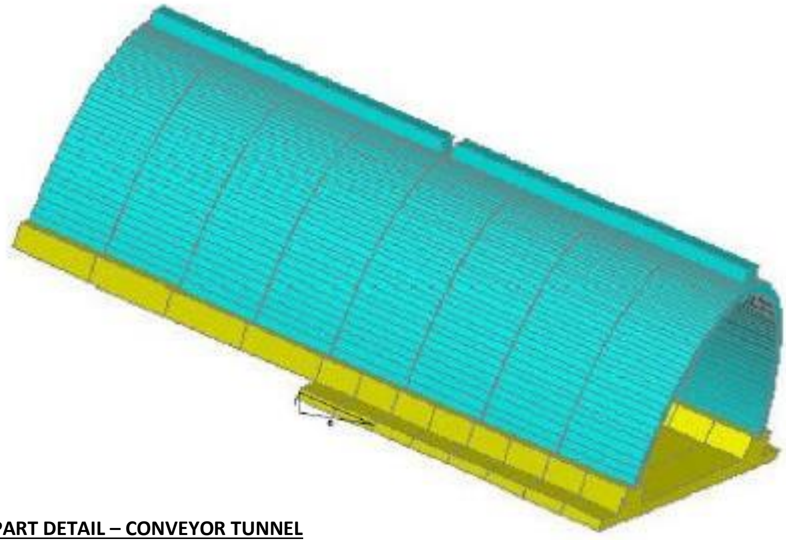


PART DETAIL – CONVEYOR TUNNEL

CASE STUDY

Kestrel Mine Portals

near Emerald, QLD, Australia

Tunnel
TechSpan®

Owner: Rio Tinto Coal
Consultants: Halliburton KBR
Contractor: BGC Contracting
Construction: January 2009

Background

Rio Tinto's Kestrel Mine, located in Queensland's Bowen Basin 50 km northeast of Emerald and 300 km west of Rockhampton, is an underground longwall operation supplying world markets with premium quality high volatile coking coal as well as thermal coal.

Rio Tinto plans to invest more than $1.1 billion to extend the Kestrel Mine. The extension will eventually increase mine production from 4 to 5.7 million tonnes of coal a year, with the first longwall coal expected to ship in 2012.

Amongst infrastructure requirements for the expansion are two new Conveyor and Transportation Drift Tunnels.

Challenge

The Reinforced Earth Company (RECO) commenced discussions regarding the Kestrel upgrade tunnels at least two years prior to the construction commencing. They worked extensively with the client pre- tender and had already presented various proposals at this stage.

The client's greatest concern was to make the design as cost-effective as possible. Other design challenges included:

- Longitudinal grade of up to 1:6.
- Swelling pressures associated with highly reactive clay: These clays, when exposed to air through excavation, swell adding a complication in the base slab design.
- Aggressive ground water conditions.
- Ability of the tunnels to withstand a 70kPa internal impulse blast pressure without collapse, as required in the Queensland Mining Act.
- A range of cast inserts and locations on the inside arch surface to support conveyor and service loads.

Solution

Various tunnel design options were considered, such as combining the two tunnels into one to avoid the extensive box cut excavation to accommodate the two separate tunnels.

Steel arches were also an option. Although they are more competitively priced, the high risk associated with potential corrosion due to the aggressive groundwater conditions ruled out their use and concrete was specified as a prerequisite.

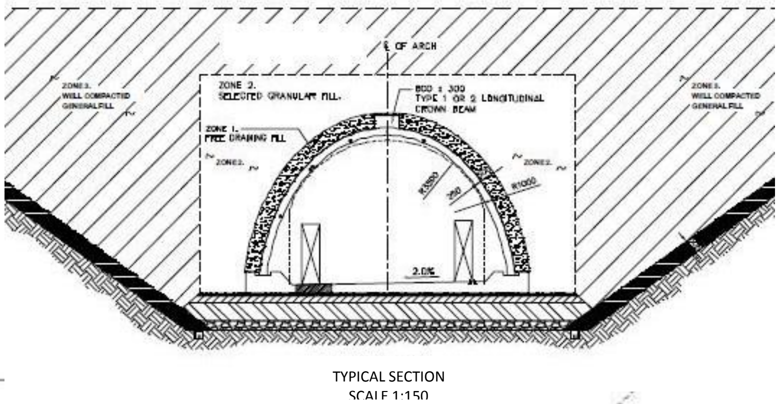
RECO was appointed to design, manufacture, deliver and supervise the installation of the precast concrete arch and base slab system for both the Conveyor and Transportation Drift Tunnels.

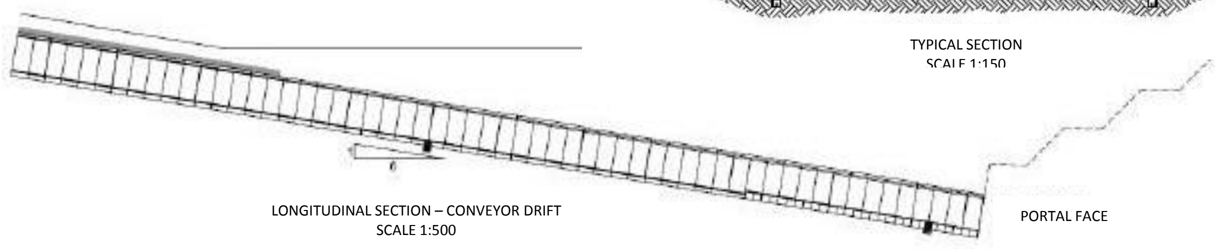
RECO's Technical Manager, Chris Lawson faced many unique challenges on this project. "The combination of grade and depth of fill meant we needed to use shear

Mining infrastructure

REINFORCED EARTH
SUSTAINABLE TECHNOLOGY

Right: Typical cross-section of TechSpan® Tunnel
Below: Longitudinal section of 1:6 conveyor drift tunnel. The transport drift tunnel has a 1:8 grade.





connectors to maintain longitudinal stability of the arch units. Due to transport capacity limitations placing each of the footing units at 25 tonnes, their width was limited to 1.1m and because the units are so narrow, these in-situ shear connectors needed to be included to prevent rotation."

RECO's head of operations, James Bye, adds "It is very complex to precast the detail on the base units as voids need to be incorporated to allow for drainage. Detailing for the longitudinal sheer connectors adds further complexity."

Precasting challenges for BB&D Civil did not stop at the base slabs. The complexity in the detailing of the tunnel interior was also a challenge. Ferrules were cast directly into each unit with additional reinforcement provided to ensure sufficient strength to avoid the ferrules pulling out during the conveyor's operation. No standard mould could be used; as there were approximately seven different variations in the position of the cast insert locations.

Altogether nine types of base slabs and 21 different arch types were required. In all cases a concrete mix incorporating fly ash, to make it impermeable and subsequently more durable was used.

At the portal entrance, the arch design was required to withstand the load imposed by 20m of fill. As the height of fill reduced, nearing the tunnel entrance, the base slab design changed, until a minimum fill height of 2.75m was reached to accommodate the internal blasting pulse pressure requirements.

Mr. Bye, who was on site to supervise the installation of the precast concrete arch and base slab system, adds, "Arch units are installed using two cranes and are placed directly opposite one another. This not only facilitates installation on a steep slope, but it speeds up the installation process making it more cost effective. Furthermore, arch unit joints coincide with base slab joints, so that if settlement does occur, it will not compromise the arch units, as would be the case if they were straddling across the joints. "

Project specifications

System	TechSpan®	
Tunnel	Transport	Conveyor
Arch Type	TS1	TS2
Span	8010mm	7925mm
Height	4.65m	4.35m
Length	180m	130.5m
Thickness	250mm	250mm
No. Units	160	116
No. Base Slabs	98	72

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