REQUEST FOR PROPOSALS

for

Greenhouse Kit Installation

for

Annmarie Sculpture Garden & Arts Center, Solomons, Maryland

Bids will be submitted to:
Ann's Circle, Inc. dba Annmarie Sculpture Garden & Arts Center
Provide bids on or before: October 25, 2023, 4:00pm

For further information contact:

Stacey Hann-Ruff, Director
Annmarie Sculpture Garden & Arts Center
13470 Dowell Road, Solomons, Maryland 20688
t. 410-326-4640   jobs@annmariegarden.org

www.AnnmarieGarden.org

Ann’s Circle, Inc. reserves the right to accept/reject any or all proposals.
Request for Proposal
Annmarie Sculpture Garden & Art Center
13470 Dowell Road, Solomons, MD 20688
Greenhouse Kit Installation

This request for bid proposal is for installation of a Janco Greenhouse, Standard Rancher 21 Model, including footers, basewall, concrete pads, and greenhouse structure. Greenhouse kit provided by client.

Bid proposal requested will be for:

Construction of a Rancher 21 A-Frame Greenhouse to be a Straight-Eave model designed to sit on a 36” tall basewall foundation. Bid to include footers, basewall, concrete pads, and greenhouse fabrication. Greenhouse kit provided by client.

Supporting documents include:
- Concrete Foundation Floor Plan
- Rancher 21 specs
- Map of location

Bids should include separate quotes for:
1) Footers, knee wall, & concrete pads
2) Greenhouse kit fabrication

Important Information:
Greenhouse kit provided on site; includes:
- Aluminum framing & 1-beam substructure
- 1/8” Clear tempered glass
- 2 Continuous manually operated ridge vent (12 sections long)
- Screen for all vent openings
- 2 Gable end walls
- Single commercial door
- Vent-o-matic vent operator
- 20” Exhaust fan with intake louver w/ thermostat
- 2 – 14” Horizontal air flow fans (includes hanging kit & plug)
- 60K BTU Natural Gas/propane hanging heater (includes thermostat & hang kit; flue pipe by others

Client will secure permit
Bidder must provide proof of liability insurance & workman’s comp
Bidder must provide three references of prior relevant work

Any questions may be emailed to Stacey Hann-Ruff at director@annmariegarden.org

Proposals need to be received by October 25, 2023, 4:00pm. A pre-construction meeting after award and prior to commencement of work is required.
BID SUBMITTAL SHEET

Janco Greenhouse Kit Installation

PROJECT ELEMENTS AND COSTS

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description</th>
<th>Cost for each item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Footers, knee wall &amp; concrete pads</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Greenhouse kit fabrication</td>
<td></td>
</tr>
</tbody>
</table>

Maryland Tax Exempt, do not include tax in bid: Ann’s Circle, Inc., #20-5109378

Total Cost __________

Bidders Name: ________________________________________________

Address: ______________________________________________________

______________________________________________________________

Telephone: ___________________________________________________

Fax: ________________________________________________________

Signature: ___________________________________________________ 

Date: ________________________________________________________
Annmarie Sculpture Garden & Arts Center
Office address: 13470 Dowell Road, Solomons, MD 20688

Greenhouse to be located at: 13320 Dowell Road, Solomons, MD 20688

Greenhouse location indicated in red
4" #57 Stone

23' 6"

6' 6"

4' 0"

4" Interior Concrete Slab

4" #57 Stone

8" Parged cinderblock wall
Filled with concrete
Extending Four feet above finished grade

*Benchmark grade for finished floor will be provided

* All Concrete slabs 3500 psi w/ 6x6-W2.0 x W2.0 Reinforced Wire Mesh

Offset 16 from garden fence

Tie into existing asphalt path

Annemarie Scupture Garden & Art Center
13470 Dowell Road Solomons, Maryland 20686

Concrete Foundation Floor Plan

Scale: Not To Scale

Annmarie Garden Sculpture Garden
Date: 10/1/2023
&A Art Center Greenhouse
Page: 1 of 1
## STRUCTURAL CALCULATIONS

<table>
<thead>
<tr>
<th>PROJECT NO.</th>
<th>2309015</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT:</td>
<td>Janco Greenhouses, Inc</td>
</tr>
<tr>
<td>PREPARED BY:</td>
<td>Moe Aldeceily</td>
</tr>
<tr>
<td>CHECK &amp; QC:</td>
<td>DATE: 09/09/2023</td>
</tr>
</tbody>
</table>

### PROJECT INFORMATION

**SCOPE OF WORK:** Generate structural and seismic calculations for this job

**BILLING ADDRESS:**

<table>
<thead>
<tr>
<th>ADDRESS:</th>
<th>3333 S Fraser Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>CITY:</td>
<td>Georgetown</td>
</tr>
<tr>
<td>STATE:</td>
<td>SC</td>
</tr>
<tr>
<td>ZIP:</td>
<td>29440</td>
</tr>
<tr>
<td>COUNTRY:</td>
<td>USA</td>
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</table>

**CONTACT:**

<table>
<thead>
<tr>
<th>NAME:</th>
<th>Zack Clewer</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEL:</td>
<td>(800) 323-6933</td>
</tr>
<tr>
<td>E-MAIL:</td>
<td><a href="mailto:zack@jancoinc.com">zack@jancoinc.com</a></td>
</tr>
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</table>

**SITE ADDRESS:**

<table>
<thead>
<tr>
<th>ADDRESS:</th>
<th>13470 Dowell Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>CITY:</td>
<td>Solomons</td>
</tr>
<tr>
<td>STATE:</td>
<td>MD</td>
</tr>
<tr>
<td>ZIP:</td>
<td>20688</td>
</tr>
<tr>
<td>COUNTRY:</td>
<td>USA</td>
</tr>
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</table>

**REFERENCES:**

| 2018 IBC/ASCE 7-16 |

Acceptance and use of this report by any party constitute a contractual agreement that the Engineers total liability arising out of or in any way related to this analysis and report shall not exceed the total sum paid to the Engineer for the services provided. Liability does not exist beyond the analysis contained in this report.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTENTS</td>
<td>2</td>
</tr>
<tr>
<td>LOAD CALCULATION</td>
<td>3</td>
</tr>
<tr>
<td>STRUCTURAL ANALYSIS</td>
<td>17</td>
</tr>
</tbody>
</table>
Project:
For: Janco Greenhouses and Glass Structures
Location: 13470 Dowell Road Solomons MD 20688
Relevant Codes: IBC 2018, ASCE 7-16

**Dead Load**

\[ DL = 10 \text{ psf} \]

Considered Roof Dead Load

\[ t_w = 6 \text{ ft} + 20.25 \text{ in} = 7.688 \text{ ft} \]

Tributary Width

\[ DL_t = DL \cdot t_w = 76.875 \text{ psf} \]

**Roof Live Load**

\[ RLL = 20 \text{ psf} \]

Considered Roof Live Load

Table 4.1 (ASCE 7-16)

\[ RLL_t = RLL \cdot t_w = 153.75 \text{ psf} \]
Snow Load

\[ P_g = 25 \text{ psf} \]

Ground snow load
ASCE 7-16 Figure 7.2-1

\[ \gamma = 0.13 \cdot \frac{P_g}{ft} + 14 \text{pcf} = 17.25 \text{pcf} \]

Density of snow (ASCE 7-16; Eqn 7.7-1)

\[ s = \frac{4}{12} \]

Roof slope (Always x/12)

\[ \theta = \text{atan}(s) = 18.435 \text{ deg} \]

Roof Angle

\[ C_e = 0.9 \]

Snow exposure factor, fully exposed (ASCE 7-16; Table 7.3-1)

\[ C_t = 0.85 \]

Thermal factor (ASCE 7-16; Table 7.3-2)

\[ C_s = 1 \]

Roof slope factor (ASCE 7-16; Fig 7.4-1)

\[ I_s = 1 \]

Importance factor (ASCE 7-16; Table 1.5-2)

\[ P_f = 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot P_g = 13.388 \text{ psf} \]

Flat Roof Snow Load

If \( 2.38 \text{ deg} < \theta < 30.2 \text{ deg} \), "unbala snowload", "No unbala snow load") = "unbala snowload"

<table>
<thead>
<tr>
<th>Risk Category from Table 1.5-1</th>
<th>Snow Importance Factor, ( I_s )</th>
<th>Ice Importance Factor—Thickness, ( l_t )</th>
<th>Ice Importance Factor—Wind, ( l_w )</th>
<th>Seismic Importance Factor, ( I_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.80</td>
<td>0.80</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>II</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>III</td>
<td>1.10</td>
<td>1.15</td>
<td>1.00</td>
<td>1.25</td>
</tr>
<tr>
<td>IV</td>
<td>1.20</td>
<td>1.25</td>
<td>1.00</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Note: The component importance factor, \( I_p \), applicable to earthquake loads, is not included in this table because it depends on the importance of the individual component rather than that of the building as a whole, or its occupancy. Refer to Section 13.1.3.
Table 7.3-1 Exposure Factor, $C_x$

<table>
<thead>
<tr>
<th>Surface Roughness Category</th>
<th>Fully Exposed</th>
<th>Partially Exposed</th>
<th>Sheltered</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (see Section 26.7)</td>
<td>0.9</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td>C (see Section 26.7)</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td>D (see Section 26.7)</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Above the tree line in windswept</td>
<td>0.7</td>
<td>0.8</td>
<td>NA</td>
</tr>
<tr>
<td>mountainous areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Alaska, in areas where trees do not exist within a 2-mi (3-km) radius of the site</td>
<td>0.7</td>
<td>0.8</td>
<td>NA</td>
</tr>
</tbody>
</table>

The terrain category and roof exposure condition chosen shall be representative of the anticipated conditions during the life of the structure. An exposure factor shall be determined for each roof of a structure.

Definitions:
- Partially Exposed: All roofs except as indicated in the following text. Fully Exposed: Roofs exposed on all sides with no shelter afforded by terrain, higher structures, or trees. Roofs that contain several large pieces of mechanical equipment, parapets that extend above the height of the balanced snow load ($h_s$), or other obstructions are not in this category. Sheltered: Roofs located in an area affected by obstructions.
- Obstructions within a distance of 100 ft, provide "shelter," where $h_s$ is the height of the obstruction above the roof level. If the only obstructions are a few deciduous trees that are leafless in winter, the "fully exposed" category shall be used. Note that these are heights above the roof. Heights used to establish the Exposure Category in Section 26.7 are heights above the ground.

Table 7.3-2 Thermal Factor, $C_t$

<table>
<thead>
<tr>
<th>Thermal Condition</th>
<th>$C_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>All structures except as indicated below</td>
<td>1.0</td>
</tr>
<tr>
<td>Structures kept just above freezing and others with cold, ventilated roofs in which the thermal resistance (R-value) between the ventilated space and the heated space exceeds $2.5,{\text{F}}\times{\text{h}}\times{\text{ft}}/\text{Btu} (4.4,\text{K}\times\text{m}^2/\text{W})$</td>
<td>1.1</td>
</tr>
<tr>
<td>Unheated and open air structures</td>
<td>1.2</td>
</tr>
<tr>
<td>Freer building</td>
<td>1.3</td>
</tr>
<tr>
<td>Continuously heated greenhouses with a roof having a thermal resistance (R-value) less than $2.5,\text{F} \times h \times ft/\text{Btu}$ (0.4 K x cm²/W)</td>
<td>0.85</td>
</tr>
</tbody>
</table>

These conditions shall be representative of the anticipated conditions during winters for the life of the structure.

Greenhouses with a constantly maintained interior temperature of 50°F (10°C) or more at any point 3 ft (0.9 m) above the floor level during winter and having either a maintenance attendant on duty at all times, or a temperature alarm system to provide warning in the event of a heating failure.

FIGURE 7.4-1 Graphs for Determining Roof Slope Factor, $C_s$, for Warm and Cold Roofs (See Table 7.3-2 for $C$, Definitions)
**Sloped Roof Snow Load**

**Balanced Snow Load**

\[ P_{bal} := C_s \cdot P_f = 13.388 \text{ psf} \]

\[ P_{bal,t} := P_{bal} \cdot t_w = 102.916 \text{ plf} \]

**Unbalanced Snow Load (W<20ft)**

\[ P_{unbal} := P_s \cdot I_s = 25 \text{ psf} \]

\[ P_{unbal,t} := P_{unbal} \cdot t_w = 192.188 \text{ plf} \]
Wind Load (Enclosed structure)

Wind Exposure: c

\[ V_{ult} := 126 \text{ mph} \quad \text{Ultimate Wind Speed} \]

Risk category: II

\[ V := V_{ult} = 126 \text{ mph} \quad \text{Risk category} \]

\[ \theta := \text{atan}(s) = 18.435 \text{ deg} \quad \text{Roof Angle} \]

\[ B := 31 \text{ ft} + 3 \text{ in} = 31.25 \text{ ft} \quad \text{Horizontal dimension of building,} \]

\[ \text{(measured normal to wind direction)} \]

\[ L := 20 \text{ ft} + 11.5 \text{ in} = 20.958 \text{ ft} \quad \text{Horizontal dimension of building,} \]

\[ \text{(measured parallel to wind direction)} \]

\[ h := \frac{4 \text{ ft} + 0.25 \text{ in} + 7 \text{ ft} + 7.375 \text{ in}}{2} = 5.818 \text{ ft} \quad \text{Mean roof height, except that eave height} \]

\[ K_z := 0.85 \quad \text{Velocity Pressure Exposure Coefficient} \]

\[ (\text{Table 26.10-1 of ASCE 7-16}) \]

\[ K_{zt} := 1.0 \quad \text{Topographic Factor} \]

\[ (\text{Figure 26.8-1 of ASCE 7-16}) \]

\[ K_d := 0.85 \quad \text{Wind Directionality Factor} \]

\[ (\text{Table 26.6-1 of ASCE 7-16}) \]

\[ G := 0.85 \quad \text{Gust factor} \]

\[ q_z := 0.00256 \frac{\text{psf}}{\text{mph}^2} \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 = 29.364 \text{ psf} \quad \text{Velocity pressure Equation ASCE 7-16} \]
**Internal Pressure coefficients (GC_{pi})**

\[ GC_{pi,P} := 0.18 \]
\[ GC_{pi,N} := -0.18 \]

**Internal pressure coefficient (Positive)**

**Internal pressure coefficient (Negative)**

**External Pressure coefficients (C_p)**

\[
\begin{bmatrix}
C_{p,WW\_Wall} \\
C_{p,WW\_Roof,1} \\
C_{p,WW\_Roof,2} \\
C_{p,LW\_Wall} \\
C_{p,LW\_Roof,1} \\
C_{p,LW\_Roof,2} \\
C_{p,SideWall}
\end{bmatrix}
= 
\begin{bmatrix}
0.8 \\
-0.363 \\
-0.494 \\
-0.5 \\
-0.7 \\
-0.6
\end{bmatrix}
\]

**ASCE 7-16 Table 26.13-1**

**ASCE 7-16 Figure 27.3-1**

**Interpolation**

\[
x_1 := 15 \quad y_1 = -0.7 \\
x_2 := 20 \quad y_2 = -0.4 \\
x = 18.435 \\
y := y_1 + \frac{(y_2 - y_1)}{(x_2 - x_1)} \times (x - x_1) = -0.404
\]

\[
\begin{bmatrix}
P_{WW\_Wall,1} \\
P_{WW\_Wall,2} \\
P_{WW\_Wall,3} \\
P_{WW\_Roof,1} \\
P_{WW\_Roof,2} \\
P_{WW\_Roof,3} \\
P_{LW\_Wall,1} \\
P_{LW\_Wall,2} \\
P_{LW\_Wall,3} \\
P_{LW\_Roof,1} \\
P_{LW\_Roof,2} \\
P_{LW\_Roof,3}
\end{bmatrix}
= 
\begin{bmatrix}
P_{t_w \cdot q_t \cdot C_{p,WW\_Wall}} \\
P_{t_w \cdot q_t \cdot C_{p,WW\_Roof,1}} \\
P_{t_w \cdot q_t \cdot C_{p,WW\_Roof,2}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Wall}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Roof,1}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Roof,2}}
\end{bmatrix} \times \begin{bmatrix}
C_{p,WW\_Wall} \\
C_{p,WW\_Roof,1} \\
C_{p,WW\_Roof,2} \\
C_{p,LW\_Wall} \\
C_{p,LW\_Roof,1} \\
C_{p,LW\_Roof,2}
\end{bmatrix}
\]

\[
\begin{bmatrix}
P_{WW\_Wall,1} \\
P_{WW\_Wall,2} \\
P_{WW\_Wall,3} \\
P_{WW\_Roof,1} \\
P_{WW\_Roof,2} \\
P_{WW\_Roof,3} \\
P_{LW\_Wall,1} \\
P_{LW\_Wall,2} \\
P_{LW\_Wall,3} \\
P_{LW\_Roof,1} \\
P_{LW\_Roof,2} \\
P_{LW\_Roof,3}
\end{bmatrix}
= 
\begin{bmatrix}
P_{t_w \cdot q_t \cdot C_{p,WW\_Wall}} \\
P_{t_w \cdot q_t \cdot C_{p,WW\_Roof,1}} \\
P_{t_w \cdot q_t \cdot C_{p,WW\_Roof,2}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Wall}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Roof,1}} \\
P_{t_w \cdot q_t \cdot C_{p,LW\_Roof,2}}
\end{bmatrix} \times \begin{bmatrix}
C_{p,WW\_Wall} \\
C_{p,WW\_Roof,1} \\
C_{p,WW\_Roof,2} \\
C_{p,LW\_Wall} \\
C_{p,LW\_Roof,1} \\
C_{p,LW\_Roof,2}
\end{bmatrix}
\]

\[
\begin{bmatrix}
P_{WW\_Wall,1} \cdot G - GC_{pi,P} \\
P_{WW\_Wall,2} \cdot G - GC_{pi,P} \\
P_{WW\_Wall,3} \cdot G - GC_{pi,P} \\
P_{WW\_Roof,1} \cdot G - GC_{pi,N} \\
P_{WW\_Roof,2} \cdot G - GC_{pi,N} \\
P_{WW\_Roof,3} \cdot G - GC_{pi,N} \\
P_{LW\_Wall,1} \cdot G - GC_{pi,P} \\
P_{LW\_Wall,2} \cdot G - GC_{pi,P} \\
P_{LW\_Wall,3} \cdot G - GC_{pi,P} \\
P_{LW\_Roof,1} \cdot G - GC_{pi,N} \\
P_{LW\_Roof,2} \cdot G - GC_{pi,N} \\
P_{LW\_Roof,3} \cdot G - GC_{pi,N}
\end{bmatrix}
= 
\begin{bmatrix}
113 \\
-137 \\
-175 \\
-110 \\
-156 \\
113 \\
-137 \\
-175 \\
-110 \\
-156 \\
194 \\
-55 \\
-94 \\
-29 \\
-74 \\
194 \\
-55 \\
-94 \\
-54 \\
-74
\end{bmatrix}
\]

\[
WWwalls_{\text{min}} := 16 \text{ psf} \cdot t_w = 123 \text{ plf}
\]

\[
Wroof_{\text{min}} := 8 \text{ psf} \cdot t_w = 61.5 \text{ plf}
\]
### Wall Pressure Coefficients, $C_p$

<table>
<thead>
<tr>
<th>Surface</th>
<th>$l/B$</th>
<th>$C_p$</th>
<th>Use With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward wall</td>
<td>All values</td>
<td>0.8</td>
<td>$q_4$</td>
</tr>
<tr>
<td></td>
<td>0-1</td>
<td>-0.5</td>
<td>$q_4$</td>
</tr>
<tr>
<td>Leeward wall</td>
<td>2</td>
<td>-0.3</td>
<td>$q_4$</td>
</tr>
<tr>
<td></td>
<td>≥4</td>
<td>-0.2</td>
<td>$q_4$</td>
</tr>
<tr>
<td>Sidewall</td>
<td>All values</td>
<td>-0.7</td>
<td>$q_4$</td>
</tr>
</tbody>
</table>

### Roof Pressure Coefficients, $C_p$ for use with $q_6$

#### Windward

<table>
<thead>
<tr>
<th>Wind Direction</th>
<th>$h/L$</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>45</th>
<th>≥50</th>
<th>10</th>
<th>15</th>
<th>≥20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal to Ridge</td>
<td>≤0.5</td>
<td>-0.7</td>
<td>-0.5</td>
<td>-0.3</td>
<td>-0.2</td>
<td>-0.2</td>
<td>$0.0^a$</td>
<td>0.4</td>
<td>0.01</td>
<td>0</td>
<td>-0.3</td>
<td>-0.5</td>
</tr>
<tr>
<td>Normal to Ridge</td>
<td>0.5</td>
<td>-0.18</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.01</td>
<td>0</td>
<td>-0.3</td>
<td>-0.5</td>
<td>-0.6</td>
</tr>
<tr>
<td>Normal to Ridge</td>
<td>0 = 10°</td>
<td>-0.18</td>
<td>-0.18</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
<td>0.01</td>
<td>0</td>
<td>-0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>Normal to Ridge</td>
<td>≥10°</td>
<td>-0.18</td>
<td>-0.18</td>
<td>-0.18</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.01</td>
<td>0</td>
<td>-0.7</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

#### Horizontal Distance from Windward Edge

<table>
<thead>
<tr>
<th>$H/L$</th>
<th>0 to $H/2$</th>
<th>$H/2$ to $H$</th>
<th>$H$ to $2H$</th>
<th>$2H$ to $3H$</th>
<th>$3H$ to $4H$</th>
<th>≥$4H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal to Ridge for All $l$</td>
<td>≤0.5</td>
<td>-0.9</td>
<td>-0.18</td>
<td>-0.9</td>
<td>-0.9</td>
<td>-0.9</td>
</tr>
<tr>
<td>Normal to Ridge for $l &lt; 10^d$ and Parallel</td>
<td>0 to $H/2$</td>
<td>-0.7</td>
<td>-0.3</td>
<td>-0.3</td>
<td>-0.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>Normal to Ridge for $l ≥ 10^d$</td>
<td>≥$1,0$</td>
<td>0 to $H/2$</td>
<td>-1.2</td>
<td>-1.2</td>
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<tr>
<td>Normal to Ridge for $l &lt; 10^d$ and Parallel</td>
<td>≥$1.0$</td>
<td>0 to $H/2$</td>
<td>-0.7</td>
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<td>-0.7</td>
</tr>
</tbody>
</table>

### Notes

1. Plus and minus signs signify pressures acting toward and away from the surfaces, respectively.
2. Linear interpolation is permitted for values of $l/B$, $H/L$, and $l$ other than shown. Interpolation shall only be carried out between values of the same sign. Where no value of the same sign is given, assume 0.0 for interpolation purposes.
3. Where two values of $C_p$ are listed, this indicates that the windward roof slope is subjected to either positive or negative pressures and the roof structure shall be designed for both conditions. Interpolation for intermediate ratios of $H/L$ in this case shall only be carried out between $C_p$ values of like sign.
4. For monoslope roofs, entire roof surface is either a windward or leeward surface.
5. Refer to Fig. 27.3-2 for domes and Fig. 27.3-3 for arched roofs.
6. For mansard roofs, the top horizontal surface and leeward inclined surface shall be treated as leeward surfaces from the table.
7. Except for MWFRSs designs consisting of moment-resisting frames, the total horizontal shear shall not be less than that determined by neglecting wind forces on roof surfaces.

---

**FIGURE 27.3-1 (Continued).** Main Wind Force Resisting System, Part 1 (All Heights): External Pressure Coefficients, $C_p$, for Enclosed and Partially Enclosed Buildings—Walls and Roofs

---

### Area, $^2$ Reduction Factor

<table>
<thead>
<tr>
<th>Area, $^2$ (m$^2$)</th>
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<tr>
<td>≤100</td>
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<td>250</td>
<td>0.9</td>
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<tr>
<td>≥1,000</td>
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Earthquake load

Risk Category II

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<td>$T$</td>
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<tr>
<td>$I_e$</td>
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<td>$S_1$</td>
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<td>$S_{N1}$</td>
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<tr>
<td>PGA</td>
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<tr>
<td>$C_v$</td>
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<td>$F_a$</td>
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<tr>
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<tr>
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<td>1.6</td>
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Seismic Design Category A

General Input

ASCE 7-16 Loading
Soil Site Class D
Risk Category II

SDC D

USGS-Provided output:

- $S_s := 0.115$  
  MCER ground motion (period=0.2s)

- $S_1 := 0.041$  
  MCER ground motion (period=1.0s)

- $S_{MS} := 0.184$  
  Site-modified spectral acceleration value

- $F_v := 2.4$  
  Long-period site Coefficient, ASCE 7-16, Table 11.4-2

- $S_{M1} := 0.090$  
  Site-modified spectral acceleration value
  ASCE 7-16, Equation 11.4-2

- $S_{PS} := 0.123$  
  Numeric seismic design value at 0.2s SA

- $S_{D1} := 0.66$  
  Numeric seismic design value at 1.0s SA
  ASCE 7-16, Equation 11.4-4
  Response Modification factor for Steel ordinary moment frames
  ASCE 7-16: Table 12.2-1

- $R := 2$

- $I_e := 1$  
  Seismic Importance Factor

Seismic Response Coefficient

$$C_s := \frac{S_{PS}}{R \cdot I_e} = 0.062$$

ASCE 7-16: Equation 12.8-2
Approximate Fundamental Period

$C_t := 0.028$  
$\frac{h_n}{ft} = 5.818 \text{ ft}$  
$\varepsilon := 0.8$  
$T_a := (C_t \cdot h_n^\varepsilon) \ s = 0.038$

Fundamental Period

$C_u := 1.7$  
$T := C_u \cdot T_a = 0.065$  
$T_L := 6 \text{ s}$

Maximum seismic response coefficient

$$C_{s,\text{max}} := \begin{cases} T \leq T_L, \frac{S_{D1} \cdot 1}{T \cdot \left( \frac{R}{I_e} \right)} & , \frac{S_{D1} \cdot T_L \cdot 1}{T^2 \cdot \left( \frac{R}{I_e} \right)} \end{cases} = 5.084$$

Minimum seismic response coefficient

$$C_{s,\text{min}} := 0.5 \frac{S_1}{R} = 0.01 \frac{R}{I_e}$$

if $(C_{s,\text{max}} > C_s > C_{s,\text{min}}$, "OK", "NOT OK") = "OK"

Weight of the Structure

$SL := P_g = 25 \text{ psf} \quad $ Snow Load

$RLL = 20 \text{ psf} \quad $ Roof live load
\[ DL = 10 \text{ psf} \quad \text{Dead load} \]

\[ TL := DL + \max(0.2 \cdot SL, 0.25 \cdot RLL) = 15 \text{ psf} \]

\[ W := t_w \cdot L \cdot TL = (2.417 \cdot 10^3) \text{ lbf} \]

**Base Shear**

\[ \bar{V} := C_s \cdot W = 148.631 \text{ lbf} \]

\[ V_{each} := \frac{V}{2} = 74.315 \text{ lbf} \]
**Purlin Analysis**

- Total Width = 3.180 in
- Total Height = 4.885 in
- Centroid, X₀ = 81.037 in
- Centroid, Y₀ = 35.372 in
- X-Barrier (Right) = 1.443 in
- X-Barrier (Left) = 1.737 in
- Y-Barrier (Top) = 2.439 in
- Y-Barrier (Bot) = 2.445 in
- Max Thick = 4.885 in
- Area, A₀ = 2.133 in²
- Inertia, Iₓₓ = 5.942 in⁴
- Inertia, Iᵧᵧ = 1.047 in⁴
- Inertia, Iₓᵧ = -0.766 in⁴
- Sₓ (Top) = 2.436 in³
- Sₓ (Bot) = 2.430 in³
- Sᵧ (Left) = 0.601 in³
- Sᵧ (Right) = 0.726 in³
- rx = 1.667 in
- ry = 0.700 in
- Plastic Zₓ = 3.322 in³
- Plastic Zᵧ = 1.209 in³
- Torsional J = 0.040 in⁴
- As-ᵩx Def = 1.000
- As-ᵧᵧ Def = 1.000
- As-ᵩx Stress = 1.000
- As-ᵧᵧ Stress = 1.000

\[ E := 10000 \text{ ksi} \]
\[ F_{tu} := 38 \text{ ksi} \]
\[ F_{ty} := 35 \text{ ksi} \]
\[ F_{cy} := 35 \text{ ksi} \]
\[ F_{sy} := 20 \text{ ksi} \]
\[ \phi_y := 0.95 \]
\[ \phi_u := 0.85 \]
\[ \phi F_L t := \phi_y \cdot F_{ty} = 33.25 \text{ ksi} \]

**Mechanical properties of 6061-T6**

**Allowable extreme tension fibers stress**
\[ B_c := F_{cy} \left( 1 + \left( \frac{F_{cy} \cdot \frac{1}{ksi}}{2250} \right)^{0.5} \right) = 39.365 \text{ ksi} \]

\[ D_c := \frac{B_c}{10} \cdot \left( \frac{B_c}{E} \right)^{0.5} = 0.247 \text{ ksi} \]

\[ C_c := 0.41 \cdot \frac{B_c}{D_c} = 65.347 \]

\[ \phi_b := 0.85 \]

\[ S_1 := 1.2 \cdot \frac{B_c - \phi_y \cdot F_{cy}}{\phi_b} = 1.203 \]

\[ S_2 := 1.2 \cdot C_c = 78.417 \]

\[ L_b := 122 \text{ in} \quad r_y := 1.667 \text{ in} \]

\[ \frac{L_b}{r_y} = 73.185 \]

\[ \phi F_{Lc1} := \phi_y \cdot F_{cy} = 33.25 \text{ ksi} \]

\[ \phi F_{Lc2} := \phi_b \cdot \left( B_c - \frac{D_c \cdot L_b}{12 \cdot r_y} \right) = 32.18 \text{ ksi} \]

\[ \phi F_{Lc3} := \frac{\phi_b \cdot \pi^2 \cdot E}{\left( \frac{L_b}{1.2 \cdot r_y} \right)^2} = 22.554 \text{ ksi} \]

\[ \phi F_{Lc} := \begin{cases} 
\frac{L_b}{r_y} < S_1, & \phi F_{Lc1}, \\
S_1 < \frac{L_b}{r_y} < S_2, & \phi F_{Lc2}, \\
S_2, & \phi F_{Lc3} \end{cases} \]

\[ = 32.18 \text{ ksi} \]
 Loads Applied on the purlin

Wind Loads:

\[
\begin{bmatrix}
P_{WW_{Wall},1} \\
P_{LW_{Wall},1} \\
P_{SideWall,1} \\
P_{WW_{Roof},1} \\
P_{LW_{Roof},1}
\end{bmatrix} = q_2 \cdot \begin{bmatrix}
C_{p,WW_{Wall}} \\
C_{p,LW_{Wall}} \\
C_{p,SideWall} \\
C_{p,WW_{Roof},1} \\
C_{p,LW_{Roof}}
\end{bmatrix} \cdot G - GC_{pi,P} = \begin{cases}
15 \\
-18 \\
-23 \\
-14 \\
-20
\end{cases} \text{ psf}
\]

\[
\begin{bmatrix}
P_{WW_{Wall},2} \\
P_{LW_{Wall},2} \\
P_{SideWall,2} \\
P_{WW_{Roof},2} \\
P_{LW_{Roof},2}
\end{bmatrix} = q_2 \cdot \begin{bmatrix}
C_{p,WW_{Wall}} \\
C_{p,LW_{Wall}} \\
C_{p,SideWall} \\
C_{p,WW_{Roof},2} \\
C_{p,LW_{Roof}}
\end{bmatrix} \cdot G - GC_{pi,P} = \begin{cases}
15 \\
-18 \\
-23 \\
-18 \\
-20
\end{cases} \text{ psf}
\]

\[
\begin{bmatrix}
P_{WW_{Wall},3} \\
P_{LW_{Wall},3} \\
P_{SideWall,3} \\
P_{WW_{Roof},3} \\
P_{LW_{Roof},3}
\end{bmatrix} = q_2 \cdot \begin{bmatrix}
C_{p,WW_{Wall}} \\
C_{p,LW_{Wall}} \\
C_{p,SideWall} \\
C_{p,WW_{Roof},1} \\
C_{p,LW_{Roof}}
\end{bmatrix} \cdot G - GC_{pi,N} = \begin{cases}
25 \\
-7 \\
-12 \\
-4 \\
-10
\end{cases} \text{ psf}
\]

\[
\begin{bmatrix}
P_{WW_{Wall},4} \\
P_{LW_{Wall},4} \\
P_{SideWall,4} \\
P_{WW_{Roof},4} \\
P_{LW_{Roof},4}
\end{bmatrix} = q_2 \cdot \begin{bmatrix}
C_{p,WW_{Wall}} \\
C_{p,LW_{Wall}} \\
C_{p,SideWall} \\
C_{p,WW_{Roof},2} \\
C_{p,LW_{Roof}}
\end{bmatrix} \cdot G - GC_{pi,N} = \begin{cases}
25 \\
-7 \\
-12 \\
-7 \\
-10
\end{cases} \text{ psf}
\]

\[
W_u = P_{LW_{Roof},1} = -20.261 \text{ psf}
\]

Uplift wind load

\[
W_d = P_{WW_{Roof},4} = -7.044 \text{ psf}
\]

Dead load

\[
SL = P_{unbal} = 25 \text{ psf}
\]

Dead load

\[
DL = 10 \text{ psf}
\]

Dead load

\[
I_t = 8.282 \text{ ft}
\]

Tributary width of purlins
Load combinations

$LC1 := 1.4 \ DL = 14 \ psf$

$LC2 := 1.2 \ DL + 0.5 \ RLL = 22 \ psf$

$LC3 := 1.2 \ DL + 0.5 \ SL = 24.5 \ psf$

$LC4 := 1.2 \ DL + 1.0 \ W_d + SL = 29.956 \ psf$

$LC5 := 1.2 \ DL + 1.0 \ W_u + SL = 16.739 \ psf$

$LC6 := 0.9 \ DL + 1.0 \ W_d = 1.956 \ psf$

$LC7 := 0.9 \ DL + 1.0 \ W_u = -11.261 \ psf$

\[
M_{b \_up} := \frac{t_w \cdot LC7 \cdot L_b^2}{8} = -1.205 \cdot 10^3 \text{ ft} \cdot \text{lb}f
\]

\[
M_{b \_dn} := \frac{t_w \cdot LC4 \cdot L_b^2}{8} = (3.205 \cdot 10^3) \text{ ft} \cdot \text{lb}f
\]

$S_{xx} := 2.43 \ in^3$

$\sigma_{max} := \frac{M_{b \_dn}}{S_{xx}} = 15.829 \ ksi$

Check := if $\left( \frac{\sigma_{max}}{\phi F_{LC}} < 1, \text{"pass"}, \text{"fail"} \right)$ = "pass"
### Node Boundary Conditions

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<th>Z (kN)</th>
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### Member Primary Data

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### Basic Load Cases

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### Input Data

- **Shape:** 5X3.5I BEAM
- **Member Type:** Column
- **Length (ft):** 4.25
- **Material Type:** Aluminum
- **Design Rule:** Typical
- **Internal Sections:** 97
- **Design Code:** AA ADM1-15: ASD - Building
- **T/C Only:** Both Way

### Material Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>6061-T6</td>
</tr>
<tr>
<td>Density (k/lb ft(^3))</td>
<td>0.173</td>
</tr>
<tr>
<td>( E ) (ksi)</td>
<td>10100</td>
</tr>
<tr>
<td>( G ) (ksi)</td>
<td>3787.5</td>
</tr>
<tr>
<td>( N_u )</td>
<td>0.33</td>
</tr>
<tr>
<td>Therm. Coeff. (1/1E6 F)</td>
<td>1.3</td>
</tr>
<tr>
<td>( F_{su} ) (ksi)</td>
<td>38</td>
</tr>
<tr>
<td>( F_{sy} ) (ksi)</td>
<td>35</td>
</tr>
<tr>
<td>( F_{yy} ) (ksi)</td>
<td>38</td>
</tr>
<tr>
<td>( F_{xy} ) (ksi)</td>
<td>35</td>
</tr>
<tr>
<td>( F_{sx} ) (ksi)</td>
<td>21</td>
</tr>
<tr>
<td>( F_{sy} ) (ksi)</td>
<td>141</td>
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### Shape Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d ) (in)</td>
<td>5</td>
</tr>
<tr>
<td>( b_y ) (in)</td>
<td>3.5</td>
</tr>
<tr>
<td>( t_f ) (in)</td>
<td>0.32</td>
</tr>
<tr>
<td>( t_w ) (in)</td>
<td>0.19</td>
</tr>
<tr>
<td>( I_y ) (in(^4))</td>
<td>2.289</td>
</tr>
<tr>
<td>( I_z ) (in(^4))</td>
<td>13.597</td>
</tr>
<tr>
<td>Area (in(^2))</td>
<td>3.068</td>
</tr>
<tr>
<td>( Z_{yy} ) (in(^3))</td>
<td>1.999</td>
</tr>
<tr>
<td>( Z_{zz} ) (in(^3))</td>
<td>6.145</td>
</tr>
<tr>
<td>( S_{yy} ) (in(^3))</td>
<td>1.308</td>
</tr>
<tr>
<td>( S_{zz} ) (in(^3))</td>
<td>5.439</td>
</tr>
<tr>
<td>( C_{w} ) (in(^6))</td>
<td>12.535</td>
</tr>
<tr>
<td>( J ) (in(^4))</td>
<td>0.085</td>
</tr>
</tbody>
</table>

### Design Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( L_{b \ y-y} ) (ft)</td>
<td>3</td>
</tr>
<tr>
<td>( L_{b \ z-z} )</td>
<td>Segment</td>
</tr>
<tr>
<td>( L_{\text{comptop}} ) (ft)</td>
<td>3</td>
</tr>
<tr>
<td>( L_{\text{complow}} ) (ft)</td>
<td>3</td>
</tr>
<tr>
<td>( C_b )</td>
<td>1</td>
</tr>
<tr>
<td>( K_{y-y} )</td>
<td>1</td>
</tr>
<tr>
<td>( K_{x-x} )</td>
<td>1</td>
</tr>
<tr>
<td>Welded?</td>
<td>False</td>
</tr>
<tr>
<td>Function</td>
<td>Lateral</td>
</tr>
<tr>
<td>Max Defl Ratio:</td>
<td>L/241</td>
</tr>
<tr>
<td>Max Defl Location:</td>
<td>4.25</td>
</tr>
<tr>
<td>Span:</td>
<td>N/A</td>
</tr>
<tr>
<td>( \tau_o )</td>
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</tr>
</tbody>
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**M1**

N1  \( \cdots \) N5
AA ADM1-15: ASD - Building Code Check

<table>
<thead>
<tr>
<th>Limit State</th>
<th>Gov. LC</th>
<th>Required</th>
<th>Available</th>
<th>Unity Check</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Loading - Bending/Axial</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Applied Loading - Shear + Torsion</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Axial Tension Analysis</td>
<td>-</td>
<td>0 lb</td>
<td>59794.461 lb</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Axial Compression Analysis</td>
<td>-</td>
<td>2579.031 lb</td>
<td>48463.896 lb</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flexural Analysis (Strong Axis)</td>
<td>-</td>
<td>6.499 k-ft</td>
<td>8.541 k-ft</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flexural Analysis (Weak Axis)</td>
<td>-</td>
<td>0 k-ft</td>
<td>3.247 k-ft</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shear Analysis (Major Axis y)</td>
<td>-</td>
<td>1529.333 lb</td>
<td>11692.308 lb</td>
<td>0.131</td>
<td>PASS</td>
</tr>
<tr>
<td>Shear Analysis (Minor Axis z)</td>
<td>-</td>
<td>0 lb</td>
<td>27569.23 lb</td>
<td>0</td>
<td>PASS</td>
</tr>
<tr>
<td>Bending &amp; Axial Interaction Check (UC Bending Max)</td>
<td>-</td>
<td>-</td>
<td>0.814</td>
<td></td>
<td>PASS</td>
</tr>
</tbody>
</table>
**Detail Report: M2**

**Load Combination:** Envelope  
**Code check:** 0.819 (LC 3)

**Input Data**

- **Shape:** 5X3.5BEAM  
- **I Node:** N5  
- **Member Type:** Beam  
- **J Node:** N7  
- **Length (ft):** 11.007  
- **I Release:** Fixed  
- **Material Type:** Aluminum  
- **J Release:** Fixed  
- **Design Rule:** Typical  
- **I Offset:** N/A  
- **Internal Sections:** 97  
- **J Offset:** N/A  
- **Design Code:** AA ADM1-15: ASD - Building  
- **T/C Only:** Both Way

**Material Properties**

- **Material:** 6061-T6  
- **Density (kft⁻³):** 0.173  
- **F_{xx} (ksi):** 24  
- **E (ksi):** 10100  
- **F_{yy} (ksi):** 38  
- **G (ksi):** 3787.5  
- **F_{xy} (ksi):** 35  
- **N_u:** 0.33  
- **F_{yx} (ksi):** 35  
- **Therm. Coeff. /1E5 F/:** 1.3

**Shape Properties**

- **d (in):** 5  
- **l_{xx} (in⁴):** 13.597  
- **S_{xx} (in):** 5.439  
- **b (in):** 3.5  
- **Area (in²):** 3.068  
- **C_{w} (in):** 12.535  
- **t (in):** 0.32  
- **Z_{xy} (in³):** 1.999  
- **J (in⁴):** 0.085  
- **t_{w} (in):** 0.19  
- **Z_{zz} (in³):** 6.145  
- **R (in):** 0  
- **I_{yy} (in⁴):** 2.289  
- **S_{yy} (in³):** 1.308  
- **r_e (in):** 2.275

**Design Properties**

- **L_{yy} (ft):** 3  
- **K_{y-y}:** 0.65  
- **Max Defl Location:** 10.204  
- **L_{xx} (ft):** Segment  
- **K_{x-x}:** 0.65  
- **Span:** 1  
- **L_{comp top} (ft):** 3  
- **Welded?:** False  
- **W**: 1  
- **L_{comp bot} (ft):** 3  
- **Function:** Lateral  
- **C_{p}:** 1  
- **Max Defl Ratio:** L/208

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RISA-3D Version 21  
[ #2212006 r3d ]  
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AA ADM1-15: ASD - Building Code Check

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<td>-</td>
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<td>3.247 k-ft</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shear Analysis (Major Axis y)</td>
<td>-</td>
<td>2036.089 lb</td>
<td>11692.306 lb</td>
<td>0.174</td>
<td>PASS</td>
</tr>
<tr>
<td>Shear Analysis (Minor Axis z)</td>
<td>-</td>
<td>0 lb</td>
<td>27569.23 lb</td>
<td>0</td>
<td>PASS</td>
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<td>-</td>
<td>-</td>
<td>0.819</td>
<td>PASS</td>
</tr>
</tbody>
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