# RB Engineers, Inc.

**1312 2ND ST.**
**KIRKLAND, WA. 98033**
**PH: (425) 822-3009**
**FAX: (425) 822-2679**
**CELL: (425) 351-2085**
**EMAIL: rbe1992@gmail.com**


JOB: MERLINO
PROJECT #: 20-7888
BY: R.B. / MJT
DATE: 4/21/2021



## STUCTURAL PLAN CHECK REPLY FOR

MERLINO RESIDENCE
MERCER ISLAND, WA

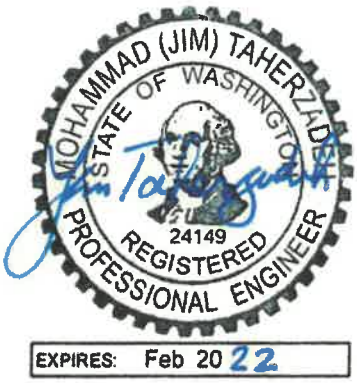
**BASIS FOR DESIGN:**

CODE: INTERNATIONAL BUILDING CODE (2015 EDITION)
WIND: 110 MPH, EXPOSURE "B" Kzt = 1.3
SEISMIC: Ss = 1.55, S1 = 0.55 (SITE CLASS D)
ROOF SNOW: 25 PSF

**INDEX TO COMPUTATIONS:**



**RB ENGINEERS, INC. IS NOT RESPONSIBLE FOR THE SITE, SOILS, WEATHER PROOFING, TRUSSES AND/OR EXISTING CONDITIONS.**



**RB Engineers, Inc.**
1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

| | | | |
|---|---|---|---|
| Project: | Merlino Residence | By: | RB/MJT |
| Client: | | Date: | 9/10/2020 |
| Subject: | Lateral Calculations | Page: | G2/ |

## LOADING CRITERIA FOR ROOF AND/OR CEILING

- Main Roof Area
- Canopy or Mansard Roof
- Ceiling Only
- Other

| Item | Material | Load PSF |
|---|---|---|
| Roofing | Composition | 2.2 |
| Sheathing or Decking | 15/32 CDX | 1.5 |
| Insulation | | 2.8 |
| Ceiling | 5/8 GWB | 2.6 |
| Fixtures | | 1.0 |
| Framing | Truss | 2.3 |
| Misc. | | 0.6 |

**TOTAL DEAD LOAD :** 13 PSF

### LIVE LOADS

- Snow Load - 25 psf - non reducible
- Ceiling Only - 10 psf
- Increase in $F_b$ and $F_v$ of 15% allowed for duration of load

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## LOADING CRITERIA FOR FLOOR

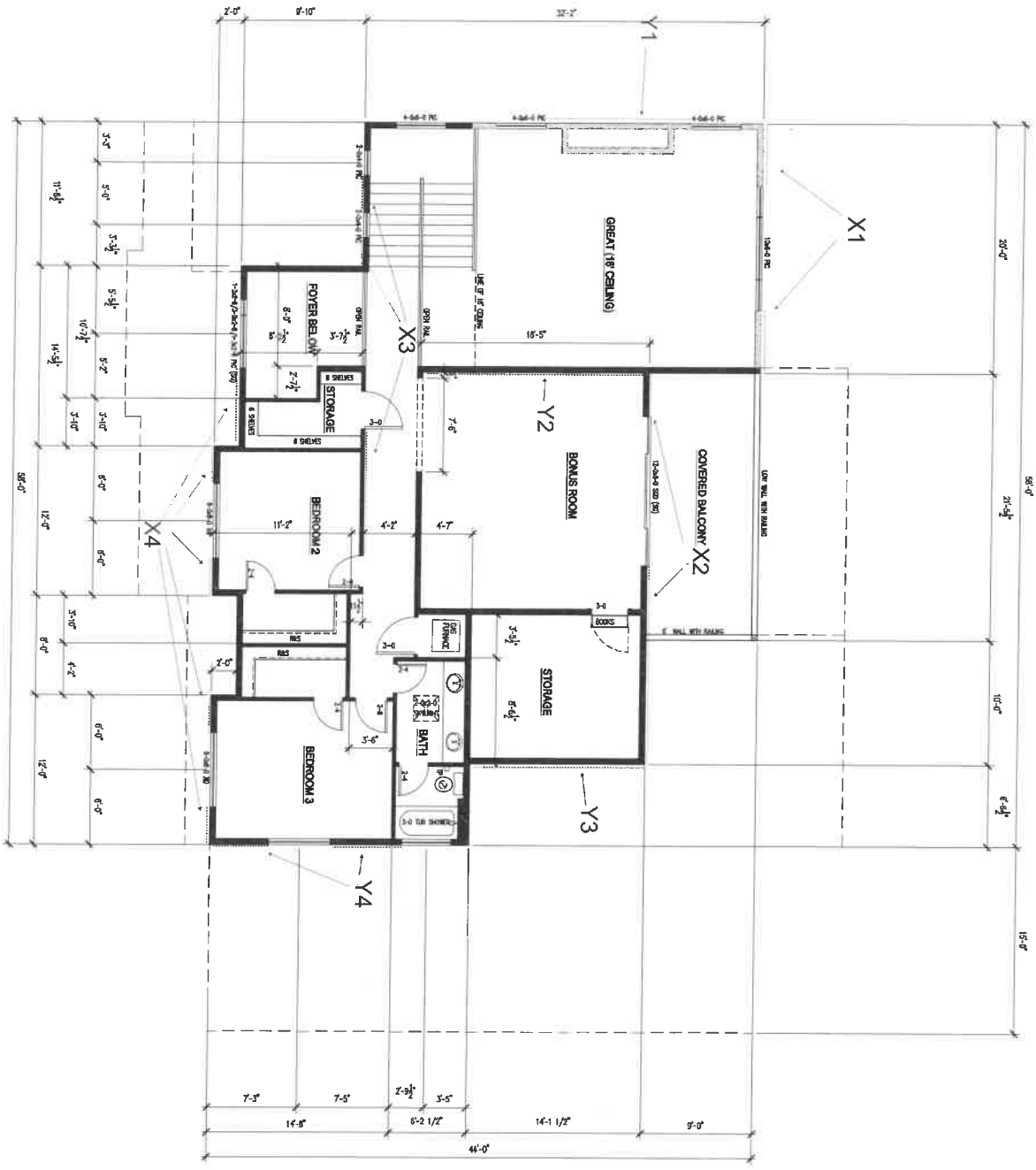
| Item | Material | Load PSF |
|---|---|---|
| Floor Covering | Carpet and Pad | 3.0 |
| Floor Sheathing | 3/4" T&G CDX | 2.3 |
| Ceiling | 1/2" GWB | 2.2 |
| Fixtures | | 1.0 |
| Framing | TJI's | 3.0 |
| Misc | | 1.5 |

**TOTAL DEAD LOAD :** 13 PSF

### LIVE LOADS

- Residential - 40 psf (reducible)
- Office - 50 psf (reducible)
- Assembly - 100 psf (non-reducible)
- Corridors and Exits - 100 psf (reducible)
- Storage - 125 psf (non-reducible)

SW Key Plan




N S E W

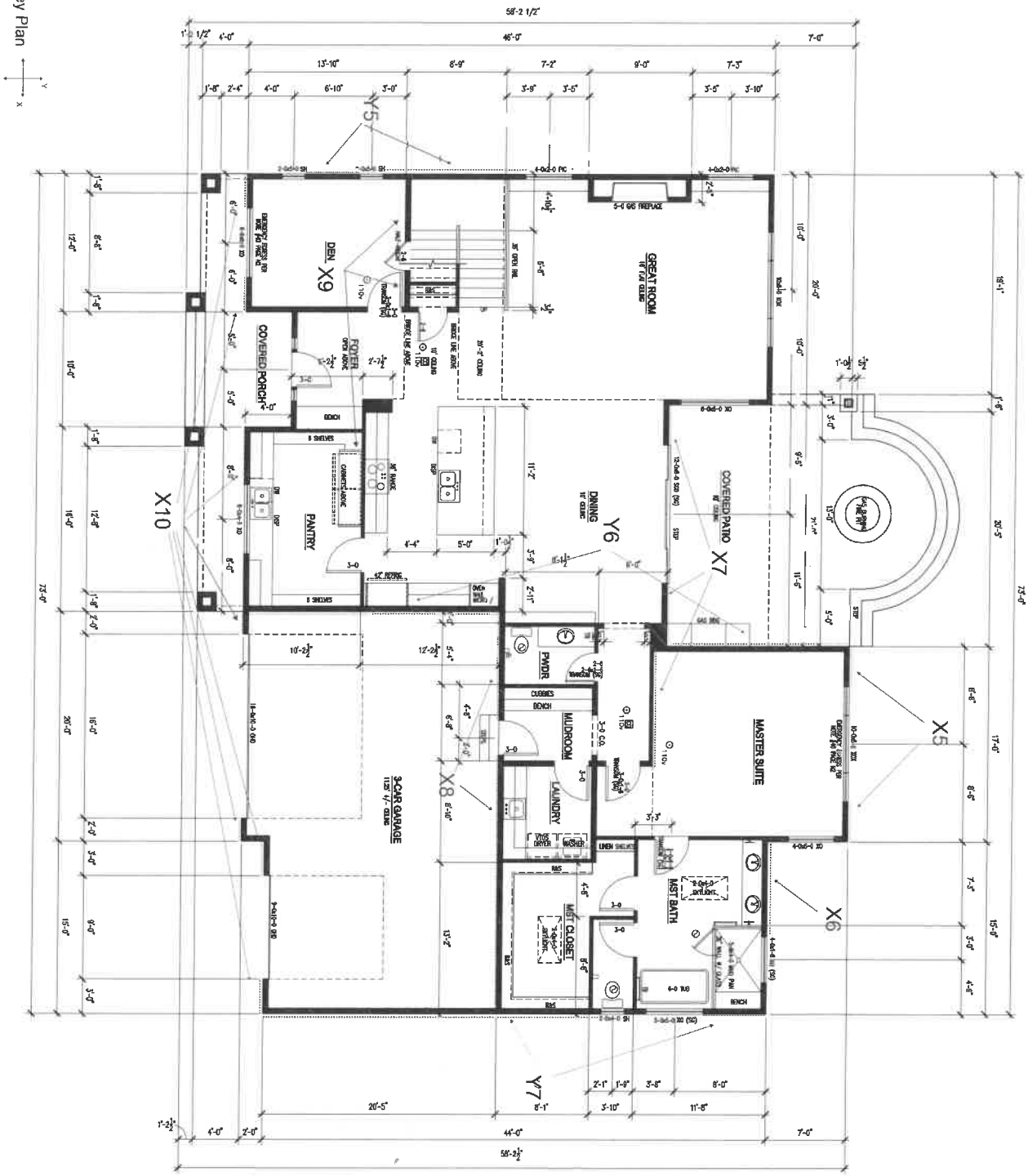
| | |
|---|---|
| SHEET NUMBER | A4 |
| COMPUTER FILE NAME | |
| REVISED | 7.24.2020 |
| SCALE | 1/4"=1'-0" |
| DATE | 7.16.2020 |

# MERLINO RESIDENCE

MERCER ISLAND, WA

## UPPER LEVEL FLOOR PLAN

206.460.6800




| FLOOR AREA: | |
|---|---|
| MAIN LEVEL: | 2442 S.F. |
| UPPER LEVEL: | 1302 S.F. |
| TOTAL HEATED AREA: | 3744 S.F. |
| GARAGE: | 764 S.F. |
| ENTRY PORCH: | 192 S.F. |
| REAR PATIO: | 360 S.F. |
| COVERED BALCONY: | 208 S.F. |

ADD 18 S.F. TO MAIN LEVEL

| FLOOR AREA RATIO: | |
|---|---|
| MAXIMUM ALLOWED: | 5245 S.F. 40% |
| TOTAL LIVING: | 3744 S.F. |
| GARAGE: | 764 S.F. |
| GREAT ROOM TALL CEILING: (460 S.F. x .5) | 230 S.F. |
| FOYER TALL CEILING: (70 S.F. x .1) | 85 S.F. |
| STAIRWELL CEILING: (193 S.F. x 1) | 193 S.F. |
| PROPOSED F.A.R. | 4016 S.F. |

# MERLINO RESIDENCE

MERCER ISLAND, WA

MAIN LEVEL FLOOR PLAN

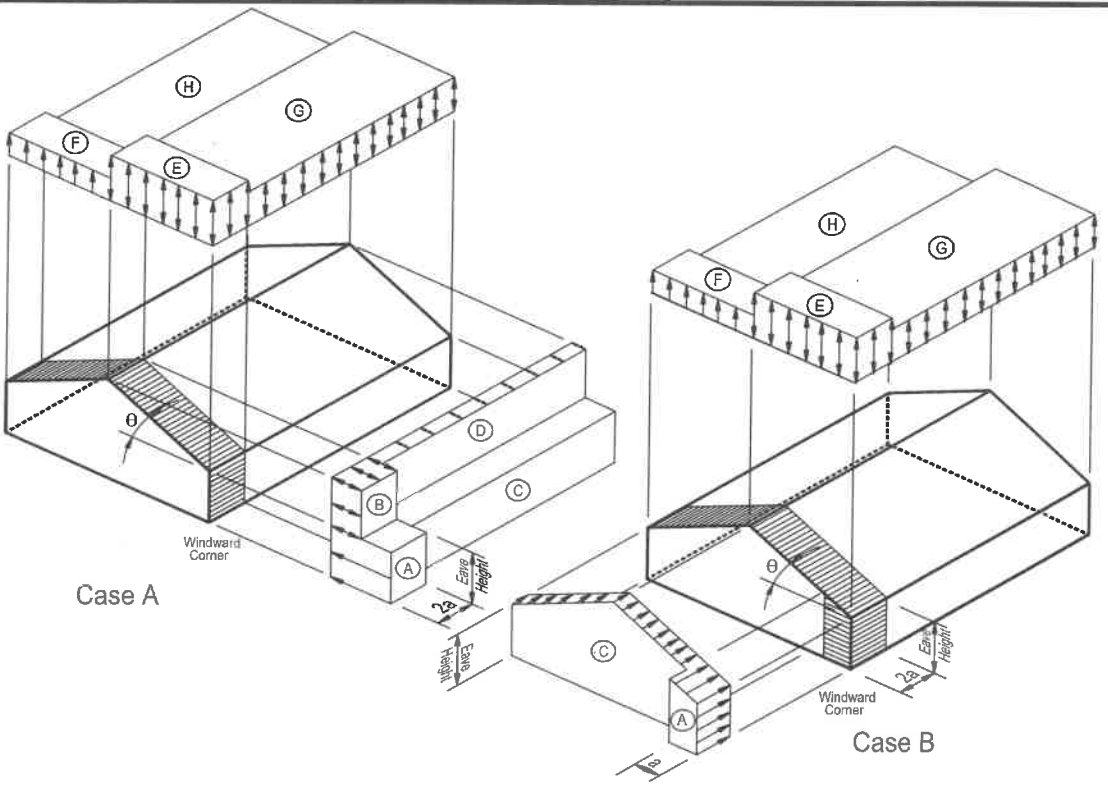
A2

7.24.2020

1/4"=1'-0"

7.16.2020

| Main Wind Force Resisting System – Method 2 | | h ≤ 60 ft. |
|---|---|---|
| Figure 28.6-1 | Design Wind Pressures | **Walls & Roofs** |
| Enclosed Buildings | | |




Notes:

1. Pressures shown are applied to the horizontal and vertical projections, for exposure B, at h=30 ft (9.1m). Adjust to other exposures and heights with adjustment factor λ.
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner. (See Figure 28.4-1)
3. For Case B use $\theta = 0°$.
4. Load cases 1 and 2 must be checked for $25° < \theta \leq 45°$. Load case 2 at 25° is provided only for interpolation between 25° and 30°.
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming $p_S = 0$ in zones B & D.
8. Where zone E or G falls on a roof overhang on the windward side of the building, use $E_{OH}$ and $G_{OH}$ for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.
9. Notation:
   - *a:* 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).
   - *h:* Mean roof height, in feet (meters), except that eave height shall be used for roof angles <10°.
   - *θ:* Angle of plane of roof from horizontal, in degrees.

| Main Wind Force Resisting System – Method 2 | | h ≤ 60 ft. |
|---|---|---|
| Figure 28.6-1 (cont'd) | Design Wind Pressures | Walls & Roofs |
| Enclosed Buildings | | |

## Simplified Design Wind Pressure , $p_{S30}$ (psf) *(Exposure B at h = 30 ft. with I = 1.0)*

| Basic Wind Speed (mph) | Roof Angle (degrees) | Load Case | Zones | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Horizontal Pressures | | | | Vertical Pressures | | | | Overhangs | |
| | | | A | B | C | D | E | F | G | H | EOH | GOH |
| 110 | 0 to 5° | 1 | 19.2 | -10.0 | 12.7 | -5.9 | -23.1 | -13.1 | -16.0 | -10.1 | -32.3 | -25.3 |
| | 10° | 1 | 21.6 | -9.0 | 14.4 | -5.2 | -23.1 | -14.1 | -16.0 | -10.8 | -32.3 | -25.3 |
| | 15° | 1 | 24.1 | -8.0 | 16.0 | -4.6 | -23.1 | -15.1 | -16.0 | -11.5 | -32.3 | -25.3 |
| | 20° | 1 | 26.6 | -7.0 | 17.7 | -3.9 | -23.1 | -16.0 | -16.0 | -12.2 | -32.3 | -25.3 |
| | 25° | 1 | 24.1 | 3.9 | 17.4 | 4.0 | -10.7 | -14.6 | -7.7 | -11.7 | -19.9 | -17.0 |
| | | 2 | ------- | ------- | ------- | ------- | -4.1 | -7.9 | -1.1 | -5.1 | ------- | ------- |
| | 30 to 45 | 1 | 21.6 | 14.8 | 17.2 | 11.8 | 1.7 | -13.1 | 0.6 | -11.3 | -7.6 | -8.7 |
| | | 2 | 21.6 | 14.8 | 17.2 | 11.8 | 8.3 | -6.5 | 7.2 | -4.6 | -7.6 | -8.7 |
| 115 | 0 to 5° | 1 | 21.0 | -10.9 | 13.9 | -6.5 | -25.2 | -14.3 | -17.5 | -11.1 | -35.3 | -27.6 |
| | 10° | 1 | 23.7 | -9.8 | 15.7 | -5.7 | -25.2 | -15.4 | -17.5 | -11.8 | -35.3 | -27.6 |
| | 15° | 1 | 26.3 | -8.7 | 17.5 | -5.0 | -25.2 | -16.5 | -17.5 | -12.6 | -35.3 | -27.6 |
| | 20° | 1 | 29.0 | -7.7 | 19.4 | -4.2 | -25.2 | -17.5 | -17.5 | -13.3 | -35.3 | -27.6 |
| | 25° | 1 | 26.3 | 4.2 | 19.1 | 4.3 | -11.7 | -15.9 | -8.5 | -12.8 | -21.8 | -18.5 |
| | | 2 | ------- | ------- | ------- | ------- | -4.4 | -8.7 | -1.2 | -5.5 | ------- | ------- |
| | 30 to 45 | 1 | 23.6 | 16.1 | 18.8 | 12.9 | 1.8 | -14.3 | 0.6 | -12.3 | -8.3 | -9.5 |
| | | 2 | 23.6 | 16.1 | 18.8 | 12.9 | 9.1 | -7.1 | 7.9 | -5.0 | -8.3 | -9.5 |
| 120 | 0 to 5° | 1 | 22.8 | -11.9 | 15.1 | -7.0 | -27.4 | -15.6 | -19.1 | -12.1 | -38.4 | -30.1 |
| | 10° | 1 | 25.8 | -10.7 | 17.1 | -6.2 | -27.4 | -16.8 | -19.1 | -12.9 | -38.4 | -30.1 |
| | 15° | 1 | 28.7 | -9.5 | 19.1 | -5.4 | -27.4 | -17.9 | -19.1 | -13.7 | -38.4 | -30.1 |
| | 20° | 1 | 31.6 | -8.3 | 21.1 | -4.6 | -27.4 | -19.1 | -19.1 | -14.5 | -38.4 | -30.1 |
| | 25° | 1 | 28.6 | 4.6 | 20.7 | 4.7 | -12.7 | -17.3 | -9.2 | -13.9 | -23.7 | -20.2 |
| | | 2 | ------- | ------- | ------- | ------- | -4.8 | -9.4 | -1.3 | -6.0 | ------- | ------- |
| | 30 to 45 | 1 | 25.7 | 17.6 | 20.4 | 14.0 | 2.0 | -15.6 | 0.7 | -13.4 | -9.0 | -10.3 |
| | | 2 | 25.7 | 17.6 | 20.4 | 14.0 | 9.9 | -7.7 | 8.6 | -5.5 | -9.0 | -10.3 |
| 130 | 0 to 5° | 1 | 26.8 | -13.9 | 17.8 | -8.2 | -32.2 | -18.3 | -22.4 | -14.2 | -45.1 | -35.3 |
| | 10° | 1 | 30.2 | -12.5 | 20.1 | -7.3 | -32.2 | -19.7 | -22.4 | -15.1 | -45.1 | -35.3 |
| | 15° | 1 | 33.7 | -11.2 | 22.4 | -6.4 | -32.2 | -21.0 | -22.4 | -16.1 | -45.1 | -35.3 |
| | 20° | 1 | 37.1 | -9.8 | 24.7 | -5.4 | -32.2 | -22.4 | -22.4 | -17.0 | -45.1 | -35.3 |
| | 25° | 1 | 33.6 | 5.4 | 24.3 | 5.5 | -14.9 | -20.4 | -10.8 | -16.4 | -27.8 | -23.7 |
| | | 2 | ------- | ------- | ------- | ------- | -5.7 | -11.1 | -1.5 | -7.1 | ------- | ------- |
| | 30 to 45 | 1 | 30.1 | 20.6 | 24.0 | 16.5 | 2.3 | -18.3 | 0.8 | -15.7 | -10.6 | -12.1 |
| | | 2 | 30.1 | 20.6 | 24.0 | 16.5 | 11.6 | -9.0 | 10.0 | -6.4 | -10.6 | -12.1 |
| 140 | 0 to 5° | 1 | 31.1 | -16.1 | 20.6 | -9.6 | -37.3 | -21.2 | -26.0 | -16.4 | -52.3 | -40.9 |
| | 10° | 1 | 35.1 | -14.5 | 23.3 | -8.5 | -37.3 | -22.8 | -26.0 | -17.5 | -52.3 | -40.9 |
| | 15° | 1 | 39.0 | -12.9 | 26.0 | -7.4 | -37.3 | -24.4 | -26.0 | -18.6 | -52.3 | -40.9 |
| | 20° | 1 | 43.0 | -11.4 | 28.7 | -6.3 | -37.3 | -26.0 | -26.0 | -19.7 | -52.3 | -40.9 |
| | 25° | 1 | 39.0 | 6.3 | 28.2 | 6.4 | -17.3 | -23.6 | -12.5 | -19.0 | -32.3 | -27.5 |
| | | 2 | ------- | ------- | ------- | ------- | -6.6 | -12.8 | -1.8 | -8.2 | ------- | ------- |
| | 30 to 45 | 1 | 35.0 | 23.9 | 27.8 | 19.1 | 2.7 | -21.2 | 0.9 | -18.2 | -12.3 | -14.0 |
| | | 2 | 35.0 | 23.9 | 27.8 | 19.1 | 13.4 | -10.5 | 11.7 | -7.5 | -12.3 | -14.0 |
| 150 | 0 to 5° | 1 | 35.7 | -18.5 | 23.7 | -11.0 | -42.9 | -24.4 | -29.8 | -18.9 | -60.0 | -47.0 |
| | 10° | 1 | 40.2 | -16.7 | 26.8 | -9.7 | -42.9 | -26.2 | -29.8 | -20.1 | -60.0 | -47.0 |
| | 15° | 1 | 44.8 | -14.9 | 29.8 | -8.5 | -42.9 | -28.0 | -29.8 | -21.4 | -60.0 | -47.0 |
| | 20° | 1 | 49.4 | -13.0 | 32.9 | -7.2 | -42.9 | -29.8 | -29.8 | -22.6 | -60.0 | -47.0 |
| | 25° | 1 | 44.8 | 7.2 | 32.4 | 7.4 | -19.9 | -27.1 | -14.4 | -21.8 | -37.0 | -31.6 |
| | | 2 | ------- | ------- | ------- | ------- | -7.5 | -14.7 | -2.1 | -9.4 | ------- | ------- |
| | 30 to 45 | 1 | 40.1 | 27.4 | 31.9 | 22.0 | 3.1 | -24.4 | 1.0 | -20.9 | -14.1 | -16.1 |
| | | 2 | 40.1 | 27.4 | 31.9 | 22.0 | 15.4 | -12.0 | 13.4 | -8.6 | -14.1 | -16.1 |

**Unit Conversions – 1.0 ft = 0.3048 m; 1.0 psf = 0.0479 kN/m$^2$**

| Main Wind Force Resisting System – Method 2 | | h ≤ 60 ft. |
|---|---|---|
| Figure 28.6-1 (cont'd) | Design Wind Pressures | Walls & Roofs |
| Enclosed Buildings | | |

## Simplified Design Wind Pressure , $p_{S30}$ (psf) *(Exposure B at h = 30 ft.)*

| Basic Wind Speed (mph) | Roof Angle (degrees) | Load Case | Zones | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Horizontal Pressures | | | | Vertical Pressures | | | | Overhangs | |
| | | | A | B | C | D | E | F | G | H | EOH | GOH |
| 160 | 0 to 5° | 1 | 40.6 | -21.1 | 26.9 | -12.5 | -48.8 | -27.7 | -34.0 | -21.5 | -68.3 | -53.5 |
| | 10° | 1 | 45.8 | -19.0 | 30.4 | -11.1 | -48.8 | -29.8 | -34.0 | -22.9 | -68.3 | -53.5 |
| | 15° | 1 | 51.0 | -16.9 | 34.0 | -9.6 | -48.8 | -31.9 | -34.0 | -24.3 | -68.3 | -53.5 |
| | 20° | 1 | 56.2 | -14.8 | 37.5 | -8.2 | -48.8 | -34.0 | -34.0 | -25.8 | -68.3 | -53.5 |
| | 25° | 1 | 50.9 | 8.2 | 36.9 | 8.4 | -22.6 | -30.8 | -16.4 | -24.8 | -42.1 | -35.9 |
| | | 2 | ------- | ------- | ------- | ------- | -8.6 | -16.8 | -2.3 | -10.7 | ------- | ------- |
| | 30 to 45 | 1 | 45.7 | 31.2 | 36.3 | 25.0 | 3.5 | -27.7 | 1.2 | -23.8 | -16.0 | -18.3 |
| | | 2 | 45.7 | 31.2 | 36.3 | 25.0 | 17.6 | -13.7 | 15.2 | -9.8 | -16.0 | -18.3 |
| 180 | 0 to 5° | 1 | 51.4 | -26.7 | 34.1 | -15.8 | -61.7 | -35.1 | -43.0 | -27.2 | -86.4 | -67.7 |
| | 10° | 1 | 58.0 | -24.0 | 38.5 | -14.0 | -61.7 | -37.7 | -43.0 | -29.0 | -86.4 | -67.7 |
| | 15° | 1 | 64.5 | -21.4 | 43.0 | -12.2 | -61.7 | -40.3 | -43.0 | -30.8 | -86.4 | -67.7 |
| | 20° | 1 | 71.1 | -18.8 | 47.4 | -10.4 | -61.7 | -43.0 | -43.0 | -32.6 | -86.4 | -67.7 |
| | 25° | 1 | 64.5 | 10.4 | 46.7 | 10.6 | -28.6 | -39.0 | -20.7 | -31.4 | -53.3 | -45.4 |
| | | 2 | ------- | ------- | ------- | ------- | -10.9 | -21.2 | -3.0 | -13.6 | ------- | ------- |
| | 30 to 45 | 1 | 57.8 | 39.5 | 45.9 | 31.6 | 4.4 | -35.1 | 1.5 | -30.1 | -20.3 | -23.2 |
| | | 2 | 57.8 | 39.5 | 45.9 | 31.6 | 22.2 | -17.3 | 19.3 | -12.3 | -20.3 | -23.2 |
| 200 | 0 to 5° | 1 | 63.4 | -32.9 | 42.1 | -19.5 | -76.2 | -43.3 | -53.1 | -33.5 | -106.7 | -83.5 |
| | 10° | 1 | 71.5 | -29.7 | 47.6 | -17.3 | -76.2 | -46.5 | -53.1 | -35.8 | -106.7 | -83.5 |
| | 15° | 1 | 79.7 | -26.4 | 53.1 | -15.0 | -76.2 | -49.8 | -53.1 | -38.0 | -106.7 | -83.5 |
| | 20° | 1 | 87.8 | -23.2 | 58.5 | -12.8 | -76.2 | -53.1 | -53.1 | -40.2 | -106.7 | -83.5 |
| | 25° | 1 | 79.6 | 12.8 | 57.6 | 13.1 | -35.4 | -48.2 | -25.6 | -38.7 | -65.9 | -56.1 |
| | | 2 | ------- | ------- | ------- | ------- | -13.4 | -26.2 | -3.7 | -16.8 | ------- | ------- |
| | 30 to 45 | 1 | 71.3 | 48.8 | 56.7 | 39.0 | 5.5 | -43.3 | 1.8 | -37.2 | -25.0 | -28.7 |
| | | 2 | 71.3 | 48.8 | 56.7 | 39.0 | 27.4 | -21.3 | 23.8 | -15.2 | -25.0 | -28.7 |

## Adjustment Factor for Building Height and Exposure, $\lambda$

| Mean roof height (ft) | Exposure | | |
|---|---|---|---|
| | B | C | D |
| 15 | 1.00 | 1.21 | 1.47 |
| 20 | 1.00 | 1.29 | 1.55 |
| 25 | 1.00 | 1.35 | 1.61 |
| 30 | 1.00 | 1.40 | 1.66 |
| 35 | 1.05 | 1.45 | 1.70 |
| 40 | 1.09 | 1.49 | 1.74 |
| 45 | 1.12 | 1.53 | 1.78 |
| 50 | 1.16 | 1.56 | 1.81 |
| 55 | 1.19 | 1.59 | 1.84 |
| 60 | 1.22 | 1.62 | 1.87 |

**Unit Conversions – 1.0 ft = 0.3048 m; 1.0 psf = 0.0479 kN/m$^2$**

leeward net pressures. $p_s$ shall be determined by the following equation:

$$p_s = \lambda K_{zt} p_{S30} \qquad (28.6\text{-}1)$$

where

$\lambda$ = adjustment factor for building height and exposure from Fig. 28.6-1
$K_{zt}$ = topographic factor as defined in Section 26.8 evaluated at mean roof height, $h$
$p_{S30}$ = simplified design wind pressure for Exposure B, at $h$ = 30 ft (9.1 m) from Fig. 28.6-1

**28.6.4 Minimum Design Wind Loads**

The load effects of the design wind pressures from Section 28.6.3 shall not be less than a minimum load defined by assuming the pressures, $p_s$, for zones A and C equal to +16 psf, Zones B and D equal to +8 psf, while assuming $p_s$ for Zones E, F, G, and H are equal to 0 psf.

**RB Engineers, Inc.**
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| Client: | | Date: | 9/10/2020 |
| Subject: | Lateral Calculations | Page: | L7/ |

## LATERAL WIND FORCES
## ENVELOPE PROCEDURE (ASCE 7-10 Chapter 28)

| | | | | | Design Wind Pressures | | |
|---|---|---|---|---|---|---|---|
| Roof Pitch: | 3:12 (14°) | | Wind Speed: | 110 mph | | | |
| Wind Exposure: | B | λ = 1.0 ASCE 7-10 p.305 | A: | 24.1 | C: | 16 | |
| Minimum Pressure: | 16 | psf (wall) 28.6.4 | B: | 0.0 | D: | 0.0 | |
| Minimum Pressure: | 8 | psf (roof) 28.6.4 | | | | | |
| Kzt: | 1.3 | | | | | | |

(ASCE 7-10) Using Allowable Stress Design, 2.4.1 Basic Combinations option 7: 0.6 D + 0.6 W

**X – X Direction**

| | | | |
|---|---|---|---|
| Σ Fw Roof = | (24.1x((4x2+4x1+9x5)) + 16.0x(32x1.5+12x4)) / 1000 = | | |
| | 2.91 x 1.3 Kzt x 0.6 = | 2.27 | kip |
| Σ Fw Upper = | (24.1x((11x5x2+4x2+5x3.5)) + 16.0x(28x10+5x4)) / 1000 = | | |
| | 8.07 x 1.3 Kzt x 0.6 = | 6.29 | kip |
| Roof Min = | ((16x(57+96)+8x(38+255)) / 1000) x 1.3 Kzt x 0.6 = | 3.74 | kip |
| Upper Min = | ((16x(135.5+300)+8x(65+18)) / 1000) x 1.3 Kzt x 0.6 = | 5.96 | kip |

**Y – Y Direction**

| | | | |
|---|---|---|---|
| Σ Fw Roof = | (24.1x((15x5)) + 16.0x(43x5)) / 1000 = | | |
| | 5.25 x 1.3 Kzt x 0.6 = | 4.09 | kip |
| Σ Fw Upper = | (24.1x((15x5x2+4.5x2.5+5x3.5)) + 16.0x(9x7.5+34x5)) / 1000 = | | |
| | 8.11 x 1.3 Kzt x 0.6 = | 6.32 | kip |
| Roof Min = | ((16x(75+215)+8x(45+215))) / 1000) x 1.3 Kzt x 0.6 = | 5.24 | kip |
| Upper Min = | ((16x(178.75+237.5)+8x(96.5+95) / 1000) x 1.3 Kzt x 0.6 = | 6.39 | kip |

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1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

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## QUAKE FORCES (ASCE 7-10)

Site Class "D" (Table 11.4.2)

Ss = 1.55 - Critical Values per Latest USG Website  Based on Latitude and Longitude

S1 = 0.55 - Critical Values per Latest USG Website  Based on Latitude and Longitude

Fa = 1.0 per Table 11.4-1

Fv = 1.5 per Table 11.4-2

Sms = Fa * Ss = 1.0 (1.55) = 1.55  11.4-1

Sm1 = Fv * S1 = 1.5 (0.55) = .825  11.4-2

Sds = 2/3 * Sms = 2/3 (1.55) = 1.03  11.4-3

Sd1 = 2/3 * Sm1 = 2/3 (0.825) = .55  11.4-4

SEISMIC RESPONSE COEFFICIENT: Use Section (12.8.1.1) ASCE 7-10 Except as Noted

To = 0.2 (Sd1/Sds) = 0.11 SEC  11.4.5

Ts = Sd1 /Sds = 0.53 SEC  11.4.5

Tstruc = Ct * (Hn)^3/4 = 0.020 (25.3)^3/4 = 0.23 SEC

Where To ≤ Tstruc ≤ Ts  Sa = Sds = 1.03 Therefore Seismic Design Category "D"

R = 6.5 for Wood Shear Walls per ASCE 7-10 Table 12.2-1

Cs = Sds /(R/I) = 1.03 / (6.5/1) = 0.158  12.8-2

Cs = 0.16

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1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

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## LATERAL QUAKE FORCES

| | | | | |
|---|---|---|---|---|
| Cs: | 0.16 | | ρ: | 1.3 |
| Roof Area: | 2867 | feet $^2$ | Roof Dead Load: | 13 |
| Upper Area | 4433 | feet $^2$ | Floor Dead Load: | 13 |
| | | | Wall Dead Load: | 8 |

ASCE 7-10 Using Allowable Stress Design, 2.4.1 Basic Combination option 8: 0.6 D + 0.7 E
ASCE 7-10 Table 12.2-1: Overstrength factor, Ω = 2.5

## DEAD LOAD OF STRUCTURE

Roof Weight = 2867 x (13+8) = = 60.21 kip

Upper Weight = 4413 x (13+8) = = 93.09 kip

153.30 kip

$V_{base}$ = Cs x Σ Weight = 0.16 x 153.30 = 24.53 kip

$V_{asd}$ = $V_{base}$ x 0.7 x ρ = **22.32** kip

## LATERAL FORCES

| | WEIGHT | | HEIGHT | | WEIGHT x HEIGHT |
|---|---|---|---|---|---|
| Roof: | 60.21 | kip | 21.5 | Feet | 1294.45 |
| Upper: | 93.09 | kip | 11 | Feet | 1024.02 |
| | | | | | 2318.47 |

Fq Roof: 22.32 x (1294.45/2318.47) = = 12.46 kip

Fq Upper: 22.32 x (1024.02/2318.47) = = 9.86 kip

Therefore, quake governs all.

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Phone: (425) 822-3009
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## WIND FORCES ON SHEAR WALLS

### Shearwalls in X – X Direction

Fw X – X @ Roof: 3.74 kips 3.74 k / 44 ft = 85.0 #/Ft

V @ X 1 = (3.74/44)x(9/2)= 0.38 / 5'+5' = 38 #/Ft
SW-4

V @ X 2 = (3.74/44)x(9/2+23/2)= 1.36 / 16'+3.5' = 70 #/Ft
SW-4

V @ X 3 = (3.74/44)x(23/2+10/2)= 1.40 / 10'+3'+2.25' = 92 #/Ft
SW-X
Restrain to window to reduce h:w ratio (For 2.25' shear walls)

V @ X 4 = (3.74/44)x(10/2+2)= 0.60 / 6'+3'+3'+3'+3' = 33 #/Ft
SW-4

---

Fw X – X @ Upper: 6.29 kips 6.29 k / 53 ft = 118.7 #/Ft

V @ X 5= (6.29/53)x(7/2)= 0.42 / 3.5'+3.5' = 59 #/Ft
SW-4

V @ X 6 = (6.29/53)x(7/2+9/2) 1.33 / 8.25'+5'+5' = 73 #/Ft
SW-4 +0.38=

V @ X 7 = (6.29/53)x(9/2+1+13.5/2) 2.81 / 10'+5.5'+3.5' = 148 #/Ft
SW-3 +1.36=

V @ X 8 = (6.29/53)x(13.5/2+8/2)= 1.28 / 22'+9.5' = 41 #/Ft
SW-4

V @ X 9 = (6.29/53)x(8/2+12.5/2) 2.62 / 5'+3.5'+9' = 150 #/Ft
SW-3 +1.40=

V @ X 10 = (6.29/53)x(12.5/2+2) 1.57 <3.375k LRP Capacity
SW-3 +0.60=
3x(24"x10' LRP)=3 x 1.125k = 3.375 k LRP Capacity

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1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

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## WIND FORCES ON SHEAR WALLS

**Shearwalls in Y – Y Direction**

| | | | | | |
|---|---|---|---|---|---|
| Fw Y – Y @ Roof: | 5.24 kips | | 5.24 k / 58 ft = | 90.3 | #/Ft |
| V @ Y 1 = (5.24/58)x(20/2)= | | 0.90 / 12' | = | 75 | # / Ft |
| SW-4 | | | | | |
| V @ Y 2 = (5.24/58)x(20/2+31.5/2)= | | 2.33 / 17.75' | = | 131 | # / Ft |
| SW-4 | | | | | |
| V @ Y 3 = (5.24/58)x(31.5/2+6.5/2)= | | 1.72 / 14' | = | 123 | # / Ft |
| SW-4 | | | | | |
| V @ Y 4 = (5.24/58)x(6.5/2)= | | 0.29 / 5.5'+4.75' | = | 29 | # / Ft |
| SW-4 | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Fw Y – Y @ Upper: | 6.39 kips | | 6.39 k / 39 ft = | 163.8 | #/Ft |
| V @ Y 5 = (6.39/73)x(38/2) | | 3.67 / 12.5'+4.75' | = | 213 | # / Ft |
| SW-3 +0.90 | | | | | |
| +2.33x(18/38)= | | | | | |
| V @ Y 6 = (6.39/73)x(38/2+3+32/2) | | 5.87 / 22'+16' | = | 154 | # / Ft |
| SW-4 +2.33x(20/38) | | | | | |
| +1.72x(22/32) | | | | | |
| +0.29x(15/32)= | | | | | |
| V @ Y 7 = (6.39/73)x(32/2) | | 2.09 / 29.5'+5.5' | = | 60 | # / Ft |
| SW-4 +1.72x(10/32) | | | | | |
| +0.29x(17/32)= | | | | | |

**RB Engineers, Inc.**
1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

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## QUAKE FORCES ON SHEAR WALLS

### Shearwalls in X – X Direction

Fw X – X @ Roof: 12.46 kips 12.46 k / 44 ft = 283.2 #/Ft

V @ X 1 = (12.46/44)x(9/2)= 1.27 / 5'+5' = 127 #/Ft
SW-4

V @ X 2 = (12.46/44)x(9/2+23/2)= 4.53 / 16'+3.5' = 232 #/Ft
SW-4
(1.25-0.125x(9/3.5))x350 #/Ft = 325 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

V @ X 3 = (12.46/44)x(23/2+10/2)= 4.67 / 10'+3'+2.25' = 306 #/Ft
SW-4
Restrain to window to reduce h:w ratio (For 2.25' shear walls)
(1.25-0.125x(9/3))x350 #/Ft = 306 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

V @ X 4 = (12.46/44)x(10/2+2)= 1.98 / 6'+3'+3'+3'+3' = 110 #/Ft
SW-4
(1.25-0.125x(9/3))x350 #/Ft = 306 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

---

Fw X – X @ Upper: 9.86 kips 9.86 k / 53 ft = 186.0 #/Ft

V @ X 5= (9.86/53)x(7/2)= 0.65 / 3.5'+3.5' = 93 #/Ft
SW-4
(1.25-0.125x(10/3.5))x350 #/Ft = 313 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

V @ X 6 = (9.86/53)x(7/2+9/2)= 2.76 / 8.25' = 335 #/Ft
SW-4

V @ X 7 = (9.86/53)x(9/2+1+13.5/2) 6.81 / 10'+5.5'+3.5' = 358 #/Ft
SW-3 +4.53=
(1.25-0.125x(10/3.5))x450 #/Ft = 402 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

V @ X 8 = (9.86/53)x(13.5/2+8/2)= 2.00 / 22'+9.5' = 63 #/Ft
SW-4

V @ X 9 = (9.86/53)x(8/2+12.5/2) 6.58 / 5'+3.5'+9' = 376 #/Ft
SW-3 +4.67=

V @ X 10 = (9.86/53)x(12.5/2+2) 0.14 / 5'+3'+3' = 12 #/Ft
SW-4 +1.98-3.38=
3x(24"x10' LRP)=3 x 1.125k = 3.375 k LRP Capacity
(1.25-0.125x(10/3))x350 #/Ft = 292 #/Ft capacity per table 4.3.4 ANSI/AF+PA SDPWS

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**RB Engineers, Inc.**
1312 2nd St Kirkland, WA
Phone: (425) 822-6409
Email: rbe1992@gmail.com

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## QUAKE FORCES ON SHEAR WALLS

**Shearwalls in Y – Y Direction**

Fw Y – Y @ Roof: 12.46 kips — 12.46 k / 58 ft = 214.9 #/Ft

| | | | | | |
|---|---|---|---|---|---|
| V @ Y 1 = (12.46/58)x(20/2)= | 2.15 / 12' | = | 179 | # / Ft |
| SW-4 | | | | | |
| V @ Y 2 = (12.46/58)x(20/2+31.5/2)= | 5.53 / 17.75' | = | 312 | # / Ft |
| SW-4 | | | | | |
| V @ Y 3 = (12.46/58)x(31.5/2+6.5/2)= | 4.08 / 14' | = | 292 | # / Ft |
| SW-4 | | | | | |
| V @ Y 4 = (12.46/58)x(6.5/2)= | 0.70 / 5.5'+4.75' | = | 68 | # / Ft |
| SW-4 | | | | | |

Fw Y – Y @ Upper: 9.86 kips — 9.86 k / 73 ft = 135.0 #/Ft

| | | | | | |
|---|---|---|---|---|---|
| V @ Y 5 = (9.86/73)x(38/2) | 7.34 / 12.5'+4.75' | = | 425 | # / Ft |
| SW-3 | +2.15 | | | | |
| | +5.53x(18/38)= | | | | |
| V @ Y 6 = (9.86/73)x(38/2+3+32/2) | 11.18 / 22'+16' | = | 294 | # / Ft |
| SW-4 | +5.53x(20/38) | | | | |
| | +4.08x(22/32) | | | | |
| | +0.70x(15/32)= | | | | |
| V @ Y 7 = (9.86/73)x(32/2) | 3.81 / 29.5'+5.5' | = | 109 | # / Ft |
| SW-4 | +4.08x(10/32) | | | | |
| | +0.70x(17/32)= | | | | |

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**CHECK OVERTURNING FOR:** X 1 (Quake)

L = 5 ft

P = 127 lb/ft

P x L = 5x127 = 0.64 kip

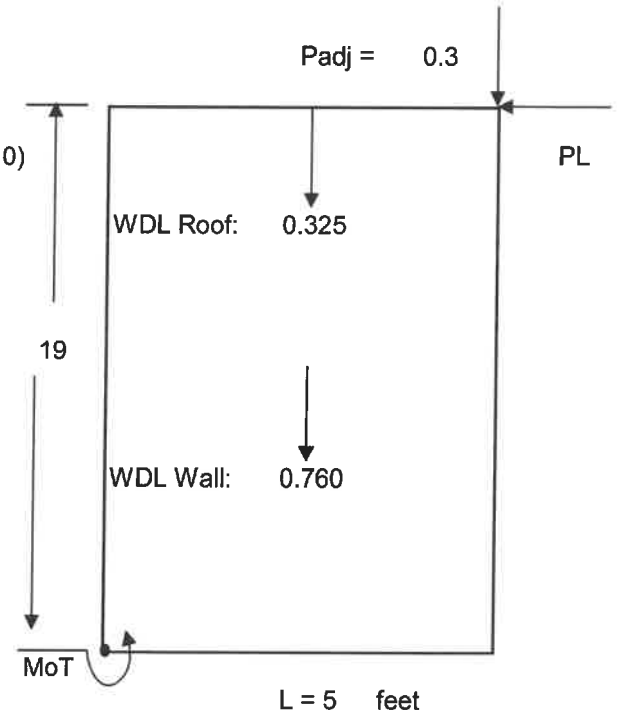
MoT = 0.64x19 = 12.07 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

MR = [(0.325+0.760)x0.5x5+0.3x5]x0.45 = 1.90 kip - ft

$T = C = \frac{MoT - MR}{L}$ = 2.03 kip

$TL_{RF}$ = 5 ft (conservative)




Therefore use STHD14 hold downs at each end

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**CHECK OVERTURNING FOR:** X 3 (Quake)

L = 2.25 ft

P = 306 lb/ft

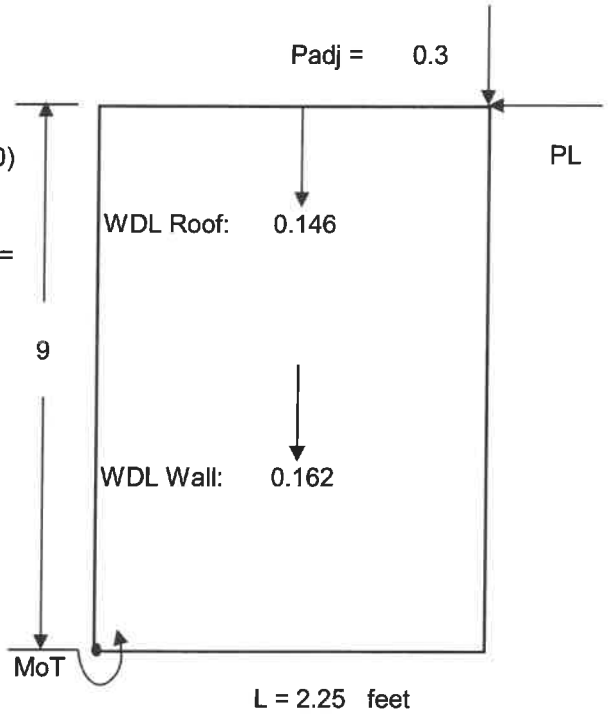
P x L = 2.25x306 0.69 kip

MoT = 0.69*9 6.20 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

$M_R$ = [(0.146+0.162)x0.5x2.25+0.3x2.25]x0.45 = 0.46 kip - ft

$T = C = \frac{MoT - M_R}{L}$ = 2.55 kip




Therefore use (2)CS16 hold downs at each end

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**CHECK OVERTURNING FOR:** X 9 (Quake)

L = 3.5 ft

P = 376 lb/ft

P x L = 3.5x376 1.32 kip

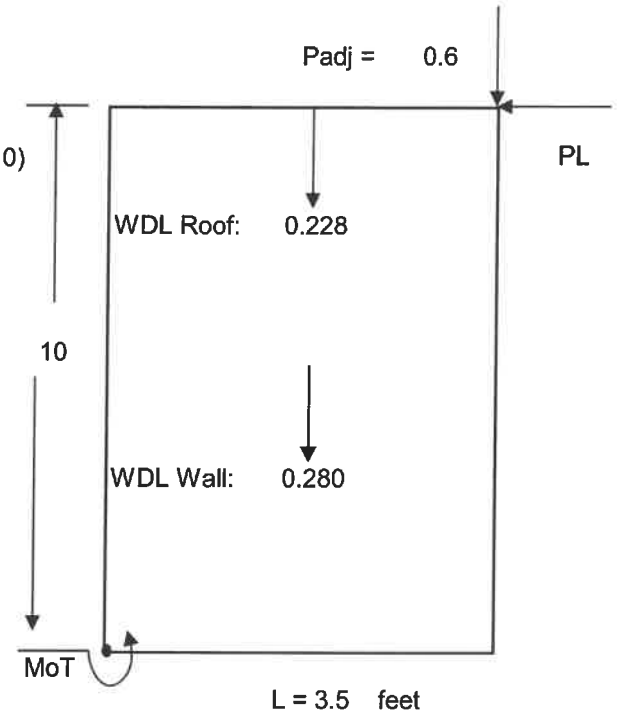
MoT = 1.32*10 13.16 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

MR = [(0.228+0.280)x0.5x3.5+0.6x3.5]x0.45 = 1.34 kip - ft

$T = C = \frac{MoT - MR}{L}$ = 3.38 kip

$TL_{RF}$ = 5 ft (conservative)




Therefore use STHD14 hold downs at each end

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**CHECK OVERTURNING FOR:** Y 1 (Quake)

L = 12 ft

P = 179 lb/ft

P x L = 12x179 2.15 kip

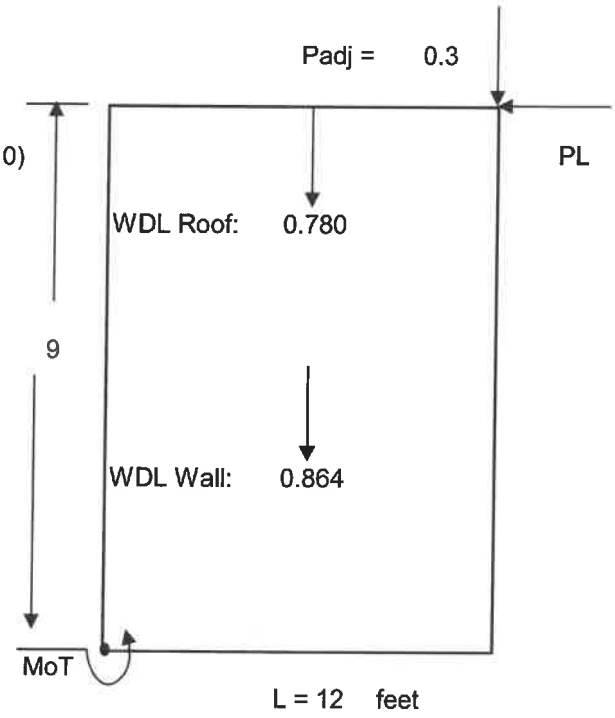
MoT = 2.15*9 19.33 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

MR = [(0.780+0.864)x0.5x12+0.3x12]x0.45 =
6.06 kip - ft

$T = C = \frac{MoT - MR}{L} =$ 1.11 kip

$TL_{RF}$ = 5 ft (conservative)




Therefore use (1)CS16 hold downs at each end

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**CHECK OVERTURNING FOR:** Y 2 (Quake)

L = 17.75 ft

P = 312 lb/ft

P x L = 17.75x312 5.54 kip

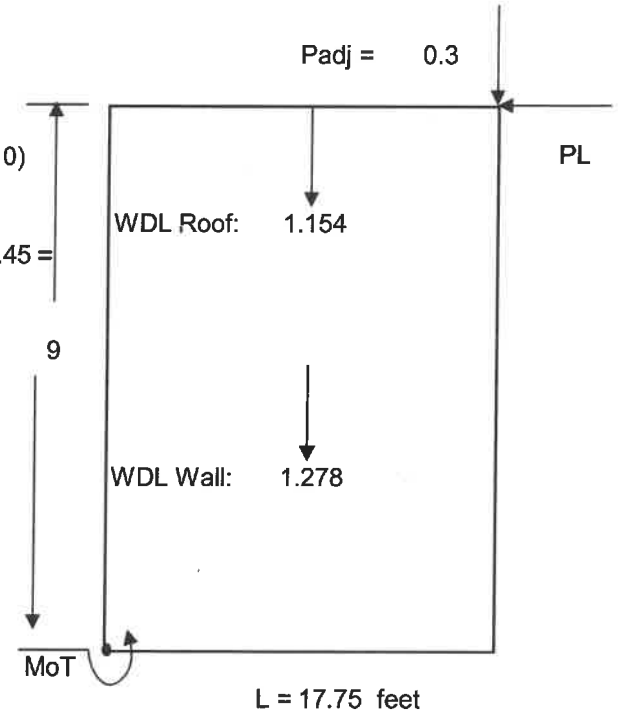
MoT = 5.54*9 49.84 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

MR = [(1.154+1.278)x0.5x17.75+0.3x17.75]x0.45 = 12.11 kip - ft

$T = C = \frac{MoT - MR}{L}$ = 2.13 kip

$TL_{RF}$ = 5 ft (conservative)




Therefore use (2)CS16 hold downs at each end

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**CHECK OVERTURNING FOR:** Y 5 (Quake)

L = 4.75 ft

P = 425 lb/ft

P x L = 4.75x425= 2.02 kip

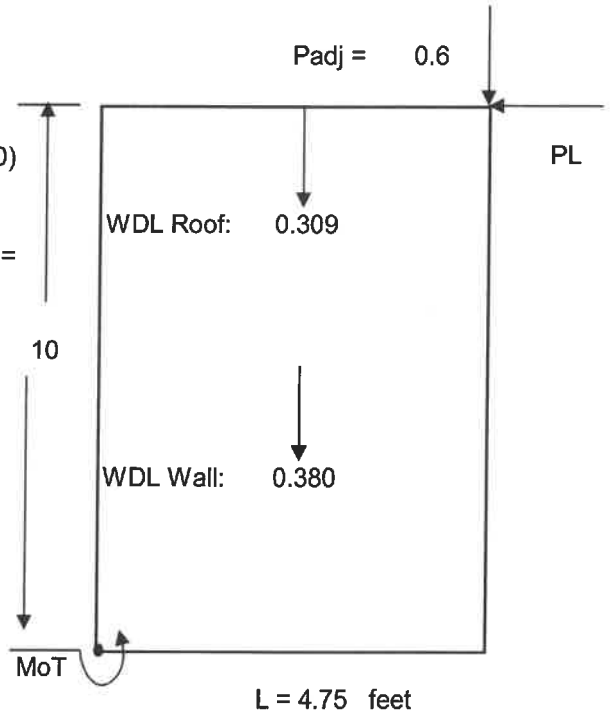
MoT = 2.02x10= 20.19 kip - ft

$DL_f$ = 0.45 (Ref. Sect. 12.4.2.3 ASC. 7-10)

MR = [(0.309+0.380)x0.5x4.75+0.6x4.75]x0.45 = 2.02 kip - ft

$T = C = \frac{MoT - MR}{L}$ = 3.83 kip

$TL_{RF}$ = 5 ft (conservative)




Therefore use STHD14 hold downs at each end

**RB Engineers, Inc.**
1312 2nd St Kirkland, WA
Phone: (425) 822-3009
Email: rbe1992@gmail.com

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## SHEARWALL SCHEDULE

**Typ. Ext. Wall Construction**

SW-6
or
1

1) Sheathing: 1/2" Plywood or 7/16" O.S.B Exterior Side, Blocked, Nail w/ 8d @ 6" O.C. All edges and @ 12" O.C. Field
2) Bolt Sill Plate to Concrete w/ 5/8" DIA. X 10" A.B.'s @ 48" O.C.
3) Nail bottom plate to framing below w/ 16d @ 4" O.C.
4) Fasten double plate to joist or blocking above per details on S1 & S2.

Capacity: 240 lb/ft

**Shearwall Schedule**

-- -- -- -- -- -- -- --

Indicates shearwall w/ Plywood one side

SW-4
or
2

1) Sheathing: 1/2" plywood or 7/16" O.S.B. one side, blocked, nail w/ 8d @ 4" O.C. all edges and 12" O.C. field.
2) Bolt sill plate to concrete w/ 5/8" DIA. X 10" A.B.'s @ 32" O.C.
3) Nail bottom plate to framing below w/ 16d @ 3" O.C.
4) Fasten double plate to joist or blocking above per details on S1 & S2.

Capacity: 350 lb/ft

-- -- -- -- -- -- -- --

Indicates shearwall w/ Plywood two sides

-- -- -- -- -- -- -- --

(2)SW-3
or
3

1) Sheathing: 1/2" plywood or O.S.B. two sides, blocked, nail w/ 8d @ 3" O.C. all edges and 12" O.C. field
2) Bolt 3x or double sill plate to concrete w/ 5/8" DIA. X 10" exp. Bolts @ 12" O.C.
3) Fasten double bottom plates to double joist or blocking below w/ 2 rows 2 layers 16d @ 6" O.C. or 2 rows A35 clips @ 16" O.C.
4) Fasten double top plates to double joist or blocking above w/ 2 rows A35 clips @ 16" O.C. or per details on S1 & S2
5) Use 3x all framing members receiving en. From abutting panels

Capacity: 900 lb/ft

-- -- -- -- -- -- -- --

Indicates shearwall w/ Plywood one side

SW-3
or
4

1) Sheathing: 1/2" plywood or 7/16" O.S.B. one side, blocked, nail w/ 8d @ 3" O.C. all edges and 12" O.C. field
2) Bolt 3x or double sill plate to concrete w/ 5/8" DIA x 10" A.B.'s @ 24" O.C. (U.N.O.)
3) Fasten double plate to joist or blocking above per details on S1 & S2.
4) Use (2) 2x studs @ 16" O.C. at detail D / S1 (U.N.O.)
5) Provide 3x stud framing at all members receiving edge nailing from abutting panels (U.N.O.)

Capacity: 450 lb/ft

-- -- -- -- -- -- -- --

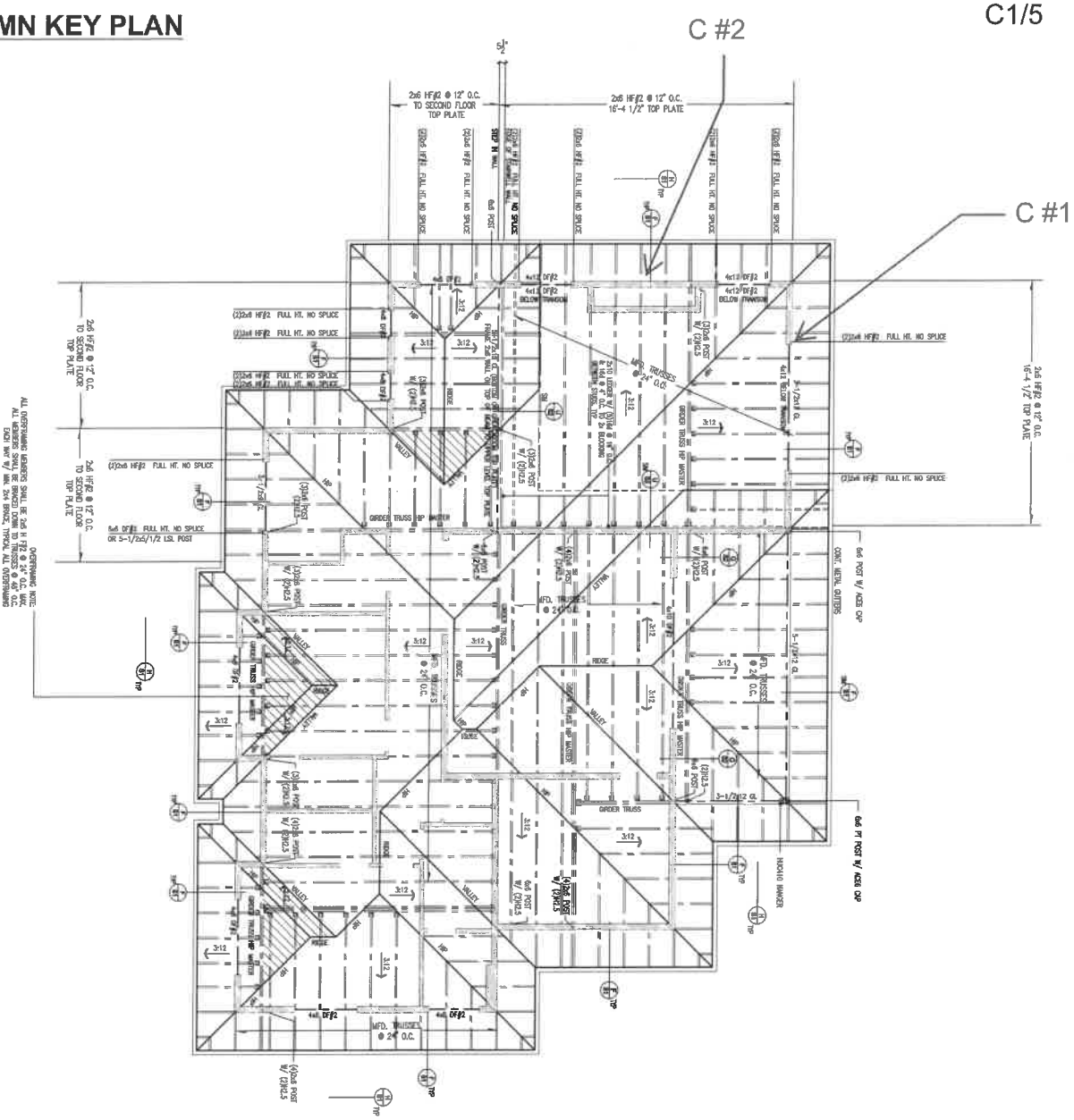
Indicates shearwall w/ Plywood one side

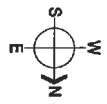
SW-2
or
5

1) Sheathing: 1/2" plywood or 7/16" O.S.B. one side, blocked, nail w/ 8d @ 2" O.C. all edges and 12" O.C. field
2) Bolt 3x or double sill plate to concrete w/ 5/8" DIA x 10" A.B.'s @ 16" O.C.
3) Fasten double plate to joist or blocking above per details on S1 & S2.
4) Provide 3x stud framing at all members receiving edge nailing from abutting panels

Capacity: 585 lb/ft

## COLUMN KEY PLAN




| | | | | | |
|---|---|---|---|---|---|
| SHEET NUMBER A6 | COMPUTER FILE NAME | SCALE 1/4"=1'-0" | DATE 7.16.2020 | REVISED 7.24.2020 | **MERLINO RESIDENCE** MERCER ISLAND, WA — **UPPER ROOF FRAMING PLAN** |

BRODST
dan@brodstdesignworks.com
206.409.2069

Printed: 21 APR 2021, 11:12AM
File: Merlino Residence.ec6

# Wood Column



Lic. # : KW-06010288
RB Engineers, Inc.

**DESCRIPTION:** C #1

## Code References

Calculations per 2012 NDS, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : ASCE 7-16

## General Information

| | |
|---|---|
| Analysis Method : | Allowable Stress Design |
| End Fixities | Top & Bottom Pinned |
| Overall Column Height | 19 ft |
| *( Used for non-slender calculations )* | |
| Wood Species | Hem-Fir |
| Wood Grade | No.2 |

| | | | |
|---|---|---|---|
| Fb + | 575 psi | Fv | 140 psi |
| Fb - | 575 psi | Ft | 375 psi |
| Fc - Prll | 575 psi | Density | 26.84 pcf |
| Fc - Perp | 405 psi | | |

| E : Modulus of Elasticity . . . | x-x Bending | y-y Bending | Axial |
|---|---|---|---|
| Basic | 1100 | 1100 | 1100 ksi |
| Minimum | 400 | 400 | |

| | |
|---|---|
| Wood Section Name | **3-2x6** |
| Wood Grading/Manuf. | Graded Lumber |
| Wood Member Type | Sawn |
| Exact Width | **4.50** in |
| Exact Depth | **5.50** in |
| Area | 24.750 in^2 |
| Ix | 62.391 in^4 |
| Iy | 41.766 in^4 |

Allow Stress Modification Factors

| | |
|---|---|
| Cf or Cv for Bending | 1.30 |
| Cf or Cv for Compression | 1.10 |
| Cf or Cv for Tension | 1.30 |
| Cm : Wet Use Factor | 1.0 |
| Ct : Temperature Factor | 1.0 |
| Cfu : Flat Use Factor | 1.0 |
| Kf : Built-up columns | 1.0 *NDS 15.3.2* |
| Use Cr : Repetitive ? | No |

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Fully braced against buckling ABOUT Y-Y Axis
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 19 ft, K = 1.0

## Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 87.649 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 19.0 ft, D = 0.460, L = 0.880 k
BENDING LOADS . . .
Lat. Uniform Load creating Mx-x, W = 0.020 k/ft

## DESIGN SUMMARY

Bending & Shear Check Results

| | |
|---|---|
| **PASS** Max. Axial+Bending Stress Ratio = | **0.3250 : 1** |
| Load Combination | +D+L |
| Governing NDS Forumla | Comp Only, fc/Fc' |
| Location of max.above base | 0.0 ft |
| At maximum location values are . . . | |
| Applied Axial | 1.428 k |
| Applied Mx | 0.0 k-ft |
| Applied My | 0.0 k-ft |
| Fc : Allowable | 177.486 psi |

| | |
|---|---|
| **PASS** Maximum Shear Stress Ratio = | **0.03084 : 1** |
| Load Combination | +D+0.60W |
| Location of max.above base | 0.0 ft |
| Applied Design Shear | 6.909 psi |
| Allowable Shear | 224.0 psi |

**Maximum SERVICE Lateral Load Reactions . .**

| | | | |
|---|---|---|---|
| Top along Y-Y | 0.190 k | Bottom along Y-Y | 0.190 k |
| Top along X-X | 0.0 k | Bottom along X-X | 0.0 k |

**Maximum SERVICE Load Lateral Deflections . . .**

Along Y-Y 0.8637 in at 9.564 ft above base
for load combination : W Only
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

**Other Factors used to calculate allowable stresses . . .**

| | Bending | Compression | Tension |
|---|---|---|---|

## Load Combination Results

| Load Combination | $C_D$ | $C_P$ | Maximum Axial + Bending Stress Ratios: Stress Ratio | Status | Location | Maximum Shear Ratios: Stress Ratio | Status | Location |
|---|---|---|---|---|---|---|---|---|
| D Only | 0.900 | 0.309 | 0.1260 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+L | 1.000 | 0.281 | 0.3250 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+0.750L | 1.250 | 0.228 | 0.2701 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+0.60W | 1.600 | 0.181 | 0.2854 | PASS | 9.436 ft | 0.03084 | PASS | 0.0 ft |
| +D+0.750L+0.450W | 1.600 | 0.181 | 0.3120 | PASS | 9.436 ft | 0.02313 | PASS | 19.0 ft |
| +0.60D+0.60W | 1.600 | 0.181 | 0.2626 | PASS | 9.436 ft | 0.03084 | PASS | 0.0 ft |
| +0.60D | 1.600 | 0.181 | 0.07246 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |

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# Wood Column

File: Merlino Residence.ec6



Lic. # : KW-06010288

RB Engineers, Inc.

**DESCRIPTION:** C #1

## Maximum Reactions

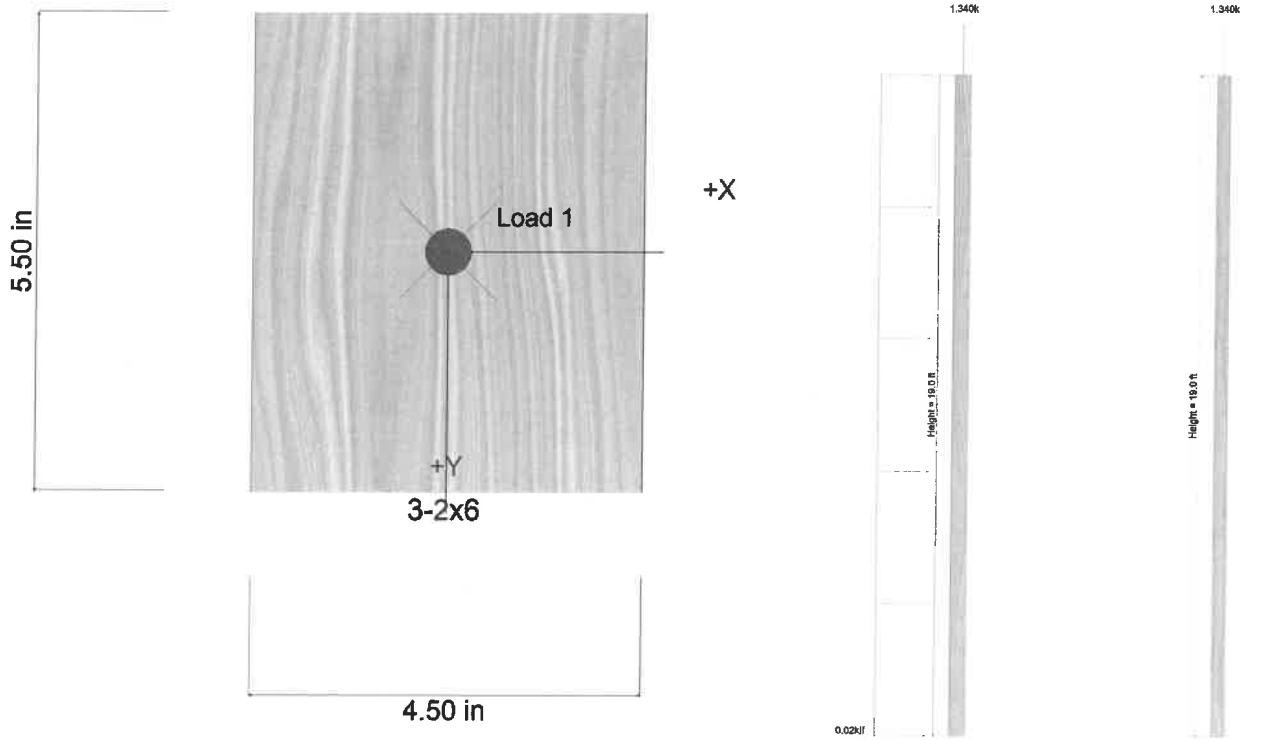
Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction @ Base | @ Top | k | Y-Y Axis Reaction @ Base | @ Top | Axial Reaction @ Base | My - End Moments k-ft @ Base | @ Top | Mx - End Moments @ Base | @ Top |
|---|---|---|---|---|---|---|---|---|---|---|
| D Only | | | | | | 0.548 | | | | |
| +D+L | | | | | | 1.428 | | | | |
| +D+0.750L | | | | | | 1.208 | | | | |
| +D+0.60W | | | | 0.114 | 0.114 | 0.548 | | | | |
| +D+0.750L+0.450W | | | | 0.086 | 0.086 | 1.208 | | | | |
| +0.60D+0.60W | | | | 0.114 | 0.114 | 0.329 | | | | |
| +0.60D | | | | | | 0.329 | | | | |
| L Only | | | | | | 0.880 | | | | |
| W Only | | | | 0.190 | 0.190 | | | | | |

## Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | Distance | Max. Y-Y Deflection | Distance |
|---|---|---|---|---|
| D Only | 0.0000 in | 0.000 ft | 0.0000 in | 0.000 ft |
| +D+L | 0.0000 in | 0.000 ft | 0.0000 in | 0.000 ft |
| +D+0.750L | 0.0000 in | 0.000 ft | 0.0000 in | 0.000 ft |
| +D+0.60W | 0.0000 in | 0.000 ft | 0.5182 in | 9.564 ft |
| +D+0.750L+0.450W | 0.0000 in | 0.000 ft | 0.3887 in | 9.564 ft |
| +0.60D+0.60W | 0.0000 in | 0.000 ft | 0.5182 in | 9.564 ft |
| +0.60D | 0.0000 in | 0.000 ft | 0.0000 in | 0.000 ft |
| L Only | 0.0000 in | 0.000 ft | 0.0000 in | 0.000 ft |
| W Only | 0.0000 in | 0.000 ft | 0.8637 in | 9.564 ft |

## Sketches



Printed: 21 APR 2021, 11:17AM
File: Merlino Residence.ec6

RB Engineers, Inc.

# Wood Column

Lic. # : KW-06010288

**DESCRIPTION:** C #2

## Code References

Calculations per 2012 NDS, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : ASCE 7-16

## General Information

| | | | |
|---|---|---|---|
| Analysis Method : | Allowable Stress Design | | |
| End Fixities | Top & Bottom Pinned | | |
| Overall Column Height | 19 ft | | |
| *( Used for non-slender calculations )* | | | |
| Wood Species | Hem-Fir | | |
| Wood Grade | No.2 | | |
| Fb + | 575.0 psi | Fv | 140.0 psi |
| Fb - | 575.0 psi | Ft | 375.0 psi |
| Fc - Prll | 575.0 psi | Density | 26.840 pcf |
| Fc - Perp | 405.0 psi | | |

| E : Modulus of Elasticity . . . | x-x Bending | y-y Bending | Axial |
|---|---|---|---|
| Basic | 1,100.0 | 1,100.0 | 1,100.0 ksi |
| Minimum | 400.0 | 400.0 | |

| | | | |
|---|---|---|---|
| Wood Section Name | **2-2x6** | | |
| Wood Grading/Manuf. | Graded Lumber | | |
| Wood Member Type | Sawn | | |
| Exact Width | **3.0** in | Allow Stress Modification Factors | |
| Exact Depth | **5.50** in | Cf or Cv for Bending | 1.30 |
| Area | 16.50 in^2 | Cf or Cv for Compression | 1.10 |
| Ix | 41.594 in^4 | Cf or Cv for Tension | 1.30 |
| Iy | 12.375 in^4 | Cm : Wet Use Factor | 1.0 |
| | | Ct : Temperature Factor | 1.0 |
| | | Cfu : Flat Use Factor | 1.0 |
| | | Kf : Built-up columns | 1.0 *NDS 15.3.2* |
| | | Use Cr : Repetitive ? | No |

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Fully braced against buckling ABOUT Y-Y Axis
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 19 ft, K = 1.0

## Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 58.433 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 19.0 ft, D = 0.0250, L = 0.050 k
BENDING LOADS . . .
Lat. Uniform Load creating Mx-x, W = 0.020 k/ft

## DESIGN SUMMARY

Bending & Shear Check Results

**PASS** Max. Axial+Bending Stress Ratio = **0.3697 : 1**

| | |
|---|---|
| Load Combination | +D+0.60W |
| Governing NDS Forumla | 1Comp + Mxx, NDS Eq. 3.9-3 |
| Location of max.above base | 9.436 ft |
| At maximum location values are . . . | |
| Applied Axial | 0.08343 k |
| Applied Mx | 0.5415 k-ft |
| Applied My | 0.0 k-ft |
| Fc : Allowable | 183.230 psi |

**PASS** Maximum Shear Stress Ratio = **0.04627 : 1**

| | |
|---|---|
| Load Combination | +D+0.60W |
| Location of max.above base | 19.0 ft |
| Applied Design Shear | 10.364 psi |
| Allowable Shear | 224.0 psi |

**Maximum SERVICE Lateral Load Reactions . .**

| | | | |
|---|---|---|---|
| Top along Y-Y | 0.190 k | Bottom along Y-Y | 0.190 k |
| Top along X-X | 0.0 k | Bottom along X-X | 0.0 k |

**Maximum SERVICE Load Lateral Deflections . . .**

Along Y-Y 1.296 in at 9.564 ft above base
for load combination : W Only

Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

**Other Factors used to calculate allowable stresses . . .**

| | Bending | Compression | Tension |
|---|---|---|---|

## Load Combination Results

| Load Combination | $C_D$ | $C_P$ | Maximum Axial + Bending Stress Ratios: Stress Ratio | Status | Location | Maximum Shear Ratios: Stress Ratio | Status | Location |
|---|---|---|---|---|---|---|---|---|
| D Only | 0.900 | 0.309 | 0.02879 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+L | 1.000 | 0.281 | 0.04556 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+0.750L | 1.250 | 0.228 | 0.04058 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |
| +D+0.60W | 1.600 | 0.181 | 0.3697 | PASS | 9.436 ft | 0.04627 | PASS | 19.0 ft |
| +D+0.750L+0.450W | 1.600 | 0.181 | 0.2817 | PASS | 9.436 ft | 0.03470 | PASS | 19.0 ft |
| +0.60D+0.60W | 1.600 | 0.181 | 0.3653 | PASS | 9.436 ft | 0.04627 | PASS | 19.0 ft |
| +0.60D | 1.600 | 0.181 | 0.01656 | PASS | 0.0 ft | 0.0 | PASS | 19.0 ft |

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# Wood Column

File: Merlino Residence.ec6



Lic. # : KW-06010288

RB Engineers, Inc.

**DESCRIPTION:** C #2

## Maximum Reactions

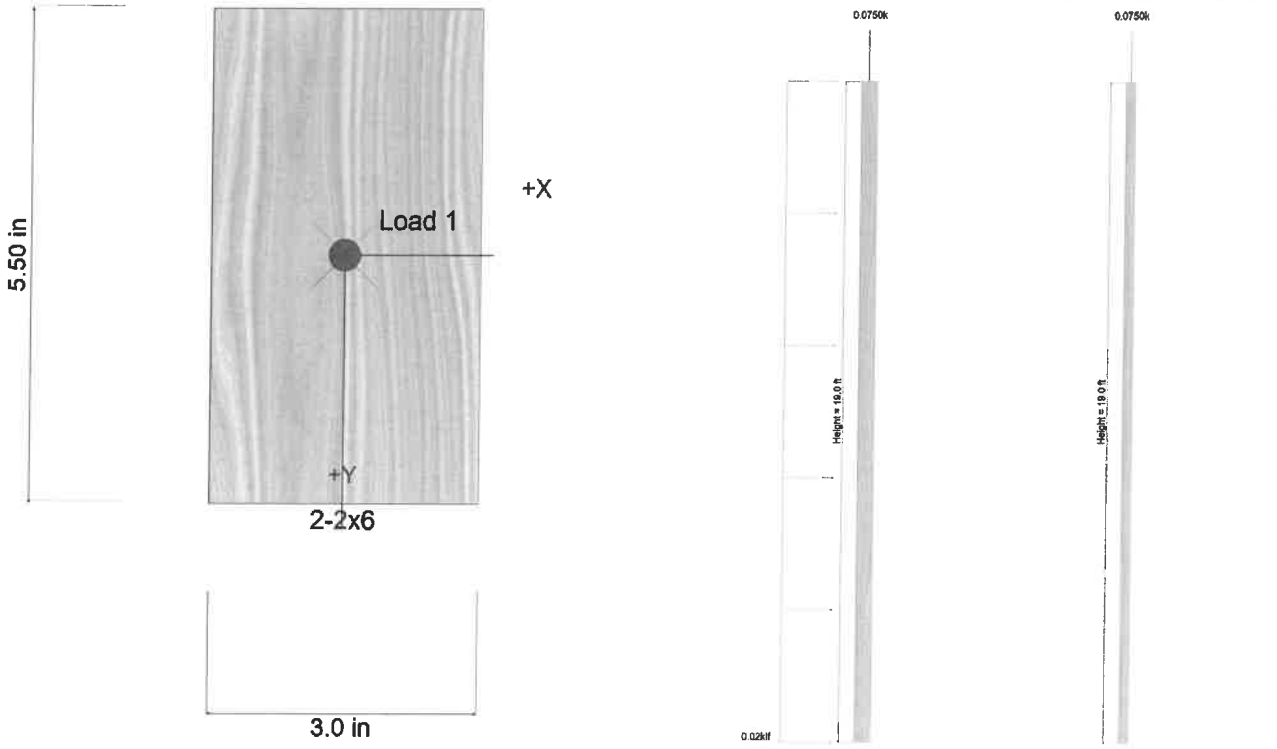
Note: Only non-zero reactions are listed.

| Load Combination | X-X Axis Reaction @ Base | @ Top | k | Y-Y Axis Reaction @ Base | @ Top | Axial Reaction @ Base | My - End Moments @ Base | @ Top | k-ft | Mx - End Moments @ Base | @ Top |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D Only | | | | | | 0.083 | | | | | |
| +D+L | | | | | | 0.133 | | | | | |
| +D+0.750L | | | | | | 0.121 | | | | | |
| +D+0.60W | | | | 0.114 | 0.114 | 0.083 | | | | | |
| +D+0.750L+0.450W | | | | 0.086 | 0.086 | 0.121 | | | | | |
| +0.60D+0.60W | | | | 0.114 | 0.114 | 0.050 | | | | | |
| +0.60D | | | | | | 0.050 | | | | | |
| L Only | | | | | | 0.050 | | | | | |
| W Only | | | | 0.190 | 0.190 | | | | | | |

## Maximum Deflections for Load Combinations

| Load Combination | Max. X-X Deflection | | Distance | | Max. Y-Y Deflection | | Distance | |
|---|---|---|---|---|---|---|---|---|
| D Only | 0.0000 | in | 0.000 | ft | 0.0000 | in | 0.000 | ft |
| +D+L | 0.0000 | in | 0.000 | ft | 0.0000 | in | 0.000 | ft |
| +D+0.750L | 0.0000 | in | 0.000 | ft | 0.0000 | in | 0.000 | ft |
| +D+0.60W | 0.0000 | in | 0.000 | ft | 0.7774 | in | 9.564 | ft |
| +D+0.750L+0.450W | 0.0000 | in | 0.000 | ft | 0.5830 | in | 9.564 | ft |
| +0.60D+0.60W | 0.0000 | in | 0.000 | ft | 0.7774 | in | 9.564 | ft |
| +0.60D | 0.0000 | in | 0.000 | ft | 0.0000 | in | 0.000 | ft |
| L Only | 0.0000 | in | 0.000 | ft | 0.0000 | in | 0.000 | ft |
| W Only | 0.0000 | in | 0.000 | ft | 1.2956 | in | 9.564 | ft |

## Sketches



# RB ENGINEERS, INC.

1312 2ND ST.

**KIRKLAND, WA. 98033**

**PH: 425 8223009**

**FAX: 425 822 2679**

**CELL: 425 351 2085**

EMAIL: rbe1992@gmail.com

**WEB WWW.R-B-ENGINEERS.COM**




**Item# 12:**

Please see revised plans, holdowns added.

**Item #13:**

Please see the revised plans.

**Item #14:**

Please see the revised plans. Cont. rims and detail O/S1 are and holdown extension notes are provided for the transfer of all lateral forces, shear, and uplift.

**Item# 15:**

Please use holdowns added on the revised plans.

**Item# 16:**

Holdown computations omitted, as Y2 walls are Balloon Frame walls, therefore the plans are OK.

Thank you for your comments,

Sincerely yours,

Ross Baharmast

# RB ENGINEERS, INC.

1312 2ND ST.

**KIRKLAND, WA. 98033**

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EMAIL: rbe1992@gmail.com

**WEB WWW.R-B-ENGINEERS.COM**




**Structural, Plan check reply**

Date: 4/ 19 /2021

Project: 4225 89th Ave SE Mercer Island, Washington

Permit #: 2012-199

To whom it may concern.

**Structural plan-check Reply:**

**Item #1:**

Please see note 1 on Structural notes S3.

**Item #2**

Please see Revised note 13 (concrete) On S3, Fc=3000 psi for exposed concrete.

**Item #3:**

By the owner.

**Item# 4:**

The city of mercer island usually requires the E.O.R to provide Structural observation, please verify.

# RB ENGINEERS, INC.

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**Item # 5:**



Please see the calcs provide.

**Item# 6:**

Thanks for the heads-up KZT= 1.23 used, please revised calcs.

**Item# 7:**

Detail Q/S2 is deleted and replace with G/S1, with a drag strut directly over the exterior shearwalls.

**Item # 8:**

Please see the revised plans, thanks for the heads-up!

**Item #9:**

Please see the revised computations attached.

**Item #10:**

X1 walls are balloon frame walls, therefore no floor straps required, referenced computations deleted.

**Item #11:**

Please see the revised plans and note provided for clarification for the holdown connection.

4. The structural observation section of the Mercer Island Cover Sheet was filled out. Was it your intent to provide structural observation?

5. Provide calculations justifying the design of the full-height wall studs at the great room for combined axial and gravity loads.

Lateral

6. We find several references to wind speed-up effects over hills, ridges, and escarpments per ASCE 26.8 that do not coordinate. The Mercer Island Wind Exposure and Wind Speed-Up map shows this site with a topographic factor, $K_{Zt}$, of 1.3. Page L7 of the calculations uses 1.2 for design and the Structural Notes on Sheet S3 references a $K_{Zt}$, of 1.6. Please coordinate. Also, use the minimum factor per the mapped condition unless specifically justified by the engineer of record.

7. Detail Q/S2 is cut at the X2 shear walls at the roof where roof drag trusses are parallel to the shear wall below. Re-evaluate the connection of the flat blocking to the bottom chord of the roof trusses as the nails are driven into the end grain and subject to withdrawal. See NDS 11.2.3.5.

8. Cut a detail on the upper Roof Framing Plan, Sheet A6, at the 10' X3 shear wall to show how lateral forces are transferred into the wall. It appears that Detail WW/S2 is intended; however, it is referenced at the wrong wall.

9. Page L12 of the calculations shows that all of the forces along X1 at the upper floor are attributed to the X6 shear wall at the lower floor. How are shears transferred to X6? The X1 wall is not connected to the floor diaphragm at the great room. It appears that the forces from X1 at the upper level should be transferred to the foundation at the great room walls. While we find SW-4 shear walls at the lower floor on Sheet A2, we do not find them evaluated, particularly for overturning. Please evaluate.

10. Page L14 of the calculations show that holdowns are needed for the X1 shear walls at the upper floor. We do not find these called out on the drawings.

11. The north end of the upper floor X2 shear wall has a holdown called out per Detail K/S1 on Sheet A3. This strap does not have a wall below as the detail reflects. If the strap is connected to the end of a TJI, an engineered design and special detailing would be necessary. Please evaluate.

12. Page L15 of the calculations shows holdowns needed for the X3 shear walls at the upper floor. We do not find these called out on the drawings.

13. Shears along X3 at the upper floor are transferred into the X8 shear walls below. The two short X3 segments occur adjacent to the stair and are not connected to the floor diaphragm. A method of transferring the shears originating in these walls into the X8 shear walls needs to be provided.

14. Since the long segment of X7 shear walls at the main floor is not continuous to the foundation, shears must be transferred out into the main floor diaphragm to alternate walls. Please evaluate. Additionally, uplift forces are resolved at double 2x joists. Hangers supporting these joists must also be able to transfer the uplift forces to supporting members. Provide supporting calculations.

KOLKE
CONSULTING GROUP, INC
BUILDING CODE SPECIALISTS

March 30, 2021

John and Colleen Merlino
4225 89th Ave SE
Mercer Island, WA 98040

**Subject:** **Merlino Residence at 4225 89th Ave SE**
**Permit No. 2012-199**

We have provided plan review as a third-party consultant approved by the City of Mercer Island for the above reference project and reviewed the documents to the following codes, as adopted and amended by the State of Washington and the City of Mercer Island:

2015 International Building Code (IBC)
2015 International Residential Code (IRC)
2010 ASCE Minimum Design Loads for Buildings and Other Structures (ASCE 7-10)
2015 Special Design Provisions for Wind and Seismic (SDPWS)
2015 Washington State Energy Code (WSEC)
Mercer Island City Code (MICC)

Please respond to the following comments:

**Nonstructural**

1. Please clarify the following at the typical stair Detail F/AD1:
    a. IRC R311.7.5.2 requires the tread depth to be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The dimension in this detail that shows 10" minimum is not from the correct measurement. Please revise the detail.
    b. Enclosed accessible space under stairs must have walls, under-stair surfaces, and any soffits protected on the enclosed side with 1/2" GWB per IRC R302.7. Please clarify this detail to address the walls. Additionally, please coordinate this detail with the Stair Construction note on Sheet A9. There are conflicting call-outs in regard to the GWB type.
    c. Is this typical detail intended at the garage steps as well? Please indicate. It is important to clarify where nosings occur because if a nosing is not intended at the garage, the tread depth is required to be at least 11 inches per IRC R311.7.5.3.
2. It appears there are a few steps at the entry and back patio, which are likely concrete. Provide a clarifying detail.
3. Show handrails in plan at all locations. Where the handrail is located at the top of a guard, the configuration must meet the requirements of IRC R311.7.8.3 regarding grip size as either a Type I or Type II handrail. Please detail each condition.
4. Safety glazing is required where the bottom exposed edge of the glazing is less than 36" above the plane of the adjacent walking surface of stairways, landings between flights of stairs, and

15. Page L17 of the calculations requires holdowns at the Y2 shear wall at the upper floor. We do not find the holdown on the west side of the wall on Sheet A3.
16. Page L18 of the calculations shows holdowns needed for the Y1 shear walls at the upper floor. We do not find these called out on the drawings.
17. Page L19 of the calculations shows holdowns needed for the 4.75' segment of Y5 shear walls at the main floor. We do not find these called out on the drawings.

Please resubmit your revised drawings and supplemental information, including an itemized response letter, directly to the City of Mercer Island following their Electronic Plan Review process. In order to assure that we are notified that resubmitted documents are ready for our review, please email me to let me know.

Supplemental documents such as calculations, geotechnical reports, etc. must remain separate from the construction drawings. The construction drawings submitted will be the official construction documents used on site. The City will not be able to approve the construction drawings if other supplemental documents are attached.

Please consider the following when preparing your responses:

- All pages of the drawings and supplemental package should be bookmarked and labeled.
- Please flatten all PDFs of drawings before uploading them.
- Cloud all revisions on the drawings.
- When responding to our comments, please be specific as to where we are to find your response. For example, if new calculations are provided, please refer us to specific pages.

If you have any questions or require additional clarification on any of the items contained in this letter, please contact me at 425-255-3099.

Sincerely,
KOLKE CONSULTING GROUP, INC.

Crystal Kolke

Crystal Kolke, CBO

cc: John and Colleen Merlino, jcmerlino@comcast.net
Don Cole, City of Mercer Island, don.cole@mercergov.org
Holly Mercier, City of Mercer Island, holly.mercier@mercergov.org

ramps per IRC R308.4.6 or where the glazing is less than 36" above the landing and within 60" horizontally of the bottom tread per IRC R308.4.7. It appears that safety glazing is required at several locations, Sheet A4.

5. Call for laminated glass typically at skylights per IRC R308.6.2.

6. Adhered masonry veneer is required to have the following clearances per IRC R703.12.1: 4" minimum above the earth, 2" minimum above paved areas, and 1/2" minimum above exterior walking surfaces which are supported by the same foundation that supports the exterior wall. Please show these clearances on Detail M/AD1. We have not found a manufacturer that warrants below-grade installation; however, if you are able to provide specific manufacturer's instructions that support such installation, please provide. Those will also need to be provided on site for installation and inspection.

7. Provide footing drains around new building perimeter per IRC R405.1. Provide at least one detail that shows both footing and roof drains.

8. Attic access openings are required by IRC R807.1. A 22"x30" opening needs to be provided where the minimum unobstructed headroom in the attic is at least 30 inches. It appears that an attic access opening may be needed at the low roof over the Den, Sheet A5. Please verify.

**Energy and Ventilation**

1. Per IRC M1503.4, if the exhaust hood in the kitchen has a capacity in excess of 400 cfm, it must be mechanically or naturally provided with makeup air at a rate of approximately equal to the exhaust air rate. Such makeup air systems must be equipped with not less than one damper. Each damper shall be a gravity damper or an electrically operated damper that automatically opens when the exhaust system operates. Please clarify the drawings.

**Geotechnical**

1. Submit a letter from the geotechnical engineer that indicates that the final plans have been reviewed and that the plans are consistent with the recommendations of the geotechnical report.

2. Geotechnical special inspections should be itemized on the drawings and on the Mercer Island Cover Sheet. At a minimum, we anticipate the following: monitoring of erosion control, observation and monitoring of excavation, subsurface drainage installation, soil bearing verification, and structural fill verification and compaction.

**Structural**

General

1. Please reference the 2015 IBC in the Structural Notes, Sheet S3. SEE

2. The compressive strength for concrete in basement walls, foundation walls, exterior walls and other vertical surfaces exposed to the weather must be 3,000 psi per the exception to IBC 1904.1. These same provisions are found in IRC R402.2. Special inspection is not required since the design uses 2,500 psi concrete. Please clarify the concrete specification on Sheet S3.

3. Please complete the Mercer Island Cover Sheet to indicate the name of the special inspection agency you are using for post-installed anchors. If unknown, we can indicate "to be determined" for later completion.