Site Formation and Infrastructure Works for Development of Anderson Road Quarry Site

Aurecon Hong Kong Limited
AURECON TUNNEL EXPERTISE

Aurecon supports the growth of communities through the delivery and maintenance of state-of-the-art tunnels and tunnel systems.

Our specialised and multidisciplinary team of tunnel consultants can design and deliver tunnels and tunnel systems in complex environments, utilising experience across multiple disciplines including structures, geotechnical, drainage, fire systems, sustainability, mechanical and electrical engineering.

The South Island Line (East), Hong Kong

Doha Metro Red Line South Underground, Qatar

NorthConnex, Australia

West Gate Tunnel, Australia
Engineering and infrastructure advisory company Aurecon played a key role in transforming the Anderson Road Quarry (ARQ) site into a multi-purpose land tract for public and private housing, to further enhance the development of Hong Kong.
ANDERSON QUARRY UNDERPASS – RECOGNITION OF CATEGORISED RISK

Longitudinal Section Plan

- Length: 130m span – 24m
- Total height of tunnel: 16m
- Shallow ground cover: 12m approx.

1. Historical Water Stream
2. Inferred Fault Zone
3. Aplite dyke
4. Photolineament from GASP report
5. Curvature in Alignment
6. Large Span of Underpass
7. Shallow Ground Cover
8. Congested Working Space
9. Confined Space

Gavin Lau, Senior Tunnel Engineer
ENHANCE WORK SAFETY INSIDE UNDERPASS & BETWEEN INTERFACE OF TEMPORARY AND PERMANENT WORKS

To minimise the risk of working in a confined space and enhance work safety of the tunnel project, we proposed using self reacting moveable formwork “Shutter” to facilitate concrete pouring for permanent lining.

**Construction Arrangement of Permanent Lining**

**Photo for Kicker**

**Example of Type 1 & 2 Self Reacting Formwork**

**Example of Type 3 Self Reacting Formwork**
A SAFER METHOD OF CONSTRUCTION — MULTI-PHASE FACE EXCAVATION

1. Site Formation at the East and West Portals
2. Excavation of the Pilot Tunnel
3. Excavation of the Full Span Heading (maintain min. 15m away from the pilot tunnel excavation)
4. Excavation of the Bottom Bench (maintain min. 15m away from the full span heading excavation)
MODULARISATION TO MINIMISE MANUAL WORKS INSIDE UNDERPASS

Steel lattice girder has been chosen as the main temporary support for the underpass excavation due to its light weight nature and flexibility.
A SIMPLER METHOD OF TEMPORARY WORKS INSTALLATION

Instead of using canopy bars, spile bars was used as the alternative reinforcement materials for temporary support.
REDUCING RISK OF WORKING AT HEIGHT

Glass fibre reinforced polymer (GFRP) was used for temporary face stabilization.

Example of Glass Fibre Reinforcement Polymer (GFRP)
CONTROL PROCEDURES, INSPECTION AND MAINTENANCE OF THE TEMPORARY WORKS AFTER ERECTION

Tunnel Information Management System (TIM) is implemented for the tunnel project to provide an integrated approach to construction monitoring built around it.

3 classifications of TIM
1. Tunnel Data Gathering and Processing System
2. Tunnel Geological Data Processing System
3. Tunnel Monitoring and Data Processing System

An effective data storage system

Benefits of using TIM

Tunnel Information Management System (TIM)
PROJECT INNOVATIONS IN DESIGN AND EXECUTION

3D Plaxis modelling is used for better estimation of the ground reaction

Illustration of PLAXIS 3D modelling

Illustration of PLAXIS 3D tunnel profile

PLAXIS 3D graphical output of deflection
PROJECT INNOVATIONS IN DESIGN AND EXECUTION

To enhance the awareness of possible encounter geology to the contractor and its workers, a 3D visualization of the surrounding ground has been established.

Automated geological section generated from Leapfrog model

Illustration of Leapfrog 3D model

Leapfrog model input borehole information
The key design principle for the tunnel temporary works was to minimise or remove safety risks throughout the project’s lifecycle. By carefully considering fit and future-proof safety initiatives in place, the project design has been highly successful.

As of September 2018, the project has achieved **99,000 manhours with no incidents**.