

77 K STREET

Washington, DC

Todd Povell | Construction Management | Consultant: Dr. John Messner



Project Overview

The 77 K Street project is a class A core and shell office base building project consisting of 11 above grade levels and 3 levels of below grade parking garage. The site is located at the intersection of 1st and K Streets in Washington, DC in the North of Massachusetts development district north of the Capitol Building. Additionally, the project is located only blocks from Union Station, Washington, D.C.'s primary rail terminal. The project includes approximately 350,000 gross square feet of above grade office space and an additional 100,000 square feet of below grade parking.

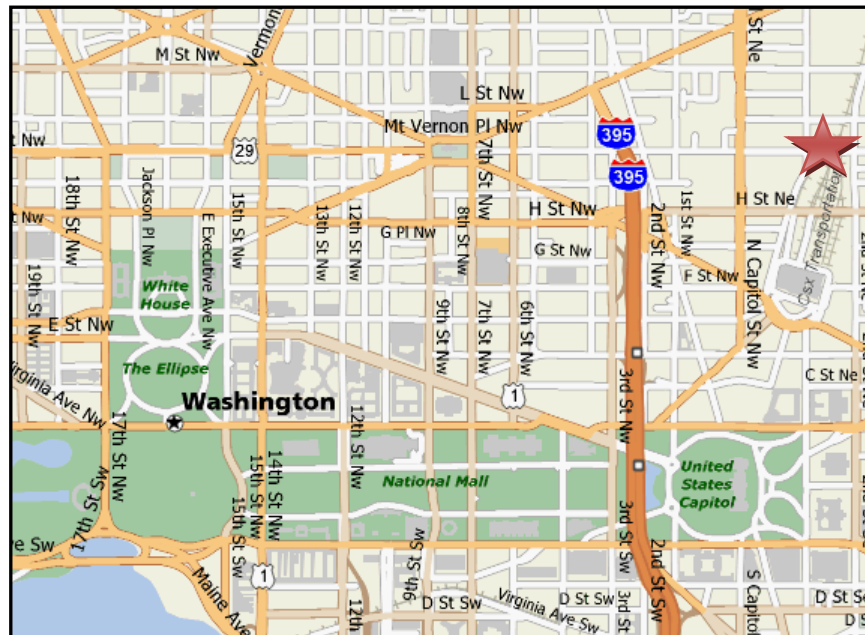


Figure 1.1: District of Columbia Map (Source: Mapquest.com)

Client Information

The owner of this project, 77 K Street LLC, is a joint venture between Brookfield Properties and ING Clarion. The original partnership at project startup was between Cafritz Company and ING Clarion but in July 2006 Brookfield Properties replaced Cafritz Company and the partnership as it is today was born.

Brookfield Properties had a number of goals and expectations that they sought to achieve on the project.

- Tenant:** Though none have been named to date, the developer is seeking to lease the building to either a government or private sector tenant on a minimum ten year lease.
- Cost:** The firm is extremely determined to finish the project within budget. Their decision to abandon contract negotiations with a general contractor in favor of opening up the project to a competitive bid in an effort to drive down the costs is a testament to this.



Quality: The building is class A construction. The owner wants high quality finishes and a first class commercial environment.

Schedule: Schedule is important and the contractor must meet the substantial completion date of July 18, 2008 and the final completion date of September 18 or face liquidated damages.

Safety: Above all the project must achieve the above objectives with a superb safety record and no accidents resulting in lost time or injury.

If the project team is able to successfully meet these objectives by providing a high quality end product within budget with a minimal number of change orders and on time, the owner will be a satisfied client. Of primary importance, the owner is targeting the exterior skin enclosure as a sequencing issue of particular importance. They are pushing the general contractor, Davis Construction, to get the facade erected soon after topping out the concrete in order to allow critical interior work to commence.

Project Team

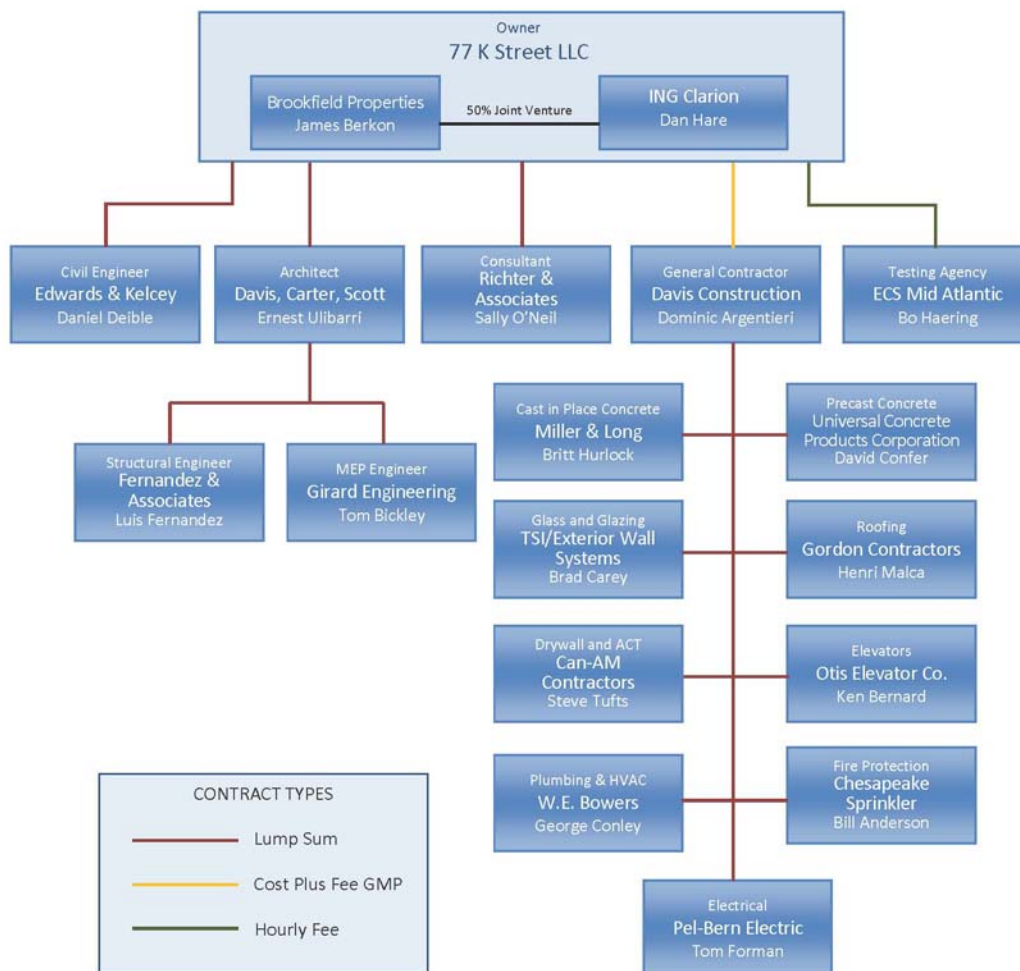


Figure 1.2: Project Team Hierarchy



Project Delivery Method

This project was developed via a design-bid-build delivery system. The ownership entity, 77 K Street LLC, sought to invest in a commercial development project in Washington, DC. After Davis, Carter, Scott developed a design, the project was put out to bid. The initial general contractor selection was based on a negotiated contract but after the owner sought a cheaper bid, the project was put out for competitive bid to a group of three shortlisted contractors. The ultimate decision was based on a number of criteria including cost, schedule, contractor's team, reputation, and qualifications with similar sized projects. Davis Construction won the job in November 2006.

The owner-general contractor agreement is AIA A111, a cost plus fee contract with a guaranteed maximum price. The guaranteed maximum price for the project is \$41,005,150 with a stipulated, lump sum fee of \$1,372,221. The contract includes clauses for increases in the fee based upon approved increases in the cost of construction. Additionally, there are stipulations for liquidated damages starting at \$1,000 per day for delays in substantial completion.

Local Conditions

Washington, DC has an ordinance restricting the height of all buildings in order to prevent any structure from standing taller than the nation's capitol building. Consequently, designers have turned to concrete design to maximize their design potential. Cast in place concrete allows for long spans with a decreased floor to floor height as compared to steel construction. When concrete is post tensioned, even longer spans are possible, such is the case in the 77 K Street project. By reducing floor heights and providing open floor plans, developers are able to maximize their rental space square footage in the district. Consequently, nearly every newly constructed building within Washington, DC will have a concrete structural system.

Tipping fees for garbage disposal are approximately \$850 per 20 CY dumpster. This includes pickup, disposal, and return of the dumpster. Dumpsters 40 CY in size are approximately double this cost. Recycling efforts were not pursued on this project.

The project is located in what is known as the Coastal Plain Physiographic Province of Washington, DC which contains mostly sedimentary soil materials. Stratum I which extends to a depth of between 13 and 22 feet below site grade consists of old fill predominantly composed of silty, clayey, and gravelly sand with varying amounts of organics, rock fragments, and gravel, as well as soils with stiff consistencies, classified as sandy clay. Stratum II which is first encountered at a depth between 13 and 22 feet below site grade consists of loose to dense silty and clayey sand with varying amounts of gravel and rock fragments. It also consists of cohesive soils classifying as clay with varying amounts of silt and sand. Such soil conditions in combination with groundwater conditions encountered at a depth between 18 and 39 feet below grade warranted the design of a mat foundation system.

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Site Layout Plan

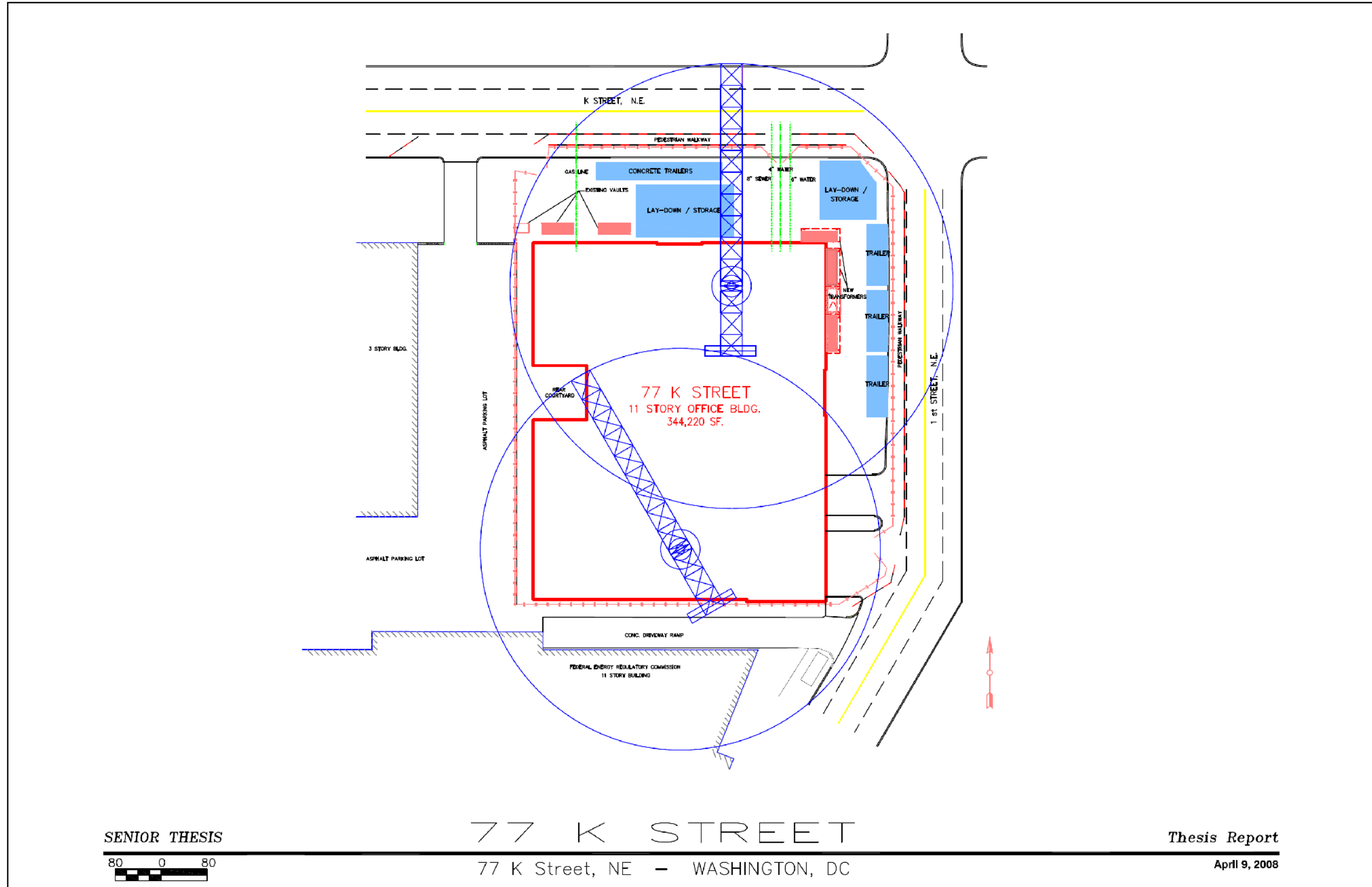
A site layout was developed for the concrete sequence of the project, which extends from April through December 2007. Concrete trucks will enter the site from K Street at the northwestern corner of the site or from the single entrance on 1st street. Their entrance location will depend on which tower crane they will be supplying concrete to.

Also of note, the layout plan has lay down areas for structural steel rebar and formwork awaiting placement within the building. One critical feature of the site plan is the placement of the southern tower crane. The crane's placement intentionally just allowed the crane to reach the southwestern corner of the rear courtyard. At this location, the crane will make a critical precast concrete pick during the façade sequence of the project.

Included on the plan are the locations of Davis Construction's trailer and spaces for subcontractor trailers. During this sequence, Miller & Long, the concrete subcontractor, will occupy one of the two remaining trailer locations. Port-O-Johns and dumpsters are also provided on the site plan. Both can be serviced via the 1st Street entrance.

Additionally, pedestrian safety is of paramount importance so pedestrian walkways have been added to protect from vehicular traffic and site equipment. Additionally, site traffic cannot exit directly at the intersection of 1st and K Street as this would be a danger to pedestrians and other vehicles alike.

The site plan developed by Davis Construction is not only appropriate but highly effective as well. It best utilizes the limited space available in an efficient, safe manner.



SENIOR THESIS



77 K STREET

77 K Street, NE - WASHINGTON, DC

Thesis Report

April 9, 2008

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Building Overview

Architecture

The 77 K Street base building project contains a variety of spaces including three levels of underground parking. The first floor contains a two-story lobby, retail space, an exercise facility, managerial offices, and a mailroom. The high-end lobby features honed granite floors, white Venetian plaster, wood veneer, and granite stone walls. Beginning at floor two, the building is designed for office tenants. The core of each floor contains the MEP rooms, elevator shafts, restrooms, and stairways.

The building was designed to reach its maximum height potential. It stands just shy of the 130' limitation, created in the District of Columbia to prevent any building from standing taller than the nation's capitol. The building also contains a rooftop terrace that provides views both east and south towards the Capitol Building, an appealing feature for the building's future tenants.

Zoning

77 K Street is zoned as type C-3-C under District of Columbia Title 11, Zoning 2002. C-3-C is a "high bulk major business and employment" zone. The code states that C-3-C "Permits matter-of-right development for major business and employment centers of medium/high density development, including office, retail, housing, and mixed uses to a maximum lot occupancy of 100%, a maximum FAR of 6.5 for residential and for other permitted uses, and a maximum height of ninety (90) feet." Because 77 K Street sits in the NoMa Development District, north of Massachusetts Avenue, the owner was able to obtain a code variance to increase both the maximum FAR and the building height.

Building Envelope

The exterior façade is predominantly composed of architectural precast concrete panels with punched out windows. Behind the precast panels, which are mounted at each slab level, there are 2" to 3-5/8" light gauge metal studs with R-13 batt insulation and either a single or double layer of 1/2" gypsum wallboard. The precast also has metal mullions attached to the outside to visually extend the lines of the windows both vertically and horizontally throughout the building.

At the entrances to the building on the north and east elevations, there are two story granite entries into the lobby. Proceeding up the building from these entranceways there are minimal amounts of precast but rather a façade predominantly composed of insulating vision glass windows, metal mullions, shadow boxes, and metal slab covers at the floor levels. The top two floors of the entire building have similar features. Elsewhere throughout the building façade, the eye is met for the most part by sets of two or three windows separated both above, below, and to the sides by light colored architectural precast.

The mechanical penthouse on the roof has an engineered insulating finish system mounted to structural steel which is not visible from street level.



The roofing system is composed of a hot fluid-applied roofing membrane directly above the concrete slab. Type VI rigid polystyrene insulation is placed above the roofing membrane. Finally, either a size 4 aggregate ballast ranging in size from 3/4" to 1-1/2" or two foot square roof pavers are placed above.

Building Systems Summary

| YES | NO | WORK SCOPE |
|-----|----|-------------------------|
| X | | Demolition Required |
| X | | Support Excavation |
| | X | Structural Steel Frame |
| X | | Cast in Place Concrete |
| X | | Precast Concrete |
| X | | Mechanical System |
| X | | Fire Suppression System |
| X | | Electrical System |
| | X | Masonry |
| X | | Curtain Wall |

Demolition

The project is being constructed on the lot of the former 65 K Street building. 65 K Street was a two story masonry building with a basement. The building sat on 16,486 SF at the northwest corner of the lot. A fifty-two car asphalt parking lot wrapped around the south and east sides of the building. Demolition of the existing building was not included in the scope of work for the 77 K Street contract. The removal of 65 K Street, the asphalt parking lot, select utility lines, and certain site features took place prior to the general contractor selection for the new building.

Support of Excavation

In order to support the excavation of the three level underground parking garage, a system of piles, soldier beams, lagging, and tiebacks was utilized. Testing by ECS Mid Atlantic estimated that groundwater would be found between 18 and 39 feet below site grade, thus a temporary dewatering system was installed during excavation and construction with a discharge on the southeast corner of the building on 1st street. Discharge rates in the range of 50 to 100 gallons per minute were to be expected and additional sump pumps were needed as excavation progressed. A permanent sump pump is to be installed in the building as well.

Cast in Place Concrete

77 K Street utilizes a cast in place concrete structural system. The foundation is a 4'-0" thick, 4,000 psi concrete mat foundation resting on undisturbed soil with a minimum 4,000 psf bearing capacity. Below grade parking levels through the first floor are 9" reinforced

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concrete flat slabs with 5-1/2" drop panels at select column locations. Floors two through the roof are 10" or 11" post-tensioned two-way slabs with 4-1/4" drop panels at all columns and around the slab perimeter. All post tensioned slabs have a force of between 130 and 1290 kips. The upper roof of the mechanical penthouse is framed using a combination of concrete and hollow structural steel members with a 8" one-way slab roof. Typical columns have a compressive strength of 5,000 psi with select columns having increased capacity up to 10,000 psi. Slab concrete capacities range from 3,000 psi at the lowest garage level to 5,000 psi for above grade slabs. Concrete is placed using two tower cranes, both staged within the footprint of the building.

Precast Concrete

The facade of the structure is a precast and glazing system. Precast panels are either exposed architectural cladding or support units with stone veneer. Precast pieces are being casted by Universal Concrete Products Corporation in Stowe, Pennsylvania and being erected by E.E. Marr Erectors. The southern and western facades will be erected utilizing the tower cranes already mobilized on site by the cast in place concrete contractor, Miller & Long. The precast on the northern and eastern facades will be erected using a mobile crane stationed on the sidewalk within the project worksite. Precast panels will be connected to the structure by embeds cast into the concrete during slab pours.

Mechanical System

In order to meet ventilation requirements, the three levels of underground garage parking each receive just over 49,000 CFMs of fresh air via intake and exhaust shafts and fans. Both the intake and exhaust shafts contain two propeller type fans at each garage level.

The first floor of 77 K Street contains two water cooled air conditioning units. One 7,200 CFM unit supplies air to the lobby of the building with a smaller 1890 CFM unit controlling air quality within the fitness center. The base building project has mechanical rooms located in the core of each floor with the primary mechanical equipment located on the roof of the building. Three 91,560 CFM cooling tower units supply chilled air to the building. One outside air, gas fired supply unit provides 50,000 CFMs to the mechanical rooms on each floor level. Additionally, each floor contains a 27,000 CFM air conditioning unit for distribution to VAV boxes located in the tenant spaces. At this time, only a limited number of variable air volume units will be installed in order to provide temporary heat to the building's tenant spaces. The majority of the VAV boxes will be stockpiled and installed during future tenant build out.

Stair pressurization shafts contain supply register diffusers at every second or third floor. Air volume at such diffusers is between 1,250 and 1,500. The top of stairwell two contains a 7500 CFM in line fan unit supplying outside air to the pressurization shaft. Stairwell one, which services only the above grade levels, contains a smaller 6,000 CFM fan.

Plenum spaces range in size from 29" in the core of the building to 22" in the tenant spaces. Typical supply ducts are 16" in height and reduce to a 12". Plenums in the tenant spaces also contain the recessed light fixtures, VAV units, and sprinkler pipes. They are concealed with two layers of gypsum drywall.



Fire Suppression System

The building is classified as a type 1-B structure and must adhere to the NFPA 13 standard for fire sprinklers. In order to reduce the fire risk to the building, above grade levels have a wet pipe fire suppression system, whereas the garage and loading dock areas have a typical dry pipe suppression system. A 6" incoming fire protection service is located on the P1 level. After passing through a double backflow preventer this service passes through a jockey and service pump to distribute water throughout the building, via two 1-1/2" standpipes with one located in each stairwell. The first level of the building contains a fire department siamese and pump test connection on the north elevation.

Electrical System

77 K Street contains a standard 408/277V and 208/120V four wire, three phase electrical system. The main switchgear room, located on the P1 level, contains three 4000A switchboards and a single 2000A switchboard. Two of the 4000A switchboards power the normal operations of the building with the third dedicated to emergency systems. The 2000A switchboard is dedicated to the retail space on the first floor. A 750kW diesel powered generator located on the roof powers the emergency systems in case of a power outage. Power is distributed throughout the building by 4000A plug-in feeder busways and panelboards ranging in size from 150 to 400 amps.

Curtain Wall

The exterior of the building is a precast cladding and glass curtain wall system. Precast panels are attached at each slab level and extend both horizontally as well vertically throughout the building. Insulating vision glass windows and shadow boxes contain metal mullions with metal mullions extending through precast elements to create a linear visual appearance. At the lower lobby entrances precast panels support a granite veneer. Precast and glazing system design will be closely coordinated between Universal Concrete Products Corporation and TSI Exterior Wall Systems, Inc. The curtain wall will be constructed using the tower cranes, mobile cranes, and from within the building.

Lighting System

The lighting in the building is a combination of metal halide and fluorescent fixtures. The metal halide lighting systems are located predominantly in the garage levels and loading dock areas. The linear and compact fluorescents are located in the core and tenant spaces. On the roof of the building there is an outdoor photocell facing north to control lighting levels within the building. Additionally, under consideration is the possibility of adding occupancy sensors with fifteen minute time-out delay settings to control lighting levels within the tenant spaces.

Transportation

The building contains two stairwells providing means of egress. Stairwell one, located on the northern side of the building core, services the above grade levels, floors one through the penthouse. Stairwell two extends from the P3 level through the penthouse, though the location of the shaft shifts when the stairwell reaches grade level.

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The building also contains nine elevators. Two elevators service the garage, one large service elevator services floors one through eleven, five typical passenger elevators service floors one through eleven, and one additional passenger elevator services floors one through the penthouse. The six passenger elevators located in the core of the building have a rated capacity of 4000 pounds, the service elevator has a capacity of 4500 pounds, and the two garage elevators have a smaller capacity of 3500 pounds. All elevators travel at a rate of 350 feet per minute.

Estimate Summary

| BUILDING CONSTRUCTION | |
|-----------------------|--------------|
| Construction Cost | \$41,005,150 |
| Cost Per Square Foot | \$91.30 |

| TOTAL PROJECT <i>Including Land Acquisition and Design Fees</i> | |
|--|---------------|
| Project Cost | \$125,000,000 |
| Cost Per Square Foot | \$278.32 |

| BUILDING SYSTEM TOTAL AND SYSTEM PER SQUARE FOOT COSTS | | | |
|---|------------------------|--------------|---------|
| 02000 | Site Utilities | \$244,800 | \$0.54 |
| 02300 | General Excavation | \$1,287,500 | \$2.87 |
| 03300 | Cast in Place Concrete | \$11,296,000 | \$25.15 |
| 03450 | Precast Concrete | \$2,950,000 | \$6.57 |
| 05000 | Miscellaneous Metals | \$617,788 | \$1.37 |
| 07100 | Waterproofing | \$201,432 | \$0.45 |
| 07500 | Roofing | \$313,595 | \$0.70 |
| 08800 | Curtainwall | \$3,734,000 | \$8.31 |
| 09250 | Drywall | \$1,482,000 | \$3.30 |
| 14200 | Elevators | \$2,334,000 | \$5.20 |
| 15000 | Mechanical & Plumbing | \$4,764,000 | \$10.61 |
| 15300 | Fire Protection | \$605,000 | \$1.35 |
| 16000 | Electrical System | \$3,588,000 | \$7.99 |

Summary Schedule

A summary schedule outlining key project activities can be found on the following four pages. Activities are arranged by floor.

