DYNAMIC STRUCTURES

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September 22, 2017

Mike Molyneux
Plan Reviewer

Re: Summit Horizon (Powder Mountain)
1500 + sq. ft. plan (Cabin 28)

The following responses are to plan review comments from the structural portions of the second plan review dated August 22, 2017.

S4A See the attached calculations for the capacity of the weld of the knife plate at each end of the pedestrian bridge.

S7 See the revised calculations using the average height between the sloping grade and the lowest floor as the seismic base. The shear walls and braces have been recalculated accordingly.

Respectfully,

Jay D. Adams, SE

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DYNAMIC STRUCTURES
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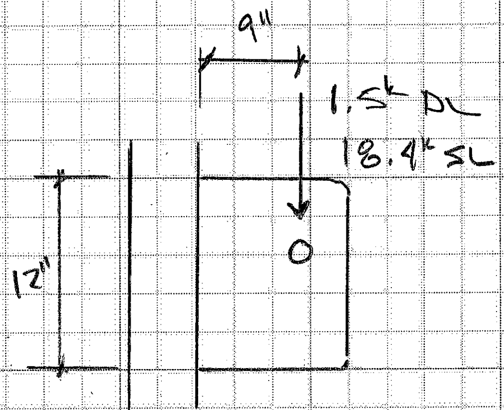
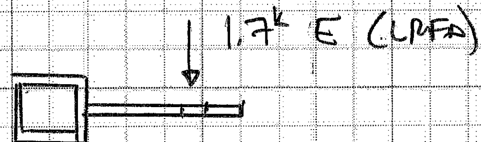
JOB: ITEM 54A
SHEET NO ______ OF ______
CALCULATED BY ______ DATE ______

WELD OF 1/2" KNIFE PLATES EACH END OF ACCESS BRIDGES

CHECK 1/4" WELD EACH SIDE OF PLATE
TOTAL WELD LENGTH = 24"



$\phi R_n = 1.392(4)(1") = 5.6^k/\text{IN}$



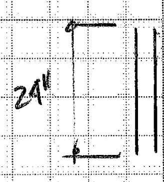
• DL + SL - SHEAR

$V_u = 1.5^k + 18.4^k = 19.9^k$

$\phi V_n = 24" (5.6^k/\text{IN}) = 134.4^k$

• DL + SL - MOMENT

$M_u = 19.9^k (9") = 179^{k\text{-IN}}$



WELDS AS LINES

$Z = d^2/2 = (24")^2/2 = 288 \text{ IN}^2$

$\phi M_n = 5.6^k/\text{IN} (288 \text{ IN}^2) = 1613^{k\text{-IN}}$

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JOB ____

SHEET NO ____ OF ____

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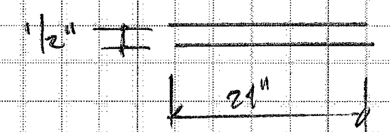
E, WEAK DIRECTION MOMENT

$M_u = 1.7^k (9") = 15.3^{k \cdot in}$



WELDS AS LINES

$Z = bd = 24"(.5") = 12\ in^2$

$\phi M_n = 5.6^k/in\ (12\ in^2) = 67.2^{k \cdot in}$

INTERACTION

$$\frac{19.9^k}{139.4^k} + \frac{179^{k \cdot in}}{1613^{k \cdot in}} + \frac{15.3^{k \cdot in}}{67.2^{k \cdot in}} = 0.49 < 1.0$$

ITEM S7

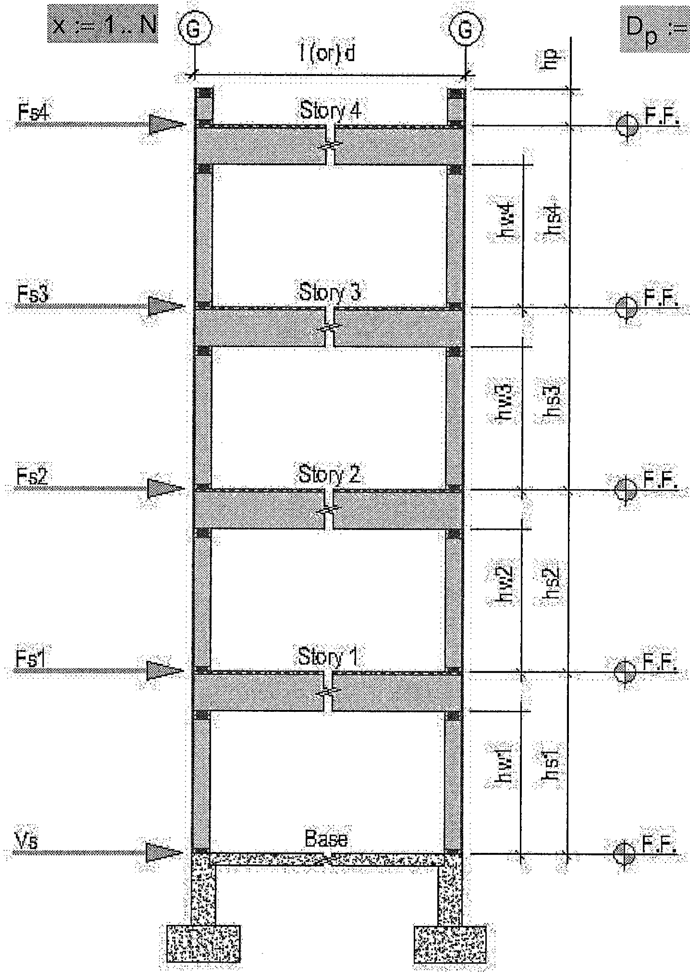
Seismic Base Shear (full structure)

This worksheet calculates the Seismic Loads applied to the building's main lateral load resisting system per ASCE 7-10, Chapters 11 and 12.

Number of Stories

$N := 3$

$x := 1 .. N$



Parapet

$h_p := 0 \cdot ft$

$D_p := 0 \cdot psf$

Story 4

$l_4 := 0 \cdot ft$

$d_4 := 0 \cdot ft$

$h_{s_4} := 0 \cdot ft$

$D_4 := 0 \cdot psf$

$D_{w_4} := 0 \cdot psf$

Story 3

$l_3 := 50 \cdot ft$

$d_3 := 22 \cdot ft$

$h_{s_3} := 9 \cdot ft$

30% snow $D_3 := (15 + 58) \cdot psf$

$D_{w_3} := 15 \cdot psf$

Story 2

$l_2 := 50 \cdot ft$

$d_2 := 22 \cdot ft$

$h_{s_2} := 10 \cdot ft$

$D_2 := 50 \cdot psf$

$D_{w_2} := 15 \cdot psf$

Story 1

$l_1 := 50 \cdot ft$

$d_1 := 22 \cdot ft$

average = (1.5' + 8') / 2 $h_{s_1} := 4.75 \cdot ft$

$D_1 := 50 \cdot psf$

Wood Shear Walls: $R := 6.5$ (Table 12.2-1) $D_{w_1} := 0 \cdot psf$

Determine the MCE SRA Parameters per Section 11.4:

Site Class: $SC := \text{"B"}$ (Table 20.3-1)

@ Short Periods	**@ 1-second Period**	
$S_s := 0.829$	$S_1 := 0.276$	(Figures 22-1 thr. 22-14)
$S_{ds} := 0.553$	$S_{d1} := 0.184$	(Equations 11.4-3 & 11.4-4)

Determine the Seismic Design Category per Section 11.6:

Occupancy Category: $OC := 2$ (IBC Table 1604.5)

$I_e := 1.0$ (Table 11.5-1)

$SDC = \text{"D"}$ (Table 11.6-1)

Calculate the Effective Seismic Weight per Section 12.7.2:

Diaphragms: $wd_x := D_x \cdot l_x \cdot d_x$

$h_{s_{N+1}} := 2 \cdot h_{s_{N+1}}$

Walls: $ww_x := \left(D_{w_x} \cdot \frac{h_{s_x}}{2} + D_{w_{x+1}} \cdot \frac{h_{s_{x+1}}}{2} \right)$

Story Weight: $w_x := wd_x + ww_x \cdot (2 \cdot l_x + 2 \cdot d_x)$

$h_{s_{N+1}} := 0.5 \cdot h_{s_{N+1}}$

Total Weight: $W := \sum w$

$W = 231.3 \cdot kip$

Calculate the Approximate Fundamental Period per Section 12.7.2:

$$h_n := \sum_{i=1}^{N+1} \frac{h_{s_i}}{ft}$$ (Section 12.8.2.1)

$C_t := 0.02$ (Table 12.8-2)

$X := 0.75$ (Table 12.8-2)

$T_a := C_t \cdot h_n^{X}$ (Equation 12.8-7)

Calculate the Fundamental Period per Section 12.7.2:

$C_u := 1.5$ (Table 12.8-1)

$T := C_u \cdot T_a$ (Section 12.8.2)

$T = 0.323$

Determine the Long-period Transition Period per Section 11.4.5:

$T_L := 8.0$ (Figure 22-15)

Calculate the Seismic Response Coefficient per Section 12.8.1.1:

$$C_s := \frac{S_{ds} \cdot I_e}{R}$$ (Equation 12.8-2)

$$C_{smin} := \begin{cases} \dfrac{0.5 \cdot S_1 \cdot I_e}{R} & \text{if } S_1 > 0.60 \\ 0.01 & \text{otherwise} \end{cases}$$ (Equations 12.8-5 & 12.8-6)

$$C_{smax} := \begin{cases} \dfrac{S_{d1} \cdot I_e}{R \cdot T} & \text{if } T \le T_L \\ \dfrac{S_{d1} \cdot I_e \cdot T_L}{R \cdot T^2} & \text{if } T > T_L \end{cases}$$ (Equations 12.8-3 & 12.8-4)

$$C_s := \begin{cases} C_{smin} & \text{if } C_s < C_{smin} \\ C_{smax} & \text{if } C_s > C_{smax} \\ C_s & \text{otherwise} \end{cases}$$

$C_s = 0.085$

Calculate the Seismic Base Shear per Section 12.8.1:

$V_s := C_s \cdot W$ (Equation 12.8-1)

$V_s = 19.7 \cdot kip$ STRENGTH

$\frac{V_s}{1.4} = 14.1 \cdot kip$ ALLOWABLE

Vertically Distribute the Seismic Base Shear per Section 12.8.3:

$$k1 := \begin{pmatrix} 1 \\ 2 \end{pmatrix} \qquad t1 := \begin{pmatrix} 0.5 \\ 2.5 \end{pmatrix} \qquad k := \begin{cases} 1.0 & \text{if } T < 0.5 \\ \text{linterp}(t1, k1, T) & \text{if } 0.5 \le T \le 2.5 \\ 2.0 & \text{if } T > 2.5 \end{cases}$$

$$C_{v_x} := \frac{w_x \cdot \left(\sum_{i=1}^{x} \frac{h_{s_i}}{ft} \right)^k}{\sum_{i=1}^{N} \left[w_i \cdot \left(\sum_{j=1}^{i} \frac{h_{s_j}}{ft} \right)^k \right]}$$ (Equation 12.8-12)

$$F_{s_x} := C_{v_x} \cdot V_s$$ (Equation 12.8-11)

	STRENGTH	ALLOWABLE
(Story 4)	$F_{s_4} = \blacksquare \cdot kip$	$0.71 F_{s_4} = \blacksquare \cdot kip$
(Story 3)	$F_{s_3} = 11.8 \cdot kip$	$0.71 F_{s_3} = 8.4 \cdot kip$
(Story 2)	$F_{s_2} = 6.2 \cdot kip$	$0.71 F_{s_2} = 4.4 \cdot kip$
(Story 1)	$F_{s_1} = 1.7 \cdot kip$	$0.71 F_{s_1} = 1.2 \cdot kip$

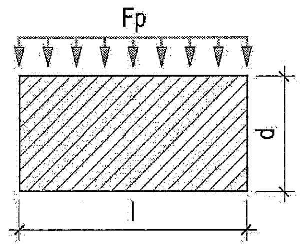
Calculate the Diaphragm Design Force (perpendicular to L) per Section 12.10.1.1:

$$F_{psl_x} := \frac{\sum_{i=x}^{N} F_{s_i}}{\sum_{i=x}^{N} w_i} \cdot \left(\frac{wd_x}{l_x} + 2 \cdot ww_x \right)$$ (Equation 12.10-1)

$$F_{pslmin_x} := 0.2 \cdot S_{ds} \cdot I_e \cdot \left(\frac{wd_x}{l_x} + 2 \cdot ww_x \right)$$ (Section 12.10.1.1)

$$F_{pslmax_x} := 0.4 \cdot S_{ds} \cdot I_e \cdot \left(\frac{wd_x}{l_x} + 2 \cdot ww_x \right)$$ (Section 12.10.1.1)

$$F_{psl_x} := \begin{cases} F_{pslmin_x} & \text{if } F_{psl_x} < F_{pslmin_x} \\ F_{pslmax_x} & \text{if } F_{psl_x} > F_{pslmax_x} \\ F_{psl_x} & \text{otherwise} \end{cases}$$



$F_{psl_4} = \blacksquare \cdot plf$ (Story 4)

$F_{psl_3} = 228.3 \cdot plf$ (Story 3)

$F_{psl_2} = 153.2 \cdot plf$ (Story 2)

$F_{psl_1} = 138.3 \cdot plf$ (Story 1)

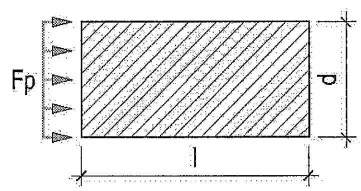
Calculate the Diaphragm Design Force (perpendicular to D) per Section 12.10.1.1:

$$F_{psd_x} := \frac{\sum_{i=x}^{N} F_{s_i}}{\sum_{i=x}^{N} w_i} \cdot \left(\frac{wd_x}{d_x} + 2 \cdot ww_x \right)$$ (Equation 12.10-1)

$$F_{psdmin_x} := 0.2 \cdot S_{ds} \cdot I_e \cdot \left(\frac{wd_x}{d_x} + 2 \cdot ww_x \right)$$ (Section 12.10.1.1)

$$F_{psdmax_x} := 0.4 \cdot S_{ds} \cdot I_e \cdot \left(\frac{wd_x}{d_x} + 2 \cdot ww_x \right)$$ (Section 12.10.1.1)

$$F_{psd_x} := \begin{cases} F_{psdmin_x} & \text{if } F_{psd_x} < F_{psdmin_x} \\ F_{psdmax_x} & \text{if } F_{psd_x} > F_{psdmax_x} \\ F_{psd_x} & \text{otherwise} \end{cases}$$



$F_{psd_4} = \blacksquare \cdot plf$ (Story 4)

$F_{psd_3} = 496.4 \cdot plf$ (Story 3)

$F_{psd_2} = 308.0 \cdot plf$ (Story 2)

$F_{psd_1} = 293.1 \cdot plf$ (Story 1)

SHEAR WALLS - LINE 1'

STORY 2

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n2 := 1$	(n = 8 max)	1:	$l2_1 := 5.5 \cdot ft$	$h2_1 := 9 \cdot ft$	$t2_1 := 1 \cdot ft$
Story Shear:	$Fa_2 := 8.6 \cdot k$	(Allowable)	2:	$l2_2 := 0 \cdot ft$	$h2_2 := 0 \cdot ft$	$t2_2 := 0 \cdot ft$
Shear Attributed To Line:	$Va_2 := 4.3 \cdot k$	(Allowable)	3:	$l2_3 := 0 \cdot ft$	$h2_3 := 0 \cdot ft$	$t2_3 := 0 \cdot ft$
Story DL:	$DL_2 := 15 \cdot psf$		4:	$l2_4 := 0 \cdot ft$	$h2_4 := 0 \cdot ft$	$t2_4 := 0 \cdot ft$
Wall DL:	$DLw_2 := 15 \cdot psf$		5:	$l2_5 := 0 \cdot ft$	$h2_5 := 0 \cdot ft$	$t2_5 := 0 \cdot ft$
Redundancy	$\rho_2 := 1.3$		6:	$l2_6 := 0 \cdot ft$	$h2_6 := 0 \cdot ft$	$t2_6 := 0 \cdot ft$
			7:	$l2_7 := 0 \cdot ft$	$h2_7 := 0 \cdot ft$	$t2_7 := 0 \cdot ft$
			8:	$l2_8 := 0 \cdot ft$	$h2_8 := 0 \cdot ft$	$t2_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_2 := \frac{\rho_2 \cdot Va_2}{\sum l2}$$

OVERTURNING CALCULATIONS $i2 := 1 .. n2$

Overturning Moment: $$Mo2_{i2} := v_2 \cdot h2_{i2} \cdot l2_{i2}$$

$$Mo2 = (50.31) \cdot k \cdot ft$$

Resisting Moment: $$Mr2_{i2} := 0.6 \cdot \left[\left[\left(DL_2 \cdot t2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] + \left[\left(DLw_2 \cdot h2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] \right]$$

Nominal Overturning: $$M2_{i2} := Mo2_{i2} - Mr2_{i2}$$

Tension at Pier Ends: $$T2_{i2} := \frac{M2_{i2}}{l2_{i2}}$$

STORY 1

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n1 := 1$	(n = 8 max)	1:	$l1_1 := 16.5 \cdot ft$	$h1_1 := 10 \cdot ft$	$t1_1 := 2 \cdot ft$
Story Shear:	$Fa_1 := 4.4 \cdot k$	(Allowable)	2:	$l1_2 := 0 \cdot ft$	$h1_2 := 0 \cdot ft$	$t1_2 := 0 \cdot ft$
Shear Attributed To Line:	$Va_1 := 2.2 \cdot k$	(Allowable)	3:	$l1_3 := 0 \cdot ft$	$h1_3 := 0 \cdot ft$	$t1_3 := 0 \cdot ft$
Story DL:	$DL_1 := 50 \cdot psf$		4:	$l1_4 := 0 \cdot ft$	$h1_4 := 0 \cdot ft$	$t1_4 := 0 \cdot ft$
Wall DL:	$DLw_1 := 15 \cdot psf$		5:	$l1_5 := 0 \cdot ft$	$h1_5 := 0 \cdot ft$	$t1_5 := 0 \cdot ft$
Sill Plate Length:	$Ls_1 := 16.5 \cdot ft$		6:	$l1_6 := 0 \cdot ft$	$h1_6 := 0 \cdot ft$	$t1_6 := 0 \cdot ft$
Redundancy	$\rho_1 := 1$		7:	$l1_7 := 0 \cdot ft$	$h1_7 := 0 \cdot ft$	$t1_7 := 0 \cdot ft$
			8:	$l1_8 := 0 \cdot ft$	$h1_8 := 0 \cdot ft$	$t1_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls):

$$v_1 := \frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right)}{\sum l1}$$

OVERTURNING CALCULATIONS

$$i1 := 1 .. n1$$

Overturning Moment:

$$Mo1_{i1} := \left[\frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right) \cdot h1_{i1}}{\sum l1}\right] \cdot l1_{i1}$$

Resisting Moment:

$$Mr1_{i1} := 0.6 \cdot \left[\left[\left(DL_1 \cdot t1_{i1}\right) \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right] + \left[\left[\left(DLw_1\right) \cdot h1_{i1}\right] \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right]\right]$$

Nominal Overturning:

$$M1_{i1} := Mo1_{i1} - Mr1_{i1}$$

Tension at Pier Ends:

$$T1_{i1} := \frac{M1_{i1}}{l1_{i1}}$$

ANCHOR BOLTS

Unit Shear (for bolts):

$$vb_1 := \frac{\left[\sum_{i=1}^{2} \left(\rho_i \cdot Va_i\right)\right]}{Ls_1}$$

1/2" bolt in 1 1/2" sill:

$$s_{0.5} := \frac{(650 \cdot lb) \cdot 1.6}{vb_1}$$

5/8" bolt in 1 1/2" sill:

$$s_{0.625} := \frac{(930 \cdot lb) \cdot 1.6}{vb_1}$$

SUMMARY, STORY 2

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i2} := \frac{l2_{i2}}{h2_{i2}}$ $\qquad$ $r2 := if(2\cdot min(ratio) > 1.0, 1.0, 2\cdot min(ratio))$ $\qquad$ $r2 = 1$

Unit Shear

$\frac{v2}{r2} = 1016\cdot plf$

	Uplift	HOLD DOWN
Pier 1:	$T2_1 = 8900\cdot lb$	MST72 EACH SIDE
Pier 2:	$T2_2 = \blacksquare\cdot lb$	
Pier 3:	$T2_3 = \blacksquare\cdot lb$	
Pier 4:	$T2_4 = \blacksquare\cdot lb$	
Pier 5:	$T2_5 = \blacksquare\cdot lb$	
Pier 6:	$T2_6 = \blacksquare\cdot lb$	
Pier 7:	$T2_7 = \blacksquare\cdot lb$	
Pier 8:	$T2_8 = \blacksquare\cdot lb$	

SHEAR WALLS

Sheathing:	7/16", APA, Exp. 1
Blocking:	All Panel Edges
Edge Nailing:	8d @ 2" o.c.
Field Nailing:	8d @ 12" o.c.

SHEATH BOTH SIDES OF WALL

SUMMARY, STORY 1

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i1} := \frac{l1_{i1}}{h1_{i1}}$ $\qquad$ $r1 := if(2\cdot min(ratio) > 1.0, 1.0, 2\cdot min(ratio))$ $\qquad$ $r1 = 1$

Unit Shear

$\frac{v1}{r1} = 472\cdot plf$

	Uplift	HOLD DOWN
Pier 1:	$T1_1 = 3484\cdot lb$	MST48
Pier 2:	$T1_2 = \blacksquare\cdot lb$	
Pier 3:	$T1_3 = \blacksquare\cdot lb$	
Pier 4:	$T1_4 = \blacksquare\cdot lb$	
Pier 5:	$T1_5 = \blacksquare\cdot lb$	
Pier 6:	$T1_6 = \blacksquare\cdot lb$	
Pier 7:	$T1_7 = \blacksquare\cdot lb$	
Pier 8:	$T1_8 = \blacksquare\cdot lb$	

SHEAR WALLS

Sheathing:	7/16", APA, Exp. 1
Blocking:	All Panel Edges
Edge Nailing:	8d @ 3" o.c.
Field Nailing:	8d @ 12" o.c.

SHEAR WALLS - LINE 4'

STORY 2

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n2 := 1$	(n = 8 max)	1:	$l2_1 := 11 \cdot ft$	$h2_1 := 9 \cdot ft$	$t2_1 := 1 \cdot ft$
Story Shear:	$Fa_2 := 8.4 \cdot k$	(Allowable)	2:	$l2_2 := 0 \cdot ft$	$h2_2 := 0 \cdot ft$	$t2_2 := 0 \cdot ft$
Shear Attributed To Line:	$Va_2 := 4.2 \cdot k$	(Allowable)	3:	$l2_3 := 0 \cdot ft$	$h2_3 := 0 \cdot ft$	$t2_3 := 0 \cdot ft$
Story DL:	$DL_2 := 15 \cdot psf$		4:	$l2_4 := 0 \cdot ft$	$h2_4 := 0 \cdot ft$	$t2_4 := 0 \cdot ft$
Wall DL:	$DLw_2 := 15 \cdot psf$		5:	$l2_5 := 0 \cdot ft$	$h2_5 := 0 \cdot ft$	$t2_5 := 0 \cdot ft$
Redundancy	$\rho_2 := 1.3$		6:	$l2_6 := 0 \cdot ft$	$h2_6 := 0 \cdot ft$	$t2_6 := 0 \cdot ft$
			7:	$l2_7 := 0 \cdot ft$	$h2_7 := 0 \cdot ft$	$t2_7 := 0 \cdot ft$
			8:	$l2_8 := 0 \cdot ft$	$h2_8 := 0 \cdot ft$	$t2_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_2 := \frac{\rho_2 \cdot Va_2}{\sum l2}$$

OVERTURNING CALCULATIONS $i2 := 1 .. n2$

Overturning Moment: $$Mo2_{i2} := v_2 \cdot h2_{i2} \cdot l2_{i2}$$ $$Mo2 = (49.14) \cdot k \cdot ft$$

Resisting Moment: $$Mr2_{i2} := 0.6 \cdot \left[\left[\left(DL_2 \cdot t2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] + \left[\left(DLw_2 \cdot h2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] \right]$$

Nominal Overturning: $$M2_{i2} := Mo2_{i2} - Mr2_{i2}$$

Tension at Pier Ends: $$T2_{i2} := \frac{M2_{i2}}{l2_{i2}}$$

STORY 1

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n1 := 1$	(n = 8 max)	1:	$l1_1 := 22 \cdot ft$	$h1_1 := 10 \cdot ft$	$t1_1 := 2 \cdot ft$
Story Shear:	$Fa_1 := 4.4 \cdot k$	(Allowable)	2:	$l1_2 := 0 \cdot ft$	$h1_2 := 0 \cdot ft$	$t1_2 := 0 \cdot ft$
Shear Attributed To Line:	$Va_1 := 2.2 \cdot k$	(Allowable)	3:	$l1_3 := 0 \cdot ft$	$h1_3 := 0 \cdot ft$	$t1_3 := 0 \cdot ft$
Story DL:	$DL_1 := 50 \cdot psf$		4:	$l1_4 := 0 \cdot ft$	$h1_4 := 0 \cdot ft$	$t1_4 := 0 \cdot ft$
Wall DL:	$DLw_1 := 15 \cdot psf$		5:	$l1_5 := 0 \cdot ft$	$h1_5 := 0 \cdot ft$	$t1_5 := 0 \cdot ft$
Sill Plate Length:	$Ls_1 := 22 \cdot ft$		6:	$l1_6 := 0 \cdot ft$	$h1_6 := 0 \cdot ft$	$t1_6 := 0 \cdot ft$
Redundancy	$\rho_1 := 1$		7:	$l1_7 := 0 \cdot ft$	$h1_7 := 0 \cdot ft$	$t1_7 := 0 \cdot ft$
			8:	$l1_8 := 0 \cdot ft$	$h1_8 := 0 \cdot ft$	$t1_8 := 0 \cdot ft$

SUBTRACT OPENINGS BELOW

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_1 := \frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right)}{\sum l1}$$

OVERTURNING CALCULATIONS $i1 := 1 .. n1$

Overturning Moment: $$Mo1_{i1} := \left[\frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right) \cdot h1_{i1}}{\sum l1}\right] \cdot l1_{i1}$$

Resisting Moment: $$Mr1_{i1} := 0.6 \cdot \left[\left[\left(DL_1 \cdot t1_{i1}\right) \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right] + \left[\left[\left(DLw_1\right) \cdot h1_{i1}\right] \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right]\right]$$

Nominal Overturning: $$M1_{i1} := Mo1_{i1} - Mr1_{i1}$$

Tension at Pier Ends: $$T1_{i1} := \frac{M1_{i1}}{l1_{i1}}$$

ANCHOR BOLTS

Unit Shear (for bolts): $$vb_1 := \frac{\left[\sum_{i=1}^{2} \left(\rho_i \cdot Va_i\right)\right]}{Ls_1}$$

1/2" bolt in 1 1/2" sill: $$s_{0.5} := \frac{(650 \cdot lb) \cdot 1.6}{vb_1}$$

5/8" bolt in 1 1/2" sill: $$s_{0.625} := \frac{(930 \cdot lb) \cdot 1.6}{vb_1}$$

SUMMARY, STORY 2

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i2} := \frac{l2_{i2}}{h2_{i2}}$ $r2 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r2 = 1$

Unit Shear		Uplift	HOLD DOWN
$\frac{v_2}{r2} = 496 \cdot plf$	Pier 1:	$T2_1 = 3972 \cdot lb$	MST48
	Pier 2:	$T2_2 = \blacksquare \cdot lb$	
SHEAR WALLS	Pier 3:	$T2_3 = \blacksquare \cdot lb$	
	Pier 4:	$T2_4 = \blacksquare \cdot lb$	
	Pier 5:	$T2_5 = \blacksquare \cdot lb$	
	Pier 6:	$T2_6 = \blacksquare \cdot lb$	
	Pier 7:	$T2_7 = \blacksquare \cdot lb$	
	Pier 8:	$T2_8 = \blacksquare \cdot lb$	

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 2" o.c.
Field Nailing: 8d @ 12" o.c.

SUMMARY, STORY 1

Reduction in shear walls due to height to width ratio less than 2:1

SUBTRACT OPENINGS

$ratio_{i1} := \frac{l1_{i1}}{h1_{i1}}$ $r1 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r1 = 1$ $t1 := \frac{(22 - 1 \cdot 6)}{22}$ $t1 = 0.73$

Unit Shear		Uplift	HOLD DOWN
$\frac{v_1}{r1 \cdot t1} = 479 \cdot plf$	Pier 1:	$T1_1 = 1832 \cdot lb$	MST48
	Pier 2:	$T1_2 = \blacksquare \cdot lb$	
SHEAR WALLS	Pier 3:	$T1_3 = \blacksquare \cdot lb$	
	Pier 4:	$T1_4 = \blacksquare \cdot lb$	
	Pier 5:	$T1_5 = \blacksquare \cdot lb$	
	Pier 6:	$T1_6 = \blacksquare \cdot lb$	
	Pier 7:	$T1_7 = \blacksquare \cdot lb$	
	Pier 8:	$T1_8 = \blacksquare \cdot lb$	

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 3" o.c.
Field Nailing: 8d @ 12" o.c.

SHEAR WALLS - LINE A

STORY 2

# Piers in Shear Line:	$n2 := 2$	(n = 8 max)
Story Shear:	$Fa_2 := 8.4 \cdot k$	(Allowable)
Shear Attributed To Line:	$Va_2 := 4.2 \cdot k$	(Allowable)
Story DL:	$DL_2 := 15 \cdot psf$	
Wall DL:	$DLw_2 := 15 \cdot psf$	
Redundancy	$\rho_2 := 1$	

PIERS	Length	Height	Tributary
1:	$l2_1 := 18 \cdot ft$	$h2_1 := 9 \cdot ft$	$t2_1 := 11 \cdot ft$
2:	$l2_2 := 24 \cdot ft$	$h2_2 := 9 \cdot ft$	$t2_2 := 11 \cdot ft$
3:	$l2_3 := 0 \cdot ft$	$h2_3 := 0 \cdot ft$	$t2_3 := 0 \cdot ft$
4:	$l2_4 := 0 \cdot ft$	$h2_4 := 0 \cdot ft$	$t2_4 := 0 \cdot ft$
5:	$l2_5 := 0 \cdot ft$	$h2_5 := 0 \cdot ft$	$t2_5 := 0 \cdot ft$
6:	$l2_6 := 0 \cdot ft$	$h2_6 := 0 \cdot ft$	$t2_6 := 0 \cdot ft$
7:	$l2_7 := 0 \cdot ft$	$h2_7 := 0 \cdot ft$	$t2_7 := 0 \cdot ft$
8:	$l2_8 := 0 \cdot ft$	$h2_8 := 0 \cdot ft$	$t2_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_2 := \frac{\rho_2 \cdot Va_2}{\sum l2}$$

OVERTURNING CALCULATIONS $i2 := 1 .. n2$

Overturning Moment: $Mo2_{i2} := v_2 \cdot h2_{i2} \cdot l2_{i2}$ $$Mo2 = \begin{pmatrix} 16.2 \\ 21.6 \end{pmatrix} \cdot k \cdot ft$$

Resisting Moment: $$Mr2_{i2} := 0.6 \cdot \left[\left[\left(DL_2 \cdot t2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] + \left[\left(DLw_2 \cdot h2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] \right]$$

Nominal Overturning: $M2_{i2} := Mo2_{i2} - Mr2_{i2}$

Tension at Pier Ends: $$T2_{i2} := \frac{M2_{i2}}{l2_{i2}}$$

STORY 1

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n1 := 1$	(n = 8 max)	1:	$l1_1 := 38\cdot ft$	$h1_1 := 10\cdot ft$	$t1_1 := 1\cdot ft$
Story Shear:	$Fa_1 := 4.4\cdot k$		2:	$l1_2 := 0\cdot ft$	$h1_2 := 0\cdot ft$	$t1_2 := 0\cdot ft$
Shear Attributed To Line:	$Va_1 := 2.2\cdot k + 3.4\cdot k$		3:	$l1_3 := 0\cdot ft$	$h1_3 := 0\cdot ft$	$t1_3 := 0\cdot ft$
Story DL:	$DL_1 := 50\cdot psf$		4:	$l1_4 := 0\cdot ft$	$h1_4 := 0\cdot ft$	$t1_4 := 0\cdot ft$
Wall DL:	$DLw_1 := 15\cdot psf$		5:	$l1_5 := 0\cdot ft$	$h1_5 := 0\cdot ft$	$t1_5 := 0\cdot ft$
Sill Plate Length:	$Ls_1 := 38\cdot ft$		6:	$l1_6 := 0\cdot ft$	$h1_6 := 0\cdot ft$	$t1_6 := 0\cdot ft$
Redundancy	$\rho_1 := 1$		7:	$l1_7 := 0\cdot ft$	$h1_7 := 0\cdot ft$	$t1_7 := 0\cdot ft$
			8:	$l1_8 := 0\cdot ft$	$h1_8 := 0\cdot ft$	$t1_8 := 0\cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_1 := \frac{\left(\rho_2\cdot Va_2 + \rho_1\cdot Va_1\right)}{\sum l1}$$

OVERTURNING CALCULATIONS $\quad i1 := 1 .. n1$

Overturning Moment: $$Mo1_{i1} := \left[\frac{\left(\rho_2\cdot Va_2 + \rho_1\cdot Va_1\right)\cdot h1_{i1}}{\sum l1}\right]\cdot l1_{i1}$$

Resisting Moment: $$Mr1_{i1} := 0.6\cdot\left[\left[\left(DL_1\cdot t1_{i1}\right)\cdot l1_{i1}\cdot\left(\frac{l1_{i1}}{2}\right)\right] + \left[\left[\left(DLw_1\right)\cdot h1_{i1}\right]\cdot l1_{i1}\cdot\left(\frac{l1_{i1}}{2}\right)\right]\right]$$

Nominal Overturning: $$M1_{i1} := Mo1_{i1} - Mr1_{i1}$$

Tension at Pier Ends: $$T1_{i1} := \frac{M1_{i1}}{l1_{i1}}$$

ANCHOR BOLTS

Unit Shear (for bolts): $$vb_1 := \frac{\left[\sum_{i=1}^{2}\left(\rho_i\cdot Va_i\right)\right]}{Ls_1}$$

1/2" bolt in 1 1/2" sill: $$s_{0.5} := \frac{(650\cdot lb)\cdot 1.6}{vb_1}$$

5/8" bolt in 1 1/2" sill: $$s_{0.625} := \frac{(930\cdot lb)\cdot 1.6}{vb_1}$$

SUMMARY, STORY 2

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i2} := \frac{l2_{i2}}{h2_{i2}}$ $r2 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r2 = 1$

Unit Shear

$\frac{v2}{r2} = 100 \cdot plf$

SHEAR WALLS

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 6" o.c.
Field Nailing: 8d @ 12" o.c.

	Uplift	HOLD DOWN
Pier 1:	$T2_1 = -720 \cdot lb$	NONE REQUIRED
Pier 2:	$T2_2 = -1260 \cdot lb$	NONE REQUIRED
Pier 3:	$T2_3 = \blacksquare \cdot lb$	
Pier 4:	$T2_4 = \blacksquare \cdot lb$	
Pier 5:	$T2_5 = \blacksquare \cdot lb$	
Pier 6:	$T2_6 = \blacksquare \cdot lb$	
Pier 7:	$T2_7 = \blacksquare \cdot lb$	
Pier 8:	$T2_8 = \blacksquare \cdot lb$	

SUMMARY, STORY 1

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i1} := \frac{l1_{i1}}{h1_{i1}}$ $r1 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r1 = 1$

Unit Shear

$\frac{v1}{r1} = 258 \cdot plf$

SHEAR WALLS

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 6" o.c.
Field Nailing: 8d @ 12" o.c.

	Uplift	HOLD DOWN
Pier 1:	$T1_1 = 299 \cdot lb$	SIMPSON MST48
Pier 2:	$T1_2 = \blacksquare \cdot lb$	
Pier 3:	$T1_3 = \blacksquare \cdot lb$	
Pier 4:	$T1_4 = \blacksquare \cdot lb$	
Pier 5:	$T1_5 = \blacksquare \cdot lb$	
Pier 6:	$T1_6 = \blacksquare \cdot lb$	
Pier 7:	$T1_7 = \blacksquare \cdot lb$	
Pier 8:	$T1_8 = \blacksquare \cdot lb$	

SHEAR WALLS - LINE B

STORY 2

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n2 := 1$	(n = 8 max)	1:	$l2_1 := 14 \cdot ft$	$h2_1 := 9 \cdot ft$	$t2_1 := 11 \cdot ft$
Story Shear:	$Fa_2 := 8.4 \cdot k$	(Allowable)	2:	$l2_2 := 0 \cdot ft$	$h2_2 := 0 \cdot ft$	$t2_2 := 0 \cdot ft$
Shear Attributed To Line:	$Va_2 := 4.2 \cdot k$	(Allowable)	3:	$l2_3 := 0 \cdot ft$	$h2_3 := 0 \cdot ft$	$t2_3 := 0 \cdot ft$
Story DL:	$DL_2 := 15 \cdot psf$		4:	$l2_4 := 0 \cdot ft$	$h2_4 := 0 \cdot ft$	$t2_4 := 0 \cdot ft$
Wall DL:	$DLw_2 := 15 \cdot psf$		5:	$l2_5 := 0 \cdot ft$	$h2_5 := 0 \cdot ft$	$t2_5 := 0 \cdot ft$
Redundancy	$\rho_2 := 1$		6:	$l2_6 := 0 \cdot ft$	$h2_6 := 0 \cdot ft$	$t2_6 := 0 \cdot ft$
			7:	$l2_7 := 0 \cdot ft$	$h2_7 := 0 \cdot ft$	$t2_7 := 0 \cdot ft$
			8:	$l2_8 := 0 \cdot ft$	$h2_8 := 0 \cdot ft$	$t2_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_2 := \frac{\rho_2 \cdot Va_2}{\sum l2}$$

OVERTURNING CALCULATIONS $i2 := 1 .. n2$

Overturning Moment: $Mo2_{i2} := v_2 \cdot h2_{i2} \cdot l2_{i2}$ $\quad Mo2 = (37.8) \cdot k \cdot ft$

Resisting Moment: $$Mr2_{i2} := 0.6 \cdot \left[\left[\left(DL_2 \cdot t2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] + \left[\left(DLw_2 \cdot h2_{i2} \right) \cdot l2_{i2} \cdot \left(\frac{l2_{i2}}{2} \right) \right] \right]$$

Nominal Overturning: $M2_{i2} := Mo2_{i2} - Mr2_{i2}$

Tension at Pier Ends: $$T2_{i2} := \frac{M2_{i2}}{l2_{i2}}$$

STORY 1

			PIERS	Length	Height	Tributary
# Piers in Shear Line:	$n1 := 2$	(n = 8 max)	1:	$l1_1 := 11 \cdot ft$	$h1_1 := 10 \cdot ft$	$t1_1 := 1 \cdot ft$
Story Shear:	$Fa_1 := 4.4 \cdot k$	(Allowable)	2:	$l1_2 := 11 \cdot ft$	$h1_2 := 10 \cdot ft$	$t1_2 := 1 \cdot ft$
Shear Attributed To Line:	$Va_1 := 2.2 \cdot k$	(Allowable)	3:	$l1_3 := 0 \cdot ft$	$h1_3 := 0 \cdot ft$	$t1_3 := 0 \cdot ft$
Story DL:	$DL_1 := 50 \cdot psf$		4:	$l1_4 := 0 \cdot ft$	$h1_4 := 0 \cdot ft$	$t1_4 := 0 \cdot ft$
Wall DL:	$DLw_1 := 15 \cdot psf$		5:	$l1_5 := 0 \cdot ft$	$h1_5 := 0 \cdot ft$	$t1_5 := 0 \cdot ft$
Sill Plate Length:	$Ls_1 := 22 \cdot ft$		6:	$l1_6 := 0 \cdot ft$	$h1_6 := 0 \cdot ft$	$t1_6 := 0 \cdot ft$
Redundancy	$\rho_1 := 1$		7:	$l1_7 := 0 \cdot ft$	$h1_7 := 0 \cdot ft$	$t1_7 := 0 \cdot ft$
			8:	$l1_8 := 0 \cdot ft$	$h1_8 := 0 \cdot ft$	$t1_8 := 0 \cdot ft$

SHEAR CALCULATIONS

Unit Shear (for walls): $$v_1 := \frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right)}{\sum l1}$$

OVERTURNING CALCULATIONS $i1 := 1 .. n1$

Overturning Moment: $$Mo1_{i1} := \left[\frac{\left(\rho_2 \cdot Va_2 + \rho_1 \cdot Va_1\right) \cdot h1_{i1}}{\sum l1}\right] \cdot l1_{i1}$$

Resisting Moment: $$Mr1_{i1} := 0.6 \cdot \left[\left[\left(DL_1 \cdot t1_{i1}\right) \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right] + \left[\left[\left(DLw_1\right) \cdot h1_{i1}\right] \cdot l1_{i1} \cdot \left(\frac{l1_{i1}}{2}\right)\right]\right]$$

Nominal Overturning: $$M1_{i1} := Mo1_{i1} - Mr1_{i1}$$

Tension at Pier Ends: $$T1_{i1} := \frac{M1_{i1}}{l1_{i1}}$$

ANCHOR BOLTS

Unit Shear (for bolts): $$vb_1 := \frac{\left[\sum_{i=1}^{2} \left(\rho_i \cdot Va_i\right)\right]}{Ls_1}$$

1/2" bolt in 1 1/2" sill: $$s_{0.5} := \frac{(650 \cdot lb) \cdot 1.6}{vb_1}$$

5/8" bolt in 1 1/2" sill: $$s_{0.625} := \frac{(930 \cdot lb) \cdot 1.6}{vb_1}$$

SUMMARY, STORY 2

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i2} := \frac{l2_{i2}}{h2_{i2}}$ $r2 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r2 = 1$

Unit Shear

$\frac{v2}{r2} = 300 \cdot plf$

	Uplift	HOLD DOWN
Pier 1:	$T2_1 = 1440 \cdot lb$	MST48
Pier 2:	$T2_2 = \blacksquare \cdot lb$	
Pier 3:	$T2_3 = \blacksquare \cdot lb$	
Pier 4:	$T2_4 = \blacksquare \cdot lb$	
Pier 5:	$T2_5 = \blacksquare \cdot lb$	
Pier 6:	$T2_6 = \blacksquare \cdot lb$	
Pier 7:	$T2_7 = \blacksquare \cdot lb$	
Pier 8:	$T2_8 = \blacksquare \cdot lb$	

SHEAR WALLS

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 4" o.c.
Field Nailing: 8d @ 12" o.c.

SUMMARY, STORY 1

Reduction in shear walls due to height to width ratio less than 2:1

$ratio_{i1} := \frac{l1_{i1}}{h1_{i1}}$ $r1 := if(2 \cdot min(ratio) > 1.0, 1.0, 2 \cdot min(ratio))$ $r1 = 1$

Unit Shear

$\frac{v1}{r1} = 291 \cdot plf$

	Uplift	HOLD DOWN
Pier 1:	$T1_1 = 2249 \cdot lb$	MST48
Pier 2:	$T1_2 = 2249 \cdot lb$	MST48
Pier 3:	$T1_3 = \blacksquare \cdot lb$	
Pier 4:	$T1_4 = \blacksquare \cdot lb$	
Pier 5:	$T1_5 = \blacksquare \cdot lb$	
Pier 6:	$T1_6 = \blacksquare \cdot lb$	
Pier 7:	$T1_7 = \blacksquare \cdot lb$	
Pier 8:	$T1_8 = \blacksquare \cdot lb$	

SHEAR WALLS

Sheathing: 7/16", APA, Exp. 1
Blocking: All Panel Edges
Edge Nailing: 8d @ 4" o.c.
Field Nailing: 8d @ 12" o.c.

DYNAMIC STRUCTURES
1887 North 1120 West
Provo, UT 84604
Tel: (801) 356-1140

JOB ____________

SHEET NO ________ OF ________

CALCULATED BY ________ DATE ________

INITIAL CALCULATIONS FOR BRACE
LEVEL USED A FULL 8' FOR THAT
LEVEL RESULTING IN A MORE CONSERVATIVE
DESIGN THAN USING THE AVERAGE HEIGHT