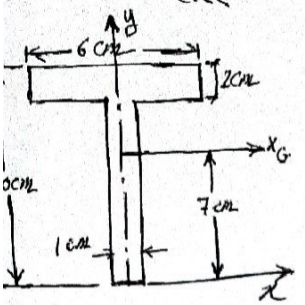
نسلّم تصحيح : مقاومة مواد - سنة ثانية هندسة ميكانيك - ملف 2021/2022 المدة: 40 دقيقة

السؤال الأول 40 دقيقة



1- تحديد مركز الثقل : نختار المحور y المار من وسط الشكل 1 $\Leftarrow x_G = 0$

$$y_G = \frac{A_1\overline{y_1} + A_2\overline{y_2}}{A_1 + A_2} = \frac{8\times1\times4 + 6\times2\times9}{8\times1 + 6\times2} = \frac{32+108}{20} = 7\,cm \quad (16)$$

$G(0,7)$

$$I_{xG} = (I_{xG})_1 + (I_{xG})_2 = \frac{1}{12}\times1\times8^3 + 8\times1\times(7-4)^2 + \frac{1}{12}\times6\times2^3 + 6\times2\times(7-9)^2$$

$$= 42.666 + 72 + 4 + 48 = 114.666 + 52 = 166.666\,cm^4$$

$$I_{yG} = (I_{yG})_1 + (I_{yG})_2 = \frac{1}{12}\times8\times1^3 + 0 + \frac{1}{12}\times2\times6^3 = 0.666 + 36 = 36.666\,cm^4$$

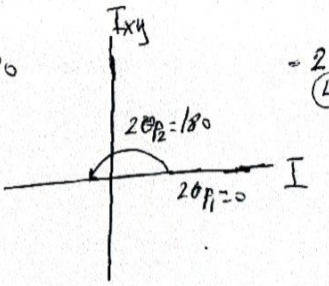
$I_{xGyG} = (I_{xGyG})_1 + (I_{xGyG})_2 = A_1 x_{GG_1} y_{GG_1} + A_2 x_{GG_2} y_{GG_2} = 0 + 0 = 0$ / y_G المار من وسط الشكل 1

$\Leftarrow x_{GG_1} = 0$ و $x_{GG_2} = 0$

$$I_{1/2} = \frac{I_{xG} + I_{yG}}{2} \pm \sqrt{\left(\frac{I_{xG} - I_{yG}}{2}\right)^2 + I_{yG}^2}$$

$I_1 = I_{xG} = 166.666\,cm^4$, $I_2 = I_{yG} = 36.666\,cm^4$

$$\tan 2\theta_{p_1} = -\frac{I_{xGyG}}{\frac{I_{xG} - I_{yG}}{2}} = 0 \Rightarrow 2\theta_{p_1} = 0 \,/\, 2\theta_{p_2} = 180$$



-2 (4)

$$\varepsilon_x = \frac{1}{E}(\sigma_x - \nu\sigma_y) = \frac{1}{200\,10^3}(20 + 0.3\times30) = 0.145\,10^{-3}$$

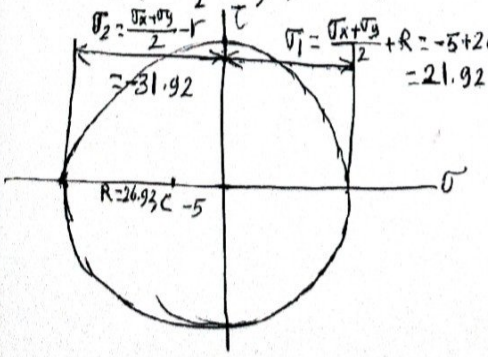
$$\varepsilon_y = \frac{1}{E}(\sigma_y - \nu\sigma_x) = \frac{1}{200\,10^3}(-30 - 0.3\times20) = -0.18\,10^{-3}$$

-3 (9)

$$\gamma_{xy} = \frac{\tau_{xy}}{G} = \frac{2(1+\nu)\tau_{xy}}{E} = \frac{2(1+0.3)\times10}{200\,10^3} = 0.13\,10^{-3}$$

$$C\left(\frac{\sigma_x+\sigma_y}{2}, 0\right) \Rightarrow C(-5, 0)\,,\ R = \sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\frac{20+30}{2}\right)^2 + 10^2} = 26.92$$

-4 (6)



$$P = T.\omega = 1500\frac{\pi n}{30} = 1500\times\frac{\pi\times300}{30} = 47123.9\,W$$

-5 (5)

$$J/R \geq \frac{T}{\tau_{adp}} \Rightarrow \frac{\pi R^3}{2} \geq \frac{1500\times100/9.81}{600}$$

$$\Rightarrow R \geq \sqrt[3]{\frac{2\times1500\times100}{9.81\times\pi\times600}} \geq \sqrt[3]{16.22} \geq 2.529$$

$$\Rightarrow D \geq 5.05\,cm$$