

ATTERBERG - LIMITS.

PROBLEM : I

Four different types of soils were encountered in a big project. Their liquid limit, plastic limit and natural moisture content are given below.

Type of Soil.	Liquid Limit WLL %	Plastic Limit WPL %	N.M.C W _n %
1	120	40	150
2	8	85	70
3	60	30	30
4	65	32	25

Determine liquidity Index and comment on the state of soil in field.

SOLUTION.

$$\text{Liquidity Index} = \frac{N.M.C - P.L}{LL - P.L}$$

$$I_L = \frac{W_n - W_{P.L}}{W_{LL} - W_{P.L}}$$

$$I_{L1} = \frac{150 - 40}{120 - 40} = 1.375$$

For soil I, $I_L > 1$, hence the state of soil is liquid.

$$I_{L2} = \frac{70 - 85}{8 - 85} = 0.195$$

Soil II is soft.

$$I_{L3} = \frac{30 - 30}{60 - 30} = 0$$

Soil III is very stiff.

$$I_{L4} = \frac{25 - 32}{65 - 32} = -0.2$$

Soil IV is semi-solid to solid state.

Shamsi Photo Copy
Girls Café (U.E.T)
Contact: 0323-4373141

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Contact: 0323-4373141

PROBLEM : 2

A sample of clay has a liquid limit 62% and plastic limit of 32%. What is the state of consistency of soil if its natural moisture content is 34%?

SOLUTION

$$W_{L.L} = 62\%$$

$$W_{P.L} = 32\%$$

$$W_n = 34\%$$

$$I_L = \frac{W_n - W_{P.L}}{W_{L.L} - W_{P.L}}$$

$$= \frac{34 - 32}{62 - 32}$$

$$= 0.066$$

Soil is soft

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PROBLEM: 3.

A soil with Liquidity Index 0.20 has a liquid limit 56% and Plasticity index 20%. What is the natural moisture content of soil?

SOLUTION.

$$\text{Liquidity Index} = I_L = 0.2$$

$$\text{Plasticity Index} = I_P = 20\%$$

$$\text{Liquid Limit} = L.L = 56\%$$

$$\text{N.M.C} = W_n = ?$$

We know that

$$\begin{aligned} \text{OR. } I_P &= L.L - P.L \\ P.L &= L.L - I_P \\ &= 56 - 20 = 36\% \end{aligned}$$

Also

$$I_L = \frac{W_n - W_{PL}}{W_{LL} - W_{PL}}$$

$$0.2 = \frac{W_n - 36}{56 - 36}$$

$$0.2 \times 20 = W_n - 36$$

$$W_n = 4 + 36 = 40\%$$

Prob No. 4 :- The liquid limit test carried out on two samples of clay gave following information

Sample ①	m.c (%)	120	114	98	96
	N	7	10	30	40

Sample ②	m.c (%)	96	74	45	30
	N	9	15	32	46

Plastic limit of sample ① is 40% and plastic limit of sample ② is 32%. Determine Flow Index & Toughness Index of samples

Sol :-

Sample ①

P.L = 40%

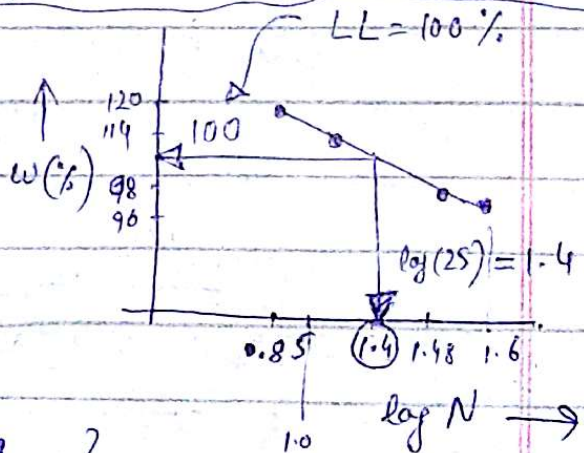
(Plasticity Index) P.I = L.L - P.L
 (Flow Index) F.I = $\frac{w_1 - w_2}{\log \frac{N_2}{N_1}}$

Toughness Index $I_T = \frac{P.I}{F.I}$

LL = ?
 FI = ? \Rightarrow Flow index is the slope of graph b/w $w(\%)$ and $\log(N)$

\Rightarrow L.L. (Liquid limit is $w(\%)$ against 25 no. of blows)
 $\log 25 = 1.4$

m.c	N	$\log N$
120	7	0.85
114	10	1.00
98	30	1.48
96	40	1.60



Slope = F.I = $\frac{114 - 98}{1.48 - 1} = 33.33$

L.L = 100%

** graph is not to the scale

$$P.I = LL - PL$$

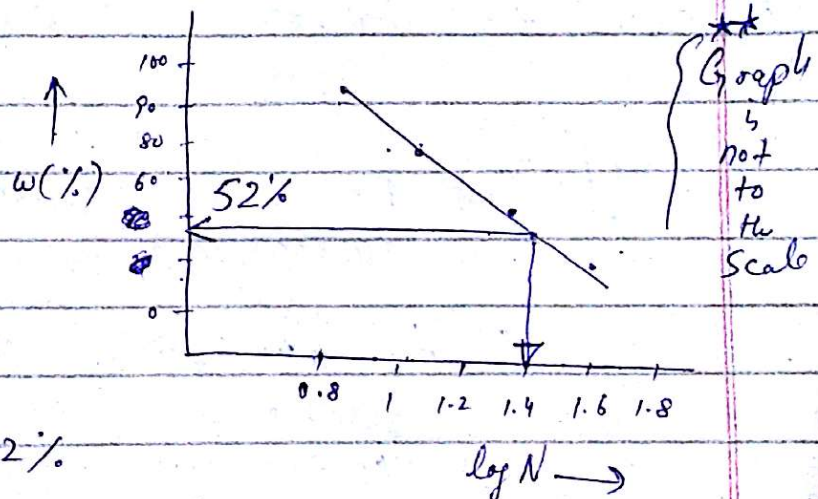
$$= 100 - 40$$

$$P.I = 60$$

$$\text{Taylor's Index} = \frac{P.I}{F.I} = \frac{60}{33.33} = 1.8$$

Sample ②

$w(\%)$	N	$\log N$
96	9	0.95
74	15	1.18
45	32	1.51
30	46	1.66



$$L_d = 52\%$$

$$F.I = \text{slope} = \frac{74 - 45}{1.51 - 1.18} = 88\%$$

$$P.I = LL - PL = 52 - 32 = 20$$

$$T.I = \frac{P.I}{F.I} = \frac{20}{88} = 0.25$$