ToppersNotes

IES/GATE
CIVIL ENGINEERING

SURVEYING
&
BUILDING MATERIALS
&
PERT CPM CONSTRUCTION EQUIPMENT

VOLUME-IX

Sierra Innovations Pvt. Ltd.

Contents

SURVEYING

(#) 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

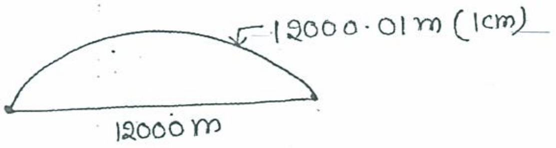
difference = 42.95 km

0.34 %

(#) Types of surveying :

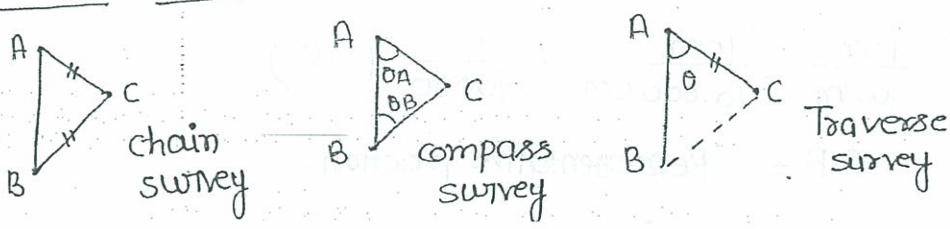
(1) **Geodetic Survey** : If earth curvature is considered for survey work.

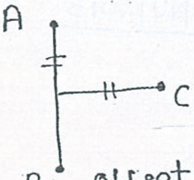
(2) **Plane survey** : If earth curvature is not considered. suitable for small distance.



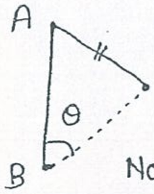
(#) Principle of surveying :-

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



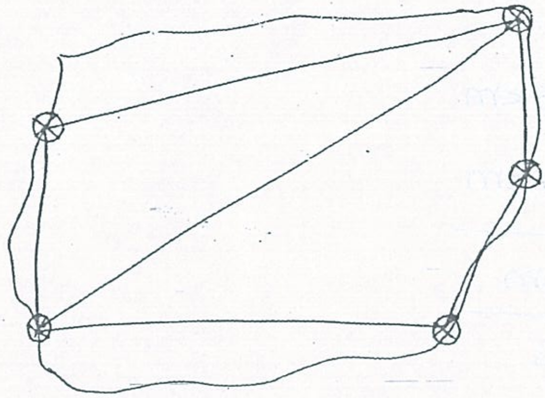


offset method



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.

LINEAR MEASUREMENTS

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

If on the drawing

scale ⇒ 1cm = 100m

1 cm on paper = 100m on ground

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

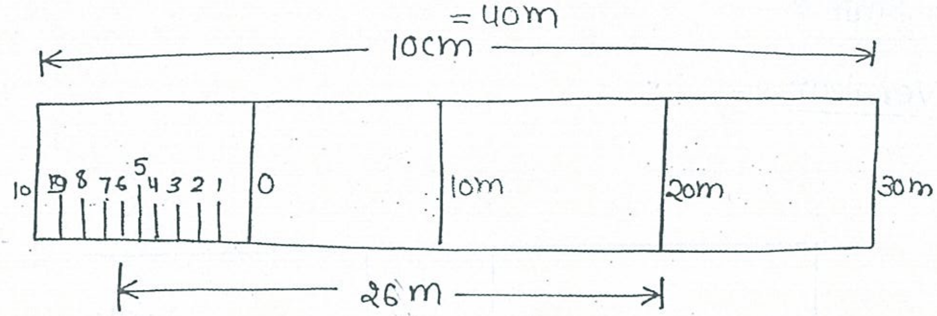
R.F = Representative fraction.

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.

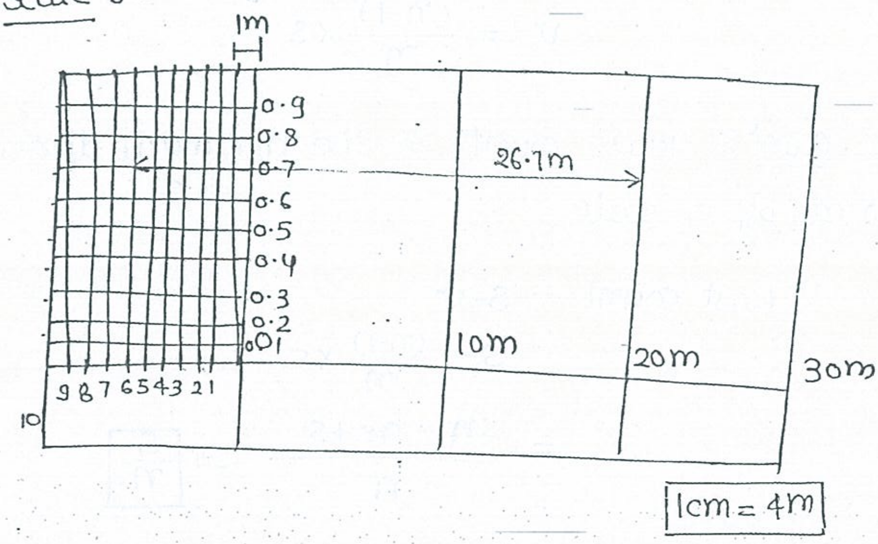
(2) Now divide I[st] part in another 10 parts. This smaller divisions will show 1m.

Two dimension that can be read

(1) 10m (Decameter)

(2) 1m (meter)

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

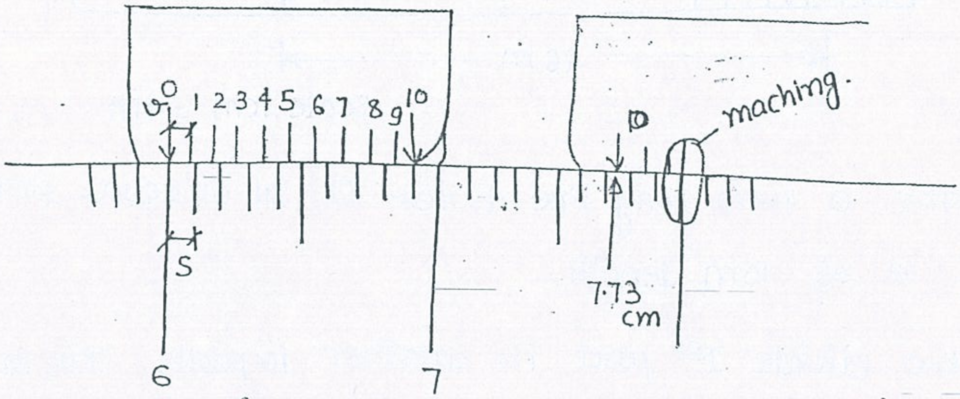


→ It works on the principle of similar triangle.

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

(3) Verniear Scale :-

(i) Direct Verniear :-



main scale

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

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

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

(4) 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 –

$S = 1m$

$n = 10$

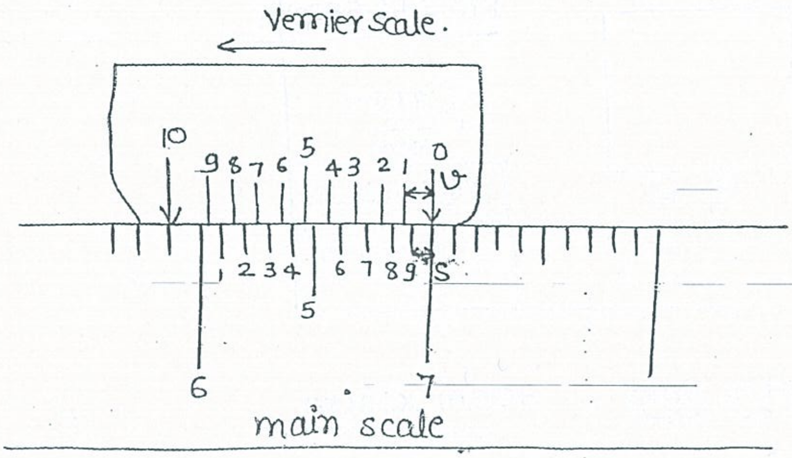
Least Count

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

(#) 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 dirⁿ of main scale.

(ii) Retrograde Verniers –



→ 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

$S = 1mm$

$n = 10mm$

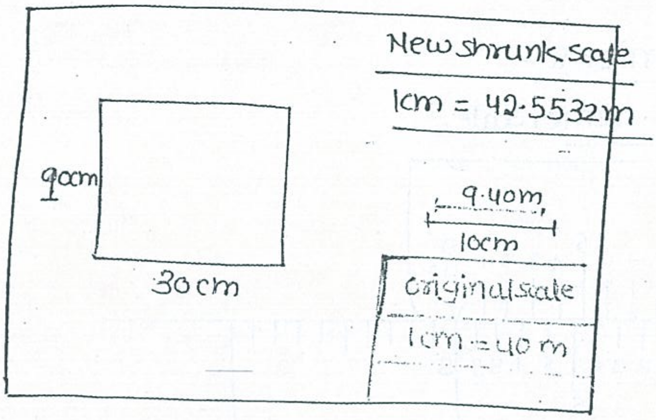
$$L.C = \frac{1}{10} = 0.1mm.$$

→ In this scale, Vernier scale moves in opposite dirn 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 –

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

$$= 31.915 \text{ cm}$$

Ground length = 31.915 × 40
= 1276.60 m.

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

$$10.638 \times 40 = 425.53 m.$$

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

$$= \frac{1}{4000}$$

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

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

$$\boxed{1\,cm = 42.5532\,m}$$

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

$$\boxed{A = 543232.23\,m^2}$$

(#) 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

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

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

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 $L = 30\,m$

$L' = 29.70\,m$

$l' = 6500\,m$

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

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

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

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 :-

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

[+ve → (+) Correction
  −ve → (−)]
Value.

(#) Total Correction required :-

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

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

case: (1)

$L = 30m$

$L' = 30.10m$

$l' = 7200m$

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

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

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

Correction per chain length

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

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

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

$$\text{Total correction} = 240 \times 0.10 = +24m.$$

$$\text{corrected length} = 7200 + 24 = 7224m.$$

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

(##) In case of Area :-

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

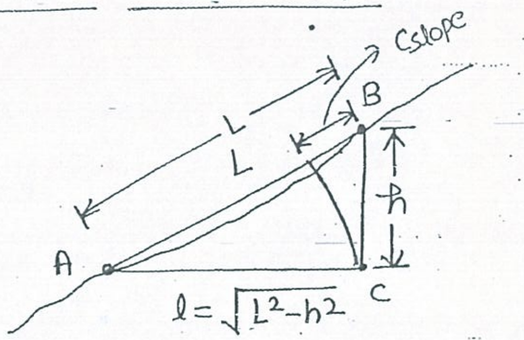
(##) In case of Volume :-

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

(##) For length :

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

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



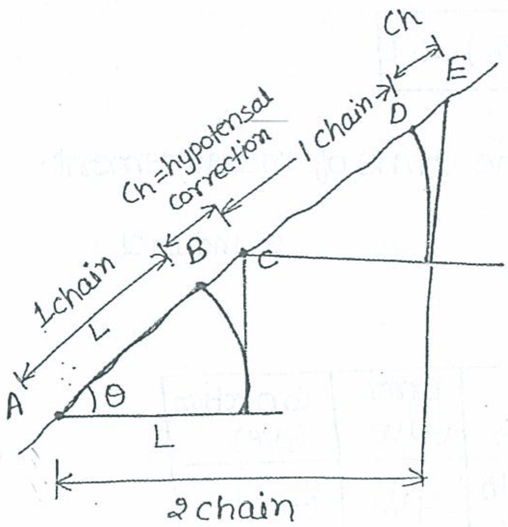
correction : For slope

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

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

This correction is always (−) ve.

Hypotensal Correction



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

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

$= 50\ \theta^2$ links

$AC = L\sec\theta$

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

$Ch = L(\sec\theta - 1) \rightarrow$ Hypotenusal correction.

applied (added) after every chain length

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(3) Correction due to Alignment :-

correction due to alignment –

$C_{al} = L - \sqrt{L^2 - h^2}$

$\boxed{C_{al} = \frac{h^2}{2L}} \rightarrow$ This correction is also (–)ve. (always).

(4) Correction due to temperature :-

Correction :

$$C_T = (T_m - T_0) \cdot \alpha \cdot L$$

T_m = Temp. at the time of measurement.

T_0 = " " " Standard.

$T_m > T_0$	Length of Tape more	error (-) ve	Correction (+ve)
$T_m < T_0$	Tape length less	+ve	(-) ve.

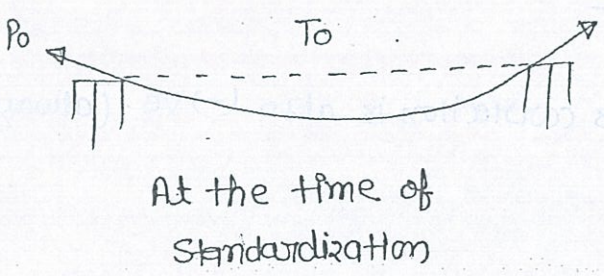
(5) Correction due to pull applied :-

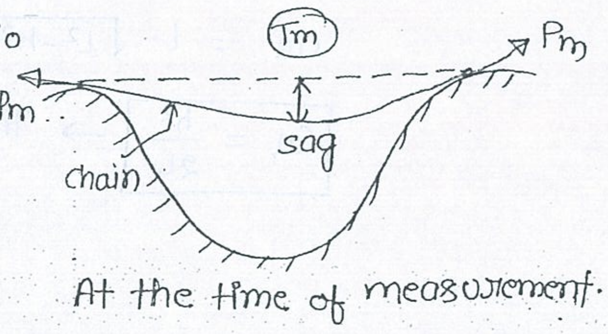
$$C_{pull} = \frac{(P_m - P_0) \cdot l}{AE}$$

P_m = Pull applied at the time of measurement.

P_0 = " " " " " Standardization.

$P_m > P_0$	Error (-) ve	Correction (+) ve
$P_m < P_0$	(+) ve	(-) ve





(6) Due to Sag :-

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

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.

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

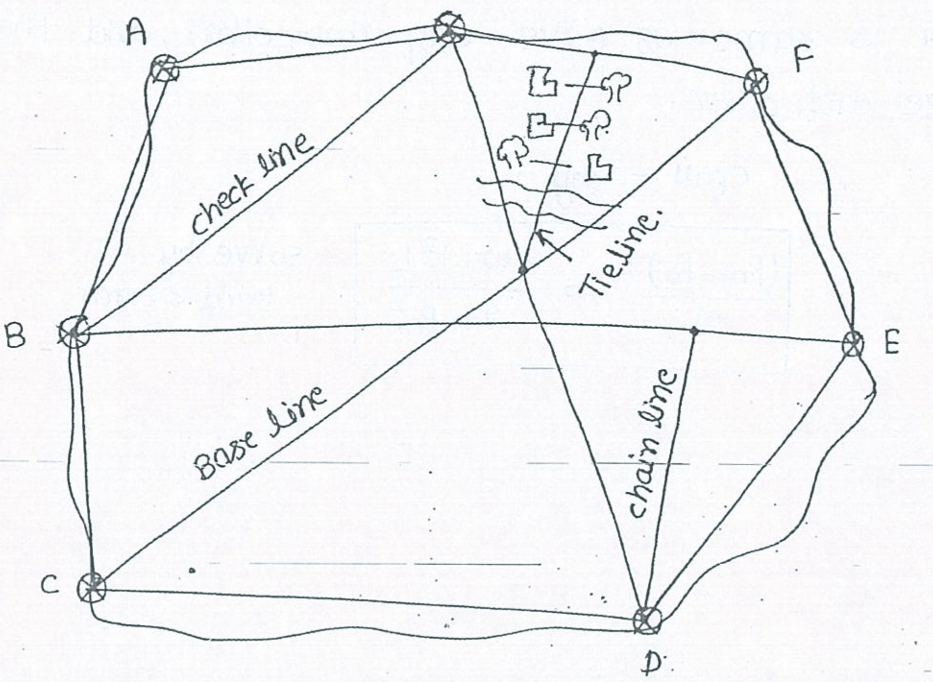
$$\frac{(P_m - P_o)\,L}{AE} = \frac{(wL)^2.L}{24\,P_m^2}$$

solve by trial & error

CHAIN SURVEY

⊕ Limiting length of offset :-

Important Points of chain survey :-



(1) Main stations :- Major control points to divide the area are called main stations.

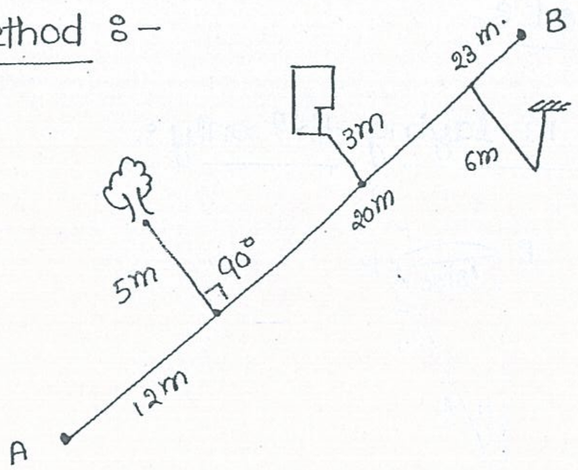
(2) Main lines :- Lines joining main stations.

(3) Base lines : The longest line in the area that divide the total area almost in two parts.

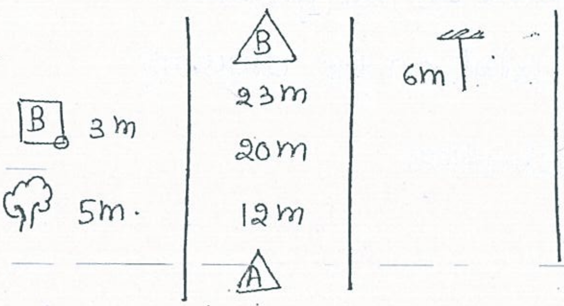
(4) check line : Check lines are measured to check the accuracy of survey work done.

(5) Tie line : Any line drawn to collect more information about different objects in area (for collecting details.)

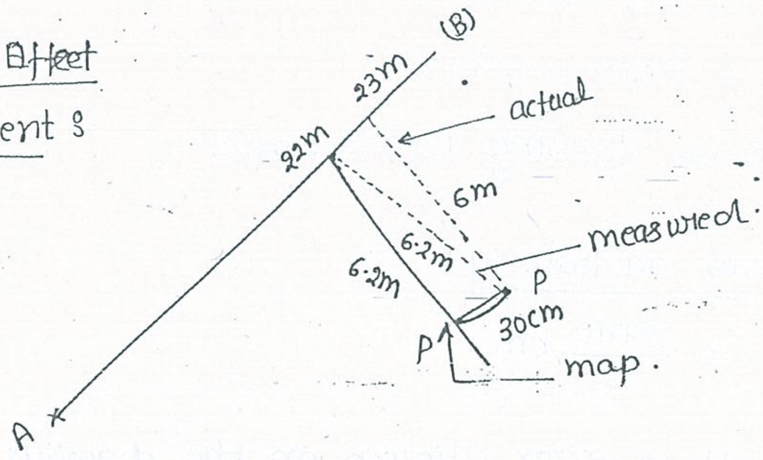
(iii) Offset Method :-



Field Book



Error In Offset Measurement :



If error
≯ 0·025 cm.
≯ 0·25 mm.

If scale 1cm = 20 m

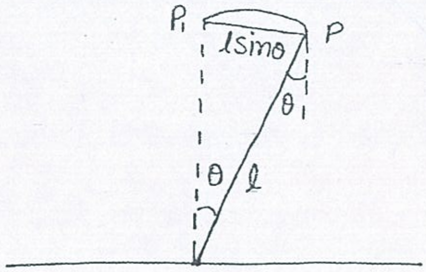
$$30 \text{ cm} \Rightarrow \frac{30\text{m}}{20\text{m}} = 0{\cdot}015\text{cm} = 0{\cdot}15 \text{ mm}$$

If scale 1cm = 2m

$$30\text{cm} \Rightarrow \frac{0{\cdot}30}{2} = 0{\cdot}15\text{cm} = 1{\cdot}5\text{mm}.$$

Limiting length of offset :-

Case (1) If the error is in laying dir^n only :



P = actual location of point on the ground.

P_1 = Plotted position of point on the drawing.

θ = error in laying direction.

Length of error on ground

= lsinθ (meter)

if scale of drawing 1cm = Smeter.

Length of error on drawing :

$= \frac{l\sin\theta}{S}$ cm.

Max^m length of error allowed on the drawing = 0.25mm

= 0.025cm

So, $\frac{l\sin\theta}{S}$ cm = 0.025 cm

$$\boxed{l = \frac{0.025S}{\sin\theta}}$$ limiting length of offset.