

# Ground Improvement



Structural Guide



# Why we need Ground Improvement

Ground improvements are done specially for shallow foundations when they are constructed in weak soils. Based on the classification of soil under the foundation, the type of improvement is selected. The type of loadings will also be taken into account when the improvement technique is finalized.



# Methods of Ground Improvements



Vibro Compaction

Vacuum Consolidation

Preloading of Soil

Vibro-replacement stone columns

Grouting

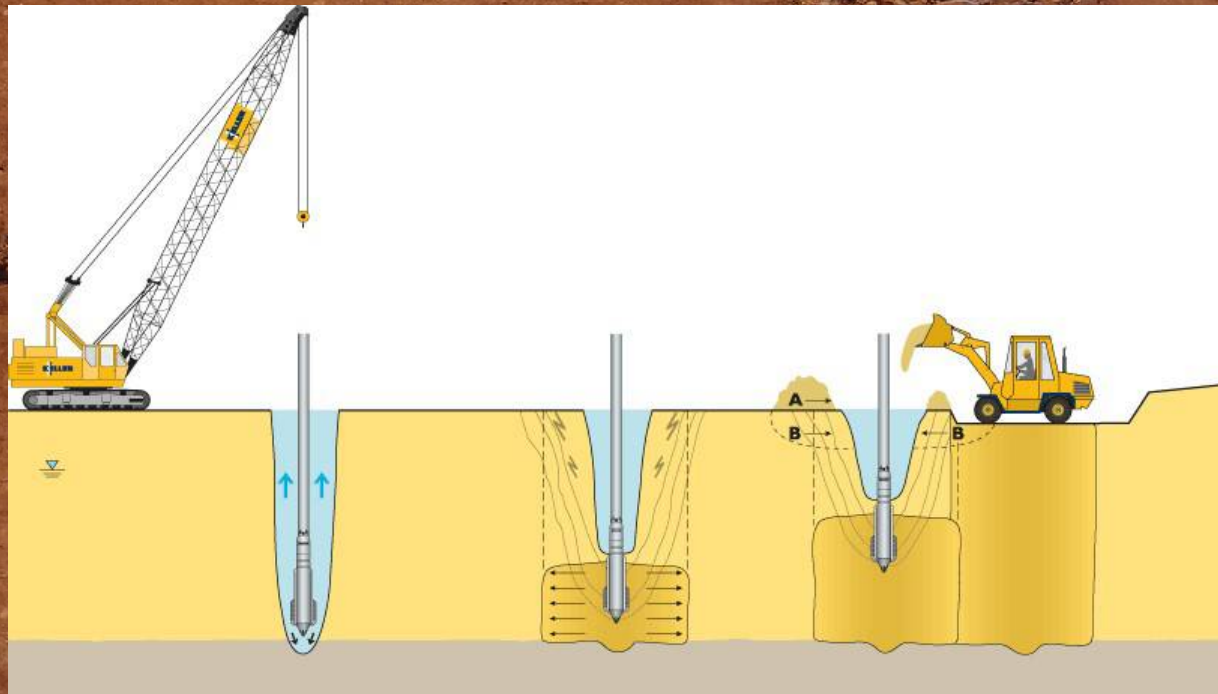
Improvement by Admixtures

Dynamic Compaction of Soil



# Vibro Compaction

Compaction of the ground by vibration is the Vibro compaction. In this method, the loose ground is vibrated to change the configuration of the soil to a dense form. Due to the high vibration, soil particles are rearranged to a configuration that reduces the void ratio and increases the density. This method is more suitable for sandy soils.



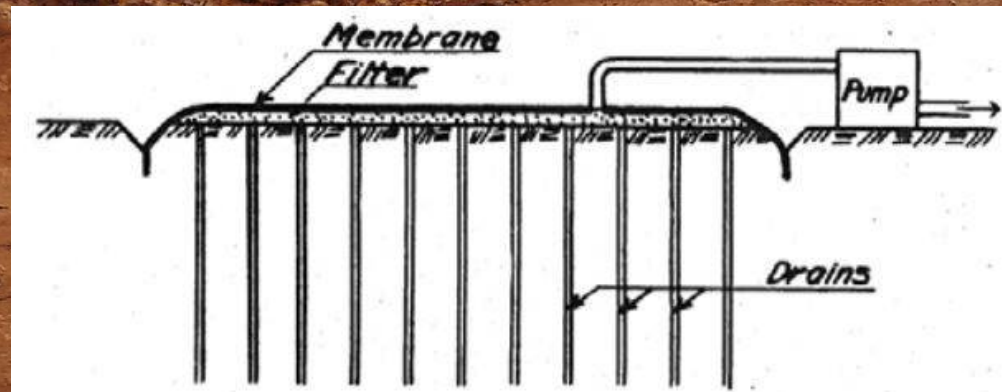
# Vacuum Consolidation

Vacuum consolidation is used for soft soils.

It is a process of applying vacuum pressure on the soil which is protected from the surface from losing the pressure by a sealing membrane.

perforated vertical drains inserted into the soil to generate the vacuum pressure on the soil. It allows to drain out of the pore water.

As a measure to speed up or when required for higher consolidation, surcharge pressure could also be applied on the soil in addition to the surcharge applied in the form of a vacuum.

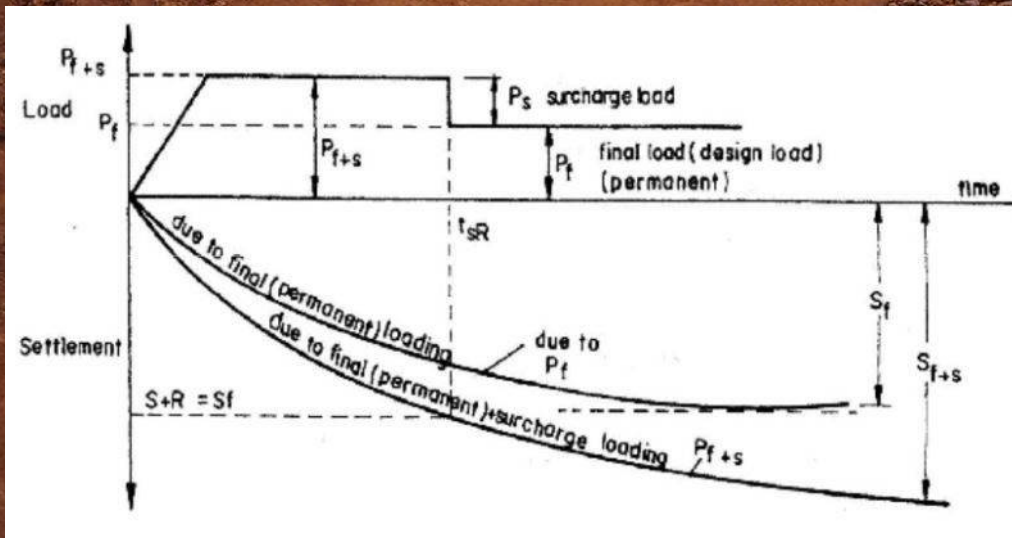




# Preloading of Soil

Preloading or pre-compression is a process of applying a load on the soil to remove the pore water over time. The reduction of the pore water causes the settlement of the soil and it is an economical method when it is easy to find the soil for this purpose.

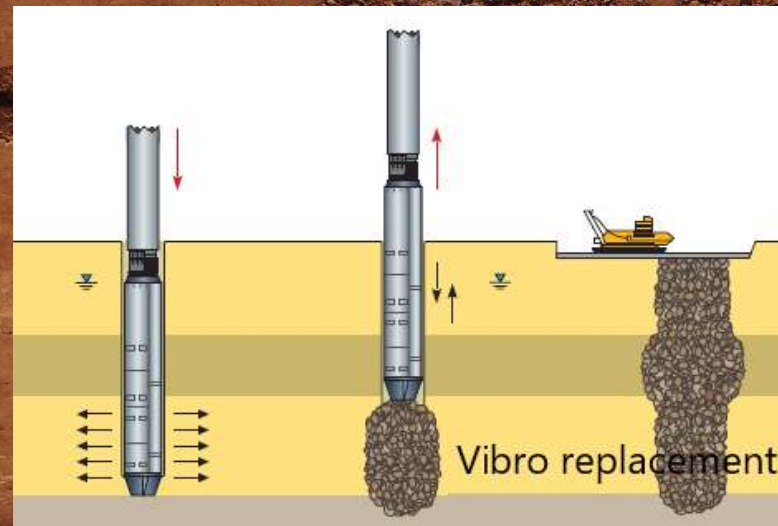
This is done prior to the construction as it is required to keep for a reasonable time depending on the design requirement to have the required settlement. This process can be implemented for compressible soft soils (soft to medium soft) such as saturated clay and silt, organic clay, peat, etc.



# Vibro-Replacement Stone Columns

Vibro-replacement is the construction of densely compacted stone columns in the soil. This method is suitable for improving soft soils such as clays, silts, etc. With the introduction of stone columns, the bearing capacity of the soil will improve considerably.

It is an economical and environmentally friendly method. However, the economy may vary with the availability of the machinery used for this purpose.





# Grouting

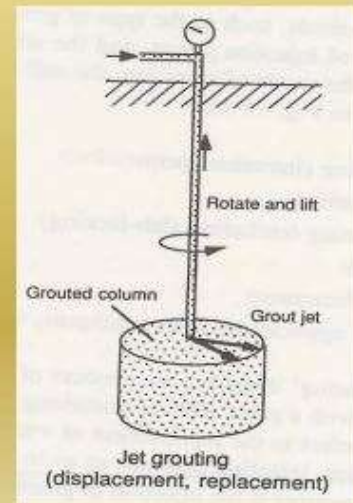
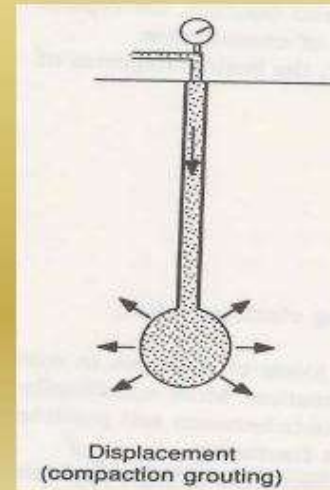
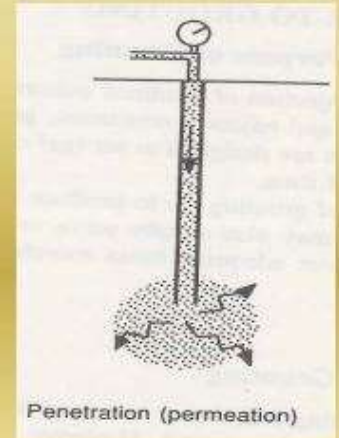
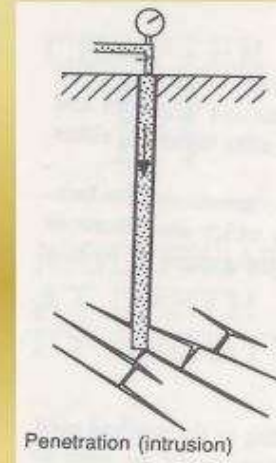
Grouting is a more commonly used construction of dams and buildings.

Grout is used to fill the cavities in the rock and to decrease the permeability in dams

As a result of grout filling, cohesion and shear strength will increase.

Cement-based grout mixtures are used commonly and admixtures that harden the grout quickly could be added depending on the requirement of the project.

When there is weak ground with sufficient permeability for flowing the grout, grout can be injected into the soil for improving its bearing capacity.





# Ground Improvements by Admixtures

When it says the admixtures, it is always not the chemical admixtures most people think. Mainly there are two types of admixtures namely inert admixtures and chemical admixtures.

Inert admixtures consist of inert materials that do not react with soil but improve the density, grain size distribution, shear strength and bearing capacity and reduce the porosity and permeability.

Chemical admixtures are usually lime, cement, industrial wastes and combination of industrial wastes and other chemicals available in the market.

## *Industrial Waste*

*Coal combustion products such as fly ash and bottom ash*

*Ground granulated blast furnace slag (GGBS)*

*Cement kiln dust*

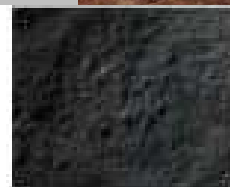
*Lime kiln dust*



Brick bats



Brick dust



Coal dust



Coal slag



Rice Husk Ash



Tyre chips



# Dynamic Compaction of Soil

Dynamic compaction involves dropping heavy weight on the soil in a regular sequence to increase the density of the soil. Used when there is a large area to be improved.

Weight to be dropped is selected based on the degree of compaction required. This method is suitable for all granular soils to mention in the following list.

**Non-organic**

**Non-homogeneous fill**

**Made grounds (areas of land that is man-made by reclamation)**

**Reclamation areas with different characteristics**

**When underground obstructions are presents**

**Soils with large air voids (refused dumps, poorly filled ground, etc.)**

The use of this method provides more advantages such as the compact large area of loose granular fill, reduce the volume of landfill waste, increase the density and bearing capacity of the soil and reduces the post-construction settlements.





Thank you



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Civil & Structural Engineering Knowledge Base