

SUMMARY OF MONITORING TECHNIQUES COMMONLY USED IN UNDERGROUND MINING

DESCRIPTION	QUANTITY MEASURED	NATURE OF MEASUREMENT	COMMENTS
Visual observations.	Physical characteristics.	Surface of excavations or borehole.	Observers look for signs of instability, stress effect, rock mass deterioration, etc.
Wire extensometer.	Movement of the anchor position relative to the borehole collar.	Inside the rock mass, along a line: 1 dimension.	Extensometer installed in a borehole. The measurement is made to the anchor location only. Measurements are best over small displacements.
Time Domain Reflectometry (TDR).	Location of break along TDR cable.	Inside the rock mass, along a line: 1 dimension.	TDR installed in a borehole. Provides continual monitoring along length of the TDR.
Instrumented reinforcement.	Elongation of the reinforcement.	Attached to rockbolt or cable bolt: 1 dimension.	Can provide an indication of the load acting on the rock bolt/cable bolt.
Stress cells.	The strain of the rock is interpreted to estimate stress changes.	Point measurement inside the rock mass.	Installed in areas where stress change is anticipated.
Cavity Monitoring Systems (CMS).	Laser measurement of distance to the excavation boundary from a fixed point.	Void measurement: 3 dimensions.	Access to the cavity will be limited. Risk of losing expensive equipment is high. CMS will give the actual void geometry.
Seismic monitoring.	Seismic wave generated by rock failure. Location and seismic parameters are estimated from recorded waveforms.	Large volume of rock mass: 3 dimensions.	Equipment installation can be remote from the production area. The only assessment of rock mass response over a large volume. Mine scale seismic systems are expensive and require extensive interpretation to be useful.

Pro-Active Inspection of Excavation

The pro-active inspection of excavation, looking for rockfalls and other hazards, is every individual's duty of care and an integral part of everyday procedures for accessing and carrying out their work-related task in the workplace.

It is good practice for underground workers to conduct an informal risk assessment when they enter a working area. This informal approach aims to raise risk awareness in day-to-day tasks compared to a formal and structured comprehensive risk assessment. Good practices for risk assessment that are commonly used in mines include:

- 'Plan' (Pause, Look, Act, Note).
- Stop and Think.
- 'Hudson's Rule of Three'.
- PASS (Positive Attitude Safety System).
- 'Spend a Minute - Save a Life'.

In some mines, rockfall risk awareness is supported with field books that describe what to look for when identifying rockfall hazards, failure mechanisms and bolting patterns as well as a checklist of potential hazards.

Pro-active inspection of excavations can also take the form of routine inspections of the mine by front line supervisors, mine management and/or geotechnical personnel. Formal geotechnical audits involving geotechnical personnel accompanied by selected competent personnel, (regulators, consultants, management, front line supervisors and/or operators), should also be performed periodically. It is important that all inspections are followed-up with appropriate action plans to remediate any immediate or longer-term concerns.

Reference:

Minerals Council of Australia, Management of Rockfall Risks in Underground Metalliferous Mines.

