

Is the roof falling?

Will advances in roof control technology raise safety levels enough, **John Chadwick** asks? Roof bolting remains the industry's most dangerous task

Strata control remains a key factor in safety management. For example in South Africa, where some of the toughest strata control challenges have to be addressed, 114 deaths occurred in 2005, and 46 of them were rock-related, according to the government's Mine Health and Safety Council (MHSC). Furthermore, 757 more workers in South Africa's mines suffered serious injuries owing to rockfalls that year. Given these statistics, it is commendable that the MHSC recently called for companies to submit proposals to conduct research into predicting rockfalls in South African mines, which, the council said, caused an "unacceptably high number" of deaths and serious injuries.

Much of this discussion in South Africa is similar to calls for, and actions being taken in, safety improvement and miner education in the USA following well publicized accidents at the beginning of the year.

Prevention, and early warning, of possible rockfalls will assist in reducing rockfalls and removing people from the danger areas. Injuries, whatever the cause, have a cost in human life and suffering, and in lost production. They reduce morale and degrade the reputation of the mine concerned and the industry in general. They impact on our ability to recruit quality people.

The MHSC hopes to determine the possibility of monitoring and measuring with new instrumentation to collect data that gives sufficient indications, in terms of time and space, of impending rockfalls. It expects this to involve identifying the critical parameters involved in early movements of rock, before they detach from the rockmass and fall.

The council has also called for research into how the industry can be made more aware of the value that appropriate, although sometimes costly, safety measures in mining can pay dividends in reducing injuries and problems. "There is a cost to improving safety on mines and there is enormous spending on safety in local mines," the MHSC stated. "However, what is often overlooked, probably through ignorance, is the benefit that is added through improved safety."

The MHSC has also called for proposals as to how the industry can be encouraged to comply with best practice and regulations that had been put in place for rock-related safety. "There have been significant inputs to encourage compliance with best practice in rock engineering, but experience suggests that this does not always happen," according to the MHSC. It also notes that there is great knowledge about rockmass behaviour and support performance, but that there was a "disconnection" between knowledge and practice. The gap must be bridged.



Atlas Copco Boltec Cable L

Roof bolting

The US Mine Safety and Health Administration (MSHA) notes that more fatalities occur to roof bolter operators than any other occupation in mining.

To perform their jobs safely, MSHA says roof bolter operators must:

- ◆ Always visually examine the roof, face, and ribs immediately before any work is started in a place
- ◆ Never go close to the face past the permanent roof supports, especially to mark a roof bolting pattern
- ◆ Keep a bar of suitable length on the roof bolting machine to scale down loose rock (pry up, not down!)
- ◆ Always test roof, face, and ribs; do not take shortcuts
- ◆ Ensure the Automated Temporary Roof Support (ATRS) system is in proper operating condition before installing bolts and never operate when the ATRS is inoperative or does not contact the roof
- ◆ Only use manufacturer's approved extensions for ATRS systems
- ◆ Ensure the roof bolter is in proper operating condition before installing bolts; this includes all levers, tram control, panic bar, etc.
- ◆ Know and follow the approved roof control plan; this includes all manufacturer's recommendations on installation of bolts and resin



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Our engineers have one overriding aim: to develop, refine and implement the innovative systems that improve safety at the same time as increasing productivity and cost efficiency. Day in and day out, they delve deeper to discover more about the problems Minova customers face and the products needed to overcome them.

Our ability to integrate local knowledge with global resources allows us to call upon the very best people almost anywhere in the world where their expertise is most needed. Wherever they go, they speak the same language as their customers – the international language of mining. It's this fluency gained over three decades that allows us to go further by challenging convention and uncovering the very best solutions.

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Solutions from Materials Technology



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- ◆ Add additional supports at any indication of adverse roof conditions
- ◆ Stay in a safe location under permanent support when installing roof supports
- ◆ Always follow bolt installation sequence
- ◆ Drill all holes to proper depth (not over 25 mm deeper than the bolt's length)
- ◆ Use the proper finishing bit when installing shell type bolts
- ◆ Be sure resin is maintained at mine temperature before use
- ◆ Check to ensure all bolts are installed in the proper torque range
- ◆ Drill additional test holes if there is a question about adverse roof conditions
- ◆ Roof conditions detected during drilling should be communicated by the roof bolter to co workers
- ◆ Never hold drill steel or place hands on drill pot while installing bolts
- ◆ Control respirable dust.

Equipment simulators are becoming ever more common for operator training, and this includes roof bolters. South African company 5DT's roof bolting training simulators are used across the globe to train thousands of operators. Training in a virtual mine uses controls that accurately resemble those of the real machine. Operators work through a series of training scenarios that vary from elementary to very complex and challenging. Computer multimedia training and virtual mock mine training may enhance roof bolter training.

5DT says, "it is a cost-effective training tool that increases safety awareness and allows accurate monitoring of operator technique and actions. True-to-life realism enables trainees to transition from the classroom to the workplace quickly and safely. The tireless efficiency of the system means that best practices can be drilled into trainees while consistently high training standards are maintained."

The full roof bolter controls include tramming, roof bolting boom and temporary roof support valve banks. A big screen projection provides a true-to-life view of the surroundings and there is a tool selection bench where the trainee must select the correct drill steels, resins etc.

On a recent visit to South African platinum mines, IM noted the success of Fletcher's low-profile roof bolters there. DBT Africa's Fletcher ADO-D/E is a low-profile, single-head arm feed roof bolter that offers the option of either a diesel or electric power, making it an extremely versatile machine.

The arm feed drilling mechanism was developed specifically for low working heights and DBT Africa says this machine has the lowest and shortest profile of any comparable drilling system. It can operate in working heights from 1.5 to 2.5 m. It features four-wheel drive, articulated steering, vertical articulation and an oscillating axle allowing it to negotiate the most difficult paths.

The versatile stackable drilling system enables the drilling of 26 mm diameter holes, and when used with a 20 mm resin bolt the resultant annulus provides a high quality and cost effective bolt installation. The high torque drillhead is able to correctly tension the roof bolt to the required loading by applying a torque from between 0 to 400 Nm.

Chemgrout's Model 542H is ideal for non-flowable cement grouts with water/cement ratios as low as 0.40. Maximum output 31 litres/min and maximum pressure 18 bar (optional 36 bar). Power options include air, hydraulic, electric/hydraulic and diesel/hydraulic.



REED Manufacturing's new 'Mine Version' C50HPS-SKE shotcrete pump was specifically designed for extremely long distance underground applications. Powered by the combination of a 93 kW electric motor and 180 cc main hydraulic pump, it has a maximum output of 40 m³/h, 129 bar concrete pressure. The very high performance of this shotcrete pump is required on many jobs where shotcrete needs to be pumped hundreds of meters before it is sprayed.

Low maintenance requirements have been proven in the field. For example one Fletcher ADO-D/E was operational in a platinum mine for three years, and still using its original drillhead.

Famous grout

The ChemGrout CG-542 Series are skid-mounted grout plants specially designed for work in confined work areas. Low profile and compact, they are ideal for the grouting of rock bolts and cable stays. They feature two 84 litre mix tanks; a 38 litre holding hopper and progressing cavity pump to provide a continuous, non-stop pumping process. Mix tanks

are equipped with baffles, bag breakers and variable speed, high-efficiency paddles that provide rapid mixing. A unique feature of these mix tanks enables the tops to be removed for quick and easy clean up.

Once mixed, material passes through the large slide gates of the tank outlet valves into the holding hopper. This is equipped with an auger to keep material thoroughly mixed while waiting to advance to the pump suction housing. A positive displacement, progressing cavity, rotor-stator type pump then delivers the material to the application.

Operator controls are centrally located for efficient production. All components are easily accessible for operating, cleaning and maintenance.

Minova's Tekflex PM

Minova notes that coal mines employ traditional gunite for structural support, prevention of long term surface weathering, and fire proofing of coal ribs. However, conventional dry spray gunite produces high dust levels and work is generally prohibited in the down stream ventilation air. Traditional gunite is also very porous and does not adequately protect the underlying rock from moisture damage. The poor adhesion of traditional dry spray gunite results in high rebound material losses and difficulty coating overhead and vertical surfaces.

Minova developed a polymer modified gunite developed in response to demand for more easily applied gunite with improved adhesion and reduced permeability. Tekflex PM was specifically designed for pumping through specially designed multiple function machines. The units are all in one continuous mixer, air compressor and pump. The Tekflex PM is mixed with the proper amount of water and pumped to a three way nozzle, through standard mine hose. Compressed air simultaneously accelerates the Tekflex PM and mixes it with an accelerator. The application is dust free and can be conducted in the up stream ventilation air nearby other mine functions and workers. It is as strong as conventional gunite, but is three orders of magnitude less permeable and prevents water vapour from degrading the underlying coal measure rocks.

Tekflex PM is especially suited for large remediation or preventative sealing and offers fast and easy application. This high strength cement coating is ideal for quickly coating an entryway with a strong durable sealant. Uses include the



Applying Minova's Tekflex PM

prevention of spalling from moisture ingress and helping ensure the structural integrity of drifts.

Tekflex PM has been proven effective in numerous coal mines in the eastern USA. It has been especially useful in extending the stability of friable and moisture sensitive coal measure rock in long-term use slope, belt, and main entries. It has also been successful in fire proofing battery charging and belt transfer stations. *IM*


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