Grouting

ATLANTIC TGV - MONTPARNASSE STATION

MONTPARNASSE STATION PROJECT - COVER SLAB - PARIS - FRANCE

Filling of underground galleries and consolidation of collapsed rock prior to constructing deep, heavy load bearing foundations

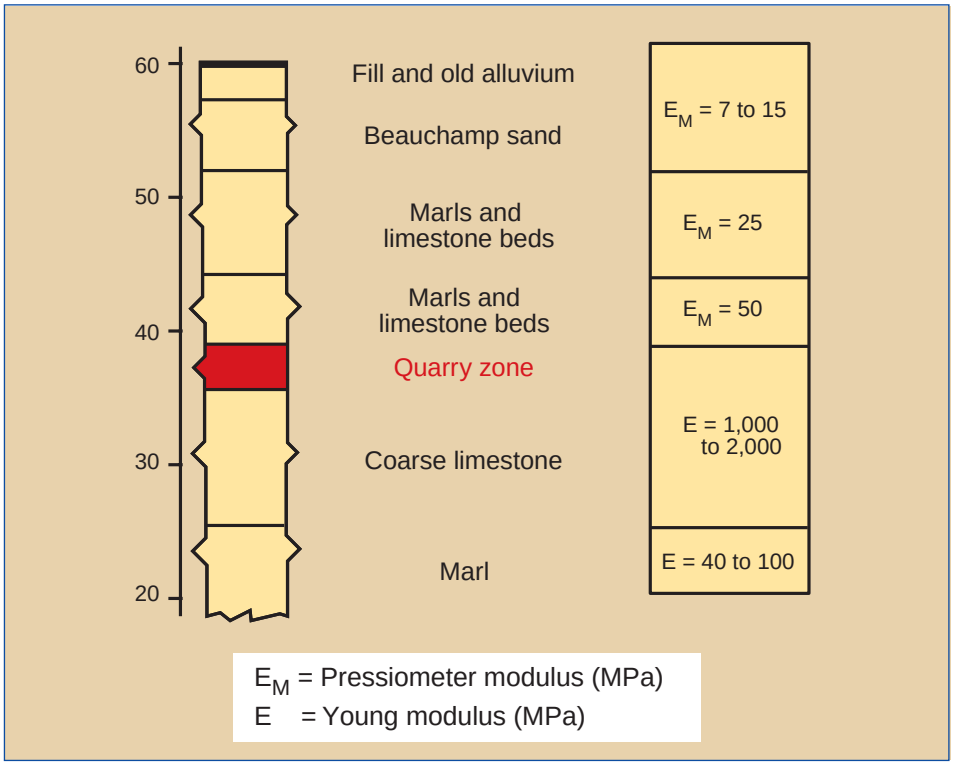
Geological and historical background

The Montparnasse Station Project in Paris consisted of building a cover slab over the existing railway tracks to support a future building complex.

It was decided to carry the loads involved in the project on heavy load capacity barrettes socketed into the coarse limestone at about 25 m depth.

This hard limestone bed had been mined in the past in its upper section for building stone, leaving some open and some partially filled galleries. Locally, collapse of the gallery roofs had caused bell-shaped subsidence features in the overlying marls and gravel soils.

The construction of the foundations thus necessitated the complete infilling of the galleries to avoid mud losses during the excavation of the barrettes. The upper slumped soils also had to be compacted and consolidated by grouting from the existing working platform level, to mobilise lateral positive friction along the surfaces of the barrettes.



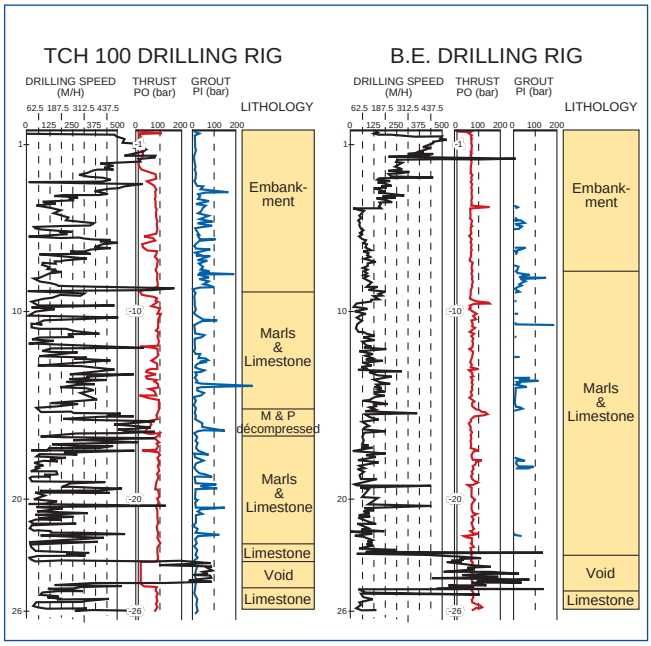
Geological section

CLIENT:	S.N.C.F. (FRENCH RAILWAYS)
CONSULTING ENGINEERS:	SIMECSOL
INSPECTION AUTHORITY:	SOCOTEC
MAIN CONTRACTOR:	J.V. FOR THE PARIS-MONTPARNASSE COVER SLAB
CONSULTANT:	TERRASOL
SPECIALIST CONTRACTOR:	BACHY
DURATION OF WORKS:	AUGUST 1987 TO NOVEMBER 1989

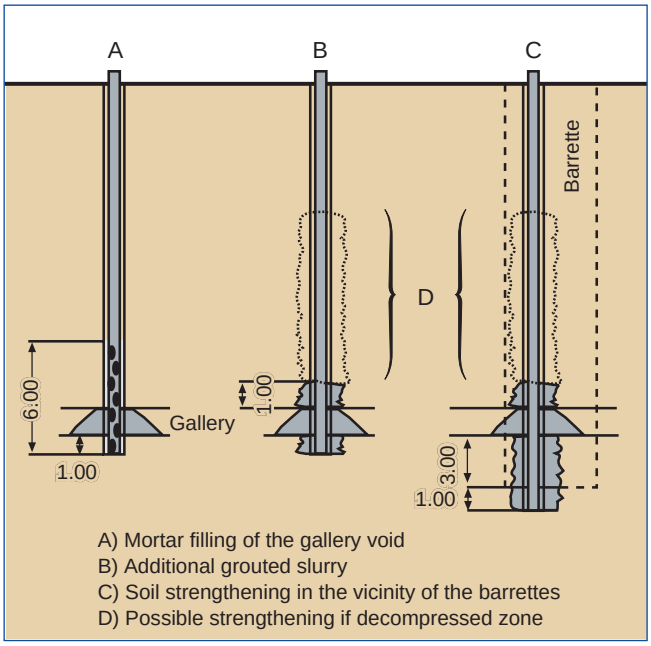
WORKS QUANTITIES

- 71,500 linear meters of drilling
- 31,000 m³ of mortar injected
- 16,200 m³ of grout injected

SOLETANCHE BACHY



Recording of the drilling parameters



Injection borehole equipment

Surveying the voids and the subsidence

In order to be able to modify the treatment required on a hole by hole basis, bearing in mind the random distribution of the voids and loosened ground, a systematic survey was carried out by drilling a pattern of holes with digital recording of the drilling parameters.

Filling and Quality Control

Open cavities were filled with mortar while loosened ground was pressure grouted with traditional bentonite cement grout adapted to the ground conditions anticipated locally. For each process criteria were established based on maximum pressures and precisely calculated grout quantities related to the digital drilling parameter data for that hole.

The grouts and mortars were continuously monitored for consistency with the designed mixes in a completely automated batching and mixing plant. This had a capacity of 40 m^3/h for grouts and 25 m^3/h for mortar. The actual volumes injected were measured at the individual pumps by electromagnetic flow meters.

Rate of Production for Stage 1

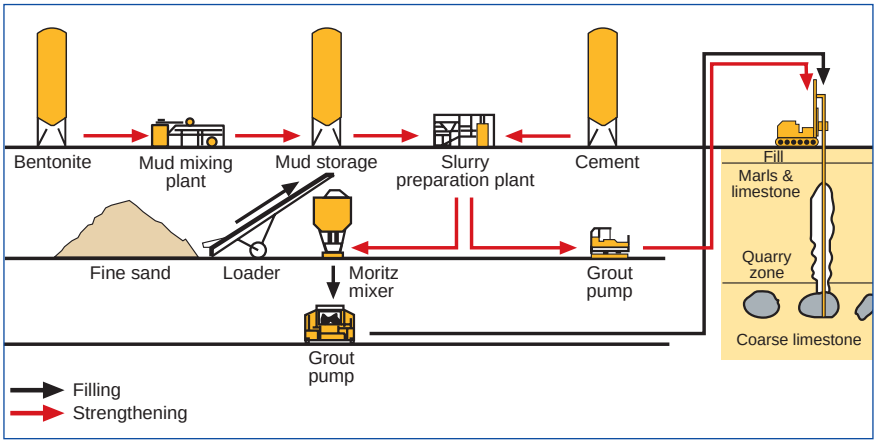
- 30 no to 40no drill holes per day with 4 no rigs working double shift,
- 200 to 300 m^3 of mortar and 100 to 500 m^3 of grout injected per day with 6 no mortar pumps and 12 no grout pumps working double shift.

Grouting chronology

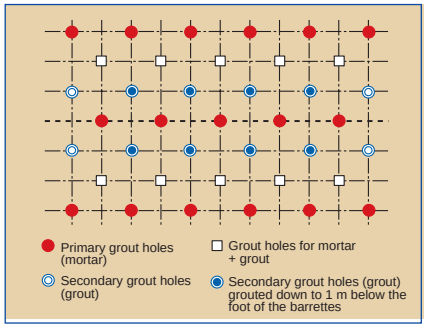
- preliminary infilling of the open galleries by gravity injection of mortar (5 m x 5 m grid),
- pressure grouting at the crown of the filled gallery zones to access any remaining voids and to compensate for shrinkage on setting of the mortar,
- consolidation of the overlying loosened rocks and soils by injection of bentonite-cement grout,
- grouting of any limestone fissures below the toes of the barrettes.

These latter operations were carried out by grouting under pressure through "tubes-à-manchettes" installed in a new series of holes on a 5 m x 5 m grid across the site.

Peripheral barriers were installed around various zones in the site through a series of "tubes-a-manchettes". Both mortar and grout were injected in the formation of these barriers.



Mud preparation plant and grouting process



Injection treatment grid around a group of barrettes

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