



Senior Thesis Program
The Department of Architectural Engineering
The Pennsylvania State University
University Park, PA

Breadth Analysis: Lighting/Electrical
Ideas and suggestions for breadth analysis in lighting/electrical
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Lighting Design

1. Select one or more spaces and design the lighting and control system for these spaces. Ignore the existing systems.
 - a. List the *Design Criteria* for the space. List the space tasks and specific numerical and non-numerical goals of your lighting system. Reference Source for design guidelines: IESNA Handbook (Reference Shelf, Engineering Library). Power limits must conform to ASHRAE/IESNA 90.1, 1999.
 - b. Select hardware: Lamps, ballasts, luminaires and controls
 - c. Provide photometric data (IES file Printout, Manufacturer's data sheet, etc.) for all equipment.
 - d. List Light Loss Factors and all assumptions made in determining them.
 - e. Provide a summary or output of your calculations. If using software, attach a disk or CD that contains the files used for your calculations.
Software programs available include Luxicon, AGI-32, Lightscape and Viz 4. Movies will be available to help you learn AGI-32 and Lightscape (possibly also VIZ-4). Lumen-Method analysis can also be performed.
 - f. Provide drawings and/or renderings of your designs, including how they will be controlled and circuited.
2. Analyze the costs of different lighting system solutions or their impacts on other aspects of the project.
3. Study the integration of daylight into your building with a study of solar angles, overhangs, Solar gain and envelope losses, daylight levels and possible lighting energy savings within one or more spaces. Note, some energy modeling programs permit you to model the impact of photosensor control (although they use somewhat crude daylight modeling algorithms).

Electrical Design

1. Calculate the design loads for your building electrical distribution system. Compare these loads to the installed system and investigate potential modifications to the system.
2. If you are redesigning the Building Mechanical or Structural System and your redesign has an impact on the Electrical or Lighting System, redesign the portion of the Electrical System that is impacted. This would apply to virtually all Mechanical Designs and provides an excellent opportunity to address system integration, as well as to fully analyze all of the costs associated with a change in systems (by addressing any changes in the electrical system cost).
3. Integrate the Building Electrical and Mechanical Systems through data provided by occupancy sensors to permit additional energy savings in your building.
4. Layout the fire alarm system according to the relevant codes.
5. Address the control of Building Mechanical System equipment in detail by selecting the necessary equipment to properly control and protect this equipment.
6. Analyze the costs of different electrical system solutions or their impacts on other aspects of the project.