# Executive Summary

The New Hospital of the University Medical Center at Princeton is a six-story facility which rises 106'-0 above grade and is the centerpiece of an entire medical complex currently under construction in Plainsboro, NJ. The current structural system of the hospital is steel framing with a composite beam floor diaphragm. Lateral forces are resisted by eighteen braces frames spread throughout the building and two long moment frames on both the north and south exterior faces. Spread footings are located underneath each steel column to carry the loads to the ground.

The aim of this thesis is to eliminate net tension forces found at the base of the braced frames due to lateral loads. By redesigning the structure in concrete, the increase in building weight should provide enough additional compressive force to negate the tension at the footings. This would eliminate the need for tension-only mini piles to anchor the spread footings to bedrock.

Being that this facility is a hospital which contains sensitive equipment, the second goal of this thesis is to redesign the floor system with the intention of meeting particular vibration standards for sensitive areas including operating rooms, MRI rooms, and labs.

The structural system of the New Hospital was modeled, analyzed, and designed in RAM Structural System. The eighteen braced frames of the original lateral design were replaced with thirteen concrete shear walls placed at similar locations in the building. Even with the significant increase in building mass, wind forces still controlled the design in each of the principal directions. Columns sized at 24" square extend the first four stories of the building and are tapered to 20" square for the remainder of the structure's height. In order to avoid disruption to the floor plan, the column grid was preserved from the original design. Concrete moment frames replace the steel moment frames on the north and south facades of the hospital. The frames are designed to participate more in the east-west lateral force resisting system as opposed to the moment frames of the original design.

An 8" two-way flat slab was designed using RAM Concept and is found on the 1$^{st}$ and 2$^{nd}$ floors. This floor system just meets the 4000$\mu$in/s vibration velocity requirement for areas with sensitive equipment. The thickness of the slab reduces to 7" for the remaining floors in order to meet punching shear requirements. These slabs easily meet the standards for human perception of vibration due to walking.

Redesigning the structure in concrete has significant impacts on the architecture of the hospital. A Revit model of the hospital was created in order to investigate the interaction of the concrete columns with the prominent glass curtain wall on the south façade. The thicker concrete columns are successful at providing vertical breaks to the strong horizontal spandrel panels located at the floor levels. However on the interior side of the lobby, these same columns squeeze the space and at times produce over boding shadows on the lobby floor.

A cost investigation of the two structural systems concluded that the steel system is less expensive but this calculation did not include the additional foundation costs of the original steel system. A schedule analysis determined that the original steel design will be built in a timelier manner than the redesigned concrete structure.