PBW 620 Advanced Soil Mechanics
PBW 584 Applied Soil Mechanics

Public Works Department

MSc. Degree

Spring Semester

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Soil Mechanics and Foundations Research Lab
Faculty of Engineering- Cairo University

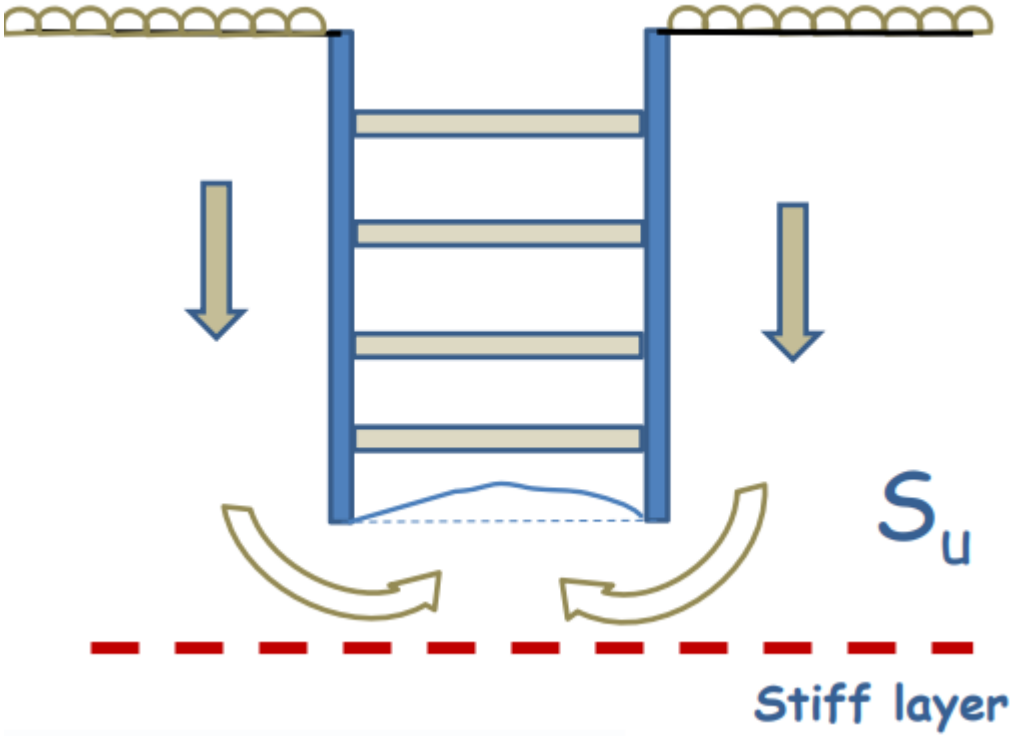
Lecture Five

SPECIAL CONDITIONS IN EARTH PRESSURE CALCULATIONS-PART2

Lecture Outline

- Base stability
- Dealing with water pressure and drains

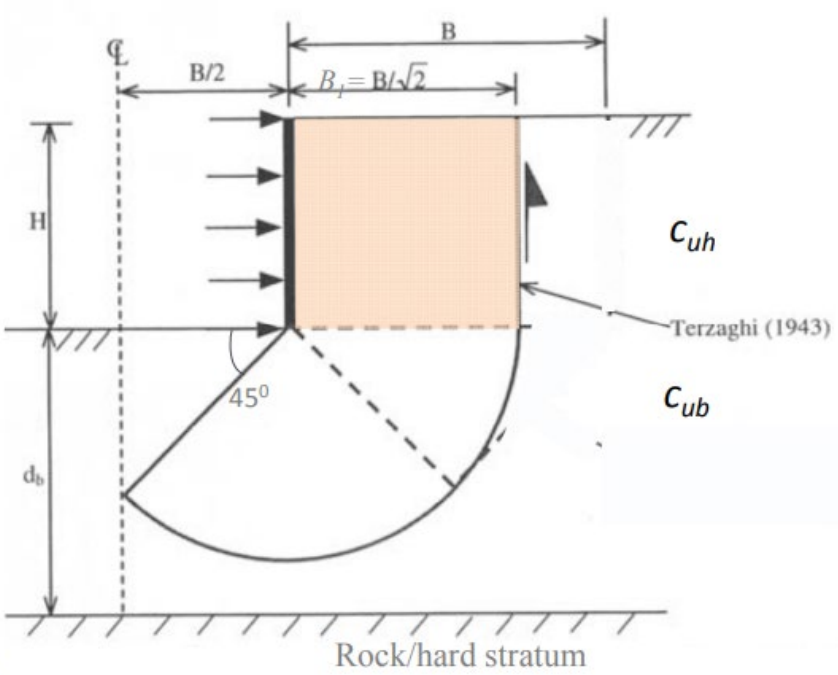
Base Stability Problem

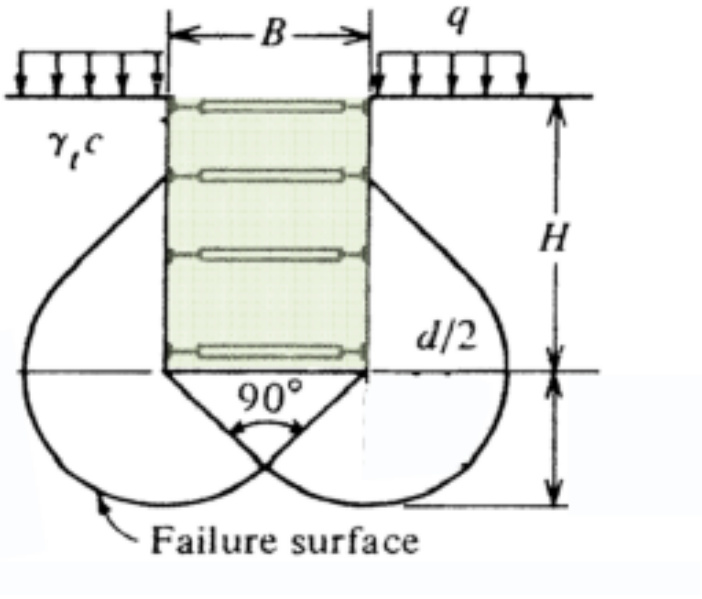


Reversed B/C problem
(critical for cohesive soils)

Credit : Dr Mostafa Mosaad

Factor of Safety





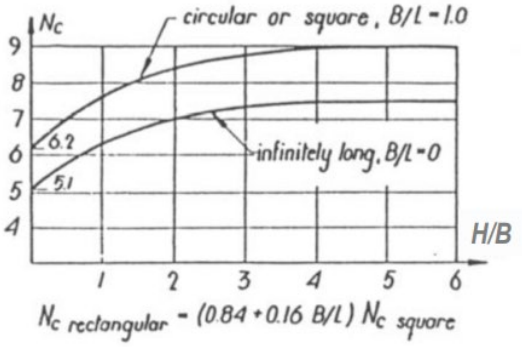
Terzaghi (1943)

$$FS_{T1} = \frac{5.7 C_{ub}}{(\gamma H) - C_{uh} H/B_1} \quad ; for\ (d_b \geq B/\sqrt{2})$$

- If $d_b < B/\sqrt{2}$, then d_b replaces B_1 in the above equation

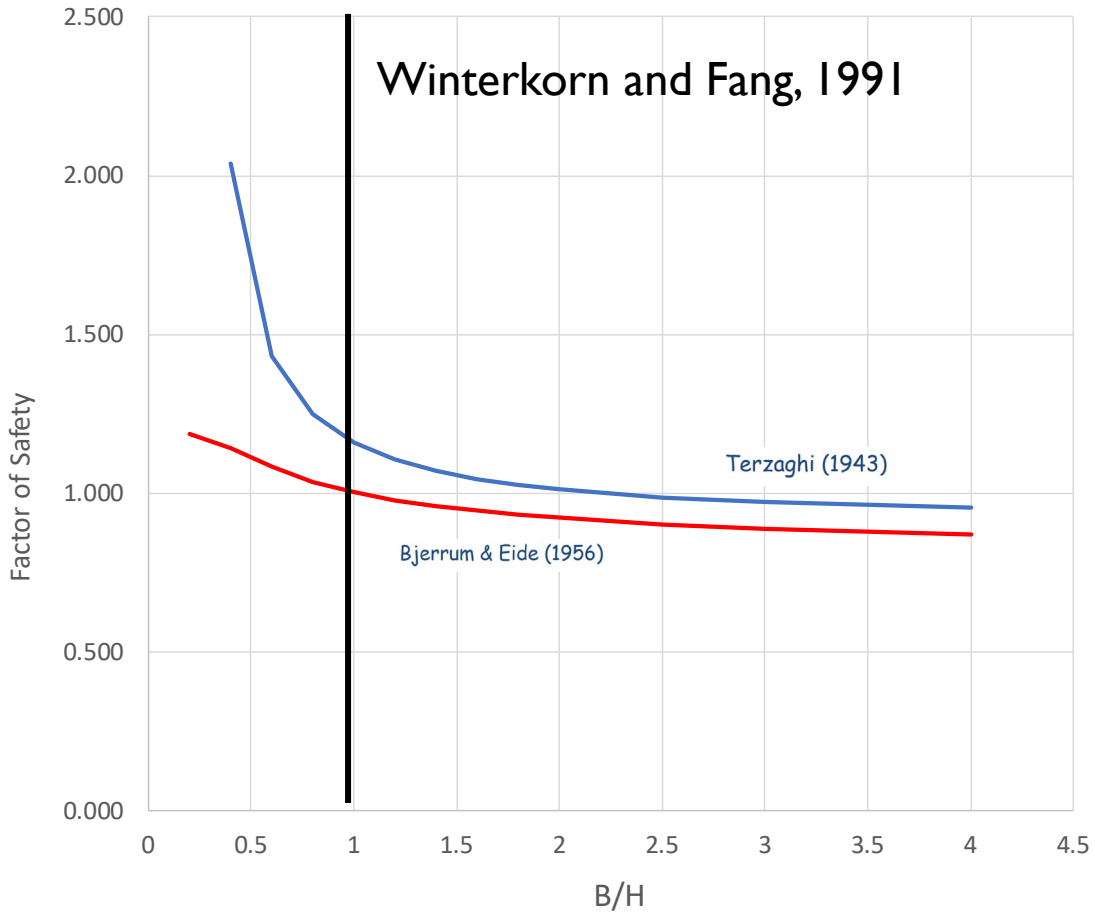
Bjerrum & Eide (1956)

$$FS_B = \frac{c_u N_c}{\gamma H}$$



Deep and Wide Excavations

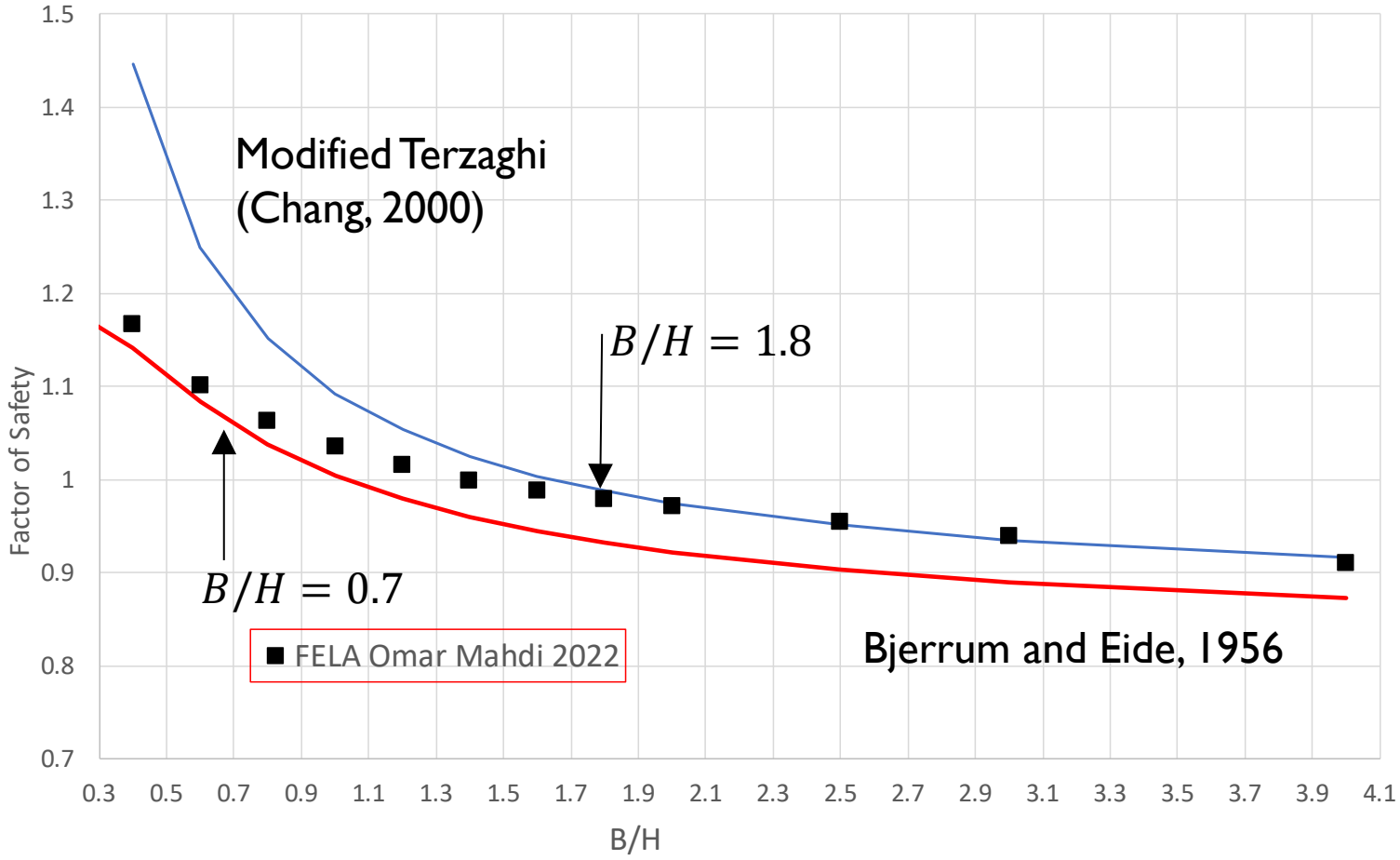
Unit Weight	18	kN/m^3
q	10	kPa
Su	30	kPa
H	10	m.



Deep and Wide Excavations

- Strength Reduction analysis
- Average of using upper bound and lower bound elements

Unit Weight	18	kN/m^3
q	10	kPa
Su	30	kPa
H	10	m.

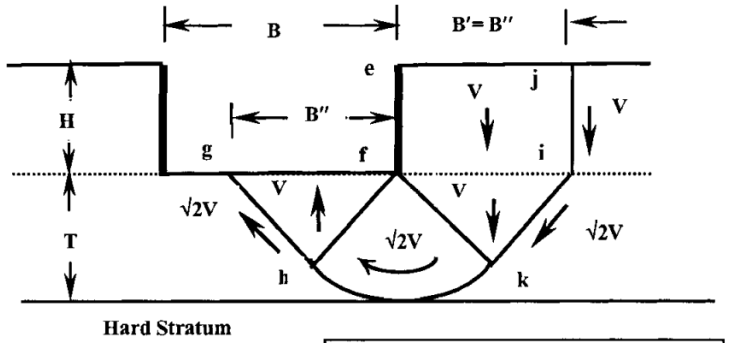


Application of limit analysis

Chang (2000)

$$H_{cr} = \frac{(\pi + 2)s_u}{(\gamma - s_u/B')} = \frac{5.14s_u}{(\gamma - s_u/B')}$$

$$FoS = H_{cr}/H$$



L= Length of cut
B= Width of cut
H= Height of cut
T= Clay thickness below base of cut
V= Velocity of plastic flow

$$dW = \gamma B'HV + \frac{\gamma V}{2}(B')\left(\frac{B'}{2}\right) + \int_{\pi/4}^{3\pi/4}(\gamma)\left(\frac{1}{2}\right)\left(\frac{B'}{\sqrt{2}}\right)\left(\frac{B'}{\sqrt{2}}d\theta\right)$$

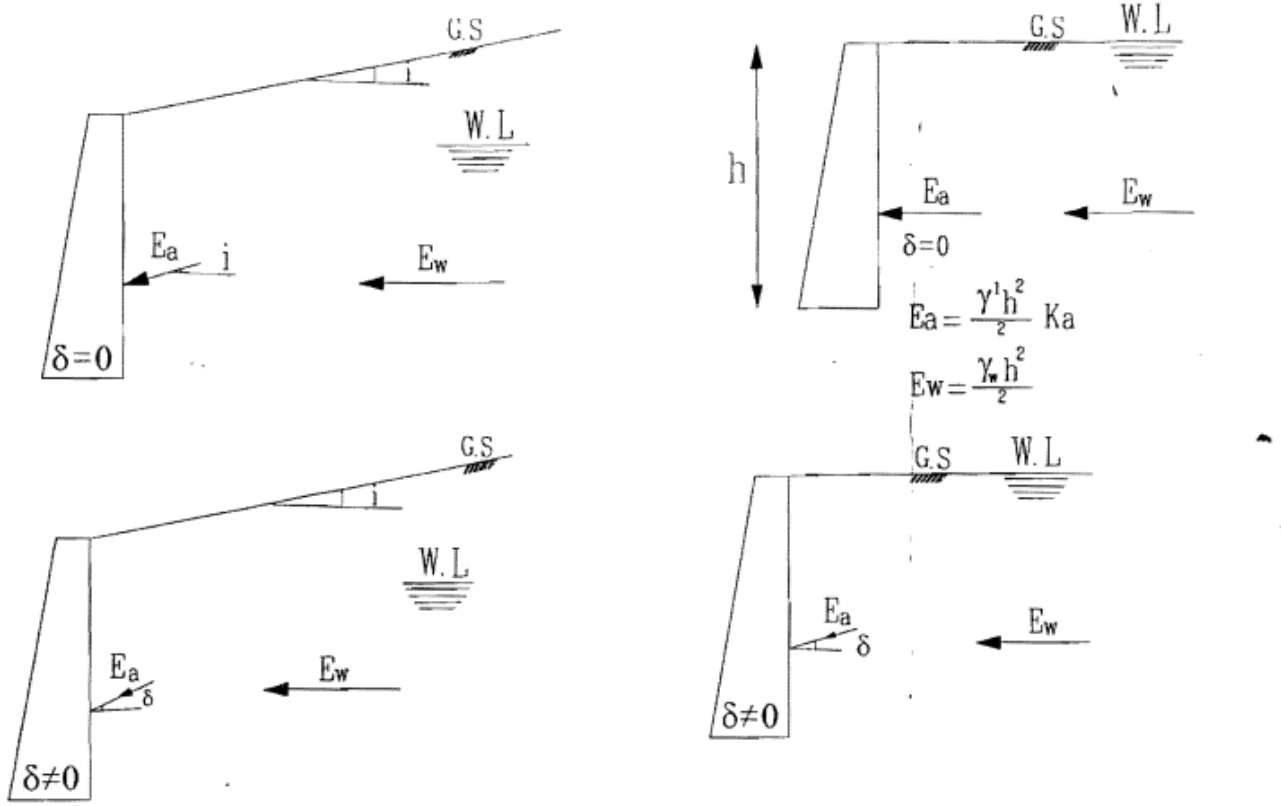
$$\cdot(\sqrt{2}V\cos\theta) - \frac{\gamma V}{2}(B'')\left(\frac{B''}{2}\right) = \gamma B'HV \qquad (5)$$

$$dE_i = s_uHV + (\sqrt{2}V)\left(\frac{B'}{\sqrt{2}}s_u\right) + 2(\sqrt{2}V)\left(\frac{\pi}{2}\right)\left(\frac{B'}{\sqrt{2}}s_u\right)$$

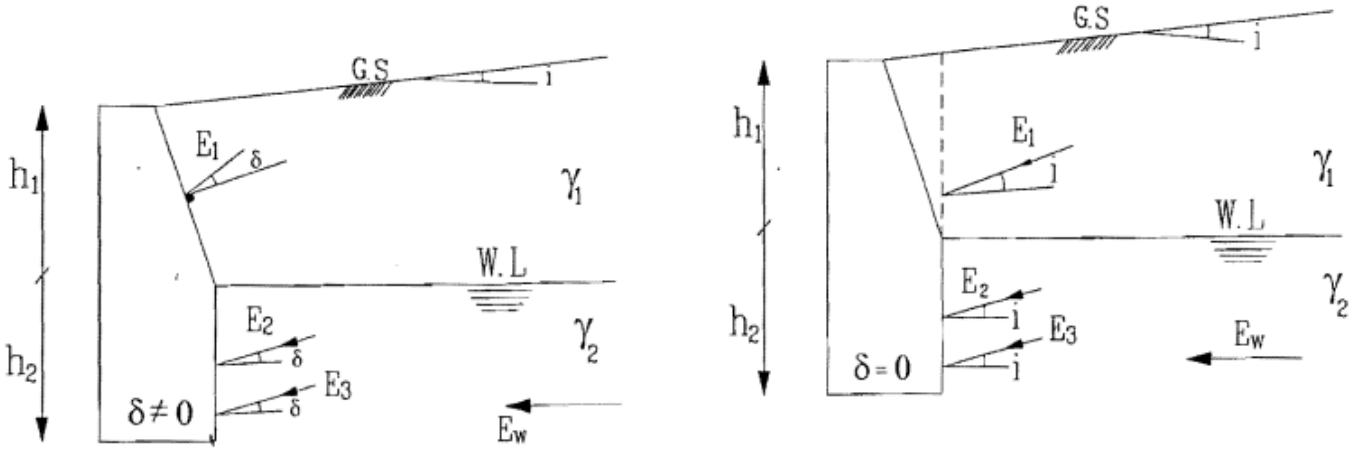
$$+ (\sqrt{2}V)\left(\frac{B''}{\sqrt{2}}s_u\right) = s_uHV + 2s_uB'V + \pi s_uB'V \qquad (6)$$

Dealing with Water Pressure

1- Static Ground Water



Considering irregular walls



$E_1 = 1/2\ (\gamma_1 h_1^2 K_a)$
$E_2 = \gamma_1 h_1 h_2 K_a \qquad E_w = 1/2\ \gamma_w h_2^2$
$E_3 = 1/2\ (\gamma_2' h_2^2 K_a)$

$E_1 = 1/2\ (\gamma_1 h_1^2 K_a)$
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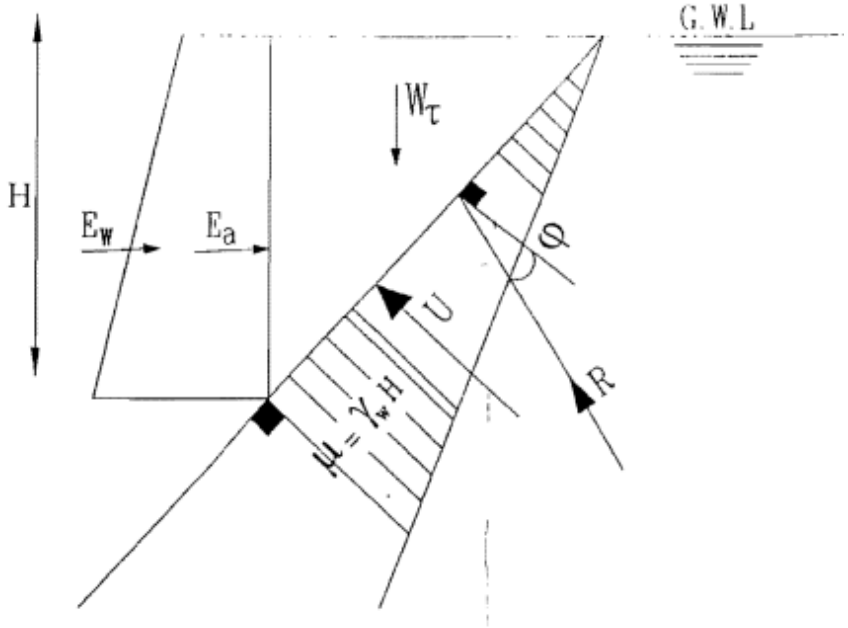
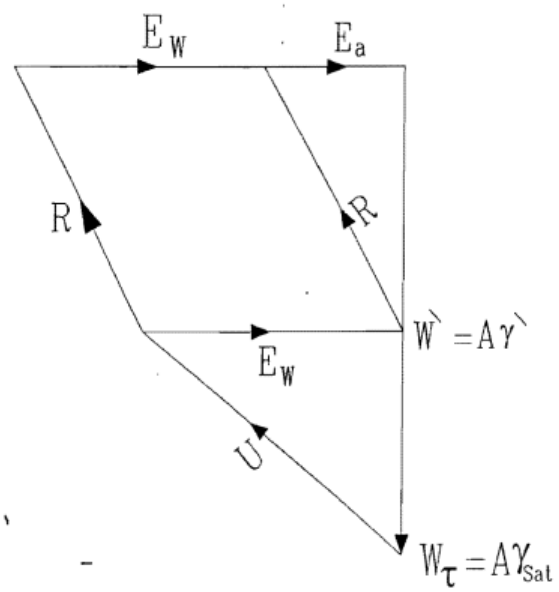
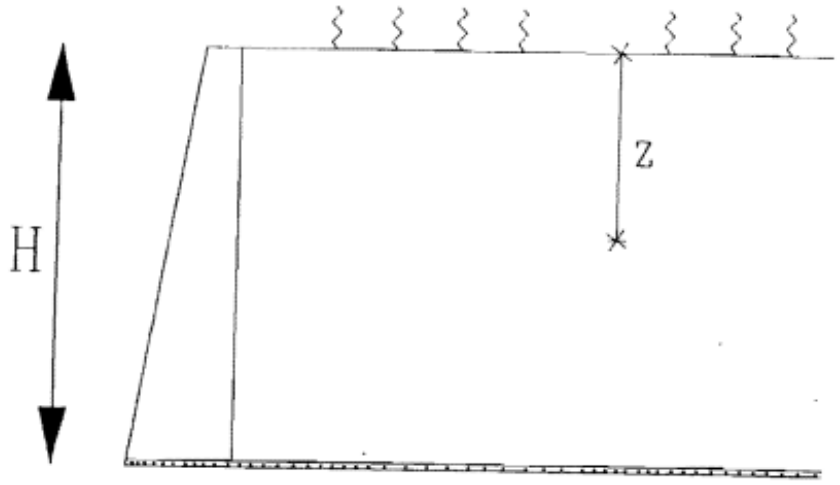
Total vs effective stresses





Horizontal Drains



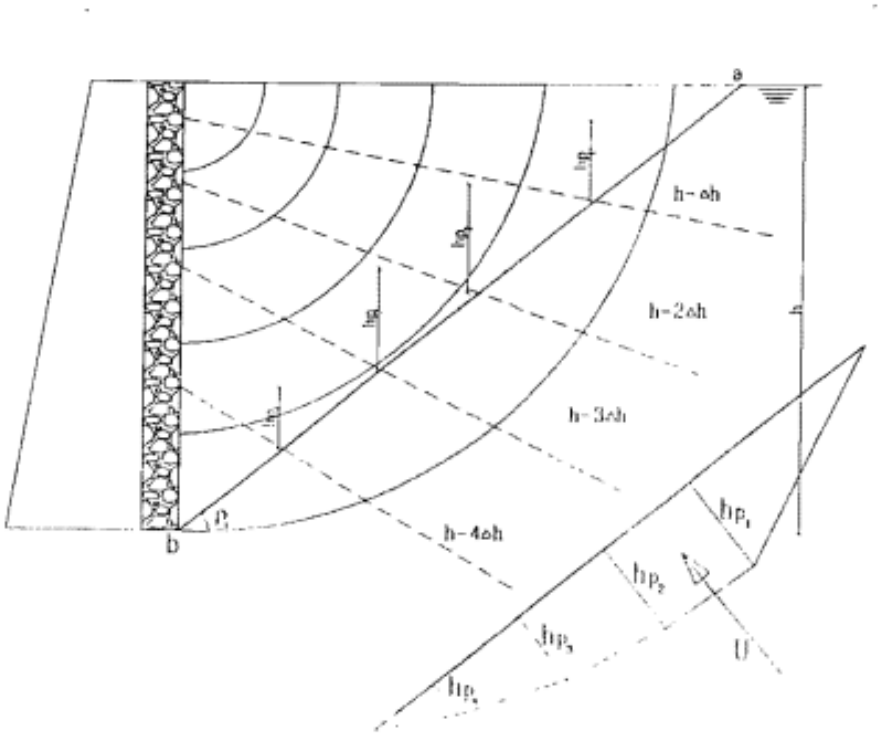
Seepage press

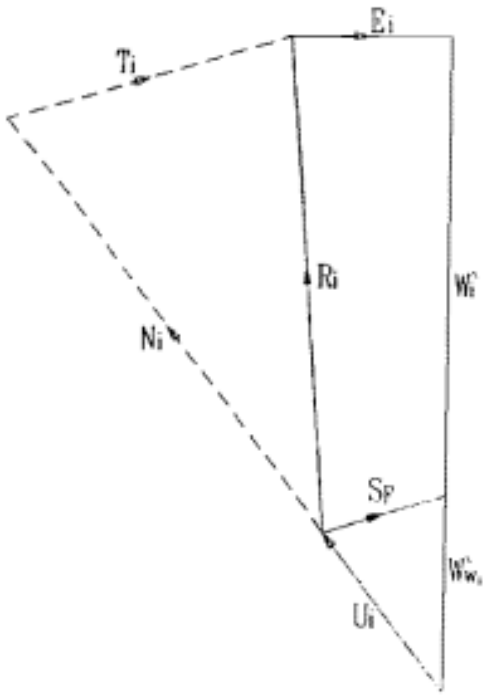
$$\sigma_v = Z(\gamma' + \overbrace{\gamma_w i}) = Z(\gamma' + \gamma_w i)$$

where $i = \frac{H}{L} = \frac{H}{H} = 1$

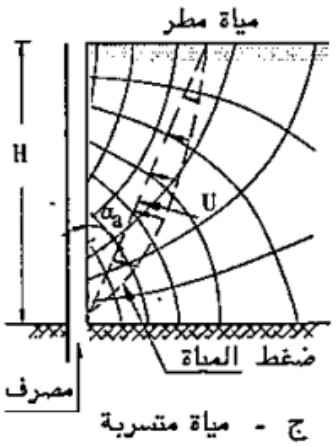
$$\sigma_v = Z(\gamma' + \gamma_w) = Z\,\gamma_{sat}$$

Vertical Drains

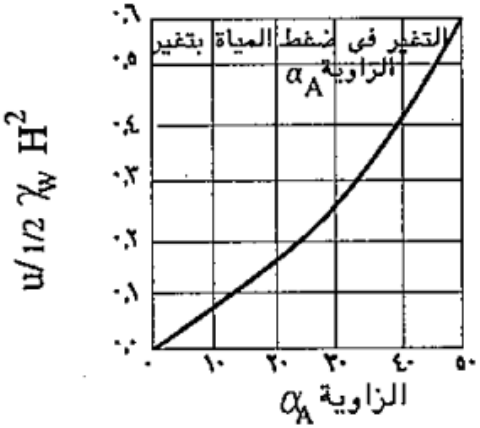


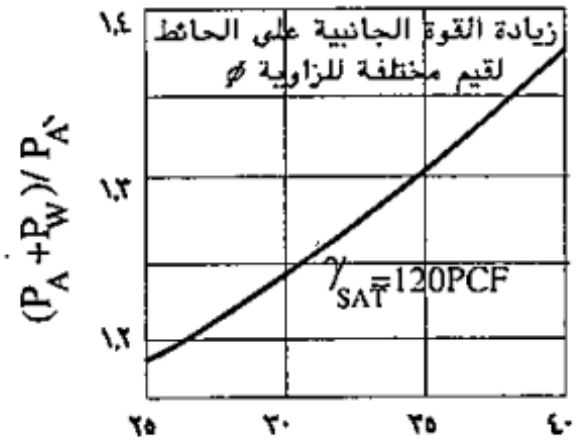


From Different Codes



ج - مياة متسربة





From ECP202

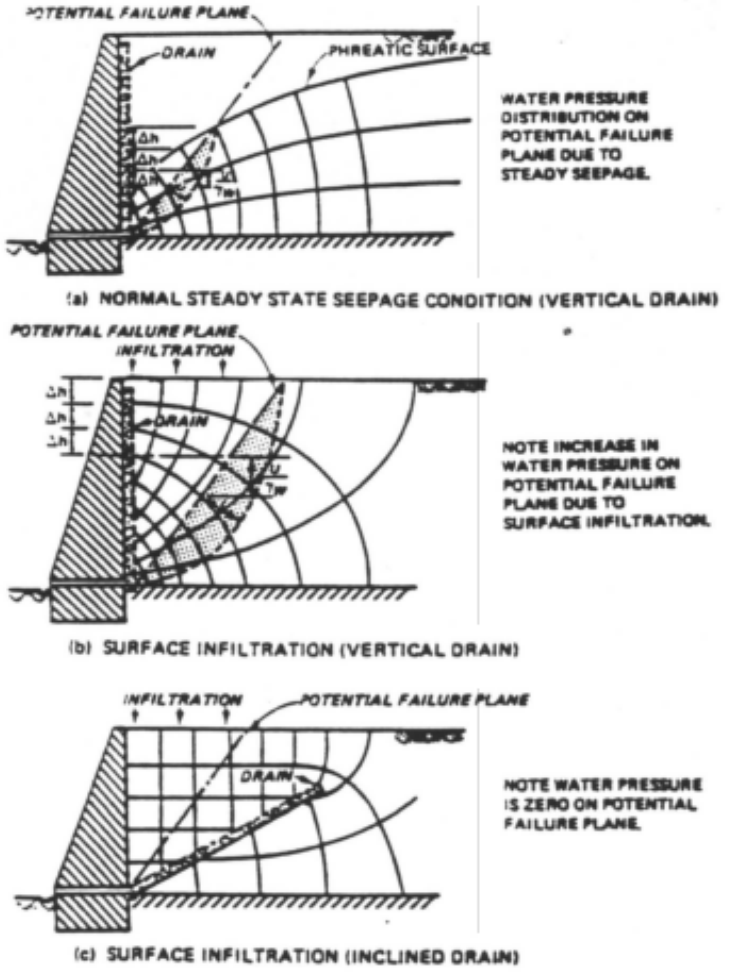


Figure 3.4. Effect of drain location on excess hydrostatic pressures on the failure plane. (From Geotechnical Control Office, 1982)

Thank you