SEEPAGE FORCE
(GAYA ALIRAN)

PENGERTIAN

ALIRAN AIR DAPAT MEYEBABKAN **PENAMBAHAN** ATAU **PENGURANGAN** NILAI **TEKANAN EFEKTIF** PADA TANAH

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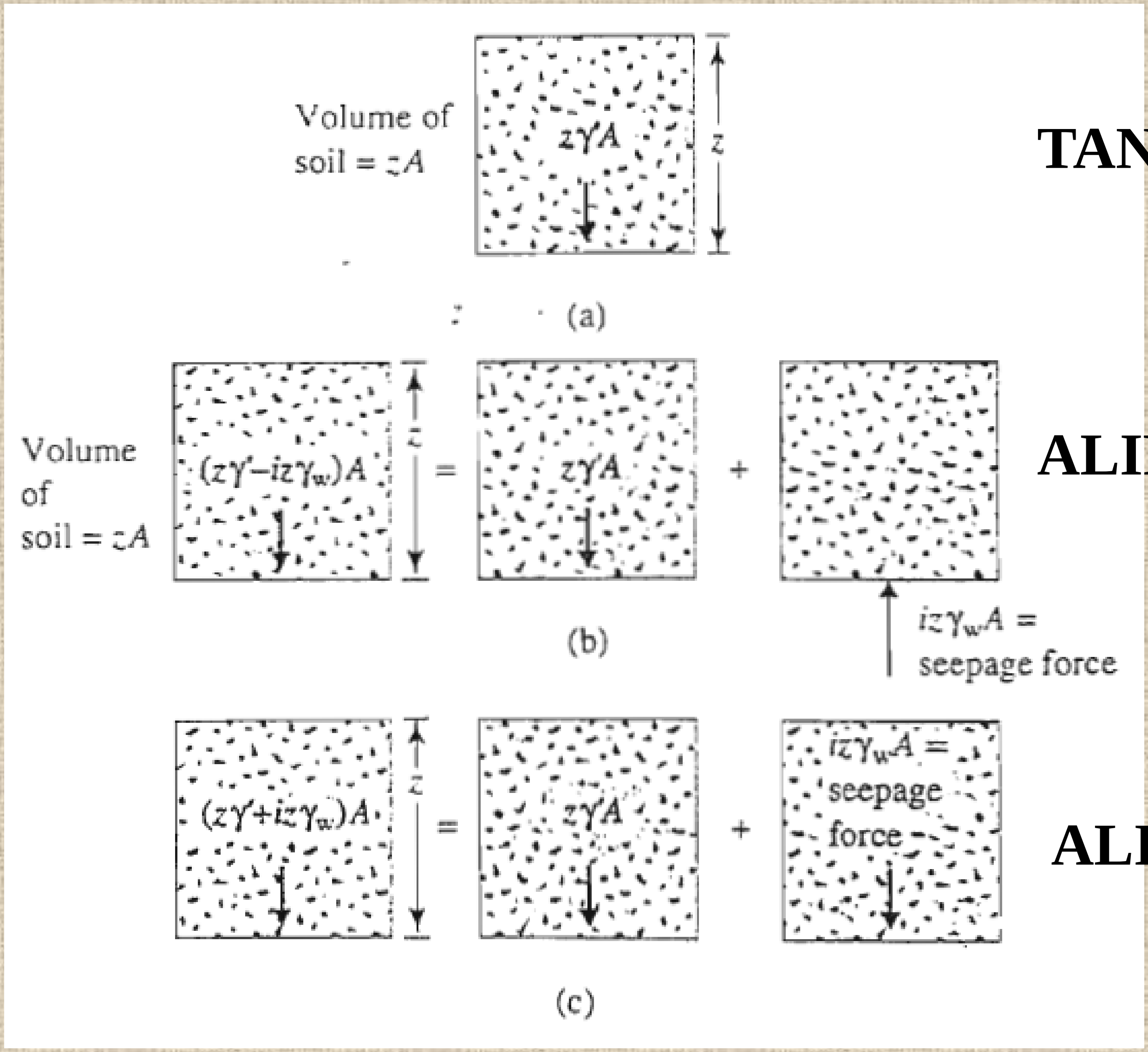
LEBIH MUDAH UNTUK MENYATAKAN NILAI ALIRAN AIR INI DALAM BENTUK GAYA ALIRAN PERSATUAN LUAS

PENGERTIAN



TANPA ALIRAN

ALIRAN KE ATAS

ALIRAN KE BAWAH

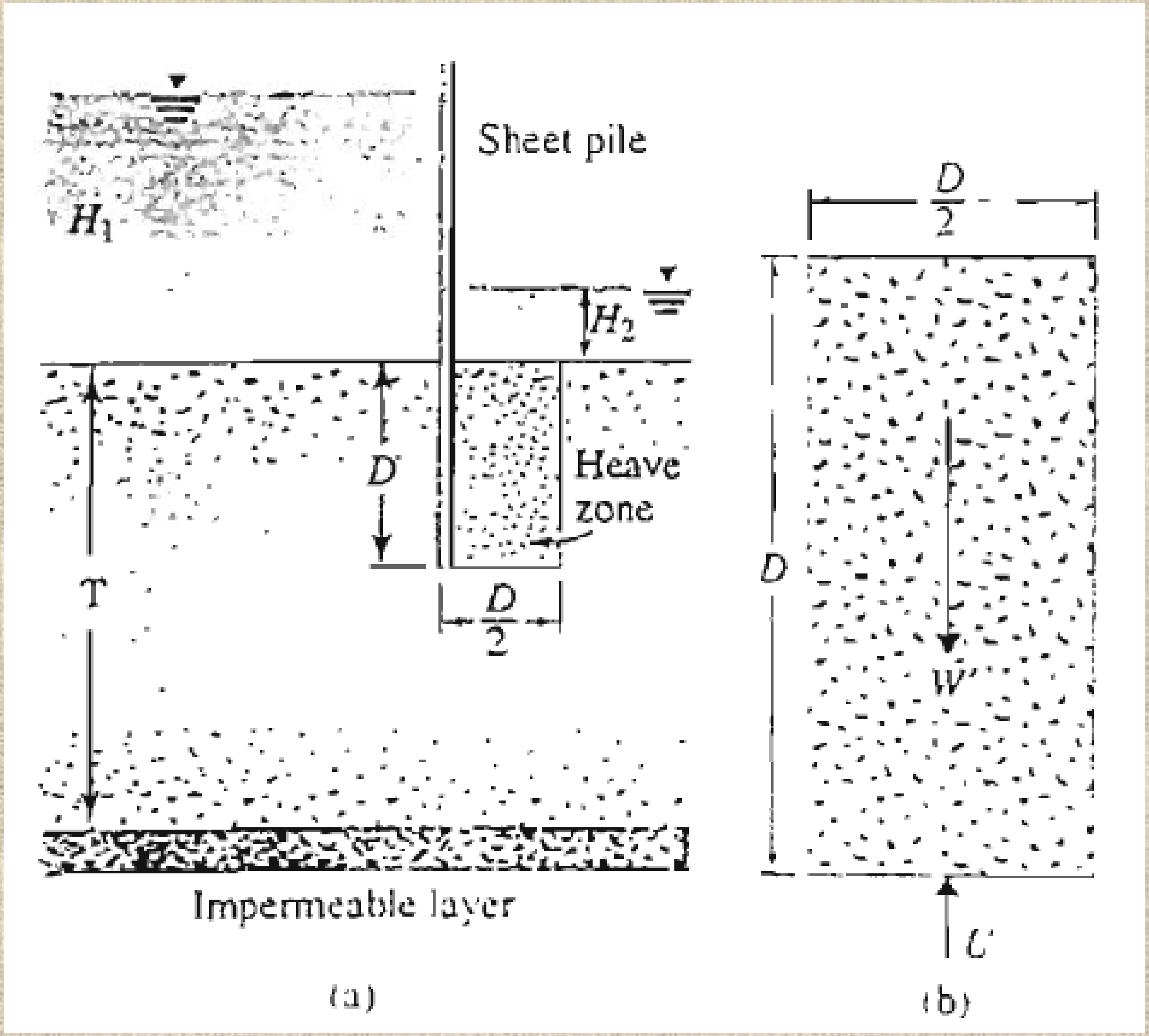
PENGERTIAN

- Tanpa aliran = $P'_1 = z.\gamma'.A$
- Aliran ke atas = $P'_2 = (z.\gamma' - i.z.\gamma_w).A$
- Penurunan tekanan efektifnya menjadi :

$$P'_1 - P'_2 = i.z.\gamma_w.A$$

$$\frac{P'_1 - P'_2}{(\text{Volume of soil})} = \frac{iz\gamma_w A}{zA} = i\gamma_w$$

FAKTOR KEAMANAN TERHADAP HEAVING



FAKTOR KEAMANAN TERHADAP HEAVING

$$FS = \frac{W'}{U}$$

where FS = factor of safety

W' = submerged weight of soil in the heave zone per unit length of sheet pile = $D(D/2)(\gamma_{sat} - \gamma_w) = (\frac{1}{2})D^2\gamma'$

U = uplifting force caused by seepage on the same volume of soil

From Eq. (8.11),

$$U = (\text{Soil volume}) \times (i_{av}\gamma_w) = \frac{1}{2}D^2 i_{av}\gamma_w$$

where i_{av} = average hydraulic gradient at the bottom of the block of soil.

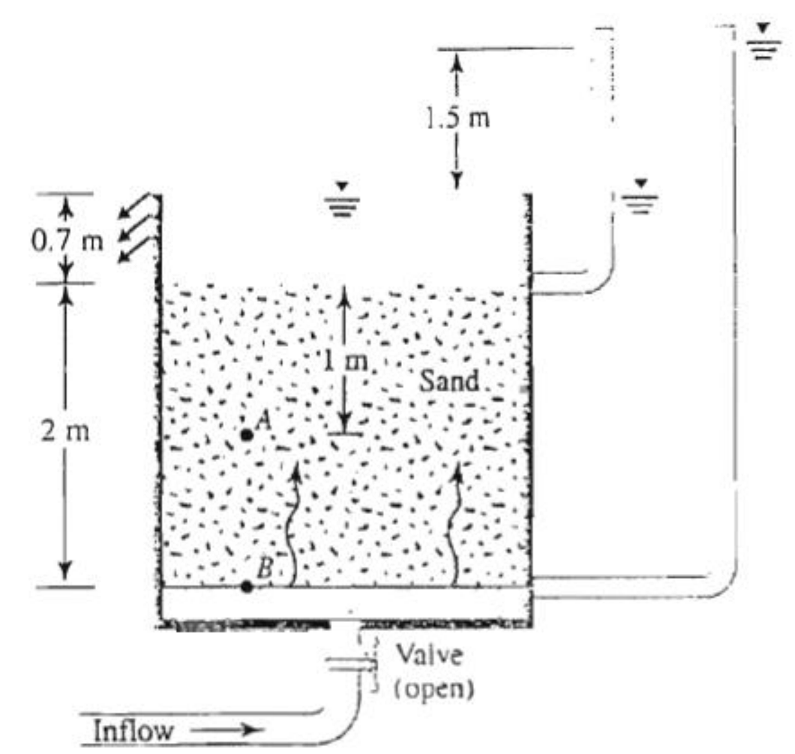
$$FS = \frac{\gamma'}{i_{av}\gamma_w}$$

CONTOH - 1

Consider the upward flow of water through a layer of sand in a tank as shown in Figure 8.9. For the sand, the following are given: void ratio (e) = 0.52 and specific gravity of solids = 2.67.

a. Calculate the total stress, pore water pressure, and effective stress at points A and B.

b. What is the upward seepage force per unit volume of soil?



CONTOH – 1

$$\gamma_{sat} = \frac{(G_s + e)\gamma_w}{1 + e} = \frac{(2.67 + 0.52)9.81}{1 + 0.52} = 20.59 \text{ kN/m}^3$$

Point	Total stress, σ (kN/m^2)	Pore water pressure, u (kN/m^2)	Effective stress, $\sigma' = \sigma - u$ (kN/m^2)
A	$0.7\gamma_w + 1\gamma_{sat} = (0.7)(9.81) + (1)(20.59) = \mathbf{27.46}$	$\left[(1 + 0.7) + \left(\frac{1.5}{2}\right)(1)\right]\gamma_w = (2.45)(9.81) = \mathbf{24.03}$	**3.43**
B	$0.7\gamma_w + 2\gamma_{sat} = (0.7)(9.81) + (2)(20.59) = \mathbf{48.05}$	$(2 + 0.7 + 1.5)\gamma_w = (4.2)(9.81) = \mathbf{41.2}$	**6.85**

b. Hydraulic gradient (i) = 1.5/2 = 0.75. Thus, the seepage force per unit volume can be calculated as

$$i\gamma_w = (0.75)(9.81) = 7.36 \text{ kN/m}^3$$

CONTOH – 2

Figure 8.10 shows the flow net for seepage of water around a single row of sheet piles driven into a permeable layer. Calculate the factor of safety against downstream heave, given that γ_{sat} for the permeable layer = 17.7 kN/m^3. (Note: thickness of permeable layer T = 18 m)

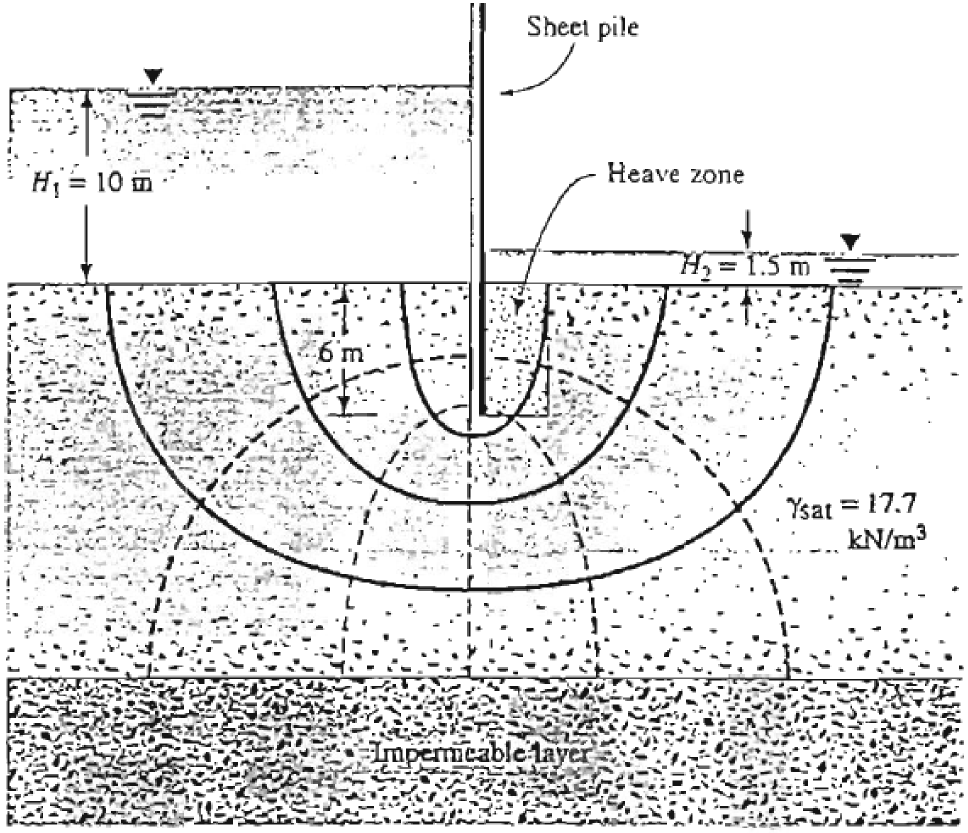


Figure 8.10 Flow net for seepage of water around sheet piles driven into permeable layer

CONTOH – 2

Solution

From the dimensions given in Figure 8.10, the soil prism to be considered is 6 m × 3 m in cross section.

The soil prism is drawn to an enlarged scale in Figure 8.11. By use of the flow net, we can calculate the head loss through the prism as follows:

- At b, the driving head $= \frac{3}{6}(H_1 - H_2)$
- At c, the driving head $\approx \frac{1.6}{6}(H_1 - H_2)$

Similarly, for other intermediate points along bc, the approximate driving heads have been calculated and are shown in Figure 8.11.

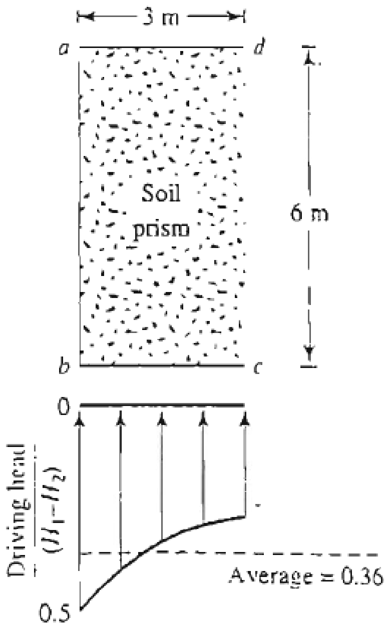


Figure 8.11 Soil prism — enlarged scale

CONTOH – 2

Solution

From the dimensions given in Figure 8.10, the soil prism to be considered is 6 m × 3 m in cross section.

The average value of the head loss in the prism is $0.36(H_1 - H_2)$, and the average hydraulic gradient is

$$i_{av} = \frac{0.36(H_1 - H_2)}{D}$$

Thus, the factor of safety [Eq. (8.13)] is

$$FS = \frac{\gamma'}{i_{av}\gamma_w} = \frac{\gamma' D}{0.36(H_1 - H_2)\gamma_w} = \frac{(17.7 - 9.81)\,6}{0.36(10 - 1.5) \times 9.81} = \mathbf{1.58}$$