1. FUNDAMENTAL CONCEPTS OF SURVEYING

INTRODUCTION

Surveying is the art of determining the relative positions of points on, above or beneath the surface of earth by means of direct or indirect measurements of distance, directions & elevation.

PLANE SURVEYING

Plane surveying is that type of surveying in which the mean surface of the earth is considered as a plane and the spheroidal shape is neglected.

GEODETIC SURVEYING

It is that type of surveying in which the shape of the earth is taken into account.

SCALES

Scale is the fixed ratio that every distance on the plan bears with corresponding distance on the ground.

Representative Fraction (RF)

$$RF = \frac{\text{Map distance}}{\text{Ground distance}}$$

(a) **Plain scale:** Plain scale is one on which it is possible to measure two dimensions only such as units and lengths and diameters, miles and furlongs etc.

(b) **Diagonal scale:** On a diagonal scale it is possible to measure three dimensions such as meters, decimeters and centimeters; units, tenth and hundreds; yards, feet and inches.

(c) **The Vernier:**

(i) **Direct vernier:** It is so constructed that (n – 1) divisions of the main scale is equal to n division of the vernier.

In direct vernier, vernier scale moves in same direction of main scale.

$$\text{Least count} = \frac{s}{n}$$

where s = value of one smallest division of main scale

n = number of division on the vernier

v = value of one smallest division of vernier

also $nv = (n-1)s$

(ii) **Retrograde vernier:** It is so constructed that (n + 1) division of main scale is equal to n division of vernier.

In retrograde vernier, vernier scale moves in opposite direction of main scale.

$$\text{Least count} = \frac{s}{n}$$ also $nv = (n+1)s$

(d) **Shrunk scale**

$$\text{Shrunk scale} = \text{original scale} \times \text{shrinkage factor}$$

$$\text{Shrinkage factor} = \frac{\text{Shrunk length}}{\text{Actual length}}$$

Type or purpose of syrvey	Scale	R.F.
(a) Topographic survey		
1. Building sites	1 cm = 10 m or less	$\frac{1}{1000}$ or less
2. Town planning schemes, reservoirs etc.	1 cm = 50 m to 100 m	$\frac{1}{5000}$ to $\frac{1}{10000}$
3. Location surveys	1 cm = 50 m to 200 m	$\frac{1}{5000}$ to $\frac{1}{20000}$
4. Small scale topographic maps	1 cm = 0.25 km to 2.5 km	$\frac{1}{25000}$ to $\frac{1}{250000}$
(b) Cadastral maps	1 cm = 5 m to 0.5 km	$\frac{1}{500}$ to $\frac{1}{5000}$
(c) Geographical maps	1 cm = 5 km to 160 km	$\frac{1}{500000}$ to $\frac{1}{16000000}$
(d) Longitudinal sections		
1. Horizontal scale	1 cm = 10 m to 200 m	$\frac{1}{1000}$ to $\frac{1}{20000}$
2. Vertical scale	1 cm = 1m to 2m	$\frac{1}{100}$ to $\frac{1}{200}$
(e) Cross-secions		
(Both horizontal and vertical scales equal)	1 cm = 1 m to 2 m	$\frac{1}{100}$ to $\frac{1}{200}$

ERROR DUE TO USE OF WRONG SCALE

(a) $\text{Correct length} = \frac{\text{RF of wrong scale}}{\text{RF of correct scale}} \times \text{Measured length}$

(b) $\text{Correct Area} = \left(\frac{\text{RF of wrong scale}}{\text{RF of correct scale}}\right)^2 \times \text{Calculated Area}$

ERROR DUE TO INCORRECT LENGTH OF CHAIN OR TAPE

(a) True length of the line, (l)

$$l = \left(\frac{L'}{L}\right) \times l'$$

Here, L = Designated length of tape/chain
L′ = Actual but wrong length of the chain or tape
l' = Wrong measured length of the line
l = Actual true length of the line

Case (a): In case of Area

$$A = \left(\frac{L'}{L}\right)^2 \cdot A'$$

where, A= True area
A′ = Wrong measured area

Case (b): In case of volume

$$V = \left(\frac{L'}{L}\right)^3 \cdot V'$$

where, V = True volume
V′ = Wrong measured volume

MOST PROBABLE VALUE

$$E_s = \pm 0.6745\sqrt{\frac{\Sigma V^2}{n-1}} \qquad E_m = \pm 0.6745\sqrt{\frac{\Sigma V^2}{n(n-1)}} = \frac{E_s}{\sqrt{n}}$$

where E_s = Probable error of single observation
V = Difference between any single observation and the mean of the series
E_m = Probable error of the mean
n = Number of observation in the series

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