

DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/  
MANAGEMENT/COMMERCIAL PRACTICE, APRIL-2020

**GEOTECHNICAL ENGINEERING**

[Maximum marks: 75]

(Time: 2.15 Hours)

**PART – A**

(Answer any *three* questions in one or two sentences. Each question carries 2 marks)

- I. (1). Define water content of soil.  
(2). Define the term voids ratio of soil.  
(3). What is meant by permeability of soil.  
(4). Define ultimate bearing capacity of soil.  
(5). Define the term foundation of a structure. (3 x 2 = 6)

**PART – B**

(Answer any *four* of the following questions. Each question carries 6 marks)

- II. (1). Explain three phase system of soil with block diagram.  
(2). List the factors affecting the permeability of soil.  
(3). List the factors affecting compaction of soil.  
(4). Distinguish general and local shear failure of soil under foundation.  
(5). List the objectives of soil investigation.  
(6). Distinguish shallow and deep foundation.  
(7). List the objectives of foundation of a structure. (4 x 6 = 24)

**PART – C**

(Answer *any of the three units* from the following. Each question carries 15 marks)

**UNIT –I**

- III. (a). A soil sample has a porosity of 37% and specific gravity of soil solids is 2.65. Find voids ratio, unit weight of soil when it is fully dry, when 50% saturated and 100% saturated with porosity remains unchanged. (8)  
(b). Explain the procedure to find water content of soil using oven drying method. (7)

**OR**

- IV. (a). A soil has a bulk unit weight of  $20.11 \text{ KN/m}^3$  and a water content of 15%. Calculate water content if soil partially dries to a unit weight of  $19.42$  if voids ratio is unchanged. Find voids ratio if specific gravity of soil solids is  $2.65$ . (6)
- (b). Explain the procedure to find specific gravity of soil solids using pycnometer. (9)

**UNIT-II**

- V. (a). Explain the procedure to find permeability of soil using constant head permeameter with the help of a neat sketch. (9)
- (b). Explain different type of soil water. (6)

**OR**

- VI. (a). Explain the procedure for standard proctor test. (9)
- (b). Explain any four soil compacting equipments. (6)

**UNIT-III**

- VII. (a). With sketches explain different types of combined footings. (6)
- (b). Explain the procedure for standard penetration test. (9)

**OR**

- VIII. (a). Explain the disadvantages of seismic method of soil exploration. (6)
- (b). Explain the procedure of electrical resistivity method of soil exploration. (9)

**UNIT-IV**

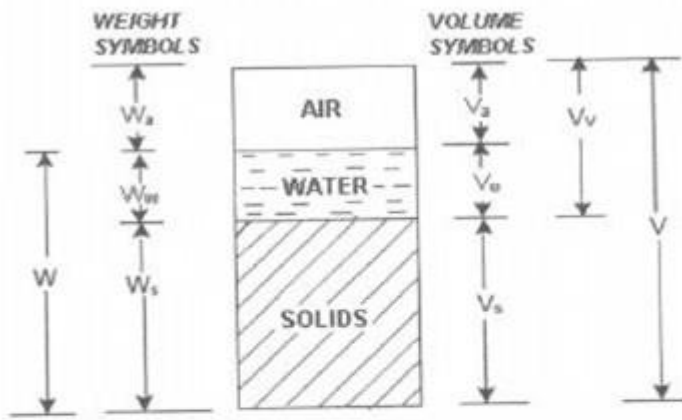
- IX. (a). With neat sketch explain mat foundation. (6)
- (b). Explain the classification of pile foundation. (9)

**OR**

- X. (a). Draw the section and mark the components of a well foundation. (6)
- (b). Describe the rectification for tilt and shift of well foundation with sketch. (9)

Month and Year:- April 2020  
Revision:- 2015  
Course Title:- Geotechnical Engineering  
Course code:- 5013

Question No	Answer	Splitup score	Sub total	Total
I.1	<p>Define water content of soil.  It is defined as the ratio of weight of water (W<sub>w</sub>) to Weight of solids (W<sub>s</sub>).  It is usually expressed in percentage.</p> $w = \frac{W_w}{W_s}$	2	2	
I.2	<p>Define the term voids ratio of soil  Void ratio is defined as the ratio of Volume of voids (V<sub>v</sub>) to Volume of solids (V<sub>s</sub>)</p> $e = \frac{V_v}{V_s}$	2	2	
I.3	<p>What is meant by permeability of soil  It is the ability of soil to permit flow of water through it.</p>	2	2	
I.4	<p>Define ultimate bearing capacity of soil  The ultimate bearing capacity of a foundation denotes the maximum load that foundation soils can withstand.</p>	2	2	
I.5	<p>Define the term foundation of a structure  It is the lower most member any building. Main function of foundation is to distribute load of superstructure evenly to earth.</p>	2	2	
II.1	<p>Explain three phase system of soil with block diagram.</p> <p>Soil is not a coherent solid material like steel and concrete, but is a particulate material. Soils, as they exist in nature, consist of solid particles (mineral grains, rock fragments) with water and air in the voids between the particles. The water and air contents are readily changed by changes in ambient conditions and location.</p> <p>As the relative proportions of the three phases vary in any soil deposit, it is useful to consider a soil model which will represent these phases distinctly and properly quantify the amount of each phase. A schematic diagram of the three-phase system is shown in terms of weight and volume symbols respectively for soil solids, water, and air. The weight of air can be neglected.</p>	6	6	



The soil model is given dimensional values for the solid, water and air components.

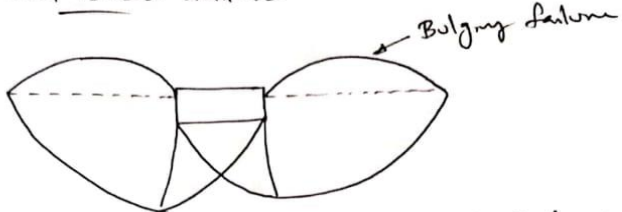
$$\text{Total volume, } V = V_s + V_w + V_v$$

<p>II.2</p>	<p>List the factors affecting the permeability of soil</p> <ul style="list-style-type: none"> <li>• Viscosity:- As viscosity of fluid increases, permeability decreases</li> <li>• Unit weight:- As unit weight of fluid increases, permeability increases</li> <li>• Grain size:- As grain size of particles increases, permeability increases</li> <li>• Voids:- if void presence in in the soil is high, then permeability will be more</li> <li>• Entrapped air:- Presence of entrapped air and other foreign matters in the soil decreases the permeability</li> <li>• Degree of saturation:- Higher degree of saturation results lesser permeability.</li> </ul>	<p>1 1 1 1 1 1</p>	<p>6</p>	
<p>II.3</p>	<p>List the factors affecting compaction of soil.</p> <p>a) Effect of water content on Compaction of soil At low water content the soil is stiff and offers more resistance to compaction. As the water content is increased, the soil particles get lubricated. The soil mass becomes more workable and the particles have closer packing.</p> <p>b) Amount of compaction The compaction of soil increases with the increase in amount of compactive effort.</p> <p>c) Type of soil The compaction of soil depends upon the type of soil. The maximum dry density and optimum moisture content are different on different soil.</p> <p>d) Method of soil compaction The dry density achieved depends not only upon the amount of compactive effort but also on the method of compaction.</p>	<p>1.5  1.5  1.5  1.5</p>	<p>6</p>	

II.4

Distinguish general and local shear failure of soil under foundation

1. General Shear failure



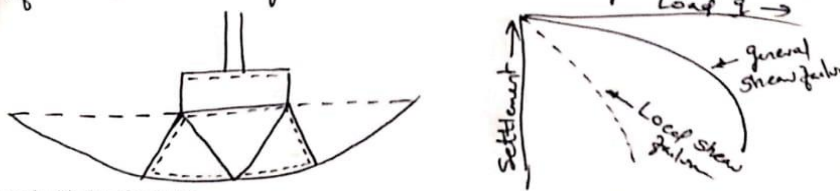
A shear failure occurs in the soil at that load and the failure surfaces extend to the ground surface. This type of failure is called general shear failure.

- (i) This failure takes place abruptly and is catastrophic.
- (ii) A heave on the sides is always observed.
- (iii) A slight downward movement of footing develops fully plastic zone.
- (iv) If Relative density  $> 70\%$  - general shear failure occurs. eg:- Dense Sand.

2. Local Shear failure

Loose soil begins to fail at a load much less than the ultimate bearing capacity.

- (i) The soil beneath the foundation gets compressed significantly. eg:- loose sand or soft clays.
- (ii) Very slight bulging of ground surface adjacent to the foundation is found.
- (iii) Well defined pattern of failure is observed only under the foundation and beyond the edges of foundation.
- (iv) When  $\phi \leq 29^\circ$ , local shear failure is likely to occur.
- (v) If relative density  $< 20\%$ , local shear failure occurs.



Scanned with CamScanner

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II.5

List the objectives of soil investigation

- i. Determination of the nature of deposits of soil.
- ii. Determination of depth and thickness of various soil strata and their extend in horizontal direction.
- iii. To determine the depth of ground water and its fluctuation
- iv. Obtaining soil and rock sample from various strata.
- v. Determination of engineering properties of soil and rock strata, that affect performance of structure.
- vi. Determination of in-situ properties by performing field tests.

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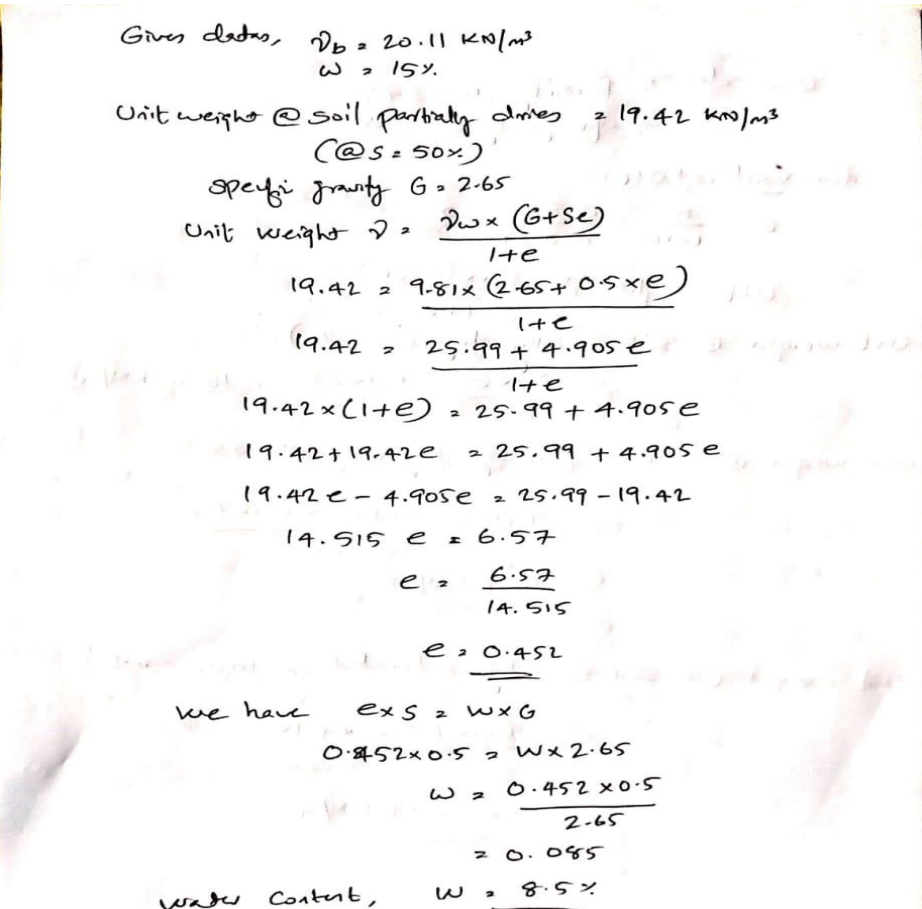
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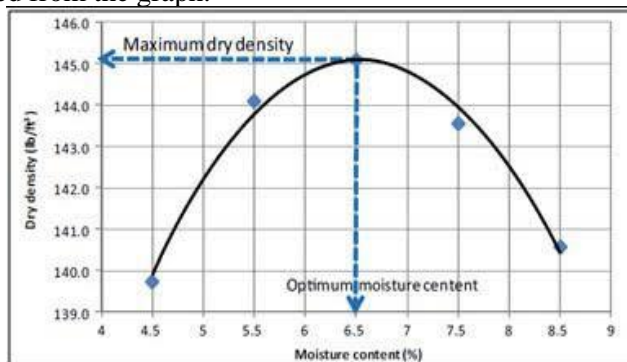
II.6	<p>Distinguish shallow and deep foundation</p> <p><u>Shallow foundation:</u> Depth of foundation is less than breadth of foundation is called Shallow foundation (Depth &lt; Breadth)</p> <p><u>Deep foundation:</u> Depth of foundation is greater than breadth of foundation is called Deep foundation. (Depth &gt; Breadth)</p>	3	6	
II.7	<p>List the objectives of foundation of a structure</p> <ul style="list-style-type: none"> <li>• A foundation is supposed to transmit the structural loading to the supporting soil in such a way that soil is not under stressed and that serious settlement of structure are not caused.</li> <li>• Foundation gives the lateral stability to the structure against various horizontal forces such as wind, rain, earthquake, etc.</li> <li>• Gives stability to the building.</li> <li>• It provides safety to the structure against undermining or scouring due to animals, flood water, etc.</li> <li>• Footing decreases the chances of settlement of building.</li> <li>• Footing decreases the load intensity.</li> </ul>			
III.a	<p>A soil sample has a porosity of 37% and specific gravity of soil solids is 2.65. Find void ratio, unit weight of soil when it is fully dry, when 50% saturated and 100% saturated with porosity remains unchanged.</p> <p>Given data, Porosity, <math>n = 37\%</math> Specific gravity <math>G = 2.65</math></p> <p>for void ratio (<math>e</math>)  <math display="block">e = \frac{n}{1-n} = \frac{0.37}{1-0.37} = \underline{0.587}</math> </p> <p>Unit weight <math>\gamma = \frac{\gamma_w \times (G + Se)}{1+e}</math></p> <p>Unit weight @ soil is fully dry (<math>S = 0\%</math>)  <math display="block">\gamma = \frac{\gamma_w \times G}{1+e} = \frac{9.81 \times 2.65}{1+0.587} = \underline{16.38 \text{ KN/m}^3}</math> </p> <p>Unit weight @ soil is partially dry (<math>S = 50\% = 0.5</math>)  <math display="block">\gamma = \frac{9.81 \times (2.65 + 0.5 \times 0.587)}{1+0.587} = \underline{18.18 \text{ KN/m}^3}</math> </p> <p>Unit weight @ soil is fully saturated (<math>S = 100\% = 1</math>)  <math display="block">\gamma = \frac{9.81 \times (2.65 + 1 \times 0.587)}{1+0.587} = \underline{20.009 \text{ KN/m}^3}</math> </p> <p>CS Scanned with CamScanner</p>	8		

III.b	<p>Explain the procedure to find water content of soil using oven drying method.</p> <p><u>Oven dry method:-</u></p> <p>Equipments:-</p> <ul style="list-style-type: none"> <li>• Containers</li> <li>• Dessicator with any suitable desiccating agent</li> <li>• Thermostatically controlled oven</li> <li>• Weighing balance with accuracy of 0.01 gm.</li> </ul> <p><u>Procedure:-</u></p> <ol style="list-style-type: none"> <li>1. Clean the container, dry it and weight it with the lid. (W1)</li> <li>2. Take the required quantity of the wet soil specimen in the container &amp; weight it with the lid.(W2)</li> <li>3. Place the container with its lid removed, in the oven till its weight become constant.</li> <li>4. When the soil has dried, remove the container from the oven using tongs.</li> <li>5. Place the container on Dessicator for some time to cool down.</li> <li>6. Find the weight (W3) of the container with the lid and the dry soil sample.</li> </ol> <p>Now, water content can be calculated as</p> $\text{water content, } w = \frac{M2 - M3}{M3 - M1} \times 100$	7		
IV.a	<p>A soil has a bulk unit weight of 20.11 KN/m<sup>3</sup> and a water content of 15%. Calculate water content if soil partially dries to a unit weight of 19.42 if voids ratio is unchanged. Find voids ratio if specific gravity of soil solids is 2.65.</p>  <p>Given data, <math>\gamma_b = 20.11 \text{ KN/m}^3</math>  <math>w = 15\%</math></p> <p>Unit weight @ soil partially dries = 19.42 KN/m<sup>3</sup>    (@ <math>s = 50\%</math>)</p> <p>Specific gravity <math>G = 2.65</math></p> <p>Unit weight <math>\gamma = \frac{\gamma_w \times (G + Se)}{1 + e}</math></p> $19.42 = \frac{9.81 \times (2.65 + 0.5 \times e)}{1 + e}$ $19.42 = \frac{25.99 + 4.905e}{1 + e}$ $19.42 \times (1 + e) = 25.99 + 4.905e$ $19.42 + 19.42e = 25.99 + 4.905e$ $19.42e - 4.905e = 25.99 - 19.42$ $14.515e = 6.57$ $e = \frac{6.57}{14.515}$ $e = 0.452$ <p>We have <math>es = w \times G</math></p> $0.452 \times 0.5 = w \times 2.65$ $w = \frac{0.452 \times 0.5}{2.65}$ $= 0.085$ <p>Water Content, <math>w = 8.5\%</math></p>	6		

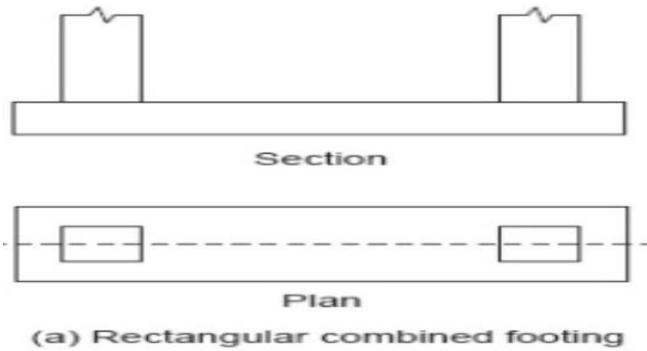
IV.b	<p>Explain the procedure to find specific gravity of soil solids using pycnometer</p> <p>a) Pycnometer bottle method:- pycnometer method is only used for coarse grained soil. Apparatus required- Pycnometer bottle, weighing balance, 4.75mm IS sieve. <u>Procedure:-</u> 1. Clean and dry the pycnometer. Find its mass with cap as M1. 2. Place about 200 gm of oven dried soil passing through 4.75 mm sieve. 3. Determine mass of pycnometer with dry soil as M2. 4. Add water to the soil in the pycnometer. Determine mass of pycnometer with soil and water as M3. 5. Empty the pycnometer, clean it and wipe it. 6. Fill the pycnometer with distilled water and find its mass as M4. Specific gravity, <math>G = \frac{M2-M1}{(M4-M1)-(M3-M2)}</math></p>	9	9	
V.a	<p>Explain the procedure to find permeability of soil using constant head permeameter with the help of a neat sketch</p> <ol style="list-style-type: none"> <li>1. Take about 2.5 kg of representative specimen of soil and rise its water content to the OMC. Fill the soil mix to airtight container in two layer with 15 blows of 2.5 kg dynamic ramming tool.</li> <li>2. Place porous disc and place the filter paper on above it and place the container above it. Then place a porous disc with filter paper above it.</li> <li>3. Assemble the remaining constant head permeameter setup with air tight container.</li> <li>4. Connect the inlet tube of the constant head tank to the inlet nozzle of the permeameter. Adjust the hydraulic head.</li> <li>5. Start the stop watch. Measure the quantity of water collected in the beaker after a specified time interval.</li> <li>6. If Q is the total quantity of flow in time interval 't'</li> </ol> <p>Coefficient of permeability, <math>k = \frac{QL}{Aht}</math></p> <p>Q= Quantity of water collected in measuring jar L= Length of specimen A= Area of cross section of soil specimen h= Hydraulic head t= Time interval during collection of water on measuring jar.</p>			
V.b	<p>Explain different type of soil water</p> <p>Adsorbed water:- Soil grains through appear to be dry, attract a very thin layer of water and which will surround the individual grains. Water present as a thin layer around the mineral grains of the soil is called adsorbed water.</p> <p>Capillary:-</p>	1.5	1.5	

	<p>The water rising in the voids of soil mass against gravity due to surface tension of water is called adsorbed water.</p> <p>Free water:- It is the subsurface water that fills the voids continuously and is subjected to forces other than gravity. Hence this water is also known as gravitational water.</p> <p>Held water:- Held water is that water which is held in the voids or in the proximity or closeness of the soil grains</p>	1.5		
VI.a	<p>Explain the procedure for standard proctor test.</p> <p>Aim:- To determine the optimum moisture content and corresponding dry density of soil.</p> <p>Apparatus:-</p> <ol style="list-style-type: none"> <li>1. Cylindrical mould of internal dia 100mm and height 127.3mm and its volume is 1000 ml.</li> <li>2. A detachable collar of 60mm effective height.</li> <li>3. A detachable base plate</li> <li>4. A 50mm diameter metal rammer of weight 2.5kg with a height of fall of 300mm.</li> <li>5. Rubber mallet, trowel, wire brush, straight edge, Container for moisture content determination</li> </ol> <p><b>Procedure:-</b></p> <ol style="list-style-type: none"> <li>1. Air dried soil is sieved through 4.75mm and about 3Kg is taken to metal tray.</li> <li>2. The soil is thoroughly mixed with some amount of water (4% for coarse grained soil and 10% for fine grained soil)</li> <li>3. Take the empty weight of the mould</li> <li>4. Fill the soil in the mould in three layers, each layer is compacted 25 no. of blows with the standard rammer</li> <li>5. The collar is removed and the excess soil is trimmed off to make it level.</li> </ol> <p>The total mass of soil and mould is taken with the help of weighing balance.</p> <ol style="list-style-type: none"> <li>6. The wet mass of soil (M) is obtained by subtracting the weight of empty mould.</li> <li>7. Bulk density of soil is obtained by dividing mass of soil (M) with Volume of soil (V).</li> </ol> $\rho = \frac{\text{Mass of soil}}{\text{Volume of soil}}$ <ol style="list-style-type: none"> <li>8. Take some amount of soil sample from the mould and determine the water content (w)</li> </ol> $\rho_d = \frac{\rho}{1 + w}$ <ol style="list-style-type: none"> <li>9. The water content of soil is increased 2 to 4%. Test is repeated for 5 to 6 times and each time the dry density is calculated.</li> </ol>	9		

10. A graph is drawn between moisture content on X axis and dry density on Y axis. A curve with a well defined peak is obtained. The moisture content corresponding to the peak of the curve, called optimum moisture content (OMC) and corresponding dry density are noted from the graph.



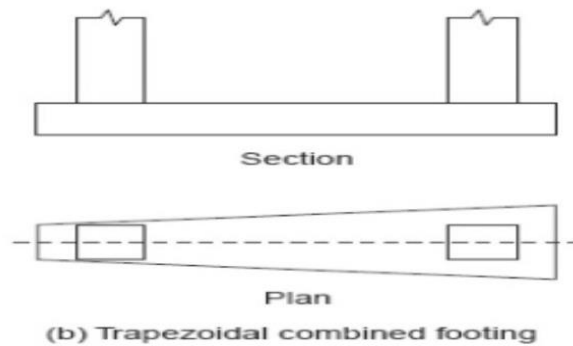
VI.b	<p>Explain any four soil compacting equipments</p> <p>1. Smooth Wheel rollers:- Smooth wheel rollers are one of the most common type of compaction equipment used. Weighing from 5 to 15 tones. They are suitable for compacting sand, gravel, broken stones etc.. They are used for compacting highway base course.</p> <p>2. Sheep foot rollers In this type, on the outer surface of a metal cylinder, metal pieces of the shape of sheep foot are fixed. Weight of drum is about 1.5 to 10 tones. It is suitable for compacting cohesive soil.</p> <p>3. Grid rollers As the name suggests, these rollers have a cylindrical heavy steel surface consisting of a network of steel bars forming a grid with square holes. The weight of this roller can be increased by ballasting with concrete blocks.</p> <p>4. Tamping rollers These rollers are similar to sheep foot rollers with lugs of larger area than sheep foot rollers. Tamping rollers have static weight in the range of 15 to 40 tonnes. Tamping rollers are best suitable for compacting cohesive soils.</p>	1.5  1.5  1.5  1.5	6
VII.a	<p>With sketches explain different types of combined footings</p> <p>Combined footings are constructed for two or more columns when they are close to each other and their foundations overlap. Mainly combined footings are two type.</p> <p><u>1. Rectangular combined footing</u> The rectangular combined footings are part of combined footings. They have rectangular shapes. They are supporting two or more columns. These are used when having a rectangular shape and have to carry equal loads.</p>	3	6



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2. Trapezoidal combined footing

The trapezoidal footing, which may be used to carry two columns of unequal loads when distance outside the column of the heaviest load is limited. ... To overcome this difficulty, a trapezoidal footing is used in such a way that the center of gravity of the footing lies under the resultant of the loads.



VII.b

Explain the procedure for standard penetration test.

**Standard Penetration Test (SPT)**

- i. A clean hole of diameter 55 to 150mm is made with casing driven around.
- ii. A thick wall split tube sampler of 50.8mm outer diameter and 35mm inner diameter is driven in to the undisturbed soil at the bottom of the hole under the blows of 65kg (Hammer weight) with 75cm free fall.
- iii. The first 15cm penetration is considered as seating penetration or seating drive.
- iv. It is further driven through 30cm, the no.of blows required to drive the sampler 30cm beyond the seating drive is termed as penetration resistance (N).

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In very fine silty or saturated sand , then there is apparent increase in resistance occurs.

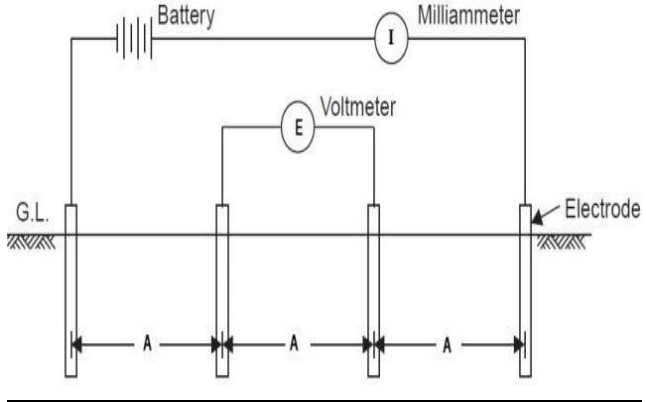
When 'N' is greater than 15, Ne is givenby,

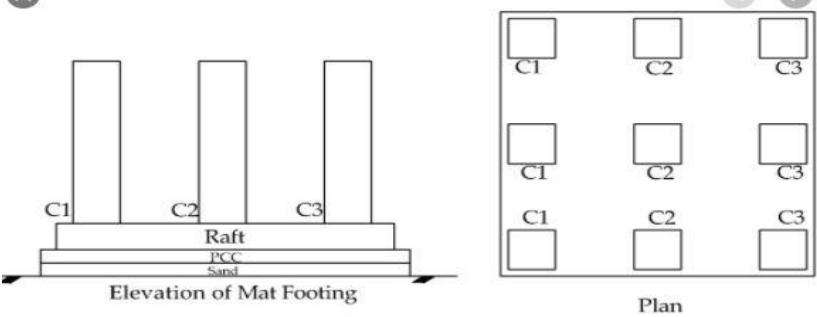
$$N_e = 15 + \frac{1}{2} (N - 15)$$

Where N= Actually observed no.of blows

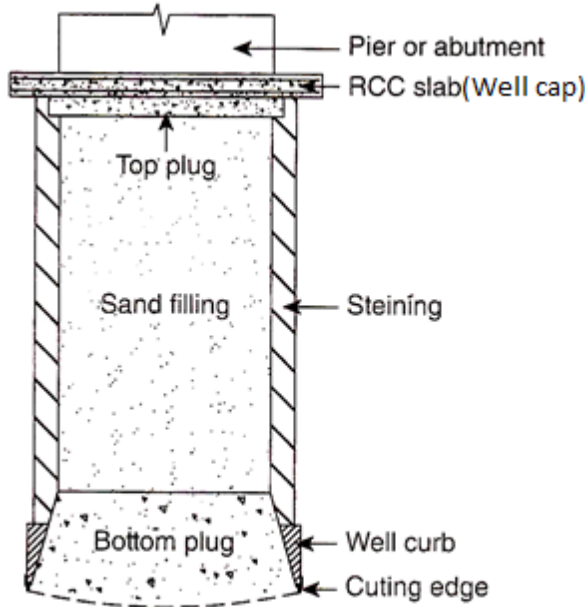
Ne= Corrected no.of blows

VIII.a	<p>Explain the disadvantages of seismic method of soil exploration</p> <ul style="list-style-type: none"> <li>• Many sources and receiver are required, so its more expensive</li> <li>• Processing is more extensive (Time consuming process)</li> <li>• Interpretation requires more expertise due to the lengthy processing needed</li> <li>• Skilled expertise are required.</li> <li>• Velocity increases with increase in depth</li> <li>• When the seismic ray going from a lighter to denser medium the ray is refracted back to the surface.</li> </ul>	6	
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VIII.b	<p>Explain the procedure of electrical resistivity method of soil exploration</p>  <p>Each soil has its own resistivity depending upon water content, compaction and composition. Eg:- Resistivity is low for saturated silt and high for solid rock.</p> <p><u>Procedure:-</u></p> <ol style="list-style-type: none"> <li>1. Four electrodes are driven in to the ground in a straight line at equal distance 'A'</li> <li>2. A direct voltage is applied between the outer potential meter electrodes.</li> <li>3. The potential drop is measured between the inner electrodes.</li> <li>4. The mean resistivity, <math>\rho = 2\pi AR</math></li> </ol> <p><math>\rho =</math> mean resistivity (ohm cm), <math>R =</math> Resistance (V/I)  <math>V =</math> potential drop b/w electrodes, <math>I =</math> Current in amperes  <math>A =</math> Distance b/w electrodes in cm</p>		
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IX.a	<p>With neat sketch explain mat foundation.</p> 	6	
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	<p>A raft or mat foundation is a large continuous rectangular or circular concrete slab that carries the entire load of the superstructure and spreads it over the whole area beneath the building. It is considered as one type of shallow foundation and is useful in controlling the differential settlement. A mat foundation spreads out under the footprint of the building and declines the contact pressure compared to conventional strip or trench footing. It is a suitable solution for low bearing capacity soil, spread footing cover about 70% of the structure, high structure loads, soft pockets or cavities of in the soil to unknown extent raft, and highly compressible soil that extends to a great depth.</p>			
IX.b	<p>Explain the classification of pile foundation.  <i>Classification of pile based on material:-</i></p> <p>a) Concrete pile</p> <ul style="list-style-type: none"> <li>• Precast pile</li> <li>• Cast in situ pile</li> </ul> <p>b) Timber piles</p> <p>c) Steel piles</p> <ul style="list-style-type: none"> <li>• H-pile</li> <li>• Pipe pile</li> <li>• Sheet pile</li> </ul> <p>d) Composite pile</p> <ul style="list-style-type: none"> <li>• Concrete and timber</li> <li>• Concrete and steel</li> </ul> <p><i>Classification of pile based on method of installation:-</i></p> <p>a) Driven piles</p> <p>b) Driven and cast in situ piles</p> <p>c) Bored and cast in situ piles</p> <p>d) Screw piles</p> <p>e) Jacked piles</p>	9		
X.a	<p>Draw the section and mark the components of a well foundation.</p> <p><b>Well foundation:-</b></p> <ul style="list-style-type: none"> <li>• Well foundation is a type of deep foundation which is generally provided below the water level for bridges.</li> <li>• A well foundation can be constructed on the dry river bed, after making a sand island</li> <li>• When the velocity of water is high, wells can be fabricated on river banks and then floated to the final position.</li> <li>• Once the well has touched the bed of river, then sand bags are placed around the well to prevent scour.</li> </ul>	1	6	
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Components of well foundation

**Component parts of Well foundation**

**1. Cutting edge:-**

Cutting edge is a very sharp member usually made up of steel. Which helps in cutting through the soil and facilitates easy penetration of the well.

**2. Well curb:-**

Well curb is tapered in shape and made up of reinforced concrete.

**3. Well Steining:-**

It is the body of the well foundation and usually made up of brick or stone masonry or reinforced concrete or PCC

**4. Bottom plug:-**

The bottom of the well is filled with concrete called bottom plug. The bottom plug forms the base of the well.

**5. Top plug:-**

On completion of bottom plug the well is filled with sand and top layer is filled with concrete. And the top layer is called top plug.

**6. Well cap**

The well cap is used for transferring the load from the super structure to the well steining. Generally the piers are constructed on the top of the well cap.

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X.b

Describe the rectification for tilt and shift of well foundation with sketch.

**Rectifying methods**

1. Eccentric loading
2. Excavation on higher side
3. Water jetting
4. Pulling the well
5. Pushing using Jacks

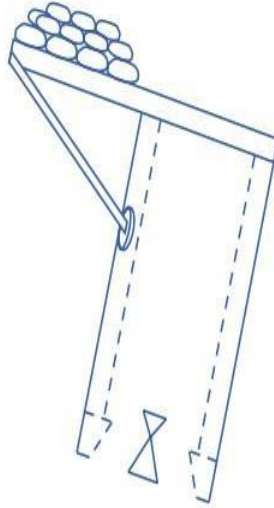
**Eccentric loading:-**

- The well tilt can be rectified by placing eccentric loading on the higher side

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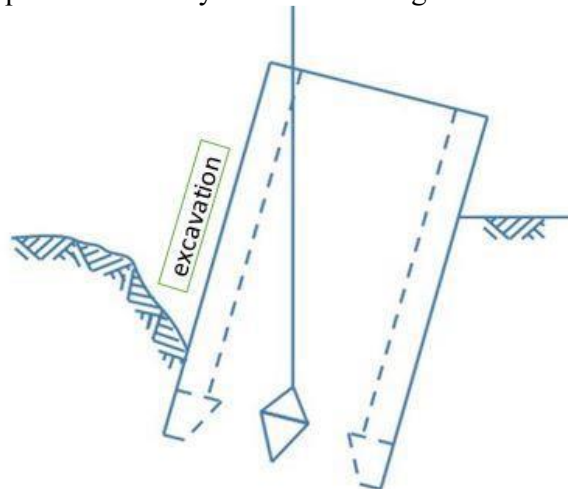
9

- A loading platform is constructed on the higher side and load is placed on it.
- The eccentric load will increase downward pressure on higher side and correct the tilt
- The amount of load and eccentricity is based on the depth of sinking.
- If depth of sinking is high, then eccentric load will be greater.



#### ***Excavation on higher side:-***

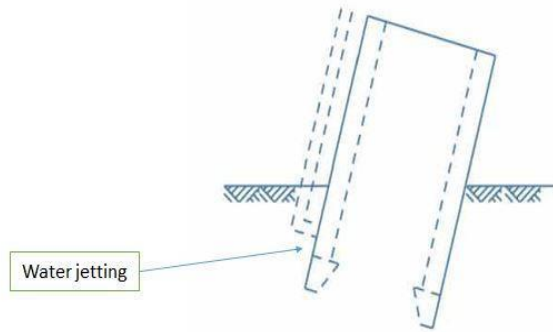
- When well is tilted to one side, excavation should be increased on the other side which is opposite to tilted side.
- By using rope and pulley, the tilt can be rectified.
- This technique is useful only in the initial stages well sinking



#### ***Water jetting:-***

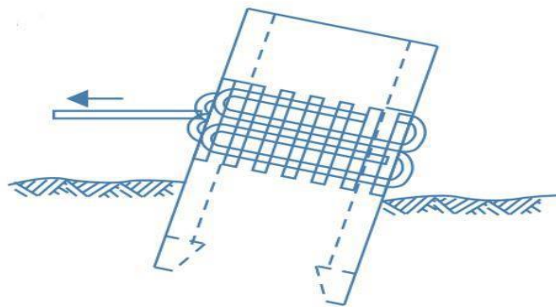
- Water jetting on external surface of well on the higher side is another remedial measure for rectifying tilt.

- When water jet is forced towards surface of well, the friction between soil and well surface get reduced and the higher side of well become lowered to make well vertical.



***Pulling the well:-***

- The well can be pulled towards higher side using steel ropes.
- One or more steel ropes are wound around the well with wooden sleepers packed in between well and ropes to prevent damage to the well steining by distributing load over to large area of steining.
- Pull should be carefully done otherwise, shifting of well foundation may occur.



***Pushing using Jacks***

- Another method to rectify tilting and shifting of well foundation is using hydraulic jacks or mechanical jacks, the tilted well can be pushed from lower side to higher side.
- It requires neighbour vertical well foundation or suitable arrangements made will give support to the jack system.
- Care should be taken while pushing the well otherwise the well may shift.

