THESIS PROPOSAL

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Construction Management

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The Scripps Research Institute

Biomedical Research Building

Florida Atlantic University

Jupiter, FL

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Executive Summary

This proposal contains four topics which will be researched throughout the spring semester Thesis coursework relating to The Scripps Research Institute Biomedical Research Building. Through this research alternative methods will be examined, and impacts to the cost, schedule and constructability of the project will be analyzed. The results of this research will promote value engineering ideas that arise during the analysis process.

The analyses described in this proposal are the result of issues identified on The Scripps Research Institute Biomedical Research Building project. My research will focus on the following topics which include a Mechanical/Electrical breadth as well as a Structural breadth.

- **Analysis I**
  The first analysis focuses on researching the feasibility of pre-fabricating the MEP rough-in for the numerous islands on this project. Reducing the cost and schedule impacts that this activity has on the project is the key focus of this analysis.

- **Analysis II**
  The second analysis focuses on re-designing the Emergency Generator System to a Co-Generation Plant. This includes a Mechanical/Electrical design breadth for the selection and sizing of the natural gas turbine system as well as the electrical distribution system. Analyzing the cost savings/payback period for this system will be the key focus of this analysis.

- **Analysis III**
  The third analysis focuses on identifying alternate formwork methods to increase productivity of this phase of construction. A structural design breadth will be covered by selecting an alternate structural system which will be sized, durations calculated and compared to those of the current structural system. Cost and schedule impacts associated with the alternate systems are the main focus of this analysis.

- **Critical Industry Issue**
  This analysis is intended to research the impacts that the industry Transition to BIM is having on companies in the act of changing over. The positive impact of BIM having an effect in lending itself to pre-fabrication of systems from the model will also be researched. Interacting with the industry members necessary to perform this analysis will be critical.

Project Background

Name	The Scripps Research Institute Biomedical Research Building
Location	Jupiter, Florida
Size	132,675 SF
Total Construction Cost	$47.53 Million
Project Duration	October 2006 through January 2009
Owner	Scripps

Structural System

The structural system is a two way cast in place 10" flat slab with 14" drop panels, 24"x24" perimeter beams, and 24" square concrete columns which run to 12' square spread footings which are 2' deep. Typical bays are 22' by 32'. The floor to floor height on the first floor is 18' and 15' at the other levels. The lateral system is comprised of concrete moment frames formed by the concrete columns and the flat slab. The mechanical penthouse consists of steel joists on 12" masonry. The horizontal formwork for the slabs and beams was all plywood and timber formwork construction onsite. The vertical formwork for the columns was all steel forms which were prefabricated and bolted together onsite. At the front entryway there are tapered columns. Creating the formwork for these columns posed difficulties which were handled by United Forming Inc. The concrete placement method for this project varied based on whether the elements were vertical or horizontal. For horizontal elements such as slabs and beams, placement was done using a pump truck. For the vertical elements such as columns, the placement was done using a crane and bucket. Due to the nature of the climate in this area, a threshold inspector took a reading of the temperature of each concrete truck that came on site to verify that the temperature met the placement requirements. If the temperature was above 100 degrees, the truck was turned away so that there would be no strength issues due to improper curing. Super plasticizers were used to ease concrete placement as well.

Backup Generator

Backup power is supplied by a 2.25 Megawatt, 6,200HP diesel backup generator housed in a weather protected enclosure. Loads on emergency power include egress lighting and exit signs per NFPA 101, 100% of all lighting in the vivarium, 25% of all lighting in the laboratory areas, 100% of lighting within the fume hoods, the fire alarm control panel, elevator cab lighting and receptacles, along with the fire pump and jockey pump. No loads are classified as legally required standby per NEC article 701. Loads on optional standby power include laboratory receptacles defined by lab programming, 100% of all vivarium receptacles and support equipment, information technology equipment, elevators, access control doors, air handling units and fume exhaust fans to maintain pressurization and safe ventilation in the laboratory and vivarium areas only. Under these circumstances, the fans will be set back to provide ventilation at minimum flow rates. Chilled water primary equipment to serve the vivarium spaces and specific spaces for standby cooling, along with heating hot water to serve vivarium spaces and specific spaces for standby heating, and the pumps and associated equipment to support the chilled water and heating systems are also on optional standby power along with the HVAC controls.

ANALYSIS ONE – Island MEP Pre-Fabrication

The first analysis to be performed concerns the installation of Laboratory Islands. There are a significant number of these islands throughout The Scripps Research Institute on the Florida Atlantic Campus in Jupiter, Florida. A recurring issue throughout the project in each building was associated with MEP rough-in at the island casework in the laboratory areas. These issues caused delays which affected the finishing trades, in particular the casework installer. The installation of the Island Tube Supports followed the framing of the walls and installation of flooring under the areas to have casework. Once the tube supports were installed the Casework could be installed on one side of the supports and left open on the other for the MEP trades to rough-in the Laboratory services required at each island. Whenever hold ups occurred with the rough-in of these islands the casework contractor was delayed in installing the other side of the island casework, leading to delays in setting the epoxy tops, sinks and metal shelving for each island.

Goal

The goal of this analysis is to remove this issue from the construction sequencing through utilizing pre-fabrication of the MEP rough-in with the Island supports, lifting them into the building, bolting them down and installing the casework with the intent of reducing cost and installation time as well as reducing the impact on the finishing trades. It will be necessary to consult with the mechanical designer/contractor as well as the casework installer to verify that this type of method would be applicable on this project, and also to obtain scheduling and cost information for this.

Design Analysis

- Calculate the maximum weight of the pre-fabricated system
- Determine where to maintain access for loading the system into the building

Cost Analysis

- Determine the cost of all materials
- Determine the cost of equipment rentals to hoist the system into the building
- Determine man-hours for pre-fabricating and installing
- Compare overall cost to that of the installed system

Schedule Analysis

- Determine the installation time for the pre-fabricated system
- Coordinate the delivery with the installation production of the system
- Gauge the overall schedule savings obtained from utilizing this system

Resources

- AE Faculty Members
- ISEC Incorporated and the Mechanical Design/Contractors on the project
- R.S. Means Cost Data & MC^2 Cost Data

ANALYSIS TWO – Emergency Generators / Co-Generation Plant

The second analysis to be performed is a redesign of The Scripps Research Institute's emergency generator system. The number of systems that rely on backup power means that the size of the generators on this project are quite substantial, therefore the cost for the emergency generators is significant. There were issues on this project with late delivery of the emergency generators which led to a highly detailed preplanning of the Emergency Generator installation sequencing along with the associated Transfer Switches. Even with the high level of planning overtime was still necessary to accommodate the late delivery of the Emergency Generators.

Goal

By designing a natural gas turbine system Co-Generation plant in place of the current backup generator system, and assuming that because of the technical nature of this system design that adequate time for delivery is an up-front concern of the project team, the cost for the emergency generator system will be eliminated and replaced by a system that will pay for itself in a short period of time. The impact on scheduling and cost will be key to this analysis.

Design Analysis

- Determine the system size required and system manufacturers
- Location of the combined system for efficient distribution

Cost Analysis

- Determine total cost of the new system and compare with the existing system
- Determine payback based on utility rates in the area

Schedule Analysis

- Determine installation sequencing
- Determine installation time

Resources

- AE Faculty Members
- ISEC Incorporated and the Mechanical Design/Contractors on the project
- R.S. Means Cost Data & MC^2 Cost Data

ANALYSIS THREE – Structural Formwork

The formwork on the structure of this project had a significant impact on both the cost and schedule. In this analysis other more efficient formwork systems for the existing structural design will be compared with a redesign of the structure to either a waffle slab or steel frame.

Goal

Determining a more effective structural plan will be done by examining the impacts of more efficient formwork methods for the structural system chosen on this project to those of alternate structural systems with respect to the cost and schedule of the project with the intent of reducing cost and schedule time for the structural system of this project.

Design Analysis

- Select alternate forming method
- Select alternate structural system and size the system components

Cost Analysis

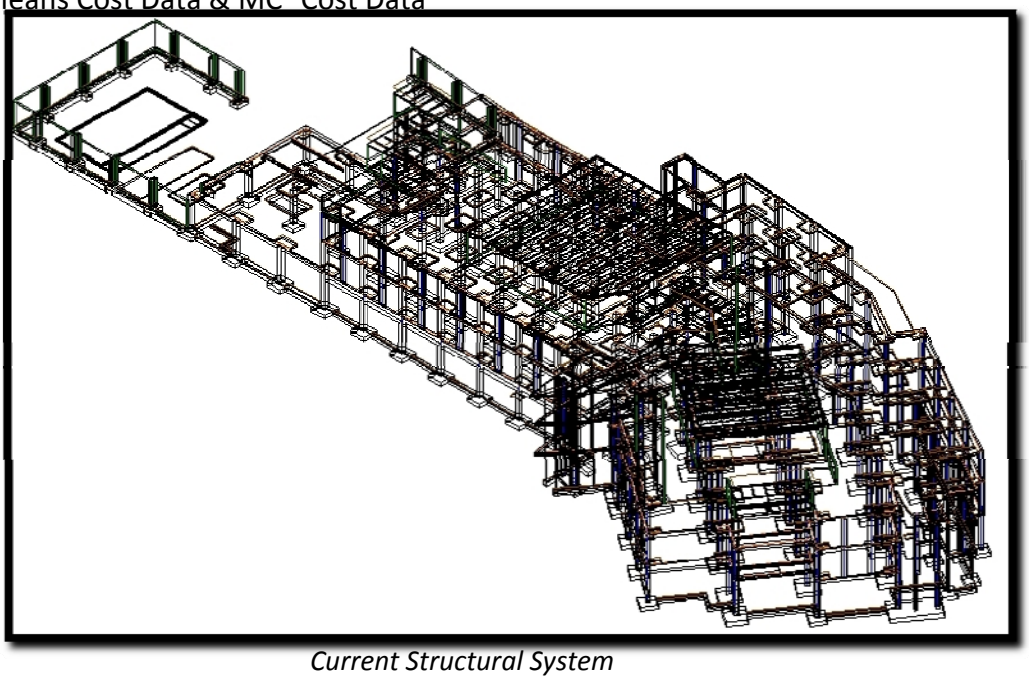
- Compare cost difference of alternate forming system
- Estimate and compare the cost of the alternate structural system

Schedule Analysis

- Calculate durations of alternate forming method and compare
- Calculate durations for alternate structural system and compare

Resources

- AE Faculty Members
- Structural Engineer on the project
- Formwork manufactures in the industry
- Professionals who have installed the system
- R.S. Means Cost Data & MC^2 Cost Data



Current Structural System

Industry Research into BIM implementation and Pre-fabrication

In this analysis the intent is to analyze the effects that BIM has on companies as it becomes more prevalent throughout the industry, and how companies are handling this transition.

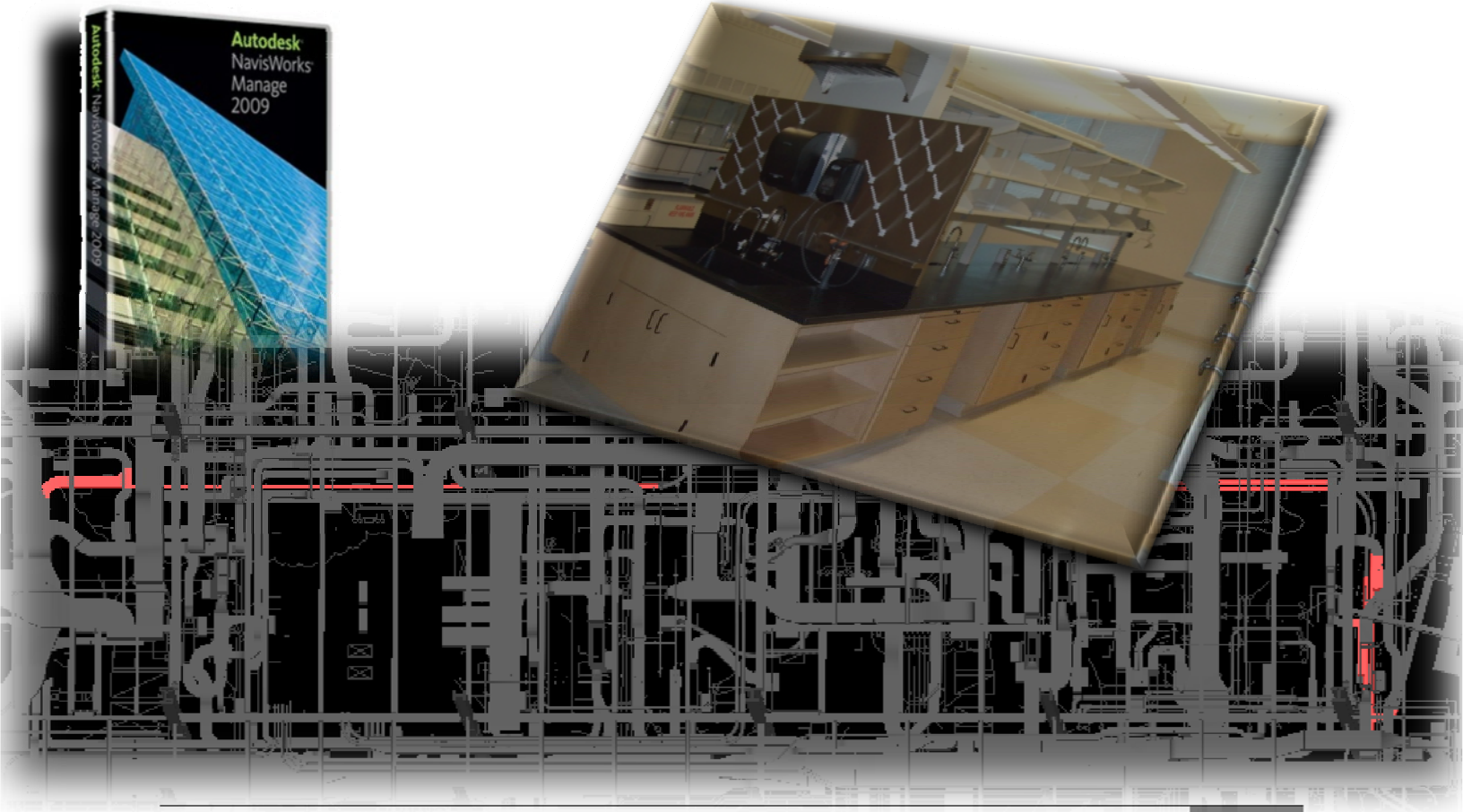
GOAL

Through this analysis I believe that it will become evident that BIM lends itself to system pre-fabrication as an advantage to the construction process of many systems, but specifically MEP systems. By surveying and selecting a company who is in the process of implementing these processes on a company wide basis these effects will be observed, and the issues facing the transition will be addressed, and advantages created by these processes identified. This will lead to identifying systems on The Scripps Research Institute Biomedical Research Building which would have benefitted from implementing BIM and pre-fabrication methods. Also issues that face BIM coordination due to the various software packages either required by owners, or utilized by the different contractors on the job, and also the time it takes to train members of the company on new software packages for these technologies to be useful.

Process

- Survey companies and industry professionals who are involved with this type of transition phase who practice pre-fabrication.
- Research how it is having an impact both negative and positive to the company.
- Identify the advantages pre-fabrication has on their projects.
- Survey industry member's views on pre-fabrication and BIM.

. . . . Major opportunity exists for the integration of engineering systems using a shared product model to improve the coordination of construction in all phases and on all levels . . . .



Summary

Through this research, specific construction issues identified on The Scripps Research Institute Biomedical Research Building project will be addressed. The analyses established in this proposal aim to challenge and test the skills that have been developed through the Architectural Engineering program. In Pursuing a Mechanical/Electrical design breadth, as well as a structural breadth, I will be faced with design issues from the Mechanical, Electrical, and Structural disciplines. By analyzing the issues set forth in this proposal I believe that I will gain substantial and benefits to take with me to my career in the Construction Management field. Through my research, I intend to study the effects that BIM and Pre-Fabrication have in the industry, and how each could have been used to benefit The Scripps Research Institute Biomedical Research Building project cost and schedule. These analyses create a great opportunity to interact with industry professionals over a broad range of topics with the intent of bringing creative solutions to problems that occur on projects that I will be involved in throughout my career.

Below is a weight matrix which shows how my efforts will be spread over the different analyses which are outlined in this proposal.

Weight Matrix

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	TOTAL
Analysis I *Island Pre-Fab*			10	15	25
Analysis II *Co-Generation*	15	10	10		35
Analysis III *Structural*	5	10		15	30
Analysis IV *BIM/Pre-Fab*	10				10
TOTAL	30	20	20	30	100%

Appendix A: Breadth Studies

***Breadth 1**: Co-Generation Mechanical Design/Electrical Distribution*

Re-designing this mechanical system by eliminating the Emergency Generators from the current design will require extensive mechanical system sizing and research to determine the most efficient natural gas turbine system for this three building project. Also locating this system in the most efficient place on the site for distribution purposes will require sizing of the electrical distribution system for this system as well. The cost and schedule impacts of this system will be calculated and compared with that of the current backup generator design. The payback for this system will also be calculated.

***Breadth 2**: Structural System Re-Design*

Re-designing this buildings structural system to a waffle-slab, or steel frame will require extensive structural analysis to size the various members of this system. The purpose of performing this re-design is to achieve schedule and cost savings based on the type of forming system required by the current structural design. By calculating and comparing the cost and duration of the various systems clear advantages and disadvantages to both will be clear.