DESIGNING AND MAKING PRINCIPLES

Use this Learning Mate to help you during your NEA and to help you revise and prepare for Section 3 – Designing and Making Principles in your Exam. Take note of any subject specific language used.

1. INVESTIGATION – PRIMARY AND SECONDARY DATA

PRIMARY DATA

Information and Data that are gathered from **Primary Sources** is usually **more specific** to a design task as the investigation can be tailored to the **Design Brief** and/or **Design Specification.**

Primary Sources:

- Interviews - User/Client
- Questionnaires – Target Market
- Focus Groups – Target Market
- Case Studies – Existing Products/Designers
- Product Analysis
- Material Testing
- Observations of Users with Existing Products.
- Important Measurements

SECONDARY DATA

Information and Data gathered from **Secondary Sources** means that the research already exists and was **carried out by someone else.**

Secondary Sources:

- Books
- Magazines
- Websites
- Statistics
- News
- Radio
- Television
- Reviews

MARKET RESEARCH

Gathering **Market Research** is an important exercise in any design process. By conducting Market Research you can find out whether your ideas are **Commercially Viable** and make necessary amendments to your approach to suit the needs of the **User.**

INTERVIEWS AND QUESTIONNAIRES

Asking questions in the form of a **focus group** allows you to gather as much data as needed from a range of people. You may need to conduct a few interviews throughout the design and manufacture of the product. Focus groups are often recorded, **getting the user group to interact with prototypes** or the finished product to gain an insight into how people use products differently.

PRODUCT ANALYSIS

This involves looking at what is already available on the market and critically analysing it to see how it performs **functionally** and **aesthetically** as well as how commercially viable it is. Reviews help pinpoint good and bad points to help steer future designs or developments. Product analysis also gives you an insight into how products are made, which materials are used and how they are finished.

ANTHROPOMETRICS AND ERGONOMICS

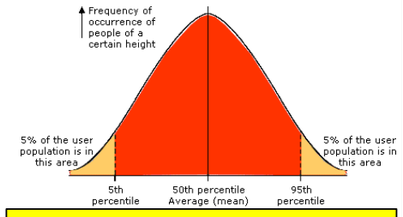
ANTHROPOMETRIC DATA

Anthropometrics is 'The Study of Human Measurements'.

Anthropometric data is used to ensure products and environments are the correct size for the intended users.

Anthropometric Data is split into 3 categories, **The 5th (smallest), 50th (mid) and 95th (largest) percentiles.**

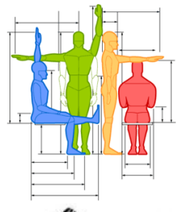
Opposite are examples of where the various percentiles could be used to ensure the maximum amount of people can use the space or product.



5th Percentile – Fire Guard: If the smallest peoples fingers cant fit through neither can the mid or high.
50th Percentile – Public Bench: To ensure it's not too short and not too high for the average person to sit.
95th – Door Frame: If the tallest person can fit through then so can the smallest and mid.

ERGONOMICS

Take a look around your environment now. Everything you can see that is man-made has been designed to fit the end user, from the handle on a coffee mug, to the shape and size of the room you're in. Nothing is accidental.



Ergonomic means that special attention has been given to the design to make sure it is the best possible fit for the user, the environment and the task.

The Dyson Vacuum has been Ergonomically Designed.

- **The handle is designed so the average hand can hold the vacuum firmly and comfortably to minimise the risk of dropping it.**
- The trigger is in the optimum position for your index (main) finger.
- **The weight is distributed near your hand to make it easier to move.**
- The vacuum is cordless which allows you to reach difficult places.
- **The vacuum has an easy clip system to release and empty the bin section.**
- The design is colour coded. Red shows clips/triggers.
- **The vacuum is easily wall mounted for charging.**
- The vacuum is lightweight so it is easy to carry and change direction

DESIGN BRIEF

A **Design Brief** is written by the designer in consultation with a user/client. The Design Brief should outline the **Problem, Need and Design Opportunity**. The document will outline the deliverables and aim of the project including any aesthetics, function, timings and budget.

Set out your Design Brief in 3 sections:

- **Project Name**
- **Problem/Context**
- **Task and Time-frame**

What is the aim of the Design Task?

DESIGN SPECIFICATION

A **Design Specification** is a list of criteria that your Designs and Final Product must meet in order to be successful.

Your Design Specification points should be carefully thought out and **justified**. This means that you should have research or requirements that back up each Specification Point. Here are a few possible focus areas:

- **User requirements**
- **Aesthetic requirements**
- **Functional requirements**
- **Environment requirements (where the product will be used)**
- **Size requirements**
- **Material requirements**
- **Cost requirements**
- **Safety requirements**
- **Sustainability/Environmental requirements (Environmental Impact)**
- **Ethical requirements**

You will constantly **evaluate your Designs, Models and Final Product against your Design Specification** since this is essentially the **'Success Criteria'** for your whole project.

2. DESIGN STRATEGIES

USER CENTRED DESIGN

User-Centred Design focuses specifically on the wants and needs of the end user. The Client and/or User are consulted at every stage of the design process to gather feedback on how they think the design is progressing. The designer is then able to make modifications going forward to ensure the product's sales are maximised when it is released.

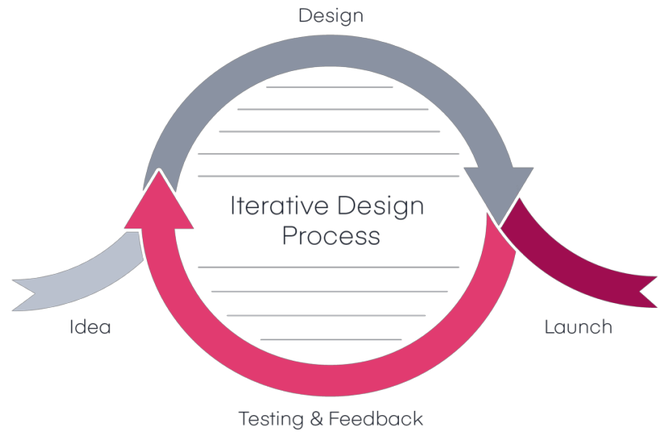
GCSE projects should be User-Centred as the prototype is designed for a specific client or user group. Ensuring the user is consulted throughout the process helps make the final design one that will satisfy the user and be fit for purpose.

COLLABORATION

Working with others is a good way to get ideas flowing. By working in. a 'design team' you can maximise initial ideas. Designers can feed off the ideas of colleagues and inspire others around them.

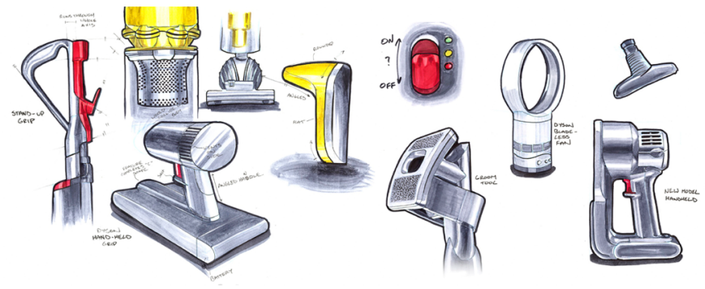
ITERATIVE DESIGN

Iterative Design involves constant refining and development of ideas as new information is gathered. Designing, Prototyping, Testing, Research, Investigations, Analysing and Evaluating are all parts of the Iterative Process and either of these can happen at any stage of the process in order to progress.



SKETCHING

Sketching allows a designer to **get ideas down quickly.** Getting ideas down quickly is important – there is always time later to tidy up and refine them. Sketching should allow you to communicate your idea to others through both drawing, rendering and annotating. Colour can be added to show important features.



MODELLING

Modelling is a great way to **test ideas in 3D** to see if they have any potential. Modelling should be carried out using **cheap and easy to work materials** such as cardboard, clay, straws and other craft-like products. Modelling can also be carried out using CAD. CAD models can be easily rendered to make them look look realistic and also easily modified once feedback has been obtained.

TESTING

Testing involves a range of checks to see if the design/model is suitable to take forward.

Non-destructive Testing: Tests that are carried out until it starts to show signs of failure/breaking. Testing limits.

Destructive Testing: How does the product cope under extreme conditions? This can help the designer select suitable materials to cope under extreme stresses.

Market Testing: The product is given to a user group to see how it performs in use. Feedback is given to help take the design forward.

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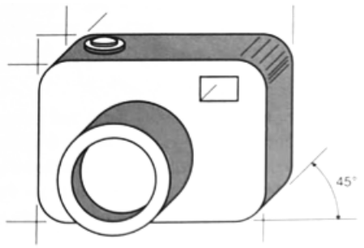
DESIGNING AND MAKING

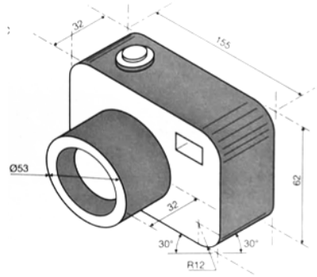
3. COMMUNICATING DESIGN IDEAS

DRAWING TECHNIQUES

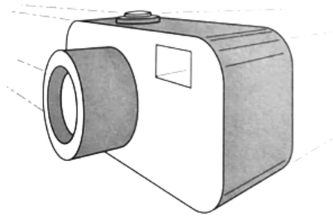
CABINET OBLIQUE



ISOMETRIC PROJECTION



TWO POINT PERSPECTIVE



Cabinet Oblique: Design is drawn from the front in 2D. 45° lines are drawn to show the depth of the product. This is the quickest and easiest 3D drawing technique.

Isometric Projection: Uses 30° lines (parallel) to show the width and depth of a product. The height is drawn with vertical lines. Much more detailed than Cabinet Oblique and can be a quick drawing technique if practiced.

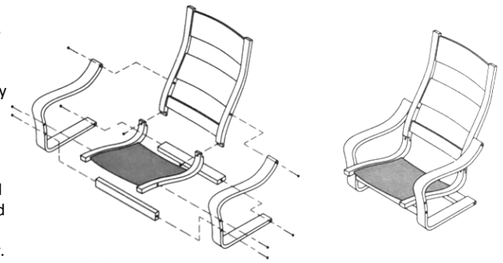
2 Point Perspective: Uses Vanishing Points. The Width and Depth are drawn towards the vanishing points. 2 point perspective is the most time consuming technique but also the most accurate as it emulates how the human eye would view a product.

EXPLODED DRAWINGS

Exploded Drawings: Used to show how a product or components fit together. The paths represent the way the product is assembled.

Exploded drawings are a good way to show components that are usually hidden using standard drawing methods.

Exploded drawings are often used in instruction packs for flat packed products to help the customer assemble the product more easily.

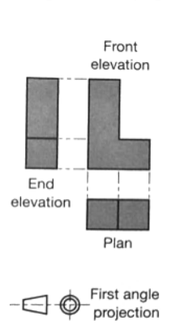


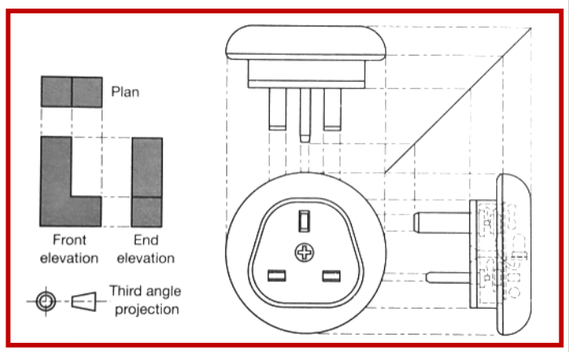
WORKING DRAWINGS

In order for products to be manufactured, a **Working Drawing** is usually produced to communicate the full idea from the most important angles. This usually includes Front, Side and Plan viewpoints. Working Drawings also show **Sectional Views** which allows you to see inside the component if parts are hidden.

The most common types of working drawing are **First Angle Orthographic Projection and Third Angle Orthographic Project.** They use the same format however, the layout of views is slightly different between them.

We most commonly use Third Angle Orthographic Projection in GCSE Design and Technology. A Third Angle drawing of a British plug is shown below in the red box.





4. QUALITY CONTROL AND TOLERANCES

QUALITY CONTROL

In manufacturing, **quality control is a process that ensures customers receive products free from defects and meet their needs.** When done the wrong way, it can put consumers at risk. For example, the recent defect found in Takata airbags resulted in the biggest automotive recall in history. The recall includes almost 69 million airbag inflators and may cost billions of pounds.

Major recalls like these can be prevented through effective quality control in manufacturing. Customers expect and demand high-quality products. When customers receive quality products you will:

- **Increase customer loyalty**
- Gain repeat business
- **Gain new customers from referrals/reviews**
- Maintain or improve your position in the market
- **Improve safety**
- Contribute to overall positive branding of your product

Manufacturers with quality control procedures in place are far less likely to face product recalls or place customers at risk from poorly made products.

TOLERANCES

Tolerance is the amount of 'error' that is allowed for a specific component. It is often thought of as a **measurement that is Plus or Minus (±)** a specific distance e.g. ±1mm. In this specific instance, the component would be allowed to be either 1mm longer or shorter than the required measurement. **It can also refer to measurements such as weight, sound, temperature, strength etc..**

During a making activity it may not be possible to achieve 100% accuracy. Therefore an appropriate degree of tolerance needs to be considered so that the product can be manufactured but also perform it's intended function. Tolerances can vary from a fraction of a millimetre to a few millimetres.

In industry generally, the narrower the level of tolerance required, the more an item will cost to produce. It is simply more time consuming and therefore more expensive to make due to the intense Quality Control in place. However, well-made products tend to work more effectively and last longer, so may in the end be better value for money.

A component being manufactured to 38mm (±1mm) could be anywhere between 37-39mm to be within tolerance.

QUALITY SYMBOLS

Many products sold in the UK and in Europe have to meet strict standards. If a manufacturer believes their product meets certain quality and safety standards they might be able to display the following logo's on their product to make it more appealing to consumers and increase their sales.

BRITISH STANDARDS KITEMARK

When you see a product with a Kitemark this means that the British Standards Institution has independently tested it, has confirmed that the product conforms to the relevant British Standard, and has issued a BSI license to the company to use the Kitemark. The manufacturer pays for this service and their product is tested, and the manufacturing process is assessed, at regular intervals.

EUROPEAN STANDARDS

The European Standards symbol (*Conformité Européenne*, meaning European Conformity). Companies are allowed to display this symbol on products if they feel that the product meets certain standards of quality and safety set out by the EU. The product is not independently tested, therefore, it is the responsibility of the company to ensure that the product meets the standards before displaying the symbol.

THE LION MARK

The Lion Mark was developed in 1988 by the British Toy & Hobby Association as a symbol of toy safety and quality for the consumer.

For a toy to display the Lion Mark, the supplier has signed a strict Code of Practice which, as well as covering toy safety matters, demands the highest standards of ethics. This symbol is of great importance to parents who can make decisions based on whether a toy has gone through strict safety control measures before giving it to their child to play with.

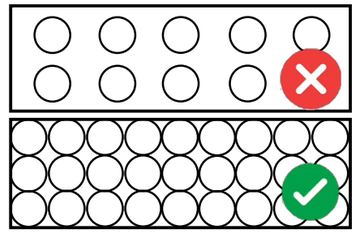
5. MATERIAL MANAGEMENT AND MARKING OUT

PLANNING

MARKING OUT

The key to material management is **calculating how much material is required for a job** whilst **minimising the amount of waste** material produced. The general rule is that you **mark from the edge of a piece of material, not somewhere in the middle.** This means that the remaining material is as large as possible.

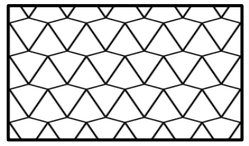
Clustering your marking out close together and arranging pieces to maximise the use of material is essential for cost cutting and saving material waste.



TESSELLATION

Cutting cost and reducing waste a key priorities for manufacturers. The **nesting of similar shapes** means that they can be cut from a piece of material whilst minimising waste.

The process of **interlocking shapes is known as tessellation**. Clever layout planning can make use of waste areas in a sheet material.

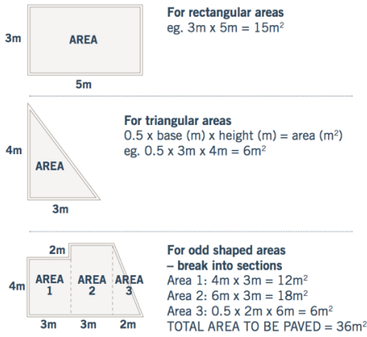


MATERIAL REQUIREMENTS

One of the most important considerations before marking out is to gather the correct amount of material required for the manufacturing process. You must work out the total area needed to manufacture the component or product therefore, knowing the size of each piece needed is extremely important.

The basic area calculation for the size of a rectangular shape is LxW (Length x Width). The area of an A4 piece of paper would be calculated as follows: **L**297mm x **W**210mm = 62,370mm²

Knowing the overall size of the material being used, you can calculate the cost of the material for the parts required plus how much waste will be left over. The waste would still count towards the total cost of manufacturing unless it could be used elsewhere.



6. PRODUCTION AIDS

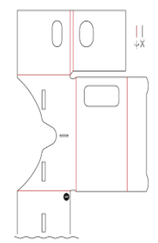
MAKING MULTIPLE PRODUCTS

When making multiple products it is important that all products look and function in the same way. The quality of each product should be the same in order to prevent different users having different experiences. The following production aids are commonly used to ensure the quality and accuracy of each part.

TEMPLATE

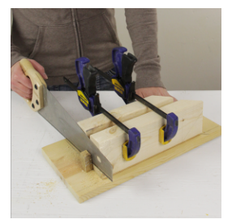
A template is something that can be traced or printed multiple times to ensure each time a part is marked out, it is identical to the last.

Templates for nets are usually produced to ensure the final product can be assembled accurately.



JIG

Jigs are produced to assist in cutting, drilling or routing each component in the exact same place each time without the need for marking out. See cutting jig opposite.



MOULD

A mould is a cavity that molten metals and plastics are poured into. The material will take the exact same shape each time.

DIE

A die is used whilst cutting or extruding a piece of material. The die is a set of blades that ensure the material is cut/extruded into the same shape each time.

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