

Lindsay Frederick

Lighting + Electrical

Dr. Houser | Faculty Advisor

North American Cultural Center | Arizona

Spring Semester Thesis Proposal

Executive Summary

The Native American Cultural Center in Arizona is a one story, 48,600 sf facility created for tribe members and visitors to learn about the culture and heritage of the Arizona tribe. It has a mixed-use occupancy with museum, auditorium, classrooms, offices, and art rooms. The spring semester will be used to redesign portions of the lighting, electrical, mechanical, and architectural systems within the building.

The lighting design will pertain to the entry lobby, promenade, classroom and museum, with an overarching concept to embrace: embrace nature, embrace culture, embrace the world in which we live. The spring semester will pick up where the fall semester left off by finalizing schematic design, working through design development and finishing off with documentation. The lighting designs will be analyzed verified such that they not only fulfill the concepts, but also meet design criteria such as IES illuminance recommendations and ASHRAE standards.

In response to the lighting changes, the branch circuiting of the electrical system will be modified appropriately and specific controls will be implemented. Additionally the electrical depth will include the study of the feasibility of introducing PV panels to supplement the power supply. The second study will be the introduction of a different emergency power system, specifically a generator. Each of these topics will be studied for cost and benefits to determine feasibility.

In addition to lighting and electrical systems, two breadth topics will be explored: Mechanical and Architectural. The mechanical breadth will study the effects of different glass types on the mechanical loads in the corresponding spaces (the classroom and entry lobby), as well as the consequent effect on useful daylight. The architectural breadth will help bring design concepts into the classroom. It will include the modification of the ceiling to provide continuity throughout the cultural center.

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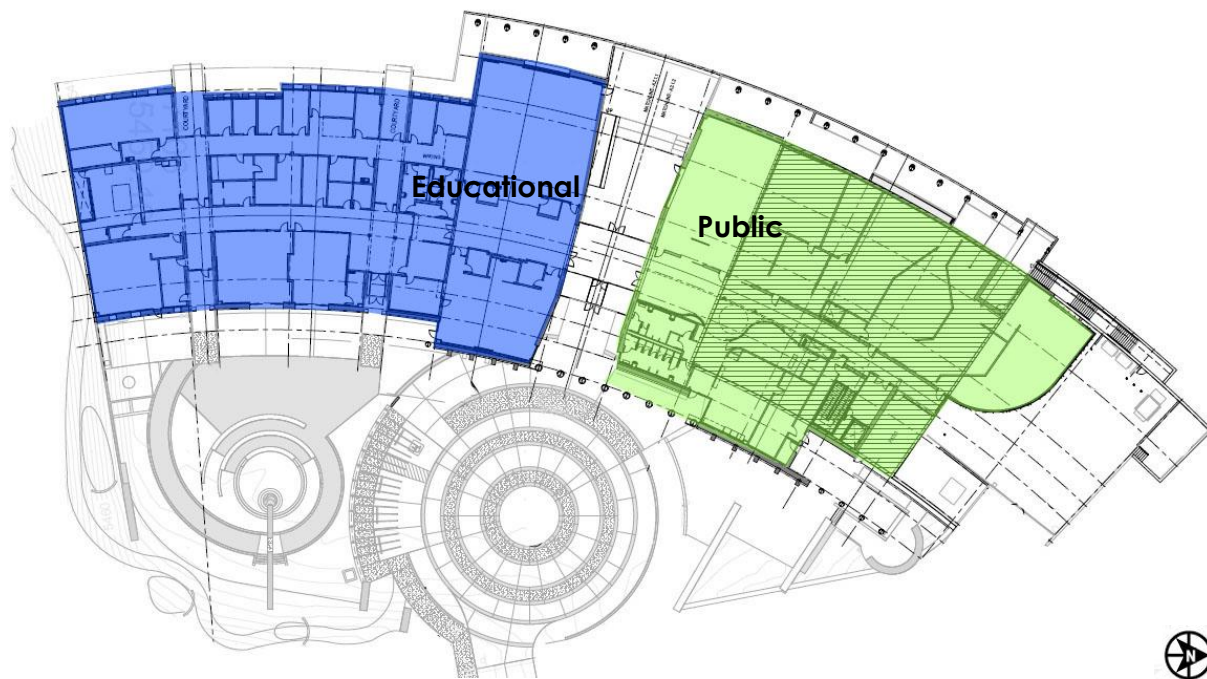
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Background

The Native American Cultural Center in Arizona is a one story, 48,600 sf facility created for tribe members and visitors to learn about the culture and heritage of the Arizona tribe. It has a mixed-use occupancy with museum, auditorium, classrooms, offices, and art rooms.

The building has two halves: the educational wing to the south and the public wing to the north; these are connected by the entry lobby at the center.



Project Team

Architecture/Engineering: SmithGroupJJR

Project Manager: Kent Willcox
Design Architect: Mark Roddy
Architect: Eric Watson
Architect: Ben Ayers
Electrical Engineer: Mark Greenawalt
Mechanical Engineer: Jon Silhol
Interiors: Kai Ekbundit
Landscape: Rick Jones

Civil Engineering: Coe & Van Loo Consultants Inc.

Structural Engineering: Caruso Turley Scott Inc.

Construction: Brignall Construction

Museum Design: BRC Imagination Arts

Audio Visual: Convergent Technologies

Lighting Depth

The lighting depth encompasses four spaces: the entry lobby, the promenade, a classroom, and the museum. Throughout the spring semester the schematic design for each space will be finalized and developed to meet all design criteria and considerations laid forth by Technical Report 1¹, which includes both electrical and natural lighting considerations. The final product will include lighting and reflected ceiling plans, renderings, and analyses.

Concept

Because the purpose of the cultural center is to bring people together to learn, understand, and celebrate the tribe's culture and heritage, the lighting should be responsive and enhance this idea. Their culture values nature, wisdom, respect, and genuineness, all of which should be taken into consideration throughout the building's lighting design. The concept for the lighting is to embrace, to embrace all aspects of the world we live in, from nature to the people.

Lutron Designer Comments

Shawn Good

- Slow down a little
- All images for entry are at night – how does it look during the day
- Connect concept imagery to spaces, especially the classroom
- Show how layers of lighting build on plan view
- Talk about Flynn impressions for each room, not just the required room

Sandra Stashik

- Pretend you are presenting to the client
- Talk more about daylight in the lobby and classroom
- Try a different perspective for the lobby sketch
- Talk about controls in the classroom
- Reconsider how to create a festive impression in the museum
- Don't pursue curved panel design in lobby

Entry Lobby

The all-glass entry lobby is the heart of the Native American Cultural Center. It is the sole transition space between the educational and public sides of the center, as well as the main entry space for the building.

In the spring semester, the entry lobby schematic design will be finalized from the three designs required in fall semester, to one final design which will then be developed further; this will include electrical and daylighting performance analyses. The final

¹ http://www.engr.psu.edu/ae/thesis/portfolios/2013/lrf5039/Tech1_doc.pdf

design must echo the concept to embrace visitors as they come into the center to provide an initial sense of feeling welcome. The design will have perimeter emphasis and will serve as either a simple transition space that reflects the adjacent lighting and architectural designs, or serve as a unique space itself – depending which of the schematic designs chosen.

Promenade

The exterior promenade is not only a place for visitors to enjoy the outdoors, but it is also a key façade that overlooks the adjacent city from the hillside.

The lighting should complement the materials and architectural features while allowing visitors to enjoy nature, which is something that the tribe values greatly. The design provides an emphasis on the “heart” which is the entry lobby; it creates balance and symmetry; and it maintains an over-all subdued effect which will invite visitors to enjoy the scenery and nature that surrounds them.

The lighting design must comply with recommendations from the IES Handbook, and integrate with the lobby lighting. In addition, it must take dark-sky legislation into consideration by implementing curfew hours for lighting to be extinguished when the building is not in use.

Classroom

The classroom, located in the educational wing of the cultural center, is a task-based space where the illuminance levels and uniformity drives much of the design. It should however apply the design concept just as equally as the other spaces, as learning is one of the core values for the tribe. The fact that one of the interior walls is glass shows the application of the idea of embracing cultures because it is a transparent barrier where visitors can actually see what is going on in these spaces. The concept will be implemented in conjunction with the architectural breadth to submerge students in a cultural learning environment.

The lighting must be flexible for normal and audiovisual settings, as well as provide additional lighting for the front of the room and the cabinetry. The classroom will also integrate daylight features into the space by including shading and photosensors.

Museum

The museum is the main component of the public wing of the Native American Cultural Center. The museum designers created an interactive space that takes visitors through the, both, literal and metaphorical seasons of the tribe's history.

The lighting design will be flexible for moveable partition walls and displays. It should also be responsive to UV- and IR-sensitive displays. There should be two layers, one for

ambient lighting, which will be simple and non-obtrusive; the other will be track lighting to focus light on the displays.

The concept for the museum is two-fold: it must relate to the concept of embracing the world we live in, while creating psychological impressions that correspond to the mood set forth by the displays. For instance, in the winter display, the March of Tears display should have a somber impression where there is little contrast and an overall low light level. The opposite will be the seasons in which they celebrate their heritage; these spaces will incorporate a festive atmosphere where the lighting will provide a higher ambient light, stronger contrast, and sparkle.

Methods and Tools

Designing and finalizing the lighting in the spring semester will require the multiple methods and software. Revit and 3D Studio Max will be the main software used to verify lighting levels, render images, and analyze and document results. Daysim will be used when daylighting studies are required. Calculations will be conducted to verify that the designs meet design criteria such as lighting power densities.

Electrical Depth

The existing electrical system for the Native American Cultural Center utilizes a 1200A, 277/480V, 3 phase – 4 wire service from the power company, which connects to a switchboard in the basement level. This service is then separated to three distribution panels and then again to the respective panelboards. The conductors are copper and they are housed in rigid steel conduit. Currently all of the emergency power is operated by battery; there is no alternate power source, nor added layer of redundancy.

The electrical depth will include the respective modifications due to the new lighting designs; this includes circuiting, controls, and panelboard changes. As specific fixtures, and their respective light sources, are chosen during the spring semester, lighting loads will be altered, calling for the branch circuit modifications.

Because the Native American Cultural Center is located in Arizona, this depth will include the research of supplementing the current power source with a photovoltaic array. This depth will include calculating the total possible energy production and analyzing the cost vs. savings of the implementation of the PV array.

The electrical depth will also include the cost and benefits analysis of incorporating an emergency power source, specifically a generator to replace the existing battery power solution.

Mechanical Breadth

In addition to studying the lighting in the lobby and classroom, I also intend to study the mechanical load effects caused by altering the glazing types. This depth will include the analysis of the contribution/hindrance on heating and cooling loads, useful daylight, and overall aesthetics. I will also calculate the cost savings/expenditures due to these modifications of the glass types.

The mechanical breadth will elicit the use of COMFEN to analyze the effects on heating and cooling energy required and the use of Carrier HAP energy modeling software to verify changes to the heating and cooling loads.

Architectural Breadth

The importance of the Architectural Breadth is to build a conceptual connection between the classroom and the other spaces in the cultural center through architectural modifications. I intend to incorporate the concept into the classroom, specifically, by changing the ceiling texture, shape, and color. As existing, the classroom has an overall simple design based on its function. I want to create a ceiling that mirrors other aspects of the cultural center, such as the iconic basket weave or the interactive learning style of the museum. This breadth will be conducted through hand sketches and 3D Studio renderings.

Spring Semester Schedule

Submitted 12/17/2012

Senior Thesis Final		1/28/2013 Milestone 1		Go - No Go Milestone 2		3/1/12 Milestone 3		3/26/13 Milestone 4			Lindsay Frederick Lighting + Electrical Dr. Houser Native American Cultural Center							
1/7/2013	1/14/2013	1/21/2013	1/28/2013	2/4/2013	2/11/2013	2/18/2013	2/25/2013	3/4/2013	3/11/2013	3/18/2013	3/25/2013	4/1/2013	4/8/2013	4/15/2013	4/22/2013			
IES Annual Trip 17-20 Revise Schematic Designs & Select Luminaires Model Lighting selections in 3DS (except		Model Classroom Verify numbers meet criteria		Start Electrical redesign for branch ckt's for all Research PV		PV Depth Emergency Pwr. Depth		Spring Break			Render Images in 3DS			Faculty Jury Presentation April 8-13				
Design Ceiling for Classroom		Document		Document		Document		Calculate Loads Analysis and Design			Document		Final Report April 3		Presentation			
Senior Banquet April 26th																		
Key		1: Three Lighting Models Complete, Classroom Design Started 2: Lighting Criteria Verified, Documentation Started, Electrical Redesign Started 3: Electrical Depth Complete 4: Mechanical Breadth Complete, Renders Started																
		Lighting	Electrical	Architectural	Mechanical	General	Completed											