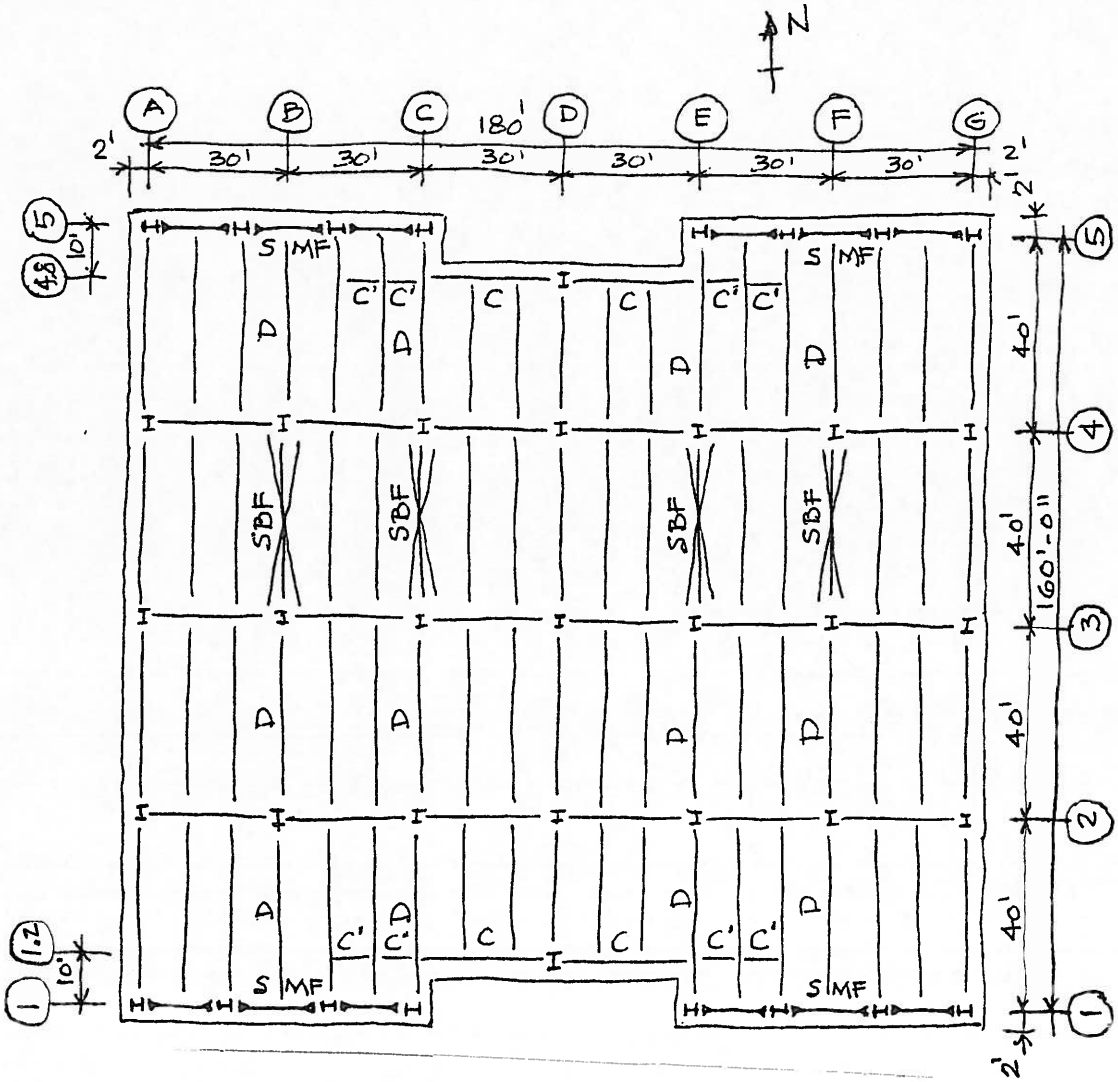
Assignment #13

Using the building in Assignment #7:

1. Find the Max. Drag (D) Force to the SBF for typical floors (2nd - 5th)
2. Find the Max Chord (C) Force for N-S seismic forces.
3. Find the Max. Diaphragm shear (#/ft.) and required 3/4" ϕ stud spacing.
4. For chord Members C', how many studs are required



Determine Earthquake Forces Multi-Story Building

Steel Special Braced Frames - Assignment #13 - 2017

Ss =	2.637
S1 =	0.928
Fa =	1.000
Fv =	1.500
S_{MS} =	2.637
S_{M1} =	1.392
S_{DS} =	1.758
S_{D1} =	0.928

Risk Category II
Seismic Design Category D
Building Period $T_a = C_t h_n^x$

C_t =	0.020
h_n (ft) =	75.00
x =	0.75
T_a (sec) =	0.510
k =	1.005

C_U =	1	T (sec) =	0.510
R =	6	ρ =	1
I =	1		

$C_s = S_{DS}/(R/I)$ =	0.2930	Eq. 12.8-2
C_s (max) = $S_{D1}/T/(R/I)$ =	0.3034	Eq. 12.2-3
$C_s(min)=0.5S_{D1}/(R/I)$ =	0.0773	Eq. 12.8-6 IF $S_1>=0.6$
C_s =	0.2930	
V (kips) =	4031.7	

Story	hx	Wx	$w_x h_x^k$	Fx	Vx	C=Fx/Wx	Wpx	Sum Fx	Sum Wpx	Fpx	Fpx(min)	C=Fpx/Wpx
Roof	75	2824	216288	1375.6	1375.6	0.4871	2824	1375.6	2824	1375.6	992.9	0.487
5th Floor	60	2734	167335	1064.3	2439.9	0.3893	2734	2439.9	5558	1200.2	961.3	0.439
4th Floor	45	2734	125326	797.1	3237.0	0.2916	2734	3237.0	8292	1067.3	961.3	0.390
3rd Floor	30	2734	83386	530.4	3767.4	0.1940	2734	3767.4	11026	934.2	961.3	0.352
2nd Floor	15	2734	41553	264.3	4031.7	0.0967	2734	4031.7	13760	801.1	961.3	0.352
		13760	633887	4031.7								

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Determine Earthquake Forces Multi-Story Building

Steel Special Moment Frames - Assignment #13 - 2017

Ss =	2.637
S1 =	0.928
Fa =	1.000
Fv =	1.500
S_{MS} =	2.637
S_{M1} =	1.392
S_{DS} =	1.758
S_{D1} =	0.928

Risk Category II

Seismic Design Category D

Building Period $T_a = C_t h_n^x$

C_t =	0.028
h_n (ft) =	75.00
x =	0.80
T_a (sec) =	0.886
k =	1.193

C_u =	1.4	T (sec) =	1.240
R =	8	ρ =	1
I =	1		

$C_s = S_{DS}/(R/I)$ =	0.2198	Eq. 12.8-2
C_s (max) = $S_{D1}/T/(R/I)$ =	0.0936	Eq. 12.2-3
$C_s(min)=0.5S_{D1}/(R/I)$ =	0.0580	Eq. 12.8-6 IF S_1>=0.6
Cs =	0.0936	
V (kips) =	1287.5	

Story	hx	Wx	$w_x h_x^k$	Fx	Vx	C=Fx/Wx	Wpx	Sum Fx	Sum Wpx	Fpx	Fpx(min)	C=Fpx/Wpx
Roof	75	2824	486832	470.8	470.8	0.1667	2824	470.8	2824	470.8	992.9	0.3516
5th Floor	60	2734	361179	349.3	820.0	0.1277	2734	820.0	5558	403.4	961.3	0.3516
4th Floor	45	2734	256271	247.8	1067.9	0.0906	2734	1067.9	8292	352.1	961.3	0.3516
3rd Floor	30	2734	158002	152.8	1220.6	0.0559	2734	1220.6	11026	302.7	961.3	0.3516
2nd Floor	15	2734	69120	66.8	1287.5	0.0244	2734	1287.5	13760	255.8	961.3	0.3516
		13760	1331403	1287.5								

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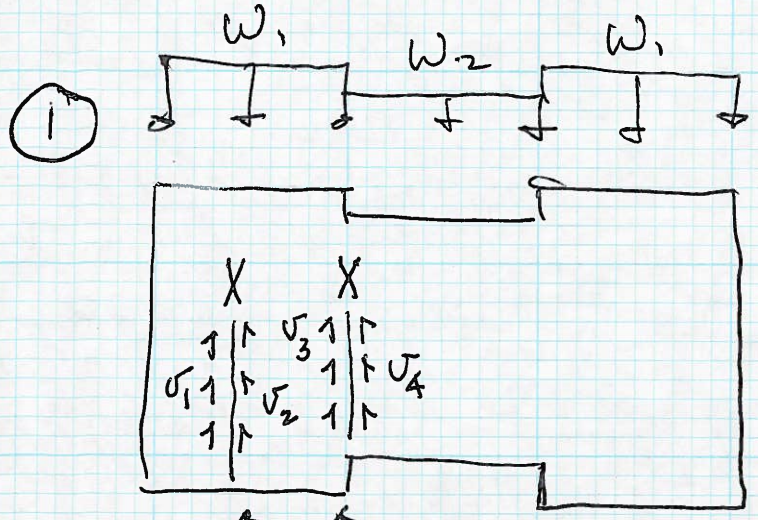


$W_x = 2734$

$C = 0.439$

Floor Area $= 29056^{\square'}$

$W_1 = 0.439 \left(\frac{2734}{29056}\right) 164' = 6.77^{K}/ft.$

$W_2 = 0.439 \left(\frac{2734}{29056}\right) 144' = 5.95^{K}/ft.$

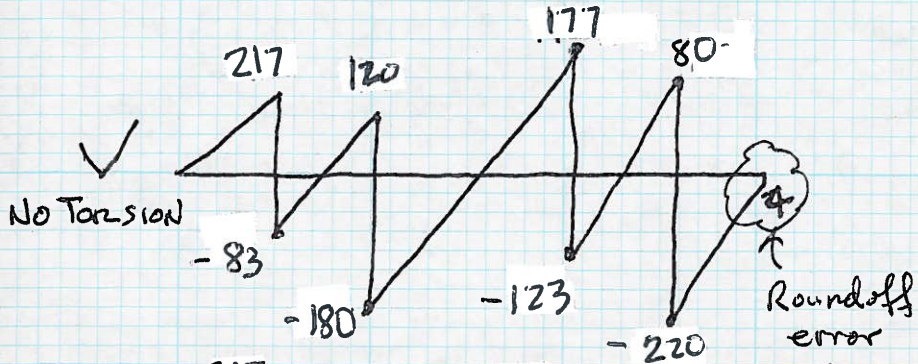
$R = 1200.2/4 = 300^{K}$

$R_1 = 0.31 \times 1200.2 = 372.1^{K}$

$R_2 = 0.28 \times 1200.2 = 336.1^{K}$

$R_3 = 0.22 \times 1200.2 = 264.0$

$R_4 = 0.19 \times 1200.2 = 228.0$

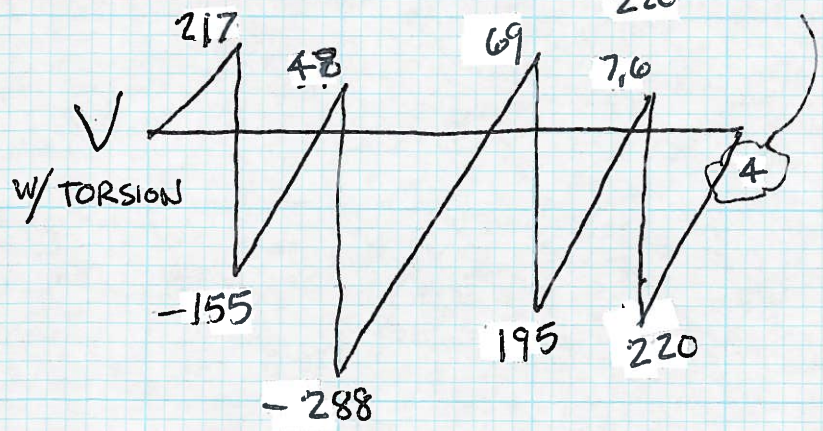


$v_1 = 217/160 = 1.36$ K/ft

$v_2 = 83/160 = 0.52$

$v_3 = 120/160 = 0.75$

$v_4 = 180/140 = 1.29$



$v_1 = 217/160 = 1.36$

$v_2 = 155/160 = 0.97$

$v_3 = 48/160 = 0.30$

$v_4 = 288/140 = 2.06$

GRID B $F_D = (1.36 + 0.52)80' = 150.4^{K}$

$F_D = (1.36 + 0.97)80' = 186.4^{K}$ W/ TORSION

GRID C $F_D = 0.75 \times 80' + 1.29 \times 70' = 150.3^{K}$

$F_D = 0.30 \times 80' + 2.06 \times 70' = 168.2^{K}$ W/ TORSION

(2) Max Chord Force between Grids C & E

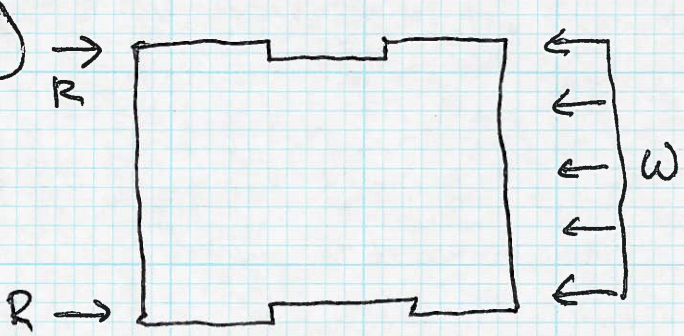
$$T = C = \frac{M_u}{b} = \frac{W_2 \times 60^2}{12 \times 140'} = 10.2^k$$

$$\Omega_o T = 2 \times 10.2 = 20.4^k$$

(4) $$\text{No. Studs} = \frac{20.4^k}{\phi Q_n} = \frac{20.4}{0.65 \times 17.2} = 1.8$$ Need only 2 studs

Typically would have minimum $3/4''\phi$ studs @ 2'-0" o.c.

(3)



$W_x = 2734$

$C = 0.3516$

Floor Area $= 29056^{0'}$

$$w = 0.3516\left(\frac{2734}{160}\right) = 6.01^{k/'}$$

$R = 6.01 \times 160/2 = 480.3$ NO TORSION

$R = 0.55 \times 961.3 = 528.7$ w/ TORSION

$$v_{EW} = \frac{528.7}{180'} = 2.94^{k/'}$$ w/ TORSION ← Max

$v_{NS} = 2.06^{k/'}$ w/ TORSION (v_4)

Spacing of studs

$$\frac{\phi Q_n \cdot \left(^k/_{stud}\right)}{\Omega_o v_{max} \left(^k/_{ft.}\right)} = \frac{0.65 \times 17.2}{3 \times 2.94} = 1.27 \text{ ft/stud.}$$

↑ Ω_o for SMF

← $3/4''\phi$ studs @ 12" o.c.