

建筑结构基础与识图

P212

模块二 习题答案

1 答案

增加条件：板的保护层厚度为 15mm，梁的保护层厚度为 25mm，轴线中线均与梁中线对齐。

②号钢筋： $\Phi 8@150$

$$l_2 = 4200 + 6.25 \times 8 \times 2 = 4300mm$$

$$n_2 = \left[\frac{7200 - 2 \times \frac{300}{2} - \frac{150}{2} \times 2}{150} + 1 \right] \times 6 = 46 \times 6 = 276 \text{ 根}$$

⑤号钢筋： $\Phi 8@200$

$$l_5 = 700 + (300 - 25 + 15 \times 8) + 6.25 \times 8 + (100 - 2 \times 15) = 1215mm$$

$$n_5 = \left[\frac{7200 - 2 \times \frac{300}{2} - \frac{200}{2} \times 2}{200} + 1 \right] \times 6 = 35 \times 6 = 210 \text{ 根}$$

⑥号钢筋： $\Phi 8@200$

$$l_6 = 2 \times 750 + 300 + (100 - 2 \times 15) \times 2 = 1940mm$$

$$n_6 = \left[\frac{7200 - 2 \times \frac{300}{2} - \frac{160}{2} \times 2}{160} + 1 \right] \times 3 = 44 \times 3 = 132 \text{ 根}$$

2 答案

增加条件：板的保护层厚度为 15mm，梁的保护层厚度为 25mm。

(1) 板底贯通筋

X 向钢筋： $\Phi 10@150$

$$l_x = 3600mm$$

$$n_x = \left[\frac{6900 - 2 \times \frac{300}{2} - \frac{150}{2} \times 2}{150} + 1 \right] = 44 \text{ 根}$$

Y 向钢筋： $\Phi 8@150$

$$l_y = 6900mm$$

$$n_y = \left[\frac{3600 - 2 \times \frac{250}{2} - \frac{150}{2} \times 2}{150} + 1 \right] = 23 \text{ 根}$$

(3) 板顶非贯通筋

①号钢筋： $\Phi 8@150$

$$l_1 = 1000 + \left(\frac{250}{2} - 25 + 15 \times 8 \right) + (150 - 2 \times 15) = 1340mm$$

$$n_1 = \left\lceil \frac{6900 - 2 \times \frac{300}{2} - \frac{150}{2} \times 2}{150} + 1 \right\rceil = 44 \text{ 根}$$

②号钢筋: $\Phi 10@100$

$$l_2 = 1800 \times 2 + (150 - 2 \times 15) \times 2 = 3840mm$$

$$n_2 = \left\lceil \frac{6900 - 2 \times \frac{300}{2} - \frac{100}{2} \times 2}{100} + 1 \right\rceil = 66 \text{ 根}$$

⑧号钢筋: $\Phi 8@100$

$$l_8 = 1000 \times 2 + (1500 + 150 \times 2) + (150 - 2 \times 15) \times 2 = 4040mm$$

$$n_8 = \left\lceil \frac{3600 - 2 \times \frac{250}{2} - \frac{100}{2} \times 2}{100} + 1 \right\rceil = 34 \text{ 根}$$

⑤号钢筋: $\Phi 8@150$

$$n_5 = \left\lceil \frac{3600 - 150 - 125 - \frac{150}{2} \times 2}{150} + 1 \right\rceil = 23 \text{ 根}$$

$$\text{圆弧段的根数: } n' = \left\lceil \frac{2250 - 150 - 150 - \frac{150}{2}}{150} + 1 \right\rceil = 13 \text{ 根}$$

通过 CAD 软件可得到圆弧段长度分别为 1244, 1445, 1607, 1741, 1854, 1949, 2028, 2093, 2146, 2188, 2219, 2219, 2239, 2249, 总长度为 25000mm, 则⑤号钢筋总长为:

$$\begin{aligned} l_5 &= (25000 - 13 \times 25 + 15 \times 8 \times 13) + 300 \times 3 + 1000 \times 13 + (150 - 2 \times 15) \times 13 \\ &\quad + (23 - 13) \times (1000 + 2400 + 150 - 25 + 15 \times 8 + 150 - 2 \times 25) \\ &= 82345mm \end{aligned}$$

(3) 分布筋: $\Phi 8@250$

$$l_x = 3600 - 1000 - 1800 + 150 \times 2 = 1100mm$$

$$l_y = 6900 - 1000 - 1000 + 150 \times 2 = 5200mm$$

$$n_{x8} = \left\lceil \frac{1000 - \frac{300}{2} - \frac{200}{2}}{250} + 1 \right\rceil = 4 \text{ 根}$$

$$n_{x5} = \left\lceil \frac{1000 - \frac{300}{2} - \frac{200}{2}}{250} + 1 \right\rceil = 4 \text{ 根}$$

$$n_{y1} = \left\lceil \frac{1000 - \frac{250}{2} - \frac{250}{2}}{250} + 1 \right\rceil = 4 \text{ 根}$$

$$n_{y2} = \left\lceil \frac{1800 - \frac{250}{2} - \frac{250}{2}}{250} + 1 \right\rceil = 8 \text{ 根}$$

3 答案

KL4 由题意可得: 梁柱的保护层厚度为 25mm, 柱截面为 $500 \times 450mm$, 抗震锚固长度 $l_{aE} = 33d$, 设为焊接。

(1) 梁上部通长筋为 2Φ22

$$h_c = 450 < l_{aE} = 33 \times 22 = 726\text{mm} \text{ 弯锚}$$

$$l_1 = (2400 + 150 + 6900 + 1800 + 6900) - 25 + 12 \times 22 + 150 - 25 + 15 \times 22 = 18844\text{mm}$$

$$\text{焊头数: } 1884 \times 2 = 57688\text{mm}$$

(2) 梁上部支座负筋

A 轴第一排支座负筋: ②2Φ22

$$l_2 = 2400 + 150 - 25 + 12 \times 22 + 300 + \frac{6900 - 300 \times 2}{3} = 5189\text{mm}$$

$$\text{总长: } 5189 \times 2 = 10378\text{mm}$$

A 轴第二排支座负筋: ③ 2Φ22

$$l_3 = 2400 + 150 - 25 + 12 \times 22 + 300 + \frac{6900 - 300 \times 2}{4} = 4664\text{mm}$$

$$\text{总长: } 4664 \times 2 = 9328\text{mm}$$

B、C 轴第一排支座负筋: ④2Φ22

$$l_4 = 1800 + 300 \times 2 + \frac{6900 - 300 \times 2}{3} = 4500\text{mm}$$

$$\text{总长: } 4500 \times 2 = 9000\text{mm}$$

B、C 轴第二排支座负筋: ⑤2Φ22

$$l_5 = 1800 + 300 \times 2 + \frac{6900 - 300 \times 2}{4} = 3975\text{mm}$$

$$\text{总长: } 3975 \times 2 = 7950\text{mm}$$

D 轴第一排支座负筋: ⑥2Φ22

$$l_6 = 450 - 25 + 15 \times 22 + \frac{6900 - 300 \times 2}{3} = 2855\text{mm}$$

$$\text{总长: } 2855 \times 2 = 5710\text{mm}$$

D 轴第二排支座负筋: ⑦2Φ22

$$l_7 = 450 - 25 + 15 \times 22 + \frac{6900 - 300 \times 2}{4} = 2330\text{mm}$$

$$\text{总长: } 2330 \times 2 = 4660\text{mm}$$

(3) 梁下部钢筋

C、D 跨: ⑧7Φ20

$$l_8 = (6900 - 300 \times 2) + (450 - 25 + 15 \times 20) + 33 \times 20 = 7685\text{mm}$$

$$\text{总长: } 7685 \times 7 = 53795\text{mm}$$

B、C 跨: ⑨2Φ20

$$l_9 = (1800 - 150 \times 2) + 33 \times 20 \times 2 = 2820\text{mm}$$

$$\text{总长: } 2820 \times 2 = 5640\text{mm}$$

A、B 跨: ⑩6Φ22

$$l_{10} = (6900 - 300 \times 2) + 33 \times 20 \times 2 = 7620\text{mm}$$

$$\text{总长: } 7620 \times 2 = 15240\text{mm}$$

悬挑部分: Ⅱ2Φ16

$$l_{11} = 2400 + 150 - 25 - 150 \times 16 = 2615\text{mm}$$

$$\text{总长: } 2615 \times 2 = 5230\text{mm}$$

(4) 构造筋 $\square 4 \phi 10$

$$C、D \text{ 跨: } (6900 - 300 \times 2) + 15 \times 10 \times 2 = 6600mm$$

$$A、B \text{ 跨: } (6900 - 300 \times 2) + 15 \times 10 \times 2 = 6600mm$$

$$B、C \text{ 跨: } (1800 - 150 \times 2) + 15 \times 10 \times 2 = 1800mm$$

$$\text{悬挑部分: } 2400 - 150 + 150 - 25 + 15 \times 10 \times 2 = 2525m$$

$$\text{总长: } (6600 + 1800 + 6600 + 2525) \times 4 = 70100mm$$

(5) 拉筋 $\square \phi 6@400$

$$\text{由 } b = 250mm < 350mm$$

$$\therefore d = 6mm, s = 400mm$$

$$d_{13} = (b - x) + [\max(75, 10d) + 1.9d] \times 2 = 373mm$$

$$n_1 = \left[\frac{6900 - 2 \times 300 - 50 \times 2}{400} + 1 \right] = 17 \text{ 根}$$

$$n_2 = \left[\frac{1800 - 2 \times 150 - 50 \times 2}{400} + 1 \right] = 5 \text{ 根}$$

$$n_3 = \left[\frac{6900 - 2 \times 300 - 50 \times 2}{400} + 1 \right] = 17 \text{ 根}$$

$$n_4 = \left[\frac{2400 + 150 - 150 - 25 - 50}{400} + 1 \right] = 7 \text{ 根}$$

$$\text{总长: } 373 \times (17 + 5 + 17 + 5 + 7) = 17158mm$$

(6) 箍筋 $\square \phi 10@100/200 (2)$

$$d_{14} = [(b - 2c) + (h - 2c) + 1.9d + \max(10d, 75)] \times 2 = 1938mm$$

C、D 跨:

$$n_1 = \left[\frac{\max(1.5 \times 700, 500) - 50}{100} + 1 \right] = 11 \text{ 根}$$

$$n_2 = \left[\frac{6900 - 2 \times 300 - 1.5 \times 700 \times 2}{200} - 1 \right] = 20 \text{ 根}$$

B、C 跨:

$$n_3 = \left[\frac{1800 - 2 \times 150 - 50 \times 2}{100} + 1 \right] = 15 \text{ 根}$$

A、B 跨:

$$n_4 = \left[\frac{\max(1.5 \times 700, 500) - 50}{100} + 1 \right] = 11 \text{ 根}$$

$$n_5 = \left[\frac{6900 - 2 \times 300 - 1.5 \times 700 \times 2}{200} - 1 \right] = 20 \text{ 根}$$

悬挑部分:

$$n_6 = \left[\frac{2400 + 150 - 150 - 25 - 50}{100} + 1 \right] = 25 \text{ 根}$$

$$\text{总长: } 1938 \times (11 \times 2 + 20 + 15 + 11 \times 2 + 20 + 25) = 240312mm$$

4 答

$$KZ4 \text{ 设为柱 包梁锚固长为 } l_{aE} = 1.5l_{abE} = 1.5 \times 31d, C_s = 40mm, C_c = 30mm$$

(1) 受力筋

外侧纵筋:

$$l_1 = 14450 + 200 + 5200 - 40 + \max(6d, 150) - 600 + 1.5 \times 31 \times 18 = 20197mm$$

$$n_1 = 4 \text{ 根}$$

内侧纵筋

$$l_2 = 14450 + 200 + 5200 - 40 + \max(6d, 150) - 30 + 12 \times 18 = 20146mm$$

$$n_2 = 8 \text{ 根}$$

$$\text{总长: } 20197 \times 4 + 20146 \times 8 = 241956mm$$

(2) 箍筋

外大箍

$$l_0 = [(b - 2c) + (h - 2c) + 1.9d + \max(10d, 75)] \times 2$$

$$l_1 = [(500 - 2 \times 30) + (500 - 2 \times 30) + 1.9 \times 8 + 10 \times 8] \times 2 = 1951mm$$

$$l_2 = [(500 - 2 \times 30) + (500 - 2 \times 30) + 1.9 \times 10 + 10 \times 10] \times 2 = 1998mm$$

内小箍

$$l = [(b - 2c) + 1.9d + \max(10d, 75)] \times 2 + \left[\frac{(b - 2c - 2d - 4D)}{3} + 2D + 2d \right] \times 2$$

$$l_3 = [(500 - 2 \times 30) + 1.9 \times 8 + 10 \times 8] \times 2$$

$$+ \left[\frac{500 - 30 \times 2 - 2 \times 8 - 4 \times 18}{3} + 2 \times 18 + 2 \times 8 \right] \times 2 = 1410mm$$

$$l_4 = [(500 - 2 \times 30) + 1.9 \times 10 + 10 \times 10] \times 2$$

$$+ \left[\frac{500 - 30 \times 2 - 2 \times 10 - 4 \times 18}{3} + 2 \times 18 + 2 \times 10 \right] \times 2 = 1462mm$$

基础内: 外大箍

$$n_1 = \max \left[\frac{650 - 100 - 40}{500} + 1, 2 \right] = 3 \text{ 根}$$

嵌固部位以上 $\frac{H_n}{3}$ 内:

$$H_n = 5200 - 500 - 650 = 4050mm$$

$$n_2 = \left[\frac{\frac{H_n}{3} - 50}{100} + 1 \right] = 14 \text{ 根}$$

$$n_3 = \left[\frac{h_{b1} + \max(\frac{H_n}{6}, h_c, 500)}{100} + 1 \right] = 13 \text{ 根}$$

$$n_4 = \left[\frac{H_n - \frac{H_n}{3} - \frac{H_n}{6}}{200} - 1 \right] = 10 \text{ 根}$$

$$\text{一层: } H_{n1} = 3650 + 200 - 600 = 3250mm$$

$$\text{二层: } H_{n2} = 7250 - 3650 - 600 = 3000mm$$

$$n_5 = \left[\frac{\frac{H_n}{3} - 50}{100} + 1 \right] = 12 \text{ 根}$$

$$n_6 = \left[\frac{\max\left(\frac{H_{n1}}{6}, h_c, 500\right) + 600 + \max\left(\frac{H_{n2}}{6}, h_c, 500\right)}{100} + 1 \right] = 18 \text{ 根}$$

$$n_7 = \left[\frac{3250 - 509 - 500}{200} - 1 \right] = 11 \text{ 根}$$

二层: $H_{n2} = 3000mm$

三层: $H_{n3} = 3000mm$

$$n_8 = \left[\frac{\max\left(\frac{H_{n2}}{6}, h_c, 500\right) + 600 + \max\left(\frac{H_{n3}}{6}, h_c, 500\right)}{100} + 1 \right] = 17 \text{ 根}$$

$$n_9 = \left[\frac{3000 - 500 - 500}{200} - 1 \right] = 9 \text{ 根}$$

三层: $H_{n3} = 3000mm$

四层: $H_{n4} = 2400mm$

$$n_{10} = \left[\frac{\max\left(\frac{H_{n3}}{6}, h_c, 500\right) + 600 + \max\left(\frac{H_{n4}}{6}, h_c, 500\right)}{100} + 1 \right] = 17 \text{ 根}$$

$$n_{11} = \left[\frac{3000 - 500 - 500}{200} - 1 \right] = 9 \text{ 根}$$

四层: $H_{n4} = 2400mm$

$$n_{12} = \left[\frac{600 - 30 + 500}{100} + 1 \right] = 12 \text{ 根}$$

$$n_{13} = \left[\frac{2400 - 500 - 500}{200} - 1 \right] = 6 \text{ 根}$$

总 长 : $l_2 \times (n_1 + n_2 + n_3 + n_4) + l_1 \times (n_5 + \dots + n_{13}) + l_4 \times (n_2 + n_3 + n_4) + l_3 \times (n_5 + \dots + n_{13}) = 503724mm$

5 答案

已知: 墙保护层厚度为 15mm, $l_{aE} = 37d$

(1) 墙身 Q1

1) 水平钢筋① $\Phi 12@200$ /② $\Phi 10@200$

$$l_{1\text{外}} = 6900 + 150 \times 2 - 15 \times 2 + 0.8 \times 37 \times 12 = 7525mm$$

$$l_{1\text{内}} = 6900 + 150 \times 2 - 15 \times 2 + 15 \times 12 = 7350mm$$

$$l_{2\text{外}} = 6900 + 150 \times 2 - 15 \times 2 + 0.8 \times 37 \times 10 = 7465mm$$

$$l_{2\text{内}} = 6900 + 150 \times 2 - 15 \times 2 + 15 \times 10 = 7320mm$$

$$n_1 = \frac{4500 - 200}{200} + 1 = 23 \text{ 根}$$

$$n_2 = \frac{4200 - 200}{200} + 1 = 21 \text{ 根}$$

$$n_3 = \frac{3600 - 200}{200} + 1 = 18 \text{ 根}$$

$$n_4 = n_5 = \dots = n_{16} = 18 \text{ 根}$$

$$n_{\text{屋}} = \frac{3300 - 200}{200} + 1 = 17 \text{ 根}$$

总长:

$\Phi 12@200$

$$l_{1\text{外}} \times (n_1 + \dots + n_9) = 1279250 \text{ mm}$$

$$l_{1\text{内}} \times (n_1 + \dots + n_9) = 1249500 \text{ mm}$$

$$\Phi 12 \text{ 总长} = 1279250 + 1249500 = 2528750 \text{ mm}$$

$\Phi 10@200$

$$l_{2\text{外}} \times (n_{10} + \dots + n_{16} + n_{\text{屋}}) = 1067495 \text{ mm}$$

$$l_{2\text{内}} \times (n_{10} + \dots + n_{16} + n_{\text{屋}}) = 1046760 \text{ mm}$$

$$\Phi 10 \text{ 总长} = 1067495 + 1046760 = 2114255 \text{ mm}$$

2) 竖向钢筋③ $\Phi 12@200$ /④ $\Phi 10@200$

$$l_3 = 4500 + 4200 + 3600 \times 7 + 1.2 \times 37 \times 9 \times 12 - 30 + \max(6 \times 12, 150) \\ = 38816 \text{ mm}$$

$$l_4 = 3600 \times 7 + 3300 - 15 + 12 \times 10 + 1.2 \times 37 \times 10 \times 7 = 31713 \text{ mm}$$

$$n = \frac{6900 - 150 \times 2 - 600 \times 2 - 2 \times 50}{200} + 1 = 31 \text{ 根}$$

总长:

$\Phi 12@200$

$$38816 \times 31 \times 2 = 2406592$$

$\Phi 10@200$

$$31713 \times 31 \times 2 = 1966206 \text{ mm}$$

3) 拉筋 $\Phi 6@600 @600$

$$l = (b - 2c) + [1.9d + \max(10d, 75)] \times 2$$

$$l_1 = 443 \text{ mm}$$

$$l_2 = 393 \text{ mm}$$

$$n_1 = \left\lceil \frac{(6900 + 150 \times 2 - 600 \times 2) \times 4500}{600 \times 600} \right\rceil = 75 \text{ 根}$$

$$n_2 = \left\lceil \frac{(6900 + 150 \times 2 - 600 \times 2) \times 4200}{600 \times 600} \right\rceil = 70 \text{ 根}$$

$$n_3 = \left\lceil \frac{(6900 + 150 \times 2 - 600 \times 2) \times 3600}{600 \times 600} \right\rceil = 60 \text{ 根}$$

$$n_4 = \dots = n_{16} = 60 \text{ 根}$$

$$n_{\text{屋}} = \left\lceil \frac{(6900 + 150 \times 2 - 600 \times 2) \times 3300}{600 \times 600} \right\rceil = 55 \text{ 根}$$

$$\text{总长: } l_1 \times (n_1 + n_2 + n_3 + \dots + n_9) + l_2 \times (n_{10} + \dots + n_{16} + n_{\text{屋}}) = 251330mm$$

(2) 墙柱 YBZ1

1) 纵筋

$$l = 12270 + 30 - 30 + \max(6 \times 20, 150) - 15 + 12 \times 20 = 12645mm$$

$$\text{总长: } 12645 \times 24 = 303480mm$$

2) 箍筋

$$l = [(1050 - 2 \times 15) + (300 - 2 \times 15) + 1.9 \times 10 + 10 \times 10] \times 2 \\ + [(300 - 2 \times 15) + (600 - 2 \times 15) + 1.9 \times 10 + 10 \times 10] \times 2 \\ + [(300 - 2 \times 15) + (1.9 \times 10 + 10 \times 10) \times 2] \times 2 = 5752mm$$

$$n = \frac{12270 + 30 - 30 - 15}{100} + 1 = 123 \text{ 根}$$

$$\text{总长: } 5752 \times 123 = 707496mm$$

(3) 墙梁 (第3层 LL2)

$$l_{aE} = 37 \times 22 = 814mm < 1050mm \text{ 和 } d1200mm \text{ 直锚}$$

1) 上部纵筋①4Φ22

$$l_1 = 1800 + 37 \times 22 \times 2 = 3428mm$$

$$\text{总长: } 3428 \times 4 = 13712mm$$

2) 下部纵筋②4Φ22

$$l_2 = l_1 = 3428mm$$

$$\text{总长: } 3428 \times 4 = 13712mm$$

3) 梁侧纵向构造筋

$$l_3 = l_2 = l_1 = 3428mm$$

侧面纵筋根数: 按墙内水平构造筋的直径与间距取

$$n = \left(\frac{2520 - 2 \times 25 - 2 \times 200}{200} + 1 \right) \times 2 \approx 24 \text{ 根}$$

$$\text{总长: } 3428 \times 24 = 82272mm$$

4) 箍筋

$$l_3 = [(300 - 2 \times 15) + (2520 - 2 \times 15) + 1.9 \times 10 + 10 \times 10] \times 2 = 5758mm$$

$$n_1 = \frac{1800 - 50 \times 2}{100} + 1 = 18 \text{ 根}$$

$$n_2 = \frac{37 \times 22 - 100}{150} + 1 = 6 \text{ 根}$$

$$n = 18 + 6 \times 2 = 30 \text{ 根}$$

$$\text{总长: } 5758 \times 30 = 172740 \text{ mm}$$

5) 拉筋

排数: $12 \div 2 = 6$ 排

每排根数: 设拉筋间距是箍筋的两倍, 数量为箍筋的一半

$$30 \div 2 = 15 \text{ 根}$$

$$\text{拉筋总根数} = 15 \times 6 = 90 \text{ 根}$$

拉筋长度按前面计算的结果取 443mm

$$\text{总长} = 443 \times 90 = 39870 \text{ mm}$$

其它连梁计算方法相同, 不再重复

6 答案

已知: 楼梯保护层 20mm, $l_a = 39d$, 12 跑

(1) 底筋

1) 纵筋 $\Phi 10@100$

$$n = \frac{1900 - 20 \times 2}{100} + 1 \approx 20$$

$$k = \frac{\sqrt{3080^2 + 1650^2}}{3080} = 1.134$$

$$l = 3080 \times 1.134 + 0.12 \times 2 + 6.25 \times 10 \times 2 \approx 3618 \text{ mm}$$

$$\text{总长: } 3618 \times 20 = 72360 \text{ mm}$$

2) 分布筋 $\Phi 8@280$

$$n = \frac{3080 \times 1.134}{280} + 1 = 14 \text{ 根}$$

$$l = 1900 - 20 \times 2 = 1860 \text{ mm}$$

$$\text{总长: } 1860 \times 14 = 26040 \text{ mm}$$

(2) 面筋

1) 负筋 $\Phi 10@100$

$$n = \frac{1900 - 20 \times 2}{100} + 1 \approx 20$$

$$\text{低端: } l = \frac{3080}{4} \times 1.134 + 39 \times 10 + 120 - 2 \times 20 + 6.25 \times 10 \times 2 = 1593 \text{ mm}$$

$$\text{高端: } l = \frac{3080}{4} \times 1.134 + 0.4 \times 39 \times 10 + 15 \times 10 + 6.25 \times 10 + 120 - 2 \times 20 = 1322 \text{ mm}$$

$$\text{总长: } (1593 + 1322) \times 20 = 5830 \text{ mm}$$

2) 分布筋 $\Phi 8@280$

$$n = \frac{3080 \times 1.134}{4 \times 280} + 1 \approx 5 \text{根}$$

$$l = 1900 - 20 \times 2 = 1860 \text{mm}$$

$$\text{总长: } 1860 \times 5 = 9300 \text{mm}$$

7 答案

钢筋保护层：底筋保护层为 40mm（有垫层），基础顶筋保护层为 20mm。

(1) TJB_{pot}(6B) 钢筋计算 (Ⓐ轴、Ⓔ轴线基础底板钢筋 B: $\Phi 20 @ 140 / \Phi 12 @ 180$)

① $\Phi 20$ 受力钢筋 (间距 140mm)

根数 = $(40.80 - 0.04 \times 2) \div 0.14 + 1 = 292$ 根 (钢筋根数按只入不舍计算, 后同)

单根钢筋长度 = $2.10 - 0.04 \times 2 = 2.02 \text{m}$

② $\Phi 14$ 构造钢筋 (间距 180mm)

根数 = $(2.10 - 0.04 \times 2) \div 0.18 + 1 = 13$ (根)

单根钢筋长度 = $40.8 - 0.04 \times 2 = 40.72 \text{m}$

(2) TJB_{pot}(6B) 钢筋计算 (Ⓑ轴、Ⓒ轴线基础钢筋)

① 基础底板底部钢筋 (B: $\Phi 20 @ 140 / \Phi 12 @ 180$)

$\Phi 20$ 受力钢筋 (间距 140mm)

根数 = $(40.80 - 0.04 \times 2) / 0.15 + 1 = 292$ (根)

单根钢筋长度 = $(1.8 + 2 \times 1.05) - 0.04 \times 2 = 3.82 \text{m}$

$\Phi 12$ 构造钢筋 (间距 180mm):

根数 = $(3.90 - 0.04 \times 2) / 0.18 + 1 = 22$ (根)

单根钢筋长度 = $40.8 - 0.04 \times 2 = 40.72 \text{m}$

② 基础底板顶部钢筋 (T: $\Phi 18 @ 100 / \Phi 14 @ 200$)

$\Phi 18$ 受力钢筋 (间距 100mm)

根数 = $(40.80 - 0.02 \times 2) / 0.10 + 1 = 409$ (根)

单根钢筋长度 = $1.8 - 0.15 \times 2$ (梁宽) + $44 \times 0.016 \times 2$ (锚固) = 2.91m

基础底板顶部钢筋保护层为 20mm; 钢筋锚固长度为 44d (混凝土强度等级 C20、抗震等级为二级)。

$\Phi 14$ 构造钢筋 (间距 200mm)

根数 = $[(1.8 - 0.15 \times 2) \div 0.20 - 1] + [(0.704 - 0.3) \div 0.20] \times 2 = 7 + 2 \times 2 = 11$ (根)

注: 钢筋根数必须分段计算; 基础梁处不布置构造钢筋; 由于受力钢筋的锚固长度为 $44 \times 0.016 = 704$ (mm), $704 - 300$ (基础梁宽) = 404 (mm), 所以基础梁外侧按 404mm 计算。

单根钢筋长度 = $40.80 - 0.02 \times 2 = 40.76 \text{m}$

(3) TJB_{P03}(3B) 钢筋计算 (②~⑥轴线基础钢筋 B: $\Phi 18 @ 180 / \Phi 10 @ 220$)

① $\Phi 18$ 受力钢筋 (间距 180mm):

根数 = $[(0.75 - 0.04 + 2.10 \div 4) \div 0.18 + 1] \times 2 + [(4.80 + 2.10 \div 4 + 3.90 \div 4) \div 0.18 + 1] \times 2$
 $= 8 \times 2 + 36 \times 2 = 88$

单根钢筋长度 = $2.10 - 0.04 \times 2 = 2.02 \text{m}$

② $\Phi 10$ 构造钢筋 (间距 220mm):

根数 = $(1.05 - 0.15 - 0.04) \div 0.22 \times 2 = 8$ (根)

单根钢筋长度 = $19.20 - 0.04 \times 2 = 19.02 \text{m}$

(4) TJB_{P04}(3B) 钢筋的计算 (①轴、⑦轴线基础钢筋 B: $\Phi 16 @ 180 / \Phi 10 @ 220$)

① $\Phi 16$ 受力钢筋 (间距 180mm):

根数 = TJB_{P03}(3B) 钢筋根数 = 88 根

单根钢筋长度=2.10-0.04×2=2.02m

② Φ10 构造钢筋(间距 220mm):

根数=(1.05-0.15-0.04)÷0.22×2=8 (根)

单根钢筋长度=19.20-0.04×2=19.02m