工学系

公務員試験
専門試験問題
演習講座

2019年国家総合職工学２次記述　No.19

（土質力学）

土木

(1)(a)

$\rho_d = 1.5\ g/cm^3$, $\rho_t = 1.8\ g/cm^3$, $\rho_s = 2.7\ g/cm^3$, $\rho_w = 1.0\ g/cm^3$

(w)

$\rho_t = \left(1 + \frac{w}{100}\right)\rho_d$ より. $w = \frac{\rho_t - \rho_d}{\rho_d} \times 100 = \frac{0.3}{1.5} \times 100 = 20\%$ //

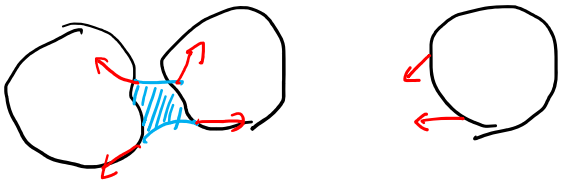
(e) $\rho_d = \frac{\rho_s}{1+e}$ より. $e = \frac{\rho_s}{\rho_d} - 1 = \frac{2.7}{1.5} - 1 = 0.8$ //

(S_r) $w\rho_s = eS_r\rho_w$ より $S_r = \frac{w\rho_s}{e\rho_w} = \frac{20 \times 2.7}{0.8 \times 1.0} = 67.5\%$

(b) w_0：最適含水比

◎サクション：表面張力により生じる
結合力

（前提）



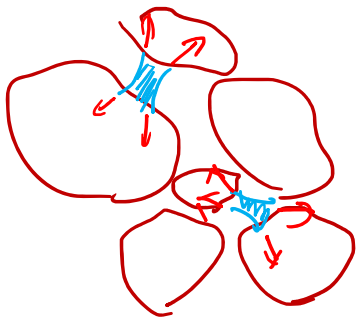
○サクション：隙間が小さい
⇒力が大きい

〈締固め〉

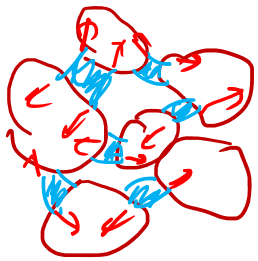
① 強い力によって土粒子が近付く
→間隙は小さくなる

② 力が除去される→元に戻らない

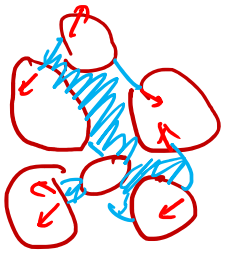
◎水が多くなると⇒
サクションが働く
水塊が多くなる



〈小〉



〈w_0〉



〈大〉

多くなりすぎると⇒水浸しサクションのはたらく水面が減る

(c)

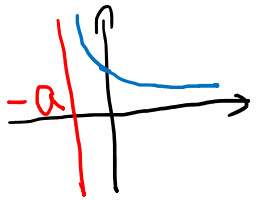
$$\rho_d = \frac{\rho_s}{1+e} = \frac{\rho_s}{1+\frac{w\rho_s}{S_r\rho_w}} = \frac{1}{\frac{1}{\rho_s}+\frac{w}{S_r\rho_w}}$$

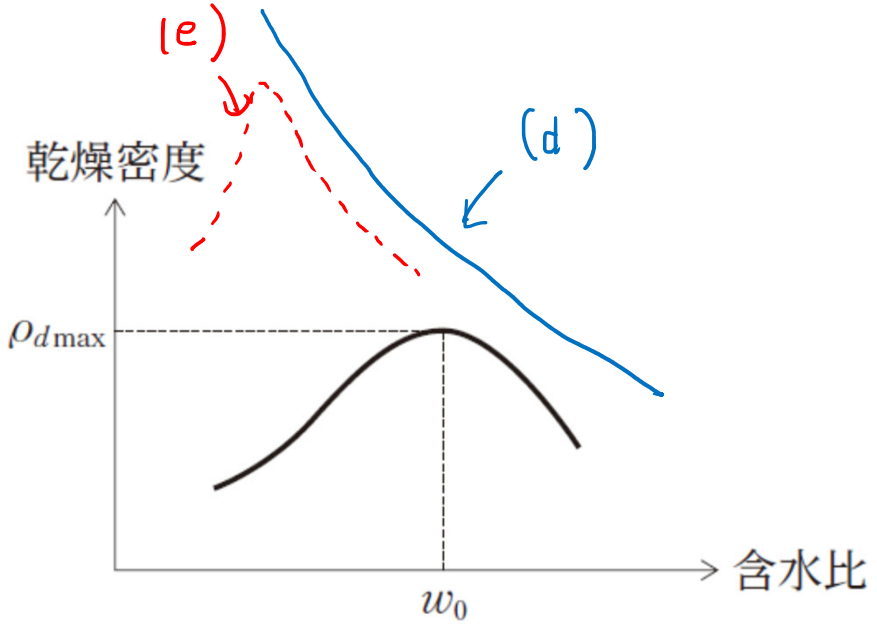
$w\rho_s = eS_r\rho_w$

$$= \frac{1}{\frac{1}{2.7}+\frac{20}{100\times 1.0}} = 1.75\ g/cm^3 \;//$$

(d) $\rho_d = \dfrac{1}{\frac{1}{2.7}+\frac{w}{100}}$

$\left(y = \dfrac{b}{x+a} \quad b>0 \right)$



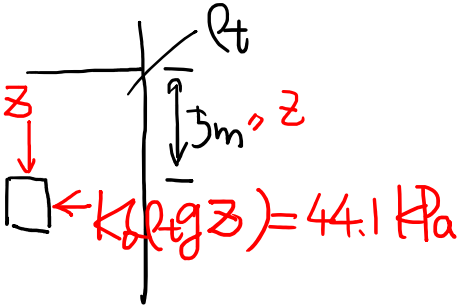


(2)(a)

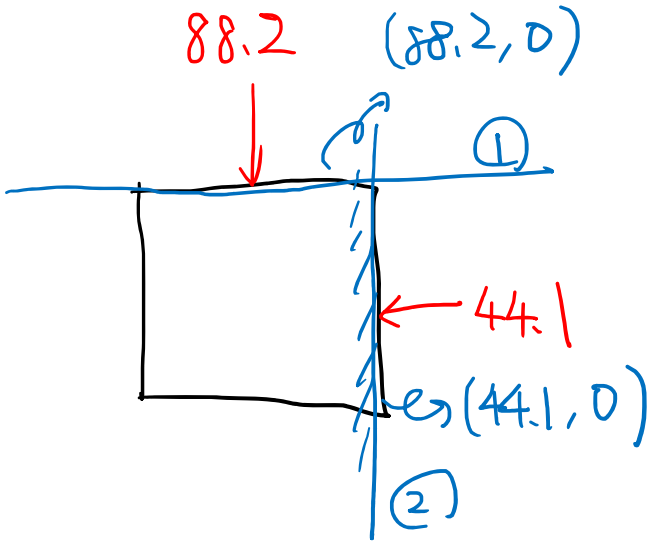
上にのる土の重さ

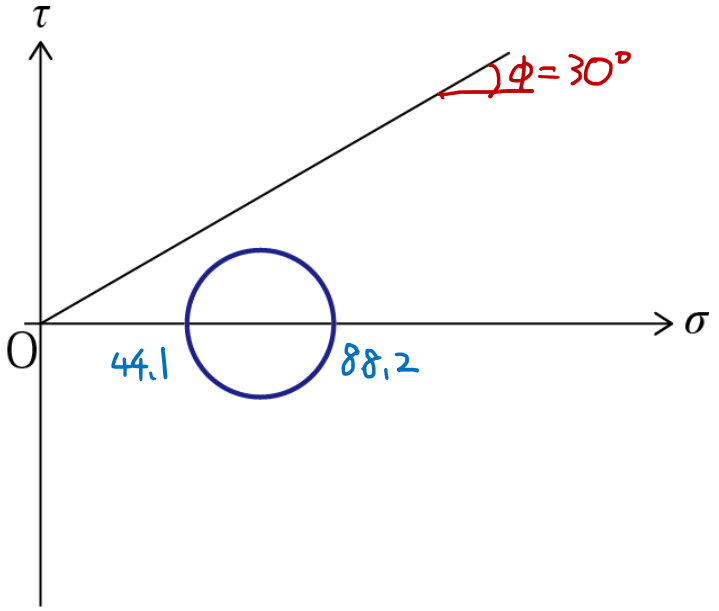
$1.8\times9.8\times5=\rho_t g z$

$=88.2\,kPa$

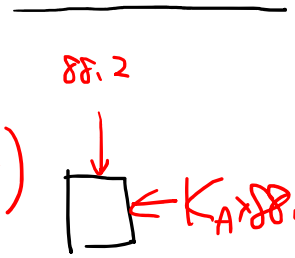


$\rho_t g=1.8\times9.8=17.64\ kN/m^3$





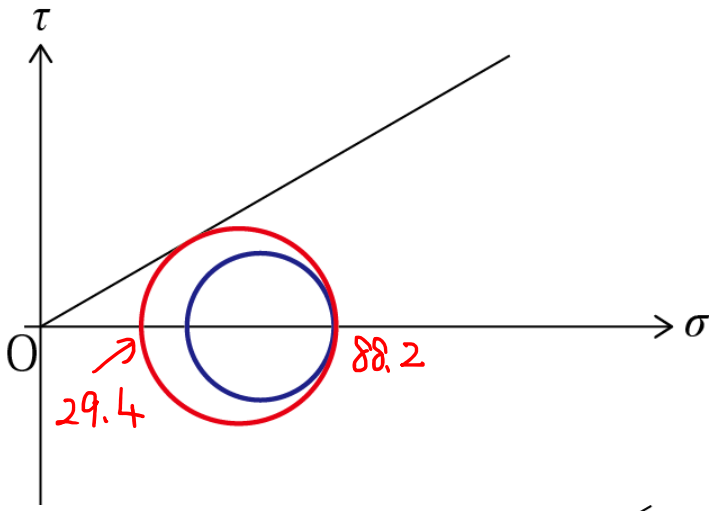
(b)



$K_A = \tan^2\left(45° - \frac{\phi}{2}\right)$

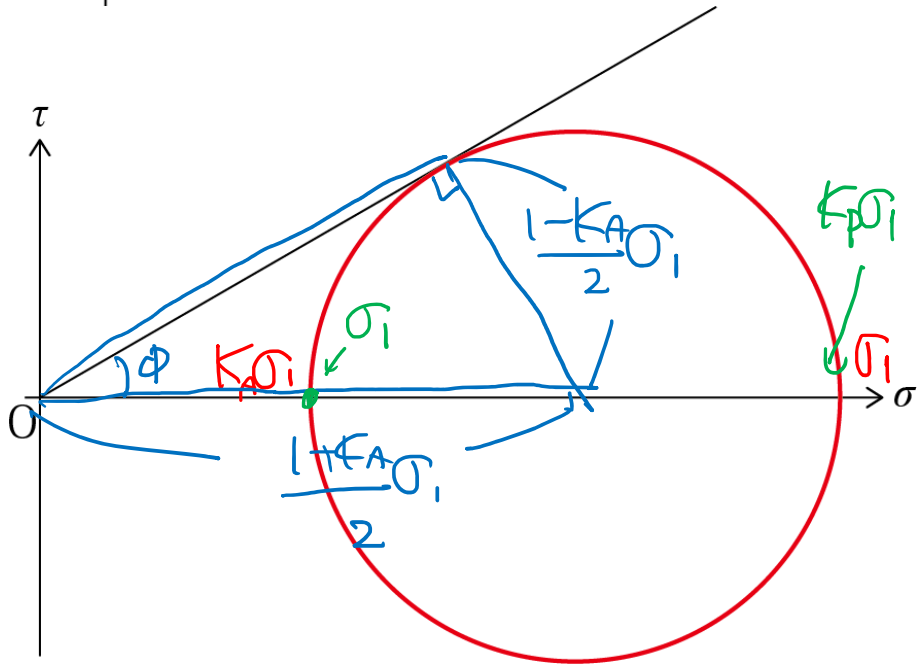
$= \frac{1}{3}$

$88.2 \times \frac{1}{3} = 29.4$



$\frac{1+K_A}{2}\sigma_1 \times \sin\phi = \frac{1-K_A}{2}\sigma_1$

$\therefore K_A = \frac{1-\sin\phi}{1+\sin\phi}$ //

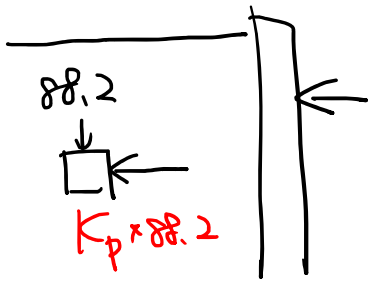


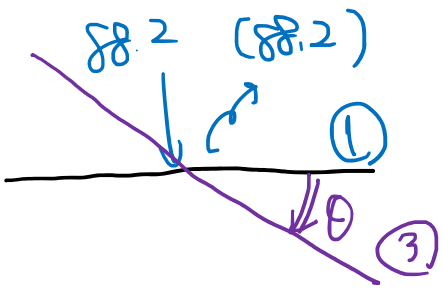
(c)

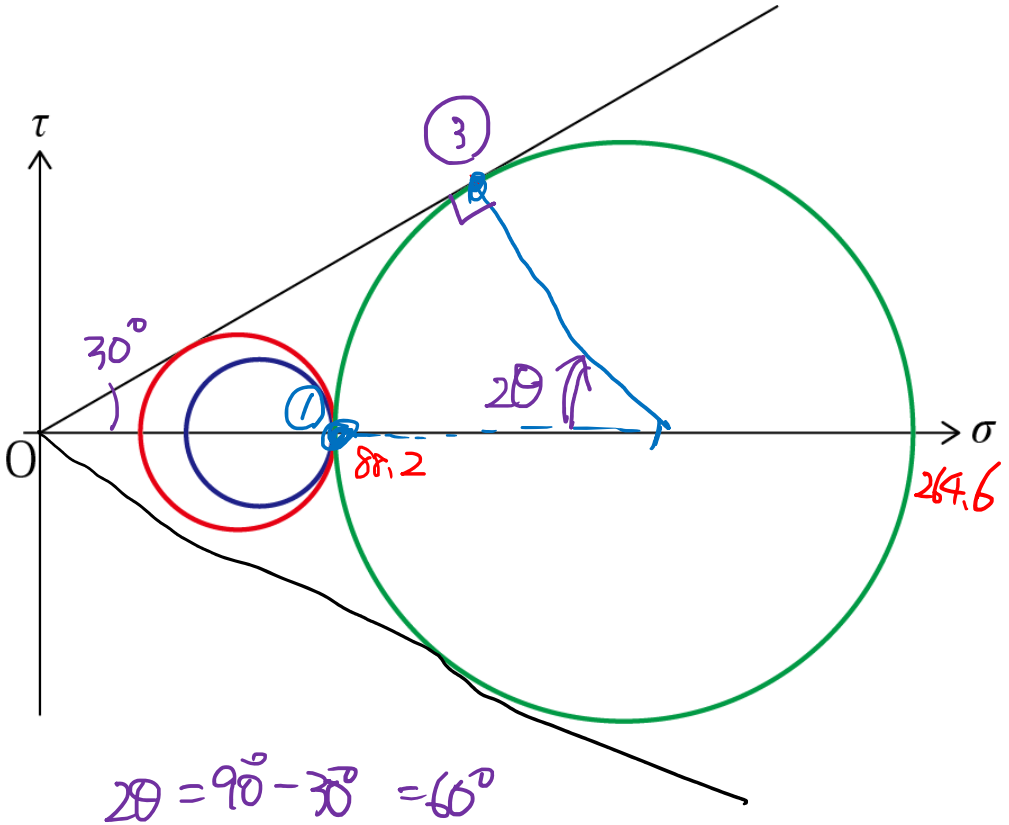
$K_p = \tan^2\left(45° + \frac{\phi}{2}\right)$

$= 3$ //

$K_p = \frac{1+\sin\phi}{1-\sin\phi}$ //







$2\theta = 90° - 30° = 60°$

$\therefore \theta = 30°$ //

(3)(a)

モーメントのつり合い

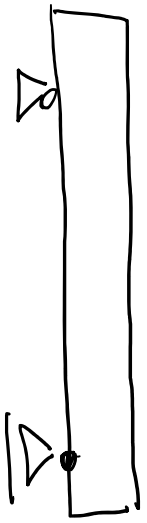
$$6\times N + 2K_2\rho_t g \times \frac{2}{3} = \frac{49}{2}K_1\rho_t g \times \frac{7}{3}$$

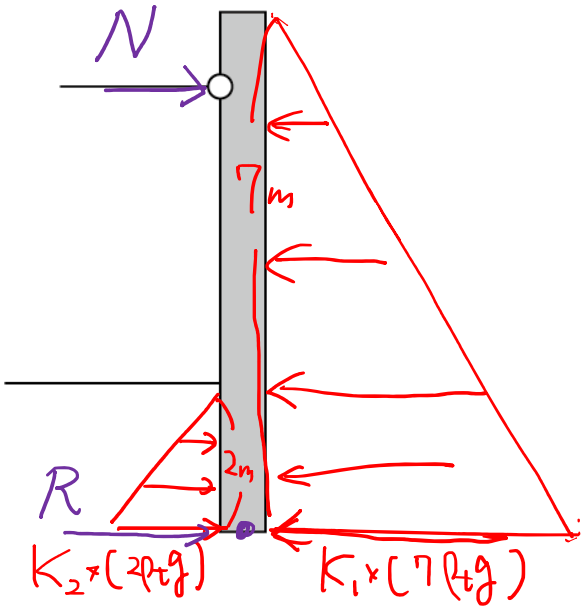
$$N = \left(\frac{343}{36}K_1 - \frac{2}{9}K_2\right)\rho_t g$$

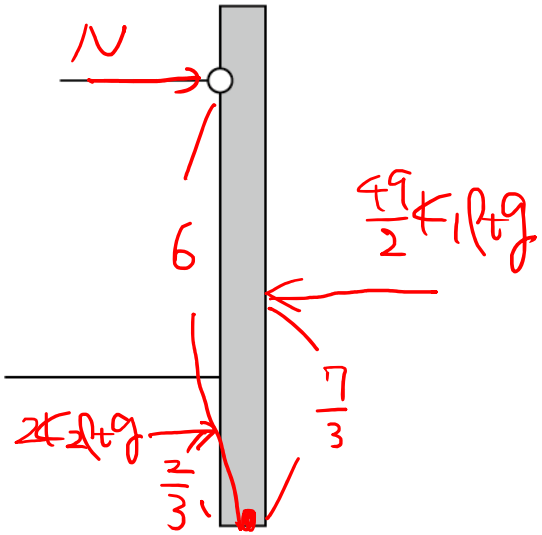
$$= \left(\frac{343}{20}K_1 - \frac{2}{5}K_2\right) g$$

静止：$K_1 = K_2 = K_0 = 0.5 \Rightarrow N = 82.075\ kN$ //

破壊：$K_1 = K_A = \frac{1}{3}$, $K_2 = K_p = 3 \Rightarrow N = 44.263\ kN$ //







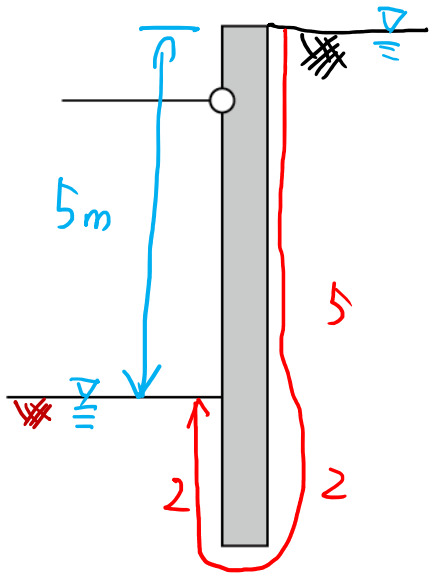
(b)

限界動水勾配

$$i_c = \frac{\gamma'}{\gamma_w} = \frac{(\rho_{sat} - \rho_w)}{\rho_w} = \frac{\rho_s - 1}{1 + e}$$

$$= \frac{2.7 - 1}{1 + 0.8}$$

$$= \frac{17}{18} = 0.944$$



iがこれを超えると×

$$i = \frac{\text{水頭差}}{\text{さより}} = \frac{5}{5+2+2} = \frac{5}{9} = 0.555$$

- ディープウェル
- ウェルポイント
- 薬液注入

(固結：深層混合処理)

- 根入れを深くする.