Use of arched sill mats made of cemented backfill to improve the stability in the underhand cut and fill mining method

Introduction

The underhand cut and fill mining method with sill mats made of cemented backfill is widely used when the rock mass is of poor mechanical conditions (i.e., RMR < 45% or Q < 0.1). As the stope becomes wider and go further in depth, the stability of the sill mats remains more and more critical. Several solutions have been investigated to improve the stability of the excavation and to strengthen the backfill. The solutions include addition of reinforcement made of bolts, cables, or implementing new materials in the backfill, which improve at the end the cost of the backfilling process.

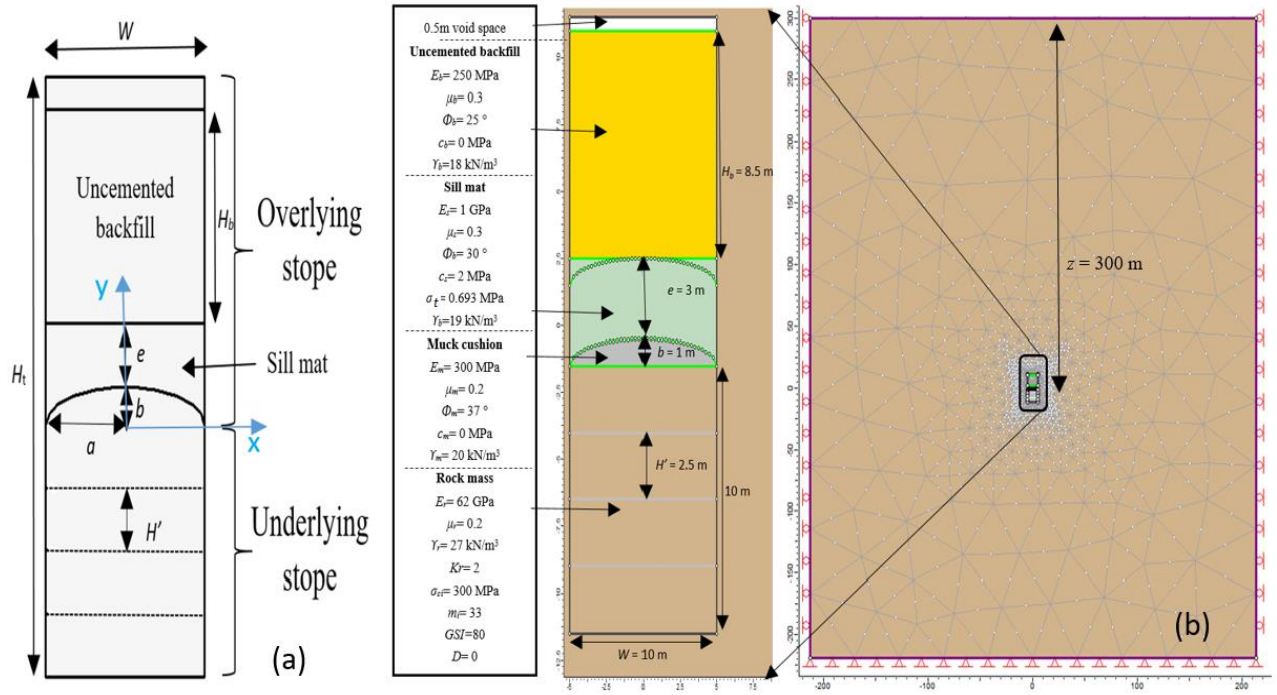
To address the loss of strength of the sill mats and the risk of failure in large stopes (W ≥ 10 m), this presentation show the results of the comparison between the stability of arched sill mats proposed as a new solution and the traditional rectangular sill mats. The adjustment of the shape of the sill mats has never been investigated in mining before and this proposal open a path for improving the stability of underground excavations and the safety of the mining workers.

Methodology

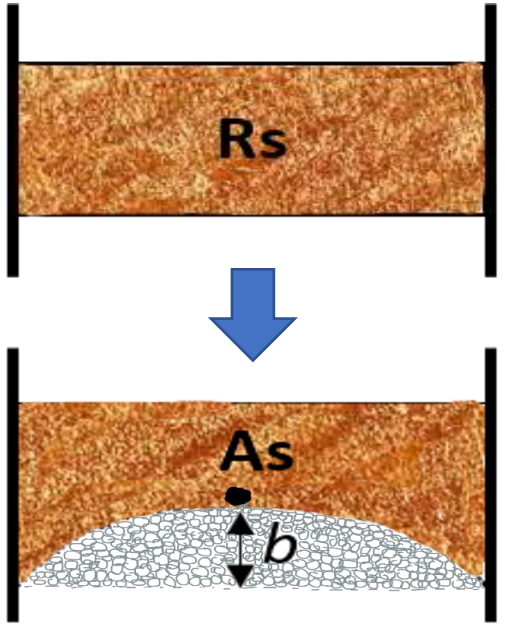
Choice of the numerical modeling software (RS2 V10, Rocscience 2020)

Validation of the software (sensitivity analysis of the mesh and the domain, reproduction of some laboratory tests)

Definition of the simulation plan and parameters to consider (e.g., width, height of the arch, height of backfill)

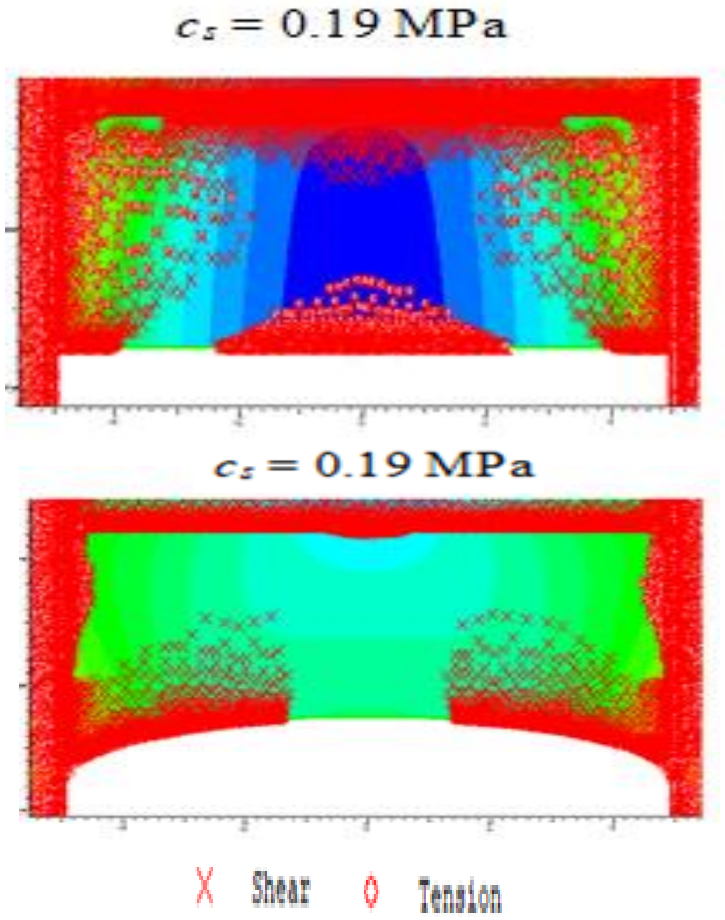


Physical and numerical models of the arched sill mats(Keita et al. 2021)

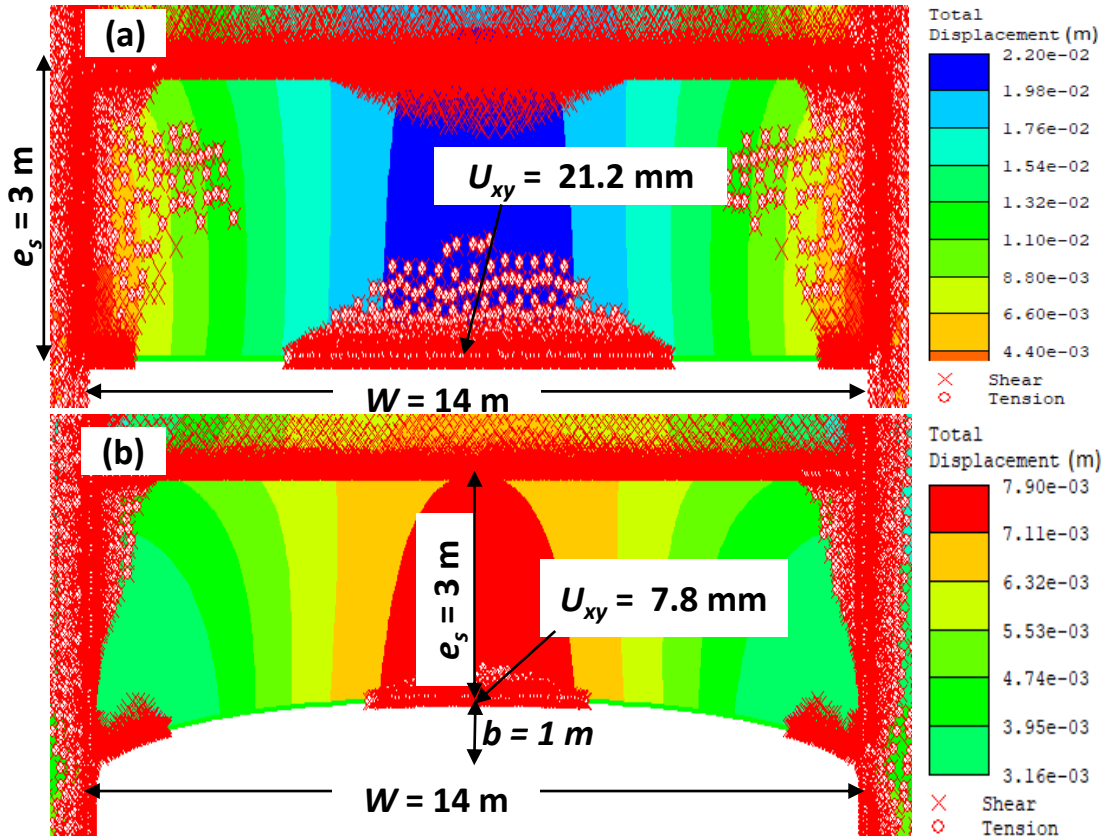


Schematic representation of the rectangular sill mat vs the arched sill mat overlying the muck cushion

Results

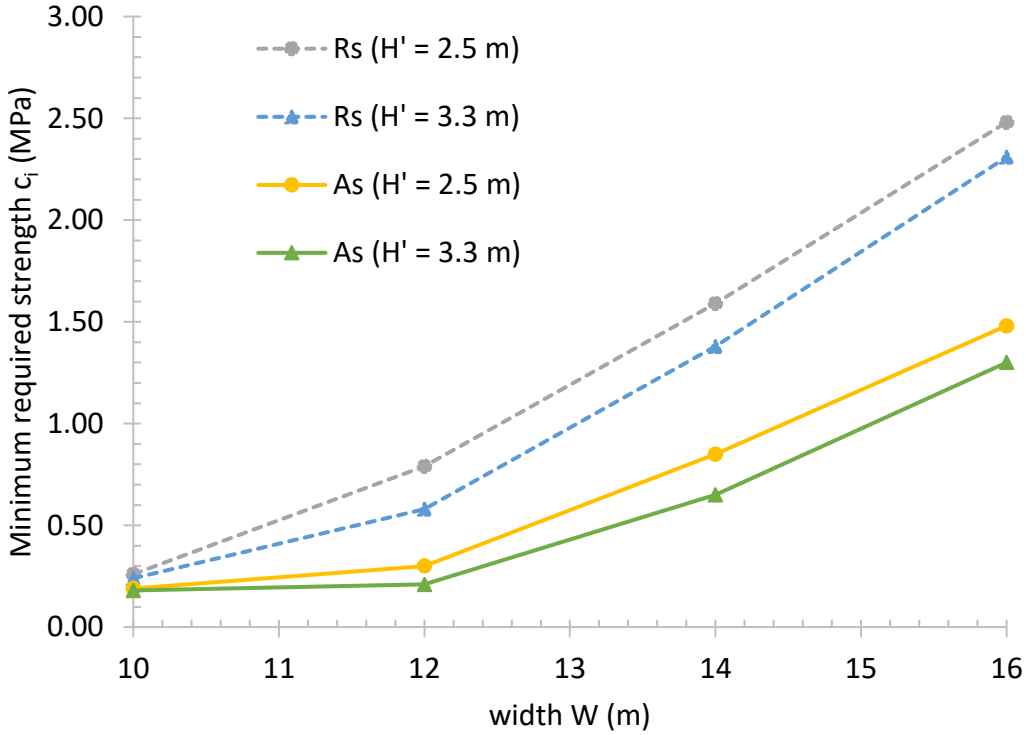


Reduction of the tension at the center base of the arched sill mat and increase of the shearing at the corners

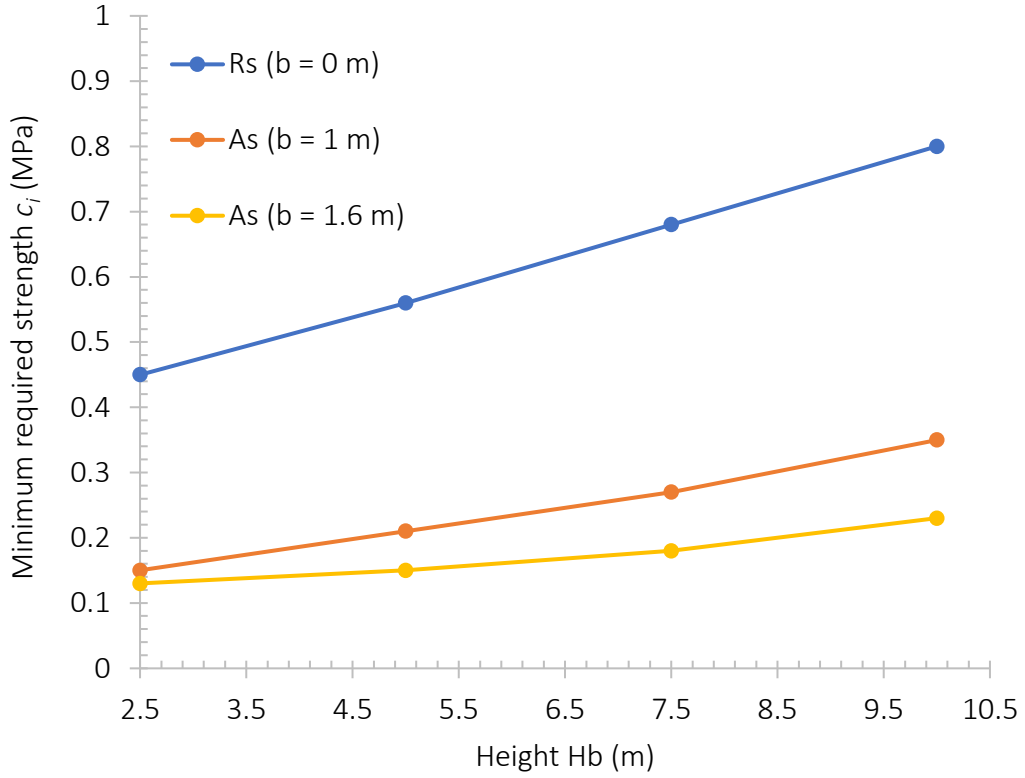


Reduction of the tension and the flexion at the center base of the arched sill mat

Results (continued)



Reduction of the minimum required strength in the arched sill mats for the same width. Increase of the required strength for thin excavation sequences in the underlying stope.



Reduction of the minimum required strength as function of the height of the arch. Increase of the required strength as function of the surcharge (height of the uncemented backfill)

Conclusion

- In large stopes (W ≥ 10 m) , flexion is the controlling failure mode of the sill mats made of cemented backfill. The risk of failure can be controlled using arched sill mats which exhibits higher stability.
- Arched sill mats require less design strength than the traditional rectangular sill mats. This corresponds to a reduction of the quantity of binder or reinforcement materials, leading to a reduction of the cost of the backfilling process.
- The increase of the height of the arch reduce the required strength. However, the increase of the shear at the corners is a concern that can be investigated in further analysis.

Bibliography

- Keita, A. M. T., Jahanbakhshzadeh, A., & Li, L. (2021). Numerical analysis of the stability of arched sill mats made of cemented backfill. *International Journal of Rock Mechanics and Mining Sciences*, *140*, 104667