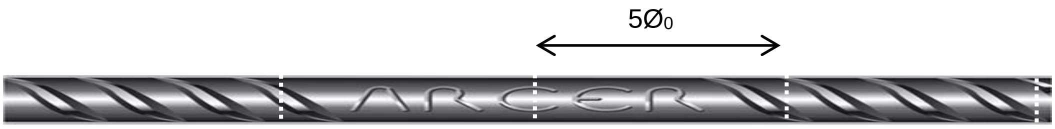
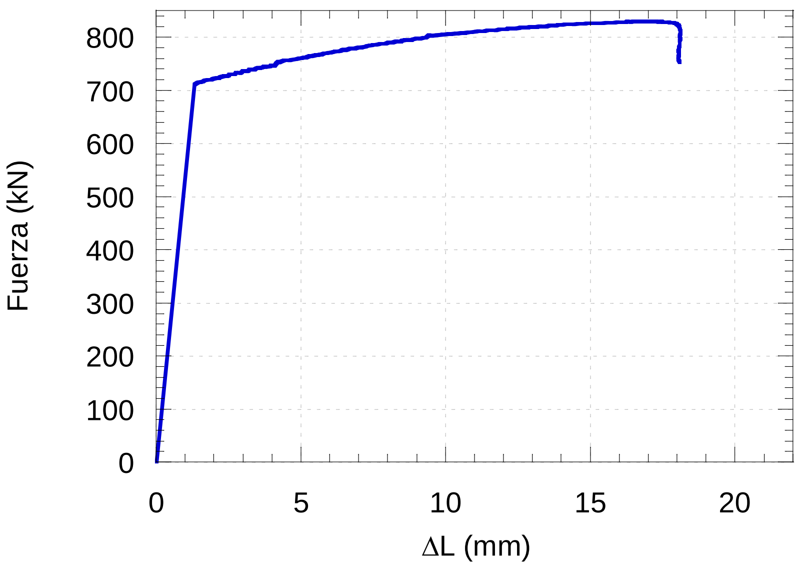
*Subject: MATERIALS*
*Degree: GRADO en INGENIERÍA MECÁNICA. 2nd Grade*

**TENSILE STRENGHT**

1. A metallic cylindrical specimen, originally having 12,8 mm of diameter and a measurement base of 50,8 mm, is stretched until its fracture. The diameter at the breaking point is 6,6 mm and the measurement base 72,4 mm. Calculate the ductility in terms of area reduction and the relative elongation.

2. A tensile test is carried out on a steel bar of 40 mm of diameter ($Ø_0$), employing for this purpose an extensometer of 500 mm of measurement base ($L_0$), and obtaining the F-ΔL curve shown below. Prior to the test, longitudinal marks separated $5Ø_0$ were made on the specimen. The area reduction was 15%.




Determine:

a) Young's Modulus in GPa.
b) 0,2% proof stress and ultimate stress
c) Diameter of the necking section in mm.
d) Distance between the two marks that contain the necking when recomposing the specimen after breaking, if the strain at the ultimate stress measured on the specimen is coincident with the strain under maximum load registered graphically.
e) Poisson's ratio of the material, knowing that when applying 500 KN on the bar its diameter is 39,975 mm.

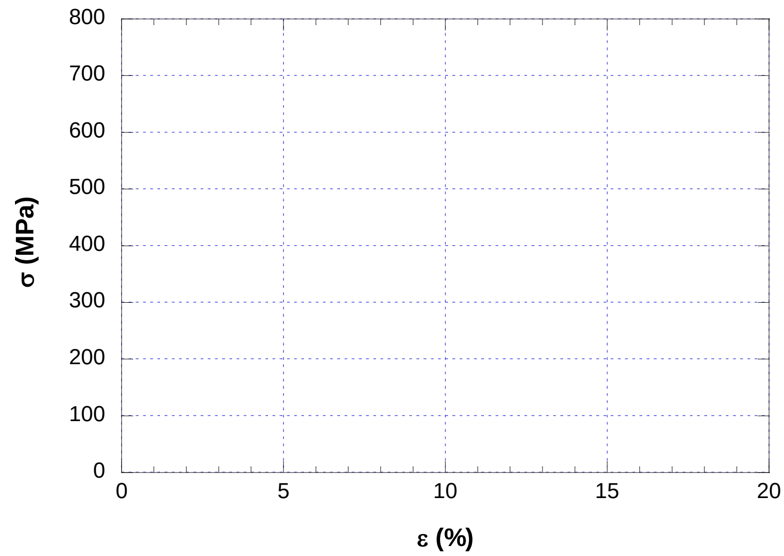
A certain stress is applied on another bar of the same material and identical geometry, such that when unloaded it had acquired a plastic deformation of 1,2%. In these conditions determine:

f) Maximum load applied on the bar in KN.
g) Diameter of the bar once it is unloaded.
h) Yield stress in MPa.
i) Strain under maximum load if it is tested up to its rupture.

3. A 20 m long and square cross section of 25 mm of edge steel strap is subjected to a tensile load such that it starts to plasticize when the edge dimension turns to be 24,9791 mm (Spot 1). Complete the σ-ε diagram of the material of the strap up to the maximum load, as well as the following table, considering:

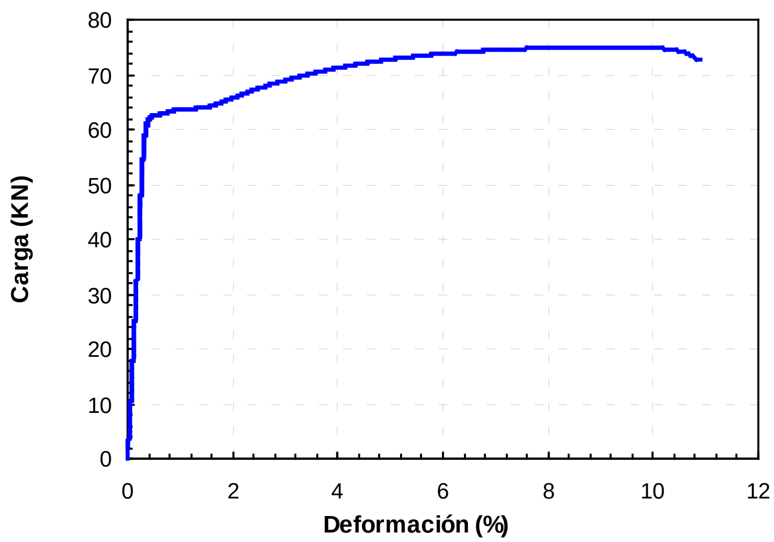
E = 210 GPa (Young's Modulus).
ν = 0,33 (Poisson's coefficient).

The material has a yielding plateau, that will produce a 1 m elongation in the strap (Spot 2).
When the loaded strap is 22 m long, it recovers 61,9 mm of length after unloading it (Spot 3).
When applying 468,75 KN the strap section is reduced 13% (Spot 4).
The necking starts when on the strap is acting a tensile load of 50 Tn, reaching in this situation a length of 23,6 m (Spot 5).




| Spot | σ (MPa) | ε (%) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

**4.** A 5 m long structural component made of steel (Young's Modulus E = 210,5 GPa; Poisson's ratio: ν = 0.33) of 50 mm of diameter, underwent an overload such that it has been plastified in a way that its diameter was reduced 1 mm. In order to assess the component's state, a tensile test is carried out on a specimen of 12 mm of diameter made from the same steel, obtaining the diagram shown in the next figure.

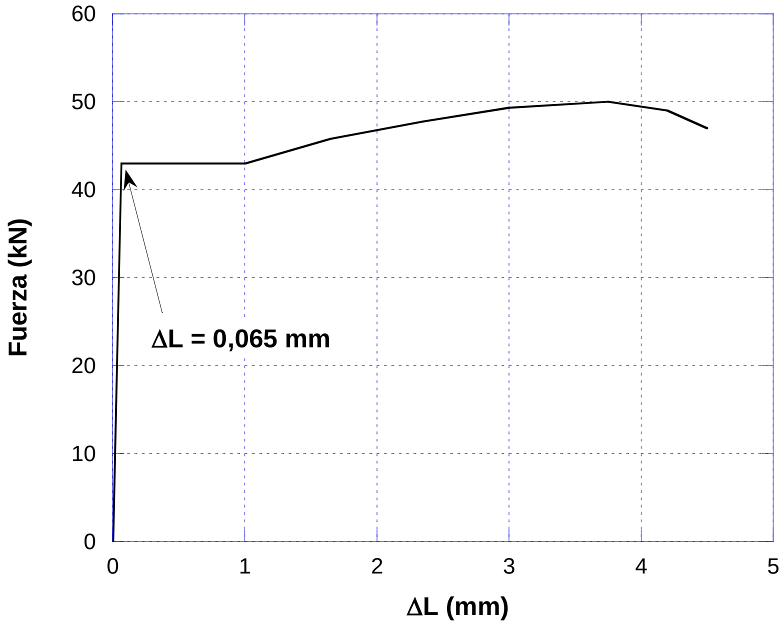



In these conditions it is requested:

1) Estimate the transversal strain experimented by the component after the overload.
2) Determine 0,2% proof stress of the steel
3) Determine the mechanical tensile resistance of this steel.
4) Estimate the value of the overload at which the component was subjected expressed in Tons.
5) Calculate the diameter of the component when, during the overload, it was subjected to a stress of 450 MPa.

6) Given that the component is not secure any more, it was decided to test it up to its failure in a tensile test. Estimate its diameter in the fracture section if the area reduction was of 18%. Estimate the diameter of the component in any play out of the necking

**5.** For a singular construction an experimental ribbed bar of Ø = 100 mm of diameter was manufactured, having a distance between ribs of $d_c$ = 70 mm, as it is show in the figure. From the bar, a cylindrical specimen of 10 mm of diameter is obtained in order to perform a tensile test. The result obtained is the one shown in the F – ΔL diagram, where an extensometer of 25 mm of measurement base was employed.




1) Determine the yield stress, tensile strenght, Young's modulus and the strain under máximum load.
2) Determine the maximum load that this ribbed bar of Ø100 mm and 10 m long is able to stand.
3) Estimate the maximum length reached by the bar after an unload taking place just before the necking starts.
4) If after the accidental application of a certain load on another identical bar the distance between ribs was transformed into 77,0 mm after its unload, determine the value of the force accidentally applied, as well as the diameter of this bar after unloading.
5) Determine the same parameters than in point 1 for the deformed material of this last bar (suppose that neither the initial diameter nor the measurement base are modified).