Building A

138 East Beaver Ave

State College, PA

Report By: Robert Dawson

Advisor: DR. Linda Hanagan

Structural Notebook A

Table of Contents

1.0 Executive Summary

Building A (fake name) is a mixed-use building in downtown State College, PA. The building will serve as an apartment building for students at The Pennsylvania State University and will feature retail spaces along the street level for local people to enjoy. The building is 132,000sf with 5 stories of residential space and 2 stories of commercial retail space. The designing architects are WTW Architects and the builder is the general contractor Leonard S. Fiore. The project's delivery method is Design – Bid – Build and it is on a 2-year project schedule. Construction is to start on September 1st, 2018 and it is to be completed by June 1st, 2020. The total cost for this project is $21,764,00.

The building will be constructed with concrete slabs and CMU blocks. The building features a parking garage on the 1st and 2nd floors and columns hold up the structure here. From floors 3-7 these columns do not continue to maximize apartment living space. The third floor features a very thick (26") transfer slab to allow for this and the CMU block units bear most of the gravity weight in the residential floors of the building.

The design for this building is in accordance with IBC 2009. The concrete design follows ACI and the steel is designed with the AISC reference standard.

2.0 Abstract

2.1 Project Team and Info

Owner: HFL Corporation

Architect: Penn Tera Engineering

Builder: Leonard S. Fiore

No. of Stories:7 above grade, 2 below

Occupancy Type: Mixed Use/Student Housing

Cost: $21,764,000

2.2 Systems

Construction

- Design – Bid – Build
- 2-year timeline
- September 2018 August 2022
- Demo site before construction

Structural

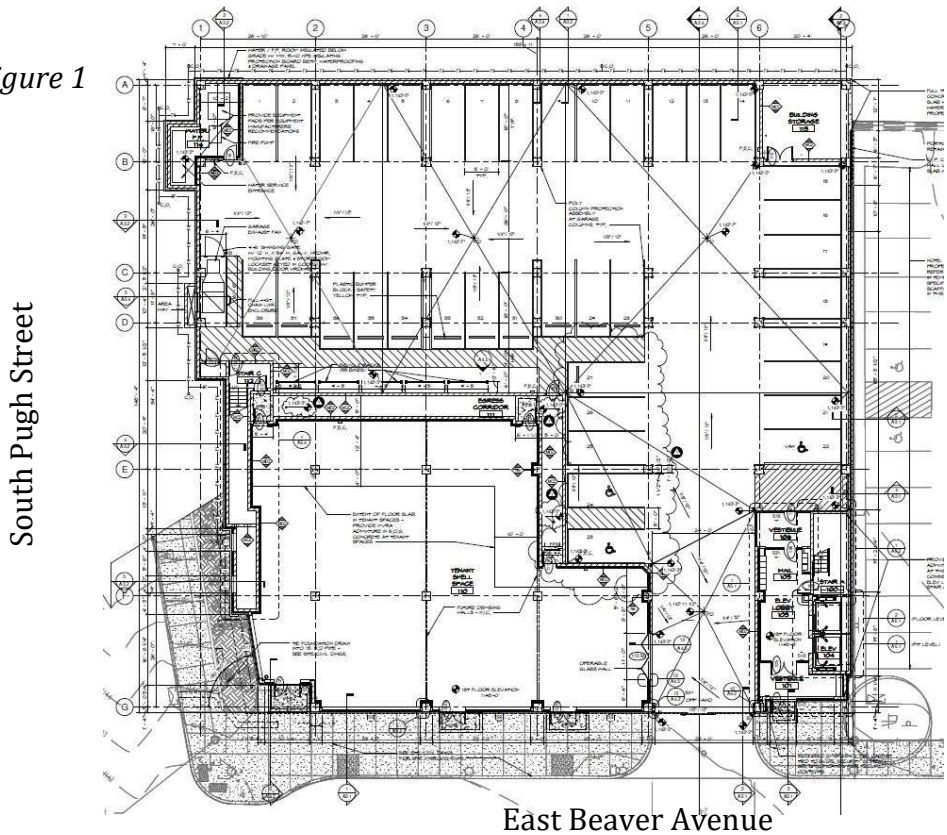
- Hollow-core plank on block
- Transfer slab between parking garage and residential spaces
- Concrete frame

MEP

- PTAC AC units in each apartment
- Efficient Lighting

3.0 Site Plan

Figure 1



4.0 Applicable Codes and Documents

Building A complies to IBC 2009 and IBC 2015 for Ch. 11 only. Wind and Seismic design is in accordance with 2009 IBC. The reference standard for concrete in this building is ACI. The reference standard for steel construction AISC.

Documents

- Building A Construction Plan
- Specs
- Building A Drawings

5.0 Gravity Loads

5.1 Roof Bay

Loads:

- Live – 30psf
- Snow – 40psf (2009 IBC)
- Dead – 110psf
    - 8” Hollow Core Roof Plank – 100psf
    - Rigid Insulation – 1.5psf
    - Misc. (MEP, Ceiling) – 8psf

ASCE Load Combination **3** controls roof design.

1.2D + 1.6S + L = **226psf**

5.2 Floor Bay

Residential Loads:

- Live – 40 psf
- Dead – 135psf
    - 8” Hollow Core Plank – 100psf
    - CMU Partitions – 25 psf
    - Misc. (MEP, Ceiling) – 10psf

ASCE Load Combination **2** controls residential floor design.

1.2D + 1.6L = **226psf**

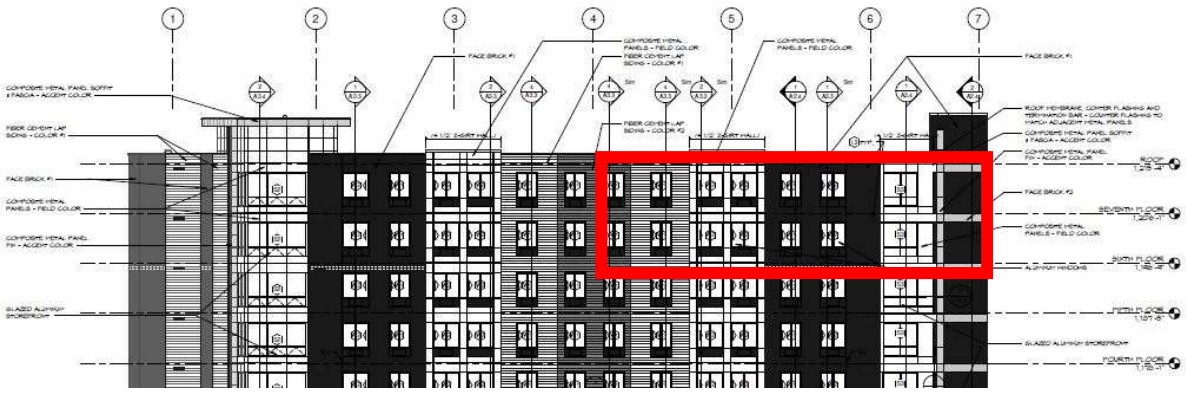


Figure 2

Typical Roof and Floor Bay: 72’ – 4 5/8” x 26’

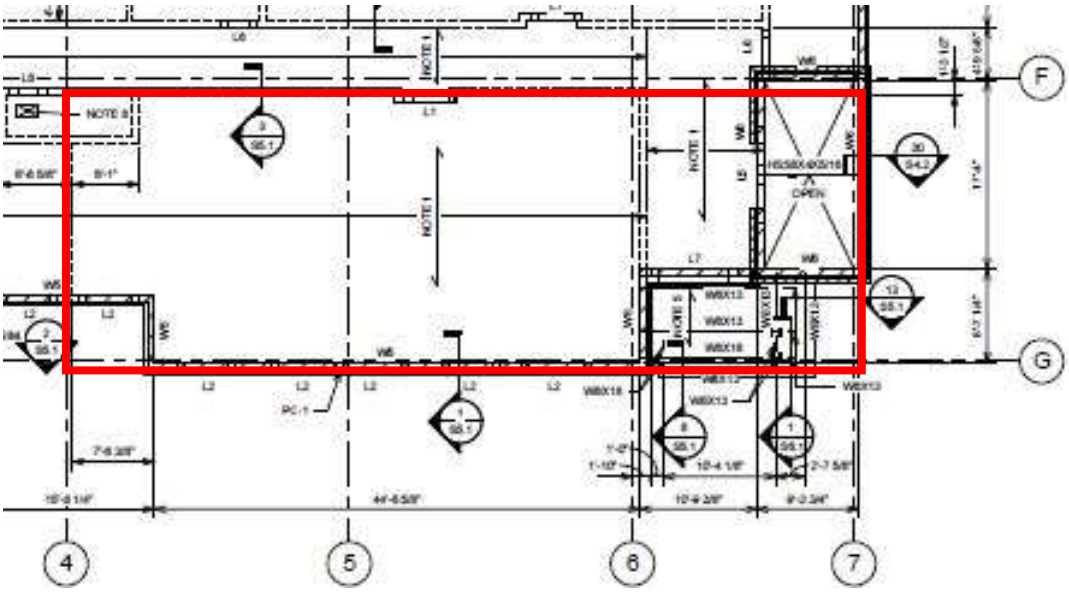


Figure 3

Cross Sections of Typical Floor and Roof Construction.

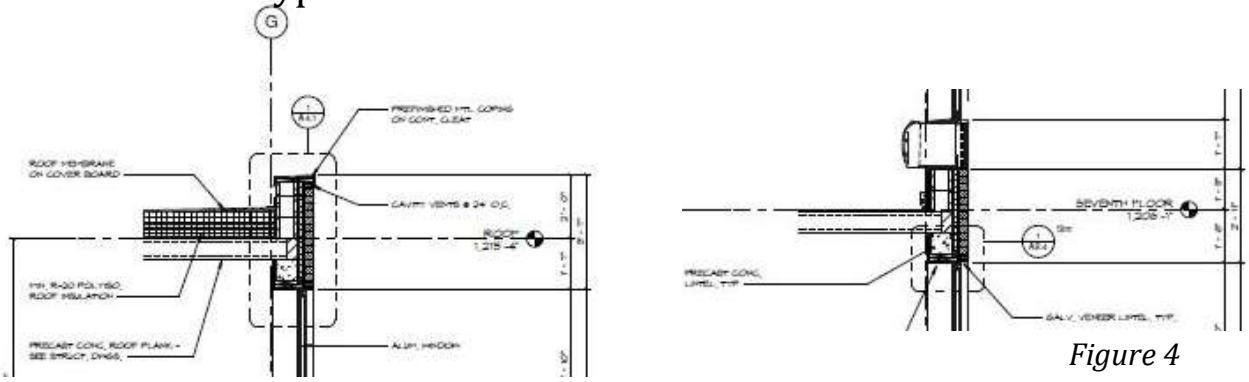


Figure 4

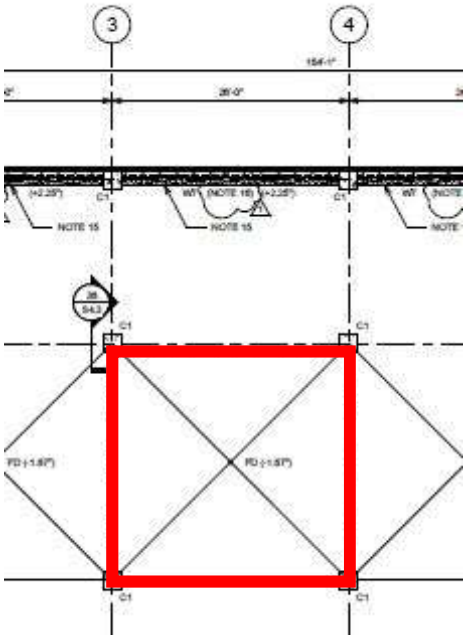
Parking Garage Loads:

- Live – 40psf + 3000lb point load
- Dead – 160psf
  - 12” Reinforced Slab – 120psf
  - Misc. (MEP) – 10psf

ASCE Load Combination **2** controls parking garage design.

1.2D + 1.6L = **<u>256psf + 4800lb</u>**

Figure 5



Typical Garage Bay:

26’ x 26’

5.3 Exterior Wall

Typical Wall Load:

1. Dead – 75
   - Exterior Brick – 55psf
   - Glazing – 15psf
   - Siding – 5psf

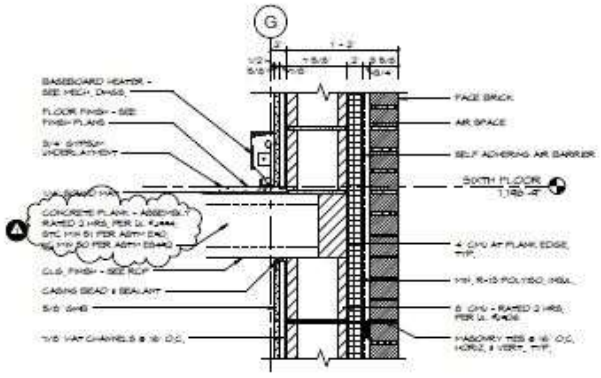


Figure 6

Exterior brick is not supported by the floor slab.

6.0 Lateral Loads

6.1 Wind Loads

Building A meets the conditions for the ASCE-7 "Simplified Directional Procedure for Buildings <160ft"

Class 2 Building Requirements

1. Meets Section 26.2 Simple Diaphragm
2. Mean Roof Height = 72' (60'< 72' < 160')
3. L/B = 1.07 OR 0.93 (0.2 < 1.07 < 5.0)
4. N_a = 1.042
5. K_{zt} = 1.0 (No adjustment)

Risk Category: Category II (Apartments/Offices/Retail Space)

Terrain: Sloped Terrain

Basic Wind Speed: V = 115mph (90 in drawings. State College, PA)

Exposure Category: B

Topographic Factor: K_{zt} = 1.0

From Table 27.6-1: Net pressures on walls @ the top and base:

Direction	L/B	P_h	P_o	P_z
N-S	1.07	28.9	22.4	29.6
E-W	0.963	29.1	22.7	29.8

Table 1

Values Linearly Interpolated based on L/B and h = 72'

Total E–W Base Shear:

= ((29.1+22.7)/2)(72')(143.33') + (29.8)(4')(143.33')(2.25)

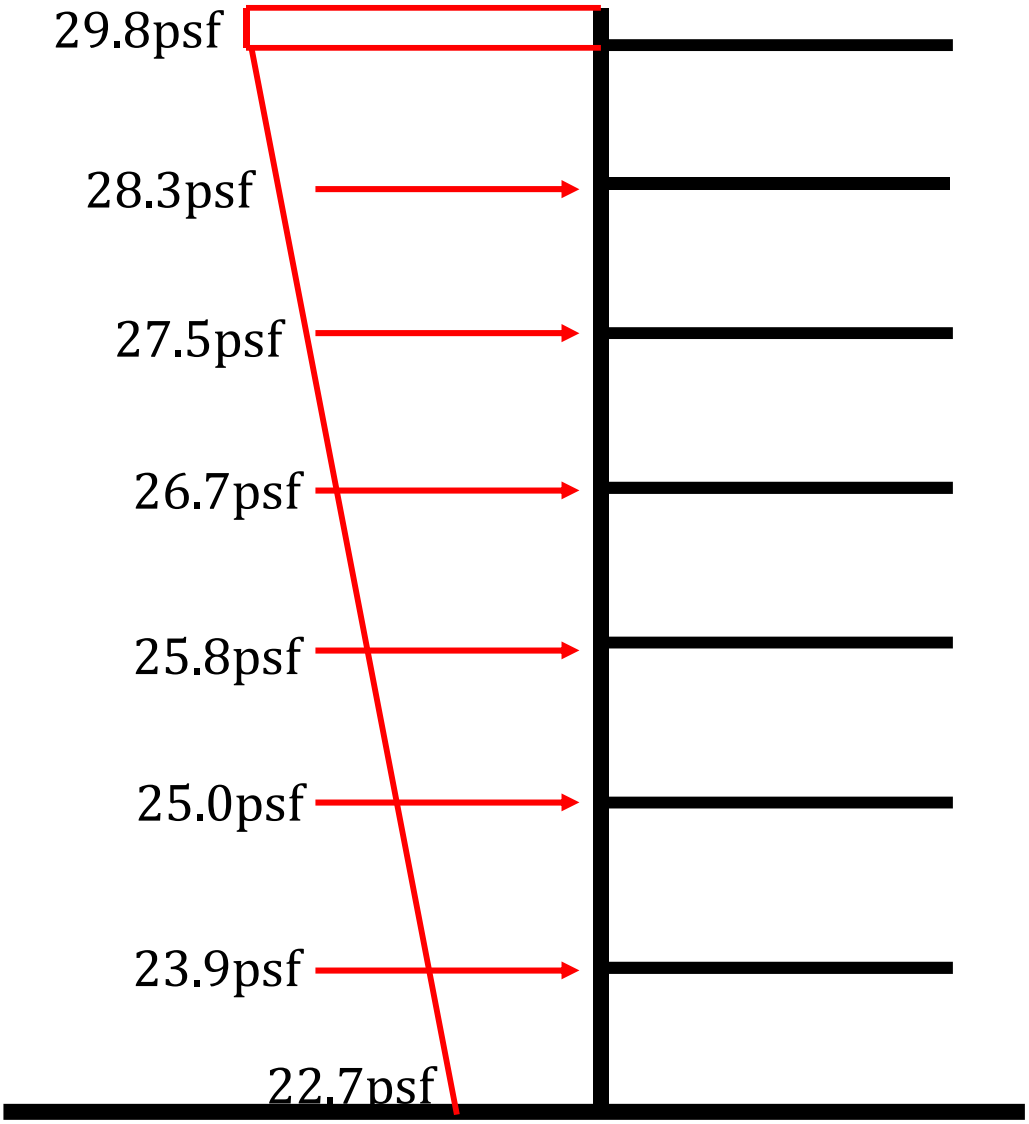
= **306kip**

Total N–S Base Shear:

= ((28.9+22.4)/2)(72')(154') + (29.6)(4')(154')(2.25)

= **326kip**

E-W Diagram



Base Shear = 306kip

Figure 7

N-S Diagram

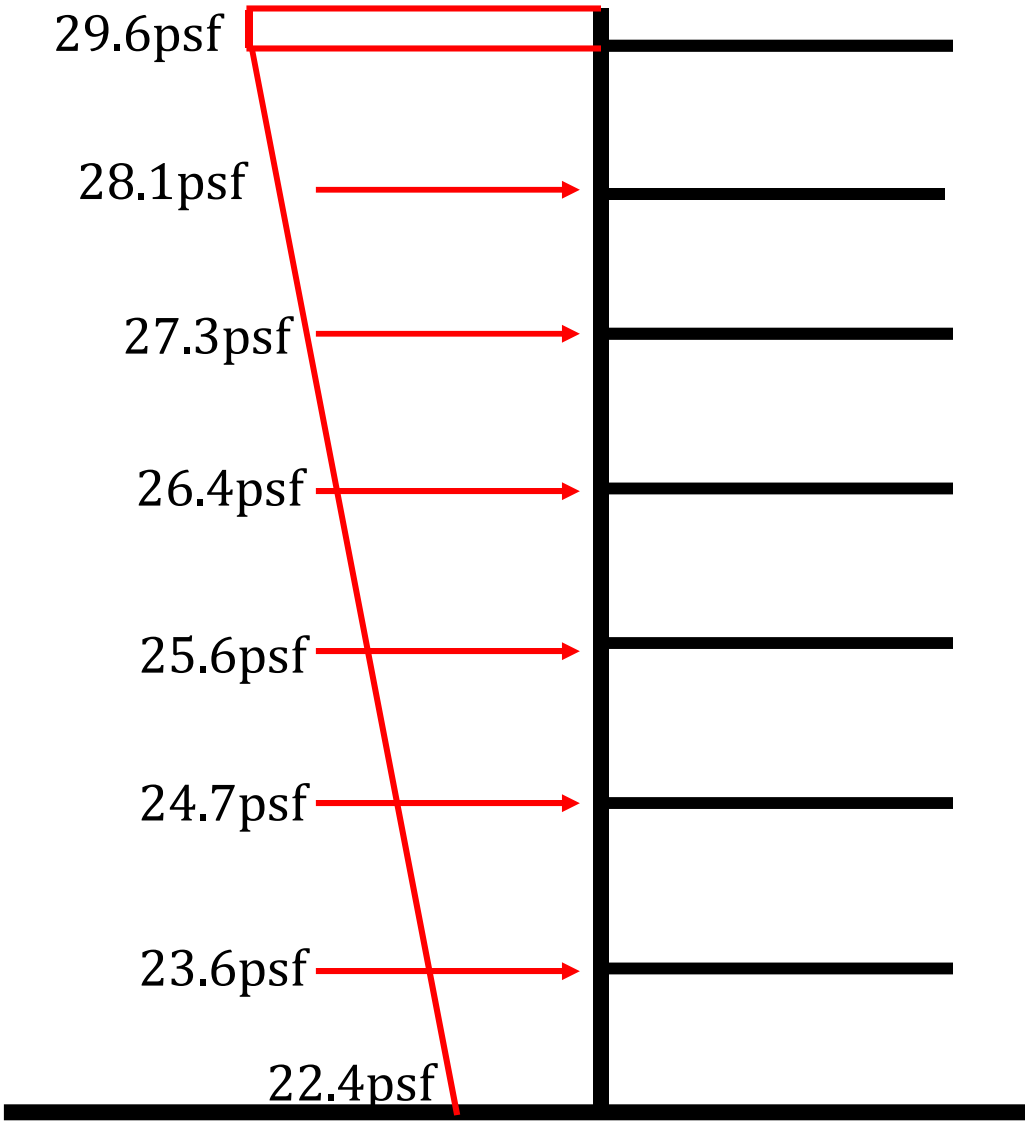


Figure 8

Base Shear = 326kip

6.2 Seismic Loads

Seismic Loads determined from ASCE 7-10.

Risk Category: Category II

$S_1 = 0.049$

$S_s = 0.147$

$S_{DS} = 0.098$ (Category A)

$S_{D1} = 0.033$ (Category A)

Seismic Response Coefficient:

$C_{s\,max}$:

$T_a = (C_t)(h_i^x) = 0.7511$

$C_t = 0.016$

$h_i = 72'$

$x = 0.9$

$T_a = 0.1N = 0.7$

$N = 7$ (Stories above grade)

$T_a =$ **0.7511** $T < T_L$; Use Eqn. 12.8-3

$C_{s\,max} = S_{D1}/(T(R/I_e)) = 0.01719$

$R = 1.5$ (Ordinary Plain Masonry Shear Walls)

$I_e = 1.0$ (Used in Design)

$C_{s\,min}$ Check:

$C_{s\,min} = (0.044)(0.098)(1.0) = 0.004312$ $C_{s\,max}$ OK

Seismic Weight:

Floors

Floor	Floor Area (ft^2)	Loading (psf)	Weight (kip)
1	22,126	160	3541
2	22,109	160	3538
3-7	16550	135	2235
Roof	16550	110	1821

Table 2

Total Floor Weight = **11,135kip**

Exterior Wall

Group 1 (Walls around floors 1-2)

Surface area of group = 9520ft^2

Material	Material Area (ft^2)	Loading (psf)	Weight (kip)
Masonry	7616	100	762
Glazing	1904	15	26

Table 3

Group 2 (Walls around floors 3-7)

Material	Material Area (ft^2)	Loading (psf)	Weight (kip)
Fiber Siding	24,000	5	120
Metal Panels	4,800	10	48
Brick	4,800	55	264
Glazing	14,400	15	216

Table 4

Total Wall Weight = **1436kip**

Total Building Weight = 12,600kip

Base Shear (same in both directions)

V = 0.01719(12,600) = **220kip**

7.0 Appendix

List of Tables

List of Figures