Soil Mechanic ID= 13639

Q1

M-I-T soil classification system

=> In this system soil classified on the Basis of grain sizes, names gravel, sand, silt and clay are used to indicate various grain sizes. soil with grain sizes from 100mm to 2mm are termed as gravel, soil with grain sizes from 2mm - 0.06mm are termed as sand, soil with grain size from 0.06 - 0.002mm are termed as silt and soil with grain sizes. less then 0.002mm are termed as clay.

=> Sand and silt are further sub divided into course, Medium and fine sand/silt.

* The details are shown in table.

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Q1

Gravel	Sand			Silt size			Clay size
100mm	2mm			0.06mm			0.002mm
	coarse	medium	fine	coarse	medium	fine	
2	0.6	0.2	0.06	0.02	0.06	0.002	

=> This system is also called is particle sizes classification system B/c the names are given to the particle on basis of their sizes. This system does not identify/signify the naturaly occur soil. which are Mixture of particle of different size.

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Q1

AASHTO Soil classification System.

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

(1) According to this system soil are divided into 8 groups as, A-1, A-2, A-3, A-4, A-5, A-6, A-7, A-8.

(2) The group A-1 is subdivided into two groups as, A-1-a, A-1-b. This subdivision is Based on the basis of ~~Percent~~ percent passing through sieve #10, sieve #40 and sieve #200

(3) The group A-2 is also subdivided into four subgroups.

A-2-4, A-2-5, A-2-6, A-2-7 The subdivision.

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is also based on the percent passing through sieve No 10, 40, 200. The group A-7 is sub divided into A-7-5, A-7-6,. This subdivision is based on Liquid limit and Plasticity index.

(4) The group A-3 is placed in B/w A-1 and A-2 B/c its properties are in B/w A_1 and A_2.

⇒ The soil belonging to A_1, A_2, A_3 is called granula Material. such Materials have percent passing through No 200 sieve less or equal to 35.

⇒ The soil beloging to A-4, A-5, A-6, A-7, is termed as silty-clay (fine materials) such soil have percent passing through sieve No 200 greater than 35 OR ($F_{200} > 35$). The group A-8 is not shown in the classification chart.

⇒ It is highly organic weak soil.

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Q2

Permeability of soil

=) Is the property of the soil sample which permits the flow of water throughit. inter connected voids. The soil which has more and larger interconnected voids will be highly Permeable such as gravel. While the soil having less and smaller number Connected voids will be least Permeable Such as clay.

=) Permeability of soil is important in Soil Mechanics for Estimating the Quantity of Underground Seepage under various hydraulic Structurs, for Investigating problems invalving the Pumping of waters for Underground Construction.

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Q2

Factors Affecting of Permeability

(1) Grain Size

=> The Permeability varies approximately as the square of grain size. It depends on the effective diameter of the grain size (D_{10}), $K = C(D_{10})^2$ K is Permeability in cm/sec, "C" is constant lies Blw 100-150

(2) Properties of Pore Fluid

=> Pore fluids are fluids that occupy pore spaces in a soil or rock. Permeability is directly proportional to the unit weight of pore fluid and inversely proportional to viscosity of pore fluid.

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Q2

(3) Temperature

=> As the viscosity of the pore fluid decrease with the temperature, Permeability Increases with temperature, as unit weight of pore fluid does not change much with change in temperature.

(4) Void ratio

=> Increase in the void ratio Increases the area available for flow hence Permeability Increases for critical conditions.

(5) Degree of Saturation

=> The permeability of partially saturated soil is less than that of fully saturated soil

(6) Adsorbed water. (7) Stratification of soil, (8) Shape of particles (9) Structure of soil mass (10) Entrapped Air And organic Impurities.

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Q3

(A) 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 → rumming, 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 Provids high shear Strength for ~~behaving~~ bearing capacity for foundation, higher CBR (California bearing ~~capacity~~ ratio).

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Q3

A

For Pavements and greater stability against land sliding natural or man made.

(2) To lower compressibility and hence smaller settlement of building structures and lesser deformation of Earth structure.

(3) To lower permeability. It reduces the H_2O absorption and the resulting loss of Stength. It also reduces water percolation and hence reduces seepage Qualities.

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

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

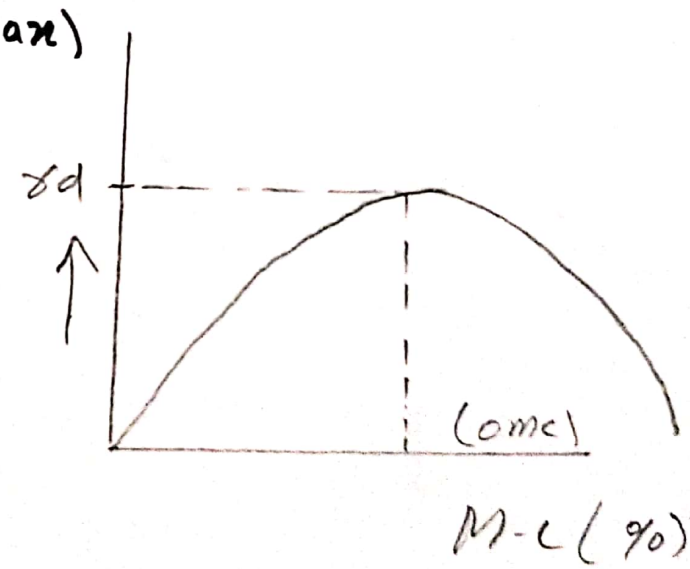
Q3

A

Moisture Content - Density Relation.

=> For given soil type and compaction energy, the dry density (weight density) first increases 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.

w	γ_d
2%	γ_{d_1}
4%	γ_{d_2}
8%	γ_{d_3}



The moisture content at which γ_d becoming Maximum is called optimum moisture content (OMC). The explemtion for above moisture.

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Q3

(A) Content density relation is that when water is added to the soil during compaction

⇒ It acts as lubricant causing soil particles to soften and more workable. Due to the film of water surrounding the soil particles they slide over ~~one~~ one another move easily and move into and deasily packed position, thus giving high dry density and low air content when water content is increased beyond OMC then the thickness of water film arround a particles increases to such an extend that it tends to keep the soil particles apart from one another and thus dry density decreases. This is B/C the water takes up the space that would have been otherwise occupied by soil particles.

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Q3

(B)

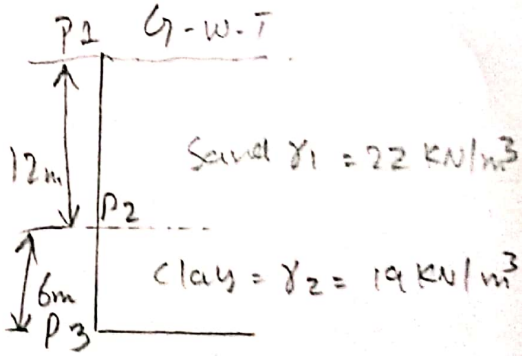
Given Data

Thickness of sand layer = 12 m

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

Thickness of clay layer = 6m

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



Req

(A) .... ?

(B) ..... ?

Q3 (B)

Sol

For A

At point 1

=> Pore water pressure

$u = 0$

∵ Soil is dry

$u = 0$

=> Effective stresses

$\sigma = \gamma h$

$= \gamma(0)$

= At point 1

hight = $h = 0$

Total stress, $\sigma = 0$

At point 2

Pore water pressure

$u = \gamma_w h_w$

$= 9.81 \times 12$

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

∵ Unit weight of water $= 9.81 \text{ KN/m}^3$

Q3 (B)

Total stresses :-

$$\sigma = \gamma_1 h_1$$

$$= 22 \times 12$$

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

Effective Stresses

$$\sigma = \sigma' + u$$

$$\sigma' = \sigma - u$$

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

$$\sigma' = 146.28 \text{ KN/m}^2$$

At Point 3

$$u = \gamma_w h_w$$

$$= 9.81 \times 18$$

$$= 176.58$$

page 15 Q3 B

Total stresses

$$\sigma = \gamma_1 h_1 + \gamma_2 h_2$$

$$= (22 \times 12) + (19 \times 6)$$

$$= 264 + 114$$

$$\sigma = 378 \text{ KN/m}^3$$

Effective stress:

$$\sigma = \sigma - u \pm$$

$$1 = 378 - 176.58$$

$$\sigma' = 201.42$$

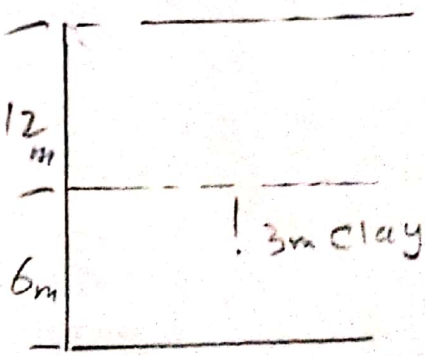
For B

At Middle of clay layer

Pore water poessure

$$u = 9.81 \times 15$$

$$= 147.15 \text{ KN/m}^3$$



Total stress:

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Q3

B

$$\sigma = \gamma_1 h_1 + \gamma_2 h_2$$

$$= (22 \times 12) + (15 \times 3)$$

$$= 264 + 57$$

$$= 321 \text{ KN/m}^3$$

Effective stresses

$$\sigma' = \sigma - u$$

$$= 321 - 147.5$$

$$\sigma' = 173.5 \text{ KN/m}^2$$

Ans