Important Instructions to examiners:

1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

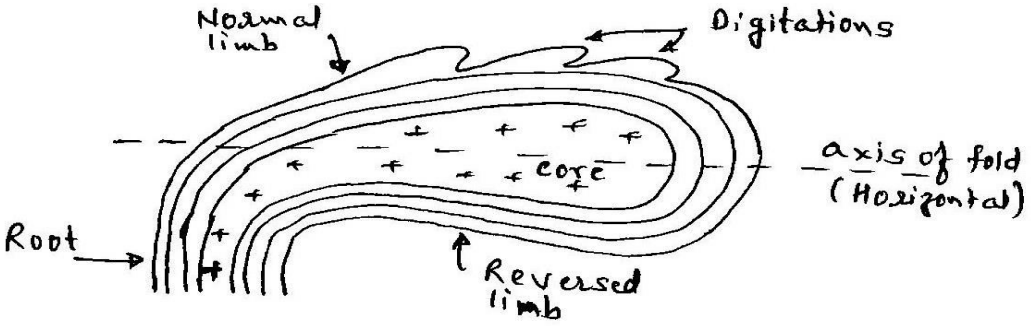
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

Question and Model Answers	Marks
Q.1. a) Attempt any SIX of the following	**12M**
i) Define petrology and rock **Petrology:** - Petrology is study of formation of various types of rocks, their mode of occurrence, composition, texture & structures, distribution on the earth. **Rock:** - Aggregation of minerals is called rock or minerals occurring in natural aggregated form called rock.	**1M** **1M**
ii) Enlist any four physical properties of minerals. i) Colour ii) Luster iii) Streak iv) Hardness v) Cleavage vi) Fracture vii) Tenacity viii) Structure (form) ix) Specific gravity x) Miscellaneous-Magnetic, Electrical.	**1/2X4 =2M**
iii) Define Dip and strike **Dip** – Dip is the angle made by an inclined bed or formation with horizontal plane. **Strike** – Strike is the line of intersection of an inclined bed or formation with its horizontal projection (Plane)	**1M** **1M**

iv) Draw neat sketch of

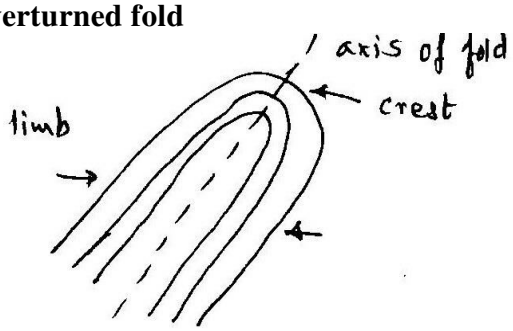
1) Recambent fold



1M

1M

2) Overturned fold



v) State any four methods to find water content of soil sample.

The direct determination of moisture content can be made by

a) Oven drying b) Infrared c) Sand bath method.

The indirect method are

a) Calcium carbide
b) Penetration resistance (proctor needle)
c) Nuclear
d) Pycnometer

1/2X4 =2M

vi) State salient features for any one dam in Maharashtra State.

Students are expected to write :-

1. Name of river on which dam is constructed
2. Type of dam
3. Height of dam
4. Length of dam
5. Gross storage capacity
6. Reservoir area
7. Effective storage
8. Spillway discharge capacity
9. Purpose

1/2X4 =2M

vii) State importance of soil as a foundation bed for structures in Civil Engg. — **1M**

a) Foundation soil affect the type of foundation selection — **1M**

b) As a material it offers strength & stability to the foundation of dam/structure.

viii) Define void ratio, porosity, degree of saturation, water content. — **1/2M**

a) **Void Ratio (e)** – It is the ratio of volume of voids to the volume of solids (vs),

$$e = \frac{Vv}{Vs}$$

b) **Porosity (n)** – It is the ratio of volume of voids to the total volume of soil, — **1/2M**

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

c) **Degree of saturation (s)** - It is the ratio of volume of water (Vw) to the volume of voids (Vv), — **1/2M**

$$g = \frac{Vw}{Vv}$$

d) **Water content (w)** - It is the ratio o the mass of water (Mw) to the mass of solids (Ms) — **1/2M**

$$W = \frac{Mw}{Ms} = \frac{Ww}{Ws}$$

Q.1 b) Attempt any TWO of the following	**08**

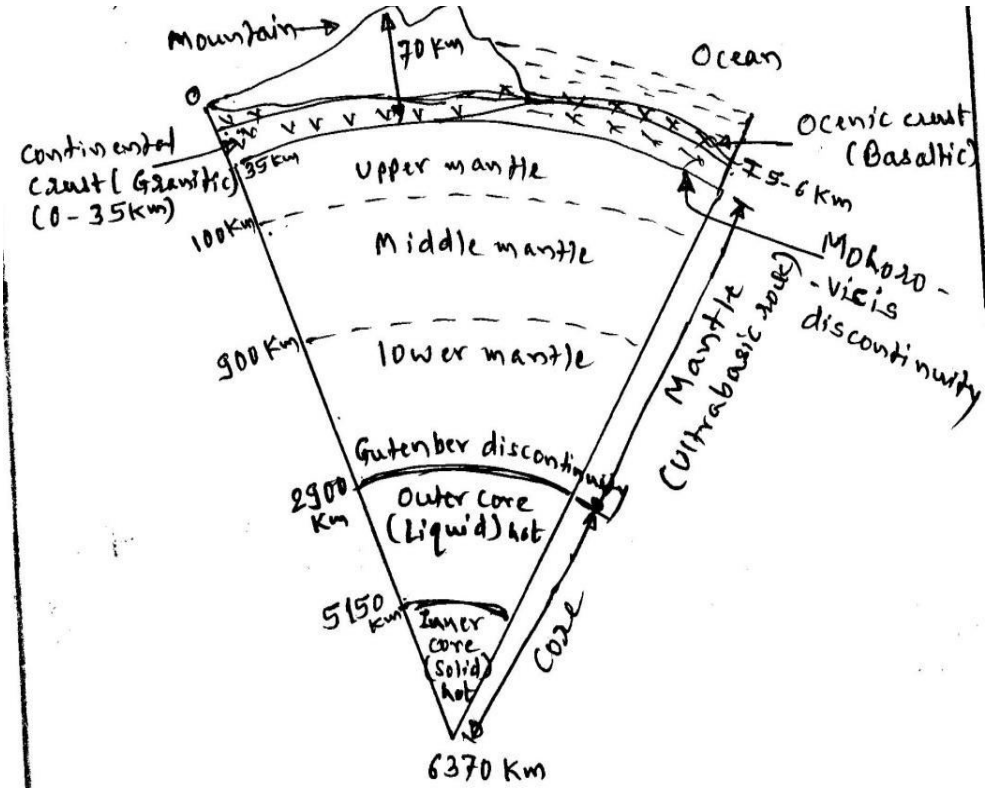
i) Explain crust, mantle and core with a neat sketch.

The planet earth is composed of 3 parts namely :-

a) Atmosphere
b) Lithosphere
c) Hydrosphere

The Lithosphere is solid and stony portion of the earth. The body of earth is subdivided into three specific zone as

1) Crust
2) Mantle
3) Core



1M

Structure of Lithosphere *

Crust – It is topmost solid shell of the earth having varying thickness 5 – 6 km at ocean, 30 – 35 km at continent and 60 – 70 km at mountains. Oceanic crust is darker called basaltic layer. It is heavier, having SP. GRAVITY 2.8-2.9. It contains silica & magnesia therefore called SIMA. The continent crust is light in colour called granitic layer. It having low density, sp.gr 2.7 and contains silica & alumina (S;AL)

1M

Mantle – This zone between lower boundary of the crust upto depth of 2900 km. It is subdivided into i) Upper ii) Middle iii) Lower mantle

This layer is ultra basic rock which is rich in iron and magnesia and poor in silica. The density varies from 3.3 g/cc at top to 5.7 g/cc at lower mantle it is highly plastic in nature.

1M

Core – The innermost shell of the earth is starting from 2900 km to centre of earth. It is divided into two portions, the outré core & inner core. The outré core is hot liquid. The density at top is 9.9 g/cc and at junction of inner core is 12.7 g/cc. It is elastic to no shear strength material.

The inner core is hot and solid. The average density is about 12 g/cc. It consist iron & nickel.

ii) Define fault and state its classification

Fault – It is defined as the rupture / fracture along which there is a relative movement of beds. The movement may vary from few centimeters to many km. depending upon nature and magnitude of stresses and resistance offered by rock.

1M

Classification of fault :

1) Based on position of fault plane.
   (a) Normal Fault
   (b) Reverse Fault

½x6 =3

Based on their genesis
   a) Gravity fault
   b) Thrust fault
   c) Strike / slip fault
2) Horst and Graben
3) Step fault
4) Bedding fault
5) Dip fault
6) Strike fault

iii) Explain any four field applications of Geotechnical Engineering.

The Field application of GTE as
   a) Foundation design
   b) Pavement design
   c) Design of earth retaining structures
   d) Design of earthen dams
   e) Design of embankment slopes
   f) Design of underground structures

a) **Foundation Design**

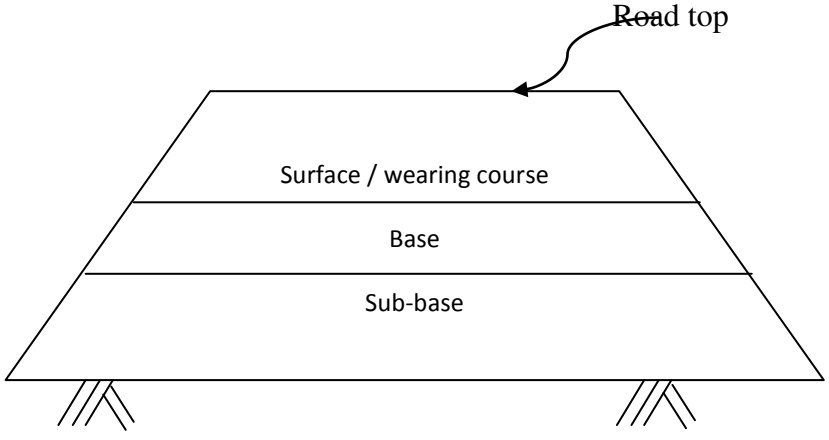
Foundation is required to transfer the load of super structure to foundation soil and to give stability to the super structure. The size and type of foundation is affected by the bearing capacity of soil. The GTE helps in design of foundation by investigation bearing capacity.

b) **Pavement Design**

Any 4

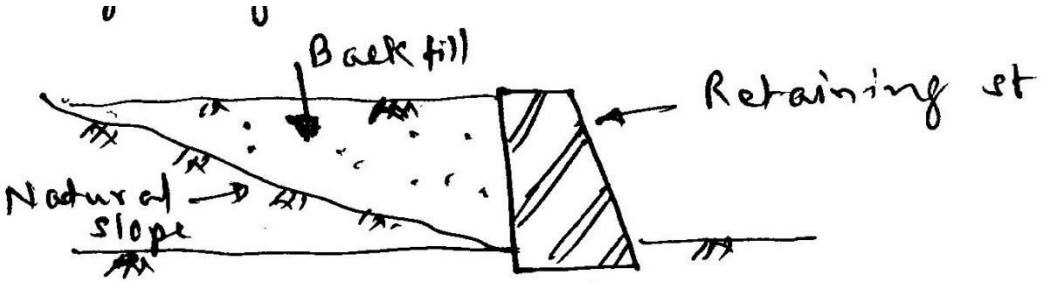
1M each

A pavement constructed with various material placing in layer in compact, dense form which support to vehicle wheel loads. The wheel load is repetitive and varying in magnitude. The thickness of each layer for type road, nature, climate condition & bearing capacity of soil on which pavement is constructed is varying. The GTE is applicable in pavement layer design (Thickness)



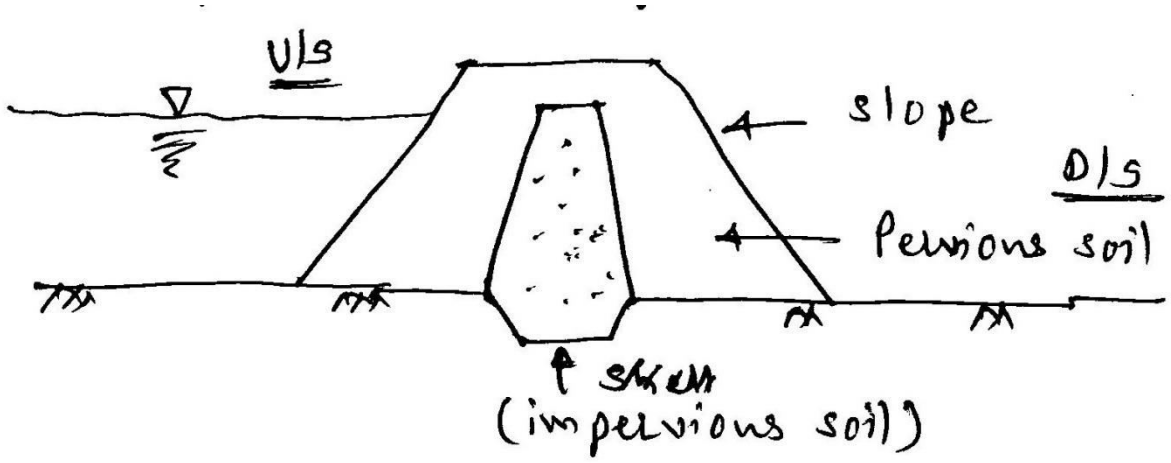
c) Design of earth retaining structure

The sloping ground is to be levelled by constructing earth retaining st. and Filling natural soil behind it



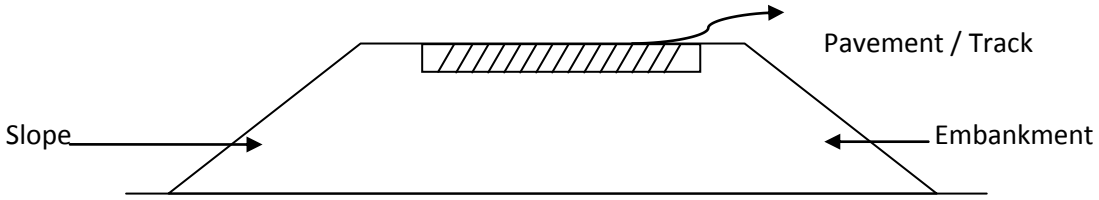
d) **Design of earthen dam**

The construction of earthen dam requires permealile and impermeable soil. The position each soil, their function is different. The section of dam should be stable against water pressure , seepage pressure.



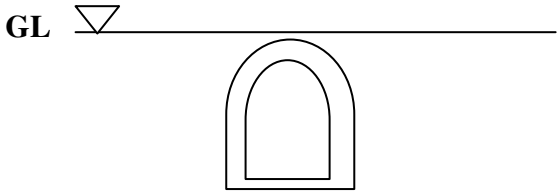
e) **Design of embankment**

The highway is construction in deep valley portion, depressions is made with huge soil filling called embankment. The stability of slope affects the of stability pavement or railway track.



f) Underground structures

The shape of tunnel depends on the type of soil, geological stability of beds



Q.2 Attempt any FOUR of the following — 16

a) Explain formation process of soil, state various types of soil available in India.

Soil formation — 1/2X4 =2M

Soil formation is controlled by a number of factors of which the most important are

Climate – Affects soil formation through precipitation and temperature. This factor is responsible for an increase in the organic & clay contents.

Vegetation cover – Plant roots may bind soil particles together and prevents erosion of soil cover. This make soil highly humus content especially forest & grassland soils.

Parent materials – Depends upon favourable decomposition, hydration, oxidation, dissolving elements present in parent material affect the rate of soil formation.

Topography – Sue o steep slope the top portion of rock erodes with faster rate and forms soil due to faster drainage in soil.

Micro – organisms & time for which rock is exposed to weathering.

Types of soil available in India

1) Residual soil — 1M
   a) Red Soil
   b) Laterite soil
   Black cotton soil
2) Transported soil — 1M
   a) Colluvial Soil
   b) Alluvial soil
   c) Glacial soil
   d) Lacustrine soil
   e) Eolian soil

Q.2. b) State two causes and effects of earthquake

Causes of earthquake : — Any two 1M each= 2M

1) Landslide & rock fall
2) Volcanic activity
3) Fault
4) Plate tectonics
5) Nuclear explosion
6) Rock bursting in mine

Effects of Earthquake

A) Primary effects

a) Creation of slopes
b) Fissures
c) Warping of beds
d) Emergence or subsidence of costal lines
e) Changing in the course of streams
f) Origin of new springs
g) Creation of sand dykes
h) Liquefactions

Any two points

1/2x2= 1M

B) Secondary effects

a) Some landslides & crack
b) Damages to bldg, bridges, dams, poles due to shaking movements
c) Overturning / thrown away to looses objects
d) Breaking of telephone / electrical cables.
e) Stopping of mechanical clock
f) Creation of Tsunamis
g) Uprooting of trees / stem breaking

Any two points

1/2x2= 1M

Q.2 c) State method of construction of Earthquake resisting structure

In addition to safety factor, some general precaution has to be followed to minimize the danger of collapse / failure of bldg.

a) The foundation :
- i) Should rest on hard solid bed
- ii) Should be withstanding shock when constructed on loose soil.
- iii) Foundation should be provided at some level throughout the bldg.
- iv) Keys should be provided at base.

b) The body of structure
- i) Lighter walls & possible RCC
- ii) Continuing of the cross walls
- iii) Keys should be provided at walls junction
- iv) Minimum openings in wall

c) The roof of structure
- i) Flat roof are greater resistance against shocks
- ii) Light wt material
- iii) Avoid projections / overhanging
- **iv)** Uniform mass

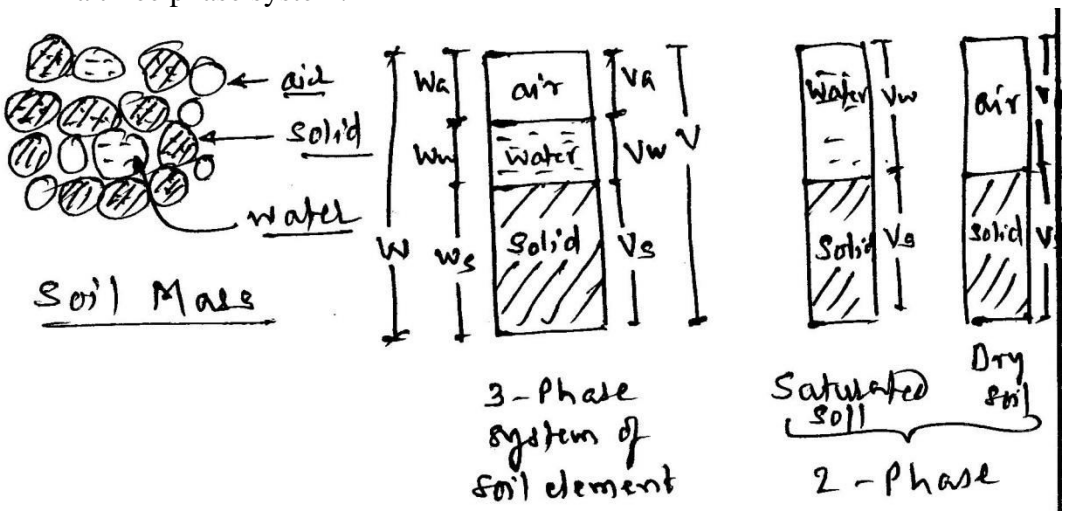
d) General
- a. Ties at various levels of constant
- b. uniform height of component
- c. Symmetrical plan
- d. Provide expansion joints at discontinuity
- e. Equal loading on floors
- f. Provide shear walls
- g. Avoid stilt floor
- **h.** Ductile detailing of steel reinforcement RCC components.

Any 4 1M each =4M

c) State constituents of soil and any two physical properties of soil

Constituents of soil

A soil element comprising solid soil particles, water and air can be represented by a three phase system. **1M**



1M

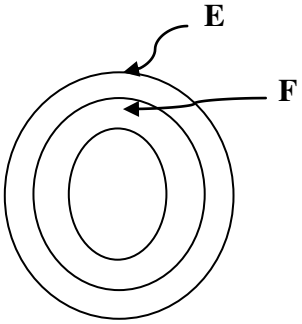
Physical Properties of Soil

Any two 1M each =2M

1) Density of soil ϱ = M / V
2) Water content w = Mw/Ms = Ww/Ws
3) Voids ratio e= Vv/Vs
4) Porosity n = Vv/V
5) Degree of saturation S = Vw/Vv
6) Specific gravity G = q_s/ q_w = rs/rw

d) Define

I) **Epicentre** – This is the point on the earth's surface which is vertically above the focus. **1M**



II) **Focus** (Hypo centre) – It is a point within the earth where earthquake originates. Focus may be point or zone of disturbances **1M**

III) **Seismology** – A branch of geophysical science dealing with to study the causes and effects of the earthquakes and to make predictions of their occurrence in the future **1M**

IV) **Seismic Waves** – When an earthquake occurs, it releases tremendous energy, which is then manifested in the form of body waves. These are elastic waves generated at the place of origin (disturbance) and these spread in all directions. **1M**

e) Define plasticity index and classify soil on its basis.

a) **Plasticity index (Ip)**
It is give measure of degree of plasticity of soil. It is difference be liquid limit and plastic limit **2M**

$$Ip = W_L - Wp$$

Greater plasticity index, the greater is degree of plasticity of the soil.
[Definition in other word as "The range of moisture content over which the soil is in the plastic state is called the plasticity index"]

b) **Classification of soil based on Ip**
i) Non plastic soil **1M**
If wp = o Ip = w_L

ii) Plastic soil **1M**

Q.3 Attempt any FOUR of the following **16**

a) Explain IS classification o soil as per IS:1498

IS 1498 : Classification of soil indicate the behaviour of soil as a construction material

Soil is broadly classified into **2M**

i) Coarse grained soil
ii) Fine grained soil
iii) Highly organic soils and other miscellaneous materials

IS classification table

Particle size in mm

0.002	0.075	0.425	2.0	4.75	20	80	300	
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	Cobble	Boulder
		Sand			Gravel			

2M

b) Define permeability and coefficient of permeability

Definition

i) **Permeability (k)** "It is defined as the properly of soli which permits the seepage of fluid through interconnecting voids under gravity **2M**

OR

Permeability (k) It is defined as the speed at which the water flows through voids under unit head at unit hydraulic gradient

ii) **Coefficient of permeability** **2M**

It is defined as velocity of flow under a unit hydraulic gradient through soil mass

It is measured in cm / sec or mm / sec or m / sec or m / day

Mathematically, it is represented as K = v/i

Where v = discharge velocity in m/s

i = hydraulic gradient

c) Explain with neat sketch Phreatic line in earthen dam with pressure head at different point and show construction points of this line.

Procedure for locating the Phreatic line

i) Draw an earthen dam having upstream face AB with water surface.

ii) On water surface measure distance BC = 0.3 L C is starting pt of base parabola. Let 'F'is focus.

iii) Working principle: Any point on parabola is equidistant from focus and directrix.

iv) Locate directrix using pt ç'as centre and CF as redius to draw an arc and cutting line passing through CB at pt 'D', so that CF = CD . DH is directrix **2M**

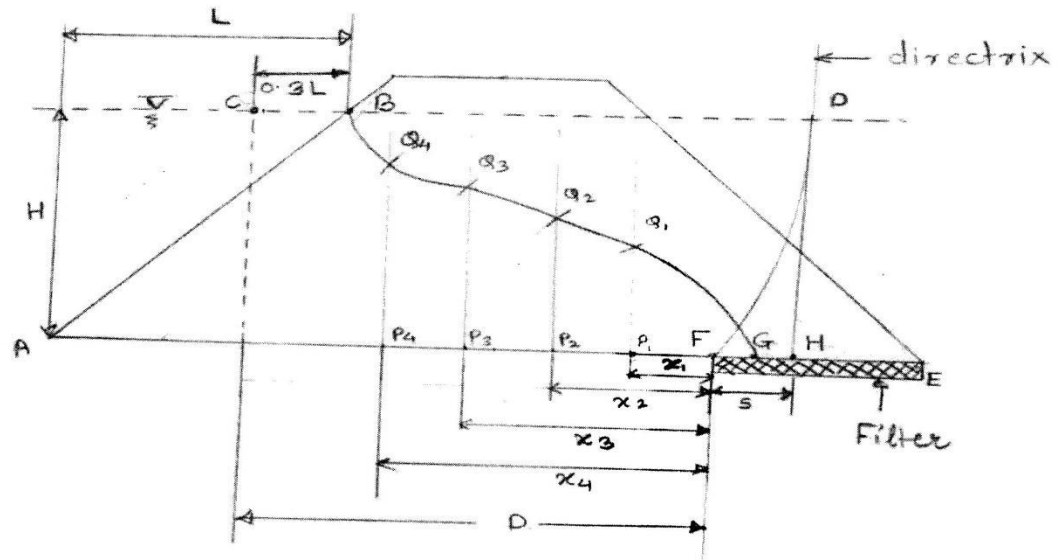
v) Find midway between 'F'& 'H'.

vi) Repeat the above step by selecting points at base AE measures their distance from H pt. With 'F'as centre and respective distance as radius, draw an arc cutting that vertical line passing through selected point.

vii) Join all such points to get base parabola i.e. Phreatic line.

viii) Here G,Q_1,Q_2,Q_3,Q_4 and B represent Phreatic line

(3c) DIAGRAM (2marks). **2M**



d) State any four factors which affect shear strength of soil	
Shear strength is affected by i) <u>Soil composition</u> Mineralogy, grain size, shape of soil particles, pore fluid type and content, clay content. ii) <u>Initial State</u> Loose, dense, normally consolidated, over consolidated, stiff, soft etc iii) <u>Structure</u> Arrangement of soil particles, stratifications presence of voids, cementation etc. iv) <u>Properties</u> Relative density, permeability, compaction, confining pressure etc gradation v) <u>Type of loading</u> static, dynamic vi) <u>Drainage conditions</u> Undrained, drained vii) <u>Stress conditions</u> deviator stress, confining stress, intermediate stress **(Any four from above are acceptable)**	**1M each =4M**
e) Explain vane shear test to determine shear strength soil specimen in laboratory with neat sketch i) The undrained shear strength of soft clays can be determined in a laboratory by a vane shear test ii) **Apparatus** – A) Consist of a vertical steel rod having four thin stainless steel blades fixed at bottom end B) Height (H) of vane equals twice the overall diameter (D) (D = 2.5 mm and H = 60 mm) (Length of rod = 24 mm) recommended values C) Container having d = 38 mm and ht = 75 mm is fixed securely to the base plate. D) Vane is gradually lowered into container having soil mass at a depth of 10 to 20 mm below the top of specimen E) Torque is applied at rate of 6^{o}per minute Till the specimen fails is shear Torque applied is measured iii) **Measurement of shear strength** The shear strength of soil is measured using $$S = \frac{T}{\pi D^2 \left(\frac{H}{2} + \frac{D}{6} \right)}$$ when Both top & bottom end partakes in shearing	**2M** **1M**

$$S = \frac{T}{\pi D^2 \left(\frac{H}{2} + \frac{D}{12} \right)} \quad \text{when}$$

Only bottom end partakes in shearing where S is in N / mm^2 and T is in N – mm

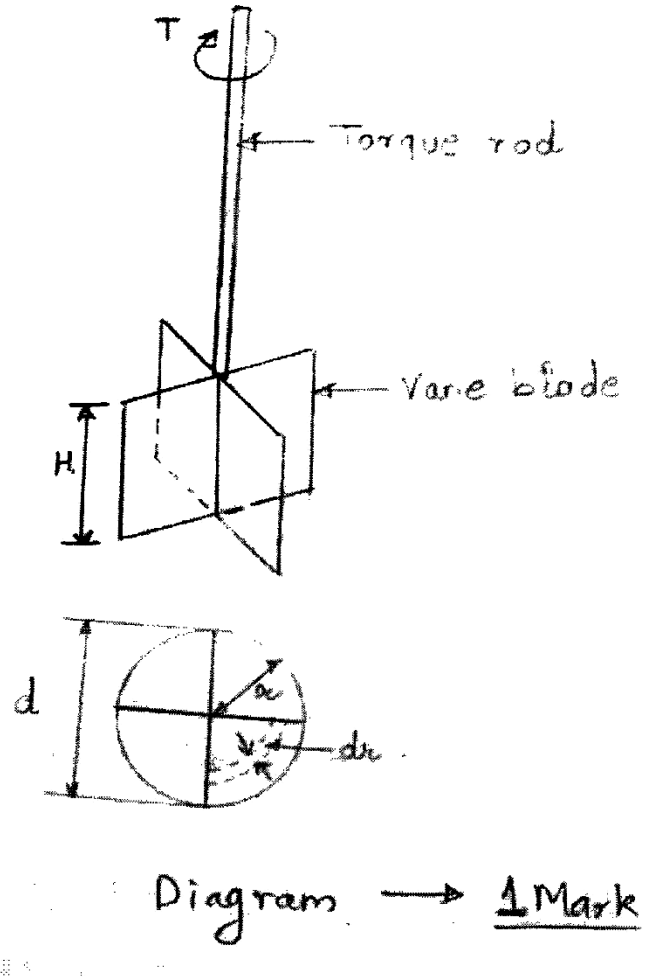


Diagram → 1 Mark

1M

Q.3. f) Define-

i) Active Earth Pressure- (Pa)- **1M**

A state of active earth pressure occurs when the soil mass yields in such a way that it tends to stretch horizontally. It exists when retaining wall moves away from backfill.

ii) Passive Earth Pressure (Pp)- **1M**

A state of passive earth pressure exists when the movement of wall in such a way that the soil tends to compress horizontally. It exists when retaining wall moves towards backfill.

iii) Earth Pressure at Rest(Po)- The lateral earth pressure is called at rest pressure when the soil mass is not subjected to any lateral yielding and retaining wall is firmly fixed at its top (not allowed to rotate or move laterally)	**1M**
iv) Coefficient of earth pressure – It is function of the angle of shearing resistance (Ø) ex.- Ka = $\frac{1- \sin Ø}{1+ \sin Ø}$	**1M**
Q.4 Attempt any FOUR of the following	**16M**
a) State the effect of water table on bearing capacity. Explain Effect of water table on bearing capacity - (i) The rise in water table from below the foundation results in decrease in granular soil (ii) When the water table reaches the ground where depth of footing is greater, bearing capacity is reduced by 50% (iii)Bearing capacity of purely cohesive soil is not affected. (iv)Bearing capacity of non cohesive soil decreases with water table. (v) Bearing capacity of shallow foundations is poor as compared to deep foundations in presence of water table.	**Any four points** **1M each =4M**
b) Suggest typical values of S.B.C. for following soil types **Safe bearing capacity (SBC) (qs)** The maximum pressure which the soil can carry safely without risk of shear is called the safe bearing capacity Typical values of SBC for following soils are : a) Sand gravel mixture – 440 KN / M^2 b) Block cotton soil – 130 – 160 KN / M^2 c) Hard moorum – 880 KN / M^2 d) Soft moorum – 440 KN / M^2	**1M each =4M**
c) State different methods of soil stabilization and explain any one i) **Mechanical stabilization** – It is the process of improving properties of soil by changing its gradation. It depends on mechanical strength of aggregate, mineral composition etc Eg – Compaction at near OMC either static or dynamic. ii) **Cement Stabilization** – It is done by mixing soil and cement together to form a stranger material, which becomes hard & durable & develops strength. Eg – Clay and lime is used for soil containing harmful organic matter.	**Listing- 2M**

iii) **Bituminous stabilization** – It is done using asphalt as binder due to its chemical properties such as viscosity. Any inorganic soil can be mixed with asphalt

Expl.- 2M

Eg – For cohesionless soils, asphalt acts as binding material

iv) **Chemical Stabilization** – Different chemicals such as chlorides and silicates area added to soil, it is used where setting and curing time needs to be controlled. It is expensive compared to other method

Eg – Chlorides in soil increase electrical attraction and form flocculated structure to improve permeability of soil

v) **Thermal Stabilization** :- it is done by either heating or cooling soil. It is used to drive off pore water or freeze it to improve strength of clayey soils.

vi.) Electrical Stabilization :- Electro – osmosis method is used to drain out water from cohesive soils to increase it's strength by exchange of anions and cations in soil & water

vii) **Grouting** : Grouting is injecting stabilizer into soil under certain pressure. It is costlier method and works for undisturbed soils.
Eg – An area close to existing building can be stabilized using this method.

viii) **Geotextiles :** Geotextiles are used as reinforcing material in soil they help to drain water, increase strength, decrease mixing of soil, filters the water etc.

d) Mention criteria for deciding the location and number of trials pits and bore holes as per IS (1892 – 1972)

IS 1892 – 1972 recommends that

i) For a compact building site covering an area of 0.4 hectare, 1 bore – hole or trial pit at centre and one at each corner is adequate

2M

ii) For larger areas divide the area in grid pattern at a spacing of 50 m to 100 m using sounding tests / cone penetration test. Number of bore holes and trial pits is decided by examining the variation in penetration resistance

2M

e) The following observations were made using SPT on soil sample.

Bulk density gm/cc	1.65	1.95	2.1	2.2	2.15	2.05
Water content	5	10	16	22	25	30

Determine OMC and MDD -

Calculate Dry density in gm /cc by using relation

$$\rho_d = \frac{\rho_b}{1 + w} \quad \text{..... (gm /cc)}$$

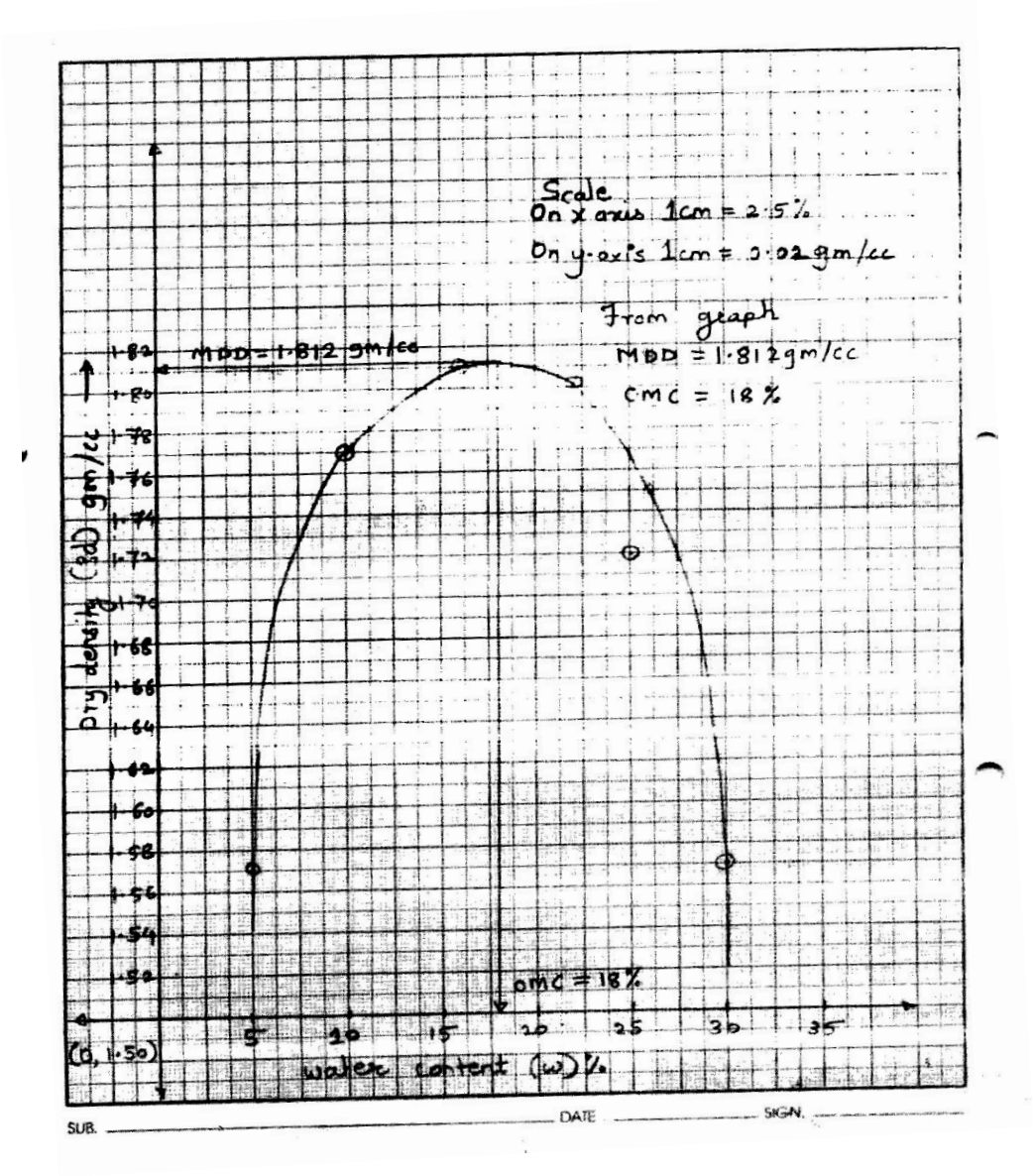
Bulk density (ρ_b) gm/cc	1.65	1.95	2.1	2.2	2.15	2.05
Water content (%)	5	10	16	22	25	30
Dry density (gm /cc) $\rho_d = \frac{\rho_d}{1 + w}$	1.57	1.77	1.81	1.80	1.72	1.57

Calculation- 2M

Plot a graph of 'ODD' vs 'w'

From graph – MDD = 1.812 gm / cc
OMC = 18%

Graph on next page----------



Graph- 2M

f) Define CBR and state the significance of CBR Value

i) **Definition** : The California Bearing Ratio abbreviated as CBR is defined as the ratio of test load to the standard load, expressed as percentage for a given penetration of plunger

$$CBR = \frac{\text{Test load}}{\text{Standard load}} \times 100$$

2M

ii) **Significance :**

a) It is most widely used method for design of flexible pavement.
b) For a given CBR, appropriate thickness of construction required above a material for different wheel load and traffic conditions can be determined
c) It is used for evaluating the suitability of subgrade, sub – base and base course materials.

Any two points 1M each

Q.5	Attempt any TWO of the following	16

a) **A saturated clayey sample weighing 1540 gm, weighs 1120 gm after oven drying. If its dry density is 1359 kg/m^3, determine its water content, void ratio, porosity and degree of saturation. Assume G = 2.70 and γ_w = 10 kN / m^3**

W = 1540 gm
Ws = 1120 gm
γd = 1350 kg / m^3
G = 2.7, γw = 10 Kn/ m^3 = 1 gm / cm^3 …….. **1M**

1) Water content (w)
Wt of water (Ww) = W – Ws = 1540 – 1120
Ww = 420 gm

$$\text{Water content (w)} = \frac{Ww}{Ws} \times 100 = \frac{420}{1120} \times 100$$ **2M**

W = 37.5 % ……..

2) Void ratio (e)

$$\text{Dry density } \gamma d = \frac{G.\gamma w}{1+e}$$ …… **1M**

$$1.35 = \frac{2.7 \times 1}{1+e}$$ e=1 …… **1M**

3) Porosity (η)

$$\eta = \frac{e}{1+e} = \frac{1}{1+1}$$ $\eta = 0.5$ ……..… **1M**

4) Degree of saturation (Sr)

$$Sr = \frac{G.w}{e} = \frac{2.7 \times 0.375}{1}$$
Sr = 1.0125 X 100 **2M**

[Sr = 101.25 %] ……..

The water content can be calculated (alternative sol)

$\gamma_d = \frac{W_s}{V}$ $\text{Vol } V = \frac{W_s}{\gamma_d} = \frac{1120}{1.35} = 829.63 \text{ cm}^3$ $\gamma = \frac{W}{V} = \frac{1540}{829.63} = 1.856 \text{ gm / cm}^3$	$\gamma_d = \frac{\gamma}{1 + w}$ $1+w = \frac{1.856}{1.35}$ W= 0.375 X 100 W = 37.5 %

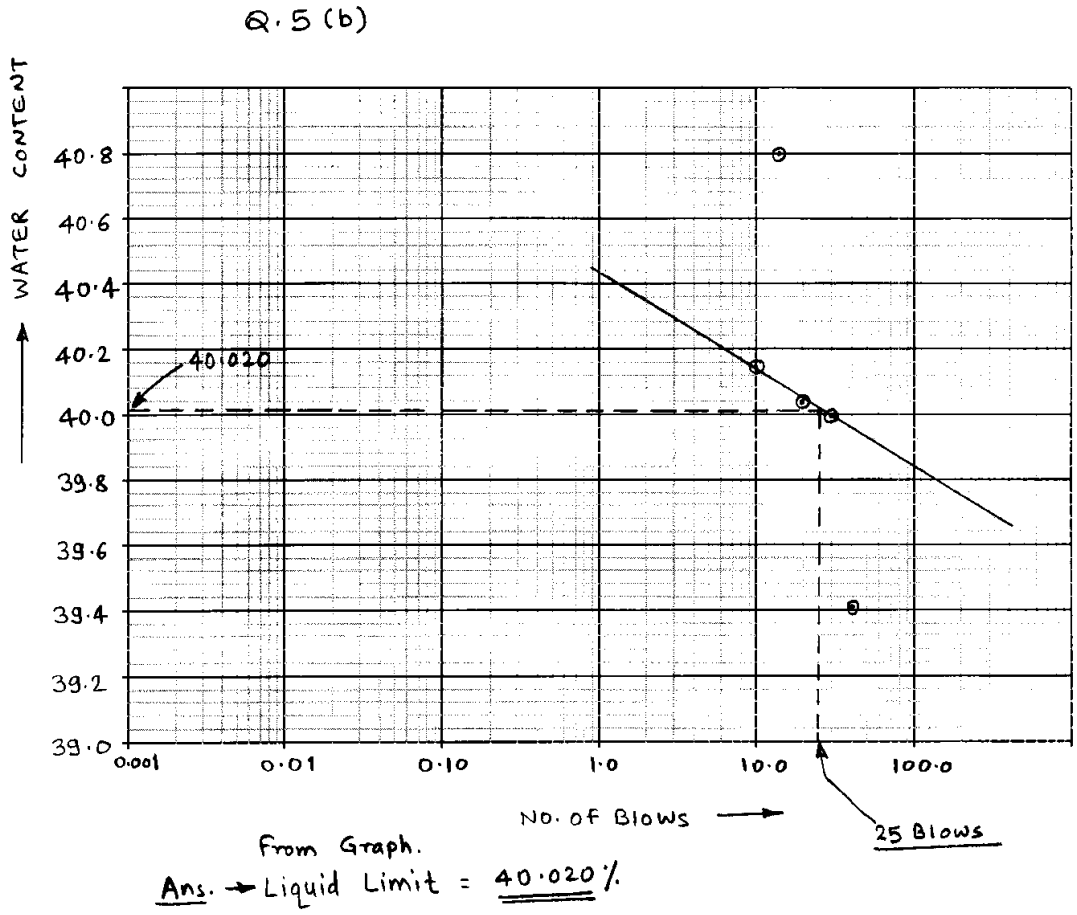
b) Following observations were recorded in liquid limit test. Determine liquid limit. Weight of container W_3= 6 gm

No of blows	40	50	20	15	10
Wet wt W_1 (gm)	30.67	32.20	31.20	32.75	30.05
Dry wt W_2 (gm)	22.00	23.00	22.35	23.26	21.44
Weight of water (Ww) gm	8.67	9.2	8.95	9.49	8.61
Water content (w) %	39.41	40.00	40.04	40.8	40.158

2M
2M

1. Calculate weight of water $W_w = W_1 - W_2$
   $= 30.67 - 22$
   [Ww = 8.67 gm]…….. **1M**

2. Calculate water content (w) $= \frac{W_w}{W_2} \times 100$
   $= \frac{8.67}{22} \times 100$
   = 39.41 % …… **1M**



Graph- 2M

c) Explain laboratory procedure for mechanical sieve analysis of soil.

1M

Laboratory Procedure for mechanical sieve Analysis
Mechanical in laboratory 1) Dry sieve Analysis 2) Wet sieve analysis

Apparatus required for test –

i) Weighing balance accurate to 1g and 0.1g
ii) Set of I C sieves – 80 mm, 40mm, 20 mm, 10 mm & 4.75 mm for gravels and for sand set of sieves 4.75 mm, 2.36mm, 2mm, 1.7mm, 1.18mm 600µ, 300µ, 150µ, and 75µ size

1M

iii) Thermostatically controlled oven
iv) Water tight trays
v) Seive brushes and a wire brush
vi) Mechanical sieve shaker
vii) Riffler

a) Dry sieve analysis

1M for each step=4M

i) The soil sample is taken in suitable quantity. The large the particle size the more is the quantity of soil required.
ii) The soil sample is first oven dried and it should be pulverized. It matters; it can be used air dry instead of oven dry.
iii) The sieves are arranged in chronological descending order and sample is sieved through set of sieves. The portion retained on 4.75 mm sieve is called gravel fraction and the portion passed through 4.75 mm and retained on 75 micron sieve is sand fraction.

iv) The weight of the soil portion retained on each sieve and pan is obtained to the nearest 0.1 gm and percentages weight retained is calculated for each sieve size and then % finer or % passing is obtained for each sieve size.

Dry sieve analysis is suitable for cohessionless soils with little or no fine particles

b) Wet sieve analysis

i) If soil contains substantial quantity about more than 5% of fine particles a wet sieve analysis is done. All lumps are broken into individual particles.

ii) A representative sample is taken using riffler and dried in an oven. The dried sample is taken in a tray and soaked in the water. **2M**

iii) The slurry is sieved through 4.75 mm sieve. The portion retained on 4.75mm sieve is gravel fraction. The material passing through 4.75 mm sieve is sieved through a 75 micron sieve. The material is washed until the wash water becomes clear.

iii) The material retained on 75μ sieve is collected and dried in an oven. Then it is sieved through the set of sieves. The material retained on each sieve is weighed and analysed

Q.6 Attempt any TWO of the following — 16

a) In a constant head permeameter diameter of a soil sample was 4 cm and length was 14 cm under 1 constant head of 25 cm the discharge was found to be 80cc in 10 minutes. Calculate coefficient of permeability.

Dia of soil sample (d) = 4cm
Length of sample (L) = 14 cm
Constant head (h) = 25 cm
Quantity of water (Q) = 80 cm^3

Time period (t) = 10 minutes = 10 X 60 = 600 seconds …… **1M**

i) c/s Area of soil sample

$$A = \frac{\pi}{4} \times (d)^2 = \frac{\pi}{4} \times (4)^2 = 12.566\ cm^2$$ …… **1M**

ii) Coefficient of permeability is calculated by

$$K = \frac{Q}{t} \times \frac{I}{A} \times \frac{L}{h}$$ …… **2M**

$$K = \frac{80}{600} \times \frac{1}{12.566} \times \frac{14}{25}$$ …….. **2M**

$K = 5.94 \times 10^{3}$ m/sec …… **2M**

b) Explain plate load test and draw a load settlement curve

i) Plate load test is a filed test to determine the ultimate bearing capacity f soil and probable settlement under given loading.
ii) The test essentially consist in loading a rigid plate, called bearing plate at the foundation level and determining the settlement corresponding to each load increment.
iii) The ultimate bearing capacity is taken as the load at which plate starts sinking at a rapid rate.
iv) The test pit having width equal to 5 times the width of bearing plate is dug upto a depth of proposed foundation. Plate size may vary in width from 300 mm to 750mm and 25 mm thick. **4M**
v) The loading to the test plate may be applied with the help of a hydraulic jack. The reaction of hydraulic jack may be borne by either of following two methods

a) By gravity loading platform methods.
b) By reaction truss method

vi) In the case of gravity loading method, a platform is constructed over a vertical column resting on the test plate and the loading i done with the help of sand bags, stones or concrete blocks.
vii) When the load is applied to the plate, it sinks or settles. The settlement of plate is measured with the help of sensitive dial gauge and for square plate two dial gauge.
ix) The dial gauges are mounted on independently supported datum bar. As the plate settles, the ram of the dial gauge moves down and settlement is recorded. The load is indicated on the load gauge of the hydraulic jack. Load is applied in increment of 1/10 th of estimated failure load.
x) Settlement readings are made at regular instead of 1,2,5,10,20,40 & 60 minutes. Until the rate of settlement becomes less than about 0.02 mm/hr
xi) the results of test are plotted between settlement and load intensity **2M**

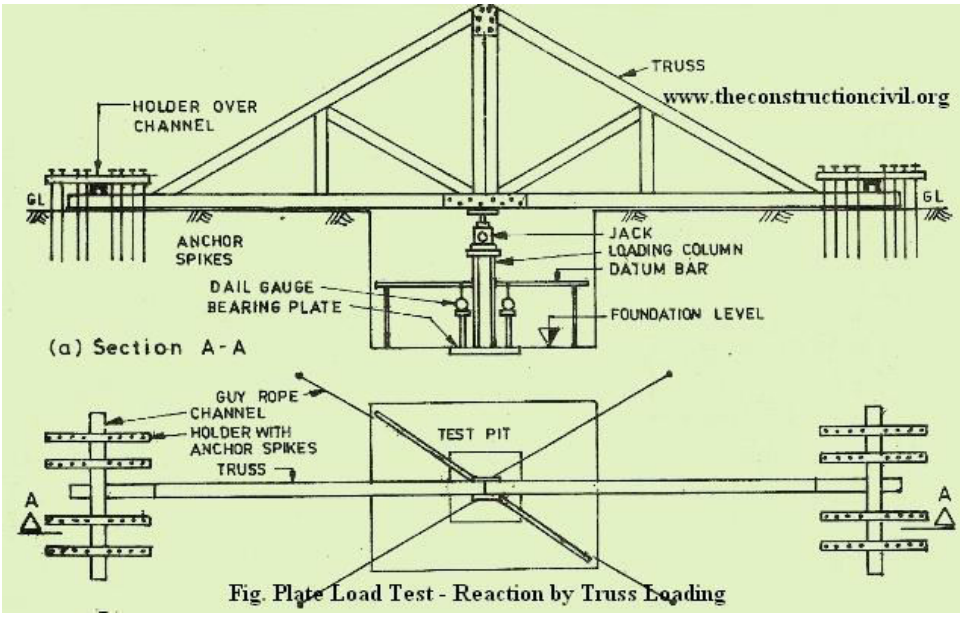


Fig. Plate Load Test - Reaction by Truss Loading

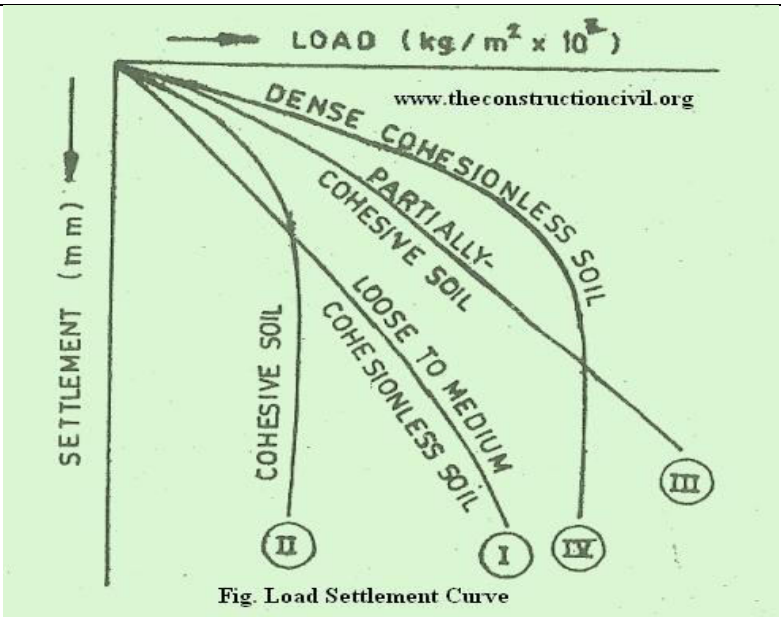


Fig. Load Settlement Curve

2M

c) Explain dry strength and Dilatancy test on soil.

This is simple test which is used in the field for rough classification of soil.

i) The prepared soil sample is completely dried in the sun or by air drying. Its strength is tested by breaking between the fingers.
ii) Dry strength or resistance to breaking is a measure of plasticity and is considerably induced by the colloidal fraction content of the soil.
iii) If the dry sample can be easily powered, it is said to have low dry strength, whereas, if considerable finger pressure is required to break the lumps, it is said to have a medium dry strength and if it cannot be powdered at all, it is said to have a high dry strength
iv) Dry strength is characteristics of clays of high plasticity. Typical inorganic silts have only a slight dry strength. Silty fine sand and silts have practically the same low dry strength but can be distinguished from each other by their feel during powdering of the dry sample.

1M each step= 4 M

<u>Dilatancy Test</u>

This is also a simple test used in the field for rough classification of soil.

i) A 5 cm^3 of soil sample is taken and enough water is added to nearly saturate it. The part of soil is placed in the open palm of the hand and shaken horizontally, striking rigorously against the other hand several times.
ii) The pat is then squeezed between the fingers. The appearance and disappearance of water with shaking and squeezing is reffessed to as a positive reaction.
iii) The reaction is called quick, if water appears and disappears rapidly. It is called slow, if water appears and disappears slowly and no reaction if water does not appear.
iv) The type of reaction is observed and recorded; inorganic soils exhibit a quick reaction whereas clays exhibit known to slow.

1M each step= 4 M