2002

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Publication Details

This conference paper was originally published as Tarrant, G, Doyle, R & Mills, K, Investigations Aimed to Improve Tailgate Serviceability at Dartbrook Mine, in Aziz, N (ed), Coal 2002: Coal Operators' Conference, University of Wollongong & the Australasian Institute of Mining and Metallurgy, 2002, 154-158.

INVESTIGATIONS AIMED TO IMPROVE TAILGATE SERVICEABILITY AT DARTBROOK MINE

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ABSTRACT: Dartbrook Mine has experienced rib control difficulties because of deterioration in the tailgate corner of the longwall face as overburden depth has increased. This paper summarises an investigation to optimise support and develop strategies to improve the serviceability of the tailgate roadways.

Field measurements undertaken in the tailgate of Longwall 6 identified roadway softening mechanisms, deformation characteristics and factors controlling deformation. This provides the basis for optimising the reinforcement system as part of an ongoing Strata Management Plan at the mine.

INTRODUCTION

Tailgate conditions experienced during longwall extraction have variously included:

- Severe rib softening to the extent that rib to rib reduction in width of up to 2m has been noted.
- Guttering and cavity formation ahead of the Longwall chocks at the tailgate end.
- Roof falls adjacent to the faceline in the tailgate.

A program of geotechnical work was undertaken to gain a better understanding of the deformation characteristics, the deformation mechanics and the major driving forces. This information provides the basis for design guidelines to improve roof and rib control and management of tailgate conditions.

SCOPE OF INVESTIGATIONS

The scope of the investigations included field based monitoring, analytical evaluation of pillar loading and limited monitoring of longwall chock loading. The focus of this paper is on the field investigation which was conducted at two sites: inbye 10 Cut-through and inbye 5 Cut-through. Figure 1 shows a summary of the monitoring at 10 Cut-through. The measurements undertaken included:

- Depth of rib yield on the chain pillar and block sides.
- Magnitude of roof and rib displacement.
- Timing of deformation with respect to longwall face position.
- Shear displacement in the roof.
- Load developed in the standing support.
- Load profile developed in the roof bolts.

The instruments were installed in advance of longwall mining and monitored during longwall extraction.

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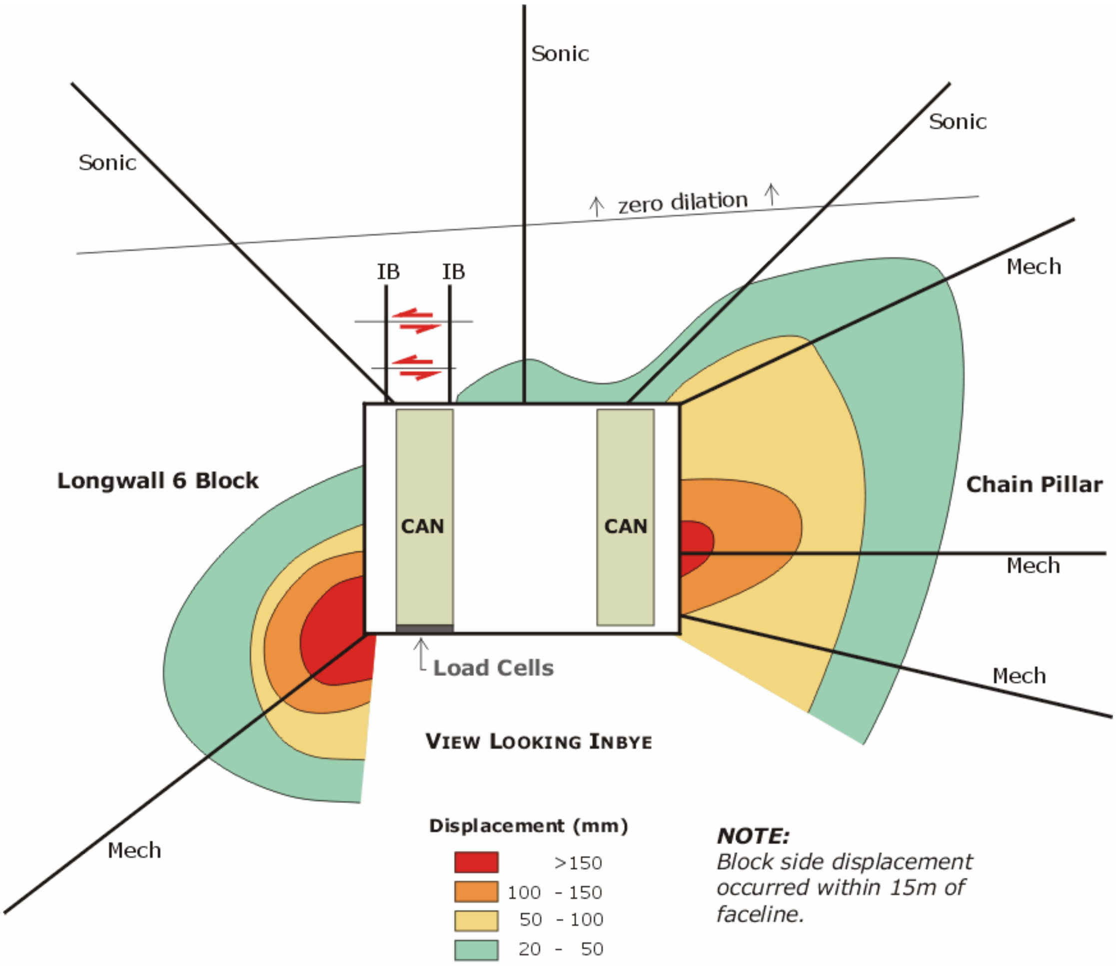

Sonic - 20 position extensometer
Mech - 8 position extensometer (2,3,4,5,6,7,8,9m)
IB - instrumented bolt

Figure 1 Displacement summary and layout of instrumentation Longwall 6 tailgate, inbye 10 C/T.

RESULTS

The deformation characteristics of the monitoring sites are included in Fig. 1. Results are summarised as follows:

- Softening of the ribs both sides of the roadway (5.4m wide by 4.0m high) occurred to a depth of approximately 5m.
- The softening within the ribs extended into the floor on the block side and the roof on the chain pillar side.
- The intensity of the softening increased steadily from approximately 75m outbye the faceline and accelerated within 20m of the faceline.
- The roof and floor outside the area described above exhibited minimal deformation until within 20m of the faceline. Then the movement within this area was characterised by shear displacement along horizontal planes, essentially creating a shortening of the roof and floor heave.

Results from the 5 Cut-through monitoring site are summarised in Figure 2. The location of and sense of shear displacement is apparent. A contour of displacement measured by the extensometers is also shown.

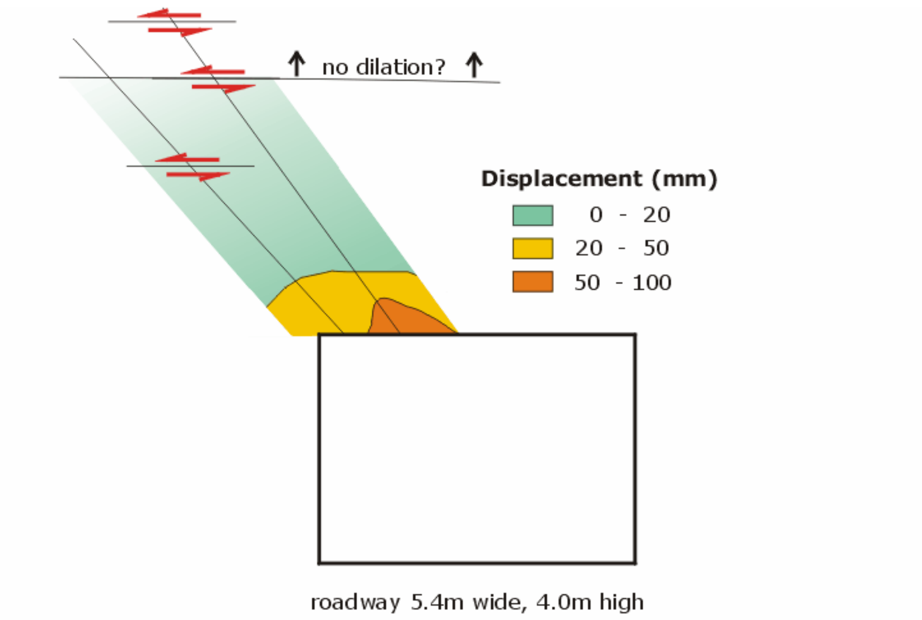

Figure 2 Displacement summary - Longwall 6 tailgate, inbye 5 C/T.

DISCUSSION OF RESULTS

Deformation is characterised by intense shearing of the rib in the top right and lower left corners of the ribs looking inbye as shown in Fig. 3. The zone of intense shearing extends sub-horizontally into the rib for an estimated distance of up to 2m. Further rib spall associated with cleat produces a softened zone extending into the rib some 50% to 65% of the rib height. The lower right and upper left ribs looking inbye typically exhibit no visible signs of deterioration.

Typically the roof conditions are excellent with no visible signs of deterioration. The angle of the roadway with respect to the seam dip is considered a major factor in producing the side to side rib softening bias. The horizontal roof of the heading makes an angle of approximately 6° with the seam. The stresses within the coal seam appear to align with the seam dip and cause biased rib deterioration.

The vertical abutment loads for future tailgates are predicted to increase as depth of cover increases which implies that the induced floor heave and roof shortening is likely to increase in subsequent tailgates. An optimised reinforcement strategy is aimed to compensate for this anticipated increased deterioration.

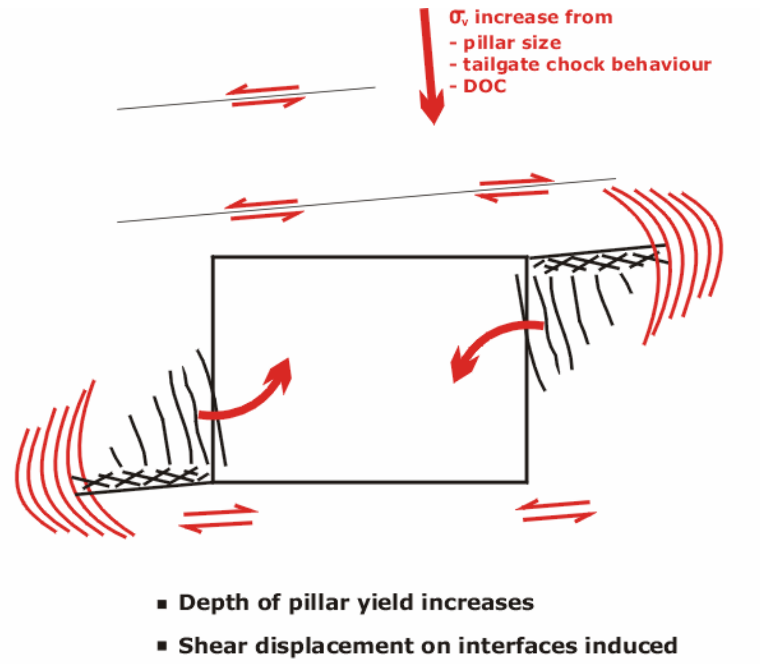

Figure 3(a) State of softening during longwall advance Longwall 6 tailgate (<75m from face).

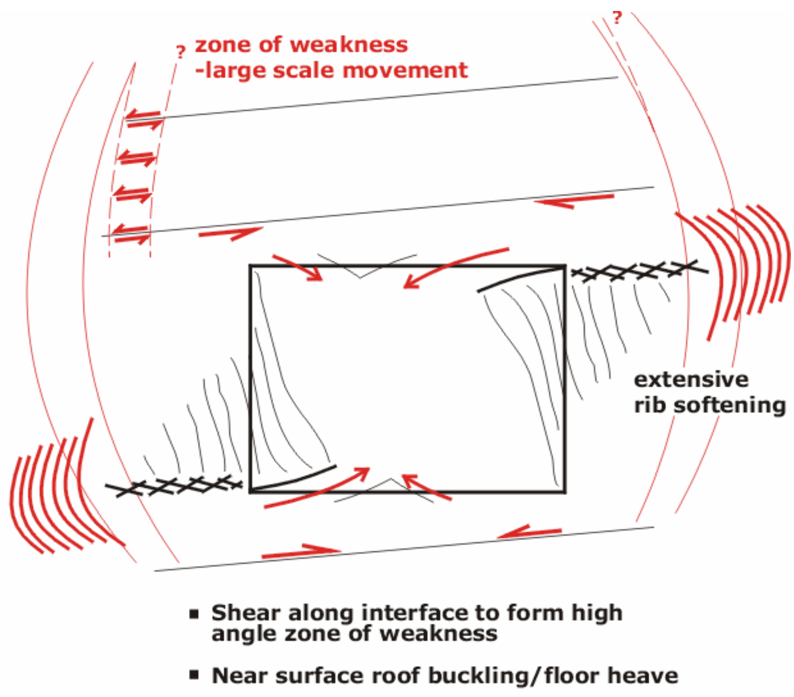

Figure 3(b) Late stage deformation (<20m from face).

REINFORCEMENT STRATEGY

The monitoring program has defined the roadway deformation characteristics and allowed the formulation of a 'working theory' regarding the deformation mechanics.

The current reinforcement design is composed of initial primary roof and rib bolting, intensive secondary rib support and tertiary support in the form of cans and timber cribs in the tailgate. With this system, excessive rib deformation is still evident.

The monitoring results indicate that compression of the coal ribs on either side of the roadway from the approaching vertical abutment loads results in severe rib softening and, within 20m of the faceline, roof and floor shortening.

While it is not possible to avoid some increase in rib softening associated with abutment loading, it is aimed to reduce the current level of rib deformation through modifications to the existing control methods. This is a balance between geotechnical considerations, and issues such as safety, cost, machine availability and contractor access.

The underlying philosophy of the approach described is to increase the post failure strength of the softened coal and maintain roadway serviceability.

The following aspects are considered to maximise the possibility of generating confinement within the ribs through reinforcement:

- Installation of reinforcement as early as possible.
- Use of the high capacity reinforcement systems.
- Full encapsulation.
- Targeted reinforcement to the known areas of softening identified through mapping and observation.

CONCLUSIONS

Based on the monitoring data, the following guidelines are proposed to improve the level of rib deformation and reduce roof and floor shortening:

- Use of fully encapsulated long tendons.
- Biased long tendon pattern targeted to increase reinforcement density in areas of expected softening.
- Length of tendons increased to 6m where possible.
- Use of 'caged' type tendons over plain strand tendons.
- Installation of long tendons prior to side abutment loading where possible.
- Continued use of rib mesh and supplementary bolts to maintain the integrity of the immediate rib skin.
- Standing support varied to suit the prevailing conditions.