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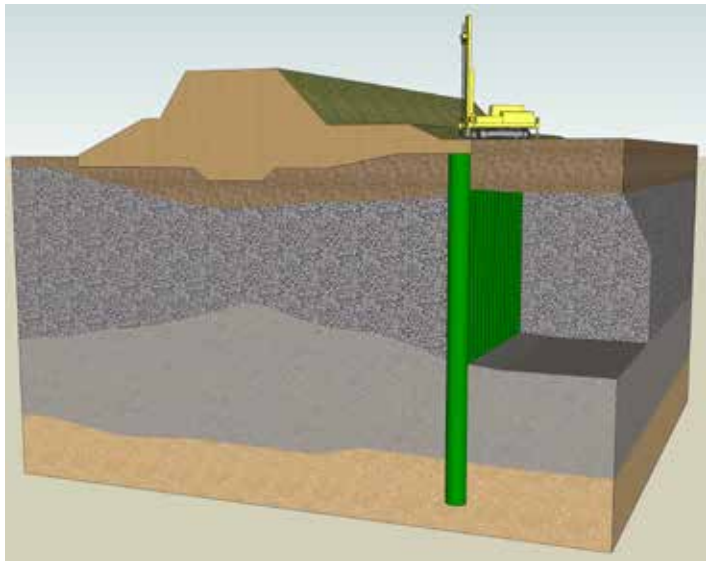
ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

PACCHIOSI DRILL

WATERPROOFING



GROSSETO (ITALY)

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PROJECT:

Construction of a waterproof diaphragm using Jet Grouting technology on the right bank of the Ombrone River (Grosseto).

PERIOD OF EXECUTION :

June – December 2001

CLIENT :

Regione Toscana

Fig. 1. View of the worksite.

Fig. 2. Plan of intervention area.

Purpose of the work, difficulties encountered and solutions applied.

The catastrophic flood of November 1966 burst through the embankment along the Ombrone river in a number of points, flooding the plain around the city of Grosseto, and causing problems of hydraulic seal in the foundations. Subsequent works of restoration strengthened the embankment and partially repaired the foundations by means of a series of vertical drainages (built in 1990). A few years later the partial lack of efficiency of the drainage system and the forecast of particularly heavy flood tides induced the Region of Tuscany to build a waterproof diaphragm in the embankment's foundation soil (Fig. 2).

The purpose was to protect the embankment from the danger of piping, to reduce the neutral pressures and filtration speed in the foundation soil, and to lower hydraulic gradient. The screen had to cross the plastic silty clay layers characterized by a natural water content close to the limit of liquidity, and enter the compact fine silty sand at the base of the stratigraphic sequence (Fig. 3).

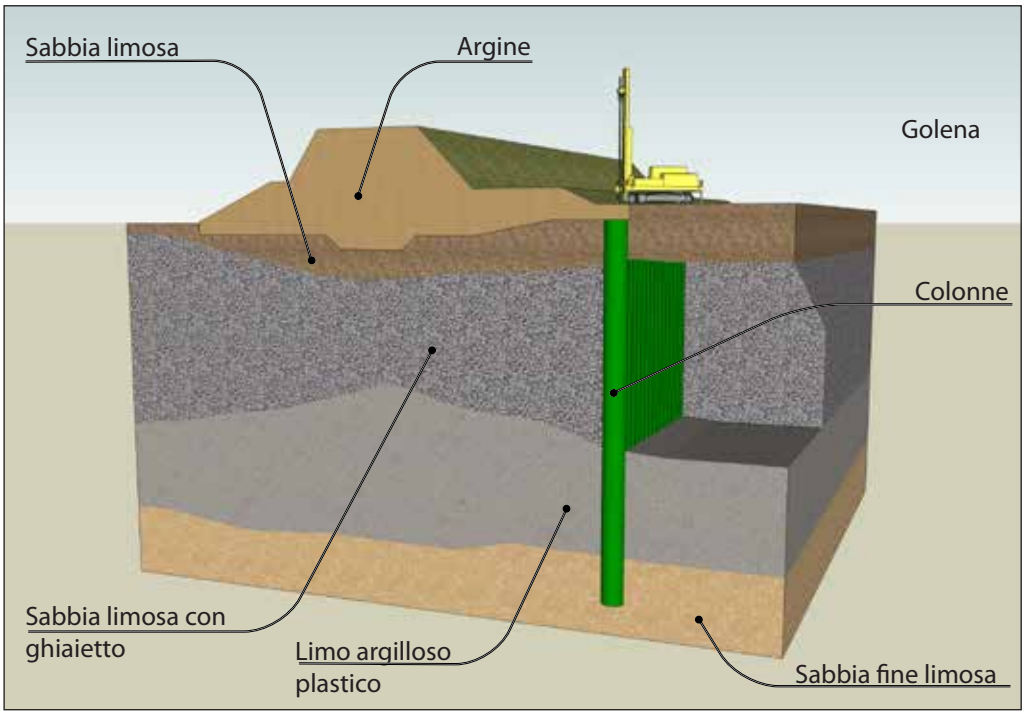

Fig. 3. Stratigraphy of the work zone.

Fig. 4. P 1500 ES drill rig during Jet Grouting injection.

Fig. 5. Detail of P 1500 ES drill rig during the Jet Grouting injection stage.

The project specifications required the construction of a diaphragm about 800 m long, with the following features:

- a minimum thickness: 800 mm;
- a coefficient of permeability not higher than 1x10-8 m/sec;
- a resistance to simple compression for samples of consolidated terrain now below 2 Mpa.

Lithology.

Deposits of fluvial origin consisting of a stratigraphic sequence of silty sand, silty sand with levels of gravel, silty plastic clay and fine compact sand and silt (Fig. 3).

Description of works.

The method used to construct the screen was the **Pacchiosi Triple Jet Grouting Pacchiosi System (PS3)**. The screen was built with a row of jet grouting columns, spaced 1 m apart, from a minimum of 15 to a maximum of 26 m long with a minimum diameter of 1300 mm. After each perforation the verticality was measured along the entire length of the hole with the Pacchiosi **P 401** inclinometer.

All drilling and injection parameters were automatically recorded with the **Pacchiosi PRS3 data acquisition system** (Fig. 6). The control holes on the columns were drilled with continuous core sampling, within which permeability tests were performed. The samples of consolidated soil indicated a percentage of cement for 65% of the volume treated, resistance values always higher than the limits indicated in the project specifications and permeability values lower than $1x10^{-8}$ m/sec.

Fig. 6. Registration of data during Jet Grouting injection.

Fig. 7. Laser pump 2500 C

Fig. 8. Detail of motor pump at ultrahigh pressure mod. Laser 2500 C.

Fig. 9. P 1500 ES hydraulic drill rig.

Fig. 10. Pacchiosi mixing and injection installations.

Fig. 11. MA 500 C turbo-mixer.

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