MHSC
Mine Health and Safety Council

Tackling Falls of Ground and Rockbursts: MHSC Research

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20th of March 2025

Every mine worker returning from work unharmed every day. Striving for zero harm in our lifetime.

Presentation outline

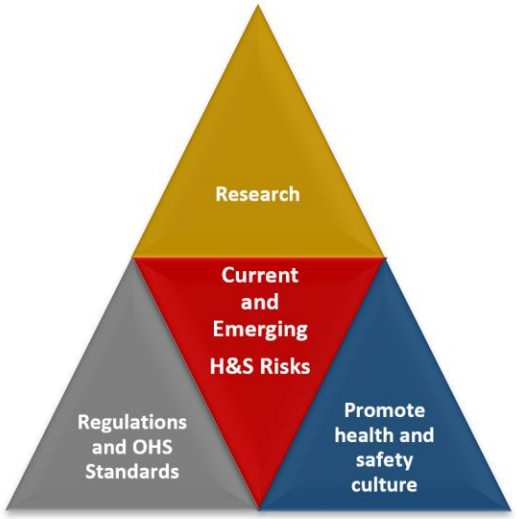
- MHSC mandate, structure and research focus areas
- MHSC research outcomes
- FoG and Rockbursts project pipeline
- Research ideation session – FoG and Rockbursts
- Conclusions

MHSC mandate

Vision: Zero Harm to Mine Employees and Communities Affected by Mining Activities.

Mining Employees

- Zero fatalities
- Elimination of injuries
- Elimination of occupational diseases
- Safety and security of women



Mining Communities

- Reduction in complaints
- Minimise negative impact on communities as a result of mining activities

Organised Labour ⟷ State ⟷ Employers

Biennial review of the state of health and safety in the SAMI through the **Mine Health and Safety Tripartite Summit.**

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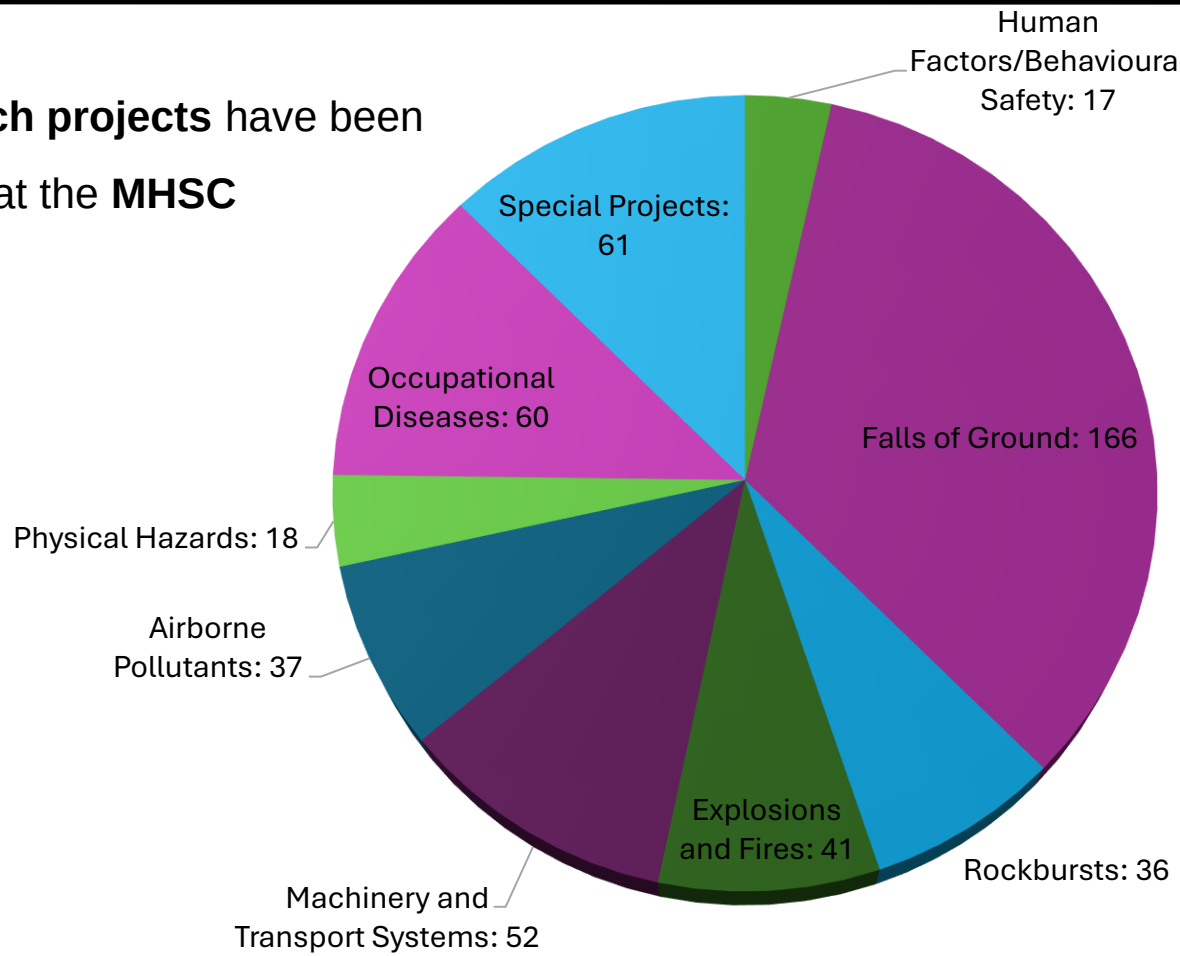
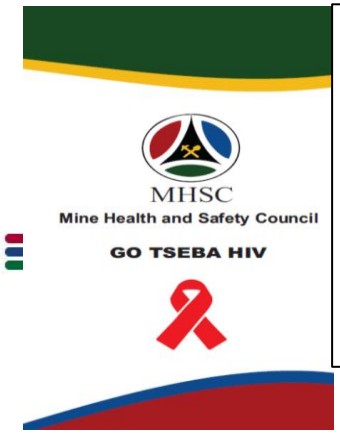
MHSC research focus areas

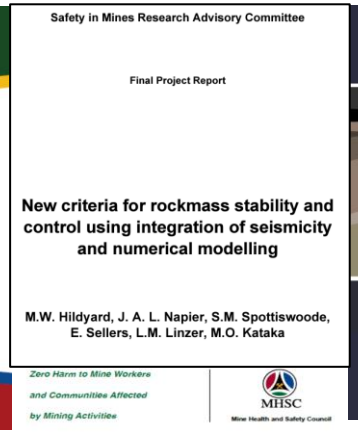
A total of **488 research projects** have been completed at the **MHSC**

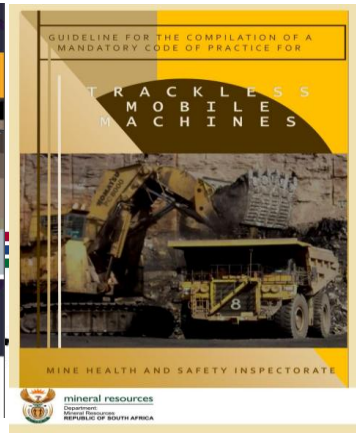


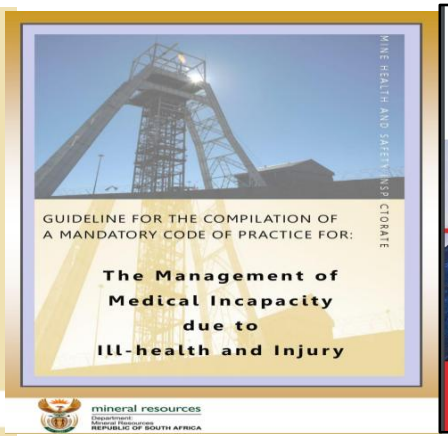
MHSC research outcomes: Knowledge Generation

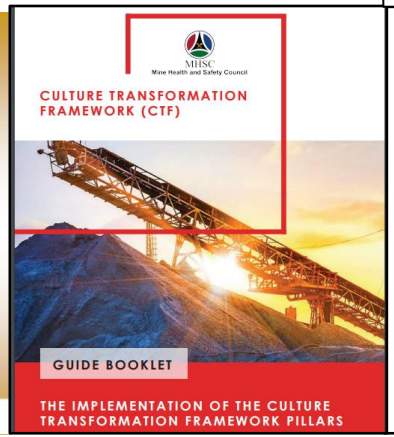
- MHSC research outcomes have assisted the mining sector to eliminate/reduce occupational fatalities, injuries and diseases resulting from agencies such as falls of ground, transport & machinery systems, explosions & fires and occupational exposures.
- MHSC research have generated some knowledge that have advanced MHS practice in South Africa and globally.
  - Books/handbooks in focus areas such as rock engineering, safety, ergonomics, occupational health and hygiene.
  - Culture transformation framework (CTF) - Promoting a culture of OHS in the SAMI.
  - Training and awareness material (banners, pamphlets, posters, videos, etc).
  - Improving health, safety and security of WIM.





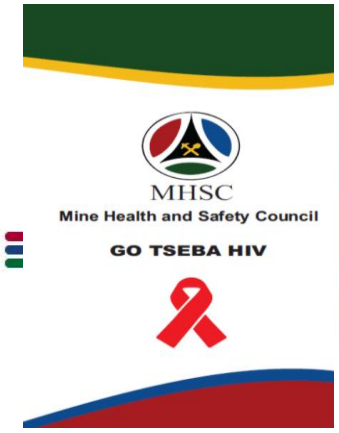


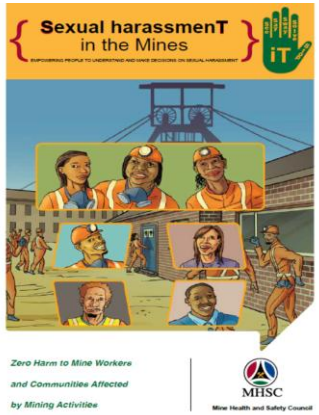


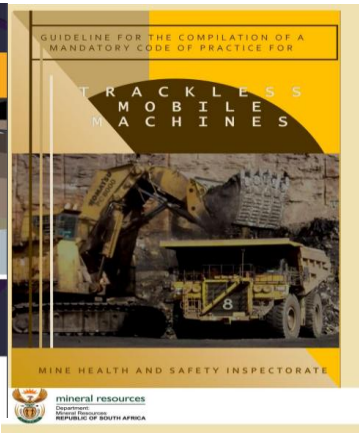


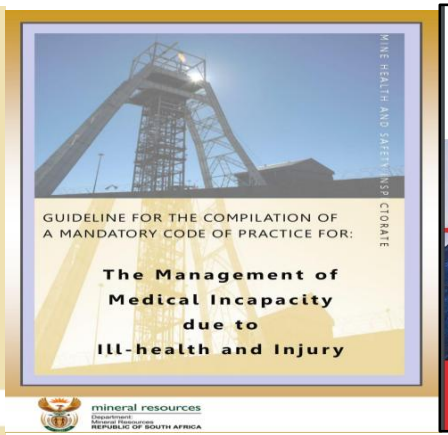
Research outcomes - Technology Development

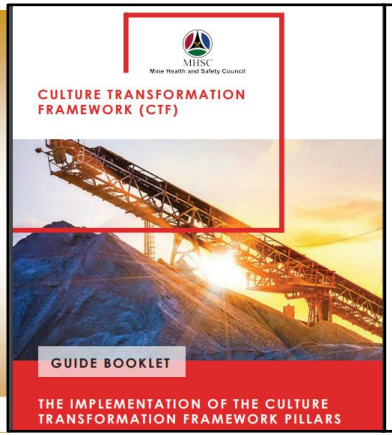
- **Innovations Triggered by Research include:**
  - Nets with bolts
  - Bagged Stone Dust Barrier
  - Remote-controlled mining equipment to reduce worker exposure
  - Proximity detection and collision avoidance systems.
  - Rock mass condition assessment tools
  - Enhanced ventilation and dust suppression technologies.
  - Missing person locator systems
  - Fundamental seismic research led to better ground control strategies





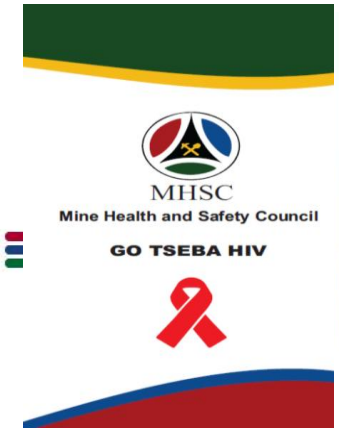


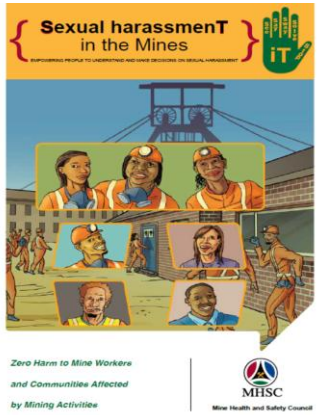


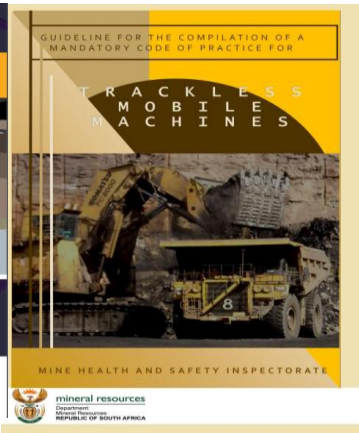


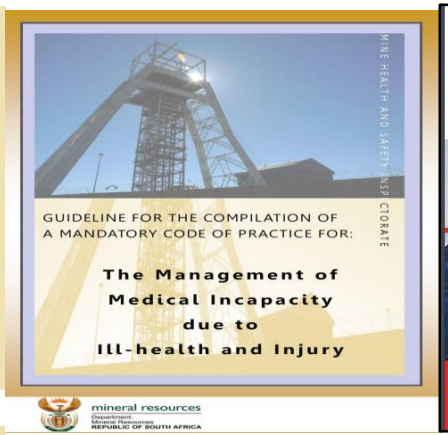
Research outcomes: Regulations, Guidelines and Policy

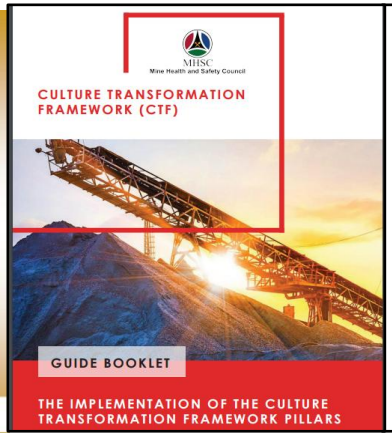
- MHSC research could recommend some improvements to the MHS legislative framework:
  - Reviewing existing legislation.
  - Developing new legislation.
- Examples of regulations include refuge bays, explosives, electrical, trackless mobile machines, etc.
- Examples of guidelines include cyanide management, PPE for WIM , Safety and security for WiM, underground rail-bound equipment, management of medical incapacity due to ill health and injury, etc.
- MHSC research could recommend regulatory changes to promote the adoption of technology that assist the mines to improve the management of MHS risks:
  - TMM regulations - CPS (Chapter 8) – promulgated
  - Amendments to the Chapter 16 regulations: underground mine and surface mines with slope failure risk to implement missing person locator systems – promulgated
- Potential guidelines from ongoing MHSC research include Cannabis and Preconditioning





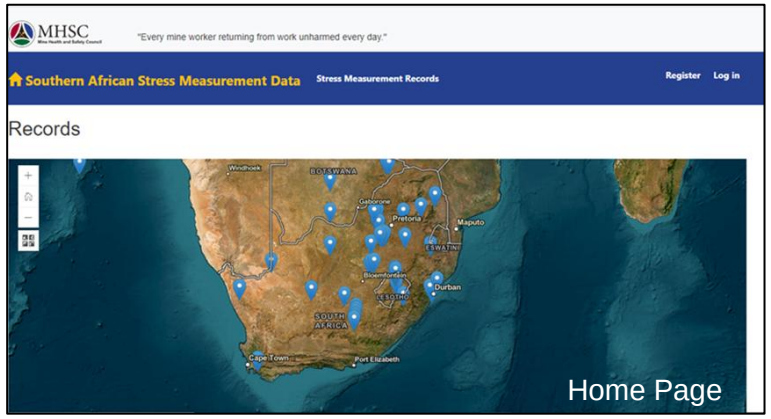


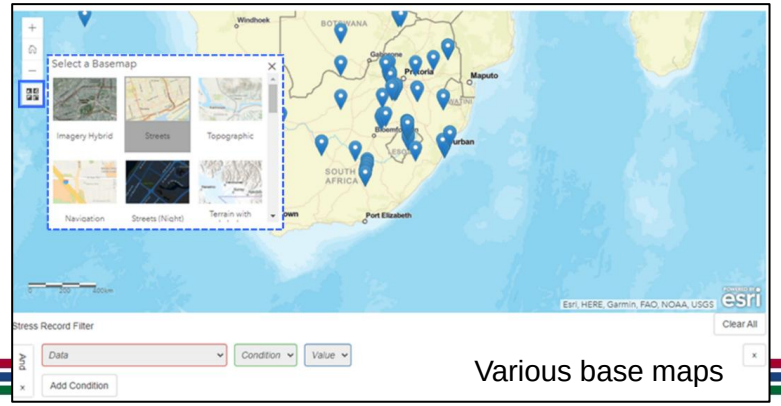




Research outcome: Stress Measurement Application

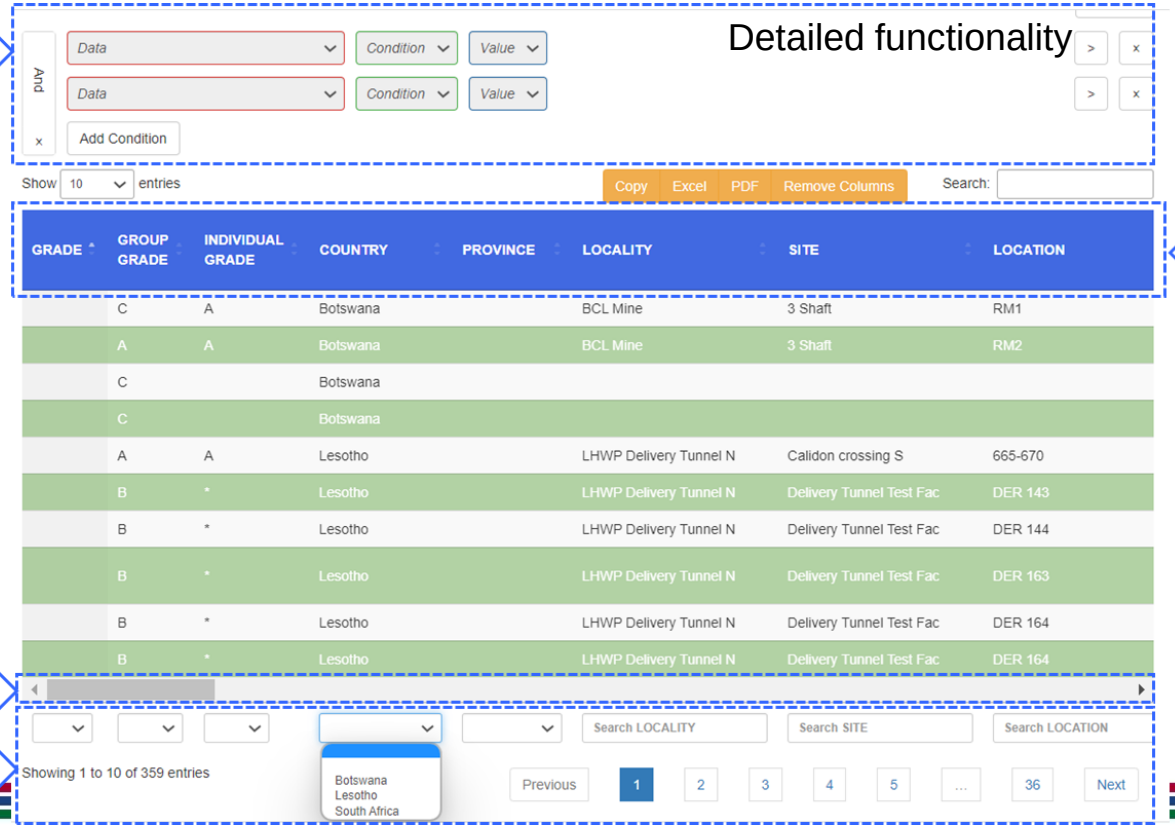
Successful Development of a User-Friendly Web Application for Recording and Accessing Stress Data





Filter

Detailed functionality



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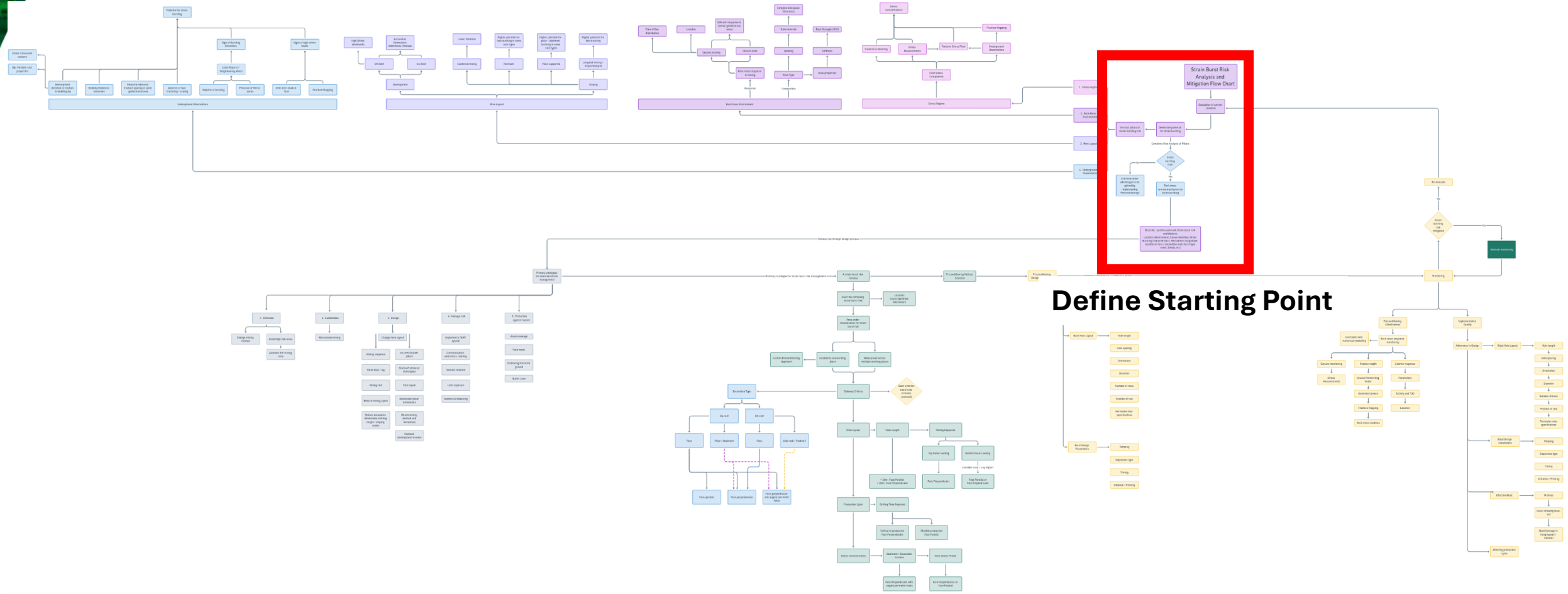
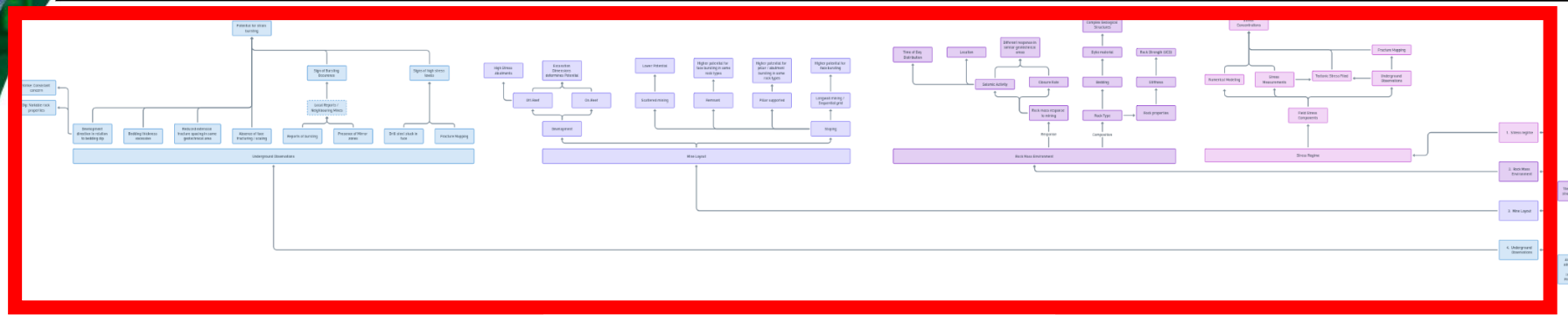
Research outcomes: Preconditioning

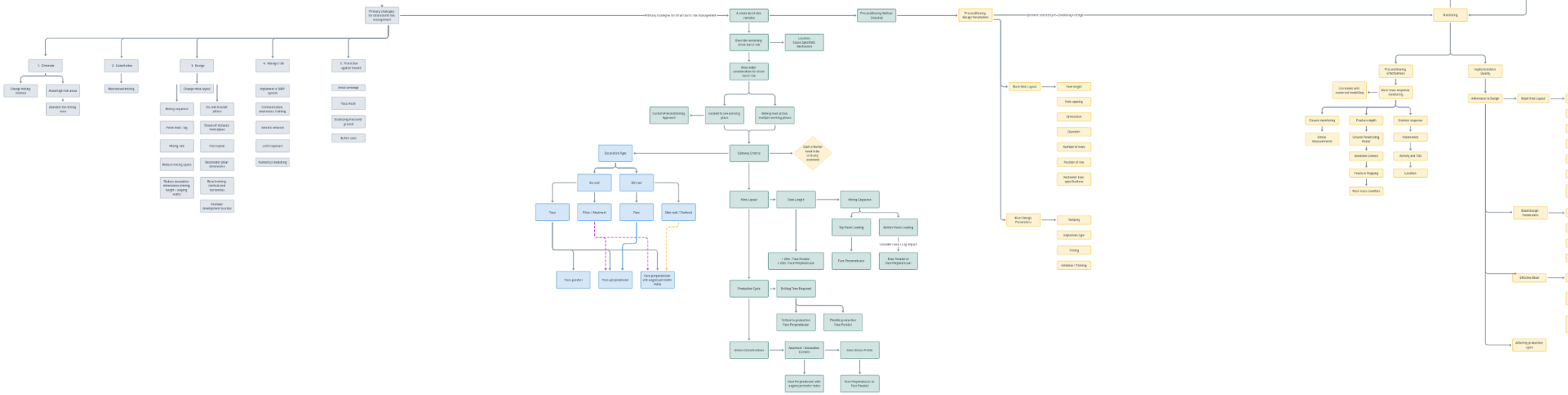


Define Starting Point

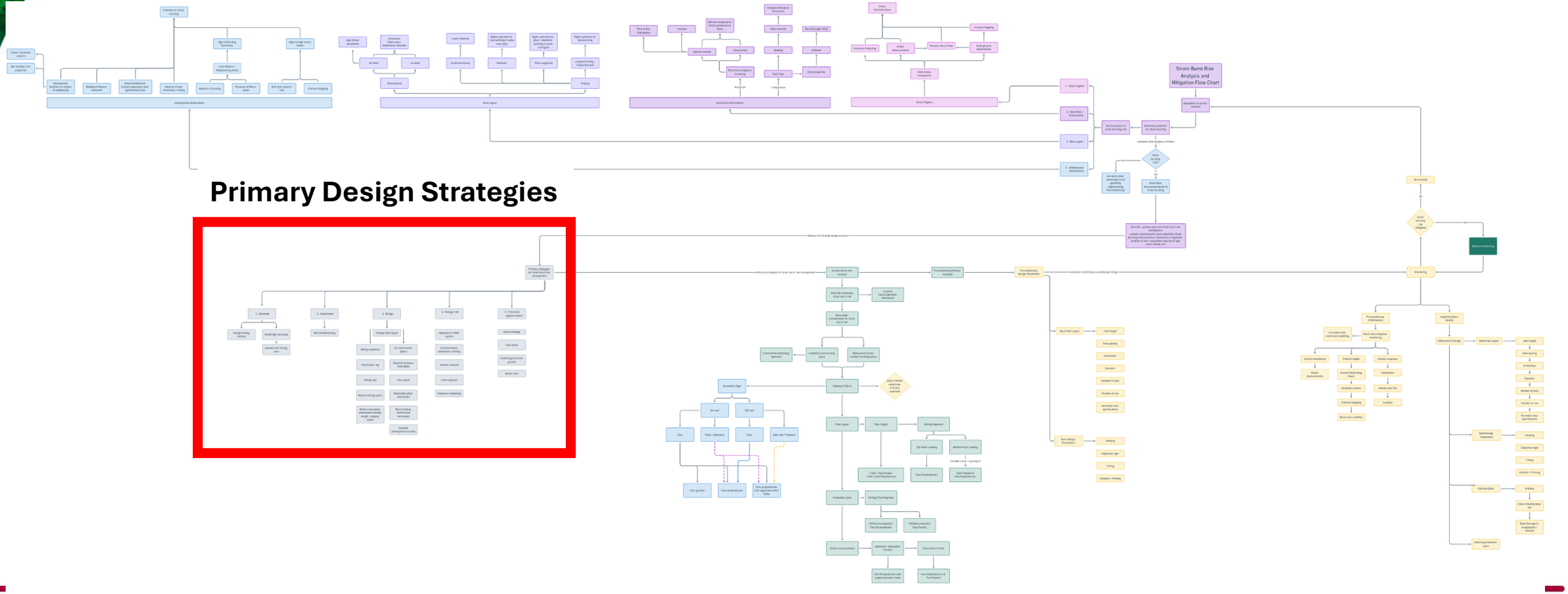
Research outcomes: Preconditioning



Analyse Strain Burst Risk



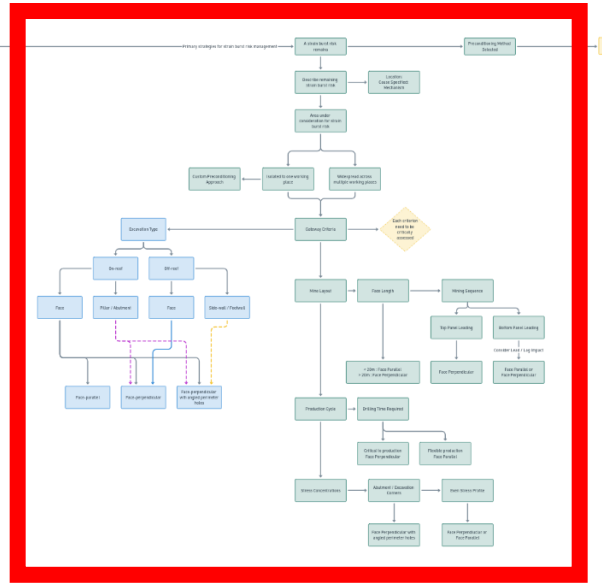
Research outcomes: Preconditioning



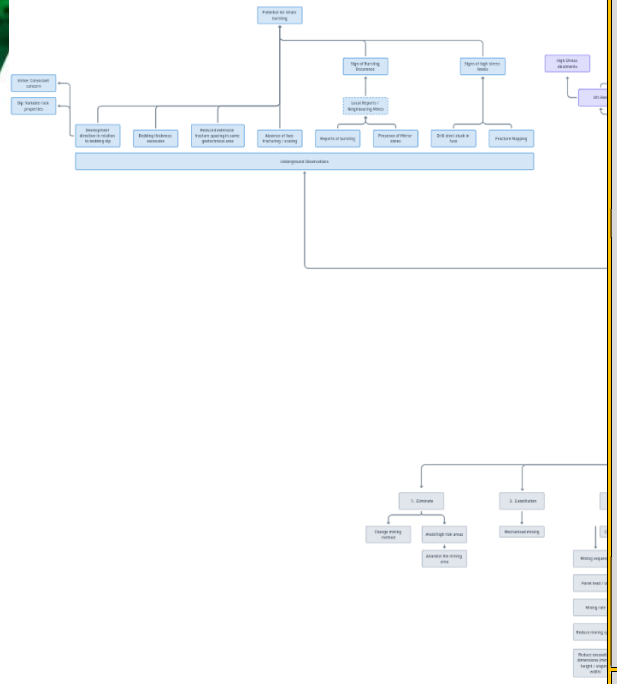
Primary Design Strategies

Research outcomes: Preconditioning

Preconditioning Method	Excavation Type	Mine Layout	Production Cycle	Stress Concentration	Perimeter Holes Required? (Third method)	Total Score
Face-parallel			X	XX		3
Face-perpendicular	XX	X		X	X	5

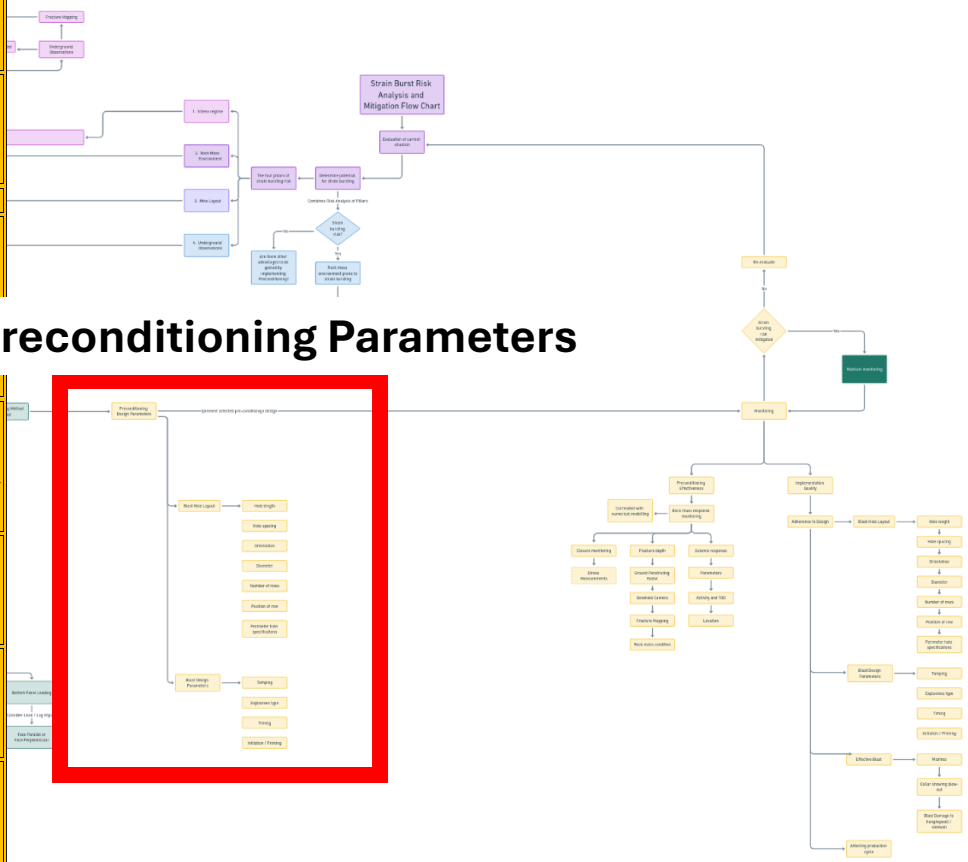


Research outcomes: Preconditioning

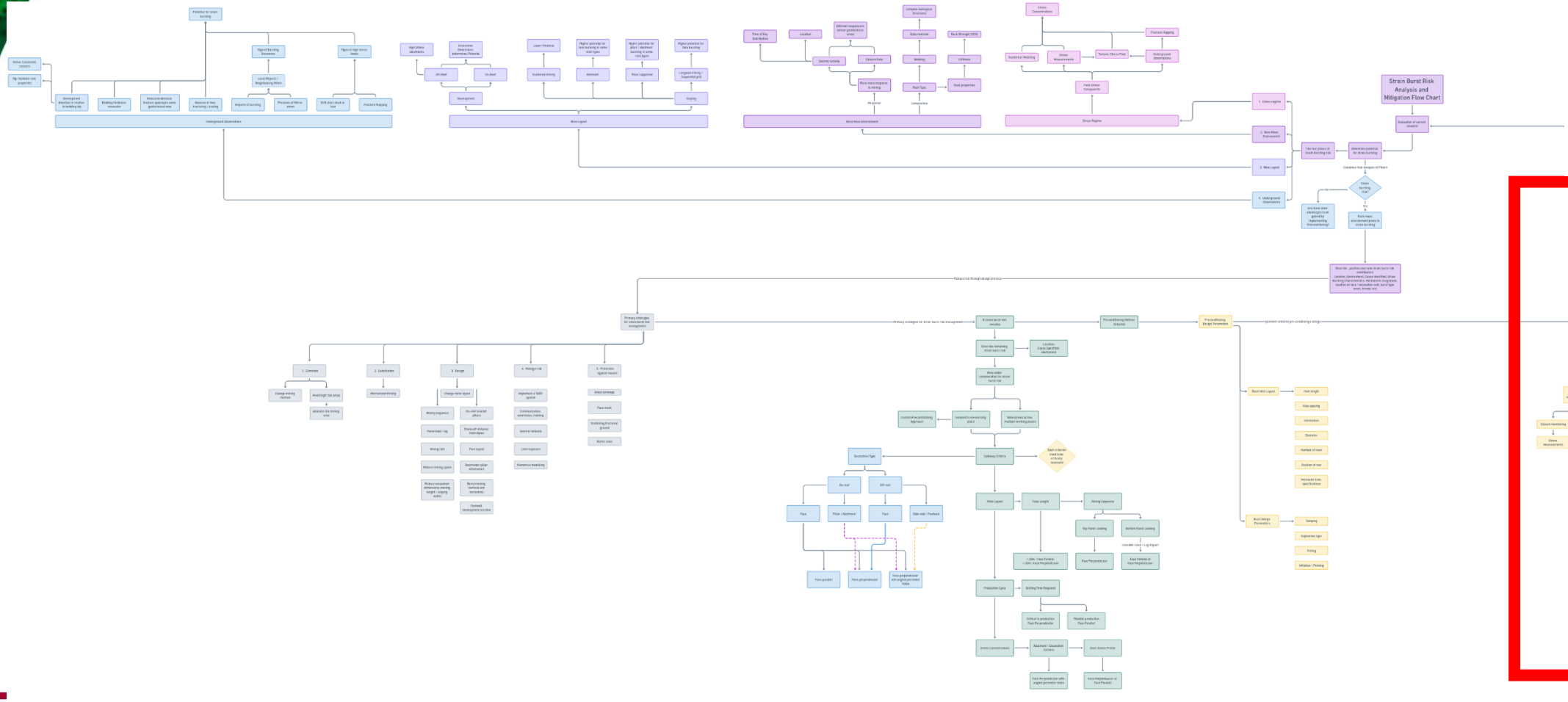


Main Category	Subcategory	Face-Parallel Range	Face-Perpendicular Range
Blast Hole Layout	Hole length	**15–30 m** Longer holes are drilled parallel to the mining face to cover a larger area ahead of the face.	**2.4–3 m** Minimum 2.4 meters. Shorter holes are drilled perpendicular to the face, typically extending slightly beyond the next normal blast round length.
	Hole spacing	**3–5.5 m** Wider spacing or a fanned-out pattern is used to achieve effective stress redistribution over a larger area.	**2.5-3 m** Holes are evenly spaced across the face to ensure uniform Preconditioning.
	Orientation	**Parallel to face**	**Perpendicular to face**
	Diameter	**75–100 mm** Depending on the required coverage and the specific geological conditions.	**34-38 mm** Smaller diameters are sufficient for the shorter holes used in this method.
	Number of rows	**1–2** Depending on the required coverage and the specific geological conditions.	Typically, one placed strategi face.
	Position of row	**3.5–5.5 m ahead of mining face.** Positioned to precondition the rock mass well in advance of the approaching face.	**Along the centre plane of the face, between the hanging wall and footwall.** This central positioning targets the area most susceptible to stress concentrations.
	Perimeter hole specifications	**Not typically used.** Not typically used. Face-parallel Preconditioning focuses on deep holes parallel to the face, making perimeter holes unnecessary.	**Standard 34–38 mm diameter at a 45-degree angle to the direction of advance.**
Blast Design Parameters	Tamping	**70–80% of hole length.** Effective stemming is crucial to contain the explosive energy within the borehole, ensuring efficient fracturing.	**Approximately 30% of the hole length.** Proper stemming materials are used to maximize retention time and contain explosive energy.
	Explosives type	**High-energy emulsions or water gels.** These explosives provide the necessary energy output for extensive fracturing in longer holes.	**Low-energy explosives such as ANFO (Ammonium Nitrate Fuel Oil) or low-energy emulsions.** These are suitable for shorter holes and provide adequate fracturing with minimal damage to the surrounding rock.
	Timing	**Electric detonators with sequential delays (10–20 ms).** Sequential firing ensures controlled energy release, reducing the risk of uncontrolled fracturing and enhancing safety.	**Simultaneous with production**
	Initiation/Priming	**Electric detonators**	**Shock tube initiation**

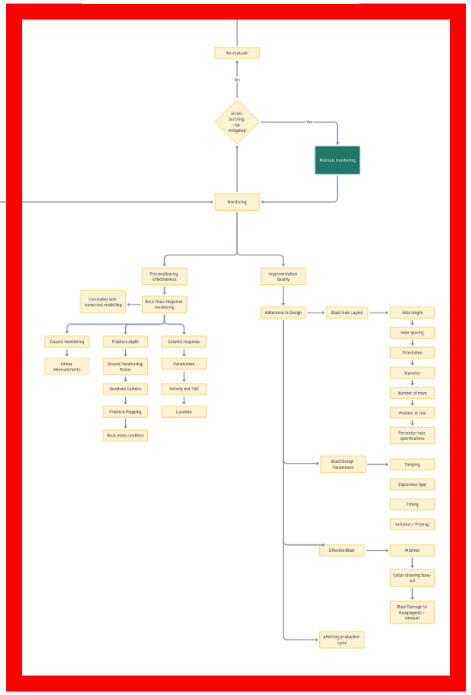
Select Preconditioning Parameters



Research outcomes: Preconditioning



Monitoring



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FoG & Rockbursts Project Pipeline

APPROPRIATE AVERAGE PILLAR STRESS (APS) CRITERION

- **Focus**: Design of regional pillars for platinum, gold, and other minerals

STRATEGIES FOR SAFE MINING OF UNDERGROUND PILLARS

- **Focus**: Developing industry-wide pillar support strategies

ANIMATED VIDEO TRAINING ON GOOD LEDGING PRACTICES

- **Focus**: Visual training to improve safety

ANALYSIS OF FOG AND ROCKBURST INCIDENT AND FATALITY DATA

Research Ideation - FoG and Rockbursts

What are Research Ideation Sessions?

- MHSC's main process for soliciting research topics from the industry
- Held in **Cullinan, February 2025**
- Featured **5 research focus areas**

Sessions Held:

✅ **Occupational Hygiene/Environmental Engineering**
✅ **Occupational Medicine**
✅ **Falls of Ground/Rockbursts**
✅ **Machinery & Transport Systems**
✅ **Human Factors, Behavioural Safety & Special Projects**

Key Project Highlight:

💡 **Falls of Ground Session:**
🎤 Presentation on ***"Developing Anti-Spin Cable Bolt (Cable Anchor): Pre-Tension Requirements for Different Rock Mass Conditions"***

Conclusions

Key Takeaways from This Presentation:

✅ *MHSC research has contributed to reducing fatalities, injuries, and occupational diseases through guidelines, regulations, and safety initiatives.*

✅ *We have completed 488 research projects, including 166 focused on Falls of Ground and 36 on Rockbursts, demonstrating our commitment to addressing critical mining hazards.*

✅ *Ongoing research projects, such as APS criterion, pillar mining strategies, and training videos, are focused on mitigating Falls of Ground and Rockburst risks.*

✅ *The research ideation sessions allow us to engage with industry experts and stakeholders to develop impactful research that addresses emerging challenges, such as anti-spin cable bolts for different rock mass conditions.*

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