

# APPLICATION OF RELIABILITY-BASED DESIGN METHODS TO UNDERGROUND EXCAVATION IN ROCK

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# Research objectives

This report investigates the advantages and disadvantages of applying reliability-based design methods in underground excavation in rock.

The objective is to identify:

- the types of design problems that are suitable for reliability-based methods,
- subjects for future research regarding how to implement such methods fully.

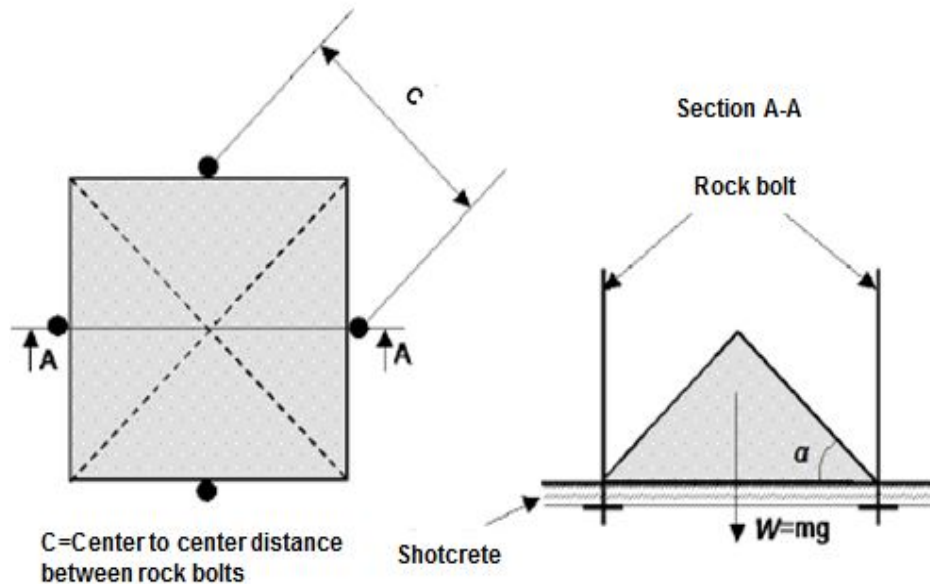
# Report content

- Characteristic features of rock engineering design.
- Basic principles of reliability-based design (RBD).
- Literature study of performed research on application of RBD to underground rock excavation.
- Application of RBD to limit states defined by Trafikverket's guidelines.
- Discussion of the applicability in practice.

# An example of an analysed limit state

Single block with adhesive rock–shotcrete contact:

$$G = \sigma_{\text{adk}} \delta_m O_m - \gamma_{\text{rock}} V_{\text{block}} \geq 0$$



# Summary of main contributions and conclusions

- For many rock mechanical problems, the affecting factors (e.g. geometry and uncertainties) may vary significantly from one place to another. Such conditions are not ideal when applying partial coefficients.
- Reliability-based methods, alone or in combination with the observational method, may be more favourable to achieve rational design from a structural safety perspective.
- The report shows how reliability-based methods have the ability to account for parameter uncertainties and model uncertainties in the design.

# Suggestions for further research

Further research is needed with respect to:

- How to quantify model and parameter uncertainties,
- How to combine numerical analysis with reliability-based methods for complex design situations,
- How to achieve a consistent and acceptable level of safety for the finalised structure as well as during construction.