# Shaping and forming

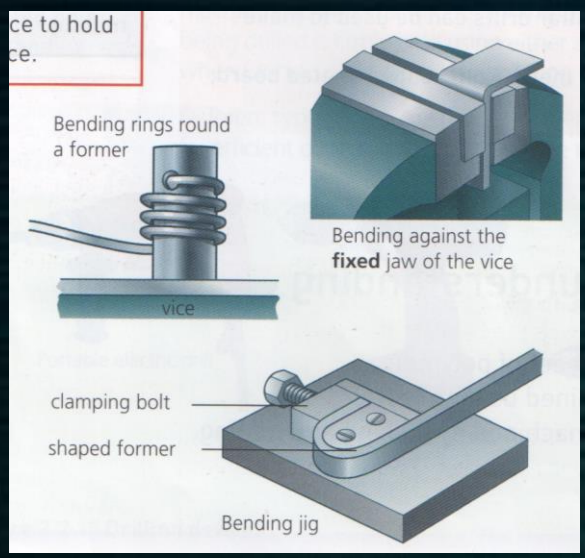
SECTION 2.3

## What is forming?

This is where the material is changed in shape by applying force and can involve bending, folding or press forming. The force can be applied via hammering, forging, pressing, air pressure or by a vacuum.

## What is shaping?

This is where material is poured or a liquid is forced into a mould and then left to harden to take a particular shape. This allows for complex shapes to form in a single operation. Shaping can be completed by casting, injection moulding or composite layup.




## Bending

Bending involves physically deforming a material that is ductile and / or malleable, brittle materials will just shatter.

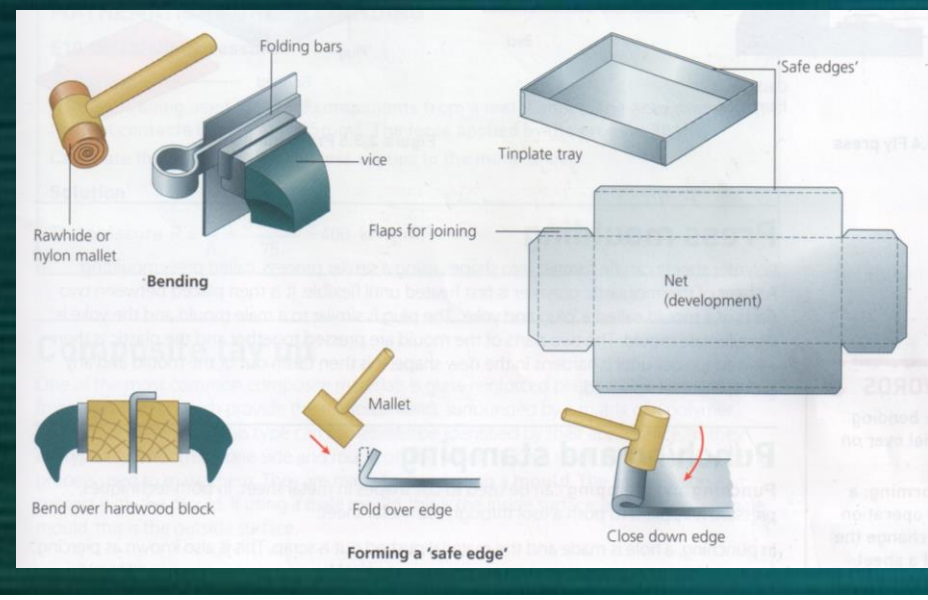
Thin sections of Ferrous metals are easily bent even without heat but applying heat will make them easier to bend. Non Ferrous metals such as aluminium and copper are annealed (heated and left to soak at that temperature).
If accurate bending is needed then a former or jig is made for the metal to be bent within.

Plastics can be easily bent by heating up the plastic first to make it more malleable otherwise it will snap. A line bender can be used to heat a piece of plastic to obtain the correct shape and held until it re hardens.

## Folding

Folding is where material is bent over itself so that one part covers another.
Folding can be achieved by securing it in a vice and then hitting it with a mallet to get the right fold.

In large quantities  hydraulic presses  can be used to apply pressure along the fold lines to push the material into a former, the former helps to ensure accuracy and consistency.




## Press forming

Press forming is used in industry to make 3D shapes from sheet metal, the level of complexity varies from simple domes to whole car door panels. The metal used needs to be ductile so that it can take the shaped without rupturing or fracturing.

The process is completed using two moulds or a die and ram, these fit together with a small gap between them that the sheet metal can fit in. This makes the shape in the metal completing the product.

The moulds tend to be made from high carbon steel so they are hard and resist wear but are expensive to make as it can't be machined and needs to be cast.

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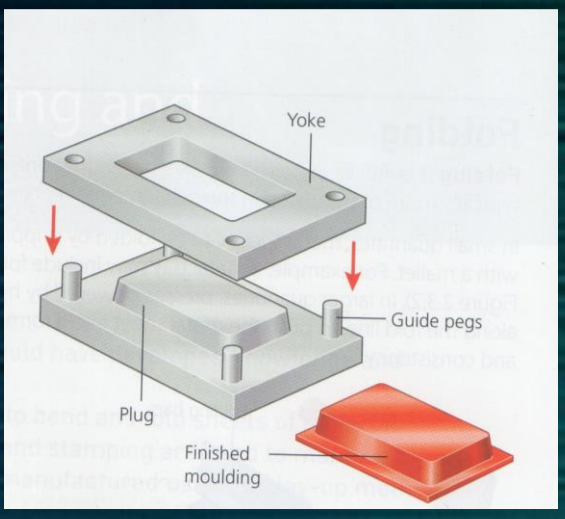
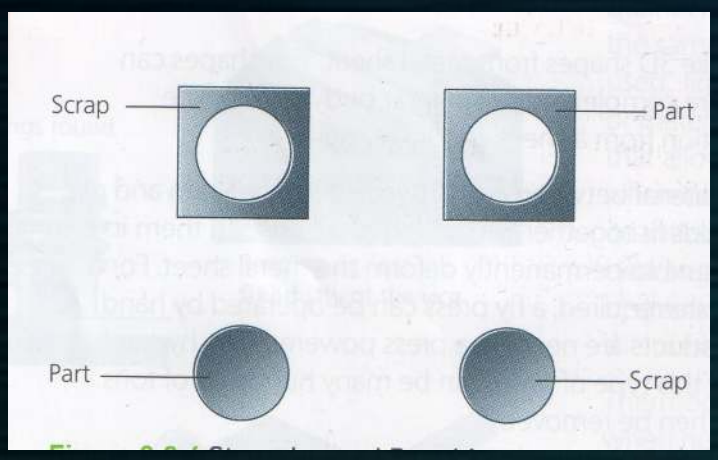
## Press moulding

This process is completed on plastic sheets that have been heated to form particular shapes.
The plastic is first heated making it flexible and then placed between two moulds called a plug and a yoke.
All three parts are then pushed together and held in place until the plastic has solidified.
The plastic is taken out and the excess removed.




## Punching and Stamping

This process involves cutting shapes in or out of sheet metal. In both processes pressure I used to cut a shape out from the sheet metal.

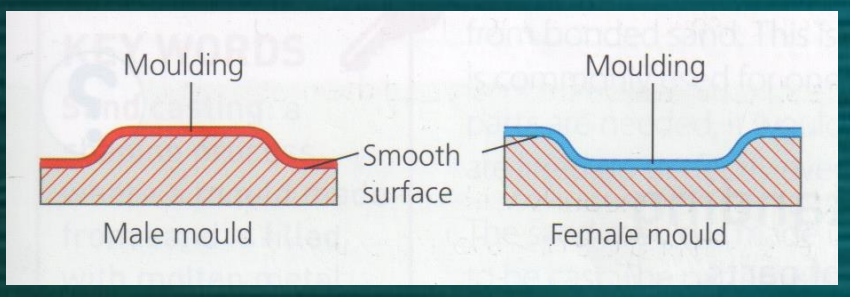
In punching, the shape is pushed out of the sheet and the shape is the waste.

In stamping, the shape pushed out is the needed piece and the sheet metal is the waste.

These process both use a die or ram and a hydraulic press.

Before punching or stamping the pressure required needs to be calculated using the following equation:

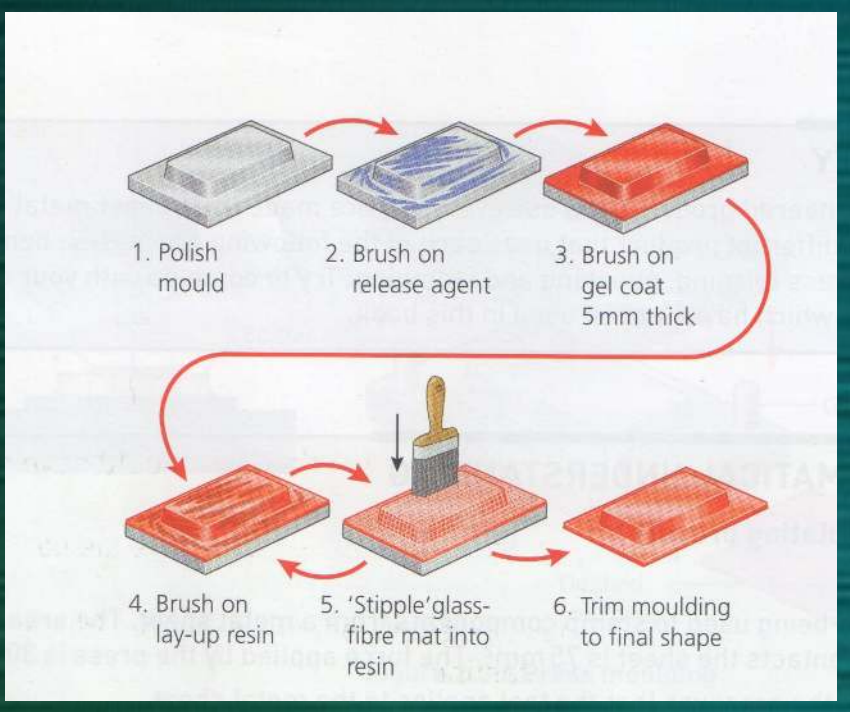
$$\text{Pressure} = \frac{\text{Force}}{\text{area}}$$




## Composite lay up

This process is completed on composite materials like GRP and carbon fibre. In this process you use a mould where the composite material is put against the mould so this side is smooth and the other side is rougher.

The process is completed by:
Making a mould and coating it with a release agent, with GRP a gel coat is applied
Layers of reinforcement are applied and pushed into corners
The reinforcement is the soaked in resin using a brush
More layers of reinforcement are added with further resin.
Vacuum can be applied to remove any trapped air.
Part is left to cure (resin hardens)



# Shaping and forming

SECTION 2.3

What are the main difference between Forming and Shaping?

Define the term bending

What can be made to help the process of bending be fore accurate?

What materials can be bent into shape?

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What needs to be done with some of these materials?

Explain how materials can be folded?

What can be made to aid in making the forming accurate?

Define the term Press forming

What is needed when you Press form

How is Press moulding different from Press forming?

Draw down a diagram to show the process of Punching and Stamping showing the waste and wanted parts

Using the Pressure equation calculate the following pressure needed

A press is being used to stamp components from a metal sheet. The area over which the tool contacts the sheet is 85mm$^2$. The force applied by the press is 10MN.
Calculate the pressure that the tool applies to the metal sheet.

A press is being used to stamp components from a metal sheet. The area over which the tool contacts the sheet is 45mm$^2$. The force applied by the press is 25MN.
Calculate the pressure that the tool applies to the metal sheet

A press is being used to stamp components from a metal sheet. The area over which the tool contacts the sheet is 15mm$^2$. The force applied by the press is 5MN.
Calculate the pressure that the tool applies to the metal sheet

Explain the process of composite lay up.