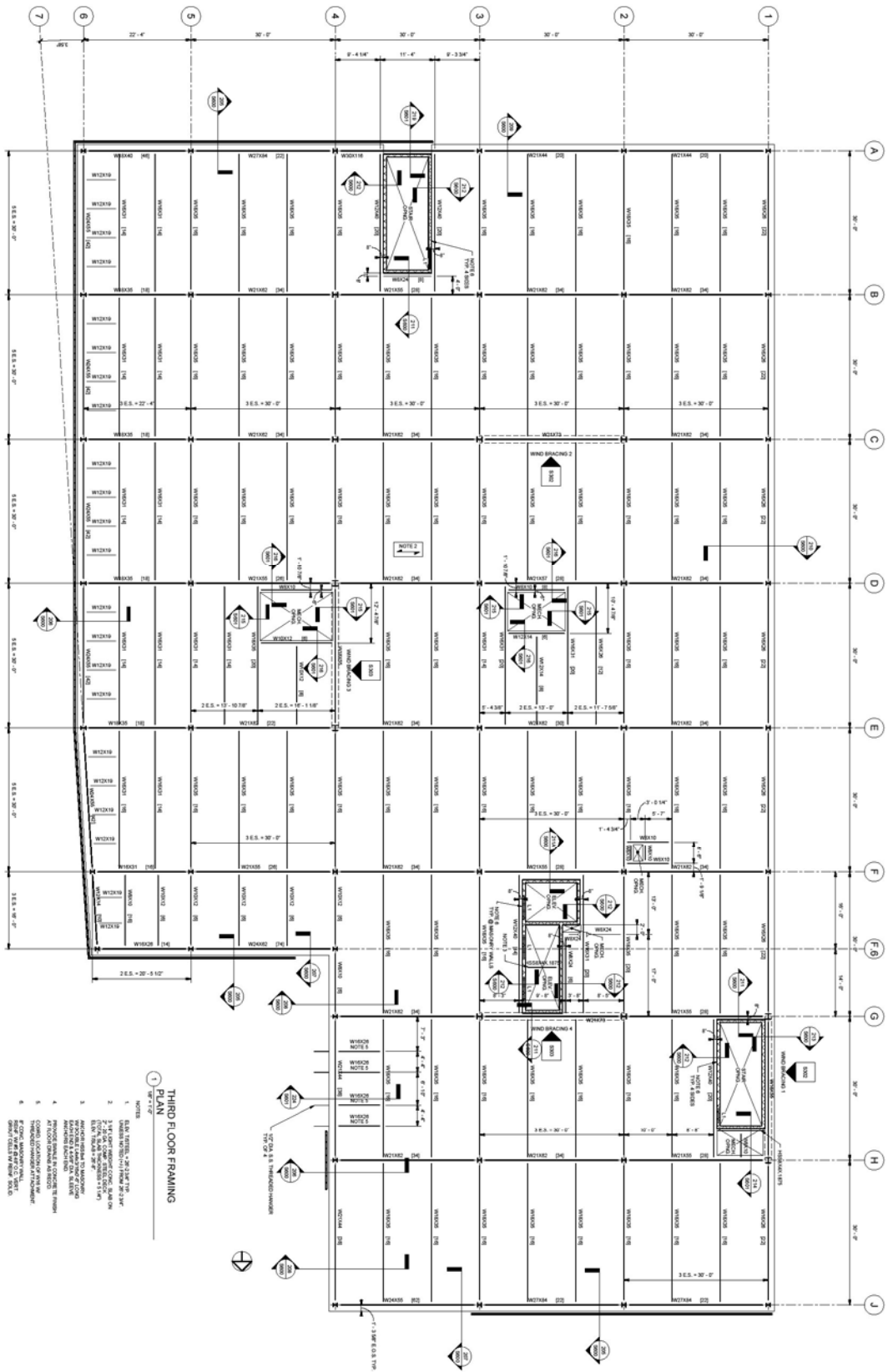


APPENDIX A: BUILDING LAYOUT

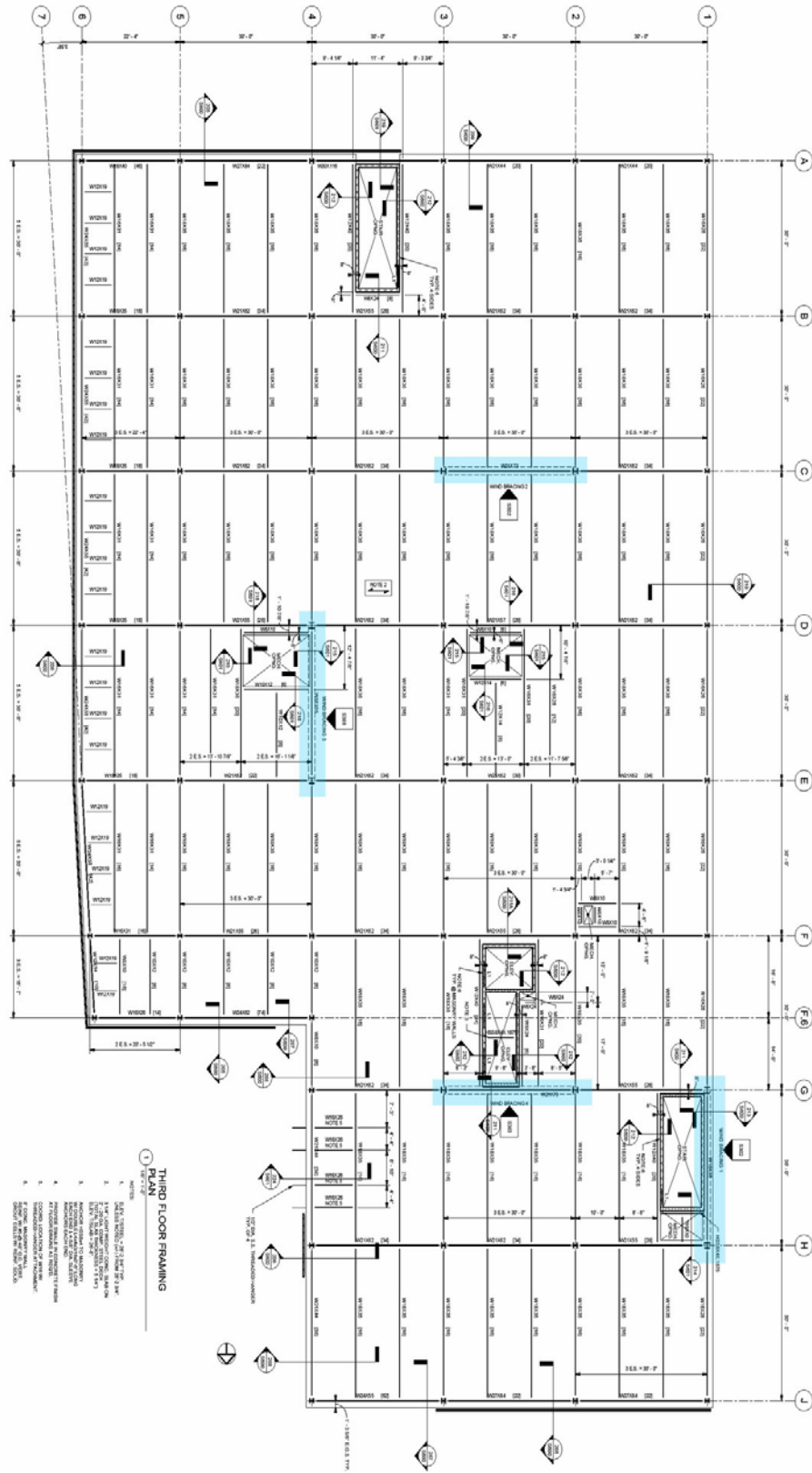


THIRD FLOOR FRAMING PLAN

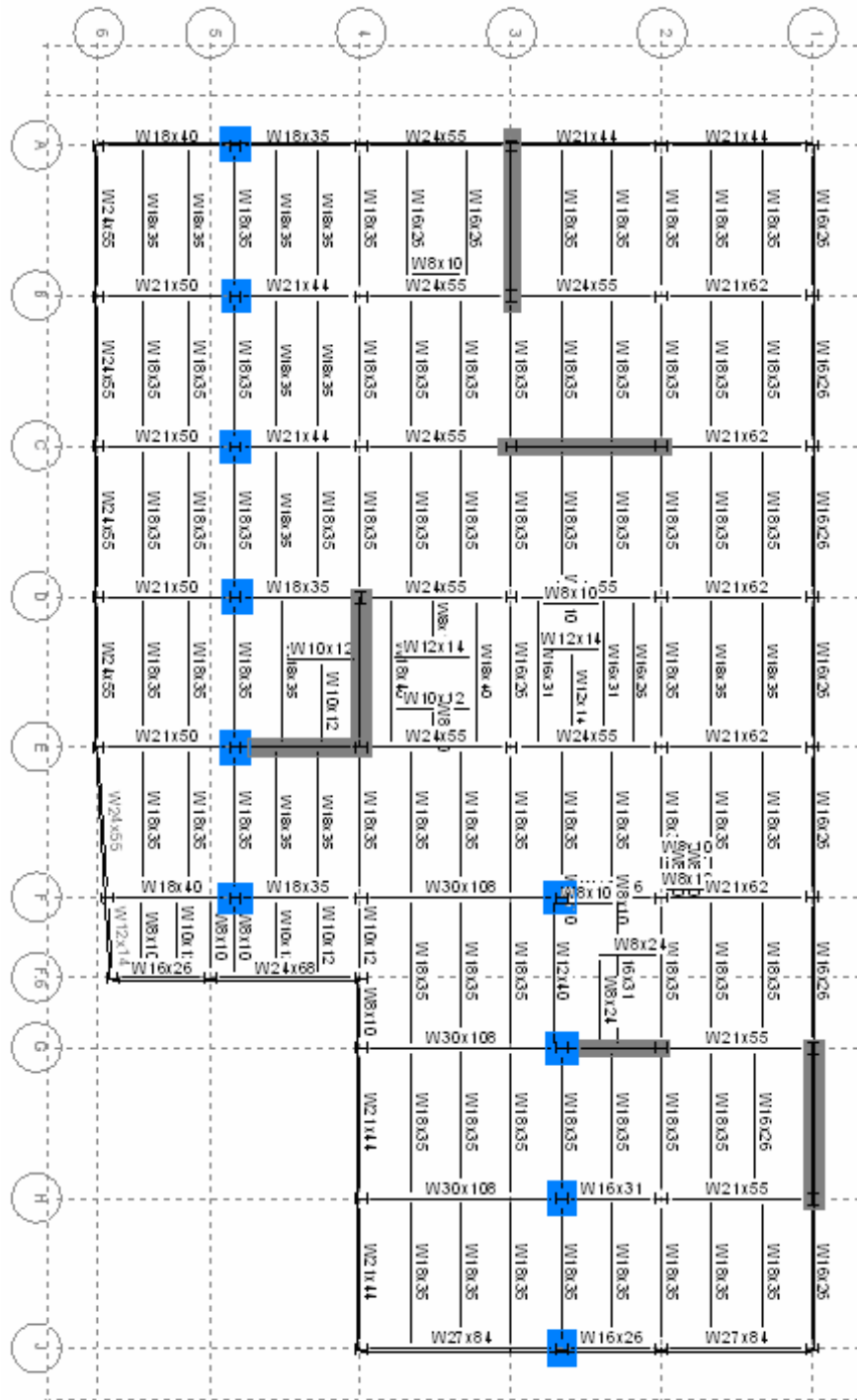
NOTES:

1. SEE GENERAL NOTES TO THIS SET.
2. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS OTHERWISE NOTED.
3. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE NOTED.
4. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
5. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
6. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
7. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
8. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
9. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.
10. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED.

Typical Floor Plan



Modified Floor Plan



APPENDIX B: WIND AND SEISMIC DATA

WIND DESIGN

ASCE 7-05 METHOD 2

BASIC WIND SPEED $V = 90 \text{ MPH}$ (FIG 6-1)

IMPORTANCE FACTOR $I = 1.0$ (TABLE 6-1)
CATEGORY II

EXPOSURE CATEGORY = B (SEC 6.5.6.3)

TOPOGRAPHIC FACTOR
FLAT SITE $K_{zt} = 1.0$

WIND DESIGN

ASCE 7-05 METHOD 2

BASIC WIND SPEED $V = 90$ MPH (FIG 6-1)

IMPORTANCE FACTOR $I = 1.0$ (TAB 6-1)

CATEGORY II

EXPOSURE CATEGORY-B (SEC 6.5.6.3)

VELOCITY PRESSURE EXPOSURE COEFFICIENT, K_z (TAB 6-3)

FLOOR	ACTUAL HT	EST HT	K_z
2	13-4"	15'	0.57
3	26-8"	30'	0.70
4	40-0"	40'	0.76
5	53-4"	60'	0.85
ROOF	67-4"	70'	0.87

TOPOGRAPHIC FACTOR $K_{tt} = 1.0$ (FLAT SITE)

$$\text{GUST EFFECT FACTOR } G_1 = 0.925 \left[\frac{(1 + 1.79 G I_z(Q))}{1 + 1.79 G I_z} \right] \quad (\text{EQ 6-4})$$

$$h = 67-4"$$

$$C = 0.30 \quad (\text{TAB 6-2})$$

$$Z_{min} = 30' \quad (\text{TAB 6-2})$$

$$\bar{Z} = 0.6h = 32.4'$$

$$I_z = C \left(\frac{33}{\bar{Z}} \right)^{1/6} = 0.3 \left(\frac{33}{32.4} \right)^{1/6} = 0.3 \quad (\text{EQ 6-5})$$

$$Q = \sqrt{1 + 0.63 \left(\frac{B+h}{L_z} \right)^{0.63}} \quad (\text{EQ 6-6})$$

$$B = 240' \text{ OR } 146'$$

$$L_2 = l \left(\frac{Z}{33} \right) \bar{E} = 320 \left(\frac{32.4}{33} \right)^{1/30} = 318.05 \text{ ft}^2$$

$$l = 320' \quad \bar{E} = 1/30 \quad (\text{TAB 6-2})$$

$$Q_{B=240} = \sqrt{\frac{1}{1 + 0.63 \left(\frac{240 + 67.3}{318.05} \right)^{0.63}}} = 0.787$$

$$Q_{B=146} = \sqrt{\frac{1}{1 + 0.63 \left(\frac{146 + 67.3}{318.05} \right)^{0.63}}} = 0.819$$

$$G_{N-S} = 0.925 \left[\frac{1 + 1.7(3.4)(0.3)(0.787)}{1 + 1.7(3.4)(0.3)} \right] = 0.80$$

$$G_{E-W} = 0.925 \left[\frac{1 + 1.7(3.4)(0.3)(0.819)}{1 + 1.7(3.4)(0.3)} \right] = 0.819$$

ENCLOSURE CLASSIFICATION = ENCLOSED (SEC 6-2)

INTERNAL PRESSURE COEFFICIENT

$$GC_{pi} = \pm 0.18 \quad (\text{FIG 6-5})$$

EXTERNAL PRESSURE COEFFICIENT

$$\text{WINDWARD WALL} \quad C_p = 0.8$$

$$\text{LEeward WALL} \quad C_{p_{E=240}} \quad \frac{1}{8} = 146/240 \quad C_{p_{E=240}} = -0.5$$

$$C_{p_{B=146}} \quad \frac{1}{8} = 240/140 \quad C_{p_{E-W}} = -0.87$$

$$\text{SIDEWALL} \quad C_p = -0.7$$

VELOCITY PRESSURE (EQ 6-15)

$$q_z = 0.00256 K_z K_{zt} K_d V^2 I \quad (\text{lb/ft}^2)$$

(SPREADSHEET)

DESIGN WIND PRESSURES (EQ 6-17)

$$P = q(GC_{pi} - q_i(GC_{pi})) \quad (\text{lb/ft}^2)$$

(SPREADSHEET)

SEISMIC DESIGN ASCE 7-05

LATITUDE 39.35 LONGITUDE 84.3

OCCUPANCY CATEGORY II

IMPORTANCE FACTOR (I) = 1.0

USGS $S_s = 0.137$
 $S_1 = 0.057$

SOIL SITE CLASS D

SITE COEFFICIENTS

$F_a = 1.6$ (TABLE 11.4-1)
 $F_v = 2.4$ (TABLE 11.4-2)

$S_{MS} = F_a S_s = 1.6(0.137) = 0.219$
 $S_{M1} = F_v S_1 = 2.4(0.057) = 0.137$

SEISMIC DESIGN CATEGORY \Rightarrow B

$S_{DS} = 0.15 \rightarrow A$
 $S_{D1} = 0.09 \rightarrow B$

RESPONSE MODIFICATION FACTOR

$R = 3.25$
 $\Omega = 2$
 $C_d = 3.25$

ORDINARY STEEL CONCENTRICALLY
BRACED FRAMES
TABLE 12.2-1

$$C_s = \frac{S_{0.5}}{(R/I)} \geq 0.01$$

$$\frac{S_{0.1}}{T(R/I)} \quad T \leq T_L \geq 0.01$$

$$\frac{S_{0.1}}{T^2(R/I)} \quad T \geq T_L \geq 0.01$$

$$T_a = C_t(h_n)^x = 0.02(67.3)^{0.75} = 0.47$$

$$T_L = 12 \quad (\text{FIG 22-15})$$

$$C_u = 1.7 \quad (\text{TAB 12.8-1})$$

$$T = C_u T_a = 1.7(0.47) = 0.800$$

$$C_s = \frac{S_{0.1}}{T(R/I)} = \frac{0.09}{0.8 \left(\frac{3.25}{1} \right)} = 0.035$$

$$V = C_s W$$

WEIGHT OF BUILDING

$$\text{TOP FLOOR AREA} = 31,322 \text{ ft}^2$$

TOP FLOOR LOADS

PARTITIONS	20 PSF
FIN & MISC	5 PSF
M.E.P.	10 PSF
5.25" SLAB/DECK	42 PSF
BEAMS COL	15 PSF
	<u>92 PSF</u>

ROOF LOADS

M.E.P.	10 PSF
ROOF MAT	20 PSF
SLAB/DECK	40 PSF
MISC.	5 PSF
BEAM/JOISTS	10 PSF
	<u>85 PSF</u>

$$\text{ROOF: } 31,322 (85) = 2662 \text{ K}$$

$$\text{FLOORS: } 4(31,322)(92) = 11526 \text{ K}$$

$$\text{TOTAL WT} = 14188 \text{ K}$$

$$V_s = 0.035(14188) = 497 \text{ K}$$

$$K = 1.65 \quad \text{SEC 12.8.3}$$

(SPREADSHEET FOR BASE SHEAR
& OVERTURNING MOMENT)

SEISMIC DESIGN ASCE 7-05

LAT- 40.684 LONG- -111.8057

OCC CAT II

IMPORTANCE FACTOR (I) = 1.0

USGS $S_s = 1.546$
 $S_1 = 0.602$

341L SITE CLASS D

SITE COEFFICIENTS $F_a = 1.00$ TAB 11.4-1
 $F_v = 1.5$ TAB 11.4-2

$$S_{MS} = F_a S_s = 1.00(1.546) = 1.546$$

$$S_{M1} = F_v S_1 = 1.5(0.602) = 0.903$$

DESIGN ACCELERATIONS

$$S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3}(1.546) = 1.03$$

$$S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3}(0.903) = 0.602$$

SEISMIC DESIGN CATEGORY

$$\begin{array}{l} S_{DS} > 0.5 \\ S_{D1} > 0.2 \end{array} > D$$

$$R = 6.00$$

$$\Omega = 2$$

$$C_b = 5.00$$

SPECIAL STEEL CONCENTRICALLY
BRACED FRAMES
TABLE 12.2-1

$$C_s = \frac{S_{D1}}{(R/I)}$$

$$= \frac{S_{D1}}{T(R/I)} \quad \text{FOR } T \leq T_L \quad \geq 0.01$$

$$= \frac{S_{D1} T_L}{T^2 (R/I)} \quad \text{FOR } T > T_L \quad \geq 0.01$$

TABLE 12.8-2 $C_t = 0.02$
 $\kappa = 0.75$

EQ 12.8-7

$$T_a = C_t h_n^{\kappa}$$

$$= 0.02 (67.3)^{0.75}$$

$$= 0.47$$

$T_L = 8 \Rightarrow$ FIG 22-15

TABLE 12.8-1 $C_u = 1.4$

SEL 12.8.2 $T = C_u T_a = 1.44 (0.47) = 0.68$

$$C_s = \frac{0.602}{(0.68)(6.00/1)} = 0.148$$

WEIGHT OF BUILDING

$$\text{TYP FLOOR AREA} = 31,322 \text{ ft}^2$$

TYP FLOOR LOADS		ROOF LOADS	
PARTITIONS	20 PSF	MEP	10 PSF
FIN & MISC	5 PSF	ROOF MAT	20 PSF
MEP	10 PSF	SLAB/DECK	40 PSF
5.25" SLAB/DECK	42 PSF	MISC.	5 PSF
BEAMS/COL	15 PSF	BEAM/JOISTS	10 PSF
	<u>92 PSF</u>		<u>85 PSF</u>

$$\text{ROOF: } 31,322 \text{ ft}^2 (85 \text{ PSF}) = 2,662 \text{ K}$$

$$\text{FLOORS: } 4 (31,322 \text{ ft}^2) (92 \text{ PSF}) = 11,526 \text{ K}$$

$$\text{TOTAL WT} = 14,188 \text{ K}$$

$$V_s = C_s W = 0.148 (14,188) = 2100 \text{ K}$$

$$K = 1.65 \quad \text{SEC 12.8.3}$$

(SPREAD SHEET FOR BASE SHEAR
& OVERTURNING MOMENT)

APPENDIX C: TORSIONAL ANALYSIS

5 Story West Virginia Building

Center Of Rigidity		
Level	x	y
Roof	117.57	102.71
5th	118.24	103.12
4th	117.72	101.8
3rd	116.37	99.88
2nd	111.99	92.95

Center Of Mass		
Level	x	y
Roof	111.43	84.32
5th	108.96	74.53
4th	108.98	74.54
3rd	108.96	74.53
2nd	107.8	74.23

Eccentricity 5%		
Level	x	y
Roof	12.05	7.17
5th	12.05	7.17
4th	12.05	7.17
3rd	12.05	7.17
2nd	13	7.17

Calculation of R - E/W Direction			
Frame	1	3	
Rel. Stiff.	0.55	0.45	
Level	Rigidity	R per Floor	
Roof	258.20	142.01	116.19
5th	356.63	196.15	160.49
4th	545.85	300.22	245.63
3rd	983.28	540.81	442.48
2nd	2645.50	1455.03	1190.48
	Total	2634.21	2155.26
Σ R		4789.47	

Calculation of R - N/S Direction			
Frame	2	4	
Rel. Stiff.	0.47	0.53	
Level	Rigidity	R per Floor	
Roof	227.84	107.09	120.76
5th	312.79	147.01	165.78
4th	488.04	229.38	258.66
3rd	867.30	407.63	459.67
2nd	2197.80	1032.97	1164.84
	Total	1924.08	2169.71
Σ R		4093.78	

X - Torsional Rigidity				
Frame 1		Frame 3		J
C	R * C ²	C	R * C ²	
40.29	4276068	50.38	5470364	9746433
39.88	4189483	50.79	5559764	9749247
41.2	4471410	49.47	5274530	9745940
43.12	4897874	47.55	4873051	9770925
50.05	6598698	40.62	3556147	10154846

Y - Torsional Rigidity				
Frame 2		Frame 4		J
C	R * C ²	C	R * C ²	
62.43	7499104	57.57	7191065	14690169
61.76	7339007	58.24	7359418	14698425
62.28	7463111	57.72	7228586	14691698
63.63	7790163	56.37	6894405	14684569
68.01	8899555	51.99	5864627	14764181

RAM - Seismic N/S				
Level	Floor Ht. (ft.)	Force (k)	Story Shear (k)	Moment (ft-k)
Roof	67.3	55.25	0	3718.325
5th	53.83	164.36	55.25	8847.4988
4th	39.83	113.39	219.61	4516.3237
3rd	26.67	66.69	333	1778.6223
2nd	13.33	22.65	399.69	301.9245
Base	0	0	422.34	0

RAM - Seismic E/W				
Level	Floor Ht. (ft.)	Force (k)	Story Shear (k)	Moment (ft-k)
Roof	67.3	55.24	0	3717.652
5th	53.83	164.74	55.24	8867.9542
4th	39.83	113.74	219.98	4530.2642
3rd	26.67	66.88	333.72	1783.6896
2nd	13.33	22.65	400.6	301.9245
Base	0	0	423.25	0

5 Story Utah Building

Center Of Rigidity		
Level	x	y
Roof	107.59	91.36
5th	109.02	89.63
4th	113.02	89.49
3rd	113.47	86.57
2nd	124.59	87.16

Center Of Mass		
Level	x	y
Roof	111.64	84.31
5th	109.11	74.53
4th	109.15	74.55
3rd	109.14	74.56
2nd	107.93	74.28

Eccentricity 5%		
Level	x	y
Roof	12.05	7.17
5th	12.05	7.17
4th	12.05	7.17
3rd	12.05	7.17
2nd	13	7.17

Calculation of R - N/S Direction				
Frame	1	2	3	
Rel. Stiff.	0.39	0.37	0.24	
Level	Rigidity	R per Floor		
Roof	625.27	243.86	231.35	150.07
5th	869.34	339.04	321.66	208.64
4th	1403.31	547.29	519.23	336.79
3rd	2484.47	968.94	919.25	596.27
2nd	7716.05	3009.26	2854.94	1851.85
	Total	5108.39	4846.42	3143.63
ΣR		13098.45		

Calculation of R - E/W Direction				
Frame	4	5	6	
Rel. Stiff.	0.29	0.39	0.33	
Level	Rigidity	R per Floor		
Roof	666.31	193.23	259.86	219.88
5th	928.68	269.32	362.18	306.46
4th	1470.59	426.47	573.53	485.29
3rd	2639.22	765.37	1029.30	870.94
2nd	8183.31	2373.16	3191.49	2700.49
	Total	4027.55	5416.36	4583.07
ΣR		14026.98		

Y - Torsional Rigidity						
Frame 1		Frame 2		Frame 3		J
C	R*C ²	C	R*C ²	C	R*C ²	
47.59	11569531	12.41	746388.7	72.41	16482690	28798610
49.02	12275268	10.98	584286.9	70.98	15838096	28697651
53.02	14360310	6.98	236119.8	66.98	14103317	28699747
53.47	14605106	6.53	206655.9	66.53	13914450	28726212
64.59	21311544	4.59	102105	55.41	9651777	31065427

X - Torsional Rigidity						
Frame 4		Frame 5		Frame 6		J
C	R*C ²	C	R*C ²	C	R*C ²	
8.525	292704.7	39.03	8250962	51.64	12221635	20765302
6.795	185960.1	37.3	7535727	53.37	13054229	20775917
6.655	178376.2	37.16	7479265	53.51	13122807	20780448
3.735	56185.22	34.24	6350019	56.43	14594087	21000291
4.325	75337.83	34.83	6570743	55.84	14290508	20936588

RAM - Seismic N/S				
Level	Floor Ht. (ft.)	Force (k)	Story Shear (k)	Moment (ft-k)
Roof	67.3	249.95	0	16821.635
5th	53.83	756.7	249.95	40733.161
4th	39.83	548.38	1006.65	21841.9754
3rd	26.67	338.53	1555.03	9028.5951
2nd	13.33	145.09	1893.56	1934.0497
Base	0	0	2038.65	0

RAM - Seismic E/W				
Level	Floor Ht. (ft.)	Force (k)	Story Shear (k)	Moment (ft-k)
Roof	67.3	249.95	0	16821.635
5th	53.83	756.7	249.95	40733.161
4th	39.83	548.38	1006.65	21841.9754
3rd	26.67	338.53	1555.03	9028.5951
2nd	13.33	145.09	1893.56	1934.0497
Base	0	0	2038.65	0