

RPSC 2024

Rajasthan Public Service Commission

Assistant Engineer

CIVIL ENGINEERING

Soil Mechanics and Foundation Engineering



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SOIL TYPES AND FORMATIONS

INTRODUCTION

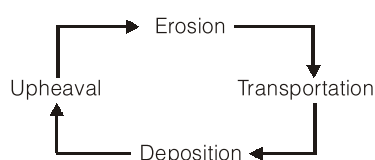
- Soil is the unaggregated or uncemented deposits of mineral and/or organic particles or fragments covering large portion of the earth's crust.
- It includes widely different materials like boulders, sands, gravels, clays, and silts and the range in the particle sizes in a soil may extend from grains only a fraction of micron (10^{-4} cm) in diameter upto large size boulders.

SOIL ENGINEERING/SOIL MECHANICS/GEOTECHNIQUE

- Soil mechanics is one of the youngest disciplines of civil engineering involving the study of soil, its behaviour and application as the engineering material.
- According to Terzaghi (1948): "Soil mechanics is the application of laws of mechanics and hydraulics to engineering problems dealing with sediments and other unconsolidated accumulations of solid particles produced by the mechanical and chemical disintegration of rock regardless of whether or not they contain an admixture of organic constituent."

Do you know?

- *Terzaghi is father of soil mechanics.*
- *The geological cycle of soil formation consists of four steps*



- There are two main groups of soils according to their origin (i) soils formed by physical weathering e.g., Gravel & Sand (ii) Soils formed by chemical weathering e.g., silts and clays.
- If the products of rock weathering are still located at the place of origin, they are called **Residual** soils.
- Any soil that has been transported from its place of origin by wind, water, ice or any other agency and has been redeposited is called **Transported** soil.
- According to the transporting agency transported soils are further classified as:
 - Alluvial Soils** : deposited from suspension in Running Water.
 - Lacustrine Soils** : deposited from suspension in still, fresh water of lakes.
 - Marine Soils** : deposited from suspension in sea water.
 - Aeolian Soils** : Transported by wind.
 - Glacial Soils** : Transported by Ice.

SOME SPECIAL/TYPICAL SOILS

- **Loess** : A loose deposit of windblown silt that has been weakly cemented with calcium carbonate and montmorillonite.
- **Bentonite**: A chemically weathered volcanic ash.
- **Peat**: A highly organic soil; fibrous and highly compressible.
- **Muck**: A mixture of fine particles, inorganic soil and black, decomposed organic matter.

Note: Peat and Muck are also called cumulous soils.

- **Colluvial Soil:** The accumulation of rock debris or **Talus** at the base of a steep cliff or a rock escarpment due to action of gravity.
- **Marl :** A very fine grained calcium carbonated soil of marine origin.

SOME COMMON SOILS & ENGINEERING PROBLEMS ENCOUNTERED WITH THEM

(a) Marine Deposits

- Marine clays are very soft and may contain organic matter.
- These Possess low shear strength and high compressibility hence, pose problems as foundation material.

(b) Laterites And Lateritic Soils

- Formed by decomposition of rock, removal of the bases and silica and formation of oxides of iron and aluminium at the top of the soil profile.
- These are of two types-Primary and Secondary; Primary laterite is found at high altitude near hills. Secondary laterites are found at coastal belts.
- Generally laterites pose no difficulties as foundation material and retain their slopes well.

(c) Black Cotton Soils

- These soils have been formed from basalt or trap and contain clay mineral montmorillonite, which is responsible for the excessive swelling and shrinkage characteristics of the soil.

Do you know?

Under reamed piles should be used in foundations in Black Cotton Soils.

Practice Questions : Level-1

- Q.1** Glaciers are formed by
- Compaction and recrystallization of snow
 - Continuous freezing of water
 - A sudden drop in temperature below 0°C
 - None of the above processes

- Q.2** When the products of rock weathering are not transported as sediments but remain in place the soil is known as
- Alluvial soil
 - Glacial soil
 - Residual soil
 - Aeolian soil
- Q.3** Identify the true statements from the following:
- A soil transported by gravitational force is called talus
 - Lateritic soil is a category of organic soil
 - Water held firmly to the clay particles has the same properties as ordinary water
 - A clay deposit which exhibits no evidence of fissuring is described as intact
 - Most clay crystals consists of atomic sheets, principally of two types: silica and alumina

Practice Questions : Level-2

- Q.4** Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

	List-I (Soil deposit)	List-II (Soil name)
A.	Gravity	1. Stratified drift
B.	Lake	2. Talus
C.	Glacier	3. Loess
D.	Wind	4. Lacustrine

Codes:

	A	B	C	D
(a)	1	3	2	4
(b)	2	4	1	3
(c)	3	4	1	2
(d)	4	3	2	1

- Q.5** Bentonite is a material obtained due to the weathering of
- limestone
 - quartzite
 - volcanic ash
 - shales
- Q.6** Match **List-I** (Type of soil) with **List-II** (Feature) and select the correct answer using the codes given below the lists :

List-I

- A. Lacustrine
- B. Alluvial
- C. Aeolian
- D. Marine

List-II

- 1. Transported by wind
- 2. Transported by running water
- 3. Deposited at the bottom of lakes
- 4. Deposited in sea water

Codes:

	A	B	C	D
(a)	1	4	3	2
(b)	3	2	1	4
(c)	3	4	1	2
(d)	1	2	3	4

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ANSWERS

1. (b) 2. (c) 3. (a) 4. (b) 5. (c)
6. (b)

Hints & Solutions

5. (c)
Bentonite is decomposed volcanic ash containing high percentage of clay mineral-montmorillonite.
6. (b)
A-3, B-2, C-1, D-4
Lacustrine - Deposited at the bottom of lakes
Alluvial - Transported by running water
Aeolian - Transported by wind
Marine - Deposited in sea water

■■■