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BOSTON COMMONWEALTH PIER # 5 PROJECT PROFILE

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World Wide Project Reports

Geofoam™ Low Density Cellular Concrete Replaces Heavy Fill on Boston Waterfront

Boston World Trade Center (Commonwealth Pier)

Landmark building conversion into high tech office and exhibition center. Renovation and expansion of pile-supported Commonwealth Pier. 850,000 sf.

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To convert a building on the Boston waterfront into a 850,000- sq-ft World Trade Center, the construction team first had to lighten the load on the aging earthen pier that supports it.

The pier was constructed at the turn of the century from harbor bottom back-filled inside a granite block quay wall. The wall encloses an area 1,150 ft long and 300 ft wide. The earthen pier was subsequently covered with a concrete slab on grade. The 50- ft-high, steel-frame building was constructed in 1913. The building is carried above the pier by 570 steel columns resting on pyramidal, 10-ft-high pile caps of unreinforced concrete All of the estimated 1,000 friction piles end far short of bedrock. The two outboard rows of columns rest on concrete caissons bearing on bedrock.

A major obstacle in the renovation was the different soil conditions at either end of the pier. Lateral earth pressures on the quay wall, coupled with down drag at its bottom, overstressed piles supporting the wall, causing it to rotate landward and settle. An analysis of the pier by Geotechnical consultants Goldberg, Zoino & Associates, Upper Newton Falls, Mass., showed that the pier was just barely within safety limits.

New team. A development team headed by the Pier 5 Limited Partnership renovated the pier and structure, called Boston Commonwealth Pier No. .5, a historic landmark. The partnership, which took over the project, shelved the original concept of converting the pier to a high-technology center called Boscom. The partnership was the John Drew Co., a Boston developer, and O'Connell Brothers Construction, Quincy, Mass., construction manager for the $70-million World Trade Center. The Boston office of Gilbane Building Co., Providence, assumed from the $6-million construction management contract for below-grade work. The current renovation, designed by Boston architect Jung/Brannen Associates, Inc., calls for 400,000 sq ft of office space, 120,000 sq ft of exhibit space and 200,000 sq ft of display rooms. A 40,000 sq.ft. mezzanine for meeting rooms and an auditorium was built between the slab-on-grade and the first floor level above it. The mezzanine adds about 70 psf of dead load and about 100 psf of live load, says Rimas Veitas, engineer with the Cambridge office of structural engineer Weidlinger Associates.

The solution chosen was to remove existing fill and slab to depths of as much as 10 ft. along the quay wall and 3 ft. at the center, 78,000 cu. yd. and replace it with an equal volume of low-density Geofoam ™ cellular concrete. The lightweight material, poured in sections, relieved loads on the relatively weak, highly compressible organic deposits by replacing material that weighs about 120 lb per cu. ft. with material that weighs 36 lb. per cu. ft. This relief reduced the consolidation of the existing soils, relieving the down drag on the foundation piles and the pressure on the quay wall.

Settling slowed. The lightweight pour reduces settlement at the center of the pier to two inches in the next 40 years, says Robert J. Palermo, project manager with GZA. Palermo says the pour stabilizes the pier and offers a controlled pattern of settlement acceptable to the structural engineer. GZA and Weidlinger recommended the lightweight concrete pour after studying the stability of the pier's underpinning on behalf of the owner, The Massachusetts Port Authority, and the original developer. New winged footings will take up the loads that exceed the capacity of the piles and disperse it into the poured material beneath it and into tile foundation system. Louis J. Miorielli, of Eastern Cellular Concrete Associates, Hazelton, Pa., the lightweight concrete subcontractor, says the job used a record volume of low-density concrete. Eastern Cellular used three custom-designed, high output batching rigs to prepare the proper mix of cement, water and low density cellular concrete foam. The concrete contains 80 % air by volume, is a quarter of the weight of conventional concrete and has a minimum compressive strength of 80 psi. Cellular Concrete Solutions, Allentown, PA. (formerly Mearl Corp.) supplied the Geofoam liquid foam concentrate used to make the lightweight concrete.

Because the quay wall is permeable and beneath the level of high tides, general contractor J.F. White Contracting Co., Newtonville, Mass., faced a problem in holding down the lightweight material. To solve it, workers built a system of reinforced concrete beams. The beams connect the piers carrying the perimeter steel columns above the quay wall. The lightweight concrete pour in that area was spread under the beams, which hold the concrete in place using the weight of the building. Pumps drained the inner foundation area.

At one point, progress of the lightweight concrete placement was slightly delayed because the tides weren't charted carefully enough. Eastern's crew poured a section of lightweight concrete at the perimeter of the pier. The next morning they found that the pour had floated away. After that, pours had to be timed more carefully to nature's rhythms.

"We put lunar charts in our offices," says Bert Speranza, project engineer for Gilbane. "We all consulted the moon."

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