

②

$$\begin{aligned}
 t &\Rightarrow 0.125 \text{ mm} \\
 d &\Rightarrow 1 \text{ mm} \\
 \nu &\Rightarrow 0.18
 \end{aligned}$$

$$\begin{aligned}
 E_1 &= 125 \text{ kPa} \\
 E_2 &= 9.5 \text{ kPa} \\
 k_{12} &= 5.6 \text{ kPa} \\
 \nu_{12} &= 0.24
 \end{aligned}$$

stiffness Matrix in plane stress:-

$$\begin{pmatrix} \sigma_{11} \\ \sigma_{22} \\ \sigma_{12} \end{pmatrix} = \begin{bmatrix} Q_{11} & Q_{12} & 0 \\ Q_{12} & Q_{22} & 0 \\ 0 & 0 & Q_{66} \end{bmatrix} \begin{pmatrix} \epsilon_{11} \\ \epsilon_{22} \\ \gamma_{12} \end{pmatrix}$$

$$Q_{11} = \frac{E_1}{1 - \nu_{12}\nu_{21}}$$

$$Q_{66} = k_{12}$$

$$Q_{22} = \frac{E_2}{1 - \nu_{12}\nu_{21}}$$

$$Q_{12} = \frac{\nu_{12}E_2}{1 - \nu_{12}\nu_{21}}$$

$$Q = \begin{bmatrix} 125 & 228 & 0 \\ 228 & 9.5 & 0 \\ 0 & 0 & 5.6 \end{bmatrix} \text{ kPa}$$

For Relation of Axes,

$$\begin{pmatrix} \sigma_{11} \\ \sigma_{22} \\ \tau_{12} \end{pmatrix} = \begin{bmatrix} \cos^2\theta & \sin^2\theta & 2\cos\theta\sin\theta \\ \sin^2\theta & \cos^2\theta & -2\cos\theta\sin\theta \\ -\cos\theta\sin\theta & \cos\theta\sin\theta & \cos^2\theta - \sin^2\theta \end{bmatrix} \begin{bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \tau_{xy} \end{bmatrix}$$

$[T]$

original
Coordinate
system

$$1. \bar{\sigma} = [T]^T [\sigma] [T]$$

Total transformation matrix

$$T = \begin{bmatrix} 0.8830 & 0.1170 & 0.6428 \\ 0.1170 & 0.8830 & -0.6428 \\ -0.3214 & 0.3214 & 0.7660 \end{bmatrix}$$

$$\bar{\sigma} \Rightarrow \begin{bmatrix} 100.3808 & 13.3882 & 31.7988 \\ 13.3882 & 11.9027 & 5.3222 \\ 31.7988 & 5.3222 & 16.7082 \end{bmatrix}$$