**Birzeit University**
**Faculty of Engineering & Information Technology**
**Department of Civil & Environmental Engineering**
**ENCE233 Mechanics of Materials**
**Homework assignment #3**

---

## Problem 1:

Given the following data for a tension test for an unknown material. The original specimen has a circular cross section with a diameter of 9.11 mm.

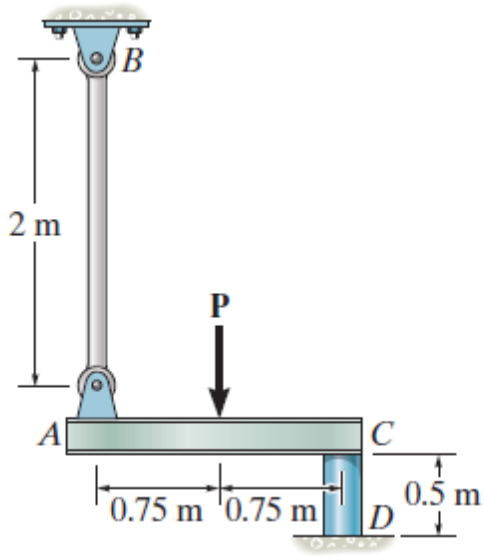
- Draw the stress-strain diagram for this material. Is it a ductile or brittle material? justify your answer.
- Draw the elastic stress-strain curve. Determine the proportional limit, yield strength (upper & lower), ultimate strength, and fracture stress and strain.
- Determine the elastic modulus (Young's modulus).
- **BONUS: Calculate modulus of resilience and modulus of toughness (+10 Points)**

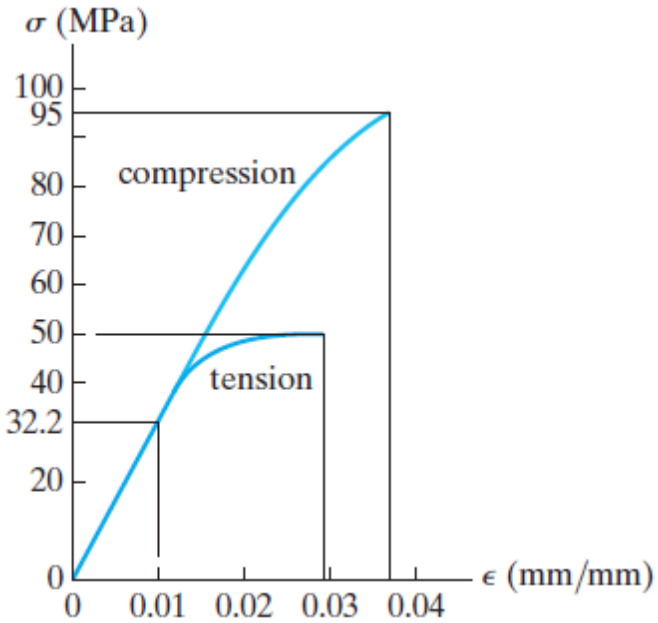
| Force (kN) | Length (mm) |
|---|---|
| 0 | 50.800 |
| 6.67 | 50.825 |
| 13.34 | 50.852 |
| 19.13 | 50.874 |
| 17.79 | 50.917 |
| 17.21 | 50.957 |
| 17.53 | 51.054 |
| 17.44 | 51.156 |
| 17.21 | 51.308 |
| 17.50 | 51.460 |
| 18.00 | 51.664 |
| 19.00 | 52.070 |
| 20.77 | 53.289 |
| 21.94 | 54.610 |
| 22.68 | 55.499 |
| 23.65 | 56.490 |
| 24.25 | 57.150 |
| 24.68 | 58.166 |
| 25.11 | 59.893 |
| 25.35 | 60.904 |
| 25.71 | 61.874 |
| 25.75 | 62.687 |
| 25.69 | 63.957 |
| 25.56 | 64.973 |
| 25.04 | 66.345 |
| 23.49 | 67.564 |
| 21.35 | 68.478 |
| 18.90 | 69.088 |
| 17.39 | 69.393 |

Use Excel to present your solution. Watch this video to learn how to use Excel https://www.youtube.com/watch?v=5ZG-3THmF3Q

**Problem 2:**

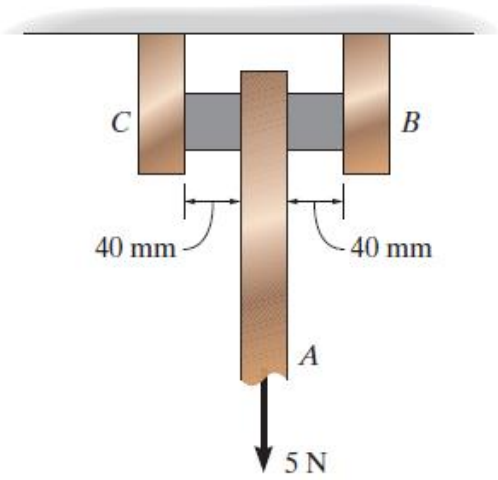
The stress–strain diagram for a polyester resin is given in the figure. If the rigid beam AC is supported by a strut AB and post CD, both made from this material, and subjected to a load of P = 80 kN, determine the angle of tilt of the beam when the load is applied. The diameters of the strut and post are 40 mm and 80 mm, respectively. Determine the largest load P that can be applied to the beam before failure in strut AB or post CD.



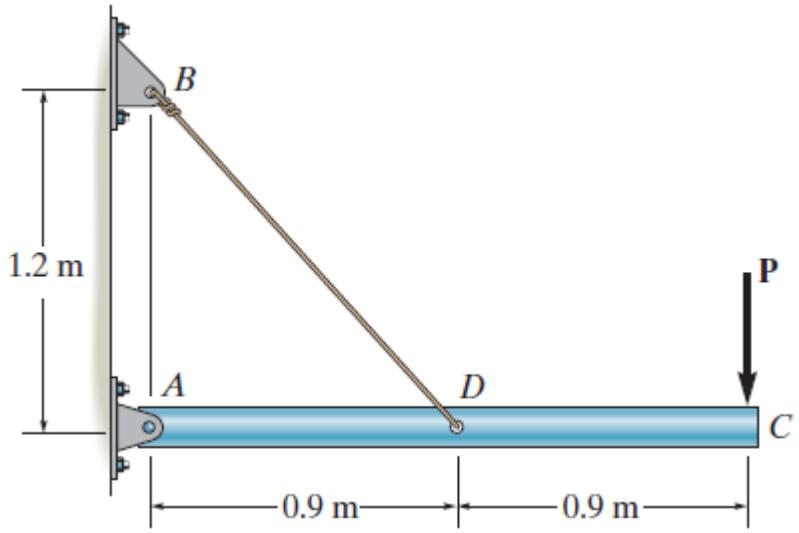

**Problem 3:**

The support consists of three rigid plates, which are connected using two symmetrically placed rubber pads. If a vertical force of 5 N is applied to plate A, determine the approximate vertical displacement of this plate due to shear strains in the rubber. Each pad has cross-sectional dimensions of 30 mm and 20 mm. $G_r$ = 0.20 MPa.



**Problem 4:**

The rigid pipe ADC is supported by a pin at A and a wire at D. The wire made from the same material in Problem 1 and has a diameter of 6 mm. Determine (a) the elongation of the wire BD if P = 2 kN and P = 3.5 kN. (b) the permanent strain after the load is removed for each case.




**Problem 5:**

The block shown is made of a magnesium alloy for which E = 45 GPa and $\upsilon$ = 0.35. Knowing that $\sigma_x$ = -180 MPa, determine (a) the magnitude of $\sigma_y$ for which the change in the height of the block will be zero, (b) the corresponding change in the area of the face ABCD, (c) the corresponding change in the volume of the block.