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BUILDING OFFICIAL

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Bellingham MARINE ®

May 22, 2023

Roshanak Amirazizi P.E.
Civil Engineer
OC Development Services / Building and Safety
Orange County, CA

RE: BNR21-0604 Dana Point Harbor, Aluminum Gates – Dock E1, E2, E3
Deferred Submittal

Dear Roshanak,

Please find the attached revised drawings and calculations for the aluminum gates to be used at docks E1, E2 and E3 of the Dana Point Harbor Revitalization Project (permit number BNR21-0604). The drawings and calculations are dated 5/18/2023.

The gates are a manufactured product from Specialty Steel Products, Inc. and have been engineered and sealed by Grantham Engineering. As Engineer-of-Record for the marina portion of the redevelopment, I have reviewed the drawings and calculations for general conformance with the project requirements. This includes review of the attachment of the gates to the floating docks.

Sincerely,

Bellingham Marine Engineering

Craig S. Funston, P.E., S.E.

REGISTERED PROFESSIONAL ENGINEER
CRAIG S FUNSTON
S 4878
EXP. 6/30/2023
STRUCTURAL
STATE OF CALIFORNIA

Craig S
Funston
2023.05.22
13:51:46-07'00'

Attachments:

| | |
|---|---|
| SSP Aluminum Gate Drawing | 2023-05-18 |
| SSP Aluminum Gate Calculation Set | 2023-05-18 |

Bellingham Marine Engineering
144 River Rd.
Lynden, Washington 98264
T 360.392.1433

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# STRUCTURAL CALCULATIONS FOR

# E-1 AND E-3 GATES

# AT

# DANA POINT MARINA

REGISTERED PROFESSIONAL ENGINEER
FREDERICK WILLIAM GRANTHAM
No. 82413
CIVIL
STATE OF CALIFORNIA

MAY 18, 2023

Prepared By:

Grantham Engineering, Inc.
7807 Hillandale Drive
San Diego, CA 92120
(619) 994-0748

GRANTHAM ENGINEERING
Civil • Mechanical • Marine

BELLINGHAM MARINE INDUSTRIES, INC.

- [x] NO EXCEPTIONS TAKEN
- [ ] REVISE AND RESUBMIT (RAR)
- [ ] OTHER: ____________________

REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS, ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE; ENGINEERING; FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION; COORDINATION OF THEIR WORK WITH THAT OF ALL OTHER TRADES AND THE SATISFACTORY PERFORMANCE OF THEIR WORK.

Craig Funston P.E., S.E.

05/22/2023

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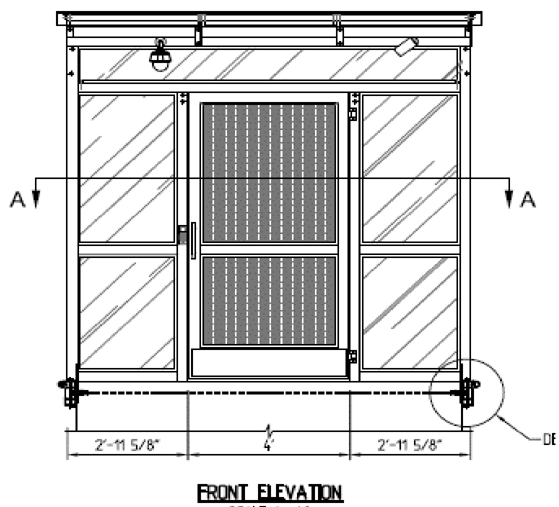
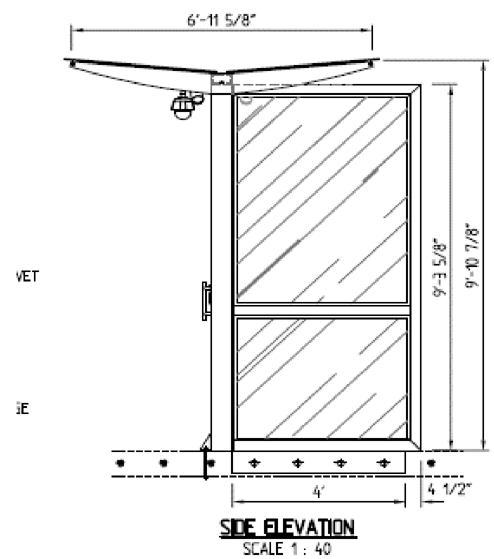
| | | | |
|---|---|---|---|
| 1 | **Structural Calculations for Dana Point Gangway E1 and E3 ADA Gates** | | |
| 2 | **Applicable Codes** | | |
| 3 | ASCE 7-16 Minimum Design Loads for Building and other Structures | | |
| 4 | California Layout and Design Marina Berthing Facilities 2005 | | |
| 5 | Aluminum Design Manual 2015 and 2020 | | |
| 6 | California Building Code 2019 | | |
| 7 | **Analytical Software** | | |
| 8 | RISA 3D Version 20 ( Structural ) | | |
| 9 | MECAWind PRO V2342 (Wind Loading) | | |
| 10 | **View of Gate** | | |
| 11 |     | | |
| 12 | **Item** | **Value** | **Comments** |
| 13 | **Gate RISA Model** | | |

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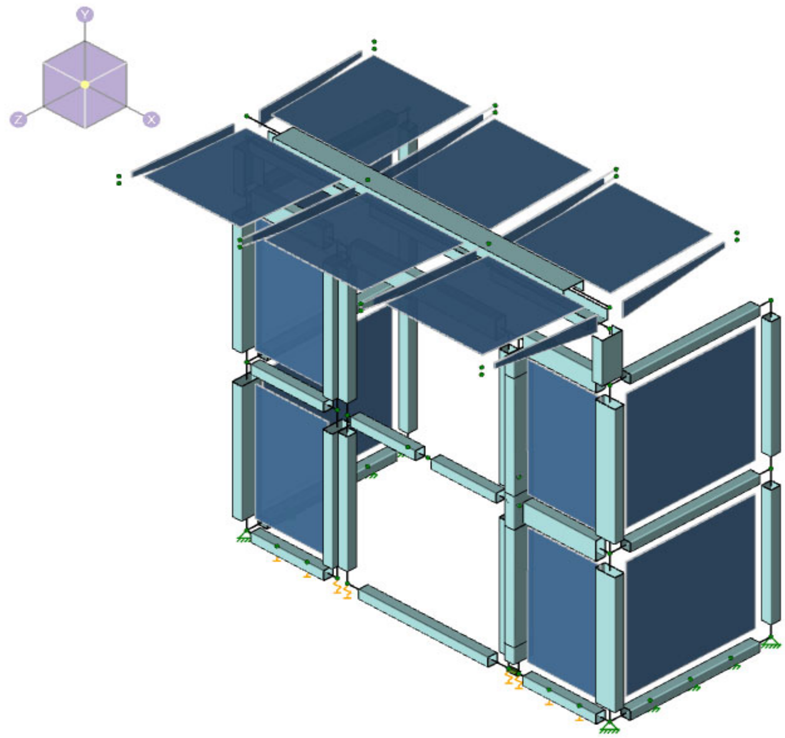
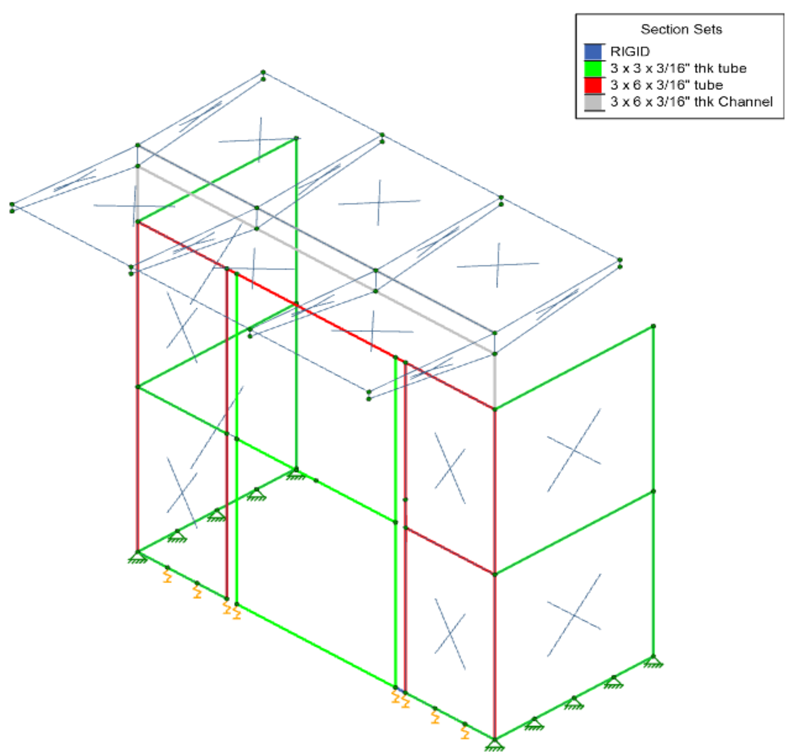
|---|---|
| 14 |   |
| 15 |   |

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Aluminum Section Sets

Hot Rolled | Cold Formed | Wood | Concrete | Aluminum | Stainless

| | Label | Shape | Type | Design List | Material | Design Rule |
|---|---|---|---|---|---|---|
| 1 | 3 x 3 x... | RT3X3X0.188 | None | None | 6061-T6 | Typical |
| 2 | 3 x 6 x... | RT3X6X0.188 | None | None | 6061-T6 | Typical |
| 3 | 3 x 6 x... | 3X6X3/16"T... | None | None | 6061-T6 | Typical |

17

The Section Sets define the major structural components of the Model match the parts list defined on the drawing

18

The glass panels are model as plates

19

General Materials Properties

Hot Rolled | Cold Formed | Wood | Concrete | Masonry | Aluminum | Stainless | General

| | Label | E [ksi] | G [ksi] | Nu | Therm. Coeff. [1e⁵°F⁻¹] | Density [k/ft³] | Plate Methodo... |
|---|---|---|---|---|---|---|---|
| 1 | gen_Conc3NW | 3155 | 1372 | 0.15 | 0.6 | 0.145 | Isotropic |
| 2 | gen_Conc4NW | 3644 | 1584 | 0.15 | 0.6 | 0.145 | Isotropic |
| 3 | gen_Conc3LW | 2085 | 906 | 0.15 | 0.6 | 0.11 | Isotropic |
| 4 | gen_Conc4LW | 2408 | 1047 | 0.15 | 0.6 | 0.11 | Isotropic |
| 5 | gen_Alum | 10600 | 4077 | 0.3 | 1.29 | 0.173 | Isotropic |
| 6 | gen_Steel | 29000 | 11154 | 0.3 | 0.65 | 0.49 | Isotropic |
| 7 | RIGID | 1e+6 | | 0.3 | 0 | 0 | Isotropic |
| 8 | Glass | 1e+6 | | 0.3 | 0 | 0.175 | ...opic |

20

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | P14 | N46 | N41 | N43 | N49 | Glass | 0.31 |
| 10 | P15 | N41 | N47 | N52 | N43 | Glass | 0.31 |
| 11 | P16 | N43 | N52 | N58 | N44 | Glass | 0.31 |
| 12 | P17 | N49 | N43 | N44 | N55 | Glass | 0.31 |

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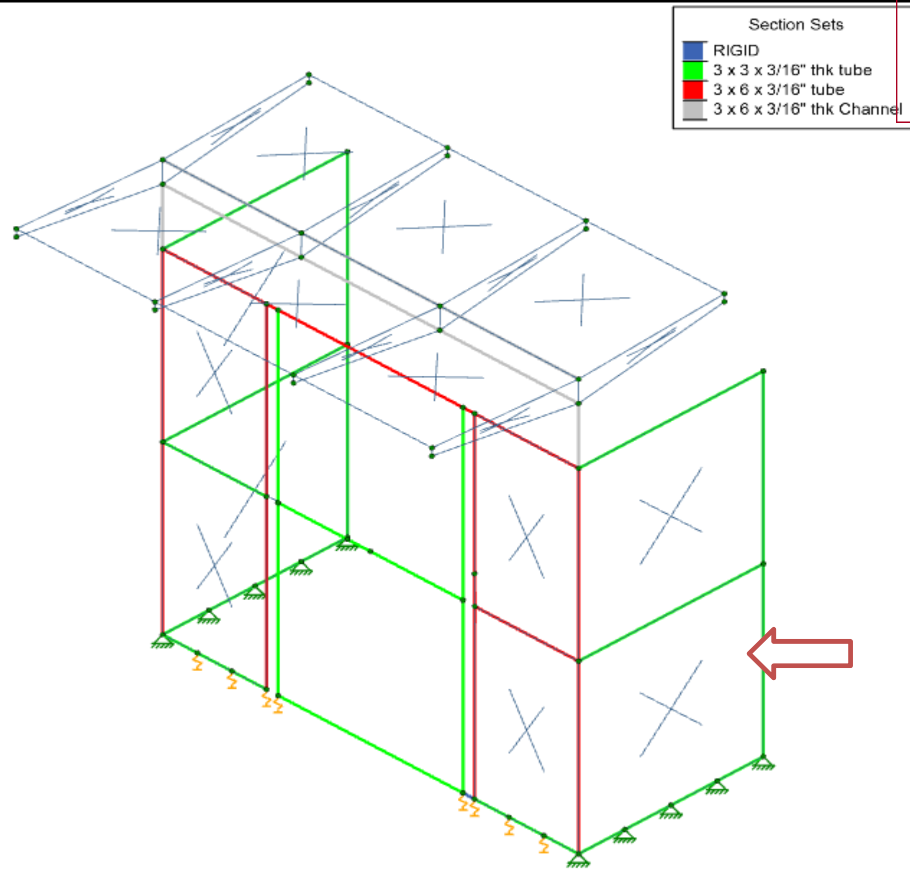
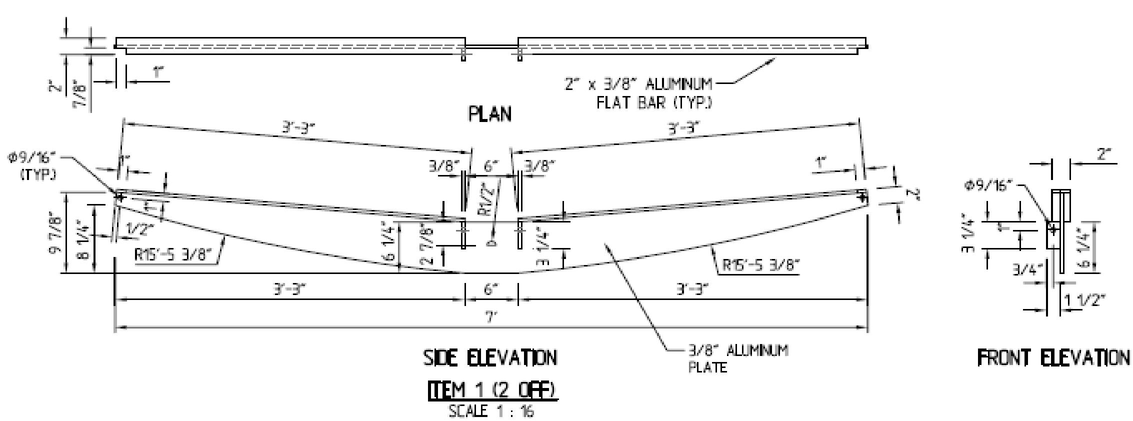



22 Roof Structure

23



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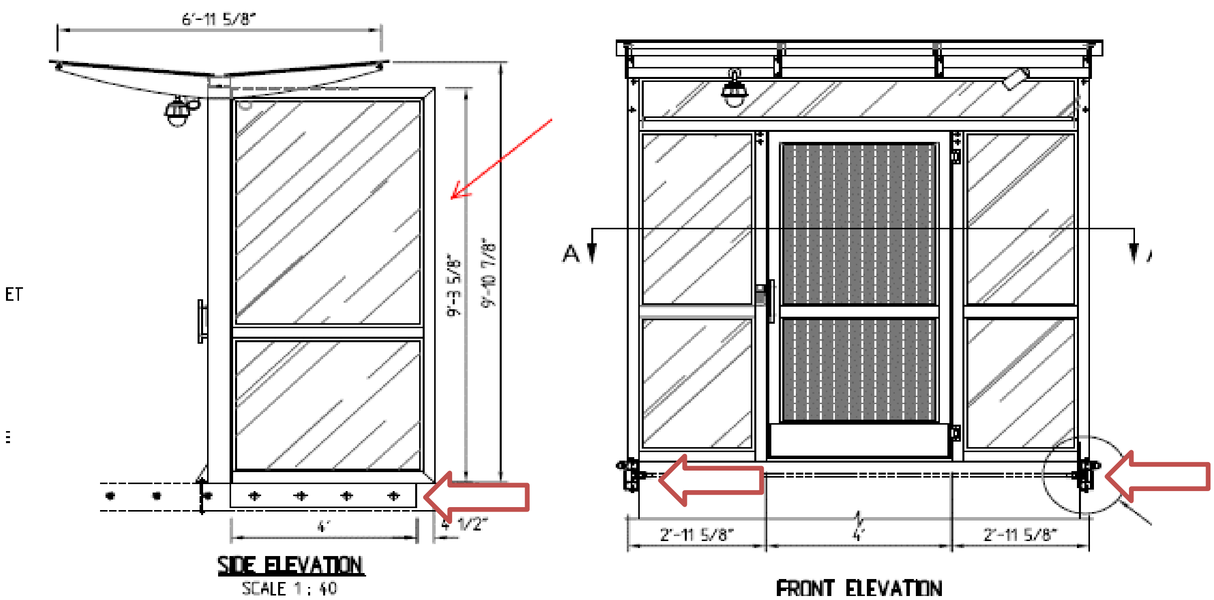
24

| | Label | A Node | B Node | C Node | D Node | Material | Thickness [in] |
|---|---|---|---|---|---|---|---|
| 1 | P1 | N41 | N46 | N45 | N29 | gen_Alum | 0.375 |
| 2 | P2 | N41 | N47 | N48 | N29 | gen_Alum | 0.375 |
| 3 | P3 | N43 | N52 | N53 | N54 | gen_Alum | 0.375 |
| 4 | P4 | N43 | N49 | N50 | N54 | gen_Alum | 0.375 |
| 5 | P5 | N44 | N58 | N59 | N60 | gen_Alum | 0.375 |
| 6 | P6 | N44 | N55 | N56 | N60 | gen_Alum | 0.375 |
| 7 | P7 | N42 | N64 | N65 | N30 | gen_Alum | 0.375 |

25

Add reaction points.

26



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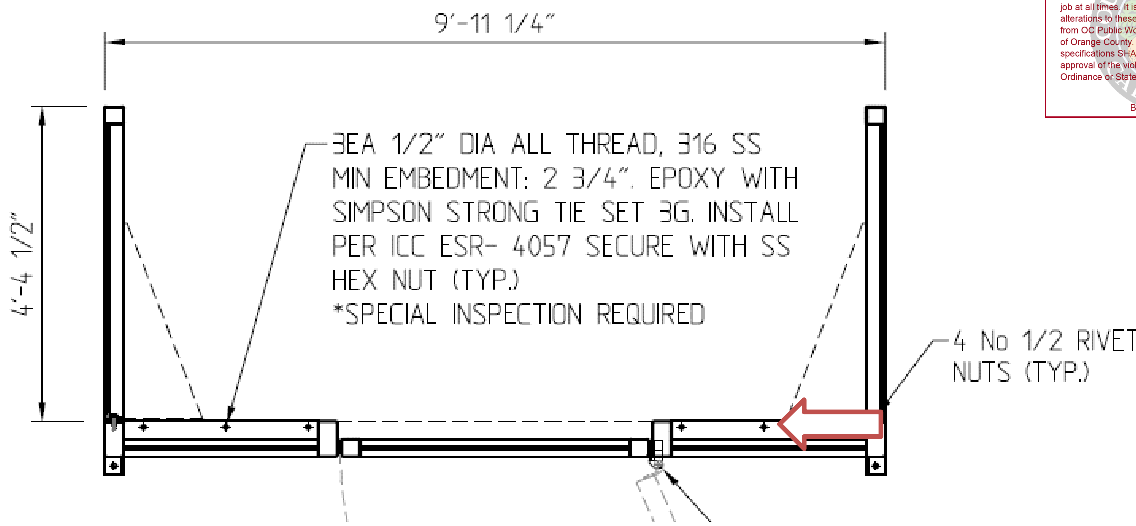
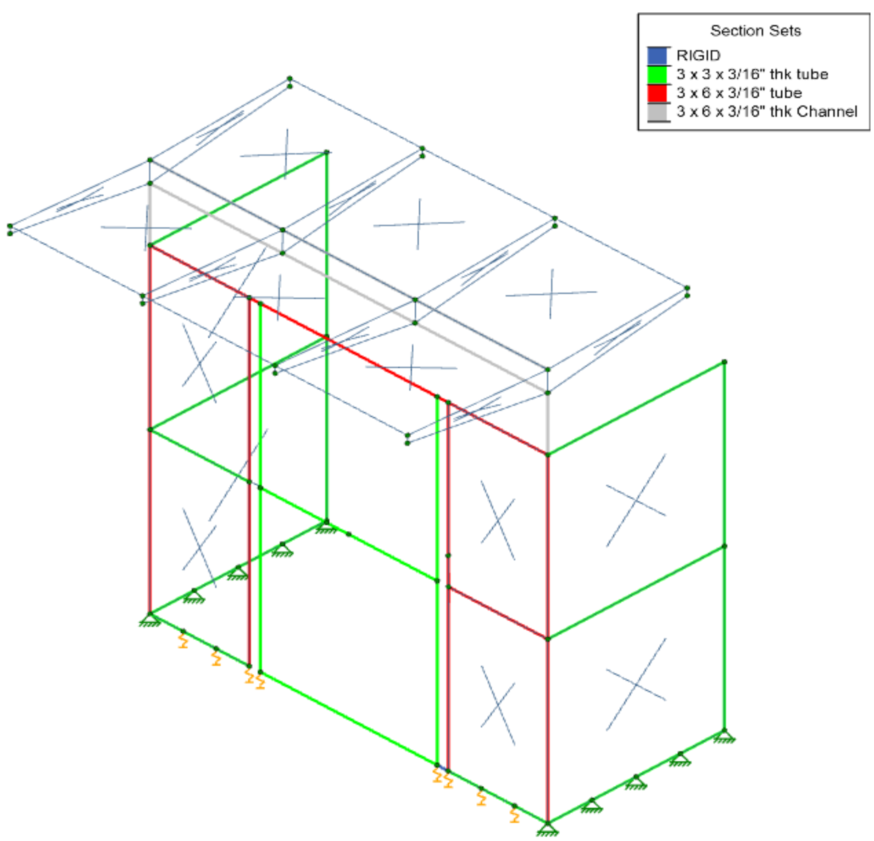
|---|---|
| 27 |  |
| 28 |  |
| 29 | **Loading the RISA Model** |

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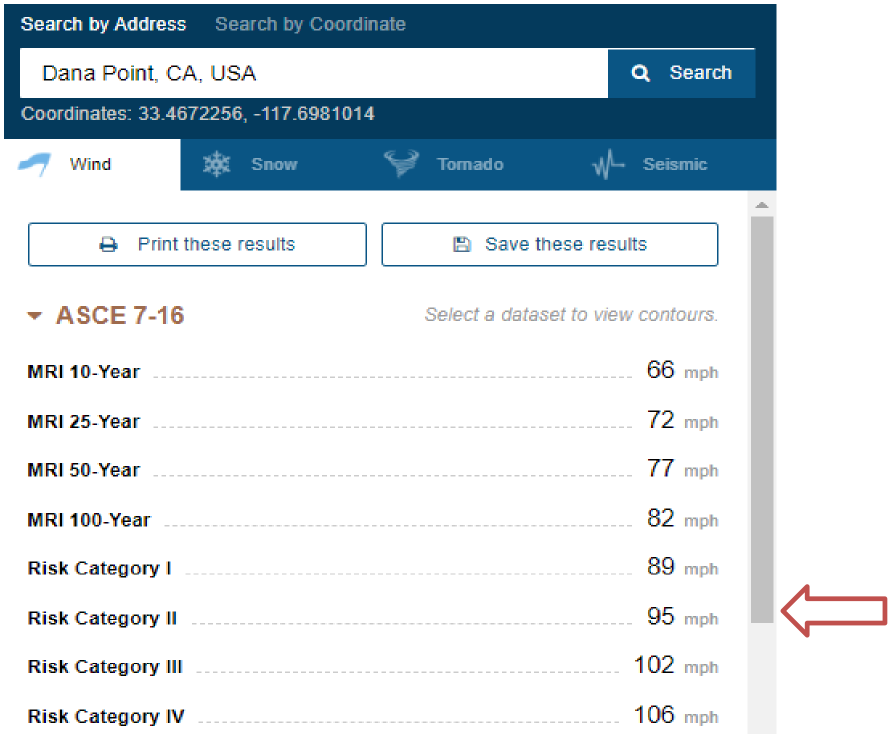
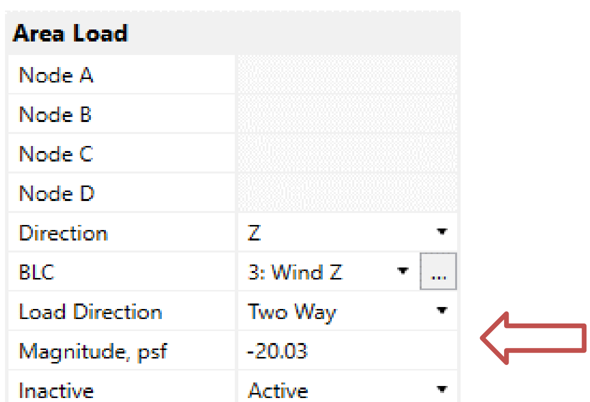
<table>
<tr><td>30</td><td>Wind Pressure, Qz (lbs/ft^2)</td><td>20.03</td><td>0.00256 x kz x kzt x Kd x Ws^2, Kz = .85 Kzt = 1.2<br>Kd =.75 Use in RISA analysis</td></tr>
<tr><td>31</td><td>Basic Wind Speed, V (mph)</td><td>95.00</td><td>See below</td></tr>
<tr><td>32</td><td colspan="3">
</td></tr>
<tr><td>33</td><td>Wind Directionality factor, Kd</td><td>0.85</td><td>Section 26.6-1</td></tr>
<tr><td>34</td><td>Exposure Category</td><td>C</td><td>Section 26.7.3, If not Exposure B or D, use Exposure C.</td></tr>
<tr><td>35</td><td colspan="3">
</td></tr>
<tr><td>36</td><td colspan="3">Wind Load in the Z-direction</td></tr>
</table>

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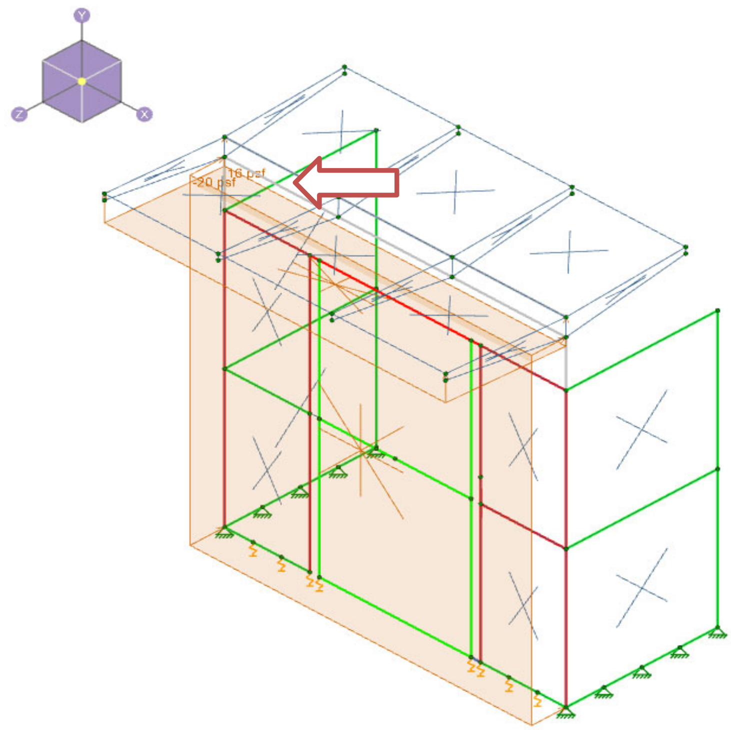
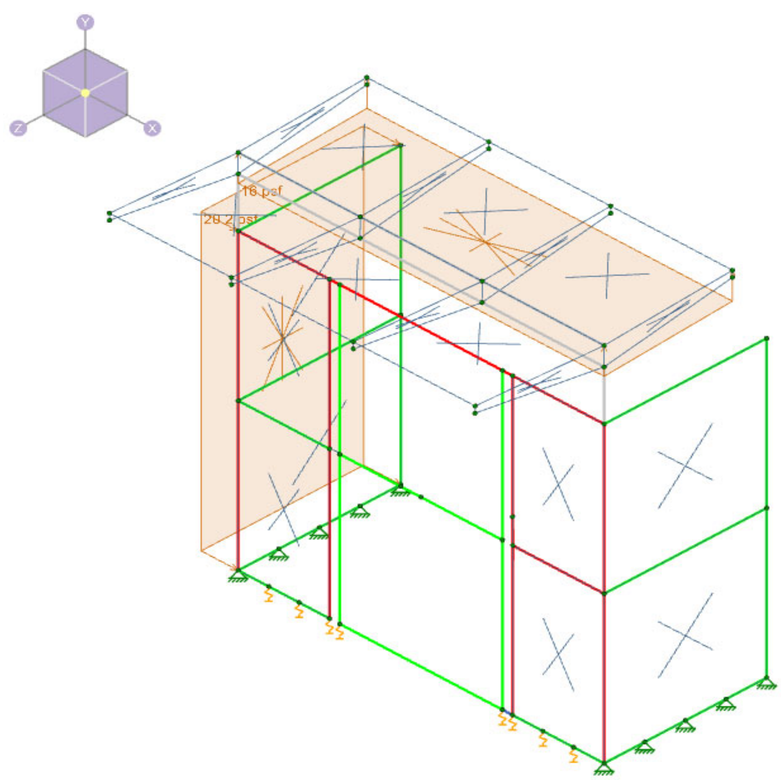
| 37 |  |
| 38 | Wind Load in the X-direction |
| 39 |  |

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| | | | |
|---|---|---|---|
| 40 | **Wind Uplift Load** | | |
| 41 | Wind Uplift Load, Wu (psf) | 16 | See Below |

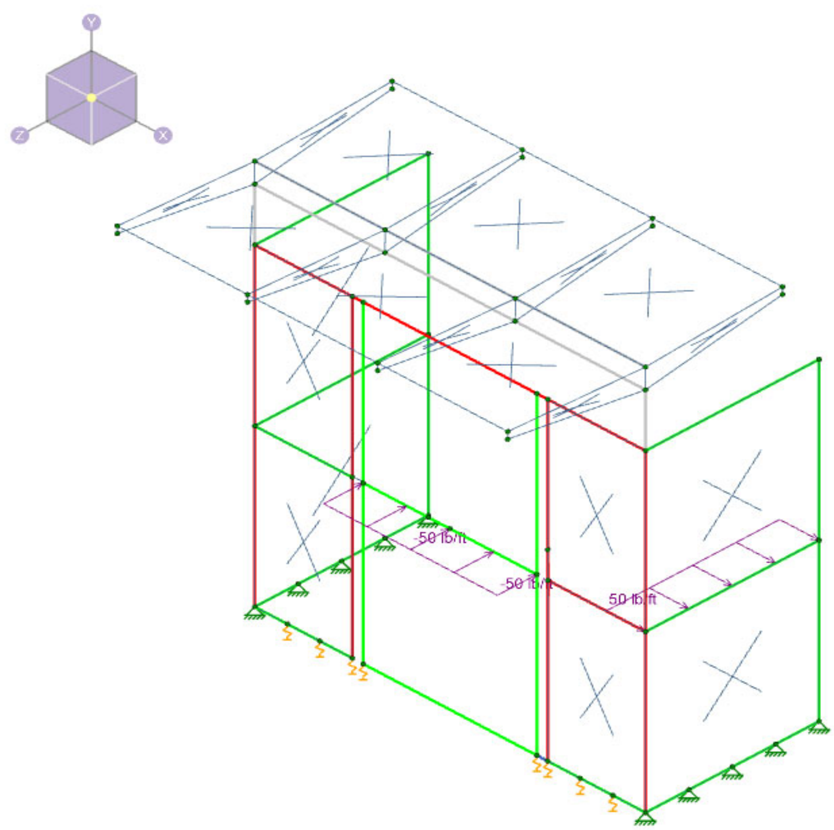
42

Wind Pressures for C&C on a Canopy per Ch 30 Part 7 and Sec 30.11
Wind Pressures for C&C on Canopy per Ch 30 Part 7 & Fig 30.11-1A/B
All wind pressures include a load factor of 1.0

| Description | Zone | Width ft | Span ft | Area ft | GCp Pos | GCp Neg | P Min psf | P Max psf |
|---|---|---|---|---|---|---|---|---|
| Zone Lower Surface | Lower Surface | 9.000 | 26.000 | 234.000 | 0.600 | -0.650 | -16.00 | 16.00 |
| Zone Upper Surface | Upper Surface | 10.000 | 26.000 | 260.000 | 0.600 | -0.700 | -16.00 | 16.00 |

| | |
|---|---|
| 43 | **See above in both the X and Z directions** |
| 44 | **Seismic Analysis (none) The Gate is not effected by base shear loads on a floating dock.** |
| 45 | Uniform Handrail Load - 50 plf |

46




| | |
|---|---|
| 47 | Concentrated Handrail Load - 200 lbs |

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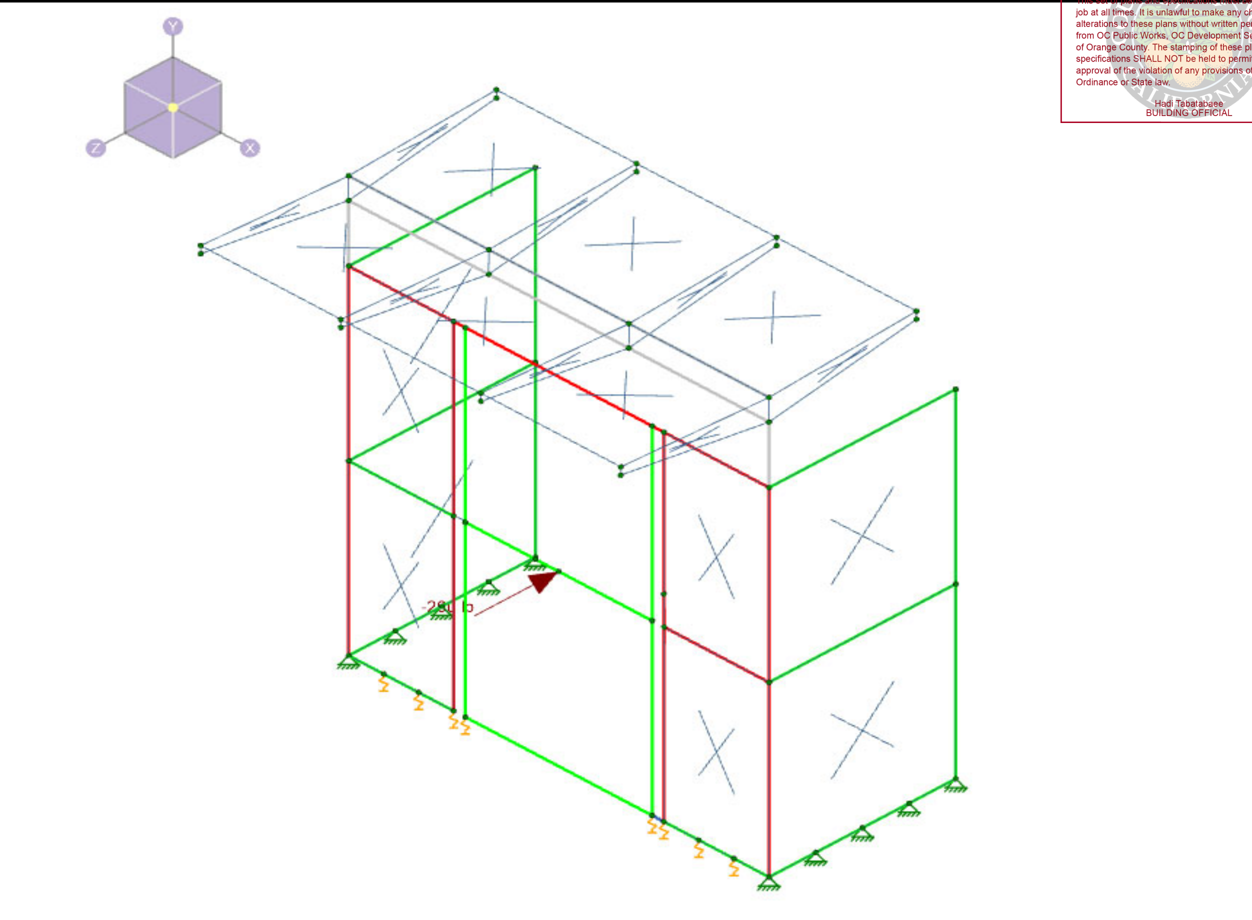
| 48 |  |
| 49 | Roof Live Load: 20 psf |

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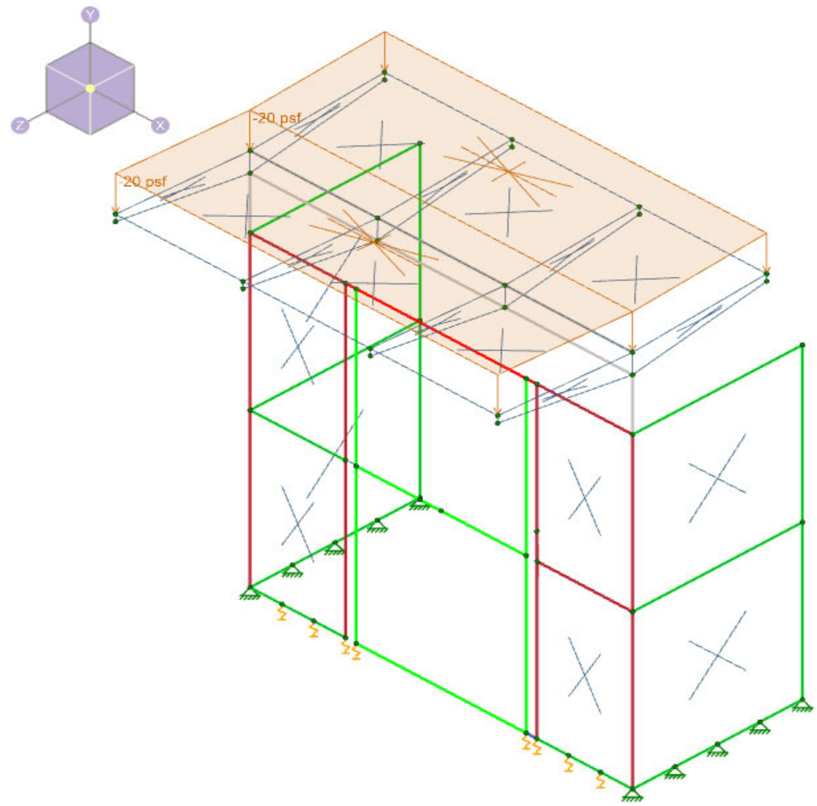
50




51 Define Basic Load Cases

52

**Basic Load Cases**

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Nodal | Point | Distributed | Area(Member) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Self Weight | DL | | -1 | | | | | |
| 2 | Wind X | WLX | | | | | | | 2 |
| 3 | Wind Z | WLZ | | | | | | | 2 |
| 4 | Seismic X | ELX | | | | | | | |
| 5 | Roof Live Load | RLL | | | | | | | 2 |
| 6 | Seismic Z | ELZ | | | | | | | |
| 7 | Uniform handrail load | OL1 | | | | | | 3 | |
| 8 | Concentrated Load | OL2 | | | | 1 | | | |

53 **Define Load Combinations**

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**Load Combinations**

Combinations | Design

LC Generator | RSA Scaling Factor

| | Description | Solve | P-Delta | SRSS | BLC | Factor | BLC | Factor |
|---|---|---|---|---|---|---|---|---|
| 1 | Dead Load | ☑ | Y | | DL | 1 | | |
| 2 | Roof Load | ☑ | Y | | DL | 1.2 | RLL | 1.6 |
| 3 | Concentrated... | ☑ | Y | | DL | 1.2 | OL2 | 1.6 |
| 4 | handrail unifo... | ☑ | Y | | DL | 1.2 | OL1 | 1.6 |
| 5 | Wind Down X | ☑ | Y | | DL | 1.2 | WLX | 1 |
| 6 | Wind Up X | ☑ | Y | | DL | 0.9 | WLX | 1 |
| 7 | Wind Down Z | ☑ | Y | | DL | 1.2 | WLZ | 1 |
| 8 | Wind Down -Z | ☑ | Y | | DL | 0.9 | WLZ | -1 |
| 9 | Wind Up Z | ☑ | Y | | DL | 0.9 | WLZ | 1 |
| 10 | Wind Up -Z | ☑ | Y | | DL | 0.9 | WLZ | -1 |

55 **Deflection Analysis**

56 Run all the Load Combinations to determine the largest deflection

57

**Envelope Node Displacements**

| | Node Label | | X [in] | LC | Y [in] | LC | Z [in] | LC | X Rotation [rad] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | N35 | max | 0 | 6 | 0 | 9 | 0.225 | 10 | -4 |
| 2 | | min | 0 | 2 | -0.002 | 6 | -0.225 | 9 | -6.326e-4 |
| 3 | N38 | max | 0.006 | 6 | 0 | 9 | 0.157 | 10 | 2.467e-3 |
| 4 | | min | 0 | 7 | -0.003 | 6 | -0.157 | 9 | -2.467e-3 |
| 5 | N82 | max | 0.006 | 6 | 0 | 9 | 0.133 | 10 | 1.594e-3 |

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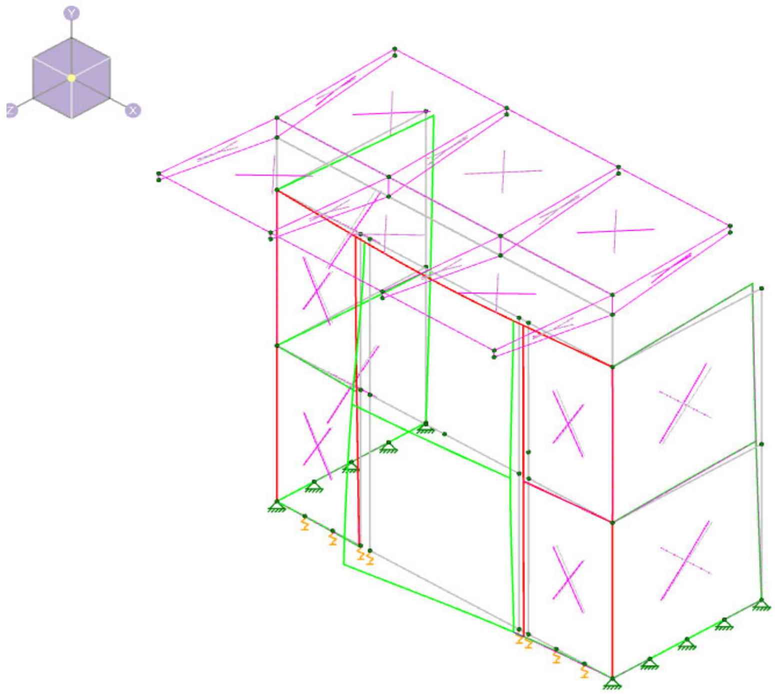
| | | | |
|---|---|---|---|
| 58 |  | | |
| 59 | Max Allowable Deflection, Dam (in) | 1.333 | 10 ft height x 12 /180 x 2 for Cantilever Systems. |
| 60 | Max Deflection, Dm (in) | 0.225 | See above |
| 61 | **Safety Factor** | **5.93** | **Dam/Dm >1 OK** |
| 62 | **Verify Code Compliance** | | |

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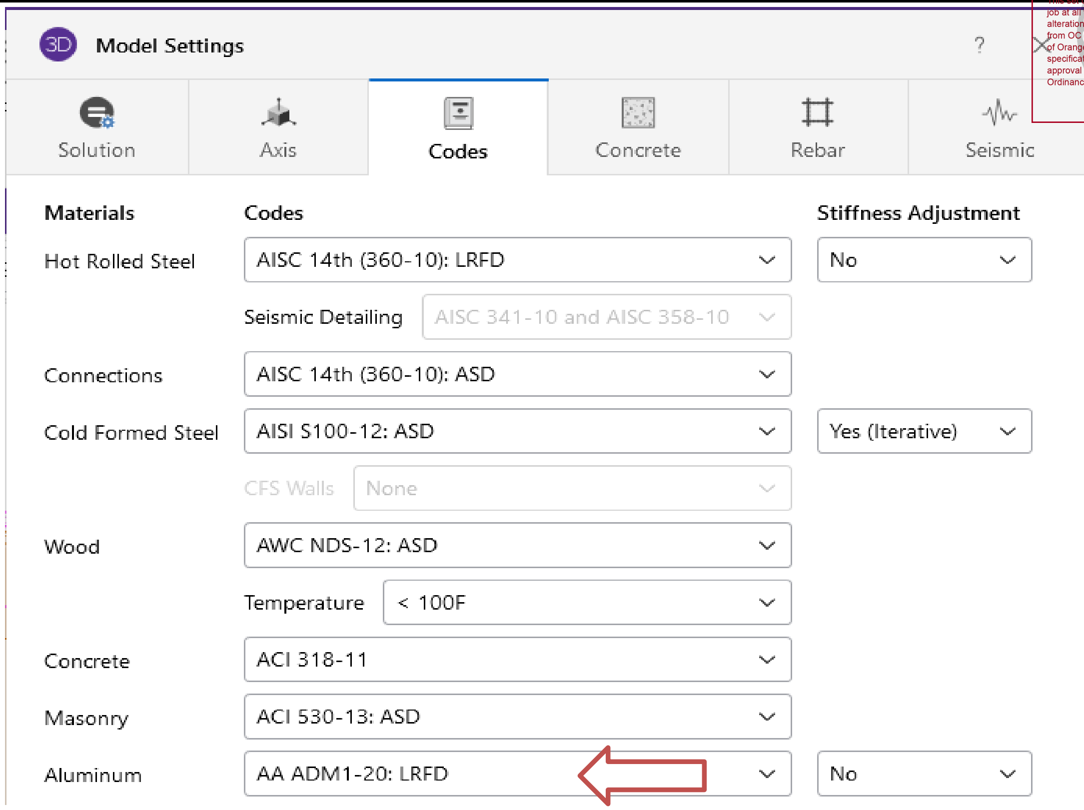
| 63 |  |
| 64 | **Strength Analysis** |
| 65 | Run the all Load Combinations |

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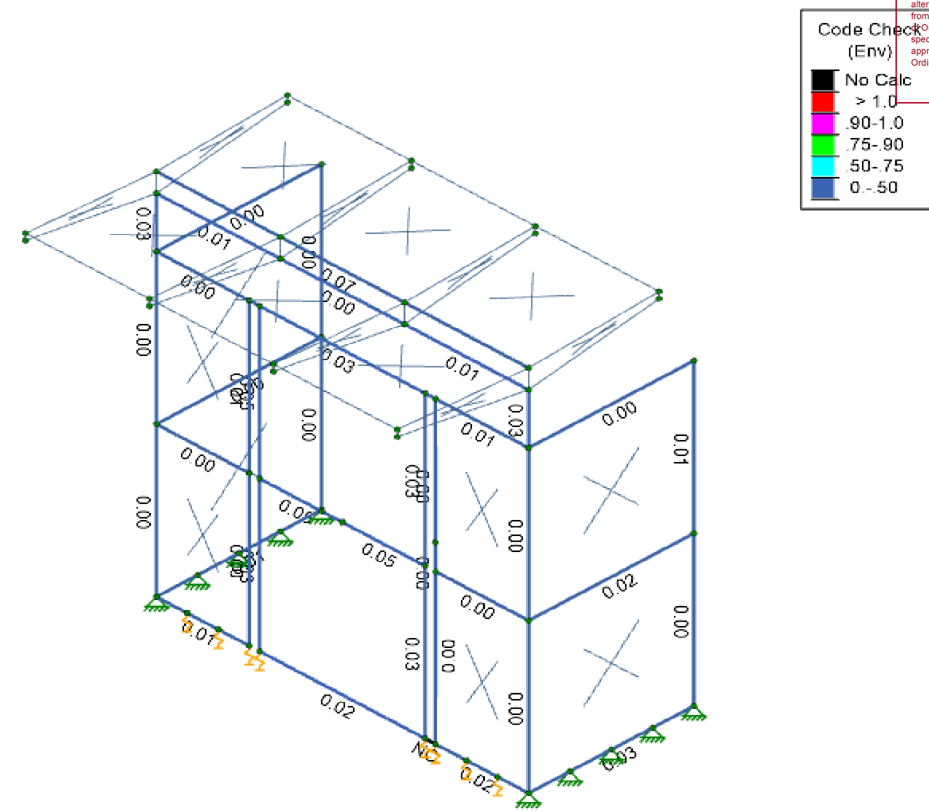


67

**Envelope AA ADM1-15: LRFD - Building Aluminum Code Checks**

Hot Rolled Steel | Cold Formed Steel | Wood | Concrete Beams | Concrete Columns | Aluminu

| | Member | Shape | Code Check | Loc[in] | LC | Shear Check | Loc[in] | Dir | LC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | M32 | 3X6X3... | 0.069 | | 2 | 0.017 | 108.06 | z | 2 |
| 2 | M14 | RT3X3... | 0.05 | 0 | 4 | 0.011 | 47.5 | y | 4 |
| 3 | M78 | RT3X3... | 0.045 | 0 | 3 | 0.018 | 24.02 | z | 4 |
| 4 | M19 | RT3X3... | 0.045 | 24.02 | 3 | 0.018 | 0 | z | 4 |

68

The code check values are the UC Max and Shear UC shown on the bridge. The colors represent a factored ratio of actual to allowable load for LRFD based on the provisions of the Aluminum Design Manual 2020. Ratios greater than 1 are shown in RED; therefore, any member in RED is not acceptable.

69

**Check Nylon Rod Shear Capacity**

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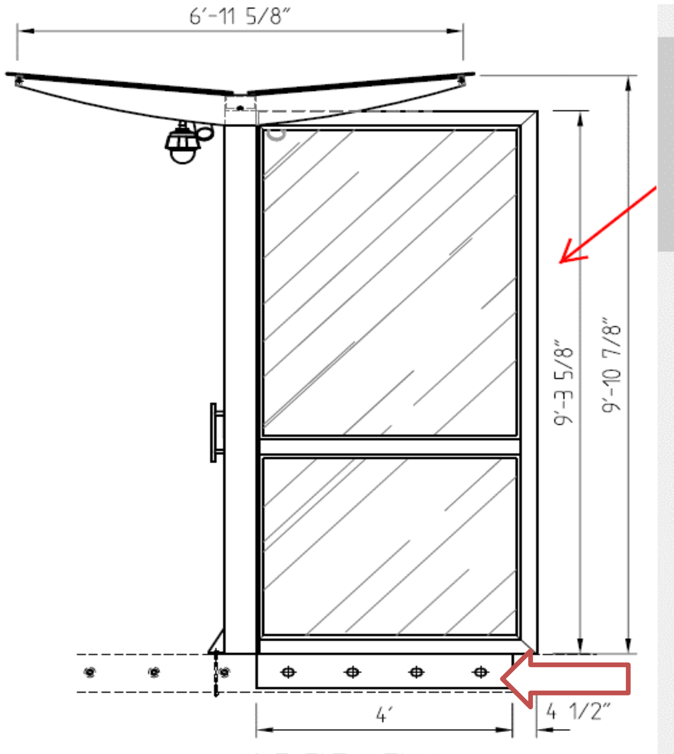
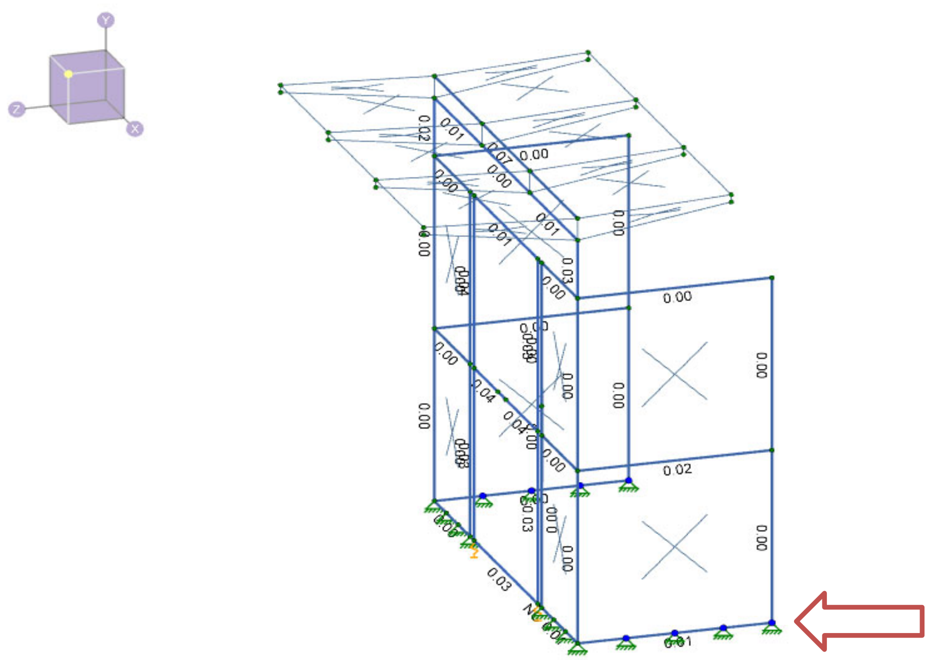
| | |
|---|---|
| 70 |  |
| 71 |  |
| 72 | **Run all load combinations** |

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73

**Envelope Node Reactions**

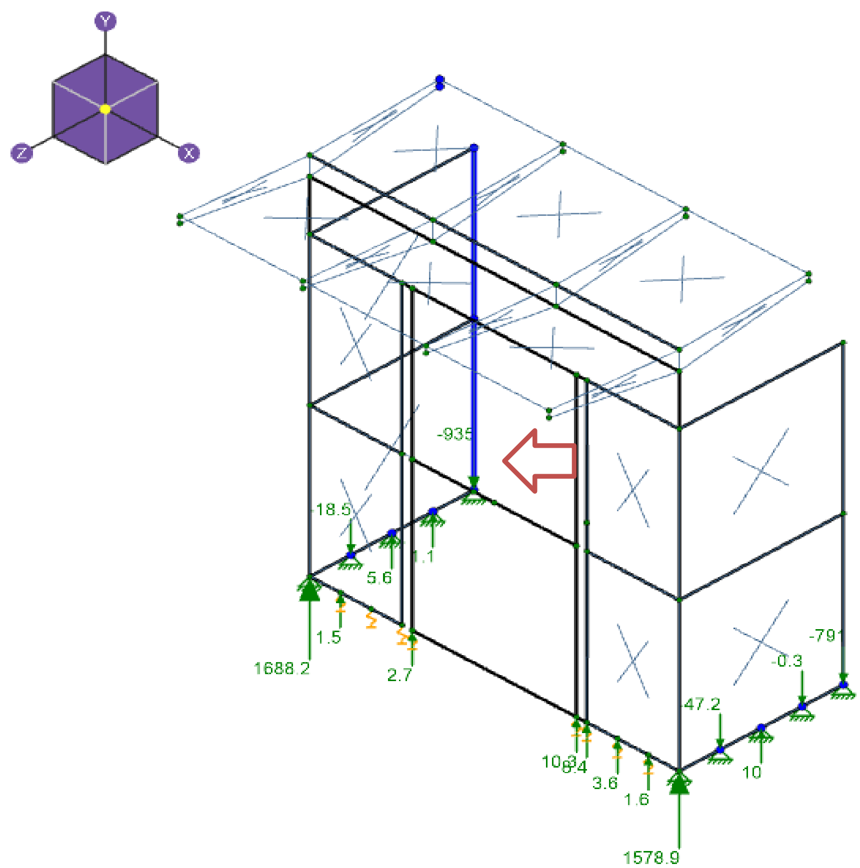
| | Node Label | | X [lb] | LC | Y [lb] | LC | Z [lb] | LC | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | N71 | max | 81.388 | 7 | 1151.661 | 7 | 440.964 | 7 | ( |
| 2 | | min | -119.256 | 6 | -935.014 | 8 | [illegible]47 | 8 | ( |
| 3 | N51 | max | 34.66 | 10 | 1007.658 | 7 | 411.119 | 7 | ( |
| 4 | | min | -82.626 | 4 | -791.028 | 8 | -335.926 | 8 | ( |
| 5 | N74 | max | 420.771 | 10 | 52.74 | 7 | 0 | 9 | ( |

74

**Node Reactions (By Combination)**

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] | M |
|---|---|---|---|---|---|---|
| 1 | 8 | N71 | -81.343 | -935.014 | [illegible]66.747 | 0 |
| 2 | 8 | N51 | 34.66 | -791.028 | -335.926 | 0 |
| 3 | 8 | N74 | 420.771 | -47.154 | 0 | 0 |
| 4 | 8 | N79 | -159.547 | -18.49 | 0 | 0 |

75




| | | | |
|---|---|---|---|
| 76 | **Shear Load on Nylon Rods, T (lbs)** | **935** | **See above** |

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| | | | |
|---|---|---|---|
| 77 | Diameter of Rods, Dr (in) | 0.75 | |
| 78 | Cross Sectional Area of Rods, Ar (in^2) | 0.44 | .25 X 3.141 X Dr^2 |
| 79 | Number of Rods, N | 1.00 | |
| 80 | Shear Stress per Rod, Vr (psi) | 1,058.40 | T / Ar / N/ 2 faces (double shear) |
| 81 | Shear Capacity of Nylon, Vc (psi) | 7,200.00 | 9600 psi x 0.75 (resistance factor) |
| 82 | | | |

Nylon 6/6 Mechanical Properties (73o F / 23o C)

| TENSILE STRENGTH | D638 | 12,000 PSI. | 82.7 MPA |
|---|---|---|---|
| ELONGATION | D638 | 60% | 60% |
| SHEAR STRENGTH | D732 | 9,600 PSI. | 66.2 MPA |
| FLEXUARAL MODULUS | D790 | 410,000 PSI. | 2.,287 MPA |
| IMPACT STRENGTH | D256 | 1.0 FT/LB/IN | 5.5 KG/CM2 |
| HARDNESS | D785 | R121 | M79 |
| SPECIFIC GRAVITY | D792 | 1.13 | 1.13 |
| MELTING POINT | D789 | 500 F | 2600 C |
| DIELECTRIC STRENGTH | D149 | 600 V/MIL | 10 OHM-CM |
| UNDERWRITERS LABORATORY RATING | BUL. 94 | 94V2 | 94V2 |

| | | | |
|---|---|---|---|
| 83 | Safety Factor | 6.80 | Vc/ Vr > 1 OK |
| 84 | Determine Fatigue Stress on Connection | | |
| 85 | Wind Load at 25 mph (psf) | 2.00 | |

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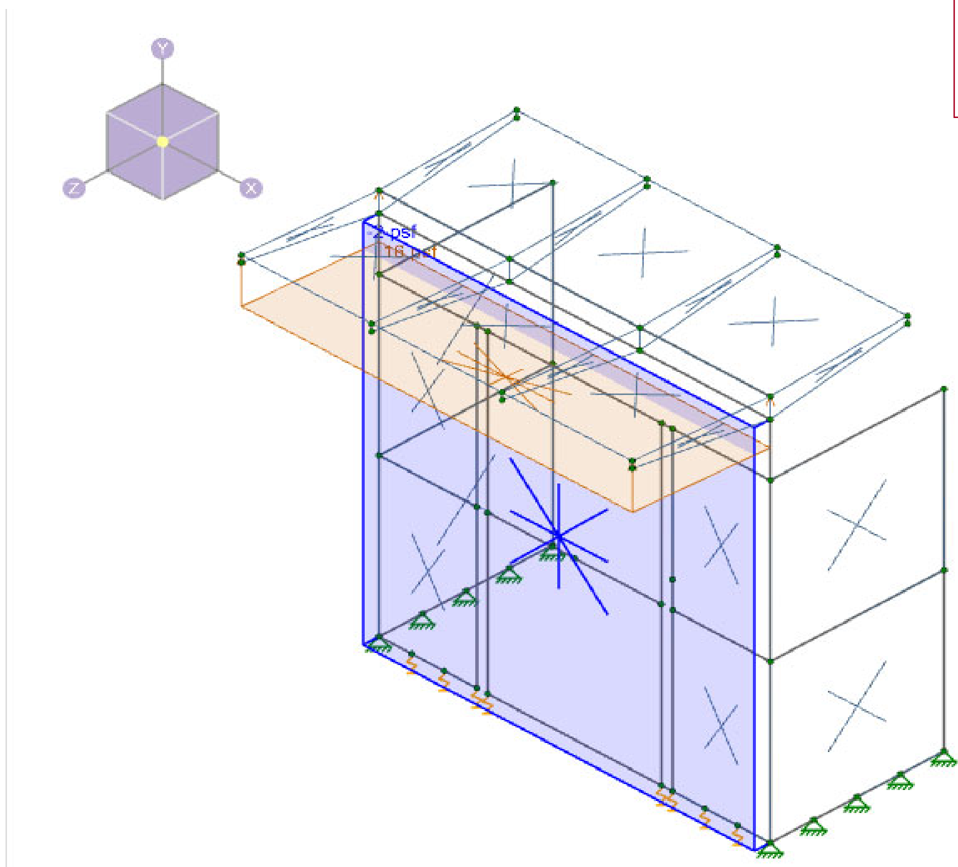
86




87

**Node Reactions (By Combination)**

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] |
|---|---|---|---|---|---|
| 1 | 8 | N71 | -8.117 | -9.939 | 4.281 |
| 2 | 8 | N74 | 42.086 | -2.554 | 0 |
| 3 | 8 | N28 | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| 88 | **Shear Load on Nylon Rods, T (lbs)** | **9.90** | **See above** |
| 89 | **Diameter of Rods, Dr (in)** | **0.75** | |
| 90 | **Cross Sectional Area of Rods, Ar (in^2)** | **0.44** | **.25 X 3.141 X Dr^2** |
| 91 | **Number of Rods, N** | **2.00** | |
| 92 | **Shear Stress per Rod, Vr (psi)** | **5.60** | **T / Ar / N/ 2 faces (double shear)** |
| 93 | **Shear Capacity of Nylon, Vc (psi)** | **7,200.00** | **9600 psi x 0.75 (resistance factor)** |

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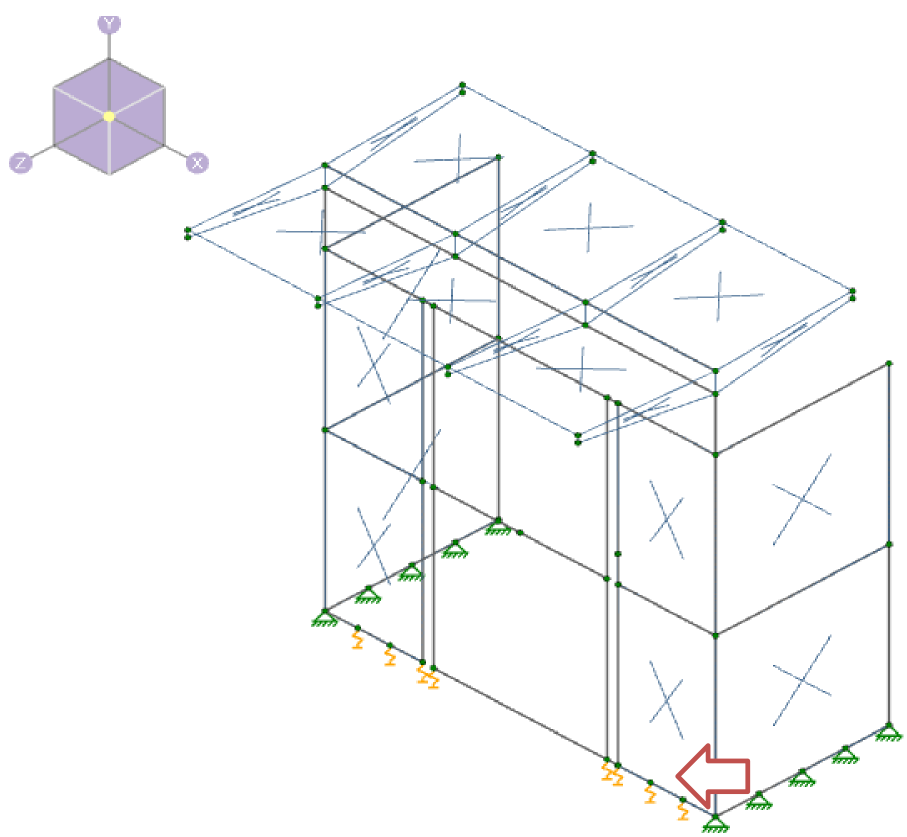
Nylon 6/6 Mechanical Properties (73o F / 23o C)

| | | | |
|---|---|---|---|
| TENSILE STRENGTH | D638 | 12,000 PSI. | 82.7 MPA |
| ELONGATION | D638 | 60% | 60% |
| SHEAR STRENGTH | D732 | 9,600 PSI. | 2 MPA |
| FLEXUARAL MODULUS | D790 | 410,000 PSI. | 2.,287 MPA |
| IMPACT STRENGTH | D256 | 1.0 FT/LB/IN | 5.5 KG/CM2 |
| HARDNESS | D785 | R121 | M79 |
| SPECIFIC GRAVITY | D792 | 1.13 | 1.13 |
| MELTING POINT | D789 | 500 F | 2600 C |
| DIELECTRIC STRENGTH | D149 | 600 V/MIL | 10 OHM-CM |
| UNDERWRITERS LABORATORY RATING | BUL. 94 | 94V2 | 94V2 |

| | | | |
|---|---|---|---|
| 95 | **Safety Factor** | **1,284.95** | **Vc/ Vr > 1 OK** |
| 96 | **Check Concrete Anchors** | | |

97 **The concrete anchors are modeled as springs. They do not take any tension loads because they can only resist about 400 lbs of load. Their purpose is to "sturdy" the gate. The significant loads are resisted by the Nylon members defined above**

98




| | | | |
|---|---|---|---|
| 99 | **Tensile Capacity of Anchor, T (lbs)** | **400.00** | **See below** |

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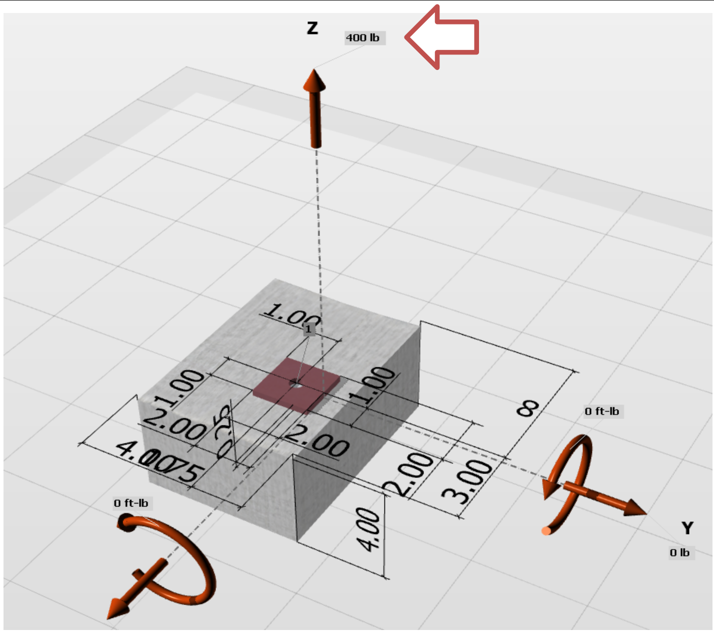
100




**Input Data**

Design method: ACI 318-14
Anchor: SET-3G w/ 1/2"Ø A193 Gr. B8/B8M (304/316SS)
Effective Embedment depth: 2.750 inch
Concrete: Normal-weight
State: Cracked
Compressive strength: 3000 psi
Seismic design: No

**Resulting Anchor Forces**

| # | Tension [lb] | Shear [lb] |
|---|---|---|
| 1 | 882 | 0 |

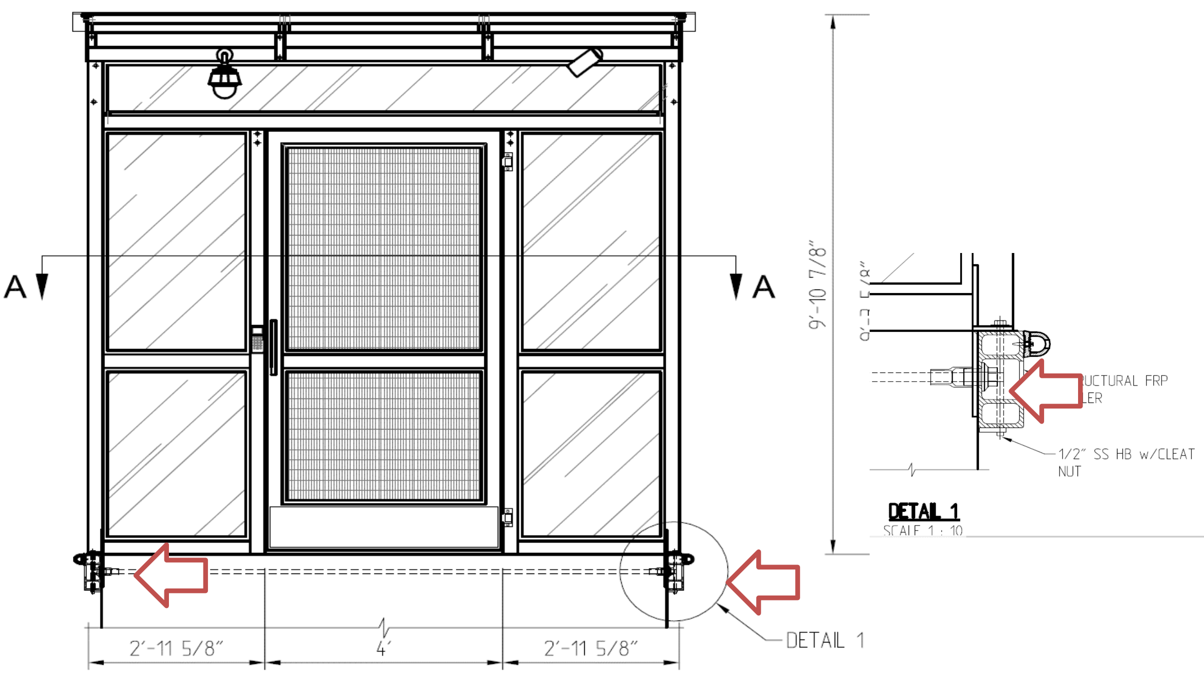
**Governing tension ratio: 97.5% (Pass)**

| | Ratio | $N_{ua}$ [lb] | $\Phi N_n$ [lb] |
|---|---|---|---|
| Steel strength | 14.5% | 882 | 6071 |
| Concrete breakout | 64.0% | 882 | 1378 |
| Adhesive | 97.5% | 882 | 905 |

**SET-3G w/ 1/2"Ø A193 Gr. B8/B8M (304/316SS) with hef = 2.750 inch meets the selected design criteria.**

101 **Waler Anchors**

102



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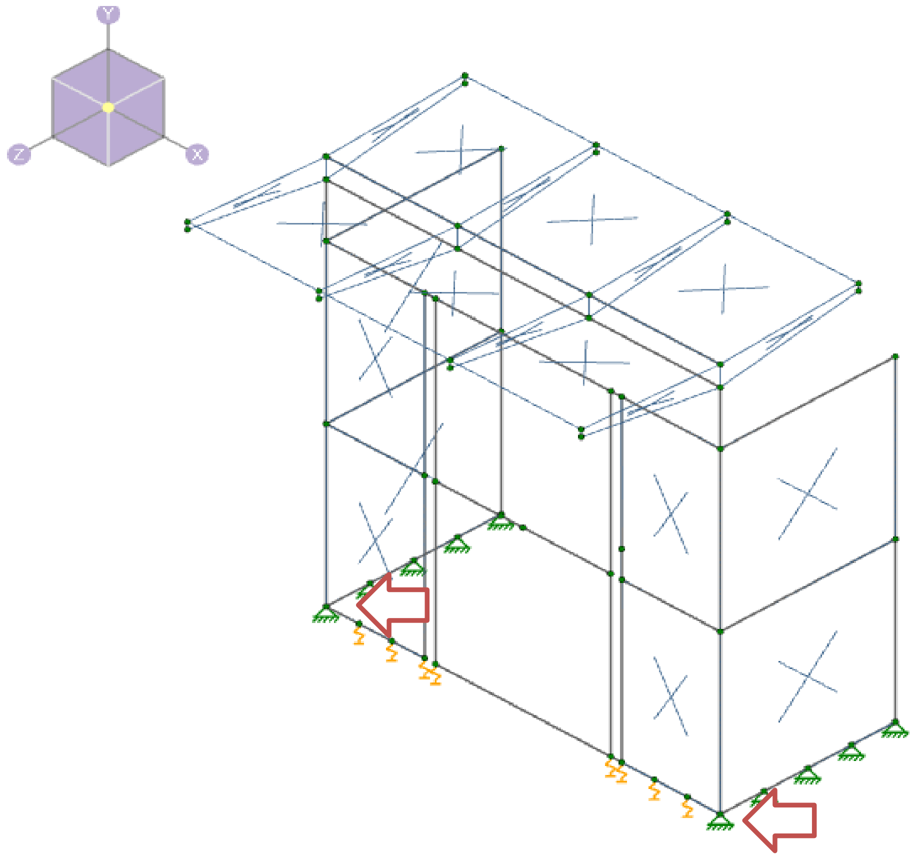
103




104 **Run all load combinations**

105

## Envelope Node Reactions

| | Node Label | | X [lb] | LC | Y [lb] | LC | Z [lb] | LC |
|---|---|---|---|---|---|---|---|---|
| 1 | N27 | max | 384.391 | 10 | 1688.158 | 10 | 324.062 | 9 |
| 2 | | min | -320.52 | 9 | -856.236 | 9 | -387.674 | 8 |
| 3 | N66 | max | 718.204 | 9 | 1578.893 | 10 | 511.13 | 9 |
| 4 | | min | -782.048 | 8 | -736.692 | 9 | -575.578 | 8 |

## Node Reactions (By Combination)

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] |
|---|---|---|---|---|---|
| 1 | 9 | N27 | -320.52 | -856.236 | 324.062 |
| 2 | 9 | N66 | 718.204 | -736.692 | 511.13 |
| 3 | 9 | COG (in): | X: 59.137 | Y: 29.958 | Z: -15.219 |

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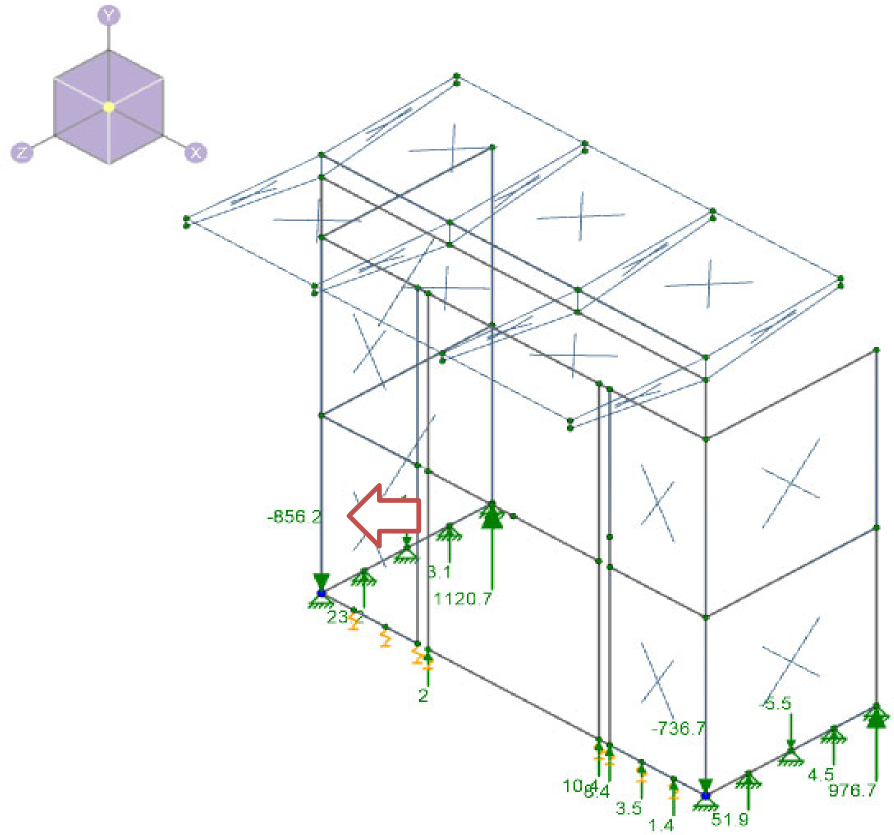
| | | | |
|---|---|---|---|
| 106 |  | | |
| 107 | **Bolt Capacity Check** | | |
| 108 | Tensile Strength, Yield 215 MPa 31200 psi at 0.2% offset | | |
| 109 | Nominal Tensile Strength of Fastener, Fnt (ksi) | 31.20 | See above |
| 110 | Nominal Shear Strength of Fastener, Fnv (ksi) | 18.00 | .577 x Fnt |
| 111 | Bolt Diameter, Db (in) | 0.5 | 1/2" |
| 112 | Cross Sectional Area of Bolt, Ab (in^2) | 0.20 | .25 x 3.141 x Db^2 |
| 113 | Tensile Strength of Bolt, Rnt (lbs) | 4,593.71 | Fnt x Ab x .75 (Resistance Factor) x 1000 (matches values in Table 7-2) |
| 114 | Shear Strength of Bolt, Rnv (lbs) | 2,650.57 | Fnv x Ab x .75 (Resistance Factor) x 1000 (matches values in Table 7-1) |

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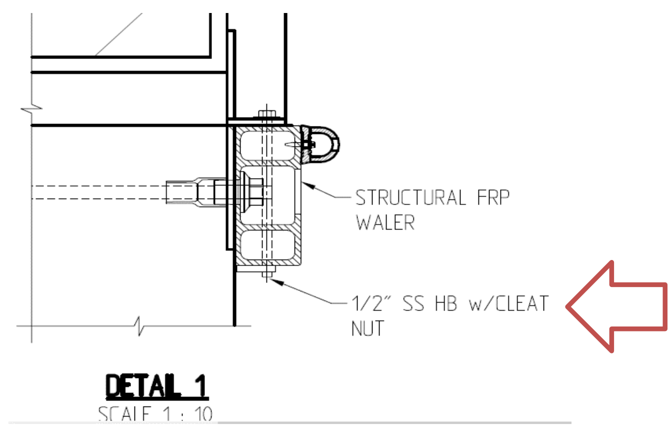
| | | | |
|---|---|---|---|
| 115 | Tensile Load on the single bolt, Tsb (lbs) | 856.0 | See above |
| 116 | Shear Load on a single bolt, Vsb (lbs) | 455.4 | (320^2 + 324^2)^1/2 |
| 117 | **Combined Tension and Shear in Bearing-Type Connections** Tests have shown that the strength of bearing fasteners subject to combined shear and tension resulting from externally applied forces can be closely defined by an ellipse (Kulak and others, 1987). The relationship is expressed as $\left(\frac{f_t}{\phi F_{nt}}\right)^2 + \left(\frac{f_v}{\phi F_{nv}}\right)^2 = 1$ (LRFD) (C-J3-5a) | | |
| 118 | Value needs to be less than 1 | 0.0642 | See above formula <1 OK |
| 119 |   | | |
| 120 | **Verify Polycarbonate Plate will meet the loads.** | | |
| 121 | Check Wing Walls (straight wind loads) | | |

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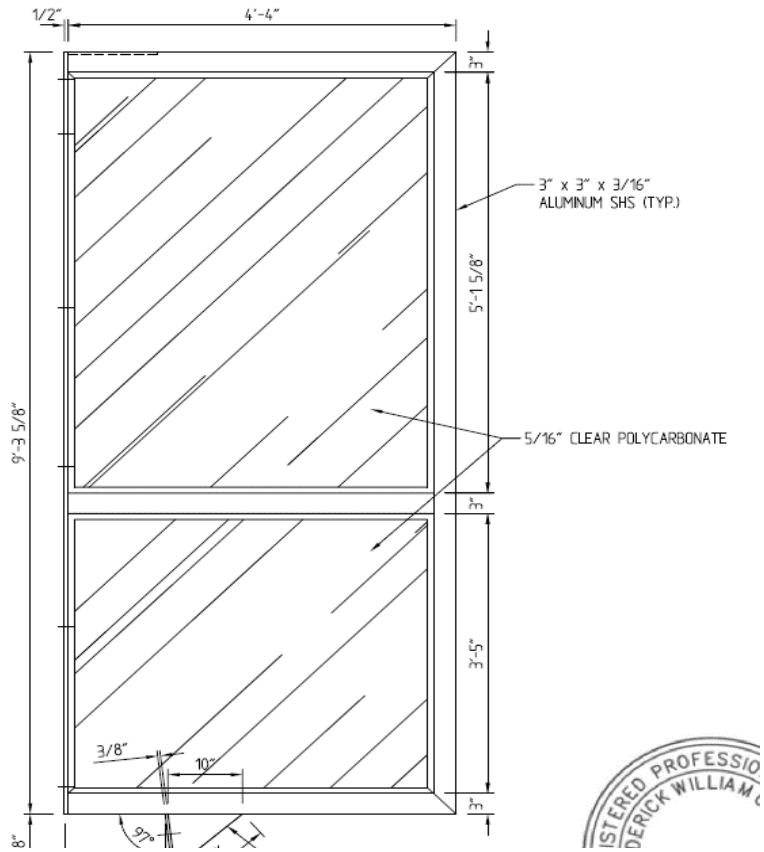
| | | | |
|---|---|---|---|
| 122 |  | | |
| 123 | Use solidworks simulation to determine the max stress on the material. | | |
| 124 | Roof Uplift Load, RLL (psf) | 16 | See above |
| 125 | Wing Wall Wind Load, Wm (psf) | 20.03 | See above |
| 126 | Max wind load, Wm (psi) | 0.14 | Wm is controlling both in magnitude and has a larger span between supports. Wm / 144 |

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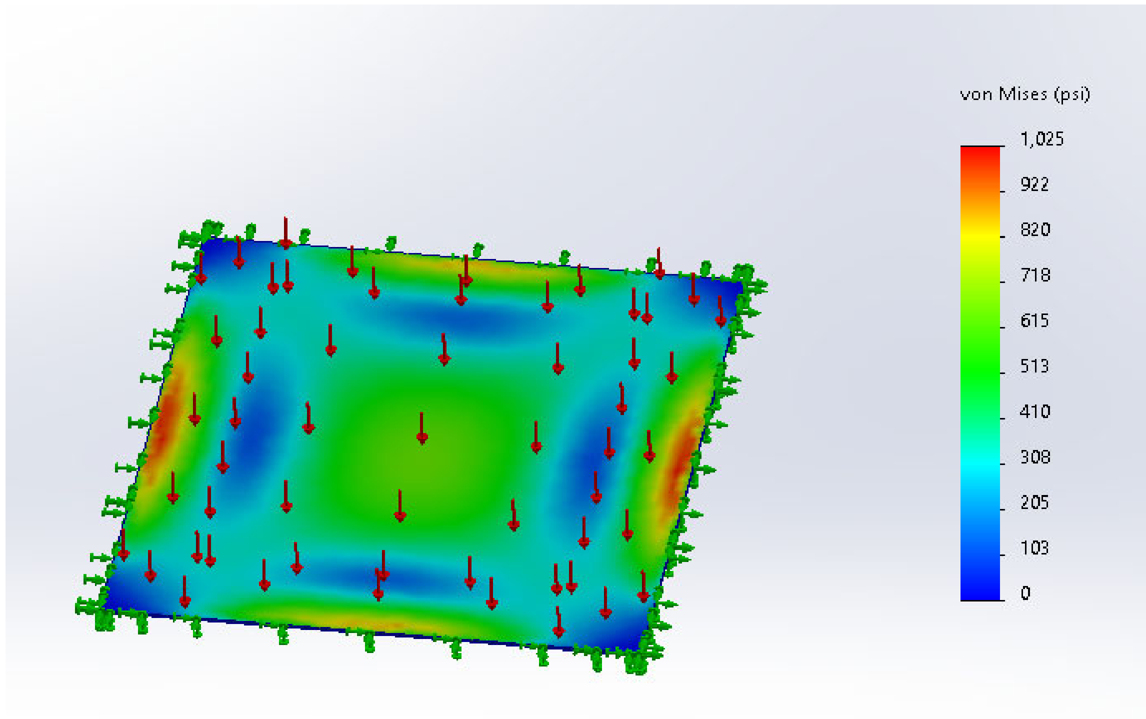
127

External Loads
Pressure-1 (:0.13909722 psi:)




| | | | |
|---|---|---|---|
| 128 | Max stress of polycarbonate, Fm (psi) | 1,095.00 | See above |
| 129 | Yield Stress of Material, Fy (psi) | 6,705.00 | See below. 8940 x 0.75. |

130

TUFFAK® GP sheets with thicknesses ranging between 0.030 to 0.060-inch-thick (0.76 to 1.5 mm) for wall and ceiling applications comply with the interior finish requirements of IBC Section 803.1. Select TUFFAK® GP,

| MECHANICAL | | | |
|---|---|---|---|
| Tensile Strength, Ultimate | ASTM D 638 | psi | 9,500 |
| Tensile Strength, Yield | ASTM D 638 | psi | 9,000 |
| Tensile Modulus | ASTM D 638 | psi | 340,000 |

| | | | |
|---|---|---|---|
| 131 | Safety Factor | 6.12 | Fy / Fm > 1 OK |
| 132 | End of Analysis | | |

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# STRUCTURAL CALCULATIONS FOR

# E-2 GATE

# AT

# DANA POINT MARINA

REGISTERED PROFESSIONAL ENGINEER
FREDERICK WILLIAM GRANTHAM
No. 82413
CIVIL
STATE OF CALIFORNIA

MAY 18, 2023

Prepared By:

Grantham Engineering, Inc.
7807 Hillandale Drive
San Diego, CA 92120
(619) 994-0748

GRANTHAM ENGINEERING
Civil • Mechanical • Marine

BELLINGHAM MARINE INDUSTRIES, INC.

- [X] NO EXCEPTIONS TAKEN
- [ ] REVISE AND RESUBMIT (RAR)
- [ ] OTHER: ______________________

REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE; ENGINEERING; FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION; COORDINATION OF THEIR WORK WITH THAT OF ALL OTHER TRADES AND THE SATISFACTORY PERFORMANCE OF THEIR WORK.

Craig Funston P.E., S.E.

05/22/2023

Building&Safety: Roshanak Amirazizi 6/22/2023

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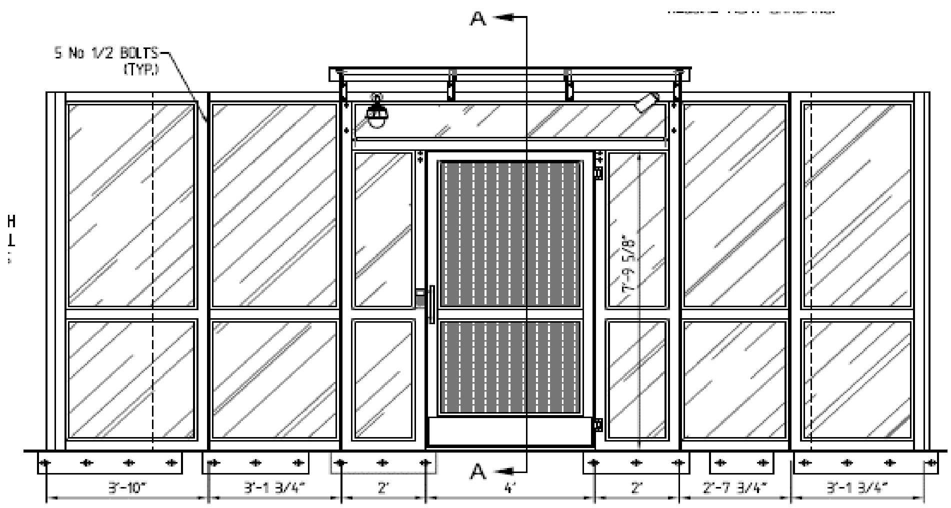
| | | | |
|---|---|---|---|
| 1 | **Structural Calculations for Dana Point Gangway E2 ADA Gate** | | |
| 2 | **Applicable Codes** | | |
| 3 | ASCE 7-16 Minimum Design Loads for Building and other Structures | | |
| 4 | California Layout and Design Marina Berthing Facilities 2005 | | |
| 5 | Aluminum Design Manual 2015 and 2020 | | |
| 6 | California Building Code 2019 | | |
| 7 | **Analytical Software** | | |
| 8 | RISA 3D Version 20 ( Structural ) | | |
| 9 | MECAWind PRO V2342 (Wind Loading) | | |
| 10 | **Front View of Gate** | | |
| 11 |   FRONT ELEVATION<br>SCALE 1 : 40 | | |
| 12 | **Item** | **Value** | **Comments** |
| 13 | **Gate RISA Model** | | |

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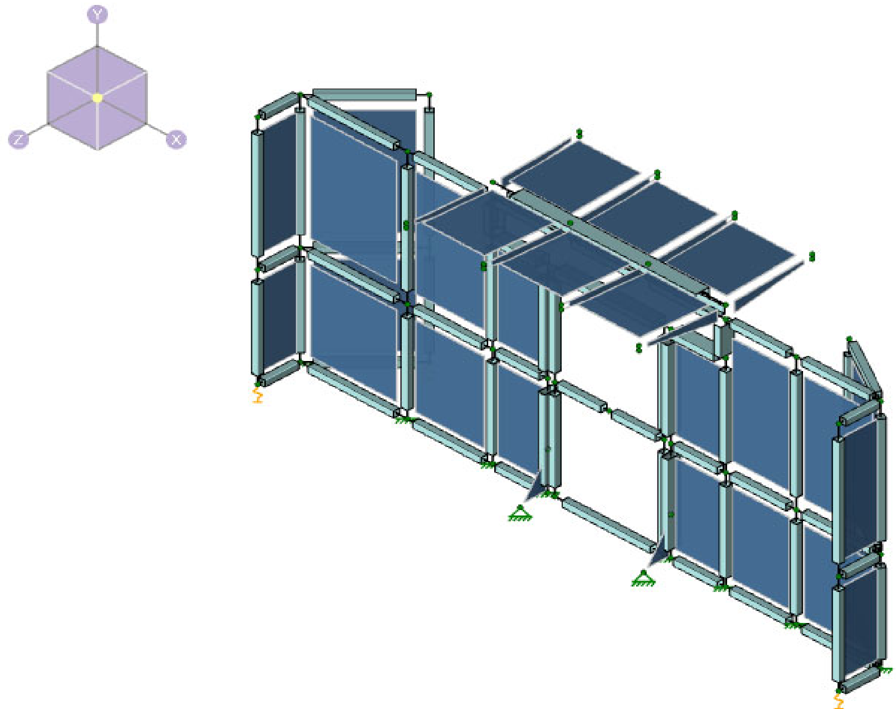
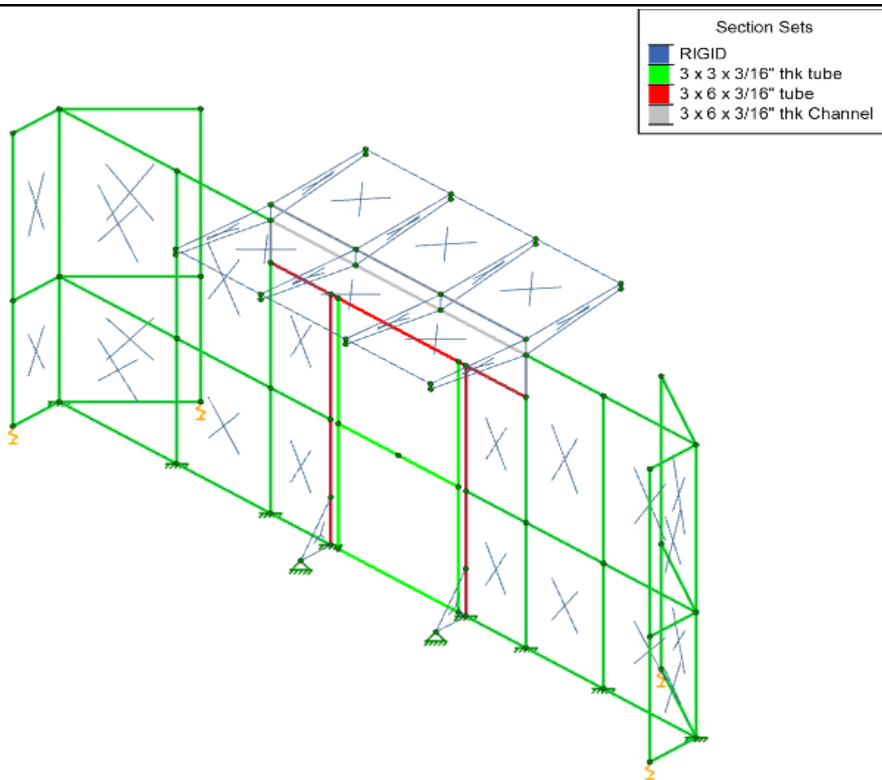
| | |
|---|---|
| 14 |  |
| 15 | <br> |

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16

Aluminum Section Sets

Hot Rolled | Cold Formed | Wood | Concrete | Aluminum | Stainless | General

| | Label | Shape | Type | Design List | Material |
|---|---|---|---|---|---|
| 1 | 3 x 3 x 3/16" thk tube | RT3X3X0.188 | None | None | 6061-T6 |
| 2 | 3 x 6 x 3/16" tube | RT3X6X0.188 | None | None | 6061-T6 |
| 3 | 3 x 6 x 3/16" thk Channel | 3X6X3/16"THK | None | None | 6061-T6 |
| 4 | Door Frame | RT2X2X0.125 | None | None | 6061-T6 |

17 The Section Sets define the major structural components of the Model match the parts list defined on the drawing

18 The glass panels are model as plates

19

General Materials Properties

Hot Rolled | Cold Formed | Wood | Concrete | Masonry | Aluminum | Stainless | General

| | Label | E [ksi] | G [ksi] | Nu | Therm. Coeff. [$1e^{5}$°$F^{-1}$] | Density [$k/ft^{3}$] | Plate Methodo... |
|---|---|---|---|---|---|---|---|
| 1 | gen_Conc3NW | 3155 | 1372 | 0.15 | 0.6 | 0.145 | Isotropic |
| 2 | gen_Conc4NW | 3644 | 1584 | 0.15 | 0.6 | 0.145 | Isotropic |
| 3 | gen_Conc3LW | 2085 | 906 | 0.15 | 0.6 | 0.11 | Isotropic |
| 4 | gen_Conc4LW | 2408 | 1047 | 0.15 | 0.6 | 0.11 | Isotropic |
| 5 | gen_Alum | 10600 | 4077 | 0.3 | 1.29 | 0.173 | Isotropic |
| 6 | gen_Steel | 29000 | 11154 | 0.3 | 0.65 | 0.49 | Isotropic |
| 7 | RIGID | 1e+6 | | 0.3 | 0 | 0 | Isotropic |
| 8 | Glass | 1e+6 | | 0.3 | 0 | 0.175 | opic |

20

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | P14 | N46 | N41 | N43 | N49 | Glass | 0.31 |
| 10 | P15 | N41 | N47 | N52 | N43 | Glass | 0.31 |
| 11 | P16 | N43 | N52 | N58 | N44 | Glass | 0.31 |
| 12 | P17 | N49 | N43 | N44 | N55 | Glass | 0.31 |
| 13 | P18 | N44 | N58 | N64 | N42 | Glass | 0.31 |
| 14 | P19 | N55 | N44 | N42 | N61 | Glass | 0.31 |
| 15 | P13 | N93 | N89 | N86 | N90 | Glass | 0.31 |

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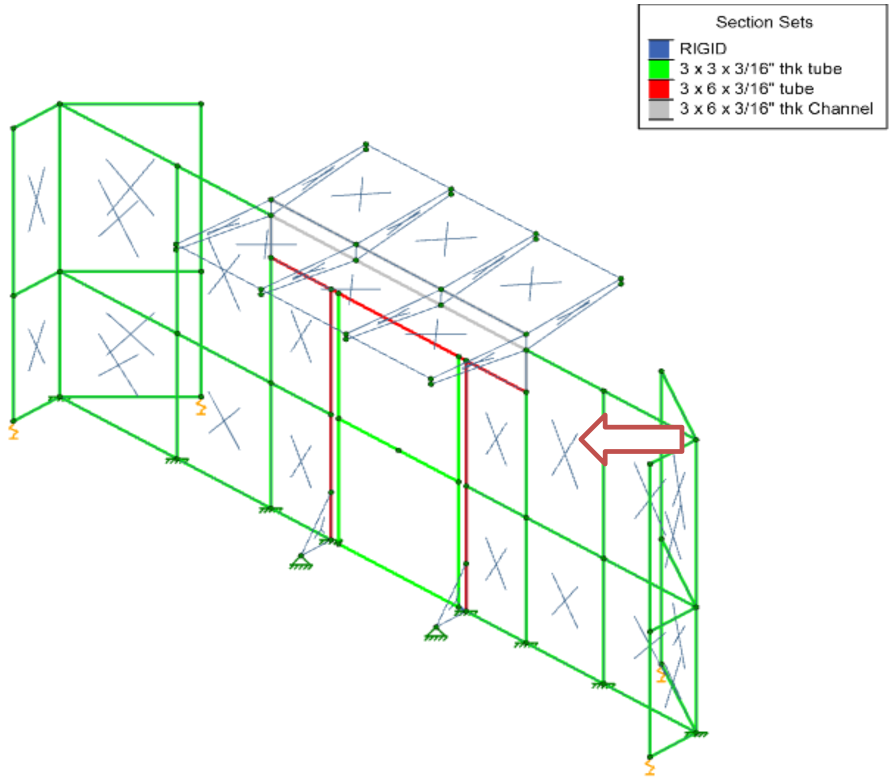
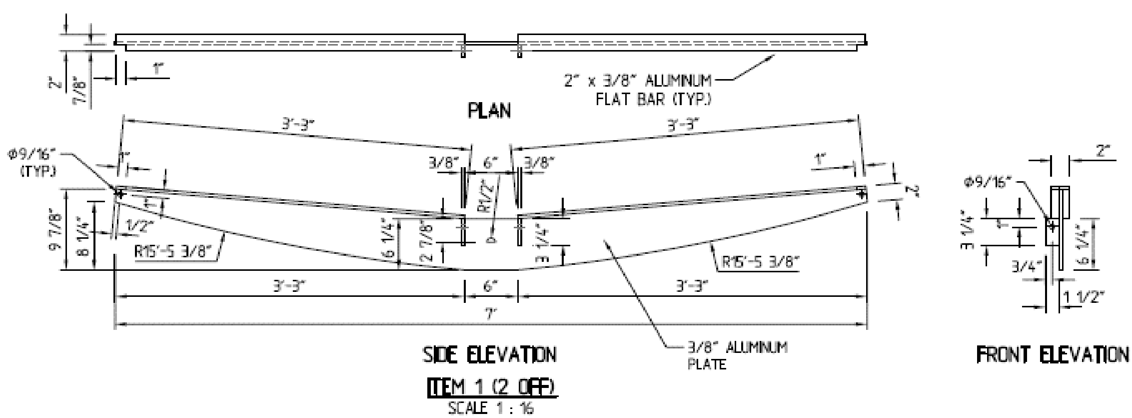
21




22

Roof Structure

23




24

| | Label | A Node | B Node | C Node | D Node | Material | Thickness [in] |
|---|---|---|---|---|---|---|---|
| 1 | P1 | N41 | N46 | N45 | N29 | gen_Alum | 0.375 |
| 2 | P2 | N41 | N47 | N48 | N29 | gen_Alum | 0.375 |
| 3 | P3 | N43 | N52 | N53 | N54 | gen_Alum | 0.375 |
| 4 | P4 | N43 | N49 | N50 | N54 | gen_Alum | 0.375 |
| 5 | P5 | N44 | N58 | N59 | N60 | gen_Alum | 0.375 |

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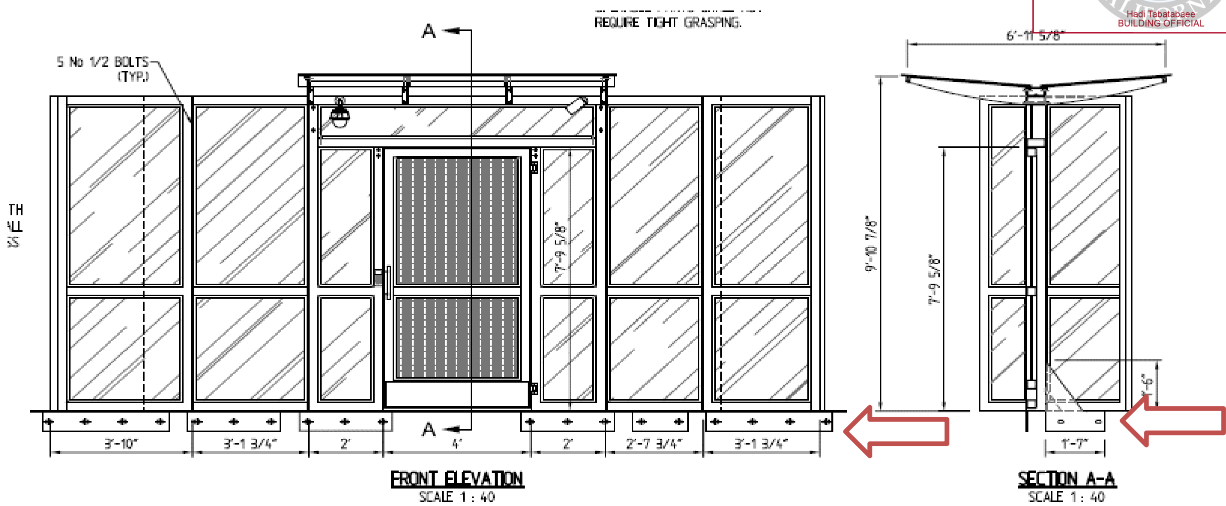
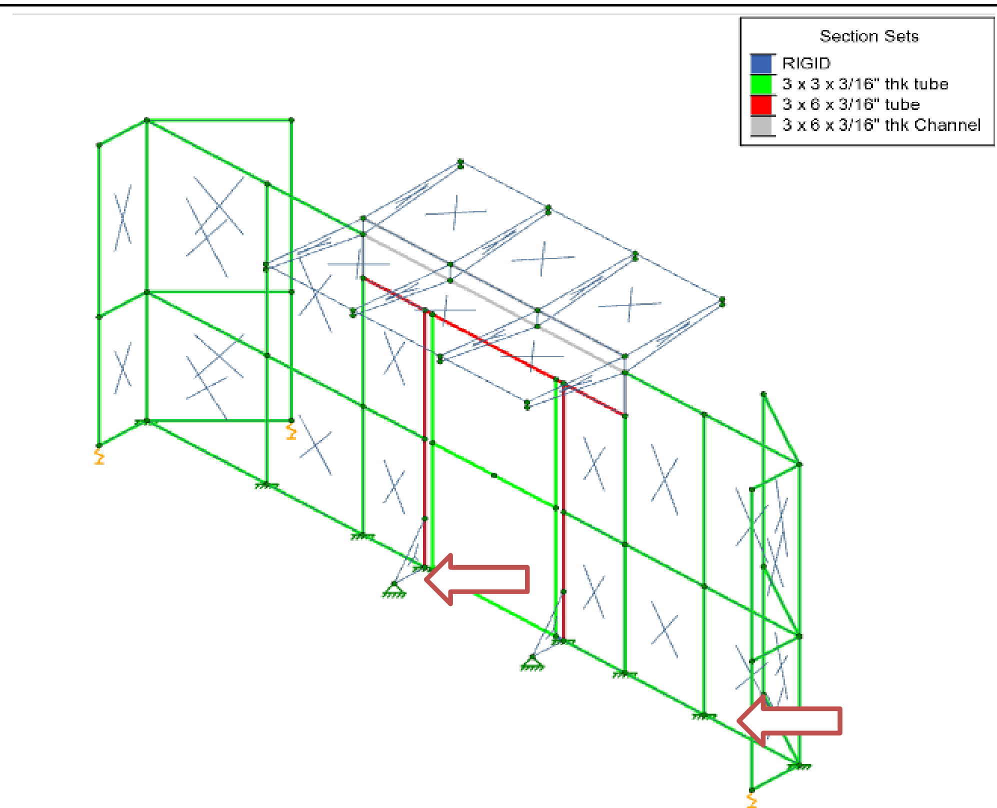
| | |
|---|---|
| 25 | Add reaction points. The wall connection to the dock will be analysed in using solidworks simulation |

26




27




| | | | |
|---|---|---|---|
| 28 | **Loading the RISA Model** | | |
| 29 | Wind Pressure, Qz (lbs/ft^2) | 20.03 | 0.00256 x kz x kzt x Kd x Ws^2, Kz = .85, Kzt = 1.2, Kd =.75 Use in RISA analysis |
| 30 | Basic Wind Speed, V (mph) | 95.00 | See below |

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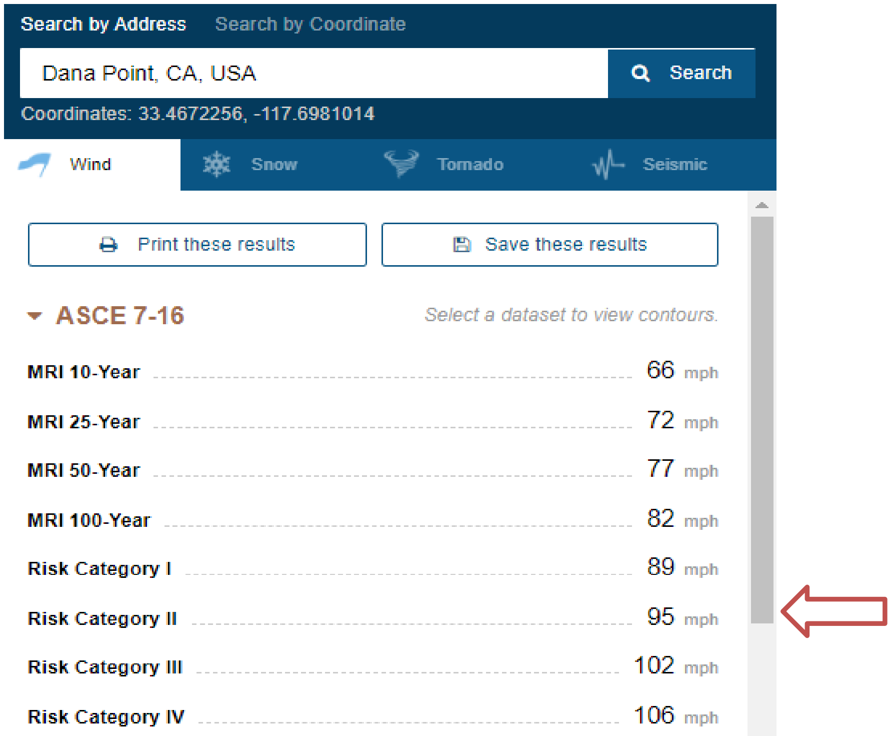
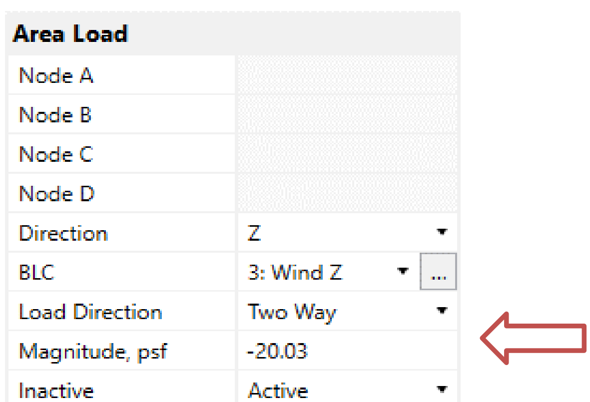
31




| | | | |
|---|---|---|---|
| 32 | Wind Directionality factor, Kd | 0.85 | Section 26.6-1 |
| 33 | Exposure Category | C | Section 26.7.3, If not Exposure B or D, use Exposure C. |

34




35 Wind Load in the Z-direction

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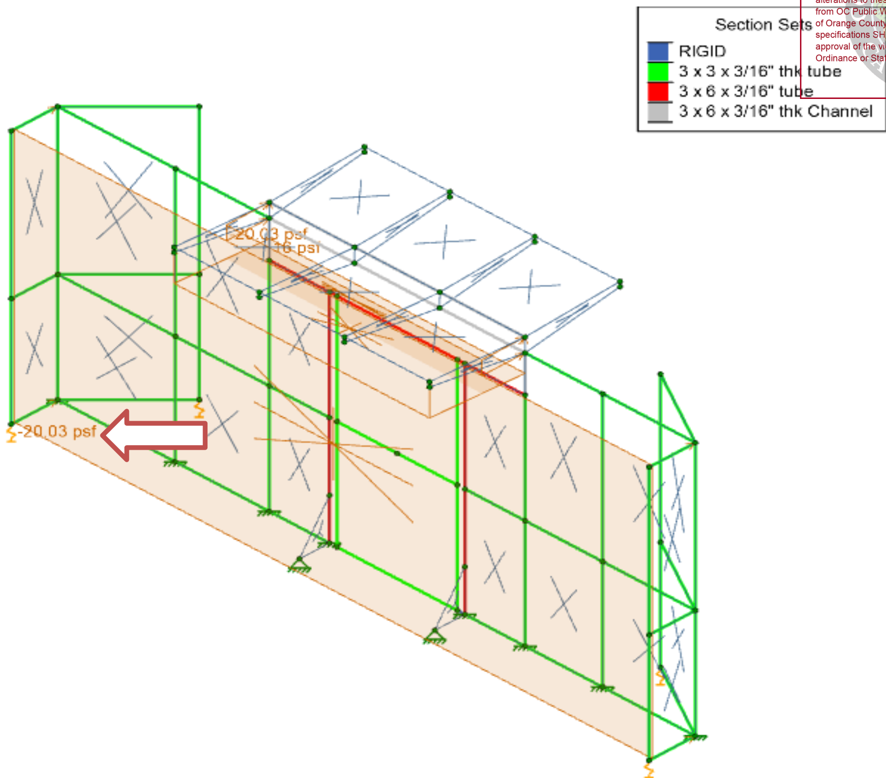
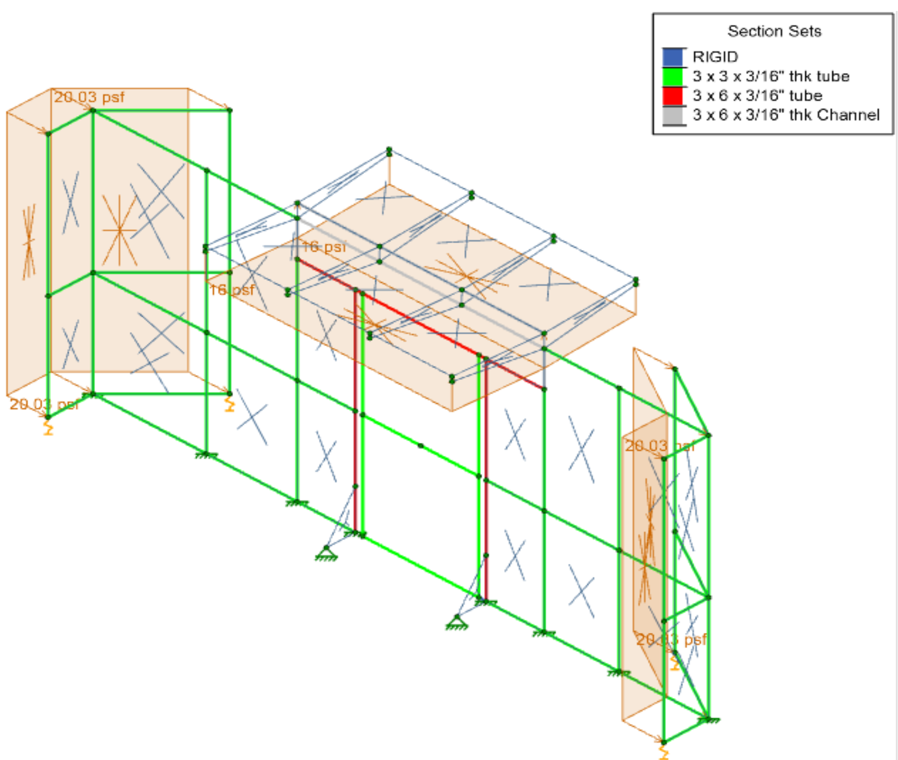
| | |
|---|---|
| 36 |  |
| 37 | Wind Load in the X-direction |
| 38 |  |

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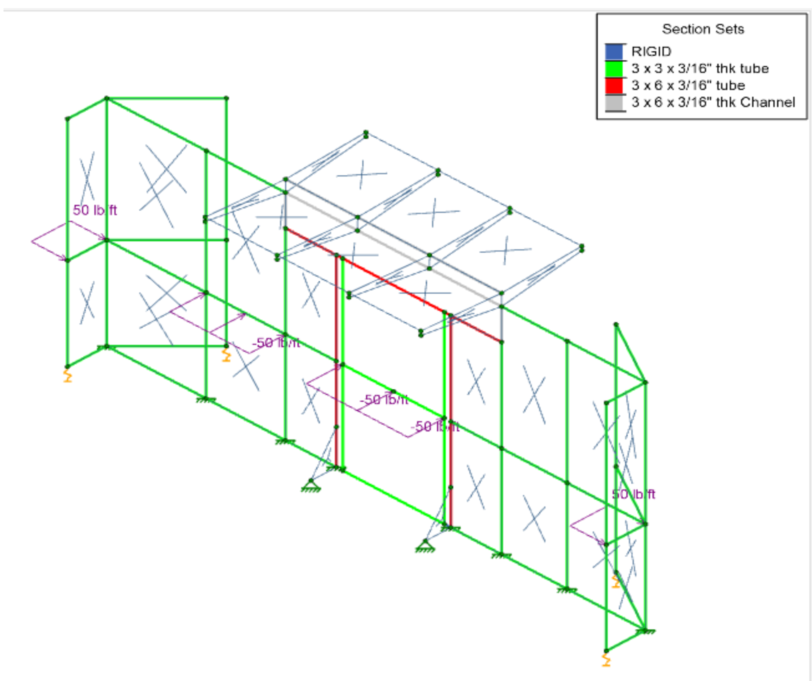
<table>
<tr><td>39</td><td colspan="3">Wind Uplift Load</td></tr>
<tr><td>40</td><td>Wind Uplift Load, Wu (psf)</td><td>16</td><td>See Below</td></tr>
<tr><td>41</td><td colspan="3">Wind Pressures for C&C on a Canopy per Ch 30 Part 7 and Sec 30.11<br>Wind Pressures for C&C on Canopy per Ch 30 Part 7 & Fig 30.11-1A/B<br>All wind pressures include a load factor of 1.0<br>
<table>
<tr><th>Description</th><th>Zone</th><th>Width<br>ft</th><th>Span<br>ft</th><th>Area<br>ft</th><th>GCp<br>Pos</th><th>GCp<br>Neg</th><th>P<br>Min<br>psf</th><th>P<br>Max<br>psf</th></tr>
<tr><td>Zone Lower Surface</td><td>Lower Surface</td><td>9.000</td><td>26.000</td><td>234.000</td><td>0.600</td><td>-0.650</td><td>-16.00</td><td>16.00</td></tr>
<tr><td>Zone Upper Surface</td><td>Upper Surface</td><td>10.000</td><td>26.000</td><td>260.000</td><td>0.600</td><td>-0.700</td><td>-16.00</td><td>16.00</td></tr>
</table></td></tr>
<tr><td>42</td><td colspan="3">See above in both the X and Z directions</td></tr>
<tr><td>43</td><td colspan="3">Seismic Analysis (none) The Gate is not effected by base shear loads.</td></tr>
<tr><td>44</td><td colspan="3">Uniform Handrail Load - 50 plf</td></tr>
<tr><td>45</td><td colspan="3">
</td></tr>
<tr><td>46</td><td colspan="3">Concentrated Handrail Load - 200 lbs</td></tr>
</table>

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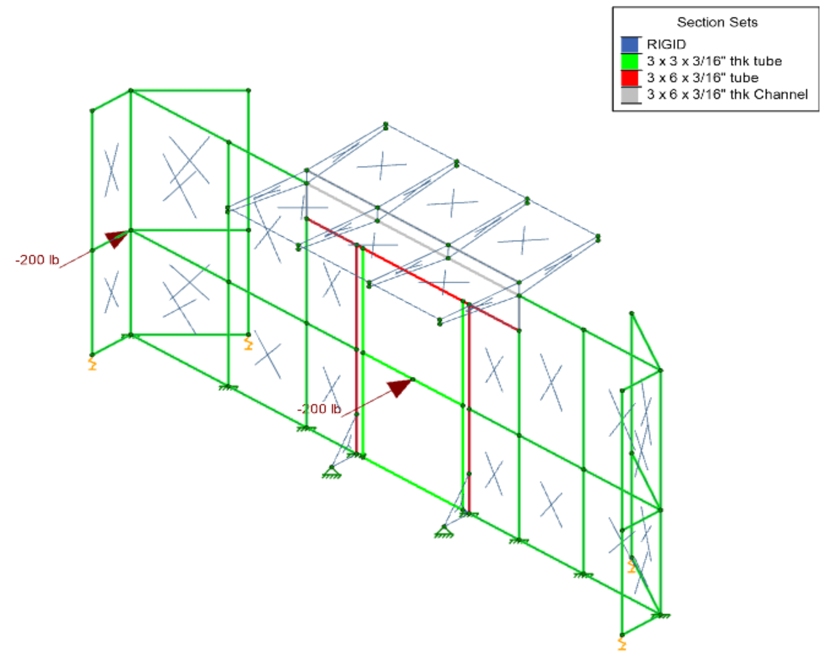
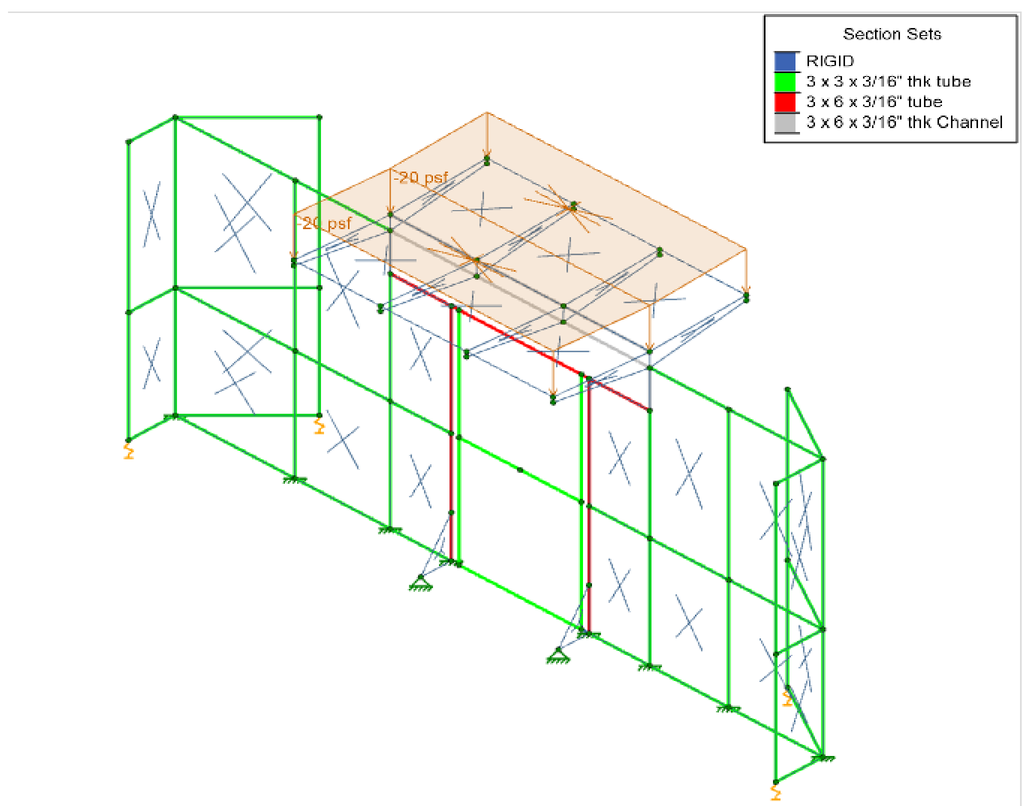
|---|---|
| 47 |   |
| 48 | Roof Live Load: 20 psf |
| 49 |   |
| 50 | Define Basic Load Cases |

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**Basic Load Cases**

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Nodal | Point | Distributed | Area(Member) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Self Weight | DL | | -1 | | | | | |
| 2 | Wind X | WLX | | | | | | | 6 |
| 3 | Wind Z | WLZ | | | | | | | 3 |
| 4 | Seismic X | ELX | | | | | | | |
| 5 | Roof Live Load | RLL | | | | | | | 2 |
| 6 | Seismic Z | ELZ | | | | | | | |
| 7 | Uniform handrail load | OL1 | | | | | | 5 | |
| 8 | Concentrated Load | OL2 | | | | 2 | | | |

52 **Define Load Combinations**

53

**Load Combinations**

Combinations | Design

LC Generator | RSA Scaling Factor

| | Description | Solve | P-Delta | SRSS | BLC | Factor | BLC | Factor |
|---|---|---|---|---|---|---|---|---|
| 1 | Dead Load | ☑ | Y | | DL | 1 | | |
| 2 | Roof Load | ☑ | Y | | DL | 1.2 | RLL | 1.6 |
| 3 | Concentrated handrail load | ☑ | Y | | DL | 1.2 | OL2 | 1.6 |
| 4 | handrail uniform load | ☑ | Y | | DL | 1.2 | OL1 | 1.6 |
| 5 | Wind Down X | ☑ | Y | | DL | 1.2 | WLX | 1 |
| 6 | Wind Up X | ☑ | Y | | DL | 0.9 | WLX | 1 |
| 7 | Wind Down Z | ☑ | Y | | DL | 1.2 | WLZ | 1 |
| 8 | Wind Down -Z | ☑ | Y | | DL | 0.9 | WLZ | -1 |
| 9 | Wind Up Z | ☑ | Y | | DL | 0.9 | WLZ | 1 |
| 10 | Wind Up -Z | ☑ | Y | | DL | 0.9 | WLZ | -1 |

54 **Deflection Analysis**

55 Run all the Load Combinations to determine the largest deflection

56

**Envelope Node Displacements**

| | Node Label | | X [in] | LC | Y [in] | LC | Z [in] | LC | X Rotation [rad] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | N47 | max | 0.012 | 7 | 0.192 | 10 | 0.208 | 10 | [illegible]3 |
| 2 | | min | -0.012 | 8 | -0.192 | 7 | -0.208 | 7 | -5.054e-3 |
| 3 | N46 | max | 0.012 | 10 | 0.192 | 9 | 0.208 | 10 | 5.053e-3 |
| 4 | | min | -0.012 | 9 | -0.192 | 8 | -0.208 | 9 | -5.035e-3 |
| 5 | N48 | max | 0.012 | 9 | 0.192 | 10 | 0.198 | 10 | 0 |

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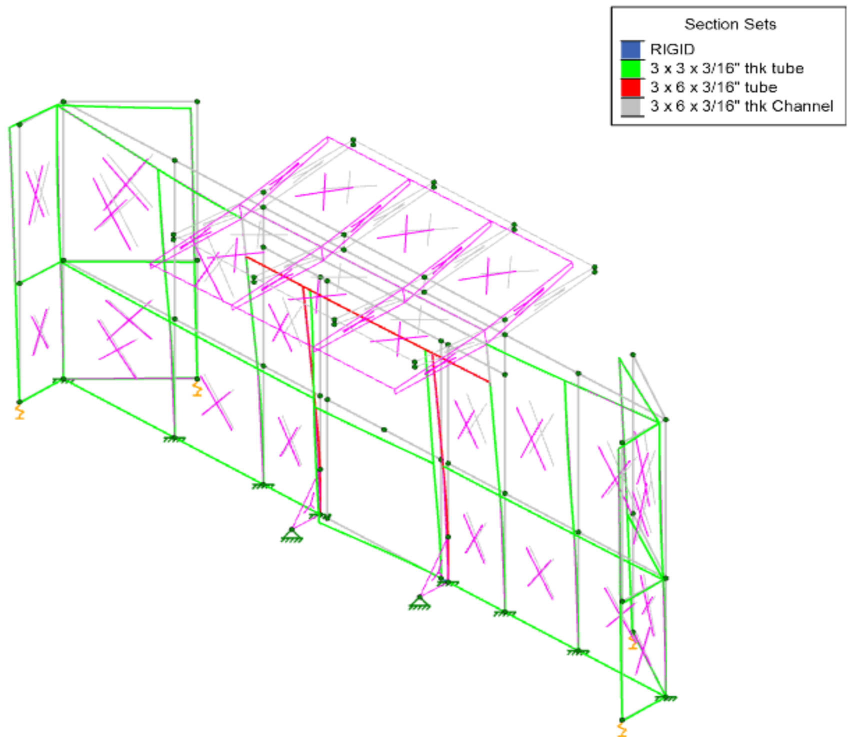
| | | | |
|---|---|---|---|
| 57 |  | | |
| 58 | Max Allowable Deflection, Dam (in) | 1.333 | 10 ft height x 12 /180 for Cantilever Systems. |
| 59 | Max Deflection, Dm (in) | 0.208 | See above |
| 60 | **Safety Factor** | **6.41** | **Dam/Dm >1 OK** |
| 61 | **Verify Code Compliance** | | |

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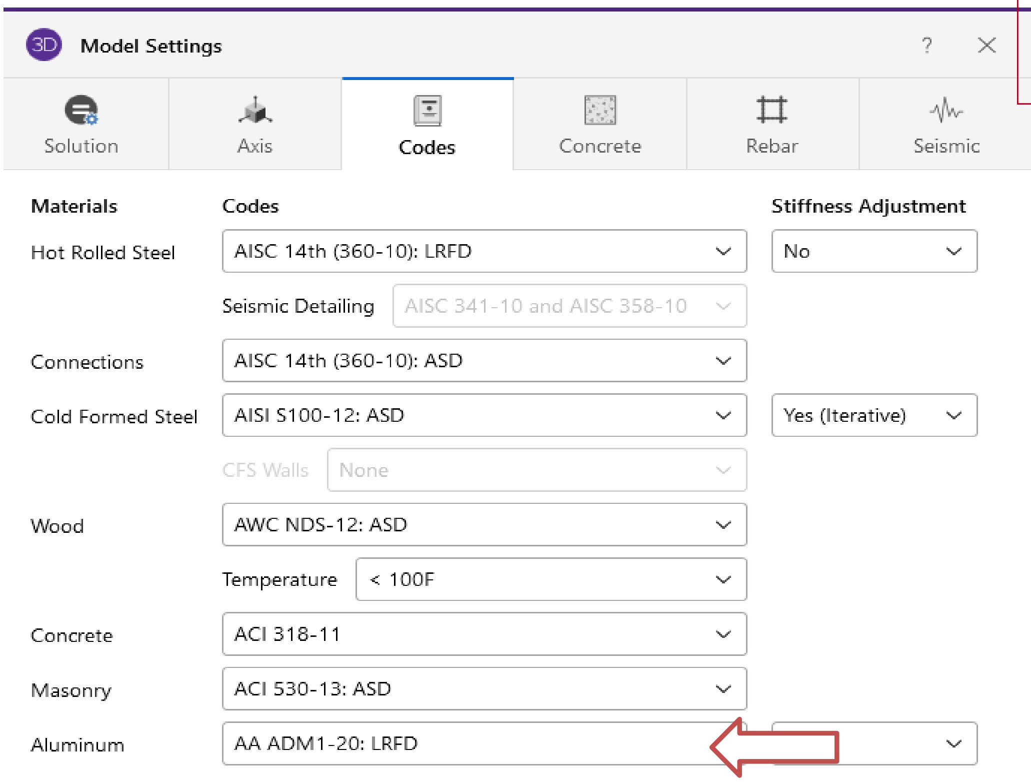
| 62 |  |
| 63 | **Strength Analysis** |
| 64 | Run the all Load Combinations |

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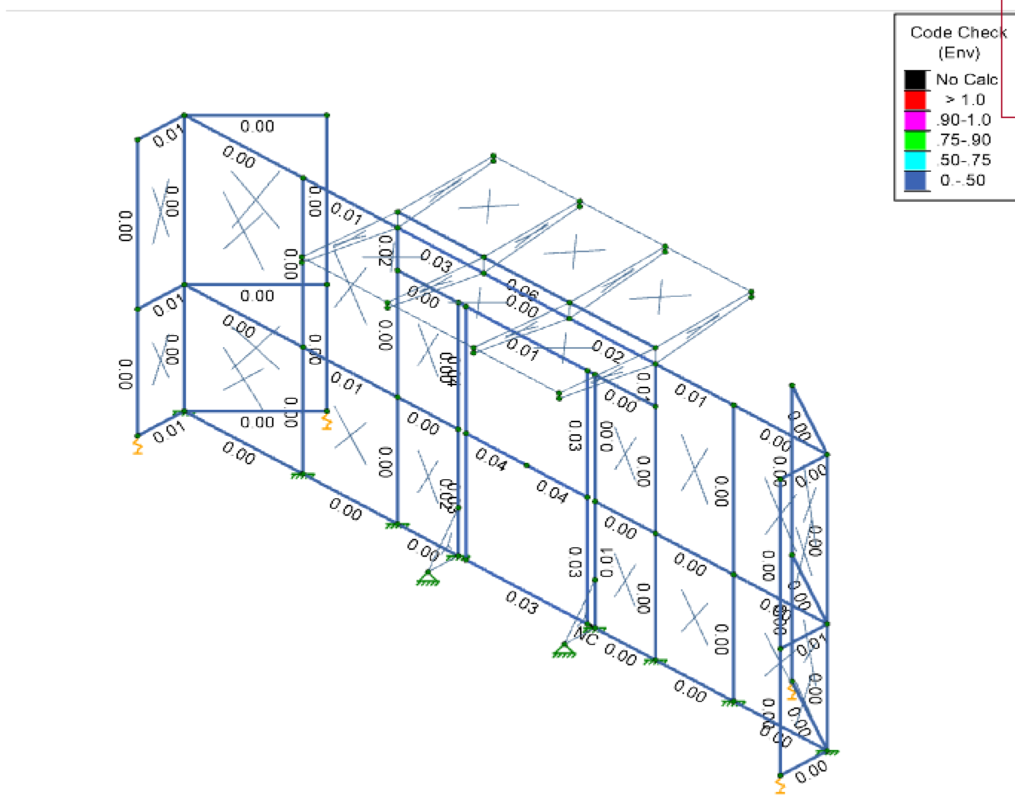


66

**Envelope AA ADM1-20: LRFD - Building Aluminum Code Checks**

Hot Rolled Steel | Cold Formed Steel | Wood | Concrete Beams | Concrete Columns | Aluminum

| | Member | Shape | Code Check | Loc[in] | LC | Shear Check | Loc[in] | Dir | LC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | M32 | 3X6X3... | 0.059 | [illegible] | 2 | 0.014 | 0 | z | 2 |
| 2 | M78 | RT3X3... | 0.044 | 0 | 3 | 0.014 | 24.02 | z | 4 |
| 3 | M19 | RT3X3... | 0.044 | 24.02 | 3 | 0.015 | 0 | z | 4 |
| 4 | M14 | RT3X3... | 0.04 | 0 | 4 | 0.008 | 47.5 | y | 3 |

67

The code check values are the UC Max and Shear UC shown on the bridge. The colors represent a factored ratio of actual to allowable load for LFRD based on the provisions of the Aluminum Design Manual 2020. Ratios greater than 1 are shown in RED; therefore, any member in RED is not acceptable.

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**Check Wall to Dock Connections**

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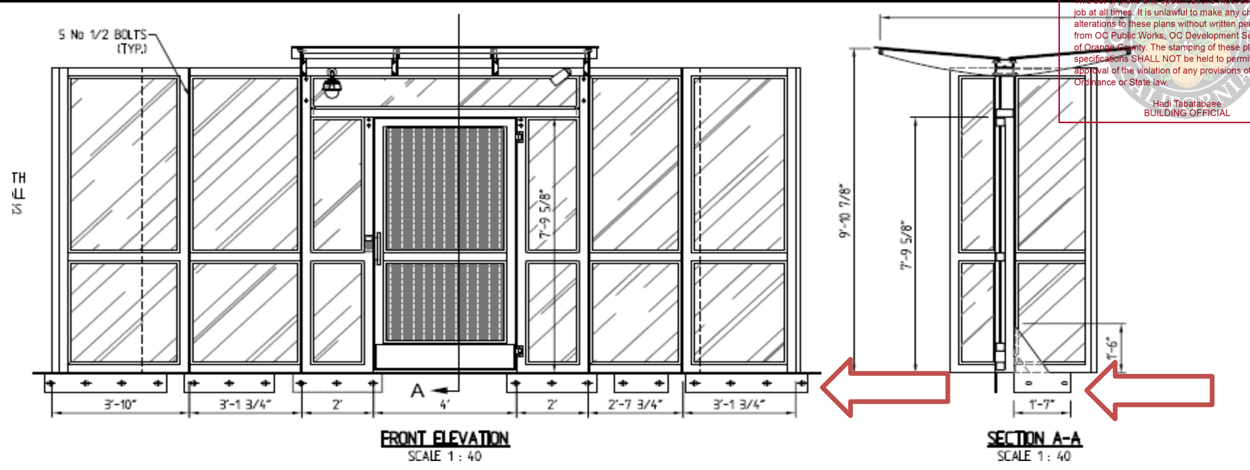
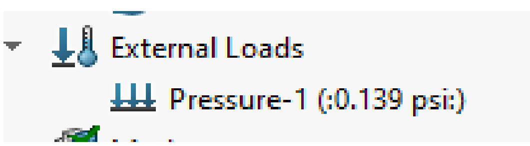
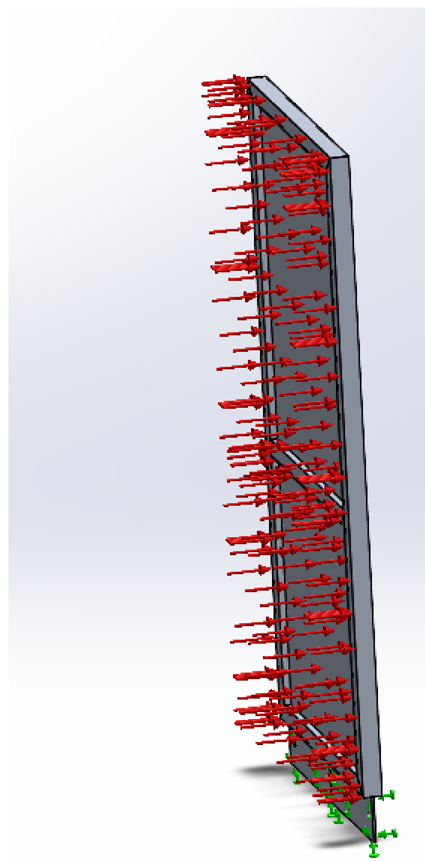
|---|---|---|---|
| 69 |   | | |
| 70 | **Wind Load, WL (psf)** | **20.03** | **See above** |
| 71 | **Wind Load, WL (psi)** | **0.139** | **WL/144** |
| 72 |    | | |

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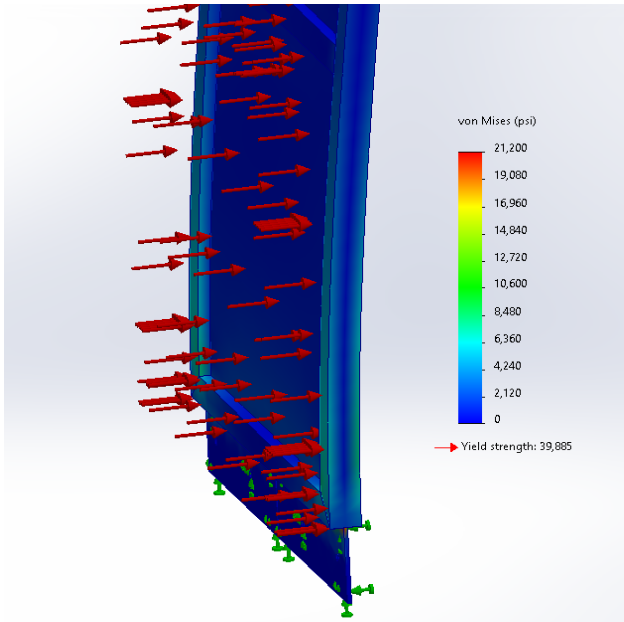
|---|---|---|---|
| 73 |  | | |
| 74 | Max Stress of Member, Fm (psi) | 8,500 | See above. This area is in the weld effected zone. |
| 75 | Yield Stress of Material, Fy (psi) | 11,250.00 | See below. 15,000 (Welded affected Zone Area) x 0.75 (strength reduction factor). |
| 76 | **Design of Aluminum Structure**<br>**Design of member in Tension**<br>**Strength reduction factor and safety factor**<br>**LRFD design:**<br>Strength reduction factors-building type structures<br>$\phi = 0.75$ for tensile rupture<br>$\phi = 0.75$ for tensile yielding | | |
| 77 | **Safety Factor** | **1.32** | **Fy/Fm > 1 OK** |
| 78 | **Check Nylon Rod Shear Capacity** | | |

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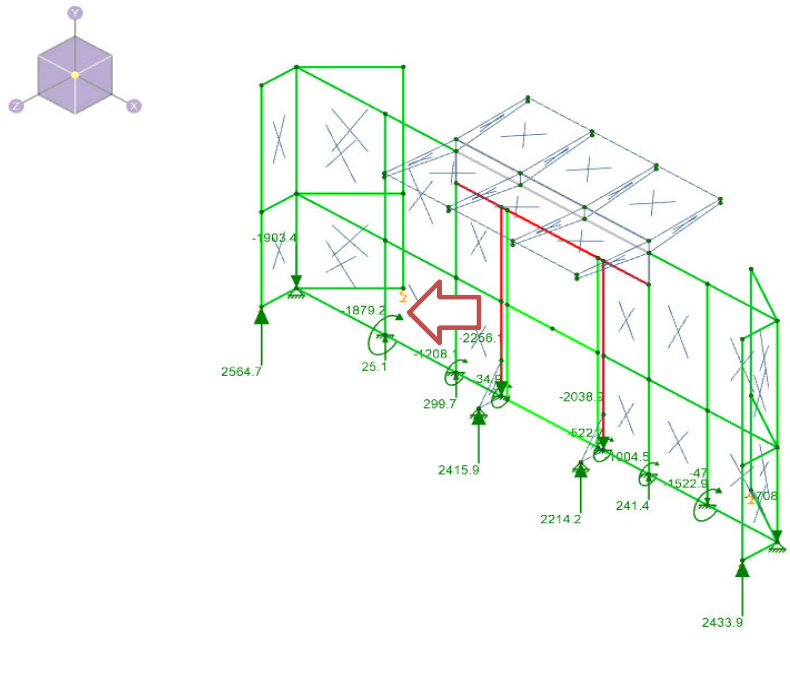


80

Node Reactions (By Combination)

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] | MX [lb-ft] | MY [lb... | MZ [lb... |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | N87 | 362.294 | 25.128 | -829.629 | -1879.181 | 4.781 | -1.385 |
| 2 | 8 | N71 | -376.497 | -47.028 | -735.567 | -1522.883 | 244.168 | 0.111 |
| 3 | 8 | N27 | 62.32 | 299.677 | -338.326 | -1208.132 | -60.674 | -0.982 |
| 4 | 8 | N69 | -87.765 | 241.405 | -284.524 | -1004.515 | 56.815 | 0.45 |

| | | | |
|---|---|---|---|
| 81 | **Moment Load on Wall, ML (ft-lbs)** | **1,879.00** | **See above** |

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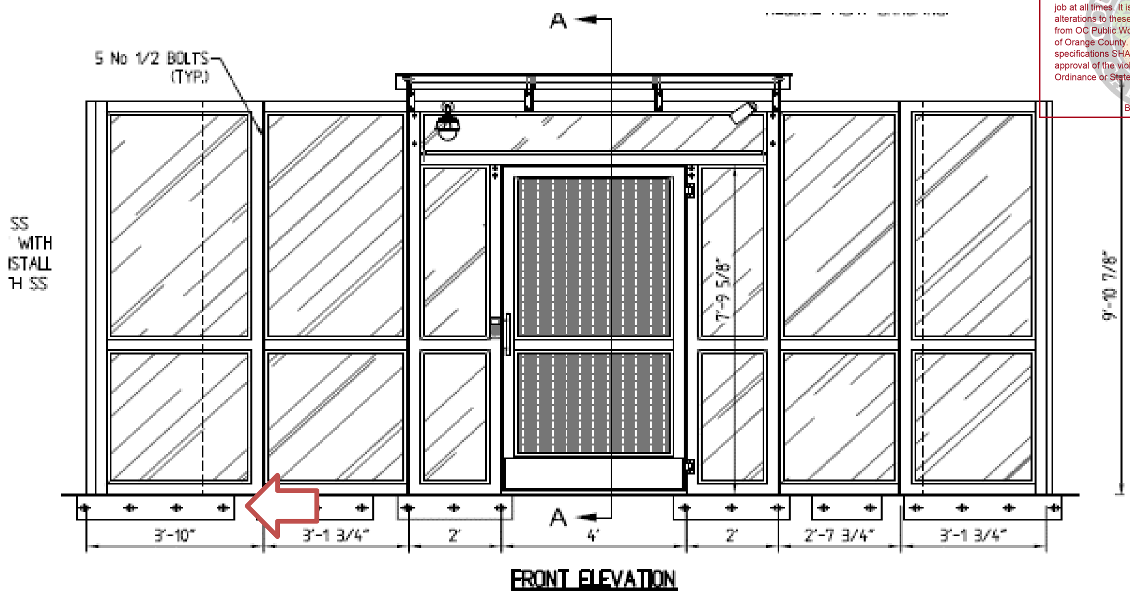
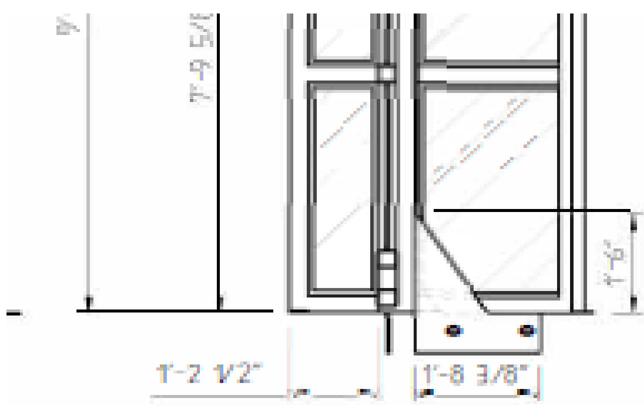
|---|---|---|---|
| 82 |  | | |
| 83 | **Distance from Blade to Wall Edge, D (in)** | **1.50** | **See below** |
| 84 |  | | |
| 85 | **Shear Load on Nylon Rods, T (lbs)** | **15,032.00** | **ML / (D/12)** |
| 86 | **Largest Direct Shear Load at connection (not controlling)** | | |
| 87 | Node Reactions (By Combination) — see table below | | |



**Node Reactions (By Combination)**

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] | MX [lb-ft] | MY [lb... | MZ [lb... |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | N28 | -61.41 | -2256.098 | .408 | -34.85 | -137.646 | -0.486 |
| 2 | 8 | N25 | 66.105 | -2038.888 | -784.644 | -522.719 | -399.632 | -9.009 |
| 3 | 8 | N91 | -176.428 | -1903.39 | -326.204 | 0 | 0 | 0 |
| 4 | 8 | N72 | 211.381 | -1708.035 | -226.815 | 0 | 0 | 0 |

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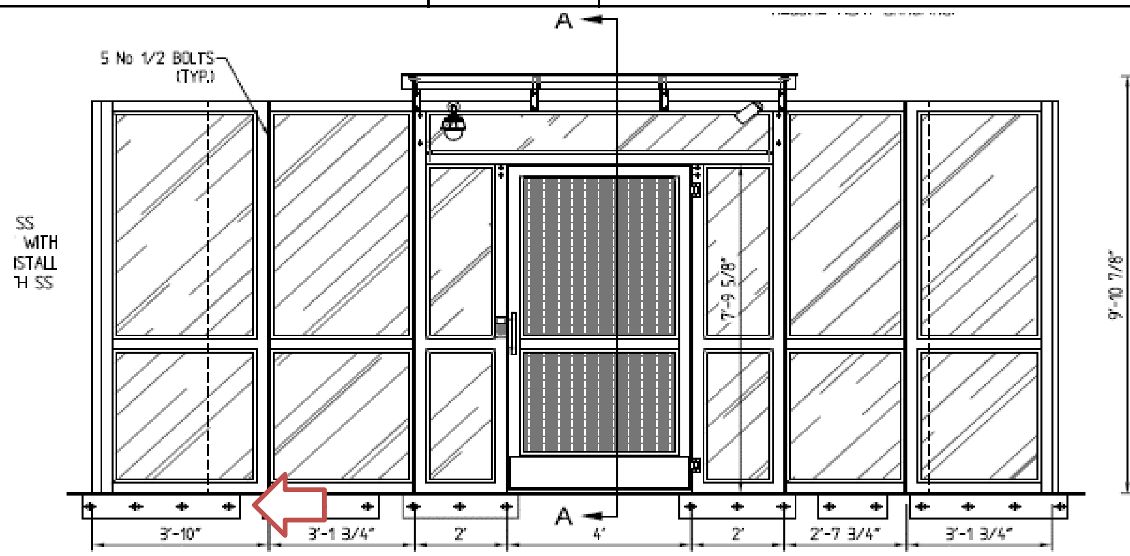
| | | | |
|---|---|---|---|
| 88 | **Diameter of Rods, Dr (in)** | **0.75** | |
| 89 | **Cross Sectional Area of Rods, Ar (in^2)** | **0.44** | **.25 X 3.141 X Dr^2** |
| 90 | **Number of Rods, N** | **4.00** | **See above** |

91




FRONT ELEVATION

| | | | |
|---|---|---|---|
| 92 | **Shear Stress per Rod, Vr (psi)** | **4,253.99** | **T / Ar / N/ 2 faces (double shear)** |
| 93 | **Shear Capacity of Nylon, Vc (psi)** | **7,200.00** | **9600 psi x 0.75 (resistance factor)** |

94

**Nylon 6/6 Mechanical Properties (73o F / 23o C)**

| TENSILE STRENGTH | D638 | 12,000 PSI. | 82.7 MPA |
|---|---|---|---|
| ELONGATION | D638 | 60% | 60% |
| SHEAR STRENGTH | D732 | 9,600 PSI. | 66.2 MPA |
| FLEXUARAL MODULUS | D790 | 410,000 PSI. | 2.,287 MPA |
| IMPACT STRENGTH | D256 | 1.0 FT/LB/IN | 5.5 KG/CM2 |
| HARDNESS | D785 | R121 | M79 |
| SPECIFIC GRAVITY | D792 | 1.13 | 1.13 |
| MELTING POINT | D789 | 500 F | 2600 C |
| DIELECTRIC STRENGTH | D149 | 600 V/MIL | 10 OHM-CM |
| UNDERWRITERS LABORATORY RATING | BUL. 94 | 94V2 | 94V2 |

| | | | |
|---|---|---|---|
| 95 | **Safety Factor** | **1.69** | **Vc/ Vr > 1 OK** |
| 96 | **Check Wall Stress between Blade and Tubing** | | |

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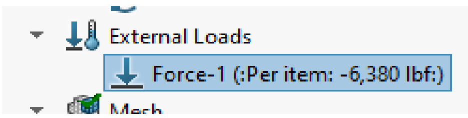
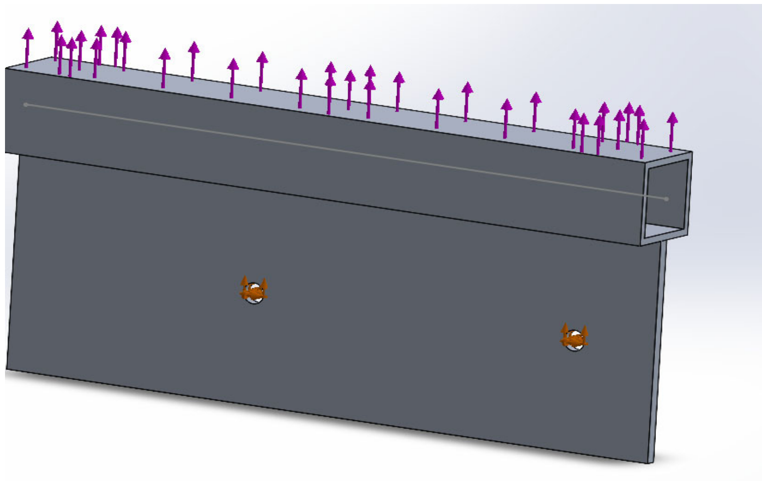
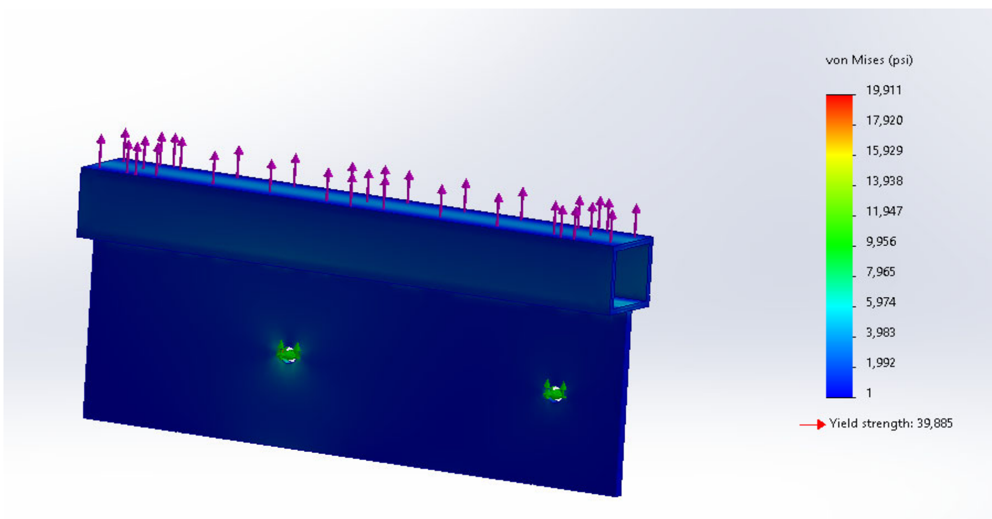
<tr><td>97</td><td colspan="3">

</td></tr>
<tr><td>98</td><td colspan="3">
</td></tr>
<tr><td>99</td><td>Max Stress of Member, Fm (psi)</td><td>5,500</td><td>See above. This area is in the weld effected zone.</td></tr>
<tr><td>100</td><td>Yield Stress of Material, Fy (psi)</td><td>11,250.00</td><td>See below. 15,000 (Welded affected Zone Area) x 0.75 (strength reduction factor).</td></tr>
</table>

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# Design of Aluminum Structure

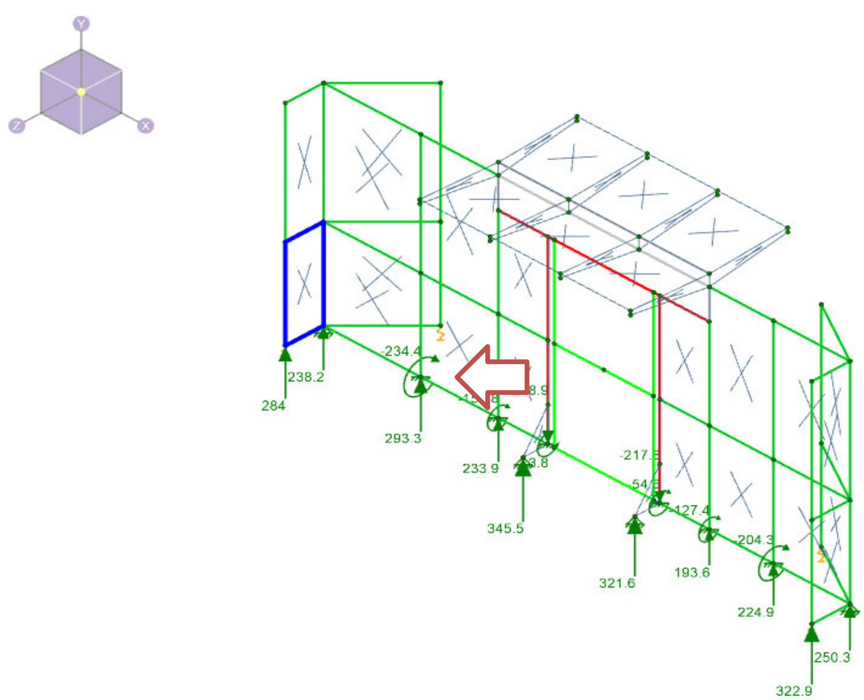
## Design of member in Tension

### Strength reduction factor and safety factor

**LRFD design:**
Strength reduction factors-building type structures
$\phi = 0.75$ for tensile rupture
$\phi = 0.75$ for tensile yielding

| | | | |
|---|---|---|---|
| 102 | **Safety Factor** | **2.05** | **Fy/Fm > 1 OK** |
| 103 | **Shear Load, V (lbs)** | **954.00** | **See above** |
| 104 | **Determine Fatigue Stress on Connection** | | |
| 105 | **Wind Load at 25 mph (psf)** | **2.00** | |

106




107

**Node Reactions (By Combination)**

| | LC | Node Label | X [lb] | Y [lb] | Z [lb] | MX [lb-ft] | MY [lb... | MZ [lb... |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | N87 | 67.713 | 293.251 | -106.64 | -234.396 | -43.936 | -1.171 |
| 2 | 8 | N71 | -61.775 | 224.943 | -102.114 | -204.264 | 46.268 | 0.52 |
| 3 | 8 | N27 | 32.987 | 233.858 | -37.022 | -150.787 | -9.31 | -0.989 |
| 4 | 8 | N69 | -31.807 | 193.583 | -31.56 | -127.383 | 9.308 | 0.448 |

| | | | |
|---|---|---|---|
| 108 | **Moment Load on Wall, ML (ft-lbs)** | **234.00** | **See above** |

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| | | | |
|---|---|---|---|
| 109 | **Distance from Blade to Wall Edge, D (in)** | **1.50** | |
| 110 | **Shear Load on Nylon Rods, T (lbs)** | **1,872.00** | **ML / (D/12)** |
| 111 | **Diamer of Rods, Dr (in)** | **0.75** | |
| 112 | **Cross Sectional Area of Rods, Ar (in^2)** | **0.44** | **.25 X 3.141 X Dr^2** |
| 113 | **Number of Rods, N** | **4.00** | |
| 114 | **Shear Stress per Rod, Vr (psi)** | **529.77** | **T / Ar / N/ 2 faces (double shear)** |
| 115 | **Shear Capacity of Nylon, Vc (psi)** | **7,200.00** | **9600 psi x 0.75 (resistance factor)** |

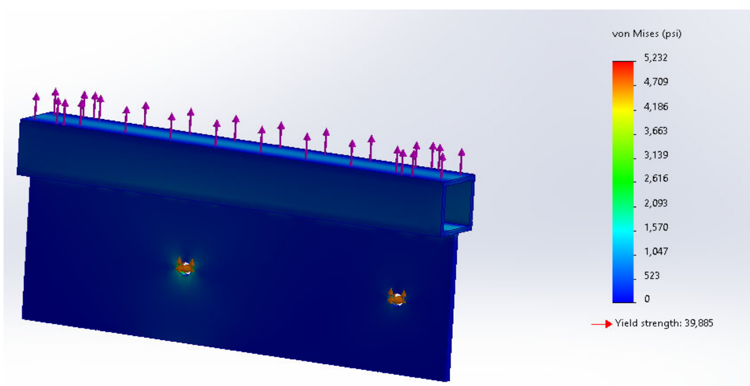
116

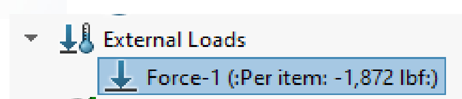
Nylon 6/6 Mechanical Properties (73o F / 23o C)

| TENSILE STRENGTH | D638 | 12,000 PSI. | 82.7 MPA |
|---|---|---|---|
| ELONGATION | D638 | 60% | 60% |
| SHEAR STRENGTH | D732 | 9,600 PSI. | 2 MPA |
| FLEXUARAL MODULUS | D790 | 410,000 PSI. | 2.,287 MPA |
| IMPACT STRENGTH | D256 | 1.0 FT/LB/IN | 5.5 KG/CM2 |
| HARDNESS | D785 | R121 | M79 |
| SPECIFIC GRAVITY | D792 | 1.13 | 1.13 |
| MELTING POINT | D789 | 500 F | 2600 C |
| DIELECTRIC STRENGTH | D149 | 600 V/MIL | 10 OHM-CM |
| UNDERWRITERS LABORATORY RATING | BUL. 94 | 94V2 | 94V2 |

| | | | |
|---|---|---|---|
| 117 | **Safety Factor** | **13.59** | **Vc/ Vr > 1 OK** |
| 118 | **Check Wall Stress between Blade and Tubing** | | |

119




| | | | |
|---|---|---|---|
| 120 | Max Stress of Member, Fm (psi) | 1,000 | See above. |

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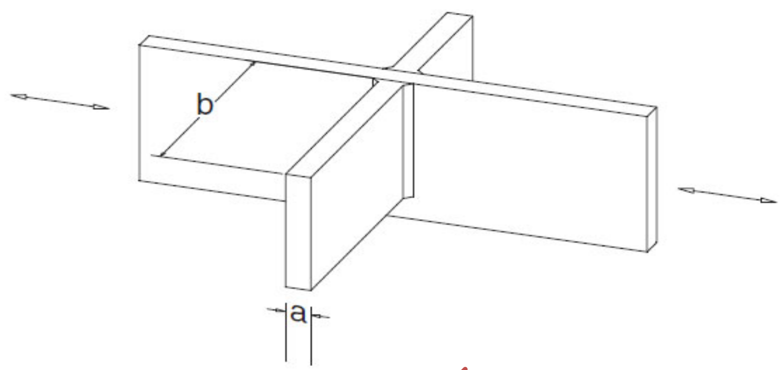
## B.3.5 Design for Fatigue

Structures and their components subjected to repeated loading shall meet the requirements of Appendix 3. Fatigue need not be considered for seismic loads.

122

## Figure 3.1
## FATIGUE DESIGN DETAILS

123




19

124

**Table 3.1**
**STRESS CATEGORY**

| GENERAL CONDITION | DETAIL | Detail Category | Fatigue Design Details ① |
|---|---|---|---|

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| | | | |
|---|---|---|---|
| Attachments | Base metal detail of any length attached by groove welds subject to transverse and/or longitudinal loading, with a transition radius $R \geq 2$ in. (50 mm) and with the weld termination ground smooth: | | |
| | $R \geq 24$ in. (610 mm) | B | 13 |
| | 24 in. > $R \geq 6$ in. (150 mm) | C | 13 |
| | 6 in. > $R \geq 2$ in. (50 mm) | D | 13 |
| | Base metal at a detail attached by groove welds or fillet welds with a detail dimension parallel to the direction of stress $a < 2$ in. (50 mm) | C | 19 |
| | Base metal at a detail attached by groove welds or fillet welds subject to longitudinal loading, with a transition radius, if any, < 2 in. (50 mm): | | |
| | 2 in. (50 mm) $\leq a \leq 12b$ or 4 in. (100 mm) | D | 14 |
| | $a > 12b$ or 4 in. (100 mm) | E | 14, 19, 20 |
| | Base metal at a detail of any length attached by fillet welds or partial-penetration groove welds in the direction parallel to the stress, with a transition radius $R \geq 2$ in. (50 mm), and the weld termination is ground smooth: | | |
| | $R \geq 24$ in. (610 mm) | B | 16 |
| | 24 in. > $R \geq 6$ in. (150 mm) | C | 16 |
| | 6 in. > $R \geq 2$ in. (50 mm) | D | 16 |

126

## Table 3.2
## CONSTANTS FOR S-N CURVES

| Detail Category | $C_f$ ksi | $C_f$ MPa | $m$ | Constant Amplitude Fatigue Limit ksi | Constant Amplitude Fatigue Limit MPa |
|---|---|---|---|---|---|
| A | 96.5 | 665 | 6.85 | 10.2 | 70 |
| B | 130 | 900 | 4.84 | 5.4 | 37 |
| C | 278 | 1920 | 3.64 | 4.0 | 28 |
| D | 157 | 1080 | 3.73 | 2.5 | 17 |
| E | 160 | 1100 | 3.45 | 1.8 | 13 |
| F | 174 | 1200 | 3.42 | 1.9 | 13 |
| F1 | 29.0 | 200 | 7.31 | 3.2 | 22 |

Constant amplitude fatigue limit is based on $N = 5 \times 10^6$ except for detail category F1 where $N = 10 \times 10^6$.

| | | | |
|---|---|---|---|
| 127 | Max Stress of Member, Fm (psi) | 1,000 | See above. This area is in the weld effected zone. |
| 128 | Fatigue Stress Limit, Ff (psi) | 4,000 | See above |
| 129 | **Safety Factor** | **4.00** | **Ff / fm > 1 ok** |
| 130 | **The concrete anchors are limited to 400 lbs of Tension** | | |

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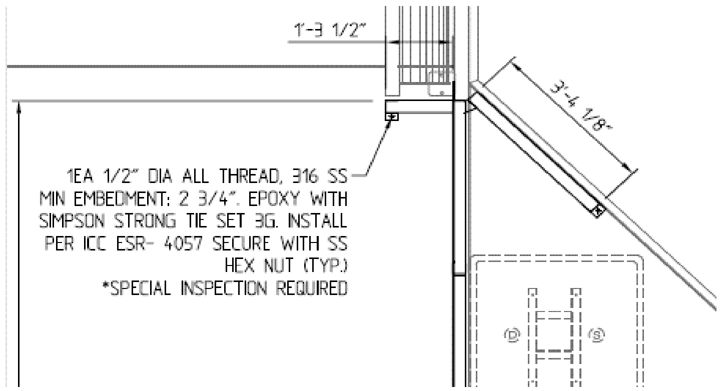
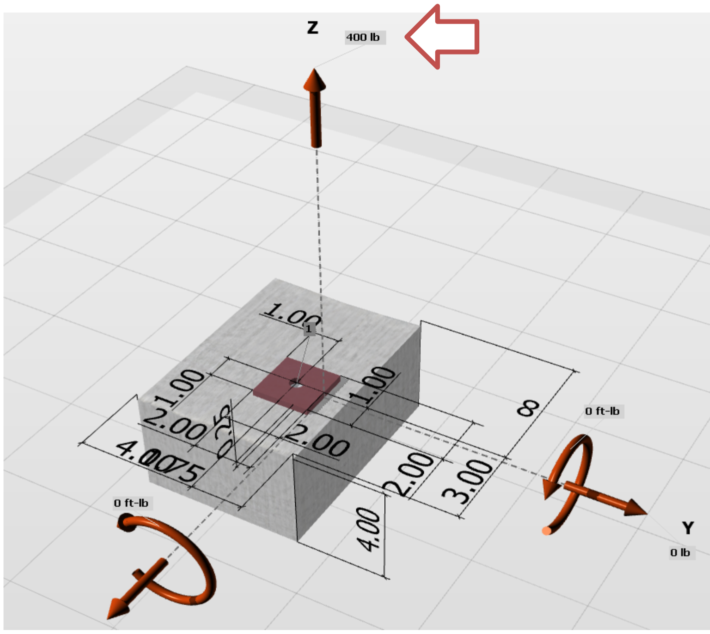
| | |
|---|---|
| 131 | <br> |
| 132 | <br><br>**Input Data**<br>Design method: ACI 318-14<br>Anchor: SET-3G w/ 1/2"Ø A193 Gr. B8/B8M (304/316SS)<br>Effective Embedment depth: 2.750 inch<br>Concrete: Normal-weight<br>State: Cracked<br>Compressive strength: 3000 psi<br>Seismic design: No<br><br>**Resulting Anchor Forces**<br># / Tension [lb] / Shear [lb]<br>1 / 882 / 0<br>**Governing tension ratio: 97.5% (Pass)**<br>Ratio / $N_{ua}$ [lb] / $\Phi N_n$ [lb]<br>Steel strength / 14.5% / 882 / 6071<br>Concrete breakout / 64.0% / 882 / 1378<br>Adhesive / 97.5% / 882 / 905<br>**SET-3G w/ 1/2"Ø A193 Gr. B8/B8M (304/316SS) with hef = 2.750 inch meets the selected design criteria.** |
| 133 | **These anchors help resist the 25 mph wind loads but not much else.** |
| 134 | **Verify Polycarbonate Plate will meet the loads.** |
| 135 | Check Wing Walls (straight wind loads) |

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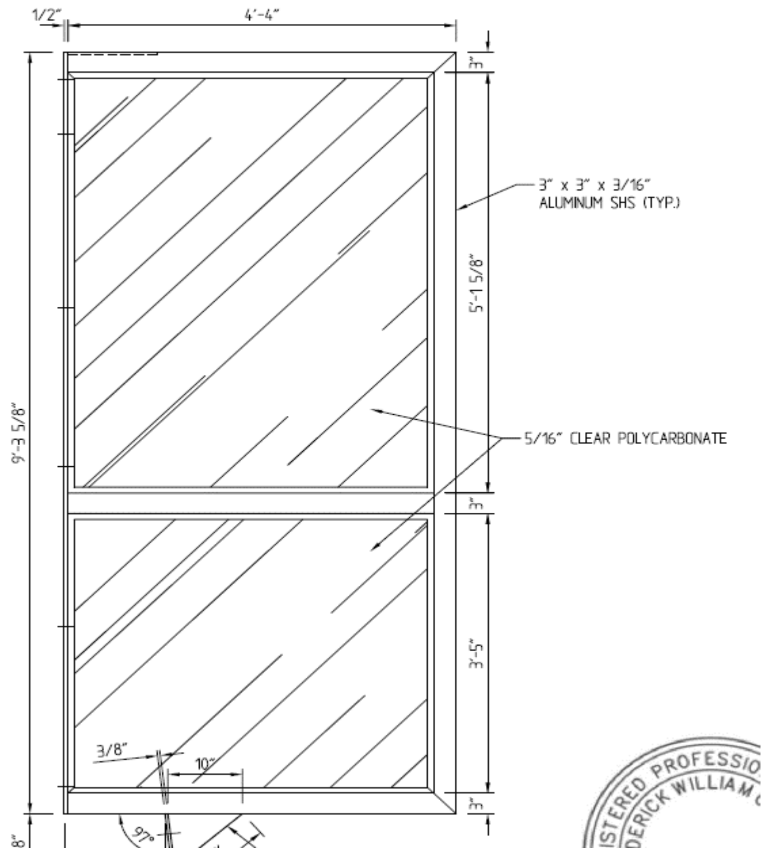
| | | | |
|---|---|---|---|
| 136 |  | | |
| 137 | Use solidworks simulation to determine the max stress on the material. | | |
| 138 | Roof Uplift Load, RLL (psf) | 16 | See above |
| 139 | Wing Wall Wind Load, Wm (psf) | 20.03 | See above |
| 140 | Max wind load, Wm (psi) | 0.14 | Wm is controlling both in magnitude and has a larger span between supports. Wm / 144 |

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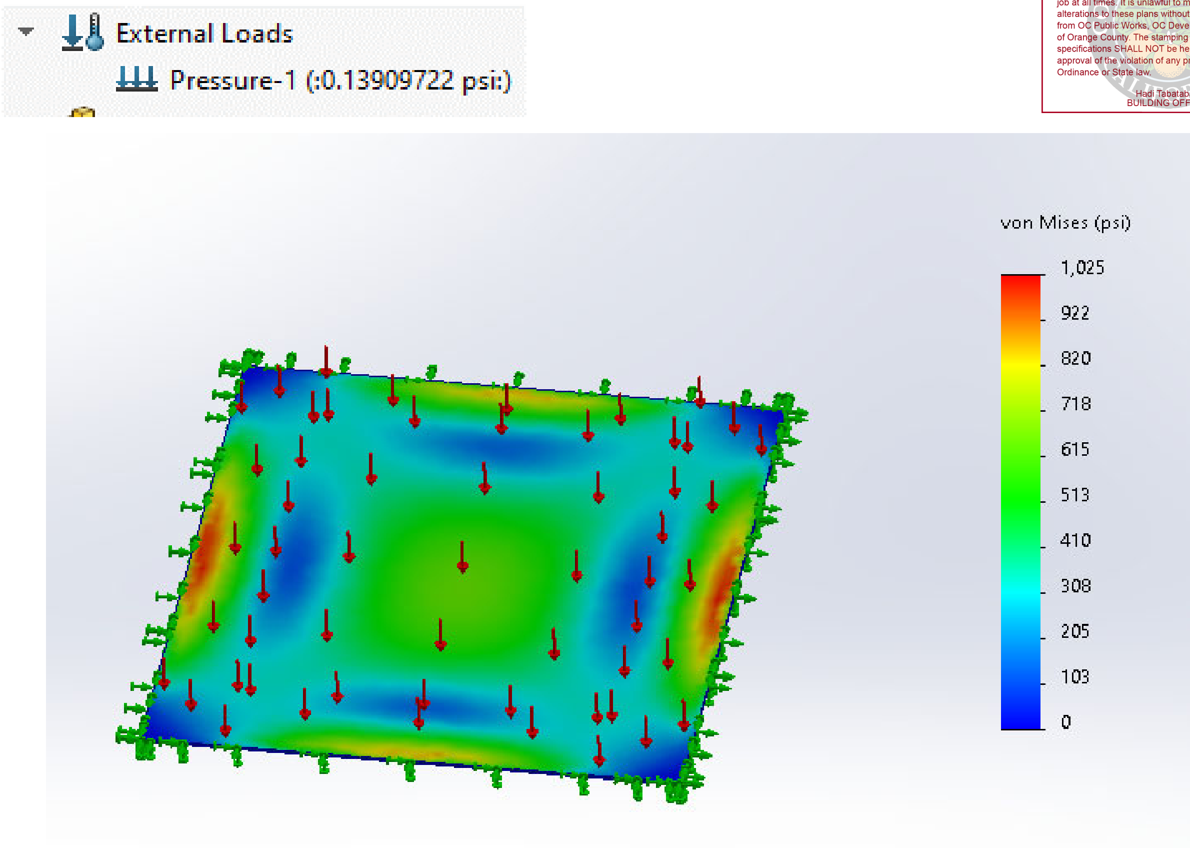
<table>
<tr><td>141</td><td colspan="3"></td></tr>
<tr><td>142</td><td>Max stress of polycarbonate, Fm (psi)</td><td>1,095.00</td><td>See above</td></tr>
<tr><td>143</td><td>Yield Stress of Material, Fy (psi)</td><td>6,705.00</td><td>See below. 8940 x 0.75.</td></tr>
<tr><td>144</td><td colspan="3">TUFFAK® GP sheets with thicknesses ranging between 0.030 to 0.060-inch-thick (0.76 to 1.5 mm) for wall and ceiling applications comply with the interior finish requirements of IBC Section 803.1. Select TUFFAK® GP,<br><br>MECHANICAL<br>Tensile Strength, Ultimate | ASTM D 638 | psi | 9,500<br>Tensile Strength, Yield | ASTM D 638 | psi | 9,000<br>Tensile Modulus | ASTM D 638 | psi | 340,000</td></tr>
<tr><td>145</td><td>Safety Factor</td><td>6.12</td><td>Fy / Fm > 1 OK</td></tr>
<tr><td>146</td><td colspan="3">End of Analysis</td></tr>
</table>