CE 103

Surveying

Chain Surveying

Contents

❑Introduction

- ❖The chain survey is the simplest method of surveying.
- ❖In the chain survey, only measurements are taken in the field.
- ❖Here only linear measurements are made.
- ❖ No angular measurements are made.
- ❖This is most suitably adapted to small plane areas with very few details. If carefully done, it gives quite accurate results.

❑ Principle of Chain Surveying

- The principle of chain surveying is triangulation.
- This means that the area to be surveyed is divided into a number of small triangles which should be well conditioned.
- In chain surveying the sides of the triangles are measured directly on the field by chain or tape, and no angular measurement are taken.

❑ Large-Scale and small-scale Map

❖When 1 cm of a map represents a small distance, it is a said to be a large-scale map.

For example: 1 cm = 1 m i.e. RF = 1/100

❖When I cm of the map represents a large distance, it is called a small-scale map.

For example: 1 cm = 100 m i.e. RF= 1/10,000

✓A map having an RF of less than 1/500 is considered to be large-scale.

✓A map of RF more than 1/500 is said to be small-scale.

❑ Suitability of chain survey

❖ Chain surveying is recommended when:

1. The ground surface is more or less level
2. A small area is to be surveying
3. A small-scale map is to prepared and
4. The formation of well-conditioned triangles is easy.

❖ Chain surveying is unsuitable when:

1. The area is crowded with many details.
2. The area consists of too many undulations .
3. The area is very large and .
4. The formation of well-conditioned triangles becomes difficult due to obstacles.

❑ Well- conditioned and ill-conditioned triangles

- ❑ A triangle is said to be well-conditioned when no angle in it is less then 30° or greater than 120°
- ➢ An equilateral is considered to be the best-condition or ideal triangle (Figs 2.1(a) and (b)).
- ❑ Well-conditioned triangles are preferred because their apex points are very sharp and can be located by a single dot. In such a case, there is no possibility of relative displacement of the plotted point.

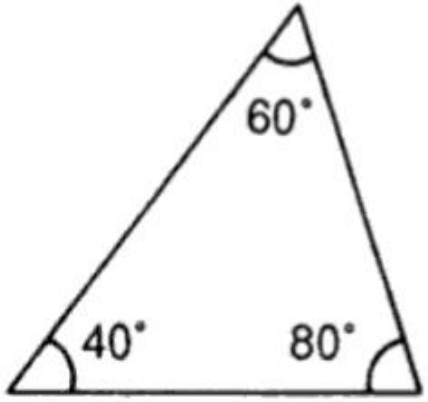


Fig. 2.1(b) Well-Conditioned Triangle

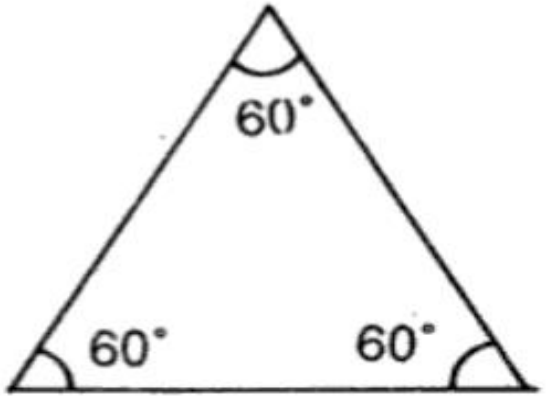


Fig. 2.1(a) Ideal Triangle

❑ Procedure in Chain Survey

1.Reconnaissance: The preliminary inspection of the area to be surveyed is called reconnaissance. The surveyor inspects the area to be surveyed, surveyor prepares index sketch or key plan.
2.Marking Station: The surveyor fixes up the required no stations at places from where maximum possible stations are possible.
3.Then he selects the way for passing the mainline, which should be horizontal and clean as possible and should pass approximately through the center of work.
4.Then ranging roads are fixed on the stations.
5.After fixing the stations, chaining could be started.
6.Make ranging wherever necessary.
7.Measure the change and offset.
8.Enter in the field the book.

❑ Basic concept of chain survey

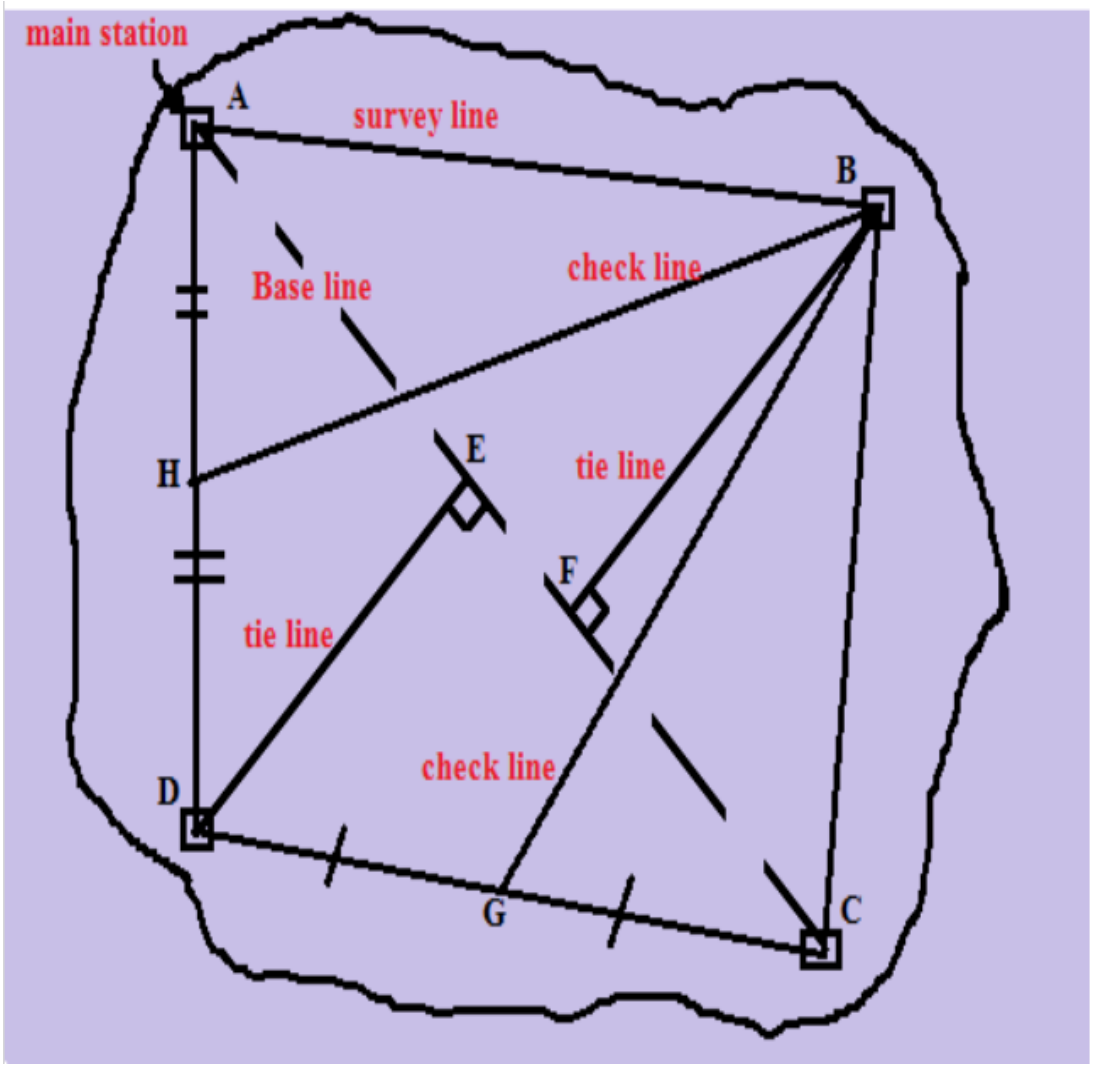
❑Base Line

The line on which the framework of the survey is built known as the ‘base line’. It is the most important line of the survey. Generally , the longest of the main survey lines is considered the base line .

This line should be taken through fairly level ground , and should be measured very carefully and accurately . The magnetic bearing of the base line are taken to fix the north line of the map.

➢Check Line

The line joining the apex point of a triangle to some fixed point on its base is known as the 'check line'. It is taken to check the accuracy of the triangle. Sometimes this line helps to locate interior details.

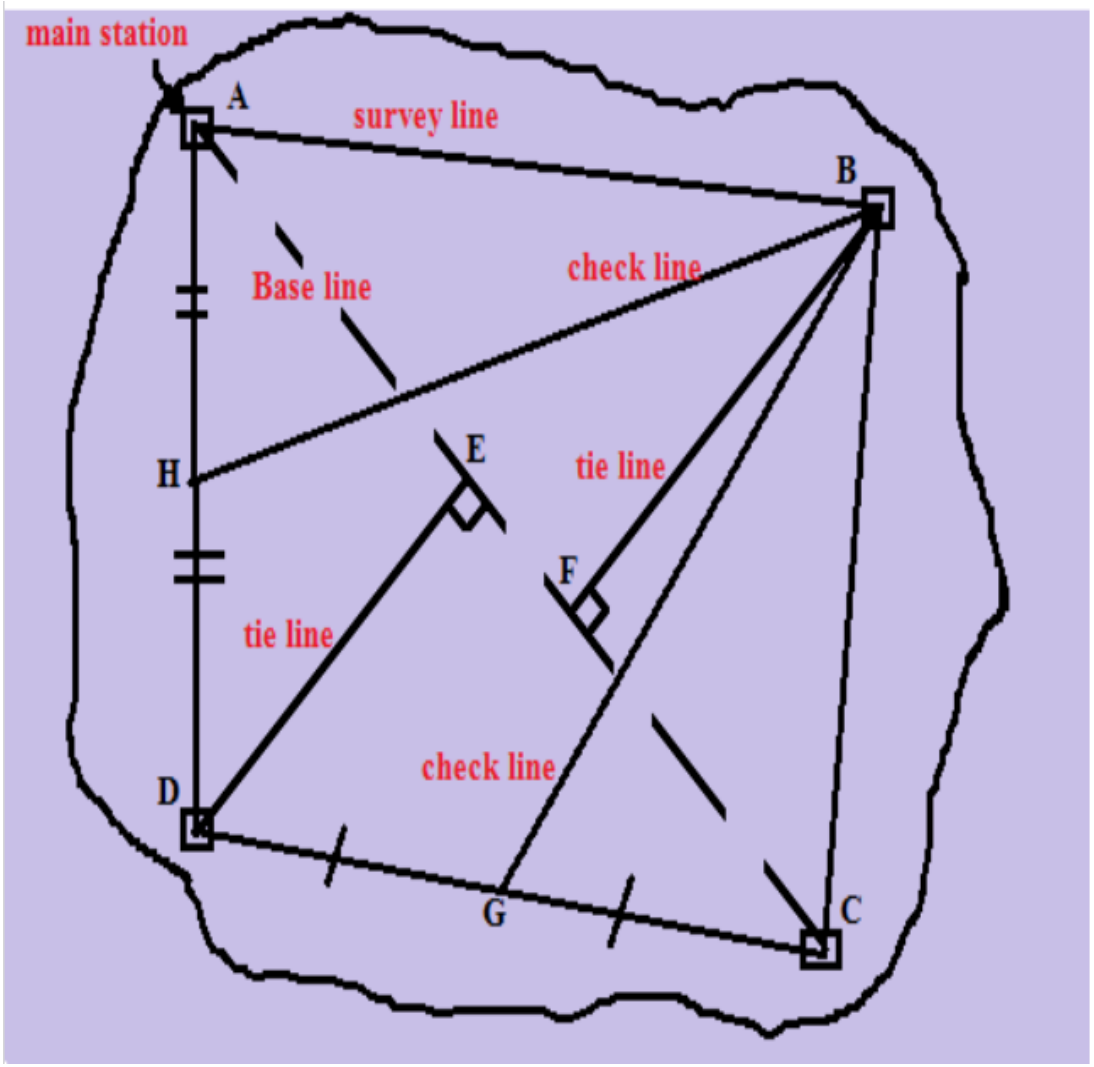


Basic concept of chain survey

➢**Tie or Subsidiary Lines**

A tie line joints two fixed points on the main survey lines. It helps to check the accuracy of surveying and to locate the interior details. The

position of each tie line should be close to some features, such as paths, buildings, etc.



❑ Survey stations

- Survey stations are the points at the beginning and the end of a chain line. They may also occur at any convenient points on the chain line. Such stations may be:

    1. Main stations
    2. Subsidiary stations and
    3. Tie stations

1. Main stations : stations taken along the boundary of an area as controlling points are known as ‘main stations’ . The lines joining the main stations are called ‘ main surveyed . The main survey lines should cover the whole area to be surveyed . The main stations are denoted by with letters A, B, C, D, etc. . The chain lines are denoted by “---…---….---…---”.

2. Subsidiary stations :stations which are on the main survey lines or any other survey lines are known as “subsidiary stations”. These stations are taken to run subsidiary lines for dividing the area into triangles, for checking the accuracy of triangles and for locating interior details . These stations are denoted by with letters S_1, S_2, S_3etc.

3. Tie stations : These are also subsidiary stations taken on the main survey lines . Lines joining the tie stations are known as tie lines . Tie lines are mainly taken to fix the directions of adjacent side of the chain survey map . These are also taken (chain angles are described in chapter 3) . Sometimes tie lines are taken to locate interior details . Tie stations are denoted by with letters T_1,T_2,T_3. etc.

❑ Reconnaissance survey and Index sketch

- **Reconnaissance survey:** Before the commencement of any survey work, the area to be surveyed is thoroughly examined by the surveyor, who then thinks about the possible arrangement of the framework of survey.
- **Index sketch:** The neat hand sketch of the area which is prepared during reconnaissance survey is known as the 'index sketch' or 'key plan'. The index sketch shows the skeleton of the survey work.

Offset

- Offset: The lateral measurement taken from an object to the chain line is known as ‘offset’.

Offset two types-

1. perpendicular offsets
2. Oblique offsets

1. Perpendicular offsets : when the lateral measurements are taken perpendicular to the Chain line .

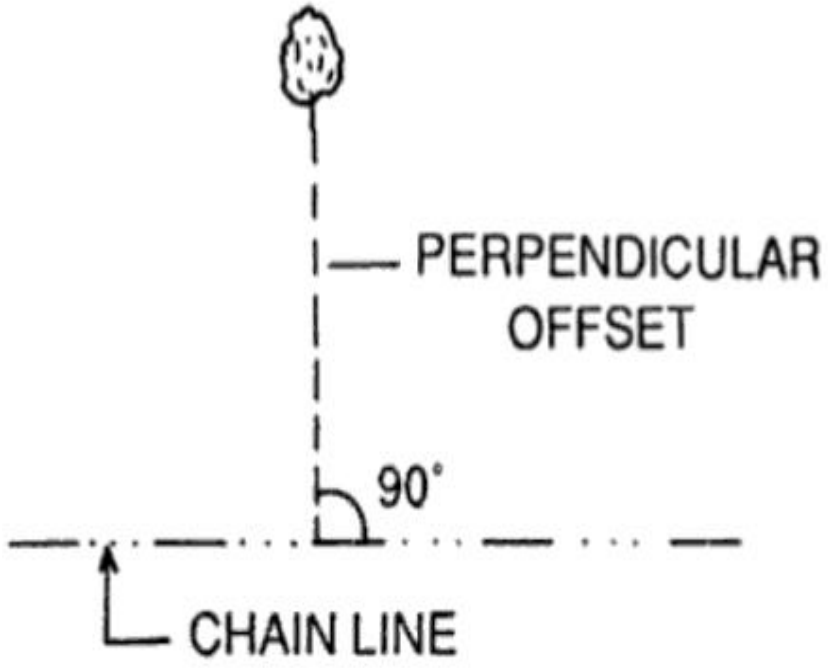


Fig. 2.3

2. Oblique offsets : any offset not perpendicular to the chain line is said to be oblique offset.

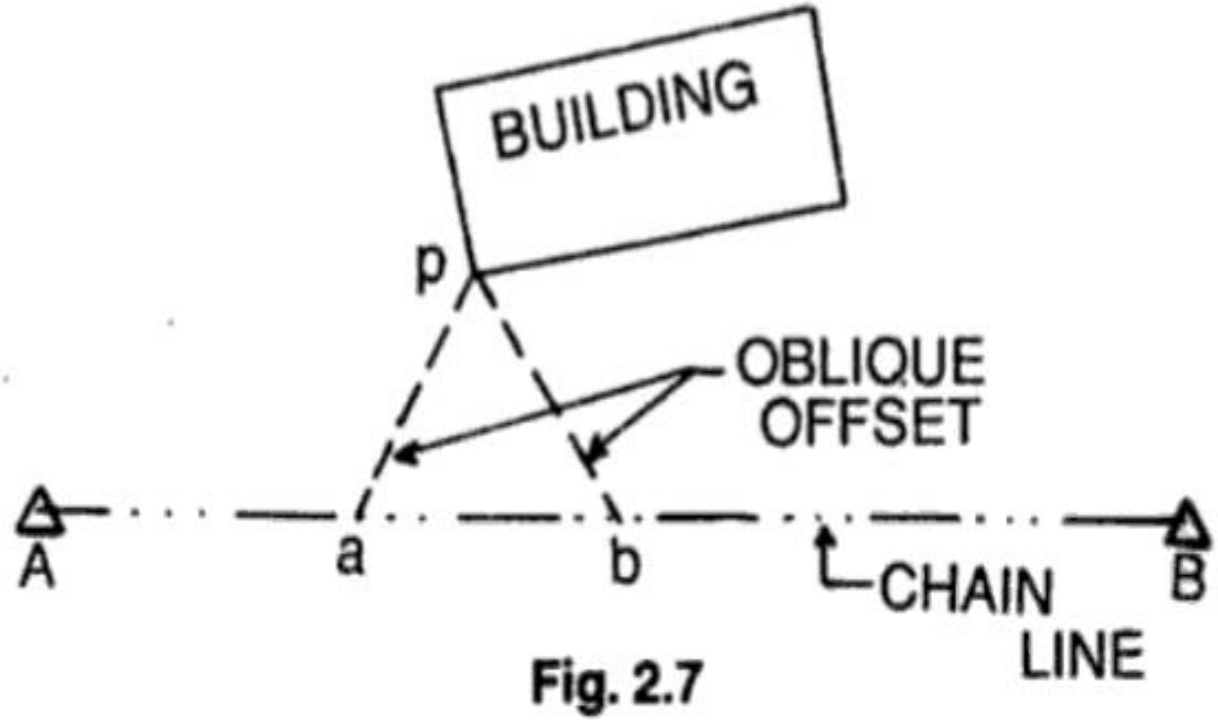


Fig. 2.7

Number of offsets

- When the boundary of the object is approximately parallel to the chain HL line, perpendicular offsets are taken at regular intervals (Fig. 2.8)

- When the boundary is straight, perpendicular offsets are taken at both ends of it (Fig. 2.9).

- ✓When the boundary line is zigzag, perpendicular offsets are taken at every point of bend to represent the shape of the boundary accurately. In such a case, the interval of the offsets may be irregular (Fig. 2.10).

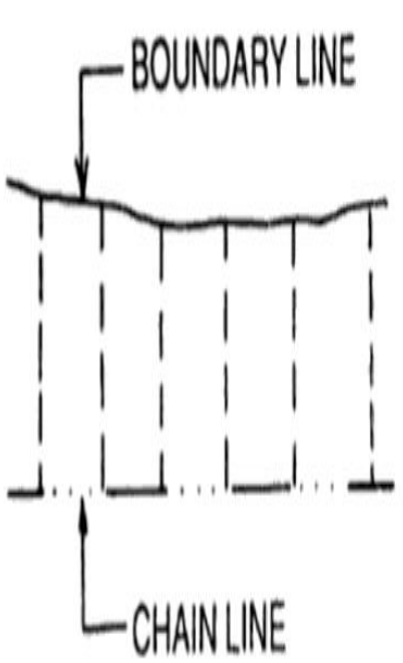


Fig.2.8

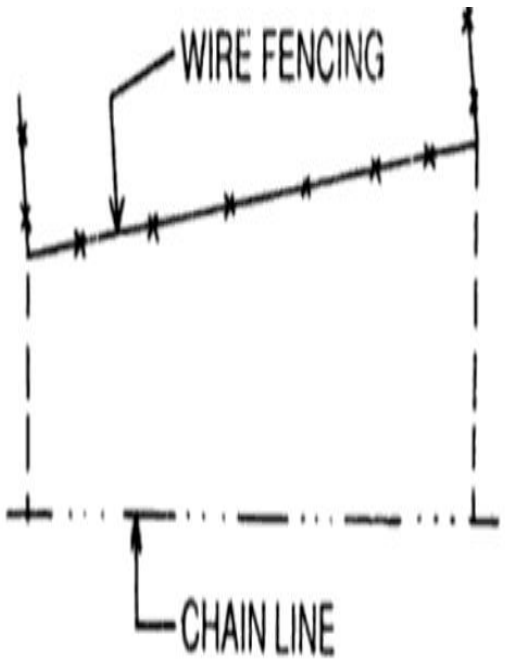


Fig.2.9

Number of offsets

- When a road crosses the chain line perpendicularly, the chainage of the intersection point is to be noted (Fig. 2.11).
- When a road crosses a chain line obliquely, the chainages of intersection points 'a' and "b' are noted. Then at least one offset is taken on both sides of the inter-section points. More offsets may be taken depending on the nature of the road. Here, perpendicular offsets are taken at 'c' and d (Fig. 2.12).

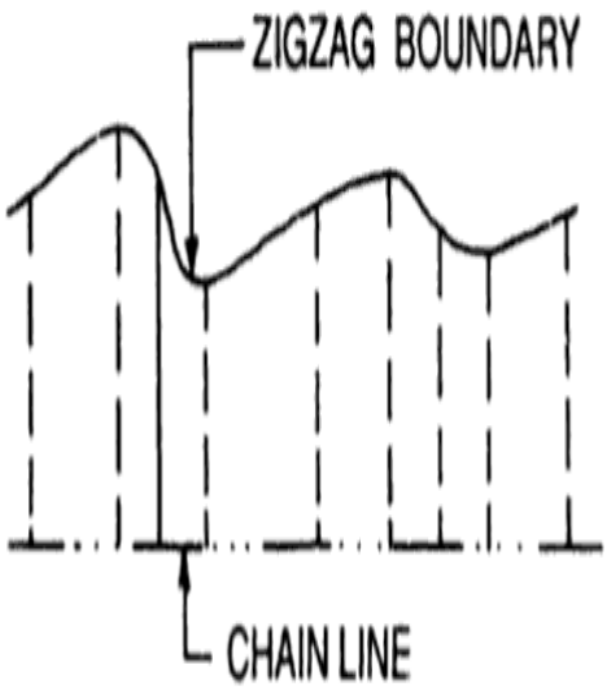


Fig. 2.10

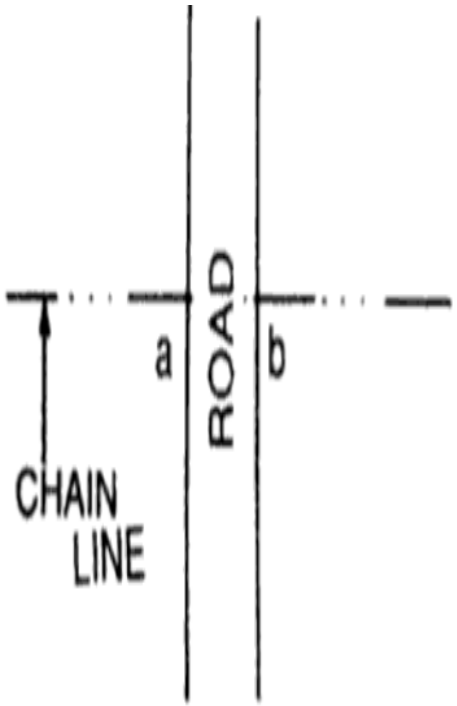


Fig. 2.11

Number of offsets

- When the building is small, its comers are fixed by perpendicular or oblique offsets and the other dimensions are taken directly on the field and noted in the field book (Fig. 2.13).

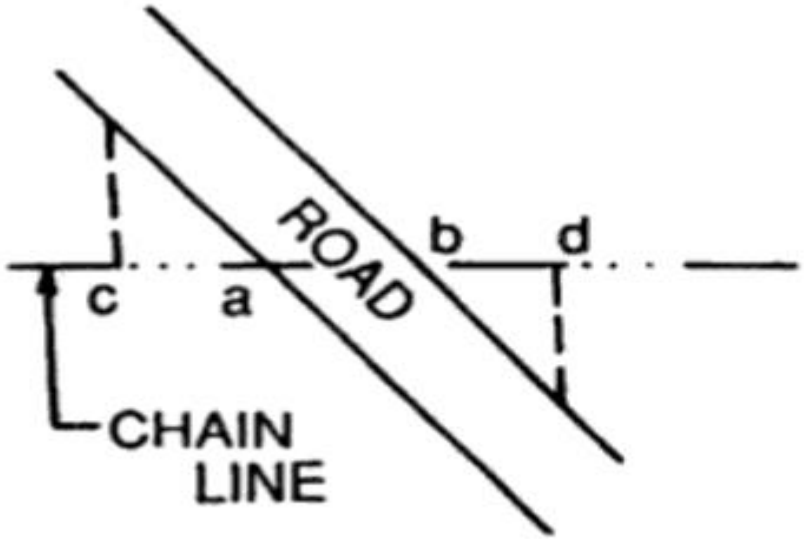


Fig. 2.12

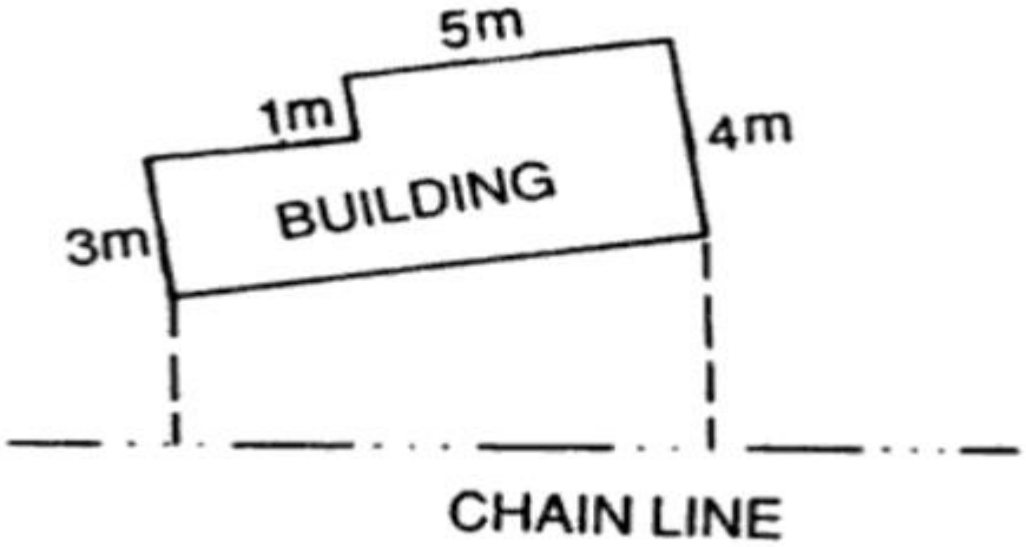


Fig. 2.13

Number of offsets

- When the building is large, zigzag in shape and oblique to the chain line, then the corners are fixed by perpendicular or oblique offsets. Then the full plan of the building is drawn on a separate page along with all the dimensions. This page should be attached with the field book at the proper place (Fig. 2.14).

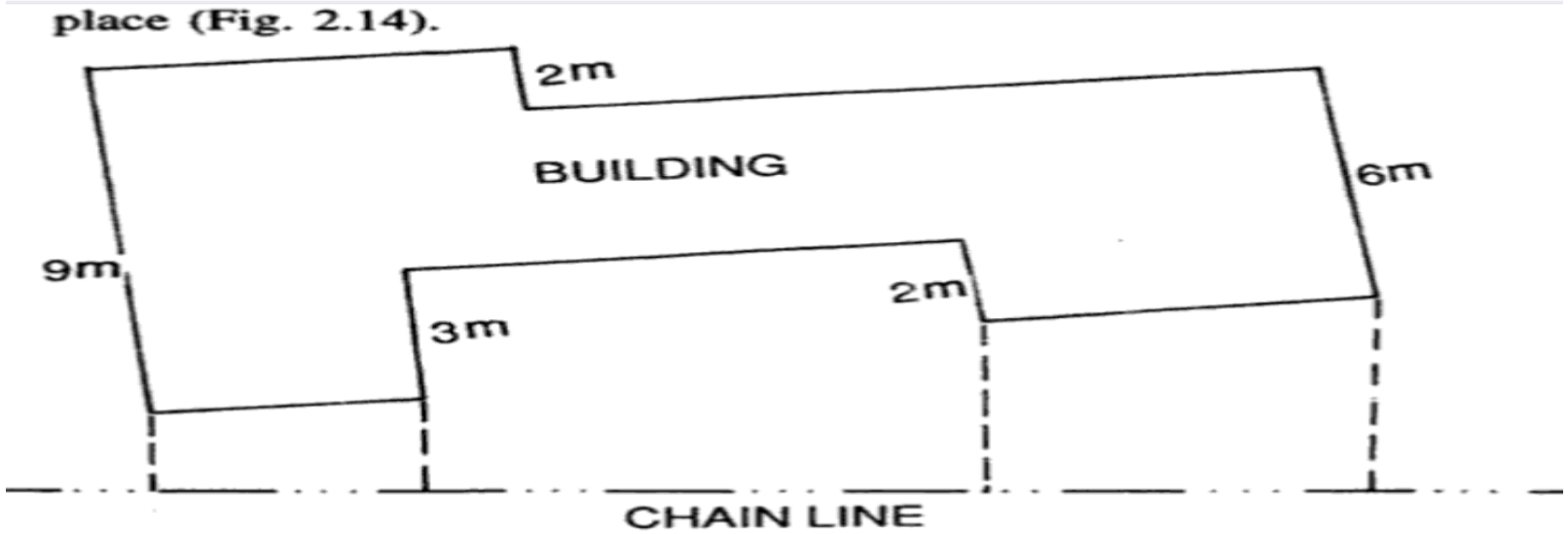


Fig. 2.14

❑ Selection of survey stations

The following points should be remembered during the selection of survey stations:

1. The stations should be so selected that the general principle of surveying may be strictly followed.

2. The stations should be intervisible.

3. The stations should be selected in such a way that well-conditioned triangles may be formed.

4. The base line should be the longest of the main survey lines.

5. The survey lines should be taken through fairly level ground, as far as practicable.

6. The main survey lines should pass close to the boundary line of the area to be surveyed.

7. The survey lines should be taken close to the objects so that they can be located by short offsets.

8. The tie stations should be suitably selected to fix the directions of adjacent sides .

9. The subsidiary stations should be suitably selected for taking check lines.

10. Stations should be so selected that obstacles to chaining are avoided as far as possible.

11. The survey lines should not be very close to main roads, as survey work may then be interrupted by traffic.

❑ Equipment for chain survey

The following equipment are required for conducting chain survey :

1. Metric chain (20 m) = 1 no.
2. Arrows = 10 no.
3. Metallic tape (15 m) = 1 no.
4. Ranging rods = 3 no.
5. Offset rod = 1 no.
6. Clinometer = 1 no.
7. Plumb bob with thread = 1 no.
8. Cross staff or optical square = 1 no.
9. Prismatic compass with stand = 1 no.

Equipment for chain survey

10. Wooden pegs = 10 no.
11. Mallet = 1 no.
12. Field book = 1 no.
13. Good pencil = 1 no.
14. Pen knife = 1 no.
15. Eraser (rubber) = 1 no.

Obstacles in Chaining

✓**3 Main Types of Obstacles in Chaining of a Line**

1. Chaining Free, Vision Obstructed
2. Chaining Obstructed, Vision Free
3. Chaining and Vision Both Obstructed.

Chaining Free, Vision Obstructed

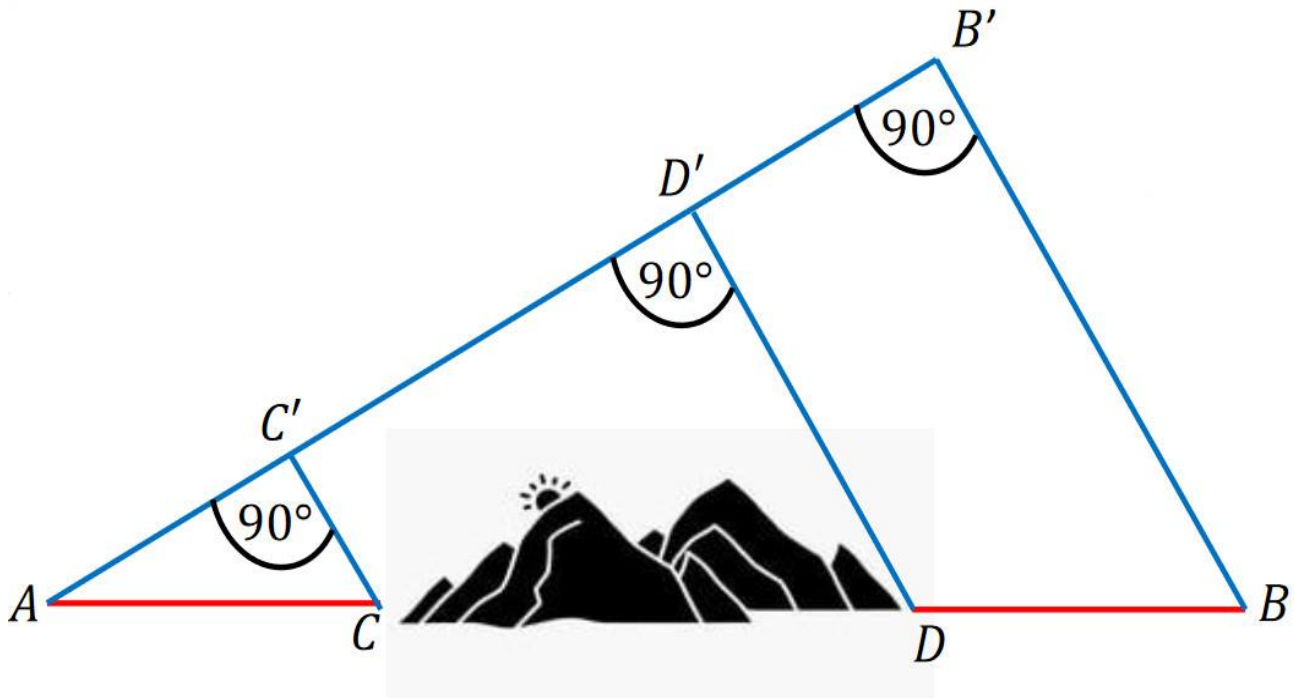
In this type of obstacles, the ends of the lines are not intervisible e.g. rising ground, hill or jungle intervening.

$$\frac{CC'}{BB'} = \frac{AC'}{AB'} \quad \therefore CC' = BB' \times \frac{AC'}{AB'}$$

$$Similarly \therefore DD' = BB' \times \frac{AD'}{AB'}$$

$$AB2 = AB'2 + BB'2$$

$$\therefore AB = \sqrt{AB'^2 + BB'^2}$$



Chaining Obstructed, Vision Free

The typical obstacle of pond the width of which in the direction of measurement exceeds the length of the chain or tape. The problem consists in finding the distance between convenient points on the chain line on either side of obstacle.

(a) Set out equal perpendiculars AC and BD [Fig. 3.21 (a)]. Measure CD which is equal to AB.

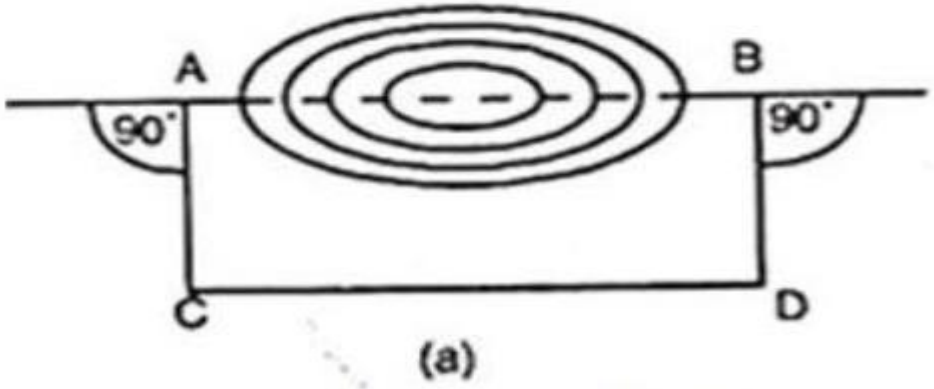


Fig 3.21(a)

Chaining Obstructed, Vision Free

(b) Erect perpendicular AC [Fig 3.21(b)] of sType equation here.uch a length that CB clears the obstacle and measure AC and CB.

$$BC^2 = AC^2 + AB^2 \quad \therefore AB = \sqrt{BC^2 - AC^2}$$

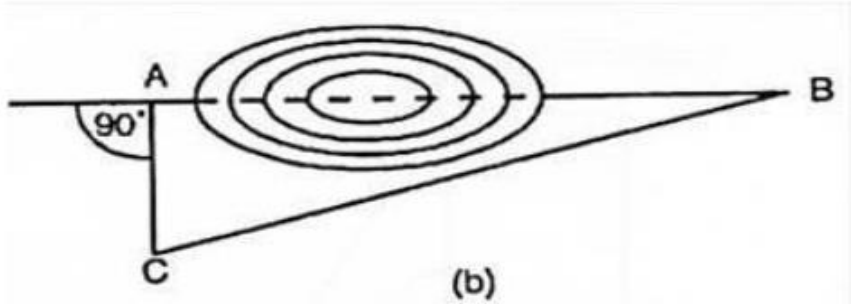


Fig. 3.21. (b)

(C) Find by optical square or a cross-staff a point C such that ∠ACB is right angle [Fig. 3.21(c)] Measure AC and BC.

$$AB^2 = AC^2 + BC^2 \quad \therefore AB = \sqrt{AC^2 + BC^2}$$

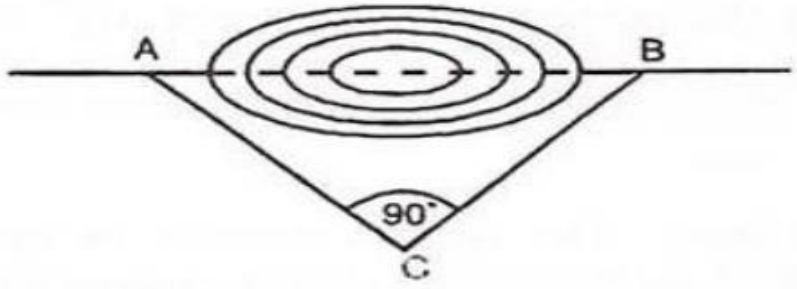


Fig 3.21 (c)

Chaining Obstructed, Vision Free

(d) Mark a point C so that CA and CB clear the obstacle [Fig. 3.21. (d)]. Range E in line with AC so that CE = AC. Then range D in the line with BC so that CD = BC. The triangles CAB and CED are congruent. Therefore DE = AB.

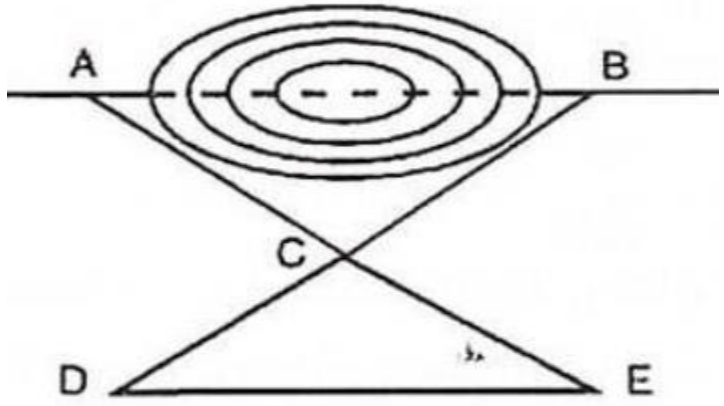


Fig 3.21 (d)

(e) Fix two points A and B as before [Fig. 3.22 (e)].

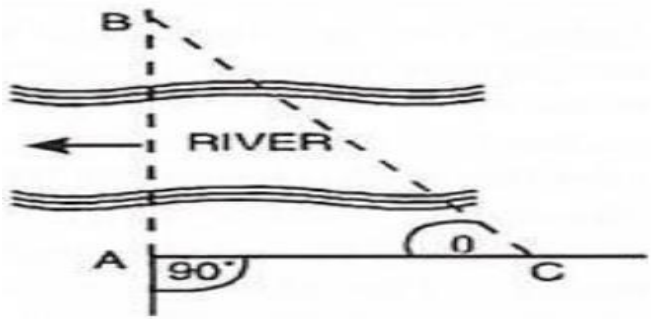


Fig. 3.22 (d)

$$tan\,\theta = \frac{AB}{AC}$$

$$\therefore AB = AC\,tan\,\theta$$

Chaining and Vision Both Obstructed

A building is a typical example of this class of obstacles. The problem in this case consists both in prolonging the line beyond the obstacle and finding the distance across it.

(a) Select two points A and B on the chain line [Fig. 3.23 (a)]. At A and B, erect equal perpendiculars AC and BD. Join CD and produce it past the obstacle. Select two points E and F on it. At E and F, set out perpendiculars EG and FH, each equal in length to AC. The points G and H then lie on the chain line and BG = DE.

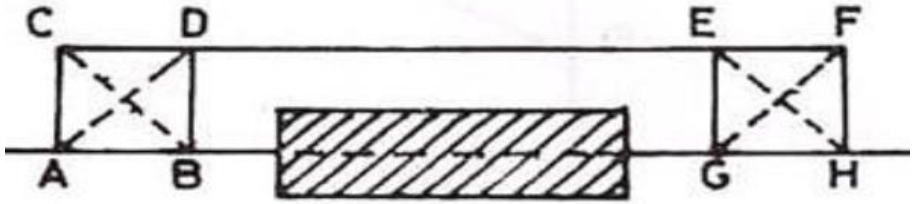


Fig. 3.23. (a)

There is an obstacle in the form of a pond on the main chain line AB. Two points C and D were taken on the opposite sides of the pond. On left of CD, a line CE was laid out 100 m in length and a second line CF, 80 m long was laid out on the right of CD such that E, D and F are in the same straight line. ED and DF were measured and found to be 60 m and 56 m respectively. Find out the obstructed length CD.

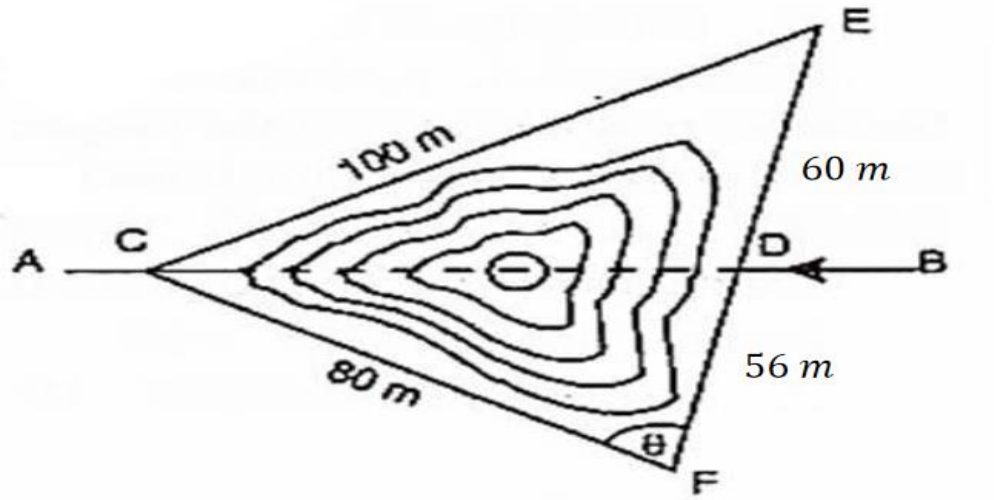
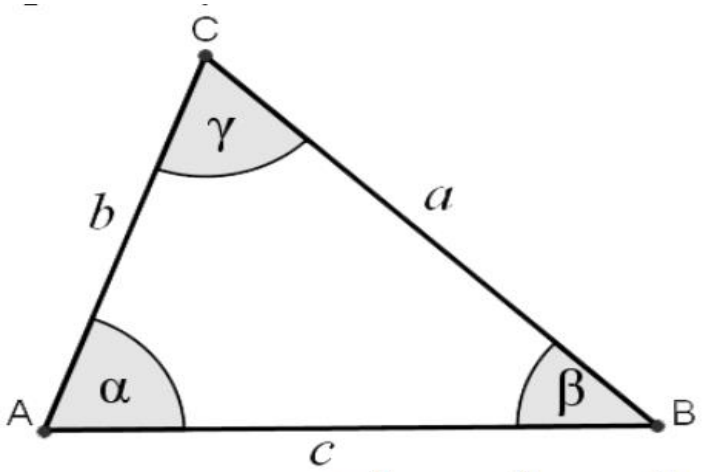


FIG. 3.24



$$Cos\alpha = \frac{b^2 + c^2 - a^2}{2bc}$$

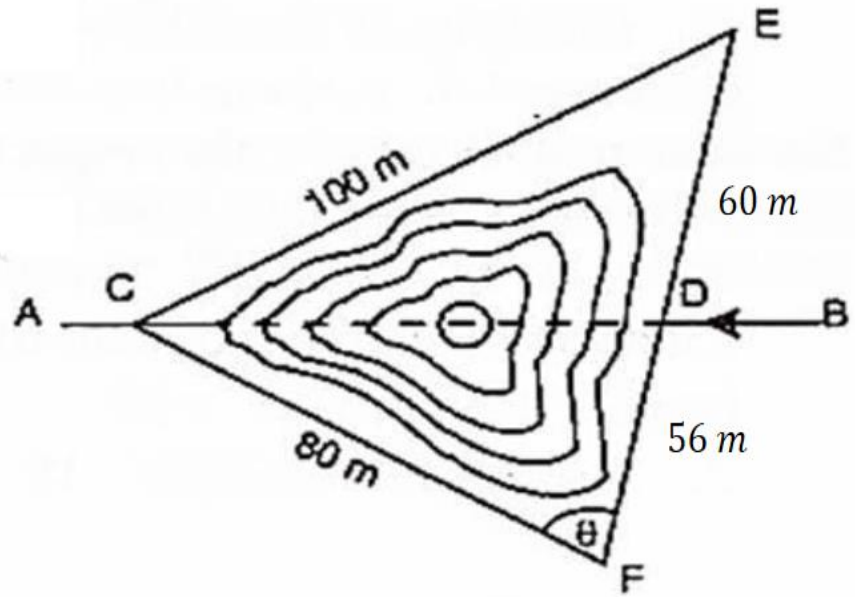


FIG. 3.24

ΔFCE

$$Cos\theta = \frac{FC^2 + FE^2 - CE^2}{2.FC.FE}$$

$$Cos\theta = \frac{80^2 + 116^2 - 100^2}{2 \times 80 \times 116}$$

ΔFCD

$$Cos\theta = \frac{FC^2 + FD^2 - Cd^2}{2.FC.FE}$$

$$Cos\theta = \frac{80^2 + 56^2 - CD^2}{2 \times 80 \times 56}$$

$$\frac{80^2 + 116^2 - 100^2}{2 \times 80 \times 116} = \frac{80^2 + 56^2 - CD^2}{2 \times 80 \times 56} \quad \therefore CD = 69.123\,m$$

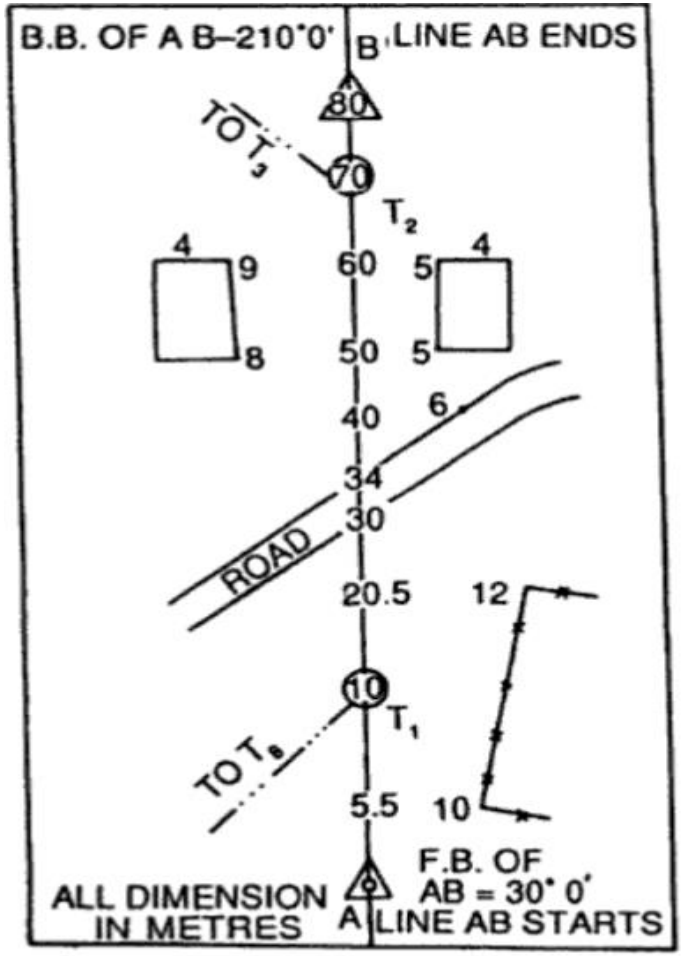
The field book

The field book :

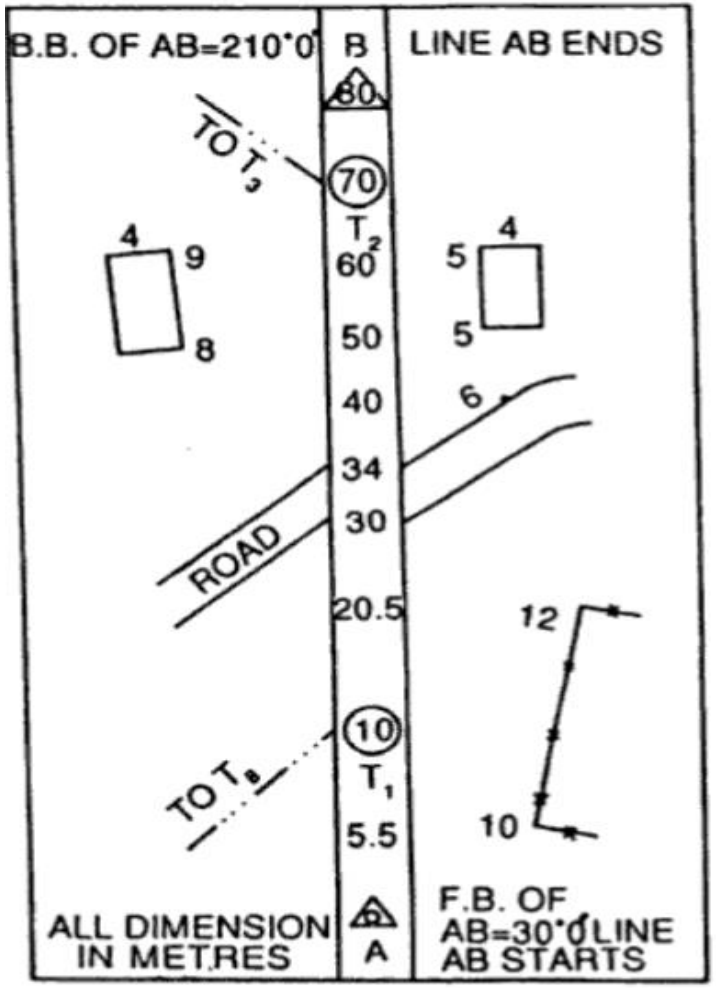
The notebook in which field measurements are noted is known as the 'field book’. The size of the field book is 20 cm x 12 cm and it opens lengthwise. Field books may be of two types:

1. Single-line, and
2. Double-line.

1. Single-line field :



2. Double-line field book :



Practical Problems

Problem1:

While measuring a chain line AB, the following offsets are taken. How would you enter the field book?

(a) A telegraph post is 10 m perpendicularly from chainage 2.5 m to the right of the chain line.

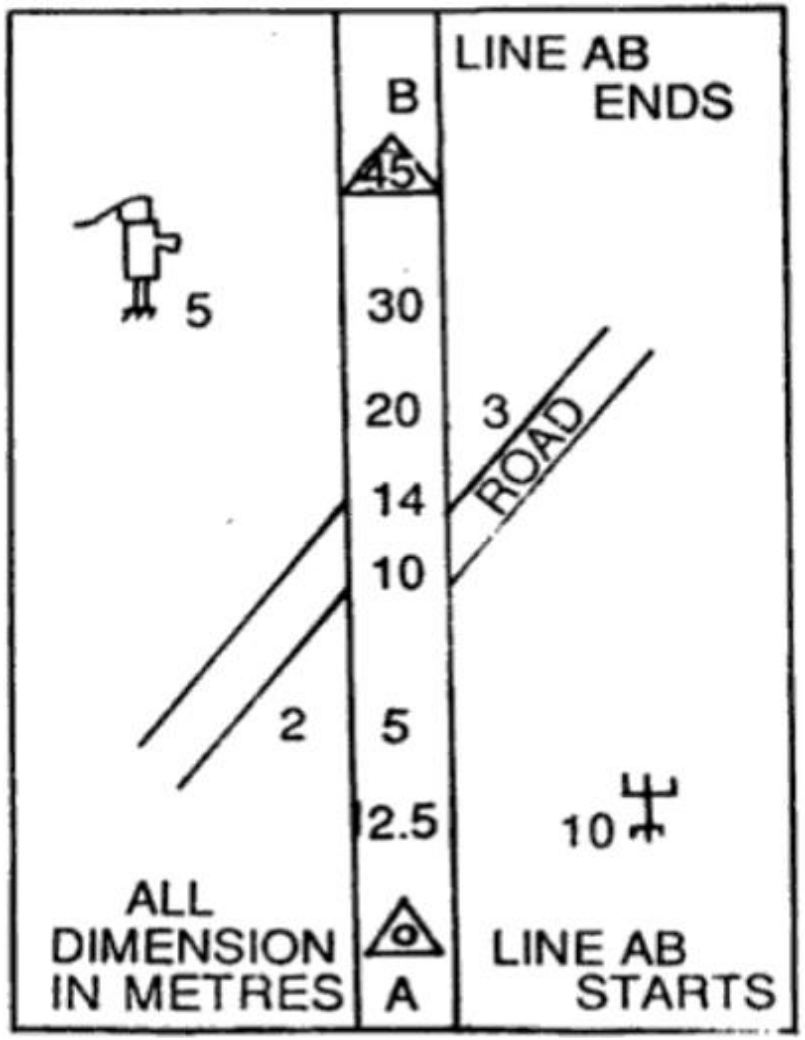
(b) A road crosses obliquely from left to right at chainage 10 m and 14m.

Perpendicular offsets are 2 m and 3 m to the side of the road from chainage 5 m and 20 m respectively.

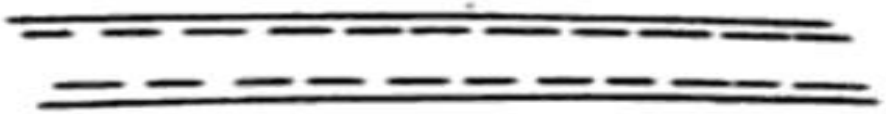
(c) A tube-well is 5 m perpendicularly from chainage 30 m to the left of the chain line.

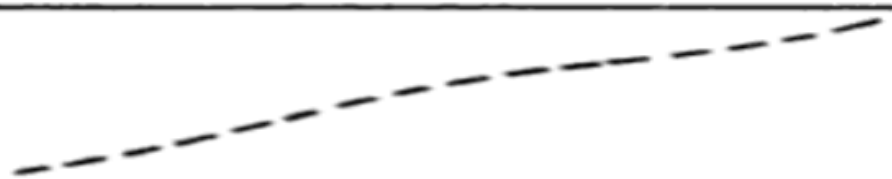
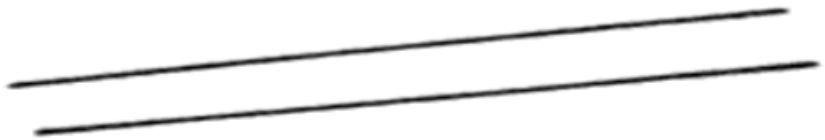
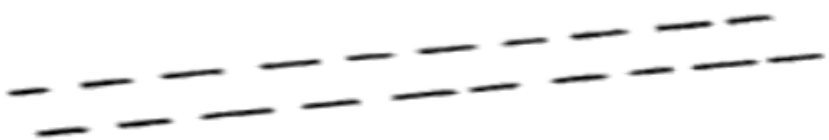
(d) Total chainage of AB is 45 m.

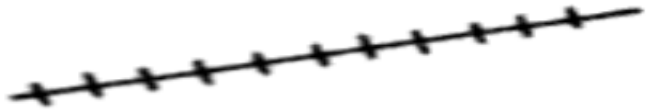
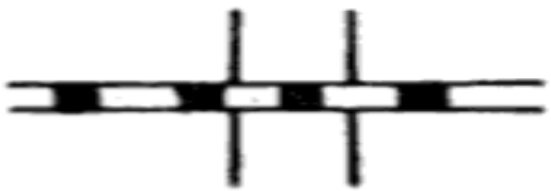
Solution :

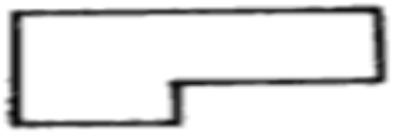
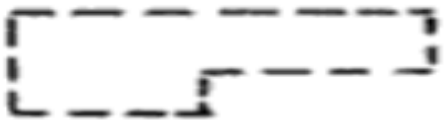
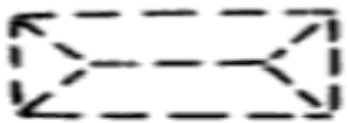

LINE AB
ENDS
B
45
5
30
20
3
ROAD
14
10
2
5
2.5
10
ALL
DIMENSION
IN METRES
A
LINE AB
STARTS

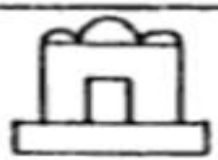
Conventional symbols

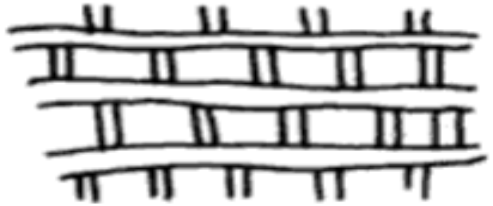
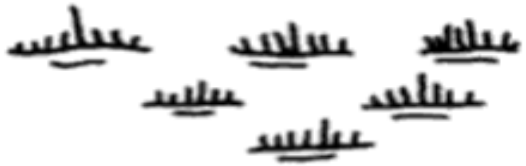
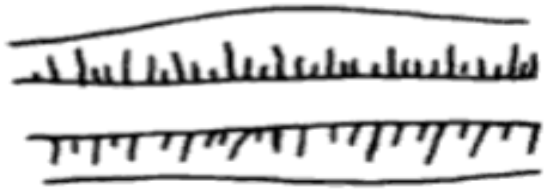
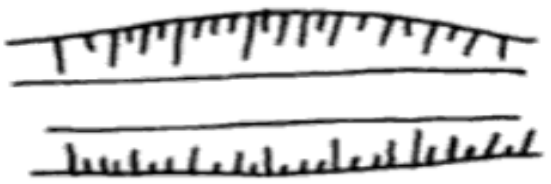
S. No.	Object	Symbol
1.	North line	
2.	Main stations or triangulation stations	
3.	Traverse stations or substations	
4.	Chain line	
5.	River	
6.	Canal	

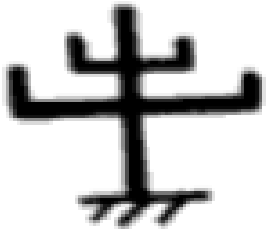
S. No.	Object	Symbol
7.	Lake or pond	
8.	Open well	
9.	Tube well	
10.	Footpath	
11.	Metalled road	
12.	Unmetalled road	

13.	Railway line (single)	
14.	Railway line (double)	
15.	Road bridge or culvert	
16.	Railway bridge or culvert	
17.	Level-crossing	
18.	Wall with gate	
19.	Boundary line	

20.	Hedge	
21.	Wire fencing	
22.	Pipe fencing	
23.	Wood fencing	
24.	Building (*Pukka*)	
25.	Building (*katcha*)	
26.	Huts	

27.	Temple	
28.	Church	
29.	Mosque	
30.	Benchmark	
31.	Tree	
32.	Jungle	
33.	Orchard	

34.	Cultivated land	
35.	Barren land	
36.	Rough pasture	
37.	Marsh or swamp	
38.	Embankment	
39.	Cutting	

40.	(a) Telegraph line	
	(b) Telegraph post	
41.	(a) Electric line	
	(b) Electric post	


thank you!