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Construction Management Option
Technical Assignment 3
Alternative Methods and Research



The Pennsylvania State University
Health and Counseling Services Building
University Park, Pennsylvania

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Executive Summary

This paper will focus on research ideas and methodologies for the spring semester. Included in this document are the results of sessions attended at the PACE Roundtable, a critical issue facing the industry and the associated research idea proposed, multiple problematic areas of Health and Counseling Services from a technical standpoint, and three of the aforementioned problem areas with associated research intentions. Technical assignment #3 will be the basis of a thesis research proposal in December.

At the 15th annual PACE Roundtable, three sessions were attended. These sessions were green building materials, building information modeling (BIM) with respect to education and workforce, and the last session discussed building respect with subcontractors. During each of these small group discussions, the industry members and students talked about critical issues that construction was facing and some proposed solutions. The green building sessions helped to formulate the basis of my industry research.

The critical industry problem that will be the basis of future research is related to LEED design. More specifically, LEED and the cost increase that subcontractors and general contractors apply to LEED projects due to inexperience or misconceived notions of LEED design. This will be accomplished through interviews, surveys, phone conversations, and analysis of LEED points.

Through a technical analysis and constructability review many problematic areas were located. Due to time constraints, three of these problems will be studied in further detail. These three problems are non typical steel sizes of structural members, curtain wall schedule, and the emergency electrical system.

Critical Industry Issues

The PACE Roundtable held on October 12, 2006 was an opportunity for industry professionals from varying construction expertise and students of the Penn State Architectural Engineering program to discuss many issues about where the construction industry is at presently and where it will be in the future. The three sessions that I was able to attend dealt with building system challenges, building information modeling technology, and building respect with different construction parties. Due to the limited time, I was only able to attend one of the three to four different topic rooms associated with these sessions. The rooms that I chose to attend were discussions about green building materials, education and workforce issues for building information technologies, and building respect with specialty contractors. The remainder of this section will look into what was discussed at the 15th annual PACE Roundtable.

The green building materials session discussed trends in the industry, procurement challenges, common unexpected or secondary outcomes, contracting of consultants, and lessons learned. This section will highlight the points that I found most interesting from the conversation. During the beginning of the discussion recent trends in specifications and design were discussed. The consensus was that there are many architects that are producing specifications for materials that are not readily available within 500 miles of the project. During a summer internship in Washington D.C., I noticed that sometimes projects that are not LEED rated can find that green materials are being used on the site. For example, metal studs that contain recycled content were used and found to be slightly cheaper and stronger than traditional metal studs.

Owners, on the other hand, seem to be more concerned with the amount of energy efficiency that they will be gaining by using the green building design over more traditional methods. The most obvious credit is the mechanical system and its energy efficiency; therefore it is no surprise that a typical owner asks about this item first. Another request that an owner often wants to see is a representation of each LEED point's effective cost. A misconception that green buildings are more costly than traditional construction is still prevalent in the industry. A detailed analysis of the LEED

points associated with the Health Services building could yield interesting results during future research.

Building information modeling technology (BIM) was discussed with specific emphasis on issues relating to education and workforce. The consensus among the industry representatives within the group was that the implementation of BIM for construction phase uses was 10 or more years away. The industry is not ready to fully use the potential of BIM due to the lack of technical experience and difficulty learning how to use the software. While this can be resolved with more emphasis being placed on college graduates being taught BIM as part of their education, the industry still views this primarily as a tool to win a project during the bidding phases over a competitor that may not know how to use this new tool. An interesting point that was brought up during this session was that a new entry-level employee might benefit from knowing how to use BIM. During interviews, it was said that a potential employee that has even a little experience with this technology would have a heads up over other interviewees. The ability to visualize construction is something that is typically learned over many years of being on construction sites, but a 4D model could help to alleviate some of the basic confusion associated with scheduling projects.

The last session of the day was Building Respect. I attended the specialty contractors' specific session specifically due to its relevance with problems I encountered during a summer internship. Respect is earned by giving it out and the ability to receive it. The previous statement summarizes everything about this session. Quite frequently, a general contractor or specialty contractor will want to be respected without giving any respect to other contractors on the job site. This can cause heated arguments between trades, causing schedule disruption and even cost increases if it escalates too far.

Lying or being called a liar on a job site is very harmful to yourself and the company you represent on a project. The ability to accept that a mistake has been made and to begin the process of remedying the situation is a good way to earn the respect of your peers. One method suggested to alleviate problems between superintendents and project managers was to place them in a room by direction of a project executive or even vice president within the company. Once inside, push the topic of conversation to the point that the problem is brought up and then discussed or argued about until a resolution

is made. One job site I interned on had a similar scenario occur. Superintendents from multiple trades and from with the company I was working for were having problems with construction sequences and personalities of the individuals. After calls were made to the project managers and sometimes presidents of the associated companies, everyone sat down within a room until the problem was solved and work could commence on the tightly scheduled project.

After spending the day at the PACE Roundtable, I was surprised at the way the industry representatives were able to openly discuss construction issues that they had faced while their competing firms listened in. Interestingly, each company agreed on most topics that were discussed and had very similar problems to share. I did not expect that the industry representatives would be so opposed to building information modeling. This area could be an insightful research topic. It would be interesting to see if 4D modeling could be applied to my thesis structure and be of help during the construction phase rather than the time consuming hindrance that was suggested.

The green building materials session specifically applied to my LEED designed thesis building. Specifically the discussion about a cost analysis of LEED points before construction has started as a way of tracking the associated costs or benefits. Key contacts that I met during my day at the PACE Roundtable were John Bechtel (PSU Office of Physical Plant), Chris Magent (Alexander Building Construction), and Katie Lynahan (Gilbane Building Company).

Critical Issues Research Method

Problem Statement:

General contractors, subcontractors, and owners have a misconception that LEED designed projects are more expensive and take longer to build than traditional projects. The challenge that the industry is facing is that LEED design is still a new concept even though it has been used in the practice for about 10 years. Owners are hesitant to accept LEED and contractors think that LEED points cause higher costs and longer schedule durations. This issue was identified through the PACE Roundtable green building session and through an industry contact, Mr. James Bognet.

Proposed Solution:

The increased schedule durations and cost increases transferred to owners can be decreased by a variety of methods. The education of construction workforces is the foremost solution. By increasing awareness of LEED systems, materials, and designs the learning curves associated with them can be minimized. Another solution may be the government adopting LEED or a similar green design system to enforce it as law, similar to the ADA requirement. Also a detailed analysis of each LEED point on a project would show where, if any, cost increase should occur.

Research Goal:

The goal of this research will be to identify the causes behind LEED design misconceptions. Through this research a detailed analysis of LEED points and their initial and life cycle costs will be performed. The benefit of this will be to show all construction entities an analysis disproving their common misconceptions.

Research Steps:

Interviews of multiple construction parties that have been involved in LEED rated projects will be performed. These interviews will supply the necessary information regarding misconceptions and fears that will allow the research to become more focused. Some of the questions that will be asked are in the following bullets.

- How would you describe a LEED rated project?
- Have you ever been involved in a LEED rated project? If yes, what was your function?
- Do you think that LEED rated projects cost more than non LEED rated project? Why?
- Do you think that LEED rated projects take longer to construct than non LEED rated projects? Why?
- What could be done to help integrate LEED design into the construction mainstream?

Please note that these are preliminary questions that will be asked; as the process is put into motion a greater or broader focus may be realized.

Expected Outcomes:

The results of the research should show that by educating the workforce of LEED materials and designs LEED projects will become less expensive and consume less time.

All parties involved in construction projects will benefit from this research, but general contractors, construction managers, and owners will find the most use for this research.

Problem Identification

This section will discuss various features of the Health and Counseling Services building that may be problematic during the construction process. Each of these items has been selected so that an analysis could be potentially performed of building systems or constructability in order to achieve a solution. Items that have been highlighted in bold show the most potential for further research.

- **The structural drawings show a significant amount of steel members that are not typically found in steel warehouses. The steel mill being used will not be starting a new run until after the steel needs to be placed. Resizing of the steel members to fit the next largest typical size is the most likely solution.**
- The concrete pours for the foundation and elevated slabs will occur during the winter. This is due to the tight schedule that is allotted for a completion in May of 08. Proper protection and heating will be required to offset the cold and precipitation filled winters of Pennsylvania.
- **The curtain wall estimates were received at a higher price than anticipated. With an analysis of this system through constructability a more cost effective solution may be possible. All effort must be taken to maintain the quality level of the curtain wall as well as finishing the curtain wall within the 2 month scheduled duration.**
- **The owner has decided that the building will have the ability to be fully operational under an alternate power source separate from the design in the documents. By analyzing the electrical system and the requirements of each of these systems, a cost analysis and O&M analysis will show the potential benefits and/or consequences of this decision.**

- The site has only one access point off of Bigler Road. With the congested site conditions, traffic flow of materials and equipment may slow construction. Another access point to the site would allow for less congestion. Possible locations for this separate entrance include using the Eisenhower Parking Deck access road or making a second entrance along Bigler road.
- Site utilities and under slab utilities were done under separate contracts. By using the same contractor for both, the site work could be done quicker due to the increased learning curve.
- Crane locations show a potential problem. The north side of the site is extremely limited, and may be able to allow a mobile crane's access. Possible solutions are to extend the area included inside the site fence on the north end of the site or increasing the size of the crane so that locating the crane on that side would not be needed.
- **The use of pre-cast brick façade panels rather than hand laid brick could decrease the schedule time allocated to that activity. An analysis would need to be conducted of cost impacts with crane use and site congestion if this option were implemented.**
- The roof system over the North entrance has been redesigned multiple times by the structural engineer. The connection details between the multiple systems have been the focus of these addenda. The connections between the North entrance roof and the façade have been difficult to design. Possible solutions that have been evaluated thus far have been too expensive for the owner. By analyzing the connections and materials chosen a more appropriate and less complex system could be found.

Technical Analysis Methods

This section will evaluate three of the problems identified in the previous section in respect to cost, schedule, and constructability. Through a technical analysis of these problems, solutions will be generated and presented in a final proposal. Each of these problematic areas identified are subject to change if at any point it is found that the analysis goes beyond the scope of this thesis or is too time consuming to perform in one semester.

- **Resizing non-typical structural steel members**

Problem Statement:

Many members of the structural steel frame are non-typical sized in the construction documents. This has caused a problem for the steel contractor to meet the proposed schedule. The steel mills that have been contacted within the 500 miles set by LEED credit MR 5.1 and 5.2 are not starting a new mill run in time for the steel erection to begin in January 2007. This problem was identified through contact with Mr. Chad Spackman of Penn State's Office of Physical Plant.

Proposed solution:

The members should be upsized to the next greatest size so that they can be procured through a steel distribution warehouse.

Research Steps:

The cost impact of upsizing the steel will be compared against the original design. After the cost has been determined the schedule will be updated to reflect the availability of the typical steel.

Expected Outcomes:

The upsized steel should have a negative impact on the cost of the contract. Although the costs will most likely increase, the schedule should be able to flow as originally proposed for steel erection.

- **Curtain Wall Schedule**

Problem Statement:

The curtain wall is scheduled to be installed over a two month time frame beginning in June 2007. With the schedule being tight for completion of the project by

fall semester 2008, quicker installation would allow more time to be dedicated to unforeseen conditions. The curtain wall package bids have been received and show a distinctly larger cost than the estimate showed. Redesign of this system or use of alternate materials will be evaluated.

Proposed Solution:

In order to solve this problem, the constructability of the proposed system and the associated learning curve will need to be evaluated. Other curtain wall systems will be priced and evaluated against the schedule. Alternate materials such as glass types will be researched.

Research Steps:

In order to test the proposed solution, curtain wall manufacturers, material manufacturers, and installers will be contacted to verify lead times, connection details, prices, and ease of constructability. Once these details have been supplied, a cost comparison will be completed. When a system is found that is of similar price to the original design, a schedule update will be done. At this point, the curtain wall installer on Health and Counseling Services will be asked to evaluate the new schedule and offer acceptance or criticism.

Expected Outcomes:

A new curtain wall system will have an overall negative impact on the Health and Counseling Services building. The redesign, submittal process, and lead time will most likely have a negative impact on the schedule. Although a price decrease may be possible, the schedule will have to remain the biggest concern. Use of alternative glass for the curtain wall will be the most effective solution. Value engineering of this material will most likely allow for a large cost savings while keeping within the schedule.

• **Emergency Electrical System**

Problem Statement:

Penn State has included emergency power requirements above standard. The standby power system will be utilized to supply electricity to one half of one floor of the building if normal power was lost. Also, the standby power will have the ability to supply electricity to one entire floor of Health and Counseling Services if normal power is lost. The problem is that Penn State wants the building to have the ability to run entirely from

a separate power source, or redundant system, if a national or statewide emergency were to occur. Chad Spackman, Penn State's Physical Plant, identified this problem during a progress meeting in October.

Problem Solution:

In order to solve this problem, a constructability review and cost analysis will be performed. The demand on the campus standby power would be large. The standby system needs to be evaluated to see if it can handle that amount of load.

Research Steps:

Research will be acquired through interviews and meeting with the electrical contractor, owner, and general contractor for Health and Counseling Services. A cost comparison of the original design and re-design will show the associated cost increase.

Expected Outcomes:

The expanded design of the emergency electrical system should have an increased cost associated with it. There will be a fairly complex switch over from the normal system to the secondary system and will need highly trained personnel.

Weight Matrix					
Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
Steel Sizes	0%	10%	0%	10%	20%
Curtain Wall		5%	5%	10%	20%
Emerg. Power	5%	5%	10%	0%	20%
LEED Design	20%	10%	10%	0%	40%
Total	25%	30%	25%	20%	100%