Executive Summary

The Race Street Dormitory is a recently constructed residence hall housing students in twelve stories of 4 person suites, 12 suites per floor. Architecturally, it is a sharply angled building with two nearly perpendicular wings. Bays in the building are very typical from the 2nd floor up, as they are predominately identical suites. It is a steel framed building with a hollow core plank floor system and brace frame lateral load resisting system. The structural system was mainly chosen for speed of construction and cost efficiency. Other traditional alternative systems do not compare in speed and cost. This report is an attempt to completely redesign the building in concrete with a system that meets these goals.

The alternative that will be studied is a structural system based around room tunnel form construction. Tunnel form construction is a method of using pre-built forms to form the sides of walls and flat slab together as one. Essentially, the structure becomes a complex shear wall and slab system since wall and slab elements are securely fixed to each other. The system is very economic for uniform bays and very rapidly constructed, as forms are poured one per day, then taken out the next to form another part of the structure. Simple designs are economic, variations cost extra, but blocking off sections of the walls is common practice for all sorts of openings. Problematic variations tend to be different bay sizes, and non rectilinear shapes.

The development of a redesign began with simple layout based on a typical bay within a suite. Problems arose because the building was not as uniform as it seemed- different forms were required, as well as aspects poured outside of the system, lateral resistance became a problem because of the number of walls and reentrant corner. It became apparent that the system was so stringent it could not be applied to design, but designed from scratch. Furthermore, the building would be designed as two structures.

Once a greater understanding the system developed, a uniform center line to center line 10’ high by 10’ wide bay was developed. This 6” slab and 7” walls were designed as well as beams and wall sections to accommodate major cutouts in the wall system on the first floor. Thin wall segments under high gravity loading were checked for capacity using PCA column, slab was reinforced using ADOSS. Wind was found to control in on both directions on one structure, and on one in the other. Walls were reinforced as shear walls based on the lateral load each resists due to its relative stiffness. The weak axis moment induced in the walls due to uneven live loading was found through moment distribution and the shear wall reinforcement was checked for sufficient capacity in this direction.

An architecture layout was performed based on adding the elements of the existing building into the redesign. Floors 2-11 had become more open and spacious due to a larger plan area needed to accommodate the forms. The first floor became clustered as it had been designed for more large open spaces which require deep beams to carry the walls above. A construction timeline was developed to find the time for construction in order to evaluate cost. The estimated time saving is 24 days, not accounting for an elimination of time constructing partition walls. Cost is questionably low, but likely to be cheaper than the existing structure.

Overall the system was effective in achieving design goals of speed and cost, but it came at a high price, and has impacted the entire building considerably. Most of this impact has been negative.