Toppersnotes
Unleash the topper in you

IES/GATE

CIVIL ENGINEERING

VOLUME – X

Surveying,

Building Materials

SIERRA INNOVATIONS

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Surveying, building materials

Building materials

SURVEYING

Chapter 1 - Introduction

(#) Introduction :-

Earth - earth is an oblate spheroid.

Diameter = 12740 km (Average)

Average Radius = 6370 km

At equator = 12756.75 km

At Poles = 12713.80 km

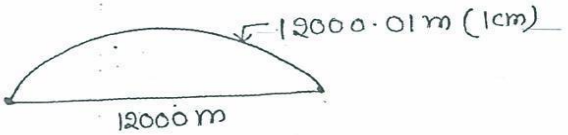
difference = 42.95 km

0.34 %

(#) Types of Surveying :

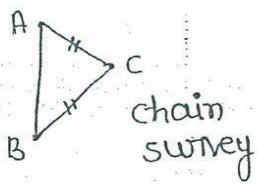
(1) Geodetic Survey : If earth curvature is considered for survey work.

(2) Plane survey : If earth curvature is not considered. suitable for small distance.

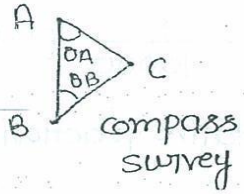


(#) Principle of surveying :-

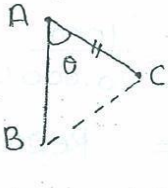
(1) Location of point is measured w.r.t. two reference point :



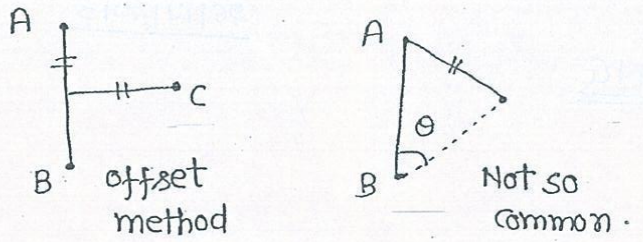
chain survey



compass survey



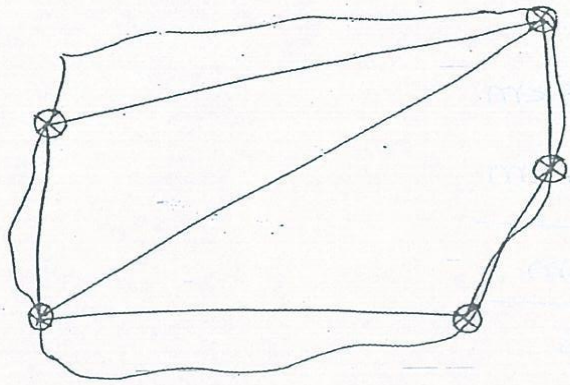
Traverse survey



offset method

Not so common.

(2) Working Whole to part :-



→ Major control points are decided & measured accurately with high degree of precision. Minor details can be collected later to avoid the error to be accumulated

Classification Based on Purpose :-

1. Topographical Survey :-

→ These surveys are used to obtain Maps which show details of natural and man made features on the Earth surface including elevation

Scale :- 1 : 25000 to 1 : 10,00,000 (No need to remember)

Ex :- mountains, water bodies, woods, valley, rivers etc

2. Engineering Survey :-

→ These are surveys used for Engineering works like Railway, Highway, Canal, Bridge etc

Building :- 1 : 50 to 1 : 200

Bridge & other civil engineering works :- 1 : 500 to 1 : 2500

Highway :- 1 : 1250 to 1 : 50,000

3. Cadastral Survey :-

→ It is done to establish Property boundaries (సరిహద్దులు)

Scale :- 1 : 1000 to 1 : 5000

4. Hydrographic Survey :-

→ These are the surveys done on (or) near the water body

Ex :- River, lake etc

5. Astronomical Survey :-

→ with the help of this survey we can determine Latitude, longitude and Local mean time at any place on the earth surface.

6. Geological Survey :-

→ It is done to determine information about various strata of earth surface

Classification based on Instrument :-

Chain Surveying :-

→ It is simplest type of surveying in which only linear measurements are done with the help of chain and tape and no angular measurements are done.

Compass Surveying :-

→ It is the branch of Surveying in which horizontal angles and directions of lines are measured with Compass and length of line are measured with chain and tape.

Theodolite Survey :-

→ In this Surveying horizontal and vertical angles are measured with theodolite and distances are measured with chain or Tape.

Levelling :-

→ In this type of survey, elevations of various points are measured with a levelling instrument and a vertical staff.

Plane table Surveying :-

→ In plane table surveying, plan or map is produced by determing directions of various points and taking linear measurements with chain or Tape.

Tacheometric Surveying :-

→ In this surveying horizontal & vertical distances are measured with a instrument called "Tacheometer".

Photogrametric Survey :-

→ In this survey photographs are taken for an area which are inaccessible (or) time available is less and area to be survey is large.

LINEAR MEASOREMENTS

(#) (1) **Scale** :- Scale is a ratio of map distance to ground distance.

If on the drawing

Scale $\Rightarrow$ 1cm = 100m

1 cm on paper = 100m on ground

Ratio : $\frac{1cm}{100m} = \frac{1cm}{10.000cm} = \frac{1}{10,000}$ (R.F.)

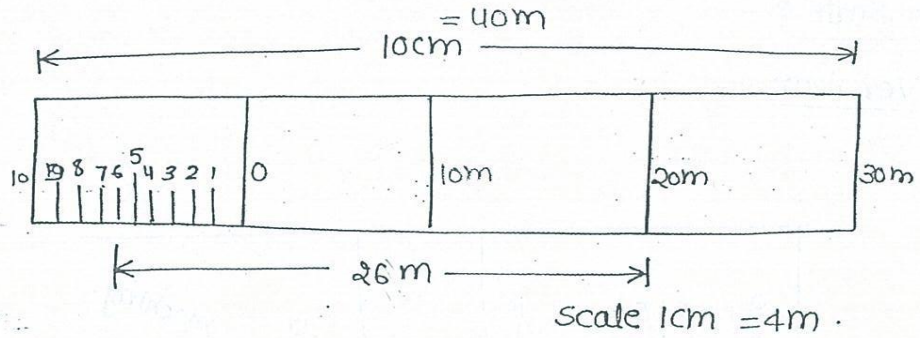
R.F = Representative fraction.

Types of Scale :-

(1) Plane Scale :- Plane scale measure only two dimension.

1cm = 4m

(#) How to make a scale 1cm = 4m —



Scale 1cm = 4m.

(1) Take a 10cm long line divide it in 4 equal parts. Each part is of 10m length.

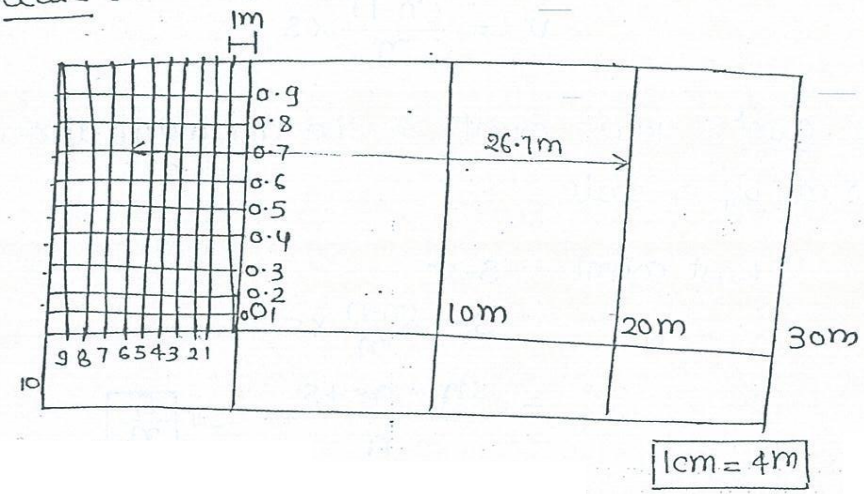
(2) Now divide 1st part in another 10 parts. This smaller divisions will show 1 m.

Two dimension that can be read

① 10m (Decameter)

② 1m (meter)

(2) Diagonal Scale :- this scale can read upto three dimension

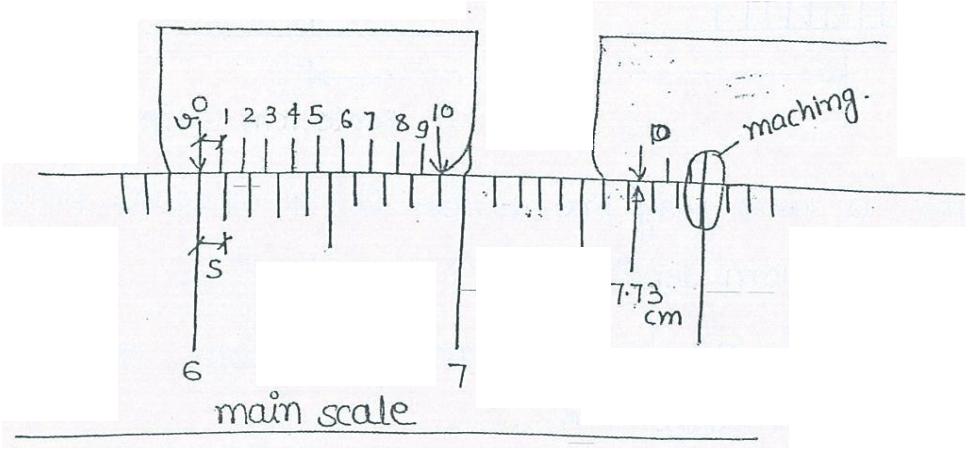


→ It works on the principle of similar triangle.

→ Three dimension | ① 10m → Decameter
(2) 1m → meter
(3) 0.1m (10cm) → Decimeter.

(3) Vernier Scale :-

(I) Direct Vernier :-



→ In case of direct vernier (n-1) division of main scale is divided into n divisions of vernier scale.

$$(n-1)S = n \times v$$

$$v = \frac{(n-1)}{n} \times S$$

(II) Least Count : Least count is the minimum dimension that can be read by a scale.

$$\text{Least count} = S - v$$

$$= S - \frac{(n-1)}{n} \times S$$

$$= \frac{Sn - nS + S}{n} = \boxed{\frac{S}{n}}$$

For Example –

$S = 1m$

$n = 10$

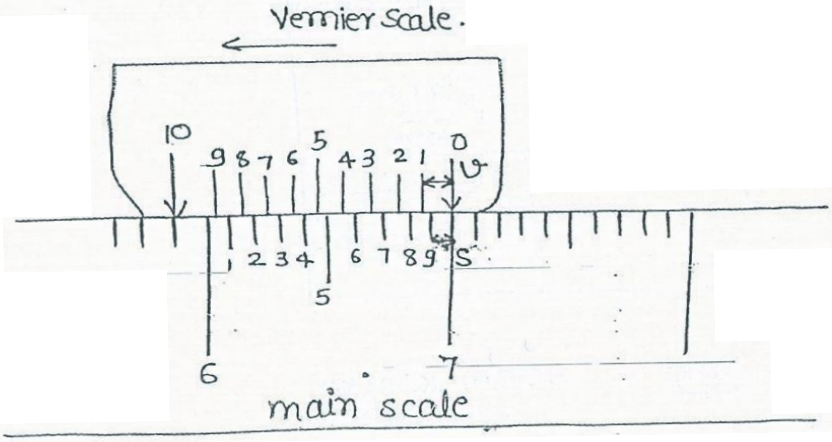
Least Count

$= \frac{S}{n} = \frac{1mm}{10} = 0.1mm.$

(#) Reading of Vernier is taken by the line of Vernier scale that will be exactly above of any one line of main scale.

In direct Virner → Vernier scale moves in the same dir^n of main scale.

(ii) Retrograde Vernier :-



→ In this case

(n+1) division of main scale is divided into n division of Vernier scale.

$$(n+1)S = n \cdot v$$

$$v = \left(\frac{n+1}{n}\right) \cdot S \quad \text{—— (1)}$$

Least Count →

$$= V - S = \left(\frac{n+1}{n}\right)S - S = \frac{nS + S - nS}{S}$$

$$= \frac{S}{n}$$

Example

$S = 1mm$

$n = 10mm$

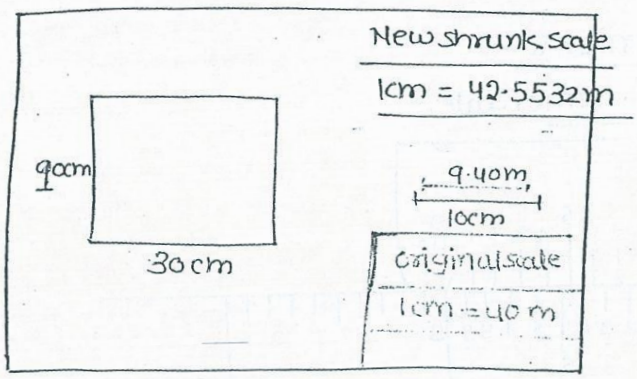
$L.C = \frac{1}{10} = 0.1mm.$

→ In this scale, Vernier scale moves in opposite dir^{n} to the main scale.

(iii) Double Vernier :-

The direct vernier (or Retrograde Vernier), placed back to back with common zero value is called double vernier.

(4) Shrunk Scale :-



Present dimension Read : 30cm × 10cm

9.40 line was 10cm long —

$$30\text{cm} \longrightarrow \frac{10}{9.40} \times 30\text{ cm}$$

$$= 31.915\text{ cm}.$$

Ground length $= 31.915 \times 40$

$$= 1276.60\text{ m}.$$

$$10\text{cm} \longrightarrow \frac{10}{9.4} \times 10 = 10.638\text{ cm}.$$

$$10.638 \times 40 = 425.53\text{ m}.$$

Actual area of plot

$$L \times B = 1276.6 \times 425.53 = 543234.m^2.$$

Shrunk scale —

$$\text{Shrinkage Factor} = \frac{\text{shrunk length}}{\text{original length}}$$

Shrunk scale = shrinkage factor × original scale.

Shrinkage Factor

$$S.F. = \frac{9.40}{10.0} = 0.94$$

original scale
1 cm = 40 m
$= \frac{1}{4000}$

Shrunk scale $= 0.94 \times \frac{1}{4000}$

$$= \frac{1}{4255.319}$$

$$1\,cm = 42.5532\,m$$

Area of the plot = $(30 \times 42.5532) \times (10 \times 42.5532)$

$$A = 543232.23\,m^2$$

Correction due to Incorrect length of chain/tape :-

If

L = Designated (True) length of a tape (should be) (say 30.0 m.)

L' = Wrong length of Tape (say 30.25 m)

l' = wrong length of line measured

l = True length of line.

True × True = wrong × wrong

$L \times l = L' \times l'$

$$l = \left(\frac{L'}{L}\right) \times l' \quad \text{— (A)}$$

example (1) $L = 30\,m$

$L' = 30.25\,m$

$l' = 6500\,m$.

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

$$= \frac{30.25}{30} \times 6500$$

$$\boxed{l = 6554.167\,m}$$

Ex:2 $L = 30m$

$L' = 29.70m$

$l' = 6500\,m$

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

$$= \left(\frac{29.70}{30}\right) \times 6500$$

$$\boxed{l = 6435m}$$

Measured Value on ground	Noted down value	Error	correction
30.25 m (more)	30 m (less)	(−)Ve (−0.25)	(+) Ve (+) 0.25 m
29.70 m (less)	30(m) (more)	(+)Ve (+0.3)	(−) Ve (−) 0.30 m

⊕ Tape Correction :-

(1) Correction due to standardization :-

If length of Tape/chain is not correct.

⊕ Correction per chain length :-

$$\boxed{C = (L' - L)}$$

$$\left[\begin{array}{l} +ve \longrightarrow (+) \\ -ve \longrightarrow (-) \end{array}\right]^{\text{Correction Value.}}$$

⊕ Total Correction required :-

$$C_{Total} = \left(\begin{array}{c}\text{No. of} \\ \text{chains}\end{array}\right) \times C$$

$$\boxed{C_{Total} = \left(\frac{l'}{L}\right)(L' - L)}$$

Case : (1)

$L = 30\,m$

$L' = 30.10\,m$

$l' = 7200\,m$

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

$= \frac{30.10}{30} \times 7200$

$\boxed{l = 7224\,m}$

Correction per chain length

$C = (L' - L) = (30.10 - 30.0)$

$\boxed{C = 0.10\,m}$

No. of chains $= \frac{7200}{30} = 240$ chains.

Total correction $= 240 \times 0.10 = +24\,m$.

corrected length $= 7200 + 24 = 7224\,m$.

This correction may be either '+ve' or '-ve'

(#) In case of Area :-

$$A = \left(\frac{L'}{L}\right)^2 \times A' \quad \text{— (2)}$$

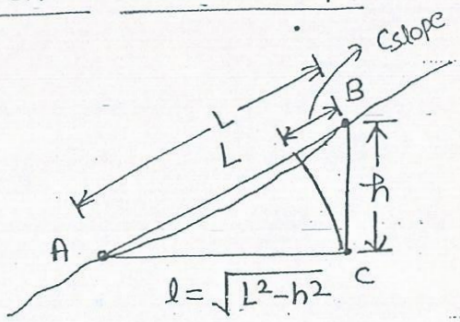
(##) In case of Volume :-

$$V = \left(\frac{L'}{L}\right)^3 \times V' \quad \text{— (3)}$$

(###) For length :

$$l = \left(\frac{L'}{L}\right) \times l' \quad \text{— (1).}$$

(###) (2.) Correction due to slope :-



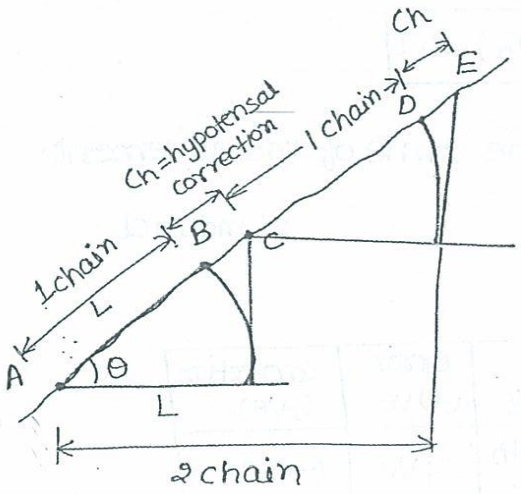
correction : For slope

$$C_{slope} = L - l = L - \sqrt{L^2 - h^2} \rightarrow \text{exact difference.}$$

$$C_{slope} = \frac{h^2}{2L} \rightarrow \text{approximate formula.}$$

This correction is always (-) ve.

Hypatensal Correction



$Ch = L(\sec\theta - 1)$

$= 100 \text{ links} \times \frac{\theta^2}{2}$

$= 50\ \theta^2 \text{ links}$

$AC = L\sec\theta$

$BC = AC - BA = L\sec\theta - L$

$Ch = L(\sec\theta - 1)$ → Hypatenusal correction.

applied (added) after every chain length

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(3) Correction due to Alignment :-

Correction due to alignment –

$Cal = L - \sqrt{L^2 - h^2}$

$\boxed{Cal = \frac{h^2}{2L}}$ → This correction is also (–)Ve. (always).

(4) Correction due to temperature :-

Correction :

$$C_T = (T_m - T_o) \cdot \alpha \cdot L$$

T_m = Temp. at the time of measurement.

T_o = " " " Standard.

$T_m > T_o$	Length of Tape more	error (−) ve	correction (+ve)
$T_m < T_o$	Tape length less	+ve	(−) ve.

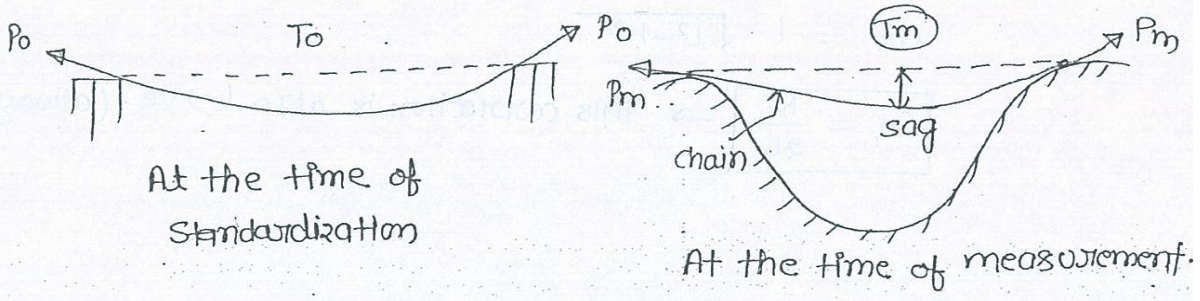
(5) Correction due to pull applied :-

$$C_{pull} = \frac{(P_m - P_o) \cdot L}{AE}$$

P_m = Pull applied at the time of measurement.

P_o = " " " " " Standardization.

$P_m > P_o$	Error (−) ve	correction (+) ve
$P_m < P_o$	(+) ve	(−) ve



(6) Due to Sag :-

$$C_{sag} = \frac{(w \cdot L)^2 \cdot L}{24\, P_m^2}$$

The correction is always (-ve)

w = wt. of tape / unit length.

Normal tension :

It is the value of pull (P_m) applied so that (+)ve pull correction is same as (-)ve sag correction, and they neutralize each other.

$$C_{pull} = C_{sag}$$

$$\frac{(P_m - P_o)\, L}{AE} = \frac{(wL)^2 \cdot L}{24\, P_m^2}$$

Solve by trial & error