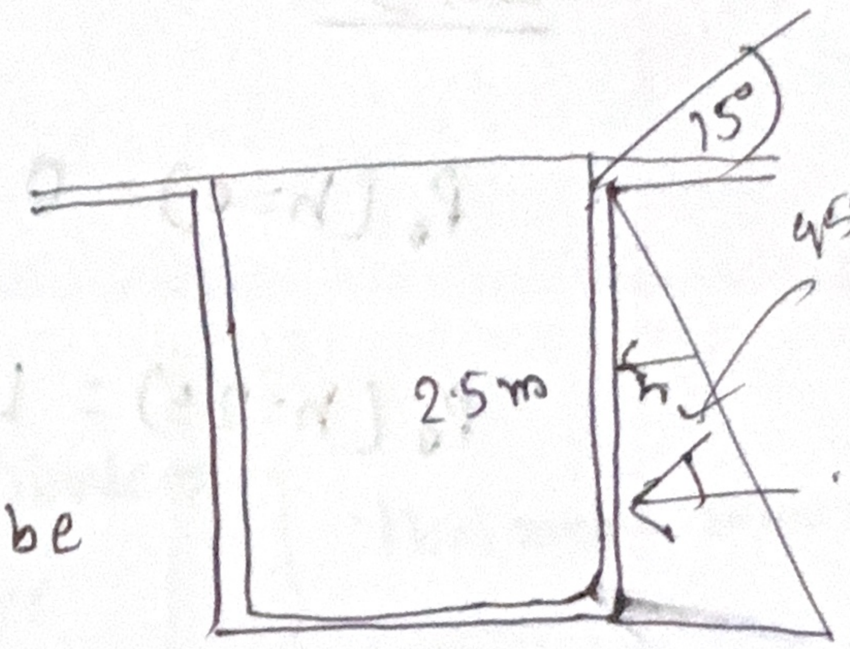
P22/

Step 1



For basement the lateral earth pressure induced will be earth pressured at rest

coeff. = K_0

$K_0 = (1 - \sin\phi)\ OCR^{\sin\phi}$

$= (1 - \sin 35^\circ)\ 2^{\sin 35^\circ}$

$= 0.635$

$c = 0$

$\phi = 35^\circ$

$\gamma = 18\ kN/m^3$

$OCR = 2$

Step 2

$P_o(h) = k_o \gamma h$

$= 0.635 \times 18 \times h$

$= 11.43h$

Step 3

$P_0 (h=0) = 0$

$P_0 (h=2.5) = 11.43 \times 2.5 = 28.58$ kPa

Step 4

$P_0 = \frac{1}{2}\ 28.52 \times 2.5 = 35.65$ kN/m

$\bar{y} = \frac{2.5}{3} = 0.83$ m

∴ connection factor for inclination

$(1 + 0.5 \tan\beta)^2 = (1 + 0.5 \tan 15^\circ)^3$

$= 1.29$

Point $\lambda_d = 35.65 \times 1.29$

$= 45.84$ kN/m

$\frac{1}{2} \times 0.635 \times 18 \times 2.5^2$

$= 35.7$ kN/m

On xm, if asked for pressure dist, then draw else can use direct formula

Earth Pressure Theories

Active earth pressure

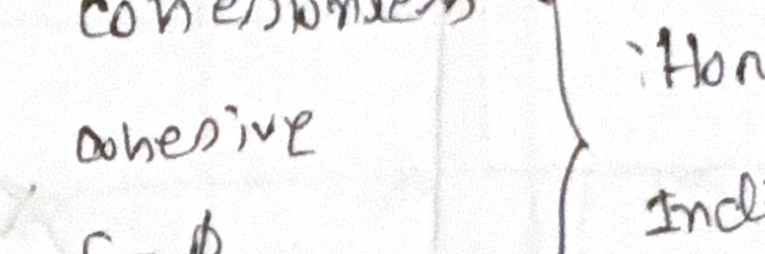
- Rankine's Theory
- Coulomb's Theory

} cohesionless, cohesive, C-ϕ

} Horizontal Ground Surface; Inclined " "

Rankine's Theory

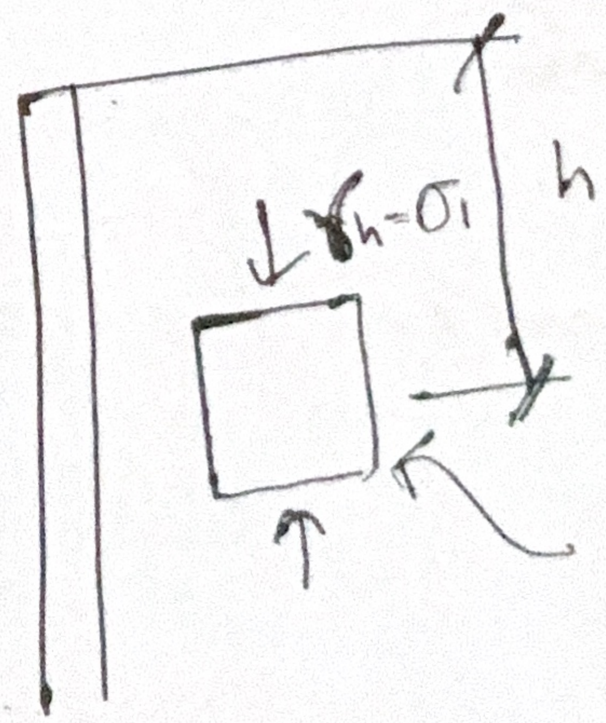
Conjugate test →



Assumptions

cohesionless

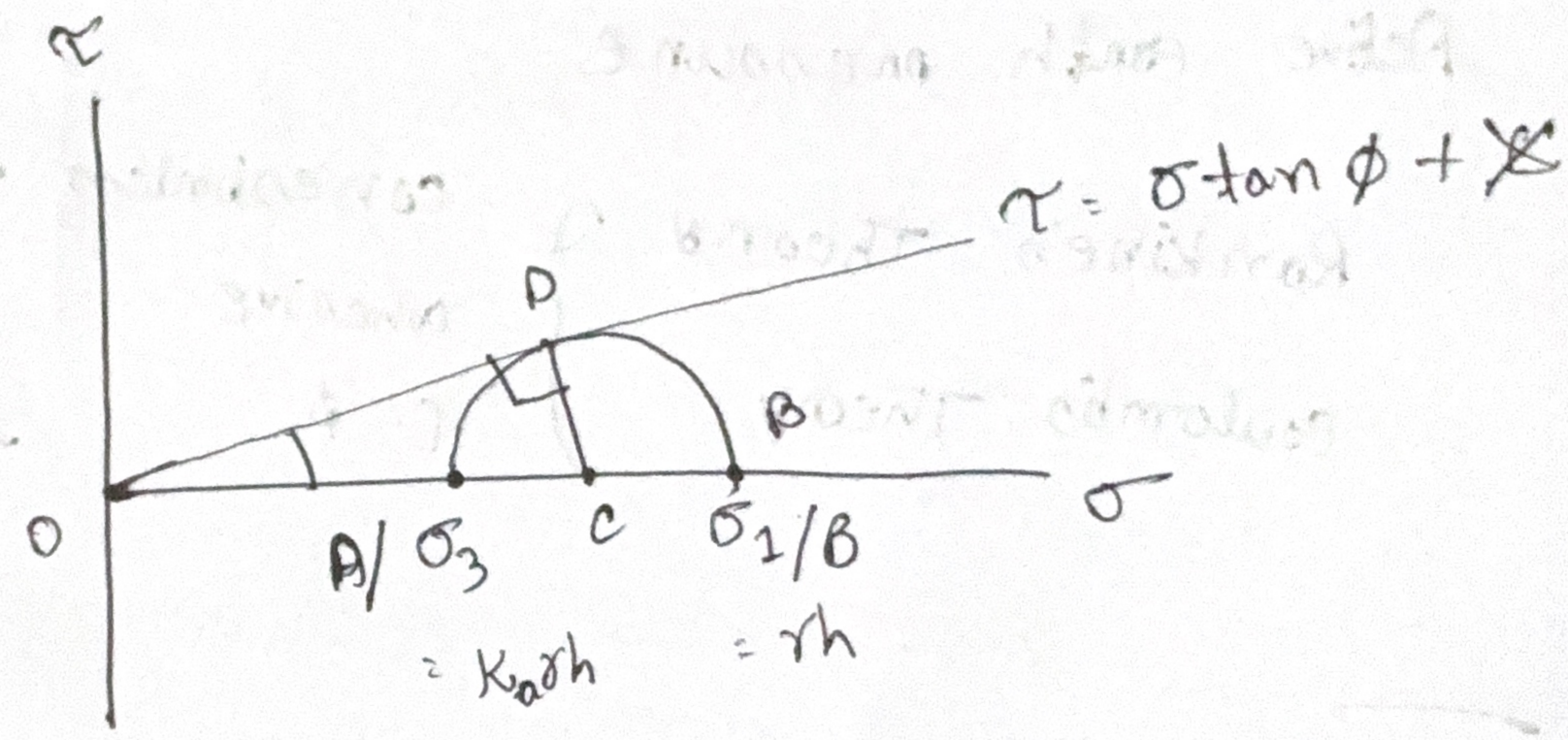
2. most impo



$\sigma_h > k_a \gamma h$

$(\sigma_1, 0)$:

$(\sigma_3, 0)$



$$K_a = \frac{\sigma_3}{\sigma_1} = \frac{OA}{OB} = \frac{OC - AC}{OC + BC}$$

$$= \frac{OC - CD}{OC + CD}$$

$$= \frac{1 - \frac{CD}{OC}}{1 + \frac{CD}{OC}}$$

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

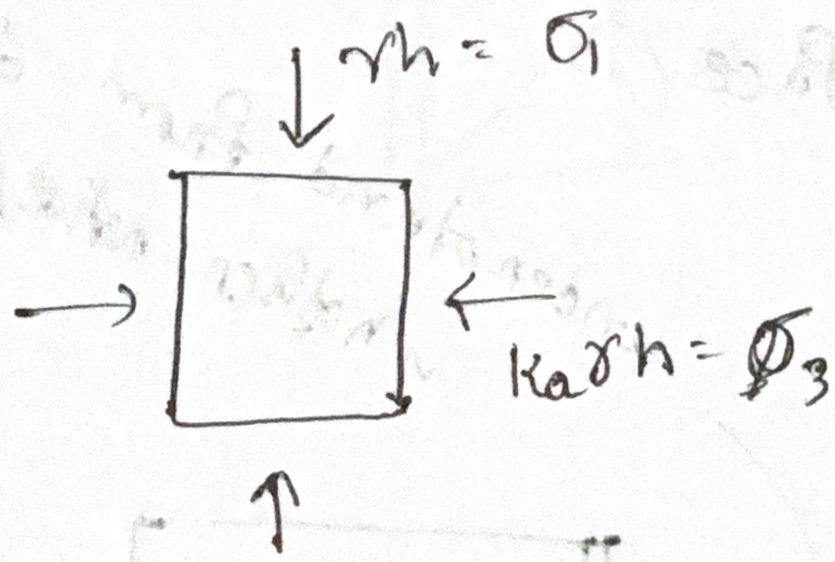
$$= \tan^2(45 - \phi/2)$$

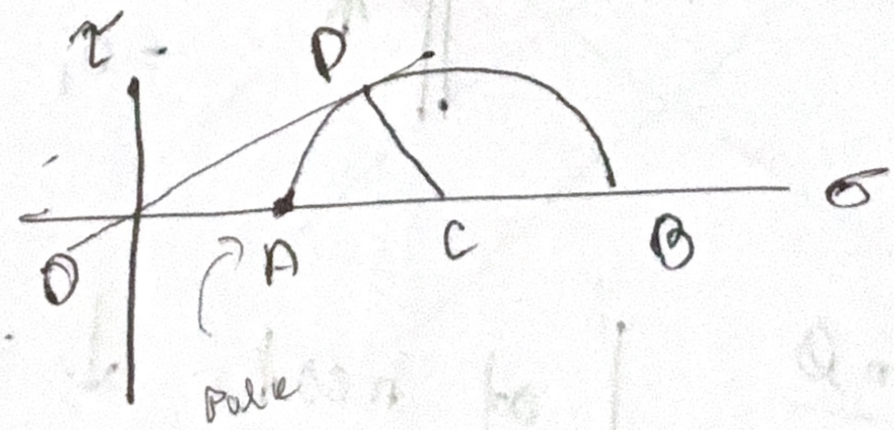
SA/LOG

02/12

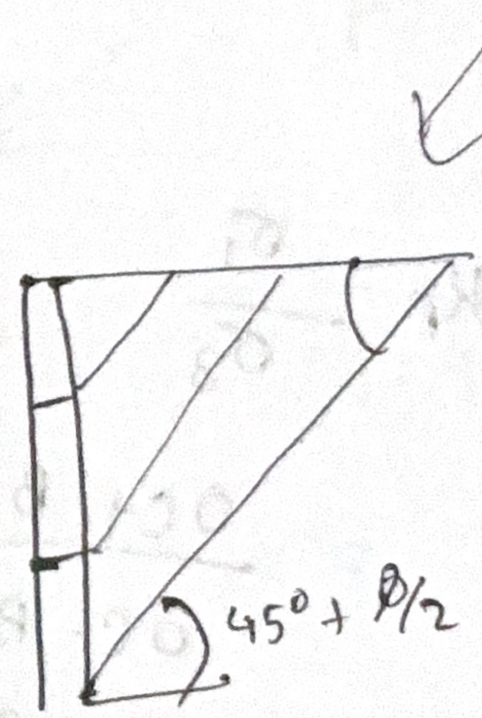
$$K_a = \frac{1-\sin\phi}{1+\sin\phi}$$

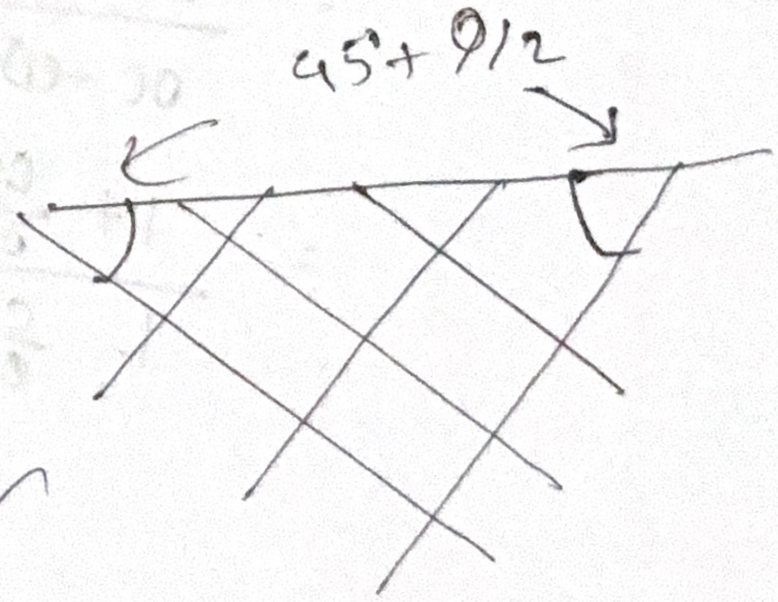
$$= \tan^2(45 - \phi/2)$$





Q Draw the qualitative failure line for active case





Rankine's Theory

Passive Earth Pressure

Cohesionless soil

Horizontal Ground surface

understand from dia whether active/passive

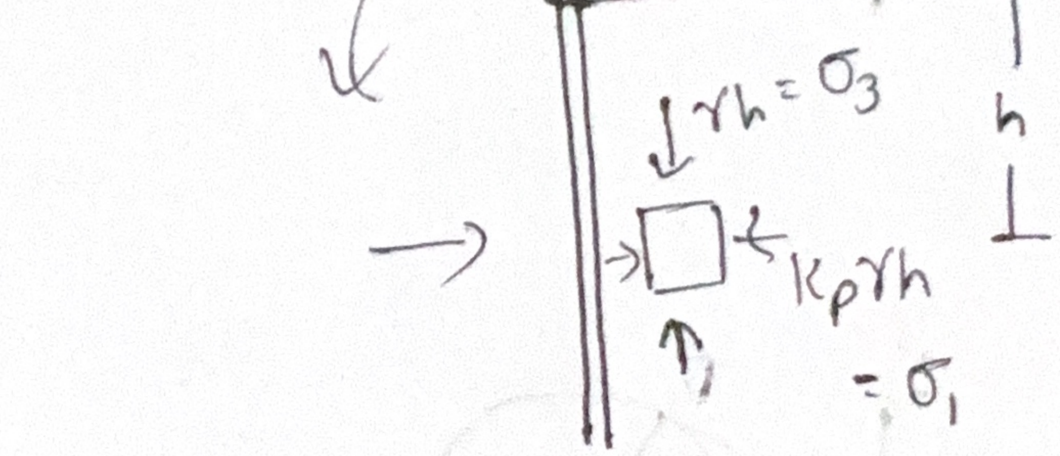
$$K_p = \frac{\sigma_1}{\sigma_3}$$

$$= \frac{OC + BC}{OC - AC}$$

$$= \frac{OC + CD}{OC - CD}$$

$$= \frac{1 + \frac{CD}{OC}}{1 - \frac{CD}{OC}} = \frac{1 + \sin\phi}{1 - \sin\phi}$$

$$= \tan^2(45 + \phi/2)$$



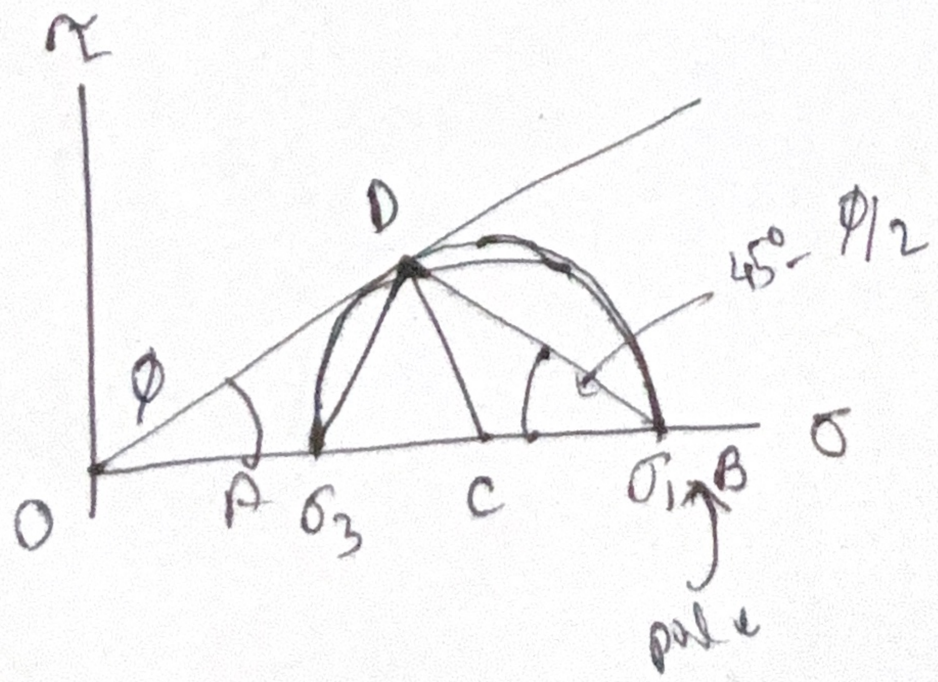
at rest, $\downarrow = \rightarrow$

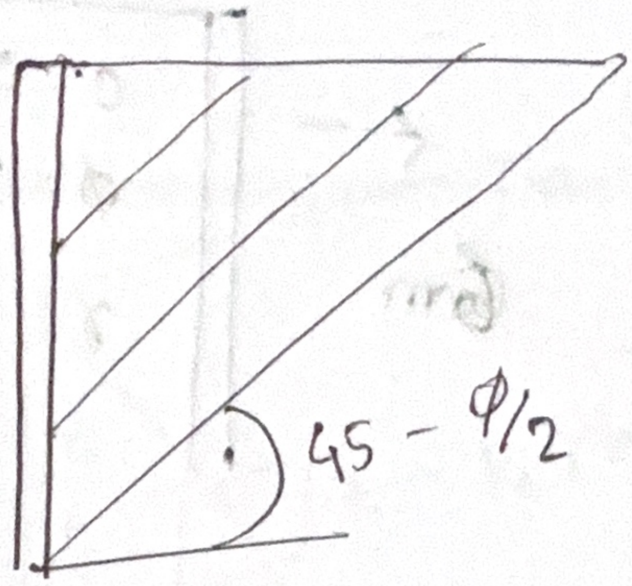
upon contraction (wall moves right)

→ increases

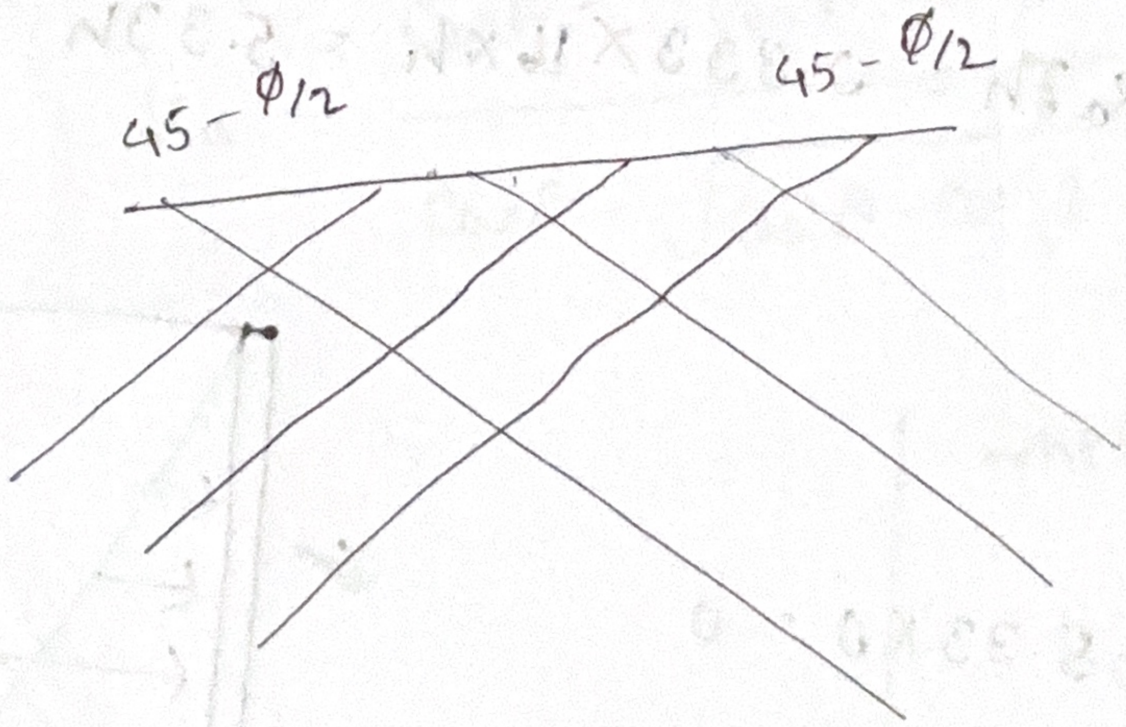
$\therefore \sigma \; K_p \gamma h > \gamma h$

$\sigma_1 \quad \sigma_3$





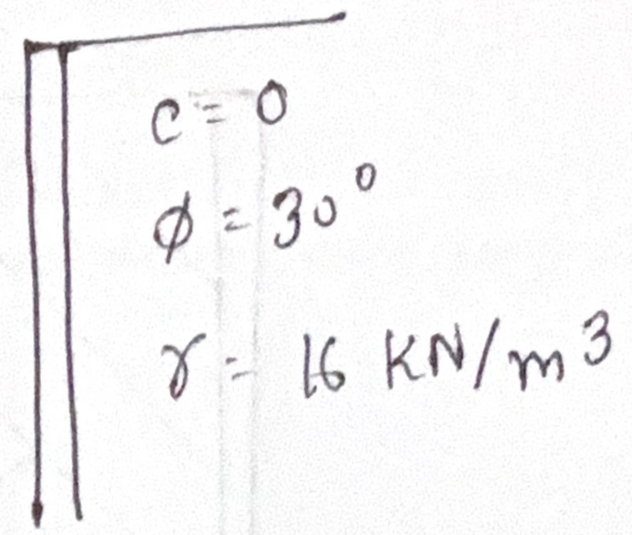
qualitative line
(passive)



Step 1

$$K_a = \frac{1-\sin\phi}{1+\sin\phi}$$

$$= \frac{1-\sin 30^\circ}{1+\sin 30^\circ} = 0.333$$



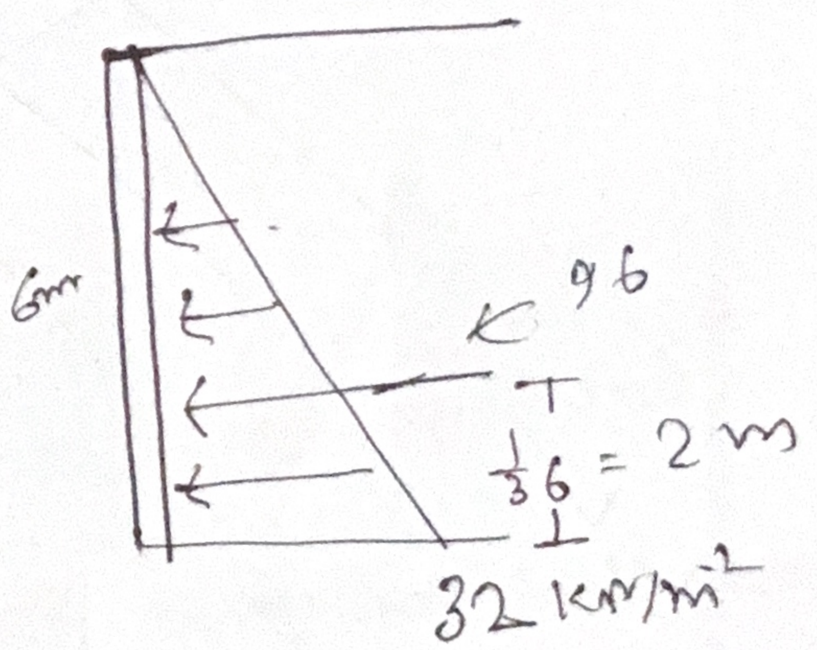
Step 2

$$P_a(h) = K_a \gamma h = 0.333 \times 16 \times h = 5.33h$$

Step 3

$$P_a(h=0) = 5.33 \times 0 = 0$$

$$P_a(h=6m) = 5.33 \times 6 = 32\ KN/m^2$$



if distribution curve not asked then apply direct formula

Step 4

$$P_a = \frac{1}{2} \times 32 \times 6$$

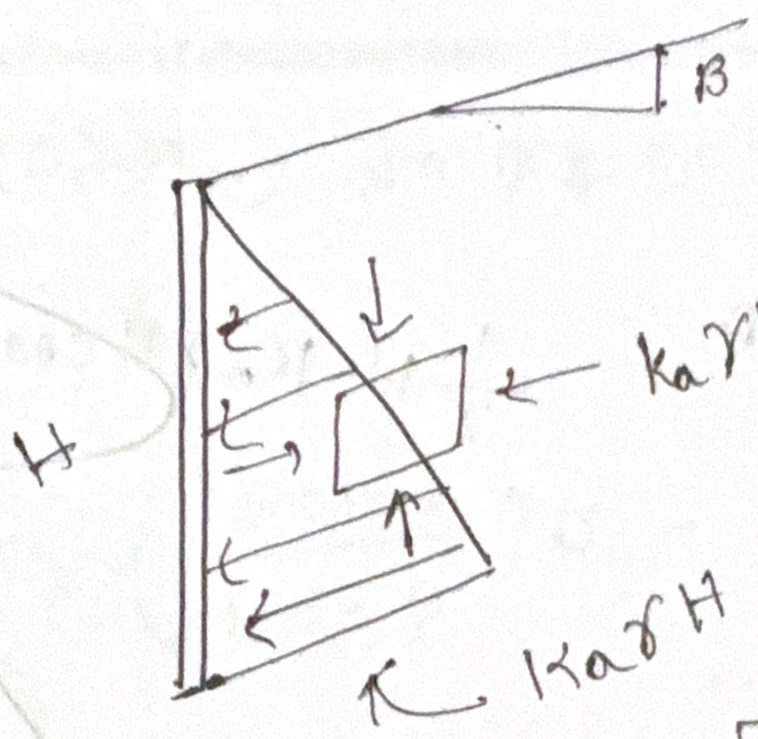
$$= 96\ KN/m$$

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

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

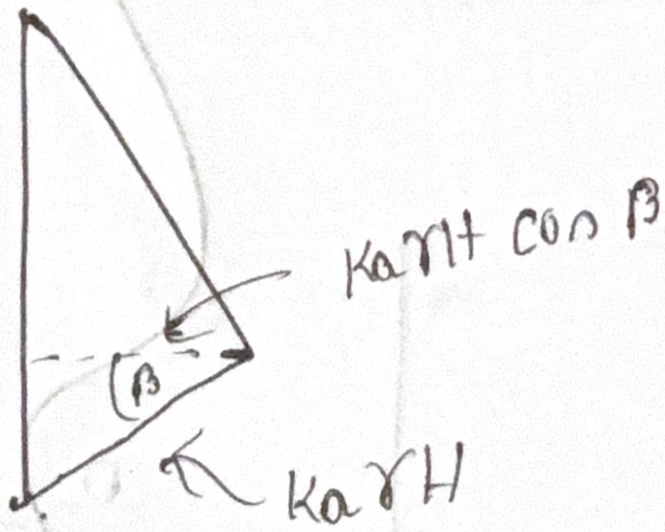


Inclined backfill surface ~~(passive)~~



active

$$K_a = \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}$$



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

$$\therefore \frac{1}{2} K_a \gamma_a H^2 \cos\beta$$

when horizontal $\beta = 0^\circ$

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

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

calc active thrust

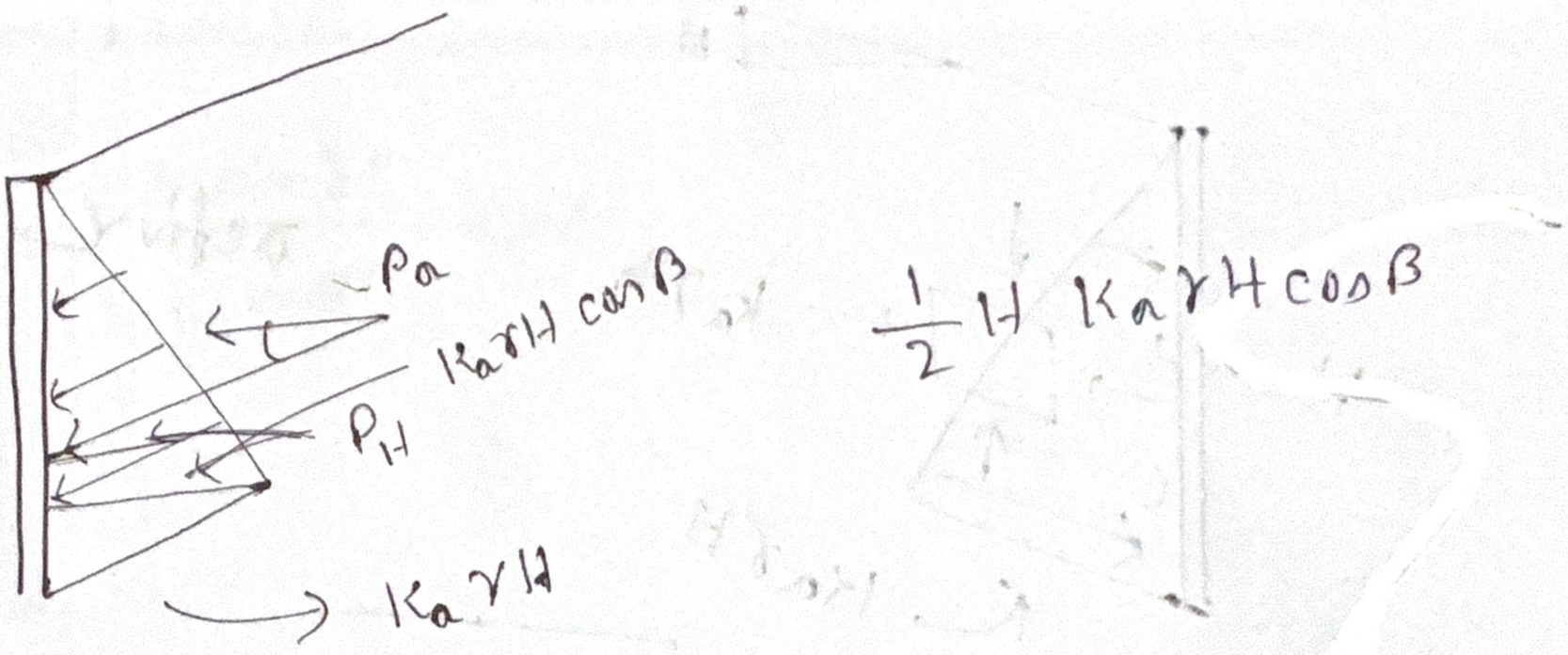
calc horizontal thrust comming on the wall

↑ again X by cos

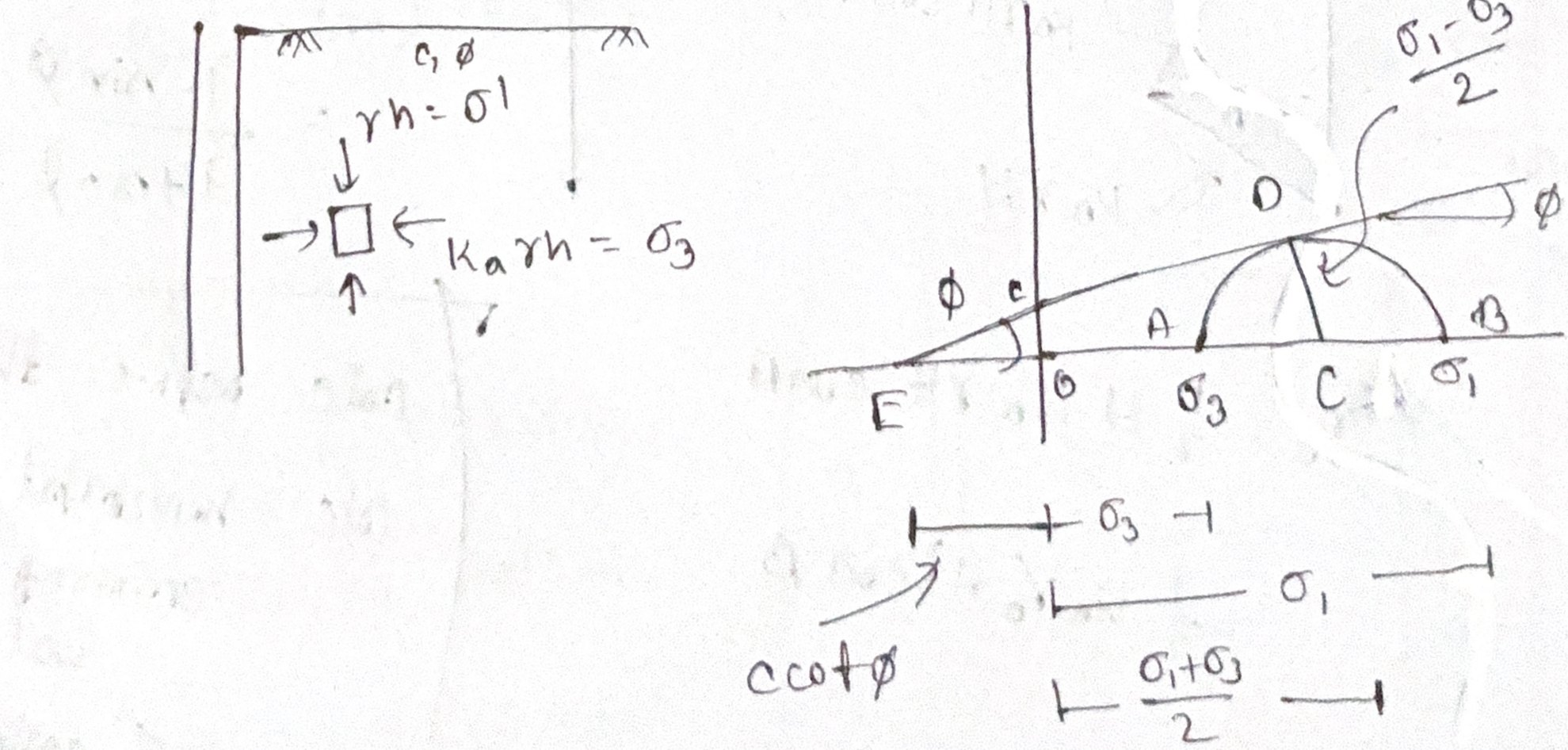
$$P_h = \frac{1}{2} K_a \gamma H^2 \cos\beta \times \cos\beta$$

SAIL-OS 08/12

Active Earth pressure (inclined backfill surface)



Active Earth pressure for partially cohesive (c-ϕ) soil : Rankine's Theory



$$\sin\phi = \frac{CD}{EC} = \frac{CD}{EO + OC} = \frac{\frac{\sigma_1 - \sigma_3}{2}}{c\cot\phi + \frac{\sigma_1+\sigma_3}{2}}$$

$$\Rightarrow (\sigma_1 + \sigma_2)\sin\phi + 2c\cot\phi\sin\phi = \sigma_1 - \sigma_2$$

$$\Rightarrow \ldots$$

$$\Rightarrow \sigma_3 = \left(\frac{1-\sin\phi}{1+\sin\phi}\right)\sigma_1 - \frac{2c\cos\phi}{1+\sin\phi}$$

← connections

Now, $\frac{c\cos\phi}{1+\sin\phi} = \ldots$

$$= \sqrt{\frac{1-\sin\phi}{1+\sin\phi}} = \sqrt{K_a}$$

$$\Rightarrow \sigma_3 = P_{ac} = K_a\gamma h - 2c\sqrt{K_a}$$

derive

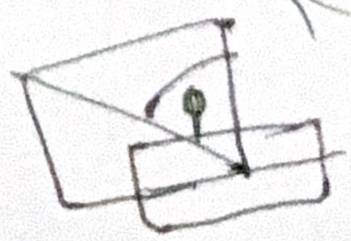
when $h = 0$

$$\sigma_3 = -2c\sqrt{K_a}$$

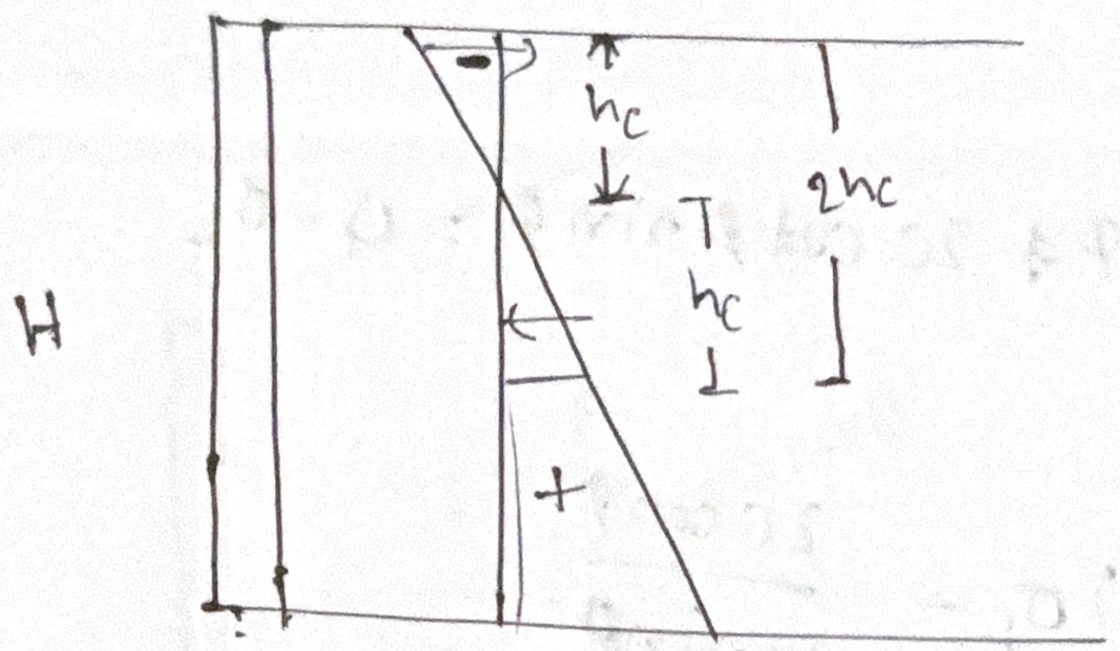
$$= -2c\tan\left(45 - \frac{\phi}{2}\right)$$

[$\phi < 90°$ always]

$\not<$?



→ at h=0, → 0 (-)



tension - (-)

depth of tension crack h_c

at $2h_c$,

resultant force = 0

Theoretical unsupported ht, $H_a = 2h_c$

derive

$$0 = K_a \gamma h_c - 2c\sqrt{K_a}$$

$$\Rightarrow h_c = \frac{2c\sqrt{K_a}}{\gamma K_a} = \frac{2c}{\gamma}\frac{1}{\sqrt{K_a}}$$

Depth of tension crack, $h_c = \frac{2c}{\gamma}\frac{1}{\sqrt{K_a}}$

$$= \frac{2c}{\gamma}\frac{1}{\sqrt{\tan^2(45-\phi/2)}} = \frac{2c}{\gamma}\frac{1}{\tan(45-\phi)}$$

$$= \frac{2c}{\gamma}\cot(45-\phi/2)$$

$$= \frac{2c}{\gamma}\tan(45+\phi/2)$$

$H_a = 2h_c$

$= \frac{4c}{\gamma}\tan(45+\phi/2)$

For purely cohesive soil, $\phi = 0$

$$h_c = \frac{2c}{\gamma}$$

$$P_a = K_a \gamma h - 2c\sqrt{K_a}$$

P_{rev}

$$K_a = \frac{1-\sin\phi}{1+\sin\phi}$$

For passive EP

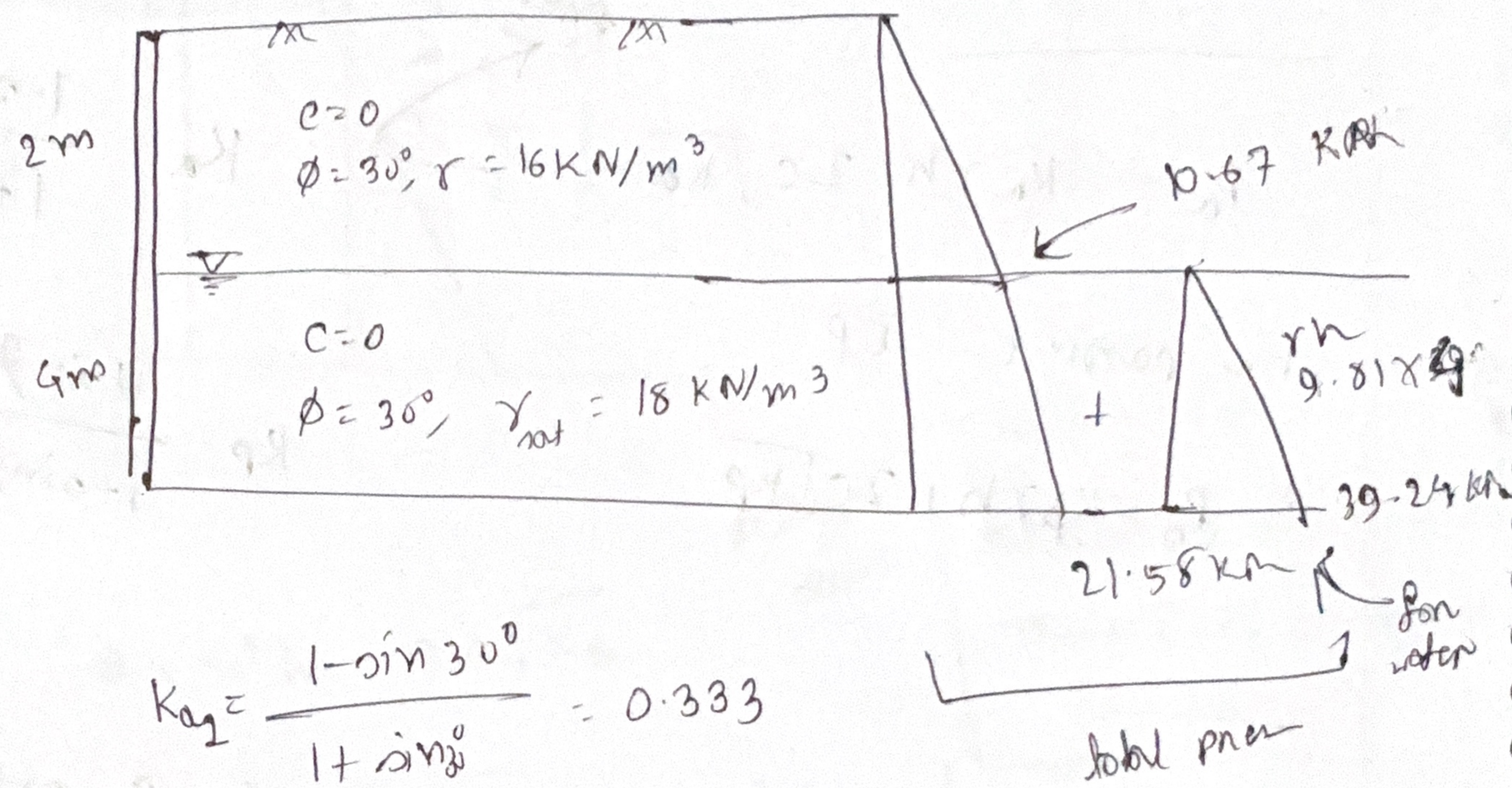
$$P_b = K_p \gamma h + 2c\sqrt{K_p}$$

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

For inclined ground surface (c-ϕ soil)

~~derive~~ not req for exam ← e.g. on hilly slope

Effect of water table



$$K_{a_1} = \frac{1-\sin 30^\circ}{1+\sin 30^\circ} = 0.333$$

---

hor. pressure → eff. ver. pre. × K_a

@2m → 2×16 = 32 → × K_a → 10.67

$$K_{a2} = \frac{1-\sin 30^\circ}{1+\sin 30^\circ} = 0.333$$

$2\times16 + 4\times(18-9.81) = 64.76 \rightarrow 21.58$ KPa