Problem Statement and Solution Method

Problem Statement

Upon reviewing the design of the Hershey Academic Support Center, it was apparent that the lateral system design was unique. There were a total of three systems in place that helped to resist lateral loads: composite flooring, braced frames, and moment frames. The composite flooring provided minimal lateral resistance support, mostly taking the excess moment from the moment connections while the braced frames were only used to support the Mechanical Penthouse. This leaves the 617 moment connections in the building to provide most of the lateral support. When conducting analysis of the moment frames under full restraint, it was found that the system was over designed and that the total number of connections could be reduced, saving cost. The problem with this data is that it's based off of the assumption that all the partially restrained connections were fully restrained, which isn't true. The question posed itself, if the moment connections were given their actual restraint values, would there still be savings like before? Another factor to consider is that this building is designed using the principals of "Type 2 with Wind Design," so changing the partial fixity will change the wind moments and possibly alter the floor system from it's current setup. These two defining factors, the number of connections and the size of the floor system, are the basis of this study in the hopes that either one or both can be reduced to save on overall building costs.

Lateral Analysis

To first make the change from fully restrained to partially restrained, the nature of partially fixed moment connections had to be reviewed. Research was conducted to determine the flexibility of partially restrained connections as well as methods to apply the partial fixity to loading on a structure. Specific moment values were calculated and applied to the structure depending on the location and type of connection. Checks for fracture versus yield were performed on the moment connection plates to make sure they would allow for flexibility before failing. After these calculations were performed, a 3D SAP2000 model was

created of the entire structure as well as individual framing sections. The moment percentages were entered into SAP with the current connection configuration and checks were made on the structure to ensure that the moment frames were still properly designed and to see if any changes could be made to save cost. Attempts to reduce the number of connections were performed and the results tallied.

The second system affected by the redistribution of moments according to the connection fixity is the Type 2 with Wind floor system. Since these members rely on the moment created by the wind for their design, the new calculated moment values would have to be checked against the current floor system to see if the design matches. All appropriate checks were made and the final system was found using the moment values and RAM Steel Software.

Construction Management Breadth

The Hershey Academic Support Center contains 16 different moment connections with three main types supported in the building. Each of the three main types of moment connection has a price associated with materials and installation. In an effort to reduce cost, the prices of the main moment connections were calculated and obtained from a steel fabricator to compare between the types. The lowest cost moment connection was then used as the base type and a system was made to replace the other connections as could be allowed by calculation. Time was also considered in the replacement with a scheduling comparison between all three types using RS Means.

Architectural Breadth

Another interesting system in the Hershey Academic Support Center is the Fire Prevention System. Going by the Pennsylvania Department of Labor and Industry's Fire and Panic Code, the building was designed with an extensive sprinkler system as well as the code required 2 hour fire rating between floors. The interesting thing about this design is that instead of making the Lightweight concrete composite slab 3.5” to meet the 2 hour fire code, they instead made the

slab 2.5" with ½" spray on cementitious fireproofing on the deck, beams, and girders. Cost could potentially be saved if the slab thickness was increased and also more options architecturally would be open because the beams and columns wouldn't need the spray on fireproofing that resulting in some columns from being hidden from view.