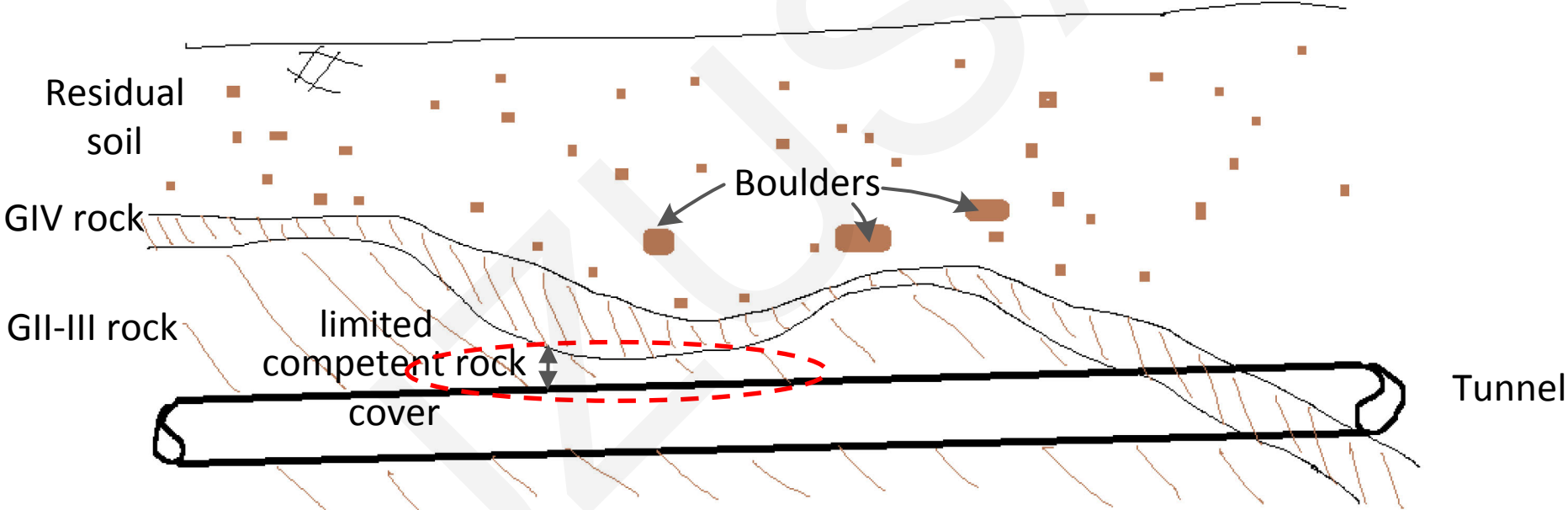


Discontinuum analyses of openings constructed with side drift and limited rock cover

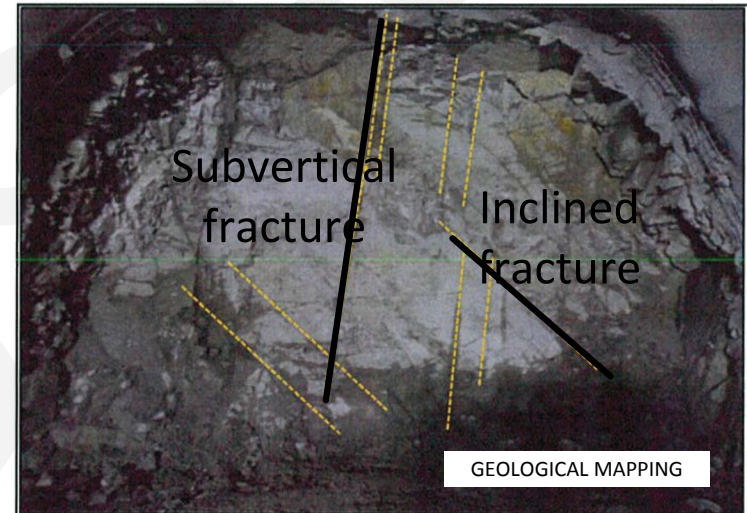
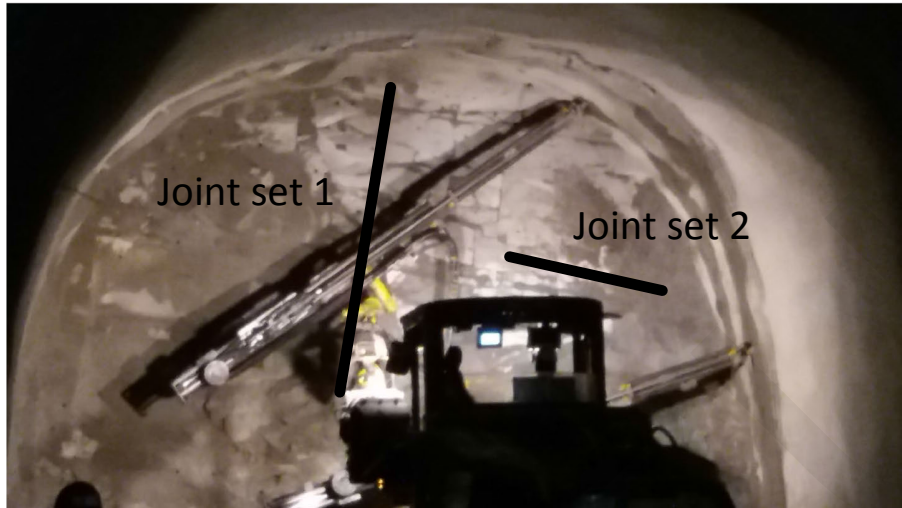
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<https://doi.org/10.1631/jzus.A1700496>

Undulating rockhead with limited competent rockhead

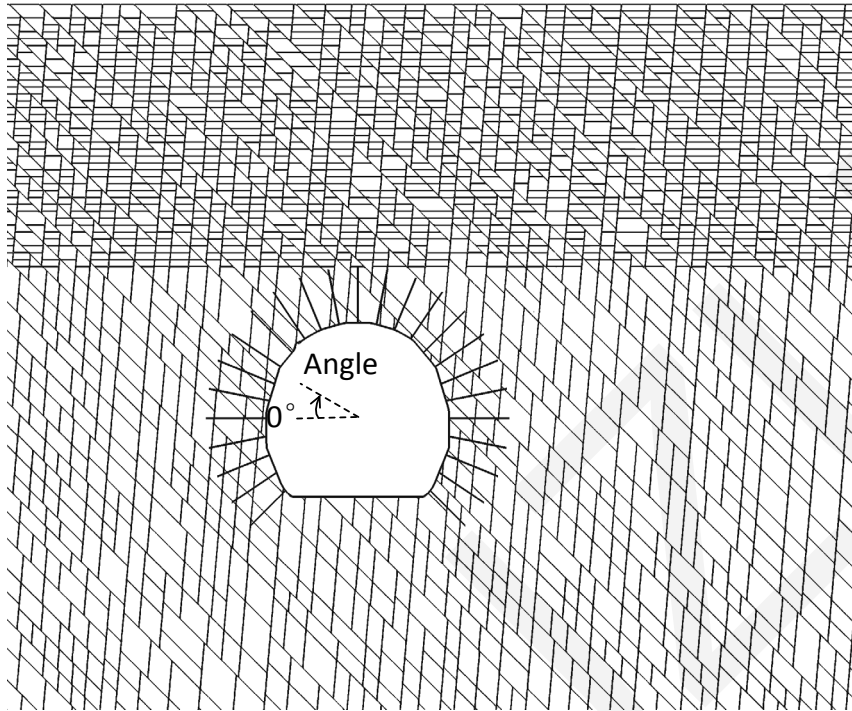


Example of a tunnel in jointed rock mass

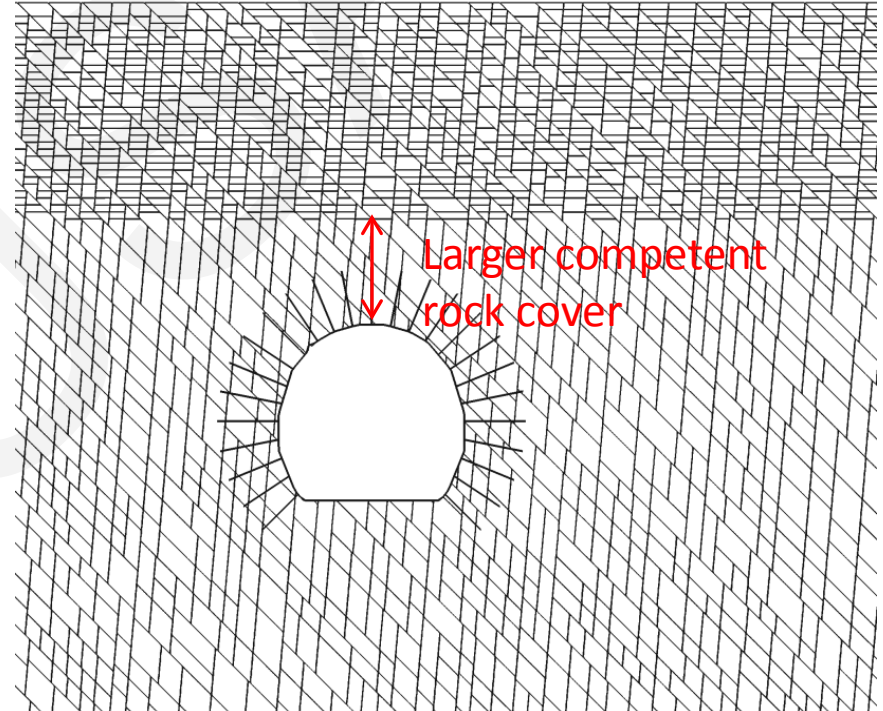


Distinct Element Analyses of Different Rock Covers

4 m GIII rock cover



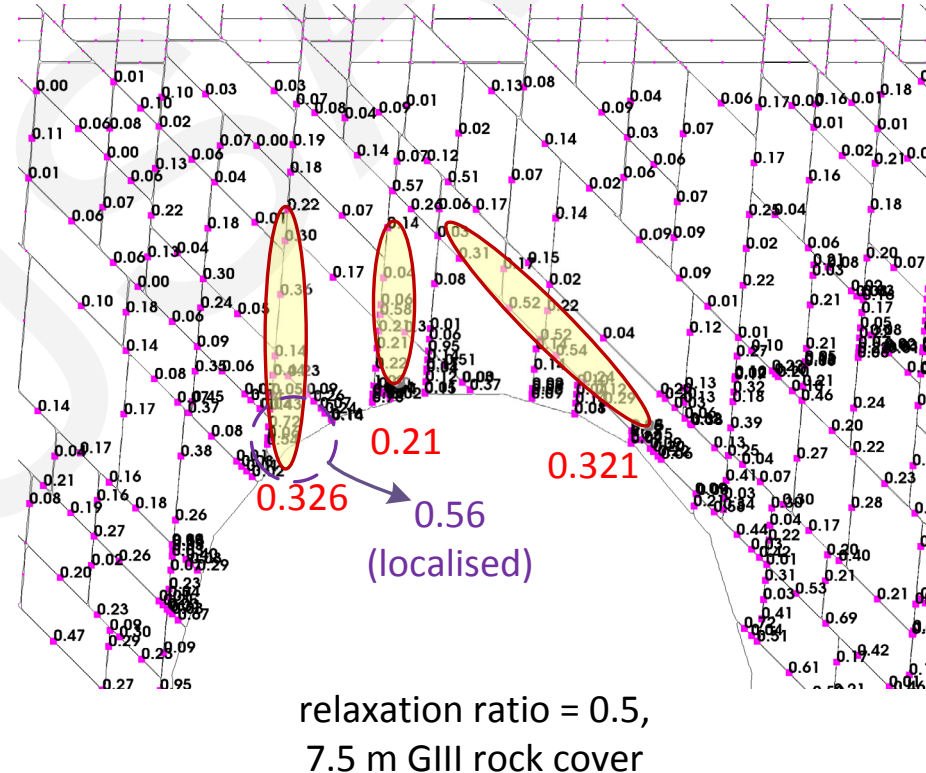
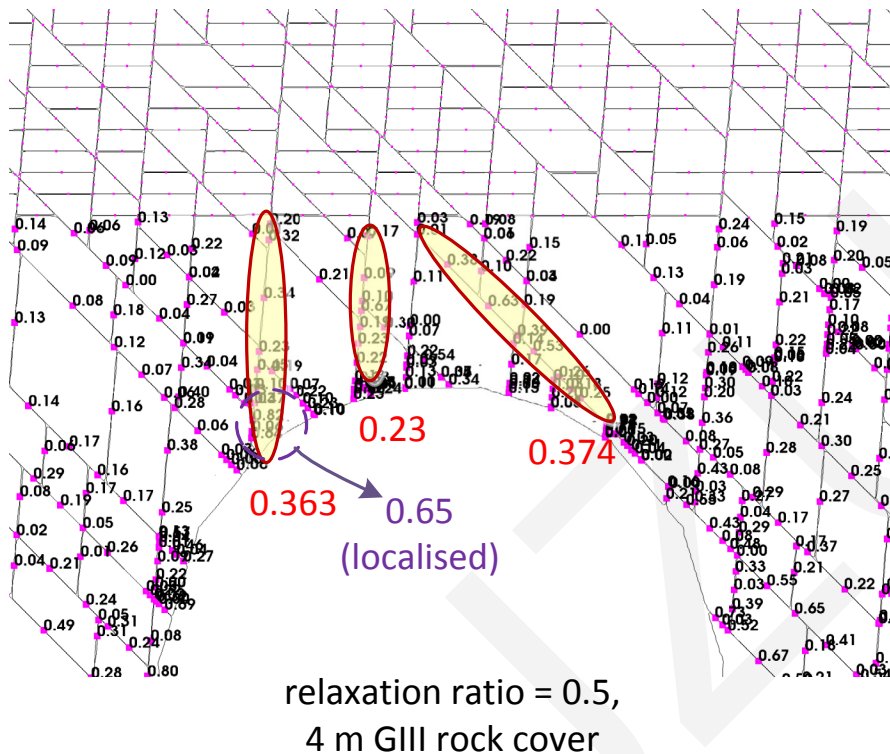
7.5 m GIII rock cover



Numbers show ratio of “Mobilised resistance/Frictional resistance”

4 m GIII rock cover

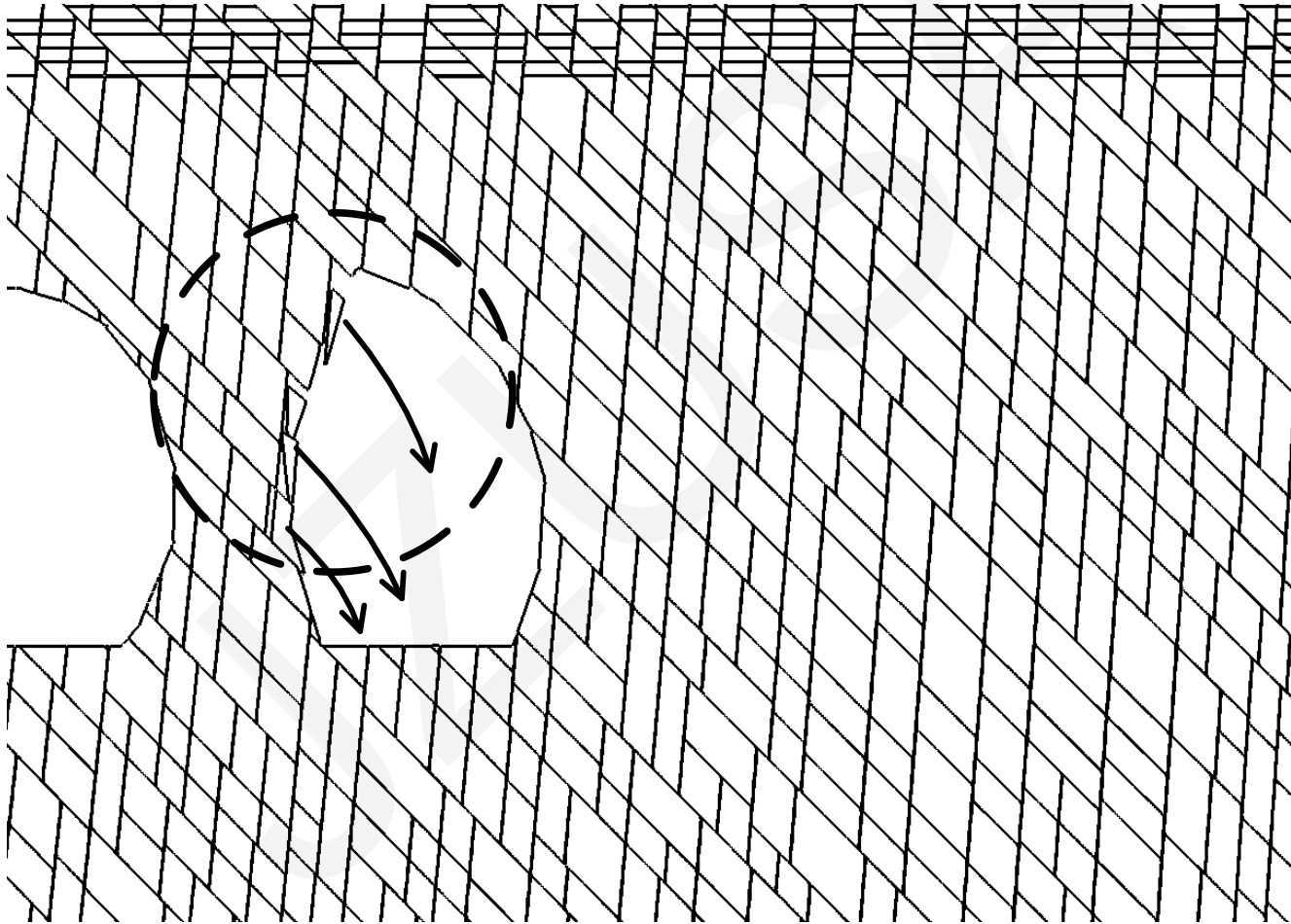
7.5 m GIII rock cover



Rock bolts are not displayed for clarity

Mobilisation ratios averaged along potential sliding planes were found to increase by 10-17%, when rock cover reduced from 7.5 m to 4 m

Failure mechanism of side drift



Results and Conclusions

Influence of rock cover

- For an opening size of about 12 m and average block size of 1.5 m, a reduced GIII rock cover of 4 m thickness compared to 7.5 m thickness was found to result in marginally larger support forces, with differences in the range of 3-9%, for a single tunnel
- For a conservative relaxation ratio of 0.5 before support installation, the mobilisation ratios averaged along potential sliding planes were found to increase by 10-17% when the GIII rock cover decreased from 7.5 m to 4 m

Influence of side drift

- When the side drift was excavated adjacent to the first tunnel, the displacements and forces of the bolts (away from the rock pillar) and shotcrete lining were found to increase marginally, and they were within the capacities of the support
- From the results, however, it was found that the bolt forces at the pillar approximately doubled, suggesting that in practice it may be necessary to provide additional rock bolt reinforcement