Executive Summary

Building Description:

The Washingtonian Center is a 200,000 square foot office building located in Gaithersburg Maryland. The building is eight stories rising approximately 106.5 feet to the roof level, while the top of the mechanical penthouse rises to 120'. The structure of the building is a steel frame. The gravity framing consists of composite steel deck and beams with a lightweight concrete topping while the lateral forces are resisted by concentrically braced frames located around the core of the building.

Project Goals:

Owing to the fact that the Washingtonian Center will be office building, an open and flexible floor plan is required. The current and future tenants of the building are given the option of laying out their space to best fit their needs, with nonstructural partitions and furniture arrangement. This requires that the structure of the building maintains a clear free plan that is minimally intrusive to the leasable space. As with any building project, economics also played a controlling role in the design and construction of the Washingtonian Center. Limiting the cost of the building was of utmost importance. With these goals in mind, this report focuses on maximizing the cost effectiveness of the structure of the building, while remaining fully functional in its intended use.

One way to improve the cost effectiveness of a structural system is to provide additional leasable space within the same overall volume of the structure. This was noted as an area of the design that left room for significant improvement. The height of the structural floor system in the original design of the building was quite deep. It was noted that by reducing the depth of the floor system, major height savings on each floor could be achieved and when these savings were accumulated over all eight stories of the building, an additional floor could be added on top of the structure without increasing the height. This was accomplished by redesigning the structural systems of the building in concrete.

Structural Depth

The structural redesign utilized a two-way post-tensioned flat plate as the new floor system, with concrete columns carrying the gravity loads, shear walls resisting the lateral loads, and redesigned spread footings to complete the structural systems. The floor plate was able to be limited to eight inches thick which allowed for an additional floor to be added into the design under the imposed height restriction of 125'. To allow for a concrete slab without drop panels or beams, additional column lines had to be added into the leasable space. All columns in the building were designed to be the same size to simplify the construction process. This resulted in every column being 20" x 20". The footings were redesigned to carry the adding loading from

the concrete structure. They grew significantly in size but were able to still be designed as spread footings.

Construction Management Breadth

A construction management breadth study was done to compare the costs of the new concrete structural systems with that of the original steel system. This study included the material, equipment and labor costs of the two systems, as well as the time it would take to construct them. The additional revenue from the added floor was also considered in the study. The cost analysis showed that the concrete structure would cost slightly over $700,000 more than the steel structure to build, however it would provide about $100,000 more in yearly revenue for leasing the space from the added floor. This would give a payback period of around seven years to offset the additional cost of the structure. In addition to the cost analysis, the impact on the construction schedule was also evaulated. This investigation concluded that the concrete structure would take about seven weeks longer to build than the steel design.

Architectural Breadth

An architectural breadth study was conducted to investigate the success of the design goal of maintaining a clear and open floor plan. A Revit model of a possible layout of the leasable space was done. This model showed that the additional columns required by the concrete floor system do not significantly limit the flexibility of the leasable space.

Final Recommendation

After an extensive investigation it was decided that the original steel design was the best choice of structural systems for the Washingtonian Center. The steel system when compared directly to the concrete design was the better choice in most of the situations. The steel design allows for long beam spans within the leasable space which means that the floor plan can be completely open without any columns obstructing the area. Even though the columns in the concrete design don't completely limit the options of the space, it clearly is better to not have columns. The steel structure costs less to build then its concrete counterpart, and it takes significantly less time to construct. Similarly the foundations for the steel building use less material and are smaller than the ones in the concrete design. Steel is also a very sustainable material, while concrete isn't reusable at all. The only benefit that the concrete design offered was a thinner floor slab and an additional floor of leasable space. While this was the primary goal of the redesign, when compared with all the areas that the concrete system isn't as good as the steel design, it only makes sense to implement the steel design in the final building.