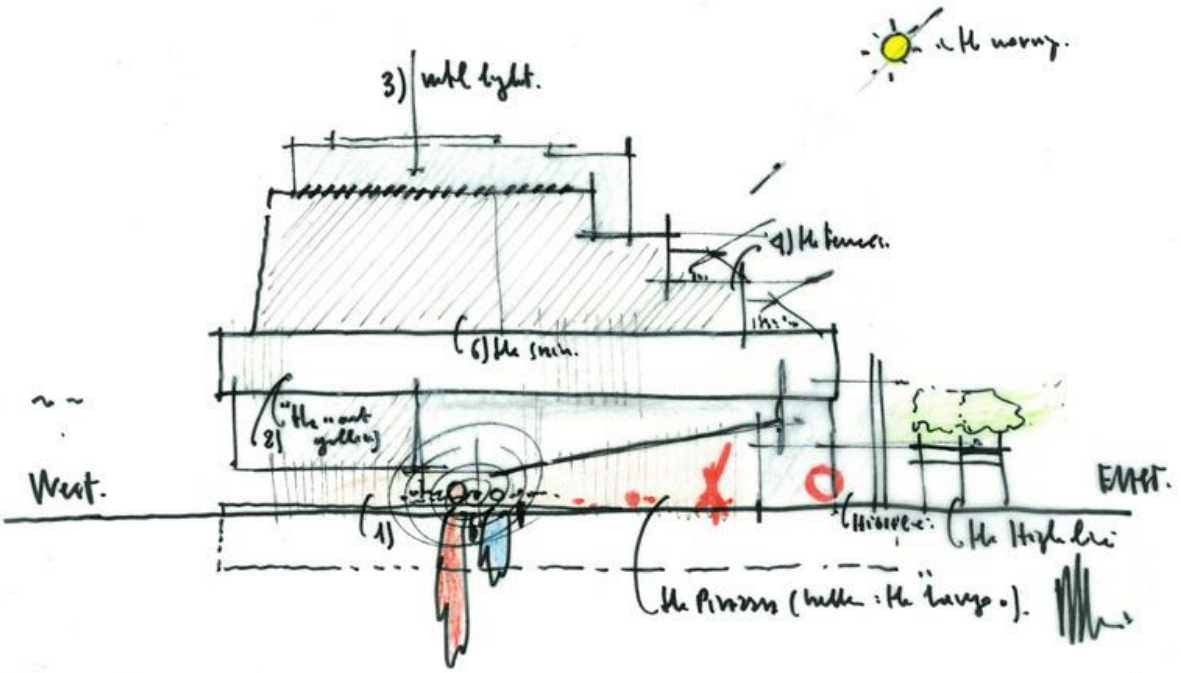
TECHNICAL REPORT 1

The Metro Museum of American Art



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This Technical Report will provide an overview of the construction of the Metro Museum of American Art construction project. Included will be an analysis of schedule, building systems, project cost, site logistics, local conditions, and the project delivery system.

Executive Summary

This following technical report details the Metro Museum of American Art (MMAA) new construction building and the construction techniques employed to build it. The project's exact location is to be held confidential however it can be known that the MMAA will be built in a major US city. This report analyzes the project schedule, building systems, cost, site logistics, local conditions, and the project delivery system. This page will describe the key findings of the report.

The owner, Whitney Museum of American Art, is expanding to a new downtown location and is building this state of the art facility to house their ever expanding collection. It will include 50,000 square feet of traditional indoor gallery space along with 13,000 square feet of outdoor gallery space. Also included in the program is office space for the Metro Museum staff, an education center complete with classrooms and a film room, a restaurant, and a theatre which can hold up to 170 people. Some of the interesting features of the museum include the large cantilevered entrance that draws the public into the space, and the fact that the museum will have the largest column free gallery in the city.

After an analysis of the project cost information was complete, it was found that the construction and total project costs of the building were significantly higher than the square foot and assemblies estimates. This can be attributed to the fact that the MMAA uses high end finishes and systems throughout the building and it seems that no item would be considered cost prohibitive. Also, estimating references do not carry square foot estimate data for museums due to their high variability in price. The MMAA has a total project cost of approximately $1,200 per square foot. The most expensive building system was the curtainwall followed by the foundation & excavation, mechanical, and electrical systems. All of these systems were above the $20M mark. The curtainwall system is mainly constructed of a carbon steel rainscreen cladding system that ties into the structural steel frame. The excavation & foundation work was so costly because the site sits on poor subsurface soil and water conditions. A large portion of organic matter and unstable soil conditions made a deep foundation that ties into bedrock necessary. Also the cellar floor sits 20' below the water table so the foundation had to act as a bathtub that kept the water out inside of in; all of which drove up the cost of the building.

The project delivery method for the MMAA is Design-Bid-Build. Turner Construction Company was awarded the work due to their expertise and reputation and entered into a cost plus contract with an option for a Guaranteed Maximum Price (GMP) for the owner. This will give the owner the flexibility to adjust the project while still having a capped maximum price. The subcontractors are contracted directly with Turner with the approval of the Metro Museum ownership. The overall construction duration is from October, 2011 to November, 2014, or thirty seven months.

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PROJECT SUMMARY SCHEDULE

The project summary schedule (attached in Appendix A) provides an overview of the major design, preconstruction, and construction activities that are required to construct the Metro Museum of American Art (MMAA). This schedule is limited to the major activities and milestones of the project so that the general project duration, scope and magnitude can be understood. The overall construction duration is from October, 2011 to November, 2014, or thirty seven months. This timeframe is from the start of construction with the installation of caissons/piles to the completion of punch list items and the issuance of the temporary certificate of occupancy.

Foundation

As you can see from Figure 1 the MMAA is located very close to the cities river. Due to this and the fact that the cellar floor is twenty feet below the water table; the foundation will need to act as a large concrete bathtub that keeps the water out instead of in. The first scheduled activity for the foundation is the drilling of the caissons/piles. After this the general excavation can begin. The access for equipment and trucks to the site/ramp is located at the southwest corner of the site. Due to this the excavation, soil retention, and foundation work will begin on the east side of the site and work its way west until excavation & foundation are fully complete. Also, the entire excavation/foundation schedule is divided into two main sections; the west side and the east side. Then these main sections are broken down into sub-sections such as the north, and the south/east sub-sections for the east side. This is done because the construction techniques for the excavation, soil retention and ultimately foundation construction are slightly different depending on the section of the site plan. For example, on the west side the north/south sub-section receives shotcrete, whalers, and cross lot bracing for its soil retention. Meanwhile the west subsection receives tiebacks and shotcrete to retain the soil.

Figure 1: View of the site from above. Courtesy of google.com.

Once this is complete the construction of the foundation can begin. This process will also progress from the east to the west side of the site. The foundation consists of a 2.5’ cast in place foundation wall that ties into a hydrostatic pressure concrete slab that is being supported by caissons/piles. There is also a 5” concrete wearing slab above a 19” gravel drainage layer that acts as the finish slab on grade for the cellar level.

Structural

The schedule for the structural steel is fairly straightforward. Once the excavation and foundation work is nearing completion the structural steel team will mobilize and start erecting the cranes that will be needed for the steel erection process. The crawler crane will be erected first, followed by the tower crane. From there the steel erection will start on the first floor. There is no special phasing for the steel erection; each floor's framing will be erected in its entirety before the erectors move up to the next building level.

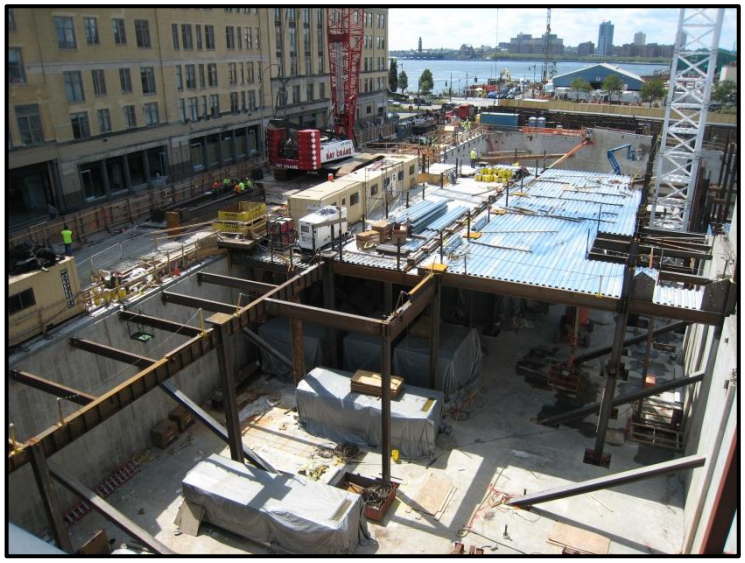


Figure 2: Photo of steel erection underway looking southwest. Photo taken by Vincent Rossi.

Once a floor is erected completely the raising gang can the move on to the next level and repeat until the steel is topped out. After the raising gang has moved on to the next level the steel detailing can begin. This includes tightening and plumbing the structure as well as laying the metal deck. After this process is complete each subsequent floor can be turned over to be prepped for the concrete placement. Figure 2 shows the steel erection underway on August 13th, 2012 with the erection of the first floor columns and framing. See Table 1 for some of the typical durations for the steel erection process.

Table 1: Typical Steel Erection Durations.

TYPICAL STEEL ERECTION DURATIONS	
Description	**Days**
Average Erection Duration per Floor	11
Average Detailing Duration per Floor	22
Total Duration of Steel Erection / Detailing	129

Interior Finishes

This section will focus on the sequencing for the interior fit out for the gallery spaces throughout the MMAA.

The interior fit out sequence for the gallery spaces starts on the first floor and works upwards as floors are being constructed and prepped for fit out. There are a total of five floors that include gallery spaces; these are the first, fifth, sixth, seventh, and eighth floors. The fit out process begins with the installation of hangers into the above floor structure. Then the schedule progresses as follows:

- Cure the spray on fireproofing for 28 days.
- Paint the metal deck and spray on fireproofing.
- Overhead MEP rough-in.
- Rough partitions / sheetrock partitions.

- Three coats of skim coat on the walls.
- Layout the ceiling structure and hang the drop rods / unistrut.
- Install the W5 steel sections & infill pieces for the ceiling system.
- Rough-in the lighting system.
- Install sprinkler heads.
- Install ceiling panels & trim.
- Layout, frame, and install sleepers and wood sub-floor. (Except for the first floor which skips this step because its finish floor is stone)
- Patch skim coat & paint.
- Install lights and MEP finish trim.
- Install finish wood flooring. (Install finish stone flooring on the first floor.)
- Punchlist.

BUILDING SYSTEMS SUMMARY

The MMAA is a new construction building located downtown in a major US city that will house the galleries for the MMAA. It will include 50,000 square feet of traditional indoor gallery space along with 13,000 square feet of outdoor gallery space. Also included in the program is office space for the Metro Museum staff, an education center complete with classrooms and a film room, a restaurant, and a theatre which can hold up to 170 people. Table 2 outlines the major building systems associated with the construction of the MMAA. Each of these building systems will be discussed in detail in the following pages.

Table 2: Building System Checklist

BUILDING SYSTEMS CHECKLIST		
Work Scope	**Yes**	**No**
Demolition Required		X
Structural Steel Frame	X	
Cast in Place Concrete	X	
Precast Concrete	X	
Mechanical System	X	
Electrical System	X	
Masonry	X	
Curtain Wall	X	
Support of Excavation	X	

Structural Steel Frame

The structural system for the MMAA consists of a concrete slab on composite metal deck that bears on structural steel framing. The structural engineer, Robert Silman Associates (RSA), considered many structural systems such as a flat plate concrete system, post-tensioned concrete structure, and the system that would ultimately be used. RSA determined that the steel frame with concrete on composite deck would be the most effective scheme because it is the lightest, most cost effective, and left the owner with most flexibility for future uses.

Figure 3: Photo of the crawler crane on site. Photo taken by Vincent Rossi.

The structural system uses multiple concentrically braced frames to resist the horizontal forces on the building. These braced frames are located throughout the building and consist of mainly W shaped steel members; however a few of the braced frames utilize HSS shapes as well. There is also one large truss/braced frame that runs along the entire south side of the building between the fifth and sixth floors. This location is adjacent to where the largest column

free gallery in the city is located.

The nine story building is framed with mainly with W shaped structural steel members that are connected with a mix of shear and moment connections. There is also horizontal bracing consisting of HSS and L shaped members within the floor framing where needed. The columns are almost all W12 or W14s with the exception of a few custom made pipe and bar columns.

Figure 4: View of the tower crane on site. Photo taken by Vincent Rossi.

There are two cranes on site during the steel erection. First there is a Liebherr LR 1200 crawler crane, shown in Figure 3, located on the south central perimeter location of the site. Also there is a Favelle Favco tower crane, shown in Figure 4, whose tower ascends through the grand staircase of the museum. The locations of the cranes can be better understood from looking at the site logistics plan located in Appendix E.

Cast in Place Concrete

Cast in place concrete was used throughout the Metro Museum. First off the foundation system is in effect a concrete bathtub because the cellar elevation is twenty feet below the water table. As shown in Figure 5, the foundation consists of a 2.5' cast in place foundation wall that ties into a hydrostatic pressure concrete slab that is being supported by caissons/piles. There is also a 5" concrete wearing slab above a 19" gravel drainage layer that acts as the finish slab on grade.

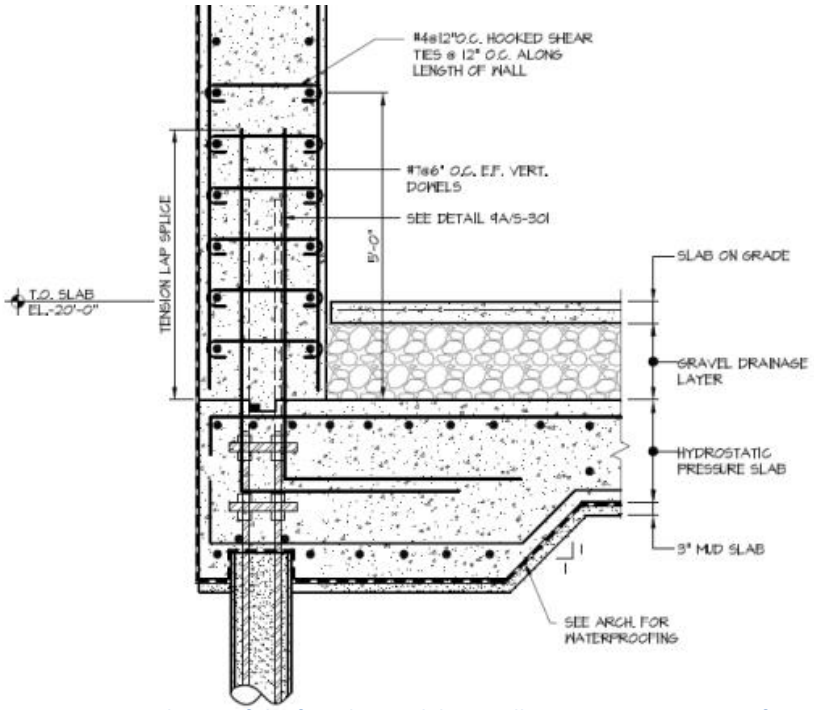


Figure 5: Sectional view of the foundation slab to wall connection. Courtesy of Renzo Piano Building Workshop.

As mentioned previously the floor systems are composed of concrete slab on deck (SOD). There are multiple different variations of this floor system including the following examples.

- First, a 3-1/4" light weight concrete slab on 3"-18 gage composite metal deck is used for all of the gallery spaces.
- Another SOD system consists of a 6" normal weight concrete slab on 3"-18 gage composite metal deck that is used as the floor of the third floor theatre.

The methodology for the concrete placement is that the concrete will be pumped into place and the metal decking will act as the horizontal formwork. Also, for the vertical formwork, the slabs will have either a pour stop or a 3/8" bent plate along the slabs perimeter.

Precast Concrete

Precast concrete is used as in interior and exterior wall type for the Metro Museum. As an interior wall type it is used throughout the core of the building up through level five and acts as part of a two hour firewall for the stairs and elevator shafts. Beyond this level partition walls are used to obtain the necessary two hour fire rating. This type of pre-cast concrete is divided into vertical planks that are one story tall and have various widths. They are fastened to the structural steel HHS members with embedded anchors and the joints are then sealed. These pre cast members are erected using the onsite crane and are scheduled to be erected as steel erection is still proceeding on the upper floors. Their erection will proceed only after the concrete SOD has been poured on the corresponding level and allowed to cure for seven days. One interesting note about the erection of these interior precast members is that the tower crane's tower passes directly through the shaft of the grand stairway. Because of this the precast planks that are scheduled to line the grand stairway need to wait to be installed until after the steel is topped out and the tower crane is deconstructed and removed from the site. After this, the crawler crane can then hoist the remaining interior precast panels into place.

Various sections of the exterior wall enclosure of the building are also pre-cast concrete panels. There are seventy panels on the north elevation, seventy four on the south elevation, forty two on the east elevation, and thirty two on the west elevation for a total of 218 exterior precast panels. These panels will also be hoisted into place using the onsite crane. Similar to the interior panels, the exterior panels will also be connected to the structural steel elements such as W & HSS shapes using an embedded anchor. An example of this type of connection can be seen on the next page in Figure 6.

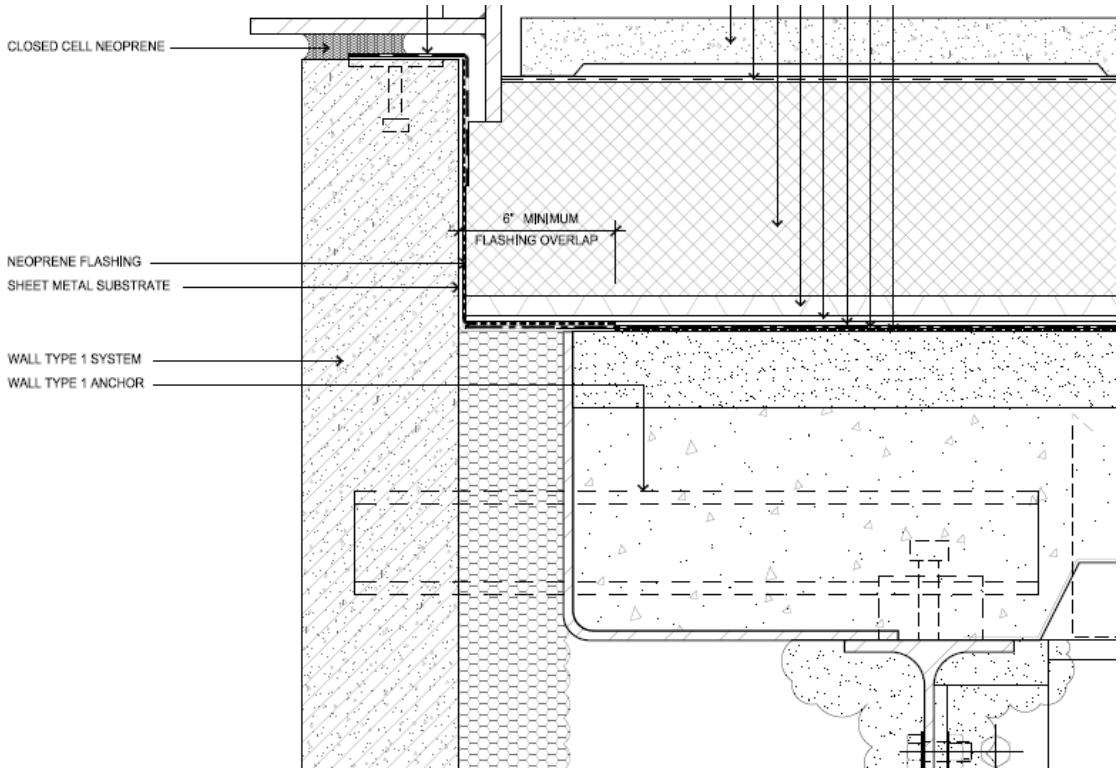


Figure 6: View of the support for the pre-cast panels. Courtesy of Renzo Piano Building Workshop.

Mechanical Systems

The mechanical makeup for the Metro Museum is complex and uses many different types of heating, ventilating, and air conditioning systems to make the building comfortable all year long. The air conditioning systems used for the galleries, office spaces, lobby, auditorium, and restaurant will be discussed here; including what feeds the hot and cold water coils of these systems.

The gallery and office spaces will be served by an all-air, variable air volume conditioning system. This system will consist of a total of four air conditioning units. Three of the four units are located in the cellar fan room and will each handle one third of the load for the gallery/office spaces that are located between the cellar and seventh floors. The fourth unit is located in the fan room on the ninth floor and will serve the eighth floor spaces. Supply air to, and return air from, each floor will be carried through multiple mechanical riser shafts throughout the building. The supply air that will be going to the gallery spaces will be controlled by VAV units that are located adjacent to the air condition systems in the cellar or ninth floor fan rooms. Once the air is transferred to its destination it is delivered to and returned from the space by traditional diffusers and grilles in the office areas; or in the case of the galleries an open ceiling plenum is used for the return air. The lobby, auditorium, and restaurant are all conditioned by similar in nature, but independent air conditioning systems. These systems are factory-assembled packaged all-air constant volume systems that are also located in the cellar fan room.

The chilled water for these mechanical systems originates from three electrically driven centrifugal refrigeration machines that are sized at 300 tons-refrigeration each. These are all located in the cellar of the building and each have an individual pump that will distribute the chilled water to its end users throughout the building. The building heat originates from a hot water boiler plant also located in the cellar that includes five condensing three million BTUh hot water boilers. Pumps then circulate the hot water to the air conditioning systems or finned tube radiators.

The fire protection system for the Metro Museum is a full building sprinkler system. The network consists of three different types of sprinkler systems; preaction, dry, and wet. The preaction system is used in sensitive areas of the Museum such as server rooms where accidental discharge of the system is critical to avoid. The dry system uses an air buffer in the lines so that the pipes do not burst in cold temperatures; this makes it an ideal system for areas such as the truck bay. Finally, the wet system is a generic sprinkler used in all other areas that the dry and preaction sprinklers are not being used.

Electrical System

Two electrical service lines enter the building's electrical room at the south west side of the cellar level from the vault / bus compartment of the service provider. Each line connects to a separate service switchboard that has a rating of 4,000A, 3ø, 4W, 208Y/120V. The two service switchboards also run a bus to two identical distribution switchboards that have the same rating of the service switchboards. From these four switchboards all of the power is distributed throughout the building.

An interesting idea that the project team had for the electrical service was to get at least partial service from the permanent electrical equipment up and running as early as possible on the project. In order to do this the masons would be directed to complete the interior electrical room first and then it would be made watertight before any other part of the building. Once this is done then the electrical equipment could be installed in the electrical room and the buildings permanent power source could be energized and distributed earlier than usual.

Masonry

The scope of the masonry work for this project is very small in comparison to the overall project size. In fact the unit masonry accounts for only 0.6% of the overall construction cost. A large portion of the masonry work is the construction of an insulated CMU exterior wall on the north elevation of the project where it edges up against the existing highline maintenance building. The rest of the masonry work is the construction of various interior partition walls throughout the building.

Curtain Wall

There are a total of ten different types of exterior wall systems that make up the building enclosure for the Metro Museum. However, only a few of them define the majority of the building; so those are the ones that will be discussed in detail. The wall type that is by far the most common on the building is the metal panel rain screen cladding system. It consists of a

5/16” thick steel plate cladding system with stainless steel fasteners and hardware attached to custom extruded aluminum frames. Between these extruded aluminum frames is an aluminum liner sheet, galvanized steel sheet vapor barrier, and semi-rigid insulation. Anchor brackets connect the system to the structural frame of the building. The wall system is hoisted into place with the crane in two sections. First, the backup material for the metal panels is lifted into place. Then the metal panels themselves are lifted into place and the final connections are made. Figure 7 shows a horizontal section of this curtain wall.

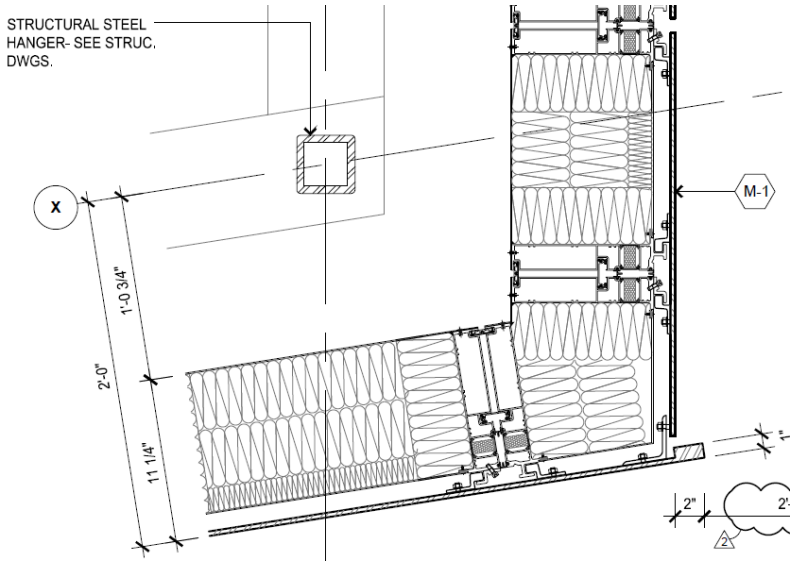


Figure 7: Horizontal section of the metal panel curtain wall. Courtesy of Renzo Piano Building Workshop.

Another curtain wall is the gallery storefront glazing system. It consists of a stick built system that has 3’4” wide insulated glass panels that are held vertically by extruded aluminum adapters and rest on custom mullions that are built-up steel tees. Once again, these are just two examples of the ten exterior wall types, but they are by far the most commonly found curtain walls on the building.

Excavation Support

As detailed before, the foundation for the MMAA is basically a concrete bathtub bearing on caissons/piles. Also, due to the downtown site location the excavation has to go vertically into the ground with no setbacks. There are a few different types of excavation support used for the construction of the MMAA foundations, including cross lot bracing, shotcrete and tiebacks, and soldier piles and walers.

As excavation progressed, the north and south sub sections of the west side received shotcrete treatment in order to retain the soil. Also, walers were used between the H piles to form a wall that would effectively retain the soil until the foundation walls were formed and poured. On the west sub section of the west side shotcrete was also used to initially resist the soil. Then tiebacks were installed in multiple tiers in order to retain the earth. The east side of the site also uses a mixture of shotcrete, tiebacks, and walers as excavation support.

Throughout the entire site cross lot bracing was installed as an earth retention system. It was generally installed in the north to south direction across the whole site. An example of the cross lot bracing can be seen in Figure 8. As you can see this photo was taken after the foundation walls have been poured and the start of the structural steel erection. However, the cross lot bracing is still in place.

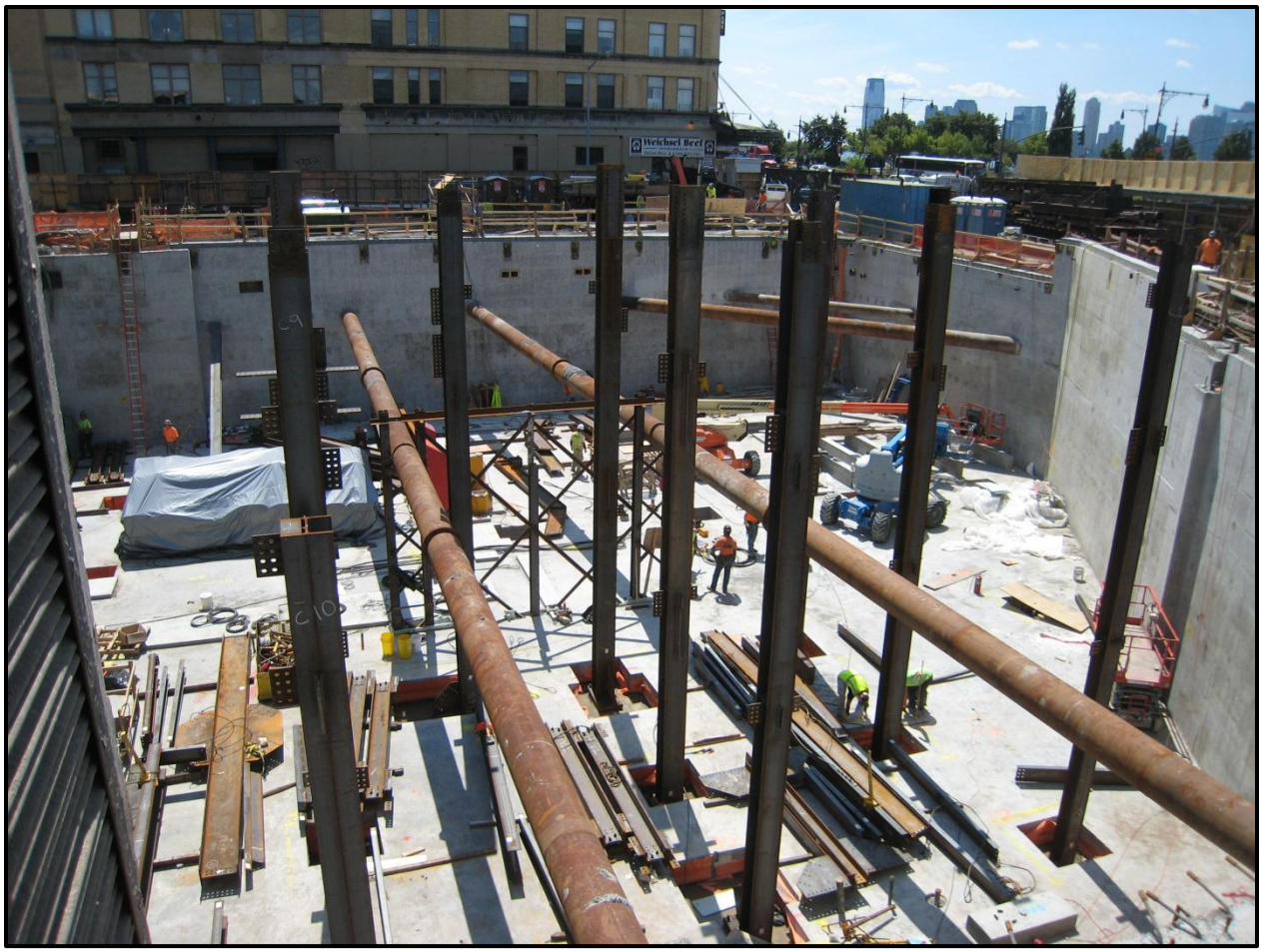


Figure 8: Photo of cross lot bracing located on the west side of the site looking south. Photo taken by Vincent Rossi

PROJECT COST EVALUATION

In order to fully comprehend the costs associated with the Metro Museum of American Art, it was important to review the cost data for the project and to prepare some preliminary estimates. This includes reviewing the building cost data and the specific building systems cost data and comparing these values to a square foot estimate for the building and assemblies estimates for the mechanical and electrical systems.

Building Cost Data

Here, the buildings cost is displayed in two forms; as the construction cost and as the total project cost. The construction cost is the costs associated with the physical construction of the building. This cost leaves out land costs, site work, permitting, general conditions, and fees. The total project cost is the cost associated with the delivery of the entire building. This cost data does include all of the aforementioned exclusions. This cost data can be seen in Table 3 below. As you can see from these tables the cost for this museum is very high per square foot, around $1,200. This is due to the high end finishes, its unique design, and other factors which will be addressed in the coming sections.

Table 3: Building Cost Data

BUILDING COST DATA		
Description	**Cost ($)**	**Cost ($/SF)**
Construction Cost	$213,690,741	$958.46
Total Project Cost	$266,345,323	$1,194.63

Next, some of the main building system costs are highlighted. This can be seen in Table 4. The table breaks the cost down into total cost, cost per square foot, and percent of total building cost. As you can see the curtainwall system on the building is the highest priced system on the building. As described before, the curtainwall system is mainly constructed of a carbon steel rainscreen cladding system. This unique building material really drove up the cost of this building system.

Table 4: Building Systems Cost Data

BUILDING SYSTEMS COST DATA			
Building System	**Cost ($)**	**Cost ($/SF)**	**% Of Total**
Excavation & Foundation	26,559,609	119.13	10.0
Structural Steel	21,209,500	95.13	8.0
Superstructure Concrete	5,300,831	23,78	2.0
Drywall/Carpentry/Ceilings	17,723,026	79.49	6.7
Curtainwall	30,637,767	137.42	11.5
HVAC Work	24,432,743	109.59	9.2
Electrical Work	24,845,611	111.44	9.3

Square Foot & Assemblies Estimate

Next a square foot estimate was prepared for the building using costworks, which can be seen in Appendix B. When preforming a square foot estimate one of the main selections is determining the building type. However, estimating references do not carry square foot estimate data for museums due to their high variability in price. My building is a perfect example of this because its unique construction and high end finishes makes its cost per square foot extremely high. The cost range for museums could range anywhere from $150/SF to no defined upper limit. Because of this I decided to approach the square foot estimate as a hybrid of multiple types of buildings and simply combined multiple estimates into one overall square foot cost estimate. For example the MMAA has an auditorium, restaurant, office space, educational facilities, and gallery space in its program. So I will use a 9 story office building estimate to cover the main structure of the building and the office space. Then I will add separate estimates for the auditorium, restaurant, and educational facilities. This will give me my final rough square foot estimate for the building. The results of these estimates can be seen in Table 5.

Table 5: Square Foot Estimate Review

SQUARE FOOT ESTIMATE RESULTS	
Estimate	**Cost ($)**
Base 9 Story Office	$40,036,500
Restaurant	$759,000
Auditorium	$1,495,500
Education Center	$3,521,500
Total	**$45,812,500**

As you can see the square foot estimate is only a small fraction of the actual cost of the building. The main contributing factor to the low price is the fact that there was no reasonable way to account for the gallery space through costworks. The galleries in the MMAA are wide open spaces that are full of high end finishes. For example the sixth floor gallery is the largest column free gallery in the city. As you could imagine achieving this requires that the structural members to be sized much higher than what is usually considered economical steel design. Also, the buildings unique and over the top design greatly adds to the cost. For example, the architect decided that the gallery ceiling will consist of an elaborate design of W5 steel members and other shapes that hold up all of the lighting fixtures. Above this are the exposed structural steel beams that are over 40” deep. Each beam has multiple beam penetrations so that the ductwork lines can run perpendicular through the beams throughout the gallery space. This was done for aesthetic reasons alone and shows that there was not much in this building that would be cost prohibitive.

Also, as noted before the excavation and foundation work for this project is very complex due to the poor subsurface soil and water conditions. At $27M this price significantly drove up the cost of the building. If this building was placed on solid soil conditions this portion of the budget would be a fraction of what it is currently. Other items that significantly added to the cost of the

building include the carbon steel curtainwall system, the large cantilevered entrance, the high end finished throughout the building, and high story heights (approximately 18.8').

Table 6: Assembly Estimate Details

ASSEMBLY ESTIMATE RESULTS	
System	**Cost ($)**
Electrical	$17,092,083
HVAC	$16,599,860

The next step was to prepare an assemblies estimate also using costworks. The details of this estimate can be seen in Appendix C. As you can see from Table 6, the assembly estimate that I provided is significantly lower than the actual building estimate. This is due to multiple reasons. First, and most likely the main reason for the difference in price is human error and my inexperience with estimating a building this large. I have never estimated any building system anywhere near this large, let alone a complex mechanical system such as the one that the MMAA has. Also, as mentioned before the MMAA is made up of high end materials and components and these mechanical and electrical systems are no different.

EXISTING CONDITIONS SITE PLAN

The existing conditions site plan can be seen in Appendix D. Reference this drawing for a better understanding of the site and its description below.

Figure 9: View of the site from above. Courtesy of google.com.

The construction site for the Metro Museum of American art is located in the downtown area of a major US city. Access to the site can be difficult especially during rush hour traffic times. The MMAA site is one block wide east to west and approximately half a block wide north to south. As you can see from Figure 9, past the west side of the building is a main vehicular highway and just beyond is the city's river. Directly adjacent to the west side of the building is street "C", which is a small back road that eventually has access to the highway. Along the south side of the MMAA site is a 90' tall existing structure. Separating the MMAA and this structure is street "B" which is on

Figure 10: View of the highline walkway taken from across street from the southeast corner of the site. Photo taken by Vincent Rossi.

average 30’ wide from sidewalk to sidewalk. On the east side of the building enters the highline structure. Seen in Figures 10 & 11, the highline is an abandoned metro line that has been transformed into a pedestrian walkway / park. It is approximately 20’ off the ground and runs along the entire east side of the MMAA. Past the highline is street “A” and across the street are various shops and restaurants. At the north east corner of the site is a separate and ongoing construction project. This project is the construction of the highline maintenance building. Its finish height will be at the sixth floor of the MMAA, and this project will be completed before the MMAA. The north side of the building is lined with some of the old manufacturing district buildings and warehouses. These buildings are not very tall; the closets building adjacent to the MMAA is only 30’ high. Note that there is no parking listed on the site plan due to the fact that space is limited around the site and no worker parking is available directly at the site.

Figure 11: View of the southeast corner of the site and the termination of the highline walkway. Photo taken by Vincent Rossi.

SITE LAYOUT PLANNING

The site layout plans for the excavation, foundation, and superstructure phases can be seen in Appendix E. Reference these drawings for a better understanding of the site and its description below.

Excavation Phase

First, we will discuss the excavation phase and the site logistics associated with it. As mentioned before this is a very constricted site due to the fact that it is located downtown in a major US city. As you can see from the plan there will be three entrances to the site; one on each of the northwest, southwest, and southeast corners. The main entrance / exit for this phase will be the southwest entrance due to the fact that this exits onto street C which will take you directly to a red-light with the highway that runs just beyond the west side of the site. From there the excavated material can leave the city with relative ease. To facilitate the use of the southwest entrance a ramp will be constructed at this corner of the site that will provide access from the street level down to the excavation area.

Site fencing will be constructed along the entire south and west sides of the site as shown on the phasing plan. There is double fencing along the west side of the site to provide a 5' pedestrian walkway along that side of the building. Also, site fencing will be constructed on the east side of the site under the highline to restrict the site from the public. This can be seen in Figure 11, which is a photograph that was taken looking at the south east corner of the site and the highline structure. The north side of the site is enclosed by three elements. These include site safety fencing on the west end, an existing building at the center, and a separate construction project on the east end. This separate construction project is the construction of the highline maintenance building described in the previous section.

There is a 25' strip of multi-use construction area along the south and west perimeter of the site that can be used to place construction materials and equipment as necessary. During the excavation phase there is a dewatering system, guard booth, dumpsters, temporary toilet station, and storage area located on this construction area. This phasing plan is almost identical to the one that Turner used for their logistics plan. This setup for the excavation phase makes the most sense in terms of accessibility and workflow. As mentioned before the excavation work will mainly work from east to west and this is due to the nature of the sites existing conditions and the fact that the best egress out of the site is from the west side. The only items that I added to Turners logistics plan for this phase were the dumpsters and the temporary toilets. However these are flexible and could easily be moved to the south perimeter of the site if necessary.

Foundation Phase

The foundation phase is very similar to the excavation phase in terms of layout. None of the site fencing or entrances have been moved, and the 25' multi-use construction area remains present. Now, in this phase the ramp that was used during excavation has been removed from above and guardrails have been erected along the entire foundation perimeter. These are

necessary because there is a vertical drop of twenty two feet from the street level to the foundation floor.

The foundation phase will have two concrete pumping stations; one by the southeast entrance and one by the southwest entrance. This will allow the concrete trucks to have easy access to the site and allow them to be turned over efficiently. This is important because there is a lot of cast in place concrete going into this foundation. The foundation wall that wraps the entire perimeter of the building is 2.5' thick and there are also multiple pours that make up the foundation floor slab structure. Due to this the concrete work needs to move as efficiently as possible to stay on schedule.

Other items that were added to the site for this phase were two stair towers in the southeast and northwest corners of the site. These will provide access to the foundation floor for the workers who are forming and pouring the concrete structures. Also, the highline maintenance building will have started its superstructure by this time. Due to this, temporary safety netting will line the perimeter of the highline maintenance building in order to provide overhead protection for the Metro Museum workers on site and the pedestrian traffic on the highline itself.

Superstructure Phase

As we move on to the superstructure phase the site begins to become a lot more congested. During the superstructure phase many more trades will be on site which naturally increases the need for on-site trailers. The superstructure phasing plan shows four total trailers; two forty foot trailers and two seventy foot trailers. These will be placed on the interior side of the construction fencing throughout the site. It is worth noting that there is not a Turner trailer because they have obtained office space in a building nearby the site.

The main addition to the project site is the two cranes. The crawler crane arrived on site first and then helped erect the tower crane. As detailed earlier the tower crane is located through the shaft of the grand staircase. This central location on the site allows the crane's reach to be maximized and saves space around the already constricted site. As these cranes make their way on site and the building rises overhead protection must be provided for personnel safety as well as the protection of existing buildings. So, as you can see from the plan, overhead protection was built in the form of horizontal sheds or sheathing that will provide protection to any exposed public spaces.

Also during this phase a dual car hoist will be installed near the northwest entrance of the site. Access to both of these cars will be through a 12'x14' platform located on opposite sides of the hoist area. My superstructure site plan is very similar to the one that Turner used in their site logistics plan; however, I changed a few elements. The first thing that I changed was that I inserted a steel lay down area on the west side of the crawler crane. This area would allow for a delivery truck to back into the southwest entrance, deliver the steel and then proceed back out of the site. Also, I added dumpster locations inside the construction fencing near the steel lay down area. Organizing the site this way seems to maximize the available space on-site.

LOCAL CONDITIONS & CLIENT INFORMATION

This section will describe the local conditions associated with the project including typical construction methods in the region, parking availability, and subsurface soil and water conditions. Next the owner of the project and their expectations will be described.

Local Conditions

The MMAA is located in a major US city that has a vast history of building skyscrapers. Although the MMAA is not a skyscraper itself, topping out at approximately 170 feet, it still utilizes some of the same type of construction methods that skyscrapers do. It uses caissons/piles to bear directly on the bedrock below the surface. The superstructure consists of concrete slab on composite metal decking that bears on structural steel. This type of construction is very common in the area and is one of the preferred methods of construction.

One problem that naturally comes with being in a city is the lack of available parking. This is especially true at the MMAA where there is no on-site parking available for the workers. Even going to simply visit the site, it is difficult to find a parking spot within walking distance of the site. Therefore, the workers will have to find an alternate way to get to the site daily.

URS supplied the owners and project team with a full geotechnical report that detailed the subsurface soil and water conditions. An interesting finding of the report is that the shoreline of the city's river used to be just east of the site, so the entire site was underwater at this point. The groundwater was measured at the site to be approximately 6.5 to 12 feet below the surface. Also, the report found that the site has from nine to 30 feet of fill material below the surface. Underneath this fill is a layer of organic silt and clay that is thicker on the west side of the site and thins out moving east. The general thickness of this layer ranges from 36 feet to five feet. Below this is a four to ten foot layer of clayey sand followed by a layer of sand and glacial till. Finally, bedrock was encountered and varied in depth from 75 to 91 feet below the surface except for a section on the far east side of the site where the depth of bedrock dropped off to a range between 110 and 119 feet below the surface.

Due to the poor soil conditions under the site it was recommended that the foundation consist of caissons/piles that are socked into bedrock. Also, due to the high water table the foundation slab would have to be designed to resist the hydrostatic uplift forces. This is why the foundation slab is designed as a pressure slab that has the capacity to resist the tensile forces that this will create. A section of this foundation wall/slab can be seen on page seven in Figure 5.

Client Information

The Metro Museum of American Art is an art museum that displays works of art from the twentieth and twenty first centuries. Ever since its founding in the early 1900s, it has been expanding and growing its art collection as well as its following. Because of this they have decided to build a new facility in a downtown location. The MMAA will expand to this location which will provide ample gallery space for its collection, an education center, and many other amenities. This expansion will provide the MMAA the opportunity to grow and become part of

the community even more than it is already. One way that the museum will give back to the community is by having the 1st floor gallery open and free to the public at all times.

The owner expects this building to be of a very high quality. Its overall cost per square foot is approximately $1,200. Because of this, implementing a good quality control plan will be key element in providing owner satisfaction. Another important item is keeping on schedule so that the temporary certificates of occupancy can be issued on time. Approximately half of the building is to receive its temporary certificate of occupancy on September 8th of 2014, while the full building temporary certificate of occupancy is scheduled for November the 28th 2014. These items need to be completed successfully in order to have a satisfied owner.

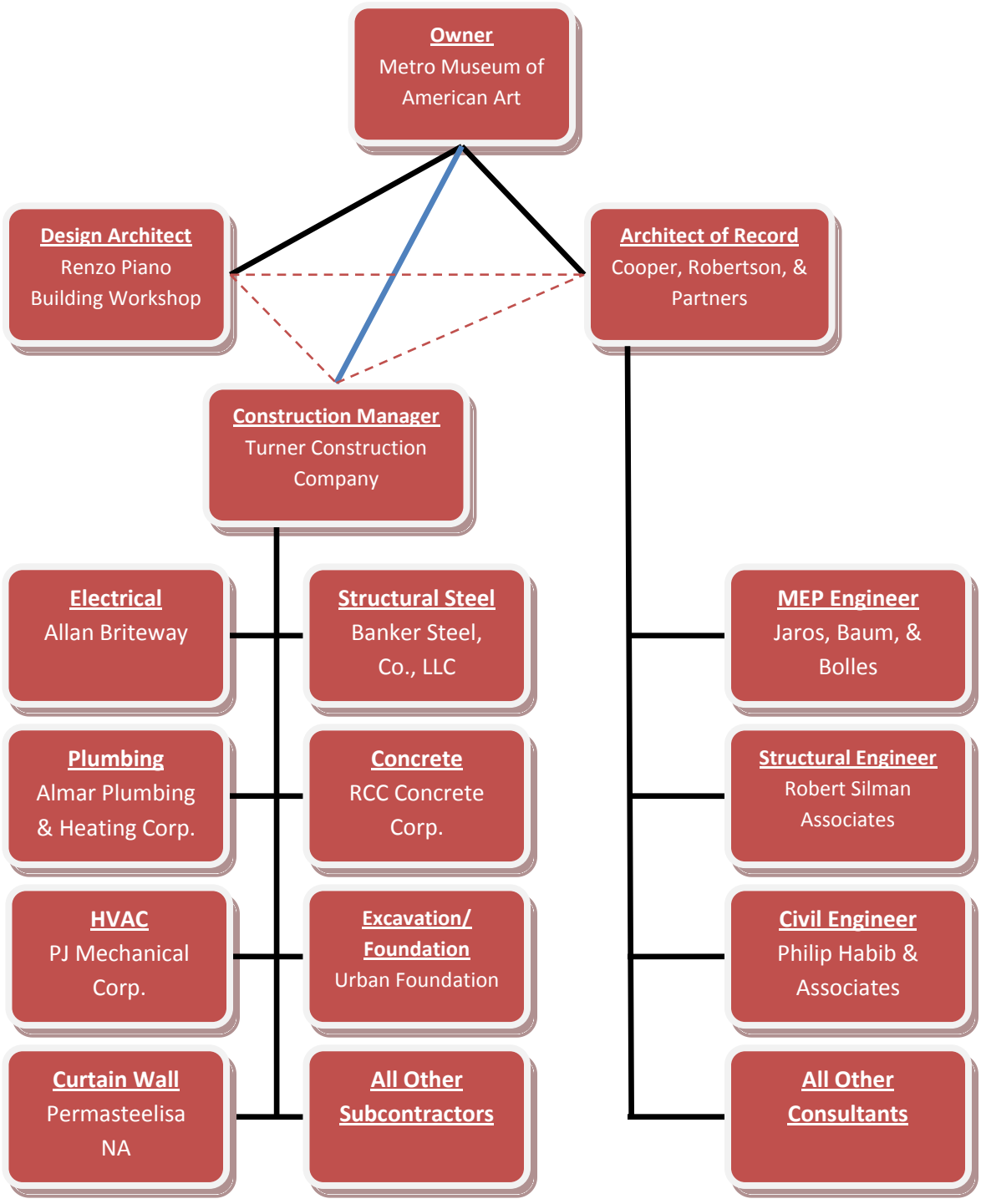
PROJECT DELIVERY SYSTEM

Turner Construction Company got awarded the work because of their high quality reputation and expertise. They are one of the premier contractors in the United States and are capable of successfully delivering large and complex projects like the Metro Museum of American Art. Before bidding, Turner provided some preconstruction services for the MMAA ownership. This included Turner's estimating department putting together design development estimate by obtaining proposals from subcontractors. This allowed the Metro Museum ownership to be confident that they had the proper financing in place for the job, and also gave Turner a leg up on the competition when bidding because they had already become familiar with the project conditions.

The project delivery method for the MMAA is Design-Bid-Build. As stated before, Turner Construction Company was awarded the work and entered into a cost plus contract with an option for a Guaranteed Maximum Price (GMP) for the owner. This will give the owner the flexibility to adjust the project while still having a capped maximum price. There are liquidated damages for completing the project late; however, those values are not public. Also, any bonus information for early completion and any savings sharing information are not public. Turner will bond all of the subcontractors through their subguard program. A subguard is used in lieu of traditional performance and payment bonds and covers all of the subcontractors on the project in one policy. In this policy if any of the subcontractors defaults the insurance company will step in and provide compensation. Turner also has a contractor controlled insurance policy (CCIP) which wraps the general contractor and all of the subcontractors under a single general liability / workers' compensation policy. Also, builders risk insurance is carried by the owner on this project.

On the next page is an organizational chart for the project that details all of the main parties involved and their relationships by contract type. As mentioned earlier Turner is contracted with the owner through a cost plus contract that has an option for a GMP. The subcontractors are contracted directly with Turner with the approval of the Metro Museum ownership. Each of the work packages are hard bid out to a minimum of three bidders with the scope being checked by Turners purchasing department to ensure that no scope coverage is missed. The contracts between the owner and the design architect and architect of record are listed as lump sum contracts. The contracts between the architect of record and the engineering consultants are also listed as lump sum contracts. Finally, there are lines of communication shown between all of the main design and building parties.

Project Organization Chart

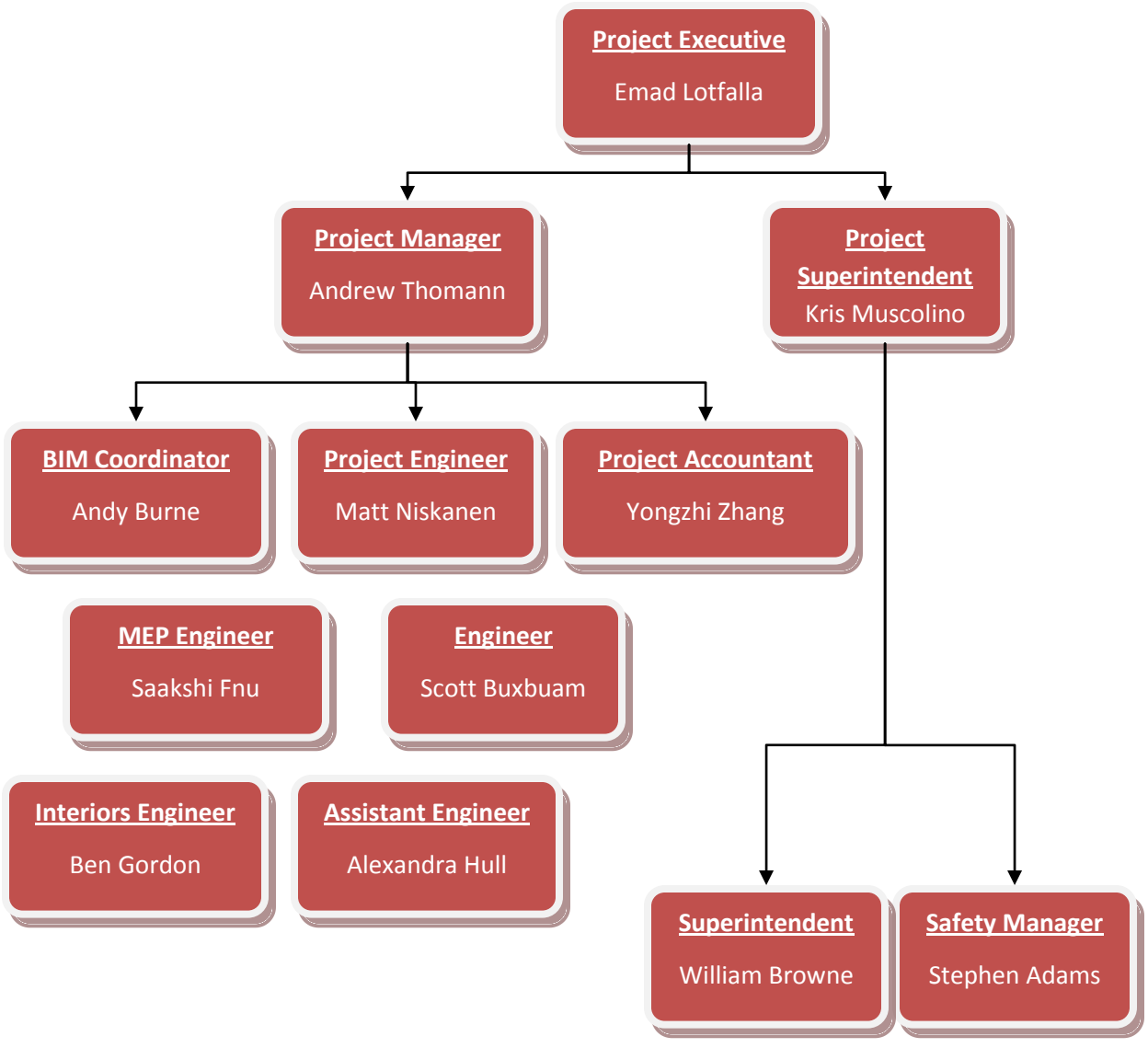


Legend

- Lump Sum Contract
- Cost Plus Contract with GMP Option
- Communication

STAFFING PLAN

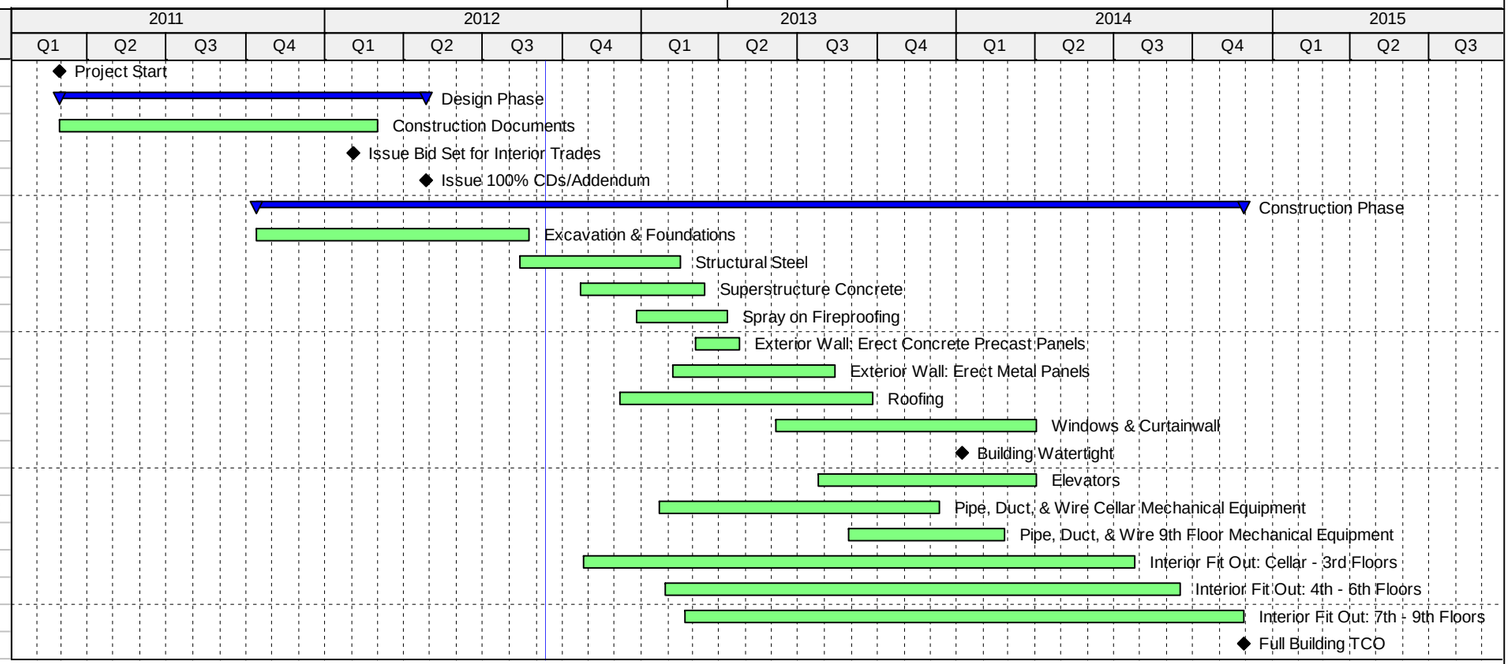
The project staff is located a block north of the construction site. Here, they have established their office for the duration of the project. A project staffing plan can be seen below that was created using the project directory. Everybody in this staffing plan works out of the field office except for the project executive. The number of superintendents on site could be more than what is shown depending on the amount of work being done on site. Also, Turner has BIM capable team on site that is led by Andy Burne. Different individuals of the team will focus their efforts on one building system. For example, Ben Gordon is working on coordinating the interior work of the building especially the gallery spaces. This will allow the team to understand the entire building more intimately.



APPENDIX A

PROJECT SUMMARY SCHEDULE

Activity ID	Activity Name	Original Duration	Start	Finish
001	Project Start	0	28-Feb-11	
1000	Design Phase	299	28-Feb-11	27-Apr-12
1010	Construction Documents	259	28-Feb-11	02-Mar-12
1020	Issue Bid Set for Interior Trades	0		03-Feb-12
1030	Issue 100% CDs/Addendum	0		27-Apr-12
5000	Construction Phase	803	13-Oct-11	28-Nov-14
5010	Excavation & Foundations	222	13-Oct-11	24-Aug-12
5020	Structural Steel	129	14-Aug-12	14-Feb-13
5030	Superstructure Concrete	101	22-Oct-12	14-Mar-13
5040	Spray on Fireproofing	74	27-Dec-12	10-Apr-13
5050	Exterior Wall: Erect Concrete Precast Panels	38	04-Mar-13	24-Apr-13
5060	Exterior Wall: Erect Metal Panels	132	06-Feb-13	12-Aug-13
5070	Roofing	205	07-Dec-12	26-Sep-13
5080	Windows & Curtainwall	211	06-Jun-13	02-Apr-14
5085	Building Watertight	0		07-Jan-14
5090	Elevators	178	25-Jul-13	03-Apr-14
5100	Pipe, Duct, & Wire Cellar Mechanical Equipment	229	22-Jan-13	12-Dec-13
5110	Pipe, Duct, & Wire 9th Floor Mechanical Equipme	126	29-Aug-13	25-Feb-14
5120	Interior Fit Out: Cellar - 3rd Floors	449	25-Oct-12	25-Jul-14
5130	Interior Fit Out: 4th - 6th Floors	421	29-Jan-13	16-Sep-14
5140	Interior Fit Out: 7th - 9th Floors	457	21-Feb-13	28-Nov-14
5150	Full Building TCO	0		28-Nov-14



(New Bar) Actual Work Critical Remaining Work
Actual Level of Effort Remaining Work Milestone

TASK filter: All Activities

APPENDIX B

COSTWORKS SQUARE FOOT ESTIMATE DETAILS

Square Foot Cost Estimate Report

Estimate Name:	**MMAA SF**

Building Type:	**Office, 5-10 Story with Precast Concrete Panel / Steel Frame**
Location:	National Average
Stories Count (L.F.):	**9.00**
Stories Height	**18.33**
Floor Area (S.F.):	**222,952.00**
LaborType	**Union**
Basement Included:	Yes
Data Release:	**Year 2012 Quarter 3**
Cost Per Square Foot	**$179.57**
Total Building Cost	**$40,036,500**

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly

Parameters are not within the ranges recommended

		% of Total	Cost Per SF	Cost
A Substructure		**3.1%**	**4.37**	**$974,500**
A1010	**Standard Foundations**		**2.46**	**$549,000**
	Strip footing, concrete, reinforced, load 14.8 KLF, soil bearing capacity 6 KSF, 12" deep x 32" wide			
	Spread footings, 3000 PSI concrete, load 500K, soil bearing capacity 6 KSF, 9' - 6" square x 30" deep			
A1030	**Slab on Grade**		**0.57**	**$126,500**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.39**	**$86,000**
	Excavate and fill, 10,000 SF, 8' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**0.96**	**$213,000**
	Foundation wall, CIP, 12' wall height, pumped, .52 CY/LF, 24.29 PLF, 14" thick			
B Shell		**37.5%**	**52.91**	**$11,795,500**
B1010	**Floor Construction**		**23.53**	**$5,245,500**
	Cast-in-place concrete column, 20" square, tied, 500K load, 12' story height, 394 lbs/LF, 4000PSI			
	Steel column, W5, 25 K, 16' unsupported length, 16 PLF			
	Steel column, W8, 125 KIPS, 16' unsupported height, 40 PLF			
	Steel column, W10, 150 KIPS, 16' unsupported height, 45 PLF			
	Steel column, W12, 300 KIPS, 16' unsupported height, 72 PLF			
	Steel column, W12, 400 KIPS, 16' unsupported height, 87 PLF			
	Steel column, TS14, 500 KIPS, 16' unsupported height, 109 PLF			
	Flat slab, concrete, with drop panels, 6" slab/2.5" panel, 12" column, 15'x15' bay, 75 PSF superimposed load, 153 P			
	Floor, composite metal deck, shear connectors, 5.5" slab, 20'x25' bay, 21.5" total depth, 75 PSF superimposed load,			
	Fireproofing, sprayed fiber, 1.5" thick, 8" steel column, 2 hour rating, 6.3 PLF			
	Fireproofing, sprayed fiber, 1.5" thick, 10" steel column, 2 hour rating, 7.9 PLF			
	Fireproofing, sprayed fiber, 1.5" thick, 14" steel column, 2 hour rating,10.8 PLF			
B1020	**Roof Construction**		**0.74**	**$165,000**
	Floor, steel joists, beams, 1.5" 22 ga metal deck, on columns, 20'x25' bay, 20" deep, 40 PSF superimposed load, 60			
B2010	**Exterior Walls**		**23.11**	**$5,151,500**
	Exterior wall, precast concrete, ribbed, 6" thick, 20' x 10', aggregate finish, 2" rigid insulation, high rise			

		% of Total	Cost Per SF	Cost
B2020	**Exterior Windows**		**4.67**	**$1,040,500**
	Windows, aluminum, sliding, insulated glass, 5' x 3'			
B2030	**Exterior Doors**		**0.26**	**$57,500**
	Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x 10'-0" opening			
	Door, steel 18 gauge, hollow metal, 1 door with frame, no label, 3'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**0.61**	**$135,500**
	Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			
C Interiors		**18.6%**	**26.25**	**$5,853,000**
C1010	**Partitions**		**3.49**	**$778,500**
	Metal partition, 5/8" water resistant gypsum board face, no base layer, 3-5/8" @ 24" OC framing ,same opposite face			
	1/2" fire ratedgypsum board, taped & finished, painted on metal furring			
C1020	**Interior Doors**		**2.98**	**$665,500**
	Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8"			
C1030	**Fittings**		**0.69**	**$154,500**
	Toilet partitions, cubicles, ceiling hung, plastic laminate			
C2010	**Stair Construction**		**2.91**	**$649,000**
	Stairs, steel, cement filled metal pan & picket rail, 16 risers, with landing			
C3010	**Wall Finishes**		**0.99**	**$221,000**
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Vinyl wall covering, fabric back, medium weight			
C3020	**Floor Finishes**		**8.32**	**$1,855,000**
	Carpet, tufted, nylon, roll goods, 12' wide, 36 oz			
	Carpet, padding, add to above, minimum			
	Vinyl, composition tile, maximum			
	Tile, ceramic natural clay			
C3030	**Ceiling Finishes**		**6.86**	**$1,529,500**
	Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support			
D Services		**40.8%**	**57.65**	**$12,852,500**
D1010	**Elevators and Lifts**		**15.53**	**$3,461,500**
	Traction, geared passenger, 3500 lb, 8 floors, 12' story height, 2 car group, 200 FPM			
D2010	**Plumbing Fixtures**		**2.61**	**$582,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, wall hung			
	Lavatory w/trim, vanity top, PE on CI, 20" x 18"			
	Service sink w/trim, PE on CI,wall hung w/rim guard, 24" x 20"			
	Water cooler, electric, wall hung, 8.2 GPH			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**0.54**	**$120,000**
	Gas fired water heater, commercial, 100< F rise, 200 MBH input, 192 GPH			
D2040	**Rain Water Drainage**		**0.28**	**$61,500**
	Roof drain, CI, soil,single hub, 5" diam, 10' high			
	Roof drain, CI, soil,single hub, 5" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**16.75**	**$3,734,500**
	Rooftop, multizone, air conditioner, offices, 25,000 SF, 79.16 ton			
D4010	**Sprinklers**		**3.02**	**$673,500**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF			

		% of Total	Cost Per SF	Cost
	Standard High Rise Accessory Package 8 story			
D4020	**Standpipes**		**0.79**	**$175,500**
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor			
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, additional floors			
	Fire pump, electric, with controller, 5" pump, 100 HP, 1000 GPM			
	Fire pump, electric, for jockey pump system, add			
D5010	**Electrical Service/Distribution**		**0.68**	**$152,500**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 1600 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 60 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 200 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 1600 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 1600 A			
D5020	**Lighting and Branch Wiring**		**11.84**	**$2,640,500**
	Receptacles incl plate, box, conduit, wire, 16.5 per 1000 SF, 2.0 W per SF, with transformer			
	Miscellaneous power, 1.2 watts			
	Central air conditioning power, 4 watts			
	Motor installation, three phase, 460 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP			
	Motor connections, three phase, 200/230/460/575 V, up to 5 HP			
	Motor connections, three phase, 200/230/460/575 V, up to 100 HP			
	Fluorescent fixtures recess mounted in ceiling, 1.6 watt per SF, 40 FC, 10 fixtures @32watt per 1000 SF			
D5030	**Communications and Security**		**4.47**	**$997,500**
	Telephone wiring for offices & laboratories, 8 jacks/MSF			
	Communication and alarm systems, fire detection, addressable, 100 detectors, includes outlets, boxes, conduit and			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		**1.14**	**$253,500**
	Generator sets, w/battery, charger, muffler and transfer switch, diesel engine with fuel tank, 100 kW			
	Uninterruptible power supply with standard battery pack, 15 kVA/12.75 kW			
E Equipment & Furnishings		**0.0%**	**0.00**	**$0**
E1090	**Other Equipment**		**0.00**	**$0**
F Special Construction		**0.0%**	**0.00**	**$0**
G Building Sitework		**0.0%**	**0.00**	**$0**
Sub Total		**100%**	**$141.18**	**$31,475,500**
Contractor's Overhead & Profit		**20.0%**	**$28.23**	**$6,295,000**
Architectural Fees		**6.0%**	**$10.16**	**$2,266,000**
User Fees		**0.0%**	**$0.00**	**$0**
Total Building Cost			**$179.57**	**$40,036,500**

Square Foot Cost Estimate Report

Estimate Name: **MMAA SFrest**

Building Type:	**Restaurant with Stucco on Concrete Block / Steel Joists**
Location:	National Average
Stories Count (L.F.):	**1.00**
Stories Height	**18.88**
Floor Area (S.F.):	**3,500.00**
LaborType	**Union**
Basement Included:	No
Data Release:	**Year 2012 Quarter 3**
Cost Per Square Foot	**$216.86**
Total Building Cost	**$759,000**

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly

Parameters are not within the ranges recommended

		% of Total	Cost Per SF	Cost
A Substructure		**8.2%**	**14.00**	**$49,000**
A1010	**Standard Foundations**		**2.86**	**$10,000**
	Strip footing, concrete, reinforced, load 11.1 KLF, soil bearing capacity 6 KSF, 12" deep x 24" wide			
	spread footings, 3000 PSI concrete, load 25K, soil bearing capacity 3 KSF, 3' - 0" square x 12" deep			
A1030	**Slab on Grade**		**5.14**	**$18,000**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.57**	**$2,000**
	Excavate and fill, 4000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**5.43**	**$19,000**
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B Shell		**26.4%**	**45.00**	**$157,500**
B1020	**Roof Construction**		**4.71**	**$16,500**
	Roof, steel joists, 1.5" 22 ga metal deck, on bearing walls, 35' bay, 25.5" deep, 40 PSF superimposed load, 60 PSF t			
B2010	**Exterior Walls**		**16.43**	**$57,500**
	Stucco, 3 coat, self furring metal lath 3.4 Lb/SY, on regular CMU, 12" x 8" x 16"			
B2020	**Exterior Windows**		**16.43**	**$57,500**
	Aluminum flush tube frame, for 1/4"glass,1-3/4"x4", 5'x6' opening, no intermediate horizontals			
	Glazing panel, plate glass, 1/4" thick, tempered			
B2030	**Exterior Doors**		**5.14**	**$18,000**
	Door, aluminum & glass, without transom, full vision, double door, hardware, 6'-0" x 7'-0" opening			
	Door, aluminum & glass, with transom, non-standard, double door, hardware, 6'-0" x 10'-0" opening			
	Door, steel 18 gauge, hollow metal, 1 door with frame, no label, 3'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**2.14**	**$7,500**
	Insulation, rigid, roof deck, fiberglass, 3'x4' or 4'x8' sheets, 15/16" thick, R3.70			
	Gutters, box, aluminum, .027" thick, 5", enameled finish			
	Downspout, aluminum, rectangular, 2" x 3", embossed mill finish, .020" thick			
B3020	**Roof Openings**		**0.14**	**$500**
	Skylight, plastic domes, insulated curbs, nominal size to 10 SF, double glazing			

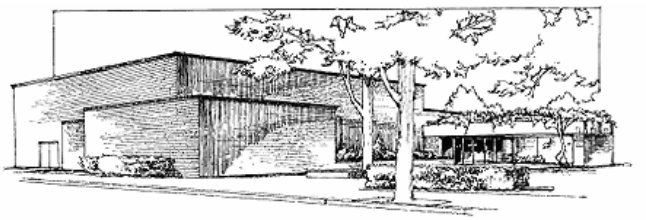
		% of Total	Cost Per SF	Cost
C Interiors		**14.8%**	**25.29**	**$88,500**
C1010	**Partitions**		**5.57**	**$19,500**
	Wood partition, 5/8"fire rated gypsum board face, none base,2 x 4,@ 16" OC framing,same opposite face, 0 insul			
	5/8" gypsum board, taped & finished, painted on metal furring			
C1020	**Interior Doors**		**2.00**	**$7,000**
	Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, hollow core			
C1030	**Fittings**		**0.71**	**$2,500**
	Toilet partitions, cubicles, ceiling hung, plastic laminate			
C3010	**Wall Finishes**		**1.86**	**$6,500**
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**8.29**	**$29,000**
	Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz			
	Tile, quarry tile, mud set, minimum			
	Tile, quarry tile, mud set, maximum			
C3030	**Ceiling Finishes**		**6.86**	**$24,000**
	Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support			
D Services		**50.5%**	**86.14**	**$301,500**
D2010	**Plumbing Fixtures**		**11.14**	**$39,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, wall hung			
	Lavatory w/trim, vanity top, PE on CI, 20" x 18"			
	Kitchen sink w/trim, countertop, stainless steel, 44" x 22" triple bowl			
	Service sink w/trim, PE on CI,wall hung w/rim guard, 24" x 20"			
	Shower, stall, baked enamel, terrazzo receptor, 36" square			
	Water cooler, electric, wall hung, dual height, 14.3 GPH			
D2020	**Domestic Water Distribution**		**7.86**	**$27,500**
	Gas fired water heater, commercial, 100< F rise, 500 MBH input, 480 GPH			
D2040	**Rain Water Drainage**		**1.71**	**$6,000**
	Roof drain, CI, soil,single hub, 3" diam, 10' high			
	Roof drain, CI, soil,single hub, 3" diam, for each additional foot add			
	Roof drain, CI, soil,single hub, 4" diam, 10' high			
	Roof drain, CI, soil,single hub, 4" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**35.29**	**$123,500**
	Rooftop, multizone, air conditioner, restaurants, 3,000 SF, 15.00 ton			
	Commercial kitchen exhaust/make-up air system, rooftop, gas, 2000 CFM			
D4010	**Sprinklers**		**8.29**	**$29,000**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 2000 SF			
	Wet pipe sprinkler systems, steel, ordinary hazard, 1 floor, 1000 SF			
D4020	**Standpipes**		**1.86**	**$6,500**
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor			
D5010	**Electrical Service/Distribution**		**6.43**	**$22,500**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 400 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 400 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 400 A			
D5020	**Lighting and Branch Wiring**		**9.71**	**$34,000**
	Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 watts per SF			
	Miscellaneous power, 1.8 watts			
	Central air conditioning power, 6 watts			
	Fluorescent fixtures recess mounted in ceiling, 1.6 watt per SF, 40 FC, 10 fixtures @32watt per 1000 SF			

		% of Total	Cost Per SF	Cost
D5030	**Communications and Security**		**3.43**	**$12,000**
	Communication and alarm systems, fire detection, addressable, 12 detectors, includes outlets, boxes, conduit and w			
	Fire alarm command center, addressable without voice, excl. wire & conduit			
D5090	**Other Electrical Systems**		**0.43**	**$1,500**
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 1			
E Equipment & Furnishings		**0.0%**	**0.00**	**$0**
E1090	**Other Equipment**		**0.00**	**$0**
F Special Construction		**0.0%**	**0.00**	**$0**
G Building Sitework		**0.0%**	**0.00**	**$0**
Sub Total		**100%**	**$170.43**	**$596,500**
Contractor's Overhead & Profit		**20.0%**	**$34.14**	**$119,500**
Architectural Fees		**6.0%**	**$12.29**	**$43,000**
User Fees		**0.0%**	**$0.00**	**$0**
Total Building Cost			**$216.86**	**$759,000**

Square Foot Cost Estimate Report

Estimate Name: **MMAA Saudi**

Building Type:	**Auditorium with Precast Concrete / Steel Frame**
Location:	National Average
Stories Count (L.F.):	**1.00**
Stories Height	**36.00**
Floor Area (S.F.):	**3,200.00**
LaborType	**Union**
Basement Included:	No
Data Release:	**Year 2012 Quarter 3**
Cost Per Square Foot	**$467.35**
Total Building Cost	**$1,495,500**



Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly

Parameters are not within the ranges recommended

		% of Total	Cost Per SF	Cost
A Substructure		**6.7%**	**24.69**	**$79,000**
A1010	**Standard Foundations**		**6.25**	**$20,000**
	Strip footing, concrete, reinforced, load 6.8 KLF, soil bearing capacity 3 KSF, 12" deep x 32" wide			
	spread footings, 3000 PSI concrete, load 50K, soil bearing capacity 6 KSF, 3' - 0" square x 12" deep			
	Spread footings, 3000 PSI concrete, load 100K, soil bearing capacity 6 KSF, 4' - 6" square x 15" deep			
A1030	**Slab on Grade**		**6.09**	**$19,500**
	Slab on grade, 6" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.16**	**$500**
	Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**12.19**	**$39,000**
	Foundation wall, CIP, 4' wall height, direct chute, .197 CY/LF, 9.44 PLF, 16" thick			
B Shell		**67.7%**	**248.75**	**$796,000**
B1010	**Floor Construction**		**2.97**	**$9,500**
	Steel column, W8, 100 KIPS, 20' unsupported height, 40 PLF			
	Floor, concrete, slab form, open web bar joist @ 2' OC, on bearing wall, 30' span, 24.5" deep, 125 PSF superimpose			
	Floor, concrete, slab form, open web bar joist @ 2' OC, on bearing wall, 5/8" gypsum board fireproofing on metal furi			
B1020	**Roof Construction**		**9.22**	**$29,500**
	Roof, steel joists, 1.5" 22 ga metal deck, on bearing walls, 30' bay, 23.5" deep, 40 PSF superimposed load, 60 PSF t			
	Roof, steel joists, 1.5" 22 ga metal deck, on bearing walls, 100' bay, 57.5" deep, 40 PSF superimposed load, 65 PSF			
	Roof joist, light gauge, 12 ga			
	Roof joist, light gauge, 14 ga			
B2010	**Exterior Walls**		**183.12**	**$586,000**
	Exterior wall, precast concrete, flat, 8" thick, 20' x 10', white face, low rise			
B2020	**Exterior Windows**		**41.25**	**$132,000**
	Aluminum flush tube frame, for insulating glass, 2" x 4-1/2", 5'x20' opening,3 intermediate horizontals			
	Glazing panel, plate glass, 1/4" thick, tempered			
B2030	**Exterior Doors**		**2.03**	**$6,500**
	Door, aluminum & glass, without transom, narrow stile, double door, hardware, 6'-0" x 7'-0" opening			

		% of Total	Cost Per SF	Cost
	Door, steel 18 gauge, hollow metal, 2 doors with frame, no label, 6'-0" x 7'-0" opening			
B3010	**Roof Coverings**		**10.00**	**$32,000**
	Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			
	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick			
B3020	**Roof Openings**		**0.16**	**$500**
	Roof hatch, with curb, 1" fiberglass insulation, 2'-6" x 3'-0", aluminum			
C Interiors		**10.5%**	**38.44**	**$123,000**
C1010	**Partitions**		**3.59**	**$11,500**
	Concrete block (CMU) partition, light weight, hollow, 6" thick, no finish			
C1020	**Interior Doors**		**2.97**	**$9,500**
	Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8"			
C2010	**Stair Construction**		**2.03**	**$6,500**
	Stairs, steel, cement filled metal pan & picket rail, 20 risers, with landing			
C3010	**Wall Finishes**		**15.00**	**$48,000**
	2 coats paint on masonry with block filler			
	Painting, masonry or concrete, latex, brushwork, primer & 2 coats			
	Painting, masonry or concrete, latex, brushwork, addition for block filler			
	Wall coatings, epoxy coatings, maximum			
C3020	**Floor Finishes**		**10.47**	**$33,500**
	Carpet, tufted, nylon, roll goods, 12' wide, 36 oz			
	Carpet, padding, add to above, maximum			
	Vinyl tile, maximum			
	Add for sleepers on concrete, treated, 24" OC, 1"x2"			
	Underlayment, plywood, 5/8" thick			
C3030	**Ceiling Finishes**		**4.38**	**$14,000**
	Acoustic ceilings, 3/4" fiberglass board, 24" x 48" tile, tee grid, suspended support			
D Services		**15.1%**	**55.62**	**$178,000**
D1010	**Elevators and Lifts**		**3.91**	**$12,500**
	Hydraulic passenger elevator, 4500 lb., 2 floor, 125 FPM			
D2010	**Plumbing Fixtures**		**7.81**	**$25,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, stall type			
	Lavatory w/trim, wall hung, PE on CI, 18" x 15"			
	Service sink w/trim, PE on CI, corner floor, 28" x 28", w/rim guard			
	Shower, stall, fiberglass 1 piece, three walls, 36" square			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**3.12**	**$10,000**
	Gas fired water heater, commercial, 100< F rise, 600 MBH input, 576 GPH			
D2040	**Rain Water Drainage**		**0.94**	**$3,000**
	Roof drain, DWV PVC, 5" diam, 10' high			
	Roof drain, DWV PVC, 5" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**12.66**	**$40,500**
	Rooftop, single zone, air conditioner, restaurants, 10,000 SF, 50.00 ton			
D4010	**Sprinklers**		**3.59**	**$11,500**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
D4020	**Standpipes**		**0.31**	**$1,000**
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor			

		% of Total	Cost Per SF	Cost
D5010	**Electrical Service/Distribution**		**2.50**	**$8,000**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 800 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 800 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 800 A			
D5020	**Lighting and Branch Wiring**		**12.19**	**$39,000**
	Receptacles incl plate, box, conduit, wire, 8 per 1000 SF, .9 watts per SF			
	Wall switches, 2.0 per 1000 SF			
	Miscellaneous power, 1 watt			
	Central air conditioning power, 3 watts			
	Motor installation, three phase, 200 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 15 HP, 230 V 15 HP, 460 V 40 HP, 575 V 50 HP			
	Fluorescent fixtures recess mounted in ceiling, 2.4 watt per SF, 60 FC, 15 fixtures @ 32 watt per 1000 SF			
D5030	**Communications and Security**		**7.19**	**$23,000**
	Communication and alarm systems, includes outlets, boxes, conduit and wire, sound systems, 30 outlets			
	Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and w			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
D5090	**Other Electrical Systems**		**1.41**	**$4,500**
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 1			
E Equipment & Furnishings		**0.0%**	**0.00**	**$0**
E1090	**Other Equipment**		**0.00**	**$0**
F Special Construction		**0.0%**	**0.00**	**$0**
G Building Sitework		**0.0%**	**0.00**	**$0**
Sub Total		**100%**	**$367.50**	**$1,176,000**
Contractor's Overhead & Profit		**20.0%**	**$73.44**	**$235,000**
Architectural Fees		**6.0%**	**$26.41**	**$84,500**
User Fees		**0.0%**	**$0.00**	**$0**
Total Building Cost			**$467.35**	**$1,495,500**

Square Foot Cost Estimate Report

Estimate Name: **MMAA S class**

Building Type:	**College, Classroom, 2-3 Story with Decorative Concrete Block / Bearing Walls**
Location:	National Average
Stories Count (L.F.):	**2.00**
Stories Height	**18.88**
Floor Area (S.F.):	**15,000.00**
LaborType	**Union**
Basement Included:	No
Data Release:	**Year 2012 Quarter 3**
Cost Per Square Foot	**$234.77**
Total Building Cost	**$3,521,500**

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly

Parameters are not within the ranges recommended

		% of Total	Cost Per SF	Cost
A Substructure		**4.6%**	**8.53**	**$128,000**
A1010	**Standard Foundations**		**1.73**	**$26,000**
	Strip footing, concrete, unreinforced, load 2.6 KLF, soil bearing capacity 3 KSF, 8" deep x 16" wide			
	Strip footing, concrete, reinforced, load 11.1 KLF, soil bearing capacity 6 KSF, 12" deep x 24" wide			
A1030	**Slab on Grade**		**2.57**	**$38,500**
	Slab on grade, 4" thick, non industrial, reinforced			
A2010	**Basement Excavation**		**0.13**	**$2,000**
	Excavate and fill, 100,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	**Basement Walls**		**4.10**	**$61,500**
	Foundation wall, CIP, 4' wall height, direct chute, .099 CY/LF, 4.8 PLF, 8" thick			
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick			
B Shell		**25.4%**	**46.93**	**$704,000**
B1010	**Floor Construction**		**8.07**	**$121,000**
	Floor, concrete, slab form, open web bar joist @ 2' OC, on bearing wall, 35' span, 20" deep, 125 PSF superimposed			
B1020	**Roof Construction**		**4.57**	**$68,500**
	Roof, steel joists, 1.5" 22 ga metal deck, on bearing walls, 70' bay, 41.5" deep, 30 PSF superimposed load, 52 PSF t			
B2010	**Exterior Walls**		**12.73**	**$191,000**
	Concrete block (CMU) wall, split rib, 8 ribs, hollow, regular weight, 8x8x16, reinforced, vertical #5@32", grouted			
B2020	**Exterior Windows**		**17.30**	**$259,500**
	Aluminum flush tube frame, for 1/4"glass,1-3/4"x4", 5'x6' opening, no intermediate horizontals			
	Glazing panel, plate glass, 1/4" thick, clear			
B2030	**Exterior Doors**		**0.67**	**$10,000**
	Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x 10'-0" opening			
B3010	**Roof Coverings**		**3.60**	**$54,000**
	Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			

		% of Total	Cost Per SF	Cost
	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick			
C Interiors		**24.4%**	**44.93**	**$674,000**
C1010	**Partitions**		**12.07**	**$181,000**
	Concrete block (CMU) partition, light weight, hollow, 6" thick, no finish			
	8" concrete block partition			
C1020	**Interior Doors**		**5.97**	**$89,500**
	Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8"			
C1030	**Fittings**		**5.97**	**$89,500**
	Chalkboards, liquid chalk type, wood frame & chalktrough			
	Cabinets, school, counter, wood, 32" high			
C2010	**Stair Construction**		**3.27**	**$49,000**
	Stairs, steel, cement filled metal pan & picket rail, 20 risers, with landing			
C3010	**Wall Finishes**		**5.83**	**$87,500**
	2 coats paint on masonry with block filler			
	Painting, masonry or concrete, latex, brushwork, primer & 2 coats			
	Painting, masonry or concrete, latex, brushwork, addition for block filler			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	**Floor Finishes**		**4.97**	**$74,500**
	Carpet, tufted, nylon, roll goods, 12' wide, 36 oz			
	Carpet, padding, add to above, maximum			
	Vinyl, composition tile, minimum			
	Vinyl, composition tile, maximum			
	Tile, ceramic natural clay			
C3030	**Ceiling Finishes**		**6.87**	**$103,000**
	Acoustic ceilings, 3/4"mineral fiber, 12" x 12" tile, concealed 2" bar & channel grid, suspended support			
D Services		**45.6%**	**84.17**	**$1,262,500**
D1010	**Elevators and Lifts**		**3.57**	**$53,500**
	Hydraulic passenger elevator, 2500 lb., 2 floor, 125 FPM			
D2010	**Plumbing Fixtures**		**16.53**	**$248,000**
	Water closet, vitreous china, bowl only with flush valve, wall hung			
	Urinal, vitreous china, wall hung			
	Lavatory w/trim, wall hung, vitreous china, 19" x 17"			
	Lab sink w/trim, polyethylene, single bowl, double drainboard, 54" x 24" OD			
	Service sink w/trim, vitreous china, wall hung 22" x 20"			
	Water cooler, electric, wall hung, wheelchair type, 7.5 GPH			
D2020	**Domestic Water Distribution**		**2.33**	**$35,000**
	Gas fired water heater, commercial, 100< F rise, 600 MBH input, 576 GPH			
D2040	**Rain Water Drainage**		**0.60**	**$9,000**
	Roof drain, CI, soil,single hub, 6" diam, 10' high			
	Roof drain, CI, soil,single hub, 6" diam, for each additional foot add			
D3050	**Terminal & Package Units**		**19.70**	**$295,500**
	Rooftop, multizone, air conditioner, schools and colleges, 25,000 SF, 95.83 ton			
D4010	**Sprinklers**		**3.23**	**$48,500**
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF			
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF			
D4020	**Standpipes**		**0.33**	**$5,000**
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor			
	Dry standpipe risers, class III, steel, black, sch 40, 6" diam pipe, additional floors			
D5010	**Electrical Service/Distribution**		**16.47**	**$247,000**
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A			

		% of Total	Cost Per SF	Cost
	Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A			
	Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A			
D5020	**Lighting and Branch Wiring**		**13.60**	**$204,000**
	Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 W per SF, with transformer			
	Wall switches, 1.0 per 1000 SF			
	Miscellaneous power, 1.2 watts			
	Central air conditioning power, 4 watts			
	Motor installation, three phase, 460 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP			
	Fluorescent fixtures recess mounted in ceiling, 2.4 watt per SF, 60 FC, 15 fixtures @ 32 watt per 1000 SF			
D5030	**Communications and Security**		**7.07**	**$106,000**
	Communication and alarm systems, includes outlets, boxes, conduit and wire, sound systems, 30 outlets			
	Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and w			
	Fire alarm command center, addressable with voice, excl. wire & conduit			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master clock systems, 20 rooms			
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 30 outle			
	Internet wiring, 8 data/voice outlets per 1000 S.F.			
D5090	**Other Electrical Systems**		**0.73**	**$11,000**
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 1			
E Equipment & Furnishings		**0.0%**	**0.00**	**$0**
E1090	**Other Equipment**		**0.00**	**$0**
F Special Construction		**0.0%**	**0.00**	**$0**
G Building Sitework		**0.0%**	**0.00**	**$0**
Sub Total		**100%**	**$184.57**	**$2,768,500**
Contractor's Overhead & Profit		**20.0%**	**$36.90**	**$553,500**
Architectural Fees		**6.0%**	**$13.30**	**$199,500**
User Fees		**0.0%**	**$0.00**	**$0**
Total Building Cost			**$234.77**	**$3,521,500**

APPENDIX C

RS MEANS COSTWORKS ASSEMBLIES ESTIMATE DETAILS

Assembly Detail Report

Cost Estimate Report CostWorks RSMeans

Year 2012

Date: 20-Sep-12

MMAA Assembly

Prepared By:
vincent rossi
penn state

Assembly Number			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D Services							
D30105202040			Commercial building heating system, fin tube radiation, forced hot water, 100,000 SF, 1mil CF, total 3 floors	222,952.00	S.F.	$6.14	$1,368,925.28
D30105301960			Commercial building heating systems, terminal unit heaters, forced hot water, 100,000 SF bldg, 1mil CF, total, 3 floors	222,952.00	S.F.	$5.81	$1,295,351.12
D30201081480			Heating systems, CI boiler, gas, terminal unit heaters, 5,032 MBH, 67,100 SF bldg	10.00	S.F.	$10.56	$105.60
D30201301100			Boiler, cast iron, gas, hot water, 2856 MBH	5.00	Ea.	$89,725.40	$448,627.00
D30203301020			Pump, base mounted with motor, end-suction, 3" size, 5 HP, to 225 GPM	25.00	Ea.	$20,646.60	$516,165.00
D30203301040			Pump, base mounted with motor, end-suction, 5" size, 15 HP, to 1000 GPM	5.00	Ea.	$34,756.80	$173,784.00
D30301401020			Chiller, centrifugal, water cooled, packaged hermetic, standard controls, 400 ton	3.00	Ea.	$231,364.80	$694,094.40
D30303101030			Cooling tower, galvanized steel, packaged unit, draw thru, 300 ton	1.00	Ea.	$73,378.80	$73,378.80
D30401061020			AHU, field fabricated, built up, cool/heat coils, filters, constant volume, 60,000 CFM	3.00	Ea.	$152,639.80	$457,919.40
D30401121020			AHU, central station, cool/heat coils, VAV, filters, 10,000 CFM	1.00	Ea.	$68,112.00	$68,112.00
D30401121030			AHU, central station, cool/heat coils, VAV, filters, 15,000 CFM	3.00	Ea.	$93,318.00	$279,954.00
D30401121040			AHU, central station, cool/heat coils, VAV, filters, 20,000 CFM	3.00	Ea.	$115,943.20	$347,829.60
D30401201030			Fan coil A/C system, cabinet mounted, electric heat, controls, 2 pipe, 1-1/2 ton	9.00	Ea.	$4,932.60	$44,393.40
D30401201040			Fan coil A/C system, cabinet mounted, electric heat, controls, 2 pipe, 2 ton	18.00	Ea.	$6,822.00	$122,796.00
D30401201050			Fan coil A/C system, cabinet mounted, electric heat, controls, 2 pipe, 3 ton	17.00	Ea.	$9,481.20	$161,180.40
D30401221020			Fan coil A/C system, cabinet mounted, controls, 4 pipe, 1 ton	10.00	Ea.	$6,661.30	$66,613.00
D30401221040			Fan coil A/C system, cabinet mounted, controls, 4 pipe, 2 ton	40.00	Ea.	$7,579.70	$303,188.00
D30401381050			VAV terminal, cool, hot water reheat, fan powered, with actuator/controls, 1000 CFM	25.00	Ea.	$12,983.10	$324,577.50
D30401381060			VAV terminal, cool, hot water reheat, fan powered, with actuator/controls, 1250 CFM	20.00	Ea.	$15,789.40	$315,788.00
D30401381070			VAV terminal, cool, hot water reheat, fan powered, with actuator/controls, 1500 CFM	30.00	Ea.	$18,369.40	$551,082.00
D30401381080			VAV terminal, cool, hot water reheat, fan powered, with actuator/controls, 2000 CFM	30.00	Ea.	$24,430.60	$732,918.00
D30402201050			Fan system, in-line centrifugal, 3500 CFM	30.00	Ea.	$55,025.60	$1,650,768.00
D30402201060			Fan system, in-line centrifugal, 5000 CFM	25.00	Ea.	$80,614.80	$2,015,370.00
D30402301020			Utility fan set system, belt drive, 3500 CFM	15.00	Ea.	$37,774.80	$566,622.00
D30402301030			Utility fan set system, belt drive, 5000 CFM	20.00	Ea.	$51,991.60	$1,039,832.00

Assembly Number			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D30402301050			Utility fan set system, belt drive, 10,000 CFM	7.00	Ea.	$81,459.60	$570,217.20
D30402301060			Utility fan set system, belt drive, 15,000 CFM	2.00	Ea.	$83,406.80	$166,813.60
D30402301070			Utility fan set system, belt drive, 20,000 CFM	3.00	Ea.	$94,905.60	$284,716.80
D30402601040			Commercial kitchen exhaust/make-up air system, rooftop, gas, 8000 CFM	6.00	Ea.	$86,568.80	$519,412.80
D30406101020			Plate heat exchanger, 800 GPM	9.00	Ea.	$115,384.40	$1,038,459.60
D30501301050			Space heater, suspended, horizontal mount, hot water, propeller fan, 200 MBH	10.00	Ea.	$7,921.90	$79,219.00
D30501301060			Space heater, suspended, horizontal mount, hot water, propeller fan, 300 MBH	15.00	Ea.	$9,620.50	$144,307.50
D30502021020			A/C packaged, DX, air cooled, electric heat, VAV, 20 ton	4.00	Ea.	$44,334.90	$177,339.60
D	**Services Subtotal**						**$16,599,860.60**

Assembly Detail Report

Cost Estimate Report CostWorks RSMeans

Year 2012

MMAA

Prepared By:
vincent rossi
penn state

Date: 20-Sep-12

Assembly Number			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
D Services							
D50101200320			Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 400 A	50.00	Ea.	$10,313.93	$515,696.50
D50101200440			Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 1000 A	20.00	Ea.	$24,177.98	$483,559.60
D50102300240			Feeder installation 600 V, including RGS conduit and XHHW wire, 100 A	30,000.00	L.F.	$38.80	$1,164,000.00
D50102300280			Feeder installation 600 V, including RGS conduit and XHHW wire, 200 A	4,000.00	L.F.	$69.08	$276,320.00
D50102300320			Feeder installation 600 V, including RGS conduit and XHHW wire, 400 A	20,000.00	L.F.	$137.63	$2,752,600.00
D50102300560			Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A	1,000.00	L.F.	$827.26	$827,260.00
D50102301240			Branch installation 600 V, including EMT conduit and THW wire, 20 A	100,000.00	L.F.	$11.60	$1,160,000.00
D50102301320			Branch installation 600 V, including EMT conduit and THW wire, 50 A	50,000.00	L.F.	$18.16	$908,000.00
D50102400400			Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A	12.00	Ea.	$73,289.80	$879,477.60
D50201100520			Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 watts per SF	222,952.00	S.F.	$4.62	$1,030,038.24
D50201300320			Wall switches, 2.5 per 1000 SF	222,952.00	S.F.	$0.92	$205,115.84
D50201400280			Central air conditioning power, 4 watts	222,952.00	S.F.	$0.93	$207,345.36
D50202081000			Fluorescent fixtures, type B, 35 fixtures per 1600 SF	222,952.00	S.F.	$17.88	$3,986,381.76
D50202160280			Incandescent fixtures recess mounted, type A, 3 watt per SF, 24 FC, 18 fixtures per 1000 SF	222,952.00	S.F.	$10.87	$2,423,488.24
D50303101020			Telephone wiring for offices & laboratories, 8 jacks/MSF	80,000.00	S.F.	$3.41	$272,800.00
D Services Subtotal							**$17,092,083.14**

APPENDIX D

EXISTING CONDITIONS PLAN

NORTH

MOVEABLE WATER BARRIER

FIRE HYDRANT

20 ' SWING GATE WORKER & EQUIP. ACCESS

CONCRETE HIGHWAY BARIER

STREET C

P

BUILDING PERIMETER

EXISTING BUILDING 1
2 STORIES
ROOF ELEVATION: 30'

HIGHLINE MAINTENANCE BUILDING CONSTRUCTION SITE.

NOT IN CONTRACT

STEPS DOWN TO SI WALK BELOW

P

HIGHLINE TRAILER & EQUIPMENT SPACE. N.I.C.

EXISTING SIDEWALK

STREET A

METRO MUSEUM OF AMERICAN ART
BUILDING FOOTPRINT
9 STORIES
BUILDING HEIGHT: 169'

CONSTRUCTION SPACE AVAILABLE FOR TRAILERS OR OTHER VARIOUS NEEDS (NOTE THAT DIFFERENT PHASES WILL HAVE DIFFERENT ARRANGEMENTS)

25' TYP

5' PEDESTRIAN WALKWAY

EXISTING HIGH-LINE PEDESTRIAN WALKWAY / PARK

APPROX 20' HIGH

CONSTRUCTION FENCING (TYP)

PROPOSED CATCH BASIN

PROPOSED ELECTRICAL VAULT

GUARD BOOTH

EXISTING FIRE HYDRANT. KNOCK DOWN DOOR APPROVED BY FIRE DEPARTMENT

20 ' SWING GATE WORKER & EQUIP. ACCESS

STREET B

EXISTING SIDEWALK

20 ' SWING GATE WORKER & EQUIP. ACCESS

EXISTING BUILDING 2
7 STORIES
ROOF ELEVATION: 90'

FIRE HYDRANT

EXISTING LIGHT POLE (TYP)

LEGEND

- CONSTRUCTION FENCING
- MMAA BUILDING PERIMETER
- PEDESTRIAN TRAFFIC FLOW (P)
- HIGHLINE CONSRUCTION SITE PERIMETER
- EXISTING BUILDING
- ASPHALT ROADWAY
- MULTI-USE CONSTRUCTION AREA
- MMAA BUILDING FOOTPRINT
- HIGHLINE BUILDING FOOTPRINT
- EXISTING SIDEWALK
- HIGHLINE WALKWAY
- FIRE HYDRANT
- LIGHT POLE
- MOVEABLE WATER BARRIER
- MANHOLE COVER
- SWINGING GATE

DATE: SEPTEMBER 17th, 2012

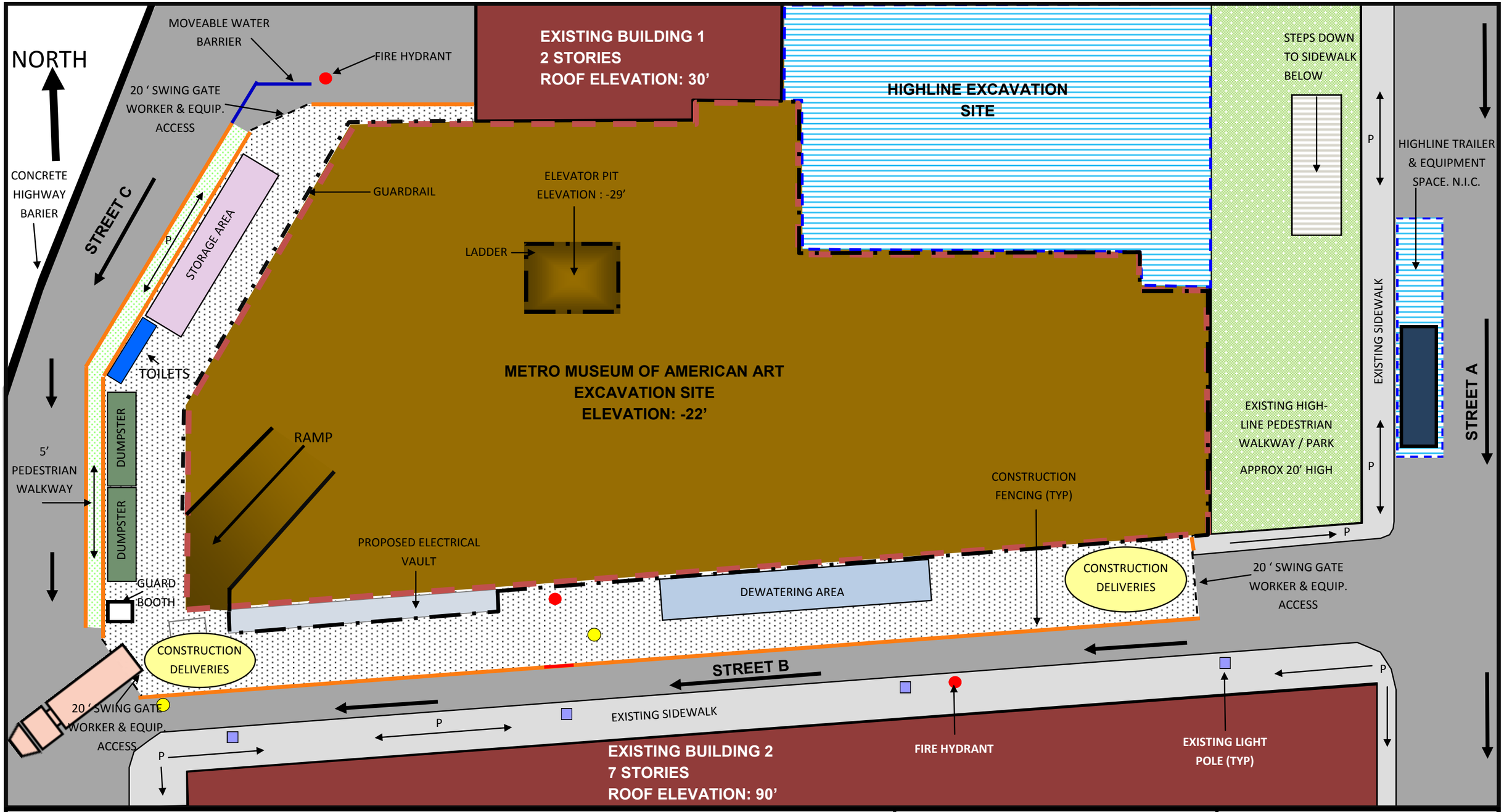
AUTHOR: VINCENT A. ROSSI

METRO MUSEUM OF AMERICAN ART

EXISTING CONDITIONS PLAN

APPENDIX E

SITE PHASING PLANS



LEGEND

- CONSTRUCTION FENCING
- MMAA BUILDING PERIMETER
- PEDESTRIAN TRAFFIC FLOW
- HIGHLINE CONSRUCTION SITE PERIMETER
- EXISTING BUILDING
- ASPHALT ROADWAY
- MULTI-USE CONSTRUCTION AREA
- MMAA EXCAVATION AREA
- HIGHLINE BUILDING FOOTPRINT
- EXISTING SIDEWALK
- HIGHLINE WALKWAY
- FIRE HYDRANT
- LIGHT POLE
- MOVEABLE WATER BARRIER
- MANHOLE COVER
- GUARDRAIL

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METRO MUSEUM OF AMERICAN ART

PHASE 1: EXCAVATION

NORTH

MOVEABLE WATER BARRIER

FIRE HYDRANT

20 ' SWING GATE WORKER & EQUIP. ACCESS

EXISTING BUILDING 1
2 STORIES
ROOF ELEVATION: 30'

HIGHLINE SUPERSTRUCTURE CONSTRUCTION

ELEVATION: APPROX 40'

STEPS DOWN TO SIDEWALK BELOW

CONCRETE HIGHWAY BARIER

STREET C

STAIR TOWER

P

STORAGE AREA

ELEVATOR PIT ELEVATION : -29'

CRANE PAD INTEGRAL TO FOUNDATION SLAB

LADDER

STORAGE AREA

TOILETS

METRO MUSEUM OF AMERICAN ART FOUNDATION ELEVATION: -22'

HORIZONTAL STATIC NETTING DURING HIGHLINE MASONRY WORK FOR OVERHEAD PROTECTION

EXISTING HIGH-LINE PEDESTRIAN WALKWAY / PARK

APPROX 20' HIGH

P

EXISTING SIDEWALK

HIGHLINE TRAILER & EQUIPMENT SPACE. N.I.C.

STREET A

5' PEDESTRIAN WALKWAY

CONCRETE PUMP STATION

STAIR TOWER

CONCRETE PUMP STATION

PROPOSED ELECTRICAL VAULT

REBAR BENDING AREA

TOILETS

DUMPSTER

DUMPSTER

STREET B

20 ' SWING GATE WORKER & EQUIP. ACCESS

GUARD BOOTH

EXISTING SIDEWALK

FIRE HYDRANT

EXISTING LIGHT POLE (TYP)

EXISTING BUILDING 2
7 STORIES
ROOF ELEVATION: 90'

LEGEND

- CONSTRUCTION FENCING
- MMAA BUILDING PERIMETER
- PEDESTRIAN TRAFFIC FLOW
- HIGHLINE CONSRUCTION SITE PERIMETER
- EXISTING BUILDING
- ASPHALT ROADWAY
- MULTI-USE CONSTRUCTION AREA
- MMAA FOUNDATION AREA
- HIGHLINE BUILDING FOOTPRINT
- EXISTING SIDEWALK
- PROTECTIVE NETTING
- FIRE HYDRANT
- LIGHT POLE
- MOVEABLE WATER BARRIER
- MANHOLE COVER
- GUARDRAIL

DATE: SEPTEMBER 17th, 2012

AUTHOR: VINCENT A. ROSSI

METRO MUSEUM OF AMERICAN ART

PHASE 2: FOUNDATIONS

NORTH

MOVEABLE WATER BARRIER

EXISTING BUILDING 1

ROOF &OVERHEAD PROTECTION

HIGHLINE MAINTENANCE FACILITY
COMPLETED
ROOF ELEVATION: 65'
6 STORIES

STEPS DOWN TO SIDEWALK BELOW

20 ' SWING GATE WORKER & EQUIP. ACCESS

CONCRETE HIGHWAY BARIER

STREET C

P

SOF PUMP

10'X14' PLATFORM

DUAL CAR HOIST

WALK OFF PLATFORM FOR SOF

12'X14' PLATFORM

STANDPIPE

40' TRAILER

20' RAMP

TOWER CRANE

STAIR FOR CONSTRUCTION EGRESS

STAIR FOR CONSTRUCTION EGRESS

COUNTER WEIGHT PATH:
44' RADIUS

METRO MUSEUM OF AMERICAN ART SUPERSTRUCTURE

MAX LOAD PATH:
93' RADIUS

LOAD PATH:
50' RADIUS

MAX PICK POINT
190'

EXISTING HIGH-LINE PEDESTRIAN WALKWAY / PARK

APPROX 20' HIGH

P

HIGHLINE TRAILER & EQUIPMENT SPACE. N.I.C.

EXISTING SIDEWALK

STREET A

5' PEDESTRIAN WALKWAY

70' TRAILER

CRAWLER CRANE

COUNTER WEIGHT PATH:
13.5' RADIUS

WALK OFF PLATFORM FOR SOF

SOF PUMP

TOILETS

40' TRAILER

70' TRAILER

20 ' SWING GATE WORKER & EQUIP. ACCESS

GUARD BOOTH

DELIVERY TRUCK

STEEL LAY DOWN AREA

DUMPSTER

DUMPSTER

STREET B

20 ' SWING GATE WORKER & EQUIP. ACCESS

EXISTING SIDEWALK

FIRE HYDRANT

EXISTING LIGHT POLE (TYP)

EXISTING BUILDING 2
7 STORIES
ROOF ELEVATION: 90'

LEGEND

- CONSTRUCTION FENCING
- MMAA BUILDING PERIMETER
- PEDESTRIAN TRAFFIC FLOW
- HIGHLINE BUILDING PERIMETER
- EXISTING BUILDING
- ASPHALT ROADWAY
- MULTI-USE CONSTRUCTION AREA
- MMAA BUILDING AREA
- HIGHLINE BUILDING FOOTPRINT
- EXISTING SIDEWALK
- ROOF/OVERHEAD PROTECTION
- FIRE HYDRANT
- LIGHT POLE
- MOVEABLE WATER BARRIER
- MANHOLE COVER
- CRANE SWING RADIUS

DATE: SEPTEMBER 17th, 2012

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PHASE 3: SUPERSTRUCTURE