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SSC JE 2023

JKSSB JE | RRB JE

15 दिन Complete Concepts

STRENGTH OF MATERIALS CONCEPTS

COMBINED STRESSES

DAY-7

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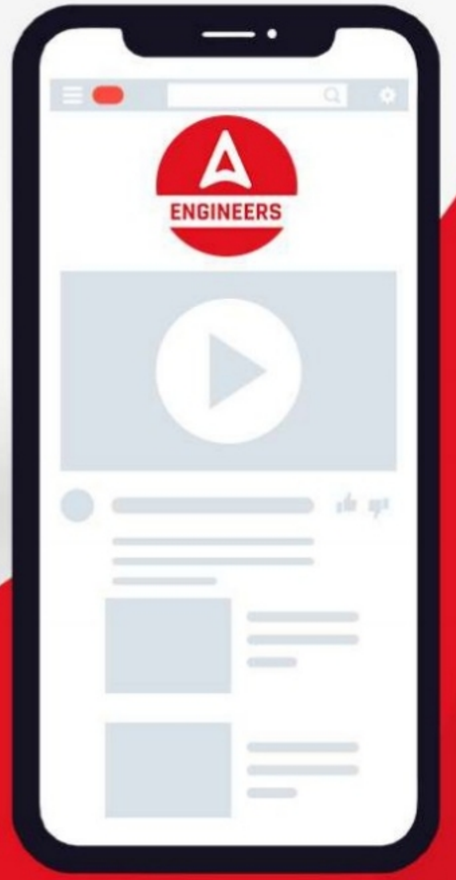

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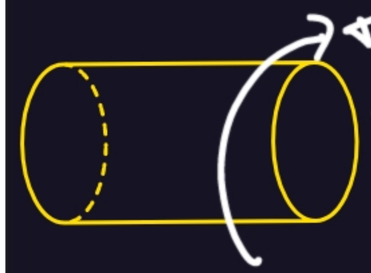


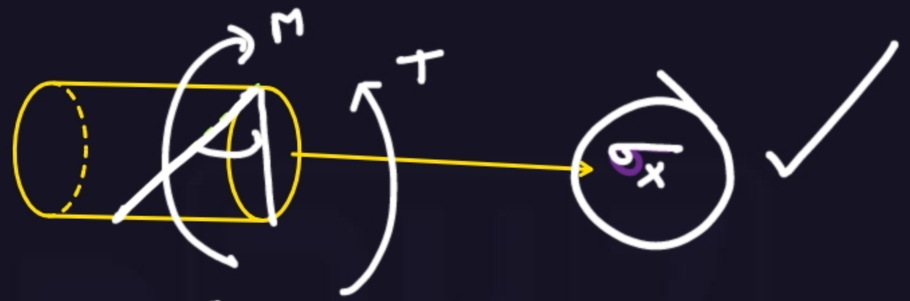
$\tau_{max} = \frac{16T}{\pi d^3}$ ✓

$\sigma_{max} = P/A$ ✓

$\sigma_b = \frac{M}{Z} = \sigma_{b_{max}}$

Combined stress

Real life → M/C/ structure



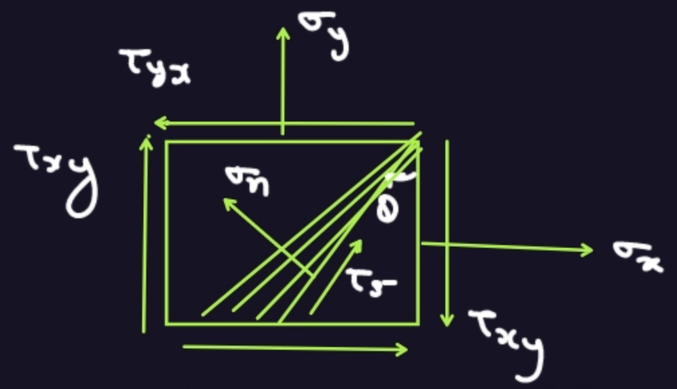
$(\sigma_n)_{max} = ?$ | कहा होगी

$(\tau_s)_{max} = ?$

$T_{eq} = ?$ ✗

$M_{eq} = ?$ ✗

Bi axial state stress



σ_x, σ_y) ⊕

τ_{xy} + C.W

$\theta \rightarrow$ x face (C.W) θ +

$$\sigma_n = \frac{(\sigma_x + \sigma_y)}{2} + \left(\frac{\sigma_x - \sigma_y}{2}\right)\cos 2\theta + \tau_{xy}\sin 2\theta$$

$\theta \rightarrow$ Infinit

$\sigma_n \rightarrow$ n

O.P & C.O.B ⊥

C.O.P angle from x face 90+θ

$$\sigma_n' = \left(\frac{\sigma_x + \sigma_y}{2}\right) + \left(\frac{\sigma_x - \sigma_y}{2}\right)\cos 2(90+\theta) + \tau_{xy}\sin 2(90+\theta)$$

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$\sigma_n + \sigma_n' = \sigma_x + \sigma_y$ → vvimp:

O.P → $\tau_s = -\frac{(\sigma_x + \sigma_y)}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$

C.O.P → $\tau_s' = \xrightarrow{(90+\theta)}$

$\tau_s' = ? - \frac{(\sigma_x + \sigma_y)}{2} \sin 2(90+\theta) + \tau_{xy} \cos 2(90+\theta)$

$\tau_s + \tau_s' = 0$

$\tau_s = -\tau_s'$ Complimentry shear stress

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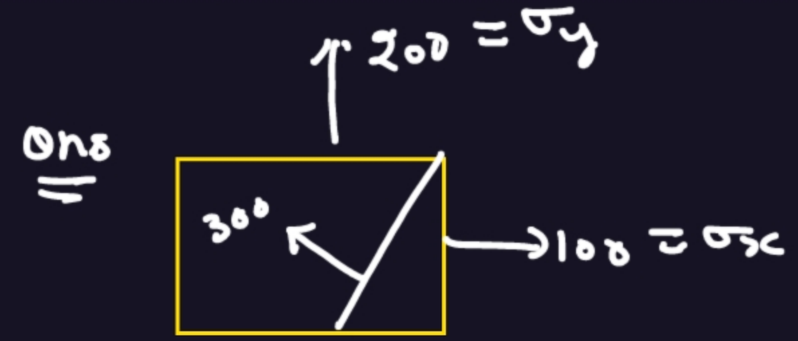


σn' = ?

(A) 100

(B) 200

(C) 300

(d) None

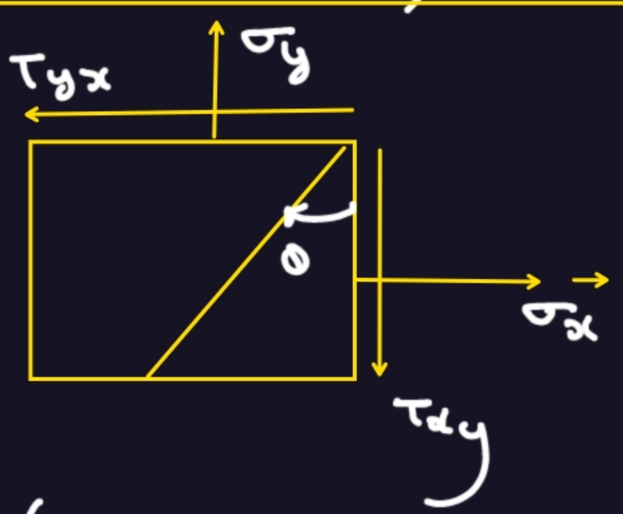
(10) Sec

$\sigma_n + \sigma_n' = \sigma_x + \sigma_y$

$300 + \sigma_n' = 300$

$\sigma_n' = 0$

Principal stress and Plane



(σ_n and τ_s) Infinite value

$\theta \rightarrow$ infinite

$(\sigma_n)_{max} \rightarrow \sigma_1 \rightarrow$ M.P.S (By magnitude) $\rightarrow$ Corresponding angle θ_1

$(\sigma_n)_{min} \rightarrow \sigma_2 \rightarrow$ Minor P.S $\rightarrow \theta_2$

OR

Principal Plane $\rightarrow (\sigma_n)_{max/min}$ or $\tau_s = 0$ or Plane of Zero Shear

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Principal Plane

$$\tau_{s=\theta} = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta + \tau_{xy}\cos 2\theta$$

$$\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta = \tau_{xy}\cos 2\theta$$

$$\tan 2\theta = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

θ_1, θ_2 values

$(\sigma_n)_{\theta=\theta_1} = (\sigma_n)_{max} \rightarrow \sigma_1$

$(\sigma_n)_{\theta=\theta_2} \rightarrow (\sigma_n)_{min} \Rightarrow \sigma_2$

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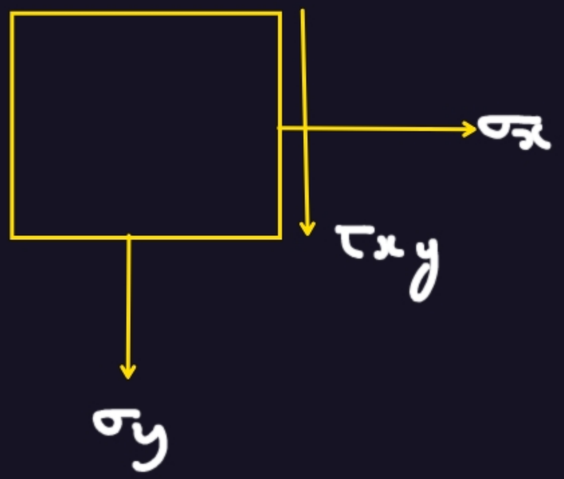

$$\sigma_1, \sigma_2 = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$(\sigma_1)_{max} \rightarrow$ M.P.S

$(\sigma_3)_{min} \rightarrow$ Minor P.S

Maximum Shear stress

$$\tau_s = \frac{d\tau_s}{d\theta} = 0$$

$\left.\begin{matrix} \sigma_3, \\ \sigma_4, \end{matrix}\right) \rightarrow : (\tau_s)$

$$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

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