Thesis Proposal

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Lighting/Electrical Option
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National Intrepid Center of Excellence | Bethesda, MD

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Executive Summary

This proposal details the work to be completed in the Spring of 2009. It presents a description of the redesign of several systems present in the National Intrepid Center of Excellence (NICoE). Included are explanations of two depth and two breadth topics. This document does not conclude that there are actual problems with the existing systems, it is just meant to provide an approach to alternate solutions.

The lighting depth presents new design concepts in four proposed spaces: exterior site and façade, lobby, auditorium, and physical and occupational therapy/waiting areas. The new design aims to create a comfortable, pleasant, and workable atmosphere that is tailored to the needs of the occupants. The space should also be functional, with light levels that meet those specified in the IESNA Handbook. All power density requirements present in ASHRAE 90.1 should also be met.

The electrical depth includes a redesign of the branch circuit distribution for the four spaces to be re-lighted. A protective device coordination study and short circuit analysis will also be conducted. A voltage drop analysis will lead to a comparative cost study of increasing feeder sizes to save energy and money. SKM software will then be used to perform a short circuit analysis, protective device coordination, and arc fault study for the distribution system.

The mechanical and architectural breadths will be developed as a direct result of daylighting and systems integration. The mechanical breadth will cover the effect of eliminating the east-facing clerestory in the physical therapy/occupational therapy space. The change in cooling loads will be closely analyzed. The architectural breadth will include a redesign of the size, layout, and materials used for the wood ceiling panels located in the auditorium. This will enable the full integration of all building systems.

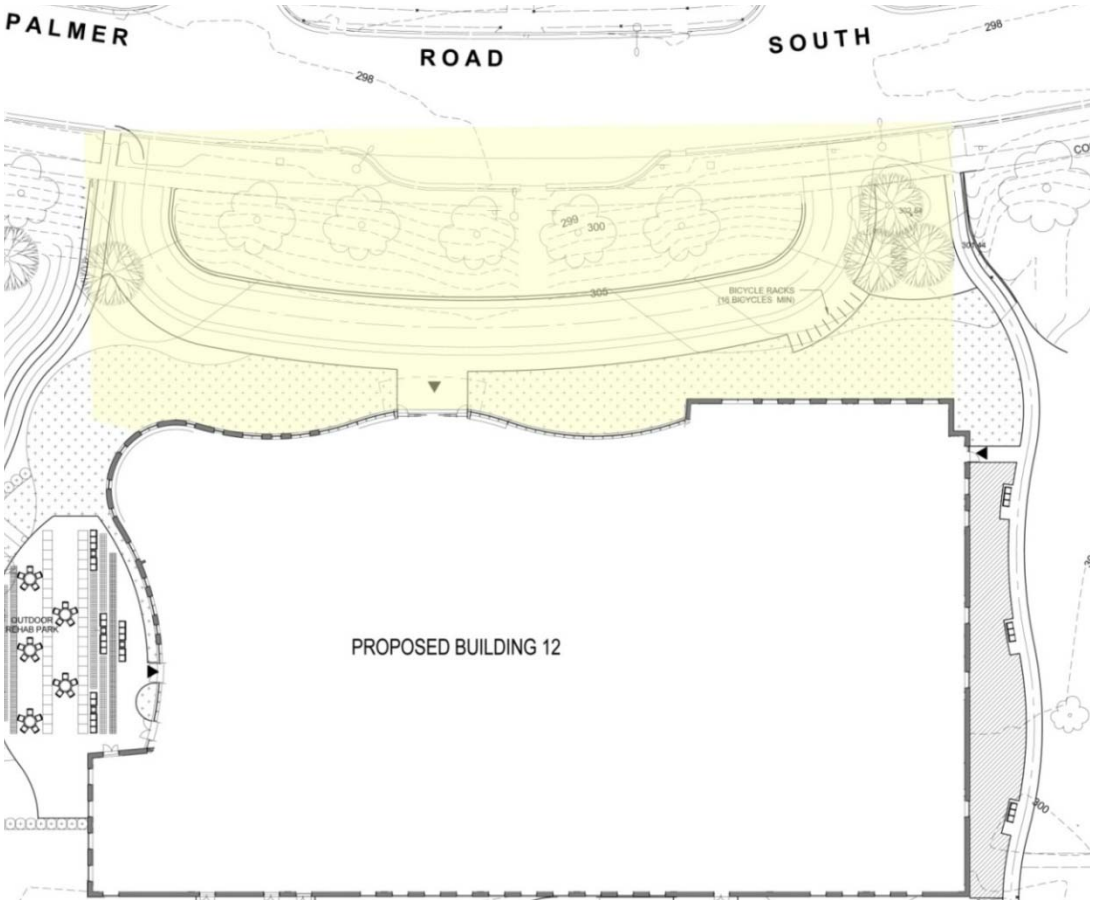
Background

The National Intrepid Center of Excellence is a 2 story, 72,000 sq.ft. building located at the National Naval Medical Center in Bethesda, Maryland. It is a state of the art medical facility designed to provide health services to military personnel and veterans suffering from traumatic brain injury and psychological health issues. NICoE will provide advanced services through research, diagnosis, and treatment. With an estimated budget of $65 million, construction is estimated to extend from June 2008 to October 2009. The building is currently owned by the Intrepid Fallen Heroes Fund and will be transferred to the Department of Defense upon completion.

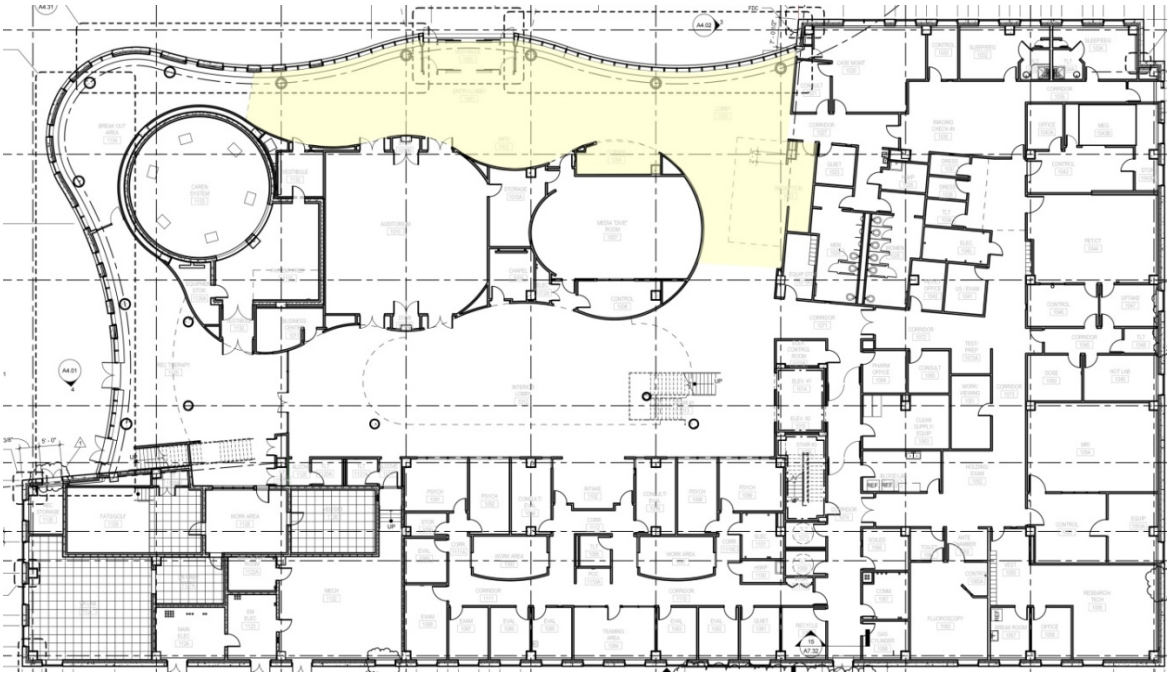
The structure is designed with two distinct zonal areas. The "L" shape is located on the east and south sides of the building. This area contains spaces dedicated to the clinical functions of the facility, such as exam rooms, research labs, offices, and simulation rooms. The amorphous form positioned on the north and west areas of the site houses the healing and public areas of the building, including the open lobby, waiting rooms, lounge, auditorium, and rehabilitation rooms. There are also indoor/outdoor spaces for patients and families to relax and interact.

The following four spaces are those on which each of the depth and breadth topics will be focused:

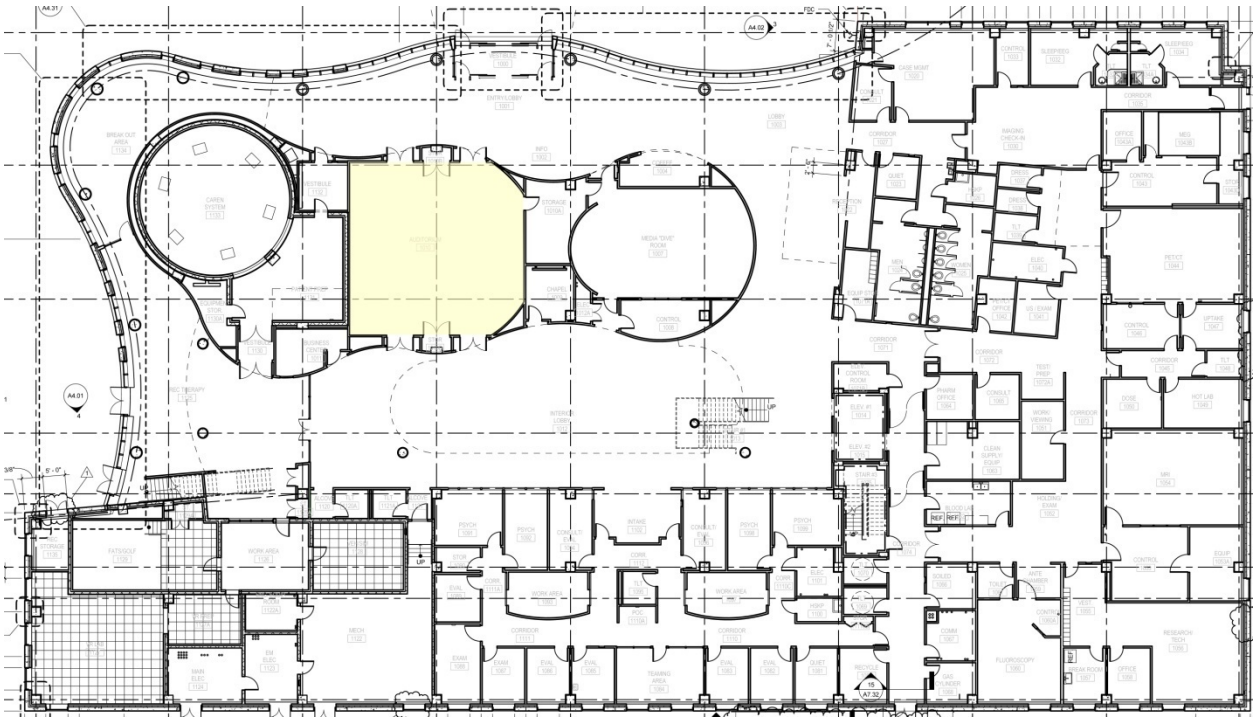
Exterior Building Façade and Site (Floor 1)**:**



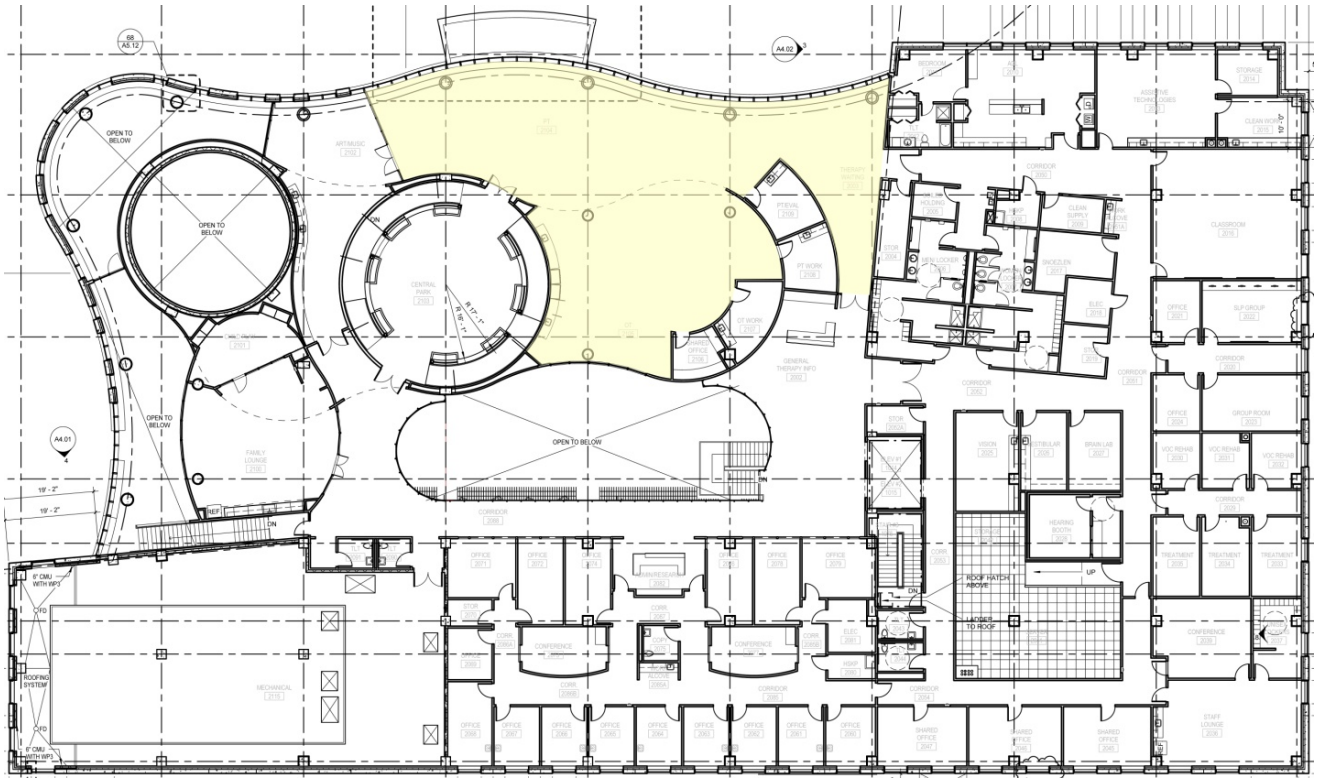
Lobby (Floor 1)**:**



Auditorium (Floor 1)**:**



Physical Therapy/Occupational Therapy/Therapy Waiting (PT/OT) (Floor 2)**:**



Space	Area (sq. ft.)
Floor 1	38,800
Floor 2	33,200
Lobby	3760
Auditorium	1460
PT/OT/Waiting	4100

Lighting Depth

Overview

A majority of the lighting in the existing L-shaped "bar" area is generally functional with fluorescent downlights. Other fixtures are used in spaces with specialized medical operations. Corridors contain a mix of linear fluorescents, downlights, and LEDs to create visual interest in the long hallways. The amorphous area contains more therapy and relaxation spaces, so the lighting is aimed more toward creating specific feelings or a certain mood in the area. Decorative and custom fixtures that provide indirect, wallwash, accent, and track lighting are placed in lobbies, waiting rooms, and other similar areas. Exterior fixtures located at entrances, exits, pathways, recreation areas and service spaces provide lighting for nighttime use. A large curtainwall system and clerestories provide a large amount of daylight in the space throughout the day. Switches, timers, occupancy sensors, and photosensors are utilized and connected through control panels throughout the building.

Lutron Comments

Shawn Good

- Don't over-think things and go back to the basics (for the façade)
- Good concept of a soldier
- Good slide graphics
- Façade:
  - Laid out well, but over-thinking things
  - Since the interior is two parts, celebrate the differences; don't need to unify it
- Five designs was a bit much for the façade
- Show façade elements in elevation (concrete)
- Think about mullion shadowing
- Lobby:
  - It's good that it's clean
  - Think about soffit
  - Don't need to present footcandle values here
  - Good detailed sections; easy to follow
- Auditorium:
  - Integrate track fixtures (don't drop them down) – between panels
  - Good that you showed projector
  - Good overall concept
- Occupational Therapy:
  - Humanize the scale
- The delicacy of all the little pendants hanging down might not emphasize "strength"
  - Such as a bar hanging down
  - Flush it out

Andrea Hartranft

- Good, but slow down; Breathe more; Less umms
- Good concept
- At the end: "strength and structure"
    - "strength" – carry a burden (like in uplighting)
    - This would start to show strength
    - Consistency of where the light comes from is critical in this building
- Celebrate the different facades
- Point source idea is good
- Lobby:
    - Good uplighting
    - Pendant vs. graphic lighting issue
    - You would want them to feel safe
- Be careful with projector and lights interaction

Mike Barber

- The concept is great
- Focus on one or two qualities of a soldier
- Strength idea is good, but there are lots of soft things
- Could work off of the duality of the granite and concrete
- Insert fascia to integrate into architecture
- Enforce strength more
- Think about lighting the columns inside
- OT:
    - Reiterates Shawn's idea
- Outside:
    - Think about light from above rather than lower to the ground along the pathway to light vertical/higher faces

Solution

As a facility for military veterans, the main goal within the building is to make the occupants feel comfortable and calm within the healing environment. By utilizing the concept of the qualities of a soldier, the space would exhibit the appreciation of these patients. Each of the selected spaces should portray one of the following qualities: unity, leadership, focus, and strength. The unique building shape should also be emphasized by the lighting design. Surfaces and architectural features within the building should be articulated, especially the curved walls. Due to the sensitivity of TBI patients, high brightness, glare, and contrast should be avoided.

Exterior Site and Façade

As an outdoor space, the front of the building is an entrance that should be inviting to visitors. Visual clarity is very important in this area. The walkway should be adequately lit in order to light the path to the doorway. The lighting should also adequately light the people moving throughout the area. The concept of unity and

teamwork should be implemented through the lighting of the building façade. Creating a similar lighting scheme on both ends of the façade will bring all parts of the building together as one. The idea of stars and stripes should also be resembled on the façade design. The entrance should stand out in order to draw and guide occupants inside. These exterior lights should be controlled by an astronomical time clock.

Lobby

The lobby should create a smooth transition from the exterior. As the main circulation space in the building, the lobby should help to guide people to their destination. A sense of relaxation and pleasantness is necessary to calm anxious patients. The concept of leadership should be implemented through light that guides visitors through the space. Points of interest which include the information desk, coffee shop, and reception desk should stand out and lead occupants from one location to another. The curved interior wood wall should be highlighted to accentuate the unique shape and material. A wash of light onto the ceiling from a soffit along the curtainwall will portray daylight entering into the space. The lighting should be suitable for a variety of tasks to be performed in the area. Lights located along the curtainwall should be dimmable and controlled with photsensors that are dependent on the amount of daylight that enters the space throughout the day. All other lighting should be on timers. At night, only lights highlighting the vesibule and curved interior wall should be on.

Auditorium

The auditorium will house a variety of activities, including research/clinical/training sessions, conferences, and seminars. The use of the space for video-teleconferencing increases the importance of adequate light levels. The concept of focus fits well with the functional aspect of the space, and visual clarity is imperative. Uniform distribution on the task plane, indirect lighting, and some peripheral emphasis on the wood walls will ensure that the space is functional as well as comfortable. The moveable partition, projector, and projection screen should all be carefully considered and accounted for when lighting the space. The multi-functionality creates the need for a very versatile lighting design. Specific scenes for conferences/meetings, presentations, and video-teleconferencing is necessary.

Physical Therapy/Occupational Therapy/Therapy Waiting

This workspace consists of three different areas. The therapy waiting area consists of seating for patients waiting for treatment. The physical therapy space provides for large movement activities and exercises. The occupational therapy area includes locations for screening and evaluating patients' abilities. Visual clarity and relaxation are important impressions in these types of rooms. Through a lighting concept of strength, occupants should feel encouraged and uplifted while in this space. The unique architectural surfaces and solid structure should be highlighted. Lights located along the curtainwall should be dimmable and controlled with photosensors that are dependent on the amount of daylight that enters the space throughout the day. All other lighting should be on timers. At night, only lights highlighting the interior curved wall should be on. These controls should mimic those of the lobby for nighttime exterior views to the inside.

M.A.E. Focus: Daylighting

The second floor PT/OT space and first floor lobby are located along the northern building façade, which consists of a glass curtainwall system with ceramic frit. As a result, daylight plays a prominent role in this space. This resource is a valuable tool that can greatly increase energy savings and occupant satisfaction. Dimming photosensors will be used to control a large portion of the fixtures in the space. However, the proper type of photosensor – open or closed loop – is unknown. A daylight study and analysis will be conducted to make this determination.

Solution Method

The comments provided by the industry professionals will aid in solidifying the final design concepts for each space. The lighting solutions will be completed using computer software calculations and renderings. Final documentation of the solutions, which includes cut sheets, lighting plans, calculations, and photorealistic renderings of at least two of the spaces will be presented.

Tasks and Tools

1. **Schematic Lighting Design:**
   Finalize lighting design with the use of comments from the design professionals.

2. **Model Spaces:**
   Use AutoCAD to accurately model all four selected spaces.

3. **Analyze Daylighting:**
   Use AGI32 to calculate the amount of daylight that enters each space.

4. **Equipment Selection:**
   Choose all equipment to fulfill all schematic design goals and criteria.

5. **Calculations:**
   Use AGI32 to perform all calculations that ensure the lighting design provides adequate illuminance levels specified in the IESNA Handbook. Analyze the power density for each space to guarantee that it meets the standards of ASHRAE 90.1.

6. **Final Renderings:**
   Apply accurate materials to create final renderings of each space using AGI32.

7. **Documentation:**
   Properly document all materials which includes a fixture schedule, cut sheets, reflected ceiling plans, lighting plans, and calculation summaries.

Electrical Depth

Overview

NICoE's overall electrical system is a radial system with one point of service entrance at the southwest corner. It is tied to a campus system and receives this power through a 2500kVA utility transformer that steps down the voltage from 13.8kV to a 480Y/277V, 3P, 4W voltage system. A 3000A switchboard provides power to all equipment loads. Transformers feed a 208Y/120V, 3P, 4W main system to receptacles and some lighting devices. All other loads are connected to the 480Y/277V voltage system. An exterior diesel standby emergency generator rated at 400kW, 480Y/277V, 3P, 4W provides backup power to both life safety and equipment branches. A 225kVA UPS battery backup system is also connected to two PDUs that are utilized for Server Room emergency power.

Solution/Methods/Tasks & Tools

1. **Branch Circuit Distribution**

The four spaces to be redesigned are the exterior façade and site, lobby (includes entry/lobby, vestibule, info desk, coffee shop, and reception desk), auditorium, and therapy spaces (includes therapy waiting room, physical therapy, and occupational therapy). In order to accommodate for the new lighting design, the branch circuit distribution will be redesigned. This entails modifying the panel board layout and resizing feeder and electrical equipment.

2. **Protective Device Coordination Study and Short Circuit Analysis**

A protective device coordination study that addresses a single-path through the distribution system will be implemented. The path extends from the utility to the main switchboard to panel LPA. The coordination of protective devices for the redesigned system components along this path will be shown. Short circuit calculations will also be included.

3. **Cost Benefit Analysis of Various Wire Sizes**

A study will be performed to compare the amount and cost of energy lost through the use of different wire sizes. While the initial cost of using a smaller wire size will be less, there is more impedance, and therefore, more energy lost during electrical transmission. By gathering the first cost of different wire sizes and calculating the total amount and cost of energy lost for identical run lengths, a conclusion will be made as to which is more economical and cost-effective.

4. **System Analysis Using SKM Software**

A total examination of the electrical system is necessary to ensure the economic feasibility and safety of the system. By performing a short circuit analysis, protective device coordination, and arc fault study for the entire distribution system, it can be determined whether the designed system is sufficient for the existing loads. The evaluation will begin at the service entrance and continue to all panel boards. Analysis will be performed using the SKM software. A familiarity with these programs will also benefit in future studies.

Breadth 1: Architecture

The auditorium has some very unique architectural features. The ceiling geometry is especially important in terms of the lighting layout. In order to accommodate for a lighting design that is both functional and visually pleasing, the ceiling details will be slightly modified. The materials, shape, and location of the existing wood panels will be altered, and additional paneling will be placed. This will make the space more architecturally pleasing and create a more efficient lighting design. The location of mechanical equipment and the coordination with other components located above the ceiling will be considered to fully integrate all building systems.

Breadth 2: Mechanical

The therapy waiting area contains a 2.5' clerestory that runs along the east wall. The location of this clerestory above the dropped ceiling does not enable this window to contribute an adequate amount of daylight into the space. The elimination of the element will greatly affect the total cooling load necessary in the space. A comparative study will be completed to determine the difference in energy load between the glass and a standard wall system. Additional cooling load contributors within the space will also be calculated.

Schedule

Spring 2009 Schedule		
Week	**Focus**	**Activity**
Winter Break	Lighting	Finish Schematic Design
		Begin Modeling All Spaces in AutoCAD
1/11/2009	Lighting	Finish Modeling Auditorium in AutoCAD
		Auditorim Luminaire Selection and bring into AGI
	All	1/14 - Add Name to Discussion Board
		1/16 - Update Schedule, Make Necessary Assignment Corrections
1/18/2009	Lighting	Auditorium Calculations and Documentation
		Exterior Façade Luminaire Selection and bring into AGI
	All	1/20 - Post Upated Proposal, Submit Markup of Schedule
1/25/2009	Electrical	Start Electrical System in SKM Software
		Start Electrical Redesign for Auditorium
	Lighting	Start Exterior Façade Calculations and Documentation
	All	1/26 - Submit Markup of Schedule, Milestone #1 (work to date)
		1/31 - Post Question to Discussion Board
2/1/2009	Lighting	Finish Exterior Façade Calculations and Documentations
		Auditorium Renderings
	Electrical	Finish Electrical System in SKM Software
		Finish Electrical Redesign for Auditorium
2/8/2009	Lighting	Model PT/OT in AutoCAD and bring into AGI
		Complete Daylight Study
	All	2/9 - Submit Markup of Schedule, Milestone #2 (work to date)
	Electrical	2/13 Progress Submission #1
2/15/2009	Lighting	PT/OT Calculations and Documentation
	Electrical	Electrical Redesign for Exterior Façade
	All	2/16 - Complete Consultation with Faculty Consultant
2/22/2009	Structural	Structural Breadth Analysis
	Lighting	Mechanical Breadth Analysis
	All	2/23 - Submit Markup of Schedule, Milestone #3 (work to date)
		2/27 - Last Day for "Go - No Go" Confirmation
3/1/2009	Electrical	Electrical Redesign for PT/OT
		Start Redesign of Equipment Supplying Power to HVAC
3/8/2009 (Spring Break)	-	No Work
3/15/2009	Lighting	Model Lobby in AutoCAD, bring into AGI, and start Calculations
	Electrical	Finish Redesign of Equipment Supplying Power to HVAC
	All	3/16 - Submit Markup of Schedule, Milestone #4 (work to date)
	Electrical	3/20 - Progress Submission #2
3/22/2009	Lighting	Lobby Documentation and Rendering
	All	Electrical Redesign for Lobby
		3/23 - One Page Presentation Outline

3/29/2009	Lighting	Finish Documentation
	Electrical	Short Circuit Analysis and Coordination Study
	All	3/31 - Updated Presentation Outline
4/5/2009	All	Report Complete
		PowerPoint Presentation
		4/7 - Final Report
4/12/2009	All	4/15 - Faculty Jury Presentations
4/19/2009	All	ABET Assessment Chart
		Reflection
4/26/2009	All	Other Updates
		4/30 - Finalize CPEP site
	-	4/30 - Evening Event
		5/1 - Awards Presentation and Banquet
5/3/2009	All	5/6 - Change Resume to Updated Bio