Executive Summary:

The South Patient Tower is a new, 236,000 square foot hospital/patient tower part of the Inova Fairfax Hospital system located in Falls Church, Virginia. The construction costs reach an estimated value of roughly $76 million and the patient tower has several architectural features that separate this structure from a normal patient tower. The façade is composed largely of a curtain wall system with a precast concrete panel assembly to match the surrounding architecture. The main gravity system consists of a two-way flat slab with drop panels resting on cast-in-place concrete columns. The lateral system consists of shear walls and moment frames scattered throughout the building to resist the shears in both the orthogonal directions.

The bulk of this report is comprised of two redesigns of the original structure. Because the existing structure adequately resisted the shear forces applied from both wind and seismic forces, the choice was made to move the structure to a new location. However, before the relocation, the existing structure was redesigned using a one-way concrete slab in place of the two-way flat concrete slab in order to increase the overall stiffness of the structure and decrease torsional effects. The weight decreased slightly due to the redesign, but minimal effects were seen in terms of the base shear values.

A scenario was then created in which the University of California's branch campus located near Sacramento, California (specifically Davis, CA) requested the construction of a similar patient tower to serve the campus. A geotechnical report was obtained for the new site resulting in similar design parameters as the existing site location. The one-way slab system (CA – Base Model) was then used to calculate new wind and seismic forces and account for torsional irregularities.

Finally, two separate structures were designed to meet similar performance requirements. A high performance seismic building was investigated throughout this report. The two designs were intended to meet S-1 "Immediate Occupancy" criteria set forth in ASCE's "Seismic Rehabilitation of Existing Buildings" (ASCE 41-06). The first structure designed modifies the CA – Base Model to meet the requirements for S-1. This design relied heavily on larger members, including thicker shear walls and deeper concrete moment frames. The second model constructed included the use of base isolators to achieve the high performance requirement while keeping the structural member sizes to a minimum. This was achieved by modifying the CA – Base Model and using nonlinear properties to accurately model the isolators in ETABS. Master's level coursework was integrated throughout the report, including the computer modeling of structures (AE 597A), earthquake resistant design (AE 538) and building enclosures (AE 542).

To fully compare the structures designed, a construction management breadth was undertaken which calculated the estimated costs and schedule impacts of requiring a higher seismic performance guideline. Quantities were used to calculate take-offs and daily output values for the structural components to determine the durations for activities. The existing schedule was modified to account for the CA – Fixed Model and the CA – Base Isolation Model. This analysis found that the CA – Fixed Model was roughly $700,000 less than CA – Base Isolated Model and about a month less in overall duration.

Finally, with the relocation of the building to California, the use of a lower U-value glazing system was analyzed to improve the thermal performance of the existing façade assembly in Sacramento, CA. Using H.A.M. Toolbox and TRACE, the existing façade was analyzed for condensation issues in CA. Utilizing TRACE, the main hospital was modeled with a typical patient room as the main focus point. Although the alternate glass system costs more up front, the lower U-value system allows for annual savings to compensate for the additional immediate costs.