**Constraints and Material Notes**

**Constraints**

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| --- | --- | --- | --- |
| **Constraints** | **Examples** | **Description** | **Symbol** |
| Compression | What's In Your Sponge Stock Photo titled: Female Hand Squeezing Soft Drink Can, unlicensed use prohibited |  |  |
| Tension | Dig in! When you go ice climbing you have to use special pick axes to climb!http://jvitaleed314.pbworks.com/f/1236123779/Tug-O-War2.gif |  |  |
| Torsion | WringOutTowel Step 5.jpg http://upload.wikimedia.org/wikipedia/commons/a/af/Medway_Bridge_76.jpg |  |  |
| Deflection | http://www.orangepower.com.au/wp-content/uploads/2012/08/clothesline.jpghttp://www.exmouthflyfishing.com.au/blog/wp-content/uploads/angus-rod-bending.jpg |  |  |
| Shearing | Scissors Cutting a Paper Heart - Royalty Free Clipart Picturehttp://www.cartoonstock.com/lowres/gardening-hedges-hedge_trimming-trimming_hedge-trimmed-trimming-tda0108l.jpg |  |  |

**Deformations**

Depending on the constrains there are three types of deformations which can occur.

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| --- | --- | --- |
| **Type of deformation** | **Example** | **Description** |
| Elastic | Elastic Business Cards |  |
| Plastic  | easily teach science |  |
| Fracture  | Cut eight cuts from cut edge to bottom of can to make feathers photo SodaCanTurkeyTutorial8.jpg |  |

**Properties**

Mechanical properties describe how a material reacts when subjected to one or more constraints.

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| --- | --- | --- |
| **Property** | **Description** | **Example** |
| Hardness |  | DiamondsCeramic  |
| Elasticity |  | Elastics Bedsprings |
| Resilience  |  | PlasticsMetals |
| Ductility  |  | Elastics Metals  |
| Malleability  |  | Metal Plastics  |
| Stiffness |  | Ceramics Concrete  |
| Fragility |  | CeramicGlass  |

 **Other properties**

|  |  |  |
| --- | --- | --- |
| Resists corrosion |  | CeramicsPlastic  |
| Electrical conductivity |  | Metals Salt water |
| Thermal conductivity |  | Metals  |

**Materials**

Looking at characteristics, degradation and protection.

**Degradation:** breaking down or wearing down of a material.

**5 Materials**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Wood and modified wood** | **Ceramics** | **Metals and alloys** |
| **Fact** | Wood is produced by the harvesting of trees and modified wood is wood mixed with other substances (glue, plastics) | Created by heating inorganic matter Usually formed using an oxide, sand and clay. | A metal is extracted from an ore. An alloy is made up of many metals and or other substances. Ferrous alloy has iron in it. |
| **Pros** | Resilient and does not conduct. Can recover from water damage | Hard, does not rust and does not conduct. Used in building materials. | Conducts heat and electricity. Malleable and ductile. |
| **Cons** | Can be ruined by too much water. Damaged by insects | Very fragile | Will rust |
| **Degradation** | Sun, insects and water | Can be deteriorated by certain acids and bases. | Rust due to water and salt |
| **Protection** | Treating wood with a solution containing copper | Care in baking process can determine its resiliency | Coatings are put on the metal (paint and oils). Galvanized- coated with zinc. |

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| --- | --- | --- |
|  | **Plastics** | **Composites** |
| **Fact** | Plastics are made from fossil fuels. Thermoplastics will soften when heated and changes shape when cooled. Thermosetting plastics remain hard even when heated. | Made up of 2 parts: 1- Matrix (skeleton and gives shape) 2- Reinforcement (fills the matrix). Used in airplane wings, bulletproof vests and sport equipment. |
| **Pros** | Can be used for basically everything and anything. Cheap to produce. Can be molded in all colours and sizes. | Produces high quality products. |
| **Cons** | All thermosetting plastics are not recyclable. Cheap, therefore creates a lot of waste. | Very expensive to produce. |
| **Degradation** | Water, oxygen and UV rays can damage them. | Matrix and reinforcement loses its adherence. Deformation or fracture of materials. |
| **Protection** | Use waterproof coating, add antioxidants and add pigments which absorb UV rays. | Using products which will adhere together well. |

**Past exam question**

* + - 1. A circuit performer holds onto a twisted rope, maintaining the same position for a few seconds.



Which of the following choices indicates the two mechanical constraints to which the rope is subjected at the location where the arrow is pointing?

A) tension and compression C) deflection and torsion

B) compression and deflection D) torsion and tension