The Potomac Yard Land Bay E

Arlington, VA

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Construction Management
Thesis Proposal
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Executive Summary:

The purpose of this thesis proposal is to analyze current construction industry issues and how they apply to the Potomac Yard Land Bay E project in Arlington, VA. A large portion of this proposal is focused on energy conservation in the industry and ways that new technologies and construction methods may be applied to my project.

The first analysis involves implementing a supplemental energy source on the rooftop of the building. This proposes the use of Solyndra PV panels. Solyndra solar panels are proven to be more efficient than most conventional PV panels because of the 360-degree solar absorption. This design works particularly well with white TPO roofing membrane that is already installed on the Potomac Yard project. The areas of research for this topic involve investigating the cost of the panels and their mounting hardware and the amount of energy produced compared to the total building's energy consumption.

The second analysis deals with changing the building envelope from a combination of a curved curtain wall and architectural precast panels with punched windows to a solid curtain wall system. The main areas for analysis on this topic are the different structural load on the building, schedule reduction, construction needs and serviceability.

The third analysis topic deals with the mechanical system of the building. This analysis proposes changing the existing forced air VAV distribution system to a chilled beam mechanical system. The main areas for research are the comparison between the installations of the original and proposed system, schedule implications and the reduction of tonnage cooling load from the reduced floor height.

The fourth analysis topic for this proposal will be pursued but only implemented if one of the first three analyses becomes unachievable. This analysis consists of interchanging the existing compact florescent lighting CFL to light emitting diode LED lamps. The main areas of study for this analysis would be efficiency, heat production, lifespan, durability and disposal of the fixtures. An interview with a construction professional and product data will assist in the comparison between these two lighting systems.

The two breadth analyses for this proposal will cover the structural system and the electrical system for the Potomac Yard Land Bay E. The structural breadth will be used to help determine if the proposed solid curtain wall system would cause the CIP concrete structural system to be upgraded or not. The electrical breadth consist of the analysis of the building's total energy consumption and compare it to the supplemental energy produced by the Solyndra solar array.

Project Background:

The Potomac Yard Land Bay E is a 369,000 square foot base building with a 235,000 square foot underground parking garage located next to US Route 1 and the George Washington Memorial Parkway in Arlington Virginia. Land Bay E is positioned near Reagan National Airport and south of Crystal City Virginia. The project is located on an old train yard that has been converted into commercial land development. Land Bay E sits on a 15-acre complex that is owned by The Meridian Group which houses a variety of buildings that range from hotel, office, residential and retail space.

Upon completion of the project it is to have achieved a LEED Gold Certification. The construction site is constrained to 1.35 acres and houses two tower cranes, two material hoists and management office trailer. The deliveries, excavation and construction are able to take place with out disturbing the surrounding traffic flow and operations. Construction on the project is projected to take 20 months beginning on January 2, 2008 and it's scheduled to be completed by September 30, 2009.

The project includes new construction of a three level underground parking garage which will house 600 parking spots and two building towers that reach 9 stories of office space. The project also includes the construction of an outdoor interim space that consists of a landscaped park with a one-story building structure that will house either a small restaurant or a retail store. This space will fill the void between Land Bay E buildings East and West.

Electrical:

The electrical service that is supplied to this building consists of a 3,000A 277/480V, 3 phase, 4 wire system that enters the building on the northern building elevation. The transformer vault for Land Bay E is located in the NW corner of Building A on Level P2. The main electrical room for the building complex is located in the NW corner of Building A on Level P1. There are 65 panel boards located throughout the parking garage and buildings A and B.

Lighting:

The lighting system that will be utilized for the typical floors on this project is most commonly 4' fluorescent tube light fixtures that are operated on 277V. The reason for the common use of fixtures is because the interior of the building will be fit out at a later period when specific tenants are specified. Throughout the parking garage there are 16 different lighting fixtures that operate on both 120 and 277V. In the base building cores and finished spaces there are 36 different light fixtures being utilized on both 120 and 277V.

Mechanical:

The mechanical system that is utilized on this project is a Variable Air Volume (VAV) system that is supplied by (8) Air Handling Units (AHU), which range from 16,400-20,400 CFM on 480/3. There are (3) cooling towers and (2) 350-ton chillers that are

installed on the roof of the building that are used to handle the cooling load for the building.

Structural:

The structural system that is utilized on the Land Bay E project is predominantly Cast In Place (CIP) concrete. The floor system is constructed of elevated post tension concrete slabs. There are a variety of concrete strengths that are used in this project. The slabs and beams utilize 5,000 psi concrete, slab on grade uses 4,500 psi concrete, walls and piers use 4,000 psi, pile caps use 5,000 psi and the CMU fill uses 2,500 psi strength concrete. The placement of the concrete for the project was performed by Miller and Long using a variety of placing tools which include: concrete pump truck, crane and bucket, direct shoot and Georgia buggies. All of the steel reinforcing being used on the project must meet ASTM A615, Grade 60.

The typical size of the concrete columns used on the Land Bay E project are 12'x12' exterior and 16"x16" interior. The typical column bay size on a typical floor is 28' wide with the use of an 8" slab and 72"x18" post-tension beams. The foundation that was used on this project is a deep foundation consisting of 14"x14" precast concrete piles with a bearing capacity of 125 tons. The piles were driven into the ground at an average depth of 30' below the lowest floor level.

Fire Protection:

The fire resistance for the building ranges from 1.5 hours to 3 hours on certain building items. For the structural frame and bearing walls the fire resistance must have a minimum of a 3-hour rating, the floor construction must have a 2-hour rating and the roof must have a 1.5-hour fire rating. The fire protection systems utilized in the Land Bay E building consist of both wet and dry pipe sprinkler systems.

Transportation:

The Potomac Yard Land Bay E building project accommodates nine total elevators. For both buildings A and B four elevators serve each of the building's typical floors and the three parking levels underneath of the two towers. The ninth elevator solely serves LA Fitness that only travels between floors P1 and Ground in Building B.

Analysis #1: Supplemental Energy

Opportunity Statement:

The United States is one of the world's highest energy consumers for which over 50% of the country's energy consumption is used by commercial buildings. The building industry is under much scrutiny to produce more energy efficient buildings in order to reduce the country's energy consumption. In the United States there is approximately 30 billion square feet of commercial roof area that could be used for placement of supplemental solar energy harvesting. By placing solar panel systems on this large area of unusable space the commercial building energy consumption could be reduced by supplementing the buildings with solar energy. The current roof system that is utilized on the Potomac Yard Land Bay E project is a white TPO roofing membrane that is designed to reflect large amounts of the sun's energy instead of transferring it into the building. By adding a supplemental solar panel system to the 43,800 SF roof of this building would result in optimum performance for harvesting energy and a reduction of energy consumption from nation's energy supply. By performing this analysis a comparison of energy created by the PV system will be compared to the building's total energy consumption and the energy cost savings will be determined.

Research:

The installation of Solyndra PV panels would add to the sustainability of the Potomac Yard Land Bay E building and will help to reduce the energy consumption from the grid. Since this is a new technology of harvesting the sun's energy from 360 degrees by absorbing direct, reflected and diffuse sunlight. This is made possible by installing the solar array on top of the existing white TPO roofing membrane. An analysis will be conducted to analyze the cost and installation implications to the owner and the building. After gathering the cost and installation information for the products it would then have to be compared to the energy savings and increased sustainability to the building before a recommendation of the use of this product would occur. Another item that would need attention when considering this system would be the constructability implications that would affect the building. An analysis of the weight of the product and its support system will be performed to determine if it would have any structural impact on the roof of the building. The anchoring method of the PV system will need to be analyzed to determine the proper way of penetrating the roof structure of the building. If it was found that the roof structure would need to be upgraded that information would have to be considered in the decision whether or not to install the equipment.

Figure 1: Solyndra Design

Expected Outcome:

Solyndra PV panels are a very efficient design for harvesting the sun's solar energy and converting it into a valuable resource for the building. The PV system should produce enough energy to supplement the building's energy demands from the nation's power plants. The structural impact caused from the PV system on the building should be minimal because the design of the anchoring system is very lightweight and easy to install. The reason for its lightweight frame is because of the shape of the panels. The panels consist of many long tubular shaped solar collectors that allow the air to flow around and between the arrays that reduces the amount of wind resistance. Another feature that the system possesses is that it is mounted horizontally, parallel with the roof's surface, which would reduce the uplift affect. Maintenance walkways may need to be considered for access to clean the panels along with proper waterproofing around the roof penetrations for anchoring. The installation of these solar collectors should not impede the schedule of the project because they can be installed as other work on the building is progressing without interruption. All of these features and the enhancement of green technology image for the building will probably outweigh the initial cost and installation of the product.

Sources: Solyndra, The Shape of Solar; 12/6/09, http://www.solyndra.com/

Analysis #2: Façade Change

Opportunity Statement:

The current building envelope system used on the Potomac Yard Land Bay E project consists of both an architectural precast façade with punched windows and a curved curtain wall system on the ends of the buildings. Using two different types of building envelope systems for a project causes delivery issues and site congestion while storing the variety of materials before use on the building. By switching to a single building envelope system the duration of installation for the building may become shorter due to the repetitive activities and familiarity of connections. A reoccurring trend in the construction industry is the usage of prefabricated materials. By changing the building envelope for the Potomac Yard from two systems to a single glass curtain wall system that consists of two floor prefabricated glazed panels. This would help to reduce the use of varying materials that would speed up the installation period for the building envelope thus reducing the total project schedule.

Research:

To determine whether this type of building envelope system would be beneficial to the Potomac Yard project an analysis of the cost, duration of installation, weight of material and aesthetics would have to be performed. To determine the cost of implementing this type of building envelope system a curtain wall subcontractor, like Enclos Corp. from Detroit Michigan, would have to be contacted to determine the price per wall area for a common curtain wall system. An analysis of the weight differential between the curtain wall and the architectural precast and punch windows will be performed to compare the loads of the two systems and their anchoring devices. The reason for conducting this analysis is to determine if the current structural system would need any adjustment to accommodate the proposed system. If the curtain wall system were heavier than the current system then the structural system for the building would have to be modified accordingly.

When determining if the curtain wall system would reduce the schedule or not the use of the Constitution Center project team at Davis Construction will be utilized. The contractor Enclos Corporation installed the sealed curtain wall system on the Constitution Center project in Washington DC. Another item for investigation would be the installation method for the curtain wall panels. A comparison of lifting mechanisms for the installation of the curtain wall could be conducted to see which one is most efficient. The methods typically used on curtain wall installation are tower crane, mobile crane, floor crane and a monorail system. If the tower crane is not needed for the curtain wall installation it could possibly be removed sooner in the project resulting in a lower crane cost. To determine which lifting mechanism is preferred Enclos could be contacted to give their opinion on which method would cost the least and which method would take the least amount of time to install the curtain wall system.

Expected Outcome:

The proposed curtain wall system would most likely reduce the schedule of the project because of the standardized use of materials and connection for the building envelope, prefabricated panels, placing methods and repetition of anchoring. The prefabricated panels will eliminate on site assembly and will just involve lifting and securing the materials on the building façade. If the monorail or floor crane system is chosen the site will become less congested and will allow for early removal of the tower cranes. While reducing the site congestion the typical floor will likely become crowded with panel layout. The floor staging will have to be considered because it may impede some ceiling work from being performed. Other positive outcomes that may arise from switching to the curtain wall system will be the increased amount of natural daylight that enters into the typical floor space because of the floor to ceiling glazing which may result in higher rent for the owner. Along with the increased natural daylight in the building includes an increased amount of solar gain. The consideration of the increased cooling load on the building will also have to be considered because of the likelihood of it increasing.

Analysis #3: Utilization of Chilled Beams

Opportunity Statement:

The current mechanical system used on the Potomac Yard Land Bay E project is a typical forced air VAV distribution system. The disadvantage with this system is that it uses large ductwork to distribute its forced air throughout the building's floor areas. The disadvantage to the traditional forced air system is that it takes up a large area of the ceiling for the ductwork and it is a much less efficient way of transferring energy than by using water or some other fluid. The Potomac Yard Land Bay E project is also projected to achieve a LEED Gold rating upon completion. The current VAV system that is used in this building is not as sustainable as some other mechanical systems on the market and should be exchanged for the more energy efficient chilled beam mechanical system. The advantages for using this mechanical system is that the floor to ceiling height will be reduced thus reducing the area of conditioned space. Another advantage of using this type of mechanical distribution system is that it consumes less energy than forced air that would help with the building's total energy consumption.

Research:

When determining if the chilled beam mechanical system would be valuable or not to the Potomac Yard Land Bay E project an analysis of cost, constructability and schedule impact will need to be conducted. To determine the cost and installation of a system like this I will have to contact a manufacturer of chilled beams to determine the price of the products and obtain prices of installation from similar projects like the Constitution Center project in Washington DC. The general contractor on that job was also Davis Construction so the knowledge of the management team on that project could also be used in determining these items. To determining the constructability and schedule impact of the installation of the chilled beams the difference in installation time of running hydronic piping and forced air metal ductwork will have to be analyzed by interviewing the project team on the Potomac Yard for the VAV system and the project team on the Constitution Center project for the chilled beam system. Finally an analysis of the difference in required mechanical plenum space for each system to operate will need to be performed to determine the decreased volume of conditioned space in the building.

Expected Outcome:

When comparing the initial cost of the two systems I expect that the chilled beam mechanical system will cost more than the traditional VAV system. When looking further into my study I believe that it will take less time to run hydronic piping in comparison to the larger forced air metal ductwork that will reduce the schedule for the mechanical installation. When performing a typical floor mechanical calculation I will be able to extrapolate to determine the total building's reduction in the cooling load. From this calculation I expect that the reduction of air volume in the building will reduce the demand on the mechanical equipment to condition the air in the building.

Analysis #4: LED Lighting Conversion

Opportunity Statement:

The current light fixtures used in the cores, lobby areas and mechanical rooms on the Potomac Yard Land Bay E project is predominantly florescent lighting. Typically florescent lighting produces more heat and consumes more energy than other light sources on the market. Also florescent lights contain toxic gases like mercury that are harmful to the earth's environment. Disposal of the expended florescent light over the lifespan of the building may become problematic. By implementing LED lighting into the Potomac Yard project the energy consumption and disposal fees will be reduced over the life of the building. This analysis will be pursued during the semester but will only be implemented in the final report and presentation if one of the following analyses does not work out.

Research:

When comparing florescent lightning systems to light emitting diodes (LED) systems I will need to compare energy consumption, heat emittance, fixture prices, installation costs, durability, lifespan and disposal requirements. When trying to determine the energy consumption and heat produced from the products I will have to look at the data sheets provided by the manufacturers. To determine the installation time and cost for a LED fixture I could consult Jeremy Sibert from Hensel Phelps. Mr. Sibert is currently working on the renovation of the wedges for the Pentagon in Arlington, VA. This project is utilizing LED light fixtures throughout the renovation. The labor rates and time for installing these products should be the same as the Potomac Yard Land Bay E project because they are both located within the same city. Just before determining if implementing the use of LED lighting in the building I must look into the average life expectancy of an LED bulb in comparison to a CFL and the proper disposal methods of each. To determine this I can look at previous projects that have used both types of lighting systems.

Expected Outcomes:

When looking at both of the proposed lighting systems I would expect that the LED lighting system would probably cost more initially because it is a newer technology and it is currently not commonly used in the commercial building industry but will probably become more popular as the technology advances. When looking at the performance of the two systems it has been proven that the LED lighting uses one-third less energy than a CFL and emits less heat. When looking at the lifecycle of the two systems the LED lamps consistently last about five times longer than a CFL and are much more durable. I would assume that the installation of both systems take approximately the same amount of time because they both require a powering device, lamp and fixture. Having considered all of the variables the LED lighting may cost more initially but over the life of the building may pay for themselves and require less maintenance.

Conclusion, Weight Matrix:

From the four analysis sections described previously I hope to provide an in depth study of the construction management issues facing the Potomac Yard Land Bay E project. The four topics stated above in this proposal will be the majority of my research for my thesis project in the upcoming semester. I hope to demonstrate what I have learned throughout my college career through my analysis of these topics and gain some more knowledge about construction management that I will be able to take into my career.

The table below symbolizes the time that I will allocate to the specified topics for each analysis next semester. The majority of my time will be focused on research for the new technologies that I plan to implement into my project in hope of helping to reduce the energy consumption of my building.

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Analysis 1	20%	----	5%	----	25%
Analysis 2	10%	----	10%	10%	30%
Analysis 3	10%	5%	10%	----	25%
Analysis 4	10%	10%	----	----	20%
Total	50%	15%	25%	10%	100%

Figure 2: Weight Matrix

Appendix A: Breadth Studies

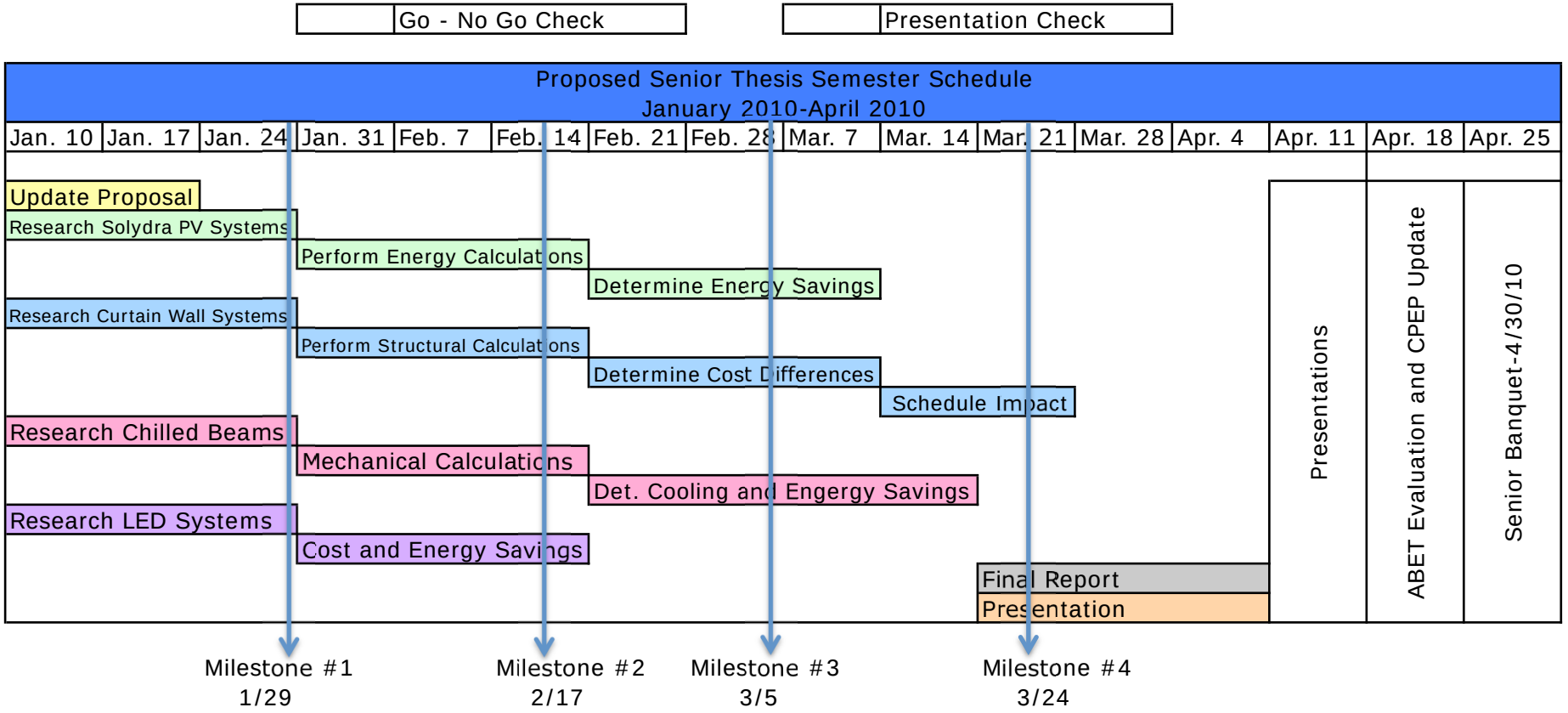
Structural Breadth:

Changing the building envelope and adding items to the roof will cause a need to look at the structural system of the building. When changing the building envelope from curtain wall and architectural precast with punched windows to a solid curtain wall system the connections and load distributions will change on the building. A structural analysis will need to be performed to determine if the current CIP concrete structure is sufficient to hold the curtain wall or must the system be upgraded or could it be relaxed. Also when adding solar arrays on the rooftop of the building a structural analysis of the roof system must be performed to determine if the current roof structure can withstand the wind and dead load of the panels.

Electrical Breadth:

As part of my analysis of adding a Solyndra PV system on the roof of the Potomac Yard project I will perform energy production calculations produced by the system. Also in this analysis I will be performing calculations to determine the building's total energy consumption so that I can determine the percentage of energy savings that the building can achieve to help reduce the demand of energy on the United States energy grid. In doing so it may be determined if the system will pay for itself during its lifespan.

Appendix B: Proposed Thesis Schedule



Milestone Activity List:
1. Complete Research
2. Organize Computations
3. Midway thru Determination of Implicati
4. Started Final Report and Presentation

	Analysis #1: Implementation of Solyndra PV, Electrical Breadth
	Analysis #2: Replacing Building Façade, Structural Breadth
	Analysis #3: Implementing Chilled Beams
	Analysis #4: Implementation of LED