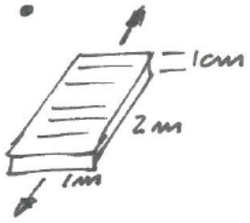
Composites Polymères

Mécanique des composites

Corrections Exo 2024

6)



a) $\varepsilon_2 = \frac{\sigma_2}{E_2} = 0{,}01 \rightarrow \Delta y = 4 . \varepsilon_2 = 2\,cm$

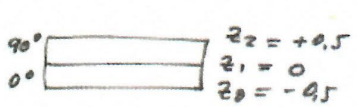
$\varepsilon_1 = S_{12} . \sigma_2 = -\frac{\vartheta_{12}}{E_1} . \sigma_2 = -0{,}2 . 10^{-3} \rightarrow \Delta x = -0{,}2\,mm$

b) $\varepsilon_1 = 0 = S_{11}\sigma_1 + S_{12}\sigma_2 \rightarrow \sigma_1 = -\frac{S_{12}}{S_{11}} . \sigma_2 = \vartheta_{12} . \sigma_2$

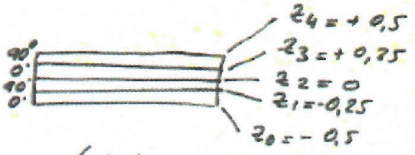
$= 2 . 10^7\ N/m^2$

$N_x = \sigma_1 . A_x \rightarrow N_x = 4 . 10^5\ N$

(7) •



0/90



$(0/90)_2$

• $A_{ij} = \overline{Q_{ij}}\big|_{0°}(0-(-0,3)) + \overline{Q_{ij}}\big|_{90°}(0,5-0)$

$A_{ij} = \frac{1}{2}\overline{Q_{ij}}\big|_{0°} + \frac{1}{2}\overline{Q_{ij}}\big|_{90°}$

$\Rightarrow A_{ij}\big|_{(0/90)} = A_{ij}\big|_{(0/90)_2}$

$A_{ij} = \overline{Q_{ij}}\big|_{0°}(-0,25-(-0,3)) + \overline{Q_{ij}}\big|_{90°}(0-(-0,25)) + \overline{Q_{ij}}\big|_{0°}(0,25-0) + \overline{Q_{ij}}\big|_{90°}(0,5-0,25) = \frac{1}{2}\overline{Q_{ij}}\big|_{0°} + \frac{1}{2}\overline{Q_{ij}}\big|_{90°}$

• $B_{ij}\big|_{(0/90)} = \dots = -\frac{1}{8}\overline{Q_{ij}}\big|_{0°} + \frac{1}{8}\overline{Q_{ij}}\big|_{90°}$

$B_{ij}\big|_{(0/90)_2} = \frac{1}{2}B_{ij}\big|_{(0/90)} \Rightarrow$ lorsque $N \to \infty \Rightarrow B_{ij} \to 0$

• $D_{ij}\big|_{(0/90)} = D_{ij}\big|_{(0/90)_2} = \frac{1}{24}\overline{Q_{ij}}\big|_{0°} + \frac{1}{24}\overline{Q_{ij}}\big|_{90°}$

← Application

$\overline{Q_{11}}\big|_{0°} = \cos^4\theta \cdot Q_{11} + \dots \overset{0}{\sin^4\theta} = Q_{11} = \frac{E_1}{(1-\nu_{12}\cdot\nu_{21})} = 41,1$ GPa

$\overline{Q_{12}}\big|_{0°} = Q_{12}\cdot\cos^4\theta = Q_{12} = \frac{\nu_{12}E_2}{(1-\nu_{12}\nu_{21})} = 3,7$ GPa

$\overline{Q_{22}}\big|_{0°} = Q_{22}\cdot\cos^4\theta = Q_{22} = \frac{E_2}{(1-\nu_{12}\nu_{21})} = 12,3$ GPa

$\overline{Q_{66}}\big|_{0°} = \cos^4 Q_{66} = Q_{66} = G_{12} = 4$ GPa

$\overline{Q_{11}}\big|_{90°} = \cos^4(90)\,Q_{11} + \dots + \overset{1}{\sin^4 90}\cdot Q_{22} = Q_{22} = 12,3$ GPa

$\overline{Q_{12}}\big|_{90°} = \overset{0}{Q_{12}} \qquad \overline{Q_{22}}\big|_{90°} = Q_{11}$

$$A_{ij} = \begin{bmatrix} 26,7 & 3,6 & 0 \\ 3,6 & 26,7 & 0 \\ 0 & 0 & 4 \end{bmatrix} \text{ N/m} \qquad B_{ij}\big|_{0/90} = \begin{bmatrix} 3,59 & 0 & 0 \\ 0 & -3,3 & 0 \\ 0 & 0 & 0 \end{bmatrix} \text{ N} \qquad D_{ij} = \begin{bmatrix} 2,22 & 0,31 & 0 \\ 0,31 & 2,22 & 0 \\ 0 & 0 & 0,33 \end{bmatrix} \text{ N.m}$$

26,7 3,59