

习题答案

1、解：

$$(a) \quad a \text{ 点: } \sigma_{cz} = 0 \quad b \text{ 点: } \sigma_{cz} = 37.2kPa \quad c \text{ 点: } \sigma_{cz} = 91.5kPa$$

$$(b) \quad a \text{ 点: } \sigma_{cz} = 0 \quad b \text{ 点: } \sigma_{cz} = 18.6kPa \quad c \text{ 点: } \sigma_{cz} = 27.4kPa \\ d \text{ 点: } \sigma_{cz} = 52.6kPa$$

2、解：

$$(1) \quad z = 0.75m \quad b = 3m \quad \frac{z}{b} = 0.25$$

$$0 \text{ 点: } x = 0, \quad \frac{x}{b} = 0 \quad \alpha_{sz} = 0.96 \quad \sigma_z = 192kPa$$

$$B、B' \text{ 点: } x = 0.75, \quad \frac{x}{b} = 0.25 \quad \alpha_{sz} = 0.9 \quad \sigma_z = 180kPa$$

$$A、A' \text{ 点: } x = 1.5, \quad \frac{x}{b} = 0.5 \quad \alpha_{sz} = 0.5 \quad \sigma_z = 100kPa$$

$$(2) \quad x = 0 \quad b = 3m \quad \frac{x}{b} = 0$$

$$z = 0.75m, \quad \frac{z}{b} = 0.25 \quad \alpha_{sz} = 0.96 \quad \sigma_z = 192kPa$$

$$z = 1.5m, \quad \frac{z}{b} = 0.5 \quad \alpha_{sz} = 0.82 \quad \sigma_z = 164kPa$$

$$z = 3m, \quad \frac{z}{b} = 1 \quad \alpha_{sz} = 0.55 \quad \sigma_z = 110kPa$$

$$z = 6m, \quad \frac{z}{b} = 2 \quad \alpha_{sz} = 0.31 \quad \sigma_z = 62kPa$$

3、解：

$$(1) O \text{ 点: } \frac{l}{b} = 1.4 \quad \frac{z}{b} = 2 \quad \alpha_{c1} = 0.1034 \quad \sigma_{zo} = 4\alpha_{c1}P_0 = 0.4136P_0$$

$$(2) A \text{ 点: } \frac{l}{b} = 4 \quad \frac{z}{b} = 2 \quad \alpha_{c1} = 0.135 \quad \frac{l}{b} = 1.2 \quad \frac{z}{b} = 2 \quad \alpha_{c2} = 0.0947$$

$$\sigma_{zA} = 2(\alpha_{c1} - \alpha_{c2})P_0 = 0.0806P_0 \quad \frac{\sigma_{zo}}{\sigma_{zA}} = 5.13$$

4、解：

$$e_0 = \frac{\gamma_w d_s (1 + \omega)}{\gamma} - 1 = 0.78 \quad e_i = e_0 - \frac{s_i}{h_0} (1 + e_0)$$

$$p = 50kPa \quad s = 0.48mm \quad e = 0.737 \quad p = 100kPa \quad s = 0.808mm \quad e = 0.71$$

$$p = 200kPa \quad s = 1.232mm \quad e = 0.67 \quad p = 400kPa \quad s = 1.735mm \quad e = 0.626$$

$$\alpha_{1-2} = 0.4MPa^{-1} > 0.1MPa^{-1} < 0.5MPa^{-1} \quad E_s = 4.28MPa \quad \therefore \text{该土属于中压缩性土。}$$

5、解：（1）用分层总和法计算地基的沉降

1) 地基分层

$0.4b = 0.4 \times 4 = 1.6m$ 基底至地下水位面 2.4m 间分两层，每层 1.2m。

地下水位以下分 4 层，每层 1.6m，共 6.4m。

2) 计算各分层处的自重应力

z_i (m)	$\sigma_{cz} = \sum \gamma_i h_i$ (kPa)		z_i (m)	$\sigma_{cz} = \sum \gamma_i h_i$ (kPa)
1.2	35.2		5.6	77.44
2.4	54.4		7.2	88.96
4.0	65.92		8.8	100.48

3) 计算各分层处的附加应力

$$p_0 = \frac{F_K + G_K}{A} - \gamma_0 d = 94kPa$$

z_i (m)	l/b	z/b	α_{cl}	$\sigma_z = 4\alpha_{cl}p_0$ (kPa)
1.2	1.0	0.6	0.2229	83.8
2.4	1.0	1.2	0.1516	57
4.0	1.0	2.0	0.084	31.6
5.6	1.0	2.8	0.0502	18.88
7.2	1.0	3.6	0.0326	12.26
8.8	1.0	4.4	0.0227	8.54

$$z_n = 8.8m \quad \frac{\sigma_{zn}}{\sigma_{czn}} = \frac{8.54}{100.48} = 0.085 < 0.2 \quad \therefore \text{计算深度满足要求。}$$

4) 计算各层土和压缩量

$z_i (m)$ 层底深	层号	$\overline{\sigma_{zi}} = \frac{\sigma_{zi}^{\text{上}} + \sigma_{zi}^{\text{下}}}{2}$ (kPa)	$p_{1i} = \overline{\sigma_{czi}} = \frac{\sigma_{czi}^{\text{上}} + \sigma_{czi}^{\text{下}}}{2}$ (kPa)	$\frac{p_{2i}}{\overline{\sigma_{zi}} + \overline{\sigma_{czi}}}$ (kPa)	e_{1i}	e_{2i}	$\Delta s_i = \frac{e_{1i} - e_{2i}}{1 + e_{1i}} h_i$ (mm)
1.2	①	88.9	25.6	114.5	0.975	0.942	20
2.4	②	70.4	46.1	116.5	0.968	0.94	17.07
4.0	③	44.3	60.2	104.5	0.957	0.948	7.36
5.6	④	25.24	71.7	96.94	0.956	0.95	4.91
7.2	⑤	15.57	83.2	98.77	0.952	0.947	4.1
8.8	⑥	10.4	94.72	105.12	0.951	0.948	2.46
合计							46.08

(2) 规范法

设 $z_n = 8.8m$ $2m < b \leq 4m$ 查表2-10得: $\Delta z = 0.6m$

地基土分三层: $h_1 = 2.4m$ $h_2 = 5.8m$ $h_3 = 0.6m$

1) 计算 E_s

$$p_1 = 60.2kPa \quad e_1 = 0.957 \quad p_2 = 114.5kPa \quad e_2 = 0.942 \quad \alpha = \frac{e_1 - e_2}{p_2 - p_1} = 0.276MPa^{-1}$$

$$E_s = \frac{1 + e_1}{\alpha} = 7.09MPa$$

2) 列表计算 Δs_i

$$p_0 = 94kPa \quad E_s = 7.09MPa \quad \Delta s_i = \frac{p_0 (\overline{\alpha_i z_i} - \overline{\alpha_{i-1} z_{i-1}})}{E_s} \quad \psi_s = 0.993$$

$z_i (m)$	l/b	z/b	$\overline{\alpha_{i1}}$	$\overline{\alpha_i} = 4\overline{\alpha_{i1}}$	$\overline{\alpha_i z_i}$ (m)	$\overline{\alpha_i z_i} - \overline{\alpha_{i-1} z_{i-1}}$ (m)	Δs_i (mm)
0	1.0	0	0.25	1.0	0	—	
2.4	1.0	1.2	0.2149	0.86	2.064	2.064	27.36
8.2	1.0	4.1	0.1092	0.437	3.58	1.516	20.1

8.8	1.0	4.4	0.1035	0.414	3.64	0.06	0.8
合计 s'							48.26

$$s = \psi_s s' = 47.93mm$$

6、解： $l = 3m$ $b = 2m$ $F_k = 550kN$ $M_K = 250KN.m$ $d = 1.0m$

$$G_K = 120KN \quad e = \frac{M_K}{F_K + G_K} = 0.373m < \frac{l}{6} = 0.5m$$

$$\begin{aligned} p_{k\min} &= 28.4kPa \\ p_{k\max} &= 195kPa \end{aligned}$$

7、解： $G_K = 96KN$ $P_k = 124kPa$ $\sigma_{cz} = 20.84kPa$ $p_0 = 103.16kPa$