

$$\begin{aligned}
 H_T &= H - H_D \\
 &= 0.785 G^2 p - H_D \\
 &= 0.785 \times 279^2 \times 10 - 478921 \\
 &= 132131 \text{ (N)}
 \end{aligned}$$

$$\begin{aligned}
 h_T &= 0.25(2C - B - G) \\
 &= 0.25 \times (2 \times 383 - 247 - 279) \\
 &= 60 \text{ (mm)}
 \end{aligned}$$

$$\begin{aligned}
 M_p &= H_D h_D + H_T h_T \\
 &= 478921 \times 58 + 132131 \times 60 \\
 &= 35705278 \text{ (N} \cdot \text{mm)}
 \end{aligned}$$

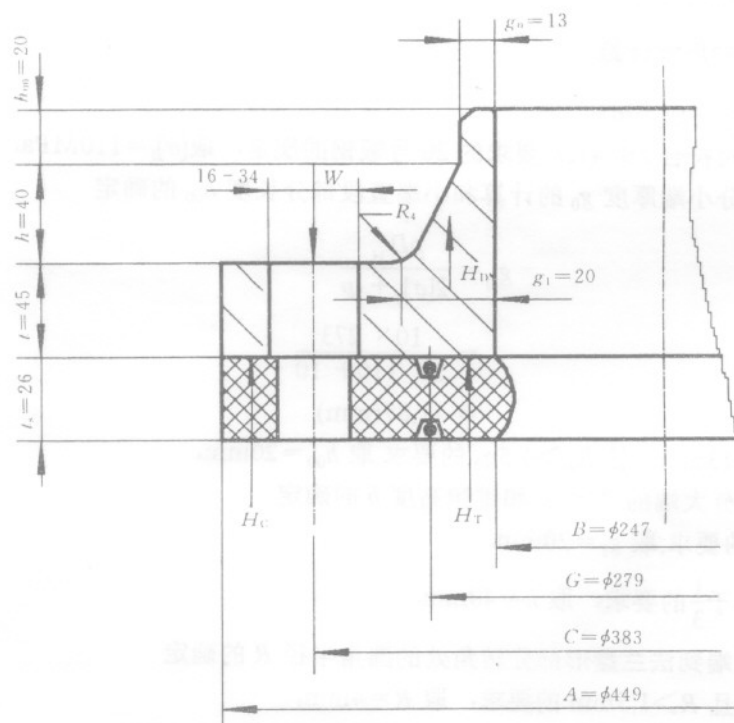


图 B1 法兰各部分尺寸假定图

B3.3 按式 (A1) 估算法兰厚度 t 。

$$\begin{aligned}
 t &= 1.78 \sqrt{\frac{M_p}{[\sigma]_r C}} \\
 &= 1.78 \sqrt{\frac{35705278}{110 \times 383}} \\
 &= 51.82 \text{ (mm)}
 \end{aligned}$$

取 $t=45\text{mm}$ ，作法兰强度试算。

B3.4 按假定出的法兰尺寸求取一些中间数据。

有：

$$\frac{g_1}{g_0} = \frac{20}{13} = 1.54$$

$$\frac{h}{h_0} = \frac{h}{\sqrt{Bg_0}} = \frac{40}{\sqrt{247 \times 13}} = 0.706$$

可由图 A2~图 A6 查得:

$$C_1 = 1.48$$

$$C_2 = 1.18$$

$$C_3 = 1.21$$

$$C_4 = 0.57$$

$$C_5 = 0.36$$

由图 A7 和图 A8 查得:

$$\begin{aligned} j &= 0.55 \frac{g_0}{t} \sqrt{\frac{B_1}{g_0}} \\ &= 0.55 \times \frac{13}{45} \times \sqrt{\frac{260}{13}} \\ &= 0.711 \end{aligned}$$

$$\begin{aligned} k &= 2 \left(\frac{K^2 + 1}{K^2 - 1} + \mu \right) \frac{g_0}{B_1} \\ &= 2 \times \left(\frac{3.304 + 1}{3.304 - 1} + 0.3 \right) \times \frac{13}{260} \\ &= 0.217 \end{aligned}$$

由图 A9 查取 r_B , 步骤如下:

过图上 $n=16, d=34$ 两点连线 (线 1);

过线 1 与 r_B 轴的交点和 $C=383$ 两点连线 (线 2), 在 F_1 轴上读得 $F_1=0.7$;

将 $F_1=0.7$ 移到 d 轴的左侧;

将已移到 d 轴左侧的 $F_1=0.7$ 点与 $n=16$ 点连线 (线 3), 在线 3 与 r_B 轴的交点上读得 $r_B=0.046$ 。

计算得:

$$\begin{aligned} Z &= \frac{A^2 + B^2}{A^2 - B^2} \\ &= \frac{449^2 + 247^2}{449^2 - 247^2} \\ &= 1.868 \\ \alpha &= \frac{A + C}{2B} \\ &= \frac{449 + 383}{2 \times 247} \\ &= 1.684 \end{aligned}$$

$$\begin{aligned}\beta &= \frac{C + B_1}{2B_1} \\ &= \frac{383 + 260}{2 \times 260} \\ &= 1.2365\end{aligned}$$

$$\begin{aligned}L_3 &= 2t + t_s + 2S + 2S_1 + M \\ &= 2 \times 45 + 26 + 2 \times 6 + 2 \times 5 + 27 \\ &= 165 \quad (\text{mm})\end{aligned}$$

$$r_E = \frac{E_f}{E_b} \approx 1$$

$$\text{取 } r_s = 1 - \frac{S_i}{[\sigma]_b} = 0.7,$$

$$\begin{aligned}J_1 &= 0.951C_1 \left[\frac{C_2(1 + C_2j)}{1 + C_1jk} + C_3j \right] \\ &= 0.951 \times 1.48 \times \left[\frac{1.18 \times (1 + 1.18 \times 0.711)}{1 + 1.48 \times 0.711 \times 0.217} + 1.21 \times 0.711 \right] \\ &= 3.698\end{aligned}$$

$$\begin{aligned}J_2 &= 5.19j^4 \left[\frac{C_1C_2(C_4 - k)}{1 + C_1jk} + 1.1C_5 \right] \\ &= 5.19 \times 0.711^4 \times \left[\frac{1.48 \times 1.18 \times (0.57 - 0.217)}{1 + 1.48 \times 0.711 \times 0.217} + 1.1 \times 0.36 \right] \\ &= 1.1909\end{aligned}$$

$$\begin{aligned}J_3 &= 1.901 \frac{C_1(1 + C_2j)}{j(1 + C_1jk)} \\ &= 1.901 \times \frac{1.48 \times (1 + 1.18 \times 0.711)}{0.711 \times (1 + 1.48 \times 0.711 \times 0.217)} \\ &= 5.942\end{aligned}$$

$$\begin{aligned}J_4 &= 10.38 \frac{C_1j^3(C_4 - k)}{1 + C_1jk} \\ &= 10.38 \times \frac{1.48 \times 0.711^3 \times (0.57 - 0.217)}{1 + 1.48 \times 0.711 \times 0.217} \\ &= 1.587\end{aligned}$$

B3.5 试算 M_s 值:

B3.5.1 按式 (A6) 计算 h_c 。

先假定 $M_s = -0.32M_p$,

$$h_c = 0.929 \sqrt{\frac{\alpha t^3 L_3 r_E r_s [\sigma]_b B_1}{M_p + M_s}}$$

$$\begin{aligned}
&= 0.929 \sqrt{\frac{1.68 \times 45^3 \times 165 \times 1 \times 0.7 \times 205 \times 260}{0.68 \times 35705278}} \\
&= 183 \quad (\text{mm})
\end{aligned}$$

h_c 计算值大于 $\frac{A-C}{2}$, 取 $h_c = h_{c,\max} = \frac{A-C}{2} = 33\text{mm}$.

B3.5.2 计算 J_5 、 J_6 、 θ_B 诸值。

$$\begin{aligned}
J_5 &= \frac{1.738}{B_1} \left(\frac{2h_D}{\beta} + \frac{h_c}{\alpha} + \pi B_1 r_B \right) \\
&= \frac{1.738}{260} \times \left(\frac{2 \times 58}{1.2365} + \frac{33}{1.684} + \pi \times 216 \times 0.046 \right) \\
&= 1.009
\end{aligned}$$

$$\begin{aligned}
J_6 &= J_5 - 1.738 \frac{h_D}{B_1 \beta} \\
&= 1.009 - 1.738 \times \frac{58}{260 \times 1.2365} \\
&= 0.6954
\end{aligned}$$

$$\begin{aligned}
\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A-C} - 0.29 \frac{(A-C)(M_p + M_s)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_r} \\
&= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.68 M_p}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\
&= 0.001652 \quad (\text{rad})
\end{aligned}$$

$$\begin{aligned}
\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_r t^3} + \theta_A \\
&= \frac{1.009 \times (-0.32 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001652 \\
&= 0.002348 \quad (\text{rad})
\end{aligned}$$

B3.5.3 计算 M_H 、 Q 和 M_s , 并将计算得的 M_s 值与假定的 M_s 值相比较。

$$\begin{aligned}
M_H &= -g_0^2 J_1 E_r \theta_B t + J_2 p t^4 / g_0 \\
&= -(13)^2 \times 3.698 \times 2.1 \times 10^5 \times 0.002348 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\
&= -10110544 \quad (\text{N} \cdot \text{mm})
\end{aligned}$$

$$\begin{aligned}
Q &= -g_0^2 J_3 E_r \theta_B + J_4 p t^3 / g_0 \\
&= -(13)^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002348 + 1.587 \times 10 \times 45^3 / 13 \\
&= -383907 \quad (\text{N})
\end{aligned}$$

$$\begin{aligned}
M_s &= M_H + \frac{1}{2} Q t \\
&= -10110544 + \frac{1}{2} \times (-383907) \times 45 \\
&= -18748452 \quad (\text{N} \cdot \text{mm})
\end{aligned}$$

这时,

$$\frac{M_s}{M_p} = \frac{-18748454}{35705278} = -0.525$$

与假定的 $M_s = -0.32M_p$ 相差太多, 重新假定 $M_s = -0.48M_p$ 再算。这时相应地有:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_r} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.52 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001666 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_r t^3} + \theta_A \\ &= \frac{1.009 \times (-0.48 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001666 \\ &= 0.002060 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_r \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.698 \times 2.1 \times 10^5 \times 0.002060 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8409687 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_r \theta_B + J_4 p t^3 / g_0 \\ &= -(13)^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002060 + 1.587 \times 10 \times 45^3 / 13 \\ &= -323173 \quad (\text{N})\end{aligned}$$

$$\begin{aligned}M_s &= M_H + \frac{1}{2} Q t \\ &= -8409687 + 0.5 \times (-323173) \times 45 \\ &= -15681080 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

这时,

$$\begin{aligned}\frac{M_s}{M_p} &= \frac{-15681080}{35705278} \\ &= -0.4392\end{aligned}$$

与假定值 $M_s = -0.48M_p$ 相差仍太大, 应再重新假定 M_s 值进行试算。

再重新假定 $M_s = -0.46M_p$, 相应地有:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_r} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.54 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001664 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_f t^3} + \theta_A \\ &= \frac{1.009 \times (-0.46 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001664 \\ &= 0.002095 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_f \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.689 \times 2.1 \times 10^5 \times 0.002095 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8616353 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_f \theta_B + J_4 p t^3 / g_0 \\ &= -13^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002095 + 1.587 \times 10 \times 45^3 / 13 \\ &= -330554 \quad (\text{N})\end{aligned}$$

$$\begin{aligned}M_s &= M_H + \frac{1}{2} Q t \\ &= -8616353 + 0.5 \times (-330554) \times 45 \\ &= -16053818 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

这时,

$$\begin{aligned}\frac{M_s}{M_p} &= \frac{-16053818}{35705278} \\ &= -0.4496\end{aligned}$$

与假定值 $M_s = -0.46 M_p$ 已比较接近。

再假定 $M_s = -0.45 M_p$, 相应地有:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_f} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.55 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001663 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_f t^3} + \theta_A \\ &= \frac{1.009 \times (-0.45 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001663 \\ &= 0.002113 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_f \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.689 \times 2.1 \times 10^5 \times 0.002113 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8722659 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_f \theta_B + J_4 p t^3 / g_0 \\ &= -13^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002113 + 1.587 \times 10 \times 45^3 / 13\end{aligned}$$

这时,

$$\frac{M_s}{M_p} = \frac{-18748454}{35705278} = -0.525$$

与假定的 $M_s = -0.32M_p$ 相差太多, 重新假定 $M_s = -0.48M_p$ 再算。这时相应:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_r} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.52 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001666 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_r t^3} + \theta_A \\ &= \frac{1.009 \times (-0.48 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001666 \\ &= 0.002060 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_r \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.698 \times 2.1 \times 10^5 \times 0.002060 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8409687 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_r \theta_B + J_4 p t^3 / g_0 \\ &= -(13)^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002060 + 1.587 \times 10 \times 45^3 / 13 \\ &= -323173 \quad (\text{N})\end{aligned}$$

$$\begin{aligned}M_s &= M_H + \frac{1}{2} Q t \\ &= -8409687 + 0.5 \times (-323173) \times 45 \\ &= -15681080 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

这时,

$$\begin{aligned}\frac{M_s}{M_p} &= \frac{-15681080}{35705278} \\ &= -0.4392\end{aligned}$$

与假定值 $M_s = -0.48M_p$ 相差仍太大, 应再重新假定 M_s 值进行试算。

再重新假定 $M_s = -0.46M_p$, 相应:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma]_b L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_r} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.54 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001664 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_f t^3} + \theta_A \\ &= \frac{1.009 \times (-0.46 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001664 \\ &= 0.002095 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_f \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.689 \times 2.1 \times 10^5 \times 0.002095 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8616353 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_f \theta_B + J_4 p t^3 / g_0 \\ &= -13^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002095 + 1.587 \times 10 \times 45^3 / 13 \\ &= -330554 \quad (\text{N})\end{aligned}$$

$$\begin{aligned}M_s &= M_H + \frac{1}{2} Q t \\ &= -8616353 + 0.5 \times (-330554) \times 45 \\ &= -16053818 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

这时,

$$\begin{aligned}\frac{M_s}{M_p} &= \frac{-16053818}{35705278} \\ &= -0.4496\end{aligned}$$

与假定值 $M_s = -0.46 M_p$ 已比较接近。

再假定 $M_s = -0.45 M_p$, 相应地有:

$$\begin{aligned}\theta_A &= \left[\frac{r_E r_s [\sigma] L_3}{A - C} - 0.29 \frac{(A - C)(M_s + M_p)}{B_1 \alpha t^3} \right] \cdot \frac{1}{E_f} \\ &= \left[\frac{1 \times 0.7 \times 205 \times 165}{449 - 383} - 0.29 \times \frac{(449 - 383) \times 0.55 \times 35705278}{260 \times 1.684 \times 45^3} \right] \times \frac{1}{2.1 \times 10^5} \\ &= 0.001663 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}\theta_B &= \frac{J_5 M_s + J_6 M_p}{E_f t^3} + \theta_A \\ &= \frac{1.009 \times (-0.45 \times 35705278) + 0.6954 \times 35705278}{2.1 \times 10^5 \times 45^3} + 0.001663 \\ &= 0.002113 \quad (\text{rad})\end{aligned}$$

$$\begin{aligned}M_H &= -g_0^2 J_1 E_f \theta_B t + J_2 p t^4 / g_0 \\ &= -13^2 \times 3.689 \times 2.1 \times 10^5 \times 0.002113 \times 45 + 1.1909 \times 10 \times 45^4 / 13 \\ &= -8722659 \quad (\text{N} \cdot \text{mm})\end{aligned}$$

$$\begin{aligned}Q &= -g_0^2 J_3 E_f \theta_B + J_4 p t^3 / g_0 \\ &= -13^2 \times 5.942 \times 2.1 \times 10^5 \times 0.002113 + 1.587 \times 10 \times 45^3 / 13\end{aligned}$$

$$= -334350 \text{ (N)}$$

$$\begin{aligned} M_s &= M_H + \frac{1}{2} Ql \\ &= -8722659 + 0.5 \times (-334350) \times 45 \\ &= -16245534 \text{ (N} \cdot \text{mm)} \end{aligned}$$

这时,

$$\begin{aligned} \frac{M_s}{M_p} &= \frac{-16245534}{35705278} \\ &= -0.455 \end{aligned}$$

与假定值 $M_s = -0.45M_p$ 已足够接近 ($\frac{0.45 - 0.455}{0.45} \times 100\% = -1.11\%$).

计算结果:

$$M_s = -16245534 \text{ N} \cdot \text{mm}$$

$$M_H = -8722659 \text{ N} \cdot \text{mm}$$

$$Q = -334350 \text{ N}$$

B3.6 法兰各部分的应力计算:

B3.6.1 法兰盘状部分, 在螺栓圆处的径向应力 σ_{r1} 按式 (A11) 计算。

$$\begin{aligned} \sigma_{r1} &= \pm \frac{6(M_p + M_s)}{t^2(\pi C - nd)} \\ &= \pm \frac{6 \times (35705278 - 16245534)}{45^2 \times (\pi \times 383 - 16 \times 34)} \\ &= \pm 87.49 \text{ (MPa)} \end{aligned}$$

B3.6.2 法兰盘状部分上, 在与锥颈大端交界处的径向应力 σ_{r2} 按式 (A12) 计算。

$$\begin{aligned} \sigma_{r2} &= -\left(\frac{Q}{\pi B_1 t} + p\right) \pm \frac{6M_s}{\pi B_1 t^2} \\ &= -\left(\frac{-334350}{\pi \times 260 \times 45} + 10\right) \pm \frac{6 \times (-16245534)}{\pi \times 260 \times 45^2} \\ &= 58 \text{ (MPa)} \end{aligned}$$

B3.6.3 法兰盘状部分上, 在与锥颈大端交界处的环向应力 σ_{π} 按式 (A13) 计算。

$$\begin{aligned} \sigma_{\pi} &= \left(\frac{Q}{\pi B_1 t} + p\right) Z \pm \left(\frac{E_r t \theta_B}{B_1} + \frac{1.8M_s}{\pi B_1 t^2}\right) \\ &= \left(\frac{-334350}{\pi \times 260 \times 45} + 10\right) \times 1.868 \pm \left(\frac{2.1 \times 10^5 \times 45 \times 0.002113}{260} + \frac{1.8 \times (-16245534)}{\pi \times 260 \times 45^2}\right) \\ &= 60.8 \text{ (MPa)} \end{aligned}$$

B3.6.4 锥颈上, 在与法兰盘状部分交界处的纵向应力 σ_{H1} 按式 (A14) 计算。

$$\begin{aligned}
 \sigma_{H1} &= \frac{pB_1}{4g_1} \pm \frac{6M_H}{\pi B_1 g_1^2} \\
 &= \frac{10 \times 260}{4 \times 20} \pm \frac{6 \times (-8722659)}{\pi \times 260 \times 45^2} \\
 &= 64.14 \text{ (MPa)}
 \end{aligned}$$

B3.6.5 锥颈上, 在与法兰盘状部分交界处的环向应力 σ_{H2} 按式 (A15) 计算。

$$\begin{aligned}
 \sigma_{H2} &= \left(\frac{Q}{\pi B_1 t} + p \right) (Z + \mu) + \frac{Et\theta_B}{B} + 0.075 \frac{pB_1}{g_1} \pm \frac{1.8M_H}{\pi B_1 g_1^2} \\
 &= \left(\frac{-334350}{\pi \times 260 \times 45} + 10 \right) \times (1.868 + 0.3) + \frac{2.1 \times 10^5 \times 45 \times 0.002113}{247} \\
 &\quad + 0.075 \times \frac{10 \times 260}{20} \pm \frac{1.8 \times (-8722659)}{\pi \times 260 \times 20^2} \\
 &= 140.59 \text{ (MPa)}
 \end{aligned}$$

B3.7 法兰强度条件:

有:

$$\begin{aligned}
 \sigma_{R1} &= 87.49 \text{ MPa} < [\sigma]_f \\
 \sigma_{R2} &= 58 \text{ MPa} < [\sigma]_f \\
 \sigma_{IT} &= 60.8 \text{ MPa} < [\sigma]_f \\
 \sigma_{H1} &= 64.14 \text{ MPa} < 1.5[\sigma]_f \\
 \sigma_{H2} &= 140.59 \text{ MPa} < 1.5[\sigma]_f
 \end{aligned}$$

且:

$$\begin{aligned}
 \frac{\sigma_H + \sigma_{R1}}{2} &= 99.3 \text{ MPa} < [\sigma]_f \\
 \frac{\sigma_H + \sigma_{IT}}{2} &= 100.7 \text{ MPa} < [\sigma]_f
 \end{aligned}$$

法兰强度条件满足。

B3.8 法兰螺栓的计算:

B3.8.1 工作状态下, 法兰接触圆上的接触反力 H_c 按式 (A4) 计算。

$$\begin{aligned}
 H_c &= \frac{M_p + M_s}{h_c} \\
 &= \frac{35705278 + (-16245534)}{33} \\
 &= 589889 \text{ (N)}
 \end{aligned}$$

B3.8.2 工作状态下螺栓的总载荷 W 按式 (A3) 计算。

$$\begin{aligned}
 W &= H + H_c \\
 &= 0.785 G^2 P + H_c
 \end{aligned}$$

$$\begin{aligned}
 &= 0.785 \times 279^2 \times 10 + 589889 \\
 &= 1204940 \quad (\text{N})
 \end{aligned}$$

B3.8.3 法兰螺栓的螺纹小径 d'_b 按式 (A16) 计算。

$$\begin{aligned}
 d'_b &= \sqrt{\frac{4W}{n\pi[\sigma]_b}} \\
 &= \sqrt{\frac{4 \times 1204940}{16\pi \times 205}} \\
 &= 22.386 \quad (\text{mm})
 \end{aligned}$$

B3.8.4 螺栓螺纹基本尺寸的选定: 从 GB/T 196 中查得, 相应于螺纹小径计算值 22.386mm 的螺纹基本尺寸为 M27×3。

螺纹 M27×3 的根部直径为:

$$\begin{aligned}
 d_{\text{根}} &= d - 2 \times \frac{5}{8} H \\
 &= 27 - 2 \times \frac{5}{8} \times 0.866 \times 3 \\
 &= 23.75256 \quad (\text{mm})
 \end{aligned}$$

现 $d_{\text{根}} > d'_b$ 。