

2018050055

$$G_2 = 2, G_3 = 13$$

$$d_1 = 0,06 \text{ m}$$

$$d_2 = 0,11 \text{ m}$$

$$l_1 = 1,2 \text{ m}$$

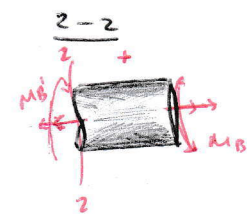
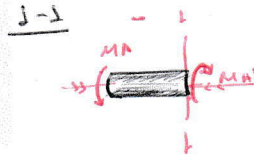
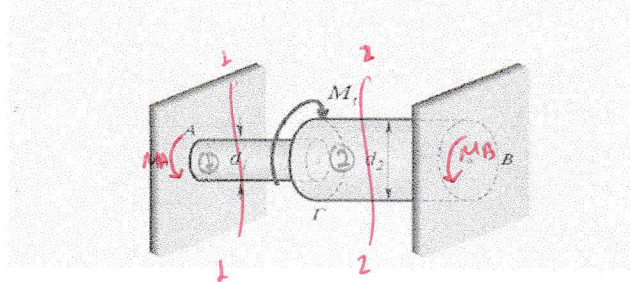
$$l_2 = 0,9 \text{ m}$$

$$G_1 = 70 \text{ GPa}$$

$$G_2 = 93 \text{ GPa}$$

$$\tau_{\text{α}1} = 110 \text{ MPa}$$

$$\tau_{\text{α}2} = 70 \text{ MPa}$$

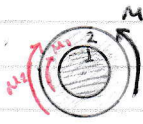


α)

Μέγιστη ροπή στρέψης: $M = M_A + M_B$

$$T_1 = \frac{T_1 l_1}{J_{P1}}$$

Έστω ① κριτήριο: $\tau_1 = \tau_{\alpha 1} = 110 \text{ MPa} \Rightarrow \frac{T_1 \cdot 0,03}{\frac{1}{2} \pi (0,03)^4} = 110 \cdot 10^6 \Rightarrow T_1 = 4,66 \text{ kNm}$



$$\phi_{AB} = 0 \quad \phi_{AG} + \phi_{GB} = 0$$

$$\Rightarrow \frac{4,66 \cdot 1,2}{\frac{1}{2} \pi (0,03)^4 \cdot 70 \cdot 10^9} = \frac{T_2 \cdot 0,9}{\frac{1}{2} \pi (0,11/2)^4 \cdot 93 \cdot 10^9} \Rightarrow T_2 = 92 \text{ kNm}$$

$$\Rightarrow \tau_2 = \frac{92 \cdot 10^3 \cdot 0,11/2}{\frac{1}{2} \pi (0,11/2)^4} = 0,35 \text{ MPa} < 110 \text{ MPa} \quad \text{OK}$$

Έστω ② κριτήριο: $\tau_2 = 70 \text{ MPa} = \frac{T_2 \cdot 0,11/2}{\frac{1}{2} \pi (0,11/2)^4} \Rightarrow T_2 = 18,3 \text{ kNm}$

Αντίθετα

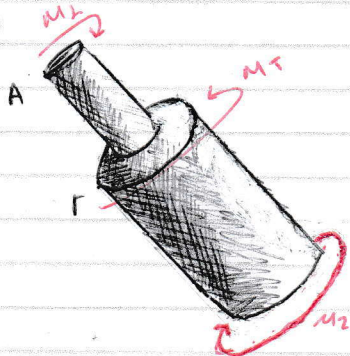
$$\phi_{AG} + \phi_{GB} = 0$$

$$\Rightarrow \frac{18,3 \cdot 0,9}{\frac{1}{2} \pi (0,11/2)^4 \cdot 93 \cdot 10^9} = \frac{T_1 \cdot 1,2}{\frac{1}{2} \pi (0,03)^4 \cdot 70 \cdot 10^9} \Rightarrow T_1 = 219,3 \text{ MPa} > \tau_{\alpha 1}$$

Αποκρίση

Άρα μέγιστη ροπή που μπορεί να εφαρμοστεί: $M = 4,66 + 0,35 \approx 5 \text{ kNm}$

β)



1-1

$$M_{11} = 4,66 \text{ kNm}$$

2-2

$$M_{22} = 92 \text{ kNm}$$

Άρα αλληλεπίδραση

(φB=0)

$$\phi_{B \rightarrow G} = \phi_{GB} = \frac{92 \cdot 10^3 \cdot 0,9}{\frac{1}{2} \pi (0,11/2)^4 \cdot 93 \cdot 10^9}$$

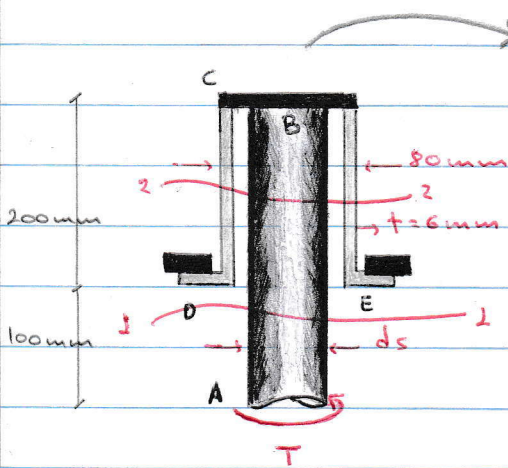
$$= 0,062 \text{ rad} \approx 3,55^\circ$$

$$\phi_{A \rightarrow G} = \phi_{AG} = \frac{4,66 \cdot 1,2}{\frac{1}{2} \pi (0,03)^4 \cdot 70 \cdot 10^9}$$

$$= 0,062 \text{ rad}$$

Project 5 2)

Παυλος Αγγελος
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$$d_s = 53 \text{ mm}$$

$$G_{st} = 77 \text{ GPa}$$

$$\tau_{\text{const}} = 80 \text{ MPa}$$

$$G_{\text{tube}} = 38 \text{ GPa}$$

$$\tau_{\text{tube}} = 50 \text{ MPa}$$

$$\phi = ?$$

$$\rightarrow J_{\text{p st}} = \frac{1}{2} \pi \left(\frac{53}{2} \right)^4 \cdot 10^{-12} = 7,7 \cdot 10^{-7}$$

$$\rightarrow J_{\text{pt}} = \frac{1}{2} \pi \left[(80 \cdot 10^{-3})^4 - (74 \cdot 10^{-3})^4 \right] = 1,72 \cdot 10^{-5}$$

$$T = T_{AB11} = T_{AB22} + T_{\text{tube}2}$$

Εάν οι ταινίες τω συνίχουν ηλόγισμα: $\tau_{\text{tube}} = 50 \text{ MPa}$

$$\Rightarrow 50 \cdot 10^6 = \frac{T \cdot r}{J_{\text{pt}}} = \frac{T \cdot 40 \cdot 10^{-3}}{1,72 \cdot 10^{-5}} \Rightarrow T_t = 21,5 \text{ kNm}$$

$$\text{λόγισμα } \phi_t + \phi_{AB2} = 0 \Rightarrow \frac{0,2 \cdot 21,5 \cdot 10^3}{1,72 \cdot 10^{-5} \cdot 38 \cdot 10^9} = \frac{0,2 \cdot T_{AB2}}{7,7 \cdot 10^{-7} \cdot 77 \cdot 10^9} \Rightarrow T_{AB2} = 1,95 \text{ kNm}$$

Ελέγξ

$$T_{AB2} = \frac{1,95 \cdot 10^3 \cdot \frac{53}{2} \cdot 10^{-3}}{7,7 \cdot 10^{-7}} = 67 \text{ MPa} < 80 \text{ MPa} \quad \underline{\underline{\text{OK}}}$$

$$\text{Αρα } T = T_t + T_{AB2} = 23,45 \text{ kNm}$$

$$\phi_c = \phi_{AB} + \phi_{\text{tube}} = \frac{23,45 \cdot 10^3 \cdot 0,3}{7,7 \cdot 10^{-7} \cdot 77 \cdot 10^9} - \frac{21,5 \cdot 10^3 \cdot 0,2}{1,72 \cdot 10^{-5} \cdot 38 \cdot 10^9} = 0,11 \text{ rad}$$

$$\hat{=} \frac{0,11 \cdot 180}{\pi} = 6,3^\circ$$