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Subject : Soil mechanics

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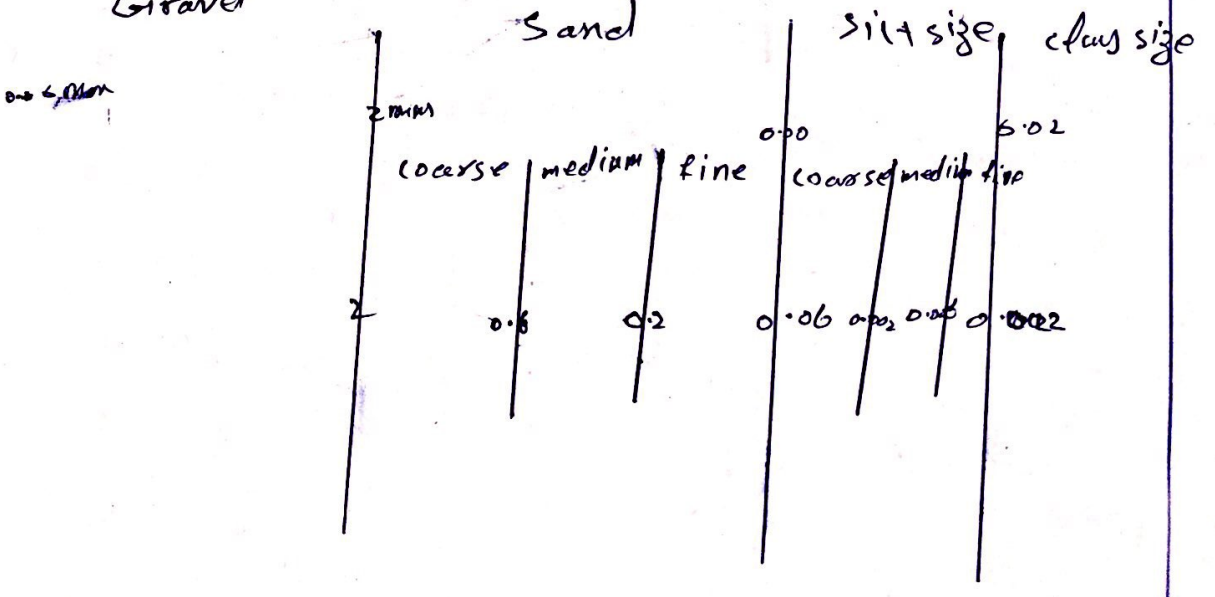
Q.No.1

M.I.T :- In this system soil are classified on the basis of grain sizes, where gravel, sand, silt and clay are used to indicate various grain sizes. Soil with grain sizes from 100 mm to 2 mm are termed as gravels, soil with grain sizes from 2mm - 0.06 mm are termed as sand, soil with grain size from 0.06 - 0.002mm are termed as silt and soil with grain sizes less than 0.002 mm are termed as clay

=> sand and silt are further sub divided into coarse medium and fine sand / silt. The details are shown in table.



Q.1

(2)

This system is also called is Particle sizes classification system because the names are given to the particle on basis of thier sizes. this system does not identify / signify the naturally occur soil. which are mixture of Particle of different sizes.

AASHTO :-

This system also called highway research board (HRB) classification of material for highway subgrade. Its main charatteristics are as follow.

i) According to this system soil are divided into ~~two~~ eight groups as.
A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8.

(ii) The group ~~A-1(a), A-1-b. this sub division is based~~ A-1 is sub devicded into two groups as A-1-a, A-1-b. This subdivision is based on the basis of percent passing through sieve # 10, sieve # 20 and sieve # 200

Q.1

iii) The group A-2 is also subdivided into four sub groups.

A-2-4, A-2-5, A-2-6, A-2-7, the subdivision is also based on the Percent Passing through sieve No 10, 40, 200. The group A-7 is subdivided into A-7-5 A-7-6. This subdivision is based on Liquid limit and Plasticity index.

iv) The group A-3 is placed in b/w A-1 and A-2 because its properties are in b/w A-1 and A-2. The soil belonging to A-1, A-3, A_3 is called granural material such material have percent passing through No 200 sieve less or equal to 35. The soil belonging to A-4, A-5, A-6, A-7 is termed as silty - clays (fine material) such soil have percent passing through side no 200 greater than 35 or ($F_{200} > 35$). The group A-8 is not shown in the classification chart. it is highly organic weald soil.

Q.NO.2

Permeability:- of Soil:- 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 imp in soil mechanics for estimating the quantity of underground seepage under various hydraulic structures, for invistigating problems invaling the pumping of waters for under ground construction (dewatering) for maning stability analysis earth dams and earth retaining structures that are subject seepage forces.

3.2

Factors Affecting Permeability of soil.

1) Particle size:- The permeability varies approximately as the square of grain size. it depends on the effective diameter of the grain size (D_{10})

2) Void Ratio:- increase in the void ratio increase the area available for flow hence permeability increase for critical conditions.

3) Temprature:- As the vescosity of the Pore fluid decrease with temprature, Permeability increases with temprature as unit weight of pore fluid does not change much with change in temprature.

4) Water/cement ratio:- for the pastes hydrated to the same degree. the Permeability is lower with lower water/cement ratio or higher cement content.

5) Use of admicture:- use of water Proofing admixture redules Permeability of Leen mixes. in general. the use of extra cement will be more effective

in reducing the permeability. in case of porus concrete surface treatment decreases permeability.

6) Age of concrete:- The permeability of cement paste also varies with the age of concrete or with the degree of hydration. in fresh paste the flow of water is controlled by the size, shape and concentration of the origined cement grains

7) Aggregate:- the permeability of aggregate affects the behaviour of the concrete if the aggregate has a very low permeability its presence redues the effective area over which flow can take place.

8) Degree of saturation:- the permeability of partially saturated soil is less than that fully saturated soil.

Q. No 3 (1)

(a) Compaction:- It is the process of bringing soil particals closer to a dense of state by mechanical means, thus it is densification of soil by removal of air from the voids the mechanical means may includ rolling, ramming, vibration etc.

Advantages:- The main objective of compaction is the improvement of engineering Properties of soil which are listed below.

1) To increase shear strain.
it Provides high shear strength for bearing capacity for foundation higher (CBR) for pavements and greeter stability against land sliding natural man mad.

2) To lower comprisibility and hence smaller settelment of building structures and lesser deformation of earth structure.

3) To lower Permeability it reduces the H_2O absorption and the resulting less of strength. It also reduces water Percolation. and hence reduce seepage qualities.

4) To lower the frost for susceptibility and hence reduces the risk of frost heave (Rise)

5) To reduce the possibility of formation of tension cracks.

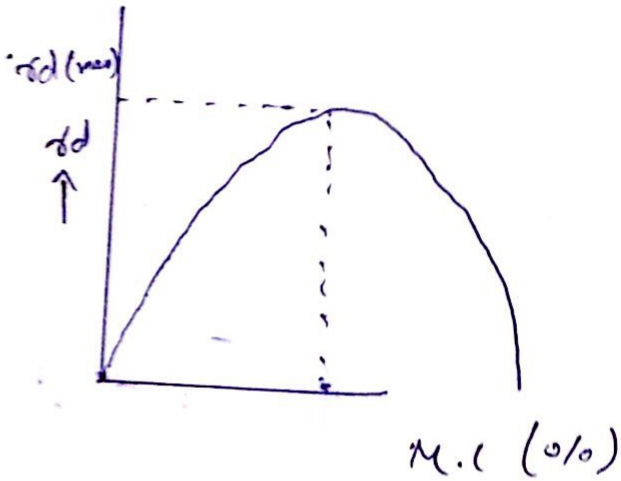
MOISTURE DENSITY RELATION:-

⇒ for given soil type and compaction energy the dry density (weight density) first increses with increase in the moisture content reaching to a maximum value at certain moisture content and then decreases with further increase in the moisture content. this is shown in figure.

Q.3
(a)

(3)

w	γ_d
2%	γ_{d1}
4%	γ_{d2}
8%	γ_{d3}



The moisture content at which γ_d becomes maximum is called optimum moisture content (OMC). The explanation for above moisture content density relation is that when water is added to the soil during compaction. it acts as lubricant causing soil particles to soften and moves workable. Due to the film of water surrounding the soil particle they slide over one another more easily and more into and forced position, thus giving high dry density and low air content.

when water content is increased

beyond some then the thickness of water film around particles increase such an extent that it tends To keep the soil particles apart from one another and thus dry density decreases. This is because the water takes up the space that would have been otherwise occupied by soil particles.

Q.NO.3:- (1)

(b)

Given data.

Thickness of sand = 12m

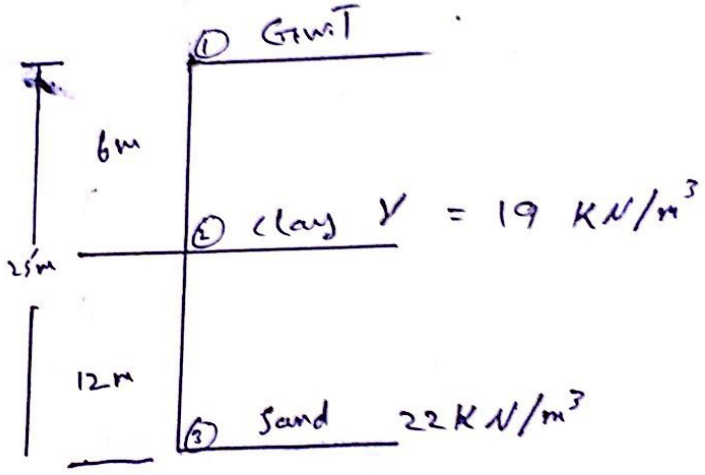
" " clay = 6m

γ_{sat} for sand = 22 KN/m³

γ_{sat} for clay = 19 KN/m³

Ans:-

Solution.



At Point ① $u = 0$

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

At Point ② $u = \gamma_w h_w = 9.81 \times 6$

$= 58.86 \text{ KN/m}^2$

$\sigma = \gamma_1 h_1 = 19 \times 6 = 114 \text{ KN/m}^2$

$\sigma' = \sigma - u = 114 - 58.86$

3.3
(b)

(2)

$$\sigma' = 55.14\ KN/m^2 + 58.86 = 114\ KN/m^2$$

At Point (3) $u = \gamma_w h_w = 9.81 \times 18 = 176.58\ KN/m^2$

$$\sigma = \gamma_1 h_1 + \gamma_2 h_2 = 114 + (22 KN)$$

$$\sigma' = 378\ KN/m^2$$