Two types of structures

**Frame Structure**
- They have a ‘Frame’
- They are made up of different parts
- They may or may not have a ‘skin’

**Shell Structure**
- They rely on the shape they have been moulded into for their strength.
- Usually lighter than frame structures.

Note: Frame structures might look like shell structures but this is only because they have a ‘skin’.

**Man-Made vs. Natural Structures.**

Made-made structures are made by humans, whereas natural structures are structures that occur naturally.

In the pictures above, the skeleton, eggs and snail shell are all natural structures.

**Two types of members in a structure**

**Structural member** - It is a necessary part of the structure and is undergoing some sort of force. (Without it the structure would not be strong)

**Redundant member** – It is part of the structure but is not undergoing any force. (If it was taken out of the structure it wouldn’t affect the strength of the structure)
Structures

**Force**

A force is a push or a pull. They are measured in Newtons (N).

**Types of Load**

Structures support loads. There are two types of loads: Static (not moving) or Dynamic (moving)

**Forces acting on Structures**

**Compression**

‘Squashing’ force

**Tension**

‘Pulling’ force

**Torsion**

‘Twisting’ force

**Shear**

‘Tearing’ or ‘ripping’ force.
(forces moving against each other in opposite directions)

**Bending**

When a member undergoes bending, the top surface is in compression and the bottom is in tension.
(chomp bar example)
Structures

**Triangulation**

Putting the diagonals in this structure make it rigid. Without them it would collapse.

Friction

It occurs when two surfaces are in contact. It is a force that tries to stop one surface from sliding against another.

**Advantages**

- Allows us to walk, cycle, pick up things. And allows cars to start and stop

**Disadvantages**

- Friction between car tyres and road wears the tyres and slows them down meaning we have to use more petrol

Sometimes we need to minimise friction – pedals moving easily, wheels need to move easily, chain needs to move easily. We use oil to reduce the friction. Bearings are also used to reduce friction

Sometimes we need to maximise friction – Where brake pads meet the wheel – rubber is used. Where wheels meet the ground.

Parts of structures

Tie – In tension (being pulled)

Strut – In compression (being squashed)

**Beam** – Horizontal member that spans a gap. (book p.50)

**Contilever** – Part of a beam that extends past its support

**Column/Pillar** – Vertical member to support loads directly on top (legs)
Structures

Types of beams

- I-section beam
- T-section beam
- L-section beam
- U-section beam
- Circular section beam
- Square section beam

Structure design

**Function:** A structure must first of all fulfil its purpose by doing what it is supposed to do.

**Safety:** All structures must be safe.

**Aesthetics:** depending on where it is and how much money there is to spend, it is important that structures are aesthetically pleasing (look good)

**Environment:** Every structure affects the environment. It is important that designers consider the impact of a structure on the environment.