Executive Summary

Global Village is a European-inspired complex that provides commercial and residential space for the campus at the Rochester Institute of Technology in Rochester, NY. Each location has been designed to incorporate themes and materials that represent different regions from around the world, including marble from Italy and wood siding from Denmark. Global Village is a four-story building that also supports a fifth story dedicated to mechanical equipment; making it rise to an overall height of 62.5 feet. The building is constructed of steel with metal deck and lightweight concrete at the first, second, and third floors while the other floors have wood framing. The building's main lateral-resisting system consists of concentrically braced frames in both directions.

This report focusses on altering the existing dual structural system to a more uniform system. Concrete was chosen as the main material since most on-campus residential buildings are constructed of either concrete or masonry. A reinforced concrete flat plate was then selected for the gravity system due to its flexibility to work around the floor plan. Columns were placed as best as possible to avoid altering the floor plan. However, some interior columns interfered with the fan coil unit areas located on the third floor and thus the fan coil units had to be relocated. A new floor plan for the second floor was also designed as a result of the new column layout.

After the column layout was finalized, column sizes were found using hand calculations and verified using spColumn. The size of the column was mainly dependent on the unbalanced moment transferred by eccentricity of shear. Multiple slab thicknesses and column sizes were tried and a 20" by 20" column with (8) #10 bars was determined to be adequate. A slab thickness was then found using Table 9.5c of ACI 318-08. The table gave a minimum slab thickness of 8.25" but since deflection checks were inadequate, the slab thickness was increased to 8.5". In order to calculate the required reinforcement due to gravity loads, a spreadsheet following the direct design procedure was created. The spreadsheet was also used to design the reinforcement for the moment connections.

To analyze the proposed buildings lateral system, a model was built in ETABS and was used to check story drift and to find column moments in order to design the moment connections. These moments were input into the unbalanced moment section of the spreadsheet and the reinforcement was designed. The maximum drifts in both the N-S and E-W Directions were controlled by loads due to seismic. The total drift from ETABS in the N-S Direction is 1.751" and 1.488" in the E-W Direction; which are well below the allowed 10.441". As a note, a maximum total drift of 1.696" caused by wind in the N-S Direction is below the allowable 1.740". As a result, the lateral system is adequate for drift.

As a result of using concrete as the main structural material, many areas in construction and building serviceability are improved. The use of concrete provides a more durable building and improves the fire rating. A drawback of using concrete is that the cost of the proposed building is more than triple the cost of the existing building. RSMeans was used to calculate the cost of each system and it was found that the proposed structure costs $1,826,436 where the existing design was calculated to cost $571,588.