COLORADO
Division of Fire Prevention & Control
Department of Public Safety

8 CCR 1507-30
Code Enforcement & Certification of Inspectors Public Schools, Charter Schools, & Junior Colleges

Documents have been reviewed for compliance with adopted codes.

S. Joellen Thiel

Review shall not relieve the applicant of the responsibility to comply with adopted codes.

CONSULTING ENGINEERS

COLORADO LICENSED
MARK C. CORMIER
23790
PROFESSIONAL ENGINEER
03.30.18

**JVA JOB NO. 19053**

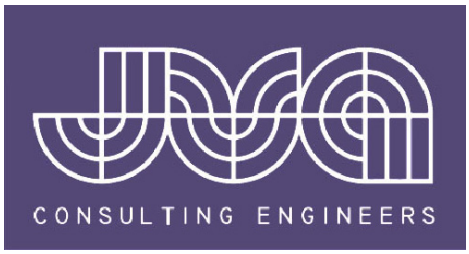
# STRUCTURAL CALCULATIONS

Middle School Mechanical Upgrades

Steamboat Springs School District Re-2

39610 Amethyst Drive
Steamboat Springs, CO 80487

**2018/03/30**




**JVA JOB NO. 19053**

# SECTION 1 - GENERAL CODE, LOAD, AND MATERIALS INFORMATION

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Date: Page: of

By: Checked By:

Job No:

Project:

Client:

☐ Preliminary ☐ Final

## GENERAL CODE, LOAD, SYSTEMS, AND MATERIALS INFORMATION

| | |
|---|---|
| JOB NUMBER = | **19053** |
| PROJECT NAME = | **MS Mechanical Upgrades** |
| PROJECT LOCATION = | **Steamboat Springs, CO** |
| BUILDING DEPT = | **Steamboat Springs** |
| **CODE** | **IBC 2015** |
| AMENDMENTS = | **Town of Steamboat Springs** |
| **ASCE7** | **10** |
| **OCCUPANCY CATEGORY / RISK CATEGORY** | **III** |

## GRAVITY LOADS

### DEAD LOADS*

| | | |
|---|---|---|
| Roof approx. TL = Self wt. + Superimposed DL = | **20** | psf |

*SEE DESIGN LOADS SECTION BELOW FOR ITEMIZED DEAD LOADS OF FLOOR & ROOF ASSEMBLIES

### ROOF LIVE LOADS

| | | |
|---|---|---|
| • Pg Flat-Roof Snow = | **91** | psf |
| • $P_g$ (Basic Ground Snow) = | **118** | psf |
| • $I_s$ (Importance factor) = | **1.1** | |
| • $C_e$ (Snow exposure factor) = | **1.0** | |
| • $C_t$ (Snow thermal factor) = | **1.0** | |

## LATERAL LOADS

### WIND

| | | |
|---|---|---|
| Basic Wind Speed = | **120** | mph |
| • Exposure = | **C** | |
| • Air Density Coefficient = | **0.84** | |

### SEISMIC

| | | |
|---|---|---|
| Spectral Response Acceleration Coefficient $S_s$ = | **0.205** | g |
| Spectral Response Acceleration Coefficient $S_1$ = | **0.057** | g |
| • Importance Factor ($I_e$) = | **1.25** | |
| • Soils Site Class = | **D** | |
| • Seismic Design Category = | **B** | |
| • Response Modification Coefficient = R = | **3** | |
| • Analysis Procedure = | **Equivalent Lateral Force** | |
| • Basic Force Resisting Structural System = | **Steel system not specifiacally detailed for seismic resistance** | |

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## FOUNDATIONS

| | | |
|---|---|---|
| SOILS ENGINEER = | Chen & Assoc. Inc | |
| REPORT NUMBER = | 19306 | |
| REPORT DATE = | Oct 31, 1979 | |
| FROST DEPTH = | 36 | in |

### SPREAD FOOTINGS

| | | |
|---|---|---|
| • Maximum allowable bearing pressure = | 2,000 | psf |

## MATERIALS

### STRUCTURAL STEEL =

| | | |
|---|---|---|
| • Wide Flange Shapes = | ASTM A992 50 | ksi |
| • Tube Sections = | ASTM A500, Gr B, 50 | ksi |
| • Other Shapes (Angles, channels, plates) = | ASTM A36, Gr B, 36 | ksi |
| • Bolts = | ASTM A325-N | |
| • Anchor Bolts = | ASTM A36, Gr B, 36 | ksi |
| • High Strength Anchor Bolts = | ASTM A449 92 | ksi |
| • Bolted Connections = | Brg.-type w/ ¾" diameter | |
| • Welded Connections = | E70-xx | Electrodes |

### CEE STUD

| | | |
|---|---|---|
| • 16 gage & heavier = | ASTM A570, 50 | ksi |
| • 18 gage & lighter = | ASTM A611, Gr C, 33 | ksi |

### CONCRETE

| | | |
|---|---|---|
| • Weight | 150 | pcf |
| DESCRIPTION (CEMENT TYPE) / STRENGTHS | | |
| • Footings (Type I/II) = | 3000 | psi |

### PRIMARY SYSTEM REINFORCEMENT

| | | |
|---|---|---|
| • Primary reinforcing = | ASTM A615, 60 | GRADE |

## SERVICEABILITY REQUIREMENTS

### DEFLECTIONS

| | |
|---|---|
| • Roof TL = | L/240 |
| • Roof LL = | L/360 |
| • Brick Supporting elements TL = | 3/8" Max. and L/600 |

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## REFERENCES

| | |
|---|---|
| • Dietrich Metal Stud Catalog | **2009** |
| • Hilti North America Product Technical Guide | **2011** |
| • Simpson Wood Construction Connector Catalog | **C-2011** |
| • Alpine Wood Truss Catalog | **1991** |
| • Vulcraft Steel Joist and Joist Girder Catalog | **2009** |
| • Vulcraft Steel Roof and Floor Deck Catalog | **2008** |

## SOFTWARE

| | |
|---|---|
| • RISA2D and 3D Structural Analysis Software | **v10.1, 10.0** |
| • RAM V8i SELECT Series 5 | **14.05.01.00** |
| • TEDDS Element Analysis Software | |
| • Forte Joist / LVL Software | **v4.0** |
| • Simpson Connector Selector Software | **v2012.1.1** |
| • Hilti Profis Anchor | **V2.3.1** |
| • Powers Design Assist 2 | **2.1.NET** |
| • Simpson Anchor Selector for ACI 318 | **V4.7.0.0** |

## SNOW DRIFT - ASCE 7-10 referenced by 2012-2015 IBC

| **Flat Roof Snow Loads** 1.0 - Section 7.3 (1/2" per foot or less) | | | | |
|---|---|---|---|---|
| Prescriptive Roof Snow Load not based on Ground Snow Load | | $p_b$ | 50.00 | psf |
| Basic Ground Snow Load | | $p_g$ | 118.00 | psf |
| Density of Snow | $.13*p_g+14<=30$ | $\gamma$ | 29.3 | pcf |
| Exposure | | | Partially Exposed | |
| Terrain Category - See Sec. 6.5.6.1 | | | B | |
| Exposure Factor | Table 7-2 | $C_e$ | 1.0 | |
| Thermal Factor | Table 7-3 | $C_t$ | 1.00 | |
| Importance Factor | Tables 1-1 & 7-4 | I | 1.10 | |
| Flat Roof Snow Load (slope <=5°) | $.7Ce*C_t*Is*p_g$ | $p_f$ | **90.9** | psf |
| Flat Roof Snow Load (slope <=5°) | minimum | $p_m$ | **90.9** | psf |

| **Sloped Roof Snow Load 1.1** - Section 7.4 | | | | |
|---|---|---|---|---|
| Reduce Load due to Slope? | | | No | |
| Surface | | | Other | |
| Roof Slope Ratio | | | 8 | 12 |
| Roof Slope | | a | 33.7 | ° |
| | | | 0.91 | |
| | | | 1.00 | |
| | | | 1.00 | |
| Roof Slope-Reduction Factor | | $C_s$ | 1.00 | |
| Sloped Roof Snow Load | $p_f*C_s$ | $p_s$ | **90.9** | psf |

| **Sloped Roof Snow Load 1.2** - Section 7.4 | | | | |
|---|---|---|---|---|
| Reduce Load due to Slope? | | | No | |
| Surface | | | Other | |
| Roof Slope Ratio | | | 0.5 | 12 |
| Roof Slope | | a | 2.4 | ° |
| | | | 1.00 | |
| | | | 1.00 | |
| | | | 1.00 | |
| Roof Slope-Reduction Factor | | $C_s$ | 1.00 | |
| Sloped Roof Snow Load | $p_f*C_s$ | $p_s$ | **90.9** | psf |

## ISOLATED PAD FOOTING LOADS (MAXIMUM)

**Design Criteria:**

- 2006-15 International Building Code
- ACI 318-05 thru 14
- ASCE7-05, 10

**Notes:**

- 4,000 psi max
-
-

ACI 318- **11**

| | | | |
|---|---|---|---|
| Bearing Capacity = | **2** | ksf | |
| Min dead load = | **0** | ksf | |
| Conc. Wt. = | **12.5** | psf-in. | *Use 0 if Net Bearing* |
| fc' = | **3** | ksi | |
| fy = | **60** | ksi | |
| ϕshear = | **0.75** | | *ACI 9.3.2.3* |
| ϕbending = | **0.9** | | *ACI 9.3.2.1* |
| ϕbearing = | **0.65** | | *ACI 9.3.2.4* |
| Maximum Factor = | **1.6** | | |
| Rebar clearance = | **3** | in | |

**Pedestal Bearing**

| Footing width in. | Footing thick. in. | Pedestal width in. | Pedestal depth in. | Rebar size # | Quantity ea. Way # | Pu ksf | Vup punching Kips | Vu Kips | Mu Kip-ft | ϕBn *10.14.1* kips | ϕVc *11.11.2.1* kips | ϕVn *11.1* kips | ϕMn *10.2* Kip-ft | Min Dead load Kips | Max load Kips |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Column Bearing**

| Footing width in. | Footing thick. in. | Plate width in. | Column width in. | Rebar size # | Quantity ea. Way # | Pu ksf | Vup punching Kips | Vu Kips | Mu Kip-ft | ϕBn *10.14.1* kips | ϕVc *11.11.2.1* kips | ϕVn *11.1* kips | ϕMn *10.2* Kip-ft | Min Dead load Kips | Max load Kips |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **36** | **12** | **12** | **4** | **5** | **3** | 3.20 | 28.80 | 4.00 | 6.53 | 238.68 | 153.80 | 26.62 | 36.03 | **0.00** | **16.65** |
| **72** | **16** | **11** | **5** | **5** | **5** | 3.20 | 115.20 | 30.40 | 68.27 | 200.5575 | 290.51 | 76.90 | 88.00 | **0.00** | **64.80** |
| **78** | **16** | **11** | **5** | **5** | **6** | 3.20 | 135.20 | 38.13 | 88.47 | 200.5575 | 290.51 | 83.31 | 105.38 | **0.00** | **76.05** |

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|---|---|---|---|
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| Client: | xxxxx | Job No: | xxxxxx |
| Date: | 2/9/2016 | Sheet: | xxxxxx |

# Base Plates - Gravity Downward Only

**AISC 14th Edition (2010) Section J.8, 14-4**

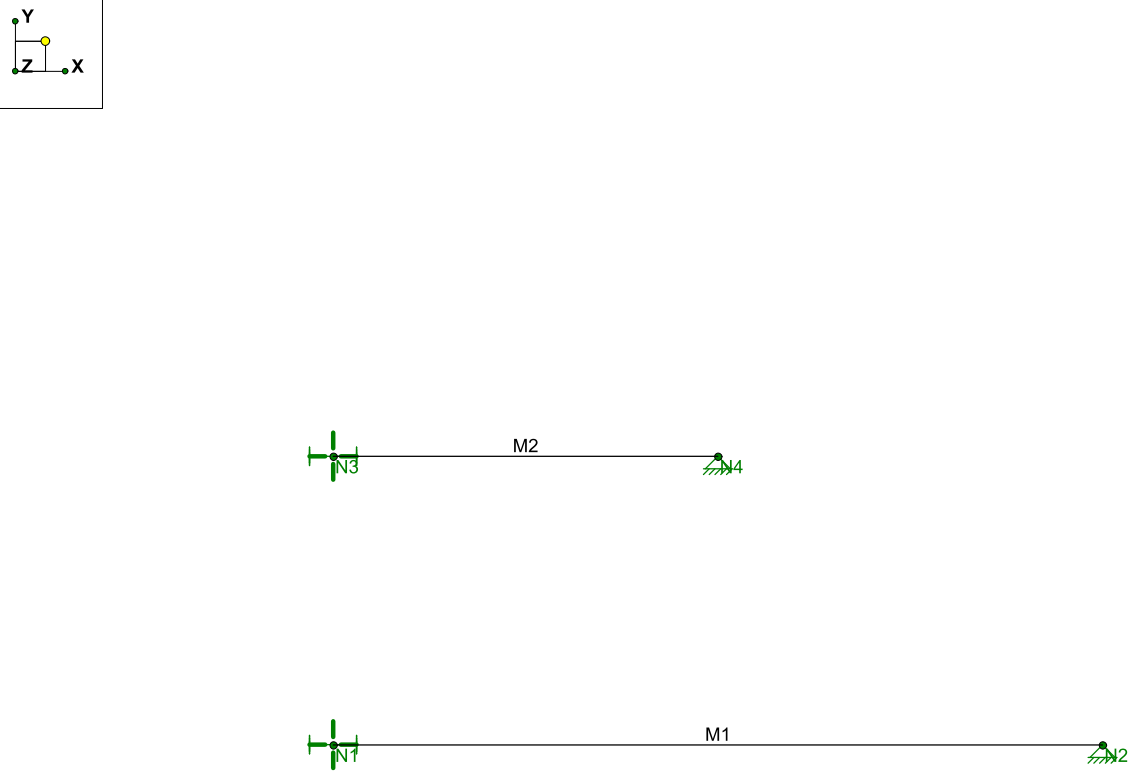
**A2 = area of base plate unless overridden**

| Select Design Method | |
|---|---|
| ASD | Allowable Bearing |

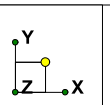
| | | |
|---|---|---|
| Ωc | = | 2.31 |

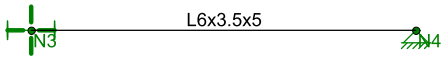
| Key |
|---|
| Input |
| Input (Default Values, can be changed) |
| Errors |
| Adequate / Important Output |
| Updated 3/14/2016 By EZ |

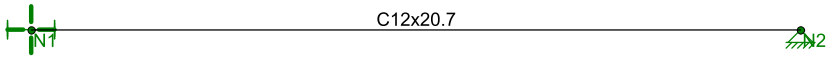
| Total Allowable Load Kips | f'c psi | depth of col in | width of col in | N plate depth in | B plate width in | Fy plate ksi | A1 $in^2$ | A2 override $in^2$ | A2 selected $in^2$ | Allowable Bearing strength Kips | | tp in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67.55 | 3000 | 6 | 6 | 12 | 12 | 36 | 144.00 | 0 | 144 | 158.96 | O.K. | 0.750 |
| 60.08 | 3000 | 5 | 5 | 11 | 11 | 36 | 121.00 | 0 | 121 | 133.57 | O.K. | 0.750 |
| 52.59 | 3000 | 4 | 4 | 10 | 10 | 36 | 100.00 | 0 | 100 | 110.39 | O.K. | 0.750 |
| | | | | | | | | | | | | |
| 91.95 | 3000 | 6 | 6 | 12 | 12 | 36 | 144.00 | 0 | 144 | 158.96 | O.K. | 0.875 |
| 81.74 | 3000 | 5 | 5 | 11 | 11 | 36 | 121.00 | 0 | 121 | 133.57 | O.K. | 0.875 |
| 71.59 | 3000 | 4 | 4 | 10 | 10 | 36 | 100.00 | 0 | 100 | 110.39 | O.K. | 0.875 |
| | | | | | | | | | | | | |
| 120.01 | 3000 | 6 | 6 | 12 | 12 | 36 | 144.00 | 0 | 144 | 158.96 | O.K. | 1.000 |
| 106.68 | 3000 | 5 | 5 | 11 | 11 | 36 | 121.00 | 0 | 121 | 133.57 | O.K. | 1.000 |
| 93.43 | 3000 | 4 | 4 | 10 | 10 | 36 | 100.00 | 0 | 100 | 110.39 | O.K. | 1.000 |




| | | |
|---|---|---|
| | | SK - 1 |
| | | Mar 30, 2018 at 3:51 PM |
| | | new opening lintel beam.r3d |




| | | |
|---|---|---|
| | | SK - 2 |
| | | Mar 30, 2018 at 3:52 PM |
| | | new opening lintel beam.r3d |

## Hot Rolled Steel Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm (\1E..Density[k/ft... | Yield[ksi] | Ry | Fu[ksi] | Rt |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A992 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 2 | A36 Gr.36 | 29000 | 11154 | .3 | .65 | .49 | 36 | 1.5 | 58 | 1.2 |
| 3 | A572 Gr.50 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 4 | A500 Gr.B RND | 29000 | 11154 | .3 | .65 | .527 | 42 | 1.4 | 58 | 1.3 |
| 5 | A500 Gr.B Rect | 29000 | 11154 | .3 | .65 | .527 | 46 | 1.4 | 58 | 1.3 |
| 6 | A53 Gr.B | 29000 | 11154 | .3 | .65 | .49 | 35 | 1.6 | 60 | 1.2 |
| 7 | A1085 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.4 | 65 | 1.3 |

## Joint Boundary Conditions

| | Joint Label | X [k/in] | Y [k/in] | Z [k/in] | X Rot.[k-ft/rad] | Y Rot.[k-ft/rad] | Z Rot.[k-ft/rad] |
|---|---|---|---|---|---|---|---|
| 1 | N1 | Reaction | Reaction | Reaction | Reaction | | |
| 2 | N2 | Reaction | Reaction | Reaction | | | |
| 3 | N3 | Reaction | Reaction | Reaction | Reaction | | |
| 4 | N4 | Reaction | Reaction | Reaction | | | |

## Joint Coordinates and Temperatures

| | Label | X [ft] | Y [ft] | Z [ft] | Temp [F] | Detach From D... |
|---|---|---|---|---|---|---|
| 1 | N1 | 0 | 0 | 0 | 0 | |
| 2 | N2 | 16 | 0 | 0 | 0 | |
| 3 | N3 | 0 | 6 | 0 | 0 | |
| 4 | N4 | 8 | 6 | 0 | 0 | |

## Hot Rolled Steel Design Parameters

| | Label | Shape | Length[ft] | Lbyy[ft] | Lbzz[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torqu... | Kyy | Kzz | Cb | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | C12x20.7 | 16 | | | Lbyy | | | | | | Lateral |
| 2 | M2 | L6x3.5x5 | 8 | | | Lbyy | | | | | | Lateral |

## Member Point Loads

| Member Label | Direction | Magnitude[k,k-ft] | Location[ft,%] |
|---|---|---|---|
| No Data to Print ... | | | |

## Member Distributed Loads (BLC 1 : Dead)

| | Member Label | Direction | Start Magnitude[k/ft,F,ksf] | End Magnitude[k/ft,F,... | Start Location[ft,%] | End Location[ft,%] |
|---|---|---|---|---|---|---|
| 1 | M1 | Y | -.45 | -.45 | 0 | 16 |
| 2 | M2 | Y | -.188 | -.188 | 0 | 8 |

## Member Distributed Loads (BLC 2 : Snow)

| | Member Label | Direction | Start Magnitude[k/ft,F,ksf] | End Magnitude[k/ft,F,... | Start Location[ft,%] | End Location[ft,%] |
|---|---|---|---|---|---|---|
| 1 | M1 | Y | -.12 | -.12 | 0 | 16 |

## Member End Reactions

| | LC | Member Label | Me... | Axial[k] | y Shear[k] | z Shear[k] | Torque[k-ft] | y-y Moment[k-ft] | z-z Moment[k-ft] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | M1 | I | 0 | 4.726 | 0 | 0 | 0 | 0 |
| 2 | | | J | 0 | -4.726 | 0 | 0 | 0 | 0 |
| 3 | 1 | M2 | I | 0 | .791 | 0 | 0 | 0 | 0 |
| 4 | | | J | 0 | -.791 | 0 | 0 | 0 | 0 |

## Beam Deflections

| | LC | Member Label | Span | Location [ft] | y [in] | (n) L/y Ratio |
|---|---|---|---|---|---|---|
| 1 | 1 | M1 | 1 | 8 | -.291 | 659 |
| 2 | 1 | M2 | 1 | 4 | -.109 | 880 |

## Member AISC 14th(360-10): ASD Steel Code Checks

| | LC | Member | Shape | UC Max | Loc[ft] | Shear UC | Loc[ft] | Dir | Pnc/om [k] | Pnt/om [k] | Mnyy/om... | Mnzz/om... | Cb | Eqn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | M1 | C12x20.7 | .862 | 8 | .108 | 16 | y | 15.739 | 131.066 | 4.949 | 21.925 | 1.136 | H1-1b |
| 2 | 1 | M2 | L6x3.5x5 | .551 | 4 | .033 | 0 | y | 26.037 | 62.299 | 1.907 | 5.419 | 1.136 | H2-1 |

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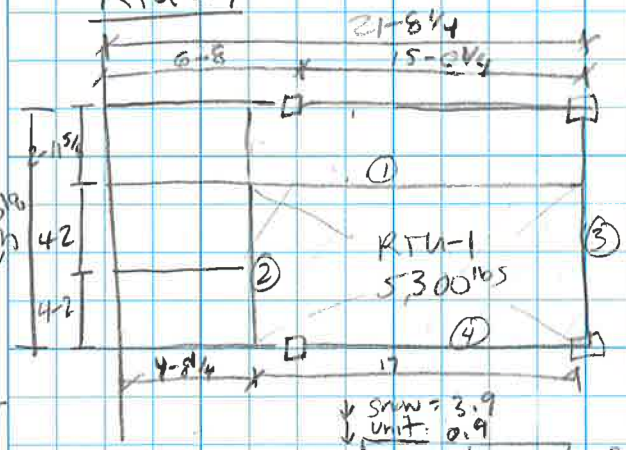
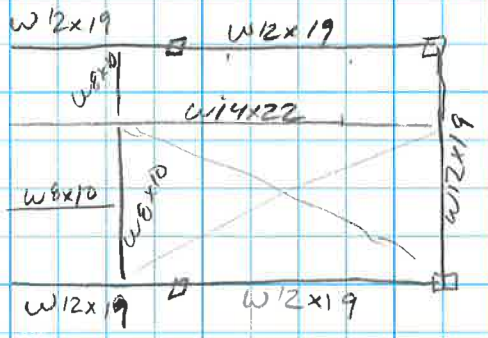
RTU - 1



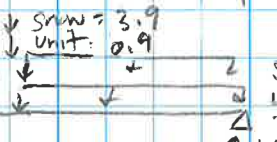




controlled deflection → W14x22

Braced every 5' max

0.87 in def

Beam1

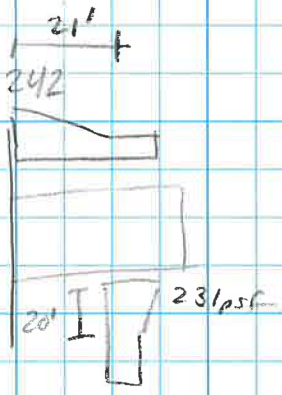



Unit: 5300 lbs / 4 / 17' = 78 plf

Snow: 91 psf x 17' x 8.33'/4 = 322 / 17' = 190 plf

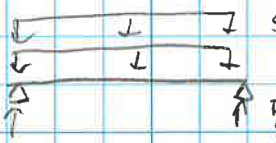
225 psf x 3'/2 = 338 plf

DL: 20 psf x 3'/2 = 30 plf




Beam2

W8x10




Snow 937 plf

Unit 159 plf + 47 plf = 206 plf

Unit = 5300/4 / 8.33' = 159 plf

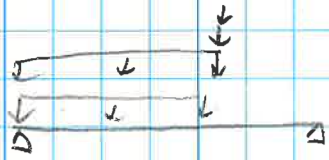
Snow = 91 psf x 17 x 8.33'/4 / 8.33' = 387 plf

235 x 4.67/2 = 550 plf

DL = 20 psf x 4.67/2 = 47 plf

Beam3

W12x19

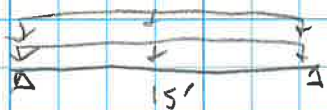



Unit = 5300/4 / 8.33'

Snow = 91 psf x 17 x 8.33/4 / 8.33' = 387 plf

Beam4

W12x19




Snow 480 plf (230 psf)

Unit 78 plf

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Job No: _____
Project: _____
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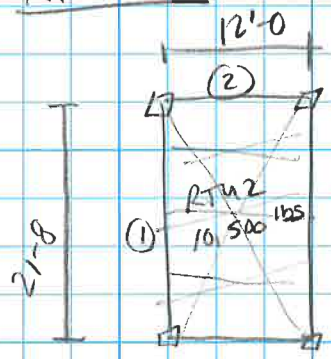
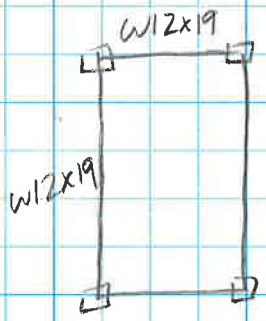
RTU - 2.




Beam 1

Snow = 273 plf
unit = 122 plf

Braced every 5' max

4.5k Total
1.5k Dead
11.8k Snow

Beam 2

Snow = 500 plf
unit = 219 plf

Unbraced

Total 4.4k
Dead 1.4k
Snow 3k

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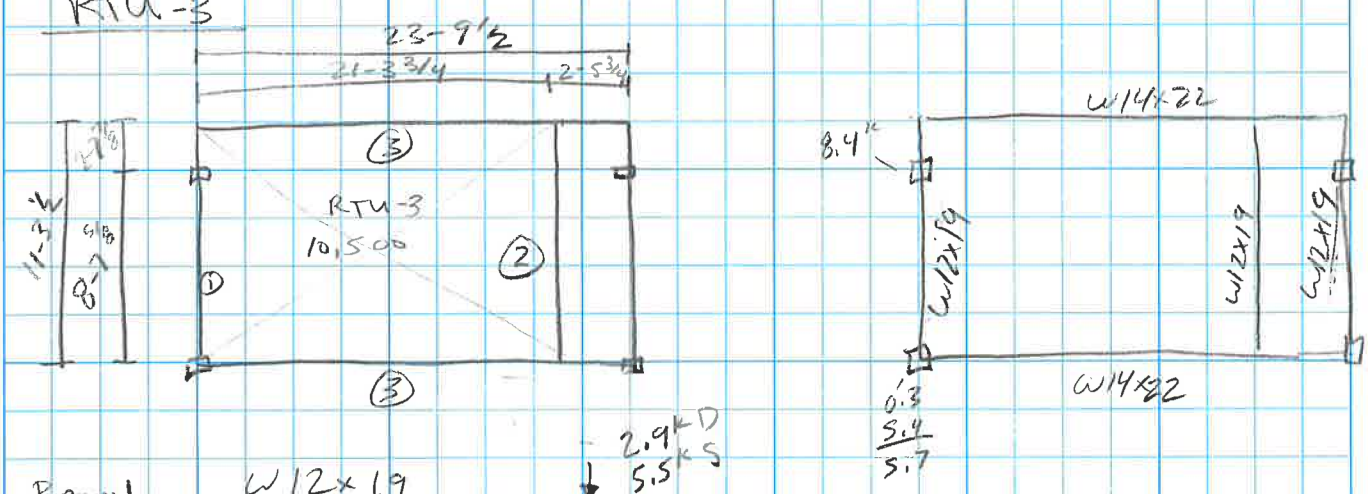
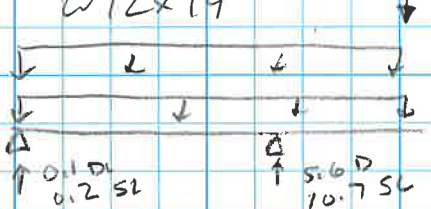
RTU-3



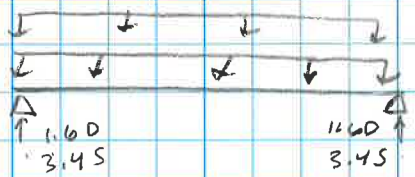

Beam1 W12x19




unif load: 10,500 lbs/4 = 2.63k / 11.3' = 233plf

snow: 91psf x (21.3' x 11.3')/4 = 5.5k / 11.3' = 485 plf

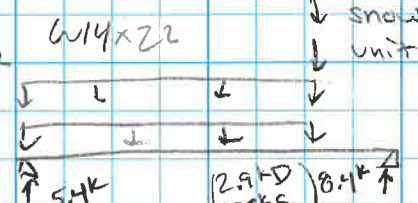
Beam2 W12x19




unif load 10,500 lbs/4 = 2.63k / 11.3' = 233plf

Snow: 91psf x (21.3' x 11.3')/4 + 91psf x (2.5' x 11.3')/2 = 6.76k / 11.3' = 600plf

Beam 3 W14x22




top fl braced ... deflec controls

Point loads from Beam2: 233plf x 11.3'/2 = 1.5k

unif uniform 10,500/4 = 2.63k/21.3' = 124plf

91psf x (21.3 x 11.3)/4 = 5.48k/11.3' = 257plf

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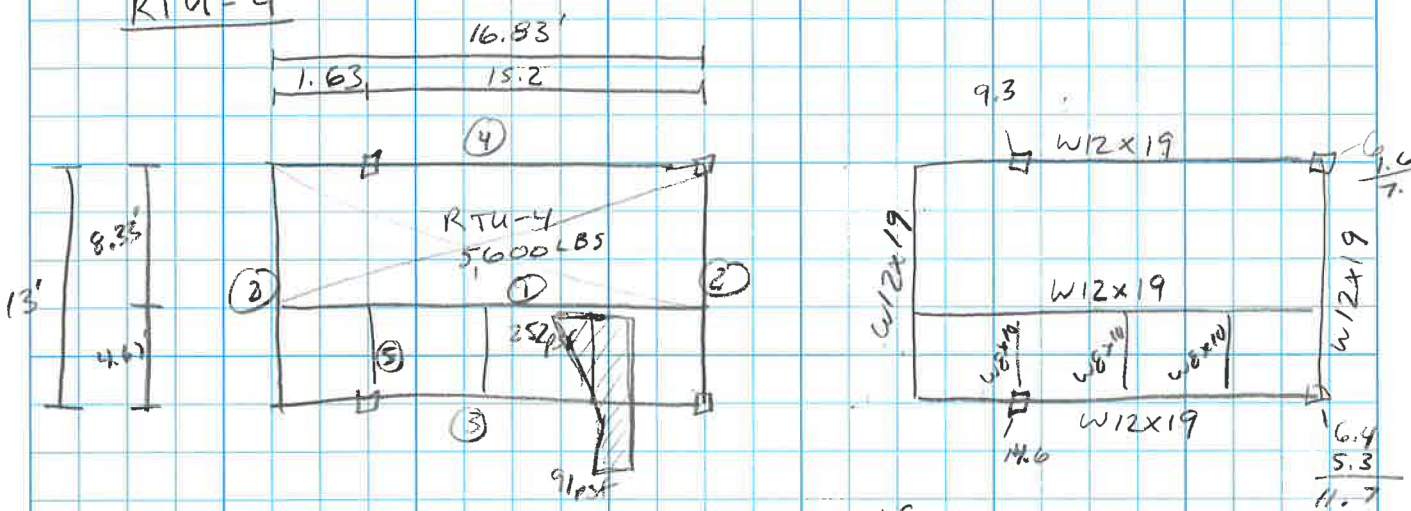
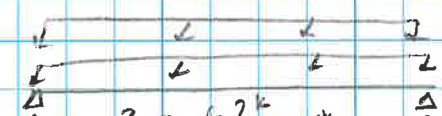
# RTU-4




## Beam 1
W12x19



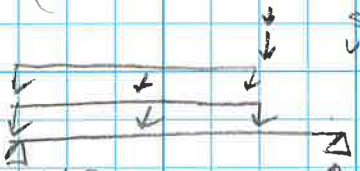

S = 778 plf
unit = 83.2 plf
DL = 47 plf
Total DL = 130 plf

unit = 5600 / 4 = 1400 / 16.83' = 83.2 plf

TDL = 20psf × 16.83' × 4.67' / 2 = 786 lbs / 16.83' = 47 plf

Snow = (91psf × 8.33' × 16.83' / 4 + 252 psf × 16.83' × 4.67' / 2) = 13.1k / 16.83' = 778 plf

## Beam 2
W12x19

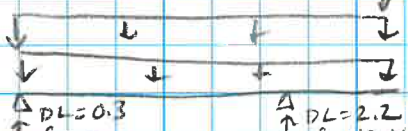



Snow = 383 plf
unit = 168 plf.

unit: 1400 / 8.33' = 168 plf

Snow (91psf × 8.33' × 16.83' / 4) / 8.33' = 383 plf

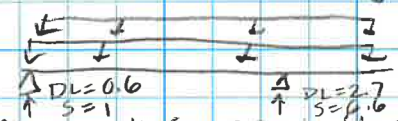
## Beam 3
W12x19




S = 738 plf
TDL = 47 plf

TDL = (20psf × 4.67' × 16.83' / 2) / 16.83' = 47 plf

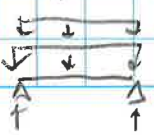
## Beam 4
W12x19




Snow = 190 plf
unit = 83 plf

Snow 91 psf × 16.83 × 8.33 / 4 / 16.83' = 190 plf

## Beam 5
W8x10



S = 1.175 k/lf
DL = 100 plf

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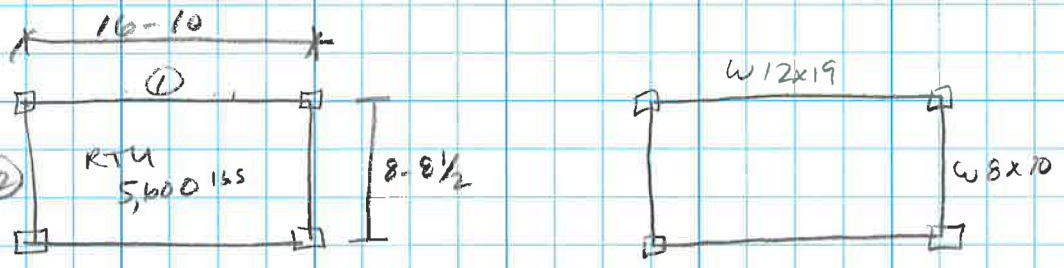
## RTU 5 & RTU 6




**Beam 1**

Snow 200plf
Unit 85plf

0.9DL
1.7S
2.6

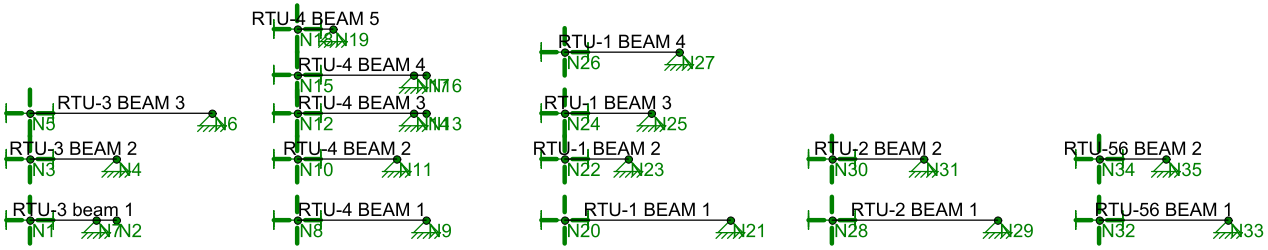
No Bracing req

**Beam 2**

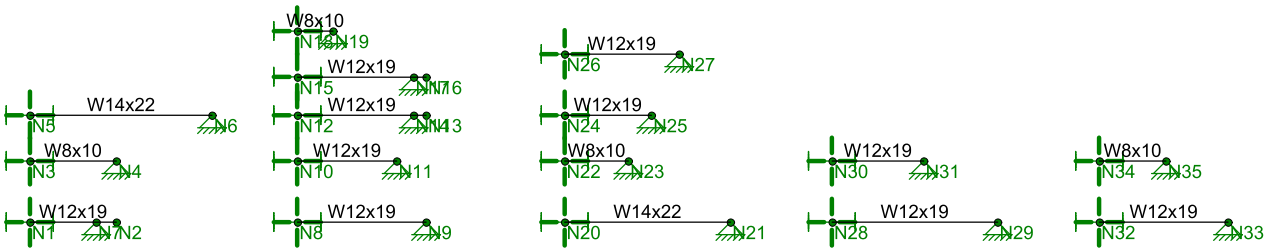
Snow 385plf
Unit 161plf

0.7DL
1.7S
2.4

No Bracing Req.




| | | |
|---|---|---|
| | | SK - 1 |
| | | Mar 30, 2018 at 3:45 PM |
| | | RTU framing members.r3d |




| | | |
|---|---|---|
| | | SK - 2 |
| | | Mar 30, 2018 at 3:46 PM |
| | | RTU framing members.r3d |

## Hot Rolled Steel Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm (\1E..Density[k/ft... | Yield[ksi] | Ry | Fu[ksi] | Rt |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A992 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 2 | A36 Gr.36 | 29000 | 11154 | .3 | .65 | .49 | 36 | 1.5 | 58 | 1.2 |
| 3 | A572 Gr.50 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.1 | 65 | 1.1 |
| 4 | A500 Gr.B RND | 29000 | 11154 | .3 | .65 | .527 | 42 | 1.4 | 58 | 1.3 |
| 5 | A500 Gr.B Rect | 29000 | 11154 | .3 | .65 | .527 | 46 | 1.4 | 58 | 1.3 |
| 6 | A53 Gr.B | 29000 | 11154 | .3 | .65 | .49 | 35 | 1.6 | 60 | 1.2 |
| 7 | A1085 | 29000 | 11154 | .3 | .65 | .49 | 50 | 1.4 | 65 | 1.3 |

## Joint Coordinates and Temperatures

| | Label | X [ft] | Y [ft] | Z [ft] | Temp [F] | Detach From D... |
|---|---|---|---|---|---|---|
| 1 | N1 | 0 | 0 | 0 | 0 | |
| 2 | N2 | 11.3 | 0 | 0 | 0 | |
| 3 | N3 | 0 | 8 | 0 | 0 | |
| 4 | N4 | 11.3 | 8 | 0 | 0 | |
| 5 | N5 | 0 | 14 | 0 | 0 | |
| 6 | N6 | 23.83 | 14 | 0 | 0 | |
| 7 | N7 | 8.67 | 0 | 0 | 0 | |
| 8 | N8 | 35 | 0 | 0 | 0 | |
| 9 | N9 | 51.83 | 0 | 0 | 0 | |
| 10 | N10 | 35 | 8 | 0 | 0 | |
| 11 | N11 | 48 | 8 | 0 | 0 | |
| 12 | N12 | 35 | 14 | 0 | 0 | |
| 13 | N13 | 51.83 | 14 | 0 | 0 | |
| 14 | N14 | 50.2 | 14 | 0 | 0 | |
| 15 | N15 | 35 | 19 | 0 | 0 | |
| 16 | N16 | 51.83 | 19 | 0 | 0 | |
| 17 | N17 | 50.2 | 19 | 0 | 0 | |
| 18 | N18 | 35 | 25 | 0 | 0 | |
| 19 | N19 | 39.67 | 25 | 0 | 0 | |
| 20 | N20 | 70 | 0 | 0 | 0 | |
| 21 | N21 | 91.69 | 0 | 0 | 0 | |
| 22 | N22 | 70 | 8 | 0 | 0 | |
| 23 | N23 | 78.33 | 8 | 0 | 0 | |
| 24 | N24 | 70 | 14 | 0 | 0 | |
| 25 | N25 | 81.33 | 14 | 0 | 0 | |
| 26 | N26 | 70 | 22 | 0 | 0 | |
| 27 | N27 | 85 | 22 | 0 | 0 | |
| 28 | N28 | 105 | 0 | 0 | 0 | |
| 29 | N29 | 126.67 | 0 | 0 | 0 | |
| 30 | N30 | 105 | 8 | 0 | 0 | |
| 31 | N31 | 117 | 8 | 0 | 0 | |
| 32 | N32 | 140 | 0 | 0 | 0 | |
| 33 | N33 | 156.83 | 0 | 0 | 0 | |
| 34 | N34 | 140 | 8 | 0 | 0 | |
| 35 | N35 | 148.7 | 8 | 0 | 0 | |

## Joint Boundary Conditions

| | Joint Label | X [k/in] | Y [k/in] | Z [k/in] | X Rot.[k-ft/rad] | Y Rot.[k-ft/rad] | Z Rot.[k-ft/rad] |
|---|---|---|---|---|---|---|---|
| 1 | N5 | Reaction | Reaction | Reaction | Reaction | | |
| 2 | N6 | Reaction | Reaction | Reaction | | | |
| 3 | N4 | Reaction | Reaction | Reaction | | | |
| 4 | N3 | Reaction | Reaction | Reaction | Reaction | | |
| 5 | N1 | Reaction | Reaction | Reaction | Reaction | | |
| 6 | N2 | | | | | | |
| 7 | N7 | Reaction | Reaction | Reaction | | | |
| 8 | N8 | Reaction | Reaction | Reaction | Reaction | | |
| 9 | N9 | Reaction | Reaction | Reaction | | | |
| 10 | N10 | Reaction | Reaction | Reaction | Reaction | | |
| 11 | N11 | Reaction | Reaction | Reaction | | | |
| 12 | N12 | Reaction | Reaction | Reaction | Reaction | | |
| 13 | N13 | | | | | | |
| 14 | N14 | Reaction | Reaction | Reaction | | | |
| 15 | N15 | Reaction | Reaction | Reaction | Reaction | | |
| 16 | N16 | | | | | | |
| 17 | N17 | Reaction | Reaction | Reaction | | | |
| 18 | N18 | Reaction | Reaction | Reaction | Reaction | | |
| 19 | N19 | Reaction | Reaction | Reaction | | | |
| 20 | N20 | Reaction | Reaction | Reaction | Reaction | | |
| 21 | N21 | Reaction | Reaction | Reaction | | | |
| 22 | N22 | Reaction | Reaction | Reaction | Reaction | | |
| 23 | N23 | Reaction | Reaction | Reaction | | | |
| 24 | N24 | Reaction | Reaction | Reaction | Reaction | | |
| 25 | N25 | Reaction | Reaction | Reaction | | | |
| 26 | N26 | Reaction | Reaction | Reaction | Reaction | | |
| 27 | N27 | Reaction | Reaction | Reaction | | | |
| 28 | N28 | Reaction | Reaction | Reaction | Reaction | | |
| 29 | N29 | Reaction | Reaction | Reaction | | | |
| 30 | N30 | Reaction | Reaction | Reaction | Reaction | | |
| 31 | N31 | Reaction | Reaction | Reaction | | | |
| 32 | N32 | Reaction | Reaction | Reaction | Reaction | | |
| 33 | N33 | Reaction | Reaction | Reaction | | | |
| 34 | N34 | Reaction | Reaction | Reaction | Reaction | | |
| 35 | N35 | Reaction | Reaction | Reaction | | | |

## Hot Rolled Steel Design Parameters

| | Label | Shape | Length[ft] | Lbyy[ft] | Lbzz[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torqu... | Kyy | Kzz | Cb | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RTU-3 bea... | W12x19 | 11.3 | | | Lbyy | | | | | | Lateral |
| 2 | RTU-3 BEA... | W8x10 | 11.3 | 5 | | Lbyy | | | | | | Lateral |
| 3 | RTU-3 BEA... | W14x22 | 23.83 | 5 | | Lbyy | | | | | | Lateral |
| 4 | RTU-4 BEA... | W12x19 | 16.83 | 5 | | Lbyy | | | | | | Lateral |
| 5 | RTU-4 BEA... | W12x19 | 13 | 8.33 | 8.33 | Lbyy | | | | | | Lateral |
| 6 | RTU-4 BEA... | W12x19 | 16.83 | 5 | 5 | Lbyy | | | | | | Lateral |
| 7 | RTU-4 BEA... | W12x19 | 16.83 | | | Lbyy | | | | | | Lateral |
| 8 | RTU-4 BEA... | W8x10 | 4.67 | | | Lbyy | | | | | | Lateral |
| 9 | RTU-1 BEA... | W14x22 | 21.69 | 5 | | Lbyy | | | | | | Lateral |
| 10 | RTU-1 BEA... | W8x10 | 8.33 | | | Lbyy | | | | | | Lateral |
| 11 | RTU-1 BEA... | W12x19 | 11.33 | 8.33 | 8.33 | Lbyy | | | | | | Lateral |

## Hot Rolled Steel Design Parameters (Continued)

| | Label | Shape | Length[ft] | Lbyy[ft] | Lbzz[ft] | Lcomp top[ft] | Lcomp bot[ft] | L-torqu... | Kyy | Kzz | Cb | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | RTU-1 BEA... | W12x19 | 15 | | | Lbyy | | | | | | Lateral |
| 13 | RTU-2 BEA... | W12x19 | 21.67 | 5 | | Lbyy | | | | | | Lateral |
| 14 | RTU-2 BEA... | W12x19 | 12 | | | Lbyy | | | | | | Lateral |
| 15 | RTU-56 BE... | W12x19 | 16.83 | | | Lbyy | | | | | | Lateral |
| 16 | RTU-56 BE... | W8x10 | 8.7 | | | Lbyy | | | | | | Lateral |

## Member Point Loads (BLC 1 : Dead)

| | Member Label | Direction | Magnitude[k,k-ft] | Location[ft,%] |
|---|---|---|---|---|
| 1 | RTU-3 BEAM 3 | Y | -1.5 | 21.3 |
| 2 | RTU-3 beam 1 | Y | -2.9 | 11.3 |
| 3 | RTU-4 BEAM 2 | Y | -1.3 | 8.33 |
| 4 | RTU-4 BEAM 3 | Y | -1.4 | 16.83 |
| 5 | RTU-4 BEAM 4 | Y | -1.6 | 16.83 |
| 6 | RTU-1 BEAM 1 | Y | -.9 | 4.69 |
| 7 | RTU-1 BEAM 3 | Y | -1.3 | 8.33 |

## Member Point Loads (BLC 2 : Snow)

| | Member Label | Direction | Magnitude[k,k-ft] | Location[ft,%] |
|---|---|---|---|---|
| 1 | RTU-3 BEAM 3 | Y | -3.4 | 21.3 |
| 2 | RTU-3 beam 1 | Y | -5.5 | 11.3 |
| 3 | RTU-4 BEAM 2 | Y | -6.2 | 8.33 |
| 4 | RTU-4 BEAM 3 | Y | -5 | 16.83 |
| 5 | RTU-4 BEAM 4 | Y | -4.4 | 16.83 |
| 6 | RTU-1 BEAM 1 | Y | -3.9 | 4.69 |
| 7 | RTU-1 BEAM 3 | Y | -6.3 | 8.33 |

## Member Distributed Loads (BLC 1 : Dead)

| | Member Label | Direction | Start Magnitude[k/ft,F,ksf] | End Magnitude[k/ft,F,... | Start Location[ft,%] | End Location[ft,%] |
|---|---|---|---|---|---|---|
| 1 | RTU-3 beam 1 | Y | -.233 | -.233 | 0 | 11.3 |
| 2 | RTU-3 BEAM 2 | Y | -.258 | -.258 | 0 | 11.3 |
| 3 | RTU-3 BEAM 3 | Y | -.124 | -.124 | 0 | 21.3 |
| 4 | RTU-4 BEAM 1 | Y | -.13 | -.13 | 0 | 16.83 |
| 5 | RTU-4 BEAM 2 | Y | -.168 | -.168 | 0 | 8.33 |
| 6 | RTU-4 BEAM 3 | Y | -.047 | -.047 | 0 | 16.83 |
| 7 | RTU-4 BEAM 4 | Y | -.083 | -.083 | 0 | 16.83 |
| 8 | RTU-4 BEAM 5 | Y | -.1 | -.1 | 0 | 4.67 |
| 9 | RTU-1 BEAM 1 | Y | -.108 | -.108 | 4.69 | 21.69 |
| 10 | RTU-1 BEAM 2 | Y | -.206 | -.206 | 0 | 8.33 |
| 11 | RTU-1 BEAM 3 | Y | -.159 | -.159 | 0 | 8.33 |
| 12 | RTU-1 BEAM 4 | Y | -.078 | -.078 | 0 | 15 |
| 13 | RTU-2 BEAM 1 | Y | -.122 | -.122 | 0 | 21.69 |
| 14 | RTU-2 BEAM 2 | Y | -.219 | -.219 | 0 | 12 |
| 15 | RTU-56 BEAM 1 | Y | -.085 | -.085 | 0 | 16.83 |
| 16 | RTU-56 BEAM 2 | Y | -.161 | -.161 | 0 | 8.7 |

## Member Distributed Loads (BLC 2 : Snow)

| | Member Label | Direction | Start Magnitude[k/ft,F,ksf] | End Magnitude[k/ft,F,... | Start Location[ft,%] | End Location[ft,%] |
|---|---|---|---|---|---|---|
| 1 | RTU-3 beam 1 | Y | -.485 | -.485 | 0 | 11.3 |

## Member Distributed Loads (BLC 2 : Snow) (Continued)

| | Member Label | Direction | Start Magnitude[k/ft,F,ksf] | End Magnitude[k/ft,F,... | Start Location[ft,%] | End Location[ft,%] |
|---|---|---|---|---|---|---|
| 2 | RTU-3 BEAM 2 | Y | -.6 | -.6 | 0 | 11.3 |
| 3 | RTU-3 BEAM 3 | Y | -.257 | -.257 | 0 | 21.3 |
| 4 | RTU-4 BEAM 1 | Y | -.778 | -.778 | 0 | 16.83 |
| 5 | RTU-4 BEAM 2 | Y | -.383 | -.383 | 0 | 8.33 |
| 6 | RTU-4 BEAM 3 | Y | -.738 | -.738 | 0 | 16.83 |
| 7 | RTU-4 BEAM 4 | Y | -.19 | -.19 | 0 | 16.83 |
| 8 | RTU-4 BEAM 5 | Y | -1.175 | -1.175 | 0 | 4.67 |
| 9 | RTU-1 BEAM 1 | Y | -.528 | -.528 | 4.69 | 21.69 |
| 10 | RTU-1 BEAM 2 | Y | -.937 | -.937 | 0 | 8.33 |
| 11 | RTU-1 BEAM 3 | Y | -.387 | -.387 | 0 | 8.33 |
| 12 | RTU-1 BEAM 4 | Y | -.48 | -.48 | 0 | 15 |
| 13 | RTU-2 BEAM 1 | Y | -.273 | -.273 | 0 | 21.67 |
| 14 | RTU-2 BEAM 2 | Y | -.5 | -.5 | 0 | 12 |
| 15 | RTU-56 BEAM 1 | Y | -.2 | -.2 | 0 | 16.83 |
| 16 | RTU-56 BEAM 2 | Y | -.385 | -.385 | 0 | 8.7 |

## Basic Load Cases

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Joint | Point | Distributed | Area(Memb... | Surface(Plate/Wall) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dead | None | | -1 | | | 7 | 16 | | |
| 2 | Snow | None | | | | | 7 | 16 | | |

## Load Combinations

| | Description | S... | P-Delta | SRSS | B... | Fac... | BLC | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... | B... | Fac... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D | Yes | Y | | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| 2 | S | Yes | Y | | 2 | 1 | | | | | | | | | | | | | | | | | | | | |
| 3 | D+S | Yes | Y | | 1 | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | |

## Beam Deflections

| | LC | Member Label | Span | Location [ft] | y [in] | (n) L/y Ratio |
|---|---|---|---|---|---|---|
| 1 | 3 | RTU-3 beam 1 | 1 | 5.532 | .039 | 2692 |
| 2 | | | 2 | 11.3 | -.122 | 519 |
| 3 | 3 | RTU-3 BEAM 2 | 1 | 5.65 | -.446 | 304 |
| 4 | 3 | RTU-3 BEAM 3 | 1 | 12.163 | -.78 | 366 |
| 5 | 3 | RTU-4 BEAM 1 | 1 | 8.415 | -.555 | 364 |
| 6 | 3 | RTU-4 BEAM 2 | 1 | 6.771 | -.264 | 590 |
| 7 | 3 | RTU-4 BEAM 3 | 1 | 7.188 | -.226 | 807 |
| 8 | | | 2 | 16.83 | .045 | 875 |
| 9 | 3 | RTU-4 BEAM 4 | 1 | 5.961 | -.035 | 5156 |
| 10 | | | 2 | 16.83 | -.018 | 2200 |
| 11 | 3 | RTU-4 BEAM 5 | 1 | 2.335 | -.019 | 2911 |
| 12 | 3 | RTU-1 BEAM 1 | 1 | 10.619 | -.868 | 299 |
| 13 | 3 | RTU-1 BEAM 2 | 1 | 4.165 | -.175 | 571 |
| 14 | 3 | RTU-1 BEAM 3 | 1 | 6.019 | -.154 | 880 |
| 15 | 3 | RTU-1 BEAM 4 | 1 | 7.5 | -.218 | 826 |
| 16 | 3 | RTU-2 BEAM 1 | 1 | 10.835 | -.681 | 381 |
| 17 | 3 | RTU-2 BEAM 2 | 1 | 6 | -.114 | 1261 |
| 18 | 3 | RTU-56 BEAM 1 | 1 | 8.415 | -.182 | 1110 |

## Beam Deflections (Continued)

| | LC | Member Label | Span | Location [ft] | y [in] | (n) L/y Ratio |
|---|---|---|---|---|---|---|
| 19 | 3 | RTU-56 BEAM 2 | 1 | 4.35 | -.1 | 1040 |

## Joint Reactions

| | LC | Joint Label | X [k] | Y [k] | Z [k] | MX [k-ft] | MY [k-ft] | MZ [k-ft] |
|---|---|---|---|---|---|---|---|---|
| 1 | 3 | N5 | 0 | 5.272 | 0 | 0 | 0 | 0 |
| 2 | 3 | N6 | 0 | 8.27 | 0 | 0 | 0 | 0 |
| 3 | 3 | N4 | 0 | 4.905 | 0 | 0 | 0 | 0 |
| 4 | 3 | N3 | 0 | 4.905 | 0 | 0 | 0 | 0 |
| 5 | 3 | N1 | 0 | .353 | 0 | 0 | 0 | 0 |
| 6 | 3 | N7 | 0 | 16.375 | 0 | 0 | 0 | 0 |
| 7 | 3 | N8 | 0 | 7.8 | 0 | 0 | 0 | 0 |
| 8 | 3 | N9 | 0 | 7.8 | 0 | 0 | 0 | 0 |
| 9 | 3 | N10 | 0 | 5.937 | 0 | 0 | 0 | 0 |
| 10 | 3 | N11 | 0 | 6.399 | 0 | 0 | 0 | 0 |
| 11 | 3 | N12 | 0 | 5.353 | 0 | 0 | 0 | 0 |
| 12 | 3 | N14 | 0 | 14.577 | 0 | 0 | 0 | 0 |
| 13 | 3 | N15 | 0 | 1.55 | 0 | 0 | 0 | 0 |
| 14 | 3 | N17 | 0 | 9.364 | 0 | 0 | 0 | 0 |
| 15 | 3 | N18 | 0 | 3.001 | 0 | 0 | 0 | 0 |
| 16 | 3 | N19 | 0 | 3.001 | 0 | 0 | 0 | 0 |
| 17 | 3 | N20 | 0 | 8.239 | 0 | 0 | 0 | 0 |
| 18 | 3 | N21 | 0 | 7.852 | 0 | 0 | 0 | 0 |
| 19 | 3 | N22 | 0 | 4.803 | 0 | 0 | 0 | 0 |
| 20 | 3 | N23 | 0 | 4.803 | 0 | 0 | 0 | 0 |
| 21 | 3 | N24 | 0 | 4.996 | 0 | 0 | 0 | 0 |
| 22 | 3 | N25 | 0 | 7.367 | 0 | 0 | 0 | 0 |
| 23 | 3 | N26 | 0 | 4.327 | 0 | 0 | 0 | 0 |
| 24 | 3 | N27 | 0 | 4.327 | 0 | 0 | 0 | 0 |
| 25 | 3 | N28 | 0 | 4.485 | 0 | 0 | 0 | 0 |
| 26 | 3 | N29 | 0 | 4.485 | 0 | 0 | 0 | 0 |
| 27 | 3 | N30 | 0 | 4.428 | 0 | 0 | 0 | 0 |
| 28 | 3 | N31 | 0 | 4.428 | 0 | 0 | 0 | 0 |
| 29 | 3 | N32 | 0 | 2.558 | 0 | 0 | 0 | 0 |
| 30 | 3 | N33 | 0 | 2.558 | 0 | 0 | 0 | 0 |
| 31 | 3 | N34 | 0 | 2.419 | 0 | 0 | 0 | 0 |
| 32 | 3 | N35 | 0 | 2.419 | 0 | 0 | 0 | 0 |
| 33 | 3 | Totals: | 0 | 179.353 | 0 | | | |
| 34 | 3 | COG (ft): | X: 57.777 | Y: 8.659 | Z: 0 | | | |

## Member AISC 14th(360-10): ASD Steel Code Checks

| | LC | Member | Shape | UC Max | Loc[ft] | Shear UC | Loc[ft] | Dir | Pnc/om [k] | Pnt/om [k] | Mnyy/om... | Mnzz/om... | Cb | Eqn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | RTU-3 beam... | W12x19 | .580 | 8.71 | .180 | 8.71 | y | 30.736 | 166.766 | 7.435 | 41.771 | 1.721 | H1-1b |
| 2 | 3 | RTU-3 BEA... | W8x10 | .728 | 5.65 | .183 | 0 | y | 60.752 | 88.623 | 4.071 | 19.044 | 1 | H1-1b |
| 3 | 3 | RTU-3 BEA... | W14x22 | .451 | 13.156 | .131 | 23.83 | y | 139.726 | 194.311 | 10.953 | 76.514 | 1 | H1-1b |
| 4 | 3 | RTU-4 BEA... | W12x19 | .623 | 8.415 | .136 | 0 | y | 110.009 | 166.766 | 7.435 | 52.663 | 1 | H1-1b |
| 5 | 3 | RTU-4 BEA... | W12x19 | .770 | 8.26 | .112 | 13 | y | 56.561 | 166.766 | 7.435 | 38.435 | 1 | H1-1b |
| 6 | 3 | RTU-4 BEA... | W12x19 | .603 | 15.252 | .134 | 15.252 | y | 110.009 | 166.766 | 7.435 | 18.405 | 1.329 | H1-1b |
| 7 | 3 | RTU-4 BEA... | W12x19 | .337 | 15.252 | .113 | 15.252 | y | 13.856 | 166.766 | 7.435 | 29.203 | 2.108 | H1-1b |
| 8 | 3 | RTU-4 BEA... | W8x10 | .160 | 2.335 | .112 | 4.67 | y | 63.379 | 88.623 | 4.071 | 21.87 | 1.136 | H1-1b |

## Member AISC 14th(360-10): ASD Steel Code Checks (Continued)

| | LC | Member | Shape | UC Max | Loc[ft] | Shear UC | Loc[ft] | Dir | Pnc/om [k] | Pnt/om [k] | Mnyy/om... | Mnzz/om... | Cb | Eqn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 3 | RTU-1 BEA... | W14x22 | .612 | 9.715 | .131 | 0 | y | 139.726 | 194.311 | 10.953 | 76.514 | 1 | H1-1b |
| 10 | 3 | RTU-1 BEA... | W8x10 | .629 | 4.165 | .179 | 8.33 | y | 31.439 | 88.623 | 4.071 | 15.893 | 1.136 | H1-1b |
| 11 | 3 | RTU-1 BEA... | W12x19 | .572 | 8.261 | .128 | 11.33 | y | 56.561 | 166.766 | 7.435 | 38.435 | 1 | H1-1b |
| 12 | 3 | RTU-1 BEA... | W12x19 | .883 | 7.5 | .075 | 0 | y | 17.443 | 166.766 | 7.435 | 18.368 | 1.136 | H1-1b |
| 13 | 3 | RTU-2 BEA... | W12x19 | .461 | 10.835 | .078 | 21.67 | y | 110.009 | 166.766 | 7.435 | 52.663 | 1 | H1-1b |
| 14 | 3 | RTU-2 BEA... | W12x19 | .527 | 6 | .077 | 0 | y | 27.255 | 166.766 | 7.435 | 25.215 | 1.136 | H1-1b |
| 15 | 3 | RTU-56 BE... | W12x19 | .684 | 8.415 | .045 | 0 | y | 13.856 | 166.766 | 7.435 | 15.742 | 1.136 | H1-1b |
| 16 | 3 | RTU-56 BE... | W8x10 | .349 | 4.35 | .090 | 8.7 | y | 28.822 | 88.623 | 4.071 | 15.072 | 1.136 | H1-1b |