TECHNICAL REPORT #3
LATERAL SYSTEM ANLYSIS

CITY VISTA.

BUILDING 2. 5TH AND K STREET . WASHINGTON D. C.

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DECEMBER 3, 2007

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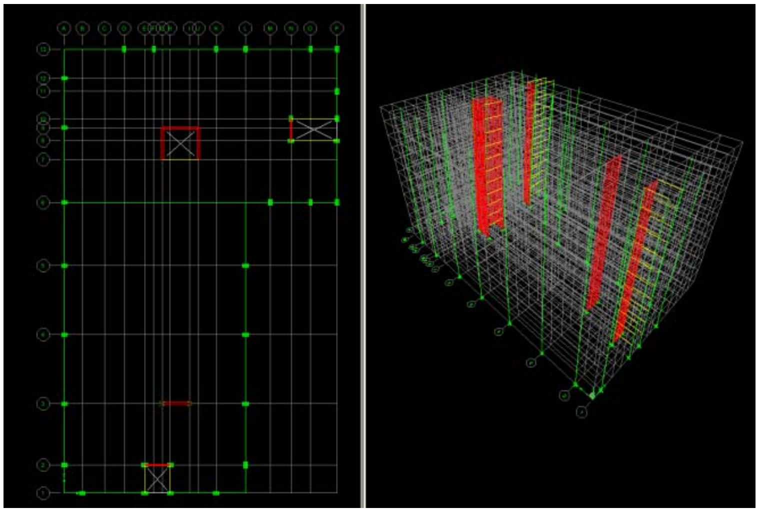
EXECUTIVE SUMMARY



City Vista, Building 2 is a mixed use complex located in downtown Washington D.C. The building uses a flat plate post tension system with (4) shear walls for lateral support. The deep foundation system uses augured cast in place piles and a 4" slab. Tendon are unbounded and span in both directions. Building 2 is 324,298 sqft and 114'-0" tall.

The following technical repot takes an in-depth look at the current lateral system which is composed of (4) shear walls. The walls are cast in place concrete and span 114' in and height. Three walls compose the central core, while the other is located 97'-4" away.

After calculating seismic and wind base shear values it is concluded that seismic will control. Torsional and direct shear values are calculated using relative stiffness and eccentricity found using the center of mass, center of rigidity, and geometric center. These base shears were then distributed up the full length of the wall. Story drift and required reinforcing was then computed. The building was then modeled in E-Tabs to compare to hand calculations to verify accuracy.

Comparison yielded similar results for shear, but conflicting results for story drift. I can confidently say that limited computer knowledge was the result of the errors. Below is a summary of torsional and direct shear for all (4) shear walls.

Shear Due to Seismic				
	North - South		East - West	
	Direct	Torsional	Direct	Torsional
Wall #1	-	57.85	544.5	280.54
Wall #2	-	57.85	544.5	280.54
Wall #3	886.5	373.82	-	24.8
Wall #4	202.5	363.59	-	50.98
SHEAR	1089 K	850 K	1089 K	635.78 K

Shear Due to Wind				
	North - South		East - West	
	Direct	Torsional	Direct	Torsional
Wall #1	-	4.96	390.95	71.34
Wall #2	-	4.96	390.95	71.34
Wall #3	345.74	32.14	-	6.307
Wall #4	78.94	31.21	-	12.96
SHEAR	425 K	73.3 K	781 K	161.83 K

City Vista is restricted to a story drift of 3.42 inches according to industry standards. This is met with a *1.56 in.* displacement in the X direction and *2.52 in.* in the Y direction, according to E-Tabs.

City Vista is a three building mixed used complex in downtown Washington D.C. Building 2 is strictly residential and contains 149 condos along with a community room, library, steel frame pedestrian bridge, and outdoor patio. This 11 story 324,298 square feet building reaches a height of 114'-0".

Building 2 is a flat plate post tension structure with a 4" slab on grade, deep foundation system. There are 250 16" augured cast in place piles, drilled to a depth of 60-65'. The two way 7 ½" PT slab uses unbounded tendons banded in one direction and uniform in the other. *The District of Columbia Building Code* was used in conjunction with the IBC, ASCE 7-05 and ACI.

1.LATERAL SYSTEM

Building two is a joint less structure with a central core. The slab is a two way post tension system supported by a grid of (52) cast in place concrete columns. (4) Concrete shear walls are used for lateral stability, three of which surround the elevator shaft (i.e. the central core). Cold form metal studs are used for most wall construction with the exception of stairwells, mechanical rooms and storage areas which are masonry construction.(See FIG.2)

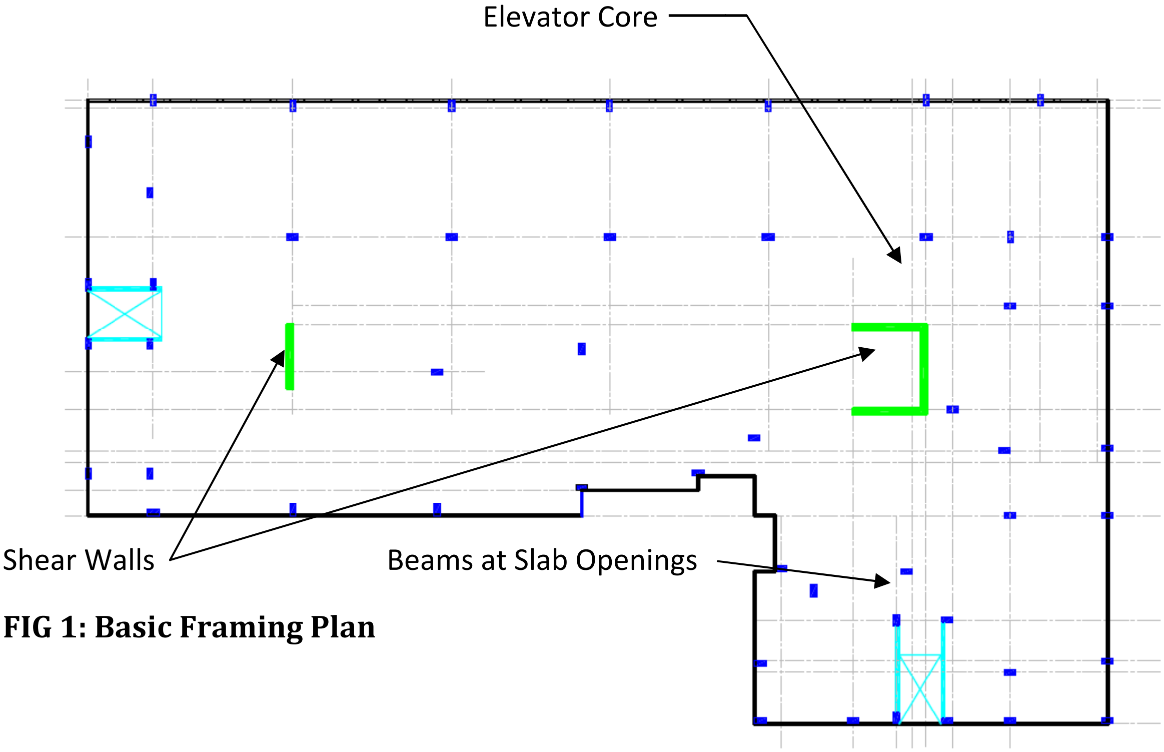
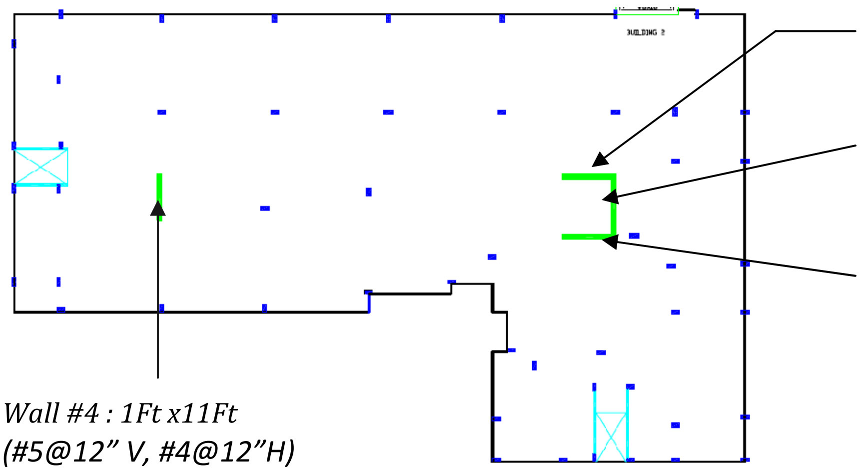


FIG 1: Basic Framing Plan

Shear Walls: Shear walls footings are to be reinforced at a depth of 25’-0” with vertical bars and ties. Typical shear wall reinforcing are #4@12” vertical and horizontal, 8#8 in the middle, and #3 ties in various arrangements.



Wall #1 : 1Ftx 13Ft
(#5@12” V, #4@12”H)

Wall #3: 1Ft X 18 Ft
(#5@12” V, #4@12”H)

Wall #2: 1Ft X 13 Ft
(#5@12” V, #4@12”H)

Wall #4 : 1Ft x11Ft
(#5@12” V, #4@12”H)

FIG. 2: Shear Wall Locations and Sizes

2. LOADING CONDITIONS

DEAD LOAD

7 ½” Post Tension Slab	150 PCF
Beams	VARIES
Façade #1 (4” Brick, 8” CMU)	95 PSF
Façade #2 (4” Brick, Glass, Cold form)	35 PSF
Superimposed Dead Loads:	
Partitions	20 PSF
Mechanical/Electrical	5 PSF

LIVE LOAD

Residential Units:	40 PSF
Lobbies/Corridors:	100 PSF
Balconies:	100 PSF
Mechanical/Storage:	125 PSF
Canopy:	60 PSF
Public Areas:	100 PSF
Snow:	30 PSF
Elevator Rooms:	150 PSF

3. SEISMIC

Seismic calculations were done in accordance with ASCE7-05. City Vista has a site classification of D, building height of 114'-0", and is a concrete moment frame with ordinary reinforced shear walls. Using latitude and longitude the computer output a S_s and S_1 value which, was used to get the short and long period coefficients. A building mass of 56,956 Kips was used in conjunction with a seismic response coefficient of 0.0191 to calculate base shear.

Results from software :

$S_s = 0.153$
$S_1 = 0.05$
Fa = 1.6 (Table 11.4-1)
Fv = 2.4 (Table 11.4-2)
$Sm_s = FaS_s = 0.245g$
$Sm_1 = FvS_1 = 0.12g$
$SD_s = 0.163g$
$SD_1 = 0.08g$

Base Shear : V = C_sW = 1089 Kips

Overturning Moment : M=V*h
= 77,962 Kips-Ft

T : Fundamental Period of Structure = $C_tH_n^x$= .697
$\mathbf{T_L}$ = Long-Period transition period = 8 Sec

Seismic Use Group: Group Importance Factor: 1.0
W = Weight of Building = 57,029 Kips
$T \le T_L \rightarrow \mathbf{C_s} = .0191$

Seismic Loading

K = 1.1	Level	H_x	F_x (kips)	Vx (kips)	Mx (kip-Ft)
Penthouse	13	117.00	28.64	-	3350.88
Roof	12	107.21	69.14	28.64	7412.4994
Residential	11	95.30	184.99	97.78	17629.547
Residential	10	85.97	165.17	282.77	14199.6649
Residential	9	76.64	145.56	447.91	11155.7184
Residential	8	67.31	126.19	593.5	8493.8489
Residential	7	57.98	107.09	719.7	6209.0782
Residential	6	48.65	88.3	826.79	4295.795
Residential	5	39.32	69.86	915.09	2746.8952
Residential	4	29.99	51.86	984.95	1555.2814
Residential	3	20.66	34.42	1036.81	711.1172
Residential	2	11.33	17.77	1071.23	201.3341
Lobby	1	0.00	0	1089	0
TOTAL MOMENT				**77,962.06 Kip-Ft**	

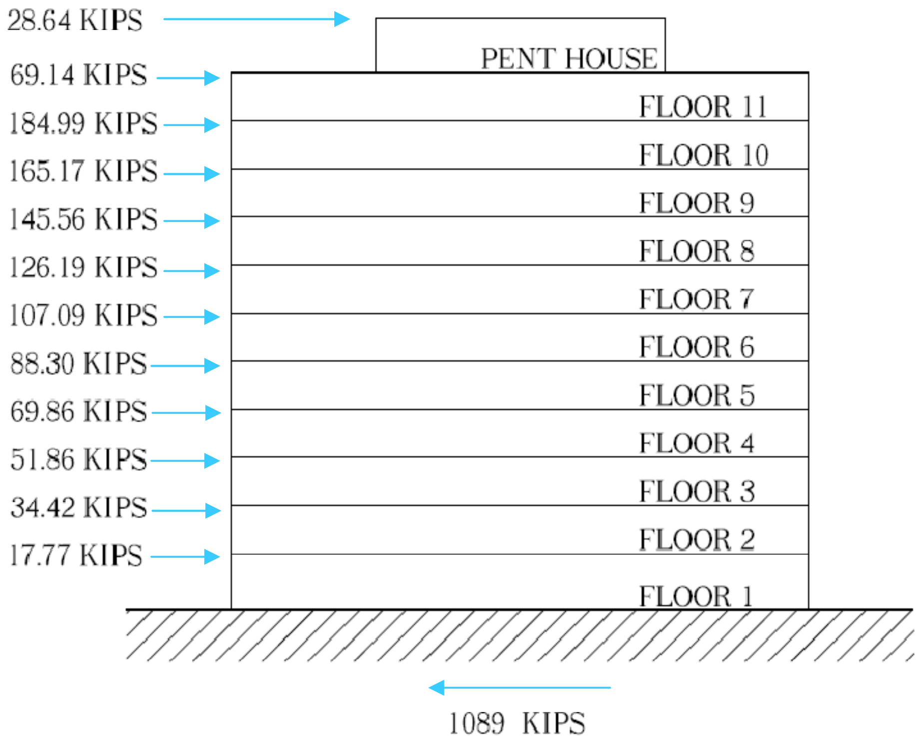


FIG 3 : Story Forces

4. WIND

Wind Calculation were done in accordance to ASCE7-05. A Base shear of 782 Kips and a 52,321Kip-Ft overturning moment was calculated in the east to west (Y) direction and a 425 kips shear and 28,9665 Kip-Ft overturning moment in the north to south (X) direction. Comparing this to the 1089 seismic shear it can be concluded that seismic shear will control. A 1.6 modification factor was applied to all wind loads.

Rigid Building : T=.697 Sec < 1Sec
Exposure Category : B
Enclosure Category : *Enclosed Building*
Basic Wind Speed: V = 90 mph
Importance Factor : I = 1.0
Mean Roof Height : 114'-0"

GC_{pi} = +/- 0.18	
GC_{pi} = +/- 0.18 East/West	$C_{P\ Windward}$ = 0.80 $C_{P\ Leeward}$ = -0.50
North/South	$C_{P\ Windward}$ = 0.80 $C_{p\ Leeward}$ = -0.30 $C_{P\ Side}$ = -0.70

WIND FROM N-S					WIND FROM E-W				
Windward		Leeward		TOTAL (PSF)	Windward		Leeward		TOTAL (PSF)
H	P	H	P		H	P	H	P	
0-15	15.104	0-15	-11.72	26.824	0-15	14.83	0-15	-16.32	31.15
20	16.048	20	-11.72	27.768	20	15.76	20	-16.32	32.08
25	16.8	25	-11.72	28.52	25	16.49	25	-16.32	32.81
30	17.44	30	-11.72	29.16	30	17.23	30	-16.32	33.55
40	18.56	40	-11.72	30.28	40	18.34	40	-16.32	34.66
50	19.616	50	-11.72	31.336	50	19.2	50	-16.32	35.52
60	20.368	60	-11.72	32.088	60	20	60	-16.32	36.32
70	21.12	70	-11.72	32.84	70	20.74	70	-16.32	37.06
80	21.76	80	-11.72	33.48	80	21.48	80	-16.32	37.8
90	22.432	90	-11.72	34.152	90	22	90	-16.32	38.32
100	22.992	100	-11.72	34.712	100	22.56	100	-16.32	38.88
120	23.84	120	-11.72	35.56	120	23.504	120	-16.32	39.824

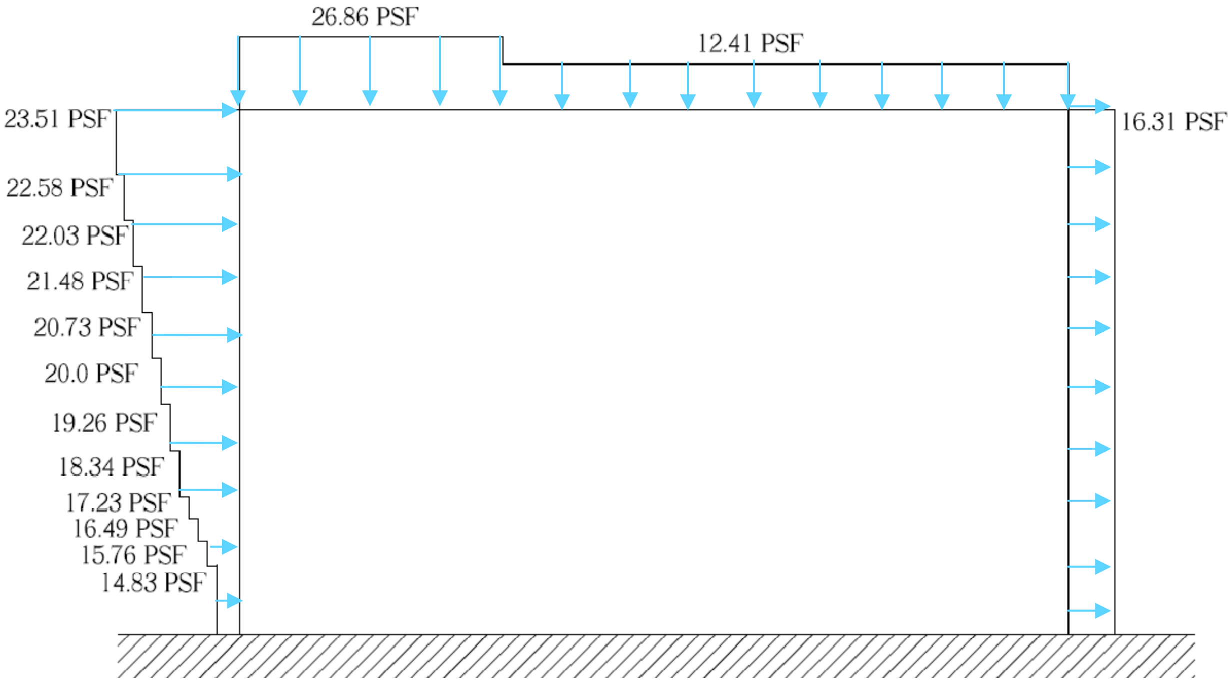


FIG 4: Wind Pressure E-W

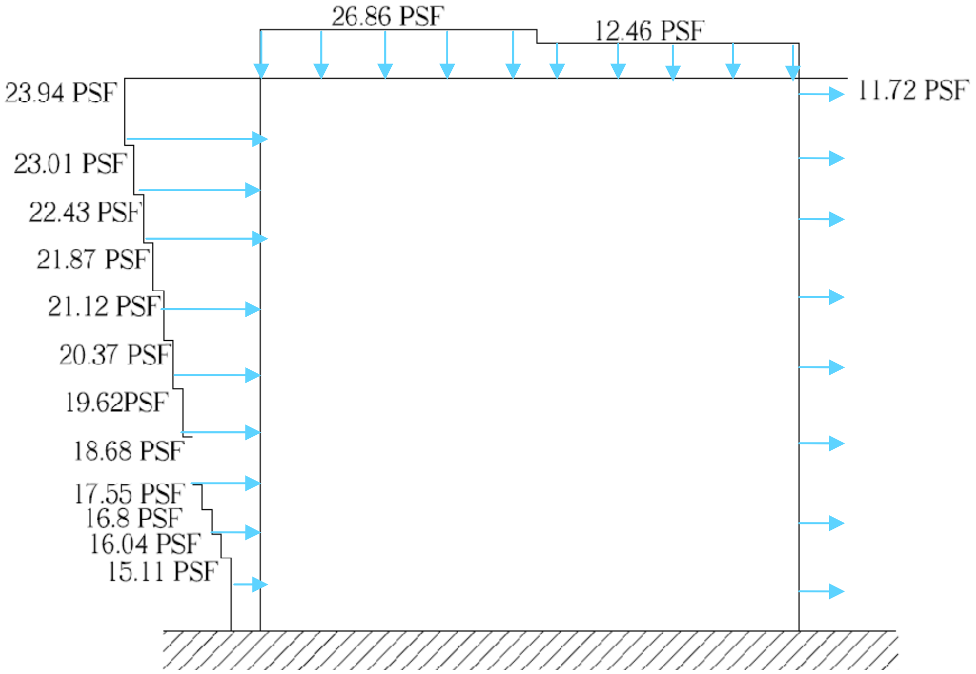


FIG 5: Wind Pressure N-S

5.DISTRIBUTION OF SHEAR FORCES

Seismic and wind shear distributions were considered for this exercise. Base shear values are a combination of torsional and direct shear values. To calculate the torsional shear the center of mass (COM), center of rigidity (COR), and geometric center were calculated (as seen in FIG: 5). Torsion caused by seismic forces is a result of the eccentricity of the COR and COM. Torsional affects due to wind are a result of the eccentricity between the COM and geometric center.

1. *Center of Rigidity* X : 46.75
   Y : 124.6
2. *Center Of Mass* X : 45.17
   Y : 105
3. *Geometric Center* X : 43.75
   Y : 96.667

Eccentricity for Seismic :

X: E-W : 1’ – 6”
Y:N-S : 37’ – 6”

Eccentricity for Wind :

X: E-W : 1’ - 5”
Y: N-S : 8’ – 4”

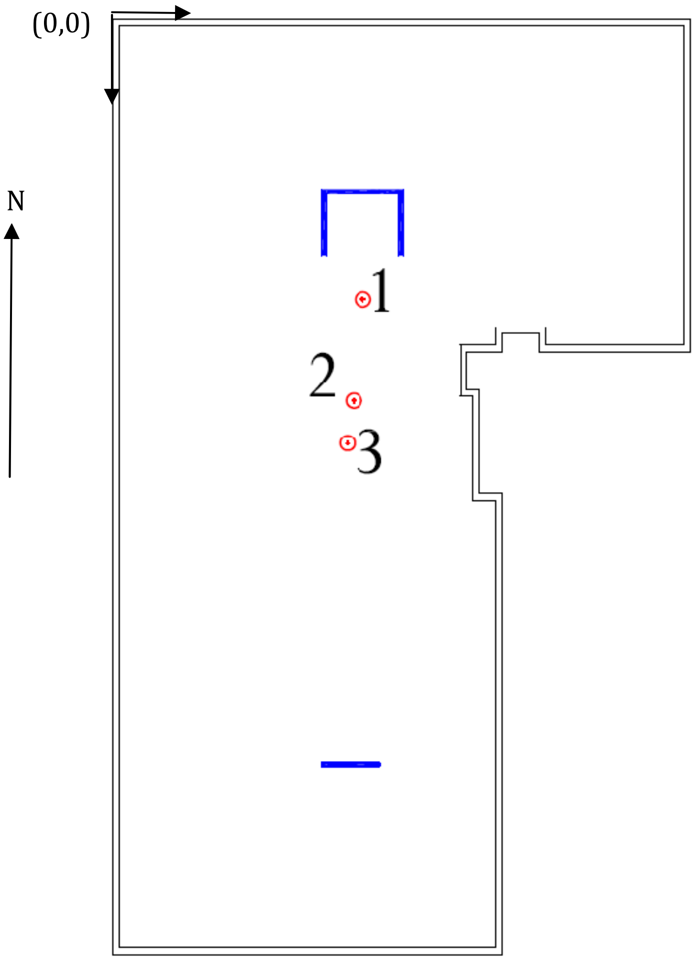


FIG 5: Location of COM, COR, & GC

Direct shear is calculated by dividing each walls rigidity by total rigidity and multiplying by base shear. (Full detail can be seen in the appendix page 19) Torsional shear is found by multiply the base shear by eccentricity, and wall rigidity then dividing by torsional rigidity .

Torsional Shear:

$$\boxed{V_i^t = \frac{V*e*Di*Ri}{J}}$$

Direct Shear:

$$\boxed{V_i = \frac{R_i}{R1+R2+R3+R4} * V}$$

Shear Due to Seismic (KIPS)				
	North – South (X)		East – West (Y)	
	Direct	Torsional	Direct	Torsional
Wall #1	-	57.85	544.5	280.54
Wall #2	-	57.85	544.5	280.54
Wall #3	886.5	373.82	-	24.8
Wall #4	202.5	363.59	-	50.98

Shear Due to Wind (KIPS)				
	North – South (X)		East – West (Y)	
	Direct	Torsional	Direct	Torsional
Wall #1	-	4.96	390.95	71.34
Wall #2	-	4.96	390.95	71.34
Wall #3	345.74	32.14	-	6.307
Wall #4	78.94	31.21	-	12.96

Summary of Forces in Walls Due to Seismic:

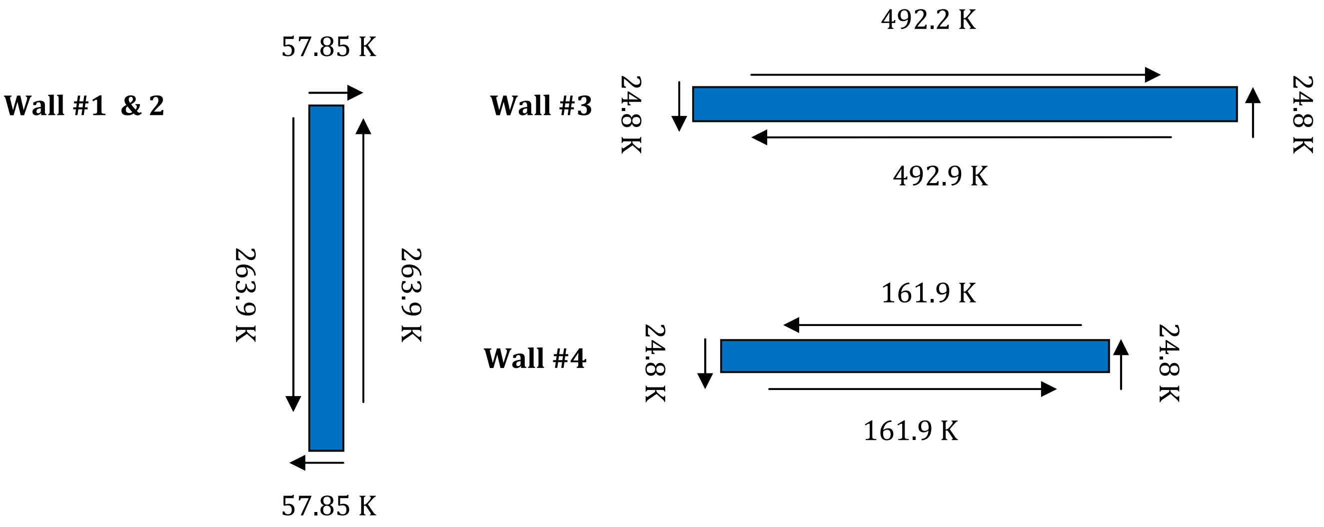


FIG 6 : Seismic base shear summary

Distribution of Shear Forces Due to Seismic:

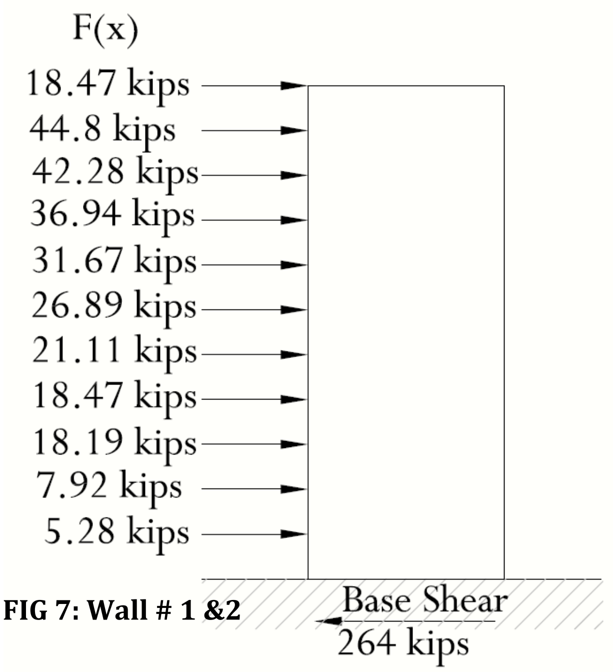


FIG 7: Wall # 1 &2

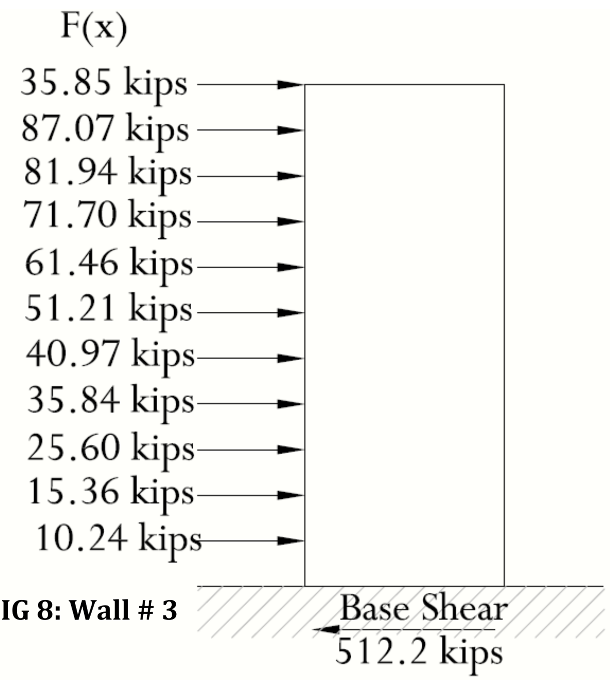


FIG 8: Wall # 3

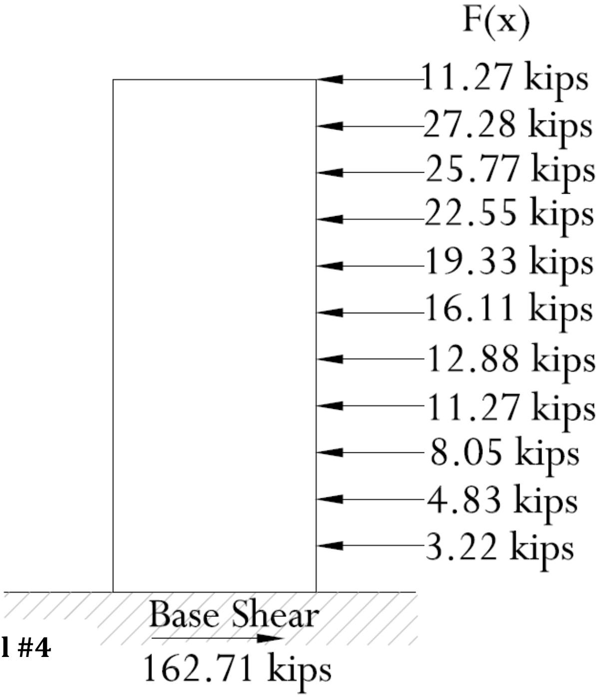


FIG 9: Wall #4

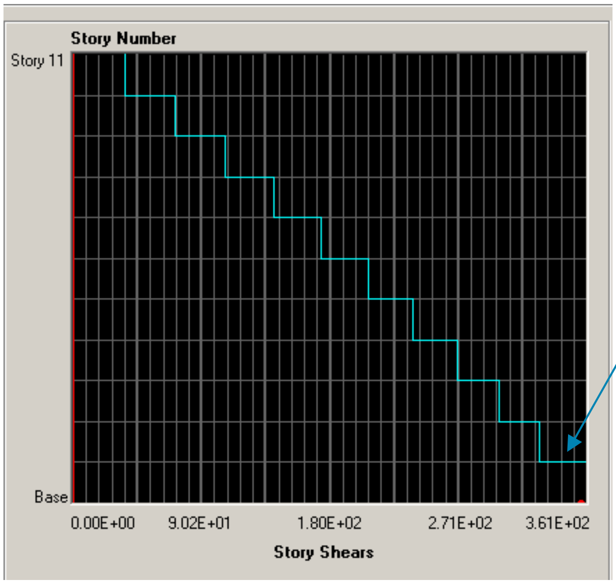
Overturning Moment Consideration:

The foundation system was then examined to support the maximum seismic overturning moments of 77,962 Ft-Kips. This is not a huge concern because a deep foundation system is used. Pile are 60 ft deep with a rating of 125 tons or 62.5 kips. Each column is supported by 4+ piles. As a result foundation failure will not be an issue

6. COMPUTER COMPARISON

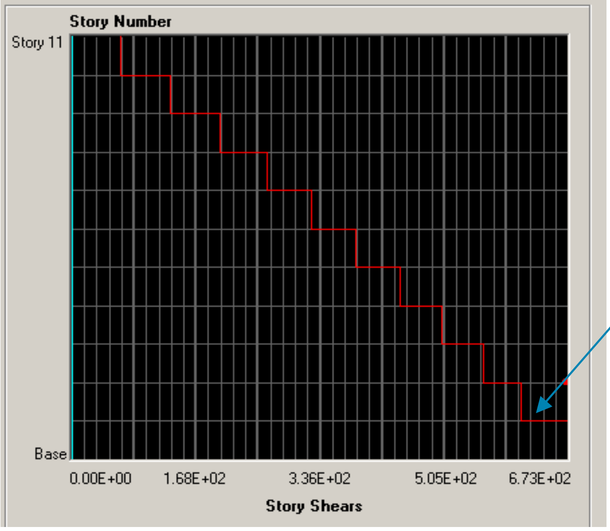
Analysis was also done using E-Tabs. A simplified model was built consisting of exterior columns and the (4) shear walls. Wind loads and seismic loads will be input manual at each level in accordance with wind and seismic load calculation in section 3 and 4. After analysis story shear outputs will be compared to hand calculation to verifies the shear values are correct. Wind results are summarized in detail below, results summarize direct shear only.

Wind Results:



The computer model calculated a base shear of *360.68 Kips* and. This value is close to the *350 Kips* base shear value.

FIG 10 : Wind E to W (X Dir) Story Shear plot



For wind from the North the computer calculated a base shear of *671.02 Kips*. Hand calculations give a base shear of *620.04 kips.*

FIG 11: Wind N to S (Y Dir) Story Shear plot

Seismic Results:

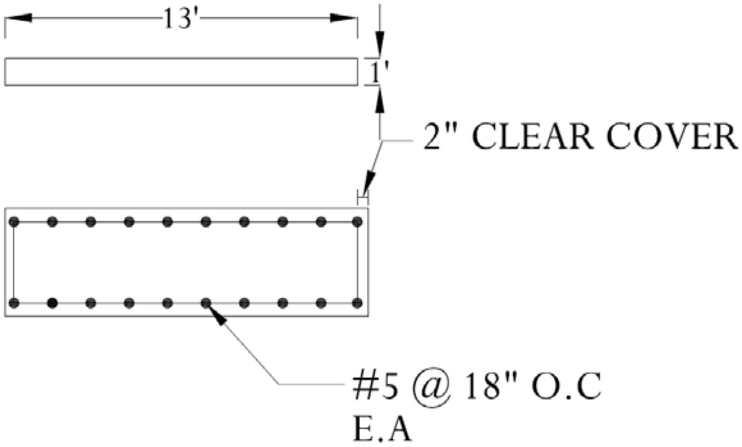
	Computer Results:	E to W (X Dir) = 1055 Kips
		N to S (Y Dir) = 1055 Kips
		Moment : 73,163 Kip-Ft
	Hand Results:	E to W (X Dir) = 1088 Kips
		N to S (Y Dir) = 1088 Kips
		Moment: 77,962 Kip-Ft

7. SHEAR WALL DESIGN

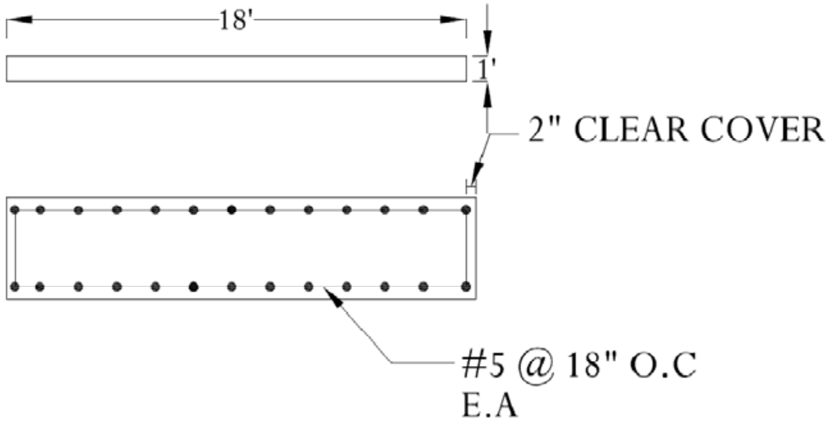
Shear walls were then designed to verify current designs stability using the hand calculated seismic shear values. Hand values were used because they consider tensional and direct shear.

After calculating the required longitinal and transversal reinforcing the following was concluded.

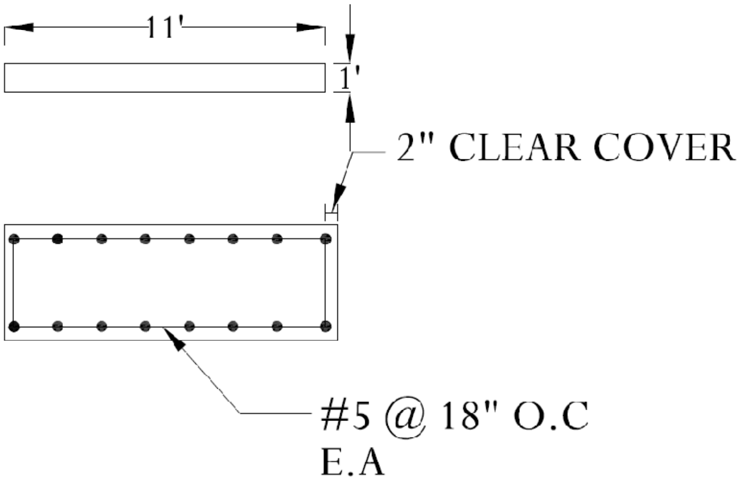
Wall 1&2 :



Wall 3:



Wall 4:



Shear walls reinforcing is different than the original structural plans. Both reinforcing is sufficient to carry the required shear. It could be concluded that alternate reinforcing spacing may have been used for constructability and reasons.

8. STORY DRIFT

Story drift was calculated for each shear wall then added together to get overall building drift in each direction. Columns drift was not considered since it is very minimal, shear walls take most if not all the lateral movement. An industry standard drift limitation was used to check drift values. E-tabs output was also compared with hand solution.

Drift Limitation:
$\Delta = H/400 \rightarrow 114ft/400 = .285ft$ or ***3.42 in***

Drift:

$$\Delta = \frac{PH^3}{3E_mI} + \frac{1.2PH}{E_vA}$$

Shear wall Deflection Due to Seismic
Wall 1: Δ = 0.78 in
Wall 2: Δ = 0.78 in
Wall 3: Δ = 2.04 in
Wall 4: Δ = 0.48 in
Displacement X: **1.56in**
Displacement Y: **2.52in**

E-Tabs outputs a
Story Displacement: X: **2.46in**
Y: **3.42in**

CONCLUSION

After detailed analysis of each shear wall and its direct and torsional affects it can be concluded the current lateral system is sufficient to resists seismic base shear. Seismic shear was calculated using ASCE7-05.

Base Shear:

After detailed analysis of each shear wall and its direct and torsional affects it can be concluded the current lateral system is sufficient to resists the 1089 Kips seismic base shear. This was a slight concern because the center of rigidity and center of mass are at different locations causing eccentricity, resulting in torsional shears Overturning moment was calculated as well checked against the current foundation system for stability. The deep foundation is more than sufficient to resist the 77,962 Kips-Ft overturning moment.

Story Drift:

Seismic story drift was calculated in each direction for each shear wall. Deflection in the X and Y direction both meet the industry standards of H/400. When values were compared with E-Tabs deflections were not consistent. The difference can be attributed to several issues.

1. E-Tabs includes diaphragm drift hand calculations only consider shear wall drift.
2. Modeling issues in E-Tabs

APPENDIX

ADDITIONAL CALCULATIONS NOT INCLUDED
IN APPENDIX CAN BE OBTAINED BY REQUEST

1.SEISMIC:

Building Weight:

Building Weight (W) = DEAD LOAD + 20% SNOW LOAD + ROOFTOP UNITS+20PSF PARTITION
Post Tension Slab = 150 PCF
Wall #1 = 35 PSF (4” Face Brick, Glass, Cold Form Framing)
Wall #2 = 95 PSF (4” Brick, 8” CMU Back Up)
Snow = 30 PSF
Roof Top Units = 8000 lbs
TOTAL BUILDING WEIGHT = 56,956 KIPS

Seismic Loading								
K = 1.1	Level	W_x	H_x	$W_xH1.1_x$	C_{vx} (k)	F_x (kips)	Vx (kips)	Mx (kip-Ft)
Penthouse	13	615.2	117.00	115883.28	0.03	28.64		3350.66
Roof	12	1635	107.21	279754.18	0.06	69.14	28.64	7412.01
Residential	11	4980	95.30	748568.48	0.17	184.99	97.78	17629.86
Residential	10	4980	85.97	668360.79	0.15	165.17	282.77	14199.80
Residential	9	4980	76.64	589020.47	0.13	145.56	447.94	11156.04
Residential	8	4980	67.31	510642.42	0.12	126.19	593.50	8494.17
Residential	7	4980	57.98	433346.58	0.10	107.09	719.70	6209.23
Residential	6	4980	48.65	357289.68	0.08	88.30	826.79	4295.64
Residential	5	4980	39.32	282685.94	0.06	69.86	915.09	2746.90
Residential	4	4980	29.99	209847.33	0.05	51.86	984.95	1555.26
Residential	3	4980	20.66	139274.85	0.03	34.42	1036.81	711.09
Residential	2	4980	11.33	71925.39	0.02	17.77	1071.23	201.39
Lobby	1	4980	0.00	0.00	0.00	0.00	1089.00	0.00
TOTAL								77962.06

2.WIND:

K_z: Table 6-3

K_{zt} : 1.0 :

K_d: Table 6-4 / *Building Main wind force resisting System*

$G = .0925\ (1+1.7gI_zQ)/(1+1.7*gI_z)$ → n-s = 0.833
→ w-e = 0.818

$Iz = .3(33/68.4)^{1/3}=907.4$

G = 3.4

Q = → w-e = 0.885
→ n-s = 0.833

C_{pi} : FIG 6-5 = +/- 0.18

Cp: FIG 6.6 → w-e : LEEWARD = -0.5 (L/B = .616)
WINDWARD= 0.8
n-s: LEEWARD = -0.3 (L/B = 1.6)
WINDWARD = 0.8

Wind From W-E								
Windward		Leeward		TOTAL	Area (ft^2)	P (kips)	Shear	Moment
h	P	h	p					
0-15	14.83	0-15	-16.32	31.15	2700	84.105	782.4834	0
20	15.76	20	-16.32	32.08	900	28.872	698.3784	577.44
25	16.49	25	-16.32	32.81	900	29.529	669.5064	738.225
30	17.23	30	-16.32	33.55	900	30.195	639.9774	905.85
40	18.34	40	-16.32	34.66	1800	62.388	609.7824	2495.52
50	19.2	50	-16.32	35.52	1800	63.936	547.3944	3196.8
60	20	60	-16.32	36.32	1800	65.376	483.4584	3922.56
70	20.74	70	-16.32	37.06	1800	66.708	418.0824	4669.56
80	21.48	80	-16.32	37.8	1800	68.04	351.3744	5443.2
90	22	90	-16.32	38.32	1800	68.976	283.3344	6207.84
100	22.56	100	-16.32	38.88	1800	69.984	213.3504	6998.4
120	23.504	120	-16.32	39.824	3600	143.3664	143.3664	17203.968
				Base Shear		782.4 Kips		
				Moment		52359.363		

Wind From N-S

Windward		Leeward		TOTAL	Area (ft^2)	P(Kips)	Shear	Moment
h	P	h	p					
0-15	15.104	0-15	-11.712	26.816	1665	44.64864	424.9879	0
20	16.048	20	-11.712	27.76	555	15.4068	380.3393	308.136
25	16.8	25	-11.712	28.512	555	15.82416	364.9325	395.604
30	17.44	30	-11.712	29.152	555	16.17936	349.1083	485.3808
40	18.56	40	-11.712	30.272	1110	33.60192	332.929	1344.0768
50	19.616	50	-11.712	31.328	1110	34.77408	299.327	1738.704
60	20.368	60	-11.712	32.08	1110	35.6088	264.553	2136.528
70	21.12	70	-11.712	32.832	1110	36.44352	228.9442	2551.0464
80	21.76	80	-11.712	33.472	1110	37.15392	192.5006	2972.3136
90	22.432	90	-11.712	34.144	1110	37.89984	155.3467	3410.9856
100	22.992	100	-11.712	34.704	1110	38.52144	117.4469	3852.144
120	23.84	120	-11.712	35.552	2220	78.92544	78.92544	9471.0528
				Base Shear		424.9 Kips		
				Moment		28665.972		

3.SHEAR WALL DISTRIBUTION

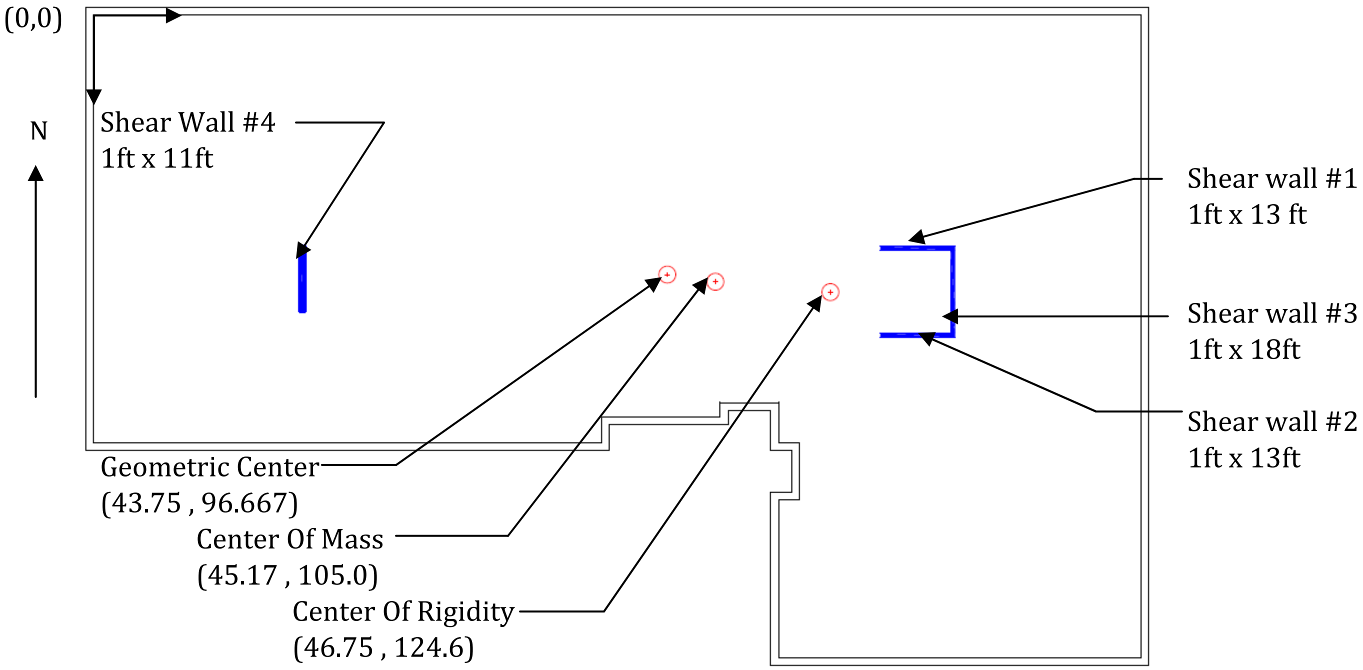


FIG : Center or rigidity, mass, and shear wall locations

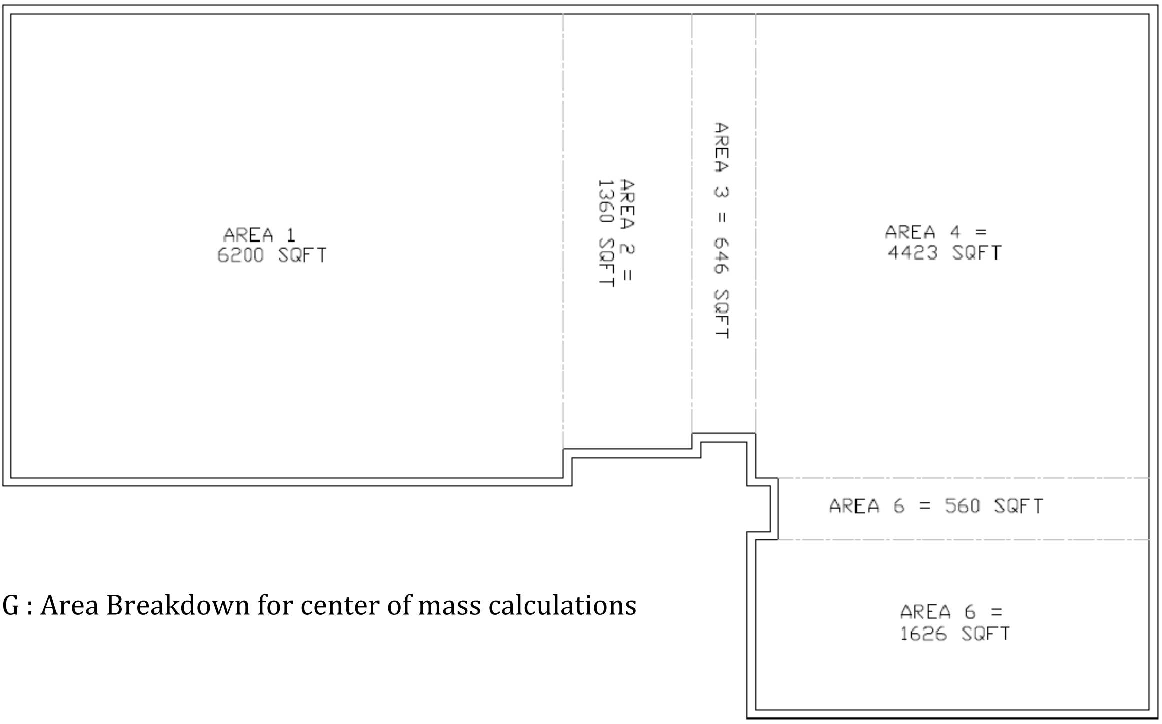
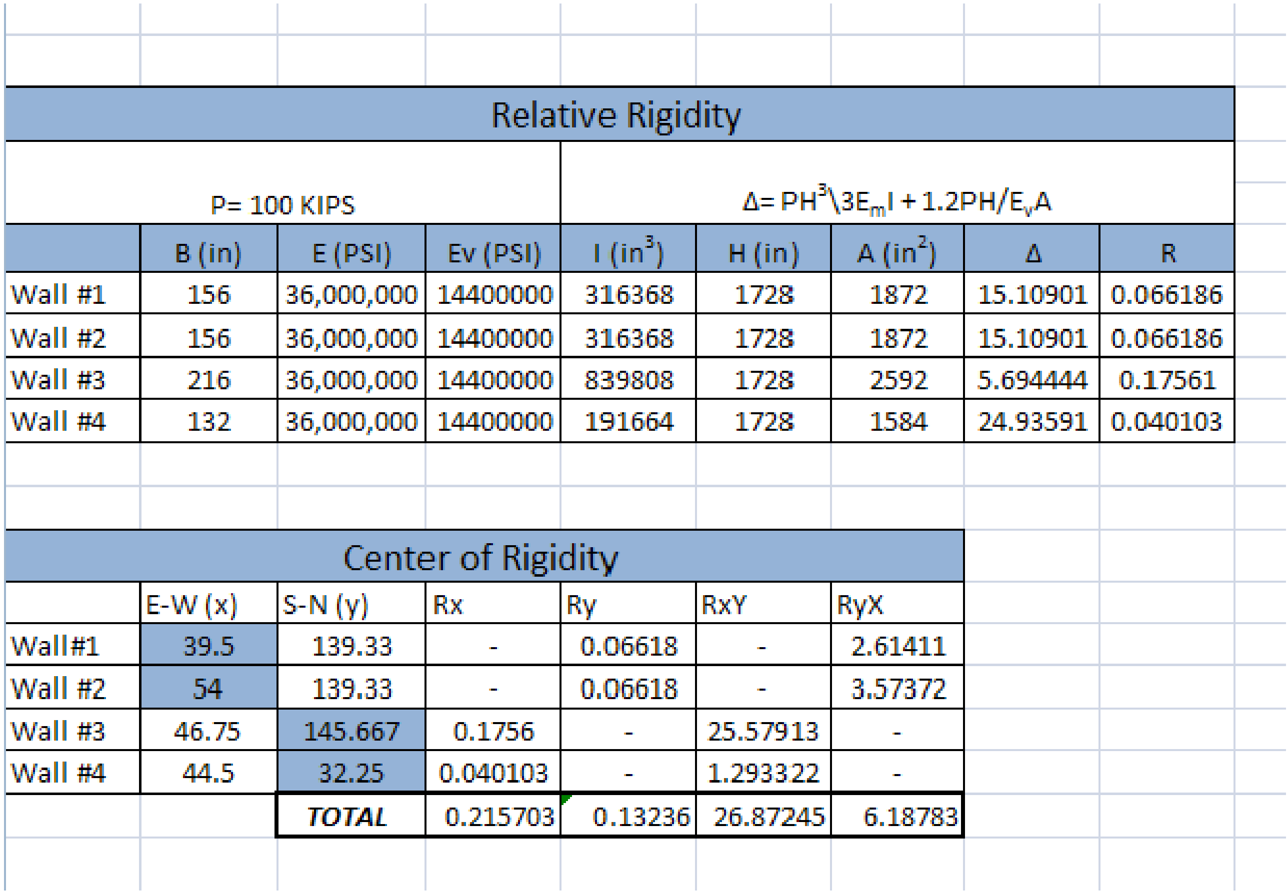


FIG : Area Breakdown for center of mass calculations



Relative Rigidity

P= 100 KIPS

Δ= PH³\3E$_m$I + 1.2PH/E$_v$A

	B (in)	E (PSI)	Ev (PSI)	I (in³)	H (in)	A (in²)	Δ	R
Wall #1	156	36,000,000	14400000	316368	1728	1872	15.10901	0.066186
Wall #2	156	36,000,000	14400000	316368	1728	1872	15.10901	0.066186
Wall #3	216	36,000,000	14400000	839808	1728	2592	5.694444	0.17561
Wall #4	132	36,000,000	14400000	191664	1728	1584	24.93591	0.040103

Center of Rigidity

	E-W (x)	S-N (y)	Rx	Ry	RxY	RyX
Wall#1	39.5	139.33	-	0.06618	-	2.61411
Wall #2	54	139.33	-	0.06618	-	3.57372
Wall #3	46.75	145.667	0.1756	-	25.57913	-
Wall #4	44.5	32.25	0.040103	-	1.293322	-
		TOTAL	0.215703	0.13236	26.87245	6.18783

Center Of Rigidity:

Xr=	46.75
Yr=	124.6

Center Of Mass								
					SLAB		*SHEAR WALLS*	
	Floor Area	X-COORD	Y-COORD	Slab W (kips)	WX	WY	WX	WY
Area 1	6200	36.1667	43	581.25	21021.89	24993.75	602.77	2126.17
Area 2	1360	36.1667	96	127.50	4611.25	12240.00	-	-
Area 3	646	32.667	111	60.56	1978.40	6722.44	-	-
Area 4	4423	36.1667	146.5	414.56	14996.75	60747.14	2850.53	8653.30
Area 5	560	41	148.1667	52.50	2152.50	7778.75	-	-
Area 6	1626	95.25	148.1667	152.44	14519.67	22585.16	-	-
			TOTAL	1388.91	62733.77	145847.71		

Shear Walls					
	W (kips)	X-COORD	Y-COORD	WX	WY
Area 1	15.26	39.5	139.33	602.77	2126.1758
Area 4	18.037	39.5	139.33	712.4615	2513.09521
" "	18.037	54	139.33	973.998	2513.09521
" "	24.9	46.75	145.667	1164.075	3627.1083

Center Of Mass

Xm=	45.17
Ym=	105.01

Torsional Rigidity:

$$\boxed{J=R_i{*}D_i^2}$$

D_i = Dist from COR to wall

J (E-W) = $(.0662{*}7.5^2) + (.0662{*}7.5^2) + (.1756{*}.25^2) + (.0401{*}2.5^2) = \underline{7.7091\ (k/in)ft^2}$

J (N-S) = $(.0662{*}8.5^2) + (.0662{*}8.5^2) + (.1756{*}20.75^2) + (.0401{*}88.25^2) = \underline{397.47(k/in)ft^2}$

Direct Shear in Walls – DUE TO SEISMIC :

$$\boxed{V_i = \frac{R_i}{R1+R2+R3+R4} * V}$$

V=1089 Kips

Wall #1 (E-W) $\frac{0\ .0662}{0.0662 + 0.0662}(1089) = \underline{544.5\ Kips}$

Wall #2 (E-W) $\frac{0.0662}{0.0662 + 0.0662}(1089) = \underline{544.5\ Kips}$

Wall #3 (N-S) $\frac{0\ .1756}{0.1756 + 0.0401}(1089) = \underline{886.5\ Kips}$

Wall #4 (N-S) $\frac{0.0401}{0.1756 + 0.0401}(1089) = \underline{202.55\ Kips}$

Torsional Shear in Walls – DUE TO SEISMIC :

$$\boxed{V_i^t = \frac{V{*}e{*}Di{*}Ri}{J}}$$

[EAST – WEST]

V= 1089 Kips e = 1'-6" J = 7.7091

Wall #1 $\frac{1089 * 4 * 7.5 * 0.0662}{7.7091} = \underline{280.54\ Kips}$

Wall #2 $\frac{1089 * 4 * 7.5 * 0.0662}{7.7091} = \underline{280.54\ Kips}$

Wall #3 $\frac{1089 * 4 * .25 * 0.1756}{7.7091} = \underline{24.80\ Kips}$

Wall #4 $\frac{1089 * 4 * 2.25 * 0.0401}{7.7091} = \underline{50.98\ Kips}$

[NORTH - SOUTH]

V=1089 Kips e= 37'-6" J = 397.54

Wall #1: 57.85 Kips

Wall #2: 57.85 Kips

Wall #3: 373.82 Kips

Wall #4: 363.59 Kips

Direct Shear in Walls –DUE TO WIND:

V= 781.9 Kips
Wall #1 (E-W) : 390.95 Kips
Wall #2 (E-W): 390.95 Kips
V=424.9 Kips
Wall #3 (N-S): 345.9 Kips
Wall #4(N-S): 78.94 Kips

Torsional Shear in Walls - DUE TO WIND:

[EAST – WEST] (Y Dir)
V= 781.9 Kips e= 1'-5" J= 7.7091
Wall #1 : 71.34 Kips
Wall #2 : 71.34 Kips
Wall #3 : 6.307 Kips
Wall #4 : 12.96 Kips

[NORTH – SOUTH] (X Dir)
V= 424.9 Kips e = 8'-4" J= 397.54
Wall #1 : 4.96 Kips
Wall #2 : 4.96 Kips
Wall #3 : 32.14 Kips
Wall #4 : 31.21 Kips

Total Shear (seismic):

[E-W]

Wall #1: 544.5k – 280.54k = 263.9 Kips
Wall #2: 544.5 – 280.54k = 263.9 Kips

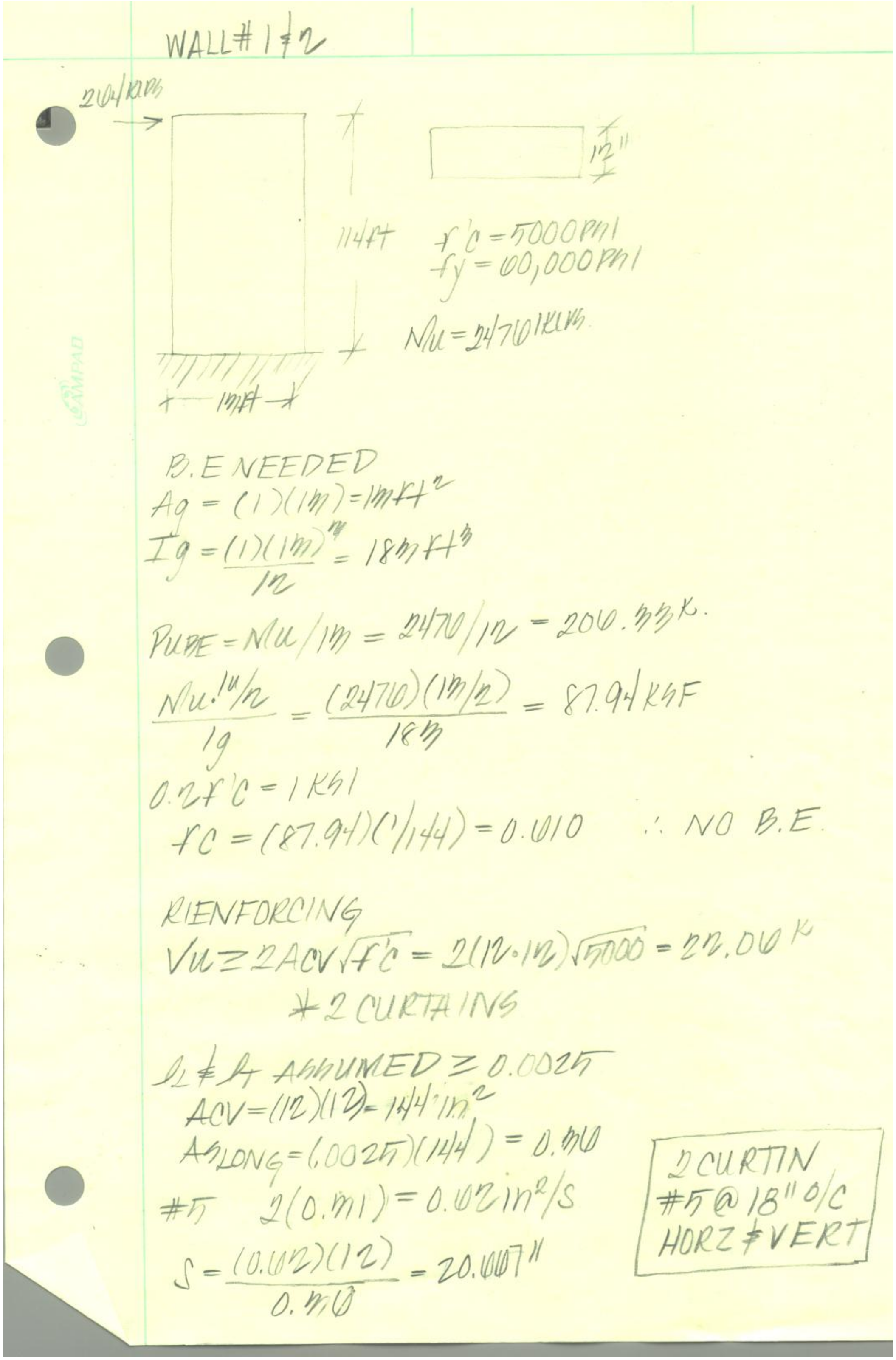
Wall #3: 0 – 24.80k = -24.80 Kips
Wall #4: 0 – 50.98 k = -50.98 Kips

[N-S]
Wall #1: 0 – 57.85k = -57.85 Kips
Wall #2: 0 – 57.85k = -57.85 Kips

Wall #3: 886.5k - 374.36k = 513.5 Kips
Wall #4: 202.55k - 363.59k = - 161.9 Kips

Distribution of Base Shear								
			(E-W)		(N-S)		(N-S)	
			Wall 1&2		Wall 3		Wall 4	
	Level	Cx	Fx (Kips)	Vx(Kips)	Fx (Kips)	Vx (Kips)	Fx (Kips)	Vx (Kips)
Roof	12	0.07	18.473	-	35.8526	-	-11.277	-
Residential	11	0.17	44.863	18.473	87.0706	35.8526	-27.387	-11.277
Residential	10	0.16	42.224	63.336	81.9488	122.9232	-25.776	-38.664
Residential	9	0.14	36.946	105.56	71.7052	204.872	-22.554	-64.44
Residential	8	0.12	31.668	142.506	61.4616	276.5772	-19.332	-86.994
Residential	7	0.1	26.39	174.174	51.218	338.0388	-16.11	-106.326
Residential	6	0.08	21.112	200.564	40.9744	389.2568	-12.888	-122.436
Residential	5	0.07	18.473	221.676	35.8526	430.2312	-11.277	-135.324
Residential	4	0.05	13.195	240.149	25.609	466.0838	-8.055	-146.601
Residential	3	0.03	7.917	253.344	15.3654	491.6928	-4.833	-154.656
Residential	2	0.02	5.278	261.261	10.2436	507.0582	-3.222	-159.489
Lobby	1	0	0	266.539	0	517.3018	0	-162.711
MOMENT			2,476 FT-KIPS		4,805.5 FT-KIPS		1551.52 FT-KIPS	

4.Shear Wall Design



WALL # 1 & 2

$f'c = 5000\text{psi}$
$fy = 60{,}000\text{psi}$

$Nu = 2476\text{kips}$

B.E NEEDED

$Ag = (1)(13) = 13ft^2$

$Ig = \frac{(1)(13)^3}{12} = 183ft^3$

$P_{u,BE} = Nu/13 = 2476/12 = 206.33^k.$

$\frac{Nu \cdot {}^{lw}/_2}{Ig} = \frac{(2476)(13/2)}{183} = 87.94\,KSF$

$0.2f'c = 1\,KSI$

$fc = (87.94)(1/144) = 0.610 \quad \therefore$ NO B.E.

RIENFORCING

$Vu \geq 2ACV\sqrt{f'c} = 2(12 \cdot 12)\sqrt{5000} = 22.06^k$

$*$ 2 CURTAINS

ρ_l & ρ_t ASSUMED ≥ 0.0025

$ACV = (12)(12) = 144\,in^2$

$As_{LONG} = (.0025)(144) = 0.36$

$\#5 \quad 2(0.31) = 0.62\,in^2/s$

$S = \frac{(0.62)(12)}{0.36} = 20.667''$

$$\boxed{\begin{array}{l}\text{2 CURTIN}\\ \#5 @ 18''\ O/C\\ \text{HORZ \& VERT}\end{array}}$$

$V_N = A_{CV}(\alpha_c\sqrt{f'c} + \rho_T f_y)$

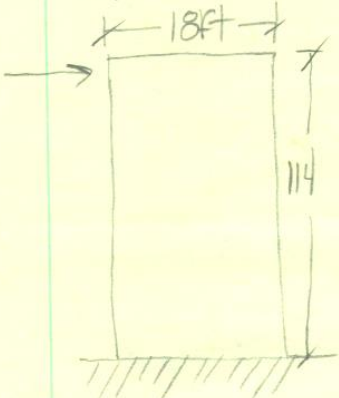
$\alpha_C = \frac{H}{L} = \frac{144}{13} \doteq 11.07 \rightarrow 3$

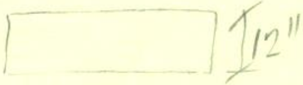
$\rho_T = \frac{(2)(.31)}{(18)(12)} = .0028$

$V_n = 1872((3)\sqrt{5000} + .0028(60{,}000)) = 711.07^{KIPS}$

$\phi V_N - 427^K < 1058.9^K \quad \therefore OK$

WALL #3





$f'c = 5000psi$
$f_y = 60{,}000psi$
$N_U = 4805.5$ KIPS.

B.E NEEDED

$A_g = 18ft^2$
$I_g = 486ft^3$
$P_{UB} = 4805.5/18 = 266.97^K$

$$\frac{(4805.5)(18/2)}{486} = 88.9$$

$f_C = .617 < 1 \quad \therefore NO\ B.E$

REINF.

$V_u \geq 2(12 \cdot 12)\sqrt{5000} = 20.36$ * 2 CURTAINS.