

# Ground anchors

## PROVENCE OPERA BUILDING

RUE DE PROVENCE - PARIS - FRANCE



## Heavy duty, composite material ground soil anchors

### Introduction to the project

The construction of an underground car park for the PROVENCE-OPERA Building in Paris required the installation of a peripheral diaphragm wall, the stability of which, as a temporary measure, was assured by a covering slab and three rows of temporary anchors. One side of the excavation is situated along Rue Joubert, underneath which a railway tunnel for the SNCF EOLE project was foreseen. The ground anchors for the lowest two rows on this side of the site intersect the future works.

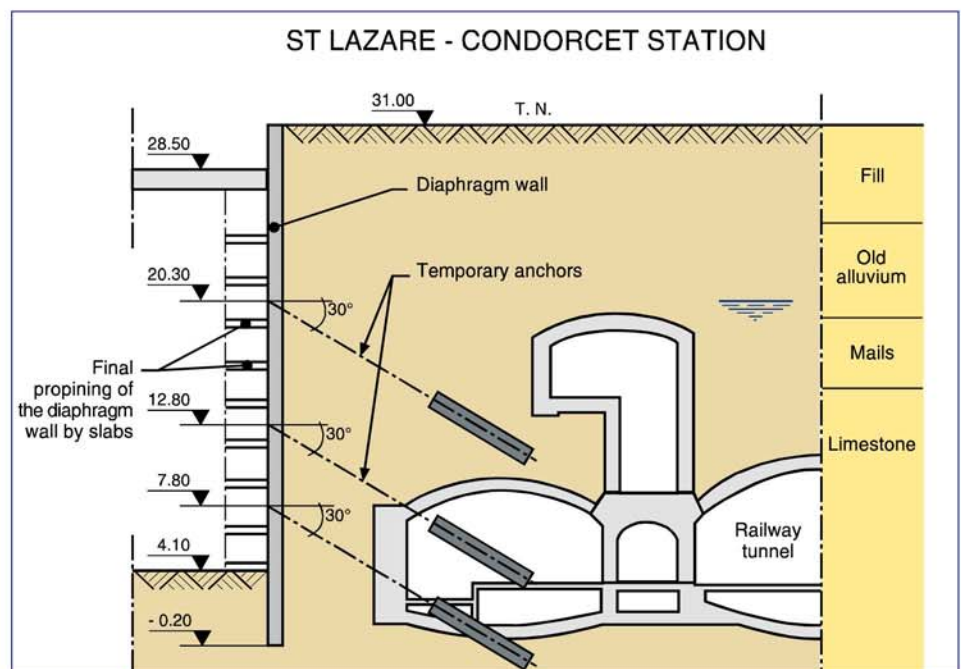
Building permission for the development on the PROVENCE-OPERA site was granted only on the express condition that no elements would be installed in the ground that could impede tunnelling machines excavating the proposed tunnel.

Bachy proposed the installation of destructible, non metallic ground anchors of a composite material and this allowed the condition referred to above to be fully satisfied.

### Development of the process

#### Preliminary tests

The installation of ground



Typical cross-section under Rue Joubert

CLIENT:	GTM DS
INSPECTION OFFICE:	CEP
MAIN CONTRACTOR:	GTM BTP
SPECIALIST CONTRACTOR:	BACHY
DATE OF WORKS:	1992

### WORKS QUANTITIES

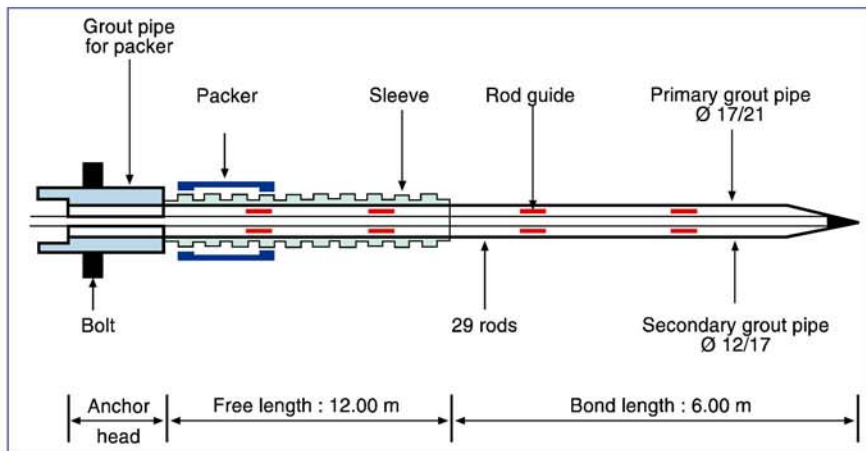
66 no. anchors were installed with the following characteristics:

- Working load: 1,250 kN
- Tendon consisted of 29 no. JITEC strands, 10.7 mm diameter and ultimate tensile stress of 1,400 MPa
- Bond length: 6 m
- Free length: 12 m

Bearing in mind the novelty of the anchor system proposed, load cells were installed and continuous measurement were of the actual load carried by 13 no individual anchors distributed along this portion of the works.



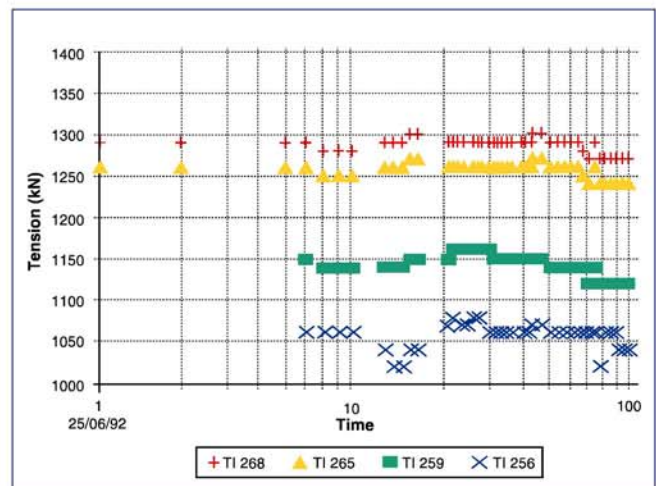
Drilling for the third row of anchor installation



Section of the composite ground anchor system



Installing a ground anchor



Working load monitoring

anchors with composite, non metallic strands required the development of a stressing system adapted to the mechanical properties of the strands.

After a laboratory development phase site trials were organised to meet the following principal objectives:

- confirmation of satisfactory functioning of the proposed anchoring system,
- confirmation of the behaviour of the bond length of the anchor in the ground bearing in mind the relatively low modulus of elasticity of the strand material,
- development of appropriate installation methodology,
- observation of the behaviour of the composite material ground anchors related to time.

The ground anchor system developed and implemented at the PROVENCE-OPERA site has significantly widened the range of application for anchors where possible physical or legal problems arise from leaving permanently in place in the ground high strength steel strands or other ferrous items.