
Perot Museum of Nature and Science

Dallas, TX

Spring Semester
Thesis Proposal

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Lighting & Electrical

Faculty Adviser:

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Executive Summary

This document indicates proposed design works to be done in spring 2014 semester for the Perot Museum of Nature and Science, including two depth studies, two breadth studies and an additional graduate level research.

Lighting depth involves architectural lighting design for 5 spaces serve various purposes, including classroom, theater, lobby, facade and escalator cartridge. The design concerns not only about physical appearance of each space but also energy performance and system integration. Professional publications such as IES handbook and ASHRAE standard will be used to establish lighting criteria that meets code requirement.

Electrical depth has a focus on lighting control system design, making sure that lighting system is only activated where and when it is needed. Wiring and panel board system will also be redesigned to fit updated electrical load. Emergency power distribution will also be altered with biology lab being considered into an emergency space.

Day lighting Breadth will use computer program to analyze distribution and quantity of solar energy acquired by relevant space. Based on the result proper shading devices might also be proposed to enhance energy efficiency.

Acoustic Breadth studies the design of theater space from an acoustical perspective, evaluating three proposed lighting scheme from a different perspective. This study will help the selection of final lighting scheme used in the theater space.

Color rendering quality will be studied as a master level research topic. The pectoral power distribution of both daylight and interior lighting will be imported into a pre-established spreadsheet used to calculated color rendering index and other relevant properties. Practical conclusion will be summarized from the technical data with potential improvements suggested.

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Building Overview

Building Statistic

Building name: Perot Museum of Nature and Science
Location and site: 2201 N Field St, Dallas, TX 75201
Building Occupant Name: Perot Museum of Nature and Science
Occupancy or function types: Public Museum
Size: 180,000 ft²
Number of stories above grade / total levels: 5
Dates of construction: 05/2010 – 12/2012
Cost Information: not available at this time
Project Delivery Method: Design Assist

Primary project team

Owner:

Perot Museum of Nature and Science | <http://www.perotmuseum.org/>

Project Architect / Architect of record / Interior designer:

Morphosis Architects | <http://www.morphosis.com/>

Lighting Consultant:

Office for Visual Interaction | <http://www.oviinc.com/>

Associate architect / Sustainability Consultant:

Good Fulton & Farrell | <http://www.gff.com/>

Engineer:

Structural: Datum Engineers | <http://www.datumengineers.com/>

Consulting structural engineer: John A. Martin Associates, Inc. | <http://www.johnmartin.com/>

MEP: Buro Happold | <http://www.burohappold.com/>

Civil: URS Corporation | <http://www.urscorp.com/>

General contractor / Construction manager:

Balfour Beatty Construction | <http://www.balfourbeattyus.com/>

Consultant:

Landscape Architecture & Sustainability: Talley Associates | <http://www.talleyassociates.com/>

Acoustical: Jaffe Holden | <http://jaffeholden.com/>

Lighting Depth

Overview

The lighting depth will focus on interior lighting design for classroom, theater, lobby, facade and escalator cartridge. The key design concept is unite, exploring how urban lifestyle can be united with science to create entertainment facilities, how science and nature can be united to inspire young minds, how natural element can be merged into urban environment to create a retreat from fast passed urban life.

Lutron Comments

Lee Waldon:

- Apparently you had fun with the design, good attitude.
- The design of classroom is effective.
- Lot of concept presented, I would like to see some further development.
- Facade lighting should have more explanation.
- Wonder if the facade lighting can be observed from far distance. If not, the owner will not accept the design.
- Facade lighting should highlight more on the sculptural nature of the texture.

Lee Brandt:

- All three proposed design for theater rely heavily on cove lighting, might want to consider some other lighting technique.
- Concept for lobby is a little weak since Dallas do not have beach, beach is by Texas State.
- For the ocean scheme of lobby, might want to consider replace the dinosaur skeleton to ocean creatures.
- Small windows are ignored on the facade

Classroom

The classroom is located in the basement level, 25 by 25 feet in dimension with a 20 feet roof height. Unique skylight feature take drain directly from the landscape plinth on the site.

Design of this space will full integrate complicated roof system to educate visitor about building system. Featured luminaire selection will decorate this space as an underground cave, allow children to study while adventure in an underground dungeon.

Theater

The museum's theater is designed for displaying 3D movies with a maximum occupancy of 298 seats. The interior space has a strong visual impact due to uniquely designed acoustic panel.

The lighting design will take advantage of the sense of isolation in a theater space, creating scenes making audience to think they have reached a different world such as a micro world inside a computer chip, a macro world within the galaxy or a world where flow of energy is visible. Customization of acoustic panel will be the major method to demonstrate design concept. Additional lighting strategy such as recessed luminaire and surface mounted luminaire will also be used to enhance the scheme and add variety of light source.

Lobby

Lobby is the busiest space in the museum, with entrance, exit and reception desk integrated together. Perforated metal ceiling of the lobby has an elegant curve that creating visual interest. Part of the landscape plinth is brought into the interior space, providing seating area as well as the base for a dinosaur skeleton.

Lighting design of this space uses linear LED luminaire to mark up enters and exit route, guiding the traffic flow in the space. Circular luminaire will be hung above the ceiling, parallel to the ceiling surface, to simulate bubbles in the water and help relax visitors. Light blue architectural glazing film will be used on curtain walls to mimic a space embraced by water like aquarium. Warm colored spot light and projector will be applied on the dinosaur skeleton make it an attention getter that entertains visitor.

Facade

South facade of the museum is consisting of precast concrete panels with iconic texture and large area of glazing. With a public plaza located right below, the south facade of the museum can also be seen as a public sculpture work share by the entire city.

Design of facade lighting is dedicated to create a peaceful atmosphere in a busy downtown area, using non-uniform, low light level warm light referring to Dr. John Flynn's physiological enhancement model. This is achieved by using facade attached luminaire to graze the facade texture with less attention on vertical surface. Different glazing material allows interior lighting being filtered into different colors, dissecting the facade into simple geometrical forms and demonstrates the facade structure to visitor. Projection of textured light will also be considered to add more night time attention on the facade from a civil perspective.

Task and Tools

Schematic Design

Concept based schematic design is created and presented using photoshop images based on realistic photographs. Since the target of this phase is to generate conceptual design solution, the concept image will not include detailed textures but only the rough geometry of each space.

Design Development

Spaces will be modeled in programs such as REVIT, AGI32 and DAYSIM for a more realistic special layout arrangement, lighting quality calculation and day lighting analysis. Equipment will be selected for to calculate electrical load, lighting output as well as estimated cost. Acoustic calculation and color rendering analysis will also be performed for breadth works.

Construction Document

Final rendering will be created from the computer model. Critical data such as lighting level, energy load will be summarized and compared with the design criteria to examine the performance of final design.

Final Submittal

Electrical Depth

The electrical depth of this project will focus on control system, load analysis and emergency power distribution.

Control Strategy

Control system will be designed to guarantee that light is only used when a space is occupied and actively adjust lighting output depend on the daylight gain of the space. Customized navigation system in the theater space will also rely on the application of lighting control and sensor placement.

Electrical Load Analysis

By using energy efficient luminaire and produce design that only offer light to where it is needed, the design will minimize energy consumption.

Emergency Power Distribution

Current emergency power system can be expanded to include critical spaces such as BIO lab in order to protect fragile exhibitions. This will require rewire of emergency panel boards and recalculation for emergency load.

BREADTH 1: DAYLIGHT

Daylight study will be one of my breadth options, with the focus on program based energy study using AutoCAD and Daysim. The study will analyze the average daylight gain of anytime during a year, discussing its influence to interior lighting quality as well as thermal comfort. Possible solutions such as installation of shading device will also be considered as part of the breadth.

BREADTH 2: ACOUSTIC

Three schematic lighting design schemes were designed for theater with each of them proposing a different layout of acoustic panels that closely associated with lighting layout. Therefore, analysis on acoustical performance of these three designs will be very helpful for me to compare acoustic quality of each design as a reference for final design selection.

MAE PROPOSAL: SPACIAL COLOR STUDY

Graduate level education of color science will be applied in this project to determine the influence of day lighting as well as interior lighting (especially solid state lighting) on interior color rendering qualities. This study will assist the luminaire selection from an aesthetical perspective, making sure that lighting quality will not be ignored on the way of pursuing energy efficiency.

Task Name	Duration	Start	Finish
Lighting Depth - AGI Modeling	10 days?	Mon 1/13/14	Fri 1/24/14
Lighting Depth - Luminaire Selection	3 days?	Mon 1/27/14	Wed 1/29/14
Lighting Depth - AGI Calculation	3 days?	Wed 1/29/14	Fri 1/31/14
Daylight Breath - Dayism Modeling and Analysis	5 days?	Mon 2/3/14	Fri 2/7/14
Acoustic Breath - Theater Acoustic Calculation	5 days?	Mon 2/10/14	Fri 2/14/14
Electrical Depth - Design Control System	15 days	Mon 2/17/14	Fri 3/7/14
Electrical Depth - Load Calculation	4 days	Mon 3/3/14	Thu 3/6/14
MAE - Color Rendering Study	10 days	Mon 3/10/14	Fri 3/21/14
REVIT modeling and rendering	8 days	Fri 3/21/14	Tue 4/1/14
Documentation and Presentation	6 days	Tue 4/1/14	Tue 4/8/14
Reserved	17 days?	Tue 4/8/14	Wed 4/30/14

The Gantt chart displays the following task durations:

- Lighting Depth - AGI Modeling:** Jan 19, '14 to Jan 29, '14 (Green bar)
- Lighting Depth - Luminaire Selection:** Jan 27, '14 to Jan 29, '14 (Green bar)
- Lighting Depth - AGI Calculation:** Jan 29, '14 to Feb 3, '14 (Green bar)
- Daylight Breath - Dayism Modeling and Analysis:** Feb 3, '14 to Feb 7, '14 (Yellow bar)
- Acoustic Breath - Theater Acoustic Calculation:** Feb 10, '14 to Feb 14, '14 (Yellow bar)
- Electrical Depth - Design Control System:** Feb 17, '14 to Mar 7, '14 (Red bar)
- Electrical Depth - Load Calculation:** Mar 3, '14 to Mar 6, '14 (Red bar)
- MAE - Color Rendering Study:** Mar 10, '14 to Mar 21, '14 (Blue bar)
- REVIT modeling and rendering:** Mar 21, '14 to Apr 1, '14 (Yellow bar)
- Documentation and Presentation:** Apr 1, '14 to Apr 8, '14 (Light blue bar)
- Reserved:** Apr 8, '14 to Apr 30, '14 (Light blue bar)