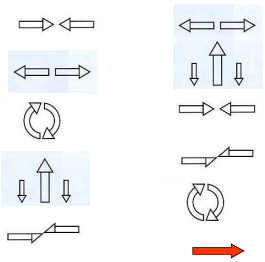
12.1 Constraints & Deformations

Write into notes please

- Stress caused by normal use.
- ***Constraints*** are the different types of stresses

1. Compression (crush)
2. Tension (stretch)
3. Torsion (twist)
4. Deflection (bend)
5. Shearing (cut)



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12.3 THE MAIN TYPES OF CONSTRAINTS

Type of constraint	Description	Symbol	Examples
Compression	A material subjected to forces that tend to crush it is undergoing compression.		• hands squeezing a wet sponge • a foot crushing a can
Tension	A material subjected to forces that tend to stretch it is undergoing tension.		• copper stretched into wire • two teams in a tug of war
Torsion	A material subjected to forces that tend to twist it is undergoing torsion.		• an earthquake twisting a bridge • hands wringing a wet towel
Deflection	A material subjected to forces that tend to bend it is undergoing deflection.		• a fish bending a fishing rod • clothes weighing down a clothesline
Shearing	A material subjected to forces that tend to cut it is undergoing shearing.		• scissors cutting paper • metal cutters trimming shapes from metal

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Write into notes please

- **Deformation** is the change in shape caused by a constraint.
  1. **Elastic (go back to original shape)**
  2. **Plastic (changed into new shape)**
  3. **Fracture (break)**

Video Link

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12.2 Mechanical Properties

Write into notes please

- ***Mechanical properties*** of a material determine how it will react when subjected to one or more constraints.

Main

1. Hardness (resist dents without breaking)
2. Elasticity (return to its original shape)
3. Resilience (resist shocks)
4. Ductility (stretches)
5. Malleability (flattened/bent without breaking)
6. Stiffness (keep its shape)

Other

7. Resist Corrosion
8. Electrical conductivity (carry current)
9. Thermal conductivity (transmit heat)

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12.3 Categories of Materials and their Properties

Write title into notes please

- Let's have a closer look at the following materials and their properties:
  1. Wood and Modified Wood
  2. **Ceramics**
  3. Metals and Alloys
  4. Plastics
  5. **Composites**

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Please paste table into notes!

Metals and alloys	Electrical conductivity Hardness Magnetism Oxidation	
Ceramics	Hardness Low electrical conductivity Wear resistance Heat resistance Corrosion resistance	
Composites	Durability Hardness Elasticity Lightness Resilience Stiffness Corrosion resistance	
Plastics	Thermoplastics	Chemical neutrality (unreactive) Elasticity Lightness Resilience Corrosion resistance
	Thermosetting plastics	Hardness Resilience Heat resistance Stiffness

You need to be able to explain, using these properties, why a material is or is not a good choice

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Our Focus will be on …

Degradation and Protection

- The ***degradation of a material*** is the decline in some of its properties due to the effects of the surrounding environment.
- The ***protection of a material*** is the application of procedures that prevent or delay its degradation.

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Degradation and Protection of Wood

- Unprotected wood can degrade swiftly.
- Since wood is an organic substance, many fungi, microorganisms, and insects can infest the wood, feed off it and cause it to rot.
- Wood can be painted, stained, varnished or treated with other protective coatings to help prevent its deterioration.

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Write into notes please

Degradation and Protection of Wood

- **Treated wood** is made resistant to rot by:
  - *Dipping it in an **alkaline solution** containing copper. This wood usually has a **greenish colour**.*
  - *Heating it to a **high temperature**.*
- ***Some woods, such as cedar, have a natural resistance to rot.***
- *Coatings (paint, stain, varnish)*

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Complete worksheet "self-notes: on materials and degradations

- This sheet covers all notes needed for the characteristics of metals, ceramics, and plastics.

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The Degradation and Protection of Composites

Write into notes please

- The degradation of composites usually takes one of two forms:
  1. The deformation or fracture of the matrix or the reinforcements.
     Eg. Matrix (**cement**) reinforcement (**rebar**).
  2. The loss of adherence between the matrix and the reinforcement.
- The speed of degradation depends on the type of matrix & reinforcement, and the conditions of use.

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