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Lighting/Electrical
Thesis Proposal
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Dr. Mistrick

Dorrance H. Hamilton Building
Philadelphia, PA

EXECUTIVE SUMMARY

The depth and breadth proposals provide the foundation for the analysis of the Dorrance H. Hamilton Building in the spring semester. Four topics will be investigated throughout the next couple of months, which are the lighting design of four spaces, the electrical redesign, the redesign of a portion of the mechanical system, and the cost analysis of the electrical system redesign.

The four spaces in the lighting design consist of the 60,000 ft^2 exterior plaza, the lobby, the auditorium, and the sixty capacity classroom located on the fifth floor.

The electrical redesign will comprise of a few different areas of analysis. The branch circuit distribution for the four spaces in the lighting design will be redesigned with the new lighting equipment installed. An analysis will be done to determine whether or not any changes to the general layout or equipment would be advantageous to the owner, such as a central transformer versus distributed transformers and feeders running to each floor versus a bus duct. One major mechanical equipment motor control center and its associated feeder will be redesigned. The electrical design will also include the process of conducting a protective device coordination study that addresses a single-path through distribution system, which will show the coordination of protective devices for your redesigned system components along the path.

The first breadth component will consist of a mechanical redesign of the electrical rooms with regards to the distributed transformers. The second breadth component will be a cost analysis of the existing electrical system versus the redesigned electrical system.

BACKGROUND

The Dorrance H. Hamilton building is a 129,000 ft^2 medical education building, which is a portion of the Thomas Jefferson University (TJU) campus in Philadelphia, PA. The building is comprised of six stories above grade, plus a mechanical floor, and the roof. The 2 floors of the 215 space parking garage will be located underground.

The project will transform the TJU campus. The complex will include an expansive grassy plaza which will become the new focal point of campus. The building will house a technologically-advanced auditorium, small and large group classrooms and a two-floor clinical skills center featuring virtual diagnostic and surgical suites. The entrance faces the grassy plaza which provides an interaction area among students and professors. Other areas of interaction include common meeting areas on each floor and a rooftop terrace and lounge for special events. The curved façade features large expanses of glass that will open onto the plaza to highlight the "new heart of campus," the Thomas Jefferson University President Robert L. Barchi, M.D., PhD said. The transparency of the façade carries through the entire ground floor, which allows people on the street to look into the lobby, through the building and out to the plaza.

DEPTH WORK - LIGHTING DESIGN

Problem

The work involves a redesign of the lighting system in at least four spaces, which include the 60,000 ft^2 plaza, lobby, auditorium, and the fifth floor sixty capacity classroom. The lobby will have a thorough comparison and critical analysis of at least two different, yet acceptable, approaches to the redesign, considering important issues such as daylighting, cost, performance, energy savings, and constructability. Some of the important design criteria for the building consist of the appearance of the space and luminaires, daylighting integration and control, luminances of room surfaces, reflected glare, system control and flexibility, VDT use, power density and horizontal illuminance.

Solution Method

The redesign will meet all of the design criteria, while incorporating an intriguing design into the medical education building. In order to accomplish this task, AGI32 software will be utilized in order to analyze luminaire layout, uniformity ratios, and horizontal illuminance numbers.

Tasks & Tools

Schematic Design

- Refine schematic design
- Develop alternatives to design
- Develop finalized solution

Design Development
- Refine system layout

Equipment Selection
- Find suitable fixtures for design
- Find .ies files for use with AGI32
- Compare fixtures for efficiency, flexibility, and power consumption

Computer Modeling
- AutoCAD model of four spaces
- Import AutoCAD model into AGI32
- Set all mesh levels and import .ies files
- Place fixtures and analyze renderings

Daylighting Analysis
- Analyze daylighting in the lobby
- Different window glazing types will be analyzed for the most energy efficient daylighting system (mechanical breadth)

DEPTH WORK – ELECTRICAL DESIGN

Problem

The current power distribution system provides the building with power; however, an alternative design solution will be analyzed. This analysis will be done in order to compare the two different systems by cost analysis, efficiency, and power consumption.

Solution

The system redesign is comprised of a variety of different tasks, which include the redesign of branch circuits for the four re-lighted spaces, analysis of a central transformer versus distributed transformers, analysis of feeders versus a bus duct spanning to the penthouse, the analysis of a motor control center, and a protective device coordination study. The redesign of the power distribution system will be compared to the existing system regarding cost analysis, efficiency, and power consumption. The cost analysis will be a part of the construction management breadth work.

Solution Method

The power distribution system will be redesigned following the 2005 NEC handbook. The branch circuits will be recalculated along with feeders and panelboard schedules for all four areas of the redesign of the lighting systems. A central transformer will be utilized instead of distributed transformers on each floor. The elimination of a variety of feeders in place of a bus duct spanning to the penthouse should be an advantageous change to the power distribution system. The installment of a mechanical equipment motor control center will be analyzed by calculating the design loads for branch conductors, feeders, and protective devices. Also, a short circuit current calculation will be investigated for a single-path through the distribution system.

Tasks & Tools

Branch Circuit Redesign
- Prepare new panelboard schedules indicating new loads of redesign lighting systems
- Resize/layout the new panelboards
- Resize the feeders for the new panelboards
- Layout branch circuits and controls for each redesigned space

Central Transformer vs. Distributed Transformers
- Redesign with central transformer
- Create riser diagram and single line diagram for change
- Find advantages/disadvantages to redesign

Feeders vs. Bus Duct
- Redesign with bus duct
- Create riser diagram and single line diagram for change
- Find advantages/disadvantages to redesign

Motor Control Center
- Analyze and design one major mechanical equipment motor control center and associated feeder
- Provide a schedule and equipment elevations
- Calculation of design loads for branch conductors, feeders, and protective devices
- Find advantages/disadvantages to design

Short Circuit Calculations
- Conduct a protective device coordination study that addresses a single-path through distribution system
- Show the coordination of protective devices for your redesigned system components along this path
- Short circuit calculations

BREADTH WORK – MECHANICAL REDESIGN

The mechanical system of the electrical rooms will be analyzed with regard to the distributed transformers. A comparison will be done between the distributed transformer and central transformer with respect to the air flow.

BREADTH WORK – CONSTRUCTION MANAGEMENT COST ANALYSIS

The second breadth area of study will be a cost analysis of the existing electrical system versus the redesigned portions of the electrical system. The cost analysis will include the following: central transformer versus distributed transformers and feeders running to each floor versus a main bus duct to penthouse.

Week	Planned Task(s)
Week of January 7th	Refine schematic design, develop design alternatives, and develop finalized solution(s).
Week of January 14th	AutoCAD model of four spaces, import AutoCAD model into AGI32, set all mesh levels.
Week of January 21st	AutoCAD model of four spaces, import AutoCAD model into AGI32, set all mesh levels.
Week of January 28th	Find suitable fixtures for design with .ies files, compare fixtures, refine system layout by placing fixtures into AGI32.
Week of February 4th	Branch circuit redesigns for four spaces (prepare new panelboard schedules, resize/layout new panelboards, resize feeders, layout branch circuits and controls), analyze AGI32 renderings of spaces. Try to get AutoCAD drawings of single line diagram from electrical engineer at Burt Hill.
Week of February 11th	Finish preliminary submittal of 2 lighting spaces with associated electrical requirements by 2-16.
Week of February 18th	Finish all lighting redesign spaces, branch circuit redesigns for the four spaces, and initial daylighting analysis. Revise design as needed. Prepare Final Report and PowerPoint. Finished preliminary submittal of 2 lighting spaces.
Week of February 25th	Redesign with a central transformer, create riser diagram and single line diagram for change, and find advantages/disadvantages to redesign.
Week of March 4th	Redesign with bus duct, create riser diagram and single line diagram for change, and find advantages/disadvantages to redesign. Start analysis and design of one major mechanical equipment motor control center. Finish & turn in Thesis Presentation Outline.
Week of March 11th	Spring Break!!! Revise design as needed.
Week of March 18th	Finish motor control center design, which includes a schedule and equipment elevations, the calculation of design loads for branch conductors, feeders, and protective devices, and the advantages/disadvantages to design. Prepare Final Report and PowerPoint.
Week of March 25th	Mechanical breadth work with daylighting analysis studies. Application/extension of concepts to other spaces in building for lighting redesign of four spaces. Construction management cost analysis of electrical system redesign.
Week of April 1st	Conduct a protective device coordination study that addresses a single-path through distribution system. Finish the final report and anything that is not yet completed and start PowerPoint presentation. Binding/Printing of final report.
Week of April 8th	Finish and practice the PowerPoint presentation. Final CPEP updates and maintenance including ABET Evaluation and Reflections.
Week of April 15th	Senior Thesis Presentations