

Framework for risk-based pillar design in underground mines (2023-03037)

Project leader

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Partners

Luossavaara-Kiirunavaara AB (LKAB), Boliden Mineral AB, Lundin Mining (Zinkgruvan), Royal Institute of Technology (KTH)

Project duration

January 2024 – July 2025



Goals of the project

Stress and load?



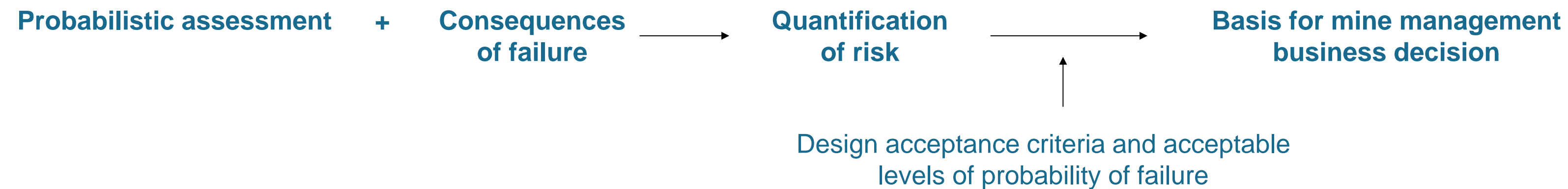
Material properties?

Common for all types of rock engineering structures are the uncertainty about the material properties and the actions (stress, load etc.). Today's use of deterministic methods consider the uncertainty and variation in the ground by min and max values.

Probabilistic methods allow for direct quantification of uncertainties. Probabilistic assessment together with consequences of failure would be the basis for a risk-based design.

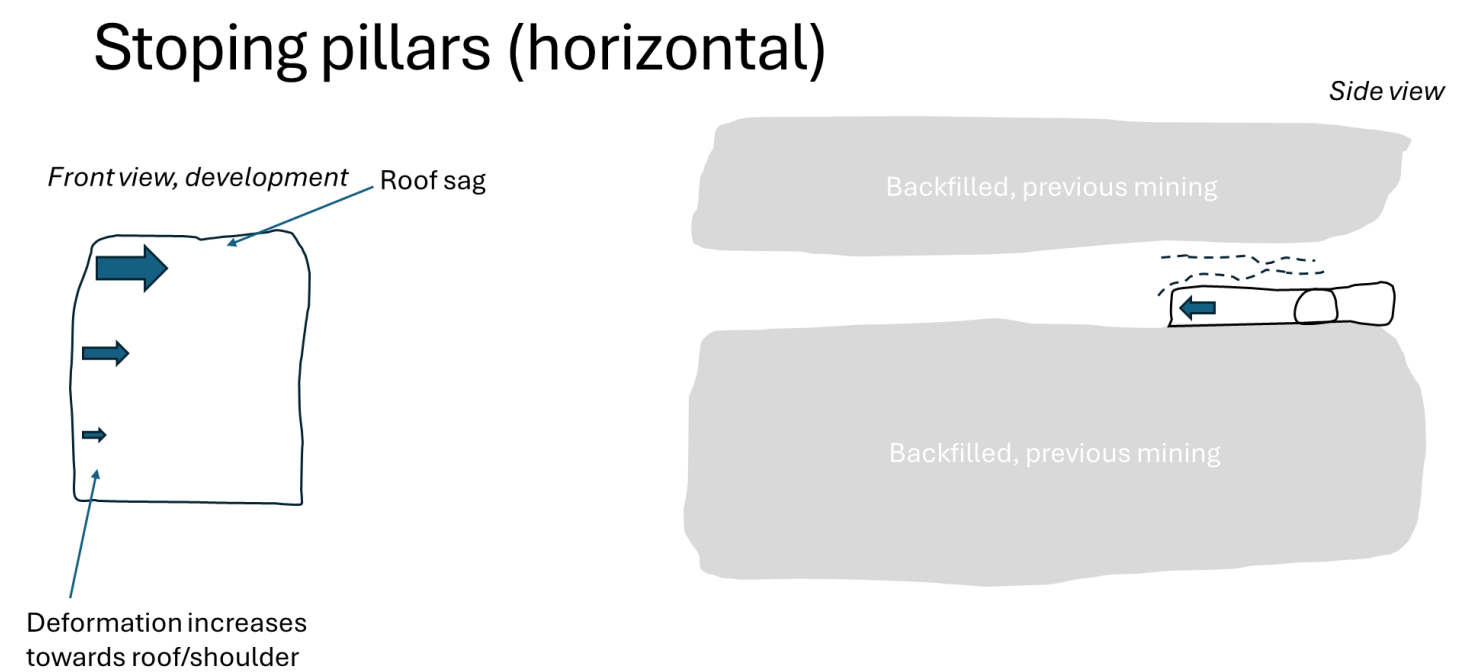
Pillars are essential structural units of most underground mines.

This project seeks to develop methods for risk-based rock pillar design based on probabilistic analysis, thus providing a framework that will consider risk assessment, work environment, and safety in underground mines.



Results so far

- Relevant examples of probabilistic design methods within pillar design engineering are summarized based on a literature and case study review.
- Mining cases for the development of a framework for risk-based pillar design has been collected based on a set up of case requirements to fulfill an ideal case description/condition. This in order to develop a usable framework for a variety of design situations.



Priority	Parameter	Value	Comment
Geometry			
1	Mining sequence	At least 5 blast prior to damage	
1	Pillar geometry	3D CAD model	Preferably scanned
Failure/damage description			
1	Date of observation	Connected to mining sequence	
1	Damage type	e.g. Wedge failure, excessive deformation, strain burst, crushing, support failure	
2	Rehabilitation	If applicable	
2	Continued sequence	After damage initiation	
Geological and geomechanical data			
1	Rock type boundaries		
1	Discontinuities (explicit)	e.g. shear and fracture zones	
1	<i>In situ</i> stress relations	Magnitude and orientation relative CAD north	
2	Major joint set orientations	Note any rotation relative to CAD north	
Mapping data			
1	GSI/RMR	Origin	Stope/core mapping
1	GSI/RMR	Delineation	By rock type, by tunnel/core interval
2	GSI/RMR	Mapping interval	Averaging lengths
Laboratory data			
1	UCS/PLT	Testing type	
1	Database of σ_{ci}	Minimum mean, max & min value encountered	
2	Elastic constants		
3	m_i		

Upcoming activities and next step

WP2 (Documented pillar cases) to finalize in November (delayed 5 months).

WP3 (Probabilistic description of rock masses) is ongoing and to be finalized in February 2025 (delayed 3 months)

WP4 (Probabilistic design tools for rock pillar) is ongoing and to be finalized in March 2025 (delayed 3 months)

WP5 (Risk-based design framework for rock pillars) will be completed mid June 2025 (delayed 2 weeks).

WP6 (Reporting and External Communication) will be completed according to schedule. Includes preparation for a paper (conference or journal). The final written technical report, in English, will be shared among the partners.

Final reporting of the project at the Vinnova portal.



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