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Subject : Ground Improvement Techniques.

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CONO:1 (A)

ANS:- There are various techniques used for the improvement of the soil based on the construction activity and type of soil. The soil improvement techniques are,

1) Surface Compaction:-

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

2) Drainage Methods:-

Ground water is one of the most difficult problems in excavation work. The presence of water increases the pore water pressure and decreases the shear strength. Further heavy inflow of water to the excavations is liable to cause erosion or collapse. Common drainge methods are well-point systems, Deep-well drainge, Vacuum Detwatering system etc.

3) Vibration Methods:.

Viberation methods can be effectively used for rapid densification of saturated non-cohesive soils. viberations and shock waves in loose deposits of such materials cause liquefaction followed by densification accompanying the dissipation of excess pore water pressures. some of the mostly adopted vibration methods are blasting, viberation probe, vibratory rollers, vibro displacement compaction piles, vibrofloatation, Heavy Tamping etc.

4) Pre-Compression and Consolidation:.

This method aims to consolidate the soil before construction. Various techniques adopted are preloading and surcharge fills, vertical drains, Dynamic consolidation, Electro osmotic consilidation etc

5) Grounting and injection:.

Grounting is a process whereby stabilizers, either in the form of suspension or solution are injected into subsurface soil or rock for one or more of the following.

- Control of ground water during construction.
- Void filling to prevent excessive settlement.
- strengthening adjacent foundation soils to protect them against damage during excavation, pile driving etc.
- soil strengthening to reduce lateral support requiremets
- Stabiliazation of loose sands against Liquefaction.
- Foundation underpinning.

(6) Chemical stabilization :-

Chemical stabilization has been widely used in the form of lime, cement, fly ash and the combination of the above is widely used in soil stabilization. chemical stabilization reduce permeability of the soils, improve shear strength, increase bearing capacity, decrease settlement settlement and expedite construction.

(7) Soil Reinforcement :-

Soil Reinforcement is in the form of a weak soil reinforcement by high-strength thin horizantal membrances. A large variety of materials such as rubber, aluminum and thermoplastics have been used sucessfully.

(8) Geotextiles and Geomembranes :-

Geotextiles are porous fabrics manufactured from synthetic materials, which are primarily Petroleum products and others, such as polyester, polyethylene, Polyporplene and polyvinyl chlorid, nylon, fiber glass and various mixtures of these Geotextiles are used as separators, filters, drains etc.

9) Other Methods :-

Other Methods include Thermal methods, moisture barriers, Prewetting, addition or removal of soils etc

Q No.1 (B) There are four important dewatering methods one should be aware of:

(1) Wellpoint method of dewatering.
(2) Eductor wells.
(3) Open Sump Pumping and.
(4) Deep Wellpoint method.

WELLPOINT METHOD OF DEWATERING:-

(i) A series of wells of required depth are created in the vicinity of the excavated area from where the water has to be pumped out. The wells are arranged either in a line or a rectangular form where the wellpoints are created at a distance of at least 2m from each other.

(ii) Riser pipes or dewatering pipes are then installed into those closely spaced wells which on the surface are connected to a flexible swing pipe which is ultimately Appended to a common header pipe that is responsible for discharging the water away from the site.

(2) EDUCTOR WELLS METHOD OF DEWATERING EXCAVATION:

The method is very similar to the wellpoint method of dewatering; the only difference lies in the usage of high-pressure water in the risers units instead of vaccume to draw out water from the wellpoints The method uses the venturi principle which is the reduction in fluid pressure that results when a high-pressure fluid flows through a constricted section of a pipe. The biggest advantage of using eductor system is, the water table can be lowered from depth of 10-45m if multiple pumps are operated from a single pump section.

(3) OPEN SUMP PUMPING METHOD OF DEWATERING EXCAVATION:

This is the most common and economical method of dewatering as gravity is the main playing force. Sump is created in the excavated area into which the surrounding water converges and accumulates facilitating easy discharge of water through robust solid handling pumps. If the excavation area is large, several sumps may be placed along the longer side or simply use a long narrow sump which is called a ditch.

(4) DEEP WELL METHOD OF DEWATERING Excavation:-

Just like the wellpoint method, wells are drilled around the excavated area, but the diameter of wells in this case, varies b/w 150-200m. By creating deep wells around the vicinity, the groundwater is made to fall into them under the influence of gravity.

As a result, the groundwater level in the surroundings would decline. According to the type and arrangement of pumps, the depths of the wells could reach up to 30m. This method is generally adopted when a heavy amount of water from the ground has to be drawn out.

Q No. 9 PART (A) :-

ANS :- **SOIL NAILING** :- soil nailing is a construction remedial measure to treat unstable natural soil slopes or as a construction technique that allows the safe over-steepening of new or existing soil slopes. The technique involves the insertion of relatively slender reinforcing elements into the slope - often general purpose reinforcing bars (rebar) although proprietary solid or hollow-system bars are also available. Solid bars are usually installed into pre-drilled holes and then grouted into place using a separate grout line - whereas hollow bars may be drilled and grouted simultaneously by the use of a sacrificial drill bit and by pumping grout down the hollow bar as drilling progresses.

These are the conditions under which soil nailing is prefarable.

* The main considerations for deciding whether soil nailing will be appropriate include; the ground conditions, the suitability of other systems, such as ground anchors, geosynthetic materials, and so on and cost.

Q2 (A)

Although soil nails are versatile and can be used for a variety of soil types and conditions, it is preferable that the soil should be capable of standing without supports to a height of 1-2 m for no less than 2 days when cut vertical or near-vertical.

Soil which are particularly suited to soil nailing include clays, clayey silts, silty clays, sandy clays, glacial soils, sandy silts, sand, gravels. soil nailing can be used on weathered rock as long as the weathering is even (i-e without any weakness planes) throughout the rock...

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Q No. 3 (A): WHY GROUND IMPROVEMENT TECHNIQUES ARE REQUIRED?

Ground improvement techniques are used when the behaviour of the fill mass and/or the underlying soil does not meet required design criteria.

Ground improvement is carried out to:

* Prevent excessive settlements of the surface of the reclamation area when structures like buildings roads and other foundations are loaded on it;
* improve shear strength of the fill and subsoil to ensure sufficient bearing capacity of the foundation and/or sufficient stability of the slopes;
* Increase the density of the fill mass and/or subsoil to prevent liquefaction; and
* Improve soil permeability in order to increase drainage capacity.

Q No. 3 (B) VARIOUS GEOTECHNICAL Problem of expansive soil:-

Case examples of some geotechnical applications. Expansive soil is considered to be one of the more problematic soils and it causes damage to various civil engineering structures because of its swelling and shrinking potential when it comes into contact with water. Expansive soil behave differently from other normal soils due to their tendency to swell and shrink. Because of this swelling and shrinking behaviour, expansive soils may cause the following problems in structures of construction projects:

- ★ structural damage to lightweight structures such as sidewalks and driveways
- ★ Lifting of buildings, damage to basements, and building settlement.
- ★ Cracks in walls and ~~ceil~~ ceilings.
- ★ Damage to pipelines and other public utilities.

Q No. 4 (A)

Ans: Stone column 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 liquefication potential of soils. They are mainly used for stabelization soft soil such as soft clays, silts and silty-sands.

Q4 Part (B)

ANS: Labortory model footing tests has been carried out on embedded, single stone column with and without encasement of geosynthetic of different grades in black cotton soil. Experiments are conducted to find out the arrangement keeping diameter and length of the stone column varying. The model tests are conducted in a steel cylindrical tank of diameter 250mm and height of 300mm. The small scale model footing tests are conducted on unreinforced and reinforced black cotton soil.