Technical Report 3

The Residences
Anne Arundel County, Maryland

11/29/2010
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Executive Summary

The lateral analysis of The Residences is performed using the lateral and gravity loads that are determined in the first technical report. Two build expansion joints are located in the build which allows for a simple analysis to be preformed. Load combinations provided by ASCE 7-05 that had later loads are studied in this report. Seismic loads are analyzed for both strength and deflection, and wind is only analyzed for deflection.

The direct shear and torisional shear from the lateral loading cases are calculated for each shear wall. The rigidity of each shear is determined by understanding that each shear wall is comprised of multiple similar x-brace frames. It can then be assumed that the number of x-brace frames per shear wall is proportional to the stiffness of that wall and can be used as a relative stiffness. The loads are taken about the Center of Rigidity which is calculated using the relative stiffness of the shear wall frames.

Spot check are completed on shear wall frame B1 and 7 because the loads on the frame are larger compared to other shear wall frames. The frames are found to be able to carry the loads with no problems. A check on the foundation system is also performed and is checked for the impact of overturning. It is found that the foundation would need to resist uplift and further investigate wound need to be conducted.

The drifts of each shear wall frames are calculated by the use of computer analysis, for this report STAAD is used and is checked by inspection. The deflection for each shear wall frame is compared to allowable story drift and total drift as set by ASCE 7-05. The results show that no shear frame exceeded the allowable story drift and total drift.

Introduction

Located in Anne Arundel County, Maryland the Residence is a new construction apartment and retail building which is part of the Arundel Preserve Town Center Phase I Project (Figure 1). The Residence is a five to six story, 300,000 s.f., residential apartment building with 6,000 s.f. retail space surrounding a 5 story precast parking garage. This apartment building houses 242 upscale residential units consisting of studio, one and two bedroom layouts, and two level units. Along with the residential units, the building also includes a terrace level that contains a clubhouse, health center, and an outside pool. Construction of The Residence began in the fall of 2009 and should be completed in the beginning of 2011. It is owned and managed by the Somerset Construction Company and was designed by KTGY.

The structure of The Residence is comprised of the Hanbro floor system, this system uses a steel bar joist that supports a concrete slab (Figure 2). The floor systems are supported by 6" light gage metal studs bearing and shear walls located throughout the building. A more in-depth structural analysis and details will follow in this report.

Figure 1: Site plan, Light Brown area represents the building; Gray area represents the parking garage. Source: Construction documents by Cates Engineering.

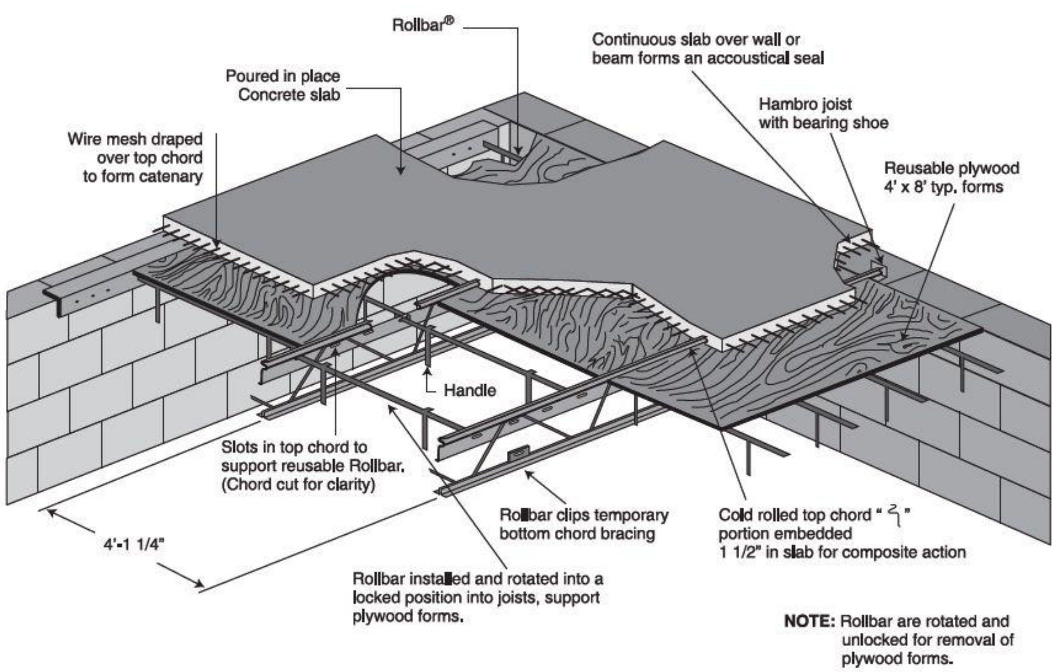


Figure 2: Hambro floor joist system. Source: Hambro Joist Company.

Structural System

Foundation System

According to the geotechnical report, the building rests on Silt-Clay Facies[1] which is identified as clay, silt, and subordinate fine to medium grained muddy sand. The groundwater table is located to be at a minimum 24 feet below existing grade, which is well below the foundation of the building. From the report, it is determined that the structures can be supported on shallow spread footings with an allowable bearing pressure of 5,000 pounds per square foot.

The building foundation system uses a 3'-0" wide strip footing with 3'-0"x3'-0" to 15'-0"x15'-0" column footing pads located mainly around the retail space and clubhouse area (Figure 3). The concrete slab on grade is 4" thick reinforced with 6 x 6 W1.4 xW1.4 welded wire fabric. All foundation concrete is to be a 3,000 psi at 28 day strength.

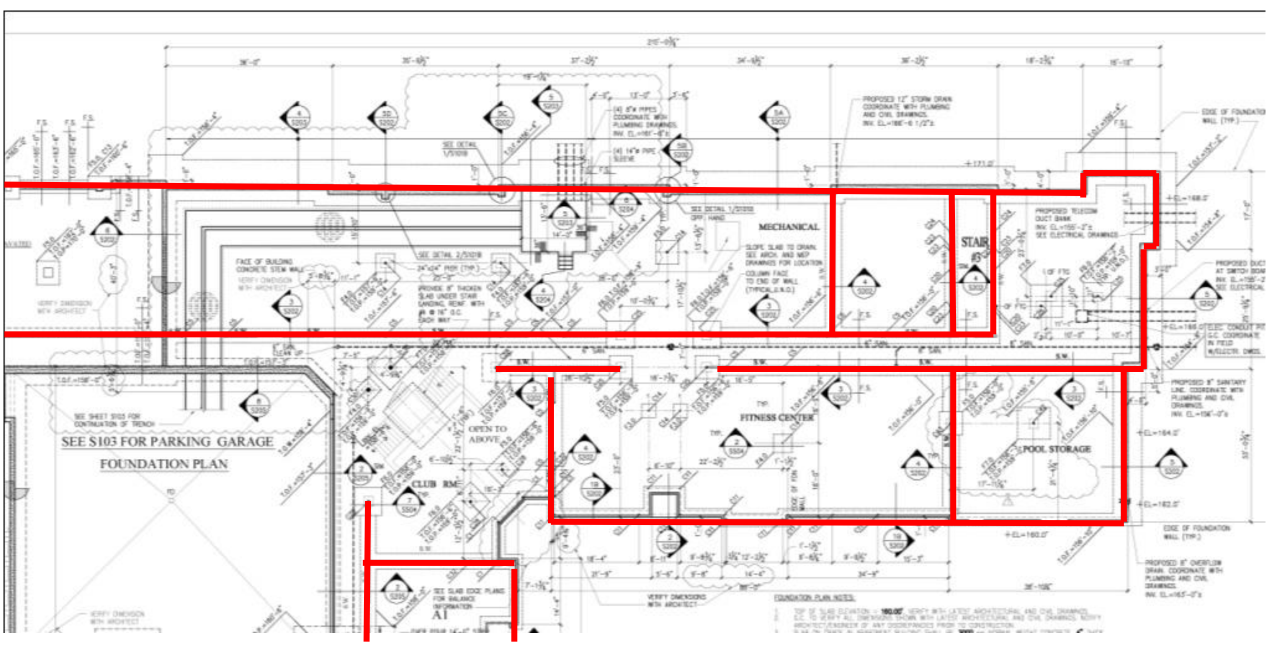
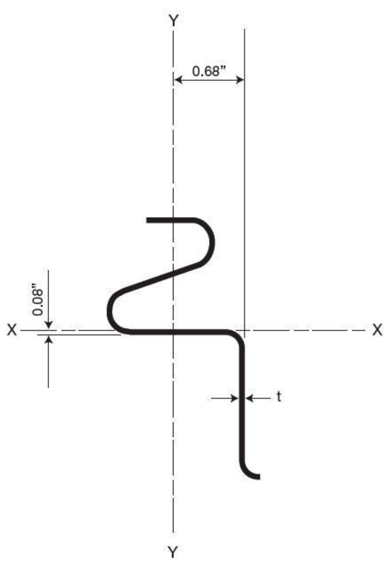


Figure 3: Foundation plan, Part of the east wing. Source: Construction documents by Cates Engineering.

[1] In geology, facies are a body of rock with specified characteristics.

The floor system for the Residence is the Hambro floor joist system (Figure 2). The Hambro floor system uses a specially design steel bar joist with a "S" shape top compression chord that serves three functions, a compression member in the non-composite joist during the construction stage, a chair for the welded wire fabric, and a continuous shear connection for the composite (cured concrete) stage. Detail information of the "s" shape top cord can be seen in Figure 4. The floor slab is a 3" thick 3,000 psi concrete with 6 x 6 W2.9 x W2.9 welded wire fabric. This particular floor thickness is chosen to give the system a 2 hour fire rated system. The slab is then supported by a 20" deep Hambro bar joist.

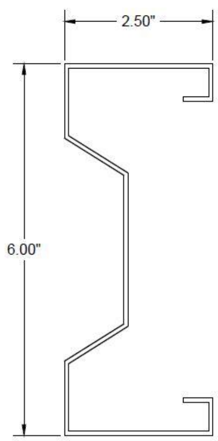


I_x = 0.66 in.^{4}
Top Chord S_x = 0.45 in.^{3}
Bottom Chord S_x = 0.287 in.^{3}
L_y = 0.187 in.^{4}
S_y = 0.167 in.^{3}
t = 13 ga. = 0.090 in.
A_{net} = 0.56 in.^{2}
= (deducting 3/8" deep slot = 6.25 x 0.090)
F_y = 50 ksi min.
F_a = 29.1 ksi

Figure 4: Top chord of the Hambro joist, "s" chord, with section properties.

Framing System

The design framing system in the Residence is light gage steel load bearing walls that are used to support the Hambro floor system and gravity loads in the building. The particular system uses the SigmaStud® load bearing light gage steel stud, a product of The Steel Network Company. The stud design is engineered to have a significant increase in load capacity when compared to the conventional "C" shaped studs. The Residence uses a 6” wide 18 gage stud with a flange length of 2.5”, as detailed in Figure 5. The exterior wall and interior corridor walls of the Residence are the primary bearing walls in the building. Figure 6 shows the location of the bearing walls in the building.



$A=0.772\ in^2$

$I_x=4.183\ in^4$

$I_y=0.513\ im^4$

$F_y=50\ ksi$

$r_x=2.328\ in$

$r_y=0.815\ in$

$E=29,000\ ksi$

Figure 5: Section of light gage steel stud, with section properties.

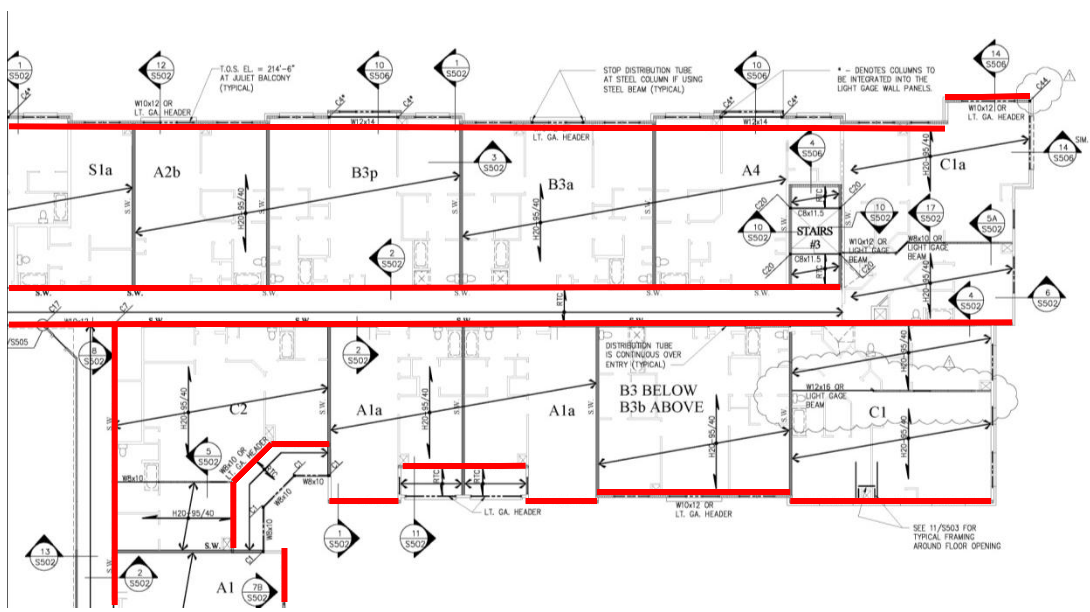


Figure 6: Location of bearing walls, See Appendix A for more plans. Source: Construction documents by Cates Engineering.

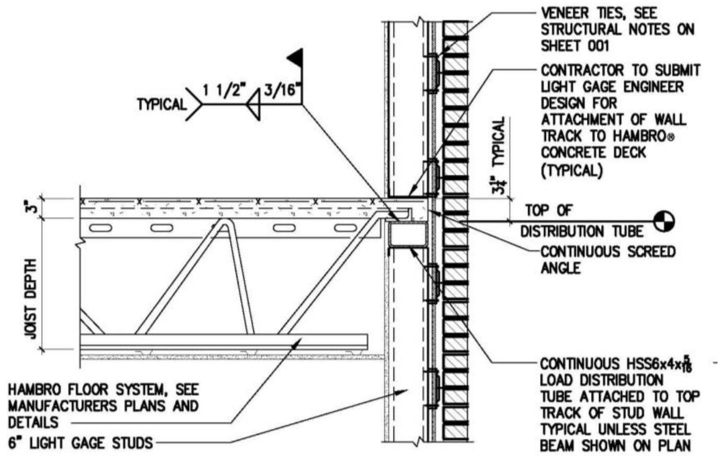


Figure 7: Exterior wall framing details. Source: Construction documents by Cates Engineering.

Lateral System

The lateral system in the Residence is a light gage shear wall system designed and engineered by The Steel Network Company. The system utilizes light gage 50 ksi steel hot dipped galvanized coated straps on both sides of the wall for shear resistance. A 6" wide flat strap is used in the lateral system of the Residence. (See figure 8 for a simple framing detail). The shear walls are located all throughout the building (figure 9), with most of the shear wall located in the corridor walls and the walls separating adjacent apartments.

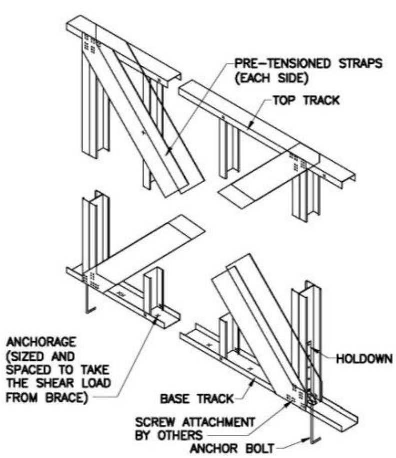


Figure 8: Lateral resistance system. Source: Construction documents by Cates Engineering.

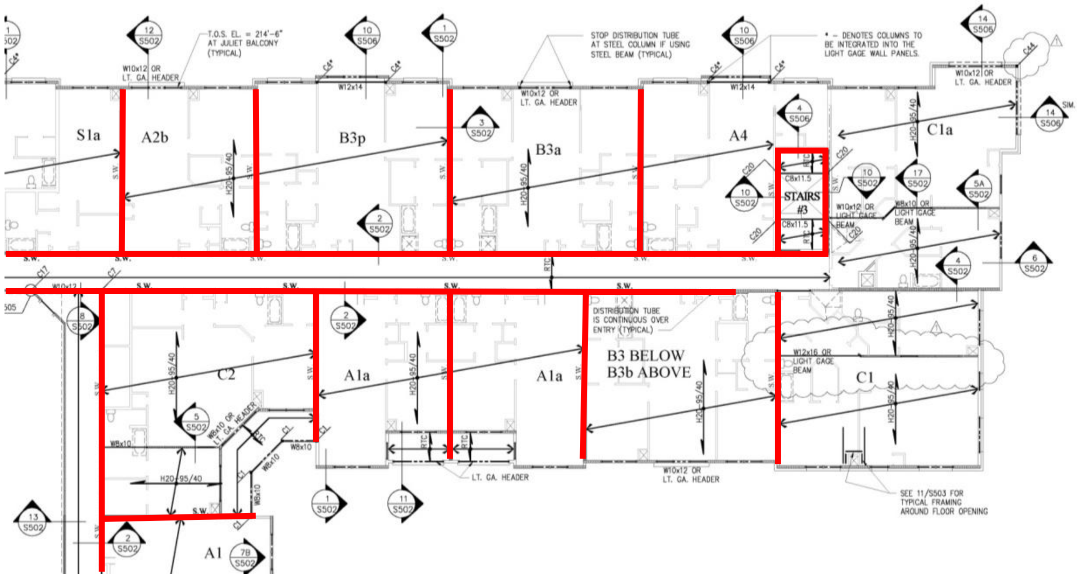


Figure 9: Location of the shear walls, Appendix A for more details. Source: Construction documents by Cates Engineering.

Roof System

The roof system is the same system, Hambro flooring system, which is used for the floor throughout the building. The roof slab is 3" thick 3,000 psi concrete with 6 x 6 W2.9 x W2.9 welded wire fabric, which is supported by a 20" deep Hambro joist.

Materials Used

Concrete

Floor Slab	Normal Weight	f'c=3,000 psi
Roof Slab	Normal Weight	f'c=3,000 psi
Slab on grade	Normal Weight	f'c=3,000 psi
Footings	Normal Weight	f'c=3,000 psi

Steel

W shapes	ASTM A992	Grade 50
Square and Rectangular HSS	ASTM 500	Grade B
Channels	ASTM A36	
Angles shapes	ASTM A36	
Steel Plates	ASTM A36	

Reinforcement

Deformed bars	ASTM A-615	Grade 60
Welded wire Fabric	ASTM A-185	

Codes and References

Design Codes

National Model Code:
- 2006 International Building Code

Design Codes:
- Steel Construction Manual 13th edition, AISC
- American Iron and Steel Institute (AISI) 2008 Design of Cold Formed Steel Structural Members
- American Concrete Institute (ACI) ACI 530-05, Building Code Requirements for Masonry Structures
- American Concrete Institute (ACI) ACI 318-08, Building Code Requirements for Structural Concrete

Structural Standards:
- American Society of Civil Engineers (ASCE), ASCE 7-05, Minimum Design Loads for Buildings and Other Structures

Thesis Codes

National Model Code:
- 2006 International Building Code

Design Codes:
- Steel Construction Manual 13th edition, AISC
- American Concrete Institute (ACI) ACI 318-08, Building Code Requirements for Structural Concrete

Structural Standards:
- American Society of Civil Engineers (ASCE), ASCE 7-05, Minimum Design Loads for Buildings and Other Structures

Load Analysis

Gravity Load

For this report and all further reports, the use of the ASCE7-05 design loads will be used. When comparing the design live loads to the minimal ASCE7-05 loads, it is found that all loads except the roof live load are identical to the ASCE7-05. Table 1.1 shows the design and ASCE7-05 live loads on the building. The roof live load is designed to be 30 psf which is slightly higher than what is stated in ASCE7-05, 20 psf.

Table 1.1: Live Loads

Location	Design (psf)	ASCE7-06 (psf)
Roof	30	20
Living	40	40
Private Decks/Balconies	60	60
Corridors Exit stairs	100	100
Light Storage	125	125

Dead loads values are found from a series of sources including, but not limited to, ASCE7-05 and manufacturer specification. Design dead load on the building can be found in Table 1.2. A listing of assumed dead loads can also be found in Table 1.3.

Table 1.2: Design Dead Loads

Location	Design (psf)
Roof	40
Living	55
Private Decks/Balconies	45
Corridors Exit stairs	45
Light Storage	45

Table 1.3: Assumed Dead Load

	Assumed load (psf)
Slab	36*
Joist	5
Superimpose Dead load	15
wall	15

*** Slab dead load was calculated using a 3" think slab and 145 pcf for concrete**

Snow Load

Due to the location of this building being a snow region, snow loads are calculated in accordance to ASCE7-05 section 7. The results of the load calculation can be seen in table 2. Detail calculation and notes can be found in Appendix B.

Table 2: Snow loads

Ground snow load	Pg= 30 psf
Flat roof snow load	Pf= 21 psf
Slop roof snow load	Ps= 21 psf

Wind Load

Wind Load on Whole Structure

The wind loads on the building was determined using method 2 of the ASCE7-05 Section 6. The assumption that the building acts rigidly is assumed and was confirmed later to be an accurate assumption. The results of the analysis can be seen in the following tables with detail calculations being found in Appendix C. Figure 10 show the building base plan and the designated N-S and E-W direction that will be used in the analysis.

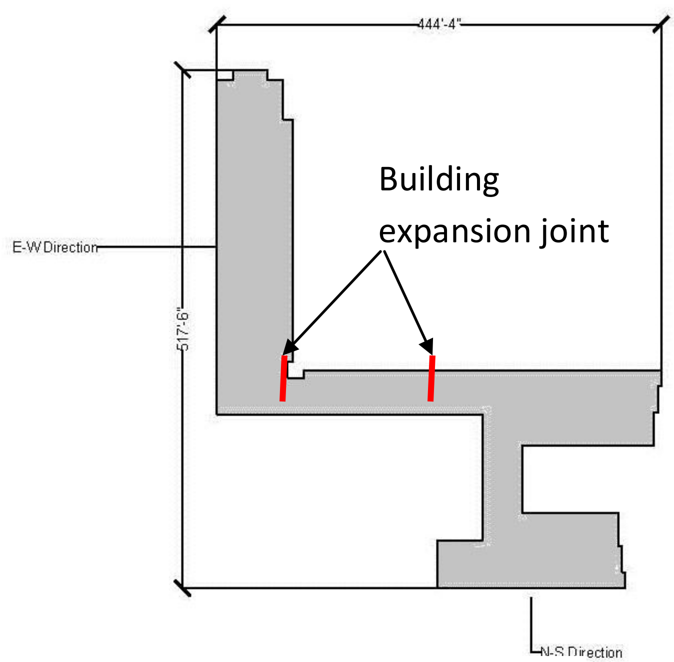


Figure 10: Wind site plan.

Table 3.1A: E-W wind load pressures.

E-W Direction	z	K_z	q_z	Cp	P w/+int (psf)	P w/-int (psf)
Windward	0.00	0.57	10.05	0.80	3.46	8.91
	15.00	0.57	10.05	0.80	3.46	8.91
	20.00	0.62	10.93	0.80	4.01	9.46
	25.00	0.67	11.81	0.80	4.55	10.00
	30.00	0.70	12.34	0.80	4.88	10.32
	35.00	0.73	12.87	0.80	5.20	10.65
	40.00	0.76	13.40	0.80	5.53	10.98
	45.00	0.79	13.92	0.80	5.85	11.30
	50.00	0.81	14.28	0.80	6.07	11.52
	55.00	0.83	14.63	0.80	6.29	11.74
	60.00	0.85	14.98	0.80	6.50	11.95
	62.17	0.86	15.14	0.8	6.60	12.05
Leeward	-	-	15.14	-0.50	-8.52	-3.13
Side	-	-	15.14	-0.70	-10.85	-5.46
Roof						
zone 1	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
zone 2	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
zone 3	-	-	15.14	-0.50	-8.52	-3.13
	-	-	15.14	-0.18	-4.79	0.60
zone 4	-	-	15.14	-0.30	-6.19	-0.80
	-	-	15.14	-0.18	-4.79	0.60
Parapets	-	0.886	15.62		23.42	-15.62

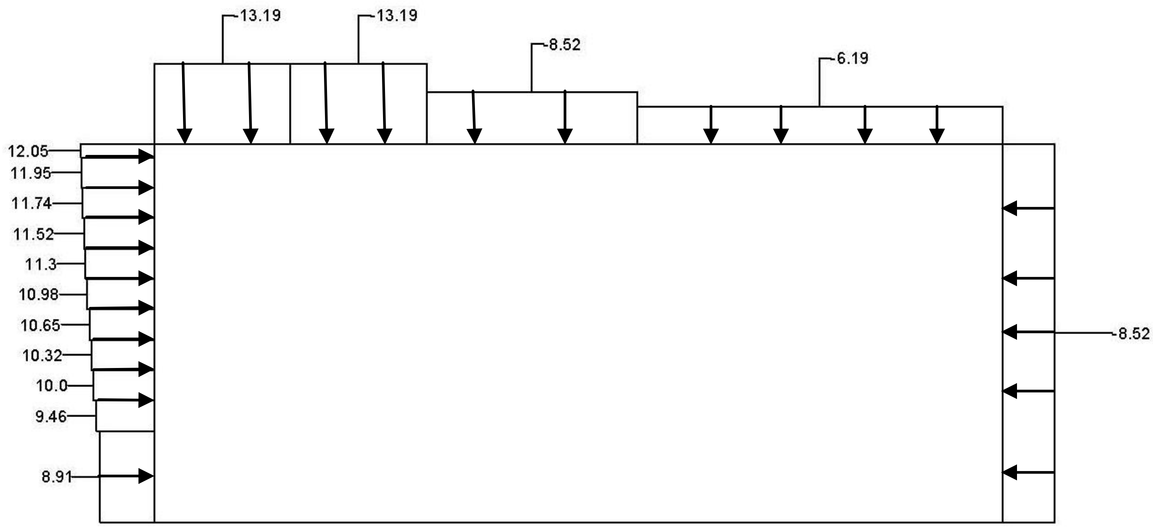


Figure 11.A: E-W Pressures in psf.

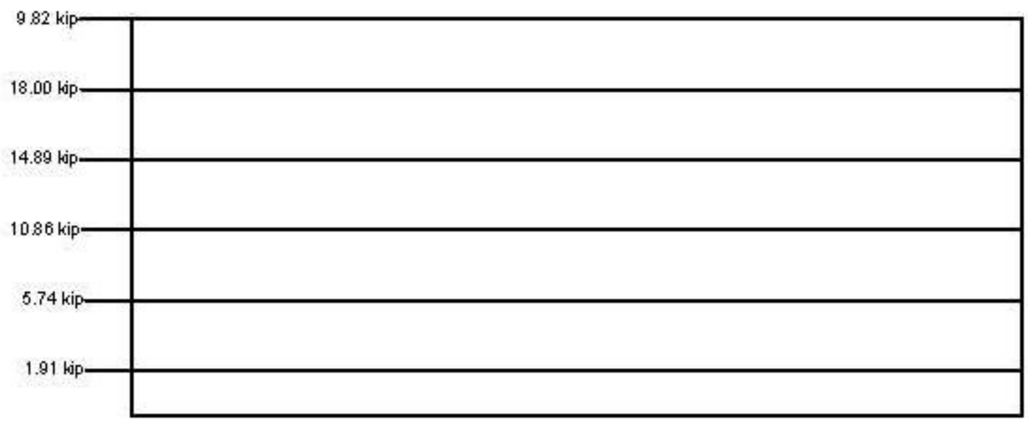


Figure 11.B: E-W Wind load story shear.

Base Shear:

V=245Kip

Over turning moment:

M=8,188 Kip-ft

Table 3.2A: N-W Wind load pressers.

N-S Direction	z	K_z	q_z	Cp	P w/+int (psf)	P w/-int (psf)
Windward	0.00	0.57	10.05	0.80	3.46	8.91
	15.00	0.57	10.05	0.80	3.46	8.91
	20.00	0.62	10.93	0.80	4.01	9.46
	25.00	0.67	11.81	0.80	4.55	10.00
	30.00	0.70	12.34	0.80	4.88	10.32
	35.00	0.73	12.87	0.80	5.20	10.65
	40.00	0.76	13.40	0.80	5.53	10.98
	45.00	0.79	13.92	0.80	5.85	11.30
	50.00	0.81	14.28	0.80	6.07	11.52
	55.00	0.83	14.63	0.80	6.29	11.74
	60.00	0.85	14.98	0.80	6.50	11.95
	62.17	0.86	15.14	0.80	6.60	12.05
Leeward	-	-	15.14	-0.47	-8.17	-2.78
Side	-	-	15.14	-0.70	-10.85	-5.46
Roof						
zone 1	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
zone 2	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
zone 3	-	-	15.14	-0.50	-8.52	-3.13
	-	-	15.14	-0.18	-4.79	0.60
zone 4	-	-	15.14	-0.30	-6.19	-0.80
	-	-	15.14	-0.18	-4.79	0.60
Parapets	-	0.886	15.62		23.42	-15.62

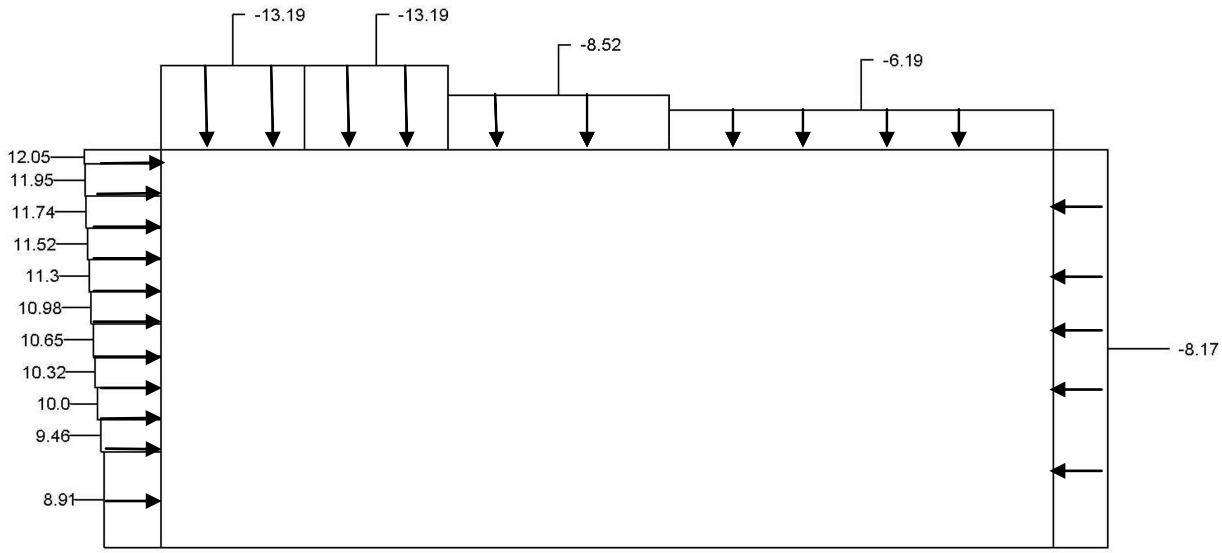


Figure 13.A: N-S Wind load pressure in psf.

Figure 12.B: N-S Wind load story shear.

Base Shear:

V=249Kip

Over turning moment:

M=7,989 Kip-ft

Wind Load on Portion of Building

For this report, the wind load is reanalyzed for a smaller portion of the building to simplify the analysis of the lateral system. This can be done because of a building expansion joint that exist which can be seen in figure 10. The calculation and values of the loads can be found is table 3.3.

Table 3.3: Story Forces due to Wind

	N-S Direction	E-W Direction
Gourd	11.8 kip	11.6 Kip
Second	13.4 Kip	13.2 kip
Third	15.4 Kip	15.1 kip
Fourth	15.0 Kip	14.7 kip
Fifth	21.6 kip	21.2 kip
Roof	8.1 kip	7.97 kip
Base Shear	123.6 kip	121.6 kip

Seismic Load

Seismic Load on whole structure

Seismic load is determined using the Equivalent Lateral Force method as described in ASCE7-05 section 11 and 12. A sit class D is recommended from the Geotechnical report and will be used in this analysis. The building weight is assumed and calculated. The values used and the final building weight can be seen in Table 4.1. The results of the analysis can be seen in the following tables and figures with detail information in Appendix D.

Table 4.1: Story weight.

	High	Area (sf)	Kips
Gourd	11’	61,709	4391.3
Second	22’	61,709	4391.3
Third	33’	61,709	4391.3
Fourth	44’	61,709	4391.3
Fifth	55’	61,709	4391.3
Roof	67’-8”	61,709	3456.0

Table 4.2: Assumed dead load.

Load	
Slab	36 psf
Joist	5 psf
Superimpose Dead load	15 psf
Wall	15 psf
Total	71 psf

Table 4.3: Seismic load.

	Story Height (ft)	h_x	w_x	$w_x h_x$	C_{vx}	Lateral Force F_x	Story Shear Vx	Moments Mx
Ground	11	11	4391.3	48304.3	0.0504	68.3	1355.3	751.4
Second	11	22	4391.3	96608.6	0.1008	136.6	1287.0	3005.6
Third	11	33	4391.3	144912.9	0.1512	204.9	1150.4	6762.6
Fourth	11	44	4391.3	193217.2	0.2016	273.2	945.5	12022.3
Fifth	11	55	4391.3	241521.5	0.2520	341.5	672.2	18784.9
Roof	12.667	67.667	3456	233857.2	0.2440	330.7	330.7	22377.8
			25412.5	958421.7		1355.3		63704.5

Base Shear:

V=1,355.5 Kip

Over turning moment:

M=63,704.5 Kip-ft

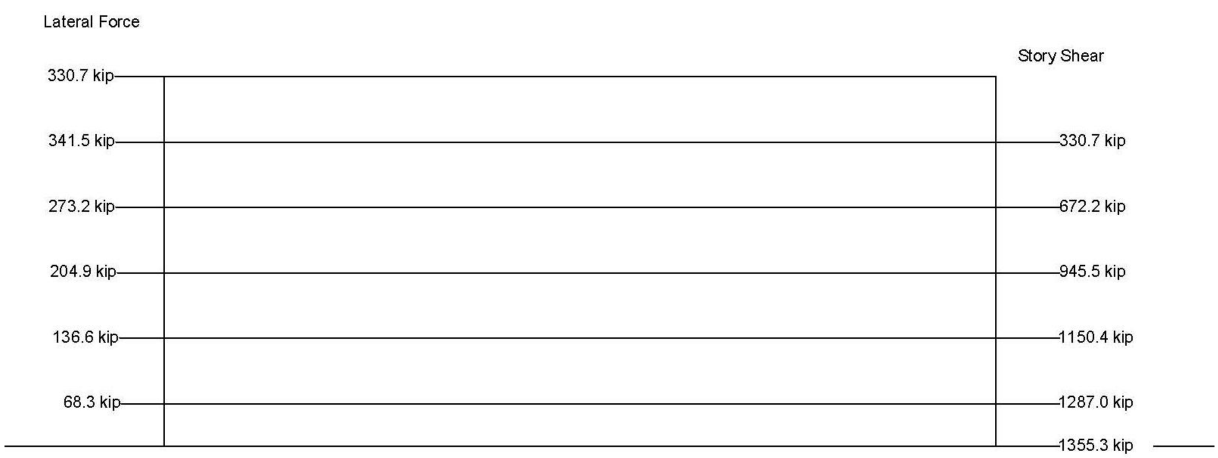


Figure 13: Seismic load diagram.

Seismic Load on Portion of Building

For this report, the seismic load is reanalyzed for a smaller portion of the building to simplify the analysis of the lateral system. This can be done because of a building expansion joint that exists which can be seen in figure 10. The calculation and values of the loads can be found is table 4.4

Table 4.4: Seismic Load

	Story Height (ft)	h_x	w_x (kip)	$w_x h_x$	C_{vx}	Lateral Force F_x (k)	Story Shear Vx	Moments Mx
1	11	11	1,959.32	21,552.48	0.050	30.28	601.12	333.1
2	11	22	1,959.32	43,104.95	0.101	60.56	570.84	1332.3
3	11	33	1,959.32	64,657.43	0.151	90.84	510.28	2997.8
4	11	44	1,959.32	86,209.90	0.201	121.12	419.44	5329.3
5	11	55	1,959.32	107,762.38	0.252	151.40	298.32	8327.1
6	12.67	67.67	1,545.38	104,570.96	0.244	146.92	146.92	9941.5
			11,341.96	427,858.10		601.12		28,261.1

Load Combination

Lateral load analysis is performed for this report and the load combinations that are provided by ASCE7-05 section2 that did not include lateral load forces is disregarded. It is also noted that the load combinations that includes the factor of .9D are used to calculate uplift forces for the later loads.

- 1.2D+1.6W+L+.5(Lr or S or R)
- 1.2D+1.0E+L+.2S
- .9D+1.6W+1.6H
- .9D+1.0E+1.6H

To determine the governing load case, it can be simplified to whether 1.6W+L is greater than 1.0E for the general loading conditions, and whether 1.6W is greater than 1.0E for uplift. Since the seismic loads are much greater than the wind loads, it is safe to assumed that the 1.2D+1.0E+L+.2S and .9D+1.0E+1.6H are the controlling strength design for general loading and uplift respectively.

Distribution of Lateral Forces

The lateral forces are assumed to be distributed throughout the structure by the concept of relative stiffness. Shear walls with a higher stiffness take a larger part of the lateral load compared to walls with a lower stiffness. The loads are transmitted through the floor that is assumed to act as a rigid diagram and are then transferred to the shear walls. The lateral loads act on the shear walls by both a Direct Shear and Torisional Shear.

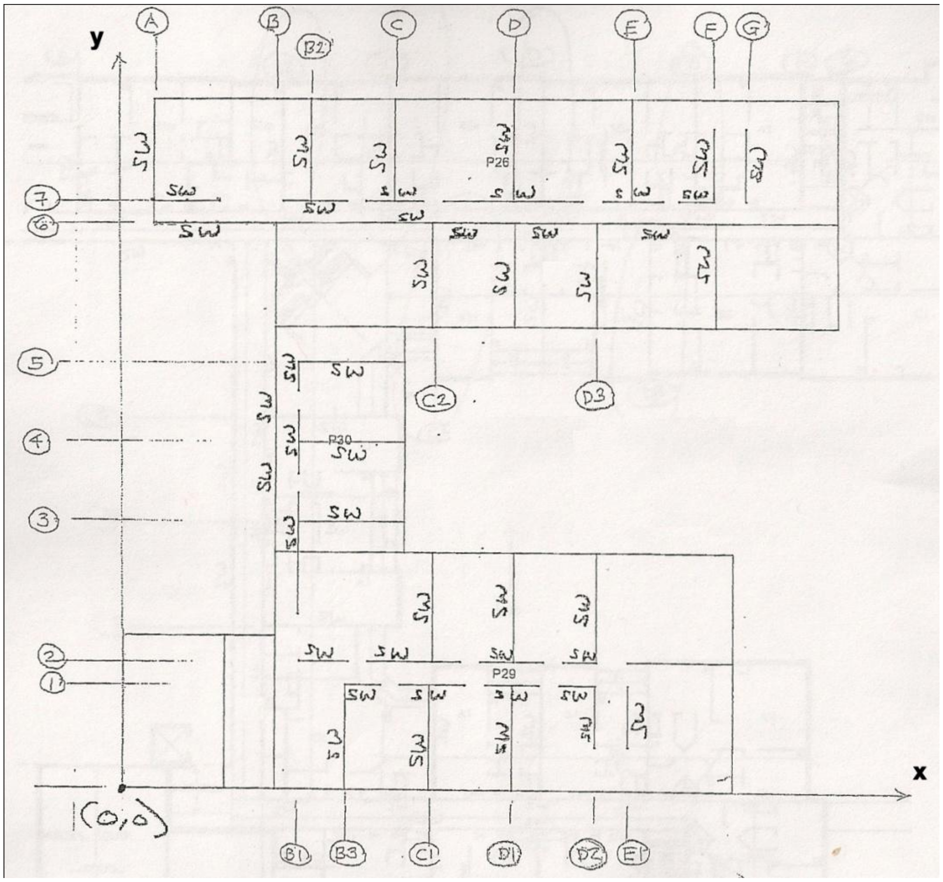


Figure 14: Shear wall location and Designation.

Direct Shear

The Direct Shear acting on each shear wall is calculated using the relative stiffness of each shear wall. The rigidity of each shear is determined by understanding that each shear wall is comprised of multiple similar x-brace frames. It can then be assumed that the number of x-brace frames per shear wall is proportional to the stiffness of that wall and can be used as a relative stiffness. The distribution of the direct shear is determined using the equation$F_{id} = V \times {k_i}/{\sum k}$. Excel is utilized to determine the direct forces in each frame and results can be found in Appendix E.

Torisional Shear

In order to calculate the Torisional effects on the shear walls, the center of rigidity and torisional rigidity needs to be determined. Excel is utilized to determine both center of rigidity and torisional rigidity and can be found in Appendix E.

Distribution of Lateral Forces

After determining the direct and torisional shear distribution to the shear walls, the values are combined to produce the great load per shear wall. The results can be seen in Table 5, and it is determined that Frame B1 and Frame 7 have the greatest loads applied to them and would be considered for further check. A full set of calculation can be found in Appendix E.

Table 5: Story Forces per frame per diafram.

Story Force per frame per Diafram						
	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	1.42	2.84	4.26	6.61	6.31	6.12
Frame B	1.92	3.83	5.75	8.91	9.65	6.28
Frame B1	3.36	6.72	10.08	13.39	19.37	18.92
Frame B2	1.44	2.88	4.32	6.70	6.47	6.32
Frame B3	1.45	2.89	4.34	6.72	6.49	6.35
Frame C	1.45	2.91	4.36	6.75	6.55	6.42
Frame C1	2.91	5.83	8.74	9.02	13.15	12.91
Frame C2	1.46	2.92	4.37	4.52	6.59	6.47
Frame D	3.32	6.64	9.97	10.29	14.36	13.66
Frame D1	3.31	6.62	9.93	10.25	14.31	13.62
Frame D2	2.86	5.72	8.58	13.29	18.45	13.99
Frame D3	1.72	3.43	5.15	5.32	7.38	13.99
Frame E	1.74	3.48	5.22	8.08	7.47	7.06
Frame E1	1.15	2.31	3.46	5.36	7.43	7.04
Frame F	2.99	5.98	8.97	13.89	15.32	14.44
Frame G	1.21	2.42	3.64	5.63	7.74	7.29
Frame - X - Direction						
Frame 1	3.59	7.18	10.77	14.36	22.06	24.93
Frame 2	6.00	11.99	17.99	23.98	29.54	31.28
Frame 3	1.82	3.63	5.45	7.27	11.35	6.40
Frame 4	1.83	3.66	5.48	7.31	11.51	6.48
Frame 5	1.99	3.99	5.98	7.97	11.72	6.65
Frame 6	8.92	17.85	26.77	35.70	44.04	40.89
Frame 7	8.97	17.95	26.92	35.90	32.16	41.06

Shear Wall Check

A spot check of shear wall Frame B1 and Frame 7 is performed using the seismic loading. This is conducted because the seismic loads produce the largest forces in the wall. Appendix F provides the supporting calculation for the spot check. The check is performed on the lower lever because this is where the member would experience the greatest loads. Once the forces on each member are found, it is compared to the allowable forces and is determined to carry the load.

Foundation Analysis

An overturning analysis of the foundation supporting shear wall frame G is performed using the load combination .9D+1.0E+1.6H. Frame G is selected since it has the shortest length and will therefore prove to be critical for overturning forces. From the analysis, the uplift forces are determined in the frame and it is found that the dead load would not be sufficient to counteract it. Overturning will be an issue on the foundation. See Appendix G for supporting calculations.

Deflection Analysis

The deflection of each shear wall frame is calculated use of a structural analysis computer program, for this report STAAD is used. The results of the STAAD output can be found in Appendix H. Since deflections due to wind loads are a serviceability issue, the shear walls are analyzed using unfactored service loads. These values are then compared with industry standard of H/400. Since deflections due to seismic loads are classified as a strength issue, factored loads are used in the drift check. These drifts are compared to a maximum drift of $0.02H_{sx}$. The allowable Total drifts and story drifts for wind and seismic are provide in Table 6. It is found that none of the total drifts or story drifts exceeded the allowable drifts.

Table 6: Allowable Deflections

		Wind H/400		Seismic 0.02 H_{sx}	
	Story Height (ft)	Story Drift	Total Drift	Story Drift	Total Drift
Ground (1)	11	0.33”	0.33”	2.64”	2.64”
Second (2)	11	0.33”	0.66”	2.64”	5.28”
Third (3)	11	0.33”	0.99”	2.64”	7.92”
Fourth (4)	11	0.33”	1.32”	2.64”	10.56”
Fifth (5)	11	0.33”	1.65”	2.64”	13.20”
Roof (6)	12.67	0.38”	2.03”	3.04”	16.24”

The deflections of the shear walls are calculated individually using separate 2D computer models. The diaphragm of the build allows the shear walls to act together and the actual deflection of the building can be determined best by using a full 3D model. A 3D computer model is not produced and is outside of the scope of this report.

Conclusion

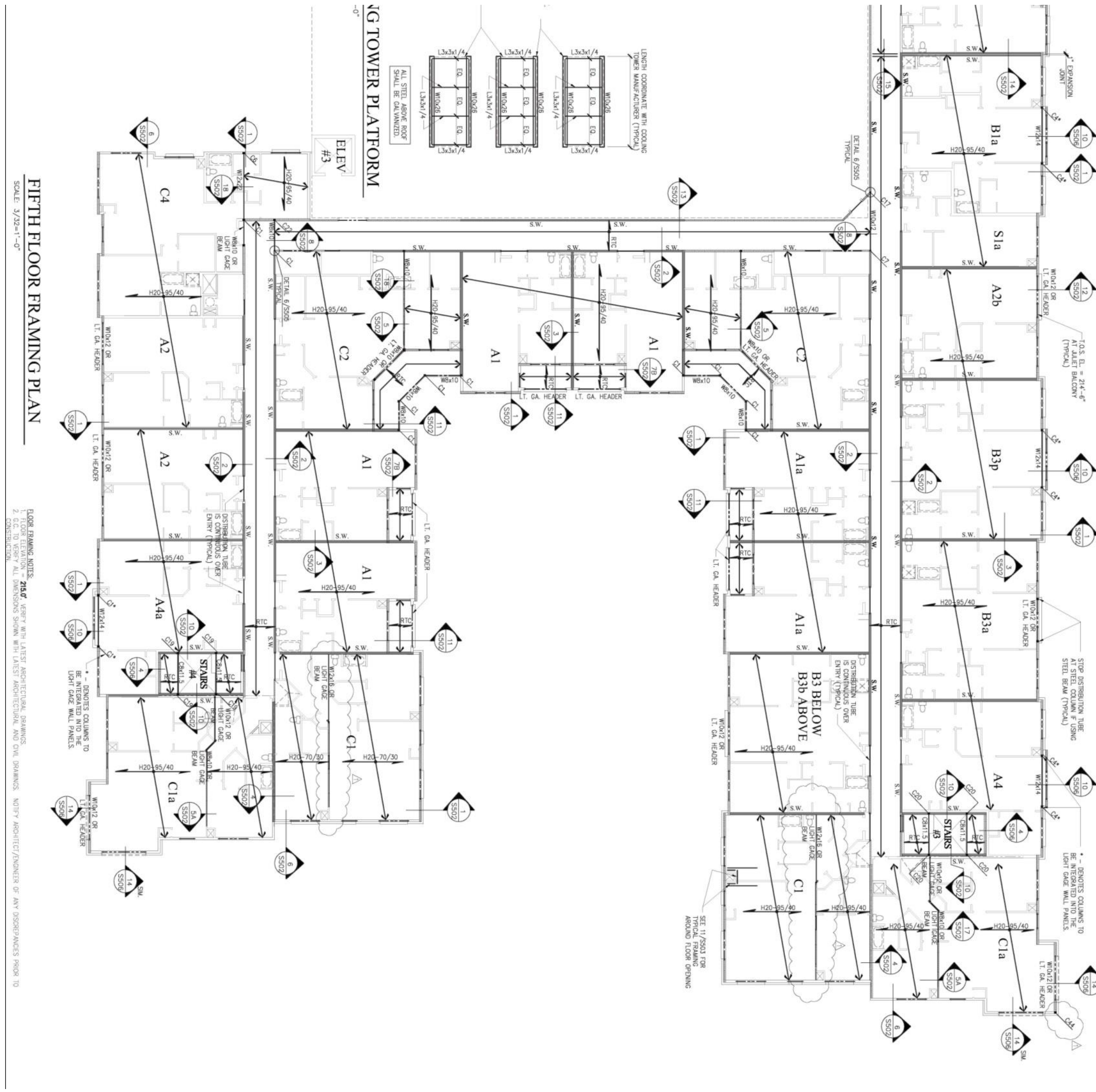
Different load combinations by ASEC 7-05 are studied and the load combination that included lateral loads is used to check the later resistance members of The Residences. Seismic loads are analyzed for strength and both seismic and wind loads are analyzed for deflection.

The direct shear and torisional shear from the lateral loading are calculated on each of the shear wall frames. The loads are taken about the Center of Rigidity which is calculated using the relative stiffness of the shear walls.

Spot check is conducted on shear wall frame B1 and Frame 7. These frames were picked because of the large loads compared to the other shear wall frames. From the analysis, it is found that the frames are able to carry the loads with no problem. A foundation check on shear wall frame G is preformed because of the short length of the frame and is found that foundation would need to resist uplift and further analysis of the foundation would need to be conducted to get an actual impact on the foundations.

Deflections for each shear wall are compared to the allowable story drift and total drift as set by ASCE 7-05. None of the shear wall frames are found to exceed the allowable drift.

Appendix A: Plans



Appendix B: Snow Load Analysis

ASCE7-05 Section 7

(7.2) Ground Snow Load

Pg= 30 psf

(7.3) Flat Roof

Pf= 0.7 Ce Ct I Pg

(7.3.1) Exposure Factor

Table 7-2

Ce = 0.9

(7.3.2) Thermal Factor

Ct = 1.1

(7.3.3) Importance Factor

I = 1.0

Pf= 0.7(0.9)(1.1)(1.0)(30)= 20.79 -> 21 psf

(7.4) Slop Roof

Ps=Cs Pf

Cs =1.0

Ps = 21 psf

Snow Drifting

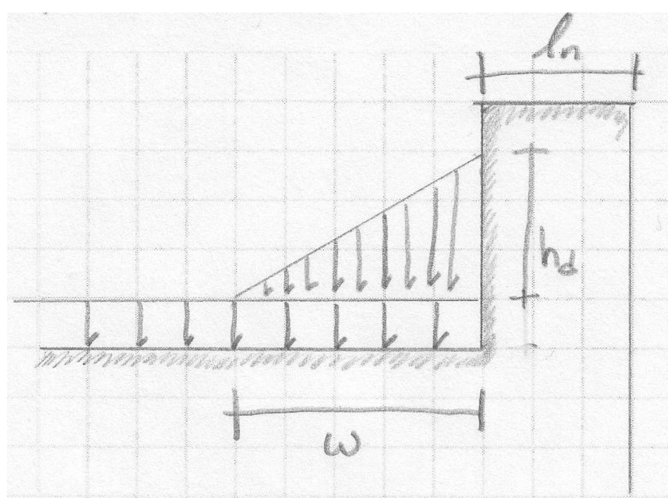
L_n = 11'-6"

$h_d = 0.34\sqrt[3]{l_n}\sqrt[4]{P_g + 10} - 1.5$ = 2.64'

w = 4 h_d = 10.58'

γ = 0.13 Pg +14 = 17.9

Pd = h_d γ = 47.25 psf



Appendix C: Wind Load Analysis

ASCE7-05 Section 6: Method 2

(6.5.4) Basic Wind Speed

Fig 6-1, V=90 mph

(6.5.5) Importance Factor

Occupancy Category: II

I=1.00

(6.5.6) Exposure Category

Exposure Category: B

(Table 6-3) Kz (B case 2)

z	K_z
0.00	0.57
15.00	0.57
20.00	0.62
25.00	0.67
30.00	0.70
35.00	0.73
40.00	0.76
45.00	0.79
50.00	0.81
55.00	0.83
60.00	0.85
62.17	0.86

(6.5.7) Top Factor

Kzt = 1.0

(6.5.8) Gust Effect

n_1=75/h=75/62'-2"=1.2 > 1

n_1=100/h=100/62'-2"= 1.61>1

- Structure is ridge.

$$G=0.925\left(\frac{(1+1.7\,g_Q I_z Q)}{1+1.7\,g_v I_z}\right)$$

$$I_z = c\left(\frac{33}{z}\right)^{1/6}$$

$$Q = \sqrt{\frac{1}{1+0.63\left(\frac{B+h}{L_z}\right)^{0.63}}}$$

$$L_z = l\left(\frac{z}{33}\right)^{\epsilon}$$

Z	37.32	
z min	30	
c	0.3	
Ɛ	0.333333	
l	320	
gq	3.4	
gv	3.4	
Iz	0.293912	
Lz	333.3951	
	E-W	N-S
Q	0.727009	0.741373
G	0.77	0.77

(6.5.9) Enclosure Classification

Enclosed Building

(6.5.11.1) internal Pressure Coefficient

$GC_{pi} = \pm 0.18$

(6.5.11.2) External Pressure coefficients Cp

	E-W	N-S
L/B	0.8586	1.1647
H/L	0.135	0.1159

See table for values.

(6.5.10)

$q_z=0.00256\ K_z\ K_{zt}\ K_d\ V^2\ I$

$K_d = 0.85$

(6.5.12)

$P=q\ G\ C - q_i\ (GC_{pi})$

(6.5.12.2.4) Parapets

$Pp = q_p \, GC_{pn}$

h=69 ft

GC_{pn}= +1.5 Windward

-1.0 Leeward

EW	
k_{zt}	1.00
K_d	0.85
v	90
I	1.00
GCpi	0.18
G	0.77

	z	K_z	q_z	Cp	P w/+GC_{pi}	P w/-GC_{pi}
Windward	0.00	0.57	10.05	0.80	3.46	8.91
	15.00	0.57	10.05	0.80	3.46	8.91
	20.00	0.62	10.93	0.80	4.01	9.46
	25.00	0.67	11.81	0.80	4.55	10.00
	30.00	0.70	12.34	0.80	4.88	10.32
	35.00	0.73	12.87	0.80	5.20	10.65
	40.00	0.76	13.40	0.80	5.53	10.98
	45.00	0.79	13.92	0.80	5.85	11.30
	50.00	0.81	14.28	0.80	6.07	11.52
	55.00	0.83	14.63	0.80	6.29	11.74
	60.00	0.85	14.98	0.80	6.50	11.95
	62.17	0.86	15.14	0.8	6.60	12.05
Leeward	-	-	15.14	-0.50	-8.52	-3.13
Side	-	-	15.14	-0.70	-10.85	-5.46

Roof						
Zone 1	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
Zone 2	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
Zone 3	-	-	15.14	-0.50	-8.52	-3.13
	-	-	15.14	-0.18	-4.79	0.60
Zone 4	-	-	15.14	-0.30	-6.19	-0.80
	-	-	15.14	-0.18	-4.79	0.60

Parapets	
Kz	0.886
q	15.62

GCpn	1.50	
	-1.00	
P Wind	23.42	(psf)
P Lee	-15.62	(psf)

NS	
k_{zt}	1.00
K_d	0.85
v	90
I	1.00
GCpi	0.18
G	0.77

	z	K_z	q_z	Cp	P w/+GC_{pi}	P w/-GC_{pi}
Windward	0.00	0.57	10.05	0.80	3.46	8.91
	15.00	0.57	10.05	0.80	3.46	8.91
	20.00	0.62	10.93	0.80	4.01	9.46
	25.00	0.67	11.81	0.80	4.55	10.00
	30.00	0.70	12.34	0.80	4.88	10.32
	35.00	0.73	12.87	0.80	5.20	10.65
	40.00	0.76	13.40	0.80	5.53	10.98
	45.00	0.79	13.92	0.80	5.85	11.30
	50.00	0.81	14.28	0.80	6.07	11.52
	55.00	0.83	14.63	0.80	6.29	11.74
	60.00	0.85	14.98	0.80	6.50	11.95
	62.17	0.86	15.14	0.80	6.60	12.05
Leeward	-	-	15.14	-0.47	-8.17	-2.78
Side	-	-	15.14	-0.70	-10.85	-5.46

Roof						
Zone 1	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
Zone 2	-	-	15.14	-0.90	-13.19	-7.79
	-	-	15.14	-0.18	-4.79	0.60
Zone 3	-	-	15.14	-0.50	-8.52	-3.13

	-	-	15.14	-0.18	-4.79	0.60
Zone 4	-	-	15.14	-0.30	-6.19	-0.80
	-	-	15.14	-0.18	-4.79	0.60

Parapets		
Kz	0.886	
q	15.62	
GCpn	1.50	
	-1.00	
P Wind	23.42	(psf)
P Lee	-15.62	(psf)

Appendix D: Seismic Load Analysis

ASCE7-05 Seismic Equivalent Lateral Force Procedure

Seismic Importance Factor: 1.0

Seismic Occupancy Category: II

Site Class D (from Geotechnical Report)

(11.4) Seismic Ground Motion Values

S_s= 0.2g $S_{ms}= F_a S_s$ $S_{ds}=(2/3)S_{ms}$

S1=0.06g $S_{m1}=F_v S_1$ $S_{d1}=(2/3)S_{m1}$

Table 11.4-1

Fa=1.6

Table 11.4-2

Fv=2.4

(12.8)

Base Shear V=Cs W

$Cs=S_{ds}/(R/I) = S_{ds}/R$

R for Light Framed Walls with System Using Flat Straps Bracing: R=4

Cs= 0.0533

(12.8.2) Fundamental Period

$Ta=C_t h_n^x = 0.4312$

Ct=0.02 x=.75 h_n=67.67

(12.8.3) Distribution of Seismic Forces

$F_x=C_{vx} V$

$Cvx=\frac{w_x h_x^k}{\sum w_i h_i^k}$

Ta=0.4312 < 0.5: K=1.0

SIF	1
SOC	II
Site Class	D
Ss	0.200
S1	0.060
Sms	0.320
Sma	0.144
Sds	0.213
Sd1	0.096
SDC	B
R	4
Cs	0.053
Ct	0.02
hn	67.667
x	0.75
Ta	0.472
V	1355.333

	Story High (ft)	h_x	w_x	$w_x h_x$	C_{vx}	Lateral Force F_x	Story Shear Vx	Moments Mx
Ground	11	11	4391.3	48304.3	0.0504	68.3	1355.3	751.4
Second	11	22	4391.3	96608.6	0.1008	136.6	1287.0	3005.6
Third	11	33	4391.3	144912.9	0.1512	204.9	1150.4	6762.6
Fourth	11	44	4391.3	193217.2	0.2016	273.2	945.5	12022.3
Fifth	11	55	4391.3	241521.5	0.2520	341.5	672.2	18784.9
Roof	12.667	67.667	3456	233857.2	0.2440	330.7	330.7	22377.8
Total			25412.5	958421.7		1355.3		63704.5

Appendix E: Distribution of Lateral Forces

Diaframs								
	Height(h)	Area (sf)	Width x (ft)	Length y (ft)	e_x ±(ft)	e_y ±(ft)	COM_x(ft)	COM_y(ft)
1	11	27596	208.6	212.5	10.43	10.625	101.25	114.92
2	22	27596	208.6	212.5	10.43	10.625	101.25	114.92
3	33	27596	208.6	212.5	10.43	10.625	101.25	114.92
4	44	27596	208.6	212.5	10.43	10.625	101.25	114.92
5	55	27596	208.6	212.5	10.43	10.625	101.25	114.92
6	67.67	27596	208.6	212.5	10.43	10.625	101.25	114.92

Story shear								
	Story Height (ft)	h_x	w_x (kip)	$w_x h_x$	C_{vx}	Lateral Force F_x (k)	Story Shear Vx	Moments Mx
1	11	11	1,959.32	21,552.48	0.050	30.28	601.12	333.1
2	11	22	1,959.32	43,104.95	0.101	60.56	570.84	1332.3
3	11	33	1,959.32	64,657.43	0.151	90.84	510.28	2997.8
4	11	44	1,959.32	86,209.90	0.201	121.12	419.44	5329.3
5	11	55	1,959.32	107,762.38	0.252	151.40	298.32	8327.1
6	12.67	67.67	1,545.38	104,570.96	0.244	146.92	146.92	9941.5
			11,341.96	427,858.10		601.12		28,261.1
					% error	3.58%		

Lateral Forces		
	Force x (k)	Force y (k)
1	30.28	30.28
2	60.56	60.56
3	90.84	90.84
4	121.12	121.12
5	151.40	151.40
6	146.92	146.92

Diafram 1	
Force (k)	30.28
CoR x (ft)	94.39
CoR y (ft)	121.00
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	6.86
e_y (ft)	6.08

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	$K*x^2$	$K*y^2$	F_{id} x (k)	F_{id} y (k)	$+F_{it}$ (k)	$-F_{it}$ (k)	F_{total} ($+F_{it}$)	F_{total} ($-F_{it}$)	F_{total} (k)
Frames - Y - Direction														
Frame A	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42	0.00	0.00	1.42	1.42	1.42
Frame B	4	37.50	0.00	150.00	0.00	5625.00	0.00	0.00	1.89	0.11	0.02	1.78	1.92	1.92
Frame B1	7	44.73	0.00	313.10	0.00	14004.78	0.00	0.00	3.31	0.23	0.05	3.08	3.36	3.36
Frame B2	3	48.36	0.00	145.09	0.00	7017.40	0.00	0.00	1.42	0.11	0.02	1.31	1.44	1.44
Frame B3	3	56.36	0.00	169.09	0.00	9530.90	0.00	0.00	1.42	0.12	0.03	1.29	1.45	1.45
Frame C	3	73.36	0.00	220.09	0.00	16147.09	0.00	0.00	1.42	0.16	0.03	1.26	1.45	1.45
Frame C1	6	81.36	0.00	488.19	0.00	39721.19	0.00	0.00	2.84	0.36	0.07	2.48	2.91	2.91
Frame C2	3	84.78	0.00	254.34	0.00	21563.61	0.00	0.00	1.42	0.19	0.04	1.23	1.46	1.46
Frame D	6	109.36	0.00	656.19	0.00	71763.69	0.00	0.00	2.84	0.48	0.10	3.32	2.74	3.32
Frame D1	6	106.36	0.00	638.19	0.00	67880.57	0.00	0.00	2.84	0.47	0.10	3.31	2.74	3.31
Frame D2	5	134.78	0.00	673.91	0.00	90829.99	0.00	0.00	2.37	0.50	0.10	2.86	2.26	2.86
Frame D3	3	134.78	0.00	404.34	0.00	54498.00	0.00	0.00	1.42	0.30	0.06	1.72	1.36	1.72
Frame E	3	145.36	0.00	436.09	0.00	63392.60	0.00	0.00	1.42	0.32	0.07	1.74	1.35	1.74
Frame E1	2	141.36	0.00	282.73	0.00	39967.90	0.00	0.00	0.95	0.21	0.04	1.15	0.90	1.15
Frame F	5	169.82	0.00	849.11	0.00	144199.09	0.00	0.00	2.37	0.62	0.13	2.99	2.24	2.99
Frame G	2	180.36	0.00	360.73	0.00	65062.78	0.00	0.00	0.95	0.27	0.05	1.21	0.89	1.21
	64			6041.21	0.00	711204.60	0.00							
Frame - X - Direction														
Frame 1	6	0.00	32.88	0.00	197.28	0.00	6486.57	3.56	0.00	0.11	0.03	3.46	3.59	3.59
Frame 2	10	0.00	40.11	0.00	401.14	0.00	16091.33	5.94	0.00	0.21	0.06	5.72	6.00	6.00
Frame 3	3	0.00	81.98	0.00	245.94	0.00	20161.67	1.78	0.00	0.13	0.04	1.65	1.82	1.82
Frame 4	3	0.00	106.98	0.00	320.94	0.00	34333.52	1.78	0.00	0.17	0.05	1.61	1.83	1.83
Frame 5	3	0.00	131.98	0.00	395.94	0.00	52255.37	1.78	0.00	0.21	0.06	1.99	1.72	1.99
Frame 6	13	0.00	173.68	0.00	2257.80	0.00	392128.10	7.72	0.00	1.21	0.33	8.92	7.39	8.92
Frame 7	13	0	180.906	0	2351.778	0.00	425450.75	7.72	0.00	1.26	0.34	8.97	7.38	8.97
	51			0.00	6170.81	0.00	946907.31							

Diafram 2	
Force (k)	60.56
CoR x (ft)	94.39
CoR y (ft)	121.00
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	6.86
e_y (ft)	6.08

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	$K*x^2$	$K*y^2$	F_{id} x (k)	F_{id} y (k)	$+F_{it}$ (k)	$-F_{it}$ (k)	F_{total} ($+F_{it}$)	F_{total} ($-F_{it}$)	F_{total} (k)
Frames - Y - Direction														
Frame A	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.84	0.00	0.00	2.84	2.84	2.84
Frame B	4	37.50	0.00	150.00	0.00	5625.00	0.00	0.00	3.79	0.22	0.05	3.56	3.83	3.83
Frame B1	7	44.73	0.00	313.10	0.00	14004.78	0.00	0.00	6.62	0.46	0.10	6.16	6.72	6.72
Frame B2	3	48.36	0.00	145.09	0.00	7017.40	0.00	0.00	2.84	0.21	0.04	2.63	2.88	2.88
Frame B3	3	56.36	0.00	169.09	0.00	9530.90	0.00	0.00	2.84	0.25	0.05	2.59	2.89	2.89
Frame C	3	73.36	0.00	220.09	0.00	16147.09	0.00	0.00	2.84	0.32	0.07	2.51	2.91	2.91
Frame C1	6	81.36	0.00	488.19	0.00	39721.19	0.00	0.00	5.68	0.72	0.15	4.96	5.83	5.83
Frame C2	3	84.78	0.00	254.34	0.00	21563.61	0.00	0.00	2.84	0.37	0.08	2.46	2.92	2.92
Frame D	6	109.36	0.00	656.19	0.00	71763.69	0.00	0.00	5.68	0.97	0.20	6.64	5.48	6.64
Frame D1	6	106.36	0.00	638.19	0.00	67880.57	0.00	0.00	5.68	0.94	0.19	6.62	5.48	6.62
Frame D2	5	134.78	0.00	673.91	0.00	90829.99	0.00	0.00	4.73	0.99	0.21	5.72	4.53	5.72
Frame D3	3	134.78	0.00	404.34	0.00	54498.00	0.00	0.00	2.84	0.60	0.12	3.43	2.72	3.43
Frame E	3	145.36	0.00	436.09	0.00	63392.60	0.00	0.00	2.84	0.64	0.13	3.48	2.71	3.48
Frame E1	2	141.36	0.00	282.73	0.00	39967.90	0.00	0.00	1.89	0.42	0.09	2.31	1.81	2.31
Frame F	5	169.82	0.00	849.11	0.00	144199.09	0.00	0.00	4.73	1.25	0.26	5.98	4.47	5.98
Frame G	2	180.36	0.00	360.73	0.00	65062.78	0.00	0.00	1.89	0.53	0.11	2.42	1.78	2.42
	64			6041.21	0.00	711204.60	0.00							
Frame - X - Direction														
Frame 1	6	0.00	32.88	0.00	197.28	0.00	6486.57	7.12	0.00	0.21	0.06	6.91	7.18	7.18
Frame 2	10	0.00	40.11	0.00	401.14	0.00	16091.33	11.87	0.00	0.43	0.12	11.45	11.99	11.99
Frame 3	3	0.00	81.98	0.00	245.94	0.00	20161.67	3.56	0.00	0.26	0.07	3.30	3.63	3.63
Frame 4	3	0.00	106.98	0.00	320.94	0.00	34333.52	3.56	0.00	0.34	0.09	3.22	3.66	3.66
Frame 5	3	0.00	131.98	0.00	395.94	0.00	52255.37	3.56	0.00	0.42	0.12	3.99	3.45	3.99
Frame 6	13	0.00	173.68	0.00	2257.80	0.00	392128.10	15.44	0.00	2.41	0.66	17.85	14.78	17.85
Frame 7	13	0	180.906	0	2351.778	0.00	425450.75	15.44	0.00	2.51	0.68	17.95	14.75	17.95
	51			0.00	6170.81	0.00	946907.31							

Diafram 3	
Force (k)	90.84
CoR x (ft)	94.39
CoR y (ft)	121.00
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	6.86
e_y (ft)	6.08

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	$K*x^2$	$K*y^2$	F_{id} x (k)	F_{id} y (k)	$+F_{it}$ (k)	$-F_{it}$ (k)	F_{total} ($+F_{it}$)	F_{total} ($-F_{it}$)	F_{total} (k)
Frames - Y - Direction														
Frame A	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.26	0.00	0.00	4.26	4.26	4.26
Frame B	4	37.50	0.00	150.00	0.00	5625.00	0.00	0.00	5.68	0.33	0.07	5.35	5.75	5.75
Frame B1	7	44.73	0.00	313.10	0.00	14004.78	0.00	0.00	9.94	0.69	0.14	9.24	10.08	10.08
Frame B2	3	48.36	0.00	145.09	0.00	7017.40	0.00	0.00	4.26	0.32	0.07	3.94	4.32	4.32
Frame B3	3	56.36	0.00	169.09	0.00	9530.90	0.00	0.00	4.26	0.37	0.08	3.88	4.34	4.34
Frame C	3	73.36	0.00	220.09	0.00	16147.09	0.00	0.00	4.26	0.49	0.10	3.77	4.36	4.36
Frame C1	6	81.36	0.00	488.19	0.00	39721.19	0.00	0.00	8.52	1.08	0.22	7.44	8.74	8.74
Frame C2	3	84.78	0.00	254.34	0.00	21563.61	0.00	0.00	4.26	0.56	0.12	3.70	4.37	4.37
Frame D	6	109.36	0.00	656.19	0.00	71763.69	0.00	0.00	8.52	1.45	0.30	9.97	8.22	9.97
Frame D1	6	106.36	0.00	638.19	0.00	67880.57	0.00	0.00	8.52	1.41	0.29	9.93	8.23	9.93
Frame D2	5	134.78	0.00	673.91	0.00	90829.99	0.00	0.00	7.10	1.49	0.31	8.58	6.79	8.58
Frame D3	3	134.78	0.00	404.34	0.00	54498.00	0.00	0.00	4.26	0.89	0.18	5.15	4.07	5.15
Frame E	3	145.36	0.00	436.09	0.00	63392.60	0.00	0.00	4.26	0.96	0.20	5.22	4.06	5.22
Frame E1	2	141.36	0.00	282.73	0.00	39967.90	0.00	0.00	2.84	0.62	0.13	3.46	2.71	3.46
Frame F	5	169.82	0.00	849.11	0.00	144199.09	0.00	0.00	7.10	1.87	0.39	8.97	6.71	8.97
Frame G	2	180.36	0.00	360.73	0.00	65062.78	0.00	0.00	2.84	0.80	0.16	3.64	2.67	3.64
	64			6041.21	0.00	711204.60	0.00							
Frame - X - Direction														
Frame 1	6	0.00	32.88	0.00	197.28	0.00	6486.57	10.69	0.00	0.32	0.09	10.37	10.77	10.77
Frame 2	10	0.00	40.11	0.00	401.14	0.00	16091.33	17.81	0.00	0.64	0.18	17.17	17.99	17.99
Frame 3	3	0.00	81.98	0.00	245.94	0.00	20161.67	5.34	0.00	0.39	0.11	4.95	5.45	5.45
Frame 4	3	0.00	106.98	0.00	320.94	0.00	34333.52	5.34	0.00	0.51	0.14	4.83	5.48	5.48
Frame 5	3	0.00	131.98	0.00	395.94	0.00	52255.37	5.34	0.00	0.63	0.17	5.98	5.17	5.98
Frame 6	13	0.00	173.68	0.00	2257.80	0.00	392128.10	23.16	0.00	3.62	0.99	26.77	22.17	26.77
Frame 7	13	0	180.906	0	2351.778	0.00	425450.75	23.16	0.00	3.77	1.03	26.92	22.13	26.92
	51			0.00	6170.81	0.00	946907.31							

Diafram 4	
Force (k)	121.12
CoR x (ft)	94.23
CoR y (ft)	121.00
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	7.02
e_y (ft)	6.08

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	K*x^2	K*y^2	F_{id} x (k)	F_{id} y (k)	+F_{it} (k)	-F_{it} (k)	F_{total} (+F_{it})	F_{total} (-F_{it})	F_{total} (k)
Frames - Y - Direction														
Frame A	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.61	0.00	0.00	6.61	6.61	6.61
Frame B	4	37.50	0.00	150.00	0.00	5625.00	0.00	0.00	8.81	0.51	0.10	8.30	8.91	8.91
Frame B1	6	44.73	0.00	268.37	0.00	12004.10	0.00	0.00	13.21	0.91	0.18	12.30	13.39	13.39
Frame B2	3	48.36	0.00	145.09	0.00	7017.40	0.00	0.00	6.61	0.49	0.10	6.12	6.70	6.70
Frame B3	3	56.36	0.00	169.09	0.00	9530.90	0.00	0.00	6.61	0.57	0.11	6.03	6.72	6.72
Frame C	3	73.36	0.00	220.09	0.00	16147.09	0.00	0.00	6.61	0.75	0.15	5.86	6.75	6.75
Frame C1	4	81.36	0.00	325.46	0.00	26480.79	0.00	0.00	8.81	1.10	0.22	7.71	9.02	9.02
Frame C2	2	84.78	0.00	169.56	0.00	14375.74	0.00	0.00	4.40	0.57	0.11	3.83	4.52	4.52
Frame D	4	109.36	0.00	437.46	0.00	47842.46	0.00	0.00	8.81	1.48	0.29	10.29	8.52	10.29
Frame D1	4	106.36	0.00	425.46	0.00	45253.71	0.00	0.00	8.81	1.44	0.28	10.25	8.53	10.25
Frame D2	5	134.78	0.00	673.91	0.00	90829.99	0.00	0.00	11.01	2.28	0.45	13.29	10.56	13.29
Frame D3	2	134.78	0.00	269.56	0.00	36332.00	0.00	0.00	4.40	0.91	0.18	5.32	4.23	5.32
Frame E	3	145.36	0.00	436.09	0.00	63392.60	0.00	0.00	6.61	1.48	0.29	8.08	6.32	8.08
Frame E1	2	141.36	0.00	282.73	0.00	39967.90	0.00	0.00	4.40	0.96	0.19	5.36	4.22	5.36
Frame F	5	169.82	0.00	849.11	0.00	144199.09	0.00	0.00	11.01	2.88	0.56	13.89	10.45	13.89
Frame G	2	180.36	0.00	360.73	0.00	65062.78	0.00	0.00	4.40	1.22	0.24	5.63	4.17	5.63
	55			5182.73	0.00	624061.57	0.00							
Frame - X - Direction														
Frame 1	6	0.00	32.88	0.00	197.28	0.00	6486.57	14.25	0.00	0.42	0.11	13.83	14.36	14.36
Frame 2	10	0.00	40.11	0.00	401.14	0.00	16091.33	23.75	0.00	0.86	0.23	22.89	23.98	23.98
Frame 3	3	0.00	81.98	0.00	245.94	0.00	20161.67	7.12	0.00	0.53	0.14	6.60	7.27	7.27
Frame 4	3	0.00	106.98	0.00	320.94	0.00	34333.52	7.12	0.00	0.69	0.19	6.44	7.31	7.31
Frame 5	3	0.00	131.98	0.00	395.94	0.00	52255.37	7.12	0.00	0.85	0.23	7.97	6.89	7.97
Frame 6	13	0.00	173.68	0.00	2257.80	0.00	392128.10	30.87	0.00	4.82	1.31	35.70	29.56	35.70
Frame 7	13	0	180.906	0	2351.778	0.00	425450.75	30.87	0.00	5.02	1.37	35.90	29.51	35.90
	51			0.00	6170.81	0.00	946907.31							

Diafram 5	
Force (k)	151.40
CoR x (ft)	96.92
CoR y (ft)	115.21
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	4.33
e_y (ft)	0.29

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	K*x^2	K*y^2	F_{id} x (k)	F_{id} y (k)	+F_{it} (k)	-F_{it} (k)	F_{total} (+F_{it})	F_{total} (-F_{it})	F_{total} (k)
Frames - Y - Direction														
Frame A	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.31	0.00	0.00	6.31	6.31	6.31
Frame B	3	37.50	0.00	112.50	0.00	4218.75	0.00	0.00	9.46	0.45	0.18	9.01	9.65	9.65
Frame B1	6	44.73	0.00	268.37	0.00	12004.10	0.00	0.00	18.93	1.07	0.44	17.86	19.37	19.37
Frame B2	2	48.36	0.00	96.73	0.00	4678.27	0.00	0.00	6.31	0.38	0.16	5.92	6.47	6.47
Frame B3	2	56.36	0.00	112.73	0.00	6353.94	0.00	0.00	6.31	0.45	0.19	5.86	6.49	6.49
Frame C	2	73.36	0.00	146.73	0.00	10764.73	0.00	0.00	6.31	0.58	0.24	5.72	6.55	6.55
Frame C1	4	81.36	0.00	325.46	0.00	26480.79	0.00	0.00	12.62	1.30	0.53	11.32	13.15	13.15
Frame C2	2	84.78	0.00	169.56	0.00	14375.74	0.00	0.00	6.31	0.67	0.28	5.63	6.59	6.59
Frame D	4	109.36	0.00	437.46	0.00	47842.46	0.00	0.00	12.62	1.74	0.72	14.36	11.90	14.36
Frame D1	4	106.36	0.00	425.46	0.00	45253.71	0.00	0.00	12.62	1.69	0.70	14.31	11.92	14.31
Frame D2	5	134.78	0.00	673.91	0.00	90829.99	0.00	0.00	15.77	2.68	1.11	18.45	14.66	18.45
Frame D3	2	134.78	0.00	269.56	0.00	36332.00	0.00	0.00	6.31	1.07	0.44	7.38	5.87	7.38
Frame E	2	145.36	0.00	290.73	0.00	42261.73	0.00	0.00	6.31	1.16	0.48	7.47	5.83	7.47
Frame E1	2	141.36	0.00	282.73	0.00	39967.90	0.00	0.00	6.31	1.12	0.46	7.43	5.84	7.43
Frame F	4	169.82	0.00	679.29	0.00	115359.27	0.00	0.00	12.62	2.70	1.12	15.32	11.50	15.32
Frame G	2	180.36	0.00	360.73	0.00	65062.78	0.00	0.00	6.31	1.44	0.59	7.74	5.72	7.74
	48			4651.95	0.00	561786.16	0.00							
Frame - X - Direction														
Frame 1	6	0.00	32.88	0.00	197.28	0.00	6486.57	21.63	0.00	0.45	0.43	21.18	22.06	22.06
Frame 2	8	0.00	40.11	0.00	320.91	0.00	12873.06	28.84	0.00	0.74	0.70	28.10	29.54	29.54
Frame 3	3	0.00	81.98	0.00	245.94	0.00	20161.67	10.81	0.00	0.56	0.53	10.25	11.35	11.35
Frame 4	3	0.00	106.98	0.00	320.94	0.00	34333.52	10.81	0.00	0.74	0.70	10.08	11.51	11.51
Frame 5	3	0.00	131.98	0.00	395.94	0.00	52255.37	10.81	0.00	0.91	0.86	11.72	9.95	11.72
Frame 6	11	0.00	173.68	0.00	1910.45	0.00	331800.70	39.65	0.00	4.39	4.15	44.04	35.50	44.04
Frame 7	8	0	180.906	0	1447.248	0.00	261815.85	28.84	0.00	3.32	3.15	32.16	25.69	32.16
	42			0.00	4838.70	0.00	719726.74							

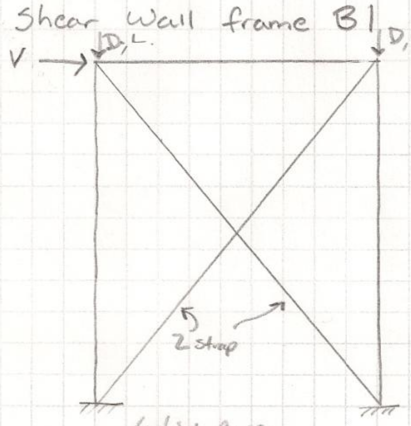
Diafram 6	
Force (k)	146.92
CoR x (ft)	98.94
CoR y (ft)	115.86
CoM x (ft)	101.25
Com y (ft)	114.92
$e_{x,ac}$ ±(ft)	10.43
$e_{y,ac}$ ±(ft)	10.63
e_x (ft)	2.31
e_y (ft)	0.94

	Relitive stiffness k	Distance X (ft)	Distance Y (ft)	K*x	K*y	$K*x^2$	$K*y^2$	F_{id} x (k)	F_{id} y (k)	+F_{it} (k)	-F_{it} (k)	F_{total} (+F_{it})	F_{total} (-F_{it})	F_{total} (k)
Frames - Y - Direction														
Frame A	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.12	0.00	0.00	6.12	6.12	6.12
Frame B	1	37.50	0.00	37.50	0.00	1406.25	0.00	0.00	6.12	0.24	0.15	5.88	6.28	6.28
Frame B1	3	44.73	0.00	134.19	0.00	6002.05	0.00	0.00	18.36	0.87	0.55	17.50	18.92	18.92
Frame B2	1	48.36	0.00	48.36	0.00	2339.13	0.00	0.00	6.12	0.31	0.20	5.81	6.32	6.32
Frame B3	1	56.36	0.00	56.36	0.00	3176.97	0.00	0.00	6.12	0.36	0.23	5.76	6.35	6.35
Frame C	1	73.36	0.00	73.36	0.00	5382.36	0.00	0.00	6.12	0.47	0.30	5.65	6.42	6.42
Frame C1	2	81.36	0.00	162.73	0.00	13240.40	0.00	0.00	12.24	1.05	0.67	11.19	12.91	12.91
Frame C2	1	84.78	0.00	84.78	0.00	7187.87	0.00	0.00	6.12	0.55	0.35	5.57	6.47	6.47
Frame D	2	109.36	0.00	218.73	0.00	23921.23	0.00	0.00	12.24	1.42	0.90	13.66	11.34	13.66
Frame D1	2	106.36	0.00	212.73	0.00	22626.86	0.00	0.00	12.24	1.38	0.88	13.62	11.37	13.62
Frame D2	2	134.78	0.00	269.56	0.00	36332.00	0.00	0.00	12.24	1.74	1.11	13.99	11.13	13.99
Frame D3	2	134.78	0.00	269.56	0.00	36332.00	0.00	0.00	12.24	1.74	1.11	13.99	11.13	13.99
Frame E	1	145.36	0.00	145.36	0.00	21130.87	0.00	0.00	6.12	0.94	0.60	7.06	5.52	7.06
Frame E1	1	141.36	0.00	141.36	0.00	19983.95	0.00	0.00	6.12	0.91	0.58	7.04	5.54	7.04
Frame F	2	169.82	0.00	339.65	0.00	57679.63	0.00	0.00	12.24	2.20	1.40	14.44	10.84	14.44
Frame G	1	180.36	0.00	180.36	0.00	32531.39	0.00	0.00	6.12	1.17	0.74	7.29	5.38	7.29
	24			2374.61	0.00	289272.96	0.00							
Frame - X - Direction														
Frame 1	4	0.00	32.88	0.00	131.52	0.00	4324.38	24.49	0.00	0.53	0.44	23.96	24.93	24.93
Frame 2	5	0.00	40.11	0.00	200.57	0.00	8045.66	30.61	0.00	0.80	0.67	29.81	31.28	31.28
Frame 3	1	0.00	81.98	0.00	81.98	0.00	6720.56	6.12	0.00	0.33	0.27	5.79	6.40	6.40
Frame 4	1	0.00	106.98	0.00	106.98	0.00	11444.51	6.12	0.00	0.43	0.36	5.69	6.48	6.48
Frame 5	1	0.00	131.98	0.00	131.98	0.00	17418.46	6.12	0.00	0.53	0.44	6.65	5.68	6.65
Frame 6	6	0.00	173.68	0.00	1042.06	0.00	180982.20	36.73	0.00	4.16	3.49	40.89	33.24	40.89
Frame 7	6	0	180.906	0	1085.436	0.00	196361.89	36.73	0.00	4.33	3.63	41.06	33.10	41.06
	24			0.00	2780.53	0.00	425297.65							

Story Force per frame per Diafram						
	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	1.42	2.84	4.26	6.61	6.31	6.12
Frame B	1.92	3.83	5.75	8.91	9.65	6.28
Frame B1	3.36	6.72	10.08	13.39	19.37	18.92
Frame B2	1.44	2.88	4.32	6.70	6.47	6.32
Frame B3	1.45	2.89	4.34	6.72	6.49	6.35
Frame C	1.45	2.91	4.36	6.75	6.55	6.42
Frame C1	2.91	5.83	8.74	9.02	13.15	12.91
Frame C2	1.46	2.92	4.37	4.52	6.59	6.47
Frame D	3.32	6.64	9.97	10.29	14.36	13.66
Frame D1	3.31	6.62	9.93	10.25	14.31	13.62
Frame D2	2.86	5.72	8.58	13.29	18.45	13.99
Frame D3	1.72	3.43	5.15	5.32	7.38	13.99
Frame E	1.74	3.48	5.22	8.08	7.47	7.06
Frame E1	1.15	2.31	3.46	5.36	7.43	7.04
Frame F	2.99	5.98	8.97	13.89	15.32	14.44
Frame G	1.21	2.42	3.64	5.63	7.74	7.29
Frame - X - Direction						
Frame 1	3.59	7.18	10.77	14.36	22.06	24.93
Frame 2	6.00	11.99	17.99	23.98	29.54	31.28
Frame 3	1.82	3.63	5.45	7.27	11.35	6.40
Frame 4	1.83	3.66	5.48	7.31	11.51	6.48
Frame 5	1.99	3.99	5.98	7.97	11.72	6.65
Frame 6	8.92	17.85	26.77	35.70	44.04	40.89
Frame 7	8.97	17.95	26.92	35.90	32.16	41.06

Appendix F: Shear Wall Check

Shear Wall frame B1



$V = \text{Story Shear} / \text{\# of Frams @ level} = 71.83/7 = 10.26^K$

Strap (x brace) 6"

$A = 0.324 \text{ in}^2$ $F_y = 50 \text{ Ksi}$

$I = 0.972 \text{ in}^4$

$E = 29000 \text{ Ksi}$

Column

$A = 1.231 \text{ in}^2$ $F_y = 50 \text{ Ksi}$

$I = 0.940$

E 29000 Ksi

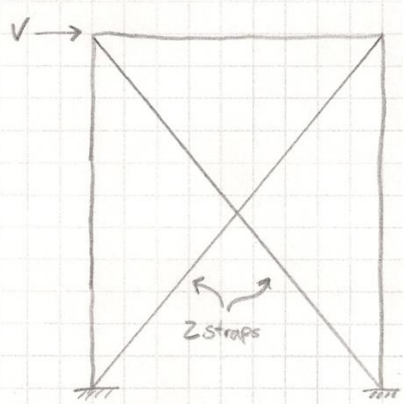
loding Case

1.2D + 1.0E + L

From a 2D RISA analysis the max tension force for each Strap to be 4.456^K which is less than the allowable of 7.81^K.

$4.456 < 7.81$ ok.

Shear wall Frame 7.



$V = 162.97/13 = 12.53$

Strap 6"

$A = 0.324 \text{ in}^2$ $F_y = 50 \text{ Ksi}$

$I = 0.972 \text{ in}^4$

$E = 29000^K$

Column

$A = 1.231 \text{ in}^2$ $F_y = 50 \text{ Ksi}$

$I = 0.94 \text{ in}^4$

$E = 29000$

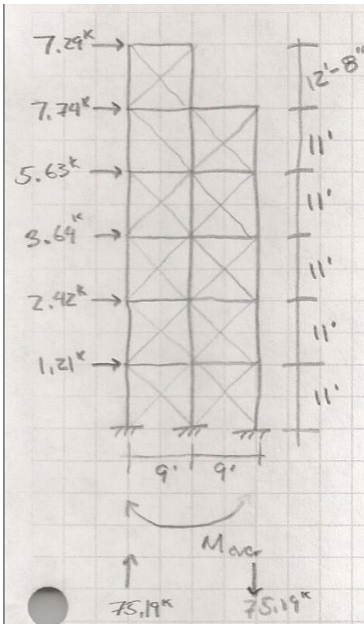
loding Case

1.2D + 1.0E + L

From a Computer analysis the tension force for each Strap to be 4.91^K which is less than the allowable of 7.81^K

$4.91 < 7.81$ OK.

Appendix G: Foundation Analysis



Check overturning on Frame G since it has the shortest frame width and will control.

$$M_{over} = 1.21(11') + 2.42(22) + 3.64(33) + 5.63(44) + 7.74(55) + 7.29(67.67) = 1353.4'^{k}$$

$$\text{uplift Force} = \frac{M_{over}}{\text{Frame length}} = \frac{1353.4}{18} = 75.19^{k}$$

IF DL acting on the frame is greater than uplift the Foundation will not overturn.

$$w_{DL} = 71 \text{ psf}$$

$$\text{Trib Area} = (9')\left(\frac{5'\text{-}6''}{2} + 32'\right)(5) = 843.75 \text{ ft}^2$$

$$P_{DL} = 71(843.75) = 59{,}906 \text{ lb} \rightarrow 60^{k} < 75.19^{k}$$

∴ Overturning will be an issue

Appendix H: Deflection Analysis

Total Deflections Due To Seismic						
	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	0.36	0.78	1.25	1.70	2.18	2.87
Frame B	0.27	0.58	0.89	1.18	1.47	1.93
Frame B1	0.28	0.56	0.84	1.19	1.50	1.86
Frame B2	0.36	0.78	1.25	1.70	2.18	2.87
Frame B3	0.36	0.78	1.25	1.70	2.18	2.87
Frame C	0.36	0.78	1.25	1.70	2.18	2.87
Frame C1	0.27	0.54	0.81	1.16	1.47	1.89
Frame C2	0.29	0.63	1.00	1.46	1.94	2.57
Frame D	0.27	0.54	0.81	1.16	1.47	1.89
Frame D1	0.27	0.54	0.81	1.16	1.47	1.89
Frame D2	0.37	0.76	1.16	1.53	1.86	2.30
Frame D3	0.29	0.63	1.00	1.46	1.94	2.57
Frame E	0.36	0.78	1.25	1.70	2.18	2.87
Frame E1	0.48	1.18	2.03	2.92	3.82	4.94
Frame F	0.37	0.76	1.16	1.53	1.86	2.30
Frame G	0.48	1.18	2.03	2.92	3.82	4.94
Frame - X - Direction						
Frame 1	0.39	0.80	1.21	1.60	1.93	2.29
Frame 2	0.32	0.63	0.93	1.18	1.42	1.71
Frame 3	0.42	0.91	1.44	1.98	2.47	3.11
Frame 4	0.42	0.91	1.44	1.98	2.47	3.11
Frame 5	0.42	0.91	1.44	1.98	2.47	3.11
Frame 6	0.35	0.69	1.00	1.26	1.48	1.77
Frame 7	0.32	0.64	0.92	1.15	1.43	1.73

Story Drift Due To Seismic						
	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	0.36	0.43	0.46	0.46	0.47	0.69
Frame B	0.27	0.30	0.31	0.30	0.28	0.47
Frame B1	0.28	0.29	0.27	0.35	0.30	0.36
Frame B2	0.36	0.43	0.46	0.46	0.47	0.69
Frame B3	0.36	0.43	0.46	0.46	0.47	0.69
Frame C	0.36	0.43	0.46	0.46	0.47	0.69
Frame C1	0.27	0.28	0.26	0.35	0.31	0.42
Frame C2	0.29	0.34	0.37	0.46	0.48	0.63
Frame D	0.27	0.28	0.26	0.35	0.31	0.42
Frame D1	0.27	0.28	0.26	0.35	0.31	0.42
Frame D2	0.37	0.39	0.40	0.38	0.32	0.44
Frame D3	0.29	0.34	0.37	0.46	0.48	0.63
Frame E	0.36	0.43	0.46	0.46	0.47	0.69
Frame E1	0.48	0.70	0.85	0.89	0.90	1.12
Frame F	0.37	0.39	0.40	0.38	0.32	0.44
Frame G	0.48	0.70	0.85	0.89	0.90	1.12
Frame - X - Direction						
Frame 1	0.39	0.41	0.41	0.38	0.33	0.36
Frame 2	0.32	0.32	0.29	0.25	0.23	0.29
Frame 3	0.42	0.49	0.54	0.53	0.50	0.64
Frame 4	0.42	0.49	0.54	0.53	0.50	0.64
Frame 5	0.42	0.49	0.54	0.53	0.50	0.64
Frame 6	0.35	0.34	0.31	0.26	0.22	0.30
Frame 7	0.32	0.31	0.29	0.23	0.28	0.30

Total Deflections Due To Wind						
	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	0.07	0.16	0.26	0.35	0.45	0.59
Frame B	0.06	0.12	0.18	0.24	0.30	0.40
Frame B1	0.06	0.12	0.17	0.24	0.31	0.38
Frame B2	0.07	0.16	0.26	0.35	0.45	0.59
Frame B3	0.07	0.16	0.26	0.35	0.45	0.59
Frame C	0.07	0.16	0.26	0.35	0.45	0.59
Frame C1	0.06	0.11	0.17	0.24	0.30	0.39
Frame C2	0.06	0.13	0.20	0.30	0.40	0.53
Frame D	0.06	0.11	0.17	0.24	0.30	0.39
Frame D1	0.06	0.11	0.17	0.24	0.30	0.39
Frame D2	0.08	0.16	0.24	0.32	0.38	0.47
Frame D3	0.06	0.13	0.20	0.30	0.40	0.53
Frame E	0.07	0.16	0.26	0.35	0.45	0.59
Frame E1	0.10	0.24	0.42	0.60	0.79	1.02
Frame F	0.08	0.16	0.24	0.32	0.38	0.47
Frame G	0.10	0.24	0.42	0.60	0.79	1.02
Frame - X - Direction						
Frame 1	0.08	0.17	0.25	0.33	0.40	0.47
Frame 2	0.07	0.13	0.19	0.24	0.29	0.35
Frame 3	0.09	0.19	0.30	0.41	0.51	0.64
Frame 4	0.09	0.19	0.30	0.41	0.51	0.64
Frame 5	0.09	0.19	0.30	0.41	0.51	0.64
Frame 6	0.07	0.14	0.20	0.26	0.30	0.36
Frame 7	0.07	0.13	0.19	0.24	0.29	0.36

Story Drift Due To Wind

	Diafram 1	Diafram 2	Diafram 3	Diafram 4	Diafram 5	Diafram 6
Frames - Y - Direction						
Frame A	0.07	0.09	0.09	0.09	0.10	0.14
Frame B	0.06	0.06	0.06	0.06	0.06	0.10
Frame B1	0.06	0.06	0.06	0.07	0.06	0.07
Frame B2	0.07	0.09	0.09	0.09	0.10	0.14
Frame B3	0.07	0.09	0.09	0.09	0.10	0.14
Frame C	0.07	0.09	0.09	0.09	0.10	0.14
Frame C1	0.06	0.06	0.05	0.07	0.06	0.09
Frame C2	0.06	0.07	0.08	0.09	0.10	0.13
Frame D	0.06	0.06	0.05	0.07	0.06	0.09
Frame D1	0.06	0.06	0.05	0.07	0.06	0.09
Frame D2	0.08	0.08	0.08	0.08	0.07	0.09
Frame D3	0.06	0.07	0.08	0.09	0.10	0.13
Frame E	0.07	0.09	0.09	0.09	0.10	0.14
Frame E1	0.10	0.14	0.17	0.18	0.19	0.23
Frame F	0.08	0.08	0.08	0.08	0.07	0.09
Frame G	0.10	0.14	0.17	0.18	0.19	0.23
Frame - X - Direction						
Frame 1	0.08	0.08	0.08	0.08	0.07	0.07
Frame 2	0.07	0.06	0.06	0.05	0.05	0.06
Frame 3	0.09	0.10	0.11	0.11	0.10	0.13
Frame 4	0.09	0.10	0.11	0.11	0.10	0.13
Frame 5	0.09	0.10	0.11	0.11	0.10	0.13
Frame 6	0.07	0.07	0.06	0.05	0.04	0.06
Frame 7	0.07	0.06	0.06	0.05	0.06	0.06