Introduction

1.1 Definition of soil and rock
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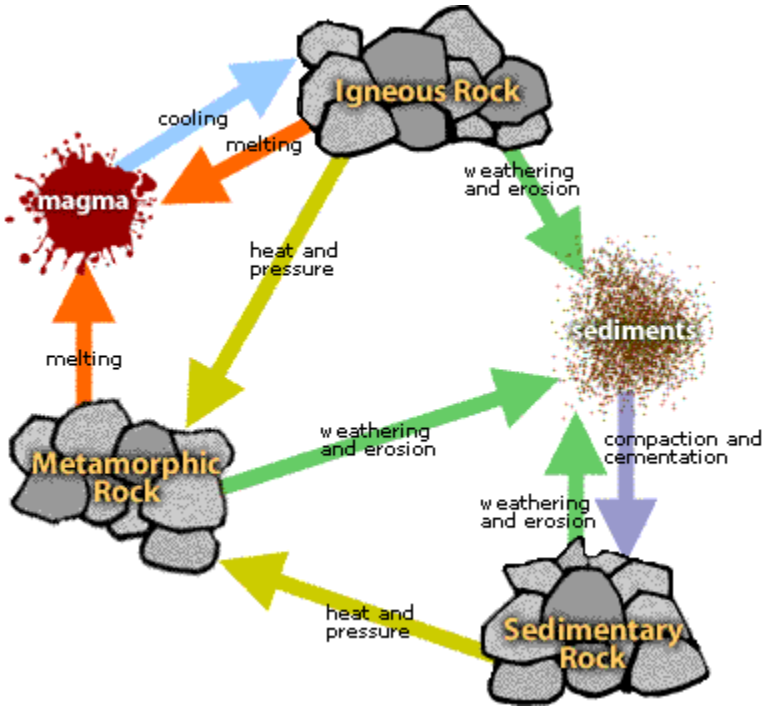
Definition of Soil and Rock

Unconsolidated material, composed of solid particles produced by the disintegration of rocks is called soil. The void space between solid particles may contain air, water or both.

A natural aggregate of mineral particles bonded by strong and permanent cohesive force is called rock. The rock cycle is shown alongside.

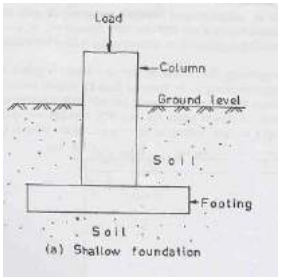


Definition of Soil Mechanics and its importance in Civil Engineering

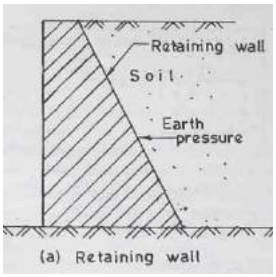
Soil mechanics is the application of laws of mechanics and hydraulics to engineering problems dealing with sediments and other unconsolidated accumulation of solid particles produced by the mechanical and chemical disintegration of rocks.

Importance in Civil Engineering

a) **Foundation Design and Construction**
Every civil engineering structure is constructed on or below the surface of the earth. Foundation transmits the load of the structure to soil safely and efficiently. It is therefore necessary to know the bearing capacity of soil, settlement of foundation, effect of ground water. The stability of foundation depends upon the type of soil strata, magnitude of loads and ground water.

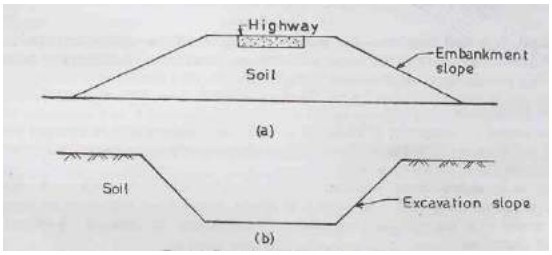


b) **Retaining Structures**
Sufficient space may not be available for a mass of soil to spread and form a safe slope. In such cases, a structure to retain soil is needed to be constructed. Soil engineering gives the theories of earth pressure on retaining structures that is necessary for the design.



c) Stability of Slopes

When the soil surface is not horizontal, there is a component of weight of soil which tends to move it downward making the slope unstable. Soil engineering provides the methods for checking slope stability. Design of slope and height of embankment and depth of excavation requires a thorough knowledge of shear strength.

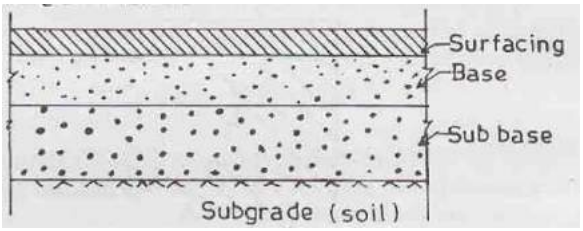


d) Underground Structures

The forces exerted by the soil on tunnel and conduits need to be analyzed and evaluated for their design and construction.

e) Pavement Design

The thickness of pavement depends upon characteristics of sub-soil where traffic intensity is high. Knowledge regarding soil improvement techniques is much helpful in constructing pavement in poor soil.



f) Earthen Dam

Construction of earthen dam requires knowledge regarding soil mechanics.

Formation process of soil and its major types

a) Physical Disintegration

- Soil has the properties of parent rock.
- Coarse grained soils as gravel and sand are formed.

i) Temperature Changes

Different minerals of rock have different coefficient of thermal expansion. Unequal expansion and contraction of mineral occur due to temperature changes. Stress is induced due to such changes. The repetition of stress causes the particles to detach from the rocks leading to the formation of soil.

ii) Wedging action of ice

Water in the pores and mineral cracks of rocks freeze during cold climate. Expansion occurs due to increase in volume. Rocks break into pieces when large stress is developed in the cracks due to wedging action of ice.

iii) Spreading of roots of plants

Forces act on rocks when the roots of trees and shrubs grow in the cracks and fissure of rocks leading to disintegration.

iv) Abrasion

The movement of wind, rivers and glaciers over the surface of rock leads to abrasion and scouring.

b) Chemical Decomposition

- Original rock minerals are transformed into new minerals by chemical reactions.
- Clayey soils are formed.

i) Hydration

Water combines with rock minerals and results in the formation of new chemical compound. Chemical reaction causes a change in volume and decomposition of rock takes place.

ii) Carbonation

CO_2 in atmosphere combines with water to form carbonic acid. Carbonic acid reacts with rocks and causes their decomposition.

iii) Oxidation

Oxygen ions combine with mineral in rocks resulting in decomposition.

iv) Solution

Some of the rock minerals form a solution when dissolved in water. Chemical reaction takes place in solution and soil is formed.

v) Hydrolysis

Chemical process in which water gets dissociated into H^+ and OH^- ions is called hydrolysis. The hydrogen cation replace the metallic ions such as calcium, sodium and potassium in rock materials and soils are formed.

Types of Soils

Broadly on the basis of origin of their constituents, soils are classified as residual soil and transported soils.

Residual Soil: Soils that remain at the place of their formation as a result of the weathering action of parent rocks are called residual soil. The size of grains of residual soil is indefinite. The depth of residual soil depends upon climatic condition and time of exposure.

Transported Soil: Soil formed at a place may be transported to the other places by agents as water, wind, ice, gravity. Such soils are called transported soil.

i) Water Transported Soils (Alluvial Deposits)
   - Swift running water carries a large quantity of soil either in suspension or by rolling along the bed.
   - Water erodes the hills and deposits the soil in the valleys.
   - Size of soil particles carried by water depends upon the velocity.
   - Swift can carry boulder and gravels.
   - With a decrease in velocity, the coarse particles get deposited.
   - The finer particles are carried further downstream and are deposited when the velocity reduces.

ii) Lacustrine Deposits: Deposit made in lakes.

iii) Marine Deposits: Deposits formed when the flowing water carries soil to ocean or sea.

iv) Aeolian Deposits: Soil transmitted by winds. The particle size depends upon the velocity of the wind.

v) Glacial Deposits: Glaciers are large mass of ice formed by the compaction of snow. Soil gets mixed with ice and transported far away from their original position.

vi) Gravity Deposits: Soils can be transported through short distance under the action of gravity. The soil mass deposited at the bottom of the cliff is an example of gravity deposit.