# Virginia Tech Basketball Practice Facility

Blacksburg, Virginia

## Proposal for Spring 2010

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Lighting/Electrical Option
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December 15, 2009

# Executive Summary

This report summarizes the work planned for the spring semester. The spring semester work will include work in redesigning both lighting and electrical engineering systems. There will also be an analysis of two breadth topics. There will also be a portion of the semester's work that will specifically address content learned in the M.A.E. portion of the curriculum.

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# Building Overview

The Virginia Tech Basketball Practice Facility is a new athletic facility located on the university's Blacksburg, VA campus. The building is made up of a number of spaces that serve the Virginia Tech Basketball Program. Among these spaces are a full size basketball court, player lounges, locker rooms, coaches' offices and strength training facilities. The building is a two story facility with a total of 50,000 $ft^2$. The building was designed to fit in to the vernacular of the campus, using materials that are found throughout the campus. The primary materials are course stone and smooth precast concrete. The building was designed to earn the USGBC's LEED silver rating.

The figures below show the plan of the building. The areas of concern for the lighting redesign are highlighted.

**Figure 1. Level 1 Plan showing spaces to be analyzed.**

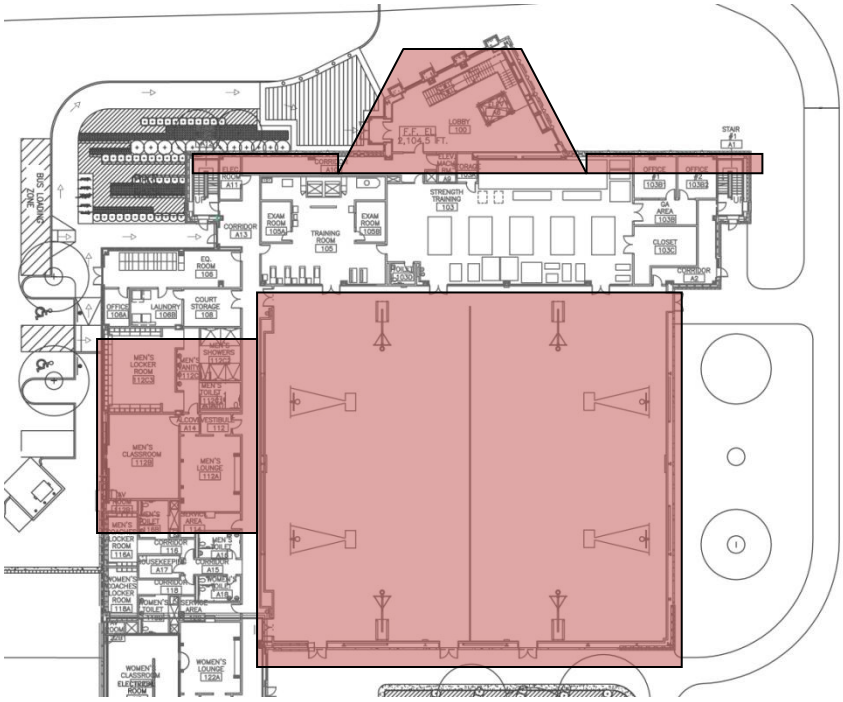
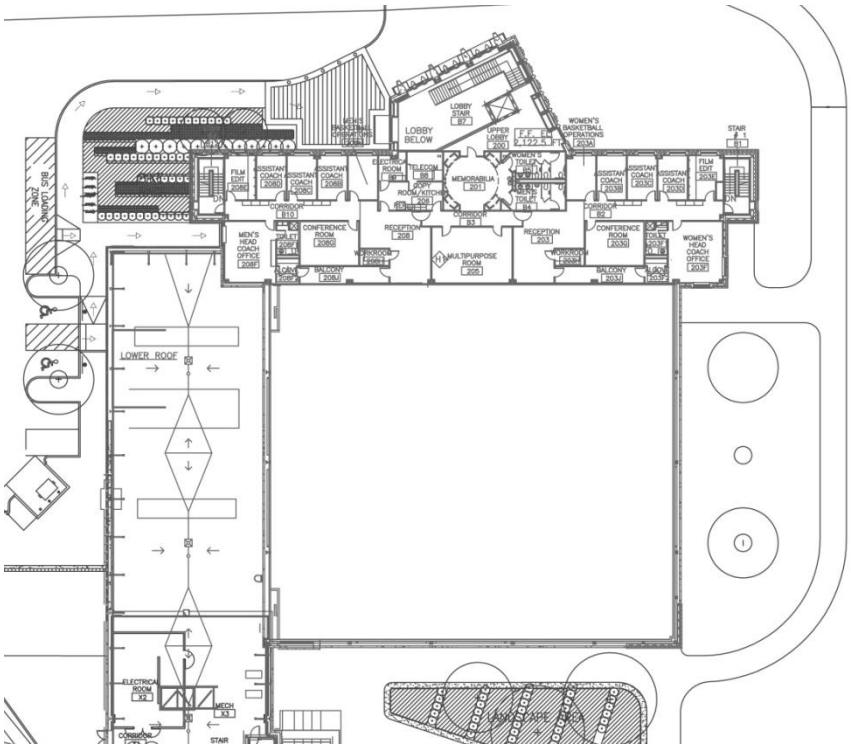


**Figure 2. Level 2 Plan.**



# Lighting Depth

### *Overview*

The lighting in this facility is designed for minimal energy consumption. In every space excluding the lobby and the gymnasium, all of the luminaires feature linear fluorescent lamps with high frequency electronic ballasts.

In the gymnasium there are high bay metal halide luminaires. The luminaires circuited to the life safety panel feature metal halide lamps with emergency quartz restrike for instant switching. The lobby space is the only location in the building where the lighting design acts to specifically highlight or accent the architectural features. There are wall washing luminaires, mounted under the floor and in the ceiling, that accent the large graphical wall depicting Virginia Tech Basketball scenes. There are also mini theatrical spotlight luminaires to create additional focal points in the lobby space.

There is minimal exterior lighting for this building. There are four recessed metal halide uplight luminaires at the entrance of the building to accent the vertical concrete fins of the façade

### *Gymnasium*

In the gymnasium area, which is the large workspace, I propose to implement a daylighting system that will allow for a reduction in energy consumption. It will be important to analyze the issues of glare and uniformity from the daylight penetrating into the space. The final step will be detailing a control system to ensure that the electric light responds appropriately to the daylight conditions to maximize energy savings while maintaining lighting uniformity and minimal glare. Software packages such as AGI32, DaySimPSU, and Radiacne will be necessary to perform a thorough analysis.

### *Locker Room and Lounge*

The special purpose space is the Men's Basketball Lockeroom and Lounge area. The lighting in this space will reinforce the mood of relaxation and comfort encouraged by the furnishings in the space. This is an important space for recruiting new players, because it shows that the players on the team have a comfortable place to spend time as a team.

### *Lobby*

The circulation space is the two-story lobby at the entrance of the building. The interior design of this space is intended to demonstrate the history and tradition of the Virginia Tech Basketball Program. The lighting in this space will respond to the graphics that cover the walls. The lighting will also guide circulation, as this is where the circulation in the facility branches out.

### *Entrance Facade*

The final space is the building façade. The lighting here will orient visitors to the entrance, and also introduce visitors to the experience that will occur within the building. Highlighting the materials, form, and geometry of the façade is essential to a successful design.

# Lurton Presentation Comments

### *Overview*

Below is a summary of the comments made by the lighting design professionals the schematic design presentations at Luron on December 9, 2009.

### *Luke Tique*

- Good, quiet slide graphics
- Striping façade may not be the best solution, but using color is OK
- Using dynamic elements on an area not for entrance may not work
- Rethink horizontal elements façade design
- Need one more façade element
- Skylight may not be the best daylight solution in gym
- Lounge and lockeroom needs more work

### *Lee Brandt*

- The stone wants to be grazed
- Think about the vertical elements under the windows
- Think about backlighting the 1872 sign
- Really look at the graphics in the lobby, there's a lot that can be done here
- Gym daylighting- go to glazing manufactures to get ideas
- Locker room- sometimes reserving concepts, and consider uplighting in locker room

### *Helen Diemer*

- Good graphics/background and good organization
- Reconsider color on the façade- be careful of using too much
- Consider emphasizing the 1872 sign
- Be careful of the direct sun in the gymnasium
- Rethink tense vs. relaxed

### *Sandra Stashik*

- Think about lighting the logo on the façade
- The entrance is a glass box, so it is important to incorporate the glow from within
- The stone texture is important
- Step back and organize the ideas
- Does the locker room really want to be tense?
- Lounge/lockeroom graphics didn't really convey the design concepts

### *Kari Nystrom*

- Need to ramp up the hierarchy levels within the lobby
- Think of how to use lighting in lobby to really get the wow factor

### *Discussion*

On the building façade, it is clear that I need to look more into how the lighting can orient visitors, and how color can be appropriately used. Better division of the façade elements could be more successful. In the lobby, I really have to think of how the lighting can interact with the busyness of the graphical walls. Luminance ratios and focal points are important. In the gym, the materials used for the daylight opening are very important. Different delivery methods must be looked at to be sure that there is no direct view of the sun. Two psychological impressions do not work very well in the lounge and locker room. I plan to go off the basis of a relaxed environment, and be sure that the lighting reflects this mood.

# Electrical Depth

### *Overview*

The power distribution system for this building is a simple radial system, with the service entrance point in the basement electrical room. The building is fed by a 750kVA transformer that steps down 12kV primary voltage to 480Y/277V secondary voltage. The main switchboard in the basement electrical room is 1200A, 480Y/277V, 3PH, 4W, and rated at 35K AIC. This switchboard distributes power to the building, to loads at 277V or 480V or to step-own transformers for loads at 120V or 208V. The emergency system in the building is powered by a 100kW diesel generator operating at 480Y/277V 3PH, 4W. Three automatic transfer switches control the power from the generator to the emergency and optional standby loads.

### *Solution/Methods/Tasks & Tools*

1. **Branch Circuit Distribution**

   The four spaces to redesign are each of the four spaces that I plan to redesign the lighting systems. These four spaces are the gymnasium, the lounge and locker room areas, the lobby, and the building entrance façade. In the gymnasium there are currently high bay metal halide luminaires. In the gymnasium the redesign will be focused around daylighting system integration, in which will likely feature fluorescent luminaires in place of the HID luminaires because of the ease of dimming fluorescent lamps. The lighting in the lounge and locker room area is overhead fluorescent, and the proposed solution will likely add more accenting luminaires. In lobby there is a mixture of metal halide downlights, fluorescent wall washers, and tungsten-halogen accent luminaires. These luminaire types will likely be involved in my redesign of this space. For the building façade, metal halide luminaires will be used to graze the façade, and will likely incorporate some color-changing LEDs.

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 2LNL1. This path includes the distribution panel BPNL1 and step-down transformer B-T-1. The coordination of protective devices for the redesigned system components along this path will be shown. Short circuit calculations will also be included. The feeders along this run are numbers 3, 39, and 23.

3. **Copper Feeders vs. Aluminum Feeders**

   This analysis will look at the economic and performance comparison between copper and aluminum feeder for power distribution. RS Means estimating data will be the reference for the cost of aluminum as compared to copper. It will also be necessary to determine the quantity of copper used throughout the building. It will also be necessary to analyze and note the performance differences between the two materials.

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. Performing this short circuit analysis, protective device coordination, and arc fault study for the entire distribution system, will demonstrate 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.

# M.A.E Focus: Daylighting

There is a great opportunity to incorporate daylighting into the gymnasium area. This a space that spans the two stories of the facility, with only the roof above it. The goal of the daylighting design will be to reduce the energy consumption of the lighting system in the gymnasium. A good daylight design in this space will include a thorough analysis of the luminance ratios of the daylight deliver system to ensure that the daylight apertures do not inhibit the task of playing basketball in the gym. Orientation, glazing materials, controls, and shading are all elements that need further analysis.

# Breadth 1: Structural

The introduction of a daylighting system into the gymnasium will require a redesign of the roof and ceiling system in the space. The roof currently held up with joists that span the width of the space, spaced 5'-8" on center. This will likely need to be readdressed so that the daylight openings can be wide enough to optimize daylight contribution. Hand calculations will be used calculate the added load and determine the size of the new supports.

# Breadth 2: Mechanical

The introduction of a daylighting system into the gymnasium will require a redesign of the HVAC system serving the gymnasium. The addition of daylight is accompanied by infrared radiation that increases the cooling load in a space. Resizing of the air handler may be necessary. The construction of the daylight delivery opening is also important, as is the Solar Heat Gain Coefficient of the glazing used.

| Spring 2010 Timeline | | |
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| Week | Focus | Activity |
| 1/18/10 | Lighting | Finish schematic design |
| | | Continue modeling in 3D |
| 1/25/10 | Lighting | Finish modeling in 3D |
| | | Bring spaces into lighting analysis software |
| 2/01/10 | Lighting | Start fixture selection |
| | | Begin daylight analysis |
| 2/08/10 | Electrical | Start SKM analysis |
| | Lighting | Complete gym daylight study |
| 2/15/10 | Mechanical | Analyze daylight heat gain |
| | Electrical | Continue SKM analysis |
| 2/22/10 | Lighting | Lobby calculations |
| | | Documentation |
| 3/01/10 | Lighting | Façade renderings |
| | | Locker room and lounge renderings |
| 3/08/10 | Spring Break – No work planned | |
| 3/15/10 | Structural | Roof structure analysis |
| | Lighting | Continue rendering |
| 3/22/10 | Electrical | Branch Circuit Redesign |
| | | Protective device coordination study |
| 3/29/10 | Lighting | Finish renderings and documentation |
| 4/05/10 | All | Compile documentation into slide show |
| 4/07/09 | All | Final Summary Reports Due |
| 4/12/09-4/15/09 | All | Final Presentations |
| 4/30/09 | All | Awards Presentations |