

The background features a white canvas with several large, flowing, abstract shapes in light green, light blue, and light purple. Scattered throughout are numerous small, yellow, triangular shapes, some pointing upwards and others downwards, creating a festive or celebratory feel.

3. CLASSIFICATIONS **AND FIELD** **IDENTIFICATION OF** **SOILS**

• **I. CLASSIFICATIONS OF SOILS**

- **A soil classification system is the arrangement of different soils having similar properties into groups and sub-groups based on their application.**
- **It provides a common language to express briefly the general characteristics of soils.**
- **There are several methods of classifying soils.**
- **The most widely used classification systems by engineers are described here.**

1. Grain Size Classification

- It is based on grain size of the soils and is essentially useful for classifying soils in which single grain properties are of importance.
- Three of the grain size classifications that are in common use are the following.

(a) U.S. Bureau of Public Roads Classification

Gravel	Sand		Silt	Clay
	Coarse	Fine		
	2	0.25		0.05

Grain size in mm

0.005

M.I.T (Massachusetts Institute of Technology) Classification

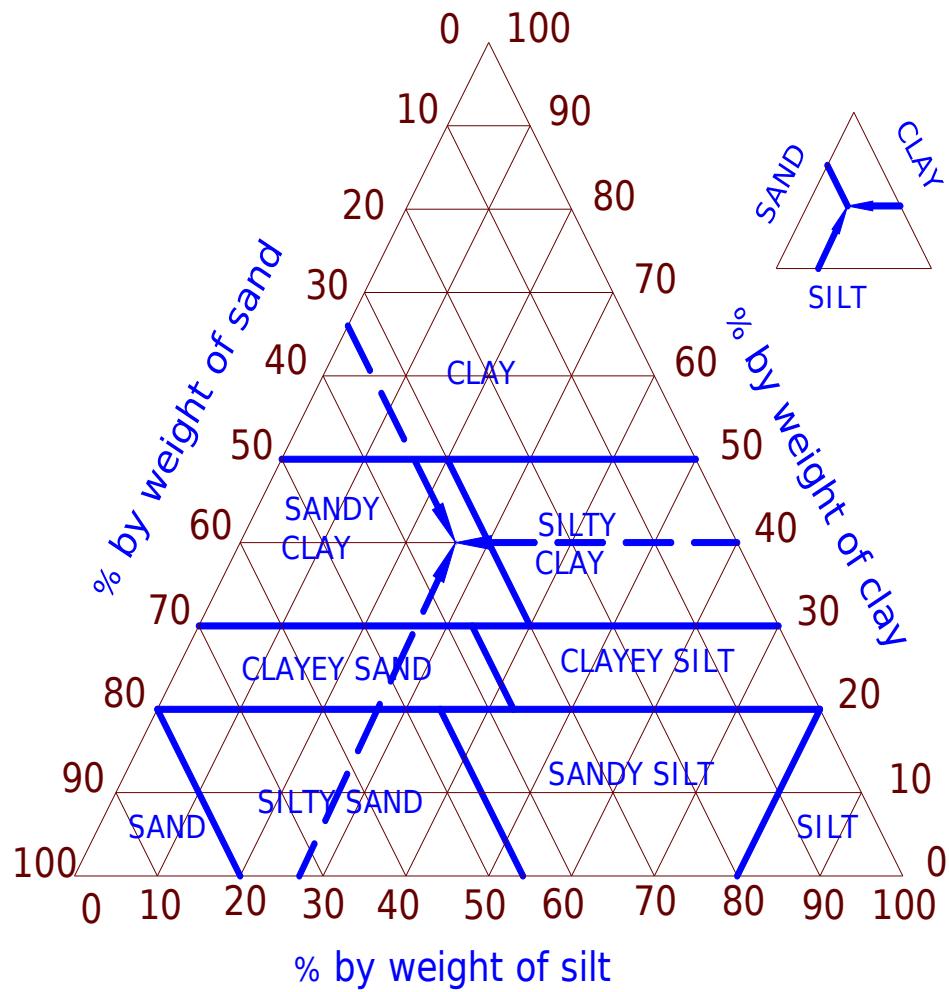
Gravel	Sand			Silt			Clay
	Coarse	Medium	Fine	Coarse	Medium	Fine	
2	0.6	0.2	0.06	0.02	0.006	0.002	
Grain size in mm							

(c) Textural Classification

- This classification is based on a triangular chart shown below. A soil with known percentage of sand, silt and clay sizes is represented by a given point on a triangular chart of this type.

Example

35% sand -, 25% silt-, and 40% clay-size particles,
This soil falls into the zone of Sandy clay.



2. Soil Classification Based on both Grain-size and Atterberg limits

- **The physical properties of fine-grained soils are dictated to a great extent by the amounts and types of clay minerals present in them. Hence, for proper interpretation of soil characteristics, the plasticity that is the result of the presence of clay minerals needs to be considered.**
- **Presently, two more elaborate classification systems that take into consideration both particle-size distribution and Atterberg limits are commonly used. They are**
 - **The AASHTO (American Association of State Highway and Transport Official) classification system and**
 - **The unified soil classification system**

2.1 AASHTO Classification System

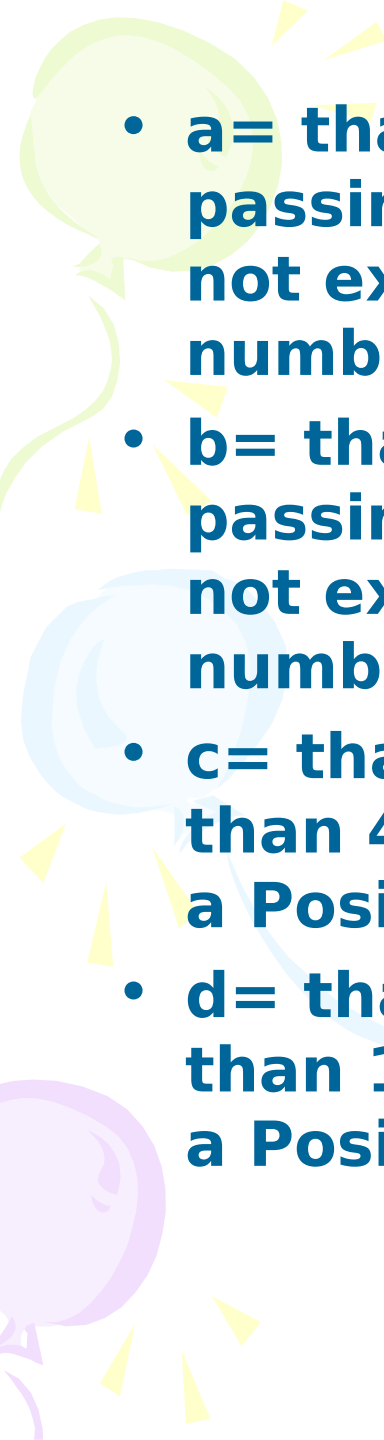
- **The AASHTO classification system, also called Public Roads Administration (PRA) classification, is based on the following three soil properties:**
 - **Grain-size distribution**
 - **Liquid limit**
 - **Plasticity index**
- **This system is generally used by highway engineers, for classification of sub-grade soils for the highway pavements.**
- **According to this system, soil is classified into seven major groups, A-1 through A-7.**

- **Soils classified under groups A-1, A-2, and A-3 are granular materials with 35% or less passing through a No. 200 sieve.**
- **-Soils with more than 35% passing a No. 200 sieve are classified under groups A-4, A-5, A-6 and A-7. These soils are mostly silt and clay-type materials.**
- **To classify a soil using AASHTO soil classification Table, one must proceed from left to right with required test data available. By the process of elimination, the first group from the left into which the test data will fit gives the correct classification.**

- **-Under this classification system, a characteristic called group index (G.I) is used to describe the performance of a soil when used as a highway sub grade material.**
- **-Group index is not used to place the soil in a particular group, but is actually a means of rating the value of a soil as a sub grade material, within its own group.**

$$\text{GI} = 0.01(\text{F200}-15)(\text{PI}-10)$$

$$= (\text{F200}-35)[0.2+0.005(\text{LL}-40)]+0.01(\text{F200}-15)(\text{PI}-10)$$

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- **a= that portion of percentage of particles passing No.200 sieve greater than 35% and not exceeding 75% expressed as a whole number(0 to 40)**
 - **b= that portion of percentage of particles passing No.200 sieve greater than 15% and not exceeding 55% expressed as a whole number(0 to 40)**
 - **c= that portion of the liquid limit greater than 40 and not exceeding 60, expressed as a Positive whole number(0 to 20)**
 - **d= that portion of the Plasticity index greater than 10 and not exceeding 30, expressed as a Positive whole number(0 to 20)**

General Classification	Granular Materials (35 per cent or less passing No. 200)							Silt-clay Materials (More than 35 percent passing No. 200)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7 A-7-5 A-7-6
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				
Sieve analysis per cent passing No. 10 No. 40 No. 200	50 max 30 max 15 max	50 max 10 max	51 min 10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 sieve Liquid limit Plasticity Index	6 (max)		N.P	40max 10max	41 min 10max	40max 11 min	41 min 11min	40 max 10 max	41 min 10 max	40 max 11 min	41 min 11 min
Group index	0		0	0		4 (max)		8 (max)	12 (max)	16(max x)	20 (max)
Usual types of significant constituent	Stone fragments		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
	The A-7 group is subdivided into A-7-5 or A-7-6 depending on the plastic limit. For P.L.<30, the classification is A-7-6, for P.L. ≥30, it is A-7-5.										

2.2 Unified Soil Classification System

- **The system is most popular for use in all types of engineering problems involving soils.**
- **It is based on recognition of the type and predominance of the constituents considering grain size, gradation and plasticity.**
- **It divides soil into three major divisions; namely:**
 - » **Coarse-grained soils,**
 - » **Fine-grained soils, and**
 - » **Highly organic (peat) soils.**

- **The name and symbols used to distinguish between the typical and boundary soil groups are given below.**

- **a) Coarse-grained soils**

G = Gravel , S = Sand

- **The gravel and sand are further divided into subgroups as;**

- **W = Well graded P = Poorly graded**

- **b) Fine-grained soils**

» **M = Inorganic silt**

» **C = Inorganic clay**

» **O = Organic silts and clays**

» **Pt = Peat**

- The above groups of fine-grained soils (excluding peat) are further subdivided according to their liquid limits into
 - » L = Low plasticity ($\omega_l < 50\%$)
 - » H = High plasticity ($\omega_l > 50\%$)
- Plasticity Chart: - The plasticity chart is a plot of plasticity index versus liquid limit. Fine-grained soils are subdivided into soils of low, medium and high plasticity following the criteria cut-lined below
 - Low plasticity ($\omega_l < 30\%$)
 - Medium plasticity (ω_l between 30% and 50%)
 - High plasticity ($\omega_l > 50\%$)
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- The diagonal line drawn in the plasticity chart is called the “A” line and is given by the equation $PI = 0.73 (\omega_l - 20)$. Clays fall above the A-line and silts below it.

∇ II. FIELD IDENTIFICATION OF SOILS

- **Soils can be identified in the field by conducting the following simple tests.**
 - **The techniques used for identification of soils in the field can conveniently be discussed under the headings of coarse-grained and fine-grained soils.**
 - **The sample is first spread on a flat surface. If more than 50% of the particles are visible to the naked eye, the soil is coarse-grained; otherwise, it is fine-grained.**

• 1. Coarse-grained Soil

- -Coarse-grained soils are mineral fragments that may be identified primarily on the basis of grain size. The different constituents of coarse-grained soils are sand and gravel.
- The size of sand varies from 0.075 mm to 2 mm
- and that of gravel from 2 mm to 60mm.
- Sand can further be classified as coarse, medium and fine.
- The description of sand and gravel should include an estimate of the quantity of material in the different size ranges as well as a statement of the shape and mineralogical composition of the grains.
- The mineral grains can be rounded, sub-rounded, sub-angular, or angular

• 2. Fine Grained Soils

- A. Inorganic Soils: - The constituent parts of fine-grained materials are silt and clay fractions.
- The classification tests used in the field for preliminary identification are;
 - a. **Dry strength:** The strength of a soil in a dry state is an indication of its cohesion and hence of its nature.
 - It can be estimated by crushing a 3 mm size dried fragment between thumb and forefinger.
 - A clay fragment can be broken only with great effort, whereas a silt fragment crushes easily.

b. Shaking test: It helps to distinguish silt from clay.

- In this test a part of soil mixed with water to a very soft consistency is placed in the palm of the hand. The surface of the soil is smoothed out with a knife and the soil pat is shaken by tapping the back of the hand. If the soil is silt, water will rise quickly to the surface and give it a shiny glistening appearance.
- Since clay soils contain much smaller voids than silts and are much less permeable, the appearance of the surface of the pat does not change during the shaking test.

c. Plasticity test: If a sample of moist soil can be manipulated between the palms of the hands and fingers and rolled into a long thread of about 3 mm diameter, the soil then contains a significant amount of clay. Silt cannot be rolled into a thread of 3 mm diameter without severe cracking.

B. Organic Soils

- The presence of an appreciable quantity of organic material can usually be recognized by the dark-grey to black color and odor of decaying vegetation, which it lends to the soil.