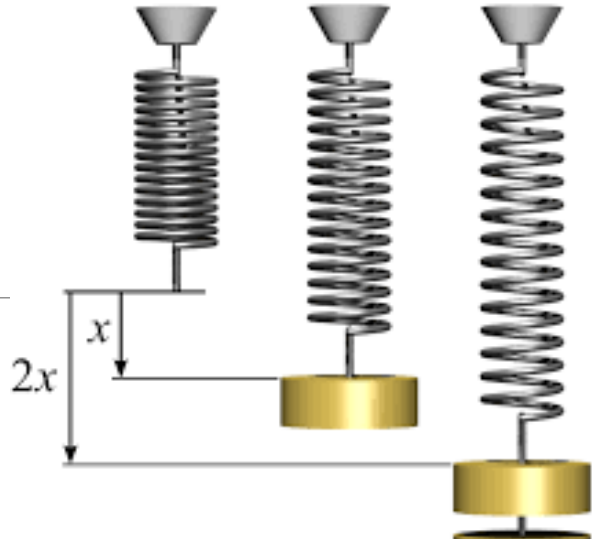
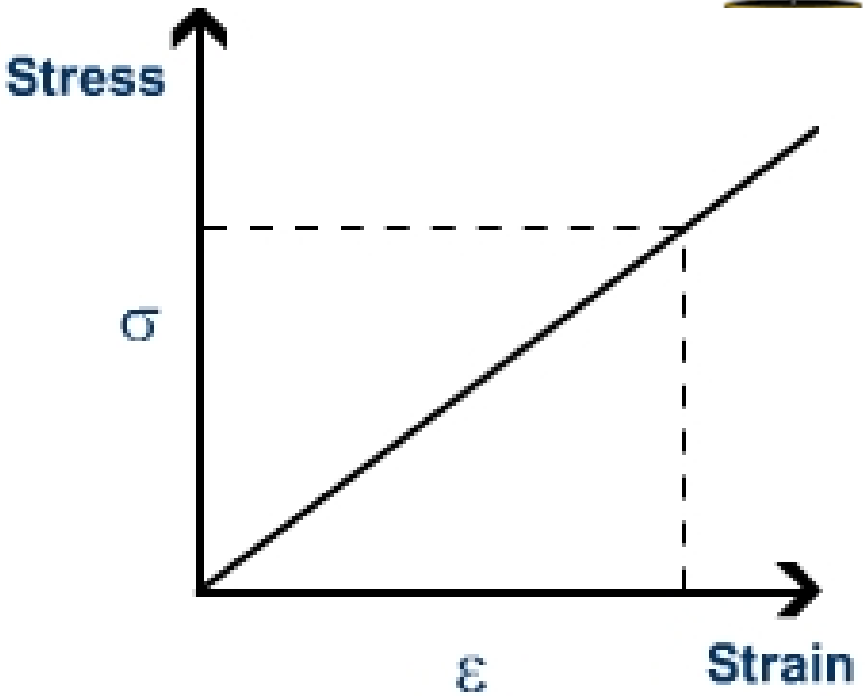
Unit 2

Hooke's Law and Forces

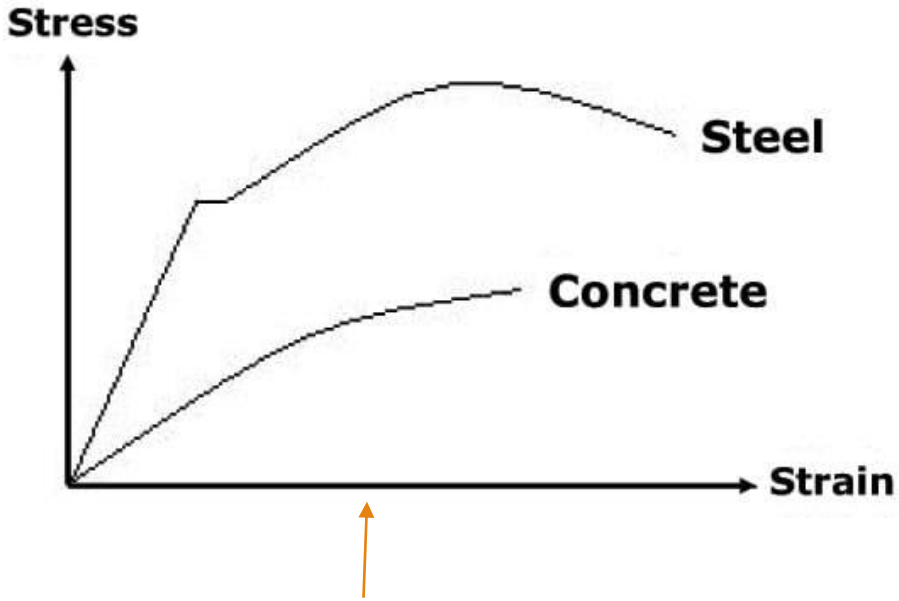
- Force is a resistance acting upon a material which causes a change in directional movement or shape of the substance.
- Stress is the force that is acting upon the area of a material that causes it to change shape or deform the object. The strain is a response in which the material has produced due to the stress applied.
- Hooke’s law is the relationship between the forces applied on a material and the extension of a material. It is a the law that states how the strain on a certain solid substance is proportional to the applied stress that is within the elastic spectrum of a material.





Comparison of Materials

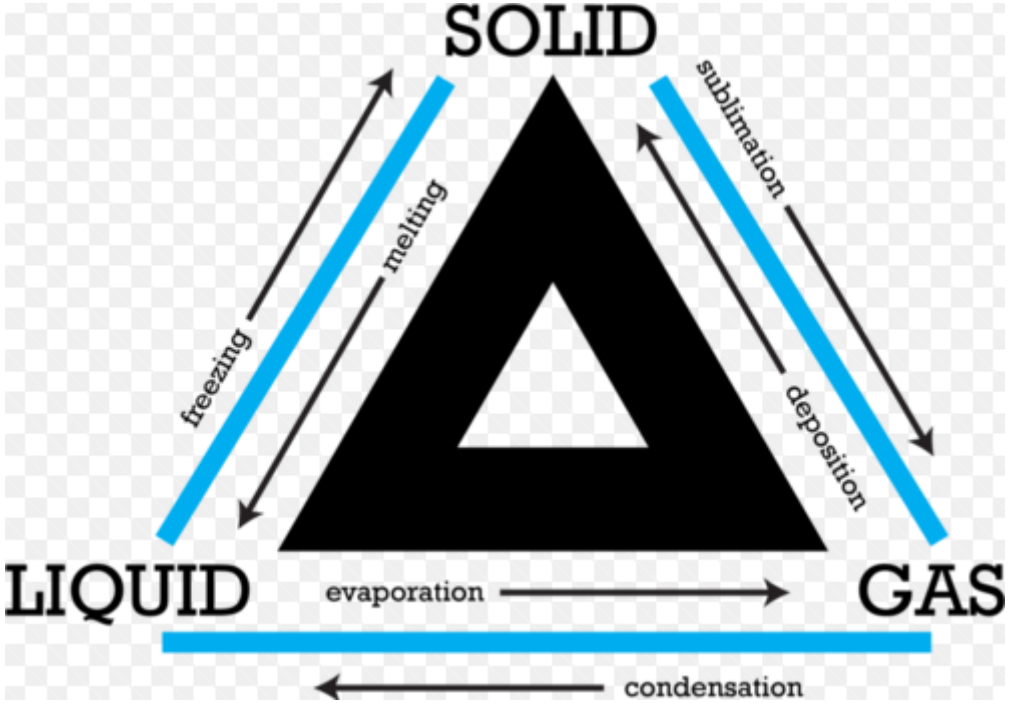
- Steel is a ductile substance which means it is capable to be deformed without using toughness. Steel is also a strong material that can withstand and hold large amounts of force with being affected by it. However, adding to much force and the material will start to deform.
- Concrete is brittle and fragile under a high load or large forces as it can crack and fracture due to this. It is also a strong material however it can not be formed once hardened as it will fracture and break. When concrete is hardened is it strong with a load spread over the surface however adding forces to a small portion will make the concrete break.
- When combined, the two materials can be used to form a super material as both properties are combined. The new material has a high strength threshold and due to this it is often used as foundations. The steel is used in rebars which help reinforce the concrete foundation.



Stress/strain graph for steel and concrete

Change of State

- There are three states that a substance can acquire.
- Sensible heat is the change in which temperature either increases or decreases. Latent heat the temperature at which the change of state takes place. (e.g., water evaporating at 100°C)
- An example of this is in construction is that concrete brick absorbs water and freezes in cold water as it is a semi-permeable surface. While it freezes it expands and cracks the brick weakening the structure.



Effects of Temperature

- Concrete is made by mixing all the ingredients together and placing them into a mould either on or off the site where they can be set into shape. The ingredients have to be measured out and made it controlled batches as if the mixture isn't correct the concrete will not be structurally sound. If there is too much water for example the mixture will be too wet and if it freezes it expands and cracks the concrete. Temp can effect the concrete as it could cause cracks and damages due to thermal shock. Aggregate expansion can also produce stress within the concrete resulting in cracks. High temps can also affect the compressive strength of concrete. If temps fall lower the concrete may be vulnerable to cracking and crumbling as the water consistency will be too high in the material which could then freeze and crack.

- Timber is made from cutting down trees and then sending them to a sawmill where they then cut into timber lengths and are stripped and processed to ensure they are strong and durable and can be used in construction to create roof rafts or beams. They also need to be tested for strength to see how much the timber can hold before breaking. When timber is affected by heat it expands. This process is known as thermal expansion and then can cause warping, swelling and potentially shrinking. Moisture also effects the wood as timber expels water from surrounding environments and when timber reaches equilibrium it can cause the timber to warp or twist and rot.

Case Study into the effects of Temperature on Common Construction Materials

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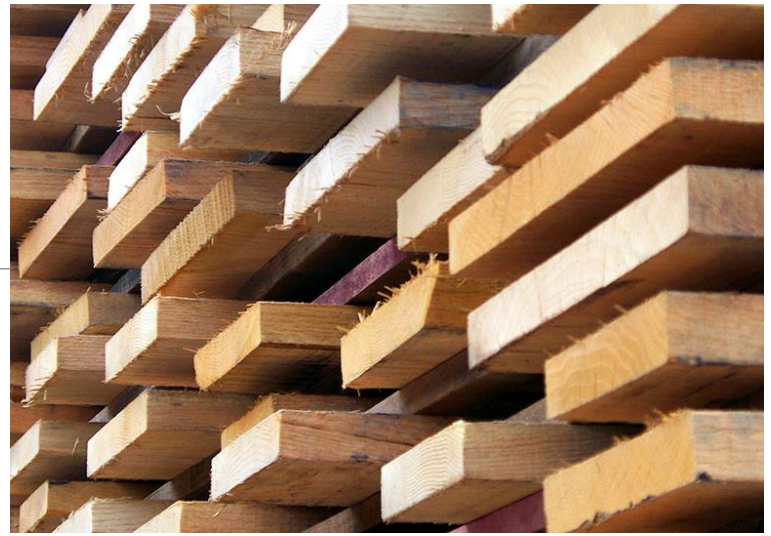
Timber



Timber is made from trees which have been cut down through deforestation and then are processed through a sawmill.

Timber is processed by cutting down trees and then sending them to a sawmill where they are cut into timber lengths which are then stripped and processes to make sure they are strong and durable enough to withstand applied force. These can then be used in the industry to create rafts and roof beams. They go through a test called timber grading which bends the wood till breaking point.

Temperature effects timber because when it is subjected to heat it expands. This process is called thermal expansion and can cause warping of the wood; swelling; potentially shrinkage. Moisture can also affects the wood as timber expands when in contact with water and whn it reaches equilibrium it can warp the timber planks, twist the wood and cause it to rot if the wood is treated (especially if the timber is subjected to cold temperatures).

Concrete

Concrete is made from a mixture of cement with sand, water and aggregate (crushed rock and rubble).

Concrete is made by mixing the ingredients together and placing them into a mould either on or off the site where they can set it into shape. The measurements have to be exact and be made in controlled batches. If the batches are unbalanced the mixture will not have the correct consistency and could decrease the structural strength. If it is subjected to water and it freezes it can cause cracks and crumbling.

Temperature can affect concrete because if the change is abrupt it can cause cracking and fracturing due to thermal shock and aggregate expansion can also produce distress in the concrete. High temperature also effect the concrete and its compressive strength. If temps fall low the concrete would be venerable to cracking if water consistency is too high,. If this then freezes it expands and crack the concretre.

Red Brick

Red brick is made from clay, sand and lime powder.

It is made by gathering the materials and mixing them with water, it is then extruded into a long line and cut into 5ft lengths and then cut into individual bricks and then dried for 2 days to ensure there is no water left. The bricks are then fired for 25 hours to give them strength, fire resistance and durability. Once the bricks have finished this process they are the tested to see if they are suitable to use on site.

High and extreme temps don’t really effect red brick as they are fired befor hand to raise their fire resistance. This means they are made to withstand high heats and resist moisture as all moisture is out of them. There is a very slight and potential risk of the brick expanding and cracking if any water gets into the brick and freezes.

Cement

Cement is made by heating powered limestone and clay.

It is made by crushing limestone and clay being mixed together and heated up to give it strong properties, it can then be added to water to make cement which can be used as mortar in-between bricks or in other materials to make concrete.

Water can affect cement as if too much water is in the compound it can cause it to set incorrectly and also cause cracking, freezing and expansion. When the water is in the mixture it can cause the substance to become weak and also set weak. If the cement cracks due to this it can have serous implications to the overall build.