

Exploring the crossover between tunnelling and mining

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AusIMM Sydney Branch

16 October 2024

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Dance card

- PSM
- Recent examples of city tunnels
- What is a tunnelling project?
- Innovations
- Lessons for mining



PSM

- Started in 1993
- 150 engineers, geologists, hydrogeologists and hydrologists
- Sydney, Brisbane, Perth, Melbourne





English Channel Tunnel





Recent examples of city tunnels



Sydney Metro









The *"cathedrals of the 21st century"*



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Sydney Metro – Completed cavern (Dec 2020)





Sydney Metro – Cavern excavation (2019)





Sydney Metro West (under construction)





Metro West – Hunter St Station





Hunter St Station - buildings



Radisson Hotel Heritage building



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Hunter St Station – existing tunnels



heritage tunnel



Hunter St Station – future basements









Hunter St Station – excavation





Hunter St Station – excavation





Increasingly complex geometry













Complexity of a mine







WestConnex – Rozelle Interchange





WestConnex – Rozelle Interchange



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Rozelle Interchange



Melbourne – Suburban Rail Loop



Ground Freezing to allow open excavation of saturated sands



Wynyard Walk



Complex Structures



Brisbane – Cross River Rail Boggo Rd Station



Big, shallow tunnels





Brisbane - Cross River Rail





CRR – Albert St station building



CRR – connections





CRR – propping





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CRR – completed cavern





A Tunnelling Project



What my friends think I do



What girls think I do



What I want to do



What my parents think I do



What my boss thinks I do



What I think I do





What kids think I do







Engineering and Construction Project













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Compliance Project

The Contractor must comply with, and must ensure that its employees, Subcontractors, 201123 Contractor Associates and any other person for whom the Contractor is responsible or over whom it is capable of exercising control engaged in carrying out any part of the Works comply with all OHS Legislation and the Workplace Health and Safety Requirements.

The Contractor must proactively consult and cooperate with the Contractor Associates and the 196956 Interface Parties so far as is reasonably practicable, throughout the performance of the Contractor's Activities to ensure that all parties are appropriately aware of the risks associated with the work under the Deed

The Contractor must facilitate the workshops described in Section 3.2 of this Part C of the 196958 PS&TR.

The Contractor must ensure that systems and procedures are implemented that ensure tender 196959 documents and contracts require compliance with the Contractor's Health. Safety and Rail Safety Management Plan and OHS Legislation.

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Approximately 10,000 requirements allocated to design packages compliance is demonstrated and verified

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Without limiting its obligations under the Rail Safety National Law, the Contractor must comply with upstream general safety duties as set out in section 53 of the Rail Safety National Law.

201124

The Contractor must ensure that the Principal is able to access the Site and review and 196960 inspect any activities in accordance with Clause 17 of the Deed.



Design review

Designer

- 1. Internal review (ISO9001)
- 2. Design Project Manager
- 3. Construction Project Manager
- 4. Construction Team Reviewer(s)
- 5. Proof Engineer
- 6. Independent Certifier
- 7. Client's Engineer(s)
- 8. 3rd Party Stakeholders

Current project – 20 people are in the Reviewer's list







Timeframe and multiple reviewers



To ensure design delivery through multiple reviewers in the time needed by the project, it might be better to design "the standard".

The pressure to do this increases with the number of reviewers and the shorter the timeframe



Result - 1

Eastern Distributor (1999) Permanent 1700 m long 8 to 24.5 m spans 12 m high About 1 km of road tunnels existed

Design + review ≈ \$900k \$5000 per km of tunnel Access tunnel (2024) Temporary 60 m long 8 m span 8 m high About 150 km of road tunnels exist

Design + review ≈ \$1,000k \$170,000 per km of tunnel



cf inflation x 1.9



Result - 2







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Advances in Tunneling Techr HOSTING THE ITATUNNELING AW

Where Innovati Meets Practic Experience



HNTB has a long histor winning work for some country's most comple projects. From small-d excavations to the lard machine-bored tunnel our experts have the knowledge to provide solutions to tunneling

normet

create Engineering ideas into reality



Increased design life of bolts



ED, 1999)

Installing bolts remotely

Manual bolting standing on the roadheader deck



Remote

bolting



Remotely installed cuttable bolts and cables





Handle-bar plates













Multiple purpose

Eastern Distributor 1.7 km long, double-deck, 2 and 3-lane tunnel

Completed in 1999 with a span of 24.5 m, it was the widest road tunnel in the world.





Multi-purpose tunnel

SMART, Kuala Lumpur, Malaysia Completed in 2007 4 km long, 13.2m diameter, stormwater management and road tunnel (part of 9.5 km tunnel)





It's been used about 50 times



Faster excavation



Junction of two 5 m tunnels and 11 m cavem. Bank St, North Sydney, 1925



3-lane 12 m wide road tunnel. Lane Cove Tunnel, 2006



Convoy of trucks to service 18 roadheaders, RIC, 2022



2-lane 8 m wide ramp tunnel. Eastern Distributor, 1998



3-lane 15 m wide road tunnel. WestConnex 1B, Haberfield, 2018



TBM, Sydney Metro West, 2024





The Geotechnical Baseline Report sets out the subsurface conditions anticipated under the contract.

It is a means of allocating and managing subsurface risks associated with subsurface

Site conditions differing from those considered in the GBR are deemed to be 'unforeseen' under the contract and are carried out at the employer's risk.

Properly drafted GBRs reduce construction costs and set clear terms between the parties in the event of more adverse ground conditions, thus contributing to dispute avoidance.

Geotechnical Baseline Reports for Construction

SUGGESTED GUIDELINES

The Technical Committee on Geotechnical Reports of the Underground Technology Research Council





Controlling seepage



Respirable dust





2010s



2023

Risk procedures

Permit to Tunnel (PTT)

Permit to Excavate (PTE)



Crossover with mining



Geophysics







Scanning









Mapping











3D structural modelling













Monitoring







Fig. 27 a Original WSN system developed at the University of Cambridge in 2009, b tilt mote (Wisen innovation), c laser distance mote (Wisen innovation) and d displacement/acceleration mote (Utterberry)

Soga et al 2019, Advances in Geotechnical Sensors and Monitoring



wireless sensor networks



Monitoring

InSAR Interferometric Synthetic Aperture Radar





Tele-remote

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TBMs in Mining

TBM Use in Mine Development R P Lovat . G I Zamel and L P Zenari VIII Australian Tunnelling Conference Sydney, 24 - 26 August 1993

Northparkes (NSW), 2013

Grosvenor (Qld), 2013

Drill and Blast tunnel viz. with Mobile Tunnel Bored tunnel

Mogalakwena (Sth Africa), 2024?

Civil tunnels have different requirements

- Acceptable performance particularly deformation
- Constrained geometry due to proximity of other assets
- The public, their homes and perceptions
- Consequence of failure
- Little or no opportunity to "try again"

Lessons for Mining

DOs

- Rigour
 - Geological data collection (televiewer interpretation, scanning / mapping)
 - Know the ground (geological / geotechnical / hydrogeological model)
 - Engineering (calculations are useful)
 - Permit to Tunnel / Excavate
- People
- We learn the most when exposed to a range of experience

DONTs

- Project management led engineering
- Review process
- Requirements traceability

Thank you

& The Tunnel Wisdoms A DRIPPING TUNNEL OR A CROWING HEN IS NEITHER GOOD TO GOD NOR MEN . Drup Happens . BETTER LATE THAN TUNNEL . Better to have tunneled and lost than never to have tunelled at all . BREVITY IS THE SOUL OF TUNNEL . If it aint Proke don't tunnel it . Fools TUNNEL IN WHERE ANGELS FEAR TO GO . TUNNEL IN HASTE, REPENT AT LEISURE . you conte have too much of a good tunnel. TUNNEL, HEAL THYSELF. Spare the rod and spoil the tunnel . TOMORROW is ANOTHER TUNNEL. Don't change houses in mid-tunnel. THE ROAD TO HELL IS TUNNELLED WITH GOOD INTENTIONS . ETC. leunig

