토목 시공

1 지반조사

$$Q = \frac{RQD}{J_n} \cdot \frac{J_r}{J_a} \cdot \frac{J_w}{SRF}$$

* 나루 호도

$\phi = \sqrt{12N} + 15$ 둥글 불량

$\phi = \sqrt{12N} + 20$ < 둥글 양호 / 뾰족 불량

$\phi = \sqrt{12N} + 25$ 뾰족 양호

$C_u \geq 6$, $1 \leq C_g \leq 3$ ⇒ 양호

	점토	모래
지지력	$q_{u(F)} = q_{u(P)}$	$q_F = q_P \times \frac{B_F}{B_P}$
침하량	$S_F = S_P \times \frac{B_F}{B_P}$	$S_F = S_P \left(\frac{2B_F}{B_F + B_P}\right)^2$

2 연약지반

정삼각형

$d_e = 1.05d$

정사각형

$d_e = 1.13d$

paper drain 직경 d_w

$$d_w = \alpha \frac{2(A+B)}{\pi} \quad (\alpha = 0.75)$$

3 토질공

$$t = \frac{T_v H^2}{C_v}$$ 양면배수시 $\frac{H}{2}$

50% → $T_v = 0.197$

90% → $T_v = 0.848$

$$C_v = \frac{k}{m_v \gamma_w}$$

$$m_v = \frac{a_v}{1+e_0}$$

$$a_v = \frac{e_0 - e_1}{P_2 - P_1}$$

압축 지수 $C_c = \dfrac{e_1 - e_2}{\log P_2 - \log P_1}$

불교란 $C_c = 0.009(W_L - 10)$

교란 $C_c = 0.007(W_L - 10)$

$$S_c = \frac{C_c H}{1+e} \log \frac{P + \Delta P}{P}$$

4 얕은 기초

극한 지지력 q_u

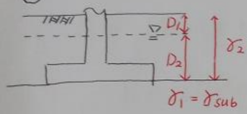
$$q_u = \alpha c N_c + \beta \gamma_1 B N_r + \gamma_2 D_f N_q$$

	연속	정방	원형
α	1.0	1.3	1.3
β	0.5	0.4	0.3

허용지지력 $q_a = \dfrac{Q_a}{A} = \dfrac{q_u}{F_s}$

국부전단 파괴의 점착력 $= \frac{2}{3}C$

①

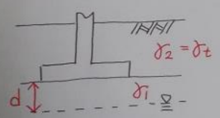


$0 \le D_1 \le D_f$

2항 $\gamma_1 = \gamma_{sub}$

3항 $\gamma_2 D_f = \gamma_t D_1 + \gamma_{sub} D_2$

② $0 < d < B$



2항 $\gamma_1 = \gamma_{sub} + \dfrac{d}{B}(\gamma_t - \gamma_{sub})$

3항 $\gamma_2 = \gamma_t$

5 깊은 기초

말뚝의 극한지지력 Q_u [단위 : t 톤]

$$Q_u = Q_p + Q_f$$

$$= 40 \cdot N \cdot A_p + \frac{1}{5} \overline{N} \cdot A_s$$

$N = N_3$ $\quad \overline{N} = \dfrac{N_1 h_1 + N_2 h_2 + N_3 h_3}{h_1 + h_2 + h_3}$

$A_p = \dfrac{\pi D^2}{4}$ $\quad A_s = \pi D l$

허용지지력 $Q_a = \dfrac{Q_u}{F_s}$

부마찰력 $R_{nf} = f_s A_s = \dfrac{q_u}{2} \cdot A_s$

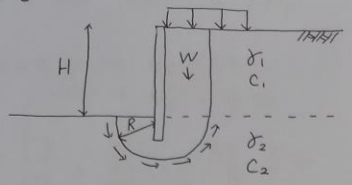
3-327 9번

$$P_A = \frac{1}{2}\gamma_1 H_1^2 K_{a1} + \gamma_1 H_1 H_2 K_{a2} + \frac{1}{2}\gamma_{sub} H_2^2 K_{a2}$$

$$+ \frac{1}{2}\gamma_w H_2^2 - 2C H_2 \sqrt{K_{a2}}$$

6 흙막이공, 옹벽

히빙



$$F_s = \frac{M_r}{M_d} = \frac{c_1 HR + c_2 \pi R^2}{\frac{R^2}{2}(q + \gamma_1 H)} \geq 1.2$$

일때 안정

최대 굴착 깊이

$$\sigma = \gamma_{sat}(H-h)$$

$$u = \gamma_w \Delta h$$

$$\bar{\sigma} = \gamma_{sat}(H-h) - \gamma_w \Delta h = 0 \text{ 일때}$$

$$h = \frac{H\gamma_{sat} - \gamma_w \Delta h}{\gamma_{sat}}$$

보일링

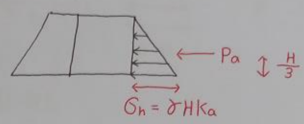
$$F_s = \frac{i_{cr}}{i} = \frac{\frac{\gamma_{sub}}{\gamma_w}}{\frac{H}{H+2d}} \leq 1$$

일때 보일링

주동토압

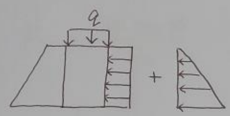
$$K_a = \tan^2\left(45 - \frac{\phi}{2}\right)$$

① 일반식



$$P_a = \frac{1}{2}\gamma H^2 K_a$$

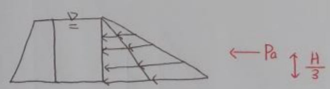
② 등분포 하중 q



$$\sigma_h = (\gamma H + q) K_a$$

$$P_a = qHK_a + \frac{1}{2}\gamma H^2 K_a$$

③ 지하수위



$$\sigma_h = \gamma_{sub} H K_a \qquad u = \gamma_w H$$

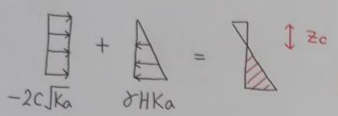
$$P_a = \frac{1}{2}\gamma_{sub} H^2 K_a + \frac{1}{2}\gamma_w H^2$$

한계고

$P_a = 0$ 일때 $z_c = \frac{2c}{\gamma}\sqrt{K_p}$

인장균열 고려 → $H_c = 2z_c$

고려X → $H_c' = \frac{4}{3}z_c$



$$\sigma_h = \gamma H K_a - 2c\sqrt{K_a}$$

① 인장균열 발생 전

$$P_a = \frac{1}{2}\gamma H^2 K_a - 2cH\sqrt{K_a}$$

② 인장균열 발생 후

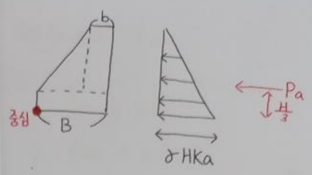
$$P_a = \frac{1}{2}(\gamma H K_a - 2c\sqrt{K_a})(H - z_c)$$

③ 인장균열 위 토압 무시 & 상재하중 고려

$$P_a = \frac{1}{2}\gamma(H - z_c)^2 K_a + \underbrace{\gamma z_c}_{q}(H - z_c)K_a$$

↳ 등분포 q의 경우로 생각

옹벽의 안정



① 전도

$$F_s = \frac{W \cdot b + P_v \cdot B}{P_a \cdot y} \geq 2.0$$

② 활동

$$F_s = \frac{W \tan\phi}{P_a} \geq 1.5$$

일때 안정

7 건설기계

① 불도저

$$Q_D = \frac{60 \times q \times f \times E}{C_m}, \quad f = \frac{1}{L}$$

② 리핑

$$Q_R = \frac{60 \times A_n \times l \times f \times E}{C_m}, \quad f = 1$$

리핑 만!

③ 덤프트럭

$$Q = \frac{60 \times q_t \times f \times E}{C_{mt}}$$

$$q_t = \frac{T}{\gamma_t} L, \quad C_{mt} = \frac{n C_{ms}}{60 E_s} + t_2 + t_3 + \cdots$$

$$n = \frac{q_t}{q \cdot k}$$

④ 래머

$$Q = \frac{ANHfE}{P}$$

P → 되풀이 찍기 다짐횟수

$$\text{조합토공} = \frac{Q_1 \times Q_2}{Q_1 + Q_2}$$

8 콘크리트공, 배합설계

배합강도 f_{cr}

①

$f_{ck} \le 35$

- $f_{ck} + 1.34S$
- $(f_{ck} - 3.5) + 2.33S$

中 큰값

$f_{ck} > 35$

- $f_{ck} + 1.34S$
- $0.9 f_{ck} + 2.33S$

中 큰값

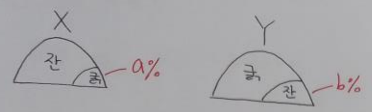
② 표준편차를 모르거나 시험횟수 ≤ 14

f_{ck}	f_{cr}
$x < 21$	$f_{ck} + 7$
$21 \le x \le 35$	$f_{ck} + 8.5$
$35 < x$	$1.1 f_{ck} + 5.0$

③ 시험횟수 ≤ 29

직선보간법으로 S 구해 ①식으로!

단위 골재량



$$X + Y = S + G$$

잔골재량 $X = \dfrac{100S - b(S+G)}{100-(a+b)}$

굵은 골재량 $Y = \dfrac{100G - a(S+G)}{100-(a+b)}$

단위 수량 $= W - W_S - W_G$

↳ 콘크리트

$V = \dfrac{W}{1000\,G}$

$G_c = \dfrac{\rho_c}{\rho_w}$

단위골재$(S+G)$의 절대 체적

$$V_a = 1 - \left(\frac{단위수량}{1000} + \frac{단위시멘트}{C비중 \times 1000} + \frac{공기량}{100} \right)$$

단위잔골재량 $= V_a \times$ 잔골재율 $\times$ 잔골재 $\rho \times 1000$

현장 잔골재량 $= X +$ 잔골재의 표면수량

공정관리 지수 C_p

양측: $C_p = \dfrac{SU-SL}{6\sigma}$ 편측: $C_p = \dfrac{SU-\bar{x}}{3\sigma}$

설계 CBR

설계 $CBR =$ 평균 $CBR - \dfrac{CBR_{max} - CBR_{min}}{d_2}$

소수점 이하 절삭 !

9 공정관리

기대시간치 $t_e = \dfrac{낙 + 4(정상) + 비}{6}$

분산 $\sigma^2 = \left(\dfrac{비 - 낙}{6}\right)^2$

$TF = LFT - (EST + D)$

$FF = EST_j - (EST_i + D)$

$DF = TF - FF$

10 품질관리

$\sigma = \sqrt{\dfrac{S}{n-1}}$

변동계수 $C_v = \dfrac{\sigma}{\bar{x}} \times 100\ (\%)$

$\bar{x}$ 관리도

$UCL = \bar{x} + A_2 \cdot \bar{R}$ $LCL = \bar{x} - A_2 \cdot \bar{R}$

R 관리도

$UCL = D_4 \cdot \bar{R}$ $LCL = D_3 \cdot \bar{R}$

여유치

양측: $\dfrac{|SU - SL|}{\delta} \geq 6$ 편측: $\dfrac{|SU - \bar{x}|}{\delta} \geq 3$

여유치 $= (X - 6) \times \delta$

$= (X - 3) \times \delta$

① 사각 각주법

$$V = \frac{ab}{4}(\Sigma h_1 + 2\Sigma h_2 + \cdots)$$

② 삼각 각주법

$$V = \frac{ab}{6}(\Sigma h_1 + 2\Sigma h_2 + \cdots)$$

* 성토 = 절토 일때 ? $H = \frac{V}{A \times n}$

① Simpson 제 1법칙

$$A_1 = \frac{d}{3}(y_0 + 4y_1 + y_2)$$

$$A_2 = \frac{d}{3}(y_2 + 4y_3 + y_4)$$

$$A_3 = \frac{d}{3}(y_4 + 4y_5 + y_6)$$

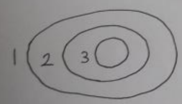
② Simpson 제 2법칙

$$A_1 = \frac{3d}{8}(y_0 + 3y_1 + 3y_2 + y_3)$$

$$A_2 = \frac{3d}{8}(y_3 + 3y_4 + 3y_5 + y_6)$$

굴착토량

$$V = \frac{h}{3}(A_1 + 4A_2 + A_3)$$



복합활동 파괴면 안전율

$$F_s = \frac{C \cdot L + W\tan\phi + P_P}{P_A}$$

크리프 비

$$가중크리프비 = \frac{2D + \frac{L}{3}}{\Delta H}$$

$$F_s = \frac{크리프비}{6.0} > 1$$ 이면 안정