Q.1. A

Soils are used to support structures, to support pavement for highways, airport and dams. Some types of soils may be used in their natural state, while others may be excavated, processed, and compacted in order to serve their purpose, so the properties, characteristics, and behavior of soil must be known in order to design or construct projects involving the use of soils.
Blending and mixing heterogeneous soils to produce more homogenous soils. They may be mixed the soil during excavation by using equipment such as a power shovel or a deep-cutting belt loader to excavate through several layers in one operation. When such material is placed on a fill, it may be subjected to further blending by several passes with a disk harrow.

There are some properties have a direct effect on the ease or difficulty of handling earth , the selection of equipment, and the production rates of equipment.

When the volume of earth increases because of losing, this increase is defined as swell. It is expressed as a percent of the original undisturbed volume. If the earth removed from a hole having a volume of 1 Cu Yd. is found to have a loose volume of 1.25 Cu Yd. The gain in volume is 0.25 Cu Yd., or 25 percent when earth is placed in a fill and compacted under modern construction methods, it will usually have a smaller volume than in its original condition. This reduction in volume is the result of an increase in the density. This reduction in volume is defined as shrinkage

The plasticity index of soil with high clay content can be reduced by incorporating hydrated lime into the soil using a disk harrow or other stabilizing equipment such as the pulverize. The explanation for this soil improvement lies in a Base Exchange reaction occurring between the lime and clay particles, which cause the clay to agglomerate and become more granular and porous. After compaction a cementing reaction occurs between the lime and free silica and alumina in the clay, resulting in a substantial improvement in the strength and stability of the soil.

Asphalt such as Mc-3 or Rc-3 are mixed with granular soils, in amounts of 5 to 7 percent of the volume of soil. To produce more

stable soil. The moisture content of the soil must be low at the time the asphalt is added, also the volatile oils must be allow to evaporate from the bitumen before finishing and rolling the material. Soil treated in this manner may be used as finished surface for low traffic density secondary roads or as base courses for high-type pavement.

This method is economical and convenient where the soil is clay or silt and native deposits of gravel or rock are scarce. The ratio of cement to soil is from 5 to 7 percent by weight.

Part b

Dewatering is a process in which groundwater contained within the site's soil is extracted , ensuring a stable foundation

1.Open dewatering 2.Well point dewatering 3.Deep well dewatering 4.General Sump pumping

1. Open dewatering : It enable one to lower the groundwater table adequately in cohesive and low permeable soils. Water is pumped off directly from sumps (ditches) along the toes of the slopes of the excavation works.The suction hose with strainer is merely placed in the sump and the collected water is primered and discharged. This makes the open dewatering system easy to install and simple to operate. The open dewatering system utilizes:

1. self priming 2. vacuum assisted centrifugal pumps, 1. Well point dewatering s

2. Well point dewatering : 1. Well point dewatering systems enable one to lower the groundwater table adequately for deep and large construction sites. 2.It has proven to be a very flexible system. The water from high permeable soils is pumped from well points, installed along the trench of the site. 3.The well points are jetted and spaced to obtain an efficient drawdown against lowest capacity.4

The well point with integral strainer are jointed to transparent flexible hoses, which are connected by quick release couplers to the ring main header pipeline. 5.Well point dewatering is done either by gravity.

3. Deep well dewatering: Deep well dewatering systems enable one to lower the groundwater table to a considerable depth. A submersible pump is installed at the bottom of the well, of which the casing generally has a minimum diameter of 150 mm. The discharge pipes from the submersible pumps of a number of adjacent wells are connected to a common delivery main. The water is raised from the well by a multi-staged pump

4. general sump pumping: Sump Pumps are used in applications where excess water must be pumped away from a particular area. They generally sit in a basin or sump that collects this excess water This classification includes bilge and ballast pumps, centrifugal pumps, cantilever pumps, sewage pump pumps, submersible sump pumps and utility pumps, among others

Q.2 A

What do you understand about soil nailing? Under what condition the soil nailing is preferable?

ANS:

Soil Nailing is a technique to reinforce and strengthen ground adjacent to an excavation by installing closely spaced steel bars called “nails”, as construction proceeds from top down.

It is an effective and economical method of constructing retaining wall for excavation support, support of hill cuts, bridge abutments and high ways.

The nails are subjected to tension compression, shear and bending moments.

History of Soil Nailing:

Technique came from New Austrian Tunneling Method in 1960.

Stabilization works in underground tunnel in Europe in 1970.

The first recorded use of soil nailing in its

Modern form was in France in 1972.

The United States first used soil nailing in 1976 for the support of a 13.7 m deep foundation excavation in dense salty sands.

FAVOURABLE CONDITION OF NAILING:

Critical excavation depth of soil is about 1-2 m high vertical or nearly vertical cut.

All soil nails within a cross section are located above groundwater table.

FAVOURABLE SOILS:

Stiff to hard fine grained soils, dense to very dense granular soils with some apparent cohesion, weathered rock with no weakness planes and glacial soils etc.

UNFAVOURABLE SOILS:

Dry, poorly graded cohesion less soils, soils with cobbles and boulders, soft to very soft fine grained soils, organic soils.

ADVANTAGES:

- 1 With the right soil and site conditions, a rapid and economical means of constructing earth retention support systems and retaining walls.
- Shorter drill holes.
- Smaller diameter bars at shorter lengths.
- Retaining walls are secured laterally into the soil, eliminating piles and foundation footers.
- Grouting only once is required, saving time and labor.
- The technique is flexible, easily modified

DISADVANTAGES:

- Nail encroachment to retained ground rendering unusable underground space
- Tendency of high ground loss due to drilling technique, particularly at course grained soil
- Less suitable for course grained soil and soft clayey soil, which have short self-support time, and soils prone to creeping
- Suitable only for excavation above groundwater

CONCLUSION:

Since this process is effective in cohesive soil, broken rock, shale, or mixed face conditions it permits flexibility to conform to a variety of geometric shapes to meet specific site needs.

Due to its rather straightforward construction method and is relatively maintenance free, the method has gained popularity in India for highway and also hillside development projects. Soil nailing is an economical means of creating shoring systems and retaining walls.

Part **B:**

Grout is a construction material used to embed rebars in masonry walls, connect sections of pre-cast concrete, fill voids, and seal joints (like those between tiles). ♦ Grout is generally composed of a mixture of water, cement, sand, often color tint, and sometimes fine gravel (if it is being used to fill the cores of cement blocks). It is applied as a thick liquid and hardens over time, much like mortar. ♦ Initially, its application confines mainly in void filling, water stopping and consolidation. Nowadays, it extends to alleviate settlement of ground caused by basement and tunnel excavation works, to strengthen ground so that it can be used as a structural member or retaining structure in solving geotechnical problems

Grouting is the process to inject grout into the ground. Hence, the volume of the ground ready to accept grout is the primary consideration before any other considerations. ♦ GROUT can be defined as a solution, an emulsion or suspension in water, which will harden after a certain time b. Liquid Grout or Solution Grout. interval. It can be divided into two main groups: ♦ a. Suspension Grout ♦ ♦ Suspension grout is a mixture of one or several inert materials like cement, clays etc. suspended in a fluid -- water. According to its dry matter content it is either of the stable or unstable type. suspension grout is a mixture of pure cement with water. ♦ Liquid grout or solution grout consists of chemical products in a solution or an emulsion form and their reagents. The most frequently used products are sodium silicate and certain resins.

Q.3.

<u>Part A</u>

Causes:

Mechanical properties are notadequate • Swelling and shrinkage • Collapsible soils • Soft soils • Organic soils and peatysoils • Sands and gravellydeposits. • Foundations on dumps and sanitarylandfills • Handling dredged materials • Handling hazardous materials in contactwith soils • Use of old mine pits

(1)To increase the bearing capacity
(2) To control deformations and accelerate consolidation
(3) To provide lateral stability
(4) To form seepage cut-off and environmental control
(5) To increase resistance to liquefaction

Part B:

Expansive Soil Can Cause Foundation Problems. Expansive spoil is distinguished by the presence of swelling clay minerals that can absorb a significant amount of water molecules. When expansive soils obtain moisture, they expand or swell up. Likewise, when expansive soils lose moisture, they begin to shrink.Since foundation walls are designed to support loads from above rather than lateral (sideways) bearings, expanding soil can cause foundation problems. Hence, when rain or improperly channeled water enters too quickly and oversaturates your backfill soil, that excess water will exert immense pressure against your foundation walls. This is known as hydrostatic pressure.

The Problem with Hydrostatic Pressure

Water is heavy! And it can build up underneath the floor, pushing upwards against your foundation. This is known as hydrostatic pressure and will enter the home through any weak point it can find.

When that pressure bearing down becomes greater than your below ground basement or crawl space walls can handle, the affected walls will begin to crack, bow, and push inwards.

As pressure continues to build over time, what starts as a hairline crack will worsen and can eventually result in extreme wall failure, typically in the form of buckling, shearing, or even complete collapse.

In addition to hydrostatic pressure caused from heavy or steady rains, factors such as expansive clay (which all homes in Georgia reside on) and water thawing too quickly after a winter freeze can also create too much stress on basement walls, causing them to crack, bow, and deteriorate.

Q.4.A

Stone columns are extensively used to improve the bearing capacity of poor ground and reduce the settlement of structures built on them. A stone column is one of the soil stabilization methods that is used to increase strength, decrease the compressibility of soft and loose fine graded soils, accelerate a consolidation effect and reduce the liquefaction potential of soils. They are mainly used for stabilization soft soil such as soft clays, silts and silty-sands. It is believed that this method was used first in France in 1830s. This method is in wide range of use especially in Europe since 1950s. The columns consist of compacted gravel or crushed stone arranged by a

vibrator. This article presents installation methods, design and failure modes of stone columns.

Stone columns are installed using either top- or bottom-feed systems, either with or without jetted water. The top-feed method is used when a stable hole can be formed by the vibratory probe. With the dry method (top or bottom-feed), the probe is inserted into the ground and penetrates to the target depth under its own weight and compressed air jetting (Taube and Herridge, 2002). Most widely used methods for installation of stone columns are: • Vibro-Replacement (Wet, Top Feed Method) • Vibro-Displacement (Dry, Top and Bottom Feed Method) The construction of stone columns is generally carried out using either a replacement or a displacement method. In the displacement or dry method, native soil is displaced laterally by a vibratory probe using compressed air. This installation method is appropriate where ground water level is low and in situ soil is firm. This method is shown in the Figure 1 and Figure 2. In the replacement or wet method, native soil is replaced by stone columns in a regular pattern where the holes are constructed using a vibratory probe accompanied by a water jet. This method is shown in the Fig. 3 (Lee and Pande, 1998)

Blasting is the use of buried explosives to cause the densification of loose cohesion less ground. The principal is that the blasting of explosives in a predetermined pattern causes liquefaction, followed by the expulsion of pore water and subsequent densification of the ground. Blast densification is being utilized for more than 80 years to densify loose, saturated sand deposits.

The aim of this ground-improvement technique is to densify and improve the engineering characteristics of loose sand deposits and thus prevent or minimize the effects of liquefaction during an earthquake. The liquefaction of loose, saturated sands due to seismically induced ground motions continues to be the major source of damage to facilities and loss of human lives after severe earthquake events.

- Series of boreholes are drilled and Pipe of 7.5 to 10 cm is driven to the required depth
- The detonator and the dynamic sticks are both enclosed in a water proof bundle and is lowered through casings
- Casing is withdrawn and a wad of paper or wood is placed against the charge of Explosive (To protect it from misfire)
- Boreholes are backfilled with sand to obtain full force of blast
- The charge is fired in definite pattern

- **Blasting is more effective in loose sands that contain less than 20% silt and less than 5% clay. In case of partial saturated soil, the capillary action obstructs the densification tendency by preventing soil particles to come close. So this method is not useful for partial saturated soils. When deeper deposits are in question, the blasting is done in stages. Repeated shots are more effective than a single larger one.**

Part. B

Black cotton soils are boon to agriculture but are proved to be serious threat to construction founded on it. These soils have the property of high swelling due to imbibing of water in monsoon and

shrinkage due to evaporation of water in summer seasons. This swelling and shrinkage nature is attributed to the presence of mineral montmorillonite. Because of this high swelling and shrinkage nature, the structures constructed on these soils experience cracks, making it unsuitable for foundation. Hence there is a need for improving black cotton soil to suite as foundation material.

Over the past few decades, stabilization is found to be the best technique for reducing the swelling and shrinkage nature of black cotton soil. Various researchers had tried stabilizing black cotton soil using lime, cement, fly ash, rich husk ash, etc. [1–5]. Of these, lime stabilization is one of the techniques which is in use for stabilizing black cotton soil from the past few decades. Use of lime reduces the high plasticity of black cotton and makes it workable. Also reaction between lime and soil makes the soil-lime mixture more strength resistant [1]. But in recent days, the cost of lime has increased. This resulted in increase of cost of lime stabilization of soil [2]. Also in the present study, an attempt is made in stabilizing the black cotton soil with lime which turned out to be unsuitable as subbase material. Hence the need for alternative and cost-effective materials has aroused.