



# The Potomac Yard Land Bay E

Arlington, VA

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## **Executive Summary:**

Technical Assignment 3 will identify the constructability challenges, schedule acceleration scenarios and value engineering topics that were faced during the construction of the Potomac Yard Land Bay E project. These three issues were determined from an interview with a member of the project management team. Other topics covered in this paper include problems identified from the research conducted on this project throughout the semester and from the interview. Finally a technical analysis of the topics presented will be evaluated to determine possible research topics for the thesis proposal.

The constructability challenges section includes a description of the challenges that the management team faced when building the Potomac Yard Land Bay E project. This section also includes a description of how the team overcame the issues on the project. The three issues discussed include the erection sequence for the architectural precast, problems procuring the curtain wall glazing and the dewatering issues in the underground parking garage during construction.

The schedule acceleration section starts with identifying the critical path of the project schedule for the Potomac Yard and why it is so important to follow it. Next in this section includes a schedule acceleration scenario in which the project team implemented to help shorten the critical path of the project schedule. In this section it is stated that the team acquired two mobile cranes to assist in the erection of the architectural precast panels. The reason for the acceleration of this task was to have the window contractor begin work earlier than projected. Finally in this section is the discussion of the cost and techniques that were used to make this acceleration scenario possible.

The next section of the technical assignment includes areas of value engineering options that were implemented on the project. In this section the opportunities were identified along with their corresponding dollar amounts. A description of the selection process of approving the ideas was also described. Lastly in this section the value engineering options that were proposed but not implemented was identified along with the dollar amount that corresponds to each idea.

The problem identification section includes problems or opportunities that I have found through either my research or interview with a member of the project team. In this section there are many different areas of the project where I describe items that I think can be improved upon or changed. Some of the main areas of consideration are the building envelope, energy efficiency, design coordination and punchlist problems.

The final section of the paper includes possible technical analysis methods that could be utilized for areas of research for my final proposal and next semester work. The items that I found to be good possible research topics included supplemental energy, solid curtain wall system, more efficient mechanical system and LED lighting.

## **Constructability Challenges:**

The Potomac Yard Land Bay E project is a 370,000 square feet two tower office building that also includes a 235,000 square feet underground parking garage. This project is scheduled for a 20 month long project duration and having its final completion in late September of 2009. To achieve this date the project management team at Davis Construction needed to overcome some constructability issues that occurred throughout the construction of the project. This project has many interesting features that make it a unique project and pose some difficult challenges to the construction of the project. The project is located on a 1.35-acre site that is surrounded by other structures. Once the underground parking garage was completed the site limitations for large equipment was reduced. This building is also projected to be certified LEED Gold upon its completion. This status alone causes a need for different construction methods and acquisition and disposal of materials. The three main constructability challenges that faced the Potomac Yard Land Bay E project include: sequencing of the architectural precast, glass and glazing and the dewatering of garage.

### **Precast:**

The building envelope of the Potomac Yard Land Bay E project consists of two types of systems. One of the systems is a curved curtain wall system and the other consists of architectural precast panels with punch windows. One of the main constructability concerns that the project team had when building this project was how to sequence the erection of the architectural precast panels so that it would not impede the project's schedule. The problem that arose during this process was that the contractor only wanted to use one crane, which was the tower crane that corresponded with the use for the structure of the building. The problem with this scenario was that this would not allow the erection process to meet the timeline.

The project team came up with a solution that involved starting the erection process for the architectural precast panels before the top two floors of structural CIP concrete was topped out. It was determined that when the concrete crews were assembling formwork and placing supports between decks that the precast erection crew would have time to use the crane's services. This created a safety problem for the precast erectors because they had to work below the structural concrete workers above. The project team determined that this was the best solution for keeping the project on track by only using one crane. The project team addressed the safety issue by not allowing the concrete crew to work directly above the precast erection crew working below. On the entire remaining floor of the building a no work zone of 5 feet was implemented to allow for the safety of the workers. The project team also implemented daily safety meeting to coordinate the different areas that each of the crews would be working.

See Appendix A for Precast Sequencing

## **Glazing:**

Another issue that the project team faced during construction of the building was the curtain wall system. The procurement of the glass curtain wall system became a problem as the project neared completion. The curtain wall contractor, TSI, was not receiving enough material to keep them on track for finishing the glazing in the timeline provided. TSI's material supplier failed to provide the correct amount of ordered material to complete the project. This was critical because the building needed to be closed in for some of the other trades to complete their work.



Figure 1: Curtain Wall System

The project team needed to act quickly to resolve this matter because this issue had the potential to hold up the whole project causing it to not complete on time. To resolve this problem the construction manager contracted both TSI and their vendor to provide the number of units that were not on-site needed to complete the curtain wall system. A detailed building façade schedule was part of made part of the contract specifying when each elevation's material must be delivered and installed. TSI realized that this was an important part of the project and stepped up their manpower in order to complete the curtain wall system on time.

## **Dewatering:**

Another constructability issue that was encountered on this project was the large amount of water on the site. This site sits almost at sea level and has a very high water table. When the geotech report was conducted for this project it was determined that a deep foundation system would be required to support the structure and a permanent dewatering system would need to be installed in the lower level of the parking garage. The water issue caused problems in the lower level of the parking garage with flooding during construction. During construction dirt and debris would enter into the retention basin located in the bottom of the parking structure and would cause problems for the pumping system.

The project team had to hire a pumping company to come to the site with a suction truck and pump out the dirt and debris in the retention structure. Once that was completed the

pumps needed to be cleaned and rechecked to ensure proper performance. To stop the construction debris and dirt from entering this area, the parking garage was cleaned and swept. Since the parking structure is underground the entrance to the facility needed to be re-graded to divert rainwater and soil deposits from entering the garage drainage system. By completing these steps the dewatering system was able to operate correctly.

## **Schedule Acceleration Scenarios:**

The schedule for the Potomac Yard Land Bay E project consisted of a duration of 20 months with a project completion date of September 30, 2009. The schedule has many important milestones throughout that must be obtained in order to keep the project on track to achieve its final completion date. The critical path of a project's schedule are a sequence of activities that govern the schedule and must be completed on time to ensure that the total project's timeline is upheld.

The critical path for this project begins with the sheeting and shoring for the foundation and parking garage. The next item on the critical path of the project is the excavation for the parking garage and foundation. The sheeting and shoring along with the excavation take about seven months to complete. After the excavation is completed the deep foundation installation may begin. The precast piles and pile caps take about five months to complete. The next item on the critical path for the Potomac Yard is the structural system. The cast in place concrete structure takes about five months to complete for both towers. The next activity that was critical to the project's completion was the erection of the architectural precast panels. This task takes about three months to complete. After the precast is put into place the punched window and the curtain wall system begins being installed. The duration of these activities take about three months for completion. The final activity on the critical path of the project's schedule is the roofing system. This activity is completed by September 11, 2009.

Some issues that would be a risk for obtaining the project's final completion date are obtaining the necessary materials from suppliers on time for installation, having the correct amount of manpower on site to perform the need installation, weather delays and limited equipment. Making sure that all of the subcontractor's vendors have the material in stock or fabricated is very important to a project schedule. If the subcontractors do not have all of the necessary materials to install on the project, like the curtain wall subcontractor, that would cause the project to experience delays that may extend the final completion. Another risk that a project may have is the lack of required manpower to install critical systems on the critical path of the schedule. If this were to occur the subcontractor would need to acquire more manpower or be forced to work overtime and weekends to uphold their contract timeline.

One big issue that may be a risk to the project completion date may include the weather. The weather cannot be controlled by the project team and may cause some timely delays that could slow down many different trades. An example of this would be the sheeting and shoring, excavation and foundations. These activities are crucial to the project's schedule. If these items start later than planned then the whole project has the potential to be behind. Another item that is problematic for a project is having the correct amount of equipment on site and ready for use. An example of this includes having the right amount of cranes for lifting the various systems into place on the building. Many of these systems include the structural concrete, building façade, roofing system and equipment.

An activity that was accelerated on the Potomac Yard project was the erection of the architectural precast panels on the east elevation. This was achieved by bringing two supplementary mobile cranes. By doing this the architectural precast was installed at a faster rate which would allow the window contractor to begin the punch window installation much sooner than originally decided. The cost and implication of performing this task was the cost renting the mobile cranes and paying an operator to be on site. The benefits of performing the erection this way was that the precast was erected much faster and another trade was able to come in and perform their installation much sooner which helped to save time on the overall project schedule.



## Value Engineering Topics:

Value engineering is a process that is considered on most construction projects. Some owner's in the industry do not like the term of value engineering but prefer cost saving ideas. Value engineering is the examination of cost and quality of a product. Most often it is looked at for substituting a product for a similar product that costs less but still has the same quality or performance. Sometimes a value engineering suggestion involves a product that improves quality and performance but may cost more than the original design. In this case the use of this item must surpass the designed item and be approved by the owner.

There were many value engineering suggestions made for the Potomac Yard Land Bay E project. The majority of the value engineering options that were determined for this project would involve the site work and MEP systems. Some of the value engineering items that were used on the project include:

- Revise the fill below Clark Street from 21A to structural fill - \$205,000
- Revise soil fill on garage to 50% topsoil on the top of the existing site soil - \$150,00
- Change to Prospect waterproofing instead of prefabricated - \$32,400
- Use elastomeric paint in the garage, helps with waterproofing - \$145,000
- Elimination of the discharge duct and damper downstream of the VAVs - \$29,000
- Do not connect VAV until tenant is secured - \$28,000

The project team feels that the goals and needs of the owner were met by implementing these value engineering options. All of the items listed above were discussed and approved by the general contractor (DAVIS), owner (The Meridian Group), design group (DCS) and the MEP engineers (Allen & Sheriff Corporation). The MEP engineering group was consulted only on the matters involving Divisions 15&16. All of the value engineering options that were implemented on this project total \$589,400.

The Potomac Yard Land Bay E project also considered many more value engineering options but were not implemented on the project. The options that were considered but not used include the following:

- Changing the insulation on the Polyphase motors for the HVAC pumps to increase efficiency, change from class H to class F - \$11,000
- Change the stainless steel used on the cooling towers - \$10,000
- Change the original design of the buss duct from copper to aluminum - \$89,000
- Do not run the branch circuits to the VAVs until tenant acquired - \$130,000
- Change out the typical floor light fixtures - \$9,500

All of the proposed valued engineering items above were not implemented on the project because one of the three parties did not agree with the item or think that it would be beneficial to the building. The total cost of the value engineering options that were not implemented is \$249,500.

## **Problem Identification:**

After analyzing the construction management, building systems, schedule, cost, site and local conditions, and constructability for the Potomac Yard Land Bay E project a number of issues with the project and areas for improvement have been identified. All of the problems will be a good area of research for alternative methods or material, schedule acceleration and value engineering. From these items a proposal for research during next semester will be completed.

### **Building Envelope:**

The architectural precast panels erection turned out to be a longer process than anticipated. This erection process had to be taken into careful consideration in order for it to be completed in the contract schedule. This process needed to be performed during the structural topping out of the building that resulted in extra meetings for coordination and safety precautions between the GC and subcontractors. An interesting topic of research would be different erecting methods for architectural precast panels and faster connections.

The installation of the curtain wall system for this building became a problem for the contractor when the vendor for the materials stopped delivery on the items needed for completion. It is critical that all the correct materials are ordered in a timely fashion and the deliveries are on time. If building materials are not delivered on time for installation and the activity is on the critical path, the project may be in serious jeopardy of not finishing on time. To solve this problem other building envelope systems could be proposed for this section of the building enclosure or make the whole building enclosure one solid system.

### **Energy Efficiency:**

The Potomac Yard Land Bay E is a large office building with an underground parking garage. This type of a building typically uses large amounts of energy for lighting, MEP systems, computers and security. Mostly all of these systems will be running 24/7. Since this project is projected to be a LEED Gold building upon completion it would only make sense to propose some energy saving systems. Energy consumption in commercial buildings is at a very high level in comparison to other countries around the world so implementing more efficient building systems and supplemental energy devices for this building could be a great research topic.

### **Design Coordination:**

The Potomac Yard Land Bay E project did not implement any 3D models or design drawings. Everything was completed with hard copy drawings and submittals. This project, like all other construction projects, had design problems, equipment clashes and long field assembly. If the design team had more time and resources it may have been possible for them to implement a Building Information Model that would have helped with the coordination of trades and drawings. If a BIM model would have been used it

would have helped reduce the number of RFIs, clashes in the field, increase prefabrication efforts, tracking materials and much more.

**Punchlist:**

On this project there were a lot of items that were listed on the punchlist that were caused by damage and not because of completion issues. The problem was that many finished items were put into place in high traffic areas for access to other locations of the building that were unfinished. Many of the typical items that were damaged and needed repaired or replaced included: finished doors, drywall, railings, paint and fixtures. Other means of access should have been provided but nearing the end of the project the material hoists and cranes were removed making the stairs and designated elevators the only means of access to the higher floors. An interesting research topic could be looking for new protective materials for walls, rails, floors and window sills.

## Technical Analysis Methods:

Four areas for technical analysis on the Potomac Yard Land Bay E project have been identified as further research opportunities for my thesis project. These four items will yield for an in depth technical analysis in the future. Below is an outline of what could be analyzed.

### Supplemental Energy by the use of Solyndra PV Panels:

Although the Potomac Yard Land Bay E is projected to receive LEED Gold upon final completion there is always room for improvement concerning the building's energy consumption. By installing the Solyndra PV panels this would help supplement the building's energy supply and reduce its dependence on energy from the grid. Another reason that the use of this energy system would be beneficial to this building is to harvest the reflected sunlight from the white TPO roofing membrane that has already been installed. When installing the Solyndra panels with a white reflective roof you will receive optimum performance from the product.

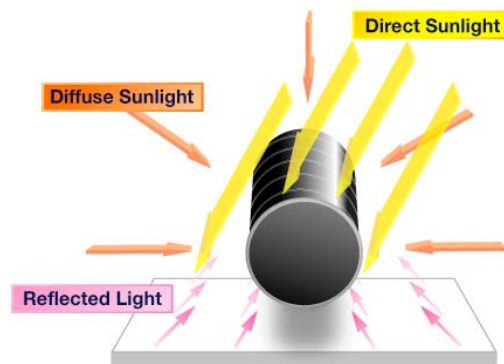


Figure 2: Solyndra PV Tube

From a construction management perspective of the project an analysis of the cost and schedule impact would need to be considered before the implementation of this product would commence. To determine the cost implications of using this product a study of how much the product costs, installation costs, lifecycle determination for payback and average energy production would have to be performed. For schedule impact scenarios research would have to be conducted by consulting Solyndra's website and by contacting Solyndra to determine the installation procedures for the panels. For the design aspect of implementing this product a study would have to be conducted to determine if the additional weight of the panels and anchoring assemblies would overload the roof structure of the current design.

### Punch Window & Precast Panels to Solid Curtain Wall:

The current façade system for the Potomac Yard Land Bay E project consists of both a curved curtain wall system and punched windows surrounded by architectural precast panels. One way to implement some cost savings into the project could be by changing the entire building façade to a curtain wall system. By having a solid curtain wall system

need for a variety of different material types for the exterior would be eliminated and the schedule for the building façade should be shortened which would turn into cost savings for the project. Another reason for implementing a solid curtain would be for receiving higher rent from the tenants because of the increased amount of natural light being allowed into the typical floor because of the glazing running from floor to ceiling.

There are a few constructability aspects that would need some attention before implementing this type of building envelope system. The weight of the system would have to be determined and then compared to the existing system to determine if any structure impact would occur. The building would not have a need for blast resistant glazing which would obviously weigh more than the original system but the weight of the normal glazing would have to be determined for comparison. The cost of this system would also have to be determined to see if it would be cost effective to implement this system. If the system costs more than an analysis of the time saved to extra cost would have to be performed to determine if the use would be feasible. To determine the cost, schedule impact and weights of material I would have to contact Enclos Corp. and Davis Construction to discuss my ideas. I worked for DAVIS on the Constitution Center where Enclos implemented this type of a system and exceeded the scheduled timeline.

### **Mechanical System:**

The current mechanical system that is utilized on the Potomac Land Bay E project is a typical VAV distribution system. The system that could be proposed for use on this project may be a chilled beam mechanical system. Although this system is not commonly used in the United States yet it has been implemented in Europe on several occasions. I have also had the privilege of working on the Constitution Center project for Davis Construction for the summer of 2009. This project used the chilled beam system throughout its typical office floors. The Constitution Center is a sealed office building just like the Potomac Yard project so the implementation of the curtain wall system and the chilled beam system would work great together.



Figure 3: Trox Chilled Beam

Typically the chilled beam system works best in a sealed building environment with little humidity. This system is also known for its high efficiency due to transportation of energy through water piping which is more efficient than forced air systems. Another positive to this system is that the use of hydronic piping instead of large forced air ductwork would allow for a shorter plenum space which results in lower floor to floor height and a cost savings in the reduction of concrete usage. The cost implications of this system would

obviously be a higher up front cost to the owner but a study of the reduction of concrete and energy would have to be performed and compared to the initial cost differential between the two mechanical systems to see if it would be an effective substitution.

To research this idea I would have to work with the Constitution Center team at DAVIS for ideas and information to determine the items stated above. I would also have to contact the manufacturer of the chilled beam system, Trox Technik, to determine some of the design considerations. Also by talking with the DAVIS professionals I will be able to determine the schedule implications that would be caused by changing to this type of a mechanical system.

### **LED vs. Florescent Lighting:**

The Potomac Yard Land Bay E project is a base building project with currently only two tenants. The building interior will be completed at later time when the owner finds a client to rent the space. The lighting system throughout the building is predominately tubular florescent lamps. I will not perform a study on changing the lights on the typical floors but look into a study for interchanging the existing lighting fixtures in the cores, lobbies and gym areas. These areas are already at their finished state. By changing the lighting in this building from one system to another research will have to be conducted to determine the differences in price, energy consumption, heat production, lifecycles and serviceability.

When determining whether or not to implement this type of a lighting system I will also have to look at the time it takes to install the fixtures. Both systems need some kind of powering device, for florescent it is called a ballast and for LED is called an engine. I am not very familiar with LEDs so research must be conducted to see how these items are installed to determine if there would be any schedule impacts. I may be able to obtain some information from Jeremy Sibert from Hensel Phelps about the installation, cost and energy consumption of LED systems. Jeremy is one of the project managers that are currently working on the wedge renovation of the Pentagon in Arlington, VA. On this project they are using LED fixtures throughout the renovation. This may be a good source of information since the project is located in the same city as the Potomac Yard Land Bay E project.

## Appendix A: Precast Sequencing Diagrams







**Elevation From US Route 1**

**Low - Crane 1**

- Phase 1 - 2/9 through 2/11
- Phase 3 - 2/18 through 2/24
- Phase 4 - 2/25 through 2/27

**High - Crane 1**

- Phase 5 - 3/17
- Phase 6 - 3/19 through 2/27

**EXTERIOR MATERIAL LIST**

- ① PRECAST CONCRETE
- ② GRANITE FINISH SYSTEM SURFACES
- ③ SEE BILLS MATERIALS
- ④ 1/2" TYPED BLIND BUILT WALL W/
- ⑤ 1/2" TYPED BLIND BUILT WALL W/
- ⑥ 1/2" TYPED BLIND BUILT WALL W/
- ⑦ 1/2" TYPED BLIND BUILT WALL W/
- ⑧ 1/2" TYPED BLIND BUILT WALL W/
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