Your notes

GCSE Engineering: revision notes

# Structural systems

## Contents

1. Forces in structures
2. Types of structure
3. Stress, strain and safety
4. Key terms
5. Quick questions
6. What to do next

## Forces in structures

- **Tension**: a pulling force that stretches a member. **Compression**: a pushing force that squashes it.
- **Torsion**: a twisting force, as in a drive shaft. **Shear**: forces acting in opposite directions that make parts slide apart, as on a bolt. Bending: a combination of **tension** and compression, as in a loaded beam.
- Static loads don't move (the weight of a bridge). Dynamic loads move or change (traffic crossing a bridge, or wind).

## Types of structure

- Frame structures are made of members joined together, such as bridges, cranes and pylons. Shell structures are hollow and get strength from their shape, such as car bodies and drinks cans. Solid (mass) structures rely on their weight, such as dams.
- Triangulation makes frames rigid, because a triangle can't change shape without changing a side length.
- **Struts** are members in **compression**; ties are members in **tension**.
- I-beams resist bending using less material, by placing most material at the top and bottom where **stresses** are greatest.

## Stress, strain and safety

- **Stress** = force ÷ area. A force of 5,000 N on an area of 25 $mm^2$ gives a **stress** of 200 $N/mm^2$.
- Strain = extension ÷ original length. An extension of 0.5 mm on 250 mm gives a strain of 0.002 (no units).
- **Factor of safety** = failure load ÷ working load. A part that fails at 12 kN with a working load of 3 kN has a **factor of safety** of 4. Higher factors are used where failure would be dangerous.

© LycoLearn · lycolearn.co.uk · Free GCSE and KS3 revision

## Key terms

| | |
|---|---|
| **Tension** | A pulling force that stretches a member. |
| **Compression** | A pushing force that squashes a member. |
| **Torsion** | A twisting force. |
| **Shear** | Forces acting in opposite directions that make parts slide apart. |
| **Strut** | A member in compression. |
| **Tie** | A member in tension. |
| **Stress** | Force divided by area. |
| **Factor of safety** | Failure load divided by working load. |

## Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is tension?
2. Which force twists a drive shaft?
3. Why does triangulation make frames rigid?
4. Which is a shell structure?
5. What is a strut?
6. A force of 5,000 N acts on 25 mm². What is the stress?
7. A part fails at 12 kN and its working load is 3 kN. What is the factor of safety?
8. Which is a dynamic load?

### Answers

1. A pulling force that stretches a member
2. Torsion
3. A triangle can't change shape without changing a side length
4. A drinks can
5. A member in compression
6. 200 N/mm²
7. 4
8. Traffic crossing a bridge

## What to do next

**Practise 10 questions on this topic**

**Try 3 exam questions, with mark schemes**

**Read the lesson, one step at a time**

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

Your notes