HD WOODSON HIGH SCHOOL

Construction Project Management

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THESIS PROPOSAL

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EXECUTIVE SUMMARY

This proposal will discuss the four analysis topics chosen for HD Woodson High School. The four topics will encompass a distribution of study covering Critical Issues Research, Value Engineering, Constructability Review and Schedule Reduction. Besides the Construction depth topics a breadth analysis of Mechanical and Structural will be proposed.

Analysis Topic 1: Maximizing Building Information Modeling Investments

In the construction industry today many projects are beginning to use Building Information Modeling for system coordination and design. This topic will aim to determine if the high initial investment can result in providing and facilitating even more than 3-dimensional coordination in an easier to use organized manner. Through the use of the BIM Ex Plan and other resources this topic will cover **Industry Research** and **Constructability Review.**

Analysis Topic 2: Optimizing Value Engineering

Value Engineering is a topic that is a systematic method to adding "value" to a project, in this analysis the goal is to evaluate the potential savings from value engineering alternative solutions to LEED design elements that are often over looked during the Value Engineering Process. A focus will be on reducing or eliminating the green roof with little to no impact on LEED points. The topic will discuss **Industry Research, Value Engineering** and **Schedule Reduction.**

Analysis Topic 3: Alternative Exterior Wall Assemblies

The exterior masonry walls on this project are a schedule risk in numerous ways. This analysis will provide two alternative assemblies for the structural elements of the exterior walls. A breadth analysis will also be covered under this section in mechanical energy use with the alternative wall properties. Core areas of study to focus in for this topic are **Value Engineering, Constructability Review** and **Schedule Reduction.**

Analysis Topic 4: Alternative Steel Truss Construction

The gymnasium and natatorium at HD Woodson High School are spaces over 100 feet between supports and continuous steel trusses are used to span the distance. These trusses were shipped in a single piece from Delmar, Delaware to NE Washington DC. This analysis will propose splicing the trusses to ease shipping costs and efforts. A structural breadth will be completed in this topic and the focus areas will be **Value Engineering** and **Constructability Review.**

PROJECT BACKGROUND

HD Woodson High School has been design to replace the former HD Woodson High School on the existing site. There will be 3 stories above ground at the highest point and only below making a total of four stories. A total of 230,130 gross square feet will accommodate up to 900 Students. A design focus around the Science, technology, Engineering and Math, or STEM learning system provides a non-typical school facility. It allows for an integral classroom and hands on laboratory teaching approach.

LEED Gold Certification is being pursued and is currently on track with the project team and owner's full support. The use of a green roof and highly reflective EDPM roofing material and grey-water system are a portion of the LEED Design elements.

The exterior architecture will be made up of a brick base up to a water table around the structure with masonry panels as the façade. Storefront style glass curtain wall is used in some areas as well as aluminum cladding on overhang spaces. A main feature of the project will be a grand entry way with a metal canopy extending out from the front doors.

Along with lab and classroom spaces the design also calls for a competition gymnasium, auxiliary gymnasium, natatorium, auditorium, cafeteria, kitchen, common areas, offices and a large atrium space as a design feature.

ANALYSIS TOPIC 1: MAXIMIZING BIM INVESTMENT

PROBLEM IDENTIFICATION

The use of Building Information Modeling, BIM, on HD Woodson High School was an effective way to facilitate trade coordination. The original decision to use BIM was due to the large amount of MEP systems in areas confined by low floor to structure heights and the desire to eliminate filed clashes of these components. While this decision was a great way to coordinate MEP Systems there are many uses that could have made the BIM efforts more beneficial and allowed for a smooth modeling process. Building Information Modeling can be much more than a clash detecting model if the goals and uses are defined early on in a project. This critical industry issue of high initial costs associated with BIM can be justified if the end results of all three components of a Building Information Model are maximized. This topic was a discussion at the PACE Roundtables.

RESEARCH GOAL

The goal of this analysis is to identify the beneficial uses of BIM that were not utilized and how these uses could have benefited the schedule and constructability of HD Woodson HS, while maximizing the initial investment and making BIM make business sense.

METHODOLOGY

- Work through BIM Execution Planning Guide to identify viable BIM Goals and Uses
- Use BIM Ex Plan as guide to identify how communication exchanges could have been simplified
- Interview personnel on site and explore drawings to develop potential areas for bulk prefabrication to accelerate schedule
- Explore benefits to the owner for Operations and Maintenance
- Draw conclusions from viable options and effects of Implementing BIM Ex Plan

RESOURCES AND TOOLS

- Building Information Modeling Execution Planning Guide
- Key personnel on site from HESS Construction and Engineering Services
- BIM/IPD Studio experience

EXPECTED OUTCOME

The majority of this analysis will be qualitative and provide minimal quantitative analysis. Show the possibility of expanding BIM to create opportunities in the areas of prefabrication and operation and maintenance. The efforts of planning the design process can benefit the design and construction team in many ways and with reduced struggles with the implementation of the BIM Ex Plan.

ANALYSIS TOPIC 2: OPTIMIZING VALUE ENGINEERING

PROBLEM IDENTIFICATION

The Value Engineering process for HD Woodson High School was limited by the LEED Gold design requirement. However, this process could have been optimized by digging deeper into certain LEED requirements. The Green roof comes with an expensive price tag and complicated assembly with high risks. Value Engineering that dismisses evaluating LEED Options may overlook more cost effective benefits. Thinking about this topic and discussing the green roof construction with the project team, the desire for an investigation into LEED elements with Value Engineering peaked my interest.

RESEARCH GOAL

To identify costs savings and impacts on other building systems if the green roof area is reduced or eliminated. Develop a scheme that still allows these LEED points to be counted at a lower cost and within a shorter time period. Determine the possible implications to a project by elevating design elements that are being counted for LEED points past the Value Engineering process.

METHODOLOGY

- Perform LEED Scorecard Analysis
- Determine physical properties that must be maintained from Green Roof
- Evaluate effect on grey water system and develop other rain water management system if necessary
- Evaluate LEED criteria to assist in developing alternate way of collecting designated points
- Develop cost savings and schedule impacts for alternate methods created

RESOURCES AND TOOLS

- LEED for schools and actual project scorecard
- Previous coursework with material properties
- Rain water calculation tables for design purposes
- Estimating and Scheduling experience from courses and internships

EXPECTED OUTCOME

Design elements intended for LEED certification cannot be overlooked by project teams, alternatives exist that can save money and time while still performing in a similar manner.

ANALYSIS TOPIC 3: ALTERNATIVE EXTERIOR WALL ASSEMBLIES

PROBLEM IDENTIFICATION

The exterior enclosure is a major schedule risk to the projects timely completion. The current design is exterior masonry panels with CMU backing. Issues that come from use a CMU wall are its time, weather impacts, cleanliness and ability for changes during MEP rough in. The time and weather are directly related with CMU construction. When temperatures reach a certain point it must either be completely shut down or costly temporary heat and tents must be used. The process tends to clutter a site and requires vigilant "house cleaning" efforts. It also makes the MEP rough in cumbersome, especially the in-wall electrical conduits. The path to this topic began with a site visit, during which the masons were laying block and having to lift the blocks over the conduits stubbed up out of the walls.

RESEARCH GOAL

To develop two alternative methods, for exterior wall construction, that has potential to accelerate the schedule and eliminate risk of delaying the exterior enclosure process. Ensure little to no impact on the architecture of the building, while evaluating material properties and their impact on other systems.

METHODOLOGY

- Develop baseline for material properties and wall assembly with minimum requirements to match with alternative assemblies
- Determine two alternate wall construction assemblies that eliminate the problems associated with CMU walls
- Evaluate costs, schedule impacts and other building system impacts.
- Compare the three wall types and evaluate if a viable solution exists

RESOURCES AND TOOLS

- Industry professionals
- Material Properties, particularly Thermal and Moisture Barriers
- Estimating and scheduling experience

EXPECTED OUTCOME

A reduced schedule would be expected as well as a cleaner less congested site due to debris. The reduced schedule may have an increased cost, which could be offset by reduction of general conditions.

ANALYSIS TOPIC 4: ALTERNATIVE STEEL TRUSS CONSTRUCTION

PROBLEM IDENTIFICATION

Transportation of construction materials can be a difficult and arduous task. The transportation of steel trusses, for the gymnasium and natatorium areas on HD Woodson High School, became extremely challenging. Multiple trusses over 100 feet long had to be transported from Delmar Delaware to NE Washington DC, roughly 112 miles, with police escorts and at great stress and expense to the project team. This topic was derived from a conversation with the project team about the truss transportation.

RESEARCH GOAL

The goal of this analysis will be to analyze the feasibility of splicing the trusses to allow easier transportation and a cost and risk savings. Determine if it is possible to reduce the transportation risk and cost by designing the truss to splice and reduce overall shipping length. While erection time and site assembly may increase the time needed to erect the large trusses the risks and other expenses may be eliminated.

METHODOLOGY

- Consult with Engineer to determine feasibility
- Create alternative Design or splice that allows truss to breakdown into smaller units
- Determine costs of transportation for both plans
- Calculate influences on schedule

RESOURCES AND TOOLS

- Structural engineer
- Previous structural design courses
- Estimating and scheduling experience

EXPECTED OUTCOME

The outcome of this analysis will hopefully show that the transportation costs and time can be reduced by splicing the large trusses in the project. However, the true feasibility of this change will be determined by the additional costs associated with erecting multiple pieces or assembling the pieces on site prior to erection. The costs may be too close to determine a definite winner on cost, but by making the transportation a safer process, then something is to gain.

ANALYSIS CONCLUSIONS

The four analysis topics chosen have four areas of investigation that are distributed throughout. These four topics: Critical Issue Research, Value Engineering, Constructability Review and Schedule Acceleration will make up the core areas of my analyses. Beyond these four core topics a demonstration of breadth will also be performed within the analyses.

In Table 1 the weight matrix shows the approximate distribution of investigation areas. Percentages of the area expected to be covered in each analysis are shown.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	TOTAL
Analysis 1: Maximizing BIM	15		5		**20**
Analysis 2: Optimizing VE	5	15		15	**35**
Analysis 3: Alternative Ext. Walls		5	15	10	**30**
Analysis 4. Steel Truss Construction		5	10		**15**
TOTAL	**20**	**25**	**30**	**25**	**100**

Table 1 Weight Matrix

For breadth topics, mechanical and structural have been chosen. The mechanical breadth will be demonstrated in the Analysis of alternative exterior walls, while the structural breadth will be covered in alternative steel truss construction. More details on both of these topics are in the Breadth 1 and 2 sections.

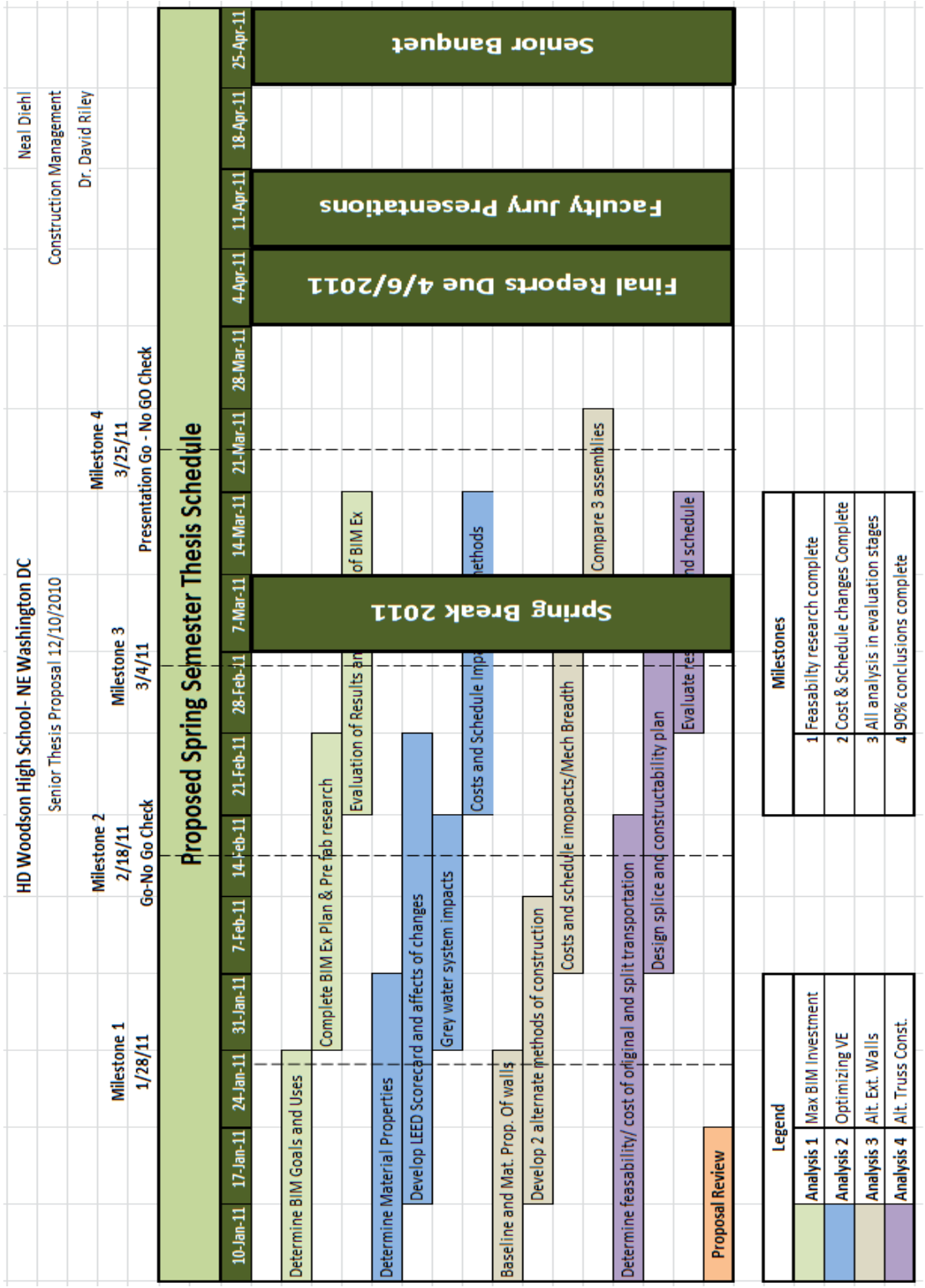
BREADTH ANALYSIS

STRUCTURAL

Structural breadth will be demonstrated in the Value Engineering Optimization, analysis two. Looking at the reduction of green roof loads and reducing structural steel will provide a demonstration of structural breadth. The analysis needed to determine the feasibility will allow the determination of cost reductions and the allowable reduction in steel member sizes.

MECHANICAL

Within Analysis two, the proposed exterior wall assemblies will have differing R and U values that could result in a change in the buildings energy use. In order to show breadth, a study of energy use will be done with existing designs and proposed designs to demonstrate the impact of changing the exterior walls, for constructability, on the mechanical system.



MILESTONE SCHEDULE