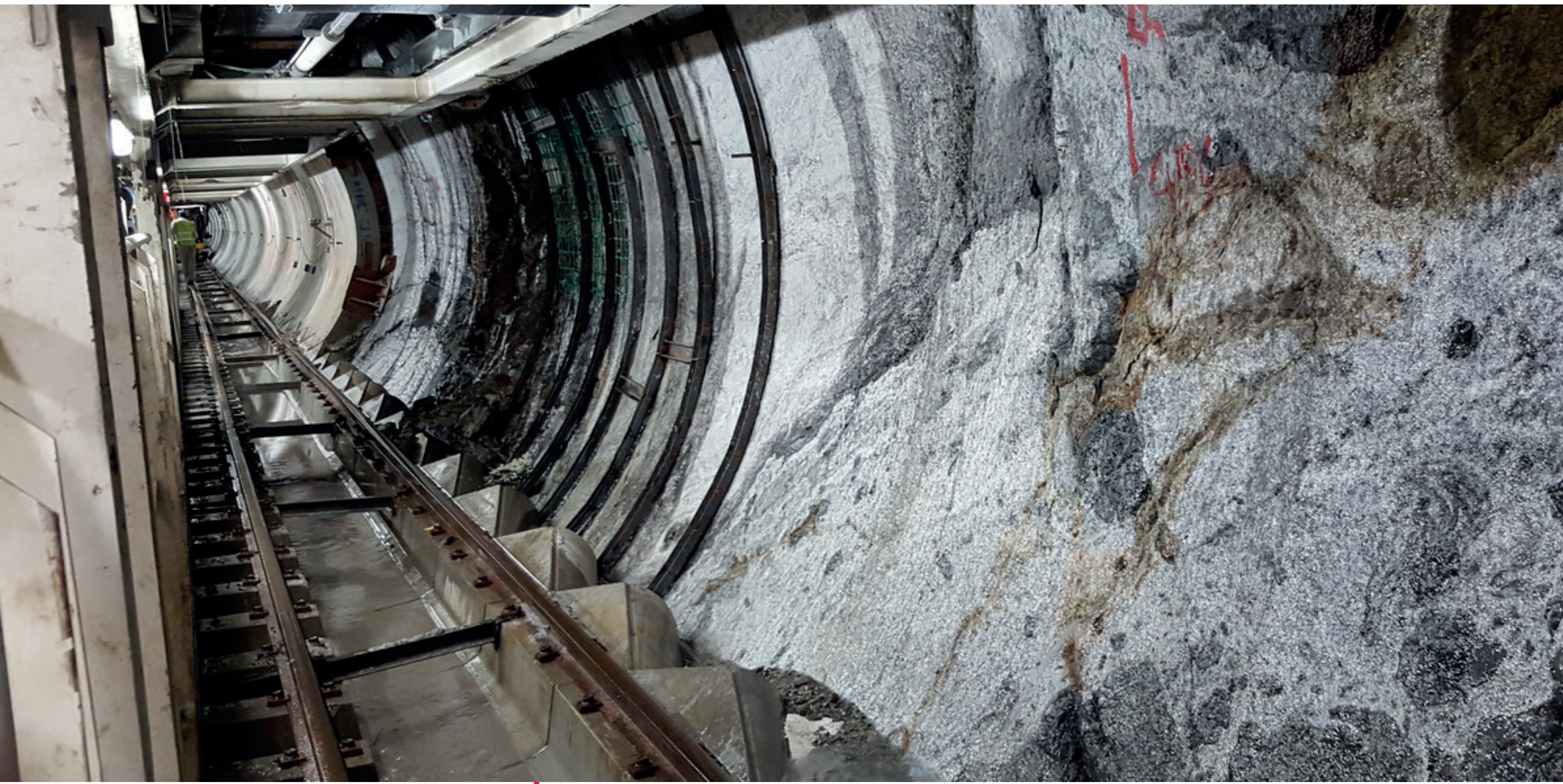
SmartMeasures
Tough projects call for smart measures.

AmbergSeismics

Ministry of Irrigation & Water Resources
Uma Oya Multipurpose Development Project – Sri Lanka



Project

- Uma Oya Multipurpose Development Project
- Water transfer for irrigation purposes, hydropower generation and control of seasonal floods
- Conveyance (3.75 km), headrace (15.55 km) and (3.65 km) tailrace tunnels among other major structures
- Contractor: Farab Co.
- Subcontractor: Parhoon Tarh Co.

Duration

- 2014 - ongoing

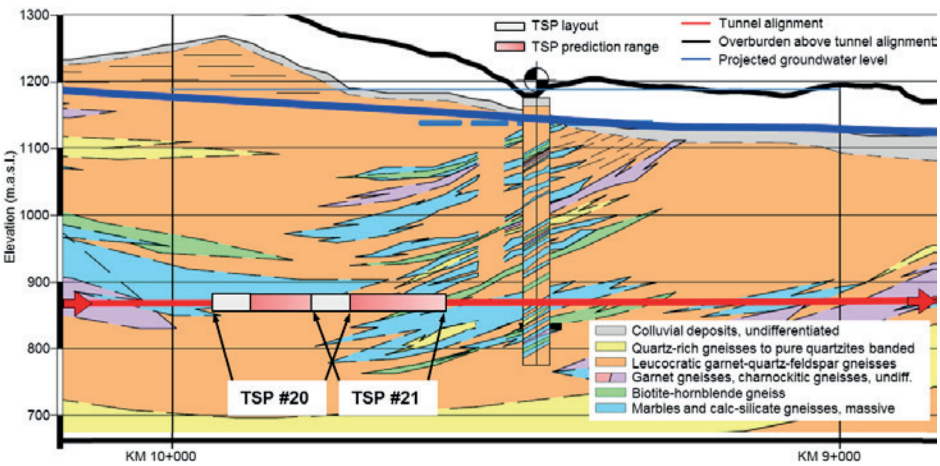
Task

- Forecast of geological structures such as fracture zones, fault zones and significant changes in the rock mass condition that could be associated to possible water bearing or other risky zones.

Fertile water diversion for central Sri Lanka

The Uma Oya Multipurpose Project is located in the south-eastern part of the central highlands of Sri Lanka and comprises the construction of three tunnels for water conveyance and hydro power with a total length of 22.6 km.

Excavation of the 15.55 km headrace tunnel (HRT) at this project has faced many challenges including very hard and abrasive rock, mud inflow and high water inflow (up to 400 L/s). Due to the limited amount of geotechnical information and considering the presence of shear and fault zone and high overburden, continuous site investigations from tunnel face have been done through probe drills and TSP seismic measurements.



AMBERG TECHNOLOGIES

«The headrace tunnel of the Uma Oya project is a very difficult tunnel with significant local media and political attention. TSP has been an invaluable tool in assisting the excavation team to determine the potential hazards within the tunnel, to optimise the probe drilling and pre-grouting program, and maximise the excavation rate and provide answers to the complex hydrogeological conditions met. »

Ataollah Rahbar (left)
Site Manager of Headrace Tunnel,
Farab Co, Sri Lanka

Ali Kooshari (right)
Head of Engineering Section,
Parhoon Tarh

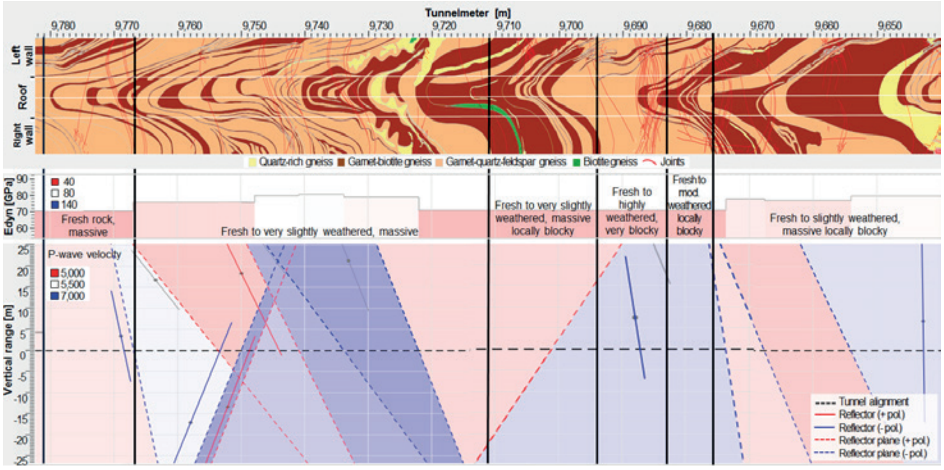
Challenges

- Excavation through highly fractured metamorphic rock with sudden changes and high risk of water seepage
- Mixed operation mode: Shield and Gripper

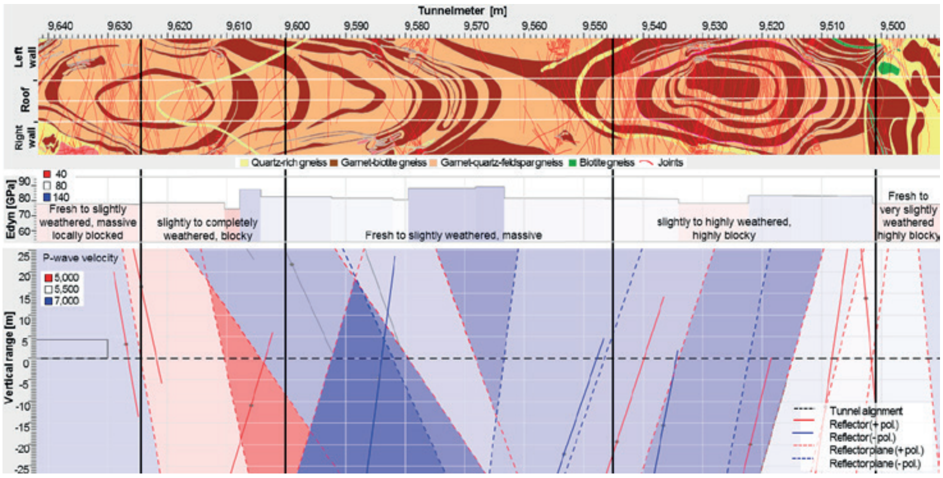
Products Used

- TSP 303 Plus system

The HRT is being excavated in the so-called Highland Complex geological unit. The type of rock of this strongly tectonised complex consists of charnokitic gneiss of Precambrian age. Folding at the project area is characterised by large domes, basins and anticline and syncline structures. According to the geological forecast section, two TSP campaigns (#20 and #21) were performed in a syncline characterised by the presence of leucocratic garnet-quartz-feldspar gneisses, marbles and calc-silicate gneisses. Average overburden varies from 414 to 370m. Due to the experienced adverse conditions, the use of the TSP system has been intensified in order to detect fractures zones or cluster of joints which could be hydraulic active representing areas of potential water ingress.



The image above depicts the geological profile (top), chart of dynamic Young's modulus (Edyn, middle) and P-wave velocity (Vp) at extracted reflectors (bottom) along the prediction range of campaign #20. Rock descriptions correspond to geologist´s observations in tunnel. Sections of massive rock mass with fresh to slightly weathered conditions and occurrence of quartz-rich gneiss (TM 9,766 to 9,711 and TM 9,676 until end) are in good agreement with increased Edyn and Vp while blocky rock with moderate to highly weathered conditions and higher joint density correspond to a decrease in these parameters (TM 9,711 to 9,676).



Similarly, in campaign #21, the highest Edyn and Vp are found in massive rock mass (TM 9,600 to 9,546). In turn, sections starting at TM 9,625 and 9,546, both characterized by blocky to highly blocky rock mass and highly to completely weathered conditions, show a decrease in Edyn. At these sections the joint density significantly increases which results in more extracted reflectors. In terms of seismic velocities, a significant decrease of Vp is observed only at the first section. Contrary, for the second section, a decrease of Vs is found from TM 9,534 to 9,522 (not shown) which results in a drop of Edyn. This zone corresponds to the highest joint density.

Conclusion

The continuous application of TSP helps identify areas of high joint density or high weathering that represents high risk zones of potential water ingress. Once these zones are being identified, targeted probe drills are defined by the project supervisor for verification purposes ensuring a safe and effective excavation.

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