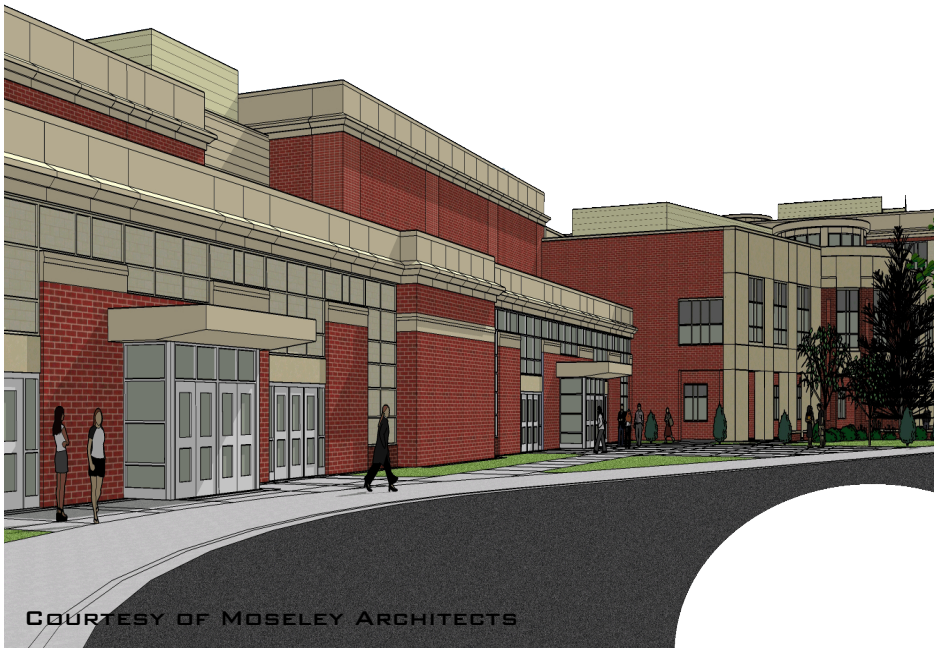
Technical Report 3



Courtesy of Moseley Architects

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Construction Option

Paint Branch High School

Burtonsville, Maryland

Dr. Riley

11/29/10

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Executive Summary

The purpose of Technical Report 3 is to become familiar with key features of the project that may have been or will potentially become a problem on the project. Several areas of investigation have been identified and proven to be good candidates for further research. These topics of research will further explore value engineering ideas, schedule compression and alternative methods of construction.

On November 10, 2010, an interview with Matt Evans, the Senior Project Manager on the Paint Branch project was conducted. The interview included questions regarding challenging constructability issues on the project, schedule acceleration scenarios, and any value engineering techniques exercised on the project.

There were three constructability issues that were discussed during the interview. One challenging issue the project team had encountered was the installation of deep utilities that were approximately 20' in ground. Another issue the project team has not yet encountered but is approaching is the work required for Phase two. The project team is to complete 12 weeks of work in a matter of eight weeks. Finally, the third constructability issue was the coordination between trades. There was a lack of communication and coordination between the Architect and Engineers. This resulted in the birth of a BIM model that has allowed for a better form of coordination amongst trades.

The critical path of the project runs through foundations, steel structure, masonry enclosure, MEP rough-in, and interior fit-out. If schedule acceleration is necessary, steel, concrete, and finishes will require extra manpower, extended hours and potentially Saturday and Sunday work days.

There were several Value Engineering ideas brought to the table during the design phase of the project. With MCPS being an experienced owner, they only accepted on Value Engineering concept suggested by the project team. They had accepted the idea to change several retaining walls from concrete to a stacked stone system. This idea saved MCPS $250,000 and also saved the project team 60 days in their schedule.

After reviewing the interview conducted with Matt, several areas were identified as a potential problem to the project. These problems are discussed in the report and five of the identified problems have been selected to conduct further research as a technical analysis. Topics for technical analysis include site congestion, LEED Certification, brick façade, phase two work and finally, BIM coordination.

Constructability Challenges

Installation of Deep Utilities

The construction team on the Paint Branch project experienced some constructability issues when they came across installing the deep utilities adjacent to wall 7. The walls were approximately 20' in height in a fill area and the utilities were also approximately 20' underground. Originally, the walls were value engineered to be stacked. This meant backfilling was necessary with a geo grid and the fill material would follow bringing up the grade behind the walls. With this method of installation, the construction team ran into a constructability issue when they wanted to go back and install the storm utilities. They realized they could not go back and dig underground due to the geo grid being in the way. This resulted in installing the storm lines concurrently with the walls, delaying the turnover date of the laydown areas between the building pad and wall. Drawings cannot be provided due to the fact that the drawings were never updated and only show the original concrete walls.

Phase Two Work

Although phase two work has not begun yet, the construction team will have only eight weeks to perform 12 weeks of site work. This includes completing underground utility crossing, regarding sites with major elevation changes, and tying in parking, while keeping the existing educational facility active. The construction team plans to accomplish this by working double shifts in order to ensure work is done on time. The HESS construction team has yet to see if their plan in place will work seeing how this phase hasn't begun yet.

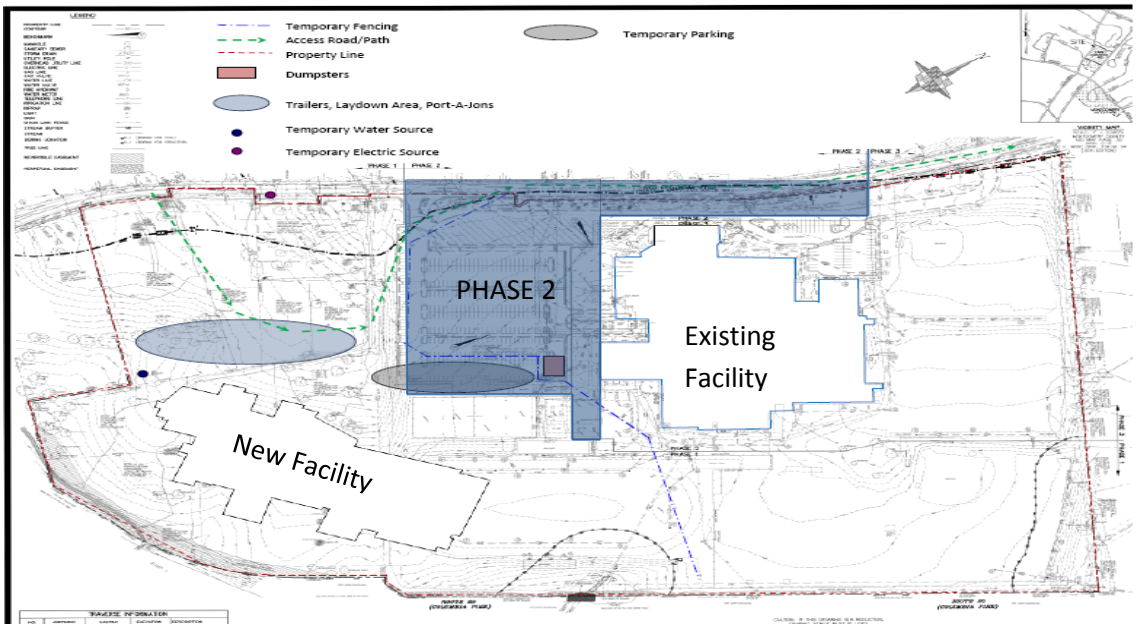

Figure 1 – Phase Two Site Work

Coordination of Trades

Unfortunately, there was a lack of communication on this project between the Architect, Structural Engineer, and MEP Engineers. This issue was addressed by starting a BIM process in March of 2010 prior to field work. According to the Senior Project Manager, Matt Evans, the BIM process was a painstaking process trying to create a building in a virtual world prior to field work. The steel, mechanical, sprinkler, plumbing, and electrical contractors were required to construct a BIM model for production of shop drawings. Each of the subcontractor's models was fitted into an Architectural model performed by HESS. Most of the issues that were found utilizing the BIM model were due to the routing of the MEP piping. These issues were resolved by being very creative with the MEP routing in order to not affect the structure or ceiling heights. Currently, there is still about six weeks of modeling to complete the full BIM model.

Schedule Acceleration Scenarios

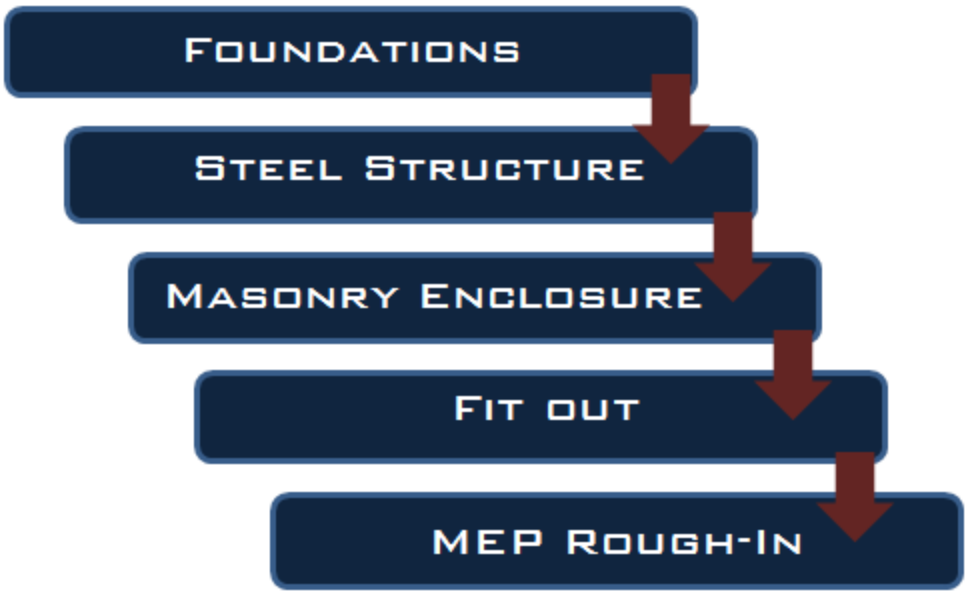

Figure 1 – Critical Path

Currently, the critical path runs through the buildings foundations, steel structure, masonry enclosure, fit out and MEP rough-in. The biggest risk on this project is a delay on the final project completion date. The penalty for a late completion is a fee of $2,500 per day for the first 30 days and then $5,000 a day after with no cap. If it becomes necessary to accelerate the schedule to finish the project on time, Matt mentioned accelerating the concrete, steel and finishes for the building. Their first option would be to bring on additional manpower to accelerate each area of work. If they found that additional manpower was not adequate support, the project team would extend work ours and require paying for over time and even including Saturday's and Sunday's.

The biggest construction activity that would be a great risk in the project completion date is the structural steel. The steel erection and the masonry activities work together, that is, as steel is being erected, the masonry block walls are being erected for shear support. The masonry shear walls provide support for the structural steel as it is being erected. If there becomes a decrease in productivity of the masonry shear walls, the structural steel erection will be delayed, causing an overall delay in the project.

Value Engineering Topics

Montgomery County Public Schools (MCPS) is one of the more sophisticated clients HESS has. MCPS has a very strong base program which they tend not to deviate from too often. There are 200 schools under the Montgomery County School District, which shows MCPS having experience in knowing what works for them and what they want. They are also one of the more financially capable counties when it comes to funding; therefore, saving isn't a big driving factor in MCPS's end goal. All of the value engineering ideas were obtained prior to the bid process and selectively integrated into the design.

Accepted Value Engineering Ideas

MCPS only allowed for one value engineering idea to be incorporated into the design. Walls 2, 2A, 6, 7, and 8 were changed from concrete retaining walls to a stack stone system. This allowed the construction team to start the walls and backfill without having to wait on the cure time for the concrete prior to backfill. This also allowed weather to not play a big factor during installation of the walls and reduced the schedule completion date by 60 days. This value engineering idea also saved MCPS approximately $250,000.

Rejected Value Engineering Ideas

- Use of metal clad (MC) cable on light circuits vs. the base drawing requiring electrical metal tubing (EMT) to light with Greenfield for the whip. Typically EMT would be run to a box above the ceiling then daisy chain lights with MC.
    - Total Savings: $100,000
- Use of aluminum conductors for major runs from the main gear to remote electronic rooms vs. base drawings being sized with copper.
    - Total Savings: $80,000
- Fiberglass reinforced panels (FRP) at the main entrance vs. base drawings use of cast stone.
    - Total Savings: $200,000
- The use of concrete masonry units from the foundation to the slab elevations vs. the base drawings using concrete walls to the slab, then concrete masonry unit from slab to the desired elevation.
    - Total Savings: $60,000

- Standard grey mortar vs. custom color on brick.
  - Total Savings: $30,000
- Conventional air barrier vs. base spec of integrated Air/water barrier on concrete masonry unit backup.
  - Total Savings: $50,000
- Free wire for the Fire Alarm system in non-exposed areas vs. all fire alarm wire in EMT.
  - Total Savings: $135,000

Had MCPS chosen to accept the rejected value engineering ideas proposed by HESS, they would have had a potential savings of $655,000.

Problem Identification

Congested Site

Although the project site is approximately 45 acres, there are still limited laydown areas. An existing facility, staff/student parking, construction trade parking, and the area for the current erection of the new 350,000 square foot facility all contribute to a congested site. Currently, the project site is occupied by the steel erectors, MEP contractors, masons and site work crew. This has caused limited safety control as well as efficiency to the project. Not only has a congested site affected safety and efficiency, but it has a potential to hinder the project schedule. With a congested site, there is a potential for a lack of coordination and communication among trades, causing a drop in productivity, concluding in a delay in the project schedule.

Steel/Masonry Delays

Currently, along with MEP and site work active on site, there is steel erection and masonry work on site. The steel erection and masonry shear walls are concurrent. That is as one phase of steel is erected, the masonry shear walls are also being erected as well. It is crucial that the shear walls are erected on time with the steel erection to keep the steel erection schedule on track. The shear walls need to be constructed in order to provide support for the erected steel. Also, with masonry work comes scaffold erection for high stories. With a tight site and several trades already on site, this can cause a delay in the masonry work, therefore, affecting the steel erection causing a delay in the project schedule.

Brick Façade

The Paint Branch High school is 350,000 square feet and has a façade that is primarily face brick. With such a huge area, and the façade being mainly face brick, there is a potential for the masonry work to fall behind. Also, with a large amount of masonry work comes a tremendous amount of scaffold erection. This can add to the congested site and cause delays to the project. This problem has a potential to become a topic for further research as a technical analysis.

Gymnasium ERU Start Up

Start up of the Energy Recovery Units (ERU) for the gymnasium is very crucial to the project. This is because the hardwood flooring in the gymnasium require conditioned air to avoid swelling and bowing in the wood flooring. With a delay in ERU start up for the gymnasium area, the potential damage that can be done to the wood flooring can impact the project schedule.

LEED Certification

The LEED certification on this project is believed to have not met its fullest potential. Seeing how MCPS has been constructing LEED certified educational facilities since 2004, LEED seems to be a great deal of importance. However, it is believed that not all options have been exercised and carefully thought out. The project currently is pursuing a LEED Gold certification and with enough time and consideration, this project has a potential to attain a LEED Platinum certification and save MCPS money in the overall life cycle cost of the building.

Phase Two Site Work

As addressed in the previous section, the work that is required to be complete for phase two has a potential to cause a delay in the project schedule. With only eight weeks to complete 12 weeks worth of work, the project team is faced with a difficult task. The installation of underground utilities and tying in with the existing parking lot all while keeping the occupied existing facility will be very challenging. This problem has a potential to become a topic of research as a technical analysis.

Public Safety

Since the construction of the new educational facility is to be constructed on an active site, several safety issues arise. The safety of the staff and students is a great deal of importance while active construction is ongoing near the existing facility. Extreme safety precautions must be taken to isolate the active construction from the staff and students. The existing parking lot on site is what separates the active construction from the existing occupied facility. One major construction activity that must be closely monitored is the use of the crane near the existing facility during steel erection. The use of a crane near an occupied facility raises several safety issues that need to be carefully taken into account.

BIM Coordination

The use of BIM has played an important role in coordination with several trades on the project. Although, it may not seem to be a problem now, it was a problem prior to the start of the BIM model. As pointed out in the previous section, there was a lack of coordination and communication amongst the Architect and Engineers during the design phase. After a BIM model was created, several issues arose, which called for coordination. Theses issues were addressed by creatively rerouting the MEP work to avoid a change in ceiling height and structure of the building. This change in MEP routing may cause an increase in productivity, cost, as well as a delay in the project schedule.

Technical Analysis Methods

Technical Analysis #1: Site Congestion

Site Congestion is a great concern to the project team. This has a potential to affect several trades on site including steel erectors, masons, and MEP contractors. A congested site has the potential to directly affect the steel erectors and masons. The masons require a substantial amount of room for material and scaffolding. Since steel erection is affected by the masonry shear walls, and steel erection is a critical path, the project has a potential to fall behind in schedule.

To begin research on this topic, I will need to consider durations and sequences of all trades currently on site. With this information, I can then configure the most efficient way to conduct construction activities. I will also need to consider the sequencing of steel and look for alternative ways to sequence steel erection to potentially save time and eliminate site congestion. I will need to research traditional methods of erecting steel and the compatibility between shear walls and steel erection and how each directly affects the other.

Technical Analysis #2: LEED Certification

Building sustainable buildings has been of great importance to MCPS. They have been constructing LEED certified educational facilities since 2004. Currently, Paint Branch High School is striving to achieve a LEED Gold Certification upon completion. However, it is believed that the building has not been designed to its full potential for LEED Certification.

To begin research on this topic, I will need to analyze all the major sustainable design features being used and investigate alternative methods. These alternative methods may show an increase in cost savings to the owner and provide a more sustainable building than originally designed. I will also research other educational facilities that maybe close to size and location and consider some of the sustainable design features used on that facility.

Technical Analysis #3: Brick Façade

The Paint Branch project utilizes a great deal of face brick for its façade. As noted in the previous section, this can cause a significant affect in the project schedule. The face bricks are to be laid by masons and will take a great deal of time to complete with a 350,000

square foot building. This also will require a great deal of man power as well as man hours to complete, and can potentially affect the overall quality. However, with the use of prefabricated masonry panels, a great deal of time, money, and productivity can be saved.

The use of prefabricated masonry panels has a potential to reduce the project schedule, and have a savings in the total project cost. Factors that will be considered throughout this analysis will include the delivery of the panels, storage areas, installation methods and sequencing.

To begin research on this topic, I will need to identify how much of the new façade is composed of face brick. I will then need to obtain shop drawings of prefabricated masonry panels and figure out the quantity of prefabricated panels needed to replace the face brick. I will also need to obtain methods of installation from a prefabricated contractor along with durations of installation per panel and equipment required for installation. I will also need to take into consideration how the use of prefabricated panels will affect the structure of the facility.

Technical Analysis #4: Phase two Work

The volume of work required for Phase two is abnormally high in comparison to the other phases. The project team is only given eight weeks to complete 12 weeks of work. This is said to be done with additional man power, extended work days and overtime. However, it is believed that with reconfiguring the sequencing of work needed will eliminate the need for additional work days and overtime. This may have a potential of overall savings in the total project cost.

To conduct research on this topic, I will need to have a full understanding of the scope of work for Phase two. I will also need to know what equipment and material will be needed to complete this work and if any work can be done concurrently. Also, I will look into starting this phase at an earlier time and how that may affect the project in schedule. Also, a great deal of safety techniques will need to be considered in this research since the area of construction is in close proximity to the occupied existing facility.

Technical Analysis #5: BIM Coordination

Originally, there was no use of a BIM model on the Paint Branch project. It was not until there was a lack of communication and coordination between the Architect and Engineers when designing the new educational facility. The lack of communication and coordination

led to the use of a BIM model a few months prior to breaking ground. After the BIM model was in use, several issues arose and resulted in having to creatively reroute the MEP work to avoid changes in the structural design and ceiling heights.

The idea of rerouting MEP work throughout the building can cause several issues in construction and delays in the project schedule. It can also cause an unnecessary increase in cost of material and manpower due to the fact of creative rerouting. With rerouting MEP work, there is a potential for difficult pipe laying that can cause a decrease in productivity, and an increase in material which may lead to an increase in cost.

To conduct research on this topic, I will need to understand the traditional installation techniques for MEP work, and compare to the creative installation techniques used on this project. I will also need to obtain material cost data for MEP equipment and cost of manpower to install MEP work. This will then lead me to conduct an analysis on any savings that could have been made to the project cost and schedule if a BIM model was put to use at an earlier time.