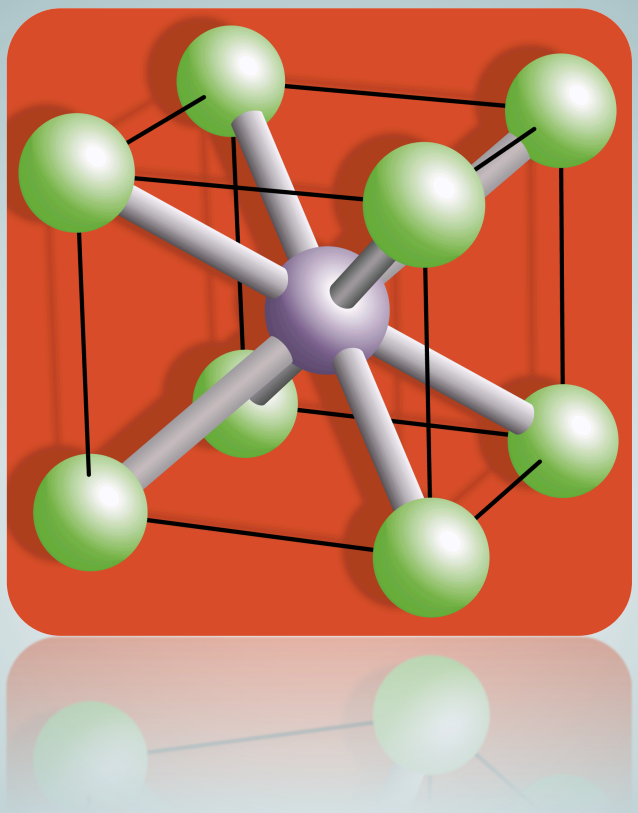
Materials

Exercises Topic 2. Hoke's Law



José Antonio Casado del Prado
Borja Arroyo Martínez
Diego Ferreño Blanco

Department of Science And Engineering of Land and Materials

Subject: MATERIALS
Degree: GRADO en INGENIERÍA MECÁNICA. 2nd Grade

HOOKE'S LAW

1. A cylindrical titanium wire of 3 mm of diameter and $2.5 \cdot 10^4$ mm long is considered. Determine its elongation when a 500N load is applied. The total of the deformation is supposed to be elastic and the elasticity modulus of the material E = $10{,}7 \cdot 10^4$ MPa.

2. Determine the maximum longitude of a 1.8 mm diameter wire in order not no cause its rupture when suspended from one of its edges. Material's density: 8.8 g/cm^3, ultimate stress: 2.33 MPa

3. A certain brass alloy, plastic deformation starts at a stress of 345 MPa, and its Young's modulus is $10.3 \cdot 10^4$ MPa.

a) ¿Which is the maximum load that can be applied to a specimen of 130 mm^2 of section for not producing any plastic deformation?

b) If the original length of the specimen is 76 mm, ¿which is the maximum length that it can be stretched without causing any plastic deformation?

4. A cylindrical bar of 15 cm^2 of cross section and 1 meter long must support 46 tones without plastic deformation and, at least, 101 tones before breaking.

a) Select the most convenient material among the ones shown in the following table.
b) Calculate the minimum diameter of the bar if the stainless steel 304 is selected..

If just the longitude of the bar, but not its cross section, is limited:

c) Decide which material will supply the lightest solution. ¿And the cheapest?

d) Draw the F(kN)–ΔL(mm) diagram of each bar with its corresponding cross section, simplified in two straight tracts, assuming as base length the total length of each bar.

MATERIAL	E (GPa)	σ_Y (MPa)	σ_R (MPa)	ε_R (%)	ρ (g/cm^3)	Price (€/kg)
Stainless steel 304	193	205	515	40	7.8	3
Ti-6Al-4V	110	825	895	10	4.5	16
Brass-aluminum	110	320	652	34	7.6	2.5
Monel 400	179	283	579	39.5	8.9	6