Association of Geotechnical & Geoenvironmental Specialists (Hong Kong)

Book Prize Reports

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Event: Technical Visit to Route 11 – Horizontal Directional Coring (HDC)

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On 11 May 2024, the AGS (HK) organized a technical visit to the Horizontal Directional Coring (HDC) ground investigation site of the Route 11 (The Section between Yuen Long and North Lantau). The technical visit covered a 30-minute introductory presentation conducted by Arup and Driltech at the site office, followed by an on-site visit to one of the three HDC sites in Tsing Lung Tau.

Directional Core Drilling (DCD) is an advanced ground investigation technique developed in Norway in the 1980s, and the wireline version which has been extensively used in mineral and fossil fuel exploration was subsequently launched in 2001. The DCD provides steerable and continuous core samples along a pre-defined trajectory. Additionally, it enables groundwater inflow testing over long lengths parallel to the proposed tunnel axis. Therefore, the DCD technique reduces geological and hydrogeological uncertainties along the tunnel alignment, compared to using only isolated vertical or inclined drillholes.

Three HDCs, which were proposed as part of the ground investigation works of the investigation stage of Route 11 project, are currently ongoing. Each HDC is planned to provide a core length of 1000m along the proposed So Kwun Wat Link Road and Tai Lam Chung tunnels. The Route 11 HDC operates on three fundamental components: steerable drilling, coring orientation survey and in-situ field test.

Three coring trajectories with control points and tolerance envelop of 25m are designed along the Route 11 proposed tunnels. N-size wireline system (NQ) with a core diameter of 47.6mm is used for a straight section while the Devidrill Coring System with core diameter of 31.5mm is used for steering sections. While the drill advances, the coring direction and curvature are controlled by the bending angle at the core barrel. After each coring, a survey is carried out to record the location along the advanced core length to ensure that the coring progress remains within the acceptable tolerance envelope. Field tests such as discontinuity survey, packer test and groundwater inflow test are carried out along the depths of HDCs as part of the Route 11 Ground Investigation (GI) works. These field tests help to gather realistic hydrogeological data along the tunnel alignment.

As HDC exhibits directional deviation in mixed ground conditions, it becomes exceedingly challenging to maintain control over the drilling direction. In addition, the limitation of the maximum drill length of HDC makes the GI work difficult if the tunnel exceeds 3000m, and it can only be accessed at the start and end points. This is precisely the scenario encountered in the proposed implementation of two HDCs on both sides of the So Kwun Wat Link Road tunnel for the Route 11 project.

From this technical visit, I have learned that it is important to comprehend the drilling technique, capabilities and limitations of HDC. This knowledge facilitates the planning and implementation of appropriate GI strategy in order to achieve optimal results in the early stage of a project.