

# Steel City High-Rise



## TECHNICAL REPORT 1

Senior Thesis

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Project Location: Pittsburgh, PA

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## EXECUTIVE SUMMARY

The information contained within this document relates to the construction of the Steel City High-Rise in Pittsburgh, Pennsylvania. The purpose of this project is to provide new opportunities for retail, businesses, and hotel stays within the heart of the city. In fact, this will be the first privately owned high-rise to grace the Pittsburgh skyline in over 30 years. This project has been widely recognized and accepted by the local government and community. It has been deemed a revitalization project as it is estimated to annually bring in \$4 million in tax revenues. Additionally, the structure is expected to provide approximately 750 new jobs in the heart of the city. In an effort to continue to benefit and protect the city, the project is on track to achieve a LEED Silver rating as they strive towards a sustainable city.

The investors for this building joined Pittsburgh in this regeneration effort in 2006, and since then have developed several commercial and residential retail spaces throughout the Greater Pittsburgh area. The particular high-rise is a 440,000 GSF structure that will rise 18-stories in the Pittsburgh Skyline. This structure that will include 23,000 square feet of ground-level retail spaces, a 330 car parking garage, 100,000 square feet of Class A office space, and 198 hotel rooms. The project duration is anticipated to be 23 months; however, Turner Construction is aiming to fast-track the project in order to have an October 2015 substantial completion, rather than a December 2015 completion.

The overall project cost is expected to be \$100 million, while the cost of construction will be \$67,000,000. The construction costs will be further subdivided by two prime contractors to have construction and MEP separated. The construction costs will then have Turner Construction contracted at \$57,000,000 and Scalise Industries contracted for \$10,000,000 worth of MEP. These contracts are unique in that they also contain equity for the prime contractors. Each of the prime contractors (Turner and Scalise) will own 2% equity in the building upon its completion in late 2015.

## DELIVERY METHOD

The project's delivery method is somewhat unusual and unique in that Turner Construction was not initially a prime contractor for this project. A smaller general contractor was originally signed on to do the construction contract portions; however, they did not end up having the means to perform the work for a job of this magnitude. During the demolition phase, Turner was asked to come in and take over the project due to the good relations that Millcraft and Turner had on previous projects. Turner agreed to a lump sum for the preconstruction services and then the construction was contracted as a Guaranteed Maximum price with the Construction Manager at Risk. The other design entities had been contracted prior to Turner and with the original Construction Manager, so their contracts remained modified Design-Build. The design parties included TDA – The Design Architect (architect for hotel interiors and standards), JGA – Jezerinac Geers (structural engineer), CJL Engineering and Scalise Industries (MEP engineers), and Arquitectonica (lead architect).

## SUBCONTRACTOR SELECTION AND STAFF

Aside from Turner, the contractors for the project were selected via a public bid. In most instances the lowest bidder was awarded the project; however, due to specific funding the project needed to meet certain MBE and WBE quotas, so in some cases the lowest bidder did not qualify. Payment and performance bonds, as well as bond verifications are required for all of the subcontractors involved in the project. In addition to the P&P bonds, all of the contractors are covered under CCIP policies as well.

The project staff is continuously growing as the project progresses in phases and introduces new trades and components to the site. The expected project staffing for Turner Construction Company will include a senior project manager, a project engineer, an assistant engineer, a superintendent, two assistant superintendents, a safety manager, a safety engineer, an estimating manager, a cost engineer, and a purchasing agent. There is a potential for a few additional assistant engineers and superintendents; however, that will be determined as needed. Additionally, Turner has continued to staff an estimating manager in order to manage future interior outfits that will be handled by the interiors division of Turner, otherwise known as the Special Projects Division (SPD).

## SITE LOGISTICS

The project is in the heart of downtown Pittsburgh and it is within walking distance of the cultural district, the historic district, Pointe State Park, Market Square, many colleges and universities, notorious businesses, entertainment, farmer's markets, sporting event, and so much more. The area is a high traffic zone to both pedestrian and vehicular traffic. The streets to the north and south of the site are each one way streets, one having traffic travel to the west and the other to the east. To the west of the site is a popular outdoor gathering space and to the east is a traffic heavy road. Logistically, it was a challenge to please all parties with access to the site and access to the normal Pittsburgh amenities that are close by; however, a consensus was agreed upon. It was agreed upon that the outdoor space would only be used in the case of an emergency, as this was an area that is densely populated with the employed population of the city. It was determined that the street to the north of the site would be cut off from all pedestrian and vehicular traffic in order to accommodate deliveries, crews, and materials for the project. Careful coordination is being consider for the delivery of materials and the local municipality has been helping to control and direct the traffic during this time.

The demolition of the area was minimal requiring the demolition of a small building and the rest of the footprint area being a parking lot. During the excavation process, old wells and utilities that were never document were found and temporarily delayed the work for a single work day. During that time a team of archeologists came to remove any valuables from the remains and then work proceeded as usual the following work day. The unmarked utilities posed a bit of a problem, but careful planning allowed the team to complete the excavation process without any incidents causing delay or harm to the project or the surrounding areas. Also, due to the site being surrounded along the East and West sides by existing buildings, there is no need for retention walls; however, it is crucial to monitor the condition of the basement walls as they are exposed during the excavation to ensure that excavation could be completely successfully and safely. The proposed and approved backfill for the excavation and

foundation work is a crushed and screened concrete/masonry material that is to be compacted to a minimum of 100% of its maximum dry density.

Due to the fact that the footprint of the building is taking up most of the site footprint, there is no room for on-site job trailers. Fortunately, an adjacent building to the site had a vacant first floor that is currently being leased-out as the field office. This has allowed all of the on-site trades to work collaboratively under one collective roof. Additionally, because the site is extremely congested, there is minimal parking allocated to the superintendent and specific members of the team. Fencing is placed on all sides of the project where the site is not abut with an adjacent building and the fences will have a lock system on them for each trade in order to give access to only those directly involved with the construction.

## **BUILDING SYSTEMS**

### **STRUCTURAL SYSTEM**

There are three different structural systems that are used throughout this building to serve three very different spaces. The entire building's structural system will be supported by a system of mat foundations, grade beams, auger cast piles, and footings accompanied by a backfill of crushed/screened concrete. The structure above grade will consist of wide flanged W14 columns that will span several stories and will range in size from a W 14x43 to a W 14x426. Between these columns span various series of wide flanged beams and girders to support each floor and slab. These beams and girders can be found in a range of depths from W8-W44 that vary in weight. The structure is also comprised of composite metal deck, concrete, and hollow tube steel components; however, these are separated into the aforementioned "three" separate spaces.

The first of these regions is what is called the podium. The podium is comprised of the first three levels of the structure which will house the garage ramp, retail space, a portion of the garage, and the restaurant space for the hotel. The first floor will span a height of 17.5 feet, while the next two floors will be 12 feet in height. The retail space floors are not to be finished within the contract, so they will have 4" of crushed aggregate on grade, while the other spaces on the first floor will be 4" of slab on grade concrete over 4" of the crushed aggregate. The remainder of the parking garage (in the podium and beyond) will be a 5" post-tensioned, normal weight slab, except over the retail space there will be a 4" wearing slab. The hotel slab within the podium region will be a 3 ¼" lightweight slab over a 2" 18 GA composite metal deck. The remaining hotel space above the podium will be 3 ¼" lightweight slab over a 3" 18 GA composite metal deck, while the office space will be a 3 ¼" lightweight slab over a 2" 18 GA composite metal deck. In addition to the columns and beams throughout the hotel region, there is a hollow structural steel system that spans from levels 4-1. These members are 4"x4" and have a thickness range of ¼" to ½".

### **MECHANICAL SYSTEM**

The mechanical systems and the electrical systems are much more straightforward and simple in retrospect. The mechanical system will be comprised of six rooftop air handling units. Two of the units will be 50,000 CFM for the office tower and will contain enthalpy wheels to supply the region with air. The other four will be for the hotel corridor (12,000 CFM), office lobby (1,600 CFM), kitchen (4,000 CFM), and the laundry room (3,600 CFM). These air handling units will feed the entire structure through ducts and exhaust fans with the exceptions of the garage (it is open to outside airflow), the hotel rooms,

and the retail spaces. The hotel rooms will each have their own self-contained packaged terminal air conditioning units (PTACs) that are thru-wall units and will have an outside air CFM of 70. The retail packages are to remain core and shell and will be designed and outfitted by the respective tenants.

### **ELECTRICAL SYSTEM**

The buildings electrical service is owned by Duquesne Light and is fed by 6, 3-½" conduit containing 4-#600MCM and 1#400EGC and 7, 4" conduits containing 4-#750MCM and 1#600EGC . The 3-½" feeders are providing power to a 277/480V main switchboard sized at 2000A and the 4" feeders are providing power to a 277/480V main switchboard sized at 2500A. From these main switchboards there are 65 panels throughout the structure.

### **BUILDING FAÇADE SYSTEM**

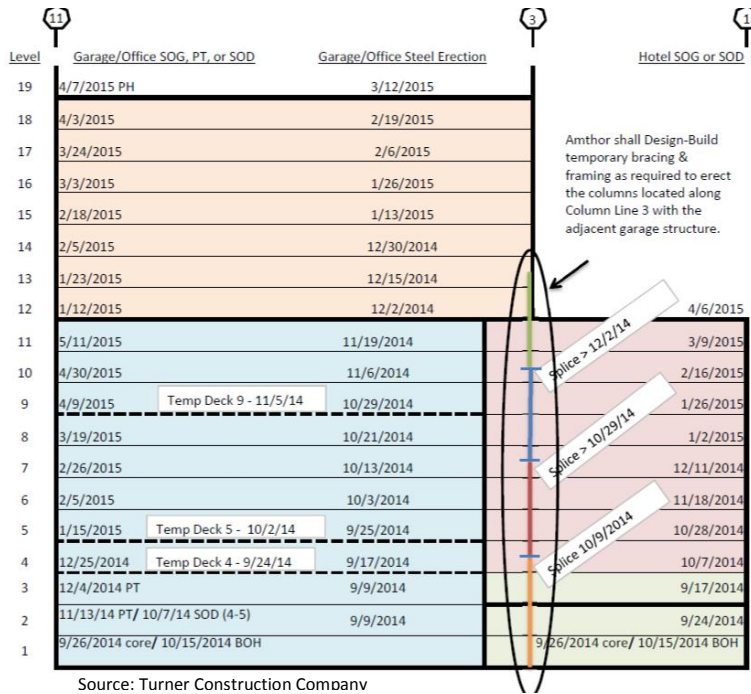
The façade of this building is fairly consistent and limited with the materials. Nearly every exposed face of the building is composed of vision glass, spandrel glass, metal panels, and metal louvers. The metal panels and louvers are metallic painted steel that will have both interior and exterior primer finishes. The lower retail spaces and the unexposed facades (facing other buildings) are an 8" concrete masonry unit wall due to the close proximity to adjacent spaces preventing further exterior finishes. The roofing is 3" corrugated metal deck that has an overlaying system composed of TPO (Thermoplastic Polyolefin) Roofing and Fluid-Applied Protected Membrane Roofing. The TPO will withstand uplift pressures, reduce thermal movement, and shall remain watertight throughout exposure to weather. The Fluid-Applied Protected Membrane Roofing will improve the lifecycle of the roof, while also reflecting solar radiation in order to reduce energy costs.

### **LEED**

As previously mentioned, this project is aiming to earn a LEED Silver certification based upon the 2007 LEED Reference Guide for Green Building, Design & Construction Version 2.2. Some of the means by which this rating will be achieved include the coordination of the curtain wall R-values and the loads of the rooftop air handling units, a bike rack, local resources and materials, and separate sanitary and storm lines. In addition to aiming for LEED Silver, alternative designs for a Green Roof Garden have been designed, but they will only be implemented if time and resources are available further along in the project.

### **SCHEDULE AND SEQUENCING**

Construction for the project began on January 13, 2014 with a 23 month duration that is currently aiming for an expedited 21 month schedule in hopes of a substantial completion date in early December of 2015. The schedule has a unique sequencing schedule as shown in the visual below. The steel will be erected based first and foremost according to the sequencing of the erection drawings, and secondly it will be erected based regions of the building. In a traditional building an entire floor may be sequenced together in a building, where as this project will erected several stories of steel for a given sequence, as well as pour decks on an office floor, prior to the hotel floors below. This system greatly reduces the OSHA issues by eliminating the risk of workers performing their responsibilities under slab edge conditions while iron workers are working at higher elevated sequences.



The schedule is going according to plan; however, the erection of the steel is expected to continue through the Pittsburgh winter months. Pittsburgh winters are less than desirable working conditions for the iron workers and it can often be difficult to predict whether or not it will be a severe winter with snow/ice accumulation and freezing/below freezing temperatures. The two month cushion that Turner has allotted due to the fast-track plan will help in the case that there is not currently enough leeway in the schedule for weather delays. Additionally, much of the project schedule is at the mercy of the steel fabricator, Amthor Steel Company. Early on in the project, the concrete/foundations subcontractor was able to fast-track their work and get ahead of the schedule; however, the intended steel was not able to swiftly follow due to the fabrication time associated with the members. Luckily, this did not set the project back, but it simply did not allow as much of a jump in the preliminary schedule time.

**PREVIOUS QUESTIONS AND SOLUTIONS**

<b>Questions from Presentation</b>	<b>Solutions/Addressed Issues</b>
<b>Who are the Owner and VP of Construction in the Staffing Plan chart in the PowerPoint?</b>	Removed the Millcraft Investments representation from chart and only included the Turner Construction staffing.
<b>Did the contracts change after the original CM contract was terminated and Turner was brought in? Investigate contracts between Owner and Designers.</b>	
<b>Does SF estimate from RSMeans account for all building types in structure (hotel, garage, retail, office)?</b>	New SF estimate reflects multiple building types in the structure.



## SUMMARY ESTIMATE

**Building Parameters**

**Model:** Office, 11-20 Story with Double Glazed Heat Absorbing Tinted Plate Glass Panels / Steel Frame

**Location:** PITTSBURGH, PA

**Stories (Ea.):** 11

**Story Height:** 10

**Floor Area:** 260,000

**Basement:** No

**Additive Cost:** \$0.00

**Cost per S.F.:** **\$108.65**

**Building Cost:** **\$28,250,000.00**




Figure 4: Office Space SF Estimate

**Building Parameters**

**Model:** Store, Retail with Face Brick on Concrete Block / Steel Joists

**Location:** PITTSBURGH, PA

**Stories (Ea.):** 1

**Story Height:** 14

**Floor Area:** 23,000

**Basement:** No

**Additive Cost:** \$0.00

**Cost per S.F.:** **\$74.98**

**Building Cost:** **\$1,724,500.00**

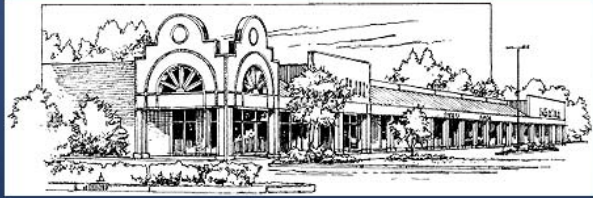


Figure 5: Retail SF Estimate

**Building Parameters**

**Model:** Garage, Parking with Reinforced Concrete / Steel Frame

**Location:** PITTSBURGH, PA

**Stories (Ea.):** 5

**Story Height:** 10

**Floor Area:** 145,000

**Basement:** No

**Additive Cost:** \$0.00

**Cost per S.F.:** **\$64.56**

**Building Cost:** **\$9,361,500.00**




Figure 6: Parking Garage SF Estimate

**Building Parameters**

**Model:** Hotel, 8-24 Story with Glass and Metal Curtain Walls / Steel Frame

**Location:** PITTSBURGH, PA

**Stories (Ea.):** 10

**Story Height:** 11

**Floor Area:** 117,000

**Basement:** No

**Additive Cost:** \$0.00

**Cost per S.F.:** **\$150.89**

**Building Cost:** **\$17,654,000.00**




Figure 7: Hotel SF Estimate

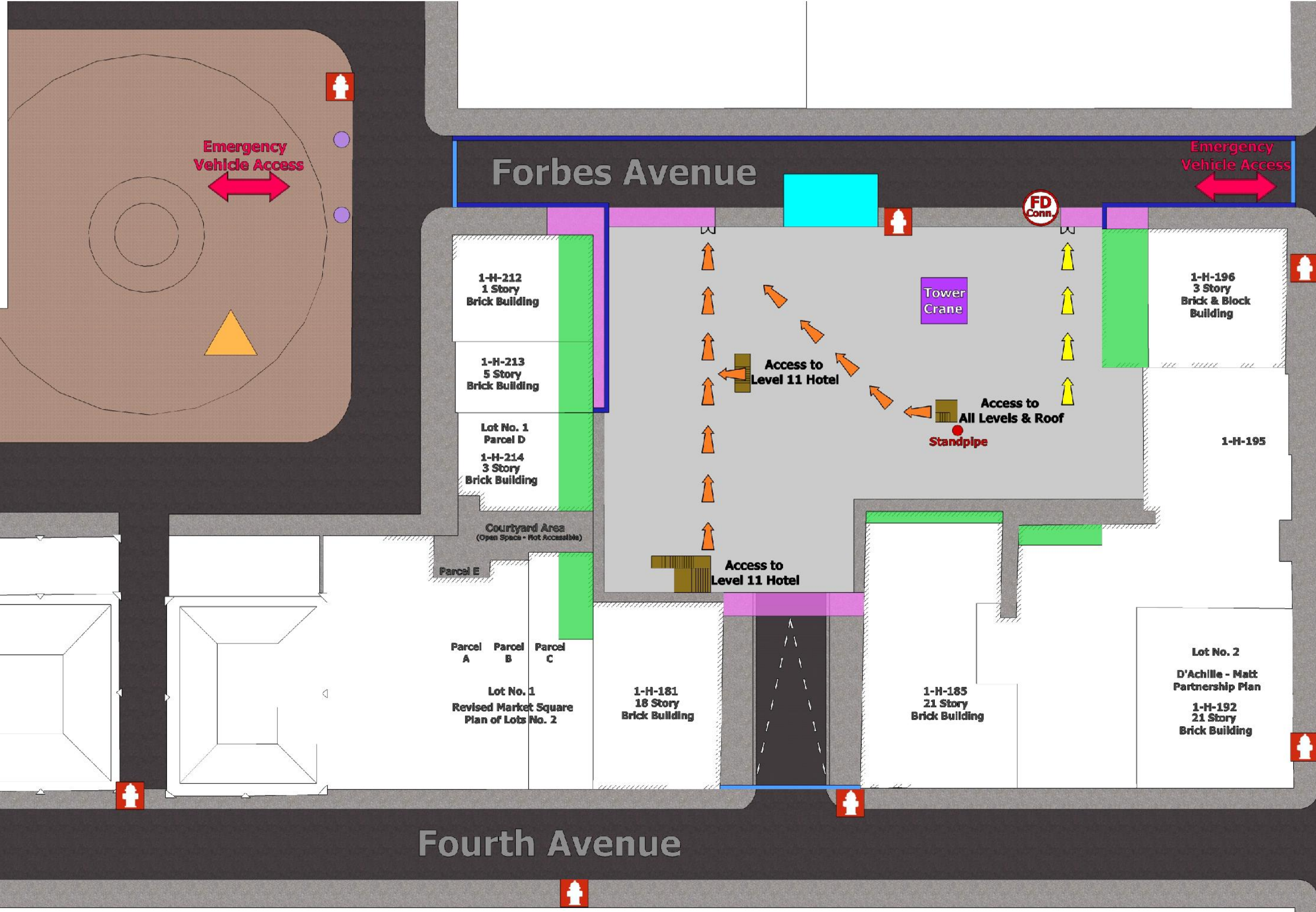
	<b>Turner</b>	<b>MILLCRAFT INVESTMENTS</b>	<b>RSMeans</b> <small>of Reed Construction Data</small>
	Construction Cost	Project Cost	Estimated SF Cost
Cost/SF Hotel			\$150.89
Cost/SF Office	\$152.27	\$227.27	\$121.41
Cost/SF Parking Garage			\$64.56
Cost/SF Retail			\$74.98
<b>Total Cost</b>	<b>\$67 M</b>	<b>\$100 M</b>	<b>\$51.7 M</b>

Figure 8: Various Estimates Comparison and Totals



# LEGEND

- Roof Protection
- Overhead Protection
- Loading Dock/Hoist
- Site Fence
- Gate
- Stairs
- Fire Hydrant
- Primary Egress Path
- Secondary Egress Path
- Mustering Point
- Removable Bollard

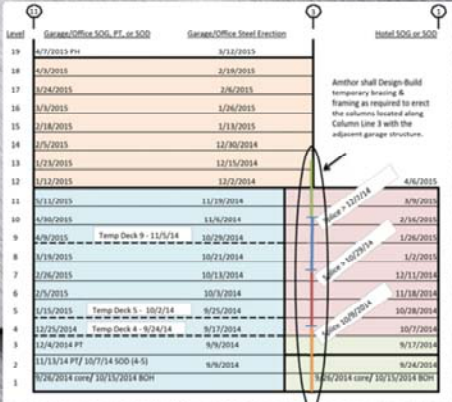


Fourth Avenue

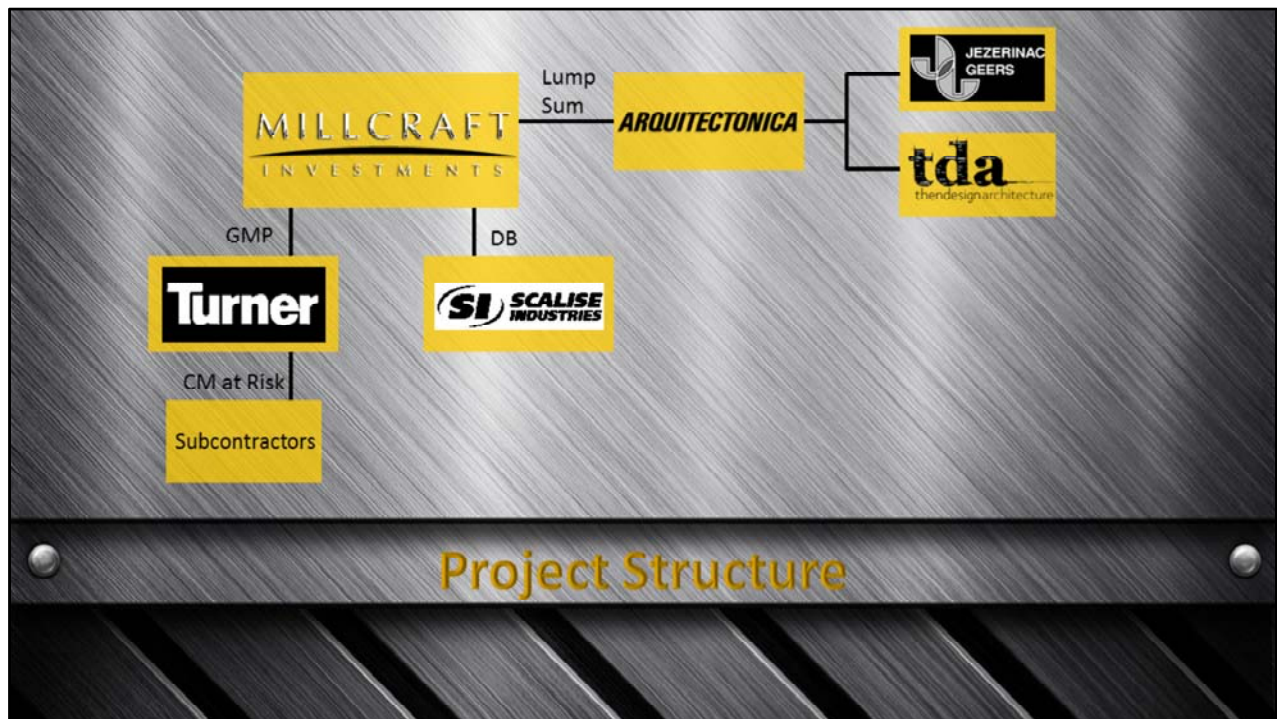
Wood Street



- Mission: Growth and opportunity for city
- Cost: \$67,000,000 and \$100,000,000
- Schedule: 23 months
  - Aiming for 21 months
- Unique Sequencing
- Must be compliant with hotel standards

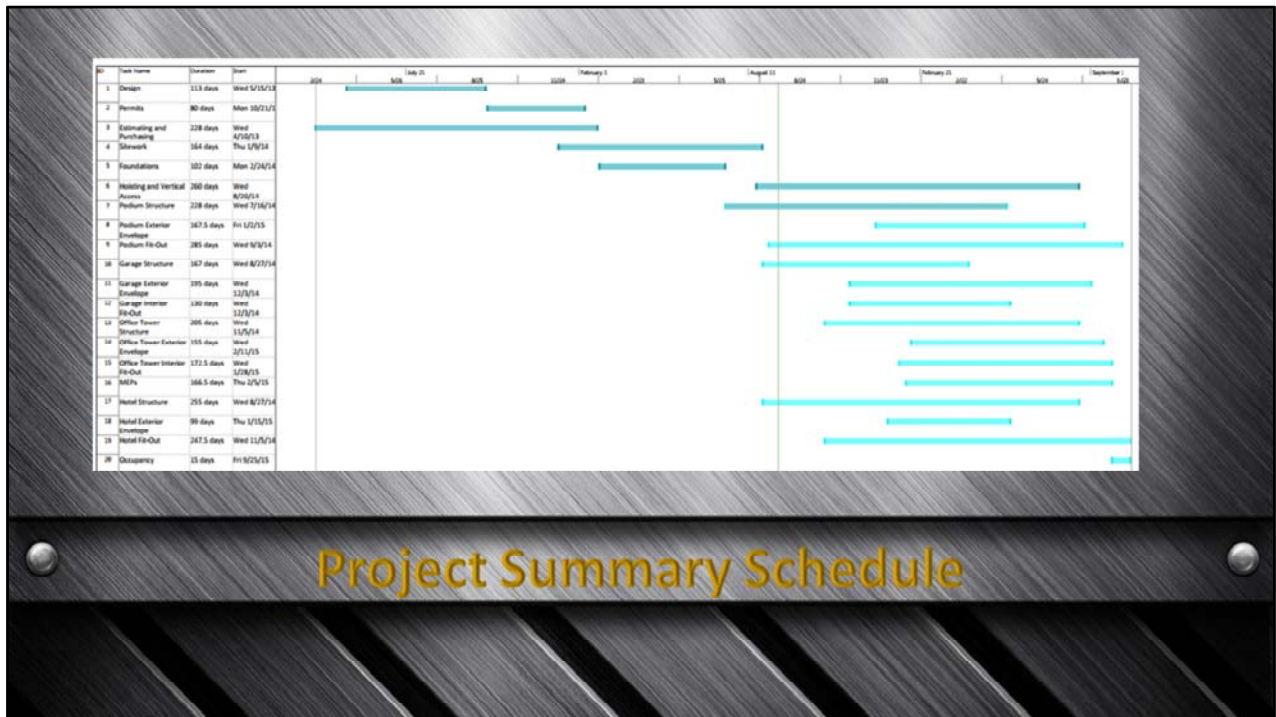


- First privately owned high-rise to grace the Pittsburgh skyline in over 30 years
- Estimated to bring in \$4 million in tax revenues annually
- Expected to provide approximately 750 new jobs
- Investors for this building joined Pittsburgh in this regeneration effort in 2006



The overall project is a design build with a GMP CM at risk contract.

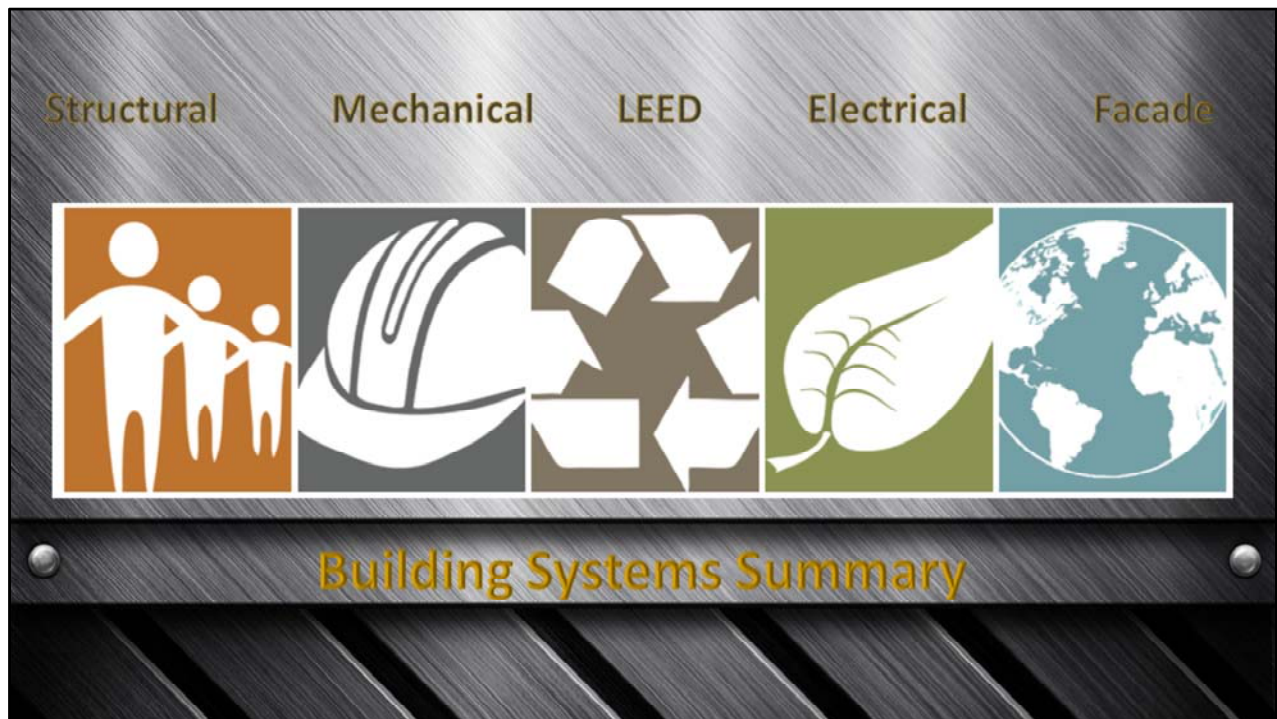
- Unique: Original GC was unable to continue during the preconstruction, so Turner was brought on to the project late
- Preconstruction costs as a lump sum, while the rest of the project is a GMP.
- Multiple primes to reduce the fees that the GC would typically charge.
- Aside from Turner, the contractors for the project were selected via a public bid. In most instances the lowest bidder was awarded the project; however, due to specific funding the project needed to meet certain MBE and WBE quotas, so in some cases the lowest bidder did not qualify



The project is on a fast-track schedule to hopefully finish up to two months ahead of time. While the structure and slabs are being sequenced in a unique way, the above schedule is not broken into the sequences. The structure will be erected according to steel member sequences from when they are erected and then the schedule is dictated by the type of space, the floors, and the overhead, working slab edge conditions.



The differing prices are a result of RSMeans limitations in the materials that are being used in the project. Our owner is known for using more expensive finishes and materials. Additionally, there is no one category that this structure fits in, so there is room for varying prices with the garage, retail, and office spaces as well. The structural system is also unique and not clearly defined within RSMeans. Additionally the MEP will account for 15% of the construction costs.



**Structural:** There are three different structural systems that are used throughout this building to serve three very different spaces. The entire building's structural system will be supported by a system of mat foundations, grade beams, auger cast piles, and footings accompanied by a backfill of crushed/screened concrete. The structure above grade will consist of wide flanged W14 columns that will span several stories. Between these columns span various series of wide flanged beams and girders to support each floor and slab. The first of these three regions is what is called the podium. The podium is comprised of the first three levels where the retail space floors are not to be finished within the contract, so they will have 4" of crushed aggregate on grade, while the other spaces on the first floor will be 4" of slab on grade concrete over 4" of the crushed aggregate. The remainder of the parking garage (in the podium and beyond) will be a 5" post-tensioned, normal weight slab, except over the retail space there will be a 4" wearing slab. The hotel and office slabs will be lightweight concrete over 18 GA composite metal deck. In addition to the columns and beams throughout the hotel region, there is a hollow structural steel system that spans from levels 4-1. These members are 4"x4" and have a thickness range of ¼" to ½".

**Mechanical:** This system will be very basic, as the tenants of the retail spaces and businesses will be determining their mechanical systems separate from the rest of the building. The spaces within contract will be served by six rooftop AHUs and Ptacs (packaged terminal air conditioners) that will feed all of the various spaces in the hotel and office.

**LEED:** The project is aiming for LEED Silver and will be achieving this through materials, location of materials, energy consumption, bike racks, and other standard circumstances.

**Electrical:** Utility transformers are under the ownership of the power company. There are 65 panels in the building with voltages of either 120/280 or 277/480.



**Façade:** Composed of large curtain wall systems and metal panels, with concrete-masonry block used on facades that are abutted to adjacent buildings. It has a very modern look and also been designed to have an alternate green roof garden feature to allow for more green space in the urban setting.



Avenue #1 is shut off completely from all pedestrian traffic. Avenue #2 is open to normal traffic and will only occasionally and briefly close for backfill deliveries. The square to the left of Avenue #1 is only to be used in cases of emergencies.



-The project team is relatively small at the moment, but it continuing to expand as the project is moving out of foundations and more trades are coming on site