

MRT2 BMN @Sg Besi

Fissure Ground Treatment and Ground Anchor Work at Bandar Malaysia North Station

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In previous newsletter under business development section, we have briefly penned on the Secant Bored Pile (SBP) construction for the BMNS. This time, we will present another work scope involved in BMNS, namely rock treatment and ground anchoring works.

Fissure grouting (i.e. Curtain and toe grouting) is used for rock treatment work for karstic limestone and its work is carried out behind the SBP wall as shown in Figure 1. This treatment to curtail/minimise any possible water seepage ingress during rock excavation for the BMNS box station. Failure which, subsequent water drawdown beyond the box station may lead to occurrence of ground distress/depression or possible sinkhole if necessary measure did not carry out.

Grouting operations shall initially be performed through the previously drilled grout holes. Ascending method shall be executed using a conventional single packer system with grout injection at stages of 5m intervals (provided the rock is of relatively good quality with little or no risk of collapse of the borehole). The prescribed grout mix and termination pressure will follow suit the consultant's requirement

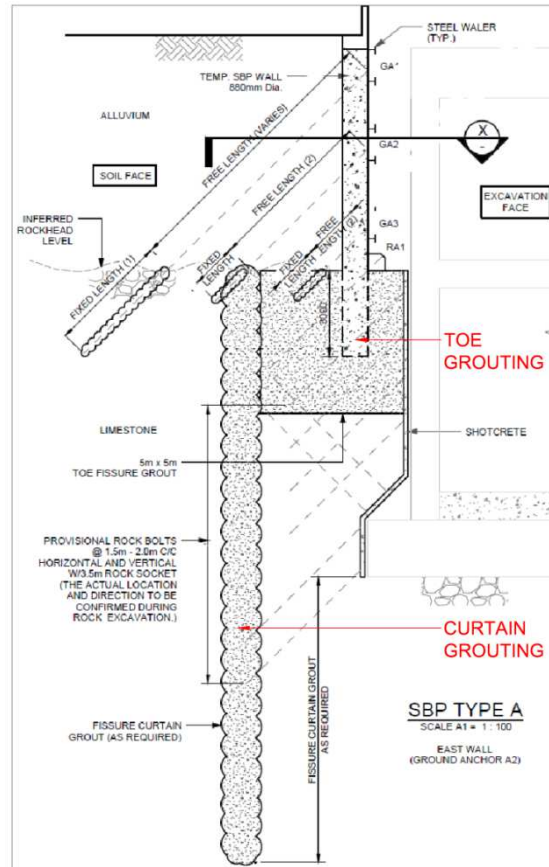


Figure 1 : Typical Treatment for Fissure Grouting

In general, the typical treatment grouting pattern consisting of Primary/Secondary/Tertiary grout Holes etc. as set out in a pattern of 4m /2m /1m as shown in the attached Figure 2 below.

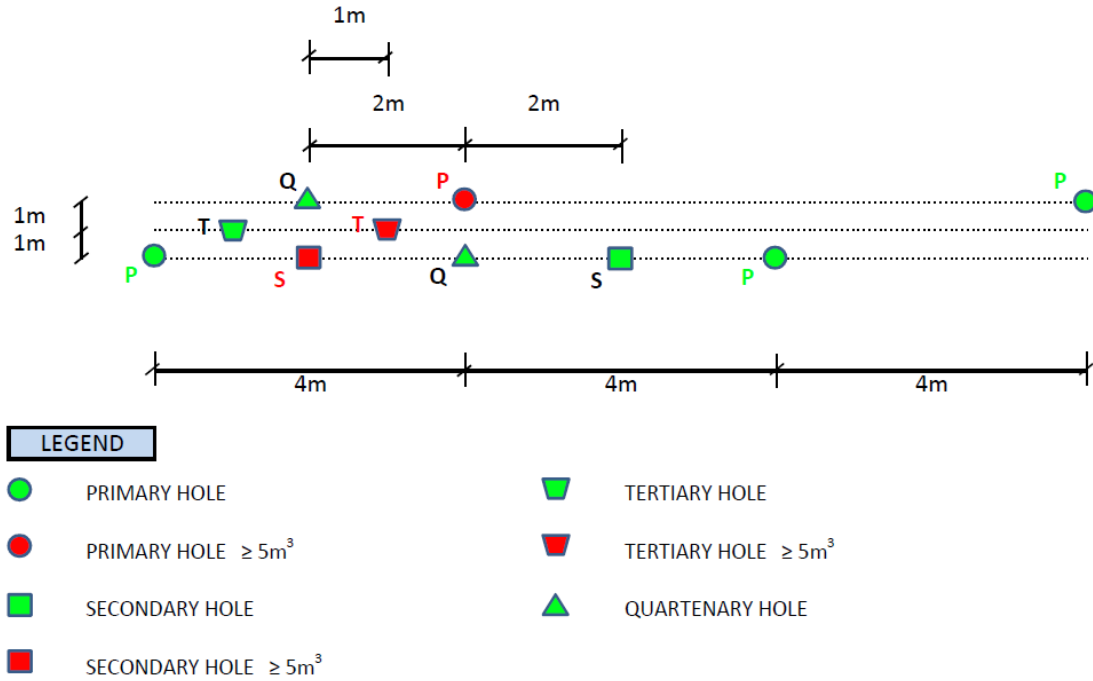


Figure 2 : Typical Grouting Pattern

For this treatment work, the intake grout for the primary hole is exceed $5m^3$ per section for a prescribed pressure at a given depth, then a pair of secondary holes are introduced at the adjacent particular primary location. The same concept will be used for the tertiary holes when the intakes for the secondary holes are still excessive (i.e. $>5m^3$) so forth. For the high grout take observed in primary holes, selective secondary holes could provide joint mapping info with the use of state of the art borehole tele-viewer (See Figure 3) for additional information on subsurface rock mass/joint conditions.



Figure 3 : Televiewer Probe

The tele-viewer will provide better and more accurate information of the in-situ rock joint orientation and conditions compared to laboratory logs as it is usually disturbed and is

extremely difficult to establish the dip and dip direction of the discontinuities (except from orientated coring)(See Figure 4).



Figure 4 : Logged Cores Show Rock Mass/Joint Condition

Upon the completion of Secant Bored Pile (SBP) wall and ground treatment work, the ground anchor work is commenced to tie back the SBP wall for controlling the wall deflection during the unloading effect of excavation work. Prior to drilling work, the ground anchor positions on each pile points shall be marked by licensed surveyor on top of capping beam of Secant Pile Wall in accordance to approved shop drawings. The drilling methods shall be cutting bit, which is attached at the end of the steel casing or mounted at the end of the drilled rod. Bits attached with tungsten carbon will be used when drilling into rock required. For rock drilling, either cutting bit with wash boring or down-the-hole-hammer (DTHH) with compressed air will be adopted, which subject to actual site condition. Subject to the complexity of soil/rock condition especially during encountering cavities, sometimes both of the method will be combined for the drilling of ground anchor.



Photo 1 : G-Klem Machine is carrying out the drilling work

In this work, removable type U-loop anchor system is adopted for this tie back system. Cast iron U-head and unbonded 0.6" PC strand are fabricated on site in accordance to required drilled length.

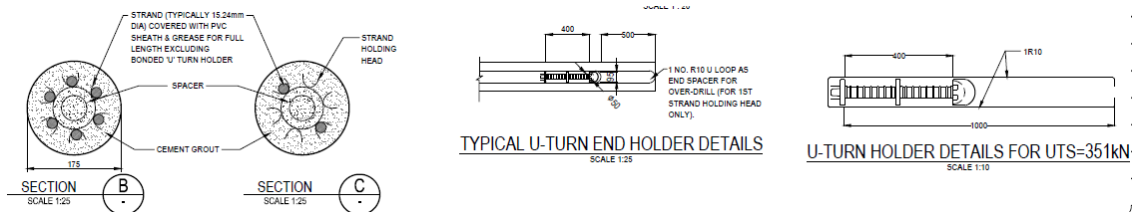


Figure 6 : Details of U-Loop System

The anchor has to be stressed to the required design load to be functional as per design intend. At present, the applied load is distributed evenly to each holding piece (i.e. Strands are provided in pair for each U-loop) in the load transfer mechanism of the applied load. This is achieved by taking care of initial differential elongation of each pairs of strands. As such, each pair of strands has been stressed sequentially from the longest to the shortest, to overcome the differential elongation between them such that they can be stressed as a group. For QA/QC purpose, there are three tests to be carried out, namely proving test, suitability test and acceptance test. The proving test is required to demonstrate and investigate the ground condition in advance of installation of working anchors. The following photo is overall site progress.



Overall Site Photo