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

Aurecon Hong Kong Limited

Gavin Lau, Senior Tunnel Engineer

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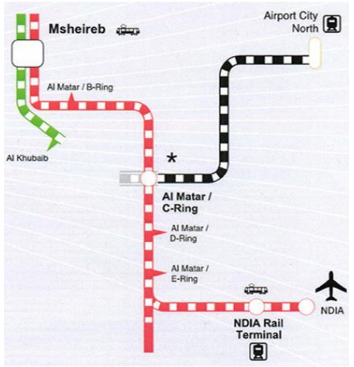
AURECON TUNNEL EXPERTISE

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

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PROJECT BACKGROUND




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.


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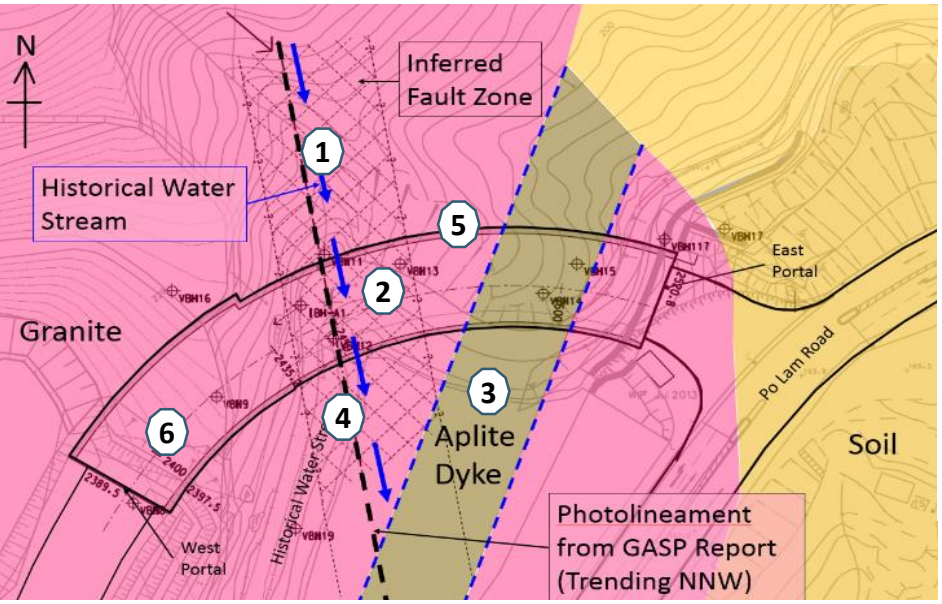
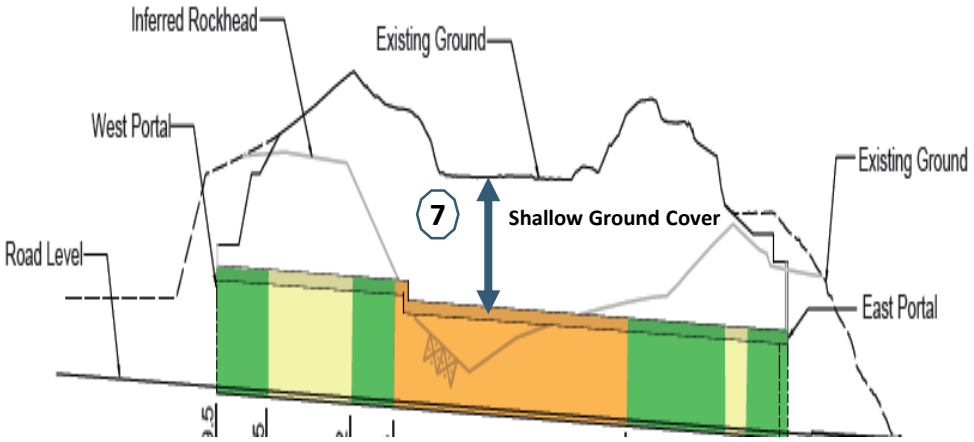
ANDERSON QUARRY UNDERPASS – RECOGNITION OF CATEGORISED RISK

Longitudinal Section Plan





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

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

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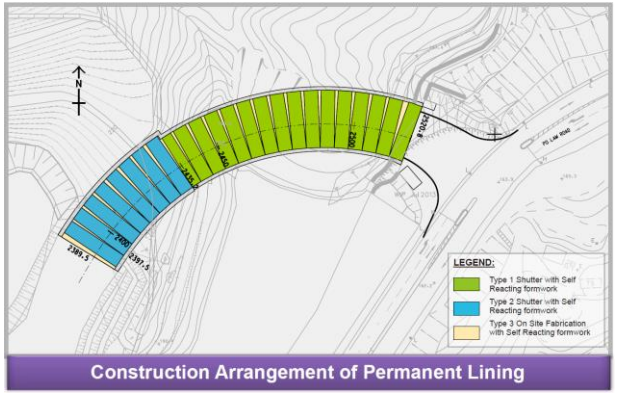
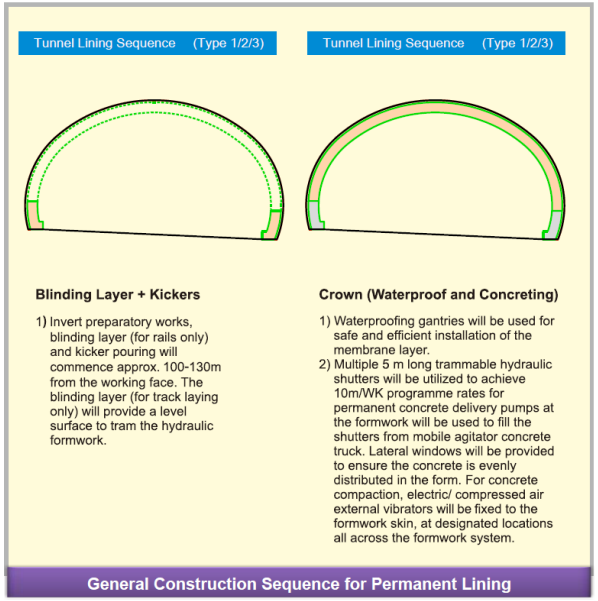
ENHANCE WORK SAFETY INSIDE UNDERPASS & BETWEEN INTERFACE OF TEMPORARY AND PERMANENT WORKS

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.



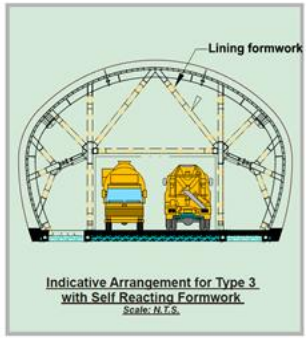
Construction Arrangement of Permanent Lining


Photo for Kicker

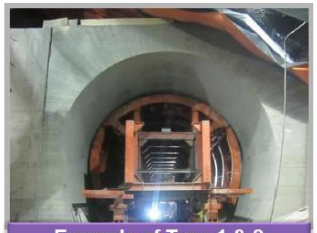


General Construction Sequence for Permanent Lining


Indicative Arrangement for Type 1 and Type 2 Shutter with Self Reacting Formwork
Scale: N.T.S.



Indicative Arrangement for Type 3 with Self Reacting Formwork
Scale: N.T.S.


Example of Type 1 & 2 Self Reacting Formwork


Example of Type 3 Self Reacting Formwork

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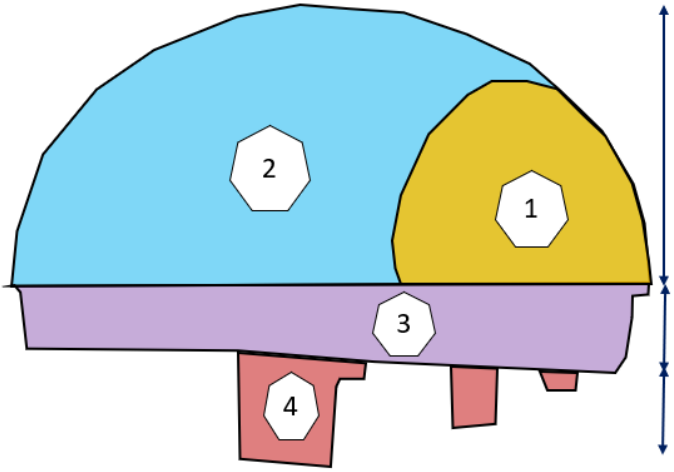
A SAFER METHOD OF CONSTRUCTION – MULTI-PHASE FACE EXCAVATION



Top Heading Excavation

Bottom Bench Excavation

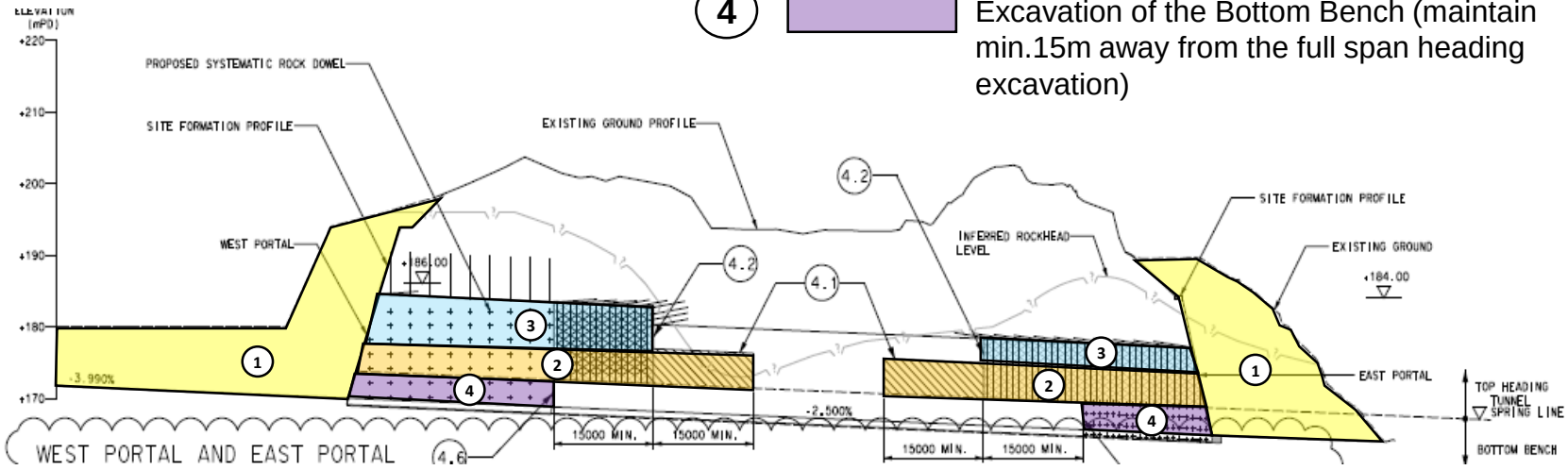
Box Culvert Excavation

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)



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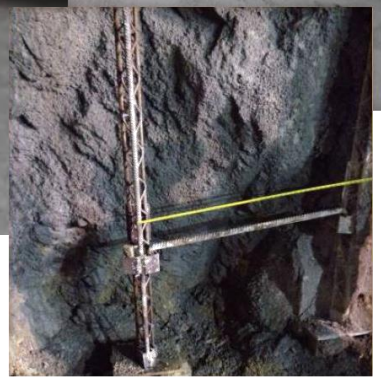
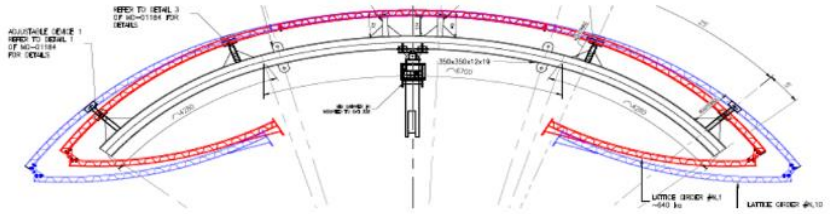
MODULARISATION TO MINIMISE MANUAL WORKS INSIDE UNDERPASS

Steel lattice girder has been chosen as the main temporary support for the underpass excavation due to its light weight nature and flexibility.



Picture of prefabricated Lattice Girder

Illustration of easy installation by small excavator



Typical Arrangement for the installation of lattice girder

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A SIMPLER METHOD OF TEMPORARY WORKS INSTALLATION

Instead of using canopy bars, spile bars was used as the alternative reinforcement materials for temporary support

Illustration of complete row of spile bars

Illustration of spile bars installation

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REDUCING RISK OF WORKING AT HEIGHT

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

Example of Glass Fibre Reinforcement Polymer (GFRP)

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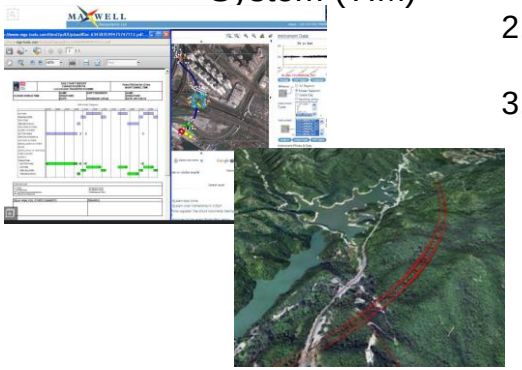
CONTROL PROCEDURES, INSPECTION AND MAINTENANCE OF THE TEMPORARY WORKS AFTER ERECTION

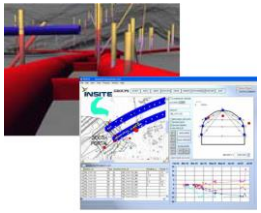
Tunnel Information Management System (TIM) is implemented for the tunnel project to provide an integrated approach to construction monitoring built around it.

Tunnel Information Management System (TIM)

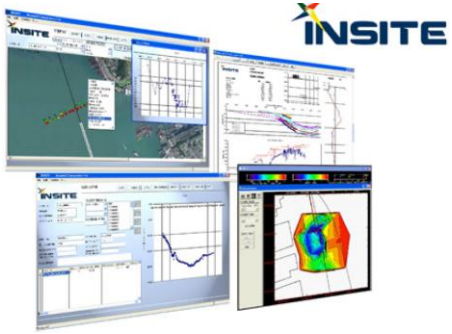


3 classifications of TIM

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

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PROJECT INNOVATIONS IN DESIGN AND EXECUTION

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

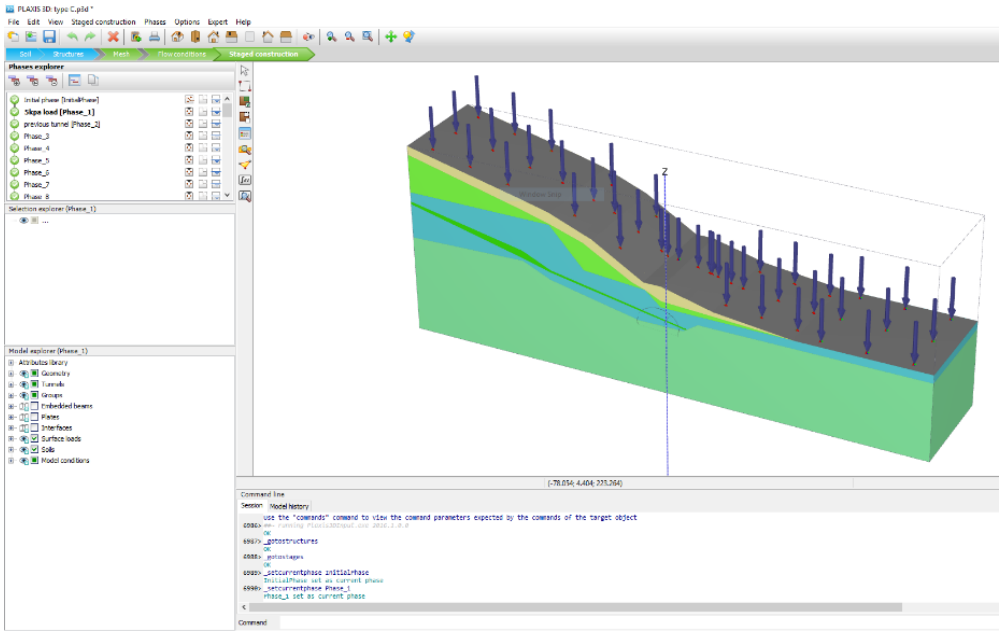


Illustration of PLAXIS 3D modelling

PLAXIS 3D graphical output of deflection

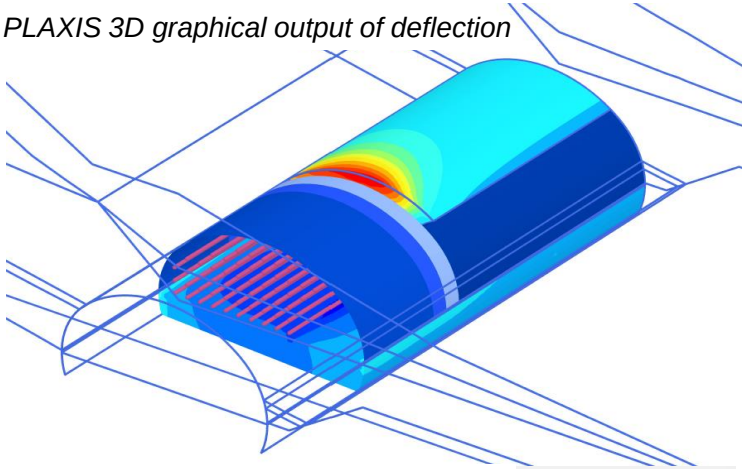
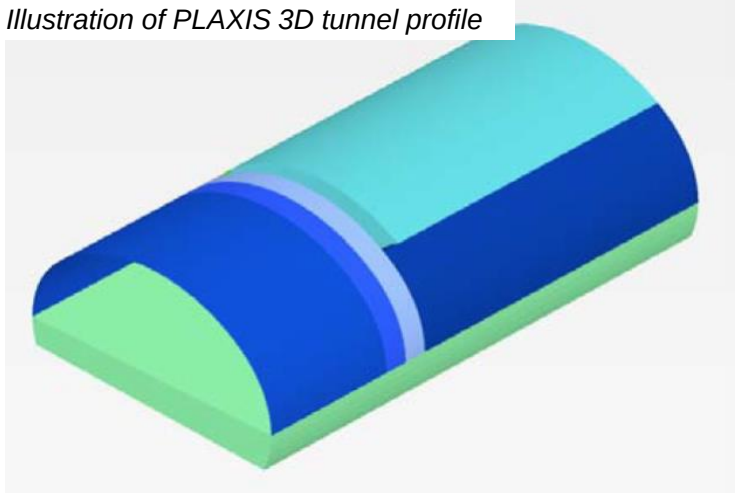


Illustration of PLAXIS 3D tunnel profile



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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.

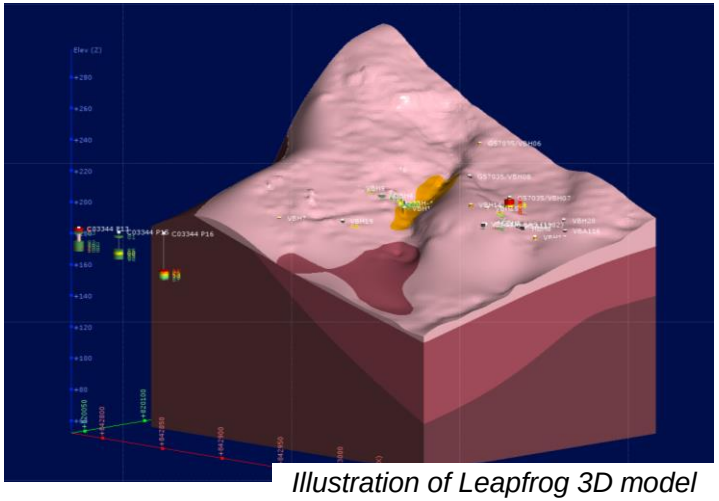
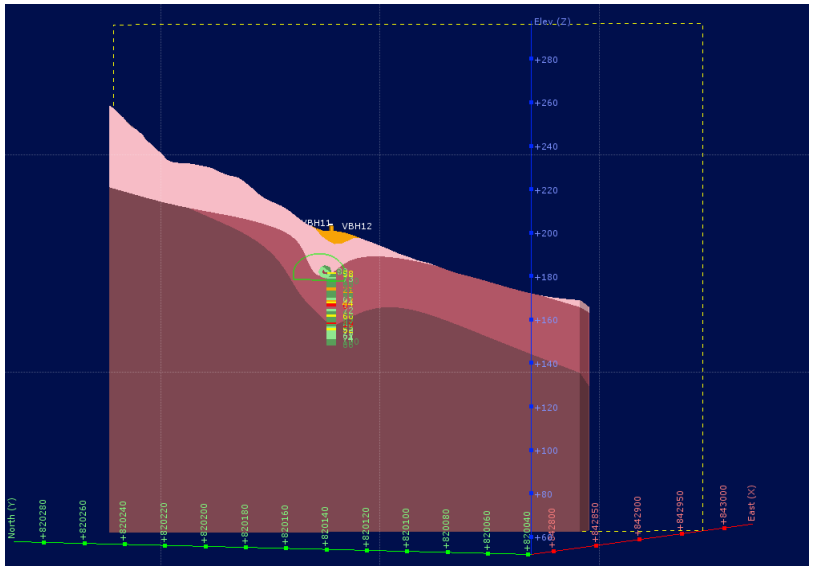
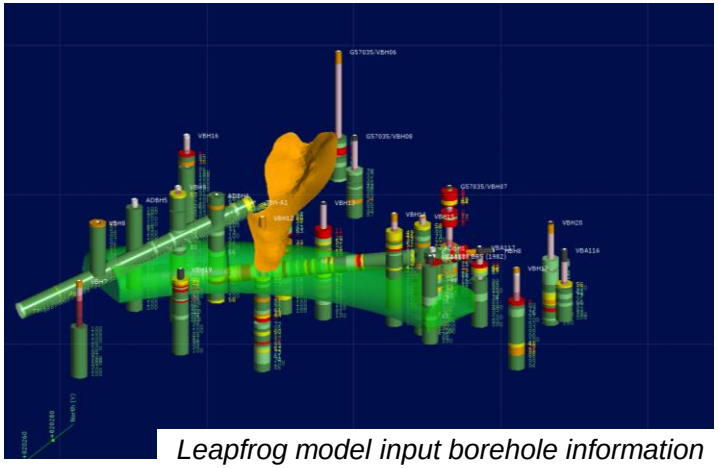


Illustration of Leapfrog 3D model



Automated geological section generated from Leapfrog model



Leapfrog model input borehole information

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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.**

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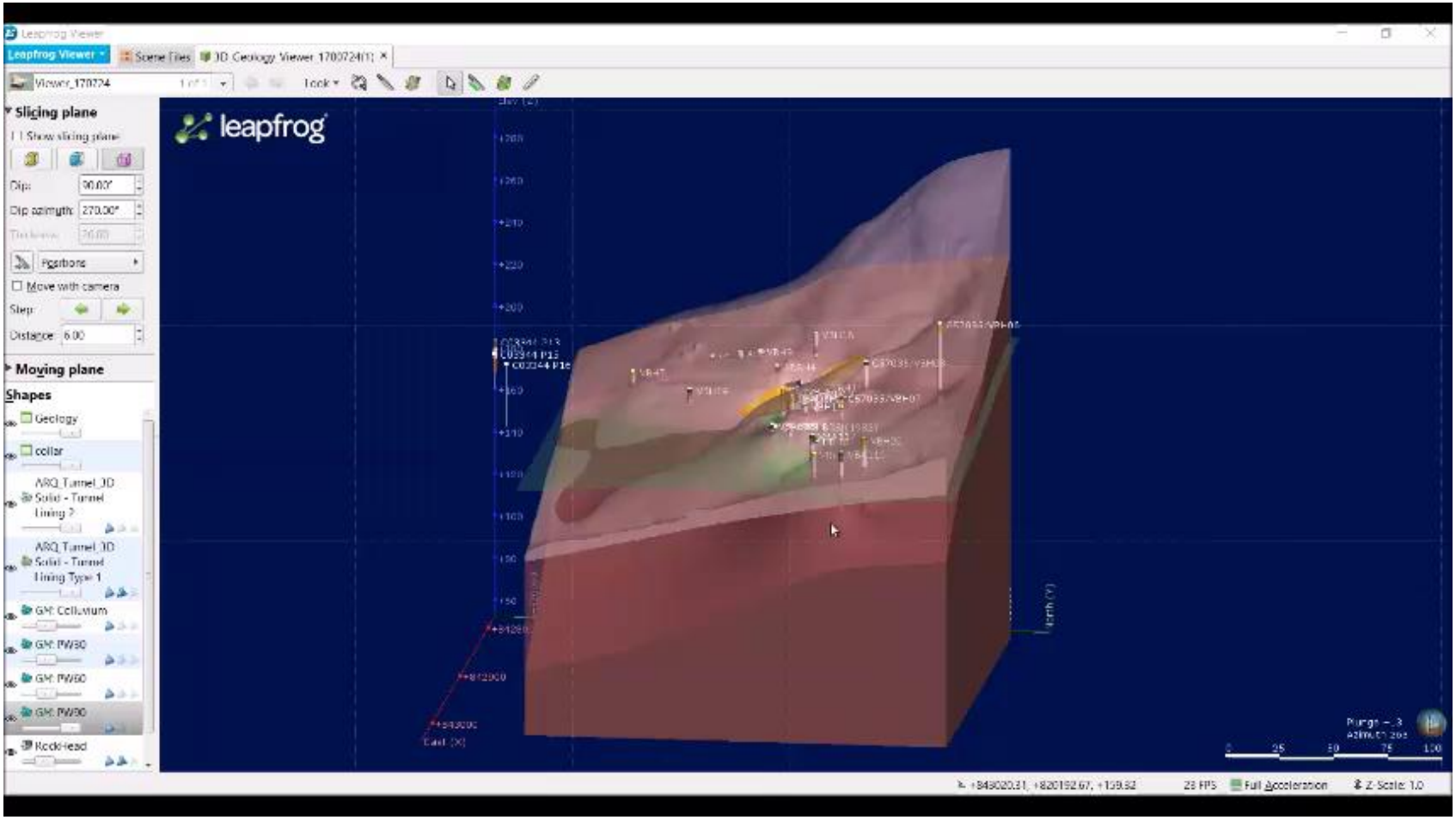

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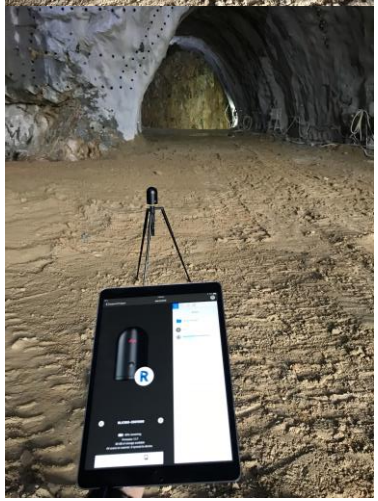

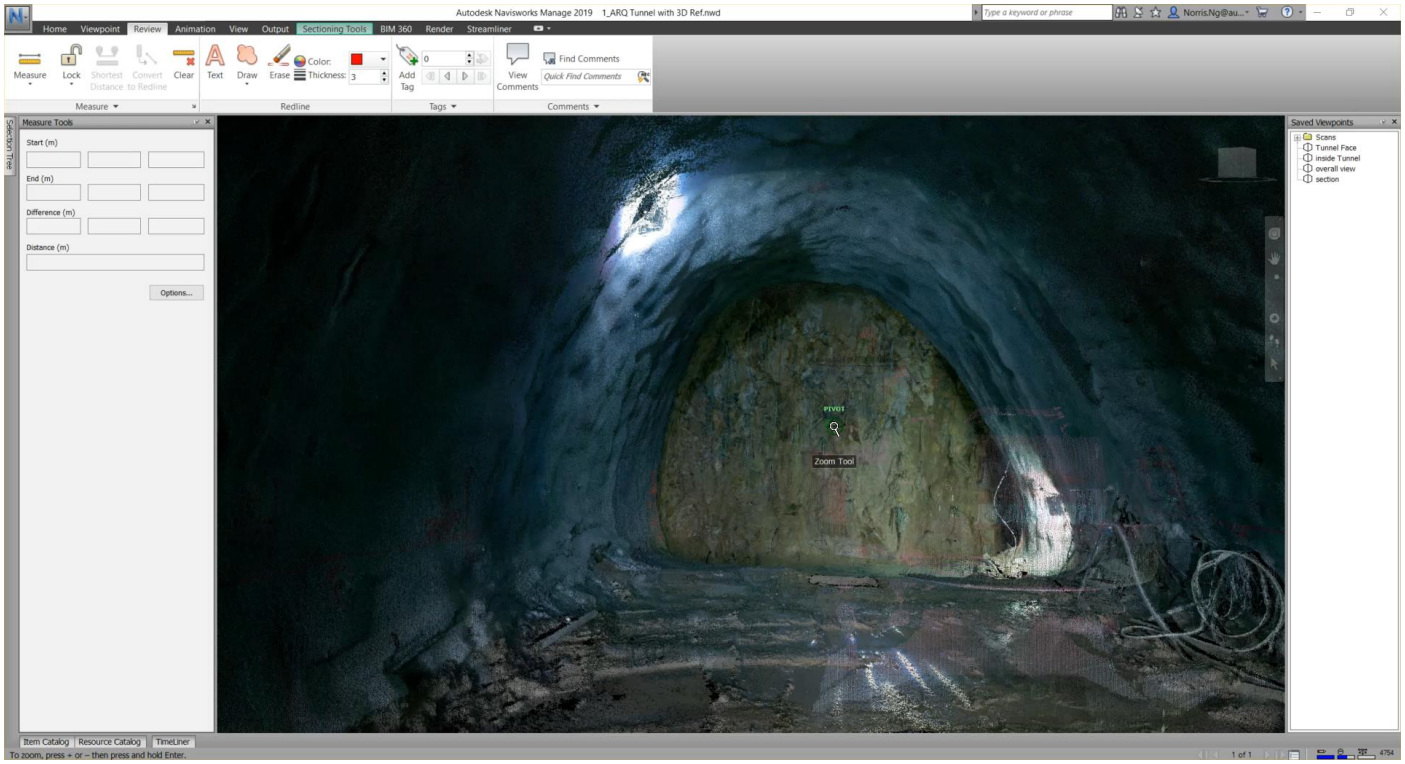

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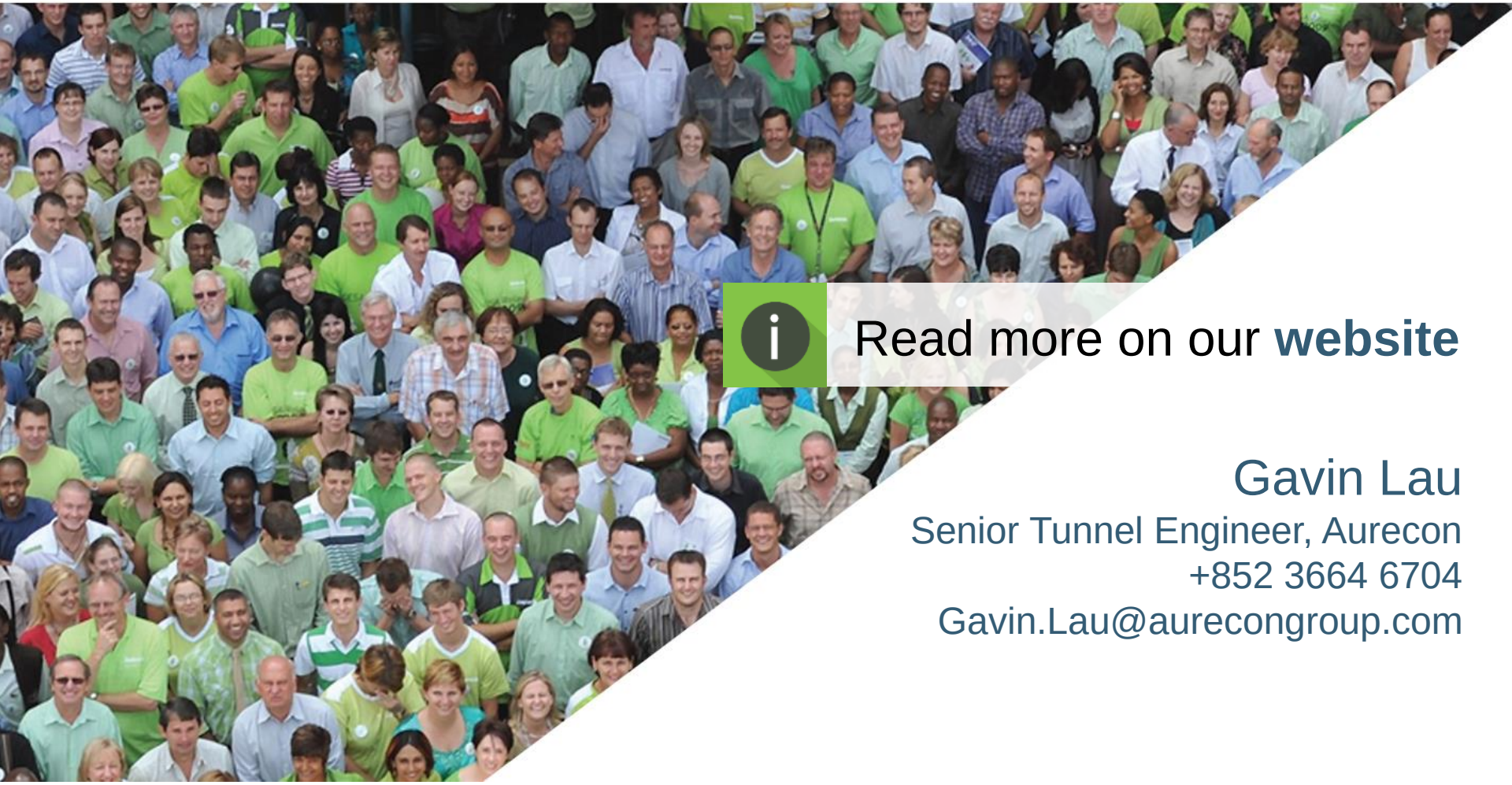

Read more on our **website**

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