Introduction to Soil Mechanics Geotechnical Engineering-II



ground

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Soil Formation

- Soil derives from Latin word "Solum" having same meanings as our modern world.
- From Geologist point of view, "The superficial unconsolidated mantle of disintegrated and decomposed rock material"-The entire mantle or rock decay.
- Soil is a complex of inorganic matters that may or may not contain organic decomposed organic residues and other substances, which blanket the earth's crust, which is formed by the process of weathering (Disintegration and decomposition) of rock and mineral.
- The weathering agents include physical, mechanical or chemical agents.

The factors of weathering in the process of soil formation may be atmospheric such as pressure, temperature, wind and water erosion and transportation by the water erosion and transportation by water and glaciers, plant and animal life.

- Soil is a mixture of Water, Air and Solids. The solids are mixture of mineral matters with particle sizes differing in sizes, shapes and structure and varying in chemical compositions.
- The top soil which supports vegetation is called "Top soil" and the undisturbed strata lying immediately below the natural top soil is termed as " sub soil".

Types of Soils:

- Six main types:
 - Gravels.
 - Sands
 - Silts
 - Clay
 - Fine grained soils and pets.
- They are further classified into two types:
 - Cohesive soils: Clay, shale and silts.
 - Non cohesive or Cohesion-less soils: Sand and Gravels, which possesses no plasticity and tend to lack cohesion specially when in dry state.

Problems to be studied before execution of the projects

- How deep the soil exploration must be made? What is the safe and allowed bearing capacity?
- What is the load of structures to be applied at the soil?
- What is the intensity and stress distribution in a soil induced by various kinds of loading?
- How thick should be thickness of layer of good soil over a poor one in order to prevent the foundation from punching.
- Does soil possesses properties (friction and cohesion) which will assure satisfactory stability for foundation.
- How much counter weight must be placed as remedial measures against the lateral motion of soil

- The settlement of soils under applied loads and its rate and nature.
- The depth of ground water and its variation at various depths.
- Depth of frost penetration and subsequent depth of foundation and effect of freeze and thaw on pavement and structures.
- The suitability of soil for the construction of structures like dams, roads and buildings.
- The issues relating to water logging and salinity in soils etc.

Natural Soil Deposits

- Soils are the results of weathering, mechanical disintegration, and chemical decomposition of the parent material, mainly rocks
- The products of weathering may have the same composition as the parent material, or they may be new minerals that have resulted from the action of water, carbon dioxide, and organic acids with minerals comprising the parent material.
- The products of weathering that remain in place are termed residual soils.
- In most cases gravity and erosion by ice, wind, and water move these soils to form new deposits, termed transported soils.
- In humid and tropical climates, weathering may significantly affect the character of the soil to great depths, while in temperate climates it produces a soil profile that primarily affects the character of surface soils.
- The character of natural soil deposits usually is complex.

Identification of Soils

- Soils are identified by visual examination and by means of their index properties (grain-size distribution, Atterberg limits, water content, specific gravity, and void ratio).
- A description based on visual examination should include color, odor when present, size and shape of grains, gradation, and density and consistency characteristics.
 - Coarse grained soils: soils have more than 50 percent by weight retained on the No. 200 sieve and are described primarily on the basis of grain size and density
 - Fine-grained soils have more than 50 percent by weight finer than the No. 200 sieve. Descriptions of these soils should state the color, texture, stratification, and odor, and whether the soils are soft, firm, or stiff, intact or fissured.
 - The visual examination should be accompanied by estimated or laboratory determined index properties.

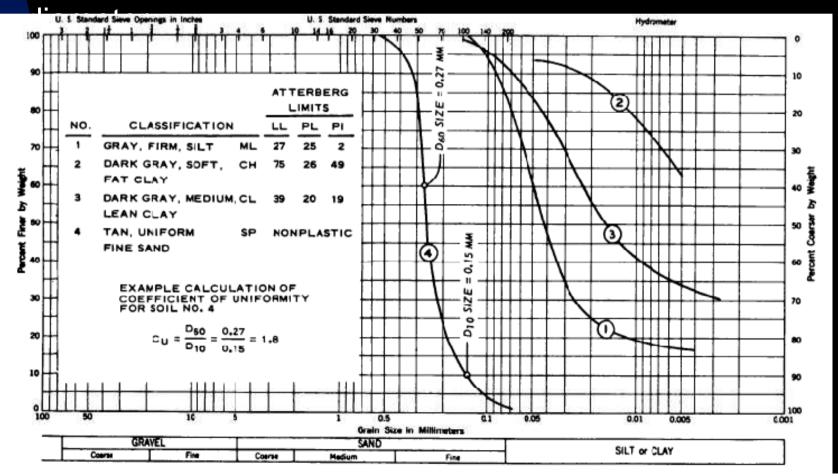
Physical properties of soils

Color: Depends on

- Minerals of soil.
- Organic contents
- Amount of oxides
- * Color is natural state is noted.
- Soil Structure: depends on
 - * Size and shapes of soil particles.
 - Terzaghi grouped soil in three groups
 - Granular or single grained soil: Silt and Clay
 - Flocculent Structure: Clay
 - Dispersed Structure: Transportation process: Man
 - fills.
- Particle Shapes:
 - Angular
 - Sub Angualr
 - Rounded
 - Elongated
 - Flaky

Soil Index Properties:

Grain-size distribution. The grain-size distribution of soils is determined by means of sieves and/or a hydrometer analysis, and the results are expressed in the form of a cumulative semi-log plot of percentage finer versus grain



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- Atterberg limits. The Atterberg limits indicate the range of water content over which a cohesive soil behaves plastically. The upper limit of this range is known as the liquid limit (LL); the lower, as the plastic limit (PL). The LL is the water content at which a soil will just begin to flow when slightly jarred in a prescribed manner. The PL is the water content at which the soil will just begin to crumble when rolled into threads 1/8 inch in diameter.
- **Density.** The mass density of a soil material is its weight per unit volume. The dry density of a soil is defined as the weight of solids contained in the unit volume of the soil and is usually expressed in pounds per cubic foot.
- **Specific gravity.** The specific gravity of the solid constituents of a soil is the ratio of the unit weight of the solid constituents to the unit weight of water. For routine analyses, the specific gravity of sands and clayey soils may be taken as 2. 65 and 2. 70, respectively.
- Consistency. The consistency of an undisturbed cohesive soil may be expressed quantitatively by the unconfined compressive 11 strength qu.

Soil Classification

Unified Soil Classification: The Unified Soil Classification System, based on identification of soils according to their grain-size distribution, their plasticity characteristics, and their grouping with respect to behavior, should be used to classify soils in connection with foundation design.

Major Distations		Group Symbols	Typical Name	Field Identification Procedures (Excluding particles larger than) (s.			Information Required for Describing Boble	<u> </u>	Eacountery Classification Dynamia					
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ω	(1) Brandary classifications: Soils passenting characteristics of two groups are designated by combinations of group symbols. For example Ok.C., well-graded gravelisand actuary with city binder. (2) All slowe sizes on this chart are U.S. standard.													

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Weight Volume relationships of soils

WATER CONTENT	$w = \frac{w_w}{w_s}$
SPIECIFIC GRAVITY	$G_s = \frac{W_s}{V_s \gamma_w}$
VOLUME OF SOLIDS	$V_s = \frac{W_s}{G_s \gamma_w}$
VOLUME OF VOIDS	$V_v = V - V_b$
VOID RATIO	$e = \frac{V_v}{V_s} = \frac{n}{1 - n}$
POROSITY	$n = \frac{V_v}{V} = \frac{e}{1+e}$
DEGREE OF SATURATION	$S = \frac{V_w}{V_v} = \frac{w G_s}{e}$
UNIT WEIGHT OF WATER (FRESH WATER)	$\gamma_w = \frac{W_w}{Y_w} = 62.4 \text{ PCF}$
DRY UNIT WEIGHT	$\gamma_{d} = \frac{W_{s}}{V} = \frac{\gamma_{m}}{1+W}$
WET UNIT WEIGHT	$\gamma_m = \frac{W}{V}$
SUBMERGED (BOUYANT) UNIT WEIGHT	$\gamma' = \gamma_m - \gamma_w = \frac{G_s - 1}{1 + e} \gamma_w$

