

1(a) I.D (15613) Salman Durrani (1)
(Geotechnical Improvement Techniques)

Soil improvement in its broadest sense is the alternative of any property of a soil to improve its engineering performance such as strength reduced.

compressibility, reduce permeability

or improve ground water condition

This may be either a temporary process to permit construction of facility or may be permanent measure

to improve performance of the

complete facility. We will

discuss about the details of soil improvement.

There are various techniques used for improvement of the soil based on the construction activity and type of soil.

Surface compaction:-

(2)

One of the oldest method of soil densification is surface compaction. Construction of new road runway an embankment or any soft or loose site needs compacted base for laying the structure. If the depth to be densified is less the surface compaction alone can solve the problem.

The usual surface compaction device are roller and rammers.

1) Drainage Method:-

Ground water is one of most difficult problem in excavation work. The presence of water increase the pore water pressure and decrease the shear strength. Further heavy inflow of cause of water to excavation is liable to cause erosion or collapse.

of the sides open excavation
Certain methods are available to
control the ground water and ensure
a safe and economical construction
Scheme.

③

③ Vibration Method:-

Vibration method can
be effectively used for rapid densification
of saturated non cohesive soil.

Vibration & shock waves in loose
deposit such material cause liquefaction
followed by densification of excess
pore water pressure.

4) Pre-compression & consolidation:-

This method aims to consolidate
the soil before construction

Grouting & injection :-

(4)

Grouting is process whereby stabilizers either in form of suspension or solution are injected sub surface soil or rock for one or more following

control of ground water during construction.

Void filling.

Foundation Underpinning.

Reduction of machine foundation.

6) Chemical Stabilization

has been widely used in form of lime.

7) Soil Reinforcement.

is in form of weak soil reinforcement by high strength

the horizontal membranes

8) Geotextile & Geomembrane: -

⑤

are porous fabrics
manufactured from synthetic material,
which are primarily petroleum
products & others

1) (b) Dewatering is the term (7)
for the control of ground water
by pumping. On construction sites
it may be known as construction
dewatering. The method is also used
on mine site mine dewatering.

The process of dewatering can be defined
as pumping from well or sumps
to temporarily lower ground water
level to allow excavation to be
made in dry & stable condition
below natural ground water level.

Definition of Dewatering:-

As an alternative to ground
water control by pumping physical
cut of walls can be installed
around site exclude ground water
from site.

Dewatering techniques

(8)

Sump Pumping:-

Water is collected in deeper parts of excavation called sump

Simple & cheap method of dewatering in favorable ground.

The sump takes up space within excavation can lead to water solution problem due to silt laden water

Well point

Commonly used for dewatering of pipeline trenches.

Can be a very flexible & effective method of dewatering in sand or sand & gravel.

Deep wells

well are drilled at wide

spacing (10 to 60m) between wells to form a ring around the outside of excavation.

Effective in wide range of ground condition, sands gravel fissured rocks.

Eductor Wells :-

Wells are drilled around or along side the excavation.

Suitable when well yield are low flow capacity 30 to 50 liter

Drawdown generally limited 25 to 30m below pump level

2(a) Soil Nailing is technique to Reinforce & strengthen ground adjacent to an excavation by installing closely spaced steel bars called nails as construction proceed from top down.

10

It is an effective & economical method of constructing retaining walls for excavation support, support of hill cut bridge abutment & highway.

The nails are subjected to tension, compression, shear & bending moment.

The main consideration for deciding whether soil nailing will be appropriate include the ground condition the suitability of other system such as ground anchors, geo synthetic material & so on the cost.

~~Q. 2~~ Soil which are particularly suitable to soil nailing include clays, clayey silts, silty clay, sandy silts. Soil nailing can be used on weathered rock as long as the weathering is even without any weakness planes. (11)

2B) Grouting :- is a construction material used to embed rebars in masonry walls connect section of pre-cast concrete fill voids and seal joints.

Grouting :- is the process to inject grout into the ground. hence the volume of the ground ready to accept grout is primary consideration before any other consideration.

a) Suspension grout:-

is a mixture of one or several inert material like cement clays suspended in fluid water according to its dry matter content

(12)

b) liquid grout solution grout:- consist of chemical product in a solution or emulsion form and their reagents. The most frequently used product is sodium silicate & certain resins.

Grout characteristics:-

Groutability

Stability

Setting time

Permanence

Toxicity:-

Groutability:- To obtain satisfactory performance grain size distribution should be known because it shall show the relationship b/w the grout particles size & the void dimension.

Pumping pressure should not be large enough for particles of soil to be disturbed.

Stability:- Capacity of grout to remain in a fluid state & not separate into separate components.

Settle time:- Time required for the grout to set into cemented mass or gel. Early setting causes difficulty in the grout reaching its destination.

Permeance:- Resistance the grout offers against being displaced from the soil voids with time.

Toxicity:- Capacity of grout to contaminate ground water.

Advantages:- The ability to use small drilling tools (90mm diameter) to create large element (1.2mm to 2.4mm diameter) using pressure & flow.

2) The ability to drill underneath obstacle & solidfy zone which are hard to access.

(14)

3) the use of technically sophisticated technre such as high powered pump & monitoring device with continuous measurment of all operational parameter.

Disadvantages:-

Grouting adjacent to unsupported

Slopes may be infective

Not suitable in decomp osable material

Danger of filling underground pipe with grout.

Effectivness quistionable in saturated

clays.

3a Ground Improvement:

Development of Infrastructures ⁽¹⁵⁾ in cities compelled the engineers to improve the properties of soil to bear load transferred by the structures.

As land available may not be suitable for structural load.

The purpose of these technique to increase bearing capacity of soil & reduce the settlement to considerable extent.

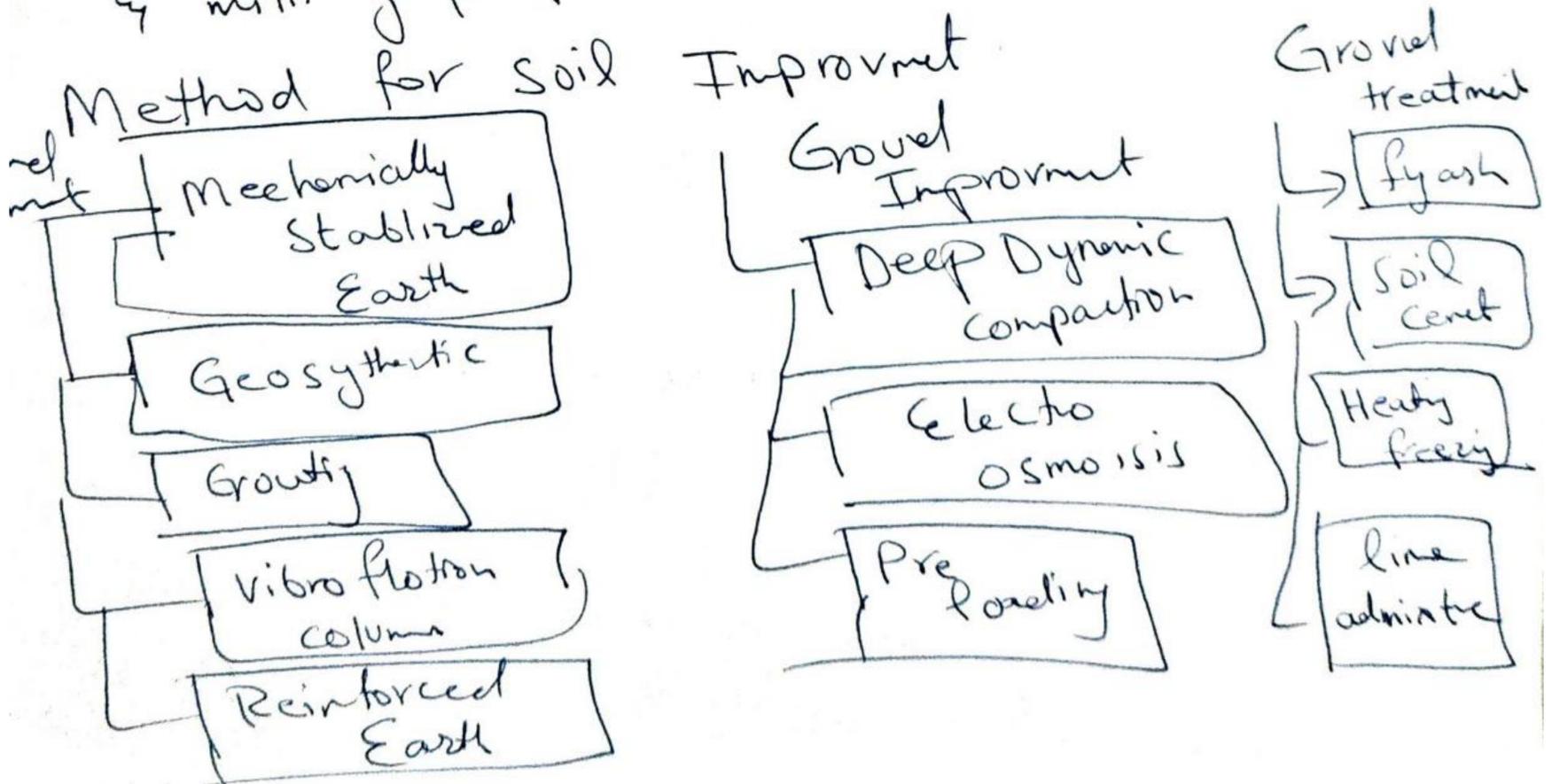
Effect of Ground Improvement:

The process reduce the permeability of soil mass.

The process reduce compressibility and consolidation.

The process improve the bearing capacity of soil mass.

The process is used to make an area traffable within short period of time for emergency & military purpose.



Vibro compaction:

(16)

Combined action of vibration & water saturation by jetting rearranges loose sand grains into a more compact & densified state to create stable foundation.

Vacuum consolidation:-

The soil site is covered with an airtight membrane and vacuum is created underneath it by using dual venturi & vacuum pump which improve saturated soft soils.

Pre loading:- Process of applying additional vertical stress on a compressible soil to remove pore water over time which reduces the total volume causing settlement.

Heating:- It uses electrical current to heat of soil & modify the physical characteristics of the soil.

Ranges b/w 300 & 1000 degree Celsius.

Ground freezing:- Use of refrigeration to convert in situ pore water to ice.

The ice act as cement or glue bonding together adjacent particles of soil increase their combined strength & make them impervious.

Vibro Replacement:

Extend the range of soil that can be improved by vibratory techniques to include cohesive soil. (17)

36) Expansive clays are soil that are very special as regards the impact of external factors from an engineering point of view the occurrence of substructure shrinkage phase after the swelling phase is the most dangerous of construction

Geotechnical problem of expansive soil is considered to be one of more problematic soil & it causes dangerous various

civil engineering building / structure b/c of its swelling & shrinkage potential when it comes to into contact with water

Expansive soil due to their tendency to swell & shrink

Main geotechnical problem of expansive soil are some of following

Structural Damage to light weight
structure such as side walk & driveway (18)

lifting of building damages to basement
& building settlement.

Cracks in walls & ceiling

Damage to pipe line & other building
public utility.

loss of Residual shear strength
cause instability of slope etc.

lateral movement of foundation and

Retaining wall due to pressure
exerted on vertical wall,

Therefore it is essential to check the
pressure of expansive soil and suitable
treat ment method should be
adopted before commencing any
construction project.

4a) Abstract & figure:

19

Stone columns are extensively used to improve the bearing capacity of poor ground & reduce the settlement of structure built on them. A stone column is one of soil stabilization methods that is used to increase strength & decrease the compressibility of soft & loose fine grained soil accelerate a consolidation effect & reduce the liquefaction potential of soil.

They are mainly used for stabilization of soft soil such as soft clay. The method is in wide range of use especially in Europe since 1950.

The columns consist of compacted gravel or crushed stone arranged by vibrator. This article presents installation method design.

4 fabric ~~method~~ mode of
stone column.

(20)

Blasting:- through the use of buried
time delayed explosive charge
has been used to densify loose
granular soil. The sands &
gravel must be essential
cohesion less with max of 15
Percent of their particle
passing No 200 sieves
size & 3 percent passing 0.0005
mm size. The moisture condition
of the soil is important
for surface tension force
in partially saturated state
limit effectiveness of technique.

Sand compaction pile & Stone column:-

Piles consist driving ~~column~~ hollow steel pipe with the bottom closed with collapsible plate down to required depth filling with sand and with driving the pipe while air pressure is directed against the sand inside

Stone column:-

The method described for installing sand compaction pile or the vibro float described earlier can be used to construct stone column.

46) Black cotton soil is highly clayed soil they are found in many parts of the world. Such kind of soil generally consist of active clay mineral. Geotechnical engineer face various problem while designing foundation.

To overcome those problem

research concentrated on soil improvement technique by adding lime by adding lime to black cotton soil the pozzolonic reaction take place &

stabilization occur. They hydrated lime react with clay particle and permanently transform them into a strong cementitious matrix.