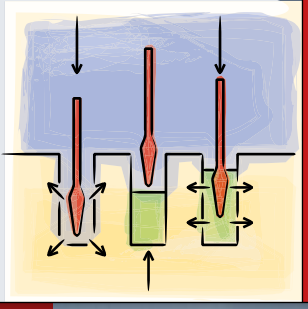
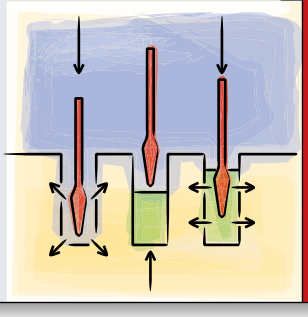


Stone columns

Stone columns are formed by inserting a vibratory probe to incorporate granular material into the ground and create vertical inclusions with high stiffness, shear strength and draining characteristics.

Under uniformly loaded structures such as embankments and slabs-on-grade, stone columns are installed on a regular grid spacing. In this case, a load transfer platform is designed and installed between the top of the columns and the structure.
The stone columns installation results in a significant reduction of the total and differential settlements.
Stone columns can also be installed as a group to support isolated loads (shallow spread footings) or directly under linear loadings such as strip footing or retaining walls. In this case, Stone columns increase the bearing capacity of the soil while reducing the magnitude of settlement.

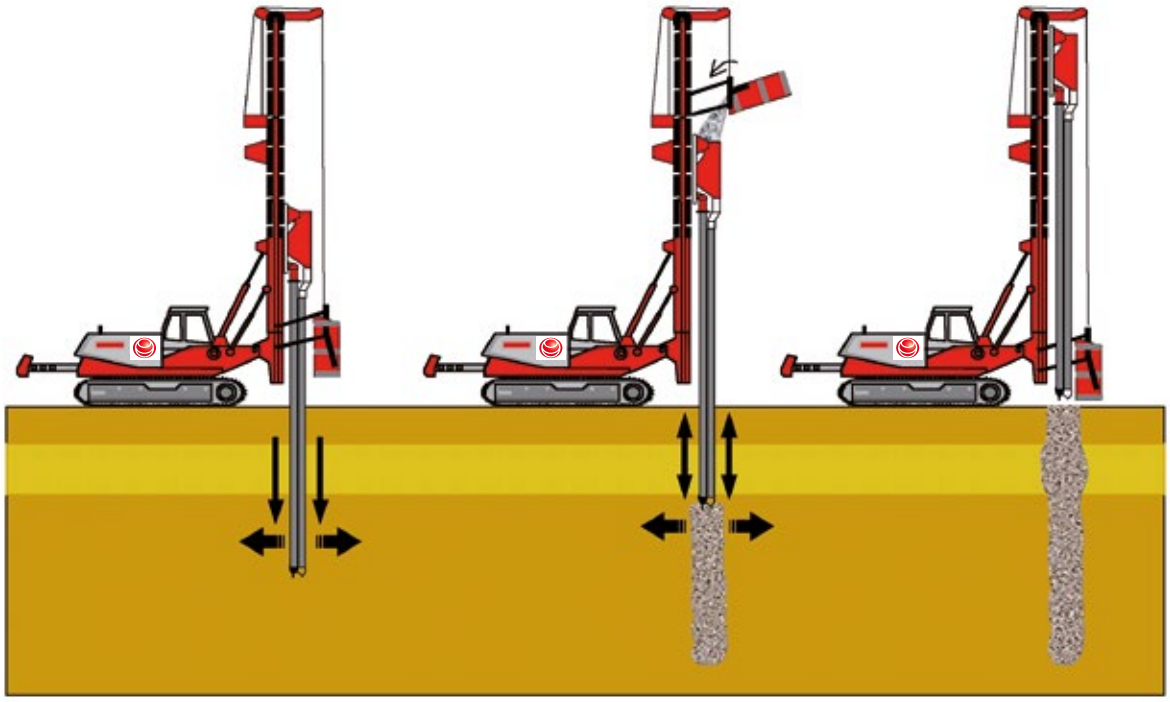
This technology is well suited for the improvement of soft to very soft soils (sillty sand, clays, silts, heterogeneous fill...). However, when the surrounding soils present a risk of long term degradation of their geotechnical characteristics (organic soils, very soft clays, peat...) with very limited lateral confinement, stone columns should not be used for settlement reduction or bearing capacity improvement.



Stone columns

Implementation and methods

Stone columns are formed by inserting an hydraulic or electric vibroflot equipped with a pressure chamber equipment (130 kW using air as a jetting fluid). This combination gives the best result for the incorporation of the granular backfill to the bottom of the system and warrants the continuity and optimum compaction of the columns.



Penetration of the probe assisted by compressed air jetting

Backfilling and compaction of the granular backfill

Completed column

1) Under combined effect of sustained vibrations, its own weight and the pull-down force, the vibratory probe penetrates the soil down to the prescribed depth or down to refusal. During penetration, the soil is displaced laterally without any spoil extraction.

2) As the probe is lifted, the ballast material falls down by gravity in the void that is created. The process is facilitated by continuous injection of compressed air. The aggregates are inserted and compacted by extraction and repenetration of the vibrating probe through repeated incremental lifts of 30 to 50 cm, each cycle being repeated till the probe reaches the surface.

3) The diameter of the stone columns depends on the properties of the surrounding soil: in softer soils, the compaction process results in higher lateral expansion of the columns. Over the length of the entire column, variable diameter could thus be created due to variable layers with different soil conditions.

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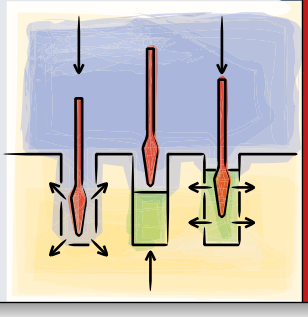
Off-shore stone columns
- Dunkirk harbour (France).



Stone columns

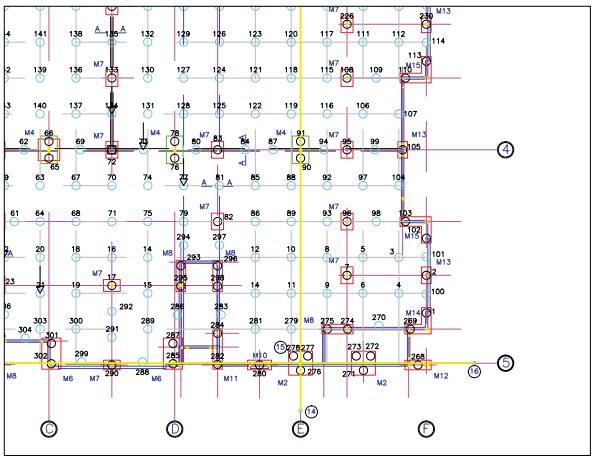
Advantages

- Stone columns are designed to reduce settlements of compressible soil layers in order to be able to build most structures with shallow footings and slab-on-grades on very soft soil;
- When applicable, their draining characteristics result in an increase in the time rate of consolidation settlement in soft cohesive soil;
- Because they are made of compacted granular material, no curing period is necessary and no cut-off to the shallow footing grades are required as the excavation of the footing can immediately follow the installation of the stone columns down to the required elevation;
- High production rates;
- Stone columns are also well-adapted to the mitigation of liquefaction potential thanks to the combined effect/advantage of their draining potential and the increase of shear strength and stiffness of the improved soils.

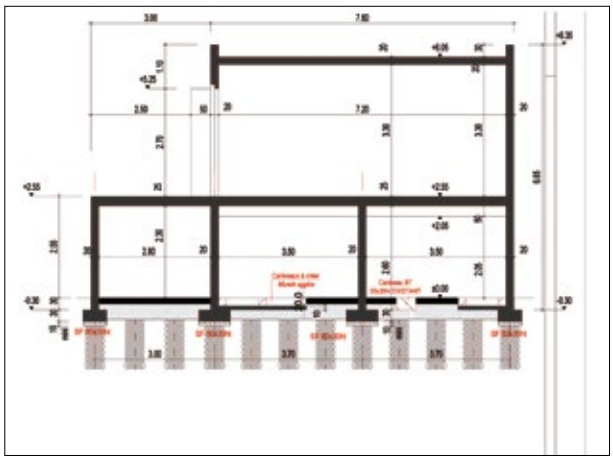
Applications

- Industrial warehouses and commercial buildings;
- Condominium, apartment buildings, townhouses and single-family residential developments;
- Reclaimed platforms (harbours, container terminals);
- Sewage treatment plants;
- Railway and roadway embankments;
- Retaining walls;
- Liquefaction mitigation and building support in seismic areas.

Typical arrangement under structure and slab



Top view



Sectional view

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