

Chapter 9

Solutions to Exercises

Exercise 9.1

65% of maximum deviator stress = $0.65 \times 950 = 617.5$ kPa

corresponding strain = 7.5 %

$$\rho_i = \frac{pB(1-\mu^2)I_p}{E} = \frac{600 \times 1 \times (0.75) \times 1.22}{8345} = 0.066\text{m} = 66 \text{ mm}$$

Typo: Answer should read 66 mm in book.

Exercise 9.2

(i) Split into 4 rectangles: $B = 1$, $N_p = 0.76$

$$\rho_i = \frac{pB(1-\mu^2)N_p}{E} = \frac{400 \times 1 \times (0.75) \times 0.76}{10000} \times 4 = 92 \text{ mm}$$

(ii) Split into 2 rectangles: $B = 2$, $N_p = 0.56$

$$\rho_i = \frac{pB(1-\mu^2)N_p}{E} = \frac{400 \times 2 \times (0.75) \times 0.56}{10000} \times 2 = 67 \text{ mm}$$

(iii) Split into 2 rectangles: $B = 1$, $N_p = 0.96$

$$\rho_i = \frac{pB(1-\mu^2)N_p}{E} = \frac{400 \times 1 \times (0.75) \times 0.96}{10000} \times 2 = 58 \text{ mm}$$

Exercise 9.3

$$\text{Net pressure} = 400 - (1 \times 18) = 382 \text{ kPa}$$

$$\gamma' = 18 - 9.81 = 8.19 \text{ kPa}$$

Layer	Thickness (m)	P_{01} at layer centre (kPa)	N	C_r (= 400 x N) (kPa)	C_s (= 1.5 C_r/P_{01})
1	2.0	$1 \times 8.19 = 8.19$	15	6000	1098.9
2	2.0	$3 \times 8.19 = 24.57$	15	6000	366.3
3	2.0	$5 \times 8.19 = 40.95$	15	6000	219.8
4	2.0	$7 \times 8.19 = 57.33$	15	6000	157.0

Layer	B/z	L/z	I_σ (Fig 4.6)	$4I_\sigma$	$\frac{\sigma \Delta z}{4pl\sigma}$	$\ln \left[\frac{p_0 + \Delta \sigma_z}{p_0} \right]$ (*)	$dz/C_s \times (*)$
1	1.000	5.000	0.206	0.82	314.8	3.6746	0.0067
2	0.333	1.667	0.098	0.39	149.7	1.9593	0.0107
3	0.200	1.000	0.057	0.23	87.1	1.1400	0.0104
4	0.143	0.714	0.035	0.14	53.5	0.6590	0.0084
Σ							0.0362

$$\text{Total settlement} = 0.0362 \times 1000 = 36\text{mm, say } 40\text{mm}$$

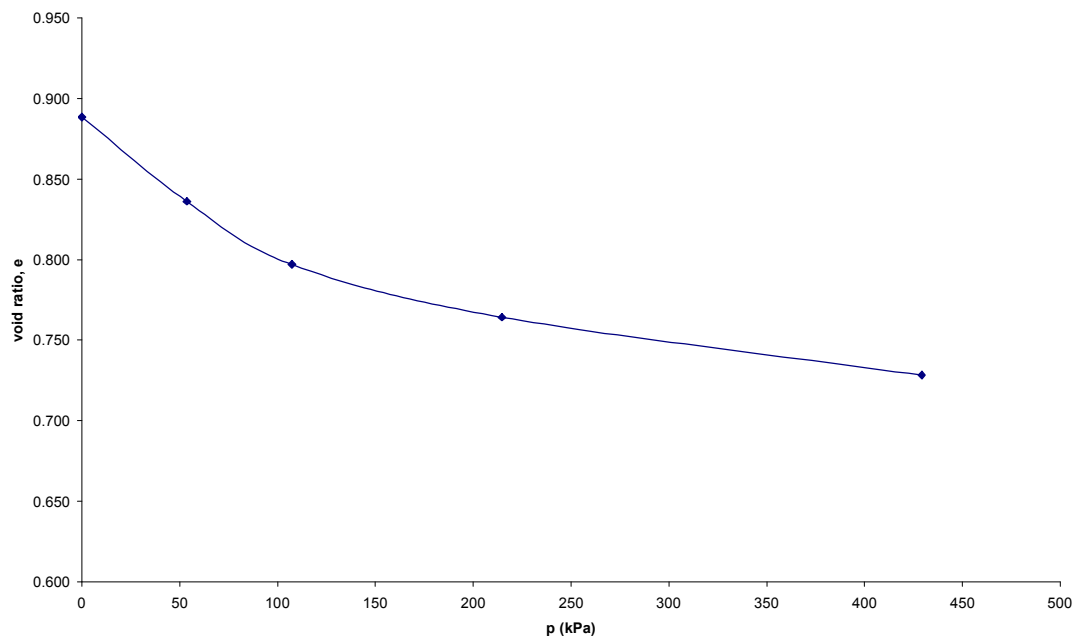
Exercise 9.4

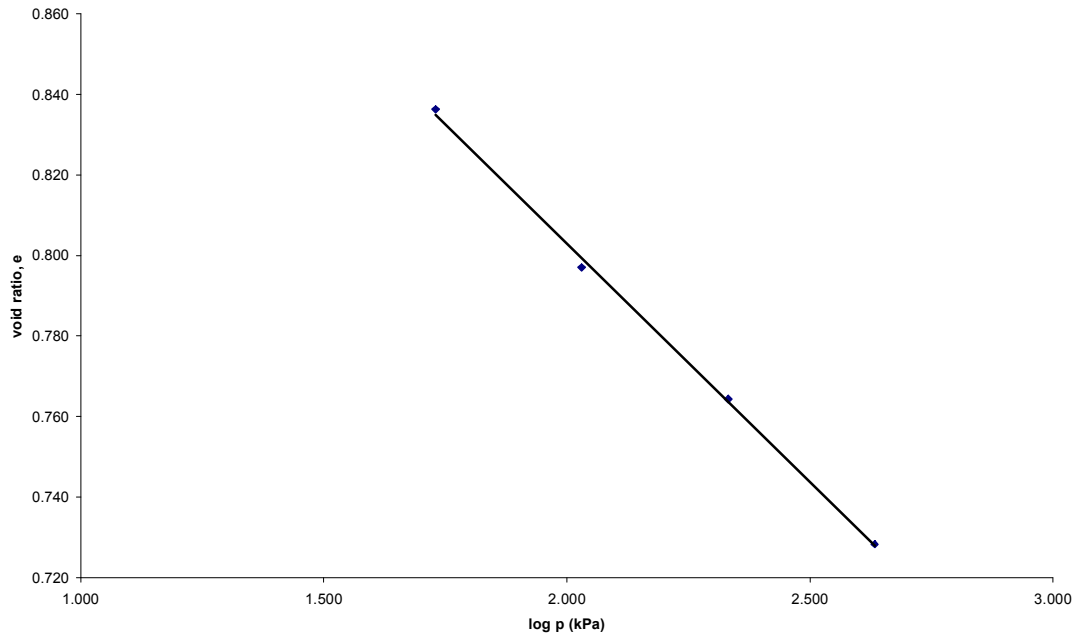
$$e = wG_s = 0.302 \times 2.65 = 0.800$$

$$de = (1 + e) / 19.25 = 0.0935$$

Pressure	H (mm)	dH (mm)	de	e
0	17.32	0.81	0.088	0.889
53.65	16.84	0.33	0.036	0.836
107.3	16.48	-0.03	-0.003	0.797
214.6	16.18	-0.33	-0.36	0.764
429.2	15.85	-0.66	-0.072	0.728
0	16.51	0	0.000	0.800

e - p plot:



e – log p plot:**Settlement by Compression Index:**

From e-log p plot, Compression index, $C_c = 0.118$

$p_1 = 107.3$ kPa

Increase in pressure = 80.5 kPa, $\Rightarrow p_2 = 187.8$ kPa

Thickness of layer, $H = 6.1$ m

$$\rho_c = \frac{C_c}{1 + e_1} \log_{10} \left(\frac{p_2}{p_1} \right) \times H$$

Settlement, $\rho_c = 98$ mm

Settlement by m_v :

e at 107.3 kPa = 0.797

e at 187.8 kPa = 0.771

$$m_v = \frac{\left(\frac{0.797 - 0.771}{80.5} \right)}{1 + 0.797} = 0.000183 \text{ m}^2/\text{kN}$$

Settlement, $\rho_c = m_v \times H \times dp = 0.000183 \times 6.1 \times 80.5 \times 1000 = 90\text{mm}$

Typo: Answer should read 90mm in book.