CLASSIFICATION & IDENTIFICATION OF SOIL

DATE - 17/02/2020

Soil have any more Inder Properties

- water content
- specific Gravity
- particle size distribution
- Comistency limit
- In Situ density
- Density Inder

(1) Water content (w) = $\frac{W_w}{W_s} \times 100$

water content can find from are four →

① Laboratry method
- → oven drying method
- → by pycnometer
- → Torsism balanced

② field method
- → by Alchol
- → Calcium Carb-(Rapid m
- → Sand bath

or

Infrared moisturment method

(II) Specific Gravity :- $G = \frac{\gamma_s}{\gamma_w}$

Pycnometer द्वारा G ज्ञात करने हेतु -

$$G_{at\,27^\circ C} = \frac{W_2 - W_1}{(W_2 - W_1) - (W_3 - W_4)}$$

where W_1 = wt. of empty pycnometer
W_2 = wt. of soil with pycno.
W_3 = wt. of soil + water with pycnom.
W_4 = wt. of water with pycnometer.

at another Temp.

$$G_{at\,27^\circ C} = \frac{G_{at\,T^\circ C} \times \gamma_{w\,at\,T^\circ C}}{\gamma_w \text{ at } 27^\circ C}$$

AA

Soil	Value of G
Organic soil	1·2 to 1·41
Inorganic soil	2·6 to 2·75

III). Particle size distribution / Grain Size distribution :

मृदा में कणों के विभिन्न प्रकार व उनकी परिमाप निम्न हैं—

- बोल्डर (Boulder) - > 30cm
- कोबिल (Coble) — 8-30cm
- बजरी (Gravel) — Coarse – (80mm-20mm)
  - Fine – (20mm-4.75mm)
- रेत या बालू (Sand) — Coarse (4.5-2mm)
  - medium (2mm-425μ)
  - fine (425μ-75μ)
- सिल्ट (Silt) — 75μ-2μ
- मृत्तिका (Clay) - < 2μ

Particle size
Gravel > Sand > Silt > Clay

Fine Soil :- works on Stoke's law of velocity
- ↳ Sedimentry analysis
  - → hydrolic analysis
  - → Pepette method
- ↳ Size – 0.2mm to 0.2μ

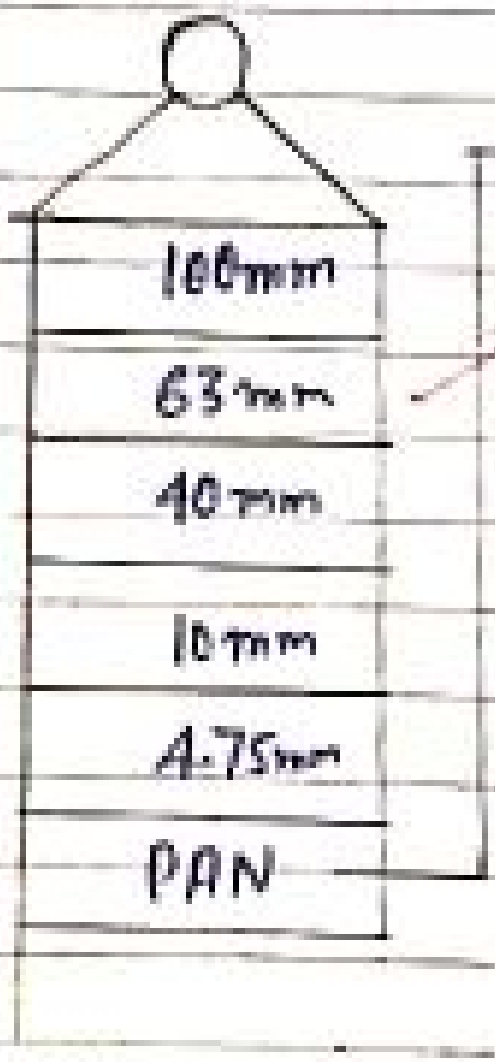
$$v = \frac{g}{18}\left[\frac{\rho_s - \rho_w}{\mu}\right] D^2$$

1. Sieve Analysis (चालनी विश्लेषण) :

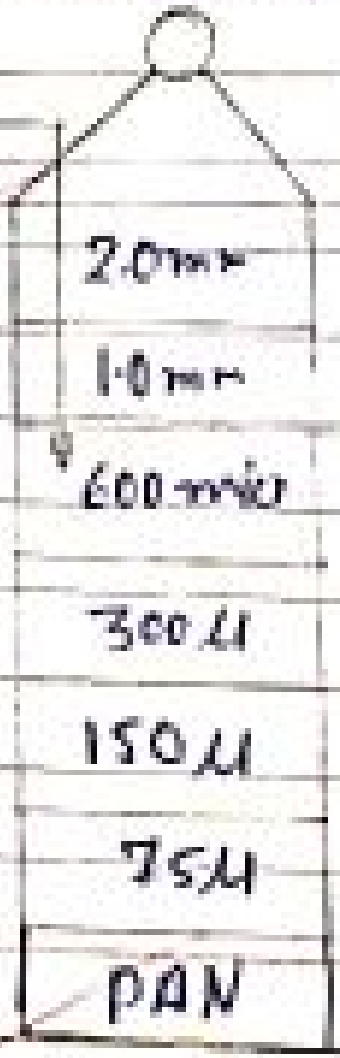
मृदा में 300 75μ परिमाप तक के कणों का विश्लेषण चालनियों की सहायता से किया जाता है Sieve Analysis दो प्रकार का-

I - Coarse sieve - क्रमानुसार 100 mm, 63 mm, 40, 20 10, 4.75 mm

II - Fine sieve - 2 mm, 1 mm, 600 μ, 425 μ, 300 μ, 150 μ, 75 μ



Coarse Sieve Analysis



Fine Sieve Analysis

2-Sedimentation Analysis : (अवसादन विश्लेषण)

75 μ से छोटे कणों का चालनी विश्लेषण सम्भव नहीं है, अतः मृदा में 75 μ से महीन कणों का वितरण ज्ञात करने के लिए अवसादन विश्लेषण किया जाता है, इसे गीला विश्लेषण भी कहते हैं, यह विश्लेषण स्टोक नियम पर आधारित है।

स्टोक नियम (Stoke's Law) :- इस नियमानुसार द्रव निलम्बन में उपस्थित कण बैठने की दर निम्न तत्वों पर निर्भर-

- कण का आकार
- कण का घनत्व
- कण का परिमाप अथवा साइज

कण परिमाप वितरण वक्र (Particle size distribution curve)

किसी भी कण परिमाप वितरण में D_{60}, D_{30} व D_{10} के मान पढ़े जा सकते हैं, इन परिमाणों के कुछ महत्वपूर्ण गुणांक निम्न हैं-

(I) Coefficient of Uniformity (समानता गुणांक) :-

- यह मृदा के D_{60} व D_{10} का अनुपात है।

$$C_u = \frac{D_{60}}{D_{10}}$$

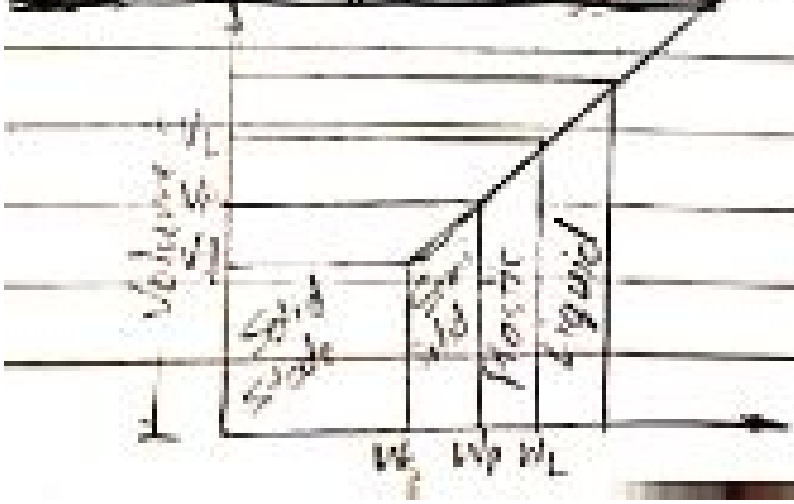
if $C_u = 1$ (uniformly Graded Soil)
$C_u > 4$ (Gravel)
$C_u > 6 \rightarrow$ Sand

(II) Coefficient of Curvature (वक्रता गुणांक)

$$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

for well Graded soil $[1 < C_c < 3]$

(3) ~~(Specific G)~~ Consistency Limit / Atterberg's Limit :- Only for fine Soil



Consistency Limit → Consistency limit वह w (water content) है जिस पर मृदा एक अवस्था से दूसरी अवस्था में परिवर्तित होती है।

(I) Liquid Limit (w_L):- the minimum water content at which the soil is still in the liquid satee but has some small shearing resistance.

(II) Plastic Limit (w_p):- the minimum water content (w) at which the soil will just begin to crumble when rolled into a thread of approximaly 3mm in diameter.

(III) Shrinkage Limit (w_s):- the maximum waten content at which a reduction in water content will not calls a decrease in the volume of soil mass.

Some Important Indices:

1- Plasticity Index; I_p:-

$$I_p = w_L - w_p$$

I_p %	Description of Unit
0	Non plastic
1-5	Slight plastic
5-10	Low plastic
10-20	Medium plastic
20-40	High plastic
>40	Very high plastic

2- Consistency Index (I_c)

$$I_c = \frac{w_L - w_N}{I_p}$$

w_N = natural water content

if $w_N = w_L \Rightarrow I_c = 0$ (Soil is in Liquid State)
if $w_N = w_p \Rightarrow I_c = 1$ (Soil in at plastic Stage)
if $I_c > 1$, then soil is semisolid or will be very hard.

Liquidity Index (I_L):-

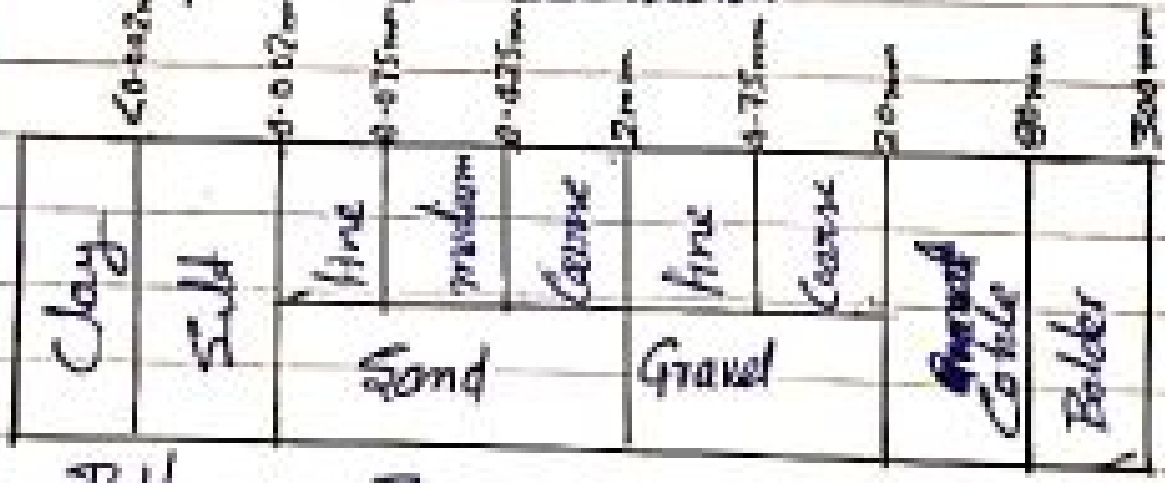
$$I_L = \frac{w_n - w_p}{I_p}$$

Solid State	Description	I_L
Liquid	Liquid	>1
Plastic	very soft	0.75 – 1
	soft	0.5 – 0.7
	medium Stiff	0.25 – 0.5
	Stiff	0 – 0.25
Semi Solid	Very Stiff Harder	<0
Solid	Harder Very hard	<0

Classification of Soil :

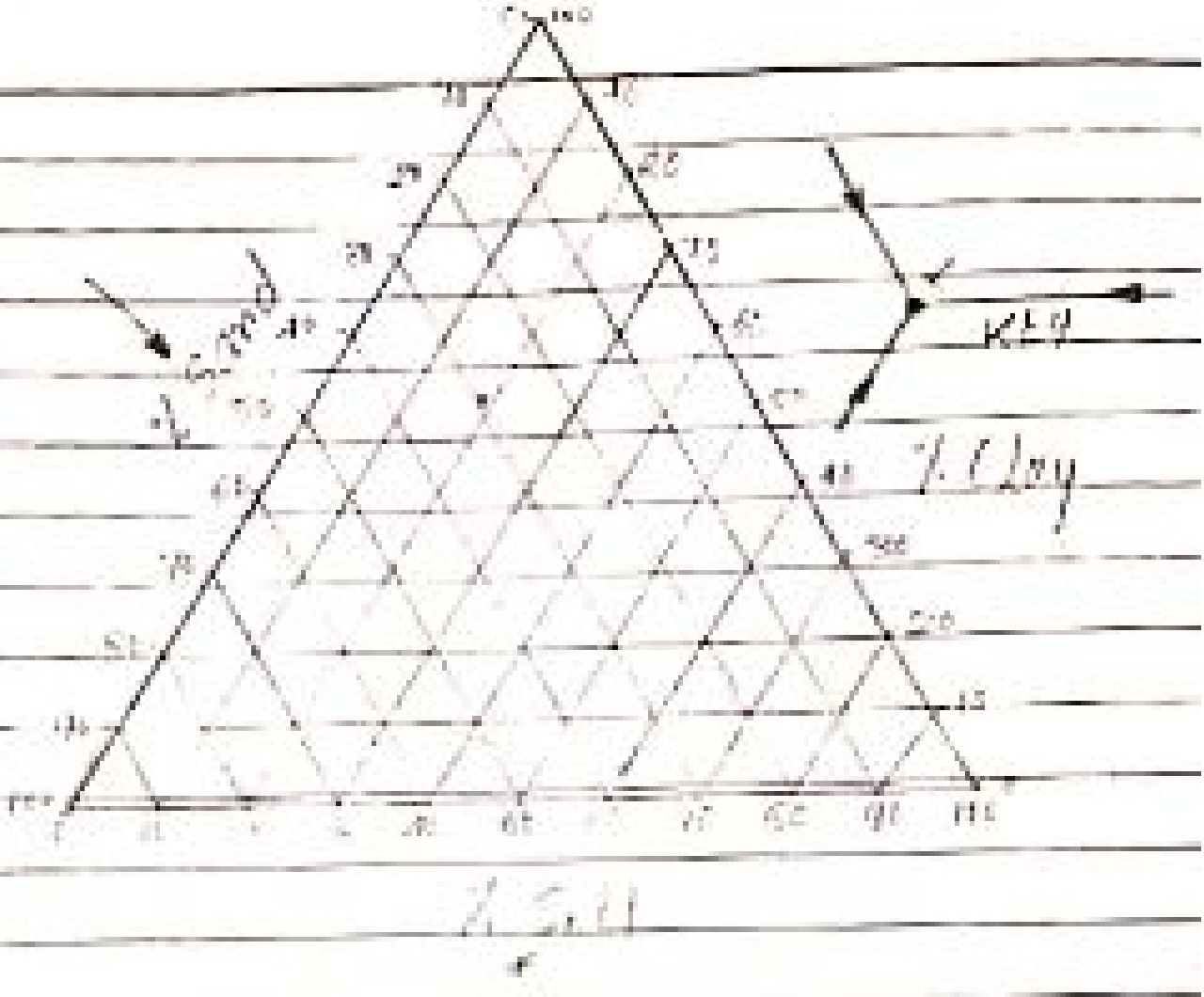
→ Particle size classification
→ Textural classification.
→ Highway research board class.
→ Indian Soil classification System.

(1) Particle size (or) classification →
Indian particle size distribution -



Boulder - > 300 mm
Cobble - 80 mm - 300 mm
Gravel { Coarse (80mm - 20mm)
Fine (20mm - 4.75mm)
Sand { Coarse (4.75mm - 2mm)
medium (2mm - 0.425mm)
Fine (0.425mm - 0.075mm)
Silt - (0.075mm - 0.002mm), Clay - < 0.002mm

Textural Classification →



LOAM = mixture of Sand + Silt + Clay

(iii) HRB Classification :-

(A1, A2, A3, A4, A5, A6, A7)

{ G.I = 0.2a + 0.005ac + 0.01bd }

Grp Index

at here, a = (P-35) ≠40

b = (P-50) ≠40

c = (LL-40) ≠20

d = (Ip-10) ≠20

P = % passing from 75 μ Sieve

G.I	Cond. of Soil
0	Excellent
$0 < G.I \leq 4$	Good
$4 < G.I \leq 8$	fair
$8 < G.I \leq 12$	Poor
$12 < G.I \leq 20$	Very poor

(IV) Indian Standard Soil Class. System –

Coarse
- Particle size
- Cu
- Cc
- fineness

Fine
- Plasticity Index
- Liquid limit

Soil type	Prefix
Gravel	G
Sand	S
Silt	M
Clay	C
Organic Soil	O
Peat	Pt.

Class of Course :-

Case-I ; when fines is < 5%.

1- GW - well Graded Gravel
$C_u > 4$ $1 < C_c < 3$

2- GP - Poorly Graded Gravel
C_u & C_c are not satisfied

3- SW - well Graded Sand
$C_u > 6$ & $1 < C_c < 3$

4- SP - Poorly Graded Sand
C_u & C_c are not satisfied

Case-II - when fineness is b/w 5% to 12%.

(Dual Symbole use)

1- GW-GC → well graded Gravel containing clay
Clay > Silt, Gravel > Sand & $C_u > 4$, $1 < C_c < 3$

2- GW-GM → well graded Gravel containing Silt
Silt > Clay $C_u > 4$, $1 < C_c < 3$

3- SW-SC → well graded Sand containing clay
Sand > Gravel, Clay > Silt, $C_u > 6$, $1 < C_c < 3$

4- SW-SM - well graded Sand containing Silt
Silt > Clay, $C_u > 6$, $1 < C_c < 3$

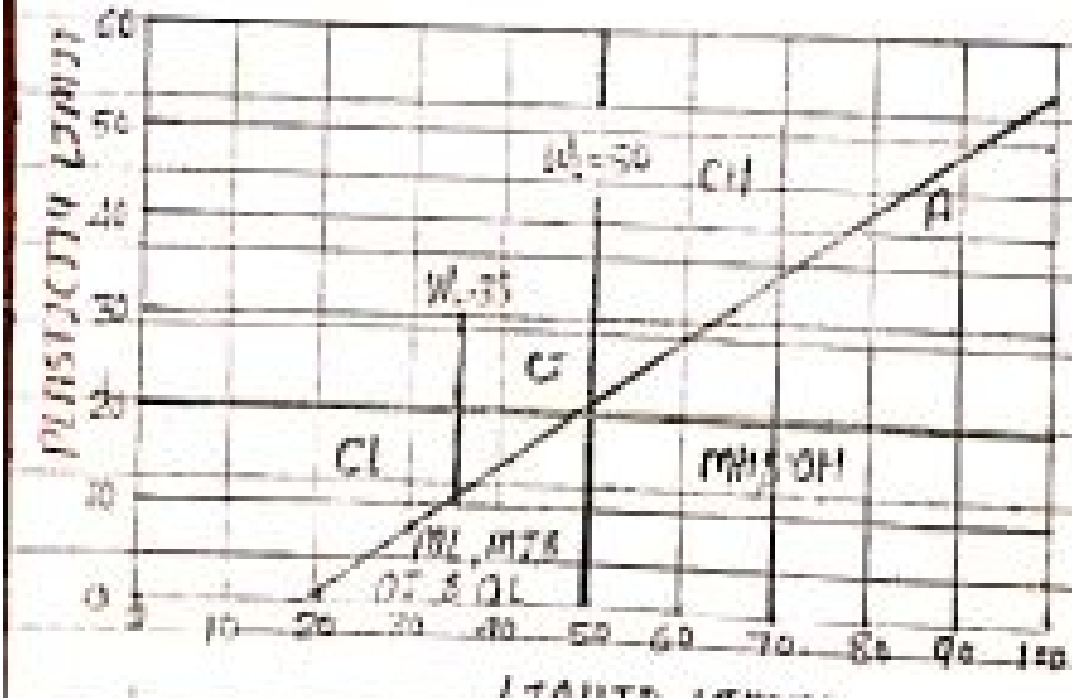
Case III: when finess is >12% (Plasticity Index)

1- GC → Clayey Gravel $I_p > 7\%$
2- GM → Silty Gravel $I_p < 4\%$
3. SC → Clayey Sand $I_p > 7\%$
4. SM → Silty Sand $I_p < 4\%$

Classification of fine Soil: -

(1) Silt → fine (2μ - 10μ)
medium (10μ - 20μ)
Coarse (20μ - 75μ)

(2) Clay →



al term A Line Equation :-

$$I_p = 0.73(w_L - 20)$$

Case-I : $w_L < 35\%$

CL - low plastic inorganic clay
ML - Low plastic silt
OL - Low plastic organic clay

(L - low
I - Inter mediate
H - High
C - Clay
M - Silt
O = Organic)

Case-II : w_L b/w 35% to 50%

CI - medium plastic inorganic clay
MI - medium plastic silt
OI - medium plastic organic clay

Case III : $w_L \geq 50\%$

CH - High plastic inorganic clay.
MH - High plastic clay.
OH - High plastic organic clay.

Minerals on @ soil →

- Montmorillonite (find in Black cotton soil)
- Illite
- Kaolinite