Executive Summary

This paper contains the development and detailing of the lateral system for Paseo Caribe, a 22 story high end apartment complex and parking structure located in San Juan, Puerto Rico. The building is located in a high seismic zone and needs to comply with code requirement according to the UBC 1997. The current building is a bearing wall system out of cast-in-place concrete. The high seismic requirements, large weight of the building, and multiple lateral irregularities of the lateral resisting elements resulted in an over design of the current lateral system.

A study was conducted to evaluate the feasibility of a new system that would allow for a reduced and more efficient number of lateral elements. The preferred lateral system for high seismic zones will have a ductile behavior and its behavior should be predictable. The location and development of plastic hinges should be dictated by the designer to minimize the impact on the structure. This paper attempts at modeling the requirements for coupled shear walls in high seismic zones. First, a frame gravity system was introduced in order to minimize the weight of the building and increase the R value allowed by code for the calculations of Vase Shear from the current 4.5 value. From the results of the new gravity system, the lateral elements were modeled. Major changes in the lateral system include relocating the walls away from the core in order to minimize the impact of torsion, the use of higher strength concrete, and thicker walls (24" from 12") coupled with diagonal reinforcement.

A large part of this project was devoted to selecting the appropriate location of the walls and modeling the impact of the different configurations with the architecture, story displacements, and the redundancy factor, ρ. The frame system's weight and required height had to be incorporated with the lateral design. Finally, once the pier forces were obtained from the software program, ETABS, the walls were sized and detailed. Considerations include flexural strength, shear capacity, boundary zone tie detailing requirements, and diagonal reinforcement requirements in the coupled beams. An analysis based on virtual work was performed on a typical wall in order to predict the location of plastic hinge development. A recommendation is made for the design of the shear walls based on a magnified shear demand that will ensure flexural hinging at the wall base prior to shear failure.

Other considerations in the design include a study of architectural advantages of the new open frame design, acoustical performance between spaces, and a vibration study. Finally, a cost comparison is made for changes in the design as applicable to the United State and Puerto Rico.