THESIS PROPOSAL

The Mary J. Drexel Home Assisted Living Addition

Bala Cynwyd, PA

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Construction Option
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Executive Summary

The purpose of this proposal is to outline four construction analyses and two breadth studies that will be explored in an effort to provide feasible solutions to increase the success of the Mary J. Drexel Project. For each analysis topic, the problem will be identified and supported by: background research, potential solutions, necessary steps needed to perform the analysis, and the expected outcome.

Analysis 1: Project Sequencing

With most of the emphasis of the project focused on cost and quality, not much emphasis was considered regarding the project schedule. Much of the construction therefore was not sequenced in a manner that would have been efficient, such as overlapping construction activities. Many activities were scheduled to start after the previous one was completed. This analysis will focus on re-sequencing the current project schedule which will shorten the schedule, resulting in a decrease in general condition costs for the project.

Analysis 2: MEP Prefabrication

Multi-trade prefabrication allows for multiple building systems to be constructed in an environment off-site while other building systems are being constructed on-site. Many unforeseen delays occurred throughout this project causing the MEP trades to increase manpower in order to meet the schedule. To avoid this, the implementation of prefabricated MEP corridor racks would have been beneficial. This will allow for reduced site congestion while improving productivity results and efficiency. Although there may be costs associated with prefabrication techniques, cost savings are available through the reduction of the schedule.

Analysis 3: Green Roof Implementation

Many value engineering efforts were taken into consideration for this project. Although many of these efforts focused on lowering initial capital costs, not as much consideration was given to the life-cycle costs of the changes that were implemented. The implementation of a green roof would have been a great consideration for this project instead of the EPDM system that was chosen. With the exceptional performance of a green roof regarding reducing energy costs and improving human health and comfort, the long-term economic benefits would definitely outweigh the start-up costs. An acoustical and structural breadth will also be performed for this analysis.

Analysis 4: Alternate Delivery Method

Utilizing two different delivery methods caused delays due to design changes as well as coordination and communication issues. Research will be performed of the feasibility of using another delivery approach such as Integrated Project Delivery. The MEP systems were Design-Build while all other systems were approached with a Design-Bid-Build approach. Integrating one or two other trades into the preconstruction process would have been beneficial and any complications that may have arisen would have been resolved more efficiently.

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Project Background

The Mary J. Drexel Home Assisted Living Addition project is located just outside of Philadelphia, PA and is owned and operated by Liberty Lutheran Services. The campus consists of a three-story mansion that was constructed in 1878 and has been providing senior-care center and nursing home services. However, these services were suspended in mid-2008, pending renovation and new construction.

The historic mansion is receiving new attached two-story East and West wings that will serve as the assisted living residence. Each two-story wing consists of two separate "households" with each household serving 20 residents for a total assisted living resident population of 80 residents. The existing historic mansion will be used as the focal point for Liberty Lutheran Services marketing and business aspects as well as a connection between the new wings.

General Building Data

Building Name: The Mary J. Drexel Home Assisted Living Addition
Location: 238 Belmont Ave | Bala Cynwyd, PA 19004
Occupancy Type: Assisted Living Residence (ALR)
Size of West Wing: 34,108 gross square feet
Size of East Wing: 40,600 gross square feet
Number of Stories above ground: 2
Size of Existing Mansion: 21,000 gross square feet
Number of Stories above ground: 3

Construction Information

Construction Start: November, 2012
Construction Completion: December, 2013
Cost Information: $14.6 Million
Project Delivery Method: Design-Bid-Build*
*MEP Systems were Design-Build

Owner: Liberty Lutheran Services
Architect: SFCS, Inc.
CM/GC: Wohlsen Construction Company

The goal of this project is to construct a high quality senior-care living facility at a budgeted cost value. The owner wants the residents to have an "at-home" feeling instead of the traditional institutional/hospital feeling as many senior-care facilities have.

Rendering of the Mary J. Drexel Project. Courtesy of SFCS, Inc.

Analysis 1: Project Sequencing

Problem Identification

For this construction project, significant emphasis was placed on the costs and quality of the project with less on the overall project schedule. Thus, the project schedule was produced in a way to minimize scheduling risks due to the added schedule float. Many construction activities were scheduled with one following another without any overlap. This results in having a longer project schedule which then also results in an increase cost for general conditions. This analysis will focus on shortening the project schedule to minimize costs for the owner.

Background

The simplest and cheapest way for the project team to accelerate the schedule is through re-sequencing the entire project schedule. The current schedule is set up so that the East wing is delayed a few weeks after the West wing and for the trades to start right after another trade was finished working.

This method was predominantly shown in the structural phase of the project. This allowed for the structural setting crew to install their work without any worry of another trade getting in the way. This is an easy opportunity for the schedule to be cheaply accelerated if necessary. Since the concrete slabs were poured in two pours, the erection of the structural wall panels could begin as soon as the first pour is cured and move on forward in this pattern. Similar options to re-sequence activities throughout the project schedule are available when more analysis is taken into consideration. Looking at Figure 1 it is clearly shown that activities were schedule one after the other without any overlap.

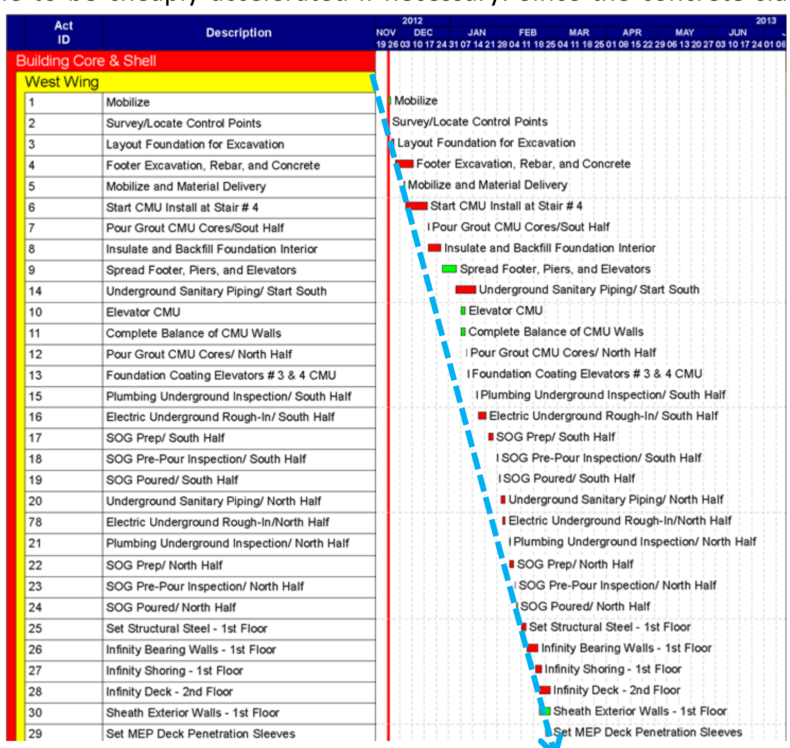


Figure 1 – Project Schedule

Potential Solutions

The results of this analysis will yield the following potential solutions in regard to re-sequencing the project schedule:

- The construction activities will be sequenced in a manner that allows for an overlap between trades and activities wherever possible.
- Any extra float that is found may be reduced as well.

Any reduction in the overall project schedule will result in cost savings for the owner.

Methodology

In order to complete the analysis and determine if the project schedule could be shortened and improved, the following steps would need to be performed.

- Analyze schedule and locate gaps in the project schedule.
- Analyze schedule and determine where trade activities may overlap.
- Interview industry members and perform research to ensure if gaps between activities are necessary for proper installation of the building trades/systems.
- Interview industry members and perform research to ensure that the overlapping of certain activities does not affect other trades.
- Re-sequence project schedule.
- Calculate total time saved from the re-sequencing and overlapping of activities.
- Calculate the costs of general conditions for updated schedule and compare to the original cost to determine if any costs could be saved.

Expected Outcome

Re-sequencing construction activities so there are overlapping activities is the simplest and most cost effective way to reduce construction costs. The potential scheduling changes outlined above should help shorten overall project schedule duration leading to a decrease in the general conditions costs on the project, saving money for the owner.

Analysis 2: MEP Prefabrication

Problem Identification

Throughout the project, many unforeseen delays arose that lead to a need for an increase in manpower and productivity in regards to the MEP systems installation. Although these delays were not a direct result from the performance of the MEP trades, they were forced to employ extra crews during the week and start overtime work on the weekends in order to meet the schedule. The MEP trades were brought onto the project at an early stage under a design-build contract and this analysis will examine how the implementation of a prefabricated MEP corridor rack would have benefited the MEP trades.

Background

The extra efforts could have been avoided if the MEP systems were fabricated at an off-site warehouse and then transported to the construction site. The main focus of implementing MEP prefabrication will be placed on common corridor racks for both wings since they each have identical layouts respectively as shown in Figure 2 below.

Figure 2 – Floor Plan layout for West Wing (left) and East Wing (right)

As stated in Technical Report 3, a vast majority of the project was assembled in place. This is very standard, but not as efficient in terms of schedule durations. After having discussions with the project team and industry members at the 2013 PACE Roundtable, the idea of using a different installation method such as prefabrication could have been beneficial to everyone on the project. The MEP systems could have been constructed off-site then transported and connected on site which would have increased productivity and been more efficient in terms of schedule duration.

Potential Solutions

Upon completion of this analysis, the possible solutions that could be reached include:

- The prefabrication of MEP Corridor Racks is feasible for the project and can be implemented to reduce installation time and increase productivity.
- Not all parts of the MEP corridor components will be able to be designed in the rack and will need to be assembled on site.
- There may be added costs associated with prefabrication, but there is a potential for cost savings through schedule reductions.

Methodology

In order to complete the analysis and determine how the implementation of prefabricated MEP corridor racks will benefit the project, the following steps would need to be performed.

- Acquire AutoCad models from Wohlsen Construction Company.
- Review modeling of MEP corridor.
- Research how BIM is used to facilitate prefabrication techniques.
- Contact Mr. Rhodes with Southland Industries & Mr. Tomasco with Truland to discuss typical techniques when prefabricating corridor racks.
- Determine which components of the MEP systems can be fabricated into a common corridor rack to be used throughout each wing.
- Assess the time required to fabricate and then install assemblies.
- Determine feasibility of implementing MEP Prefabrication and cost and schedule savings associated.

Expected Outcome

Upon completion of this analysis, it is likely that a more efficient method of construction will be discovered which will expedite the project completion date. Since the construction site is restricted in size, it is expected that the prefabrication of MEP corridor racks will reduce site congestion, improve efficiency and productivity. There may be additional costs that are associated with using prefabrication techniques, but this will most likely be overcome by potential cost savings from schedule reductions.

Critical Issues Research

The multi-trade prefabrication process allows multiple building systems to be constructed in a controlled environment off-site while other building systems such as the structure are being constructed on-site. There are many projects that have repetitive elements that are well suited for this process. The use of multi-trade prefabrication is a process that revamps the building delivery process and produces high quality projects more quickly, safely, and cost effectively.

BIM is the enabler of prefabrication and it all depends on the contract and project type. Design of prefabricated units are developed in the beginning stages with all building system trades heavily involved in coordinating and setting tolerances.

One of the largest concerns regarding the use of multi-trade prefabrication is actually getting paid for the work completed. It can be difficult to receive payment for a module that is completed, but is not necessarily installed out on the actual project yet. Other industry concerns include:

- Site restrictions
- Trucking to and from site and laws associated
- Permits and hoisting
- Liability

Many concerns can be mitigated with the increased level of pre-planning that takes place with the contracts and such. The goal of researching mutli-trade prefabrication for this project will not only help identify the advantages and disadvantages, but also how BIM enables the production of prefabricated building components. This all leads to a reduction in overall cost and time of the project delivery while increasing quality. If the research turns out positive, future owners could understand the benefits of utilizing multi-trade prefabrication for their projects.

Analysis 3: Green Roof Implementation

Problem Identification

Although many value engineering efforts were made to benefit the owner, very few sustainable techniques were considered that could have provided more financial benefit to the owner, Liberty Lutheran Services. Many of the value engineering decisions were made based on lowering initial capital cost without much consideration into future economic advantages.

Background

This project is not achieving any LEED accreditation thus not many sustainable features are employed. Incorporating a green roof into the project however not only benefits the owner, but also benefits the building occupants as well and the environment. Green roofs have become increasingly popular in building design because of their exceptional performance in reducing energy use, reducing air pollution and greenhouse gas emissions, improving human health and comfort, and enhancing stormwater management and water quality. The ultimate goal of this analysis is to determine the benefits to the owner and occupants as well as the long-term economic benefits vs. the start-up costs.

Potential Solutions

While the green roof implementation is not being added to achieve LEED points, it may have a significant economic impact to the building owner in terms of life-cycle costs when compared to the current EPDM membrane roofing on the project. Another potential solution includes benefiting the senior residents by providing noise attenuation. Also implementing a green roof provides health benefits to occupants that could be an extra benefit.

Methodology

In order to complete the analysis and determine how the implementation of a green roof system will benefit the project, the following steps would need to be performed.

- Research variations of green roof systems and determine which type would be most appropriate to use on the project.
- Analyze the green roof system's load impact on the current structural system of the project.
- Analyze the amount of noise reduction provided by the addition of the green roof from the rooftop air handler units and daily traffic from highly-traveled road nearby.
- Perform a life-cycle cost analysis of implementing a green roof system and determine feasibility of implementing on project.
- Determine schedule impacts of green roof construction.

Expected Outcome

Upon completion of this analysis, it is expected that the Mary J. Drexel Home will benefit from incorporating a green roof system in lieu of the value engineered EPDM roof system. Although the start-up costs may be expensive, the life-cycle costs will outweigh that of the EPDM roof. After performing this analysis, it also may be shown that the current load-bearing structure will be able to support the green roof system without much alteration. This system will also provide decreased sound levels for the senior residents and thus making their experience a comfortable one.

Analysis 4: Alternate Delivery Method

Problem Identification

The project had some sort of hybrid method of delivering the project using two delivery methods. The GC was brought on early as well as the MEP trades to Design-Build the MEP Systems. The GC was then offered a Design-Bid-Build approach on the rest of the project. These two delivery methods caused delays due to design changes as well as coordination and communication issues.

Background

Technical Report 1 contains initial research into the project delivery approach that was chosen for the Mary J. Drexel Project. As stated, there was extreme confidence that there would not have been many changes to the original bid documents once the contracts were awarded, but the approach of using two delivery methods caused coordination issues amongst the project members. Thus, causing design changes and delays that could have been avoided. Figure 3 below depicts all the different trades involved and how easily coordination issues could cause problems. Research into the feasibility of other delivery methods could be explored more thoroughly, specifically an Integrated Project Delivery method and the benefits associated with it.

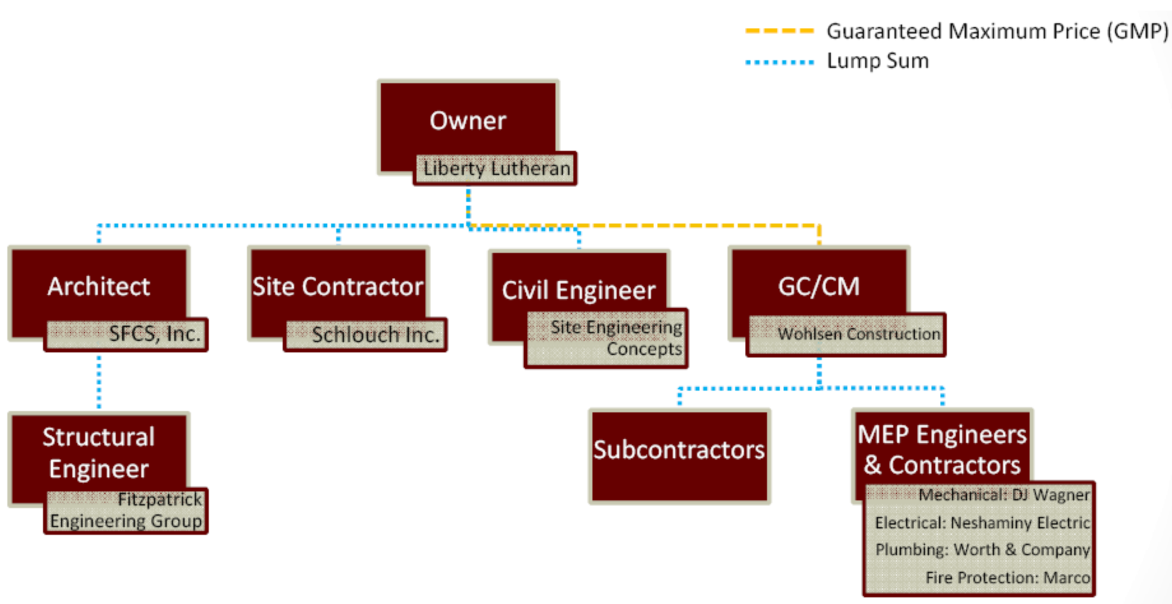


Figure 3 – Project Delivery w/Contract Types

Potential Solutions

The goal if this analysis is to determine a better approach that could have been taken for this project. By reformatting the way in which subcontractors were chosen and possibly having one or two more trades come in earlier in the project, constructability issues and schedule concerns could have been avoided.

Methodology

In order to complete the analysis and determine how beneficial implementing an alternate delivery would be, the following steps would need to be performed.

- Interview project management team to determine feasibility of other project delivery methods.
- Research case studies related to alternate project delivery methods.
- Create process maps for the project using models.
- Analyze the constructability and schedule impacts based on feedback from the project management team.
- Explain conclusion of research.

Expected Outcome

Upon completion of this analysis, it is expected that by further integrating work processes and bringing in trades earlier in the project, it would have been more beneficial and efficient than the current path chosen. Also, it would show how the project players would be able to resolve problems more efficiently and easily.

Conclusion

The four technical analyses mentioned prior, combined with the two breadth topics described in Appendix A, all focus on maintaining the high quality desired by the owner of the Mary J. Drexel Project and potentially improving it while attempting to reduce project costs. Whether it is re-sequencing the project schedule, implementing multi-trade prefabrication and a green roof system, or by utilizing an alternate delivery method, it is anticipated that these analyses will produce outcomes that would have benefited the owner and the project team of the Mary J. Drexel Project.

Appendix A: Breadth Topics

Breadth Topics

The following breadth topics will be analyzed along with Analysis #3: Green Roof Implementation. These breadths are additional analyses that must be covered outside the construction option technical analysis. They will illustrate other skills developed by the Penn State Architectural Engineering program beyond just construction management.

Structural Analysis of Green Roof [Incorporated into Analysis #3]

The existing structural system of the project consists of load-bearing metal panel walls with a few structural steel members in the common areas allowing larger spans. Incorporating a load-bearing green roof system will require a structural analysis of the additional loads of the roof as compared to the EPDM roof system that was value engineered to be used.

Research on the different types of green roof systems will be conducted and calculations will be performed to determine if the existing load-bearing structural systems can support the dead load of the green roof. Additional support such as the structural members in the common areas and the metal roof deck may need to be redesigned to efficiently support the new green roof system. This will be followed with evaluating any new costs and any schedule impacts that may arise.

Acoustical Analysis on Impact of Green Roof [Incorporated into Analysis #3]

The incorporation of the green roof system over an EPDM roof system should result in better acoustical performance. A study of sound transmission of the green roof system will be compared to that of the EPDM system. The rooftop air handling units must be able to resist vibrations and noise transmission below. This will require finding the sound transmission class (STC) of the system components and performing a full acoustical evaluation comparing the current design and the green roof design. This value engineering analysis will determine if implementing the green roof system will create a better living experience for the senior living residents in their living units.

Appendix B: Thesis Analysis Weight Matrix

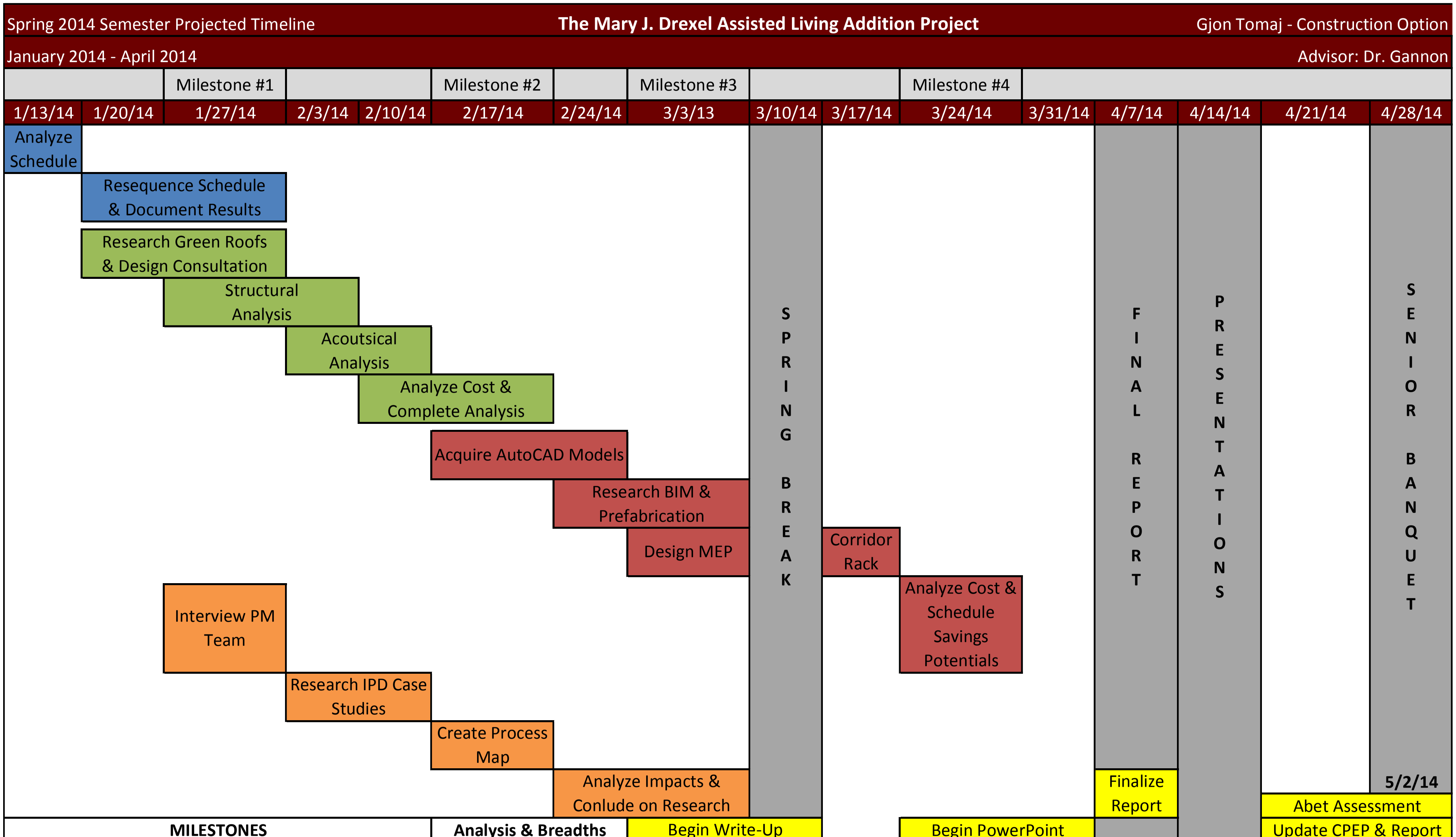
Analysis Weight Matrix

As shown in Table 1 below, a weight matrix has been developed to breakdown percentage of time that will be considered for each analysis topic discussed prior. The weighting of the two breadths are included in the related depth analysis as well.

Table 1 – Technical Analysis Weight Matrix

Description	Research	Value Engineering	Constructability Review	Schedule Acceleration	TOTAL
Project Sequencing	-	-	10 %	10 %	**20** %
MEP Prefabrication	10 %	5 %	5 %	5 %	**25** %
Green Roof Implementation	10 %	15 %	10 %	-	**35 %**
Alternate Delivery System	10 %	-	10 %	-	**20** %
TOTAL	30 %	20 %	35 %	15 %	**100** %

Appendix C: Spring Semester Projected Timetable



	MILESTONES	Analysis & Breadths
1	Analysis #1 Complete	Project Sequencing
2	Analysis #2 Complete	MEP Prefabrication
3	Analysis #4 Complete & Start Write-up	Green Roof
4	Completion of all Analyses	Alternative Delivery