Executive Summary

The following report investigates and discusses the effects of redesigning the above grade gravity and lateral systems of the UNC Imaging Research Building from concrete to steel while maintaining key architectural concepts. Using RAM Structural System, the floor system was reduced from 30" to 24 ¼", opening up 5 ¾" of vertical trade space. This is because girders were limited to 18" in depth. Columns were also kept to a minimal 14" in depth, compared to the typical 24"x24" columns in the existing structure. Also by replacing the existing shear walls and replacing SCBF' as the main lateral force resisting system above grade, the number of lateral frames was reduced while still meeting both strength and drift requirements. With all of the gravity and lateral designs, hand calculations were completed to confirm the results that were determined with RAM.

An overall cost analysis and schedule comparison for the two framing systems was also completed. An initial square foot cost estimate was done followed by a detailed estimate of both options. To make an "apples-to-apples" comparison, only the beams and girders, columns, and lateral frames were evaluated. The cost of the existing concrete system was estimated to be approximately 4.83 million, while the cost for the redesigned steel framing was estimated to be 3.68 million. As far as erection time is concerned, the steel system had the advantage taking only 225 days versus 315 days for concrete, but the use of more crews (other than the suggested amount by R.S. Means) would increase this schedule, increasing the cost as well.

Using the Depart of Defense's Unified Facilities Code, the glass façade on the south face of IRB was designed for blast loading to effectively protect the occupants of the building. It was determined that 5/16" heat strengthened, laminate panels between mullions will effectively withstand an equivalent TNT charge of 220 pounds at a standoff distance of 50 feet. This is the equivalent of a roadside attack by a small compact vehicle. A redesign of this magnitude would certainly incur a cost increase compared to the existing façade, but in today's heightened risk of terroristic attacks, it is a consideration that might be of value.

Overall, it was determined that the steel structure would be a viable alternative to the existing concrete design. While certainly not a complete evaluation of the two systems, the research and analysis done in this report are substantial enough to make this assertion.