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Q(4) Explain Compaction in soil. Also write note on moisture density relationship and its effect in compaction of soil.

Answer

Compaction in soils:- Soil is used as a basic material for Construction.

* Retaining Walls
* Highways, Embankments, Ramps
* Airports
* Dams, Dikes etc

* Compaction is a function of four variables.
  1. Dry Density
  2. Water Content
  3. Compactive Effort/Type
  4. Soil Type
     - gradation, Presence of clay minerals etc.

The advantages of using soil are:
- is generally available everywhere, soil is durable and it will last for a long time. Soil has Comparatively low cost.

[redacted] in most instances in civil Engineering and/or Construction Pratice, whenever soils are imported or excavated and re-applied, They are Compacted.

Compaction means the removal of Porosity

Principles of Compaction: Compaction of soil is achieved by reducing the volume of voids, it is assumed that the Compaction process does not decrease the volume of solids or soil grains.

- The degree of compaction of a soil is measured by the dry density/unit weight of the skeleton.
- The dry unit weight correlates with the degree of packing of the soil grains.

$$P_d = P_s/(1+e)$$

- The more compacted a soil is:
  - ★ The smaller its void ratio (e) will be.
  - ★ The higher its dry density will be.

What does Compaction do

① Increased shear strength

② Reduced Permeability

③ Reduced Compressibility

④ Control swelling and Shrinking

⑤ Reduce Liquefaction potential

Moisture density relationship:

Moisture content (mc) definite relationship with dry density.

$$P_d = P_t/(1+w)$$

★ Specific soil, specific value with Specific Compactive effort.

Proctor test M-D relationship

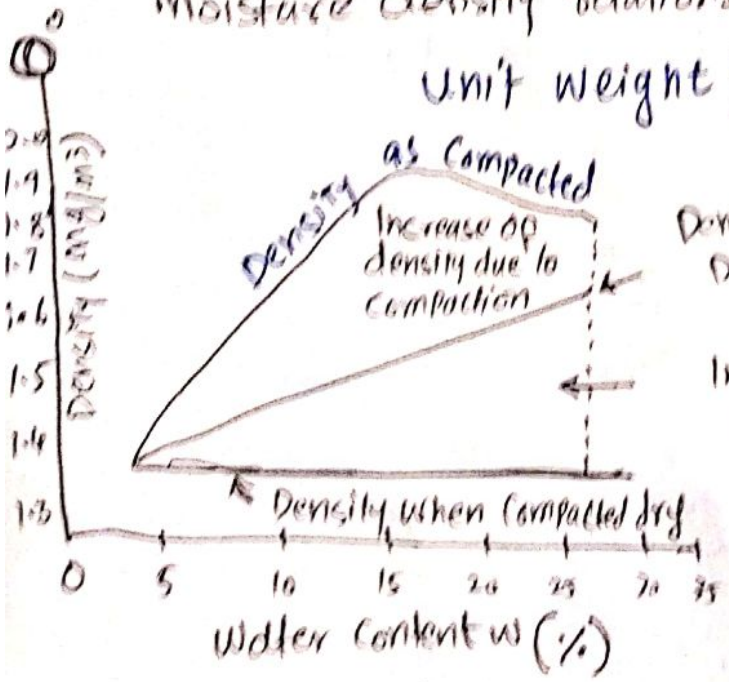
Sand cone method T191-02

Specific gravity of soil solids

M-D Lab tests

- Determine compaction curve
- Determine structural capacity of soil for estimation of design parameters.
- Establish compaction specifications for adequate quality control.

Moisture density relationship effect on compaction of soil.



Q1 Explain Weathering and Erosion.

Answer:-

Weathering:- Weathering describes the breaking down or dissolving of rocks and minerals on the surface of the earth. Water, ice, acids salts, plants, animals and changes in temperature are all agents of weathering.

Weathering is the wearing away of the surface of rock, soil and minerals into smaller pieces.

Example of Weathering: Wind and water cause small pieces of rock to break off at the side of a mountain.

There are four main types of weathering. These are:

1. Freeze - thaw
2. Onion skin (exfoliation)
3. Chemical weathering
4. Biological weathering

(1) Freeze - Thaw:- Most rocks are very hard. However, a very small amount of water can cause them to break. When water seeps into cracks and freezes it then expands. This powerful force can increase the size of cracks. Overtime the repeated freeze - thaw action of water can breaks rocks apart. Eventually, pieces of rock break off creating scree.

(2) Exfoliation or Onion skin weathering:- As the sun shines on rocks during the day it causes them to expand. During the night the rocks contracts due to the colder temperature. Overtime this continued process causes small pieces of surface rock to flake off

(3) Chemical Weathering:- Chemical weathering causes an alteration to the chemical composition of rock due to a reaction. Water that is slightly acidic can dissolve rock. An example of this would be slightly acidic rain changing the chemical composition of limestone to form a limestone pavement. this occurs on the surface and along the joints and bedding planes of limestone

(4) Biological weathering:- Biological weathering is the effect of living things. For example as the roots of a tree extend into the ground they can prise rocks apart. Ivy growing up a building can cause bricks to loosen. it also occurs on a much smaller scale through lichens and moss.

Erosion: Erosion is the wearing away of an object or substance through an external forces. typically, erosion refers to the gradual wearing away of soil, dirt, rock, or other land structure over time through natural forces such as water or wind.

Examples of Erosion:-

1. ~~Caves~~ Caves
2. River bank
3. Cracks and rocks
4. Gravilation erosion
5. Coastal erosion

(1) Caves:- Caves are carved out over thousands of years by flowing water, but that activity can be [redacted] sped up by carbonic acid present in the water. As fresh water leeches through the rock and soil and drips through cracks, the resulting Carbonic acid erodes the rock until over time, A cave formation occurs.

(2) River bank: This type of soil erosion often comes as a result of water moving past the banks or walls of

a river bed. Also, rocks in the river itself can be worn down and smoothed due to the constant rolling or "tumbling" motion the moving water causes. (3)

(3) Cracks and rocks:- the rapid expansion can cause small cracks to form, cracks which make the rock vulnerable to wind and water erosion.

(4) Gravitation Erosion:- Gravitation Erosion can occur from nothing more than the force of the earth's gravity pulling on a section of rock, dirt, or land on a steep grade like a mountain cliff or hill side over time, the soil or rock become loose and slides downwards due to the gravitational pull.

(5) Coastal erosion:- The impact of waves hitting the shore line can cause ~~b~~erosion of the coasts.

Q2 Write a note on Shear Strength of Soils.

Answer:-

Shear strength of a soil is indicative of its resistance to erosion. Specifically, it is defined as the resistance to deformation by the action of tangential (shear) stress. Soil shear strength is made up of cohesion between particles and resistance of particles sliding over each other due to friction or interlocking. Shear strength has three components.

(1) Effective normal stress

(2) Cohesion

(3) Angle of internal friction

(6) Shear strength = Cohesion + Normal Stress x Tan(angle of internal friction) OR $S = C + \sigma \cdot (\tan\theta)$

Effective Normal Stress:

There are three conditions for normal Stress.

① Dry Soil: $\sigma = \sigma - 0$

② Unsaturated Wetted Soil: $\sigma = \sigma - (-u)$

③ Saturated Soil: $\sigma = \sigma - u$

Cohesion:

- Bonding
- Rocks
- Chemical bonds - Cements
- Clays
- Electrostatic forces - Attractive forces between particles and lubrication by water.

Apparent Cohesion:

- Produced by capillary forces and interlocking friction of particle surfaces.
- Affected by size, shape and mineralogy of particles.
- Moist soil
- Particles have apparent cohesion due to capillary forces and are under suction due to matric suction effects.

Friction

- Strength of rocks/soils part controlled by frictional resistance between mineral particles in contact. Interlocking friction and Planar friction.
- Friction Strength Proportional to NORMAL STRESS holding grains in contact
- Contact Points due to size, shape and resistance to crushing of grains
- Poor sorting increases contacts and interlocking friction.

Q③ What is meant effective size D10. Also explain Atterberg limits and Consistency Indices.

Answer

Effective size D10 ★ Effective size D_{10} can be correlated with the hydraulic conductivity (describing the permeability of soils).

★ Predicting soil movements

★ Frost susceptibility

Limitations / Salient features

- Sieve sizes
- Statically representative sample
- Sample size
- Sampling procedure
- Shape.

Atterberg limits and Consistency indices

General: Property of soil manifested by resistance to flow. Cohesive and not inter granular. Affected by moisture contents of soil.

Consistency Limits: Atterberg's six stages of soil consistency range.

* Liquid limit
* Sticky limit
* Cohesive limit
* Plastic limit
* Shrinkage limit

Typical values of Atterberg Limits

Mineral	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit
montmorillonite	100-900	50-100	8.5-15
Nontronite	37-72	19-27	
illite	60-120	35-60	15-17
Kaolinite	30-110	25-40	25-29
Hydrated Halloysite	50-70	47-60	
Dehydrated Halloysite	35-55	30-45	
Attapulgite	160-230	100-120	
Chlorite	44-47	36-40	
Allophane (undried)	200-250	130-140	

Q (5) (10)

Write note on geo-Physical Testing

Answer: ★ Geophysical Exploration consits of making indirect measurments.

★ from the earth's surface or in borehole

★ to obtain subsurface information

Requirement of Geotechincal investigations:

- Grouping of the subsurface strata with similar geotechnical properties.
- Strength
- Stiffness

★ Geophysical Exploration helps in

- Rapid location and correlation and geological features
- Stratigraphy
- Lithology.
- Discontinuities
- Ground water

★ In-situ measurement of

- Modulli densities

SEISMIC TECHNIQUES

➡ Poincipie: difference in stiffness of different soil/rock layers.

➡ Procedure: An elastic wave is generated in the ground

- by impactive force (Falling weight or Hammer blow)
- Explosive charge
- Resulting ground motion is measured using vibration detectors (geophones)
- Time elapsed will help to evaluate different wave velocities in different layers.

Wave Types

- Longitudinal Waves (P Waves)
- Transverse Waves or Shear Waves (S Waves)
- Rayleigh Waves
- Love Waves

Methods

- Refraction
- Reflection
- Cross-Hole
- Down-Hole

Electrical Techniques

➡ Principle: Difference in electrical resistivity of different soil/rocks layers.

➡ Procedure:
- An electrical current is made to flow through the ground under an electrical potential
- Resulting apparent resistivity of the ground is measured.

Q 5 (B)

Figure.

Answers

The nomograph given also provides the necessary thickness for the surface layer, at 4 in thick for critical areas and 3 in thick for noncritical areas, such as pavement shoulders. The same process applied to determine the thickness of the subbase course.

LCN data analysis based on this approach variable.

Aircrafts type	Main Landing Configuration	MTOW (lbs)	Wheel number	Tire pressure (Psi)	gear loads (lbs)	Tire contact Area inch²
ATR 72-600	Dual Wheel	50,705	4	55	12,042	219
B 737-800 B (7-38)	"	174,700	4	204	41,491	203
B-722-900 B- 739	"	188,200	4	204	44,698	219
A-319	Dual Tandem Wheel	141,095	8	200	16,755	84
A-320	"	158,730	8	200	18,849	94
B 737-300 B 733	"	140,000	8	166	16,625	100
B 737-400 B-734	"	150,500	8	177	17,872	101
	Maximum			204	44698	219