Renovation of an Office Building in Washington D.C.

Washington, D.C.

Technical Report #3: Alternative Methods Analysis

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Executive Summary

Technical Assignment Three is intended to identify areas of the project that are good candidates for research, alternative methods, value engineering, and schedule compression for the Office Building in Washington, D.C. This project includes a 550,000 SF renovation of an existing office building. One of the largest challenges associated with this project is the existing chilled water plant on the Sub-basement level, which provides chilled water for an adjacent building, must remain in operation 24/7.

The top three constructability challenges identified on this project are maintaining the operation of an existing chilled water plant that serves an adjacent building and must remain in operation 24/7, working within the constraints of an extremely tight site, and the cutting of a new 8-story 20'x100' atrium through the existing building. Each issue presents different challenges that must be addressed by the project team. The critical path of the project is set up to run through procurement, demolition, curtain wall installation, and MEP. Several schedule acceleration scenarios are identified and include focusing on the curtain wall and MEP systems by increasing crews. A formal Value Engineering process was not considered in the design phase or any other phase of the project because it was a public works project.

Through the in-depth analysis of the constructability challenges, schedule acceleration scenarios, value engineering topics along with an interview with the Project Management team, several features were identified as potential challenging areas on the Office Building project. Several of the identified problem areas are further discussed in the four construction management analysis activities that include Simplifying the Façade, adding Photovoltaic panels to the green roof, using an Integrated Project Delivery method, and the coordination of the existing chilled water plant. Each of the methods discussed provide insight into possible research topics for the spring thesis proposal.

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Constructability Challenges

Considering that Notice to Proceed occurred on March 2, 2010, it is difficult to determine many challenges as they have yet to occur. During the Project Manager interview, the project manager was able to identify several areas that may potentially present challenges to the construction team. The three major challenges facing the Project Management team are maintaining the operation of an existing chilled water plant that serves an adjacent building and must remain in operation 24/7, working within the constraints of an extremely tight site, and the cutting of a new 8-story 20'x100' atrium through the existing building.

Challenge #1: Maintaining Operation of the Existing Chilled Water Plant

The interior of the Office Building was demolished with the exception of an existing chilled water plant located on the Subbasement level, which provides chilled water for an adjacent building and must remain in operation 24/7. The project manager identified this as the largest constructability challenge. The chillers in the subbasement are eventually going to be replaced, but they are being replaced in the exact location of where they sit now. Their challenge was to determine how to replace the existing chillers in the chiller plant without interrupting service to the adjacent building.

To resolve this issue, the project management team brought temporary chillers in on a truck bed and placed them in the existing parking lot between the two sets of project trailers. ***Figure 1*** below shows the exact location of these temporary chillers in red. They are located on the North Side of the building between the Construction Manager and General Contractor's trailers.

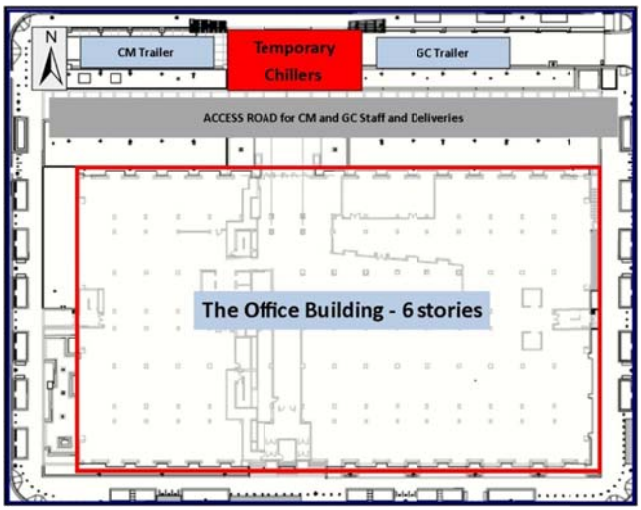

Figure 1: Location of Temporary Chillers

Challenge #2: Site Constraints

Building in Washington, D.C. can be a challenge because of the limited space there is to spread out. The site of the Office Building takes up an entire city block and is therefore locked in with streets on all four sides. Refer to ***Figure 2*** below to see the site plan. There are a couple of key elements of the construction process that can be affected by a tight site. Some of these elements include onsite staff trailers/offices, material lay down areas and delivery of materials. As far as onsite offices go, the Construction Manager and General Contractor were the only groups allowed to have onsite trailers. There was no room for the subcontractors to have trailers onsite, so it was up to them to figure out where they would run their operations. There was limited room in the underground garage and basement level for the subcontractors to set up if they were on site that day. Another issue with a tight site is material lay down areas. As of now, the majority of the material being delivered on site is being stored inside the building. The material is lifted with a crane and brought into the building through the windows. As time goes on, material lay down space will decrease and it will be harder to coordinate where everything is going to be stored. They are currently starting ductwork and mechanical work and are finding that the material is taking up a lot of space. Deliveries are also a challenge with a project located in a city. It is a process that needs to be heavily coordinated and scheduled properly.

One way the project management team is alleviating the constraints of a tight site is by obtaining a Public Space Permit from the city of Washington, D.C. The public space permit allowed the project management team to fence in the sidewalk on 3rd Street and D Street. They were trying to obtain the parking spots on 2nd Street for additional space, but the government officials who use the spot were reluctant to give them up. The General Contractor has offered to buy them other spots in the city, but they won't accept it. ***Figure 2*** on the next page highlights in yellow the areas where the Public Space Permit has taken affect.

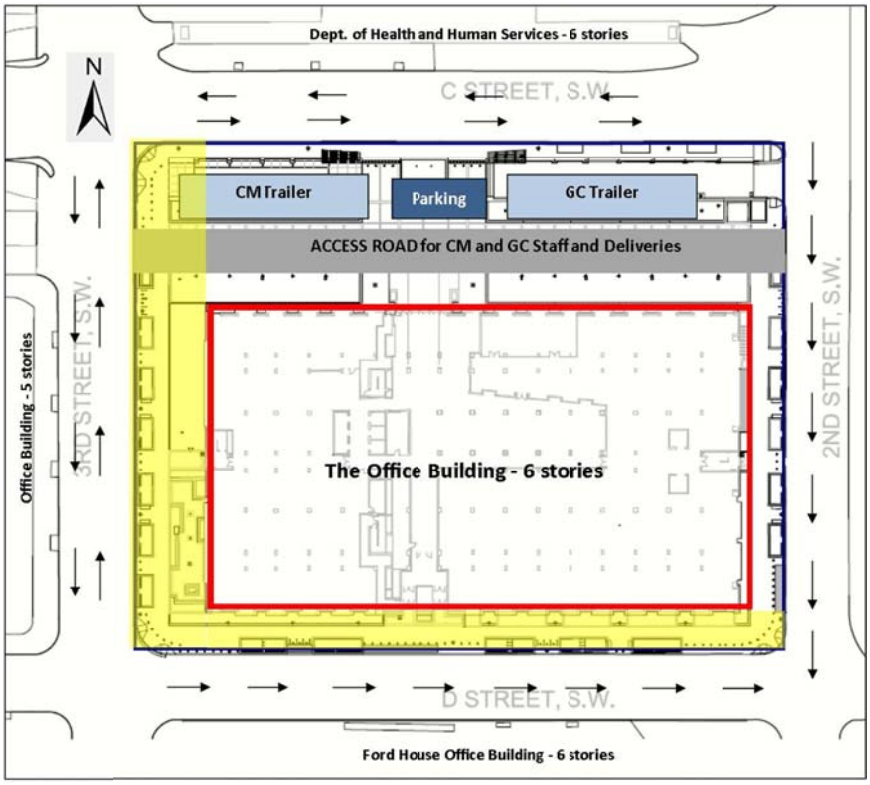

Figure 2: Area of Public Space Permit

Challenge #3: Central Atrium Construction

The Office Building was originally built in the 1970s and therefore does not have the most reliable as-built drawings. The owner did not do an efficient job keeping track of the as-built drawings which was a challenge to the project management team when this project first came up. Before any demolition or construction began, a survey team had to come in and survey the building and distinguish where all of the columns and beams are located. The survey team assumed that all of the columns lined up throughout the building, but that ended up not being the case. This presented a challenge when cutting the 8-story Central Atrium through the building. To solve this problem, the project team dealt with the discrepancies on a floor-to-floor basis. In the end, the Central Atrium ended up moving a little bit to coordinate with the existing columns. As a result, the existing drawings do not match with the actual conditions.

Schedule Acceleration Scenarios

Critical Path

The critical path for the Office Building consists of procurement of subcontractors and materials, demolition of the existing building, construction of the curtain wall, and the MEP work for the building. Construction of the Curtain Wall drove the entire project and really determined the schedule. Currently, the general contractor is dealing with a couple of issues of getting the Curtain Wall approved. Because the Office Building is so close to the U.S. Capitol, there are extra restrictions as far as blast protection goes. The project management team is confident that these issues will be resolved before construction of the Curtain Wall is scheduled to begin. A visual of the Critical Path can be seen below in ***Figure 3***.

Figure 3: Critical Path

One of the biggest factors that could potentially push the project completion date back is issues concerning the owner. Throughout the project, RFIs, change orders and submittals have taken too long on the owner's side. The general contractor has been keeping track of everything that is sent to the owner and monitoring how long it takes them to respond. When it comes to the end of the project and it does not look like the project management team will be able to make the completion date, they have a log of how long the owner has delayed them throughout the project. There are liquidated damages on the project, but due to the confidentiality of the project, the exact amount for liquidated damages could not be provided.

Acceleration Techniques

After talking with the project management team, key areas that have potential to accelerate the schedule are the Curtain Wall and MEP. Like discussed earlier, the Curtain Wall is on the critical path of the project schedule, so any sort of delays are unacceptable. Construction of the curtain wall has not begun yet, but once construction does begin, two ways to accelerate the schedule would be to work extended shifts and have multiple crews working at the same time. These options would of course come with extra costs, but that is where it is up to the owner to decide if those extra costs are worth having the building turned over at an earlier date. The chilled water plant in the basement is another area where the schedule could have been accelerated. It took the project management team longer than they have expected to get the temporary chillers approved and set up on site.

Value Engineering Topics

A formal Value Engineering process was not considered in the design phase or any other phase of the project because it was a public works project. This type of project is hard bid and does not provide much incentive for value engineering to occur. Had the project been a privately owned one, value engineering would have been a great idea. The reason for this is that the contractor would then have more incentive and flexibility to work with value engineering ideas. The owner of the Office Building was very clear that they wanted to focus on the architecture of the building and the use of high-end finishes. The façade of the building included the use of very expensive materials and complex connections of the curtain wall. One value engineering idea would have been to simplify the curtain wall and make the fabrication details simpler. This could save money and installation time.

Unfortunately, the design firm was unavailable and could not comment on some ideas they had in case cost cutting would have been needed or, if the project came in low, what they would have changed.

Problem Identification

Site Layout

Additionally, the limited site layout is a challenging construction method of the Office Building. Although the site takes up an entire city block, the only storage space is around the perimeter of the site on the existing sidewalk and parking lot. The General Contractor had to obtain a public space permit in order to close the sidewalk on 3rd Street. Both of these areas were available for a limited time and heavy coordination was involved for the installation of the curtain wall façade and the streetscape.

MEP Coordination

A problematic feature of the Office Building is the density of MEP installation that needs to be placed into the 12" plenum space. The space needs to be utilized by numerous subcontractors for items including fire protection, cable tray, branch duct, branch piping, duct mains, supply air ducts, returned air register, and hot/cold water piping. MEP coordination was also an issue because the drawings of the original building showed the plenum space as completely open when in fact there were multiple concrete beams that ran through the plenums.

Existing Chiller Plant in the Sub-Basement

One of the largest challenges encountered in this project was the existing chilled water plant in the sub-basement. The chilled water plant serves an adjacent building and must remain in operation 24/7 throughout the entire construction period. It took a while for the construction team to come up with a plan to coordinate the operation of the plant.

Curtain Wall and Façade

The Office Building has a complicated façade system, a mixture of existing limestone and granite panels and new glass curtain wall. The interaction between these systems creates coordination issues more complicated than a standard curtain wall façade on a new building. This is something that needs to be coordinated and planned ahead very carefully to avoid schedule issues when this phase of construction is reached.

Lack of Effective Coordination

Coordination is an issue on almost every construction project and the Office Building was no different. Had a more intense coordination process taken place in the design phase,

discrepancies between different trades and drawings could have been recognized early on which would have prevented a lot of challenges that were encountered on the project.

Technical Analysis Methods

TECHNICAL ANALYSIS #1: SIMPLIFYING THE FAÇADE

As described in the previous section, the façade of the building is a mixture of existing granite and limestone panels and glass curtain wall. Working with two different systems can provide many challenges in the field concerning the constructability of the façade. The connections can be very time consuming and quality could be lost along the way. There are added difficulties because the granite and limestone panels are existing while the glass curtain wall is new construction. The proposal is to change the façade to a prefabricated glass curtain wall system that can be attached to the existing panels more easily.

The main focus of this analysis will be an attempt to shorten the schedule and reduce the cost of the façade, while remaining aesthetically pleasing. The Curtain Wall and façade is on the critical path, so changing the façade should have a great affect on the schedule. An analysis will also be done of the structural effects of changing the façade. A comparison between the costs of the existing system and proposed system will be done to evaluate the cost benefits, if there are any. If a reduction in overall schedule is determined, the savings in general conditions and management fees will be calculated to further prove the benefit to the owner.

Research will begin by learning about different prefabrication options for the facade system followed by their respective costs. Curtain Wall and façade manufacturers will need to be contacted to help better understand prefabrication options and their cost benefits.

TECHNICAL ANALYSIS #2: ADDITION OF PV PANELS TO THE GREEN ROOF

The design of the Office Building was very focused on attaining LEED accreditation points. About half of the roof consists of a green roof, but one alternative would be to place photovoltaic (PV) panels on top of the green roof. The combination of PV panels and a green roof has proven to be more efficient than a green roof on its own. Although it will be more expensive up front, it may prove to be more efficient over the long run. The PV panels would also be able to work off of the SmartGrid and create its own energy for the building. This would help the owner out with energy costs throughout the lifespan of the building. Research would need to be conducted about the combination of PV panels and green roofs and the benefits would have to be weighed. The SmartGrid would also have to be looked into.

A cost benefit analysis of the current green roof system and the proposed combination system of PV panels and a green roof will be run to determine if this would actually be a better alternative for the owner and the future of the building.

TECHNICAL ANALYSIS #3: PROJECT DELIVERY METHOD

Issues developed on this project due to the design not being closely managed and difficulty to coordinate all of the different trades. Changing the project delivery method to an Integrated Project Delivery Method (IPDM) would eliminate these issues. The traditional design-bid-build delivery method used on this project, while familiar, created issues along the way.

Using an IPDM as the delivery method provides many benefits to the owner and the overall design of the project. An IPDM provides high quality design and construction because the architect plays a major role and is responsible directly to the owner. Having involvement from all of the different designers can save time in the design phase and the increased coordination will benefit everyone. Only one set of drawings would need to be issued to the subcontractors, removing many errors down the road. Also, with multiple design teams working on the same project at the same time, the chances of mistakes being caught during design instead of during construction are much higher. Finally, having a construction manager involved in the IPDM can assist with the costs of the design and help bring the final building costs down for the owner while still leaving the owner highly involved in the process.

The analysis will involve research into the basic methods of how the integrated project delivery method works. It will involve case studies and if possible talking to people who have worked on IPDM projects. The basic analysis will be in terms of efficient design and construction practices. The current method of design-bid-build creates a lot of wasted efforts for each group and does not always deliver the best possible product. A secondary objective will be to examine any cost and possible schedule benefits from using this method.

TECHNICAL ANALYSIS #4: COORDINATION OF THE EXISTING CHILLED WATER PLANT

The coordination of the existing chilled water plant in the sub-basement was a huge challenge for the construction team. If planning would have occurred at an earlier stage of the project, some of the larger costs that were incurred could have been avoided. When demolition of the existing building began back in March 2010, a solution to coordinating the chilled water plant had not been thought of yet. So as the project progressed without a solution for the chilled water plant, the cost of a solution increased. The proposal is to bring temporary chillers onto the site in the very beginning of the project and to switch out the old chillers with the new chillers. The main focus of this analysis will be to reduce the cost of the temporary chillers by having them on site for a shorter amount of time. This also has a chance of reducing the schedule by placing this activity at the very beginning of the project.

Research will include looking into temporary chillers and how much they cost to have on site and be functional. The project management team will also be utilized to help with real time cost and analysis.