Centrex completes difficult Hong Kong project

Installing nine pre-bored H-piles to 60 m depth underneath a flyover with a 6.8 m height restriction and in difficult terrain—comprising fill containing ‘fresh’ granite boulders—was made possible using Dritech Mission’s Centrex system, according to main sub-contractor Bachy Soletanche.

Hong Kong’s West Rail Phase 1 project for Kowloon-Canton Railway Corp. (KCRC) is a 30.5 km domestic passenger railway linking the town of Tuen Mun in the New Territories with the West Kowloon peninsula, and will have a total of nine stations. One of the main interchanges with the existing MTR (underground railway) will be at Nam Cheong station, the West Rail’s southern terminus. The station is located on the West Kowloon Reclamation Area, west of Nam Cheong Estate, Nam Cheong Park and Tung Chau Street. It lies directly beneath the West Kowloon Expressway and is bordered on the north side by Tonkin Street and Hing Wah Street. The complete site, measuring 250 m x 50 m wide is situated on a land reclamation scheme undertaken in the 1980s.

The 250 m-long station concourse will combine facilities for both MTR and KCR rail systems in a single hall and allow passengers to travel easily between the two.

West Rail contract CC402 at Nam Cheong station began in June 2000 and involved construction of 80 barrettes, bored piles, ground investigation and improvement, grouting, pre-bored H-piling, mini piling, sheet piling and driven H-piles. Main contractor for the project is the Balluffi Beatty Zen Pacific JV, while the main foundation sub-contractor for foundation work is Bachy Soletanche.

Bachy Soletanche installed nine pre-bored H-piles through granite boulders and infill material, using Dritech Mission’s Centrex system

Due to the height restriction beneath the expressway, and the difficult soil conditions, Bachy Soletanche decided to use the Centrex Drilling system, which has successfully used on two previous Hong Kong projects. A Centrex 555B together with a Dritech Mission SD18 hammer was used in conjunction with an HD 200 drill rig (below) with a reduced, shortened mast.

Centrex 555B together with a Dritech Mission SD18 hammer was used in conjunction with an HD 200 drill rig (below) with a reduced, shortened mast.

One major benefit of the 555B system is that it drills a 555 mm OD socket. This allows 305 x 305 mm ‘H’ beams to be installed within the correct thickness of grout cover 40 mm either side. No chamfering of web edges is required.

The encountered bedrock was 49 mpd and the rig had to drill through multiple layers of boulders, within the sand and gravel. The fill is underlain by alluvial layers below 20 m and deeply weathered rock. With the first layer of interlaced boulders encountered in the loose sand, movement of the drilling could have made tube placement difficult for any system other than Centrex, according to Bachy Soletanche.

The ‘fresh’ granite boulders incorporate a hardness factor of 246 MPa with a compressive strength of 2,400 bar. Conventional boring methods for the nine piles would have meant time consuming delays, with tube placement and replacement to meet the minimal deflection permitted, without taking into account the extremely restricted headroom.

The specification required nine piles with a verticality factor of just 1 mm in 100 mm—for example, with 50 m piles just 0.3 m deviation was permitted over its full length. At the same time minimum ground disturbance was allowed, with the site located alongside the existing high speed airport rail link.

“The Centrex system can form vertical shafts better than other products as well as save time,” said Bachy’s Project Manager. “The system proved ideal in the overburden and infill areas with fast penetration and easy hammer extraction. There is also no need to change the hammer for rock socket drilling.”

In addition the hammer has no eccentric force because of its axis, and therefore drills straighter, deeper holes. The system also increases control of the final casing depth.

Thanks to a unique ring bit and casing shoe assembly the casing can be advanced and set many times by relocking the centre and ring bit and drilling to the required depth.

For the prebored piles a 609.6 mm OD sacrificial casing was used. Due to the height restriction there was insufficient room for a crane and vibrator to extract the casing on completion of piling. In addition to the casing, the contractor has also left the ring bit on completion of each hole.

The nine pre-bored H-piles were installed over a four month period, with the deepest drillhole being 68.6 m with an actual foundation level of 64.44 m. The shallowest drillhole was 57.99 m with an actual foundation level of 54.10 m.

A major advantage of the Centrex system is its ability to form a rock socket with extrac-
Drilling times of 3 m in 15-20 minutes was achieved in the overburden layer, while the best rock drilling time achieved was in the region of 3 m in 45 minutes.

Once drilled, the H-piles were inserted together with four steel Y50 bars and a non-shrink cement grout with a strength of 30 MPa was tremmied to the full pile depth. Each of three barrettes contain three H-piles, measuring 4 m x 1.9 m wide. The barrettes are encased by two 6 m long steel structures fixed together to provide a total depth of 12 m. Within each encasement an 81.2 mm OD steel sleeve was positioned over each prebored pile to sit on the first layer of boulders.

According to Bachy Soletanche the nine H-piles were one of the most difficult parts of the foundations work on the entire project. “Reliability was absolutely essential to avoid any breakdowns as it would have been impossible to retrieve the casing and bore a new hole with the reduced headroom,” said the site project manager. Once completed the columns will form piers for a realigned flyover.

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