

# Craviale and Turina Tunnels

## Project specifications

Project type: Road tunnel  
Application: Sprayed concrete primary and final lining

## Partners

Owner: Agenzia Torino 2006  
Contractor: Baldassini Tognozzi



The Craviale and Turina road tunnels needed to be done in time for the 2006 Olympics in Turin, Italy. Both are located on a main artery connecting the city to the Alps where a number of the winter games would be held. While the excavations seemed straightforward, mainly through rock with relatively low overburden, the contractor needed to find ways to optimise construction to meet the schedule.

## The challenge

The 1,055m-long Craviale tunnel is largely in the Dora Maira complex, a hard, jointed meta-diorite bedrock with uniaxial compressive strengths between 9-140 MPa, with a maximum overburden of 90m.

Initially, the design called for a top heading and bench excavation with conventional steel reinforcement. Instead the contractor opted for a full-face excavation under a jet grouted column front and proposed an alternative lining that would reduce the amount of steel bars needed and also improve ductility.

For the 665m-long Turina tunnel, around a third of the alignment had similar geology, with the rest of the excavation through alluvial deposits of sandy and silty gravel.

## The solution

Calculations confirmed fibre-reinforcement would be capable of resisting design forces and the contractor replaced traditional reinforcement with Dramix® 3D 65/35BG steel fibres at a rate of 30kg/m<sup>3</sup> for the initial and final linings. In areas of rock that needed additional reinforcing, such as tunnel portals, the excavation is supported with one layer of wire mesh.

The choice of fibres reduced the set-up time, requiring only 16 hours for every 12m length of tunnel. This lining system also offered higher crack resistance, reduced brittleness, reduced fissuring during the hardening process, and it required less effort during the installation.