THE PENNSYLVANIA STATE UNIVERSITY

Crocker West Building

STATE COLLEGE, PA

Senior Thesis Proposal

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Architectural Engineering
Structural Option

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-- EXECUTIVE SUMMARY --

The Crocker West Building (CWB) is an $18 million, 3-story office building and research facility being constructed in State College, Pa. The 121,000 square foot structure will function as a specialized research facility for a branch of the U.S. Department of Defense. This high-security infrastructure will include lab and office area on all but the third floor level, which was designated mainly for office space. CWB will be constructed using different precast systems, including the twenty-eight shear walls that make up the main lateral force resisting system. Crocker West Building is also being designed to achieve LEED certification.

Upon request of the tenant, necessary actions were taken to allow for the addition of several floors needed for office space. The new structure will be designed with 2 additional levels of office space totaling 5 stories, plus an additional portion of the building extending to an overall height of 7 stories. With the addition of these levels, the structure shall be redesigned using steel framing as the main lateral and gravity systems. Research and advice taken from a co-working engineer suggests braced frames be used to maximize the strength of the lateral system. Additionally, a concrete core shall also be considered to aide with torsion and drift criteria. Other structural issues, like the green roofs introduced, will be addressed during design phase to avoid any unnecessary strength calculations.

Converting the precast structure to a taller, steel framed structure will also stimulate changes to the envelope and overall perspective of the new edifice. An architectural breadth will be conducted to facilitate changes with overall architectural layout and aesthetics. The aesthetics portion of the architectural breadth will be directly related to changes of the structural system, where as additional levels will inevitably change the elevation view of the structure and shall be investigated. In addition to the architectural breadth, a construction management breadth shall also be conducted to compare cost and schedule differences between the existing precast system and the proposed steel system.

This proposal details the tasks to be completed during the second part of the senior thesis project along with a schedule of those tasks broken down over a weekly course of the semester.

--BREADTH STUDIES --

ARCHITECTURE:

Introducing a completely different steel framing method for Crocker West will have ramifications to the existing floor plan and overall design. Great effort will be taken in order to maintain a majority of the existing layout spaces and areas, relocating areas as deemed necessary. In an attempt to minimize deflection and vibration concerns, the 35'x35' typical bays will be considered and possibly reduced to incorporate shallower floor plenums and stiffer diaphragms. Special interest will be devoted to floors 1 & 2 based on the amount of open lab space desired and other occupant requests. Furthermore, removing the precast panel envelope around the perimeter lends itself to a variety of different façade and glazing finishes. The change induced on the exterior of the edifice due to the redesigned steel framing and glass curtain façade will be analyzed and incorporated in the appearance overhaul.

In addition, with the existing structure striving for LEED certification, additional green space shall be incorporated into the floor plan. Determination of additional LEED points from adding the green roof, altering the building's perspective, and switching the structural system shall be considered.

CONSTRUCTION MANAGEMENT:

Transforming the existing structural system from architectural precast concrete to a modern steel framed design, plus the accumulation of construction materials for the additional levels will lend itself to an assortment of construction management issues. A project schedule shall be constructed based on the new steel system and related materials; also, an overall cost shall be determined from the new specified material list. Information gathered regarding each systems schedule & cost impact shall be compared and used to recommend one system over the other.

-- TASKS & PROPOSED SCHEDULE --

TASKS & TOOLS:

Task 1. Architectural Breadth (Part 1):

Sketch a schematic redesign of the existing structure, including: altered floor plans with new steel framing and grid pattern, elevations of the proposed structure detailed with story heights and overall building height, and potential wall sections displaying feasible building components (i.e. – glazing, column covers, etc.) required of the new structure.

Task 2: Preliminary Design:

Verify the buildings existing/new gravity loads. Determine trial sizes for structural members using a combination of hand calculations and computer modeling, along with an experienced, working engineer's guidance. Similar to Tech II, this requires typical bay floor systems be analyzed and designed via hand calculations & computer modeling for the various gravity loads to obtain relative member sizes.

Task 3: Preliminary Analyses:

Use the schematic design information & estimated member sizes acquired in Tasks 1 and 2 to perform a lateral load analysis. Analyses will consist of wind and seismic forces estimated from existing information (gravity loads, superimposed loads) and assumptions taken from the schematic design (seismic weight of the structure, overall height due to plenum depth variance).

Task 4: Model System:

Construct 3-D model of proposed structure using ETABS, RAM, or any other program capable of performing the task. Determine practical locations to introduce braced frame(s) and determine whether or not a concrete core should be incorporated to oppose the effects of torsion and drift.

(TASKS & TOOLS cont.)

Task 5: Lateral System Design:

Perform any necessary adjustments to the structure found through computer based modeling and hand calculations to come up with a finalized lateral force resisting system design for the new structure; making sure all required braced frames are in their respective positions.

Task 6: Lateral Analysis:

The preliminary analysis performed in Task 3 should yield the controlling lateral load combination(s). The governing load combination(s) shall be reanalyzed similar to Tech III with the finalized system of Task 5 in order to determine how the lateral loads will be distributed throughout the building, and the amount of load each member is required to resist. Also, determine if the new structure will require the foundation system to be redesigned.

Task 7: Architectural Breadth (Part 2):

Research the impact of additional levels on essential LEED credits. Determine whether or not feasible to try for a Platinum rating. Incorporate green roofs considered during structural design phase.

Task 8: Construction Management Breadth:

Construct an updated project schedule relating to the new construction materials using Primavera computer software (existing project schedule built in Primavera). Performing all necessary calculations for strength and sustainability prove the selected blast resistant components are practical.

Task 9: Final Presentation:

Conclude any results and final design problems which may have arose, organizing these results into a written final thesis report. A 10 minute presentation summarizing this report will be composed and presented to the faculty and jury of the Architectural Engineering Department.

PROPOSED SCHEDULE:

Will be inserted upon discussion and approval with thesis advisors.