

# 材料力学学习题集附录

清华大学材料力学教研组编

高等教育出版社

# 附 录

## (一) 常用材料的机械性质

| 材 料    | $\sigma_s$<br>(kg/mm <sup>2</sup> ) | $\tau_s$<br>(kg/mm <sup>2</sup> ) | $\sigma_b$<br>(kg/mm <sup>2</sup> ) | $\sigma_{-1}$<br>(kg/mm <sup>2</sup> ) | $\tau_{-1}$<br>(kg/mm <sup>2</sup> ) | $\delta\%$ |
|--------|-------------------------------------|-----------------------------------|-------------------------------------|----------------------------------------|--------------------------------------|------------|
| G2 鋼   | >21                                 | 14                                | >34                                 | 17                                     | 8.5                                  | >31        |
| G3 鋼   | >22                                 | 16                                | >38                                 | 17                                     | 10                                   | >25        |
| G4 鋼   | >24                                 |                                   | >42                                 | 19                                     |                                      | >23        |
| G5 鋼   | >27                                 | 19                                | >50                                 | 22                                     | 13                                   | >19        |
| 30 号鋼  | >28                                 | 17                                | >48                                 | 20                                     | 11                                   | >20        |
| 35 号鋼  | >30                                 | 19                                | >52                                 | 22                                     | 13                                   | >18        |
| 40 号鋼  | >32                                 |                                   | >57                                 |                                        |                                      | >17        |
| 45 号鋼  | >34                                 | 22                                | >60                                 | 25                                     | 15                                   | >15        |
| 50 号鋼  | >35                                 |                                   | >63                                 | 27                                     | 16                                   | >13        |
| 55 号鋼  | >36                                 |                                   | >64                                 |                                        |                                      | >11        |
| 60 号鋼  | >37                                 |                                   | >65                                 |                                        |                                      | >10        |
| 45Cr 鋼 | 80                                  |                                   | 100                                 | 35                                     | 22.5                                 | 9          |
| 鑄鋼     | >20                                 |                                   | >40                                 |                                        |                                      | 20         |
| 黃銅     |                                     |                                   | 30                                  |                                        |                                      | 12         |
| 鑄鉄     |                                     |                                   | { 15 (拉)<br>65 (压)                  | 7                                      | 5                                    |            |
|        |                                     |                                   | { 24 (拉)<br>85 (压)                  | 12                                     | 10                                   |            |
| 球墨鑄鉄   | 32                                  | 54( $\tau_b$ )                    | { 40 (拉)<br>150(压)                  | 16                                     |                                      | 15         |
| 鋁合金    | 5—25                                |                                   | 18—42                               |                                        |                                      | 15—22      |

## (二) 常用材料的弹性常数

| 材 料           |     | $E(\text{kg/cm}^2)$     | $\mu$     |
|---------------|-----|-------------------------|-----------|
| 碳             | 鋼   | $2.1 \times 10^6$       | 0.28      |
| 鑄             | 鋼   | $2.2 \times 10^6$       | 0.30      |
| 鎳             | 鉻 鋼 | $2.1 \times 10^6$       | 0.30      |
| 黃             | 銅   | $1.0 \times 10^6$       | 0.39      |
| 鑄             | 鐵   | $1.2 \times 10^6$       | 0.25      |
|               | 鋁   | $0.66 \times 10^6$      | 0.26      |
| 鋁             | 合 金 | $0.70 \times 10^6$      | 0.30      |
| 橡             | 膠   | 80                      | 0.47      |
| 混 凝 土 (100 号) |     | $0.14-0.20 \times 10^6$ | 0.10—0.18 |
| (150 号)       |     | $0.16-0.25 \times 10^6$ | 0.10—0.18 |
| (200 号)       |     | $0.18-0.29 \times 10^6$ | 0.10—0.18 |
| 球 墨 鑄 鐵       |     | $1.6 \times 10^6$       | 0.25      |
| 木 材 (順紋)      |     | $0.10 \times 10^6$      | —         |

鋼的剪切彈性系數..... $G = 8.2 \times 10^5 \text{ kg/cm}^2$

鋼的綫膨脹系數..... $\alpha = 125 \times 10^{-7} \text{ 1/}^\circ\text{C}$

銅的綫膨脹系數..... $\alpha = 165 \times 10^{-7} \text{ 1/}^\circ\text{C}$

鋼的密度..... $\gamma = 7.8 \text{ g/cm}^3 = 7.8 \times 10^{-3} \text{ kg/cm}^3$

混凝土的密度..... $\gamma = 2.4 \text{ t/m}^3$

### (三) 矩形截面杆自由扭转应力及变形公式

长度为  $l$  的矩形截面直杆承受自由扭转时, 若横截面上扭矩为  $M_K$ , 材料剪切弹性模量为  $G$ , 则横截面上剪应力  $\tau$  及两端截面的相对扭转角  $\varphi$  为

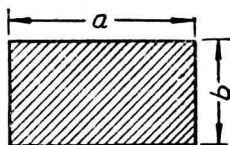
$$\tau_{\max} = \frac{M_K}{W_K} \text{ (长边中点);}$$

$$\tau_1 = k_1 \tau_{\max} \text{ (短边中点);}$$

$$\varphi = \frac{M_K l}{GJ_K};$$

$$W_K = kab^2;$$

$$J_K = k' ab^3;$$

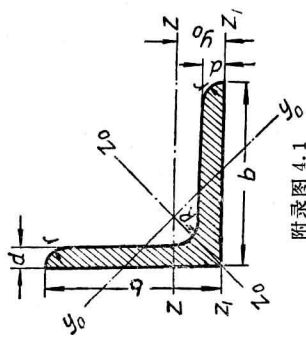


附录图 3.1

此处  $k, k_1$  及  $k'$  决定于截面长边与短边边长之比  $\frac{a}{b} (>1)$ , 如下表所示:

| $\frac{a}{b}$ | 1.00  | 1.20  | 1.50  | 1.75  | 2.00  | 2.50  | 3.00  | 4.00  | 5.00  | 6.00  | 8.00  | 10.00 |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| $k$           | 0.208 | 0.219 | 0.231 | 0.239 | 0.246 | 0.258 | 0.267 | 0.282 | 0.291 | 0.299 | 0.307 | 0.312 |
| $k_1$         | 1.00  | 0.93  | 0.86  | 0.82  | 0.79  | 0.77  | 0.75  | 0.74  | 0.74  | 0.74  | 0.74  | 0.74  |
| $k'$          | 0.141 | 0.166 | 0.196 | 0.214 | 0.229 | 0.249 | 0.263 | 0.281 | 0.291 | 0.299 | 0.307 | 0.312 |

(四) 型钢表



符号意义:  
 $b$ ——腿 宽  
 $d$ ——腿 厚  
 $R$ ——内面圆弧半径  
 $r$ ——腿端圆弧半径  
 $J$ ——惯 矩  
 $i$ ——惯性半径  
 $y_0$ ——形心距离

表 1

| 角<br>钢<br>号<br>数 | 尺寸(mm) |      |     | 截<br>面<br>面<br>积<br><br>(cm <sup>2</sup> ) | 每<br>米<br>重<br>量<br><br>(kg) | 参 考 数 值 |      |                                  |                                      |                                  |                                                        |                                    |                                                        |
|------------------|--------|------|-----|--------------------------------------------|------------------------------|---------|------|----------------------------------|--------------------------------------|----------------------------------|--------------------------------------------------------|------------------------------------|--------------------------------------------------------|
|                  |        |      |     |                                            |                              | 轴 z—z   |      | 轴 z <sub>0</sub> —z <sub>0</sub> | 轴 y <sub>0</sub> —y <sub>0</sub>     | 轴 z <sub>1</sub> —z <sub>1</sub> |                                                        |                                    |                                                        |
|                  |        |      |     |                                            |                              |         |      |                                  |                                      |                                  |                                                        |                                    |                                                        |
|                  |        | b    | d   |                                            |                              | R       |      |                                  | J <sub>z</sub><br>(cm <sup>4</sup> ) | i <sub>z</sub><br>(cm)           | J <sub>z<sub>0</sub></sub><br>最大<br>(cm <sup>4</sup> ) | i <sub>z<sub>0</sub></sub><br>(cm) | J <sub>y<sub>0</sub></sub><br>最小<br>(cm <sup>4</sup> ) |
| 2                | 20     | 3    | 3.5 | 1.2                                        | 1.13                         | 0.40    | 0.60 | 0.63                             | 0.75                                 | 0.17                             | 0.39                                                   | 0.81                               | 0.60                                                   |
|                  |        | 1.46 |     |                                            | 0.49                         | 0.58    | 0.78 | 0.73                             | 0.21                                 | 0.38                             | 1.09                                                   | 0.64                               |                                                        |

|     |    |   |      |      |      |      |       |      |      |      |       |      |
|-----|----|---|------|------|------|------|-------|------|------|------|-------|------|
| 2.5 | 25 | 3 | 1.43 | 1.12 | 0.80 | 0.75 | 1.28  | 0.95 | 0.32 | 0.47 | 1.56  | 0.73 |
|     |    | 4 | 1.86 | 1.46 | 1.02 | 0.74 | 1.63  | 0.94 | 0.41 | 0.47 | 2.12  | 0.77 |
| 3   | 30 | 4 | 2.27 | 1.78 | 1.82 | 0.90 | 2.90  | 1.13 | 0.75 | 0.58 | 3.62  | 0.89 |
|     |    | 5 | 2.78 | 2.18 | 2.20 | 0.89 | 3.47  | 1.12 | 0.93 | 0.58 | 4.58  | 0.93 |
| 3.5 | 35 | 4 | 2.67 | 2.10 | 3.02 | 1.06 | 4.77  | 1.34 | 1.27 | 0.69 | 5.74  | 1.01 |
|     |    | 5 | 3.28 | 2.57 | 3.61 | 1.05 | 5.71  | 1.32 | 1.51 | 0.68 | 7.23  | 1.05 |
| 4   | 40 | 4 | 3.08 | 2.42 | 4.60 | 1.22 | 7.26  | 1.53 | 1.93 | 0.79 | 8.53  | 1.13 |
|     |    | 5 | 3.79 | 2.97 | 5.54 | 1.21 | 8.75  | 1.52 | 2.34 | 0.78 | 10.70 | 1.17 |
|     |    | 6 | 4.48 | 3.52 | 6.41 | 1.20 | 10.10 | 1.50 | 2.70 | 0.78 | 13.00 | 1.21 |
| 4.5 | 45 | 4 | 3.48 | 2.73 | 6.60 | 1.38 | 10.50 | 1.74 | 2.68 | 0.88 | 12.10 | 1.26 |
|     |    | 5 | 4.29 | 3.37 | 8.00 | 1.37 | 12.70 | 1.72 | 3.26 | 0.87 | 15.30 | 1.30 |
|     |    | 6 | 5.08 | 3.99 | 9.29 | 1.35 | 14.80 | 1.71 | 3.78 | 0.86 | 18.40 | 1.34 |
| 5   | 50 | 5 | 4.80 | 3.77 | 11.2 | 1.53 | 17.8  | 1.92 | 4.61 | 0.98 | 20.9  | 1.42 |
|     |    | 6 | 5.69 | 4.47 | 13.1 | 1.52 | 20.7  | 1.91 | 5.39 | 0.97 | 25.2  | 1.46 |
| 6   | 60 | 5 | 5.82 | 4.57 | 19.9 | 1.85 | 31.4  | 2.32 | 8.29 | 1.19 | 35.9  | 1.66 |
|     |    | 6 | 6.91 | 5.42 | 23.3 | 1.84 | 36.8  | 2.31 | 9.76 | 1.19 | 43.3  | 1.70 |

續表 1

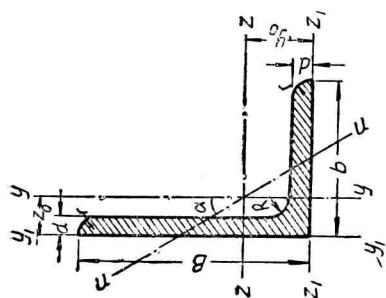
| 角<br>鋼<br>號<br>數 | 尺 寸(mm) |    |     | 每<br>米<br>重<br>量<br>(kg) | 截<br>面<br>面<br>積<br>(cm <sup>2</sup> ) | 參 考 數 值 |                                      |                                  |                                                        |                                    |                                                        |                                    |                        |                                                  |
|------------------|---------|----|-----|--------------------------|----------------------------------------|---------|--------------------------------------|----------------------------------|--------------------------------------------------------|------------------------------------|--------------------------------------------------------|------------------------------------|------------------------|--------------------------------------------------|
|                  |         |    |     |                          |                                        | 軸 z—z   |                                      | 軸 z <sub>0</sub> —z <sub>0</sub> |                                                        | 軸 y <sub>0</sub> —y <sub>0</sub>   |                                                        | 軸 z <sub>1</sub> —z <sub>1</sub>   | y <sub>0</sub><br>(cm) |                                                  |
|                  | b       | d  | R   |                          |                                        | r       | J <sub>z</sub><br>(cm <sup>4</sup> ) | i <sub>z</sub><br>(cm)           | J <sub>z<sub>0</sub></sub><br>最大<br>(cm <sup>4</sup> ) | i <sub>z<sub>0</sub></sub><br>(cm) | J <sub>y<sub>0</sub></sub><br>最小<br>(cm <sup>4</sup> ) | i <sub>y<sub>0</sub></sub><br>(cm) |                        | J <sub>z<sub>1</sub></sub><br>(cm <sup>4</sup> ) |
| 6                | 60      | 8  | 6.5 | 2.2                      | 9.03                                   | 29.6    | 1.81                                 | 46.8                             | 2.28                                                   | 12.4                               | 1.17                                                   | 58.2                               | 1.78                   |                                                  |
|                  |         | 65 | 6   |                          |                                        | 7.55    | 29.8                                 | 1.98                             | 47.2                                                   | 2.50                               | 12.3                                                   | 1.28                               | 54.8                   | 1.82                                             |
|                  |         |    | 8   | 8.0                      | 2.7                                    | 9.87    | 38.1                                 | 1.96                             | 60.3                                                   | 2.48                               | 15.8                                                   | 1.27                               | 73.7                   | 1.90                                             |
| 6.5              | 65      | 10 |     |                          | 12.1                                   | 45.4    | 1.94                                 | 72.0                             | 2.44                                                   | 18.8                               | 1.25                                                   | 92.9                               | 1.98                   |                                                  |
|                  |         | 75 | 6   |                          |                                        | 8.78    | 46.7                                 | 2.31                             | 73.3                                                   | 2.89                               | 20.1                                                   | 1.51                               | 83.9                   | 2.06                                             |
|                  |         |    | 8   |                          |                                        | 11.5    | 60.1                                 | 2.28                             | 94.9                                                   | 2.87                               | 25.3                                                   | 1.48                               | 113                    | 2.14                                             |
| 7.5              | 75      | 10 | 9.0 | 3.0                      | 14.1                                   | 72.2    | 2.26                                 | 114                              | 2.84                                                   | 30.3                               | 1.47                                                   | 142                                | 2.22                   |                                                  |
|                  |         | 12 |     |                          | 16.7                                   | 83.3    | 2.24                                 | 132                              | 2.81                                                   | 34.9                               | 1.45                                                   | 172                                | 2.30                   |                                                  |
|                  |         | 8  | 80  | 6                        |                                        |         | 9.38                                 | 57.0                             | 2.47                                                   | 90                                 | 3.11                                                   | 23.5                               | 1.58                   | 102                                              |
| 8                | 9.0     |    |     | 3.0                      | 12.3                                   | 73.3    | 2.44                                 | 116                              | 3.07                                                   | 30.3                               | 1.57                                                   | 137                                | 2.27                   |                                                  |
| 10               |         |    |     |                          | 15.1                                   | 88.4    | 2.42                                 | 140                              | 3.05                                                   | 36.5                               | 1.56                                                   | 172                                | 2.35                   |                                                  |

|    |     |    |    |      |      |     |      |     |      |      |      |      |      |
|----|-----|----|----|------|------|-----|------|-----|------|------|------|------|------|
| 9  | 90  | 8  |    | 14.0 | 11.0 | 106 | 2.76 | 168 | 3.46 | 43.6 | 1.77 | 194  | 2.51 |
|    |     | 10 | 11 | 17.2 | 13.5 | 128 | 2.74 | 204 | 3.44 | 53.1 | 1.76 | 244  | 2.59 |
|    |     | 12 |    | 20.4 | 16.0 | 149 | 2.71 | 237 | 3.41 | 61.7 | 1.75 | 294  | 2.67 |
|    |     | 14 |    | 23.4 | 18.4 | 169 | 2.69 | 267 | 3.38 | 71.9 | 1.75 | 345  | 2.74 |
|    |     |    |    |      |      |     |      |     |      |      |      |      |      |
| 10 | 100 | 8  |    | 15.6 | 12.3 | 147 | 3.07 | 233 | 3.87 | 61.0 | 1.98 | 265  | 2.75 |
|    |     | 10 | 12 | 19.2 | 15.1 | 179 | 3.05 | 284 | 3.85 | 74.9 | 1.97 | 333  | 2.83 |
|    |     | 12 |    | 22.8 | 17.9 | 209 | 3.03 | 331 | 3.81 | 87.6 | 1.96 | 402  | 2.91 |
|    |     | 14 |    | 26.3 | 20.6 | 237 | 3.01 | 375 | 3.78 | 99.1 | 1.95 | 472  | 2.99 |
|    |     | 16 |    | 29.7 | 23.3 | 265 | 2.99 | 416 | 3.75 | 113  | 1.95 | 542  | 3.06 |
| 12 | 120 | 10 |    | 23.3 | 18.3 | 316 | 3.68 | 503 | 4.64 | 130  | 2.36 | 575  | 3.33 |
|    |     | 12 | 13 | 27.6 | 21.7 | 371 | 3.66 | 590 | 4.62 | 153  | 2.35 | 693  | 3.41 |
|    |     | 14 |    | 31.9 | 25.1 | 423 | 3.64 | 671 | 4.59 | 174  | 2.34 | 811  | 3.49 |
|    |     | 16 |    | 36.1 | 28.4 | 474 | 3.62 | 749 | 4.56 | 199  | 2.34 | 931  | 3.56 |
|    |     | 18 |    | 40.3 | 31.6 | 520 | 3.60 | 822 | 4.54 | 219  | 2.33 | 1052 | 3.64 |
| 13 | 130 | 10 |    | 25.3 | 19.8 | 406 | 4.01 | 646 | 5.05 | 166  | 2.56 | 730  | 3.58 |
|    |     | 12 | 13 | 30.0 | 23.6 | 477 | 3.99 | 759 | 5.03 | 196  | 2.55 | 880  | 3.66 |

續表 1

| 角<br>鋼<br>號<br>數 |     | 尺寸(mm) |     | 截<br>面<br>面<br>積<br>(cm <sup>2</sup> ) | 每<br>米<br>重<br>量<br>(kg) | 參 考 數 值                               |                   |                                       |                   |                                 |               |             |  |
|------------------|-----|--------|-----|----------------------------------------|--------------------------|---------------------------------------|-------------------|---------------------------------------|-------------------|---------------------------------|---------------|-------------|--|
|                  |     |        |     |                                        |                          | 軸 $z-z$                               |                   | 軸 $z_0-z_0$                           |                   | 軸 $y_0-y_0$                     |               | 軸 $z_1-z_1$ |  |
|                  |     |        |     |                                        |                          |                                       |                   |                                       |                   |                                 |               |             |  |
| $b$              | $d$ | $R$    | $r$ | $J_z$<br>(cm <sup>4</sup> )            | $i_z$<br>(cm)            | $J_{z_0}$<br>最大<br>(cm <sup>4</sup> ) | $i_{z_0}$<br>(cm) | $J_{y_0}$<br>最小<br>(cm <sup>4</sup> ) | $i_{y_0}$<br>(cm) | $J_{z_1}$<br>(cm <sup>4</sup> ) | $y_0$<br>(cm) |             |  |
| 13               | 130 | 14     | 13  | 4.3                                    | 34.7                     | 27.3                                  | 866               | 5.00                                  | 223               | 2.54                            | 1030          | 3.74        |  |
|                  |     | 16     |     |                                        | 39.3                     | 30.9                                  | 967               | 4.96                                  | 249               | 2.52                            | 1182          | 3.82        |  |
| 15               | 150 | 12     | 15  | 5.0                                    | 34.9                     | 27.4                                  | 1186              | 5.83                                  | 305               | 2.95                            | 1347          | 4.15        |  |
|                  |     | 14     |     |                                        | 40.4                     | 31.7                                  | 1358              | 5.80                                  | 356               | 2.97                            | 1577          | 4.22        |  |
|                  |     | 16     |     |                                        | 45.8                     | 36.0                                  | 1522              | 5.77                                  | 399               | 2.95                            | 1808          | 4.30        |  |
|                  |     | 18     |     |                                        | 51.1                     | 40.1                                  | 1679              | 5.73                                  | 440               | 2.94                            | 2041          | 4.38        |  |
|                  |     | 20     |     |                                        | 56.4                     | 44.3                                  | 1830              | 5.70                                  | 478               | 2.91                            | 2275          | 4.46        |  |
|                  |     |        |     |                                        | 48.8                     | 38.3                                  | 2405              | 7.03                                  | 625               | 3.58                            | 2721          | 4.97        |  |
| 18               | 180 | 15     | 15  | 5.0                                    | 55.4                     | 43.5                                  | 2705              | 7.00                                  | 703               | 3.56                            | 3117          | 5.05        |  |
|                  |     | 16     |     |                                        |                          |                                       |                   |                                       |                   |                                 |               |             |  |
|                  |     | 18     |     |                                        | 61.9                     | 48.6                                  | 2994              | 6.94                                  | 775               | 3.54                            | 3515          | 5.13        |  |

|    |     |    |    |     |       |      |      |      |      |      |      |      |       |      |
|----|-----|----|----|-----|-------|------|------|------|------|------|------|------|-------|------|
| 20 | 200 | 16 |    |     | 62.0  | 48.7 | 2355 | 6.17 | 3755 | 7.79 | 954  | 3.93 | 4264  | 5.55 |
|    |     | 18 |    |     | 69.3  | 54.4 | 2619 | 6.15 | 4165 | 7.77 | 1074 | 3.93 | 4808  | 5.62 |
|    |     | 20 | 18 | 6.0 | 76.5  | 60.1 | 2868 | 6.13 | 4560 | 7.74 | 1175 | 3.92 | 5355  | 5.70 |
|    |     | 24 |    |     | 90.8  | 71.3 | 3349 | 6.07 | 5313 | 7.66 | 1384 | 3.90 | 6456  | 5.85 |
|    |     | 30 |    |     | 111.5 | 88.3 | 3999 | 5.96 | 6373 | 7.49 | 1685 | 3.87 | 8093  | 6.03 |
| 22 | 220 | 16 |    |     | 68.4  | 53.7 | 3168 | 6.80 | 5046 | 8.59 | 1307 | 4.37 | 5661  | 6.04 |
|    |     | 20 |    |     | 84.5  | 66.4 | 3859 | 6.75 | 6120 | 8.51 | 1592 | 4.34 | 7003  | 6.20 |
|    |     | 24 | 21 | 7.0 | 100.4 | 78.8 | 4514 | 6.71 | 7148 | 8.44 | 1870 | 4.32 | 8560  | 6.35 |
|    |     | 28 |    |     | 115.9 | 91.0 | 5135 | 6.66 | 8130 | 8.37 | 2141 | 4.30 | 10029 | 6.50 |
|    |     |    |    |     |       |      |      |      |      |      |      |      |       |      |
| 23 | 230 | 24 | 20 | 7.0 | 105.3 | 82.6 | 5207 | 7.03 | 8266 | 8.86 | 2144 | 4.51 | 9780  | 6.59 |



符号意义:

$B$ ——长腿的宽度

$b$ ——短腿的寬度

$d$ ——腿厚

$R$ ——內面圓弧半徑

$r$ ——圆端圆弧半径

矩 陣

i——慣性半徑

 $u_0, z_0$ ——形心距离 $\alpha$ ——主形心慣軸的傾斜角2  
表

附录图 4.2

| 角<br>鋼<br>号<br>数 | 尺寸(mm) |    |   |   |     | 截<br>面<br>面<br>积<br><br>(cm <sup>2</sup> ) | 每<br>米<br>重<br>量<br><br>(kg) | 参 考 数 值                              |                        |                                      |                        |                                                  |                        |                                                  |                        |                                            |                              |       |
|------------------|--------|----|---|---|-----|--------------------------------------------|------------------------------|--------------------------------------|------------------------|--------------------------------------|------------------------|--------------------------------------------------|------------------------|--------------------------------------------------|------------------------|--------------------------------------------|------------------------------|-------|
|                  |        |    |   |   |     |                                            |                              | 軸 z—z                                |                        | 軸 y—y                                |                        | 軸 z <sub>1</sub> —z <sub>1</sub>                 |                        | 軸 y <sub>1</sub> —y <sub>1</sub>                 |                        | 軸 u—u                                      |                              |       |
|                  | B      | b  | d | R | r   |                                            |                              | J <sub>z</sub><br>(cm <sup>4</sup> ) | i <sub>z</sub><br>(cm) | J <sub>y</sub><br>(cm <sup>4</sup> ) | i <sub>y</sub><br>(cm) | J <sub>z<sub>1</sub></sub><br>(cm <sup>4</sup> ) | y <sub>0</sub><br>(cm) | J <sub>y<sub>1</sub></sub><br>(cm <sup>4</sup> ) | z <sub>0</sub><br>(cm) | J <sub>u</sub><br>最小<br>(cm <sup>4</sup> ) | i <sub>u</sub><br>最小<br>(cm) | tg α  |
| 3/2              | 30     | 20 | 3 | — | 3.5 | 1.43                                       | 1.12                         | 1.27                                 | 0.94                   | 0.45                                 | 0.56                   | 2.69                                             | 1.00                   | 0.82                                             | 0.51                   | 0.26                                       | 0.43                         | 0.430 |
|                  |        |    |   |   |     | 1.86                                       | 1.46                         | 1.61                                 | 0.93                   | 0.56                                 | 0.55                   | 3.61                                             | 1.04                   | 1.12                                             | 0.55                   | 0.34                                       | 0.43                         | 0.422 |
| 3.5/2            | 35     | 20 | 4 | — | 3.5 | 2.06                                       | 1.62                         | 2.48                                 | 1.10                   | 0.53                                 | 0.53                   | 5.62                                             | 1.25                   | 1.11                                             | 0.51                   | 0.37                                       | 0.42                         | 0.320 |
|                  |        |    |   |   |     | 2.52                                       | 1.98                         | 2.98                                 | 1.09                   | 0.70                                 | 0.53                   | 7.15                                             | 1.29                   | 1.45                                             | 0.55                   | 0.45                                       | 0.42                         | 0.310 |

|       |    |    |    |     |     |      |       |       |      |      |      |      |      |      |      |      |      |       |
|-------|----|----|----|-----|-----|------|-------|-------|------|------|------|------|------|------|------|------|------|-------|
| 4.5/3 | 45 | 30 | 4  |     |     | 2.88 | 2.26  | 5.81  | 1.42 | 2.06 | 0.84 | 12.1 | 1.48 | 3.65 | 0.72 | 1.21 | 0.65 | 0.432 |
|       |    |    | 6  | 5.0 | 1.7 | 4.18 | 3.28  | 8.15  | 1.40 | 2.85 | 0.83 | 18.3 | 1.56 | 5.65 | 0.82 | 1.69 | 0.64 | 0.423 |
|       |    |    | 5  |     |     | 4.83 | 3.79  | 17.4  | 1.90 | 6.19 | 1.13 | 35.8 | 1.95 | 10.8 | 0.97 | 3.62 | 0.87 | 0.432 |
| 6/4   | 60 | 40 | 6  | 7.0 | 2.3 | 5.72 | 4.49  | 20.3  | 1.88 | 7.20 | 1.12 | 43.1 | 2.00 | 13.1 | 1.01 | 4.20 | 0.86 | 0.430 |
|       |    |    | 8  |     |     | 7.44 | 5.84  | 25.8  | 1.86 | 9.04 | 1.10 | 57.9 | 2.08 | 17.9 | 1.09 | 5.39 | 0.85 | 0.420 |
|       |    |    | 5  |     |     | 6.11 | 4.80  | 34.9  | 2.39 | 12.5 | 1.43 | 69.9 | 2.39 | 20.9 | 1.17 | 7.24 | 1.09 | 0.435 |
|       |    |    | 6  |     |     | 7.25 | 5.69  | 41.0  | 2.37 | 14.6 | 1.42 | 84.0 | 2.44 | 25.3 | 1.21 | 8.48 | 1.08 | 0.434 |
| 7.5/5 | 75 | 50 | 8  | 8.0 | 2.7 | 9.47 | 7.43  | 52.4  | 2.35 | 18.6 | 1.40 | 113  | 2.52 | 34.3 | 1.29 | 10.9 | 1.07 | 0.428 |
|       |    |    | 10 |     |     | 11.6 | 9.11  | 63.0  | 2.33 | 22.1 | 1.38 | 141  | 2.60 | 43.7 | 1.36 | 13.2 | 1.07 | 0.423 |
|       |    |    | 6  |     |     | 7.85 | 6.16  | 50.6  | 2.53 | 19.6 | 1.58 | 102  | 2.56 | 33.4 | 1.33 | 11.1 | 1.19 | 0.462 |
| 8/5.5 | 80 | 55 | 8  | 8.0 | 2.7 | 10.3 | 8.06  | 64.9  | 2.51 | 24.9 | 1.56 | 136  | 2.64 | 45.3 | 1.41 | 14.3 | 1.19 | 0.458 |
|       |    |    | 10 |     |     | 12.6 | 9.90  | 78.2  | 2.49 | 29.8 | 1.54 | 171  | 2.72 | 57.5 | 1.48 | 17.4 | 1.18 | 0.452 |
|       |    |    | 6  |     |     | 8.78 | 6.90  | 72.4  | 2.87 | 26.0 | 1.72 | 145  | 2.88 | 43.4 | 1.41 | 14.7 | 1.30 | 0.437 |
| 9/6   | 90 | 60 | 8  | 9   | 3   | 11.5 | 9.08  | 93.2  | 2.85 | 33.2 | 1.70 | 194  | 2.96 | 58.6 | 1.49 | 19.3 | 1.29 | 0.433 |
|       |    |    | 10 |     |     | 14.1 | 11.10 | 113.0 | 2.82 | 39.8 | 1.68 | 244  | 3.05 | 74.4 | 1.56 | 23.5 | 1.29 | 0.429 |

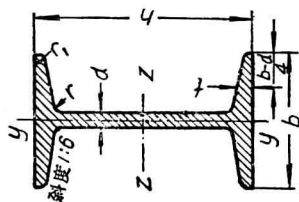
續表 2

| 角<br>鋼<br>號<br>數 | 尺 寸 (mm) |     |     | 每<br>米<br>重<br>量<br>(kg) | 参 考 数 值 |                             |               |                             |               |                                 |               |                                 |               |                                   |                     |                     |
|------------------|----------|-----|-----|--------------------------|---------|-----------------------------|---------------|-----------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|-----------------------------------|---------------------|---------------------|
|                  |          |     |     |                          | 軸 $z-z$ |                             | 軸 $y-y$       |                             | 軸 $z_1-z_1$   |                                 | 軸 $y_1-y_1$   |                                 | 軸 $u-u$       |                                   |                     |                     |
|                  | $B$      | $b$ | $d$ | $R$                      | $r$     | $J_z$<br>(cm <sup>4</sup> ) | $i_z$<br>(cm) | $J_y$<br>(cm <sup>4</sup> ) | $i_y$<br>(cm) | $J_{z_1}$<br>(cm <sup>4</sup> ) | $y_0$<br>(cm) | $J_{y_1}$<br>(cm <sup>4</sup> ) | $z_0$<br>(cm) | $J_u$<br>最小<br>(cm <sup>4</sup> ) | $i_u$<br>最小<br>(cm) | $\text{tg } \alpha$ |
| 10/7.5           | 100      | 75  | 10  | 10                       | 3.3     | 16.7                        | 3.13          | 78.5                        | 2.17          | 333                             | 3.20          | 143                             | 1.96          | 42.6                              | 1.60                | 0.545               |
|                  |          |     | 12  |                          |         | 19.7                        | 3.11          | 91.1                        | 2.15          | 402                             | 3.27          | 173                             | 2.04          | 49.8                              | 1.59                | 0.541               |
|                  |          |     | 8   |                          |         | 13.5                        | 3.16          | 65.0                        | 2.19          | 266                             | 3.11          | 113                             | 1.88          | 35.4                              | 1.62                | 0.548               |
| 12/8             | 120      | 80  | 10  | 11                       | 3.7     | 19.2                        | 3.81          | 99.6                        | 2.27          | 575                             | 3.93          | 178                             | 1.96          | 57.7                              | 1.73                | 0.436               |
|                  |          |     | 12  |                          |         | 22.8                        | 3.79          | 116                         | 2.25          | 692                             | 4.01          | 210                             | 2.04          | 66.6                              | 1.71                | 0.432               |
|                  |          |     | 8   |                          |         | 15.6                        | 3.83          | 82.3                        | 2.30          | 459                             | 3.85          | 137                             | 1.88          | 47.6                              | 1.75                | 0.438               |
| 13/9             | 130      | 90  | 10  | 12                       | 4.0     | 25.2                        | 4.10          | 167                         | 2.57          | 879                             | 4.25          | 297                             | 2.27          | 94.8                              | 1.94                | 0.467               |
|                  |          |     | 12  |                          |         | 29.1                        | 4.08          | 189                         | 2.55          | 1028                            | 4.33          | 349                             | 2.35          | 109                               | 1.93                | 0.464               |
|                  |          |     | 8   |                          |         | 17.2                        | 4.15          | 118                         | 2.62          | 583                             | 4.08          | 195                             | 2.11          | 66.5                              | 1.97                | 0.471               |

|       |     |     |    |      |      |      |      |      |      |      |      |      |      |     |      |       |
|-------|-----|-----|----|------|------|------|------|------|------|------|------|------|------|-----|------|-------|
| 15/10 | 150 | 100 | 10 | 24.3 | 19.1 | 557  | 4.78 | 201  | 2.87 | 1120 | 4.81 | 335  | 2.35 | 115 | 2.18 | 0.439 |
|       |     |     | 12 | 28.8 | 22.6 | 655  | 4.76 | 235  | 2.85 | 1347 | 4.90 | 405  | 2.43 | 137 | 2.18 | 0.437 |
|       |     |     | 14 | 33.3 | 26.2 | 749  | 4.73 | 267  | 2.83 | 1575 | 4.98 | 476  | 2.51 | 156 | 2.16 | 0.434 |
|       |     |     | 16 | 37.7 | 29.6 | 839  | 4.71 | 297  | 2.81 | 1804 | 5.06 | 549  | 2.59 | 175 | 2.15 | 0.430 |
| 18/12 |     |     | 12 | 34.9 | 27.4 | 1156 | 5.75 | 417  | 3.46 | 2325 | 5.79 | 695  | 2.82 | 240 | 2.62 | 0.440 |
|       | 180 | 120 | 14 | 40.4 | 31.7 | 1326 | 5.73 | 476  | 3.44 | 2717 | 5.87 | 816  | 2.90 | 279 | 2.62 | 0.438 |
|       |     |     | 16 | 45.8 | 35.9 | 1490 | 5.71 | 532  | 3.41 | 3111 | 5.95 | 939  | 2.98 | 309 | 2.60 | 0.436 |
|       |     |     | 12 | 37.3 | 29.2 | 1546 | 6.45 | 428  | 3.39 | 3188 | 6.64 | 696  | 2.68 | 259 | 2.64 | 0.364 |
| 20/12 | 200 | 120 | 14 | 43.2 | 33.9 | 1776 | 6.42 | 489  | 3.36 | 3725 | 6.72 | 818  | 2.76 | 295 | 2.61 | 0.362 |
|       |     |     | 16 | 49.0 | 38.4 | 1997 | 6.38 | 547  | 3.34 | 4264 | 6.80 | 941  | 2.84 | 331 | 2.60 | 0.360 |
|       |     |     | 12 | 41.0 | 32.2 | 1666 | 6.37 | 810  | 4.44 | 3181 | 6.08 | 1347 | 3.62 | 436 | 3.26 | 0.552 |
|       |     |     | 16 | 53.9 | 42.3 | 2155 | 6.32 | 1043 | 4.40 | 4272 | 6.27 | 1812 | 3.78 | 562 | 3.23 | 0.549 |
| 20/15 | 200 | 150 | 17 | 60.3 | 47.3 | 2388 | 6.30 | 1153 | 4.38 | 4800 | 6.33 | 2048 | 3.85 | 623 | 3.21 | 0.548 |
|       |     |     | 18 | 66.5 | 52.2 | 2614 | 6.27 | 1258 | 4.35 | 5344 | 6.41 | 2285 | 3.93 | 683 | 3.21 | 0.546 |
|       |     |     | 20 |      |      |      |      |      |      |      |      |      |      |     |      |       |
|       |     |     |    |      |      |      |      |      |      |      |      |      |      |     |      |       |

符号意义:

- $h$ ——工字鋼高度  
 $b$ ——翼緣寬度  
 $d$ ——腹板厚度  
 $t$ ——翼緣的平均厚度  
 $r$ ——內弧半徑  
 $r_1$ ——腿端弧半徑  
 $J$ ——慣 矩  
 $W$ ——截面系数  
 $i$ ——慣性半徑  
 $S_z$ ——半个截面对  $z-z$  軸的靜矩



附录图 4.3

表 3

| 工字鋼<br>号 数 | 尺 寸 (mm) |    |     |     |     |                | 截面<br>面积<br>(cm <sup>2</sup> ) | 每米<br>重量<br>(kg) | 参 考 数 值                              |                                      |                        |                                       |                                      |                                      |                        |
|------------|----------|----|-----|-----|-----|----------------|--------------------------------|------------------|--------------------------------------|--------------------------------------|------------------------|---------------------------------------|--------------------------------------|--------------------------------------|------------------------|
|            | z—z      |    |     |     |     |                |                                |                  | y—y                                  |                                      |                        |                                       |                                      |                                      |                        |
|            | h        | b  | d   | t   | r   | r <sub>1</sub> |                                |                  | J <sub>z</sub><br>(cm <sup>4</sup> ) | W <sub>z</sub><br>(cm <sup>3</sup> ) | i <sub>z</sub><br>(cm) | J <sub>z</sub> S <sub>z</sub><br>(cm) | J <sub>y</sub><br>(cm <sup>4</sup> ) | W <sub>y</sub><br>(cm <sup>3</sup> ) | i <sub>y</sub><br>(cm) |
| 10         | 100      | 68 | 4.5 | 7.6 | 6.5 | 3.3            | 14.3                           | 11.2             | 245                                  | 49.0                                 | 4.14                   | 8.59                                  | 33.0                                 | 9.72                                 | 1.52                   |
| 12         | 120      | 74 | 5.0 | 8.4 | 7.0 | 3.5            | 17.8                           | 14.0             | 436                                  | 72.7                                 | 4.95                   | 10.3                                  | 46.9                                 | 12.7                                 | 1.62                   |
| 14         | 140      | 80 | 5.5 | 9.1 | 7.5 | 3.8            | 21.5                           | 16.9             | 712                                  | 102                                  | 5.76                   | 12.0                                  | 64.4                                 | 16.1                                 | 1.73                   |
| 16         | 160      | 88 | 6.0 | 9.9 | 8.0 | 4.0            | 26.1                           | 20.5             | 1130                                 | 141                                  | 6.58                   | 13.8                                  | 93.1                                 | 21.2                                 | 1.89                   |

|    |                                             |     |     |      |      |      |      |      |       |      |      |      |     |      |      |
|----|---------------------------------------------|-----|-----|------|------|------|------|------|-------|------|------|------|-----|------|------|
| 18 | 180                                         | 94  | 6.5 | 10.7 | 8.5  | 4.3  | 30.6 | 24.1 | 1660  | 185  | 7.36 | 15.4 | 122 | 26.0 | 2.00 |
| 20 | $\begin{Bmatrix} a \\ b \end{Bmatrix}$      | 200 | 100 | 7.0  | 11.4 | 9.0  | 35.5 | 27.9 | 2370  | 237  | 8.15 | 17.2 | 158 | 31.5 | 2.12 |
|    |                                             | 200 | 102 | 9.0  | 11.4 | 9.0  | 39.5 | 31.1 | 2500  | 250  | 7.96 | 16.9 | 169 | 33.1 | 2.06 |
| 22 | $\begin{Bmatrix} a \\ b \end{Bmatrix}$      | 220 | 110 | 7.5  | 12.3 | 9.5  | 42.0 | 33.0 | 3400  | 309  | 8.99 | 18.9 | 225 | 40.9 | 2.31 |
|    |                                             | 220 | 112 | 9.5  | 12.3 | 9.5  | 46.4 | 36.4 | 3570  | 325  | 8.78 | 18.7 | 239 | 42.7 | 2.27 |
| 24 | $\begin{Bmatrix} a \\ b \end{Bmatrix}$      | 240 | 116 | 8.0  | 13.0 | 10.0 | 47.7 | 37.4 | 4570  | 381  | 9.77 | 20.7 | 280 | 48.4 | 2.42 |
|    |                                             | 240 | 118 | 10.0 | 13.0 | 10.0 | 52.6 | 41.2 | 4800  | 400  | 9.57 | 20.4 | 297 | 50.4 | 2.38 |
| 27 | $\begin{Bmatrix} a \\ b \end{Bmatrix}$      | 270 | 122 | 8.5  | 13.7 | 10.5 | 54.6 | 42.8 | 6550  | 485  | 10.9 | 23.8 | 345 | 56.6 | 2.51 |
|    |                                             | 270 | 124 | 10.5 | 13.7 | 10.5 | 60.0 | 47.1 | 6870  | 509  | 10.7 | 22.9 | 366 | 58.9 | 2.47 |
| 30 | $\begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$ | 300 | 126 | 9.0  | 14.4 | 11.0 | 5.5  | 61.2 | 8950  | 597  | 12.1 | 25.7 | 400 | 63.5 | 2.55 |
|    |                                             | 300 | 128 | 11.0 | 14.4 | 11.0 | 5.5  | 67.2 | 9400  | 627  | 11.8 | 25.4 | 422 | 65.9 | 2.50 |
|    |                                             | 300 | 130 | 13.0 | 14.4 | 11.0 | 5.5  | 73.4 | 9850  | 657  | 11.6 | 25.0 | 445 | 68.5 | 2.46 |
|    |                                             | 330 | 130 | 9.5  | 15.0 | 11.5 | 5.8  | 68.1 | 11900 | 721  | 13.2 | 28.3 | 460 | 70.7 | 2.60 |
| 33 | $\begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$ | 330 | 132 | 11.5 | 15.0 | 11.5 | 5.8  | 74.7 | 12500 | 757  | 12.9 | 27.9 | 484 | 73.4 | 2.55 |
|    |                                             | 330 | 134 | 13.5 | 15.0 | 11.5 | 5.8  | 81.3 | 13100 | 794  | 12.7 | 27.5 | 510 | 76.1 | 2.51 |
|    |                                             | 360 | 136 | 10.0 | 15.8 | 12.0 | 6.0  | 76.3 | 15760 | 875  | 14.4 | 30.7 | 552 | 81.2 | 2.69 |
| 36 | $\begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$ | 360 | 138 | 12.0 | 15.8 | 12.0 | 6.0  | 83.5 | 16530 | 919  | 14.1 | 30.3 | 582 | 84.3 | 2.64 |
|    |                                             | 360 | 140 | 14.0 | 15.8 | 12.0 | 6.0  | 90.7 | 17310 | 962  | 13.8 | 29.9 | 612 | 87.4 | 2.60 |
| 40 | $\begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$ | 400 | 142 | 10.5 | 16.5 | 12.5 | 6.3  | 86.1 | 21720 | 1090 | 15.9 | 34.1 | 660 | 93.2 | 2.77 |
|    |                                             | 400 | 144 | 12.5 | 16.5 | 12.5 | 6.3  | 94.1 | 22780 | 1140 | 15.6 | 33.6 | 692 | 96.2 | 2.71 |
|    |                                             | 400 | 146 | 14.5 | 16.5 | 12.5 | 6.3  | 102  | 23850 | 1190 | 15.2 | 33.2 | 727 | 99.6 | 2.65 |
| 45 | $\begin{Bmatrix} a \\ b \\ c \end{Bmatrix}$ | 450 | 150 | 11.5 | 18.0 | 13.5 | 6.8  | 102  | 32240 | 1430 | 17.7 | 38.6 | 855 | 114  | 2.89 |
|    |                                             | 450 | 152 | 13.5 | 18.0 | 13.5 | 6.8  | 111  | 33760 | 1500 | 17.4 | 38.0 | 894 | 118  | 2.84 |
|    |                                             | 450 | 154 | 15.5 | 18.0 | 13.5 | 6.8  | 120  | 35280 | 1570 | 17.1 | 37.6 | 938 | 122  | 2.79 |

續表 3

| 工字鋼<br>号 数                                                       | 尺 寸 (mm) |          |          |          |          | 截面<br>面积<br>(cm <sup>2</sup> ) | 每米<br>重量<br>(kg) | 参 考 数 值               |                                            |                                            |                              |                                            |                                            |                                            |
|------------------------------------------------------------------|----------|----------|----------|----------|----------|--------------------------------|------------------|-----------------------|--------------------------------------------|--------------------------------------------|------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
|                                                                  |          |          |          |          |          |                                |                  | z—z                   |                                            |                                            | y—y                          |                                            |                                            |                                            |
|                                                                  | <i>h</i> | <i>b</i> | <i>d</i> | <i>t</i> | <i>r</i> |                                |                  | <i>r</i> <sub>1</sub> | <i>J<sub>z</sub></i><br>(cm <sup>4</sup> ) | <i>W<sub>z</sub></i><br>(cm <sup>3</sup> ) | <i>i<sub>z</sub></i><br>(cm) | <i>J<sub>z</sub>:S<sub>z</sub></i><br>(cm) | <i>J<sub>y</sub></i><br>(cm <sup>4</sup> ) | <i>W<sub>y</sub></i><br>(cm <sup>3</sup> ) |
| 50<br>$\left\{ \begin{array}{l} a \\ b \\ c \end{array} \right.$ | 500      | 158      | 12.0     | 20.0     | 14.0     | 7.0                            | 93.6             | 46470                 | 1860                                       | 19.7                                       | 42.8                         | 1120                                       | 142                                        | 3.07                                       |
|                                                                  | 500      | 160      | 14.0     | 20.0     | 14.0     | 7.0                            | 101              | 48560                 | 1940                                       | 19.4                                       | 42.4                         | 1170                                       | 146                                        | 3.01                                       |
|                                                                  | 500      | 162      | 16.0     | 20.0     | 14.0     | 7.0                            | 109              | 50640                 | 2030                                       | 19.0                                       | 41.8                         | 1220                                       | 151                                        | 2.96                                       |
| 55<br>$\left\{ \begin{array}{l} a \\ b \\ c \end{array} \right.$ | 550      | 166      | 12.5     | 21.0     | 14.5     | 7.3                            | 105              | 62870                 | 2290                                       | 21.6                                       | 46.9                         | 1370                                       | 164                                        | 3.19                                       |
|                                                                  | 550      | 168      | 14.5     | 21.0     | 14.5     | 7.3                            | 114              | 65640                 | 2390                                       | 21.2                                       | 46.4                         | 1420                                       | 170                                        | 3.14                                       |
|                                                                  | 550      | 170      | 16.5     | 21.0     | 14.5     | 7.3                            | 123              | 68410                 | 2490                                       | 20.9                                       | 45.8                         | 1480                                       | 175                                        | 3.08                                       |
| 60<br>$\left\{ \begin{array}{l} a \\ b \\ c \end{array} \right.$ | 600      | 176      | 13.0     | 22.0     | 15.0     | 7.5                            | 118              | 83860                 | 2800                                       | 23.5                                       | 51.8                         | 1700                                       | 193                                        | 3.36                                       |
|                                                                  | 600      | 178      | 15.0     | 22.0     | 15.0     | 7.5                            | 128              | 87460                 | 2920                                       | 23.2                                       | 50.7                         | 1770                                       | 199                                        | 3.30                                       |
|                                                                  | 600      | 180      | 17.0     | 22.0     | 15.0     | 7.5                            | 137              | 91060                 | 3040                                       | 22.8                                       | 50.2                         | 1840                                       | 205                                        | 3.24                                       |