

# CR110 SOFTEYE BETWEEN TAMPINES NORTH STATION AND DEFU STATION TAMPINES, EAST REGION, SINGAPORE

## Excavation Consolidation and Reinforcement

### Problem

Singapore's Cross Island Line (CRL) is a high-capacity mass rapid transit (MRT) line that will connect Changi to Jurong Industrial Estate via Loyang, Pasir Ris, Hougang, Ang Mo Kio, Sin Ming, Bukit Timah, Clementi and the West Coast. The 58 km line will replace the East West Line as the longest line on Singapore's MRT network upon its complete opening by the 2040s, serving roughly about 27 stations.

Tampines North and Defu stations were awarded to Nishimatsu Construction Co., Ltd. The contract includes the design and construction of the bored tunnel between the stations.

### Solution

After a comparison in terms of cost and demolition timing, the Contractor opted for the construction of a "Soft-Eye" for the launching of the TBM. Soft-Eyes are diaphragm walls or secant bored pile walls reinforced with Glass Fibre Reinforced Plastic bars (GFRP) instead of steel re-bars. Unlike steel, GFRP bars can be easily cut by the TBM, without causing any damage to its cutting heads.

Maccaferri GFRP bar reinforcement elements are made from reinforced polyester resin matrix, with a unidirectional Glass-Fibre (GFRP type E-Glass) continuous thread profile. The thread process does not affect the glass fibre integrity with the resultant benefit of significant enhancement of both friction effect (pull-out) and overall tensile strength capacity. Maccaferri GFRP bars have been engineered to meet the high-performance requirements for fibreglass reinforced concrete.

A large-diameter TBM, 12.6m in diameter, the largest TBM ever to be deployed in Singapore, will be used to construct a single 2.9km long tunnel with two tracks in it and will be launched from the underground space made to eventually accommodate the electrical and mechanical requirements of CRL1, 35 m below ground.

To accommodate the large TBM, the Soft-Eye has an effective diameter of 13.3m and is the largest ever built in Singapore so far.

The design of the Soft-Eye was run according to ACI 440.1R (Guideline and Construction of Structural Concrete reinforcement with FRP Bars) and the GFRP bars were tested according to ACI 440.3R (Guideline Test Method for Fiber-reinforced Polymers for Reinforcing or Strengthening Concrete Structure).

**Client:** Land Transport Authority

**Designer / Consultant:** Cowi Singapore Pte. Ltd

**Contractor:** Nishimatsu Construction Co., Ltd

**Products used (Qty.)**

- GFRP Bar & Stirrups

**Date of construction:** 06/2022 - 12/2029



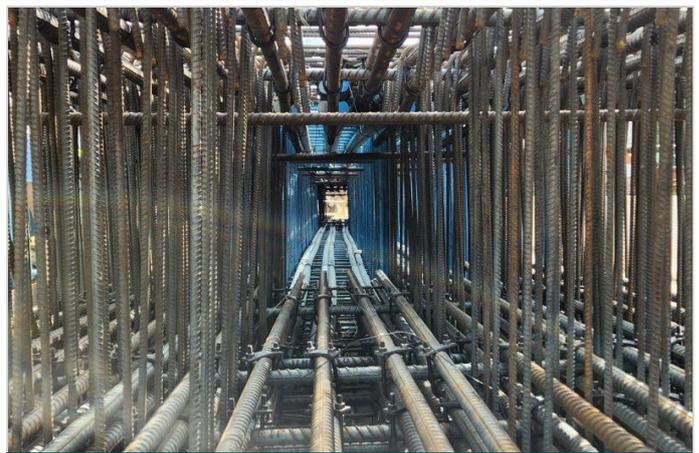
GFRP Soft Eye Reinforcement



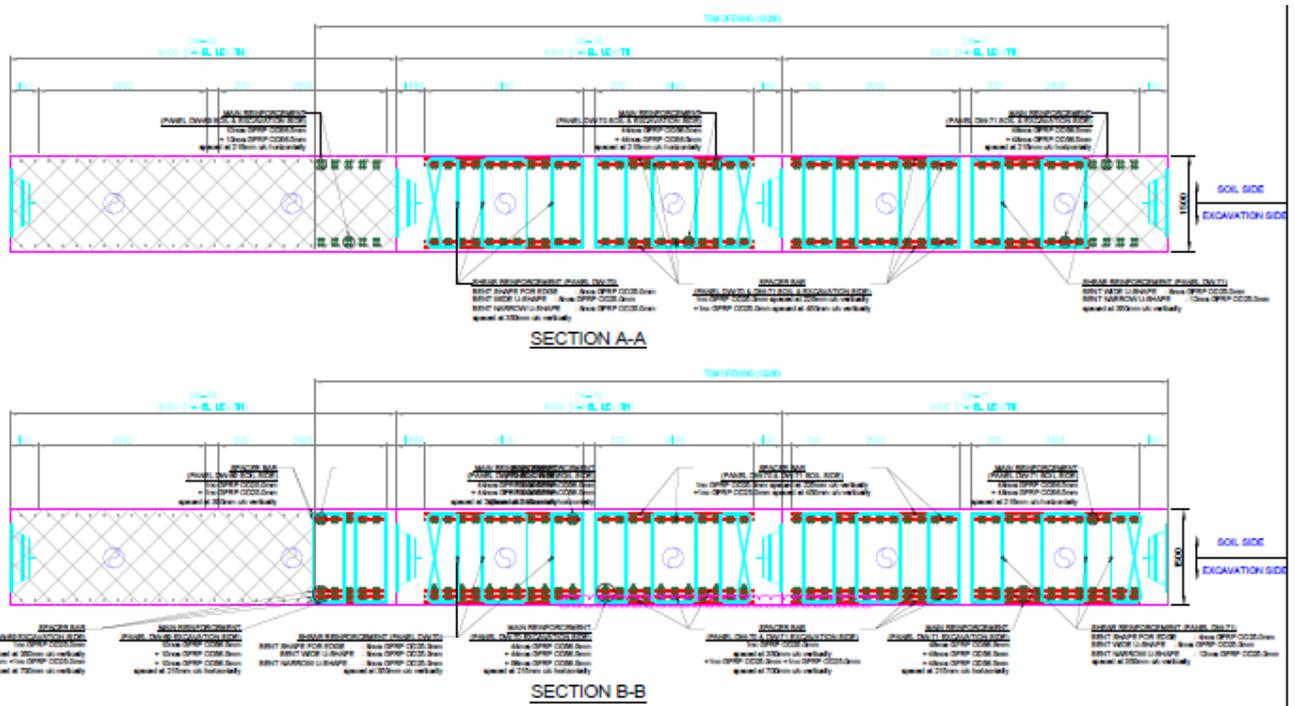
Reinforcement Installation



Reinforcement Installation



Steel and GFRP Reinforcement detail



Section