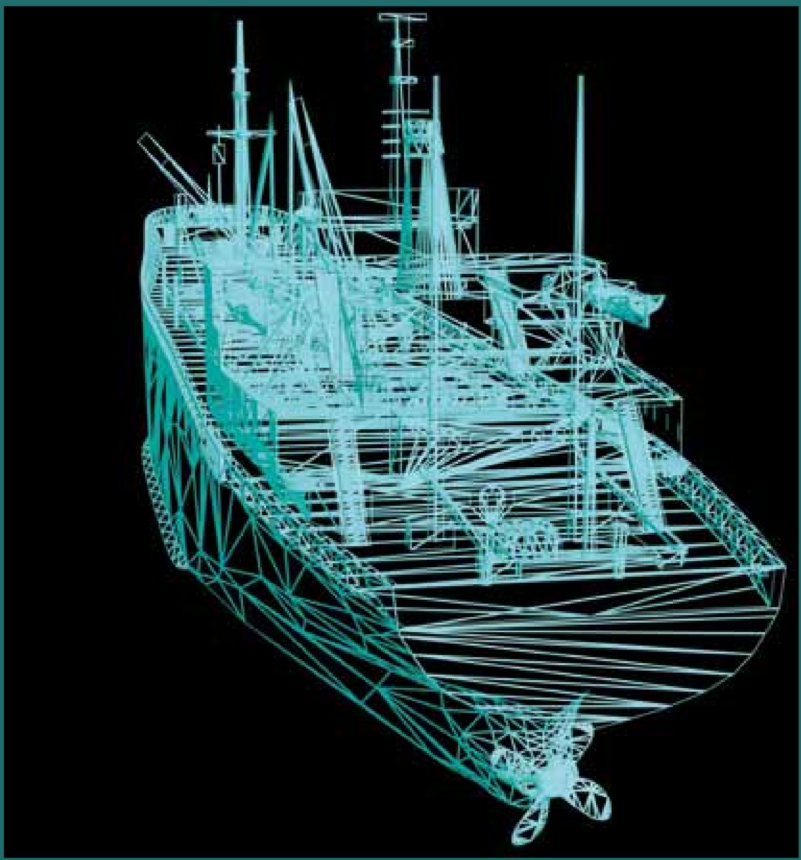
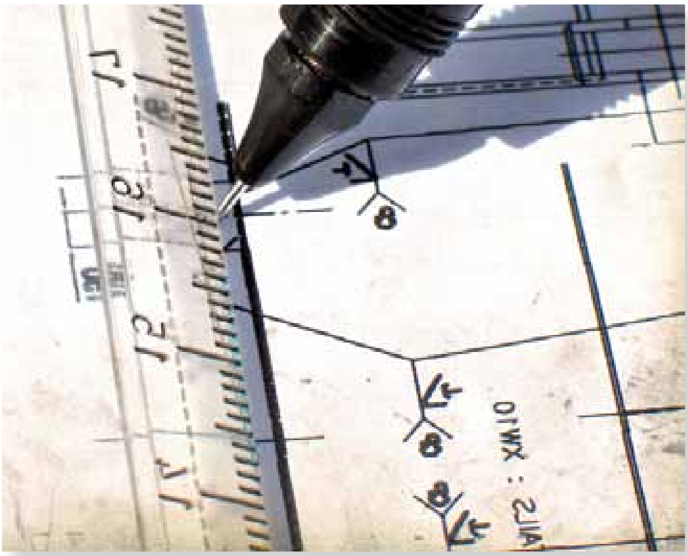
Drawing:
technical drawing



Introduction

Humans have always used images to communicate. Cave paintings, some of which are over 40,000 years old, are the earliest example of this artistic form of communication.



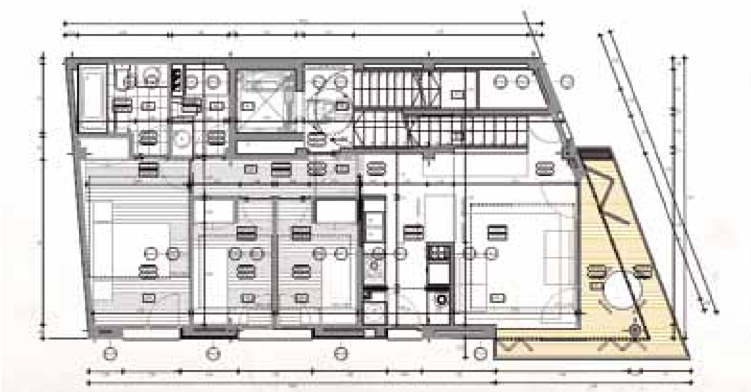
These paintings usually represented aspects of everyday life: stars, animals, hunting, etc. and were drawn on the walls and ceilings of caves. Cave paintings could also have magical connotations. For example, some villages believed that drawings of women with large breasts ensured fertility, while other drawings were of dances or rituals to favor hunting.

Throughout history, this artistic expression has evolved, giving rise, on the one hand, to artistic expression and, on the other, technical drawing. Artistic drawing is a way of freely expressing sensations, emotions, or a vision of the world, whereas technical drawing tries to display reality in the best way possible. Therefore, we define technical drawing as a system to represent objects, devices, or installations in a totally objective manner, trying to represent the shape and size as exactly as possible.

Fundamentals of technical drawing

Guidelines

Guidelines are a series of rules that dictate how plans should be drawn up. To ensure everything works properly, guidelines have to be followed as though they were traffic rules.



Symbols always define a specific element and describes how it relates to other elements.

Standardization

Standardization is defined as the definition and application of standards to the characteristics of an object or an industrial project, and its manufacture and production.

Objectives of standardization

1. The reduction of costs: the cost of the final product is reduced for several reasons:
   - Because the same product can be used by different manufacturers.
   - Because standardization can combine the transportation and storage of the product.

2. Elements that have been previously manufactured to the same standards can be reused, thereby simplifying the designs of new products.
3. It increases the quality of the future product, guaranteeing is it constructed well and ensuring it works properly.
4. It guarantees spare parts are available.

Drawing an object

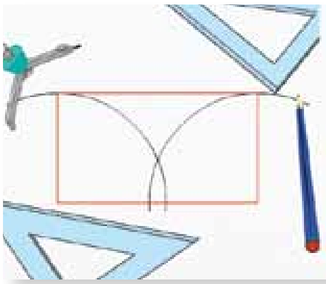
Drawing materials and tools

- Paper
- Pencil or propelling pencil
- Ruler
- Compass
- Angle based and side based set squares
  - Side based set square: this is an instrument for technical drawing formed by an isosceles triangle with one angle of 90º and two of 45º.
  - Angle based set square: this is an instrument for technical drawing formed by a scalene triangle with angles of 90º, 60º, and 30º.

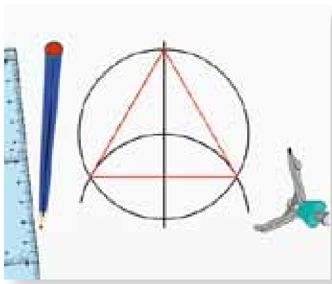
Basic geometric shapes

The basic geometric shapes are:

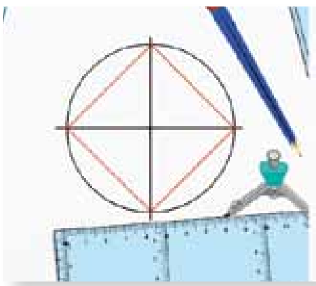
Circle



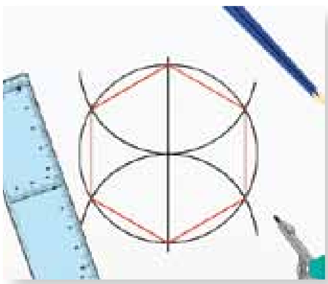
Rectangle



Triangle from the radius



Square from the radius



Hexagon from the radius

Circles, triangles, squares, rectangles, and **hexagons.**
Excepting circles, all the other shapes can be drawn in two different ways: from a radius or from the side.

Scale

As we have already seen, technical drawing enables us to represent the reality that surrounds us or design new objects, like chairs, that can then be built. However, we can't draw things at their real size. We need to make them bigger if they are very small or make them smaller if they are too big. This is why technical experts use something called a scale.

A scale is the ratio between the size of a drawing and the life size object.

$$\text{Scale} = \frac{\text{size of the drawing}}{\text{real size}}$$

Reduction scale.

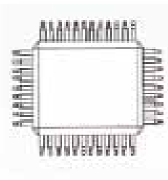
Reduction scale

Obviously we can't draw life size plans and drawings because they wouldn't fit on the piece of paper! However, we still need to draw objects in a way that allows everyone to understand the real size of each object so everything fits together perfectly. For example, when designers at NASA design rockets, they have to use the reduction scale because the drawings are smaller than the objects in real life.

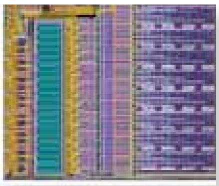
Enlargement scale

But what happens if the object is too small to draw at real size? In these cases the scale must be enlarged so the object is bigger than in reality. For example, the people who design computer chips use this type of scale.

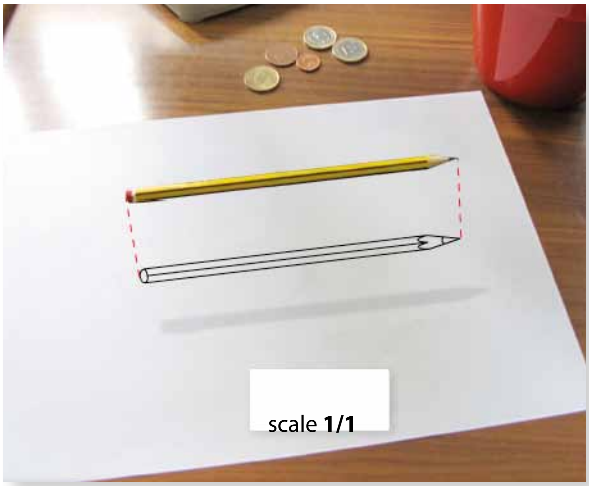
1:1 scale



10:1 scale



1000000:1 scale



Full scale

If we can draw an object at its real size then we refer to full scale. This scale has a ratio of 1/1 or 1:1, as one unit of the drawing is equal to a unit of reality. For example, a pencil.

Drawing a plan

Sketches

We can define sketches as freehand illustrations, without using a ruler, set square, etc., which provide an impression of the object's design, with proportions that are more or less true to life. A sketch can also have titles and notes that explain how the pieces will fit together in the case of an object, etc.

Sketches are usually made by using a soft pencil (HB o 2B), an eraser, and a sheet of paper.

Some tips for drawing sketches: use soft pencils, slightly tilt the pencil when you draw, use the edges of the paper as a reference to draw horizontal and vertical lines, which will help you draw lines in a single stroke.

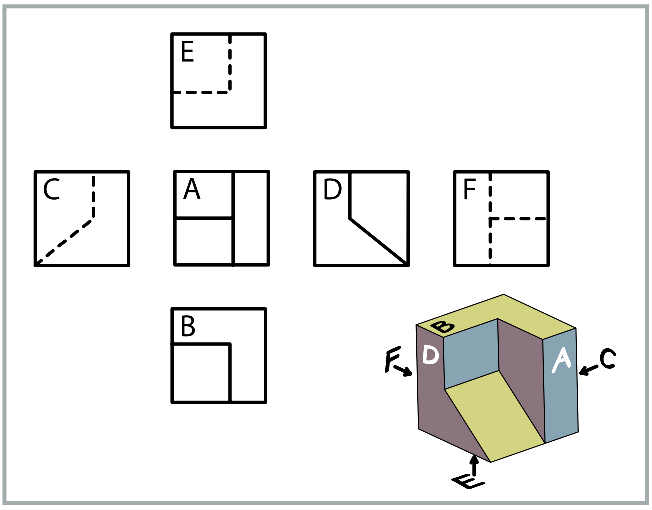
Diagram

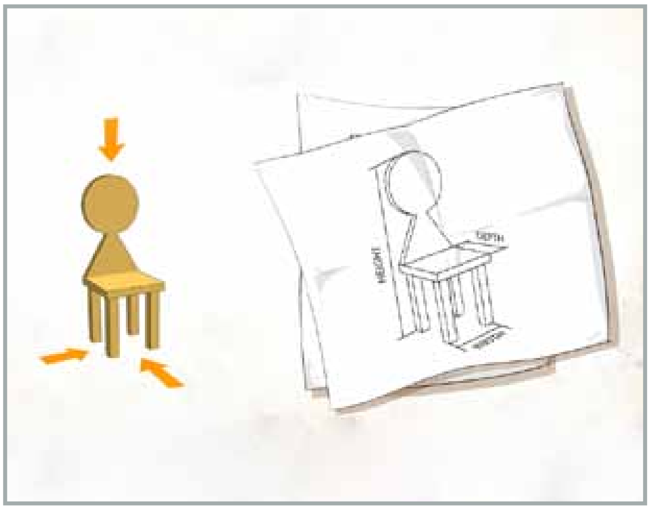
Like sketches, diagrams are drawings that represent different views or projections of an object in proportions more or less true to life. However, drafts also include what we call annotations, which are written at the side and describe the real measurements of the object.

Views or projections

A three-dimensional object has 6 views or projections: seen from the front, from behind, from either side, from above, and from below.
Take a look at the cube: the front view is in the middle, the lateral views (side views) are right next to it. The position of the top or bottom view depends on how we're looking at the cube (from above or below). Although objects have three dimensions, you don't always have to draw them from 6 different angles. There is usually sufficient with less, especially in the case of symmetrical objects, as there is a correspondence between the dimensions of the different views we have drawn.

- The front view, the top view, the bottom view, and the rear view all have the same width.
- The front view, the right side view, the left side view, and the rear view all have the same height.





Describing an object

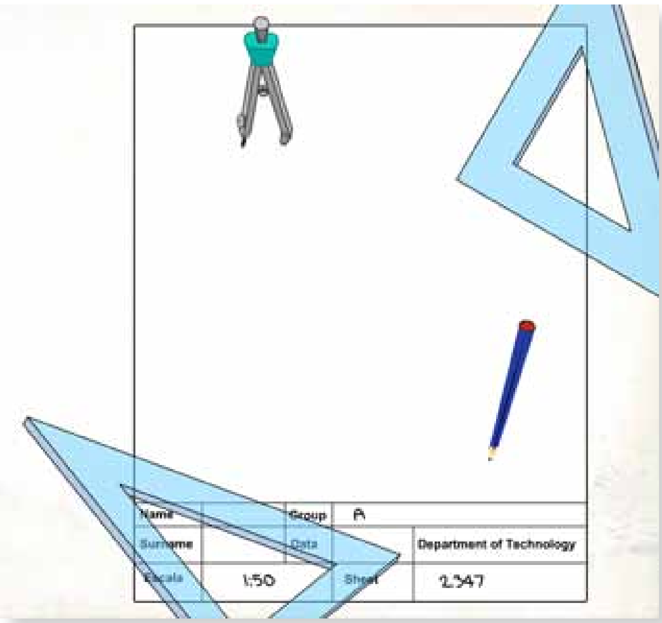
Another way of specifying height, width, and depth is to draw a representation in three dimensions (3D) on a sheet of paper, where we can write all the necessary measurements so we can build it afterwards: the height, the width, and the depth.

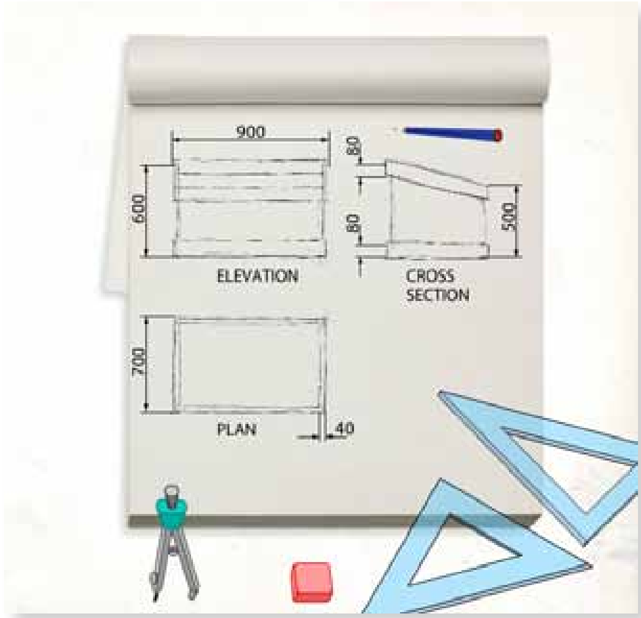
Dimensioning

Notation is the process of annotating the exact measurements of the object on the drawing by means of arrows, lines, numbers and symbols, following a series of established standards.

Plans

Once we have drawn all the views and we have defined the real measurements of the object, we have to draw up a plan. This is the last step before building an object, and the final technical drawing we will give to the builder!





Plans are illustrations that correspond exactly to reality. They are drawn to scale by means of drawing instruments (set squares, ruler, compasses, etc.) and they always display the views that are necessary, as well as the real measurements of the object.

We must never draw plans in a hurry. We have to follow a series of very precise, standardized steps, so any technician will know how to build the object we have chosen, for example, an aquarium for terrapins.

1. One, find all the drawing instruments you're going to need.

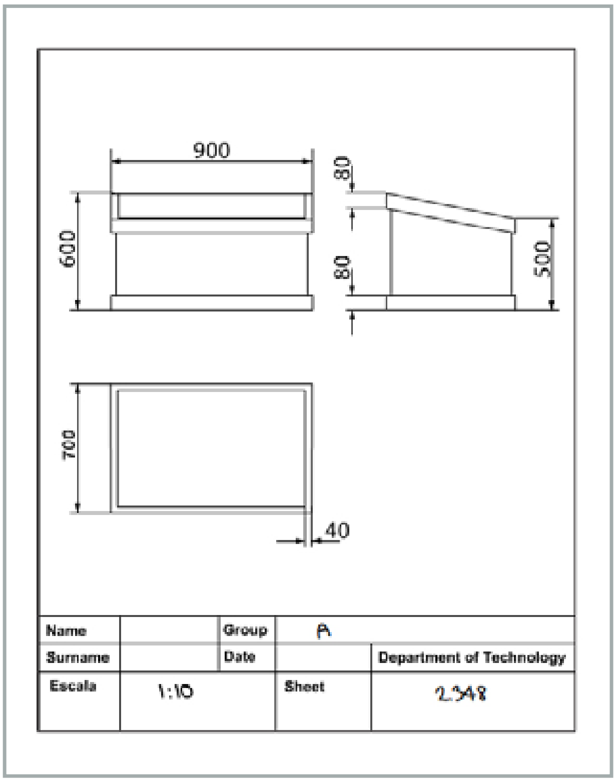
2. Two, we need to make a sketch of the object to get an idea of how we're going to draw up the plans. To do this, we need to look carefully at all the views and choose the one that provides us with the most information. This is usually the front view, also known as elevation. The object seen from the front!

3. Three, using the front view, we can draw the top view, the object seen from above. Usually, the front view and the top view must be about 30 or 50 millimeters apart.

4. Four, we can now draw the side view, also by using the front view. Remember to set it 30-50 mm from the other drawings. As you can see, all the projections are drawn next to the front view, and, evidently, they must all be lined up and drawn to the same scale.

5. The time has come when we can draw all the dimension lines and measurements of the object. In this case, I want the aquarium to measure 900x600x700 mm.

6. Finally, we can draw the plan on a sheet of A4 drawing paper, using the drawing instruments, such as the set squares, etc., and according to the corresponding scale. The best scale for drawing an aquarium would be 1:10.



Drawing with perspective

Since ancient times, perspective has been very important in painting. But it was during the Renaissance when mathematicians worked out how to use optical illusions to make paintings more realistic and help people appreciate the depth and distance of some objects.

Types

Perspective is the art of drawing tri-dimensional objects that have volume (height, width, and depth), on a flat, two-dimensional surface (height and width), and using mathematical methods to show the depth. Therefore, in order to depict reality, we need to apply a few mathematical tricks to make our drawing as big as possible. We are going to discover two tricks, two different perspectives, that enable us to illustrate depth on a flat, two-dimensional surface.

Conical perspective

Conical perspective gives great depth to an image. It is very useful for showing distances between objects, but it is not often used to represent simple objects. In this type of perspective the lines of the drawing seem to converge at a point known as the vanishing point, and which is usually found at the point directly opposite the eye of the observer.
There are two types of conical perspective:

One-point perspective

The front side of the object is drawn parallel to the surface of the paper. If we mark the coordinates on our sheet of paper, we can see that the front side of the object is parallel to both the x and y axes.

The line of the horizon, which must correspond to the spectator's eye level, and the vanishing point must be directly opposite the observer's viewpoint.

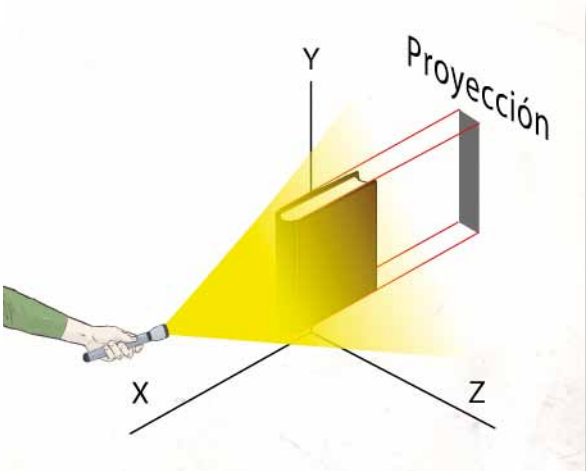
Conical perspective

Two-point perspective

The front side of the object is oblique to the surface of the paper.
In this case, there are two vanishing points which, when joined by a line, create a horizontal line which is parallel to the surface of the paper (the x coordinate).

Axonometric perspective

This perspective consists in representing objects by means of its coordinates: X, Y, and Z (height, width, and depth), is such a way the proportions of the three dimensions are maintained: height, width, and depth or length.



Conical perspective

Axonometric projections have a few properties that are different to the conical projections we have already seen, which means they are more suited to technical drawing, as they are truer to real life.

In this type of perspective:

1. The scale of the object does not depend on its distance from the observer.

2. Two perpendicular lines in the drawing are also perpendicular in real life.

No side is distorted and the scale of the three sides is maintained.

Depending on the position of the coordinate axes (X,Y,Z), we will talk about different types of axonometric perspective. However, we are only going to explain two of them:

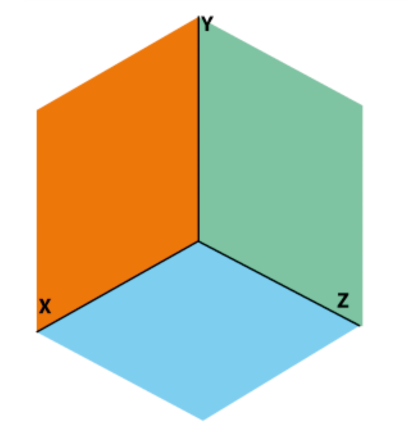
Isometric perspective

Isometric perspective corresponds to when the angles that are formed between the two coordinate axes are of 120º. Therefore, each side will be represented in the same way.

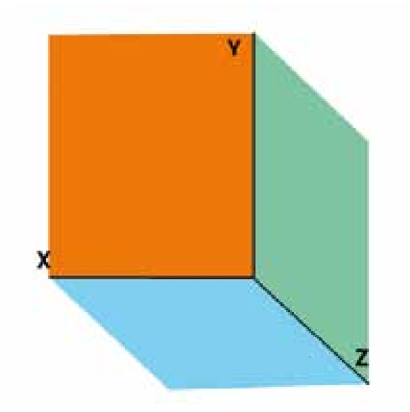
As you have seen in this type of axonometric perspective the angles that are formed between the coordinate axes add up to 120º; therefore all the sides of the object will be represented in the same way.

Cavalier perspective

In this type of perspective the axes of reference have two angles that are equal and one that is different. Therefore, one plane or dimension will be different to the other two.



Isometric perspective



Dimetric or cavalier perspective