



SARMENTO TUNNEL

Italy, 1995

PROJECT CHARACTERISTICS

Works: circular concrete lined free flow tunnel and 3-aeration shaft

Purpose: trans-basin water conveyance to increase the water supply of an existing multiannual regulating reservoir.

Dimensions:

- *Internal diameter:* 3.0 m
- *Lining thickness:* 0.5 m minimum
- *overall length:* 3820 m

Subsurface conditions:

- Overconsolidated argillites, silts and clays with interbedded, waterbearing sands and gravels in layer up to 10 m thick

Construction method:

- Full-face excavation within an open shield
- First supports with steel ribs and precast concrete dowels
- Unreinforced concrete lining



PROFESSIONAL SERVICES PERFORMED

Analysis of the tunnel safety after a mud inflow at the front. Study of a safe method to recover the shield, to overcome the collapsed section and to excavate the remaining portion of the tunnel. Modifications to the first supports and permanent lining. Geotechnical and hydro-geological survey and study along the tunnel alignment. Assistance during construction.

The Sarmento tunnel crosses a complex formation consisting of over-consolidated clays and clay-stones and, including several gently dripping sand and gravel layers and old cracks in form of chimneys, filled with loose, saturated silts. The water table is, at some places, more than 100 m above tunnel grade and both the sand and gravel interbeddings and silt chimneys are saturated and waterbearing.

Construction begun in 1985 and has been ridden with difficulties since. Sections of squeezing ground were encountered and several water inflows produced which required special provisions to advance further. Excavation, started with conventional methods, was soon changed to a mechanised one. A shield was lost in a collapse. An improved shield has allowed advancing the excavation full-face. The new shield finds the reaction needed for its forward movement, on the edge of the first supports, which are erected inside the shield. The first support is a ring of precast concrete dowels some 0.7 m long held in place by wide flange H steel circular ribs.

Three water-bearing layers were crossed, after grouting annular plugs with ultrafine cements and silicates and after reducing the pore pressure in the rock with fans of drain holes.