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Dendrobium Mine Longwall Pre-driven Recovery Roads Including Developing Cuttable Grout Pillars

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DENDROBIUM MINE LONGWALL PRE-DRIVEN RECOVERY ROADS INCLUDING DEVELOPING CUTTABLE GROUT PILLARS

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ABSTRACT: Longwall face recovery is a complex geotechnical challenge with high potential for losses due to the occurrence of ground control problems. In recent times, the use of pre-driven recovery roads has improved the overall efficiency and safety of moving longwall equipment from panel to panel.

In 2015 Dendrobium Mine and Golder Associates developed a grout pillar design that could be constructed within the pre-driven recovery road prior to the holing and recovery of the longwall equipment. The challenging ground conditions often experienced in longwall pre-driven recovery roads provided the main impetus for the decision to construct large yieldable grout pillars in a roadway that will be subjected to a cantilevering roof and a yielding fender on holing. Due to the resulting increase in support density, recovery road conditions have improved as shown by roadway monitoring data. Longwall operators have considerably less exposure to potential hazards during bolting operations with reduced bolt up time resulting in increased longwall productivity.

All elements of support including 47 grout pillars had to be safe to cut and remove via the mine conveyor system. Due to lack of surface access, all materials to construct the grout pillars were transported up to 14 km from the mine portals. Grout pillar formwork design initially incorporating fabric bladders and steel formwork has since been replaced with a lattice of fibreglass (FG) dowels and hessian coated FG mesh, sprayed with a Gypsum based plaster. Air-driven placer pumps were replaced by electric placers with greater reliability and grout quality control procedures ensured that the target pillar strength was reached before holing of the longwall.

Pre-driven recovery road support design incorporating cuttable grout pillars has been combined with the development of a grout delivery system and containing formwork to deliver key productivity and safety improvements during longwall recovery.

INTRODUCTION

Dendrobium Mine extracts 300 m wide longwall panels (partial mine layout shown in Figure 1) from the lower 3.7-4.1 m of the Wongawilli Seam. In the current area of operation (Area 3B), the Wongawilli Seam is approximately 9-10 m thick. Working in the lower section of the seam leaves approximately 5 m of weak coal and shale material in the immediate roof. The weak roof and thick seam longwall environment make the longwall face prone to cavity development, particularly during periods of slow retreat where convergence promotes the formation of fracturing ahead of the face. Cavities commonly reach the top of the seam and have the potential to cause significant operational delays. Cavities have proven to be the most difficult to manage from the point the recovery mesh has been pinned to the final longwall recovery.

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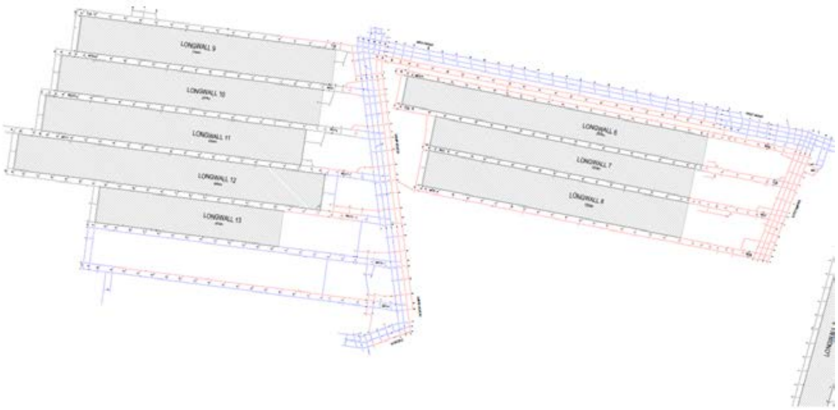

Figure 1: Dendrobium area 3A (right) and 3B (left)

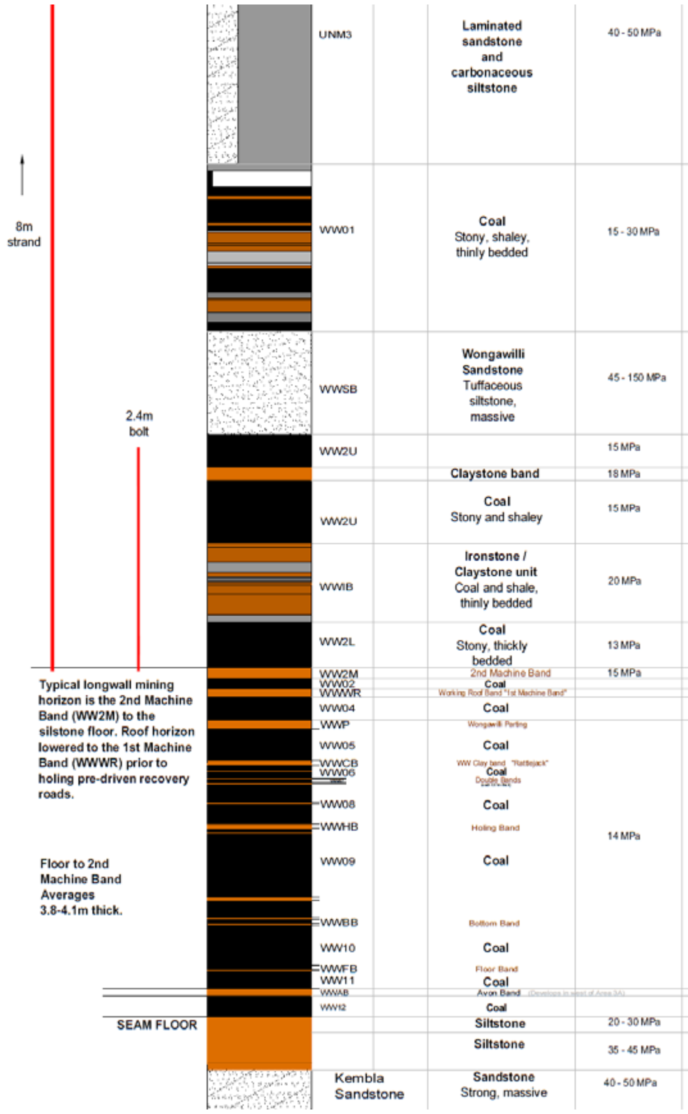

Figure 2: Dendrobium Wongawilli seam longwall mining horizon

Longwalls 6-10 at Dendrobium Mine were recovered using traditional bolt-up methods. Longwalls 11 and 12 have been recovered using a Pre-Driven Recovery Road (PDRR). With traditional bolt-up, a recovery mesh sheet was pinned to the roof approximately 15 m from the final face position with subsequent pinning towards the recovery road with nine rows of 170 roof bolts (one per support) installed using rapid face bolters (see Figure 3). Total support installed on this critical path consisted of approximately 1500 x 2.4 m roof bolts, 170 x 8 m cable bolts and 500 x 1.8 m rib bolts. This support method with the bolted recovery mesh proved difficult and time consuming to install in cavity roof conditions. Recovery mesh was commonly damaged in the process and a high degree of operator awareness was required to install the supports safely. Large cavities carried into the final recovery position often resulted in the difficult recovery of longwall supports and the requirement for additional ground consolidation and cavity fill.

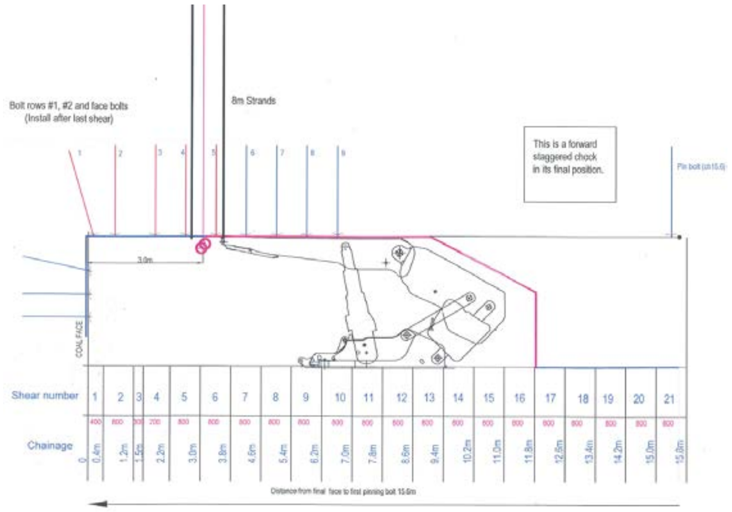

Figure 3: Typical Dendrobium bolt up arrangement (Longwalls 6-10)

There was a significant increase in the time taken from mesh on to chain break from Longwall 6 recovery onwards. The increased difficulty of bolting up the longwall face coincided with the move to Area 3 and associated increases in depth of cover and longwall abutment loading. Mesh installation to chain break averaged 9.5 days for Longwalls 1-5 and 28.4 days for Longwalls 6-10. Longwalls 11 and 12 recovered using a PDRR have averaged 4.8 days. (See Table 1 and Figure 4)

Table 1: Summary table for longwall face recovery

Longwall Panels	Depth of cover at recovery point (m)	Average time taken from mesh on to chain break (days)	Panel Width (m)
1-5	160-260	9.5	240
6-10	270-370	28.4	240, 300 m from LW8 onwards
11-12	360-390	4.8	300

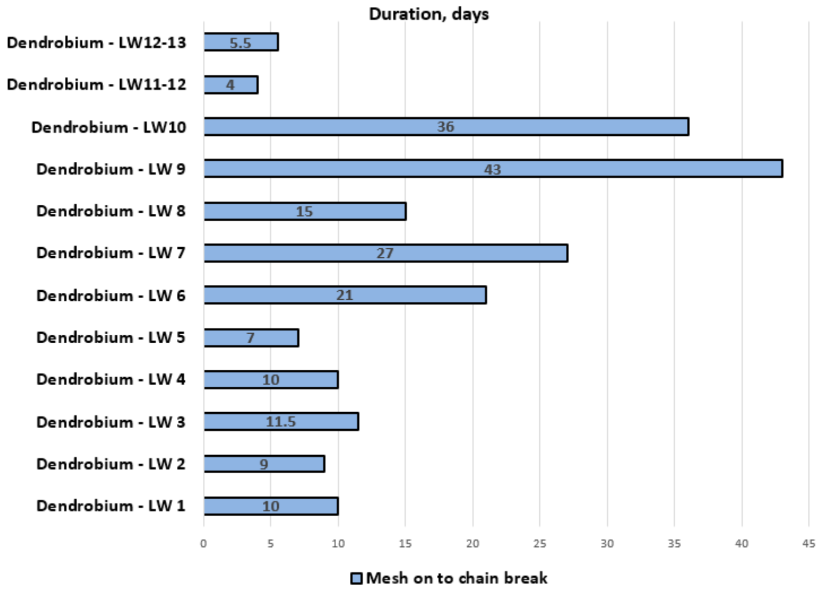

Figure 4: Increased mesh on to chain break times experienced on longwall 6-10

Following the poor recovery performance of Longwalls 6-10 the decision was made to pursue alternative options and Dendrobium Mine engaged Golder Associates and Minova to develop solutions. Several concepts were entertained including; a full face pre-driven recovery roadway (PDRR), partial pre-driven recovery roads and access roadways to allow for pre-consolidation of high cavity risk areas of the face (mid-face). Once it was demonstrated that the full face pre-driven recovery for Longwall 11 was technically feasible and operationally achievable in the scheduled time available, it was chosen as the course of action. The partial PDRR method was discounted due to concerns that slow retreat through zones prone to cavities in areas of the face with no PDRR would lead to deterioration of the fender between the face and the partial PDRR. Access galleries and pre-consolidation were discounted due to the high cost and uncertain outcome.

SUPPORT DESIGN

It is generally agreed that some form of standing support should be installed in roadways that will for various reasons, be holed through with a longwall. Considering the magnitude of the associated abutment loading in conjunction with the need to ensure that the material used is both strong and cuttable, some form of cementitious support is often used.

By far the most common type of standing support used in pre-driven roadways is some form of fibre-crete block; although a number of operations have used pumpable grout filled cribs, cement blocks or backfill; where in the case of the latter, the full cross-section of the roadway is filled with either a cement-flyash mix or cellular concrete. There are however a number of significant deficiencies associated with these cementitious supports; namely the strength and yielding ability of pumpable cribs, the need to ensure that fibre-crete or cement based supports are softened with timber such that they are able to yield in a controlled manner, the slenderness of the supports such that they are able to control any out-of-plane loading that may result on holing, and the cost and downstream impact on the conveying equipment associated with large volumes of backfill material.

An assessment has addressed the design and use of grout filled pillars, which not only offer a high capacity and squat form of standing support, but also do not necessitate the use of timber and the large volume of material and the associated infrastructure typically associated with backfill. Similarly, the placement of the grout pillar against the inbye rib, confines and in doing so maximises the strength of the fender on holing, and the strength and yielding ability of the grout pillar can be further increased through the use of mesh and/or fibre-glass bolts (Figures 5 and 6).

The study indicated that grout pillars offer several of the benefits typically associated with backfill, in particular the use of a high capacity, squat and cuttable form of support that had the added benefit of confining the inbye fender on holing. Critically however, the pillars do not necessitate the large volumes of material associated with backfill, and the large number of supports and timber typically associated with the more traditional forms of cementitious standing support.

In order to maximise stability of the fender, using PDRR and standing support elements it was decided that the PDRR would be driven at the smallest dimensions practical with Dendrobium's current JOY 12CM30's miner bolters. As a result the PDRR was driven 5.2 m wide and 2.8-3 m high.

Figure 5: Longwall 12 PDRR grout pillar, original style grout pillar. Constructed with rubber bladder and removable steel formwork

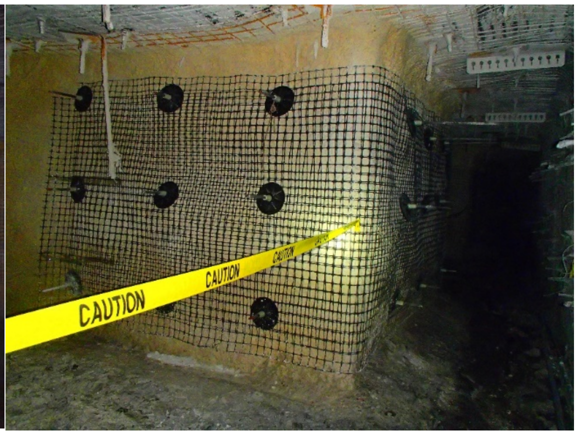

Figure 6: Longwall 13 PDRR new style grout pillar, cuttable form

The geotechnical environment and required grout pillar and bolted support densities were divided into two distinct zones; protected ends located at either end of the roadway and an intervening mid-face area.

Longwall support convergence and leg pressures were reviewed to determine the extent of the protected end areas. Based on shield loading data it was demonstrated that less vertical abutment load could be expected within 30-50 m of each gate road. The protected ends were conservatively assessed to be 30 m from the block side rib in both the tailgate and maingate of Longwall 11 PDRR.

In regard to the specifics of the installed standing support, it is of note that the pillars were filled with grout that was required to attain a minimum strength of 7 MPa on holing. Furthermore, in LW 11's PDRR a minimum standing support density of 3 MPa was installed in the mid-face area and a minimum standing support density of 2.2 MPa in the protected ends; this decision being based primarily on the considered high likelihood that the longwall could (as per the neighbouring longwalls) experience some level of periodic weighting on holing. As a point of reference in this regard, it is also of note that recent experience in longwall pre-driven recovery roads suggests that unless there is some relevant precedent that indicates otherwise, the mid-face area in the pre-driven recovery road should be supported with a standing support density of at least 1.5 MPa and the protected ends, at least 0.8 MPa.

Following the successful precedent of LW 11's holing, and accepting that the maingate end of LW 12's PDRR was driven through a significant thrust fault, it was subsequently decided to maintain the 3 MPa density of standing support in the fault affected protected end and mid-face area, and reduce the density of standing support in the remaining mid-face area to between 2.2 and 2.6 MPa and the un-faulted protected end to 2 MPa.

Other points of note with regard to the installed support include (i) the decision to reinforce the grout pillars with 1.8 m long fibre-glass bolts and Tensar Mesh, (ii) the installation of fully grouted Megadowels to help reinforce the fender and the outbye rib on holing, (iii) the use of 8m long Sumo cables in the roof to help maintain some form of beam action in the roof on holing and (iv) a combination of low angled spiles and twin-stand cables over the fender to help both reinforce the roof on the face on holing and secure the goaf edge during the recovery of the shields (for details, see Table 2 and Figures 7 and 8). Figure 7 shows a plan view of the layout of the 47 Longwall 11 PDRR grout pillars constructed against the longwall fender.

Table 2: Support density installed in LW 11's PDRR

	Roof support	Fender rib support	Fender roof spiles	Outbye Rib Support	Standing Support
Protected Ends	2 x 60 t 8 m cables/m, 8 x 2.4 m roof bolts/m	2 x 4 m 40 t cuttable dowels/m with cuttable mesh	1 x 6 m twin strand and 1 x 6 m 28 mm coupled thread bar per 1.75 m	3 x 4 m 40 t cuttable dowels/m with steel mesh	1 x 3.7m x 4m 7MPa grout pillar at 8m centres
Mid-face	2.5 x 60 t 8 m cables/m, 8 x 2.4 m roof bolts/	3 x 5 m 40 t cuttable dowels/m with cuttable mesh	1 x 6 m twin strand and 1 x 6m 28 mm coupled thread bar per 1.75 m	3 x 4m 40 t cuttable dowels/m with steel mesh	1 x 3.7 m x 4 m 7 MPa grout pillar at 6 m centres

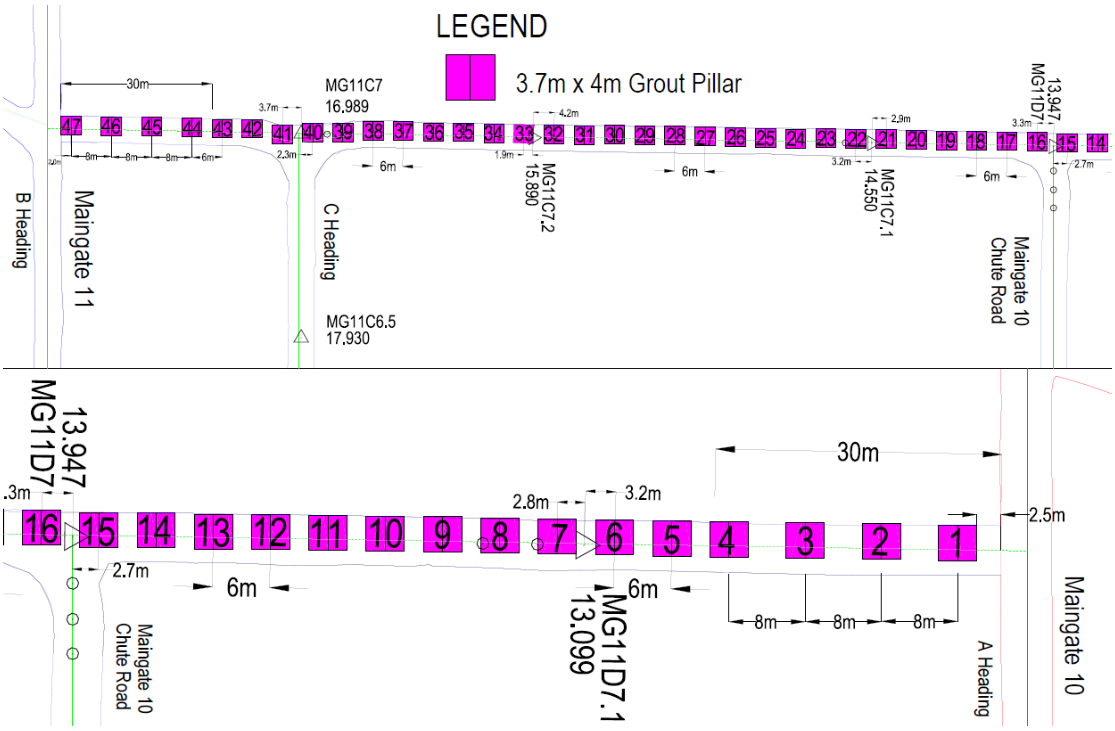

Figure 7: Longwall 11 PDRR grout pillar layout

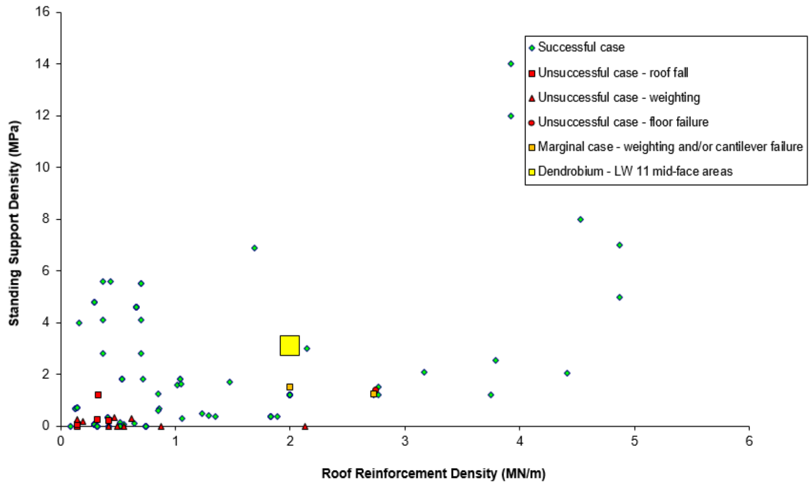

Figure 8: Standing support and roof support installed in the mid-face Area in LW 11's PDRR (Golder Associates, 2015)

DEVELOPMENT OF A CUTTABLE GROUT PILLAR FOR RECOVERY ROAD SUPPORT

As with all recovery road support elements within the longwall cutting horizon, the grout pillars used for supporting the recovery road during holing were required to be safely cut by the shearer to be loaded onto the conveyor system. Due to surface access restraints resulting from mining beneath the water catchment it was necessary to transport all grout and formwork materials from the surface portal, approximately 14 km to the recovery road sites for construction. This posed logistical and storage challenges underground.

It must be noted that there has to be sufficient mine development float in order that a recovery road can be supported with grout pillars. The time from grout manufacture and delivery to grout filling of pillar formwork, along with waiting for sufficient strength development of the last completed pillar, can take up to 6 months. Minova were asked to provide a suitable grout and pump delivery system that would reliably mix and pump grout infill for the 45 pillar supports. This system has been developed from experience gained in pillar support of the initial recovery road in Longwall 11. It also resulted in the trial and development of a new pillar formwork method and design and manufacture of electric placer pumps. A list of design guidelines critical to the success of the project was provided by the mine as follows:

1. To be able to pump one pillar (footprint 4 m length parallel to the fender, 3.7 m depth and roadway height) of approximately 50 m^3 per 24 hour period;
2. The pillars had to be pumped from a distance of up to 350 m;
3. Delivery of the grout from the factory on specific schedule;
4. The initial pillar formwork consisted of heavy steel framework and fabric bladders;
5. The grout uniaxial compressive strength (UCS) at 28 days was to be in the range 7-10 MPa;
6. The grout pillars could withstand the load from vertical abutments right up to the last shear;
7. The grout was to be transported in bulk bags and the bag height was to be lowered in order that bags could be placed over the pumps using an overhead monorail.

Development and improvement of the grout delivery method and containment for pillar construction has occurred over three recovery roads from Longwalls 11 to 13. The genesis of improvements to pillar construction since initial discussions started on the recovery road pillar project in September 2015 will be included within the following topics.

High yield grouts

FB200 high yield grout was chosen for the pillars as it is dimensionally stable and able to be 1) self-supporting due to its rapid strength gain and 2) accept strata convergence without rapid loss of strength. The mine had previous experience with using FB200 for roadway fall consolidation.

FB200 is able to penetrate into the smallest voids due to a low viscosity ≈100cP before gelation. This grout has been used for consolidating backfill to create artificial pillars for sill pillar recovery, building bulkheads including explosion rated ventilation seals and consolidation of fallen roadways via surface borehole delivery to enable re-mining and roadway recovery.

Ettringite (CaO.Al2O3.SO3.32H2O) is formed as part of the chemical process (Mutton, *et al*., 2010) with Calcium Alumino-Sulphate (CSA) cements in the hydration and formation of FB200. This provides a high yield fast setting grout with a low viscosity, able to be placed at a water/powder ratio of between 1:1 and 4:1. The dimensionally stable grout is able to accept high strains.

Development of a grout sampling method

In order to achieve the required 28 day strength, FB200 was pumped at a water to powder (W:P) ratio of 2:1. Longwall 11 recovery road pillars were initially pumped with pneumatic placers. The air supply pressure is affected by in-bye operation of equipment such as air-track bolting rigs, so that it is necessary to regularly check and adjust water flow to the placer. For this reason a method was developed to check and maintain the desired W:P ratio ensuring a grout strength requirement of 7-10 MPa at 28 days. Two 100 mm polystyrene cube mould samples were taken for each pillar for quality assurance laboratory testing. Average grout UCS at 28 days was 8.38 MPa.

Close control of grout density to a value of 1.26 was achieved by weighing 100 mm polystyrene cube samples with a 5 gram accurate 0-2 kg mechanical bench scale (Cube weight is 30 grams). Water flow to the pump was adjusted if the density fell outside the specified range. The staged procedure for FB200 density check has the following actions.

Normal operating density range of 1.26 – 1.30.

If sample weight [kg] lies between the limits >1.24, <1.26 and > 1.30, <1.34 then recalibrate the pump and prepare a new sample for weighing.

STOP PUMP. Check the operation of the pump and clean down. REPORT the low density result to the Mine Management. Recalibrate the pump and prepare sample for weighing.

Development of an electric placer pump

Because of concern over the available air pressure 14 km inbye the surface compressors, a 150 nominal bore ring main was constructed to reduce pressure losses for Longwall 11 recovery road pillar construction. However, pump rates varied considerably with air pressure ranging from 310 – 448 kPa (45-65 psi) within the duration of a shift and on this basis, a decision was made to develop electric placer pumps for LW12 pillars. Three pneumatic placer pumps were converted to 1000 volt electrical operation. Extensive redesign resulted in the placers electrical supply compliant with *AS/NZS 4871 Electrical equipment for mines and quarries General requirements* and *AS/NZS 2290 Electrical equipment for coal mines-Introduction, inspection and maintenance*, suitable for use in the non-hazardous zones of an underground coal mine.

One major improvement was to develop a two-speed drive train with a lower speed powder feed to be used when manually handling 20 kg grout bags and a high speed for bulk delivery of up to 3 tonnes per hour of dry powder. The Original Equipment Manufacturer (OEM) provided a safety dossier that also prescribes specific maintenance requirements. It was then possible to obtain a sign-off for electrical and mechanical components by suitably qualified Queensland Registered Professional Engineers (QRPE). Figure 9 shows a redesigned placer pump with larger fork-tyne pockets, Rudd lifting lugs, protected electrical boxes (high and low voltage) and rerouted air and water reticulation. Pump trials with the client were conducted to demonstrate placer operation including pumping distance and throughput.

Figure 9: 1000 volt electric placer pump side view

Bulk handling and storage of grout

Longwall 13 required the transport and storage of 650 pallets of FB200 and 250 pallets of Sprayplast™ underground before pumping proceeded. Due to the available pit top footprint,there was limited covered surface storage. Bulk bags were transported underground on their pallets to keep the grout out of the mud. With one dedicated loader and operator per shift, it was possible to transport 30 x 1.2 tonne bulk bags in a 24 hour period using a double-axle trailer with a five bulk bag capacity.

Figure 10: Double bag QDS carrier

During the first recovery road pillar construction, approximately 5% of product was being wasted during transport because of bags being ripped or being speared with fork-tynes. Improvement opportunities were identified with the packaging arrangements and how the loader would pick up the bags. A different style of bulk bag was sourced which had internal baffles and a lower profile. These helped the bulk bag sit squarely on the pallet providing a lot higher resistance to toppling during transport. The second improvement to packaging came after the introduction of the double bag handler, a load haul dump attachment allowing transport of two bulk bags on the front of the loader with the bags being supported by suspension straps. This attachment removed the issue of tynes spearing bulk bags and also provided additional support to prevent bulk bags toppling off the pallet during transport.

Two additional straps that were inserted through each pallet also secured each bulk bag to maintain stability. When lifted with the double bag handler, the pallets remained attached to the base of the bulk bags. As such no water or mud could build up on the bottom of the bulk bag once placed in-line with the monorail. With these handling improvements, wastage during transport greatly reduced to ~1%. Figure 10 shows a Quick Detach System (QDS) double bag carrier which was used underground.

Glass Reinforced Plastic (GRP) cuttable formwork method

Longwall 11 recovery road pillar formwork consisted of heavy steel framing and fabric bladders which provided operational difficulties. For longwall 12 a decision was made to trial two GRP dowel lattice and Sprayplast^{TM} pillars located at No 1 position on the tailgate four-way intersection and in the middle of the recovery road at pillar location 22. The tailgate pillar was extended to reinforce the corner of the longwall block. These pillars had GRP threaded bar in an interlocking lattice design supporting inside sheets of 4 mm GRP Powermesh^{TM} covered in hessian cloth.

Once vertical dowels are installed between the roof and floor, three evenly spaced horizontal layers of connected dowels are wrapped around the outside and tied to the vertical dowels. In addition, the formwork is reinforced internally in both horizontal directions each with nine 22 mm FRG dowels and 200 mm diameter retaining plates. Fender rib dowels are resin grouted to anchor the lattice formwork. Each pillar was sprayed with Sprayplast^{TM} Gypsum based plaster using the dry shotcrete application method. 5 to 6 pallets (1.12 tonnes each) were required for each support pillar with all edges in contact with the fender sprayed out 500 mm to lengthen the potential leakage path for the grout.

Location 22 pillar was 4.2 metres in height and was pumped successfully in one pass, whereas previous pillars required 3 separate lifts. Figure 11 shows the Tailgate trial pillar after being sprayed with Gypsum based plaster.

The trial pillars stayed intact right up to the last cut by the shearer as shown in the photograph of Figure 12. Due to the success of the trial pillars, a decision was made to construct GRP and Sprayplast^{TM} formwork for all Longwall 13 PDRR grout pillar supports.

Figure 11: Sprayed tailgate pillar

Figure 12: Shearer cutting through pillar

The GRP and Sprayplast^{TM} formwork has the following characteristics and advantages.

i. Each pillar's formwork can be constructed in 12 hours;
ii. No formwork strip time is required;
iii. Each pillar can be pumped to the roof in one pass;
iv. All pillar formwork can be constructed in one campaign before grout filling;
v. Total weight of each pillar GRP formwork is ~ 150 kg. There is a considerable reduction in manual handling of formwork and also Gypsum based plaster because it is supplied in bulk bags;
vi. Formwork is able to conform to roof cavities, broken ribs and be extended to reinforce pillars;
vii. Cost effective, rapidly installed pillars to reduce construction time;
viii. Grout will penetrate and reinforce the rib fender coal;
ix. The horizontal GRP dowels and plates reduce the bending moments on the vertical dowels from pressure of the pumped grout. The GRP dowels anchored with polyester resins into the fender coal provide stability for the whole pillar;
x. The grout will yield when subject to roof to floor convergence from abutment loads, retaining most of its strength before being cut through by the longwall shearer.

Pumping of a high yield grout

The placer pumps are capable of pumping FB200 grout at a water: powder ratio of 2:1 for 450 metres horizontally. The placer Monopump maximum delivery pressure is 12 bar (1200 kPa) requiring 16 bar (1600 kPa) working pressure 40 mm Polyline to be used for grout delivery. The pneumatically driven monorail system used for suspending and positioning the bulk bags above the placers requires a minimum working height of 4.5 m. As the bulk bag empties of powder it relaxes and lengthens. Excavation of the floor is often required to gain sufficient clearance for the suspended bag over the placer dry powder hopper.

EXPERIENCE HOLING THE RECOVERY ROADS

Longwall 11 and 12 PDRR have been successfully holed and support of Longwall 13 PDRR is nearing completion at the time of writing:

- The roadways were monitored with the following instrumentation;
- Roof to floor convergence pogo stick (see Figure 13).
- Rib to rib convergence stations
- Hydraulic borehole stress cells installed in the grout pillars
- Roof extensometers
- Daily geotechnical inspections were conducted over the last pillar of longwall retreat with the frequency increased to each shift within 50 m of holing the roadway (see Figure 14).

Figure 13: Longwall 11 PDRR monitoring station – 40 m to hole

Figure 14: Longwall 11 PDRR grout pillar with plastic sheeting removed – 40 m to hole

Very little deformation was visually observed until approximately 25-30 m from holing. At this point roof to floor convergence began to accelerate as abutment load concentrated on the fender. Deformation in the PDRR was primarily seen as floor heave and loading of the fender ribs and outbye ribs.

Sharp increases in roof to floor convergence rates were measured with 10m and 16m wide fenders in Longwall 11 and Longwall 12 PDRR respectively (see Figure 15). At this point the grout pillar supports were working to confine the fender and restrict floor heave. Bulge of the fender rib began exerting the out of plane loading that would traditionally compromise slender standing support elements. Floor heave primarily occurred in the unsupported span of floor between the pillars and between the grout pillars and the outbye rib. As convergence continued the grout pillars started to yield as shown in Figure 16, with failures up to 0.5-1 m deep into the 3.7 m x 4 m pillars observed. Confinement of the grout pillars was improved on Longwall 12 with the addition of a more substantial cuttable mesh wrapping of the pillars as shown in Figure 16.

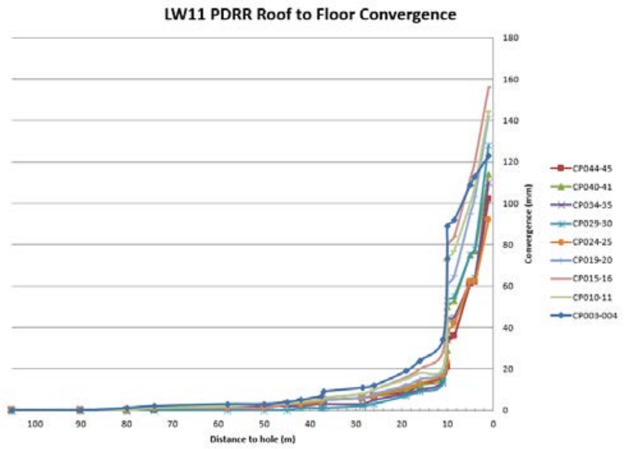

Figure 15: Roof to floor convergence measured into LW 11's PDRR

The PDRR was developed at 3 m high from the 2nd Machine Band down to a coal floor (see Figure 2). This resulted in approximately 0.8-1 m of coal being left on the floor in the roadway (see Figure 2). On the longwall face side the roof horizon and extraction height was lowered to the 1st Machine band at a height of 3.7 m. This allowed the shearer to cut in under the steel roof support installed in the PDRR.

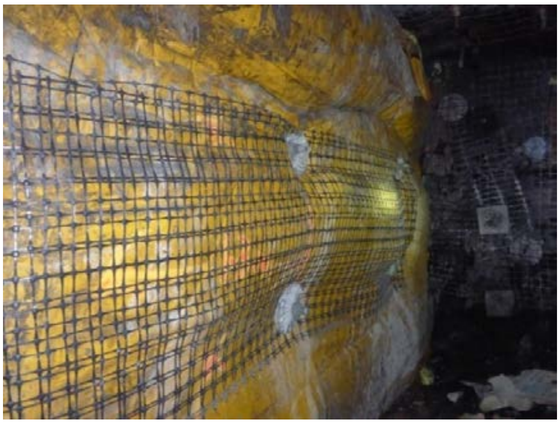

Figure 16: Heavily loaded grout pillar immediately prior to holing Longwall 11 PDRR

As the longwall holed the roadways the 0.8-1 m coal bench and the grout pillars were cut out, resulting in a final roadway height for recovery of approximately 4 m. Face conditions on the longwall from the mesh pinning row onwards were typically good. Particularly from the point that the countersunk spiles and twin strands were present in the immediate roof horizon. Face stability over the last 5 m of retreat was aided by a high density of 5 m cuttable dowels installed into the fender. Confined by the grout pillars the fender stood until holing where it was cut away to reveal the PDRR. Figures 17 and 18 show holing Longwall 11 PDRR.

Mining through the cuttable support elements in the grout pillars and fender was a successful process that required manning of key coal clearance points to avoid grout pillar cuttable formwork and plastic mesh from blocking chutes and transfers (see Figures 17 to 18). Downstream, the cuttable support elements impacted the coal washery and resulted in additional maintenance works being conducted.

The lack of a horizon marker for the lead shearer drum resulted in some challenges with horizon control that will be managed with improved use of automation from LW13 PDRR onwards. Figure 19 shows the condition of one of the grout pillars in Longwall 12 PDRR.

Figure 17: Holing longwall 11 PDRR

Figure 18: Holing longwall 11 PDRR

Figure 19: Mining through grout pillars on longwall 12 PDRR

CONCLUSIONS

The use of pre-driven recovery roads, incorporating large cuttable grout pillars on Longwall 11 and 12, successfully reduced the duration of bolt up by an average of 23 days compared to Longwall 6-10. Longwalls 6-10 were recovered using traditional bolt-up techniques in a comparable geotechnical environment. The continued refinement of the support design, grout pillar construction and pumping technology have made supporting these roadways a repeatable and efficient process that the mine is likely to pursue for the foreseeable future. Longwall 13 PDRR support is nearing completion, Longwall 14 PDRR has been developed awaiting support and Longwall 15 PDRR is currently being developed.

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