Existing Structure:

The basic structural system of Lexington II is two-way flat plate slab supported by cast in place concrete columns. The existing structural system of Lexington II is complicated by offset columns in many locations. Lateral resistance is provided by concrete shear walls around the elevator shaft at the center of the building. The entire building is resting on a MAT foundation.

Gravity System:

The existing gravity system of The Lexington is two-way flat plate slab resting on concrete columns. Flat plate slab was chosen because of its ability to maintain a shallow floor sandwich, an important criterion when designing in an area with height restrictions on buildings. In order to achieve the shallowest floor sandwich possible, columns were placed close together creating small bays for the slab to span. The column layout was planned around the building architecture and often offset or turned columns were used to better fit into architectural partitions. Column layouts for the three floor plans used in Lexington II can be found on the next three pages (Figures 1-3). The average bay size is approximately 13.5' by 16.2'. The majority of the bays have 2-way flat-plate slabs with no edge beams. However, edge beams can be found on the lower levels where the live load is increased. Edge beams are also in place along the east exterior bays on some levels.

The 2-way slab floors are concrete with a compressive strength of 4000psi. The floors of the 3 level sub-structure are 10" thick while the superstructure has floors that are 8" thick. Exceptions to flat plate slab are 5" drop panels around the southern columns of the concourse level. The drop panels are bending drops which are in place to provide for the greater flexural and shear loads caused by an increased live load on the concourse level. Another exception is an increase in the 8" slab to 10" at the south end of the ground floor. This 10" thick slab, localized to the south end of the ground floor, is a loading dock for the retail space which will have the additional weight of trucks.

The 2-way slab is reinforced with a continuous bottom mat of #4 bars 12 inches on center. These bars are ASTM A216, grade 60. In addition to the #4 bars at 12" mat, there is top reinforcing in some locations. Typically the top reinforcing are #4 or #5 bars. The top reinforcement is often located by columns and shafts cut into the slab which creates a stronger moment in these locations. For reinforcement lay out, see framing plans in Appendix, Figures A-3, A-4, A-5, A-6, A-8 and A-8.

All of the columns throughout Lexington II are 5000psi compressive strength concrete with ASTM A615, grade 60 reinforcement. Columns range in size from 14" x 14" columns reinforced by 4 #9 bars to 42" x 14" columns reinforced with 18 #11 bars. As expected, the larger columns are in the lower stories of the building which carry the building's entire weight.

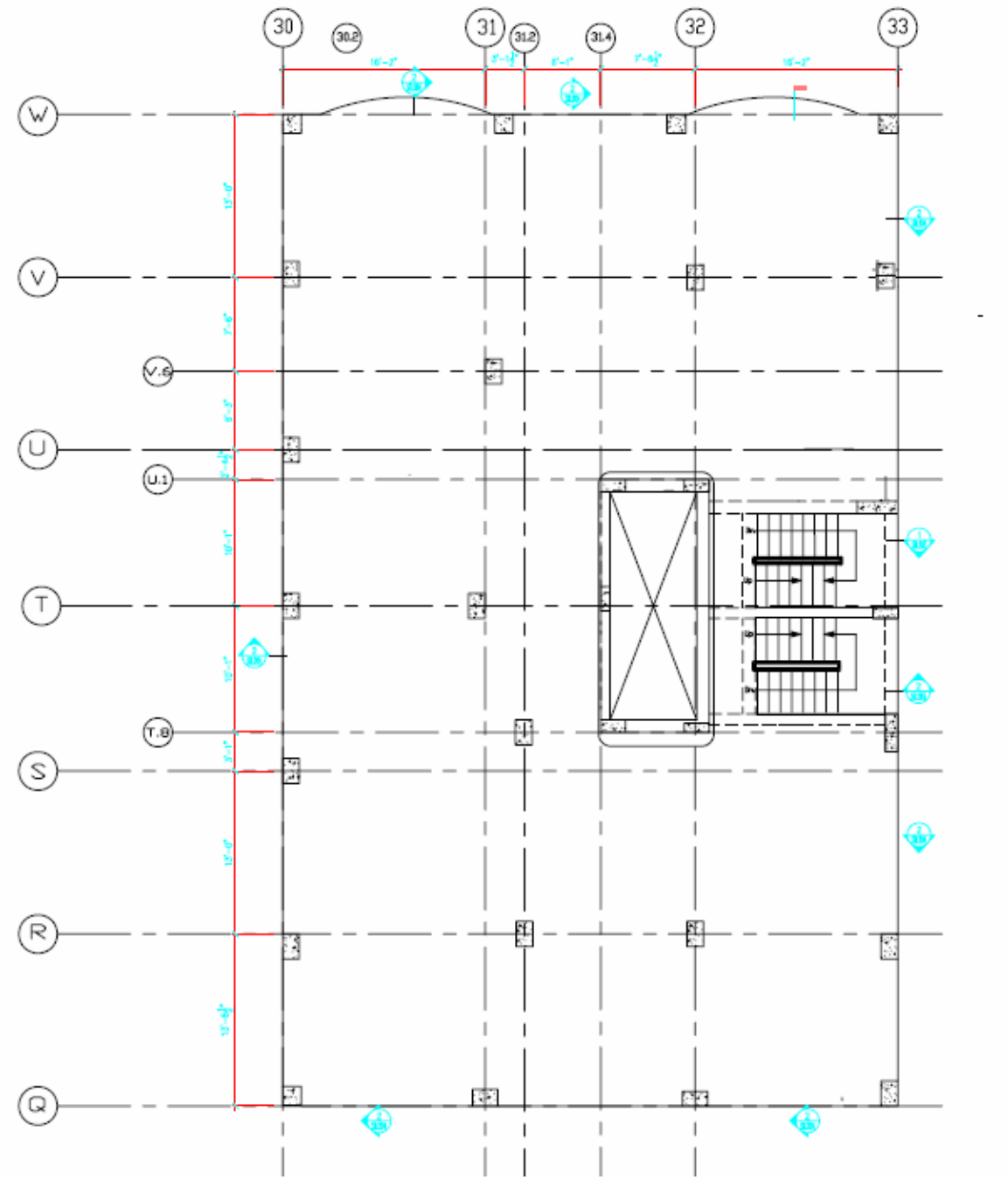


Figure 1
Column Layout for floors 12 to 8

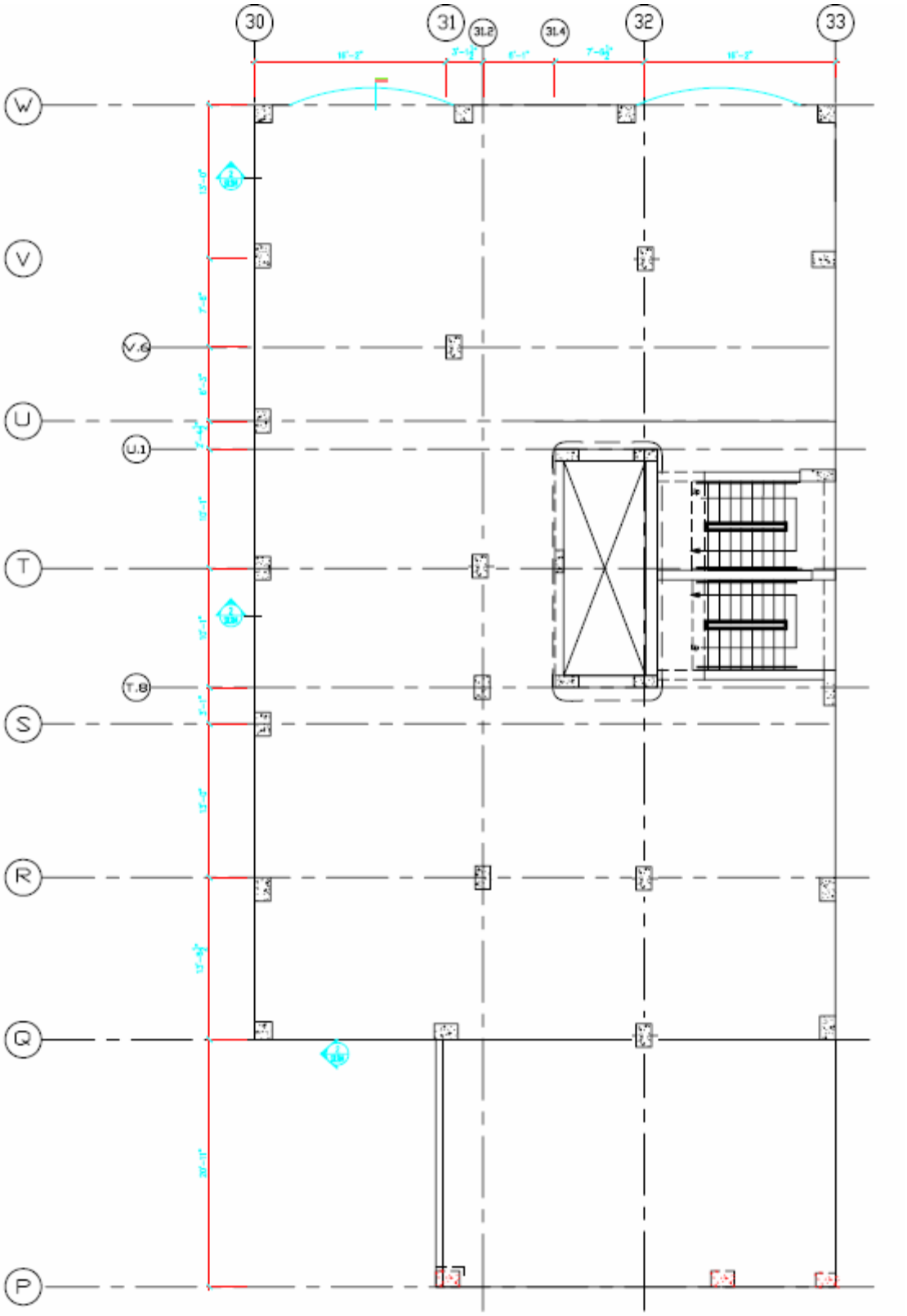


Figure 2
Column Layout for floors 7 to 2

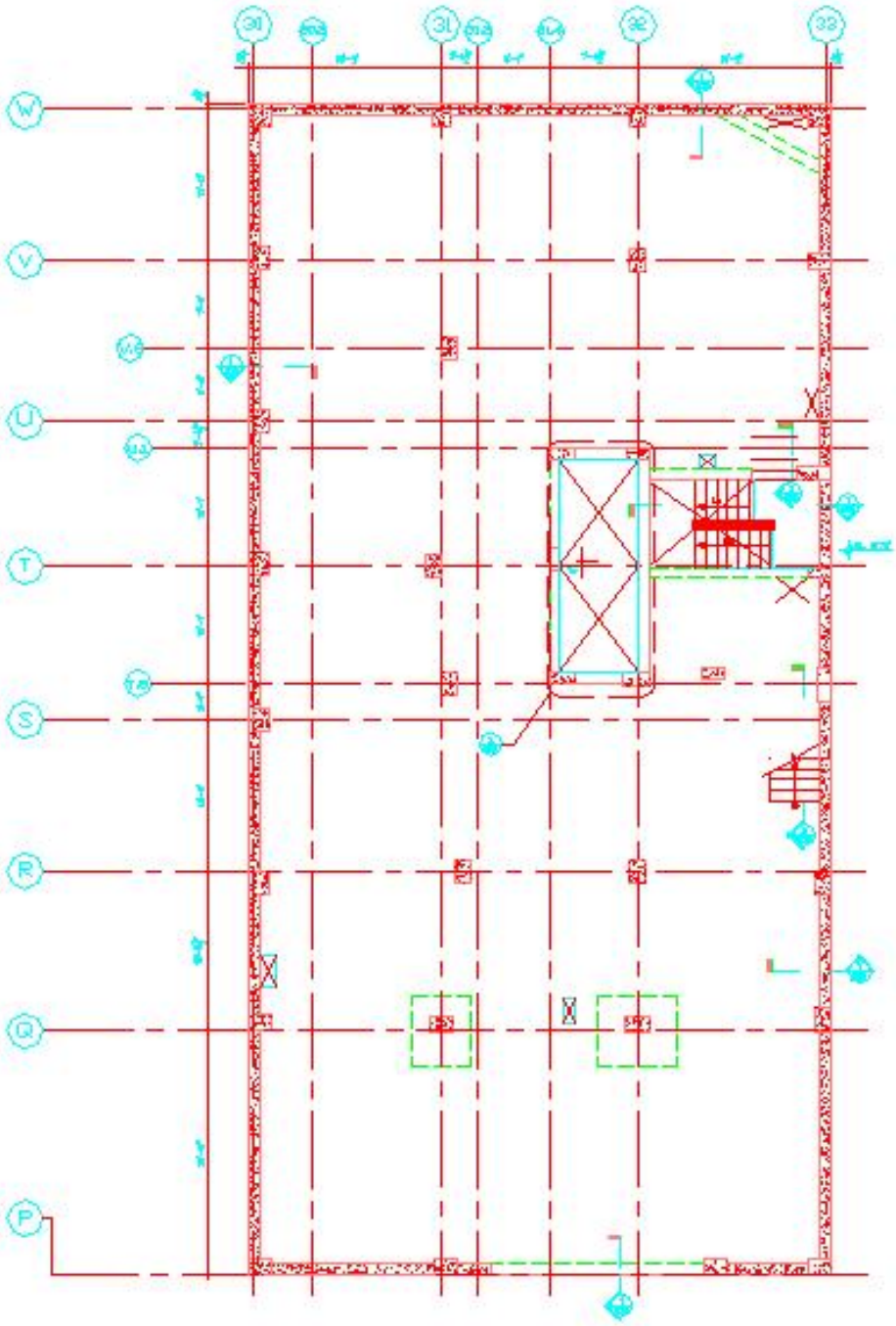


Figure 3
Column Layout for the ground floor, L-1, concourse, and P-1
Green areas represent drop plans and edge beams found on the concourse level

Lateral:

The lateral forces on Lexington are resisted by a core of shear walls located around the building's elevator shaft. See shear wall plan below, Figure 4. All shear walls are 12" thick, constructed of 4000psi concrete, and cast in place. Shear wall reinforcement includes #4 bars every 12" on center.

Since Lexington II's gravity system is monolithically poured, it naturally creates moment framing. However, contact with the structural engineer confirmed that the shear walls in Lexington II were designed with the intention of carrying the entire lateral load.

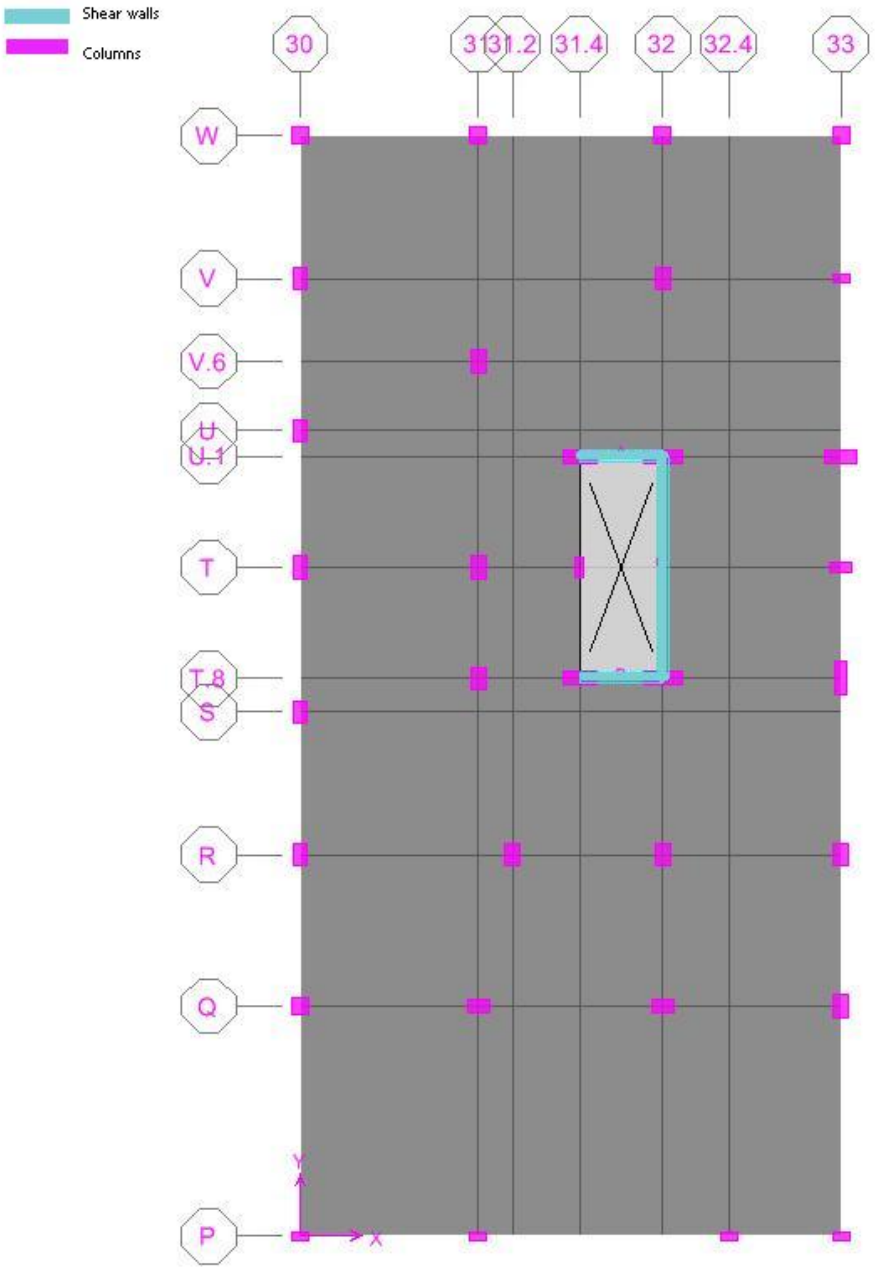


Figure 4
Shear Wall Plan

Foundation:

The foundation of Lexington II is a 3'-6" thick MAT foundation which is reinforced with deformed #8 bars located every 9" o.c. The MAT foundation is also reinforced with #11 top bars in some locations and designed in a 2-way slab formation. Below the MAT foundation is a 3" sub-grade working MAT. The foundation rests on original soil and structural fill with a compressive strength of 8000psf. Along the southern wall of Lexington II the foundation rests on HP 14 x 89 piles every five feet on center with one inch cap plates. The piles are in place because the pre-existing building to the south of Lexington II (which Lexington II abuts) is a story lower. Rather than undermining the existing building's foundation, piles were installed as an alternative to providing control fills stepped up to the new foundation level (which is more costly).

The below grade walls are reinforced concrete which is 14" thick from level P1 to the concourse level at which point they are reduced to 12" until they end at the ground level. Reinforcement in the retaining walls are #4 bars every 12" running in the longitudinal direction and #5 bars every 12" running vertically. Both the concrete walls and the MAT foundation have a compressive strength of 5000 psi. The reinforcing steel in both the MAT foundation and the below grade walls is ASTM A615, grade 60.

Summary of Structural System:

Floors 12 to 2:

Concrete:

Columns……..5000psi
8" 2-way floor slab…….….4000psi
Beams……..4000psi
Shear walls……..4000psi

Reinforcing steel:

Bar reinforcing…….ASTM A-615, grade 60, 60psi
Welded Wire Mesh……..ASTM A-185

Floors Ground to Concourse:

Concrete:

Columns……..5000psi
Basement Walls……...5000psi
10" 2-way floor slabs…..…….4000psi
Shear walls……..4000psi
Beams……..4000psi

Reinforcing steel:

Bar reinforcing…….ASTM A-615, grade 60, 60psi
Welded Wire Mesh……..ASTM A-185

Foundation:

Concrete:

MAT foundation…….5000psi
Basement Walls……...5000psi

Reinforcing steel:

Bar reinforcing…….ASTM A-615, grade 60, 60psi
Welded Wire Mesh……..ASTM A-185

Codes and Loading:

The model code used to design the existing Lexington II, completed in 2002, was the 1996 edition of the BOCA codes. Other codes used while designing Lexington II include:

ACI 318-95	Reinforced Concrete
AISC- 9th Ed.	Structural Steel (design, fabrication, and erection)
AWS D1.1-98	Structural Welding
ACI 530-95/ ASCE 5-96	Masonry

Loading: (From ASCE7-02)

Dead Load- Superimposed:

Finishes…….15psf
Partitions……included in live load, see below
Mechanical/Lighting……. 5psf
Total Superimposed……..20psf

Dead Load- Self Weight

Substructure Slab (10")…….125psf (Appendix)
Superstructure Slab (8")……100psf (Appendix)
Exterior Wall…….30psf

Live Load:

Lexington II was designed following the loading as prescribed by the 1996 edition of the BOCA code. The engineers assumed the following live loads:

Roof…….. 30psf
Ground, L1, and P1 level stairs……100psf
Mechanical Rooms……...150psf
Lobbies…….100psf
Concourse level……225psf
Residential Levels……..60psf + 20psf (for partitions)

For my report, I will be using a more recent code, ASCE7-02. Live loads obtained from ASCE 7-02 are comparable with those used in the building's original design

Roof……...20psf (Appendix)
Public Levels/ Stairs……100psf (ASCE7-02)
Lobbies……100psf (ASCE&-02)
Residential Levels…….40psf + 20psf (for partitions)

Snow Load:

Snow Load……15.75psf (Appendix)

Wind Loads:

N/S direction

Floor	P (net)	Trib Area (ft^2)	Fx (kips)	Vx (kips)	Mx (kip ft)	
ground	21.22	281.75	5.98	139.07	0.00	
1	21.22	497.15	10.55	133.09	121.32	
2	22.30	430.71	9.60	122.54	194.89	
3	22.78	430.78	9.81	112.93	285.34	
4	23.50	430.96	10.13	103.12	383.53	
5	24.10	430.78	10.38	92.99	484.45	
6	24.58	430.71	10.58	82.61	587.02	
7	25.06	430.76	10.79	72.03	693.43	
8	25.53	430.71	11.00	61.24	803.29	
9	25.89	430.83	11.16	50.24	912.89	
10	26.25	430.96	11.31	39.08	1025.34	
11	26.25	446.02	11.71	27.77	1164.17	
12	26.85	414.30	11.12	16.06	1210.73	
roof	26.85	183.75	4.93	4.93	573.99	moment total 8440.40

E/W direction

Floor	P (net)	Trib Area (ft^2)	Fx (kips)	Vx (kips)	Mx (kip ft)	
ground	11.51	575.00	6.62	170.79	0.00	
1	11.51	1014.60	11.67	164.18	134.24	
2	12.58	879.00	11.06	152.51	224.45	
3	13.06	879.15	11.48	141.44	333.97	
4	13.78	879.50	12.12	129.96	459.10	
5	14.38	879.15	12.64	117.84	590.06	
6	14.86	879.00	13.06	105.20	724.42	
7	15.34	879.10	13.49	92.13	866.44	
8	15.82	879.00	13.91	78.65	1015.64	
9	16.18	879.25	14.23	64.74	1164.06	
10	16.54	879.50	14.55	50.52	1318.20	
11	16.54	910.25	15.05	35.97	1496.69	
12	17.14	845.50	14.49	20.92	1576.94	
roof	17.14	375.00	6.43	6.43	747.61	moment total 10651.82

Table 1
For full wind load calculation, see Appendix Table A-1.

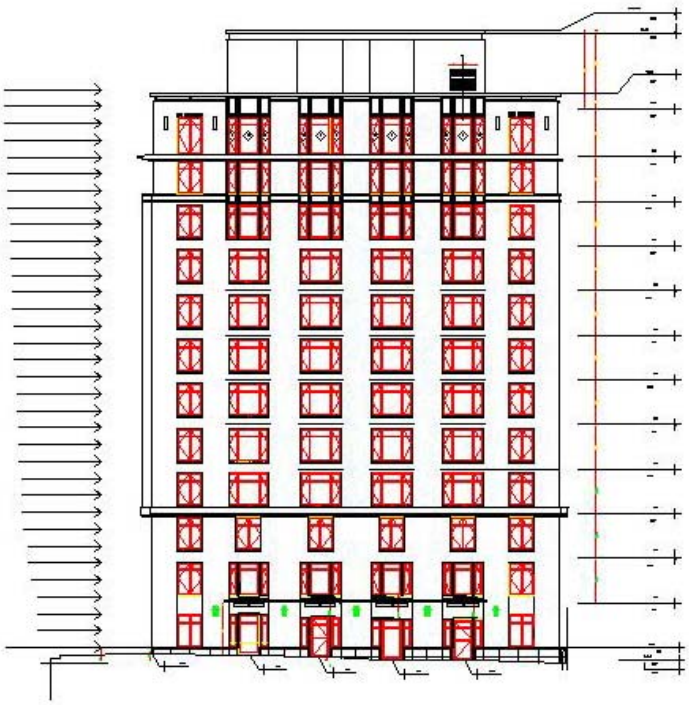


Figure 5
Wind hitting the building in the North South Direction

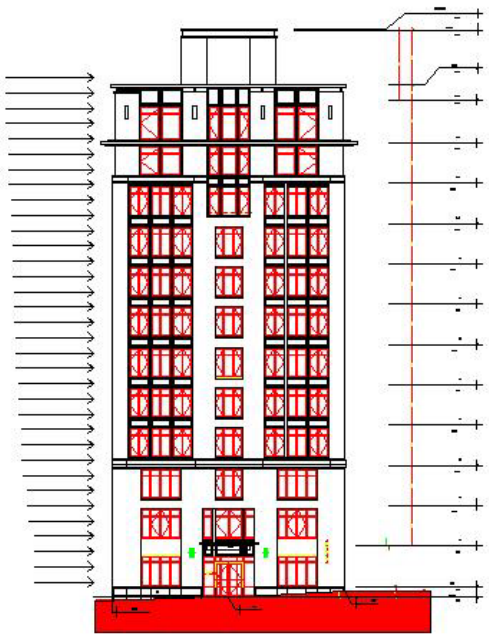
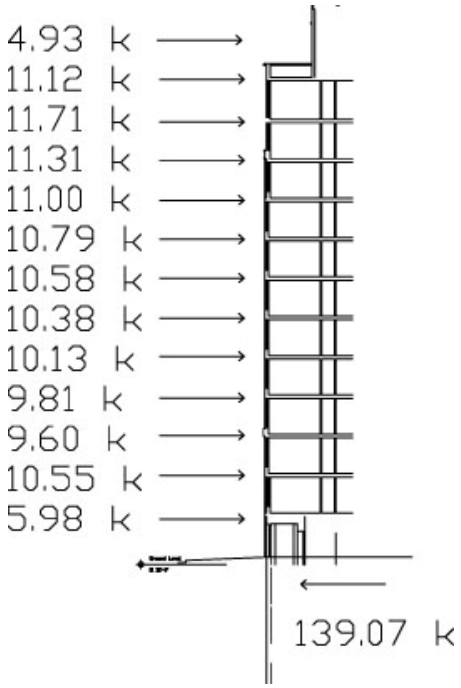
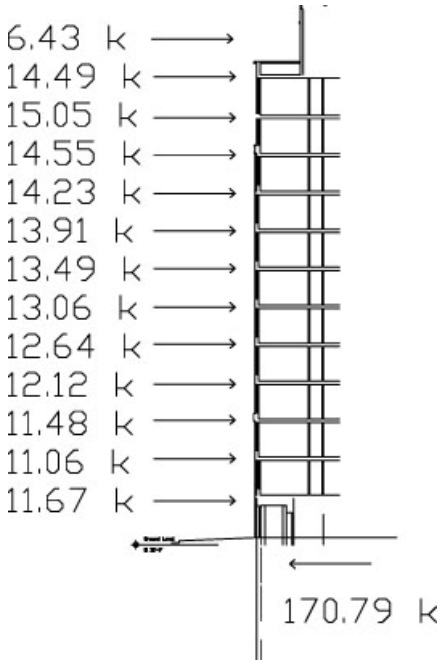


Figure 6
Wind hitting the building in the East West Direction





Wind (North-South Direction) Story Forces Wind (East-West Direction) Story Forces

Figure 7

Seismic Loads:

Floor	height (ft)	Total Load (kips)	wx*hx^k	Cvx	Fx (kips)	Vx (kips)	Mx (kip ft)
roof	108.58	423.23	68449.38	0.14	14.88	0.00	1615.74
12	99.17	457.01	66987.79	0.14	14.56	14.88	1444.20
11	90.375	454.65	60253.93	0.12	13.10	29.44	1183.82
10	81.58	454.63	53916.66	0.11	11.72	42.54	956.22
9	72.79	454.61	47641.36	0.10	10.36	54.26	753.89
8	64	454.61	41432.54	0.09	9.01	64.62	576.47
7	55.21	534.65	41510.32	0.09	9.02	73.63	498.23
6	46.42	548.54	35284.38	0.07	7.67	82.65	356.07
5	37.625	548.56	28094.23	0.06	6.11	90.32	229.80
4	28.83	548.53	21044.17	0.04	4.57	96.43	131.90
3	20.042	548.52	14183.91	0.03	3.08	101.01	61.80
2	11.25	545.65	7540.78	0.02	1.64	104.09	18.44
Ground	0	540.29	0.00	0.00	0.00	105.73	0.00
			486339.46				

Total Building Weight (kips)	6513.4607
Overturning Moment	7826.58356

Table 2

For full seismic loading calculations, see Appendix Table A-2.

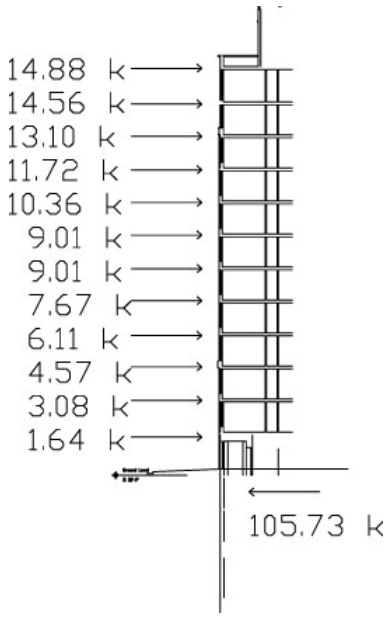


Figure 8
Seismic Story Forces

Load Combinations:

Taken from ASCE 7-02.

1.4D
1.2D + 1.6L + .5Lr
1.2D + 1.6Lr + (L or .8W)
1.2D + 1.6W + .5L + .5Lr
1.2D + E + .2S
.9D + 1.6W + 1.6H
.9D + 1E + 1.6H

The controlling load case is 1.2D + 1.6W +.5L + .5Lr. This was determined by running all load cases (psf) in an excel spread sheet. See Appendix Table A-3 for excel spread sheet and results.