Building A

138 East Beaver Ave

State College, PA

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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 Introduction

2.1 Purpose

The purpose of this report is to provide a description of the existing conditions of the structure for Building A (cannot disclose the name) in downtown State College, PA. This report will function as the template for the analysis of the structural system among other things in this building.

2.2 Scope

This report will focus on the structural elements included in the building's design and will provide commentary on several structural elements to analyzed in the future. This report will not detail each element, it will function as an outline of structural elements present in the building that need to be considered in all aspects of building design including architecture.

2.3 General Building Overview

Located in downtown State College at 138 East Beaver Avenue, Building A will be a mixed-use building (*figure 1*) with 7 total floors; 2 floors of commercial space on the street level and on the second level, and 5 floors of residential space. Level 1 (on grade) will serve as the bottom floor for the building. About half of floors 1 and 2 will have parking spaces provided for tenants (*figure 2*).

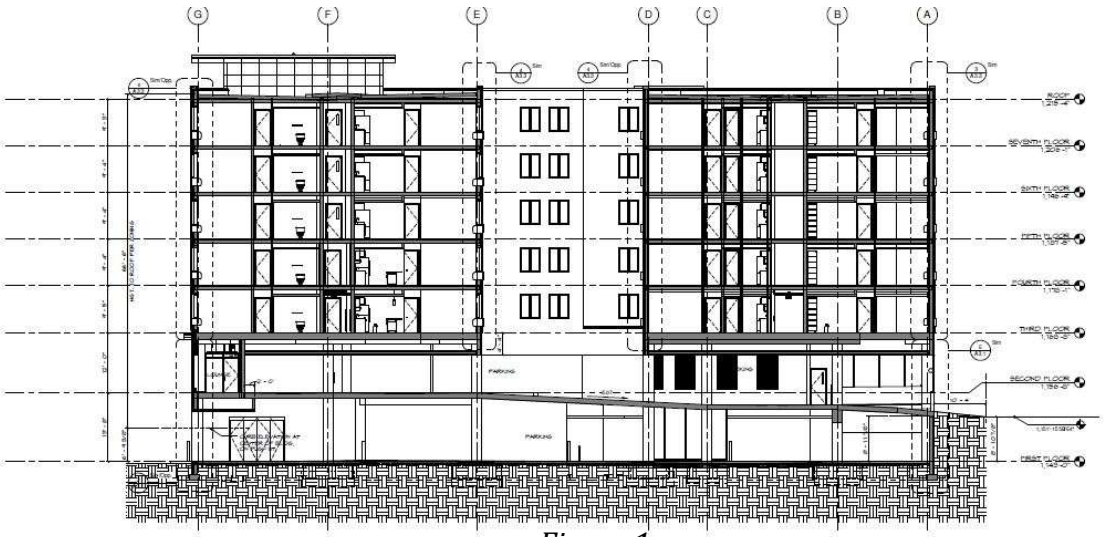


Figure 1

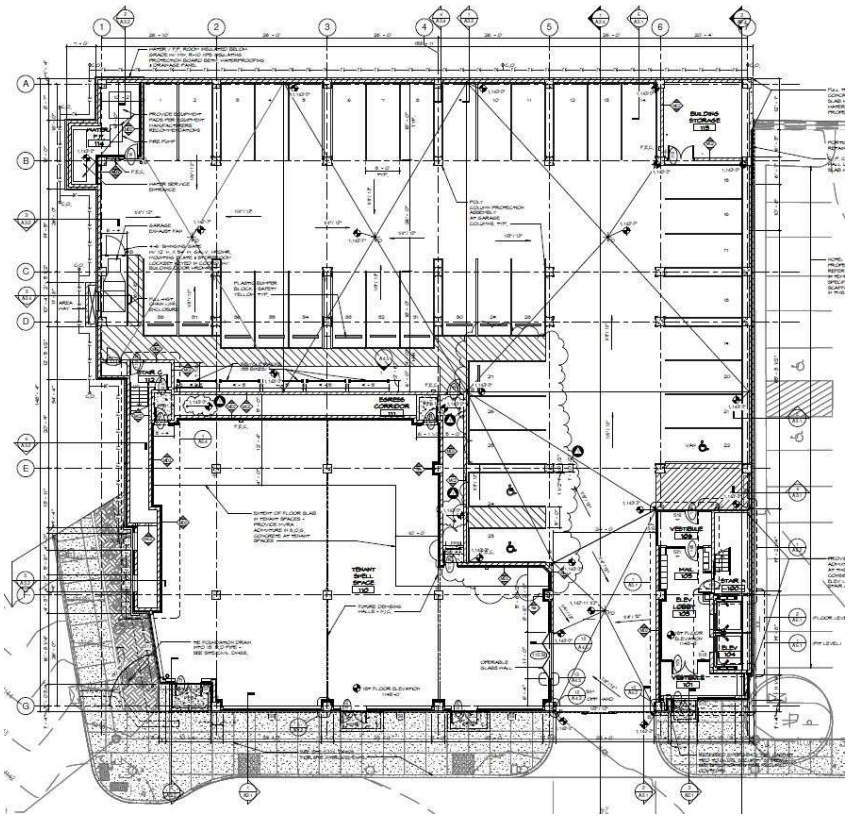


Figure 2

2.4 Structural Overview

The primary structure for Building A is a poured concrete slab supported on masonry blocks and columns. Due to the parking garage levels (floors 1 and 2) there are 24”x24” columns supporting the floors up through the floor 3. The designers decided to place a 26” cast in place transfer slab on floor 3 to compensate for the missing columns and allow for a much more open floor space in the residential areas. Slabs 4-7 are made of 8” thick hollow core plank. Inside the block walls, there are 7 5/8”x7 5/8” columns that continue up to the roof. The foundation is a 5’ thick slab on grade. Columns running from floors 1-3 are supported by various footings sizes. The building footings sit on top of hard limestone rock. Masonry bearing/ shear walls make up the bulk of the lateral force resistance in the building. The façade of the building is not a separate structural element. Precast concrete lintels cover the openings over windows and the cement fiber siding is attached to masonry walls.

3.0 Loading

3.1 Applicable Codes

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

3.2 Gravity

There are 3 primary gravity loads that need to be considered for Building A; Live, Dead (SDL), and Snow. All loads are in accordance with IB 2009. Because this building is located in State College, 40psf will be used for Snow Loads.

Live Loads

Load Type	Live Load (psf)
Residential	40
Corridors	100
Garage	40
Mechanical Spaces	125
Retail Spaces	100
Roof Live	30

Table 1: Live Loads

Dead Loads

Load Type	SDL (psf)
Interior Finishes	15
MEP	15
Partitions	5
Slab	100
Drop slab	325
Mechanical Equipment	35
Roof	25

Table 2: Dead Load

3.3 Lateral

Wind loads for Building A are in accordance with IBC 2009. The table below shows the values used to determine the wind loading.

Parameter	Value
Basic Wind Speed	90 MPH
Exposure Category	B
Importance Factor	1.0
Enclosure Classification	Enclosed
Mean Roof Height	72’

Table 3: Wind Load Values

Seismic design for Building A is in accordance with IBC 2009. The table below shows the values used to determine the values for base shear.

Parameter	Value
Occupancy Class	I
Importance Factor	1.0
Site Class	B
Seismic Design Category	A
S_s	0.147
S_1	0.049
S_{ds}	0.098
S_{d1}	0.033

Table 4: Seismic Load Values

4.0 Structural Framing System

4.1 Foundation System

The building foundation is primarily a 5” slab on grade. The foundation rests on a hard rock surface. Each column sits on a footing ranging from 1’-4” to 3’-6” thick. Rebar ties the footing to its column (or wall). The footing is not piled into the ground, it simply rests on the bedrock *(figure 3*). All footings have been designed for a 10,000psf soil bearing pressure.

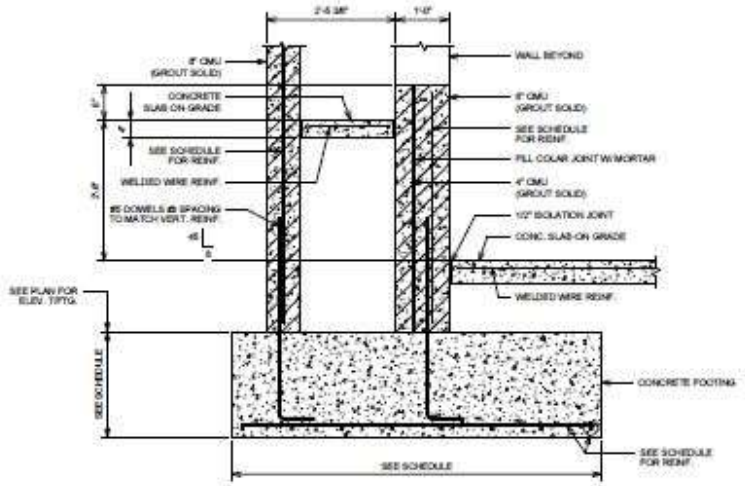


Figure 3

4.2 Gravity System

Reinforced concrete slabs and columns are the gravity force resistant system used in Building A. Floor 1 is a 5” slab on grade and floor two has a 12” reinforced concrete slab. There is a transfer slab on floor 3 that features 26” drop sections, shown in *figure 4* as a hatched line, to compensate for the large spans and no columns. Floors 4-7 feature 8” thick precast hollow core plank. Typical spacing between floors is 9’-5”.

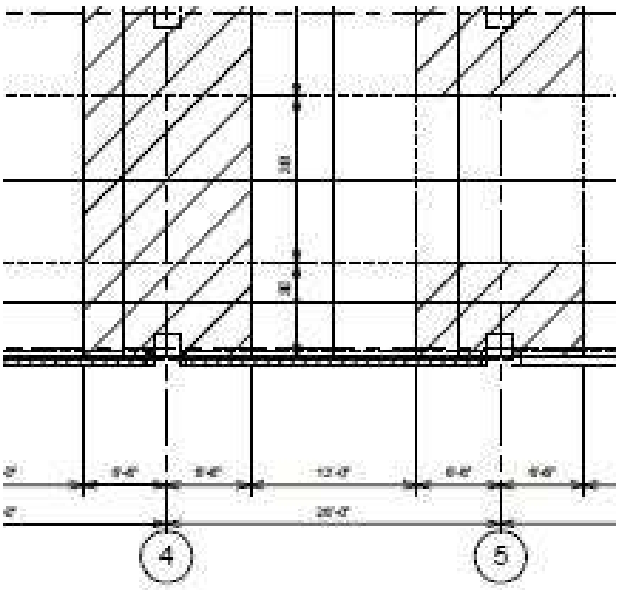


Figure 4

4.3 Typical Bay

Most bays in Building A are 26'x26' (*figure 5*). There are variations however. The largest bay is 34'-4"x26' and the smallest is 20'-4"x18'. These bay sizes only apply to floors 1and 2 as there are no columns in floors 3-7 that run through the center of the building. Floors 3-7 have a "bay" size that is about the same as the lower floors. The difference is that there are no columns that bear the gravity weight in all four corners. Masonry block walls bear the weight on these floors.

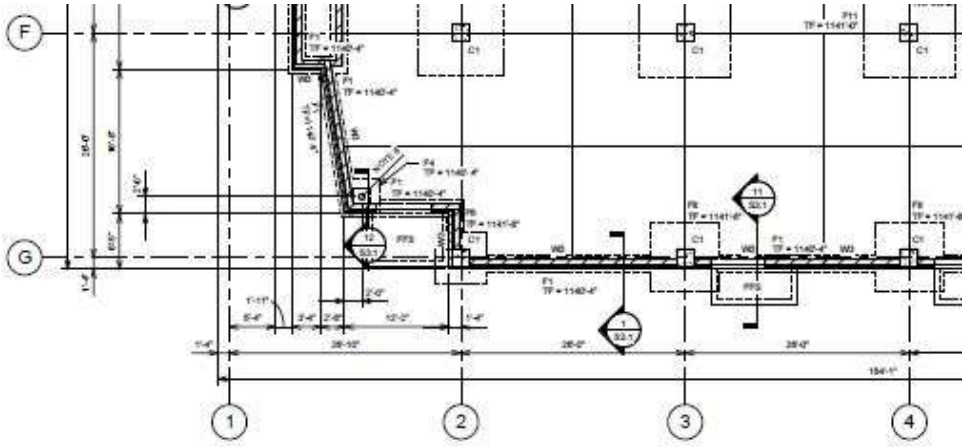


Figure 5

4.4 Lateral System

Concrete and Masonry walls make up the entire lateral force resistance in this building. The residential floors (3-7) are comprised entirely of masonry block walls that range in size from 8" thick to 14" thick (figure 6). Floors 1-2 are also made up masonry block walls, but in a slightly different layout. There are also two small concrete walls around the south garage entrance. This building is not in a serious seismic zone and the building's shape does not present any problems with wind, the resistance of all concrete/block walls is suitable for lateral strength.

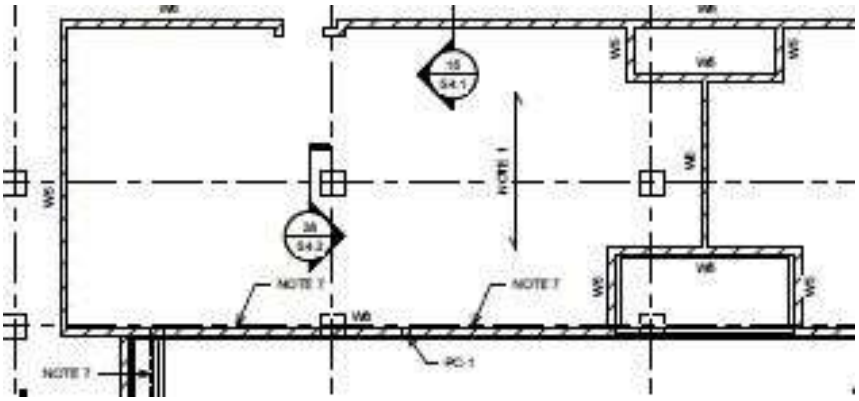


Figure 6

4.5 Columns

There are 3 main types of columns used in Building A. Column 1 (C1) is a 24”x24” reinforced concrete columns that is used from floor one to floor 3 to support most of the lower building. Column 2 is a 12”x16” reinforced concrete column (*figure 7*). This column is located around the elevator core on floor 1 and it continues up to floor 2. The other column used in this building is PC-1 (*figure 8*). This column is a 7 5/8”x7 5/8” precast reinforced concrete column. It continues from floor 3 to the roof. This column is hidden inside the masonry wall and does not affect the building’s architecture.

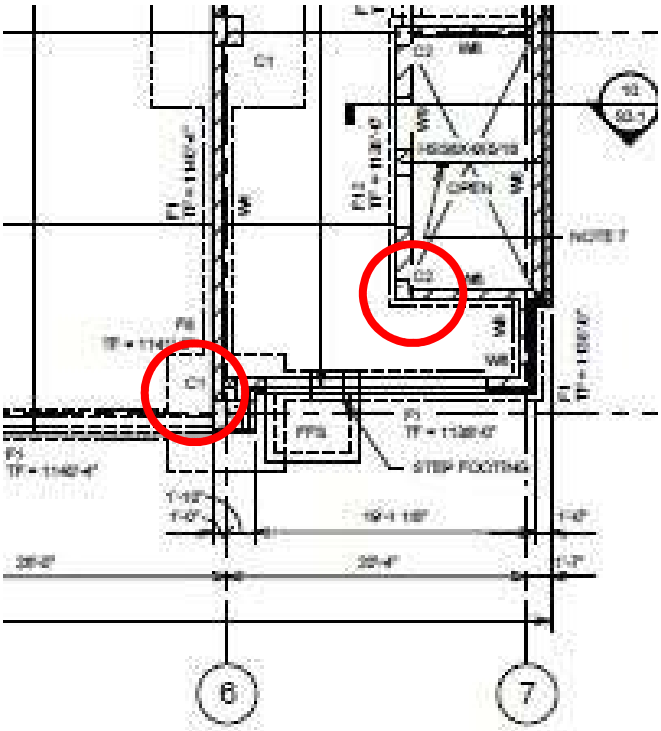


Figure 7

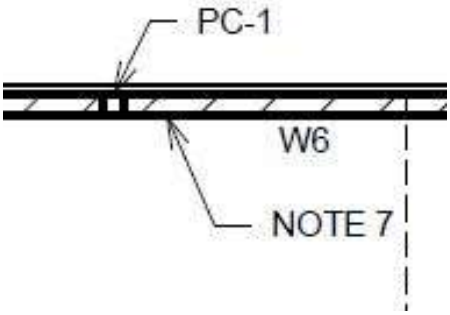


Figure 8

4.6 Load Path

Vertical loads are carried to the columns through the floor. The load travels down the columns and bearing walls and into to the building foundation and ultimately into the soil/rock below.

Lateral loads are resisted by the entirety of the concrete block interior walls. Wind loads are first received by the building façade and perpendicular block walls transfer the load down into the foundation of the building.

5.0 Other Structural Elements

5.1 Cantilever Slab

The Northeast corner of the building has a concrete cantilever that extends over the main retail entrance way (*figure 9*). The slab is reinforced and 6" thick. The slab increases to 21" thick closer to the building. This cantilever's purpose is purely aesthetic; it provides no structural support to the building.

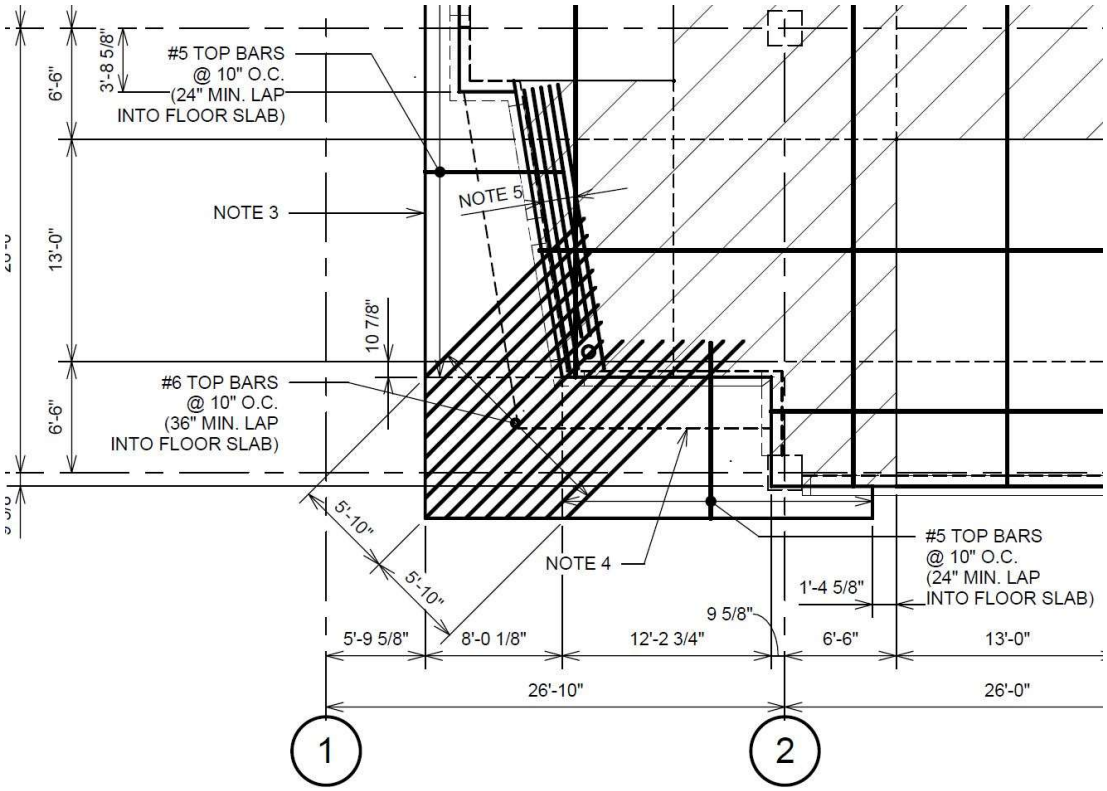
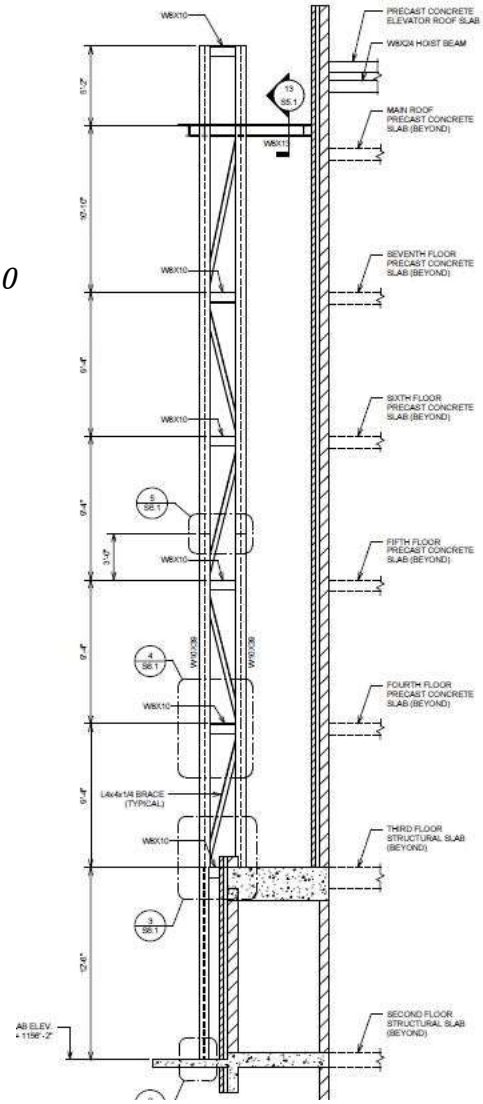


Figure 9

5.2 Structural “Fin”

On the Northwest side of the project there is a structural element called a “fin”(figure 10). The fin runs the entire height of the building and is constructed with a CMU bearing wall. Floor slabs 2 and 3 split the fin and help to support before it continues to the top of the building. The fin is also constructed with steel 2 members (W10x39) running vertically and angle bars (L 4x4x1/4) bracing the two and holding them together. These members are bolted together with A325 anchor bolts.

Figure 10



6.0 Conclusion

Building A is a mixed-use building located in downtown State College, PA. The building will serve as retail space and a student living apartment building for people in the local community and for students and the university. Due to the use of the building, a simple and fast construction design has been used.

The building presents many opportunities for future study, especially on the construction management and financial side of things. A look at other structural options for this building will be helpful to understand how efficient and appropriate this building design is.

7.0 Appendices

Figures