



Construction Technology

Ground Improvement Techniques



Ground improvement

A favoured method of increasing the strength of soils for low rise development on brownfield sites



Ground improvement



Reasons behind GI...

- No excavation
- No dewatering
- Simplifies foundation conditions

Ground improvement

Methods include:

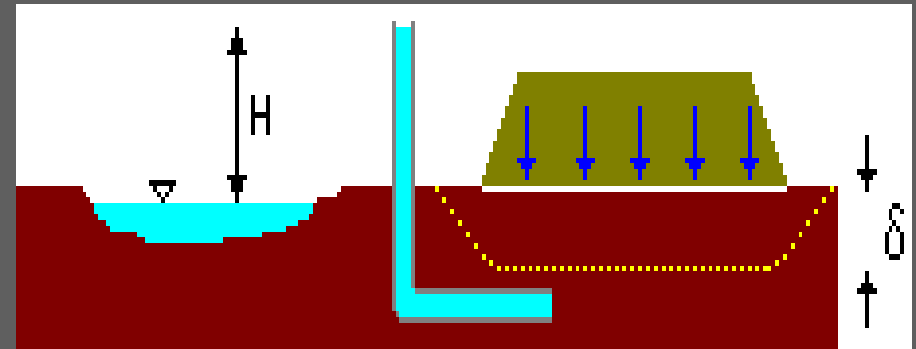
- Preloading
- Compaction
- Stone columns
- Dynamic consolidation
- Grout injections
- Lime columns



Ground improvement

Consolidation by preloading

The preload is applied by means of a mound of soil imposing a load on the ground higher than that of the permanent structure



Ground improvement



Band drains

Usage..

- Large areas of land to be reclaimed from sea
- Developments proposed on low-lying coastal plains or on river flood plains

Ground improvement



Shallow Compaction



Loose or disturbed soils
at the bottom of
excavations for strip / pad
/ raft foundations
compacted by rolling or
ramming

Ground improvement



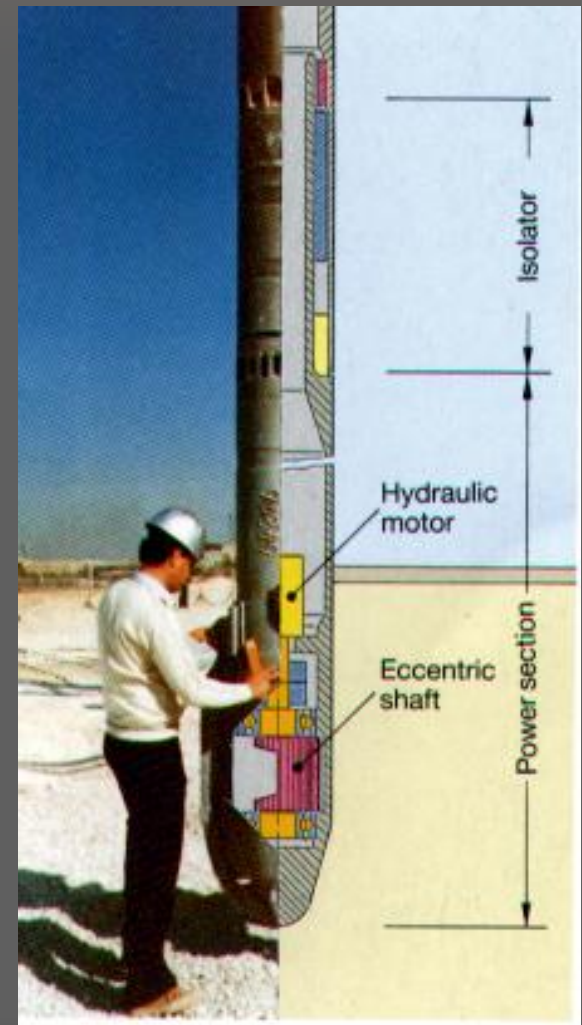
Deep compaction methods

- Vibro-flotation
- Vibro-replacement

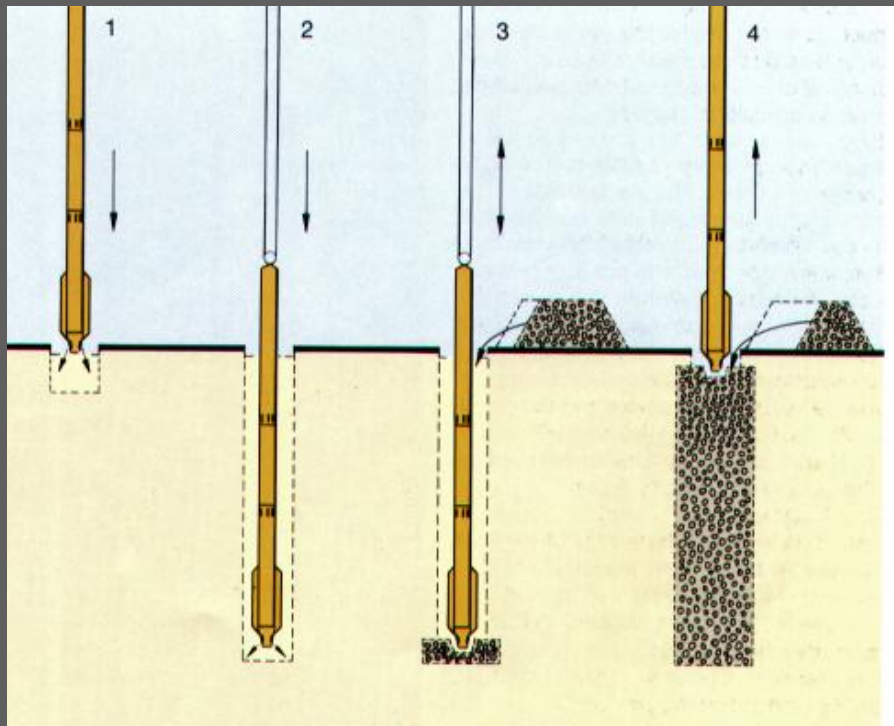
Ground improvement

Vibro-flotation

- Used in loose, granular soils
- Water jets used to aid soil penetration
- Vibrator compacts soil
- Sand inserted to fill depression
- Unit withdrawn in stages
- Process repeated 2 – 3m intervals



Ground improvement



Typical vibro-flotation system

1. Vibrator set onto ground
2. Soils liquefied allowing vibrator to sink under its own weight
3. Depth reached and sand inserted to fill voids
4. Unit withdraw in 0.25m stages

Ground improvement



Vibro-replacement using
stone columns

- Conventional dry process
- Bottom feed
- Wet process

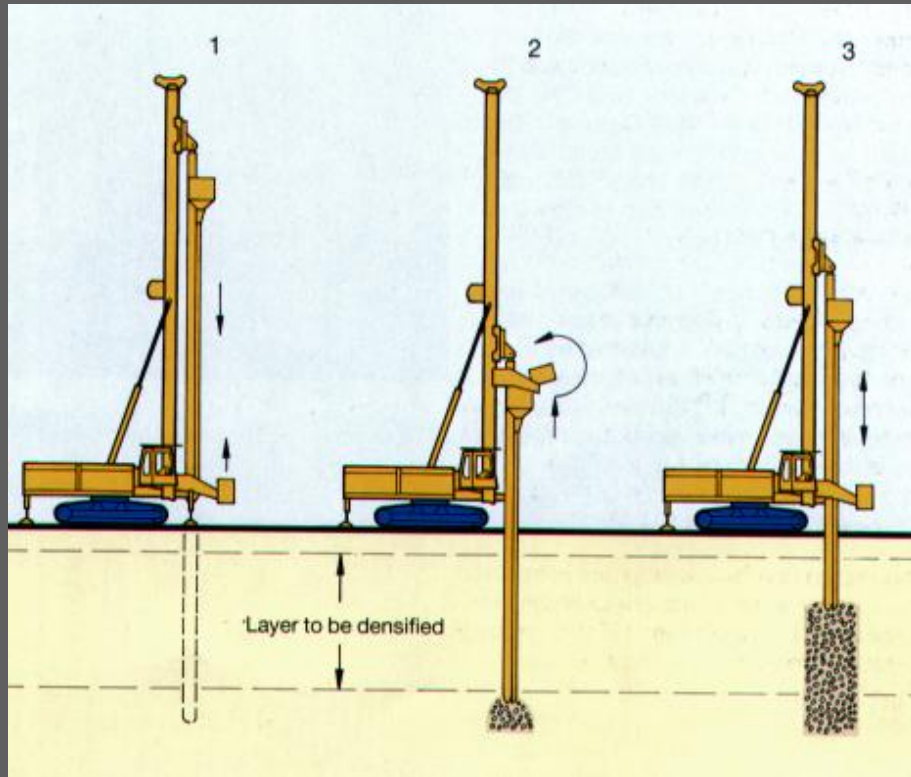
Ground improvement

Vibro-replacement applications

- Used in soft, impervious soils
- Light industrial development
- Structures not sensitive to settlement deformations



Ground improvement



Vibro-replacement: stone column

1. Vibrator positioned & storage container filled with materials
2. Vibrator lowered to required depth and extracted in 0.5 – 1.0m stages – material placed
3. Vibrator lowered to densify material – sequence repeated until optimal densification achieved



Vibro concrete columns

Ground improvement

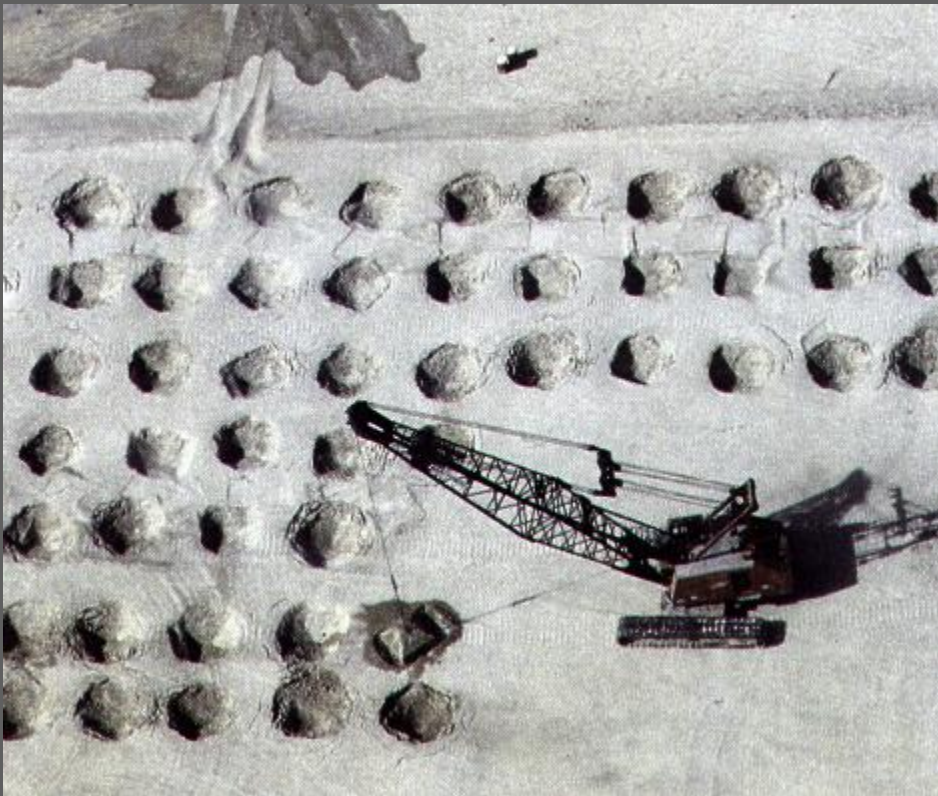
Dynamic compaction

Involves dropping a weight
onto the ground

Ideal for loose mixed
cohesive or granular fills
or weak natural granular
deposits



Ground improvement



Preparation

- Site surface area divided into a grid
- Tamping takes place within every other grid square
- Infilling carried out
- Final low energy sequence over whole area



Ground improvement

Dynamic compaction:
some advantages...

- No spoil is produced
- Allows greater flexibility in the positioning of buildings
- Flexibility in building's shape hence size
- Cost efficiency







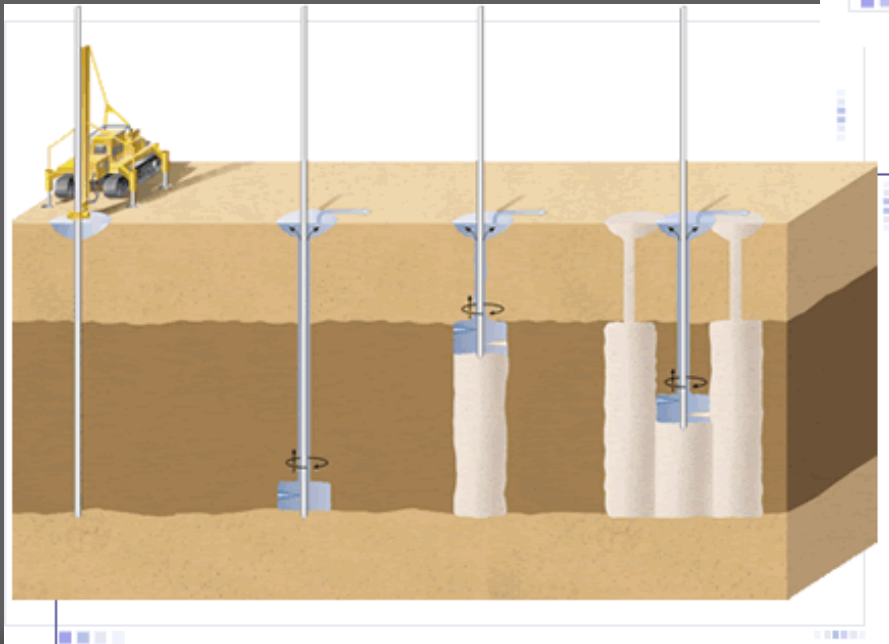
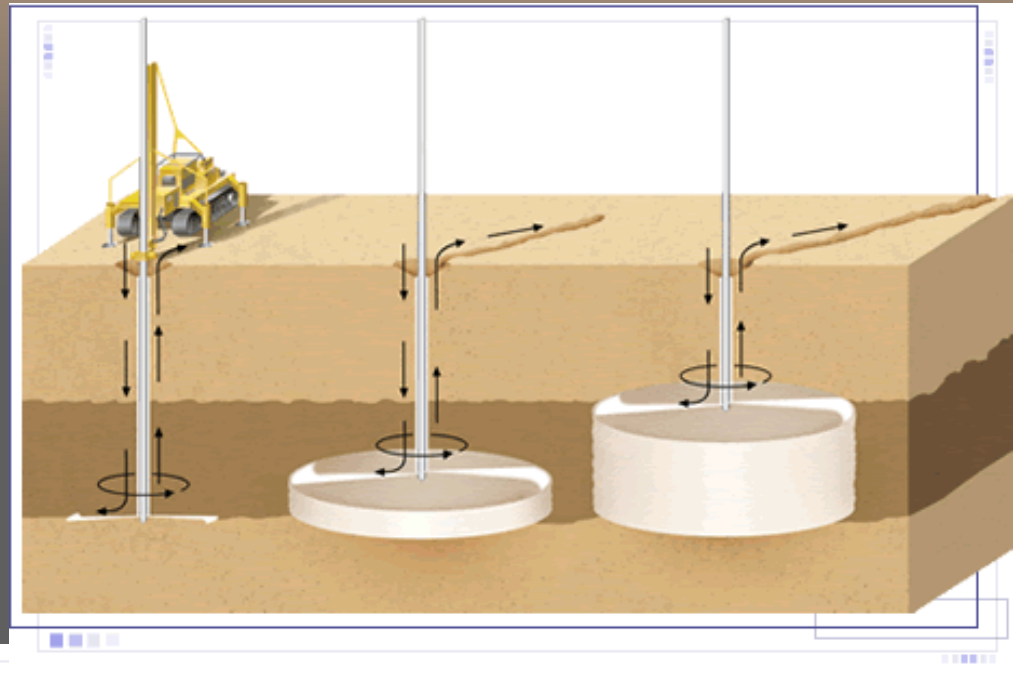
Ground improvement



Grout injections

- Compaction grouting
- Permeation grouting
- Chemical grouting
- Cement grouting

Ground improvement



Grouting applications





Ground improvement



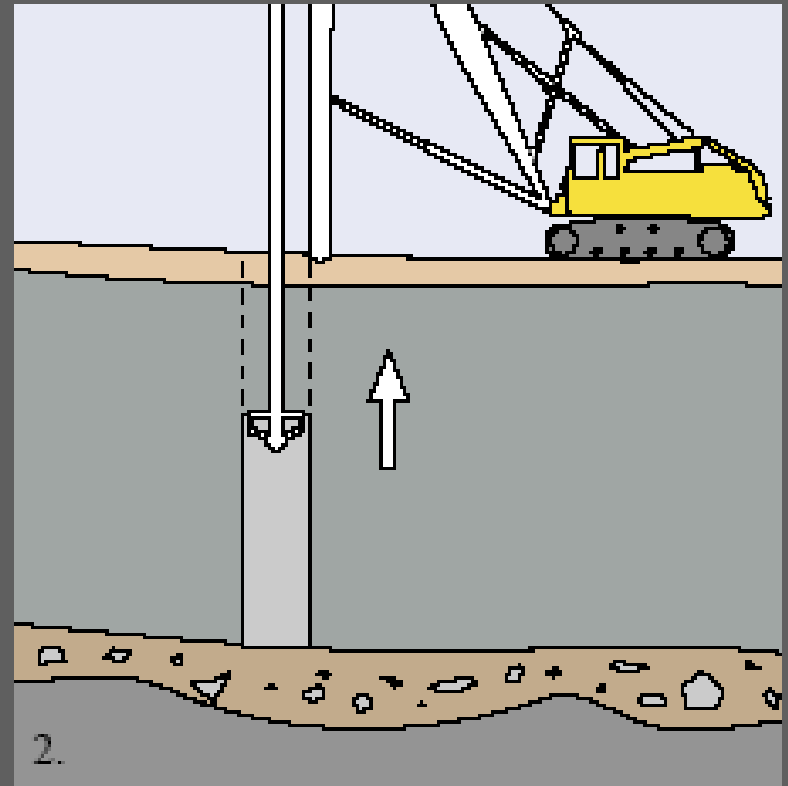
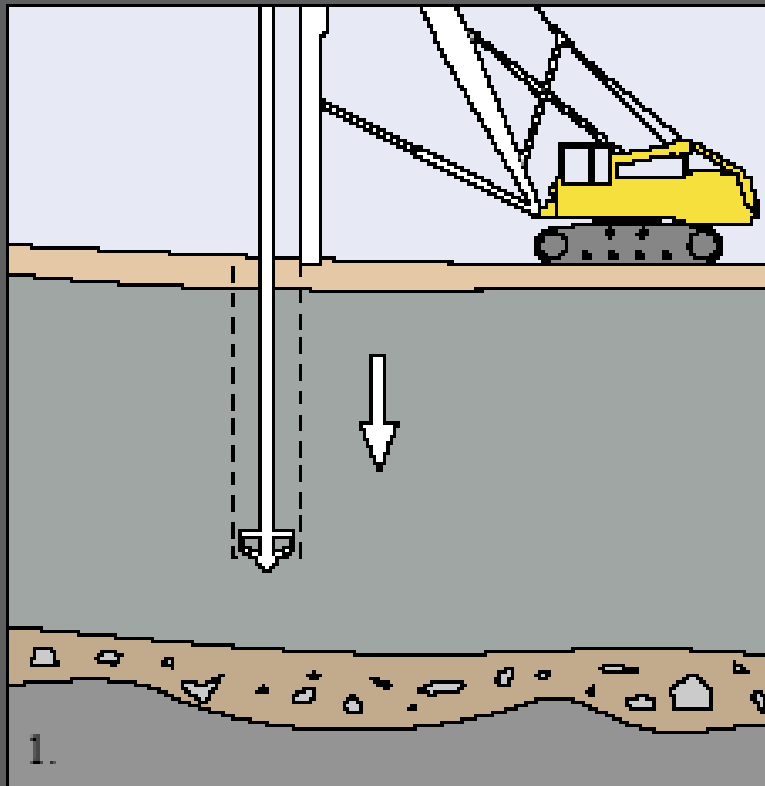
⇒ Lime columns

Lime columns involve injecting a dry mixture of un-slaked lime into the soil to be stabilised.

This method is suitable for clay and organic soils with a humidity of at least 20%.

Ground improvement

Installation of lime columns



Ground improvement

Lime cement columns



Stabilisation with lime-cement columns

improves stability and reduces embankment fills. In recent years, columns have become the most commonly used method in Sweden, partly because of its advantages over embankment construction: shorter construction times than embankment. The Institute has developed a model for stabilisation based on:

Construction documents

Link
The project is commissioned to design the lime-cement columns for the Svealand Rail Link. The area is up to 25 m. The columns are 6 m and terminate at three differ-

ent levels, 5, 10 and 15 m. The project is being followed up by measuring deformations, pore pressures and temperatures in order to study the mechanism of stepped lime-cement column strengthening and to determine whether the "Limeset" calculation model currently used is also suitable for lime-cement columns. A comparison has been made of the strength properties of the columns measured in the field and in the laboratory to determine differences between the methods and their influence on the calculation results. Columns have been extracted and triaxial tests carried out on 500 mm diameter samples. The SGI is conducting the follow-up jointly with the National Rail Administration.

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Workshop: ground improvement

Outline the factors that will affect the choice of method for ground improvement.

Consider previous study on foundations and identify suitable testing methods that will show ground treatment using vibro methods as a satisfactory process.

