TED (15) 5013

(Revision-2015)

N20-06082

Reg.No.....

Signature.....

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

GEOTECHNICAL ENGINEERING

[Maximum marks: 75] (Time: 2.15 Hours)

PART – A

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

1. Define the term soil mechanics
2. Identify residual and transported soil.
3. State Darcy's law.
4. Differentiate between ultimate and allowable bearing capacity.
5. Define the term foundation. (3 x 2 = 6)

PART – B

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

1. Illustrate three phase system of soil mass with figure.
2. Derive the functional relationship between void ratio and porosity.
3. Define free water, held water, adsorbed water and capillary water.
4. List the factors affecting permeability
5. Explain compaction of soil using phase diagrams.
6. Compare disturbed and undisturbed samples in soil exploration.
7. Identify the objectives of foundation. (4 x 6= 24)

PART – C

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

UNIT –I

III (a) Explain the procedure for finding field density of soil by core cutter method. (8)

(b) The bulk unit weight of a soil is 16kN/m^3. It has a water content of 17% and specific gravity 2.67. If the unit weight of water is 10kN/ m^3 determine the porosity and dry unit weight. (7)

OR

IV (a) Explain the procedure for determination of specific gravity of soil by pycnometer (8)

(b) Illustrate the procedure for determination of liquid limit. (7)

UNIT-II

V (a) Explain the concept of zero air void line in compaction curve of soil (8)

(b) A soil sample of height 6cm and area of cross section of 100 cm^2 was subjected to falling head permeability test in a time interval of 5 minutes. The head dropped from 60cm to 20 cm If the cross-sectional area of the standpipe is 2 cm^2, compute the coefficient of permeability of soil sample. (7)

OR

VI (a) Explain standard proctor test (8)

(b) A sand sample of 35cm^2 cross sectional area and 20 cm long was tested in a constant head permeameter under a head of 60 cm, the discharge was 120 ml in 6 min. The dry weight of sand used for the test was 1120 g. and Gs=2.68. Determine the hydraulic conductivity in cm/sec and the discharge velocity. (7)

UNIT-III

VII (a) List the objectives of site exploration (7)

(b) Describe the method of standard penetration test (8)

OR

VIII (a) State Terzaghi's theory of bearing capacity (7)

(b) Explain plate load test (8)

UNIT-IV

IX (a) Illustrate different types of shallow foundations with sketches. (7)

(b) Explain with sketch the components of well foundation. (8)

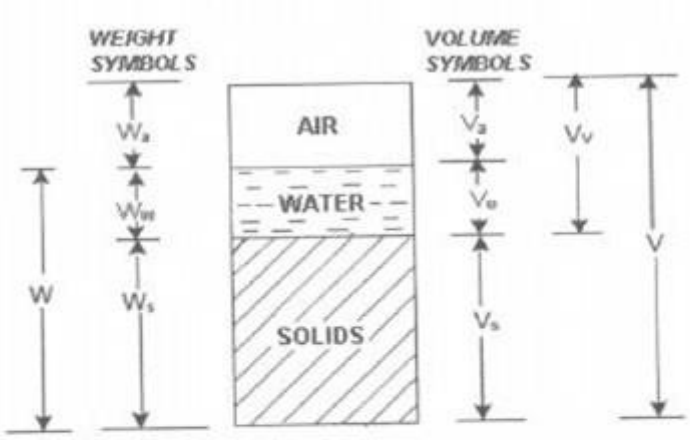
OR

X (a) Compare shallow and deep foundation (7)

(b) Explain the Rectification methods of shifting and tilting in well foundations. (8)

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

Question No	Answer	Splitup score	Sub total	Total
I.1	Define the term soil mechanics It is the branch of science which deals with the study of application laws of mechanics and hydraulics to the problem related to soil.	2	2	
I.2	Identify residual and transported soil. Residual soil:- These are the soil which remains only on parent rock without getting transported. Transported soil:- These are the soil formed at one point and finally deposited in another location.	2	2	
I.3	State Darcy's law. For laminar flow condition in a saturated soil mass, the rate of flow or discharge is directly proportional to the hydraulic gradient. $q \alpha i$ i= hydraulic gradient $q=kiA$ q=discharge $A=c/s$ area k=coefficient of permeability	2	2	
I.4	Differentiate between ultimate and allowable bearing capacity. Ultimate bearing capacity:- It is defined as the maximum pressure that a foundation soil can withstand without undergoing shear failure. Or It is the gross pressure at the base of the foundation at which the soil just before fails in shear Allowable bearing capacity:- Allowable bearing capacity is the ultimate bearing capacity divided by a factor of safety.	2	2	
I.5	Define the term foundation It is bottom most structural part of any building, that carry load of super structure and it evenly spread to soil beneath.	2	2	
II.1	Illustrate three phase system of soil mass with figure. 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. 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.	6		



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

Total volume, $V = V_a + V_w + V_v$

II.2	Derive the functional relationship between void ratio and porosity.	6		

Functional Relationship b/w Void ratio (e) and Porosity (n)

(i) We have Void ratio $e = \frac{V_v}{V_s}$

Total volume

wkt $V = V_v + V_s$

$V_s = V - V_v$

$= \frac{V_v}{V - V_v}$

dividing with V on both Numerator and denominator

$e = \frac{\frac{V_v}{V}}{\frac{V - V_v}{V}}$

$\boxed{e = \frac{n}{1-n}}$

$V_v/V = n$

$\frac{V}{V} = 1$

$\frac{V_v}{V} = n$

(ii) We have, $n = \frac{V_v}{V}$

$V = V_s + V_v$

$= \frac{V_v}{V_s + V_v}$

dividing by V_s on both Numerator and denominator

$n = \frac{V_v/V_s}{\frac{V_s + V_v}{V_s}}$

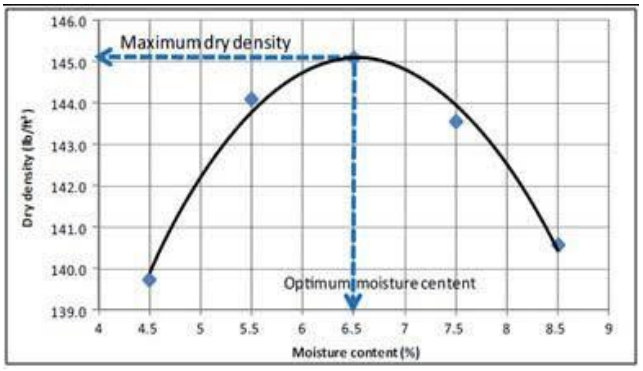
$V_v/V_s = e$

$V_s/V_s = 1$

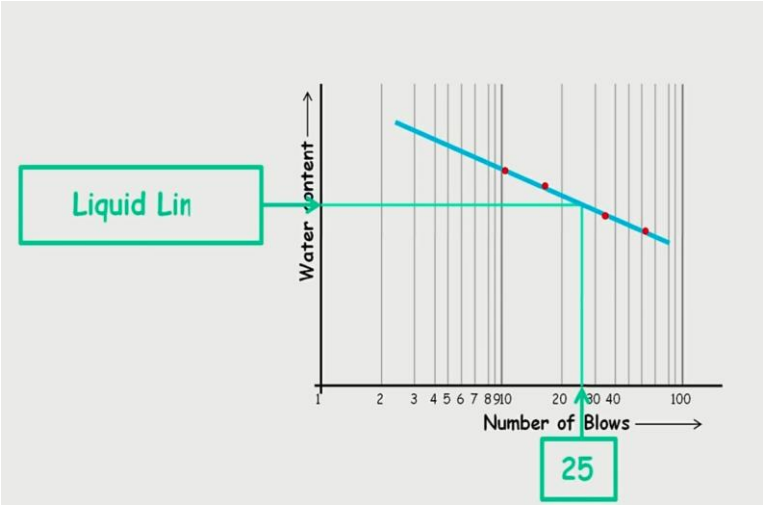
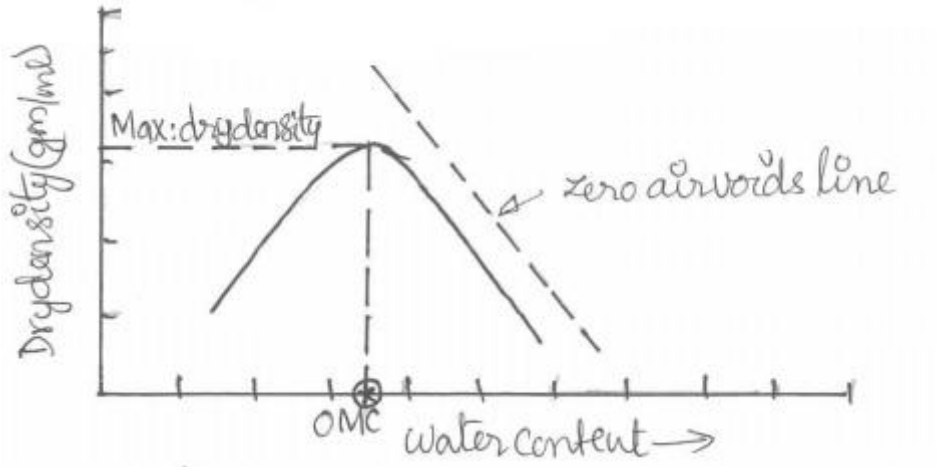
$\boxed{n = \frac{e}{1+e}}$

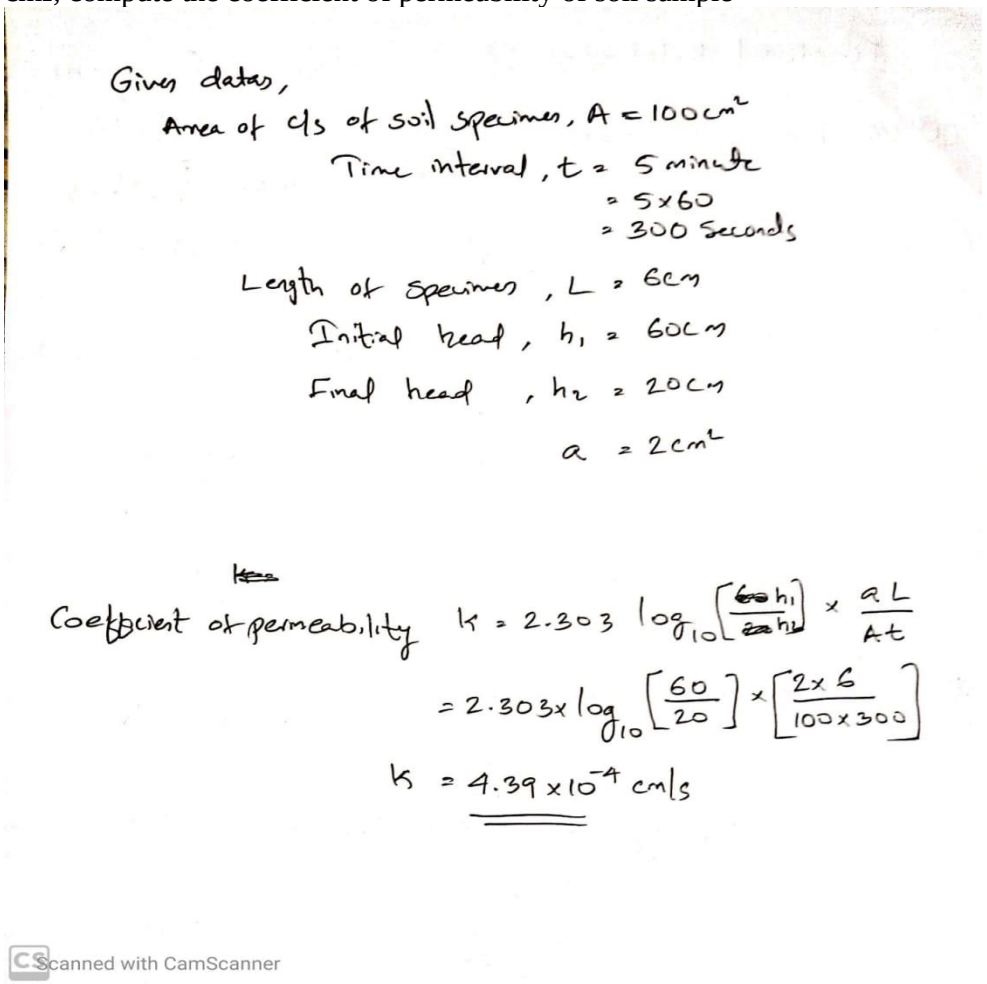
Scanned with CamScanner

II.3	Define free water, held water, adsorbed water and capillary water 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. Capillary:- The water rising in the voids of soil mass against gravity due to surface tension of water is called adsorbed water. 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. Held water:- Held water is that water which is held in the voids or in the proximity or closeness of the soil grains	1.5 1.5 1.5 1.5	6	
II.4	List the factors affecting permeability • Viscosity:- As viscosity of fluid increases, permeability decreases • Unit weight:- As unit weight of fluid increases, permeability increases • Grain size:- As grain size of particles increases, permeability increases • Voids:- if void presence in in the soil is high, then permeability will be more • Entrapped air:- Presence of entrapped air and other foreign matters in the soil decreases the permeability • Degree of saturation:- Higher degree of saturation results lesser permeability.	1 1 1 1 1 1	6	
II.5	Explain compaction of soil using phase diagrams. ***Procedure:-*** 1. Air dried soil is sieved through 4.75mm and about 3Kg is taken to metal tray. 2. The soil is thoroughly mixed with some amount of water (4%for coarse grained soil and 10% for fine grained soil) 3. Take the empty weight of the mould 4. Fill the soil in the mould in three layers, each layer is compacted 25 no.of blows with the standard rammer 5. The collar is removed and the excess soil is trimmed off to make it level. The total mass of soil and mould is taken with the help of weighing balance. 6. The wet mass of soil (M) is obtained by subtracting the weight of empty mould. 7. Bulk density of soil is obtained by dividing mass of soil(M) with Volume of soil (V). $\rho = \frac{Mass\ of\ soil}{Volume\ of\ soil}$ 8. Take some amount of soil sample from the mould and determine the water content (w) $\rho d = \frac{\rho}{1 + w}$ 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.	4	6	

	10. A graph is drawn between moisture content on X axis and dry density on Y axis. A curve with a well defined beak 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.  	2		
II.6	Compare disturbed and undisturbed samples in soil exploration <u>Disturbed and undisturbed samples</u> During the process of sampling the samples are lightly to be disturbed from their natural state andtherefore their physical properties are also likely to be changed, it is called disturbed samples. (eg:- Sand replacement method) Undisturbed sample is a sample in which the natural structure and physical properties are remain unchanged during the sampling. It can also be defined as that in which the soil is subjected to minimum disturbance during the sampling process. (eg:- Core cutter method) Test are conducted on undisturbed sample gives more reliable data than on disturbed sample.	6		
II.7	Identify the objectives of foundation • 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. • To protect the building from lateral loads. • To longlast the structure. • Gives stability to the building. • Footing decreases the chances of settlement of building. • Footing decreases the load intensity.	6		
III.a	Explain the procedure for finding field density of soil by core cutter method *Procedure:-* 1) Find the volume of core cutter by finding the internal dia and height of core cutter. 2) Weigh the empty core cutter (M1) 3) Level the soil surface 4) Place the core cutter with bevelled edge on the ground 5) Place the dolly on core cutter. Hit the rammer vertically on dolly till 15 mm of the dolly protrudes above the soil surface. 6) Remove the soil surrounding the core cutter and take out the core cutter 7) Remove the dolly. Trim the top and bottom surface of the core cutter carefully using a straight edge. 8) Weight the core cutter filled with the soil (M2) 9) Take some soil sample for water content test.	8		

	Bulk density of soil, $\rho = \frac{Mass\ of\ soil}{Volume\ of\ soil}$ $\rho = \frac{M2 - M1}{Volume\ of\ cylinder}$ Dry density, $\rho d = \frac{Bulk\ density}{1 + water\ content} = \frac{\rho}{1+w}$			
III.b	The bulk unit weight of a soil is 16kN/m3. It has a water content of 17% and specific gravity 2.67. If the unit weight of water is 10kN/ m3 determine the porosity and dry unit weight. Given bulk unit weight $\gamma = 16\ KN/m^3$ Water content, $w = 17\% = 0.17$ Specific gravity $G = 2.67$ Unit weight of water $\gamma_w = 10KN/m^3$ * Have to find porosity (n) and Dry unit weight (γ_d) We know that Dry unit weight $\gamma_d = \frac{\gamma}{1+w} = \frac{16}{1+0.17}$ Dry unit weight, $\gamma_d = 13.67\ KN/m^3$ $\gamma_d = \frac{G.\gamma_w}{1+e}$ $1+e = \frac{G.\gamma_w}{\gamma_d}$ $e = \frac{G.\gamma_w}{\gamma_d} - 1$ $\therefore e = \frac{2.67 \times 10}{13.67} - 1$ $e = 0.95$ We have relationship b/w Void ratio (e) and Porosity (n) $n = \frac{e}{1+e} = \frac{0.95}{1+095}$ Porosity $n = 0.487$ Scanned with CamScanner	7		
IV.a	Explain the procedure for determination of specific gravity of soil by pycnometer Pycnometer bottle method:- pycnometer method is only used for coarse grained soil. Apparatus required- Pycnometer bottle, weighing balance, 4.75mm IS sieve. *Procedure:-* 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.	8		

	5. Empty the pycnometer, clean it and wipe it. 6. Fill the pycnometer with distilled water and find its mass as M4. Specific gravity, G = $\frac{M2-M1}{(M4-M1)-}$			
IV.b	Illustrate the procedure for determination of liquid limit **Casagrande's method** Apparatus required:- Casagrande's device, Grooving tool, spatula, weighing balance, oven, 425micron IS sieve. Procedure:- 1) About 120 gm of soil passing through 425micron sieve is taken. 2) Soil sample mix with water or distilled water 3) Throughly mix the sample and spread in to liquid limit device. 4) A groove is made in the sample after levelling the surface. 5) Blows are applied by rotating handle of casegrande device until the groove closes by 12mm and the no. of blows required to close are noted. 6) for different water content, no.of blows required are noted. Thess are plotted on a semi log graph from which liquid limit is determined. *(water content corresponding to 25 no.of blows is the liquid limit (LL)* 	7		
V.a	Explain the concept of zero air void line in compaction curve of soil  <u>Optimum moisture content (OMC):-</u> It is the maximum moisture content corresponding to maximum dry density is known as optimum moisture content (OMC) <u>Maximum dry density:-</u>	8		

	Dry density initially increases with increase in moisture content till a maximum value is reached. This limit is called maximum dry density. Further increase in water content dry density decreases. Zero Airvoid line It is the line plotted along with compaction curve. Zero airvoid line is the line shows the relationship between water content and dry unit weight of the soil with a 100% degree of saturation			
V.b	A soil sample of height 6cm and area of cross section of 100 cm^2 was subjected to falling head permeability test in a time interval of 5 minutes. The head dropped from 60cm to 20 cm If the cross-sectional area of the standpipe is 2 cm^2, compute the coefficient of permeability of soil sample  Given datas, Area of c/s of soil specimen, $A = 100 cm^2$ Time interval, t = 5 minute $= 5 \times 60$ $= 300$ seconds Length of specimen, $L = 6cm$ Initial head, $h_1 = 60cm$ Final head, $h_2 = 20cm$ $a = 2cm^2$ Coefficient of permeability $k = 2.303 \log_{10}\left[\frac{h_1}{h_2}\right] \times \frac{aL}{At}$ $= 2.303 \times \log_{10}\left[\frac{60}{20}\right] \times \left[\frac{2 \times 6}{100 \times 300}\right]$ $k = 4.39 \times 10^{-4}$ cm/s Scanned with CamScanner	7		
VI.a	Explain standard proctor test Aim:- To determine the optimum moisture content and corresponding dry density of soil. Apparatus:- 1. Cylindrical mould of internal dia 100mm and height 127.3mm and its volume is 1000 ml. 2. A detachable collar of 60mm effective height. 3. A detachable base plate 4. A 50mm diameter metal rammer of weight 2.5kg with a height of fall of 300mm.	8		

5. Rubber mallet, trowel, wire brush, straight edge, Container for moisture content determination

Procedure:-

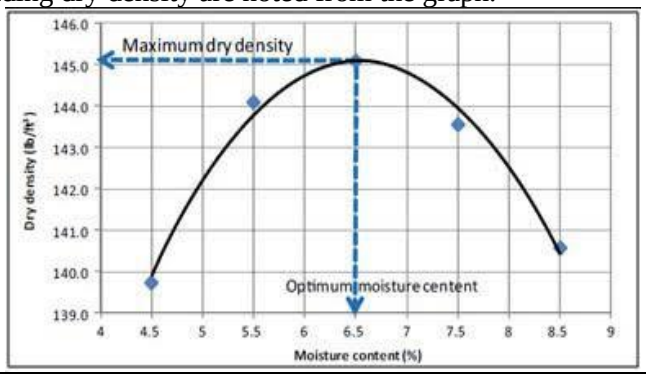
1. Air dried soil is sieved through 4.75mm and about 3Kg is taken to metal tray.
2. The soil is thoroughly mixed with some amount of water (4%for coarse grained soil and 10% for fine grained soil)
3. Take the empty weight of the mould
4. Fill the soil in the mould in three layers, each layer is compacted 25 no.of blows with the standard rammer
5. The collar is removed and the excess soil is trimmed off to make it level. The total mass of soil and mould is taken with the help of weighing balance.
6. The wet mass of soil (M) is obtained by subtracting the weight of empty mould.
7. Bulk density of soil is obtained by dividing mass of soil(M) with Volume of soil (V).

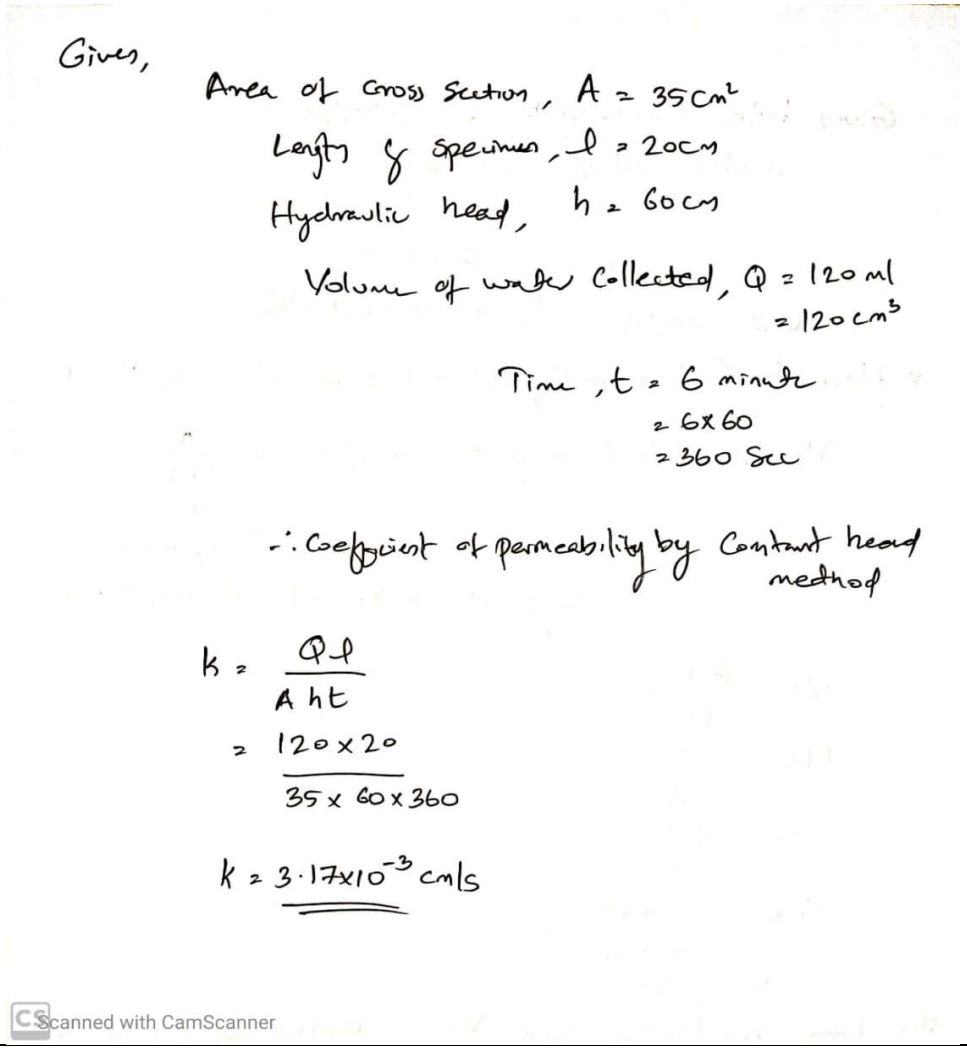
$$\rho = \frac{Mass\ of\ soil}{Volume\ of\ soil}$$

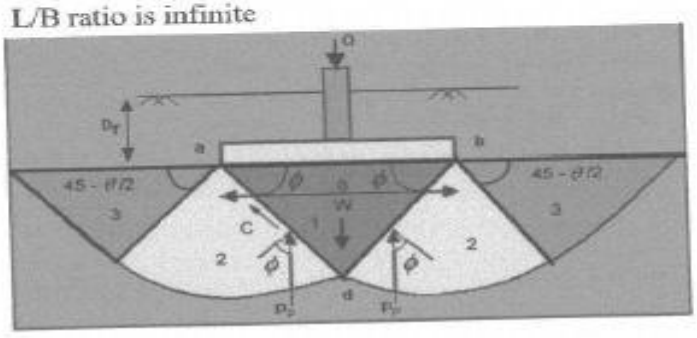
8. Take some amount of soil sample from the mould and determine the water content (w)

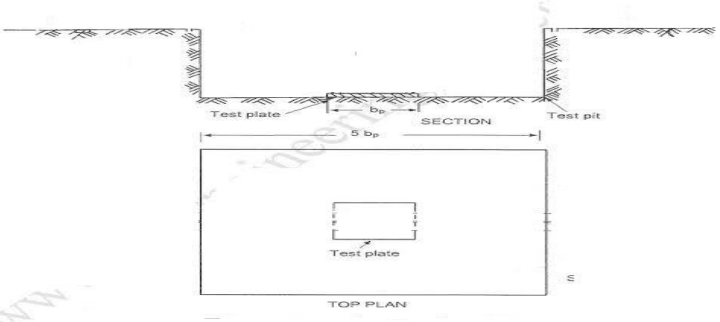
$$\rho d = \frac{\rho}{1 + w}$$

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.
10. A graph is drawn between moisture content on X axis and dry density on Y axis. A curve with a well defined beak 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.

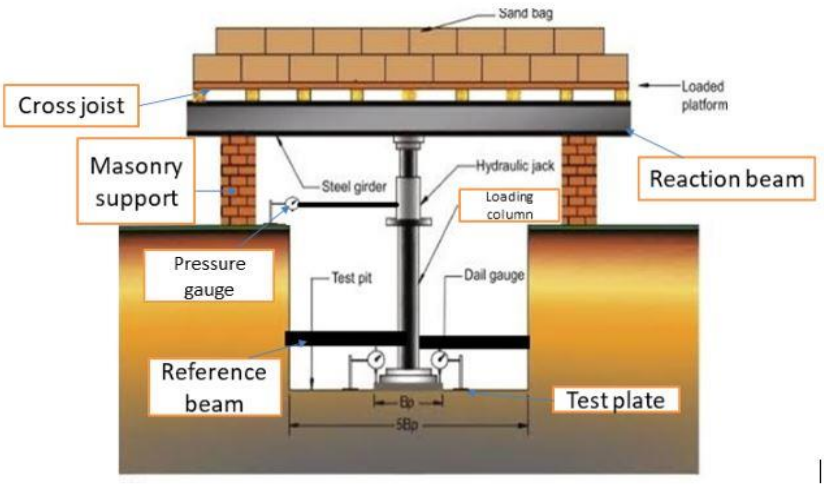


VI.b	A sand sample of 35cm2 cross sectional area and 20 cm long was tested in a constant head permeameter under a head of 60 cm, the discharge was 120 ml in 6 min. The dry weight of sand used for the test was 1120 g. and Gs=2.68. Determine the hydraulic conductivity in cm/sec and the discharge velocity  Given, Area of Cross Section, $A = 35 cm^2$ Length of specimen, $l = 20 cm$ Hydraulic head, $h = 60 cm$ Volume of water collected, $Q = 120 ml = 120 cm^3$ Time, $t = 6$ minute $= 6 \times 60 = 360$ sec $\therefore$ Coefficient of permeability by Constant head method $k = \frac{Ql}{Aht}$ $= \frac{120 \times 20}{35 \times 60 \times 360}$ $k = 3.17 \times 10^{-3}$ cm/s Scanned with CamScanner	7		
VII.a	List the objectives of site exploration i. To select the type & depth of foundation for a given structure ii. To determine the bearing capacity of soil iii. To estimate probable maximum differential settlement. iv. To establish ground water level and the properties of water. v. To predict lateral earth pressure against retaining walls vi. To select suitable construction techniques vii. To ascertain the suitability of the soil as a construction material. viii. To investigate safety of an existing structure.	7		

VII.b	Describe the method of standard penetration test 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). In very fine silty or saturated sand , then there is apparent increase in resistance occurs. When 'N' is greater than 15, Ne is givenby, **Ne= 15+1/2 (N-15)** Where N= Actually observed no.of blows Ne= Corrected no.of blows	8		
VIII.a	State Terzaghi's theory of bearing capacity Terzaghi's Bearing Capacity Theory: Assumptions in Terzaghi's Bearing Capacity Theory. Depth of foundation is less than or equal to its width. Base of the footing is rough. Soil above bottom of foundation has no shear strength; It is only a surcharge load against the overturning load Surcharge upto the base of footing is considered. Load applied is vertical and non-eccentric. The soil is homogenous and isotropic. L/B ratio is infinite 			

	we obtain, $Q_d = B(cN_c + \gamma D_f N_q + \frac{1}{2}\gamma B N_\gamma)$ the quantities N_c, N_q, N_γ are called bearing capacity factors. $N_q = \frac{a^2}{2\cos^2(45+\phi/2)}$ $N_c = \cot\phi\left[\frac{a^2}{2\cos^2(45+\phi/2)} - 1\right]$ $N_\gamma = \frac{1}{2}\tan\phi\left[\frac{K_p}{\cos^2\phi} - 1\right]$ **where *K p*= passive earth pressure coefficient** $a = \exp\left[\left(\frac{3\pi}{4} - \frac{\phi}{2}\right)\tan\phi\right]$			
VIII.b	Explain plate load test <u>Plate load test:-</u> • It is a field test to determine the ultimate bearing capacity of the soil and probable settlement under given loading. • The test consist in loading a rigid plate at foundation level and determining the settlement corresponding to each load increment and the ultimate bearing capacity is taken.  • Here the test pit usually at foundation level • Normal width= 5times the test plate width (Bp) • Test pit shall be carefully cleaned and levelled at bottom, preferably have steps to go inside the pit for setting and taking observations. ***<u>Plate load test by Gravity loading method</u>***	8		

In this method a platform is constructed over a vertical column resting on the test plate and the loading is done with the help of sand bag, stones or concrete blocks. The general arrangement of the test setup is



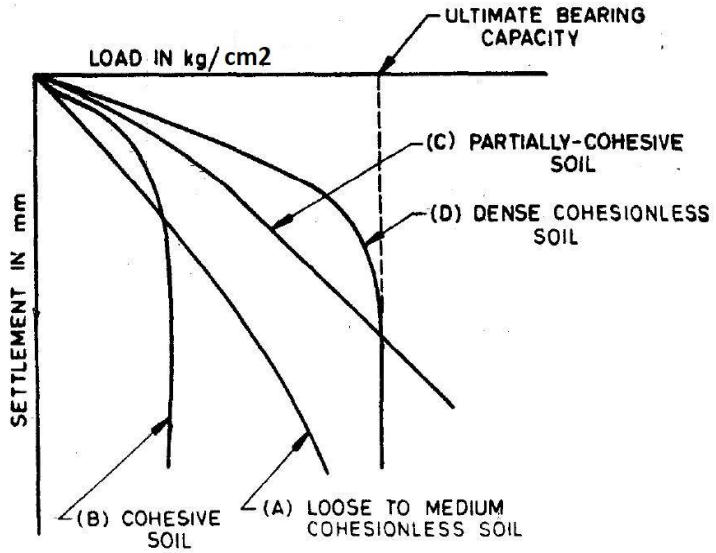
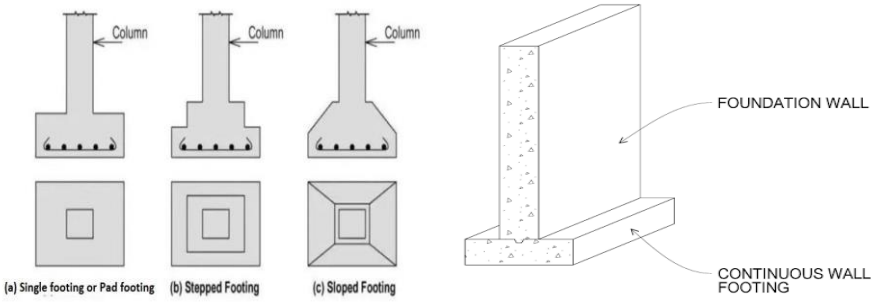
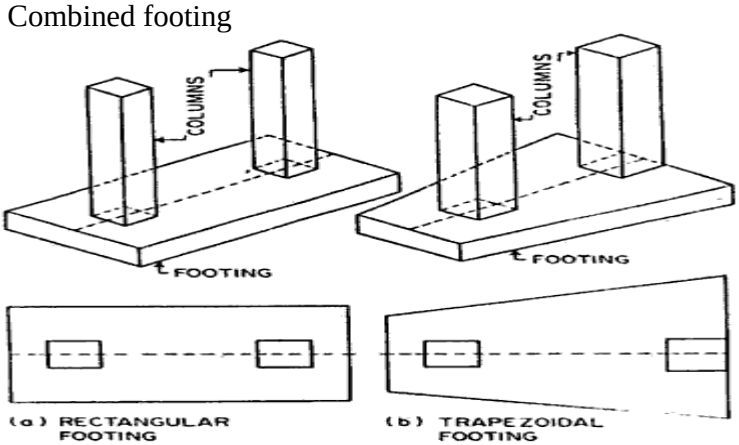
Apparatus or tools required:-

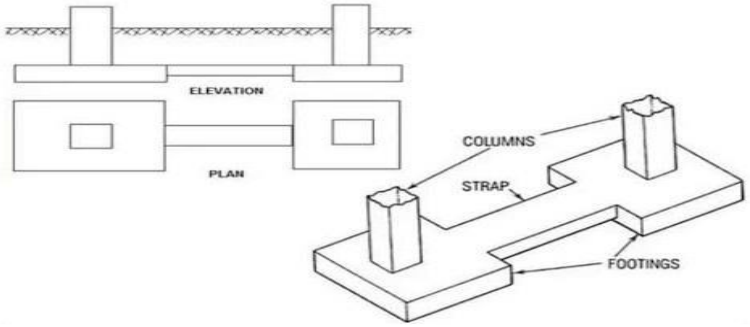
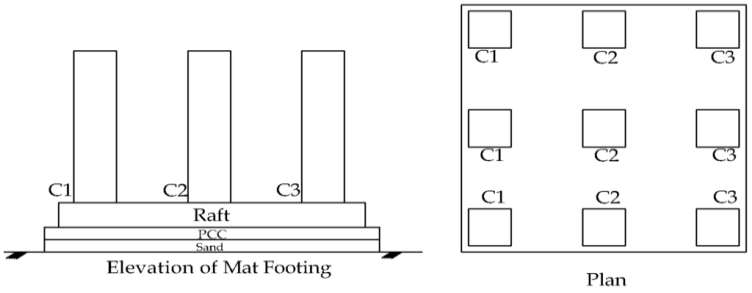
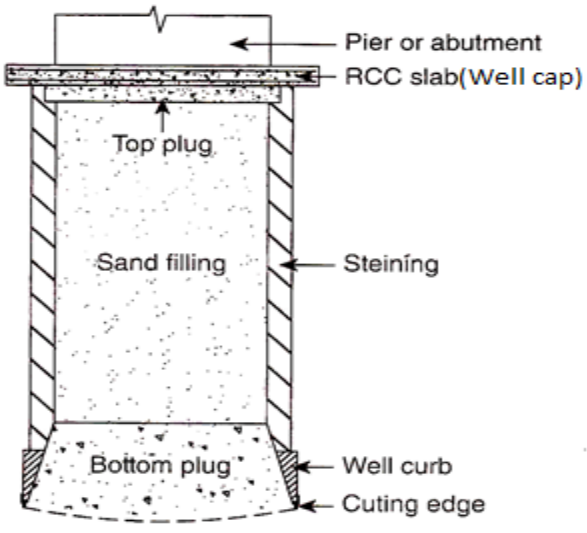
1) Loading platform
2) Hydraulic jack of required capacity
3) Load intensity measuring device
4) Circular or square bearing plate made up of mild steel of thickness not less than 25mm and size varying from 300to 750mm with a chequered or grooved bottom.
5) Settlement recording device accurate to 0.01mm
6) A beam or road strong enough to be fitted on support
7) Loading column

Procedure:-

1) A test pit of width= 5times the test plate (5 Bp) is dug and the bottom is levelled and cleaned.
2) A layer of fine sand of maximum thickness 5mm is laid and bearing plate is placed in position.
3) The reaction beam is so arranged such that the centre of plate coincides with the centre of the reaction beam.
4) A hydraulic jack which placed in between reaction beam and loading column
5). A minimum seating pressure of 70 g/cm2 shall be applied before starting the load test.

6). Two dial gauges are fixed just opposite to one another.
7). The support of the reference beam is placed over from ground.
8). Load is applied to the soil in the cumulative equal increment of about 1kg/cm2 or $1/5^{th}$ of the estimated ultimate bearing capacity whichever is less.
9). For every load increment settlements are recorded at every 1, 2.25, 4, 6.25, 9, 16, 25 at hourly intervals to the nearest 0.02mm.

	10). The test may be continued until a settlement of 25mm occurs in case of ordinary circumstances or 50mm in case of dense gravel or till failure takes place, which ever is earlier. 11). The load is also released gradually during which rebound observations are taken. 12). A graph is drawn, load on X-axis and settlement on Y-axis. This graph is known as load-settlement curve.  13). From the load-settlement curve the yield point is observed. The ultimate bearing capacity of the soil may be arrived at from the graph by noting the reading corresponding to the straight line part of the graph.			
IX.a	Illustrate different types of shallow foundations with sketches a. Spread footing or isolated footing or wall footing  b. Combined footing  	7	7	

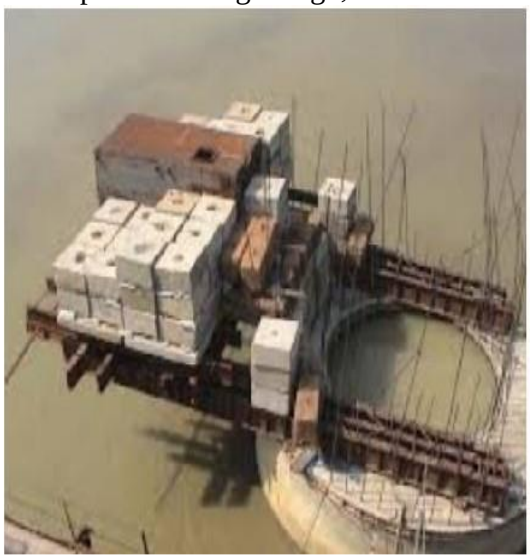
	c. Strap footing or cantilever footing  d. Mat or Raft foundation  			
IX.b	Explain with sketch the components of well foundation **Well foundation:-** • Well foundation is a type of deep foundation which is generally provided below the water level for bridges. • A well foundation can be constructed on the dry river bed, after making a sand island • When the velocity of water is high, wells can be fabricated on river banks and then floated to the final position. • Once the well has touched the bed of river, then sand bags are placed around the well to prevent scour.  Components of well foundation	8	8	

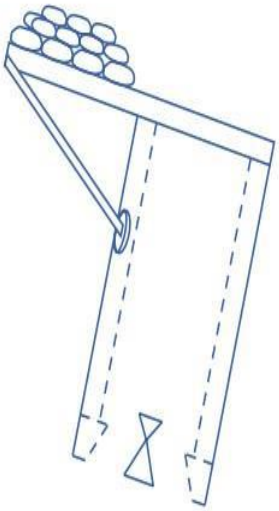
	Component parts of Well foundation 1. **Cutting edge:-** Cutting edge is a very sharp member usually made up of steel. Which helps in cutting through the soil and facilitates easy penetration of the well. **2. Well curb:-** Well curb is tapered in shape and made up of reinforced concrete. **3. Well Steining:-** 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.			
X.a	Compare shallow and deep foundation **Shallow foundation**: Depth of foundation is less than breadth of foundation is called **Shallow foundation** (Depth<Breadth) Shallow foundations are normally provided for residential buildings or light loaded structures. Shallow foundation takes lesser load when compared to deep foundation. Eg:- Spread footing, combined footing, Raft footing **Deep foundation**: Depth of foundation is greater than breadth of foundation is called **Deep foundation**. (Depth>Breadth) Deep foundations are provided when structural loads are more heavier (Bridges, high rise buildings). Deep foundation takes more load when compared to shallow foundation Eg:- Pile foundation, Well foundation. 4.	3.5 3.5	7	
X.b	Explain the Rectification methods of shifting and tilting in well foundations 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 • A loading platform is constructed on the higher side and load is placed on it.	8	8	

• 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.



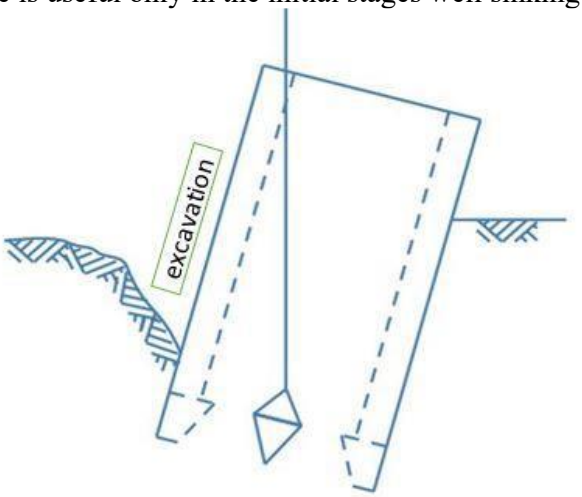


Excavation on higher side:-

• 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.

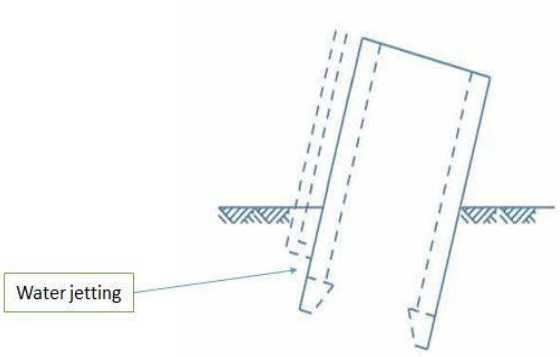
• This technique is useful only in the initial stages well sinking



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.

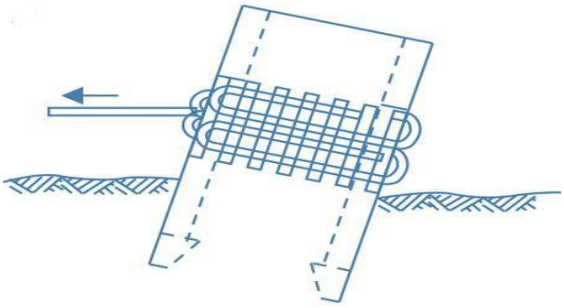


Pulling the well:-

• 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.