SILVER SPRING GATEWAY
Senior Thesis Proposal

1133 East-West Highway
Silver Spring, Maryland

INTRODUCTION

With the completion of the Silver Spring Gateway still several months away, the JBG Companies (JBG) hypothetically have already sold all commercial and residential leases for the property. Due to this simulated success and for the purposes of this thesis, JBG, theoretically, has decided to research possibilities of constructing a high security, luxury development for international diplomats and national delegates while maintaining similar qualities of square footage, layout, style, moisture and noise control and implementing more stringent security protocols and design. This proposal will address the existing conditions of the Silver Spring Gateway and the necessary methodology, tools, and schedule to determine the feasibility of the new development.

BACKGROUND

The Silver Spring Gateway (Cover and Figure 1) is located at 1133 East-West Highway in Silver Spring, Maryland. The existing tight, flat urban brownfield site, surrounded by Blair Mill Road to the Northwest, East-West Highway to the South, and CSX Transportation, Inc. Railway to the Northeast was used primarily as a parking lot (Figure 2). The Silver Spring Gateway site currently abandons a section of Blair Mill Road, transforming the original trapezoidal shaped site to a more useable, rectangular shaped site (Figure 3). Construction of the fifteen-story, 766,459 square feet building was started in July 2006 and is scheduled to be completed in July 2008 with an estimated bid cost of $89 million. The mixed-use, primarily residential, building owned by The JBG Companies was designed by Weihe Design Group (WDG) of Washington, D.C., and is being constructed under a gross mean price, design-build contract by multiple prime contractors, including general contractor and construction manager Turner Construction Company (Turner) of Washington, D.C. Tadjer, Cohen, Edelson Associates, Inc. (TCE) of Silver Spring, Maryland served as the structural engineering firm (See Appendix A for Project Team Directory).

According to the Urban Land Institute, a development containing “three or more significant revenue producing uses, significant functional and physical integration of the different uses, and conforms to a coherent plan” is defined as a mixed use development. The Silver Spring Gateway certainly exudes this quality as it contains 14,080 square feet of retail space located on the Ground Floor, 100,215 square feet of parking extending from the Basement Level (B1) to the Seventh Floor, and 395,439 square feet of residential space (condominiums and apartments) dispersed among the Second Floor through the Fifteenth Floor (Figure 9). The Basement Level is a rectangular space below grade completely dedicated to parking. The parking garage is sited in the rear of the building or northeast section and continues with the same shape and overall size for eight floors. The Ground Floor is “L” shaped with the long leg parallel to and the short leg pointing toward the East-West Highway and accommodates the lobby, fitness center, and common spaces for the residents; as well as, the retail portion of the building (Figure 5). The retail space is located in the front of the building or south and southwest section along the East-West Highway and is divided by an internal street located at the southeast corner leading to the parking garage entrance. The service corridor and loading dock for the retail space acts as a buffer between the residential public and retail spaces and the parking garage. The service corridor, loading dock, and portions of the internal street utilize a heated ceiling system.

The second floor contains a portion of the residential space located toward the front of the building and a section of the parking garage located in the rear of the building. With a shape similar to the Ground Floor, the second floor also helps reconnect the portion of the building separated by the internal street with an enclosed pedestrian bridge spanning approximately 36 feet. Floors three through six follow the same layout and shape as the second floor except for the bridge area, which contains residential space. The Seventh Floor also maintains the same layout and shape as floors three through six; however, the floor initiates a shape and layout change through the parking garage section. The center portion of the last parking garage level will be open from above and will be surrounded on three sides by the remaining floors (Photo 2). The end portions of the parking garage will utilize a heated ceiling system similar to the Ground Floor.

The remaining eight floors are strictly for residential use and organized in a "figure four". The corridor running through the center of the layout is doubly loaded. Starting on the Twelfth Floor, the southern tip of the building shortens and creates a restricted access roof for the remaining four floors. The penthouse roof maintains the "figure four" layout from below and contains several mechanical and electrical rooms, picnic areas, and a 1,000 square foot residential swimming pool with related functional amenities to complete the fifteen story mixed use development (Figure 6).

The exterior façade of the Silver Spring Gateway is comprised of several different systems. The primary system is a Norwegian and Engineer brick masonry cavity wall with cold formed light gauge steel back-up framing. The Ground Floor utilizes a similar system, however, is expressed differently with prairie stone along with an aluminum storefront curtain wall system for retail areas. Small portions of the building also exhibit Centria aluminum faced composite panels and metal screen walls near the penthouse level and on the parking garage elevation for acoustical concerns. The owner has also opted to incorporate a moisture control initiative with extensive flashing details and unorthodox elevation construction.

EXISTING STRUCTURAL SYSTEM DISCUSSION

With the Silver Spring Gateway located approximately seven miles from Washington, D.C., it comes as no surprise that the primary structural material is concrete. Per the geotechnical report published by GCE, the foundation system utilizes caissons ranging from 30 inches to 66 inches in diameter with a minimum depth of 10'-0" below grade. Exterior grade and transfer girder beams ranging in size from 12 inches by 30 inches to 54 inches by 66 inches were needed to avoid the 72 inches in diameter storm line that travels through the site. A four inch thick slab on grade and spread footings were also employed where appropriate.

While the basement level and ground floor systems are 8 inches or 12 inches thick normal weight cast in place reinforced concrete, the remaining floors utilize a 7 to 9 inches thick two way flat plate post tensioned concrete system with one-way banded tendon distribution over column lines opposite of uniformly distributed tendons (Figure 7). One hundred and seventy-six reinforced concrete columns, ranging in compressive strength from 4,000 pounds per square inch to 8,000 pounds per square inch, support the selected floor systems. The lower level columns have 10 feet by 10 feet by 5 ½ inches thick drop panels. Several columns are sloped to realign the upper floor grid with the lower floor grid. While the bay dimensions are not consistent throughout the building with rotated columns and radial column lines, the longest span of the two way flat plate post tensioned floor slab is approximately 27 to 30 feet.

The building envelop is supported by continuous 3/8 inch thick bent plates with ¾-inch diameter wedges at two feet on center. The lateral load resistance of the Silver Spring Gateway relies on a system of shear walls and concrete moment frames. Lateral loads acting in East-West direction are resisted by three 12 inches thick concrete shear walls, located in the north, east, and south corners of the building, reinforced with #6 bars at six inches on center below the Second Floor and #5 bars at eight inches on center above the Second Floor. In the North-South direction, the concrete moment frames along each column line resist the lateral loading.

Although most of the Silver Spring Gateway structure is cast in place reinforced or post tensioned concrete, the enclosed pedestrian bridge and canopy structures are exposed structural steel. The bridge system in particular is constructed of a 6 ½ inches thick composite concrete slab on six steel trusses composed of W14x114 chords and W12x210s, W12x190s, and W10x45 web members spanning approximately 36 feet (Photo 7). Several W16, W14, and W12 composite infill beams, along with the steel trusses, are moment connected utilizing full penetration welds (Photo 8). Composite W14x257 steel columns encased in a two feet by two feet concrete column supports the entire bridge structure. The canopy members and wall panel supports are typically tube shaped steel members.

PROPOSED STATEMENT AND SOLUTION

For the purposes of this thesis, JBG, hypothetically, acquired the lot surrounded by the Northwest sections of 9th Street to the East, 11th Street to the West, New York Ave to the North, and H Street to the South (Figure 8). JBG will petition to alter the C-3-C zone to a C-4 zone to gain twenty to forty more feet in building height thus matching the surrounding buildings. Altogether, this site can accommodate the same architectural layout as the Silver Spring Gateway; however, due to the high profile aspect of the clientele and proximity to government buildings, the structural design may need to be altered to resist possible terrorist or protestor attacks. First, the locations exuding the most vulnerability to an attack need determined, such as, parking garage, entrance tunnel, exterior façade, etc. Since the current design lends well to several unique scenarios, the structural elements within the existing system will be analyzed per each scenario and redesigned, if necessary, to mitigate the effects of an explosion and to prevent a progressive collapse in case a localized failure occurs.

Along with the structural alterations, architectural changes will inevitably ensue. In order to maintain as much of the architectural program as possible, the architectural layout may also need redesigned due to the structural enhancements. In addition, the façade may need further attention due to possible historic guidelines and to resisting a street side explosion. Consequently, the façade change requires focus on blast resistance, architectural and historic concerns, and different moisture control techniques and the site design will need redesigned to prevent an attack as much as possible.

METHODOLOGIES AND RESEARCH

In order to analyze the building for blast resistance capacity, possible threat scenarios, blast loads, and blast properties need researched. A few documents intended for research are listed below:

- American Concrete Institute. Building Code Requirements for Structural Concrete (318-05). Farmington Hills: American Concrete Institute, 2005.

- Departments of the Army, Navy, and the Air Force. Structures to Resist the Effects of Accidental Explosions, ARMY TM5-1300, NAVY NAVFAC P-397, AIR FORCE AFR 88-22. U.S. Department of Commerce: Springfield, 1990.

- Bangash, M.Y.H. Impact and Explosions: Analysis and Design. Boca Raton: CRC Press, 1993.

- Hinman, Eve E. "Upgrading Windows for Blast Effects." <http://www.hce.com/html /articles/glass.html>, Hinman Consulting Engineers, 2002.

- Maguire, J.R., ed. Earthquake, Blast and Impact: Measurement and Effects of Vibrations. London: Elsevier Applied Science, 1991.

- ASCE Task Committee. "Structural Design for Physical Security." American Society of Civil Engineers, 1999.

- Bulson, P.S. Explosive Loading of Engineering Structures. E&FN Spon, 1997.

- Mays, G.C. and P.D. Smith. Blast Effects on Buildings. Thomas Telford Publications, 1995.

- National Research Council. "Protecting Buildings from Bomb Damage, Transfer of Blast-Effects Mitigation Technologies from Military to Civilian Applications." National Academy Press, 1995.

The information gained through research will enable analyses on the building for the unique criteria or scenarios that are developed. Using a three-dimensional computer modeling program, such as ETABS or Staad.Pro, will show the effects of each scenario and determine whether design changes such as column sizes, incorporation of a vierendeel truss, etc. is necessary. In addition to the structure, the site plan and façade may need extensive attention. The site plan will need redesigned to mitigate the attack while still maintaining an open and inviting atmosphere. The façade may need changed entirely to match the local architecture; therefore, the blast resistance properties, day lighting, and moisture and thermal control aspects of the façade will be addressed.

TASKS AND SCHEDULE

The tasks at the beginning of the semester are well defined; however, the results of these tasks indicate the direction of the rest of this thesis. Hence, the tasks toward the end may seem vague and will certainly change as time progresses.

Task 1: Research all possible threats to the entire design

Blast or threat mitigation applies to each building system; therefore, a complete analysis will need to be completed to establish all vulnerabilities. A decision on which of those will remain within the scope of the thesis will be made based on time and resources.

Task 2: Research blast loads and properties

The loads and properties caused by explosions are unique and must receive adequate attention for complete comprehension of their effects and ultimately their execution in order to properly analyze and create the scenarios the building structure will face. For instance, currently, the Silver Spring Gateway utilizes a post tensioned floor slab; however, research may show that a different system will produce more protection and therefore need redesigned.

Task 3: Determine the analysis scenarios

Based on the research, several scenarios should present the worst-case effect of a blast. The ultimate goal is to have at least three to five scenarios to analyze for this thesis.

Task 4: Create computer model

The computer model is one of the most crucial elements in the overall analysis. ETABS will most likely be utilized for this thesis; however, if simplifications are justified Staad.Pro may be more efficient. The computer model must allow the removal of columns or sections of the building to analyze the induced stresses seen in other areas of the structure after the blast.

Task 5: Design blast resistant components

If the investigation reveals the existing structural deficient in resisting an attack or the research shows the existing floor system inadequate to hinder a progressive collapse, the compromised or deficient areas will need redesigned to incorporate additional reinforcement to become blast resistance and prevent progressive collapse.

Task 6: Research Local Architecture

The local architecture of the area will influence the façade of the new development. Since the high-rise is located in close proximity to the National Mall, White House, United States Capitol Building, and many historic structures along Pennsylvania Avenue, it will most likely need to resemble the surrounding architecture. Other zoning considerations will be researched and observed as well.

Task 7: Redesign façade

Assuming the façade will change from a modern style cladding system to a more historic form, the properties of the façade will need to be addressed along with the design. The structural system may need to be altered to support the new treatment. The blast resistance capabilities will certainly be foremost in the redesign; however, proper consideration is warranted for thermal and moisture properties due to very high standards for the high profile clientele. Day lighting effects and mechanical loads may need attention, as well.

Task 8: Redesign site and landscaping plan

This thesis does accept the occurrence of a terrorist attack on the building in the analysis of the structure's response; however, mitigating the attack entirely is certainly the best approach. Therefore, the site and landscaping for the plaza and garage entrance shall be designed to reduce the ability of the building being a potential target.

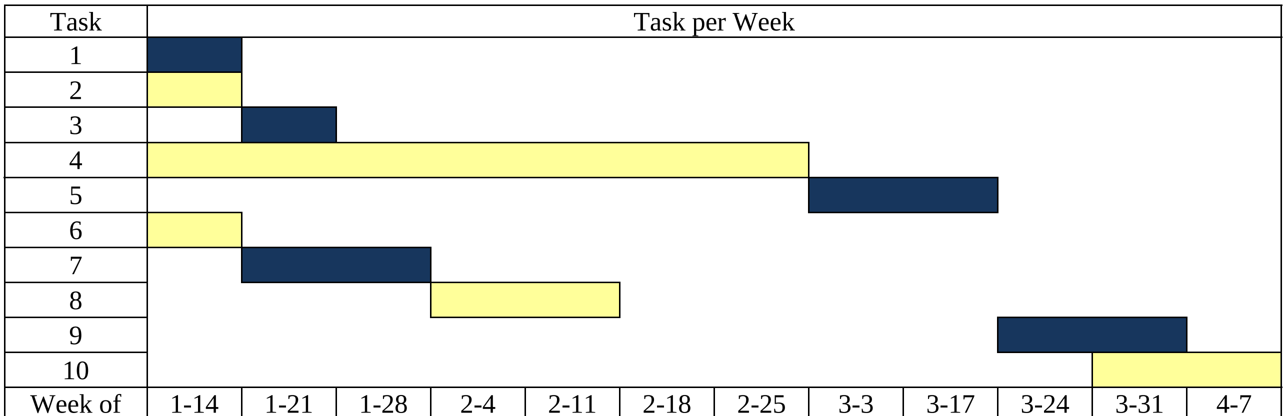
Task 9: Conclude results of analysis

The results of the research, computer modeling analysis, and subsequent redesigns will need to be documented to complete the written form of the thesis.

Task 10: Develop Presentation

The entire written thesis will need to be summarized for a ten-minute presentation for the faculty of the Architectural Engineering Department.

Schedule



**Note: Week of March 10th not shown due to Spring Break*

CONCLUSION

With JBG hypothetically looking to develop a downtown Washington D.C. lot for high profile clientele, the existing Silver Spring Gateway program layout can suit their needs; however, more attention to blast resistance is necessary. Through research and scenario analysis, the structure will be modeled to react to the blast for the determination of deficiencies. Any failures will be addressed in a redesign with minimal adverse effects on the current architectural program. The new site may also require a façade change and blast mitigation design. The schedule allows for completion of this analysis no later than the first week of April 2008.

APPENDIX A – FIGURES

Figure 1: Architectural Rendering of Silver Spring Gateway from the corner of East-West Highway and Blair Mill Road.

Figure 2: Original site (red hatch) and surrounding streets, railway, and buildings.

Figure 3: Current site (red hatch) abandons a portion of Blair Mill Road.

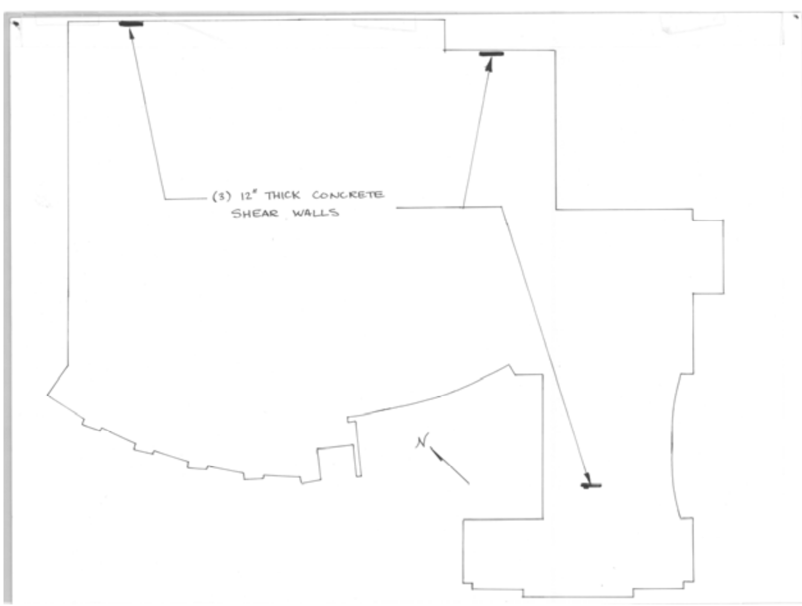


Figure 4: Location of the three shear walls designed to resist the lateral loads.

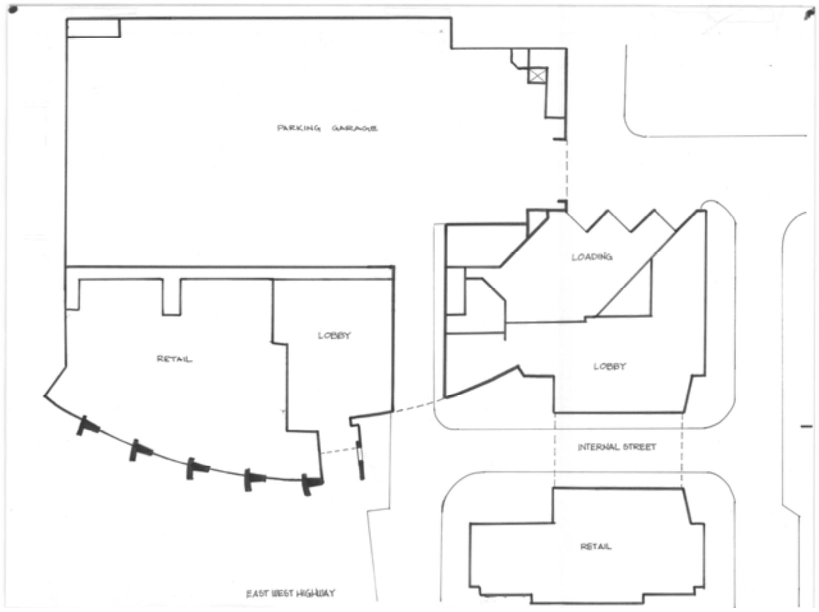


Figure 5: First Floor and Overall Site Plan showing overall shape for lower floors.

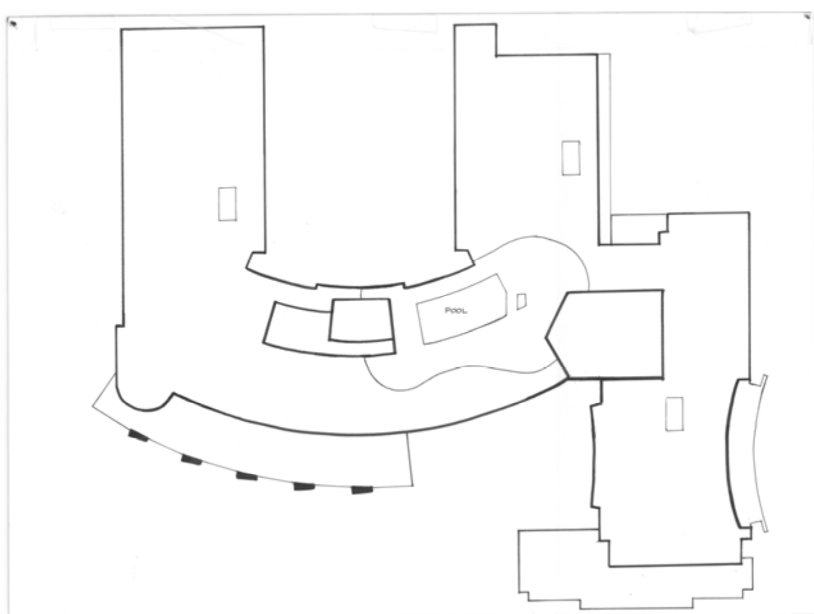


Figure 6: Penthouse Roof Plan showing overall shape of the upper floors and location of penthouse amenities.

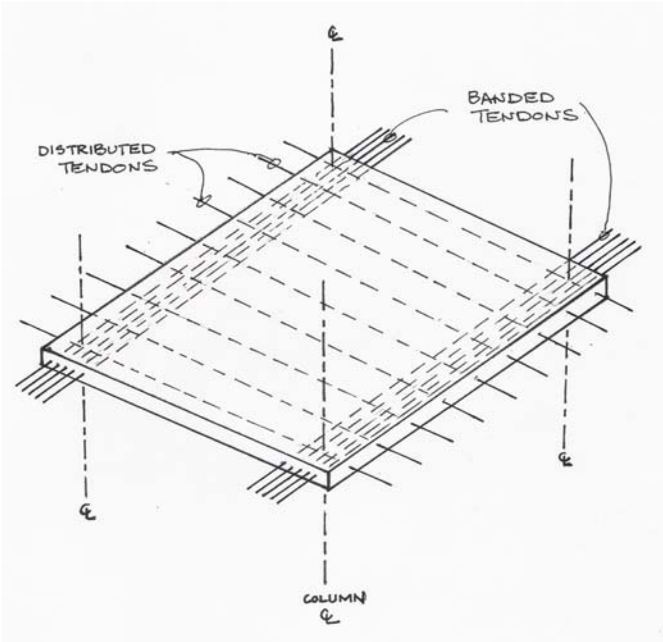


Figure 7: Typical post-tensioning tendon layout.

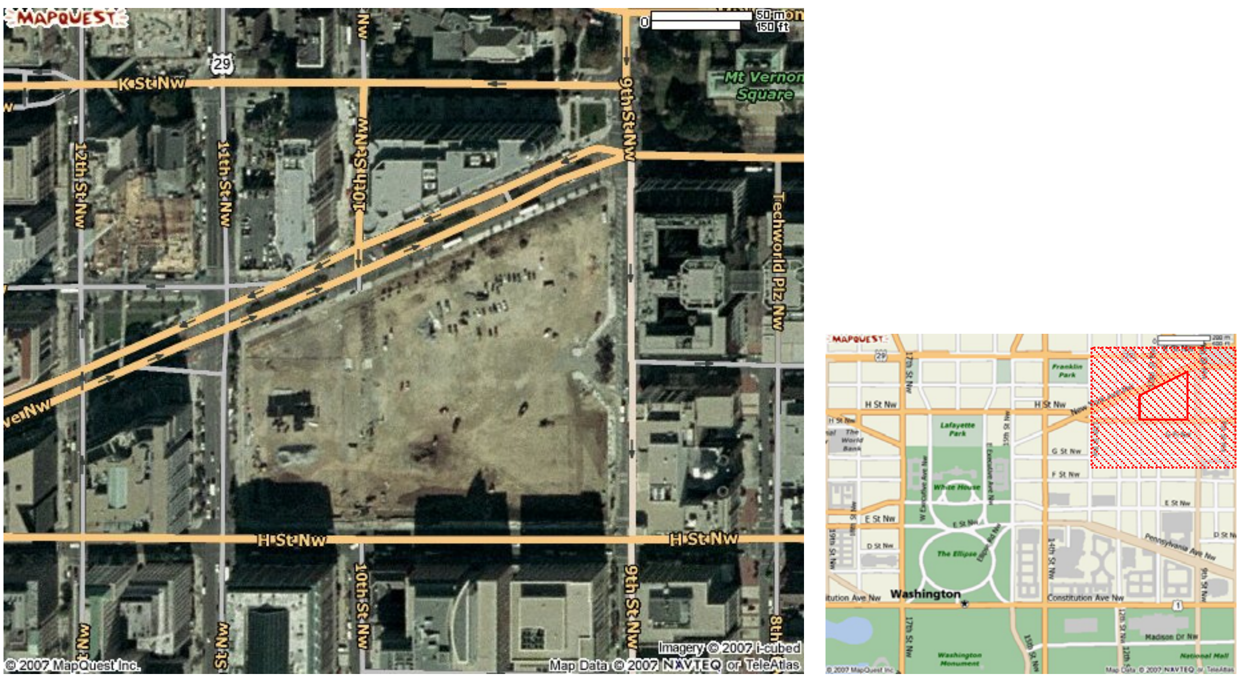


Figure 8: Location of new development site in Washington D.C.

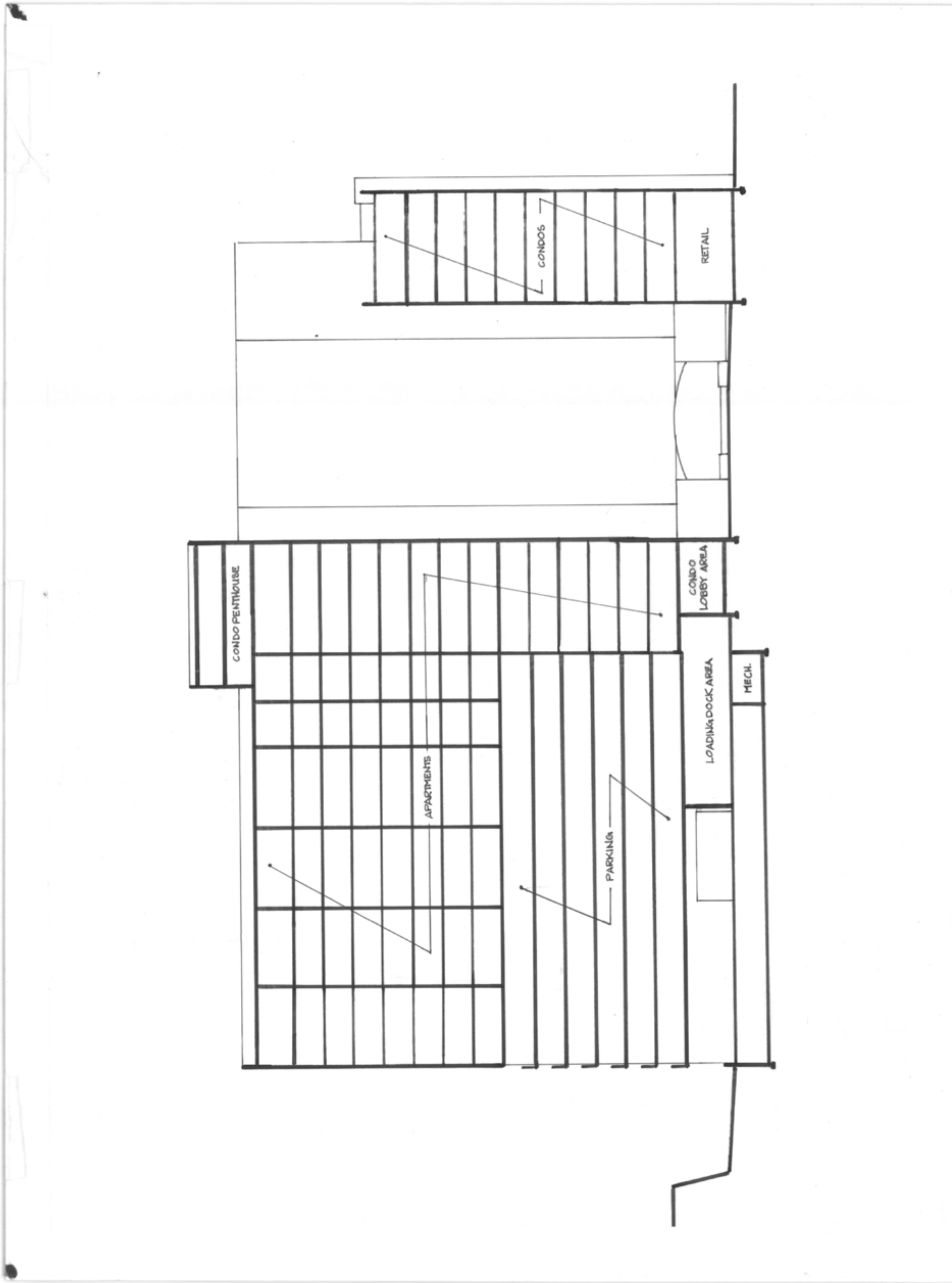


Figure 9: Building Section showing occupancies per floor.

APPENDIX B – PHOTOS

Photo 1: Overall view of Southeast elevation of Silver Spring Gateway.

Photo 2: Partial view of courtyard from the top level of the parking garage.

Photo 3: Partial view of the Southwest elevation.

Photo 4: Partial view of the inside corner between the Southwest elevation and a small portion of the West elevation.

Photo 5: Partial view of lower floor construction on East-West Highway elevation (Southwest).

Photo 6: Interior View of the parking garage.

Photo 7: Interior view of pedestrian bridge steel structure.

Photo 8: Typical full penetration welded connection of the bridge truss structure.

Photo 9: Interior view of a typical residential corridor.

Photo 10: View of post-tensioning cables prior to jacking force application.

APPENDIX C – PROJECT TEAM DIRECTORY

Role	Firm	Website
Owner	The JBG Companies 4445 Willard Ave., Suite 400 Chevy Chase, MD 20815	www.jbg.com
Architect	WDG Architecture 1025 Connecticut Ave., Suite 300 Washington, DC 20036	www.wdgarch.com
Civil Engineer	Loiederman Soltesz Associates, Inc. 1390 Piccard Drive, Suite 100 Rockville, MD 20850	www.LSAssociates.net
Structural Engineer	Tajder-Cohen-Edelson Associates, Inc. 1109 Spring Street Silver Spring, MD 20910	www.tadjerco.com
Landscape Architect	Hord Coplan Macht 750 E. Pratt Street, Suite 1100 Baltimore, MD 21202	www.hcm2.com
Interior Designer	Carlyn and Company 746 Walker Road, Suite 22 Great Falls, VA 22066	www.carlynco.com
Environmental Consultant	Environmental Resolutions, Inc. 14609 Jaystone Drive, Suite 100 Silver Spring, MD 20905	
Geotechnical Consultant	GeoConcepts Engineering, Inc. 19955 Highland Vista Drive, Suite 170 Ashburn, VA 20147	www.geoconcepts-eng.com
Acoustics Engineer	Cerami & Associates, Inc. 1250 Connecticut Ave., N.W. Washington, DC 20036	www.ceramiassociates.com
Mechanical Engineer	Atlas Air Conditioning Company 10693 Wakeman Ct. Manassas, VA 20110	www.atlascsusa.com
Electrical Engineer	Power Design, Inc. 11207 S. Danka Blvd., Suite A St. Petersburg, FL 33716	www.powerdesigninc.us
Construction Manager	Turner Construction Company 10400 Little Patuxent Pkwy., Suite 200 Columbia, MD 21044	www.tcco.com
Seismic Monitoring	Seismic Surveys P.O. Box 1185 Frederick, MD 21702	www.seismicsurveys.net