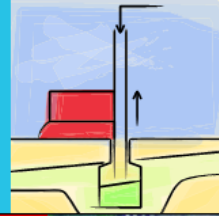


Jet Grouting



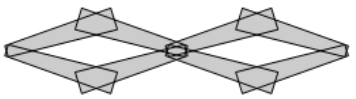
Jet Grouting



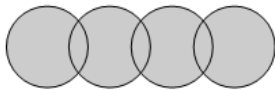
The characteristics (columns diameters, length of the panels, composition of the mix, permeability, compression strength,...) of the jet-grouting elements depend on the treatment parameters (extraction speed, speed of rotation, pressure of injection of the grout, flow, density of the grout...), as well as the soil conditions (type of soil, grain size distribution, compaction,...) and on the selected method of construction (mono, double or triple-jet).



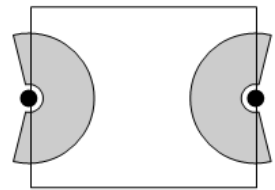
Single curtain wall



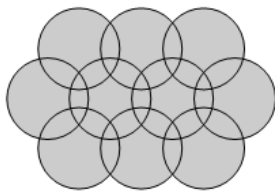
Double curtain wall



Secant columns wall



Cross-section of columns



Plug



Reinforcing columns



Reinforcing columns

Applications

Jet Grouting offers a very wide range of applications :

- Ground improvement under uniform loading (heavy storage platforms, embankments, quays, slabs...) or under localized loads (building footings, bridge piers...). In those cases, a load transfer platform (LTP) is usually required above the jet grouting columns;
- Impervious cut-off wall/impervious bottom for deep excavations can be formed with Jet-GROUT panels (without rotation of the injection rods) reinforced with Jet-GROUT columns, or using secant columns to create a continuous wall. This technique is particularly adapted for deep shaft construction and isolation, deep impervious bottom, and deep excavation in urban areas along existing sensitive structures;
- Retaining walls using secant Jet-GROUT columns designed as gravity walls or retaining walls. Steel reinforcement can be inserted in the Jet Grouting columns as required (tube, rebars, cages);
- Underpinning (settlement mitigation, excavation of additional underground floors under existing building, excavation along existing structures...);
- Tunnel pre-arching structures;
- Reinforcement of soils where existing utility lines and buried structures are present;
- Projects with limited headroom or in cramped spaces, ...



Jet-grouting improves the mechanical characteristics of the soil using a fluid jetting with very high kinetic energy that breaks up the soil structure and mixes the soil particles in-situ with a grout to create a homogeneous mass of high strength reinforced soil-cement material.

Jet-Grouting involves a combination of the following three phenomena :

- Break-up of the soil structure by a fluid injected into the soil at high velocities;
- During treatment, extraction of excess part of the spoils to the surface;
- In-situ mixing of the soil particles with an hydraulic binder (slurry).



Underpinning of "hôtel du Palais" - Biarritz (FRANCE).

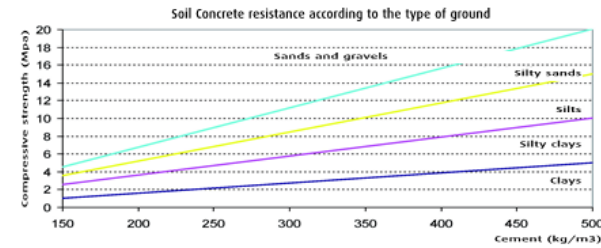


Implementation and methods

The equipment consists in a fixed grout production plant (silos, grout mixer, high pressure pump...) attached to a drilling rig with high pressure grout lines. The drill bit is equipped with injection nozzles whose characteristics depend on the type of soil and on the geometrical and mechanical characteristics of the anticipated column or element (shape, diameter, compressive strength,...).

For each injection point, the following steps are carried out:

- 1) The rig is positioned at the drilling location;
- 2) A small diameter hole is drilled (70 to 120 mm) through the layer of soil requiring treatment;
- 3) Grout is pumped through the rod with a very high flow (200 to 400 L/min) and high velocity using a high pressure pump and exits through one or several small diameter injection nozzles (1 to 10 mm) installed on a monitor at the tip of the drilling rod (diameter 70 to 120 mm);
- 4) Slow withdrawal of the tool with rotation of the drilling rod for column formation and no rotation for panel formation.



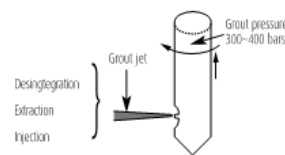
Although it is technically possible to use any type of grout, a cement slurry is commonly used in practice to create, after mixing with the surrounding soil, a high strength soil-cement material.

When the main purpose is to create an impervious cut-off system, a bentonite-cement slurry can be used.

Jet-Grouting is effective across a wide range of soil types presenting wide variations in permeability and grain size distribution. The technique can theoretically be used in any type of soft soils, from soft clay to sand and gravel. However, the technique is not suited to coarse gravel or soils with underground water flow.

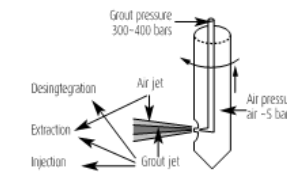


There are three Jet Grouting methods. Selection of the most appropriate method is generally determined by the soil conditions, the geometry of the element to be constructed and the application:



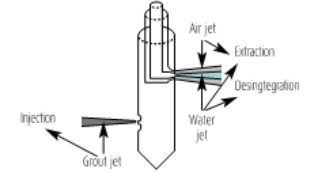
Single fluid jet grouting

The grout directly fulfils three distinctive functions of breaking down the soil matrix, removal of excess material and mixing with the soil.



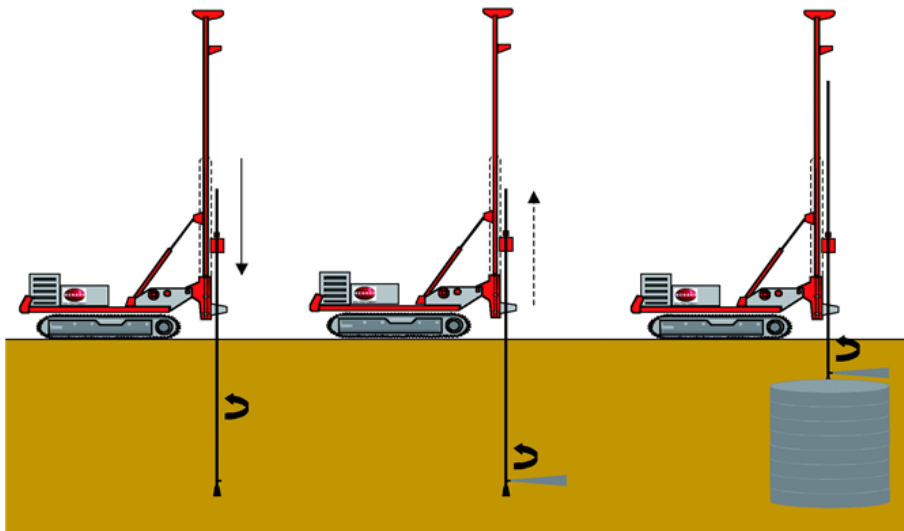
Double fluid jet grouting

A two-phase internal fluid system with a coaxial air-jet supply line around the grout-jet supply in order to increase the efficiency of the mixing process and range of action of the slurry. Air-jetting also improves, thanks to an air-lifting effect, the extraction of the spoils along the drilling rod.



Triple fluid jet grouting

Coaxial air and high-velocity water are used to erode the soil structure with an additional improvement through partial substitution of the finest soil particles. Cement grout is then injected through independent nozzles located below the water/air jets.



During Jet-Grouting, the excess volume of soil grout slurry mix are pushed to the surface and these spoils need to be regularly removed from the working platform.

