

Safety In Mines Research Advisory Committee

Final Project Report (Phase I)

The design and development of an effective
support system for tabular stopes in gold
and platinum mines

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Executive Summary

Rock mass instabilities represent the single largest cause of injuries and fatalities suffered by the workforce in South African gold and platinum mines. The majority of rock-related fatalities (± 56 per cent) occur in the immediate vicinity of the stope face. Relatively few fatalities (< 5 per cent) are associated with the back areas. The strike gully is associated with the second highest number of fatalities (15 per cent).

Stope support systems, typically consisting of combinations of tendons, props and packs or backfill, are used to stabilise the rock mass surrounding excavations and reduce the risk of rockfalls and rockbursts.

In response to the rock-related hazard, a significant research thrust was, and continues to be, directed at stope support, to combat the hazards of rockfalls and rockbursts. In spite of a considerable amount of research effort focused in the area of improved stope support, the trend in fatality rates over the past ten years has shown only a marginal improvement. It is, therefore, unlikely that conventional support systems, as currently used, will result in a *significant* improvement in accident rates. New, alternative support systems and technologies are required to significantly reduce the rock-related hazards associated with underground mining operations.

The objective of Phase I of SIMRAC Project GAP 708 is to develop a support system concept that addresses the deficiencies in current stope support systems, and that will significantly reduce fatalities in the stope face area in the short to medium term.

In order to achieve the objective, the deficiencies of current stope support systems were identified and include (i) poor area cover, (ii) poor installation practices, and (iii) poor face area support during cleaning (almost 50 per cent of all stope fatalities involve people whose activity at time of incident is related to cleaning or making safe).

Any successful alternative stope support system would have to comply with certain rock engineering and operational requirements related to gold and platinum mining. The more important rock engineering requirements relate to the support resistance and energy absorption requirements, support/rock contact stresses (to prevent punching), yieldability of support, velocity of dynamic closure, post-rockburst stoping widths and the need for better areal coverage. The operational requirements include flexibility in terms of varying stoping widths, faults and reef rolls, ease of handling, and blast resistance. Another important operational consideration is that the system should not interfere with the scraper.

It is also vital that any alternative support system should offer protection to workers during all phases of the production cycle, i.e. drilling, charging, cleaning, making safe and face preparation. It is further important to integrate the application and use of alternative support technologies into the production cycle. Thus, the proposed support system should take into account the space requirements and other factors related to barring, cleaning, drilling and blasting operations.

Eleven alternative concepts were developed by means of reviews, workshops and brainstorming sessions. The following systems are described and evaluated:

- Rockbolt Reinforcement System

- Modified Spiling System
- Twin Beam Support System
- Remotely Advanced Headboard System
- Walking Beam Wishbone Support System
- High Pressure Stope
- Pneumatic Support System
- Safety Cell
- Longhole Drilling System
- Remote Miner
- Powered Shields

These concepts were evaluated in terms of rock engineering and operational requirements, and a rating system (using current stope support systems as a benchmark) was devised to determine the relative merits of the different systems. The rating system is based on the likely **improvement in safety** due to the introduction of the system (reduction in fatalities and injuries in the face area), the **practicality** of the system (its ability to function in the difficult, varying conditions typically encountered in gold and platinum mines) and the **research and development** requirements (to get the system to a point where it can be widely implemented in South African gold and platinum mines).

Based on the above evaluation procedure, the following three systems are recommended:

- Remotely Advanced Headboard System
- Rockbolt Reinforcement System
- Longhole Drilling System

The longhole drilling mining method has been used successfully (e.g. Telfer, Australia), but requires a planar orebody, with relatively few reef rolls or faults dislocating the orebody. This system may thus be applied successfully only in certain geotechnical areas or conditions. The system will result in a substantial reduction in rock-related stope face fatalities and injuries, as people are not required to enter the stope face area.

The rockbolt reinforcement system requires more research and development, so that the effect of such a system on the stability of the hangingwall can be quantified. This system, however, is highly flexible and will not require any modification to current mining methods.

The remotely advanced headboard system is flexible, and will result in a substantial

improvement in worker safety. Furthermore, this system has the potential to be implemented in most gold and platinum mines, without requiring modifications to current mining methods, and it is cost effective. It is thus anticipated that this system will be ready for large-scale manufacture and implementation within the next two years.

Detailed costing and planning of Phase II of SIMRAC Project GAP 708 was also carried out for the three recommended systems.

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