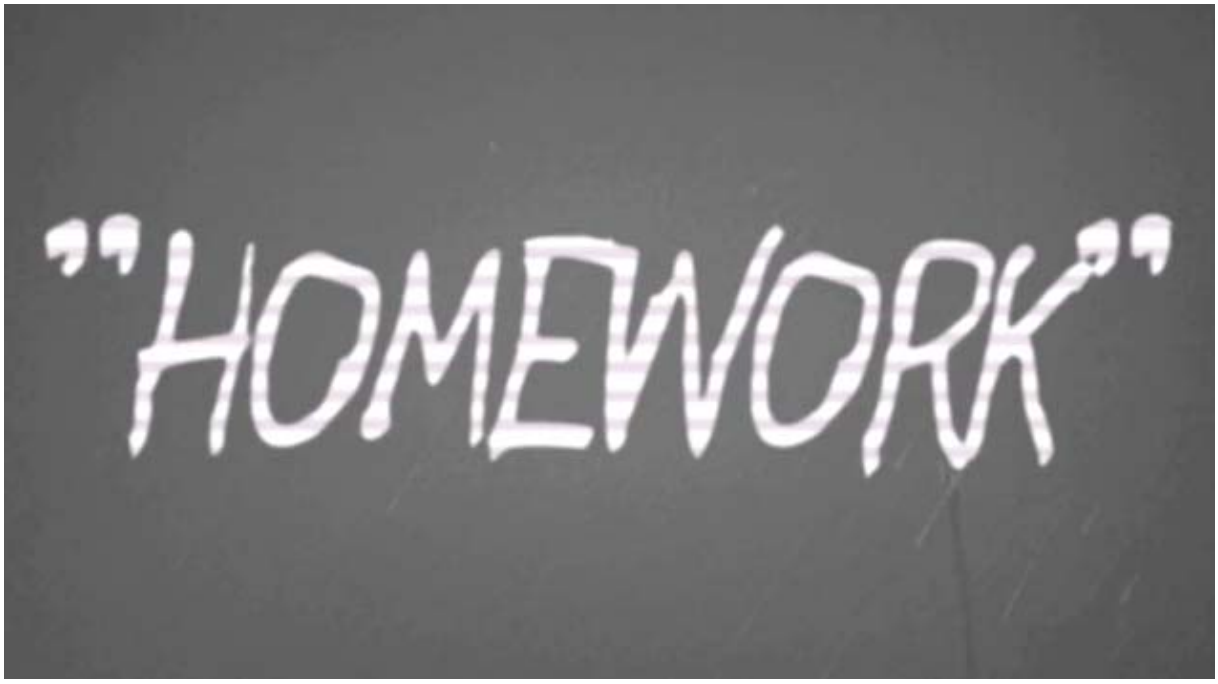
Coltness High School
Technical Department

craft



design

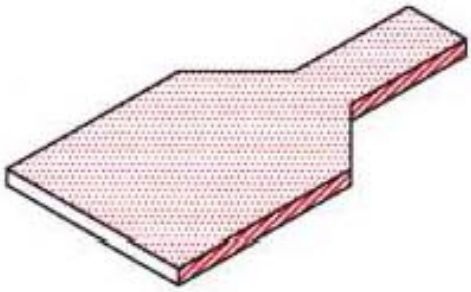
S4 Revision and Assignments 2
Commercial Production Methods

COMMERCIAL PRODUCTION

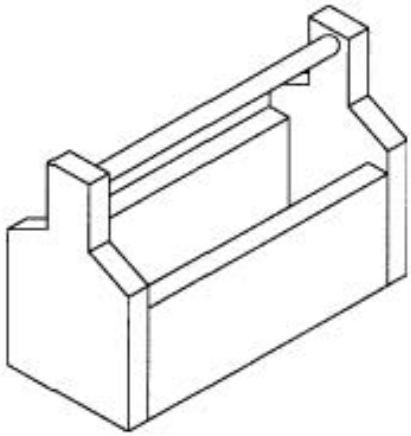
Most products are produced in large numbers, each being identical to the planned design. Dimensional accuracy is very important, especially when parts have to fit together. When a product is being handmade as a one-off, a common cause of error is incorrectly measuring when using a ruler. When a product is produced by mass or batch production methods, the need to measure using a ruler is removed by the use of **Templates** and **Jigs.**

TEMPLATES

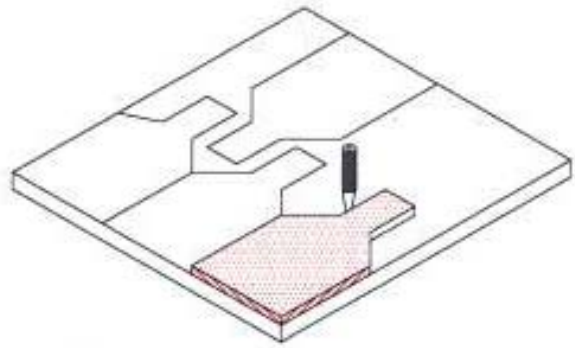
A template is an accurately formed shape, made from a rigid material. The template can be drawn around or followed repeatedly without wearing.



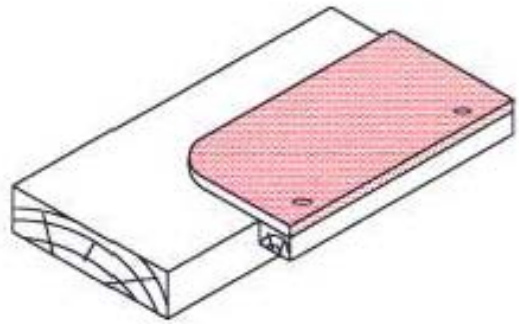
A template made from hardboard, used to mark out the ends of a bottle carrier.



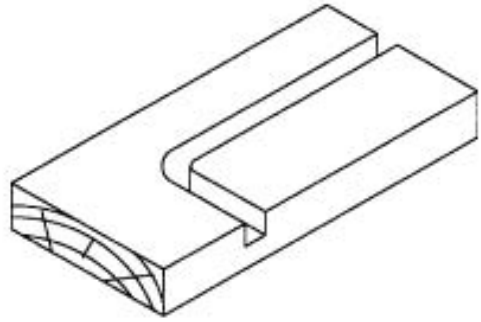
The template can also be used to save on waste when marking out a number of identical shapes on a sheet of material. When the shapes are drawn linked together, they are said to be **tessellated**.



Templates can also be used during the production process to guide a cutting tool.

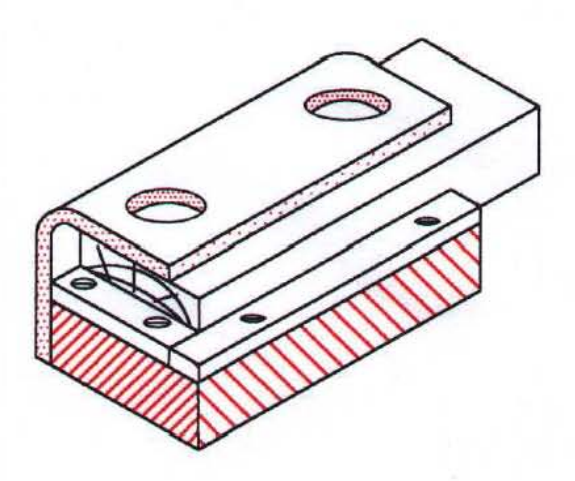


A plywood template can be used to guide the cutting of a groove, using a router.

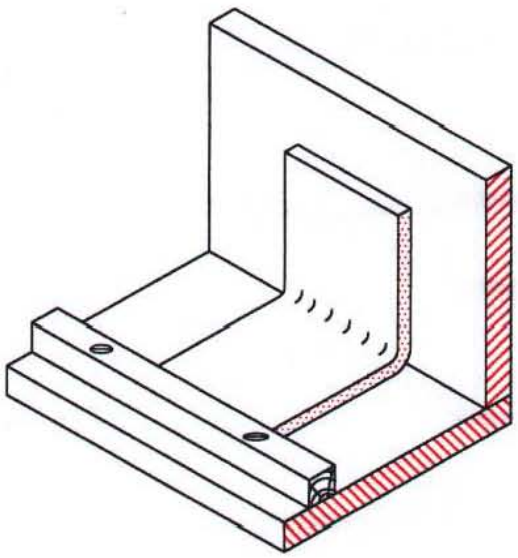


JIGS

Jigs are used to ensure that dimensions are always accurate. They are particularly useful when the positioning of holes and bends are important. They are designed so that they either hold the workpiece in the correct position or guide the cutting tool into the correct position. It should be possible to line up the jig with the workpiece and clamp them together to stop slippage.



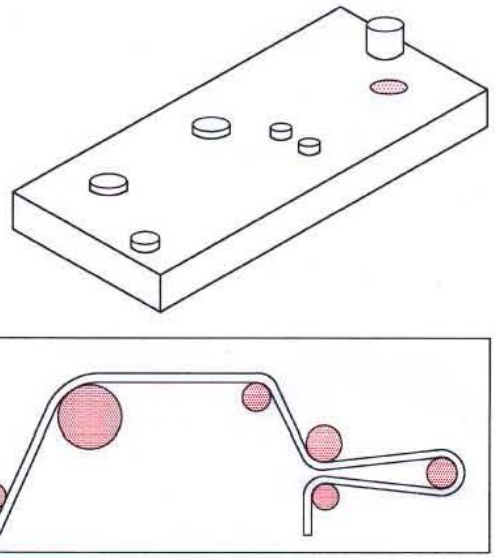
A school-made jig for lining up holes when making dowel joints.



A jig for bending heated plastic sheet in the correct position every time.

KEY WORDS Template: Tessellation: Jig:

Below is a jig used for bending steel rod to make junior hacksaw frames. The jig is made from mild steel. The pins are removable to allow the rod to be bent into position. The pin for the end of the handle is shown removed from its locating hole.



The completed frame

1. Give an example of when dimensional accuracy is important.
2. What is a common cause of error when products are handmade?
3. Describe a template.
4. Show a template being used to draw tessellations (draw your own example).
5. Apart from drawing shapes, what else can a template be used for?
6. Why is a jig used?
7. Give two examples of what a jig can be used for.
8. What can happen that stops a jig being an accurate guide?
9. Why are some pins removable in the junior hacksaw frame bending jig?
10. What material is the hacksaw frame bending jig made from?

A. Design a jig to line up the hole used to locate the handle in the ends of the bottle carrier. (shown in the first column). Show how the jig will locate with the end piece and be held in place. Name the materials used for the jig.

B. Design a jig, or jigs to allow the correct bending of sheet acrylic to produce the recipe holder shown.

Height 200mm
Width 180mm
Depth 200mm

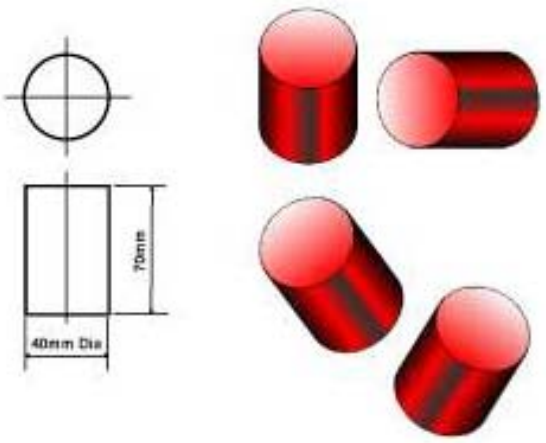
CAD/CAM

CAD/CAM stands for **Computer Aided Design / Computer Aided Manufacture**. This is the process whereby the product is designed using a computer, and the machines used to make it are controlled by a computer. Drawings and instructions written on pieces of paper are not required.

Computer Aided Design

Computer programs can be used to draw accurate, scaled drawings of the design of a product in both 2D and 3D.

In 2D, dimensions can be added automatically and drawings of parts that are used a lot, such as nuts & bolts can be inserted like clip-art, from a drawings bank. In 3D, rendering (colour & texture) can be added as well as highlighting and shading. The view can be made to twist and turn so that it can be viewed from any angle.



In industry, powerful programs can be made to animate moving parts and to work out the forces that the part will have to stand up to, so that it does not break in use. This can save hours of testing prototypes.

Advantages

Some of the advantages of using CAD are:

- Faster accurate drawing
- Drawings of common parts can be inserted from a drawings bank
- Changes can be made quickly and easily
- Dimensions can be added automatically
- Printouts can be to any scale In 3D, the object can be viewed from any angle

Disadvantages

Some disadvantages of using CAD are:

- The cost of the computer and programs
- Early ideas are recorded faster by sketching
- A pad of paper and a pencil can be used anywhere

Computer Aided Manufacture

Computers can control cutting machines such as drilling machines, lathes, milling machines etc. The computer controls the movement of the cutter very accurately (accuracy to 500th of a millimetre is possible).

In the CAD/CAM system, data from the CAD drawing is downloaded to the CAM program which is then used to control the cutting machine.

A computer can also be used to control the handling of the parts to be cut from one machine to another.

Computer controlled fabrication (joining parts together) is also possible. Parts can be automatically held together in the right positions, while they are welded, riveted or glued by computer controlled equipment.

Injection moulding, compression moulding, vacuum forming and extrusion of plastics can all be done by computer controlled machines.

Advantages

Some of the advantages of using CAM are:

- Very accurate work
- The machine does not need breaks
- The machine does not get tired and inaccurate
- Changes of design can be made quickly

Disadvantages

Some disadvantages of using CAM are:

- The cost of the computers and programs
- The high cost of the machines
- The loss of jobs

KEY WORDS CAD: CAM: 3D: 2D: Animate: Commercial Production

1. What does the term 'CAD/CAM' stand for?
2. State **two** things that can be done when drawing with a CAD program that cannot be achieved when drawing on paper.
3. List **three** advantages of using CAD.
4. List **two** disadvantages of using CAD.
5. What else can an industrial CAD program do as well as draw?
6. Name **four** machines that a CAM program can control
7. How accurate can a computer controlled cutting machine be?
8. Name **two** processes other than cutting, that can be carried out by computer controlled machines.
9. List **three** advantages of using CAM, rather than human controlled machines for manufacture.
10. List **two** disadvantages of using CAM.

A. Manufacturers of DVD systems, computers and TVs, etc. can change their models every month. Explain what part CAD/CAM plays in this rapid turnover.

RECYCLING

Recycling is processing old material to make it good enough to be used as new, e.g. melting down used aluminium drinks cans so that new cans can be made without using fresh aluminium. Sometimes the old material is added to the new. Most 'new' steel contains up to 40% melted scrap steel.

Plastics - most thermoplastics can be recycled, e.g. 'PET' used for fizzy drinks bottles is recyclable. Thermoset plastics are not recyclable.

Metals- Pure metals can be recycled. Alloys can only be effectively recycled if all the scrap is the same alloy.

Wood & Ceramics- are not recyclable.

Products that are made of material that can be recycled will normally display the three arrow symbol on the label.

Recycling is part of the government's drive to reduce the amount of waste in this country. The aim is to reclaim and re-use as much material as possible. However, this is not always possible, some materials e.g. ceramics, cannot be recycled, but can be used for other purposes, e.g. old ceramic products are used as hard-core, a layer of broken ceramics and bricks, onto which concrete is poured to make pathways, etc.

The government's policy can be called the '4Rs' policy.

Reduction - Reduce the production of waste in the first place.

Re-use - Clean and re-use products, e.g. bottles.

Recover - Recycle paper, glass, cloth, steel and aluminium, etc.

Remove - Remove as little as possible and try and gain energy from burning the waste or collecting methane gas from a landfill site.

Life Cycle Analysis (LCA) This analysis process involves collecting data at each stage of the manufacture and use of a product, from the extraction of the raw materials, to the problems it produces when it is thrown away at the end of its life. The data is about:

1. The cost of getting the raw material e.g. digging metal ore from the ground.

2. The cost of converting the raw material into a usable material, especially how much energy was used (electricity, coal, gas or oil).

3. How much recycled material was used in making the product.

4. How much time, energy and waste was involved in each making process.

5. How much material, time and energy was used in packaging the product and distributing it to the shops.

6. How easily it can be disposed of safely, or used for recycling at the end of its useful life.

LCA can be applied to the manufacture and use of a computer.

The aims of responsible manufacturers are:

A) To reduce the amount of energy used in manufacturing the product.

B) To make a product that lasts a reasonably long time.

C) To make it as recyclable as possible when it is worn out, or out of date.

Recyclable packaging

1. What do you understand by the term 'Life Cycle Analysis'?
2. How would you identify a responsible manufacturer?
3. What is the difference between the terms 'recycled' and 're-used'?
4. A clear glass jam jar is to be recycled. What would you expect to happen to it?
5. What is the government's policy about reducing waste and energy use?

A. Identify **four** products that are used at home that could be recycled. Say what they are for and what material you think they are made from.

B. Identify **four** products that are used at home that could be re-used, either for their intended use or for an alternative use. State how they could be re-used.