## 9.0 - SUMMARY

Using steel, the entire structure becomes lighter. This reduces the amount of dead load on the foundations under gravity columns. This reduces the amount of concrete and reinforcing steel needed for these foundations, decreasing the construction cost.

There are some drawbacks to the proposed steel structure. It was determined from the RAM analysis that the deflections under a code designed earthquake are about ¼" greater than the limit of H/400. The schedules are impacted because a building designed in steel has a much larger lead time that a concrete building. The individual steel members must be fabricated weeks before they will be put in place. This leaves little room for error in the final design stages of the building. The proposed steel structure will have added height of 1'-4" per floor. This will increase the area of the thin brick panel veneer needed for the façade.

There will also be an added cost associated with the steel connections. Fully restrained moment connections are required to resist the wind and seismic forces. The extensive amount of welding for these connections will drive up the cost.

The Towers could have the potential for a LEED certification with a proposed steel structure. The location of the site and the use of steel could possibly earn points. A more efficient building envelope was studied and the use of cellulose loose fill insulation can decrease the amount of heat transfer through the wall from 2.42 BTU/hr to 2.09 BTU/hr as well as help earn LEED points for material reuse.

The construction cost and schedule were impacted by changing the structure from concrete to steel. Although the exact concrete structure cost was unable to be obtained, it was determined that the approximate cost of the steel was equal to $5.4 million. Using MC2 and RSMeans, it was determined that the steel structure would cost approximately $5.6 million. The construction of the concrete frame took 140 days. Using production rates provided by RSMeans, the duration of the construction of the steel structure took 95 days.

## 10.0 - CONCLUSION

A thorough investigation of a proposed steel structural frame for The Towers was performed and was compared to the existing concrete structure. A steel structure was chosen to investigate to eliminate the need for columns in the corners of the building where the floor to ceiling windows are located. The two structures were compared based on construction cost, schedule and impact on foundations.

A steel structure is a viable option for a structural system for The Towers. Using steel, the corners of the building with the corner windows can be cantilevered, leaving the windows free of any structural members. The columns can be lined up on a regular grid, which will make the structure easy to construct. This grid also reduced the number of columns that the original structure had. From a construction standpoint, steel is a practical structural system because it is a common practice in New York City. The foundations for the proposed steel building are significantly smaller than the foundations for the concrete structure.

Based on schedule and foundation impact, a steel structure is a practical option for The Towers and could be a recommended solution. Although the cost for the steel is slightly higher than the concrete, nine weeks were saved in the erection time. The foundations for the steel structure are significantly smaller than the foundations for the existing concrete structure. Steel is also a common construction practice in New York City, which further makes constructing a steel structure possible.

There are some drawbacks for making the structure steel. A steel structure impacts the architecture considerably. The floor to floor heights for the steel and concrete designs is 10′-0″ and 8′-8″ respectively. Therefore, the steel produces an increase in height of 13′-3″. This will cause an increase in area of the precast thin brick veneer, which in turn will increase the cost. Fully restrained moment connections will be needed to resist the wind and seismic loads imposed on the building. Fully restrained connections require extensive welding which will add to the construction cost of the building. Also, the steel designs require a larger lead time, meaning the design of the structure must be complete in time for the steel to be fabricated.