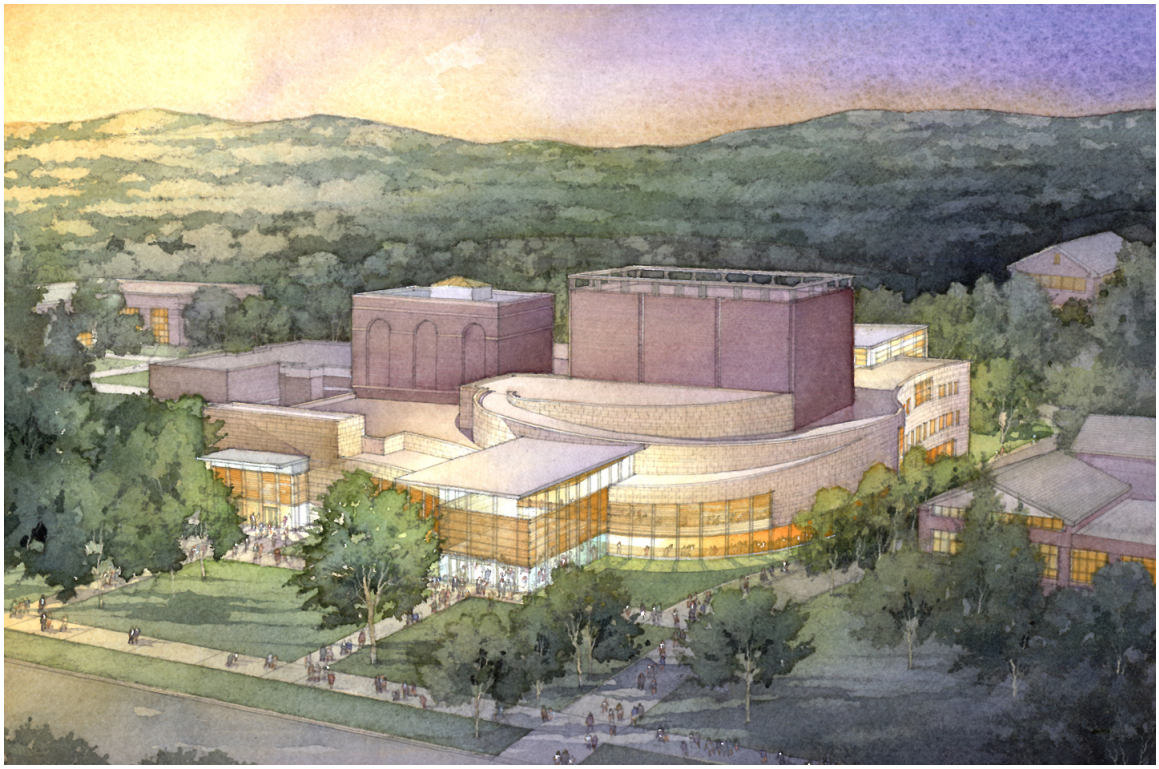
Williams College

'62 Center for Theatre & Dance



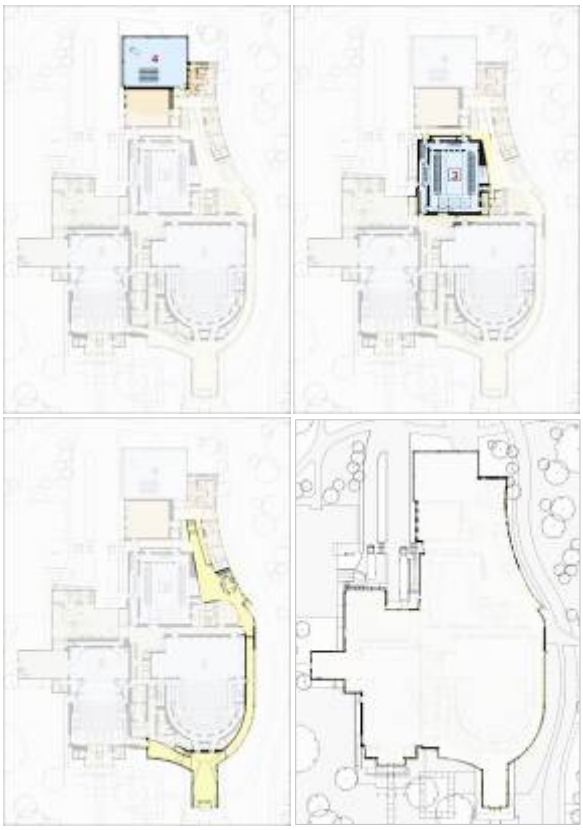
Thesis Proposal

Lighting/Electrical Depth
LEED Breadth
Structural Breadth

Devin Maurizio
Lighting/Electrical Option
R. Mistrick

Proposal Background:

The Williams College ’62 Center for Theater & Dance is a 126,000 sq.ft. building which consists of two professional stage theatres, a state-of-the-art black box theatre, a dance rehearsal studio, a directors studio, and multiple classrooms, offices, and support rooms. Being covered in a skin of limestone veneer, brick, and glass and aluminum curtain walls, the Center for Theater & Dance was recently completed in June ’06 and cost nearly fifty-four million dollars. The building uses approximately 5% of Williams College’s overall energy consumption and has not attempted LEED certification. Much of the theatrical spaces are illuminated with incandescent 130v lamps and are kept dimmed when in use to prolong life. The remainder of the building is typically fluorescent, and was designed in a very utilitarian way to save costs in the building.



Lighting Depth:

Statement of the Problem:

The original intent of the lighting design scheme was a bare minimum style of illumination that mirrored the simplicities of the natural environment that was not only reflected in the architecture, but also in the surrounding landscape. In this way, the building has succeeded in being extremely functional and cost efficient during the construction process. However, the building could emphasize the interaction between itself and its natural surroundings with a more pronounced design concept and implementation throughout the building and more loudly pronounce the programs of its occupancy.

Proposed Solution:

It may be beneficial to the building to design a lighting concept that links the entire building together, emphasizing the architecture and the buildings purpose. Solutions to particular spaces have been outline in the third technical assignment and can be viewed on the website.

Methods of the Solution:

A lighting analysis will need to be performed in order to view both the visual effects of the space and to check for appropriate light levels in order to meet code.

Tasks & Tools:

I. Check concept for visual appropriateness
- Task 1: Analyze system
  a) Using AGI32 or Photoshop, generate lifelike images that realistically portray the visual impact of the space

II. Check concept for code compliance
- Task 1: Analyze system
  a) Using AGI32, calculate light levels with all proposed luminaires to determine if selected luminaires have a high enough light output to satisfy requirements of ASHRAE 90.1.

Electrical Depth:

Statement of the Problem:

The Center for Theater & Dance has a well-organized building management system that attempts to save as much energy as possible. There may, however, be possible additional solutions to increase energy savings throughout the building.

Proposed Solution:

Adjacent to the building is a long underground parking deck with a single above ground level, covered by a roof. On this roof, it may be possible to install a series of photovoltaic arrays and generate power for the Center for Theater & Dance, thus reducing power needs from the central campus distribution system. Also, since there is a nearby wind power plant, it may be beneficial to analyze the cost-benefit of purchasing green power from this plant. Also, one of the major distribution panelboards may be able to be redesigned to cut down on peak load consumption.

Methods of the Solution:

To determine whether the addition of green power sources is beneficial to the overall cost of energy for the building, a cost analysis will need to be performed. First cost factors will way heavily on the outcome of such a study and will need to be included. Since additional lighting loads will be added as per my proposal for a lighting redesign, panelboards, feeders, and protective devices will need to be checked for any significant changes throughout.

Tasks & Tools:

I. Redesign branch circuit distribution for four re-lighted spaces.
- Task 1: Prepare new panelboards & size feeders, branch circuits
  a) Load calculations based on the NEC to generate appropriate equipment sizes

II. Analyze addition of green power sources
- Task 1: Find prices of green power & efficiency of use
  a) Contacts in the region that deal with green power will need to be made to find more information about such sources and the ease of integrating it into a college campus distribution system
  b) Compare these costs to the benefits of including such a system on both the environment and the transformer and feeder sizes necessary in the building.

LEED Breadth:

Statement of the Problem:

The building currently is largely infused with daylight. However, the building has not been wholly commissioned or designed to incorporate daylight harvesting strategies such as photosensor dimming or on-off controls. A significant amount of energy savings could occur throughout the year if such practices were integrated into the buildings automation system. Theatres tend to generate intense amounts of heat due to the incandescent lighting loads that are packed into very small spaces.

Proposed Solution:

To solve the issues of energy consumption, closed loop photosensors could be added to the main circulations spaces throughout the building and zoned in practical groups for daylight penetration. To accommodate the added heat load in the theatre without having to dramatically increase the mechanical ventilation size, the building may be able to incorporate a green roof over the theatre and circulation spaces, decreasing energy consumption and becoming more environmentally friendly.

Methods of the Solution:

In order to determine the quality of these solutions, an energy analysis will need to be performed and integrated into an overall system cost analysis, looking at the payback period of such an endeavor. A thermal building envelope study will need to be performed in order to determine the effects of a green roof on the buildings overall mechanical performance level.

Tasks & Tools:

I. Energy analysis for photosensor dimming

Task 1: Determine total energy use
- a) Sum lighting loads in the spaces that have the potential for photosensor dimming and calculate the total yearly consumption of energy.

Task 2: Determine possible savings
- a) Calculate total number of hours that lights could be off and/or what percentage lights can be dimmed to, and integrate function for total energy use while using dimming ballasts.

Task 3: Calculate payback period
- a) Compare total undimmed energy use to total usage with dimming capabilities.

b) Find simple payback period based on difference in cost of equipment and potential energy savings.

II. Addition of a green roof

Task 1: Gather information
- a) Find information about green roofs and the thermal transfer capacities.
- b) Research different types of green roofs to determine which would be most cost effective for this application.

Task 2: Determine heating loads
- a) Calculate heat generated in a typical theatrical space by the incandescent stage lights.
- b) Calculate heat infiltration through glazing in main circulation areas.

Task 3: Determine usefulness of green roof addition
- a) Compare thermal transfer properties of green roof vs. standard roofing.

Structural Breadth:

Statement of the Problem:

The addition of the green roof will add a significant amount of additional weight to the building that it was probably not designed to carry.

Proposed Solution:

It will be necessary to check the roof and columns/load bearing walls to determine whether the systems need to be redesigned to hold such additional weight.

Methods of the Solution:

In order to perform this check, a structural analysis will need to be performed, calculating the spans and allowable deflections and comparing them to the loading conditions after the introduction of a green roof, keeping in mind that a well-designed system that accounts for all conditions can be designed much closer to actual design specifications without the need for safety factors.

Tasks & Tools:

I. Determine if building can support a green roof
- Task 1: Find sizes of members & get deflection and loading criteria
  a) Meet with a structural student and get all the information I can.
- Task 2: Calculate additional loads that green roof would add.
  a) Find a structural student that knows how to do this.
  b) Do research into properties of green roofs and the typical loading per square foot that certain materials add.

Preliminary Schedule:

Week	Objective
Christmas Break	Consider ideas for adjustments to schematic design.
01/15 – 01/21	Finalize schematic design ideas and begin looking for fixtures
01/22 – 01/28	Choose fixtures and begin cad drawings Collect necessary files
01/29 – 02/04	Perform electrical calculations for new fixture selections
02/05 – 02/11	Finalize cad plans Compile cut sheets into a single document
02/12 – 02/18	Finalize AGI modeling for all 4 redesigned spaces for lighting work ***02/16 – Redesign of 2 spaces due, lighting & electrical work***
02/19 – 02/25	Begin LEED & structural breadth work
02/26 – 03/04	Perform energy modeling analysis for green roof addition, photovoltaics, and photosensors
03/05 – 03/11	Finalize LEED & structural breath work
03/12 – 03/18	***Spring Break***
03/19 – 03/25	Begin PowerPoint presentation
03/26 – 04/01	Start thinking about compiling my final thesis report
04/02 – 04/08	Compile final thesis report ***04/06 – Submit final report***
04/09 – 04/15	04/14 – My birthday Finalize and practice presentation
04/16 – 04/20	***Thesis Presentations***