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Slope Stabilisation of Highly Fractured Geological Strata Consisting of Mica Schist Layers While Construction of Tunnel Shaft

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Abstract : Introduction: The case study deals with the ground stabilisation of Nabi Karim Metro Station in Delhi, India, wherein an extremely complex geology was encountered while excavating the tunnelling shaft for launching Tunnel Boring Machine. The borelog investigation and the Seismic Refraction Technique (SRT) indicated towards the presence of an extremely hard rocky mass from a depth of 3-4 m itself, and accordingly, the Geotechnical Interpretation Report (GIR) concluded the presence of Grade-IV rock from 3m onwards and presence of Grade-III and better rock from 5-6m onwards. Accordingly, it was planned to retain the ground by providing secant piles all around the launching shaft and then excavating the shaft vertically after leaving a berm of 1.5m to prevent secant piles from getting exposed. To retain the side slopes, rock bolting with shotcreting and wire meshing were proposed, which is a normal practice in such strata. However, with the increase in depth of excavation, the rock quality kept on decreasing at an unexpected and surprising pace, with the Grade-III rock mass at 5-6 m converting to conglomerate formation at the depth of 15m. This worsening of geology from high grade rock to slushy conglomerate formation can never be predicted and came as a surprise to even the best geotechnical engineers. Since the excavation had already been cut down vertically to manage the shaft size, the execution was continued with enhanced cautions to stabilise the side slopes. But, when the shaft work was about to finish, a collapse was encountered on one side of the excavation shaft. This collapse was unexpected and surprising since all measures to stabilise the side slopes had been taken after face mapping, and the grid size, diameter, and depth of the rockbolts had already been readjusted to accommodate rock fractures. The above scenario was baffling even to the best geologists and geotechnical engineers, and it was decided that any further slope stabilisation scheme shall have to be designed in such a way to ensure safe completion of works. Accordingly, following revisions to excavation scheme were made: The excavation would be carried while maintaining a slope based on type of soil/rock. The rock bolt type was changed from SN rockbolts to Self Drilling type anchor. The grid size of the bolts changed on real time assessment. the excavation carried out by implementing a ‘Bench Release Approach’. Aggressive Real Time Instrumentation Scheme. Discussion: The above case Study again asserts vitality of correct interpretation of the geological strata and the need of real time revisions of the construction schemes based on the actual site data. The excavation is successfully being done with the above revised scheme, and further details of the Revised Slope Stabilisation Scheme, Instrumentation Schemes, Monitoring results, along with the actual site photographs, shall form the part of the final Paper.

Keywords : unconfined compressive strength (ucs), rock mass rating (rmr), rock bolts, self drilling anchors, face mapping of rock, secant pile, shotcrete

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