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Structural Design Option
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Spring Run Assisted Living
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Structural Technical Report 3

Lateral System Analysis and Confirmation Design

Executive Summary

This technical report is a detailed analysis of the lateral force resisting systems of Spring Run Assisted Living, which is the newest building in Willow Valley Retirement Community. By analyzing the buildings lateral systems, a critical load was identified. Also, wall rigidities, locations of shear walls, and location of bearing walls were also computed. Finally the building was analyzed for story and building drift along with the overturning moment capacity.

This 4 story building is constructed using all load bearing masonry walls and several columns. Some of these masonry walls are identified as shear resisting walls. All walls are made of 8" CMU and are reinforced.

After an analysis of wind and seismic loading, it was concluded that since the seismic load is over twice that of the wind, seismic will control. After identifying the controlling load, a spot check of a shear wall was possible to conclude that Spring Run Assisted Living was adequately designed to resist the lateral loads in question. It was also possible to conclude that the building drift is under the allowed limit set forth in ASCE 7-02 recommended limit.

Finally, an overturning moment analysis proved that the building can clearly resist an over turning moment of that which the building will experience. The moment resisting ability was nearly a factor 20 over that of the worst case scenario.

Introduction

Spring Run Assisted Living is a 4 story masonry and pre-cast hollow core plank floor building located just south of the heart of Lancaster, PA. This technical assignment is a detailed analysis of the lateral support for this building.

Lateral System

Brief Overview of Building:

- Load bearing masonry shear walls
- Steel columns and beams are used strategically used to support plank flooring from gravity loads.
- Foundation: Wall footings under load-bearing masonry walls and spread footings under columns
- Floor/Roof System: 8" hollow core pre-cast planks (2" topping on floors and no-topping used on roof)

Detailed Breakdown of Walls:

- All walls are of 8" CMU with 1500 psi f'm.
- All shear walls are required to have 2 #5 bars placed in the last 2 cells of the shear wall.
- First floor: #5 bars are used at 16" o.c. with full grouting.
- Second floor: #5 bars used at 24" o.c. with full grouting.
- Third and Fourth floors: #5 bars used at 48" o.c. with grouting at 24" o.c.

Foundation System:

- Spread footings vary from 3' x 3' through 9' x 9' dependant on their placement throughout the building.
- Wall footings range from 3' wide through 4' wide dependant on the location of the walls, i.e. exterior and interior walls.
- The Slab-on-Grade system is a 4" concrete slab with 6x6 – w2.9 x w2.9 WWF reinforcing.

Floor System:

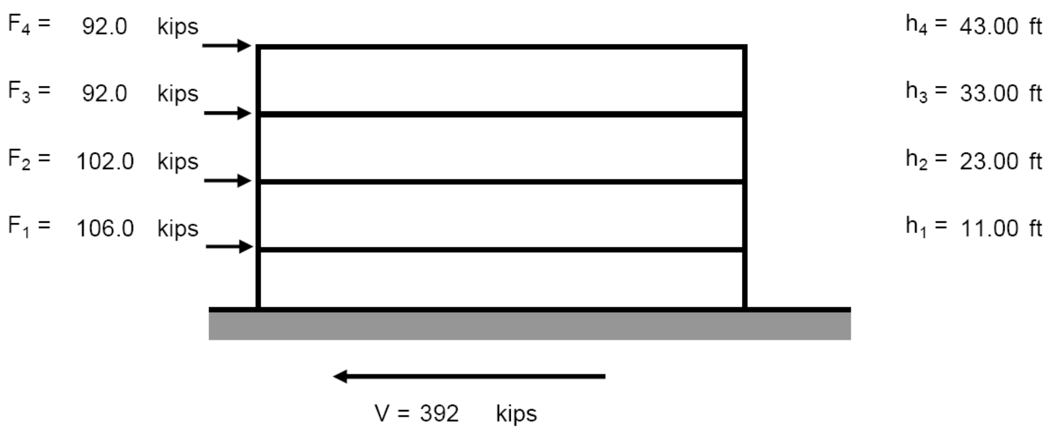
- 8" Pre-cast hollow core planks
- Spans are typically 19' or 27' dependant upon location.
- Spans are typically perpendicular to longitudinal wall of section.
- Plank flooring and steel members do not contribute to the lateral force resistance system.

Lateral Forces

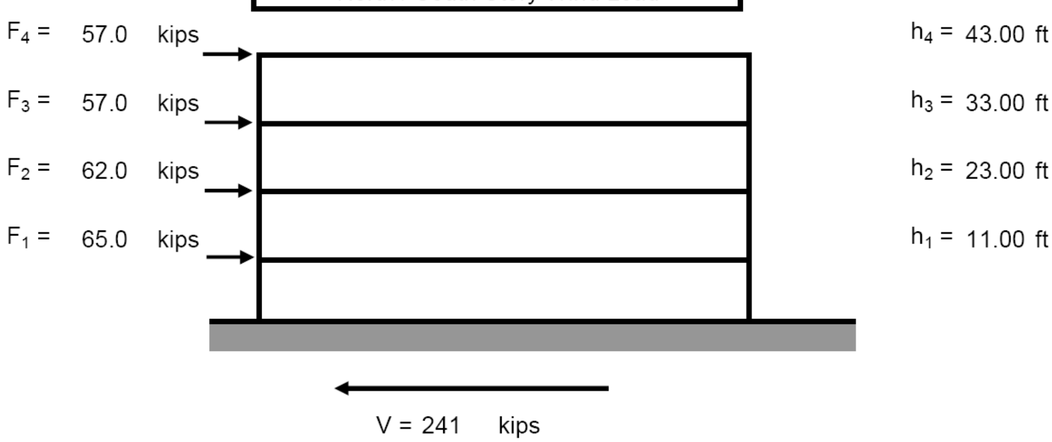
The lateral loading on the building will be controlled by either the wind loads or the seismic loads. Following is the summary of the analysis of lateral loads on the building.

Wind Loading: After analysis it was determined that Spring Run Assisted Living meets all the necessary requirements set forth in ASCE 7-02 to be analyzed for wind loading the category of components and cladding.

Wind Loading	
Basic Wind Speed	90 MPH
Exposure Category	C
Importance Factor (I_w)	1.15
λ	1.58
Building Categroy	Simple Diaphragm
	Low-Rise
	Enclodes
	Rigid Structure
Internal Pressure Coeff.	±0.18 PSF
Components and Cladding	
Walls	±28 PSF
Wall Corners	±35 PSF
Roof Zone 1	+11/-26 PSF
Roof Zone 2	+11/-43 PSF
Roof Zone 3	+11/-65 PSF



North / South Story Wind Load



East / West Story Wind Load

Seismic Loading: Spring Run Assisted Living was analyzed with the parameters set for through ASCE 7-02 for a 4-story masonry unit located in Lancaster, PA.

Seismic Design Category	**A**
S_s =	**0.279** g
S_1 =	**0.075** g
S_{MS} =	**0.223** g
S_{M1} =	**0.06** g
S_{DS} =	0.1487 g
S_{D1} =	0.04 g
I_E =	**1.25**
No. Stories = N =	**4**
C_u =	**1.7**
R =	**3.5**
h_n =	43 ft
C_T =	**0.02**
x=	**0.75**
$T_a = C_T (h_n)^x$ =	0.3358 sec
$T_{max} = C_u T_a$ =	0.571 sec
T =	0.3358 sec
$C_s = S_{DS} / (R / I_E)$ =	0.0531
$C_{s\,max} = S_{D1} / (R / I_E) / T$ =	0.0425
$C_{s\,min} = 0.044\, S_{DS}\, I_E$ =	0.0082
$C_{s\,min} = 0.5\, S_1 / (R / I_E)$ =	N/A
C_s =	0.0425

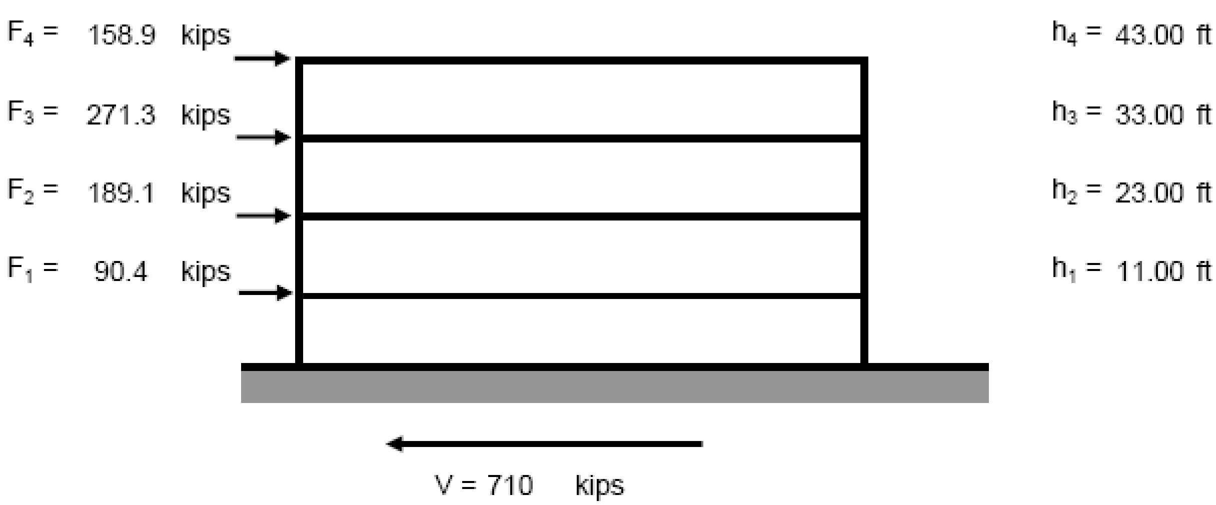
$F_x = C_{vx} V$ k = 1.00

$C_{vx} = w_x h_x^k / \text{Sum}(w_i h_i^k)$ (from i to n)

x = 1	w_x = **4837** kips	h_x = **11** ft	$w_x h_x^k$ = 53207	C_{vx} = 0.12742	F_x = 90.4 kips
x = 2	w_x = **4837** kips	h_x = **23** ft	$w_x h_x^k$ = 111251	C_{vx} = 0.26643	F_x = 189.1 kips
x = 3	w_x = **4837** kips	h_x = **33** ft	$w_x h_x^k$ = 159621	C_{vx} = 0.38227	F_x = 271.3 kips
x = 4	w_x = **2174** kips	h_x = **43** ft	$w_x h_x^k$ = 93482	C_{vx} = 0.22388	F_x = 158.9 kips
			$\text{Sum}(w_i h_i^k)$ = 417561		V = Sum (F_i) = 710 kips

Structure Weight	W = Sum (w_i) =	16685 kips
Base Shear	V = Cs W =	710 kips

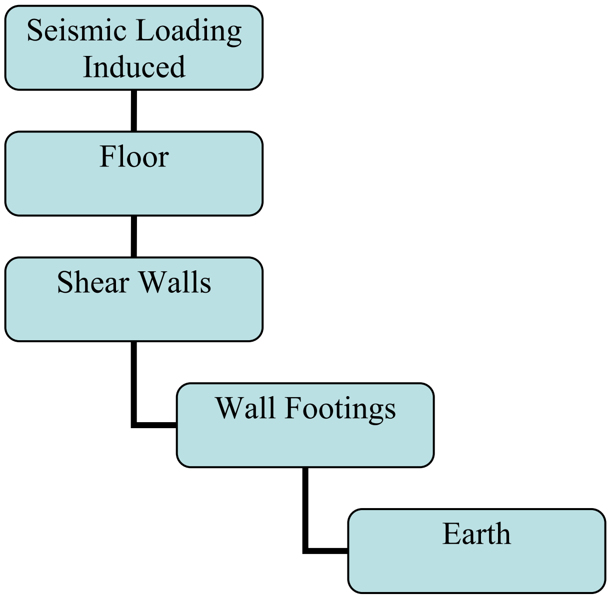
Per table 1617.4.2					
S_{D1}	>=0.4	0.3	0.2	0.15	<=0.1
C_u	1.2	1.3	1.4	1.5	1.7



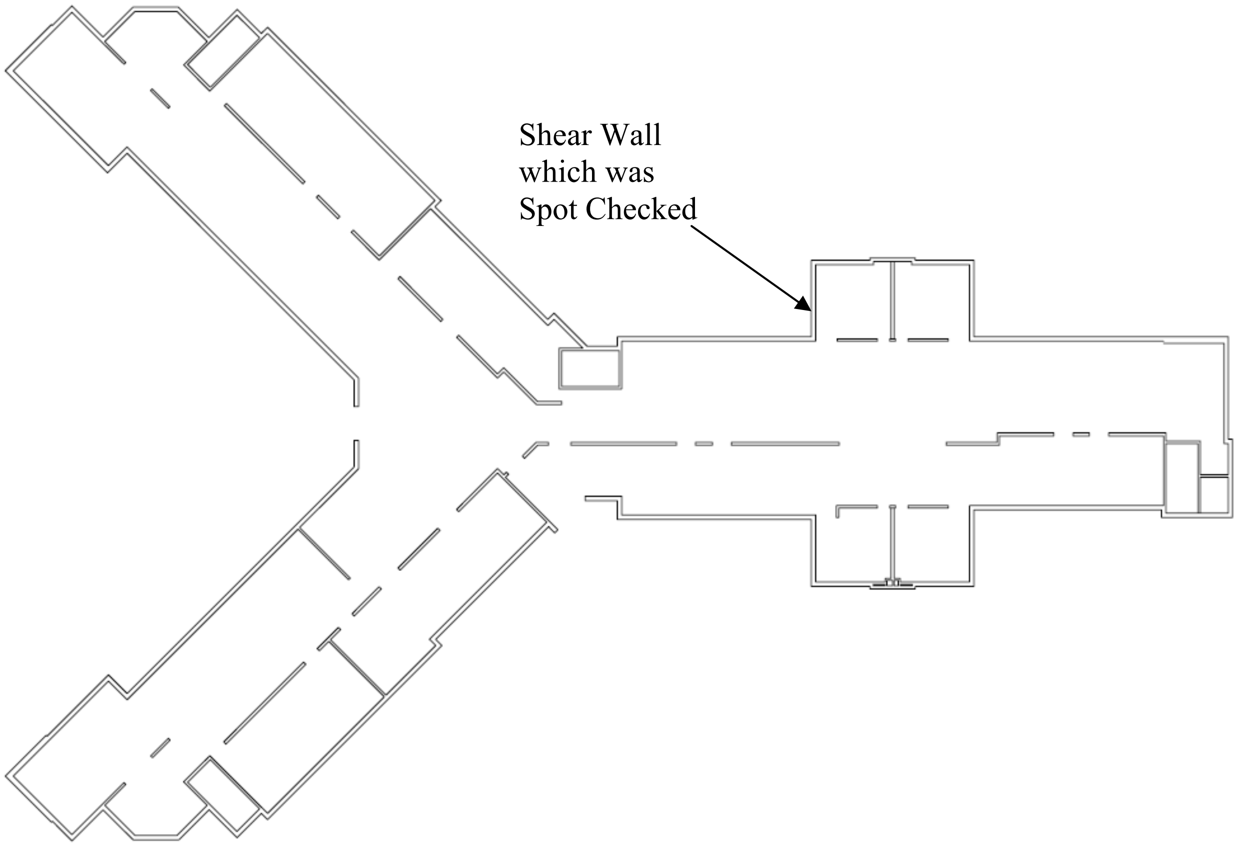
Controlling Loading: After thorough analyze of Spring Run Assisted Living and the load combinations set for in ASCE 7-02, it has been concluded that this building will experience will experience a higher later force due to seismic loading. Because the seismic loading is more then twice that of the wind loading, wind loading will never control.

Distribution of Lateral Loads

Load induced due to seismic activity will be transferred to the load bearing masonry shear walls through the floor system. The load will then follow a direct path through the shear walls directly to the wall footings. The footings bear on compacted fill rated with a minimum bearing capacity of 5^{ksi}.



Lateral Load Path



Shear Wall Plan

Shear Wall Load Resistance

Using the properties of the walls to find their rigidity and the shear which the walls experience, an analysis of the walls was performed. In **Appendix A** is a table of the rigidity of the shear walls along with the amount of shear and moment each wall is attributed.

- Rigidity of the walls was found using the equation of $R=1/\Delta$
- $\Delta = (h^3/3l) + (3h/A)$

<u>Spot Check of Wall:</u> Wall 13y on the shear wall plan was analyzed. This wall is 22' long and is located on the east wing of Spring Run Assisted Living. This wall spans the north/south direction and is located on the 3rd floor. This wall is adequate for seismic loading given that it is also designed as a bearing wall. Without gravity loads, this wall will fail seismic loading. Detailed calculations of this analysis can be found in **Appendix B**.

Drift (Story and Building)

During a lateral drift analysis using the equation of $\Delta = V/ \Sigma R$, it was concluded that the total building drift is less then the allowable l/400. Story building drift was also calculated and it was also found to be less then the l/400 allowable drift. Further details of this analysis can be found in **Appendix C**.

Overturning Moment

Using a value of T = 1 and the weight of the building used for seismic analysis, the overturning moment was checked. The overturning moment for Spring Run Assisted Living was found to be adequately resisted. Further calculations can be found in **Appendix D**.

Conclusion

After a thorough breakdown of the buildings shear walls and distribution of seismic loading, Spring Run Assisted Living was adequately designed for seismic loads in the Lancaster, PA area.

Appendix A

First Floor (North - South)											
Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	11	1.47E+01	1.62E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	11	1.47E+01	1.62E+02
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	1080	132	8640	1.53E+06	0.5	4.58E-02	5.46E-01	1.83E+00	11	1.60E+01	1.76E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	11	1.08E+01	1.18E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	11	1.08E+01	1.18E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	11	1.49E+01	1.64E+02
10	228	132	1824	1.53E+06	0.5	2.17E-01	7.17E-01	1.39E+00	11	2.83E+00	3.11E+01
11	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	11	3.85E+00	4.23E+01
12	576	132	4608	1.53E+06	0.5	8.59E-02	5.86E-01	1.71E+00	11	1.18E+01	1.29E+02
13	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	11	3.56E+00	3.91E+01
14	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	11	3.85E+00	4.23E+01

First Floor (East - West)											
Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	11	9.56E+00	1.05E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	11	8.58E+00	9.44E+01
3	960	132	7680	1.53E+06	0.5	5.16E-02	5.52E-01	1.81E+00	11	8.39E+00	9.22E+01
4	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	11	1.81E+01	1.99E+02
5	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	11	1.71E+01	1.89E+02
6	1092	132	8736	1.53E+06	0.5	4.53E-02	5.45E-01	1.83E+00	11	9.45E+00	1.04E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	11	6.30E+00	6.93E+01
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	11	6.86E+00	7.54E+01
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	11	9.43E+00	1.04E+02
10	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-

Second Floor (North - South)											
Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	12	3.29E+01	3.95E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	12	3.29E+01	3.95E+02
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	1080	132	8640	1.53E+06	0.5	4.58E-02	5.46E-01	1.83E+00	12	3.62E+01	4.35E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	12	2.29E+01	2.75E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	12	2.29E+01	2.75E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	12	3.34E+01	4.01E+02
10	228	132	1824	1.53E+06	0.5	2.17E-01	7.17E-01	1.39E+00	12	3.66E+00	4.40E+01
11	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	12	5.65E+00	6.78E+01
12	576	132	4608	1.53E+06	0.5	8.59E-02	5.86E-01	1.71E+00	12	2.69E+01	3.23E+02
13	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	12	5.10E+00	6.12E+01
14	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	12	5.65E+00	6.78E+01

Second Floor (East - West)											
Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	12	2.00E+01	2.40E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	12	1.77E+01	2.12E+02
3	960	132	7680	1.53E+06	0.5	5.16E-02	5.52E-01	1.81E+00	12	1.72E+01	2.07E+02
4	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	12	3.97E+01	4.77E+02
5	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	12	3.73E+01	4.47E+02
6	1092	132	8736	1.53E+06	0.5	4.53E-02	5.45E-01	1.83E+00	12	1.97E+01	2.36E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	12	1.23E+01	1.48E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	12	1.36E+01	1.63E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	12	1.97E+01	2.36E+02
10	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-

Third Floor (North - South)

Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	4.92E+01	4.92E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	4.92E+01	4.92E+02
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	1080	132	8640	1.53E+06	0.5	4.58E-02	5.46E-01	1.83E+00	10	5.48E+01	5.48E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	3.23E+01	3.23E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	3.23E+01	3.23E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	10	5.00E+01	5.00E+02
10	228	132	1824	1.53E+06	0.5	2.17E-01	7.17E-01	1.39E+00	10	3.77E+00	3.77E+01
11	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	6.16E+00	6.16E+01
12	576	132	4608	1.53E+06	0.5	8.59E-02	5.86E-01	1.71E+00	10	3.90E+01	3.90E+02
13	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	5.48E+00	5.48E+01
14	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	6.16E+00	6.16E+01

Third Floor (East - West)

Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	2.86E+01	2.86E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	2.48E+01	2.48E+02
3	960	132	7680	1.53E+06	0.5	5.16E-02	5.52E-01	1.81E+00	10	2.41E+01	2.41E+02
4	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	10	6.02E+01	6.02E+02
5	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	10	5.60E+01	5.60E+02
6	1092	132	8736	1.53E+06	0.5	4.53E-02	5.45E-01	1.83E+00	10	2.81E+01	2.81E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	1.63E+01	1.63E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	1.82E+01	1.82E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	10	2.81E+01	2.81E+02
10	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-

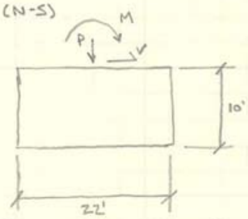
Fourth Floor (North - South)

Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	2.96E+01	2.96E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	2.96E+01	2.96E+02
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	1080	132	8640	1.53E+06	0.5	4.58E-02	5.46E-01	1.83E+00	10	3.35E+01	3.35E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	1.73E+01	1.73E+02
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	1.83E+01	1.83E+02
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	10	3.02E+01	3.02E+02
10	228	132	1824	1.53E+06	0.5	2.17E-01	7.17E-01	1.39E+00	10	1.71E+00	1.71E+01
11	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	2.89E+00	2.89E+01
12	576	132	4608	1.53E+06	0.5	8.59E-02	5.86E-01	1.71E+00	10	2.22E+01	2.22E+02
13	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	2.55E+00	2.55E+01
14	264	132	2112	1.53E+06	0.5	1.88E-01	6.88E-01	1.45E+00	10	2.89E+00	2.89E+01

Fourth Floor (East - West)

Wall	L (in)	H (in)	A (in^2)	I (in^4)	$\Delta_{flexure}$	Δ_{shear}	Δ_{total}	R	H_{story} (ft)	Wall Shear (k)	Wall Moment (ft-k)
1	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	1.66E+01	1.66E+02
2	996	132	7968	1.53E+06	0.5	4.97E-02	5.50E-01	1.82E+00	10	1.42E+01	1.42E+02
3	960	132	7680	1.53E+06	0.5	5.16E-02	5.52E-01	1.81E+00	10	1.37E+01	1.37E+02
4	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	10	3.74E+01	3.74E+02
5	1956	132	15648	1.53E+06	0.5	2.53E-02	5.25E-01	1.90E+00	10	3.45E+01	3.45E+02
6	1092	132	8736	1.53E+06	0.5	4.53E-02	5.45E-01	1.83E+00	10	1.62E+01	1.62E+02
7	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	8.75E+00	8.75E+01
8	744	132	5952	1.53E+06	0.5	6.65E-02	5.67E-01	1.77E+00	10	9.91E+00	9.91E+01
9	1008	132	8064	1.53E+06	0.5	4.91E-02	5.49E-01	1.82E+00	10	1.62E+01	1.62E+02
10	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-

WALL 13Y, 3RD FLOOR
SPAN 22'
(N-S)



MASONRY USES ASD

VENEER, WALL, F_{DL}, F_{LL}

$P_u = 40^{psf}(20') + 80^{psf}(10') + 20'(60^{psf}) + 20'(80^{psf}) = 4.4^{klf} = 96.8^k$

$V_u = 5.48^k$

$M_u = 54.8'^k$

FROM ABOVE

$M_{OVERTURNING} = 54.8'^k + 2.55^k \cdot 10' = 80.3'^k$

$S = \frac{7.625(22 \cdot 12)^2}{6} = 88,572$

$f_b = \frac{M}{S} - \frac{P}{A} = \frac{54.8}{88,572} - \frac{96.8}{(7.625)(22 \cdot 12)} = -0.0475 = -47.5$ psi COMPRESSION

THIS WALL IS ADEQUATE IF USED AS A BEARING WALL

STORY / BUILDING DRIFT

$$\Delta = \frac{V}{\Sigma k}$$

$\Delta_1 = 90.4 / [(18.3 + 16.4) \cdot 12] = 0.217''$

$\Delta_{1\,ALLOW} = \ell/400 = 12 \cdot 11/400 = 0.33''$ ok

$\Delta_2 = 279.5 / [(18.3 + 16.4) \cdot 12]_2 = 0.336''$

$\Delta_{2\,ALLOW} = \ell/400 = 12 \cdot 23/400 = 0.69''$ ok

$\Delta_3 = 550.8 / [(18.3 + 16.4) \cdot 12]_3 = 0.441''$

$\Delta_{3\,ALLOW} = \ell/400 = 12 \cdot 33/400 = 0.99''$ ok

$\Delta_4 = 709.7 / [(18.3 + 16.4) \cdot 12]_4 = 0.426''$

$\Delta_{4\,ALLOW} = \ell/400 = 12 \cdot 43/400 = 1.29''$ ok

OVERTURNING

$$M_x = \tau \sum_{i=x}^{n} F_i(h_i - h_x)$$

$\tau = 1$

$$M_x = 158.9 \cdot 43 + 271.3 \cdot 33 + 189.1 \cdot 23 + 90.4 \cdot 11$$

$$= 21{,}129.3'k$$

$$M_R = W\left(\frac{48'\text{-}6''}{2}\right) = 16685^k\left(\frac{48.5'}{2}\right) = 404{,}611\ 'k$$

FROM SEISMIC
$W = 16685^k$

$M_R > M_x$ THUS BUILDING WILL RESIST OVERTURNING.