

Harriott Valentine Engineers Inc.

## STRUCTURAL CALCULATIONS

**Project:**

Werelius Residence  
8452 North Mercer Way  
Mercer Island, WA

**Architect:**

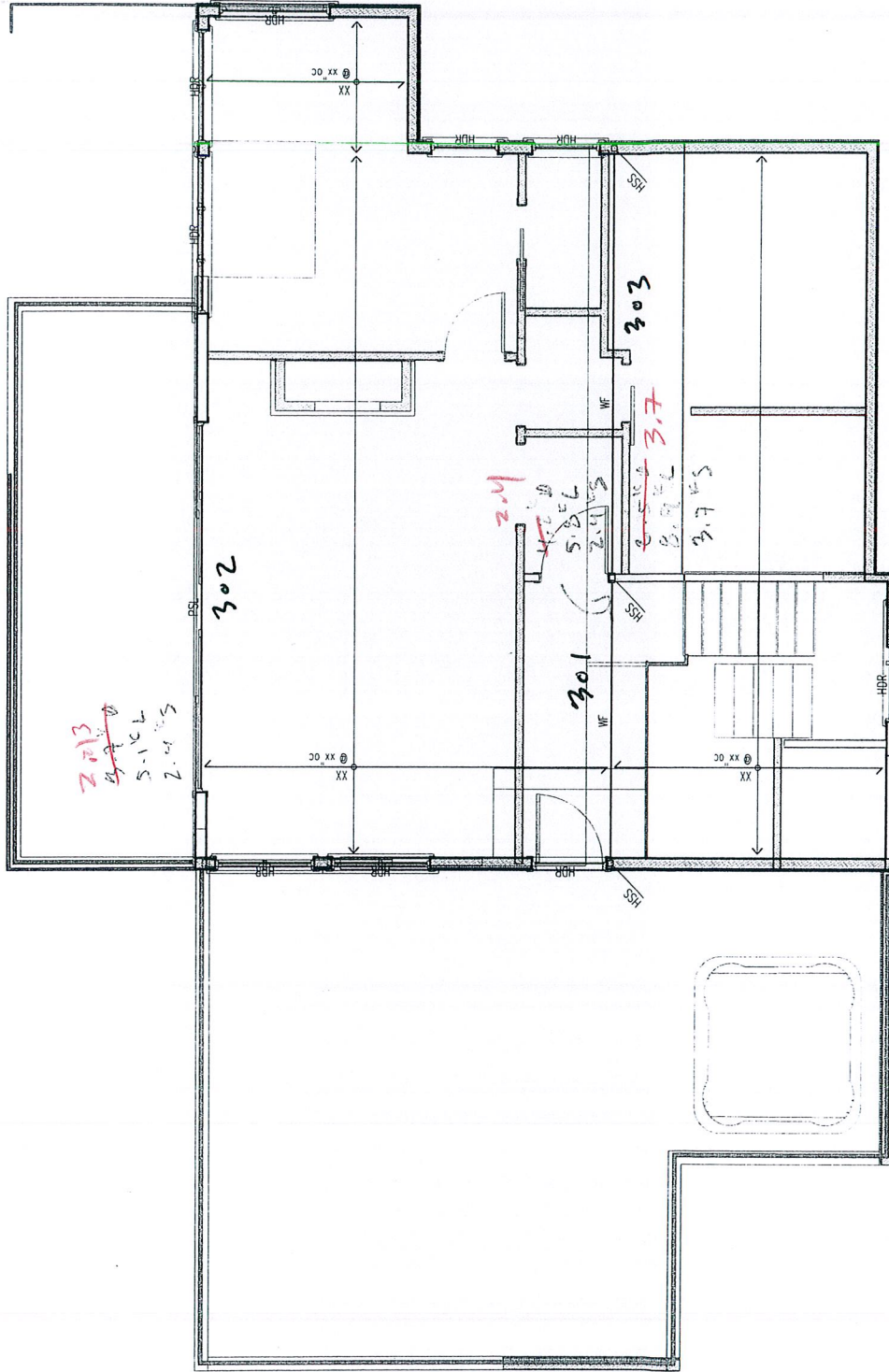
H2D Architecture and Design  
23020 Edmonds Way, #113  
Edmonds, WA 98020

**Structural Engineer:**

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1932 First Avenue, Suite 720  
Seattle, WA 98101  
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7/26/19



1 ROOF FRAMING PLAN (SECOND FLOOR WALLS)  
 S2.3  
 scale: 1/4" = 1'-0"





UPPER ROOF

JOISTS

$$L = 19'$$

$$W = 16" \times C \left( \frac{44}{20} + 40 + 25 \right)$$

59 ~~27~~ PLF @ + 80 PLF @ + 33 PLF @

.144 ~~11~~ PLF @ + .75 (L + S)

$$M = \text{STE} - F 6.5$$

$$V = \text{LTK} 1.4$$

DEAD 20 PSF + 24 PSF PAVERS

LIVE 60 PSF

SNOW 25 PSF

$$11\frac{7}{8} \text{ TJI } 560 \text{ @ } 16" \text{ OC}$$

$$W_{16} = 9.5 \text{ K} \cdot \text{DF}$$

$$V_{16} = 2.05 \text{ K}$$

$$d = 16" = \frac{L}{375}$$

$$.76" = \frac{L}{296}$$

$$V_{16} \text{ @ } 12" \text{ OC}$$

ROOF FRAM W/L

301

$l = 12'$  ~~25~~  
 $w = 16'$  (~~20~~ + 60 + 25)  
~~400~~  
 $= 200 PLF + 960 PLF + 400 PLF$   
 $M = 24 + 2.5 \cdot (L+S)$   
 $V_d = 1.4k$  ~~4.2k~~ ~~2.4k~~  
 $V_L = 5.76k$   
 $V_S = 2.4k$

PSL 7x11 ~~7E~~ ~~1.8.37k~~  
 $M_R = 39.8k \cdot ft$   
 $V_R = 16k$  ~~8.52k~~  
 $\Delta = .41" = L/349$

W 12x16 ~~OK~~

$\Delta_{TL} = 0.699" = PSL 5 \frac{1}{4} \times 11 \frac{7}{8}$   
~~L/218~~

Try 7x11 ~~7E~~  $\Delta_{TL} = 0.429"$

USE PSL 7x11 ~~7E~~ ~~L/339~~

302

$l = 17'$  ~~25~~  
 $w = 10'$  (~~20~~ + 60 + 25)  
~~250~~  
 $= 200 + (600 + 250) \cdot 0.75$   
 $M = 30.2 k \cdot ft$  ~~33.1~~  
 $V_d = 1.4k$  ~~3.7k~~ ~~2.13k~~  
 $V_L = 5.1k$   
 $V_S = 2.2k$

~~PSL 5 1/4 x 16~~

$M_R = 52k \cdot ft$  ~~32.1 k \cdot ft~~  
 $V_R = 16.2k$  ~~7.6k~~  
 $\Delta = .6" = L/361$

(4) 2x6  $\Delta = 0.74"$   
~~L/275~~

$\Delta_{all TL} = 0.85" =$

$I_{req} = 83.9 in^4$

USE W 10x19  $Z = 21.6 in^3$   
 $I = 96.3 in^4$

$Z_{req} = 12.9 in^3$

ROOF FRAMING

no 3

$l = 19'$   
 $w = 18.5' \left( \begin{matrix} 25 \\ 44 \\ 25 + 60 + 25 \end{matrix} \right)$   
 $= 682 \text{ PLF } D + 930 \text{ PLF } L + 388 \text{ PLF } S$   
 $= 1376 \text{ PLF}$   
 $M = 75.4 \text{ K} \cdot \text{FT} \quad 0.21 \text{ K} \cdot \text{FT}$   
 $V_D = 6.5 \text{ K} \quad 3.69 \text{ K}$   
 $V_L = 8.9 \text{ K}$   
 $V_S = 3.7 \text{ K}$

$w 12 \times 22$   
 $\frac{M_D}{S_x} = 92.8 \text{ K} \cdot \text{FT}$   
 $\Delta = .7" = 4/335$

$Z_{req} = 24.9 \text{ in}^3$   
 $S_{TL} = 0.95 \text{ in}$

$I_{req} = 181.6 \text{ in}^4$   
 VSC W 10 x 39  
 $Z = 46.8 \text{ in}^3$   
 $I = 209 \text{ in}^4$   
 8" wide

HEADINGS

$l = 7'$   
 $w = 440 \text{ PLF } D + 600 \text{ PLF } L + 250 \text{ PLF } S$   
 $M = 4.6 \text{ K} \cdot \text{FT}$   
 $V_D = 1.5 \text{ K}$   
 $V_L = 2.1 \text{ K}$   
 $V_S = 875 \text{ #}$

(2) LVL 1 3/4 x 9 1/2  
 $M_D = 7.11 \text{ K} \cdot \text{FT}$   
 $V_L = 4.8 \text{ K}$   
 $\Delta = .27" = 1/302$

$l = 5'$   
 $w = 198 \text{ PLF } D + 270 \text{ PLF } L + 113 \text{ PLF } S$   
 $M = 1.5 \text{ K} \cdot \text{FT}$   
 $V_D = 495 \text{ #}$   
 $V_L = 675 \text{ #}$   
 $V_S = 283 \text{ #}$

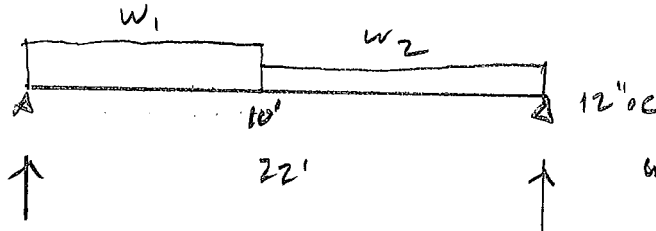
(2) 2 x 8 CE

UPPER FLOOR

HOT TUBS 90" x 110", 5500 #

JOISTS UNDER TUBS

=> 80 PSF



124  
 $w_1 = 140 \text{ PSF DECK}$   
 60 PSF LIVE  
 25 PSF SNOW

44  
 $w_2 = 20 \text{ PSF D}$   
 60 PSF L  
 25 PSF S

D	<del>836</del> 1102	<del>3.5</del> 4.9	<del>402</del> 606
L	666	3.03	666
S	275	1.5	275
D+L	<del>1519</del> 1768	<del>7.13</del> 8.53	<del>1068</del> 1332
D+S	<del>1111</del> 1397	<del>5</del> 6.4	<del>677</del> 941
D+L+S (LFS)	<del>1543</del> <u>1807</u>	<del>7.35</del> <u>8.7</u>	<del>1148</del> <u>1371</u>

$w_u = 121 \text{ PLF}$   
143

TJI 1175 S20 @ 12" OC

$w_{DL} = 9.5 \text{ K}$

$V_{HL} = 2.05 \text{ K}$

$d = 1.13 \text{ IN}$   
232 #

~~714~~  
~~418~~ 134 x 11 @ LVL

$w_{DL} = 8.9 \text{ K}$

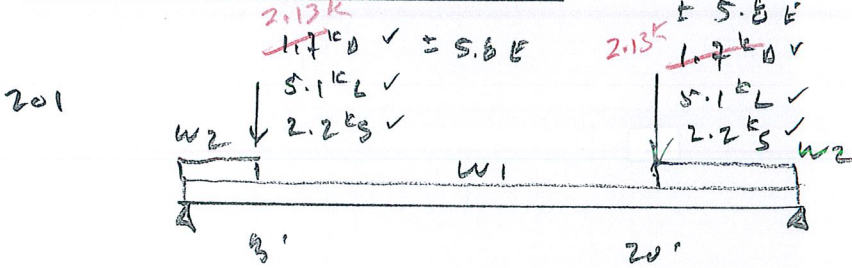
$V_{HL} = 3.9 \text{ K}$

$d = 1.18 \text{ IN}$

USE (2) 134 x 11 @ LVL

@ 12" OC ✓

SECOND FLOOR FRAMING



$S_{DS} = 1.11$   
 $R = 2.5$   
 $W1 = 180 \text{ PLF D} \checkmark$   
 $510 \text{ PLF L} \checkmark$   
 $113 \text{ PLF S} \checkmark$   
 $W2 = 311 \text{ PLF D} \checkmark$   
 $540 \text{ PLF L} \checkmark$   
 $225 \text{ PLF S} \checkmark$

		20'	
D	4.87	25	4.87
L	14.2	72.9	14.1
S	4.7	22.6	4.6
D+L	<u>19.1</u>	<u>97.9</u>	<u>18.9</u>
D+S	9.6	47.6	9.4
D+.75(L+S)	19.0	96.6	18.9
D E	± 9.6	22.7	± 3.8
R1		<del>85.75</del>	
R2		<u>142.2</u>	
R3		<del>67.6</del>	

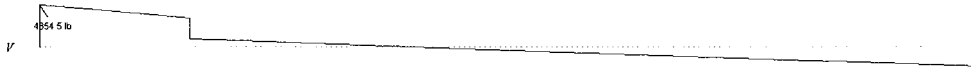
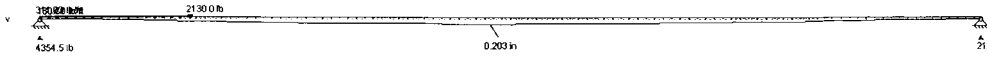
$(1.07 + .14 S_{DS}) D + R E$   
 $(1.0 + .105 S_{DS}) D + .75 R E + .75 S$   
 $(.6 - .14 S_{DS}) D + R E$

$(1 + 0.14 S_{DS}) = 1.16$   
 $(1 + 0.15 S_{DS}) = 1.17$   
 $(.6 - 0.14 S_{DS}) = 0.44$

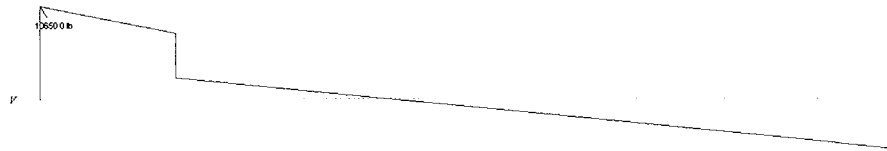
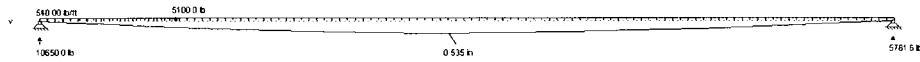
$W1 2 \times 40$   
 $\frac{M_p}{R} = 142$   
 $\Delta = 1.4" = \ell / 222$   
 $W10 \times 60$   
 $\Delta = 1.26" = \ell / 240$



Dead



Live

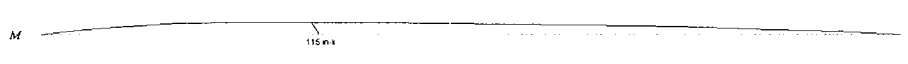
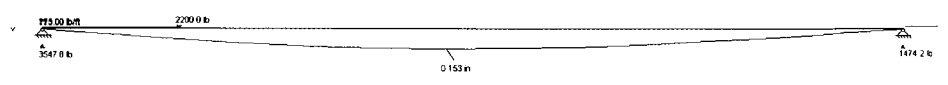


Snow

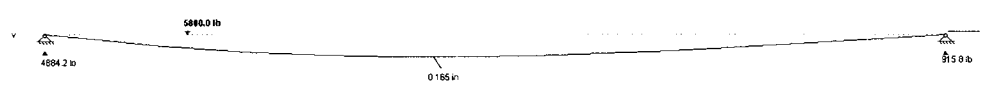
Worolius  
7/5/19

11/1

201



### Seismic



Werelius  
7/5/19

Mr

D =	150
L =	393
Lr =	
S =	115
1.0E =	176
1.0W =	0
Sds =	1.11
$\Omega_0$ =	2.5
$\rho$ =	1.3

**ASD**

D + L =	543
D + max{Lr, S} =	265
D + 0.75L + 0.75 max{Lr, S} =	531
D + 0.75L + 0.525E + 0.75S =	623.4
0.6D + 0.7 $\rho$ E =	250.16
D + 0.6W =	150
D + 0.75L + 0.45W + 0.75 max{Lr, S} =	531
0.6D + 0.6W =	90
(1.0 + 0.14Sds)D + 0.75 $\Omega$ E =	503.31
<u>(1.0 + 0.105sDS)d + 0.525<math>\Omega</math>E + 0.75(L+S) =</u>	<u>779.4825</u>
(0.6 - 0.14Sds)d + 0.7 $\Omega$ E =	374.69

Strength

$$Z_{req} = (779.5 / (1.67)) / 50 \text{ ksi} = 26.04 \text{ in}^3$$

Stiffness

$$\delta_{allow} = \frac{(19)(12)}{240} = 0.95 \text{ in}$$

$$\Delta_{Th} = 0.891 \text{ in}$$

$$\frac{(0.891)(140)}{I_{req}} = 0.95 \rightarrow I_{req} = 131.3 \text{ in}^4$$

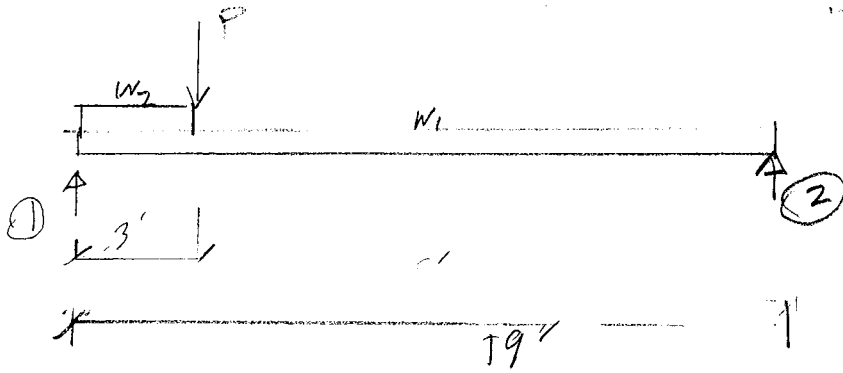
USE W8x40  $Z = 39.8 \text{ in}^3$   
 $I = 146 \text{ in}^4$



D =	4354
L =	10650
Lr =	
S =	3547
1.0E =	4884
1.0W =	0
Sds =	1.11
Ω0 =	2.5
ρ =	1.3

### ASD

- D + L = 15004
- D + max{Lr,S} = 7901
- D + 0.75L + 0.75 max{Lr, S} = 15001.75
- D + 0.75L + 0.525E + 0.75S = 17565.85
- 0.6D + 0.7ρE = 7056.84
- D + 0.6W = 4354
- D + 0.75L + 0.45W + 0.75 max{Lr, S} = 15001.75
- 0.6D + 0.6W = 2612.4
- (1.0+0.14Sds)D+0.75ΩE = 14188.11
- (1.0+0.105sDS)d+0.525ΩE+0.75(L+S) = 21919.46
- (0.6-0.14Sds)d+0.7ΩE = 10482.79

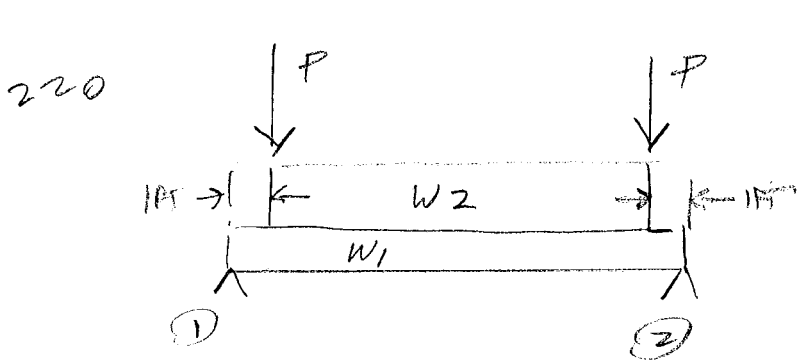


$w_1, w_2, P$  : see original calc's

①	②	
4354	212	D
10650	5781	L
3547	1474	S
$\pm 484$	7915	E

$M_R (in-k)$	$V_R$	
190	①	D
343	①	L
115	①	S
176	①	E

$\Delta (in)$	
0.203	D
0.535	L
0.153	S
<u>0.891</u>	



220  
 $S_{DS} = 1.11$   
 $\Sigma L = 2.5$

- W<sub>1</sub> = 180 p/f D
- 570 p/f L
- 113 p/f S
- W<sub>2</sub> = 311 p/f D
- 540 p/f L
- 225 p/f S

V <sub>T</sub> =	W <sub>1</sub>	W <sub>2</sub>	2P	(lb)
	540	622	2130	D
	1530	1080	5100	L
	339	450	2200	S

- P = 2130 lb D
- 5100 lb L
- 2200 lb S
- ± 5800 lb E

$V_D = 3292$  lb       $V_E = 2900$  lb

$V_L = 7710$  lb

$V_S = 2989$  lb

M <sub>T</sub> =	W <sub>1</sub>	W <sub>2</sub>	2P	(k-in)
	9.72	14.92	12.78	D
	27.5	25.9	30.6	L
	6.1	10.8	13.2	S
			34.8	E

$M_D = 37.42$  k-in

$M_L = 84.0$  k-in

$M_S = 30.1$  k-in

$M_E = 34.8$  k-in

Mr

D =	37.42
L =	84
Lr =	0
S =	30.1
1.0E =	34.85
1.0W =	0
Sds =	1.11
Ω =	2.5
ρ =	1.3

**ASD**

- D + L = 121.42
- D + max{Lr, S} = 67.52
- D + 0.75L + 0.75 max{Lr, S} = 122.995
- D + 0.75L + 0.525E + 0.75S = 141.2913
- 0.6D + 0.7ρE = 54.1655
- D + 0.6W = 37.42
- D + 0.75L + 0.45W + 0.75 max{Lr, S} = 122.995
- 0.6D + 0.6W = 22.452
- (1.0+0.14Sds)D+0.75ΩE = 108.5788
- (1.0+0.105sDS)d+0.525ΩE+0.75(L+S) = 173.0969
- (0.6-0.14Sds)d+0.7ΩE = 77.62443

$$Z_{req} = (1.67 \times 173.1) / 50 \text{ ksi} = 5.78 \text{ in}^3$$

→ see p

Vr

D =	3292
L =	7710
Lr =	
S =	2989
1.0E =	2900
1.0W =	0
Sds =	1.11
$\Omega_0$ =	2.5
$\rho$ =	1.3

**ASD**

$$\begin{aligned}
 D + L &= 11002 \\
 D + \max\{Lr, S\} &= 6281 \\
 D + 0.75L + 0.75 \max\{Lr, S\} &= 11316.25 \\
 D + 0.75L + 0.525E + 0.75S &= 12838.75 \\
 0.6D + 0.7\rho E &= 4614.2 \\
 D + 0.6W &= 3292 \\
 D + 0.75L + 0.45W + 0.75 \max\{Lr, S\} &= 11316.25 \\
 0.6D + 0.6W &= 1975.2 \\
 (1.0 + 0.14Sds)D + 0.75\Omega E &= 9241.077 \\
 (1.0 + 0.105sDS)d + 0.525\Omega E + 0.75(L+S) &= 15506.18 \\
 (0.6 - 0.14Sds)d + 0.7\Omega E &= 6538.623
 \end{aligned}$$



$$S_{TL} = 0.3 \text{ in}$$

$$W_{TL} = 1879 \text{ plf}$$

$$= 156.6 \text{ lb/in}$$

$$P_{TL} = 9430 \text{ lb}$$

$$\Delta_{TL} = \frac{(9430 \text{ lb})(12 \text{ in})}{(2.4)(29000 (10^3) \frac{15}{142})} + (3(6'.12)^2 - 4(12 \text{ in})^2)$$

$$\frac{(5)(156.6 \text{ lb/in})(6'.12)^4}{(384)(29000 (10^3))}$$

$$= 2.43 + 1.89 = 4.32 \text{ in}$$

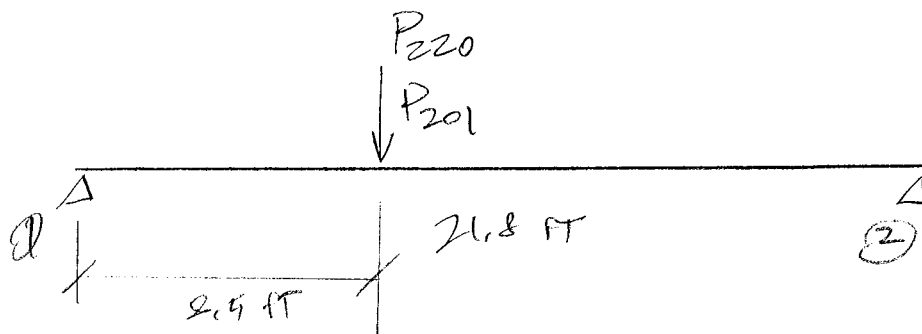
$$I_{req} = \frac{4.32 \cdot}{0.3} = 14.39 \text{ in}^4$$

USE PSL:  $5\frac{1}{4}" \times 9\frac{1}{4}"$

$$M_p = 222 \text{ in K}$$

$$\frac{I}{PSL} = 4.32 \text{ in} \left( \frac{29000 (10^3) \cdot 1}{692.5 (10^6)} \right) = 0.181 \text{ in}$$

219



	D	L	S	E
$P_{201} =$	212	5781	1474	$\pm 915$
$P_{220} =$	3292	7710	2989	0
(lb)	3504	13491	4463	$\pm 915$
$V_R =$	2138*	8231*	2723*	$\pm 558^*$
(lb)	1366	5210	1710	$\pm 357$
$M_R =$	218	839.5	278	57
(in-k)				

Vr

D =	2138
L =	8231
Lr =	0
S =	2723
1.0E =	558
1.0W =	0
Sds =	1.11
$\Omega$ =	2.5
$\rho$ =	1.3

### ASD

D + L =	10369
D + max{Lr,S} =	4861
D + 0.75L + 0.75 max{Lr, S} =	10353.5
D + 0.75L + 0.525E + 0.75S =	10646.45
0.6D + 0.7 $\rho$ E =	1790.58
D + 0.6W =	2138
D + 0.75L + 0.45W + 0.75 max{Lr, S} =	10353.5
0.6D + 0.6W =	1282.8
(1.0+0.14Sds)D+0.75 $\Omega$ E =	3516.495
(1.0+0.105sDS)d+0.525 $\Omega$ E+0.75(L+S) =	11335.06
(0.6-0.14Sds)d+0.7 $\Omega$ E =	1927.055

Mr

D =	218
L =	839.5
Lr =	0
S =	278
1.0E =	57
1.0W =	0
Sds =	1.11
$\Omega_0$ =	2.5
$\rho$ =	1.3

**ASD**

$$\begin{aligned}
 D + L &= 1057.5 \\
 D + \max\{Lr, S\} &= 496 \\
 D + 0.75L + 0.75 \max\{Lr, S\} &= 1056.125 \\
 D + 0.75L + 0.525\rho E + 0.75S &= 1086.05 \triangleleft \\
 0.6D + 0.7\rho E &= 182.67 \\
 D + 0.6W &= 218 \\
 D + 0.75L + 0.45W + 0.75 \max\{Lr, S\} &= 1056.125 \\
 \cancel{0.6D + 0.6W} &= \cancel{130.8} \\
 \cancel{(1.0 + 0.14Sds)D + 0.75\rho E} &= \cancel{358.7522} \\
 \cancel{(1.0 + 0.105sDS)d + 0.525\rho E + 0.75(L+S)} &= \cancel{1156.345} \\
 \cancel{(0.6 - 0.14Sds)d + 0.7\rho E} &= \cancel{196.6728}
 \end{aligned}$$

$$Z_{req} = (1086.1 \text{ lb-ft})(1.67) / 50 \text{ ksi} = 36.29 \text{ in}^3$$

$$S_{TL} = \frac{21.8' \times 12}{240} = 10.1 \text{ in}$$

$$I_{req} = \frac{PL^3}{48ES} = \frac{(21.48 \text{ k})(21.8' \times 12)^3}{(48)(29000 \text{ ksi})(10.1 \text{ in})} = 250.9 \text{ in}^4$$

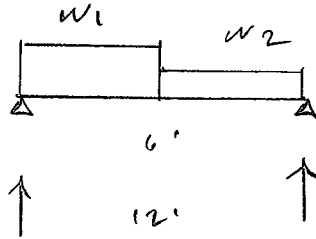
USE W8x67

$$Z = 70.1 \text{ in}^3$$

$$I = 272 \text{ in}^4$$

SECOND FLOOR FLOORING

202



D	1.7	4.6	1.4
L	4.2	11.5	3.3
S	1.9	5.1	1.5
D+L	5.9	16.1	4.7
D+S	3.6	9.7	2.9
D+.75(L+S)	<u>6.3</u>	<u>17.1</u>	<u>5.0</u>

$$W1 = 120 \text{ PLF D} + 60 \text{ PLF L} + 90 \checkmark$$

$$540 \text{ PLF L} + 0 + 240 \checkmark$$

$$225 \text{ PLF S} + 113 \text{ PLF} + 0$$

$$W2 = 75 \text{ PLF D} + 60 \text{ PLF L} + 60 \checkmark$$

$$300 \text{ PLF L} + 0 + 120 \checkmark$$

$$125 \text{ PLF S} + 100 \text{ PLF} + 0$$

W 8 x 10

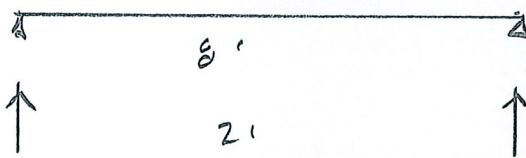
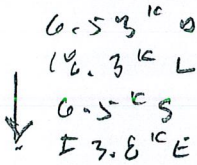
$$\frac{M_{max}}{S} = 21.9$$

$$\Delta = .5'' = \frac{9}{290}$$

SECOND FLOOR FRAMING

$S_{DS} = 1.11$   
 $R = 2.5$

20 k



Sim span 3  
 Loads to 219  
 → use W8x67

D	4.04	32.3	2.49
L	11.33	90.6	6.97
S	4.0	32	2.5
A+C	15.3	122.9	9.46
A+S	20.04	64.3	4.99
D+A+S(C+S)	<u>15.5</u>	<u>124.2</u>	<u>9.6</u>
E	2.35	18.8	1.45
$R_1$		84.5	
$R_2$		<u>16.3</u>	
$R_3$		61.2	

W10x60

$\frac{M_{px}}{R} = 166$

$\Delta = 1" \text{ at } 252$

222

$$L = 5.5 \text{ FT}$$

$$W = 360 \text{ psf } L + 135 \text{ psf } L = 9' (40 \text{ psf } L + 15 \text{ psf } D)$$

$$M = 1.36 \text{ K-FT}$$

$$V = 1.36 \text{ K}$$

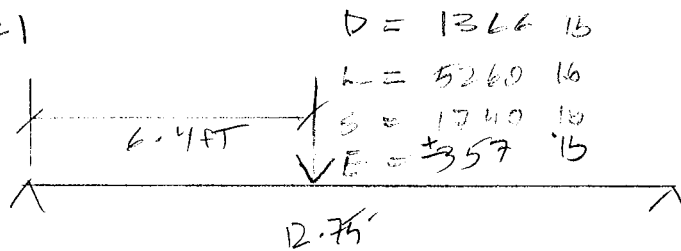
4x10

$$M_r = 4.99 \text{ K-FT}$$

$$V_r = 3.89 \text{ K}$$

$$\Delta = 0.02 \text{ in}$$

221



$$TW = 10.9 \text{ FT}$$

$$W_D = 15 \text{ psf } (10.9 \text{ FT}) = 163.5 \text{ psf}$$

$$W_L = 40 \text{ psf } (10.9 \text{ FT}) = 436 \text{ psf}$$

} uniform loads across full length of beam

	D K	L K	S K	E
M	7.7	26.2		1.13
V	1.7	5.4		0.2

SEE NEXT TWO PAGES

MP 221  
~~MT~~  
 MT

D =	7.7
L =	26.2
Lr =	0
S =	
1.0E =	1.13
1.0W =	0
Sds =	1.11
Ω0 =	2.5
ρ =	1.3

### ASD

D + L =	33.9
D + max{Lr, S} =	7.7
D + 0.75L + 0.75 max{Lr, S} =	27.35
D + 0.75L + 0.525pE + 0.75S =	27.94325 ✓
0.6D + 0.7pE =	5.6483
<del>D + 0.6W =</del>	<del>7.7</del>
D + 0.75L + 0.45W + 0.75 max{Lr, S} =	27.35
0.6D + 0.6W =	4.62
<del>(1.0 + 0.14Sds)D + 0.75ΩE =</del>	<del>11.01533</del>
<del>(1.0 + 0.105sDs)d + 0.525ΩE + 0.75(L + S) =</del>	<del>29.73056</del>
<del>(0.6 + 0.14Sds)d + 0.7ΩE =</del>	<del>5.40092</del>

$$Z_{req} = (27.9)(12)(1.67) / 50^{1.5} = 11.2 \text{ in}^3$$

$$\Delta_{allow} = 0.64 \text{ in}$$

$$P = 1366 \text{ lb} + 5260 \text{ lb} = 6626 \text{ lb}$$

$$\Delta_p = \frac{PL^3}{48EI} + \frac{5WL^4}{384II}$$

$$= \frac{17}{I_{req}} + \frac{12.3}{I_{req}}$$

$$I_{req} = \frac{29.3}{0.64 \text{ in}} \rightarrow 45.78 \text{ in}^4$$

use W8x15  
 $Z = 13.6 \text{ in}^3$   
 $I = 48 \text{ in}^4$



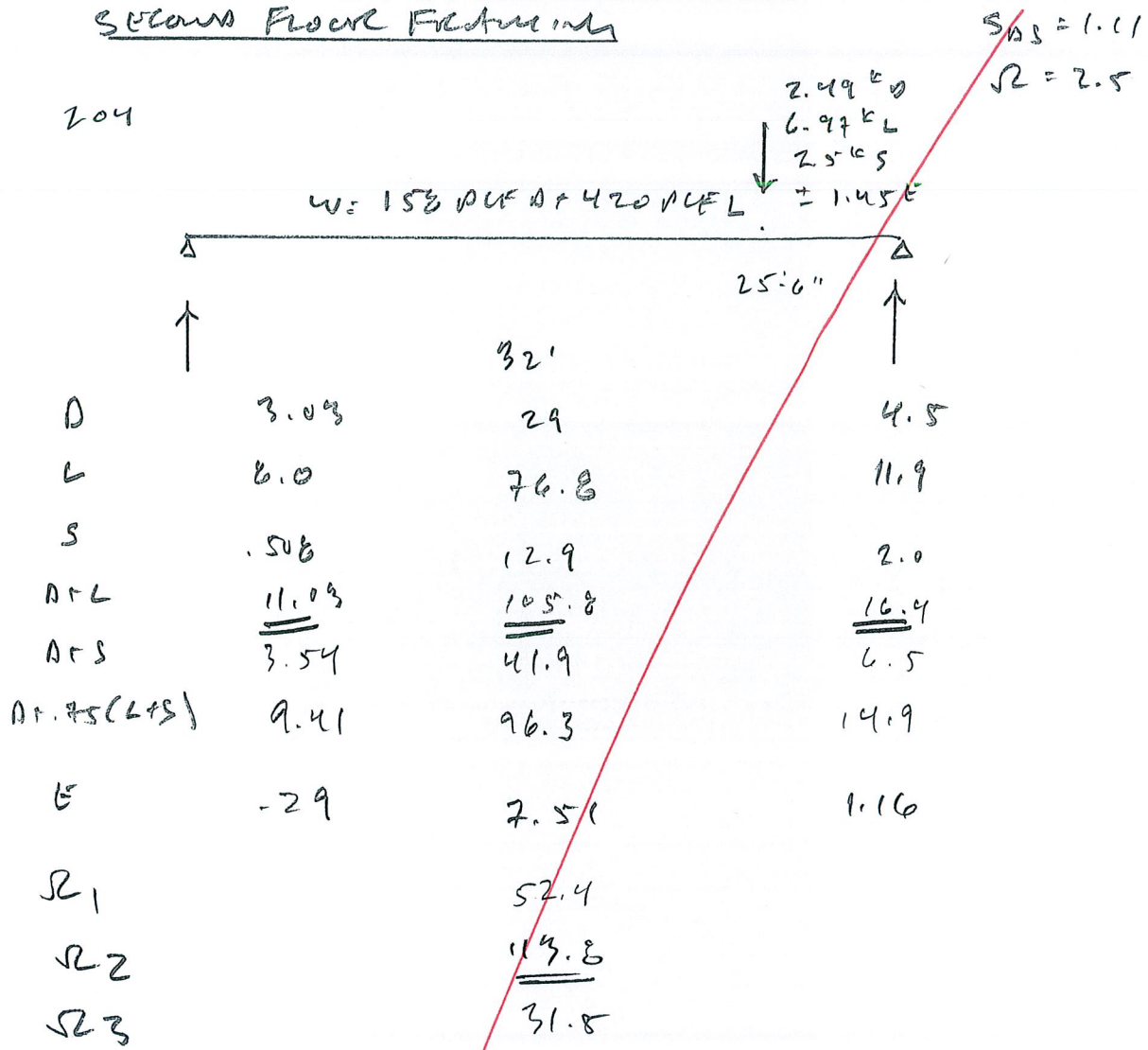
Vr

D =	1.7
L =	5.4
Lr =	0
S =	
1.0E =	0.2
1.0W =	0
Sds =	1.11
$\Omega_0$ =	2.5
$\rho$ =	1.3

### ASD

$$\begin{aligned} D + L &= 7.1 \\ D + \max\{Lr, S\} &= 1.7 \\ D + 0.75L + 0.75 \max\{Lr, S\} &= 5.75 \\ D + 0.75L + 0.525\rho E + 0.75S &= 5.855 \\ 0.6D + 0.7\rho E &= 1.202 \\ D + 0.6W &= 1.7 \\ D + 0.75L + 0.45W + 0.75 \max\{Lr, S\} &= 5.75 \\ 0.6D + 0.6W &= 1.02 \\ (1.0 + 0.14Sds)D + 0.75\Omega E &= 2.33918 \\ (1.0 + 0.105sDS)d + 0.525\Omega E + 0.75(L+S) &= 6.210635 \\ (0.6 - 0.14Sds)d + 0.7\Omega E &= 1.10582 \end{aligned}$$

SECOND FLOOR FRAMING



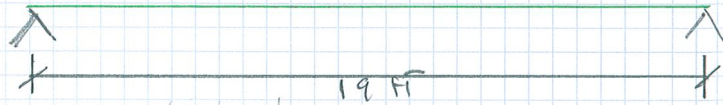
2.49 KL  
6.97 KL  
2.5' LS  
± 1.45 E

See following pages

W10x60  
 $\frac{M_{max}}{R} = 186$   
 $\Delta = 1.97 \text{ or } 1.99$   
W10x77  
 $\Delta = 2.40$

204

$$W = 158 \text{ PFD} + 420 \text{ PFL}$$



$$M = (578/12)(19 \cdot 12)^2 / 8 = 313 \text{ in-k}$$

$$V = 1.5 \text{ kD} + 4 \text{ kL} = 26.1 \text{ ft-k}$$

$$Z_{req} = (313)(1.67) / 50 \text{ ksi}$$

$$= 10.5 \text{ in}^3$$

$$\Delta_{TL} / a_{allow} = \frac{(19)(12)}{240} = 0.95 \text{ in}$$

$$I_{req} = \frac{775.86(10^{-9})(19 \text{ ft})^4(578 \text{ pfl})}{0.95 \text{ in}}$$

$$= 61.5 \text{ in}^4$$

USE W8 x 18

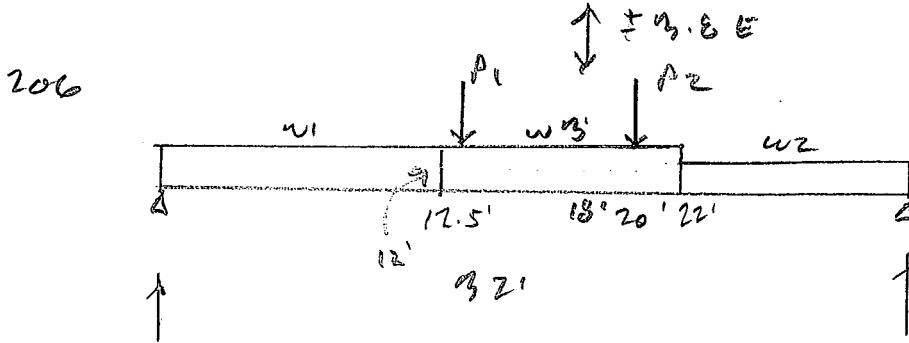
$$Z = 17 \text{ in}^3$$

$$I = 61.9 \text{ in}^4$$

$S_{ps} = 1.11$   
 $r = 2.5$

SECOND FLOOR ELEVATION

ALSO NEED STAIR COATS



D	6.2	60.6	5.1
L	15.4	140.5	12
S	4.5	35.8	3.7
D + L	<u>21.6</u>	201.1	<u>17.1</u>
D + S	10.7	96.4	8.8
D + .75(L+S)	21.1	<u>192.8</u>	16.9
E	1.06	29.9	2.14
R1		145	
R2		<u>256</u>	
R3		101	

- P1 = 3.03<sup>6</sup> D ✓
- 3.0<sup>6</sup> L ✓
- .508<sup>6</sup> S
- P2 = 3.00<sup>6</sup> D ✓
- 2.60<sup>6</sup> L ✓
- W1 = 220 PLF D ✓
- 660 PLF L ✓
- 295 PLF S ✓
- W2 = 130 PLF D ✓
- 390 PLF L ✓
- 163 PLF S ✓
- W3 = 402 PLF D ✓
- 660 PLF L ✓
- 275 PLF S ✓

W 21x44

W 21x48

$$\frac{W_{ps}}{r} = 265$$

$$\Delta = 1.28" = \frac{1}{300}$$

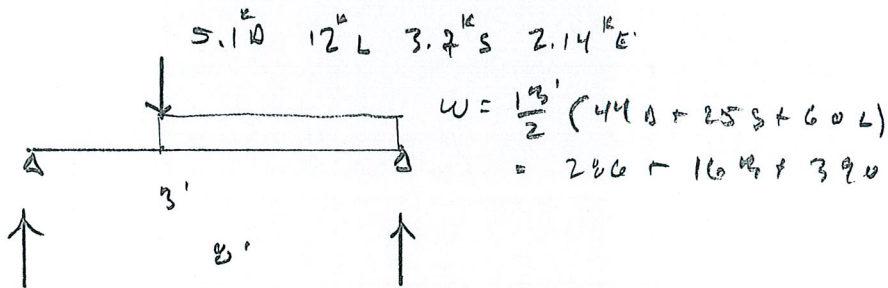
SECOND FLOOR FRAMING

205

$l = 12'$   
 $w = 4' (15 + 40)$   
 $60 \text{ PCL} + 160 \text{ PCL}$   
 $M = 3.96 \text{ K-FT}$   
 $V_D = 360 \text{ \#}$   
 $V_L = 960 \text{ \#}$

~~PSC 32 x 118~~  
~~M = 19.9 K-FT~~ 12.35 K-FT  
 $V_D = 8 \text{ K}$  6.26 K  
 ~~$\Delta = .11''$~~   
 $\Delta = 0.223''$   
 L/647

207



D	3.6	10.9	2.9
L	8.1	24.2	5.8
S	2.6	7.7	1.9
E	1.3	4.0	.3
D + L	<u>11.7</u>	35.1	<u>8.7</u>
D + S	6.2	18.6	4.8
D + S (L + S)	11.6	<u>34.8</u>	8.7
R1		22.6	
R2		<u>47</u>	
R3		14.8	

$W 12 \times 22$   
 $\frac{M_{max}}{S} = 7 \text{ K}$   
 $\Delta = .09 \text{ OK}$

SECOND FLOOR FRAMING

212

$l = 19'$  ~~13.5'~~

$w = 9' (40 \text{ PSFL} + 15 \text{ PSFD})$

$= 360 \text{ PLFL} + 135 \text{ PLFD}$

$M = 22 \text{ K}\cdot\text{F}$  ~~11.3 KFT~~

$V = 4.7 \text{ K}$  ~~3.3 K~~

PSL  $5\frac{1}{4} \times 11\frac{7}{8}$   ~~$9\frac{1}{4}$~~

M<sub>PL</sub> = ~~29.8~~ ~~18.75~~

V<sub>PL</sub> = 12.1 ~~9.3~~

$\Delta = 0.534$   ~~$\Delta = 1'' = l/230$~~

~~l/303~~ USE  ~~$7 \times 11\frac{7}{8}$~~

VSC PSL  $5\frac{1}{4} \times 9\frac{1}{4}$

213

$l = 8'$

$w = \frac{9}{2} (15 \text{ PSFD}) + \frac{9}{2} (40 \text{ PSFL}) + \frac{12}{2} (44 \text{ PSFD}) + \frac{12}{2} (60 \text{ PSFL})$

$+ \frac{12}{2} (25 \text{ PSFS})$

$= 331 \text{ PLFD} + 540 \text{ PLFL} + 150 \text{ PLFS}$

$M = 6.9 \text{ K}\cdot\text{F}$

$V_D = 1.3 \text{ K}$

$V_L = 2.2 \text{ K}$

$V_S = 600 \text{ LBS}$

PSL  $3\frac{1}{2} \times 11\frac{7}{8}$

M<sub>PL</sub> = 19.9 K·F

V<sub>PL</sub> = 2 K

$\Delta = .08'' \text{ OK}$

SECOND FLOOR FRAMING

208 cont. RUM o/c

209

$$L = 13'$$

$$W = 1102 \text{ PLF D} + 666 \text{ PLF L} + 275 \text{ PLF}$$

$$M = 38.2 \text{ k. ft}$$

$$V_D = 7.2 \text{ k}$$

$$V_L = 4.3 \text{ k}$$

$$V_S = 1.8 \text{ k}$$

PSL 54 x 14

M<sub>pl</sub> = 40.7 k. ft

V<sub>pl</sub> = 14.2 k

A = .5" =  $\frac{322}{322}$

210 (2) 2 x 8 o/c

211

$$L = 6'$$

$$W = \frac{13'}{2} (440 + 606 + 255)$$

$$= 286 + 390 + 163$$

$$M = 3.1 \text{ k. ft}$$

$$V_D = 850 \#$$

$$V_L = 1170 \#$$

$$V_S = 489 \#$$

(3) 2 x 8

M<sub>pl</sub> = 3.85 k. ft

V<sub>pl</sub> = 3.26 k

A = 0.11" =  $\frac{1654}{1654}$

SECOND FLOOR FRAMING

217

$l = 14'$

$w = 4' (40 \text{ PSFL} + 15 \text{ PSFA})$   
 $= 160 \text{ PLFL} + 60 \text{ PLFD}$

$M = 5.4 \text{ K-FT}$

$V_D = 420 \text{ LBS}$

$V_L = 1.12 \text{ K}$

$M_{allow} = 18.5 \text{ K-FT}$

NSC 2x11<sup>FB</sup>

$\Delta = .2'' \text{ OK}$

$\Delta_{allow} = 0.70 \text{ in}$

$EI_{req} = \left( \frac{5}{384} \right) \left( \frac{(220/12)(14 \cdot 12)^4}{0.7} \right)$

$= 590.6 (10^6)$

USE PSL 5 $\frac{1}{4}$  x 9 $\frac{1}{4}$  (wall studs are 5 $\frac{1}{2}$ )

218

$l = 10'$

$w = 220 \text{ PLFL}$

$M = 2.8$

$V = 1.1 \text{ K}$

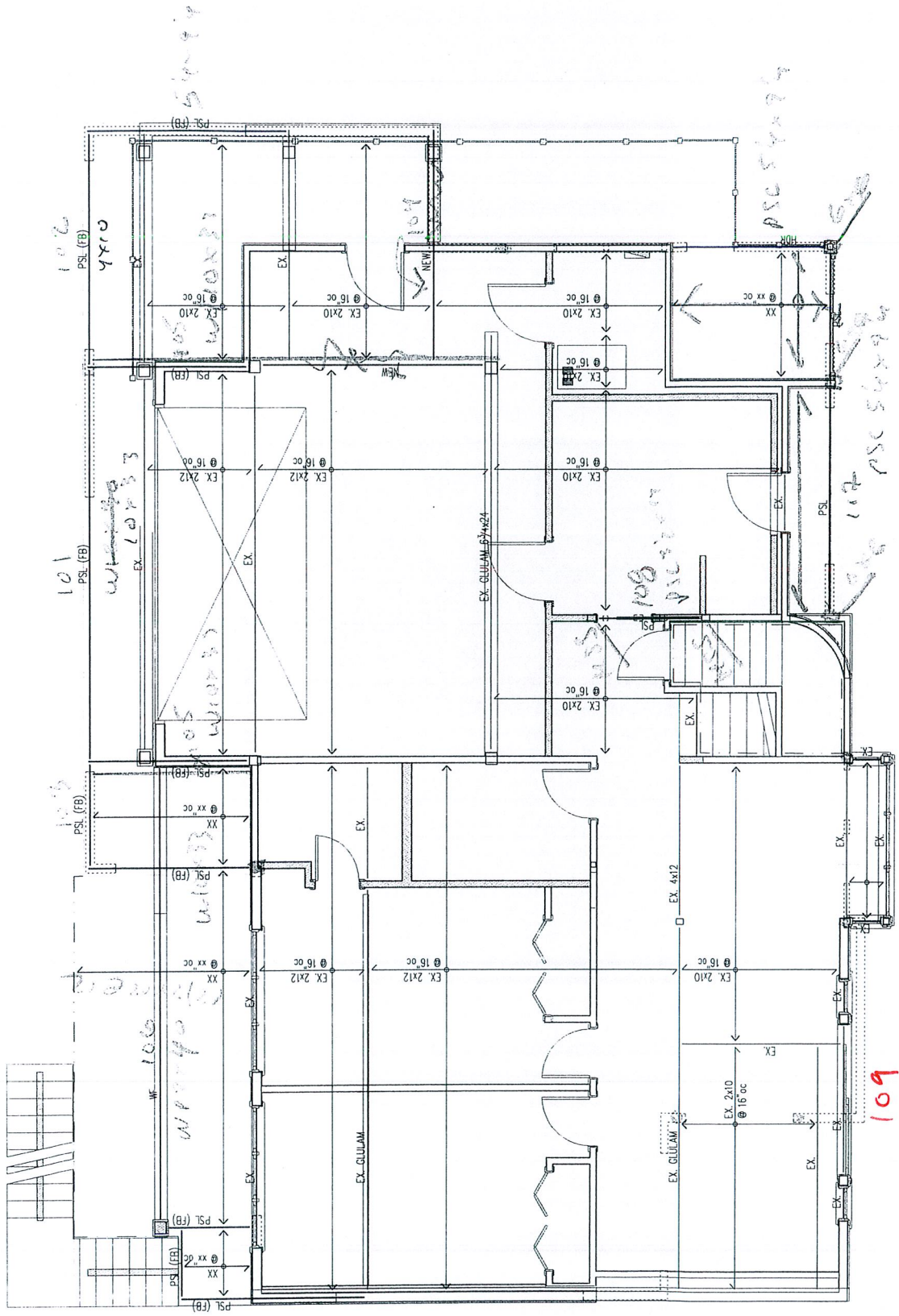
(3) 2x8

$M_R = 3.85 \text{ K-FT}$

$V_R = 3.20 \text{ K}$

$\Delta = .3'' \text{ OK}$



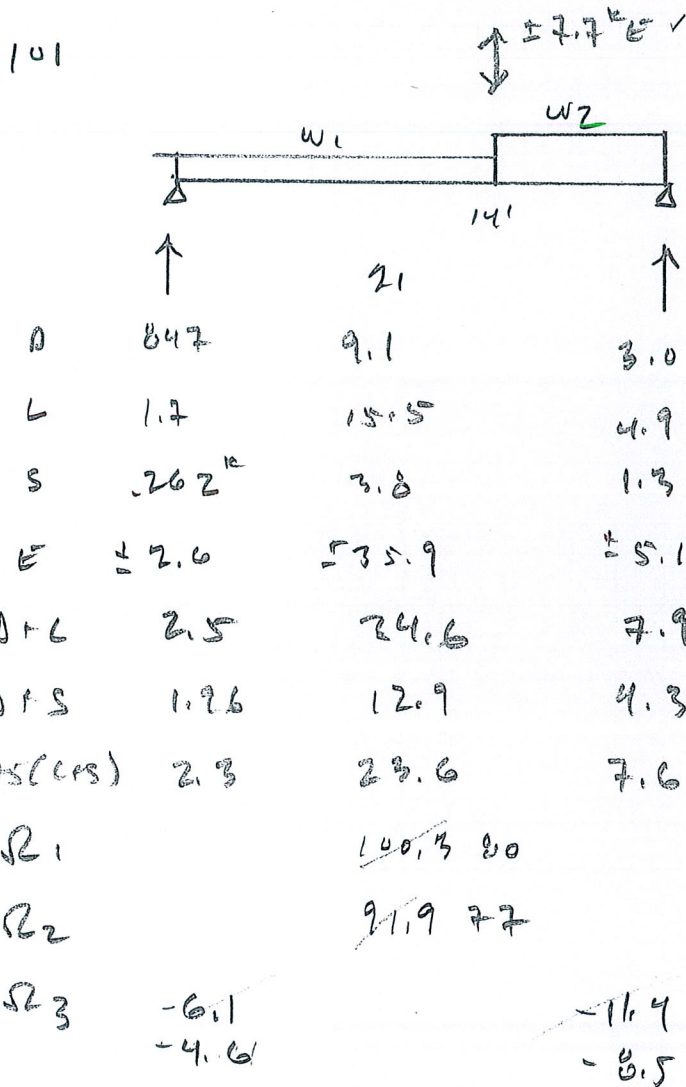


1 MAIN FLOOR FRAMING PLAN (BASEMENT WALLS)  
 scale: 1/4" = 1'-0"

MAIN FLOOR FRAMING

2138# D  
 5231# 2  
~~2723# 3~~

$S_{05} = 1.11$   
 $(2 = 2.5)$



$w_1 = 2'(150 + 406)$   
 $= 30 \text{ PLFN} + 80 \text{ PLFL}$

$w_2 = 9'(440 + 606 + 255)$   
 $+ 4'(150 + 406)$   
 $+ 2'(150 + 406)$   
 $= 480 \text{ PLFN} + 780 \text{ PLFL}$   
 $+ 225 \text{ PLFS}$

~~$w 12 \times 30$~~

$\frac{M_{px}}{R} = 108$

~~$\Delta = 0.6 = \phi / 433$~~

$w 10 \times 33$

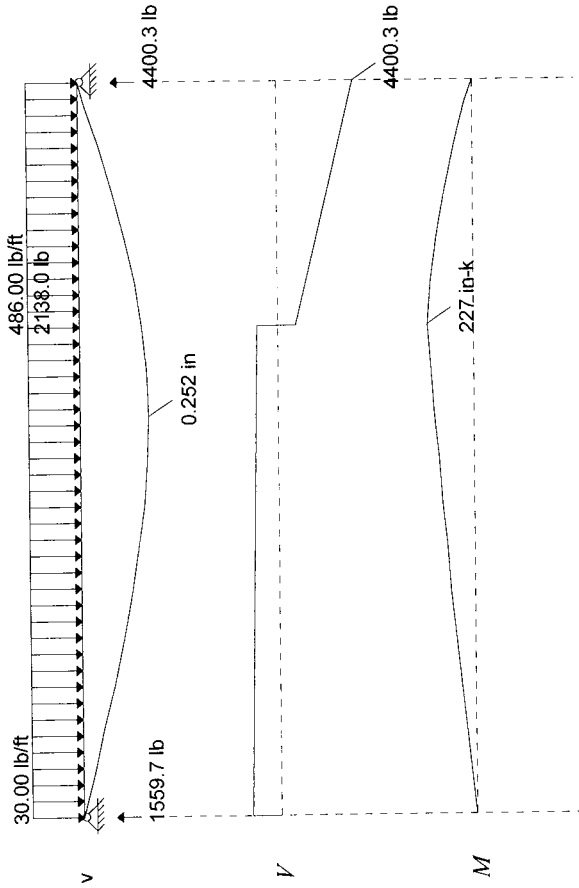
$\frac{M_{px}}{R} = 96.8$

$\Delta = 0.81 = \phi / 301$

101

Dead

File: CalcDoc1 created on Friday, July 05, 2019 at 13:09:00 last modified on Friday, July 05, 2019 at 13:09:00

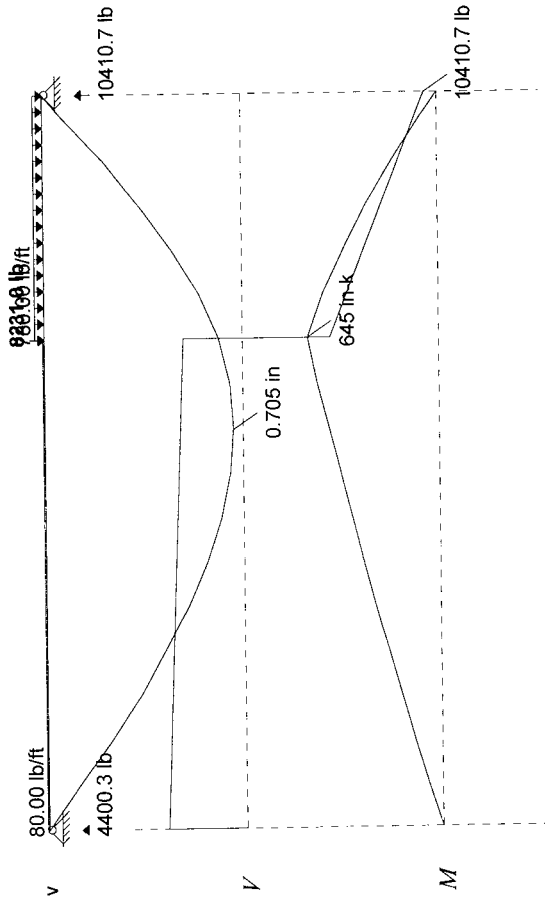


Beam Parameters: Length = 21.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

LIVE

(0)

File: CalcDoc1 created on Friday, July 05, 2019 at 13:09:00  
last modified on Friday, July 05, 2019 at 13:09:00

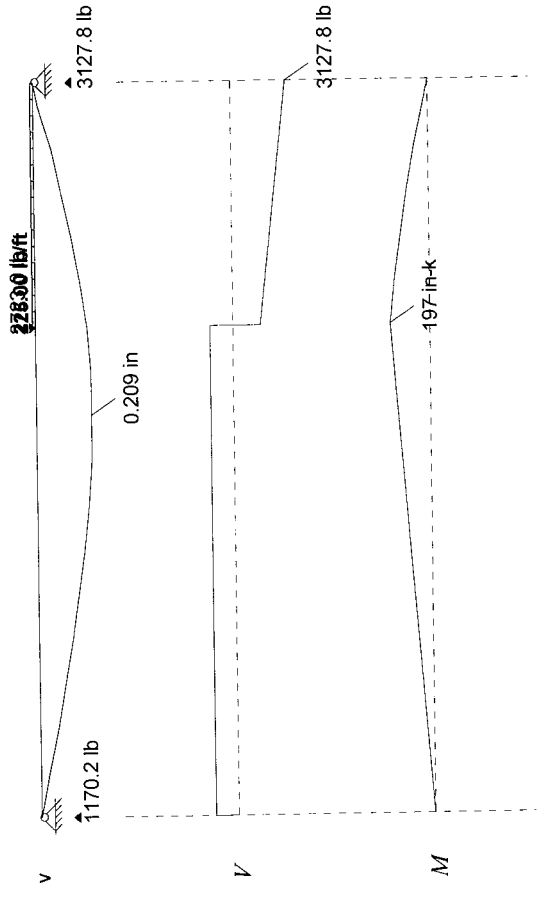


Beam Parameters: Length = 21.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

101

SNOW

File: CalcDoc1 created on Friday, July 05, 2019 at 13:09:00 last modified on Friday, July 05, 2019 at 13:09:00

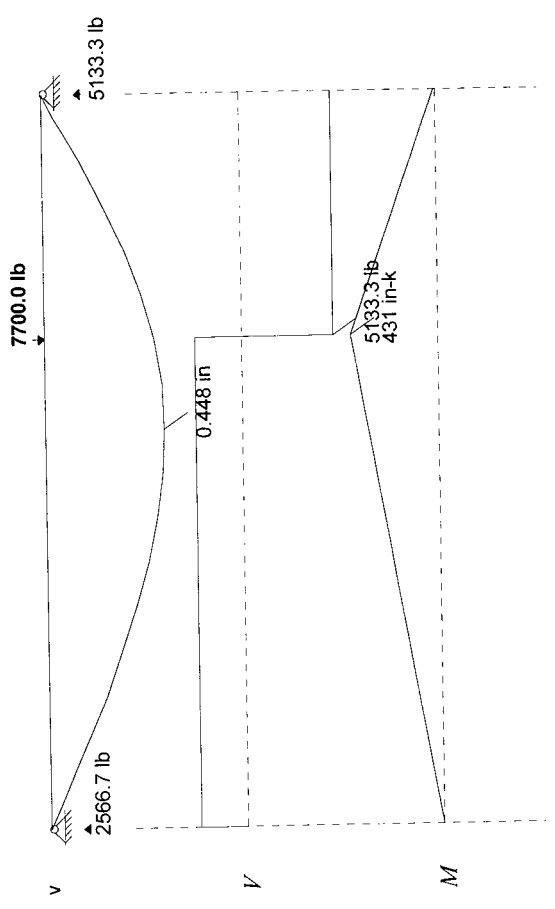


Beam Parameters: Length = 21.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

101

ER

File: CalcDoct created on Friday, July 05, 2019 at 13:09:00 last modified on Friday, July 05, 2019 at 13:09:00



Beam Parameters: Length = 21.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

10)

Mr

D =	227
L =	645
Lr =	0
S =	197
1.0E =	431
1.0W =	0
Sds =	1.11
Ω0 =	2.5
ρ =	1.3

} k-in

### ASD

$$\begin{aligned}
 D + L &= 872 \\
 D + \max\{Lr, S\} &= 424 \\
 D + 0.75L + 0.75 \max\{Lr, S\} &= 858.5 \\
 D + 0.75L + 0.525pE + 0.75S &= 1084.775 \\
 0.6D + 0.7pE &= 528.41 \\
 D + 0.6W &= 227 \\
 D + 0.75L + 0.45W + 0.75 \max\{Lr, S\} &= 858.5 \\
 0.6D + 0.6W &= 136.2 \\
 (1.0 + 0.14Sds)D + 0.75\Omega E &= 1070.401 \\
 (1.0 + 0.105sDS)d + 0.525\Omega E + 0.75(L+S) &= 1450.644 \checkmark \\
 (0.6 - 0.14Sds)d + 0.7\Omega E &= 855.1742
 \end{aligned}$$

$$Z_{req} = (1450.644) / (50 \text{ ksi}) = 48.5 \text{ in}^3$$

$$\begin{aligned}
 \Delta_{TL} &= 0.252^\circ D + 0.705^\circ L + 0.209^\circ S \\
 &= 1.17^\circ \quad (L/219)
 \end{aligned}$$

$$A_{req} = 1.05$$

$$I_{req} = \frac{1.17^\circ}{1.05^\circ} I_{W12x33} = (1.114) (171 \text{ in}^4) = 190.5 \text{ in}^4$$

USE W 8 x 33

$$Z = 59.3 \text{ in}^3$$

$$I = 228 \text{ in}^4$$

$$\Delta = \frac{1.17^\circ}{228} (171) = 0.878 \text{ in OK}$$

101

Vr (A)

D =	1560
L =	4400
Lr =	0
S =	1170
1.0E =	2567
1.0W =	0
Sds =	1.11
$\Omega$ =	2.5
$\rho$ =	1.3

### ASD

- D + L = 5960
- D + max{Lr,S} = 2730
- D + 0.75L + 0.75 max{Lr, S} = 5737.5
- D + 0.75L + 0.525 $\rho$ E + 0.75S = 7085.175 ✓
- 0.6D + 0.7 $\rho$ E = 3271.97
- D + 0.6W = 1560
- D + 0.75L + 0.45W + 0.75 max{Lr, S} = 5737.5
- 0.6D + 0.6W = 936
- (1.0+0.14Sds)D+0.75 $\Omega$ E = 6615.549
- (1.0+0.105sDS)d+0.525 $\Omega$ E+0.75(L+S) = 9288.506
- (0.6-0.14Sds)d+0.7 $\Omega$ E = 5185.826



101

Vr (B)

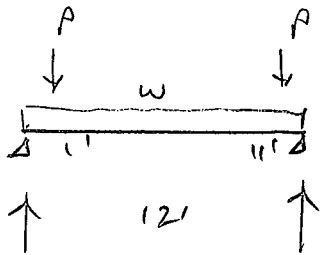
D =	4400
L =	10411
Lr =	
S =	3128
1.0E =	5133
1.0W =	0
Sds =	1.11
$\Omega$ =	2.5
$\rho$ =	1.3

### ASD

- D + L = 14811
- D + max{Lr,S} = 7528
- D + 0.75L + 0.75 max{Lr, S} = 14554.25
- D + 0.75L + 0.525pE + 0.75S = 17249.08 ✓
- 0.6D + 0.7pE = 7311.03
- D + 0.6W = 4400
- D + 0.75L + 0.45W + 0.75 max{Lr, S} = 14554.25
- 0.6D + 0.6W = 2640
- (1.0+0.14Sds)D+0.75 $\Omega$ E = 14708.14
- (1.0+0.105sDS)d+0.525 $\Omega$ E+0.75(L+S) = 21804.13
- (0.6-0.14Sds)d+0.7 $\Omega$ E = 10938.99

MAIN FLOOR EXHAUST

102

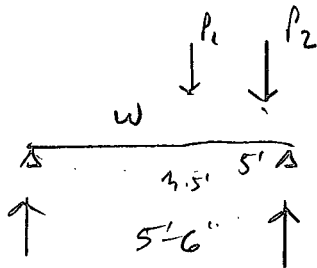


D	570	878	570
L	480	1440	480
S	562	562	562

$P = 562 \text{ lbs} + 330 \text{ lbs}$   
 $w = 30 \text{ plf D} + 80 \text{ plf L}$

$4 \times 10$   
 $M_R = 4.24$   
 $V_R = 3.24$

103



D	2.7	6.5	4.0
L	3.9	9.4	6.2
S	1.5	3.3	2.1
P E	5.7	3.5	7
D+L	6.6	15.9	10.2
D+S	4.2	10.3	6.1
D+(L+S+E)	7.5	7.3	19.0
$R_1$		14.3	
$R_2$		19.2	
$R_3$	-160		-11.7

$P_1 = 3.7 \text{ kD} + 5.1 \text{ kL} + 2.4 \text{ kS}$

$P_2 = .42 \text{ kD} + 1.12 \text{ kL} + 7.7 \text{ kE}$

$w = 9' (44 \text{ D} + 80 \text{ L} + 25 \text{ S})$   
 $+ 4.5' (150 + 40 \text{ L})$   
 $= 464 \text{ plf D} + 720 \text{ plf L}$   
 $+ 225 \text{ plf S}$

$w = 12 \times 30 \quad 10 \times 33$

combine w/ 101

MAIN FRONT FRAMING

104

$l = 60'$

(2) 2x10

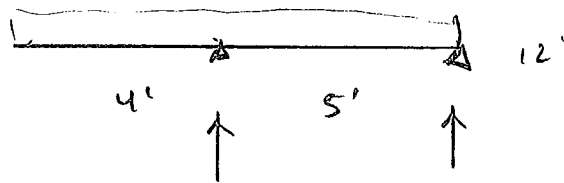
$w = 10'(15+40) = 550$

$M = 2.5 \text{ K}\cdot\text{FT}$

$V = 1.65 \text{ K}$

LOWER DECK JOISTS

$w = 44 \text{ PLF D} + 60 \text{ PLF L} + 25 \text{ PLF S}$



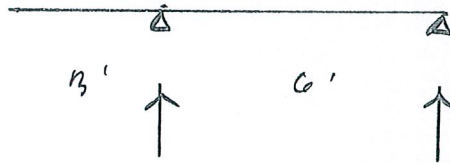
D	352	356	136	110
L	480	486	188	150
S	200	203	113	63

2x12 @ 12  
 $M_{PL} = 2.58 \text{ K}\cdot\text{FT}$   
 $V_{PL} = 1.68 \text{ K}$   
 $\Delta = .31'' = \phi 155 \text{ OK}$   
 CANT. W/ DT. 75(L+S)

MAX W/LIFT = 593 #/FT

MAIN FLOOR FRAMING

105  $P = 3.5^k D + 5.4^k L + 1.9^k S + 5.1^k E$   
 $4490^{lb} D + 1011^{lb} L + 3128^{lb} S + 5133^{lb} E$



D	10.5	5.25	-1.75
L	16.2	8.1	-2.7
S	5.7	2.9	-1.95
P E	15.3	± 7.7	± 2.6
D+L	26.7	13.3	-4.5
D+S	16.2	8.1	-2.7
D+L+S	38.4	19.3	-6.9
R1	41.6		
R2	50.3		
R3	-25		

$W_{10 \times 33}$   
 $\Delta = PL^3 / 3EI$

$I = 171$   
 $= 38.4^k (3')^3$   
 $3EI$

$= 0.12" = 1/8"$   
 OK

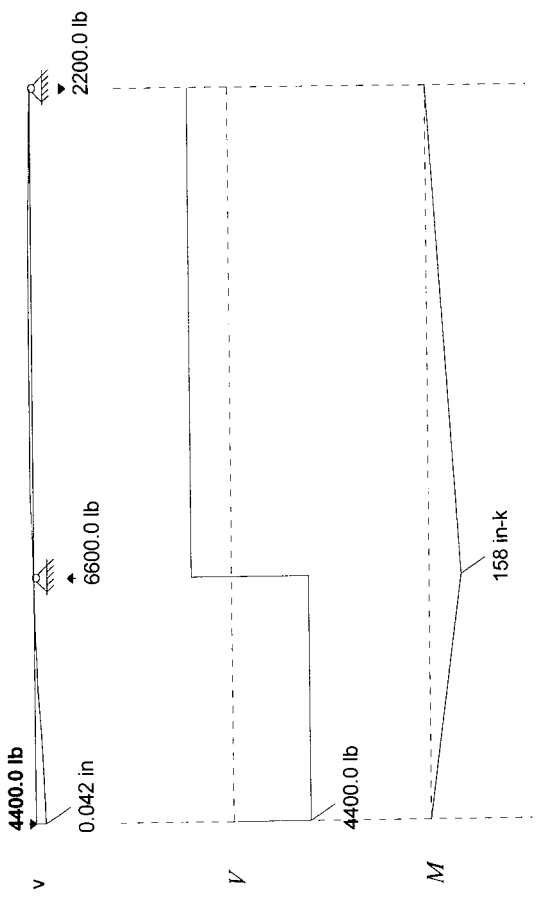
see following pages

UP

Dead

105

File: CalcDoc1 created on Friday, July 05, 2019 at 13:09:00 last modified on Friday, July 05, 2019 at 13:09:00



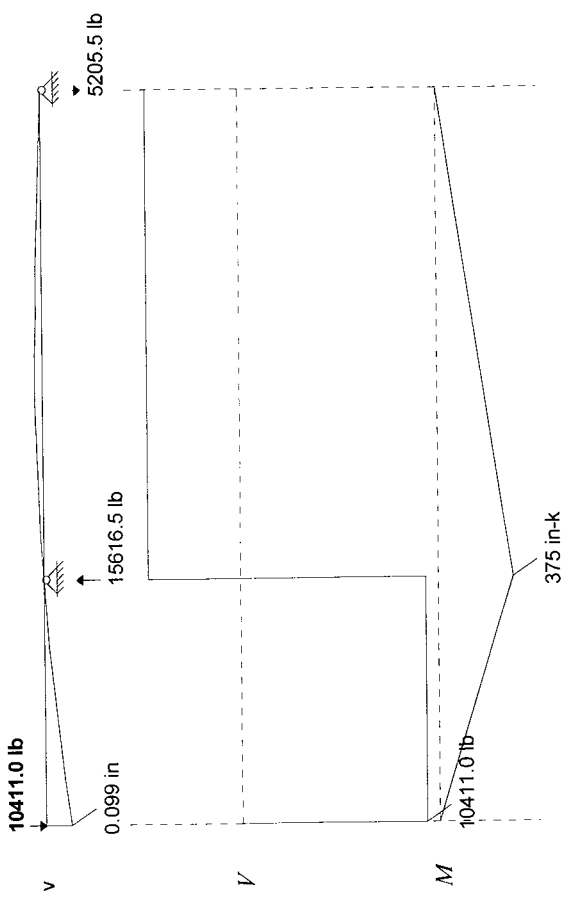
Beam Parameters: Length = 9.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

105

LIVE

File: CalcDoc1

created on Friday, July 05, 2019 at 13:09:00  
last modified on Friday, July 05, 2019 at 13:09:00



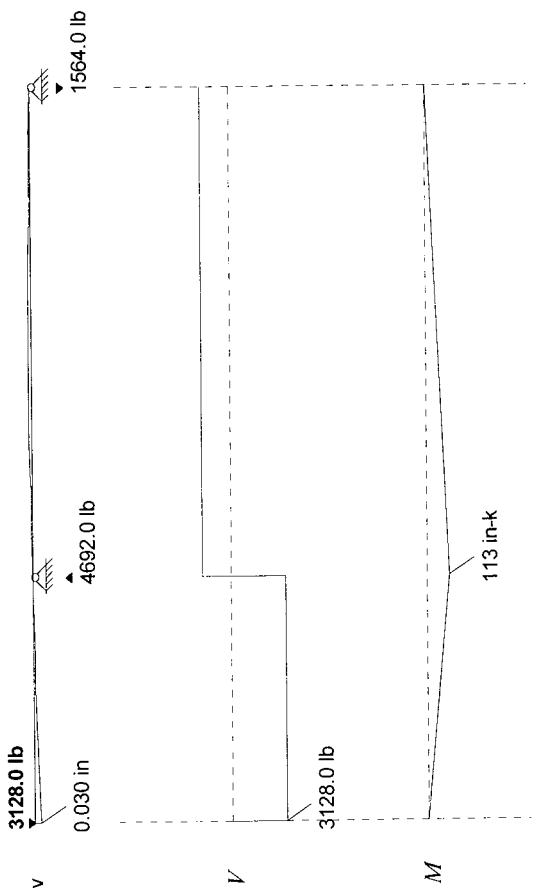
Beam Parameters: Length = 9.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

109

5th floor

File: CalcDoc1

created on Friday, July, 05, 2019 at 13:09:00  
last modified on Friday, July, 05, 2019 at 13:09:00



Beam Parameters: Length = 9.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

105

Mr

D =	158
L =	375
Lr =	
S =	113
1.0E =	185
1.0W =	0
Sds =	1.11
Ω =	2.5
ρ =	1.3

} in-k

### ASD

D + L =	533
D + max{Lr, S} =	271
D + 0.75L + 0.75 max{Lr, S} =	524
D + 0.75L + 0.525ρE + 0.75S =	621.125
0.6D + 0.7ρE =	263.15
D + 0.6W =	158
D + 0.75L + 0.45W + 0.75 max{Lr, S} =	524
0.6D + 0.6W =	94.8
(1.0+0.14Sds)D+0.75ΩE =	529.4282
(1.0+0.105sDS)d+0.525ΩE+0.75(L+S) =	785.2274 ✓
(0.6-0.14Sds)d+0.7ΩE =	393.9968

$$F_{req} = (755)(1.163)/50^4 \text{ si} = 26.21 \text{ in}^3 < F_{10K33} = 388$$

$$\Delta_{TL} = 0.042'' + 0.099 \text{ in} + 0.030 \text{ in} = 0.171''$$

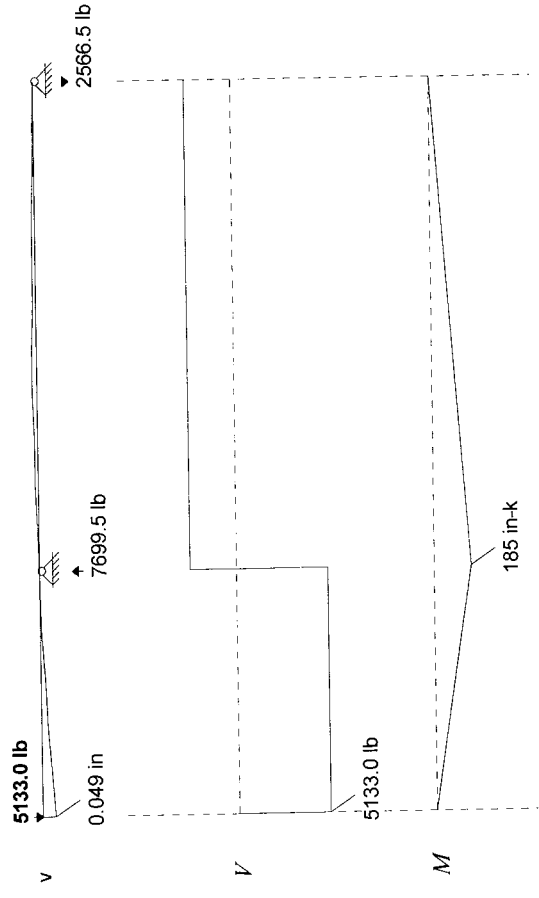
$$\frac{2L}{240} = 0.300'' > 0.171'' \quad \text{OK}$$



10/19

EQ

File: CalcDoc1 created on Friday, July 05, 2019 at 13:09:00 last modified on Friday, July 05, 2019 at 13:09:00



Beam Parameters: Length = 9.0 ft, E = 29000.0 ksi, I = 170.0 in<sup>4</sup>, A = 9.7 in<sup>2</sup>

Handwritten marks: "129" and a checkmark.

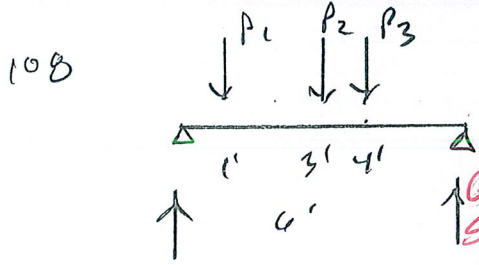
Reaction  
at Cantilever edge

D =	6600
L =	15616.5
Lr =	
S =	4696
1.0E =	7699
1.0W =	0
Sds =	1.11
$\Omega_0$ =	2.5
$\rho$ =	1.3

**ASD**

$$\begin{aligned}
 D + L &= 22216.5 \\
 D + \max\{Lr, S\} &= 11296 \\
 D + 0.75L + 0.75 \max\{Lr, S\} &= 21834.38 \\
 D + 0.75L + 0.525\rho E + 0.75S &= 25876.35 \quad \checkmark \\
 0.6D + 0.7\rho E &= 10966.09 \\
 \cancel{D + 0.6W} &= \cancel{6600} \\
 \cancel{D + 0.75L + 0.45W + 0.75 \max\{Lr, S\}} &= \cancel{21834.38} \\
 \cancel{0.6D + 0.6W} &= \cancel{3960} \\
 \cancel{(1.0 + 0.14Sds)D + 0.75\Omega E} &= \cancel{22061.27} \\
 \cancel{(1.0 + 0.105sDS)d + 0.525\Omega E + 0.75(L+S)} &= \cancel{32708.54} \\
 \cancel{(0.6 - 0.14Sds)d + 0.7\Omega E} &= \cancel{16407.61}
 \end{aligned}$$

MTU Floor Frame



$P_1 = 10.7 \text{ kD} + 14.7 \text{ kL} + 6.1 \text{ kS}$

$P_2 = 960 \text{ #D} + 960 \text{ #L}$

$P_3 = 3.4 \text{ kD} + 1.3 \text{ kL}$

D	10.2	10.2	4.2
L	3.5	10.3	3.5
S	5.1	5.1	1.0
D+L	13.7	20.5	<u>7.7</u>
D+S	15.3	15.3	<u>5.2</u>
D+(L+S)	<u>16.2</u>	<u>21.8</u>	7.6

PSC  $3 \hat{2} \times 14$

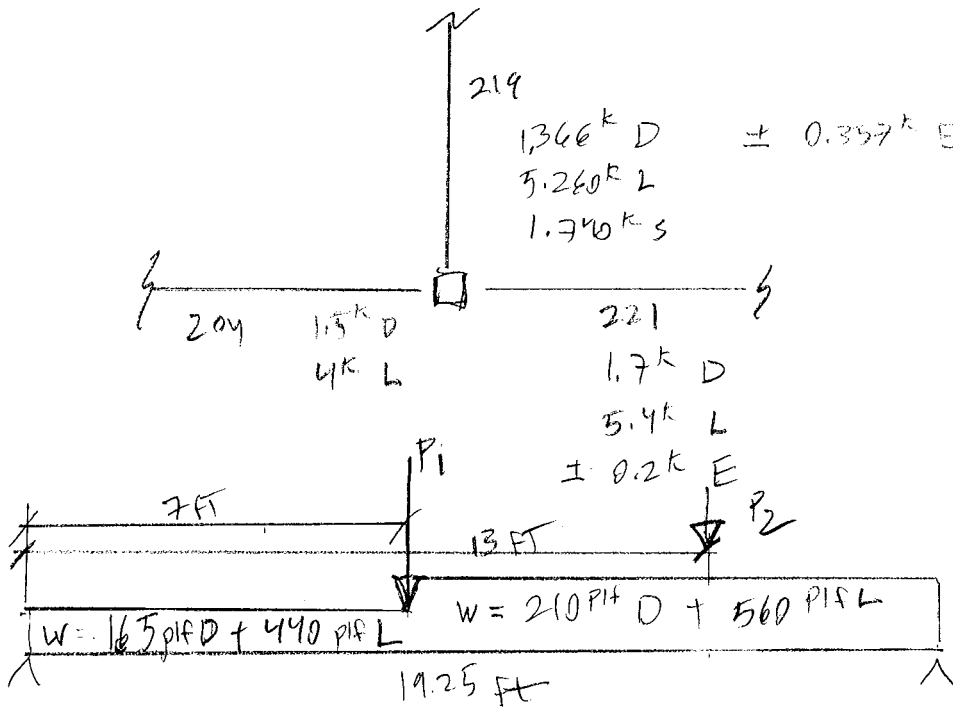
$M_{DL} = 27.16$

$V_{1L} = 9.5$

$\delta = 0.1 \frac{\text{in}}{\text{ft}}$

Ex Glulam @ Main Floor Frame (675 x 24)

Post Above



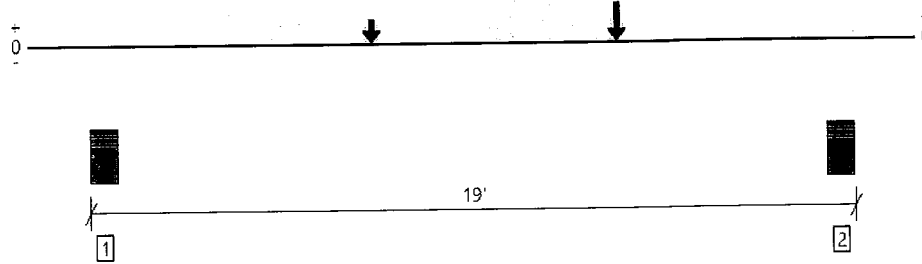
$$P_2 = 4.6^k D + 14.66^k L + 1.71^k S \pm 0.357^k E$$

$$P_1 = 4.2^k D + 3.5^k L + 1.0^k S$$

See Forte Calc on Following Page

Level, Floor: Drop Beam  
**1 piece(s) 6 3/4" x 24" 24F-V4 DF Glulam**

Overall Length: 19'



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Units	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	23644 @ 18' 6 1/4"	30586 (7.25")	Passed (77%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	21536 @ 16' 4 3/4"	28620	Passed (75%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	116059 @ 13'	119436	Passed (97%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.316 @ 9' 11 1/16"	0.601	Passed (L/686)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.468 @ 9' 9 5/8"	0.902	Passed (L/462)	--	1.0 D + 1.0 L (All Spans)

System : Floor  
 Member Type : Drop Beam  
 Building Use : Residential  
 Building Code : IBC 2015  
 Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Top Edge Bracing (Lu): Top compression edge must be braced at 13' 10" o/c unless detailed otherwise.
- Bottom Edge Bracing (Lu): Bottom compression edge must be braced at 19' o/c unless detailed otherwise.
- Critical positive moment adjusted by a volume factor of 0.92 that was calculated using length L = 18' 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Location	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)				
1 - Stud wall - DF	7.25"	7.25"	4.16"	6197	11342	1171	109/-109	18819/-109	None
2 - Stud wall - DF	7.25"	7.25"	5.60"	7026	16618	1569	248/-248	25461/-248	None

Location	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)				
0 - Self Weight (PLF)	0 to 19'	N/A	39.4	--	--	--			
1 - Uniform (PLF)	0 to 7' (Front)	N/A	165.0	440.0	-	-			floor
2 - Point (lb)	7' (Front)	N/A	4200	3500	1000	-			load from 108
3 - Uniform (PLF)	7' to 19' (Front)	N/A	210.0	560.0	-	-			floor
4 - Point (lb)	13' (Front)	N/A	4600	14660	1740	357			from post above (supporting 3 beams)

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator



ForteWEB Software Operator	Job Notes
Todd Fisher Harriott Valentine Engineers (206) 624-4760 tfisher@harriottvalentine.com	

Handwritten initials

101



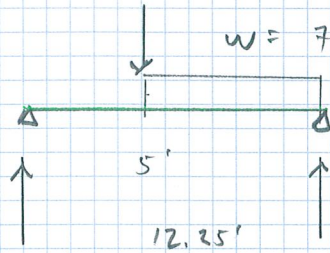
	D	L	S	EQ
$M_r$ (14-K)	227	645	197	$\pm 43$
$V_r A$ (15)	1560	4400	1170	$\pm 2567$
$V_r B$ (15)	4400	10911	3128	$\pm 5133$

MAIN FLOOR FRAMING

109

$$p = 1.9^k D + 2.2^k L + 1.4^k S \pm 2.7 E$$

$$w = 75 \text{ PCF } D + 200 \text{ PCF } L$$



D	1.3	6.4	1.2
L	1.7	8.6	1.9
S	.83	4.1	.57
E	1.6	7.9	1.1
D+L	3.0	15	3.1
D+S	2.1	10.5	1.7
D+.75(L+S)	3.2	15.9	3.0
R <sub>1</sub>	6.2	31	4.6
R <sub>2</sub>	<u>6.9</u>	<u>34</u>	<u>5.6</u>
R <sub>3</sub>	5.4	26.7	3.9

W10x22

$$\frac{M_{rx}}{r_c} = 40.5 \text{ k} \cdot \text{ft}$$

$$d = .223 \text{ in} = \frac{0.639}{1000}$$

$$(1.0 + 0.14 S_{DS}) D + .7 R_E$$

$$1.13$$

$$(1.0 + 0.105 S_{DS}) D + 0.525 R_E + .75 C$$

$$1.097 \quad + .755$$

$$(0.6 + 0.14 S_{DS}) D + 0.7 R_E$$

$$.47$$

$$S_{DS} = .9273$$

$$R = 3$$

# WIND DESIGN

ASCE 7-10

Simplified Envelope Method (Chapter 28)

$$p_s = \lambda K_z t I p_{s30}$$

$$\lambda = \text{adjustment factor} = 1.00$$

$$I = \text{importance factor} = 1.00$$

$$K_z t = \text{topographic factor} = 1.60$$

Part of Figure 28.6-1 - Adjustment Factor for Building Height and Exposure,  $\lambda$

Mean Roof Height (ft)	Exposure		
	B	C	D
15	1.00	1.21	1.47
16	1.00	1.23	1.49
17	1.00	1.24	1.50
18	1.00	1.26	1.52
19	1.00	1.27	1.53
20	1.00	1.29	1.55
21	1.00	1.30	1.56
22	1.00	1.31	1.57
23	1.00	1.33	1.59
24	1.00	1.34	1.60
25	1.00	1.35	1.61
26	1.00	1.36	1.62
27	1.00	1.37	1.63
28	1.00	1.38	1.64
29	1.00	1.39	1.65
30	1.00	1.40	1.66

Zone  
Computation

a = 10% of least horizontal dimension or 0.4 x h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 feet.

$$w = 31.00 \text{ ft} \times 0.1 = 3.10 \text{ ft}$$

$$h = 29.50 \text{ ft} \times 0.4 = 11.80 \text{ ft}$$

$$w = 31.00 \text{ ft} \times 0.04 = 1.24 \text{ ft}$$

$$a = 4.00 \text{ ft}$$

$$2a = 8.00 \text{ ft}$$

Zone B - end zone of roof

Zone A - end zone of wall

Zone D - interior zone of roof

Zone C - interior zone of wall

Part of Figure 28.6-1 - Method 2  
Design Wind Pressure,  $p_{s30}$

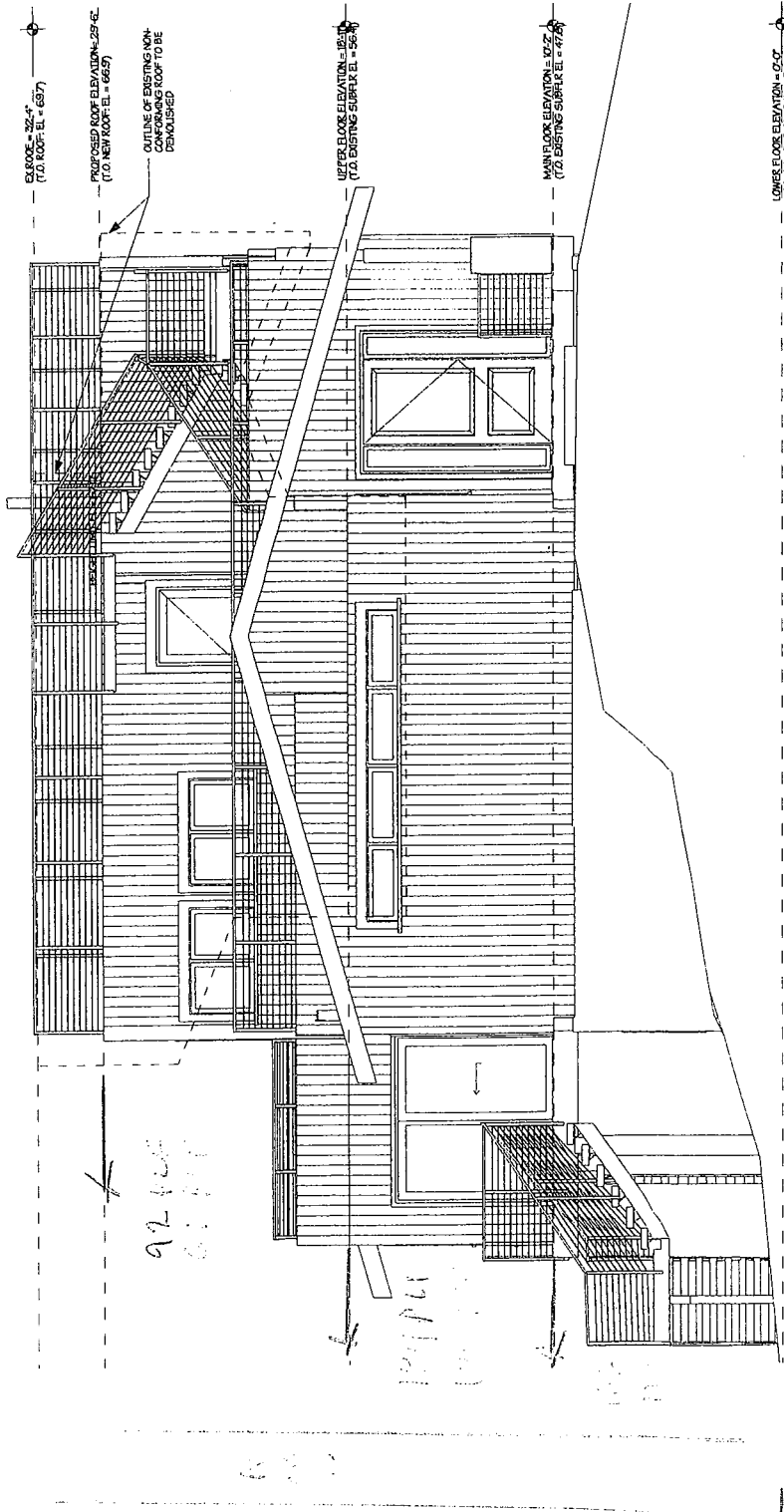
Basic Speed	Roof Angle	Roof Pitch	Horizontal Pressures (psf)			
			A	B	C	D
110	0 to 5	flat	19.2	-10.0	12.7	-5.9
	10	2	21.6	-9.0	14.4	-5.2
	15	3	24.1	-8.0	16.0	-4.6
	20	4	26.6	-7.0	17.7	-3.9
	25	6	24.1	3.9	17.4	4.0
	30 to 45	7 to 12	21.6	14.8	17.2	11.8

Design Wind Pressure, ps

Basic Speed	Roof Angle	Roof Pitch	Horizontal Pressures (psf)			
			A	B	C	D
110	0 to 5	flat	<b>30.7</b>	<b>-16.0</b>	<b>20.3</b>	<b>-9.4</b>
	10	2	34.6	-14.4	23.0	-8.3
	15	3	38.6	-12.8	25.6	-7.4
	20	4	42.6	-11.2	28.3	-6.2
	25	6	38.6	6.2	27.8	6.4
	30 to 45	7 to 12	34.6	23.7	27.5	18.9



WIND LOADS wx 0.6



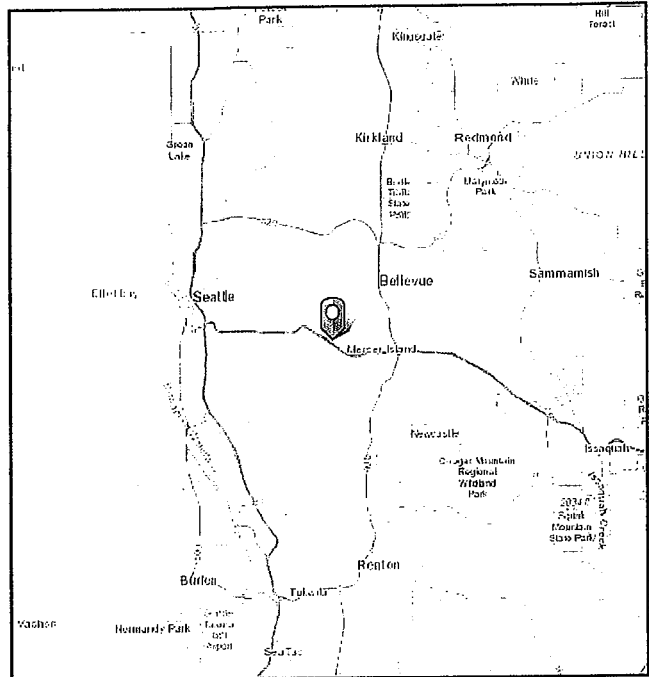
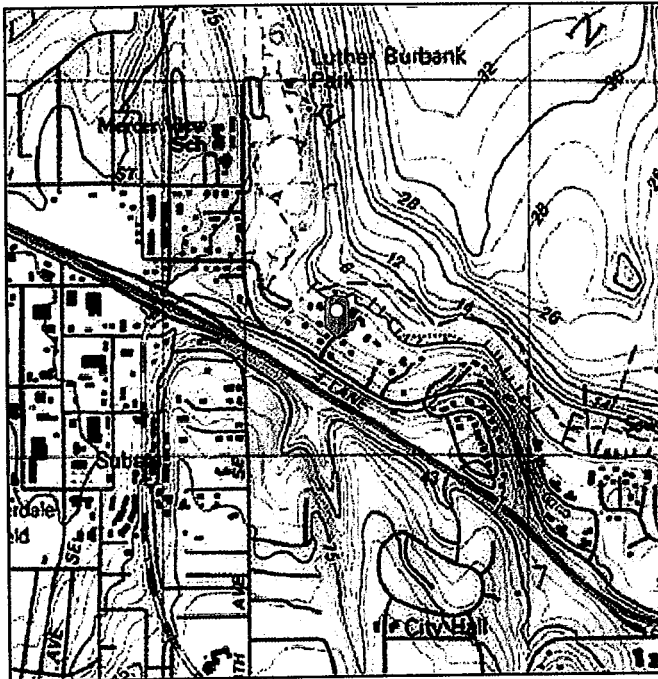


# ASCE 7 Hazards Report

**Address:**  
8452 N Mercer Way  
Mercer Island, Washington  
98040

**Standard:** ASCE/SEI 7-16  
**Risk Category:** II  
**Soil Class:** D - Default (see Section 11.4.3)

**Elevation:** 41.35 ft (NAVD 88)  
**Latitude:** 47.585278  
**Longitude:** -122.223595



## Wind

### Results:

Wind Speed:	98 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

**Data Source:** ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4

**Date Accessed:** Wed May 29 2019

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

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



## Seismic

---

**Site Soil Class:** D - Default (see Section 11.4.3)

**Results:**

$S_s$ :	1.391	$S_{D1}$ :	N/A
$S_1$ :	0.484	$T_L$ :	6
$F_a$ :	1.2	PGA :	0.595
$F_v$ :	N/A	PGA <sub>M</sub> :	0.714
$S_{MS}$ :	1.669	$F_{PGA}$ :	1.2
$S_{M1}$ :	N/A	$I_e$ :	1
$S_{DS}$ :	1.113	$C_v$ :	1.378

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

**Data Accessed:** Wed May 29 2019

**Date Source:** [USGS Seismic Design Maps](#)

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## SEISMIC DESIGN

ASCE 7-10

Equivalent Lateral Force Procedure

Occupancy Category	II	Table 1-1
Seismic Design Category	D	Table 11.6-1
Importance Factor	1.00	Table 11.5-1
Site Class	D	Table 20.3-1
S <sub>s</sub>	139.10 %g	(from USGS Seismic Hazard Curves, 2008 data)
S <sub>1</sub>	48.40 %g	(from USGS Seismic Hazard Curves, 2008 data)
F <sub>a</sub>	1.00	Table 11.4-1
F <sub>v</sub>	1.50	Table 11.4-2
C <sub>t</sub>	0.02	Table 12.8-2
x	0.75	Table 12.8-2
h <sub>n</sub>	30.00 feet	(height to highest level)

S <sub>MS</sub> = F <sub>a</sub> *S <sub>s</sub>	1.3910	Eq. 11.4-1
S <sub>M1</sub> = F <sub>v</sub> *S <sub>1</sub>	0.7260	Eq. 11.4-2
S <sub>DS</sub> = (2/3)*S <sub>MS</sub>	0.9273 g	Eq. 11.4-3
S <sub>D1</sub> = (2/3)*S <sub>M1</sub>	0.4840 g	Eq. 11.4-4
Period T <sub>a</sub> = C <sub>t</sub> *h <sub>n</sub> <sup>0.75</sup>	0.2564 s	Eq. 12.8-7
T <sub>o</sub>	0.1044 s	per section 11.4.5
T <sub>s</sub>	0.5219 s	per section 11.4.5
S <sub>a</sub>	0.9273 g	per section 11.4.5

R	6.5	Table 12.2-1
Ω <sub>o</sub>	2.5	Table 12.2-1
C <sub>d</sub>	4	Table 12.2-1
Section 9.5.5 ok?	Yes	Table 12.6-1

Equivalent Lateral Force Procedure (section 12.8)

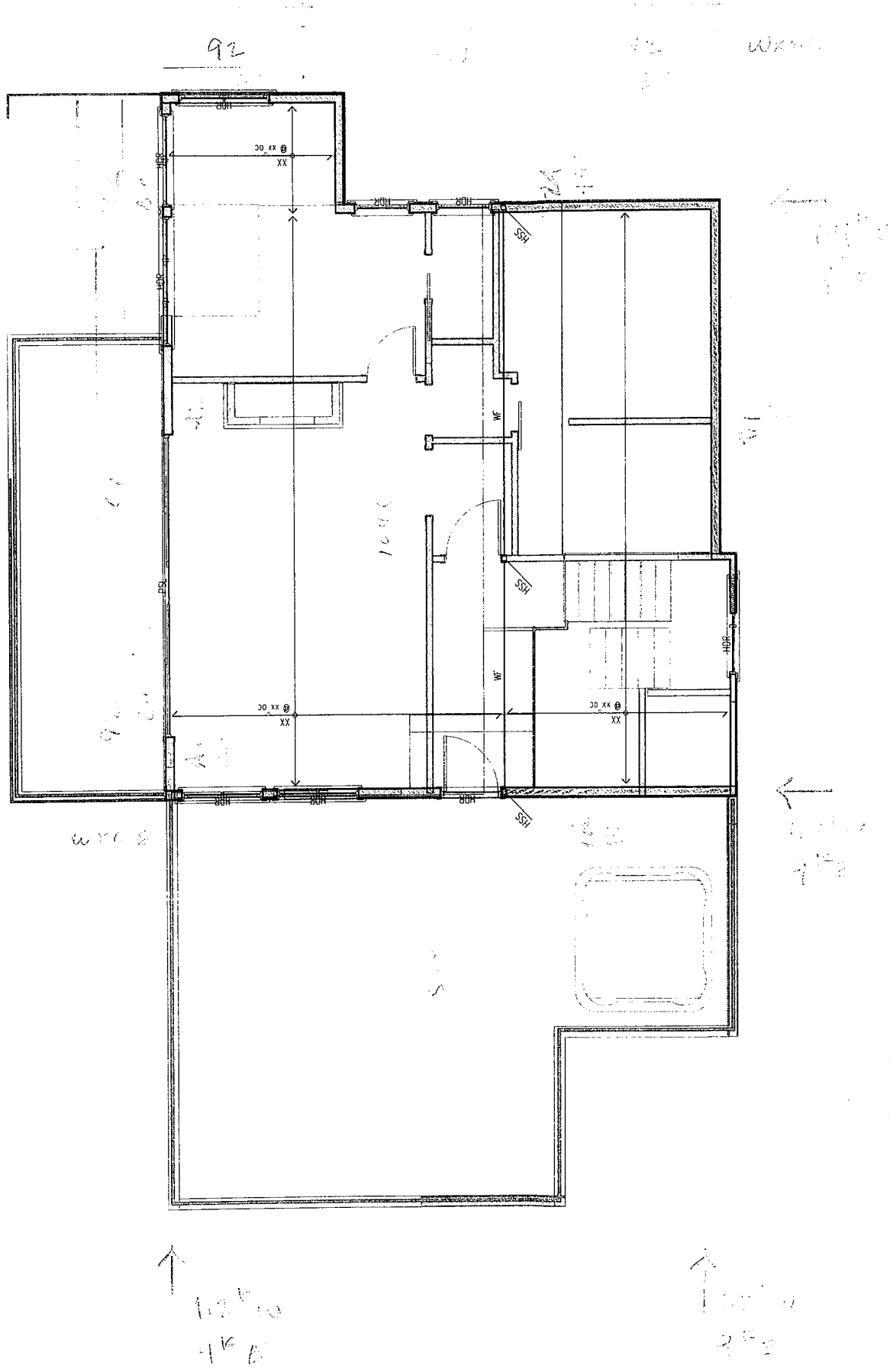
C <sub>s</sub>	0.1427	Eq. 12.8-2
W, weight	172,920 lb	per table below
Q <sub>E</sub>	24,670 lb	Eq. 12.8-1

Vertical Force Distribution (section 12.8.3)

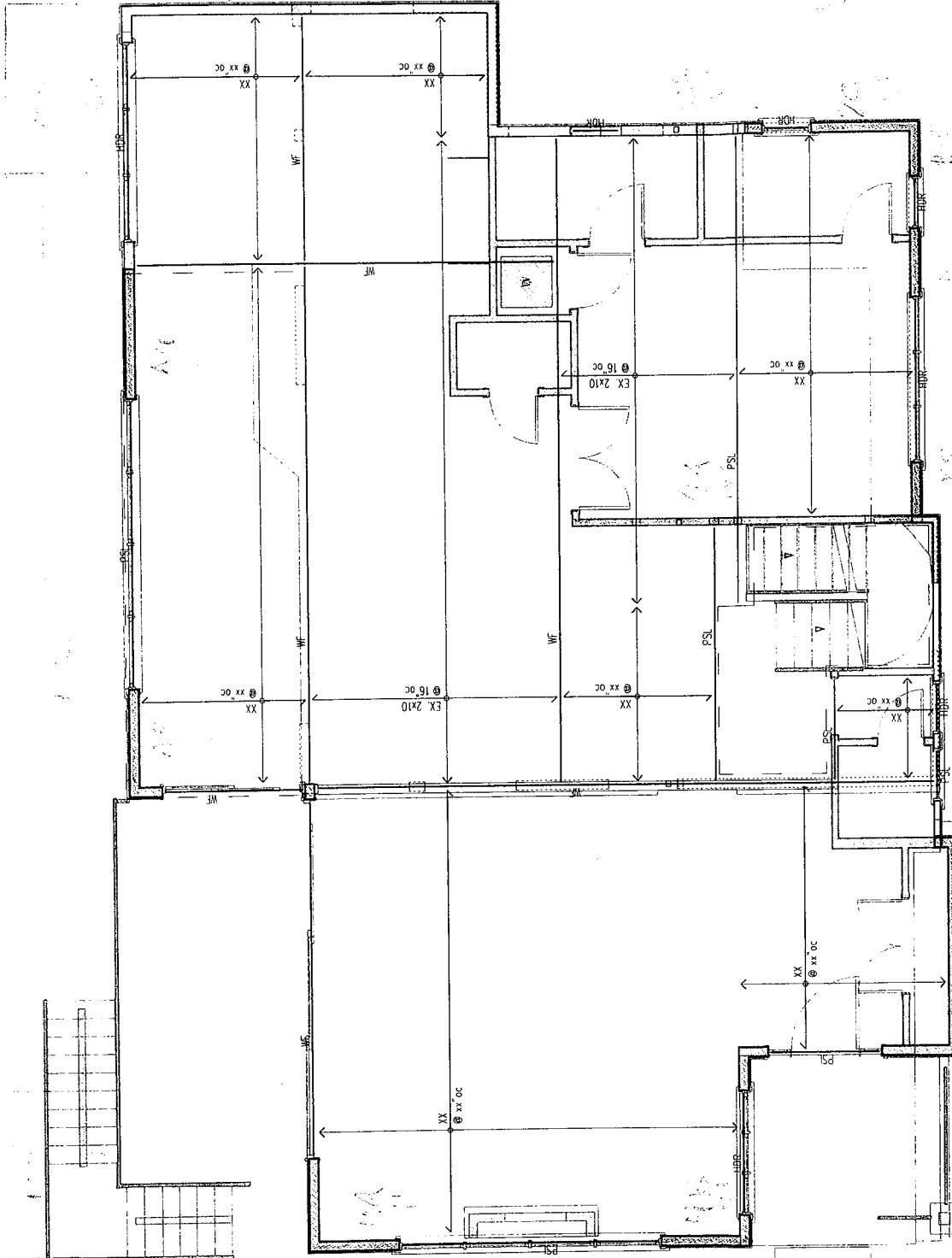
k = 1.00

Level	Hx (ft)	Floor Area (ft <sup>2</sup> )	Seismic Dead Ld (psf)	Floor Wt. (k)	Wall Length (ft)	Wall Wt. (k)	Total Wt. (k)	WxHx (k-ft)	Cvx (%)	(LRFD) Q <sub>E</sub> (k)	(ASD) 0.7Q <sub>E</sub> (k)
rood	29.50	1100	44	48.4	140	5.9	54.3	1601.3	46.3	11.42	8.00
upper	19.00	2000	29	58.0	200	15.4	73.4	1395.4	40.4	9.96	6.97
main	10.20	2000	15	30.0	200	15.2	45.2	461.0	13.3	3.29	2.30
							172.92	3457.66	100.00	24.67	17.27

# ROOF LATERAL LOADS



UPPER LATEXAZ COLAS



1 SECOND FLOOR FRAMING PLAN (MAIN FLOOR WALLS)



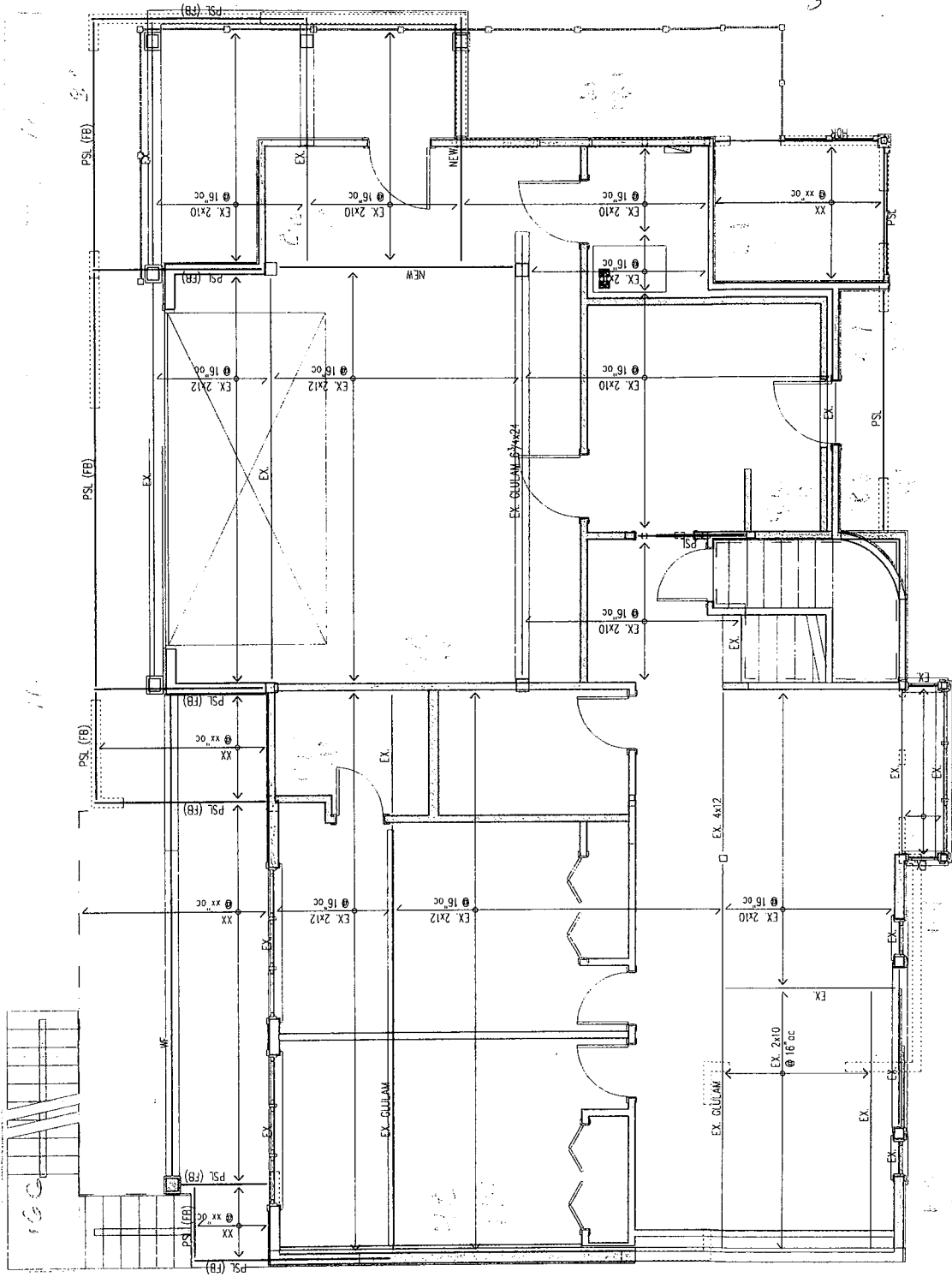
Scale: 1/4" = 1'-0"

12x10

2.6

12x10  
12x10

# MAIN CHURCH LOUIS



1 MAIN FLOOR FRAMING PLAN (BASEMENT WALLS)  
 Scale 1/4" = 1'-0"



Handwritten notes and arrows at the bottom right of the page, possibly indicating a north arrow or specific orientation.



**LATERAL FORCE DISTRIBUTION (WIND)**

**North-South**  
Walls Below Roof

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	E	V	V	L	V	SW	va	h	h/l	va'	M.ot	M.ot	OT	DL	max	I	HD	TL	C	POST
	(lb)	(abv)	(total)	(ft)	(plf)			(ft)			(lbft)	(abv)	(total)	(lb)	(lb)	(lb)		(lb)	(lb)	
A1	494	0	494	3.50	141	SW1	2241	9.50	2.71	2041	6101	0	6101	1743	0	1743		9300	11043	
A2	706	0	706	5.00	141	SW1	241	9.50	1.90	---	8719	0	8719	1744	0	1744		9300	11044	
B1	1200	0	1200	19.00	63	SW1	241	9.50	0.50	---	14820	0	14820	780	0	780		0	780	

**East-West**  
Walls Below Roof

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	E	V	V	L	V	SW	va	h	h/l	va'	M.ot	M.ot	OT	DL	max	I	HD	TL	C	POST
	(lb)	(abv)	(total)	(ft)	(plf)			(ft)			(lbft)	(abv)	(total)	(lb)	(lb)	(lb)		(lb)	(lb)	
1A	1400	0	1400	13.00	108	SW1	241	9.50	0.73	---	17290	0	17290	1330	0	1330		0	1330	
2A	1400	0	1400	13.00	108	SW1	241	9.50	0.73	---	17290	0	17290	1330	0	1330		0	1330	

**LATERAL FORCE DISTRIBUTION (WIND)**

**North-South**

Walls Below Upper Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/f)  
for wall aspect ratios greater than 2:1

WALL	E (lb)	V (abv) (total)	V (pif)	L (ft)	va	h	h/f	va'	M.ot (lbft)	M.ot (abv)	M.ot (total)	OT DL max (lb)	I (lb)	HD (lb)	TL (lb)	C (lb)	POST
A3	1160	384 1544	5.00 309	SW2	353 9.00	1.80	----	18065	0 18065	0 3613	0 3613	0 3613	1500	5113	1500	5113	
A4	1740	576 2316	7.50 309	SW2	353 9.00	1.20	----	27097	0 27097	0 3613	0 3613	0 3613	1500	5113	1500	5113	
B2	1522	126 1648	10.50 157	SW1	241 9.00	0.86	----	19282	0 19282	0 1836	0 1836	0 1836	0	1836	0	1836	
B3	435	36 471	3.00 157	SW1	241 9.00	3.00	211	5511	14820 20331	6777 0	6777 0	6777 0	1000	7777	1000	7777	
B4	508	42 550	3.50 157	SW1	241 9.00	2.57	224	6435	0 6435	1839 0	1839 0	0 1839	1000	2839	1000	2839	
B5	435	36 471	3.00 157	SW1	241 9.00	3.00	211	5511	14820 20331	6777 0	6777 0	6777 0	0	6777	0	6777	

**East-West**

Walls Below Upper Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/f)  
for wall aspect ratios greater than 2:1

WALL	E (lb)	V (abv) (total)	V (pif)	L (ft)	va	h	h/f	va'	M.ot (lbft)	M.ot (abv)	M.ot (total)	OT DL max (lb)	I (lb)	HD (lb)	TL (lb)	C (lb)	POST
2B	1167	583 1750	5.00 350	SW2	353 9.00	1.80	----	20479	17290 37769	7554 0	7554 0	0 7554	0	7554	0	7554	
2C	833	817 1650	7.00 236	SW1	241 9.00	1.29	----	19301	17290 36591	5227 0	5227 0	0 5227	0	5227	0	5227	
3A	3300	880 4180	17.00 246	SW2	353 9.00	0.53	----	48906	0 48906	2877 0	2877 0	0 2877	0	2877	0	2877	
4A	1300	260 1560	4.00 390	SW3	455 9.00	2.25	441	18252	0 18252	4563 0	4563 0	0 4563	9000	13563	9000	13563	
4B	1300	260 1560	4.00 390	SW3	455 9.00	2.25	441	18252	0 18252	4563 0	4563 0	0 4563	9000	13563	9000	13563	

**LATERAL FORCE DISTRIBUTION (WIND)**

**North-South**

Walls Below Main Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	F (lb)	V (abv)	V (total)	L (ft)	V (plf)	SW	va	h	h/l	va'	M.ot (lbft)	M.ot (abv)	M.ot (total)	OT DL max (lb)	I (lb)	HD (lb)	TL (lb)	C (lb)	POST
C1	1560	2316	3876	9.00	431	SW3	455	9.00	1.00	---	45349	0	45349	5039	0	1000	6039	0	5039
C2	1040	1544	2584	6.00	431	SW3	455	9.00	1.50	---	30233	0	30233	5039	0	0	0	5039	0
B6	473	942	1415	4.00	354	SW3	455	9.00	2.25	441	16552	0	16552	4138	0	0	0	4138	0
B7	354	706	1060	3.00	353	SW3	455	9.00	3.00	398	12405	0	12405	4135	0	0	0	4135	0
B8	472	746	1218	4.00	305	SW2	353	9.00	2.25	342	14251	0	14251	3563	0	0	0	3563	0
B9	472	746	1218	4.00	305	SW2	353	9.00	2.25	342	14251	0	14251	3563	0	0	0	3563	0
D1	827	0	827	7.00	118	SW1	241	9.00	1.29	9676	0	9676	1382	0	1382	0	0	1382	0

**East-West**

Walls Below Main Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	F (lb)	V (abv)	V (total)	L (ft)	V (plf)	SW	va	h	h/l	va'	M.ot (lbft)	M.ot (abv)	M.ot (total)	OT DL max (lb)	I (lb)	HD (lb)	TL (lb)	C (lb)	POST
2D	2200	3400	5600	13.00	431	SW3	455	9.00	0.69	---	65520	0	65520	5040	0	0	0	5040	0
3B	1043	4180	5223	8.00	653	SW5	910	9.00	1.13	---	61109	48906	110015	###	0	13752	0	13752	0
5A	1956	0	1956	15.00	130	SW1	241	9.00	0.60	---	22885	0	22885	1526	0	1526	0	1526	0
4C	2000	3120	5120	18.00	284	SW2	353	9.00	0.50	---	59904	18252	78156	4342	0	4342	0	4342	0

**LATERAL FORCE DISTRIBUTION (SEISMIC)**

**North-South**

Walls Below Main Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	E (lb)	V (abv)	V (total)	L (ft)	V (plf)	SW	va	h	h/l	va'	M.Lot (lbft)	M.Lot (abv)	M.Lot (total)	O.I.D.L.max (lb)	I (lb)	HD	IL (lb)	C (lb)	POST
C1	690	3960	4650	9.00	672	SW5	910	9.00	1.00	---	54405	0	54405	6045	6045	1000	1000	7045	4
C2	460	2640	3100	6.00	672	SW5	910	9.00	1.50	---	36270	0	36270	6045	6045	---	---	6045	4
B6	209	1321	1530	4.00	497	SW4	595	9.00	2.25	576	17896	0	17896	4474	4474	---	---	4474	3
B7	157	990	1147	3.00	497	SW4	595	9.00	3.00	521	13425	0	13425	4475	4475	---	---	4475	3
B8	209	1046	1255	4.00	408	SW4	595	9.00	2.25	576	14678	0	14678	3669	3669	---	---	3669	3
B9	209	1046	1255	4.00	408	SW4	595	9.00	2.25	576	14678	0	14678	3669	3669	---	---	3669	3
D1	366	0	366	7.00	68	SW1	241	9.00	1.29	---	4282	0	4282	612	612	---	---	612	2

rho = 1.30 per ASCE 7-05 12.3.4.2

**East-West**

Walls Below Main Floor

va' = allowable shear values multiplied by (1.25-0.125 \* h/l)  
for wall aspect ratios greater than 2.1

WALL	E (lb)	V (abv)	V (total)	L (ft)	V (plf)	SW	va	h	h/l	va'	M.Lot (lbft)	M.Lot (abv)	M.Lot (total)	O.I.D.L.max (lb)	I (lb)	HD	IL (lb)	C (lb)	POST
2D	690	5800	6490	13.00	649	SW5	595	9.00	0.69	---	75933	0	75933	5841	5841	---	---	5841	4
3B	348	5714	6062	8.00	985	SW6	910	9.00	1.13	---	70925	68854	137779	###	17222	14014	0	17222	4+2
5A	652	0	652	15.00	57	SW1	241	9.00	0.60	---	7628	0	7628	509	509	---	---	509	2
4C	536	3484	4020	18.00	290	SW2	353	9.00	0.50	---	47034	20381	67415	3745	3745	---	---	3745	3

rho = 1.30 per ASCE 7-05 12.3.4.2