Westinghouse Electric Company
Nuclear Power Engineering Campus

Technical Assignment 3

Alternative Analysis Methods

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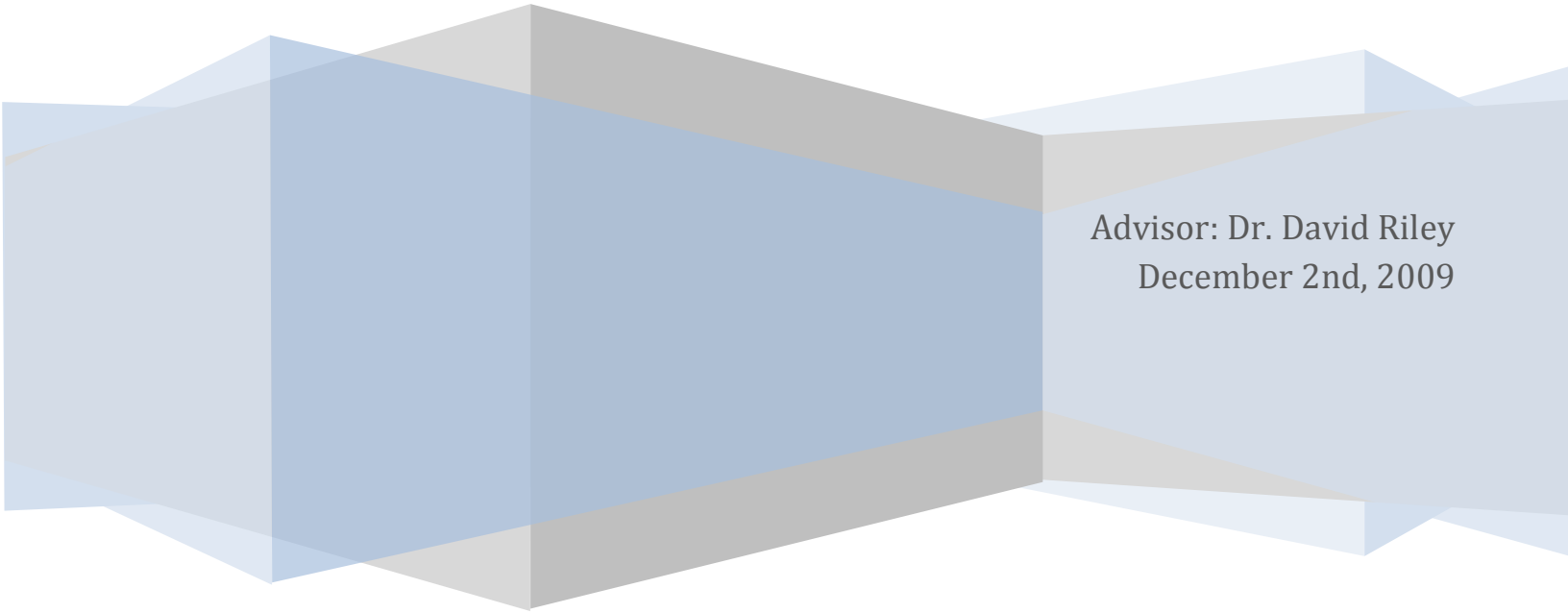

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EXECUTIVE SUMMARY

This report begins to identify areas of the Westinghouse Electric Headquarters campus project which are good candidates for research, alternative methods, value engineering, and schedule compression. Ideas from this report will act as the building blocks for the final thesis proposal.

The first three sections of this report contain information obtained through an interview of the Turner Construction's project manager at Westinghouse. During the interview conducted on November 24, 2009 information regarding the constructability challenges, possible schedule acceleration scenarios, and value engineering was gathered. Some of the challenges included the construction of the exterior walls, metal panel system, and firesafing. With respect to the schedule, some of the critical activities and risks to the completion date were identified. Finally several ideas to save money were discussed.

In the sections following, some of the problems are identified which could be looked at further and on which a detailed analysis could be performed. Also, analysis activities were developed which would look at these problems further.

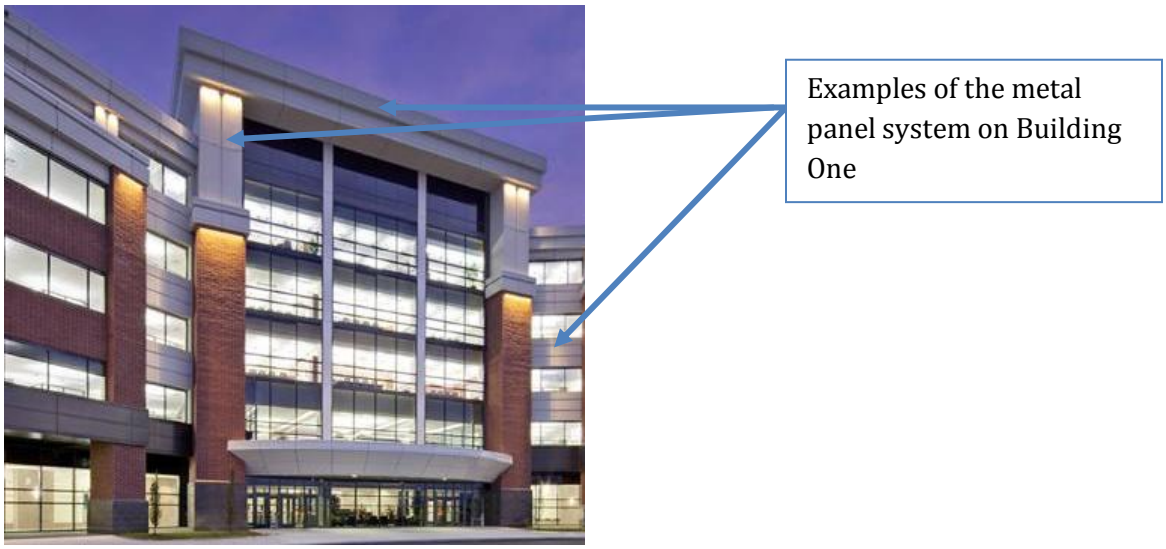
CONSTRUCTABILITY CHALLENGES

Exterior Walls

As construction began on the exterior walls of Building One , Turner was able to meet the tolerances set forth by ASCI; however they were not able to meet the tolerances required by the architect. In order to meet the required tolerances the exterior studs were reengineered from 6" studs to 3 5/8" studs. With the added time of reengineering the system the walls had to be constructed five feet away from the building. This allowed work to continue on the interior of the building. However, additional bracing and safety equipment was required and provided a challenge both constructing the walls and finishing on schedule.

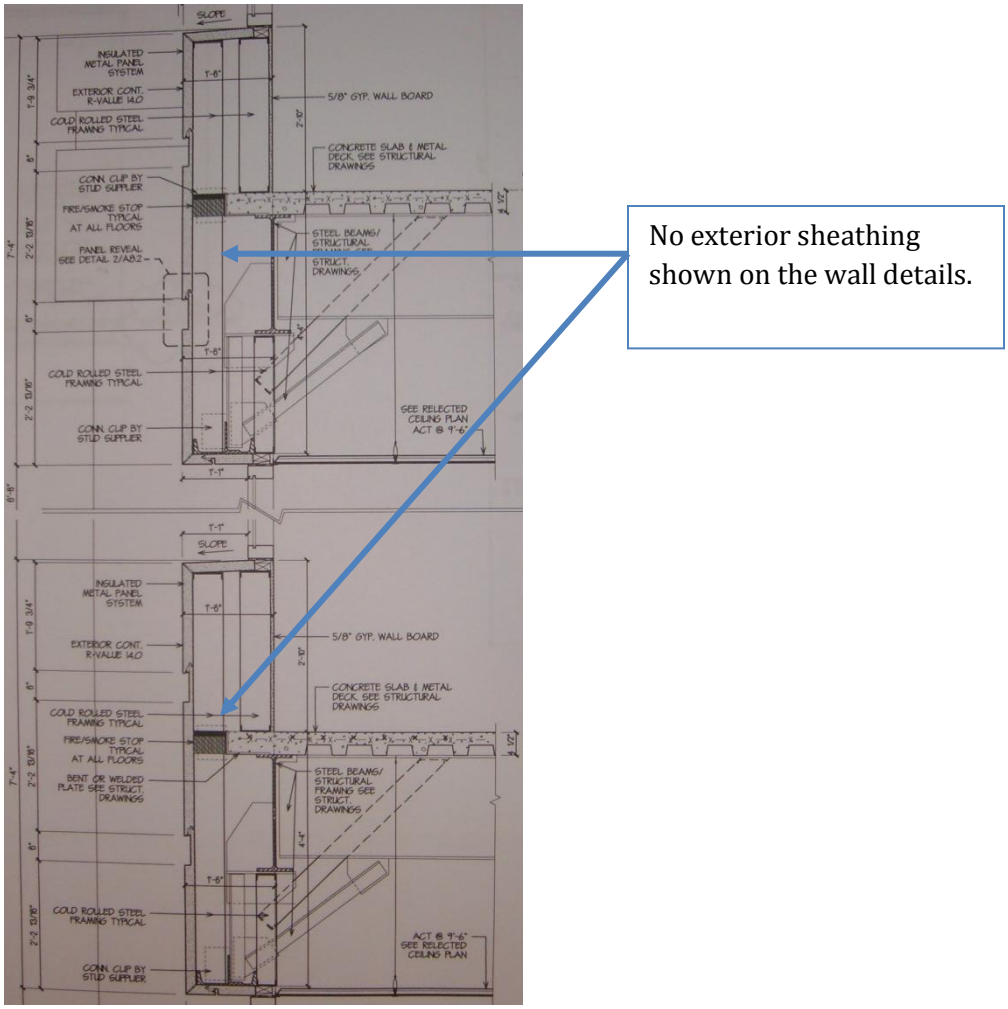
Metal Panel System

The buildings on the Westinghouse Headquarters Campus make use of a metal panel system used as an architectural feature of the facade. Early on in the process Turner identified these metal panels as a potential challenge. After bringing it to their attention, the owner and architect decided to move on with the designed system. This system required a mounting tolerance of 1/8". This was an area in which a considerable amount of time and effort was spent trying to meet these tolerances.



Firesafing Detail between floors

A problem which was not immediately identified was the omission of exterior sheathing. This added a challenge to construction process with regards to the firesafing detail between floors. Because there was no exterior sheathing both the windows and metal panels were required to be in place before the firesafing process could be begin. This limited the amount of work which could be completed in the interior of the building until the firesafing was complete. Exterior sheathing would have cost in the range of $375 to $400 thousand dollars, but could have been the better option in the long run in order to complete the work in a more timely and efficient manner.



SCHEDULE ACCELERATION SCENARIOS

Key Items along the Critical Path

The key items along the critical path of the schedule for Building One of the Westinghouse campus were the foundation and the pouring of the slab on grade. Little work could be completed before either of these activities was completed. Obviously, the foundation needed to be complete before slab on grade could be completed. The reason the slab on grade was crucial to the project delivery was the temporary bracing which was required. It was required that the foundation walls be 99% backfilled prior to steel being erected. Therefore, all temporary bracing needed to be placed on the interior of the building. This could not be done until the slab on grade was poured and able to supports the loads of the bracing; making the foundation and slab on grade critical.

Biggest Risks to Completion Date:

As mentioned above, the foundation and slab on grade were critical to completing Building One on time. There was however other activities which could have had a negative impact on the desired completion date. Obviously the completion of steel was essential. Without the framework in place very little other work can be completed. Once the steel was in place the slab on deck was the next critical item. With an already compressed schedule, it was vital to get men on the floors of the building so as much simultaneous work could be performed as possible. This also made the roof enclosure very important and another risk to the completion date. Also, as mentioned in the constructability challenges section of this report, the exterior walls provided a risk to the completion date. In order to mitigate the effects of the reengineering of the studs, the exterior wall was constructed 5' away from the edge of the building so work could continue on the interior of the building.

Schedule Acceleration Areas:

There were not many areas the schedule could have been further accelerated. The project was originally proposed to be a 22 month schedule. The tenant, Westinghouse, wanted to be able to occupy Building One before this time. The schedule was then redone and accelerated to a 15 month schedule. A large amount of overtime was used in order to help meet this schedule. An estimated $500 thousand was spent on overtime for the core and shell of Building One, while another $300 thousand was spent on overtime for the Tenant Improvements. Also, an additional $350 to $400 thousand was spent on the temporary protection for the exterior walls to accelerate the schedule even further.

VALUE ENGINEERING TOPICS

With the additional costs associated with accelerating the schedule and some of the higher end finishes required by Westinghouse, there were several ideas to help reduce the overall cost of the project. Some of these ideas were deleting items which were determined to not be necessities while other were ideas in which the quality was not compromised. Example of these cost savings ideas included:

- Deleting sunscreens for the exterior windows
- Deleting electrical conduit for branches
- Using carpet tile instead of carpet loom
    - This saved money and also fit with the constantly changing construction allowing for easier, less expensive changes
- A TPO white roof was used instead of painted EPDM roof
- Reducing the building height 5'; changed the building from a high-rise to mid-rise
    - reduced stair pressurization requirements
    - lightened steel
- Changing grades to get rid of excess spoils
- Changing caissons to spread footings
- Changing thickness of gravel beds in bioretention islands

PROBLEM IDENTIFICATION

Overall, the construction of Building One did encounter many problems during construction. Most of the problems which were encountered were a result of the compressed schedule which could not be changed. Some of the problems which may be looked at further include:

- *Exterior Walls*

The reengineering of the exterior walls from 6" to 3 5/8" studs caused a delay and as well as an additional cost when it was constructed 5' from the building.

- *Firesafing*

The firesafing caused a delay in the construction due to the lack of exterior sheathing.

- *Overtime Costs*

The cost of overtime added almost $1 million to the cost of Building One.

- *Concrete Pouring*

The schedule relied heavily on the slabs being poured on time. Delays in pouring could have pushed the schedule past its desired completion date.

TECHNICAL ANALYSIS METHODS

LEED Analysis/ Embodied Energy of Finishes

The Westinghouse Headquarters Campus is pursuing and should achieve a LEED Certified status. However, this was primarily due to a well designed building. Minimal effort was put forth to actually achieve this certification. I would like to investigate further to see what other point could have been obtained to boost the building from just LEED Certified to perhaps LEED Silver or Gold. I will especially look into the finishes and their embodied energy. Westinghouse chose to spend a large amount of money on high end finishes. As an electric company, I believe it is important to look at the life cycle costs of the materials being placed in the Westinghouse campus. Although these low energy finishes usually cost more, the budget had already been set at an above average place. I will look at maintaining or even reducing this budget to obtain these materials.

Poured in Place vs. Prefabricated Concrete Slabs

With the compressed schedule, a large emphasis was placed on the pouring of the slabs. The slab on grade was crucial to start bracing the foundation wall and continuing with the frame of the building. The slab-on-decks needed to be poured and cured so the crews could begin interior work as soon as possible. I will look at the cost of using prefabricated concrete slabs as opposed to the poured slabs. This would reduce the cure time if the prefabricated slabs could be put into place in an efficient manner. This could allow the workers to start on the interior work quicker and perhaps reduce the schedule or the amount of overtime used on the project (discussed below).

Construction Sequences

In all, almost one million dollars was spent in overtime costs in order to help reduce the original schedule from 22 to 15 months. I will analyze the construction sequences in an effort to reduce this amount of overtime. I will do this by not only looking at the way the concrete gets put in place (mentioned above), but also the interior sequences. The current sequence has the building broken down into three parts, east, central, and west. I will analyze the building in a more detailed way to better manage the subcontractors and where they are working. This could make the process more efficient and hopefully help compress the schedule and reduce overtime costs.

Implementation of BIM

Although no major coordination issues were encountered, the shortened construction schedule may have benefited from the use of building information modeling (BIM). The use of BIM could not only prevent coordination issues from occurring, but could have made these processes more efficient. Through the use of BIM the subcontractors would have a definitive idea of exactly what

they were supposed to get done and where before the day began. I will analyze the effect BIM could have had and hopefully show a reduction in the amount of time thus reducing the amount of overtime and perhaps shortening the schedule.