Blast Curtain Wall Installation Analysis

Subject: BR3250 Blast Curtain Wall System

ATI Report 57402.01-122-34

Rendered to:

International Aluminum Corporation
767 Monterey Pass Road
Monterey Park, California 91754

Prepared by:

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Scope

Architectural Testing, Inc. (ATI) was contracted by International Aluminum Corporation to perform an engineering analysis of a BR3250 curtain wall, 25' 1" high by 15' 3-17/32" wide with one 5' 3-13/32" 90 degree return as depicted in United States Aluminum drawings Series BR3250 Blast Wall System 1" Lam. Glazing Sheets 1-21 (attached). The installation analysis was performed to satisfy the Department of Defense (DoD) requirements for antiterrorism.

Curtain wall elevations and sections were taken from drawings prepared by United States Aluminum. The system is mounted to structural steel substrate. This analysis will determine the type, size and quantity of anchors needed to comply with DoD standard UFC 4-010-01 and also determine if the mullion assembly is adequate for the design pressure.

Referenced standards utilized in this project include:

DoD Minimum Antiterrorism Standards for Buildings – UFC 4-010-01. Department of Defense, 8 October 2003


Additional References:

Blast Resistant Mullion Design, Architectural Testing Report 55748.01-122-34 (Rev. 2)

Analyses

Anchorage Requirements

The requirement of UFC 4-010-01 revealed that a design pressure of 10.8 psi is required for glazing panel with a vision area less than or equal to 10.8 sq ft and 4.4 psi for glazing panel with a vision area greater than 10.8 sq ft. when determining the performance of connections. All of the curtain wall glazing panels in the submitted drawings are larger than 10.8 sq. ft.; therefore the analysis for connections will use a design pressure of 4.4 psi.

The modes of failure considered included shear failure of the fastener and bearing failure of the window frame and substrate components. All aluminum components were assumed to be extruded from 6063-T6 aluminum. Steel components are assumed to be ASTM A36 steel with an ultimate tensile strength of 58,000 psi. The structural performance of new or existing substrate is not considered in this analysis and is assumed sufficient to support the loads.
Based on glazing panel geometry, the design pressures were determined for each size panel as shown in the following table.

<table>
<thead>
<tr>
<th>Glazing Panel Designation</th>
<th>Width (inches)</th>
<th>Height (inches)</th>
<th>Area (sq. ft.)</th>
<th>Design Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>57.5</td>
<td>28.0</td>
<td>11.2</td>
<td>4.4</td>
</tr>
<tr>
<td>B</td>
<td>57.5</td>
<td>69.5</td>
<td>27.8</td>
<td>4.4</td>
</tr>
<tr>
<td>C</td>
<td>57.5</td>
<td>35.5</td>
<td>14.2</td>
<td>4.4</td>
</tr>
<tr>
<td>D</td>
<td>57.5</td>
<td>43.75</td>
<td>17.5</td>
<td>4.4</td>
</tr>
<tr>
<td>E</td>
<td>57.5</td>
<td>69.5</td>
<td>27.8</td>
<td>4.4</td>
</tr>
<tr>
<td>F</td>
<td>57.5</td>
<td>36.25</td>
<td>14.5</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**Mullion Requirements**

Mullion section properties were analyzed under ATI Report 55748.01-122-34 (Rev. 2) to determine the strength requirements utilizing a 0.2% offset yield stress for aluminum, ultimate strength for steel and deflection requirements of $\frac{L}{60}$. This analysis was based on a 1.0 psi design pressure. The moment of inertia and section modulus of the curtain wall mullions were compared against the values found in the ATI report to verify they meet the minimum requirements for strength and deflection. Since these values are based on mullions with the highest loading, all other mullions will be qualified from this data.

<table>
<thead>
<tr>
<th>Section (Part No.)</th>
<th>Span (ft)</th>
<th>Actual Moment of Inertia (in$^4$)</th>
<th>Required Moment of Inertia (in$^4$)</th>
<th>Actual Section Modulus (in$^3$)</th>
<th>Required Section Modulus (in$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (BW464)</td>
<td>5' 0&quot;</td>
<td>12.95</td>
<td>0.648</td>
<td>3.226</td>
<td>0.720</td>
</tr>
<tr>
<td>7 (BW462)</td>
<td>12' 6&quot;</td>
<td>25.62</td>
<td>3.293</td>
<td>6.77</td>
<td>3.375</td>
</tr>
<tr>
<td>8 (BW462)</td>
<td>12' 6&quot;</td>
<td>25.62</td>
<td>6.585</td>
<td>6.77</td>
<td>6.75</td>
</tr>
<tr>
<td>9 (BW492)</td>
<td>12' 6&quot;</td>
<td>91.19</td>
<td>6.585$^1$</td>
<td>16.09</td>
<td>6.75$^1$</td>
</tr>
<tr>
<td>10 (SL491) Splice</td>
<td>12' 6&quot;</td>
<td>19.91</td>
<td>6.585$^1$</td>
<td>5.04</td>
<td>$\approx0^{1,2}$</td>
</tr>
<tr>
<td>11 (SL461) Splice</td>
<td>12' 6&quot;</td>
<td>7.91</td>
<td>6.585</td>
<td>3.16</td>
<td>$\approx0^2$</td>
</tr>
</tbody>
</table>

$^1$ Blast Load at 45 degrees to corner  
$^2$ Splice positioned at location of zero bending moment
Components and conditions not covered in ATI Report 55748.01-122-34 (Rev. 2) are presented beginning on Page 7. Specifically, section properties for the SL491 splice and determination that the splice is located at a zero shear condition are presented.

**Anchorage Requirements**
Anchor and connection reaction loads based on the 4.4 psi requirement are calculated beginning on Page 11. These reactions are then compared to the capacity of the various anchoring details and conditions. Conditions that are deemed inadequate in the calculations are identified and have been corrected as shown in the referenced drawings.

**Conclusions**

The analysis and calculations reveal that the mullion constructions and spans shown in the referenced drawings meet the minimum strength and deflection requirements of UFC 4-010-01 for the 1 psi static load design condition.

Mullion end connections and perimeter anchor conditions shown in the referenced drawings also meet the minimum requirements of UFC 4-010-01 for the 4.4 psi static load condition.
Reference Drawings (attached)

_Elevation and Bill of Materials_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 1 of 21, United States Aluminum, 8/05/05
_Details (Head) "F" Clip_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 2 of 21, United States Aluminum, 8/4/05
_Details (Head) "T" Clip_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 3 of 21, United States Aluminum, 8/4/05
_Details (Hor Mull)_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 4 of 21, United States Aluminum, 8/4/05
_Details (Sill) "F" Clip_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 5 of 21, United States Aluminum, 8/4/05
_Details (Sill) "T" Clip_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 6 of 21, United States Aluminum, 8/4/05
_Details Vert. Mullion at Jamb_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 7 of 21, United States Aluminum, 8/4/05
_Details Vert. Mullion_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 8 of 21, United States Aluminum, 8/4/05
_Details Corner_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 9 of 21, United States Aluminum, 8/4/05
_Details Corner Splice_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 10 of 21, United States Aluminum, 8/4/05
_Details Splice Joint_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 11 of 21, United States Aluminum, 8/4/05
_Details Alum. "F" Clip Top View @ Head_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 12 of 21, United States Aluminum, 8/4/05
_Details Alum. "T" Anchor Top View @ Head_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 13 of 21, United States Aluminum, 8/9/05
_Details Corner Tee Anchor_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 14 of 21, United States Aluminum, 8/4/05
_Details Shear Block at Jamb_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 15 of 21, United States Aluminum, 8/4/05
_Corner Shear Blocks_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 17 of 21, United States Aluminum, 8/4/05
_Details Vert. Mullion Dead Load Anchor_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 18 of 21, United States Aluminum, 8/4/05
_Details Vert. Mullion Dead Load Anchor_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 19 of 21, United States Aluminum, 8/4/05
_Details Corner Dead Load Anchor_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 20 of 21, United States Aluminum, 8/4/05
_Details Splice Joint at Jamb_, Series BR3250 Blast Wall System, Drawing No. USA-2869, Sheet 21 of 21, United States Aluminum, 8/4/05
Reference Drawings (continued)

Splice Sleeve for Expansion Joint, Part No. SL461, Drawing No. USA-2891, U.S. Aluminum Corp., 7/29/05
Splice Sleeve for Deadload Anchor, Part No. SL462, Drawing No. USA-2892, U.S. Aluminum Corp., 7/29/05
Shear Block for 90° Corner Mullion, Part No. AC494, Drawing No. USA-2893, U.S. Aluminum Corp., 7/29/05
Anchor Slip Pad, Part No. NY401, Drawing No. USA-2894, U.S. Aluminum Corp., 7/29/05
Corner Dead Load Anchor (BW3250 Series), Part No. AN490, Drawing No. USA-2895, U.S. Aluminum Corp., 8/5/05
Vertical Mullion Wall Dead Load Anchor (IW3250 Series), Part No. AN418, Drawing No. USA-2896, U.S. Aluminum Corp., 8/5/05
Splice Sleeve for Corner Mullion Expansion Joint, Part No. SL491, Drawing No. USA-2897, U.S. Aluminum Corp., 7/29/05
Splice Sleeve for Corner Mullion Deadload Anchor, Part No. SL492, Drawing No. USA-2898, U.S. Aluminum Corp., 7/29/05
Corner "T" Anchor, Part No. AC492, Drawing No. USA-2899, U.S. Aluminum Corp., 7/29/05
Tapping Block for 90° Corner, Part No. TB490, Drawing No. USA-2900, U.S. Aluminum Corp., 8/2/05

Series-BR3250 Shear Block, Part No. AR464, International Extrusion Corp., 3/3/05
IW3250 Tee Anchor, Part No. IW189, Die No. 3973 Rev. A1, International Extrusion Corporation, 6/10/03
IW3250 "F" Clip, Part No. IW191, Die No. 3974 Rev. A1, International Extrusion Corporation, 6/10/03
Calculations

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**REGIONS**

<table>
<thead>
<tr>
<th>Area</th>
<th>3.816637</th>
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<tbody>
<tr>
<td>Perimeter</td>
<td>47.616205</td>
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</tbody>
</table>
| Bounding box | X: -1.103980 -- 1.103984  
               | Y: -3.701994 -- 3.946173 |
| Centroid | X: 0.000000  
           | Y: 0.000000 |
| Moments of inertia | X: 19.914969  
                  | Y: 2.234095 |
| Product of inertia | X: 0.000129  
                  | Y: 2.284280 |
| Radii of gyration | X: 0.765086  
                    | Y: 0.765086 |
| Principal moments and X-Y directions about centroid | I: 2.234095 along [0.000007 1.000000]  
                                                | J: 19.914969 along [-1.000000 0.000007] |

---
Bw462 with splice - 1 psi DP

Beam Length: 300.0 in
Location: 0.0 in

Deflection

Bending Stress
Tensile: 0.0  Compressive: 0.0

Average Shear Stress

824.2017
** BW462 with splice - 1 psi DP **

US Aluminum
BR3250 Curtain Wall
BW462 Vertical Mullion

BEAM LENGTH = 300.0 in

MATERIAL PROPERTIES
6063-T6 Aluminum:
Modulus of elasticity = 1000000.0 lb/in²
Stress limit = 25000.0 lb/in²

CROSS-SECTION PROPERTIES
BW462 Mullion: from 0.0 in to 112.1875 in
Moment of inertia = 25.619 in⁴
Top height = 3.5 in
Bottom height = 3.781 in
Area = 4.054 in²

SL462 Splice Sleeve: from 112.1875 in to 112.3125 in
Moment of inertia = 7.906 in⁴
Top height = 2.5 in
Bottom height = 2.5 in
Area = 2.50 in²

BW462 Mullion: from 112.3125 in to 300.0 in
Moment of inertia = 25.619 in⁴
Top height = 3.5 in
Bottom height = 3.781 in
Area = 4.054 in²

UNIFORMLY DISTRIBUTED FORCES
1.0 psi blast load: 60.0 lb/in at 0.0 over 300.0 in

SUPPORT REACTIONS ***
Floor T Clip: Simple at 0.0 in
Reaction Force = 5574.282 lb

Deadload Anchr Blt: Simple at 149.75 in
Reaction Force = 5627.005 lb

Deadload Anchr Blt: Simple at 151.25 in
Reaction Force = 5624.41 lb

Head T-Clip: Simple at 300.0 in
Reaction Force = 3374.238 lb

MAXIMUM DEFLECTION ***
3.644238 in at 236.7917 in
No Limit specified

MAXIMUM BENDING MOMENT ***
-161472.5 lb-in at 146.75 in

MAXIMUM SHEAR FORCE ***
-5556.718 lb at 148.75 in
5556.718 lb at 151.25 in

MAXIMUM STRESS ***
Tensile = 2214.59 lb/in² No Limit specified
Compressive = 2389.07 lb/in² No Limit specified
Shear (Avg) = 1355.818 lb/in² No Limit specified

ANALYSIS AT SPECIFIED LOCATIONS ***
Location = 0.0 in (Floor T clip)
Deflection = 0.0 in
Slope = 0.042725 deg
Moment = 0.0 lb-in
Shear force = 3374.282 lb
Tensile = 0.0 lb/in²
Compressive = 0.0 lb/in²
Shear stress = 824.2017 lb/in²
<table>
<thead>
<tr>
<th>Location</th>
<th>Deflection</th>
<th>Slope</th>
<th>Moment</th>
<th>Shear force</th>
<th>Tensile</th>
<th>Compressive</th>
<th>Shear stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>148.75 in</td>
<td>0.0 in</td>
<td>-0.04524355</td>
<td>-161872.5</td>
<td>-5550.718</td>
<td>76,28692</td>
<td>22114.59</td>
<td>1355.818</td>
</tr>
<tr>
<td>(Deadload Anch Bt)</td>
<td></td>
<td>deg</td>
<td>lb-in</td>
<td>lb</td>
<td>lb</td>
<td>lb/in²</td>
<td>lb/in²</td>
</tr>
<tr>
<td>151.25 in</td>
<td>0.0 in</td>
<td>0.04524323</td>
<td>-161869.3</td>
<td>-73,71308</td>
<td>5550.697</td>
<td>22114.15</td>
<td>1355.813</td>
</tr>
<tr>
<td>(Deadload Anch Bt)</td>
<td></td>
<td>deg</td>
<td>lb-in</td>
<td>lb</td>
<td>lb</td>
<td>lb/in²</td>
<td>lb/in²</td>
</tr>
<tr>
<td>300.0 in</td>
<td>0.0 in</td>
<td>-0.9427351</td>
<td>0.0</td>
<td>-3374.303</td>
<td>0.0</td>
<td>0.0</td>
<td>824.207</td>
</tr>
<tr>
<td>(Head T-Clip)</td>
<td></td>
<td>deg</td>
<td>lb-in</td>
<td>lb</td>
<td>lb</td>
<td>lb/in²</td>
<td>lb/in²</td>
</tr>
</tbody>
</table>
** BW462 with splice - 4.4 psi DP (for connections only) **

US Aluminum
BR4350 Curtain Wall
BW462 Vertical Mullion

** BEAM LENGTH - 300.0 in **

** MATERIAL PROPERTIES **

6063-T6 Aluminum:
Modulus of elasticity = 10000000.0 lb/in²
Stress limit = 25000.0 lb/in²

** CROSS-SECTION PROPERTIES **

BW462 Mullion: from 0.0 in to 112.1975 in
Moment of inertia = 15.519 in⁴
Top height = 3.5 in
Bottom height = 3.781 in
Area = 4.094 in²

Slv462 Splice Sleev: from 112.1975 in to 112.325 in
Moment of inertia = 7.906 in⁴
Top height = 2.5 in
Bottom height = 2.8 in
Area = 2.59 in²

BW462 Mullion: from 112.325 in to 300.0 in
Moment of inertia = 15.519 in⁴
Top height = 3.5 in
Bottom height = 3.781 in
Area = 4.094 in²

** UNIFORMLY DISTRIBUTED FORCES **

1.0 psi blast load: 264.0 lb/in at 0.0 over 300.0 in

** SUPPORT REACTIONS **

Floor T clip: Simple at 0.0 in
Reaction Force =-14846.84 lb

Deadload Anchr Blt: Simple at 148.75 in
Reaction Force =-24750.82 lb

Deadload Anchr Blt: Simple at 151.25 in
Reaction Force =-24747.4 lb

Head T Clip: Simple at 300.0 in
Reaction Force =-14846.93 lb

** MAXIMUM DEFLECTION **

2.822265 in at 235.7917 in
No Limit specified

** MAXIMUM BENDING MOMENT **

-12238.8 lb-in at 148.75 in

** MAXIMUM SHEAR FORCE **

-24423.16 lb at 148.75 in
24423.16 lb at 151.25 in

** MAXIMUM STRESS **

Tensile = 97304.18 lb/in² No Limit specified
Compressive = 10516.5 lb/in² No Limit specified
Shear (Avg) = 5965.599 lb/in² No Limit specified

** ANALYSIS AT SPECIFIED LOCATIONS **

Location = 0.0 in (Floor T clip)
Deflection = 0.0 in
Slope = 4.148037 deg
Moment = 0.0 lb-in
Shear Force = 24966.94 lb
Tensile = 0.0 lb/in²
Compressive = 0.0 lb/in²
Shear stress = 3676.488 lb/in²
<table>
<thead>
<tr>
<th>Location</th>
<th>Deflection</th>
<th>Slope</th>
<th>Moment</th>
<th>Shear force</th>
<th>Tensile</th>
<th>Compressive</th>
<th>Shear stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Deadload Anchr Blt)</td>
<td>146.75 in</td>
<td>0.0 in</td>
<td>-0.1990716 deg</td>
<td>-712238.8 lb-in</td>
<td>24423.16 lb</td>
<td>335.6624 lb</td>
<td>97304.16 lb/in²</td>
</tr>
<tr>
<td>(Deadload Anchr Blt)</td>
<td>151.25 in</td>
<td>0.0 in</td>
<td>0.1990703 deg</td>
<td>-712224.7 lb-in</td>
<td>-324.3376 lb</td>
<td>24423.06 lb</td>
<td>97302.25 lb/in²</td>
</tr>
<tr>
<td>(Head T-Clip)</td>
<td>300.0 in</td>
<td>0.0 in</td>
<td>-4.140036 deg</td>
<td>0.0 lb-in</td>
<td>-14846.93 lb</td>
<td>0.0 lb/in²</td>
<td>0.0 lb/in²</td>
</tr>
</tbody>
</table>

Location = 146.75 in  (Deadload Anchr Blt)
Deflection = 0.0 in
Slope = -0.1990716 deg
Moment = -712238.8 lb-in
Shear force = 24423.16 lb, 335.6624 lb
Tensile = 97304.16 lb/in²
Compressive = 105116.3 lb/in²
Shear stress = 5965.599 lb/in²

Location = 151.25 in  (Deadload Anchr Blt)
Deflection = 0.0 in
Slope = 0.1990703 deg
Moment = -712224.7 lb-in
Shear force = -324.3376 lb, 24423.06 lb
Tensile = 97302.25 lb/in²
Compressive = 105114.2 lb/in²
Shear stress = 5965.575 lb/in²

Location = 300.0 in  (Head T-Clip)
Deflection = 0.0 in
Slope = -4.140036 deg
Moment = 0.0 lb-in
Shear force = -14846.93 lb
Tensile = 0.0 lb/in²
Compressive = 0.0 lb/in²
Shear stress = 3626.511 lb/in²
ANCHOR REACTIONS

\[
A_1 = A_2 = \left(\frac{60^\circ}{2}\right) \times (150^\circ) = 4500 \text{ in}^2
\]

LOAD PER LEMENT = 4.4 psi (60") = 264 lbs/in
FROM BEAM 2D PROGRAM:

END REACTIONS

E.R. = 14847 lbs AT FLOOR

E.R. = 49506 lbs AT DEAD LOAD ANCHOR
**T** CLIP ANALYSIS

(1W189)

**SECTION 3 or 6**

END REACTION = 14847 lbs

ASSUME 5/16" THICK STEEL

**BEARING PRESSURE**

ASSUME (2) 1/2-13 UNC GR.5 BOLTS INTO SUBSTRATE

\[
\sigma_{\text{bearing pressure}} = \frac{P}{A} = \frac{P}{\frac{1}{4} \times 2 \times \text{bolts}} = \frac{14847 \text{ lbs}}{(\frac{1}{4} \text{ "})(\frac{1}{2} \text{ "})} = 59388 \text{ psi} \leq 700 \text{ psi (high)}
\]

\[
\sigma_{\text{allowable}} = \sigma_{tu} = 30000 \text{ psi} \text{ for 6063-T6}
\]

\[
\frac{59388 \text{ psi}}{30000 \text{ psi}} = 1.98 : 2 \times 2 \text{ existing bolts} = 4
\]

USE (4) 1/2-13 BOLTS TOTAL

**SHEAR OF FASTENERS**

\[
V_{\text{allowable}} = \frac{F_u (A(k))}{\sqrt{3}} \text{ (AAMA TR-89-91)}
\]

\[
V_{\text{allowable}} = \frac{120000 \text{ psi} \times 0.1419 \text{ in}^2}{\sqrt{3}} = 9831 \text{ lbs} \text{ for gr. 5}
\]

\[
V = \frac{14847 \text{ lbs}}{4} = 3711 \text{ lbs} \leq 0 \text{ K.}
\]
SHEAR OF "T" CLIP

\[ A = l \times 2 = (2 \times 0.218\)\) \times (5') = 2.18 \text{ in}^2 \]

\[ \tau_{\text{shear}} = \frac{P}{A} = \frac{14847 \text{ lbs}}{2.18 \text{ in}^2} = \frac{6811 \text{ psi}}{\text{O.K.}} \leq \]

\[ \tau_{\text{allowable}} = 14000 \text{ psi (A0M 2000)} \]

These calculations also qualify Section 14.
11F" CLIP ANALYSIS (IW 191)

SECTION 2 of 5

END REACTION = \frac{16877\text{ lbs}}{2}

E.R. = 7424\text{ lbs}

ASSUME 5/16" THICK STEEL

\[ \sqrt{ \sum M_0 } = 0 \]

\[ F_1 (2\text{")} - 7424\text{ lbs (5\frac{1}{2}\text{") = 0} \]

\[ F_1 = 20416\text{ lbs OR } 10208\text{ lbs / BOLT} \]

\[ F_2 = F_1 - 7424\text{ lbs} \]

\[ F_2 = 20416\text{ lbs} - 7424\text{ lbs} \]

\[ F_2 = 12992\text{ lbs} \] TOO HIGH

... LET'S ADD AN ADDITIONAL BOLT & SPREAD PATTERN OUT

\[ \sqrt{ \sum M_0 } = 0 \]

\[ F_{\text{TOTAL}} (1.8\text{")} - 7424\text{ lbs (4\frac{1}{2}\text{") = 0} \]

\[ F_{\text{TOTAL}} = 18560\text{ lbs} \]

\[ V_{\text{PULL}} = 4640\text{ lbs} \] O.K.
\[ V_{\text{allowable}} = \frac{F_u (A(x))}{T_3} \]

\[ V_{\text{allowable}} = \frac{120000 \text{ lbs} \times (0.1419 \text{ in}^2)}{\sqrt{3}} = 9831 \text{ lbs for Gr. 5} \]

Dead load anchor analysis

Assume 5/8-11 UNC Gr. 5 bolts

Bearing pressure on mullion

\[ \sigma_{\text{bearing}} = \frac{P}{A} = \frac{P}{T_d} = \frac{49506 \text{ lbs}}{(\frac{5}{8}'' \times 4) \times (\frac{5}{8}'' \times 2 \text{ bolts})} = 79210 \text{ psi} \leq 700 \text{ high} \]

Let's assume (4) bolts

\[ \sigma_{\text{bearing}} = \frac{79210 \text{ psi}}{2} = 39605 \text{ psi} \leq O.K. \text{ since one set of bolts is against inner rig of splicer} \]

\[ \sigma_{\text{allowable}} = 31000 \text{ psi (A.D.M. 2000)} \]
BEARING PRESSURE ON ANGLES

Assume \( \frac{1}{4} \)" thick A-36 steel

\[
\sigma_{\text{bearing}} = \frac{49506 \text{ lbs}}{1/4" \times 2" \times (5/8" \times 4")} = 39605 \text{ psi} \\
\leq 0.6X \\
\]

\( F_{\text{allowable}} = 15 F_{U} = 1.25 \times 68000 \text{ psi} = 85000 \text{ psi} \quad \text{(AISC)} \)

Preferred minimum spacing: \( 3D = 3(5/8") = 17/8" \)

SHEAR ON BOLTS

\[
y = \frac{49506 \text{ lbs}}{4 \text{ bolts}} = \frac{12377 \text{ lbs per bolt}}{0.1} \text{ per bolt} \]

\[
V_{\text{allowable}} = \frac{1}{13} F_{U} \left( A \left( \frac{1}{3} \right) \right) = \frac{1}{13} \left( 120000 \text{ psi} \right) \left( 0.2071 \text{ in}^2 \right) = 14348 \text{ lbs} \text{ for GA. 5} \\
\]

- These calculations also qualify sections 18 and 20.
**Shear Block Analysis**

**Section 16**

- $A_1 = A_2 = \left( \frac{60''}{2} \right)^2 = 900 \text{ in}^2$
- $F_1 = F_2 = \frac{(A_1 + A_2) \cdot \text{(D.P.)}}{2}$
- $F_1 = F_2 = \frac{(900 \text{ in}^2 + 900 \text{ in}^2) \cdot (4.4 \text{ psi})}{2}$
- $F_1 + F_2 = 3960 \text{ lbs}$
BEARING PRESSURE ON MULLION (8W 464)

\[ \sigma_{\text{bearing}} = \frac{P}{A} = \frac{P}{2d} = \frac{\frac{3960 \text{ lbs}}{(\frac{1}{8}) \times (\frac{3}{8} \times 2)}}{\text{ksi}} = \text{25344 psi} \leq 0.5 \]

\( \sigma_{\text{allowable}} = 31000 \text{ psi (AOM 2000)} \)

SITING ON BOLTS

\[ F_1 = \frac{3960 \text{ lbs}}{2} \leq 0.5 \]

\[ V_{\text{allowable}} = \frac{1}{\sqrt{3}} F_0 \left( \frac{A}{A} \right) = \frac{1}{2} \left( 12000 \text{ psi} \right) \left( 0.2071 \text{ in}^2 \right) = \text{14348 lbs} \]

BEARING PRESSURE ON STEEL BLOCK (AR 464)

\[ \sigma_{\text{bearing}} = \frac{P}{A} = \frac{P}{2d} = \frac{\frac{3960 \text{ lbs}}{(1\frac{1}{2}) \times (2 \times \frac{3}{8})}}{\text{ksi}} = \text{2112 psi} \leq 0.5 \]

\( \sigma_{\text{allowable}} = 31000 \text{ psi (AOM 2000)} \)

- These calculations also qualify section 12
BENDING OF CORNER DEAD LOAD ANCHOR (AN 490)

49506 lbs \div 2 = 24753 lbs

ASSUME CORNER ANCHORS ACT IN UNISON

\[ I = \frac{bc^3}{12} \]
\[ c = \frac{15}{8} '' \]

\[ \sigma_{bending} = \frac{mc}{I} = \frac{24753 \text{ lbs} \cdot (7') \cdot \left(\frac{15}{8}''\right)}{5.64 \text{ in}^4} = 49923 \text{ psi} \leq 0.1 \text{k} \]

\[ \sigma_{allowable} = \sigma_{ult} = 58000 \text{ psi} \quad \text{(ASTM A-36)} \]
## Revision Log

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<tr>
<th>Rev. #</th>
<th>Date</th>
<th>Page(s)</th>
<th>Revision(s)</th>
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<tr>
<td>0</td>
<td>8/11/05</td>
<td>All</td>
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### Bill of Materials

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<td>Horizontal</td>
<td>14</td>
<td>57 1/2&quot;</td>
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<tr>
<td>19V633</td>
<td>Horizontal Filler</td>
<td>10</td>
<td>57 1/2&quot;</td>
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<td>19V933</td>
<td>Press Bar Horizontal</td>
<td>20</td>
<td>57 1/4&quot;</td>
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<td>20V933</td>
<td>Press Bar Head</td>
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<td>57 1/4&quot;</td>
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<td>20W1019</td>
<td>Face Cover Horiz</td>
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<td>Face Cover Vert</td>
<td>4</td>
<td>108&quot;</td>
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<tr>
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<td>Press Bar Vert</td>
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<td>20W932</td>
<td>Anchor Support</td>
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<td>191 1/2&quot;</td>
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### Bill of Materials

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<td>56 23/32&quot;</td>
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<td>2#11&quot; Phil FH SM 2</td>
<td>2</td>
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<td>20S545</td>
<td>3/8-11 1/16&quot; GRS BOLT 2</td>
<td>2</td>
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<td>20S929</td>
<td>3/8-11 FLANGE NUT 2</td>
<td>2</td>
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<td>19A467</td>
<td>2#11&quot; Phil FH SM 2 14</td>
<td>1</td>
<td>(11.0 pcs)</td>
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<td>Cut from AR464 2</td>
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<td>1.500</td>
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<tr>
<td>20S177</td>
<td>2#11&quot; Phil FH SM 2</td>
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The installation details and support structure shown on sheets 1 through 21 have been evaluated by a professional engineer and are deemed acceptable for their structural performance only. Reference AF Report 57002-01-122-34.

---

Scott T. Siller, P.E.
Architectural Tailing, Inc.
130 Derry Court
York, Pennsylvania 17402-9405
(717) 786-1700

**This Space Reserved for Method Use Only.**

---

**United States Aluminum**, 710 Chur-Airway Road, Rock Hill, SC 29730; (803) 365-5655

---

**Bill of Materials**

**Subsidiary of International Aluminum Corporation**
(2) NY401 NYLATRON PADs (4 1/4 x 4 1/2) .500
3/16 x 3 1/2 (4 SIDES)
6 x 4 x 1/4 x 5 LONG STEEL ANCHOR (AM418)

4.000
3.250
2.500
.500

SL462

SPLICE SLEEVE 24" LONG

1.750

.500

1.750

MF535 - 5/8-11 x 3 1/2" GRADE 5 BOLT
MF255 - 5/8 FLAT WASHER
MF529 - 5/8-11 FLANGE NUT

NOTE:
APXXX DEAD LOAD ANCHOR PACKAGE AT JAMB.
1 EACH - AM418
2 EACH - NY401
4 EACH - MF535
4 EACH - MF255
4 EACH - MF529
1 EACH - SL462

DOW 995

This space reserved for structural engineer

This space reserved for metro-base use only

United States Aluminum
720 Cer-River Road
Rock Hill, SC 29730
200 Singleton Drive
Waxahachie, TX 75165

subsidiary of international aluminum corporation

USA-2869 18 of 21
MF545 - 5/8-11 x 4 1/2" GR5 BOLT
MF256 - 5/8 LOCK WASHER, SPLIT
MF219 - 5/8-11 HEX NUT, NYLOC
MF255 - 5/8 FLAT WASHER

19

NOTE:
APXXX DEAD LOAD ANCHOR
PACKAGE AT VERTICALS:
2 EACH - AN418
4 EACH - NY401
4 EACH - MF545
4 EACH - MF256
4 EACH - MF219
8 EACH - MF255
1 EACH - SL462

DOW 995

UNITED STATES ALUMINUM
700 Cel-River Road
Rock Hill, SC 29730
200 Singleton Drive
Vernonville, TX 75165

SUBSIDIARY OF INTERNATIONAL ALUMINUM CORPORATION
USA-2869 19 OF 21
NOTE:
1. APXXX DEAD LOAD ANCHOR PACKAGE AT CORNER MULLION.

2 EACH - AN490
4 EACH - NY401
4 EACH - MF545
4 EACH - MF256
4 EACH - MF219
8 EACH - MF255
1 EACH - SL492
NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY ON ALL DIMENSIONS SHOWN UNLESS OTHERWISE NOTED
2. PART NO - SL461

U.S. ALUMINUM CORP.
PRESTON
7/29/05
FULL SIZE
PART NO - SL461
USA-2891
NOTES:
1. 6063-T6 ALLOY AND TEMPER.
2. SLIDE FITS WITH BW478; DIE#
3. OUTSIDE PERIMETER: 14.926'
4. XXX INDICATES I.D. MARK FOR IEC-TX.

SECTIONS PROPERTIES

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<tr>
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<tbody>
<tr>
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<td>Iyy</td>
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<tr>
<td>Sxx</td>
<td>1.553 in²</td>
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NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY ON ALL DIMENSIONS SHOWN UNLESS OTHERWISE NOTED
2. PART NO. - SL462

U.S. ALUMINUM CORP.

PRESTON
7/29/05
FULL SIZE
PART NO. - SL462

USA-2892
NOTES:
1. MATERIAL = NYLON
2. PART NO. = NY401
NOTES:

1. MATERIAL: 1/4" STEEL
2. FINISH: SEE USAC P.D.
3. STANDARD SHOP TOLERANCE TO APPLY ON ALL DIMENSIONS SHOWN.

CORNER DEAD LOAD ANCHOR

U. S. ALUMINUM CORP.

PRESTON
8/05/05
FULL SIZE

USA-2895

PART NO. AN490

4.000

.688 DIA
(4)

.250 STEEL

135°

4.177
2.500
1.125
7.802
NOTES:

1. MATERIAL: 1/4" STEEL
2. FINISH: SEE USAC P.D.
3. STANDARD SHOP TOLERANCE TO APPLY ON ALL DIMENSIONS SHOWN.

U. S. ALUMINUM CORP.

VERTICAL MULLION WALL
DEAD LOAD ANCHOR
(TW3250 SERIES)
FULL SIZE

PRESTON
8/05/05
USA-2896
PART NO. AN418
NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY ON ALL DIMENSIONS SHOWN UNLESS OTHERWISE NOTED
2. PART NO. - SL491
NOTES:
1. 6063-T6 ALLOY AND TEMPER.
2. SLIDE FITS WITH BW492; DIE #
3. OUTSIDE PERIMETER: 22.395'
4. NO EXPOSED SURFACES.
NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY ON ALL DIMENSIONS SHOWN UNLESS OTHERWISE NOTED
2. PART NO. - SL492

U.S. ALUMINUM CORP.
PRESTON SPlice SLEEVE FOR CORNER MULLION DEADLOAD ANCHOR
7/29/05 PART NO. - SL492
FULL SIZE USA-2898
NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY ON ALL DIMENSIONS SHOWN UNLESS OTHERWISE NOTED
2. PART NO. - AC492

U.S. ALUMINUM CORP.

Preston
7/29/05
FULL SIZE
PART NO. - AC492
NOTES:
1. 6063-T6 ALLOY AND TEMPER
2. NO EXPOSED SURFACES
PART NO. - B4498
EXT. NO. -

NOTES:
1. STANDARD SHOP TOLERANCES TO APPLY UNLESS OTHERWISE NOTED
2. PART NO. - TB490

TAP FOR 5/8-11
CLASS 2B THREAD

U.S. ALUMINUM CORP.
PRESTON
08/02/05
FULL SIZE

TAPPING BLOCK FOR 90° CORNER
PART NO. - TB490

USA-2900
1. 6063-T6 ALLOY AND TEMPER.
2. XXX INDICATES I.D. MARK FOR IEC-TX.
3. NO EXPOSED SURFACES.
NOTES:
1. 6063-T6 ALLOY AND TEMPER.
2. PAINT PERIMETER: 9.262"
3. XXX INDICATES I.D. MARK FOR IEC-TX.
4. SNAP FITS WITH C-1183; DIE#
NOTES:
1. 6063-T6 ALLOY AND TEMPER.
2. PAINT PERIMETER: 14.250".
3. OUTSIDE PERIMETER: 22.708".
4. XXX INDICATES I.D. MARK FOR IEC-TX.
5. ▲ INDICATES POSSIBLE STREAKING.

SECTION PROPERTIES:
- Ixx = 25.619 in^4
- Sxx = 6.777 in^4
- Iyy = 3.029 in^4
- Syy = 2.423 in^4

DETAIL "A"
4 X SIZE

DETAIL "B"
4 X SIZE
NOTE:
1. NO EXPOSED SURFACES
2. 6063-T6 ALLOY & TEMPER
3. XXX INDICATES I.D. MARK

SECTION PROPERTIES
- $I_{xx} = 3.781 \text{ in}^4$
- $S_{xx} = 1.510 \text{ in}^3$
- $I_{yy} = 18.492 \text{ in}^4$
- $S_{yy} = 3.893 \text{ in}^3$

UNLESS OTHERWISE NOTED, ALL CORNERS ARE .015 R, AND TYPICAL WALL THICKNESS IS .125
NOTES:
1. NO EXPOSED SURFACES
2. XXX INDICATES I.D. MARK FOR IEC-TX
3. ALLOY & TEMPER: 6063-T6

SECTION PROPERTIES

\[ I_{xx} = 3.633 \, \text{in}^4 \]
\[ S_{xx} = 1.485 \, \text{in}^3 \]
\[ I_{yy} = 18.477 \, \text{in}^4 \]
\[ S_{yy} = 3.495 \, \text{in}^3 \]

UNLESS OTHERWISE NOTED, ALL CORNERS ARE .015 R, AND TYPICAL WALL THICKNESS IS .125