Engineering maths

Maths

Calculating Stress

To calculate the Stress on a material you need to:

Firstly work out the area of the piece using 3.142 x (R x R) = if the piece is circular or by using Area = Length x Width if the piece is square or rectangular in shape.

E7: Stress

(See section 4.1 for information on the conversion of load/extension to stress/strain and the formulae used.)

Question

A tensile test was carried out on a piece of metal. The test piece had a square section, with each side 10 mm. The force applied when the material started to yield was 24 500 newtons. Calculate the yield stress of the metal.

Solution

$$\text{Stress} = \frac{\text{force}}{\text{cross-sectional area}}$$

$$\sigma = \frac{F}{A}$$

Given force F = 24 500 N and cross-sectional area A = 10 x 10 = 100mm^2

$$\sigma = \frac{F}{A}$$

$$= \frac{24\,500}{100}$$

$$= 245 \text{ N mm}^{-2}$$

Calculating Stress questions

1, A test piece had a square section with each side 4mm. The force applied when the material started to yield was 5,000 Newtons (show all working)

2, A test piece had a rectangular section section with one side measuring 4mm and the other 8mm.. The force applied when the material started to yield was 6,000 Newtons (show all working)

3, A test piece had a cylindrical section with a radius of 2mm. The force applied when the material started to yield was 2000 Newtons (show all working)

4, A test piece had a cylindrical section with a radius of 4mm. The force applied when the material started to yield was 3500 Newtons (show all working)

5, A test piece had a cylindrical section with a radius of 5.5mm. The force applied when the material started to yield was 4750 Newtons (show all working)

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Calculating Strain

To Calculate Strain you need to:

Firstly work out the change in length by: subtracting the extended length by the original length.

Then you can divide the change in length by the original length, the answer should be very small.

MATHEMATICAL UNDERSTANDING

E8: Strain

(See section 4.1 for information on the conversion of load/extension to stress/strain and the formulae used.)

Question

A metal bar is being used as part of the lifting gear in a crane. When there is no load, the bar is 2 m long. When the crane lifts the maximum load, the bar extends to a length of 2.03 m.

Calculate the strain in the bar at the maximum load.

Solution

$$\text{Strain} = \frac{\text{change in length}}{\text{original length}}$$

$$\varepsilon = \frac{\Delta l}{l}$$

$$\varepsilon = \frac{0.03}{2} = 0.015 \text{ (or } 1.5 \times 10^{-2}\text{)}$$

Calculating Strain

Calculate the yield stress of the following metals

1, when there is no load the bar is 0.2m long. When the load is applied the bar extends to a length of 0.22m. (show all workings)

2, when there is no load the bar is 0.7m long. When the load is applied the bar extends to a length of 0.71m. (show all workings)

3, when there is no load the bar is 0.85m long. When the load is applied the bar extends to a length of 0.87m. (show all workings)

4, when there is no load the bar is 0.6m long. When the load is applied the bar extends to a length of 0.62m. (show all workings)

5, when there is no load the bar is 0.92m long. When the load is applied the bar extends to a length of 0.95m. (show all workings)