Engineering Drawing Principles L-4

Scales

Drawings of small objects can be prepared of the same size as the objects they represent.

Example: A 150 mm long pencil may be shown by a drawing of 150 mm length. Drawings drawn of the same size as the objects, are called full-size drawings.

A scale is defined as the ratio of the linear dimensions of element of the object as represented in a drawing to the actual dimensions of the same element of the object itself.

(i)	Reducing scales	1 : 2	1 : 5	1 : 10
		1 : 20	1 : 50	1 : 100
		1 : 200	1 : 500	1 : 1000
		1 : 2000	1 : 5000	1 : 10000
(ii)	Enlarging scales	50 : 1	20 : 1	10 : 1
		5 : 1	2 : 1	
(iii)	Full size scales			1 : 1

Scales

It may not be always possible to prepare full-size drawings. They are, therefore, drawn proportionately smaller or larger.

•When drawings are drawn smaller than the actual size of the objects (as in case of buildings, bridges, large machines etc.) the scale used is said to be a *reducing scale* (1 : 5).

• Drawings of small machine parts, mathematical instruments, watches etc. are made larger than their real size. These are said to be drawn on an *enlarging scale* (5 : 1).

The scales can be expressed in the following *three* ways:
(1) Engineering scale
(2) Graphical Scale
(3) Representative Fraction (RF)

Scales

•Engineering scale: In this case, the relation between the dimension on the drawing and the actual dimension of the object is mentioned numerically in the style as 10 mm = 5 m etc.

•Graphical scale: The scale is drawn on the drawing itself. As the drawing becomes old, the engineer's scale may shrink and may not give accurate results. However, such is not the case with graphical scale because if the drawing shrinks, the scale will also shrink. Hence, the graphical scale is commonly used in survey

•Representative fraction: The ratio of the length of the object represented on drawing to the actual length of the object represented is called the Representative Fraction (i.e. R.F.).

$$\textbf{R.F.} = \frac{\text{Length of the drawing}}{\text{Actual length of object}}$$

Scales

The R.F. of a drawing is less than unity when it is drawn on an reducing scale.
When a 1 cm long line in a drawing represents 1 metre length of the object,

R.F. is equal to 1cm/1m = 1 cm /100 cm = 1/100 and the scale of the drawing will be 1 : 100 or 1/100 of full size.

The R.F. of a drawing is greater than unity when it is drawn on an enlarging scale.

For example, when a 2 mm long edge of an object is shown in a drawing by a 1 cm I long, the RF is 1 cm/ 2mm = 10 mm/ 2mm = 5 · Such a drawing is said to be drawn on scale 5 : 1 or *five times full-size.*

Scales on Drawing

When an unusual scale is used, it is constructed on the drawing sheet.

To construct a scale the following information is essential:

(1) The R.F. of the scale.
(2) The units which it must represent, for example, millimetres and centimetres, or feet and inches etc.
(3) The maximum length which it must show.

The length of the scale is determined by the formula:

Length of the scale = R.F. x maximum length required to be measured.

Types of Scales

The scales used in practice are classified as under:

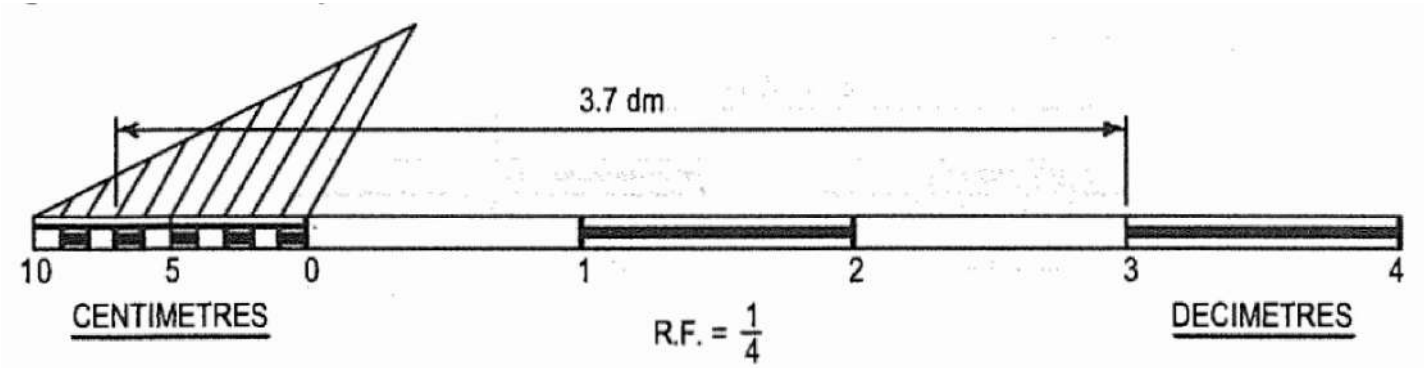
(1) Plain scales
(2) Diagonal scales
(3) Comparative scale
(4) Vernier scales
(5) Scale of chords

Plain scales: A plain scale consists of a line divided into suitable number of equal parts or units, the first of which is sub-divided into smaller parts. Plain scales represent either two units or a unit and its sub-division.

(i) The zero should be placed at the end of the first main division, i.e. between the unit and its sub-divisions.
(ii) From the zero mark, the units should be numbered to the right and its sub-divisions to the left.
(iii) The names of the units and the sub-divisions should be stated clearly below or at the respective ends.
(iv) The name of the scale (e.g. scale, 1 : 10) or its R.F. should be mentioned below the scale.

Scales

Problem: *Construct a scale of 1 : 4 to show centimetres and long enough to measure upto 5 decimeter.*



(i) Determine R.F. of the scale= ¼

(ii) Determine length of the scale.

Length of the scale = R.F. x maximum length = 4 x 5 dm = 12.5 cm.

(iii) Draw a line 12.5 cm long and divide it into 5 equal divisions, each representing1 dm.

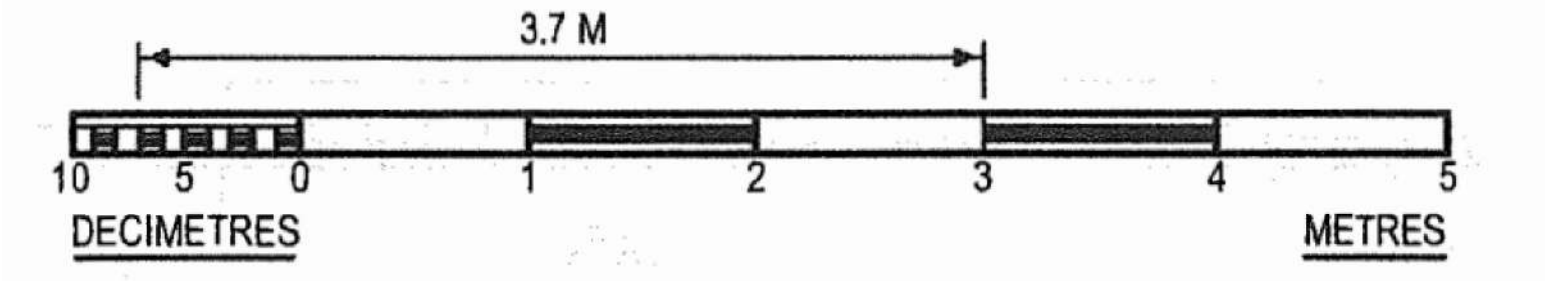
(iv) Mark **0** at the end of the first division and 1, 2, 3 and 4 at the end of each subsequent division to its right.

(v) Divide the first division into 10 equal sub-divisions, each representing 1 cm.

(vi) Mark cms to the left of **0** as shown in the figure.

Scales

Problem: *Draw a scale of 1 : 60 to show metres and decimetres and long enough to measure upto 6 m*



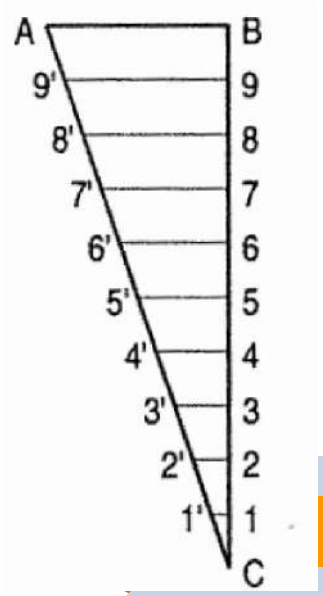
(i) Determine R.F. of the scale, here R.F. = 1/60
(ii) Determine length of the scale
Length of the scale = 60 x 6 m = 1/10 metre = 10 cm.
(iii) Draw a line 10 cm long and divide it into 6 equal parts.
(iv) Divide the first part into 10 equal divisions and complete the scale as shown.
The length 3.7 metres is shown on the scale

Scales

Diagonal scales: A diagonal scale is used when very minute distances such as 0.1 mm etc. are to be accurately measured or when measurements are required in three units; for example, dm, cm and mm, or yard, foot and inch.

Principle of Diagonal Scale: To obtain divisions of a given short line AB in multiples of 1/10 its length

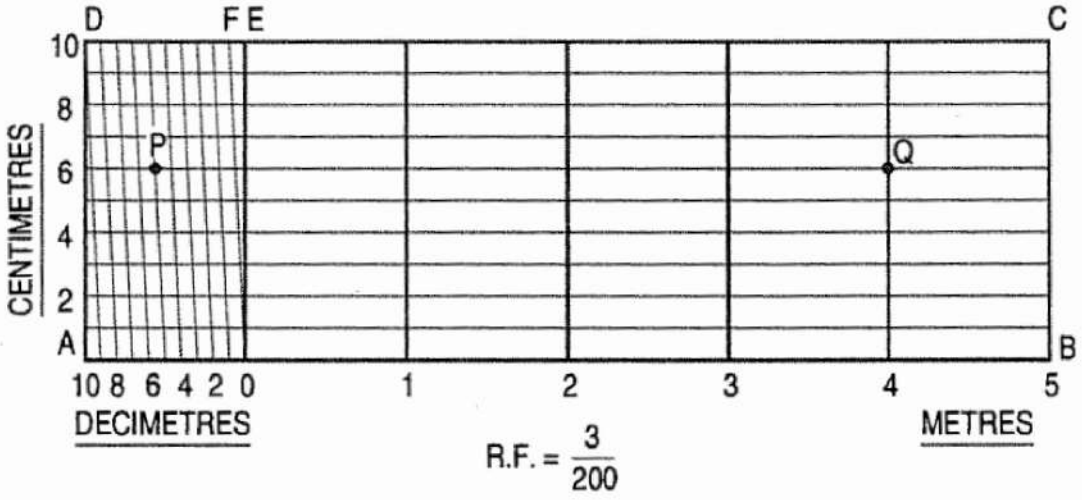
(i) At one end, say *B,* draw a line perpendicular to *AB* and along it, step-off ten equal divisions of any length, starting from *B* and ending at C.
(ii) Number the division-points, 9, 8, 7, ... 1 as shown.
(iii) Join *A* with C.
(iv) Through the points 1, 2 etc. draw lines parallel to *AB* and cutting *AC* at 1', 2' etc. It is evident that triangles 1'1 C , 2'2C ... *ABC* are similar.
Since C5 = *0.5BC,* the line 5'5 = *0.5AB.*
Similarly, 1'1 = *0.1AB,* 2'2 = *0.2* AB



Scales

Problem: *Construct a diagonal scale of 3: 200 i.e. 1: 66$\frac{2}{3}$ showing meters, decimetres and centimetres and to measure upto 6 meters*

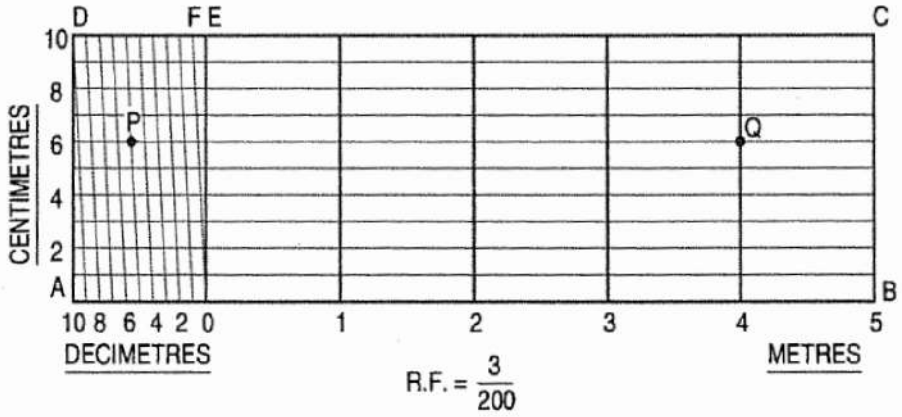
Length of the scale = $\frac{3}{200}$ × 6 m = 9 cm.



Scales

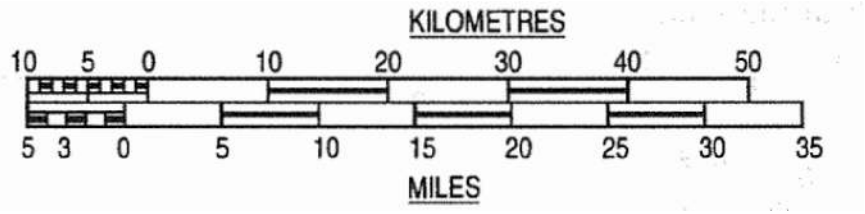
(i) Draw a line *AB* 9 cm long and divide it into 6 equal parts. Each part will show a metre.
(ii) Divide the first part *A0* into 10 equal divisions, each showing a decimetre or 0.1 m.
(iii) At *A* erect a perpendicular and step-off along it, 10 equal divisions of any length, ending at *0.* Complete the rectangle *ABCD.*
(iv) Erect perpendiculars at metre-divisions 0, 1, 2, 3 and 4.
(v) Draw horizontal lines through the division-points on *AD.*
(vi) Join *0* with the end of the first division along *A0,* viz. the point 9.
(vii) Through the remaining points i.e. 8, 7, 6 etc. draw lines parallel to *09*

Length of the scale $= \frac{3}{200} \times 6 \text{ m} = 9 \text{ cm.}$

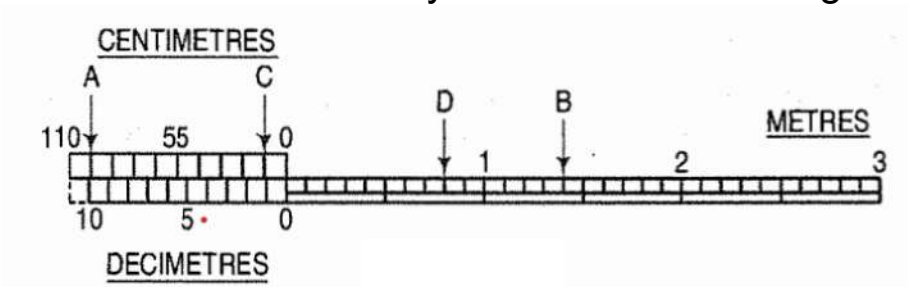


Scales

Comparative scales: Scales having same representative fraction but graduated to read different units are called *comparative scales.* A drawing drawn with a scale reading inch units can be read in metric units by means of a metric comparative scale, constructed with the same representative fraction. Comparative scales may be plain scales or diagonal scales.



Vernier scales: Vernier scales, like diagonal scales, are used to read to a very small unit with great accuracy. A vernier scale consists of two parts - a primary scale and a vernier. The primary scale is a plane scale fully divided into minor divisions. Usually used to measure angles.



Scales

1. Fill-up the blanks in the following sentences, using appropriate words, selected from those given in the brackets:

   (a) The ratio of the length of the drawing of the object to the actual length of the object is called _____ (resulting fraction, representative figure, representative fraction).

   (b) When the drawing is drawn of the same size as that of the object, the scale used is _____ (diagonal scale, full-size scale, vernier scale).

   (c) For drawings of small instruments, watches etc. _____ scale is always used (reducing, full-size, enlarging).

   (d) Drawings of buildings are drawn using _____ (full-size scale, reducing scale, scale of chords).

   (e) The R.F. in case of (b), (c) and (d) above would be, _____ , _____, and _____ respectively (equal to 1, less than 1, greater than 1).

   (f) When measurements are required in three units _____ scale is used (diagonal, plain, comparative).

   (g) The scale of chords is used to set out or measure _____ (chords, lines, angles).