POSTAL Book Package 2021

CIVIL ENGINEERING

Surveying and Geology

Conventional Practice Sets

Contents

MADE EASY Publications

1 CHAPTER Introduction

Q.1 A surveyor measured the distance between two points marked on the plan drawn to a scale of 1 cm = 1 m (RF = 1 : 100) and found it to be 50 m later on he detected that he used a wrong scale of 1 cm = 50 cm (RF = 1 : 50) for the measurement. Determine the correct length. Also determine the correct area if the measured area is 60 m^2?

Solution:

$$\text{RF of wrong scale} = \frac{1}{50}$$

$$\text{RF of correct scale} = \frac{1}{100}$$

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

$$= \frac{1/50}{1/100} \times 50 = 100 \text{ m}$$

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

$$= \left(\frac{1/50}{1/100}\right)^2 \times 60 = 240 \text{ m}^2$$

Q.2 Design a vernier for a theodolite circle which is divided into degrees and half degrees to read up to 30″.

Solution:

$$\text{Least count} = \frac{s}{n}, \quad s = 30'$$

Now $$30'' = \frac{30}{60} \text{ min.}$$

$\therefore$ $$\frac{30}{60} = \frac{30}{n}$$

$\Rightarrow$ $$n = 30 \times 2 = 60$$

59 such primary division should be taken from the main scale and then divided into 60 parts the vernier.

Q.3 The circle of a theodolite is divided into degrees and $\frac{1}{4^{\text{th}}}$ of a degree. Design a suitable decimal vernier to read up to 0.005°.

Solution:

$$\text{Least Count} = \frac{s}{n};\ s = \frac{1}{4}^{\circ};\ \text{L.C.} = 0.005^{\circ}$$

$\therefore$ $$0.005 = \frac{1}{4} \cdot \frac{1}{n}$$

$$\Rightarrow \qquad n = \frac{1}{4 \times 0.005} = 50$$

Take 49 such primary divisions from the main scale and divide it into 50 parts for the vernier.

Q.4 **Design an extended vernier for an Abney level to read up to 10′. The main circle is divided into degrees.**

Solution:

$$\text{Least Count} = \frac{s}{n}\,;\ s = 1°\ ;\ \text{L.C.} = 10'$$

$$\therefore \qquad \frac{10}{60} = \frac{1}{n}; \quad \text{or} \quad n = 6$$

Take five spaces of the main scale and then divide it into six equal parts for the vernier.

Q.5 **In a plan, a 10 cm scale drawn shrunks to 9.7 cm. If the scale of the given plan is written as 1 : 250, determine the actual length of a line which at present shows 10 cm.**

Solution:

$$\text{Present representative factor (R.F.)} = \frac{1}{250} \times \frac{9.7}{10}$$

$$\text{Actual distance} \times \text{R.F.} = \text{Drawing distance}$$

$$\text{Actual distance} = \frac{10 \text{ cm}}{\frac{1}{250} \times \frac{9.7}{10}} = 2577 \text{ cm} = 25.77 \text{ m}$$

Q.6 **A rectangular plot of land measures 20 cm × 30 cm on a village map drawn to a scale of 100 m to 1 cm. Calculate its area in hectares. If the plot is redrawn on a topo sheet to a scale of 1 km to 1 cm, what will be its area on the topo sheet? Also determine the R.F. of the scale of the village map as well as on the topo sheet.**

Solution:

(i) Village map:

$$1 \text{ cm on map} = 100 \text{ m on the ground}$$

$$\therefore \qquad 1 \text{ cm}^2 \text{ on map} = (100)^2 \text{ m}^2 \text{ on the ground}$$

The plot measures 20 cm × 30 cm i.e., 600 cm^2 on the map.

$$\therefore \qquad \text{Area of plot} = 600 \times 10^4 = 6 \times 10^6 \text{ m}^2 = 600 \text{ hectares}$$

(ii) Topo sheet

$$1 \text{ cm on map} = 1 \text{ km on ground}$$

$$\Rightarrow \qquad 1 \text{ cm}^2 \text{ on map} = 1 \text{ km}^2 \text{ on ground}$$

$$= 10^6 \text{ m}^2 \text{ on ground}$$

$$\therefore 6 \times 10^6 \text{ m}^2 \text{ ground area is represented by } \frac{1}{1000 \times 1000} \times 6 \times 10^6 = 6 \text{ cm}^2 \text{ map area}$$

(iii) R.F. of the scale of village map $= \dfrac{1}{100 \times 100} = \dfrac{1}{10000}$

R.F. of the scale of topo sheet $= \dfrac{1}{1 \times 1000 \times 100} = \dfrac{1}{100000}$

Q.7 A plan drawn to a scale of 1 : 3000 was measured by a mistake a scale of 1 : 4000. Determine the percentage error in the mesured length and measured area.

Solution:

Let the length on the plan = L

Actual length = 3000 L

$$\text{Percentage error} = \frac{4000L - 3000L}{3000L} = 33.33\%$$

$$\text{Percenrage error in area} = \frac{\text{Measured area} - \text{Actual area}}{\text{Actual area}} \times 100$$

$$= \frac{(4000L)^2 - (3000L)^2}{(3000L)^2} \times 100 = 77.77\%$$

Q.8 The area of the plan of an old survey plotted to a scale of 10 metres to 1 cm measures now as 100.2 sq. cm as found by a planimeter. The plan is found to have shrunk so that a line originally 10 cm long now measures 9.7 cm only. Find (i) the shrunk scale, (ii) true area of the survey.

Solution:

(i) Present length of 9.7 cm is equivalent to 10 cm original length.

$$\therefore \quad \text{Shrinkage factor} = \frac{9.7}{10} = 0.97$$

$$\text{True scale R.F.} = \frac{1}{10 \times 100} = \frac{1}{1000}$$

$$\therefore \quad \text{R.F of shrunk scale} = 0.97 \times \frac{1}{1000} = \frac{1}{1030.93}$$

(ii) Present length of 9.7 cm is equivalent to 10 cm original length.

∴ Present area of 100.2 sq. cm is equivalent to

$$\left(\frac{10}{9.7}\right)^2 \times 100.2 \text{ sq. cm} = 106.49 \text{ sq. cm} = \text{Original area on plan}$$

Scale of plan is 1 cm = 10 m

$$\therefore \quad \text{Area of the survey} = 106.49\,(10)^2 = 10649 \text{ sq. m}$$

Q.9 In 1950, plan of a rectangular field was drawn with a scale of 1 cm = 40 m. The present dimension of field read as 30 cm × 10 cm. If an original reference line of 9.4 cm now reads 10 cm then what is the actual area of field?

Solution:

$$\text{Extended factor,} \quad \text{E.F.} = \frac{\text{Extended length}}{\text{Original length}} = \frac{10}{9.4} = 1.06$$

$$\therefore \quad \text{R.F.}_{\text{[Extended scale]}} = (\text{E.F.}) \times \text{R.F.}_{\text{[original scale]}}$$

Original scale, 1 cm = 40 m

$$\therefore \quad [\text{RF}]_{\text{Original scale}} = \frac{1}{4000}$$

$$\therefore \quad \text{RF}_{\text{[Extended scale]}} = 1.06 \times \frac{1}{4000} = \frac{1}{3760}$$

⇒ Extended scale, 1 cm = 37.6 m

$$\therefore \quad \text{Actual area of field} = 30 \times 10 \times (37.60)^2 = 424128 \text{ m}^2 = 42.4128 \text{ ha}$$

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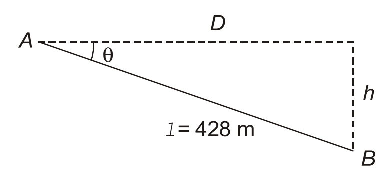
2 CHAPTER Linear Measurement

Q.1 The distance between the points measured along a slope is 428 m. Find the horizontal distance between them. if :
(a) the angle of slope between the points is 8°
(b) the difference in levels is 62 m.
(c) Slope is 1 in 4

Solution:



(a) $D = l\cos\theta = 428\cos 8° = 423.823$ m

(b) $D = \sqrt{l^2 - h^2} = \sqrt{428^2 - 62^2} = 423.49$ m

(c) $\tan\theta = \frac{1}{4}$; $\theta = 14°\ 2.17'$

$D = l\cos\theta = 428\cos 14°\ 2.17' = 415.22$ m

Q.2 The length of a survey line measured with a 30 m chain was found to be 631.5 m. When the chain was compared with a standard chain, it was found to be 0.10 m too long. Find the true length of the survey line.

Solution:

$$\text{True length of the line} = \frac{L'}{L} \times \text{Measured length of the line}$$

Here, $L' = 30.10$ m, $L = 30$ m

Measured length of survey line = 631.5 m

$$\therefore \quad \text{True length of the survey line} = \frac{30.10}{30} \times 631.5 = 633.603 \text{ m}$$

Q.3 The area of a certain field was measured with a 30 m chain and found to be 5000 sq. m. It was afterwards detected that the chain used was 10 cm too short. What is the true area of the field?

Solution:

$$\text{True area} = \left(\frac{L'}{L}\right)^2 \times \text{Measured area}$$

Here, $L' = 29.9$ m, $L = 30$ m, measured area = 5000 sq.m.

$$\text{True area} = \left(\frac{29.9}{30}\right)^2 \times 5000 \text{ sq. m}$$

$$= 4966.72 \text{ sq.m.}$$

Q.4 A 20 m chain was found to be 4 cm too long after chaining 1400 m. It was 8 cm too long at the end of day's work after chaining a total distance of 2420 m. If the chain was correct before commencement of the work, find the true distance.

Solution:

The correct length of the chain at commencement = 20 m

The length of the chain after chaining 1400 m = 20.04 m

∴ The mean length of the chain while measuring

$$= \frac{20+20.04}{2} = 20.02 \text{ m}$$

True distance for the wrong chainage of 1400 m

$$= \frac{20.02}{20} \times 1400 = 1401.400 \text{ m}$$

The remaining distance = 2420 – 1400 = 1020 m

Mean length of the chain while measuring the remaining distance

$$= \frac{20.08+20.04}{2} = 20.06 \text{ m}$$

∴ True length of remaining 1020 m $= \frac{20.06}{20} \times 1020 = 1023.06 \text{ m}$

Hence, the total true distance = 1401.40 + 1023.06 = 2424.46 m

Q.5 At the end of survey of a field a 30 m chain was found to be 10 cm too long. The area of the plan drawn with the measurements taken with this chain is found to be 125 cm^2. If the scale of the plan is 1 cm = 10 m, what is the true are of the field. Assume that the chain was exact 30 m at the commencement of the work.

Solution:

Area of plan = 125 cm^2

Scale of plan, 1 cm = 10 m

∴ Area of the field = 125 × (10)^2 = 12500 sq.m

$$\text{True area} = \left(\frac{L'}{L}\right)^2 \times \text{measured area}$$

Here, L = 30 m

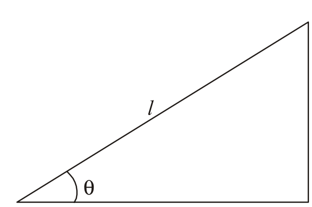
$$L' = \frac{30.0+30.10}{2} = 30.05 \text{ m}$$

Measured area = 12500 sq. m

∴ $$\text{True area} = \left(\frac{30.05}{30}\right)^2 \times 12500 = 12541.7 \text{ sq. m}$$

Q.6 Determine the slope correction required for a length of 60 m, along a gradient of 1 in 20.

Solution:



$$l = 60 \text{ m}$$

$$\tan\theta = \frac{1}{20}$$

⇒ $\cos\theta = 0.9988$

Slope correction = $L(1-\cos\theta)$

Where L = Measured distance

Hence, Slope correction = 60(1 – 0.9988)

= 7.49 cm ≃ 7.5 cm