Stage 5 Design and Technology

NOTES FOR STUDENTS

Materials

This page covers basic information about the different resistant materials which people use when making products. You'll need to understand why a designer chooses a particular material, or combination of materials, for a particular product.

Different types of materials

The most common materials are:

- metals
- plastics
- timber
- modified timber

Metals

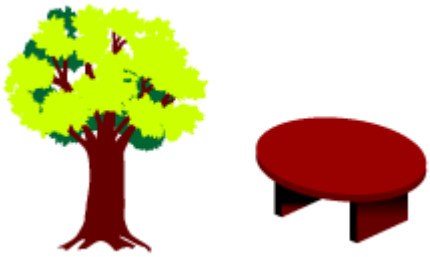
Most metals are obtained from materials taken from the earth's crust. Most pure metals are modified by combining them with other metals to improve their properties. The modified metal is called an alloy. Metals are either ferrous or non-ferrous:

- Ferrous metals have iron in them.
- Non-ferrous metals have no iron in them.

Plastics

Most plastics are produced from oil, coal and natural gas. Usually they are called polymers. There are two types of plastics:

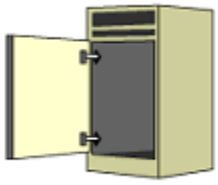
- Thermoplastics can be softened by heating, and then shaped or moulded.
- Thermosetting plastics cannot be re-shaped once they have been formed.



Timber

Timber is produced by cutting down trees, sawing it up, and drying it out by seasoning. Timbers are classified into hardwoods and softwoods:

- Hardwoods come from broad-leaved trees that have seeds in fruit or nuts, e.g. beech, oak, mahogany.
- Softwoods come from trees with narrow leaves and seeds in cones, e.g. Scots pine, cedar.



Modified timber

Modified timber products are made in factories, using natural wood and adhesives. Usually the wood is the waste from saw mills, such as sawdust or small branches that cannot be converted into planks. They are produced in large boards such as:

- chipboard
- blockboard
- plywood
- medium density fibreboard (MDF).

How to describe materials in terms of their properties

First a designer should think about the properties of materials. Sometimes these are called the characteristics of materials. The designer will ask questions such as:

- Does the material need to be light or heavy?
- Should it be flexible or stiff?
- Should it be waterproof?
- How strong must it be?
- Are colour and texture important?
- What sort of finish is needed?
-

For a checklist of the properties of materials look at the Revision Bite: *Properties of materials*. The list gives you all the words you need to know when describing the properties of a material.

Choosing materials

When choosing a material a designer needs to think about:

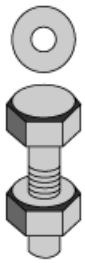
- how the finished product will be used in real life
- how the product will be manufactured
- the availability and cost of the materials
- the environmental impact of extraction, manufacturing, distribution, use and disposal of the product.

Fabrication

Most products are made from more than one piece of material. The process of putting them together is called fabricating.

- Permanent joints are intended to stay put. Use adhesives (glue), nails, rivets, or one of the heat processes of soldering, brazing or welding, for a permanent joint.

- Temporary fixings usually involve something using a screw thread - screws, nuts and bolts, or one of the many knock down fixings on the market.



Nuts and bolts

Adhesives

There are many types of adhesives to suit different materials. When you are choosing the most appropriate adhesive for your product you will need to consider:

- the type of material
- the strength of the bond required
- the environment the product will work in, e.g. if you are gluing timber for outdoor use don't use polyvinyl acetate (PVA), because it is water soluble.

Double-sided tape will join almost anything to anything. It is not just a Blue Peter product. It is widely used in industry, for example, many parts of aircraft are held together with double-sided tape!

Activity

Make a list of all the adhesives in your school workshop using their trade names. Ask your teacher or technician which sort of adhesive each of them is.

Assembly jigs

Manufacturers use assembly jigs to hold components in place while they are being joined. For example, the parts of a steel roof frame can be put into the jig and then welded together.

Joining wood

There are numerous methods of joining wood. Which one is used in manufacturing will depend on the function of the product. For example,

- joints
- gluing
- edging
- screwing
- nailing.

Check out the Revision Bite: *Joining wood* for a more detailed breakdown of the different types of joints.

Joining metal

There are several ways of joining metal permanently. Look at the Revision Bite: *Joining metal* for more details on:

- soldering and brazing

- welding
- riveting.

Joining plastics

Often plastic products are moulded so that they just snap together. If you have to make a permanent joint use adhesive or rivets.

Plastic weld is a multi-purpose plastic adhesive that joins most types of plastics, however, do not use it on foamed plastics.

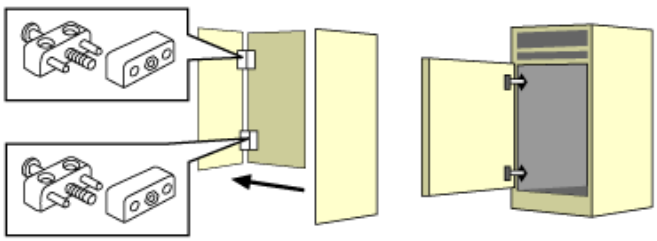
Tensol 12 is good for acrylic. It is quick and easy to use. But if spilt it marks the work. It is not very strong.

Tensol 70 is much stronger. It is acrylic based. It comes in two parts. It is not easy to use, as it takes 1.5 hours to harden and contracts.

Nuts, bolts and machine screws (see below) can be used for joining plastics. Use brass or stainless steel if you want a smart finish.

Knock-down joints

Much furniture is sold in flat packs. This makes it easy to transport and store. The customer then has to assemble it at home. Usually knock-down fittings are used. Sometimes these are called KD fittings.



Knock-down joints (a bloc-joint fitting)

- Frame connectors are used for table frames.
- Box joints are formed with corner blocks or bloc-joint fittings. Usually these are made from a plastic (often nylon).
- Nuts and bolts come in all shapes and sizes.
- Locking nuts have an inner, nylon ring. This has a thread cut into it by the nut as the two are tightened together. This helps to stop it working loose.
- Machine screws are a different shape from wood screws, which have a tapering core. The thread of a machine screw goes right up to the head. Machine screws are normally smaller than bolts. A machine screw has to go into a hole which is the right size and which has the right internal

thread.

- Self-tapping screws are made from very hard steel. They cut an internal thread as they are screwed in.
- Washers are used to protect the material when the bolt is tightened. Spring washers help to prevent joints from working loose when there is vibration.

Self-tapping screws