APPENDIX 1: Gravity Load Calculations

SELF WEIGHT:

Slab: 150psf * 8"thick slab / 12" per foot = 100psf

ROOF LIVE LOAD:

A_t= 16.2' * 13' (for a typical bay)

= 208 ft^2

R_1= 1.2 - .001* A_t

= 1.2 - .001*208

= .992

F = 0 for a flat roof

R_2 =1

L_r=20*(.992) (.1)

= 20psf

SNOW LOAD:

C_e = .9 (Table 7.2, B-urban, partially exposed)

C_t = 1 (Table 7.3)

I = 1 (Table 7.4, Category II)

P_g = 25psf (Fig. 7-1)

P_f= .7*(.9)(1)(1)(25) = 15.75psf

APPENDIX 2: Wind Load Calculations

WindCals

Basic Wind Speed (V)	90	Fig 6-1	L	50	build. Geo	qz factor	17.6256
Wind Directionality (kd)	0.85	Table 6-4	B	100	build. Geo	qh	18.330624
Importance Factor (I)	1	Table 6-4	H	116.33	build. Geo		
Topical Factor (kzt)	1		I	320	Table 6-2		

Cp windward	0.8 Fig 6-6
Cp leeward	-0.5 Fig 6-7
Cp leeward	-0.3 Fig 6-8
Gcpi (internal pressure)	0.18 Fig 6-5

Gust Factor	**0.849930408**
Iz	0.264788883
Z bar	69.798
c	0.3
Q (n/s)	0.865816967
Lz	410.7645834
gq	3.4
gv	3.4

				N/S direction (lbs/ft^2)			**E/W direction (lbs/ft^2)**		
Floor	Height	Kz values	qz	P (windward)	P (leeward)	P (net)	P (windward)	P (leeward)	P (net)
ground	0	0.57	10.05	10.13	-11.09	21.22	10.13	-1.37	11.51
1	11.5	0.57	10.05	10.13	-11.09	21.22	10.13	-1.37	11.51
2	20.292	0.66	11.63	11.21	-11.09	22.30	11.21	-1.37	12.58
3	29.08	0.7	12.34	11.69	-11.09	22.78	11.69	-1.37	13.06
4	37.875	0.76	13.40	12.41	-11.09	23.50	12.41	-1.37	13.78
5	46.67	0.81	14.28	13.01	-11.09	24.10	13.01	-1.37	14.38
6	55.458	0.85	14.98	13.49	-11.09	24.58	13.49	-1.37	14.86
7	64.25	0.89	15.69	13.97	-11.09	25.06	13.97	-1.37	15.34
8	73.04	0.93	16.39	14.45	-11.09	25.53	14.45	-1.37	15.82
9	81.83	0.96	16.92	14.80	-11.09	25.89	14.80	-1.37	16.18
10	90.625	0.99	17.45	15.16	-11.09	26.25	15.16	-1.37	16.54
11	99.42	0.99	17.45	15.16	-11.09	26.25	15.16	-1.37	16.54
12	108.83	1.04	18.33	15.76	-11.09	26.85	15.76	-1.37	17.14
roof	116.33	1.04	18.33	15.76	-11.09	26.85	15.76	-1.37	17.14

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	139.07
	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	170.79
	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

APPENDIX 3: Seismic Load Calculations

Seismic Cals

Seismic Use Group		I	Table 9.1.3
Occupancy Category		II	Table 1
Importance Factor	I	1	Table 9.1.4
Max Ground Motions			
	Ss	18.7	Fig 4.1.1
	Si	6.3	Fig 4.1.1
Site Class		C	9.4.2.4
Site Class Factors			
	Fa	1	Table 9.4.1.3.4a
	Fv	1.3	Table 9.4.1.3.4b

Sms	18.7
Smi	8.19

Sds	12.47
Sdi	5.46

Seismic Design Cat.		A	Table 9.4.21
Response Mod. Fact.	R (n/s)	5	Table 9.5.2.2
	R (e/w)	5	Table 9.5.2.2
Building Frame	Wo (n/s)	2.5	Table 9.5.2.2
	Wo (e.w)	2.5	Table 9.5.2.2
	Cd (n/s)	4.5	Table 9.5.2.2
	Cd (e/w)	4.5	Table 9.5.2.2
Structure Type	Ct	0.02	Table 9.5.5.3.2
	x	0.75	Table 9.5.5.3.2

Seismic Resp. Coef	Cs	0.025	9.5.5.2.1
	Cs (max)	0.016	
	Cs (min)	0.005	
	Cs	0.016	

Period	Ta	0.67	Eq 9.5.5.3.2-1
	k	1.09	9.5.4.4

Seismic Base Shear	V (kips)	105.73	Eq 9.5.5.2-1

height (ft)	108.58	
Ct	0.02	Table 9.5.5.3.2
x	0.75	Table 9.5.5.3.2

exterior wall weight (ft^2)	30

APPENDIX 3: Seismic Load Calculations

Floor	height (ft)	Floor Area (fts)	Slab thickness (in)	Floor Load (kips)	Exterior Wall length (ft)	Exterior wall trib height (ft)	Wall Load (kips)
roof	108.58	3871.00	8.00	387.10	256	4.71	36.13
12	99.17	3871.00	8.00	387.10	256	9.10	69.91
11	90.38	3871.00	8.00	387.10	256	8.79	67.55
10	81.58	3871.00	8.00	387.10	256	8.79	67.53
9	72.79	3871.00	8.00	387.10	256	8.79	67.51
8	64.00	3871.00	8.00	387.10	256	8.79	67.51
7	55.21	4560.64	8.00	456.06	298	8.79	78.58
6	46.42	4699.34	8.00	469.93	298	8.79	78.60
5	37.63	4699.34	8.00	469.93	298	8.80	78.63
4	28.83	4699.34	8.00	469.93	298	8.79	78.60
3	20.04	4699.34	8.00	469.93	298	8.79	78.58
2	11.25	4560.64	8.00	456.06	298	10.02	89.59
Ground	0.00	4900.00	8.00	490.00	298	5.63	50.29

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		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)	6513.46
Overturning Moment	7826.58

APPENDIX 4: Load Cases

Story	D (psf)	L (psf)	Lr (psf)	S (psf)	W (psf)	E (psf)
12	120	60	20	15.75	26.85	3.84
11	120	60	20	15.75	26.25	3.76
10	120	60	20	15.75	26.25	3.38
9	120	60	20	15.75	25.89	3.02
8	120	60	20	15.75	25.53	2.67
7	120	60	20	15.75	25.06	2.32
6	120	60	20	15.75	24.58	1.97
5	120	60	20	15.75	24.1	1.632
4	120	60	20	15.75	23.5	1.299
3	120	60	20	15.75	22.78	0.973
2	120	60	20	15.75	22.3	0.656
1	120	100	20	15.75	21.22	0.359

Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
168	250	197.48	226.96	78.99	150.96	111.84
168	250	197	226	78.91	150	111.76
168	250	197	226	78.53	150	111.38
168	250	196.712	225.424	78.17	149.424	111.02
168	250	196.424	224.848	77.82	148.848	110.67
168	250	196.048	224.096	77.47	148.096	110.32
168	250	195.664	223.328	77.12	147.328	109.97
168	250	195.28	222.56	76.782	146.56	109.632
168	250	194.8	221.6	76.449	145.6	109.299
168	250	194.224	220.448	76.123	144.448	108.973
168	250	193.84	219.68	75.806	143.68	108.656
168	314	192.976	237.952	123.509	141.952	108.359

APPENDIX 5: ETABS calculated wind and seismic loads

ETABS Load Calculations

Wind N/S

Story	FX	FY	FZ	MX	MY	MZ
STORY12	0	4.22	0	0	0	-136.044
STORY11	0	8.36	0	0	0	-371.588
STORY10	0	8.23	0	0	0	-365.653
STORY9	0	8.09	0	0	0	-359.288
STORY8	0	7.93	0	0	0	-348.578
STORY7	0	7.76	0	0	0	-337.448
STORY6	0	7.58	0	0	0	-356.066
STORY5	0	7.37	0	0	0	-347.01
STORY4	0	7.13	0	0	0	-335.659
STORY3	0	6.84	0	0	0	-323.01
STORY2	0	6.49	0	0	0	-306.656

Wind E/W

STORY12	5.75	0	0	0	0	6.955
STORY11	11.37	0	0	0	0	18.962
STORY10	11.16	0	0	0	0	18.603
STORY9	10.92	0	0	0	0	18.218
STORY8	10.68	0	0	0	0	20.627
STORY7	10.4	0	0	0	0	22.824
STORY6	11.43	0	0	0	0	1012.037
STORY5	12.35	0	0	0	0	1066.091
STORY4	11.86	0	0	0	0	1014.927
STORY3	11.28	0	0	0	0	966.653
STORY2	10.56	0	0	0	0	906.768
STORY1	11.48	0	0	0	0	834.92

Seismic N/S

Story	FX	FY
STORY12	0	33.45
STORY11	0	44.55
STORY10	0	40.6
STORY9	0	36.65
STORY8	0	32.88
STORY7	0	29.07
STORY6	0	26.84
STORY5	0	22.67
STORY4	0	18.42
STORY3	0	14.17
STORY2	0	9.88
STORY1	0	6.18

Seismic E/W

Story	FX	FY
STORY12	19.39	0
STORY11	25.48	0
STORY10	22.88	0
STORY9	20.33	0
STORY8	17.92	0
STORY7	15.52	0
STORY6	14	0
STORY5	11.51	0
STORY4	9.05	0
STORY3	6.67	0
STORY2	4.4	0
STORY1	2.51	0

Seismic Input Data

R	Seis Group	SiteClass	Ss	S1	Fa	Fv
5	I		0.187	0.063	1	1.3
5	I		0.187	0.063	1	1.3

Case	Dir	Ecc Ratio	TopStory	BotStory	T Used	CoeffUsed	WeightUsed	BaseShear
SEISMNS	Y	0.05	STORY12	BASE	0.3141	0.0249	12647.96	315.36
SEISMEW	X	0.05	STORY12	BASE	0.8141	0.0134	12647.96	169.65

APPENDIX 6: Drift results from ETABS

Story	Item	Load	Point	X	Y	Z	Drift X	Drift Y	Story Drift X	Story Drift Y
STORY12	Max Drift X	WINDNS	8	589	251	1295.5	0.002651		0.023307592	0
STORY12	Max Drift Y	WINDNS	30	0	1200	1295.5		0.002488	0	0.000283
STORY11	Max Drift X	WINDNS	8	589	251	1190	0.00268		0.02356256	0
STORY11	Max Drift Y	WINDNS	30	0	1200	1190		0.002515	0	0.0002861
STORY10	Max Drift X	WINDNS	8	589	251	1084.5	0.002716		0.023879072	0
STORY10	Max Drift Y	WINDNS	30	0	1200	1084.5		0.002547	0	0.0002897
STORY9	Max Drift X	WINDNS	8	589	251	979	0.002738		0.024072496	0
STORY9	Max Drift Y	WINDNS	5	0	251	979		0.002567	0	0.000292
STORY8	Max Drift X	WINDNS	8	589	251	873.5	0.002727		0.023975784	0
STORY8	Max Drift Y	WINDNS	30	0	1200	873.5		0.002555	0	0.0002906
STORY7	Max Drift X	WINDNS	8	589	251	768	0.002663		0.023413096	0
STORY7	Max Drift Y	WINDNS	30	0	1200	768		0.002493	0	0.0002836
STORY6	Max Drift X	WINDNS	4	589	0	662.5	0.003864		0.033972288	0
STORY6	Max Drift Y	WINDNS	30	0	1200	662.5		0.002372	0	0.0002698
STORY5	Max Drift X	WINDNS	4	589	0	557	0.003545		0.03116764	0
STORY5	Max Drift Y	WINDNS	30	0	1200	557		0.002177	0	0.0002476
STORY4	Max Drift X	WINDNS	4	589	0	451.5	0.003068		0.026973856	0
STORY4	Max Drift Y	WINDNS	30	0	1200	451.5		0.001885	0	0.0002144
STORY3	Max Drift X	WINDNS	4	589	0	346	0.00249		0.02189208	0
STORY3	Max Drift Y	WINDNS	30	0	1200	346		0.001532	0	0.0001742
STORY2	Max Drift X	WINDNS	4	589	0	240.5	0.00181		0.01591352	0
STORY2	Max Drift Y	WINDNS	30	0	1200	240.5		0.001115	0	0.0001268
STORY1	Max Drift X	WINDNS	4	589	0	135	0.000781		0.00878625	0
STORY1	Max Drift Y	WINDNS	30	0	1200	135		0.000489	0	4.347E-05
							0.031733	0.024735		
								total drift (ft)	0.280916234	0.0028012

APPENDIX 7: Drift calculations based on flexural and shear deflections

Story Drift (hand calcs)

N/S -Wall A

Story	Ec (ksi)	b (ft)	h (ft)	I (ft^4)	Aw (sq ft)	P (kips) wind	P wall	Δflexure (ft)	Δshear (ft)	Δ Story (ft)	Δ Building (ft)
12	3604.9965	7.5	8.792	212.3797	65.94	11.12	5.56	1.29942E-06	3.97E-06	5.26942E-06	5.03985E-05
11	3604.9965	7.5	8.792	212.3797	65.94	11.71	5.855	3.4209E-07	4.18064E-06	4.52273E-06	4.51291E-05
10	3604.9965	7.5	8.792	212.3797	65.94	11.31	5.655	3.30405E-07	4.03784E-06	4.36824E-06	4.06064E-05
9	3604.9965	7.5	8.792	212.3797	65.94	11.16	5.58	3.26023E-07	3.98428E-06	4.31031E-06	3.62381E-05
8	3604.9965	7.5	8.792	212.3797	65.94	11	5.5	3.21349E-07	3.92716E-06	4.24851E-06	3.19278E-05
7	3604.9965	7.5	8.792	212.3797	65.94	10.79	5.395	3.15214E-07	3.85219E-06	4.1674E-06	2.76793E-05
6	3604.9965	7.5	8.792	212.3797	65.94	10.58	5.29	3.09079E-07	3.77722E-06	4.0863E-06	2.35119E-05
5	3604.9965	7.5	8.792	212.3797	65.94	10.38	5.19	3.03236E-07	3.70581E-06	4.00905E-06	1.94256E-05
4	3604.9965	7.5	8.792	212.3797	65.94	10.13	5.065	2.95933E-07	3.61656E-06	3.91249E-06	1.54166E-05
3	3604.9965	7.5	8.792	212.3797	65.94	9.81	4.905	2.86585E-07	3.50231E-06	3.7889E-06	1.15041E-05
2	3604.9965	7.5	8.792	212.3797	65.94	9.6	4.8	2.8045E-07	3.42734E-06	3.70779E-06	7.71516E-06
1	3604.9965	7.5	11.25	444.9463	84.375	10.55	5.275	2.40864E-07	3.76651E-06	4.00737E-06	4.00737E-06

E/W -Wall C

Story	Ec (ksi)	b (ft)	h (ft)	I (ft^4)	Aw (sq ft)	P (kips) wind	P wall	Δflexure (ft)	Δshear (ft)	Δ Story (ft)	Δ Building (ft)
12	3604.9965	20.12	8.792	569.744	176.895	14.49	14.49	1.26234E-06	3.85672E-06	5.11905E-06	4.32528E-05
11	3604.9965	20.12	8.792	569.744	176.895	15.05	15.05	3.27453E-10	4.00577E-06	4.0061E-06	3.81337E-05
10	3604.9965	20.12	8.792	569.744	176.895	14.55	14.55	3.16574E-10	3.87269E-06	3.873E-06	3.41276E-05
9	3604.9965	20.12	8.792	569.744	176.895	14.23	14.23	3.09612E-10	3.78752E-06	3.78782E-06	3.02546E-05
8	3604.9965	20.12	8.792	569.744	176.895	13.91	13.91	3.0265E-10	3.70234E-06	3.70265E-06	2.64668E-05
7	3604.9965	20.12	8.792	569.744	176.895	13.49	13.49	2.93511E-10	3.59055E-06	3.59085E-06	2.27642E-05
6	3604.9965	20.12	8.792	569.744	176.895	13.06	13.06	2.84156E-10	3.4761E-06	3.47639E-06	1.91733E-05
5	3604.9965	20.12	8.792	569.744	176.895	12.64	12.64	2.75017E-10	3.36431E-06	3.36459E-06	1.56969E-05
4	3604.9965	20.12	8.792	569.744	176.895	12.12	12.12	2.63703E-10	3.22591E-06	3.22617E-06	1.23323E-05
3	3604.9965	20.12	8.792	569.744	176.895	11.48	11.48	2.49778E-10	3.05556E-06	3.05581E-06	9.10616E-06
2	3604.9965	20.12	8.792	569.744	176.895	11.06	11.06	2.4064E-10	2.94377E-06	2.94402E-06	6.05035E-06
1	3604.9965	20.12	11.25	1193.643	226.35	11.67	11.67	1.98435E-10	3.10614E-06	3.10633E-06	3.10633E-06

APPENDIX 8: Cantilever Deflection

Cantilever Deflection

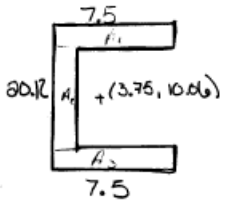
$P_{net} = 26.85$ lb/ft² @ worst level 80 total kips / 116 ft = .69 kip/ft

Pnet on wall = 1342.5 lb/ft

L = 116 ft

E = 3605 ksi

$I = \Sigma I_c + Ad^2$



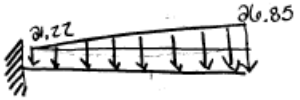
	A	d	I_c
1	7.5^{in^2}	9.56	.625
2	18.12	0	495.78
3	7.5	9.56	.625

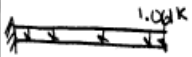
$I_x = (.625 + (7.5 \cdot 9.56^2))2 + 496$

$= 2(686.077) + 496$

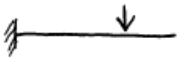
$= 1868 \ ft^4$

$\Delta = \frac{wL^4}{8EI} = \frac{1.342(116^4)}{8(3605 \cdot 144)(1868)} = .03' = .375''$





$\Delta = \frac{1.061(116^4)}{8(3605 \cdot 144)1868} = .025'$



$\Delta = \frac{1.061(3(116) - 77.3)77.3^2}{6(3605 \cdot 144)(1868)} = .004'$

$\Delta_{Total} = .029'$ or $.35''$

Torsion

Center of rigidity is 8' from geographic center - where load acts. Equivalent Moment:

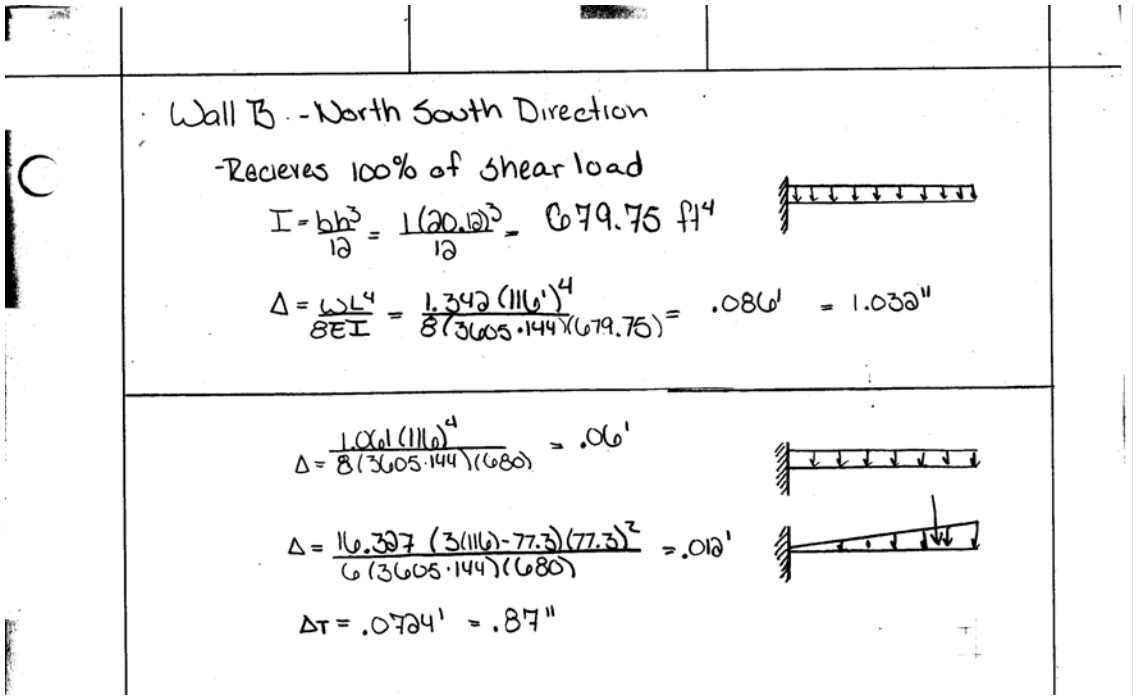
$M = Pe = 155.730 \cdot 8' = 1245.4$ ft

$\Delta = \frac{ML^2}{2EI} = \frac{1245\left(\frac{116}{2}\right)^2}{2(3605 \cdot 144)1868} = .002'$

$\Delta = \frac{w\alpha^2(3L - \alpha)}{6EI} = \frac{155\left(\frac{116}{2}\right)^2\left(3116 - \frac{116}{2}\right)}{6(3605 \cdot 144)1868} = .026'$

$\Delta_T = .3''$

APPENDIX 8: Cantilever Deflection



Wall B - North South Direction

-Recieves 100% of shear load

$I = \frac{bh^3}{12} = \frac{1(20.12)^3}{12} = 679.75\ ft^4$

$\Delta = \frac{\omega L^4}{8EI} = \frac{1.342(116')^4}{8(3605 \cdot 144)(679.75)} = .086' = 1.032''$

$\Delta = \frac{1.061(116)^4}{8(3605 \cdot 144)(680)} = .06'$

$\Delta = \frac{16.397(3(116) - 77.3)(77.3)^2}{6(3605 \cdot 144)(680)} = .012'$

$\Delta_T = .0724' = .87''$

APPENDIX 9: ETABS Torsion results

Story	Pier	Load	Loc	P	V2	V3	T	M2	M3
STORY12	A	WINDNS	Top	-1.71	-6.53	-0.02	-36.053	-0.023	21.79
STORY12	A	WINDNS	Bottom	-1.71	-6.53	-0.02	-36.053	-0.234	-35.648
STORY11	A	WINDNS	Top	-5.08	-3.2	0.02	-36.423	-0.348	-1.408
STORY11	A	WINDNS	Bottom	-5.08	-3.2	0.02	-36.423	-0.162	-29.558
STORY10	A	WINDNS	Top	-8.36	0.07	0.05	-36.865	-0.403	-13.81
STORY10	A	WINDNS	Bottom	-8.36	0.07	0.05	-36.865	0.02	-13.236
STORY9	A	WINDNS	Top	-11.55	3.31	0.08	-37.128	-0.342	-15.763
STORY9	A	WINDNS	Bottom	-11.55	3.31	0.08	-37.128	0.345	13.374
STORY8	A	WINDNS	Top	-14.63	6.6	0.11	-36.943	-0.137	-7.553
STORY8	A	WINDNS	Bottom	-14.63	6.6	0.11	-36.943	0.825	50.488
STORY7	A	WINDNS	Top	-17.55	9.99	0.13	-36.034	0.228	10.672
STORY7	A	WINDNS	Bottom	-17.55	9.99	0.13	-36.034	1.374	98.494
STORY6	A	WINDNS	Top	-18.72	13.5	0.15	-34.246	0.66	32.16
STORY6	A	WINDNS	Bottom	-18.72	13.5	0.15	-34.246	2.002	150.859
STORY5	A	WINDNS	Top	-20.57	17.17	0.2	-31.382	1.177	67.094
STORY5	A	WINDNS	Bottom	-20.57	17.17	0.2	-31.382	2.932	218.029
STORY4	A	WINDNS	Top	-21.93	21.1	0.17	-27.038	2.01	111.46
STORY4	A	WINDNS	Bottom	-21.93	21.1	0.17	-27.038	3.528	296.967
STORY3	A	WINDNS	Top	-26.7	25.13	0.12	-21.785	2.503	102.607
STORY3	A	WINDNS	Bottom	-26.7	25.13	0.12	-21.785	3.534	323.528
STORY2	A	WINDNS	Top	-28.98	29.02	0.49	-15.963	2.362	149.224
STORY2	A	WINDNS	Bottom	-28.98	29.02	0.49	-15.963	6.661	404.329
STORY1	A	WINDNS	Top	-31.85	34.62	-0.44	-6.095	5.587	166.369
STORY1	A	WINDNS	Bottom	-31.85	34.62	-0.44	-6.095	0.675	555.844
STORY12	B	WINDNS	Top	2	6.53	-0.02	-36.053	-0.023	-21.376
STORY12	B	WINDNS	Bottom	2	6.53	-0.02	-36.053	-0.234	36.059
STORY11	B	WINDNS	Top	5.77	3.2	0.02	-36.423	-0.348	2.401
STORY11	B	WINDNS	Bottom	5.77	3.2	0.02	-36.423	-0.162	30.549
STORY10	B	WINDNS	Top	9.11	-0.07	0.05	-36.865	-0.403	14.895
STORY10	B	WINDNS	Bottom	9.11	-0.07	0.05	-36.865	0.02	14.321
STORY9	B	WINDNS	Top	12.04	-3.31	0.08	-37.128	-0.342	16.459
STORY9	B	WINDNS	Bottom	12.04	-3.31	0.08	-37.128	0.345	-12.674
STORY8	B	WINDNS	Top	14.52	-6.6	0.11	-36.943	-0.137	7.379
STORY8	B	WINDNS	Bottom	14.52	-6.6	0.11	-36.943	0.825	-50.655
STORY7	B	WINDNS	Top	16.49	-9.99	0.13	-36.034	0.228	-12.198
STORY7	B	WINDNS	Bottom	16.49	-9.99	0.13	-36.034	1.374	-100.02
STORY6	B	WINDNS	Top	18.72	-13.5	0.15	-34.246	0.66	-32.159
STORY6	B	WINDNS	Bottom	18.72	-13.5	0.15	-34.246	2.002	-150.863

STORY5	B	WINDNS	Top	20.57	-17.17	0.2	-31.382	1.177	-67.094
STORY5	B	WINDNS	Bottom	20.57	-17.17	0.2	-31.382	2.932	-218.029
STORY4	B	WINDNS	Top	21.93	-21.1	0.17	-27.038	2.01	-111.46
STORY4	B	WINDNS	Bottom	21.93	-21.1	0.17	-27.038	3.528	-296.967
STORY3	B	WINDNS	Top	26.7	-25.13	0.12	-21.785	2.503	-102.607
STORY3	B	WINDNS	Bottom	26.7	-25.13	0.12	-21.785	3.534	-323.528
STORY2	B	WINDNS	Top	28.98	-29.02	0.49	-15.963	2.362	-149.224
STORY2	B	WINDNS	Bottom	28.98	-29.02	0.49	-15.963	6.661	-404.329
STORY1	B	WINDNS	Top	31.85	-34.62	-0.44	-6.095	5.587	-166.369
STORY1	B	WINDNS	Bottom	31.85	-34.62	-0.44	-6.095	0.675	-555.844
STORY12	C	WINDNS	Top	-0.07	4.27	0	-95.202	-0.008	-54.524
STORY12	C	WINDNS	Bottom	-0.07	4.27	0	-95.202	-0.012	-16.966
STORY11	C	WINDNS	Top	-0.17	12.55	0	-96.983	-0.023	-123.759
STORY11	C	WINDNS	Bottom	-0.17	12.55	0	-96.983	-0.025	-13.466
STORY10	C	WINDNS	Top	-0.19	20.72	0	-98.933	-0.026	-116.303
STORY10	C	WINDNS	Bottom	-0.19	20.72	0	-98.933	-0.026	65.868
STORY9	C	WINDNS	Top	-0.12	28.75	0	-100.392	-0.018	-33.242
STORY9	C	WINDNS	Bottom	-0.12	28.75	0	-100.392	-0.015	219.495
STORY8	C	WINDNS	Top	0.03	36.62	0	-100.657	0.001	125.123
STORY8	C	WINDNS	Bottom	0.03	36.62	0	-100.657	0.008	447.043
STORY7	C	WINDNS	Top	0.27	44.34	0	-99.011	0.035	358.88
STORY7	C	WINDNS	Bottom	0.27	44.34	0	-99.011	0.035	748.682
STORY6	C	WINDNS	Top	0	51.87	0	-95.038	0.004	604.499
STORY6	C	WINDNS	Bottom	0	51.87	0	-95.038	-0.001	1060.518
STORY5	C	WINDNS	Top	0	59.14	0	-88.176	0	960.974
STORY5	C	WINDNS	Bottom	0	59.14	0	-88.176	0	1480.94
STORY4	C	WINDNS	Top	0	66.32	0	-77.456	0	1389.81
STORY4	C	WINDNS	Bottom	0	66.32	0	-77.456	0	1972.909
STORY3	C	WINDNS	Top	0	73.28	0	-64.443	0	1465.83
STORY3	C	WINDNS	Bottom	0	73.28	0	-64.443	0	2110.054
STORY2	C	WINDNS	Top	0	79.02	0	-49.227	0	1931.629
STORY2	C	WINDNS	Bottom	0	79.02	0	-49.227	0	2626.374
STORY1	C	WINDNS	Top	0	88	0	-22.611	0	2392.85
STORY1	C	WINDNS	Bottom	0	88	0	-22.611	0	3382.837

APPENDIX 10: Full distribute of shear and torsional shear forces to individual walls

SHEAR WALL CALCULATIONS

Calculation of wall rigidities

	height	A	B	C	ΣR N/S	ΣR E/W
roof	108.58					
12	99.17	0.0972	0.0972	0.1465	0.1465	0.1943
11	90.38	0.1110	0.1110	0.1389	0.1389	0.2220
10	81.58	0.1110	0.1110	0.1389	0.1389	0.2220
9	72.79	0.1111	0.1111	0.1389	0.1389	0.2222
8	64.00	0.1111	0.1111	0.1389	0.1389	0.2222
7	55.21	0.1111	0.1111	0.1389	0.1389	0.2222
6	46.42	0.1111	0.1111	0.1389	0.1389	0.2222
5	37.63	0.1110	0.1110	0.1389	0.1389	0.2220
4	28.83	0.1110	0.1110	0.1389	0.1389	0.2220
3	20.04	0.1112	0.1112	0.1389	0.1389	0.2223
2	11.25	0.1111	0.1111	0.1389	0.1389	0.2222
Ground	0.00	0.0645	0.0645	0.1649	0.1649	0.1290

Proportion of story shear

Wall A

floor	proportion	shear (wind)	shear (seismic)
12	0.500	3.813	8.801
11	0.500	7.377	17.316
10	0.500	10.864	24.980
9	0.500	14.271	31.838
8	0.500	17.574	37.899
7	0.500	20.774	43.169
6	0.500	23.871	48.451
5	0.500	26.840	52.943
4	0.500	29.654	56.520
3	0.500	32.363	59.199
2	0.500	34.842	61.005
Ground	0.500	38.015	61.962

APPENDIX 10: Full distribute of shear and torsional shear forces to individual walls

Wall B

floor	proportion	shear (wind)	shear (seismic)
12	0.5	3.813	8.801
11	0.5	7.377	17.316
10	0.5	10.864	24.980
9	0.5	14.271	31.838
8	0.5	17.574	37.899
7	0.5	20.774	43.169
6	0.5	23.871	48.451
5	0.5	26.840	52.943
4	0.5	29.654	56.520
3	0.5	32.363	59.199
2	0.5	34.842	61.005
Ground	0.5	38.015	61.962

Wall C

floor	proportion	shear (wind)	shear (seismic)
12	1	24.701	17.602
11	1	47.788	34.631
10	1	70.558	49.960
9	1	92.999	63.677
8	1	115.027	75.797
7	1	136.633	86.338
6	1	157.817	96.901
5	1	178.485	105.886
4	1	198.520	113.040
3	1	218.117	118.398
2	1	236.774	122.010
Ground	1	260.646	123.923

APPENDIX 10: Full distribute of shear and torsional shear forces to individual walls

Base Moments

Wall A

floor	Shear (k)	Moment/story
12	8.801	77.404
11	17.316	152.290
10	24.980	219.574
9	31.838	279.860
8	37.899	333.129
7	43.169	379.455
6	48.451	426.123
5	52.943	465.633
4	56.520	496.696
3	59.199	520.478
2	61.005	686.306
Ground	61.962	0.000

Moment (ft kips) 4036.949088

Wall B

floor	Shear (k)	Moment/story
12	8.801	77.404
11	17.316	152.290
10	24.980	219.574
9	31.838	279.860
8	37.899	333.129
7	43.169	379.455
6	48.451	426.123
5	52.943	465.633
4	56.520	496.696
3	59.199	520.478
2	61.005	686.306
Ground	61.962	0.000

Moment (ft kips) 4036.949088

APPENDIX 10: Full distribute of shear and torsional shear forces to individual walls

Wall C

floor	Shear (k)	Moment/story
12	24.701	232.439
11	47.788	652.735
10	70.558	1273.296
9	92.999	2090.760
8	115.027	3101.847
7	136.633	4302.849
6	157.817	5690.058
5	178.485	7259.833
4	198.520	9005.817
3	218.117	10922.631
2	236.774	13004.346
Ground	260.646	15936.617

Moment (ft kips) 73473.229

Eccentric Center

N/S	E/W
33	60.75

Torsional Moment due to Ecc.

	N/S	E/W
12	419.9213	638.07
11	812.3981	1255.38
10	1199.492	1811.05
9	1580.987	2308.28
8	1955.459	2747.65
7	2322.758	3129.75
6	2682.884	3512.67
5	3034.244	3838.36
4	3374.839	4097.68
3	3707.993	4291.93
2	4025.155	4422.86
Ground	4430.988	4492.22

APPENDIX 10: Full distribute of shear and torsional shear forces to individual walls

Calculate (for the N/S direction)

Story 12

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.0972	10.1	9.912159283	0.044843	18.83063561
B		0.0972	10.1	9.912159283	0.044843	18.83063561
C		0.1465	3.75	2.060843734	0.025111	10.54464286
				21.8851623		

Story 11

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1110	10.1	11.32358832	0.045573	37.02348231
B		0.1110	10.1	11.32358832	0.045573	37.02348231
C		0.1389	3.75	1.95391313	0.02118	17.20634197
				24.60108976		

Story 10

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1110	10.1	11.32358832	0.045573	54.66456224
B		0.1110	10.1	11.32358832	0.045573	54.66456224
C		0.1389	3.75	1.95391313	0.02118	25.40488072
				24.60108976		

Story 9

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1111	10.1	11.33559217	0.045579	72.05916179
B		0.1111	10.1	11.33559217	0.045579	72.05916179
C		0.1389	3.75	1.953008314	0.02115	33.43791518
				24.62419265		

Story 8

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1111	10.1	11.33559217	0.045579	89.12704653
B		0.1111	10.1	11.33559217	0.045579	89.12704653
C		0.1389	3.75	1.953008314	0.02115	41.35799734
				24.62419265		

Story 7

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1111	10.1	11.33559217	0.045579	105.8680125
B		0.1111	10.1	11.33559217	0.045579	105.8680125
C		0.1389	3.75	1.953008314	0.02115	49.12637802
				24.62419265		

Story 6

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1111	10.1	11.33559217	0.045579	122.2820597
B		0.1111	10.1	11.33559217	0.045579	122.2820597
C		0.1389	3.75	1.953008314	0.02115	56.7430572
				24.62419265		

Story 5

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1110	10.1	11.32358832	0.045573	138.27985
B		0.1110	10.1	11.32358832	0.045573	138.27985
C		0.1389	3.75	1.95391313	0.02118	64.2643598
				24.60108976		

Story 4

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1110	10.1	11.32358832	0.045573	153.8018199
B		0.1110	10.1	11.32358832	0.045573	153.8018199
C		0.1389	3.75	1.95391313	0.02118	71.47806055
				24.60108976		

Story 3

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1112	10.1	11.34039584	0.045579	169.0082491
B		0.1112	10.1	11.34039584	0.045579	169.0082491
C		0.1389	3.75	1.953370305	0.021145	78.40691675
				24.63416198		

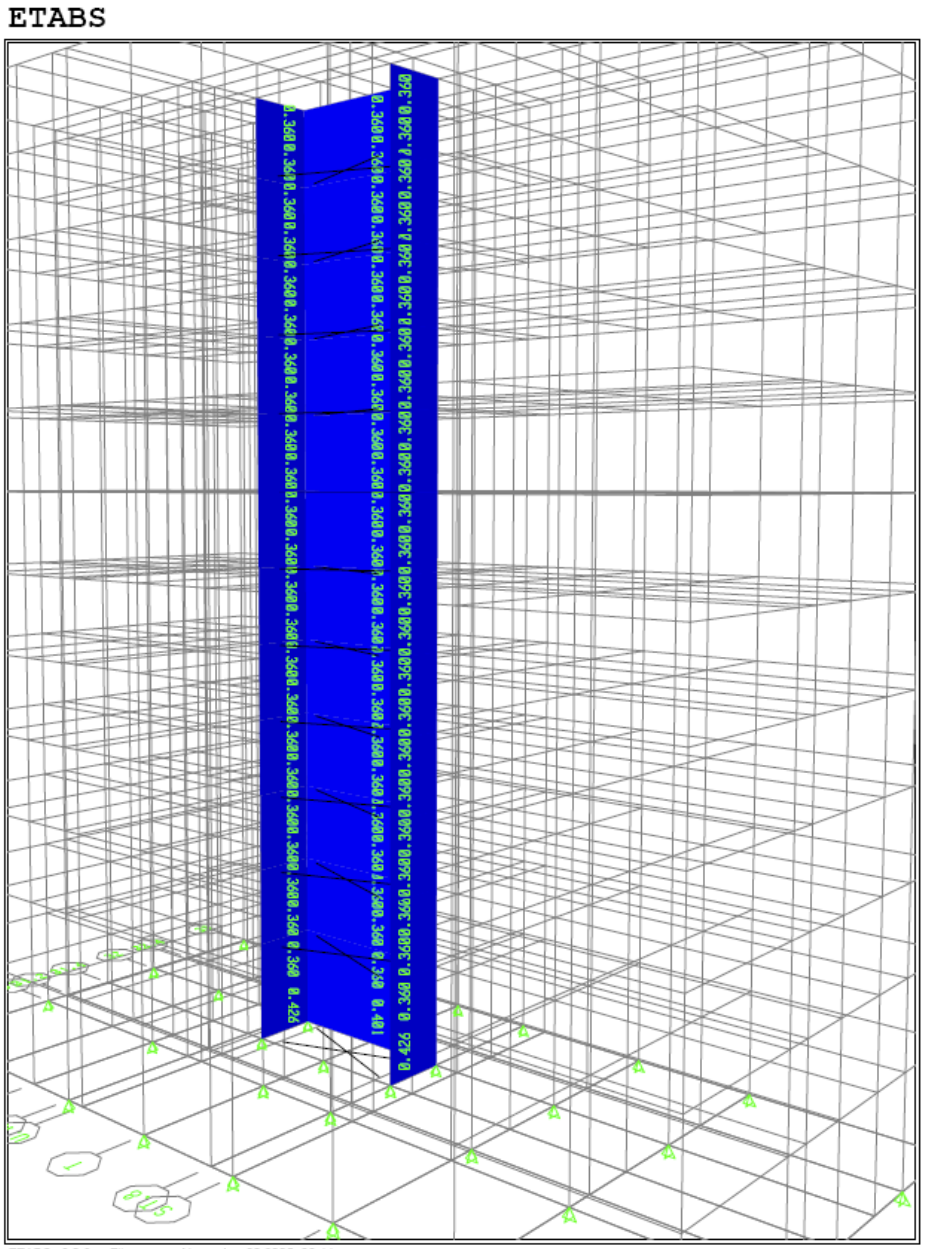
Story 2

Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.1111	10.1	11.33078971	0.045576	183.4520126
B		0.1111	10.1	11.33078971	0.045576	183.4520126
C		0.1389	3.75	1.953370305	0.021162	85.17987305
				24.61494973		

Story 1

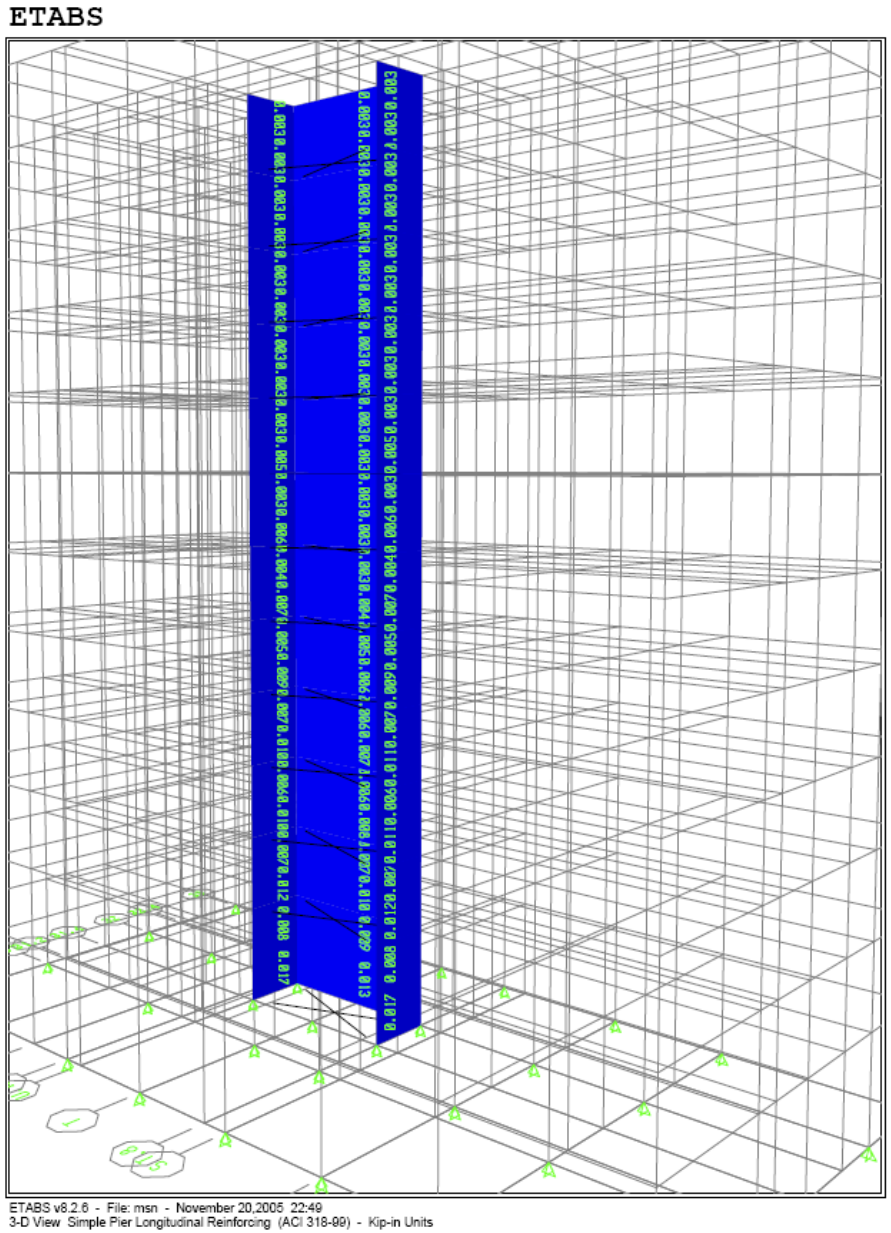
Wall	R/Et		x	Rx^2	Rx/ΣRx^2	Torsional Shear
A		0.0645	10.1	6.581290323	0.04209	186.5008465
B		0.0645	10.1	6.581290323	0.04209	186.5008465
C		0.1649	3.75	2.318790083	0.039941	176.9788212
				15.48137073		

APPENDIX 11: ETABS Shear Wall Design Results



Pier/ Spandrel Shear Reinforcement= 0.36 sq in/ft

APPENDIX 11: ETABS Shear Wall Design Results



Pier Longitudinal Reinforcement ratio
P ranges from .017 to .003

APPENDIX 12: Member Strength Design

Shear Wall Strenght

. Walls A - story 1 (worst case shear load)

thickness = 1'
$l_w = 7.5'$
$d = .8 l_w = 6.03'$ (ACI 11.10.4)

Shear carried by concrete in compression

$V_{cc} = 2\sqrt{f'_c}\, hd$
$= 2\sqrt{4000}\,(1)(6.03)(144)$
$= 110$ kips (ACI 11.10.5)

Check shear limit

$V_n = 10\sqrt{4000}\,(1)(6.03)(144)$
$= 550$ kips (ACI 11.10.3)

∴ This is okay when compared with max shear in walls A and B as found in Appendix 10

Is shear reinforcement needed

$V_u < \Phi V_c/2$
$< .75(110)/2$
$60 < 41.25$

∴ Yes, shear reinforcement is needed.

Design for shear

$V_s = V_u/\Phi - V_c$
$= 60/.75 - 110$
$= -27.33$ ∴ use min shear

Design for torsion

$A_{oh} = 12 \times 12 = 144\ in^2 = 1\ ft^2$
$A_o = .85(144) = 122.4\ in^2 = .85\ ft^2$
$A_t = T_n s / 2 A_o f_y \cot\theta$
$= \frac{73.13(12)}{2(122.4)(60)}$
$= .059\ in^2/ft$

$T_n = 73.13$ kip-in for wall A story 1 from ETABS

Total Reinforcement Needed

$2A_t + A_v =$ Min = 1 #4 every 18"
$2(.06) + \text{Min} = .12 + .3$
$= .4\ in^2/ft$

∴ Use 2 #4 bars every foot

APPENDIX 12: Member Strength Design

Longitudal Reinforcement

$A_L = P_h \cot^2\theta \, A_c / s$

$p_h = .4/144 = .0027$

$A_L = .0027 \cot^2\theta \, (.06)/12$

$= .000014$

OR

$A_{L\,MIN} = \left(5\sqrt{f'_c}\, A_{cp}/f_y\right) - \frac{A_t}{s} p_n$

$= \frac{(5\sqrt{4000}\,(.23/12))}{60{,}000} - \frac{.06}{12}(.0027)$

$= .0144$

$P_{V\,MIN} = .0025 + .5\left(2.5 - \frac{114 \cdot 12}{7.5 \cdot 12}\right)(.0027 - .0025)$

$= .0025$

$p = A_s/A_c$

$A_s = .18 \text{ in}^2$

∴ use one #4 every 12", because load changes direction, use on both faces.