

**■ Marine Structures****Reference Details:**

**Owner** Azienda Energetica Metropolitana (AEM) di Torino +++  
**Contractor** Joint Venture Astaldi S.p.A - Roma Mandataria SAE - Parigi +++  
**Design** Alpina S.p.A - Milano

**DSI Services** 15,000 m of temporary and double corrosion protected DYWIDAG Permanent Anchors dia. 32 mm, dia. 36 mm St 835/1030; 2,000 m DYWIDAG Soil Nails dia. 28 mm BSt 500 S.

**DYWIDAG Single Bar Tendons secure underground powerstation****Underground power station for the water authority Pont Ventoux, Val di Susa (Turin), Italy**

The hydroelectric power plant in Pont Ventoux is designed as an underground cavern station. Conventionally excavated, the cavern structure has a width of 21 m, a length of 50 m and varying depth of 21.5 m to 45.5 m. The hydro power station is equipped with two turbines and two generators to supply a capacity of 85 MW. DYWIDAG Soil Nails 28 mm dia. BSt 500 S stabilize the excavation in the first excavation stage. DYWIDAG Single Bar Tendons with double corrosion protection 32 mm dia. St 835/1030 and 36 mm dia. St 1080/1230 secured the second stage of the excavation. For stabilization of the cavern structure the following system were applied:

- Passive anchors temporarily strengthen and secure the cavern calotte. These anchors have to be installed following each heading (stabilization concept for the first stage)
- DYWIDAG Single Bar Anchors, installed after completion of the excavation provide permanent stabilization (stabilization concept for the second stage).

A double-layered reinforcement mat with fiber-reinforced shotcrete provides additional stabilization for the cavern. The chosen method for construction can be described as follows:

- Exploratory shafts identified the rock formation and fissures inside the shaft and in the sections adjacent to the cavern excavation.
- Geometric analysis combined with a statistical evaluation, based on various criteria identified a possible variation in the geological strata.
- The length of the stabilization system in the first and second stages were determined accounting for potential separation of the geological layers during construction.
- Data and feedback from the first stage excavation then can be applied on the system computation and stabilization of the second stage.

In the roof DYWIDAG Single Bar Anchors 32 mm dia. St 835/1030 were placed in a grid of 2 m x 2 m and 2 m x 1.5 m respectively, based on the geomechanical requirements. The anchors were tensioned to 350 kN. Along the side and the working face DYWIDAG Single Bar Anchors 36 mm dia. St 1080/1230 were placed in a 2.83 m x 2.83 m grid and tensioned to 500 kN. Furthermore, the supporting trusses for the advanced shoring system were tensioned against the rock using double corrosion protected DYWIDAG Anchors 36 mm dia. jacked to 400 kN. With a center-to-center distance of 2.0 m, the total anchor length was 15 m with a bond length of 8 m and free length of 7 m.