Factually of Engineering and Technology

Civil Engineering department

Soil mechanics

ENCE 331

Home work assignment #1

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Q1

1- $\gamma_{sat} = \gamma_{dry} + \left(\frac{e}{1+e}\right)\gamma_w$

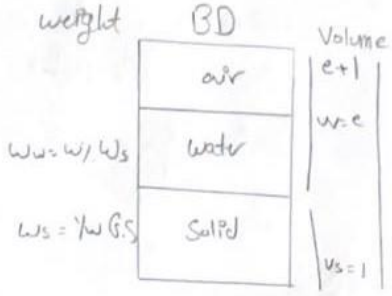
assume $V_s = 1$

$e = \frac{V_v}{V_s} = V_v \rightarrow V = \boxed{1+e}$

$W_s = G_s * \gamma_w$

$w\% = \frac{W_w}{W_s} \rightarrow W_w = w\% * W_s$

$\gamma_{sat} = \frac{W_s + \gamma_w V_v}{V} \rightarrow \frac{W_s}{V} + \frac{\gamma_w V_v}{V} \rightarrow \boxed{\gamma_{dry} + \left(\frac{e}{e+1}\right)\gamma_w}$.



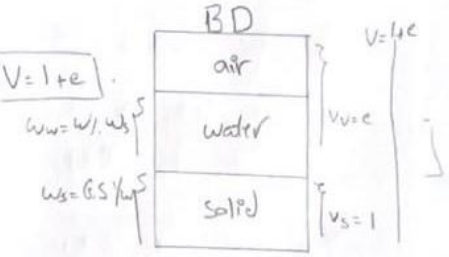
2- $\gamma_{dry} = \frac{e S \gamma_w}{(1+e)w}$

$\gamma_{dry} = \frac{W_s}{V} = \frac{G_s \gamma_w}{1+e}$

$\frac{W_s}{V} = \frac{W_w}{w\% * (1+e)} = \frac{V_w * \gamma_w}{(1+e)w}$

$V_w = S * V_v = S * e \rightarrow \boxed{\frac{S e \gamma_w}{(1+e)w}}$

assume $V_s = 1$
$V_v = e \rightarrow \boxed{V = 1+e}$.



$e = \frac{\gamma_{sat} - \gamma_{dry}}{\gamma_{dry} - \gamma_{sat} * \gamma_w}$

assume $V_s = 1$

$\gamma_{dry} = \frac{W_s}{V} = \frac{G_s \gamma_w}{V} \rightarrow \boxed{G_s \gamma_w = \gamma_d * V}$

$\gamma_{sat} = \frac{W_s + W_w \gamma_w}{V} = \frac{G_s \gamma_w + V_v \gamma_w}{V}$

$\boxed{\gamma_{sat} * V - V_v \gamma_w = G_s \gamma_w} \rightarrow (V = 1+e) \rightarrow (V_v = e)$

$G_s \gamma_w = G_s \gamma_w \rightarrow \gamma_{sat}(e+1) - \gamma_w e = \gamma_d (1+e)$

$\rightarrow \gamma_{sat} e + \gamma_{sat} - \gamma_w e = \gamma_d + e\gamma_d \rightarrow e(-\gamma_{sat} + \gamma_w + \gamma_d) - \gamma_{sat} + \gamma_d = 0$

$\Rightarrow \boxed{e = (\gamma_{sat} - \gamma_{dry}) / (\gamma_{dry} - \gamma_{sat} + \gamma_w)}$

-4 $w_{sat} = \frac{n\gamma_w}{\gamma_{sat} - n\gamma_w}$ | assume V=1 |

$\gamma_{sat} = \frac{n(1+w_{sat})}{w_{sat}}\gamma_w \rightarrow \frac{n\gamma_w + nw_{sat}\gamma_w}{w_{sat}}$

$w_{sat} = \frac{n\gamma_w}{\frac{n\gamma_w + nw_{sat}\gamma_w}{w_{sat}} - \frac{(n\gamma_w w_{sat})}{w_{sat}}}$

$w_{sat} = \frac{n\gamma_w}{\frac{n\gamma_w}{w_{sat}}} \rightarrow$ | $w_{sat} = w_{sat}$ |

Q2

$w\% = 0.14$, $G.S = 2.69$, $\gamma_B = 17.8\ KN/m^3$

$V_{total} = 1\ m^3$

$\gamma_B = \frac{w}{V} \Rightarrow 17.8 = \frac{w}{1} \rightarrow$ | $W = 17.8\ KN$ |

$W = W_s + W_w \rightarrow W_w = 0.14W_s \rightarrow 17.8 = 1.14W_s$

$\Rightarrow$ | $W_s = 15.6\ KN$ | $W_w = 0.14(15.6) =$ | $2.18\ KN$ |

- $\gamma_{dry} = \frac{W_s}{V} =$ | $15.6\ KN/m^3$ |

- $e = \frac{V_v}{V_s} \Rightarrow G.S = \frac{\gamma_s}{\gamma_w} \rightarrow$ | $26.9 = \gamma_s$ | (KN/m^3)

$\gamma_s = \frac{W_s}{V_s} \rightarrow 26.9 = \frac{15.6}{V_s} \Rightarrow$ | $V_s = 0.58\ m^3$ |

$1 - V_s \rightarrow 1 - 0.58 =$ | $0.42\ m^3 = V_v$ |

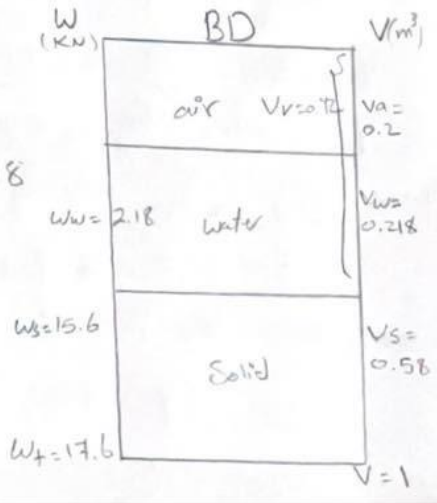
| $e = \frac{0.42}{0.58} = 0.724$ |

- $S = \frac{V_w}{V_v} \Rightarrow \gamma_w = \frac{W_w}{V_w} \Rightarrow 10(V_w) = 2.18$

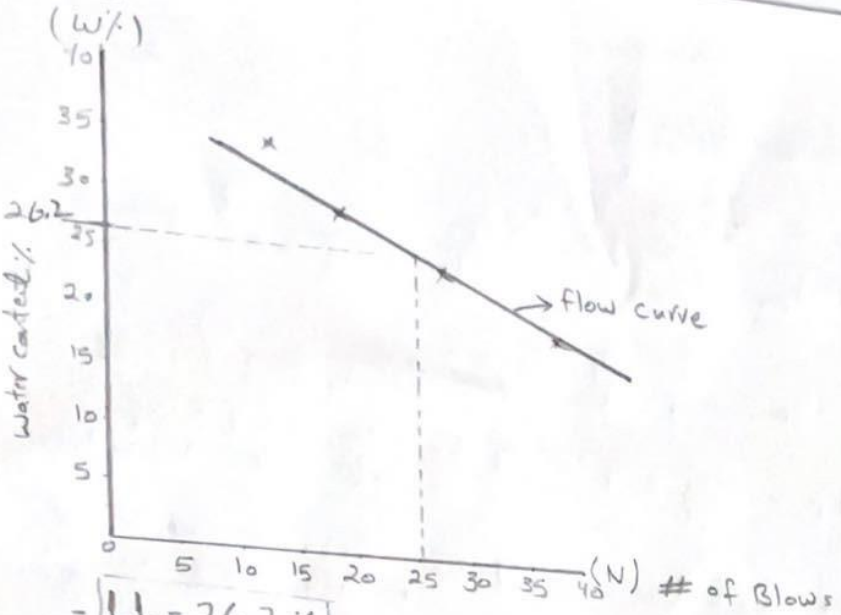
$V_w = 0.218\ m^3$

$S = \frac{0.218}{0.42} = 0.52 * 100$

| 52% |



Q3



- LL = 26.2 %
- PI = LL - PL → 6.5 = 26.2 - PL
  PL = 19.7 %
- $LI = \frac{23.8 - 19.7}{26.2 - 19.7} = \frac{4.1}{6.5} = 0.6307 \approx 0.631\%$

Q4

Sample #1

- $SL = \left(\frac{37-28}{28}\right)100 - \left(\frac{19.3-16}{28}\right)(100)(1) = 32.1 - 11.8 = 20.3\%$
- $SR = \frac{28}{16*1} = 1.75$

Sample #2

- $SL = \left(\frac{47.5-34.6}{34.6}\right)*100 - \frac{(20.6-13.8)}{(34.6)}*100*1 =$
  → 37.3 - 19.7 = 17.6 %
- $SR = \frac{34.6}{13.8*1} = 2.5$

Q5

#1 AASHTO classification systems:-

1- passing #200 > 35 → Second table

A-6 (9.5) poor clayey soil

$GI = (50-35)(0.2+0.005(38-40)) + 0.01(50-15)(29-10) = 9.5$

2- passing #200 > 35

A-7-5[a] (21) poor clayey soil

$GI = (80-35)(0.2+0.005(56-40)) + 0.01(80-15)(23-10) = 21$

3- passing #200 > 35

A-6 (11.6) poor clayey soil

$GI = (65-35)(0.2+0.005(37-40)) + 0.01(65-15)(22-10) = 11.6$

4- passing #200 > 35

A-6 (0) poor clayey soil

$GI = (45-35)(0.2+0.005(28-40)) + 0.01(45-15)(20-40) = -4.6 = 0$

5- passing #200 > 35

A-7-6[b] (0.165) poor clayey soil

$GI = (62-35)(0.2+0.005(43-40)) + 0.01(62-15)(28-40) = 0.165$

#2 USCS classification systems:-

1- passing #200 ≥ 50 → plasticity chart

CL :- Inorganic clay with low plasticity.

2- passing #200 ≥ 50

CH :- Inorganic clay with High plasticity.

3- passing #200 ≥ 50

CL :- Inorganic clay with low plasticity.

4- passing #200 < 50 → coarse Sand

5- passing #200 ≥ 50 → fine

CL :- Inorganic clay with low plasticity.