

STRUCTURAL CALCULATIONS

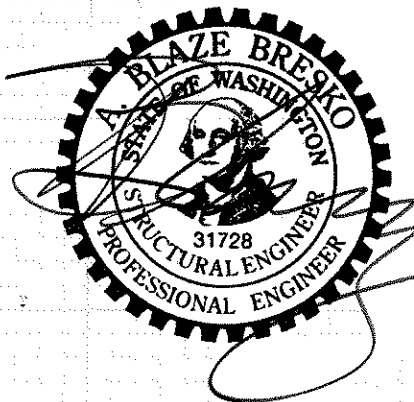
FOR THE

SIMPSON RESIDENCE

6454 E. MERCER WAY  
MERCER IS. WA 98040

ARCHITECT

STURMAN ARCHITECTS  
9-103<sup>rd</sup> AVE NE #203  
Bellevue, WA 98004



3/16/22



*Simpson*  
PROJECT

DATE

DESIGN

SHEET

*Blaze Bresko*  
*Cater*

# Criteria Sheet

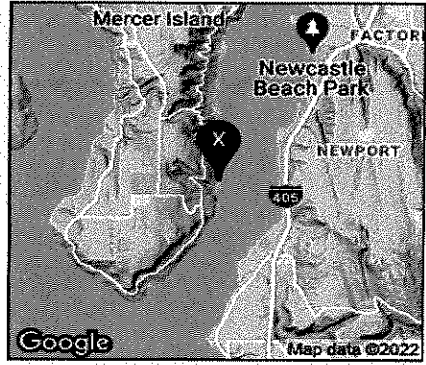
Codes		Project Location	
Structural	IBC 2018	Street & Number	6454 E Mercer way
Loading	ASCE 7-16	City	mercier island
Wood	NDS 2018	State	WA
Steel	AISC 360-16	ZIP	98040
Concrete	ACI 318-14	Latitude	47.5442 N
Masonry	TMS 402/602-16	Longitude	-122.2093 W
		Ground Elevation	31 ft

Occupancy Category	
Risk Category:	II ASCE 7 Table 1.5-1

**Seismic Load Summary:**

Analysis Procedure: Equivalent Lateral Force Procedure  
 Lateral System: Light-frame (wood) Walls Sheathed with Wood  
 Structural Panels Rated for Shear Resistance

R = 6.50	C <sub>w</sub> = 4
Base Shear V = 17 kips	Ω <sub>0</sub> = 2.5
S <sub>s</sub> = 1.448	S <sub>r</sub> = 0.501
S <sub>DS</sub> = 1.00	S <sub>DI</sub> = 0.57
C <sub>e</sub> = 0.154	I <sub>e</sub> = 1.0



**Story Information**

# Stories Above Grade (Including Mezzanine Levels)	3
--	---

**Horizontal and Vertical Irregularities:**

Is the building a "Regular Structure"? (No horizontal or vertical irregularities)  Yes

**Wind Load Summary:**

V = 98	K <sub>z1</sub> = 1.00
Exposure = C	

**Dead Loads:**

Roof		Floor	
Roofing	3 psf	Finish Floor	2 psf
1/2" Sheathing	1.5 psf	3/4" Sheathing	2.3 psf
Trusses @ 24" oc	2 psf	Joists @ 16" oc	2.2 psf
Misc./Mech.	1 psf	Misc./Mech.	1 psf
Ceiling Finish	2.5 psf	Ceiling Finish	2.5
Solar Panels	5 psf		10 psf
	15 psf	Use	10 psf
Use	15 psf	Add 5 psf for Seismic	15
Add 5 psf for Seismic	20 psf		

**Live Loads:**

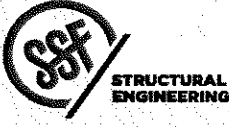
Roof	20 psf
Floor	40 psf

**Snow Loading Criteria:**

Ground Snow, p <sub>g</sub>	20 psf	Flat Roof Snow Load, p <sub>f</sub>	25.0 psf
Exposure Factor, C <sub>e</sub>	1.00	Sloped Roof Snow Load, p <sub>s</sub>	25.0 psf
Thermal Factor, C <sub>t</sub>	1.00		
Importance Factor, I <sub>s</sub>	1.00		
Slope Factor, C <sub>s</sub>	1.00		

**Soils:** Soils Report Provided?  Yes

Allowable Bearing	psf	Active	pcf (Restrained/Unrestrained)
Sliding, μ		Seismic Surcharge	
Passive	pcf		



Simpson Residence \_\_\_\_\_  
 Criteria \_\_\_\_\_  
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 \_\_\_\_\_

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 SHEET 1

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# Seismic Design

ASCE 7-16 Seismic Analysis Equivalent Lateral Force Procedure

Seismic Force Resisting System Per Table 12.2-1	System	Bearing Wall Systems
	Type:	Light-frame (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance

Seismic Design Cat.	D
Risk Category	II
Site Class	D (Default)
Diaphragm Flexibility	Flexible

I, II, or III, or IV per Table 1.5-1  
Assumed default soil properties, per 11.4.3.

### Section 12.8.1.3 Exceptions

Regular Structure	Yes
≤ 5 Stories above grade	Yes
$T \leq 0.5s$	Yes
$\rho = 1.0$	Yes
Not Site Class E or F	Yes
Risk Category I or II	Yes

If all exceptions are met,  $S_{DS}$  may be taken as 1, but not less than  $0.7 \cdot (\text{Calculated } S_{DS})$

$S_s$	1.448 g	2% in 50 yr, Latitude & Longitude lookup
$S_1$	0.501 g	2% in 50 yr, Latitude & Longitude lookup
R	6.50	
$C_d$	4.0	
$\Omega_o$	2.5	
$I_e$	1.00	Table 15-2
$h_n$	20.0 ft	
$C_t$	0.02	Table 12.8-2
x	0.75	Table 12.8-2
$T_a$	0.19 sec	Building Period Per Alternate Analysis
T	0.19 sec	Eq. 12.8-7
$T_o$	0.11 sec	
$T_s$	0.57 sec	
$T_L$	6.00 sec	
$F_a$	1.20	Table 11.4-1
$F_v$	1.70	Table 11.4-2
$S_{MS}$	1.74 g	Eq. 11.4-1
$S_{M1}$	0.85 g	Eq. 11.4-2
$S_{DS}$	1.000 g	Eq. 11.4-3
$S_{D1}$	0.568 g	Eq. 11.4-4
$C_s$	0.154 Controls	Eq. 12.8-2
	0.462	Eq. 12.8-3 need not exceed, $T < T_L$
	0.010	Eq. 12.8-5 or 12.8-6 minimum
$C_s, \text{ design}$	0.154	
Bldg. Weight	110.0 k	
$V = C_s W$	16.9 k	Eq. 12.8-1, Strength Level Base Shear
$V = C_{s, \text{ ASD}} W$	11.8 k	Eq. 12.8-1 ASD Base Shear

Building Period Per Alternate Analysis

T (sec)	
---------	--

Per Geotech Report

$F_a$	
$F_v$	

$$T_a = C_t h_n^x \quad \text{Eq. 12.8.7}$$

$$S_{MS} = F_a S_s \quad \text{Eq. 11.4-1}$$

$$S_{M1} = F_v S_1 \quad \text{Eq. 11.4-2}$$

$$S_{DS} = \frac{2}{3} S_{MS} \quad \text{Eq. 11.4-3}$$

$$S_{D1} = \frac{2}{3} S_{M1} \quad \text{Eq. 11.4-4}$$

$$C_s = \frac{S_{DS}}{(R/I_e)} \quad \text{Eq. 12.8-2}$$

$$C_s = \frac{S_{D1}}{T(R/I_e)} \quad \text{Eq. 12.8-3}$$

$$C_s = \frac{S_{D1} T_L}{T^2 (R/I_e)} \quad \text{Eq. 12.8-4}$$

$$C_s \geq 0.044 S_{DS} I_e \quad \text{Eq. 12.8-5}$$

$$C_s \geq 0.01 \quad \text{Eq. 12.8-5}$$

$$C_{VX} = w_x h_x^k / \sum_{i=1}^n w_x h_i^k \quad \text{Eq. 12.8-12}$$

$$F_{px} = \frac{\sum_{i=x}^n F_i}{\sum_{i=x}^n w_i} w_{px} \quad \text{Eq. 12.10-1}$$

$$F_{px} \geq 0.2 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-2}$$

Vertical Distribution ASD  $\rho = 1$   $k = 1.000$

Level	$h_x$ (ft)	$W_x$ (k)	$h_x^k$ (ft)	$W_x h_x^k$	Story Shear ASD			Diaphragm Force ( $\rho$ not included)				
					$C_{vx}$ (%)	$F_x$ (k)	SV (k)	$F_{px, \text{ calc}}$	$F_{px, \text{ min}}$	$F_{px, \text{ max}}$	$F_{px, \text{ design}}$	$\gamma = F_{px} / F_x$
Roof	20.0	50	20.0	1000	0.602	7.1	7.1	7.1	7.0	14.0	7.1	1.00
2	11.0	60	11.0	660	0.398	4.7	11.8	6.5	8.4	16.8	8.4	1.78
$\Sigma$		110.0		1660		11.8						



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Seismic Criteria \_\_\_\_\_

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# Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD
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### Wind Coefficients

Exposure	C	
V= 98		mph
$K_d = 0.85$		Table 26.6-1
$K_z = 0.94$		Table 26.10-1
$K_{zt} = 1.00$		Table 26.9-1
G= 0.85		26.9.4

### Transverse Wind Pressures

L/B = 0.80 h/L = 0.40

Pressure Coefficients from Figure 27.3-1:

Bldg Face	$C_p$
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.26 / 0.24
Leeward Roof	-0.60

### Location and Building Dimensions

Calculate Kzt?	Yes	
Kzt	1.00	
Roof Type	Gable	
Roof Slope - Transverse Dir	25	degrees
Roof Slope - Long Dir	25	degrees
Ground to top of roof	28	ft
Bot of roof to top of roof	8	ft
Mean Roof Height, h	24	ft
Short Plan Dimension	60	ft
Long Plan Dimension	75	ft
Parapet?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Velocity Pressure at Mean Roof Height, $q_h =$	19.6	psf
--	------	-----

### Wall Pressures (Unfactored):

Ht	$K_z$	$q_z$	$P_{ww\ walls}$	$P_{lw\ walls}$	$P_{watts\ (psf)}$
0-15	0.85	17.74	12.07	8.31	12.2
15-20	0.9	18.79	12.78	8.31	12.7
20-25	0.94	19.62	13.34	8.31	13.0
25-30	0.98	20.46	13.91	8.31	13.3
30-40	1.04	21.71	14.76	8.31	13.8
41-50	1.09	22.75	15.47	8.31	14.3
51-60	1.13	23.59	16.04	8.31	14.6
61-70	1.17	24.42	16.61	8.31	15.0
71-80	1.21	25.26	17.18	8.31	15.3
81-90	1.24	25.88	17.60	8.31	15.5
91-100	1.26	26.30	17.89	8.31	15.7

### Roof Pressures (Unfactored)

Windward			Leeward	Horiz Proj (psf)
Max	Min			
4.0	-4.3	-10.0		8.38

### Longitudinal Wind Pressures

L/B = 1.25 h/L = 0.32

Pressure Coefficients from Figure 27.4-1:

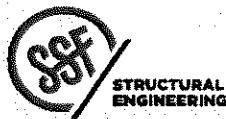
Bldg Face	$C_p$
Windward Wall	0.8
Leeward Wall	-0.45
Windward Roof	-0.23 / 0.27
Leeward Roof	-0.60

### Wall Pressures (Unfactored):

Ht	$K_z$	$q_z$	$P_{ww\ walls}$	$P_{lw\ walls}$	$P_{watts\ (psf)}$
0-15	0.85	17.74	12.07	7.48	11.73
15-20	0.9	18.79	12.78	7.48	12.16
20-25	0.94	19.62	13.34	7.48	12.50
25-30	0.98	20.46	13.91	7.48	12.84
30-40	1.04	21.71	14.76	7.48	13.35
41-50	1.09	22.75	15.47	7.48	13.77
51-60	1.13	23.59	16.04	7.48	14.11
61-70	1.17	24.42	16.61	7.48	14.45
71-80	1.21	25.26	17.18	7.48	14.80
81-90	1.24	25.88	17.60	7.48	15.05
91-100	1.26	26.30	17.89	7.48	15.22

### Roof Pressures (Unfactored)

Windward			Leeward	Horiz Proj (psf)
Max	Min			
4.5	-3.8	-10.0		8.70



Simpson Residence \_\_\_\_\_

Wind Criteria \_\_\_\_\_

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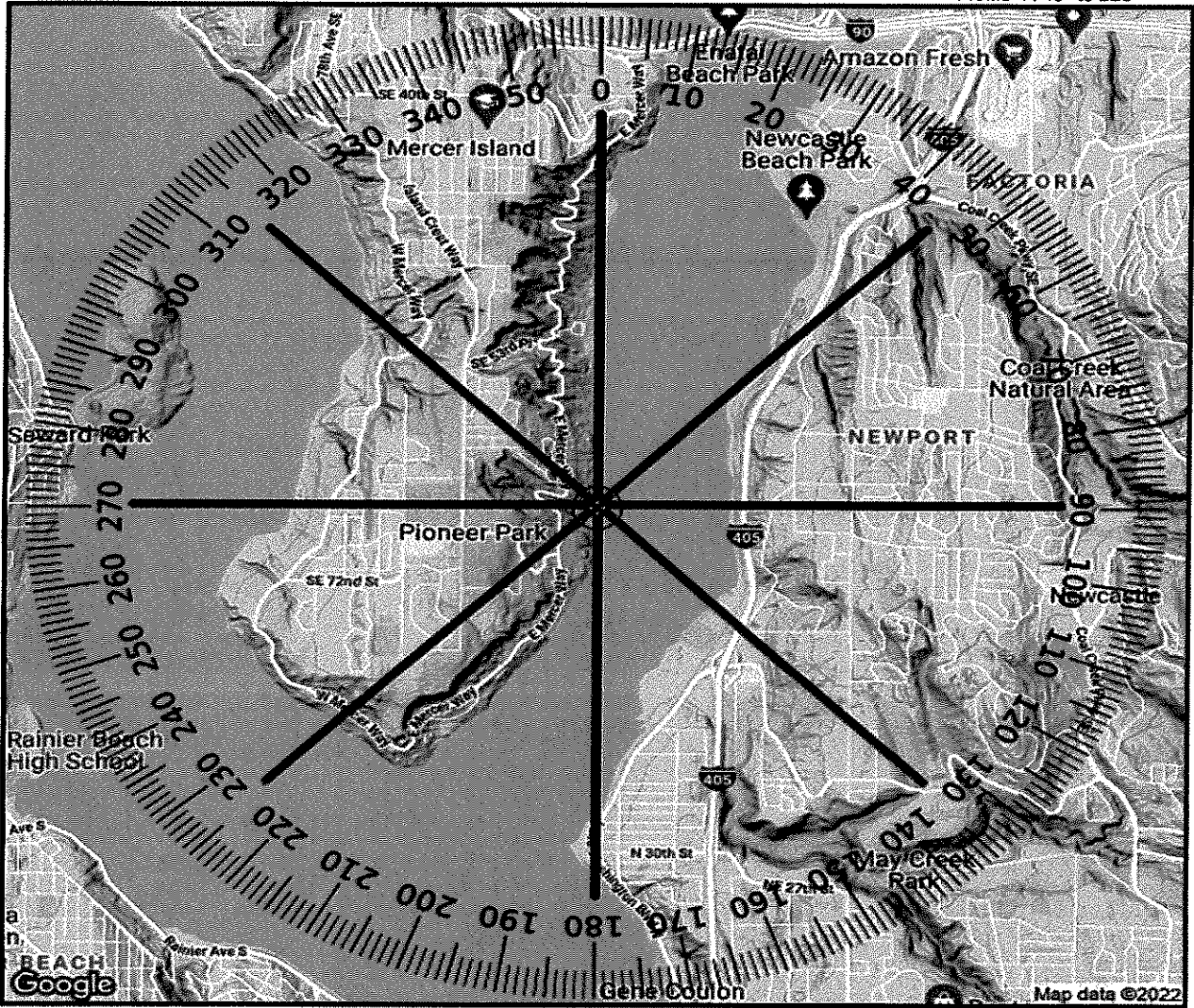
**Site Address**

Address 6454 E Mercer way  
 City: mercer island State: WA  
 Lat Long 47.54421 -122.2093

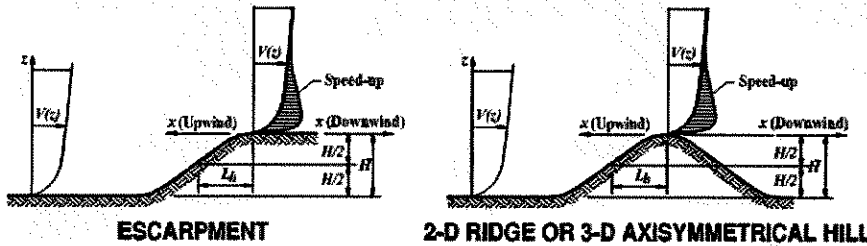
Wind Radius 2.00 Miles  
 Angle 0°  
 Exposure C

Profile 1 : 0° to 180°  
 Profile 2 : 270° to 90°  
 Profile 3 : 315° to 135°  
 Profile 4 : 45° to 225°

**SITE MAP**



Topography from Figure 26.8-1



$$K_{zt} = (1 + K_1 K_2 K_3)^2$$

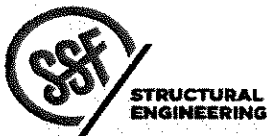
$$K_1 = \text{Per Figure}$$

$$K_2 = (1 - |x|/\mu L_h)$$

$$K_3 = e^{-\gamma z/L_h}$$

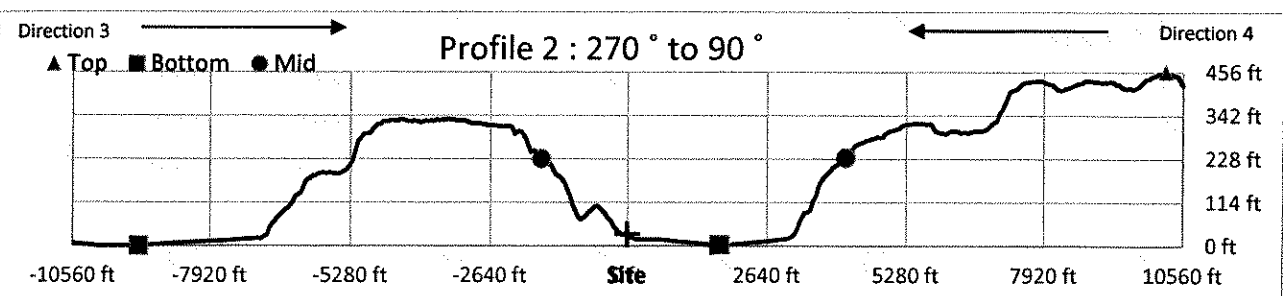
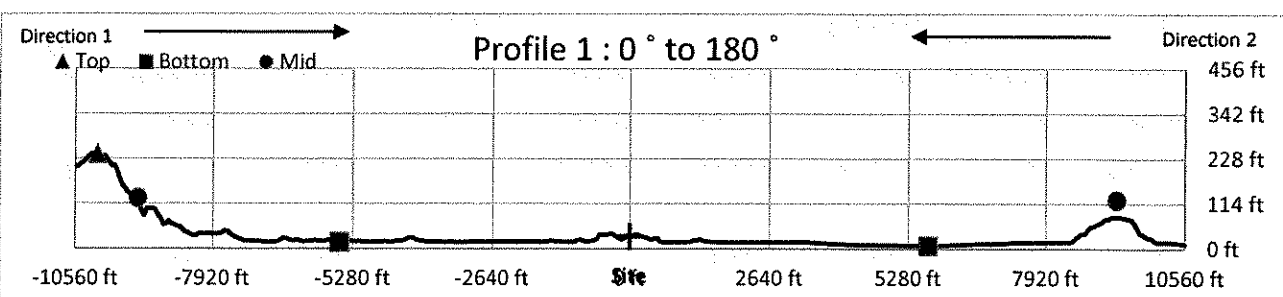
$$K_{zt} = 1, \text{ if } H/L_h \leq 0.2$$

**PER FIGURE 26.8-1**



Simpson Residence \_\_\_\_\_  
 Kzt Calculations \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

DATE 2/17/2022  
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 SHEET 4



Direction 1 - 0° to Site

Direction 2 - Site to 180°

Direction 3 - 270° to Site

Direction 4 - Site to 90°

**Site Conditions (26.8.1)**

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	Yes
5. H ≥ 15'	Yes

Kzt=1

**Site Conditions (26.8.1)**

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

**Site Conditions (26.8.1)**

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

**Site Conditions (26.8.1)**

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

**Terrain Data**

Terrain	Ridge
Top of Hill Dist.	-10135
Bott. of Hill Dist.	-5519
L @ H/2	-9339
Site	downwnd
Top of Hill Elev.	239
Bott. of Hill Elev.	16
Site Elev.	30.9
Site Dist.	0
H/2	128

**Terrain Data**

Terrain	Ridge
Top of Hill Dist.	-10135
Bott. of Hill Dist.	5678
L @ H/2	9286
Site	upwind
Top of Hill Elev.	239
Bott. of Hill Elev.	7
Site Elev.	30.9
Site Dist.	0
H/2	123

**Terrain Data**

Terrain	Ridge
Top of Hill Dist.	10242
Bott. of Hill Dist.	-9286
L @ H/2	-1645
Site	upwind
Top of Hill Elev.	457
Bott. of Hill Elev.	0
Site Elev.	30.9
Site Dist.	0
H/2	229

**Terrain Data**

Terrain	Ridge
Top of Hill Dist.	10242
Bott. of Hill Dist.	1751
L @ H/2	4139
Site	downwnd
Top of Hill Elev.	457
Bott. of Hill Elev.	3
Site Elev.	30.9
Site Dist.	0
H/2	230

**Kzt Calculations**

H=	224
Lh=	796
x=	10135
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.41
K2=	0.00
k3=	0.91
H/Lh =	0.28
Kzt =	1.00

**Kzt Calculations**

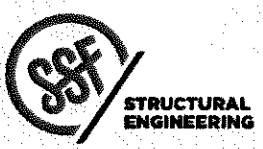
H=	232
Lh=	19421
x=	10135
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.02
K2=	0.65
k3=	1.00
H/Lh =	0.01
Kzt =	1.00

**Kzt Calculations**

H=	457
Lh=	11887
x=	10242
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.06
K2=	0.43
k3=	0.99
H/Lh =	0.04
Kzt =	1.00

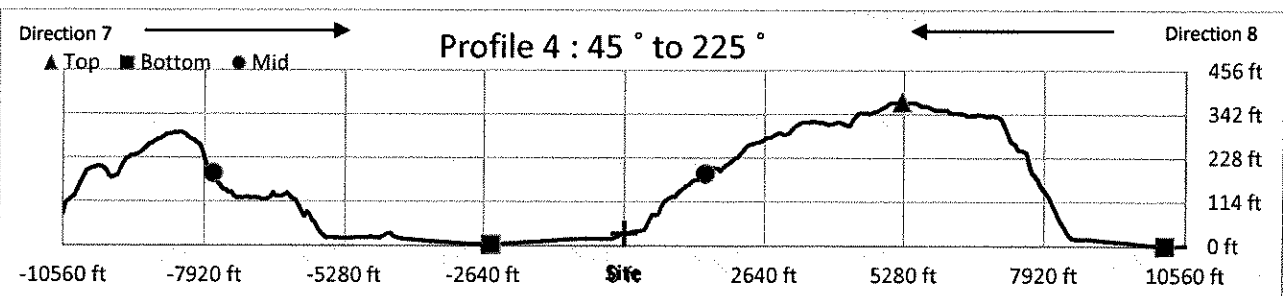
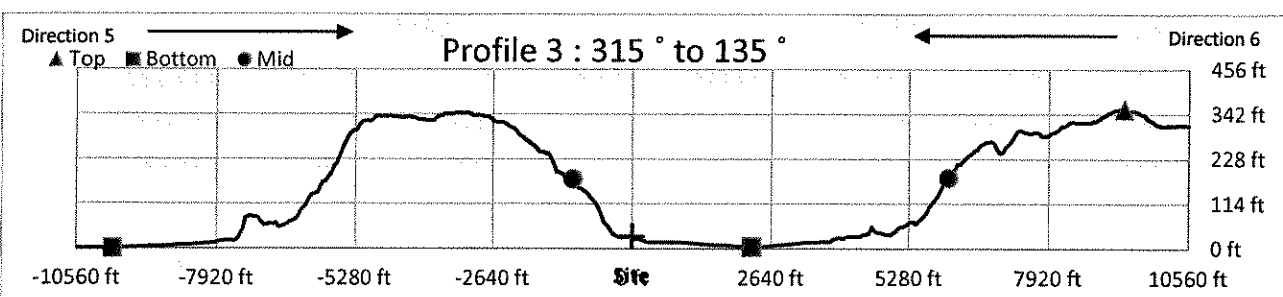
**Kzt Calculations**

H=	454
Lh=	6103
x=	10242
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.11
K2=	0.00
k3=	0.99
H/Lh =	0.07
Kzt =	1.00



Simpson Residence \_\_\_\_\_  
 Kzt Calculations \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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Direction 5 - 315° to Site

Direction 6 - Site to 135°

Direction 7 - 45° to Site

Direction 8 - Site to 225°

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	No
4. H/Lh ≥ 0.2	No
5. H ≥ 15'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	9339
Bott. of Hill Dist.	-9870
L @ H/2	-1114
Site	upwind
Top of Hill Elev.	355
Bott. of Hill Elev.	0
Site Elev.	30.9
Site Dist.	0
H/2	177

Terrain Data

Terrain	Ridge
Top of Hill Dist.	9339
Bott. of Hill Dist.	2282
L @ H/2	6049
Site	downwind
Top of Hill Elev.	355
Bott. of Hill Elev.	4
Site Elev.	30.9
Site Dist.	0
H/2	179

Terrain Data

Terrain	Ridge
Top of Hill Dist.	5253
Bott. of Hill Dist.	-2494
L @ H/2	-7748
Site	upwind
Top of Hill Elev.	373
Bott. of Hill Elev.	3
Site Elev.	30.9
Site Dist.	0
H/2	188

Terrain Data

Terrain	Ridge
Top of Hill Dist.	5253
Bott. of Hill Dist.	10189
L @ H/2	1539
Site	downwind
Top of Hill Elev.	373
Bott. of Hill Elev.	0
Site Elev.	30.9
Site Dist.	0
H/2	187

Kzt Calculations

H=	355
Lh=	10453
x=	9339
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.05
K2=	0.40
k3=	0.99
H/Lh =	0.03
Kzt =	1.00

Kzt Calculations

H=	351
Lh=	3290
x=	9339
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.15
K2=	0.00
k3=	0.98
H/Lh =	0.11
Kzt =	1.00

Kzt Calculations

H=	370
Lh=	13001
x=	5253
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.04
K2=	0.73
k3=	0.99
H/Lh =	0.03
Kzt =	1.00

Kzt Calculations

H=	373
Lh=	3714
x=	5253
z=	24
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.15
K2=	0.06
k3=	0.98
H/Lh =	0.10
Kzt =	1.00



Simpson Residence \_\_\_\_\_  
 Kzt Calculations \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_


DATE 2/17/2022  
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 SHEET 6

ROOF FRAMING

TYPICAL JOISTS L=13' MAX  
- 2x12 @ 24

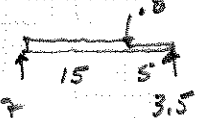
CHECK COLLAR TIE CONDITION

$M_{max} = .04(13^2/8)2' = 1.7k'$   
 $t = L = \frac{1.7(12)}{12} = 1.7k'$  use CS14  
 $T_a = 2.5k'$




**B1** L=8'  
 $w = .2k'$   
 $R = .8k'$   
 $f_3 = .61ksi$   
 $A = .08"$

**B2**  
 $w_1 = .04(9) = .36k'$   
 $w_2 = .04(3) = .12k'$   
 $M = 19k'$   
 $G L 5\frac{1}{2} \times 13\frac{1}{2}$   
 $f_3 = 1.37ksi$   
 $\Delta = .68" = \frac{1}{355}$

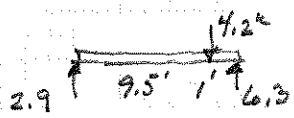


**B3** P=3.7k  
 $L = 12'$   
 $R = 1.9k$   
 $M = 11.1k'$   
 $G L 5\frac{1}{2} \times 9$  min  
 $f_3 = 1.79ksi$   
 $\Delta = .38" = \frac{1}{376}$

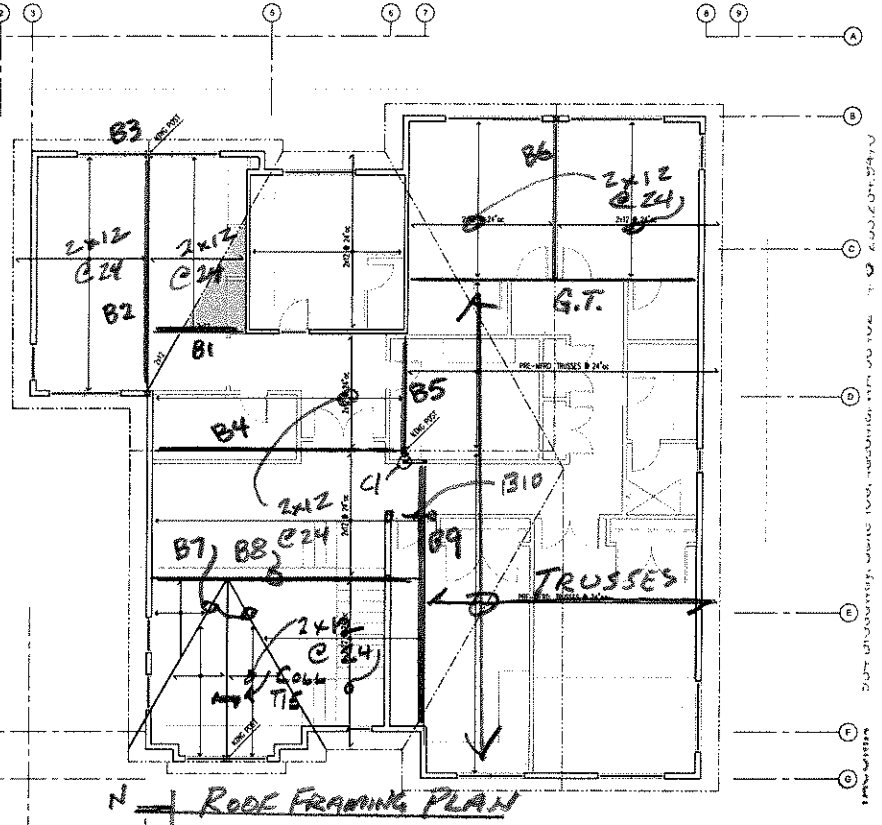


**B4** L=21'  
 $w = .04(\frac{20}{2}) = .4k'$   
 $R = 4.2k$   
 $M = 22.1k'$   
 $G L 5\frac{1}{2} \times 13\frac{1}{2}$  min  
 $f_3 = 1.58ksi$   
 $\Delta = .86" = \frac{1}{292}$


**B5**  
 $w = .04(12) = .48k'$   
 $M = 8.9k'$   
 $G L 5\frac{1}{2} \times 9$  min  
 $f_3 = 1.44ksi$   
 $f_v = 181psi$   
 $\Delta = .3" = \frac{1}{420}$



**B6** L=13'  
 $w = .04(12) = .48k'$   
 $R = 3.1k$   
 $M = 10.1k'$   
 $G L 3\frac{1}{2} \times 10\frac{1}{2}$   
 $f_3 = 1.89ksi$   
 $\Delta = .51" = \frac{1}{307}$

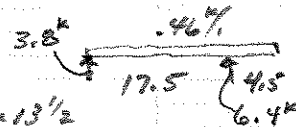


**B7 (VALLEYS)**  
 $w_{max} = .04(\frac{13 \times 12}{2}) / 1.25 = .4k'$   
 $M = 4k'$   
 $(2) 2 \times 12$   
 $f_3 = .95ksi$   
 $\Delta = .37" = \frac{1}{450}$

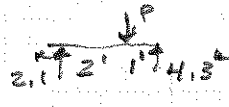


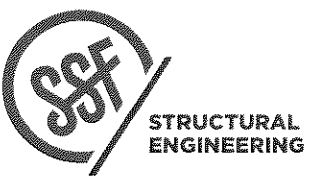
**B8** L=20'  
 $w_{avg} = .04(\frac{23}{2}) = .46k'$   
 $R = 4.6k$   
 $M = 23k'$   
 $G L 5\frac{1}{2} \times 13\frac{1}{2}$   
 $f_3 = 1.65ksi$   
 $\Delta = .82" = \frac{1}{294}$

**B9**  $M_+ = 15.4k'$   
 $M_- = 4.9k'$   
 $G L 5\frac{1}{2} \times 13\frac{1}{2}$   
 $f_3 = 1.1ksi$   
 $\Delta = .38" = \frac{1}{556}$   
 $\Delta = .27" = \frac{1}{400}$   
 FOR TAPERED END  $d = 6"$  min  $f_v = 171psi$



**B10** P=6.4k  
 $3\frac{1}{2} \times 12$   
 $f_v = 152psi$



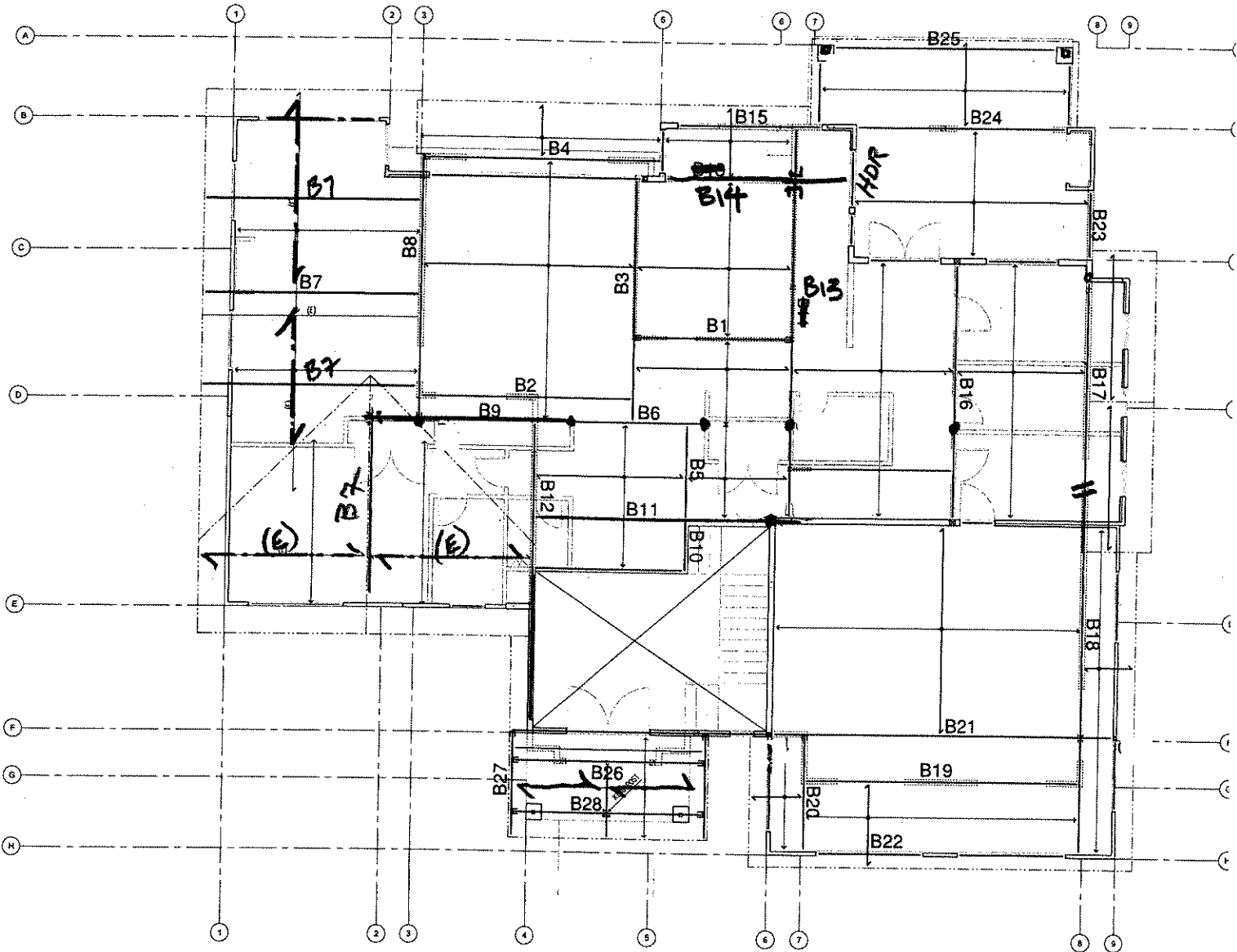


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DATE  
DESIGN  
SHEET 7



# UPPER FLOOR BEAM/KEY PLAN



Upper Floor Framing Plan  
Scale: 1/4" = 1'-0"



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DATE

PROJ

DESIGN

SHEET

8

UPPER FLOOR FRAMING

DL = 10 PSF LL = 40 PSF

MAX JOIST SPAN  $L = 20'$

14" TJI @ 16" oc

$W = (16"/12)(50 \text{ PSF}) = 67 \text{ PLF}$

$R = 0.7 \text{ K} \quad M = 3.4 \text{ K}'$

14" TJI 210 @ 16" oc

$M_a = 4.9 \text{ K}'$

$\Delta_{TL} = 0.50'' \quad 4/491$

**B1**  $L = 13.1'$

$W_{\text{roof}} = (23.25' / 2)(40 \text{ PSF}) = 407 \text{ PLF}$

$W_{\text{wall}} = (9.1')(10 \text{ PSF}) = 91 \text{ PLF}$

$R = 3.3 \text{ K}$

$M = 10.7 \text{ K}'$

LSL 3 1/2 x 14

$M_a = 21.8 \text{ K}'$

$\Delta_{TL} = 0.27'' \quad 4/591$

**B2**  $L = 18'$

$W_{\text{wall}} = (9.1')(15 \text{ PSF}) = 137 \text{ PLF}$

$P = 3.5 \text{ K}$

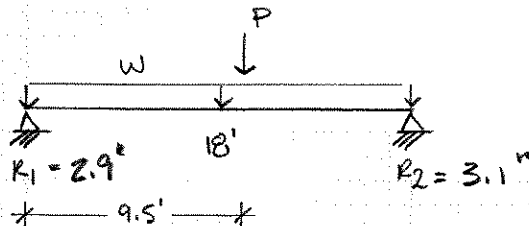
$R_1 = 2.9 \text{ K} \quad R_2 = 3.1 \text{ K}$

$M = 21.2 \text{ K}'$

FSL 3 1/2 x 14

$M_a = 27.1 \text{ K}'$

$\Delta_{TL} = 0.66'' \quad 4/328$



**B3**  $L = 20.5'$

$W_{\text{roof}} = (8.5' / 2)(30 \text{ PSF}) = 128 \text{ PLF (RED)}$

$W_{\text{wall}} = 91 \text{ PLF}$

$W_{\text{FLR}} = (31.1' / 2)(40 \text{ PSF}) = 622 \text{ PLF (RED)}$

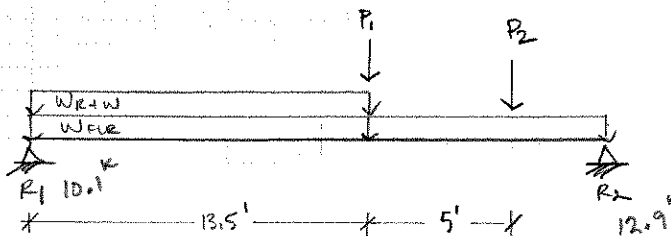
$P_1 = 4.1 \text{ K} \quad P_2 = 3.1 \text{ K}$

$R_1 = 10.1 \text{ K} \quad R_2 = 12.9 \text{ K}$

$M = 60.2 \text{ K}'$

W12 x 26

$\Delta_{TL} = 0.76'' \quad 4/324$



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PROJECT

GRAVITY

DATE

PROJ. #

MAB

DESIGN

9

SHEET

UPPER FLOOR CONT...

**B4** L = 20'

W<sub>wall</sub> = 137 PLF

P = 1.9 K

W<sub>LOW ROOF</sub> = (4.75')(40 PSF) = 167 PLF

R<sub>1</sub> = 5.1 K

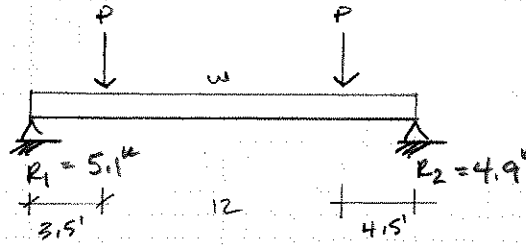
R<sub>2</sub> = 4.9 K

M = 22.8 K'

PSL 5/4 x 14

M<sub>a</sub> = 40.7 K'

Δ<sub>TL</sub> = 0.72" L/336



**B5** L = 8'

W = (21.3' / 2)(50 PSF) = 533 PLF

R = 2.2 K

M = 4.3 K'

LSL 1 3/4 x 14 Δ = 0.08" L/1215

**B6** L = 11'

P<sub>1</sub> = 12.9 K P<sub>2</sub> = 2.2 K

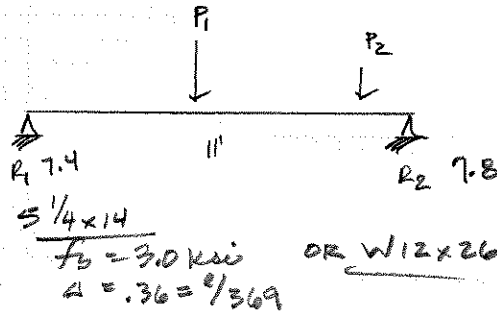
R<sub>1</sub> = 7.4 K R<sub>2</sub> = 7.8 K

M = 37 K'

W12 x 14 (ACCEPT STEEL B3)

M<sub>a</sub> = 43.4 K'

Δ<sub>TL</sub> = 0.26" L/520



**B7** L = 18' (CONTROLLING "RIDGE" BM. TO SUPPORT (E) ROOF FRAMING)

W = (15.5' / 2)(40 PSF) = 272 PLF

R<sub>1</sub> = 2.9 K R<sub>2</sub> = 2.1 K

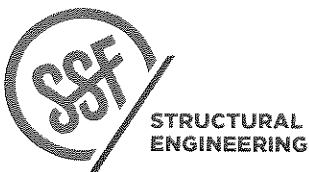
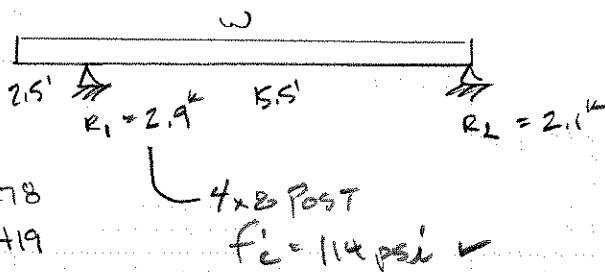
M = 7.75 K'

GL 3 1/2 x 11/4

f<sub>b</sub> = 1260 PSI

Δ<sub>TL</sub> = -0.22" @ CANT. L/278

Δ<sub>TL</sub> = 0.44" @ SPAN L/419



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PROJECT

GRAVITY

DATE

PROJ. #

MAB

DESIGN

10

SHEET

UPPER FLOOR FRAMING CONT...

**B8** L = 22'

$W_{ROOF} = 200 \text{ PLF}$

$W_{WALL} = 137 \text{ PLF}$

$W_{FLR} = (18' / 2) (10 + 35 \text{ PSF}) = 360 \text{ PLF}$

$P_1 = 5.1 \text{ K}$     $P_2 = 1.8 \text{ K}$     $P_3 = 2.9 \text{ K}$

$R_1 = 12.8 \text{ K}$     $R_2 = 8.1 \text{ K}$

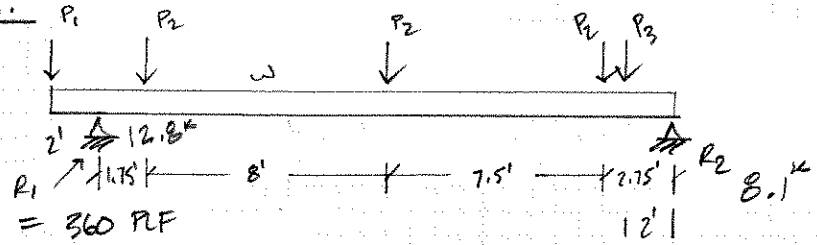
$M = 27.1 \text{ K}'$

PSL 5/4 x 14

$M_a = 40.7 \text{ K}'$

$\Delta_{TL} = -0.20''$  @ CANT. 2L / 250

$\Delta_{TL} = 0.78''$  @ SPAN 4 / 310



OR W12x26

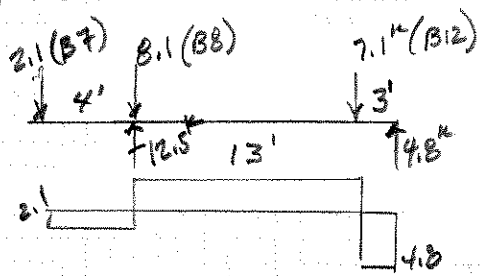
**B9**

$M_+ = 14.4 \text{ K}'$

$M_- = 8.4 \text{ K}'$

W12x26

$F_3 = 5.2 \text{ K}$



**B10** L = 4.3'

$W = (12.75' / 2) (50 \text{ PSF}) = 319 \text{ PLF}$

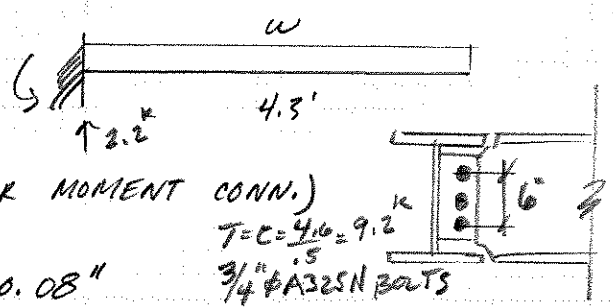
$R = 2.2 \text{ K}$

$M = 4.6 \text{ K}'$

W12x16 (SIZE TO BE WELDED FOR MOMENT CONN.)

$\Delta_{TL} = \frac{(0.495 \text{ KLF} / 12) (4.3 \times 12)^4}{8 (29,000 \times 103)} = 0.08''$

$+ W_{stairs} = (3.5') (50 \text{ PSF}) = 175 \text{ PLF}$



**B11** L = 19.75'

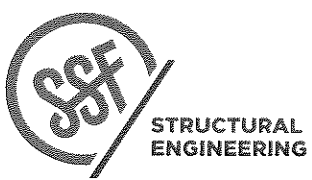
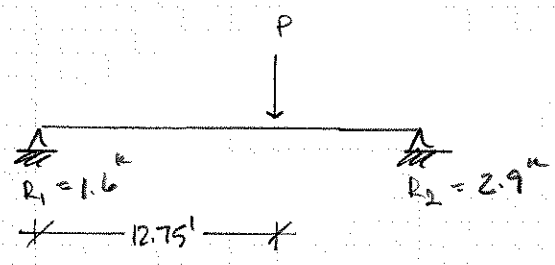
$P = 2.2 + 2.2 \text{ K} = 4.4 \text{ K}$

$R_1 = 1.6 \text{ K}$     $R_2 = 2.9 \text{ K}$

$M = 19.9 \text{ K}'$

W12x16 (SIZED FOR WELD)

$\Delta_{TL} = 0.37''$  4 / 649



SIMPSON RESIDENCE

PROJECT: GRAVITY

DATE: \_\_\_\_\_

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DESIGN: \_\_\_\_\_

SHEET: 11

UPPER FLOOR FRAMING CONT...

**B12** L = 15.3'

$P_1 = 3.6K$  (RED.)  $P_2 = 1.6K$   $P_3 = 4.0K$

$W_{wall} = 137$  PLF

$W_{FLR} = (12.75'/2)(10+30) = 255$  PLF

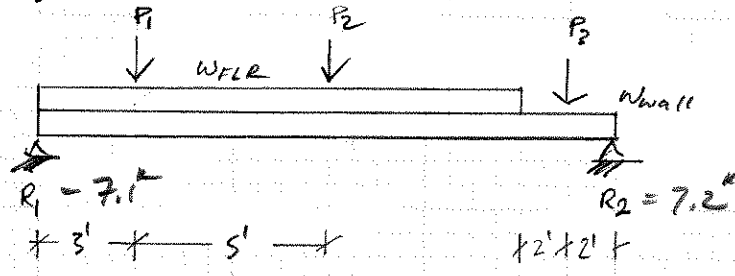
$R_1 = 7.1K$   $R_2 = 7.2K$

$M = 25.8K'$

W12 x 16

$\Delta_{TL} = 0.36"$  L/519

OR PSL 5 1/4 x 14  $\Delta = .41" = 1/446$  (USE CONTINUOUS OVER NEW EXT WALL)



**B13** 2-SPAN BEAM

$W_1 = 1.22K$  (AVG) (RF + FLOOR)

$W_2 = .54K$

$P = 6.4K$  (RF)

$M_+ = 40K'$

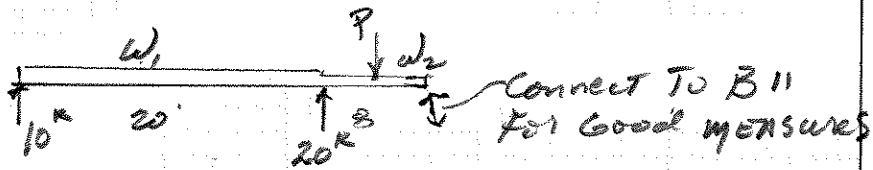
$M_- = 43K'$

W12 x 26

$f_b = 15.5$  ksi max

$\Delta_+ = .42" = 1/574$

$\Delta_- = .07" = 22/2400$



**B14**  $W = .3K$

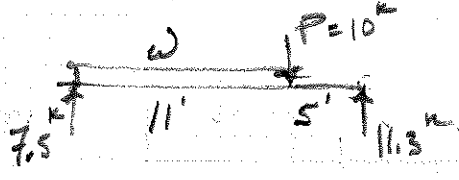
$P = 10K$

$M = 50K'$

PSL 7 x 14

$f_b = 2.6$  ksi

$\Delta = .57" = 1/335$



Hor Supporting B14

$W = .05(10) = .6K$

$R = 7.5K$

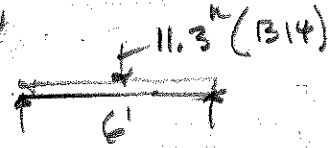
$M = 20K'$

GL 5 1/2 x 12

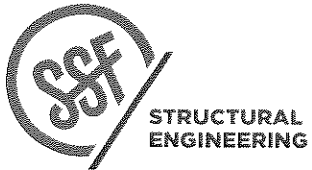
$f_b = 1.79$  ksi

$f_c = 156$  psi

$\Delta = .07" = 1/974$



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 934 Broadway, Suite 100, Tacoma, WA 98402  
 SEATTLE TACOMA  
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 253.284.9470



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PROJECT GRAVITY

DATE

PROJ # MAB

DESIGN 12

SHEET

B15 L = 12.0'

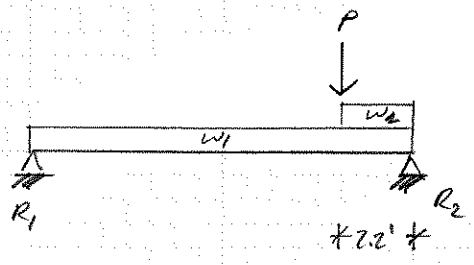
$W_1 = (5') (40 \text{ PSF}) = 200 \text{ PLF}$

$P = 3 \text{ K}$

$W_2 = 137 \text{ PLF (Wall)}$

$M = 7.9 \text{ K}'$

6x10 min  
 $f_b = 1.15 \text{ ksi}$   
 $f_t = 105 \text{ psi}$   
 $\Delta = .33" = \frac{2}{43}$



B16 L = 21.5'

$W = (24.7' / 2) (50 \text{ PSF}) = 620 \text{ PLF}$

$R_1 = 3.5 \text{ K}$     $R_2 = 9.0 \text{ K}$     $R_3 = 1.2 \text{ K}$

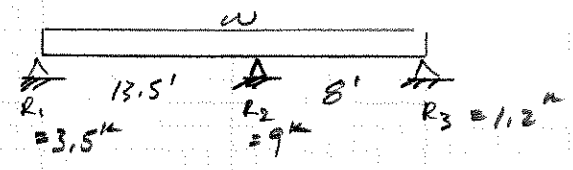
$M_{(L)} = 10.9 \text{ K}'$     $M_{(H)} = 9.47 \text{ K}'$

LSL 5 1/2 x 14 min

$M_a = 21.8 \text{ K}'$

$\Delta_{TL} = 0.22" @ \text{SPAN 1 } 4/765$

$\Delta_{TL} = -0.02" @ \text{SPAN 2}$



B17 L = 17'

$w = .04(14) + .1 = .66 \text{ PLF}$

$R = 5.6 \text{ K}$

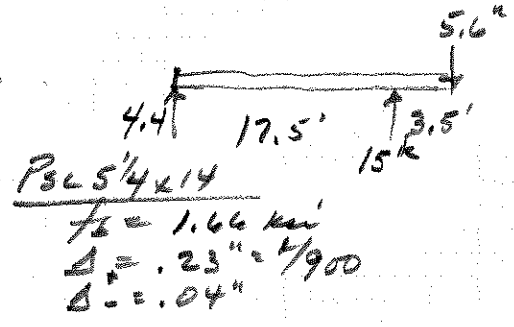
$M = 23.8 \text{ K}'$

PSL 5 1/4 x 14

$f_b = 1.67 \text{ ksi}$   
 $\Delta = .47" = \frac{2}{434}$

B18  $w = .66 \text{ PLF}$

$M^+ = 15 \text{ K}'$   
 $M^- = 24 \text{ K}'$



PSL 5 1/4 x 14

$f_b = 1.66 \text{ ksi}$   
 $\Delta = .23" = \frac{4}{900}$   
 $\Delta_s = .04"$

B19 L = 23'

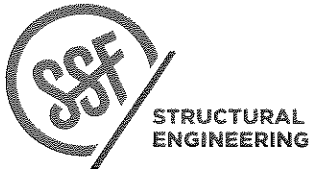
$W = 100 \text{ (low roof)} + 80 \text{ (hr)} + 137 \text{ (wall)} = 317 \text{ PLF}$

$R = 3.7 \text{ K}$

$M = 21.1 \text{ K}'$

PSL 5 1/4 x 14

$\Delta_{TL} = 0.85" \quad 4/328$



SIMPSON RESIDENCE

PROJECT GRAVITY

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DATE \_\_\_\_\_

PROJ. # MAB

DESIGN 13

SHEET \_\_\_\_\_

B20 L=10'

W<sub>1</sub> = 50 PLF (LOW ROOF)

W<sub>2</sub> = 428 PLF (ROOF)

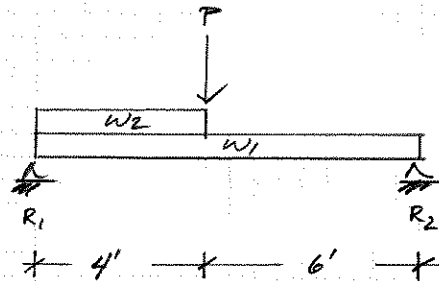
P = 3.7K

R<sub>1</sub> = 3.9K R<sub>2</sub> = 2.1K

M = 11.5K'

LSL 3 1/2 x 14 MIN

Δπ = 0.14" / 870



B21 L=28.5'

W<sub>1</sub> = (9')(50 PSF) + 160 PLF = 610 PLF

W<sub>2</sub> = 745 PLF

P<sub>1</sub> = 3.9K (RED.) P<sub>2</sub> = 9.4K (RED.)

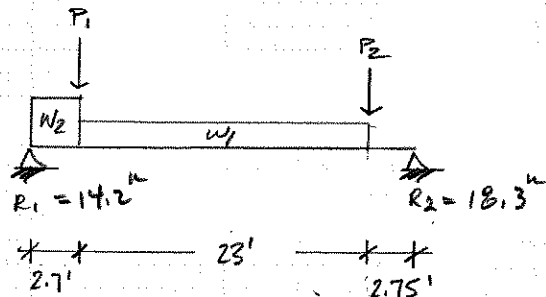
R<sub>1</sub> = 14.2K R<sub>2</sub> = 18.3K

M = 80.8K'

W12 x 50 MIN

M<sub>a</sub> = 179K'

Δπ = 1.2" / 297



B22 L=9' (GARAGE HDR.)

W = 200 PLF

R = 0.9K M = 2.1K'

DF 4 x 8 MIN

f<sub>b</sub> = 794 psi Δπ = 0.16" / 692

B23 L=6'

W = 183 (roof) + 400 (Av.) + 137 (wall) = 720 PLF (red.)

R = 2.2K M = 3.3K'

DF 4 x 10

f<sub>b</sub> = 780 psi Δπ = 0.106" (USE CONT. RIM)  
14" DEEP

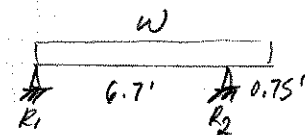
UPPER LEVEL DECK TOIST

L = 7.5'

W = (1.33')(15 + 60 BF) = 100 PLF

M = 0.82K'

2 x 8 @ 16" OC. OK f<sub>b</sub> = 498 psi ΔOK (USE TAPERED 2 x 12 JOISTS)



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PROJECT

GRAVITY

DATE

PROJ #

MAB

DESIGN

14

SHEET

B24 L = 17.5' DECK

$W_D = 137 \text{ (wall)} + (6.7' / 2) (15 \text{ PSF}) = 188 \text{ PLF}$

$W_L = (6.7' / 2) (60 + 20) (0.75) = 201 \text{ PLF}$

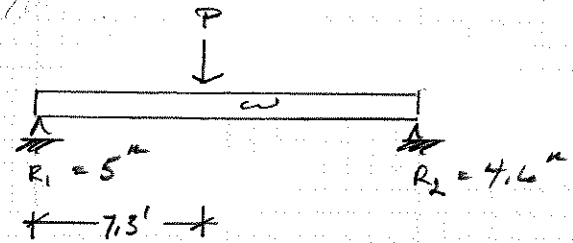
$P = 2.7 \text{ K (RED.)}$

$R_1 = 5.0 \text{ K} \quad R_2 = 4.6 \text{ K}$

$M = 26 \text{ K'}$

PSL 5/4 x 14

$M_a = 40.7 \text{ K'} \quad \Delta_{TL} = 0.56" \quad \checkmark / 380$



B25 L = 18.6' (CDECK EDGE BM.)

$W_D = 51 \text{ PLF} \quad W_L = 201 \text{ PLF}$

$R = 2.4 \text{ K}$

$M = 10.9 \text{ K'}$

GL 5/8 x 10 1/2

$f_b = 1390 \text{ psi} \quad \Delta_{TL} = 0.76" \quad \checkmark / 293 \quad (\text{use } 5'4 \times 11'8 \text{ PSL})$

B26 L = 16.2' (BM. @ ENTRY POOL COVERING)

$W_1 = 150 \text{ PLF (wall)}$

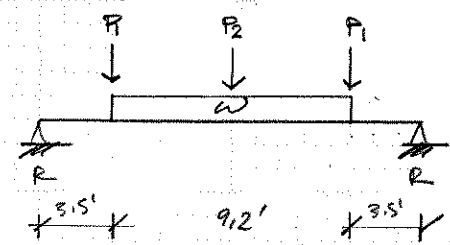
$P_1 = 0.6 \text{ K} \quad P_2 = 0.5 \text{ K}$

$R = 1.6 \text{ K}$

$M = 8.2 \text{ K'}$

GL 5 1/2 x 9

$f_b = 1314 \text{ psi} \quad \Delta_{TL} = 0.62" \quad \checkmark / 316$



B27 L = 8.75' (EDGE BM. @ ENTRY DOOR COV.)

$W = (4.1') (35 \text{ PSF}) = 145 \text{ PLF}$

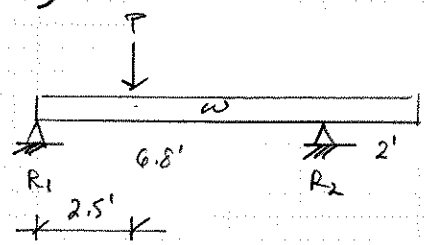
$P = 1.6 \text{ K}$

$R_1 = 1.5 \text{ K} \quad R_2 = 1.4 \text{ K}$

$M = 3.2 \text{ K'}$

DF 4 x 10

$f_b = 772 \text{ psi} \quad \Delta \text{ OK}$



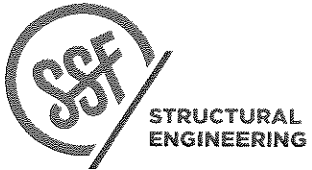
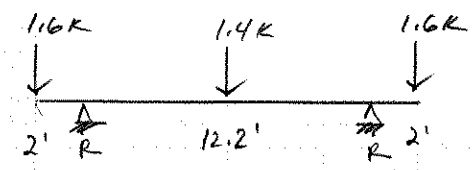
B28 L = 16.2' (BM @ ENTRY DOOR COVERING)

$R = 2.3 \text{ K}$

$M_{(-)} = 3.2 \text{ K'} \quad M_{(+)} = 1.1 \text{ K'}$

DF 4 x 10 min

$f_b = 769 \text{ psi} \quad \Delta \text{ OK}$



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# PIPE PILE DESIGN

FILE OPTIONS		Follow
2" $\phi$		6"
3" $\phi$		12"
4" $\phi$		20"

NOTES: - PILES DRIVEN TO REFUSAL  
 - WHERE PILES ARE PLACED  
 DIRECTLY BELOW FND'S, FULL  
 VALUE IS ALLOWED

CHECK DESIGN OF  
 PILES IN BENDING WHEN PILES  
 ARE OFFSET FROM FND WALL

WHEN ALL ECC IS TAKEN OUT BY PILE  
 BOLTS ARE IN SIMPLE STEAR

4"  $\phi$  PIPE Sch 40  $Z_x = 4.31 \text{ in}^3$   
 $M_a = 35(.67)(4.31) = 100 \text{ k"}$   
 $P_a = \frac{100 \text{ k}}{10} = 10.0 \text{ k}$

(4) 5/8"  $\phi$  TITEN HD @ 8" CENTERS

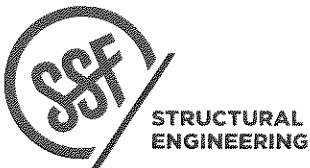
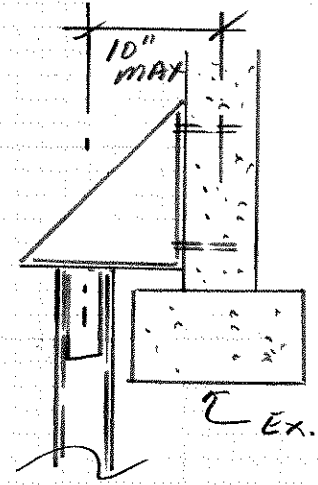
$V = 2.5 \text{ k/BOLT}$

For  $f_c' = 3 \text{ ksi}$   $V_a = 3.4 \text{ k/BOLT}$  ✓

& Embed = 4 1/8" (Ref Simpson C-A-2016)

OKAY TO SUBSTITUTE Exp BOLTS  
 OR EPOXY RODS w/ SAME Embedment

USE 4"  $\phi$  DRIVEN PILES THROUGHOUT



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DATE

DESIGN

SHEET

16

**FOUNDATIONS (4" PILES)**

**GARAGE SLAB (8")**

$w_{LL} = 40 \text{ psf}$   
(USE 100 psf FOR SLAB DESIGN)

$w_u = .12 + .16 = .28 \text{ k/ft}$   
 $M_u = \frac{.28(10)^2}{9} = 3.1 \text{ k'}$

W/ REINF CENTERED  
 $d = 4"$

$A_s = .18 \text{ in}^2$   
USE #5 @ 12 E.W. AND ADD (4) #5 TOP OVER PILES

PILES IN GARAGE  
 $P_{MAX} = .14(10)^2(1.25) = 18 \text{ k}$

(1) 4"  $\phi$  PILE,  $P_a = 20 \text{ k}$

WORST CASE LOADING AROUND GARAGE PERIMETER W/  $P = 18.3 \text{ k}$

$P_{TOT} = 18.3 \text{ k} + 1.2(\frac{3}{8})(8) + .5(8) = 28 \text{ k}$   
(2 PILES 3' APART CENTERED ON COL)

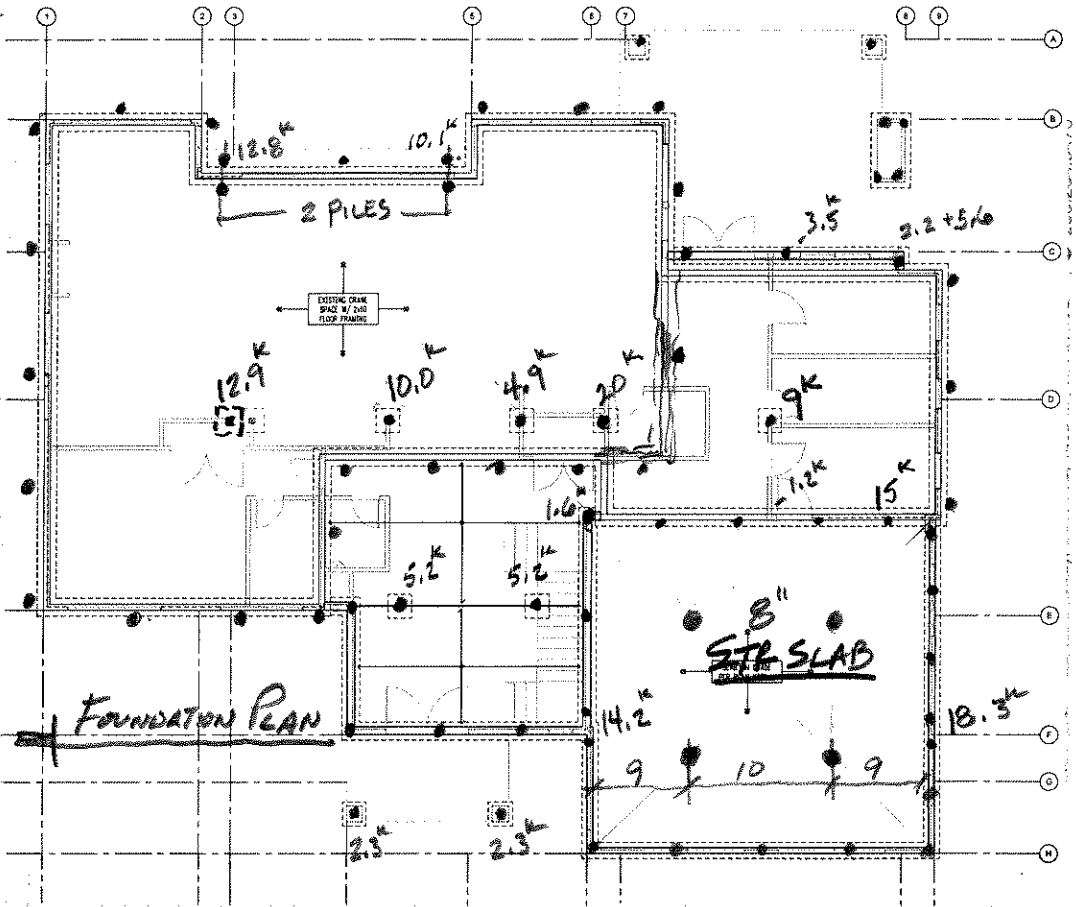
OTHER PILES AROUND GARAGE

$w_{MAX} = .2(9)(\frac{3}{8}) + .5 + .3 = 1.5 \text{ k/ft}$   
SLAB FTG MISS WALL

SAY 8' @ MAX,  $P = 12 \text{ k}$  ✓

OTHER PILES AROUND PERIMETER OF EXISTING FOUNDATIONS

$P_{MAX} = 3.5 + (.5 + .1 + .5)8 = 12.3 \text{ k}$  1-PILE  
BM FOR WALL END (CONCENTRIC)  
GRID C

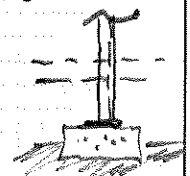


OTHER FND'S W/O POINT LOADS  
USE 4"  $\phi$  PILES @ 8' @ MAX  
 $w_{ALLOW} = \frac{10 \text{ k}}{8'} = 1.25 \text{ k/ft}$

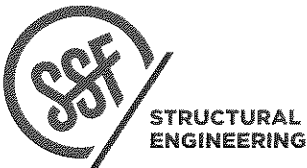
**STEEL COLUMNS**

MAX HT = 10' + 1' FLOOR + 3' CRAWL = 14'

3 x 3 x 1/4	16 k
3 x 3 x 3/8	20 k
3 1/2 x 3 1/2 x 1/4	26.8
3 1/2 x 3 1/2 x 3/8	34.6



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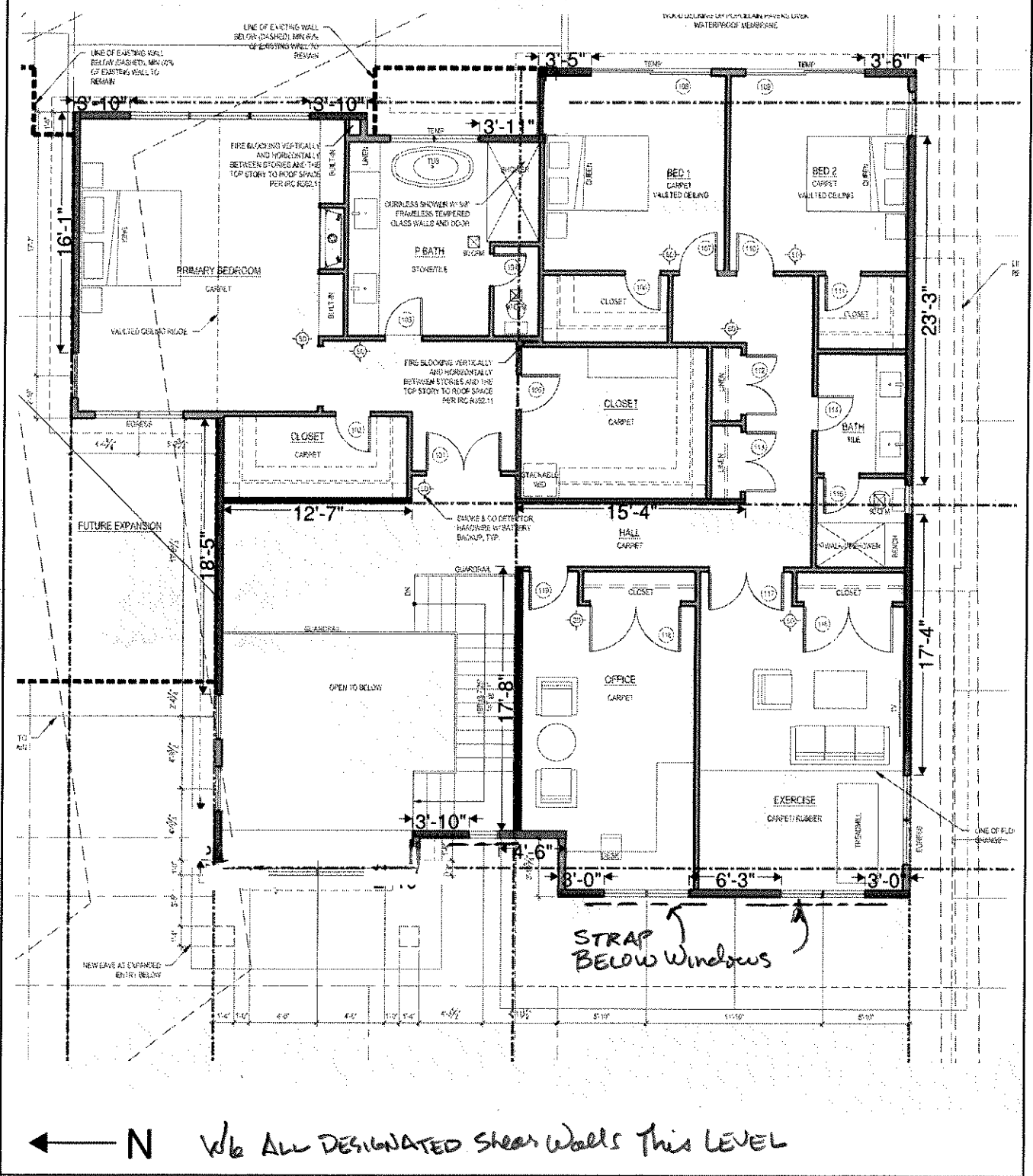
DATE

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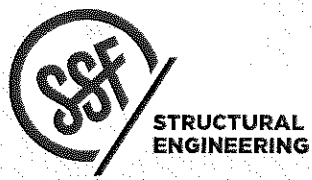
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17

# UPPER FLOOR SHEARWALL KEY PLAN



← N W/6 ALL DESIGNATED Shear Walls This LEVEL



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DATE \_\_\_\_\_

PROJ. # **MAB**

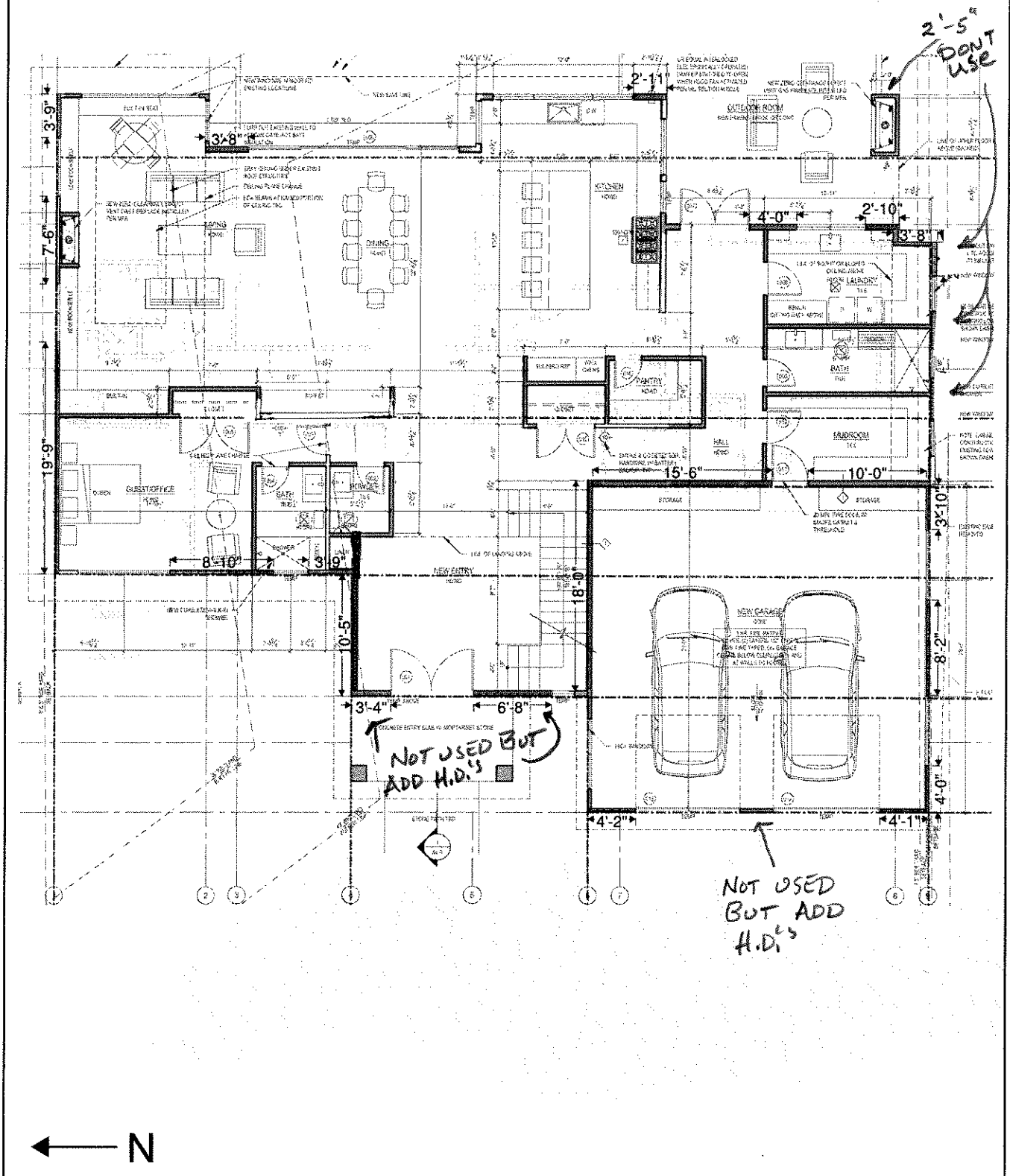
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SHEET **18**

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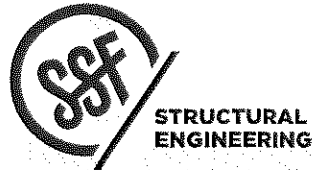
# MAIN FLOOR SHEARWALL KEY PLAN



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PROJ. #	MAB
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SHEET	

LATERAL DESIGN: WIND

REFER TO WIND CRITERIA SHEET FOR THE WIND PRESSURE VALUES

**NORTH ELEVATION (N-S) DIRECTION**

ROOF LEVEL :  $P_{WIND} = 13 \text{ PSF}$   
 $A_{TRIB} = 676 \text{ SF}$   
 TOT. FORCE = 8788 #  
 LENGTH OF DIAPHRAGM = 55.25'  
 $F_{DIA.} = \underline{160 \text{ PLF}}$

LEVEL 2 :  $P_{WIND} = 13 \text{ PSF}$   
 $A_{TRIB} = 687 \text{ SF}$   
 TOT. FORCE = 8931 #  
 $L_{DIA.} = 61.25'$   
 $F_{DIA.} = \underline{146 \text{ PLF}}$

$V_{BASE} = 17.8 \text{ K}$

**WEST ELEVATION (E-W) DIRECTION**

ROOF LEVEL :  $P_{WIND} = 13.3 \text{ PSF}$   
 $A_{TRIB} = 617 \text{ SF}$   
 TOT. FORCE = 8207 #  
 $L_{DIA.} = 56.25'$   
 $F_{DIA.} = \underline{146 \text{ PLF}}$

LEVEL 2 :  $P_{WIND} = 13.3 \text{ PSF}$   
 $A_{TRIB} = 787 \text{ SF}$   
 TOT. FORCE = 10,468 #  
 $L_{DIA.} = 74.5'$   
 $F_{DIA.} = \underline{141 \text{ PLF}}$

$V_{BASE} = 18.7 \text{ K}$



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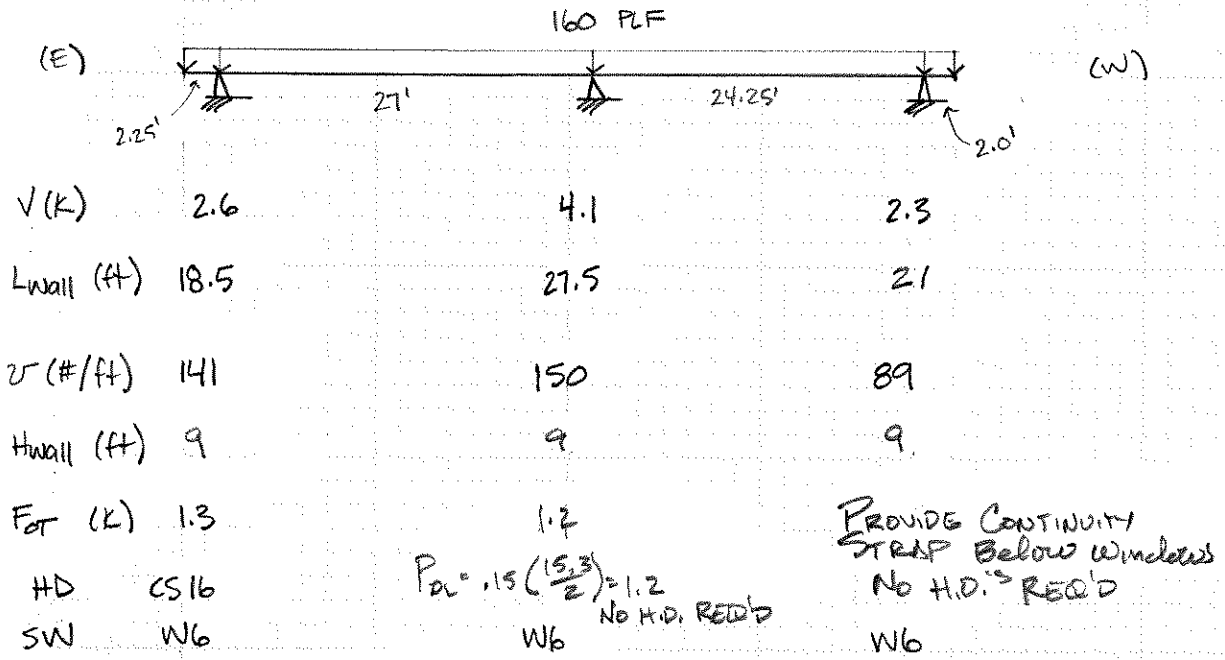
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 PROJ. # MAB  
 DESIGN 20  
 SHEET

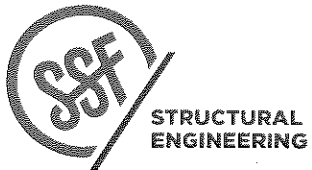
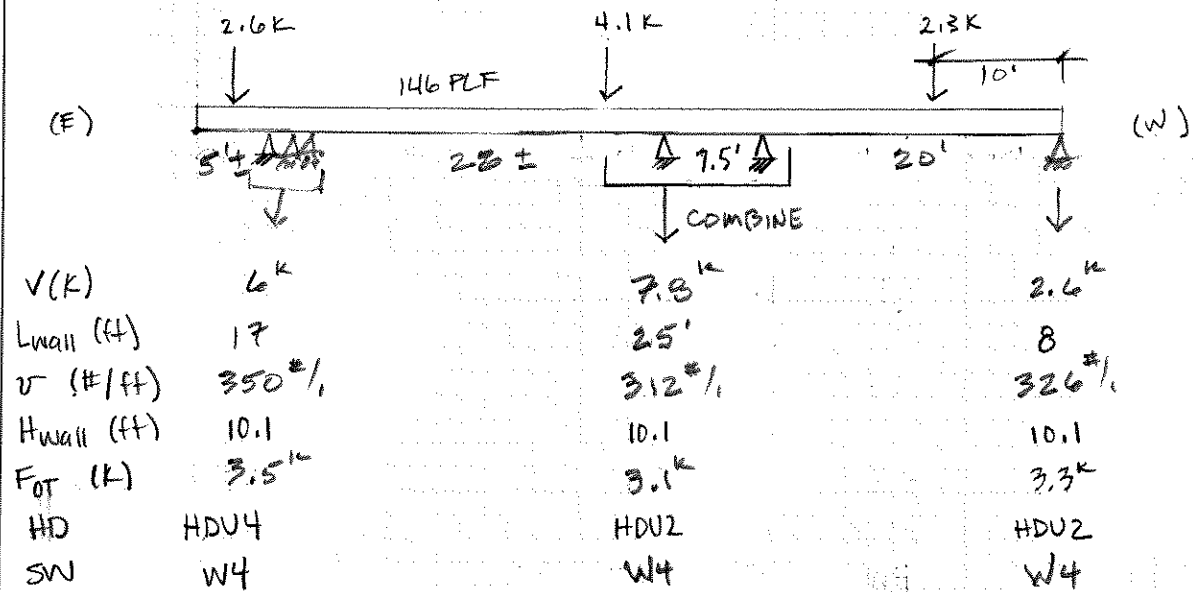
**LOAD DISTRIBUTION**

N-S DIRECTION:

ROOF LEVEL L<sub>DIA.</sub> = 55.25'



LEVEL 2 L<sub>DIA.</sub> = 61.25'



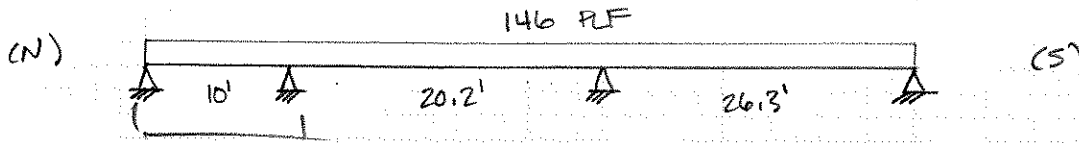
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DATE  
 PROJ. # MAB  
 DESIGN 21  
 SHEET

E-W DIRECTION:

ROOF LEVEL

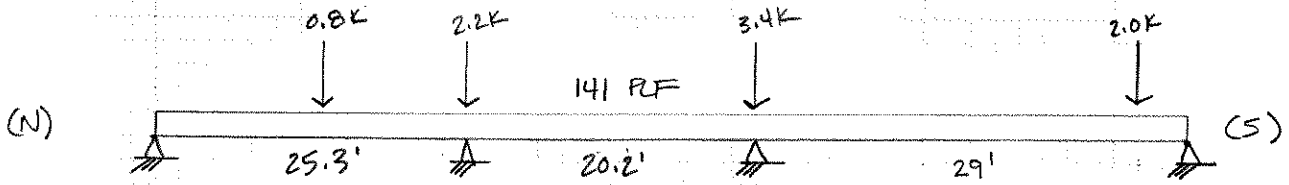
L<sub>DIA.</sub> = 56.25'



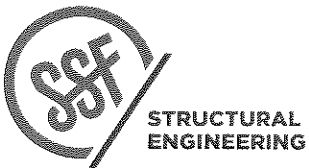
V(K)	3 <sup>k</sup>	3.4	2.0
L <sub>wall</sub> (ft)	24.5'	17.7'	40.5
V (#/ft)	122 <sup>#</sup> /1	192 <sup>#</sup> /1	50
H <sub>wall</sub> (ft)	9'	9.1	9.1
F <sub>OT</sub> (K)	Long Walls No H.D.'s REQ'D	1.7 <sup>k</sup>	Long Walls No H.D.'s REQ'D
HD	-	HDU2 @ CS16	-
SW	W6 W6	W6	W6

LEVEL 2

L<sub>DIA.</sub> = 74.5'



V(K)	2.1	5.9	7.1	3.9
L <sub>wall</sub> (ft)	31	10.5	18	16'
V (#/ft)	68	562 <sup>#</sup> /1	395	244 <sup>#</sup> /1
H <sub>wall</sub> (ft)	10.1	10.1	10.1	10.1
F <sub>OT</sub> (K)	Low shears No H.D.'s REQ'D	5.6 <sup>k</sup> - D.L. ≈ 4 <sup>k</sup> max	4.0	2.5 <sup>k</sup>
HD	-	HDU4	TIE TO HSS COLUMN EX END	HDU2
SW	W6	W2	W4	W6



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DATE

PROJ # MAB

DESIGN 22

SHEET

## SW Schedule : 3/4" Floor Sheathing (HEM-FIR)

Mark	Controlling		Sheathing
	Capacity		
	V <sub>s</sub>	V <sub>w</sub>	
W6	242	264	15/32" CDX PLYWOOD
W4	353	396	15/32" CDX PLYWOOD
W3	456	527	15/32" CDX PLYWOOD
W2	595	767	15/32" CDX PLYWOOD
2W3	911	1150	15/32" CDX PLYWD. EA. SIDE
2W2	1187	1187	15/32" CDX PLYWD. EA. SIDE
2W2-10	1432	1582	15/32" CDX PLYWD. EA. SIDE

NOT USED

Mark	Panel Edge Nailing		
	Type	Capacity	
		V <sub>s</sub>	V <sub>w</sub>
W6	8d @ 6" oc	242	339
W4	8d @ 4" oc	353	495
W3	8d @ 3" oc	456	637
W2	8d @ 2" oc	595	832
2W3	8d @ 3" oc EA. SIDE	911	1274
2W2	8d @ 2" oc EA. SIDE	1190	1665
2W2-10	10d @ 2" oc EA. SIDE	1432	2004

NOT USED

Mark	Top Plate Connection			
	Type	Capacity	Type	Capacity
	TJI	ASD	2x or LSL	ASD
W6	16d @ 6" oc	285	A35/LTP4 @ 24" oc	288
W4	16d @ 4" oc	427	A35/LTP4 @ 16" oc	431
W3	(2)rows 16d @ 4" oc	854	A35/LTP4 @ 12" oc	575
W2	(2)rows 16d @ 4" oc	854	A35/LTP4 @ 9" oc	767
2W3	n/a	-	A35/LTP4 @ 6" oc	1150
2W2	n/a	-	HGA10KT @ 8" oc	1260
2W2-10	n/a	-	HGA10KT @ 6" oc	1680

NOT USED

Mark	Base Plate Connection			
	At Wood	Capacity	At Concrete	Capacity
		ASD		ASD
W6	16d @ 6" oc	264	5/8" DIA A.B. @ 48" oc	344
W4	16d @ 4" oc	396	5/8" DIA A.B. @ 32" oc	516
W3	(2)rows 16d @ 6" oc	527	5/8" DIA A.B. @ 24" oc	688
W2	(2)rows 16d @ 4" oc	791	5/8" DIA A.B. @ 16" oc	1032
2W3	(3)rows 16d @ 4" oc	1187	5/8" DIA A.B. @ 16" oc	1284
2W2	(3)rows 16d @ 4" oc	1187	5/8" DIA A.B. @ 12" oc	1712
2W2-10	(4)rows 16d @ 4" oc	1582	5/8" DIA A.B. @ 12" oc	1712

NOT USED



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