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Final Proposal



Unionville High School Additions and Renovations

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Executive Summary

This **Final Proposal** has been compiled to outline and describe areas of research to be studied for this Thesis regarding the Unionville High School Building Additions and Renovations. The goal of each analysis area is to improve the project and the process used during construction.

Analysis 1: Façade Redesign

With a tight schedule on this educational project, time is of the essence. The originally designed stick-built façade presented the opportunity for schedule acceleration. A precast façade panel system will be designed with the goal of reducing the façade's installation timeframe and ultimately reducing the schedule. Also included in analysis 1 is Breadth 1, which will focus on the analysis and redesign (if necessary) of the structural system to hang these precast panels.

Analysis 2: BIM Implementation – 4D Phase Planning

With no BIM use on this project at all there is room for coordination improvement. BIM implementation is a critical industry issue and provides a valuable area of research for this project. 4D Phase Planning will be researched and applied to the project, resulting in phase planning models and phase safety plans.

Analysis 3: Sustainability – Renewable Energy Implementation

Although a basic LEED analysis was performed during the design of the UHS project, no renewable energy was incorporated into the project. Renewable energy options will be researched and a renewable energy system will be applied to the project. Breadth 2 centers on the energy savings based on the renewable energy system and any resulting changes to the mechanical system.

Analysis 4: Delivery Method Study

With a Single Prime delivery method system, the UHS project is unique as most Pennsylvania schools require a multiple prime approach. The difference between the two systems will be studied and a determination of the superior method for this project will be highlighted.

Analysis 5: Information Technology Implementation

Information technology has been increasing in availability and efficiency over the past several years. With lapses in information flow on the project, there exists the potential for incorporation of information tracking technology. The feasibility of implementing these technologies will be studied and a plan for application will be developed. Material tracking will also be researched, with the potential to track larger pieces of equipment such as the precast façade panels or AHU's.

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Project Background

Overview

Located at 750 Unionville Road in Kennett Square Pennsylvania, the Unionville High School Additions and Renovations project consists of new construction as well as the demolition and renovation of existing spaces. With a total size of 319,000 square feet and 3 stories, the new building is set to house not only Unionville High School but also the Unionville-Chadds Ford School District Administrative Office (Figure 1). Unionville-Chadds Ford School District, MM Architects, Inc., and Wohlsen Construction have teamed up to complete this large educational project.



Figure 1: Unionville High School

As is true with many education projects, especially renovations, there are many challenges throughout the project. The primary issue during the project is limiting the contractors' interference with the students and faculty that populate the building. Many spaces throughout the building must remain in use as adjacent spaces are built or renovated. To achieve as little interference as possible, an elaborate phasing system has been developed. With four main

phases and sixteen sub-phases throughout the project, the project team aims to complete the project as smoothly as possible while creating as little of a disturbance as possible to the building occupants.

Many new spaces are planned as a result of this large public education project. Wrestling, physical education, and fitness and weight room space are set to replace half of the existing gymnasium as a new gymnasium is constructed on the West side of the building. The existing auditorium is to be renovated into classroom space as a brand new 1,200 seat auditorium set to be built at the North end of the building, certain to become the new focal point of the building. Although no specific rating has been specified, the building team agreed to aim for LEED certification when all is said and done. The total construction cost of this Hard Bid Public Works project comes in at \$52, 895,000 with a total project cost of around \$71 Million.

The tables below outline the phases and subphases, as well as schedule dates for each phase.

Phase Descriptions

- ❖ **Phase 1:** Construction of the New 3 story addition, set to house the Unionville-Chadds Ford School District Administrative Offices, Classrooms, and Science labs.
- ❖ **Phase 2:** Construction of the New Auditorium, Art rooms, and Family and Consumer Classrooms.
- ❖ **Phase 2A:** Renovation of existing Large Group Instruction, Library, Faculty Restrooms, Cafeteria, and Kitchen.
- ❖ **Phase 2B & 2C:** Renovation of existing District Administrative Offices into High School Offices, Science Labs, and Classrooms.
- ❖ **Phase 2D:** Renovation of existing High School Offices, Music Area, and Faculty Dining.
- ❖ **Phase 2E:** Renovation of existing Science Labs and Classrooms.
- ❖ **Phase 2F:** Renovation of existing Classrooms
- ❖ **Phase 2G:** Renovation of the existing Computer Applications Labs and Classrooms.
- ❖ **Phase 2H, 2I, 2J:** Renovation of existing Classrooms.
- ❖ **Phase 3:** Renovation of existing Auditorium into Choral Room and Tech Ed Classrooms.
- ❖ **Phase 4:** Demolition of existing Classroom and Tech Ed Wing and Weight Room.
- ❖ **Phase 4A:** Renovation of existing Gymnasium, Locker and Team Rooms.
- ❖ **Phase 4B:** Demolition of existing Auxiliary gym.

Phase Timelines

Design	June 16 th 2008 – June 12 th 2009
Phase 1	June 15 th , 2009 – June 25 th , 2010
Phase 2	June 9 th 2010 – June 23 rd 2011
Phase 2A	June 2 nd 2010 – July 28 th 2011
Phase 2B & 2C	June 30 th 2010 – December 31 st 2010
Phase 2D	January 6 th 2011 – June 27 th 2011
Phase 2E	January 3 rd 2011 – January 21 st 2011
Phase 2F	January 24 th 2011 – February 11 th 2011
Phase 2G	February 14 th 2011 – March 4 th 2011
Phase 2H	March 14 th 2011 – April 1 st 2011
Phase 2I & 2J	April 4 th 2011 – June 3 rd 2011
Phase 3	June 9 th 2011 – December 30 th 2011
Phase 4	July 7 th 2011 – April 27 th 2012
Phase 4A	May 24 th 2011 – September 28 th 2012
Phase 4B	April 30 th 2012 – June 29 th 2011

Analysis 1: Façade Redesign – Precast Panel Façade System

Problem

Based on the initial design, the façade for the new additions to the Unionville High School building is to be a stick-built rock faced CMU and brick façade system. With each piece of this system to be installed separately by workers on site, the original system takes a significant amount of time to erect and adds congestion to the project site. A stick built system such as this can lead to unnecessary site congestion, unsafe working conditions, and decreased productivity.

Research Goal

Research will be conducted to determine the feasibility of replacing the existing façade system with a precast façade panel system. Furthermore, a cost and schedule analysis will be performed to determine the benefits and negatives associated with making this switch. Any changes to the structural system will be studied and necessary additions will be designed. Mechanical loads will also be studied to determine the differences between the originally designed system and the newly prefabricated façade panels.

Research Methodology

Research Methods

- ❖ Study current rock face CMU and Brick façade assembly
- ❖ Determine duration and cost of existing façade system
- ❖ Study potential precast panel façade systems
- ❖ Determine which precast panel façade system to use
- ❖ Analyze resultant effects on existing structural system
- ❖ Design any necessary additional structural connections
- ❖ Analyze effects on mechanical properties of the façade system
- ❖ Study feasibility of precast system
 - Cost, Schedule, and Constructability

Resources

- ❖ PSU AE Faculty and peers
- ❖ UHS Project Team
- ❖ MM Architects (project Architect)
- ❖ Industry professionals (with precast façade experience)
- ❖ Precast façade panel manufacturers
- ❖ Structural system analysis software
- ❖ Relevant studies, publications, and documents

Outcomes

Ultimately, a precast panel façade system will help to shorten the overall project duration without diminishing the quality of the project. The cost for the new system is likely to be comparable to the existing system, and any cost increases will be outweighed by the savings to the schedule. With three new additions, each with similar façade systems, the project has significant possibility for schedule reduction via a change from a stick build façade to precast façade panels.

Analysis 2: Safety and Phase Planning – 4D Phase Planning

Problem

As a project containing both new additions as well as renovations, safety of building inhabitants as well as contractors at UHS is an added constraint. No BIM was used on the project in any way, and no site safety plan or phasing safety plan was created for the faculty and students within the existing UHS building.

Research Goal

The PSU BIM Execution plan will be utilized to determine the feasibility of incorporating BIM on the project. 4D Modeling and Phase planning specifically will be explored and if possible, implemented on the project. From this, a 4D Phasing Plan and Safety plan will be explored in hopes of providing value to the owner and the inhabitants within the building.

Critical Industry Issue

Much of the discussion at the 2011 PACE Roundtable centered on BIM implementation. As a project without BIM implementation, studying the applications available to the project provide a unique analysis opportunity.

Research Methodology

Research Methods

- ❖ Study current structure of construction phases
- ❖ Conduct research on similar phased projects
- ❖ Determine hazardous areas for each phase
- ❖ Develop safety plan/diagram for each phase
- ❖ Develop 4D Model for all phases
- ❖ Create individual model for each phase
- ❖ Study feasibility of BIM Implementation
 - Cost, Learning Curve, and Constructability

Resources

- ❖ PSU AE Faculty and peers
- ❖ PSU BIM Execution Guide
- ❖ Industry Members (with relevant BIM experience)
- ❖ UHS Project Team
- ❖ Similar Projects

Outcomes

A 4D model for each phase within the entire project will be developed. From this model, a detailed 4D Phasing Plan and Safety plan and diagram will be created. The model and safety plan will help to provide building inhabitants with information regarding areas of the project that are currently under construction. Each phase will have a unique plan, available to both building inhabitants and contractors.

Analysis 3: Sustainability and LEED Study – Renewable Energy

Problem

Although a preliminary sustainability study was performed for UHS and a LEED scorecard was filled out, no on-site renewable energy was designed for this project. The addition of on-site renewable energy for the project will not only reduce the buildings energy usage, but may also vault the UHS project into the LEED Silver range. Research will also be conducted on the possibility of adding a green roof to the project and if this application is possible.

Research Goal

The addition and initial design of an on-site renewable energy system on the UHS project will be researched. Several systems will be researched (solar, wind, etc.) to determine which system best fits this specific project. Cost and constructability will be studied to determine the practicality of adding a system such as this to the project and what savings, if possible, are available to the owner via the integration into the existing power system.

Research Methodology

Research Methods

- ❖ Research potential on-site renewable energy systems
- ❖ Check for case studies involving similar applications
- ❖ Reach out to renewable energy suppliers to determine feasibility of this application
- ❖ Determine which system to use and design for proposed system
- ❖ Determine how this system will integrate into existing electrical system
- ❖ Study any potential changes to structural system
- ❖ Redesign structural system if necessary
- ❖ Study feasibility of renewable energy system
 - Payback period, Schedule impact, and constructability

Resources

- ❖ PSU AE Faculty and peers
- ❖ UHS Project Team
- ❖ Industry professionals
- ❖ Renewable energy manufacturers/suppliers
- ❖ Schools/buildings with similar applications
- ❖ Relevant studies, publications and documents

Outcomes

After thorough research on the practicality of integrating the new system, the successful addition of a wind energy system to the project will provide cost savings and help to build UHS' image through their effort to provide a more sustainable building. While initial setup costs are likely to be high, overall lifecycle costs should provide incentive to incorporate a wind energy system. Depending on the size and production of the system, the project may qualify for a LEED Silver rating as opposed to the currently predicted LEED Certification.

Analysis 4: Delivery Method Study

Problem

Due to legislation in the state of Pennsylvania, most projects are delivered using a Multiple Prime contract setup. On this project, Unionville Chadds Ford School District went a different route and used a Single Prime delivery method.

Research Goal

The two delivery methods, Single Prime and Multiple prime, will be studied. Research will be done to determine how UCFSF was able to bypass the multiple prime legislation and use a single prime with Wohlsen construction. The pros and cons of the two systems will be studied, and the ultimate reason for using a single prime approach will be outlined.

Research Methodology

Research Methods

- ❖ Research reason for using Single Prime
- ❖ Study current delivery method
- ❖ Research Multiple Prime delivery method
- ❖ Compare/Contrast both methods
- ❖ Develop pros/cons for both systems
- ❖ Determine best system for this project

Resources

- ❖ PSU AE Faculty and peers
- ❖ UHS Project Team
- ❖ MM Architects (project Architect)
- ❖ Industry professionals
- ❖ Projects with similar delivery system(s)
- ❖ Relevant studies, publications, and documents

Outcomes

The driving force behind the Single Prime delivery method will be highlighted. Positives and negatives from each system will be outlined and compared, showing the differences between the two delivery systems. A study will be performed to determine whether Single Prime was the most beneficial delivery method for this project. An argument for why the superior system should be the norm for projects of similar scope will be made.

Analysis 5: Information Tracking Technology Implementation

Problem

Information flow on the project, like many projects, has created some coordination problems. Delays in information flow occur do to some RFI and Submittal processing periods as a result of a breakdown in communication. Many changes have occurred on the job as a result as well. Information does not flow transparently which results in delays.

Research Goal

Information Technology implementation will be studied. Punchlist tracking, RFI and submittal logs and schedules, and material tracking will all be researched. Utilization of improved information tracking technology can help to provide better information to all parties throughout the construction process, allowing faster turnover times of RFIs and submittals. Additionally, material tracking will be researched. With precast façade panels and other large pieces of equipment set to be installed, tracking the delivery and installation can provide value to the project team.

Research Methodology

Research Methods

- ❖ Study current information tracking system(s)
- ❖ Determine gaps in process and potential downfalls
- ❖ Study alternate technologies and uses
- ❖ Choose which technologies and uses to implement
- ❖ Determine cost of implementation (learning curve, software, etc.)
- ❖ Study feasibility of implementation
 - Cost, Schedule, and Constructability

Resources

- ❖ PSU AE Faculty and peers
- ❖ UHS Project Team
- ❖ MM Architects (project Architect)
- ❖ Subcontractors
- ❖ Industry professionals (with information technology)
- ❖ Relevant studies, publications, and documents

Outcomes

Information technology will provide better communication and more efficient information flow on the project. A plan will be developed to better organize information and keep everyone on the project team abreast of information flowing within the project. Material tracking will be used on larger, more important portions of the project (façade panels, AHU's, etc) which can help to better organize deliveries, installations, and commissioning.

Weight Matrix

This weight matrix is designed to plan out which areas of study will receive which level of attention. Based on this initial matrix, research and constructability review are of the most importance. Depending on where research leads, this matrix is fluid and can change if necessary.

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Analysis 1: Façade Redesign	10	5	5	10	30
Analysis 2: BIM Implementation	5	5	10	-	20
Analysis 3: Renewable Energy	10	5	5	-	20
Analysis 4: Delivery Method Study	5	-	5	5	15
Analysis 5: Information Technology	5	-	5	5	15
Total	35	15	30	20	100

Conclusions

Research will be conducted to obtain more information on these specified analysis areas. Ultimately, constructability, efficiency, and improving sustainability are the main goals of this research. As the construction industry moves forward, improving processes is what provides a competitive advantage. The precast panels will cut down on schedule time and could clear working space on the project. Implementing BIM will bring value to both the contractor (Phase Planning) as well as the Owner (Phase Planning and Safety Plan). Applying renewable energy to the project will help to improve the buildings sustainability while also reducing energy use. A study of the delivery method will shed light on why a single prime delivery system was used. Finally, information tracking software will be researched and applications will be analyzed.

Note: This Thesis Proposal is a fluid document and is up for interpretation and change throughout the research process.

APPENDIX A: Breadth Topics

Breadth Topics

Breadth 1: Façade Redesign - Structural

Breadth 1 will focus on the existing structural system. As a result of an alternate façade design, the structural system must be analyzed. Initially, the façade was designed as a stick-built system consisting of rock face CMU blocks and bricks. Based on Analysis 1, the façade will be redesigned with the new design using precast façade panels. The structural system will be analyzed to determine if any changes must be made. If changes are necessary, the system will be revised and any new connections will be designer.

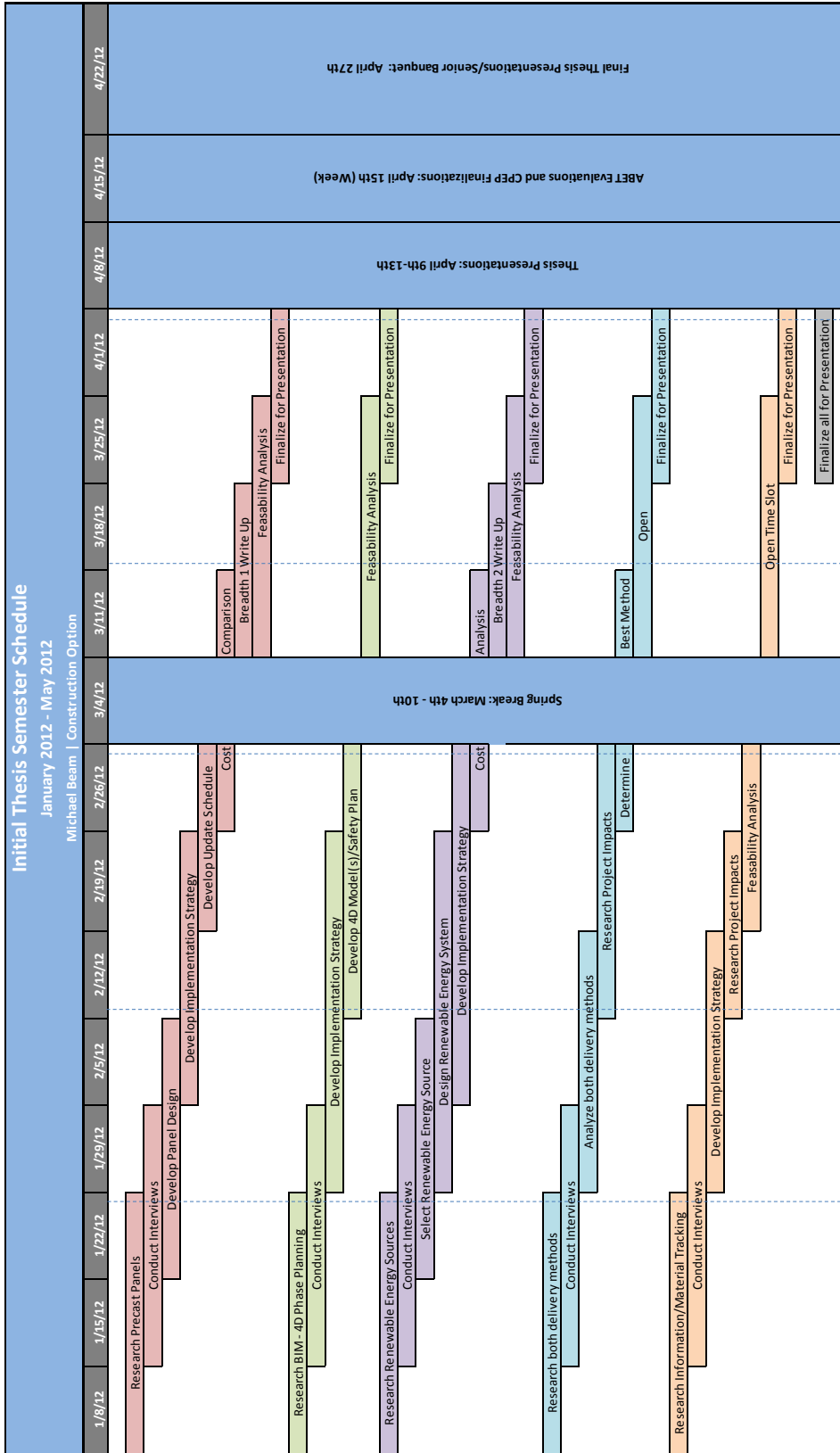
Breadth 2: Renewable Energy - Mechanical

Breadth 2 centers around the application of renewable energy on the UHS project. Analysis 3 is aimed at studying and researching different renewable energy options. Once chosen, the renewable energy source will be designed specifically for the UHS project. The system will provide energy for the school and energy savings will be compiled, analyzed, and any changes to the existing mechanical system will be researched and designed.

Breadth 3: Façade Redesign - Mechanical

As an alternative, Breadth 3 will again focus on Analysis 1. The thermal properties of the existing façade system will be researched and compared to those of the newly designed precast façade panel system. Any differences will be highlighted and the potential exists for a change in the mechanical system.

APPENDIX B: Research Schedule



Milestones
January 27, 2012 - Research Completed
February 13, 2012 - Designs Completed
March 2, 2012 - Analysis 4 Completed
March 16, 2012 - Content Complete
April 7, 2012 - Content Revised/Finalized
April 15th, 2012 - ABET Evaluations
April 15th, 2011 - CPEP Finalizations

Legend
Analysis 1: Façade Redesign - Precast Panels
Analysis 2: BIM Implementation - 4D Phase Planning
Analysis 3: Sustainability - Renewable Energy Implementation
Analysis 4: Delivery Method Study
Analysis 5: Information Tracking Technology Implementation