T72S01 Tutorial Session #6: Maths

Mentor Guide Knowledge & Skills Questions

1.9 State or derive the algebraic expressions obeyed by the stresses to ensure equilibrium.

Numerical Questions

1) Carry out the matrix multiplications in,

$$\begin{pmatrix} \sigma'_x & \tau' \\ \tau' & \sigma'_y \end{pmatrix} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} \sigma_x & \tau \\ \tau & \sigma_y \end{pmatrix} \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$$

And hence show that this reduces to,

$$\sigma'_x = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau \sin 2\theta$$

$$\sigma'_y = \sigma_y \cos^2\theta + \sigma_x \sin^2\theta - \tau \sin 2\theta$$

$$\tau' = \tau \cos 2\theta + \frac{1}{2}\left(\sigma_y - \sigma_x\right)\sin 2\theta$$

2) Find the Tresca stress of the stress matrix $\begin{pmatrix} 2 & 3 & 0 \\ 3 & 1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$.

3) In Qu.(2), what angle does the principal axis make with the original x-axis?

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