

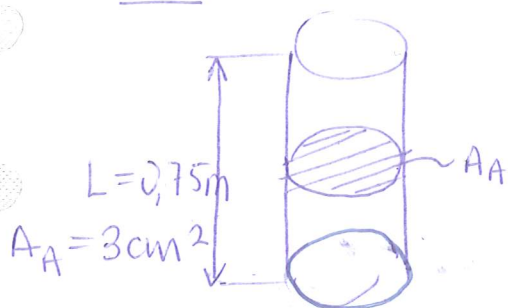
2.1.47

GIVET: man vill ersätta en aluminiumstång med en kolfiberad kompositstång med samma längd

$$L = 0,75 \text{ m}$$

ALUMINIUMSTÅNG (A)

mat: 7075-T6



$$\sigma_{s,A} = 470 \text{ MPa}$$

$$E_A = 72 \text{ GPa}$$

$$\rho_A = 2800 \text{ kg/m}^3$$

$$(\text{Tab 34.3}) \quad \sigma_B = 540 \text{ MPa}$$

- hållfasthet

- styvhet

} ska vara minst lika stor
som aluminiumkomponenten
↑
för K-komponenten

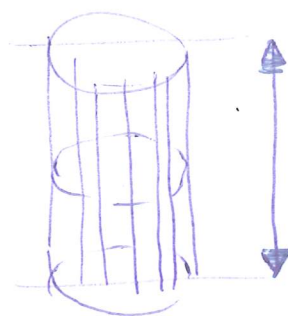
SÖKT

- A_K ?

- viktförändring

LÖSNING

KOMPOSITSTÅNG (K)



$$A_{komp} = ?$$

$$L_{komp} = 0,75$$

Kolfiber (F)

$$\sigma_{BF} = 2500 \text{ MPa}$$

$$E_F = 280 \text{ GPa}$$

$$\rho_F = 1900 \text{ kg/m}^3$$

$$V_f = 0,5$$

(volymandelen fiber är)

Polyester (M)

$$\sigma_{Bm} = 50 \text{ MPa}$$

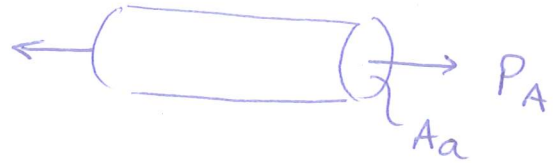
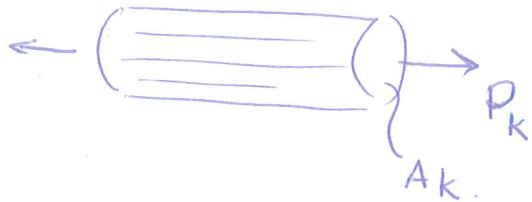
$$E_m = 3,7 \text{ GPa}$$

$$\rho_m = 1100 \frac{\text{kg}}{\text{m}^3}$$

$$V_m = 0,5$$

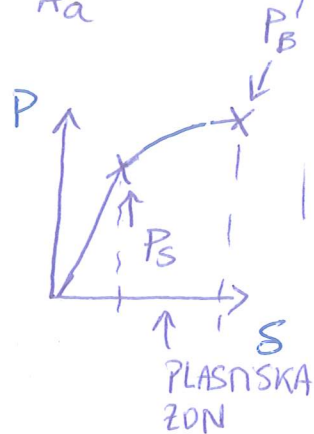
LÖSNING:

1. - Hållfasthet: komposit \geq Aluminium.



$$P_{kB} \geq P_{AS}$$

↑ ↑
brottgräns sträckgräns
(plastiska zonen för komposit, liten)



2. - Styvhet för Komp \geq Alum.

$$P = \sigma A = E \epsilon A = \frac{EA}{L} S \Rightarrow \text{Dragstyvhet } k = \underline{\underline{\frac{EA}{L}}}$$

$$k_k \geq k_A$$

1. - Hållfasthet $P_{kB} \geq P_{AS}$.

komposit:

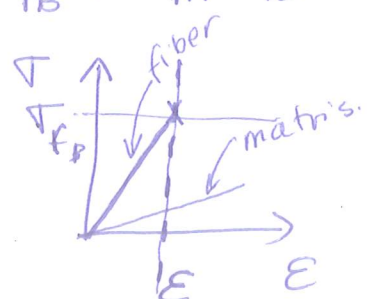
$$P_{kB} = \sigma_{kB} \cdot A_k = A_k \cdot \sigma_{kB} = \sigma_{fB} A_f + \sigma_{mB} A_m$$

$$\sigma_{kB} = \sigma_{fB} \frac{A_f}{A_k} + \sigma_m \frac{A_m}{A_k} = v_f \sigma_{fB} + v_m \sigma_m$$

↑
fibrer
börjar plastisera

↑
matrisen
elastisk

$$E = E_f = E_m$$



$$\sigma_{KB} = V_f \sigma_{fB} + V_m \cdot \frac{\sigma_m}{?}$$

$$\epsilon = \epsilon_f = \epsilon_m \rightarrow$$

$$\frac{\sigma_{fB}}{E_f} = \frac{\sigma_m}{E_m} \Rightarrow \underline{\underline{\sigma_m = \frac{E_m}{E_f} \sigma_{fB}}}$$

$$\underline{\sigma_{KB}} = V_f \sigma_{fB} + V_m \frac{E_m}{E_f} \cdot \sigma_{fB} \overset{\substack{\sim \\ \uparrow \\ E_m \ll E_f}}{\approx} V_f \sigma_{fB} = \underline{1250 \text{ MPa}}$$

Aluminium:

$$P_{AS} = \sigma_{AS} A_A = 470 \text{ MPa} (300 \text{ mm}^2) = 141000 \text{ N}$$

$$P_{KB} \geq P_{AS} \quad \sigma_{KB} A_K \geq P_{SA} \Rightarrow \underline{\underline{A_K \geq 112,8 \text{ mm}^2}}$$

2.- styvhet. $K_K \geq K_A.$

Komponent:

$$K_K = \frac{E_K A_K}{L_K} \quad ?$$

$$\begin{aligned} \sigma_K &= \sigma_f V_f + \sigma_m V_m. \\ E_K \epsilon_K &= E_f \epsilon_f V_f + E_m \epsilon_m V_m. \end{aligned}$$

$$\epsilon_K = \epsilon_f = \epsilon_m \Rightarrow E_K = E_f V_f + E_m V_m.$$

$$E_k = 141,85 \text{ GPa.}$$

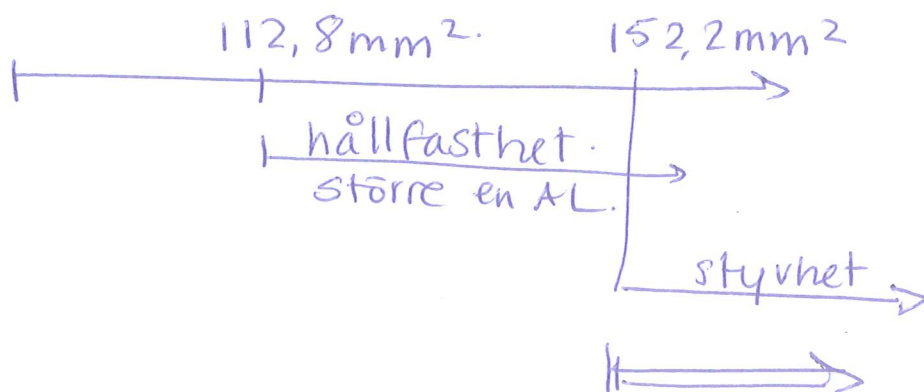
Aluminium : $k_A = \frac{E_A A_A}{L_A}$

$$\frac{E_k A_k}{L_k} \geq \frac{E_A A_A}{L_A}$$

$$A_k \geq \frac{L_k}{L_A} \frac{E_A}{E_k} A_A \rightarrow A_k \geq \frac{E_A}{E_k} A_A$$

$$A_k \geq \frac{72 \text{ GPa}}{141,85 \text{ GPa}} (300 \text{ mm}^2)$$

$$A_k \geq 152,2 \text{ mm}^2$$



$$\underline{A_k \geq 152,2 \text{ mm}^2}$$

Minst lika styv som AL
större hållfasthet än AL.

Vikt förändring: $A_k = 152,2 \text{ mm}^2$

$$\frac{m_k - m_A}{m_A} = \frac{\rho_k V_R - \rho_A V_A}{\rho_A V_A} = \frac{(\rho_f V_f + \rho_m V_m) A_k L - \rho_A A_A L}{\rho_A A_A L}$$
$$= \frac{(\rho_f V_f + \rho_m V_m) A_k}{\rho_A A_A} - 1 = \underline{\underline{-0.73}}$$

73% viktnönskning

