Yr 9 Engineering- Trowel Project

Year 9 Engineering Rotation 2 Knowledge Organiser - Know About Material Characteristics, Joining and Wasting Processes

Year 9

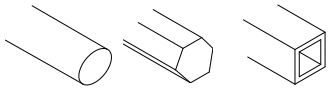
D&T @ ECC Engineering

Material characteristics

Relative cost

Ease of use

Forms of supply



Availability

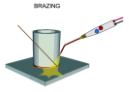
Sustainability

Safety in use

Joining processes

Brazing

Metals must be clean and free from contaminants. The join of the mating metals has a flux applied to it. The two metals are placed together and heated. A filler metal (brass) is melted into the joint. The metals are then allowed to cool.



MIG welding

Metal inert gas (MIG) has an electrode (filler metal) contained within the welding torch. Welding actually melts the base materials to help join them together. Argon gas shields the weld from oxidising

MAG welding

Metal active gas (MAG) is much the same as MIG welding but instead of using an inert gas, it uses an active gas (commonly CO_2). The active gas helps the weld achieve deeper penetration. CO_2 is also much cheaper than argon.

Riveting

Pop rivets

Pop rivets join two pieces of material together by pulling the mandrel through the body of the rivet. The mandrel snaps off and joins the materials. Pop rivets are a good choice when access to the material is limited to one side only.

Cold/ hammered rivets

Hammered rivets require the rivet end to be deformed my a form of hammering. They require access to both sides of the materials being joined.

Mechanical fastener

Nuts, bolts and screws

Nuts bolts and screws rely on a screw thread to join the components. They come in many sizes and different head types such as hex, pozi and flat head.

Self-tapping screws

Self-tapping screws often do not require a pilot hole drilling like bolts do. They create their own screw threads and join materials together.

Wasting processes

Drilling

Hand tools: Hand drill

Power tools: Cordless drill, pedestal/pillar drill.

A drill bit (consumable) is used to 'carve' through the material. Swarf (cuttings) is ejected via the flutes.

Shearing

Hand tools: Tin snips, aviation snips.

Power tools: Nibblers, bench shears.

A pair of sharpened jaws slice through the material similar to how scissors operate.

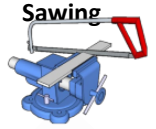
Threading

Hand tools: Tap & tap wrench (holder), die and die stock (holder). Process can also be CNC.

The cutting tools remove material in the shape of screw threads. A cutting or tapping compound (consumable) is used to lubricate the cutting of screw threads.

- Internal threads - Taps come in a various forms such as taper, bottom and plug.
- External threads – Dies come in solid form or split.

Sawing



Hand tools: Junior hacksaw, hacksaw.

Power tools: Power hacksaw

A tensioned blade (consumable) with 'teeth' is used to remove material.

Filing

Hand tool: Hand file – many types such as flat, half round, 3 square, round, square.

A hardened

Dedicated machines (can be manual or CNC)

Milling

Milling machine: Looks very similar to the pillar drill but instead of the chuck and drill bit moving up and down relative to the bed, the chuck/collet of the milling machine remains fixed and the bed is moved in relation to the cutting tool. The bed can be moved in multiple axis. Products can be very complex shapes.

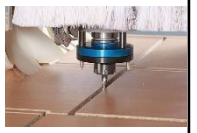
Turning

Centre lathe: Turning creates cylindrical products/components. Can be used to create holes, grooves and knurls (think grip pattern on barbells/dumbbells). A coolant (consumable) is often used to keep materials cool. This prolongs the life of the cutting tools.

Dedicated CNC processes

Routing

CNC routing requires a CAD program to operate it. The router follows the program and cuts out two-dimensional shapes from materials such as woods, composites, metals, plastics and foams.

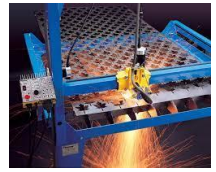


Laser cutting

laser cutting also required a CAD program to operate it. A laser beam is used to cut through materials – it essentially burns its way through and is instantly cooled via cold jet of air. Material include woods, composites and polymers.

CNC Plasma Cutting

Plasma cutting is a process that cuts through electrically conductive materials by means of an accelerated jet of hot plasma. Typical materials cut with a plasma torch include steel, stainless steel, aluminium, brass and copper, although other conductive metals may be cut as well. CNC tables allow a computer to control the torch head producing clean sharp cuts. The plasma will cut at temperatures around 1400 degrees Celsius and this is hotter than the surface of the sun.



Yr 9 Engineering- Trowel Project

Year 9 Engineering Rotation 2 Knowledge Organiser - Know About Finishing, Shaping and Forming

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Finishing processes

Painting

Brush

Using a brush is a very cost-effective way to apply paint. It does not require any specialist equipment such as spray guns, extraction or training of staff. It can however be a slow process. The surface finish is not always perfect.

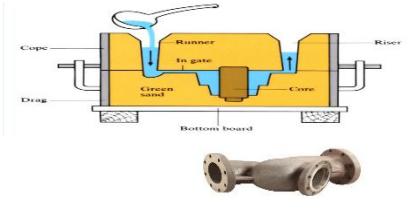
Spray

Spray painting is a very efficient way of painting materials and leaves a high-quality surface finish.
It can be allied via a aerosol can or a professional spray gun. Training is required and specialist extraction for paint fumes.

Powder coating

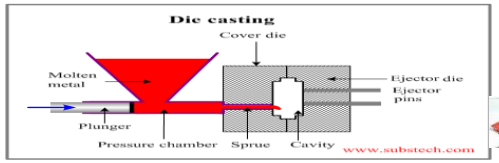
A dry coloured powder is applied to metals and woods by spraying the powder over an electrode. This creates an electrostatic charge which then attracts the powder to the grounded part being coated. Powder coating is very durable and cost effective as there is minimal waste due to the electrostatic process.

Shaping processes



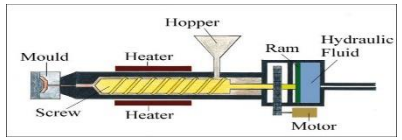
Sand casting

Sand casting uses sand to form a mould. It is split into two halves: the cope (top) and the drag (bottom). Moten metal is poured into the mould and then allowed to cool. The sand must be broken away from the casting. Secondary machining is often required.



Die casting

Die casting is similar to the process of injection moulding but it uses molten metal rather than molten plastic. Molten metal is fed into a pressure chamber which then forces the molten metal into a die. It is then allowed to cool before it is ejected.



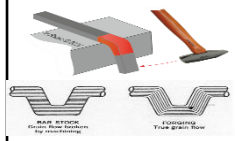
Injection moulding

Injection moulding is the process of heating plastic and forcing it into a mould under high pressure. Benefits include dimensional accuracy, automation, and both thermoplastics and thermosetting plastics can be used.

Powder metallurgy for ceramic product

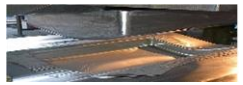
The process of mixing ceramic powder with additives. The mixture is then compacted into the required shape (green state). Heat is then used to solidify the powder.

Forming processes



Forging

Forging is the process of heating metal until it becomes 'cherry red' and then shaping it using a force. Forging improves the strength of metals and does not waste material like machining.



Press forming metal

Press forming metals is achieved by applying a force to sheet metal. The sheet metal is pressed into/onto a die. The process often removes excess material at the same time.

Strip heating polymers

Strip heating involved using a heating element to heat polymers. The polymer can then be shaped and allowed to cool – Thermoplastics only.

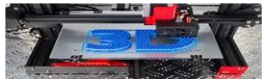
Vacuum forming

Heating a sheet of thermoplastic and then using a vacuum pump to pull the softened polymer over a mould. Moulds must have a draft angle.

Moulding composite materials

Moulding composites mostly consist of building up layers of material and applying a resin to bond the layers together. Moulds in the desired shape are used to form the composite.

Additive manufacturing: 3D Printing (fused deposit modelling)



3D Printing requires a CAD model which is then sliced into layers. The 3D printer then prints the layers to build up the product or component. PLA is commonly used.