

Tunnels



About EIC Activities

EIC Activities is CIMIC Group's engineering and technical services business.

Our engineering and risk mitigation expertise provides CIMIC Group with a competitive advantage for winning and delivering profitable projects that also generate value for clients.

EIC Activities ensures the Group's collective experience, technical capabilities, innovations and leading-edge technology applications are leveraged to deliver our client's objectives.

About CIMIC Group

CIMIC Group is an engineering-led services, construction and natural resources leader with a history dating back to 1899.

Powered by 39,000 people, and pioneering technology and engineering, we deliver high-value and sustainable solutions across the lifecycle of assets, infrastructure and resources projects in around 20 countries.

CIMIC Group comprises our engineering and construction businesses CPB Contractors and Leighton Asia, our integrated solutions providers UGL and Sedgman, our natural resources company Thiess (60% ownership), and our development and investment arm Pacific Partnerships – all supported by our in-house engineering consultancy EIC Activities.

Our mission is to generate sustainable returns by delivering innovative and competitive solutions for clients and safe, fulfilling careers for our people. We strive to be known for our principles of Integrity, Accountability, Innovation and Delivery, underpinned by Safety.





Our tunnelling services

As a member of CIMIC Group, EIC Activities provides services to CIMIC's operating companies exclusively. Our engineers are dedicated to work in the best interests of our clients in order to mitigate risk and identify opportunities to create value.

To achieve this, EIC Activities' tunnels team provides the following services:

- review and challenge of designs to mitigate risk and optimise design outcomes
- assessment and provision of alternative cost-effective design solutions
- review of tunnelling reports and factual data to advise on tunnelling conditions
- technical management of the design process, liaison with clients, reviewers and stakeholders to facilitate approvals
- advice on constructability and construction methods
- provision of implementation and monitoring data management platform GeoSens to improve efficiency of monitoring data collection, visualisation and reporting
- support with legal and commercial matters including claims, disputes and forensic engineering
- provision of design/technical management services
- provision of design delivery services including concept design, detailed design, reporting and documentation, and design verification and proof engineering.

Our tunnelling capabilities

EIC Activities' tunnels team has a diverse expertise spanning the geotechnical, structural and constructability aspects of tunnels to provide support throughout the project life-cycle - extending from early feasibility and concept, detailed design, through to construction phase services and defect liability.

The tunnels team brings together a group of industry experts and highly experienced tunnelling professionals with consulting, design and construction experience.

Our tunnels capability and expertise include:

Geotechnical interpretation for tunnels

Advice and reviews of site investigation planning, scoping and management and interpretation of geotechnical data for determination of parameters and profiles.

Numerical modelling

Capabilities to undertake complex 2D/3D numerical modelling for tunnels using advanced geotechnical packages such as PLAXIS 2D/3D, RS2/RS3, MIDAS, Strand7.

Tunnel linings

Analysis and design of tunnel support systems, including sprayed concrete, precast segmental linings and integration of lining drainage and waterproofing.

Temporary and permanent tunnel support

Analysis and design to comply with temporary support for personnel re-entry and permanent support to meet the project's design-life.

Tunnel constructability

Technical support on the assessment and selection of excavation techniques, including optimisation of construction sequences and excavation cycles.

Assessment of damage due to tunnelling

Assessment of deformation and settlement effects on buildings, utilities and infrastructure. Advice on remediation of tunnel instability problems.

Instrumentation and monitoring

Advice on planning and management of instrumentation and monitoring applied to tunnels and underground excavations.

Cross-discipline review and optimisation

Technical support for the coordination of tunnel design across different disciplines such as civil alignment design, fire engineering, ventilation, mechanical and electrical, drainage and environmental engineering.

Case studies

North East Link (NEL) - CPB Contractors

Design challenge, risk evaluation and optimisation

The EIC Activities tunnelling team was engaged by Spark North East Link to support construction of the project. CPB Contractors is a Joint Venture partner of Spark Consortium.

About the project

CPB Contractors, as part of Spark North East Link, is delivering the North East Link Primary Package PPP in Melbourne.

The Primary Package PPP provides three-lane twin tunnels that will finally close the missing link in Melbourne's freeway network.

Up to 135,000 vehicles will use North East Link every day, reducing congestion in the north-east while maintaining local roads for local trips.

Challenge

During the design development of the North East Link Sequential Excavation Method (SEM) tunnel, the project team was concerned about the stability of the pillars between the two adjoining 18-metre-wide SEM tunnel excavations.

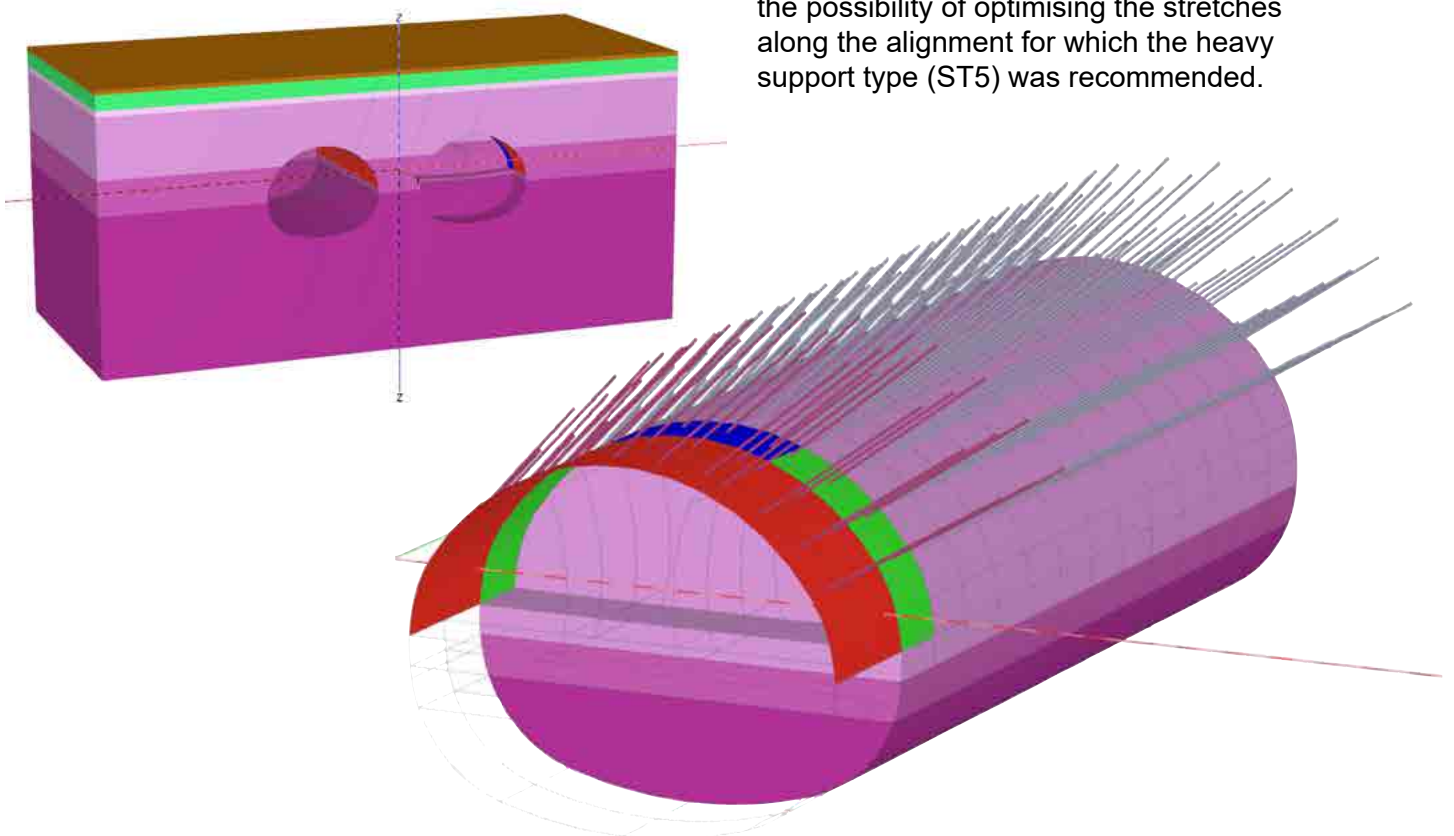
This uncertainty posed a risk to the project schedule and cost.

Additionally, due to the long lead times required to procure the canopy tube pipes needed for the heavy supports, an early assessment was necessary based on ground risk and sensitivity of ground parameters.

Solution

Rigorous geotechnical assessments and sensitivity studies were conducted using an advanced Finite Element Analysis (FEA) model, providing confidence in the pillar stability and the recommended design measures.

The EIC Activities tunnelling team identified the possibility of optimising the stretches along the alignment for which the heavy support type (ST5) was recommended.



Case studies

Sydney Metro - Western Sydney Airport, station boxes and tunnels - CPB Contractors

Optimise temporary ground support

The EIC Activities tunnelling team was engaged by the CPB Contractors project team to support the launch of the tunnel boring machines (TBMs) for the Sydney Metro - Western Sydney Airport, station boxes and tunnelling works.

About the project

CPB Contractors, in joint venture with Ghella, was selected by the NSW Government to deliver the Sydney Metro – Western Sydney Airport, station boxes and tunnelling works.

It involved the design and construction of 9.8 kilometres of twin tunnels and excavations for five stations at St Marys, Orchard Hills, Airport Business Park, Airport Terminal and Aerotropolis, and service facilities at Bringelly and Claremont Meadows.

About EIC Activities' involvement

A TBM was planned to tunnel south from the Airport Business Park (ABP) drive portal in open mode (without active face support).

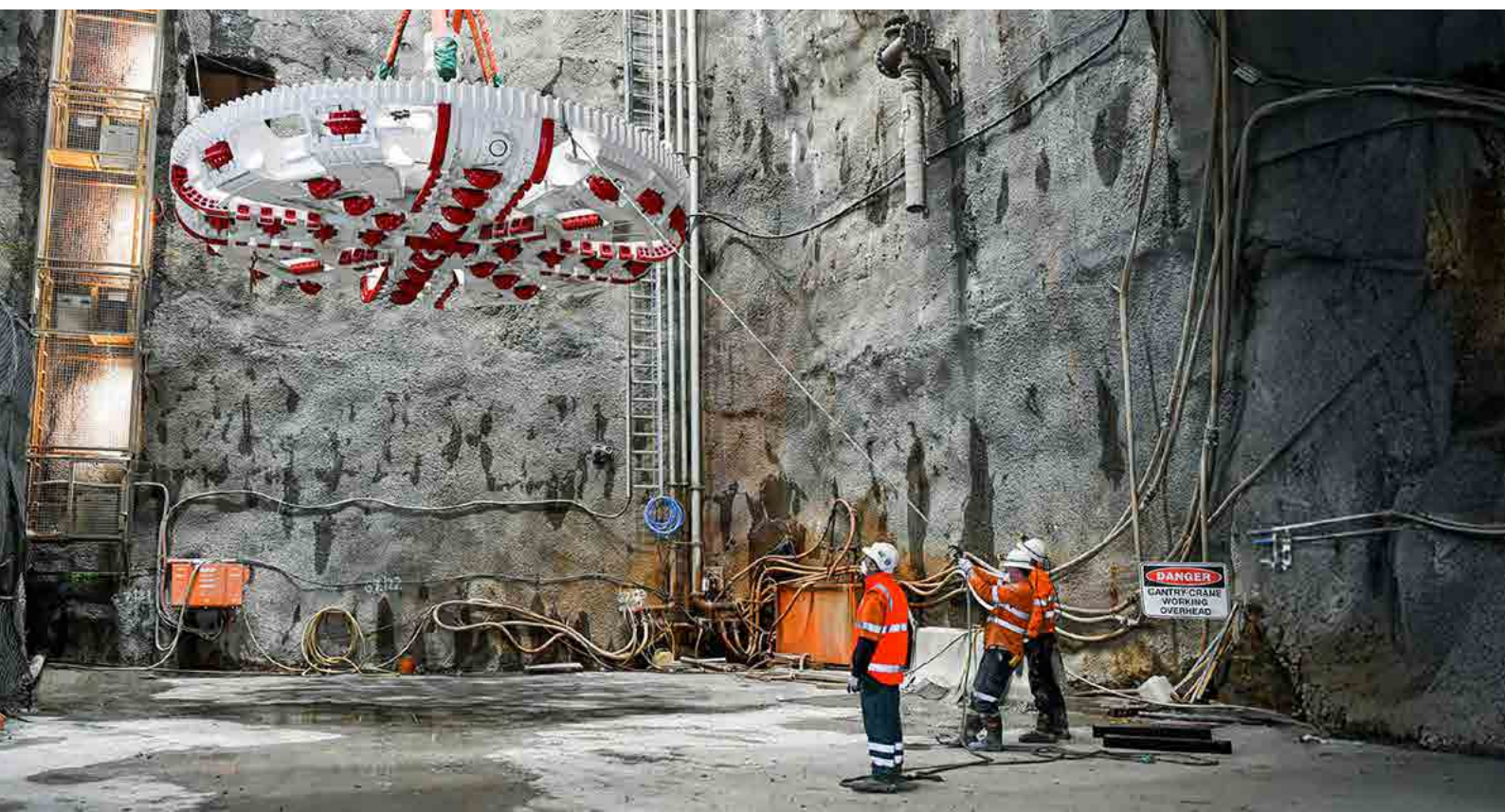
Most of the tunnelling was expected to go through Class II or better Bringelly Shale. However, at the TBM launch location, the TBM was expected to encounter Class IV-III Bringelly Shale and a clay layer at the crown, which could have resulted in face instability if the TBM drove without any face support pressure.

Hence, additional crown support from the headwall was planned for the TBM launching.

EIC Activities' tunnelling team undertook numerical modelling to demonstrate the global stability of the tunnel and that there was no need for additional pre-support measures at the dive structure.

This resulted in time saving as well as cost savings for the project team.

The project team successfully launched the TBM from the ABP portal without any face instability issues and surface settlements were within compliant limits.



Contacts



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Technical Adviser - Ground Engineering

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Sydney

Summary

- 42 years' professional experience in geotechnical engineering
- special areas of expertise include soft ground engineering, slope assessment and remediation, underground spaces and tunnels, deep foundations and retaining structures, and earthworks and materials in the sectors of roads, rail, airports, water, ports, power and buildings
- BSC (Civil), MSC (Geotechnical), PHD (Geotechnical).

Relevant experience

- geotechnical investigation and geotechnical investigation and interpretation, study, analysis and design
- project management and coordination
- construction advice and service
- numerical modelling - groundwater and soil-structure interaction
- expert witness for arbitration, litigation and legal cases
- forensic engineering.



Francisco Cortes

Technical Principal - Tunnels

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Sydney

Summary

- 24 years of experience in engineering consultancy across different regions including Australia, the United Kingdom, Europe, Hong Kong and South America
- leadership roles for multidisciplinary projects ranging from feasibility design to detailed design and construction services
- supported the expansion of EIC's capabilities in design delivery for major projects
- BEng (Civil) majoring in geotechnics; MSc (Soil Mechanics) Imperial College London.

Relevant experience

- technical advisory and independent verifier for tunnel projects
- design of tunnel support systems for soil and rock environments, assessment of the effects of tunnel excavation on adjacent structures and constructability aspects of tunnels
- geotechnical and structural aspects of segmental lining design.

Contacts



Willy Liew

Technical Director - Tunnels

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Brisbane

Summary

- 27 years' experience in design and construction of tunnels and underground infrastructure across Australia, NZ, Singapore and Saudi Arabia
- BEng (Civil) (Hons) University of New South Wales
- MIEAust, CPEng, NER, RPEQ, RPEV, APEC Engineer, IntPE(Aus).

Relevant experience

- extensive experience in design development of tunnel and underground space use including road, rail, water, utility and building basement
- structural design of permanent linings and temporary supports associated with TBM and mined tunnels construction
- cut and cover box structures including top-down construction techniques. Significant experience in deep excavation support in soft ground and deep foundation design
- experienced in major underground projects with multi-disciplinary work environment in various roles and stages of project development
- strong focus on value engineering and cost effective design solutions.



Senthilnath, GT

Principal - Tunnels

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Summary

- 17 years of experience delivering geotechnical and underground projects across Australia, Southeast Asia and India
- BEng (Civil)
- MEng (Soil Mechanics), IIT Roorkee and TU Dresden, Germany, MSc (Tunnelling and TBM) Italy.

Relevant experience

- geotechnical advisory, independent reviews and technical verification for large transport and energy infrastructure projects, including metro tunnels, pumped-hydro schemes, rail upgrades and major underground works
- design and assessment of ground and rock support systems for tunnel boring machine (TBM) and mined tunnels, deep shafts, caverns and complex ground condition, evaluation of excavation impacts on adjacent structures, utilities and critical assets
- ground-structure interaction, numerical modelling and optimisation for constructability, safety and whole-of-life performance.



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