DENNIS V. WALTER JR. | CONSTRUCTION MANAGEMENT

PHASE 2 NEW BUILDING, JOHN TYLER COMMUNITY COLLEGE

UPDATED PROPOSAL

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Image courtesy of Burt Hill

[Special thanks to the Gilbane Project Team, Burt Hill, and John Tyler Community College]

Contents

Executive Summary

This proposal serves as an outline for the research and analysis topics proposed for the spring semester thesis. After the initial proposal ideas developed in technical assignment three, the research and analysis topics have been further focused into a few key concepts. The analysis descriptions highlight three main topics which will be the featured focus for the spring thesis with a consistent theme of quality control.

Analysis One includes an analysis of a precast brick exterior wall system as an alternative to the hand-laid brick system. Quality, Cost, and Schedule Acceleration will be the major areas of study within this analysis. Using a 4D construction simulation will help visual understanding and of schedule implications. Finally, a cost and quality analysis will be performed to compare the systems.

Analysis Two includes the analysis of a reduced load on the roof's structural system based on a selection of an alternative "cool" roof system to the current green roof. Using RAM Structural software to assist in calculating loads will help resize steel members and re-design the roof structure. A life cycle cost analysis will also be developed to compare the two different systems. Quality issues with field installation will also be looked into.

~~Analysis Three includes analysis on the benefits and ability of leveraging a Building Information Model (BIM) for prefabrication. Also, the comparison of field quality control strategies in conjunction with the BIM model can determine "best practices" which can make a case for using a BIM model on this project.~~

Analysis Four includes the analysis of the electrical loads on the building and sizing a transformer with the building's expected power load and the grid tie in mind. Also, a comparison of quality control strategies which can be incorporated during the electrical design can determine "best practices" which can be followed by project teams.

A weight matrix is provided to show how much emphasis will be placed on the core areas of research, value engineering, constructability, and schedule acceleration. A detailed explanation of breadth studies can be found within Appendix A. Breadth will be performed in the areas of structural and electrical.

Analysis Descriptions

Brick Façade

Opportunity for Improvement

The hand-laid brick façade is a very common exterior wall type, it caused several complications on site dealing with the detail of the through-wall flashing and drip edge, as well as the application of a spray-on vapor barrier. This caused numerous schedule delays, and had potential for coordination and site logistic issues. Because the exterior enclosure milestone is required to begin interior fit-outs, accelerating the façade would keep delays from occurring.

Solution

This area of research will focus on the potential impacts of a precast exterior brick façade rather than the hand laid brick. There will be considerations of the quality of field installation, the cost and schedule impacts.

Benefits

A hand laid brick exterior wall system requires a high amount of detail and can be a complex wall system to install. The brick wall may also require a large amount of scaffolding and area near the building envelope during the installation process. Precast systems can eliminate this need for a mortar station and constant stocking of brick for installation. There are a large amount of workers required to keep the brick installation moving along, which increases the need for safety and coordination of manpower. Also, precast exterior facades reduce labor costs and installation time. The majority of preparation for a precast façade can be done off site in a climate controlled environment. Additionally, a precast brick exterior façade can take the place of each individual part of the wall acting as an entire wall system, and it can reduce the number of detailing issues and installation issues that could occur in the field.

Drawbacks

Precast systems are normally less flexible in design and aesthetic quality compared to a hand-laid brick wall. The design for the Phase 2 New Building required a match of the existing campus features with an emphasis on a quality appearance and an exceedingly watertight enclosure. Also, the joints between the precast panels and exterior curtain walls would need close attention. Precast systems have joints between the panels, which require close attention in the field during construction. To ensure these joints are properly closed with a quality seal, a successful mock-up would need to be constructed and tested for watertight assurance and quality aesthetic appeal.

Analysis

The focus of study will be on the schedule implications associated with a precast brick wall system, the cost impacts, and the overall quality of the newly selected system.

Research Method

Research would begin with a better understanding of different precast brick wall systems available. This will be done by studying literature and case studies of different systems. Once a better knowledge is established, it will be possible to speak intelligently with project teams and industry professionals who have experience with precast systems.

A weight matrix will then be established to compare quality, aesthetics, constructability, and cost. The best candidate will be chosen to analyze.

Following the selection of the appropriate system, the schedule will be analyzed to determine the possibility of schedule reduction using the precast system. A 4D simulation using Revit and Navisworks can be used to demonstrate the schedule impacts using different systems.

Also, cost savings will be determined based on the schedule reduction and unit costs of the system. Finally, an overall quality comparison will be conducted to determine if the precast system can offer similar or better quality than the traditional hand-laid exterior brick wall system.

Expected Outcome

This analysis will be interesting to determine what kind of schedule reductions can be made with a long lead time and quick installation being incorporated with a precast brick wall system. There will be some interesting implications to the schedule if the wall system can be prefabricated in a timely manner. Also, it will be interesting to see if a precast brick wall system can deliver the same kind of aesthetic qualities and water-tight design.

Roofing System

Opportunity for Improvement
The current green roof system could be looked at for a more practical or more "green" product. There certainly are less expensive roofing alternatives that provide similar "green" requirements for LEED and can result in greater long-term cost savings. The different systems include a wide variety of green roof systems as well as lighter "cool" white roofing systems.

Solution
This area of research will focus on the impacts associated with changing the roof system from a green roof to a lighter "cool" roof. The LEED implications as well as structural loads and quality will be considered as well.

Benefits
There are many innovative and inexpensive new roofing systems on the market that can provide excellent thermal insulation and as well as reducing energy costs and minimizing environmental impact. There are green roof systems that can be used for rain water harvesting or light "cool" roof systems with excellent UV reflectance properties. There are new products on the market that can provide an exceptional life-cycle cost savings and may benefit the John Tyler Community College in looking at cost savings over a long-term building life.

Drawbacks
The many alternative roofing systems are new and cannot provide a guaranteed assurance of system longevity. Also, there are many "green" products that do not get manufactured in an environmentally friendly process. These drawbacks must be considered when selecting a new green technology that has not yet been a proven success in a large number of applications.

Analysis
The focus of study will be on the structural implications associated with a lighter roof system, the cost impacts (life-cycle analysis), and the quality of the system.

Research Method
To begin the research, a better understanding of the alternative roofing systems will have to be researched. Consulting case studies and product information will help familiarize with the systems on the market. Next, a weight matrix to compare installation quality, cost, and structural loads will be created to select the best candidate for an alternative system. The roofing system chosen will have to provide LEED points for the roof.

After selecting a candidate for an alternative roof system, an analysis for substantially cutting down the size of the steel supporting the roof without the green roof load can occur. Structural colleagues and faculty members can be consulted for this, as well as using the RAM Structural application to assist in determining if the design of the steel supporting the roof can be reduced in size.

Once the new system is analyzed for structural implications, it will be important to research the cost implications associated with the new roof structure, as well as the difference in cost of the chosen system. A life-cycle analysis of the new and old systems can be performed to determine which may be the better economical option. Also, research comparisons of quality issues between the green roof system which is installed and the new system selected.

Expected Outcome

It will be interesting to see what kind of reduction can occur of the steel supporting the roof system after lightening the load on the roof. Also, when comparing roofing systems such as green roofs and "cool" roofs, life-cycle cost analysis is very important for selecting the best economical option. The quality issues concerning the field installation of new or unfamiliar products can be quite costly, so research into the differences in quality issues will be valuable.

Building Information Modeling

Opportunity for Improvement

Because Building Information Modeling is becoming a quickly growing tool in the construction industry and a current issue among industry professionals, it may be beneficial to look at the benefits or drawbacks that may occur by implementing the use of a BIM model on this project.

Solution

This area of research will focus on the ability to leverage a BIM model for prefabrication and comparing strategies for using the BIM model to facilitate field quality control through visual means.

Benefits

The contract with the CM, Gilbane, had left out Gilbane's Document Coordination Service, which would normally be included as a service to help coordinate the mechanical and electrical documents between trades. The incorporation of BIM may have added value to the project for the purpose of discovering trade coordination issues before they arose in the field. The Phase 2 New Building could have benefited from 3D MEP Coordination due to the larger amount of mechanical, electrical, and plumbing work that was required for the 3rd floor laboratories. Also, the owner, John Tyler Community College, could use the As-Built BIM Model as a learning tool in conjunction with the Building Automation System that is already incorporated into the building systems.

Drawbacks

There have not been many studies to show how much improvement is gained from using BIM. The project may be too "small" for a BIM model to show significant improvement in the project's outcome. The original architectural model created may need a large amount of detail added in order for the BIM model to give desirable outcomes. Also, the ability of the local trades and contractors to contribute to the BIM model may be limited or unavailable due to BIM still being relatively new to some smaller contractors.

Analysis

The focus of study will be on the benefits and ability of leveraging a BIM model for prefabrication. Also, the comparison of field quality control strategies in conjunction with the BIM model can determine "best practices" which can make a case for using a BIM model on this project.

Research Method

Research will be performed through review of the project's contract to determine the current terms of any created models. Then, research and opinions of persons on projects that have successfully leveraged a BIM model into the contract can be conducted in conjunction with interviews of industry professionals or current faculty who have knowledge in BIM models and contracts. The CIC Research team may provide a solid basis of research for past projects they are familiar with.

It will be important to also speak with the project team and industry professionals, to determine preferred strategies for facilitating quality control in the field using visual means. Research into

~~successful and intuitive ways to visually convey quality control in the field will also help determine some "best practices".~~

~~*Expected Outcome*~~

~~It will be interesting to see what the implications exist when attempting to leverage a BIM model for use on this project. Determining if a BIM model can be leveraged for prefabrication and strategically using it for quality control will be important to demonstrate that BIM models can be used in many creative ways. Developing a "best practices" for BIM as a tool for quality control will be valuable to industry professionals who have been struggling with finding a way to facilitate field quality control through visual means.~~

Electrical System

Opportunity for Improvement
The 300kVa Transformer that was specified by the power company suffered a loss of Phase "A" power. This phase loss caused severe damage to the building automation system. Many of the contracts for the VFD's were fried. This occurred several days prior to the Phase 2 New Building's First Day of Classes. The approved removal of phase protection by the Electrical Engineer is what made the phase loss occur. The electrical engineer and electrical power company never verified the service load and transformer sizing would be sufficient. The power company had to change the 300kVa transformer out for a 750kVa and an insurance claim was filed by the CM.

Solution
This area of research will focus on the sizing of the electrical transformer with the building's expected power load and the grid tie in mind. Also, the quality control of the electrical system design will be focused on.

Benefits
The electrical system that is designed for a building must be designed with safety, reliability, and efficiency in mind. The quality control that must be done during the design process is very important for delivering a building system that not only meets standards, but performs beyond expectations. The electrical system and its components can be assured to be reliable, safe, and efficient through the use of quality control during the design. The incorporation of a high level quality control strategy for the electrical system as it relates to the tie with the electric grid will reduce the risk of component failure and can ensure an improved quality design.

Drawbacks
Electrical systems can be very complex and takes a high level of understanding and experience in order to properly design a very successful system. The quality control associated with electrical systems and the components as they relate to the tie to the overall electrical grid is an area that may not be well known. This level of quality control may be difficult to guarantee on a project, and the strategy for incorporating this level of QC into the design could be quite complicated.

Analysis
The focus of study will be on the sizing of the electrical transformer with the building's expected power load and the grid tie in mind. Also, a comparison of quality control strategies which can be incorporated during the electrical design can determine "best practices" which can be followed by project teams.

Research Method
To begin research, a substantial amount of information will have to be collected from various publications, case studies, and industry standards about quality control and electrical system design. This will provide a good basis of information to begin speaking with industry professionals about measures and strategies for quality control during the design process. An interview with the project team can determine if there were any specific quality control measures done on the electrical system

design. It may also be important to contact the Electrical Engineer on the project to determine any issues that may commonly occur in the communication of these parties during the design.

Once a “best practices” of quality control for the electrical system can be put together, it will be important to apply these strategies when attempting to size the transformer for the building with the electrical grid and building’s power load in mind.

Consultations with electrical subcontractors in regards to the constructability of the re-design may assist with collecting “best practices” based on their previous experiences.

Expected Outcome

It will be interesting to see if a differing size of transformer can be found during the sizing and implementation of the “best practices” determined for quality control of the electrical systems design. Also, the “best practices” for strategies of implementing quality control can be a valuable tool for project teams during the design of the electrical systems of buildings.

Weight Matrix

~~**Description**~~	~~**Research**~~	~~**Value Engineering**~~	~~**Constructability Review**~~	~~**Schedule Reduction**~~	~~**Total**~~
~~Brick Facade~~		~~15~~	~~10~~	~~15~~	~~**40**~~
~~Roofing System~~		~~10~~	~~15~~	~~10~~	~~**35**~~
~~Building Information Modeling~~	~~15~~				~~**15**~~
~~Electrical System~~	~~10~~				~~**10**~~
~~**Total**~~	~~**25**~~	~~**25**~~	~~**25**~~	~~**25**~~	~~**100%**~~

Description	**Research**	**Value Engineering**	**Constructability Review**	**Schedule Reduction**	**Total**
Brick Facade	5	15	10	15	**45**
Roofing System	5	10	15	10	**40**
Electrical System	15				**15**
Total	**25**	**25**	**25**	**25**	**100%**

Appendix A: Breadth Studies

The breadth studies topics involve analysis and understanding outside a students' distinct technical discipline/option within the Architectural Engineering major.

Breadth One: Structural

After analyzing an alternative roof system, a reduced dead load will occur from removing the green roof. Using the RAM Structural application, loads will be calculated for redesign roof's structural system and member sizing can be evaluated. The system will then be re-designed with a reduction in steel member sizes which could be potentially significant.

Breadth Two: Electrical

The electrical design loads for the buildings' electrical distribution system will be analyzed. The comparison to the installed system and calculations for sizing the electrical transformer will be conducted. This will provide a comparison to the required size of electrical transformer needed to the 750kVa transformer that was installed to replace the original 300kVa transformer which failed due to a phase loss issue.

MAE Requirements:

To satisfy the MAE requirement, I will be demonstrating knowledge learned from AE 542: Building Enclosure Science and Design which focuses on developing an understanding of the nature, importance, functions, and performance of the building envelope in general. This will be valuable for my analysis of the Brick Façade and Roofing Systems.

I will also demonstrate knowledge gained from AE 597D: Sustainable Building Methods which focuses on strategies and technologies for green buildings and sustainable construction and an understanding of how to minimize the impacts of buildings on the environment. I will use this knowledge in deciding on alternative materials through value engineering such as a precast brick wall system and a light "cool" roof system.

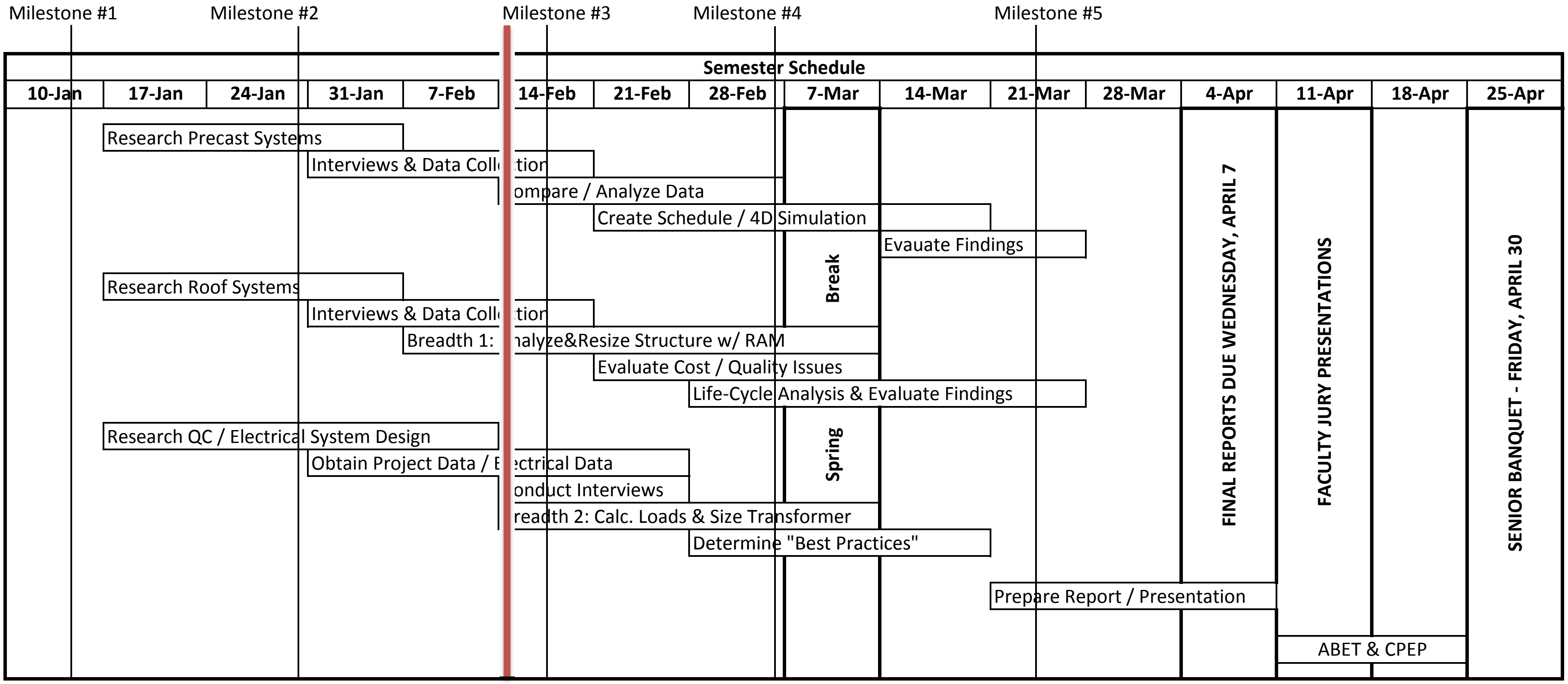
Additionally, methods taught in AE 572: Project Development and Delivery Planning will be used to create a life-cycle cost analysis between the green roof and alternative "cool" roof system to determine the feasibility of each system and the financial benefit to the owner.

Appendix B: Spring Schedule

John Tyler Community College Phase 2 New Building

Senior Thesis Progress Report
2/15/2010

Dennis Walter
Construction Management
Advisor: Jim Faust



Analysis 1: Brick Façade
Analysis 2: Roofing System
Analysis 3: Electrical System
Breadth 1: Structural - Roof System
Breadth 2: Electrical - Transformer
Current Date

Milestone Activity List

1) *Jan 15 – Friday 5 PM:* Deadline for CPEP, Stat 2, and Breadth Proposal Corrections
2) *Jan 29:* Substantial research for all analysis topics - Begin next steps
3) *Feb 17:* “Go – No Go” Confirmation
4) *March 5:* Substantial Breadth Topic Completion
5) *March 24:* Final Progress Report and Presentation Checks