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Depth and Breadth Design Proposal

Executive Summary

The Depth and Breadth Design Proposal describes the redesign of the Holy Cross Hospital – North Addition. Both the electrical and lighting redesign and two breadth topics are discussed and a tentative progress schedule is laid out. The depth of my thesis will be the electrical and lighting disciplines. I will be investigating the emergency electrical system of the hospital by redesigning the distribution method of the emergency system and comparing the redesigns to the existing distribution system. From this investigation, I will determine the positive/negative impacts that the alternative distribution systems present to the redesign and whether or not these alternatives are a feasible substitute. In addition, I will be redesigning two lighting spaces in accordance with the recommendations and guidelines in the IESNA Lighting Handbook, the ASHRAE 90.1 power density criteria, and the design concepts suggested in my Lighting Design Proposal. The two spaces to be redesigned are the main entrance lobby and the registration area. For my two breadth studies, I will be investigating the possible impact on the mechanical loads related to the two electrical distribution redesigns explained above and a detailed cost estimate/comparison of one of the electrical redesign alternatives to the existing distribution system.

Background

The Holy Cross Hospital – North Addition project is a 4-story, 80,000 square feet addition with 44,000 square feet of renovation work. Holy Cross Hospital is located north of Washington, D.C. adjacent to the Capitol Beltway. The addition consists of a main concourse, new main lobby, a gift shop, and a conference center wing on the 1st floor; a new obstetrician exam wing on the 2nd floor; a new gynecological exam wing on the 3rd floor; and unoccupied space on the 4th floor for future expansion. The new addition not only houses patient exam rooms, but is the main entrance to the hospital and is a major source of circulation on the 1st floor while connecting the North Addition with the new Emergency Department addition via the concourse.

Depth Proposal

Electrical

Problem:

When designing a new addition for a healthcare facility, the power distribution's effectiveness is extremely critical to the quality of care the facility can provide. Imperative to the electrical system's stability is the emergency branches of the system. Due to the emergency system's complexity, several methods of distribution can possibly be employed. It is important to make sure the most effective and cost savvy system is utilized in each unique situation.

Solution:

For the new expansion, I will investigate two separate alternatives to the current emergency power distribution system installed. First, I will determine whether a change in the distribution method itself will have any positive/negative effects. In brief, I will decrease the number of transformers needed by having a master 480/277V emergency panel feeding all 480/277V panels and a master 208/120V panel feeding all 208/120V emergency panels. This would differ from the current system which feeds each zone with 480/277V power from a main emergency panel in the mechanical penthouse. From there, each zone has a transformer that steps down from 480/277V to a 208/120V panel. Secondly, I will determine whether an emergency system "overhaul" will create any positive/negative effects. In brief, I will assume the entire new addition will be backed up by its own set of emergency generators essentially isolated from the existing hospital. The entire electrical system will be redesigned for this configuration and will be analyzed accordingly.

Solution Method:

First and foremost, I will consult the National Electric Code 2002 (NEC) to ensure proper code compliance concerning any changes I make to the current system. Emergency power systems for healthcare facilities are rather complex and need to be strictly adhered to. For the first study, I will remove the feeder and transformers to the existing 208/120V emergency panels. I will add a master 208/120V panel adjacent to the existing main emergency 480/277V and a transformer to feed the new panel. From there, I will size the feeders to the existing 208/120V emergency panels taking into consideration voltage drops and load calculations. I will then equate the effectiveness of the alternative by preparing a simple cost study analysis of the changes in the current system with my proposed alternative. For the second study, I will remove existing transformers and feeders to both the normal and emergency distribution system and panels. Where needed, I will consolidate panels that were previously separated due to the presence of two separate systems. Then, I will perform any necessary load calculations due to the change in load distribution. After proper load calculations are obtained, I will resize the feeders and necessary transformers making sure voltage drop and losses are accounted for. Finally, I will perform a simple cost study analysis of the changes to the current system with my proposed alternative to determine the effectiveness of the alternative.

Tasks and Tools:

I. Remove existing emergency equipment
  a) Transformers feeding zone 208/120V emergency panels
  b) Panelboards feeding normal loads in the same zone as emergency loads
  c) Feeders to/from transformers being removed, panels being removed, or panels being added to

II. Recalculate any loads changed by the redistribution of emergency power

III. Size new equipment where necessary
  a) Transformers being added to account for shift in load distribution
  b) Panelboards being added to feed panels previously fed from localized 480/277V emergency panels
  c) Feeders to/from transformers, to redistributed emergency panels, to/from newly resized equipment

IV. Perform a cost analysis of proposed change compared to current system
  a) Determine the monetary impact the removal of the current equipment imposed by calculating the cost of the equipment
  b) Determine the monetary impact the proposed equipment will impose by calculating the cost of the equipment
  c) Compare the cost impact of the current system components with the cost impact of the proposed system changes

Lighting

Problem:

As with any lighting design, the design solution to these spaces should be both consistent with the overall architectural concept while maintaining a unique quality to the particular design considerations of the space. In addition to its aesthetics, each space must be functional and efficient through adequate light levels and quality of the fixture and source type while maintaining reasonable power density. All of these criteria must not only be able to be achieved but also maintained. Therefore, the lighting design must also take into consideration sustainability of the system.

Solution:

Two spaces have been chosen for redesign: the main entrance lobby and registration area located in the concourse just off the main lobby. A full report of my lighting design proposal is located on the "Tech Assignment" portion of my thesis website: http://www.arche.psu.edu/thesis/eportfolio/current/portfolios/pem131/

Solution Method:

My proposed lighting solution combines recommended design guidelines contained in the IESNA Lighting Handbook Ninth Edition and control and power density standards from ASHRAE 90.1 while considering aesthetic design objectives for each space. After appropriate fixtures, lamps, and ballasts are chosen, the lighting design for each space will be analyzed with computer software. The electrical lighting designs will be analyzed using AGI32.

Tasks and Tools:

I. Create lighting design
   d) Consult design guidelines in IESNA Lighting Handbook
   e) Generate desired aesthetic

II. Select fixtures
   a) Consult photometric characteristics as well as performance in AGI32 while making initial selections
   b) Lamp type, quantity and wattage will be selected in accordance with ASHRAE 90.1
   c) Select ballast to provide necessary control and desired output

III. Luminaire location and spacing
   d) Determine number of fixtures and location in AGI32 to obtain proper light levels and distribution within space
   e) Cross-check solution with spacing criterion provided by manufacturer to avoid uneven distribution on workplane

IV. Software modeling
   d) Create 3-dimensional models of each space in AutoCAD
   e) Import AutoCAD models into AGI32
   f) Perform desired calculations in AGI32 to determine proper light levels and appearance of space

Breadth Proposal

The following two breadth proposals will be related to the emergency electrical system redesign explained above in the depth portion of this document.

Mechanical:

With the anticipated changes in transformer size and location with respects to the first electrical system alternative, I will be investigating the impact this will have on the mechanical loads associated with the heat losses of a transformer. Since most of the electrical rooms will be losing at least one transformer, their cooling requirements will decrease. Similarly, the mechanical penthouse will gain a significant mechanical load with the addition of a single transformer replacing the numerous smaller transformers that were dispersed throughout the addition.

Construction Management:

Although I am performing a basic cost analysis between the current system components and the second alternative, I will also be performing a detailed cost analysis of the difference between the current emergency electrical system components to be removed and the proposed alternative 1 changes. This cost analysis will consist of system component costs, installation costs, lead-time considerations, and changes in installation time.

Spring Semester Schedule

Week 1: Create 3D models in AutoCAD

Week 2: Determine what emergency equipment must be removed to install alternatives

Week 3: Redistribute loads in accordance to respective alternative and recalculate loads; perform initial lighting design in AGI32 for main lobby and finalize fixture layout/selection

Week 4: Perform initial lighting design in AGI32 for registration area and finalize fixture layout/selection

Week 5: Run final renderings for both spaces; select ballasts, lamps, and formulate fixture schedules; re-circuit and relocate new circuits on current lighting panels

Week 6: Begin normal/emergency power system union for second alternative

Week 7: Redistribute loads and determine number and size of panels needed for new system

Week 8: Size feeders and voltage drop calculations for both alternatives to any new or modified electrical equipment

Week 9: Begin pricing equipment/determining economic impact of proposed alternatives

Week 10: Begin breadth topics determining impact of new equipment mechanically and detailed comparison of current emergency system with proposed alternative 1 changes

Week 11: Create final electrical and lighting drawings; Finish outstanding work concerning breadth topics

Week 12: Write Final thesis report

Week 13: Create Final Presentation

Week 14: Present Thesis