PROJECT PROFILE

CONCRETE DIAPHRAGM CUTOFF WALL FOR HOTEL PARKING GARAGE

The Milwaukee Center project comprised construction of an office tower ranging in height from 16 to 30 stories, including an 11-story hotel tower and a low-rise theater and retail area. The project required 800 parking spaces, and the only available space for a parking garage was beneath the proposed construction footprint.

Office tower and hotel associated with the Milwaukee Center project.

Potential difficulties associated with construction of a four-story-deep underground parking garage beneath the site included the location of the Milwaukee River within 10 feet of the site and the proximity of two historic buildings - the Pabst Theater and the old Wisconsin Electric Power Building. These structures were founded on timber piles and were located within five feet of the required excavation for the garage. A tieback system was not possible because of the timber piles supporting the historic buildings, and an internal bracing system was determined to be too difficult and costly. Freeze wall construction was ruled out because it would entail permanent water cutoff.

After evaluation of various construction alternatives, it was determined that the best way to overcome the geotechnical issues and site physical constraints was to build a perimeter slurry wall and to employ "top-down" construction methodology, whereby below-grade areas would be constructed concurrently with the erection of the building superstructure. The sequence of foundation construction consisted of:

- Installation of a structural concrete diaphragm wall using slurry wall techniques to form the perimeter foundation of the building
- Construction of drilled shafts within the perimeter foundation wall to support internal building column loads
- Excavation of soil within the perimeter wall to the first level of parking and construction of a structural floor slab integral to the wall and shafts, and
- Repetition of the previous step until the lowest parking level was reached

The slurry wall needed to extend between 80 and 130 feet below grade, terminating in a dense, relatively impervious glacial till. A preconstruction pump test was performed to determine whether it would be necessary to dewater the site prior to construction. It was determined that a high pumping rate would be required to dewater the site and that this would adversely affect surrounding structures. Thus, it was decided that the slurry wall would have to be designed to resist the site ground water pressures.

In support of the foundation design, D'Appolonia conducted finite element analyses for evaluation of the required diaphragm wall thickness, permeability and depth, so that the pressure associated with the ground water surrounding the excavation would not affect construction activities or long-term operation of the facility. The analyses were performed using the GEOFLOW software, a code for numerically simulating two-dimensional fluid flow and solute mass transport in confined, semi-confined, and unconfined ground water systems.

After completion of the slurry wall construction, the interior area to be excavated was dewatered by five wells to a depth of more than 50 feet. Piezometers installed outside the slurry wall showed little change during the interior dewatering. The inflow of ground water through the slurry wall was measured and was found to range between 150 and 200 gallons per minute. This was close to the predicted inflow and could be easily handled by a sump pump system. Observed movements of nearby structures during construction was found to be insignificant.