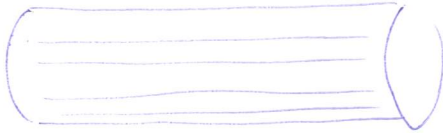


**2.1.48**

GIVET:



$$\begin{cases} E_f = 75 \text{ GPa} \\ \alpha_f = 5 \cdot 10^{-6} \text{ } 1/^{\circ}\text{C} \end{cases}$$

$$\begin{cases} E_m = 5 \text{ GPa} \\ \alpha_m = 51 \cdot 10^{-6} \text{ } 1/^{\circ}\text{C} \end{cases}$$

→ längdvidningskoefficient.

Kompositstäng

$$65\% \text{ fiber} \Rightarrow V_f = 0.65$$

$$35\% \text{ matrix} \Rightarrow V_m = 0.35$$

(tillverkningen)

Vid  $T = 180^{\circ}\text{C}$  är

kompositen spännsfri

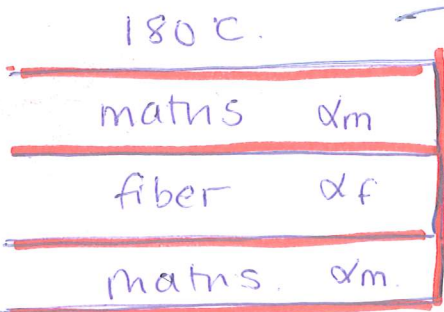
SÖKT: Restspänningar då kompositen svalnat till  $20^{\circ}\text{C}$

LÖSNING:

Varför finns restspänningar?

KOMP:

$$\begin{aligned} \sigma_f &= \sigma_m = 0 \\ \epsilon_m &= \epsilon_f = 0 \end{aligned}$$

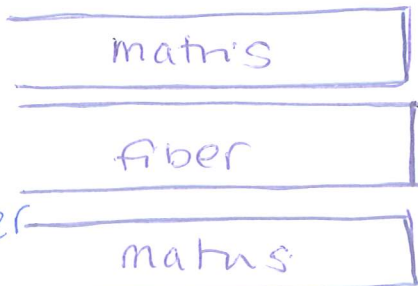


FRI:

$$\sigma_m = \sigma_f = 0$$

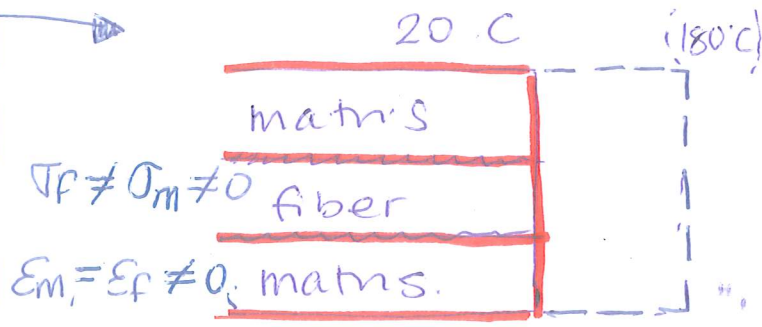
komponenter

$$\epsilon_m = \epsilon_f = 0$$



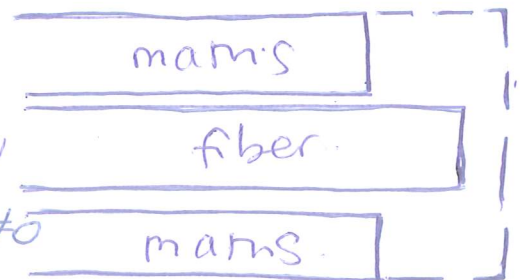
$$\sigma_f \neq \sigma_m \neq 0$$

$$\epsilon_m \neq \epsilon_f \neq 0$$



$$\sigma_m = \sigma_f = 0$$

$$\epsilon_m \neq \epsilon_f \neq 0$$



Vid  $\Rightarrow 180^\circ\text{C}$  kompositen spänningsfri

$$\sigma_f = \sigma_m = 0$$

$$\epsilon_f = \epsilon_m = 0$$

$20^\circ\text{C}$  Restspänningar.

Def. samb.

varför?  $\Rightarrow \epsilon_f = \epsilon_m$

② konstitutiva ekv. (spänningar 1D)  $\sigma_f \neq \sigma_m \neq 0$

TERMOELASTISKT  
MAT

$$\epsilon_f = \frac{\sigma_f}{E_f} + \alpha_f \Delta T$$

$$\epsilon_m = \frac{\sigma_m}{E_m} + \alpha_m \Delta T$$

③ Deformation samband / kompatibilitet.

$$\frac{\sigma_f}{E_f} + \alpha_f \Delta T = \frac{\sigma_m}{E_m} + \alpha_m \Delta T \quad (*)$$

där  $\Delta T = T_2 - T_1$

2 obekanta, 1 ekv.  $\Rightarrow$  Behöver 1 ekv.  $\Delta T = -160^\circ\text{C}$

① Samband mellan spänningarna i komp:  
Imv.  $\left\{ \begin{array}{l} \sigma_k \cdot A_k \Rightarrow \sigma_k \cdot A_k = 0 \end{array} \right. \Leftarrow$  Ingen vtrelast på komp  
 $\sigma_{\text{komp}} \cdot A_{\text{komp}} = \sigma_f \cdot A_f + \sigma_m \cdot A_m = 0$

$$\sigma_k = 0$$

$$0 \left( \sigma_f \frac{A_f}{A_{\text{komp}}} + \sigma_m \frac{A_m}{A_{\text{komp}}} \right) = \sigma_f U_f + \sigma_m U_m$$

$$-\sigma_m = \sigma_f \frac{U_f}{U_m}$$

$$\underline{\sigma_m = -\sigma_f \frac{U_f}{U_m}} \quad (**)$$

(\*) ( \* )

$$\frac{\sigma_F}{E_F} + \alpha_F \Delta T = - \frac{\sigma_F V_F}{V_M E_M} + \alpha_M \Delta T$$

$$\sigma_F = \frac{(\alpha_M - \alpha_F) \Delta T \cdot E_M E_F V_M}{E_M V_M + E_F V_F}$$

$$(*) : \sigma_M = - \frac{(\alpha_M - \alpha_F) \Delta T E_M E_F V_F}{E_M V_M + E_F V_F}$$

$$\begin{cases} \sigma_M = 33.2 \text{ MPa} \\ \sigma_F = -17.9 \text{ MPa} \end{cases}$$