

# Soil and its properties

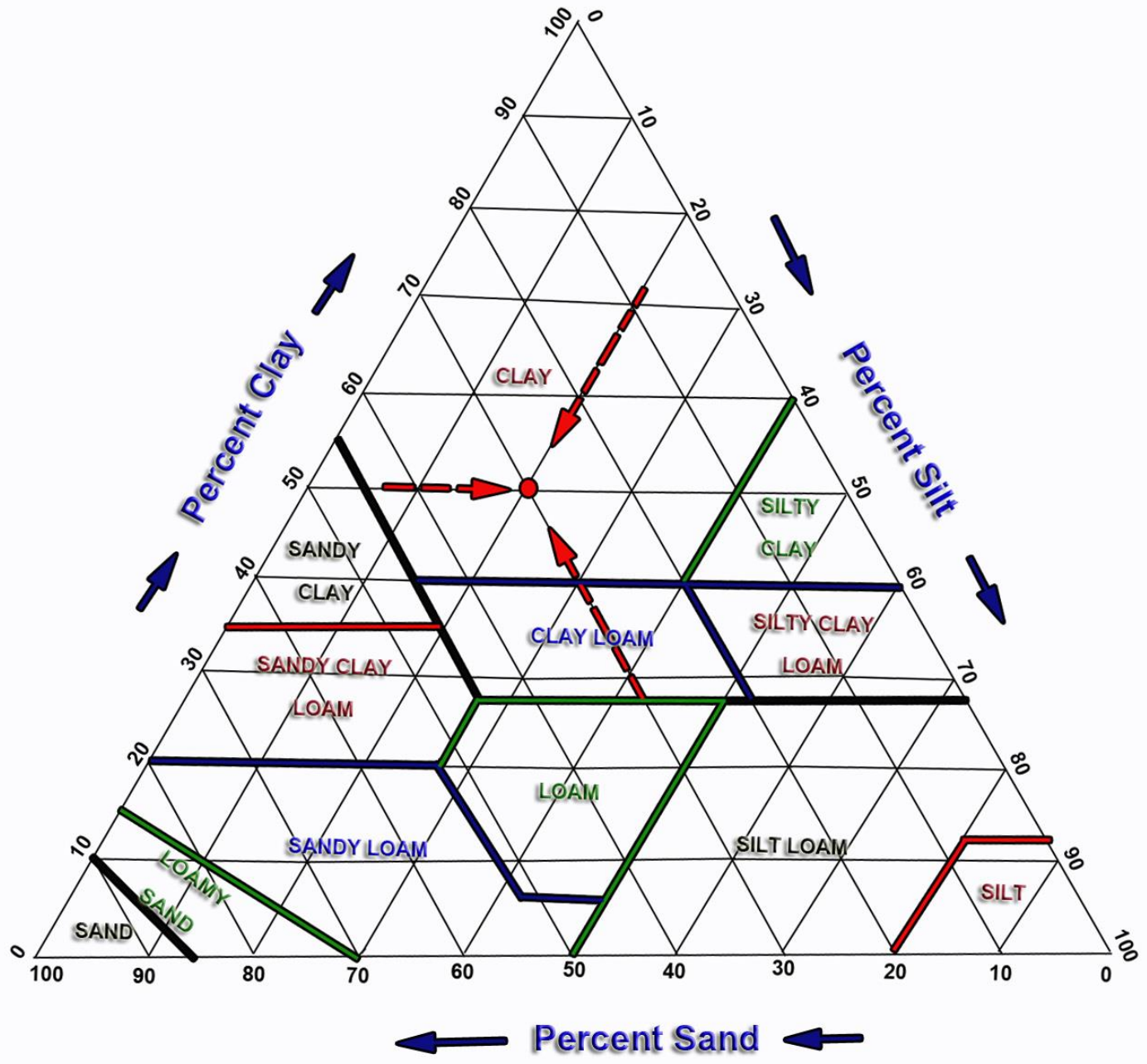
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# Soil classification

- Soil is uppermost loose profile of earth.
- Importance in nutrient cycling and pond productivity.
- Also important from construction point of view.
- **Classification of Soil - Particle size classification**

- These terms are used only as designation of particle size and do not signify the naturally occurring soil types.
- Clay < 0.002 mm
- Silt – 0.002 to 0.02m
- Sand - 0.02 to 2 mm
- Gravel > 2 mm

- **Classification of Soil - Textural classification**
- Classification of composite soil exclusively based on the particle size distribution is known as textural classification.



- **Classification of Soil - Unified soil classification and IS classification system**

According to this classification soil may be classified into three groups.

***a) Coarse grained soils***

In these soils more than half of the total material by mass is larger than 75 micron I.S. sieve size.

***b) Fine grained soils***

In these soils more than half of the material by mass is smaller than 75 micron I.S. sieve size.

- ***c) Highly organic and other miscellaneous soil material***

These soils contain large percentage of fibrous organic matter such as peat and particles of decomposed vegetation. In addition certain soils containing shells, concretions, cinders and other non soil materials in sufficient quantities are also grouped in this system (Division) Coarse grained soils are sub-divided into two sub groups.

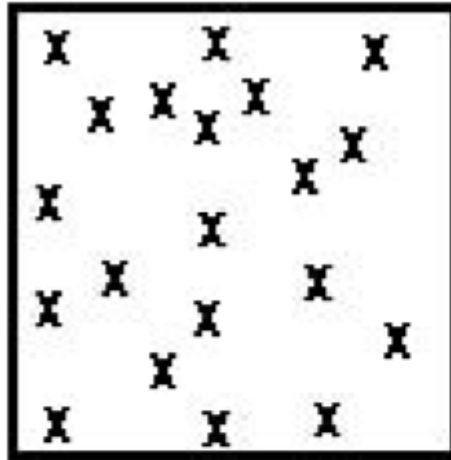
- **Gravels**

In these soils more than half the coarse fraction (75 micron) is larger than 4.75 mm I.S. sieve size.

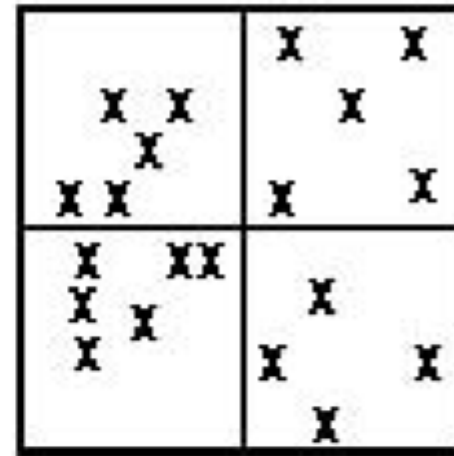
### **Sands**

In these soils more than half the coarse fraction (75 micron) is smaller, than 4.75 mm I.S. sieve size.

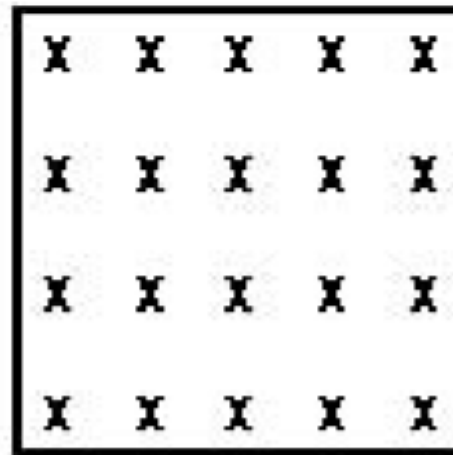
# Soil sampling



**Simple Random**



**Stratified Random**



**Systematic**

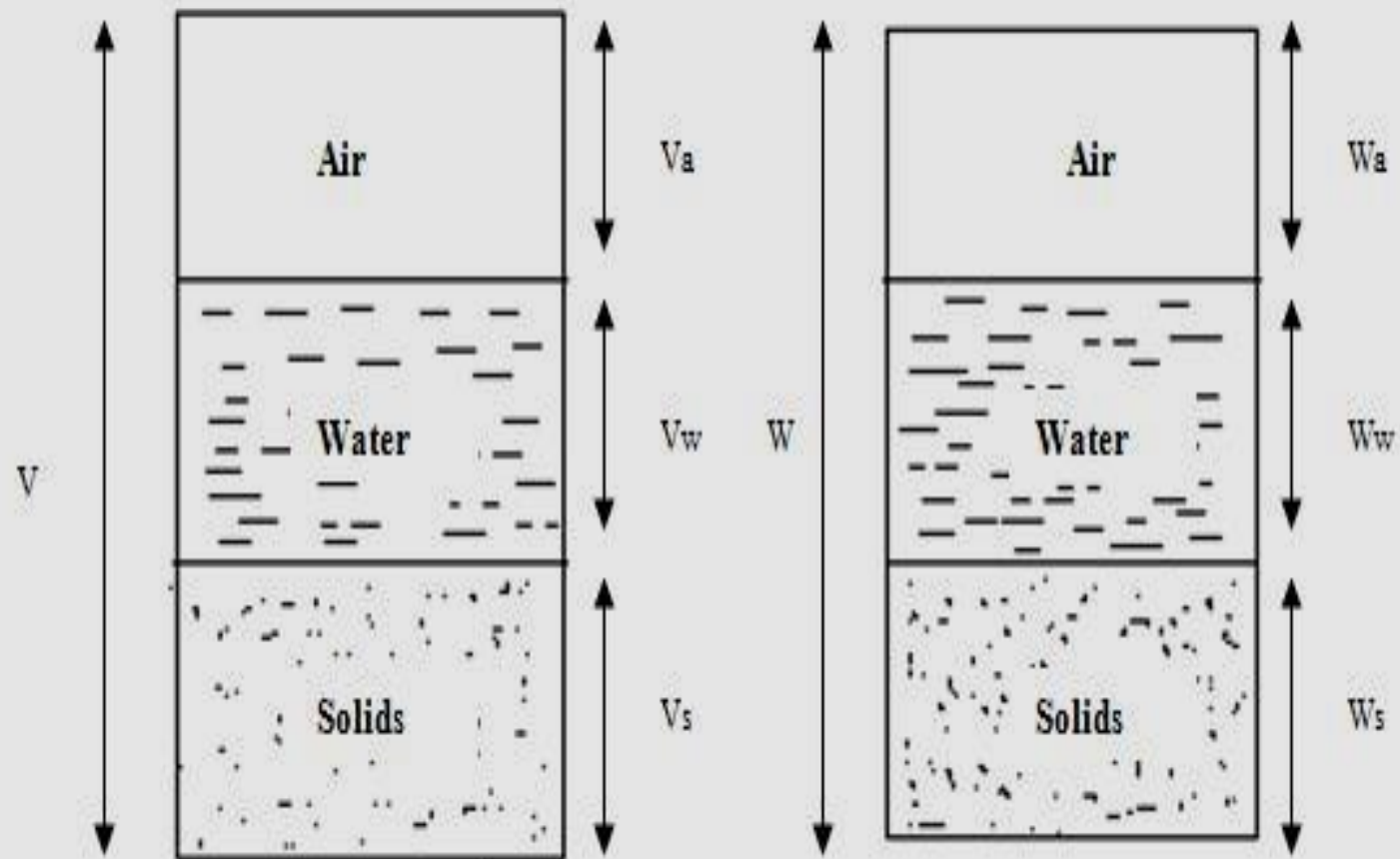


# Soil properties

- Physical properties of soil
- Texture, colour, density and structure.
- Chemical properties
- pH, conductivity, organic carbon, cation exchange capacity.

- **Three phase system of soil**

- In general, the soil sample will be consisting of soil solids, water and air, which is designated as three phase system of soil. The sum of the air content and water content of a sample is called as **voids**. If the voids are completely filled with water such a sample is called as a purely saturated sample or 100% saturated sample. If the voids of soil is completely filled with air such a sample is called as purely dried sample, on the other hand if the part of the voids are filled with water and remaining with air it is called as a moist sample. The figure shows the diagrammatic representation of the three phase system of soil element in terms of volumes and weights respectively.



In figure,

$V_a$  = Volume of air in the sample

$V_w$  = Volume of water in the sample

$V_s$  = volume of soil solids in the sample

$V_v$  = Volume of voids in the sample

$V$  = Total volume of the soil sample

$W_a$  = Weight of air in the soil sample can be considered as zero.

$W_w$  = Weight of water in the soil sample

$W_s$  = Weight of soil solids in the sample

$W$  = Total weight of soil sample.

Further  $V_v = V_a + V_w$

$V = V_s + V_v$

$W = W_w + W_s$

- **Soil properties**

- Permeability of soil**

- Permeability of soil is a very important engineering property of soil. Permeability can be defined as the property of the soil due to which it permits the flow of fluids (Usually water) through its inter connected voids or pores.

A material having continuous voids is called as permeable material. eg: Sand and gravel.

A material having least voids such as stiff clay is called as impermeable material.

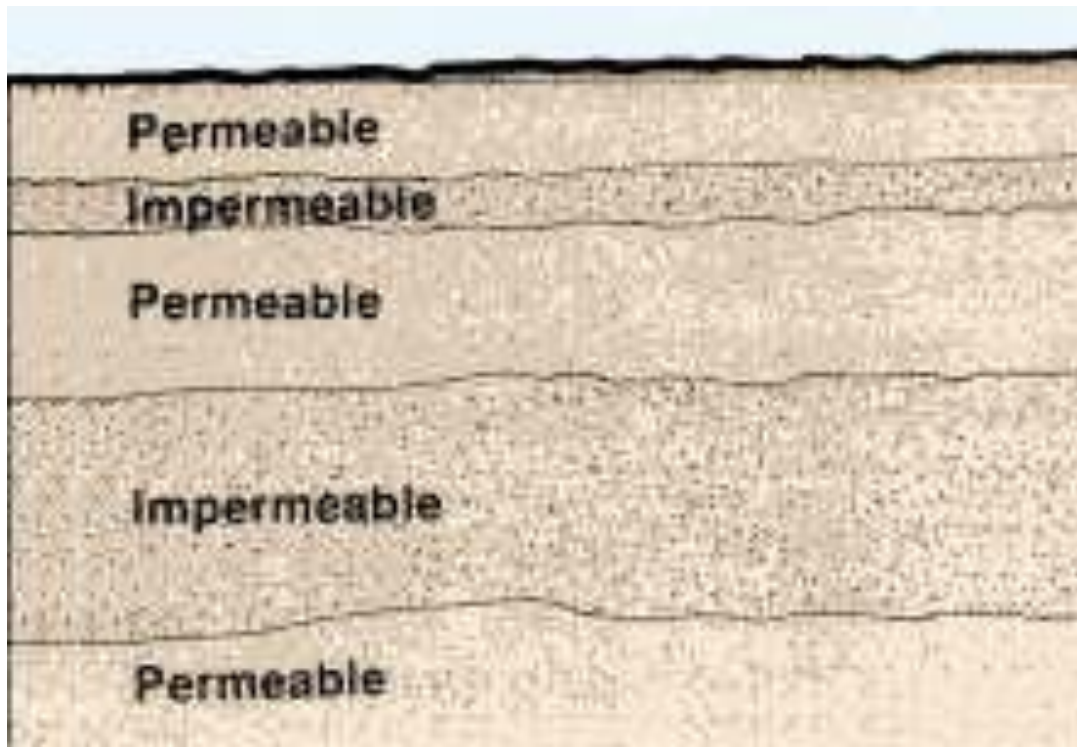
For all practical purpose gravels are considered as highly permeable.

- **Necessity of studying permeability**

The following are the factors which influences the study of percolation (movement) of water through the soil.

- Determination of rate of settlement of a saturated compressible soil layer.
- Calculation of seepage through the body of earthen dam and stability of their slopes.
- Calculation of uplift pressure under hydraulic structure and their safety against piping.
- Ground water flow towards well and drainage of soils.

- Soils are generally made up of **layers** and soil quality often varies greatly from one layer to another. Before pond construction, it is important to determine the relative position of the permeable and impermeable layers. The design of a pond should be planned to avoid having a permeable layer at the **bottom** to prevent excessive water loss into the subsoil by seepage.



Water that is lost vertically through the bottom of the pond, horizontally through the dikes by infiltration, and through the drainage system of the pond is called **seepage water**.



- Permeability is commonly measured in terms of the rate of water flow through the soil in a given period of time. It is usually expressed either as a **permeability rate** in centimetres per hour (cm/h), millimetres per hour (mm/h), or centimetres per day (cm/d), or as a **coefficient of permeability k** in metres per second (m/s) or in centimetres per second (cm/s).

- Texture

<b>Soil</b>	<b>Texture</b>	<b>Permeability</b>
Clayey soils	Fine	From very slow to very rapid
Loamy soils	Moderately fine	
	Moderately coarse	
Sandy soils	Coarse	

- Structure: Aggregation of soil particles can occur in different patterns, resulting in different **soil structures**.

Structure type		Permeability <sup>1</sup>
Platy	- Greatly overlapping	From very slow to very rapid
	- Slightly overlapping	
Blocky		
Prismatic		
Granular		