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T3 Modelling

3.2 Graphical Modelling

**Essential Idea:**
Graphical models are used to communicate design ideas.

**Concepts and principles:**
- 2D and 3D graphical models
- Perspective, projection and scale drawings
- Sketching versus formal drawing techniques
- Part and assembly drawings

**Essential understanding:**
- How graphical models are used to communicate with oneself and others
- How the choice of graphical models varies in relation to the context
- Advantages and disadvantages of using different graphical models

**Nature of design:**
Graphical models can take many forms, but their prime function is always the same—to simplify the data and present it in such a way that understanding of what is being presented aids further development or discussion. Designers utilize graphical modelling as a tool to explore creative solutions and refine ideas from the technically impossible to the technically possible, widening the constraints of what is feasible.
2D and 3D graphical models
A graphical model is a visualization of an idea, often created on paper or through software

Graphical models are used to communicate to oneself and others how a concept will look in terms of form and size. Designers use a range of freehand drawings in the early stages of developing ideas to explore shape and form (3D) and constructional details (2D).

Concept sketching
A spontaneous representation of ideas on paper without the use of technical aids. Used very early in the design process. When designers produce freehand sketches they often include brief notes or annotation to help explain the thinking behind the visual image. Designer will use a range of freehand drawing techniques in the early stages of developing design idea to explore, shape, as well as information about construction, relationship of parts.

Perspective, projection and scale drawings

Isometric
Isometric drawing is way of presenting designs/drawings in three dimensions. In order for a design to appear three dimensional, a 30 degree angle is applied to its sides. The cube opposite has been drawn in isometric projection.

Humans don’t see the world in isometric. Because it is a measured drawing technique everything is drawn to a set
scale. As a result objects close to the viewer are the same size as objects that are far away.

This limitation can create optical illusions, as in the work of Escher.

In the real world, when we look at the world objects that are far away appear smaller. This is called foreshortening.

Look at how the fence posts in the photo appear to get smaller as they go into the distance even though they are the same size. Despite this, the picture looks normal to us since this is how we see the world every day.

This foreshortening is the principle behind perspective drawings.

**One-point perspective**

A drawing has **one-point perspective** when it contains only one vanishing point on the horizon line. This type of perspective is typically used for images of roads, railway tracks, hallways, or buildings viewed so that the front is directly facing the viewer. Any objects that are made up of lines either directly parallel with the viewer's line of sight or directly perpendicular (the railroad slats) can be represented with one-point perspective. These parallel lines converge at the vanishing point.

Lines converge towards a single vanishing point directly ahead. All other lines are either vertical or horizontal.
Two-point perspective
Two point perspective drawings have lines that converge towards two vanishing points that sit on a horizon line.

A few things to note: The horizon line is at eye level. Any objects below the horizon line are lower than eye level and any objects above it are higher than eye level. The object can also cut through or cross the horizon line.

Three-point perspective
Three point perspective adds a third point which creates an extra element of reality to the communicative impact of the object.

Circles in perspectives
The key to drawing circles in perspective is to understand that the circles change their shape. They change their shape in the form of an ellipse which posses a minor and major axis.
Orthographic Projection
Orthographic Projection is a way of drawing a 3D object from different directions. Usually a front, side and plan view are drawn so that a person looking at the drawing can see all the important sides. Orthographic drawings are useful when a design has been developed to a stage whereby it is almost ready to manufacture.

IMPORTANT: There are two ways of drawing in orthographic - First Angle and Third Angle. They differ only in the position of the plan, front and side views.

Click on the image below to watch a video comparing the two different methods

The dominant layout today is 3rd angle projection and is the standard we use in Design Technology. It is the most intuitive layout with the top view above the front view and right view to the right. All orthographic drawing will also include dimensions so that the object can be made.

Scale drawings
The need to scale drawings is when the object is either too large or too small to create. Scale depends on a basic
understanding of ratios so that an appropriate scale/ratio is chosen.

Maps were some of the early drawings that we scaled. By ‘mapping’ landscapes early explorers were able to record the land and sea and make scaled drawing or maps. Topographically maps have large scales i.e. - 1:24 000 because the area they represent are huge.

A scale drawing shows a real object with accurate sizes except they have all been reduced or enlarged by a certain amount (called the scale).

**Example:** if a drawing has a scale of 1:100, anything drawn with the size of 1 would have a size of 100 in the real world. Ratio of scale can go up, 1:100 in the case of large objects, architecture or they can go down, 100:1 in the case of small objects - electronic products.

![Scale plan drawings-Hong Kong Shanghai Bank. Foster + Partners](image)

**Sketching versus formal drawing techniques**

**Sketching**
Designers will use a range of freehand drawing techniques in the early stages of developing design ideas to explore, shape, as well as information about construction, relationship of parts. Techniques might include:

3 point perspective, 2d drawings [front side + top views], exploded views, tone, shade and sometimes rendered perspectives.
**Formal drawing**

These techniques tend to be used in the development phase of the design process. Formal drawings are used to represent a more resolved idea, something that the designer has settled on or wishes to investigate in more detail.

More traditional formal drawings include orthographic projection, assembly drawings / exploded views, isometric and oblique representations.

**Part and assembly drawings**

A **parts drawing** provides the information necessary to assemble a product in a similar way that an assembly drawing does with additional benefit of having a list of parts [LOP] or Bill of Materials [BOM].

This parts list provides detailed information about the part’s material, and the quantity required to assemble the product successfully. These drawings can be specific to engineers who have a specialist knowledge or designed so that they can be used by consumers assembling flat pack furniture.
An assembly drawing shows how parts of a product fit together. They are often used to show how to assemble parts of model kits and flat-pack furniture.

There are two types of assembly drawings:

1. A **fitted assembly drawing** shows the parts put together, and can be drawn in 2D or 3D.

2. An **exploded assembly drawing** that shows the parts separated, but in the correct relationship for fitting together. Exploded views are usually drawn in 3D.

Task
Before scrolling to the next page, think of the contexts when these different graphical modelling techniques are used.

Make a list of the advantages and disadvantages of the following Graphical Modelling Techniques:
• 2D and 3D Freehand Sketching,
• Perspective
• Formal drawing (orthographic)
• Assembly drawings
## Advantages and disadvantages of using different graphical models

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2D and 3D Freehand Sketching, Perspective</strong></td>
<td><strong>2D and 3D freehand sketching, Perspective</strong></td>
</tr>
<tr>
<td>• Quick visual image to generate and develop ideas,</td>
<td>• Cannot manipulate/ handle/ change them</td>
</tr>
<tr>
<td>• Used to convey ideas to clients or consumers</td>
<td>• Rely on the ability of viewer to interpret the model – not the case with a physical model</td>
</tr>
<tr>
<td>• Explain thinking behind the visual image</td>
<td>• Can be difficult to understand by a non-technical audience</td>
</tr>
<tr>
<td>• Promotes creativity</td>
<td></td>
</tr>
<tr>
<td><strong>Formal drawing (orthographic)</strong></td>
<td><strong>Formal drawing (orthographic)</strong></td>
</tr>
<tr>
<td>• Shows in detail sizes of concept</td>
<td>• Time consuming</td>
</tr>
<tr>
<td>• Can be used to construct</td>
<td>• Requires high level of skill</td>
</tr>
<tr>
<td>• Accurate</td>
<td>• Specialist equipment needed</td>
</tr>
<tr>
<td>• Different views of object shown that couldn’t see from a 3D drawing</td>
<td></td>
</tr>
<tr>
<td><strong>Assembly drawings</strong></td>
<td><strong>Assembly drawings</strong></td>
</tr>
<tr>
<td>• Can show how the product is assembled – show how it works</td>
<td>• Very difficult to produce, time consuming and therefore expensive</td>
</tr>
</tbody>
</table>