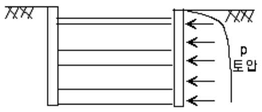
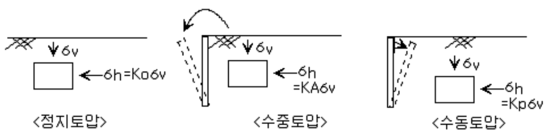
11장 토 압

~흙막이 구조물에 작용하는 하중을 계산하기 위한 수평방향의 하중이다.
ex) 옹벽, (가설)흙막이벽, 지중지하벽

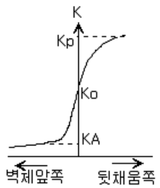


11.2 토압의 종류
①정지 토압=Ko
②주동 토압=Ka
③수동 토압=Kp



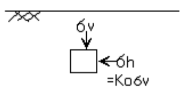
˙토압계수

$$K=\frac{\sigma_h}{\sigma_v}$$

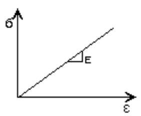


<벽체범위>

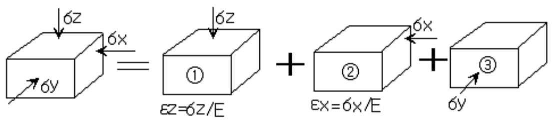
11.3 정지 토압계수



-지반을 탄성체로 가정→Hook's law를 따른다.



-중첩의 원리 적용가능



※포이송비

$$Hook's\ law: \sigma=E\epsilon_a \text{ 여기서}, \epsilon_a=\frac{dl}{l}$$

$$\mu=-\frac{\epsilon_l(\text{횡변형율})}{\epsilon_a(\text{축변형율})}(\text{정의})\rightarrow\epsilon_l=-\mu\epsilon_a=-\mu\frac{\sigma}{E}$$

$\varepsilon z=\frac{\sigma z}{E}\sigma$ $\qquad$ $\varepsilon x=\frac{\sigma x}{E}$ $\qquad$ $\varepsilon y=\frac{\sigma y}{E}$

$\varepsilon x=-\mu\varepsilon z=(-\mu\cdot\frac{\sigma z}{E})$ $\qquad$ $\varepsilon y=-\mu\cdot\frac{\sigma x}{E}$ $\qquad$ $\varepsilon x=-\mu\cdot\frac{\sigma y}{E}$

$\varepsilon y=-\mu\varepsilon z=-\mu\cdot\frac{\sigma z}{E}$ $\qquad$ $\varepsilon t=-\mu\cdot\frac{\sigma x}{E}$ $\qquad$ $\varepsilon z=-\mu\cdot\frac{\sigma y}{E}$

$$\rightarrow \varepsilon x=\frac{1}{E}[\sigma x-\mu(\sigma y+\sigma z)]$$

$$\rightarrow \varepsilon y=\frac{1}{E}[\sigma y-\mu(\sigma x+\sigma z)]$$

$$\rightarrow \varepsilon z=\frac{1}{E}[\sigma z-\mu(\sigma x+\sigma y)]$$

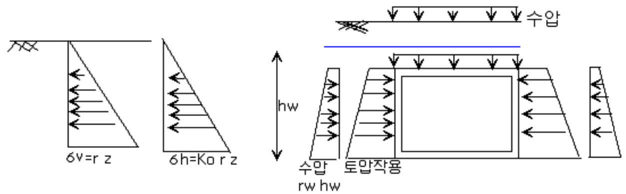
˙정지토압조건
→εx=εy=0인 조건에 해당
윗식에 대입
σx=μ(σy+σz)
σy=μ(σx+σz) 위 식에대입 $\rightarrow\sigma x=\frac{(1+\mu)\mu}{1-\mu^2}\cdot\sigma z$

$\therefore\sigma x=\frac{\mu}{1-\mu}\cdot\sigma z$ $\qquad$ $\therefore Ko=\frac{\mu}{1-\mu}$

-Jacky 공식 (경험공식)

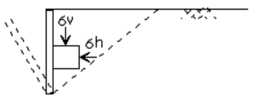
for 사질토 → Ko=1-sinφ′

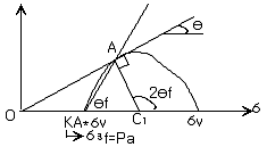
for 점성토 → Ko=(1-sinφ′)$\sqrt{O.C.R}$ $\quad$ (O.C.R=$\frac{\sigma_c'}{\sigma_{v0}'}$)



11.4 Ran kine의 토압이론
→벽면 마찰각을 무시한 토압이론

사질토(c=0) 인 경우
i)주동 토압



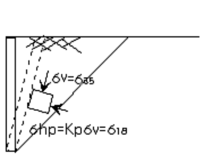


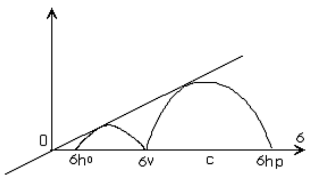
$$\sin\phi = \frac{CA}{OC} = \frac{\frac{(\sigma_v - \sigma_{ha})}{2}}{\frac{(\sigma_v + \sigma_{ha})}{2}} \quad \rightarrow \quad \frac{\sigma_{ha}}{\sigma_v} = \frac{1-\sin\phi}{1+\sin\phi} = \tan^2(45° - \frac{\phi}{2}) = K_a$$

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

$$2\Theta_f = 90° + \phi \quad \rightarrow \quad \theta_f = 45 + \frac{\phi}{2}$$

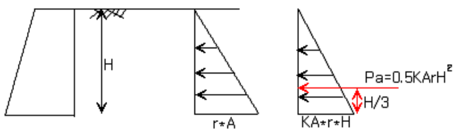
ii)수동 토압

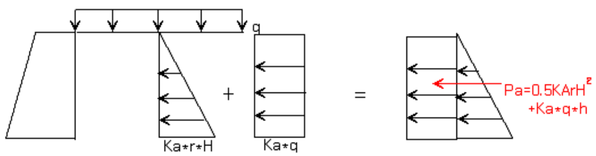




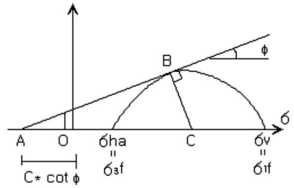
$$Kp = \frac{\sigma_{hp}}{\sigma_v} = \frac{1+\sin\phi}{1-\sin\phi} = \tan^2(45° + \frac{\phi}{2}) = \frac{1}{K_a}$$

-주동 토압의 분포와 합력의 위치





2 점성토의 주동 및 수동토압(c≠0인 경우)



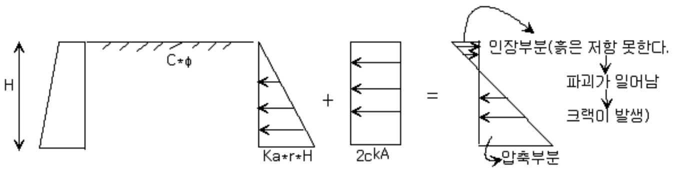
$$\sin\phi = \frac{CB}{AO + OC}$$

$$= \frac{(\sigma_v - \sigma_{ha})/2}{c \cdot \cot\phi + (\sigma_v + \sigma_{ha})/2}$$

$$\sigma_{ha} = (\frac{1-\sin\phi}{1+\sin\phi})\sigma_v - 2 \cdot c\frac{\cos\phi}{1+\sin\phi}$$

$$= Ka \cdot \gamma \cdot z - 2c\sqrt{K_a}$$

-토압분포



-인장깊이 선정

6ha=0인 시점

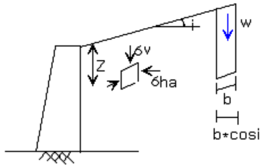
$$6ha = Ka \cdot \gamma \cdot Z_0 - 2C\sqrt{K_a} = 0$$

$$\therefore Zc = \frac{2C}{\gamma} \cdot \frac{1}{\sqrt{Kp}} = \frac{2C}{\gamma} \cdot \sqrt{Kp}$$

-수동토압계수

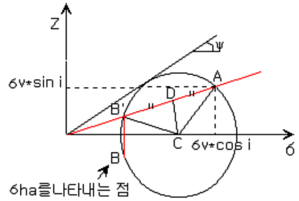
$$6hp = Kp \cdot \gamma \cdot Z + 2C\sqrt{K_p} \qquad (Kp = \frac{1+\sin\phi}{1-\sin\phi})$$

-지표면이 경사진 경우에 대한 토압



бv=W/b=Z*b′*cosi*ɤ/b′

=ɤZ*cosi



$$Ka=\frac{бha}{бv}$$

OA^2=бv² • cos²i+бv² • sin²i=бv²(cos²i+sin²i)

OA=бv

OB=бha

$$Ka=\frac{OB}{OA}=\frac{OB-AD}{OD+AD}$$

OD=OC • cos I

AD= $\sqrt{AC^2-CD^2}$ (AC=OC • sinψ, CD=OC • sin I)

$$\therefore Ka=\frac{OC\cdot \cos i-\sqrt{OC^2\cdot\sin^2\phi+OC^2\cdot\sin^2 i}}{OC\cdot\cos i+\sqrt{OC^2\cdot\sin^2\phi-OC^2\cdot\sin^2 i}}=\frac{\cos i-\sqrt{\sin^2\phi-\sin^2 i}}{\cos i+\sqrt{\sin^2\phi-\sin^2 i}}$$

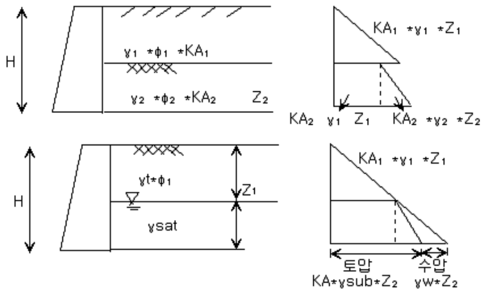
$$=\frac{\cos i-\sqrt{\cos^2 i-\cos^2\phi}}{\cos i+\sqrt{\cos^2 i-\cos^2\phi}}=\frac{1}{Kp}$$

бha=KA • бv=KA • ɤ • z • cos i

$$\therefore Pa=\frac{1}{2}KA\cdot ɤ\cdot H^2\cdot\cos I$$

11.4 뒤채움이 이층이거나 지하수위가 있는 경우

-주동토압

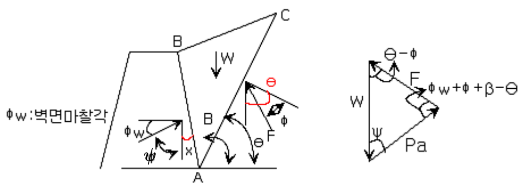


ɤsub=ɤsat-ɤw

$$=\frac{Gs-1}{1+e}ɤw$$

11.5 Coulomb의 토압이론 :~벽면에 마찰각을 고려한 토압이론

①C=0인 경우



x=90-(180-β)=β-90°

∴ψ=90-фw-(β-90)

=180-(β+фw)

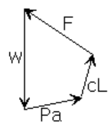
$$\frac{Pa}{\sin(\Theta-\phi)}=\frac{W}{\sin(\phi+\phi w+\beta-\Theta)}$$

$$\therefore PA=W\cdot\frac{\sin(\Theta-\phi)}{\sin(\phi+\phi w+\beta-\Theta)}$$

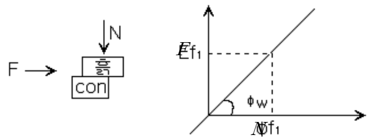
$\frac{dPA}{d\Theta}=0$일때의 Θ값 추정

$$PA=\frac{ɤH^2}{2}\left[\frac{\sin(\beta-\phi)\csc\beta}{\sqrt{\sin(\beta+\phi w)}+\sqrt{\frac{\sin(\phi+\phi w)\cdot\sin(\phi-i)}{\sin(\beta-i)}}}\right]^2$$

②C≠0인 경우



-벽면 마찰각



∴일반적으로는 фw≒$\frac{2}{3}$ф로 가정

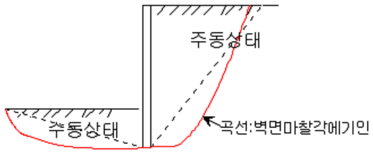
11.6실제 활동면의 현상

-수동토압의 경우 фw>$\frac{\phi}{3}$이면

실제 수동토압과 현저한 차이발생

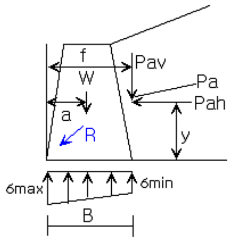
→직선파괴가정=수동토압의 크기를 실제

보다 크게 평가



11.7 옹벽의 안정

1.안정조건



①수평활동에 대한 안정

$$Fs = \frac{수평저항력}{수평활동력} = \frac{Ff}{Rh} = Rv \cdot \frac{\tan\phi w}{Rh} > 1.5$$

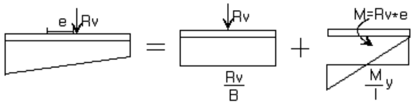
②전도에 대한 안정

$$Fs = \frac{Mr(저항모멘트)}{Mo(활동모멘트)} = \frac{W \cdot a + Pav \cdot f}{Pah \cdot y} > 1.5$$

③허용지지력 검토

$$Fs = \frac{qu}{\sigma max} > 3.0$$

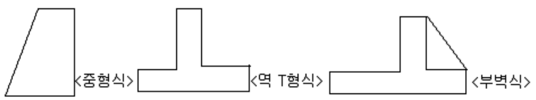
*편심

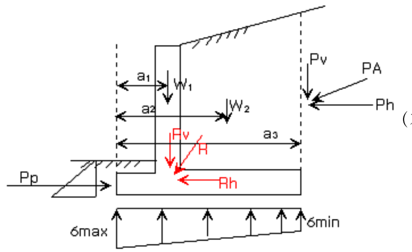


$$\frac{M}{I} \cdot y = \frac{Rv \cdot e}{\frac{1 \cdot b^3}{12}} \cdot (\frac{b}{2}) = \frac{6Rv \cdot e}{b^2}$$

$$\therefore \sigma = \frac{Rv}{B}(1 \pm \frac{6e}{B})$$

-옹벽의 종류





(가상벽면에 토압작용)

-Rankine 토압이론을 적용

①옹벽의 수평활동안정

$$Fs = \frac{Rv \cdot \tan\phi w}{Rh(=Ph)} > 1.5$$

②전도활동에 대한 안정

$$Fs = \frac{저항모멘트}{활동모멘트} = \frac{W_1 a_1 + W_2 a_2}{P_h y - P_v a_3} > 1.5$$

③허용지지력에 대한 안정

$$Fs = \frac{qu}{\sigma max} > 3 \qquad \left(qa(허용지지력) = \frac{qu}{3}(극한지지력)\right)$$

$$\therefore \sigma = \frac{Rv}{B}(1 \pm \frac{6e}{B})$$

-6min=0인 조건에서

$$\rightarrow 1 - \frac{6 \cdot e}{B} = 0인\ 지점 \quad \rightarrow \quad e = \frac{B}{6}$$

6min값이 -값이 되면 인장력이 발생

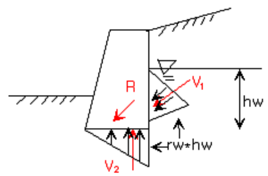
지반 반력에서 인장력이 발생하지 않도록 하기위한 최대편심 거리는 B/6이다.

(편심이 B/3안에 존재해야 한다.)

2.지하수위가 옹벽의 안정에 끼치는 영향

-활동에 대한 안전율

$$Fs = \frac{(Rv - V_2)\tan\phi w}{Rh + V_{1_h}} > 1.5$$



3.옹벽에 작용하는 간이 토압분포

-by Terzoghi , Peck (단, 옹벽높이가 6m이내일 때)

$$Ph = \frac{1}{2} Kn \cdot H^2$$

$$Pv = \frac{1}{2} Kv \cdot H^2$$ (i=0이면 → Pv=0) →Kv=0

<도표이용>