SENIOR THESIS FINAL PROPSAL

PENN STATE SENIOR AE THESIS

New York Police Academy

College Point, New York

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Construction Management

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Executive Summary:

Senior Thesis Final Proposal is intended to discuss the analyses that will be performed on the New York Police Academy. Each of the analyses has been selected to incorporate the ideas of value engineering, constructability, schedule reduction, and critical industry issues.

Analysis #1: Redesign of Castellated and Cellular Beams
Within the Physical Plant of New York Police Academy lies an indoor, quarter-mile track. For the floor system, cellular beams were designed to support the load and castellated beams were used to support the 120' span roof system. Described later in this report is the process used to allow the castellated beams to meet the required strength to support the roof. The goal of this analysis is to replace the cellular beams with a wide flange beam and the castellated beams with a structural steel truss system, as well as perform an analysis on cost and schedule impacts of the new design.

Analysis #2: Fuel Room Resequencing
In order to support the fuel oil tanks that will supply the boiler system with fuel to heat the facility, a double matt slab must be placed to allow proper support. However, the current way that this activity is sequenced is to place the first matt slab, erect steel columns, place second matt slab while steel erection continues for the second floor. This provides a large area of risk for both concrete workers and iron workers. Therefore, the goal of this analysis is to resequence the activities within this area to allow for a safer work area.

Analysis #3: Sustainable Design for a Photovoltaic Energy System
Upon early research of New York Police Academy, it was discovered that the facility draws a large amount of electrical power from the city's power grid. In order to help reduce the total amount of energy that is drawn from the grid, a photovoltaic energy system is to be analyzed and incorporated into the overall design of the facility. This analysis will focus on the construction cost of the system, construction impact on the schedule, and the use of the renewable energy to help aid in the operation costs after turnover to the owner.

Analysis #4: Façade Redesign
Along the critical path of the project schedule lie many crucial activities that must be completed by a certain date in order to turn over the project. One of these items is the curtain wall of the building. The east and west faces of the Administration/Academic Building comprise of precast concrete panels while the remaining of the curtain wall is composed of metal panels and glass. The goal of this analysis is to replace the precast concrete panel system with a metal panel system and to perform an analysis on the overall cost and schedule impacts of the project.

See APPENDIX A for a description of the implemented Breadth Studies within this proposal.

Project Background:

The purpose of this project is to bring together all the current facilities that are being used in the training of law enforcement for the NYPD to one central facility. New York City Department of Design and Construction and New York Police Department are the primary owners of the project with New York Police Department being the primary occupant. Original designs allowed for a complete facility to be constructed that provided services in academics, administration, and physical training. Due to funding issues, the project was redesigned to allow for the construction of an Academic/Administration Building and a Central Utility Plant/Physical Training Building, a project consisting of 720,000 SF, with plans for additions in the Central Utility Plant/Physical Training Building. Turner Construction Company and SVT are performing a joint venture as construction managers for the project.

Figure 1: North Face of NYPA

New York Police Academy's site is located in College Point, New York on the former NYPD's College Point Tow Pound which is approximately thirty-five acres in size with main entrances along 28th Avenue and College Point Boulevard. Due to the location of the site and the overall size, vehicular and pedestrian traffic should be a minimum interference; with this in mind, all construction traffic will flow down College Point Boulevard and Ulmer Street. Surrounding the site are mostly commercials zoned facilities such as the MTA Bus Facility, the Crystal Windows facility, several shopping centers, and a church facility.

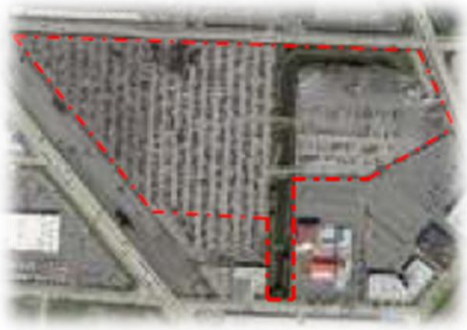

Figure 2: Arial View of Project Site

NYPA's construction life runs from October 2010 to December 2013, with the use of a modified fast-track delivery method to allow for early bid packages to be released. The overall critical path of the schedule follows the activities Piles, Foundations, Structural Steel, Structural Concrete, Curtain Wall, and Mechanical HVAC. Activities generally start in the Academics/Administration Building due to the overall size compared to the Central Utility Plant/Physical Training. The overall schedule of the facility is broken into three parts, Campus Fundamentals, East Campus, and West Campus.

Analysis #1: Redesign of Castellated and Cellular Beams:

Problem Identification

Inside the Physical Training portion of New York Police Academy is an indoor training facility. Areas included tactical training, baton training, and an inside quarter mile track for calisthenics training. Due to the large size of the track, the overall span of the area is approximately 180 feet; with cellular beams supporting the track and castellated beams supporting the roof system. In order for the roof system to be properly supported, 8 inch diameter steel piping filled with concrete will be welded to the top flange to increase the overall stiffness of the beams. This process will drastically increase the overall erection, assembly, and cost of the beam system within the Physical Training area.

Research Goal

The goal of this analysis is to investigate the possible replacement of the cellular beams with a traditional wide flange beam, and the castellated beams with a suitable steel truss system to determine the overall impact on the schedule and total construction cost.

Methodology

- Contact Pat Murray from Turner Construction Company to acquire information regarding the design of the castellated and cellular beams, as well as any similar projects
- Calculate overall loading onto beams from designated live and dead loads for the region of construction
- Determine a suitable replacement for the castellated and cellular beams
- Determine overall cost of material, labor and equipment used between original design and new design
- Determine overall schedule impact between the construction time of original design and new design
- Develop a summary of findings between the original design of castellated and cellular beams and the new design of replacement systems

Resources and Tools to be Used

- Pat Murray and other Industry Professionals
- Turner Construction Company / SVT
- AE 404: Building Structural Systems in Steel and Concrete
- Applicable literature

Expected Outcome

After completing research and an in-depth structural design, it is believed that a steel truss system and wide flange member replacement will effectively reduce the structural steel schedule. There is a possibility that the truss system may be more expensive than the original design but the overall savings in the schedule should counter act the addition costs.

Analysis #2: Fuel Room Resequencing

Problem Identification

Within the Central Utility Plant lie four separate rooms that contain the fuel oil tanks that supply the fuel to heat the entire facility. Four tanks at 20,000 gallon capacity will be installed during Phase 1 of the facility's construction while four tanks at 15,000 gallon capacity will be installed during the Phase 2 of the facility's construction. At approximately eight pounds per gallon, these tanks, when full, will contribute to a load of approximately 1,150,000 pounds. To countermeasure this force, a double matt slab will be poured in the area. The sequencing of this area consists of placing the first matt slab, steel column erection, and then placing the second matt slab while steel beam erection continues overhead. This sequencing poses many threats to the concrete workers from the overhead iron workers as they are installing structural steel members for the second floor as well as impacts the overall schedule duration of the trades due to the extra safety precautions that are in place.

Research Goals

The goal of this analysis is to perform a restructuring of the project schedule within the fuel tank rooms to shorten the project schedule as well as provide a more safe work environment for both the concrete workers and iron workers.

Methodology

- Interview with Turner Construction Company for sequencing and trade coordination with the fuel room area
- Research the availability of materials and resource leveling to help determine the production capabilities of the trades involved
- Try to contact subcontractors to discuss activity durations and manpower requirements for the fuel room area
- Evaluate findings and develop an updated sequencing for the fuel room area
- Assess impact on overall schedule
- Evaluate the increase of safety within the area, and calculate any possible savings from reduced safety measures of the original sequencing

Resources to be Used

- Pat Murray and other Industry Professionals
- Turner Construction / SVT Project Team
- AE 472: Building Construction Planning and Management
- AE 473: Building Construction Management and Control
- Applicable literature

Expected Outcome

It is expected that the work within the fuel room area can be resequenced to allow both trades, concrete and structural steel, to perform the required work at separate times. This process will minimize the overall safety risk of the area. At the moment it is unclear if this resequencing will reduce the overall schedule and allow an earlier turnover date to the owner; this will be investigated when the proper figures are calculated. With the reduced in safety risk should come a reduce in the cost for overall safety protocols within the area.

Analysis #3: Sustainable Design for a Photovoltaic System

Problem Identification

During the 19th Annual PACE Roundtable, many topics relating to Critical Industry Issues were discussed between students and industry professionals. These topics consisted of Sustainability/Green Building, Technology Applications, and Process Innovation. Upon semester-long research of New York Police Academy, many features of the building were discovered and analyzed. One area that became of interest was the southern side of the building.

New York Police Academy's southern exposure is equipped with a façade design of angular metal panels. These metal panels act as an architectural feature as well as awnings for the windows that are below them which are designed to prevent solar light from becoming an unwelcome disturbance.

Any southern side will experience the most solar light during the day time. With an understanding of this concept from previous classes, a design for a photovoltaic system will be performed. The ideal place is to install the system on the angular metal panels due to their installed angle to block the existing solar light. This design will help reduce the high electrical loads within the building, resulting in a lower operation costs for the owner after turnover and aiding in the LEED Silver accreditation as per design.

Research Goals

The goal of this analysis is to perform an overall design of an integrated photovoltaic energy system and determine the financial feasibility to include the system within the existing power plan to help reduce future energy costs to the owner as well as aid in the LEED Silver accreditation that New York Police Academy is striving for.

Methodology

- Research photovoltaic panel technologies and sustainable design
- Inquire with photovoltaic panel manufactures on design consultation
- Determine the quantity of panels needed to be installed along the angular metal panels and the amount of kWh that will be able to be produced
- After application of the photovoltaic panel system, determine if the structure will need to be upgraded to handle the additional load
- Perform an analysis on life-cycle cost, payback period, and possible energy savings

Resources and Tools to be Used

- Industry Professionals
- Consultants of New York Police Academy
- AE Faculty – Electrical and Sustainable Design
- Former Studio Professors – Architectural Concepts of Solar Design
- Applicable Literature

Expected Outcome

Through the research and design that is to be involved, it is expected that an integrated photovoltaic energy system will provide New York Police Academy a financial benefit in operation costs through the reduction in power grid dependency. Through government incentives, rebates, and life-cycle costs, it is believed that the photovoltaic energy system will provide an affordable and financially beneficial concept to the turnover operation of the New York Police Academy.

Analysis #4: Façade Redesign

Problem Identification

During early research of New York Police Academy, the critical path of the project schedule follows the activities of Piles, Foundations, Structural Steel, Concrete, Curtain Wall, and Mechanical HVAC; the Curtain Wall will be the focus on this Analysis. With a majority of material consisting of metal panels, precast concrete panels, and glass, the curtain wall system is the most logical to look into to help aid the construction process.

Along the west and east facing walls, the primary material is precast concrete panels that resembled the metal panels along the remainder of the building in color. In comparison, the precast concrete panels are generally higher in cost, weight, and installation time than a metal panel system.

Research Goals

The goal for this analysis is to perform an overall redesign of the precast concrete panels to a more functional metal panel system to analyze construction time and construction cost impacts onto the overall project.

Methodology

- Contact Pat Murray to acquire information regarding the design of the curtain wall system and how it will be constructed.
- Calculate the loading resulting from the precast concrete panel system
- Calculate the loading resulting from the redesign metal panel system
- Determine if the beams supporting the wall can be resized
- Determine overall cost of material, labor, and equipment used between original design and new design
- Determine overall schedule impact between the construction time of original design and new design
- Develop a summary of findings between the original design of castellated and cellular beams and the new design of replacement systems

Resources and Tools to be Used

- Pat Murray and other Industry Professionals
- Turner Construction Company / SVT
- AE 404: Building Structural Systems in Steel and Concrete
- AE Faculty – Structural and Construction Management
- Applicable literature

Expected Outcome

Through the design and research that is to be involved with this analysis, it is expected that the replacement of the precast concrete panel system with a metal panel system will reduce the overall construction cost and construction time of the project; this should allow the project to be turned over to the owner at an earlier time.

Analysis Weight Matrix

The weight matrix, shown below in Table 1, displays how each analysis accounts for the four main core areas of investigation. The percentages represent expected time and effort that will be allocated for the core areas in each respective analysis.

Analysis Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Redesign of Castellated and Cellular Beams		10	10	10	30
Fuel Room Resequencing	10		10		20
Sustainable Design for a Photovoltaic Energy System	5	5	10		20
Façade Redesign		10	10	10	30
Total	15	25	40	20	100

Table 1: Weight Matrix for Distribution of Core Areas of Investigation

Timetable

In order to properly schedule the work progression for each technical analysis, a preliminary semester timetable has been developed in order to stay on task and meet the project goals described. The spring semester preliminary timetable can be viewed in APPENDIX B.

Conclusions

Through thorough investigation and in-depth research involved, the proposed technical analyses will help provide information relating to possible improvements within the construction of New York Police Academy. It is expected that the replacement of the castellated and cellular beams will reduce the overall structural steel schedule but may increase the overall cost. Safety risk will be reduced for the project once the hazardous fuel room is resequenced to allow the trades involved to work at separate times. A photovoltaic energy system will help provide an affordable and financially beneficial concept for the overall operation of the facility. Finally, a façade redesign of the west and east faces will help reduce the project schedule's critical path to allow an earlier turn over date for the owner.

This proposal is intended to be a working submission with revisions expected based on feedback from the AE faculty and thesis consultants.

APPENDIX A: Breadth Topics

Breadth Topics

The following topics involve a more detailed analysis in distinct technical disciplines within the major of Architectural Engineering at The Pennsylvania State University. Each topic contributes to one of the previously mentioned analyses.

Structural Breadth: Contributes to Technical Analysis #1, Technical Analysis #3, and Technical Analysis #4

The current roof and floor of New York Police Academy's Physical Plant is metal decking atop 30' spans for the flooring and 120' spans on top cellular and castellated beams, respectively. The remaining superstructure is consisted of structural steel, concrete matt slabs, and pile cap systems.

The replacement of the castellated and cellular beams within the Central Utility Plant, as proposed in Technical Analysis #1, will be analyzed to determine the overall effects upon the existing structure. As proposed in Technical Analysis #3 and Technical Analysis #4, the general façade will be altered either with the additional of a photovoltaic energy system or replacement of the precast concrete panel system with a metal panel system; these two analyses will require a structural analysis to determine the loading and support requirements of the system. Any additional support and connections that are required for the beam replacement, precast concrete panel system replacement, and addition of the photovoltaic energy system will be evaluated for a cost and schedule impact on the overall project.

Electrical Breadth: Contributes to Technical Analysis #3

The power distribution system for the Academics/Administration building consists of a primary switchboard rated at 3000 Amps, 460 V, 3 Phase and a secondary rated at 2500 Amps, 460 V, 3 Phase switchboard; the Central Utility Plant uses two (2) 4000 Amps, 460 V, 3 Phase switchboards.

Integration of a photovoltaic energy system into the existing energy system will be analyzed to determine any additional electrical and connection requirements. Upon understanding the overall loading of the building, proper calculations will be used to determine the overall performance of the photovoltaic energy system to reduce the total electrical usage drawn from the utility power grid.

APPENDIX B: Spring Semester Preliminary Timetable

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