DRILL PAC

www.drillpac.com

ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

PACCHIOSI DRILL

WATERPROOFING

SACRAMENTO (CALIFORNIA - USA)

SACRAMENTO (CALIFORNIA - USA)

PROJECT:

construction of a waterproof diaphragm using Jet Grouting technology on the banks of the American River (Sacramento - California).

PERIOD OF CONSTRUCTION:

April 2002 – July 2003

CLIENT:

Department of the Army – U.S. Army Corp of Engineers

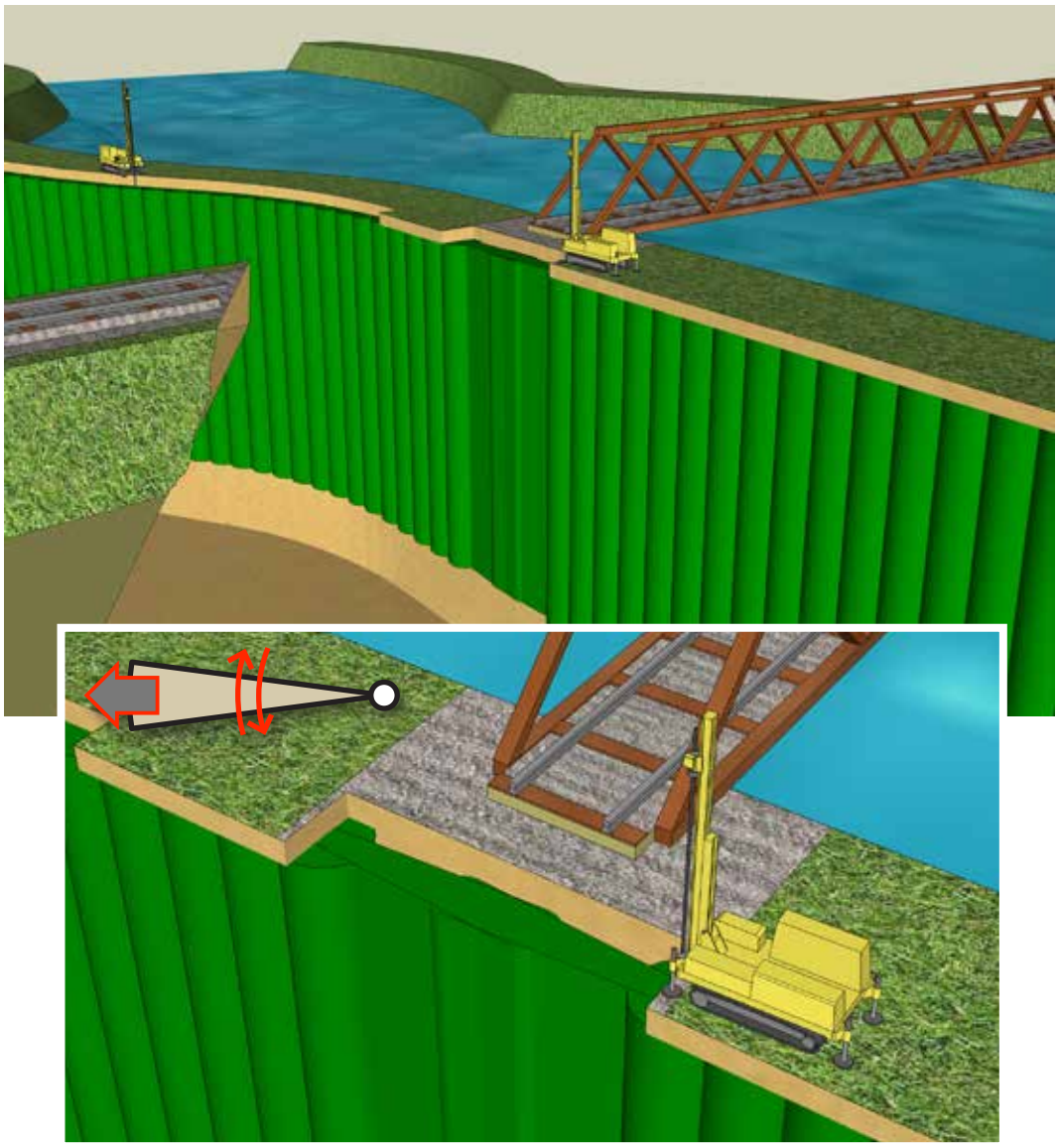

Fig. 1. 3D view of works, view of vertical panels and columns

Lithology.

The deposits involved in the works consisted mainly of sand, clay and silt. There were occasional accumulations several meters thick of gravel and cobblestones at depths greater than 17 m from the ground level. There were lateral variations between the different lithologies up to complete sections consisting of a single type of lithology.

Purpose of the work, difficulties encountered and solutions applied

The banks of the American River were not sufficient to protect the city of Sacramento from floods, as infiltrations of water were frequent. The client therefore decided to reinforce the banks by lowering permeability with a waterproof screen. Where possible, traditional diaphragms in reinforced concrete were erected, while in the case of road or rail intersections, underground services or particularly difficult soil, the Jet Grouting technology was used to securely close any "windows" left open between the concrete diaphragms.

The project called for construction, in five different locations, of continuous waterproof walls at a depth of 30 meters.

The main difficulties encountered were:

- type and conditions of the soil, often very dense, containing blocks and pebbles,

P1500 ES drill rig in action.

- considerable depth to be reached, with a heavy risk of deviation from the vertical and continuous risk of blockage of the drilling rods,
- safeguarding the communications routes and intersecting underground services;
- obligation to work mainly at night and during the weekends, to minimize stoppage of normal traffic.

Description of works.

Before the actual works could be started, it was necessary to complete a vast, detailed series of field tests, to enable the client to refine the final project of Jet Grouting treatments; the field tests necessitated construction of 85 Jet Grouting elements, including cylindrical columns having a diameter of over 4 m (Fig. 4-5), thin panels extending over 6 m in the same direction (Fig. 6÷9), circular sectors of 30° and 120°, for the following purposes:

- to examine the relation between the jet grouting treatment parameters, the column geometry and interspace between columns to obtain a continuous wall;
- to evaluate the characteristics of permeability and resistance of the soil;
- to determine the optimum injection parameters;

Fig. 2 System of data acquisition and registration with PRS3.

- to choose between possible jet grouting treatments;
- to select the most effective injection method.

The method chosen for the work was the Pacchiosi Jet Grouting Triple System (PS3).

Tests were made on the quality of the columns, the measure of deviation of the columns before each injection, tests of permeability and resistance to compression. Continuous registration was also made of the drilling and injection data, with the PACCHIOSI PRS3 system (Fig. 3).

The permeability values measured after the works were on the order of 5x10-7 m/s.

On the basis of the data obtained during the field tests it was decided to build columns with a diameter of 2.5 m and spacing of 2 m along the river banks. A total of about 6,500 sq.mt. of waterproof diaphragm were built in this way. One of the more significant aspects was the crossing of the Union Pacific Rail Road line. The difficulty of working along the tracks, which could only be closed during the night and on weekends, the need to remove the drilling machine every time a train passed, the danger of collapse along the line and the impossibility of increasing the number of columns made it necessary to propose a variation to the project, i.e. the construction of tilted columns and panels.

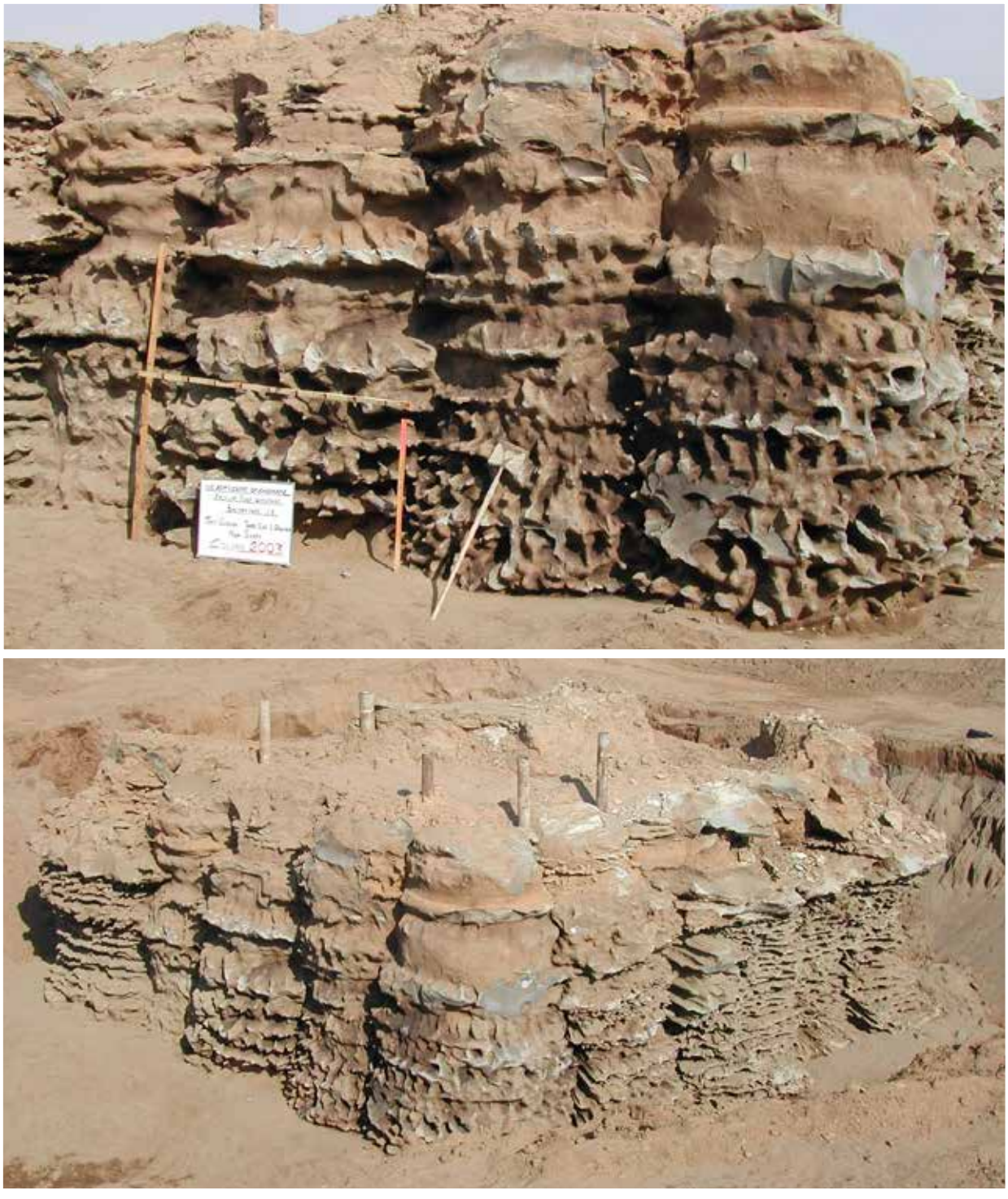

Fig. 3 - 4. Columns produced in the field tests.

The panels (Fig. 5÷8), making it possible to keep the equipment outside the track zone at all times, serve to close the gaps between columns positioned on the edge of the rail

Fig. 5 – 8 Panels facing one way produced in the field tests.

line (Fig. 9). They are all the same size and ensure the continuity of the screen. It is preferable to build a thin type to reduce the interference underneath the track zone.

From the same starting point, three different types of tilted columns were built:

- the first tilted 10° below the railroad bed
- the second tilted 5° below the railroad bed
- the third vertical, to close the gap with the jet grouting wall.

They were all installed in the same plane, perpendicular to the rail line.

Fig. 9 P 1500 ES drill rig in action along the rail line.

Worksite

Near the work zones, an adequate worksite area was set up for the installation of the fixed equipment (high pressure pump, mixer with silos for cement, compressors, containers, warehouse and workshop).

Fig. 10 ÷ 11. Installation of worksite.

A large pit was also prepared near the worksite for the collection and decanting of waste water.

ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

DRILL PAC

COMPANY WITH
QUALITY SYSTEM
CERTIFIED BY DNV GL
= ISO 9001:2015 =

Branches

AMERIQUE DU NORD PACCHIOSI INC, Canada

PACCHIOSI DRILL USA INC, USA

Drill Pac S.r.l. – Società soggetta a direzione e coordinamento di Ghella S.p.A
Sede Legale: Via Pietro Borsieri, 2/a - 00195 Roma (RM)
Tel. +39 06 45603.1 – Fax +39 06 45603040 – e-mail: info@drillpac.com
Sede Operativa: Frazione Borgonovo, 22 – 43018 Sissa Trecasali (PR)
Tel. +39 0521 379003 – Fax +39 0521 879922 - **Sito web:** www.drillpac.com