

# MAZAR HYDROELECTRIC DAM CONSTRUCTION

## PAUTE RIVER, ECUADOR

### TUNNELLING - SHOTCRETE AND SURFACE STABILISATION

**Product:** Wirand® FF3N Structural Steel Fibres

#### Problem

The Mazar Hydroelectric project is part of Ecuador's energy plan to generate power from the middle section of the Paute River in South-East Ecuador. A first phase was completed in 1983, providing over 1000MW. This second phase was to be constructed upstream of Phase 1, and would provide nearly 200MW.

The concrete faced rockfill dam would have a maximum height of over 180m and a total volume of more than 5M m3. The construction of a diversion tunnel required concrete lining over some of its length.

Additionally, slope stabilisation and reinforcement was required as a consequence of the excavations needed to construct the dam.

#### Solution

The cross section of the concrete lined tunnel was 12m x 12m and as such shotcrete would provide an ideal lining system.

Excavation was carried out using traditional techniques and the shotcrete lining applied.

Maccaferri worked with the project team to develop, test and implement the use of steel fibre reinforced shotcrete for use within the tunnel.

Wirand® FS3N was selected as the most appropriate fibre on account of its superior technical performance. Featuring a diameter of 0.75mm and a length of 33mm, this small, yet tough fibre is ideal for shotcreting operations.

20,000m<sup>3</sup> of fibre reinforced shotcrete was used for the tunnel lining. The Wirand® reinforced shotcrete specifications were:

$$\begin{aligned} \text{Dosage rate} &= 45 \text{ kg/m}^3 \\ f'c &= 280\text{kg/cm}^2 \end{aligned}$$

Maccaferri were also instrumental in the delivery of the slope stabilisation works. Here soil nails were installed to provide the macro-stabilisation to the slope. The surface was stabilised using shotcrete again reinforced with Maccaferri Wirand® FS3N steel fibres.

18,000m<sup>3</sup> of fibre reinforced shotcrete was used for the slope stabilisation in conjunction with the soil nails.

Client:

HIDROPAUTE S.A.

Main contractor:

IMPREGLIO / HERDOIZA CRESPO JV

Designer / Engineer:

CAMINOSA / TRACTEBEL

Products used:

WIRAND FS3N

Date of project:

2005 to 2007



General view of the dam position



Dam under construction, April 2008



Diversion tunnel under construction



Detail of shotcrete face in conjunction with soil nails

Wirand® FF3N steel fibres provide a very high number of fibres per unit weight within the concrete mix, directly influencing the overall residual flexural strength and ductility of the shotcrete. 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.

Maccaferri Wirand® fibres enable the reduction and in some circumstances complete elimination of traditional steel reinforcement. This reduces project costs and installation time.

Maccaferri worked alongside the concrete supplier to optimise the batching process within the concrete plant, thereby reducing the amount of labour required. Maccaferri's unique "DOSO" dosing equipment was also installed to ensure accuracy and fully automated batching.

#### Project Details

Tunnel length: 1.2km diversion tunnel  
Internal dimensions: 12m x 12m  
Wirand FF3N SFRC solution: 45 kg/m<sup>3</sup>



Diversion tunnel discharge



Maccaferri DOSO fibre dosage equipment within concrete plant

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