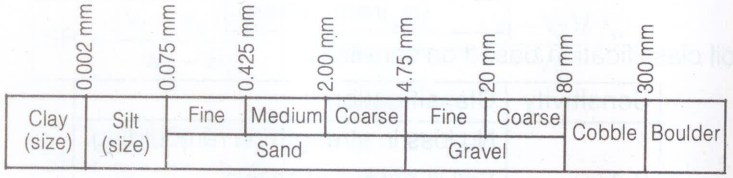
2. CLASSIFICATION OF SOILS

SOIL CLASSIFICATION

It is adopted by IS code. It was given by A-Casagrande. It is based on particle size distribution for coarse soils and plasticity for fine soils.

Unified Soil Classification

Coarse grain classification	Fine grain classification
Based on	Based on
1. Particle size	1. Plasticity (PI)
2. Cu	2. Liquid limit/compressibility
3. Cc	
4. Fineness	



Classification of soils based on grain size.

- **On the basis of fineness coarse grain soils are further classified**

Case-I: When fineness is < 5%

1. GW – Well graded gravel
   Cu > 4
   1 < Cc < 3
   Fineness < 5%
2. GP – Poorly graded gravel
   Above values of Cu and Cc are not satisfied.
3. SW – Well graded sand
   Cu > 6
   1 < Cc < 3
4. SP – Poorly graded sand/uniformly graded sand
   Cu and Cc are not in range.

Case-II: If fineness is 5% to 12% the dual symbol are used.

1. GW – GC well graded gravel containing clay.
   Fineness – 5 to 12%
   Clay > Silt
   Gravel > Sand
   Cu > 4; 1 ≤ Cc ≤ 3
2. GW – GM Well graded gravel containing silt
   Cu > 4
   1 ≤ Cu ≤ 3
   Silt > Clay
   Gravel > Sand
3. SW – SC Well graded sand containing clay
   Sand > Gravel
   Clay > Silt
   Cu > 6
   1 ≤ Cc ≤ 3
   Fineness 5 to 12%
4. SW – SM Well graded sand containing silt
   Sand > gravel
   Silt > Clay
   Cu > 6
   1 ≤ Cu ≤ 3
   Fineness 5 to 12%

For poorly graded soils like GP – GC, GP, GM, SP-SC SP-SM the values of Cu and Cc are not satisfied.

Case-III: When fineness is more than 12%

GC: Clayey gravel
   Gravel > Sand
   Clay > Silt $I_P > 7\%$

GM: Silty gravel
   Sand < Gravel
   Clay < Silt $I_P < 7\%$

SC: Clayey silt
   Sand > Gravel
   Siktl <Clay $I_P > 7\%$

SM: Silty sand
   Sand > Gravel
   Silt > Clay $I_P < 7\%$

Classification of Fine Soils

1. Silts (0.002 mm to 0.075 mm
   - Coarse 0.02 to 0.075 mm
   - Medium 0.01 to 0.02 mm
   - Fine 0.002 to 0.01 mm
2. Clay → <0.002 mm

   (i) Low plastic soils (LL < 35%)

   CL → Low plastic inorganic clay

ML → Low plastic silt

OL → Low plastic organic clay

(ii) Medium plastic soils (35% < LL 50%)

CI → Medium plastic inorganic clay

MI → Medium plastic silt

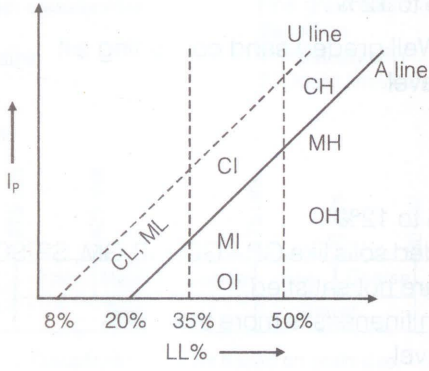
OI → Medium plastic organic clay

(iii) High plastic soils (LL > 50%)

CH → High plastic inorganic clay

MH → High plastic silt

OH → High plastic organic clay



Equation of A-line $I_P = 0.73 (W_L - 20)$

Equation of U-line $I_P = 0.9 (W_L - 8)$

	Clay mineral	Properties
1.	Kaolinite mineral	Hydrogen bond is there which is strongest bond. Ex. China clay
2.	Illite mineral	Ionic bond. Medium change in volume due to moisture change.
3.	Mont morillonite	Water bond which is weakest bond. Max change in volume due to moisture change. Ex. Black soils & Bentonite soils

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