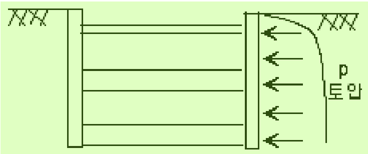
11장 토 압

˜흙막이 구조물에 작용하는 하중을 계산하기 위한 수평방향의 하중이다.

ex) 옹벽, (가설)흙막이벽, 지중지하벽

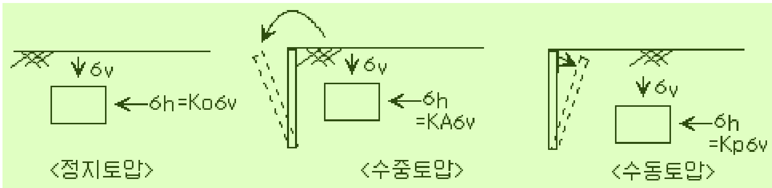


11.2 토압의 종류

①정지 토압=Ko

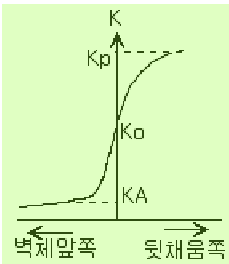
②주동 토압=Ka

③수동 토압=Kp



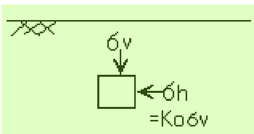
˙토압계수

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

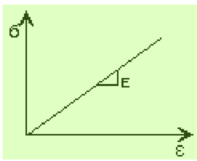


〈벽체범위〉

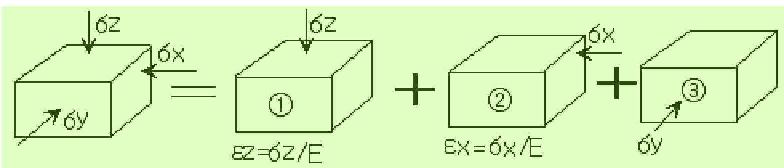
11.3 정지 토압계수



-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

$\sigma x = \mu(\sigma y + \sigma z)$

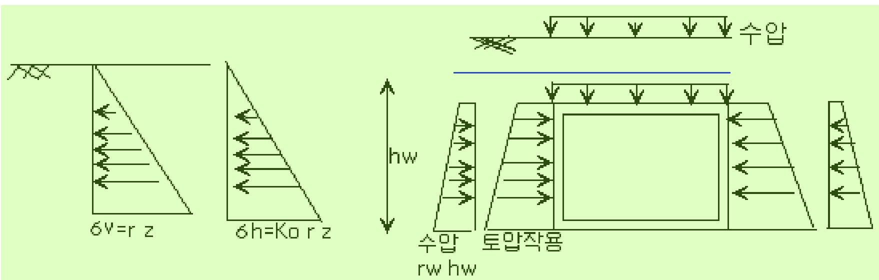
$\sigma y = \mu(\sigma x + \sigma z)$ 위 식에대입 $\rightarrow \sigma x = \frac{(1+\mu)\mu}{1-\mu^2} \cdot \sigma z$

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

-Jacky 공식 (경험공식)

for 사질토 → $Ko = 1 - \sin\phi'$

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

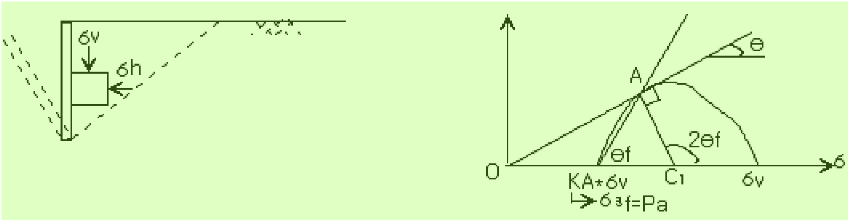


11.4 Ran kine의 토압이론

→벽면 마찰각을 무시한 토압이론

사질토(c=0) 인 경우

i)주동 토압



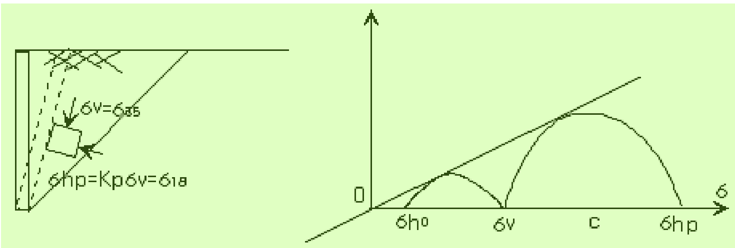
1

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

$$\therefore \ Ka = \frac{1-\sin\phi}{1+\sin\phi}$$ 3

$$2\Theta_f = 90° + \phi \quad \rightarrow \quad \theta_f = 45 + \frac{\phi}{2}$$ 4

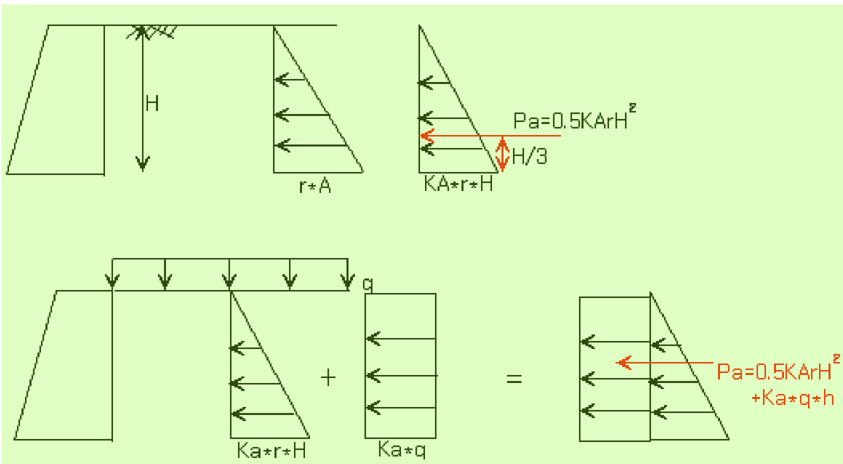
ii)수동 토압 5



6

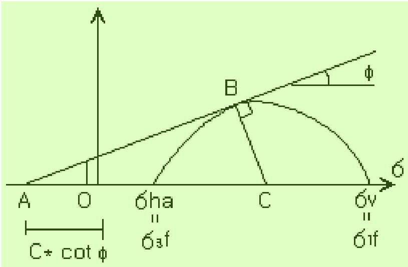
$$Kp = \frac{\sigma_{hp}}{\sigma_v} = \frac{1+\sin\phi}{1-\sin\phi} = \tan^2(45° + \frac{\phi}{2}) = \frac{1}{K_a}$$ 7

-주동 토압의 분포와 합력의 위치 8



9

2 점성토의 주동 및 수동토압(c≠0인 경우)

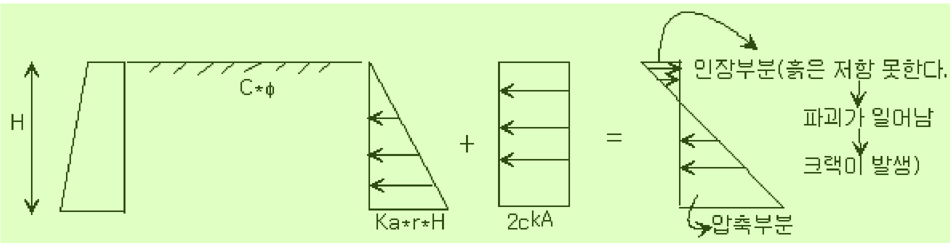


$$\sin\phi = \frac{CB}{AO+OC} = \frac{(\sigma_v - \sigma_{ha})/2}{c \cdot \cot\phi + (\sigma_v + \sigma_{ha})/2}$$

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

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

-토압분포



-인장깊이 선정

σha=0인 시점

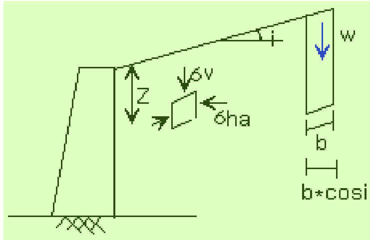
$$\sigma_{ha} = K_a \cdot \gamma \cdot Z_0 - 2C\sqrt{K_a} = 0$$

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

-수동토압계수

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

-지표면이 경사진 경우에 대한 토압 1

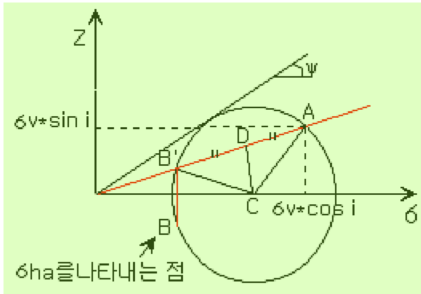


6

бv=W/b=Z*b′*cosi*ɣ/b′ 2

=ɣZ*cosi

$$Ka = \frac{бha}{бv}$$ 3



7

OA^2=бv² • cos²i+бv² • sin²i=бv²(cos²i+sin²i) 4

OA=бv

OB=бha

$$Ka = \frac{OB}{OA} = \frac{OB - AD}{OD + AD}$$ 5

OD=OC • cos I 8

AD= $\sqrt{AC^2 - CD^2}$ (AC=OC • sinψ, CD=OC • sin I) 9

$$\therefore Ka = \frac{OC \cdot \cos i - \sqrt{OC^2 \cdot \sin^2\phi + OC^2 \cdot \sin^2 i}}{OC \cdot \cos i + \sqrt{OC^2 \cdot \sin^2\phi - OC^2 \cdot \sin^2 i}} = \frac{\cos i - \sqrt{\sin^2\phi - \sin^2 i}}{\cos i + \sqrt{\sin^2\phi - \sin^2 i}}$$ 10

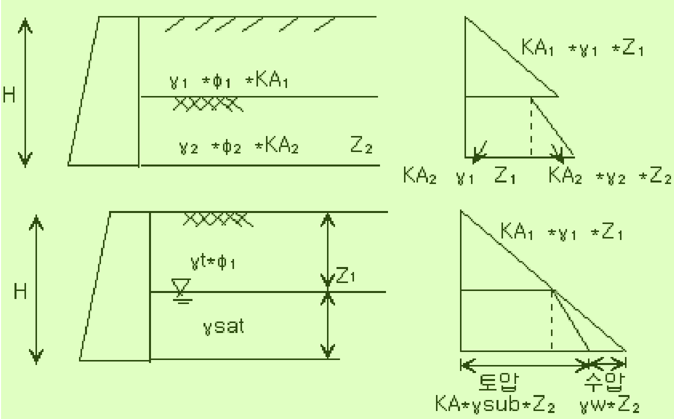
$$= \frac{\cos i - \sqrt{\cos^2 i - \cos^2\phi}}{\cos i + \sqrt{\cos^2 i - \cos^2\phi}} = \frac{1}{Kp}$$

бha=KA • бv=KA • ɣ • z • cos i

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

11.4 뒤채움이 이층이거나 지하수위가 있는 경우 11

-주동토압 12

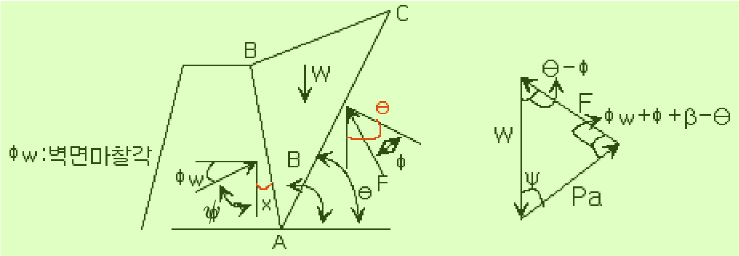


ɣsub=ɣsat-ɣw 13

$$= \frac{Gs - 1}{1 + e} ɣ_W$$

11.5 Coulomb의 토압이론 :~벽면에 마찰각을 고려한 토압이론

①c=0인 경우



$x=90-(180-\beta)=\beta-90°$

$\therefore \psi=90-\phi w-(\beta-90)$

$=180-(\beta+\phi w)$

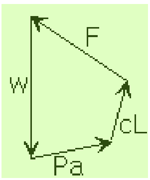
$$\frac{Pa}{\sin(\theta-\phi)}=\frac{W}{\sin(\phi+\phi w+\beta-\theta)}$$

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

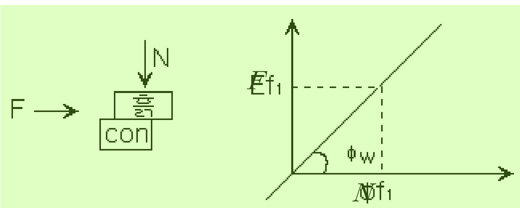
$\frac{dPA}{d\theta}=0$일때의 θ값 추정

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

②C≠0인 경우



-벽면 마찰각(ϕw)



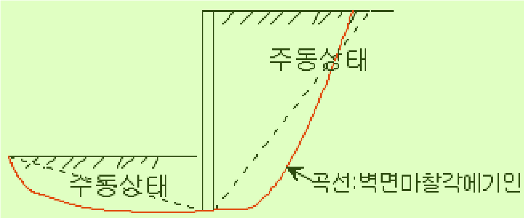
$\therefore$일반적으로는 $\phi w \fallingdotseq \frac{2}{3}\phi$로 가정

11.6실제 활동면의 현상

-수동토압의 경우 $\phi w > \frac{\phi}{3}$ 이면

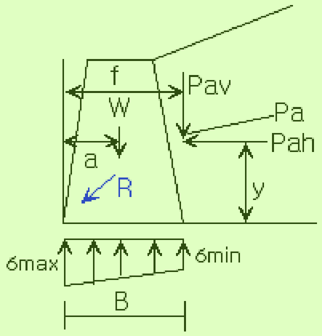
실제 수동토압과 현저한 차이발생

→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

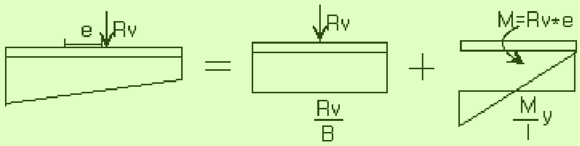
$$Fs=\frac{Mr(저항모멘트)}{Mo(활동모멘트)}=\frac{W\cdot a+Pav\cdot f}{Pah\cdot y}>1.5$$

③허용지지력 검토

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

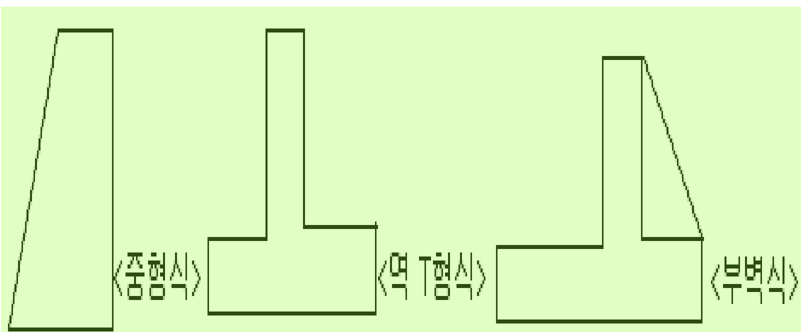
*편심

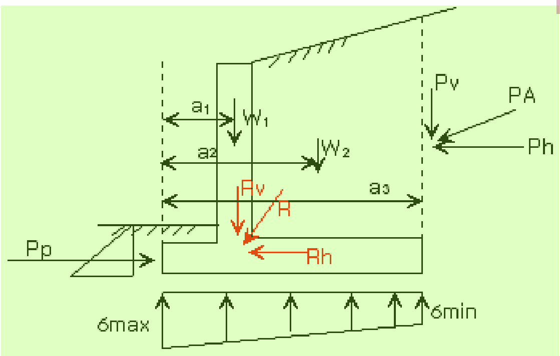
$$\frac{M}{I}\cdot y=\frac{Rv\cdot e}{\frac{1\cdot B^3}{12}}\cdot\left(\frac{B}{2}\right)=\frac{6Rv\cdot e}{B^2}$$



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

-옹벽의 종류





(가상벽면에 토압작용)

-Rankine 토압이론을 적용

①옹벽의 수평활동안정

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

②전도활동에 대한 안정

$$Fs=\frac{\text{저항모멘트}}{\text{활동모멘트}}=\frac{W_1a_1+W_2a_2}{P_hy-P_va_3}>1.5$$

③허용지지력에 대한 안정

$$Fs=\frac{qu}{\sigma\max}>3$$

$$\left(qa(\text{허용지지력})=\frac{qu}{3}(\text{극한지지력})\right)$$

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

-6min=0인 조건에서

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

6min값이 -값이 되면 인장력 발생

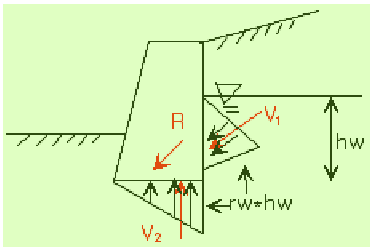
지반 반력에서 인장력이 발생하지 않도록 하기위한 최대편심 거리는 B/6이다.

(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)

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

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

<도표이용>