Thesis Proposal

8621 Georgia Avenue
Silver Spring, Maryland

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Executive Summary

The building at 8621 Georgia Avenue located in Silver Spring, Maryland is a 17 story, 161 feet tall, 347,000 SF structure. The existing structural system is both reinforced and post-tensioned concrete flat slab. The first four floors utilize reinforced concrete with drop panels, while the remainder of the building is flat slab post-tensioned concrete. The lateral system consists of 14 shear walls as well as some additional reinforced concrete moment frames.

The existing structural system has proven to adequately meet strength and serviceability requirements. As a hypothetical scenario, a redesign of the building has been proposed to investigate the feasibility of a steel system. With the switch to steel, one floor level of the building will be lost to accommodate the additional depth of the structure while still meeting the height restriction. Therefore, to maintain the original square footage, a level of the parking garage will be moved below grade. The four levels of parking garage will remain in reinforced concrete while the apartment levels will be redesigned in steel.

The proposed structural depth will develop a solution to the proposed steel system redesign. The buildings gravity and lateral system will consist of composite girders and infill beams. Both RAM and ETABS will be utilized in the analysis of this system. The column locations will not be altered in order to minimize the effect on the architectural program.

In order to provide the alternative of creating a below grade level, a mechanical system will need to be designed to ventilate that level of parking garage. The proposed mechanical breadth will investigate this design consideration.

The original concrete design and proposed steel design will be compared via a cost feasibility study. The steel redesign will explore moving a level of parking garage below grade. As a quantitative means of determining the advantages and disadvantages of each, a detailed cost analysis of the materials, construction scheduling, and economic gain of rentable space will be analyzed. This cost comparison will yield the most financially viable building design for the client.

Additionally, knowledge obtained in MAE coursework will be incorporated into this proposed redesign by computer modeling using RAM and ETABS (AE530) and steel connection design (AE534).

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Purpose and Scope

The purpose of this proposal is to present an outline of the work to be done in the spring semester. This work will be geared towards investigating the proposed design scenario. A structural depth, as well as two breadth areas of study will solve the design problems while evaluating the economic and constructability feasibility of the redesign. Additional MAE coursework will be used to supplement the structural depth and other breadth topics. The purpose of this investigation is to derive a quantitatively based opinion on the feasibility and advantage of a possible steel redesign. A detailed list and schedule of the proposed tasks of the work are included within this proposal.

Building Overview

The building at 8621 Georgia Avenue is owned by FP Wilco, LLC. in the downtown business district of Silver Springs, Maryland. The new 17 story, 347,000 ft^2 building will provide 4 floors of parking and 13 floors of apartments. The total height of the building will be 161 ft. for the residence and workers in the area. As of the 50% phase drawings, used for permit applications, the project is anticipated to cost $52 million dollars.

Great efforts were made in the design process to earn a LEED Silver rating for the building. 8621 Georgia Avenue also presents sustainable transportation features with the location of the building is within a half block of the nearest metro stop and includes parking amenities for bicyclists. Water drainage issues were also strongly considered for this urban, impervious site downtown. The green roof helps reduce the carbon footprint of the building while simultaneously dealing with a significant portion of the water run-off.

Picture 1: Rendered image from Southwest. Image courtesy of Holbert Apple Associates.

The first floor has a dual function as the space serves both the private residents of the building as well as the public. The program on the first floor includes a Cyber Café, Fitness room, apartment lobby, and parking spaces (including bicycle and ADA parking). All of these areas, except the parking garage, are double height ceilings and are accessible from the street.

The parking garage portion of the structure continues up from the ground to the 4th floor and includes a total of 197 spaces. These first four floors are the only portion of the building that maintains its rectangular footprint. Starting at the 5th floor, above the parking garage, the form of the building takes on a U-shape with a green roof with box planters in the center of the 'U'.

Floors 5 through 16 are occupied with 292 multi-family apartments of varying sizes with accessible balconies. The upper residential floors are serviced by two stair towers and three elevators. The typical floor plan for the apartments is repeated until the penthouses on the 16th floor. The rooftop of the building is adorned with a pool, bathhouse, club, and rooftop garden terrace.

The façade of the building is comprised of precast concrete panels, a glass curtain wall system, and a masonry veneer. The precast concrete panels only occur at the levels of the parking garages. The apartment levels feature a prefinished aluminum panel curtain wall system as well as a masonry veneer on the west elevation. The details of how these façade elements are tied into the structure will be discussed later in this report.

Structural Overview

Brief Structural Description

Similarly to the surrounding structures, 8621 Georgia Avenue is primarily made of concrete, but reinforced and post-tensioned. The foundation of the structure is supporting concrete columns and piers along with spread footings, strip footings, and foundation walls. The shear wall core located by the stair towers and elevator towers spans the entire height of the building and resists the majority of the lateral loads. The first four floors utilize moderately reinforced flat plate concrete slabs for the floors of the parking garage. Drop panels and beams was only used in situations where they were absolutely necessary to meet the design parameters. The 5 floor and above utilizes post-tensioned flat plate concrete slabs. This design choice to use post-tensioning was made to maximize floor to floor heights in view of the stringent zoning height ordinance.

A brief summary of the structural materials used in the project are given below.

Concrete		
Use	Strength (psi)	Weight (pcf)
Footings	3000	145
Foundation Walls	4000	145
Shear Walls	5000	145
Columns	5000-7000	145
Interior SOG	3500	145
Exterior SOG	4500	145
Reinforced Slabs / Beams	5000	145
Parking Structure	5000	145

Reinforcement	
Use	Grade
Deformed Reinforcing bars	ASTM A615, Grade 60
Weldable deformed reinforcing bars	ASTM A706
WWF	ASTM A185
7-wire Low Relaxation Prestressing	ASTM A416, Grade 270
Full Mechanical Connection	DYWIGAG, Lenton Or equivalent meeting ACI 318-12.14.3

Figure 1: Concrete and reinforcements materials and specifications.

Steel		
Use		Grade
Wide Flange		ASTM A992
Structural Shapes and Plates		ASTM A36
Structural Pipe		ASTM A53, Grade B, Fy=35ksi
HSS		A500, Grade B, Fy=46ksi
Cold-Formed Steel		ASTM A653 (G-60 Galv.)
	<43 mils	Fy=33 ksi
	>54 mils	Fy=50 ksi
Fasteners		
Use		Grade
High Strength Bolts		ASTM A325
Anchor Rods		ASTM F1554, Grade 36
Threaded Rods		ASTM A36
Shear Studs		ASTM A108

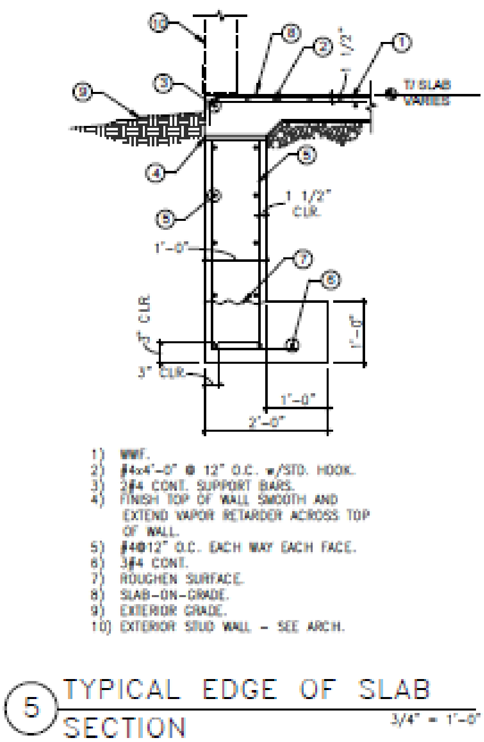
Figure 2: Fasteners and Steel materials and specifications.

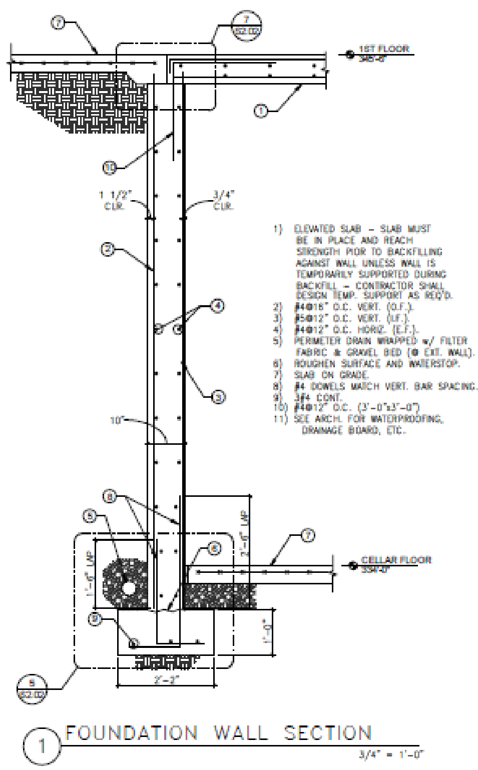
Foundation System

A geotechnical study was done on the site by Schnabel Engineering Consultants, Inc. who was able to provide useful recommendations for the foundation to the design team and structural engineer. Spread footing and column footings were recommended for the foundation system. The column footings were recommended to be designed to 8,000psf while the wall footings were suggested to be 6,000 psf.

The proximity of the water table to the depth of the foundation was a principal concern in their geotechnical evaluation. The groundwater table will only be approximately 5ft. below the lowest level (electrical cellar). This observation of the site called for sub-drainage materials adjacent to the foundation walls which will be bearing soil pressure.

Typical Foundation details are shown below:





From S2.01

Figure 4: Typical Foundation Wall Detail. From S2.01

Only a small portion of the buildings total footprint, approximately 4,854 ft^2 extends below grade. This area is strictly for service use with electrical rooms, storage, and mechanical rooms. This level utilizes foundation walls to resist the lateral force of the soil pressures.

The geotechnical report on the soil composition of the site estimated the horizontal forces on these foundation walls to be 50 pcf.

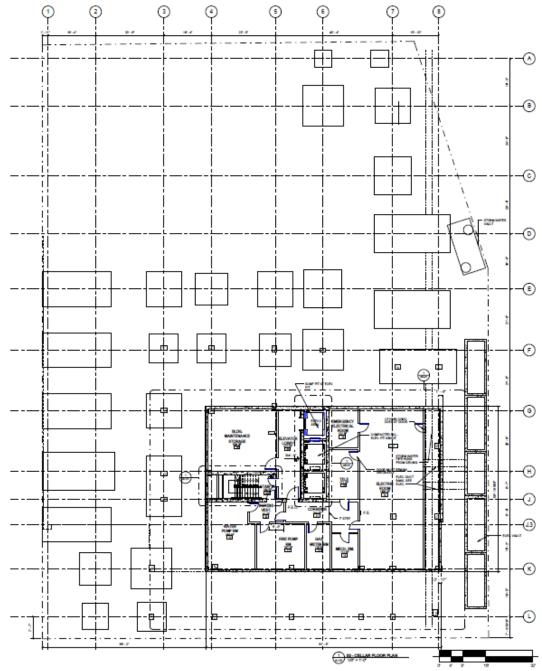


Figure 5: Cellar level floor plan

Floor System

As previously mentioned, 8621 Georgia Avenue is a concrete structure utilizing flat plate slabs throughout the building for the floor system. Drop panels are used only on the parking levels but are avoided on the apartment floors to maintain floor to floor height. The slab on grade is 8" mildly reinforced concrete slab and has an 18" step in elevation. In the floor system above the sub-grade cellar, a drop in the slab in required.

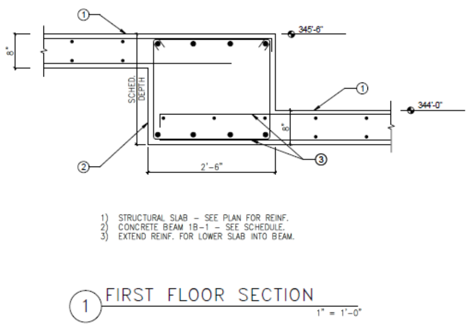


Figure 6: Typical Slab on Grade

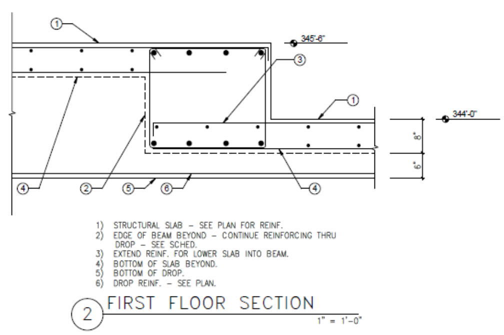


Figure 7: Slab on Grade above Cellar

Parking Garage

In the first 4 floors, as well as the first apartment level on the 5th floor, the structure will feature an 8" deep reinforced cast-in-place two-way flat plate concrete slab system. The drop panels at each interior column will be 8' x 8' x 4" while the drop panels on the exterior columns will be 4' x 4' x 4".

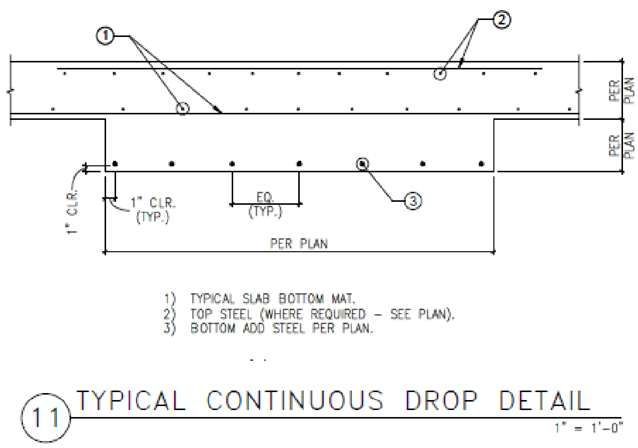


Figure 8: Typical Drop Panel

Apartments

Above the 5th floor and for the remaining floors, the structure consists of a 7.5" deep post-tensioned cast-in-place two-way flat plate concrete slab system. The use of drop panels and beams was minimized but was needed in some locations to control long-term slab deflections for longer spans. The post-tensioning system will be discussed in greater detail later in this report.

Typical Bay

A typical bay size for the project varies with columns spaces ranging from approximately 16 ft. to 24 ft. in each direction. These bay sizes are consistent throughout the whole building despite the functional transition from parking to residential. The larger bays are located in line with the drive lane of the parking garage. Because the same column locations are continued up the entire building height, there was not the need for sloped columns or large transfer girders. The only situations where transfer girders were needed were at the second floor due to the transition from retail/lobby space to the parking structure and also adjacent to the pool at the top of the building.

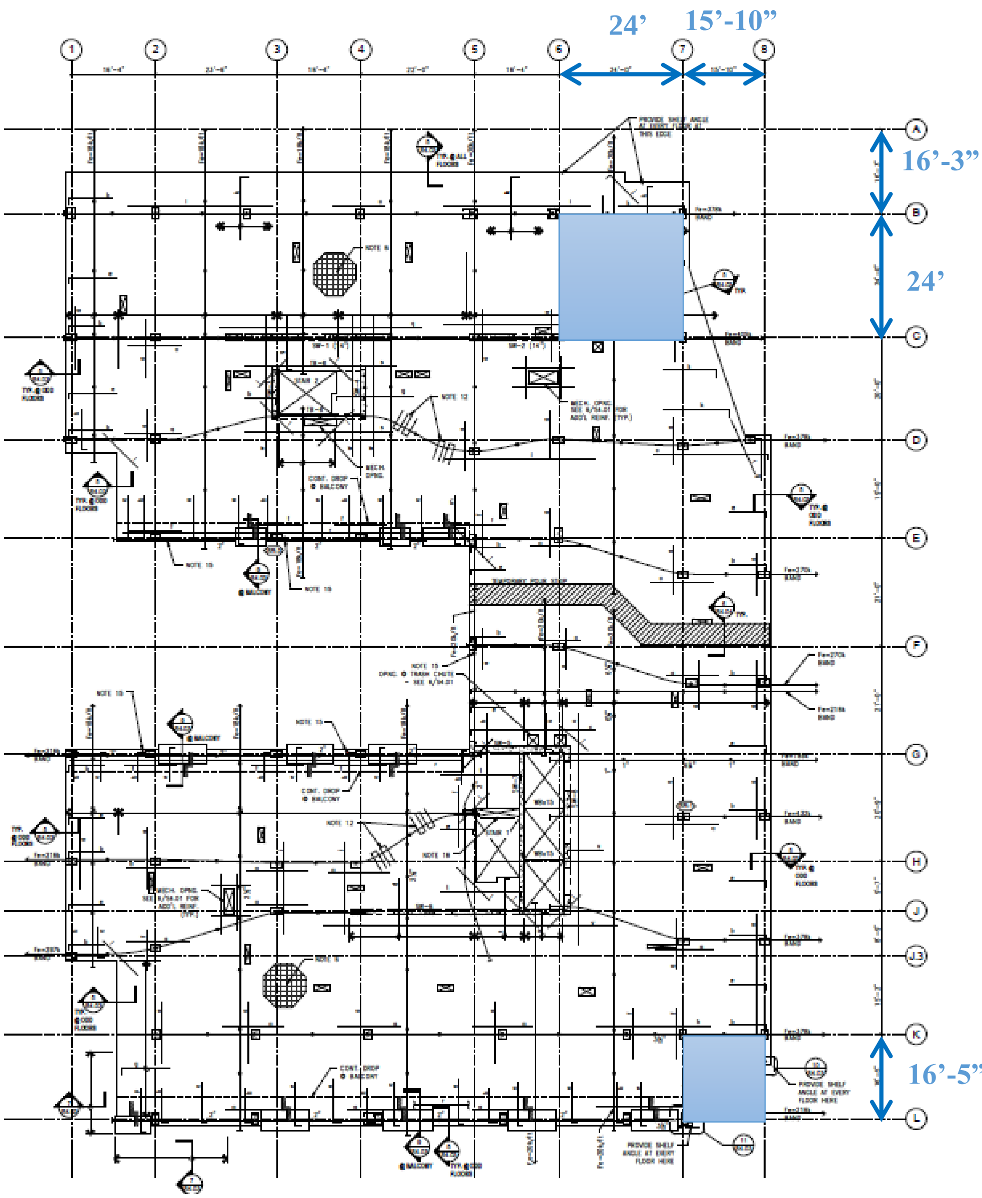


Figure 9: Typical Apartment Framing Plan

Columns

In order to accommodate the accumulated load in the lower floors, the concrete columns change in size and strength throughout the height of the building. Three different strengths of concrete are used in the columns throughout the project. The concrete strength increases in the lower floors to resist the higher axial compression loads without having to make the columns too big. This structural design decision will reap benefits by saving space in the apartment and parking garage floors.

Concrete Columns	
Location	Strength (psi)
Above 8th	5000
4^{th}-8^{th}	6000
Below 4th	7000

Figure 10: Concrete Columns Strengths

The column sizes generally seem to increase slightly by 2”- 4” in each dimension below the 4^{th} floor. Although the column sizes and strengths change, the reinforcing in the columns is uniform throughout the entire height of the building.

Post Tensioning

Floors 5 through 16, which house the multi-family apartments, are provided with post-tensioned slabs. Both banded tendons and uniformly distributed tendons are used in addition to other mild steel reinforcing. The banded tendons typically run in the plan east-west direction while the uniformly distributed tendons span across the plan north-south direction.

The banded tendons vary in effective prestress from 216 kips to 513 kips while the distributed tendons have tend to have a linear strength varying from 18 k/ft to 22 k/ft. The figure below shows the locations of these post-tensioned cables on the typical apartment framing plan. Banded tendons are preferred in areas where the tendons need to be offset.

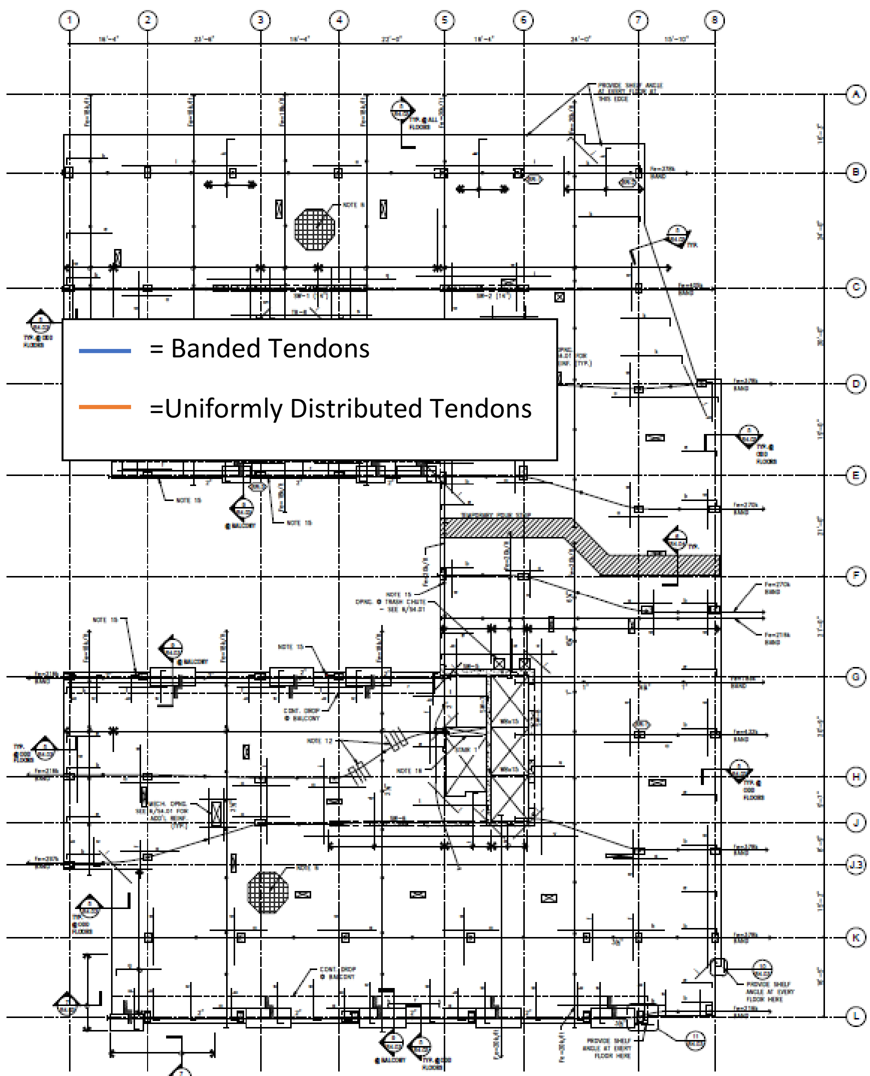


Figure 11: Typical Apartment Framing Plan

The post-tensioned strands do not span straight across the building in the center of the slab, but drape between the top and bottom of slab depending on its position relative to columns or any openings. The detail below shows the typical band orientation when being placed within a slab.

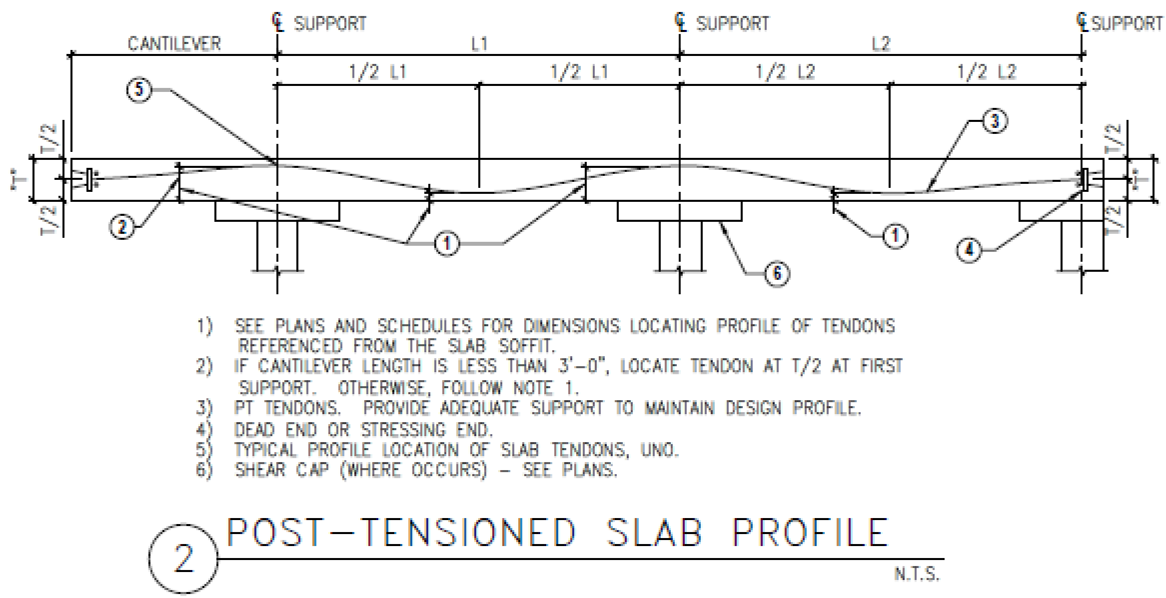


Figure 12: Typical Post-Tensioning Slab layout

Roof System

The roof area of 8621 Georgia Avenue supports an 18' x 56' pool. The structure around the pool will consist of a mild-reinforced cast-in-place concrete slab and beam system. The pool will basically be a large concrete box coated with the appropriate waterproofing materials. An isometric view of the 16th floor pool level with a club, locker room, roof terrace, and other apartment suites is shown below.

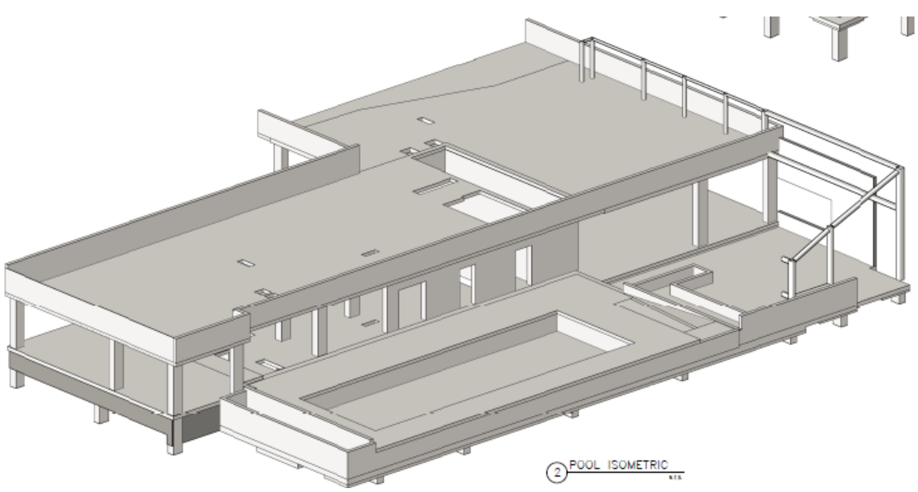


Figure 13: 16th Floor Isometric View

The roof construction is the same post-tensioned concrete two-way slab that is present in the floors below. A 1' layer of concrete topping is added to the slab then completed with a terrace finish.

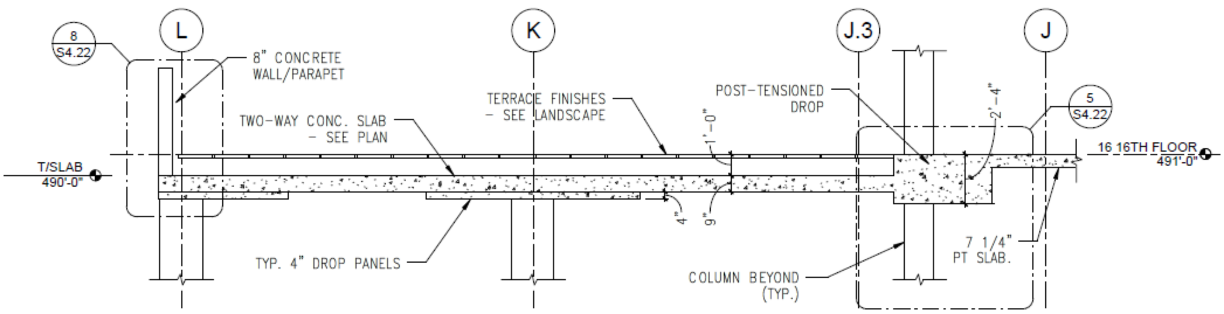


Figure 14: 16th Floor Section

Underneath the pool, the slab is depressed by 16" before additional concrete slabs and walls are built up upon it to house the pool. A section through this condition of the 16th floor slab is shown below.

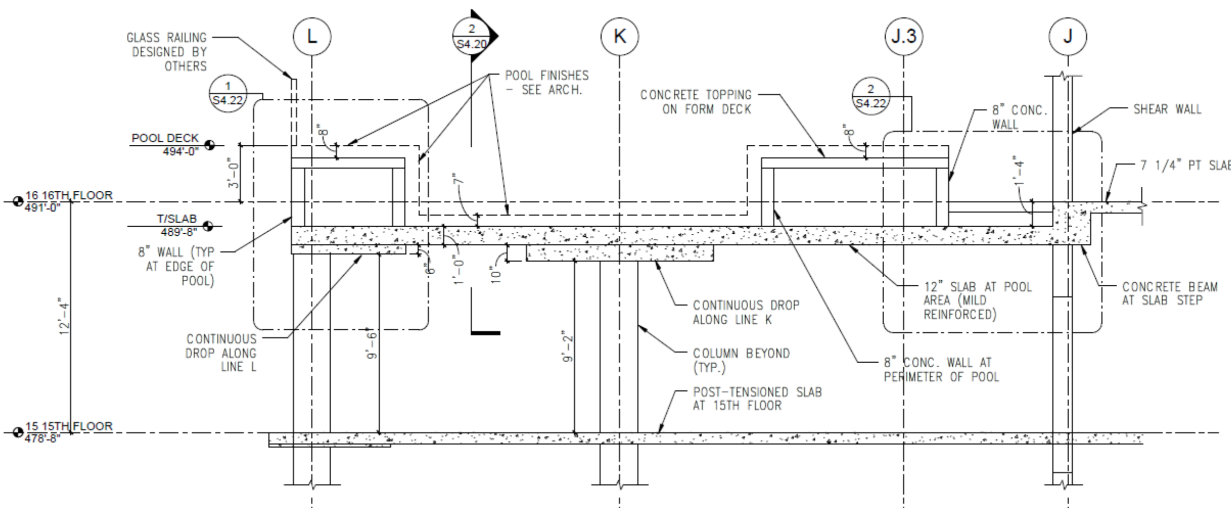


Figure 15: 16th Floor Section through Pool

Bio-Retention Area

On the fifth floor the footprint of the building plan chances and steps back into a 'U' shape from a rectangular form. The center of this 'U' is home to a bio-retention area and outdoor terraces accessible to the apartment occupants.

To deal with the massive 600 PSF superimposed dead load of the bi- retention area and surrounding planters, the concrete slab is increased to 12" thick in this section of the floor plan. The drop panels on the interior columns runs continuous through the 3 columns directly supporting the bio-retention area. In these locations, the total slab thickness would be 20 inches.

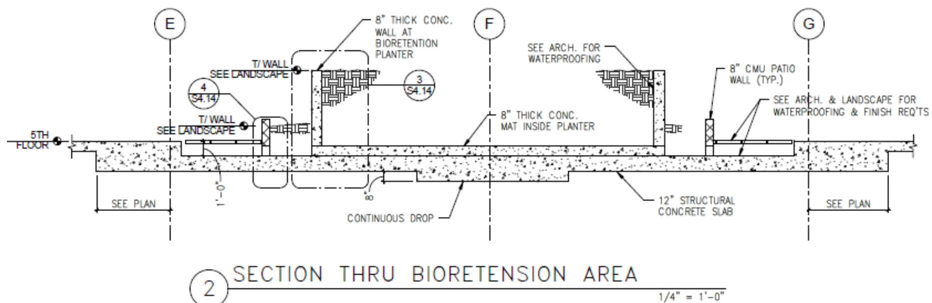


Figure 16: Shear Wall Locations

To accommodate the bio-retention area and planters, small 8" thick concrete walls resist the soil pressure from the potentially saturated beds of soils and foliage.

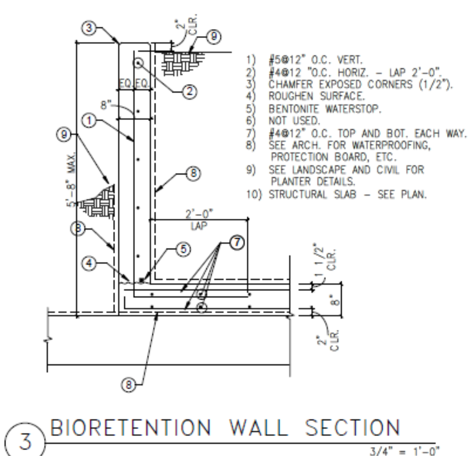


Figure 17: Bio-retention wall

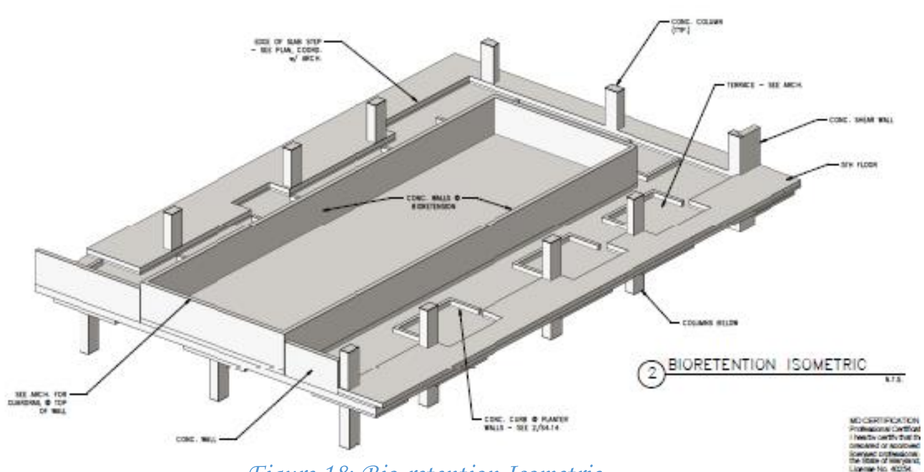


Figure 18: Bio-retention Isometric

Lateral System

The Lateral Force Resisting System (LFRS) of 8621 Georgia Avenue consists of 14 regular reinforced concrete shear walls that are 12" thick. These shear walls are concentrated around the stair and elevator towers within the building. A few concrete moment frames exist in various bays but the majority of LFRS elements are the aforementioned shear walls.

The reinforcing in each wall calls for #5's at 12 inches on center, each way, each face. This is a fairly typical rebar arrangement for shear walls and is kept uniform across each shear wall regardless of height or location. The figure below shows the locations of the shear walls

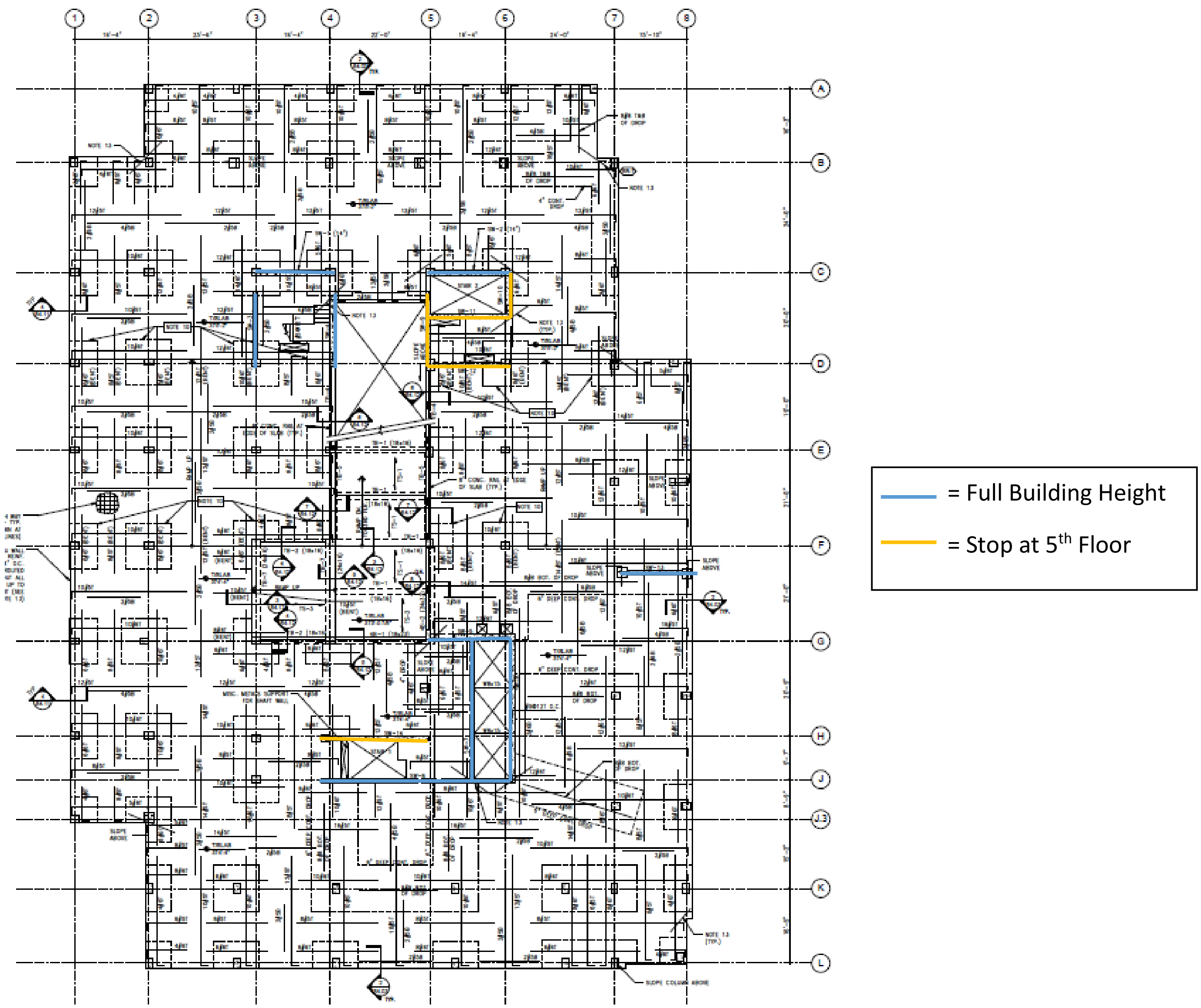


Figure 19: Shear Wall Locations

Joint Details

The following two figures show some of the typical construction joint placements for the concrete slabs and walls. The placements of the joints are to avoid excessive cracking in the concrete.

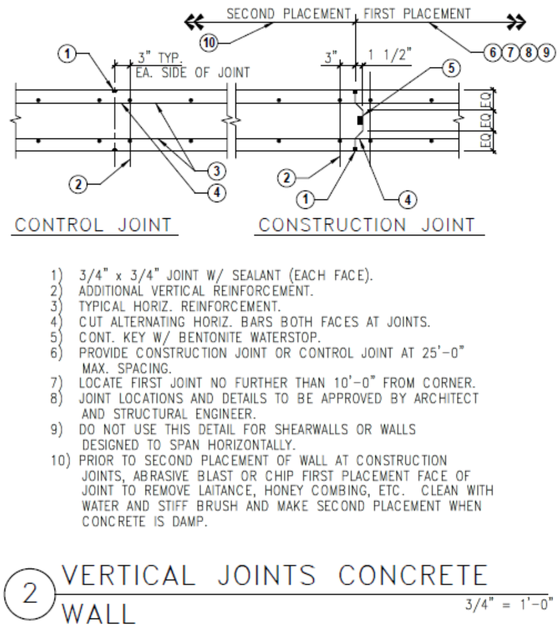


Figure 20: Concrete Vertical Joints

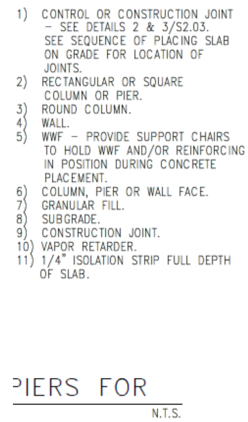


Figure 21: Slab on Grade Construction Joints

Typical Connections

In 8621 Georgia Avenue some of the typical connections involve how the façade of the building is attached to the columns and slabs. These connections are briefly discussed and shown in the following section.

Precast Panels

The precast panels line the exterior face of the building on the bottom four floors around the parking garage. The panels are attached to the slab and columns by load bearing connectors which resist loads perpendicular to the panel, like wind loads, but allows for horizontal movement.

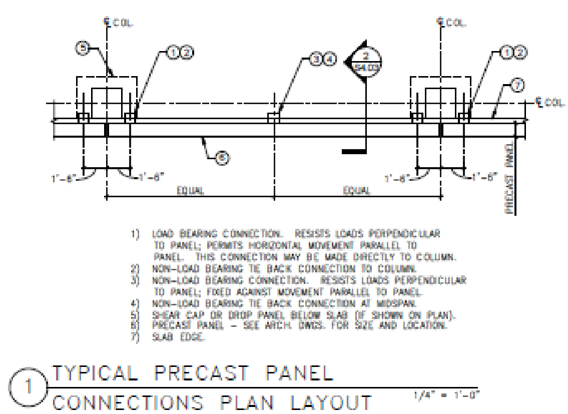


Figure 22: Precast Panel Connection

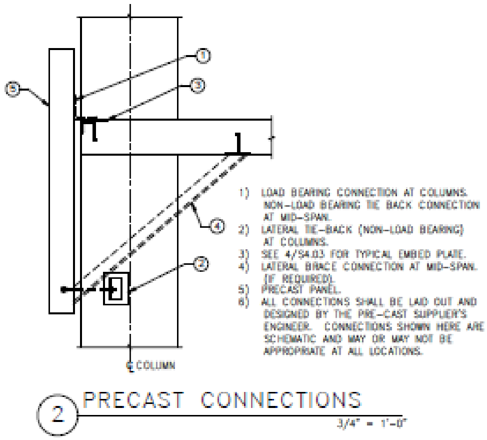


Figure 23: Precast Panel Connection, Section

The panels also utilize lateral tie backs which also connect back to the slab and column. It is through these connections that the lateral wind forces are able to be transferred to the floor diaphragms.

Curtain Wall

On the upper floors of the building above the parking garage the façade consists of a curtain wall system or a masonry veneer. The curtain wall is tied back into the slab in a very similar way that the precast panels are. The masonry veneer is supported beneath by a shelf angle that is connected into the slab by a ¾" diameter wedge insert. These shelf angles are present at each floor and support one floors height of masonry veneer.

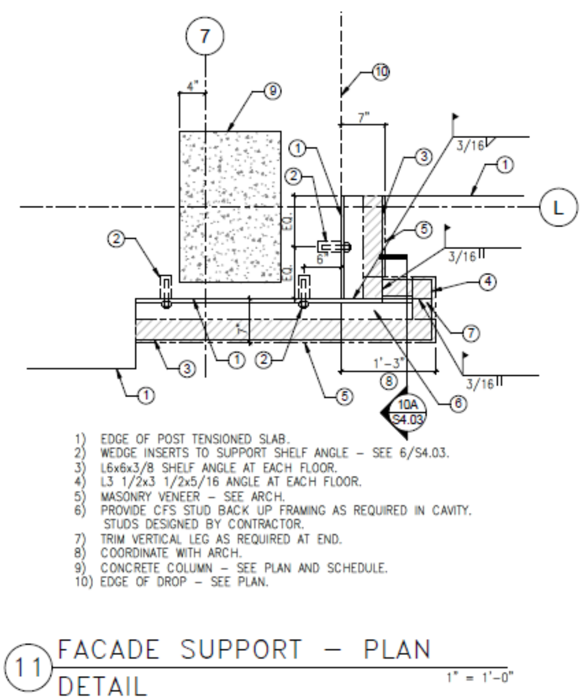


Figure 24: Façade Support

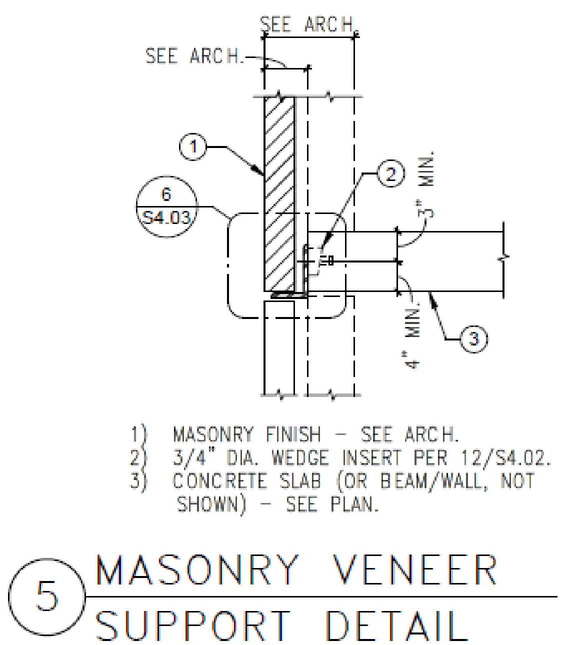


Figure 25: Masonry Veneer Detail

Design Codes and Standards

Below is given a list of all applied codes and reference standards for the structural design of the 8621 Georgia Avenue project:

- International Code Council
  - International Building Code, 2012
- American Society of Civil Engineers
  - ASCE 7-10: Minimum Design Loads for Buildings and Other Structures
- American Concrete Institute
  - ACI 318-11: Building Code Requirements for Structural Concrete
  - ACI Manual of Concrete Practice – Parts 1 through 5
- Concrete Reinforcing Steel Institute
  - Manual of Standard Practice
- Post Tensioning Institute
  - Post Tensioning Manual, 6th Edition
- American Institute of Steel Construction
  - Steel Construction Manual, 14th Edition, 2010
  - AISC 360-10: Specification for Structural Steel Buildings
- Structural Welding Code – Steel ANSI/AWS D1.1-10
- North American Specification for the Design of Cold-Formed Steel Structural Members (S100-07/SI-10)
- Metal Bar Grating Manual – 6th Edition (ANSI/NAAMM MBG 531-09)

Design Loads

The determination of the design loads for the project were found using the codes and references listed in the previous section of this report. The following section will report from where in each particular code that the design values are derived from.

National Codes

The two codes that were used in the design of the building were the IBC 2012 and ASCE 7-10. Chapters 4, 11-30 on live loads and lateral loads were used to generate the loadings for these conditions in 8621 Georgia Avenue. All of the design loads used in the project can be found on sheet S0.01

Gravity

Dead Load

The typical roof, floors, and parking areas were given an additional superimposed dead load in addition to the material self-weights. Other atypical conditions received an additional superimposed dead load based upon experience and specifications with those systems.

Superimposed Dead Loads in addition to the Self-Weight	
Structural Element	Weight (psf)
Typical Roof	30
Typical Floor	15
Parking Areas	10
Unique Conditions	
Intensive Green Roof	60
Bio-Retention Planter	600
Courtyard Planters	240

Figure 26: Superimposed Dead Load Values

Live Load

All live loads were determined using Chapter 4 of ASCE 7-10 and Chapter 16 of IBC 2012 on live loads. In accordance with IBC 2012 section 1607.02, the column, foundation, and beam live loads were able to be reduced.

Snow Load

The ground snow load for Silver Springs, Maryland is recorded as 30PSF according to Chapter 7 of ASCE 7-10. In most cases, the roof snow load can be reduced by a factor of

0.7 (assuming no other factors apply) but the Montgomery County amendments set the minimum roof snow load to 30 PSF, so there is no reduction from the ground to roof snow load

Lateral Loads

The Lateral loads for 8621 Georgia Avenue were determined using chapters 11-13 and 26-30 covering seismic and wind loading. For this project the wind load was the controlling lateral load. Similar to the gravity loads, all design loads are found on sheet S0.01.

Wind

The wind load was specifically found using chapters 26-30 from ASCE 7-10. The building is considered to be Risk Category 2 with a Wind Exposure Category C and basic wind speed of 110 MPH. Net design pressures on various parts of the enclosure are given in the table below:

Net Design Pressures	
Walls (Zone 4)	+20 PSF, -20 PSF
Walls (Zone 5)	+20 PSF, -34 PSF
Roofs (Zone 1)	-27 PSF
Roofs (Zone 2)	-44 PSF
Roofs (Zone 3)	-59 PSF

Figure 27: Net Wind Pressures

Seismic

The seismic design loads were primarily found in Chapters 11 and 12 of ASCE 7-10. Specific components and systems dealing with the architecture, mechanical, electrical, etc. also reference Chapter 13 of ASCE 7-10.

The building is a Risk Category 2 with an importance factor of 1.0 that falls in Seismic Design Category A.

Soil

The lateral soil loads on the building were the same loads recommended by the geotechnical report performed by Schnabel Engineering Consultants, Inc. The soil load was determined to have a sliding resistance of 0.35 and a net pressure of 50 PSF/ft of depth.

Load Paths

Gravity

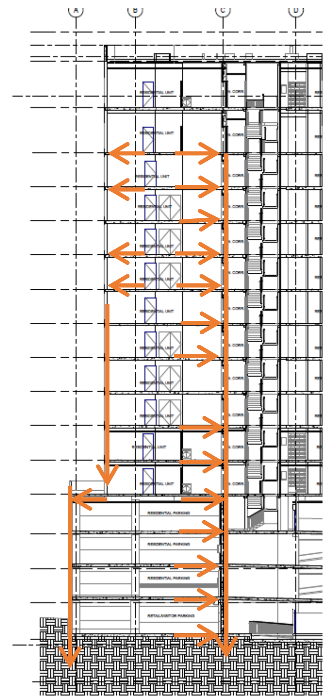


Figure 28: Gravity Load Path

The gravity loads from the building are those that caused by the combination loading of the dead and live loads. These loads will be resisted by the concrete floor slabs at each level. The slabs will distribute the load to the nearest columns (or shear walls) by which its' bay is bound by. The columns will then carry the load directly down the building and into the foundations and eventually, undisturbed, virgin soil.

The figure to the right gives an example of the load path in a section of the building due to gravity loads.

Lateral

The controlling lateral load on 8621 Georgia Avenue is wind. This wind force will exert itself on the façade of the building as a positive or negative pressure distribution. The façade with distribute the force from the wind pressure to the floor slabs via the connection by which the façade is attached to the structure. This creates a horizontal force at each floor level.

This force is distributed amongst the columns and shear walls on that floor by the diaphragmatic action of the concrete slab. Because the diaphragm is comprised of concrete, and consequently can be considered a rigid diaphragm, the loads will distribute to the LFRS elements based on stiffness. The shear walls are inherently stiffer than the columns when oriented parallel to the horizontal force. Because there are multiple shear walls in each direction, they will the primary means to resisting the lateral load as opposed to the concrete columns.

Once the lateral load has been transferred from the shell, into the diaphragm, and then into the LFRS elements, these elements carry this horizontal load down through the building and into the foundation.

Problem Statement

The building at 8621 Georgia Avenue consists of a concrete flat plate system, with a lateral system comprised of 14 shear walls. Following previous analysis in the fall semester, through a series of four technical reports, the structure was proven to be acceptable for both strength and serviceability requirements.

A hypothetical scenario is to be explored where the structure of the building is to be redesigned using a composite beam steel system. The redesign must consider the strict height restriction for the area and will undoubtedly need to eliminate a floor level. One level of the parking garage will be moved below grade to allow the same number of apartment levels as originally designed. A detailed cost assessment of the two design options will be required to determine the feasibility of each system. An additional mechanical system would also need to be designed if any of the building were to be moved below grade.

Problem Solution

The proposed solution for the design problem is a steel framing system for the apartment levels, with the use of reinforced concrete shear walls for the lateral system. The current shear wall configuration of the building will remain the same because they are needed for the stair/elevator towers and have already been proven to function as an efficient lateral system. The parking garage levels will remain in reinforced concrete while the rest of the superstructure will be redesigned in steel. RAM will be used to analyze the gravity system while ETABS will be used to analyze the lateral system in concurrence with hand spot checks.

The decision to explore a steel system is based on several factors. The primary reason to investigate a steel system is for shear educational gain and to discover the advantages and disadvantages of using steel versus concrete structural systems. Upon a site visit to the area, other surrounding buildings of similar scale were built in both steel and concrete. Therefore, empirically, both systems seem feasible but a more quantitative approach will be used for a more definitive comparison.

A steel system would decrease the building mass and effect of seismic loads on the building. In reducing the amount of formwork and concrete pours could also speed up the schedule of the project. As discovered in Technical Report 3, a steel system would appear to be plausible only if a level was eliminated. In order to compensate for that loss, the addition of a sub-grade parking level will be explored to maintain the original square footage of rentable space.

The removal of one above level of parking garage will still be a challenge and require the total structural depth to be limited to a 16 inch depth. Composite beams will be used to reduce structure depth, as opposed to non-composite beams. The majority of the connections will be pins. Some moment frames around the core and between the two stair towers are anticipated and will require moment connections. Examples of each connection type present in the redesign will be designed using knowledge acquired in AE 534.

The bay size for the steel redesign will need to be re-examined. The current bays are square in size and will most likely be combined with adjacent bays to form rectangular bays with a 2:1 ratio, which is geometry more indicative of a steel system. If this condition is not feasible while maintaining the necessary structural depth, the existing bay arrangement may be kept.

In order to facilitate this design solution, two breadth areas will be covered to create a more well-rounded design and conclusion for the building.

Breadth Topics

Mechanical Breadth: Parking Garage HVAC System

One of the scenarios being investigated involves placing a level of parking garage below grade. The levels of parking garage above ground have half walls which categorize those floors as being ventilated by open air and do not require ventilation. If a floor of the parking garage were to be moved below grade, that floor would not be able to be naturally ventilated by open air. To solve this problem an HVAC system for that floor will be designed.

Construction Management Breadth: Cost Comparison

Within the decision to redesign the building in steel, a level of the parking garage will be moved below grade which will influence the cost of the project. A detailed cost analysis will be performed to compare the cost of the steel and concrete structures as well as consider the excavation cost associated with the steel redesign. The cost of materials and labor will be considered in addition to potential economic benefits from more or less area of rentable apartment space.

MAE Requirements

Throughout the investigation process multiple areas of graduate level coursework will be implemented into the redesign of the building. Computer modelling is one area in which this knowledge will be implemented. RAM will be used to analyze the building's gravity system, while ETABS will be used to analyze the lateral system. These tasks will utilize skills attained in AE530, *Computer Modeling of Building Structures*. Additionally, a few of the typical steel connections in the redesign will be designed using methods learned in AE 534, *Analysis and Design of Steel Connections*.

Task Outline

1. Winter Break Research
    a. Obtain construction cost and scheduling information
    b. Develop adjusted column grid and beam layout
2. Design Steel System
    a. Design Gravity System
        i. Input estimated design loads
        ii. Design composite beam and girder members
        iii. Design Columns
        iv. Use RAM to analyze steel system
        v. Check deflections
3. Check Lateral System
    a. Adjust seismic load for lighter building mass
    b. Edit current ETABS model from Technical Report 4
    c. Add or eliminate shear walls as necessary
    d. If necessary, consider alternative lateral systems
4. Design Foundation System
    a. Determine soil loads
    b. Design foundation walls and footings
5. Perform Cost Analysis
    a. Cost Analysis
        i. Detailed comparison between steel and concrete system
        ii. Detailed comparison between two steel alternatives
    b. Schedule Comparison
        i. Detailed comparison between steel and concrete system
    c. Draw Conclusions in terms of feasibility
6. Design Mechanical System
    a. Research typical parking garage mechanical units
    b. Determine design loads for parking garage
    c. Design HVAC system to ventilate space
7. Design Steel Connections
    a. Select typical beam-girder or girder to column connections
    b. Design connections for both bolted and welded
    c. Design shear and moment connections
8. Write Report and Presentation
    a. Final Report Outline
    b. Write draft and final report
    c. Outline presentation
    d. Develop draft and final presentation
    e. Edit report
    f. Practice presentation

Proposed Thesis Semester Schedule

January 2015-April 2015

Nick Dastalfo | Structural
Dr. Thomas Boothby

	1/23/2015			2/13/2015			3/6/2015				4/3/2015	4/8/2015	4/13-16/2015		5/1/2015
	Milestone 1			Milestone 2			Milestone 3				Milestone 4	Final Report	Faculty Jury		Banquet
Jan. 12-18	**Jan. 19-25**	**Jan. 26-Feb. 1**	**Feb. 2-8**	**Feb. 9-15**	**Feb. 16-22**	**Feb. 23-Mar.**	**Mar. 2-8**	**Mar. 9-15**	**Mar. 16-22**	**Mar. 23-29**	**Mar. 30-Apr.5**	**Apr. 6-12**	**Apr. 13-19**	**Apr. 20-26**	
Task 1: Revise Proposal								**Spring Break**				**Final Report**	**Faculty Jury Presentations**		**Thesis Awards / Banquet**
Task 2: Design Gravity System															
	Task 3: Check Gravity System														
		Task 4: Check Lateral System													
			Task 5: Design Foundation System												
			Task 6: Design/Analysis of Mech. System												
				Task 7: Cost Analysis											
						Task 8: Design Steel Connections									
							Task 9: Schedule Analysis								
									Task 10: Comparisons						
	Structural Depth: Steel Frame System			Milestone 1:	Complete Gravity Design					Task 11: Write Final Report					
	Mechanical Breadth: Ventilation System			Milestone 2:	Complete Structural Depth + Mech. Breadth			**Spring Break**			Task 12: Create Final Presentation	**Final Report**	**Faculty Jury Presentatio**		
	CM Breadth: Cost/Schedule Analysis													Task 13: Update CPEP Site	
	MAE Requirements: Connection Design			Milestone 3:	Complete MAE Requirements										
	Report/Presentation			Milestone 4:	Complete CM Breadth										
	CPEP Site														

Conclusion

As previously noted, the concrete flat plate structural system for 8621 Georgia Avenue is sufficient for strength and serviceability. Because the building meets the necessary design criteria, a hypothetical scenario will be investigated to determine the feasibility of the redesign the building using a steel framing system.

This redesign of the structural system will incorporate composite steel beams and columns as well as either a composite or non-composite steel deck. The only disadvantageous of using steel would be the loss of a floor level. This is due to the increased structural depth of a steel system. Even after eliminating a floor, this design scenario will pose a challenge. In order to compensate for the loss of a floor, a level of parking garage will be moved below grade to maintain the square footage of originally designed parking and apartment space.

The existing lateral system of the building consists of 14 shear walls. This system seemed to work quite efficiently and is well placed to eliminate building torsion. Therefore, the existing lateral system will remain the same. The 14 shear walls will be tied into the steel system to accept the lateral loads from the diaphragm at each floor level. If necessary, additional bracing may be added to resist lateral loads on the building. Although the seismic loads on the building should decrease due to the decreased building mass.

The column locations will be left unchanged for the most part. In some conditions, columns may be eliminated to create more rectangular shaped bays, which are more indicative of steel framing.

If a floor of the parking garage were to be relocated below grade, foundation walls for the entire building would need to be designed. These foundation walls would need to resist the soil pressure and pore water pressure of the relatively high water table in the area.

Moving one floor of the parking garage below grade means that it will not be able to be naturally ventilated like the other, above grade floors. To enable this design alternate a mechanical system would need to be designed to ventilate the sub-grade space.

MAE coursework will be integrated into the redesign by the use of computer modeling and steel connection design. RAM and ETABS will be used to model and analyze the gravity and lateral system of the building. Typical beam-girder and girder-beam connections will be designed for both shear and moment connections.