

Ö18: PLASTICITETSTEORI / KOMPOSITER

PLASTICITETSTEORI - FLYTHYPOTESER

- Enaxlig belastning: σ
 $|\sigma| < \sigma_s \Rightarrow$ materialet är linjärt elastiskt
 $|\sigma| \geq \sigma_s \Rightarrow$ materialet är plastiskt

- Fleraxlig belastning: $\sigma_x, \sigma_y, \dots, \tau_{zx}$
 $\sigma_e < \sigma_s \Rightarrow$ linjärt elastiskt
 $\sigma_e \geq \sigma_s \Rightarrow$ plastiskt

FLYTHYPOTES $f(\sigma_x, \sigma_y, \dots, \tau_{zx}) = \sigma_e$

* Von Mises [F.S. 3.24]

$$\sigma_e = \sqrt{\frac{1}{2} [(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_1 - \sigma_3)^2]}$$

eller

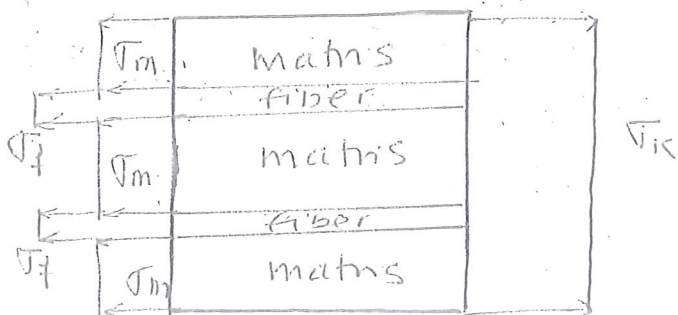
$$\sigma_e = \sqrt{\sigma_x^2 + \sigma_y^2 + \sigma_z^2 - \sigma_x \sigma_y - \sigma_y \sigma_z - \sigma_x \sigma_z + 3\tau_{xy}^2 + 3\tau_{yz}^2 + 3\tau_{zx}^2}$$

* Tresca [F.S. 3.26]

$$\sigma_e = \max(|\sigma_1 - \sigma_2|, |\sigma_2 - \sigma_3|, |\sigma_3 - \sigma_1|)$$

Trescas flythypotes är den mest konservativa

KOMPOSITER: Parallel model



$$V_f = \frac{A_f}{A_K} = \frac{V_f}{V_K}$$

$$V_m = \frac{A_m}{A_K} = \frac{V_m}{V_K}$$

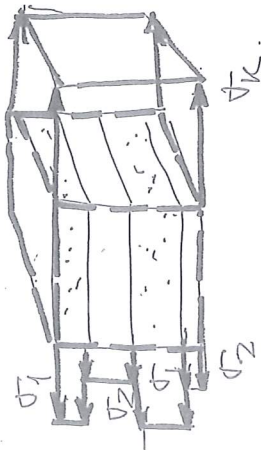
$$\sigma_K = V_f \sigma_f + V_m \sigma_m$$

$$E_K = V_f E_f + V_m E_m$$

$$P_K = V_f P_f + V_m P_m$$

$$\sigma_{B,K} = \sigma_{B,f} \left(V_f + \frac{E_m}{E_f} V_m \right)$$

LAMELLÄRA-KOMPOSIT: PARALLEL-MODEL



jämnvikt

$$\sigma_k A = \sigma_1 A_1 + \sigma_2 A_2$$

Kompatibilitet

$$\epsilon_1 = \epsilon_2 = \epsilon_k$$

konstitutiva ekvationer

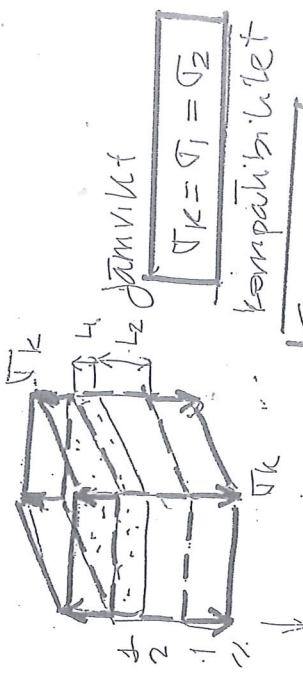
$$\left. \begin{aligned} \sigma_1 &= E_1 \epsilon_1 \\ \sigma_2 &= E_2 \epsilon_2 \end{aligned} \right\} \sigma_k = \sigma_1 \frac{A_1}{A} + \sigma_2 \frac{A_2}{A} = \epsilon_k \left(E_1 \frac{A_1}{A} + E_2 \frac{A_2}{A} \right)$$

$$= \left\{ \epsilon_1 = \epsilon_2 = \epsilon_k \right\} = \epsilon_k \left(E_1 \frac{A_1}{A} + E_2 \frac{A_2}{A} \right) = \left. \begin{aligned} \text{Volymandel} \\ v_1 &= A_1/A \\ v_2 &= A_2/A \end{aligned} \right\}$$

$$\sigma_k = E_k \epsilon_k = E_k (E_1 v_1 + E_2 v_2)$$

$$E_k = E_1 v_1 + E_2 v_2$$

LAMELLÄRA-KOMPOSITER: SERIE-MODEL



jämnvikt

$$\sigma_k = \sigma_1 = \sigma_2$$

Kompatibilitet

$$\delta_k = \delta_1 + \delta_2 = \epsilon_1 L_1 + \epsilon_2 L_2$$

Konstitutiva ekv:

$$\sigma_1 = E_1 \epsilon_1$$

$$\sigma_2 = E_2 \epsilon_2$$

$$\delta_k = \epsilon_k \cdot L_{tot} = \epsilon_1 L_1 + \epsilon_2 L_2 \Rightarrow \boxed{\epsilon_k = v_1 \epsilon_1 + v_2 \epsilon_2}$$

$$\epsilon_{tot} = \epsilon_1 \frac{L_1}{L_{tot}} + \epsilon_2 \frac{L_2}{L_{tot}} = \frac{\sigma_1}{E_1} \frac{L_1}{L_{tot}} + \frac{\sigma_2}{E_2} \frac{L_2}{L_{tot}}$$

$$\epsilon_{tot} = \frac{\sigma_k}{E_{tot}} = \sigma_k \left(\frac{1}{E_1} \frac{L_1}{L_{tot}} + \frac{1}{E_2} \frac{L_2}{L_{tot}} \right) = \left. \begin{aligned} v_1 &= \frac{L_1}{L_{tot}} \\ v_2 &= \frac{L_2}{L_{tot}} \end{aligned} \right\}$$

$$\frac{1}{E_{tot}} = \frac{1}{E_1} v_1 + \frac{1}{E_2} v_2$$