



Technical Assignment #3

Alternative Methods and Research

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A. Executive Summary

Technical Assignment #3 explores areas of Ursinus College Residence Hall 2 that are candidates for further research, alternative methods, value engineering, and schedule compression. After attending the PACE Roundtable event, completing technical assignments #1 and #2, and exploring alternative methods, many areas of this project present possible research topics for use in my final thesis proposal.

On Thursday, October 12, 2006, I attended the PACE Roundtable event held by the department. The theme this year was “Building Respect.” By attending I was able to gather information on several possible research topics. Sessions that I attended that provided valuable information from the industry members were:

- Operations and Maintenance: In-house Teams and Business Development
- BIM: Education and Workforce Development: Who will lead BIM teams
- Building Respect: With Owner’s and Operators

Shortly after this event I also had Bill Moyer of Davis Construction attend AE 473 and discuss a collapse of a parking deck that Davis Construction experienced. It was through this presentation I hope to further research precast concrete erection safety methods and provide alternative methods for that. OSHA does not offer many safety guidelines for this particular form of construction.

The Problem Identification section of this report discusses areas of Residence Hall 2 that can be further analyzed. These areas include alternative methods, value engineering, as well as schedule compression/acceleration. Most areas of interest on this project will focus on alternative methods to accelerate the schedule of the building. This is important because Warfel Construction Company has a very limited amount of time to finish a project of this size as well as have the building enclosed before bad weather arrives in Collegeville, Pennsylvania. Many of the areas that will be analyzed will also present value engineering possibilities as well. The overall theme to my research is precast concrete and constructability, cost, and schedule reviews that are a result of switching to the precast system.



B. Critical Industry Issues

Pace Roundtable

The following is a summary of the PACE Roundtable event held on October 12, 2006 at the Penn Stater Hotel and Conference Center. Many industry members, AE faculty, and students attended the even to spend the day discussing key industry issues. This year's theme to the day was "Building Respect."

Session 1D – Start-up, Operations and Maintenance

This discussion was geared towards what the most common forms of call backs and maintenance are, what practices can be applied during project start-up, and how owners can best prepare O & M teams on new projects. This topic provided many key avenues to work toward as a building industry as well as present several possible topics for further research.

Common types of call backs are building zones are too hot or too cold, the roof or windows leak, an AHU is down, the controls are malfunctioning, the owner needs training on how to operate the system, etc. It is simple to understand these types of call backs and then understand that the contractor is responsible for coming back to fix these issues. But, what can be done during start-up to best avoid certain issues that arise.

Many industry members agreed that a good way to avoid certain O & M issues is to start commissioning earlier in a construction project. Teresa Pohlman suggested that the best time for a commissioning agent to be introduced to the job is during the design phase. This should be done in order to have a knowledgeable person working on the systems throughout the project. It is very important/difficult to keep continuity in those who know the systems in a particular building. That also led to the importance of keeping an owner involved through the duration of a project and not just saying, "we'll see you in two years with a finished project." It was also discussed that there is a fine line between quality assurance, which is performed by the owner, and quality control, which is performed by the contractor. Each party will test a certain percentage of the systems but often times not 100% of the systems. As a conclusion about owners, they need to have a full understanding of the O & M of their building in order to reduce the amount of call backs.

This session provided many possible topics for research as well. Chris Magent, Teresa, and John Bechtel all suggested possible research topics that they too would be interested in. The following topics, among others, were suggested:

- Do buildings that are LEED rated operate better than those that aren't?
- What is the optimal time to measure building efficiency?
- How does maintenance track additions/renovations over the life of a project?

2B – Education and Workforce Issues for BIM

This particular session was the most difficult to generate a lot of discussion on. Part of the reason for that was the unfamiliarity with BIM's. Many of the students who attended this session only had minor exposure to the use of them in the industry. As it is not a common practice yet in the industry, many of the members did not fully see the use for it yet. The biggest topic discussed was, where should this information be used and what should it be used for?

Jim Faust and Dan Dailey were quick to point out that for right now it is geared more toward owner understanding of the project they are funding. They both agreed that it helps as a visual tool for those who can not think in 3D. Jim Faust specifically gave an example of how his company lost a recent job because they did not use BIM in their presentation to the owner. Both parties also agreed that you must convince the industry of the value that BIM will provide before it becomes common practice. The industry is at a technology barrier with this software.

Several students in the session also questioned the industry members if they expect them to have 4D software training in college and be able to use it in the working world. Jim pointed out that as he doesn't expect everyone to have training in it, he will often look kindly upon those applicants that have 4D experience. As a group we agreed that 10 years from now, it may be a different story. But in the current market, BIM is not a heavily used practice and there is definitely a technology barrier right now.

This session only provided one research topic for thesis. It is hard to gather information about a type of 4D software that is currently being researched for the first time.

- Where do companies focus BIM currently and what trades are using this technology?

3A – Building Respect With Owners and Operators

This years Roundtable was all about building respect and what better way to end the session's this year than talking about respect with owners and operators. In the end these are the people you are working for and the people that will use the building throughout its life. The biggest issue during this session was how to earn and manage the respect in a relationship between the owner and contractor.

The biggest thing that owners must understand is that construction is not perfect. The experience of the owner directly affects the relationship with the contractor and how the two parties communicate with one another. If a contractor commits to having something done by a certain date, they better follow through. This is the biggest way to build trust and respect with the owner. Another big way to earn respect is to always have a plan when bad news occurs. It is one thing to tell the owner hey this happened today on

site but what they want to hear is this is what happened and this is what we are doing to fix it.

An interesting phrase that came out of this session too was, owners like a “predictable outcome.” This is interesting because if this is the case on a project then the owner knows what he is getting. The owner knows that the project team assembled for his project has succeeded on past projects and has no reservations about his project. This is important because it is not one person that makes a job, it is a team. That team can perform and earn the respect of the owner and ultimately repeat business will prove the trust and respect the owner has for that contractor.

Also discussed was how to lose respect. This is more obvious than anything as we discussed certain things as not honoring commitments, inconvenience the owner by not making certain schedule milestones, and a contractor must learn to manage the relationship. It is often one person that has direct interaction with the owner and that person must manage that relationship in order to uphold the reputation of the company that person works for.

Several topics of research came from this session. Building respect is important in the industry and owners and operators must not disrespect their building or those who put time and effort into completing their project. The following are possible areas of research to use for thesis.

- Partnering; what are the benefits and limitations of this?
- How does this “respect” relationship determine the outcome of the project?
- How do you measure respect and customer relations throughout the project?
- What is involved with performance based contracting?



C. Critical Issues Research Method

PACE Critical Issue Research Topic

The critical issues discussed at the PACE Roundtable provided many possible research topics to explore in the spring semester. Out of the three sessions that I attended the critical issue that most interested me dealt with building efficiency. In the first session of the day our group discussed start-up, operations, and maintenance. This is an important issue to the industry because so many contractors are constantly receiving call backs and settling warranty issues on building systems. There could be many reasons for the problems such as owner knowledge or the lack there of, inadequate maintenance of the building system, and improper installation of the system during the construction phase. Possible areas of research are how owners maintain their building and if they do it properly, if LEED rated projects operate better then those that aren't, and how maintenance departments track additions and renovations that could damage these systems throughout the building's lifetime. All of these are possible research topics however there is another topic I would like to research that will coincide with my technical analyses.

Critical Issue Research Topic Proposed

In AE 473, Building Construction Management and Control, a guest lecture was presented on a precast concrete parking garage that collapsed while work was taking place. Bill Moyer, Senior Vice President of Davis Construction, gave the presentation and did a very good job presenting a catastrophe that happened to his own company. This collapse had a fatal impact on members of the construction team and critically injured others. This accident brought to the surface the issue of safety during the erection of a precast concrete structure. Residence Hall 2 is a block and plank system and erection was stopped on the first day plank was delivered due to the safety guidelines that the erection crew was not following. In this case construction was halted before any injuries occurred. This is a very important issue facing the construction industry as the Occupational Health and Safety Administration (OSHA) has dedicated all of one paragraph to this topic in their safety guide. This issue deserves more attention than what it has been given.

Davis Construction will prove to be a major resource during research for this topic. They have developed their own safety guidelines that they require all precast

erection subcontractors to abide by if they are to work on their jobs. At Residence Hall 2 there was debate as to who was in the know and if the subcontractor performing the work needed to go beyond the safety precautions that they were taking. In the issue of precast concrete erection there are too many grey areas. OSHA needs to address this and develop a more detailed safety plan. It would be interesting to find out how many construction companies have developed their own safety plan for precast concrete that goes above and beyond what is required by OSHA.

The problem with precast concrete safety is that there is no research going on about the process and OSHA seems to be content with leaving their one paragraph in the guidelines. I would like research this by surveying and meeting with certain industry members to determine the impact of more stringent safety rules for precast concrete. Some of the things I would look to find out through surveys and discussion with industry members are:

- Have you ever had safety issues with precast erection?
- How many precast projects do you annually perform?
- Does your company have safety rules that go above and beyond the OSHA guidelines?
- Do you feel that the OSHA guidelines are good enough?
- Do you add cost to estimates to compensate for safety that goes above and beyond OSHA?
- Do you add time in the schedule for safety guidelines that go above and beyond OSHA?
- Do these extra guidelines effect erection time?
- After working for a construction company that has stricter guidelines, do you feel the added cost and time was necessary?
- What safety regulations would you add to the OSHA handbook?
- Would you do more work for a company that has strict safety guidelines and actually enforces them?
- Does the complexity of the precast system affect the safety guidelines?

These are all possible questions that would help me gather information on this topic and be able to address this industry issue. Bill Moyer would be a key contact as well as Warfel Construction Company. I feel as though feedback would allow me to develop a training guide or other safety guide on precast concrete erection safety that could be put to use by construction companies.

The results could benefit all those involved in the precast industry. Safety is a major issue with many companies and the construction industry is a dangerous industry to work in. The results can also directly apply to my thesis project as I am trying to compact the schedule. My main area to decrease schedule time is to make Residence Hall 2 a precast structure. It will also provide some information on the constructability of a precast structure and how a schedule can be met in a shorter amount of time.

Please note that this is an initial idea and I am further gathering information on this and gathering feedback on the idea.



D. Problem Identification

Residence Hall 2 at Ursinus College is not the biggest of residence halls to ever be built, however this does not mean there are no features that create problems on the project. Many of the rooms are repetitive from floor to floor and there are no complex systems. This section is dedicated toward identifying possible problems within the project. These problems will then be narrowed in order to determine candidates for research, alternative methods, value engineering, and schedule compression/reduction. This project must be completed within 14 months and that is not negotiable as the college needs the dormitory for the incoming class of fall 2007. It is also under a very tight budget and part of a 3 building construction plan occurring on campus right now. The college holds both of these areas highest on their list and through research of alternative methods I hope to provide quality alternatives that address the schedule and cost of the project. The following is a list of possible candidates for further analysis and a brief description of each.

- **Insufficient Sub-base:** The site for Residence Hall 2 sits on soil that does not have sufficient bearing capacity for the building. This is due to soil being dumped on this site in the past and not properly compacted. Deep Dynamic Compaction was completed and this added cost and time to the project. I would like to investigate other possibilities that will achieve the necessary bearing capacity.
- **Structural Sequence:** This was a problem from the get go with the compressed schedule. Scheduling enough erection time for steel and plank was difficult from floor to floor. It will be a push to complete these items on schedule especially with the looming winter months.
- **Rebar Install:** Rebar was improperly installed in the ground floor walls due to a mix up on the structural drawings in the construction documents. This cost the project several days on the schedule as well as added cost as the fix required further reinforcing and CMU block.
- **MEP/FP Coordination:** MEP/FP rough-ins could not be installed as originally designed due to several space constraints. Members of the design team had to make revisions to the original design to provide the necessary space.
- **Weather:** There is a push to get this building dried in before the winter months arrive. As of now the schedule has building enclosure to be complete by January.

- **Roof Parapet:** Roof parapet leaks through manufactured stone and premature failure of the parapet stone has created a problem on the existing Richter/North Hall the college already has. They have proposed using aluminum in place of this.
- **Value Engineering:** Several areas of this project have already been accounted for. One of which is the control package being used for the mechanical system. Other possible VE areas could be alternative methods for the exterior skin of the building as well as structural system. Further analysis of problematic features will also provide VE ideas.

These ideas are aimed at other option areas to offer a variety of alternatives for this project. I have been in contact with the owner as well as the construction manager to discuss problematic areas and I am still in the process of discussing these with both parties.

Please note that this is an initial idea and I am further gathering information on this and gathering feedback on the idea.



E. Technical Analysis Methods

Technical analysis methods are devoted toward identifying core thesis investigation areas for the spring semester of 2007. I have chosen two areas that I would like to investigate and I believe will be further analyzed and applied to the core investigation areas that include critical issues research, value engineering analysis, constructability review, and schedule reduction/acceleration.

Technical Analysis 1

Technical analysis one will be an analysis of the soil compaction completed on this project. The problem originally on site was the soil did not meet the necessary bearing capacity. This became an unexpected cost for the college and added time for Warfel Construction Company (WCC) on the schedule. David Blackmore and Associates, Inc (DBA), provided the geotechnical analysis of the site. They discovered unsuitable soils and also proposed corrective options to the college in the report to meet bearing capacity. These options include partial soil exchange, complete soil exchange, deep dynamic compaction, geopiers, and deep foundations which include timber piles, steel piles and drilled caissons. Of all these methods WCC received pricing on deep dynamic compaction and geopiers. Deep dynamic compaction was chosen to be performed on site prior to foundations for the building being installed. For my analysis I would like to investigate two or three of the other options recommended by DBA. I will perform cost and schedule analyses for the alternatives chosen and do a comparative analysis of the alternatives. In order to do this I will need to meet with a structural engineer to discuss the design of other options, loading requirements for this particular project, and cost/schedule of the alternative options chosen. After my analysis is complete I hope to be able to offer a more competitive alternative to the bearing capacity problem on site. Please note that I intend on meeting with Dr. Walt Schneider of the AE department to discuss this problem as well as obtain further feedback to narrow the topic further.

Technical Analysis 2

Technical Analysis two is a more in depth analysis that will cover several areas. As of now this area is broad and I am trying to further narrow it down to have a reasonable analysis area. This analysis involves the structural system of the building and how changing the system to a complete precast concrete structure will affect the

constructability, cost, and schedule of the system. Residence Hall 2 is a CMU block and plank system sitting on cast in place concrete footings. The skin of the building is brick with several areas of glass/aluminum curtain walls, and aluminum windows. My proposal is to make the entire skin and structural of the building precast. I will have architectural precast panels for the skin, precast walls, precast floor plank, and keep the cast in place concrete footings. The intention here is it to accelerate the schedule in order to get the building enclosed faster so interior work can be completed while the building is dried in. I will also provide a cost analysis of the two systems in an attempt to save money for the college. I will have to make vast assumptions throughout this analysis because of time constraints. An example of assumptions would be the thickness of the wall without performing a detailed analysis of design. A company such as High Concrete would be consulted to guarantee that the assumptions fell within the ball park of precast design for projects similar to Residence Hall 2. By using a precast system the estimate will lose the masonry cost of the brick and CMU block walls as well as general conditions costs of scaffolding and possibly even man power on site. Using this as a technical analysis, I will also be able to demonstrate results of my critical issue analysis of precast erection safety. This all will tie in very nicely with the overall theme of my spring thesis project.

A small analysis area that could be considered is the MEP space constraints that are a problem. Switching to a precast system will impact the amount of space for the MEP rough-ins. It will be interesting to briefly research this and find that the results may not be as much of an impact as might be expected.

The obvious results of the precast analysis will be in the cost and the schedule. A precast system will be erected in a shorter period of time than the existing CMU block and plank system being used. This will ultimately allow for the building to be enclosed sooner and other trades being able to start work sooner and hopefully result in an earlier turnover date to the college.

Please Note

I have not included a third area of technical analysis because I feel as though the two listed above as well as the proposed critical issue research will provide enough breadth to cover all requirements. I am fully aware that these topics must be narrowed and become more detailed before the final proposal for the spring semester thesis. I am currently working on narrowing these topics and identifying a more detailed analysis topic for each. Suggestions would be much appreciated.



F. Weight Matrix

The following table is a weight matrix that illustrates how I plan on distributing my research analysis throughout the spring semester. The areas that the analysis will be weighted on include the four categories for core thesis investigation areas. In this case more time will be placed on technical analysis two and critical issue research as they are the most important. Less time will be spent on the alternatives to soil bearing capacity.

Description	Research	VE	Const. Rev.	Schedule Rev.	Total
Analysis 1	5%	5%	10%	5%	25%
Analysis 2	5%	10%	10%	10%	35%
Critical Issue	20%		10%	10%	40%
Total	30%	15%	30%	25%	1%