 | 1 | | | | | 106 |
| 2-1 | Right Opening 1 | 0.00 | 9.00 | 1 | | | | | 53 |
| 2-1 | Left Opening 2 | 0.00 | 12.00 | 1 | | | | | 159 |
| 2-1 | Right Opening 2 | 0.00 | 22.00 | 1 | | | | | 69 |
| 2-1 | Left Opening 3 | 0.00 | 26.00 | 1 | | | | | 211 |
| **Line 3** | | | | | | | | | |
| 3-1 | Right Opening 2 | 13.50 | 8.25 | 1 | 192 | | | 192 | |
| 3-1 | Left Opening 3 | 13.50 | 11.75 | 1 | 192 | | | 192 | |
| 3-1 | Right Opening 3 | 13.50 | 22.25 | 1 | 192 | | | 192 | |
| 3-1 | Left Opening 4 | 13.50 | 25.75 | 1 | 192 | | | 192 | |
| 3-1 | Right Opening 4 | 13.50 | 29.25 | 1 | 192 | | | 192 | |
| 3-1 | Right Wall End | 13.50 | 33.25 | 1 | 192 | | | 192 | |
| 3-2 | Left Wall End | 13.50 | 40.75 | 1 | 192 | | | 192 | |
| 3-2 | Left Opening 1 | 13.50 | 43.25 | 1 | 192 | | | 192 | |
| 3-2 | Right Opening 1 | 13.50 | 46.75 | 1 | 192 | | | 192 | |
| 3-2 | Right Wall End | 13.50 | 49.25 | 1 | 192 | | | 192 | |
| 3-2 | Left Wall End | 13.50 | 40.50 | 1 | | | | | 63 |
| 3-2 | Left Opening 1 | 13.50 | 43.50 | 1 | | | | | 18 |
| 3-2 | Right Opening 1 | 13.50 | 46.50 | 1 | | | | | 45 |
| 3-1 | Right Wall End | 13.50 | 33.50 | 1 | | | | | 0 |
| 3-1 | Right Opening 2 | 13.50 | 8.00 | 1 | | | | | 72 |
| 3-1 | Left Opening 3 | 13.50 | 12.00 | 1 | | | | | 12 |
| 3-1 | Right Opening 3 | 13.50 | 22.00 | 1 | | | | | 101 |
| 3-1 | Left Opening 4 | 13.50 | 26.00 | 1 | | | | | 41 |
| 3-1 | Right Opening 4 | 13.50 | 29.00 | 1 | | | | | 68 |
| **Line 4** | | | | | | | | | |
| 4-1 | Left Wall End | 15.90 | 33.75 | 1 | 55 | | | 55 | |
| 4-1 | Right Wall End | 15.90 | 40.25 | 1 | 55 | | | 55 | |
| **Line A** | | | | | | | | | |
| A-1 | Left Wall End | 0.25 | 0.00 | 1 | 542 | | | 542 | |
| A-1 | Left Opening 1 | 7.75 | 0.00 | 1 | 542 | | | 542 | |
| A-1 | Left Opening 1 | 8.00 | 0.00 | 1 | | | | | 221 |
| **Line B** | | | | | | | | | |
| B-1 | Left Wall End | 0.25 | 12.00 | 1 | 542 | | | 542 | |
| B-1 | Right Wall End | 13.25 | 12.00 | 1 | 542 | | | 542 | |
| **Line C** | | | | | | | | | |
| C-1 | Left Wall End | 0.25 | 22.00 | 1 | 529 | | | 529 | |
| C-1 | Right Wall End | 13.25 | 22.00 | 1 | 529 | | | 529 | |
| **Line D** | | | | | | | | | |
| D-2 | Left Wall End | 0.25 | 33.50 | 1 | 455 | | | 455 | |
| D-2 | Right Wall End | 13.25 | 33.50 | 1 | 455 | | | 455 | |
| **Line E** | | | | | | | | | |
| E-2 | Left Wall End | 0.25 | 40.50 | 1 | 394 | | | 394 | |
| E-2 | Right Wall End | 13.25 | 40.50 | 1 | 394 | | | 394 | |
| **Line F** | | | | | | | | | |
| F-1 | Left Wall End | 0.25 | 49.50 | 1 | 247 | | | 247 | |
| F-1 | Right Wall End | 13.25 | 49.50 | 1 | 247 | | | 247 | |

*Line-Wall - Shearline for forces carried by vertical elements, wall for forces at wall or opening ends; Position...- Vert. element = column or strengthened studs req'dotherwise indicates stud location at wall end or opening;. Location - Co-ordinates in Plan View; Ld. Case - Results are for critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal; Shear - Factored wind shear overturning component ; Dead - Unfactored dead load resisting component; Uplift - Uplift wind load component; Cmb'd - Sum of factored overturning, dead and uplift forces; Dragstrut Force - Factored drag strut force at opening headers and gaps in walls along shearline*

*Note:*

*This table includes tension holddown forces only.*

*Dead load contribution to combined force is factored by 0.60 load combination factor*

## Rigid Diaphragm Wind Design

*Rigid analysis performed using Case 2 loading in ASCE 7-02 Fig 6-9, using only the eccentricity prescribed to generate a torsional moment. For analysis using Case 1 loading, change the Rigid Diaphragm Analysis Design Setting, regenerate loads, and redesign.*

**SHEAR RESULTS**

| North-South Shearlines | W Gp | For Dir | Ld. Case | Shear Force [plf] V [lbs] | V/L | V/FHS | Allowable Shear [plf] Int | Ext | Co | C | Total | V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | |
| Ln1, Lev1 | 4 | Both | 2 | 76 | 10.8 | 10.8 | 592 | 592 | 1.00 | X | 1185 | 8295 | 0.01 |
| **Line 2** | | | | | | | | | | | | | |
| Ln2, Lev1 | 5 | Both | 2 | 106 | 2.1 | 10.6 | 592 | 592 | 1.00 | X | 1185 | 11850 | 0.01 |
| Wall 2-2 | 5 | Both | 2 | | - | | 592 | 592 | 1.00 | | 1185 | 0.0 | - |
| Wall 2-1 | 5 | Both | 2 | 106 | - | 10.6 | 592 | 592 | 1.00 | | 1185 | 11850 | 0.01 |
| **Line 3** | | | | | | | | | | | | | |
| Ln3, Lev1 | 5 | Both | 2 | 193 | 3.9 | 10.4 | 592 | 592 | 1.00 | X | 1185 | 21922 | 0.01 |
| Wall 3-2 | 5 | Both | 2 | 63 | - | 10.4 | 592 | 592 | 1.00 | | 1185 | 7110 | 0.01 |
| Wall 3-1 | 5 | Both | 2 | 131 | - | 10.4 | 592 | 592 | 1.00 | | 1185 | 14812 | 0.01 |
| **Line 4** | | | | | | | | | | | | | |
| Ln4, Lev1 | 4 | Both | 2 | 74 | 10.6 | 10.6 | 592 | 592 | 1.00 | X | 1185 | 8295 | 0.01 |

| East-West Shearlines | W Gp | For Dir | Ld. Case | Shear Force [plf] V [lbs] | V/L | V/FHS | Allowable Shear [plf] Int | Ext | Co | C | Total | V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | |
| LnA, Lev1 | 1 | Both | 2 | 411 | 30.5 | 51.4 | 592 | 592 | 1.00 | X | 1185 | 9480 | 0.04 |
| **Line B** | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | Both | 2 | 573 | 42.5 | 42.5 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.04 |
| **Line C** | | | | | | | | | | | | | |
| LnC, Lev1 | 2 | Both | 2 | 473 | 35.0 | 35.0 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.03 |
| **Line D** | | | | | | | | | | | | | |
| LnD, Lev1 | 3 | Both | 2 | 155 | 8.5 | 11.5 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.03 |
| Wall D-3 | 3 | Both | 2 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-1 | 3 | Both | 2 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-2 | 3 | Both | 2 | 155 | - | 11.5 | 175 | 175 | 1.00 | | 350 | 4725 | 0.03 |
| **Line E** | | | | | | | | | | | | | |
| LnE, Lev1 | 3 | Both | 2 | 176 | 9.6 | 13.0 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.04 |
| Wall E-3 | 3 | Both | 2 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-1 | 3 | Both | 2 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-2 | 3 | Both | 2 | 176 | - | 13.0 | 175 | 175 | 1.00 | | 350 | 4725 | 0.04 |
| **Line F** | | | | | | | | | | | | | |
| LnF, Lev1 | 1 | Both | 2 | 685 | 50.7 | 50.7 | 592 | 592 | 1.00 | X | 1185 | 15997 | 0.04 |

*W Grp - Wall group as listed in Materials table; For Dir - force direction, always "both" ; H/W factor - Factor due to shearwall height-to-width ratio for interior and exterior wall sheathing; V - Factored shear force applied to entire line and amount taken by each wall; V/L - Diaphragm shear force = factored shearline force divided by length of shearline;*
*Following values marked with * means that value for shearline is the one for wall with critical design response on line; V/FHS* - Design shear force = factored shear force per unit full height sheathing, Int* - Unit shear capacity of interior sheathing; Ext* - Unit shear capacity of exterior sheathing Co* - Perforation factor; C - Sheathing combination rule, A = Add capacities, S = Strongest side only, X = Strongest side or twice weakest; Total* - Combined unit shear capacity inc. perforation factor and H/W factor; V - Combined shear capacity of wall or total capacity of shearline ; Crit Resp* - Critical response = Vapp/FHS/Vcap = design shear force/unit shear capacity*

**DRAGSTRUT AND HOLDDOWN FORCES**

| Level 1 Line-Wall | Position on Wall or Opening | Location [ft] X | Location [ft] Y | Ld. Case | Tensile Holddown Force [lbs] Shear | Dead | Uplift | Cmb'd | Dragstrut Force [lbs] |
|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | |
| 1-1 | Right Wall End | -2.40 | 40.25 | 2 | 86 | | | 86 | |
| 1-1 | Left Wall End | -2.40 | 33.75 | 2 | 86 | | | 86 | |
| **Line 2** | | | | | | | | | |
| 2-1 | Left Wall End | 0.00 | 0.25 | 2 | 85 | | | 85 | |
| 2-1 | Left Opening 1 | 0.00 | 2.75 | 2 | 85 | | | 85 | |
| 2-1 | Right Opening 1 | 0.00 | 9.25 | 2 | 85 | | | 85 | |
| 2-1 | Left Opening 2 | 0.00 | 11.75 | 2 | 85 | | | 85 | |
| 2-1 | Right Opening 2 | 0.00 | 22.25 | 2 | 85 | | | 85 | |
| 2-1 | Left Opening 3 | 0.00 | 25.75 | 2 | 85 | | | 85 | |
| 2-1 | Left Opening 1 | 0.00 | 3.00 | 2 | | | | | 25 |
| 2-1 | Right Opening 1 | 0.00 | 9.00 | 2 | | | | | 13 |
| 2-1 | Left Opening 2 | 0.00 | 12.00 | 2 | | | | | 38 |
| 2-1 | Right Opening 2 | 0.00 | 22.00 | 2 | | | | | 17 |
| 2-1 | Left Opening 3 | 0.00 | 26.00 | 2 | | | | | 50 |
| **Line 3** | | | | | | | | | |
| 3-1 | Right Opening 2 | 13.50 | 8.25 | 2 | 84 | | | 84 | |
| 3-1 | Left Opening 3 | 13.50 | 11.75 | 2 | 84 | | | 84 | |
| 3-1 | Right Opening 3 | 13.50 | 22.25 | 2 | 84 | | | 84 | |
| 3-1 | Left Opening 4 | 13.50 | 25.75 | 2 | 84 | | | 84 | |
| 3-1 | Right Opening 4 | 13.50 | 29.25 | 2 | 84 | | | 84 | |
| 3-1 | Right Wall End | 13.50 | 33.25 | 2 | 84 | | | 84 | |
| 3-2 | Left Wall End | 13.50 | 40.75 | 2 | 84 | | | 84 | |
| 3-2 | Left Opening 1 | 13.50 | 43.25 | 2 | 84 | | | 84 | |
| 3-2 | Right Opening 1 | 13.50 | 46.75 | 2 | 84 | | | 84 | |
| 3-2 | Right Wall End | 13.50 | 49.25 | 2 | 84 | | | 84 | |
| 3-2 | Left Wall End | 13.50 | 40.50 | 2 | | | | | 28 |
| 3-2 | Left Opening 1 | 13.50 | 43.50 | 2 | | | | | 8 |
| 3-2 | Right Opening 1 | 13.50 | 46.50 | 2 | | | | | 20 |
| 3-1 | Right Wall End | 13.50 | 33.50 | 2 | | | | | 0 |
| 3-1 | Right Opening 2 | 13.50 | 8.00 | 2 | | | | | 31 |
| 3-1 | Left Opening 3 | 13.50 | 12.00 | 2 | | | | | 5 |
| 3-1 | Right Opening 3 | 13.50 | 22.00 | 2 | | | | | 44 |
| 3-1 | Left Opening 4 | 13.50 | 26.00 | 2 | | | | | 18 |
| 3-1 | Right Opening 4 | 13.50 | 29.00 | 2 | | | | | 30 |
| **Line 4** | | | | | | | | | |
| 4-1 | Right Wall End | 15.90 | 40.25 | 2 | 85 | | | 85 | |
| 4-1 | Left Wall End | 15.90 | 33.75 | 2 | 85 | | | 85 | |
| **Line A** | | | | | | | | | |
| A-1 | Left Wall End | 0.25 | 0.00 | 2 | 411 | | | 411 | |
| A-1 | Left Opening 1 | 7.75 | 0.00 | 2 | 411 | | | 411 | |
| A-1 | Left Opening 1 | 8.00 | 0.00 | 2 | | | | | 167 |
| **Line B** | | | | | | | | | |
| B-1 | Right Wall End | 13.25 | 12.00 | 2 | 340 | | | 340 | |
| B-1 | Left Wall End | 0.25 | 12.00 | 2 | 340 | | | 340 | |
| **Line C** | | | | | | | | | |
| C-1 | Right Wall End | 13.25 | 22.00 | 2 | 280 | | | 280 | |
| C-1 | Left Wall End | 0.25 | 22.00 | 2 | 280 | | | 280 | |
| **Line D** | | | | | | | | | |
| D-2 | Right Wall End | 13.25 | 33.50 | 2 | 92 | | | 92 | |
| D-2 | Left Wall End | 0.25 | 33.50 | 2 | 92 | | | 92 | |
| **Line E** | | | | | | | | | |
| E-2 | Right Wall End | 13.25 | 40.50 | 2 | 104 | | | 104 | |
| E-2 | Left Wall End | 0.25 | 40.50 | 2 | 104 | | | 104 | |
| **Line F** | | | | | | | | | |
| F-1 | Right Wall End | 13.25 | 49.50 | 2 | 406 | | | 406 | |
| F-1 | Left Wall End | 0.25 | 49.50 | 2 | 406 | | | 406 | |

*Line-Wall - Shearline for forces carried by vertical elements, wall for forces at wall or opening ends; Position...- Vert. element = column or strengthened studs req'dotherwise indicates stud location at wall end or opening;. Location - Co-ordinates in Plan View; Ld. Case - Results are for critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal; Shear - Factored wind shear overturning component ; Dead - Unfactored dead load resisting component; Uplift - Uplift wind load component; Cmb'd - Sum of factored overturning, dead and uplift forces; Dragstrut Force - Factored drag strut force at opening headers and gaps in walls along shearline*

*Note:*

*This table includes tension holddown forces only.*

*Dead load contribution to combined force is factored by 0.60 load combination factor*

## Wind Suction Design

**COMPONENTS AND CLADDING by SHEARLINE**

| North-South Shearlines | | | Sheathing [psf] | | | Fastener Withdrawal [lbs] | | | | | Service Cond Factors | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Force | Cap | Force/ | Force | | Cap | Force/Cap | | | |
| Line | Lev | Grp | | | Cap | End | Int | | End | Int | Temp | Moist |
| 1 | 1 | 4 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |
| 2 | 1 | 5 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |
| 3 | 1 | 5 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |
| 4 | 1 | 4 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |

| East-West Shearlines | | | Sheathing [psf] | | | Fastener Withdrawal [lbs] | | | | | Service Cond Factors | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Force | Cap | Force/ | Force | | Cap | Force/Cap | | | |
| Line | Lev | Grp | | | Cap | End | Int | | End | Int | Temp | Moist |
| A | 1 | 1 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |
| D | 1 | 3 | 10.5 | 0.0 | | 4 | 3 | 93 | 0.04 | 0.04 | 1.00 | 1.00 |
| E | 1 | 3 | 10.5 | 0.0 | | 4 | 3 | 93 | 0.04 | 0.04 | 1.00 | 1.00 |
| F | 1 | 1 | 10.5 | 30.4 | 0.35 | | | | | | 1.00 | 1.00 |

*Grp - Wall Design Group, results for design groups for rigid, flexible design listed for each wall; Sheathing: Force - Unit area end zone C&C load, Cap - Out-of-plane bending capacity of exterior sheathing assuming continuous over 3 studs; Fastener Withdrawal: Force - Force tributary to each nail in end zone and interior zone; Cap - Factored withdrawal capacity of individual fastener according to NDS 11.2-3*
**WARNING - Sheathing design capacity has been exceeded for flexible design and rigid design*

## Flexible Diaphragm Seismic Design

### SEISMIC INFORMATION

| | Building Mass [lbs] | Area [sq.ft] | Story Shear [lbs] E-W | Story Shear [lbs] N-S | Shear Ratio Rmax E-W | Shear Ratio Rmax N-S | Reliability Factor p E-W | Reliability Factor p N-S |
|---|---|---|---|---|---|---|---|---|
| **Level 1** | 14526 | 702 | 4358 | 4358 | - | - | - | - |
| **Structure** | **14526** | **-** | **4358** | **4358** | **-** | **-** | **1.00** | **1.00** |

*Vertical Earthquake Load Ev = 0.2 Sds D; Sds = 0.60; Ev = 0.12 D*

### SHEAR RESULTS

| North-South Shearlines | W Gp | For Dir | H/W Fact. Int | H/W Fact. Ext | Shear Force [plf] V [lbs] | Shear Force [plf] V/L | Shear Force [plf] V/FHS | Allowable Shear [plf] Int | Allowable Shear [plf] Ext | Allowable Shear [plf] Co | Allowable Shear [plf] C | Allowable Shear [plf] Total | Allowable Shear [plf] V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| Ln1, Lev1 | 4 | Both | 1.0 | 1.0 | 142 | 20.3 | 20.3 | 423 | 423 | 1.00 | X | 846 | 5925 | 0.02 |
| **Line 2** | | | | | | | | | | | | | | |
| Ln2, Lev1 | 5 | Both | .75 | .75 | 1381 | 27.9 | 138.1 | 317 | 317 | 1.00 | X | 635 | 7194 | 0.22 |
| Wall 2-2 | 5 | Both | 1.0 | 1.0 | | - | | 317 | 317 | 1.00 | | 846 | 0.0 | - |
| Wall 2-1 | 5 | Both | .75 | .75 | 1381 | - | 138.1 | 317 | 317 | 1.00 | | 635 | 7194 | 0.22 |
| **Line 3** | | | | | | | | | | | | | | |
| Ln3, Lev1 | 5 | Both | .75 | .75 | 1382 | 27.9 | 74.7 | 317 | 317 | 1.00 | X | 635 | 14389 | 0.12 |
| Wall 3-2 | 5 | Both | .75 | .75 | 448 | - | 74.7 | 317 | 317 | 1.00 | | 635 | 3809 | 0.12 |
| Wall 3-1 | 5 | Both | 1.0 | 1.0 | 934 | - | 74.7 | 423 | 423 | 1.00 | | 846 | 10580 | 0.09 |
| **Line 4** | | | | | | | | | | | | | | |
| Ln4, Lev1 | 4 | Both | 1.0 | 1.0 | 145 | 20.7 | 20.7 | 423 | 423 | 1.00 | X | 846 | 5925 | 0.02 |

| East-West Shearlines | W Gp | For Dir | H/W Fact. Int | H/W Fact. Ext | Shear Force [plf] V [lbs] | Shear Force [plf] V/L | Shear Force [plf] V/FHS | Allowable Shear [plf] Int | Allowable Shear [plf] Ext | Allowable Shear [plf] Co | Allowable Shear [plf] C | Allowable Shear [plf] Total | Allowable Shear [plf] V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| LnA, Lev1 | 1 | Both | 1.0 | 1.0 | 495 | 36.7 | 61.9 | 423 | 423 | 1.00 | X | 846 | 6771 | 0.07 |
| **Line B** | | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | Both | 1.0 | 1.0 | 543 | 40.2 | 40.2 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.05 |
| **Line C** | | | | | | | | | | | | | | |
| LnC, Lev1 | 2 | Both | 1.0 | 1.0 | 531 | 39.3 | 39.3 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.05 |
| **Line D** | | | | | | | | | | | | | | |
| LnD, Lev1 | 3 | Both | 1.0 | 1.0 | 561 | 30.7 | 41.6 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.12 |
| Wall D-3 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-1 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-2 | 3 | Both | 1.0 | 1.0 | 561 | - | 41.6 | 175 | 175 | 1.00 | | 350 | 4725 | 0.12 |
| **Line E** | | | | | | | | | | | | | | |
| LnE, Lev1 | 3 | Both | 1.0 | 1.0 | 498 | 27.2 | 36.9 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.11 |
| Wall E-3 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-1 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-2 | 3 | Both | 1.0 | 1.0 | 498 | - | 36.9 | 175 | 175 | 1.00 | | 350 | 4725 | 0.11 |
| **Line F** | | | | | | | | | | | | | | |
| LnF, Lev1 | 1 | Both | 1.0 | 1.0 | 422 | 31.2 | 31.2 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.04 |

*W Grp - Wall group as listed in Materials table; For Dir - Direction of wind force along shearline; Ld. case - Critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal, all other results are for this load case; V - Factored shear force applied to entire line and amount taken by each wall; V/L - Diaphragm shear force = factored shearline force divided by length of shearline;*
*Following values marked with * means that value for shearline is the one for wall with critical design response on line; V/FHS* - Design shear force = factored shear force per unit full height sheathing, Int* - Unit shear capacity of interior sheathing; Ext* - Unit shear capacity of exterior sheathing Co* - Perforation factor; C - Sheathing combination rule, A = Add capacities, S = Strongest side only, X = Strongest side or twice weakest; Total* - Combined unit shear capacity inc. perforation factor; V - Combined shear capacity of wall or total capacity of shearline ; Crit Resp* - Critical response = Vapp/FHS/Vcap = design shear force/unit shear capacity*

**DRAGSTRUT AND HOLDDOWN FORCES**

| Level 1 Line-Wall | Position on Wall or Opening | Location [ft] X | Location [ft] Y | Tensile Holddown Force [lbs] Shear | Dead | Uplift | Cmb'd | Dragstrut Force [lbs] |
|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | |
| 1-1 | Left Wall End | -2.40 | 33.75 | 162 | | | 162 | |
| 1-1 | Right Wall End | -2.40 | 40.25 | 162 | | | 162 | |
| **Line 2** | | | | | | | | |
| 2-1 | Left Wall End | 0.00 | 0.25 | 1105 | | | 1105 | |
| 2-1 | Left Opening 1 | 0.00 | 2.75 | 1105 | | | 1105 | |
| 2-1 | Right Opening 1 | 0.00 | 9.25 | 1105 | | | 1105 | |
| 2-1 | Left Opening 2 | 0.00 | 11.75 | 1105 | | | 1105 | |
| 2-1 | Right Opening 2 | 0.00 | 22.25 | 1105 | | | 1105 | |
| 2-1 | Left Opening 3 | 0.00 | 25.75 | 1105 | | | 1105 | |
| 2-1 | Left Opening 1 | 0.00 | 3.00 | | | | | 331 |
| 2-1 | Right Opening 1 | 0.00 | 9.00 | | | | | 163 |
| 2-1 | Left Opening 2 | 0.00 | 12.00 | | | | | 494 |
| 2-1 | Right Opening 2 | 0.00 | 22.00 | | | | | 215 |
| 2-1 | Left Opening 3 | 0.00 | 26.00 | | | | | 656 |
| **Line 3** | | | | | | | | |
| 3-2 | Left Opening 1 | 13.50 | 43.25 | 598 | | | 598 | |
| 3-1 | Right Opening 2 | 13.50 | 8.25 | 598 | | | 598 | |
| 3-1 | Left Opening 3 | 13.50 | 11.75 | 598 | | | 598 | |
| 3-1 | Right Opening 3 | 13.50 | 22.25 | 598 | | | 598 | |
| 3-1 | Left Opening 4 | 13.50 | 25.75 | 598 | | | 598 | |
| 3-1 | Right Opening 4 | 13.50 | 29.25 | 598 | | | 598 | |
| 3-1 | Right Wall End | 13.50 | 33.25 | 598 | | | 598 | |
| 3-2 | Left Wall End | 13.50 | 40.75 | 598 | | | 598 | |
| 3-2 | Right Opening 1 | 13.50 | 46.75 | 598 | | | 598 | |
| 3-2 | Right Wall End | 13.50 | 49.25 | 598 | | | 598 | |
| 3-2 | Left Wall End | 13.50 | 40.50 | | | | | 197 |
| 3-2 | Left Opening 1 | 13.50 | 43.50 | | | | | 57 |
| 3-2 | Right Opening 1 | 13.50 | 46.50 | | | | | 140 |
| 3-1 | Right Wall End | 13.50 | 33.50 | | | | | 2 |
| 3-1 | Right Opening 2 | 13.50 | 8.00 | | | | | 223 |
| 3-1 | Left Opening 3 | 13.50 | 12.00 | | | | | 36 |
| 3-1 | Right Opening 3 | 13.50 | 22.00 | | | | | 315 |
| 3-1 | Left Opening 4 | 13.50 | 26.00 | | | | | 128 |
| 3-1 | Right Opening 4 | 13.50 | 29.00 | | | | | 212 |
| **Line 4** | | | | | | | | |
| 4-1 | Left Wall End | 15.90 | 33.75 | 166 | | | 166 | |
| 4-1 | Right Wall End | 15.90 | 40.25 | 166 | | | 166 | |
| **Line A** | | | | | | | | |
| A-1 | Left Wall End | 0.25 | 0.00 | 495 | | | 495 | |
| A-1 | Left Opening 1 | 7.75 | 0.00 | 495 | | | 495 | |
| A-1 | Left Opening 1 | 8.00 | 0.00 | | | | | 202 |
| **Line B** | | | | | | | | |
| B-1 | Left Wall End | 0.25 | 12.00 | 322 | | | 322 | |
| B-1 | Right Wall End | 13.25 | 12.00 | 322 | | | 322 | |
| **Line C** | | | | | | | | |
| C-1 | Left Wall End | 0.25 | 22.00 | 315 | | | 315 | |
| C-1 | Right Wall End | 13.25 | 22.00 | 315 | | | 315 | |
| **Line D** | | | | | | | | |
| D-2 | Left Wall End | 0.25 | 33.50 | 333 | | | 333 | |
| D-2 | Right Wall End | 13.25 | 33.50 | 333 | | | 333 | |
| **Line E** | | | | | | | | |
| E-2 | Left Wall End | 0.25 | 40.50 | 295 | | | 295 | |
| E-2 | Right Wall End | 13.25 | 40.50 | 295 | | | 295 | |
| **Line F** | | | | | | | | |
| F-1 | Left Wall End | 0.25 | 49.50 | 250 | | | 250 | |
| F-1 | Right Wall End | 13.25 | 49.50 | 250 | | | 250 | |

*Line-Wall - Shearline for forces carried by vertical elements, wall for forces at wall or opening ends; Position...- Vert. element = column or strengthened studs req'd, otherwise indicates stud location at wall end or opening; Location - Co-ordinates in Plan View; Ld. Case - Results are for critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal; Shear - Factored wind shear overturning component ; Dead - Unfactored dead load resisting component; Uplift - Not relevant to seismic design; Cmb'd - Sum of factored overturning, dead and vertical earthquake forces;Dragstrut Force - Factored drag strut force at opening headers and gaps in walls along shearline*

*Note:*

*This table includes tension holddown forces only.*

*Shearwall does not check for either plan or vertical structural irregularities.*

*Dead load contribution to combined force is factored by 0.516 due to load combination factor and vertical seismic force*

## Rigid Diaphragm Seismic Design

### SEISMIC INFORMATION

| | Building Mass [lbs] | Area [sq.ft] | Story Shear [lbs] E-W | Story Shear [lbs] N-S | Shear Ratio Rmax E-W | Shear Ratio Rmax N-S | Reliability Factor p E-W | Reliability Factor p N-S |
|---|---|---|---|---|---|---|---|---|
| **Level 1** | 14526 | 702 | 4358 | 4358 | - | - | - | - |
| **Structure** | **14526** | **-** | **4358** | **4358** | **-** | **-** | **1.00** | **1.00** |

*Vertical Earthquake Load Ev = 0.2 Sds D; Sds = 0.60; Ev = 0.12 D*

### SHEAR RESULTS

| North-South Shearlines | W Gp | For Dir | H/W Fact. Int | H/W Fact. Ext | Shear Force [plf] V [lbs] | Shear Force [plf] V/L | Shear Force [plf] V/FHS | Allowable Shear [plf] Int | Allowable Shear [plf] Ext | Allowable Shear [plf] Co | Allowable Shear [plf] C | Allowable Shear [plf] Total | Allowable Shear [plf] V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| Ln1, Lev1 | 4 | Both | 1.0 | 1.0 | 586 | 83.8 | 83.8 | 423 | 423 | 1.00 | X | 846 | 5925 | 0.10 |
| **Line 2** | | | | | | | | | | | | | | |
| Ln2, Lev1 | 5 | Both | .75 | .75 | 621 | 12.5 | 62.1 | 317 | 317 | 1.00 | X | 635 | 7194 | 0.10 |
| Wall 2-2 | 5 | Both | 1.0 | 1.0 | | - | | 317 | 317 | 1.00 | | 846 | 0.0 | - |
| Wall 2-1 | 5 | Both | .75 | .75 | 621 | - | 62.1 | 317 | 317 | 1.00 | | 635 | 7194 | 0.10 |
| **Line 3** | | | | | | | | | | | | | | |
| Ln3, Lev1 | 5 | Both | .75 | .75 | 1338 | 27.0 | 72.3 | 317 | 317 | 1.00 | X | 635 | 14389 | 0.11 |
| Wall 3-2 | 5 | Both | .75 | .75 | 434 | - | 72.3 | 317 | 317 | 1.00 | | 635 | 3809 | 0.11 |
| Wall 3-1 | 5 | Both | 1.0 | 1.0 | 904 | - | 72.3 | 423 | 423 | 1.00 | | 846 | 10580 | 0.09 |
| **Line 4** | | | | | | | | | | | | | | |
| Ln4, Lev1 | 4 | Both | 1.0 | 1.0 | 549 | 78.5 | 78.5 | 423 | 423 | 1.00 | X | 846 | 5925 | 0.09 |

| East-West Shearlines | W Gp | For Dir | H/W Fact. Int | H/W Fact. Ext | Shear Force [plf] V [lbs] | Shear Force [plf] V/L | Shear Force [plf] V/FHS | Allowable Shear [plf] Int | Allowable Shear [plf] Ext | Allowable Shear [plf] Co | Allowable Shear [plf] C | Allowable Shear [plf] Total | Allowable Shear [plf] V [lbs] | Crit. Resp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line A** | | | | | | | | | | | | | | |
| **Level 1** | | | | | | | | | | | | | | |
| LnA, Lev1 | 1 | Both | 1.0 | 1.0 | 500 | 37.0 | 62.5 | 423 | 423 | 1.00 | X | 846 | 6771 | 0.07 |
| **Line B** | | | | | | | | | | | | | | |
| LnB, Lev1 | 2 | Both | 1.0 | 1.0 | 772 | 57.2 | 57.2 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.07 |
| **Line C** | | | | | | | | | | | | | | |
| LnC, Lev1 | 2 | Both | 1.0 | 1.0 | 713 | 52.8 | 52.8 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.06 |
| **Line D** | | | | | | | | | | | | | | |
| LnD, Lev1 | 3 | Both | 1.0 | 1.0 | 301 | 16.5 | 22.3 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.06 |
| Wall D-3 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-1 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall D-2 | 3 | Both | 1.0 | 1.0 | 301 | - | 22.3 | 175 | 175 | 1.00 | | 350 | 4725 | 0.06 |
| **Line E** | | | | | | | | | | | | | | |
| LnE, Lev1 | 3 | Both | 1.0 | 1.0 | 316 | 17.2 | 23.4 | 175 | 175 | 1.00 | X | 350 | 4725 | 0.07 |
| Wall E-3 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-1 | 3 | Both | 1.0 | 1.0 | | - | | 175 | 175 | 1.00 | | 350 | 0.0 | - |
| Wall E-2 | 3 | Both | 1.0 | 1.0 | 316 | - | 23.4 | 175 | 175 | 1.00 | | 350 | 4725 | 0.07 |
| **Line F** | | | | | | | | | | | | | | |
| LnF, Lev1 | 1 | Both | 1.0 | 1.0 | 808 | 59.9 | 59.9 | 423 | 423 | 1.00 | X | 846 | 11426 | 0.07 |

*W Grp - Wall group as listed in Materials table; For Dir - Direction of wind force along shearline; Ld. case - Critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal, all other results are for this load case; V - Factored shear force applied to entire line and amount taken by each wall; V/L - Diaphragm shear force = factored shearline force divided by length of shearline;*
*Following values marked with * means that value for shearline is the one for wall with critical design response on line; V/FHS* - Design shear force = factored shear force per unit full height sheathing, Int* - Unit shear capacity of interior sheathing; Ext* - Unit shear capacity of exterior sheathing Co* - Perforation factor; C - Sheathing combination rule, A = Add capacities, S = Strongest side only, X = Strongest side or twice weakest; Total* - Combined unit shear capacity inc. perforation factor; V - Combined shear capacity of wall or total capacity of shearline ; Crit Resp* - Critical response = Vapp/FHS/Vcap = design shear force/unit shear capacity*

**DRAGSTRUT AND HOLDDOWN FORCES**

| Level 1 Line-Wall | Position on Wall or Opening | Location [ft] X | Location [ft] Y | Tensile Holddown Force [lbs] Shear | Dead | Uplift | Cmb'd | Dragstrut Force [lbs] |
|---|---|---|---|---|---|---|---|---|
| **Line 1** | | | | | | | | |
| 1-1 | Left Wall End | -2.40 | 33.75 | 670 | | | 670 | |
| 1-1 | Right Wall End | -2.40 | 40.25 | 670 | | | 670 | |
| **Line 2** | | | | | | | | |
| 2-1 | Left Wall End | 0.00 | 0.25 | 497 | | | 497 | |
| 2-1 | Left Opening 1 | 0.00 | 2.75 | 497 | | | 497 | |
| 2-1 | Right Opening 1 | 0.00 | 9.25 | 497 | | | 497 | |
| 2-1 | Left Opening 2 | 0.00 | 11.75 | 497 | | | 497 | |
| 2-1 | Right Opening 2 | 0.00 | 22.25 | 497 | | | 497 | |
| 2-1 | Left Opening 3 | 0.00 | 25.75 | 497 | | | 497 | |
| 2-1 | Left Opening 1 | 0.00 | 3.00 | | | | | 149 |
| 2-1 | Right Opening 1 | 0.00 | 9.00 | | | | | 73 |
| 2-1 | Left Opening 2 | 0.00 | 12.00 | | | | | 222 |
| 2-1 | Right Opening 2 | 0.00 | 22.00 | | | | | 97 |
| 2-1 | Left Opening 3 | 0.00 | 26.00 | | | | | 295 |
| **Line 3** | | | | | | | | |
| 3-1 | Right Opening 2 | 13.50 | 8.25 | 579 | | | 579 | |
| 3-1 | Left Opening 3 | 13.50 | 11.75 | 579 | | | 579 | |
| 3-1 | Right Opening 3 | 13.50 | 22.25 | 579 | | | 579 | |
| 3-1 | Left Opening 4 | 13.50 | 25.75 | 579 | | | 579 | |
| 3-1 | Right Opening 4 | 13.50 | 29.25 | 579 | | | 579 | |
| 3-1 | Right Wall End | 13.50 | 33.25 | 579 | | | 579 | |
| 3-2 | Left Wall End | 13.50 | 40.75 | 579 | | | 579 | |
| 3-2 | Left Opening 1 | 13.50 | 43.25 | 579 | | | 579 | |
| 3-2 | Right Opening 1 | 13.50 | 46.75 | 579 | | | 579 | |
| 3-2 | Right Wall End | 13.50 | 49.25 | 579 | | | 579 | |
| 3-2 | Left Wall End | 13.50 | 40.50 | | | | | 191 |
| 3-2 | Left Opening 1 | 13.50 | 43.50 | | | | | 55 |
| 3-2 | Right Opening 1 | 13.50 | 46.50 | | | | | 136 |
| 3-1 | Right Wall End | 13.50 | 33.50 | | | | | 1 |
| 3-1 | Right Opening 2 | 13.50 | 8.00 | | | | | 216 |
| 3-1 | Left Opening 3 | 13.50 | 12.00 | | | | | 35 |
| 3-1 | Right Opening 3 | 13.50 | 22.00 | | | | | 305 |
| 3-1 | Left Opening 4 | 13.50 | 26.00 | | | | | 124 |
| 3-1 | Right Opening 4 | 13.50 | 29.00 | | | | | 205 |
| **Line 4** | | | | | | | | |
| 4-1 | Left Wall End | 15.90 | 33.75 | 628 | | | 628 | |
| 4-1 | Right Wall End | 15.90 | 40.25 | 628 | | | 628 | |
| **Line A** | | | | | | | | |
| A-1 | Left Wall End | 0.25 | 0.00 | 500 | | | 500 | |
| A-1 | Left Opening 1 | 7.75 | 0.00 | 500 | | | 500 | |
| A-1 | Left Opening 1 | 8.00 | 0.00 | | | | | 204 |
| **Line B** | | | | | | | | |
| B-1 | Left Wall End | 0.25 | 12.00 | 458 | | | 458 | |
| B-1 | Right Wall End | 13.25 | 12.00 | 458 | | | 458 | |
| **Line C** | | | | | | | | |
| C-1 | Left Wall End | 0.25 | 22.00 | 422 | | | 422 | |
| C-1 | Right Wall End | 13.25 | 22.00 | 422 | | | 422 | |
| **Line D** | | | | | | | | |
| D-2 | Left Wall End | 0.25 | 33.50 | 179 | | | 179 | |
| D-2 | Right Wall End | 13.25 | 33.50 | 179 | | | 179 | |
| **Line E** | | | | | | | | |
| E-2 | Left Wall End | 0.25 | 40.50 | 187 | | | 187 | |
| E-2 | Right Wall End | 13.25 | 40.50 | 187 | | | 187 | |
| **Line F** | | | | | | | | |
| F-1 | Left Wall End | 0.25 | 49.50 | 479 | | | 479 | |
| F-1 | Right Wall End | 13.25 | 49.50 | 479 | | | 479 | |

*Line-Wall - Shearline for forces carried by vertical elements, wall for forces at wall or opening ends; Position...- Vert. element = column or strengthened studs req'd, otherwise indicates stud location at wall end or opening; Location - Co-ordinates in Plan View; Ld. Case - Results are for critical load case: ASCE 7 All heights Case 1 or 2, ASCE 7 low rise T = Transverse, L = Longitudinal; Shear - Factored wind shear overturning component ; Dead - Unfactored dead load resisting component; Uplift - Not relevant to seismic design; Cmb'd - Sum of factored overturning, dead and vertical earthquake forces;Dragstrut Force - Factored drag strut force at opening headers and gaps in walls along shearline*

*Note:*

*This table includes tension holddown forces only.*

*Shearwall does not check for either plan or vertical structural irregularities.*

*Dead load contribution to combined force is factored by 0.516 due to load combination factor and vertical seismic force*

# Project Name: BeauSoleil

Location: Louisiana

By: R J Hebert PE & E Ray Desormeaux PE

Start Date: 12/8/2008

Comments: BeauSoleil University of Louisiana - Lafayette

M:\EngE-K\ERD\BeauSoleil\windUL.wls

ASCE7-05

# Local Information

| Wind Dir. | Exposure |
|---|---|
| 1 | C |
| 2 | C |
| 3 | C |
| 4 | C |

Basic Wind Speed: 60 mph

Topography: None

# Optional Factors

This project uses load combinations
from ASCE 7.

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# Section - Main Section

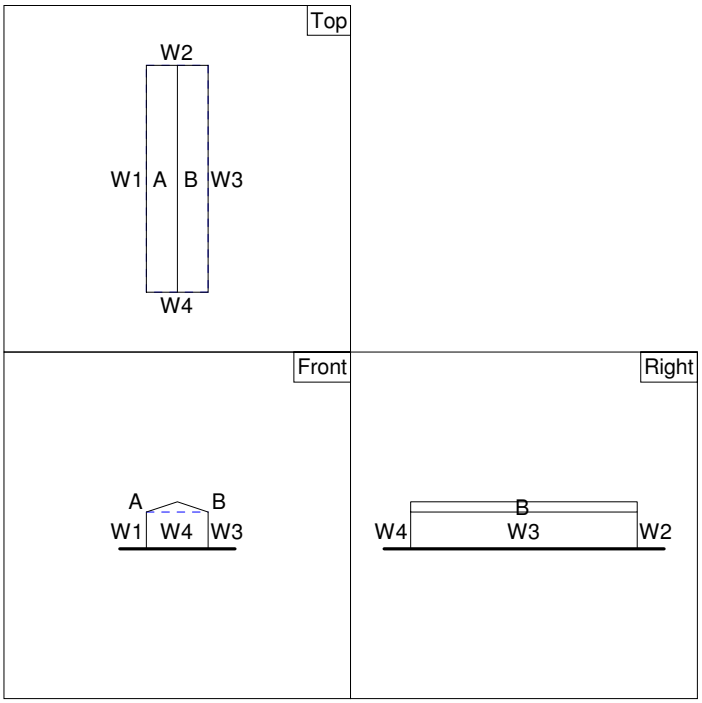
Enclosure Classification: Enclosed
Building Category: II

| Wall | Length(ft) | Overhang(ft) |
|---|---|---|
| 1 | 49.5 | 0.0 |
| 2 | 13.5 | 0.0 |
| 3 | 49.5 | 0.0 |
| 4 | 13.5 | 0.0 |

Eave Height: 8 ft
Parapet Height: 0 ft
Parapet Enclosure: Solid

Roof Shape: Gabled

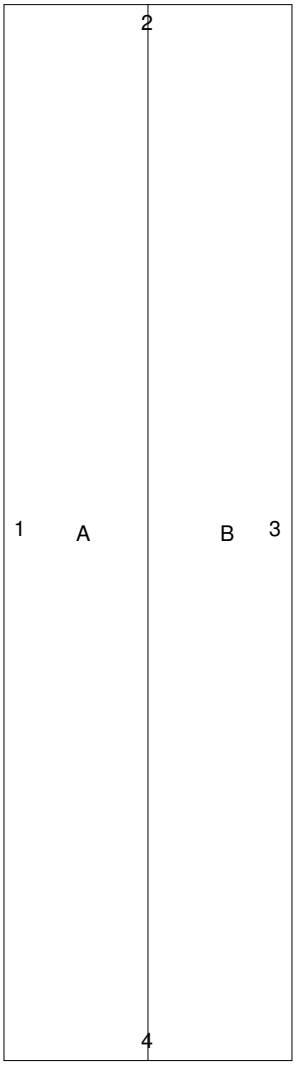
| Roof | Slope(:12) |
|---|---|
| A&B | 4.0 |



# Composite Drawing

2

3




1

4

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# Components and Cladding Input

| Component Description | Wall/Roof | Surface Label | Zone | Span(ft) | Width(ft) | Area(sqft) |
|---|---|---|---|---|---|---|
| panel | Roof | A | (All) | 8.0 | 4.0 | 32 |
| panelw | Wall | 1 | (All) | 8.0 | 4.0 | 32 |

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# Components and Cladding Output

| Component Description | Surface | Zone | z(ft) | q(psf) | GCp | GCpi | ExtPres(psf) | Net w/ +GCpi (psf) | Net w/ -GCpi (psf) |
|---|---|---|---|---|---|---|---|---|---|
| panel | A | 1 | 9.1 | 6.6 | 0.40 | 0.18 | 2.6 | 1.5 | 3.8 |
| | | | 9.1 | 6.6 | -0.85 | | -5.6 | -6.8 | -4.4 |
| | | 2 | 9.1 | 6.6 | 0.40 | | 2.6 | 1.5 | 3.8 |
| | | | 9.1 | 6.6 | -1.45 | | -9.6 | -10.8 | -8.4 |
| | | 3 | 9.1 | 6.6 | 0.40 | | 2.6 | 1.5 | 3.8 |
| | | | 9.1 | 6.6 | -2.30 | | -15.2 | -16.4 | -14.0 |
| panelw | 1 | 4 | 9.1 | 6.6 | 0.91 | 0.18 | 6.0 | 4.8 | 7.2 |
| | | | 9.1 | 6.6 | -1.01 | | -6.7 | -7.9 | -5.5 |
| | | 5 | 9.1 | 6.6 | 0.91 | | 6.0 | 4.8 | 7.2 |
| | | | 9.1 | 6.6 | -1.22 | | -8.1 | -9.2 | -6.9 |

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ASCE7-05

# MWFRS Net Pressures

This data was calculated using the low-rise building method.

Wind Direction 1

| Method | # | Surface | z (ft) | q (psf) | GCp | GCpi | Ext Pres (psf) | Net w/ +GCpi (psf) | Net w/ -GCpi (psf) |
|---|---|---|---|---|---|---|---|---|---|
| Transverse | | | | | | | | | |
| | 1 | 1 | 9.1 | 6.6 | 0.52 | 0.18 | 3.4 | 2.2 | 4.6 |
| | | 1E | 9.1 | | 0.78 | | 5.2 | 4.0 | 6.4 |
| | 2 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 3 | 4 | 9.1 | | -0.42 | | -2.8 | -4.0 | -1.6 |
| | | 4E | 9.1 | | -0.62 | | -4.1 | -5.3 | -2.9 |
| | 4 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | B | 3 | 9.1 | | -0.47 | | -3.1 | -4.3 | -1.9 |
| | | 3E | 9.1 | | -0.67 | | -4.5 | -5.7 | -3.3 |
| Longitudinal | | | | | | | | | |
| | 1 | 5 | 9.1 | 6.6 | -0.45 | 0.18 | -3.0 | -4.2 | -1.8 |
| | 2 | 4 | 9.1 | | -0.29 | | -1.9 | -3.1 | -0.7 |
| | | 4E | 9.1 | | -0.43 | | -2.9 | -4.1 | -1.7 |
| | 3 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 4 | 1 | 9.1 | | 0.40 | | 2.7 | 1.5 | 3.9 |
| | | 1E | 9.1 | | 0.61 | | 4.1 | 2.9 | 5.3 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | | 3E | 9.1 | | -0.53 | | -3.5 | -4.7 | -2.3 |
| | B | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |

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ASCE7-05

# MWFRS Net Pressures

This data was calculated using the low-rise building method.

Wind Direction 2

| Method | # | Surface | z (ft) | q (psf) | GCp | GCpi | Ext Pres (psf) | Net w/ +GCpi (psf) | Net w/ -GCpi (psf) |
|---|---|---|---|---|---|---|---|---|---|
| Transverse | | | | | | | | | |
| | 1 | 1 | 9.1 | 6.6 | 0.52 | 0.18 | 3.4 | 2.2 | 4.6 |
| | | 1E | 9.1 | | 0.78 | | 5.2 | 4.0 | 6.4 |
| | 2 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 3 | 4 | 9.1 | | -0.42 | | -2.8 | -4.0 | -1.6 |
| | | 4E | 9.1 | | -0.62 | | -4.1 | -5.3 | -2.9 |
| | 4 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | B | 3 | 9.1 | | -0.47 | | -3.1 | -4.3 | -1.9 |
| | | 3E | 9.1 | | -0.67 | | -4.5 | -5.7 | -3.3 |
| Longitudinal | | | | | | | | | |
| | 1 | 5 | 9.1 | 6.6 | -0.45 | 0.18 | -3.0 | -4.2 | -1.8 |
| | 2 | 1 | 9.1 | | 0.40 | | 2.7 | 1.5 | 3.9 |
| | | 1E | 9.1 | | 0.61 | | 4.1 | 2.9 | 5.3 |
| | 3 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 4 | 4 | 9.1 | | -0.29 | | -1.9 | -3.1 | -0.7 |
| | | 4E | 9.1 | | -0.43 | | -2.9 | -4.1 | -1.7 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | | 3E | 9.1 | | -0.53 | | -3.5 | -4.7 | -2.3 |
| | B | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |

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# MWFRS Net Pressures

This data was calculated using the low-rise building method.

Wind Direction 3

| Method | # | Surface | z (ft) | q (psf) | GCp | GCpi | Ext Pres (psf) | Net w/ +GCpi (psf) | Net w/ -GCpi (psf) |
|---|---|---|---|---|---|---|---|---|---|
| Transverse | | | | | | | | | |
| | 1 | 4 | 9.1 | 6.6 | -0.42 | 0.18 | -2.8 | -4.0 | -1.6 |
| | | 4E | 9.1 | | -0.62 | | -4.1 | -5.3 | -2.9 |
| | 2 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 3 | 1 | 9.1 | | 0.52 | | 3.4 | 2.2 | 4.6 |
| | | 1E | 9.1 | | 0.78 | | 5.2 | 4.0 | 6.4 |
| | 4 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | A | 3 | 9.1 | | -0.47 | | -3.1 | -4.3 | -1.9 |
| | | 3E | 9.1 | | -0.67 | | -4.5 | -5.7 | -3.3 |
| | B | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| Longitudinal | | | | | | | | | |
| | 1 | 6 | 9.1 | 6.6 | -0.45 | 0.18 | -3.0 | -4.2 | -1.8 |
| | 2 | 1 | 9.1 | | 0.40 | | 2.7 | 1.5 | 3.9 |
| | | 1E | 9.1 | | 0.61 | | 4.1 | 2.9 | 5.3 |
| | 3 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 4 | 4 | 9.1 | | -0.29 | | -1.9 | -3.1 | -0.7 |
| | | 4E | 9.1 | | -0.43 | | -2.9 | -4.1 | -1.7 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | B | 2 | 9.1 | | | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | | 3E | 9.1 | | -0.53 | | -3.5 | -4.7 | -2.3 |

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ASCE7-05

# MWFRS Net Pressures

This data was calculated using the low-rise building method.

Wind Direction 4

| Method | # | Surface | z (ft) | q (psf) | GCp | GCpi | Ext Pres (psf) | Net w/ +GCpi (psf) | Net w/ -GCpi (psf) |
|---|---|---|---|---|---|---|---|---|---|
| Transverse | | | | | | | | | |
| | 1 | 4 | 9.1 | 6.6 | -0.42 | 0.18 | -2.8 | -4.0 | -1.6 |
| | | 4E | 9.1 | | -0.62 | | -4.1 | -5.3 | -2.9 |
| | 2 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 3 | 1 | 9.1 | | 0.52 | | 3.4 | 2.2 | 4.6 |
| | | 1E | 9.1 | | 0.78 | | 5.2 | 4.0 | 6.4 |
| | 4 | 5 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | A | 3 | 9.1 | | -0.47 | | -3.1 | -4.3 | -1.9 |
| | | 3E | 9.1 | | -0.67 | | -4.5 | -5.7 | -3.3 |
| | B | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| Longitudinal | | | | | | | | | |
| | 1 | 6 | 9.1 | 6.6 | -0.45 | 0.18 | -3.0 | -4.2 | -1.8 |
| | 2 | 4 | 9.1 | | -0.29 | | -1.9 | -3.1 | -0.7 |
| | | 4E | 9.1 | | -0.43 | | -2.9 | -4.1 | -1.7 |
| | 3 | 6 | 9.1 | | -0.45 | | -3.0 | -4.2 | -1.8 |
| | 4 | 1 | 9.1 | | 0.40 | | 2.7 | 1.5 | 3.9 |
| | | 1E | 9.1 | | 0.61 | | 4.1 | 2.9 | 5.3 |
| | A | 2 | 9.1 | | -0.69 | | -4.6 | -5.8 | -3.4 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | B | 2 | 9.1 | | | | -4.6 | -5.8 | -3.4 |
| | | 2E | 9.1 | | -1.07 | | -7.1 | -8.3 | -5.9 |
| | | 3 | 9.1 | | -0.37 | | -2.5 | -3.7 | -1.3 |
| | | 3E | 9.1 | | -0.53 | | -3.5 | -4.7 | -2.3 |

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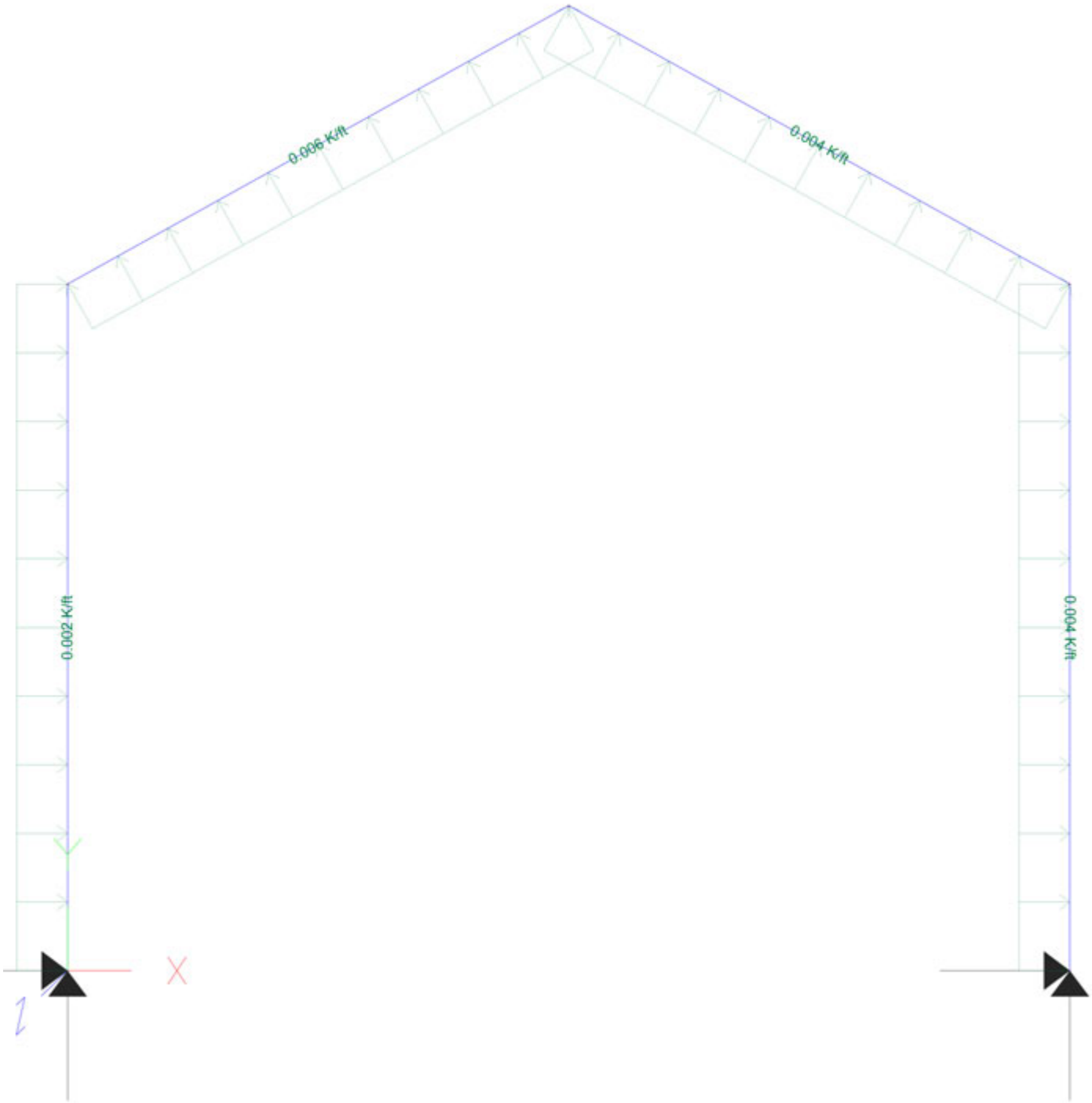
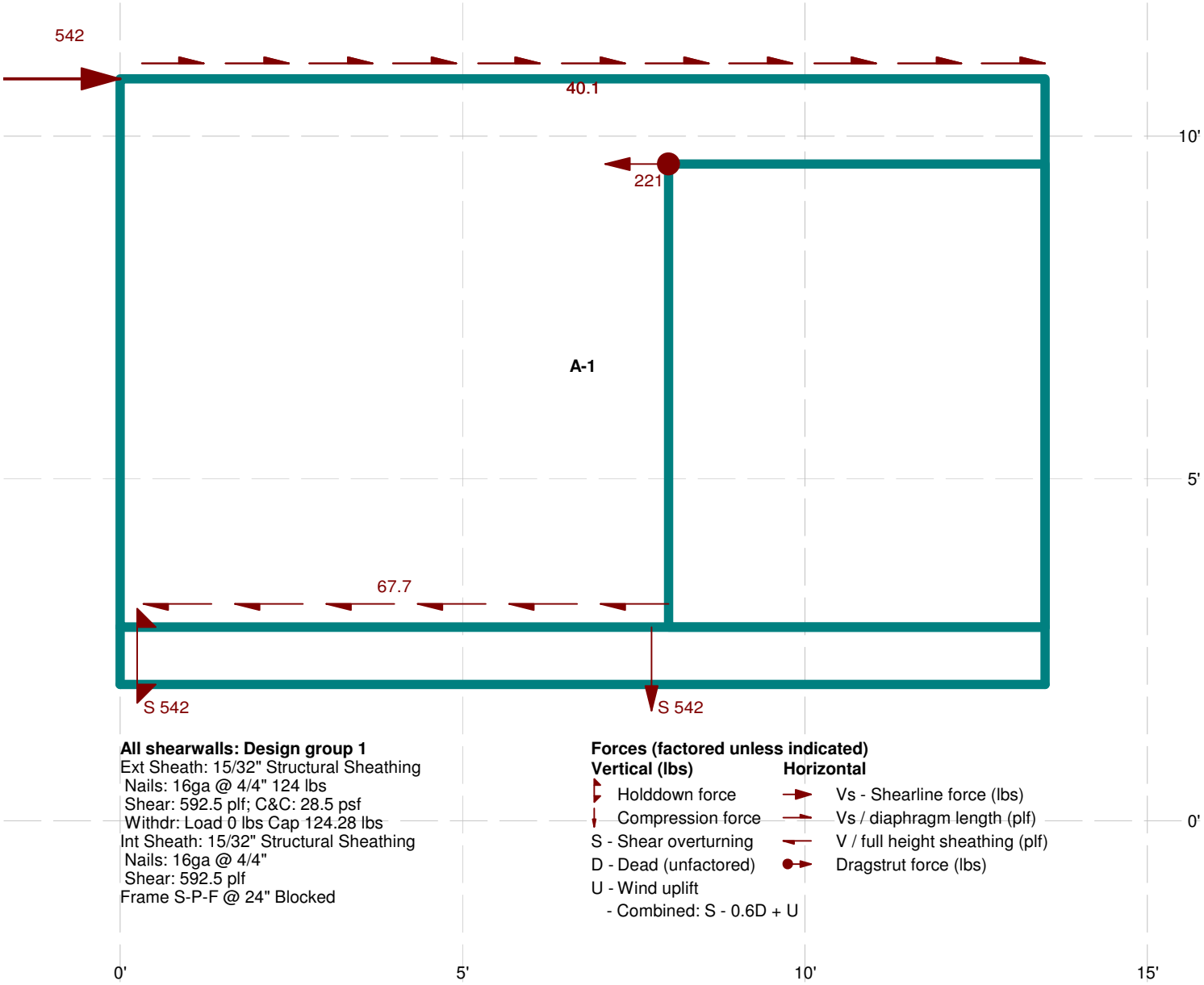
BeauSoleil Project: frame.vap
Randall J. Hebert & Assoc. Inc., Randall J. Hebert
E R Desormeaux P.E.
Dec 12, 2008; 07:56 AM
Load Case: W+X
IES VisualAnalysis 6.00.0109



**Elevation View**
**Shearline A, at Y = 0 ft, Level 1.**
**Flexible Diaphragm Wind Design.**




**All shearwalls: Design group 1**
Ext Sheath: 15/32" Structural Sheathing
Nails: 16ga @ 4/4" 124 lbs
Shear: 592.5 plf; C&C: 28.5 psf
Withdr: Load 0 lbs Cap 124.28 lbs
Int Sheath: 15/32" Structural Sheathing
Nails: 16ga @ 4/4"
Shear: 592.5 plf
Frame S-P-F @ 24" Blocked

**Forces (factored unless indicated)**

**Vertical (lbs)**
- Holddown force
- Compression force
- S - Shear overturning
- D - Dead (unfactored)
- U - Wind uplift
- Combined: S - 0.6D + U

**Horizontal**
- Vs - Shearline force (lbs)
- Vs / diaphragm length (plf)
- V / full height sheathing (plf)
- Dragstrut force (lbs)

**APPROVED**
**By Tom Meyers at 8:37 am, Dec 04, 2008**

UNIVERSITY OF LOUISIANA
Lafayette

School of Architecture and Design
Architecture
Interior Design
Industrial Design

P.O. Box 43850
Lafayette, LA 70504-3850
Office: (337) 482-6225
Fax: (337) 482-1128

Université des Acadiens

Tom Meyers
Solar Decathlon Code Official

Re: Structural Insulated Panel Approval

Dear Mr. Meyers:

Per our previous discussions and email correspondence, the University of Louisiana at Lafayette is hereby formally applying for alternate material approval under Section 104.11 of the 2006 IRC. We are proposing a SIPS system containing materials that will be permitted under the new 2007 supplement to the IRC. Specifically, the OSB is PS-2 and the adhesive meets ICC-ES AC-05. AC-05 contains the 2007 IRC Supplement standard of ASTM D 2559. The EPS foam meets ASTM- C 578 and is manufactured by Perma R Products.

We are employing Ray DesOrmeaux, a licensed professional engineer in Louisiana. Mr. DesOrmeaux will review and seal the building plans including any necessary calculations or methodology used to assess our SIP roof structure. Additionally, Mr. DesOrmeaux will perform on-site inspections of our home on the mall prior to the Solar Decathlon competition and he will provide a letter at the conclusion of construction stating that the building is constructed in substantial compliance with the design and manufacturer's specifications.

Please note that we have previously forwarded the following information you requested as a part of this approval process:

- Manufacturer's Testing Logs as required under LASBH's QA policy 11A
- UL # R9306 certifying that the foam meets code compliance from IRC-56 p. 60
- Standard SIP details from manufacturer
- Material Safety Data Sheet for Titebond Solvent Free Adhesive
- SIP structural testing data
- Engineer-stamped load tables for SIPs

We hope this meets with your approval and we look forward to hearing from you.
If you have any questions, please call me anytime at 337-278-2722.

Thanks,

W. Geoff Gjertson, AIA
Associate Professor
TEAM BeauSoleil Faculty Advisor

DETAILED WATER BUDGET

| CONTESTS | WATER REQUIRED | # OF DRAWS | TOTAL |
|---|---|---|---|
| HOT WATER | 15 gallons | 20 | 300 gal |
| CLOTHES WASHING | 19.8 gallons | 10 | 198 gal |
| DISH WASHING | 4 gallons | 5 | 20 gal |
| COOKING | 0.6 gallons | 4 | 2.4 gal |
| | | | |
| | | CONTEST TOTAL | 520.4 gal |
| | | CONTINGENCY | 180 gal |
| | | TOTAL DOMESTIC SUPPLY | 700 gal |

## SUMMARY OF UNLISTED ELECTRICAL COMPONENTS

All electrical components carry an approved testing agency's listing per Section 6.7 of the Solar Decathlon Code.

RETAIL PV PRICE QUOTES

Wholesale Solar
Toll Free: 800 / 472-1142
Local Phone: 530 / 926-2900
Fax: 530 / 926-1162
2405 S. Mt. Shasta Blvd
Mt. Shasta, CA 96067
sales@wholesalesolar.com

Sanyo HIT Power 205 $944.00 $4.60 per watt
http://www.wholesalesolar.com/products.folder/module-folder/Sanyo/sanyo-hit-power-n-205n-hip-205nkha5.html

ACME Solar Works
20738 Brown Lane
Summerdale, AL 36580
877-226-3004

Sanyo HIT Double 195 Bi-Facial $976.54 $5.01 per watt
http://acmesolarworks.net/sanyo-hit-solar-modules-p-14.html

SUMMARY OF RECONFIGURABLE ELEMENTS

The BeauSoleil Louisiana Solar Home features fourteen reconfigurable elements. These elements allow the occupants to control their experience within the spaces. The first of the elements are the six sliding/pivoting glass doors (Nanawall) in the Transitional Porch. These six doors can rotate 360 degrees around a 10' x 10' square track. They allow the Transitional Porch to function as an interior space or an exterior space. In conjunction with the north side bi-fold glass door, the second reconfigurable element, these doors allow the Transitional Porch to be separated from the living space forming a unique interior room for a guest or to simply isolate the kitchen. This door, when open adds additional square footage into the home's architectural footprint and this is shown on our Architectural Footprint Plan. The third of the elements, also in the Transitional Porch, are roll-down insect screens- a necessity in south Louisiana when the space functions as an exterior porch open to the interior. The screens also function as a shading device. The transitional porch will remain an exterior space during the tours and will only be converted to an interior space for both of the Home Entertainment dinner parties.

The fourth of the reconfigurable elements is the Murphy bed in the bedroom/studio. By retracting the bed into the wall the room becomes a workspace during the day. Also, in the bedroom, the desk rolls away when not in use as the fifth reconfigurable element. Together, these two elements transform the space into a studio. The bed will remain in the closed position during the tours and contests. The desk will be used during the tours and contests.

The sixth of the reconfigurable elements are the sliding louvered painted steel shutters on the south side of the home. The prevailing winds in Washington D.C. and Louisiana come from the south. Instead of swinging shutters which are more vulnerable to wind, the sliding shutters move on a horizontal track providing both shading and hurricane protection. Also aiding in shading are the retractable Eco-Shades on the interior of the home at the southern windows which receive the most direct sunlight. These comprise the seventh reconfigurable element. Both the south side shutters and the roll-down window shades will be used during the contests but not during the tours.

The eighth of the reconfigurable elements are the removable lattice-screen shutters for the north side windows. In their typical position, the shutters are bolted to a rack in a vertical position forming a screen-wall at the northwest corner of the deck. This screen-wall creates an intimate outdoor area with privacy, seating, a touch-screen media area, and a place to dry clothes and towels. When hurricane protection is needed, the latticed-screens can be removed from the vertical rack and bolted over the windows on the north side of the home. These screen shutters will remain fixed as a part of the porch screen-wall during the competition.

The ninth reconfigurable element is the dining room table. This table is a custom table which can be separated into two leaves (halves) and the legs retracted when not in use. Each half will be hung on the walls of the home as a piece of art when not in use. The table will remain hung on the wall the entire competition except when it is used for the Home Entertainment dinner parties.

The eleventh reconfigurable element(s) are the sliding partition doors separating the living room from the hall and the hall from the bedroom/studio. These partition doors are approximately 4' wide x 8' tall and slide on a horizontal track. (Note: the doors to the laundry closet and bathroom are also horizontal track.) All of the doors will be in the open positions during tours.

The twelfth reconfigurable element is the horizontal sliding bar counter in the kitchen. This sliding action allows the counter to be slid over the lower counter when not in use so as to not obstruct the 18" clearance to the right of the kitchen porch door. When needed, the counter and be pulled out and two bar stools to be placed in the kitchen for seating. The counter will remain in the closed (unobstructed) position for tours. The bar stools will be stored in the bedroom/studio during tours.

The thirteenth element is the fold down shower seat in the bathroom. This seat will remain in the folded down position during the entire competition. The final reconfigurable elements are the operable windows. Both casement and awning windows are used throughout the home. Although these windows may be open a various times during the competition we understand that they do not count into our architectural footprint.

Each of the reconfigurable elements is very easy for the occupant to manipulate. We understand that unless they are convenient, these elements will not be used. Therefore we have designed them for convenience.

29-May-2009 Solar Decathlon 2009

**INTERCONNECTION APPLICATION FORM**

UL Lafayette, TEAM BeauSoleil, Lot Number 102

PV SYSTEMS

| Module Manufacturer | Short Description of Array | DC Rating of Array (sum of the DC ratings) |
|---|---|---|
| Sanyo | 26: HIT Power 205 | 3690 W |
| Sanyo | 13: HIT Double 195 | 4292 W |
| | | |

Total DC power of all arrays is 7.8 kW (in tenths).

INVERTERS

| Inverter Manufacturer | Model Number | Voltage | Rating (kVA or kW) | Quantity |
|---|---|---|---|---|
| Xantrex | GT4.0.N | 240V/120V | 4kW | 1 |
| Xantrex | GT5.0 | 240V/120V | 5kW | 1 |
| | | | | |

Total AC power of all inverters is 8 kVA or kW (in whole numbers).

## ENERGY ANALYSIS AND DISCUSSION

An energy analysis simulation spreadsheet of electrical energy production and consumption was formulated and developed. The simulation results are being compared to a scaled-down system installed on the roof of the engineering building on campus. These results will be used to calibrate the simulation parameters, thus providing an accurate prediction of performance in Washington DC during October 2009.

*Scaled-down Test PV Array*

### Photovoltaic Panel Electrical Output Simulation

A simulation spreadsheet was developed to predict the performance of the Madison Hall PV System Prototype system. Two prediction models are used. The SOLPOS model [1] used data from NREL's Measurement & Instrumentation Data Center Solar Position and Intensity (SOLPOS) to calculate the solar position and intensity based on location, date, and time inputs for the years 1950–2050. This model assumes a clear sky and no attenuation from clouds or weather.

The TMY model [2] calculator (PVWatts Version 1) uses hourly typical meteorological year (TMY) weather data and a PV performance model to estimate annual energy production and cost savings for a crystalline silicon PV system. This data is based on actual measurements for 239 locations in the United States and its territories, and provides realistic performance results.

### Performance Evaluation

Results for 2009 using the TMY model with data from the Lake Charles location and the SOLPOS model are presented in Figure 1. The PV Panel DC Rating is 1.2kW, the DC to AC conversion efficiency set to 91%, and the panels elevated at $30^0$ facing south. Measured data acquired from the installed system EMU for the first two months of 2009 is also presented.

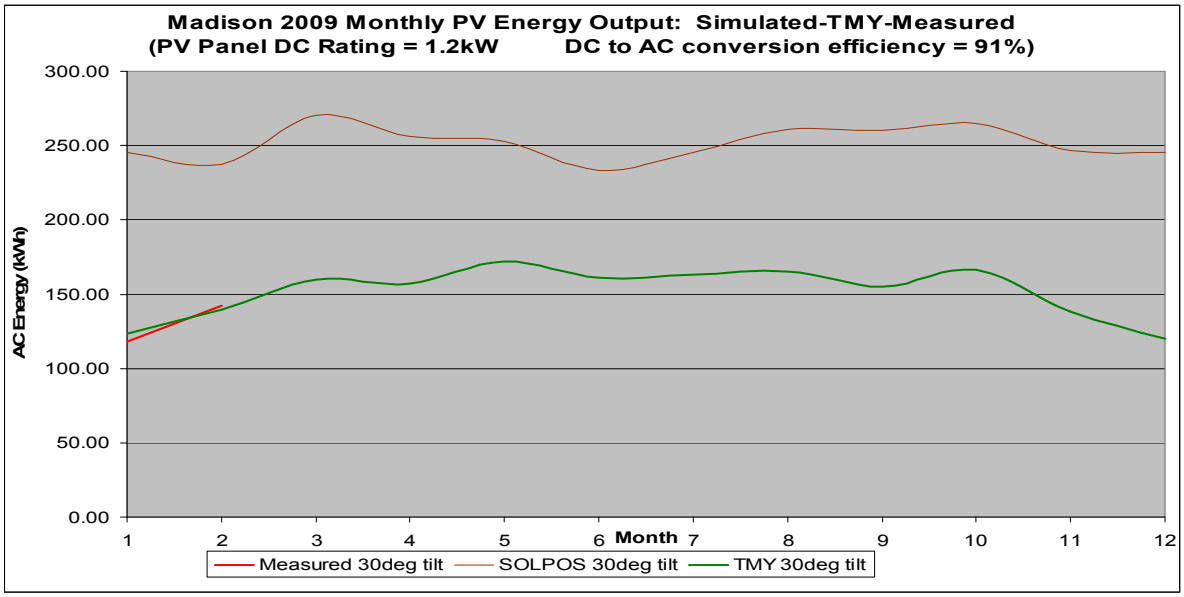



Figure 1. Madison 2009 Monthly PV Energy Output

As can be seen, there is excellent agreement between the TMY predicted performance and the measured data. This gives confidence that the parameter calibration is correct and this simulation may be used with confidence to predict performance at other locations.

## Heating/Cooling Load Simulation

The profile for the Heat Pump was determined by an HOURLY DESIGN ZONE COOLING LOAD analysis for a typical day in Washington, DC. The HVAC system capacity for the cooling and heating of the home was determined by using a software program called the Carrier E20-II – Hourly Analysis Program. Cooling and heating loads were taken for the Washington DC area to accommodate the location of the judging for the competition of the Solar Decathlon. Numerous loads were taken with varying internal loads associated with varying equipment usage and people occupancy within the home as well as varying external envelope options available for the home. Equipment was selected based on cooling and heating capacity requirements as well as available space allowed to accommodate the HVAC equipment. A high efficiency variable speed system was considered for maximum efficiency associated with equipment that could accommodate limited equipment space.

## Solar Water Heating Simulation

A solar water heater is being used in the house and only the electrical energy required for pumps and supplemental heating is included. A simulation was performed with a full-scale mock-up of the system. (Figure 2) The system is a closed loop flat-plate connector integrated into the translucent roof of the Transitional Porch. The closed loop of anti-freeze has 8” wide aluminum fins which collect additional heat. There is a heat-exchanger in a water-storage tank. For the mock-up, the team built a section of the system with identical materials and currently it is located in an exterior position where analysis can occur. From the results of dataloggers (Hobos) placed throughout the system, we are confident that adequate hot water will be produced.

Figure 2. Solar Water Heater Mock-Up

## Results

A detailed hour by hour profile of the house electrical load required to support the contest events has been determined for the contest days from 10-11-09 through 10-19-09. A simulation of the contest PV performance with a one-hour time increment using 39 Sanyo 200W PV panels tilted at an angle of 30$^0$ facing south has been set up. The PV Panel DC Rating is 7.8kW, with the DC to AC conversion efficiency set to 91%. PV power produced, house power consumed, net power, and net energy produced computed and plotted. The results for the eight contest days using the SOLPOS model are presented in Figure 3, while the results using the TMY model with data from the Baltimore location are given in Figure 4.

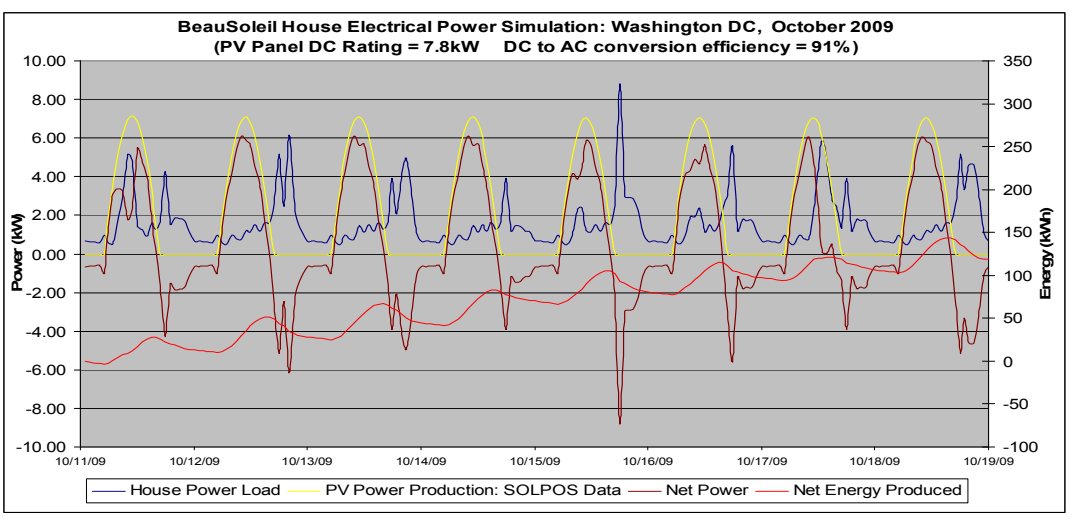



Figure 3. BeauSoleil House Electrical Power SOLPOS Simulation

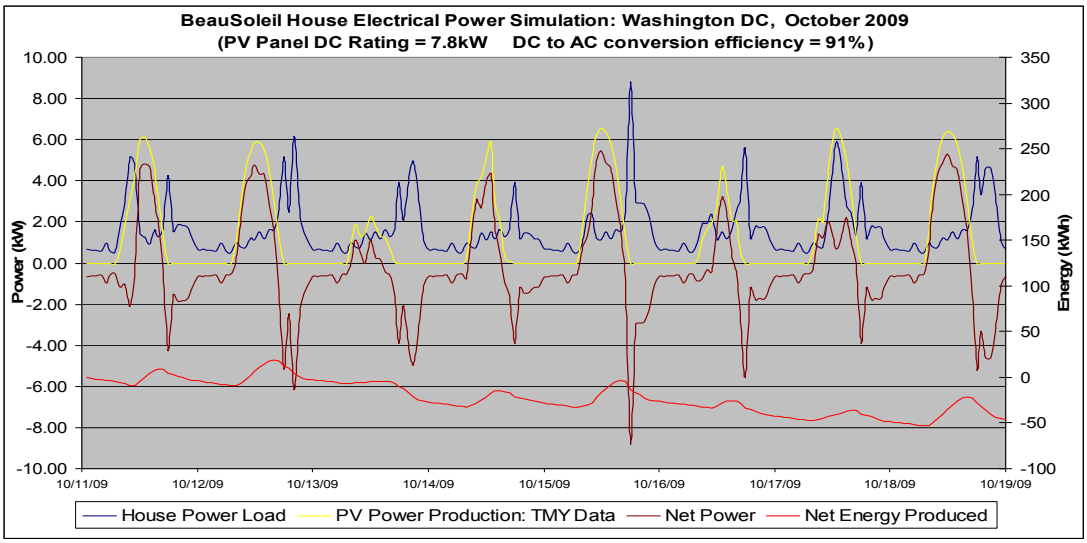



Figure 4. BeauSoleil House Electrical Power TMY Simulation

At the end of the contest, the SOLPOS model predicts a surplus energy of 118 kWh produced, while the TMY model predicts an energy deficit of 45 kWh. The realistic prediction is that from the TMY model, so it is likely that the current house design will operate near a 10% net energy deficit. Based on this simulation, the Sanyo 200W PV panels have been replaced by Sanyo Power 205W panels for added energy production, and electrical appliances redesigned for more energy-efficient operation.

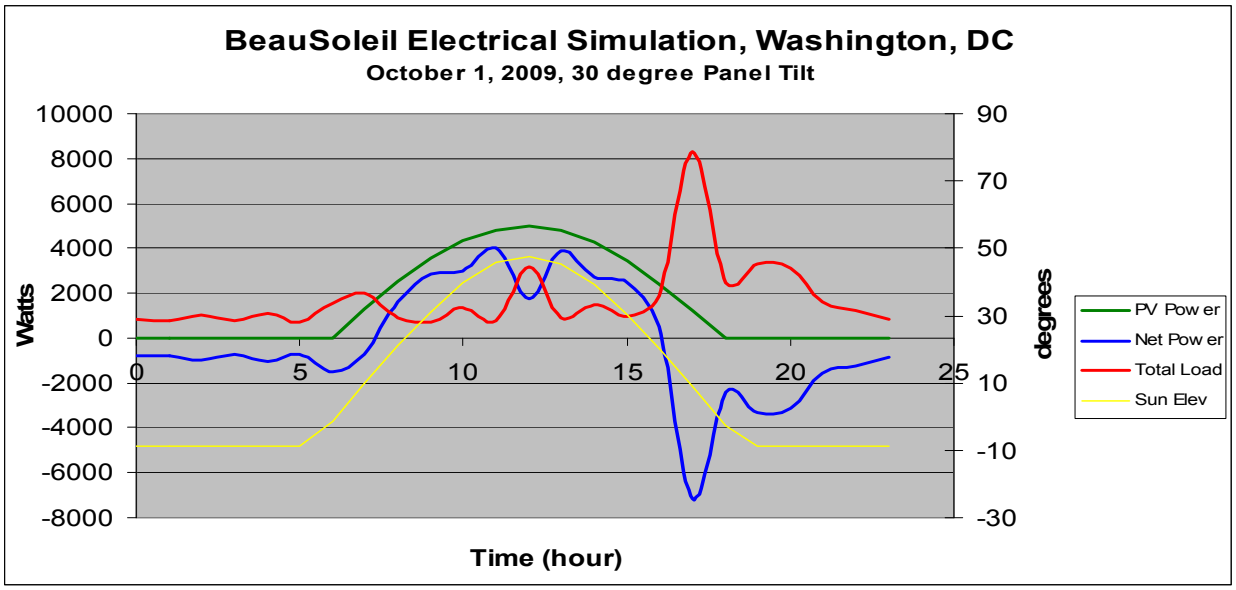
## REFERENCES

[1] SOLPOS model http://rredc.nrel.gov/solar/codesandalgorithms/solpos/
[2} TMY model http://www.nrel.gov/rredc/pvwatts/

| | | | | | | | Electrical Loads | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2009 | Time | Sun Elev | Sun Cos | PV Output | Net Power Flow | Total Electrical Load | Refrigerator | Freezer | Clothes Washer | Dishwasher | Cooktop | Oven | Inside Lights | Outside Lights | TV | Computer | Heat Pump |
| Date | Hour | deg | Incid | watt | watt | watt | watt | watt | watt | watt | watt | watt | watt | watt | watt | watt | watt |
| 10/1 | 0.00 | -9 | -0.16 | 0 | -819.24 | 819.24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 714 |
| 10/1 | 1.00 | -9 | -0.16 | 0 | -796.20 | 796.20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 691 |
| 10/1 | 2.00 | -9 | -0.16 | 0 | -1013.16 | 1013.16 | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 668 |
| 10/1 | 3.00 | -9 | -0.16 | 0 | -750.12 | 750.12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 645 |
| 10/1 | 4.00 | -9 | -0.16 | 0 | -1072.08 | 1072.08 | 345 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 622 |
| 10/1 | 5.00 | -9 | -0.16 | 0 | -704.04 | 704.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 599 |
| 10/1 | 6.00 | -1 | 0.00 | 20 | -1507.65 | 1527.48 | 0 | 0 | 0 | 0 | 0 | 0 | 505 | 105 | 240 | 90 | 588 |
| 10/1 | 7.00 | 10 | 0.26 | 1308 | -726.08 | 2034.00 | 345 | 240 | 0 | 0 | 0 | 0 | 505 | 105 | 240 | 0 | 599 |
| 10/1 | 8.00 | 21 | 0.49 | 2509 | 1600.37 | 908.16 | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 668 |
| 10/1 | 9.00 | 31 | 0.70 | 3538 | 2823.54 | 714.24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 714 |
| 10/1 | 10.00 | 40 | 0.85 | 4323 | 2977.62 | 1345.32 | 345 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 760 |
| 10/1 | 11.00 | 46 | 0.95 | 4811 | 4027.76 | 783.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 783 |
| 10/1 | 12.00 | 48 | 0.98 | 4968 | 1765.33 | 3202.92 | 345 | 240 | 0 | 0 | 900 | 900 | 0 | 0 | 0 | 0 | 818 |
| 10/1 | 13.00 | 45 | 0.94 | 4784 | 3908.14 | 875.52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 876 |
| 10/1 | 14.00 | 39 | 0.84 | 4270 | 2751.42 | 1518.12 | 345 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 933 |
| 10/1 | 15.00 | 30 | 0.68 | 3462 | 2482.81 | 979.20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 979 |
| 10/1 | 16.00 | 20 | 0.48 | 2416 | 510.26 | 1905.72 | 345 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 90 | 991 |
| 10/1 | 17.00 | 9 | 0.24 | 1205 | -7124.01 | 8329.20 | 0 | 0 | 1150 | 0 | 3600 | 1800 | 505 | 0 | 240 | 90 | 945 |
| 10/1 | 18.00 | -3 | -0.02 | 0 | -2435.04 | 2435.04 | 345 | 240 | 0 | 0 | 0 | 0 | 505 | 105 | 240 | 90 | 910 |
| 10/1 | 19.00 | -9 | -0.16 | 0 | -3310.08 | 3310.08 | 345 | 0 | 1150 | 0 | 0 | 0 | 505 | 105 | 240 | 90 | 876 |
| 10/1 | 20.00 | -9 | -0.16 | 0 | -3127.44 | 3127.44 | 345 | 240 | 0 | 750 | 0 | 0 | 505 | 105 | 240 | 90 | 852 |
| 10/1 | 21.00 | -9 | -0.16 | 0 | -1597.92 | 1597.92 | 345 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 240 | 90 | 818 |
| 10/1 | 22.00 | -9 | -0.16 | 0 | -1233.36 | 1233.36 | 345 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 783 |
| 10/1 | 23.00 | -9 | -0.16 | 0 | -853.80 | 853.80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 749 |
| | Total KWH --> | | | 37.61 | -4.22 | 41.84 | | | | | | | | | | | |
| | | | | Energy Generated | Net | Energy Consumed | | | | | | | | | | | |
| | | | | | Metered Energy | | | | | | | | | | | | |
| | 30 year Average kWH/day = | | | | 35.99 | October, Baltimore, MD | | | | | | | | | | | |

Robert Henry, P.E.

Table 1. BeauSoleil Energy Analysis Simulation for Typical Day



ARCHITECTURE NARRATIVE

The University of Louisiana at Lafayette's BeauSoleil (Bo-so-lay- *beautiful sunshine* in French) Home has three core concepts. First, the BeauSoleil Louisiana Solar Home is a balanced hybrid of active and passive energy systems- meaning that the home utilizes traditional forms of passive heating and cooling as well as providing supplemental energy from photovoltaics and solar water heating. Second, the home is a uniquely, regional work of architecture. It is a Louisiana home which acknowledges the vernacular forms and materials and reflects a culture which is alive and thriving. Third, the BeauSoleil Home is designed for the average Louisiana family. The architectural design renders the home highly adaptable and livable as well as economical. Therefore, the home is a viable option for the public who demand an affordable, "green" alternative. All three concepts reinforce each other and make the BeauSoleil Louisiana Solar Home a powerful and beautiful housing solution.

From the original conceptual statement, through vetting of dozens of schematic designs, public charrettes, intensive testing and design development, and finally through construction, the BeauSoleil Louisiana Solar Home has been focused on our core concepts. There are three primary Architectural design features which formally distinguish the BeauSoleil Home. First, the home embraces the Louisiana lifestyle which values our connection to nature. This is evidenced through the Transitional Porch (or dogtrot,) a dynamic multi-functional space that is the centerpiece of the home for dining and entertaining. The Transitional porch is both an exterior and interior space which reflects and generously accommodates Louisiana's cultural traditions. Second, the modified gable roof with shifting ridge of the BeauSoleil Home acknowledges the traditional shotgun form while at the same time reflecting a new and exciting future. Third, the home is designed to be readily reproduced by a modular home manufacturer, employing standard SIPS construction and an expandable design. The BeauSoleil Home will have a life after the Decathlon as a viable and marketable prototype. In the time leading up to, during and following the Solar Decathlon, the BeauSoleil Home is positioned to better the lives of much of Louisiana's population, raise standards for environmental and ethical accountability, and create informative and educational opportunities for a wide variety of demographics. Finally, through community partnerships in the production of the home, the project seeks to serve as an engine for economic growth in our region

The formal composition of the BeauSoleil Louisiana Solar Home draws upon the vernacular Acadian Raised cottage, southern shotgun, and dogtrot housing types. In plan, the home is cruciform with circulation along the southern edge with the four primary spaces aligned. On the exterior, the tall, vertical proportions of the windows on the south, as well as the shutters reflect these vernacular influences. The eastern facade with its traditional symmetrical gable suggests the iconic house form. The shifted ridge and shed-type roof on the west denotes the hierarchy of the kitchen within the home as well as promoting passive ventilation. The north facade with its horizontal high windows maintains the privacy of the occupants while allowing for passive ventilation. The expansion modules, which project from the main volume of the house create additional space for an accessible bathroom/shower and the laundry closet. In addition, these forms are removable for additions on the home. The galvanized, corrugated metal siding of the expansion modules reflect vernacular housing and farm building types. On the interior, the high vaulted, ceiling height of 14' increases the perception of spatial size. Diagonal views through the spaces also increase this sense

of spaciousness. A rich mixture of natural materials such as oak flooring, trim and cypress cabinets as well as synthetic materials such as polycarbonate and anodized-aluminum, provide texture and warmth in the spaces. The Transitional Porch is the conceptual and literal heart of the home. Most activity revolves around and in this multi-functional space. The openness of this space (even when it is thermally enclosed) reflects the Louisiana lifestyle which treasures entertaining and cooking.

Specific architectural features, elements and materials of the BeauSoleil Louisiana Solar Home are:

- native plants and water features
- a cistern for potable water storage
- cypress rain-screen cladding
- galvalume standing-seam roof
- aluminum-clad wood, Low-E glass windows
- roll-down insect screens which double as shading devices in the Transitional Porch
- oak flooring
- cypress cabinetry
- reclaimed Ipe countertops
- translucent polycarbonate roof with integrated closed-loop solar water heater
- reconfigurable, sliding glass doors/wall
- hurricane protection with operable steel shutters and a bifold hanger door
- BIPV's with parapets at roof edges
- open floor plan with translucent bathroom module
- trans-formative bedroom/studio with Murphy bed and integrated storage/work area
- folding desk/work area in Bedroom
- room for growth with Expansion Modules

A day in the life of the BeauSoleil Home would go something like this: One awakens in a bed facing the west. Light can be modulated to enter the space with rolling blinds or exterior louvered shutters. Your bed can be folded into the wall immediately enlarging and transforming the bedroom to a studio. Cabinetry and a desk allow for easy and efficient storage of clothing and office supplies. The bathroom provides a buffer between the public living area and private bedroom area and sliding doors allow one to access the bathroom without venturing into the living area. When entering the bathroom, one is struck by the luminosity of the polycarbonate walls bathing the space in light. The warm and bright colors and tile convey a feeling of spaciousness and cleanliness. The plumbing fixtures and accessories are designed to accommodate everyone as they age through universal design strategies. The open shower is spacious and bright with translucent windows on the west and east. Both the natural light and mechanical ventilation limit the growth of mold which is a major problem in Louisiana. An efficient yet generous medicine cabinet stores one's toiletries and make-up close at hand.

After bathing, one walks through the living room and outside through the Transitional Porch (unless the weather requires this space to function as an interior space.) By moving through the Transitional Porch, one is immediately put in close contact with the exterior and the changing temperature and light of the day. In addition, the Transitional Porch allows the kitchen to be separated from the main body of the house thus prohibiting the heat of cooking to migrate. Additionally, the kitchen can be physically separated at night or at other times it is not needed, conserving energy. The kitchen is very large for an 800 square foot house and this is no accident. Cajuns take great pride in cooking and entertaining in their kitchens. Our kitchen embraces this culture of entertaining and cooking. The vertical dimension of the kitchen is also the largest in the home which again glorifies and celebrates this important space. Also, a second set of high, north, clerestory windows allows for the expulsion of heat. Convenient placement of appliances and cabinets in the kitchen make this space highly functional. A vertical herb garden on the Kitchen porch allows one to get spices and herbs readily during cooking. After making breakfast, one can sit at the kitchen counter or dine AL Fresco on the Transitional Porch. The Transitional porch also has roll-down insect screens to allow for it to be completely connected to the interior. If you have a guest staying with you, they can sleep in the Transitional porch which can be separated with the sliding glass doors.

When you go to work, your house is working for you, generating electricity and selling it back to the grid. When you get home at night the BeauSoleil Home is waiting to greet you with timed lighting features and vacancy sensors. Also, walk-off mats remove unwanted dirt and dust from your shoes before entering the home. Once inside, the three small ductless mini-split heating/air-conditioning units quickly and efficiently provide comfort exactly where it is needed. Additionally, a dehumidifier introduces fresh-air into the highly-insulated home to improve indoor air-quality. No-VOC paint also improves indoor-air quality. After dinner on the transitional porch, adjourning to the surrounding porches effectively triples the size of this 800 SF home making if feel much larger than it is. Native plants and trees create a micro-climate and provide visual and fragrant enjoyment. As the sun sets, one enjoys the passive ventilation on the transitional porch and ponders the day. Like a sailboat, the BeauSoleil Home readily allows you to go about the rituals of life while at the same time enjoying and benefiting from the natural environment.

MARKET VIABILITY JUSTIFICATION

Livability

The BeauSoleil Louisiana Solar Home was carefully designed to address the inhabitants' comfort, privacy, convenience, functionality, flexibility, safety, accessibility, and need to maintain the home. TEAM BeauSoleil strongly believes that an environmentally sustainable, regional and marketable home cannot compromise the owner's comfort or convenience. The BeauSoleil Home addresses our Louisiana lifestyle which implies a culture predicated on entertaining and socializing, cooking and family. A strong connection to the exterior environment is essential to our culture as well. The Transitional Porch of the BeauSoleil home is one example of a feature which responds to this need for exterior connection and need for functionality, flexibility and convenience by creating a bridge to the environment.

Beginning with the exterior, the BeauSoleil home is designed for low-maintenance with naturally weathered cypress cladding which will not require repainting or refinishing. The galvalume standing seam roof and corrugated siding offer the best life cycle costs and the least maintenance required. Aluminum-clad windows and FSC-grown hardwood decking will last decades without maintenance. On the interior, gypsum board ceilings and walls provide the most economical, readily-repairable and hypoallergenic finishes. Naturally finished, oak floors, oak cabinets and trim also offer maintenance-free, beautiful surfaces.

The aesthetics of the BeauSoleil Home were also carefully considered for market-viability. Just as the design of the home offers sustainable features without compromising comfort, the aesthetics of the home combine traditional forms and materials along with a nod to the future with contemporary materials and forms. It is a hybrid house: at once modern and traditional, old and new, simple yet complex and quiet yet bold. The traditional and iconic gable on the east facade is balanced by a more asymmetrical and complex western facade. The traditional southern facade with vertical proportions and shutters is complimented by the more modern horizontal, minimal detailing of the north side.

The highly-efficient mini-split HVAC system ensures maximum temperature comfort and flexibility. The three zones allow each part of the house to adjust and adapt to the individual inhabitant and uses. A dehumidifier removes unwanted humidity in the summer which is a chronic comfort problem in Louisiana and along the Gulf Coast in general. Other amenities which enhance livability are as follows:

| Other Livability-Enhancing Amenities | |
|---|---|
| 1. Operable windows | 10. Easy to clean surfaces |
| 2. Ipe butcher block counters which are extremely durable and can be refinished | 11. Hardwood floors offer beauty, durability and ability to be refinished |
| 3. Roll-down insect screens which double as shading devices in the Transitional Porch | 12. Ceramic tile in bath and laundry offer durability, easy to clean surface and economy |
| 4. Rolling recycling and trash receptacle | 13. High (13+') vaulted ceilings |

| | |
|---|---|
| 5. Adjustable counters for space saving in kitchen | 14. Increased clearance in kitchen, bath, bedroom and hallway for universal accessibility |
| 6. Conveniently located herb garden on kitchen porch | 15. Large 10'x10' kitchen |
| 7. Stainless Steel Appliances | 16. Highly adjustable lighting for flexibility |
| 8. Vegetable and herb gardens | 17. Low-voltage LED lamps which do not have to be changed for 15-20 years |
| 9. Large 7'x10' bathroom w/ large medicine cabinet | 18. Rolling desk/work area in Bedroom |

Buildability

The BeauSoleil Louisiana Solar Home is designed to be readily reproducible by a modular home manufacturer. To accomplish this task, the design employs a logical construction sequence, standardized materials and thorough construction documentation. The construction drawings and specifications for the BeauSoleil Louisiana Solar Home are comprehensive and formatted according to architectural best practices and the Construction Specifications Institute. With over 150 sheets of detailed drawings and 300 pages of written specifications, the BeauSoleil Home is readily reproducible. In fact, as discussed below, TEAM BeauSoleil has been working with a modular home manufacturer since the beginning of the design process in order to assure that the home will be build-able. Modular/ Prefabricated construction is perfectly suited to the fabrication of the BeauSoleil Louisiana Solar Home. Structural Insulated Panels and automated production, which is readily available today, allow for accurate, fast and economic construction of the BeauSoleil Home. Finally, the design of the expandable modules allows for additional spaces to be added to the home over time.

Marketability

At the core of its beliefs, TEAM BeauSoleil has sought to market directly to the general public in the Gulf Coast Region, and in particular the average household interested in sustainable living design. Specifically, it has been conceived as a prototype for a mass-produced, hurricane-resistant home that is affordable, sustainable, and durable. We intend for the home to be financially and culturally viable for the end-user, not a high-tech, expensive gadget.

Historically, Louisiana and the Gulf Coast in general have served as a highway for energy production efforts from our land and our gulf waters nearby. We have witnessed the environmental and economic consequences of this reliance, and Louisiana residents in particular, are waking up to the need for alternative energy resources.

The BeauSoleil Home will be presented to Louisiana at a time when our housing market is experiencing a rebirth from the 2005 and 2008 hurricane seasons. Unlike other areas of the country, homebuilding continues on an upward trend as recovery funds continue to flow into the Gulf States region. The need for sustainable design and alternative energy is now being recognized by a majority of the public. Hurricanes Katrina and Rita destroyed or damaged almost 1/3rd of all Louisiana's housing *(31% according to http://www.accessmylibrary.com/coms2/summary_0286-28777652_ITM.)* Therefore, in the aftermath of these 2005 storms and Hurricanes Gustav and Ike in 2008, there has been and will continue to be a high demand for resilient, self-sufficient housing. The BeauSoleil Louisiana Solar Home has been designed by hurricane survivors who know what worked and what did not.

Combine this environmental awareness with the love of our local culture, and in particular our French heritage and Cajun music, and the BeauSoleil Home is superbly positioned. By positioning the home as a uniquely regional example of our architectural vernacular that can withstand the effects of a Category 3 hurricane, the BeauSoleil Home will be relevant and appropriate for South Louisiana. Having experienced FEMA trailers and "Katrina Cottages" firsthand, people in the Gulf region understand the need for resilient and sustainable emergency housing in the form of readily available, long-term options. In fact, in a recent marketing research survey of 377 adults in Lafayette, Louisiana, the three features of the BeauSoleil Home that respondents were most familiar

with were its sustainability, and its ability to withstand hurricane-force winds and give power back to the grid. Regarding attitudes, on average, almost one-third of respondents gave highly favorable ratings indicating that the BeauSoleil Home had not only taught them about alternative energy use and sustainable housing design options, but had also helped to convince them to adopt more green practices and to consider living in a solar home. 42% agreed or strongly agreed that the BeauSoleil Home addresses very important issues for our children as well. (36% of the sample were local-area business people, 30% were University of Louisiana alumnae and 30% were students. Thirty-six percent were under 25 years old, 21% age 25-35, 15% age 36-45, 16% age 46-55, 8% age 56-65, and 3% over age 65, with about equal numbers of men and women.)

It is our intent to commercialize and mass-produce the BeauSoleil Home with our modular home manufacturing partner, Louisiana System Built Homes. Based on producing 100 units, we have established a budget of $125,000 for the mass-produced model of the BeauSoleil Home. This price is based on the HUD Fannie Mae home calculator, which is based on the median-income family in Louisiana earning approximately $50,000 per year.

Initially, the home was designed for residents of the coastal south who specifically want the Acadian vernacular style, but our hope is that it can eventually be designed to fit the needs of customers in other regions of the country as well, without losing its unique characteristics.

TEAM BeauSoleil understands that the Market Viability contest of the 2009 Solar Decathlon is based upon the competition home brought to the mall with only a few alternates to account for permanent sites in Louisiana. The budget for the competition version of the BeauSoleil Home is approximately $250,000. Therefore, at a cost of $312 per square foot, the occupant demographic for the competition house shifts to Empty-Nesters. Based on the HUD Ginnie Mae home calculator (http://www.ginniemae.gov/2x_prequal/intro_results.asp) the income for this demographic is $120,000 or greater per year. The BeauSoleil Home, although a one-bedroom home, is designed to accommodate guests in the living room or in the Transitional Porch when converted to a sleeping porch.

From the beginning, careful and honest interpretations have informed our decisions regarding the design of the BeauSoleil Home. During the initial design phases, six bi-weekly public charrettes were held to test consumer perceptions and acceptance of the preliminary designs. These charrettes provided us with useful feedback that described the unique needs and desires of our target markets. We gathered valuable insight from attendees whom we believe exhibited characteristics of both the median income range demographic for the commercialization model, and of the empty nesters (both single and married) demographics for the prototype model in the competition. Similarly, informal personal interviews with others fitting these demographics provided additional information that helped us better understand the proposed BeauSoleil Home target segments.

Based on our research findings, some of the characteristics of Empty Nesters segments in South Louisiana are best described by Baby Boomers (age 47-63) in two of ESRI's Community Tapestry market segment groups (www.ESRI.com/Tapestry). Tapestry segments U.S. consumers into groups based on Lifemodes, Urbanization Levels, and Income Ranges. These two Tapestry groups "Prosperous Empty Nesters", and "Silver and Gold" segments share an active, athletic lifestyle, appreciation for the Arts and learning, and most have some college or an undergraduate degree, with middle incomes. According to an article in the New York Times by Stuart Elliot (April 20, 2009,) the newest Baby Boomers are unlike traditional older consumers. They are comfortable with new offerings and by next year, Boomers, between 55-64 years of age, should account for the highest median income.

The BeauSoleil Home will be offered in a fairly new product market. As is typically the case with the introductory phase of the product life cycle, diffusion may occur somewhat slowly. Adoption of the home should increase more quickly as acceptance spreads, new technologies are developed, and costs for solar and alternative energy designs decrease. We describe the innovators (first to adopt) in our target market as "environmentalists" who typically try to use recycled and "green" materials when building or remodeling their homes. They may also do composting, drive a hybrid, or possibly

utilize rain water. These consumers make it their mission to better the world in as many ways as possible.

We describe the early adopters (second to adopt) in our target market as the "green movement consumers" who are those people just beginning to listen and realize what all of our past and present mistakes are doing to the earth. They are searching for information regarding alternative, responsible options for living and choosing those options that are most viable for them.

The early majority (third to adopt) in our target market are described as "money savers" who are simply looking to save money in some way and not necessarily concerned with helping the environment as much as with finding less expensive options for living.

The BeauSoleil Home was designed for the Gulf coast region, and for areas with different levels of density. The area of density where the BeauSoleil Louisiana Solar Home would be the most market viable, hurricane-resistant housing option is:

| Target Market I.D. Parameter | Target Market Suburban Density |
|---|---|
| Location of permanent site | Lafayette, LA |
| Housing type | Single Family |
| # of occupants | 1-2 |
| Occupant demographic | • Baby Boomers, age 47-63<br>• Single or married<br>• Tapestry groups "Prosperous Empty Nesters" and "Silver & Gold" |
| Homeowners annual income | $120,000 + |
| # of bedrooms | 1 |

ENGINEERING NARRATIVE

## A Balanced Hybrid

From the outset, TEAM BeauSoleil has been committed to designing a balanced, technological hybrid of passive and active systems. By employing a hybrid systems approach, overall energy consumption is reduced while also reducing construction cost. This strategy is intended to increase market viability and life-cycle costs for the future homeowner.

## Summary of Primary Components

Electrical
- 26 205W Sanyo PV panels and 13 Sanyo 195W Bifacial Panels
- Low Watt LED lighting throughout
- Energy Star appliances throughout
- Wattstopper lighting controls
- Electric water heater to supplement solar hot water system

Mechanical
- Mitsubishi Mr. Slim Ductless Mini Split Heat Pump with 1 12,000BTU blower and 2 9,000 BTU blowers
- Ultra-Aire Dehumidifier with Humidistat and fresh air intake with operable damper
- Updraft Hood above stove
- Mechanical vent in bathroom to prevent mildew buildup

Plumbing
- Solar water heater
- Cistern for domestic water supply
- Waste tanks below deck with drains below removable sections of deck for access
- Low flow fixtures throughout
- Energy Star appliances throughout
- PEX Piping for supply lines

Structural
- 2x12's @ 12" o.c. joist floor framing
- 6-1/2" Structural Insulated Panel walls
- 8-1/2" Structural Insulated Panel roof
- Supplemental steel framing at porch opening and projecting elements

## Electrical Engineering

Powering the electrical loads of the BeauSoleil Home are some of the most efficient yet affordable Photovoltaic modules available: twenty-three (23) 205 watt Sanyo HIT Power 205 PV modules, and thirteen (13) 195 Bi-Facial Sanyo HIT Double 195 PV modules. At peak power, the system generates approximately 8kW. In energy simulations using a scaled down test array and TMY data, the system has been predicted to generate a nearly zero net metered energy balance result over the course of the

competition (Refer Energy Analysis and Discussion.)
In addition to the energy conservation due to its high thermal performance, the home utilizes Energy Star appliances, LED and CFL lighting and lighting controls with timers and sensors in order to maximize home comfort and energy efficiency. Over a twenty-year life-cycle analysis for the home it is estimated that the all of the energy-saving and energy-producing features will be pay for themselves and generate $40,000 in savings (findsolar.com.)

## Mechanical Engineering

The plumbing in the BeauSoleil Home is flexible PEX piping which is easy to work with and is safer than copper when dealing with freezing temperatures. Copper piping is used above the floor where freezing is not an issue. Supply and wastewater storage will be accomplished with modular tanks for ease of transport and assembly. A freestanding cistern will serve as the supply tank and the waste tanks will be located under the decks. Also, the cistern will be reused for rainwater collection upon returning to Louisiana. All plumbing fixtures in the home are low flow to conserve water.

Our closed-loop solar water heating system is unique in that the heat collector in integrated into a prefabricated structural roof system. The heat collectors are fin-shaped to increase their surface area. This allows them to double as shading devices to reduce glare and heat gain while providing some light penetration. Complementing this system will be a back-up electric on-demand, water heater. According to Energysaver.gov, a solar water heater like ours will generate between $13-20 per month savings while reducing your water-heating bill (one of the largest loads) by 50-80%.

The Air Conditioning system is a very high efficiency ductless mini-split heat pump which takes advantage of the latest inverter technology and uses environmentally friendly R-410A refrigerant. The multiple indoor units offer zoning within the house with individual zone temperature control with multiple indoor units and only one outdoor unit. The system smartly delivers refrigerant from the outdoor unit to multiple indoor units as capacity is needed and the refrigerant flow varies with capacity requirements. There are no duct losses with the multiple ductless indoor units. Smart sensing technology and microprocessors enhance the system's ability to measure room temperature accurately for added comfort, performance, and efficiency. Because we used SIPS construction which is known for having a tight building envelope and because of our climate in South Louisiana, we decided to complement the HVAC system with a dehumidifier to ensure comfortable humidity levels and to allow for the introduction of fresh air.

## Structural Engineering

The 6-1/2" walls and 8-1/2" roof of the BeauSoleil Home are built with SIPS construction which accomplishes two goals. The first is that we are able to achieve a high R-Value for both the roof and walls, meaning the already efficient HVAC system will not have to run as often. Secondly, we are able to build the home in controlled factory conditions which lends itself to fast and efficient construction, minimizes waste, and makes future mass production easier.

The TEAM is collaborating with a local structural engineer and a local modular home manufacturer, Louisiana System Built Homes. Therefore, the structure is also a hybrid of typical modular home construction with additional steel framing added for extended and multiple transports for the competition. However, most of the added steel framing could be eliminated in the production model of the home. After returning from the competition the team intends to work with Louisiana System Built Homes in order to begin mass producing the home at their factory.

## Conclusion

Because South Louisianans are closely tied to their environment, we tried to ensure that every piece of cutting edge, efficient technology is complemented with a common sense, simple, passive strategy. The Overall, the BeauSoleil Home balances the design and use of highly-efficient systems with simplicity and convenience in order to present a viable alternative to the homeowner.

LIGHTING NARRATIVE

## A Mix of Lighting Technologies

The lighting technology used in the BeauSoleil Louisiana Solar Home provides a rich and varied experience through the use of traditional residential lighting types and new energy saving lamp types. In a walk through of most residential settings today in the US one would expect to find primarily incandescent sources with occasional fluorescent sources. The consuming public enjoys these lamp types for both their convenience and the warmth of color they provide.

The BeauSoleil Home includes incandescent light sources in locations where color rendering is critical and where suitable alternatives were unavailable. Incandescent halogen sources are used in the light kits that are part of the fans in three of the spaces. MR-16 halogens spot lights are also to highlight art because of the quality of the color rendering they provide.

For increased energy efficiency, both CFL and T5 fluorescents are used in the solar home. Quality of light in terms of color temperature and color rendering continues to advance because of innovations in lamp production. The lighting team is taking advantage of lighting advances in the fluorescent lamps used in the home. Under-cabinet lamps in the kitchen are T5s, as well as the soffit lamps used on the exterior at the kitchen entrance and transitional porch. A footcandle level of 50 can be obtained at the work counter from the T5 under cabinet lights. CFL lamps are used in the overhead luminaires on the transitional porch and all of the light sources are fluorescent in the bathroom. A footcandle level of 30-50 is obtained at the lavatory in the bath and sufficient light is provided in the bathing area both from the fluorescent sources and the daylight in the “bump out” windows.

A model solar home that positions itself on the leading edge would be incomplete if it did not incorporate some form of LED technology. LED technology holds great potential because of the dramatic energy savings obtained through their use. The decision was made to selectively use this technology in order to obtain the energy savings over traditional lamp types. LED lamps are used in locations where color rendering is not critical and a warm Kelvin type is used to give the color temperature and consumers enjoy with current incandescent sources.

## A Layered Lighting Design

The lighting goal for the home is to create a relaxed environment that encourages socialization though the color and application of energy reducing technology. The lighting design for the Beau Soleil Louisiana Solar Home addresses interior lighting though three layers of light; ambient, accent, and task lighting. For the entire project, lighting sources were used with a warm white color temperature (2800-3200 K). The project also required a CRI of 80 or greater for all sources, especially in areas of food preparation and dressing. A rich and varied experience is created by the layers of light, by the use of three different lamp types (incandescent, fluorescent and LED) and by varying the lighting experience in each room.

In the Living Area and Bedroom, ambient light is created overhead by grazing the ceilings a high output, warm white LED light via a linear fixture. The light bathes the ceiling in a glow and maximizes lighting levels by using the ceilings as a large reflector, essentially allowing the ceiling to become an extension of the LED fixture. The effect of the glowing overhead plane is that of a late afternoon sky.

The second layer of light in these spaces is accent light that illuminates art by South Louisiana regional artists. A dual wire low voltage lighting system was chosen because it could be wall mounted, eliminating the need for extensive wiring in the ceiling SIPS panels, and because of the flexibility of adjusting the light where needed. Fixtures are fully adjustable and directed toward the art. The source is an MR-16 halogen lamp with a high CRI of roughly 95. The use of this incandescent source was based on the color rendering requirements of the art, and though it uses more energy, it better suits this application and adds to the varied lighting experience.

The final layer of light in the Living and Bedroom Areas is the task lighting. The proper footcandle level ($\geq$50) is achieved at the bedroom desk by using an LED MR-16 at the desk area The choice for LED rather than halogen was made because reading is not dependent on high color rendering. This 50 fc level is also achieved for reading in the living area by the high wire dropped pendant light.

The Transitional Porch takes a different lighting strategy. This flexible space can adjust from interior to exterior, serves as the primary place for taking meals, and plays an essential entertainment role, considering the importance of food in the Cajun culture. Again layers of light are used beginning with an ambient light of warm white CFLs from wall mounted overhead fixtures that are directed downward to provide adequate light for dining. A second layer of accent light is provided by floor mounted MR-16 up-lights that create columns of light in the four corners of the space. Another layer of accent light is found in overhead perforated metal panels that define the place between the interior and the exterior areas. Linear fluorescent fixtures behind the perforated panels allow light to pass through the perforations, creating a filtered light that defines this boundary.

In the Kitchen, a different and complementary approach is taken. Ambient light is provided by over-cabinet linear LED tape lights that direct light overhead. Instead of grazing the ceiling, as in the Living and Bedroom areas, this fixture focuses the light more intensely above the cabinets. This uneven level of overhead illumination is intended to create a relaxed mood (Flynn). Task lighting is supplied by low-output, under-cabinet linear T5 fluorescent fixtures in order to supply the recommended 50 fc level at the work surface. Finally, accent MR-16 wall-mount spotlights focus the eye on art in the space.

Exterior lighting once again uses layers of lighting; primarily task and accent lighting. The task of walking up the steps is defined by stair LED lights. The Transitional porch's entrance is complemented by the four CFL wall sconces that define the edges of the Transitional porch. Finally, underwater pool LED spots accent the aquatic plants and providing safety lighting to those relaxing on the deck. In order to prevent night sky pollution pool lights use the building to provide a cut off for the light so that none escapes into the dark sky.

### Daylighting Quality

Human factors were considered when examining the quality of daylight entering the spaces. Research has demonstrated that the ability to control the lighting conditions in a space increases the enjoyment of that space, therefore control of daylight though the use of blinds and shutters allow for increased user enjoyment. In the Beau Soleil Louisiana Solar Home, interior roll shades block out unwanted glare, harmful UV radiation and give the occupant control of their lighting environment and allows for user preference in terms of quantity of daylight entering the space. Harmful UV radiation from direct daylight is also diminished though moveable exterior shutters. These shutters give the additional benefit of preventing damage during the hurricane season that south Louisiana experiences annually. Sufficient daylight exists though many windows for plant life. Horizontal south facing windows and vertical north facing windows create variety and allow for both light control and views from the interior to the outdoors.

## Ease of Operation and Efficiency

Varied lighting control methods are used in the home interior that are intuitive in their operation and provide energy savings. The accent light for illuminating artwork in the kitchen is controlled by a dimming occupancy sensor. Timer switches are used for above and under cabinet lighting that allow for manual on and timed off at intervals between 1 and 60 minutes. In the porch and the illuminated wall between the bath and living room extended time delay switches are used and are manual on and timed off. For all of the dual track lighting in the kitchen, living room and bedroom vacancy sensors with manual on are used. On the exterior step lights motion sensors are automatic on and timed off, while pool light and pole mounted deck lights are extended time off and manual on. The combination of manual-on and timed or vacancy-off switching gives occupants ease of operation and reduced energy consumption throughout the year.

## Flexibility

By using ambient, task, and accent light, along with incandescent, fluorescent and LED sources, and varying the combination in each of the spaces, with a variety of lighting control systems, the Beau Soleil Louisiana Solar Home gives its occupants tremendous flexibility in order to meet the range of user needs throughout the year.

Aesthetically, the fixture selections relate to the Louisiana culture, and in the exterior jar luminaires, or are of a sleek, modern appearance like the Living area reading light, the dual track system or the LED bar lights. The lighting reflects the concept of the BeauSoleil home in that the building mixes the traditions of the region along with the technology to today.