FACTFILE:

GCE TECHNOLOGY & DESIGN

1.1 MATERIAL SELECTION: PART 1

Rewarding Learning

Material Choice and Selection: Part 1

Learning outcomes

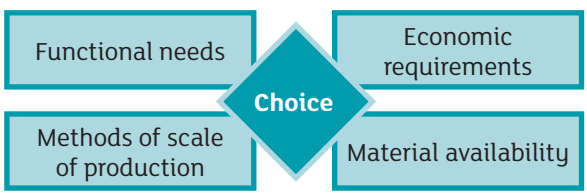
Students should be able to:
Consider the following when selecting a material

- Functional requirements (properties and characteristics);
- Manufacturing demands (scale of production and suitability of manufacturing process);
- Environment (corrosion resistance and stability);
- Availability (common form and sizes);
- Cost; and
- Appropriate joining techniques

Course content

Selecting the correct material can often be the most important decision to be made. Materials provide the aesthetic quality and properties of a product. The three main considerations when selecting a material are:

1. Will they meet the performance requirements?
2. Will they be easy to process?
3. Do they have the correct aesthetic properties?



Functional Requirements

Choosing materials has become problematic due to the extensive range of materials that are available. Many materials can be adapted to possess properties that make them more versatile.

Ideally, materials used in products should be perfectly suited to the function of the final product. The following properties or requirements might be taken into account when choosing a material:

- Hardness
- Rigidity
- Weight
- Flexibility
- Buoyancy
- Colour or texture
- Environment
- Stability

Economic requirements

Correct costing and forecasting is fundamental in the manufacture of any product, not only in the initial cost, but also in the working and processing of them. i.e., machining, joining and finishing. Any wastage must be considered in the original costing.

Other costs incurred in the production of a product include time, labour costs, repair and servicing of machinery and electricity. If new parts or components are to be produced, the workforce might require additional training.

The choice of material can determine the quality of the final outcome. Quite often expensive materials can be justified, due to the fact that they are easier to machine, process or work with.

If for example, we look at the area of seating, we can see how a range of materials can be used depending on the target consumer and the purpose of the seat, whether it be for public or private use and whether it is to be used indoors or outdoors.

The photograph shows public seating that has been designed for people to sit for short periods. The mild steel has been painted with a corrosive resistant red paint to prevent rusting. The arm rest and slight curve suggest that ergonomics have been considered.

The wooden seating for five people has been designed for indoor use. It possesses a modern and functional design and incorporates materials that will guarantee lasting aesthetic appeal. The stainless steel feet and legs would be expensive to produce and it is apparent that ergonomic comfort has been sacrificed.

Whilst the next three forms of seating are very different, they have all been designed and produced for the same purpose, aesthetic appeal. The materials have been selected because of the quality of finish and working properties.

The carver chair includes intricate woodworking and is finished with a high gloss protective varnish, whilst maintaining a correct posture for the consumer, reflecting ergonomic design.

The egg-shaped seat is a car seat for a child. The orange lining is soft, providing comfort, whereas the exterior is a tougher plastic, ABS, to guarantee durability and toughness.

Manufacturing Demands

Products are manufactured using different processes and at different scales of production dependent on consumer demand. Common types of manufacturing processes include continuous production, mass production, batch production and one-off production.

In the examples given above, the recliner and carver seats are likely to have been made in small batches whilst the child car seat would have been mass produced.

Material availability

Most types of materials are available from suppliers in standard forms, shapes and sizes. Standardisation has affected the size and materials quality.

Use of non-standard materials or sizes of materials is likely to increase the cost of raw materials.

- Wood tends to be supplied in standard sizes of sheet, plank or rod (dowel) form.
- Metals are supplied in standard sizes of sheet, plate, box section, tube, rod, coils of wire etc. (The metals factsheet supplies more information on this)
- Plastics are supplied in sheet form, rod, tube, block etc.

Appropriate Joining Techniques

Different materials can be joined in different ways depending on what the materials are made of and whether the joint needs to be permanent or semi-permanent.

Permanent: once this type of joint has been constructed, it cannot be reversed without causing damage to the material/product. Permanent methods of joining include:

- Welding – for joining metals by the use of heat, causing the 2 main pieces of metal to become molten and using a joining material to mix them before they solidify, forming a permanent, strong joint.

- Brazing – permanently joining metals such as copper and steel under heat using a rod made of an alloy of copper and zinc.
- Soldering – a similar method to brazing but carried out at lower temperatures
- Riveting – using metal pins that are placed through two metal sheets or plates and then hammered flat to join the two elements together.
- Adhesives – joining materials with glues that are generally invisible. Unlike other methods of joining, adhesives include PVA, Contact Adhesive and Epoxy Resin.
- Frame joints – for joining wood; common examples include butt joints, halving joints, mortice and tenon joints and dovetail joints. Note that these are normally used in conjunction with suitable wood adhesives.

Semi-permanent: this type of joint can be disassembled without damaging the materials. Semi-permanent methods of joining include:

- Screws, nuts, bolts and washers – used to hold two or more pieces of materials together in a semi-permanent method of joining.
- Snap joints – used for joining moulded plastic components
- Knock-down fittings – joining materials with screws and plastic or wooden corner blocks; predominantly used in self-assembly products such as 'flat-pack' furniture.

Revision Questions

1 With the aid of detailed sketches, suggest appropriate improvements for the following:

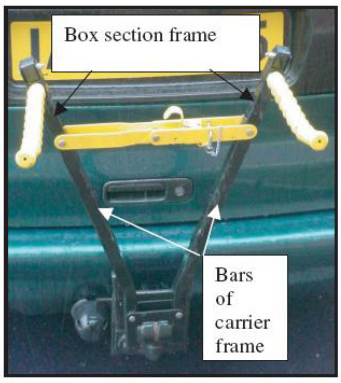


Fig. 1

Fig. 2

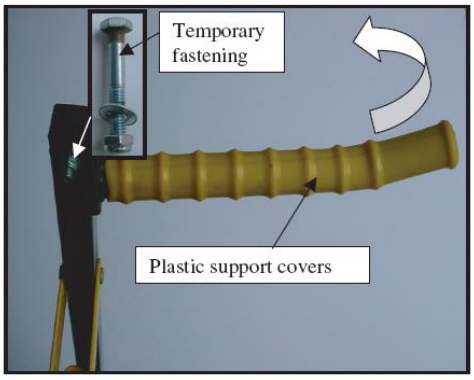


Fig. 3

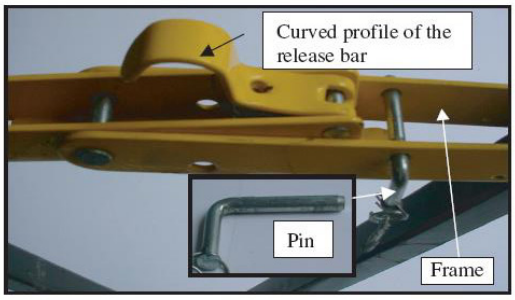


Fig. 4

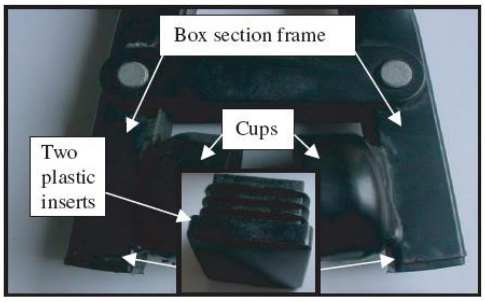


Fig. 5

i) Design an adjustable pad or block that can be quickly positioned and secured to the bars of the carrier frame (Fig. 1) to suit different sizes of bicycles and to prevent paint from both the carrier frame and the bicycle being chipped off.

Revision Questions

1 ii) Design a quickly released hand operated design that can be secured to the frame and will prevent the pin from vibrating out. (Fig. 4).

Revision Questions

2 Metals are supplied and used in a range of forms. State four different forms in which metal is available.

1. .....

2. .....

3. .....

4. .....

3 Draw annotated sketches of two types of permanent joint used for joining wooden components together.

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