

# Technical Assignment 3: Alternative Methods and Research



Plaza East  
Chantilly, Virginia

Steve Miller  
Construction Management  
Dr. David Riley

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## **Executive Summary**

Technical Assignment 3 includes Critical Industry Issues, Critical Issues Research Method, Problem Identification, and Technical Analysis Methods. The report enclosed identifies problems and concerns of the Plaza East project. This will present opportunities for further analysis and research. The topics enclosed will become the core to the final thesis proposal.

Section 1, Critical Industry Issues, summarizes the discussions had at the 2007 PACE Roundtable Meeting held in October 2007. Topics covered included: Prefabrication, Building Information Modeling (BIM), and Labor and Management shortages. Prefabrication and Building Information Modeling are two issues used to help set a base for critical issues research of this thesis proposal.

Section 2, Critical Issues Research Method, contains a critical industry issue which will be analyzed and discussed throughout the process of this thesis. The problem deals with the lack of BIM used in the construction industry today. A survey will be handed to owners and contractors to evaluate which companies have or plan on using BIM. This BIM software will also be applied on Plaza East to perform takeoffs and steel erection sequence planning.

Section 3, Problem Identification, will state project specific problems that were experienced throughout the Plaza East project. Problems include the schedule being pushed back because of redesigns, precast concrete color matching, and weather problems.

Section 4 & 5, Technical Analysis Methods and Weight Matrix, focus on problems stated in Section 3 and methods of analysis that will be used to help fix these problems. All analyses will have four core areas of investigation that can be addressed. These areas include Critical Issue Research, Value Engineering Analysis, Constructability Review, and Schedule Reduction/Acceleration Proposal. A weighted matrix depicts the distribution of effort that will be expected for all four areas of research.

## **Critical Industry Issues**

The 2007 PACE Roundtable Discussions were successful in discussing the topics concerned by professionals of the construction industry today. The meeting brought together a diverse group of people including professors, students, and professionals of the building industry. During this meeting we discussed prefabrication, building information modeling, and labor and management shortages. Each session involved a different panel of people including industry professionals and professors. Each had an opening statement about each topic followed by questions from the audience.

### **Session 1 - Prefabrication**

The first discussion began with different aspects of prefabrication. A type of prefabrication everyone notices is the house or half house you see driving down the highway on the back of a tractor-trailer. This aspect is residential. When dealing with commercial prefabrication you must look into the codes and zones of your project to be sure everything made and brought to your site is completely up to standards. It is important to be upfront with the general contractor or owner when dealing with this type of situation. When plans are not completely straight forward difficulty can come when multiple trades must coordinate as the prefabrications come together. They must organize in the field or off site to be sure everything runs smoothly. Other problems surface if the design changes after the project begins.

Green buildings and LEEDs can benefit from prefabrication by having the cost of production diminished and minimizing waste on site. Better quality means more efficient equipment. With prefabrication you can visit the sites and control the cleanliness of the project which will help in the long run. The last thing discussed was a problem of who takes charge. The panel was discussing how a project needs someone to take control in a prefabrication situation. When the precast concrete and curtain wall show up there should be a person in charge of where it's going and when it's getting erected. This is why it is always good to be upfront in the beginning with each contractor, subcontractor, and owner. To further aid with this process some

personnel had a suggestion; PACE should work with owners and architects to further educate them in the prefabrication process.

## **Session 2 – Building Information Modeling**

Discussion two began with a list of good aspects to BIM and what the software can do for a project. When you have a building information model you must have everyone starting on day one. The information from each trade must be there to put into the model. Problems become more noticeable in the early stages of planning and can be solved before anyone begins to break ground. You can get decisions from the owner much faster and save time on all angles. As of now, owners are not asking for BIM to be implemented in their buildings because they do not know as much about them. If they begin to be educated, they can realize it can cut down on change orders and save money for any project.

Subcontractors use BIM and 3D models, and have been to help save on time and money. Some more key benefits of BIM include: better analyzing of designs, improved communication, better look at efficiency and waste, and improved digital fabrication. All of these can help with the cost benefit analysis. There is no real standard when it comes to a model, at least not in the present time. The process takes time and multiple meetings for the software to be effective. A way to measure the success of using a BIM would be to compare two similar projects. The one using BIM would easily have about half the RFI's and half the response time. It was said, "Information is power", who has the rights to see these drawings and the BIM can use that information to save money and time.

When using a BIM one must realize to go beyond just the 3D model and used the attached information that comes with it. BIM is not just for very large commercial or very complex projects either. BIM can be used for any type of project and would be nothing but a benefit. This process is growing and in a few years all projects will be using building information models.

### **Session 3 – Labor and Management Shortages**

The last discussion brought up shortages of labor and management in the industry. As of now we are short on labor and a few ideas were discussed to help the situation. To not only keep our laborers but also have them grow in numbers, we must try and make our work and industry more attractive. We must better the image of the construction industry. Some people are misinformed and they should be shown there are more opportunities than expected. An example was given that some believe if they join they will be a tradesman the entire time. With this business all work is intertwined and you can branch out in many ways.

It definitely helps to be bilingual in this business. Some suggestions to having language classes are a good idea; the better the communication the better the work. Better communication can also make a company seem much friendlier to work for. When looking into laborers, there should be someone checking their former training, especially if they are from another country. Putting someone in an unfulfilling job is an easy way to lose them. Looking into migration issues is important because there are many immigrants coming into the United States.

We can also look into earlier development for students. Possibly starting trade programs in high schools would show students an early glimpse of the industry. In the end, general contractors or any contractors must be responsible to create and train their own workforce. In that way they can find ways to draw and retain people in the business.

There weren't many surprises for me throughout the discussions during the roundtable meeting. I thought the discussion of BIM will be very influential throughout the entire industry and many people at the roundtable meeting took a lot from the discussion. As each year passes more people learn about, which can only help the industry. BIM could have possibly been applied to my project to help with some of the scheduling problems that came up. I plan on making a model for Plaza East because it seems fairly straight forward, considering the simple cast-in-place design of the columns and slabs. I would like to look into BIM to see if the redesign of the lobby and elevator finishes would have been as big of a setback in the schedule. The mockup of the precast slabs and curtain wall also ran into trouble with leaks during testing. This

put the mockup behind schedule for just over two months. This issue deals more with prefabrication and further research into it might have helped move the process along faster.

I spoke with Bill Moyer, who is a Penn State graduate, during the round table discussions. I have met him before, and he gave a speech in class on safety and planning using a cast-in-place structure collapse at DAVIS as an example. I plan on contacting him with further structural questions about Plaza East. I also spoke with Charles Thomasco from Truland Systems Corporation during dinner. After our long conversation that evening I ran into him again at the career fair. He offered to give me any assistance I may need, if I decided to do a breadth with lighting and electrical. Through these contacts and others, research into the PACE Roundtable topics and breadths I feel will go much smoother.

### **Critical Issues Research Method**

An important issue facing the construction industry today is the implication of building information modeling (BIM) to projects. It is a growing technology and is not being implemented in the present time as much as it could be. If this software is used more often it can lead to better quality buildings and quicker turnovers.

#### **Problem Statement:**

What are the benefits of implementing BIM software into construction projects? After further investigation into the benefits, one must ask if these companies knew of the advantages of BIM, would they start implementing the technology on future projects?

#### **Research Goal:**

BIM is a growing technology and it is getting past its beginning stages of progression. As discussed in the PACE Roundtable discussions, it seems few companies use BIM or are aware of BIM technology and its multiple advantages to a project. If these companies were better informed, BIM would become more popular among today's current projects. Owners and contractors will be the audience and the benefactors of this

research. Besides this initial goal, BIM will be used to aid in further aspects of this thesis. By building a superstructure with the BIM software, takeoffs and sequencing will be put into practice. This secondary goal will help with time and organization involved with the structural breadth.

### **Research Steps:**

Research for this project will begin with reading and reviewing of the subject matter. After becoming completely satisfied with the knowledge base gained, a survey will be made to distribute to multiple owners and general contractors in order to discover their knowledge of BIM and the BIM process. A sample of some of the survey questions are below and may change after further investigation.

Name and Position:

Company Name:

#### Survey

1. Does your company currently use or plan on using building information modeling (BIM) technology?
2. Have you ever used BIM on a project before?
3. Do you know what BIM is, and what the process consists of?
4. Are you willing to take a course in order to learn how to use BIM technology?

If applicable:

5. As an owner/contractor, what are the benefits of using BIM?
6. Are there any negative aspects to BIM?
7. Can BIM be used after a project has been completed?

Add comments:



After the information is obtained, it will be summarized and put into the research.

Further investigations will be put into the costs of different types of BIM applications and training courses on how each of these applications are used.

When this research is concluded, a BIM model will then be combined with the structural aspect of Plaza East. Calculations will be made to use steel columns and beams instead of cast-in-place concrete columns and beams. Combining these two aspects will make it easier to perform takeoffs and develop a steel erection sequencing plan of the new structural system.

### **Problem Identification**

Plaza East ran into a few problems as the Owner, Tishman Spyer decided to re-design the Lobby and Elevator finishes. They generated a rendering, added specs, and then sent them to DAVIS Construction to go over. This re-design also changed the Architectural Precast mix design to a very dark and unpredictable mix. This redesign took place during the erection of the entire structure.

With the size of such a change, many subcontractors were involved. An entire new set of drawings was sent to all subcontractors. DAVIS had to get pricing from every subcontractor, while re-designs were constantly being repeated until it was within the Owner's budget. This problem took many months and also involved much man power which took away from the managing of the construction in progress. This also took time and effort away from the buyout of certain finish trades. This further affected the ability of the GC to get certain subcontractors under contract because their scope of work was either changed, added, or in some cases completely removed. For example the original design in the Lobby included millwork. After the Lobby was re-designed, the walls and floors were all stone with no millwork. The adding of new items and subcontractors began a long term of submittal crunches which had to be approved. Certain long lead items could not be approved fast enough and therefore impacted the schedule when they arrived late into the project. They had to be installed during overtime hours, which can compromise the quality of the work.

During the re-design the Owner and Architect were concerned about the quality and consistency of the Architectural Precast Finish. Typically the darker the precast, the more difficult it is to control the consistency of the color. The precast selected was gray and black. There was a “ghosting and shadowing” that seemed to show up in many places because of the concrete mix being used. The precast company had to clean each building with pressure washers and scrub brushes to work the precast into a consistent color. This took a few laps around both buildings to resolve the issue and cost some time.

Another problem came during the paving of the North parking lot. The gravel was placed, rolled, and packed on a Friday, and was not to be paved until the following Monday. During the Weekend an unlikely weather storm struck the area and showered down a tremendous amount of rain. The GC had to prove to the owner using NOAA data that the amount of rainfall was above and beyond the norm. Because of this event, the gravel needed to be removed, the subgrade dried and aerated, and then re-stabilized. All of this had to be redone before asphaltting, taking up more time on the project.

Most problems stemmed from the changes that ended up disrupting the majority of the planning. With that, some quality control issues came later in the schedule that should have been resolved earlier on in the job; in particular during the installation.

### **Technical Analysis Methods**

Plaza East had problems when the owner decided to redesign the lobby and the elevator finishes. The schedule became off and everything was pushed back. My goal is to research the prefabrication process of a different façade besides precast, which will be quicker to erect. This in turn will lower the loads on the building and make the columns smaller. Using steel instead of cast-in-place concrete would allow more room on each floor. Because steel is now being used a steel erection sequencing plan must be developed to ensure quick erection. For a better LEED ranking I want to add a green roof to the building in place of the usual built up roof.

**Problem 1** – Use a different building envelope than the architectural precast and curtain wall.

Research will be done on potential cost and schedule reductions as well as an increase on quality. Contacts will be made with both the original building envelope subcontractors on Plaza East and a different subcontractor to compare separate curtain wall systems. Research will be on the lead time change and the structural load differences between the two systems. If the architectural precast is no longer used, there will be no more problems with the color matching of the precast. A change in the curtain wall glass can also save on heating and cooling of the building increasing energy savings.

**Problem 2** – Use steel instead of cast-in-place concrete.

After changing the building envelope, the building will have a lesser load on the entire structure. With that information, smaller columns and beams can be used to support the entire building. This can affect the size of the crane, which in turn can save money. Research will be put into the cost of steel erection compared to the cast-in-place concrete used and an erection sequencing plan. When changing the structure of the building, a new plan must be implemented for the erection of the frame. This may cause an increase in steel prefabrication costs, but can reduce the schedule. A shorter schedule can help in a reduction in the general conditions cost.

**Problem 3** – Use a green roof in place of the current built up roof.

Adding a green roof to a project can have multiple advantages. It may cost more than the original roof designed for Plaza East, but the cost savings in the long run will be much better. With a green roof you can have a higher LEED accreditation, reduced energy costs, and extended roof life. Because there is already will be a new structural system designed for the building, it will be easier to add the additional loads a green roof entails.

## Weight Matrix

Below is the table which illustrates how this thesis research process will be distributed over the different analyses given in the previous section.

Description	Research	Value Engineering	Construction Review	Schedule Reduction	Total
Building Envelope	10	5	5	5	25
Structural			15	10	25
Green Roof System	10	5	5	5	25
BIM	25				25
<b>Total</b>	45	10	25	20	100%