Landis Run Intermediate School

Lancaster, PA

Proposal

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Executive Summary

The purpose of this proposal is to inform the reader of the analyses of the Landis Run Intermediate Project that will be performed during the spring semester of 2012. The reasons for performing the analyses, the goal of each analyses, and the methodology of each analysis will be discussed. In addition, a semester schedule for all the analyses is provided in the back of this document. The theme for all the analysis is efficiency which is meant in the general sense of the word. Further explanation of the theme can be found in the conclusion.

Analysis 1/Geothermal Heat Pumps: The quantity and life cycle cost of geothermal heat pumps on LRI will be determined. Their load capacity will then be calculated and used to calculate if the existing mechanical equipment could be downsized. The impact on the schedule from the installation of the heat pumps will be analyzed. Finally, taking into account life cycle cost, impact on schedule and constructability, and effect on existing mechanical equipment it will be determined whether or not the heat pumps would have increased the efficiency of the building at a reasonable cost to the owner.

Analysis 2/Feasibility and Design of a Modular Classroom: The typical or standard requirements of classrooms for grades five and six will be compiled and averaged out. Once the requirements are found, a modular design will be created through discussion with precast manufacturers and industry professionals. The impact on the cost and schedule of the project will be calculated versus what it actually cost using stick built classrooms. Lastly, the feasibility of the designed modular classroom will be investigated through interviews with architects.

Analysis 3/Effect of Electrical Rough-In Method on Productivity: The amount of time and cost that is associated with underground versus overhead electrical rough-in will be analyzed based on a single classroom. Once the cost and schedule impacts are known for that classroom that data will be extrapolated to the entire school. The results will be analyzed to determine which method is cheaper and which method would have allowed the school to be dried in at an earlier date. Lastly, through interviews with electrical contractors the popularity of one method versus another for similar project types will be analyzed in order to identify any trend.

Analysis 4/Alternative Project Delivery Method: The productivity of a single prime delivery method versus and multiple prime delivery method will be analyzed through interviews with all parties involved on the project, particularly the project managers for each prime. The state law regarding delivery method will be researched to identify any loopholes for obtaining an alternative delivery method. Based on feedback from the project managers, the time savings of switching to single prime will be calculated and translated to the schedule to analyze the efficiency of one method over another. Lastly, case studies of other state projects that have obtained permission to use a method other than multiple prime will be conducted in order to identify any common pathways to obtain permission.

Project Background

Landis Run Intermediate School, seen in Figure 1, is a $28 Million, 210,000 SF school located in Lancaster, PA which will serve grades 5 and 6 in the Manheim Township School District. The notice to proceed was given on December 10th, 2010 and has an anticipated completion date in August of 2012. The project duration is approximately 20 months and the project deadline is the driver of the project due to the fact that the district has nowhere else to place the 5th and 6th grade students scheduled to occupy the building. The school is one of four school buildings on a large campus, which is surrounded by homes located on the other side of a landscape buffer. The building itself is a load-bearing masonry design with brick veneer. The building is striving for LEED Silver certification. The project will utilize a combination of design features and construction practices in order to achieve the LEED Silver rating. BIM was utilized heavily in the planning and design phase of the projet. However, BIM was not used during the construction phase of the project and although it is supposed to be implement during the occupancy phase of the project it is still unclear to what extent.

Figure 1: Landis Run Intermediate School While Under Construction

Analysis 1: Geothermal Heat Pumps

Potential Opportunity

Although Landis Run Intermediate is striving for a LEED Silver rating with a total of 54 points there are a few credits that may have improved the environmental impact of the building and made sense to implement from a financial standpoint. One of these credits is on-site renewable energy. With a site as large as the one LRI sits on there are ample types of renewable energy that can be installed on site and operate successfully. Also, since schools are designed to have a life span of 50-60 years they can withstand larger payback periods. In addition, having on-site renewable energy presents another opportunity for the school district to educate the population on an ever increasingly important topic, sustainability.

Potential Solution

Due to their relatively cheap initial cost when compared with other sources of renewable energy as well as the size of the site, geothermal heat pumps appear to be the most logical choice of renewable energy for the project.

Research Goal

The goal of this research is to determine if geothermal heat pumps would improve the project based on whether or not they would provide:

- A significant cost savings to the owner in utilities cost
- A more sustainable building
- A minimal impact on the construction schedule
- The worthwhile payback period

Methodology

The following research tasks will be performed:

- Determine the quantity of heat pumps
- Calculate the impact on the construction schedule
- Determine the effects on other building systems and trades
- Analyze life-cycle cost and payback period
- Analyze the impact on the LEED rating

Expected Outcome

The expected outcome of this analysis is that geothermal heat pumps will make fiscal sense to utilize on site and will improve the energy efficiency of the building. In addition, it is expected that the installation of geothermal heat pumps will not alter the construction schedule to an extent that workforce over time, significant additional construction costs, or a later completion date would be necessary.

Analysis Sources: Project Manager on LRI, Robert Leicht

Analysis 2: Feasibility and Design of a Modular Classroom

Potential Opportunity

Given the seemingly identical requirements of classrooms, it seems redundant and wasteful to repeatedly redesign classrooms for every new school that is constructed. Construction budgets for schools could shrink substantially if the repetitive design of classrooms could be cut from the building process. In addition, if a common classroom design was created it might also cut construction costs as familiarity with the design increases.

Potential Solution

The design of a standardized modular classroom that could be shipped to the jobsite would nearly eliminate the need for any design time related to classrooms and greatly reduce associated construction costs. If small changes could be made to this standardized classroom to accommodate small differences in climate, site, aesthetics, and other miscellaneous differences from job to job than it could be used throughout the entire state.

Research Goal

The goal of this research is to determine the cost and schedule implications of utilizing a standardized modular classroom on LRI as oppose to the stick built classrooms which were constructed on site and designed specifically for this project. In addition, the analysis will research the feasibility of taking the standardized modular classroom to be used on LRI and applying it to other schools throughout the state.

Methodology

The following research tasks will be performed:

- Interview the architect to determine how much design time was spent on the classroom wings as well as the program for the classrooms
- Research modular construction and prefabrication methods by contacting manufacturer's and reading online literature
- Compile typical classroom requirements and dimensions through discussion with experienced industry professionals and compile the average classroom requirements
- Calculate savings in terms of design time, schedule, and construction cost associated with the construction of the classroom wings.
- Interview experienced industry professionals to see if they would implement the modular classroom used on LRI into another school project

Expected Outcome

The expected outcome of this analysis is that a standardized modular classroom could be used throughout most school projects in Pennsylvania with only minute changes to various systems and would save the state considerable amounts of money through reduced design and construction time.

Analysis Sources: Richard S. Fiore

Analysis 3: Effect of Electrical Rough-In Method on Productivity

Potential Problem

The superstructure on LRI was a large part of the critical path and the project team is now in a race to dry in the building before the brunt of winter hits. The electrical prime chose to do underground rough-ins which prolonged the time before slabs could be poured or before the load bearing walls could be grouted. The decision to do underground rough-in could have potentially delayed the critical path and made it hard to get the building dried in before winter.

Potential Solution

Overhead electrical rough-in would have allowed slabs to be poured earlier as well as earlier grouting of walls. This in turn would allow the structure to be completed earlier ultimately allowing the building to be dried in earlier.

Research Goal

The goal of this research is to determine whether or not underground electrical rough-in is common for similar project types. In addition, this research will determine how changing to overhead rough-in would affect the cost and schedule of that activity.

Methodology

The following research tasks will be performed:

- Interview the electrical prime on LRI and other electrical primes that have experience with schools to determine the amount of underground versus overhead rough-in they perform
- Interview electrical contractor superintendents on the time it takes to perform underground rough-in versus overhead rough-in on one typical classroom and extrapolate those time differences to the entire school
- Calculate dry-in date using overhead rough-in duration and compare with the actual dry-in date
- Perform two detailed estimates on a single classroom, one assuming underground RI and the other assuming overhead RI, and convert the costs to a SF cost to extrapolate the overall cost to the entire school in order to see which method is cheaper

Expected Outcome

The expected outcome of this analysis is that the difference in costs of overhead rough-in versus underground rough-in is negligible and that the duration of overhead rough-in is slightly longer than that of underground rough-in. However, it is expected that the overhead rough-in would have allowed the building to be dried in at a sooner date and that the longer duration of overhead rough-in would not affect the completion date.

Analysis Source: Project Manager on LRI

Analysis 4: Alternate Delivery System

Potential Opportunity

As mandated by law, the project delivery system on LRI was design-bid-build with multiple prime. However, according to the project manager, the added amount of coordination between primes with that type of delivery system adds complexity and time to a project that could be cut out of the project if one contractor was in charge and had authority over the others.

Potential Solution

The single prime delivery method makes one contractor responsible for completing the project in whole. With one contractor having authority over means, methods, and scheduling, a great deal of coordination and debate can be cut out of the schedule and possibly reduce cost and increase quality.

Research Goal

The goal of this research is to analyze the schedule impact of utilizing a single prime delivery method on LRI as opposed to a multiple prime delivery method. In addition, analysis will also research how state projects can be delivered through methods other than multiple prime by performing 2-3 case studies on other state projects that were permitted to use an alternate delivery system.

Methodology

The following research tasks will be performed:

- Interview project managers about their opinion on any reduction in coordination/time by using single prime as well as any major instances that occurred that were a result of miscommunication
- Analyze overall impact on the schedule of using single vs. multiple prime
- Use the estimated schedule impact to calculate the impact on the cost of the project, specifically the general conditions costs for all the primes
- Research other projects that have been able to use alternative delivery methods and interview the project team about that experience
- Research the state law and any loopholes that may be present
- Compile interviews and state research into case studies stating how that permission is obtained and under what circumstances

Expected Outcome

The expected outcome of this research is that using a single prime delivery method on LRI would have shortened the schedule as well as required coordination and therefore would have decreased the cost of the project. In addition, it is expected that there is no common or accepted method to obtaining that permission as of yet but rather it is given on a project by project basis.

Analysis Source: Project Manager on LRI, Project Engineer on LRI, Industry Professional

Analysis Weight Matrix

The analysis weight matrix, shown in Table 1, is a representation of the way my effort and time will be split up among the four main analysis areas in regards to the four main areas of research during the spring semester.

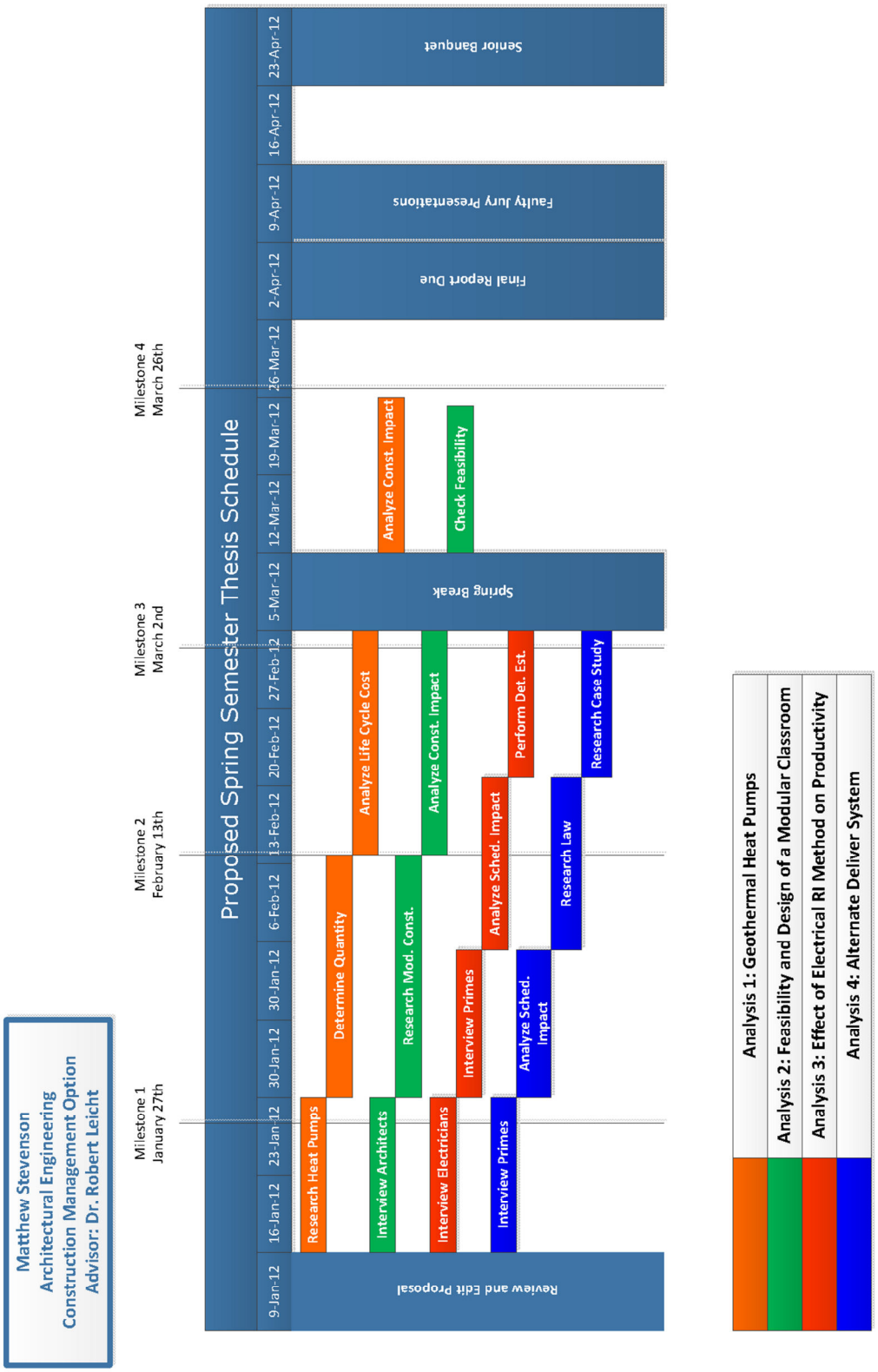
Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Geothermal Heat Pumps	5%	10%	--	--	15%
Modular Classroom	10%	10%	--	15%	35%
Electrical Rough-In Method	--	--	20%	10%	30%
Alternate Delivery System	15%	--	--	5%	20%
Total	30%	20%	20%	30%	100%

Conclusion

In conclusion, by completing the four analyses that have been discussed the efficiency of the project will be addressed. The expectation of the analyses is that they would have improved the efficiency of the project. The term efficiency is used in the general sense.

The first analysis addresses energy efficiency. It will determine whether any gained efficiency from the heat pumps would have made sense to implement from a fiscal and construction standpoint. The second analysis addresses the construction efficiency of the project. The analysis will determine whether or not the use of modular classrooms could have improved upon the construction efficiency of the project. The third analysis also addresses the construction efficiency of the project, specifically the efficiency of the electrical rough in and the critical path. The analysis will determine whether or not overhead rough-in would have allows the cost of installation to remain similar while allowing the building to be dried in sooner. Lastly, the fourth analysis addresses the efficiency of the project delivery method. This analysis will determine whether or not using a single prime delivery method versus multiple prime delivery method could have led to less coordination issues and a more efficient project.

Semester Schedule



Appendix A

The following breadth topics are intended to show competency in other areas of study besides construction management. These areas have purposefully been tied into two of the four main analysis discussed earlier in order to provide a more robust study.

Mechanical Breadth/Geothermal Heat Pumps:

The geothermal heat pumps that have been proposed to be used on the project can take a significant load off of the building's mechanical systems. The building's mechanical systems may even be able to be downsized if the load capacity of the heat pumps is significant enough. This would greatly increase the sustainability of the building since conventional mechanical equipment produce more emissions than heat pumps. Determining whether or not this is feasible and to what extent if so is the topic of my first breadth study.

Once the quantity of the geothermal heat pumps has been determined their total load capacity will be calculated. Then, their load capacity will be used to calculate the remaining total load of the building that needs to be picked up by the conventional mechanical systems in the building. Once the new load for the conventional mechanical systems is calculated new equipment will be selected to be installed in the building. Any cost savings, difference in electrical requirements, and difference in size between the mechanical equipment being installed now and the newly proposed equipment will be tabulated.

Structural Breadth/Feasibility and Design of a Modular Classroom:

Modular construction allows for quicker and more efficient construction on site as well as a higher quality of work due to tighter tolerances in the factories. However, the design of the modules must be carefully thought out to ensure that they can easily be assembled on site and will be able to handle all of the stresses that will be put on them in transit to the job site, while their being erected, and during the service life of the building. Designing the structure of a classroom module is the topic of my second breath study.

The average dimensions of the classrooms in LRI will be calculated and used at the dimensions for the modular classroom. Through discussion with manufacturers, the limits of production (i.e. size and height) will be determined for the modules. Once the modules are designed, their transportation will be planned in order to ensure that they could be shipped to the site on a flatbed and not require any special accommodations such as road closings which would ultimately decrease the feasibility of their use.