Executive Summary

The following report describes the investigation and redesign of the Harry and Jeanette Weinberg Center, Mercy Hospital's Medical Office Building, located in Baltimore, MD. The current structural system is made up of a steel frame composite action slab on deck and braced frames. Previous technical assignments and investigations showed that this steel structure works well for the current building conditions. For this project a zoning regulation change was imposed to limit the height of the building. This new condition would then require that a structural system be redesigned so that the building will meet the new height limitation that is 10 feet less than what is currently in place.

A post-tensioned one-way concrete slab and beam system was proposed for the redesigned structure. Through various consultations this system was singled out because of its abilities to have shallow floor depths and allow concrete to span relatively large distances. This would allow the current column grid layout to remain, insuring that architecturally the floor plan remains as is.

To accomplish this redesign Risa3D was used along with ACI 318, ASCE 7-02 and IBC 2003 code provisions. A slab depth of 8 inches was used and post tensioned to 24 kips/ft with ½" diameter tendons 1'-6" on center. A frame analysis was then performed to find worse case load conditions outlined in ASCE and IBC. The beams have (6) ½" diameter tendons providing a total of 173.4 kips of post-tensioning force. ACI code provisions for minimum required bonded reinforcement controlled the design of many of the beam sections; however, additional reinforcement is provided to enable the beams to work with the columns to resist lateral loads in a concrete sway frame. Columns were then designed using Risa3D which uses the PCA load contour method to determine worse case loadings and design reinforcement as required. After the ultimate strength design was completed, all structural members were then analyzed for serviceability requirements. Limitations were placed at 0.02Hsx for seismic story sway per ASCE 7-02 code requirements and an industry standard of H/400 for service wind loading. Gravity deflections of slabs and beams were compared to the industry standard of L/360.

Acoustical and lighting systems were then designed for a similar conference room to investigate for changes. It was determined that lowering the ceiling heights did indeed impact each of these systems. Reverberation times dropped below required limits and forced tile floors and wooden seats to be installed to bring the times up to an acceptable value of 0.96 seconds. Lighting spacing criteria was changed enough that additional lights would need to be added to provide adequate lighting for the room.

The current steel structure is estimated as costing $1.84 million and requiring 11960 labor hours while the redesigned structure is estimated at $1.9 million and requiring 26000 labor hours. These were both determined to be reasonable given that the percent of the structural system cost of the whole project went from 9.2% to 9.5% showing that the two systems are economically competitive. Also, given that the overall building height was reduced by more than 11 feet this report concludes that under the building height limitations a post-tensioned concrete system is a preferred alternative to steel construction.