

HD WOODSON HIGH SCHOOL

Construction Project Management



TECHNICAL ASSIGNMENT 3

Prepared For:

Dr. David Riley, PhD
Department of Architectural Engineering
The Pennsylvania State University

Prepared By:

Neal Diehl
Construction Option
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TABLE OF CONTENTS

Contents

TABLE OF CONTENTS.....	2
EXECUTIVE SUMMARY	3
CONSTRUCTABILITY CHALLENGES	4
SCHEDULE ACCELERATION SCENARIOS	8
VALUE ENGINEERING	9
PROBLEM IDENTIFICATION	10
TECHNICAL ANALYSIS METHODS	12

EXECUTIVE SUMMARY

Technical Assignment 3 aims to investigate areas of the HD Woodson High School that are good candidates for research, alternative methods, value engineering, and schedule compression. This goal is achieved through five focused areas: Constructability Challenges, Schedule Acceleration Scenarios, Value Engineering Topics, Problem Identification and Technical Analysis Methods. The first three topics, respectively, have been analyzed with the assistance of a phone interview with members of the project team. The last two are observations that I have made based on the interview and other research into the building design and construction methods.

Constructability challenges will describe difficult hurdles the project team faced during the construction of HD Woodson High School. The focus areas discussed were: pool construction, mechanical coordination, special steel deliveries and green roof construction. The way the actual project team overcame these challenges will also be included.

Schedule acceleration scenario section will discuss the make-up of the Critical Path that will lead to a successful project and present the biggest risk to the critical path. Key areas that have potential to accelerate the schedule, such as exterior masonry are explained. The cost and techniques are not calculated in detail but the potential for both of these is laid out in this section.

Value engineering topics describes the key areas the project team focused on to evaluate the viability of alternate means and methods. Design goals and Sustainable features were not sacrificed during this process in order to align the project team with the owner's goals. Lighting package, grey-water system and proposed mechanical system change are discussed.

The final two sections discuss problems that have been identified or are potential threats to the project team's success. The aim of this section is not to make accusations or bring fault to the project team. Rather, it is a way to suggest hypothetical means and methods that could have improved the design and construction process of HD Woodson High School. The technical analysis methods suggest potential areas of study to affect not only a single building system but potential changes that would impact multiples facets of the construction process. A description of how these changes will be analyzed is included as well as research needed to further develop the viability of an alternate method.

CONSTRUCTABILITY CHALLENGES

The project team has identified three constructability challenges they face on the HD Woodson High School. The Swimming pool construction in the natatorium, the mechanical coordination, and special roof truss deliveries.

Pool Construction:

The swimming pool construction was a challenge due to the depth of the pool. Nearly the entire pool structure was built at an elevation below groundwater level. This caused a lot of difficulty with dewatering and excavation. A dewatering system was used outside the excavation. Once the pool structure was being formed and waterproofed a caisson had to be built with additional pumps to keep water level below the pool structure. Figure 1 shows the approximate location of the groundwater level at the natatorium.

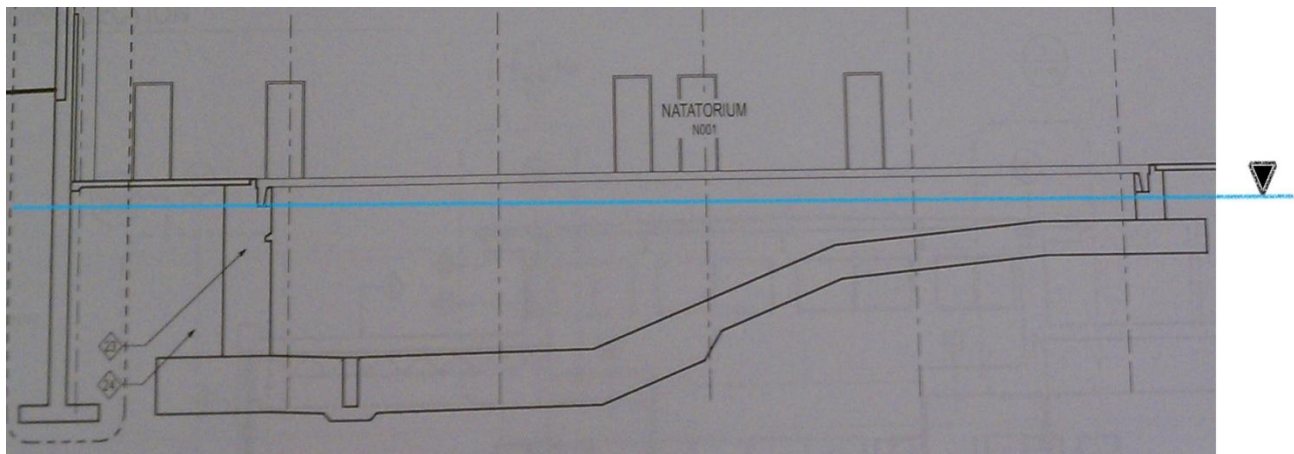


Figure 1

Mechanical Coordination:

Mechanical coordination on the project was a very intricate and challenging on the project. A low floor to floor height created much difficulty for the coordination team. A Building Information Model (BIM) was created to fully coordinate the multiple systems in the building. The clash detection and coordination was facilitated by the sub-contractors providing models of their systems. Shop drawings used were based on the BIM model and all systems are being installed based on the BIM model. Figure 2 below shows the floor to floor heights of the building. With an average depth of structure at three feet the average floor to bottom of structure is 11 feet.

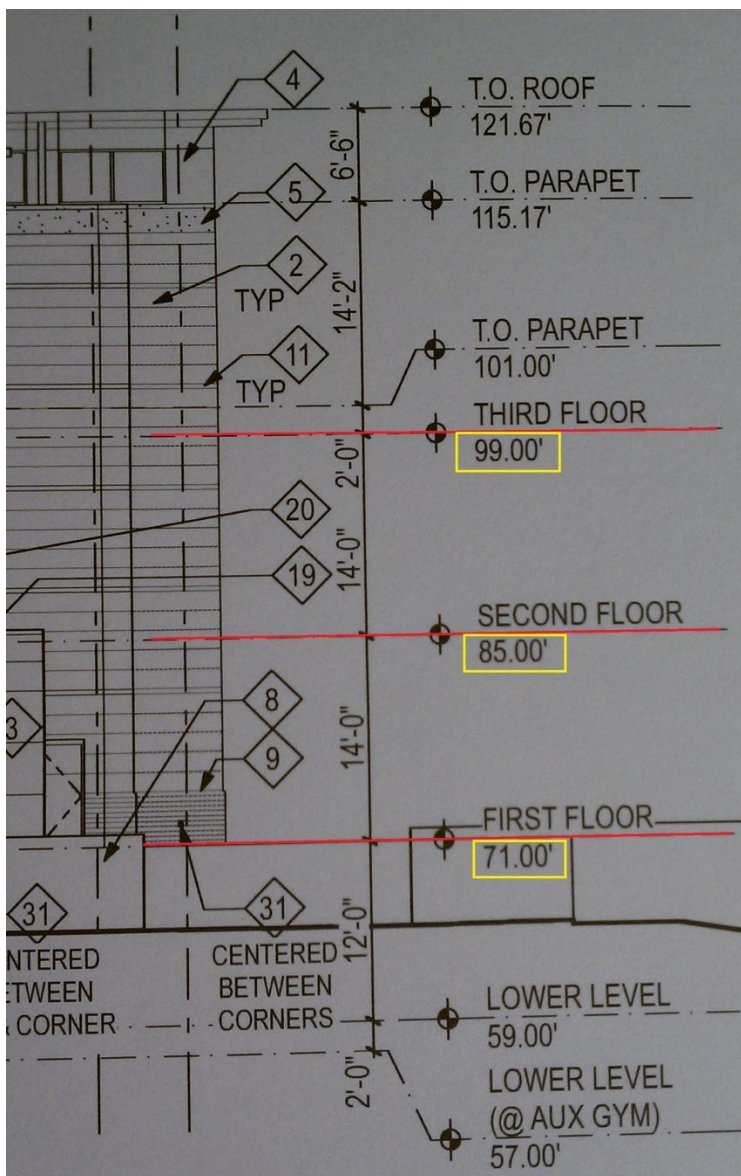


Figure 2

Steel Transportation:

The third daunting obstacle on HD Woodson High School was the transportation of trusses over 100 feet long to the site. An elaborate logistical plan was created to smoothly transport the trusses, for the natatorium and gymnasiums, from Delmar, Delaware across the Chesapeake Bay Bridge to the site in NE Washington DC. A route of roughly 112 miles had to be planned turn-by-turn. Local ordinances had to be considered and required a police escort in numerous locations. The truss shown below in Figure 3 is to be prefabricated to its full length of 105'-4" and then transported to the site.

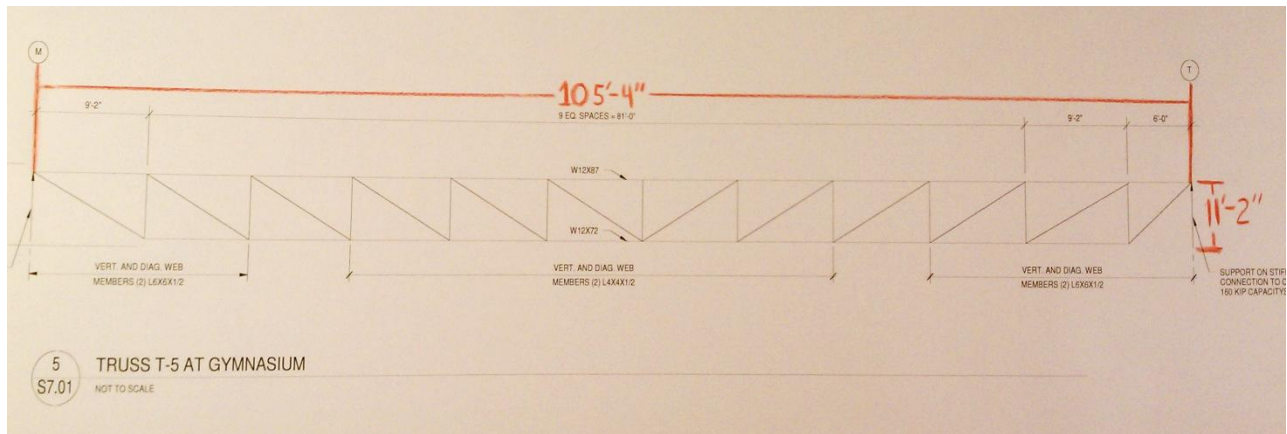


Figure 3

Green Roof Construction:

One additional topic that was challenging was the green roof construction. The waterproofing is non-typical for roof construction. The team overcame this by using a quality roofing contractor and researching the green roof methods and case studies. Figure 4 shows the typical green roof section and the complexity added compared to a typical roofing membrane.

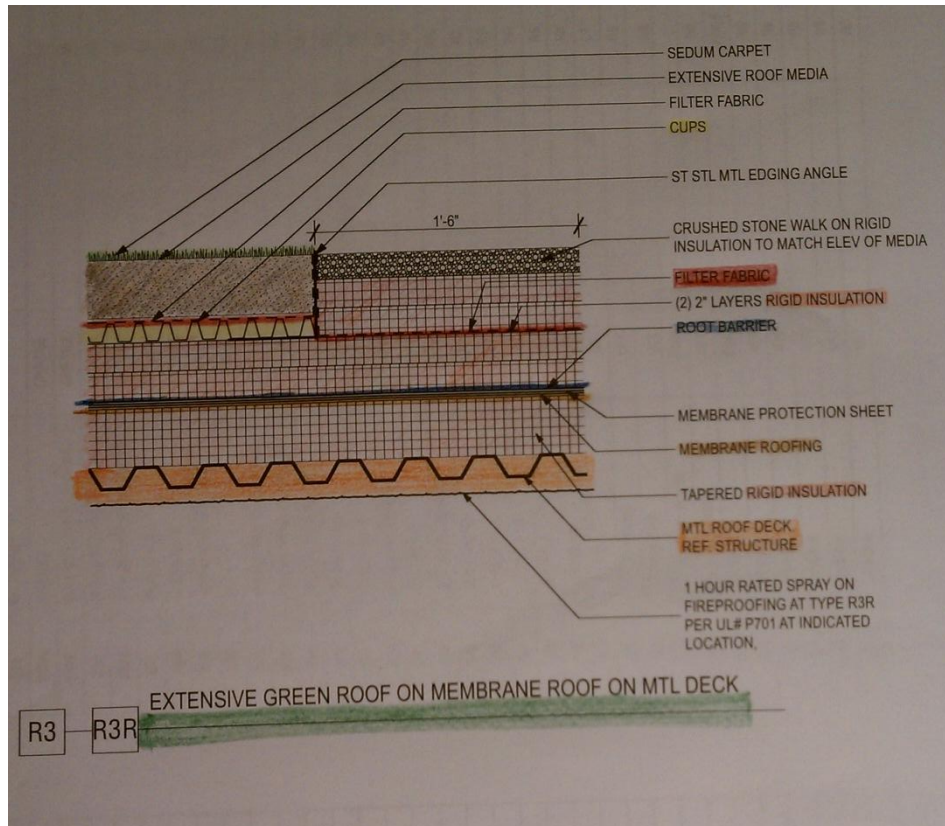


Figure 4

SCHEDULE ACCELERATION SCENARIOS

The Schedule Acceleration Scenario section will outline the critical path and suggest ways to ensure the schedule can be met. The risks to the schedule will be explained and how these risks can be minimized. The potential for delay always exists and ideas will be suggested how to maintain the schedule and keep on track.

Exterior masonry and interior finishes are the most critical part of the critical path for HD Woodson High School. The highly simplified critical path that will lead to an on-time delivery of HD Woodson HS is shown below.

1. Excavation and Site work
2. Building Pad Construction
3. Steel Fabrication
4. Pool Construction
5. Steel Erection and Concrete Slabs
- 6. Exterior CMU Walls**
- 7. Roofing**
- 8. Exterior Wall Masonry and Masonry Veneer Panels**
- 9. Interior Mechanical Rough-Ins**
- 10. Interior Finishes**
11. Final Inspections and Closeout/Commissioning

The most important section of the critical path is the building enclosure. This section must be tightly managed and monitored. While the greatest risk is in this area the greatest potential to make up time and get back on schedule, if delays do occur is also during this time. The interior finishes cannot proceed until the building is “dried-in”.

The biggest risk to the project schedule is at HD Woodson High School is weather. With the amount of work, especially masonry, in such a short period of time and level of finishes, weather delays can be very detrimental. The exterior masonry is a major part of the Critical Path and will allow eliminate a major portion of the risk if it can be completed on time.

Key areas that can accelerate the schedule are during masonry and interior finishes. The primary ways these two processes can be accelerated are by working six days a week and longer hours. The location does not prohibit working weekends and costs would be the overtime to the workers. This should not result in a higher project cost, because the sub-contractor must provide their scope of work in the time required.

VALUE ENGINEERING

Value engineering for the project looked at a few items. Light fixture package, turf grass, ceramic tile and rainwater collection were evaluated. The results from the project team's analysis provided a reduced cost on lighting fixtures and deletion of the cable tray. The cable tray was switched to J-hooks which resulted in a savings of around \$100,000.

The light fixture package was value engineered to provide reduced cost to the project. There are many light manufacturers that vary widely in cost. Many fixtures that are specified can be providing the same specifications and light output levels at a reduced cost.

The turf infield for the softball field was changed to natural grass to reduce cost, and still provide a similar result. The ceramic tile around the pool and in some bathrooms was deleted; this had minimal impact on the architecture, while allowing a savings from the total budget. A rain water collection system was expanded to use the grey and rain water system for toilet flushing.

An additional Value Engineering option that would have to be considered at a very early stage of the design would be a change in the HVAC system. By using the DOAS and an active chilled beam system a number of changes could be possible. A reduction in ductwork would allow more room in congested areas by simply moving water to meet heating and cooling loads. The change in cost of a system like this would be difficult to calculate, due to the potential labor savings and coordination challenges being reduced. Reducing the size of space needed for the mechanical systems could alleviate a lot of coordination issues.

Due to the LEED Gold rating of the building many items in the design that would typically be considered for value engineering were not. There was no change from value engineering analysis that detracted from the architecture or misaligned from the owner's goals.

PROBLEM IDENTIFICATION

Upon analysis of the construction management, schedule, cost, building systems, local conditions and constructability for HD Woodson High School project a number of problems with potential for improvement have been identified. These problems will satisfy multiple areas of research for alternative methods, schedule accelerations, value engineering and constructability review.

Mechanical Coordination:

The coordination of the mechanical systems was particularly challenging on the HD Woodson High School. Low floor to floor heights and the advanced mechanical system created a lot of the congestion in select areas. In many corridors that were highly congested and time consuming to coordinate and construct a possibility to utilize the BIM Model to pre-fabricate sections may exist. This topic was discussed at the PACE Roundtable about ways to further utilize BIM. This could have an impact on the schedule and cost to construct these areas as well.

BIM Coordination:

A BIM Model was used on the project, but based on interviews with the construction team a longer than anticipated time was needed to allow the process to run smoothly. The Building Information Modeling Execution Planning Guide could have cleared up a lot of initial confusion and allow the team to spend more time coordinating and designing the building instead of the Designing the design process. A potential to clearly define the BIM goals and uses prior to design starting could have been very helpful as well.

Exterior Enclosure:

The exterior wall construction is CMU Walls with masonry panels. This method has a high risk of weather delays and increases costs as outdoor temperatures decrease. Temporary enclosures will be required to continue through the entire winter and potential bring work to a stop. Weather is the biggest risk to the schedule and an alternate exterior enclosure method may provide many benefits.

Green Roof Planting:

The construction and planting of the green roof is currently scheduled to be completed very early in the spring. If the planting is done while weather is too cold the potential to lose a lot of plants to the weather exists. Plants not well established prior to being installed on the roof will

require a large amount of replacement planting. A potential to pick these LEED Points may exist other places and the use of a larger area of the “cool” reflective roof technology and an increased insulation could provide similar results. A full investigation into this topic would be needed and a potential to have increased grey water and rain garden areas would be needed.

Steel Deliveries:

A costly and difficult delivery of steel trusses over 100 feet created many obstacles to the construction team. To deliver the trusses from Delmar, DE required investigations into every local area ordinances and turn-by-turn planning. Police escorts were required and a massive coordination effort with escorts and departments of transportation were needed.

TECHNICAL ANALYSIS METHODS

In the Technical Analysis Methods section, construction management activities will be identified for potential analysis. Issues discussed above will be proposed with potential ways of studying the effects of implementation.

Building Information Modeling Execution Planning Guide:

Hypothesis

Implementing the BIM-Ex Planning Guide at the start of the design-build process has potential to provide clearly defined goals and uses on the HD Woodson High School. By planning what part of the design team is providing what kind of model to whom and when for what reason is a vital part of creating the BIM Model allowing maximum use and avoidance of unnecessary design.

Research/Analysis

To complete this analysis I would work through the BIM Ex Plan and establish the initial goals and uses that have potential to be used on this project. I would then obtain what formats of models were provided by the trade contractors and design team. I would then research what formats and models would be the most compatible and useful for the intended system. The main reason for performing this analysis would be to create a more smooth flowing method to Coordination and Building Information Modeling. The potential cost savings on field labor and the potential to explore pre-fabrication would lead to multiple areas of construction that could be studied further.

Exterior Enclosure:

Hypothesis

The exterior and interior CMU walls, if switched to metal stud walls with appropriate design for intended use could provide a time and cost savings to the project. By eliminating the simultaneous construction and M/E/P rough-in of multiple walls a large savings may be realized.

Research/Analysis

To evaluate this proposal I would first research the costs and time scheduled for these walls currently. I would then research the design parameters, i.e. sound and thermal ratings, to ensure the proposed designs would meet the required specifications. I would then propose the

new wall design, taking the specifications and requirements into account. A cost estimate and change in labor required would then be calculated to determine if a change in wall design to increase constructability would be viable.

Green Roof and Grey Water System:

Hypothesis

To evaluate the ability to eliminate the green roof and gather the points required for the LEED-Gold rating in different cost-effective way. Originally the grey water system was proposed as an alternate optional feature. The design team decided to implement the grey water system. Through the exploration of LEED and grey water system design I would investigate the potential to eliminate the costly and challenging green roof. This could potentially be done with the expansion of the water collection system.

Research/Analysis

Research would need to be conducted into the thermal properties of the green roof and how it could be matched with other materials. The design and construction of the grey water system would need to be evaluated. Using design properties of both systems I would analyze the difference in cost and constructability to evaluate the potential changes in not only the construction topics, but also sustainability and other added benefits. The increase in grey water system may allow for tie-in to irrigation systems. The main conclusion will be drawn from this topic; will be if the LEED Gold point's requirement can still be achieved, as this is very important to the owner.

Pool Excavation and Construction:*Hypothesis*

Develop a more detailed dewatering plan and analyze the issues that arose during the pool excavation and construction. The dewatering system originally used was not adequate and ultimately needed to be corrected. I would investigate the soils more thoroughly and develop a dewatering plan and investigate the potential for structural changes.

Research/Analysis

An in-depth investigation of the geo-tech report would need to be conducted to determine the soils conditions and groundwater level in the pool area. The original dewatering system ultimately had to be changed during construction. The cost associated with having to create two systems will be investigated and a single system from the start that could satisfy the potential loads will be proposed. This could influence the constructability, schedule and cost of the pool. The excavation used soldier beams and lagging as hold backs. I will investigate and possibly propose a different method that could assist in the dewatering efforts.