



ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

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REGGIO EMILIA (ITALY)

CONSOLIDATIONS

REGGIO EMILIA (ITALY)

PROJECT:

Consolidation of the railroad embankment by construction of Jet Grouting columns, in the Bologna – Piacenza section, between km 69+250 and km 69+875.

PERIOD OF EXECUTION:

April–December 2000

CLIENT:

Ferrovie dello Stato



Fig. 1. Sonda PRP 150 durante l'esecuzione dei lavori.

Purpose of the work, difficulties encountered and solutions applied.

In the Bologna – Piacenza section of the railroad line, between km 69+250 and km 69+875, the railroad embankment was showing signs of instability, in the form of loss of shape and lowering of the rail bed, causing dangerous flaws at the track level.

There were two main reasons for this:

1. the plasticizing of the clay under the railroad structure due to infiltrations of rainwater and the lack of an efficient surface drainage system;
2. the poor quality of the material used in the embankment.

The combination of these causes caused the clay soil to sink and created instability throughout the embankment.

A first attempt to level the embankment through repeated buildups of material was found to be entirely unsatisfactory, so it was decided to proceed with consolidation of the foundation soil by installing prefabricated cellular wall in the sections of the embankments subject to instability, and to improve the surface drainage system.

Lithology.

Deposits from freshwater rivers and lakes in succeeding layers separated by layers of silty clay with silty-sandy clay, silty sand and sand with gravel.

Description of work.

The works of consolidation were performed using the **Jet Grouting Pacchiosi System 1 (PS1)**.

The system was tested with construction of a field test that made it possible to optimize the injection parameters depending on the function of the soil to be treated (Fig. 2).



Fig. 2. View of a test field column.

The project specifications called for construction of Jet Grouting columns with diameters of 600 mm, reinforced with FeB44k iron bars with a diameter of 30 mm and length of 6 m.

The work zone was divided into three sectors, depending on the conditions of the embankment.

Sector 1.

In the first work zone, five rows of quincunx Jet Grouting columns were built, including one vertical at the foot of the embankment and four tilted along the slope with angles between 15° and 50°, and a spacing of 0.75 m, in lengths varying from 10.50 to 15 m (Fig. 3).

Sector 2.

In the second work zone, six rows of quincunx Jet Grouting columns were built, including one vertical at the foot of the embankment and five tilted along the slope with angles between 15° and 57.50°, and a spacing of 0.75 m, in lengths varying from 11 to 15 m (Fig. 4).

Sector 3.

In the third work zone, three rows of quincunx Jet Grouting columns were built, including two vertical rows at the foot of the embankment

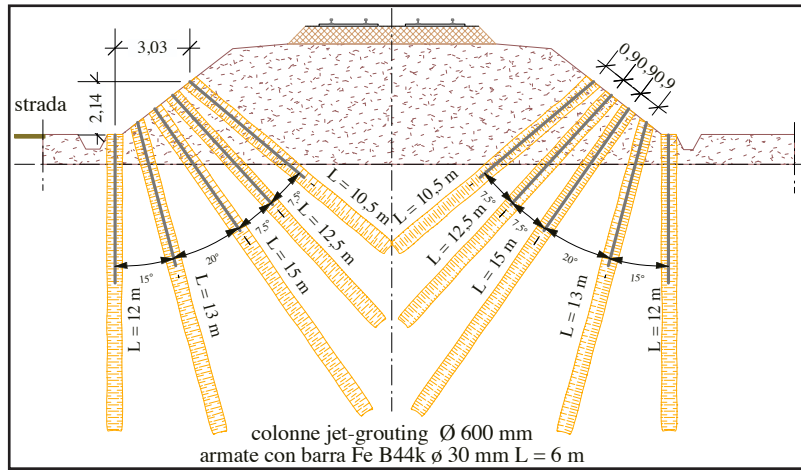


Fig. 3. Cross section showing the work methods used in Sector 1.

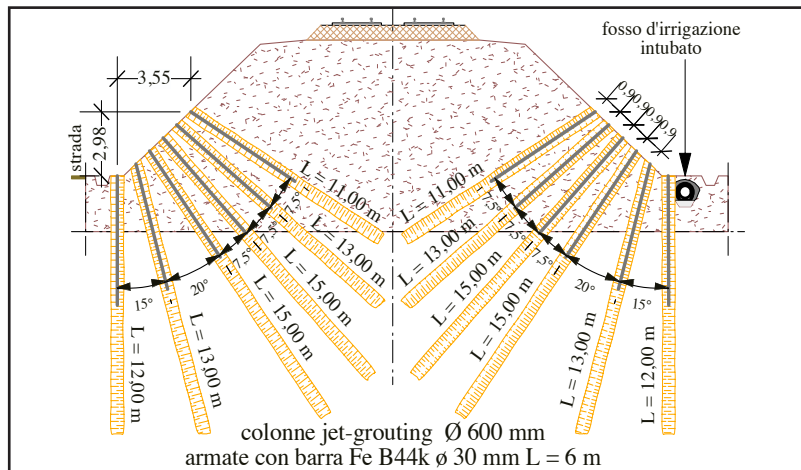


Fig. 4. Cross section showing the work methods used in Sector 2.

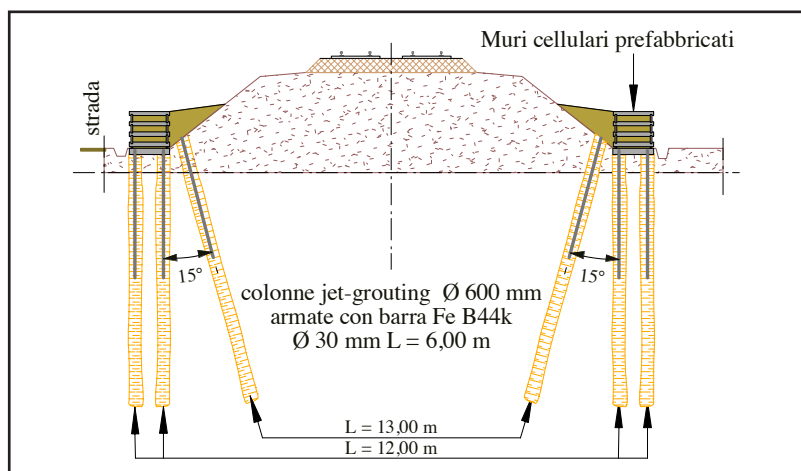


Fig. 5. Cross section showing the work methods used in Sector 3.

and one tilted along the slope, with an angle of 15° , spacing of 1.50 m and length variable from 12 to 13 m (Fig. 5).

In this zone the slope of the embankment was reinforced by installing prefabricated cellular walls (Fig. 6).

For the duration of the works, the level of the tracks was constantly monitored using a rotating laser, to ensure against the risk of uplifting. The works were completed with



Fig. 6. Prefabricated cellular walls.

Fig. 7. P 800 drill rig during Jet Grouting.



construction of pipeline trenches to drain the rainwater and prevent pooling of the water on the embankment.



Fig. 8. View of the worksite.

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