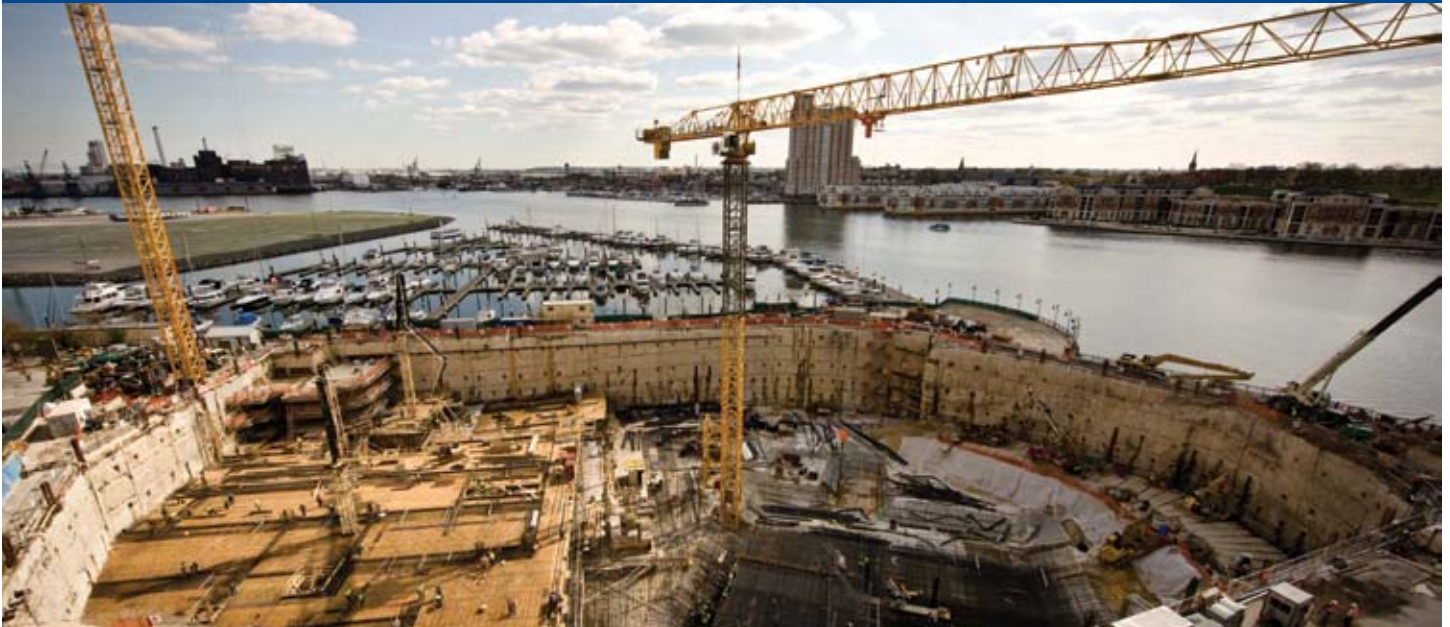


FOUR SEASONS HOTEL AND RESIDENCES

Baltimore, MD



The prestigious Four Seasons Hotel group chose the vibrant heart of Baltimore’s Inner Harbor as the location for its newest luxury property. Inner Harbor, known as the crown jewel of Baltimore, is one of the most visited and photographed areas in the city.

The Four Seasons Hotel Baltimore is a massive, 745,000-square-foot, 44-story structure that features 256 hotel rooms, 143 upscale condominiums, a world-class spa, fitness facilities, banquet and meeting spaces, a signature restaurant, bar and lounge, and five stories of below-ground parking.

PROJECT BACKGROUND

The vision for the Four Seasons Hotel Baltimore was a relaxing, urban, waterfront retreat — nestled directly in Harbor East, the city’s up-and-coming district.

The site is approximately 20 feet from the harbor’s waters. To accommodate the hotel’s design for a five-story, below-ground parking garage in such close proximity to the harbor, the foundation for the entire structure had to be constructed below the water table. The foundation’s design and development was further complicated by the hotel’s unique, asymmetrical shape and

Owner:

Harbor East Parcel D, LLC

General Contractor:

Armada Hoffer

Technique(s):

Diaphragm Wall, Tieback Anchors

Subsurface Conditions:

Fill, Silty Organics, Cretaceous Sediments, Varying depths of decomposed rock

Approximate Key Quantities:

Diaphragm Wall	90,000 square feet
Tieback Anchors	520

the presence of existing structures along the southern property line.

THE WORK

In the design phase for the foundation of the project, completed by Mueser Rutledge Consulting Engineers and ADSC Technical Affiliate Members, it was determined that an anchored structural diaphragm wall needed to be constructed for both support of excavation and protection from seawater infiltration.

It was also determined that the anchors along the south diaphragm wall, which would extend beyond the bulkhead, had to be anchored into the bedrock beneath the East Harbor active marina. A three-dimensional CAD model was used to avoid potential conflicts when installing the tieback anchors along the north wall, where the northeasterly diaphragm wall curves and then straightens back out.

Nicholson (as part of a JV with Inquip) was contracted to construct the 90,000 square-foot anchored diaphragm wall and install the tiebacks for the site. The schedule for the diaphragm wall was aggressive, and called for the construction of the wall and the installation of over 600 tiebacks to be completed in 10 months. To meet that schedule, two rigs were used working 10-hour shifts to excavate and cast the diaphragm wall panels. Construction of the wall was completed in five months, including the mobilization of an on-site slurry mixing and de-sanding plant.

The approximately 1,300 linear feet of perimeter diaphragm wall consisted of 56 panels, each



Anchor installation through diaphragm wall

averaging 23 feet long, with the exception of the primary panels, which were 18-23 feet long. The average height of the panels was 68 feet.

The depth of excavation varied from 60 feet along the diaphragm wall to 68 feet toward the middle of the site. Based on the depth of excavation, the high groundwater table and the nature of the soils at the site, a 30-inch thick wall was used to keep anticipated wall displacements to a minimum and to provide efficient panel reinforcing.

More than 520 tieback anchors, ranging from four strands in the upper rows to as many as 27-strands in the lower rows and totaling approximately 55,000 feet, were installed to laterally support the diaphragm wall.

Groundwater cut off was of prime importance for this project. The diaphragm wall was used to cut off the groundwater flow into the site and to permit the installation of an under-drainage system. Because of the site's close proximity to the harbor seawater and the bulkhead, a water-stop within a panel joint was recommended in

the original design to ensure a water-tight joint. An H-pile joint was shown on the contract drawings as the connector and joint between panels. The H-pile would be used to ensure a reliable method of keying the panel joints, thus minimizing the differential movement and providing the required water-stop. However, the tight construction schedule did not allow for the time required to obtain the H-piles. The contractor opted to use the proprietary Coffrage avec Waterstop (CWS) joint developed by Nicholson's French parent company, Soletanche Bachy. The CWS forms a water-tight joint between the panels of the slurry wall while providing the required shear key to prevent relative movement between adjacent panels. The CWS end stop casts a continuous water barrier within the concrete and provides a positive water barrier at the joint. The CWS joint solution was successful in terms of performance, and it also eliminated the additional time and costs associated with the H-pile solution.

THE RESULT

The \$197 million Four Seasons Hotel Baltimore is the centerpiece of a redevelopment effort that stretches across six blocks, connecting Inner Harbor to its surrounding neighborhoods. The initial financing for the project was granted as part of a government-sponsored stimulus package intended to "jumpstart" Baltimore's economy. The construction of the hotel created an estimated 1,273 jobs and the opening of the hotel will create close to 600 new, full-time jobs in the Baltimore area.

The hotel will welcome its first guests in November of 2011.