Final Conclusions and Recommendations

Limiting the drift of a tall building does not guarantee satisfactory motion perception performance due the accelerations caused by wind. The high wind velocities of the Atlantic Ocean shore line cause high along-wind, across-wind, and torsional accelerations on the upper levels of the Trump Taj Mahal Hotel. These accelerations are much higher on the lighter and more flexible steel braced frame core as compared to the rigid and heavy concrete shear wall core.

Because of its behavior to the high velocity wind of Atlantic City, the steel braced frame core designed in this study may require supplementary mass and damping in the form of a liquid-tuned column damper or a tuned mass damper. These devices can add substantial costs to the project; in the realm of $2 to $3 million. However, only parametric RMS acceleration calculations were performed in this study to determine the dynamic response of the steel braced frame core. In order to absolutely verify that a tuned mass damper will be required, complex wind tunnel studies must be performed.

Other costs are incurred when converting a concrete system to a steel system. Because of the 10 inch floor to floor height increase, additional costs were incurred due to increased runs of elevators, MEP equipment, and curtain wall glass and framing; as well as steel fireproofing and the addition of fire-rated partitions. The wind tunnel loads used in this report were determined for a tower that was 30 feet lower than the redesigned steel tower. This will impact the wind loads in such a way as to increase the magnitude, and thus, the strength and drift requirements. This could result in a more costly braced frame core. However for the purposes of this study, the increase was neglected (the height increase is only 6%).

The overall cost of the redesigned steel structure is in the realm of $1 to $2 million more than the concrete shear wall and filigree system if a tuned mass damper is required. Even if the steel structural frame and precast floor is completed approximately 1 month prior to the concrete frame, the additional time required to install the tuned mass damper and all required additional architectural and MEP components (curtain wall, partitions, fireproofing, soffits, etc.) will negate some of the time saved during erection. This indicates that the redesigned steel structure may top out at approximately the same time as the concrete system and may cost more overall as well.

The final conclusion and recommendation is to keep the existing concrete shear wall core and filigree flat plate system. A braced frame core was found to limit the drift of the building within an acceptable range; however the dynamic behavior may prove to cause building occupants to experience motion perception in the form of accelerations. The filigree flat plate system accommodates the architecture of a hotel tower without any negative ramifications. It is concluded that a project of this size requires years of professional design experience to fully understand the behavior and design considerations. However, results of this study do shed light on advanced high-rise design topics which can be used for further study.