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ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

PACCHIOSI DRILL

TUNNEL

ROTELLO (CAMPOBASSO-ITALY)

ROTELLO (CAMPOBASSO - ITALY)

PROJECT:

Construction of a road tunnel between the Rotello Sud and Rotello Nord exits, for connection of S. Croce di Magliano and the Ururi-Rotello railwaystation.

PERIOD OF EXECUTION:

March 2000 – March 2002

CLIENT:

Provincia di Campobasso

Fig. 1 - 2. View of the southern entrance to the tunnel before the works (alongside) and after completion of the works (below).

LITHOLOGY.

Flysch from the Daunia region characterized by limestone-marl and clay-marl.

Purpose of the work and difficulties encountered.

The Rotello road tunnel is part of the Molise regional road system to facilitate connections between the inland mountain zones, the Larino plain and the coastal areas. The work responds to the need to bypass the settlement in view of the unsatisfactory urban road system, without interfering with it.

The tunnel, which is 616 m long with a slope of 2.32%, crosses a southwest-northeast crest on which the settlement is built.

The two openings are located on the mountain sides and are characterized by the presence of detritus that covers decompressed and greatly altered rock bands.

Excavation of the natural gallery involved soils having different geotechnical characterizations. In the first section, the tunnel involves soils characterized by limestone with insertions of clay and marl: The rock did not ensure the stability of the excavation, especially in the zones with thinner, fractured layers. The presence of water circulation, though discontinuous, made the conditions of stability of the mass even more critical.

In the second section of the tunnel it passes through soil that consists mainly of a clay marl, with some limestone inclusions, that becomes sandy sandstone near the northern opening. The mass of rock is compact and hard, but has a generalized tendency to decompress and break up into small pieces, following relaxation due to excavation.

Description of works.

The excavation of the natural tunnel, in 15 meter increments, was preceded by works of consolidation at the entrance, involving the construction of an umbrella of 43 micropoles 16 m long, reinforced with steel piping having a diameter of 101.6 mm and thickness of 8.8 mm.

The procedure consisted of the following steps:

- consolidation of the front with 35÷60 fiberglass nails 20 meters long (Fig. 3); the number is variable, depending on the nature of the soil; the length of treatment and excavation always ensured constant overlapping of the insertions between two consecutive sections;

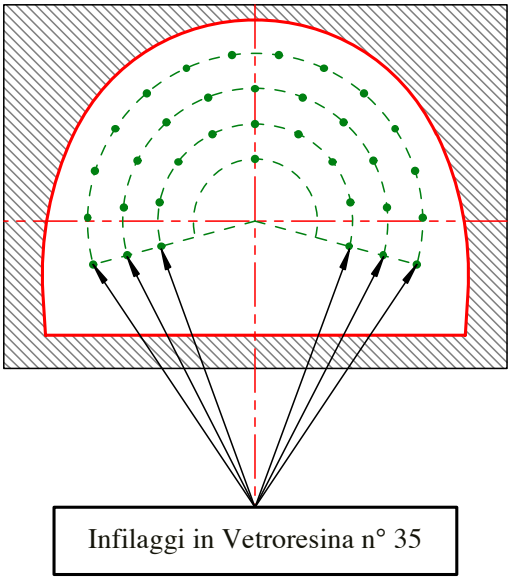

Fig. 3. Lay-out of fiberglass nails on the front.

- scavo a piena sezione, montaggio di dopfull section excavation, assembly of type H 180 double camber with 1.25 m spacing, installation of an electrically welded screen followed by pouring of spritzbeton for a thickness of 25 cm (preliminary covering) (Fig. 4);
- pouring of lateral walls;
- excavation and subsequent pouring of reinforced reverse arch;
- pouring of final lining (Fig. 5);

Fig. 4. View of the tunnel with preliminary lining.

Fig. 5. Stage of application of final lining.

Where the limestone soil is located, a vertical drainage screen was installed under the reverse arches in order to discharge any underpressure (Fig. 6).

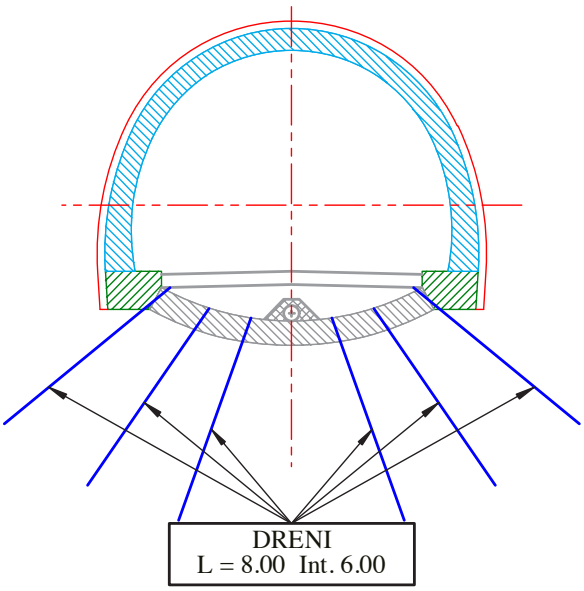

Fig. 6. Cross section of tunnel with drainages under reverse arch.

The excavation of the section of the tunnel near the entry was preceded by two consolidation procedures, both performed by insertion of 96 bars fiberglass. The second procedure, due to the greatly reduced coverage, was integrated with an umbrella with 35 micro-poles, reinforced with steel piping having a diameter of 101.6 mm and thickness of 8.8 mm (Fig. 7 - 8).

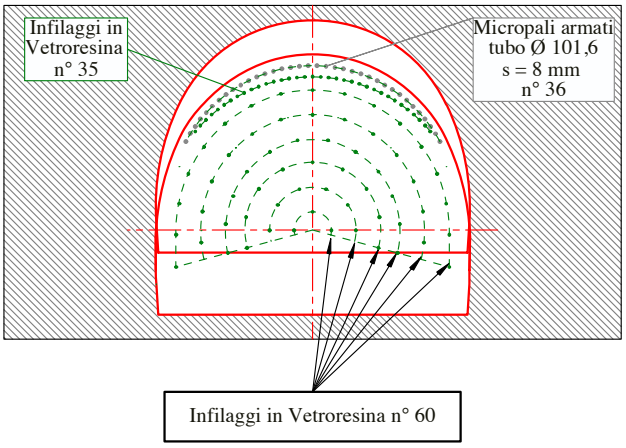

Fig. 7. Works on the entrance, lay-out of the nails and micro-piles.

The natural tunnel is preceded, on both entrances, by an artificial section installed on bulkheads in poles with a diameter of 1.20 m (Fig. 9).

The tunnel was completed with the construction of a two-lane roadway 3.50 meters wide and relative shoulders measuring 1.25 meters each.

Fig. 8. Pacchiosi P 1500 TAF SGD drill rig during works on the front.

Fig. 9. North portal of tunnel.

Wll nailed with the Cloujet method.

To prevent landslides of the slope on the north entrance of the new road from the tunnel, a nailed supporting was built with passive anchorages, using the Pacchiosi Cloujet method. In practice, the works consisted of excavation by steps, starting from the highest point and inserting nails with Diwidag type metal bars anchored in a bulb of cement mortar injected at very high pressure; to finish, step by step in descending order, the final covering is applied with electrically welded screening and projected concrete.

The finished wall is over 12 m high.

Fig. 10. Pacchiosi PRP 150 drill rig during drilling.

Fig. 11. Detail of Pacchiosi PRP 150 drill rig.

Fig. 12. View of wall during works.

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