Executive Summary

The Pennsylvania Judicial Center is a nine-story, 425,000 square foot building project currently under construction in Harrisburg, PA. This $95 million building will house the Pennsylvania Unified Judicial System, and features courtrooms, conference rooms, and offices.

The function of this building creates an increased security concern over other buildings of a similar size and location. In order for the judicial officials to be able to perform their jobs effectively, they must have a strong feeling of security. Therefore, the main focus of this thesis is an effort to improve blast resistance and progressive collapse mitigation for the Pennsylvania Judicial Center.

The area in which an attack is most likely to occur is the parking area below the building. For an interior explosive blast, some building damage is basically inevitable no matter how well designed the structural system may be. Therefore, for an interior blast, the design goal was to prevent catastrophic failure and protect life safety. This was achieved by designing large composite columns in the parking area to resist blast destruction of more than one column, and Vierendeel trusses to redistribute gravity loads if a column is removed. For the exterior of the building, the glazing was designed for blast resistance according to ASTM standards since blown out glass shards represents a serious hazard. It was determined that due to the size and location of the load, the glass could not be designed to prevent fracture, but laminated glass was specified to keep the fractured glass inside the frame.

The building was redesigned using the same type of structural system as the existing one: steel frame with composite slabs. The system will be designed to withstand

a single large, rapidly applied pressure force located anywhere in the lower parking deck. The building was analyzed as a whole using a model developed in RAM Structural System. The implemented designs are primarily based on provisions of the 13th Edition of the AISC Manual of Steel Construction. It was determined that all desired blast resistant designs could be incorporated into the structure for $93,000; therefore, the recommendation is to use composite columns, Vierendeel trusses, and blast-resistant glazing.

The breadth study of the mechanical system also focused on mitigation of the effects of a terrorist attack. Certain airborne contaminants can cause sickness or death within minutes of exposure. An auxiliary mechanical system was designed to automatically exhaust the space at a rate of 6 air changes per hour while bringing in 100% outdoor air upon sensing a dangerous level of contaminants. This system was designed for two courtrooms, which are likely to be under the greatest risk; however, it also could be easily applied to any other space desired based on the method described. While the system was effectively designed, the $39,000 estimated cost was determined to be unjustified for the protection of just two rooms in the building. Therefore, the recommendation is not to use this system unless it is one that the owner desires.

The other breadth study involves the architectural aspect of the building. In order to safely evacuate the contaminants from all occupied areas, large exhaust towers had to be added to the roof of the structure. This obviously had a big impact on its appearance; the architectural goal of this thesis was to minimize the obtrusiveness of the stacks. A shape study was performed using a computer model, and the architect's original vision for the building was maintained as well as possible.