SOIL MECHANICS

SOLUTIONS MANUAL

R.F. CRAIG

SPRINGER-SCIENCE+
BUSINESS MEDIA, B.V.

Soil Mechanics Fifth Edition Solutions Manual

R.F. Craig

Department of Civil Engineering
University of Dundee, UK

SPRINGER-SCIENCE+BUSINESS MEDIA, B.V.

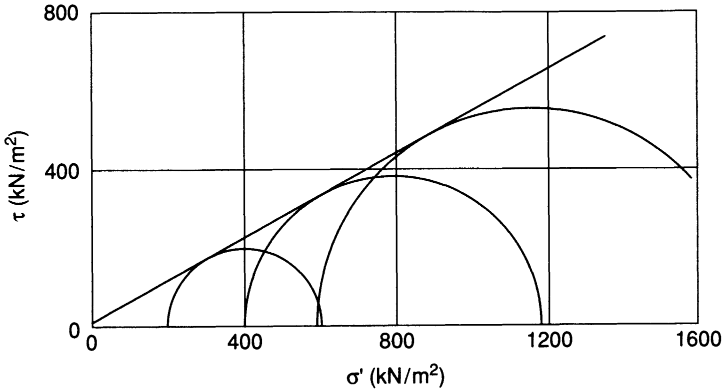

Fig. Q4.6

4.6

σ'_3 (kN/m^2)	$\Delta V/V_0$	$\Delta l/l_0$	Area (mm^2)	Load (N)	$\sigma_1 - \sigma_3$ (kN/m^2)	σ'_1 (kN/m^2)
200	0.061	0.095	1177	480	408	608
400	0.086	0.110	1165	895	768	1168
600	0.108	0.124	1155	1300	1126	1726

The average cross-sectional area of each specimen is obtained from equation 4.12; the original values of A, l and V are: $A_0 = 1134\,\text{mm}^2$, $l_0 = 76\,\text{mm}$, $V_0 = 86\,200\,\text{mm}^3$. The Mohr circles and failure envelope are drawn in Fig. Q4.6, from which $c' = 15\,\text{kN/m}^2$ and $\varphi' = 28°$.

4.7

The torque required to produce shear failure is given by:

$$T = \pi d h\, c_u \frac{d}{2} + 2\int_0^{d/2} 2\pi r \,\mathrm{d}r\, c_u r$$

$$= \pi c_u \frac{d^2 h}{2} + 4\pi c_u \int_0^{d/2} r^2 \mathrm{d}r$$

$$= \pi c_u \left(\frac{d^2 h}{2} + \frac{d^3}{6}\right)$$

Then:

$$35 = \pi\, c_u \left(\frac{5^2 \times 10}{2} + \frac{5^3}{6}\right) \times 10^{-3}$$

$$\therefore \quad c_u = 76\,\text{kN/m}^2$$

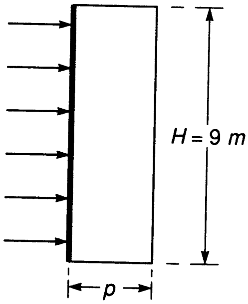

Fig. Q6.10

6.10

For $\varphi' = 40°$, $K_a = 0.22$

The pressure distribution is shown in Fig. Q6.10.

$$p = 0.65K_a\gamma H = 0.65 \times 0.22 \times 19 \times 9 = 24.5\ \text{kN/m}^2$$

Strut load $= 24.5 \times 1.5 \times 3 = 110\ \text{kN}$

6.11

$$\gamma = 18\ \text{kN/m}^3; \quad \varphi' = 34°$$

$$H = 3.50\ \text{m}; \quad nH = 3.35\ \text{m}; \quad mH = 1.85\ \text{m}$$

Consider a trial value of $F = 2.0$. Refer to Fig. 6.33.

$$\varphi'_m = \tan^{-1}\left(\frac{\tan 34°}{2.0}\right) = 18.6°$$

Then:

$$\alpha = 45° + \frac{\varphi'_m}{2} = 54.3°$$

$$W = \tfrac{1}{2} \times 18 \times 3.50^2 \times \cot 54.3° = 79.2\ \text{kN/m}$$

$$P = \tfrac{1}{2} \times \gamma_s \times 3.35^2 = 5.61\gamma_s\ \text{kN/m}$$

$$U = \tfrac{1}{2} \times 9.8 \times 1.85^2 \times \text{cosec}\ 54.3° = 20.6\ \text{kN/m}$$

Equations 6.28 and 6.29 then become:

$$5.61\gamma_s + (N - 20.6)\tan 18.6° \cos 54.3° - N \sin 54.3° = 0$$

$$79.2 - (N - 20.6)\tan 18.6° \sin 54.3° - N \cos 54.3° = 0$$

$$\therefore \quad \tan\beta = 0.234$$

$$\beta = 13^\circ$$

Water table well below surface; the factor of safety is given by equation 9.11:

$$F = \frac{\tan\phi'}{\tan\beta}$$

$$= \frac{\tan 36^\circ}{\tan 13^\circ}$$

$$= 3.1$$