Relevant Research: Highlights from *Australian Geomechanics*, December 2017

The December 2017 issue of ***Australian Geomechanics***, the Journal and News of the Australian Geomechanics Society, featured a variety of excellent research. We were delighted to see Rocscience software used in two of these articles and we're happy to showcase the work of these researchers.

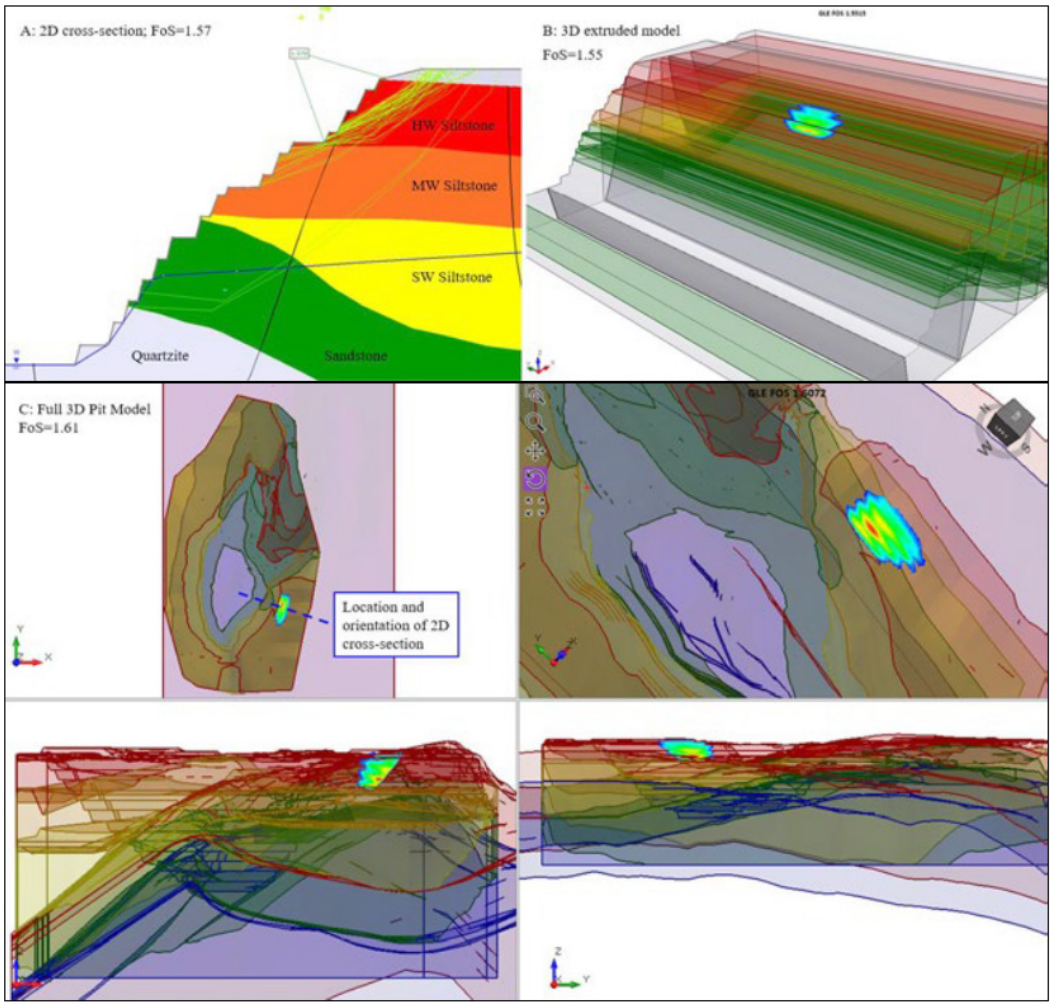
First, we look at 2D and 3D Limit Equilibrium Analysis, where Neil Bar and Geoffrey Weekes utilize both ***Slide*** and ***Slide***^{3} to compare the Factors of Safety of open pit mines from 2D cross sections, 3D-extruded cross sections and full 3D pit models. There are a variety of valuable takeaways from this research, but we were particularly interested to see the FOS increase consistently as the researchers moved from 2D though full 3D pit models.

Next, Thomas Miller and Chenui Lee explored an innovative pile solution for the Sydney Metro Northwest project. The core challenge for the project was to build a multi-level car park on top of a twin tunnel and station box excavation. The solution developed ensured that the substantial axial loads were transferred to the high-strength rock below the tunnels, while allowing the ground above the tunnels to provide lateral support to the pile to resist the horizontal loads. The researchers utilized axisymmetric finite element analysis in ***RS***^{2} for assessing the settlement and load transfer behaviour of three pile types under axial loading.

You'll find the abstracts for these papers on the next pages, or read the complete articles at their links.

Full 3D pit models remove some of the conservatism intrinsic to 2D modelling. They require slightly more computational time; however, they can be used to identify zones with potential issues rather than relying solely on 'the correct selection of cross-sections'.

- Neil Bar & Geoffrey Weekes



Yeneena Supergroup: Siltstone (highly weathered: red, moderately weathered: orange, slightly weathered: yellow), Sandstone (green) and Quartzite (light purple); A: 2D cross section (FoS-1.57); B: 3D-extruded cross-section (FoS=1.55); C: Full 3D Pit Model (FoS=1.61); Lateral confinement of gently-concaved slope profile in full 3D pit model shows marginally improved FoS

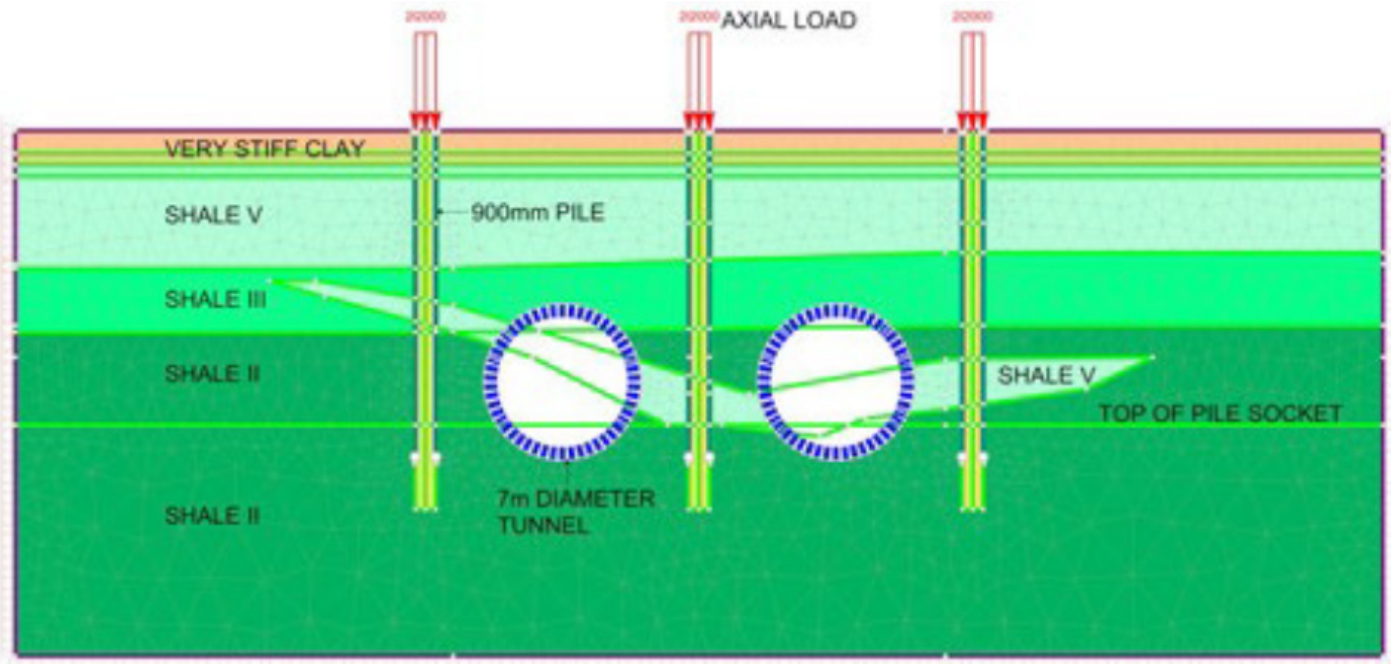
Directional Shear Strength Models in 2D and 3D Limit Equilibrium Analyses to Assess the Stability of Anisotropic Rock Slopes in the Pilbara Region of Western Australia

By Neil Bar and Geoffrey Weekes

ABSTRACT The bedded iron ore and gold deposits in the Pilbara Region of Western Australia are hosted in highly anisotropic rock masses. For iron ore, these comprise strong banded iron formations discretely interbedded with very weak shales. Gold and other precious metals deposits in the same region are hosted by interbedded siltstones, sandstone and quartzites. Slope instability mechanisms generally involve sliding along bedding planes combined with joints or faults acting as release planes.

Slope stability modelling techniques applied to highly anisotropic rock masses have developed significantly over the years from basic kinematic analysis in the 1990's through to two-dimensional limit equilibrium analysis and numerical modelling in the 2000's with the available software increasing in functionality and complexity over time. Limit equilibrium analysis software now offer a range of options to model the behaviour of anisotropic rock masses. The results obtained by these different models can vary significantly. It has been found that selecting either inappropriate anisotropic shear strength models for a given rock mass or using poorly calibrated models typically result in overly conservative slope designs. This paper presents case studies which illustrate the importance of geological interpretations, correct constitutive model selection, the use of non-linear shear strengths, and 2D and 3D modelling approaches.

READ THE FULL ARTICLE



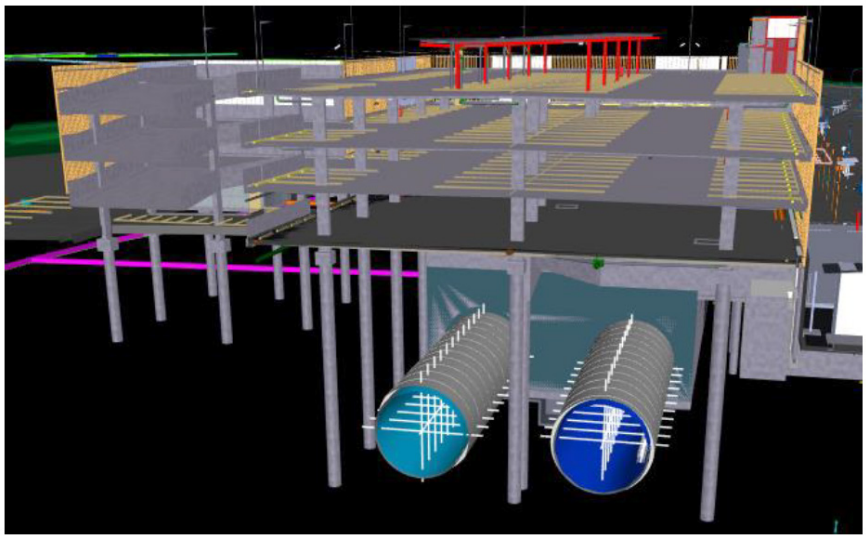
Finite element mesh with 6-noded triangular elements used for the plain strain analysis

Novel Pile Design for Multi-Level Car Park Above Twin Rail Tunnels

By Thomas Miller and Chenhui Lee

ABSTRACT Cherrybrook Station is one of 8 new stations constructed as part of the Sydney Metro Northwest project. The station is delivered under two separate contracts: the twin tunnels and station box excavation were constructed first as part of the Tunnels and Station Civils (TSC) contract, while the station and associated rail infrastructure is currently being constructed as part of the Operations, Trains and Systems (OTS) contract. As part of the OTS works, a multi-level commuter car park will be constructed at the city end of the station, directly above the existing twin tunnels and adjacent to the station box excavation. For the foundations of the car park, a novel pile design was developed to mitigate the risk of impacting the existing tunnels by ensuring that the relatively large axial loads imposed by the car park are transferred to the high-strength rock below the tunnels, while allowing the ground above the tunnels to provide lateral support to the pile to resist the relatively small horizontal loads. This paper presents this novel pile design, along with details of how the interfaces with the existing and future works were addressed in the design.

READ THE FULL ARTICLE



Section cut through the BIM model looking towards the west showing the car park structure and foundations relative to the twin rail tunnels.