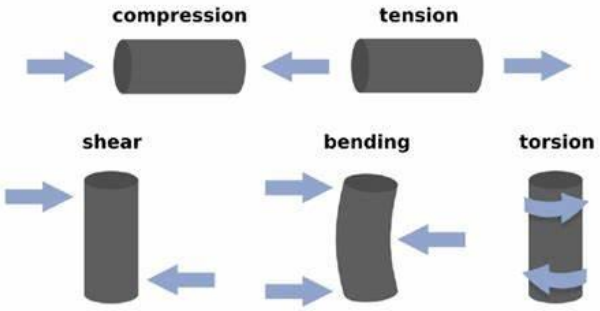
Year 8 – Forces & Stresses

Term 1 – Revision



Understanding Forces and Stresses in Structures

Vocabulary

1. **Force:** A push or pull on an object.
2. **Stress:** Internal resistance of a material to deformation.
3. **Tension:** A pulling force that stretches materials.
4. **Compression:** A pushing force that squashes materials.
5. **Bending:** A combination of tension and compression resulting in curvature.
6. **Torsion:** Twisting force that can cause rotational deformation.
7. **Shear:** A force that causes layers of material to slide past each other.
8. **Static:** Forces acting on an object at rest.
9. **Dynamic:** Forces acting on an object in motion.
10. **Reinforcement:** Methods used to strengthen materials.
11. **Stiffening:** Increasing a material's rigidity.
12. **Flexibility:** The ability of a material to bend without breaking.
13. **Lamination:** Layering materials for added strength and stability.
14. **Folding:** Creating folds to enhance structural integrity.
15. **Webbing:** Strips of strong material used for support.
16. **Interfacing:** Joining different materials or components.
17. **Load:** The weight or force applied to a structure.
18. **Suspension:** A method of supporting a load by means of cables.
19. **Cantilever:** A projecting structure supported only on one end.
20. **Arched:** A curved structure that distributes weight.
21. **Truss:** A structure made from interconnected triangles for stability.
22. **Triangulation:** Using triangles to reinforce and distribute loads.
23. **Strut:** A structural component that resists compression.
24. **Tie:** A structural component that resists tension.

Objectives

Learning Objectives:

- Be aware of the natural strength different shapes provide.
- Understand various bridge types and structures.
- Use ties and struts to strengthen structures.

- Understand how materials and structures can be strengthened through reinforcement and stiffening.
- Be aware of different methods of strengthening materials and structures.
- Be able to select different strengthening techniques for various materials and applications.

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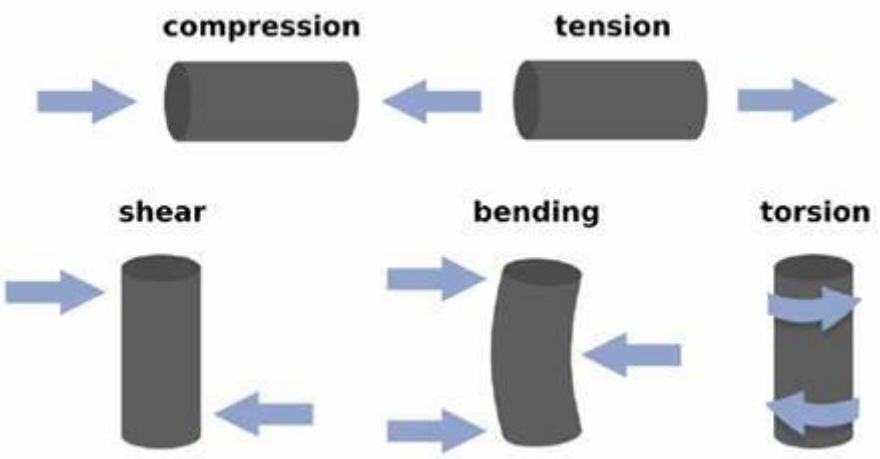
Content

Forces are everywhere around us, influencing the objects we interact with daily. We explored five key forces: **tension, compression, torsion, bending, and shear.**

A Static load does not move and will place far less stress on a material than a moving or **dynamic load**



Tension occurs when forces pull an object apart. A great example is the cables of the Golden Gate Bridge, which hold up the roadway through tension while anchored securely.

Compression is the opposite of tension; it happens when forces push an object together. Think of a balloon: when it is inflated, the air inside compresses the rubber, creating pressure.

Torsion refers to twisting forces. Imagine using a screwdriver; when you twist the handle, you apply torsion to the screw.

Bending combines both tensile and compressive forces. For instance, when you press down on a ruler at its centre, the ends are pulled upwards (tension) while the middle is pushed downwards (compression).

Shear occurs when forces act parallel to each other. For example, when you cut paper with scissors, the blades apply shear force to separate the paper.

Understanding these forces is essential for recognizing how materials behave under different conditions. For instance, a diving board bends under the weight of a diver due to a combination of tension and compression, demonstrating how different forces interact.

Reinforcing & Stiffening

Reinforcement is crucial for enhancing the strength of materials. For example, jeans have studs at stress points to prevent tearing. Similarly, reinforced concrete combines steel and concrete to make structures more durable.

Stiffening is another method used to improve the strength of objects. Baseball caps, for instance, often have stiffened peaks made from materials like Buckram, which helps maintain their shape.

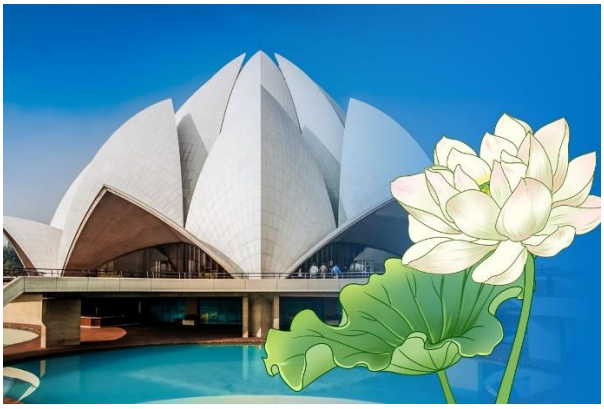
Webbing adds strength to items like bag straps, while laminating plywood enhances durability.

Laminating is adding layers of different materials which are bonded together to improve strength, stability, appearance.

Composite Materials are made from two or more materials. These will have different physical or chemical properties. When combined, a material is produced that has different characteristics from the original components

Structures & Strength

Biomimicry is the practice of studying nature's designs and processes to solve human problems. It involves looking at how plants, animals, and ecosystems have evolved over millions of years to find innovative solutions. For example, engineers have created new materials inspired by the structure of spider silk, which is incredibly strong and flexible. By mimicking nature, we can develop sustainable technologies and products that benefit both people and the environment.



There are 3 types of structures, **solid structures, frame structures and shell structures**. The shape of a structure can greatly influences its strength.

Triangular shapes are particularly strong due to their ability to distribute weight evenly **(Triangulation).** This principle is evident in truss bridges, where triangular sections transfer loads effectively.

Different types of bridges, such as suspension, arch, and cantilever bridges, utilise these principles to span large distances while minimizing material use.

Types of Bridges

Truss Bridge

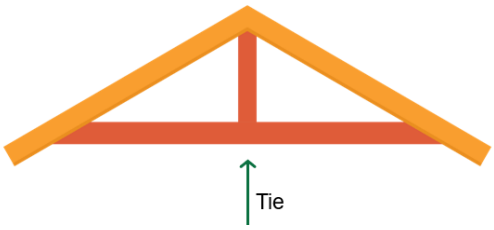
Suspension Bridge

Arch Bridge

Cantilever Bridge

Struts are used to strengthen structures. They provide an outward facing support and are under compression.

Ties are used on a structure to prevent outward movement and are under tensile force. Ties can also be made from flexible material such as cable, which is kept under tension



Health & Safety

Health and Safety in the Design and Technology Workshop

Safety is a top priority in any workshop. Establishing clear rules and guidelines helps to protect everyone involved. Here are some important workshop rules to keep in mind:

1. You must never enter the Design Technology room unless there is a teacher present.
2. All bags should be placed under the table at all times.
3. You must treat all workshop equipment with respect and leave the room tidy.
4. Horseplay and any unruly or inattentive behaviour will not be tolerated in the workshop.

5. Machines, tools and equipment must be used in the correct manner and never misused.
6. Aprons must be worn and fastened correctly.
7. Protective goggles, ear defenders and/or masks must be worn when the warning signs specify or when the teacher instructs you to.
8. Students MUST always walk around the D&T Room with caution when carrying materials, tools or projects.
9. All sharp objects MUST be carried with points facing down. (e.g. Chisels, saws etc.)
10. When operating machinery, loose jewellery (Necklaces, earrings, bracelets, rings, watches etc.) must be removed or made safe.
11. Long hair must be restrained (Either tied back, under a hairnet or pinned back) at all times.
12. Machines must not be left unattended at any time during operation, unless instructed to do so.
13. Machinery is to be operated by only one person at a time.
14. Protective guarding must be used if fitted to the machine.
15. Ensure trolley wheels are locked before using any machines.
16. You must not distract another student whilst a machine is in operation.
17. When a machine or piece of equipment is operational, never attempt to touch any of the moving parts. In an emergency, power should be switched off first.
18. Never touch sharp items (Even if the machine is not operational)
19. All spillages must be attended to and cleared immediately.
20. All breakages/damage must be reported to the teacher immediately.
21. Exhaust/dust fume extractors must be used at all times when appropriate.
22. You must put away all equipment and leave the room as you would like to find it

Personal Protective Equipment (PPE)

PPE is crucial in minimising exposure to hazards in the workshop. It includes various protective gear that helps prevent injuries. Below are some types of PPE commonly used in Design and Technology:

- **Dust Masks**: Used when sanding or sweeping to prevent inhalation of dust.
- **Respirators**: Protect against inhaling toxic fumes.
- **PVC Aprons:** Protect clothing and skin from chemicals.
- **Earmuffs and Earplugs**: Safeguard ears from excessive noise.
- **Gloves**: Protect hands from sharp edges and rough materials.
- **Safety Glasses/Goggles:** Protect eyes and face when using tools.

Safety Symbols and Colours

Recognizing safety symbols and colours is essential for maintaining a safe workshop environment. Be aware of these symbols and their meanings:

- Red: Danger or stop.
- Yellow: Caution or warning.
- Green: Safety or go.
- Blue: Mandatory action.

SAFETY COLOUR	MEANING	SHAPE	EXAMPLE
RED	• Fire-fighting equipment		
	• Prohibition		
YELLOW	• Hazard • Caution • Possible Danger		
GREEN	• First-Aid • No danger • Safe condition • Positive action		
BLUE	• Mandatory • Information		

Approach to Safety

When working in the workshop, always take your 'TIME' to assess the situation:

- **Task:** Look at the job you are doing.
- **Individual:** Consider your own safety and well-being.
- **Machine**: Understand the equipment and tools you are using.
- **Environment:** Be aware of the surroundings and potential hazards.

Workshop Safety Features

Workshops are equipped with safety features to protect users:

- **Electrical Safety Features:** Isolation switches and emergency stop buttons.
- **Dust Extraction:** Reduces the risk of inhaling harmful dust.

- **Machine Guards:** Protect users from moving parts.
- **Fire Extinguishers:** Ensure a quick response to fires.