EXECUTIVE SUMMARY

This thesis presents a case study of The Pennsylvania University Chemistry Building. The Chemistry Building is located on the University Park Campus on Shortledge Road, and serves the Pennsylvania State University's Eberly College of Science. The building houses a variety of science laboratories, the majority of the college faculty offices, faculty support staff offices, graduate student offices, conference rooms, a lecture auditorium, and several seminar halls. Architectural aspects of the building include an aluminum hip roof, which encloses a mechanical penthouse; along with a two story enclosed pedestrian bridge that connects the Chemistry Building to its adjacent building, Life Science. Also, one of the university's central chiller plants inhabits the building, which provides 4,050 tons of cooling to the surrounding university buildings. Through thorough analysis of the building, in regards to future energy cost, fire protection, and structural integrity, it is advised that certain adaptations be made to the building.

The Mechanical Focus design will investigate the issue of future energy costs for the Chemistry Building's chilled water plant. Two systems will be evaluated in the focus, the original electric centrifugal chiller system and a two stage absorption chiller system. The systems were evaluated on energy costs for operation and installed equipment cost. Allegheny Power will supply the electric input for the electric centrifugal chillers, while the absorption chiller's input will be supplied by the university coal powered steam plant. The study found that in the future, coal would save $661,431 per year. Moreover, the additional equipment required for the absorption chiller system would have a payback period of less than two years.

The second section of the document is a Fire Protection Breadth. This topic analyzes the atrium, one of the building's architectural elements. During the original design, the atrium was changed from five stories to four stories, as a result a smoke evacuation system was deemed not needed. In this breadth, the atrium was returned back to five stories and a smoke evacuation system was sized and evaluated using a transient model, and computational fluid model. A contamination study was also used to evaluate whether the air supply to other parts of the building, or other surrounding buildings would be contaminated during system use. The system was found to have too long of a delay between fire ignition and fan activation. It was determined that the system was capable of carrying out its function, but needed an automatic detection system that would detect the fire almost instantaneously. Furthermore, the performance of the design was found by the computational fluids model to be capable of further enhancement by using multiple make-up and exhaust locations to entrain the air in the space.

The third and final section of this document evaluates the structural integrity of the building's steel skeleton after the Fire Protection Breadth's centrifugal fans had been placed on the roof of the penthouse. The evaluation was conducted using a RAM Structural model on a gravity load basis and found the structural framing was in need of redesigning to support the additional load. Several beams were moved, and additional structural bracing was added to represent the specific framing needs to support the equipment. However, the columns were found capable of carrying the additional gravity based load.

In conclusion, certain aspects of the Pennsylvania State University Chemistry Building may benefit from further analysis of key issues. Future energy costs, fire protection, and structural redesign, are a few of these aspects. After evaluating these topics, it becomes evident that there are beneficial changes to be made to this building.