ONE CHRISTINA CRESCENT

125 S. West Street
Wilmington, Delaware

Thesis Proposal

November 9, 2009

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Executive Summary

The thesis proposal defines the scope and nature of work to be completed in AE 482 during the spring semester of 2010. The depth and breadth analyses for One Christina Crescent investigate issues related to aesthetics and space performance within a number of disciplines. An overview is included of the building existing conditions as they relate to the thesis work.

The depth analyses are concerned with the lighting and electrical systems of One Christina Crescent. Four spaces are to be redesigned for the lighting depth in accordance with the design criteria and conceptual design presented in Technical Assignment #1 and Technical Assignment #3, respectively. Comments about the conceptual design from the jury of lighting designers at Lutron will be addressed during the design and analysis of the system during the next semester. The design solution and its methodology are detailed within this proposal, along with a complete listing of tasks and tools.

The electrical depth addresses the redesign of branch circuits and over-current protection devices that feed the four spaces to be redesigned in the lighting depth. Also in the depth are a protective device coordination study and short circuit analysis for a single path through the electrical distribution system. Completing the electrical depth are the analysis and design of a motor control center for the new motors and photovoltaic array proposed as part of the architecture breadth. A schedule and equipment elevations will be provided in addition to calculations of design loads for branch conductors, feeders and protective devices. A layout of the photovoltaic cells will be shown on the roof plan with a cost estimate of all materials and wiring diagram for union with the building's electrical distribution system.

The breadth analyses will be conducted within the acoustics and architecture disciplines. An acoustical analysis of the second floor auditorium, one of the spaces redesigned in the lighting depth, will focus on reverberation time within the space. The results will be used to implement an acoustical solution if conditions deviate from established criteria for this space. The architecture breadth will be concerned with the geometry of the building with respect to daylight harvesting. An innovative approach to harvesting daylight will be presented and analyzed. The concept is that of a dynamic building that shifts its shape in relation to solar position, simultaneously shielding the structure from undesirable direct daylight penetration and exposing the interior to indirect diffuse natural light. This second breadth topic will integrate with the electrical depth, providing a new set of motors to shift the building as well as an array of photovoltaic cells intended to generate supplemental power for the building.

This proposal concludes with a schedule of deadlines and their respective tasks to be completed during the spring semester of 2010.

Building Overview

One Christina Crescent is a 280,000 SF, six story office building located at 125 S. West Street in Wilmington, Delaware. It serves as the corporate headquarters for Barclays Bank Delaware, the U.S. credit card operations of Barclays PLC. Barclays occupies floors two through six and the main lobby, which are in use nearly round-the-clock. There is retail space on the remainder of the first floor.

There were aspirations early in design to have the building LEED certified, but this was never fully realized. However, certain aspects of the design are remnants of that goal. The green roof is the most prominent LEED feature. Featuring more than 88,000 square feet of Pilkington Arctic Blue Eclipse Advantage exterior glazing, there is exposure to daylight throughout the building. Most of the building consists of open plan offices where daylight can infiltrate into the core.

Other spaces in the building include a 541 seat auditorium, large dining area with café/bar, and a stunning two-story main lobby. One of the more prominent features of the building is the structural tripod which supports floor three through six at one end of the building. This tripod is the centerpiece of a unique outdoor space which consists of a wraparound drive beneath the building overhang.

Lighting Depth

Three spaces within the building and one outdoor space are to undergo a lighting system redesign. These spaces include an open office, auditorium, the main lobby, and outdoor tripod space. The redesign must be in accordance with the design criteria presented in Technical Assignment #1 and all applicable codes. The design should consider IESNA design recommendations while meeting ASHRAE standard 90.1 power density requirements.

The lighting design must also address key issues related directly to the building design and use. As stated in the building overview, One Christina Crescent is highly exposed to daylight. The integration and control of daylight within the building's spaces is crucial. Since Barclays occupies and uses the building round-the-clock, the lighting design must consider the effects that night and day has on employees working varying hours. Attention to Barclays corporate image and the well-being of its employees must be present in all aspects of the lighting design. Balancing all of these issues is sure to make the redesign a challenge. A high class design will be one that will satisfy all of these demands.

Comments from jury of lighting designers at Lutron on December 13, 2007

Charles Stone

- *Time: Long…Lots on prologue, not tied into lighting too much on existing*
- *Graphics: 3 typefaces, too much text (unreadable), use more of the slide*
- *Why do you need uniform light on the task plane?*
- *Distracting gray border, blue is more dominant*
- *Where there's light there's shadow*
- *Labeled twice, images too small (important things are smallest on the slide)*
- *Need people in graphics to show scale*
- *LED, but why?*
- *Said accent was important, but didn't always explain*
- *Lobby is 'most important,' why is it third?*
- *Employee well-being should be most important goal (to owner)*
- *Sneak into take pictures*
- *Tell more about pendants*
- *Dining area – middle image like alien*
- *Tripod: Red hard to see…why is it in there then?*
- *Light coming off ceiling…why road lighting?*
- *Calculations would be good*

Andrea Hartranft

- *Order of going through spaces are key*
- *Think of space inside and outside*

- *More prioritization…lots of ideas, which are most important?*
- *LEDs are flashy, but not necessarily the best*
- *Ceiling planes graze then hit surface…how does light react?*
- *Higher levels of light needed for lectures*
- *'I'm not sure' isn't good*
- *Dining: need white light on food*

Luke Tigue

- *History interesting, but didn't relate*
- *Boxed writing no good, squeezed*
- *Too much text to read: bullet statements*
- *Sequence of going through the building (orientation)*
- *Scale of images changing*
- *Existing RCP should have new one to go with it*
- *Changing orientation of rooms in images*
- *Auditorium with horizontal stripes*
- *Fixture on ceiling would graze, not necessarily uniform*
- *What happens at night? How does the building read?*
- *Lobby: Show what is open to below*
- *Dining area: 'I'm not sure I'm going to use this' is a bad statement*
- *Colors: what happens if you're under green with no other light?*
- *Light underneath bar, people tend to avoid, just like to look at*
- *More Photoshop*

Solution

The lighting design should give priority to attention directed at employee well-being and office productivity, while reinforcing a positive image of Barclays Bank Delaware. The design will also maximize energy efficiency, minimize environmental impact, integrate daylight, and address the needs of a building that is occupied round-the-clock. A design will be tailored to the individual characteristics and requirements of each space.

The conceptual design presented in Technical Assignment #3 is considered to be the solution to the lighting depth problem. Please consult assignment #3 for a detailed look at the solution.

Method

Three dimensional computer models of the four spaces to be redesigned will need to be constructed in AutoCAD for use in lighting analyses. The analyses will consist of radiosity calculations performed in AGI32 software by use of the AutoCAD space models and photometric data acquired for lighting equipment. Appropriate equipment will need to be

selected from manufacturers' online catalogs which will achieve the goals of the lighting conceptual design presented in Technical Assignment #3. Radiosity calculations and

photo-realistic renderings will be utilized to show that the lighting design is effective in meeting design goals.

Tasks and Tools

1. Construct three dimensional models of the five spaces to be redesigned using AutoCAD
    a. Dimensions and finish specifications for the model will be taken from the architectural drawings
2. Choose luminaires, lamps, and controls from manufacturers' online catalogs
    a. Equipment choices must be recorded and fully documented
3. Obtain photometric data files from manufacturers' websites
    a. Electronically store and catalog photometric files
4. Construct luminaire models using AutoCAD and/or AGI32
    a. Luminaire specifications downloaded from manufacturers' catalogs
5. Create luminaire definitions within AGI32 using the models and photometric data
6. Perform radiosity calculations and create photorealistic renderings using AGI32
7. Verify that the lighting design has achieved design goals
    a. Utilized calculation results and renderings

Electrical Depth

1. **The existing electrical distribution system must be checked and redesigned to meet the load requirements of the lighting system redesign**. Branch circuits and over-current protective devices will need to be sized in accordance with the new electrical load conditions in all four redesigned spaces. These spaces include the open office, auditorium, lobby, and tripod outdoor space.

2. **A protective device coordination study for the path to panel 'TEP' shall be conducted**. This path runs from the service entrance through main distribution panel 'MDP,' and on through sub-distribution panels 'SDF,' 'SDG,' 'TE,' and 'TED.' Calculations for short circuit current are also to be conducted for this single path through the distribution system.

3. **Analyze and design one major mechanical equipment motor control center and its associated feeder**. One new motor control center will be designed and analyzed. The architecture breadth in its proposal to create a dynamic building capable of shifting its shape in relation to the sun's movement utilizes new electric motors to achieve this effect. Calculations of design loads for branch conductors, feeders, and protective devices will be conducted for the motor control center. An equipment schedule and elevation drawings for the control center will need to be composed. This analysis and design will be conducted in accordance with the NEC 2005.

4. **Photovoltaic array**. The addition of new electric motors as part of the architecture breadth and part three of the electrical depth inspired the desire to introduce photovoltaic cells for supplemental power generation. The hope is that the cells will be able to produce energy to power the new motors and other loads connected to the electrical distribution system. A layout of the photovoltaic cells will be shown on the roof plan as well as a wiring diagram displaying the connection into the electrical distribution system. A cost estimate of all materials proposed will be presented.

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Acoustics Breadth

The second floor auditorium is a 541 seat presentation space that is capable of being used for speakers as well as video viewing. The room currently has many glass surfaces as well as a grid of acoustical ceiling tile. The ceiling plane itself steps up from 9'-0" at the rear of the room to 10'-0" AFF at the front where the three video screens are located. The room has a parabolic shape and carpeting on the floor. A reverberation time analysis will be performed for this space and its results compared to acoustical criteria for an auditorium space such as this one. Solutions will be implemented within this space to correct deviances from established acoustical criteria if required.

Architecture Breadth

The architecture breadth will be concerned with the geometry of the building with respect to daylight harvesting. The intent is to have each level of the building slide on top of the one another to provide simultaneous solar shading and daylighting. The massing of the dynamic building will be depicted with three dimensional modeling to exhibit how the structure will shift in relation to the sun's movement. The dynamic nature of the structure will obviously have a comprehensive and correlated impact on the design and integration of various building systems. A brief consideration for the impact on each general building system will be presented. A basic calculation of the workplane illuminance at key annual points due to daylight harvesting will be conducted to prove that lighting energy savings are possible. In addition, a simple estimation of the correct overhang length based upon the solar profile angle will be shown. This second breadth topic will integrate with the electrical depth, providing a new set of motors to shift the building as well as an array of photovoltaic cells intended to generate supplemental power for the building. Although, this breadth will touch on various building systems, the intent is to focus on the building as a whole and how all systems will coordinate together as to create a space that adapts to its environment.

AE 482 Schedule		
Week	**Focus**	**Task**
Winter Vacation	LTG	Gather existing dimensions and finish specifications
		from architectural drawings
1/11 - 1/16	LTG	Construct three-dimensional models of four spaces
		using AutoCAD
1/18 - 1/24	LTG	Choose luminaires, lamps and controls
		Obtain photometric data files
	ARCH	Architecture Breadth
1/26 - 1/31	LTG	AGI32 luminaire definitions and models
	ARCH	Architecture Breadth
2/2 - 2/7	LTG	Radiosity Calculations
	ARCH	Architecture Breadth
2/9 - 2/14	LTG	Design Verification
	ARCH	Architecture Breadth
2/16 - 2/21	ELEC	Branch Circuit & over-current device redesign
	ARCH	Architecture Breadth
2/23 - 2/28	ELEC	Branch Circuit & over-current device redesign
	ACOUST	Acoustical Breadth
3/1 - 3/6	ELEC	Protective Device Coordination Study
	ACOUST	Acoustical Breadth
3/8 - 3/13	ELEC	Motor Control Center
	ACOUST	Acoustical Breadth
3/15 - 3/20	ELEC	Photovoltaic cells
	ACOUST	Acoustical Breadth
3/22 - 3/27	ALL	Arrange Final Report
	ACOUST	Acoustical Breadth
3/29 - 4/3	ALL	Begin Power Point Presentation
	ALL	Complete Outstanding Work
4/7	ALL	Final Report Due
4/12 - 4/15	ALL	Faculty Jury Presentations