Spring Thesis Proposal

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EXECUTIVE SUMMARY

This document is a proposal which includes the four topics of research and analysis for focus during the spring semester of 2013 for the University of Maryland Physical Sciences Complex located in College Park, Maryland.

Analysis 1 – Elliptical Curtain Wall Schedule Reduction

The elliptical curtain wall that makes up the interior facing façade of the PSC has been the source of many headaches and time delays for the PSC. Problems range from incomplete design drawings, delayed deliveries, inconsistent materials, and errors in labor management. A revised schedule of installation of the system will mitigate many of these problems, as well as a coordinated effort to erect the wall modularly can drastically change schedule delays originally imposed by these problems.

Analysis 2 – Elliptical Curtain Wall Material/Design Alteration

The curtain wall is overly complex. The current design uses nearly 300 panes of glass, where only a few overlap in dimensions and color. An architectural design change will allow for *significant* cost savings, but at the same time will not impact the functional aspect of the façade which is too allow light in the interior of the building and provide for a unique office/classroom space experience.

Analysis 3 – Exterior Façade Energy Collections via Concentrated Photo Voltaic

Among the design of the PSC are two very large curtain walls. One wall is south facing, and as such, has significant potential for solar energy collections. Modern photovoltaic technology, as well as a specifically designed curtain wall system that incorporates concentrated photo voltaic (CPV) technology, can allow for large year round energy savings via solar collection, while at the same time not completely eliminating the aesthetic view from the interior of the building.

Analysis 4 – Multi-shift Work Schedule Reduction

The PSC is an academic building, and as such, is used primarily in the academic semesters of the fall and spring. The completion date for the PSC is set for September of 2013, after the semester begins. By tightening up the schedule by having longer work days, close to 16 hours, using two crews, the building can have a substantial completion date far earlier than September of 2013.

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PROJECT BACKGROUND

The University of Maryland Physical Sciences Complex is expected to be the most advanced, state-of-the-art research facility for biophysics and molecular science in the United States. At 158,000 square feet and 5 above ground stories and two basement levels, the project will house 27 laser and condensed matter labs, 18 preparation labs, and 9 biophysics labs, as well as offices, lounges, study centers, class rooms, and spacious hallways. The nature of the experiments and research that will take place requires that the PSC have absolute control over the lab environment. This includes air, temperate, and exceptional vibration cancelling. This poses a challenge to construction. In order for nano-research to yield accurate and successful results, a way to shield the underground labs from the vibrations induced by traffic, walking, and mechanical units must be used.

The project is the second phase of a three phase plan developed the University of Maryland. The phases are designed to expand the scope of what the campus can research and bring about scientific interest in the academic community and provide potentially ground breaking research for the world. The building rests between two existing science complexes and will replace the existing parking lot. The PSC is designed to attach to the existing Computer Science and Space building through a series of minor renovations and will introduce an entirely new mechanical building for the immediate surrounding buildings.

The PSC also features a slew of sustainable design concepts including a green roof and recycled materials. UM aims to achieve a Silver rating on the LEED scoreboard. Details on how this is achieved are discussed later in this document.

Notable characteristics of the PSC include the large elliptical curtain wall opening in the center of the building, a 100% accessible green roof, and a large outdoor ground level storefront plaza.

The project is being administrated by Gilbane Co as CM at risk under a GMP contract. Gilbane holds 32 trades in total, and works side by side with the architectural firm, HDR Inc. The project cost is currently at $99 million.

ANALYSIS #1: ELLIPTICAL CURTAIN WALL LABOR AND MATERIAL MANAGEMENT FOR SCHEDULE REDUCTION

Problem Identification

Perhaps the most plaguing issue on the PSC currently is the management and installation of the interior, elliptical curtain wall. Early on, the date of completion for the curtain wall, which would allow the project to obtain a water-tight status, was scheduled for July of 2012. With complications in the design of the actual curtain wall, and method of installation, the date has now been pushed back to December of 2012. This push back in the schedule has caused the project team to wait on activities which would otherwise require the building to be water-tight, such as electrical wiring and lighting. One major reason for this complication was the glazing type used was embedded tint glazing which required out of country fabrication.

Research Goal

The goal of this analysis is to perform a curtain wall reschedule and investigate coordination issues with the current curtain wall design in order to mitigate schedule delays on the project and in the process saving money through labor and materials.

Approach

- Contact the curtain wall subcontractor (NEC) to coordinate design and cut sheets
- Analyze the level of coordination that took place and revisit it for improvement
- Analyze the cost, constructability, and schedule of the curtain wall
- Research if alternative designs (lead into to analysis #2) will all together mitigate schedule delays
- Contact a known curtain wall firm for consulting and input on the design (MAC)
- Research the glazing used and if it is more easily accessible elsewhere

Resources

- Bob Mathews – Owner of MAC – Mathews Architectural Concepts
    - Review other projects with similar façade systems
- Shedaker Metal Arts Inc. – Metal/glass curtain wall contractor, Philadelphia region
- NEC – Curtain wall subcontractor on the job (although it may be difficult)
- Patrick Peters – Gilbane Façade PM

Expected Outcome

The above research and analysis will yield a dramatic decrease in the construction schedule that was imposed by the elliptical façade system. As well as a schedule decrease, depending on the findings through research, a significant savings in cost can be made.

ANALYSIS #2: ELLIPTICAL CURTAIN WALL ARCHITECTURAL REDESIGN

Problem Identification

The design of the curtain wall is extremely complex. It is so overly complex that it is almost as if the thing was designed to set fire to money. Many of the dollars spent are on coordination of the material and sizes, the drawings themselves, and further coordination and corrective measures when the system inevitably does not perform or install as intended.

Research Goal

Through various methods of research, the goal of this analysis is to determine if a change in architectural design will reflect significant cost savings to the project.

Approach

- Remodel/redraw the entirety of the existing interior elliptical façade.
- Coordinate with outside metal/glass/façade contractors for feasibility of design.
- Do a brief analysis of the architectural aesthetic impact of the new design by consulting said contractors.
- Compare the costs of the original design with that of the new design.
- NOTE – The architectural design change is an analysis topic associated with ONLY changing the design, UNLIKE the previous analysis topic (Analysis #1) which only focuses on the past/current problems associated with scheduling and coordination for the EXISTING design.

Resources

- Bob Mathews – Owner of MAC – Mathews Architectural Concepts
  - Review other projects with similar façade systems
- Shedaker Metal Arts Inc. – Metal/glass curtain wall contractor, Philadelphia region
- NEC – Curtain wall subcontractor on the job (although it may be difficult)
- Genesis Architectural LLC – High end façade/curtain wall/metal & glass contractor
- Patrick Peters – Gilbane Façade PM

Expected Outcome

I fully expect the outcome of this research and design change to yield a major savings. The current cost of the interior façade exceeds 6 million dollars. For something as small in surface area as this interior façade, the cost associated is astronomical. This will be a heavy focus of my thesis research and presentation.

ANALYSIS #3: EXTERIOR FAÇADE ENERGY COLLECTIONS

Problem Identification

In the industry of construction, far too often are the long term effects of solar collection overlooked. The large primarily south facing wall of the PSC is a perfect opportunity to utilize the most modern technology when it comes to solar energy collection.

Research Goal

The goal of this analysis is to determine the cost efficiency of utilizing concentrated photovoltaic façade systems instead of the typical insulated glazing systems. By making this change, the architectural visual impact will be minimal, while being able to generate additional energy savings over a long period of time which will be determined for feasibility.

Approach

- Research the most modern approaches to façade energy collection systems
- Evaluate the cost of the upfront installation materials and labor.
- Determine the solar time for the south façade and days the system will generate a moderate amount of energy.
- Calculate a payback time period and determine the feasibility of such a system (including maintenance)

Resources

University of Maryland
Dr. John Messner
Dan Kodan P.E – Gilbane Co. MEP
Helioptix Solar Company.

Expected Outcome

I expect the outcome of this research will yield a significant advantage to replacing the exterior façade with concentrated photovoltaic technology. The limiting factors to the implementation to this technology is the riskiness associated with using it as it is not widely accepted as a construction standard.

ANALYSIS #4: SCHEDULE REDUCTION BY MULTI-SHIFT WORK HOURS

Problem Identification

The PSC is an academic building, and as such, will primarily be used during the standard fall and spring semesters of the academic school year. With the current schedule of the project, the substantial completion is set for September of 2013. This is well after the semester begins, and is not enough time to assign faculty, and classes to the PSC.

Research Goal

The goal of this analysis will be to reduce the overall schedule of the project significantly enough to allow the University time to staff the building and configure it for academic use prior to the fall semester of 2013. The analysis will look at how having two work crews working at separate times of the day for overall longer work days can reduce the schedule on the project and make logistics for the project more manageable.

Approach

- Research other similar projects that have performed work this way
- Analyze the importance of finishing early over working longer days
- Determine pay rates based on abnormal working hours and how it affects the project costs with regards to earlier substantial completion
- Analyze the cost savings on equipment and services that bill on a weekly or monthly basis
- Contact the University and discuss earlier schedule completion incentives for Gilbane

Resources

- University of Maryland
- Craig Dubler - CM
- Ted Tester –Gilbane Project Executive
- John Melching Jr. - M3AE Inc.

Expected Outcome

The outcome of this research will yield significant schedule reduction and cost savings overall while paying more for labor. The cost saving will come in the form of reduces services required, schedule incentives, and ease of logistical coordination between trades.

Weight Matrix

The following table is a weighted matrix that shows the expected time allocation by percentage of each analysis with regards to the four primary industry concerns. The highest weighted area is the redesign of the interior façade.

Time Devotion Weight Matrix

Description	Research	Value Engineering	Constructability	Schedule Reduction	Total
Elliptical Schedule/Coor		5%		15%	**20%**
Elliptical design alt.		15%	15%	10%	**40%**
Ext. façade CPV	15%	5%			**20%**
Shift Work	5%			15%	**20%**
Total	**20%**	**25%**	**15%**	**40%**	**100%**

Breadth Topics

Breadth #1: Exterior Curtain Wall - Mechanical

Breadth 1 will be incorporated into analysis #3. In this analysis, the south face exterior façade is being changed to incorporate built in concentrated photovoltaic technology. This will change the R value of the wall as well as affect the electrical usage of the building. This will require calculations to include additional breakers as well as calculations for the heat gain of this façade compared to the original.

Breadth #2: Elliptical Curtain Wall – Architectural

Breadth 2 is also a part of the elliptical curtain wall system. With a redesign of the curtain wall, it is extremely likely that the aesthetic appeal of the wall, namely the glazing, will change drastically. This architectural change will be the result of alternative glazing, removal or addition of composite metal shadow boxes, and the outward facing glazing anchors used for the wall.

Conclusion

With the above analyses options performed, hopefully the results can provide benefit to the project team for future reference. The curtain wall has vast room for improvement with both coordination in labor and materials, and with design and concept. An analysis into solar energy capture can yield benefits not yet realized. A schedule reduction by having more than one set of crews can help complete the building earlier, and as such save on major costs.