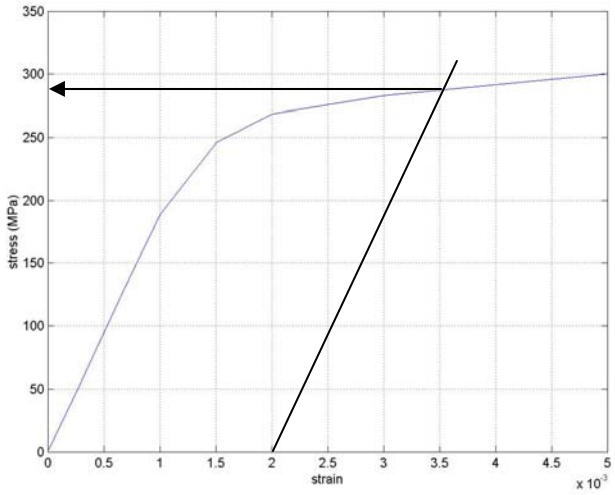
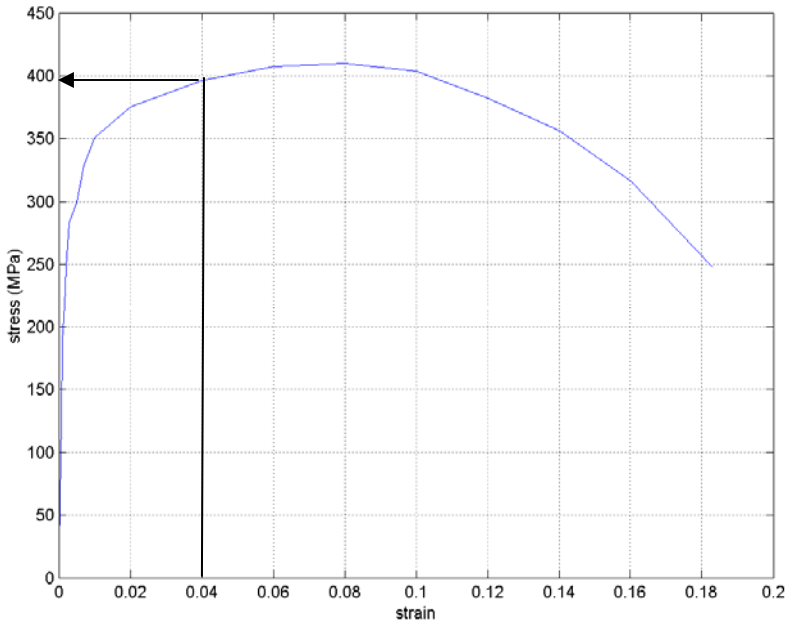
ME328 Day 2 Example Problem

The original length is 50 mm. The original cross sectional area is 129.2 mm^2.

Here is the inset – small strain region.



Here is the overall curve.



1. Calculate the modulus of elasticity of the material. (Units GPa)

The initial slope, on the left, ie. Elastic region is 180,000 MPa. Use inset.

2. We load the specimen until the strain is 0.0005 (5 x 10^{-4}). What load is required?

Hooke's law applies here. Stress = E * strain. Load = stress * area = 11600 N

3. What is the length change at the load just computed?

Length change = strain times orig. length. $\Delta L = 0.025$ mm.

4. If we now release the load just computed and go no further in the test, what will the final length change be?

Zero. We never left the elastic range.

5. What is the yield stress for the specimen? Show your work on the appropriate graph.

See top graph. It's about 280 MPa.

6. At what load would you expect to see a neck form?

UTS = 410 MPa. Load = stress times area = 53000 N approximately.

7. Calculate the Tensile Strength of the material?

Max stress. See bottom graph. 410 MPa.

8. Calculate the ductility of this material. State the measure of ductility that you used.

First, measure the final stress to be about 250 MPa. The final elastic strain is 250/180000 = 0.0014, approximately. The overall final strain looks to be about 0.183. The final plastic strain is the 0.1814, or about 18.1%. This is the ductility measure as elongation in 50 mm.

9. State the name of an alternative measure of ductility.

%Reduction in cross sectional area.

10. What would the final load be, just prior to failure?

Final load = 250 MPa times area = 32000 N approximately.

11. Calculate the stress at a strain of 0.04.

We read it off the graph!!! 395 MPa about. Please don't just do E * 0.04. Not all the strain is elastic!!!!!

12. If the specimen was loaded to the above strain, and the released, what would be the amount of elastic strain recovered? The residual strain? What would be the residual length change?

The elastic strain is the stress divided by E. It is 0.0022 approximately. It is recoverable.

The plastic strain (residual) is the total strain minus the elastic strain. It is 0.0378 approximately.

We multiply this by the original length to get the residual length change. 1.89 mm.