PROPOSAL

UCI Natural Sciences Unit 2

Irvine, CA

Updated Thesis Proposal
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Lighting / Electrical Option

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EXECUTIVE SUMMARY

This document is a proposal for the scope of senior thesis research to be completed in the spring semester of 2009. Two depth studies, two breadth studies, and an additional MAE study will be performed for *Natural Sciences Unit 2* in Irvine, California. A description of each proposed research topic is presented here, along with a general description of the project and a planned timeline for the spring semester.

The lighting depth study will focus on the redesign of architectural lighting systems for four selected spaces within the building: the north exterior façade and plaza, the first and second floor lobbies, the first floor conference room, and the third floor open office. The goal of the redesign will be to create a unified, modern aesthetic for the building while maintaining a comfortable and efficient lighting system for the occupants.

An electrical depth study will also be completed. This will involve a partial redesign of the branch distribution system, a protective device coordination study, and a short circuit analysis. In addition, the economic and performance feasibility of two design modifications will be researched. The first design modification is the addition of a photovoltaic array for power generation on the roof of the facility. A building-wide replacement of copper feeders with aluminum feeders will also be considered.

The proposed breadth study topics include a thermal impact study of the large north-facing curtain wall in the lobby space. Possible glazing and mechanical system changes will be analyzed. The second breadth topic concerns the evaluation of acoustic conditions in the lobby and conference room spaces. Analysis and recommendations will be presented. Finally, as required by the MAE program, knowledge gained in AE *565: Daylighting* will be used to propose an integrated daylight control system for the open office space.

BUILDING OVERVIEW

UCI Natural Sciences Unit 2 is a 146,000 square foot project located in Irvine, California. Owned by The University of California, the academic facility predominantly houses experimental laboratories, faculty and graduate student offices, and conference rooms for the schools of biological and physical sciences at UCI. The administrative and laboratory spaces of the building are organized into wings and are connected by a central public lobby space. The building is stands five stories high, and was completed in September of 2008 at a total cost of approximately 45 million dollars. Some major architectural features of the facility include: a central lobby space with a four-story curtain wall, a public rooftop terrace, a prominent outdoor stair, and an outdoor patio space with access to the first floor conference room.

DEPTH PROPOSAL: LIGHTING

Problem

The existing lighting system in the building in general is relatively simple and inexpensive. Recessed fluorescent and compact fluorescent sources are common throughout the building. This solution is sufficient for most of the intended uses of the spaces, but does not consider the comfort and experience of building occupants to a great extent. The facility is located in a prominent location on campus, and is intended to be a focal point of the area.

The four spaces to be redesigned are: the first and second floor entrance lobby, the first floor conference room, the third floor open office, and the northern plaza and partial building façade. The lighting redesign for the building will include the creation and reinforcement of an appropriate and unified visual aesthetic. Color-rendering and color temperature issues also appear to exist throughout the building, and will be addressed.

Exterior windows, especially in the conference room and open office have the potential to be sources of glare at certain times of day. The control of natural daylight must also be considered in the lighting redesign. At the same time, the power density of the facility must be kept to a minimum in order to abide by stringent California building energy codes. The University of California must maintain its image as a leader in sustainability.

Solution

Overall Design

The lighting redesign will create a unified modern aesthetic for the facility. Occupant experience will be held paramount in all spaces, and an overarching theme of movement and circulation will be reinforced. A strong visual connection will be created between indoor and outdoor spaces. Views to and from the

redesigned spaces, especially at night, will play a central role in the design. Lighting solutions will acknowledge to architectural nature of the building, which is radially organized about a central point within the lobby. Please refer to Technical Report 3 for a more detailed summary of preliminary design intent for each space.

Exterior Façade and Plaza

The north corner of the building and the adjacent plaza are prominent focal points. The design intent for this space is to draw occupants into the building, and to highlight circulation paths—especially the large outdoor stair. The public terrace at the top of the stair will be highlighted in order to alert occupants to its existence, and to invite visitors to explore the area.

The main visual theme of the façade and plaza area is one of radial motion from the center point located in the lobby. An "explosion" of light from the center point will create a unified focus for the building exterior and will lead pedestrians to enter the building at this point. A dynamic aesthetic in this space will accentuate points of circulation and will highlight human activity within the building.

Lobby

The lobby space adjacent to the north façade is the main entry point for the building. The central focal point of the entire structure is located within the lobby. The center point itself will be accentuated, and radially distributed light will create a strong dynamic sense within the space. Means of circulation will be highlighted. Great attention will be paid to the appearance of the lobby through the large northern curtain wall, especially at night. A sense of transparency between the lobby and the north plaza will be stressed.

Conference Room

The conference room on the first floor of the building is adjacent to the main lobby. This space in unique in that it has direct pedestrian access to a landscaped patio to the south. The transparency between these two spaces is of great importance for the lighting redesign. Whenever possible, high contrast ratios will be avoided on the southern wall of the space in order to permit a more comfortable exterior view. The landscaping on the patio must be lit sufficiently to be seen from the inside.

Within the room itself, flexibility of use is an important consideration. The lighting design is elegant and customizable to accommodate audio/visual presentations, group meetings, lectures, and casual entertaining situations. Ambient and direct options are provided separately in order to avoid contrast issues on the projection screen at the front of the space.

Open Office

Located on the third floor of the building, the open office contains workspaces for graduate students and access to adjacent faculty offices. A task/ambient system is implemented in the space in order to allow greater comfort and adjustability by its users. This space is also visible from the north plaza, and the exterior appearance of the room (especially the ceiling) is considered in the redesign. Proper Illuminance levels on the workplane are an important goal in this space.

Methods

A redesign of the lighting in the selected spaces will be completed and presented in the spring semester. The design process and important changes will be well documented. A complete lighting plan for each space will be developed and organized in a clear manner. Calculations of light levels in the space will also be performed to verify that the design goals have been met.

Tasks and Tools

Schematic space designs will be completed and refined based on comments from faculty and from the professionals at Lutron.

Appropriate lighting equipment will be selected in order to achieve desired goals within each redesigned space. Mounting information and detailed specifications for the design will be developed, as needed, as a part of the final report.

Calculations will be performed to verify compliance with stated design goals and IESNA recommended light levels. Power density and energy consumption will also be determined and compared with ASHRAE 90.1, California Title 24, and other applicable codes. AGI32 and hand methods will be used to perform these analyses.

The final design will be documented in detail and concisely presented at the end of the semester. Three-dimensional presentation renderings will be created using a combination of: AGI32, AutoCAD, 3ds Max, Google SketchUp, hand drawing, and/or Adobe Photoshop.

Designer Comments from Lutron Presentation (Dec. 11, 2008) ↓

Designers: Andrea Hartranft, Mike Barber, Sean Good

Exterior Façade and Plaza

- Two color temperatures—good idea. Warm outer, cool inner.
- Difference in color temperature may not be enough to create the effect.
- Predominantly linear solutions, washing the surfaces may help accentuate materials, color.
- Commit to the metaphor and be more aggressive.
- Favorite solution is option two-- "explosion" from center point.
- Light on the curtain wall counteracts transparency.

Lobby

- Don't graze the donor wall—can create shadows.
- Light surfaces inside to be viewed from outside.
- Radial strips may not read well in 3D. More deliberate and consistent offsets may help.

Conference Room

- Show the patio outside, show orientation.
- Need more light around the periphery, light the back wall.
- Need highlights behind and above occupants.
- Control the natural light through south-facing windows
- Create a mock-up of the diffusing surface.

Open Office

- Need light on the blank wall—peripheral emphasis.
- How does the space look from outside? Orientation of fixtures doesn't match "explosion" idea.
- Use pendants and cubicle layout to define circulation areas.
- Circulation should be treated differently from work areas—downlights in corridors are inconsistent with the rest of the space.

Presentation

- Biggest concern is ordering of information
- Hard to picture the space without section and plan on the same slide.
- Don't start with the least interesting space. Start outside, move into the building.
- Show ambient solution before task lighting.
- Conceptual terms are good, but there are too many.
- Relate metaphors to design implementation.
- Good consistency throughout.
- 3D views of spaces, especially lobby, would be helpful.
- Need sketch or detail of conference room custom fixture.

DEPTH PROPOSAL: ELECTRICAL

1. Redesign the branch circuit distribution for the four spaces that are being re-lighted.

The four spaces to be re-lighted are: the first and second floor entrance lobby, the first floor conference room, the third floor open office, and the northern plaza and partial building façade. Panelboard layouts will be produced for the new design, and distribution equipment and feeders will be modified as necessary.

2. Conduct a protective device coordination study that addresses a single-path through the distribution system, showing the coordination of protective devices for redesigned system components along this path. Calculations of short circuit current are included.

The single path to be evaluated will begin at the service entrance to the building and extend to Unit Substation US1 and finally to panelboard HLP1, which feeds the lighting loads for the first floor lobby and conference room. Protective device coordination for redesigned components and short circuit analysis will be performed along this path.

3. Investigate the effectiveness of using a photo voltaic array located on the roof of the building.

High energy costs and increased environmental awareness in the building industry demand the consideration of alternative energy solutions for new construction. The University of California is a leader is sustainable technologies research, and seeks to maintain its image of being environmentally responsible.

The feasibility of implementing a photo voltaic array on the roof of UCI Natural Sciences Unit 2 for the purpose of power generation will be analyzed. The initial cost and maintained cost of an appropriate photovoltaic system will be determined. In addition, the probable future energy savings will be estimated. Solar position studies will be completed to determine the amount of sunlight which is likely to be utilized by the photo voltaic panels. A judgment will then be made concerning the economic feasibility of such a system.

4. Perform a feasibility analysis for changing building feeders from copper to aluminum.

An investigation into the economic and performance impacts of changing the entire electrical feeder system from copper to aluminum will be completed. A final recommendation will be presented and supported based on the results of this study. Hand calculations and computer software techniques will be utilized to determine the positive and negative effects of the change.

BREADTH PROPOSALS

Breadth Study: Mechanical

A four-story glass curtain wall is one of the main features of the north plaza and lobby space. This large expanse of glass provides views of campus and allows ample daylight into the space, but may be a weak point in the thermal envelope of the building. A breadth study will be completed to analyze the thermal impact of this large glass façade. Possible improvements to glazing or mechanical distribution systems in this space will be considered to facilitate a more energy efficient building.

Breadth Study: Acoustics

Acoustical quality is particularly important in the main northern lobby space of the building. The acoustic analysis of this space will include calculation of reverberation times and sound dampening capabilities of construction materials. The acoustic effect of architectural modifications caused by the lighting redesign will be calculated and summarized. Changes to improve the acoustic conditions of the lobby will be considered and presented.

Additional MAE Study: Daylighting

In accordance with the requirements to complete the integrated MAE/BAE program, an additional depth study will be completed using knowledge gained in AE 565: Daylighting. An appropriate photosensor-based lighting control system will be considered for use within the third floor open office space. Feasibility and effectiveness of specific systems will be studied, and the potential for energy savings will be calculated using computer software and/or hand methods.

PROJECT TIMELINE

SPRING 2009		
Week	**Focus**	**Planned Activity**
Winter Break	**LTG**	Begin 3D model construction
	LTG	Develop schematic lighting design
Jan 12 – Jan 18	**LTG**	Finalize schematic lighting design
Jan 19 – Jan 25	**LTG**	Complete 3D model construction
Jan 26 – Feb 01	**LTG**	Work on fixture selection and layouts
Feb 02 – Feb 08	**BRTH**	Complete daylighting study
Feb 09 – Feb 15	**LTG**	Complete lighting calculations
	LTG	Finalize fixture selection and layouts
Feb 16 – Feb 22	**BRTH**	Complete mechanical and acoustical breadth studies
Feb 23 – Mar 01	**ELEC**	Work on electrical depth studies
Mar 02 – Mar 08	**ELEC**	Complete electrical depth studies
Spring Break		No work planned
Mar 16 – Mar 22	**LTG**	Work on lighting renderings
Mar 23 – Mar 29	**LTG**	Complete lighting renderings
	GEN	Work on final report
Mar 30 – Apr 05	**GEN**	Complete final report
Apr 06 – Apr 12	**GEN**	Final report due (Apr 08)
	GEN	Complete final presentation
Apr 13 – Apr 19	**GEN**	Final presentation

LTG	Lighting Depth Activity
ELEC	Electrical Depth Activity
BRTH	Breadth Activity
GEN	General Project Activity