Ballenger East Building

Alexandria, Virginia

Thesis Proposal

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Executive Summary

This proposal outlines the scope of research for the re-design of the Ballenger East Building in Virginia. Two depth and two breadth topics of analysis/study are proposed for spring 2009. Both the depth and breadth analyses are intended to look at the building systems in an integrated fashion. The main idea behind these analyses is not only to discover ways to improve one particular system, but to improve the all targeted systems collectively.

The **Lighting Depth** study focuses on the lighting systems in four spaces, which in this case are the building façade, main lobby, president's office and the training room. The details of these spaces were described and documented in Technical I Report, and the schematic designs were created for Technical III Report. The depth study will further develop and refine the schematic designs with the comments from faculty consultant and further revision of the spaces. Hardware and equipment would be selected accordingly to meet the design objectives and design criteria.

The **Electrical Depth** study addresses two main topics. Analysis of photovoltaic systems will be performed to examine their impact brought to existing electrical systems, in terms of functionality and energy costs. Another study will focus on the economic analysis and simplification of the existing electrical systems by using two transformers (one for normal operation, the other one for emergency situation) instead of multiple transformers. Besides, a study of redesign of feeders and circuit breakers due to the change of transformers will also be included. On top of the above analyses, a protective device coordination study will be conducted as well.

The two breadth topics will be explored are mechanical systems and sustainability.
The **Mechanical Breadth** topic will study the impact on the mechanical system and mechanical loads brought by the solar hear gain, together with the integration of daylight control systems in the president's office.
The **Sustainable Breadth** topic will study the feasibility of achieving LEED certification. Different use of materials in the building which are more environmentally-friendly and LEED certifiable might also be included accordingly.

Background

The Ballenger East Building is currently under-construction in Carlyle district, Alexandria Virginia. This new building seeks to consolidate both commercial and retail purposes. The building has four stories above grade and approximately 60,000 ft^2 of area. The building will house retail spaces at 1st and 2nd levels while the upper two levels are offices.

Power is distributed to the building through the utility transformer at the service entrance outside the building. Then two main feeders deliver power to the entire building, with the use of step-down transformers, converting 480/277V 3P 4W systems to 208/120V 3P 4W systems. There is an emergency system which includes a 275KW diesel generator. Major loads in the building include lighting loads, HVAC equipment and security systems.

The four spaces to be redesigned for the lighting department are:

- Building Façade
- Main Lobby (1st level, 850 ft^2)
- President's Office (4th level, 900 ft^2)
- Training Room (3rd level, 1200 ft^2)

Depth Proposal: Electrical

Problems

a. The existing power distribution design meets the basic needs of the occupancy use in the building. Yet, the proposed lighting design will potentially change the loads, which also results a change in protective devices, panelboards and other electrical equipment. Thus, all the affected departments should be resized accordingly.
b. This building is mixed use where long operation hours of electrical and mechanical systems are required, therefore the availability of alternate energy source is essential to reduce the energy costs.
c. Multiple transformers are used for the existing electrical systems. They are suspected to be less energy and cost efficient due to the voltage drop crossing from different levels.

Solutions

a. A protective device coordination study will be performed for single-path in the redesigned system, where the path will be from a new lighting load branch circuit through the service entrance, main switchboard, feeders, and distribution panels to the panel. A short circuit current calculation will also be conducted.

b. A study will be performed to analyze the impact of photovoltaic system brought to the existing electrical system. An electrical saving cost will be estimated with the payback period involved if the system is proved to be implementing feasible. Also, a potential LEED certification will be estimated with coordination of the re-designed lighting and electrical systems.
c. Research will be conducted on using two transformers for the entire building. One transformer will be located in the main electrical room and act as the primary transformer which works under normal operation while the other one will be located in penthouse/roof level and stand-by for emergency situations.

Solution Methods

a. The solution method involves following the National Electrical Code (NEC) and ASHRAE 90.1 accordingly. Different types of excel spreadsheet will be helpful when conducting loads calculation of panelboards.
b. Solar data for the geographic location of the building can be used with lighting software, AGI32 to create computer models, or even use readily available online software such as Retscreen, which provides weather data and programs to assist on energy analysis.
c. Manufacturer data, feeder and distribution panel information will be much needed to complete the analysis effectively.

Breadth Proposal: Mechanical

Within an area of roughly about 900 ft^2 in the president's office, there are 4 huge windows (each is about 40ft^2 in area) facing the north-east direction. It is anticipated that daylight would be the main source of illumination during the day. Even though electric lighting consumption would be reduced, solar heat gain is increased. Thus the mechanical load will be affected as a result. Thus investigation about impact of solar heat gain on mechanical load in the president's office is proposed.

Breadth Proposal: Sustainability

The Ballenger East Building is not designed with the goal of obtaining LEED certification. Therefore analyses will be performed to determine the feasibility of LEED certification and further increase sustainability by using different materials within the building. Analyses will be performed according to the changes made to the lighting and electrical systems.

Spring Semester Planned Schedule

AE 482 Schedule				
Month	**Week**	**Date**	**Description of Activities**	**Category**
Winter Break			Re-submit technical assignments	
January	**1**	Jan. 11th – 17th	Update CPEP	
	2	Jan. 18th – 24th	Begin CAD modeling of spaces	
	3	Jan. 25th – 31st	Complete 1st lighting space	Lighting
February	**4**	Feb. 1st – 7th	Begin Breadth topics	Mechanical & Sustainability
	5	Feb. 8th – 14th	Complete 1st progress submission	Electrical
	6	Feb. 15th – 21st		
	7	Feb. 22nd – 28th	Complete Breadth topics	Mechanical & Sustainability
March	**8**	March 1st – 7th	Complete 2nd lighting space	Lighting
	9	March 8th – 14th	Spring Break	
	10	March 15th – 21st	Complete 2nd progress submission Complete 3rd and 4th lighting space Progress Report	Electrical Lighting
	11	March 22nd – 28th	Complete branch circuit redesign Complete short circuit coordination study One-page presentation outline due	Electrical Electrical
	12	March 29th – April 4th	Complete PV arrays analysis (electrical depth) Complete Transformers analysis (electrical depth) Update presentation outline	Electrical Electrical
April	**13**	April 5th – 7th	Complete Tech 4 Report	Electrical
	13	April 8th	Final Summary Report Due	
	13	April 9th – 12th		
	14	April 13th – 17th	Faculty Jury	