Escola Politécnica da Universidade de São Paulo
Departamento de Engenharia Mecânica

PME-3210 - Mecânica dos Sólidos I

Aula #02

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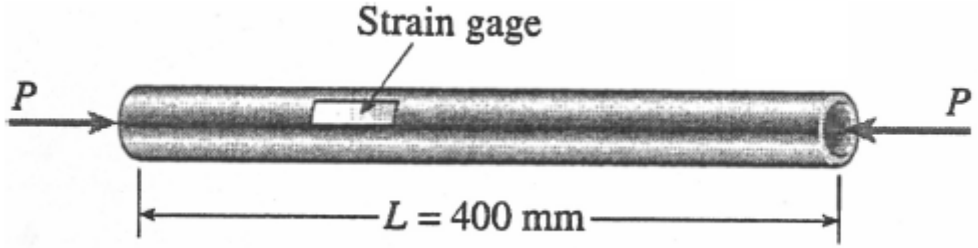
Problem 1.2-4 A circular aluminum tube of length $L = 400$ mm is loaded in compression by forces P (see figure). The outside and inside diameters are 60 mm and 50 mm, respectively. A strain gage is placed on the outside of the bar to measure normal strains in the longitudinal direction.

(a) If the measured strain in $\epsilon = 550 \times 10^{-6}$, what is the shortening δ of the bar?

(b) If the compressive stress in the bar is intended to be 40 MPa, what should be the load P?



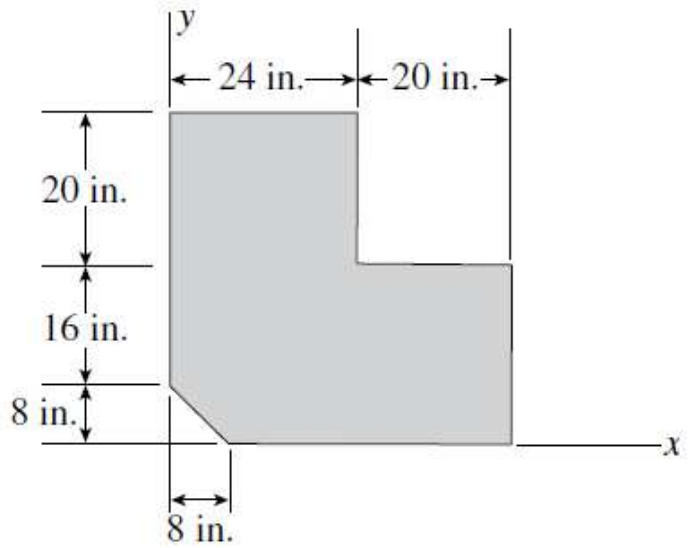
Respostas:

a) $\delta = 0{,}22\ mm$, b) $\sigma = 34{,}6\ kN$

Problem 1.2-5 The cross section of a concrete corner column that is loaded uniformly in compression is shown in the figure.

(a) Determine the average compressive stress σ_c in the concrete if the load is equal to 3200 k.

(b) Determine the coordinates x_c and y_c of the point where the resultant load must act in order to produce uniform normal stress in the column.



Respostas:

a) $\sigma_c = 2{,}13\ ksi$, b) $x_c = y_c = 19{,}22\ in$

Problem 1.3-1 Imagine that a long steel wire hangs vertically from a high-altitude balloon.

(a) What is the greatest length (feet) it can have without yielding if the steel yields at 40 ksi?
(b) If the same wire hangs from a ship at sea, what is the greatest length? (Obtain the weight densities of steel and sea water from Table H-1, Appendix H.)

Data:

Steel density: $\gamma = 490 \frac{lbf}{ft^3}$

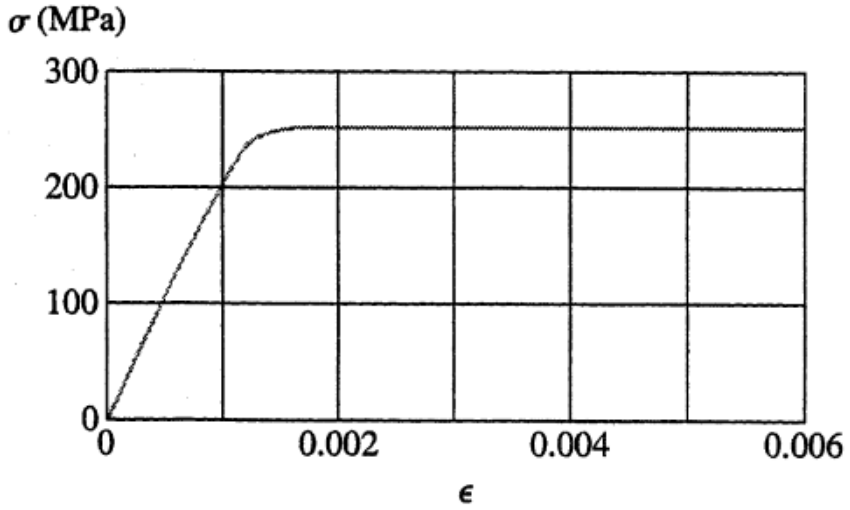
Sea water density: $\gamma = 63.8 \frac{lbf}{ft^3}$

Resp:

a) $L_{max} = 11755\ ft$ b) $L_{max} = 13515\ ft$

Problem 1.4-2 A bar of length 2.0 m is made of a structural steel having the stress-strain diagram shown in the figure. The yield stress of the steel is 250 MPa and the slope of the initial linear part of the stress-strain curve (modulus of elasticity) is 200 GPa. The bar is loaded axially until it elongates 6.5 mm, and then the load is removed.

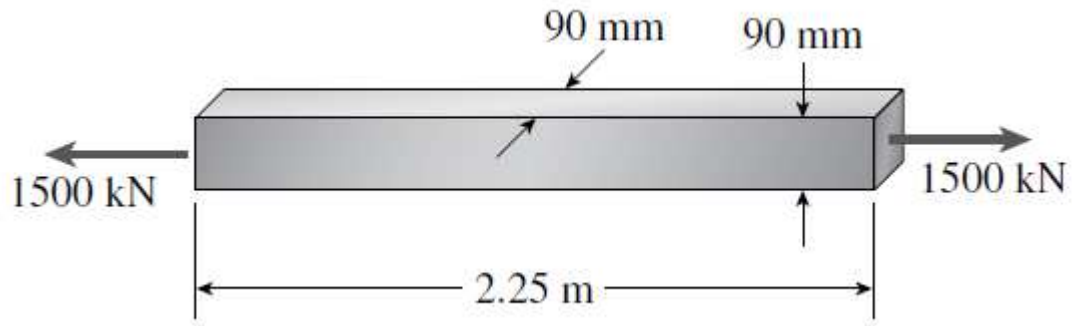
How does the final length of the bar compare with its original length? (*Hint*: Use the concepts illustrated in Fig. 1-18b.)



Resp: Final length of bar is 4.0 mm greater than its original length. ←

Problem 1.5-8 A brass bar of length 2.25 m with a square cross section of 90 mm on each side is subjected to an axial tensile force of 1500 kN (see figure). Assume that $E = 110$ GPa and $\upsilon = 0.34$.

Determine the increase in volume of the bar.



Resp: $\Delta V = 9789\ mm^3$

Referência:

[1] Gere, J.M., Goodno, B.J. Mecânica dos Materiais – Tradução da 7ª edição norte-americana. Cengage Learning, 2010, 860p, Capítulo 1.