

Internal Assessment Test 1 – April. 2023

Sub:	Applied Geotechnical Engineering					Sub Code:	18CV62	Branch:	Civil Engg		
Date:	25.04.2023	Duration:	90 min's	Max Marks:	50	Sem / Sec:	6 th A			OBE	
<u>Answer any FIVE FULL Questions</u>								MARKS	CO	RBT	
1 (a)	What is subsurface exploration? And what are the objectives of soil exploration?					[10]	CO1	L2			
2 (a)	What are geophysical methods? Explain seismic refraction method with neat sketch.					[10]	CO1	L1			
3 (a)	Explain briefly spacing and depth of boring adopted for various civil engineering structures. (With neat sketches).					[10]	CO1	L2			
4 (a)	List the different methods of boring. Explain any two methods with a neat sketch.					[10]	CO1	L2			
5 (a)	What are the different methods available for dewatering? Explain dewatering by well point system.					[10]	CO1	L1			
6 (a)	Briefly explain the components of settlement. And what is Borehole log?					[10]	CO2	L2			
7 (a)	A clay layer of 9m thickness underlies a proposed building. The existing overburden pressure at the center of the clay layer is 290Kpa & the loads due to the new building increase the pressure by 100Kpa. $C_c=0.45$, $w=50\%$, $G=2.70$. Estimate the settlement.					[10]	CO2	L3			

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IAT 1 scheme & solution

Subject: Applied Geotechnical Engineering (18CV62)

1. What is subsurface exploration? And what are the objectives of soil exploration?

Answer:

"The field and laboratory investigations required to obtain necessary data regarding the soil, for proper design and successful construction of any structure at the site are collectively called soil exploration."

Objectives of soil exploration

Soil investigations are done to obtain the information that is useful for one or more of the following purposes:

1. To know the geological condition of rock and soil formation.
2. To establish the groundwater levels and determine the properties of water.
3. To select the type and depth of foundation for proposed structure
4. To determine the bearing capacity of the site.
5. To estimate the probable maximum and differential settlements.
6. To predict the lateral earth pressure against retaining walls and abutments.
7. To select suitable construction techniques
8. To predict and to solve potential foundation problems
9. To ascertain the suitability of the soil as a construction material.
10. To determine soil properties required for design
11. Establish procedures for soil improvement to suit design purpose

12. To investigate the safety of existing structures and to suggest the remedial measures.
13. To observe the soil the soil performance after construction.
14. To locate suitable transportation routes.

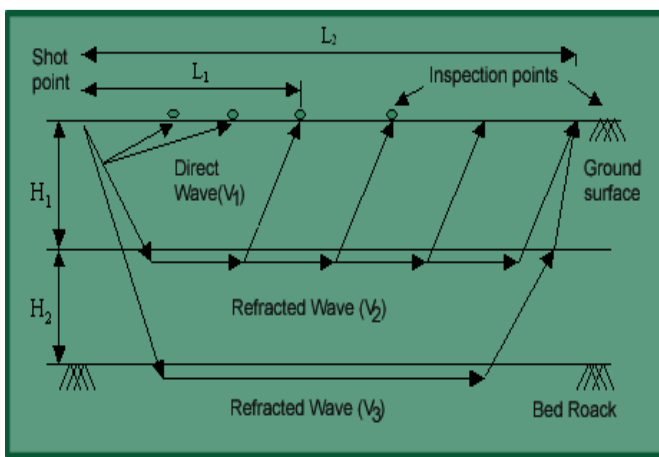
2. What are geophysical methods? Explain seismic refraction method with neat sketch.

Answer:

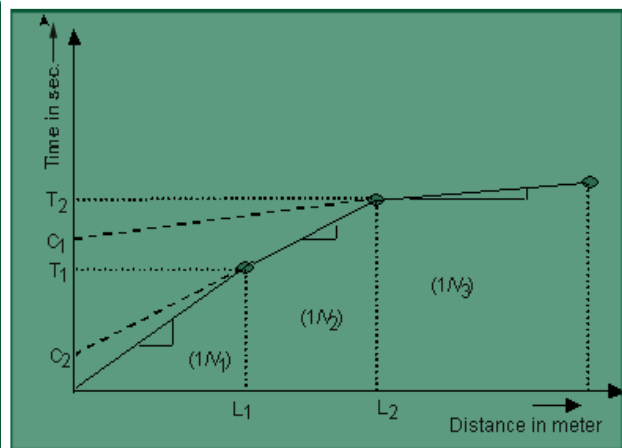
Indirect method: From surface measuring certain physical properties interpret the subsurface soil properties and based on the changes in **gravitational, magnetic, electrical, radioactive or elastic** properties of the different elements of the subsoil.

Seismic refraction method:

- ✓ Based on the fact that seismic waves have different velocities in different types of soils (or rock) and besides the wave refract when they cross boundaries between different types of soils.
- ✓ Shock waves are created into the soil by exploding small charges or by striking a plate on the soil with a hammer. These waves are classified as direct, reflected and refracted waves.
- ✓ Radiating shock waves are picked up by geophones, where the time of travel gets recorded.
- ✓ Either a number of geophones are arranged along a line or shock producing device is moved away from the geophone.
- ✓ The direct wave travel in approximately straight line from the source of impulse. The reflected and refracted wave undergoes a change in direction when they encounter a boundary separating media of different seismic velocities.
- ✓ Results are plotted as a graph shown in figure below.
- ✓ Suited for the shallow explorations for civil engineering purpose.



Seismic refraction method



Graph of Time vs Distance

3. Explain briefly spacing and depth of boring adopted for various civil engineering structures. (With neat sketches).

Answer:

- Number and spacing of boreholes must be such as to reveal any major changes in the thickness, depth and properties of strata over the base area of the structure and its immediate surroundings.
- More uniform strata-less no: of BH and more spacing can be adopted
- Erratic variation-more no: of bore holes at reduced spacing
- Wherever possible, BH must be sunk close to the proposed foundation, especially in soils of erratic variation
- When layout not planned before-Best pattern is evenly spaced grid of BH
- ConepenetrationtestscanbeperformedTevery50mintervals
- Gravelly and boulderous strata-CPT not feasible, hence geophysical methods adopted

UNIT	NO OR SPACING OF BORE HOLES
Small & less important buildings	1 at centre may suffice.
Compact buildings (covering an area of 0.4 hectares)	At least 5 (1 at centre & 4 at corner).
Large multistoreyed buildings	At all important locations, spacing should be 10 to 30m.
Highways	Along centre line, spacing should be 150 to 300m.
Concrete dams	Spacing generally varies between 40 to 80m.

4. List the different methods of boring. Explain any two methods with a neat sketch.

Answer:

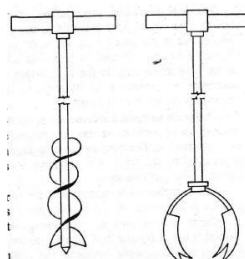
Boring refers to advancing a hole in the ground, used especially when $D > 6m$

Types:(1)Augerboring(2)Washboring(3)Percussiondrilling(4)Rotarydrilling(5)Coredrilling

Auger Boring

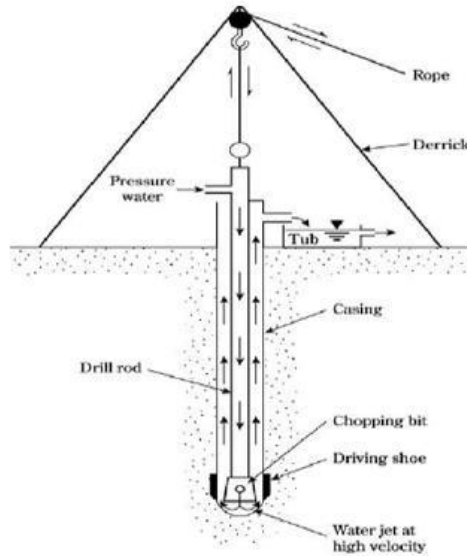
Helical auger Post hole auger

- ✓ Suitable for cohesive and other soft soils at shallow depths .
- ✓ Hand augers are suitable for a maximum depth of 6m beyond which mechanical augers may be used.
- ✓ Samples obtained by auger boring are disturbed and hence suitable for identification purpose alone.



Wash Boring

- ✓ Wash boring relies on relatively little drilling action and can form a hole primarily by jetting. This can be undertaken with light equipment without the need for a drilling rig. Suitable for all types of soils but not for rocks and boulders.
- ✓ It consists of driving a casing through which a hollow drill rod with a sharp chisel at the lower end is inserted.
- ✓ Water is forced under pressure through the drill rod.
- ✓ The resulting chopping and jetting action of the bit and water disintegrates soil.
- ✓ Cuttings are then forced up through the spacing between drill rod and casing.

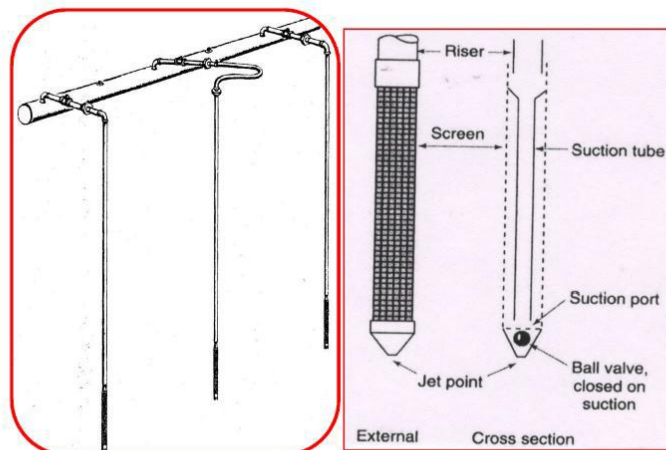


5. What are the different methods available for dewatering? Explain dewatering by well point system

Answer: Methods of dewatering

The ground water table may be lowered by the following methods:

- (1) Ditches and sumps (2) Well point system (3) Shallow well system (4) Deep well system (5) Vacuum method (6) Electro-osmosis method.



a) Well point assembly
b) Details of well point assembly
Fig.2.4 Well point system

A well point system consists of a number of well points spaced along a trench or around an excavation site.

- ✓ These well points in turn are all connected to a common header that are attached to one or more well point pumps.

- ✓ Well point assemblies-are made up of a well point, screen, riser pipe, and flexible hose swinger and joint with tuning.
- ✓ These are generally installed by jetting.
- ✓ They provide for entry of water into the system by creation of a partial vacuum.
- ✓ The water is then pumped off through the header pipe.

Advantages of well point system

- ✓ Installation is very rapid
- ✓ Requires reasonably simple and less costly equipment
- ✓ Water is filtered and carries little or no soil particles.
- ✓ There is less danger of subsidence of the surrounding ground than with open-sump Pumping.

6. Briefly explain the components of settlement. And what is Borehole log?

Answer:

The settlement in any soil mass under an applied stress is given by

$$S = S_i + S_C + S_S$$

where,

S = total settlement,

S_i = immediate (or elastic) settlement,

S_C = primary consolidation settlement, and

S_S = secondary consideration settlement

I - (S_e) - Elastic Settlement / Immediate Settlement

Immediate Settlement, S_e is that part of the total settlement 'S' which is supposed to take place during the application of loading.

- Immediate Settlement may be estimated from elastic theory.
- It occurs in all types of soil due to elastic compression.
- It depends on the elastic properties of foundation soil, rigidity, size E_s shape of foundation.

Immediate Settlement of cohesive soil is given by

$$S_i = q B I_{ef} \left[\frac{1-\mu^2}{E_s} \right]$$

where q = intensity of load
 B = Breadth of given footing
 μ = poisson's ratio
 E_s = young's modulus
 I_{ef} = influence factor

II Consolidation Settlement :-

The consolidation settlement is that part which is due to the expulsion of pore water from the voids and is time-dependent Settlement.

- It occurs due to the process of consolidation.

Consolidation Settlement is normally consolidated clayey soil is given by

$$S_c = \left[\frac{C_c}{1+e_0} \right] H \log \left(\frac{\sigma_0 + \Delta\sigma}{\sigma_0} \right)$$

where C_c = Compression index

e_0 = Initial void ratio

H = thickness of clay layer

σ_0 = Initial overburden pressure at the middle of clay layer.

3. Secondary Consolidation:-

- This settlement starts immediately after the consolidation settlement is completely over.

Some soil exhibit time dependent settlement at constant effective stress. This is known as Secondary consolidation.

- This settlement becomes important for certain type of soil such as peat & soft organic clay.

Borehole (BH) log

BORING LOG/ BORE HOLE LOG

- Information on subsurface conditions obtained from the boring operation is typically presented in the form of a boring record, commonly known as "boring log".
- A continuous record of the various strata identified at various depths of the boring is presented.
- Description or classification of the various soil and rock types encountered, and data regarding ground water level have to be necessarily given in a pictorial manner on the log.

7. A clay layer of 9m thickness underlies a proposed building. The existing overburden pressure at the center of the clay layer is 290Kpa & the loads due to the new building increase the pressure by 100Kpa. $C_c=0.45$, $w=50\%$, $G=2.70$. Estimate the settlement.

Answer:

7.9

Given: $H=9m$, $\sigma_0=290 \text{ kPa}$, $\Delta\sigma=100 \text{ kPa}$, $w=50\%$, $C_c=0.45$, $G=2.70$

$e_s = w \cdot G$
 $e_{s1} = 0.5 \times 2.7$
 $e_s = 1.35$

$S_c = \frac{C_c \times H \log_{10} \left[\frac{\sigma_0 + \Delta\sigma}{\sigma_0} \right]}{1 + e_s}$

$S_c = \frac{0.45 \times 9 \times \log_{10} \left[\frac{290 + 100}{290} \right]}{1 + 1.35}$

$S_c = 1.71 \times \log_{10} (1.344)$

$S_c = 0.2195 \text{ m}$
$S_c = 219.56 \text{ mm}$

MI NOTE 7 PRO