Endeavor Mine shines with an integrated geotechnical service

By Wouter Hartman, Coffey Mining

Consolidated Broken Hill (CBH) Resources is accessing new primary ore sources at their Endeavor Mine in Cobar, New South Wales. During this development phase the bulk of production is obtained from pillar extraction. This presents a technically challenging environment, especially considering the backlog of open voids inherited by CBH from the previous mine operators.

The skills shortage, effecting most Australian mines, has also added a degree of difficulty in providing the depth of geotechnical experience in-house within CBH to meet these challenges.

The geotechnical challenges at Endeavor were highlighted by the crown failure of the 6z2 stope in October last year. Since the collapse, CBH has returned the mine to production. Through an innovative approach, Coffey Mining and CBH have worked together to put in place geotechnical management strategies to extend the mine's life.

Under an innovative geotechnical services arrangement, the companies have provided the necessary depth of experience to support the Endeavor mine. This also provides mentoring and training to develop the in-house capability of CBH staff.

A long-term relationship such as this has mutual advantages to both companies. It enables the full depth of experience of Coffey Mining experts to be focused on specific geotechnical problems. These specialists also retain their operational edge by temporarily filling technical services production roles during CBH's recruitment phase.

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Figure 1 View of 6z1 A-Pillars

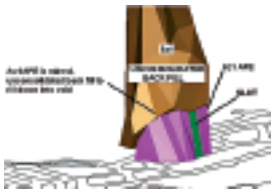

Figure 2 Cross section looking West – South west, showing fill height to be maintained during 6z1 A-Pillars extraction

By providing this continuity, a seamless integration with the CBH technical services team is maintained. As well as achieving a high degree of knowledge sharing and transfer between team members, the arrangement also allows Coffey Mining staff to provide site coverage enabling CBH staff to work on specific projects.

Work has commenced to extract the A – East and West pillars from the 6z1 stope. A high level of geotechnical focus was required for mining of this stope due to its relative position with respect to the previously failed 6z2 stope.

Integrated services process implementation

Example – integrated process

One such case of a fully integrated geotechnical service (i.e. inclusive of backfilling consisting of dry fill) was the mining of the 6z1 A-pillars (see Figure 1).

The process involved in preventing potential extensive overbreak around the 6z1 stope is outlined below:-

- All the geological and geotechnical hazards (e.g. major regional fault structures and rockmass conditions) have been assessed on-site. This information was forwarded to a senior geotechnical engineer off-site for review and evaluation. This information was combined with a fully representative rockmass model numerically analysed to determine the stress condition prior, during and after extraction.
- To evaluate and control the potential for massive overbreak, an unconsolidated waste fill height within the stope above was required to be maintained at a certain level (see Figure 2). Maintaining the waste fill height had other implications in diluting the recovered ore, hence the introduction of proper controls to ensure a low risk operation.
- These controls, e.g. modified blast rings, were evaluated and reviewed on-site during a senior geotechnical consultant site visit, which resulted in a final alternative blast ring design, reduction in blast ring quantity and strategically placed cable bolt design (see Figure 3).

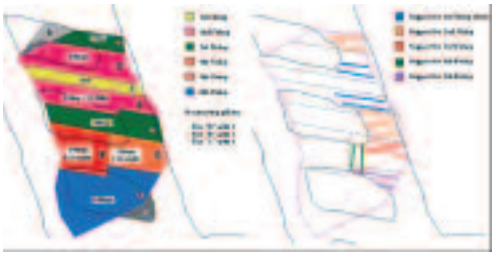

Figure 3 Plan view of alternative ring design and cable bolt reinforcement for 6z1 A-Pillars

- The necessary controls were implemented, refer to Figure 3 for ring design and cable bolt reinforcement and Figure 2 showing a cross section indicating fill height maintenance, to ensure the risk of extensive over break is mitigated and potentially eliminated.
- Feedback on the success of controls (i.e. maintaining fill height) being implemented is discussed every day at production meetings through a reconciliation process of tonnes drawn versus waste tonnes filled.

Aspects critical to the success of this integrated process, which supported the above case, are highlighted below:

- 3-dimensional numerical analysis consisting of block model construction representing different rock material properties experienced at Endeavour, combined with the site geological and geotechnical information was used in the detailed assessment to identify potential overbreak in the 6z1.
- Extracting the A-Pillars of the 6z1 will have possible stability implications when extracting the 7z1 crown pillar below and the introduction of monitoring equipment in the form of SMART cable bolts and SMART "MPBX" extensometers to provide information regarding rockmass response.
- In order to ensure that other stopes similar to the 6z1 are monitored for ground movements, rockmass response and subsequent seismic activity, the current seismic system was reviewed and developed into an expansion project (see Photo 1).

Photo 1 A geological engineer inspects the ESG Paladin seismic network

Photo 2 Good communication and teamwork are necessary to ensure continuity across roster changes

- The geotechnical data that was necessary to complete the 6z1 assessment was obtained during the geotechnical site coverage (see Photo 2). This site coverage involves good communication and teamwork, which is necessary to ensure continuity across roster changes in order to thoroughly assess blast ring design, draw point and access stability, which was indicated as critical for 6z1.
- One of the most important aspects of the integrated service is the variety of geotechnical experience exposure to the CBH site geotechnical engineer, especially in the late stage of mining.
- Mining of stopes like the 6z1 has an impact on regional stability. It is critical not to just assess the local instability when reviewing the stope for mining but to incorporate the detailed backfill assessment below.
- Backfilling the historic mine voids or maintaining fill height is another key challenge of the project and consists of:
  I. Local surface material property evaluation for dry fill placement.
  II. Local surface material property evaluations for paste fill design and placement through a dedicated paste fill reticulation system from a surface paste fill plant.
  III. Studies into cement binder quantity to ensure paste fill stability and local material interaction impact.
  IV. Dry fill placement risk assessment for high fine material content which form part of Endeavor Mine's risk management process.

Meeting the geotechnical challenges at Endeavor requires close co-operation between the geotechnical group and the mine planning engineers. Mining engineers from Coffey Mining and CBH have worked closely together to develop the mine plans and operation schedules that will underpin the future production at Endeavor.

Risk assessments, which form a key part of the planning and operations approach, have brought together expertise from CBH, Coffey Mining and other stakeholders. Discussions covered the recovery process from the October 2005 stope crown collapse. A comprehensive risk assessment process (for the planned rehabilitation of the damaged pastefill reticulation system) from the extensive overbreak in the 6z2 stope was recently completed. This risk assessment process involved senior mining and maintenance personnel from Endeavor Mine and Coffey Mining, highlighting the extent of the integration model.

Technical service integration process

All the above activities involved in the geotechnical integration process require thorough co-ordination in order to provide an unconstrained flow of information to and from mine personnel. More important is the flow of accurate information between off-site and on-site personnel to ensure prompt reporting for scheduling purposes. The integrated geotechnical service success is maintained by regular and detailed communication.

With the current skills shortage it is difficult for companies to fully staff their operations and maintain site information continuity which is vital to ensure operational risks are at an acceptable level. Traditional high level consulting can sometimes suffer from a disconnection with the operational practicalities of a producing mine environment. The project staffing model developed between CBH and Coffey Mining overcomes these issues by working as an effective team with a common focus.

This model's strength lies within the degree of shared knowledge that is built up over time and used when required, on a long-term basis.

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