Q NO 1: Write a detail note MIT and AASHTO Soil classification system.

Ans: Soil CLASSIFICATION:

The purpose of soil classification is to arrange various types of soil in to groups and sub groups on basis of agricultural properties and some other characterstics. soil classification is much useful to the soil engineers because it can give general guidence by taking an advantage of the results of the field experiance of others with the help of soil classification system one can easily determine the stability of a given soil for the required purpose.

Various Soil Classification Purpose:

Several soil classification system has been proposed by different organization/agencies/individuals etc.

Some of them are discussed below.

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① MIT soil classification: In this classification soil are classified ~~into~~ on the basis of grain sizes, names gravel, sand, silt and clay are used to indicate various grain sizes. Soil with grain sizes 100 mm to 2 mm are termed as gravel. Soil with grain sizes from 2 mm to 0.06 mm are termed as sand, soil with grain sizes from 0.06 mm to 0.002 mm are termed as silt whi Soil with grain sizes from 0.002 mm to less are named as clay.

Sand and silt are further sub-divided into Coarse, medium and fine sand or silt.

Gravel	Sand			Silt			Clay.
100 – 2 mm	2 mm – 0.06 mm			0.06 mm – 0.002 mm			0.002 — less.
	Coarse	Medium	Fine	Coarse	med	Fine	0.02
	2	0.6	0.2	0.06	0.02	0	0.002

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② AASHTO: This system is also called Highway Research Board (HRB) classification of material for highway subgrade. Its main characteristics are

① According to this system soil are divided into Eight groups - A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8

② The group A_2 is sub-divided into two groups A_1-a, A_1-b. This sub-division is based on the basis of percent passing through seive #10 and #12 and seive #200.

③ The group A_2 is also sub-divided in to four sub groups A_2-4, A_2-5, A_2-6, A_2-7. The sub-division is also based on the percent passing through the seive #10, 40, 200. The group A_2-7 is sub-divided into A_7-5, A_7-6. This sub division is based on liquid limit and Plasticity Index.

④ The group A_3 is placed in between A_1 and A_2 because its properties are in between A_1 and A_2. The soil belonging to A_1, A_2, A_3 is called granular materia

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Such material have passing percent through seive #200 less or equal to 35. The soil belonging to A_4, A_5, A_6 and A_7 is termed as silty clay (fine material). Such soil have percent passing through seive #200 greater than 35 or (F200 > 35) - The group A_8 is not shown in the classification chart. It is highly organic weak soil.

Question NO2:

Define Permeability and write a note on factors affecting permeability.

Ans: PERMEABILITY:

Permeability of soil is the property of soil due to which it permits the passage/seepage of water through its interconnected voids. The soil which has more and larger interconnected voids will be highly permeable such as gravel while the soil having less and smaller non-connected voids will be least permeable such as clay.

Permeability of soil is important in soil mechanics

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For estimating the quality of undergroup seepage, under various hydraulic structure, For Investigating Problems Involving the pumping of water For underground Construction (Dewatering).

For making stability analysis earth dams and water retaining structures that are subject to seepage foras.

FACTORS AFFECTING PERMEABILITY:

Following are the Factors affecting permeability

(1) PARTICLE SIZE:

It was studied by Allen Hazen that the co-efficient of permeability (K) of a soil is directly proportional to the Square of the particle size (D). Thus the permeability of Coarse grained soil is very large as Compared to that of Fine grained soil. Thus the permeability of Coarse sand may be not more than one million times as much that of clay

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(2) **Impurities of soil:** The presence of fine particulate impurities in a soil can decrease its permeability by progressive clogging of its porosity.

(3) **Voids Ratio:** The co-efficient of permeability varies with the voids ratio - For a given soil, the greater the void ratio, the higher the value of the co-efficient of permeability.

(4) **Degree of Saturation:** If the soil is not fully saturated, it contains air pockets. The permeability is reduced due to presence of air which cause a blockage to the passage of air

(5) **Absorbed water:** The absorbed water does not move and occupies some space around soil particles. Thus reducing the effective coarse space available for the flow of water, thus reducing permeability.

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Question No3:

(a) Define Compaction, its advantages and write a detail note on moisture density Relationship.

Ans. **COMPACTION:-** It is the process of bringing soil particles closer to a dense state by mechanical means, thus it is densification of soil by removal of air from the voids. The Mechanical means may include Rolling, Ramming, Vibration etc.

Advantages: The main objectives of Compaction is the improvement of Engineering properties of soil which are listed down.

(i) To increase shear strain.
(ii) It provides high shear strength for bearing capacity for Foundations, higher CBR (California Bearing Ratio) for pavements and greater stability against landsliding, natural or man made.

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(2) To lower Compressibility and hence smaller Settlement of building structures and lesser deformation of earth structure.

(3) To lower Permeability:
It reduce the water absorption and then resulting loss of strength - It also reduces water percolation and hence reduce seepage qualities.

(4) To lower the frost for susciptibility and hence reduce the risk of frost heave (Rise).

(5) To reduce the degree of shrinkage.
It reduces the possibility of formation of tension cracks.

Moisture Density Relation:

For given soil type and Compaction energy, the dry density (weight density) first increases with increase in the moisture content reaching to maximum value at certain moisture content

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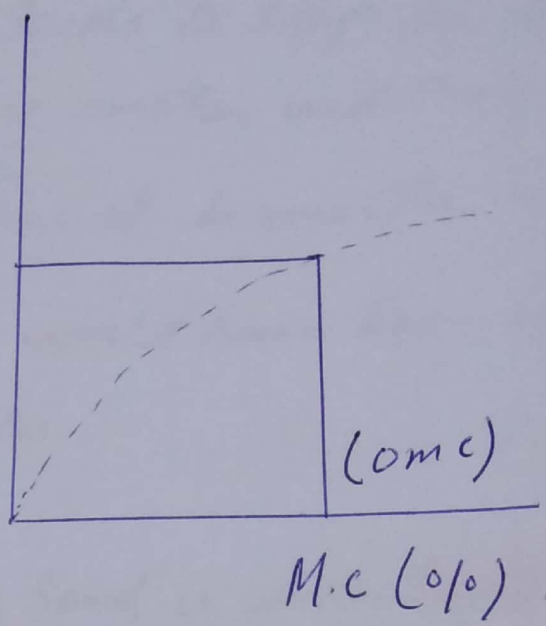
and then decreases with further increase in the moisture this is shown in figure.

w	γ_d	$\gamma_{d(max)}$
20%	γ_{d_1}	γ_d
40%	γ_{d_2}	
80%	γ_{d_3}	



The moisture content at which γ_d becomes Maximum is called optimum moisture (OMC). The explanation for above moisture content density relation is that when water is added to the soil during compaction, it acts a lubricant causing soil particle to soften and moves workable. Due to the film of water surrounding the soil particle, they slide over one another more easily and move

and density packed position. thus giving high dry density and low air content. when water content is increased beyound one then the thickness of the water film around a particle increased such on extent that it tends to keep the soil particles a part from one another and thus the dry density decreases. Thus it becomes the water takes up the space that would have been otherwise occupied by soil particles.

(b) A 12m thick weight of sand is underlayered by a layer of clay of 6m thickness. Assume γ_{sat} for Sand 22kn/m^3 and γ_{sat} for clay 19kn/m^3.

(1) Total stresses, pore water pressure, and effective stress variation with the depth of water

(2) If water table is at ground surface, find effective stresses at the middle of clay layer.

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GIVEN:

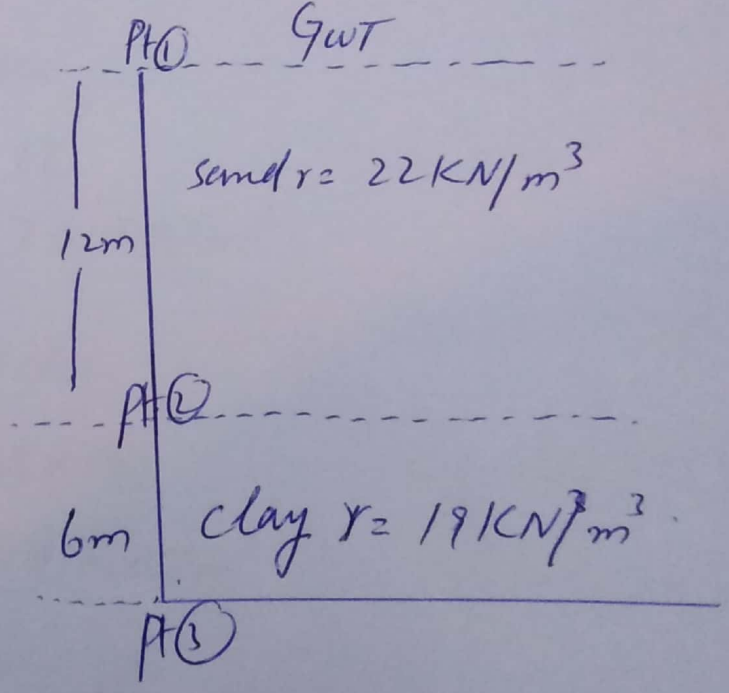
Thickness of sand layer = 12m

$\gamma_1 = \gamma_{sat} = 22\ KN/m^3$

Thickness of clay layer = 6m

$\gamma_2 = \gamma_{sat} = 19\ KN/m^3$

Required: ⟶



SOLUTION:

At point 1: Pore water pressure

$u = 0$

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Effective stress.

$$\sigma' = \gamma h$$
$$= \gamma(0)$$

Total stress $\boxed{\sigma = 0}$

At point 2:

Pore water pressure.

$$u = \gamma_w h_w$$
$$= 9.81 \times 12$$
$$= 117.72 \text{ KN/m}^3$$

Total stresses = $\sigma = \gamma_1 h_1$

$$= 22 \times 12$$
$$\sigma = 264 \text{ KN/m}^3$$

Effective stress = $\sigma = \sigma' + u$

$$= \sigma = \sigma - u$$
$$= 264 - 117.72 \text{ KN/m}^3$$

$$\boxed{\sigma' = 146.28 \text{ KN/m}^3}$$

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At point 3:

$$u = \gamma_w h_w$$
$$= 9.81 \times 18$$
$$u = 176.58$$

Total stress =

$$\sigma = \gamma_1 h_1 + \gamma_2 h_2$$
$$= (22 \times 12) + (19 \times 6)$$
$$= (264 + 114)$$
$$\boxed{\sigma = 378\ KN/m^3}$$

Effective stress.

$$\sigma' = \sigma - u$$
$$= 378 - 176.58$$
$$\boxed{\sigma = 201.42}$$

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(B).

At Middle of clay layer

Pore water Pressure = $u = 9.81 \times 15$

$= 147.15 \, kN/m^3$

Total stress: $\sigma = \gamma_1 h + \gamma_2 h$

$= (22 \times 12)(19 \times 3)$

$= 264 + 57 = 321 \, kN/m^3$

Effective stresses.

$\sigma' = \sigma - u = 321 - 147.5$

$\sigma' = 173.5 \, kN/m^2$

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