Emory University Psychology Building

Atlanta, Georgia

Revised Proposal

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Executive Summary

The Emory Psychology Building has been a very successful project for both the construction manager, Holder Construction, and the owner, Emory University. Each party has been pleased with the quality and timeliness of the current construction. However, there are some aspects of the building that with further investigation and research may be able to improve the building as a whole. This report proposes four aspects of the building to be researched and analyzed that will maximize the building's potential.

Building Information Modeling (BIM) was used on this project for MEP clash detection and planning during preconstruction. In those ways, the building information model was used effectively. However, there are some applications of building information models that were not used. Unfortunately, this is a common theme throughout the construction industry. An analysis is proposed of the use of BIM on this project as well as the industry as a whole. Research will be conducted on the best practices of BIM by interviewing industry members and asking them what has worked well and what were some lessons learned from the BIM experience. Hopefully, by interviewing several companies, they will have different applications of BIM that can be consolidated into one guide that will be a summary of all the uses of BIM. Also, there will be research on how to create a facility management tool from the model that can be given to the owner for use in managing and monitoring their new building.

The next analysis proposed in this report is the addition of a green roof to the roof of the structure. A green roof is a roof that is partially or fully covered by vegetation or soil. In the proposed analysis there will be studies on how the existing structure will perform under the add ed weight of the roof and how the extra insulation will affect the HVAC loads of the building. Following that, there will be a cost analysis of the additional initial roof cost compared to the savings caused by the additional insulation in the roof. That analysis will provide a payback period for the roof, or how long the roof will take to pay for itself.

Following that analysis is a proposed investigation of prefabrication on the Psychology Building. Prefabrication generally saves time during construction and increases the quality of the finished product since the work is completed in a controlled environment and not on-site. The prefabrication will be specific to HVAC, plumbing, and structural steel connections. Each of these has the ability to save time by shipping them to site already constructed and limits the installation time. An analysis of the schedule savings will be completed to see how effective this method is.

The final proposed analysis is the consolidation of the air handling units themselves. There are currently four units for this building that will be consolidated into two. The consolidation will save time of installation, equipment cost, and hopefully based on analysis, operation costs. The results of the analysis will be compared to the actual installation on the building to see where a savings could have been found.

A weight matrix provides a breakdown of how the analyses will attempt to investigate research, value engineering, constructability, and schedule acceleration for the Psychology Building. Lastly, a conclusion sums up the proposed analyses and how each has the potential to improve this project.

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3.1 Critical Industry Issue: Building Information Modeling

4.1.1 Problem/Opportunity Statement:

Building Information Modeling (BIM) was used on the Psychology Building to help with design, planning and clash detection within the building systems. It was used fairly effectively, but there are several ways that BIM could have provided additional services during the construction of the building. This seems to be true throughout the industry. There is a misconception that a 3D model is the same as a Building Information Model. This is not the case. An information model has information linked to it, a 3D model does not. Some companies have to come realize this and others have not. The most common usage of BIM is with clash detection, like on this project. The PACE Roundtable provided ideas for various applications of BIM that were very resourceful and could have helped during construction of the Psychology Building such as contract terms, document control, tracking for building systems, and facility management. These are some examples of BIM applications that for some reason, many companies fail to utilize.

4.1.2 Goal

The goal of the analysis of BIM would be to see how other projects have used BIM and how it has streamlined the construction process for them. One main thing to look at is document control and tracking of material. On other projects, construction managers have found a way to electronically tag items that arrive on site and monitor the status of the items on the BIM. Research on this process will tell how viable it is for the Psychology Building and for projects as a whole. Another thing that will be studied is the "life of a BIM." Research will aim to find the best practices of BIM, starting with how the contracts and RFP's are written to subcontractors. Contract language has to indicate how the files will be delivered and in what program. By taking care of this issue at the contract stage, it eliminates problems down the road. The process will follow through construction and on to post-construction, giving the owner a model of their building that they can use for facility management. Owner's have expressed an interest in facilities management, but haven't really defined what they want out of a model. Research on the subject will hopefully provide a number of things that owners are looking for. The goal is to have each party, construction manager and owner, aware of what each other expect out of the BIM.

4.1.3 Research

Research will start with how the BIM was created on the Psychology Building and looking into how the contracts were written to assure that the model could be put together easily. Other projects will also be examined to find a best practice of BIM start up. Next, methods described in the PACE Roundtable about the uses of BIM will be researched. To do this, the members of PACE will have to be interviewed about their experiences with BIM and how they have used it effectively. Specifically, Mark Konchar from Balfour Beatty and Corinne Ambler from Barton Malow could provide insight on their experience. The focus will be on tracking material to the jobsite and work progress through the model.

The following are sample questions for the industry members:

- What difficulties have you seen with subcontractor cooperation and BIM?
- In what ways could this have been prevented
- Besides clash detection, how have you used BIM on your projects?
- What were the benefits/challenges of this method?
- What, if anything, would you change about your BIM experiences?
- How has the model helped during construction?
- Would a BIM be helpful on all projects, or is it limited to a certain type?
- Do you plan to give or sell the model to the owner after construction?

Next, the owner's representative of Emory will be interviewed to see if he is planning on using the model to manage his facility, and if so, what he expects from the model. Other owners will be interviewed also to find out their knowledge and expectations of facility management using a building information model. John Bechtel of Penn State's Office of the Physical Plant could be especially helpful since some of Penn State's buildings have used BIM also.

The following are sample questions for the owners:

- Have you heard of facility management through a BIM?
- Would you be interested in having an as-built computer model of your facility?
- Have you used this before?
- How would you benefit from having a model of your facility?
- What types of information would you like to have in the model?

4.1.4 Expected Outcome

The research of BIM will hopefully give a guide of the best practices of BIM. Since BIM was used on the Psychology Building, the uses will be critiqued and determined how effectively the model was used. The outcome will be a guide for construction managers on how to implement BIM on a project. Many companies are in different stages of development of BIM implantation, but this could be a resource to anyone since it is a collection of successful methods.

4.2 Green Roof

4.2.1 Problem

The roof of the psychology building is mostly flat and unused space. That space, a total of about 14,600 square feet, could be used for a green roof. The green roof could help with water collection, insulation, and additional LEED points.

4.2.2 Goal

The goal of the green roof would be to reduce the impact that the Psychology Building has on the environment. Hopefully, the additional mass will help to increase insulation and reduce heating and cooling costs as well. Lastly, the additional LEED credits that

this system would cause may be enough to propel the building from LEED Silver Certified to LEED Gold Certified.

4.2.3 Research

The first step in researching a green roof would be to determine a system that would work for this building. Discussing the type of building and climate with contractors, suppliers, and designers should allow for a system to be designed. Next, the additional weight that the green roof would create would have to be calculated and compared to the existing structural system. Then a determination would be made whether the existing structure could support the loads, or if additional structural members would be necessary to support the added weight. After that has been decided, research would continue on how the additional insulation will help to reduce heating and cooling loads. Those calculations can be checked against the existing roof to determine how much more effective a green roof will be. A cost analysis based on energy savings and up front costs of the roof will also be completed. The analysis will determine the payback period of the initial costs. Also, the additional LEED credits will be tallied and added to the current credits to determine if the building's certification would change.

4.2.4 Expected Outcome

The green roof is expected to create additional construction costs. Although this roof installation would be more complicated than what is already used, and will take more time to install, it should not affect the overall schedule. There is actually seven weeks of float from the time that the existing roof is completed to when the building is dried in. Those seven weeks could be spent installing the green roof, and would not affect the rest of the building. The owner has already expressed interest in items that will eventually pay for themselves, so a green roof is a viable option. The additional insulation should create energy savings, so the roof would pay for itself after a period of time.

4.3 Prefabrication

4.3.1 Problem

All of the steel and mechanical connections were completed on site. Connections take up a lot of time and the quality is not always as high as connections that are made in a shop and then shipped to the site.

4.3.2 Goal

By performing the connections off-site prior to shipping, the quality would increase and the construction time would be reduced. A comparison can be made using similar connections from other projects that will tell whether off-site prefabrication would have been beneficial to this project.

4.3.3 Research

Research would start by determining what types of connections are typically pre-fabricated and how it would affect shipping. Southland Industries would be a key contact for mechanical connections since they have used pre-fabrication in the past. By

finding out what they typically pre-fabricate, there will be a general idea of what should be used for the psychology building. Steel connections are also known to be pre-fabricated. There is not a lot of steel on this building, but the connections can be analyzed to determine whether pre-fabrication would have been more efficient. Steel fabricators and other contractors would have to be interviewed to determine a cost/time analysis. Transportation of connected steel members will also be analyzed for feasibility.

4.3.4 Expected Outcome

It is expected that the off-site fabrication of connections will save time and money on installation. The mechanical connections are expected to save more time on site since there is a relatively small amount of steel used for this building.

4.4 Consolidation of AHUs

4.4.1 Problem/Opportunity Statement:

There are a total of four Air Handling Units used to control the indoor air environment of this building. There is one large unit, a medium sized unit and two smaller units. The coordination during installation of these units is difficult since there are so many for a relatively low HVAC load. Also, piping and wiring to these units gets complicated since each unit will need its own system. The operating costs of these units are also high since they operate individually.

4.4.2 Goals

By reducing the amount of units to two, there will be a reduction in initial costs, operating costs, installation costs, and installation time. An analysis of the system will determine how much cost and schedule savings a reduction of units would amount to. Additional research would go into installing energy saving units and how to limit operation time in an effort to reduce power. The main goal is to provide the same HVAC functions with less air handling units.

4.4.3 Research

To find out if a reduction of units will be a success, research will be conducted to determine how well the original system was designed to handle the building loads. After determining the proper amount of air to supply the building, new units will be selected. The basis of selection will be the operating components of the units and energy efficiency. After the new units are selected, an analysis will be completed on the energy efficiency and how it compares to the original system. Also, installation times will be analyzed of each system to see the difference in having less units and more space to install.

4.4.4 Expected Outcome

The expected outcome of this research is that the building will be sufficiently heated and cooled using two air handling units instead of four. The new system should be more energy efficient and therefore save on building operation costs. Since there will be less equipment and installation, the upfront costs and installation time will also be reduced.

4.5 Weight Matrix

The following table is a breakdown of how each analysis fits into the categories of research, value engineering, constructability, and reduction of schedule.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Critical Industry Issue - BIM Analysis	25				25
Green Roof Implementation	10		15	5	30
Prefabrication		10	5	10	25
AHU Reduction		10	5	5	20
Total	35	20	25	20	100

Table 1 Weight matrix.

4.6 Conclusions

BIM Analysis – Research how to implement BIM on a project including ownership of the model, file restrictions, and software availableResearch additional applications of BIM to determine what methods could have been used on this project and what else is being used by other construction managers. Determine how a facility model can help an owner and what they would expect from the building information model.

Green Roof Implementation – Determine if a green roof would be beneficial to this building. Find out what the payback period would be for the installation costs and if the LEED credits could make this a Gold certified building

Prefabrication – Determine if prefabrication of mechanical and steel connections could have created better quality and saved time during construction.

AHU Reduction – Determine if the amount of air handling units could be reduced and if that reduction would have saved time during construction, installation costs, operating costs, and equipment costs.

Each one of these analyses had the potential to help this building achieve its goals of being environmentally friendly, cost effective, and constructed in an efficient manner. Efficiency can be seen as an overall theme of this building. The construction process has been efficient and is ahead of schedule. The building systems are efficient and will most likely earn the Psychology Building a LEED Silver Certification. BIM was used for clash detection to minimize field clashes and rework that produces excesses waste. Recycling has been a large part of the construction and the site continues to recycle by using separate dumpsters for recyclable materials. Efficiency has been considered since the design of the building and these analyses provide additional methods on how to maximize the building's potential.

Appendix A: Breadth Studies

Structural Breadth

A structural breadth will be completed by adding a green roof to the existing structure. The new roof system will add significant weight to the structure. An analysis will be completed to see whether or not the existing structural members will need to be resized or added. Based on that analysis, the structure will be altered to safely support the new roof. The new roof and structure will then be analyzed for cost and schedule implications.

Mechanical (HVAC) Breadth

The addition of a green roof will also cause the existing mechanical system to change. A green roof has much more insulation than the existing roof and will cause the mechanical loads on the building to decrease. That decrease will cause the existing equipment to be resized to support the new load. The new loads will probably cause at least one of the AHU's to be removed, with the hope that all of the mechanical equipment will be much smaller. The energy savings associated with the smaller equipment will be compared to the installation cost of the roof to determine a payback period.