PILLAR DESIGN TO CONTROL SUBSIDENCE AT MOONEE COLLIERY

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SUMMARY Moonee Colliery are longwall mining in the Great Northern seam at depths ranging from 90m to 170m. Surface infrastructure above the first four longwall panels includes the Pacific Highway and several residential and commercial properties. This paper describes the pillar design approach used to manage surface subsidence in the area. The approach is based on previous detailed subsidence and pillar monitoring in nearby Wallarah Colliery and measurements of subsidence throughout the Lake Macquarie area for a wide range of pillar sizes and overburden depths. Undermining the Pacific Highway requires consideration of not only the amount of subsidence but also the timing and nature of subsidence. Various options were considered and a design developed to control surface subsidence to acceptable levels. This paper summarises the results of previous monitoring and outlines the issues considered in the longwall panel design for subsidence control at Moonee Colliery.

1. INTRODUCTION

Moonee Colliery was reopened as a longwall operation in 1997. During the planning phase of the new operation, one of the design requirements that emerged was the need to achieve a balance between acceptable mining conditions underground and acceptable levels of surface subsidence.

The economics of different longwall geometries were assessed in terms of their impact on surface subsidence. At one end of the spectrum, wide longwall panels were found to cause high levels of surface subsidence and subsidence related surface deformation. At the other end of the spectrum, very narrow panels were found to be economically unacceptable. The challenge was to achieve an optimum balance.

The issue of subsidence control involves not only the amount of subsidence, but also the timing of this subsidence. There have been several examples of unexpected subsidence events in the Southern Lake Macquarie area, sometimes many years after mining. The intention at Moonee is to have subsidence occur within the period of active mining (ie: as a function of the extracted geometry as mining proceeds) so that a stable surface environment is achieved within the lifetime of the mine.

Subsidence data available from nearby Wallarah Colliery and previous experience of subsidence events elsewhere in the Southern Lake Macquarie area provide a basis to design the longwall panels at Moonee Colliery to achieve these design aims.

2. SITE DESCRIPTION

Figure 1 shows the general layout of the first four longwall panels at Moonee Colliery, the depth of overburden strata, major geological structures, and the location of major items of surface infrastructure.

seam is approximately 5m thick in the longwall area but has a 0.5-0.7m thick claystone unit located approximately 0.5 from the top of the seam. Only the lower 3.5m of coal is able to be mined. The immediate floor of the Great Northern Seam includes claystone strata.

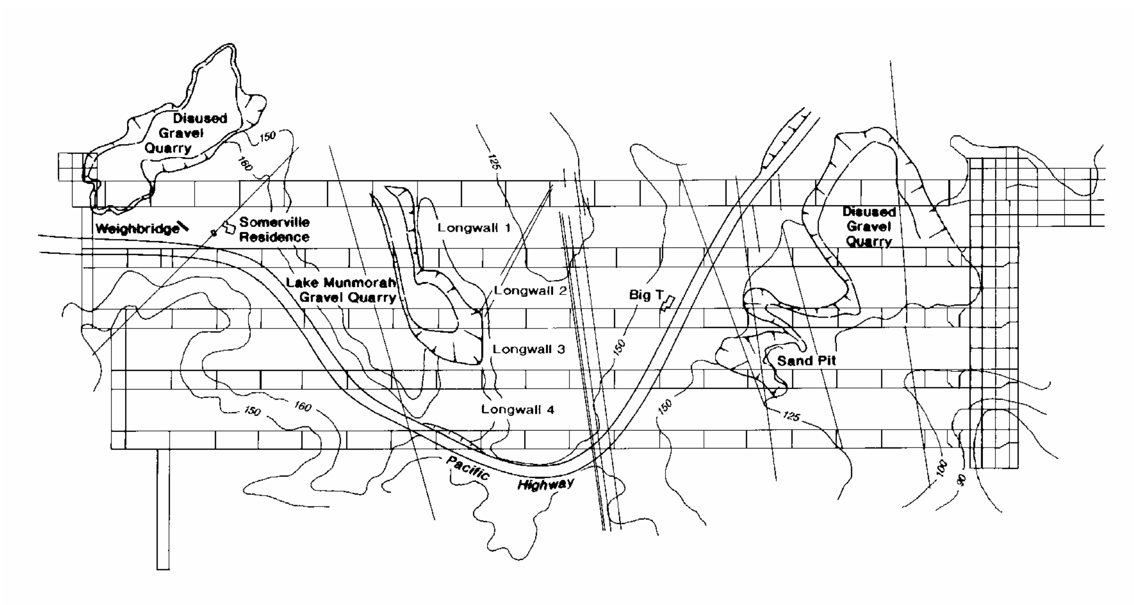

Figure 1 Site Plan of the Longwall Panels at Moonee Colliery

The Pacific highway follows a topographic ridge system. The depth of overburden ranges from 170m at the start of Longwall 1 to 90m at the finish of Longwall 4 but is generally greater than about 150m.

Two coal seams have been mined at Moonee Colliery, the Wallarah seam and the underlying Great Northern seam. Longwall mining is currently in the Great Northern seam. The overlying Wallarah seam has not been mined in this area.

The overburden strata at Moonee Colliery comprises a 35-40m thick conglomerate unit between the Great Northern seam and the Wallarah seam with further conglomerate and sandstone units between the Wallarah and the surface. The Great Northern

3. SUBSIDENCE EXPERIENCE AT WALLARAH COLLIERY

There is no previous experience of total extraction in the Great Northern Seam at Moonee Colliery. However, subsidence experience at nearby Wallarah Colliery provides a strong basis for estimating subsidence behaviour at Moonee Colliery.

Analysis of the subsidence behaviour over FCT Panels 1 to 4 at Wallarah Colliery indicates that the overburden strata is able to substantially bridge across individual panels up to 100m wide. When the total width of extraction becomes supercritical (after two or three adjacent panels are extracted), bridging is no longer possible and the resulting surface subsidence is controlled by the characteristics of the chain pillars.

Figure 2 shows the layout of FCT Panels 1 to 4 in the Great Northern Seam at Wallarah Colliery. Each panel is approximately 100m wide. The chain pillars between panels are 12m wide. The depth of overburden is approximately 125m. The seam is 3.2m thick. The interburden between the Great Northern Seam and the Wallarah Seam is 35m - 40m thick conglomerate strata.

Figure 3 shows the subsidence that was measured as each panel was mined.

After completion of FCT1 (February 1989), the maximum surface subsidence was approximately 52mm. Maximum subsidence increased when FCT2 had been mined, to approximately 900mm and was greatest over the centre of combined goaf area of FCT1 and FCT2.

When FCT3 & FCT4 had been mined, the combined goaf area was supercritical in width as indicated by the characteristic even subsidence profile over the centre of the panel. The maximum subsidence in the centre was approximately 1100mm.

A survey undertaken approximately 3 years after mining was complete showed only minor additional subsidence had occurred over the chain pillars ranging from 30mm to 58mm.

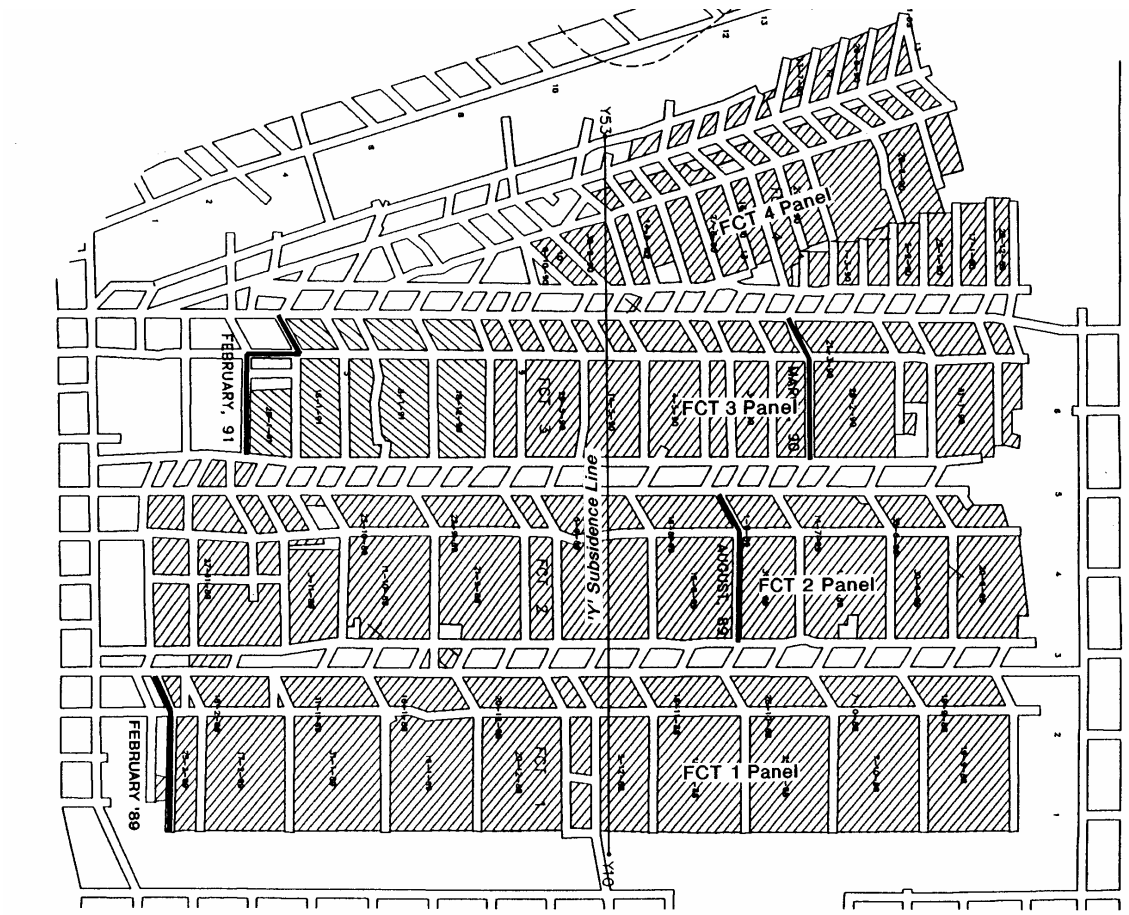

Figure 2 Plan of Subsidence Lines Over FCT Panels at Wallarah Colliery

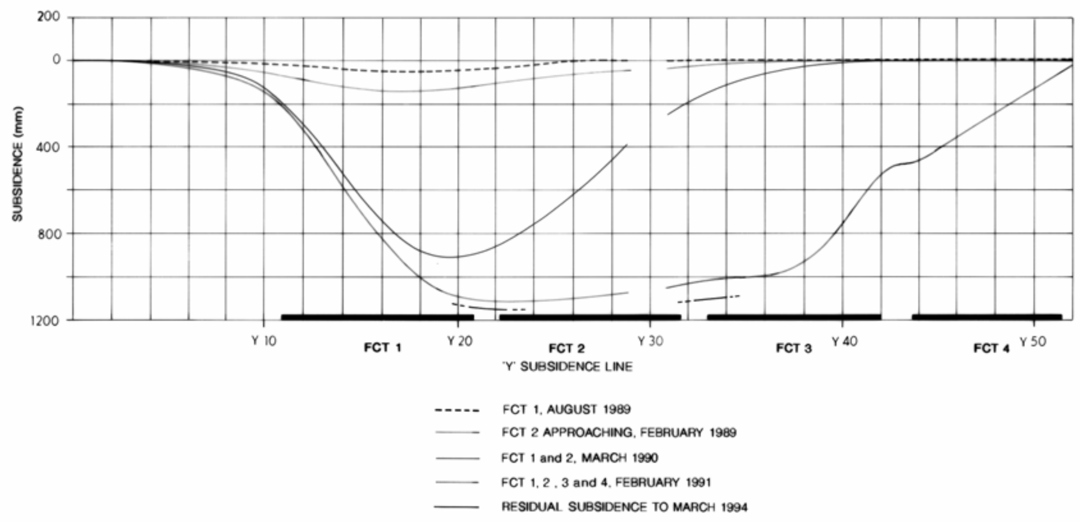

Figure 3 Subsidence Measured over FCT Panels at Wallarah Colliery

4. EXPERIENCE IN THE SOUTHERN LAKE MACQUARIE AREA

A review of subsidence behaviour in the Southern Lake Macquarie area (Mills & Edwards 1997) suggests that:

1. When coal pillars on claystone strata become overloaded, the amount of subsidence that occurs is a function of the geometry of the pillars.
2. The strength of coal pillars on claystone strata is significantly less than the strength of coal pillars in strong roof and floor strata.

Figure 4 shows the empirical relationship developed between subsidence and the width to height ratio of the pillars for supercritical panel geometries in the Southern Lake Macquarie area. The subsidence observed over the FCT panels at Wallarah Colliery is also shown and is consistent with this data.

When the overburden strata is able to bridge across individual panels, the amount of surface subsidence is controlled by the width of the pillars while the stability of the pillars controls the timing of the subsidence. Subsidence occurs more quickly when the chain pillars are smaller and when they are more heavily loaded.

The chain pillars at Moonee are designed, on the basis of past experience, to become overloaded once they are isolated in the goaf between two fully extracted longwall panels. They are designed to be large enough to allow subsidence to occur gradually but within the timeframe of mining.

5. DESIGN GEOMETRY

The design finally developed for Moonee involved longwall panels 100m wide separated by 35m wide chain pillars.

In this geometry, individual longwall panels are narrow enough to allow bridging of the surface strata across the full width of each panel. Subsidence is then controlled by the behaviour of the chain pillars because the final subsidence profile is essentially smooth and does not show humps over each row of chain pillars.

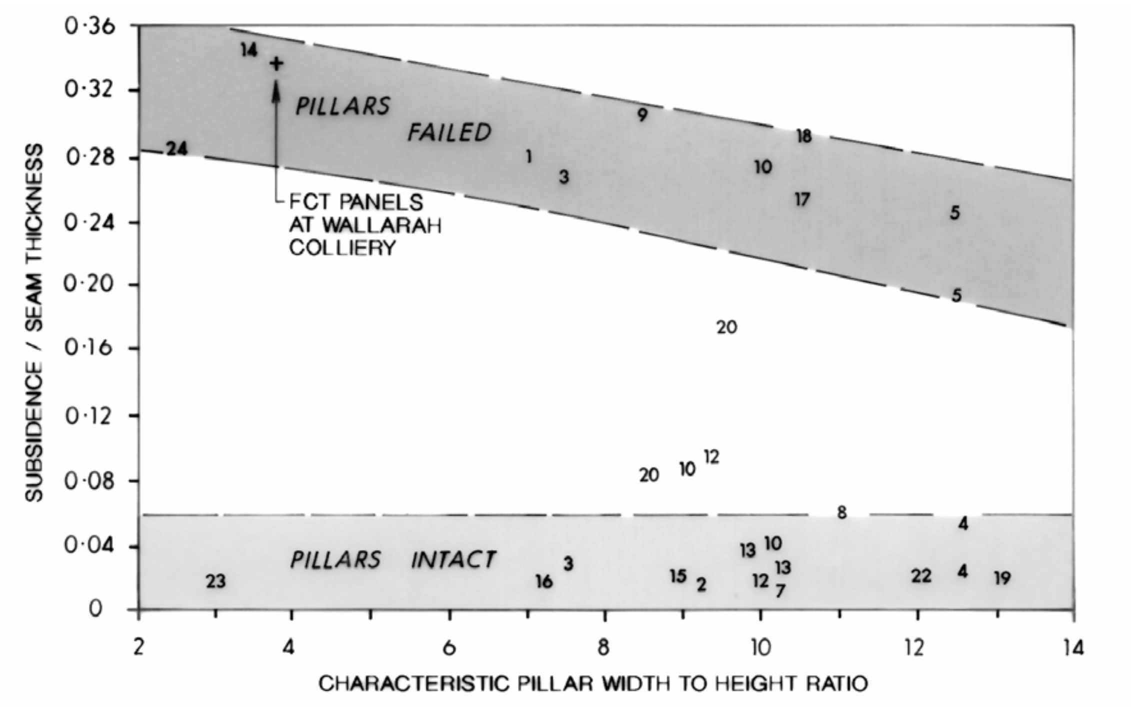

Figure 4 Effect of Chain Pillar Geometry on Maximum Surface Subsidence

The chain pillars are designed to become overloaded when they are isolated in the goaf between two fully extracted panels. The final surface subsidence is controlled by the compression of these chain pillars. By forming 35m wide chain pillars, the initial elastic compression is expected to result in approximately 200mm of surface subsidence. When the chain pillars become overloaded, they are expected to do so gradually causing 0.7-1.0m of subsidence.

6. ONGOING MONITORING

A detailed program of subsidence monitoring is being undertaken to confirm subsidence behaviour at Moonee Colliery. Subsidence points along the Pacific Highway and at various other locations are being monitored in three dimensions as mining proceeds. This monitoring is aimed to provide a basis to further improve the design of chain pillars to control surface subsidence at Moonee Colliery.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

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