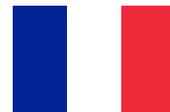


4500 linear meters of stone columns at Grenoble University, France.



Franki Fondations, a French piling contractor, was chosen to carry out 4500 linear meters of stone columns soil treatment, prior to the construction of a new 5-storey building in the Grenoble University in France.

- **VL18 BFS Productivity 150-200 linear meters/ day.**
- **35t Komatsu PC350HLC Excavator.**
- **Gravel size: 20/40mm.**
- **Stone column diameter: 750mm.**

Initial soil conditions

Type of soil	Soil layer thickness (m)	qc (MPa)	EM (MPa)	PI (MPa)
Backfill soil	1	-	-	-
Brown silt	4	0,8	2,5	0,25
Sandy gravel	1,5	10	30	3,0
Sand	0,5	2,5	7,5	0,75
Sandy gravel	Beyond	10	30	3,0



To improve the soil conditions, Franki Fondations used a Vibrolance VL18 with Bottom-feed system (BFS) for the installation and compaction of 850 stone columns of 4 to 6m deep.

The BFS system of the PTC Vibrolance allows feeding the gravel from the bottom of the column up to the surface and compacting the gravel without removing the Vibrolance from the insertion point. This ensures the stone column diameter homogeneity (750mm) and the compaction quality throughout the entire treatment depth.

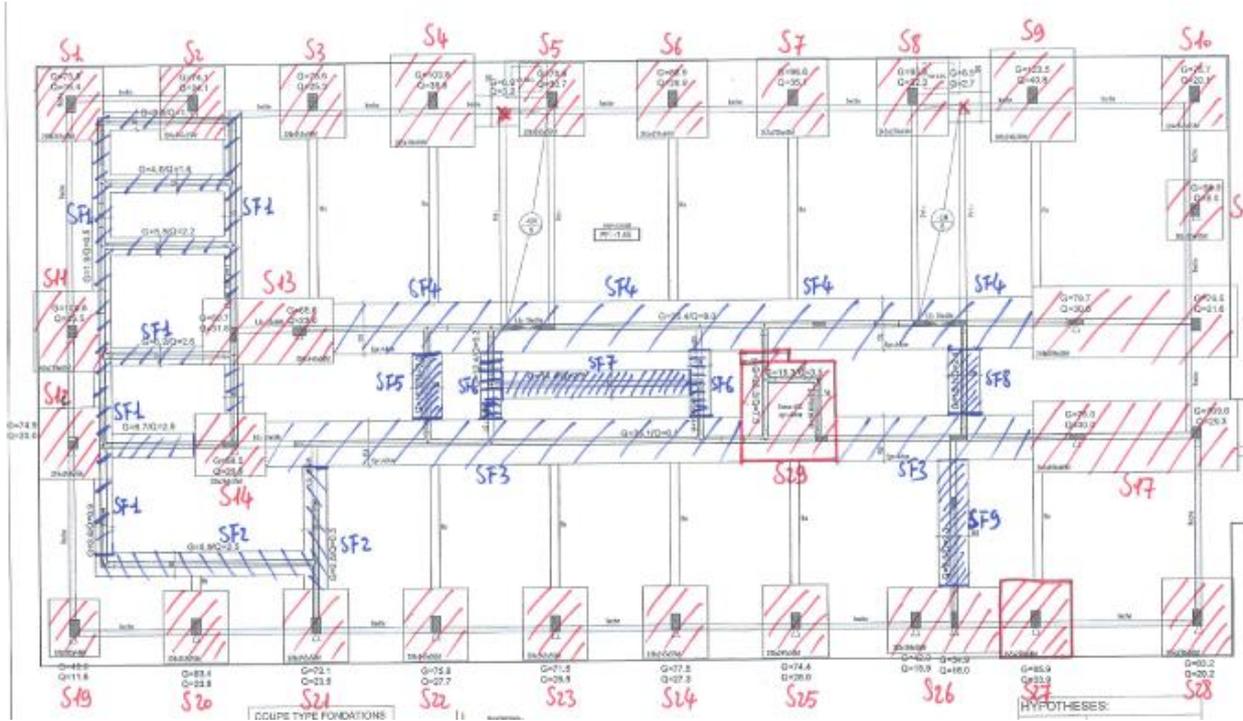
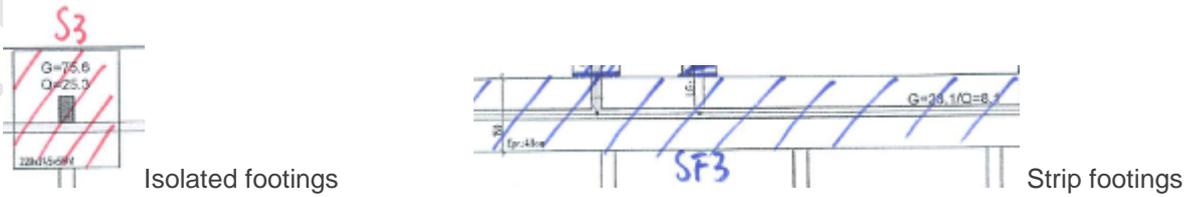
The 850 stone columns were installed at an average distance of 1.5m between each other, and precisely underneath the future building walls of the 5-storey building.

Stone columns productivity: 150-200 linear meters/ day.

The VL18BFS was mounted on 35t Komatsu PC350HLC excavator.

Footing design

The foundation design consisted in two type of footings:



Design has been conducted following Priebe’s methodology. A simplified approach was performed based on soil elasticity for calculation of settlements, which was the criteria for performing the works. Maximum allowed settlement was 25 mm.

Calculations of loads and settlements were performed for each footing to define the right pattern of stone columns. A stone column was evaluated to have a Service Limit State (SLS) of 24 tons for a stone column diameter of 750 mm.

Isolated footings accept a SLS from 61 tons (with 3 stone columns) up to 266 tons (with 12 stone columns). Strip footings accept a SLS from 8,4 tons per linear meter (1 row of stone columns with a spacing of 2,5 m) up to 34,4 tons (2 rows of stone columns with a spacing of 1,2 m).

Load test results

The contractor hired an independent firm Veritas to perform a load test on the stone columns.

The stone columns treatment obtained positive results. Under test load (1,1 x maximum load of the stone column) the soil settlement was only 16.32 mm, less than the allowed maximum settlement limit.

Load	Max allowed settlement	Results of Load test
265 kN	25 mm	16,32 mm (after 30 min)

35t Komatsu PC350HLC Excavator with variable adjustable boom, which make verticality easier to achieve and enables more versatility for treatment depth.



The gravel loader is a Manitou MT 1335, which is able to load the gravel into the tank and the bucket is adapted with a smaller opening in order to load the gravel on the front and all from the sides.

