Structural Calculations for:

# Rader Residence

7310 86th Ave SE, Mercer Island, WA 98040

Client: H2D Architecture

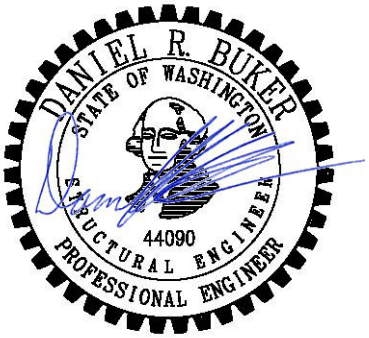
Code: 2018 International Building Code

Table of Contents


- C1 – Design Criteria
- L1 – L12 – Lateral Calculations
- F1 – F40 – Framing Calculations


Scope: Single Family Residence Addition

December 9, 2022
Revised: February 13, 2023





Buker Engineering, llc
PO Box 55124
Seattle, WA 98155
Ph: 206.258.6333

# Seismic Design Loads (ASCE 7-16)

for a Wood Framed Structure

| | | | | | |
|---|---|---|---|---|---|
| RISK CATEGORY | II | | | | |
| OCCUPANCY CAT. | II | Table 1.5-1 | | | |
| IMP. FACTOR | 1 | Table 1.5-2 | | | |
| SITE CLASS | D | Table 20.3-1 | SEISMIC | | |
| R = | 6.5 | Table 12.2-1 | DESIGN CATEGORY | D | 11.6 |

| | | | | | |
|---|---|---|---|---|---|
| $S_s$ = | 1.461 | | $T_0$ = | 0.10 | |
| $S_1$ = | 0.505 | | Ts = | 0.52 | |
| $F_a$ = | 1.20 | Table 11.4-1 | $T_L$ = | 6 | Fig 22-14 |
| $F_v$ = | 1.80 | Table 11.4-2 | T = | 0.21 | |
| $S_{DS}$= | 1.169 | | Seismic Dead Load: | 15 psf | Roof |
| $S_{D1}$= | 0.606 | | | 15 psf | Floor |
| | | | | 20 psf | Walls |
| $Cs_{ULT}$= | 0.180 | Eqn. 12.8-2 | $W_{roof}$=15 + 10= 25 psf | | |
| $Cs_{ASD}$= | 0.128 | | $W_{floor}$=10 + 10 + 10= 30 psf | | |

# Vertical Design Loads

Criteria
ASCE 7-16
IBC 2018

**Dead Loads**

| | | | | | |
|---|---|---|---|---|---|
| Roof (Composit) | 2.5 | psf | Flooring | 1 | psf |
| 1/2" Ply | 1.5 | psf | Sheathing | 2.3 | psf |
| Rafter/Truss | 2 | psf | Joist | 2.6 | psf |
| Insulation | 1 | psf | 5/8" GWB | 3.1 | psf |
| 5/8" GWB | 3.1 | psf | Misc. Mech | 1 | psf |
| Misc./Mech. | 2 | psf | | 10 | psf |
| | 12.1 | psf | | | |
| Use | 15 | psf | Use | 15 | psf |

**Live Loads**

| | | |
|---|---|---|
| Snow | 25 | psf |
| floor | 40 | psf |

**Soil Bearing**

1500
~~2000~~ psf

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Project: Rader Residence
7310 86th Ave SE
Mercer Island, WA 98(

Date: 11/7/2022
Design: CRB

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

# Hazards by Location

## Search Information


| | |
|---|---|
| **Address:** | 7310 86th Ave SE, Mercer Island, WA 98040, USA |
| **Coordinates:** | 47.5373417, -122.2236198 |
| **Elevation:** | 325 ft |
| **Timestamp:** | 2022-11-07T20:43:00.418Z |
| **Hazard Type:** | Seismic |
| **Reference Document:** | ASCE7-16 |
| **Risk Category:** | II |
| **Site Class:** | D-default |

## Basic Parameters

| Name | Value | Description |
|---|---|---|
| $S_S$ | 1.461 | $MCE_R$ ground motion (period=0.2s) |
| $S_1$ | 0.505 | $MCE_R$ ground motion (period=1.0s) |
| $S_{MS}$ | 1.754 | Site-modified spectral acceleration value |
| $S_{M1}$ | * null | Site-modified spectral acceleration value |
| $S_{DS}$ | 1.169 | Numeric seismic design value at 0.2s SA |
| $S_{D1}$ | * null | Numeric seismic design value at 1.0s SA |

* See Section 11.4.8

## Additional Information

| Name | Value | Description |
|---|---|---|
| SDC | * null | Seismic design category |
| $F_a$ | 1.2 | Site amplification factor at 0.2s |
| $F_v$ | * null | Site amplification factor at 1.0s |
| $CR_S$ | 0.902 | Coefficient of risk (0.2s) |
| $CR_1$ | 0.898 | Coefficient of risk (1.0s) |
| PGA | 0.625 | MCE$_G$ peak ground acceleration |

| | | |
|---|---|---|
| PGA | 0.625 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.2 | Site amplification factor at PGA |
| $PGA_M$ | 0.75 | Site modified peak ground acceleration |
| $T_L$ | 6 | Long-period transition period (s) |
| SsRT | 1.461 | Probabilistic risk-targeted ground motion (0.2s) |
| SsUH | 1.62 | Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years) |
| SsD | 4.296 | Factored deterministic acceleration value (0.2s) |
| S1RT | 0.505 | Probabilistic risk-targeted ground motion (1.0s) |
| S1UH | 0.562 | Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years) |
| S1D | 1.639 | Factored deterministic acceleration value (1.0s) |
| PGAd | 1.422 | Factored deterministic acceleration value (PGA) |

* See Section 11.4.8

*The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.*

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## Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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# Wind Design Loads (ASCE 7-16)

Directional Procedure - Part 1

| | | | | | | |
|---|---|---|---|---|---|---|
| Exposure | B | | | Roof Angle = | 21.4 | degrees |
| V= | 97 | mph | | Ground to top of roof | 22.8 | ft |
| $K_d$= | 0.85 | | Table 26.6-1 | Bottom of roof to top of roof | 6.31 | ft |
| I= | 1 | | | (mean roof height) h= | 19.6 | ft |
| G= | 0.85 | | 26.11.1 | | | |
| Ke= | 1.00 | | Table 26.9-1 | | | |

$K_{zt}$= 1.00

Pressure Coefficients from Figure 27.4-1:

| Bldg Face | $C_p$ |
|---|---|
| Windward Wall | 0.8 |
| Leeward Wall | -0.5 |
| Windward Roof | 0.3 |
| Leeward Roof | -0.6 |

*Note= Cp values are conservative worst case values

| **Pressures:** | Calculated using ASCE7-16 Ch. 27 (Directional Procedure) | | | | | |
|---|---|---|---|---|---|---|
| Ht | $K_z$ | $q_z$ | $P_{ww\ walls}$ | $P_{lwwalls}$ | Ultimate $P_{walls}$ (psf) | **Allowable $P_{walls}$ (psf)** |
| 0-15 | 0.57 | 11.67 | 7.94 | 5.39 | 13.33 | **8.00** |
| 15-20 | 0.62 | 12.69 | 8.63 | 5.39 | 14.03 | **8.42** |
| 20-25 | 0.66 | 13.51 | 9.19 | 5.39 | 14.58 | **8.75** |
| 25-30 | 0.7 | 14.33 | 9.75 | 5.39 | 15.14 | **9.08** |
| 30-40 | 0.76 | 15.56 | 10.58 | 5.39 | 15.98 | **9.59** |

| $P_{ww\ roof}$ | $P_{lw\ roof}$ | $P_{roof}$ (psf) | **$P_{roof}$ (psf)** |
|---|---|---|---|
| 3.24 | 6.47 | 9.71 | **5.83** |

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**Coordinates:** 47.5373417, -122.2236198

**Elevation:** 325 ft

**Timestamp:** 2022-11-07T20:42:02.369Z

**Hazard Type:** Wind


### ASCE 7-16

| | |
|---|---|
| MRI 10-Year | 67 mph |
| MRI 25-Year | 73 mph |
| MRI 50-Year | 78 mph |
| MRI 100-Year | 83 mph |
| Risk Category I | 92 mph |
| Risk Category II | 97 mph |
| Risk Category III | 104 mph |
| Risk Category IV | 108 mph |

### ASCE 7-10

| | |
|---|---|
| MRI 10-Year | 72 mph |
| MRI 25-Year | 79 mph |
| MRI 50-Year | 85 mph |
| MRI 100-Year | 91 mph |
| Risk Category I | 100 mph |
| Risk Category II | 110 mph |
| Risk Category III-IV | 115 mph |

### ASCE 7-05

| | |
|---|---|
| ASCE 7-05 Wind Speed | 85 mph |

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## Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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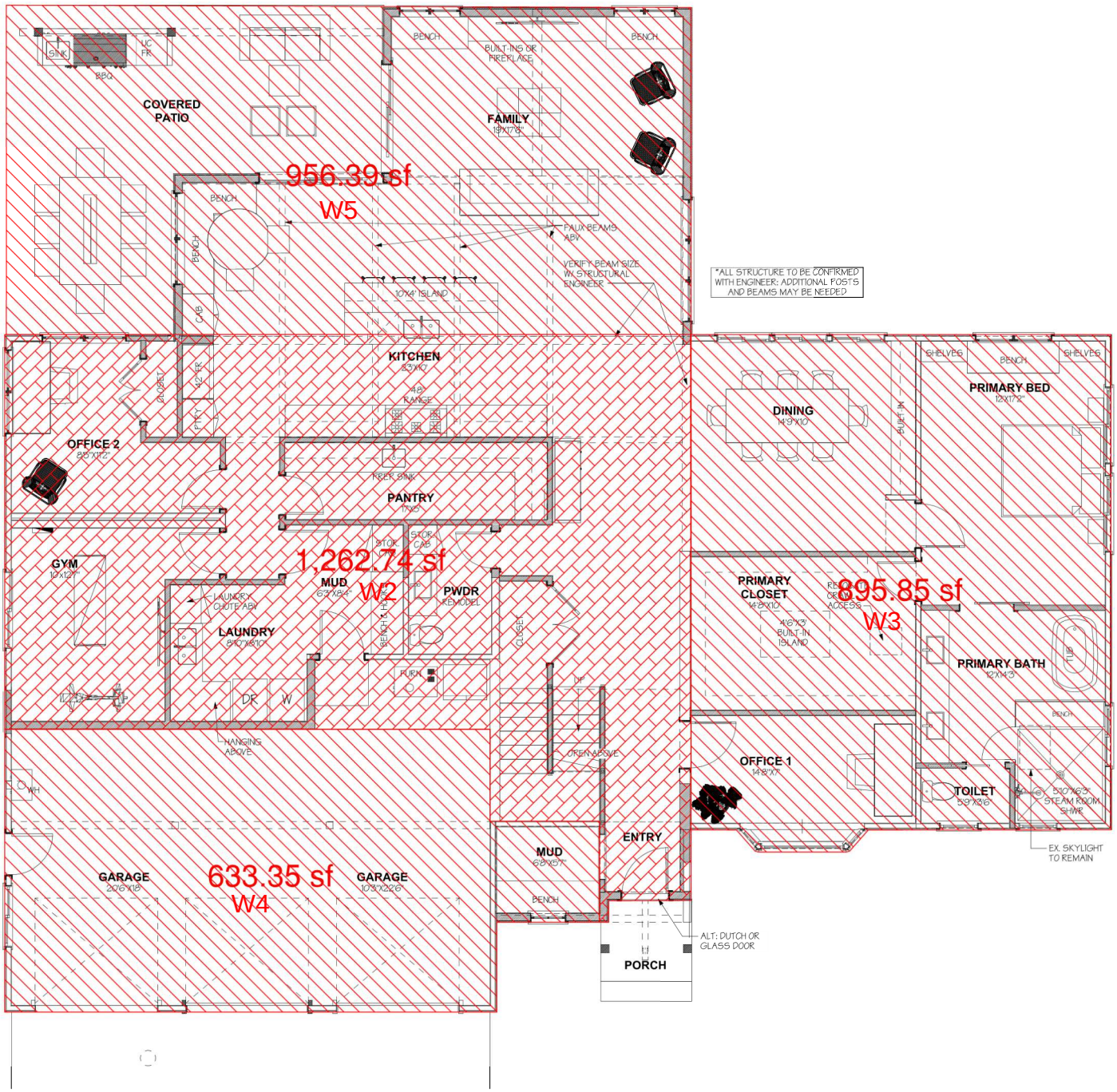
# Upper Roof Mass Calculation

W1 = 1813.34 x 25 = 45.33 kip

# Low Roof/Second Floor Mass Calculations

W2 = 1262.74 x 30 = 37.88 kips (E)
W3 = 895.85 x 25 = 22.4 kips (E)
W4 = 633.35 x 25 = 15.83 kips (E)
W5 = 956.39 x 25 = 23.91 kips (New)
Wtotal = 76.11 kips (Existing)
Wtotal = 23.91 (New)



(E) Structure

## Seismic Analysis (ASCE 7-10)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $S_s$ = | 1.461 | $F_a$ = | 1.20 | $S_{ms}$ = | 1.75 | $S_{Ds}$ = | 1.17 |
| $S_1$ = | 0.51 | $F_v$ = | 1.80 | $S_{m1}$ = | 0.909 | $S_{D1}$ = | 0.61 |

| | | |
|---|---|---|
| Site Class = | D | |
| Mean Roof Height = | 19.6 | ft |
| T = | 0.19 | sec |
| R = | 6.5 | |
| I = | 1.0 | |
| rho = | 1.0 | |
| Cs = | 0.180 | |
| W = | 121.44 | K |
| Allowable Base Shear V = | 15.29 | K |

House

| Level | Wx (K) | hx (ft) | Wxhx | Cvx | Fx (K) |
|---|---|---|---|---|---|
| Roof | 45.33 | 16.5 | 748 | 0.53 | **8.1** |
| Second | 76.11 | 8.75 | 666 | 0.47 | **7.2** |
| Sum | 121.44 | | 1414 | 1.0 | **15.3** |

Wind analysis

wroof = (6.31 + 8.25/2) x 12 psf = 126 plf
wsecond = (8.25/2 + 8.25/2) x 12 psf = 99 plf

Windload N/S: Froof = 126plf x 44.69ft = 5.6k
Fsecond = 99plf x 72.21ft = 7.1k

Total = 12.7k/15.3k = 0.83% of seismic therefore Seismic controls N/S design.

Windload E/W: Froof = 126plf x 35.4ft = 4.46k
Fsecond = 99plf x 65.7ft = 6.5k

Total = 10.96k/15.3k = 0.72% of seismic therefore Seismic controls E/W design.

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Addition

## Seismic Analysis (ASCE 7-10)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $S_s$ = | 1.461 | $F_a$ = | 1.20 | $S_{ms}$ = | 1.75 | $S_{Ds}$ = | 1.17 |
| $S_1$ = | 0.51 | $F_v$ = | 1.80 | $S_{m1}$ = | 0.909 | $S_{D1}$ = | 0.61 |

| | | |
|---|---|---|
| Site Class = | D | |
| Mean Roof Height = | 11 | ft |
| T = | 0.12 | sec |
| R = | 6.5 | |
| I = | 1.0 | |
| rho = | 1.0 | |
| Cs = | 0.180 | |
| W = | 23.91 | K |
| Allowable Base Shear V = | 3.01 | K |

House

| Level | Wx (K) | hx (ft) | Wxhx | Cvx | Fx (K) |
|---|---|---|---|---|---|
| Roof | 23.91 | 7.75 | 185 | 1.00 | **3.0** |
| Sum | 23.91 | | 185 | 1.0 | **3.0** |

Wind analysis

wroof = (4.67 + 7.75/2) x 12 psf = 103 plf
Awning = (4.67) x12 psf = 56 plf

Windload N/S: Froof = 103 plf x 33.73 ft = 3.5k
Awning = 56 plf x 11 = 0.6 k

Total = 4.1k/3.0k = 1.37% of seismic therefore Wind controls N/S design.

Windload E/W: Froof = 103plf x 21.3ft = 2.2k

Total = 2.2k/3k = 0.73% of seismic therefore Seismic controls E/W design.

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(E) Roof Diaphragm
2nd floor shearwalls

East/West Direction (Existing)

| Grid | D | E |
|---|---|---|
| Vwind (kips) | 2 | 1.24 |
| Vseismic (kips) | 4.1 | 2.5 |
| Length of wall (ft) | 12.75 | 9.25 |
| v_wind (p/f) | 157 | 231 |
| v_siesmic (p/l)** | 322 | 465 |
| h (ft) | 7.75 | 7.75 |
| OTF_Wind (lbs)* | 1216 | 1039 |
| OTF_Seismic (lbs)* | 2492 | 2095 |
| Length of shortest wall pier (ft) | 12.75 | 2.25 |
| Apect Ratio Reduction for Lateral Loads | 0.61 | 3.44 |
| Aspect Ratio Penalty | 1.0 | 0.58 |
| Shearwall | W4 | W3 |
| Holdown | MSTC66 | MSTC66 |

***OTF does not take into account dead load and weight of the wall uno**
****v_siesmic includes penalty**

Existing Second Floor Diaphragm
First Floor Walls

North/South Direction (Existing)

| Grid | 1 | 2 | 3 |
|---|---|---|---|
| Vwind (kips) | 5 | 6.4 | 1.4 |
| Vseismic (kips) | 7.3 | 9.2 | 1.9 |
| Length of wall (ft) | 24.25 | 29.5 | 16.75 |
| v_wind (p/f) | 206 | 217 | 84 |
| v_siesmic (p/l)** | 301 | 312 | 113 |
| h (ft) | 7.75 | 7.75 | 7.75 |
| OTF_Wind (lbs)* | 1598 | 1681 | 648 |
| OTF_Seismic (lbs)* | 2333 | 2417 | 879 |
| Length of shortest wall pier (ft) | 4 | 8 | 4 |
| Apect Ratio Reduction for Lateral Loads | 1.94 | 0.97 | 1.94 |
| Aspect Ratio Penalty | 1.0 | 1.0 | 1.0 |
| Shearwall | W3 | W4 | W6 |
| Holdown | HDU4 | HDU5 | HDU2 |

***OTF does not take into account dead load and weight of the wall uno**
****v_siesmic includes penalty**

East/West Direction (Existing)

| Grid | C | D | E |
|---|---|---|---|
| Vwind (kips) | 2.47 | 3.6 | 2.5 |
| Vseismic (kips) | 3.9 | 7.7 | 6.1 |
| Length of wall (ft) | 14.5 | 12.75 | 16.75 |
| v_wind (p/f) | 293 | 282 | 257 |
| v_siesmic (p/l)** | 463 | 604 | 627 |
| h (ft) | 7.75 | 7.75 | 7.75 |
| OTF_Wind (lbs)* | 1320 | 2188 | 1157 |
| OTF_Seismic (lbs)* | 2084 | 4680 | 2822 |
| Length of shortest wall pier (ft) | 2.25 | 12.75 | 2.25 |
| Apect Ratio Reduction for Lateral Loads | 3.44 | 0.61 | 3.44 |
| Aspect Ratio Penalty | 0.58 | 1.0 | 0.58 |
| Shearwall | W3 | W2 | W2 |
| Holdown | MSTC66 | HDU4 | MSTC66 |

***OTF does not take into account dead load and weight of the wall uno**
****v_siesmic includes penalty**

North/South Direction (Existing)

| Grid | 2 | 3 | 4 |
|---|---|---|---|
| Vwind (kips) | 1.3 | 1.7 | 1 |
| Vseismic (kips) | 1.2 | 1.1 | 1.3 |
| Length of wall (ft) | 3.25 | 3.5 | 12 |
| v_wind (p/f) | 477 | 538 | 83 |
| v_siesmic (p/l)** | 440 | 348 | 108 |
| h (ft) | 7.75 | 7.75 | 7.75 |
| OTF_Wind (lbs)* | 3100 | 3764 | 646 |
| OTF_Seismic (lbs)* | 2862 | 2436 | 840 |
| Length of shortest wall pier (ft) | 3.25 | 3.5 | 12 |
| Apect Ratio Reduction for Lateral Loads | 2.38 | 2.21 | 0.65 |
| Aspect Ratio Penalty | 0.84 | 0.90 | 1.0 |
| Shearwall | W3 | W4 | W6 |
| Holdown | HDU4 | HDU4 | HDU2 |

***OTF does not take into account dead load and weight of the wall uno**
****v_siesmic includes penalty**

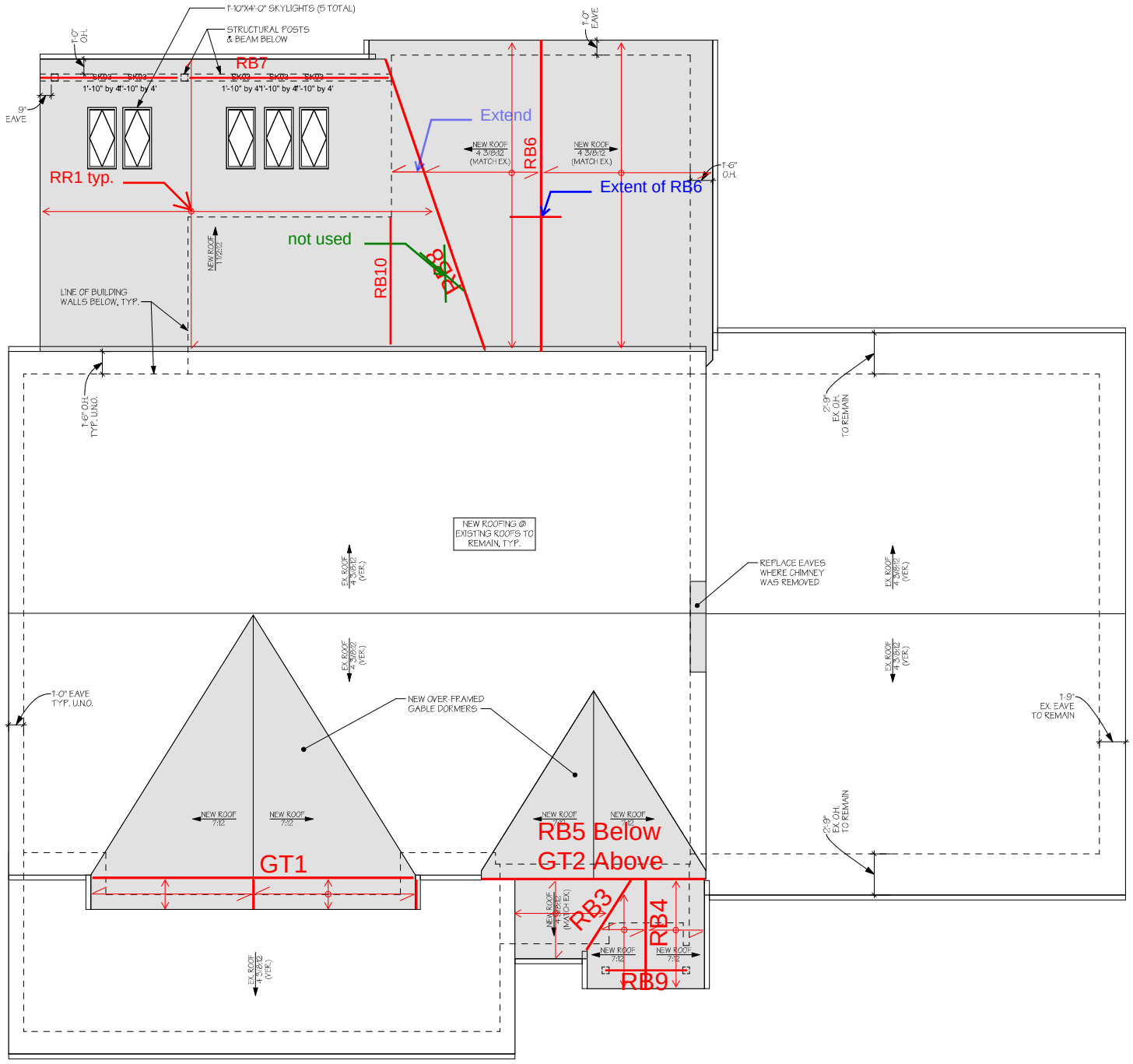
East/West Direction (Existing)

This is added to C on the (E) House

| Grid | A | B | C |
|---|---|---|---|
| Vwind (kips) | 0.56 | 1.1 | 1.1 |
| Vseismic (kips) | 0.79 | 1.5 | 0.73 |
| Length of wall (ft) | 10 | 5.5 | See |
| v_wind (p/f) | 56 | 200 | Existing |
| v_siesmic (p/l)** | 79 | 273 | House |
| h (ft) | 7.75 | 7.75 | 7.75 |
| OTF_Wind (lbs)* | 434 | 1550 | Lateral |
| OTF_Seismic (lbs)* | 612 | 2114 | Analysis |
| Length of shortest wall pier (ft) | 10 | 5.5 | 3 |
| Apect Ratio Reduction for Lateral Loads | 0.78 | 1.41 | 2.58 |
| Aspect Ratio Penalty | 1.0 | 1.0 | 0.77 |
| Shearwall | W6 | W6 | See (E) |
| Holdown | HDU2 | HDU2 | House |

***OTF does not take into account dead load and weight of the wall uno**
****v_siesmic includes penalty**

# Roof Framing Keyplan



# Section Properties & Capacities of Sawn Lumber

| | b (in) | d (in) | Sx ($in^3$) | Ix ($in^4$) |
|---|---|---|---|---|
| 2x4 | 1.5 | 3.5 | 3.06 | 5.36 |
| 2x6 | 1.5 | 5.5 | 7.56 | 20.80 |
| 2x8 | 1.5 | 7.25 | 13.14 | 47.63 |
| 2x10 | 1.5 | 9.25 | 21.39 | 98.93 |
| 2x12 | 1.5 | 11.25 | 31.64 | 177.98 |
| 2x14 | 1.5 | 13.25 | 43.89 | 290.78 |
| | | | | |
| 3x4 | 2.5 | 3.5 | 5.10 | 8.93 |
| 3x6 | 2.5 | 5.5 | 12.60 | 34.66 |
| 3x8 | 2.5 | 7.25 | 21.90 | 79.39 |
| 3x10 | 2.5 | 9.25 | 35.65 | 164.89 |
| 3x12 | 2.5 | 11.25 | 52.73 | 296.63 |
| 3x14 | 2.5 | 13.25 | 73.15 | 484.63 |
| | | | | |
| 4x4 | 3.5 | 3.5 | 7.15 | 12.51 |
| 4x6 | 3.5 | 5.5 | 17.65 | 48.53 |
| 4x8 | 3.5 | 7.25 | 30.66 | 111.15 |
| 4x10 | 3.5 | 9.25 | 49.91 | 230.84 |
| 4x12 | 3.5 | 11.25 | 73.83 | 415.28 |
| 4x14 | 3.5 | 13.25 | 102.41 | 678.48 |
| | | | | |
| 6x6 | 5.5 | 5.5 | 27.73 | 76.26 |
| 6x8 | 5.5 | 7.5 | 51.56 | 193.36 |
| 6x10 | 5.5 | 9.5 | 82.73 | 392.96 |
| 6x12 | 5.5 | 11.5 | 121.23 | 697.07 |
| 6x14 | 5.5 | 13.5 | 167.06 | 1127.67 |
| 6x16 | 5.5 | 15.5 | 220.23 | 1706.78 |

| | Hem-Fir No. 2 | | |
|---|---|---|---|
| M(#-ft) | Cd=1.0 | Cd=1.15 | Cd=1.6 |
| (2)2x4 | 651 | 748 | 1,041 |
| (2)2x6 | 1,393 | 1,602 | 2,228 |
| (2)2x8 | 2,234 | 2,569 | 3,574 |
| (2)2x10 | 3,333 | 3,833 | 5,333 |
| (2)2x12 | 4,482 | 5,155 | 7,172 |
| (2)2x14 | 5,596 | 6,435 | 8,954 |
| | DF-L No. 2 | | |
| 3x4 | 574 | 660 | 919 |
| 3x6 | 1,229 | 1,413 | 1,966 |
| 3x8 | 1,971 | 2,267 | 3,154 |
| 3x10 | 2,941 | 3,382 | 4,706 |
| 3x12 | 3,955 | 4,548 | 6,328 |
| 3x14 | 4,938 | 5,678 | 7,900 |
| | DF-L No. 2 | | |
| 4x4 | 804 | 924 | 1,286 |
| 4x6 | 1,720 | 1,979 | 2,753 |
| 4x8 | 2,989 | 3,438 | 4,783 |
| 4x10 | 4,492 | 5,166 | 7,187 |
| 4x12 | 6,091 | 7,004 | 9,745 |
| 4x14 | 7,681 | 8,833 | 12,289 |
| | DF-L No. 1 | | |
| 6x6 | 3,120 | 3,587 | 4,991 |
| 6x8 | 5,801 | 6,671 | 9,281 |
| 6x10 | 9,307 | 10,703 | 14,891 |
| 6x12 | 13,638 | 15,684 | 21,821 |
| 6x14 | 18,550 | 21,333 | 29,680 |
| 6x16 | 24,081 | 27,693 | 38,530 |

# DESIGN PROPERTIES

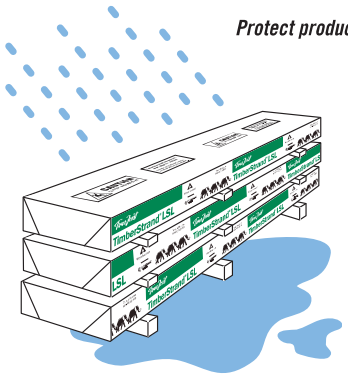
## Allowable Design Properties(1) (100% Load Duration)

| Grade | Width | Design Property | Depth | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4⅜" | 5½" | 5½" Plank Orientation | 7¼" | 8⅝" | 9¼" | 9½" | 11¼" | 11⅞" | 14" | 16" | 18" | 20" |
| **TimberStrand® LSL** | | | | | | | | | | | | | | | |
| 1.3E | 3½" | Moment (ft-lbs) | 1,735 | 2,685 | 1,780 | 4,550 | 6,335 | 7,240 | | 10,520 | | | | | |
| | | Shear (lbs) | 4,340 | 5,455 | 1,925 | 7,190 | 8,555 | 9,175 | | 11,155 | | | | | |
| | | Moment of Inertia (in.4) | 24 | 49 | 20 | 111 | 187 | 231 | | 415 | | | | | |
| | | Weight (plf) | 4.5 | 5.6 | 5.6 | 7.4 | 8.8 | 9.4 | | 11.5 | | | | | |
| 1.55E | 1¾" | Moment (ft-lbs) | | | | | | 4,950 | 5,210 | 7,195 | 7,975 | 10,920 | 14,090 | | |
| | | Shear (lbs) | | | | | | 3,345 | 3,435 | 4,070 | 4,295 | 5,065 | 5,785 | | |
| | | Moment of Inertia (in.4) | | | | | | 115 | 125 | 208 | 244 | 400 | 597 | | |
| | | Weight (plf) | | | | | | 5.1 | 5.2 | 6.2 | 6.5 | 7.7 | 8.8 | | |
| | 3½" | Moment (ft-lbs) | | | | | | 9,905 | 10,420 | 14,390 | 15,955 | 21,840 | 28,180 | | |
| | | Shear (lbs) | | | | | | 6,690 | 6,870 | 8,140 | 8,590 | 10,125 | 11,575 | | |
| | | Moment of Inertia (in.4) | | | | | | 231 | 250 | 415 | 488 | 800 | 1,195 | | |
| | | Weight (plf) | | | | | | 10.1 | 10.4 | 12.3 | 13 | 15.3 | 17.5 | | |
| **Microllam® LVL** | | | | | | | | | | | | | | | |
| 2.0E | 1¾" | Moment (ft-lbs) | | 2,125 | | 3,555 | | 5,600 | 5,885 | 8,070 | 8,925 | 12,130 | 15,555 | 19,375 | 23,580 |
| | | Shear (lbs) | | 1,830 | | 2,410 | | 3,075 | 3,160 | 3,740 | 3,950 | 4,655 | 5,320 | 5,985 | 6,650 |
| | | Moment of Inertia (in.4) | | 24 | | 56 | | 115 | 125 | 208 | 244 | 400 | 597 | 851 | 1,167 |
| | | Weight (plf) | | 2.8 | | 3.7 | | 4.7 | 4.8 | 5.7 | 6.1 | 7.1 | 8.2 | 9.2 | 10.2 |
| **Parallam® PSL** | | | | | | | | | | | | | | | |
| 2.0E | 3½" | Moment (ft-lbs) | | | | | | 12,415 | 13,055 | 17,970 | 19,900 | 27,160 | 34,955 | 43,665 | |
| | | Shear (lbs) | | | | | | 6,260 | 6,430 | 7,615 | 8,035 | 9,475 | 10,825 | 12,180 | |
| | | Moment of Inertia (in.4) | | | | | | 231 | 250 | 415 | 488 | 800 | 1,195 | 1,701 | |
| | | Weight (plf) | | | | | | 10.1 | 10.4 | 12.3 | 13.0 | 15.3 | 17.5 | 19.7 | |
| | 5¼" | Moment (ft-lbs) | | | | | | 18,625 | 19,585 | 26,955 | 29,855 | 40,740 | 52,430 | 65,495 | |
| | | Shear (lbs) | | | | | | 9,390 | 9,645 | 11,420 | 12,055 | 14,210 | 16,240 | 18,270 | |
| | | Moment of Inertia (in.4) | | | | | | 346 | 375 | 623 | 733 | 1,201 | 1,792 | 2,552 | |
| | | Weight (plf) | | | | | | 15.2 | 15.6 | 18.5 | 19.5 | 23.0 | 26.3 | 29.5 | |
| | 7" | Moment (ft-lbs) | | | | | | 24,830 | 26,115 | 35,940 | 39,805 | 54,325 | 69,905 | 87,325 | |
| | | Shear (lbs) | | | | | | 12,520 | 12,855 | 15,225 | 16,070 | 18,945 | 21,655 | 24,360 | |
| | | Moment of Inertia (in.4) | | | | | | 462 | 500 | 831 | 977 | 1,601 | 2,389 | 3,402 | |
| | | Weight (plf) | | | | | | 20.2 | 20.8 | 24.6 | 26.0 | 30.6 | 35.0 | 39.4 | |

(1) For product in beam orientation, unless otherwise noted.

*Some sizes may not be available in your region.*

## PRODUCT STORAGE



*Protect product from sun and water*

*CAUTION:*
*Wrap is slippery when wet or icy*

*Align stickers (2x3 or larger) directly over support blocks*

*Use support blocks (6x6 or larger) at 10' on-center to keep bundles out of mud and water*

## Design Stresses[1] (100% Load Duration)

| Grade | Orientation | G Shear Modulus of Elasticity (psi) | E Modulus of Elasticity (psi) | $E_{min}$ Adjusted Modulus of Elasticity[2] (psi) | $F_b$ Flexural Stress[3] (psi) | $F_t$ Tension Stress[4] (psi) | $F_{c\perp}$ Compression Perpendicular to Grain[5] (psi) | $F_{c\parallel}$ Compression Parallel to Grain (psi) | $F_v$ Horizontal Shear Parallel to Grain (psi) | SG Equivalent Specific Gravity[6] |
|---|---|---|---|---|---|---|---|---|---|---|
| **TimberStrand® LSL** | | | | | | | | | | |
| 1.3E | Beam/Column | 81,250 | $1.3 \times 10^6$ | 660,750 | 1,700 | 1,075 | 710 | 1,835 | 425 | 0.50[7] |
| | Plank | 81,250 | $1.3 \times 10^6$ | 660,750 | 1,900[8] | 1,075 | 635[9] | 1,835 | 150 | 0.50[7] |
| 1.55E | Beam | 96,875 | $1.55 \times 10^6$ | 787,815 | 2,325 | 1,070[10] | 900 | 2,170 | 310[10] | 0.50[7] |
| **Microllam® LVL** | | | | | | | | | | |
| 2.0E | Beam | 125,000 | $2.0 \times 10^6$ | 1,016,535 | 2,600 | 1,555 | 750 | 2,510 | 285 | 0.50 |
| **Parallam® PSL** | | | | | | | | | | |
| 1.8E | Column | 112,500 | $1.8 \times 10^6$ | 914,880 | 2,400[11] | 1,755 | 545[11] | 2,500 | 190[11] | 0.50 |
| 2.0E | Beam | 125,000 | $2.0 \times 10^6$ | 1,016,535 | 2,900 | 2,025 | 625[12] | 2,900[13] | 290 | 0.50 |

(1) Unless otherwise noted, adjustment to the design stresses for duration of load are permitted in accordance with the applicable code.

(2) Reference modulus of elasticity for beam and column stability calculations, per NDS®.

(3) For 12" depth. For other depths, multiply $F_b$ by the appropriate factor as follows:

- For TimberStrand® LSL, multiply by $\left[\frac{12}{d}\right]^{0.092}$
- For Microllam® LVL, multiply by $\left[\frac{12}{d}\right]^{0.136}$
- For Parallam® PSL, multiply by $\left[\frac{12}{d}\right]^{0.111}$

(4) $F_t$ has been adjusted to reflect the volume effects for most standard applications.

(5) $F_{c\perp}$ may not be increased for duration of load.

(6) For lateral connection design only.

(7) Specific gravity of 0.58 may be used for bolts installed perpendicular to face and loaded perpendicular to grain.

(8) Values are for thickness up to 3½".

(9) For members less than 1¾" thick and in plank orientation, use $F_{c\perp}$ of 670 psi.

(10) Value accounts for large hole capabilities. See **Allowable Holes** on page 26.

(11) Value shown is for plank orientation.

(12) Use 750 psi for Parallam® PSL identified with plant number 0579.

(13) For column applications, use $F_{c\parallel}$ of 500 psi. Alternatively, refer to ESR-1387, Table 1, footnote 15.

## General Assumptions for Trus Joist® Beams

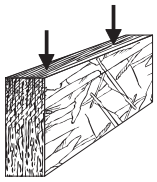
- Lateral support is required at bearing and along the span at 24" on-center, maximum.
- Bearing lengths are based on each product's bearing stress for applicable grade and orientation.
- All members 7¼" and less in depth are restricted to a maximum deflection of 5/16".
- Beams that are 1¾" x 16" and deeper require multiple plies.
- No camber.
- Beams and columns must remain straight to within $^{5L^2}/_{4608}$ (in.) of true alignment. L is the unrestrained length of the member in feet.

For applications not covered in this brochure, contact your Weyerhaeuser representative.

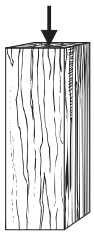
***See pages 28 and 29 for multiple-member beam connections.***

***TimberStrand® LSL, Microllam® LVL, and untreated Parallam® PSL are intended for dry-use applications***

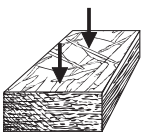
### Beam Orientation



### Column Orientation



### Plank Orientation



# Roof Framing RR1

**Rafters**

| | | | | | |
|---|---|---|---|---|---|
| L = | 10 ft 10 in | | Lumber Type = | Hem-Fir #2 | |
| $w_{DL}$ = | 15 psf | | $F_b$ = | 850 psi | |
| $w_{LL}$ = | 25 psf | | $F_v$ = | 150 psi | |
| Spacing = | 16 in o.c. | | E = | 1,300,000 psi | |
| Joist Size | 2x6 | | $C_D$ = | 1.15 | |
| S = | 7.56 $in^3$ | | $C_r$ = | 1.15 | |
| I = | 20.80 $in^4$ | | $C_F$ = | 1.3 | |
| A = | 8.25 $in^2$ | | incised | no | |
| M = | 785 #-ft | | | | |
| R1 = R2 = | 289 # | | E' = | 1300000 psi | |
| $f_b$ = | 1245 psi | | $F_b$' = | 1461 psi | **OK** |
| $f_v$ = | 52.6 psi | | $F_v$' = | 173 psi | **OK** |
| $\Delta_{DL}$ = | 0.231 in | = | L/ | 564 | |
| $\Delta_{LL}$ = | 0.384 in | = | L/ | 339 | |
| $\Delta_{TL}$ = | 0.615 in | = | L/ | 212 | |

**Rafters**

| | | | | | | |
|---|---|---|---|---|---|---|
| L = | 7 ft 9 in | | | Lumber Type = | Hem-Fir #2 | |
| $w_{DL}$ = | 15 psf | | | $F_b$ = | 850 psi | |
| $w_{LL}$ = | 25 psf | | | $F_v$ = | 150 psi | |
| Spacing = | 24 in o.c. | | | E = | 1,300,000 psi | |
| Joist Size | 2x6 | | | $C_D$ = | 1.15 | |
| S = | 7.56 $in^3$ | | | $C_r$ = | 1.15 | |
| I = | 20.80 $in^4$ | | | $C_F$ = | 1.3 | |
| A = | 8.25 $in^2$ | | | incised | no | |
| M = | 601 #-ft | | | | | |
| R1 = R2 = | 310 # | | | E' = | 1300000 psi | |
| $f_b$ = | 953 psi | | | $F_b$' = | 1461 psi | **OK** |
| $f_v$ = | 56.4 psi | | | $F_v$' = | 173 psi | **OK** |
| $\Delta_{DL}$ = | 0.090 in | = | | L/ | 1033 | |
| $\Delta_{LL}$ = | 0.150 in | = | | L/ | 620 | |
| $\Delta_{TL}$ = | 0.240 in | = | | L/ | 387 | |

**Rafters**

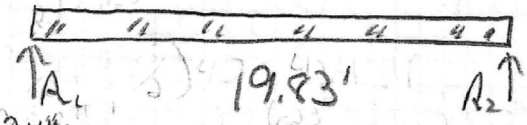
| | | | | | |
|---|---|---|---|---|---|
| L = | 19 ft 3 in | | Lumber Type = | Hem-Fir #2 | |
| $w_{DL}$ = | 15 psf | | $F_b$ = | 850 psi | |
| $w_{LL}$ = | 25 psf | | $F_v$ = | 150 psi | |
| Spacing = | 16 in o.c. | | E = | 1,300,000 psi | |
| Joist Size | 2x12 | | $C_D$ = | 1.15 | |
| S = | 31.64 $in^3$ | | $C_r$ = | 1.15 | |
| I = | 177.98 $in^4$ | | $C_F$ = | 1 | |
| A = | 16.88 $in^2$ | | incised | no | |
| M = | 2470 #-ft | | | | |
| R1 = R2 = | 513 # | | E' = | 1300000 psi | |
| $f_b$ = | 937 psi | | $F_b$' = | 1124 psi | **OK** |
| $f_v$ = | 45.6 psi | | $F_v$' = | 173 psi | **OK** |
| $\Delta_{DL}$ = | 0.267 in | = | L/ | 865 | |
| $\Delta_{LL}$ = | 0.445 in | = | L/ | 519 | |
| $\Delta_{TL}$ = | 0.712 in | = | L/ | 324 | |

# Roof Framing

DL = 15psf
SL = 25psf

## GT1

$l = 19.83'$



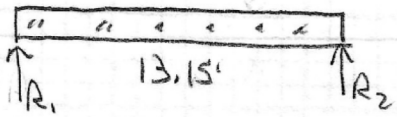

$w = (24\#/2)40 + (32.02/2)40 = 694 plf$

$M = 34.11^{\#-1}$, $R_1 = R_2 = 6882\#$

see FB3

## GT2

$l = 13.15'$




$w = 694 plf$

$M = 15.0^{K-1}$ $R_1 = R_2 = 4563\#$

Post height = 7.35'

5/8" Ø Thru Bolts $V_{ALL} = 700\#$

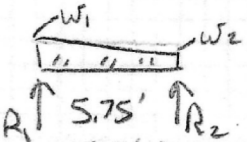
# Req'd $\frac{4563\#}{700} = 8$ Bolts @ 12" o.c.

Article Post to Post

(2)2x6

## RB3

$l = 5.75'$




$w_1 = (7.81/2 + 0.94/2)40 = 176 plf$

$w_2 = (4.85/2 + 3.92/2)40 = 176 plf$

$M = 728^{\#-1}$ $R_1 = R_2 = 506\#$

$f_b = 578 psi \le F'_b = 977 psi$

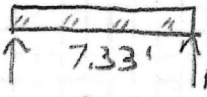
$f_v = 46 psi \le F'_v = 172 psi$

$\Delta_{TL} = 0.080" = l/861$

## RB4

4x6

$l = 7.33'$




$w = (3.92/2 + 3.92/2)40 = 160 plf$

$M = 1075^{\#-1}$, $R_1 = R_2 = 587\#$

$f_b = 732 psi \le F_b = 1035 psi$

$f_v = 46 psi \le F_v = 207 psi$

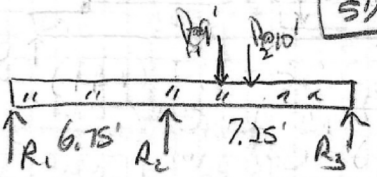
$\Delta_{TL} = 0.134" = l/657$

5 1/2 x 13 1/2 24F-V4 GLB

## RB5

5 1/2 x 9 1/2 PSL

$l = 14'$




$w = 694 plf + 80 plf = 774 plf$

$M = 5520^{\#-1}$, $R_1 = 1790\#$ $R_2 = 7670\#$ $R_3 = 2460\#$

$f_b = 839 psi \le F'_b = 2904 psi$

$f_v = 231 psi \le F'_v = 240 psi$

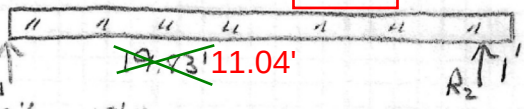
$\Delta_{TL} = 0.0409" = l/2127$ see DS calc

## RB6

~~5 1/2 x 13 1/2 24F-V8 GLB~~

~~$l = 20.83'$~~ 12.04'

6X10 GLB




$w = (10/2 + 10/2)40 = 400 plf$

$M =$ ~~19.6~~ 6 K-FT $R_1 =$ ~~3960#~~ 2190# $R_2 =$ ~~4150#~~ 2610#

$f_b =$ ~~1410 psi~~ 870 PSI $\le F'_b =$ ~~2400 psi~~ 1550 PSI

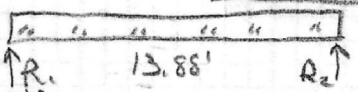
$f_v =$ ~~89 psi~~ 75 PSI $\le F'_v =$ ~~240 psi~~ 195 PSI

$\Delta_{TL} =$ ~~0.408"~~ 0.209" $= l/$ ~~314~~ 633

## RB7

5 1/2 x 10 1/2 24F-V4 GLB

$l = 13.88'$




$w = \frac{(1.8 + 1.58)^2}{18(2)}40 = 426 plf$

$M = 10.3^{K-1}$, $R_1 = R_2 = 2957\#$

$f_b = 1224 psi \le F'_b = 2400 psi$

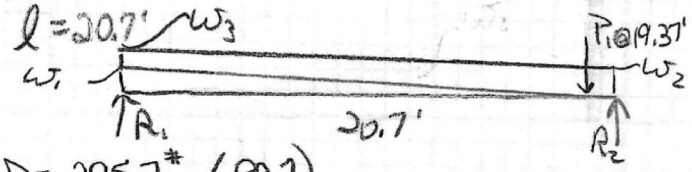
$f_v = 77 psi \le F'_v = 265 psi$

$\Delta_{TL} = 0.373" = l/447$

ROOF FRAMING (cont)

## RB8

5½x13½ 24F-V4 GLB




P = 2957# (RB7)

$w_1 = (19.33'/2)\,40 = 385$ plf

$w_2 = (10.4'/2)\,40 = 209$ plf

$w_3 = (3.7'/2)\,40 = 75$ plf

$M = 19.9^{k-1}$, $R_1 = 4090^{\#}$ $R_2 = 5800^{\#}$

$f_b = 1430$ psi ≤ $F'_b = 2400$ psi

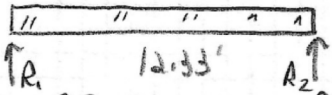
$f_v = 118$ psi ≤ $F'_v = 265$ psi

$\Delta_{TL} = 0.77" = \ell/322$

## RB9

3½x9½ LSL

l = 12.33'




w = 90 plf + 80 plf = 170 plf

$M = 3231^{ft-\#}$, $R_1 = R_2 = 1050^{\#}$

$f_b = 740$ psi ≤ $F'_b = 2325$ psi

$f_v = 50$ psi ≤ $F'_v = 310$ psi

$\Delta_{TL} = 0.228" = \ell/648$

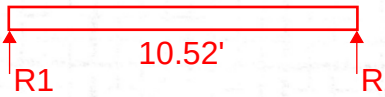
Footing @ Garage

$d = \sqrt{\frac{6304 + 4563}{2000}} = 2.3$ ∴ use 2'-6" □ ftg

## RB10

6x8

l = 10.52'




w = (19.58'+.5)^2 / (2x19.58') x 40 = 300 plf

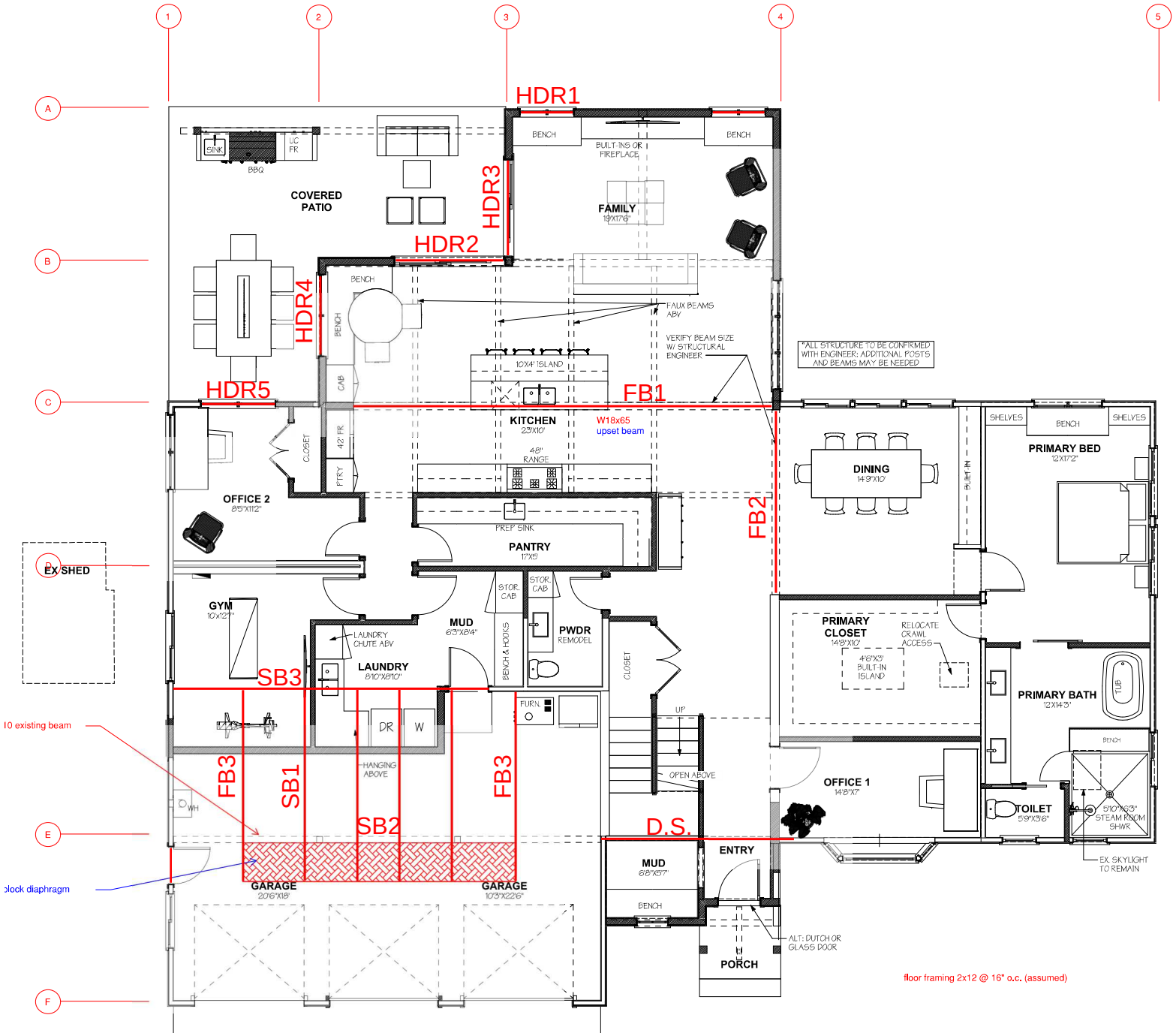
M = 4200 lb-ft, R1 = R2 = 1587 lb

fb = 980 psi </= F'b = 1550 psi

fv = 60 psi </= F'v = 195 psi

Total Deflection = 0.2672" = L/472

# Second Floor Framing Keyplan

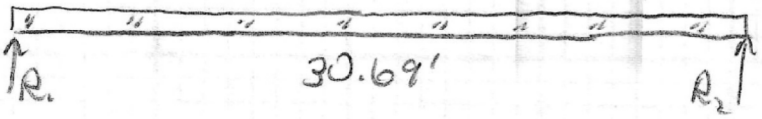


**Floor Joist FJ1 (2x8 Hem-Fir #2)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| L = | 11 ft 7 | in | | Lumber Type = | Hem-Fir #2 | | |
| $w_{DL}$ = | 15 | psf | | $F_b$ = | 850 | psi | |
| $w_{LL}$ = | 40 | psf | | $F_v$ = | 150 | psi | |
| Spacing = | 12 | in o.c. | | E = | 1,300,000 | psi | |
| Joist Size | 2x10 | | | $C_D$ = | 1.15 | | |
| S = | 21.39 | $in^3$ | | $C_r$ = | 1.15 | | |
| I = | 98.93 | $in^4$ | | $C_F$ = | 1.1 | | |
| A = | 13.88 | $in^2$ | | incised | no | | |
| M = | 926 | #-ft | | | | | |
| R1 = R2 = | 319 | # | | E' = | 1300000 | psi | |
| $f_b$ = | 519 | psi | | $F_b$' = | 1237 | psi | **OK** |
| $f_v$ = | 34.5 | psi | | $F_v$' = | 173 | psi | **OK** |
| $\Delta_{DL}$ = | 0.048 | in | = | L/ | 2926 | | |
| $\Delta_{LL}$ = | 0.127 | in | = | L/ | 1097 | | |
| $\Delta_{TL}$ = | 0.174 | in | = | L/ | 798 | | |

FB1

$\ell = 30.69'$




$W_{roof} = \left(\frac{10.375'}{2} + \frac{30.67'}{2}\right) 40 = 825 plf$

$W_{Floor} = \left(\frac{12'}{2}\right)(55 psf) = 330 plf$

$W_{Total} = 825 plf + 330 plf = 1155 plf$

$M = 136^{k-1}$, $R_1 = R_2 = 17.7^{k}$

for wood $\ell/360 = 1.02"$

keep deflection to no more than $3/4"$ $\Rightarrow I = 17,077 in^4$

try $8\frac{3}{4} \times 30$ GLB $f_b = 1243 psi$ $\geq F'_b = 2760 psi$

or $10\frac{3}{4} \times 27$ GLB $f_b = 1250 psi$ $\geq F'_b = 2760 psi$

$f_{v1} = 101 psi \leq F'_v = 265 psi$

$f_{v2} = 92 psi$

$\Delta_{TL1} = 0.65" = \ell/568$

$\Delta_{TL2} = 0.73" = \ell/504$ okay

for Steel $I_{req} = 1060 in^4$

W18x65 ($I_{prov} = 1070 in^4$)

$\frac{M_r}{\Omega_b} = 204^{k-1} \geq M_e = 136^{k-1}$

$\frac{V_n}{\Omega_v} = 165^{k} \geq V_e = 17.7^{k}$

$\Delta_{TL} = 0.74" = \ell/497$ (okay)

∴ use $8\frac{3}{4} \times 30$ 24F-V4

or $10\frac{3}{4} \times 27$ 24F-V4

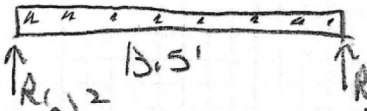
or W18x65 ← Clients Choice

d = sqrt(17700/1500) = 3.4' therefore use 3'-6" square x 12" w/ (4) #5 each way top and bottom at base of each post for beam.

# FLOOR FRAMING (cont)

## FB2 — 16x10

$l = 13.5'$




$w = \frac{(24/12 + 2)^2}{2(2)} 40 + 100\text{plf} + 16/12(55) = 334\text{plf}$

$M = 7609^{\#-'}$, $R_1 = R_2 = 2255^{\#}$

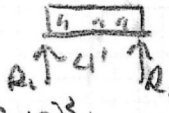
$f_b = 1104\text{psi} \le F'_b = 1550\text{psi}$

$f_v = 65\text{psi} \le F'_v = 195\text{psi}$

$\Delta_{TL} = 0.397'' = l/408$

## HDR1 — (2)2x8

$l = 4'$




$w = \left(\frac{(2+2)^2}{4}\right) 40 + 50 = 210\text{plf}$

$M = 420^{\#-'}$, $R_1 = R_2 = 420^{\#}$

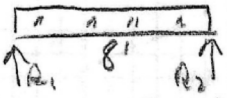
$f_b = 192\text{psi} \le F'_b = 977\text{psi}$

$f_v = 30\text{psi} \le F'_v = 172\text{psi}$

$\Delta_{TL} = 0.0195'' = l/2457$

## HDR2 — (2)2x10

$l = 8'$




$w = \left(\frac{10.33}{2} + \frac{9.5}{2}\right) 40 = 400\text{plf}$

$M = 3200^{\#-'}$, $R_1 = R_2 = 1600^{\#}$

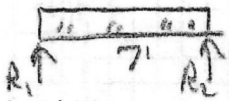
$f_b = 898\text{psi} \le F'_b = 977\text{psi}$

$f_v = 87\text{psi} \le F'_v = 172\text{psi}$

$\Delta_{TL} = 0.1433'' = l/669$

## HDR3 — (2)2x10

$l = 7'$




$w = \left(\frac{2}{2} + \frac{19}{2}\right) 40 + 20\text{plf} = 440\text{plf}$

$M = 2695^{\#-'}$, $R_1 = R_2 = 1540^{\#}$

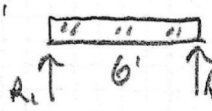
$f_b = 756\text{psi} \le F'_b = 977\text{psi}$

$f_v = 84\text{psi} \le F'_v = 172\text{psi}$

$\Delta_{TL} = 0.092'' = l/908$

## HDR4 — (2)2x8

$l = 6'$




$w = 80\text{plf} + 30\text{plf} = 110\text{plf}$

$M = 495^{\#-'}$, $R_1 = R_2 = 330^{\#}$

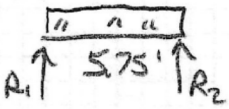
$f_b = 227\text{psi} \le F'_b = 977\text{psi}$

$f_v = 23\text{psi} \le F'_v = 172\text{psi}$

$\Delta_{TL} = 0.026'' = l/2780$

## HDR5 — (2)2x12

$l = 5.75'$




$w = \left(\frac{25.25}{2} + 29/2\right) 40 + 20\text{plf} = 935\text{plf}$

$M = 3823^{\#-'}$, $R_1 = R_2 = 2660^{\#}$

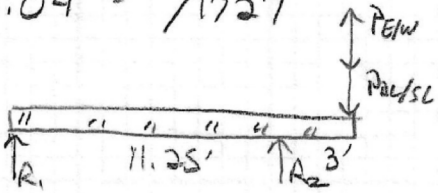
$f_b = 725\text{psi} \le F'_b = 977\text{psi}$

$f_v = 119\text{psi} \le F'_v = 172\text{psi}$

$\Delta_{TL} = 0.04'' = l/1727$

## SB1

$l = 14.25'$




$w_{DL} = 20\text{plf}$

$w_{LL} = 55\text{plf}$

$P_{SL} = 146^{\#}$

$P_{DL} = 465^{\#}$

$P_E = 2095^{\#} \Rightarrow 2993^{\#}$

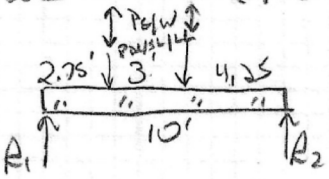
$P_W = 1039^{\#} \Rightarrow 1732^{\#}$

See Visual Analysis

use $5\frac{1}{4} \times 11\frac{7}{8}$ PSL

## SB2

$l = 10'$




$w_{DL} = 135\text{plf}$

$w_{LL} = 357\text{plf}$

$P_{DL} = 1.0^{k}$

$P_{SL} = 0.2^{k}$

$P_{LL} = 0.5^{k}$

$P_E = 3.8^{k}$

$P_W = 2.2^{k}$

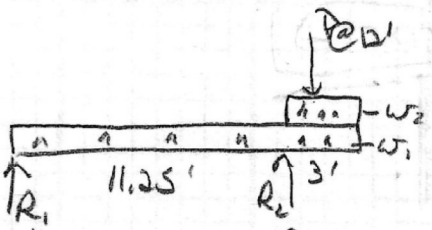
See Visual Analysis

use (2) C9X20 Sister(1) to (E) Beam

FLOOR FRAMING (cont)

FB3

$\ell = 14.25'$




$P = 6882\#$

$W_1 = (16/12)\,55 = 73.3\,plf$

$W_2 = \left(\frac{(10+2)^2}{20}\right)40 + 90\,plf = 378\,plf$

$M = 7190\,\#\text{-}'$, $R_1 = 227\#$ $R_2 = 9280\#$

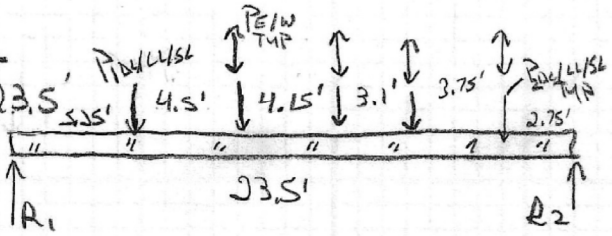
$f_b = 779\,psi \le F'_b = 2900\,psi$

$f_v = 236\,psi \le F'_v = 290\,psi$

$\Delta_{TL} = 0.108'' = \ell/667$

SB3

$\ell = 23.5'$




$W_{DL} = 188\,plf$

$W_{LL} = 500\,plf$

$P_{1DL} = 80\#$

$P_{1LL} = 278\#$

$P_{1SL} = -40\#$

$P_E = 798\#$

$P_W = 462\#$

$P_{2DL} = 218\#$

$P_{2LL} = 287\#$

$P_{2SL} = -40\#$

See Visual Analysis
W10x45

DS

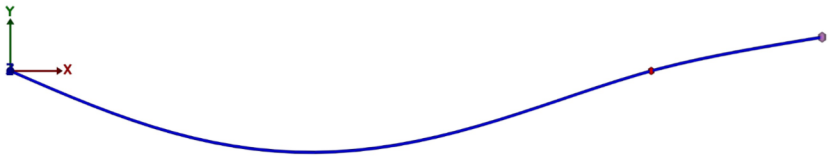
$\ell = 14'$

$P_E = 2500\#$

$P_W = 1240\#$

∴ use 5¼x 9½ PSL Beam for DS w/ MSTC66 STrap Each End of Beam to Beam or Beam to Top plate

SB1 15
L = 14.25'




Mr = 20.68 K-ft </= Ma = 26.95 K-ft
Vr = 6.96 K </= Va = 12.055 K
Total Deflection = 0.3947" => L/342


Okay, therefore use, 5 1/4 x 11 1/2 PSL for SB1

BUKER ENGINEERING, LLC
Daniel Buker
H:\Projects\2022\Rader Residence\Calculations\SB1.vap
Sunday, November 27, 2022 9:09 PM

**Project Settings**

Building Code Load Combinations:
Deflection Checks
IBC 2012 ASD
General Settings:
Vertical Direction: Y
North Axis: Plus Z
Ground Elevation: 0 ft
Occupancy Risk Category: II
Seismic Data:
Seismic Design Category: D
Spectral Acceleration SDs: 1.169
Overstrength (Omega) X: 3, Y: 3, Z: 3
Redundancy (Rho) X: 1 , Y: 1, Z: 1
Wind Data:
Wind Speed (mph): 110
Mean Roof Height: 0 ft
Ground Elevation: 0 ft
Gust Factor: 0.85
Analysis Data:
Analysis Method: PDelta
Performance: Auto
Force Tolerance: 0.1
Absolute Force Tolerance: 0.5 K
Displacement Tolerance: 0.01
Load Stepping Points: 31

**Bill of Materials: Members**

| Material | Section | Count | Total Length ft | Total Volume in^3 | Total Weight K |
|---|---|---|---|---|---|
| Parallam PSL 2.0E (Beam) | PSL-B 5.25x11.25 | 1 | 14.2500 | 10099.6875 | 0.2630 |

Total Member Weight = 0.26301 K

**Member Loads, Uniform**

| Member | Service Case | Direction | Magnitude | Full Length? | Start Offset ft | End Offset ft | Projected? | Predefined Load |
|---|---|---|---|---|---|---|---|---|
| BmX003 | D | Shear y | -0.0200 K/ft | Yes | 0.0000 | 14.2500 | No | N.A. |
| BmX003 | L | Shear y | -0.0550 K/ft | Yes | 0.0000 | 14.2500 | No | N.A. |

**Member Loads, Concentrated**

| Member | Service Case | Direction | Magnitude | Offset ft |
|---|---|---|---|---|
| BmX003 | D | Shear y | -0.4650 K | 14.2500 |
| BmX003 | E+X | Shear y | -2.9930 K | 14.2500 |
| BmX003 | E-X | Shear y | 2.9930 K | 14.2500 |
| BmX003 | S | Shear y | -0.1460 K | 14.2500 |
| BmX003 | W+X | Shear y | -1.7320 K | 14.2500 |
| BmX003 | W-X | Shear y | 1.7320 K | 14.2500 |

**Factored Load Combinations**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| 16-8 | IBC 2012 ASD | D | Allowable | Other |

**Factored Load Combinations (continued)**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| 16-9 | IBC 2012 ASD | D + L | Allowable | Dead Plus Live |
| 16-10S | IBC 2012 ASD | D + S | Allowable | Other |
| 16-11Lr | IBC 2012 ASD | D + 0.75L | Allowable | Dead Plus Live |
| 16-11S | IBC 2012 ASD | D + 0.75L + 0.75S | Allowable | Other |
| 16-12E »+X | IBC 2012 ASD | 1.16366D + 0.7E+X | Allowable | Other |
| 16-12E »+X:Ω | IBC 2012 ASD | 1.16366D + 2.1E+X | Allowable | Other |
| 16-12E »-X | IBC 2012 ASD | 1.16366D + 0.7E-X | Allowable | Other |
| 16-12E »-X:Ω | IBC 2012 ASD | 1.16366D + 2.1E-X | Allowable | Other |
| 16-12W »+X | IBC 2012 ASD | D + 0.6W+X | Allowable | Other |
| 16-12W »-X | IBC 2012 ASD | D + 0.6W-X | Allowable | Other |
| 16-13Lr »+X | IBC 2012 ASD | D + 0.75L + 0.45W+X | Allowable | Other |
| 16-13Lr »-X | IBC 2012 ASD | D + 0.75L + 0.45W-X | Allowable | Other |
| 16-13S »+X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W+X | Allowable | Other |
| 16-13S »-X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W-X | Allowable | Other |
| 16-14 »+X | IBC 2012 ASD | 1.122745D + 0.525E+X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »+X:Ω | IBC 2012 ASD | 1.122745D + 1.575E+X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X | IBC 2012 ASD | 1.122745D + 0.525E-X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X:Ω | IBC 2012 ASD | 1.122745D + 1.575E-X + 0.75L + 0.75S | Allowable | Other |
| 16-15 »+X | IBC 2012 ASD | 0.6D + 0.6W+X | Allowable | Other |
| 16-15 »-X | IBC 2012 ASD | 0.6D + 0.6W-X | Allowable | Other |
| 16-15Di | IBC 2012 ASD | 0.6D | Allowable | Other |
| 16-16 »+X | IBC 2012 ASD | 0.43634D + 0.7E+X | Allowable | Other |
| 16-16 »+X:Ω | IBC 2012 ASD | 0.43634D + 2.1E+X | Allowable | Other |
| 16-16 »-X | IBC 2012 ASD | 0.43634D + 0.7E-X | Allowable | Other |
| 16-16 »-X:Ω | IBC 2012 ASD | 0.43634D + 2.1E-X | Allowable | Other |
| D+0.75(L+W) »+X | Deflection Checks | D + 0.75L + 0.75W+X | Deflections | Other |
| D+0.75(L+W) »-X | Deflection Checks | D + 0.75L + 0.75W-X | Deflections | Other |
| D+L | Deflection Checks | D + L | Deflections | Dead Plus Live |
| D+Lr | Deflection Checks | D | Deflections | Other |
| D+S | Deflection Checks | D + S | Deflections | Other |
| Live | Deflection Checks | L | Deflections | Live Only |
| Seismic »+X | Deflection Checks | E+X | Deflections | Other |
| Seismic »-X | Deflection Checks | E-X | Deflections | Other |
| Snow | Deflection Checks | S | Deflections | Wind Or Snow |
| Wind »+X | Deflection Checks | W+X | Deflections | Wind Or Snow |
| Wind »-X | Deflection Checks | W-X | Deflections | Wind Or Snow |

**Result Cases**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-8 | 8 | Allowable (ASD) | Static | No | N.A. |
| 16-8 Second Order | 52 | Allowable (ASD) | Static | Yes | N.A. |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-9 | 9 | Allowable (ASD) | Static | No | N.A. |
| 16-9 Second Order | 53 | Allowable (ASD) | Static | Yes | N.A. |
| 16-10S | 10 | Allowable (ASD) | Static | No | N.A. |
| 16-10S Second Order | 54 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11Lr | 11 | Allowable (ASD) | Static | No | N.A. |
| 16-11Lr Second Order | 55 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11S | 12 | Allowable (ASD) | Static | No | N.A. |
| 16-11S Second Order | 56 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12E »+X | 15 | Allowable (ASD) | Static | No | Normal |
| 16-12E »+X Second Order | 59 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »+X:Ω | 16 | Allowable (ASD) | Static | No | Over-Strength |
| 16-12E »+X:Ω Second Order | 60 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12E »-X | 17 | Allowable (ASD) | Static | No | Normal |
| 16-12E »-X Second Order | 61 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »-X:Ω | 18 | Allowable (ASD) | Static | No | Over-Strength |
| 16-12E »-X:Ω Second Order | 62 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12W »+X | 13 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »+X Second Order | 57 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12W »-X | 14 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »-X Second Order | 58 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »+X | 19 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »+X Second Order | 63 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »-X | 20 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »-X Second Order | 64 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »+X | 21 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »+X Second Order | 65 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »-X | 22 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »-X Second Order | 66 | Allowable (ASD) | Static | Yes | N.A. |
| 16-14 »+X | 23 | Allowable (ASD) | Static | No | Normal |
| 16-14 »+X Second Order | 67 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »+X:Ω | 24 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »+X:Ω Second Order | 68 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-14 »-X | 25 | Allowable (ASD) | Static | No | Normal |
| 16-14 »-X Second Order | 69 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »-X:Ω | 26 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »-X:Ω Second Order | 70 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-15 »+X | 27 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »+X Second Order | 71 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15 »-X | 28 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »-X Second Order | 72 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15Di | 29 | Allowable (ASD) | Static | No | N.A. |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-15Di Second Order | 73 | Allowable (ASD) | Static | Yes | N.A. |
| 16-16 »+X | 30 | Allowable (ASD) | Static | No | Normal |
| 16-16 »+X Second Order | 74 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »+X:Ω | 31 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »+X:Ω Second Order | 75 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-16 »-X | 32 | Allowable (ASD) | Static | No | Normal |
| 16-16 »-X Second Order | 76 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »-X:Ω | 33 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »-X:Ω Second Order | 77 | Allowable (ASD) | Static | Yes | Over-Strength |
| D | 1 | No Design | Static | No | N.A. |
| D Second Order | 45 | No Design | Static | Yes | N.A. |
| D+0.75(L+W) »+X | 35 | Deflections | Static | No | N.A. |
| D+0.75(L+W) »+X Second Order | 79 | Deflections | Static | Yes | N.A. |
| D+0.75(L+W) »-X | 36 | Deflections | Static | No | N.A. |
| D+0.75(L+W) »-X Second Order | 80 | Deflections | Static | Yes | N.A. |
| D+L | 34 | Deflections | Static | No | N.A. |
| D+L Second Order | 78 | Deflections | Static | Yes | N.A. |
| D+Lr | 38 | Deflections | Static | No | N.A. |
| D+Lr Second Order | 82 | Deflections | Static | Yes | N.A. |
| D+S | 37 | Deflections | Static | No | N.A. |
| D+S Second Order | 81 | Deflections | Static | Yes | N.A. |
| E+X | 2 | No Design | Static | No | Normal |
| E+X Second Order | 46 | No Design | Static | Yes | Normal |
| E-X | 3 | No Design | Static | No | Normal |
| E-X Second Order | 47 | No Design | Static | Yes | Normal |
| L | 4 | No Design | Static | No | N.A. |
| L Second Order | 48 | No Design | Static | Yes | N.A. |
| Live | 39 | Deflections | Static | No | N.A. |
| Live Second Order | 83 | Deflections | Static | Yes | N.A. |
| S | 5 | No Design | Static | No | N.A. |
| S Second Order | 49 | No Design | Static | Yes | N.A. |
| Seismic »+X | 43 | Deflections | Static | No | Normal |
| Seismic »+X Second Order | 87 | Deflections | Static | Yes | Normal |
| Seismic »-X | 44 | Deflections | Static | No | Normal |
| Seismic »-X Second Order | 88 | Deflections | Static | Yes | Normal |
| Snow | 40 | Deflections | Static | No | N.A. |
| Snow Second Order | 84 | Deflections | Static | Yes | N.A. |
| W+X | 6 | No Design | Static | No | N.A. |
| W+X Second Order | 50 | No Design | Static | Yes | N.A. |
| W-X | 7 | No Design | Static | No | N.A. |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| W-X Second Order | 51 | No Design | Static | Yes | N.A. |
| Wind »+X | 41 | Deflections | Static | No | N.A. |
| Wind »+X Second Order | 85 | Deflections | Static | Yes | N.A. |
| Wind »-X | 42 | Deflections | Static | No | N.A. |
| Wind »-X Second Order | 86 | Deflections | Static | Yes | N.A. |

**Node Reactions**

(extreme rows: max and min)

| Node | Result Case | FX<br>K | FY<br>K | FZ<br>K | MX<br>K-ft | MY<br>K-ft | MZ<br>K-ft |
|---|---|---|---|---|---|---|---|
| N003 | 16-12E »+X:Ω | 0.0000 | **9.0507** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N003 | 16-12E »+X:Ω Second Order | 0.0000 | **9.0507** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N003 | 16-16 »-X:Ω | 0.0000 | **-7.5529** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N003 | 16-16 »-X:Ω Second Order | 0.0000 | **-7.5529** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Member Forces**

(extreme rows: max and min)

| Member | Fx Min<br>K | Fx Max<br>K | Vy<br>K | Mz Min<br>K-ft | Mz Max<br>K-ft |
|---|---|---|---|---|---|
| BmX003 | 0.0000 (88) | 0.0000 (88) | **6.9600 (16)** | **-20.6806 (60)** | **18.1717 (77)** |

**Member Relative Deflections**

| Member | Result Case | Min Dy<br>in | Max Dy<br>in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-8 | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | 16-8 Second Order | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | 16-9 | -0.0046 | 0.0099 | 17224.0902 |
| BmX003 | 16-9 Second Order | -0.0046 | 0.0099 | 17224.0902 |
| BmX003 | 16-10S | 0.0000 | 0.0292 | 5850.4011 |
| BmX003 | 16-10S Second Order | 0.0000 | 0.0292 | 5850.4011 |
| BmX003 | 16-11Lr | -0.0016 | 0.0121 | 14177.7263 |
| BmX003 | 16-11Lr Second Order | -0.0016 | 0.0121 | 14177.7263 |
| BmX003 | 16-11S | 0.0000 | 0.0182 | 9409.0154 |
| BmX003 | 16-11S Second Order | 0.0000 | 0.0182 | 9409.0154 |
| BmX003 | 16-12E »+X | 0.0000 | 0.1570 | 1089.1837 |
| BmX003 | 16-12E »+X Second Order | 0.0000 | 0.1570 | 1089.1837 |
| BmX003 | 16-12E »+X:Ω | 0.0000 | 0.4257 | 401.6807 |
| BmX003 | 16-12E »+X:Ω Second Order | 0.0000 | 0.4257 | 401.6807 |
| BmX003 | 16-12E »-X | -0.1121 | 0.0000 | 1525.9782 |
| BmX003 | 16-12E »-X Second Order | -0.1121 | 0.0000 | 1525.9782 |
| BmX003 | 16-12E »-X:Ω | -0.3807 | 0.0000 | 449.2184 |
| BmX003 | 16-12E »-X:Ω Second Order | -0.3807 | 0.0000 | 449.2184 |
| BmX003 | 16-12W »+X | 0.0000 | 0.0862 | 1984.2219 |
| BmX003 | 16-12W »+X Second Order | 0.0000 | 0.0862 | 1984.2219 |

**Member Relative Deflections (continued)**

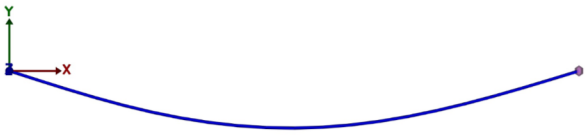
| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-12W »-X | -0.0477 | 0.0000 | 3587.3685 |
| BmX003 | 16-12W »-X Second Order | -0.0477 | 0.0000 | 3587.3685 |
| BmX003 | 16-13Lr »+X | 0.0000 | 0.0592 | 2888.5061 |
| BmX003 | 16-13Lr »+X Second Order | 0.0000 | 0.0592 | 2888.5061 |
| BmX003 | 16-13Lr »-X | -0.0435 | 0.0000 | 3931.4768 |
| BmX003 | 16-13Lr »-X Second Order | -0.0435 | 0.0000 | 3931.4768 |
| BmX003 | 16-13S »+X | 0.0000 | 0.0661 | 2586.1037 |
| BmX003 | 16-13S »+X Second Order | 0.0000 | 0.0661 | 2586.1037 |
| BmX003 | 16-13S »-X | -0.0367 | 0.0000 | 4655.1823 |
| BmX003 | 16-13S »-X Second Order | -0.0367 | 0.0000 | 4655.1823 |
| BmX003 | 16-14 »+X | 0.0000 | 0.1189 | 1437.9602 |
| BmX003 | 16-14 »+X Second Order | 0.0000 | 0.1189 | 1437.9602 |
| BmX003 | 16-14 »+X:Ω | 0.0000 | 0.3200 | 534.3485 |
| BmX003 | 16-14 »+X:Ω Second Order | 0.0000 | 0.3200 | 534.3485 |
| BmX003 | 16-14 »-X | -0.0842 | 0.0000 | 2029.7878 |
| BmX003 | 16-14 »-X Second Order | -0.0842 | 0.0000 | 2029.7878 |
| BmX003 | 16-14 »-X:Ω | -0.2852 | 0.0000 | 599.6444 |
| BmX003 | 16-14 »-X:Ω Second Order | -0.2852 | 0.0000 | 599.6444 |
| BmX003 | 16-15 »+X | 0.0000 | 0.0783 | 2183.3081 |
| BmX003 | 16-15 »+X Second Order | 0.0000 | 0.0783 | 2183.3081 |
| BmX003 | 16-15 »-X | -0.0552 | 0.0000 | 3100.4356 |
| BmX003 | 16-15 »-X Second Order | -0.0552 | 0.0000 | 3100.4356 |
| BmX003 | 16-15Di | 0.0000 | 0.0121 | 14182.6071 |
| BmX003 | 16-15Di Second Order | 0.0000 | 0.0121 | 14182.6071 |
| BmX003 | 16-16 »+X | 0.0000 | 0.1428 | 1197.1113 |
| BmX003 | 16-16 »+X Second Order | 0.0000 | 0.1428 | 1197.1113 |
| BmX003 | 16-16 »+X:Ω | 0.0000 | 0.4116 | 415.4522 |
| BmX003 | 16-16 »+X:Ω Second Order | 0.0000 | 0.4116 | 415.4522 |
| BmX003 | 16-16 »-X | -0.1260 | 0.0000 | 1357.5638 |
| BmX003 | 16-16 »-X Second Order | -0.1260 | 0.0000 | 1357.5638 |
| BmX003 | 16-16 »-X:Ω | -0.3947 | 0.0000 | 433.2757 |
| BmX003 | 16-16 »-X:Ω Second Order | -0.3947 | 0.0000 | 433.2757 |
| BmX003 | D | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | D Second Order | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | D+0.75(L+W) »+X | 0.0000 | 0.0921 | 1855.8632 |
| BmX003 | D+0.75(L+W) »+X Second Order | 0.0000 | 0.0921 | 1855.8632 |
| BmX003 | D+0.75(L+W) »-X | -0.0762 | 0.0000 | 2245.5208 |
| BmX003 | D+0.75(L+W) »-X Second Order | -0.0762 | 0.0000 | 2245.5208 |
| BmX003 | D+L | -0.0046 | 0.0099 | 17224.0902 |
| BmX003 | D+L Second Order | -0.0046 | 0.0099 | 17224.0902 |

**Member Relative Deflections (continued)**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | D+Lr | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | D+Lr Second Order | 0.0000 | 0.0201 | 8509.5642 |
| BmX003 | D+S | 0.0000 | 0.0292 | 5850.4011 |
| BmX003 | D+S Second Order | 0.0000 | 0.0292 | 5850.4011 |
| BmX003 | E+X | 0.0000 | 0.1919 | 891.2819 |
| BmX003 | E+X Second Order | 0.0000 | 0.1919 | 891.2819 |
| BmX003 | E-X | -0.1919 | 0.0000 | 891.2819 |
| BmX003 | E-X Second Order | -0.1919 | 0.0000 | 891.2819 |
| BmX003 | L | -0.0168 | 0.0000 | 10159.7552 |
| BmX003 | L Second Order | -0.0168 | 0.0000 | 10159.7552 |
| BmX003 | Live | -0.0168 | 0.0000 | 10159.7552 |
| BmX003 | Live Second Order | -0.0168 | 0.0000 | 10159.7552 |
| BmX003 | S | 0.0000 | 0.0094 | 18271.2797 |
| BmX003 | S Second Order | 0.0000 | 0.0094 | 18271.2797 |
| BmX003 | Seismic »+X | 0.0000 | 0.1919 | 891.2819 |
| BmX003 | Seismic »+X Second Order | 0.0000 | 0.1919 | 891.2819 |
| BmX003 | Seismic »-X | -0.1919 | 0.0000 | 891.2819 |
| BmX003 | Seismic »-X Second Order | -0.1919 | 0.0000 | 891.2819 |
| BmX003 | Snow | 0.0000 | 0.0094 | 18271.2797 |
| BmX003 | Snow Second Order | 0.0000 | 0.0094 | 18271.2797 |
| BmX003 | W+X | 0.0000 | 0.1110 | 1540.1887 |
| BmX003 | W+X Second Order | 0.0000 | 0.1110 | 1540.1887 |
| BmX003 | W-X | -0.1110 | 0.0000 | 1540.1887 |
| BmX003 | W-X Second Order | -0.1110 | 0.0000 | 1540.1887 |
| BmX003 | Wind »+X | 0.0000 | 0.1110 | 1540.1887 |
| BmX003 | Wind »+X Second Order | 0.0000 | 0.1110 | 1540.1887 |
| BmX003 | Wind »-X | -0.1110 | 0.0000 | 1540.1887 |
| BmX003 | Wind »-X Second Order | -0.1110 | 0.0000 | 1540.1887 |

SB2
L = 10'

23




Mr = 19.97 K-ft </= Ma = 30.4 K-ft
Vr = 6.30 K </= Va = 52.2 K
Total Deflection = 0.1531" => L/783


Okay, therefore use, (2) C9x20 for SB2

BUKER ENGINEERING, LLC
Daniel Buker
H:\Projects\2022\Rader Residence\Calculations\SB2.vap
Sunday, November 27, 2022 9:19 PM

**Project Settings**

Building Code Load Combinations:
Deflection Checks
IBC 2012 ASD
General Settings:
Vertical Direction: Y
North Axis: Plus Z
Ground Elevation: 0 ft
Occupancy Risk Category: II
Seismic Data:
Seismic Design Category: D
Spectral Acceleration SDs: 1.169
Overstrength (Omega) X: 3, Y: 3, Z: 3
Redundancy (Rho) X: 1 , Y: 1, Z: 1
Wind Data:
Wind Speed (mph): 110
Mean Roof Height: 0 ft
Ground Elevation: 0 ft
Gust Factor: 0.85
Analysis Data:
Analysis Method: PDelta
Performance: Auto
Force Tolerance: 0.1
Absolute Force Tolerance: 0.5 K
Displacement Tolerance: 0.01
Load Stepping Points: 31

**Bill of Materials: Members**

| Material | Section | Count | Total Length ft | Total Volume in^3 | Total Weight K |
|---|---|---|---|---|---|
| ASTM A36 | C9X20 | 1 | 10.0000 | 704.4000 | 0.2000 |

Total Member Weight = 0.20005 K

**Member Loads, Uniform**

| Member | Service Case | Direction | Magnitude | Full Length? | Start Offset ft | End Offset ft | Projected? | Predefined Load |
|---|---|---|---|---|---|---|---|---|
| BmX003 | D | Shear y | -0.1350 K/ft | Yes | 0.0000 | 10.0000 | No | N.A. |
| BmX003 | L | Shear y | -0.4650 K/ft | Yes | 0.0000 | 10.0000 | No | N.A. |

**Member Loads, Concentrated**

| Member | Service Case | Direction | Magnitude | Offset ft |
|---|---|---|---|---|
| BmX003 | D | Shear y | -1.0000 K | 2.7500 |
| BmX003 | D | Shear y | -1.0000 K | 5.7500 |
| BmX003 | E+X | Shear y | -3.8000 K | 2.7500 |
| BmX003 | E+X | Shear y | 3.8000 K | 5.7500 |
| BmX003 | E-X | Shear y | -3.8000 K | 5.7500 |
| BmX003 | E-X | Shear y | 3.8000 K | 2.7500 |
| BmX003 | L | Shear y | -0.5000 K | 2.7500 |
| BmX003 | L | Shear y | -0.5000 K | 5.7500 |
| BmX003 | S | Shear y | -0.2000 K | 2.7500 |
| BmX003 | S | Shear y | -0.2000 K | 5.7500 |

**Member Loads, Concentrated (continued)**

| Member | Service Case | Direction | Magnitude | Offset ft |
|---|---|---|---|---|
| BmX003 | W+X | Shear y | -2.2000 K | 2.7500 |
| BmX003 | W+X | Shear y | 2.2000 K | 5.7500 |
| BmX003 | W-X | Shear y | -2.2000 K | 5.7500 |
| BmX003 | W-X | Shear y | 2.2000 K | 2.7500 |

**Factored Load Combinations**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| 16-8 | IBC 2012 ASD | D | Allowable | Other |
| 16-9 | IBC 2012 ASD | D + L | Allowable | Dead Plus Live |
| 16-10S | IBC 2012 ASD | D + S | Allowable | Other |
| 16-11Lr | IBC 2012 ASD | D + 0.75L | Allowable | Dead Plus Live |
| 16-11S | IBC 2012 ASD | D + 0.75L + 0.75S | Allowable | Other |
| 16-12E »+X | IBC 2012 ASD | 1.16366D + 0.7E+X | Allowable | Other |
| 16-12E »+X:Ω | IBC 2012 ASD | 1.16366D + 2.1E+X | Allowable | Other |
| 16-12E »-X | IBC 2012 ASD | 1.16366D + 0.7E-X | Allowable | Other |
| 16-12E »-X:Ω | IBC 2012 ASD | 1.16366D + 2.1E-X | Allowable | Other |
| 16-12W »+X | IBC 2012 ASD | D + 0.6W+X | Allowable | Other |
| 16-12W »-X | IBC 2012 ASD | D + 0.6W-X | Allowable | Other |
| 16-13Lr »+X | IBC 2012 ASD | D + 0.75L + 0.45W+X | Allowable | Other |
| 16-13Lr »-X | IBC 2012 ASD | D + 0.75L + 0.45W-X | Allowable | Other |
| 16-13S »+X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W+X | Allowable | Other |
| 16-13S »-X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W-X | Allowable | Other |
| 16-14 »+X | IBC 2012 ASD | 1.122745D + 0.525E+X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »+X:Ω | IBC 2012 ASD | 1.122745D + 1.575E+X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X | IBC 2012 ASD | 1.122745D + 0.525E-X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X:Ω | IBC 2012 ASD | 1.122745D + 1.575E-X + 0.75L + 0.75S | Allowable | Other |
| 16-15 »+X | IBC 2012 ASD | 0.6D + 0.6W+X | Allowable | Other |
| 16-15 »-X | IBC 2012 ASD | 0.6D + 0.6W-X | Allowable | Other |
| 16-15Di | IBC 2012 ASD | 0.6D | Allowable | Other |
| 16-16 »+X | IBC 2012 ASD | 0.43634D + 0.7E+X | Allowable | Other |
| 16-16 »+X:Ω | IBC 2012 ASD | 0.43634D + 2.1E+X | Allowable | Other |
| 16-16 »-X | IBC 2012 ASD | 0.43634D + 0.7E-X | Allowable | Other |
| 16-16 »-X:Ω | IBC 2012 ASD | 0.43634D + 2.1E-X | Allowable | Other |
| D+0.75(L+W) »+X | Deflection Checks | D + 0.75L + 0.75W+X | Deflections | Other |
| D+0.75(L+W) »-X | Deflection Checks | D + 0.75L + 0.75W-X | Deflections | Other |
| D+L | Deflection Checks | D + L | Deflections | Dead Plus Live |
| D+Lr | Deflection Checks | D | Deflections | Other |
| D+S | Deflection Checks | D + S | Deflections | Other |
| Live | Deflection Checks | L | Deflections | Live Only |
| Seismic »+X | Deflection Checks | E+X | Deflections | Other |

**Factored Load Combinations (continued)**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| Seismic »-X | Deflection Checks | E-X | Deflections | Other |
| Snow | Deflection Checks | S | Deflections | Wind Or Snow |
| Wind »+X | Deflection Checks | W+X | Deflections | Wind Or Snow |
| Wind »-X | Deflection Checks | W-X | Deflections | Wind Or Snow |

**Result Cases**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-8 | 8 | Allowable (ASD) | Static | No | N.A. |
| 16-8 Second Order | 52 | Allowable (ASD) | Static | Yes | N.A. |
| 16-9 | 9 | Allowable (ASD) | Static | No | N.A. |
| 16-9 Second Order | 53 | Allowable (ASD) | Static | Yes | N.A. |
| 16-10S | 10 | Allowable (ASD) | Static | No | N.A. |
| 16-10S Second Order | 54 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11Lr | 11 | Allowable (ASD) | Static | No | N.A. |
| 16-11Lr Second Order | 55 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11S | 12 | Allowable (ASD) | Static | No | N.A. |
| 16-11S Second Order | 56 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12E »+X | 15 | Allowable (ASD) | Static | No | Normal |
| 16-12E »+X Second Order | 59 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »+X:Ω | 16 | Allowable (ASD) | Static | No | Over-Strength |
| 16-12E »+X:Ω Second Order | 60 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12E »-X | 17 | Allowable (ASD) | Static | No | Normal |
| 16-12E »-X Second Order | 61 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »-X:Ω | 18 | Allowable (ASD) | Static | No | Over-Strength |
| 16-12E »-X:Ω Second Order | 62 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12W »+X | 13 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »+X Second Order | 57 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12W »-X | 14 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »-X Second Order | 58 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »+X | 19 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »+X Second Order | 63 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »-X | 20 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »-X Second Order | 64 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »+X | 21 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »+X Second Order | 65 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »-X | 22 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »-X Second Order | 66 | Allowable (ASD) | Static | Yes | N.A. |
| 16-14 »+X | 23 | Allowable (ASD) | Static | No | Normal |
| 16-14 »+X Second Order | 67 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »+X:Ω | 24 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »+X:Ω Second Order | 68 | Allowable (ASD) | Static | Yes | Over-Strength |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-14 »-X | 25 | Allowable (ASD) | Static | No | Normal |
| 16-14 »-X Second Order | 69 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »-X:Ω | 26 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »-X:Ω Second Order | 70 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-15 »+X | 27 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »+X Second Order | 71 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15 »-X | 28 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »-X Second Order | 72 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15Di | 29 | Allowable (ASD) | Static | No | N.A. |
| 16-15Di Second Order | 73 | Allowable (ASD) | Static | Yes | N.A. |
| 16-16 »+X | 30 | Allowable (ASD) | Static | No | Normal |
| 16-16 »+X Second Order | 74 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »+X:Ω | 31 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »+X:Ω Second Order | 75 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-16 »-X | 32 | Allowable (ASD) | Static | No | Normal |
| 16-16 »-X Second Order | 76 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »-X:Ω | 33 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »-X:Ω Second Order | 77 | Allowable (ASD) | Static | Yes | Over-Strength |
| D | 1 | No Design | Static | No | N.A. |
| D Second Order | 45 | No Design | Static | Yes | N.A. |
| D+0.75(L+W) »+X | 35 | Deflections | Static | No | N.A. |
| D+0.75(L+W) »+X Second Order | 79 | Deflections | Static | Yes | N.A. |
| D+0.75(L+W) »-X | 36 | Deflections | Static | No | N.A. |
| D+0.75(L+W) »-X Second Order | 80 | Deflections | Static | Yes | N.A. |
| D+L | 34 | Deflections | Static | No | N.A. |
| D+L Second Order | 78 | Deflections | Static | Yes | N.A. |
| D+Lr | 38 | Deflections | Static | No | N.A. |
| D+Lr Second Order | 82 | Deflections | Static | Yes | N.A. |
| D+S | 37 | Deflections | Static | No | N.A. |
| D+S Second Order | 81 | Deflections | Static | Yes | N.A. |
| E+X | 2 | No Design | Static | No | Normal |
| E+X Second Order | 46 | No Design | Static | Yes | Normal |
| E-X | 3 | No Design | Static | No | Normal |
| E-X Second Order | 47 | No Design | Static | Yes | Normal |
| L | 4 | No Design | Static | No | N.A. |
| L Second Order | 48 | No Design | Static | Yes | N.A. |
| Live | 39 | Deflections | Static | No | N.A. |
| Live Second Order | 83 | Deflections | Static | Yes | N.A. |
| S | 5 | No Design | Static | No | N.A. |
| S Second Order | 49 | No Design | Static | Yes | N.A. |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| Seismic »+X | 43 | Deflections | Static | No | Normal |
| Seismic »+X Second Order | 87 | Deflections | Static | Yes | Normal |
| Seismic »-X | 44 | Deflections | Static | No | Normal |
| Seismic »-X Second Order | 88 | Deflections | Static | Yes | Normal |
| Snow | 40 | Deflections | Static | No | N.A. |
| Snow Second Order | 84 | Deflections | Static | Yes | N.A. |
| W+X | 6 | No Design | Static | No | N.A. |
| W+X Second Order | 50 | No Design | Static | Yes | N.A. |
| W-X | 7 | No Design | Static | No | N.A. |
| W-X Second Order | 51 | No Design | Static | Yes | N.A. |
| Wind »+X | 41 | Deflections | Static | No | N.A. |
| Wind »+X Second Order | 85 | Deflections | Static | Yes | N.A. |
| Wind »-X | 42 | Deflections | Static | No | N.A. |
| Wind »-X Second Order | 86 | Deflections | Static | Yes | N.A. |

**Node Reactions**

(extreme rows: max and min)

| Node | Result Case | FX<br>K | FY<br>K | FZ<br>K | MX<br>K-ft | MY<br>K-ft | MZ<br>K-ft |
|---|---|---|---|---|---|---|---|
| N001 | 16-14 »+X:Ω | 0.0000 | **6.3043** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N001 | 16-14 »+X:Ω Second Order | 0.0000 | **6.3043** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | 16-16 »+X:Ω | 0.0000 | **-1.6849** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | 16-16 »+X:Ω Second Order | 0.0000 | **-1.6849** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Member Forces**

(extreme rows: max and min)

| Member | Fx Min<br>K | Fx Max<br>K | Vy<br>K | Mz Min<br>K-ft | Mz Max<br>K-ft |
|---|---|---|---|---|---|
| BmX003 | 0.0000 (88) | 0.0000 (88) | **6.3043 (68)** | **-7.7718 (75)** | **19.9711 (70)** |

**Member Relative Deflections**

| Member | Result Case | Min Dy<br>in | Max Dy<br>in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-8 | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | 16-8 Second Order | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | 16-9 | -0.1313 | 0.0000 | 914.1327 |
| BmX003 | 16-9 Second Order | -0.1313 | 0.0000 | 914.1327 |
| BmX003 | 16-10S | -0.0616 | 0.0000 | 1948.6929 |
| BmX003 | 16-10S Second Order | -0.0616 | 0.0000 | 1948.6929 |
| BmX003 | 16-11Lr | -0.1121 | 0.0000 | 1070.4173 |
| BmX003 | 16-11Lr Second Order | -0.1121 | 0.0000 | 1070.4173 |
| BmX003 | 16-11S | -0.1173 | 0.0000 | 1022.7116 |
| BmX003 | 16-11S Second Order | -0.1173 | 0.0000 | 1022.7116 |
| BmX003 | 16-12E »+X | -0.0527 | 0.0000 | 2274.8855 |

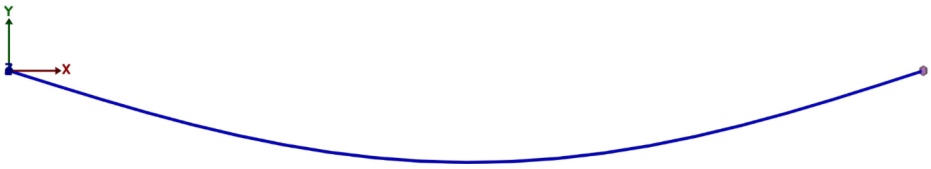
**Member Relative Deflections (continued)**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-12E »+X Second Order | -0.0527 | 0.0000 | 2274.8855 |
| BmX003 | 16-12E »+X:Ω | -0.0400 | 0.0000 | 2999.1150 |
| BmX003 | 16-12E »+X:Ω Second Order | -0.0400 | 0.0000 | 2999.1150 |
| BmX003 | 16-12E »-X | -0.0763 | 0.0000 | 1572.0094 |
| BmX003 | 16-12E »-X Second Order | -0.0763 | 0.0000 | 1572.0094 |
| BmX003 | 16-12E »-X:Ω | -0.1039 | 0.0000 | 1155.4739 |
| BmX003 | 16-12E »-X:Ω Second Order | -0.1039 | 0.0000 | 1155.4739 |
| BmX003 | 16-12W »+X | -0.0489 | 0.0000 | 2451.5618 |
| BmX003 | 16-12W »+X Second Order | -0.0489 | 0.0000 | 2451.5618 |
| BmX003 | 16-12W »-X | -0.0608 | 0.0000 | 1972.7381 |
| BmX003 | 16-12W »-X Second Order | -0.0608 | 0.0000 | 1972.7381 |
| BmX003 | 16-13Lr »+X | -0.1077 | 0.0000 | 1114.5089 |
| BmX003 | 16-13Lr »+X Second Order | -0.1077 | 0.0000 | 1114.5089 |
| BmX003 | 16-13Lr »-X | -0.1167 | 0.0000 | 1028.3729 |
| BmX003 | 16-13Lr »-X Second Order | -0.1167 | 0.0000 | 1028.3729 |
| BmX003 | 16-13S »+X | -0.1129 | 0.0000 | 1062.8926 |
| BmX003 | 16-13S »+X Second Order | -0.1129 | 0.0000 | 1062.8926 |
| BmX003 | 16-13S »-X | -0.1219 | 0.0000 | 984.3004 |
| BmX003 | 16-13S »-X Second Order | -0.1219 | 0.0000 | 984.3004 |
| BmX003 | 16-14 »+X | -0.1153 | 0.0000 | 1041.1555 |
| BmX003 | 16-14 »+X Second Order | -0.1153 | 0.0000 | 1041.1555 |
| BmX003 | 16-14 »+X:Ω | -0.1001 | 0.0000 | 1198.2979 |
| BmX003 | 16-14 »+X:Ω Second Order | -0.1001 | 0.0000 | 1198.2979 |
| BmX003 | 16-14 »-X | -0.1334 | 0.0000 | 899.7230 |
| BmX003 | 16-14 »-X Second Order | -0.1334 | 0.0000 | 899.7230 |
| BmX003 | 16-14 »-X:Ω | -0.1531 | 0.0000 | 783.9068 |
| BmX003 | 16-14 »-X:Ω Second Order | -0.1531 | 0.0000 | 783.9068 |
| BmX003 | 16-15 »+X | -0.0274 | 0.0000 | 4382.8899 |
| BmX003 | 16-15 »+X Second Order | -0.0274 | 0.0000 | 4382.8899 |
| BmX003 | 16-15 »-X | -0.0391 | 0.0000 | 3068.9042 |
| BmX003 | 16-15 »-X Second Order | -0.0391 | 0.0000 | 3068.9042 |
| BmX003 | 16-15Di | -0.0328 | 0.0000 | 3662.5133 |
| BmX003 | 16-15Di Second Order | -0.0328 | 0.0000 | 3662.5133 |
| BmX003 | 16-16 »+X | -0.0156 | 0.0000 | 7708.3748 |
| BmX003 | 16-16 »+X Second Order | -0.0156 | 0.0000 | 7708.3748 |
| BmX003 | 16-16 »+X:Ω | -0.0101 | 0.0218 | 5498.6426 |
| BmX003 | 16-16 »+X:Ω Second Order | -0.0101 | 0.0218 | 5498.6426 |
| BmX003 | 16-16 »-X | -0.0372 | 0.0000 | 3226.3446 |
| BmX003 | 16-16 »-X Second Order | -0.0372 | 0.0000 | 3226.3446 |
| BmX003 | 16-16 »-X:Ω | -0.0656 | 0.0000 | 1829.6215 |

**Member Relative Deflections (continued)**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-16 »-X:Ω Second Order | -0.0656 | 0.0000 | 1829.6215 |
| BmX003 | D | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | D Second Order | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | D+0.75(L+W) »+X | -0.1048 | 0.0000 | 1144.8899 |
| BmX003 | D+0.75(L+W) »+X Second Order | -0.1048 | 0.0000 | 1144.8899 |
| BmX003 | D+0.75(L+W) »-X | -0.1198 | 0.0000 | 1001.5205 |
| BmX003 | D+0.75(L+W) »-X Second Order | -0.1198 | 0.0000 | 1001.5205 |
| BmX003 | D+L | -0.1313 | 0.0000 | 914.1327 |
| BmX003 | D+L Second Order | -0.1313 | 0.0000 | 914.1327 |
| BmX003 | D+Lr | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | D+Lr Second Order | -0.0546 | 0.0000 | 2197.5080 |
| BmX003 | D+S | -0.0616 | 0.0000 | 1948.6929 |
| BmX003 | D+S Second Order | -0.0616 | 0.0000 | 1948.6929 |
| BmX003 | E+X | 0.0000 | 0.0206 | 5832.9324 |
| BmX003 | E+X Second Order | 0.0000 | 0.0206 | 5832.9324 |
| BmX003 | E-X | -0.0206 | 0.0000 | 5832.9324 |
| BmX003 | E-X Second Order | -0.0206 | 0.0000 | 5832.9324 |
| BmX003 | L | -0.0767 | 0.0000 | 1565.2232 |
| BmX003 | L Second Order | -0.0767 | 0.0000 | 1565.2232 |
| BmX003 | Live | -0.0767 | 0.0000 | 1565.2232 |
| BmX003 | Live Second Order | -0.0767 | 0.0000 | 1565.2232 |
| BmX003 | S | -0.0070 | 0.0000 | 17209.5384 |
| BmX003 | S Second Order | -0.0070 | 0.0000 | 17209.5384 |
| BmX003 | Seismic »+X | 0.0000 | 0.0206 | 5832.9324 |
| BmX003 | Seismic »+X Second Order | 0.0000 | 0.0206 | 5832.9324 |
| BmX003 | Seismic »-X | -0.0206 | 0.0000 | 5832.9324 |
| BmX003 | Seismic »-X Second Order | -0.0206 | 0.0000 | 5832.9324 |
| BmX003 | Snow | -0.0070 | 0.0000 | 17209.5384 |
| BmX003 | Snow Second Order | -0.0070 | 0.0000 | 17209.5384 |
| BmX003 | W+X | 0.0000 | 0.0119 | 10075.0651 |
| BmX003 | W+X Second Order | 0.0000 | 0.0119 | 10075.0651 |
| BmX003 | W-X | -0.0119 | 0.0000 | 10075.0651 |
| BmX003 | W-X Second Order | -0.0119 | 0.0000 | 10075.0651 |
| BmX003 | Wind »+X | 0.0000 | 0.0119 | 10075.0651 |
| BmX003 | Wind »+X Second Order | 0.0000 | 0.0119 | 10075.0651 |
| BmX003 | Wind »-X | -0.0119 | 0.0000 | 10075.0651 |
| BmX003 | Wind »-X Second Order | -0.0119 | 0.0000 | 10075.0651 |

SB3
L = 23.5' 31





Mr = 55.02 K-ft </= Ma = 85.8 K-ft
Vr = 9.02 K </= Va = 70.7 K
Total Deflection = 0.7330" => L/384

Okay, therefore use, W10x45 for SB3

BUKER ENGINEERING, LLC
Daniel Buker
H:\Projects\2022\Rader Residence\Calculations\SB3.vap
Sunday, November 27, 2022 9:29 PM

**Project Settings**

Building Code Load Combinations:
Deflection Checks
IBC 2012 ASD
General Settings:
Vertical Direction: Y
North Axis: Plus Z
Ground Elevation: 0 ft
Occupancy Risk Category: II
Seismic Data:
Seismic Design Category: D
Spectral Acceleration SDs: 1.169
Overstrength (Omega) X: 3, Y: 3, Z: 3
Redundancy (Rho) X: 1 , Y: 1, Z: 1
Wind Data:
Wind Speed (mph): 110
Mean Roof Height: 0 ft
Ground Elevation: 0 ft
Gust Factor: 0.85
Analysis Data:
Analysis Method: PDelta
Performance: Auto
Force Tolerance: 0.1
Absolute Force Tolerance: 0.5 K
Displacement Tolerance: 0.01
Load Stepping Points: 31

**Bill of Materials: Members**

| Material | Section | Count | Total Length ft | Total Volume in^3 | Total Weight K |
|---|---|---|---|---|---|
| ASTM A992 Grade 50 | W10X45 | 1 | 23.5000 | 3750.6000 | 1.0652 |

Total Member Weight = 1.0652 K

**Member Loads, Uniform**

| Member | Service Case | Direction | Magnitude | Full Length? | Start Offset ft | End Offset ft | Projected? | Predefined Load |
|---|---|---|---|---|---|---|---|---|
| BmX003 | D | Shear y | -0.1350 K/ft | Yes | 0.0000 | 23.5000 | No | N.A. |
| BmX003 | L | Shear y | -0.5000 K/ft | Yes | 0.0000 | 23.5000 | No | N.A. |

**Member Loads, Concentrated**

| Member | Service Case | Direction | Magnitude | Offset ft |
|---|---|---|---|---|
| BmX003 | D | Shear y | -0.0800 K | 9.7500 |
| BmX003 | D | Shear y | -0.0800 K | 13.9000 |
| BmX003 | D | Shear y | -0.0800 K | 17.0000 |
| BmX003 | D | Shear y | -0.0800 K | 20.7500 |
| BmX003 | D | Shear y | -0.0250 K | 5.2500 |
| BmX003 | E+X | Shear y | -2.3620 K | 9.7500 |
| BmX003 | E+X | Shear y | -2.3620 K | 17.0000 |
| BmX003 | E+X | Shear y | 2.3620 K | 13.9000 |
| BmX003 | E+X | Shear y | 2.3620 K | 20.7500 |
| BmX003 | E-X | Shear y | -0.7980 K | 13.9000 |

**Member Loads, Concentrated (continued)**

| Member | Service Case | Direction | Magnitude | Offset ft |
|---|---|---|---|---|
| BmX003 | E-X | Shear y | -0.7980 K | 20.7500 |
| BmX003 | E-X | Shear y | 0.7980 K | 9.7500 |
| BmX003 | E-X | Shear y | 0.7980 K | 17.0000 |
| BmX003 | L | Shear y | -0.2870 K | 9.7500 |
| BmX003 | L | Shear y | -0.2870 K | 13.9000 |
| BmX003 | L | Shear y | -0.2870 K | 17.0000 |
| BmX003 | L | Shear y | -0.2870 K | 20.7500 |
| BmX003 | L | Shear y | -0.2780 K | 5.2500 |
| BmX003 | S | Shear y | 0.0400 K | 9.7500 |
| BmX003 | S | Shear y | 0.0400 K | 13.9000 |
| BmX003 | S | Shear y | 0.0400 K | 17.0000 |
| BmX003 | S | Shear y | 0.0400 K | 20.7500 |
| BmX003 | S | Shear y | 0.0610 K | 5.2500 |
| BmX003 | W+X | Shear y | -0.4620 K | 9.7500 |
| BmX003 | W+X | Shear y | -0.4620 K | 17.0000 |
| BmX003 | W+X | Shear y | 0.4620 K | 13.9000 |
| BmX003 | W+X | Shear y | 0.4620 K | 20.7500 |
| BmX003 | W-X | Shear y | -0.4630 K | 20.7500 |
| BmX003 | W-X | Shear y | -0.4620 K | 13.9000 |
| BmX003 | W-X | Shear y | 0.4620 K | 9.7500 |
| BmX003 | W-X | Shear y | 0.4620 K | 17.0000 |

**Factored Load Combinations**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| 16-8 | IBC 2012 ASD | D | Allowable | Other |
| 16-9 | IBC 2012 ASD | D + L | Allowable | Dead Plus Live |
| 16-10S | IBC 2012 ASD | D + S | Allowable | Other |
| 16-11Lr | IBC 2012 ASD | D + 0.75L | Allowable | Dead Plus Live |
| 16-11S | IBC 2012 ASD | D + 0.75L + 0.75S | Allowable | Other |
| 16-12E »+X | IBC 2012 ASD | 1.16366D + 0.7E+X | Allowable | Other |
| 16-12E »+X:Ω | IBC 2012 ASD | 1.16366D + 2.1E+X | Allowable | Other |
| 16-12E »-X | IBC 2012 ASD | 1.16366D + 0.7E-X | Allowable | Other |
| 16-12E »-X:Ω | IBC 2012 ASD | 1.16366D + 2.1E-X | Allowable | Other |
| 16-12W »+X | IBC 2012 ASD | D + 0.6W+X | Allowable | Other |
| 16-12W »-X | IBC 2012 ASD | D + 0.6W-X | Allowable | Other |
| 16-13Lr »+X | IBC 2012 ASD | D + 0.75L + 0.45W+X | Allowable | Other |
| 16-13Lr »-X | IBC 2012 ASD | D + 0.75L + 0.45W-X | Allowable | Other |
| 16-13S »+X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W+X | Allowable | Other |
| 16-13S »-X | IBC 2012 ASD | D + 0.75L + 0.75S + 0.45W-X | Allowable | Other |
| 16-14 »+X | IBC 2012 ASD | 1.122745D + 0.525E+X + 0.75L + 0.75S | Allowable | Other |

**Factored Load Combinations (continued)**

| Name | Code | Effective Equation | Design | Deflection |
|---|---|---|---|---|
| 16-14 »+X:Ω | IBC 2012 ASD | 1.122745D + 1.575E+X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X | IBC 2012 ASD | 1.122745D + 0.525E-X + 0.75L + 0.75S | Allowable | Other |
| 16-14 »-X:Ω | IBC 2012 ASD | 1.122745D + 1.575E-X + 0.75L + 0.75S | Allowable | Other |
| 16-15 »+X | IBC 2012 ASD | 0.6D + 0.6W+X | Allowable | Other |
| 16-15 »-X | IBC 2012 ASD | 0.6D + 0.6W-X | Allowable | Other |
| 16-15Di | IBC 2012 ASD | 0.6D | Allowable | Other |
| 16-16 »+X | IBC 2012 ASD | 0.43634D + 0.7E+X | Allowable | Other |
| 16-16 »+X:Ω | IBC 2012 ASD | 0.43634D + 2.1E+X | Allowable | Other |
| 16-16 »-X | IBC 2012 ASD | 0.43634D + 0.7E-X | Allowable | Other |
| 16-16 »-X:Ω | IBC 2012 ASD | 0.43634D + 2.1E-X | Allowable | Other |
| D+0.75(L+W) »+X | Deflection Checks | D + 0.75L + 0.75W+X | Deflections | Other |
| D+0.75(L+W) »-X | Deflection Checks | D + 0.75L + 0.75W-X | Deflections | Other |
| D+L | Deflection Checks | D + L | Deflections | Dead Plus Live |
| D+Lr | Deflection Checks | D | Deflections | Other |
| D+S | Deflection Checks | D + S | Deflections | Other |
| Live | Deflection Checks | L | Deflections | Live Only |
| Seismic »+X | Deflection Checks | E+X | Deflections | Other |
| Seismic »-X | Deflection Checks | E-X | Deflections | Other |
| Snow | Deflection Checks | S | Deflections | Wind Or Snow |
| Wind »+X | Deflection Checks | W+X | Deflections | Wind Or Snow |
| Wind »-X | Deflection Checks | W-X | Deflections | Wind Or Snow |

**Result Cases**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-8 | 8 | Allowable (ASD) | Static | No | N.A. |
| 16-8 Second Order | 52 | Allowable (ASD) | Static | Yes | N.A. |
| 16-9 | 9 | Allowable (ASD) | Static | No | N.A. |
| 16-9 Second Order | 53 | Allowable (ASD) | Static | Yes | N.A. |
| 16-10S | 10 | Allowable (ASD) | Static | No | N.A. |
| 16-10S Second Order | 54 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11Lr | 11 | Allowable (ASD) | Static | No | N.A. |
| 16-11Lr Second Order | 55 | Allowable (ASD) | Static | Yes | N.A. |
| 16-11S | 12 | Allowable (ASD) | Static | No | N.A. |
| 16-11S Second Order | 56 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12E »+X | 15 | Allowable (ASD) | Static | No | Normal |
| 16-12E »+X Second Order | 59 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »+X:Ω | 16 | Allowable (ASD) | Static | No | Over-Strength |
| 16-12E »+X:Ω Second Order | 60 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12E »-X | 17 | Allowable (ASD) | Static | No | Normal |
| 16-12E »-X Second Order | 61 | Allowable (ASD) | Static | Yes | Normal |
| 16-12E »-X:Ω | 18 | Allowable (ASD) | Static | No | Over-Strength |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| 16-12E »-X:Ω Second Order | 62 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-12W »+X | 13 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »+X Second Order | 57 | Allowable (ASD) | Static | Yes | N.A. |
| 16-12W »-X | 14 | Allowable (ASD) | Static | No | N.A. |
| 16-12W »-X Second Order | 58 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »+X | 19 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »+X Second Order | 63 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13Lr »-X | 20 | Allowable (ASD) | Static | No | N.A. |
| 16-13Lr »-X Second Order | 64 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »+X | 21 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »+X Second Order | 65 | Allowable (ASD) | Static | Yes | N.A. |
| 16-13S »-X | 22 | Allowable (ASD) | Static | No | N.A. |
| 16-13S »-X Second Order | 66 | Allowable (ASD) | Static | Yes | N.A. |
| 16-14 »+X | 23 | Allowable (ASD) | Static | No | Normal |
| 16-14 »+X Second Order | 67 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »+X:Ω | 24 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »+X:Ω Second Order | 68 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-14 »-X | 25 | Allowable (ASD) | Static | No | Normal |
| 16-14 »-X Second Order | 69 | Allowable (ASD) | Static | Yes | Normal |
| 16-14 »-X:Ω | 26 | Allowable (ASD) | Static | No | Over-Strength |
| 16-14 »-X:Ω Second Order | 70 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-15 »+X | 27 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »+X Second Order | 71 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15 »-X | 28 | Allowable (ASD) | Static | No | N.A. |
| 16-15 »-X Second Order | 72 | Allowable (ASD) | Static | Yes | N.A. |
| 16-15Di | 29 | Allowable (ASD) | Static | No | N.A. |
| 16-15Di Second Order | 73 | Allowable (ASD) | Static | Yes | N.A. |
| 16-16 »+X | 30 | Allowable (ASD) | Static | No | Normal |
| 16-16 »+X Second Order | 74 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »+X:Ω | 31 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »+X:Ω Second Order | 75 | Allowable (ASD) | Static | Yes | Over-Strength |
| 16-16 »-X | 32 | Allowable (ASD) | Static | No | Normal |
| 16-16 »-X Second Order | 76 | Allowable (ASD) | Static | Yes | Normal |
| 16-16 »-X:Ω | 33 | Allowable (ASD) | Static | No | Over-Strength |
| 16-16 »-X:Ω Second Order | 77 | Allowable (ASD) | Static | Yes | Over-Strength |
| D | 1 | No Design | Static | No | N.A. |
| D Second Order | 45 | No Design | Static | Yes | N.A. |
| D+0.75(L+W) »+X | 35 | Deflections | Static | No | N.A. |
| D+0.75(L+W) »+X Second Order | 79 | Deflections | Static | Yes | N.A. |
| D+0.75(L+W) »-X | 36 | Deflections | Static | No | N.A. |

**Result Cases (continued)**

| Name | ID | Design Checks | Result Type | P-Delta? | Seismic Type |
|---|---|---|---|---|---|
| D+0.75(L+W) »-X Second Order | 80 | Deflections | Static | Yes | N.A. |
| D+L | 34 | Deflections | Static | No | N.A. |
| D+L Second Order | 78 | Deflections | Static | Yes | N.A. |
| D+Lr | 38 | Deflections | Static | No | N.A. |
| D+Lr Second Order | 82 | Deflections | Static | Yes | N.A. |
| D+S | 37 | Deflections | Static | No | N.A. |
| D+S Second Order | 81 | Deflections | Static | Yes | N.A. |
| E+X | 2 | No Design | Static | No | Normal |
| E+X Second Order | 46 | No Design | Static | Yes | Normal |
| E-X | 3 | No Design | Static | No | Normal |
| E-X Second Order | 47 | No Design | Static | Yes | Normal |
| L | 4 | No Design | Static | No | N.A. |
| L Second Order | 48 | No Design | Static | Yes | N.A. |
| Live | 39 | Deflections | Static | No | N.A. |
| Live Second Order | 83 | Deflections | Static | Yes | N.A. |
| S | 5 | No Design | Static | No | N.A. |
| S Second Order | 49 | No Design | Static | Yes | N.A. |
| Seismic »+X | 43 | Deflections | Static | No | Normal |
| Seismic »+X Second Order | 87 | Deflections | Static | Yes | Normal |
| Seismic »-X | 44 | Deflections | Static | No | Normal |
| Seismic »-X Second Order | 88 | Deflections | Static | Yes | Normal |
| Snow | 40 | Deflections | Static | No | N.A. |
| Snow Second Order | 84 | Deflections | Static | Yes | N.A. |
| W+X | 6 | No Design | Static | No | N.A. |
| W+X Second Order | 50 | No Design | Static | Yes | N.A. |
| W-X | 7 | No Design | Static | No | N.A. |
| W-X Second Order | 51 | No Design | Static | Yes | N.A. |
| Wind »+X | 41 | Deflections | Static | No | N.A. |
| Wind »+X Second Order | 85 | Deflections | Static | Yes | N.A. |
| Wind »-X | 42 | Deflections | Static | No | N.A. |
| Wind »-X Second Order | 86 | Deflections | Static | Yes | N.A. |

**Node Reactions**

(extreme rows: max and min)

| Node | Result Case | FX K | FY K | FZ K | MX K-ft | MY K-ft | MZ K-ft |
|---|---|---|---|---|---|---|---|
| N002 | 16-9 | 0.0000 | **9.0204** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | 16-9 Second Order | 0.0000 | **9.0204** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | D+L | 0.0000 | **9.0204** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | D+L Second Order | 0.0000 | **9.0204** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | E+X | 0.0000 | **-0.7940** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | E+X Second Order | 0.0000 | **-0.7940** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Node Reactions (continued)** (extreme rows: max and min)

| Node | Result Case | FX K | FY K | FZ K | MX K-ft | MY K-ft | MZ K-ft |
|---|---|---|---|---|---|---|---|
| N002 | Seismic »+X | 0.0000 | **-0.7940** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N002 | Seismic »+X Second Order | 0.0000 | **-0.7940** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Member Forces** (extreme rows: max and min)

| Member | Fx Min K | Fx Max K | Vy K | Mz Min K-ft | Mz Max K-ft |
|---|---|---|---|---|---|
| BmX003 | 0.0000 (88) | 0.0000 (88) | **-9.0204 (34)** | **-2.6142 (88)** | **55.2048 (24)** |

**Member Relative Deflections**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-8 | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | 16-8 Second Order | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | 16-9 | -0.7330 | 0.0000 | 384.7251 |
| BmX003 | 16-9 Second Order | -0.7330 | 0.0000 | 384.7251 |
| BmX003 | 16-10S | -0.1784 | 0.0000 | 1580.8050 |
| BmX003 | 16-10S Second Order | -0.1784 | 0.0000 | 1580.8050 |
| BmX003 | 16-11Lr | -0.5969 | 0.0000 | 472.4327 |
| BmX003 | 16-11Lr Second Order | -0.5969 | 0.0000 | 472.4327 |
| BmX003 | 16-11S | -0.5892 | 0.0000 | 478.6139 |
| BmX003 | 16-11S Second Order | -0.5892 | 0.0000 | 478.6139 |
| BmX003 | 16-12E »+X | -0.2635 | 0.0000 | 1070.2779 |
| BmX003 | 16-12E »+X Second Order | -0.2635 | 0.0000 | 1070.2779 |
| BmX003 | 16-12E »+X:Ω | -0.3525 | 0.0000 | 800.0734 |
| BmX003 | 16-12E »+X:Ω Second Order | -0.3525 | 0.0000 | 800.0734 |
| BmX003 | 16-12E »-X | -0.2049 | 0.0000 | 1376.5804 |
| BmX003 | 16-12E »-X Second Order | -0.2049 | 0.0000 | 1376.5804 |
| BmX003 | 16-12E »-X:Ω | -0.1758 | 0.0000 | 1603.9053 |
| BmX003 | 16-12E »-X:Ω Second Order | -0.1758 | 0.0000 | 1603.9053 |
| BmX003 | 16-12W »+X | -0.1960 | 0.0000 | 1438.8368 |
| BmX003 | 16-12W »+X Second Order | -0.1960 | 0.0000 | 1438.8368 |
| BmX003 | 16-12W »-X | -0.1814 | 0.0000 | 1554.7123 |
| BmX003 | 16-12W »-X Second Order | -0.1814 | 0.0000 | 1554.7123 |
| BmX003 | 16-13Lr »+X | -0.6024 | 0.0000 | 468.1255 |
| BmX003 | 16-13Lr »+X Second Order | -0.6024 | 0.0000 | 468.1255 |
| BmX003 | 16-13Lr »-X | -0.5914 | 0.0000 | 476.8117 |
| BmX003 | 16-13Lr »-X Second Order | -0.5914 | 0.0000 | 476.8117 |
| BmX003 | 16-13S »+X | -0.5947 | 0.0000 | 474.1939 |
| BmX003 | 16-13S »+X Second Order | -0.5947 | 0.0000 | 474.1939 |
| BmX003 | 16-13S »-X | -0.5837 | 0.0000 | 483.1088 |
| BmX003 | 16-13S »-X Second Order | -0.5837 | 0.0000 | 483.1088 |

**Member Relative Deflections (continued)**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | 16-14 »+X | -0.6452 | 0.0000 | 437.1041 |
| BmX003 | 16-14 »+X Second Order | -0.6452 | 0.0000 | 437.1041 |
| BmX003 | 16-14 »+X:Ω | -0.7111 | 0.0000 | 396.5614 |
| BmX003 | 16-14 »+X:Ω Second Order | -0.7111 | 0.0000 | 396.5614 |
| BmX003 | 16-14 »-X | -0.6013 | 0.0000 | 468.9814 |
| BmX003 | 16-14 »-X Second Order | -0.6013 | 0.0000 | 468.9814 |
| BmX003 | 16-14 »-X:Ω | -0.5793 | 0.0000 | 486.8188 |
| BmX003 | 16-14 »-X:Ω Second Order | -0.5793 | 0.0000 | 486.8188 |
| BmX003 | 16-15 »+X | -0.1205 | 0.0000 | 2339.5736 |
| BmX003 | 16-15 »+X Second Order | -0.1205 | 0.0000 | 2339.5736 |
| BmX003 | 16-15 »-X | -0.1059 | 0.0000 | 2662.3079 |
| BmX003 | 16-15 »-X Second Order | -0.1059 | 0.0000 | 2662.3079 |
| BmX003 | 16-15Di | -0.1132 | 0.0000 | 2491.1369 |
| BmX003 | 16-15Di Second Order | -0.1132 | 0.0000 | 2491.1369 |
| BmX003 | 16-16 »+X | -0.1266 | 0.0000 | 2227.7073 |
| BmX003 | 16-16 »+X Second Order | -0.1266 | 0.0000 | 2227.7073 |
| BmX003 | 16-16 »+X:Ω | -0.2164 | 0.0000 | 1303.0548 |
| BmX003 | 16-16 »+X:Ω Second Order | -0.2164 | 0.0000 | 1303.0548 |
| BmX003 | 16-16 »-X | -0.0677 | 0.0000 | 4163.8311 |
| BmX003 | 16-16 »-X Second Order | -0.0677 | 0.0000 | 4163.8311 |
| BmX003 | 16-16 »-X:Ω | -0.0399 | 0.0000 | 7064.9572 |
| BmX003 | 16-16 »-X:Ω Second Order | -0.0399 | 0.0000 | 7064.9572 |
| BmX003 | D | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | D Second Order | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | D+0.75(L+W) »+X | -0.6061 | 0.0000 | 465.2974 |
| BmX003 | D+0.75(L+W) »+X Second Order | -0.6061 | 0.0000 | 465.2974 |
| BmX003 | D+0.75(L+W) »-X | -0.5878 | 0.0000 | 479.7739 |
| BmX003 | D+0.75(L+W) »-X Second Order | -0.5878 | 0.0000 | 479.7739 |
| BmX003 | D+L | -0.7330 | 0.0000 | 384.7251 |
| BmX003 | D+L Second Order | -0.7330 | 0.0000 | 384.7251 |
| BmX003 | D+Lr | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | D+Lr Second Order | -0.1887 | 0.0000 | 1494.6821 |
| BmX003 | D+S | -0.1784 | 0.0000 | 1580.8050 |
| BmX003 | D+S Second Order | -0.1784 | 0.0000 | 1580.8050 |
| BmX003 | E+X | -0.0646 | 0.0000 | 4367.6125 |
| BmX003 | E+X Second Order | -0.0646 | 0.0000 | 4367.6125 |
| BmX003 | E-X | 0.0000 | 0.0218 | 12927.6950 |
| BmX003 | E-X Second Order | 0.0000 | 0.0218 | 12927.6950 |
| BmX003 | L | -0.5443 | 0.0000 | 518.0756 |
| BmX003 | L Second Order | -0.5443 | 0.0000 | 518.0756 |

**Member Relative Deflections (continued)**

| Member | Result Case | Min Dy in | Max Dy in | \|L/Dy\| |
|---|---|---|---|---|
| BmX003 | Live | -0.5443 | 0.0000 | 518.0756 |
| BmX003 | Live Second Order | -0.5443 | 0.0000 | 518.0756 |
| BmX003 | S | 0.0000 | 0.0103 | 27435.2486 |
| BmX003 | S Second Order | 0.0000 | 0.0103 | 27435.2486 |
| BmX003 | Seismic »+X | -0.0646 | 0.0000 | 4367.6125 |
| BmX003 | Seismic »+X Second Order | -0.0646 | 0.0000 | 4367.6125 |
| BmX003 | Seismic »-X | 0.0000 | 0.0218 | 12927.6950 |
| BmX003 | Seismic »-X Second Order | 0.0000 | 0.0218 | 12927.6950 |
| BmX003 | Snow | 0.0000 | 0.0103 | 27435.2486 |
| BmX003 | Snow Second Order | 0.0000 | 0.0103 | 27435.2486 |
| BmX003 | W+X | -0.0126 | 0.0000 | 22329.6550 |
| BmX003 | W+X Second Order | -0.0126 | 0.0000 | 22329.6550 |
| BmX003 | W-X | 0.0000 | 0.0126 | 22366.7716 |
| BmX003 | W-X Second Order | 0.0000 | 0.0126 | 22366.7716 |
| BmX003 | Wind »+X | -0.0126 | 0.0000 | 22329.6550 |
| BmX003 | Wind »+X Second Order | -0.0126 | 0.0000 | 22329.6550 |
| BmX003 | Wind »-X | 0.0000 | 0.0126 | 22366.7716 |
| BmX003 | Wind »-X Second Order | 0.0000 | 0.0126 | 22366.7716 |

***Column Buckling Calculations***

*Column Geometry Data*

| | | |
|---|---|---|
| $d_2$ or b | 1.5 | in |
| $d_1$ | 5.5 | in |
| $Le_1$ | 14.0 | ft |
| $Le_2$ | 1.0 | ft |

*Bracing*

| |
|---|
| 81 |
| |

*Column Design Values*

| | | |
|---|---|---|
| $F_b$ | 2900 | psi |
| $F_c$ | 2900 | psi |
| Emin' | 1016 | ksi |
| Fcperp (Hem Fir Plt) | 625 | psi |
| cb | 1.25 | |

| *Bearing* |
|---|
| *Area* |
| *Increase* |
| no |

*Column Loading*

| | | |
|---|---|---|
| P | 6100 | lbs |
| $W_1$ | 774 | plf |
| $M_1$ | | ft-lbs |
| $W_2$ | 0 | plf |
| $M_2$ | 0 | ft-lbs |

*Flexural Stress Adjustment Factors*

| | |
|---|---|
| Roof/EQ / Wind - $C_D$ | 1.60 |
| Size Factor - $C_F$ | 1.00 |
| Repetitive - $C_r$ | 1.15 |

*Compressive Stress Adjustment Factors*

| | |
|---|---|
| Roof/EQ / Wind - $C_D$ | 1.15 |
| Size Factor - $C_F$ | 1.00 |

*Other Factors*

| | |
|---|---|
| c | 0.8 |
| Kf | 1 |
| Ke | 1 |
| $R_{B1}$ | 20.26 |
| $R_{B2}$ | 0.77 |

*Column Stability Factor Calculation*

| | Strong Axis | | Weak Axis | |
|---|---|---|---|---|
| $Fce_1$ | 895 | psi | $Fce_2$ 13049 | psi |
| $Fc^*_1$ | 3335 | psi | $Fc^*_2$ 3335 | psi |
| $Fce_1/Fc^*_1$ | 0.268 | | $Fce_2/Fc^*_2$ 3.913 | |
| $Cp_1$ | 0.251 | | $Cp_2$ 0.940 | |

*Beam Stability Factor Calculation*

| | Strong Axis | | Weak Axis | |
|---|---|---|---|---|
| $Fbe_1$ | 2969 | psi | $Fbe_2$ 2048933 | psi |
| $Fb^*_1$ | 5336 | psi | $Fb^*_2$ 5336 | psi |
| $Fbe_1/Fb^*_1$ | 0.6 | | $Fbe_2/Fb^*_2$ 384 | |
| $CL_1$ | 0.53 | | $CL_2$ 1.00 | |

*Adjusted Allowable Stresses*

| | Strong Axis | | Weak Axis | |
|---|---|---|---|---|
| $Fc'_1$ | 839 | psi | $Fc'_2$ 3137 | psi |
| $Fb'_1$ | 2812 | psi | $Fb'_2$ 5335 | psi |

*Imposed Column Stresses*

| | Strong Axis | | Weak Axis | |
|---|---|---|---|---|
| $fc_1$ | 739 | psi | $fc_2$ 739 | psi |
| $fb_1$ | 0 | psi | $fb_2$ 0 | psi |

*Perpendicular to Grain Stress Check*

| | | | |
|---|---|---|---|
| Fcperp | 781 | psi | |
| fcperp | 739 | psi | OK |

*Allowable Stress Interaction Formula* 0.78 OK

$$\left(\frac{f_c}{F_c'}\right)^2+\frac{f_{b1}}{F_{b1}'\left[1-f_c/F_{cE1}\right]}+\frac{f_{b2}}{F_{b2}'\left[1-f_c/F_{cE2}-\left(f_{b1}/F_{bE1}\right)\right]}\le 1.0$$

*Slenderness Check le/d* 31 OK

*Slenderness Check le/b* 8 OK

Date: 11/29/2022
Project #: Rader Residence
Design: CRB
Sheet: Mercer Island, WA