Port of Miami Makes Room for Super Ships

By John Miller

Feature

Overview

Opened in 1905, the Government Cut is a manmade shipping channel between Miami Beach and Fisher Island, which allows better access to the Port of Miami in Miami, Florida. Before the Cut was established, a single peninsula of dry land stretched from what is now Miami Beach to what is now Fisher Island, and boats destined for the port at the mouth of the Miami River had to pass around Cape Florida, to the south of Key Biscayne.

Unseen on most maps are the water and sewer mains that traverse the Cut to service the citizens of Miami-Dade County. The existing mains were installed using the cut-and-cover method. The mains pass under the navigable sections of the Cut and Fisherman's Channel with burial cover depths ranging from about 5 to 20 ft below mudline. These mains are being replaced as part of the Miami Harbor Dredging Program that will deepen and widen the main channels by up to 20 ft in order to accommodate the Post-Panamax "Super" Ships. Upon its completion in 2014, the Port of Miami will be one of only three East Coast ports capable of accepting these new larger ships.

The Team

The ADSC was represented in many scopes throughout the construction of the project. ADSC Technical Affiliate Member, AECOM was retained to assist in collecting the necessary data, developing the conceptual design, acquiring the necessary permits and easements, and procuring a Design-Build team to complete the work. That team included ADSC Technical Affiliate Member, Kaderabek Company (KACO) working as the soil engineer along with general contractor Ric-Man Construction. Also involved was ADSC Associate Member, International Drilling Equipment, Inc. (IDE) who provided a Casagrande M9 and a Casagrande C850 for the launch and retrieval secant pile shafts.

Project

The project required the Design-Build of a 80 ft deep and 850 ft long 72 in diameter microtunnel from the Port of Miami to Fisher Island to replace an existing 20 in water main and a 72 in diameter micro-tunnel from Fisher Island to an in-water shaft south of South Beach. The 1,200 ft, 72 in micro-tunnel was installed at a depth of 80 ft and will carry a new 54 in diameter sewage force main, replacing the existing force main which transmits waste water to Miami-Dade Water and Sewer Central District Wastewater Treatment Plant on Virginia Keys.

Soil Conditions

The subsurface conditions along both main alignments were found to be quite similar, consisting of the Fort Thompson formation, a very porous coralline limestone with inclusions and layers of loose to medium sand. Up to six layers were found with significant variability in the vertical direction. The limestone bedrock layers of this formation are characterized as karstic, exhibiting vugs and solution cavities of various sizes.

The Fort Thompson formation is part of the Biscayne aquifer, a surficial aquifer system in southeastern Florida, and

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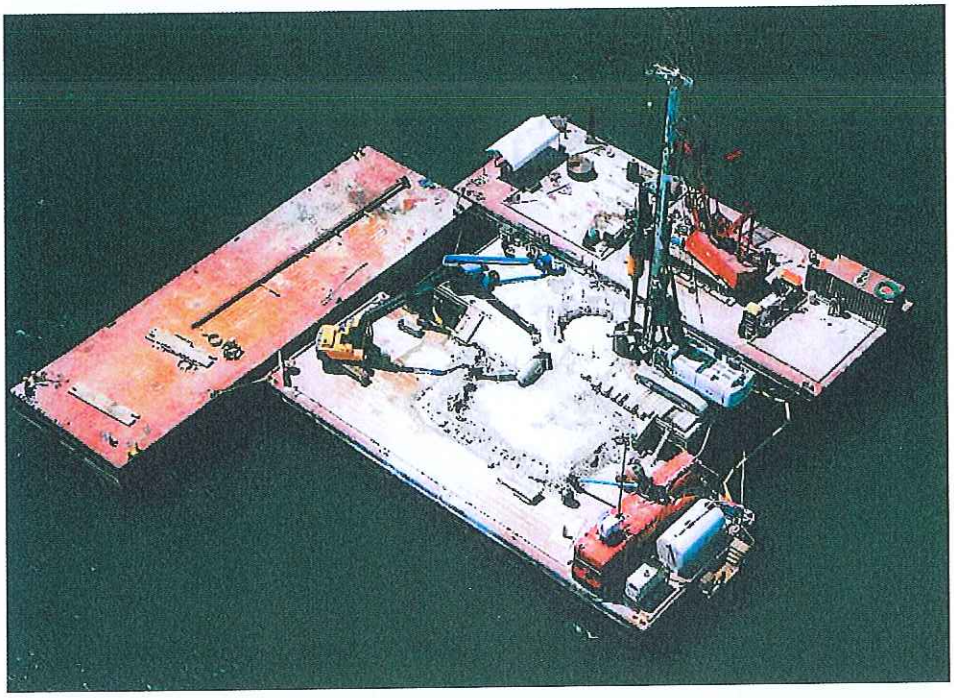

is classified as one of the most permeable aquifers in the world due to a combination of solution pipes, vugs and matrix porosity. The Fort Thompson Formation bedrock layers exhibit extremely variable intact and rock mass properties. The intact core samples had UCS values ranging from as little as 50 psi to as much as 12,000 psi, although typically below 4,000 psi. In the project area the maximum in-situ permeability of the Fort Thompson bedrock was found to on the order of 5 cm/s, making it some of the most challenging geology in the world for mircrotunneling.

The soil conditions represented several challenges for completing the retrieval and launch shafts, including mixed face conditions with competent zones embedded in softer materials, sudden and large scale water inflow from karst feature or "super-k" zones, flowing sands, and rock mass with frequently changing deformation and hydraulic conditions.

Drilled Shafts

The launch and retrieval shafts utilized unreinforced secant piles with internal metal CMP (annulus filled with concrete).The project team drilled 34 holes for the launch shaft and 23 holes for the retrieval shaft. All holes were 42 in in diameter to a depth of 100 ft on the launch shaft and 80 ft on the retrieval shaft.

Both shafts together required 1,000 cubic yards (cy) theoretical and 1,200 cy and include Sika Plastiment ES and AEA. The project team also used fly ash and retarder to delay strength for drilling secondary secants with 10 in overlap.

Due to the tunnel being approximately 80 ft below sea level, the shafts had to be water tight. The secant pile installation required pre-grouting to avoid and voids. This was accomplished by using the Casagrande M9-1. The proximity of the existing live water main made for the verticality of the piles to be crucial. The verticality tolerance for the 110 ft deep shafts was .05%. All the installed shafts were well within the required parameters at no more than .03%. This was achieved greatly in part by using a 3 ft thick guide wall, double wall segmented casing and the Casagrande C850) drill rig.

Launch Shaft

The launch shaft was excavated in-the-wet inside the secant pile wall. A 21 ft diameter corrugated metal plate liner was also installed in the excavation in sections and centered within the secant pile structure. A reinforced concrete plug was constructed in-the-wet to resist buoyancy forces.

Retrieval Shaft

Concurrent with the launch shaft construction, the team began construction of the force main (FM) retrieval shaft. This retrieval shaft was considered one of the most challenging aspects of the project. Not only did this shaft serve as the Tunnel Boring Machine (TBM) retrieval shaft, but also had to be enlarged and constructed over the footprint of the existing FM. Most challenging was the fact that all the work took place on barges over water approximately 15 ft deep and 330 ft from the shoreline. This challenging overwater work required construction of an integrated, impervious excavation support and bottom slab system through pervious sands and limestone without the use of dewatering. This work had to be accom-

plished without damaging or impacting the existing FM located with an invert about 20 ft below mudline because it had to remain in service. Once completed, the retrieval shaft was 13 ft in diameter.

Special Challenges

In addition to the numerous typical challenges related to soil conditions and over water conditions, the project had several other conditions to contend with during the process.

Time Frame

All existing mains under the Government Cut needed to be lowered or relocated to allow dredging of the shipping channel before the opening of the Panama Canal expansion, scheduled for completion by summer of 2015. Failure to meet this requirement will result in liquidated damages of $5,000 per day.

Location

✓ The launch shaft located on Fisher Island had no land access.
✓ The retrieval shaft was located in open water outside of the shipping channel.
✓ The addition of a second launch shaft in South Point Park in Miami Beach.
✓ All areas were within the 100 year flood zone and hurricane red zone.
✓ The water area part of Biscayne Bay Pristine Area had strict environmental restrictions.

Logistic

✓ The staging area was located within a secure area of the Port of Miami.
✓ All access to Fisher Island and in-water platform was via barge or tender boat (men, material and equipment).
✓ All concrete was produced onsite for Fisher Island and in water platform, using self-contained batch truck including a separate compartment for fly ash.

Conclusion

Work on the replacement 54 in wastewater force main, started in summer 2011 with the secant shaft construction completed the summer of 2012. The microtunneling is expected to be completed by summer 2013 and has a minimum life span of 80 years.

Port of Miami's Deep Dredge project scheduled for completion by summer of 2014 will deepen the Port's existing channel from its current 42 ft depth to minus 50-52 ft in preparation for the Panama Canal Expansion, scheduled for completion in 2015. The Deep Dredge will make Port of Miami the only U.S. port south of Norfolk that can accommodate the new, mega cargo vessels that will pass through the expanded Panama Canal.

The deepening of Miami's channel will create 33,000 new jobs, double cargo throughput, and increase Port of Miami's annual economic impact to more than $34 billion. Located in the heart of downtown Miami, Port of Miami is the second largest revenue producing department in Miami-Dade County. Port of Miami contributes nearly $27 billion annually to the local and state economies and supports 270,000 jobs, both directly and indirectly, in the state of Florida. Port of Miami is recognized and known for being the Cargo Gateway of the Americas.

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