

# Diaphragm wall - Civil works

Grouting

## SAINT-MICHEL CAR PARK

PARIS V & VI - FRANCE



### Design and construction of 6-floor 430 place underground car park

**S**oletanche Bachy was in charge of the complete project, from site selection to final works completion:

- representations to the Major Developments Agency of the Paris City Council (the ultimate owner of the asset),
- design, with support from an architect for submitting the permitting application,
- financial package for the whole operation (construction, operation, interest payments),
- engineering to solve all the problems associated with the site,
- construction of structural support and civil works.



View of car park

#### General description

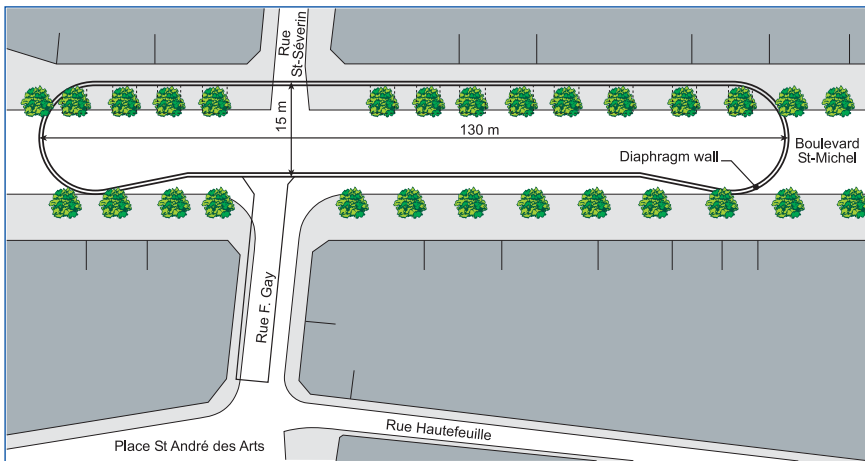
130m long, 15m wide (except for end spirals) and 19.50m deep, the car park under the Boulevard Saint-Michel extends from Place Saint-Michel near the river Seine to Boulevard Saint-Germain, fitting snugly in between the Paris Metro, RER rapid transit underground railway and the buildings flanking the Boulevard.

In addition to coping with the lack of street-level space for the work, the design and construction scheduling had to meet other requirements:

OWNER:	SPSM
ENGINEER:	PROJETUD
CONTRACTOR:	SOLETANCHE BACHY
CONSTRUCTION PERIOD:	APRIL 1994 - DECEMBER 1997

#### MAIN WORKS QUANTITIES:

- Diaphragm wall ..... : 6700 m<sup>2</sup>
- Grout curtain ..... : 6500 m<sup>3</sup> ground treated
- Floors ..... : 7400 m<sup>2</sup>
- Cover slab ..... : 2000 m<sup>2</sup>
- Berlin wall for archaeological dig ..... : 2000 m<sup>2</sup>
- Excavation ..... : 38,000 m<sup>3</sup>



Plan view

- Road traffic had to be maintained along the Boulevard Saint-Michel, which is a red route, as well as pedestrian traffic.

- The trees standing within the car park site along one side of the Boulevard had to be preserved intact.

- Provision had to be made for incorporating an existing telephone cable tunnel passing through the third car park level.

A further constraint was to allow archaeologists to dig to a depth of 6 metres behind a Berlin wall (steel soldier beams and timber lining). Among the many finds was an ancient road paved with limestone blocks, older than the Gallo-Roman city of Lutetia (modern-day Paris).

### Description of works Construction procedure

The retaining wall around the excavation is a diaphragm wall, 0.63m thick and 25m deep, with its toe embedded

in a coarse-grained limestone bed. It was built with a Latine Hydrofraise rig, the machine most suited to the cramped conditions (small working area, closely-spaced trees and limited headroom under trees) and capable of digging through hard ground (marl and stone, and coarse-grained limestone).

A grout curtain extends 8m downwards from the diaphragm wall toe, into the limestone, to reduce underseepage and pumpage during construction and operation (the 6<sup>th</sup> level floor raft is drained).

Where the telephone cable tunnel passes through, a grout curtain and wall built during excavation replaces a section of the diaphragm wall. Trees encroaching on the cover slab were "potted," by inserting horizontal steel pipes in drilled holes under the root systems, the



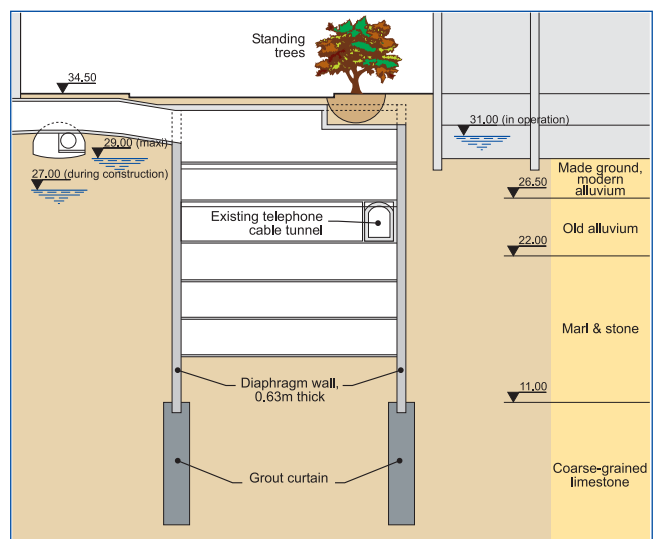
Latine Hydrofraise at work on the diaphragm wall

pipes being embedded at one end in the diaphragm wall, and attached to the cover slab ribs at the other.

The diaphragm wall, grout curtain, in situ cover slab, temporary support and the few prefounded columns were built in two phases, in order to maintain traffic along the Boulevard Saint-Michel. Subsequently, the ribbed floor slabs were built by the top-down method. The spiral access ramps at each end were built after completion of the excavation work.



Underpinning the trees



Typical cross section