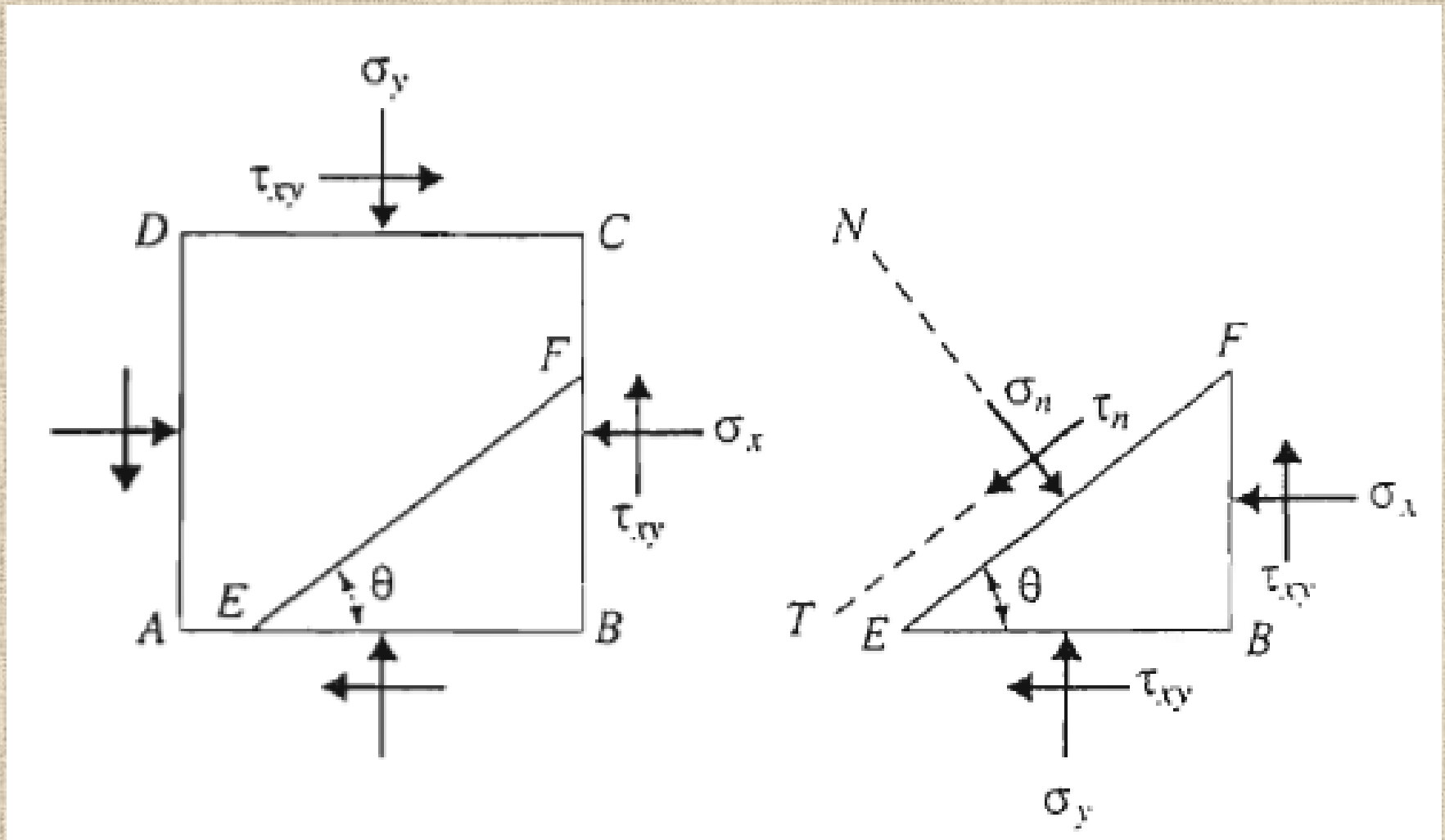
STRESSES IN SOIL MASS
(TEGANGAN PADA MASSA TANAH)

PENGERTIAN

- **KONTRUKSI PONDASI MENYEBABKAN PERUBAHAN TEGANGAN DALAM TANAH → NET STRESS MENINGKAT**
- **NILAI NET STRESS TERGANTUNG PADA BEBAN, KEDALAMAN, DAN FAKTOR LAIN**
- **PENTING UNTUK MENGHITUNG PENINGKATAN TEKANAN INI → PERHITUNGAN PENURUNAN**

TEGANGAN NORMAL DAN GESER PADA SUATU BIDANG



TEGANGAN NORMAL DAN GESER PADA SUATU BIDANG

$$\overline{EB} = \overline{EF}\cos\theta$$

$$\overline{FB} = \overline{EF}\sin\theta$$

Summing the components of forces that act on the element in the direction of N and T, we have

$$\sigma_n(\overline{EF}) = \sigma_x(\overline{EF})\sin^2\theta + \sigma_y(\overline{EF})\cos^2\theta + 2\tau_{xy}(\overline{EF})\sin\theta\cos\theta$$

or

$$\sigma_n = \sigma_x \sin^2\theta + \sigma_y \cos^2\theta + 2\tau_{xy}\sin\theta\cos\theta$$

or

$$\sigma_n = \frac{\sigma_y + \sigma_x}{2} + \frac{\sigma_y - \sigma_x}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

TEGANGAN NORMAL DAN GESER PADA SUATU BIDANG

$$\tau_n(\overline{EF}) = -\sigma_x(\overline{EF}) \sin\theta \cos\theta + \sigma_y(\overline{EF}) \sin\theta \cos\theta$$
$$- \tau_{xy}(\overline{EF}) \cos^2\theta + \tau_{xy}(\overline{EF}) \sin^2\theta$$

or

$$\tau_n = \sigma_y \sin\theta \cos\theta - \sigma_x \sin\theta \cos\theta - \tau_{xy}(\cos^2\theta - \sin^2\theta)$$

or

$$\tau_n = \frac{\sigma_y - \sigma_x}{2} \sin 2\theta - \tau_{xy} \cos 2\theta$$

$$\tan 2\theta = \frac{2\tau_{xy}}{\sigma_y - \sigma_x}$$

TEGANGAN NORMAL DAN GESER PADA SUATU BIDANG

Major principal stress:

$$\sigma_n = \sigma_1 = \frac{\sigma_y + \sigma_x}{2} + \sqrt{\left[\frac{(\sigma_y - \sigma_x)}{2}\right]^2 + \tau_{xy}^2}$$

Minor principal stress:

$$\sigma_n = \sigma_3 = \frac{\sigma_y + \sigma_x}{2} - \sqrt{\left[\frac{(\sigma_y - \sigma_x)}{2}\right]^2 + \tau_{xy}^2}$$

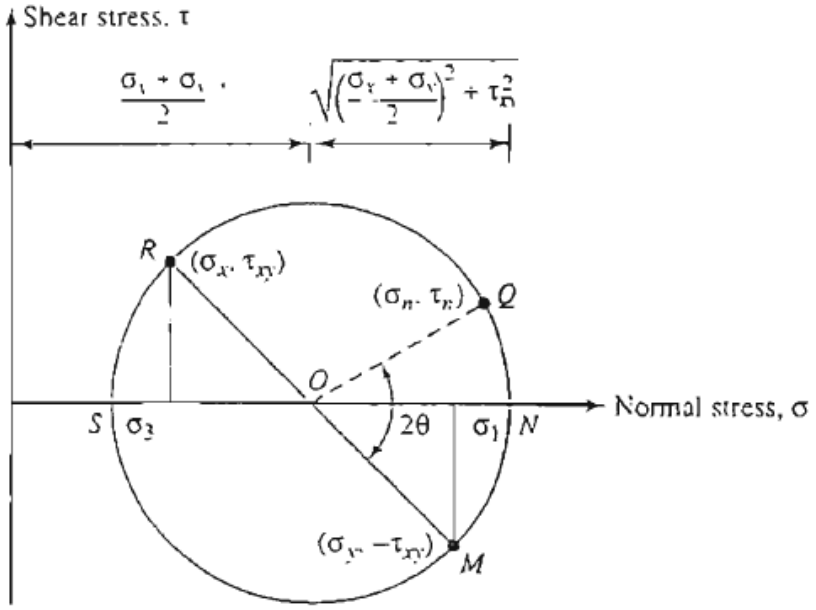


Figure 9.2 Principles of the Mohr's circle

TEGANGAN NORMAL DAN GESER PADA SUATU BIDANG

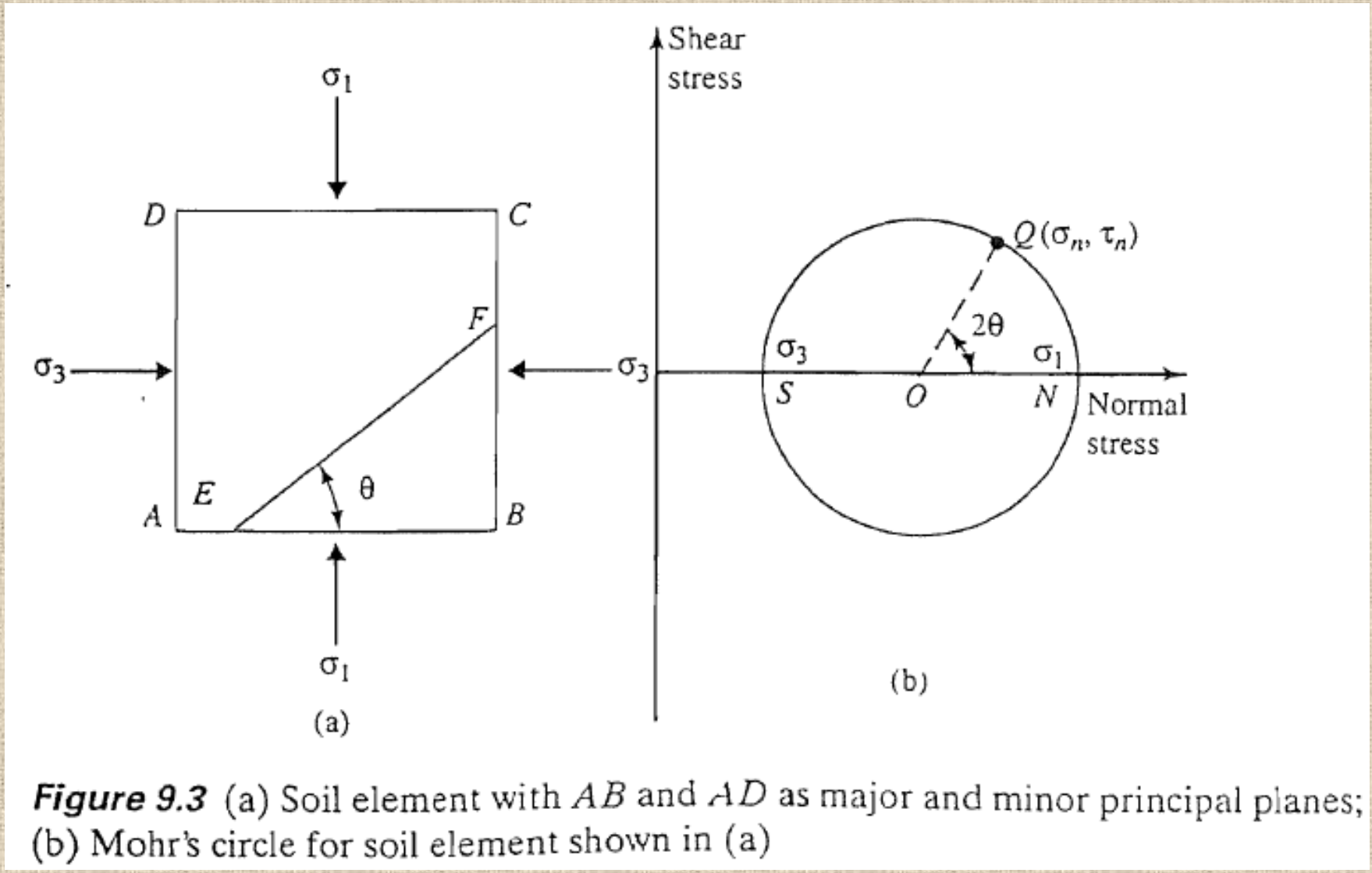


Figure 9.3 (a) Soil element with AB and AD as major and minor principal planes; (b) Mohr's circle for soil element shown in (a)

CONTOH

A soil element is shown in Figure 9.4. The magnitudes of stresses are $\sigma_x = 120\ \text{kN/m}^2$, $\tau = 40\ \text{kN/m}^2$, $\sigma_y = 300\ \text{kN/m}^2$, and $\theta = 20°$. Determine

a. Magnitudes of the principal stresses

b. Normal and shear stresses on plane AB. Use Eqs. (9.3), (9.4), (9.6), and (9.7).

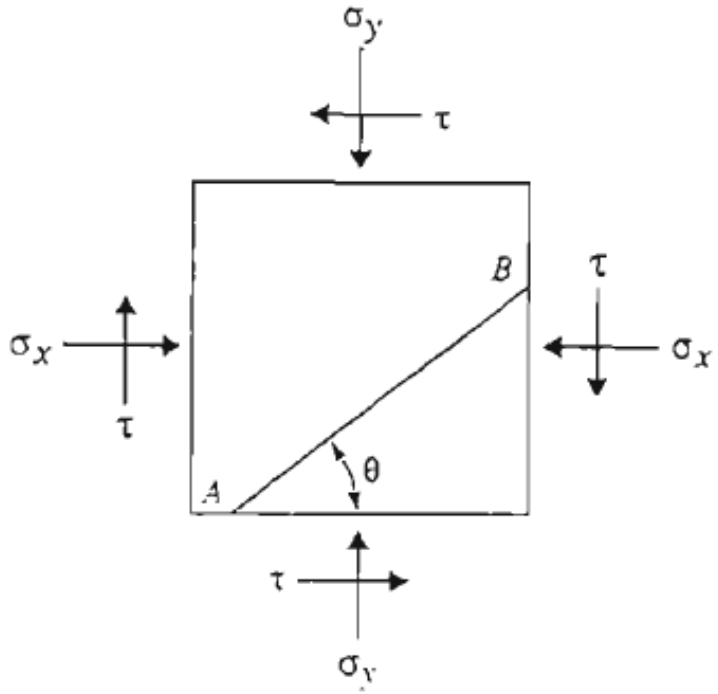


Figure 9.4 Soil element with stresses acting on it

CONTOH

Solution

a. From Eqs. (9.6) and (9.7),

$$\left.\begin{matrix}\sigma_3\\ \sigma_1\end{matrix}\right\} = \frac{\sigma_y + \sigma_x}{2} \pm \sqrt{\left[\frac{\sigma_y - \sigma_x}{2}\right]^2 + \tau_{xy}^2}$$

$$= \frac{300 + 120}{2} \pm \sqrt{\left[\frac{300 - 120}{2}\right]^2 + (-40)^2}$$

$$\sigma_1 = \mathbf{308.5\ kN/m^2}$$

$$\sigma_3 = \mathbf{111.5\ kN/m^2}$$

b. From Eq. (9.3),

$$\sigma_n = \frac{\sigma_y + \sigma_x}{2} + \frac{\sigma_y - \sigma_x}{2}\cos 2\theta + \tau \sin 2\theta$$

$$= \frac{300 + 120}{2} + \frac{300 - 120}{2}\cos (2 \times 20) + (-40)\sin (2 \times 20)$$

$$= \mathbf{252.23\ kN/m^2}$$

CONTOH

From Eq. (7.4),

$$\tau_n = \frac{\sigma_y - \sigma_x}{2} \sin 2\theta - \tau \cos 2\theta$$

$$= \frac{300 - 120}{2} \sin (2 \times 20) - (-40) \cos (2 \times 20)$$

$$= \mathbf{88.49\ kN/m^2}$$