MAP SCALES

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INTRODUCTION

Before preparing a map, we always decide how much actual ground distance should be represented by a map distance. This means a map always bears a definite proportion to the mapped area. This proportion between the map distance and actual ground distance is known as map scale or scale and is defined as "the proportion between a distance on the map and the corresponding distance on the ground." In the form of a formula, it can be represented as –

$$\text{Map Scale} = \frac{\text{Distance between two points on the map}}{\text{Distance between the same two points on the actual ground}}$$

For example, suppose the distance between two points A and B on a map is 1 cm and the distance between same two points on the ground is 2 kilometres, then the scale of the map is 1cm = 2 kilometres or 1cm to 2 kilometres or 1:200,000. Similarly if ground distance is 1mile and the map distance is 1 inch, then the scale is 1 inch = 1 mile or 1 inch to 1 mile or 1:63,360. It can also be represented as a vulgar fraction i.e. $\frac{1}{63,360}$ or 1/63,360.

The scale we choose mainly depends on

> ➢ The size of the area to be mapped
> ➢ The amount of details to be depicted on the map and
> ➢ The size of the paper

Thus, according to our needs, we can have small scales and large scales. On small scales we draw Atlas maps or chorographical maps because we show only generalised picture regarding physical, climatic, economic and socio-cultural aspects of the whole earth or a part of it. These may vary from few kilometres to a centimetre to several hundred kilometres to a centimetre. On large scales we draw Topographical Sheets/ maps, Navigator's charts, Cadastral maps and Plans because we depict detailed information on such maps. These scales may vary from 1cm = 20 meters to 1 cm = 2.5 kilometres.

Scale is drawn on every map at its southern margins in three ways.

METHODS OF EXPRESSING A SCALE

The scale is expressed in three ways on a map. It is

(i)   Stated in words such as 1 cm to 2 kilometres or 2 inches to a mile.

(ii)   Expressed as a fraction such as 1:200,000.

(iii)   Drawn as a line divided in parts.

I STATEMENT OF THE SCALE:

When stated in words, it is known as statement of the scale. It is expressed as 1 cm to 2 kilometres, 1 inch to 3 miles, 3 inches to a mile, 2cm to 1 kilometre.

Map distances are represented by a centimetre or centimetres, an inch or inches and ground distances by a kilometre or kilometres, a mile or miles. In this method either map distance or the ground distance is represented by unity.

Although it is the easiest way of expressing a scale but its usefulness is very limited because

- ➢ Different countries have different units of length in use. So it may not be very well understood by foreigners. For example if on a Russian map it is stated that one Paletz = one Verst, then a person, who is not familiar with the old Russian system of linear measurements, will not be able to read distances on that map.

- ➢ The fractional distances involve intricate mathematical calculations. For example 1 cm = 1 kilometre, 5 hectometre, 2 decametre, 6 meter and 40 centimetres.

- ➢ If a map, whose scale is stated in words, is either enlarged or reduced, then this original scale carry no meaning.

II REPRESENTATIVE FRACTION (R.F.):

When expressed as fraction, it is known as Representative Fraction (R.F.). In some countries it is also known as Numerical Scale.

This scale is represented by a vulgar fraction in which the numerator is always one and the denominator is also in the same unit of length. The numerator indicates the distance on the map and denominator indicates the actual distance on the ground.

$$\text{Thus R.F.} = \frac{\text{Distance between two points on the map}}{\text{Distance between the same two points on the actual ground}}$$

For example, if R. F. of a map is 1/100,000 or 1: 100,000, it means that one unit of length on the map represent 100,000 units of length on the ground. This unit may be an inch or a centimetre or a paletz or any other foreign unit. If it is a centimetre, then 1 centimetre on a map represents 100,000 centimetres on the ground i.e. 1 centimetre represents 1 kilometre. If it is an inch, then 1 inch on the map represents 100,000 inches on the ground i.e. 1 inch represents 1.58 miles. If it is a paletz, then 1 paletz on the map represents 100,000 paletz on the ground i.e. 1 paletz represents 1.19 versts (because 1 verst = 84,000 paletz).

The greatest advantage of expressing the scale in terms of R. F. is that, it can be read into different units of length very easily. For example meaning of R.F. 1: 100, 000 appended to a map in metric system it is 1cm = 100,000 cms, in British system it is 1 inch = 100,000 inches and in Russian system, it is 1 paletz =100,000 paletz.

The disadvantages of R.F. are

➢ If a map is either enlarged or reduced then original scale carry no meaning.

➢ The R.F. is printed in fractional form such as $\frac{1}{100,000}$ occupies more space than that occupied by other type. It is therefore, adjusted in a line by using a small type. These figures are often so small as to make it difficult to read the fraction. So R.F. is printed on maps as 1: 100,000 or 1/100,000.

CONVERSON OF SCALES

Sometimes we need to convert statement of the scale into R.F. or R.F. into statement of the scale.

Converting Statement of the Scale into R.F.

In the statement of the scale, a centimetre or centimetres represents map distances and a kilometre or kilometres ground distance. To convert a statement of scale into R.F., take the distance on the map as numerator and after converting the ground distance into the same unit of length as denominator. Now change the numerator into one. With the help of an example, it is easier to understand this process.

Convert 1cm = 2kms into R.F.

Because R.F. = Map distance / Ground distance

Since one centimetre on the map represents two kilometres or 200,000 centimetres on the ground

Therefore R.F. = 1:200,000

Converting R.F. into Statement of the Scale

Since R.F. = Map distance/ Ground distance and both map distance and ground distance are in same units of length i.e. centimetres or inches. So we change the denominator of R.F. into kilometres or miles to convert it into statement of scale. It is easier to understand the process with the help of an example.

Example: The R.F. of a map is 1: 10, 00,000. What is the statement of the scale?

Solution: Since R.F. = Map distance / Ground distance

So 1 unit on the map represents 10, 00,000 units on the ground

Or 1cm on the map represents 10, 00,000 cms on the ground

Or 1cm on the map represents 10, 00,000/ 100,000 = 10 kms on the ground

Hence statement of the scale is 1cm = 10 kms.

III PLAIN SCALE OR GRAPHICAL SCALE

When shown as a straight line divided into a number of equal parts and marked to show what these divisions represent on actual ground, then it is known as Plain scale or Graphical scale or Linear scale. The ground distances are either shown in International system of measurement i.e. kilometres, Metres or British system of measurement i.e. miles, furlongs, yards, feet.

The scale appended to a map by this method has several advantages. These are:

➢ It is much easier to find the ground distances between two points with the help of a paper strip or thread or dividers from a plain scale. Thus mathematical calculations can be avoided.

➢ In the process of enlargement or reduction of original map by Photostat and photographic methods, the plain scale is also enlarged or reduced in the same proportion in which the map is enlarged or reduced. Hence the plain scale remains useful and true.

The characteristics of a good scale are

➢ It should read to the greatest accuracy required.

➢ It should be convenient to use.

CONSTRUCTION OF A GRAPHICAL SCALE

While constructing a graphical scale the following points should be kept in mind.

(i) It should be sufficiently long. For practical purposes, the scale line should be about 15 cm or 6 inches long but not more than 30 cm or 12 inches.

(ii) It should be accurately divided using geometrical methods of dividing a line in equal parts (perpendicular method or acute angle method) and carefully numbered.

(iii) Zero must always be placed between the units and its subdivisions.

(iv) The name of the scale together with its R.F. should be written on the map.

(v) It should be easily read and should not involve any arithmetic calculation in measuring distance on the map. The main divisions called primary divisions should, therefore, represent one, ten or hundred units.

(vi) One division on the left should further be divided into a few equal parts known as secondary divisions.

(vii) As far as possible it should be represented by a single line.

TYPES OF GRAPHICAL SCALE

Based on the need different types of graphical scales can be constructed. But here, we will discuss only three major types of graphical scales.

1. Simple or Plain Scale

2. Comparative Scales - (i) Comparative Scales of Different Units (ii) Time Scale (iii) Scale of Revolutions or Revolution Scale

3. Diagonal Scale

PLAIN SCALE OR SIMPLE SCALE

On a plain scale, it is possible to read only two dimensions such as kilometres and hectometres, metres and decimetres, miles and furlongs, yards and feet etc. Usually plain scale is appended on maps and plans.

COMPARATIVE SCALES

The graphical scales which have a common representative fraction but can read in different measures are called comparative scales. For example one scale is reading to kilometres and the other to miles. For the first time, these scales were constructed to facilitate British and American soldiers, who went to France during the First World War. These soldiers were provided with maps having comparative scales. The main

advantage of comparative scale is that measurements can be taken directly from a plan or a map in the desired units without any calculations for example kilometres and miles, paces and metres, metres and yards.

TYPES OF COMPARATIVE SCALES

Comparative scales are mainly of three types. These are:

(i)   Comparative scale of different units

(ii)   Time scale

(iii) Scale of Revolutions or Revolution scale

Before construction of a comparative scale, following points should be kept in mind.

➢ It has a common R.F.

➢ It is shown as two graphical scales on the same scale but one scale line showing one unit of measurement and the other scale line showing the other unit of measurement are placed side by side in such a way that zero of one scale line lies immediately above that of the other scale line i.e. zero lies on the same perpendicular line.

➢ Sometimes as in the time scale, we do not construct two scale lines but divide a scale line in such a way that distances in different units can be read.

➢ The remaining method of construction of a comparative scale is similar to the method used in construction of a simple scale.

(i)   COMPARATIVE SCALE OF DIFFERENT UNITS

To save oneself from botheration of converting one unit of measurement into another i.e. miles into kilometres or paces into yards or paces into metres or yards into metres etc comparative scales of different units are constructed.

(ii) TIME SCALE

It is also known as comparative scale of time and distance because from this scale, we can know directly the time spent in covering a certain distance. This scale is particularly useful for aeroplanes, ships and army marching over short or long routes. The construction of time scale is similar to the construction of other comparative scales except the following two points.

➢ The scale line showing the time and distance should be of same length.

➢ The scale line showing distance and time should have the same number of primary and secondary divisions.

REVOLUTION SCALE

Scale of revolutions is a comparative scale composed of two graphic scales, one showing the ground distances and the other showing the number of revolutions. For drawing this type of scale we measure ground distances with a wheel whose radius is known or whose circumference is measured with the help of a tape. The distance to be measured may now be covered by rolling the wheel along the ground. After one revolution, the distance covered by wheel can be known from the formula $2\pi r$ where $\pi=22/7$ and r is the

radius of the wheel. Thus by noting the number of revolutions and multiplying them with the circumference of the wheel, ground distance can be calculated. This is a quick method for ascertaining the ground distances with the help of a wheel or bicycle or any other vehicle, whose radius of the wheel is known.

- **DIAGONAL SCALE**

Diagonal scale is that plain scale whose secondary divisions are further divided into smaller parts diagonally. This is drawn mainly for large scale maps for measuring very small distances correctly. On a diagonal scale, it is possible to read distances in three dimensions such as yard-feet-inch, kilometre-hectometre-decametre, metre-decimetre- centimetre etc. It is also possible to measure a distance up to a hundredth part of a mile or kilometre from a diagonal scale.

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