Engineering maths

Maths

Calculating Young's modulus

To calculate Young's modulus you need to:

Firstly work out the stress but before you can do this you have to work out the area of the test piece.

So you need to use 3.142 x (R x R) if the shape is a circle or Area = Length x Width if the shape is square or rectangular.

Once you know the area you can then put the area into the Stress equation and calculate the Stress.

Then you can convert the Strain from standard form into a whole number by moving the decimal point (see image below).

Once converted you can then divide the Stress by the Strain to calculate the Young's modulus.

MATHEMATICAL UNDERSTANDING

E9: Young's Modulus

Question

A tensile test was carried out on a ceramic test piece. The test piece was cylindrical in shape with a radius of 29.3 mm.

At the point when the applied force was 270 kN, the strain in the test piece was calculated to be 2.5×10^{-4}.

Calculate the Young's Modulus of the material.

Solution

Given

$$\text{Young' s Modulus, E} = \frac{\text{stress, } \sigma}{\text{strain, } \varepsilon}$$

and

$$\text{Stress, } \sigma = \frac{\text{force, F}}{\text{cross-sectional area, A}}$$

$$\text{Cross-sectional area} = \pi r^2 = 2697 \text{ mm}^2$$

$$\text{Stress, } \sigma = \frac{270}{2697} \approx 0.1 \text{kN mm}^{-2}$$

$$\text{Young's Modulus, E} = \frac{0.1}{2.5 \times 10^{-4}} = 400 \text{kN mm}^{-2}$$

Convert to Standard Form

Move the decimal point until there is one digit to the left of the decimal point.

Exponent goes up ← Decimal point moves left • Decimal point moves right → Exponent goes down

Examples:

$156000. = 1.56 \times 10^5$

Move decimal point 5 places left, exponent goes up by 5

$0.0000053 = 5.3 \times 10^{-6}$

Move decimal point 6 places right, exponent goes down by 6

Calculating Young's Modulus

1, A tensile test was carried out on a ceramic test piece. The test piece was square section 35mm x 35mm
At the point when the force was 150kN, the strain in the test piece was calculated to be 1.4×10^{-3}

Calculate the Young's modulus of the material. (show all workings)

2, A tensile test was carried out on a ceramic test piece. The test piece was rectangular in section 50mm x 25mm
At the point when the force was 220kN, the strain in the test piece was calculated to be 1.2×10^{-3}

Calculate the Young's modulus of the material. (show all workings)

3, A tensile test was carried out on a ceramic test piece. The test piece was cylindrical in shape with a radius of 16mm.
At the point when the force was 120kN, the strain in the test piece was calculated to be 1.8×10^{-3}

Calculate the Young's modulus of the material. (show all workings)

4, A tensile test was carried out on a ceramic test piece. The test piece was cylindrical in shape with a radius of 18mm.
At the point when the force was 250kN, the strain in the test piece was calculated to be 1.75×10^{-3}

Calculate the Young's modulus of the material. (show all workings)

5, A tensile test was carried out on a ceramic test piece. The test piece was cylindrical in shape with a radius of 17mm.
At the point when the force was 235kN, the strain in the test piece was calculated to be 1.4×10^{-3}

Calculate the Young's modulus of the material. (show all workings)