

TECHNICAL PAPER

NORTH STRATHFIELD RAIL UNDERPASS PROJECT

5TH FEBRUARY 2016



The North Strathfield Rail Underpass (NSRU) project is part of the Northern Sydney Freight Corridor, a joint initiative of the Australian and NSW governments. The primary aim of the NSRU is to grade separate south bound diesel hauled freight trains from the electrified suburban rail network north of Sydney between Rhodes and the Flemington Goods Loop. The \$270M project was designed, constructed and commissioned by the North Strathfield Rail Underpass Alliance (NSRUA), comprising Transport for NSW (TfNSW), Bouygues Travaux Publics and John Holland. Also, a new station was constructed at Concord West.

The new 3.5 kilometre long freight line passes under three heavily trafficked railway lines with a minimum cover of just 2.5 metres. North Strathfield is a critical part of the Sydney Trains network, extensively used by suburban and regional passenger services, and intrastate and interstate freight trains up to 3500 tonnes and 1500 metres long. Hence any delays to services would have been unacceptable and only four weekends per year without trains were available. This led NSRUA to significant innovations, particularly in tunnelling.

The original concept for the underpass provided for a cut and cover tunnel that would take between three and five years to construct due to the track possession regime. The Alliance developed its own tunnel design and construction methodology which differed quite significantly from the approach taken by the designer for the reference design. While the reference design included lattice girder, NSRUA proposed the use of light steel sets and continuous grout bags to make contact with the rock. Further work by the NSRUA Methods and Construction teams evolved a final detailed design of the tunnel lining based on synthetic fibre reinforced shotcrete without steel sets or lattice girders. This was agreed with the designers and successfully constructed within a much shorter time frame.

While the reference design was developed as a heading and bench excavation, for efficiency of construction and to allow large plant to pass each other in the tunnel, the Alliance requested that the tunnel be a full height heading excavation and at least 1.5m wider. The designer confirmed that this would have minimal additional impact on the predicted surface settlement and that the seamless shotcrete lining over the full tunnel profile would add to its durability and lower permeability.

NSRUA's Methods Team reduced the length of the tunnel from the reference design length of 170 metres to 148 metres. This was a result of the construction methodology allowing the piling works in the southern drive structure to be constructed closer to the operating railway line. Also, the shallow cover over the driven tunnel necessitated that the tunnel design and construction methodology minimise surface settlements so that there would be no speed restrictions placed on the operation of the existing train services. This was achieved using canopy tubes and the placement of the shotcrete lining as close as possible to the excavated face of the tunnel.

Another NSRUA innovation related to settlement monitoring, a key requirement for safety of train operations and tunnelling works. NSRUA determined that it would be best for the project, client and Sydney Trains to move beyond the traditional daily monitoring regime, where survey results are taken "back to the office" to process and analyse. Instead, it was decided that that only a fully automated 24 X 7 system would provide the required level of assurance and safety that the NSRUA needed.

As there was no "off-the-shelf" system available that would measure and report on the four key track parameters, the Alliance developed its own system, the Automatic Deformation Measurement System (ADMS). The system used three remotely controlled theodolites, measuring some 385 rail mounted and 25 ground targets on an hourly basis. Measurements were automatically recorded and analysed, with any alarms sent by e-mail and/or SMS depending on severity. An automatic escalation procedure would have notified NSRUA and Sydney Trains staff, but there were no exceedances during tunnelling or construction.

Overall, the NSRU project was delivered under budget, ahead of schedule and to the satisfaction of all stakeholders.