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ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

PACCHIOSI DRILL

UNDERPINNING

CERRO MAGGIORE (MILANO – ITALY)

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PROJECT:

Works of functional and structural restoration of the retaining wall of a waste dump for the urban waste system (sectors 1, 2 and 3) of the Controlled Public Urban Waste Dump of the Municipality of Cerro Maggiore – Rescaldina (Mi).

PERIOD OF EXECUTION:

1998 - 1999

CLIENT:

SIMEC (Sistemi Impianti Ecologici) S.p.A.

Fig. 1. Views of the worksite.

Lithology.

Sand and gravel with thin silty layers.

Purpose of the work, difficulties and solutions applied.

The retaining wall for solid urban waste at the Controlled Public Dump of the municipality of Cerro Maggiore (Fig. 1) was built in 1991, and is about 300 m long, with variable height from 24 to 26 m. The structure is divided into 6 sectors 50 meter long, each formed by 10 panels.

Over the years, the weight of the mass of waste has caused two kinds of damage:

- 1. breakage of the wall in several points, with leakage of waste fluids;
- 2. ollapse of the foundation soil under the wall slab.

This situation threatened the stability of the structure and induced the local administration to order works for the structural and functional restoration of the wall.

The first works were completed in 1994 and involved sectors 4, 5 and 6; after that they were extended to sectors 1, 2 and 3, due to the accentuation of the deformation and collapse, aggravated by infiltrations of rainwater, concentrated along the section upstream of the wall face.

Restoration of the wall in sectors 1, 2 and 3.

The works were carried out in three stages:

- 1) consolidation the soil under the foundation slab;
- 2) structural reinforcement;
- 3) construction of tie rods for application of the load to the wall.

Description of works.

1) Consolidation of the foundation soil under the wall slab.

The method used for this work was **Pacchiosi Jet Grouting System 1 (PS1)**, with the construction of 4 groups of tilted columns at a 0 to 45° angle, length from 4 to 6 m, diameter between 800 and 900 mm, spacing 1.5 m.

The treatment was done near the wall slab, without interfering with its reinforcement (Fig. 2).

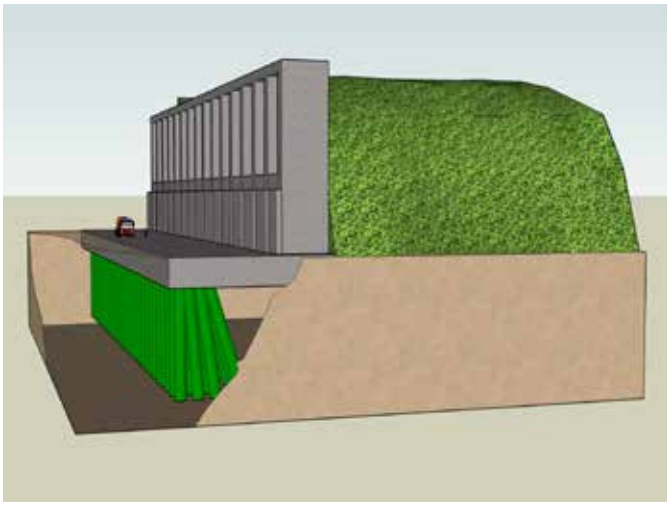

Fig. 2. Detail of slab consolidation.

The consolidated soil samples gave readings of resistance to compression better than 50 Mpa.

Fig. 3. Pouring of concrete between the panels.

2) Structural reinforcement of the wall.

The structural reinforcement of the wall was obtained by joining the panels with a first pouring of concrete at a height of 5 meters from the foundation (Fig.3), installing tie rods and completing the wall with filling to a final height of 8 m.

3) Construction of tie rods for application of the load to the wall.

The tie rods were installed in the reinforcing structure of the wall (one in every panel). In the first meters the tie rod is housed in the metal covering, at a 40° angle from vertical (Fig. 4). The tie rod consists of 29 strands of 600 ton harmonic super steel, with a work load of 480 ton, total length of 32 m of which 16 anchored. To install them, Pacchiosi Drill developed a drilling machine capable of making the hole in a single operation, starting from a height of 5 m from the work surface.

The procedure for construction of the tie rods consisted of the following steps:

- 1) coring of the wall slab in reinforced concrete, through the metal covering pipe;
- 2) drilling into underlaying soil until the required depth;

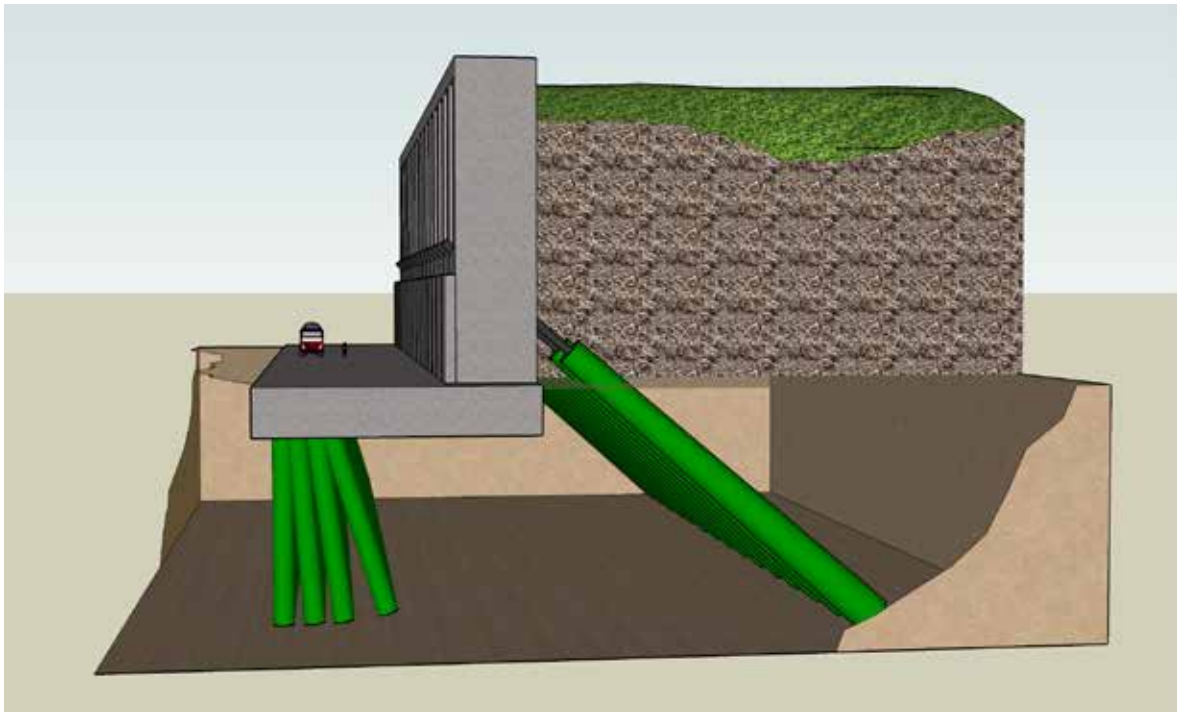

Fig. 4. Detail of tie rod construction.

- 3) construction of a Jet Grouting column with the PS1 system, with a diameter between 1500 and 1600 mm to consolidate the soil (Fig. 5);
- 4) coring of the column in its entire length after hardening, drilling a hole 220 mm in diameter;
- 5) installation of the tie rod (Fig. 6-7 and Fig. 8);

Fig. 5. P 2000 TAF drill rig.

Fig. 6 - 7. Installation of tie rod.

- 6) injection of the tie rod at low pressure with cement mortar;
- 7) tightening of the tie rod (Fig. 9 - 11 and Fig. 12).

Fig. 8. Installation of tie rod.

Fig. 9 ÷ 11. Tie rod head and tightening of the tie rod.

Fig. 12. Tightening unit.

- Due to big dimensions, tie rods have been totally made on site (Fig. 13-14).

Fig. 13 - 14. Preparation of tie rods and detail of strands.

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