5th and Jackson Building

By Tom C. Xia Ph.D. SE

The 5th and Jackson Building and DCI Engineers (Bellevue, WA) were presented an Outstanding Project Award (Buildings $5M to $25M in Construction Value) in the NCSEA 2003 Excellence in Structural Engineering Awards program.

The 5th and Jackson Building is a ten-story commercial/office building with two levels of underground parking garage. The building is located in downtown Seattle on a very demanding site. The footprint of the building covers essentially the entire site with little room for shoring. There are two underground Metro bus tunnels going through the entire length of the site. Both tunnels are made of thin concrete shells that are sensitive to any overloading. Although there were caisson casings installed between the tunnels for a future structure, a large corner of the building will have to be built over the tunnels without any footing support. At the south end of the building, the structure has to be built over the existing machine rooms that must stay in operation at all times. Prior to the design of this project, two developers tried and failed to make this property a financially viable site for an office building. It is a great challenge for the structural engineer to solve these design problems and keep the project within budget.

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It is obvious that concrete construction is a good choice for the foundations and the two underground garage levels. For floors above the ground level, however, steel framing was used to reduce the building weight. In comparison with an all-concrete structure, the total structural weight is reduced by 40%, which is significant in terms of reducing the gravity load and seismic demand on the foundation.

After careful study of various foundation options, a mat foundation supported by caissons was selected to transfer building loads to the soil below the tunnels. The depth of the mat foundation varies from 2 ½ -feet to 6-feet, depending on the gravity and seismic loads. This design approach gave the architect the freedom to place building columns and shear walls efficiently without the restraints of existing caisson locations. This is a dramatic improvement in comparison with a previous design by a different team. In that design, building columns would be randomly located per existing caisson locations. As a result, it would not only require costly framing to transfer building column loads at the upper levels, but also prevent the underground levels from being used as parking garage, vitally important for an interurban project like this one.

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The use of a mat foundation also allowed the engineer to solve other design challenges. At the northwest corner, where the building

has to be built over the tunnels without footing support, concrete basement walls were designed as deep beams with the mat footing and the floor slab as beam flanges. At the south end, two 18-inch concrete walls are used as the cantilevered beams to support the structures that are built above the existing machine rooms for the Metro bus tunnels. Along the west property line, where there is no easement for shoring anchors, the caissons and mat foundations are used as the foundation of the internal bracing to support the 8-inch micro piles for shoring.

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To maximize rental spaces, the owner added a floor to the building prior to submittal for construction permit. As a result, the story height for a typical floor was reduced from 12'-4" to 11'-8". With a ceiling height of 8 ½ - feet, this design change created a great challenge for the team to place mechanical and electrical ducts with minimum beam penetrations. After extensive study of different steel framing options, a cost effective solution was fond. Since the building floor plan is long in one direction and narrow in the other, the 24-inch deep girders are placed along the long direction, and the 12-inch beams were placed along the short direction. This approach allowed all mechanical and electrical ducts to go under the 12-inch beams without any penetration. There are only 4 places along the interior girder line where beam copes are required. What is amazing about the steel framing is that the steel framing weight for a typical floor is only 6 pounds per square foot.

To reduce the construction schedule, special details are designed to allow the fly-form of concrete shear walls during the construction of the two levels of garage. This insured the completion of casting the concrete walls before steel erection. As a result, it took only two weeks to erect all structural steel for the ten-story building. This creative construction method not only avoided the cost of re-mobilizations between steel and concrete sub-contractors, but also reduced the overall construction schedule significantly. Despite all the design challenges and complications created by the unforeseen site conditions, the project was completed on time and within budget. It is truly a team effort that leads us to the success of the design and construction of this project. The role of structural engineer as a team member is well recognized.■

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