EWCE 103

Surveying

Chain Survey

What we going to discuss?

- Field Book
- Procedure in Chain Survey
- Four Basic Problems in Chain Survey
- Obstacles in
- Plotting
- Problems

Instruments -Chain Surveying

Chain surveying includes the following **instruments:**

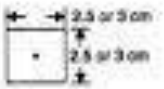
- **Chain or tape**
- **Arrows**
- **Pegs**
- **Offset rods**
- **Ranging rods**
- **Plumb bob**

Instruments -Chain Surveying











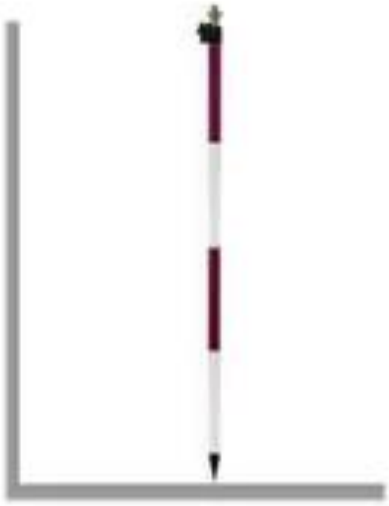




Instruments -Chain Surveying



Offset Rods







Field Book:

- **Observations and measurements** taken during chain surveying are to be **recorded** in a standard **'Field Book'.**

- A **oblong book** of size **200 mm × 120 mm** (7.8inch x 4.7inch), which can be carried in the pocket.

- **Two forms of the book:**
  (i). **Single line Field Book** and
  (ii). **Double line Field Book**.

Field Book (cont..):

Single Line

- Pages of a single line book are having **a red line along** the length of the paper in the **middle of the width**, **indicates the chain line.**

- **Chainage are written across it**. Spaces on either side of the line are used for **sketching the object** and for **noting offset distances**.

Double Line

- **Two blue lines** with a **space of 15 to 20 mm** is the middle of each page of double line Field Book.

- **Space between** the two lines is utilized for **noting the chainages**.

Field Book (cont..):

Characteristics:

- **Chain line starts** from the **bottom of the page** and works upward.

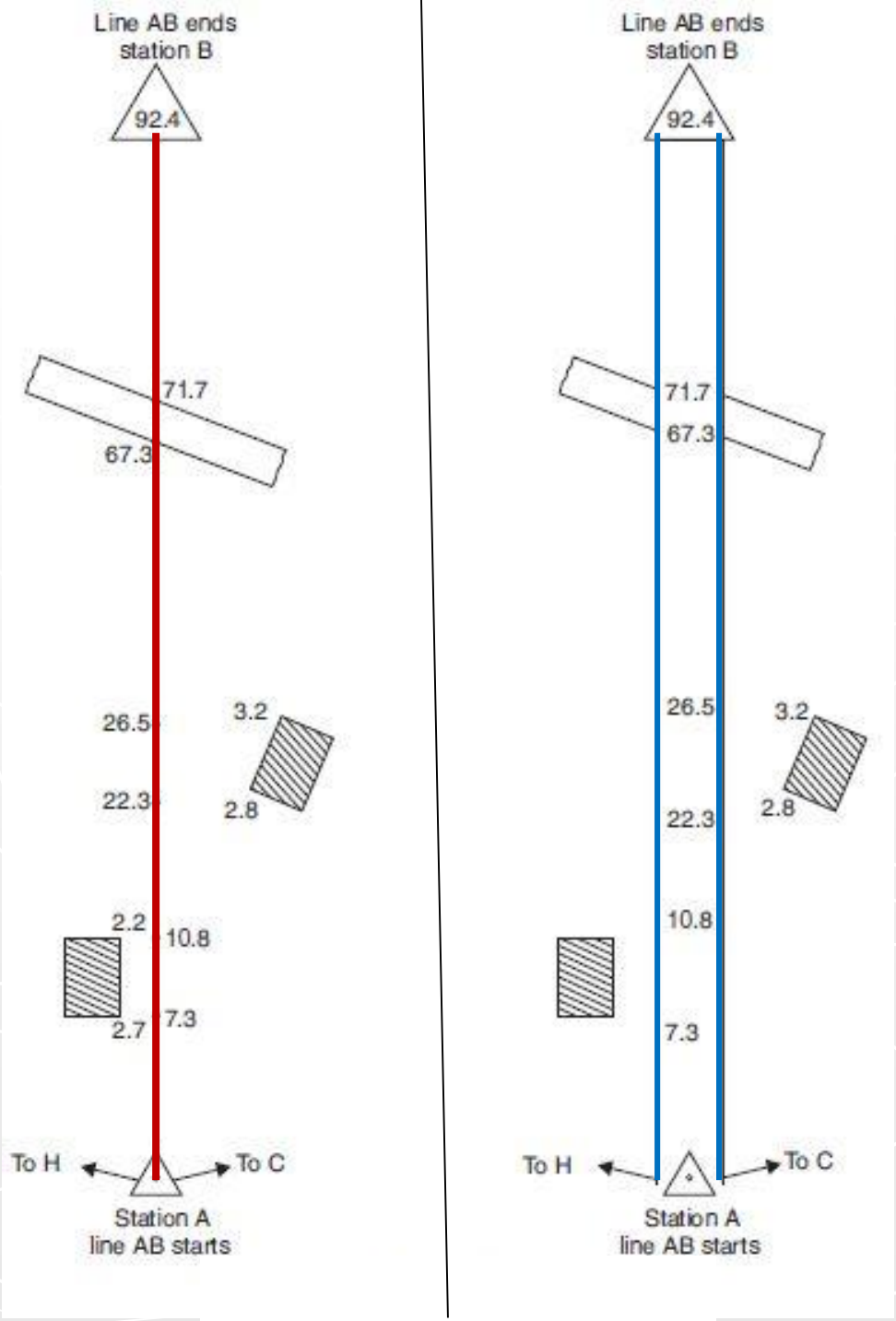
- **All distances along chain line entered** in the **middle or across single line.**

- **Offsets are entered** either to left or right of the chain line in the order they appear at the chain line.

Field Book (cont..):

Characteristics:

- As various **details of offsetting distances are reached**, they are **sketched are entered**.
- **Every chain line** must be **started from a fresh page**.
- **All pages are machine numbered**.


Line AB ends
station B
92.4
71.7
67.3
26.5
22.3
3.2
2.8
2.2
10.8
2.7
7.3
To H
To C
Station A
line AB starts
Line AB ends
station B
92.4
71.7
67.3
26.5
22.3
3.2
2.8
10.8
7.3
To H
To C
Station A
line AB starts

Summary –Field Book

- **Observations and measurements recorded Arrows.**
- A **oblong book** of size **200 mm × 120 mm** can be carried in the pocket. **Ranging rods.**
- **Two forms of the book;** **Single line** and **Double line**.
- Single line book has **a red line and double line has two blue line along the middle.**
- **Chainage are written across and in the middle of line/lines.**
- **Offsets are entered** either to left or right of the chain line in the order they appear at the chain line.
- **Every chain line** must be **started from a fresh page**.
- **All pages are machine numbered**.

Procedure -Chain Surveying

Entire operation of chain survey can be divided into three main groups:

- **Fieldwork**
  a. **Reconnaissance**
  b. **Marking and fixing survey stations**
  c. **Running survey lines**

- **Keeping of records in field book**

- **Plotting of data to prepare map**

Question: Briefly describe the procedure of chain surveying.

Reconnaissance in Field Work

What is reconnaissance in the field works of surveying?

- Before starting the actual survey measurements, **field reconnaissance** to be conducted.
- Surveyor to **walk around the area to fix** best position of **survey lines** and **survey stations**.
- A ***reference sketch of the ground*** should be prepared by the surveyor.
- Sketch, **shows the skeleton of the surveying** work

Question: A reference sketch of the ground shows the skeleton of the of the survey work. Explain

Things to do during reconnaissance:

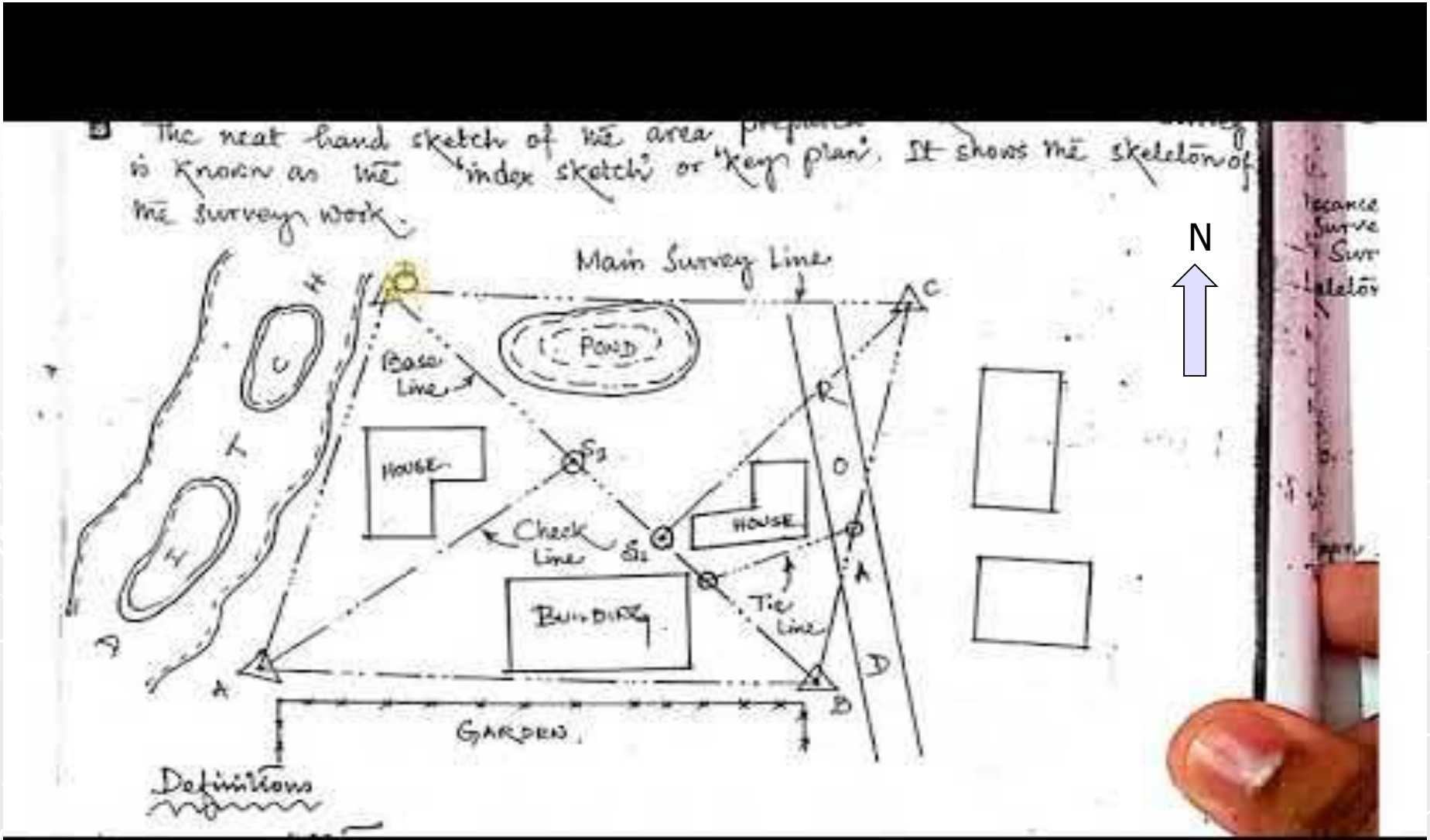
- **General arrangement of lines**, **principal features** such as buildings, roads, canals, ditches, culverts etc. to be shown on the sketch.

- **Examine** the **inter-visibility of stations** before selecting the stations and **note the positions** of buildings, roads, streams etc.

- **Investigate various difficulties** that may arise and their solutions to be thought.

Question: As a surveyor, what you will do during reconnaissance of the field in surveying?

Reference sketch of the ground



SURVEY STATIONS

Survey Stations

- Survey stations are **the points at the beginning and the end of a chain line.**
- **May also occur at any convenient points** on the chain line.

- Such station may be:
  - **Main stations.**
  - **Subsidiary stations. And**
  - **Tie stations.**

SURVEY STATIONS

Main Stations:

- **Stations taken along the boundary of an area as controlling points** are known as ‘main stations’.
- **Lines joining the main stations** are called **‘main survey lines’.**
- Main survey lines should **cover the whole area** to be surveyed.
- Main stations are denoted by with letters A, B, C, D, etc.
- Chain lines are denoted by --- ___ ---

SURVEY STATIONS

Subsidiary Stations:

- **Stations are on the main survey lines or any other survey lines** are known as “subsidiary station”.

- Stations are taken to **run subsidiary lines** for:
  -dividing the area into triangles, for
  -checking the accuracy of triangles and for
  -locating interior details.

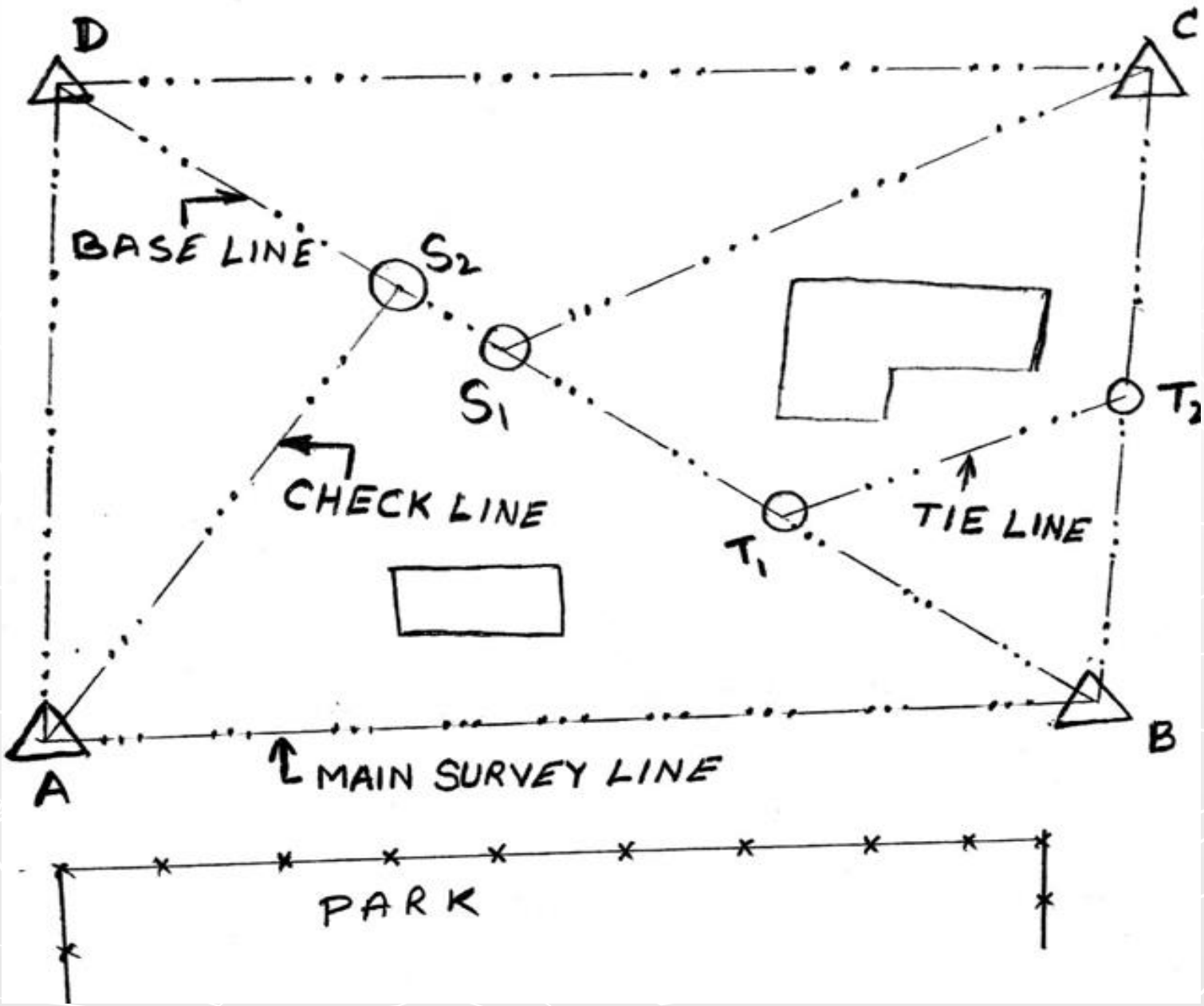
- Stations are denoted with letters S1, S2, S3, etc.

SURVEY STATIONS

Tie Stations:

- **Tie stations are taken on the main survey lines.**
- Lines joining the tie stations are called **tie lines.**
- Also taken to **form 'chain angles'** in chain traversing, when triangulation is not possible.
- **Lines are taken to locate interior details.**
- Tie stations are denoted with letters T1, T2, T3, etc.

SURVEY STATIONS



Base Line:

- **Line on which the framework of survey is built** is known as the ‘base line’.
-
- It is **most important line** of the survey.
- **Longest of the main survey lines** is considered the base line.
- Line should be **taken through fairly level ground**, and should be **measured very carefully and accurately.**
- Magnetic bearing of base line are taken to **fix the north line of the map.**

SURVEY STATIONS

Check Line:

- **Line joining** the **apex points of triangle to some fixed point on its base** is known as the ‘check line’.

- It is taken to **check the accuracy of the triangle**.

Marking & Fixing Survey Stations

Marking & Fixing Survey Stations:

- Survey stations to be **marked to enable them to be easily discovered** during the progress of the survey.

- **Marking of a station depend upon the following considerations**:

  -Triangle should be well defined one i.e., n**early equilateral triangle.**

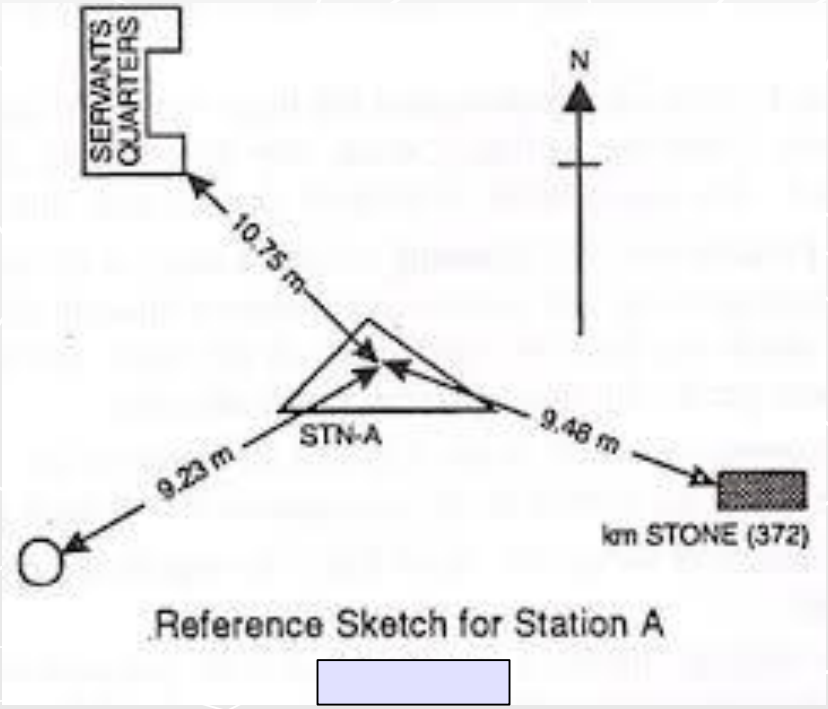
  -Every main station should be visible from any other two.

Marking & Fixing Survey Stations

- In soft ground, **wooden pegs should be driven, leaving a small projection above the ground**.

- Name of the station may be written on top .

- **Every stations should have referred** to two to three permanent points.



Reference Sketch for Station A

Marking & Fixing Survey Station



Chain line/lines should have following requirements:

- **Minimum number of obstacles** in **ranging** and chaining.
- Run **near the boundary** as far as possible of the plot.
- Be as **few as possible.**
- Should be over an approximately **leveled ground.**

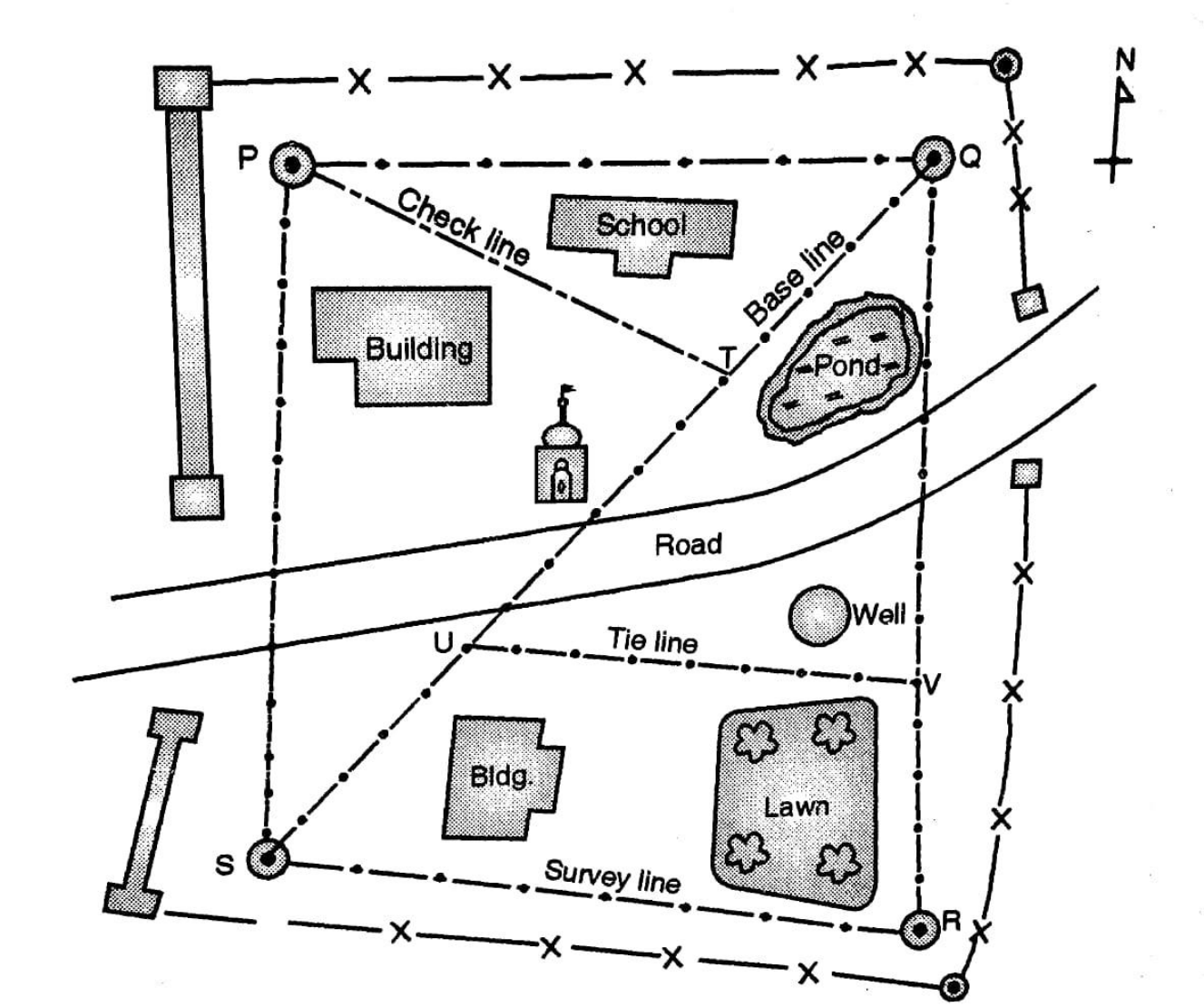
- In case of **chaining along the road**, it is always better to **run chains at one side of the road** so as to avoid interruption of vehicles. It is better not to cross road frequently.

- **In soft ground**, **wooden pegs should be driven, leaving a small projection above the ground**. The name of the station may be written on top .

- **Offsets should not exceed one chain**.

- **Check and tie lines** should be provided **in sufficient numbers** so that all the main lines, offsets and other details can be checked thoroughly.

Field Work


N
P
Q
Check line
School
Base line
Building
T
Pond
Road
Well
U
Tie line
V
Bldg.
Lawn
S
Survey line
R

Running Survey Lines

Running Survey Lines

General Points

- **Chaining to be started from the base line.**

- **Work in running survey** line in two folds:
  -to **chain the line** and
  -to **locate the adjacent details**.

- **Offsets are taken** in order of their chainage.

- **Chaining and offsetting is repeated** until end of chain line.

- **Distances along the survey lines**, at which fences, roads etc and **intersected** by **to be recorded**.

Field works

Example: Running Survey Lines:

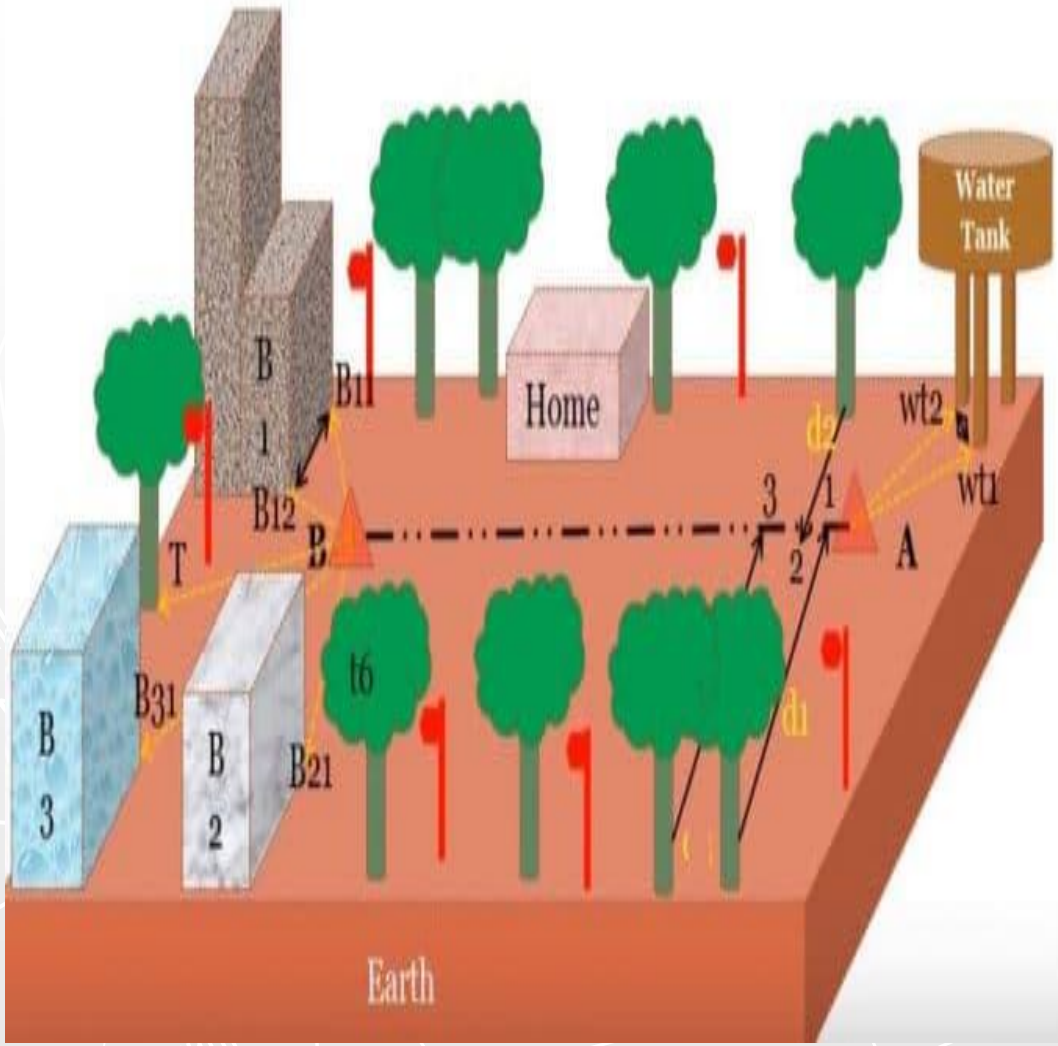
- For a line AB, **a ranging rod is first fixed** on both of the end (A and B).
- **Another ranging rod** is fixed at an **intermediate point C** in between A and B.
- **Three rods will be in a straight line** when only the intermediate rod is visible if a person looks from A to B.
- Now **measurement of line AB is taken by chain**. The chain should be properly stretched so that there **is no sag** in it.

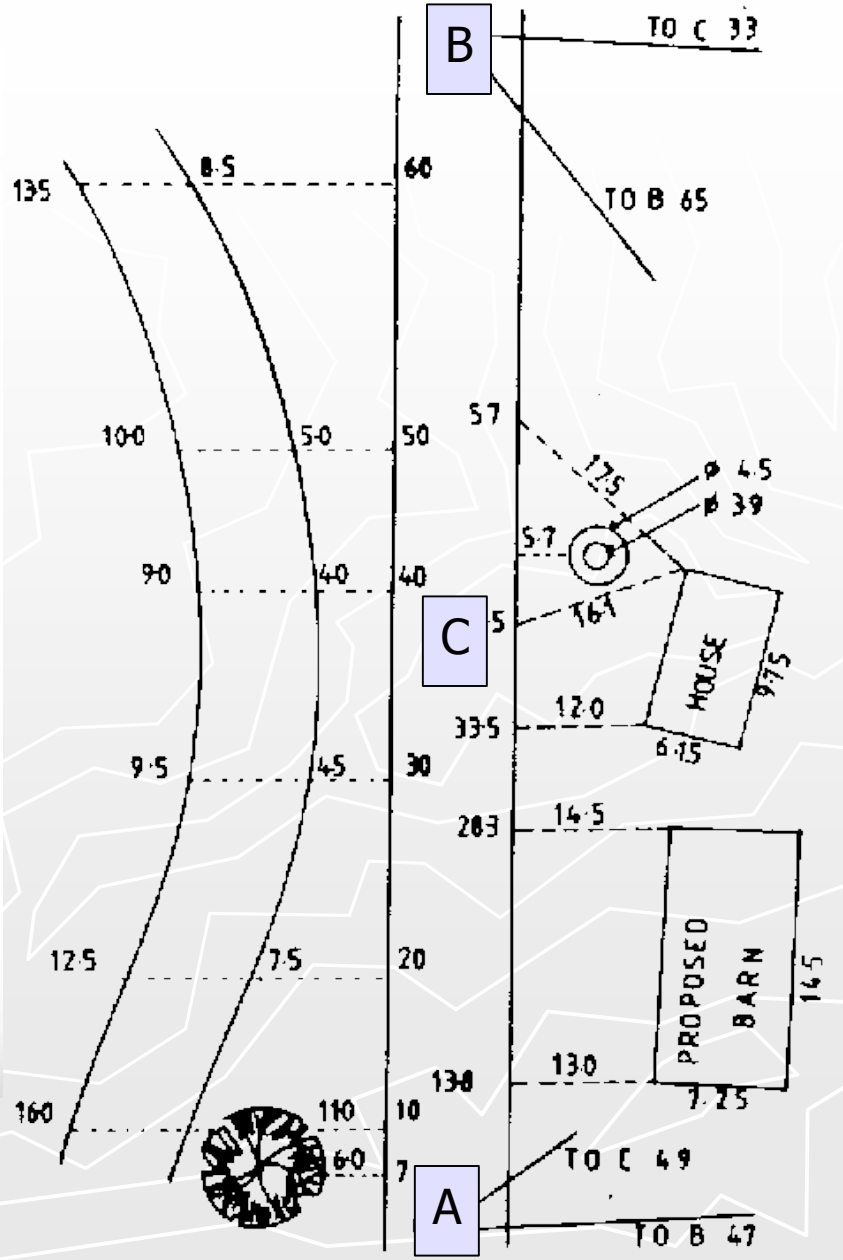
Field works

Running Survey Lines (cont..):

- As the **measurements proceed**, **offsets are taken on both sides of the line AB** and **recorded in the field book**.
- In this way all the lines including **tie and check lines are measured** and **offsets are taken** and recorded in the **field book.**

Field works


B
1
B1
B12
Home
Water
Tank
wt2
wt1
T
B
3
1
2
A
B
3
B31
B
2
B21
t6
Earth


B
C
A
TO C 33
TO B 65
TO C 49
TO B 47
8·5
60
135
10·0
5·0
50
9·0
4·0
40
9·5
4·5
30
12·5
7·5
20
16·0
11·0
10
6·0
7
5·7
12·5
ø 4·5
ø 39
5·7
16·7
5
HOUSE
9·75
12·0
33·5
6·15
20·3
14·5
PROPOSED
BARN
14·5
13·0
13·0
7·25

Problems in Chaining

Problems in Chaining

Four basic problems in chaining such as:

- **Erect a perpendicular to a chain line** from a point on it.
- **Drop a perpendicular to a chain line** from point outside it.
- **Run a parallel to chain** through a given point.
- **Run a parallel to a given inaccessible line** through a given point.

Problem

Erect a perpendicular to a chain line from a point on it:

3-4-5 Method:

- Let it be required to erect a perpendicular to the chain line **at a point C** in it. **Point E** is established at a distance of 3m from C.

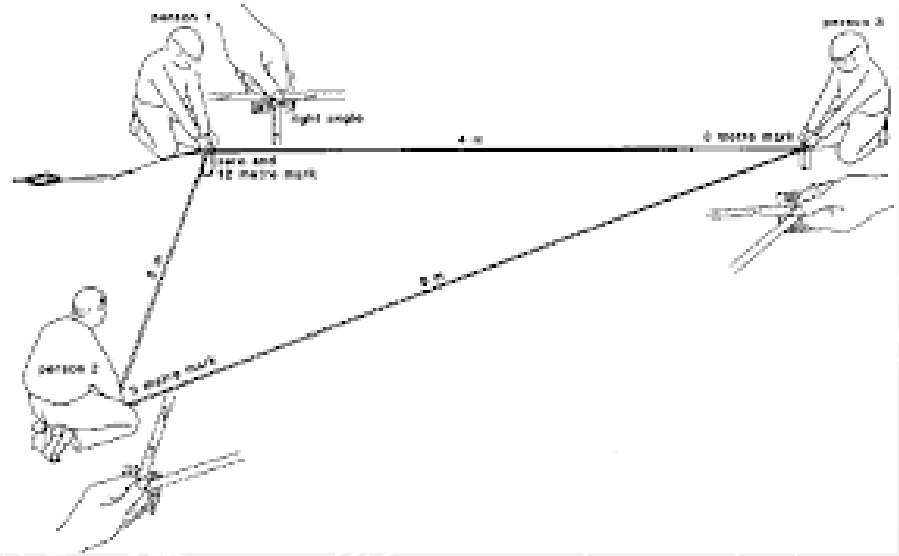
- '**0 (zero)' end** of a **10m long tape/chain** is **put at E** and the **'10 (ten)' end** is put **at C**.

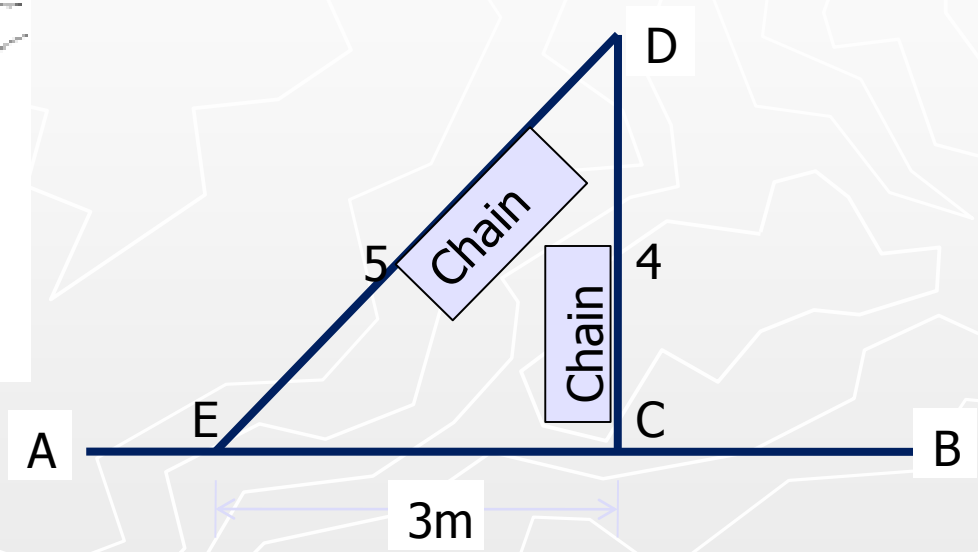
- The **5m and 6m marks are brought together to form a loop** of 1m.

- **Tape is now stretched tight** by fastening the ends E and C. The point D is thus established. Angle DCE will be 90^{o}.

Problems in Chaining

Erect a perpendicular to a chain line from a point on it







Problem in Chaining

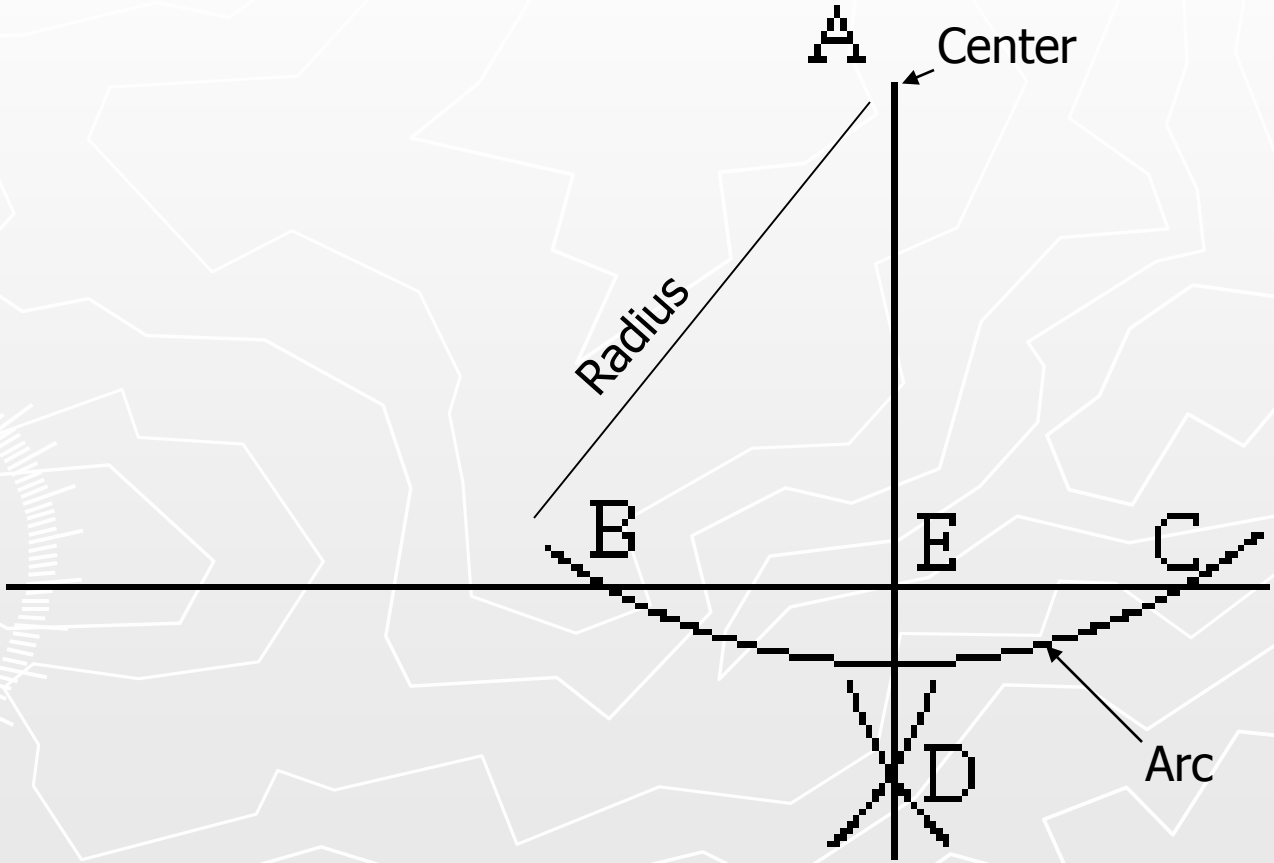
Drop a perpendicular to a chain line from point outside it

Method:

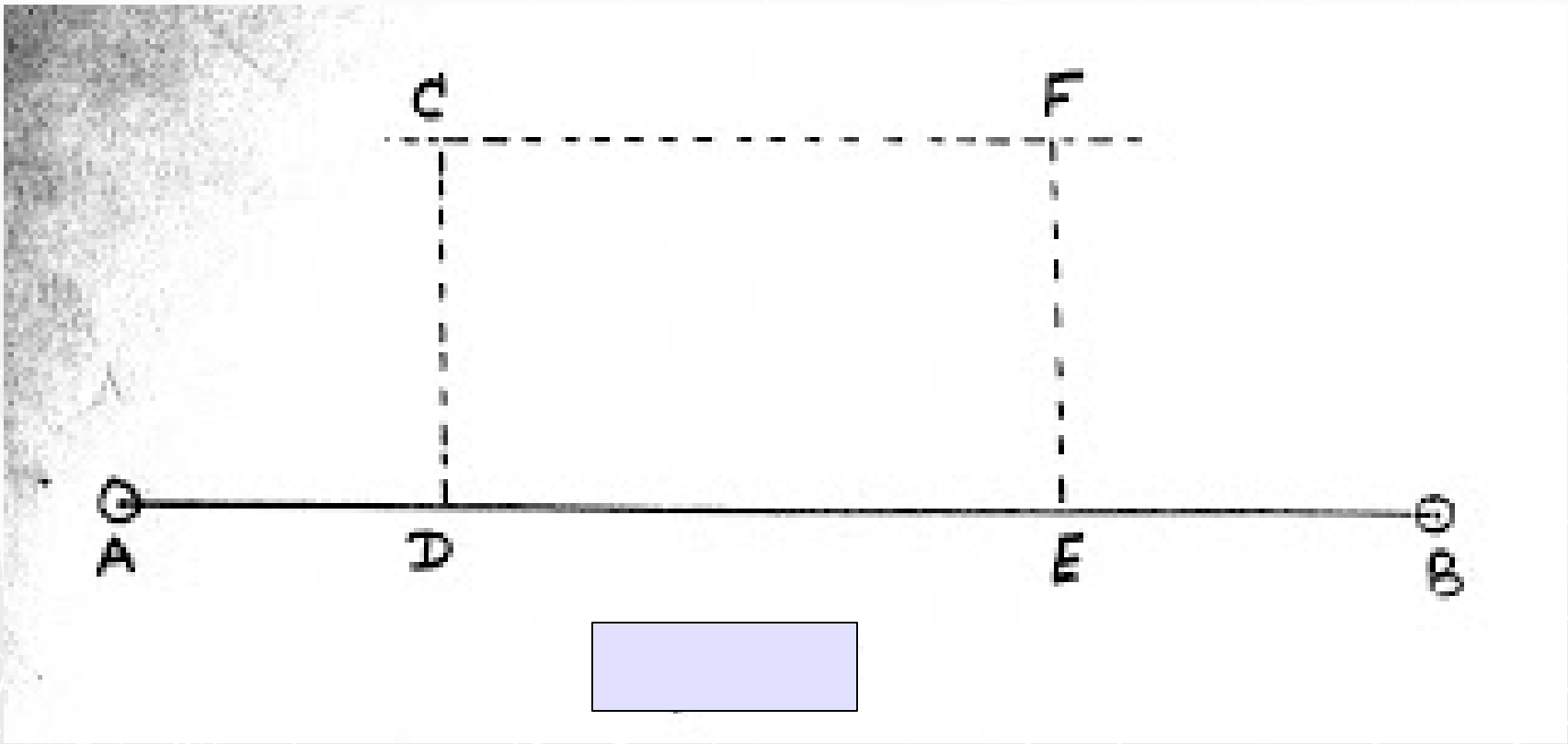
- Let it be required to **drop a perpendicular to a chain line** from a point A outside it.
- Any point **B is selected** on the line.
- With **A as centre** and **AB as radius**, an **arc to cut chain line** is drawn in B.
- Then **BC is bisected at D**.
- **AE will be perpendicular to BC**.

Problem

Drop a perpendicular to a chain line from point outside it



Problem in Chaining: To run a parallel line to chain line through a given point



Problem in Chaining: To run a parallel line to chain line through a given point

- Let **AB, be the chain line** and **C the point** through which it is desired to lay out a line parallel to AB.
- From C lay out **CD perpendicular to AB** and **measure the length** of CD.
- Choose a point **E on the line AB as far as possible from D** and at E erect a perpendicular EF to AB equal in length to CD
- **Line Joining Points C and F** will then be on a straight line parallel to AB.

Problem in Chaining

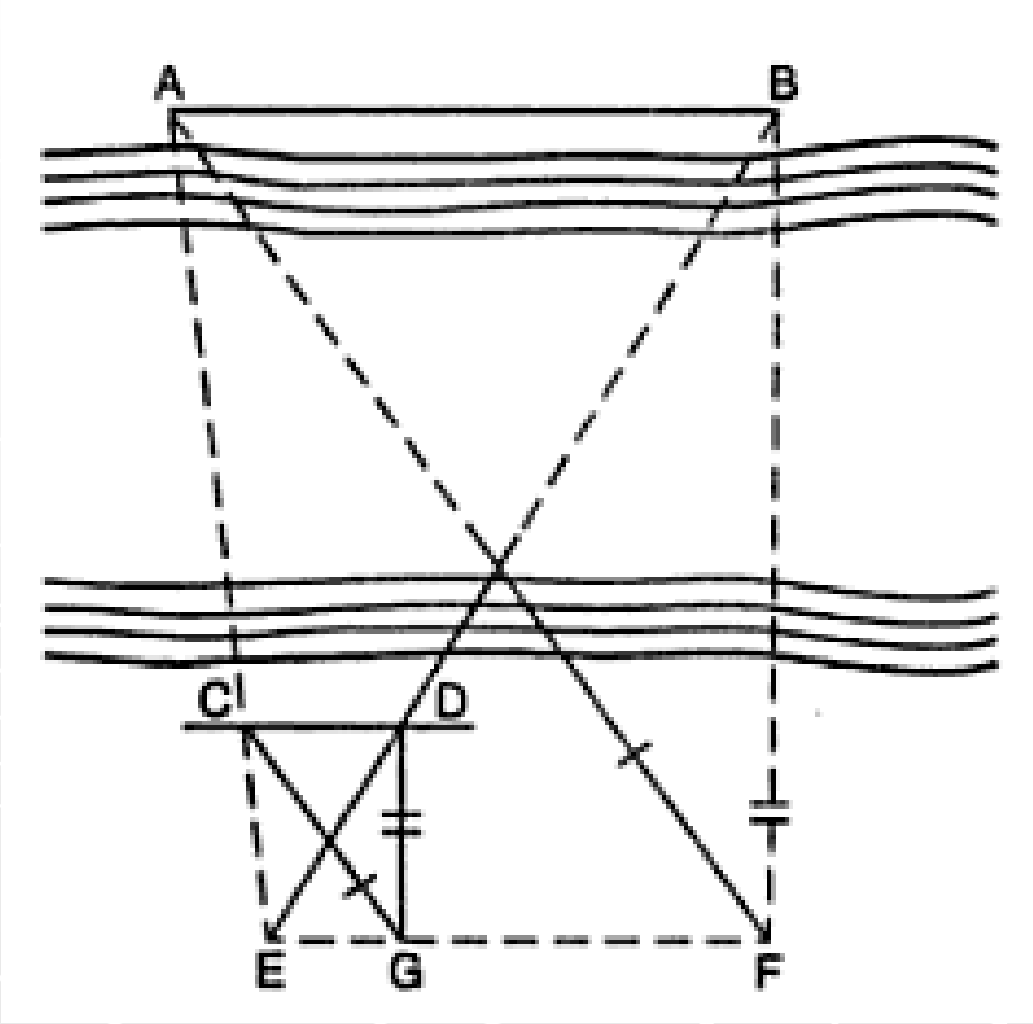
Run a parallel to a given inaccessible line through a given point

Let **AB be the given inaccessible line** and **C be the given point** through which the parallel is to be drawn.

Method:

- Any **point E is selected in line with A and C**.
- Similarly any other convenient **point F is selected**.
- **E, F are made join**.
- Through C, a line **CG parallel to AF is** drawn.
- Through G, a line **GD parallel to BF** is drawn, cutting **CE at D.**
- CD will be then the required line.

Problem: To run a parallel to a given inaccessible line through a given point



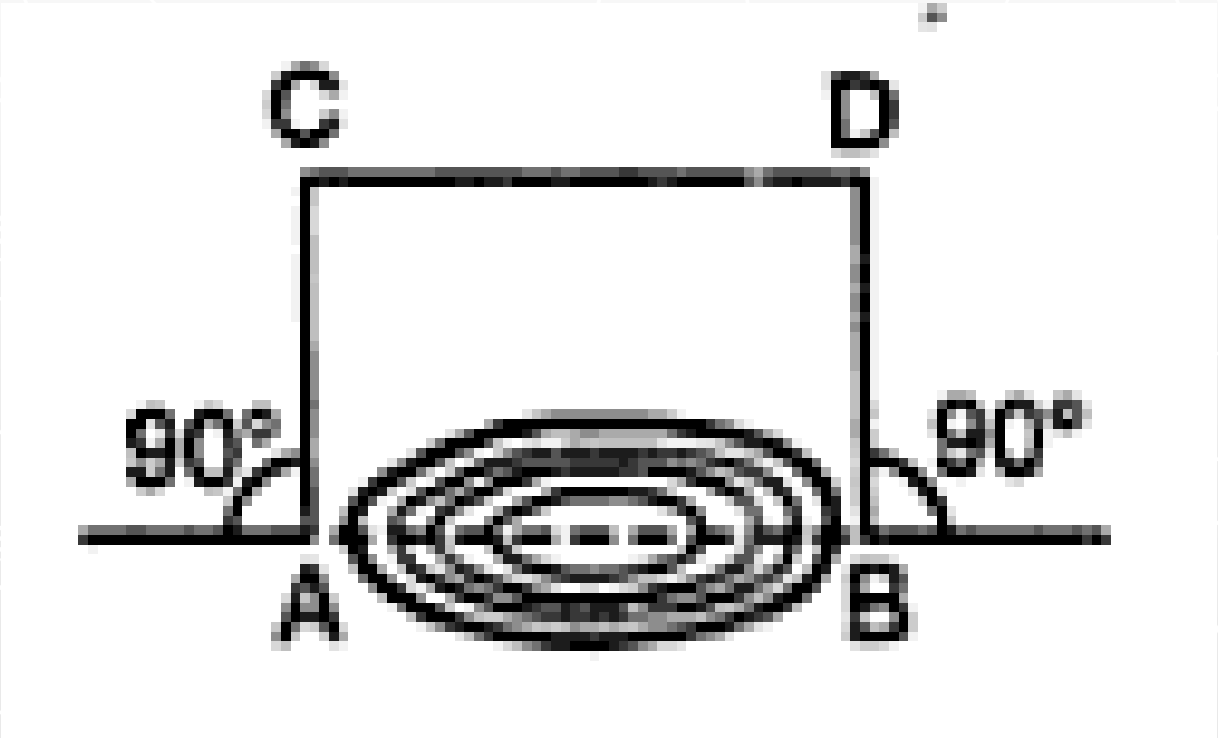
Obstacles in Chaining

Obstacles in Chaining and Ranging

Obstacles to Chaining

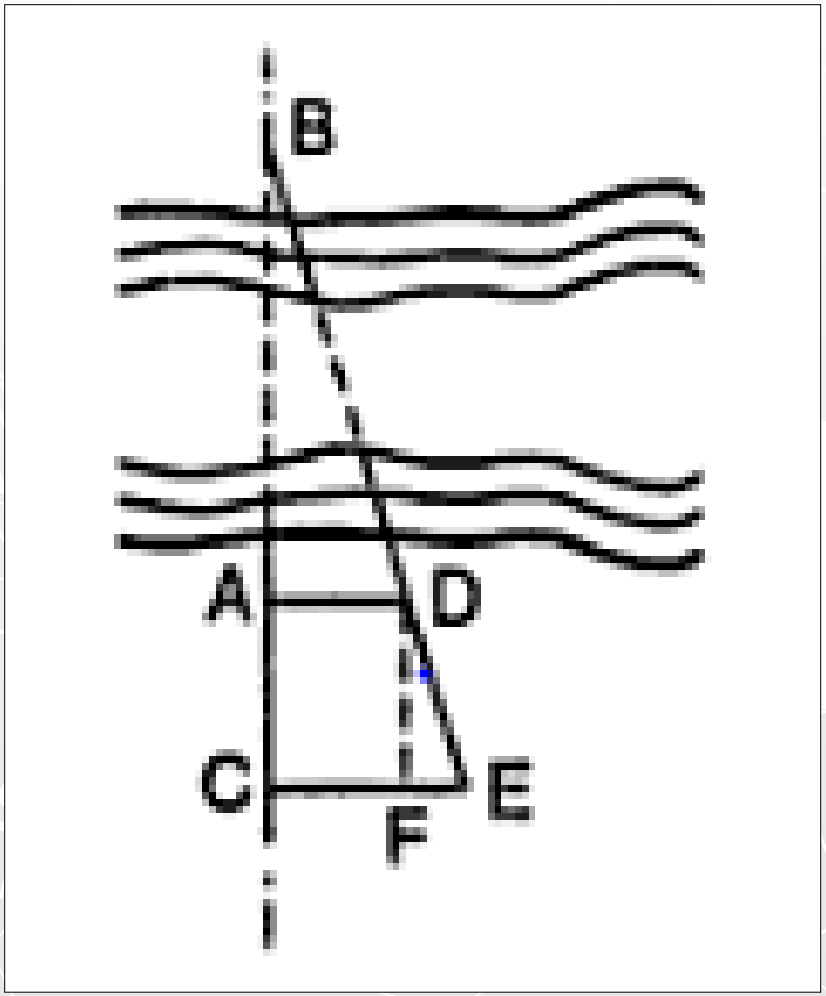
Two cases

- When it is **possible to chain** round the obstacles **(i.e a pond, hedge etc.)**



Obstacles to Chaining

ii. When it is **not possible to chain** round the obstacles (i.e. river)



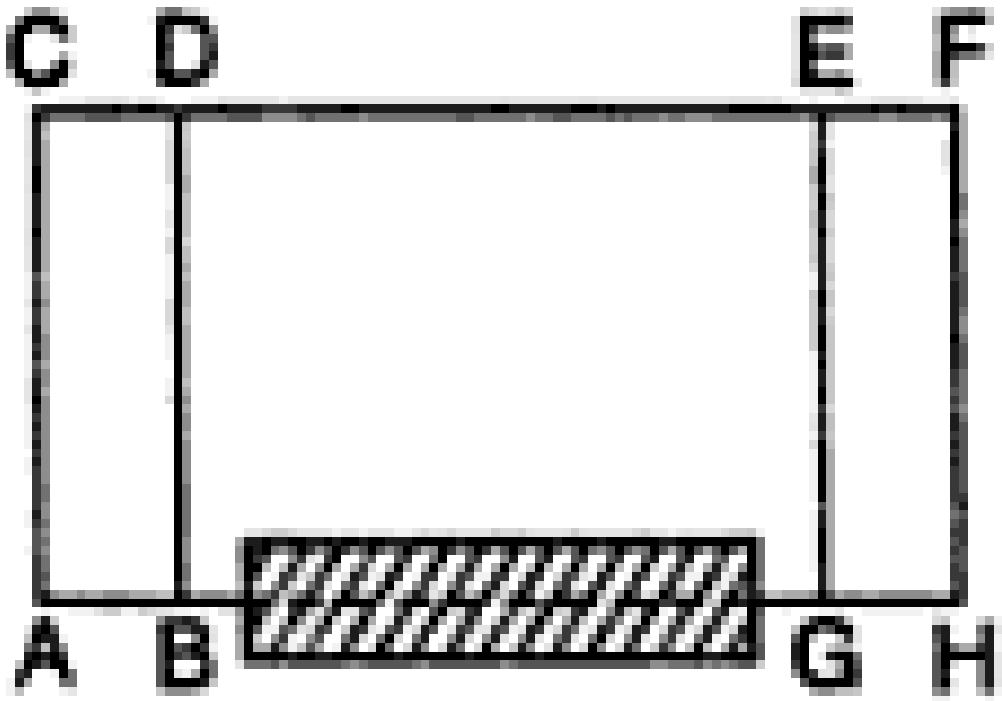
$$\frac{AB}{AD} = \frac{DF}{FE}$$

$$FE = CE - CF = CE - AD \text{ , and } DF = AC.$$

$$\frac{AB}{AD} = \frac{AC}{CE - AD} \qquad \text{From which} \qquad AB = \frac{AC \times AD}{CE - AD}$$

Obstacles to both Chaining and Ranging

Example: Building



$$BG = DE$$

Obstacle to both Chaining and Ranging

- Select two points A and B **on one side** of the obstacle.
- Erect **perpendiculars AC and BD** of equal length.
- **Join CD and prolong** it past the obstacle.
- **Choose two points E and F on the line CD** and erect perpendiculars EG and FH equal to that of AC or BD.
- **Join GH and prolong it.**
- **Measure DE = BG**

Plotting the Details

Plotting work

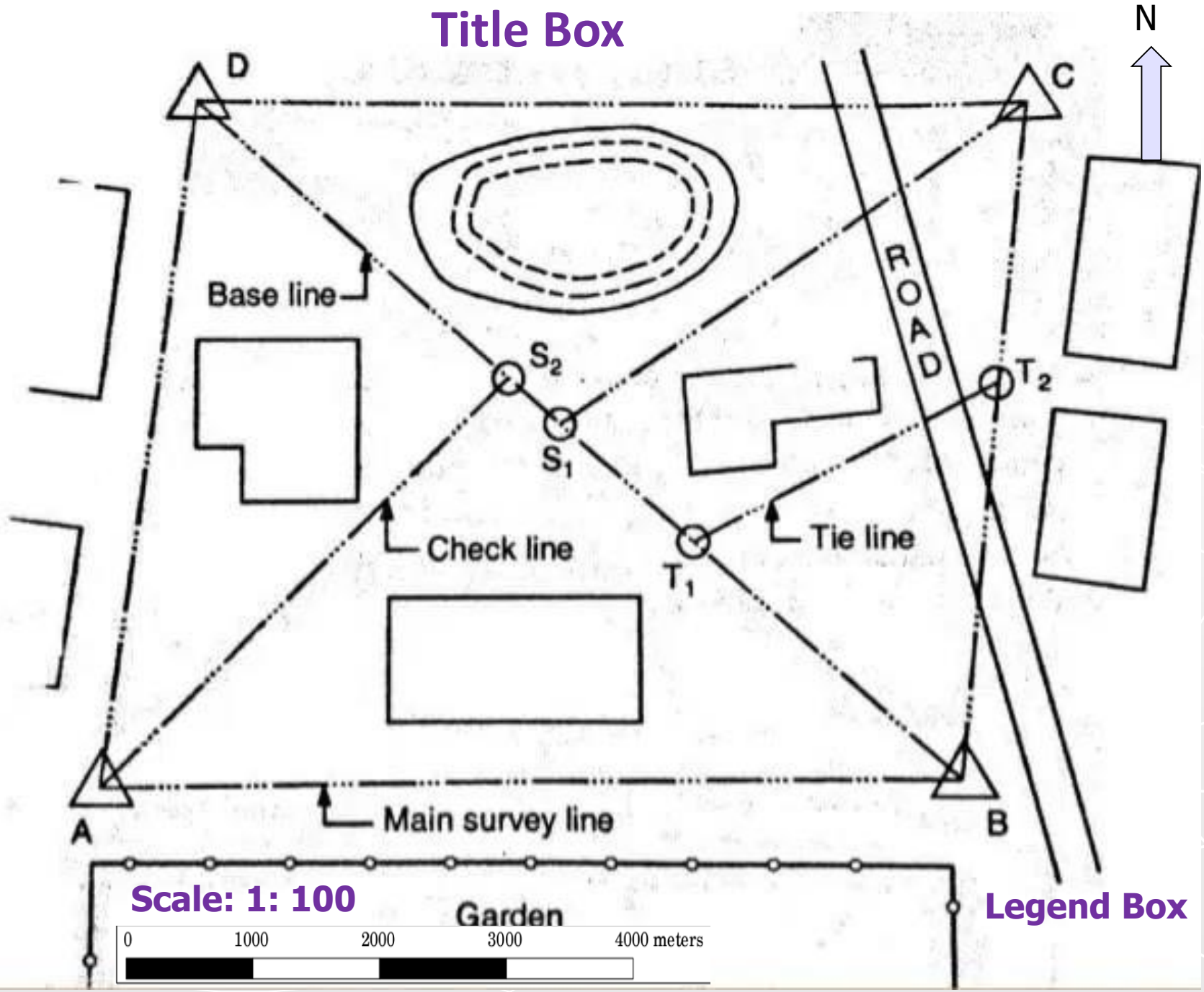
- Choose a **suitable scale and** mark the **north direction.**
- Start with the **base line.**
- Triangle is first **plotted** according to a suitable reduced scale.
- Tie lines and check lines are drawn and **check the accuracy** of the work.
- **Plot offsets** like rail roads, trees, buildings, electric posts etc.

Plotting the Details

Plotting work (cont..)

- **Lines are taken up** one by one, and on it, the distances where offsets have been taken, are marked.
- **Offsets are laid down** on either sides of the lines.
- When offsets are plotted, the **conventional signs** for offsets are putt in.
- Title and legend.

Title Box



Scale: 1: 100

Legend Box

Chain Survey is Suitable when:

- Ground is fairly level and simple
- Plans are required on large scale.
- When area is small in extent

Chain Surveying is Not Suitable

- For Large Areas
- When too many details are required
- Wooded countries
- Undulating areas

Mathematical problems:

1. The length of a line measured with 20m chain was found to be 500m. It was subsequently found that the chain was 0.04m too long. What is the length of line?

Correct length of chain L' = 20 + 0.04 = 20.04m

Actual Length L = 20m

Measured length, = 500m

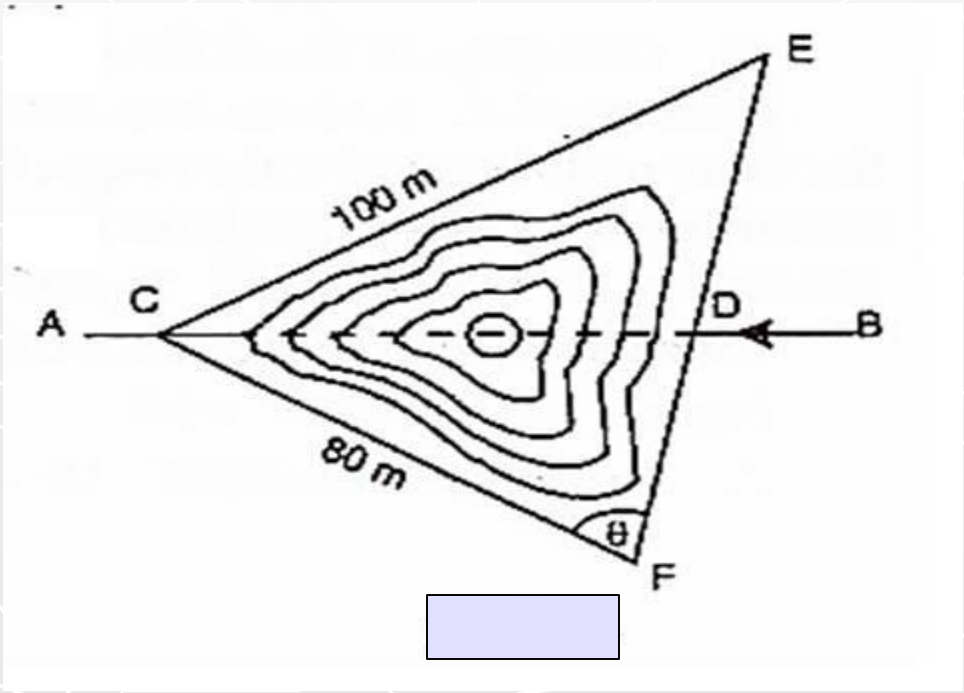
True length = (L'/L) * measured length

= (20.04/20) * 500

= 501m

Mathematical problems:

 # 2. 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 DC, 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.



CFE

CFD

Mathematical problems:

Solution:

In Fig. CD is the obstructed length of the pond on the chain line AB. CE and CF are known to be 100 and 80 m respectively and

EF = 60 + 56= 116 m.

Let angle $CFE = \theta$, then in triangle CFE,

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

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

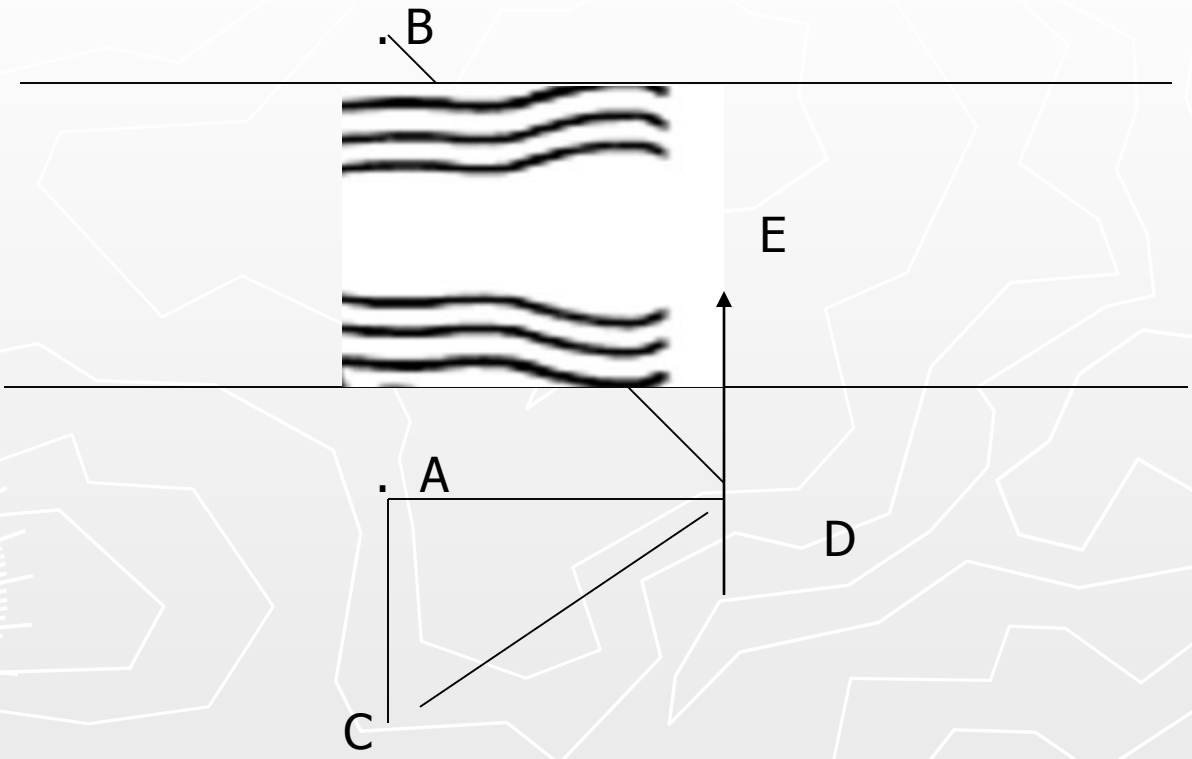
Also in triangle CFD.

$$\cos\theta = \frac{FC^2 + FD^2 - CD^2}{2.FC.FD} = \frac{80^2 + 56^2 - CD^2}{2 \times 80 \times 56}$$

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

or $CD = \mathbf{69.123\ m\ (Ans.)}$

Ex 3: Chain line at point A at home bank has to stop because of river and can not be reached at B, on other side of the river. C point is located at chain line and is measured 8.12’. AD is perpendicular drawn at point A and AD is measured as 25’. At D, magnetic bearings of point B and point C are 370^0 and 280^0. Find AB?.



Thank you