TECHNICAL ASSIGNMENT THREE

PENN STATE SENIOR AE THESIS

New York Police Academy

College Point, New York

Shawn Sidelinger

Construction Management

Dr. Robert Leicht

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Executive Summary:

Technical Assignment Three is intended to help address ideas for further research in areas such as alternate methods, value engineering, and schedule compression of the New York Police Academy. This project consists of the new construction of a 720,000 SF facility in College Point, New York, equipped with space for academics, administrations, physical training, and a central utility plant; with plans for renovations in the future. At the moment there are no major challenges that await the project team due to size and location of the site.

During the early stages of this report, an interview was conducted with project manger of New York Police Academy, Pat Murray, in which several items such as constructability challenges, schedule acceleration scenarios, and value engineering were discussed. The constructability challenges that were mentioned are the sequencing of trade work within the fuel tank rooms of the Central Utility Plant, the creation and coordination of the castellated and cellular beams within the physical training area, and the hoist connections within the atrium of the Academics/Administrations building. Each issue represents a different challenge to the project team and solutions are discussed within this report. Over the course of the project, the critical path of the schedule runs along these activities: Piles, Foundations, Steel, Concrete, Curtain Wall and Mechanical HVAC; with Mechanical HVAC being the top priority. Several risks and schedule acceleration scenarios were discussed and cover areas such as the risk of discovering more contaminated fill than perceived, the risk of not obtaining systems startup by third-quarter of 2012, and the benefit of longer work days, weekends, and hidden float within the schedule. Finally, value engineering topics that are being planned to be incorporated are described and contain the replacement of glazed masonry within the Academic/Administration building, scope production of site work, and replacement of return ducts within the Academic/Administration building.

Through an in-depth analysis of the constructability challenges, schedule acceleration scenarios, value engineering topics, and the interview with Pat Murray from Turner Construction, project manager of New York Police Academy, several items were discovered as potential problematic areas. Several of the problematic areas are further discussed in the four construction management analysis activities that include redesign of the castellated and cellular beams within the physical training area, the addition of LEED systems, resequencing of the fuel room construction, and redesign of the Academic/Administration building's façade. Each method listed should provide ideas into possible research topics for the proposal of spring thesis.

Constructability Challenges

For Technical Assignment Three, an interview was performed with the project manager on site, Pat Murray. Unlike similar projects that are being performed by colleagues, the New York Police Academy is starting the early stages of construction at the time of this report. This leads to the conclusion, that the top three constructability challenges are unknown and can only be predicted from analyzing the drawings. Upon finishing the interview, Pat Murray provided notes on the following issues: Fuel Tank Room Sequencing, Castellated/Cellular Beams in the Physical Training, and Hoist Connections within Academic/Administration.

Fuel Tank Room Sequencing

Within the Central Utility Plant lie four separate rooms that contain two fuel oil tanks each. Four tanks will be installed at the start of the construction, 20,000 gallon capacity, with space provided for four future tanks, 15,000 gallon capacity. At eight pounds per gallon, these tanks, when full, will contribute to a load of approximately 1,150,000 pounds. To countermeasure this force, a double matt slab will be poured in the area.

Figure 1 displays an East-West section with the slab in question, highlighted. Figure 2 displays a North-South section that displays the related beams and columns within the area as well as the first set of tanks to be installed.

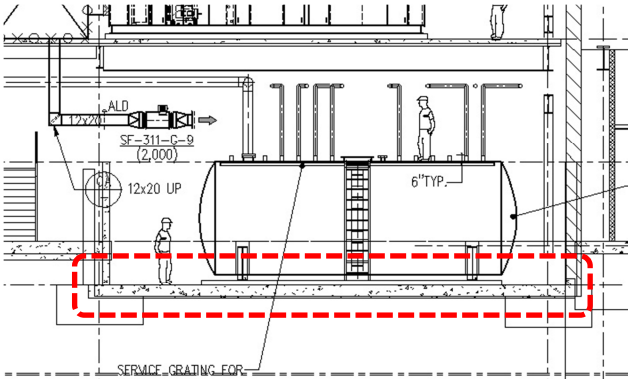

Figure 1: East-West Section of Central Utility Plant

During construction, work in the area is schedule to place matt slab one, erect structural steel columns, and place matt slab two while steel erection is in process for the upper levels. This sequencing of trades produces a high level of safety risk for the concrete subcontractor, since the concrete workers will be right under the iron workers as they are installing the structural steel members for the second floor. To ensure that no worker is injured, Turner Construction and SVT will enforce all relating OSHA regulations to the letter. Proper hoisting methods, moving one piece at a time and a high level of safety management are some of the items that will be employed. As well as the safety issues stated, this constructability challenge

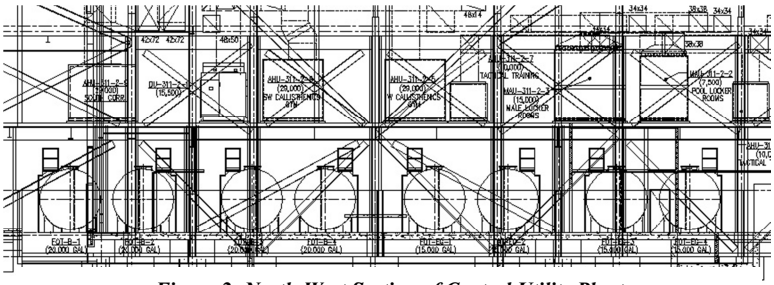

Figure 2: North-West Section of Central Utility Plant

can pose threats to the overall schedule. To ensure that the schedule is not affected to drastically, the project team plans to use high levels of coordination between the two teams to properly sequence the work that must take place. Since the fuel tank rooms are spread across four bays, the teams can start in opposite ends and work towards each other but must work in a rhythm that is slow enough to ensure safety among the team and cannot be too slow that it will affect the overall schedule.

Castellated / Cellular Beams in the Physical Training

Inside the Physical Training portion of New York Police Academy is an indoor training facility. Areas include tactical training, baton training, and an inside quarter mile track for calisthenics training. Due to the large size of the track, the overall span of the area is approximately 180 feet. Construction documents show that cellular beams are used to support the floor with the track and castellated beams are used to support the roof overhead.

On the drawings, the cellular beams have a call sign of LB60 x 199 and the castellated beams have a call sign of LB60 x 211. Figure 3 displays the second floor framing and Figure 4 displays the framing for the overall roof. Note that Figure 4 only shows one third of the overall span between column line D4 and column line D7, while Figure 3 shows the entire span, column line D6 to column line D7.

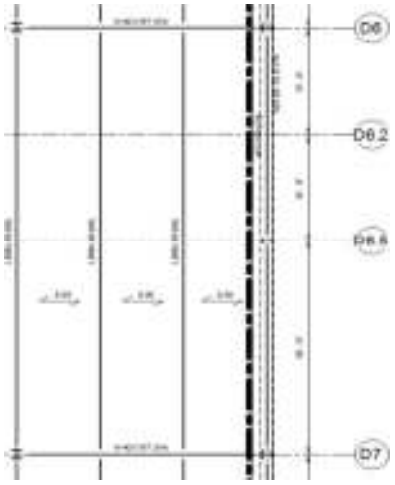

Figure 3: Second Floor Framing Part 7 of West Campus

Figure 4: Roof Framing Part 7 of West Campus

During construction, the primary members that will be focused on are the castellated beams that support the roof system. At the moment, the current plan of design is three castellated beams will be connected together, via moment connections, to complete the span between column lines D4 and D7. In order for the beams to be able to support the weight over such a large span, steel structural pipes at a size of 18 feet long and 8 inches in diameter will be welded to the top flange of the beam and then filled with concrete. This method will allow the castellated beams to meet the required strength needed, but can affect the overall schedule of the project. In order to ensure that this sequence of the project happens swiftly and efficiently, the project team plans to use a high level of coordination between the iron workers, concrete workers, and welders since all the tasks needed to complete the work will be highly time cumbersome; the work has to happen at a pace that optimizes quality but does not reduce time from the schedule.

Hoist Connections within Academic / Administration

Along the southern side of the Academic / Administration building is an atrium that spans from the ground floor to the eighth floor. Along the curtain wall face, the atrium is equipped with architectural style steel tubing that is positioned in a bracing pattern. Figure 5 shows the general area of the atrium on the ground floor and Figure 6 shows the pattern for the steel tubing. It was noted that in the interview that the steel tubing shown in Figure 6 is not included with the structural steel package and will be installed when the interior finishes are in process. Finally, Figure 7 shows a section of the steel tubing that will be installed behind the curtain wall

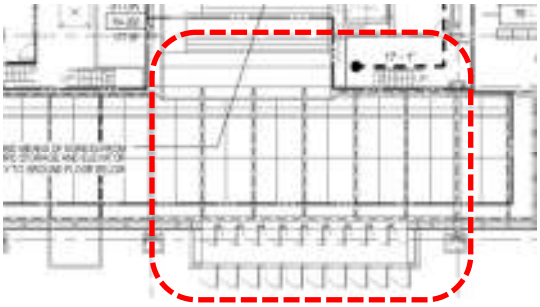

Figure 5: Ground Floor Layout of Atrium Area

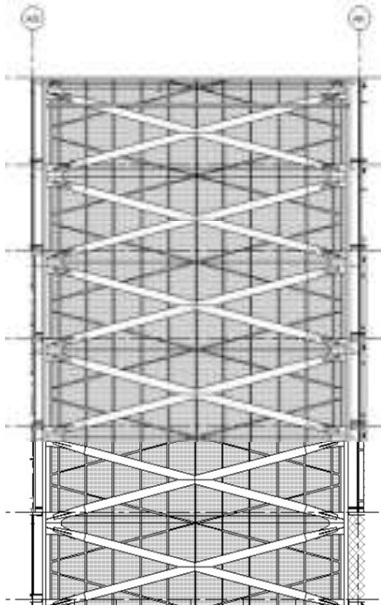

Figure 6: Face View of Steel Tubing Design

During the stages of the interior finishing, the project team is planning on bringing in a hoist complex close to the atrium area but will not connect it to the overall building; the idea is to erect scaffolding in the space and use it as a general walk on platform from the hoist complex.

After the vertical transportation systems are installed inside the building, the hoist complex will be removed from the structure but the scaffolding will remain in place to allow the installation of finishes within the atrium's higher floors. Some key items are drywall and the terrazzo along the balconies. Once all finish work is completed, the scaffolding will be removed and a crane will be moved into place to erect the architectural steel tubing into and help aid in the finishing of the curtain wall.

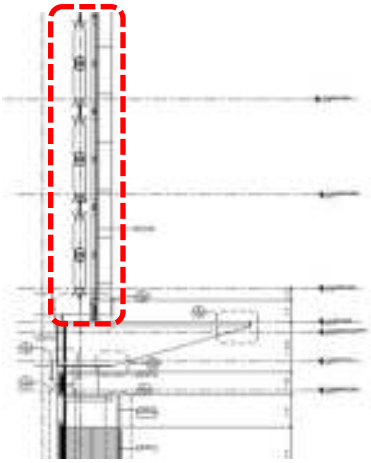

Figure 7: Section View of Steel Tubing Design

This entire process is scheduled to take place during the final stages of construction right before substantial completion. Due to this fact and the large number of trades that will be doing work, there are a few key issues that must be maintained. Coordination between the trades must be in effect in order to provide the proper sequence so that the schedule is not affected from the time the hoist complex is pulled to turnover to the owner. The project team plans on bringing the trades in early and explaining the importance of meeting the deadlines and the positive aspects of coordination between the trades.

Schedule Acceleration Scenarios

New York Police Academy's critical path of the project schedule follows Piles, Foundations, Steel, Concrete, Curtain Wall and Mechanical HVAC. During the interview with Pat Murray, project manager of New York Police Academy, Pat explained two possible risks that can affect the overall schedule as well as a basic method that Turner Construction and SVT are implementing to reduce the overall time period of the early stages of the schedule (structural steel and concrete). The two areas of risk that will be discussed are the excavation of the project and the ability to have interior systems ready by a certain date.

Excavation Risks

The site for New York Police Academy is located on the former NYPD College Point Tow Pound in College Point, New York; Figure 8 displays the overall project site. As the vehicles that were impounded sit over time, they tend to leak fluids such as gas and oil; these fluids can become hazardous to organisms if ingested or exposed to over long periods of time. After exiting the vehicle, the fluids will leak onto the paved area of the site and eventually work its way into the soil underneath.

Figure 8: Arial View of Project Site

With the risk of unknown amounts of contaminated soil, the overall cost and time that is needed for the excavation of the project site is unknown at this time. Contaminated soil loses its compressive and shear strength due to any hazardous foreign compounds; hence the leaking vehicle fluids. If there is a large amount of contaminated soil, the excavation may have to remove more fill than what is needed for subsurface work and more efficient fill will have to be trucked into the site to replace the inefficient soil. Excavation costs result from primary what is removed from the site and if more fill is removed, especially contaminated fill, the overall cost and timeframe that were budgeted for excavation will grow drastically.

Systems Ready for Start-Up by Third Quarter of 2012

Pat Murray mentioned that at the moment, they are planning to have the mechanical system installed and ready for start-up by the third quarter of 2012 to efficiently finish the interior work of both buildings. The items that are to be ready are the boilers, chillers, and electrical distribution equipment. By October of 2012, the project team is planning to have the boiler system installed and providing heat throughout the interior of the building. In order to install and run the chillers, which are being installed close to the third quarter of 2012, the temporary power will be upsized to approximately 5,000 Amps in order to handle the loads of the chillers. Finally,

the power distribution equipment will have to slowly happen throughout the jobsite and will be completed at approximately the same time that the electrical utility company turns over permanent power.

Due to the fact that the Mechanical HVAC is the final stage of the critical path schedule, proper management and care must be exercised in order to achieve the goal of installation by the third quarter of 2012. If the systems are not ready, the interior finishes will be pushed back and may cause the overall schedule to extend past the expected turnover date; this will cause the project team to either work longer/more days or hire more workers to accelerate the work that needs to be caught up, this will have an unknown cost to be added to the overall project.

Schedule Acceleration

Aside from the typical methods of schedule acceleration, longer work days and working weekends, the main area that was reanalyzed was the lagging of activities. During the interview with Pat Murray, Pat mentioned that the original schedule listed all the activities as finish to start; this is not how real construction schedules are created. Upon lagging the activities onto one another, hidden float was generated. One example that was provided follows the layout below:

- Finish Pile Caps in either building
- Start Foundation
- At 50% Foundation completion, start Structural Steel

Due to the total amount of work not changing, the overall cost of construction will remain the same; however, the effect of lagging will reduce the schedule by approximately three months. This process has only been implemented for activities such as piles, foundations, structural steel and concrete to allow for the buying of these earlier trades. Once work progresses, the same procedure will be used for all interior work.

Value Engineering Topics

Value engineering is a process in which a product is replaced with a cheaper product but does not lose value in either quality or performance. During the interview with Pat Murray, project manager for the New York Police Academy, the subject of possible items to be value engineered was discussed. At the moment, there are three items that are planned to be value engineered: The Glazed Blocks in Common Corridors of the Academics/Administration, Scope Production of Site Work, and Return Duct Replacement. Note that these items are the most reasonable options at the time of this report due to the project entering the early stages construction. Other items are likely to appear as the project continues to progress through the construction period.

Glazed Blocks in Common Corridors of Academics/Administration Building

Along the common corridors of the Academics/Administration building, the interior wall assembly consists of a glazed block design. Figure 9 shows one of the inner corridor walls with hatching to represent masonry units. One downside of masonry design is that it tends to consume a large amount time and depending on the type of masonry used, can become costly if there is a high enough quantity present.

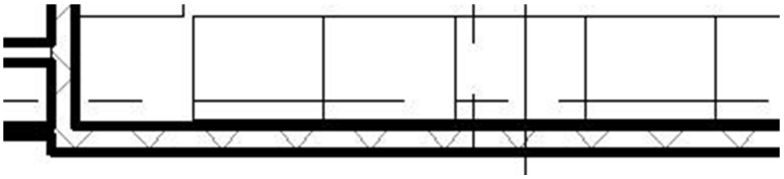

Figure 9: View of Glazed Masonry Blocks in Common Corridors

The project team plans to replace all the glazed block wall systems with tradition gypsum board wall system. New plans for the wall systems are to use standard steel studs with a gypsum board exterior that has a sheet rock appearance. Due to the glazed block only being on one side of the corridors, performance will remain the same but the quality can be affected if the finish appearance is not properly done; this will save the owner between two million and three million dollars.

Scope Production of Site Work

Along the exterior of the overall building lies security protection known as K-12 Barriers. These barriers are comprised of reinforced concrete and consist of approximately twelve million dollars in scope and surround the facility at approximately 100 feet from the exterior wall. The barriers serve as an additional layer of protection from any explosive ordinance that might threaten the facility.

Along the outside of these barriers lies additional field work, outside quarter mile track, and a 762 car parking lot. New York Police Academy is a two phase project with phase one being the construction of the Academics/Administration, Central Utility Plant, and the fundamentals of the Physical Training Plant. Phase two is to finish the Physical Training Plant and to add to the Central Utility Plant to handle the need for additional cooling and heating loads.

Turner Construction and SVT plans to move all exterior work outside the K-12 Barriers to the second phase of the project. This will allow the project team to save time on the schedule for phase one of construction and allow the ability to turn the project over to the owner sooner than planned. Due to the unknown levels of scope the owner wants to switch to the second phase of construction, the overall time and cost that can be saved is unknown.

Return Duct Replacement

Throughout both buildings, there is a large amount of return duct work to properly redistribute the air quality into the mechanical system from all occupied areas. The design is very efficient but consumes a large amount of the overhead space within the ceiling due to the amount of sheet metal duct work that must be ran from a room to a specific unit.

To reduce the cost of labor and materials, the project team wants to utilize a return system that focuses around the use of return grills. These grills will be placed within the ceiling above and redirect the return air to a shorter distance. The cost difference between the two systems is unkown at this time, but the amount of sheet metal duct work should be reduced by one third of the total amount originally designed; this will save a large amount of money for the owner due to the high labor rates of installing mechanical systems and price of sheet metal duct work.

Problem Identification

Through the analysis of constructability challenges, schedule acceleration scenarios, and value engineering topics based from the Project Manger interview, several items were identified as problematic situations within New York Police Academy. The following items may possibly be pursued in upcoming research topics.

Fuel Tank Room Sequencing

Sequencing within the Fuel Tank Rooms causes problems within two areas of construction; safety and schedule. Due to two major hazardous trades being performed within the same area, steel and concrete, major dedication must be implemented in order to ensure that all craftsmen go home safely. Items such as number of workers, erection schedule, and pour schedule must be considered prior to this phase of the construction.

Beam Erection of Castellated and Cellular Beams

The erection of the castellated and cellular beams under and over the quarter-mile, indoor track poses several problems onto the schedule. Due to the amount of work required to stiffen the beams, the sequencing of trades involved, structural steel and concrete, must be thoroughly analyzed to ensure a proper time frame is established and maintained. Failure to do this can cause large delays within the Central Utility Plant / Physical Training due to the large amount of members that need to be erected.

Hoist Connections within the Academic / Administration Building

Throughout the majority of construction for the Academic / Administration Building, one hoist complex will be connected to scaffolding. This procedure poses a large area of risks upon the site workers if the scaffolding is not constructed properly. Safety coordination between the trades and strict OSHA guidelines will have to be analyzed and followed in order to provide a safe and functional work environment.

Contaminated Site Fill

Due to the location of the site being on the former NYPD College Point Tow Pound, there is a high risk for contaminates to be present. This will cause high impacts both on schedule duration and safety for both workers and the surrounding environment. As mentioned before, if contaminated soil is discovered, it must be trucked out and new, clean fill must be trucked in to replace it; this will consume valuable time during the excavation process of construction. Also,

if workers or the surrounding environment are exposed to the contaminate fill in some way, unknown effects could result.

LEED Involvement

Throughout the early stages of research on the New York Police Academy, it was discovered that the building will pursue a LEED rating of at least silver. This is required by law in the state of New York for any government funding building project. However, it is unclear what credits are being pursued; this may be a direct effect from the project being on a modified fast track design. A further analysis into the systems to be implemented could provide substantial research as New York Police Academy currently has high electrical, heating, and cooling loads which will affect the overall operation onto the owner, The New York Police Department

Startup of Central Utility Plant

A large portion of the interior finishes schedule relies on the startup of several items, such as boilers, chillers, and electrical distribution equipment, within the Central Utility Plant. The only major problem that will result from this situation is one in which the CUP is not ready for startup. This will further delay all interior finish work and cause an unknown cost for correction onto the overall construction cost of the project. A further analysis on sequencing and/or the overall cost of mishap could provide substantial research topics.

Value Engineering

With the project being split into two phases due to funding, value engineering can provide a possibility to obtain some items from the second phase to be implemented into the first phase. At the moment, the biggest item that will be affected is the possible sitework outside the K12 barriers that will be moved from the first phase to the second phase. However, if all three options mentioned above are performed, a minimum of three million dollars will be saved; this additional funding could be used for items that were left out such as the indoor shooting range, tactical village, or indoor driving course. A further analysis on the overall cost savings from value engineering to the overall cost of some of the smaller items such as the tactical village or indoor shooting range could provide substantial information for upcoming research topics.

Technical Analysis Methods

Technical Analysis Method #1: Redesign of Castellated and Cellular Beams

As mentioned in the Constructability Challenges section, the method for the construction of the castellated and cellular beams is very time and labor intensive. Each beam will have 8 inch diameter steel piping, filled with high strength concrete, welded to the upper flange to increase the overall stiffness of the beam; this process will allow the beams to span the distances required.

This analysis will focus on the research to either find a similar beam or truss system that will perform the same without the need for the additional reinforcement that is being implemented. In order to ensure the replacement beam or truss is sufficient enough, basic fundamentals from AE 404 will be implemented within the research. AE 404 is an architectural engineering class that helps non-structure options understand the process and concepts behind structural design. After a suitable replacement is found, a cost comparison will be performed to identify any possible savings. Finally, a comparison on overall construction time for the specific activity will be performed to identify any possible key changes to the overall schedule that will help the project team deliver the project earlier to the owner.

Technical Analysis Method #2: LEED Systems Addition

As mentioned in the previous section, it is unknown what LEED systems are to be installed. This comes from the modified fast track design approach of the building and an incomplete set of building specifications. Currently the New York Police Academy is designed to operate on high cooling, heating, and electrical loads.

This analysis will focus on the research of mechanical units that have a design focused around sustainability. Some small examples would be the identification of high efficiency chillers and cooling towers for the cooling loads and high efficiency boilers for the heating loads. Basic skills in mechanical design will be used to ensure that the overall performance of the system will not change in overall quality for the occupants. As for the electrical loads, high efficiency lighting units and equipment will be used for design. Through the use of lighting software, a comparison between the designed fixtures and high efficiency fixtures can be analyzed; the key concept that will be analyzed is the overall foot-candles produced on the work plane to see if the current system can be replaced. Finally, the windows on the southern side of the building are fitted with architectural awnings from the curtain wall system; these awnings are made from two pieces of metal panels set at a specific angle. An idea is to mount photovoltaic cell arrays to these angled panels to capture solar electricity. An overall cost analysis on installation as well as overall savings onto the electrical load will be performed for this system. Also, an analysis on

the overall impact of the schedule will have to be performed due to the extra work that will take place.

Technical Analysis Method #3: Fuel Room Resequencing

As mentioned in the Constructability Challenges section of this report, the fuel room sequencing is somewhat of a safety nightmare; during the construction of this area, steel members will be erected over an active concrete pour. New York Police Academy's project manager stated that the project team is taking every precaution in order to sequence the work so the two trades involved, concrete and steel, do not interfere with one another's safety.

This analysis will focus on reorganizing the schedule to allow the trades to do the work needed at two different times. Upon understanding the amount of work that is needed to be put into place by both parties, a proper analysis of time involved can be included. With this number known, the schedule can be resequenced to allow sufficient time for the steel erection to move on to the next area and allow the concrete contractor to move in and perform work without the fear of an accident happening.

To perform this analysis more efficiently, contact with Pat Murray, project manager of New York Police Academy, will be used to identify any small details about this specific area. There is a slight chance that the schedule will be shorten which will reduce the overall cost of the project by lowering the general conditions portion of the construction cost.

Technical Analysis Method #4: Façade Redesign

During early assignments it was noted that the northern face of the Academic/Administration building was equipped with the same angular metal panel design as the southern side. This angular design is being implemented to perform shading from solar light for the occupant; however, the northern side will not have to worry about this situation as much as the southern side will. Also, the western and eastern sides of the building are covered with a matching color precast panel system to that of the metal panel system.

This analysis is to redesign the northern, western, and eastern side of the building to a straight metal panel design. In order to complete this analysis, a full structural reduction will be included for all three sides due to the reducing weight of the materials, a cost comparison between the before and after appearance, and a timeframe comparison of the schedule between the before and after appearance. Finally, a detailed discussion with known architect's will be have to ensure the building's appearance still meets its overall function.