Soil Mechanics
HW5

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Problem ①: (A) The maximum dry unit = 1.6222 g/cm

The optimum moisture content = 20%

(B) doesn't intersects the compaction curve

(C) I attach an Excel file contain all the figures

(d) $e_{omc} = 0.664$

$S_{omc} = 0.82$

(e) $DOC = \dfrac{\gamma_d\,(field)}{\gamma_d\,(max)}$

$\longrightarrow \gamma_d(field) = 0.95 * 1.6222 = 1.54109$ g/cm

Problem ②: Given: * Calibration density of sand = 1667 Kg/m³

* mass of sand needed to fill the cone = m_1
= 0.117 Kg

* mass of jar + cone + sand before use = m_2
= 6.1 Kg

* mass of jar + cone + sand after use = m_3
= 2.83 Kg

* mass of moist soil from the hole = m_4
= 3.35 Kg

* $W = 16.1\% = 0.161$

* Volume of sand:

$$V = \frac{m_2 - m_3 - m_1}{\rho_{sand}} = 1.89 * 10^{-3} \ m^3$$

* mass of dry soil:

$$m_d = \frac{m_4}{1+w} = 2.885 \ Kg$$

(A) γ_d: $\gamma_{dry} = \frac{m_d \ g}{V_t} = \frac{2.885 * 9.81}{1.89 * 10^{-3}}$

$= 14.98 \ KN/m^3$

$= 1.527 \ Kg/m^3$

(B) $(\gamma_d)_{max} = \dfrac{G_s \gamma_w}{1 + e_{min}}$

e_{min} when $S = 1$: $e = W G_s$

$= 0.161 * 2.65$

$= 0.427$

$\rightarrow \gamma_d(max) = \dfrac{2.65 * 9.81}{1.427}$

$= 18.218 \ KN/m^3 = 1.857 \ Kg/m^3$

$*$ Doc $= \dfrac{1.527}{1.857} = 0.822 * 100\%$

$= 82.2\%$

(C) Doesn't met

(d) $* \gamma_d = \dfrac{G_s \gamma_w}{1+e} \longrightarrow 1+e = \dfrac{G_s \gamma_w}{\gamma_d}$

$e = \dfrac{2.65 * 1}{1.527} - 1$

$\longrightarrow e = 0.735$

$* S = \dfrac{2.65 * 0.161}{0.735} = 0.58 * 100\% = 58\%$

Problem 3:- $e_{embankment} = \frac{V_T - V_s}{V_s}$

$$0.7\,V_s + V_s = 7500$$

$$V_s = 4411.76\ m^3$$

	$e = \frac{V_T - V_s}{V_s}$	Cost
borrow pit 1	$V_T = 8161.756\ m^3$	89779.316 \$
borrow pit 2	$V_T = 8470.58\ m^3$	67764.64 \$
borrow pit 3	$V_T = 9749.990\ m^3$	87749.91 \$
borrow pit 4	$V_T = 8338.23\ m^3$	83382.3 \$

borrow pit 2 → lower Cost

Problem 4:- (An Excel file attach with the Sol.)

The maximum dry unit = 17.38 KN/m^3

The optimum moisture content = 16.9%

* from the second Curve:

location 1
location 2 → met
location 3

location 4 → Rejected
location 5

Problem 5 :- Given: $\gamma_{d\,max} = 16.9\ KN/m^3$

$\gamma_{d\,min} = 14.2\ KN/m^3$

field Relative density, $D_r = 82\%$

(A): $$D_r = \frac{\gamma_{dmax}}{\gamma_d}\left(\frac{\gamma_d - \gamma_{d\,min}}{\gamma_{dmax} - \gamma_{dmin}}\right)$$

γ_d ↙ field dry density

$$\rightarrow 0.82 = \frac{16.9}{\gamma_d}\left(\frac{\gamma_d - 14.2}{16.9 - 14.2}\right)$$

$$0.131\,\gamma_d = \gamma_d - 14.2$$

$$\gamma_d = 16.34\ KN/m^3$$

* Degree of compaction:

$$D_c = \frac{\gamma_d}{\gamma_{dmax}} * 100\% = \frac{16.34}{16.9} * 100\%$$

$$= 96.86\%$$

(B) $\gamma_d = 16.34\ KN/m^3$

(C) $\gamma = \gamma_d(1+\omega) = 16.34\,(1.15)$

$$= 18.791\ KN/m^3$$