Executive Summary

A redesign of the building structure was completed using post-tensioned concrete. To minimize the structural depth, a one-way post-tensioned slab was designed in the long direction of the building, supported by wide shallow post-tensioned girders in the short direction. Between the girders the centerline spacing was 30'-0", therefore post-tensioning for an 8" slab was designed using ADAPT PT. The slab was divided into 4 different zones, based on the number of spans and span distances, and individually designed. A hand calculation verified the amount of conventional reinforcement determined by the program. 60"x20" typical girders were then designed to support the slab. Only 3 individual girders were specifically designed.

1. A typical girder
2. A girder adjacent to two slab openings
3. A 5th floor transfer girder

The second of the three girders provided a unique case, due to the lack of an effective flange width, which helps decrease the precompression stress. To limit the precompression stress, the amount of tendons in each span had to be varied. Roof loads are transferred at the back of the building to the PT girders. It was necessary to see if the girder was capable of supporting the column's axial load. A design was achieved, but the girder depth had to be increased to 24" in the third span.

Concrete moment frames were then used to resist the lateral loads on the buildings. All nine frames in the short direction of the building were used as moment frames, while exterior perimeter beams were introduced in the long direction. An ETABS model of the lateral system was created, with reduced moment of inertias of 0.70 for columns and 0.40 for beams. Maximum deflections from ASCE 7-05 wind load case 1 were successfully limited to L/400. Story drifts created by the increased seismic loads were well under the allowable standard of 0.02*hsx.

Torsional capacity of the transfer girders was then determined sufficient enough to resist the ultimate torsional load without additional reinforcement. A column part of the lateral system was then designed, considering P-Δ effects. A 24"x24" column with a concrete strength of 5000 psi was capable of supporting the load with (12) #11's. The percent of steel exceeds the 2%, requiring some form of mechanical rebar splice.

Cost and schedule comparisons performed between the new and existing structure. Only the structure itself was investigated. The steel framing was both more cost efficient and quicker to erect. A total of 70 days was required for the concrete system, while the steel only required 50 days.