

جواب السؤال الأول : (32 درجة)

1-

$$A1 = \pi \times 20^2 = 1256.637 \text{ mm}^2$$

$$A2 = \frac{\pi^2}{2} \times 5 \times 40 = 986.96 \text{ mm}^2$$

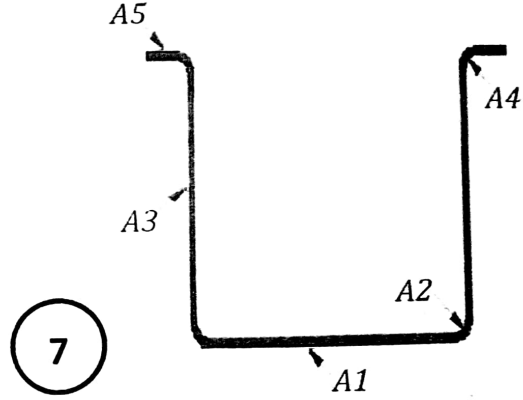
$$A3 = \pi \times 50 \times 60 = 9424.778 \text{ mm}^2$$

$$A4 = \frac{\pi^2}{2} \times 5 \times 60 = 1480.44 \text{ mm}^2$$

$$A5 = \pi(33^2 - 30^2) = 593.76 \text{ mm}^2$$

$$D^2 = \frac{4}{\pi} (1256.637 + 986.96 + 9424.778 + 1480.44 + 593.76) = 17497.59$$

$$\Rightarrow D = 132.28 \text{ mm}$$



2-

$$\frac{s}{D} \times 100 = \frac{1}{132.28} \times 100 = 0.756$$

من الجدول نجد $m_1 = 0.54, m_2 = 0.77, m_3 = 0.8, m_4 = 0.82$

$$d_1 = m_1 \cdot D = 0.54 \times 132.28 = 71.43 \text{ mm}$$

$$d_2 = m_2 \cdot d_1 = 0.77 \times 71.43 = 55 \text{ mm}$$

$$d_3 = m_3 \cdot d_2 = 0.8 \times 55 = 44 \Rightarrow d_3 = 50 \text{ mm}$$

بالتالي عدد مراحل السحب ثلاث مراحل
حساب أبعاد الموجبة والسالبة لكل مرحلة:

$$\epsilon = S \cdot \sqrt{\frac{D}{d}} = 1 \cdot \sqrt{\frac{132.28}{71.43}} = 1.36 \text{ mm}$$

$$d_1^- = 71.43 + 1 = 72.43 \text{ mm}$$

$$d_1^+ = 72.43 - 2 \times 1.36 = 69.71 \text{ mm}$$

$$d_2^- = 55 + 1 = 56 \text{ mm}$$

$$d_2^+ = 56 - 2 \times 1.36 = 53.28 \text{ mm}$$

$$d_3^- = 50 + 1 = 51 \text{ mm}$$

$$d_3^+ = 51 - 2 \times 1.36 = 48.28 \text{ mm}$$

3-

$$I = 132.28 + 6 \times 5 = 162.28 \text{ mm}$$

$$\Rightarrow B = 1.5 \times t = 1.5 \text{ mm}, H = 142.28$$

$$W = H + 2B = 142.28 + 3 = 145.28 \text{ mm}$$

$$C = I + B = 163.78 \text{ mm}$$

$$A = t + 0.015 H = 1 + 0.015 \times 142.28 = 3.13 \text{ mm}$$

$$N = \frac{L-A}{C} = \frac{2500-3.13}{163.78} = 15$$

$$A_{\text{product}} = \frac{\pi}{4} (132.28 - 3 \times 2)^2 = 12524.46 \text{ mm}^2$$

$$\text{عامل الاستفادة} = \frac{N \times A_{\text{product}}}{A_{\text{strip}}} \times 100 = \frac{15 \times 12524.46}{145.28 \times 2500} \times 100 = 51.72\%$$

4-

$$L_1 = \frac{\pi}{180} \times 176 \times \left(\frac{132.28}{2} + \frac{142.28}{2} \right) + 10 + 2 \times 2\pi \times 7.5 = 525.94 \text{ mm}$$

$$D = 132.28 \text{ mm}, H = 142.28$$

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$$F_1 = L_1 \cdot S \cdot \tau_s = 525.94 \times 1 \times 256 = 134.64 \text{ kN}$$

$$L_2 = \frac{\pi}{180} \times 176 \times \left(\frac{132.28}{2} + \frac{142.28}{2} \right) + 10 = 431.69 \text{ mm}$$

$$F_2 = 431.69 \times 1 \times 256 = 110.512 \text{ kN}$$

$$L_3 = 2 \times \left(\frac{\pi}{180} \times 110 \times \left(\frac{152.28}{2} + \frac{162.28}{2} \right) + 10 \right) = 623.91 \text{ mm}$$

$$F_3 = 623.91 \times 1 \times 256 = 159.721 \text{ kN}$$

$$F_4 = \pi \cdot d_1 \cdot S \cdot \bar{\sigma}_y \left(\left(\frac{D}{d_1} \right) - 0.65 \right) = \pi \times 71.43 \times 200(1.852 - 0.65) = 53.946 \text{ kN}$$

$$F_5 = \pi \times 55 \times 200(1.298 - 0.65) = 22.324 \text{ kN}$$

$$F_6 = \pi \times 50 \times 200(1.1 - 0.65) = 14.137 \text{ kN}$$

$$F_7 = \pi \times 60 \times 1 \times 256 = 48.254 \text{ kN}$$

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القوة المكبس اللازمة لعملية السحب بالقالب التتابعي:

$$F_{tot} = \sum F_i = 543.54 \text{ kN}$$

جواب السؤال الثاني : (25 درجة)

1-

$$W_L = \gamma \cdot V = \gamma \cdot A_a \cdot 100 \Rightarrow 2.806 = 2.83 \times A_a \times 100 \Rightarrow$$

$$A_a = 9.915 \text{ cm}^2$$

$$A_b = \frac{\pi \cdot D_b^2}{4} = \frac{\pi \times 200^2}{4} = 314.159 \text{ cm}^2$$

$$N_p = F \cdot V_b \Rightarrow F = \frac{N_p}{V_b}$$

$$V_b \cdot A_b = V_a \cdot A_a \Rightarrow V_b = V_a \cdot \frac{A_a}{A_b} = 63.37 \times \frac{9.915}{314.159} = 2 \frac{\text{mm}}{\text{sec}}$$

$$= 2 \times 10^{-3} \frac{\text{m}}{\text{sec}}$$

$$\Rightarrow F = \frac{37300}{2 \times 10^{-3}} = 18650 \times 10^3 \text{ N}$$

$$F = \sigma_{xL} \cdot A_b \Rightarrow \sigma_{xL} = \frac{F}{A_b} = \frac{18650 \times 10^3}{314.159} = 593.65 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{xb} = \bar{\sigma}_y \cdot \left(0.8 + 1.5 \times \ln \frac{A_b}{A_a} \right)$$

$$\sigma_{xb} = 60 \times \left(0.8 + 1.5 \times \ln \frac{314.159}{9.915} \right) = 359.03 \frac{\text{N}}{\text{mm}^2}$$

$$\sigma_{xL} = \bar{\sigma}_y + (\sigma_{xb} - \bar{\sigma}_y) \cdot e^{\frac{4 \times \mu \cdot L}{D}}$$

$$593.65 = 60 + (359.03 - 60) \cdot e^{\frac{4 \times 0.07 \times L_{max}}{20}}$$

$$533.65 = (299.03) \cdot e^{0.014 \times L_{max}}$$

$$\Rightarrow L_{max} = 41.371 \text{ cm}$$

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2-

$$\zeta = 63.37 \times 10^{-3} \times 3600 = 228.132 \frac{m}{hour}$$

بالتالي فإن الإنتاجية (بالطن / الساعة):

$$\eta = \zeta \cdot W_L = 228.132 \times 2.806 \times 10^{-3} = 0.64 \frac{ton}{hour}$$

جواب السؤال الثالث: (23 درجة)

1-

$$\left. \begin{array}{l} N_r = T \cdot \omega \\ T = 0.4 \cdot F \cdot L \\ F = 1.2 \times \bar{\sigma}_y \cdot W \cdot L \end{array} \right\} \Rightarrow N_r = 0.48 \times \bar{\sigma}_y \cdot \omega \cdot W \cdot L^2$$

$$\left. \begin{array}{l} N_b = T_b \cdot \omega \\ T_b = \frac{F}{2} \cdot \mu_b \cdot \frac{d}{2} \\ F = 1.2 \times \bar{\sigma}_y \cdot W \cdot L \end{array} \right\} \Rightarrow N_b = 0.3 \times \mu_b \cdot \bar{\sigma}_y \cdot d \cdot \omega \cdot W \cdot L$$

$$\omega = \frac{2\pi n}{60} = \frac{2\pi \times 200}{60} = 20.944 \frac{rad}{sec}$$

$$N_r = 0.48 \times 200 \times 10^6 \times 1.2 \times 20.944 \times L^2 = 2412.75 \times 10^6 L^2$$

$$N_b = 0.3 \times 0.01 \times 200 \times 10^6 \times 0.2 \times 20.944 \times L = 2.51 \times 10^6 L$$

$$N_m = \frac{1}{\eta_m} (2N_r + 4N_b)$$

$$550 \times 10^3 = \frac{1}{0.85} (4825.5L^2 + 10.04L) \times 10^6 \Rightarrow$$

$$4825.5 \times 10^3 L^2 + 10040L - 467.5 = 0$$

$$\Rightarrow L = 0.00885 m = 8.85 mm$$

$$\Rightarrow \Delta h = \frac{L^2}{R} = 0.522 mm$$

2-

سرعة خروج المعدن من المنصة بإهمال الانزلاق الأمامي :

$$V_f = \frac{2\pi \cdot n}{60} \cdot R = 20.944 \times 0.15 = 3.1416 \left[\frac{m}{s} \right] = 11.30976 \left[\frac{km}{h} \right]$$

$$G_{l=1} = A_f \times 1 \times \gamma = (4.478 \times 1200) \times 10^{-6} \times 7850 = 42.182 \frac{kg}{m}$$

$$\text{إنتاجية المنصة النظرية} = 11309.76 \times 42.182 = 477077 = 477.077 \frac{ton}{h}$$

انتهى السلم

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