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TECHINICAL ASSIGNMENT # 3
DR. HORMAN



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Executive Summary

This report is intended to outline the ideas and steps needed to conduct my thesis research. This document contains an overview of the PACE Roundtable in the Critical Industry Issues section, my research area in the Critical Issue Research section, Problem Identification of key problematic areas, Technical Analysis Methods describing how to analyze the problems outlined, and the Weight Matrix showing a breakdown of grading.

The topics covered at the PACE Roundtable include the benefits of prefabrication, developing the work force, and implementing BIM. These are current issues facing the industry that need to be addressed. My critical research area addresses implementing green building technologies during the early stages of planning as to not increase the first cost of the project. This is also tied into the problem identification area by applying those technologies to the acoustic and mechanical problem, and applying the benefits of prefabrication to the garage construction. The technical analysis method section explains the ways in which these problems will be redesigned and compared to the original systems based on value engineering, constructability, and schedule reduction.

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Critical Industry Issues

“The PACE Roundtable meeting provides a forum for building industry professionals and students to share perspectives on the current challenges facing the industry.” While attending the PACE Roundtable at the Nittany Lion Inn there were three main industry topics that were discussed: Building Information Modeling (BIM), pre-fabrication, and expanding the labor work force. These areas were designed to focus and relate to the main theme of the roundtable this year: Building Collaboration: Big Solutions to Big Problems.

Pre-fabrication; can the U.S. adopt successful prefabrication techniques that are in use around the world? The industry members that were discussing the benefits of prefabrication touched on the increased quality and schedule reduction that comes as a result of prefabrication. They explained that by prefabricating materials in a shop the quality of work is much higher due to the controlled conditions in the closed environment. It was also explained that there are great schedule savings by prefabricating systems that are difficult to build on site. Mike Miller from Southland Industries explained that at the Baltimore Hilton Convention Center by prefabricating the shower risers and duct risers in the shop they were able to complete the MEP installation on one floor in about a week. This was a huge help to the schedule on this project because the time frame to complete the project was difficult to meet.

After this session I was talking with Bob Grottenthaler from Barton Malow about the benefits of prefabrication and he brought up an excellent point that I had not thought about. He said that on one of his projects they were prefabricating sections of the façade and that it was very difficult to get the sections to be installed and lined up correctly to make it look like one continuous façade. I thought this was interesting because I think the prefabrication is a great method of delivering difficult systems quickly. I did not think about the issues involved with external systems visible to the public or the fact that just because the panels are built in a controlled environment that there might be problems with them. Usually most people believe that anything that is prefabricated is nearly perfect because it has been built in a controlled protected space, they do not think that there are still challenges in making sure everything lines up appropriately.

This topic will be able to help me in my research because I plan to explore the possibilities of prefabrication of the façade at an off site facility and then installing the façade in panels. This is important in my project because it is currently behind schedule and has virtually no on site storage or lay down area. I will investigate possible schedule savings from prefabrication and differences in cost and quality of the finished product. During my research I plan to consult with Bob to discuss any issues I might have missed, he will be able to play a role as an important contact for this portion of my research.

Workforce Development, what creative techniques to address labor and management workforce challenges? These are very pertinent questions about the labor force that the construction

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industry hires. The panel had some very poignant points that are of great concern to maintaining the current work force and expanding it.

One of the main points being the construction industry's reputation. Construction workers have a reputation for not earning much money, that the work is very hard and you are not rewarded for the hard work, and that the workers are not very intelligent. These stereotypes hurt our industry greatly because many people do not realize the skill level required to perform the work. People do not know about the training programs that the unions provide to ensure that the workers know how to properly build the building as well as keeping them safe with regulations and rewarding them for their work with promotions and wages.

One interesting way that was suggested by Sheldon Henry a graduate student was by making the industry seem more glamorous. There are so many shows about criminal justice, like Law & Order and CSI that the enrollment for the criminal justice field has greatly increased. This is also true for the medical field because of shows like ER and Grey's Anatomy medical school enrollment has increased by 25%. Sheldon suggested that the construction industry try something like that to get the knowledge out to the public that construction workers are very intelligent and have training programs to ensure high quality work. This would help dispel many of the current stereotypes about the construction field and increase interest in the field by making it apparent to the public that construction workers do have long fruitful careers that pay well.

The second point that was discussed which I believe is readily becoming a problem is communication. The majority of the labor force is of minority descent and many of them do not know how to speak English. This lack of communication has many consequences the biggest being safety on site as well as communicating the order in which things are to be built. This affects everyone on site especially the other workers. If there is no communication the safety hazards can increase because not everyone will know what is happening and to be prepared to move if something goes wrong. This also affects the project staff on site mainly the superintendents. They need to know what is happening with the construction on a very detailed level and if they cannot communicate with their work force any potential problems will go unchecked.

The BIM discussion focused on the value of BIM, what primary motivators/success stories are helping to usher in the age of BIM, and looking at reduction in schedule and change orders. Representatives from Barton Mallow and other companies experienced with BIM were on the panel discussing the success they have had by implementing BIM into their projects.

They explained that with the implementation of BIM the number and cost of change orders has decreased greatly as well as the number of field clashes. BIM was able to pin point the possible problem areas and clashes and were resolved before being constructed on site. The representative from Barton Malow explained that they have had to take the lead in creating and

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using the BIM model. They create it with the architect early in the design phase and have the trades and designers add to it, which puts a great deal of risk on them but that it is being contracted between multiple parties.

The one thing that I thought was very interesting during this discussion was the topic of only modeling a portion of the building that is believed to be the most complicated. I think that the entire building should be modeled for problems otherwise there will be sections that are ok and others that are not. After the session was over I was talking with Raj Vora from Southland Industries and he was explaining to me that he was involved with another company that only modeled parts of the building that were deemed the most difficult and it actually made the total on site collaboration more difficult. He said there were portions of the building that were modeled that had no clashes with itself but then didn't come close to lining up with the rest of the non-modeled sections of the building. He said it was more difficult to resolve these problems on site because the sections that were modeled had an efficient layout but did not match the less efficient on site layout. There were more change orders associated with this project than there would have been if they had either not created a BIM model or had modeled the entire building. The thought behind this was to save money by not modeling the whole building but ended up paying more in change orders than the extra cost of a full model.

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Critical Issues Research Method

While working on my thesis project throughout the summer and learning about the project specific issues, I have chosen to research ways in which to increase the “green” in the hotel industry by applying the research to the Residence Inn Marriott. The city of Alexandria, VA is trying to help this cause in new construction by requiring all new buildings to have at least 20 LEED points. However, there is still the persistent idea that going green or achieving LEED simply costs too much no matter the benefits. While budgeting for this project it was determined to only do what would qualify for only the required 20 points because of this idea of green technologies costing too much money.

Marriott firmly believes in adding green or LEED credits to many of their new hotels and resorts. They focus on many things are not even apparent to their guests such as instituting greywater systems to increase water efficiency. “Marriott's Environmentally Conscious Hospitality Operations program (ECHO) focuses on water and energy conservation, clean air initiatives, wildlife preservation, "reduce-reuse-recycle" waste management, and clean-up campaigns.” This philosophy ties into adding green technologies across the industry. Since Marriott is one of the leading hotel chains their ideas and practices will filter to all other hotel chains. “Marriott is the first hospitality management company to join the EPA's Climate Leaders program and is on track to reduce its greenhouse gas emissions by nearly one-fifth over the ten year period from 2000 to 2010--approaching one million tons of climate warming gases.” Marriott shows that they are one of the leaders in green technologies and are willing to try new energy and mechanical systems.

The owner and operator of this building show the two extremes in the thinking on green buildings: one is all for it and the other believes it's not worth the extra cost. This will help in my research and breadth studies about re-designing some systems with green technologies. To show this added value and efficiency of green technologies the following steps will be instrumental in my research:

- Comparing life cycle costs of the current interior finishes to the “green” interior finishes.
- Comparing energy use of the current guestroom mechanical units to the newly controlled units.
- Comparing the water use of the current system to the new greywater system.
- Comparing the up front costs of the current interior finishes and mechanical system to the new green finishes and systems.

Through these tasks I will be able to show that green building technologies are not more expensive up front, have a longer life cycle cost, and increase energy and water efficiency. I also plan to show what LEED points would have been earned with a small amount of pre-planning.

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Problem Identification

Problem 1: Acoustics

This project has some very unique aspects and some problems when addressing the acoustics. There are three metro tracks that cross through the site, the closest coming within 30' of the building footprint. The current glazing system has been selected after extensive analysis and on site testing with meters and mock up designs. The problem that is faced acoustically is sound levels ranging from 100 to 102 dB created from the passing metro trains. These high sound levels cause problems with speech intelligibility and hearing damage. Inside the guestrooms there is suppose to be insulation and two layers of drywall, however in attempt to save money some of these materials have been eliminated. This change in façade and interior partitions can potentially cause a large sound transfer problem: sound from the metro tracks and from other rooms.

There are a number of possible solutions to these problems. I plan to investigate what materials can be used for insulation and interior sound attenuation that will have the required absorption and possibly count for more LEED credits than originally designed for. I also plan to investigate the possibility of off-site prefabrication of the façade system with the windows.

Problem 2: Guestroom Mechanical Units

The mechanical system is designed to condition the guest rooms and other spaces as well as masking the noise from the metro tracks. The mechanical fan coil units are designed to run 24 hours a day to create a white noise background. This is a potentially large problem because there will be guests that want the unit to be shut off which will not be able to happen causing guests to be upset. If the units are too loud it can cause guests to be unhappy and possibly spread this bad experience to other future guests. I plan to investigate the options of control systems for the units to provide user control during the day and noise control at night. This means that the units can be shut off during the day but there will be certain times of the day or night that the unit will be on. This more advanced control will also help reduce energy use in the building.

I will also be investigating the possible use of grey water. Hotels create a great deal of greywater and if it can be reused that will also help to reduce energy consumption and potable water use. Each guest room has a typical bathroom with a shower, sink, and toilet, but since the Residence Inn Marriott is for long term stay the rooms also have kitchenettes with a sink. This increases the greywater production in each room.

The energy savings and greywater can also be applied to achieving LEED credits.

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Problem 3: Garage Cast in Place Concrete

The underground garage is entirely constructed of cast in place concrete. This was designed to minimize the floor depth to be able to help maximize the total number of floors in the building. The problem associated with the cast in place concrete is schedule time. During excavation water problems were encountered unexpectedly which slowed the excavation process due to de-watering systems being installed. Once excavation was finished there was a huge push to accelerate the cast in place concrete and the floors above to get the schedule back on track. This was difficult to accelerate because of the time required to properly place the reinforcing steel for the mat slab foundation, garage walls, and floors, then to pour and cure the concrete before working on the slabs.

One possible to solution is to switch the cast in place concrete to a Filigree concrete system. Filigree virtually eliminates formwork and is very easy and quick to install. This system uses a small amount of shoring to support the pre-stressed prefabricated Filigree panels. The Filigree panels once supported act as the “formwork” for the topping slab the ties the system together structurally. The Filigree panels come with shear stud imbedded and can be used as a flat plate system or a beam and slab system.

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Technical Analysis Methods

Analysis 1: Acoustical Attenuation Materials and Construction

The re-design of the interior materials and insulation will include analyzing the current status of the materials and construction and comparing the values to the calculated values with the new system. This will also include researching materials that are green and possibly count for LEED credits. The glazing system is very sensitive construction since it is within the façade that contains many materials. The off-site prefabrication will address the constructability issues associated with the façade and glazing system. The off-site prefabrication is intended to reduce construction problems with the window flashing and sealant as well as reduce the schedule by increasing productivity. Façade materials will also be addressed for LEED materials and reflective qualities to enhance the sound attenuation of the building from the outside and increase the value engineering.

Analysis 2: Mechanical Controls and Greywater

The re-design of the guestroom mechanical unit controls will include investigating Energy Star controls to help reduce energy consumption. The greywater design is intended to greatly reduce water waste and increase efficiency. The current mechanical design is an all water system which should enable the institution of a greywater retention system and should not add complications in construction. These areas are also going to be applied to LEED since the Marriott must achieve 20 points, these applications can easily help the project achieve more points. This investigation will analyze each new design based on LEED credits, value engineering, constructability, and any possible schedule reduction.

Analysis 3: Structural Re-Design: Cast in Place Concrete vs. Filigree Concrete System

The Filigree panels are thin pre-stressed concrete panels that are prefabricated then tied together by a topping slab that is poured on site. This reduces the amount of poured concrete and the curing time needed before shoring is removed. There are two systems that can be designed: a flat plate or a beam and slab. The flat plate system, Figure 1 on the following page, has all flat wide beam panels tied and grouted together and composite with the topping slab. The slab and beam system, Figure 2 on the following page, requires more beams to be in place; however the Filigree panels are shaped in thin pre-stressed concrete as the beams that are tied to the flat wide beams to create the slabs.

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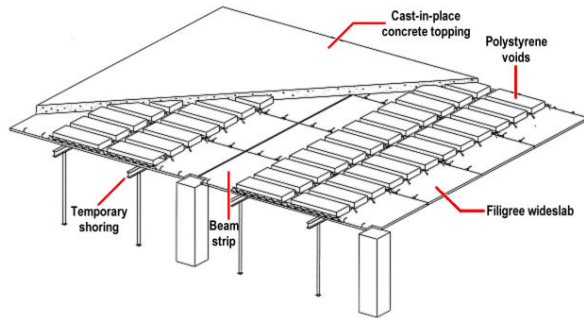


Figure 1: Flat Plate Filigree System

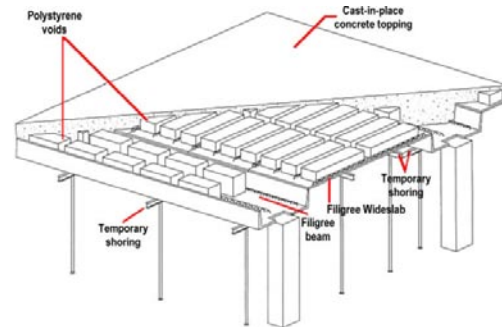


Figure 2: Slab and Beam Filigree System

The goal of the re-design is to try to maintain the minimal floor depth while accelerating the construction sequence. The current floor depth is 8" to keep the floor depth as small as possible the flat plate system will be analyzed as the new structural system for the underground garage. The new system will also be analyzed by comparing any possible cost savings and schedule reduction to the original estimate and schedule.

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Weight Matrix

The table below shows a breakdown of how each analysis area will be weighted into the grading system and directly correlates to the efforts put forth while researching these areas for my senior thesis.

<i>Description</i>	<i>Research: Going "Green"</i>	<i>Value Engineering</i>	<i>Constructability Review</i>	<i>Schedule Reduction</i>	<i>Total</i>
<i>Acoustics</i>	20%	5%	5%	5%	35%
<i>Mechanical</i>	10%	15%	5%		30%
<i>Structural</i>			5%	15%	20%
<i>Pre-fabrication</i>		5%	5%	5%	15%
<i>Total</i>	30%	25%	20%	25%	100%