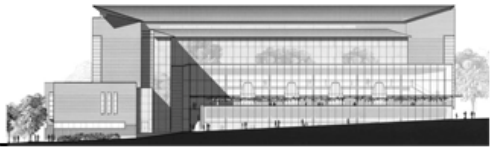
Thesis Proposal

William H. Gates Hall
Seattle, WA

Katherine Jenkins
Lighting/Electrical Option
December 14, 2006

Faculty Advisors:
Dr. Mistrick
Ted Dannerth



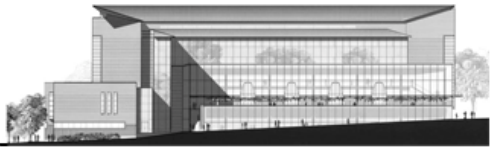
Executive Summary: Thesis Proposal

The thesis proposal outlines and defines the work that will be completed for the various redesigns of systems in William H. Gates Hall during the Spring 2007 semester. Both the depth and breadth will look at the building systems from an integrated standpoint, to best determine systems that will be effective in not just one building system, but beneficial to all systems. The depth analysis work will be completed in the areas of lighting and electrical design.

The depth work for the lighting design portion of the thesis project will look at redesigning the lighting systems for four different spaces within the building. These spaces will include the Marion Gould Gallagher Law Library (reading area), the Senator Warren G. Magnuson & Senator Henry M. Jackson Trial Courtroom, the Jeffery & Susan Brotman Galleria, and the terrace. While aiming to produce an aesthetically leasing lighting design that complements the architecture of the building, the design will also strive to meet standards set forth by IESNA and ASHRAE 90.1. In addition to this, a daylighting analysis will be conducted for the law library and galleria.

In addition to a lighting redesign, the depth work will also include an electrical analysis portion. In the electrical work, several topics will be explored. These topics will include a coordination and redesign of the electrical system due to lighting changes; a transformer redesign using distributed transformers; the design of a motor control center for all the building's air handling units, and a protective device coordination study.

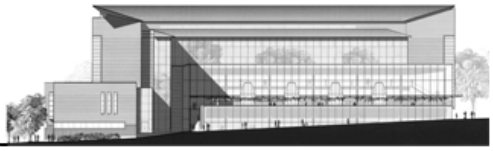
The Breadth topics will look at the feasibility of implementing a rain water catchment system in order to offset the cooling tower makeup water requirements for William H. Gates Hall. The LEED Breadth topic will look at what requirements are needed for such a system, the amount of collectible rain fall, and the makeup water requirements of the cooling towers. The Construction Management Breadth topic will serve to determine if a rainwater catchment system is justifiable by analyzing the cost of such a system and the payback compared to the amount of water cost savings that will be incurred.



Building Background

Located in Seattle, Washington, William H. Gates Hall provides a new facility for the University of Washington, School of Law. Spanning six floors, four of which are above grade, the building provides classrooms, mock courtrooms, seminar rooms, conference rooms, administrative offices, a pro-bono law clinic and the “Northwest’s finest law library” to students faculty and visitors. Previously, the law school was located in Condon Hall, a facility located off campus that lacked amenities that would allow the program to grow to its full potential. The new building brings the school back to the main campus, provides students and faculty with 196,000 square feet of state-of-the-art facilities that showcase the tradition and excellence of the law school.

Construction of William H. Gates Hall began in July of 2001 and its doors were opened to the public at a dedication ceremony on September 12, 2003. Strategically located in a prominent area of campus, the building boasts distinguishing architectural features that are clearly visible to all. It is a combination of these features as well as the vast array of resources offered that sets William H. Gates Hall apart from any other building on campus.



Depth Analysis: Lighting Design

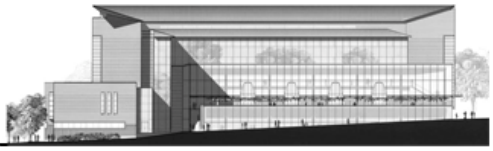
Problem:
The lighting design of a building should strive to achieve a balance between providing a building aesthetic that is complementary of the architecture and function of the building and delivering a product that is energy efficient and adheres to criteria set forth by IESNA and ASHRAE 90.1. By achieving a design that is conscious of both of these aspects and considers the integrated aspects of lighting, an optimal lighting design can be achieved.

Solution:
As the UW Law School moves into its new home, it is important for the lighting design to reflect the tradition and excellence of the program, while highlighting the modern architecture of the building. In addition to this, an underlying awareness for creating an energy efficient design is necessary. Four specific spaces have been chosen for a redesign of the lighting system. These include the Marion Gould Gallagher Law Library (reading area), the Senator Warren G. Magnuson & Senator Henry M. Jackson Trial Courtroom, the Jeffery & Susan Brotman Galleria, and the terrace.

In redesigning the trial courtroom, the ultimate goal is to provide a realistic courtroom setting. Knowing that this space will be used to help prepare students for their legal careers, it is essential to provide a space that is reflective of “real life” settings. Through the incorporation of ambient and task lighting, a visual hierarchy should be created to draw emphasis on the most important areas of the space. It is also imperative to provide adequate light levels throughout the space and a system that is flexible to accommodate for the variety of tasks that are likely to occur.

Located at the center of the building, the two-story law library space acts as the “heart” of the building. In redesigning this space, it is essential that the lighting systems are appropriate for this task intensive space and help to resonate that this is the “Northwest’s finest law library.” An interesting, yet not distracting, lighting design should be used in complementing the space’s architecture. In addition to this, a daylight study of the four large overhead skylights will be performed in order to maximize the incorporation of daylight while avoiding undesirable direct glare.

The galleria space acts as the main artery of the building, moving people from one end of the building to the other. This double height space, while fairly modest from an architectural standpoint, acts as a “viewing window” for the law school, with substantial exposure to the surrounding campus. The lighting design of the space should not only aim to help guide people through the space, but also provide a welcoming and interesting space to viewers from afar. Also, the

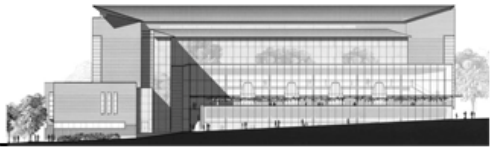


adjacent terrace should also be taken into consideration, in order provide a design that is complementary to this visually adjacent space. In addition to this, consideration should be given to how the large influx of daylight into this space via the double-height glass curtain wall will be integrated into the lighting design. A daylighting analysis of this space will be conducted, which will be taken into consideration when determining electric light needs.

Sitting directly atop of the law library, the terrace provides an outdoor gathering space for students and visitors. Due to the space being sandwiched between both the law library and the adjacent galleria, consideration of how the lighting design of each of these three spaces directly affects one another is imperative. With the presence of several prominent architectural features in the space, including the skylights and perimeter trellis, the lighting design should aim to highlight such aspects while providing adequate light levels for safety.

While each of these four spaces are individually distinguishable from one another, an overall effort will be made to provide lighting systems that reflect the excellence of the law school and takes into consideration the importance of energy efficiency design. For further detailed information regarding lighting concerns and approaches for theses spaces, refer to the Lighting Existing Conditions and Design Criteria Report and the Lighting Schematic Design Proposal.

Task and Tools:
In redesigning the lighting systems for these four spaces, computer modeling will be utilized to ensure that design requirements and parameters, as well as desired aesthetics, are met. Design criteria for the four spaces will be developed according to the design requirements and criteria outlined in the IESNA handbook. Keeping these criteria in mind, lamps, ballasts and luminaires will be selected and used in AGI 32 lighting software to determine achieved illuminance values and obtain photorealistic renderings of the space. Upon completion of renderings and obtaining calculation values, the lighting design compliance with ASHRAE 90.1 will be verified and appropriate lighting control systems will be determined. In order to clearly communicate the design intentions, lighting plans, schedules, control diagrams and renderings will be produced.

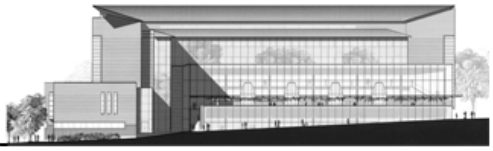


Design Outline

I. Fixture Selection and Design Development
- a. Luminaires will be selected based on desired appearance, efficiency and photometric distribution
- b. Corresponding energy efficient lamp types will be selected
- c. Compatible ballast for each luminaire will be selected
- d. Lighting layout and spacing will be developed based on established design criteria

II. Electric Lighting Analysis
- a. AGI models for each of the four spaces will be created and analyzed
- b. Illuminance values for spaces determined
- c. Rendered images of each space created

III. Daylighting Analysis
- a. Analyze current daylight conditions in library and galleria
- b. Analyze and integrate appropriate daylight controls into spaces to determine energy savings through decreased electric lighting needs



Depth Analysis: Electrical Design

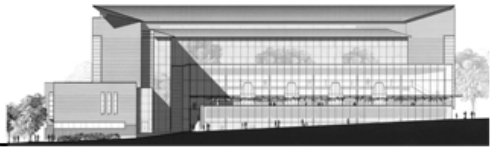
Problem:
While the electrical distribution system of William H. Gates Hall does not have any overwhelming design issues or concerns, an analysis of a modified system should be considered to seek addition energy and cost savings. While this building was not designed specifically under the direction of LEED criteria, the building as a whole should include systems that run as efficiently as possible. By incorporating both energy efficient lighting and the proper electrical distribution system, building systems meeting this criterion can be achieved.

Solution:
There are several areas of analysis within the electrical spectrum that will take place as part of the electrical depth. The first area pertains to the electrical coordination required in conjunction with the lighting redesign. For each of the four spaces to be redesigned in the lighting depth, the branch circuit distribution will be analyzed and redesigned to accommodate for the changes made. This includes redesigning the circuits and corresponding panelboards for the circuits that have been changed. All branch circuits, as well as equipment and controls are to be considered and (re)designed to the appropriate panels.

The second topic that will be explored is the overall design and layout of the transformers in the building. Currently a central transformer configuration is utilized, with the majority of the step-down transformers located in the main electrical room on Level L2. This dictates the use of larger wire sizes up through the building to serve each floor's respective panels. In my analysis a different design approach will be used, distributed transformers. I will redesign the electrical distribution system to allow for localized transformers on each floor to serve the respective panelboards and loads. This will allow for smaller wire sizes to be used throughout the building. Once equipment has been selected and sized, a cost comparison of the existing and new configurations/systems will be conducted.

Additionally, a motor control center will be designed for all of the air handling units in the building. There nine air handling units are all located on the fourth floor of the building separate from the majority of the building mechanical equipment. By providing a motor control center in the fourth floor mechanical room next to the air handling units, more localized control of these motors will be provided.

Lastly, a protective device coordination study with be conducted in which a single path through the distribution system will be analyzed to ensure proper coordination of protective devices. This analysis will also include short circuit current calculations.



For additional information on the current electrical distribution system, refer to Electrical Systems Existing Conditions and Load Summary Report.

Task and Tools:
The 2005 National Electric Code will be used extensively throughout this depth work to determine resizing of electrical equipment due to building load changes.

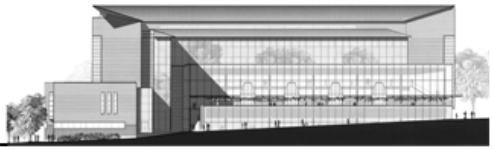
Design Outline

I. Coordination of Lighting Changes
- a. Prepare panelboard schedules that are affected by lighting redesign
- b. Indicated branch circuits that change as a result of the redesign
- c. Prepare new panelboard schedules indicating new loads
- d. Resize/layout affected panelboards
- e. Layout branch circuits and controls for each designed space

II. Central Transformers vs. Distributed Transformers
- a. Evaluate existing transformer configuration and determine loads served by each transformer
- b. Select and redesign transformers, using smaller, distributed transformers
- d. Adjust changes to electrical distribution system caused as a result of changed transformers
- e. Conduct a cost savings analysis of original system and redesigned system

III. Motor Control Center Design
- a. Determine loads/motors to be controlled by motor control center.
- b. Determine motor starter types and size control center.
- c. Determine layout of motor control center
- d. Prepare new one-line diagram

IV. Protective device coordination study
- a. Determine single path through distribution system that has been redesigned
- b. Verify all protection devices have been sized appropriately
- c. Determine if components through this path have been coordinated properly
- d. Perform short circuit calculations for this feeder path
- e. Adjust any feeder/protection device sizes if necessary

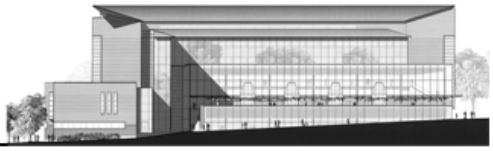


Breadth Analysis: LEED

The LEED Breadth portion will look at the feasibility of implementing a rainwater catchment system to help offset the cooling tower make up water requirements. This study will investigate the amount of water required to offset the cooling tower water makeup and the potential collectable rainfall per year. Additionally, the LEED Breadth will explore other requirements and equipment needed to implement such a system.

Breadth Analysis: Construction Management

While the LEED Breadth portion will look at the feasibility of implementing a rainwater catchment system to offset the cooling tower water makeup requirements in William H. Gates Hall, the cost implications of such a system need to be analyzed to determine if the first cost are justifiable in the lifecycle of the system. The Construction Management Breadth will examine these cost and the payback period of implementing a rainwater catchment system.



Time Table

Week	Task
1/14/07 - 1/20/07	Finalize AGI Models
1/21/07 - 1/27/07	Daylighting Study Electric Lighting - Fixture Selection
1/28/07 - 2/3/07	Lighting - Calculations and Determine Controls(Space 1 & 2) Electrical - Lighting Coordination (Space 1 & 2)
2/4/07 - 2/10/07	Lighting - Calculations and Determine Controls (Space 1 & 2) Electrical - Lighting Coordination (Space 1 & 2)
2/11/07 - 2/17/07	Lighting - Calculations and Determine Controls (Space 3 & 4) Electrical - Lighting Coordination (Space 3 & 4) Mid-Semester Submission – Lighting (Spaces 1 & 2)
2/18/07 - 2/24/07	Lighting - Calculations and Determine Controls (Space 3 & 4) Electrical - Lighting Coordination (Space 3 & 4)
2/25/07 - 3/3/07	Electrical - Transformer Redesign and Analysis Research – Enthalpy Wheels & Rain Water Catchment Systems
3/4/07 - 3/10/07	Electrical – Motor Control Center Design
3/11/07 - 3/17/07	Spring Break
3/18/07 - 3/24/07	LEED Breadth –Rain Water Catchment System
3/25/07 - 3/31/07	Mechanical Breadth – Enthalpy Wheel Finalize Repot
4/1/07 - 4/7/07	Finalize Report Print & Bind Report
4/8/07 - 4/14/07	Finalize Presentation Practice/Prepare for Presentation Final Report Due
4/15/07 - 4/21/07	Thesis Presentations
4/22/07 – 4/28/07	Final CPEP Updates, Evaluations & Reflections