DIFFICULTIES IN TUNNELLING THROUGH WEAK GEOLOGICAL ZONES
CASE STUDY AT MPANGA HYDROPOWER PROJECT, UGANDA

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Underground excavation works maintain higher level of safety precautions to keep an accident free environment for the workers. In addition, to retain durability, necessary supports are applied in adequate quantities. However, in a situation with limited available resources such as skilled man power, machineries and equipment, adequate quantities of tunnel supports and explosive in standard levels, is undoubtedly a challenging task. Tunnel Portals with steep slopes and exposed jointed rock with detached rock blocks were in high risk and it could have taken the workers in to jeopardy. The Headrace Tunnel at "Mpanga" Hydropower project in Uganda was designed to excavate by Drilling and Blasting method. Stability evaluation, Tunnel penetration rates and Temporary Support Systems were designed based on the Rock Quality analysis carried out by NGI-Q system obtained at the investigation stage.

Originally designed inlet Portal preparation system had to be changed in order to avoid vulnerable situations. Tunnel excavation was carried out along slightly to moderately weathered rock. This case study discusses the obstructions while working at tunnel portals and along the tunnel under difficult ground conditions such as low vertical and lateral rock cover, tunnel portals with steep jointed rock slopes and highly fractured weak zones. Intense hair cracks oriented in different directions and large detached rock blocks were the other key problems arose at excavation phase. In addition, the case study represents the applied temporary tunnel supports based on rock quality analysis based NGI-Q system. Therefore, sufficient production from full face blasting system was not achieved due to such physical properties which are adversely controlled by limited supply of explosive. Various conventional methods such as use of Jack Hammers for face drilling, Electric Detonators for blasting as well as limited number of techniques while scaling and applying temporary tunnel supports had to be employed to perform the task.

Number of temporary tunnel support systems, such as dry mix shotcrete, rock bolts and steel ribs were employed to stabilize Portals, tunnel walls and crown. Data were collected from each blasting cycle and tabulated. Those data were correlated and three relationships were identified. They are, Tunnel Advanced Ratio and Drilling Time were directly proportional to the RQD/Jn and Total utilized Electric Detonators directly proportional to the Average RQD. Further to that, application of alternative temporary tunnel supports such as Pipe Roofing method, installation of Shotcrete Ribs, Swellex Rock Bolts and Lattice Girders are discussed to enhance the safety. Moreover, efficient new techniques such as use of Non Electric Detonators instead of Electric Detonators, Pre-Excavation Grouting, and application of Control Blasting system are proposed. Probing Ahead, Artificial Ground Freezing method and application of instrumentation monitoring systems are recommended to maintain a safe working environment while soft ground tunneling.