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EXECUTIVE SUMMARY

The thesis proposal outlines the items to be addressed during the Spring 2008 semester for The Maryland Transportation Authority Police Training Facility. It includes both lighting and electrical depths, which involve the redesign of the respective systems in four spaces: the large classroom, physical training gymnasium, firing range, and the exterior front façade and main entrance.

The firing range, the largest space in the Maryland Transportation Authority Police Training Facility, has special air flow requirements. Laminar air flow is especially important in the range area so that ammunition particles settle to the floor and are not ingested by the users of the range. The mechanical breadth will examine changes to the mechanical system that will decrease turbulent air flow.

Currently, the range incorporates Tectum panels, a type of acoustical paneling, to limit the attenuation of sound into the surrounding spaces, and provide absorption within the space. The acoustical breadth will examine alternate materials that could further improve the acoustical isolation of the space.

BUILDING OVERVIEW

The Maryland Transportation Authority Police Training Facility is to be located in Baltimore, Maryland off of Interstate 695, the outer loop of the beltway near the Francis Scott Key Bridge. It will replace an older facility that is near the new site. The facility will be become the primary site for the training of new MdTA Police recruits.

With two stories above grade and 42,000 square feet of interior building space, the training facility provides a variety of spaces. Offices, classrooms, meeting rooms, and investigation areas are included as well as a physical training gymnasium, locker rooms. A 20,000 square foot firing range encompasses more than half of the building footprint which will be used for training purposes.

LIGHTING DEPTH

Problem

The lighting design for the Maryland Transportation Authority Police Training Facility should first and foremost aid in the educating and training of the police that will use the facility. Incorporating flexibility into the lighting system, as well as meeting the design criteria of the IESNA and ASHRAE 90.1, is also a high priority. Focusing on these aspects will lead to a design that fulfills the functional needs and the code and energy requirements for the building.

Proposed Solution

The large classroom, physical training gymnasium, and firing range are the three most crucial areas where training occurs in the building. The exterior front façade and main entrance provides identification and is the first impression of the building. These four spaces have been chosen for lighting redesign.

Demonstrations, presentations, exams, and meetings are just some of the events which could take place in the large classroom. Allowing for controls with multiple switching options and zones is important so that the lighting design can adapt to a variety of circumstances. Learning and productivity are important in a space such as a classroom. The lighting design should respond to these goals and provide the most comfortable learning environment possible through fixture and lamp selection, orientation, location, and controls.

The physical training gymnasium provides a half basketball court as well as fitness and weightlifting equipment. The space is 15’-6” in height, which is on the low side for a basketball gymnasium. Exposed trusses supporting the roof span the ceiling of this space. Uplighting the exposed structure will visually heighten the space while highlighting an architectural feature that is only present in this space. The fixtures used within the gymnasium must not interfere with the basketball court, meaning that mounting must be at or above the ceiling trusses. Lamp warm-up time is important in the gymnasium. Unlike some gymnasiums that are in use all day long, the gym at the MdTA Police Training Facility will probably be used more intermittently. Being able to enter the space and automatically switch fixtures on to full, or almost full, output is important. Also, controls should provide for the option of only a portion of the gym lighting to be used at a time.

As the Police Training Facility, the firing range will be used to equip trainees for real-life situations. A variety of lighting scenes will be established to simulate different real world environments that police could encounter including interior and exterior conditions. Control systems will play a major role in this space. Safety will also be of concern and will be addressed in the lighting design.

The front face and main entrance canopy create the exterior presence of the building. A hierarchy of light should be established, including higher illuminance level under the canopy and near the entrance doors and highlighting the logos and building identification on the façade. Facial modeling is also important as there are security cameras on the premise that would be needed to identify any intruders. Also, uplight should be limited to restrict the amount of light pollution created by the facility.

Methods

The schematic lighting design from Technical Assignment 3 will be revised to integrate the comments of the design professionals from the presentation at Lutron. Computer modeling will then be utilized to determine that aesthetic goals and design criterion are being met for the lighting design for each of the four redesigned spaces. Models will be generated in AutoCAD. Based on established design criteria, luminaires, lamps, and ballasts will be selected to obtain the desired effect. AGI32 software will be used to run radiosity calculations to confirm that the desire illuminance levels are being achieved. ASHRAE and IESNA will be used to determine that the lighting design meets the code requirements.

Tools & Tasks

Task 1: Integrate comments made by design professionals at Lutron presentation
Task 2: Model all four spaces in AutoCAD
Task 3: Select Equipment
- Luminaires
- Lamps
- Ballasts

Task 4: AGI modeling
- Create surface materials and import luminaires
- Illuminance values
- Photo-realistic renderings

Task 5: Control Selection and Plans
Task 6: Reference IESNA and ASHRAE

ELECTRICAL DEPTH

Problem

The original electrical system design for the building was adequate to meet the demand of the building as well as satisfy the National Electrical Code and ASHRAE requirement. Analysis and redesign, however, will be done to conform to the new demands of the redesigned lighting. Examinations and studies of other areas to minimize cost and maximize efficiency will be performed.

Proposed Solution

Several elements of the electrical system will be investigated. The redesigned classroom, physical training gymnasium, firing range, and exterior façade and canopy will require branch circuit distribution for those spaces to be redesigned. Also, a protective device coordination study will be conducted, along with short circuit analysis, for the entire building.

The HVAC system for the firing range will be modified for a mechanical breadth. Electrical design loads based on these modifications will be calculated and distribution equipment will be selected. Energy efficient transformers will be compared to standard transformers by determining costs and payback periods.

Methods

The 2005 National Electric Code will be reference throughout this depth to determine resizing of electrical equipment due to modifications of building loads.

Tools & Tasks

Task 1: Redesign branch circuits to meet new lighting demand
Task 2: Redesign electrical system to meet modified mechanical demand
Task 3: Conduct protective device coordination study
- Size protective devices affected by lighting or mechanical redesign
- Analyze short circuit current

Task 4: Power efficient transformers
- Research power efficient transformers
- Cost analysis / payback period

BREADTH TOPICS

Mechanical Breadth

The firing range, the largest space in the Maryland Transportation Authority Police Training Facility, has special air flow requirements. Laminar air flow is especially important in the range area so that ammunition particles settle to the floor and are not ingested by the users of the range. The mechanical breadth will examine changes to the mechanical system that will decrease turbulent air flow.

Acoustical Breadth

Currently, the range incorporates Tectum panels, a type of acoustical paneling, to limit the attenuation of sound into the surrounding spaces, and provide absorption within the space. The acoustical breadth will examine alternate materials that could further improve the acoustical isolation of the space.

TIMELINE

Week	Task
Winter Break	Finalize Conceptual Schematic Design
1/13-1/19	Create AutoCAD Models Import Models into AGI
1/20 -1/26	Select Luminaires, Lamps, and Ballsts Prepare AGI Models for Calculations
1/27 -2/2	Lighting Layouts, Calculations, and Controls
2/3 - 2/9	Electrical Coordination Study Branch Circuit Redesign Based on Lighting
2/10 - 2/16	Lighting Plans, Electrical Plans, Luminaire Schedule
2/17 - 2/23	Research Laminar Flow Mechanical Systems Research Energy Effiencient Transformers Research Acoustical Attenuation Solutions
2/24 - 3/1	Breadth Work - Modeling & Conclusions
3/2 - 3/8	Electrical Redesign Based on Mechanical Create Photo-Realistic Renderings
3/9 - 3/15	Spring Break
3/16 - 3/22	Electrical Transformer Analysis Create Photo-Realistic Renderings
3/23 - 3/29	Create Photo-Realistic Renderings Finalize Report
3/30 - 4/5	Finalize Report, Print & Bind
4/6 - 4/12	Finalize Presentation
4/13 - 4/19	Thesis Presentations