THE MUSEUM OF THE BIBLE

Washington, DC

Technical Assignment 4B: Thesis Proposal

Paige Donnell

L/E Option

Advisor—Dr. Richard Mistrick

EXECUTIVE SUMMARY:

The Museum of the Bible was chosen as the focus for this thesis project which will incorporate a scope of work which includes a lighting depth, an electrical depth, two breadth topics and two additional depths for the Schreyer and Masters programs. As stated in the Building Statistics portion of this report, the building is a non-sectarian museum focusing on the history and impact of the Bible with a core collection compilation of more than 40,000 biblical antiquities and rare biblical texts and artifacts.

The lighting depth will focus on the development of a concept and the redesign of five different spaces which include:

LOBBY + ARCADE

PERFORMANCE HALL

COLLECTIONS LAB

BIBLICAL GARDENS

GALLERY ADDITION

This depth will follow the design process of a lighting designer in the professional field, starting with conceptual development and schematic design, followed by design development and documentation of designs using several programming and design tools. The overall concept for the redesign is the idea of an induced awakening, taking the occupants on a journey to education and enlightenment. Furthermore, each space incorporate a specific function that relates to this journey and lighting strategies will help to enforce these functions. Additionally, daylighting design will be incorporated into the Gallery Addition space.

In response to the lighting redesign, an electrical depth will focus on a branch redesign to accommodate the alterations and ensure the accuracy and efficiency of the feeders and panelboards located throughout the building. Additionally, this depth will also study the existing primary load and equipment design for potential cost reductions as well as energy reduction strategies through the use of controls.

Two depths will require additional work, outside the scope of the regular thesis requirements, for the Schreyer and Masters program. These analyses will include a parametric optimization daylighting study that will access the potential of the façade system and a nighttime reflection study that assess the Gallery Addition's surfaces in order to inform design of the electric lighting systems to minimize obstruction of view to the Capitol building.

Finally, two final breadths will assess the acoustical performance of the Performance Hall and the mechanical performance in the Gallery Addition. These breadths will integrate additional education learned throughout the AE curriculum that extend the scope of the lighting/electrical option.

This technical report concludes with a proposed schedule for completing my senior thesis project in a timely and efficient manner in the spring semester. The schedule ends with a final presentation in early April.

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BUILDING OVERVIEW:

The Museum of the Bible (MOTB) is a non-sectarian museum focusing on the history and impact of the Bible with a core collection compilation of more than 40,000 biblical antiquities and rare biblical texts and artifacts. The Museum has several uses which include exhibit space, library resources, meeting spaces and guest rooms for visiting scholars, space for certain affiliated museums and their exhibits, and ground floor accessory retail uses, such as a gift shop and café or food service establishment. The MOTB will also be a center of study for the Green Scholars Initiative, where established scholars and students will conduct research to pioneer new biblical and classical discoveries on items from the collection.

The Washington Design Center (WDC) originally was an eight-story 241, 073,000 SF brick and concrete building, designed in the Renaissance Revival style, and built for the Terminal Refrigerating and Warehousing Company in 1922. In 1982, the original building was renovated to house the WDC, which included the construction of an addition to the east. The Washington Design Office Center -Phase II (WOC) was later added in 1989 to complete the block.

The new construction of MOTB includes a demolition of the 1982 addition, adding six stories above the original footprint. This addition includes over 430,000,000 square feet of construction, including three stories below grade, to accommodate rotating exhibit gallery collections, storage, and a lower level central plant. The exterior aesthetics honor the historic characteristics of the building, and a curved glass roof will be added to allow daylight exposure as well as beautiful views of central D.C. as well as the capital building.

GENERAL FACTS:

Building Name | Museum of the Bible (MOTB)

Location and Site | Washington, D.C.; property name known as Washington Design Center (WDC)

Building Occupant Name | Museum of the Bible

Occupancy or Function Types (type of building) | Museum

Size (total square feet) | 430,000 SF

Number of Stories | 6 stories above grade; 9 total levels

Primary Project Team | Museum of the Bible - http://www.museumofthebible.org/

SmithGroupJJR - http://www.smithgroupjjr.com/

Tadjer Cohen Edelson Associates Inc. - http://www.tadjerco.com/

RK&K - http://www.rkk.com/

Michael Vergason - http://www.vergason.net/

Fluidity Fountain - http://www.fluidity-design.com/

Theatre Consultants Collaborative, Inc. - http://theatrecc.net/non_flash/

Dates of Construction | Feb 2015 – Fall 2017

Actual Cost Information | Contract Value: $237 million

Project Delivery Method | Design – Bid – Build

LIGHTING ANALYSIS DEPTH:

The main concept for the lighting design of the Museum of the Bible is dictated by the function of the spaces being analyzed. The goal of the museum is to educate the public about the importance of the Bible and its history. The transition throughout the space takes individuals on a journey to enlightenment, inducing an awakening of sorts in their minds, bodies, and souls. To honor this important relationship between people and the written word, each space chosen for analysis takes on a certain function that supports this journey. The following descriptions introduce how this concept transitions into each of the spaces chosen, addressing certain design considerations and criteria that are essential for the space's task performance.

LOBBY + ARCADE

This space has a significant purpose because it is the first space people experience as they enter the museum. It gives the first impression of the building and functions as the initial step in a journey, meaning that we must light to guide people to enlightenment. The goal for the lighting design is to evoke an impressionable, emotional response from visitors by implementing a sensation of spaciousness. In order to achieve this goal, peripheral lighting will help to accent the walls and widen the visual experience. Additionally, certain considerations that are important to this space's success are circulation and transition, accenting major elements, and controls or scenes. Reflections are also a very important consideration because of a large glass wall element that reaches to the top of the second level of the two story arcade.

Some of the major elements that need to stand out include a high-res LED screen that spans the ceiling, multiple media consoles, interactive media screens, and information desks. Lighting strategies will subtly accent these elements and draw people in the direction of these areas for information gathering without detracting from the main architectural elements.

PERFORMANCE HALL

This space is a grand, monumental space that is meant for people to experience the stories of the Bible through various performance and musical productions. This is the point in the journey where knowledge is transferred, meaning that we must light to educate the public. Three schematic design strategies were produced for this space, all meant to express the space's architectural form and help expose the people to the magic of the arts. Large, wavy, fabric wrapped acoustical panels span the room and wood is a widely used material. Considerations that are important to this space's success include spatial versatility, fixture glare, and controls and dimming strategies for different performances.

Lighting will accent the shape and flow of the large acoustical panels, implementing dimming strategies to add additional layers, or a rhythm to the space. Functional down lighting will also be implemented to account for periods where high task lighting is required. Additionally, railing lighting and step lighting will provide a means of egress for occupants.

COLLECTIONS LAB

This space houses the important artifacts and books that fuel the function of the entire museum. Preservation, restoration, research and documentation are the main tasks that happen in this space. This space is important for maintaining the main elements of the museum, so here we must light to preserve history. The goal is to use lighting strategies to create a sterile and functional lab space for artifact retrieval . Considerations for the design include uniformity and controls, scenes and dimming capabilities. Additionally, artifact exposure considerations and UV radiation assessments will help to understand the controls needed.

Efficient LED pendants will be implemented as well as a task-ambient control system with under cabinet and personal task options. This will accommodate for the vast amount of project types and restoration specific tasks for the space.

BIBLICAL GARDENS

This space is an exterior rooftop garden space that houses important vegetation and foliage that are referenced in the Bible. The goal for this space is to honor and highlight the precious plants in the garden and provide a break out space for occupants. In terms of our journey to enlightenment, this is where we light to induce personal reflection and help people gather the knowledge they gained in the museum in order to access what it means to them. Important considerations for this space include low level lighting and perimeter highlighting to make the space feel larger as well as accent the foliage. Controls and weather resistant products are also required here.

A green wall and a water feature will be illuminated to further highlight the perimeter. The glass - water system will feature an etched glass element that will be lit from below and path lighting will help for transitioning and drawing people in to view the biblical foliage.

GALLERY ADDITION

This space is a double level hallway, enclosed by a large, curved glass façade feature that presents the potential for daylighting. This space is a final stop in the journey, representing how our education can help us to see the world from a new perspective. The goal of this space is to implement a unique, parametrically optimized daylighting strategy that interacts with the interior control system. In terms of electric lighting, it is important to provide a nighttime condition that is low level and considers the identity of the building from both an interior and exterior perspective. Wayfinding, transition and site-seeing of the Capitol are important functions of this space. Furthermore, integrated controls, glare, and reflections must be assessed.

Simple track lighting will provide ambient light in the space and allow versatility for wall lighting gallery displays. Additionally, light will subtly highlight the structure of the space.

SCHEMATIC DESIGN FEEDBACK

KEN DOUGLAS | Illumination Arts

- Professional presentation.
- Slow down a bit when speaking.
- Lobby recognized the vertical illumination needs with the fiber optic glass solution.
    - There is a concern in this space with too much going on, fiber optic system may fight with the LED screen, how ever you still need to light that surface.
    - Confused on the explanation of the screen/glass, try to clarify. How do they interact?
- All good ideas for the performance space.
    - Avoid penetrating the acoustic ceiling in downlight design.

SHAWN GOOD | Brinjac Engineering

- Prefers to introduce each space's concept before the criteria.
- Lobby space needs to not distract from the LED screen and therefore vertical glass may be a distraction.
    - Be careful with reflections from the perimeter lighting.
- Performance space: may have presented too many details rather then focusing more on the concept.
- Gallery: consider what it looks like from the street?
    - Could implement occupied and unoccupied settings and consider what these look like.

LEE WALDRON | Grenald Waldron

- Likes the concept.
- Enjoyed the explanation on how problems would be solved.
- Lobby: interactive space, maybe integrate something where the Bible could learn from you?
    - Light could change as you walk through, "live through the space."
- Auditorium: talk about the stage, perhaps consider video projectors (Cooledge Systems) and what's on stage.
- Talk more about task lighting in the collections lab.
    - Fixture can give users different CCT options for different artifacts.

Dr. Richard Mistrick | Thesis Advisor

- Look more into preservation lighting, maybe try to talk to a professional.
- Try to talk to Lutron about different control opportunities for the performance space.

AREAS TO REVISIT BASED ON FEEDBACK

LOBBY + ARCADE

- Alter the representation of my technical spaces, maybe consider a different pendant style.
- Better understand the relationship between the glass and the LED screen, then reconsider a solution there.
- Consider how to light the acrylic panels behind the reception desk from below.

PERFORMANCE HALL

- Work to better express the concept for this space in relation to the three strategies.
- Study the acoustical panels and avoid cutting into them.
- Reconsider downlights and hiding them behind the panels.
- Consider different dimming strategies to create a better flow and movement component.
- Understand what happens on the space in terms of screen considerations.

COLLECTIONS LAB

- Reference a professional about requirements and common controls for this type of space.
- Better understand the task-ambient system and what types of task lights are available in the market.
- Study the effects of different CCT and how it can effect the visual experience of the space. Maybe include multiple settings for different tasks?

BIBLICAL GARDENS

- Understand how lighting can effect the vegetation growth.
- Include settings to eliminate lighting during closed hours of operation.
- Integrate the lighting system into the water feature and understand the effects of the etched glass.

GALLERY ADDITION

- Consider the identity of the lit space in the nighttime environment, both internally and externally.
- Implement controls for occupied and unoccupied conditions.
- Further analyze the daylighting strategies and control systems.

ELECTRICAL ANALYSIS DEPTH:

The building utilizes a voltage of 480/277V, 3 PH, 4W which feeds from a secondary service, provided by Pepco distribution company, to several different panelboards on multiple levels. This power is distributed into separate risers which provide each floor with a 480/277V and a 208/120V power option, which are tapped into by bus-ducts where needed. Additional transformers assist in the step-down process of the voltage when necessary. Tele-communication systems, audio/visual equipment, and security are a huge component of this building, therefore they have been backed up heavily to allow for secure and reliable protection and overall function of the building. Regarding wiring techniques, copper is the most widely used material option. A reliable emergency power system, supported by eight generators on the penthouse level, is designed to allow for sufficient functionality of the building in the case of an emergency or power shut down. Overall, this building relies on an extremely complex electrical system which will be further assessed for means of improvement.

The electrical depth of this design will incorporate the following studies:

PRIMARY LOAD ANALYSIS

Currently, this building's mechanical load is almost double the expected load because of it's emergency power system. Since one of my mechanical breadths looks to analyze the heating/cooling systems in the building, some of this mechanical load may be alleviated. These mechanical loads will be analyzed for their importance and methods will be used to lower the costs associated with additional power supply to the building.

EQUIPMENT ANALYSIS

The design of this building's riser system is logical, supplying each floor with two different voltage options for the corresponding floors, 208/120V and 480/277V, to tap into using bus ducts. However some of the panelboards requiring 208/120V still tap into the 480/277V riser to acquire power, meaning that some of the transformers used throughout the building may be unnecessary. A study of this system could provide substantial cost savings throughout the 6 floor building design. In regards to the materials used for the wiring in the building, which in this case is copper, there is also potential for improvement from a cost standpoint. Transitioning to a cheaper option, such as aluminum, has the opportunity to lower costs given that the reliability of the building's system is not severely effected.

ENERGY REDUCTION STRATEGIES

The addition of more building control systems , integrated into the electrical and mechanical areas of the building, could be an adequate method of energy reduction throughout the building. Currently, there are some sensors located in the public areas that assess occupancy controls, however additional daylighting sensors present the potential for electrical and mechanical integration to control heating/cooling systems in relation to solar heat gain. Shade control on the exterior façade is another method that could prove to be useful for energy saving strategies.

BRANCH CIRCUIT REDESIGN

With the redesign of the lighting in my 5 chosen spaces, a branch circuit redesign will ensure the accuracy and efficiency of the feeders and panelboards located throughout my building.

MAE + SCHREYER DEPTHS:

MAE DEPTH

My MAE depth will incorporate techniques learned in both AE 565 (Daylighting) and AE 562 (Luminous Flux Transfer). Daylighting in my gallery addition is a huge opportunity for passive design strategies, meaning that DaySim could offer an meaningful analysis of this space. This daylighting study will integrate with the work I will be doing for my Schreyer analysis. Additionally, I would like to integrate a Radiance study into this space to analyze the reflections in the glass façade. This space exhibits a certain nighttime identity and acts as a way for occupants to view the Capitol building at night. However, electric lighting can cause reflections in the glazing. A study of the different reflections of the surfaces in the space will help inform how and where to place the light.

SCHREYER DEPTH

My Schreyer depth will study the opportunity of parametric optimization design to study multiple iterations of a façade design and assess them for energy efficiency, solar gain, and aesthetic appeal. I will use the Rhino/Grasshopper interface and incorporate DIVA as a energy plug-in to the system in order to asses the outputs of my designs for these parameters. Different shading techniques to consider in the space include louvers, glazing types and frit patterns. The goal will be to maintain the shape of the current façade and the view of the Capitol building, while increasing occupant comfort and efficiency with passive design strategies.

BREADTH TOPICS:

ACCOUSTICAL BREDTH

For my acoustical breadth, I intend to study the Performance Hall for additional acoustical analysis. Since I plan to alter the form of the architectural features in my space, the acoustical performance may be altered as well, meaning that a study is necessary to ensure that my solutions still obtain the necessary requirements. Careful consideration of fixture integration will accommodate the studies done in order to minimize the effects of their locations in the space. Background information for this study will come from the knowledge gained in AE 309.

MECHANICAL BREDTH

Since my Schreyer breadth will asses different façade and glazing solutions for optimal daylighting techniques, I will incorporate a mechanical breadth to asses how these changes will alter the heating and cooling performance of the space. Since the space is vast and exposed to an ample amount of daylighting, minimizing the daylight through different shading techniques, mentioned in my Schreyer depth section, with help to eliminate some of the additional loads on the mechanical system. The goal hear is to increase energy efficiency in the space without too many additional costs. Background information for this study will come from the knowledge gained in AE 310.

ADDITIONAL INFORMATION:

DESIGN PROCESS + TOOLS

The different tools that I plan to use throughout the steps in my process include:

Schematic Design:

Photoshop, sketches, PowerPoint

Design Development:

Photoshop, sketches, basic modeling in Revit and 3DS Max Design

Lighting Analysis:

3DS Max Design, AGI 32, Rhinoceros/Grasshopper with DIVA plug-in, radiance studies

Documentation:

AutoCAD 2015, Photoshop, Illustrator

Final Rendering:

Revit, 3DS Max Design, Photoshop, PowerPoint

GNATT CHART PROPOSED TIMELINE