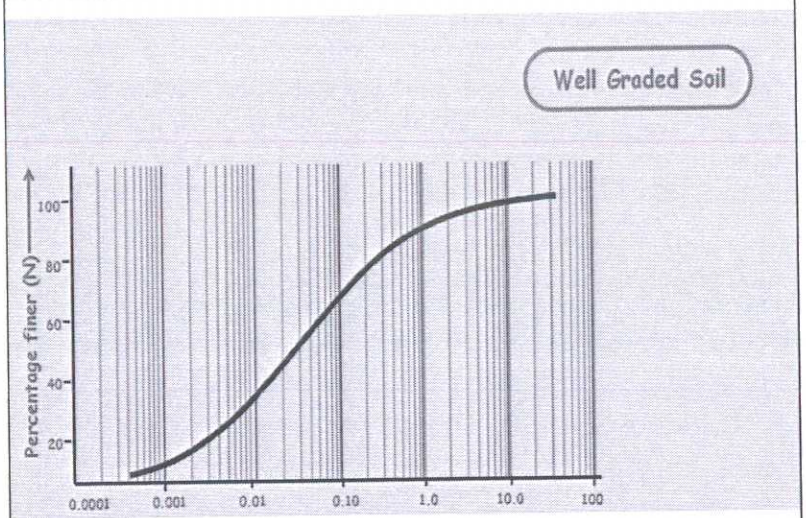
SCHEME OF EVALUATION

Scoring Indicators

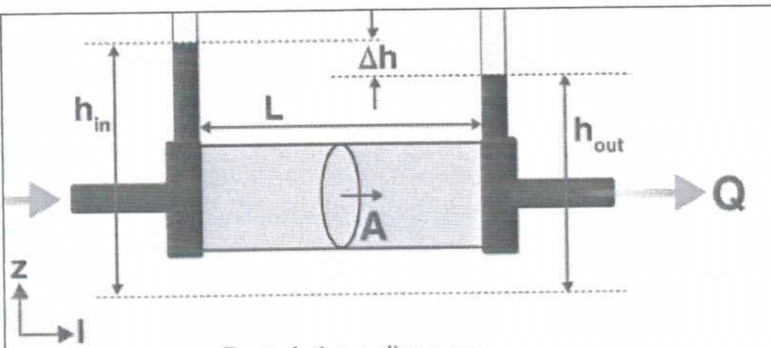
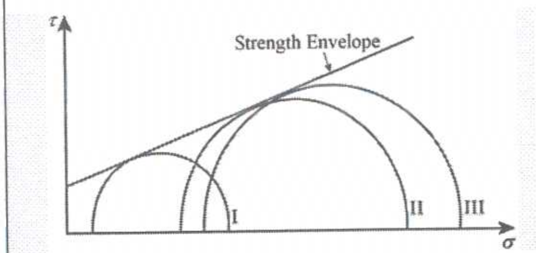
COURSE NAME : GEOTECHNICAL ENGINEERING

COURSE CODE : 4011 **QID :** 2103230188

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	Colluvial soil		1	
I. 2	It is the ratio of the natural water content of a soil minus its plastic limit to its plasticity index $I_L = \frac{w - w_P}{I_P}$		1	
I. 3	1.Grain size/ Particle size: size and shape of particles 2. Properties of pore fluid 3. void ratio of the soil 4. Structural arrangement of soil particles 5. Entrapped air and foreign matter 6. Stratification ***Mention any two points. Each point carries 0.5 marks***		1	
I. 4	**Cohesive soils** are a type of soil that in which there is inter-particular attraction and rely on surface forces. eg: clay, silt **Cohesionless soils** are soils in which the particles do not adhere to each other and rely on friction. eg: sand, gravel	0.5 0.5	1	
I. 5	The line showing the dry density as a function of water content for soil containing no air voids is called **zero air voids line**		1	
I. 6	**Ultimate bearing capacity**: gross pressure intensity at base of foundation at which the soil fails in shear **Safe bearing capacity:** the maximum pressure which the soil can carry safely without the risk of shear failure	0.5 0.5	1	
I. 7	1.Pits 2. Trenches 3. Drifts 4.Shafts ***Mention any two Methods. Each point carries 0.5 marks***		1	
I. 8	1.To select type and depth of foundation 2. To determine bearing capacity of soil 3. To select suitable construction methods and materials			

	4. To analyze the safety or causes of failure of existing structures and suggest remedial measures 5. To obtain information about soil ,hydrological and geological conditions 6. To know engineering properties of soil 7. To estimate maximum probable settlement of soil 8. to establish ground water level and properties of water ***Mention any two points Each point carries 0.5 marks***		1	
I. 9	Raft/ Mat Footing		1	
	PART B			24
II. 1	**Density Index:** ratio of the difference between the voids ratio of the soil in its loosest state and its natural voids ratio to the difference between voids ration in loosest and densest states $I_D = (e_{max} - e)/ (e_{max} - e_{min})$ **Degree of saturation:** it is defined as the ratio of volume of water present in a given soil mass to the total volume of voids in it $S = V_w / V_v$ **Water content:** It is the ratio of weight of water to the weight of solids in a given mass of soil $w = W_w / W_d$	1 1 1	3	
II. 2	 Particle Diameter (mm) For Coarse Grained soil D_{10}, D_{30}, and D_{60} size of particle holds higher significance & can be found	1	3	

	using the particle size distribution curve **<u>Uniformity Coefficient (Cu)</u>** It represents particle size range of distribution curve. It is defined as ratio of D_{60} size of particles to the D_{10} size of particles. $C_c=D_{60}/D_{10}$ **<u>Coefficient of Curvature (C_c)</u>** It represents shape of particle size distribution curve. It is defined as $C_c=D_{30}^2/(D_{60}\cdot D_{10})$	2		
II. 3	**<u>Internal Friction:</u>** It is an internal force that resists the movement between the particles of soil **<u>Shear strength of soil</u>** It is the resistance to deformation by continuous shear displacement of soil particles or on masses upon the action of a shear stress	1.5 1.5	3	
II. 4	Darcy's law states that for laminar flow conditions in a saturated soil , the velocity of flow through the soil (v) is directly proportional to the hydraulic gradient (i). $\mathbf{v = ki}$ $\mathbf{q = vA = kiA}$ where 'k' is a constant called coefficient **of permeability** 'A' is the cross-sectional area of soil including both the solids and voids.	1.5	3	

	 Darcy's Law diagram ***Statement and equation: 1.5 marks*** ***Figure: 1.5 marks***	1.5		
II. 5	**Strength Envelope** The curve obtained when the normal and shear stress corresponding to failure are plotted 	1	3	
	Shear strength equation for purely cohesive soil $$\tau = c$$	1		
	Shear strength equation for cohesionless soil $$\tau = c + \sigma \tan\phi$$	1		
II. 6	Factors affecting compaction are as follows a) **Water content**: as the water content is increased, the compacted density goes on increasing, till a maximum dry density is achieved after which further addition of water decreases the density b) **Amount of compaction**: The effect of increasing the compactive energy results in an increase in the maximum dry density and decrease in optimum moisture content c) **Method of Compaction:** The variables in this aspect are (i) weight of the compacting equipment (ii) the manner of operation (iii) time and area of contact		3	

	d) **Type of soil:** Well graded coarse grained soils attain high density and lower optimum moisture content than fine grained soils e) **Addition of admixtures:** the compaction properties of soil can be modified by a number of admixtures ***Any three points with single line explanation***			
II. 7	The different field methods of compaction are a) **Rolling :** smooth wheel rollers, pneumatic tyred rollers , sheep foot rollers, lorries and pneumatic tyred construction plant, track laying vehicles b) **Ramming (by impact):** dropping weight type, internal combustion type, pneumatic type c) **Vibration:** the vibrating equipment mounted on screeds, plates or rollers are of two types : dropping weight type, pulsating hydraulic type		3	
II. 8	**Primary consolidation** ➢ Occurred due to the expulsion/extrusion of the water that occupies the void spaces. ➢ Primary consolidation settlement is a result of a volume change in saturated cohesive soils. ➢ Very slow and continues over a long period of time. **Secondary consolidation** ▪ Additional form of compression that occurs at constant effective stress at a very slow rate. ▪ Observed in saturated cohesive soils. ▪ Result of the plastic adjustment and rearrangement of soil fabrics. ▪ Occurs after the primary consolidation settlement ended	1.5 1.5	3	
II.9	**Wash Boring method**			

	➢ The method consists of first driving a casing through which a hollow drill rod with a sharp chisel or chopping bit at the lower end is inserted. ➢ Water is forced under pressure through the drill rod which is alternatively raised and dropped and also rotated. ➢ The cuttings are forced up to the ground surface in the form of soil-water slurry through the annular space between the drill rod and the casing. ➢ The change in soil stratification could be guessed from the rate of progress and the color of wash water.		3	
II.10	**a) <u>Based on Function</u>** 1. End bearing pile 2. Friction pile 3. Compaction pile 4. Tension or uplift pile 5. Anchor pile 6. Fender pile 7. Batter pile 8. Sheet pile ***Any 3 types -1.5 marks*** **b) Based on materials and composition** 1. Concrete piles: precast , cast in situ 2. Timber piles 3. Steel piles 4. Composite piles: concrete and timber, concrete and steel ***Any 3 types -1.5 marks***	1.5 1.5	3	

	PART C			42
III. 1	**<u>Void ratio and porosity</u>**			
	a) By the definition of **<u>porosity</u>**, we have, $n = V_v/V$			7
	Where, V_v = Volume of voids in a given soil mass.			
	V= Total volume of the soil mass = Volume of voids in the given soil mass(V_v) + Volume of soil solids in the given soil mass(V_s).			
	Thus, n = Vv / (Vv + Vs)			
	⟹ n = 1 / (1 + Vs/Vv) [Both sides diveded by Vv]	2.5		
	⟹ n = 1 / (1 + 1/e)		7	
	[By the definition of **void ratio** $e=V_v/V_s$]			
	⟹ **n = e / (1 + e)**			
	b) **<u>Void ratio, degree of saturation, water content & specific gravity</u>**			
	Let,			
	W_s= Weight of soil solid in a given soil mass. W_w = Weight of water. V_s = Volume of soil solid in a given soil mass. Vw = Volume of water present in the given soil mass. γ_s = Unit weight of soil solids γ_w= Unit weight of water By definition of **water content**, we can write			
	⟹ $w = \frac{W_w}{W_S}$			
	⟹ $w = \frac{\gamma_w V_W}{\gamma_S V_S}$ (1)	4.5		

	But $G = \frac{\gamma_s}{\gamma_w}$ ⇒ $\gamma_s = G\gamma_w$ (2) Also $S = \frac{V_w}{V_v}$ ⇒ $V_w = SV_v$ (3) Substituting (2) and (3) in (1) $w = \frac{\gamma_w V_W}{\gamma_S V_S}$ ⇒ $w = \frac{\gamma_w S V_v}{G\gamma_w V_S}$ ⇒ $w = \frac{SV_v}{GV_S}$ (4) But $e = \frac{V_v}{V_S}$ (5) Substituting (5) in (4) $w = \frac{Se}{G}$ $\boldsymbol{wG = Se}$			
III. 2	**APPARATUS REQUIRED** 1. Sand pouring cylinder 2. Tools for excavating holes 3. Cylindrical calibrating container 4. Balance to weigh unto an accuracy of 1g. 5. Metal containers to collect excavated soil. 6. Metal tray with 300 mm/450 mm square and 40 mm/50 mm deep with a 100 mm/200 mm diameter hole in the centre.	1		7

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7. Glass plate about 450 mm/600 mm square and 10mm thick.
8. Clean, uniformly graded natural sand passing through 1.00 mm I.S.sieve and retained on the 600micron I.S.sieve. It shall be free from organic matter and shall have been oven dried and exposed to atmospheric humidity.
9. Suitable non-corrodible airtight containers.
10. Thermostatically controlled oven with interior on non-corroding material to maintain the temperature between 105^{0}C to 110^{0}C.
11. A dessicator with any desiccating agent other than sulphuric acid.
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<u>Calibration of the Cylinder</u>

Fill the sand pouring cylinder with clean sand so that the level of the sand in the cylinder is within about 10 mm from the top.
Find out the initial weight of the cylinder plus sand (W_1) and this weight should be maintained constant throughout the test for which the calibration is used.
Allow the sand of volume equal to that of the calibrating container to run out of the cylinder by opening the shutter, close the shutter and place the cylinder on the glass sand takes place in the cylinder close the shutter and remove the cylinder carefully.
Weigh the sand collected on the glass plate. Its weight (W_2) gives the weight of sand filling the cone portion of the sand pouring cylinder.
Repeat this step at least three times and take the mean weight (W_2) Put the sand back into the sand pouring cylinder to have the same initial constant weight (W_1)

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<u>Determination of Bulk Density of Soil</u>

Determine the volume (V) of the container be filling it with water to the brim. Check this volume by calculating from the measured internal dimensions of the container.
Place the sand poring cylinder centrally on the top of the calibrating container making sure that constant weight (W_1) is maintained.
Open the shutter and permit the sand to run into the container.

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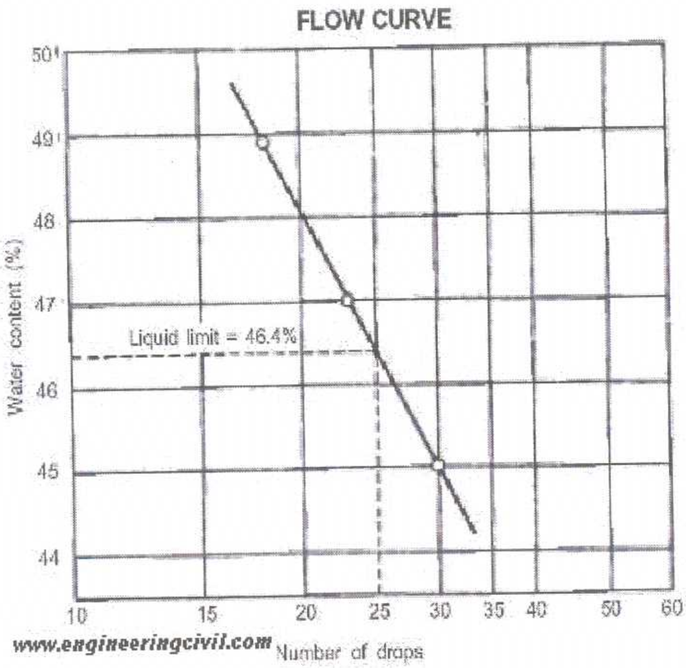
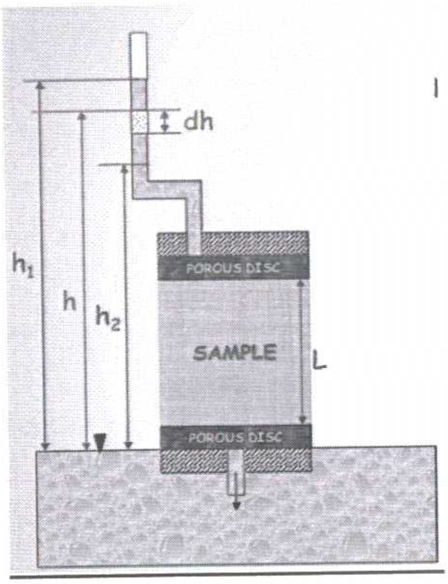
	➢ When no further movement of sand is seen close the shutter, remove the pouring cylinder and find its weight (W_3). **<u>Determination of Dry Density of Soil In Place</u>** ➢ Approximately 60 sqcm of area of soil to be tested should be trimmed down to a level surface, approximately of the size of the container. ➢ Keep the metal tray on the level surface and excavate a circular hole of volume equal to that of the calibrating container. ➢ Collect all the excavated soil in the tray and find out the weight of the excavated soil (W_w). ➢ Remove the tray, and place the sand pouring cylinder filled to constant weight so that the base of the cylinder covers the hole concentrically. ➢ Open the shutter and permit the sand to run into the hole ➢ . Close the shutter when no further movement of the sand is seen. ➢ Remove the cylinder and determine its weight (W_3). ➢ Keep a representative sample of the excavated sample of the soil for water content determination.	2		

III. 3	**<u>Consistency limits</u>** **<u>Liquid limit (w_L)</u>** Minimum water content at which the soil has the tendency to flow upon disturbance is the liquid limit **Plastic limit (w_P)** Minimum water content at which the soil is just in the plastic stage is the plastic limit **Shrinkage limit (w_S)** It is the minimum water content at which the soil is fully saturated **OR** Maximum water content below which there is no volume change **<u>Procedure for determination of liquid limit</u>** ➢ Place a portion of the paste in the cup of the liquid limit device. ➢ Level the mix so as to have a maximum depth of 1cm. ➢ Draw the grooving tool through the sample along the symmetrical axis of the cup, holding the tool perpendicular to the cup. ➢ After the soil pat has been cut by a proper grooving tool, the handle is rotated at the rate of about 2 revolutions per second and the no. of blows counted, till the two parts of the soil sample come into contact for about 10mm length. ➢ Take about 10g of soil near the closed groove and determine its water content ➢ The soil of the cup is transferred to the dish containing the soil paste and mixed thoroughly after adding a little more water. Repeat the test. ➢ By altering the water content of the soil and repeating the foregoing operations, obtain at least 5 readings in the range of 15 to 35 blows. ➢ Liquid limit is determined by plotting a 'flow curve' on a semi-log graph, with no. of blows as abscissa (log	3	7	7

	scale) and the water content as ordinate and drawing the best straight line through the plotted points ➢ Report the water content corresponding to 25 blows, read from the 'flow curve' as the liquid limit. A sample 'flow curve' is given as 	4		
III. 4	Mass of soil in cutter , M = 3195- 1286 = 1909 g Bulk density , $\rho = M/V = 1909/1000 = 1.909$ g/cm^3 Bulk unit weight , $\gamma = 9.81 \times \rho = 9.81 \times 1.909 = 18.73$ kN/m^3 ➡ $\gamma_d = \frac{\gamma}{1+w} = \frac{18.73}{1+0.12} = 16.72\ kN/m^3$ ➡ $\gamma_d = \frac{G\ \gamma w}{1+e}$	1 2	7	7

	$\Rightarrow \quad 1+e=\frac{\gamma_w G}{\gamma_d}$ $\Rightarrow \quad e=\frac{\gamma_w G}{\gamma_d}-1=\frac{9.81\times2.7}{16.72}-1=0.584$ But ,eS = wG $\Rightarrow$ S= wG/e = (0.12x2.70)/0.584 = 0.555= 55.5%	3 1		
III. 5	**Variable head permeability test**  **Procedure** ➢ Soil specimen of length 'L' and area 'A' is kept in a mould between two porous discs ➢ A vertical stand pipe of area 'a' is fitted on top of sample ➢ The whole assembly is placed in a constant head chamber ➢ The soil is allowed to get fully saturated ➢ The water in the stand pipe flows through the soil and overflows through the constant head chamber ➢ The water level in the stand pipe falls from h_1 to h_2 in time t Consider an instant at which the head is 'h' • At an infinitely small time 'dt' head falls by 'dh' Velocity of fall , v = -(dh/dt) (-ve as head decreases with time)	2 2	7	7

	• Now flow at this instant, q= a x v = - a (dh/dt) …….. (1) • From Darcy's law, flow through soil q= kiA = $k\frac{h}{L}A$ (as i=h/L) …. (2) • Equating (1) and (2) ➡ $k\frac{h}{L}A = -a\,\frac{dh}{dt}$ ➡ $\frac{Ak}{aL}\,dt = -(\frac{dh}{h})$ Head falls from h_1 to h_2 in time t ($t_2 - t_1$) Integrating on both sides ➡ $\frac{Ak}{aL}\int_{t_1}^{t_2} dt = -\int_{h_1}^{h_2}\frac{dh}{h}$ ➡ $\frac{Ak}{aL}[t]_{t_1}^{t_2} = -[\ln h]_{h_1}^{h_2}$ ➡ $\frac{Ak}{aL}(t_2 - t_1) = \ln(\frac{h_1}{h_2})$ Rearranging $\boldsymbol{k = \frac{aL}{At}\ln(\frac{h_1}{h_2})}$ $\boldsymbol{k = 2.303\frac{aL}{At}log_{10}(\frac{h_1}{h_2})}$	3		
III. 6	**APPARATUS** 1. Direct shear apparatus 2. Dial gauges 3. Weights **Procedure:** ➢ Measure the inside dimensions of the shear box. ➢ Assemble the two halves of the shear box together using connecting pins. ➢ Place the friction plate in the bottom box with its grooves perpendicular to the direction of shear.	1	7	7

	➢ Place sufficient quantity of soil in the shear box to the required density. ➢ Place the top friction plate parallel to the bottom one. ➢ Place the loading pad over the plate ➢ Transfer the shear box to the shear test apparatus ➢ Apply the desired normal load by putting load in the loading pan. ➢ Adjust the shear box so that it just touches the proving ring. ➢ Attach the dial gauges, which measure shear and normal displacements. Record the initial readings or set them to read zero. ➢ Separate the two halves of the shear box by removing the connecting pins and raise the upward frame slightly by turning the spacing screws.Start shear loading at a constant rate of strain of 1.25mm/min. ➢ Take readings on all the two dial gauges for every 2.5mm increment on proving ring dial gauge. ➢ Continue the test to failure at which the horizontal force becomes constant	4		

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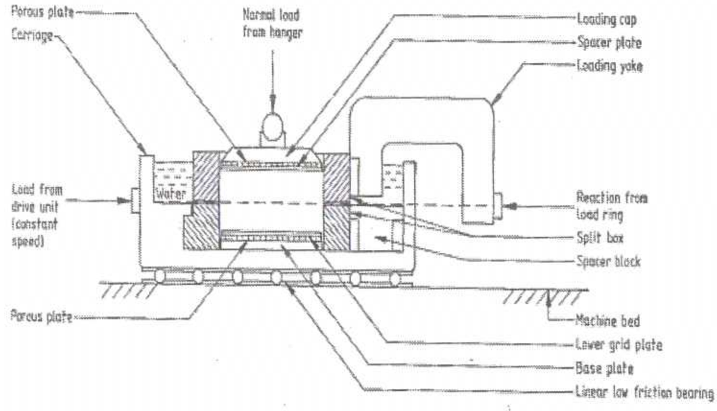
<td>

Apparatus – 1 mark

Procedure – 4 marks

Figure – 2 marks</td>
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<td>III. 7</td>
<td><u>Procedure for standard Proctor test</u>

➢ Find the volume of mould (V) by measuring its internal dimensions.

➢ Weigh the empty mould with the base plate, but without the collar (W_1).

➢ Take about 3kg of thoroughly mixed air dried soil passing through 20mm IS test sieve.

➢ Add sufficient water to the soil so as to bring the moisture content to about 8% to 10% below plastic limit of soil if the soil is cohesive. For sandy and gravelly soils, bring water content to 4 to 6%. Mix thoroughly

➢ Fill the mould with this soil mix for about 1/3rd height by placing the collar above it and smoothen its surface by gently pressing.

➢ Compact the soil in three equal layers with 25 evenly distributed blows of the rammer weighing 2.6kg with a free fall of 310mm.</td>
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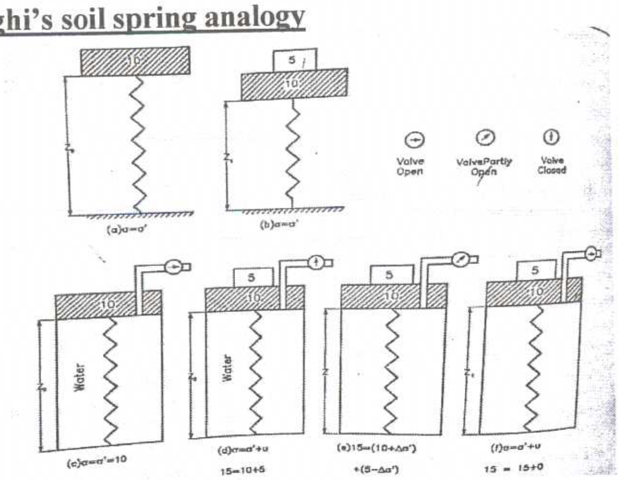
	➢ Scratch the previously compacted layer with a scale before beginning to compact the next layer. ➢ Remove the collar and trim off the soil above the top of the mould. ➢ Weigh the cylindrical mould with the base plate and the compacted sample (W_2). ➢ Remove the soil from the mould and take a representative sample for water content determination. The water content sample should be made up with specimens from the top, middle and bottom of the compacted soil. ➢ Repeat the above procedure with increasing water content until the total weight decreases or remains constant.			
III. 8	**<u>Terzaghi's soil spring analogy</u>**  	2	7	7

	Fig shows a spring with a piston on its top. Let the length of the spring be z_0 under a pressure of 10 units. Ifg 5 units of pressure are added to its top, the spring wil be compressed immediately to a length z_1. A further application of load will result in further decrease in the length of spring. If this spring and piston is placed in a cylinder containing water up to the bottom of the piston , 10 units of pressure applied with valve open, water will be free of stress, since the whole load is carried by the spring alone. If the pressure on the piston is increased to 15 units, and the valve is closed, the spring can not deform si9nce water is incompressible. Hence the additional pressure of 5 units is entirely born by water. Let, σ = total pressure σ' = pressure in the spring $\bar{u}$ = pressure in water $\sigma = \sigma' + \bar{u}$ $15 = 10 + 5$ Now, let the valve be opened slightly so that some water escapes and then valve is closed. Due to escape of some water, the piston moves down, the spring is compressed and hence some pressure out of 5 units borne by water is now transferred to the spring. $\therefore\ 15 = (10 + \Delta\sigma') + (5 - \Delta\sigma')$ Where, $\Delta\sigma'$ = transfer of pressure from water to spring If the valve is completely opened , sufficient water will escape till the length of the spring is reduced to `z_{1}`. Thus, the whole 5 units of pressure is transferred from water to the spring. The water becomes free of pressure and spring carries the whole pressure. This **analogy** can be applied to the consolidation process of soil mass containing soil- water system. The solid particles of the soil represents the spring while the voids filled with the water represen by the cyliender. The valve opening is represented by the permeability of the soil mass.	5		
III. 9	**Seismic refraction method** ➢ This soil exploration method is based on the principle that sound waves travel faster in rock than in soil. This is on account of the fact that velocity of sound waves is different in different media. ➢ In this method shock waves (or sound waves of vibration) are created into the soil at ground level or at a certain depth below it, either by striking a plate on the soil with the hammer or by exploding small charge in the	5	7	7

soil.

- The shock waves so produced travel down in the sub-soil strata and get refracted after striking a hard rock surface below.
- The refracted or radiated shock waves are picked up by the vibration detector (also known as geophone) where the time of travel of the shock waves gets recorded
- .Knowing the time of travel of the primary and refracted waves at various geophones, tune and distance graphs are drawn based on which it is possible to evaluate the depth of various strata in the sub-soil.
- Different materials such as clay, gravel, silt rock, hard rock etc. have characteristics seismic velocities and hence it is possible to establish their identity in the sub-soil based on time distance graph

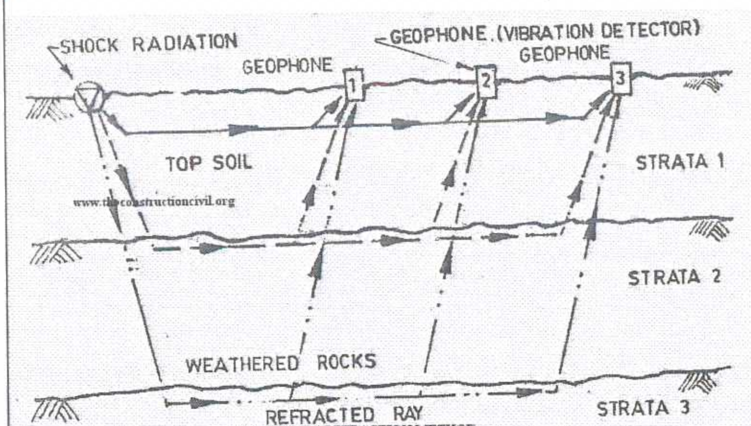


Fig. SEISMIC REFRACTION METHOD

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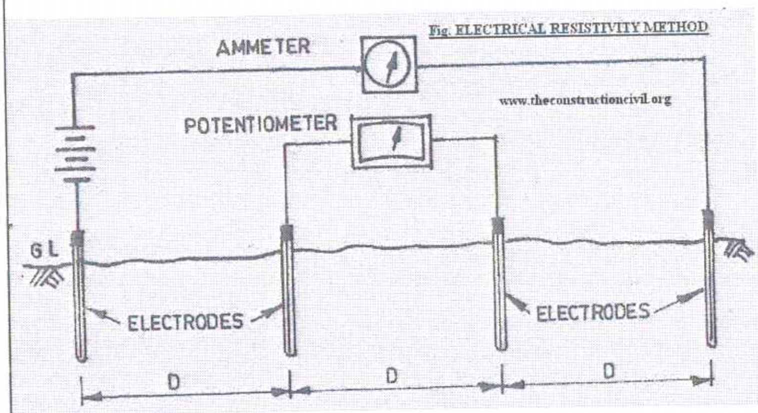
OR

Electrical Resistivity Method:

- This soil exploration method is based on the principle that each soil has different electrical resistivity, depending upon the type of soil, its water content, compaction and composition.
- Thus saturated soil has lower electrical resistivity as compared to loose dry gravel or solid rock.
- In this method 4 electrodes are driven in the ground at equal distance apart and in a straight line.
- The distance between two electrodes being the depth of exploration or depth up to which the ground resistance is to be measured.

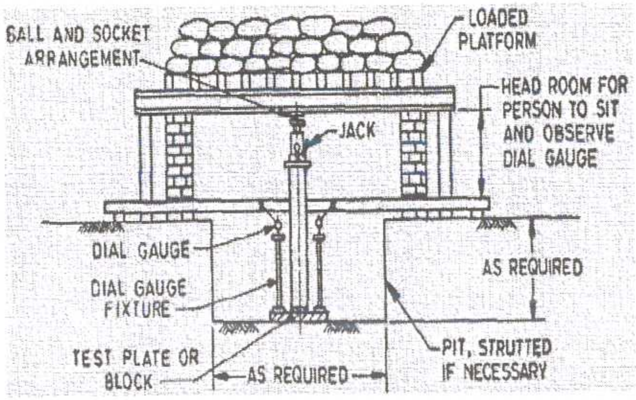
5

	➢ A current is passed between the two outer electrodes and the potential drop between the inner electrodes is measured by use of potentiometer. The mean resistivity is calculated by the following formula:- $P = 2 \pi D (E/I)$ Where, P=mean resistivity (ohm.cm) D=distance between electrodes (cm) E =potential drop between inner electrodes (volts) I = current flowing between outer electrodes *(amperes)*  ***Any one geophysical method of soil exploration***	2		
III. 10	**<u>Depth of soil Exploration</u>** Exploration should be carried out to a depth up to which the increase in pressure due to structural loading is likely to cause perceptible settlement or shear failure of foundation. This depth is known as *significant depth,* which depends upon the following factors. ▪ Type of structure ▪ Load on structure ▪ Size and shape of foundation ▪ Position of loaded areas ▪ Soil profile and its properties	2	7	7

	➢ The depth of exploration should be one and half times to two times the estimated width (lower dimension) of the footing, single or combined, from base level of the foundation. ➢ In case of weak soils, the exploration should be continued to a depth at which the loads can be carried by the stratum without excessive settlement or shear failure. ➢ Isolated spread footing or a raft: one and a half times the width. ➢ Adjacent footings with clear spacing less than twice the width: one and half times the length ➢ Pile foundation: 10 to 30 meters, or more, or at least one and a half times the width of the structure ➢ Base of the retaining wall: one and a half times the base width or one and a half times the exposed height of face of wall, whichever is greater. ➢ For floating basement the depth of construction should be equal to the depth of construction.	5		
III. 11	Assuming general shear failure $q_f = cN_c + \sigma' N_q + 0.5\,B\gamma N_\gamma$ for $\phi = 25^0$, $N_c = 25.1$, $N_q = 12.7$, $N_\gamma = 9.7$ Also, $\sigma' = \gamma\,D = 18 \times 1.6$ Substituting the values , $q_f = (20 \times 25.1) + (18 \times 1.6) \times 12.7 + 0.5 \times 18 \times B \times 9.7$ $q_f = 502 + 365.8 + 87.3\,B$ Hence , Intensity of pressure, at F.S of 3 at footing = $q_f/3 = \frac{867.8+87.3\,B}{3}\ kN/m^2$ Applied load intensity = $\frac{750}{B\,X1} = \frac{750}{B}\ kN/m^2$ Equating the two, ➡ $\frac{750}{B} = \frac{867.8+87.3\,B}{3}$	1 1 1 1 1	7	7

	$\Rightarrow$ $87.3\ B^2 + 867.8\ B - 2250 = 0$ $\Rightarrow$ $B^2 + 9.94\ B - 25.77 = 0$ Solving , **B = 2.134 m**	2		
III. 12	➢ Excavate test pit up to the desired depth. The pit size should be at least 5 times the size of the test plate (B_p). ➢ At the center of the pit, a small hole or depression is created. The size of the hole is the same as the size of the steel plate. The bottom level of the hole should correspond to the level of the actual foundation. ➢ A mild steel plate is used as a load-bearing plate whose thickness should be at least 25 mm thickness and size may vary from 300 mm to 750 mm. The plate can be square or circular. Generally, a square plate is used for square footing and a circular plate is used for circular footing. ➢ A column is placed at the center of the plate. The load is transferred to the plate through the centrally placed column. ➢ The load can be transferred to the column either by gravity loading method or by truss method ➢ For gravity loading method a platform is constructed over the column and load is applied to the platform by means of sandbags or any other dead loads. The hydraulic jack is placed in between column and loading platform for the application of gradual loading. This type of loading is called reaction loading. ➢ At least two dial gauges should be placed at diagonal corners of the plate to record the settlement. The gauges are placed on a platform so that it does not settle with the plate. ➢ Apply seating load of 0.7 T/m^2 and release before the actual loading starts. ➢ The initial readings are noted. ➢ The load is then applied through the hydraulic jack and increased gradually. The increment is generally one-fifth of the expected safe bearing capacity or one-tenth of the ultimate bearing capacity or any other smaller value. The applied load is noted from the pressure gauge.	5	7	7

- The settlement is observed for each increment and from dial gauge. After increasing the load-settlement should be observed after 1, 4, 10, 20, 40, and 60 minutes and then at hourly intervals until the rate of settlement is less than .02 mm per hour. The readings are noted in tabular form.
- After completing the collection of data for a particular loading, the next load increment is applied and readings are noted under new load. This increment and data collection is repeated until the maximum load is applied. The maximum load is generally 1.5 times the expected ultimate load or 3 times of the expected allowable bearing pressure



Qn No	Module Outcome	Cognitive Level	Score	Time in Minutes
I.1	1.01	Remembering	1	1.46
I.2	1.04	Understanding	1	1.46
I.3	2.01	Understanding	1	1.46
I.4	2.03	Understanding	1	1.46
I.5	3.01	Understanding	1	1.46
I.6	4.04	Understanding	1	1.46
I.7	4.03	Understanding	1	1.46
I.8	4.01	Remembering	1	1.46
I.9	4.08	Remembering	1	1.46
II.1	1.01	Remembering	3	4.38
II.2	1.05	Applying	3	4.38
II.3	2.03	Understanding	3	4.38
II.4	2.01	Understanding	3	4.38
II.5	2.04	Understanding	3	4.38
II.6	3.02	Remembering	3	4.38
II.7	3.03	Understanding	3	4.38
II.8	3.04	Understanding	3	4.38
II.9	4.03	Understanding	3	4.38
II.10	4.08	Understanding	3	4.38
III.1	1.02	Understanding	7	10.22
III.2	1.03	Understanding	7	10.22
III.3	1.04	Understanding	7	10.22
III.4	1.02	Applying	7	10.22
III.5	2.02	Applying	7	10.22
III.6	2.04	Understanding	7	10.22
III.7	3.01	Understanding	7	10.22
III.8	3.04	Applying	7	10.22
III.9	4.03	Understanding	7	10.22
III.10	4.06	Understanding	7	10.22
III.11	4.04	Applying	7	10.22
III.12	4.05	Applying	7	10.22

BLUE PRINT

Mark Distribution

Module	Hr / Module	$(hi / \sum Hi) * 123$	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
I	15	26-36%	2	2	2	6	4	28	8	36
II	13	22-32%	2	2	3	9	2	14	8	25
III	12	20-30%	1	1	3	9	2	14	7	24
IV	18	33-43%	4	4	2	6	4	28	8	38
Total			9	9	10	30	12	84	31	123

Cognitive Level Wise Question Analysis

Mark Distribution

Cognitive Level	% Marks	Marks	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
R	7.32	9	3	3	2	6			5	9
U	67.48	83	6	6	7	21	8	56	21	83
A	25.20	31			1	3	4	28	5	31
Total	100	123							31	123