Mine Wide Risk Assessment

What is the state of your arteries ?

Tuesday, January 30, 2007

Locality

Background

- **Geotechnical mine wide risk assessment**
- **Systematic inspections, description and assessment**
- **Risk ranking and prioritisation of rehabilitation resources**
- **Ensure a safe and sustainable production environment**
- **Once off assessment in 2002-2003**

Ground Support Strategy

Primary Ground Support

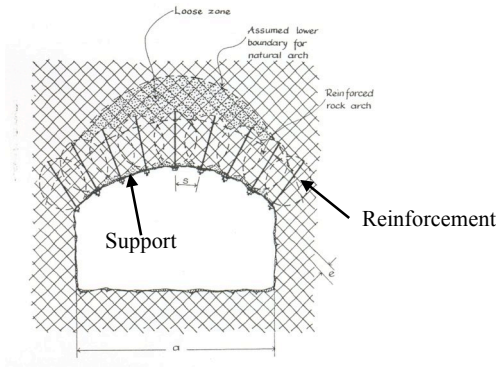
- Surface support and tendons
- Galvanised Mesh (100 x 100) or Steel fibre reinforced shotcrete
- Friction or resin bolts

Secondary Ground Support

- Deep reinforcement
- Full column grouted cable anchors

"No person is to work under unsupported ground"

Self Supporting



Tendon and Surface Support

Ground Support Design

Empirical Design

- Rock mass classification
- Design charts

Ground Support Interaction

- Observation
- Pull testing
- Monitoring
- Numerical analysis

Ground Support Design

Dynamic Loading

- Blast induced and seismic related dynamic failures are considered
- Potential of dynamic failure

Rockfall Back Analysis

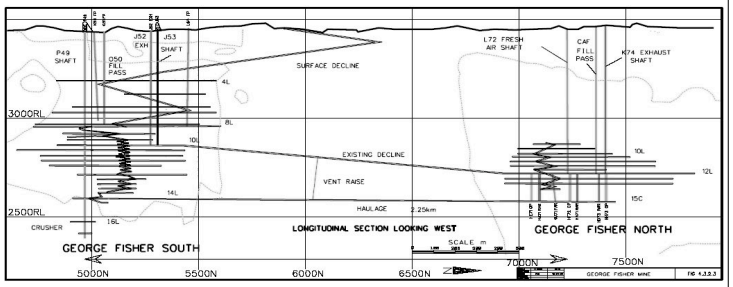
- Falls of ground greater than 1tonne are investigated
- Flagging of potential problem areas
- Information is used during the risk assessment process

Risk Assessment Process

Systematic Approach

- All access and egress routes are assessed

Longitudinal Section



Risk Assessment Process

Assessment Elements

- Ground condition
- Ground support
- Potential mode of failure
- Event trigger
- Exposure of personnel and importance
- Risk ranking
- Prioritisation

Risk Assessment Process

Rehabilitation Index

- **R0 – No Rehabilitation Required**
- **R1 – Low Priority**
  - No obvious problems
  - Ground support is faulty
  - The drive or intersection can remain open
  - Rehabilitation will be required in the future

Risk Assessment Process

R2 – Medium Priority

- Drive or intersection can remain open
- Inspections and scaling as necessary
- Some loose rock with no obvious dangerous or life threatening potential

R3 – High Priority

- Obvious loose blocks or wedges
- Drive should be closed immediately

Risk Assessment Process

Installed Ground Support

- Mesh
- Fibrecrete
- Friction or resin bolts
- Cable bolts

Ground Condition

- Generally good
- Average
- Mostly poor

Risk Assessment Process

Event Causes

- No ground support
- Corrosion
- Stress change
- Active water flow
- Insufficient ground support
- Inappropriate ground support
- Ground deterioration
- Blast vibration
- No apparent problem

Risk Assessment Process

Exposure

- Continuous use >50% of shift (>6hrs)
- Major travel way 20-50% of shift (2.5-6hrs)
- Intermediate 5-20% of shift (0.5-2.5hrs)
- Rarely used 0.1-5% of shift (1-30mins)
- Barricaded <0.1% of shift

Risk Rating

LIKELIHOOD

Level	Descriptor	Description	Quantification
A	Almost Certain	The event is expected to occur in most circumstances	Employees are exposed to the event occurring to its final outcome daily
B	Likely	The event will probably occur in most circumstances	Employees are exposed to the event occurring to its final outcome greater than once per week but no more than 4 times a month
C	Occasional	The event should occur at some time	Employees are exposed to the event occurring to its final outcome greater than once per month but no more than 12 times per year
D	Unlikely	The event could occur at some time	Employees are exposed to the event occurring to its final outcome greater than once per year but no more than 5 times in 5 years
E	Rare	The event may only occur in exceptional circumstances	Employees are exposed to the event occurring to its final outcome greater than once in 5 years

CONSEQUENCES

Level	Descriptor	Example Detail Description		
		People	Business Impact	Environment
5	Catastrophe	Fatality/Fatalities	=>$10M	Catastrophe – long term, significant legal implications and potential to effect community
4	Major	Permanent Disability	=>$1M-<10M	Major Impact – harm or breach of license conditions or obligations, discharges off site
3	Moderate	Disability/Lost Time Incident (LTI)	=>$100k-<1M	Moderate Impact – external to local area, generally contained on site
2	Minor	Medical	=>$10-<100k	Minor Impact – minimal impact outside the local area
1	Indignificant	Minor	<$10k	Minor Non-Conformance – no impact, minor breach in procedure

Risk Rating

Risk=Consequence x likelihood

Where:
Likelihood = Exposure x likelihood of a rockfall

			Almost Certain	Likely	Occassional	Unlikely	Rare
			A	B	C	D	E
Exposure	continuous use	1	1	2	3	4	5
	major travelway	2	2	3	4	5	5
	intermediate	3	3	4	5	5	5
	rarely used	4	4	5	5	5	5
	barricaded	5	5	5	5	5	5

Risk Matrix

			insignificant	minor	moderate	major	catastrophic
			1	2	3	4	5
Likelihood	almost certain	A	2	2	3	4	4
	likely	B	1	2	2	3	4
	moderate	C	1	1	2	3	3
	unlikely	D	1	1	2	2	3
	rare	E	1	1	1	2	2

1=Low
2=Moderate
3=High
4=Extreme

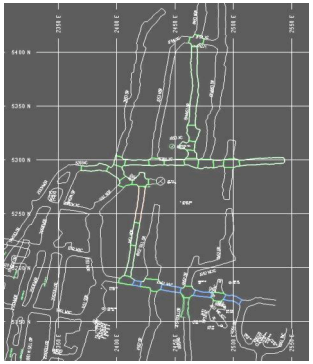
Outputs

- **Risk profile of mine access and egress routes**
- **Immediate action plans for high and extreme ratings**
- **Medium to long term management plans for low and moderate ratings**
- **Areas with identical risk ratings, exposure is used to prioritise in most cases**
- **Rehabilitation priority list**
- **Summary report**

Future Work

Inclusion into MineSight

MineSight Example



Future Work

- **Inclusion into MineSight**
- **Corrosion index**
- **Compile a procedure for quality assurance**

Conclusions

- **Mine wide geotechnical risk assessment provides a systematic process to evaluate the level of risk to access and egress routes**
- **Provides management with a useful tool as part of the risk management process**
- **Drives the short and long term support strategies to ensure stability and sustainable mining**

"You cannot manage what you don't measure"

Conclusions

"***There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction***"
(John F. Kennedy)

Questions

So, what are the state of your arteries

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