2010

WESTINGHOUSE BUILDING 4

Final Proposal

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Executive Summary

The final proposal will define and explain four separate analyses that will be carried out on the Westinghouse Building 4 project. Through in depth research and calculations, new construction industry tactics and technologies will be explored to determine their monetary and schedule acceleration value. The final proposal will also include a time management schedule and a weight matrix. These two entities will ensure that the research will stay on pace and truly portray the information that each analysis is intended to show. A brief description of the four analyses is given below.

Analysis 1: The façade of the building will be changed from brick masonry to precast panels. Switching to precast panels will add stress to the building structure and will require a breadth study to be preformed to ensure that the building will still be stable. A breakdown of the costs and benefits of changing the system will be done to show that the advantages of this façade type out weight the negative aspects.

Analysis 2: Phasing a project in such a way that the critical path can alternate between two trades can add extensive schedule acceleration benefits to a project. This analysis will show that alternating the critical path between steel erection and concrete will significantly reduce the schedule with little added cost.

Analysis 3: Through research and calculation a photovoltaic array will be designed to be placed on the roof of the Westinghouse Building 4 building. This analysis will look at all aspects of this design change including up front, projected returns, and added structural stress to the building. Research will be required to select an appropriate PV system and determine life expectancy and electricity output. An electrical breadth analysis will be done to provide adequate evidence that the system is possible and worthwhile. The Breadth will also include construction drawing updates that define where the PV electrical wiring will tie into the building's existing systems.

Analysis 4: The final analysis will be performed to show that schedule acceleration can be achieved by using a short interval production schedule, or SIPS schedule, to place the finishes in the building. This type of schedule relies in a repetitive process replicated over and over to achieve maximum efficiency in that process.

Project Background

Westinghouse Building 4 is 121,000 square foot office building that is being built by Turner Construction in Cranberry Pennsylvania. The building is located adjacent to the main headquarters of the Westinghouse Electric Company in the Cranberry Woods Business Complex. The building was required due to the recent expansion of Westinghouse, which meant that schedule and timeliness were held at a premium on the project. The building is to consist of 3 floors and was allotted a 14 month time schedule.

Delays and design changes early in the building process threatened to push the finish date over the deadline. Through a variety of schedule acceleration techniques and value engineering, the construction team was able to keep the project on schedule and on budget. The RS Means estimated cost of the building is $18.3 million. Construction was schedule to begin in late August 2009 and end in early November 2010.

Technical Analysis Methods

Technical Analysis #1: Changing the Building Façade Using Precast Sections

Problem Identification:

The Building 4 façade caused some early design and constructability challenges early on in the project. To the project team, changing the façade from brick to aluminum solved one problem while it created several others. In making the façade more aesthetically pleasing to the eye, the construction team created undesirable penetrations in the vapor barrier that had to be sealed. In addition, the connection between the metal panels and the roof added extra water penetration dangers to the building.

Research Goal:

The goal of this analysis is to create a faster more efficient method of combining and installing the façade system of the building.

Methodology:

- Research precast brick and aluminum façade types and companies
- Research attachment methods of precast façade to existing building structure
- Contact industry professionals for advice on precast systems
- Contact precast manufacturers for design ideas and pricing
- Analyze any additional stress added to the structure
- Analyze schedule effects of having a precast façade
- Analyze the effect on the original problem with the facade
- Research precast facility for quality and code requirements
- Research transportation option for the precast pieces

Resources and Tools:

- Turner contact
- Industry professionals
- Structural Option classmates
- Precast manufacturer
- LLI/IKM Architects
- ProSTAAD structural software
- Applicable literature

Expected Outcome:

After analyzing all aspects of changing the building façade to precast, it should be apparent that precast panels solve the original constructability issues and subtract time from the schedule. Through economical analysis, the addition benefits of this system should outweigh the added costs of the system.

Technical Analysis #2: Schedule Acceleration Threw Phasing

Problem Identification:

The new Westinghouse building started off on a bad foot when complications with documentation put a two week delay on the project. Permits are just one of the threats that menace a project's schedule, but a construction team must always be ready to recover the lost times through methods such as phasing. Many items that were on the critical path of the initial schedule had a finish-to-start relationship. By changing this relationship to a start-to-start, it would be possible to continue with critical path items while their predecessors were still underway.

Research Goal:

The goal of this analysis is to identify critical path items that can be changed from finish-to-start to start-to-start relationship. By adjusting these relationships substantial time could be saved on the project's schedule.

Methodology:

- Interview PM on the project to discuss critical schedule activities
- Investigate steel erection and concrete pouring/drying durations
- Formulate new schedules of trades
- Determine new resource loading demands
- Discuss safety plans with the project safety manager
- Create new overall project schedule to coordinate downstream activities
- Determine savings do to schedule duration reduction

Resources:

- Turner project team
- Project Schedule
- Industry Professionals
- Applicable literature

Expected Outcome:

The results of the research and rescheduling should show that by shifting the critical path back and forth between concrete and steel, the schedule can be substantially reduced. The reduction in schedule will yield significant monetary savings and be of great benefit to the owner. It will be shown that these two activities can be done simultaneously and in a safe manner. Schedules will show that contractors will not be overloaded or understaffed at any time. Research will also show that the necessary materials can be delivered and stored on site without delay or adding congestion to the site.

Technical Analysis #3: Installation of Photovoltaic Panels

Problem Identification:

Westinghouse Building 4 is being built for the Westinghouse Electric Company, who advertises itself as a green power company because they design and build nuclear power plants. The building currently has minimal sustainable features that the company could use to back their claim of being a green company. Initial costs of photovoltaic systems are very high, but returns over time could offset this cost.

Research Goal:

The objective of this analysis is to show that a photovoltaic array would not only pay for itself, but also provide a viable source of backup power for the building in the event of a loss of electricity.

Methodology:

- Research possible PV arrays and their designs and layouts
- Calculate available square footage of roof space for PV array
- Calculate maximum electricity output in KWh
- Analyze roof structure and account for added weight of PV panels
- Alter construction drawings to incorporate PV wiring tie-in
- Determine time of return on the investment in the PV array
- Estimate total earnings over the lifetime of the PV array

Resources:

- Industry Professionals
- PV manufacturers
- AE department specialist Dr. Riley
- Applicable literature

Expected Outcome:

The results of this study will show that it is not only feasible to install a PV array on the roof of Westinghouse Building 4, but it is also an economically smart decision. A photovoltaic array will be able to recover its upfront cost over time and then begin generating positive revenue for the owner. The array will also prove to be a pinnacle in Westinghouse's campaign to portray themselves as a green company.

Technical Analysis #4: Use of a Short Interval Production Schedule for Building Finishes

Problem Identification:

Being that Westinghouse Building 4 is an office building, the interior finishes are very repetitive. By phasing the project differently, certain parts of the building will be ready for finishes before others. This will create inefficiencies if workers and materials are waiting to begin installing the finishes on an entire floor. The sooner Westinghouse employees can move out of their leased buildings and into their new facility, the sooner the company can save money. This creates a need for the shortest finishes schedule possible.

Research Goal:

By laying out a defined SIPS schedule the work involved will become very repetitive and familiar to all entities involved. This repetitive nature of the craftsman's work will allow them to work faster and eliminate mistakes and inefficiencies, thus reducing the schedule.

Methodology:

- Break down and analyze the original finishes schedule
- Section the building into smaller segments with similar finishes
- Set up a SIPS schedule for one area of the building
- Determine all materials, equipment and workers involved
- Calculate a reasonable amount of time per section and extrapolate
- Maintain a level resource schedule to achieve constant productivity
- Compare duration of SIPS schedule to the original duration
- Identify costs and benefits of implementing a SIPS schedule

Resources:

- Industry Professionals
- Professor Craig Dubbler (AE 473)
- Turner PM
- Applicable literature

Expected Outcome:

An analysis of implementing a SIPS schedule will show that the schedule can be significantly reduced using this method of construction. By identifying and using a repetitive process workers will become more efficient in their installation of the building finishes. Added cost is to be expected, but side by side comparison will show that the reduction in schedule duration is worth the investment.

Analysis Weight Matrix:

Table 1 below shows the distribution of how time will be spent on each analysis. It also provides insight into which of the core areas will require the most time so that steps can be taken to plan accordingly.

Weight Matrix					
Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Analysis 1: Façade	-	10%	10%	10%	30%
Analysis 2: Phasing	-	-	10%	10%	20%
Analysis 3: PV Panels	10%	10%	10%	-	30%
Analysis 4: SIPS	10%	-	-	10%	20%
Total	20%	20%	30%	30%	100%

Table 1: Shows the distribution of focus across the primary research areas.

Timetable:

To help stay on pace and finish on time a timetable schedule was produced. Appendix B shows a timetable break down of when each analysis should start and finish. A key objective of this timetable is to help the user be aware of any simultaneous work so they may plan accordingly.

Conclusion:

Through research and investigation the analysis topics chosen for the Westinghouse Building 4 project will not only benefit the individual project, but the construction industry as a whole. Using precast façade panels is an up and coming technology, but the full benefits, especially in schedule acceleration, are not fully known. The advantages of phasing a project will be proved by its ability to maintain the same manpower and resources while providing an early end date of the project. Sustainability technologies like photovoltaic arrays are sparingly used due to their high up-front cost. Through research and calculation it will be shown that the array not only pays for itself over time, but generates substantial savings over the lifetime of the system. Finally, using a short interval production schedule on the finishes it will be shown that through repetitive processes the schedule can be reduced with no added manpower or resources.

Appendix A: Breadth Studies

Breadth Topics:

The following topics are embedded in the analysis topics, but will be researched in more detail. This detailed research will show competency in areas of architectural engineering outside of the construction management option.

Structural Breadth:

Changing from brick masonry to a precast façade will alter the loads on the building's steel structure. This coupled with the addition of a photovoltaic array on the roof of the building will need to be analyses in depth to determine the added loads and stresses. An in depth knowledge of structural design will be displayed through a variety of hand calculations and the development of new structural designs and details.

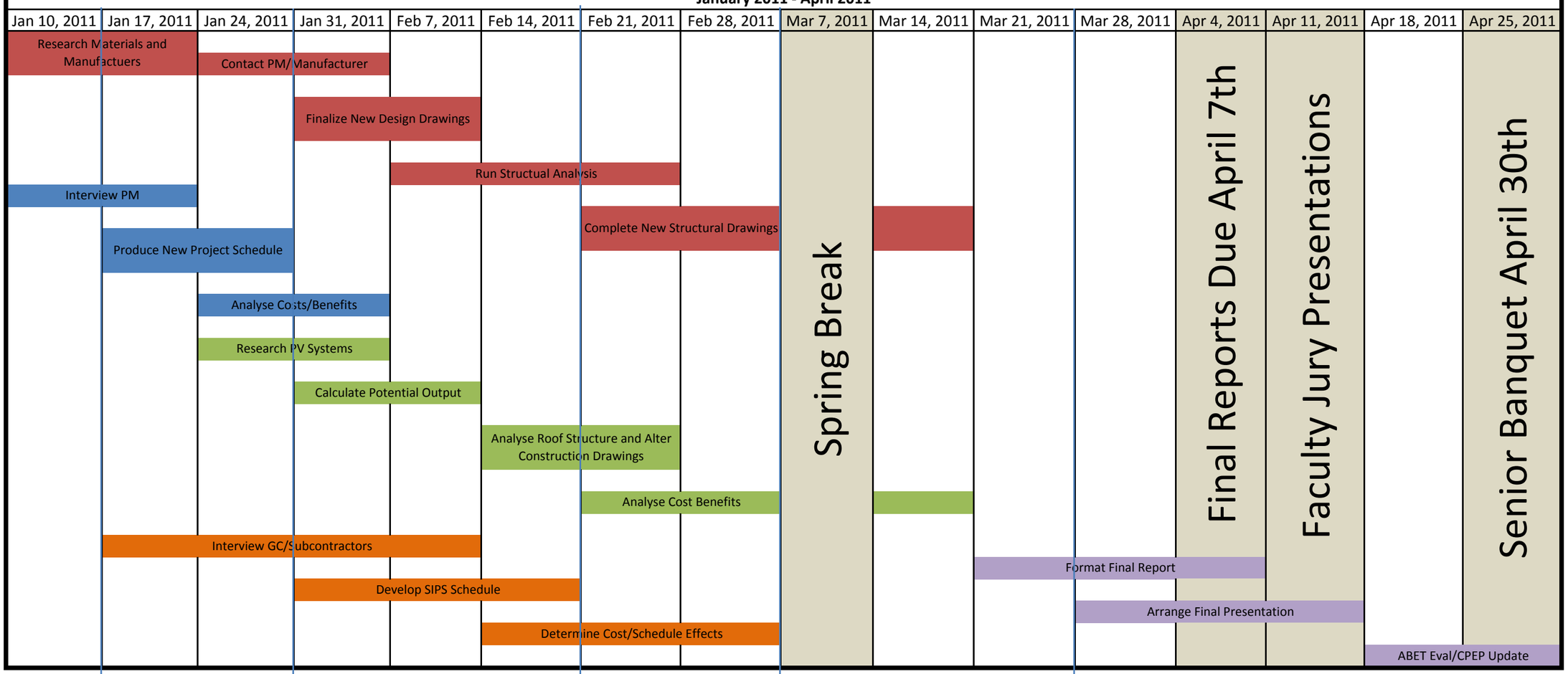
Sustainable Technologies/Electrical Breadth:

Adding a photovoltaic array to the roof of Westinghouse Building 4 will allow the building to generate some of its own power. Substantial research and calculations will be done to determine the total amount of KWh that the system is able to generate. Alterations will be made to the original contract documents to specify where the electric wiring from the array will tie into the building's power. Constructability reviews will also be conducted to ensure that the current building systems and the PV array systems are both compatible and practical.

Appendix B: Timetable

Proposed Thesis Semester Schedule

January 2011 - April 2011



Milestones	
Milestone #1	All Initial Interviews have been conducted
Milestone #2	Analysis 2 complete, Precast façade and PV array chosen, SIPS schedule developed
Milestone #3	Analysis #4 Complete, Breadth topics substantially complete
Milestone #4	All analysis complete, Only formatting remains

- Analysis #1: Changing Building Façade to Precast Sections - Structural Breadth
- Analysis #2: Schedule Acceleration Threw Phasing
- Analysis #3: Installation of Photovoltaic Panels - Electrical Breadth
- Analysis #4: SIPS Scheduling of Finishes