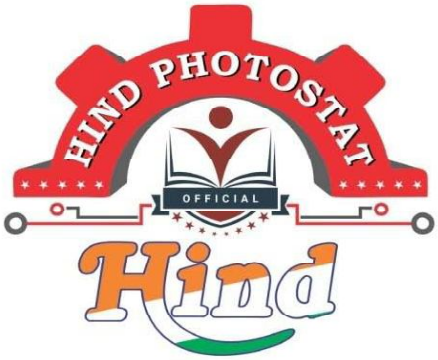

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SOIL MECHANICS

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

BY-KANCHAN SIR

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Name – Mohammad Rashid

B-Tech (Civil Engineer)

Soil Mechanics

Date
1/09/2021

Soil Mechanics

Gopal Ranjan & Rao
Punamia
K.R. Arora

*(1) Origin of Soil
****(2) Soil water relationship
*(3) Classification of soil
*(4) Clay minerals & Soil structure
*****(5) compaction
*****(6) permeability
*****(7) Effective stress
*****(8) Seepage
**(9) Vertical stress
*****(10) consolidation
*****(11) shear strength of soil
***(12) Slope stability
*****(13) Earth pressure
*****(14) shallow foundation
*****(15) Deep foundation
**(16) Expansion of soil
*(17) Expansive soil & Collapsable soil.

- Application of soil mechanics is known as Geotechnical engineering.

(1) Origin of Soil

due to { disintegration → होते -2 particle में टूटना / breaking down of the rock
weathering → एक process होता है जिससे soil टूटता है
unconsolidated → मतलब soil पूरी तरह से compress नहीं है (in particles form)

- Soil is defined as an unconsolidated material, composed of solid particles produced by disintegration and transportation of igneous rock called parent rock or due to decomposition of organic matter.
- Disintegration is caused by weathering which is a mechanical and or chemical process that breaks down the rock mass in-situ.
- disintegration of rock by physical forces → called physical weathering.

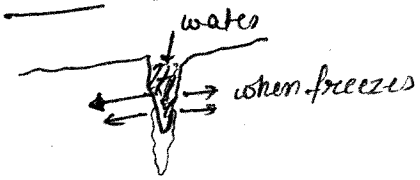
single grained particle → no bond b/w the particles.

The weathering process may be classified as

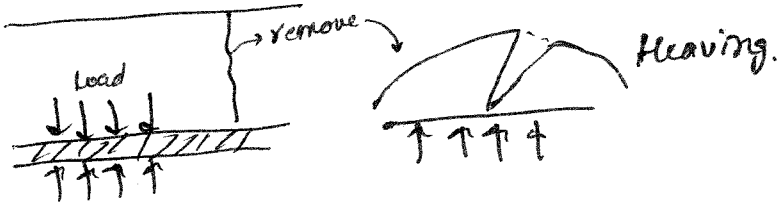
(1) Physical weathering
(2) Chemical weathering

(1) Physical weathering :- • The physical weathering process may be:

(1) Erosion of rock caused by the action of wind, water & glaciers.
(2) Expansive force of freezing water.



(3) Sudden change in Temperature.
(4) Due to organic activity like growth of plants roots in the existing fissures (crack) and by activity of worms and Rodents
(5) Due to unloading which leads to cracking.



Physical Weathering

- The resulting soil particles retain the same mineralogical composition as that of parent rock.
- Particles of this type are described as being of Bulky form like sand and gravel. sand → 75 µ - 4.75 mm gravel → > 4.75 mm
- Their shape can be indicated by terms such as Angular, Rounded, elongated and flat.

Bulky → all size of particle exist in physical weathering

Angular

Rounded

Elongated

Flat. (less thickness & flaky

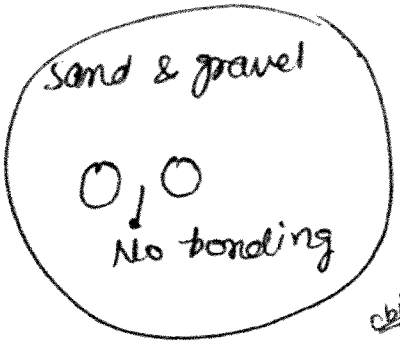
Eg →

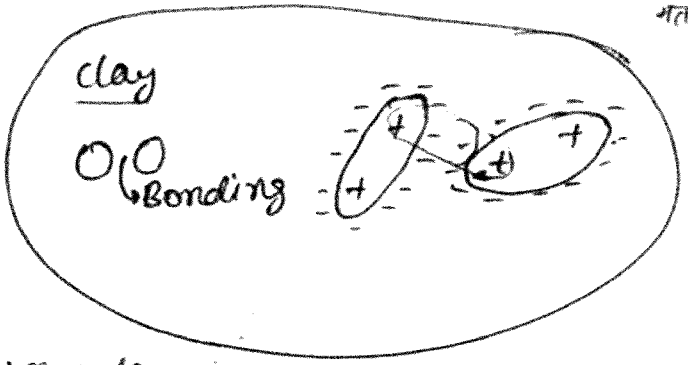
2 is more elongated as compared to 1.

obj
- The structural arrangement of these are described as single grain structure i.e. each particle are in direct contact with adjoining particles, without their being any bond b/w them.

obj
- Quartz, mica and feldspar are primary soil minerals (non-clay mineral) found in the soil formed during physical weathering.

obj
- Physical weathering is a fore-runner for chemical weathering.

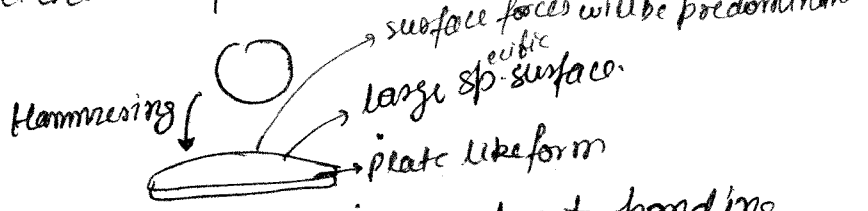




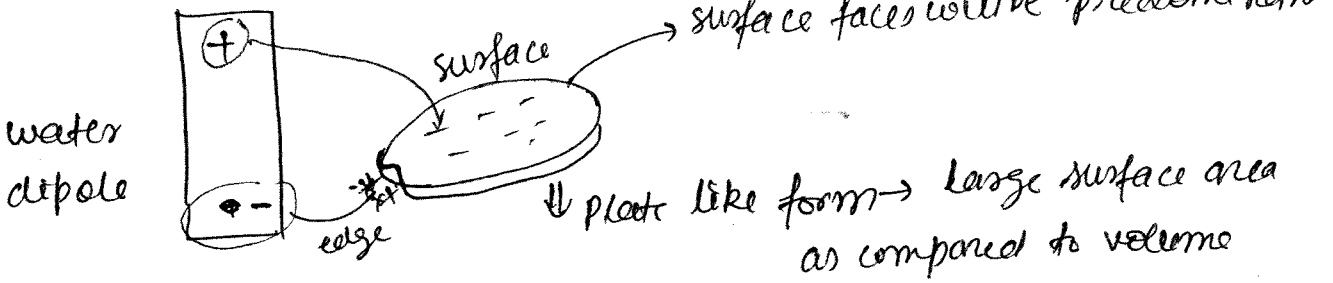
obj
Mica → non clay mineral.

(2) Chemical weathering

- The chemical process results in change in the mineralogical form of parent rock due to the action of water especially if it contains acid to alkali, oxygen and CO_2.
- Chemical weathering results in the formation of group of crystalline particles of colloidal size (< 2μ) known as clay minerals like Kaolinite, illite, Montmorillonite.
- Most clay minerals particles have plate like form having a high specific surface (i.e. high surface area to mass ratio) with the result that their structure is influenced significantly by surface forces.



- Water can significantly affect their behaviour due to bonding with clay particles.



In chemical weathering → single grain structure ✗

clay size < 2μ
silt → 75 - 2μ
sand → 75μ - 4.75 mm
gravel > 4.75 mm

} single grained structure

Residual and Transported Soil

- If the products of rock weathering are still located at the place where they originated, they are called Residual soil.
- Most residual soil are weekly bonded, they have widely varying void ratio. They contain* angular particle.
- The fragmented material during weathering is transported by agents such as wind, water or ice to new locations are called Transported Soil. Residual soil have better engineering property. eg → laterite.
- Transported soil, have generally small particle sizes, large amount of Pores

✓ angular particle → residual ✓ Rounded particle → transported.

clay size < 2μ
silt → 75μ - 2μ
sand → (75μ - 4.75mm)
gravel > 4.75mm
} single grained structure. (no bond b/c of the particles)

According to the Transporting agency, soils are classified as;

Alluvial deposit → Transported by Running water like River
Lacustrine deposit → Soil deposited in Lakes (still water)
Marine deposite → deposited in marine environment (sea water)
G-2010 Aeoline deposit → Transported by wind
Glacial deposit → Transported by glaciers.

Peat → organic soil
marl → deposits of marine origin

obj Due to wind → aelonie, Dune, loess
due to snow → drift soil, Till
swelling → Black cotton soil (expansive soil) CE-2017
sticky and plasticity → Gumbo soil

Names of Various types of Soils

(1) Bentonite :⇒ • It is a type of clay with a very high percentage of clay mineral Montmorillonite. (French)

• It is a highly plastic clay, obtained from the decomposition of **volcanic ash. (means easily deformed)

• It is highly water absorbent and has high swelling & shrinkage.

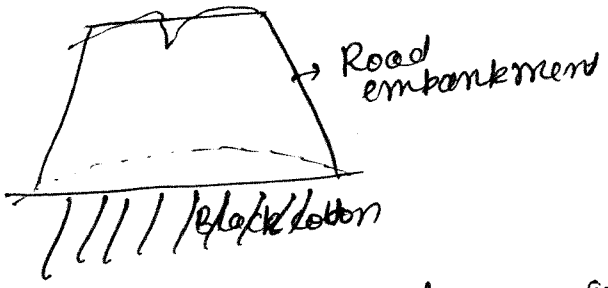
(2) Black cotton Soil :⇒ • It is a residual soil containing a high percentage of the clay mineral Montmorillonite.

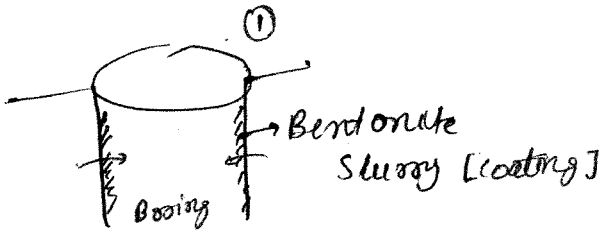
• It has very low Bearing capacity and high swelling and shrinkage.

obj ✓ • It is stablized by **lime treatment.

• It is formed from Decomposition of **Basalt rock.

• It is dark in colour and good for growing cotton.





***** (3) Loess :⇒ • This is a fine-grained (silt range), homogeneous, friable (easily crushable), wind-borne deposit. (means no attraction b/w particle)

• It has very uniform grain size and high void ratio.

• The soil can stand deep vertical cuts because of slight cementation between particles due to $CaCO_3$ & montmorillonite.

• It is formed in Arid and semi-arid regions.

obj • Its permeability in vertical direction is much more than that in horizontal direction. It is highly compressible.

(bcz of wind blow, उसमें water जैसा नहीं round हो पाता)

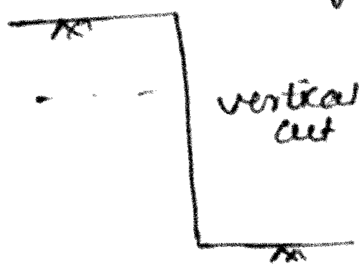
- Loess grains are <u>angular</u> and composed of crystals of quartz, feldspar mica and other minerals.
- These deposits have <u>low</u> density and <u>high</u> compressibility.
- The bearing capacity of such soils is very <u>small</u>.
- ES-03 These deposits are often subject to collapse if <u>saturated</u>.

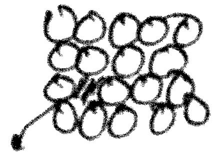
fine grained <75 μ → clay, silt

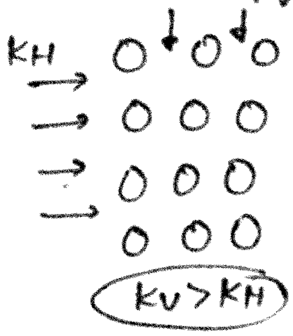
coarse grained >75 μ → sand, gravel

- These deposits are often subjected to collapse if <u>saturated</u>.

bonding → ① cementation जैसे हुआ – Loess by $CaCO_3$ ② chemical bonding





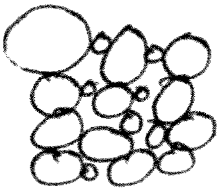


<u>(4) Till:</u> → • It is an <u>unstratified deposit</u> formed by melting of a <u>glacier</u>.

- The deposit consists of particles of <u>different sizes</u>, ranging from <u>clay</u> to <u>Boulder</u>.
- It can be easily <u>densified</u> by compaction. They have <u>high</u> shear strength.
- The soil is generally <u>well</u> graded.
- Till is also known as <u>boulder-clay</u>.

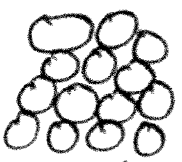
loess → uniform size of particles

Till → diff. types of particles (सभी particles)



<u>well graded</u>

↓ mean high strength.



uniformly graded / poorly graded.