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BETWEEN A ROCKFALL AND A HARD PLACE

by Danie Burger, Flip de Wet, At von Wielligh and Rudolf Ottermann

A new safety system has been designed to protect miners' lives in the event of accidents. Rockfalls continue to be the biggest cause of accidents that result in fatalities and injuries in underground mines in South Africa. It would be possible to reduce rockfalls drastically if an affordable, effective face-support system were available.

Statistics from the governmental Department of Minerals and Energy reveal that the rockfall hazard has not been effectively addressed during the last 10 years, as injury rates have remained almost constant. The cost of rockfall injuries far outweighs the cost of an effective rockfall prevention measure.

The most effective routes to rockfall control include:

- Good blasting practice;
- Effective making-safe procedures;
- Vigilance and safety-consciousness of employees;
- Effective roof-support systems; and
- Compliance with support standards and code of practice.

This project aims to develop an effective face-support system to minimise rockfalls in rockfall-prone mines. The primary output of this project was to develop and surface-test a technology demonstrator roof-support unit and to do a risk assessment of the system. Mines with rockfall problems in the face areas will use the roof-support system to reduce fatalities and injuries in the face area of stopes.

Different concepts were developed and evaluated against the system specifications. The developed roof-support system consists of two similar support units connected via two crank mechanisms to each other (see → 1,2). Each unit consists of a headboard supported by a "wishbone" structure (top and bottom leg). A threaded bar with struts similar to a scissors jack keeps the legs apart. All the components are manufactured from high-strength steel with a yield limit of 700 MPa. To move the system forward, one support unit is collapsed and then hangs from the other, to which it is connected. The collapsed unit is then manually cranked forward and pre-stressed. If the required position is still not achieved, the other unit is released and moved forward. Different models will be used for different stope heights. The existing design covers a stope height of 900 mm to 1,200 mm (see → 3).

During the detail analysis a complete finite-element analysis of the final design was constructed and the system was evaluated to a minimum safety factor of 1.5. The finite element method (FEM) plot of the top leg is given in → 4, with red colours depicting large stresses while lower stresses are indicated by greens and blues.

A technology demonstrator was then developed and surface-tested. The technology demonstrator development process included detailed design, building and testing of components and sub-systems, design reviews and the building and commissioning of the technology demonstrator. The testing of the technology demonstrator was done in a 500-ton hydraulic press and in a mock-up stope. A risk analysis, in which technical, logistical and economic aspects were assessed, was performed to ascertain the critical areas of the system. The technology demonstrator is currently being tested and evaluated underground in a platinum mine in the Rustenburg area.

The tests and risk assessment of the roof-support system identified certain areas that need to be addressed in order to implement the new support system safely underground. For the further development of the support system the areas that need attention are:

- Improvement of the design, taking the test results into account;
- Quality control during manufacture;
- Correct and safe installation procedures; and
- Safe operating procedures.

During the next phase of the project, working prototypes will be developed for underground evaluation. During these trials a full panel will be equipped.

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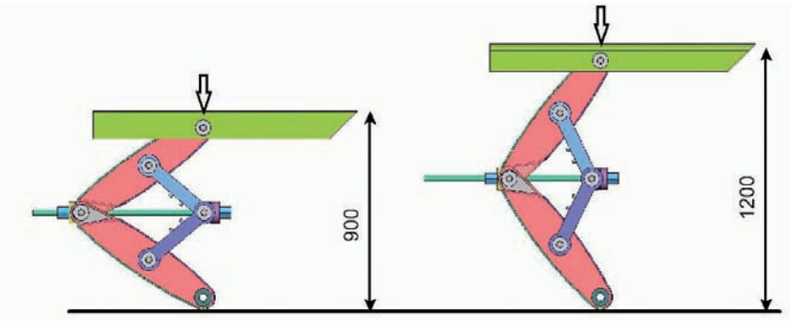
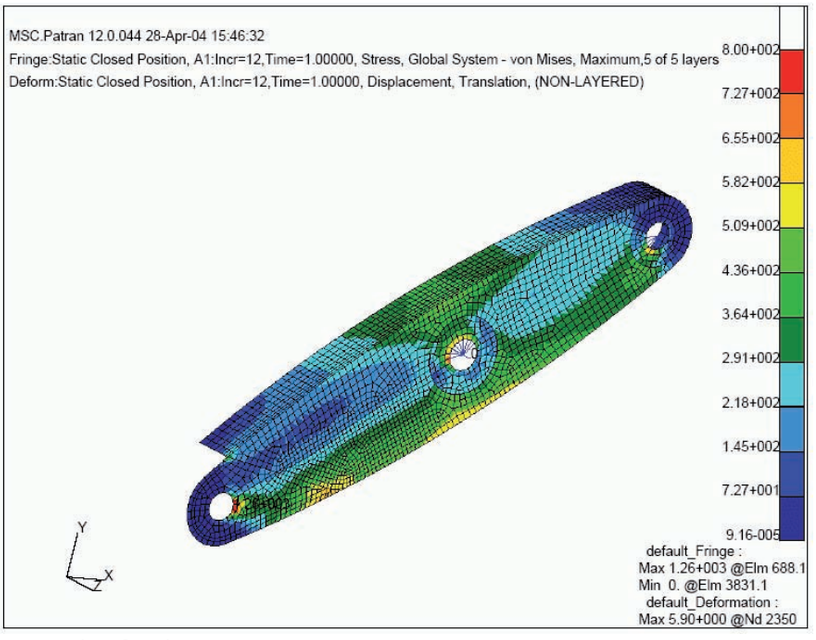
→ *2. Loose rock held up by support*



→ *3. Height range of roof support system (scale: millimetres)*



→ *4. FEM plot of top leg*