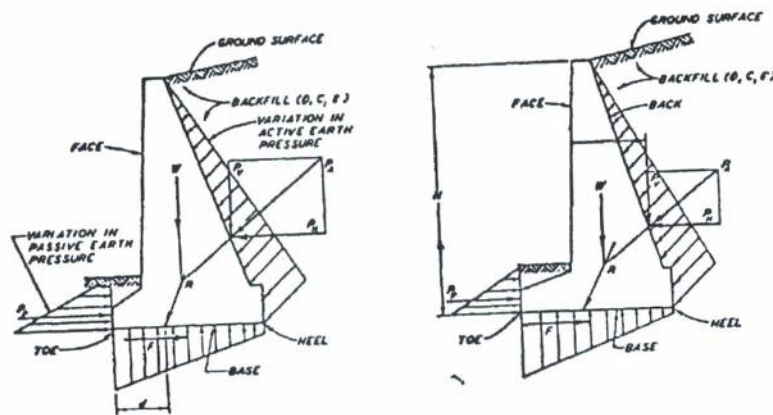


DIKTAT
REKAYASA GEOTEKNIK – 1

MODUL - 1:

SYSTEM PENAHAN TANAH DANGKAL
Retaining Wall



By : Idrus Muhammad Alatas Ir. M.Sc
Educative Staff in Civil Engineering Department FTSP-ISTN

REKAYASA PONDASI 1: MODUL -1

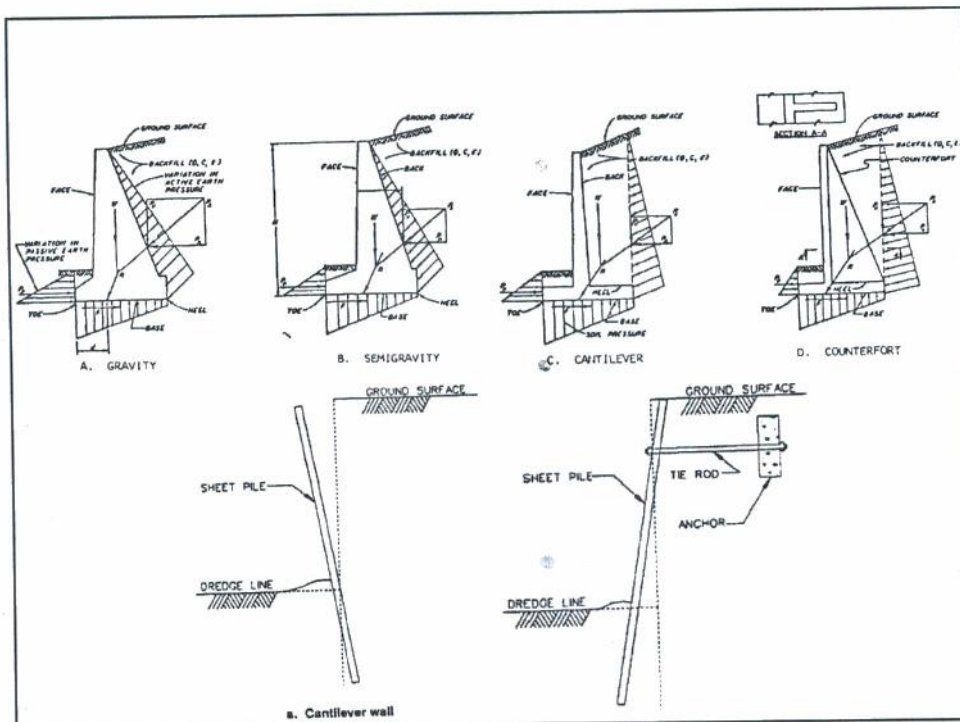
SISTEM PENAHAN TANAH SEDERHANA / DANGKAL

Ir. Idrus M.Sc

STAFF JURUSAN TEKNIK SIPIL FTSP-ISTN

SISTEM PENAHAN TANAH SEDERHANA / DANGKAL

- Menguasai jenis dan sistem penahan tanah sederhana
- Menguasai metode perhitungan sistem penahan tanah
- Menguasai parameter tanah yang dibutuhkan



Review

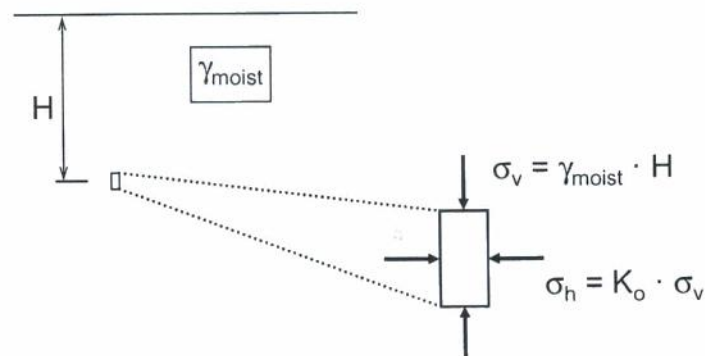
- Tekanan lateral tanah
 - Kondisi diam
 - Perubahan: Aktif & Pasif
- Dinding penahan tanah
 - Dinding gravitasi & kantilever
 - Cantilever sheetpile walls
 - Anchored sheetpile walls

TEKANAN LATERAL TANAH DIAM

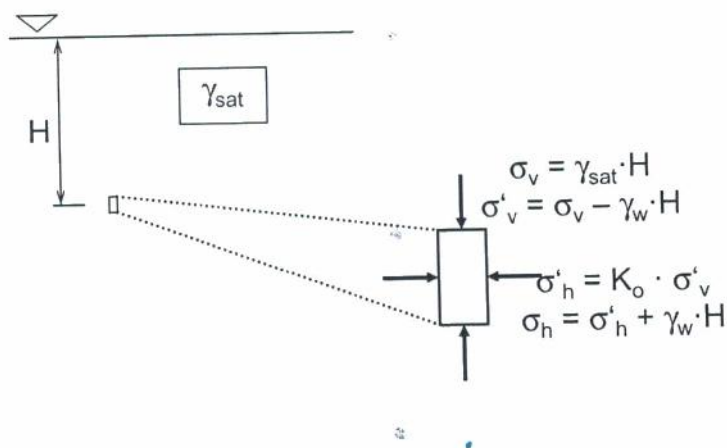
- Tanah tidak digali, kondisinya adalah tekanan lateral tanah diam (*at rest lateral pressure*)
- Jika tidak movement dari dinding, kondisinya adalah tekanan lateral tanah diam (*at rest lateral pressure*)
- Koefisien:

$$K_o = [1 - \sin(\phi')] \nu_{OCR}$$

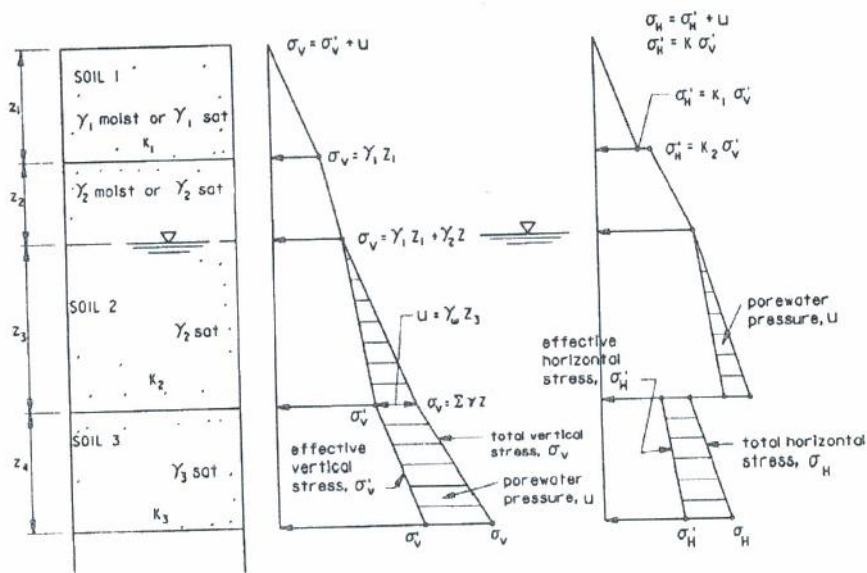
TEKANAN LATERAL TANAH DIAM – MOIST



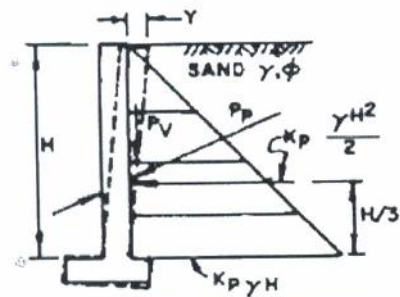
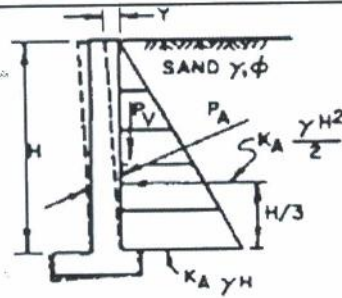
TEKANAN LATERAL TANAH DIAM – SAT.



TEKANAN LATERAL TANAH DIAM



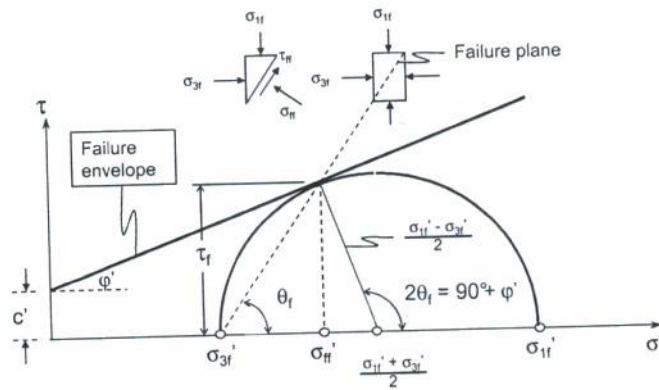
PERUBAHAN TEK. LATERAL



PERUBAHAN TEK. LATERAL

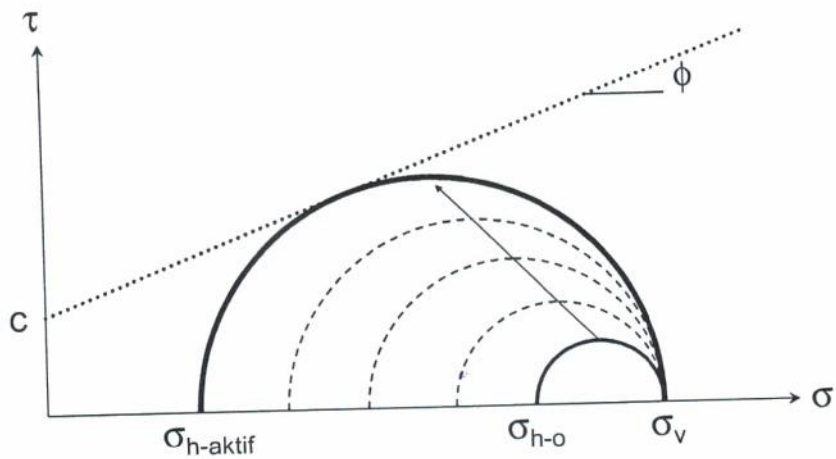
- Rankine: Lower Bound
- Coulomb: Upper Bound
- Beban & Efek Pemadatan

KEKUATAN GESER TANAH

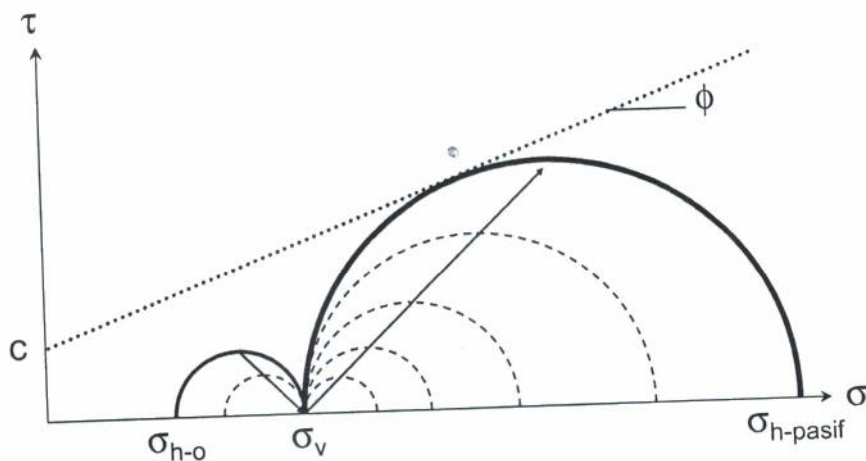


$$\sigma_{1f}' = \sigma_{3f}' \tan^2(45^\circ + \phi'/2) + 2 c' \tan(45^\circ + \phi'/2)$$

PERUBAHAN – AKTIF



PERUBAHAN – PASIF



AKTIF – Rankine (1)

- Untuk tek. lateral tanah aktif:

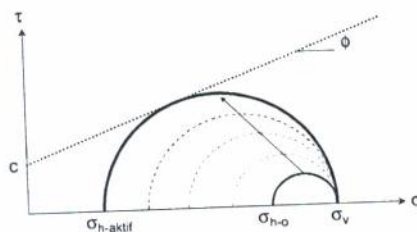
$$\sigma_v = \sigma_{h-aktif} \tan^2(45^\circ + \phi/2) + 2c \tan(45^\circ + \phi/2)$$

$$\sigma_{h-aktif} = [\sigma_v - 2c \tan(45^\circ + \phi/2)] / \tan^2(45^\circ + \phi/2)$$

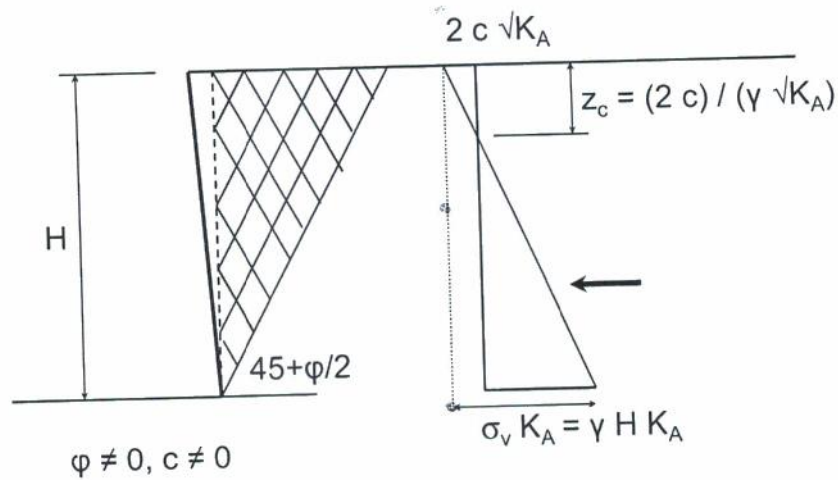
$$\sigma_{h-aktif} = \sigma_v K_A - 2c \sqrt{K_A}$$

dengan

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



AKTIF – Rankine (2)



PASIF – Rankine (1)

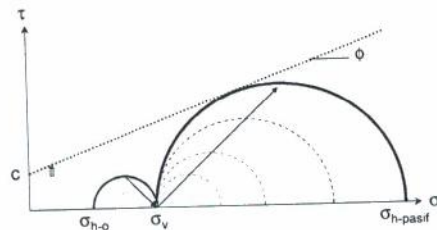
- Untuk tek. lateral tanah pasif:

$$\sigma_{h\text{-pasif}} = \sigma_v \tan^2(45^\circ + \varphi/2) + 2c \tan(45^\circ + \varphi/2)$$

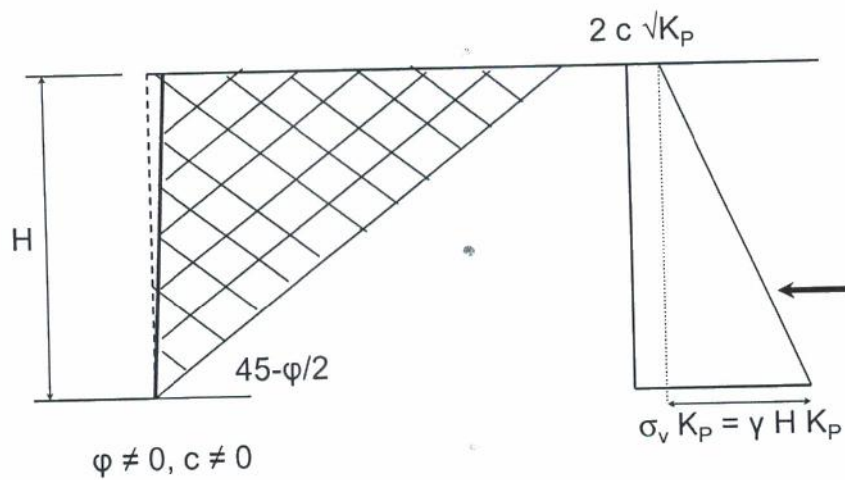
$$\sigma_{h\text{-pasif}} = \sigma_v K_p + 2c \sqrt{K_p}$$

dengan

$$K_p = \tan^2(45^\circ + \varphi/2)$$



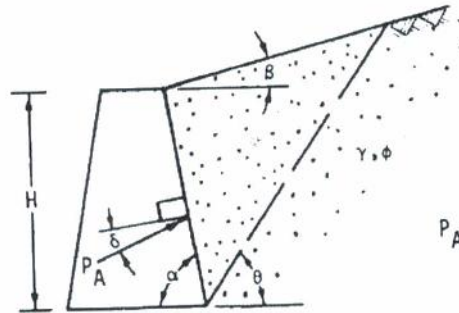
PASIF – Rankine (2)



PERUBAHAN TEK. LATERAL

- Rankine: Lower Bound
- Coulomb: Upper Bound
- Beban & Efek Pemadatan

AKTIF – Coulomb (1)



$$P_A = \frac{\gamma H^2}{2} K_A$$

$$\text{Where } K_A = \frac{\sin^2(\alpha + \phi)}{\sin^2 \alpha \sin(\alpha - \delta) \left[1 + \frac{\sin(\phi + \delta) \sin(\phi - \beta)}{\sin(\alpha - \delta) \sin(\alpha + \beta)} \right]^2}$$

∴ Component of P_A perpendicular to wall back is:

$$P_{AN} = P_A \cos \delta = \frac{\gamma H^2}{2} K_A \cos \delta$$

AKTIF – Coulomb (2)

Special cases

① If $\alpha = 90^\circ$, $\beta = 0^\circ$, then:

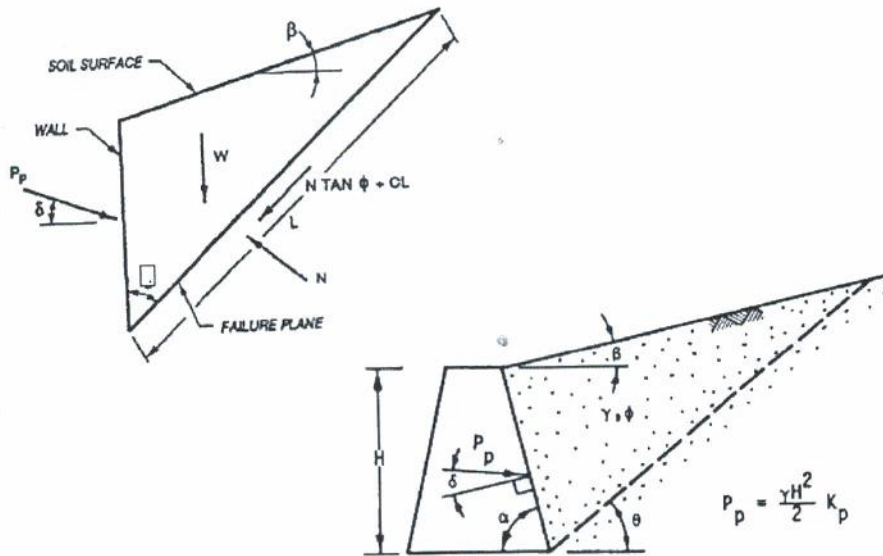
$$P_A = \frac{\gamma H^2}{2} K_A$$

$$\text{where } K_A = \left[\frac{\cos \phi}{\sqrt{\cos \delta + \sqrt{\sin(\delta + \phi) \sin \phi}}} \right]^2$$

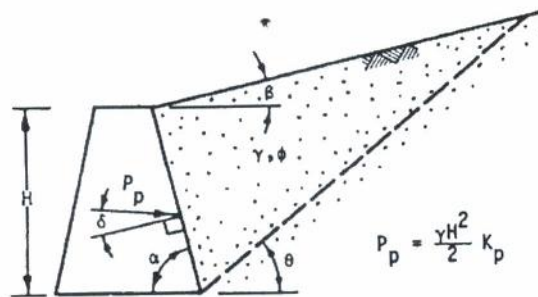
② If, in addition, $\delta = 0$:

$$K_A = \frac{\cos^2 \phi}{(1 + \sin \phi)^2} = \frac{1 - \sin \phi}{1 + \sin \phi} = \tan^2 \left(45 - \frac{\phi}{2} \right)$$

PASIF – Coulomb (1)



PASIF – Coulomb (2)



Where $K_p = \frac{\sin^2(\alpha - \phi)}{\sin^2 \alpha \sin(\alpha + \delta) \left[1 - \sqrt{\frac{\sin(\phi + \delta) \sin(\phi + \beta)}{\sin(\alpha + \delta) \sin(\alpha + \beta)}} \right]^2}$

∴ Component of P_p perpendicular to wall back is:

$$P_{pn} = P_p \cos \delta = \frac{\gamma H^2}{2} K_p \cos \delta$$

PASIF – Coulomb (3)

Special cases

① If $\alpha = 90^\circ$, $\beta = 0^\circ$, then:

$$P_p = \frac{\gamma H^2}{2} K_p$$

where $K_p = \left[\frac{\cos \phi}{\sqrt{\cos \delta} - \sqrt{\sin(\phi + \delta) \sin \delta}} \right]^2$

② If, in addition, $\delta = 0$:

$$K_p = \frac{\cos^2 \phi}{(1 - \sin \phi)^2} = \frac{1 + \sin \phi}{1 - \sin \phi} = \tan^2 \left(45 + \frac{\phi}{2} \right)$$

Note: Equations are unconservative and should not be used for $\delta > \frac{\phi}{2}$; they are satisfactory for $\delta \leq \frac{\phi}{2}$.

FRIKSI DINDING (1)

Interface Materials	Friction factor, tan (delta)	Friction angle (delta) degrees
* Mass concrete on the following foundation materials:		
Clean sound rock.....	0.70	35
Clean gravel, gravel-sand mixture, coarse sand.....	0.55 to 0.60	29 to 31
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel.....	0.45 to 0.55	24 to 29
Clean fine sand, silty or clayey fine to medium sand.....	0.35 to 0.45	19 to 24
Fine sandy silt, nonplastic silt.....	0.30 to 0.35	17 to 19
Very stiff and hard residual or preconsolidated clay.....	0.40 to 0.50	22 to 26
Medium stiff and stiff clay and silty clay.....	0.30 to 0.35	17 to 19
* Masonry on foundation materials has same friction factors.		
* Steel sheet piles against the following soils:		
Clean gravel, gravel sand mixture, well-graded rock fill with spalls.....	0.40	22
Clean sand, silty sand-gravel mixture, single size hard rock fill.....	0.30	17
Silty sand, gravel or sand mixed with silt or clay.....	0.25	14
Fine sandy silt, nonplastic silt.....	0.20	11
* Formed concrete or concrete sheet piling against the following soils:		
Clean gravel, gravel-sand mixture, well-graded rock fill with spalls.....	0.40 to 0.50	22 to 26
Clean sand, silty sand-gravel mixture, single size hard rock fill.....	0.30 to 0.40	17 to 22
Silty sand, gravel or sand mixed with silt or clay.....	0.30	17
Fine sandy silt, nonplastic silt.....	0.25	14
* Various structural materials:		
Masonry on masonry, igneous and metamorphic rocks.....	0.70	35
Dressed soft rock on dressed soft rock.....	0.65	33
Dressed hard rock on dressed soft rock.....	0.55	29
Dressed hard rock on dressed hard rock.....	0.50	26
Masonry on wood (cross grain).....	0.50	26
Steel on steel at sheet pile interlocks.....	0.30	17

FRIKSI DINDING (2)

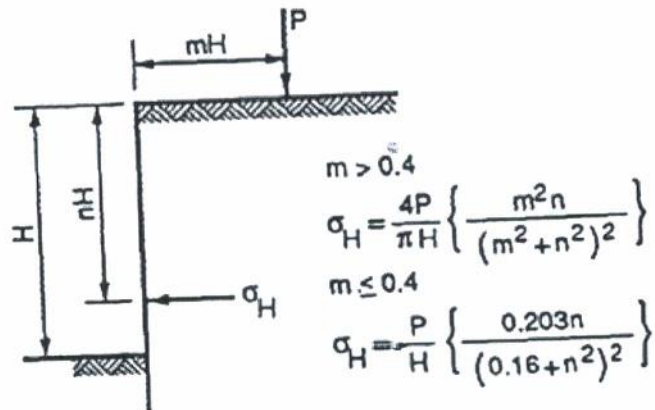
Interface Materials (Cohesion)	Adhesion c+a. (psf)
• Very soft cohesive soil (0 - 250 psf)	• 0 - 250
• Soft cohesive soil (250 - 500 psf)	• 250 - 500
• Medium stiff cohesive soil (500 - 1000 psf)	• 500 - 750
• Stiff cohesive soil (1000 - 2000 psf)	• 750 - 950
• Very stiff cohesive soil (2000 - 4000 psf)	• 950 - 1,300

PERUBAHAN TEK. LATERAL

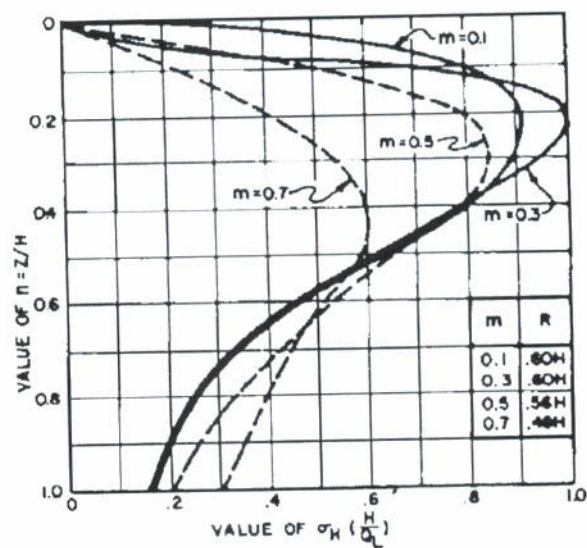
- Rankine: Lower Bound
- Coulomb: Upper Bound
- Beban & Efek Pemadatan

BEBAN LUAR (1)

- Tekanan akibat beban luar (surcharge)



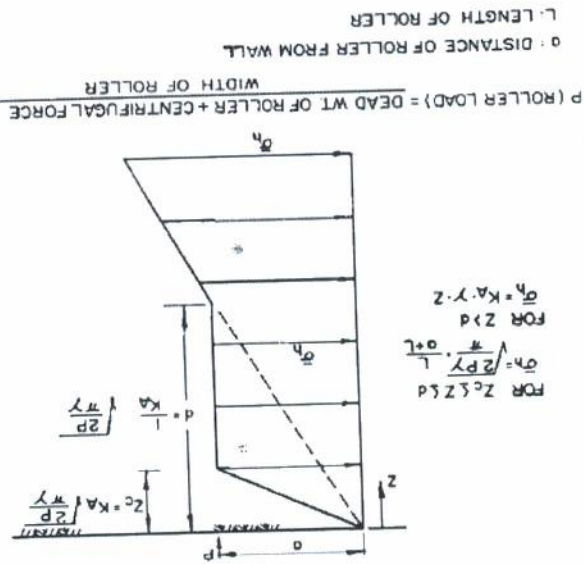
BEBAN LUAR (2)

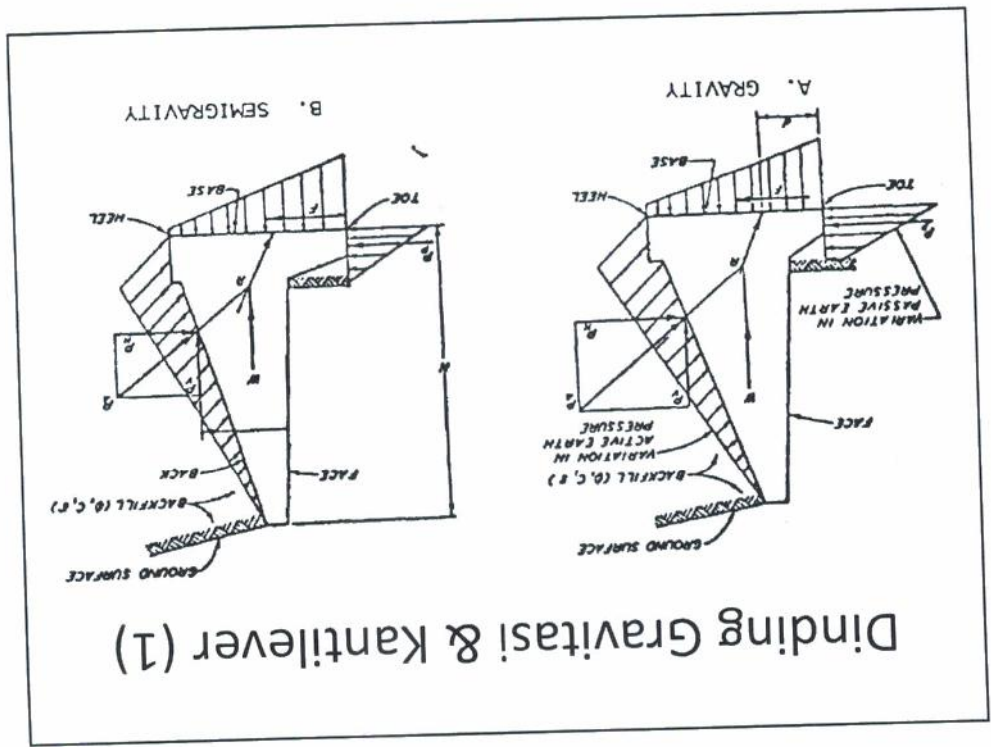


Review

- Tekanan lateral tanah
 - Kondisi diam
 - Perubahan: Aktif & Pasif
- Dinding penahan tanah
 - Dinding gravitasi & kantilever
 - Cantilever sheetpile walls
 - Anchored sheetpile walls

EFEK PEMADATAN



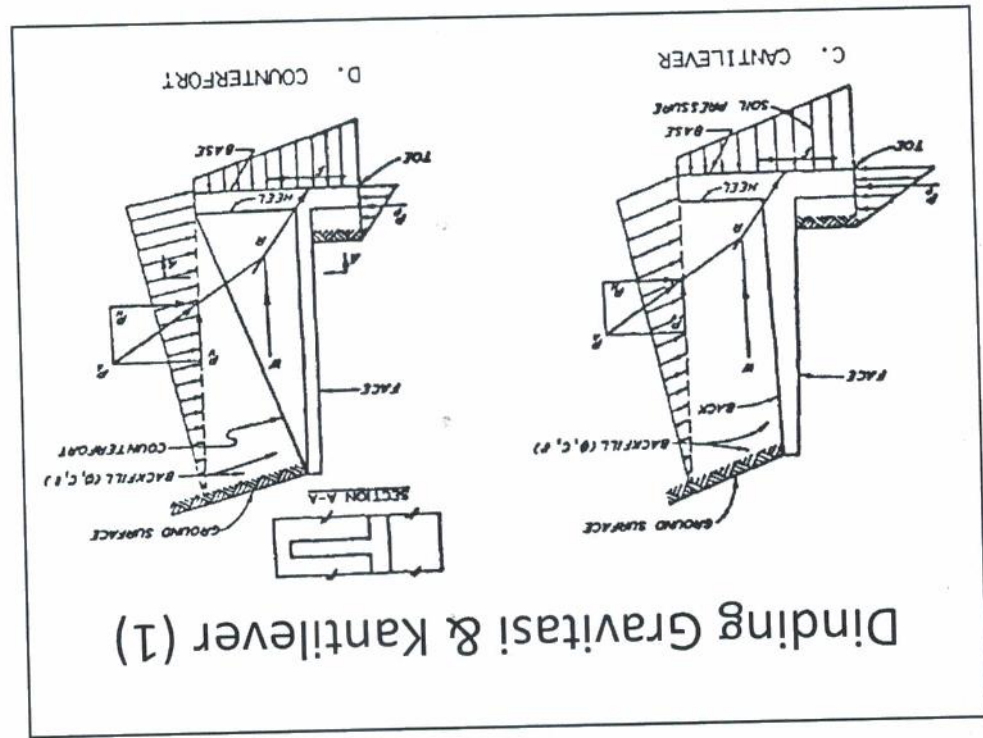


Dinding Gravitasi & Kantilever (1)

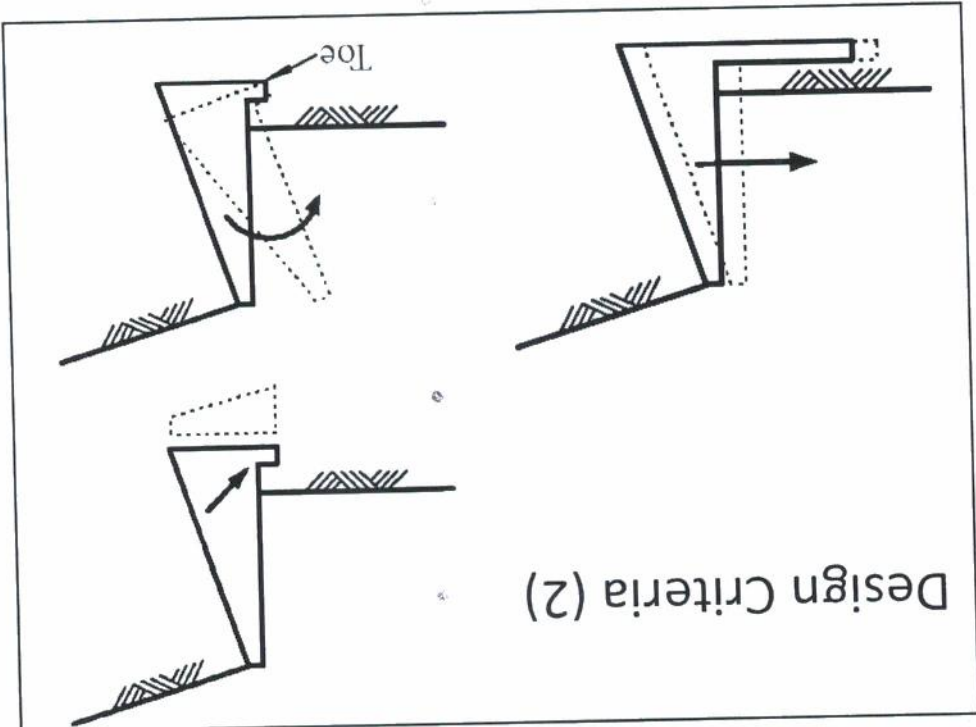
- Dinding Penahan Tanah
- Dinding gravitasi & kantilever
 - Dinding turap (cantilever sheetpile walls)

- Foundation pressures \leq allowable bearing pressures
- Adequate safety factors against sliding
- Adequate safety factors against overturning
- Adequate safety factors against general stability
- Wall settlements tolerable
- Adequate structural strength

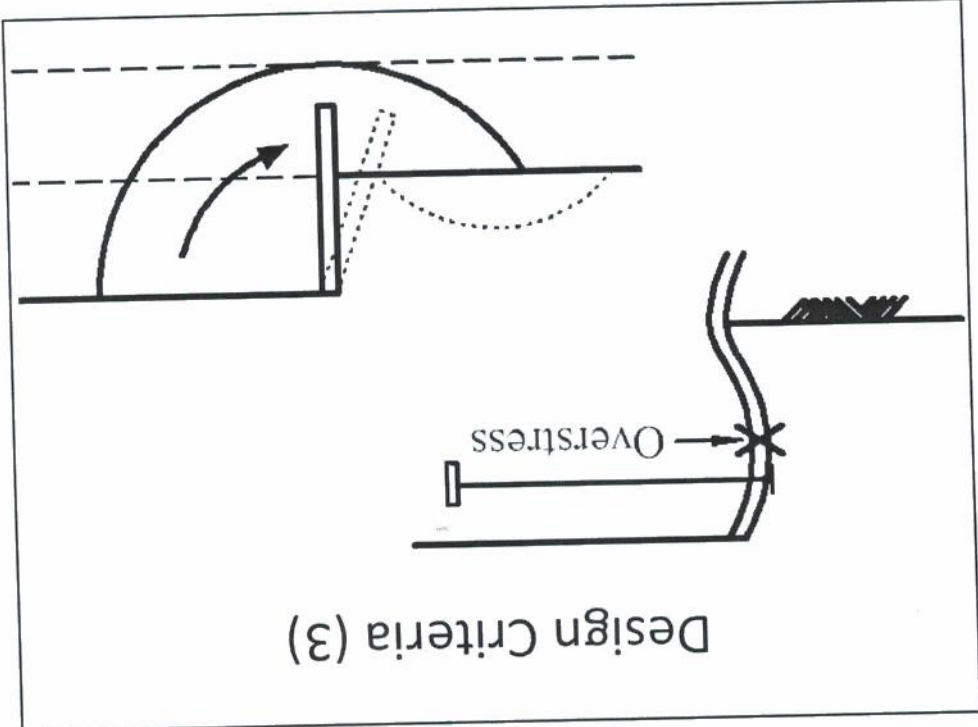
Design Criteria (1)



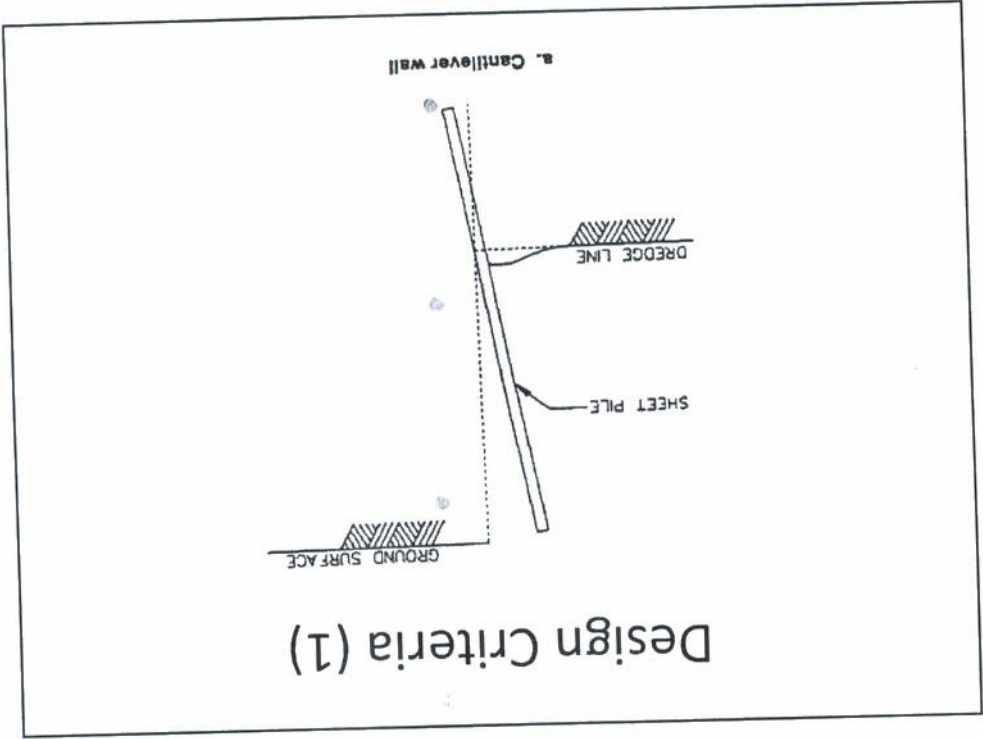
Dinding Gravitasi & Kantilever (1)



Design Criteria (2)



Design Criteria (3)



Design Criteria (1)

- Design Criteria
 - Deep-Seated Failure
 - Rotational Failure due to Inadequate Penetration
 - Flexural Failure
 - Lateral movement

Cantilever Sheet Pile Walls

