

VICTORIAN DESALINATION PLANT TUNNELS WONTHAGGI, MELBOURNE, AUSTRALIA

TUNNELLING - PRECAST CONCRETE SEGMENTS

Product: Wirand® FF3 Structural Steel Fibres

Problem

In common with many regions of the world experiencing stress upon their water supply, the Victorian Government and their Melbourne Water department, are responsible for the security of water availability to a growing population. Part of this strategic plan includes the construction of a new desalination plant in Wonthaggi, approximately 80km south of Melbourne. When this plant becomes operational in late 2011, it will have a production capacity of 150 billion litres per year with an option to increase this to 200 billion, if required. The desalination plant will be connected to the existing Melbourne water system via a new 84km pipeline. The seawater environment associated with desalination operations is aggressive, requiring high performance transfer tunnels to be constructed.

Solution

The project is being delivered through a Public Private Partnership (PPP). The Victoria Department of Sustainability and Environment to manage this PPP contract with the Aquasure consortium who were selected to design, build, finance, operate and maintain the facility.

Intake and outfall tunnels are underground and undersea. They are constructed using a TBM and lined with precast concrete tunnel segments;

- Intake tunnel: 4.0m dia, 1.2km length. The introduction of pre-treatment additives to the sea water reduces the pH and reduces biofouling within the tunnel and plant.
- Outfall tunnel: 4.0m dia, 1.5km length. Brine (saline concentrate) leaving the plant, discharges into the Bass Strait.

Maccaferri worked closely with the precast manufacturer and the concrete supplier to achieve the required performance criteria set out by the designers Parsons Brinckerhoff/Beca JV. Early trials using fibres from another manufacturer did not yield satisfactory results and the precast segment producer needed alternative solutions. Maccaferri, through its recent experience on the Adelaide desalination plant project, proposed Wirand FF3 fibre. The product was tested using various dosage rates to satisfy the specified performance and FF3 was selected as the preferred fibre. The chemical exposure conditions demanded that the concrete has very high strength with very high durability to meet the design life requirements.

Client:

MELBOURNE WATER

Main contractor:

AQUASURE (Thiess Tunnelling/Degremont JV)

Designer:

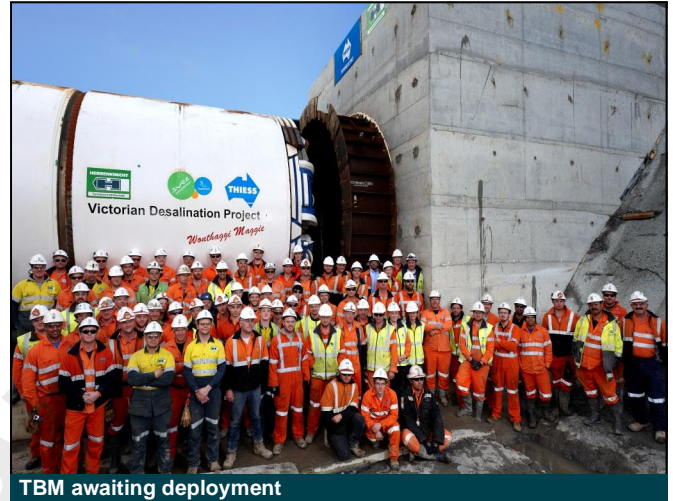
PARSONS BRINCKERHOFF BECA JV

Products used:

WIRAND FF3

Date of segment production

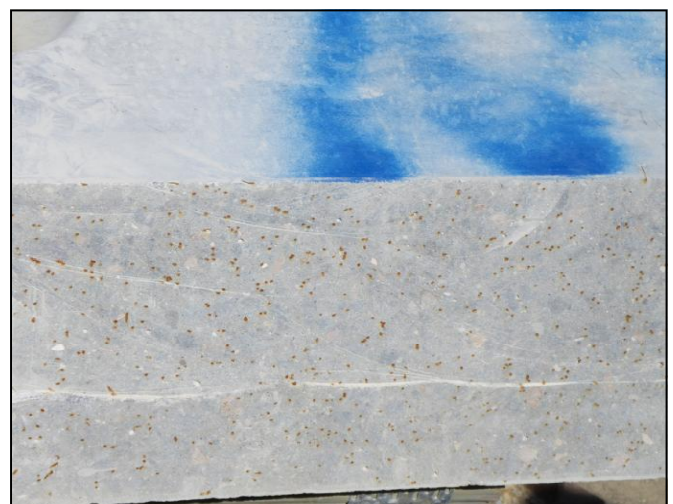
June 2010 to December 2010



TBM awaiting deployment



Maccaferri dosing system integrated in batching plant



Cross section of segment showing well orientated fibres



TBM installing precast concrete segments

Wirand® FF3 steel fibres provide a very high number of fibres per unit weight (5,700/kg) within the concrete mix, directly influencing the overall residual flexural strength and ductility required for this project. By this, the high inherent brittleness of the concrete can be overcome, providing the specified high toughness performance. Wirand® steel fibres offer high strength at low strain, and do not creep when loaded. Consequently, Wirand® steel fibres can be used for structural reinforcement of concrete. Further, the aggressive nature of the effluents within the pipes required the reassurance of high performing steel fibres.

The concrete ductility provided by the steel fibres ensured the pre-cast segments were more able to resist damage during transportation from the Newcastle manufacturing facility to Melbourne. Furthermore, because steel fibres provide reinforcement right up to the edges of the segment, they can withstand the extreme focussed forces of the TBM jacks, pushing on the segments, during installation.

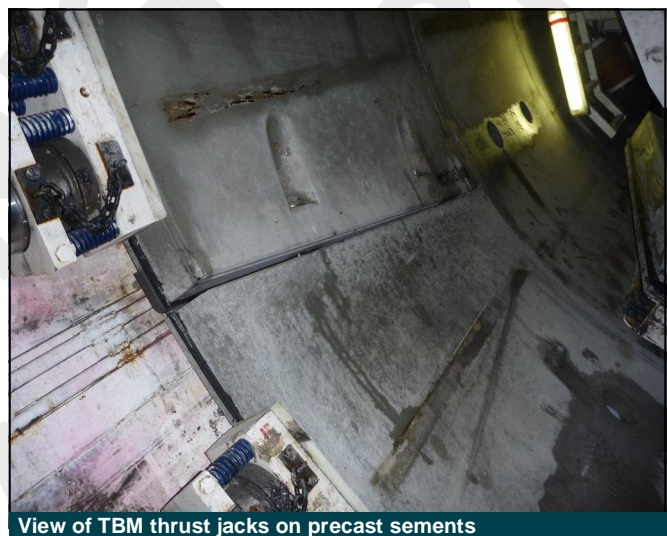
Maccaferri Wirand® fibres offered cost savings to the client:

- Entirely replaced traditional steel reinforcement
- Shorter precasting cycle times due to earlier de-moulding
- Reduced rejected segments through damage during transportation or installation

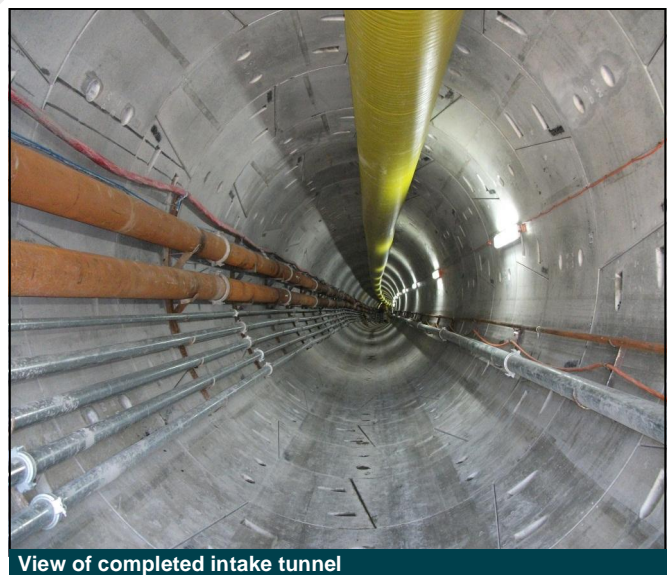
Maccaferri worked alongside the concrete supplier and the precast manufacturer to optimise the batching process within the concrete plant, thereby reducing the amount of labour required. Maccaferri's unique dosing equipment was also installed to ensure accuracy and fully automated batching. The system was integrated into the batching process and connected to the batch computer to allow the concrete plant to control and record all batches for QA purposes.

Project Details

Tunnel length: 1.2km intake tunnel, 1.5km outfall tunnel
Internal diameter: 4.0m
Lining thickness: 230mm
Ring setup: 4 + 2 universal segments
Segment slenderness: 9.6
Ring length: 1.50m
Erector points: 0 (vacuum lift)
Grout holes: 2 in line
TBM type: Earth pressure balance
Concrete class @ 28d: 50MPa
Wirand FF3 SFRC solution: 45 kg/m³



View of TBM thrust jacks on precast segments



View of completed intake tunnel

Maccaferri Pty Ltd.

22 Powers Road Seven Hills NSW 2147
PO Box 575, Seven Hills NSW 1730
Tel. (02) 8825 6300 - Fax (02) 8825 6399
E-mail: sales@maccaferri.com.au - Web site: www.maccaferri.com.au

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