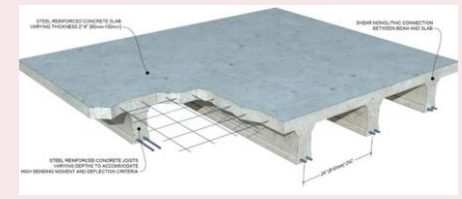
Material properties

SECTION 1.1

Property	Definition	Example
Strength	The ability of a material to withstand force, three different types of force – Tension (material being pulled apart), Compression (material being push together compressed) and Torsion material being twisted. Yield strength = forced needed to start permanently deforming the material. Ultimate Yield strength = when the material fails.	
Ductility	The amount a material can be deformed into long thin wires or stands like synthetic fibres or copper wire.	
Malleability	The ability of a material to be deformed without rupturing, think of materials that can be easily moulded into various shaped like clay or bluetack.	
Hardness	The ability of a material to withstand scratching and abrasion and won't wear aware easily. Think of stainless steel and how you use them everyday but they don't wear away.	
Toughness / Brittleness	The ability of a material to withstand an impact without breaking / shattering, think of a hammer when you strike a nail or the opposite when you drop a ceramic plate or a glass product.	
Stiffness	The ability of a material to resist bending like the beams that you stand on when on a second floor of a house. The beams can hold your weight without bending or moving.	

Mathematical understanding – Stress

$$\text{Stress} = \frac{\text{Force}}{\text{Cross sectional area}}$$

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}}$$

$$\text{Young's modulus, E} = \frac{\text{Stress}}{\text{Strain}}$$

Example layout of questions:

Stress
Force = (read through question)
Cross section area = (length x width) or use Pi x R2.

Then put number in the equation.

Strain
Original length = (read through question)
Change in length = extended length – original length

Then put numbers in equation

Young's modulus
Combine the two layouts above to work out each bit.

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What is meant by the term Strength?

Below sketch the three different types of forces

What is the difference between yield strength and ultimate tensile strength?

Mathematical understanding – Stress

Calculate the yield stress of the following metals

Mathematical understanding – Stress

$$\text{Stress} = \frac{\text{Force}}{\text{Cross sectional area}}$$

1, A test piece had a square section with each side 10mm. The force applied when the material started to yield was 24,500 Newtons (show all working)

2, A test piece had a square section with each side 20mm. The force applied when the material started to yield was 20,000 Newtons (show all working)

3, A test piece had a square section with each side 35mm. The force applied when the material started to yield was 14,000 Newtons (show all working)

4, A test piece had a square section with each side 12mm. The force applied when the material started to yield was 12,750 Newtons (show all working)

5, A test piece had a square section with each side 35mm. The force applied when the material started to yield was 47,250 Newtons (show all working)

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Give an example of product that demonstrates the strength property

Explain how this product has high strength?

Give an example of product that demonstrates the Ductility property

Explain how this product has good Ductility?

Give an example of product that demonstrates the Malleability property

Explain how this product is malleable?

Give an example of product that demonstrates the Harness property

Explain how this product uses this property?

Give an example of product that demonstrates the Toughness property

Explain how this product uses toughness?

Material properties

SECTION 1.1

Calculate the yield stress of the following metals

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}}$$

1, when there is no load the bar is 1.55m long. When the load is applied the bar extends to a length of 2.25m. (show all workings)

2, when there is no load the bar is 1.15m long. When the load is applied the bar extends to a length of 1.65m. (show all workings)

3, when there is no load the bar is 3.4m long. When the load is applied the bar extends to a length of 3.45m. (show all workings)

Calculate the ***Young's modulus*** of the following metals

$$\text{Young's modulus, E} = \frac{\text{Stress}}{\text{Strain}}$$

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 160kN, 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 60mm x 25mm

At the point when the force was 285kN, the strain in the test piece was calculated to be 1.5×10^{-3}

Calculate the Young's modulus of the material.

(show all workings)