

HIGH SPEED RAILWAY BOLOGNA - FLORENCE BOLOGNA / FLORENCE, ITALY

TUNNEL LINING: STEEL FIBRE REINFORCED SHOTCRETE

Product: Wirand® FS4

The Bologna to Florence high speed railway line in Italy forms part of Corridor 1 on the European Union Trans-European high-speed rail network. Corridor 1 connects Berlin in the North of Germany, to Palermo in the South of Italy.

The Bologna - Florence element of this line links Santa Maria Novella station in Florence at its southern end, to Bologna Centrale station in the North, where it connects to the Milan-Bologna high speed line.

The line is 78.5km long and includes:

- 73.8km of tunnels
- 3.6km of embankment
- 1.1km on viaduct

There are 9 tunnels on the track alignment, the longest is Vaglia Tunnel at 16.7km in length. Twin tracks run within the tunnels, at a maximum depth of 700m below ground level as they travel beneath mountains.

The route of the line is through complex geology, with both gas and ground water present.

During the excavation of the tunnel galleries, a first coating of sprayed concrete was used to temporarily maintain stability of the freshly excavated bore. Following this, reinforcement was placed and further concrete layers were applied to achieve the final lining thickness. The phasing of these works, in parallel with the tunnelling operation were essential to avoid the risk of possible collapse of the excavation.

Wirand® steel fibre reinforcement was designed into the sprayed concrete to enhance the properties of the concrete including;

- Prevention of plastic shrinkage cracking
- Increased capacity to absorb temperature change
- Increased capacity to absorb energy during post-cracking
- Increase in bending / tensile strength
- Increased impact resistance

Maccaferri Wirand® FS4 (With modified dimensions of 0.6mm x 30mm) was proposed for use and qualification tests were implemented to verify the compliance of the performance of the steel fibres to the project specification. A dosage of 30kg/m³ was shown to providing the required performance.

Client:

TRENO ALTA VELOCITA S.p.A

Main contractor:

CAVET CONSORTIA

Products used:

WIRAND® FS4

Date of construction

1997 - 2002



Maccaferri Doso machine installed at the batching plant



Loading Wirand® fibres into the dosing machine



Sprayed concrete primary lining with fibre reinforcement



View of the completed tunnel awaiting track laying

Officine Maccaferri SpA entered into a framework agreement with the project consortia to also provide dosage control equipment (Maccaferri's Doso Boxes). These were installed within the 13 concrete batching yards along the railway alignment. The units controlled the dosage of fibres into the concrete mix. The management of the 13 fibre reinforced concrete dosage plants, for the production of more than 500,000m³ of fibre reinforced concrete was a major project for the Maccaferri organisation. It was this capability that distinguished Maccaferri from other fibre suppliers.

With Wirand[®] manufacturing facilities worldwide, Maccaferri has the capacity to customise products and mixes of Wirand[®] fibres, (including Fibromac polymeric fibres) to suit the demands of major projects. On some projects, research and development of Wirand[®] fibre-concrete mixes has led to the development of specific fibres. Instead of a 'one-size fits all' approach, Maccaferri offers clients an optimum solution approach and therefore better value.

The Bologna - Florence high speed line finally opened to the public in late 2009. It has reduced journey times on this short section of the EU Corridor 1 high speed line from 59 to 30 minutes.



Large Bags of Wirand[®] Fibres

Maccaferri Ltd - Head Office

7600 The Quorum,
Oxford Business Park, North,
Garsington Road, Oxford, OX4 2JZ
T: 01865 770555
F: 01865 774550
E: oxford@maccaferri.co.uk
W: www.maccaferri.co.uk

Area offices

Perth:
T: 01738 621317 F: 01738 442283
Belfast:
T: 028 9026 2830 F: 028 9026 2849
Dublin:
T: 01 885 1662 F: 01 885 1601
Web: www.maccaferri.ie

E: perth@maccaferri.co.uk

E: belfast@maccaferri.co.uk

E: dublin@maccaferri.ie



Oxford, Perth, Belfast