Structural Breadth, Analysis II:

Partial Redesign of Post-Tensioned Slabs with Alternative Systems

Problem: The current cost and schedule projections are behind what was initially planned one year ago. After discussions with the project manager, project engineer, and the superintendents, it was found that the complicated post-tensioning slabs in the St. Paul building slowed the schedule extensively. The second-fourth floors of the St. Paul building are extensively complicated and include high live loads from dining and meeting spaces. Also the second floor features a large open staircase and a perimeter open space making post-tensioning much more convoluted. In addition, the post-tensioned slabs are on the critical path for the project and were underestimated in scheduling.

The alternatives for a two-way partially post-tensioned slab on the second-fourth floors of St. Paul building are few and far in between when the building height cannot be compromised. First, it is important to define what components are already incorporated in the existing structure:

- *Post-tensioning* – standard four-strand tendons are in bundles comprising of one up to thirty-four tendons.
- *Concrete* – 4500 psi and 6000 psi concrete is used at 8" thickness used to hold live loads at 125 psf.

- *Concrete reinforcing* – a partially post-tensioned system requires various rebar located at the top and bottom of the slab to take loads residual from the post-tensioning and increase stiffness.
- *Drop-caps* – spans averaging 26' require drop-caps of 16" depths

Alternative Analysis and Redesign: Forming, delivering, placing, and tracking all of these different components for a structural slab is what makes post-tensioning difficult. Alternatives for the second-fourth floors of St. Paul consist of:

- *Flat plate reinforced concrete slab*
- *Two-way reinforced concrete beams with flat plate reinforced concrete slab*
- *Two-way reinforced concrete beams with precast hollow core planks*

Value Engineering: Equipped with a detailed estimate of the existing structure, a detailed estimate of the three proposed alternates would prove the most cost-efficient structure.

Constructability Review: A constructability review discussing the factors of site congestion, weather, formwork, and crew experience would isolate the best solution to construct.

Schedule Reduction: The schedule reduction associated with each alternative would take in consideration the installation of formwork for the slabs, bending rebar and setting post-tensioning tendons, setting embeds, pouring each floor altogether, stripping the formwork, and stressing the tendons.

Anticipated Results: The redesign will require more concrete and more reinforcing in nearly all cases. The justification will be schedule savings, constructability, and general conditions cost savings.