

Surveying and Geomatics

Unit-1

Name : S.Ekasila

Designation: Assistant Professor

Department: Civil Engineering

UNIT - I

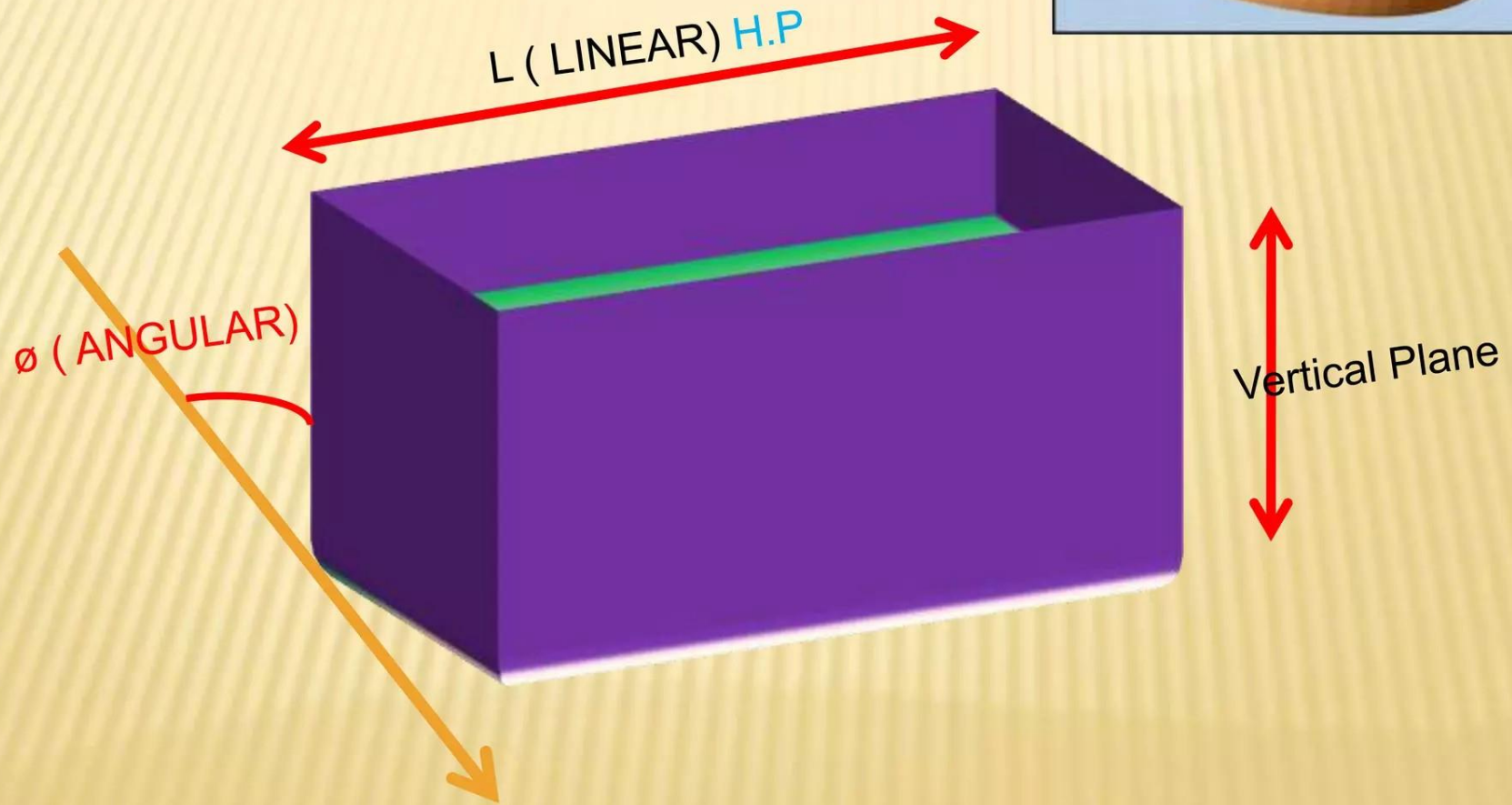
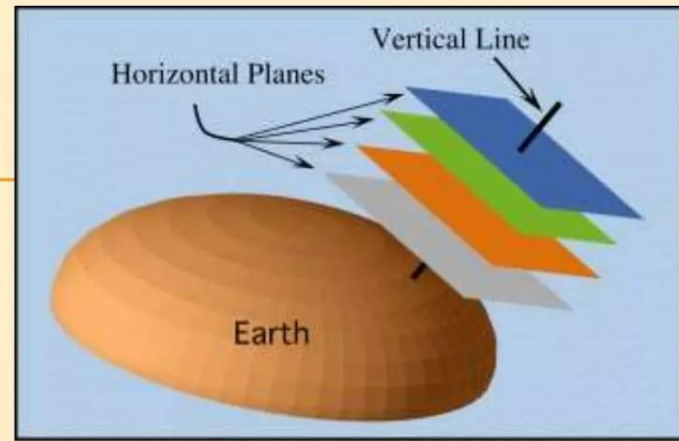
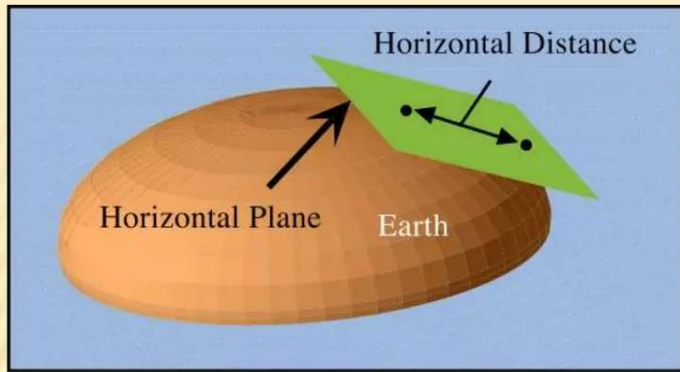
1.1 INTRODUCTION

DEFINITION:

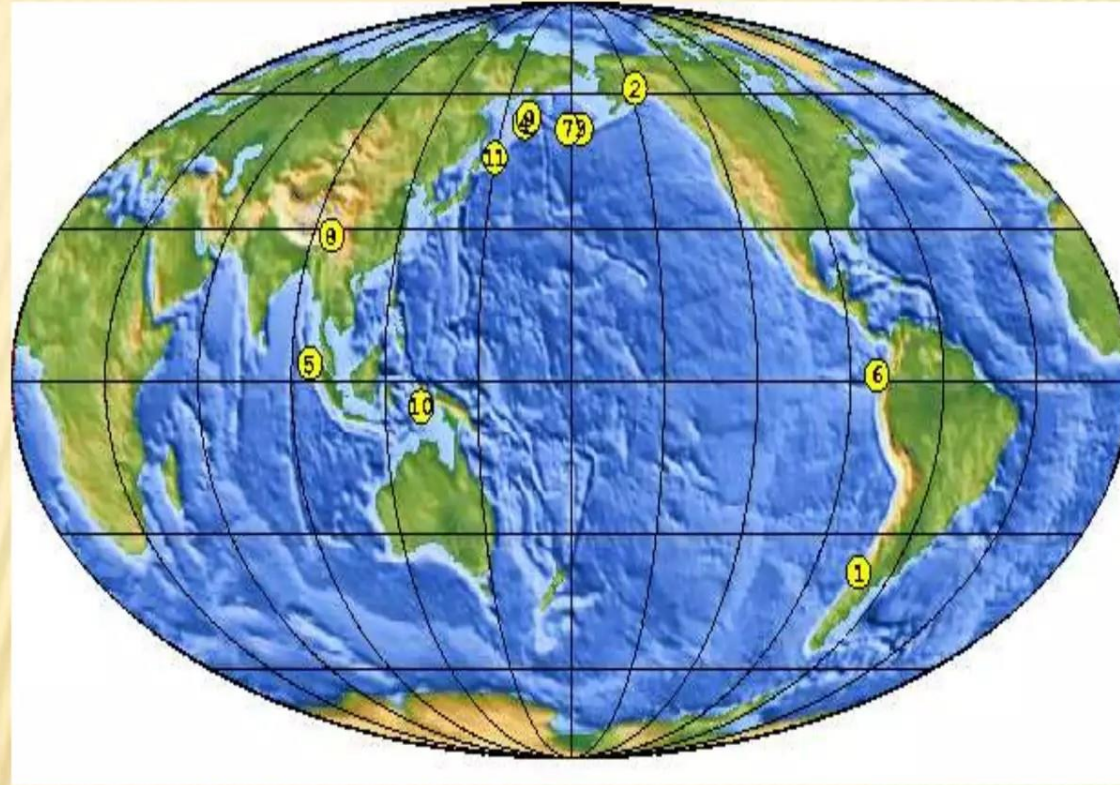
- Surveying is defined as the art of making linear or angular measurements to determine the relative positions of objects on the surface of earth
- The measurements in the horizontal plane on a paper is known as a plan or map
- The vertical plane measurements represented on a paper is known as section or elevation

OBJECTIVES:

- The primary objectives of surveying is to prepare a plan or map



EARTH SURFACE ; SPHERICAL SHAPE



MAIN DIVISIONS OF SURVEYING

➤ PLANE SURVEYING

- Curvature of earth surface is not considered
- Flat surface
- Small area
- Accuracy small

ASSUMPTIONS;

1. Survey area small (less than 250sqkm)
2. Line connecting any two point – straight line
3. Angle between two points is plane angle
4. Plum at any point of survey is perpendicular
5. Accuracy small

➤ GEODETIC SURVEYING

- Curvature of earth surface is considered
- Large area
- Accuracy more

- **GTS : Great Trigonometrical survey dpt. of India**



GENERAL CLASSIFICATION OF SURVEYING

➤ BASED ON THE NATURE OF FIELD OF SURVEYING

➤ Land surveying

- Topography survey (Location of hills, valley, river etc..)
- Cadastral survey (Locate property boundary)
- City survey (location of buildings, streets etc..)
- Engineering survey(Civil related works)

➤ Marine / navigation surveying (Survey near water body)

➤ Astronomical surveying (latitude, longitude, azimuths, local time)

➤ BASED ON THE OBJECT OF SURVEYING

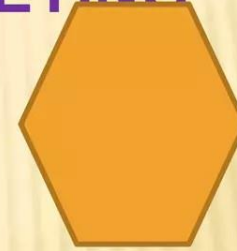
➤ Archeological surveying (ancient property, monuments)

➤ Geological surveying (soil structures)

GENERAL CLASSIFICATION OF SURVEYING

➤ **BASED ON THE METHOD OF SURVEYING**

- Triangulation survey
- Traverse survey



➤ **BASED ON THE INSTRUMENTS USED IN THE SURVEY**

- Chain survey
- Compass survey
- Plane table survey
- Leveling
- Theodolite survey
- Tachometric survey
- Aerial and photo graphic survey
- Hypsometric survey
- EDM

USES OF SURVEYING

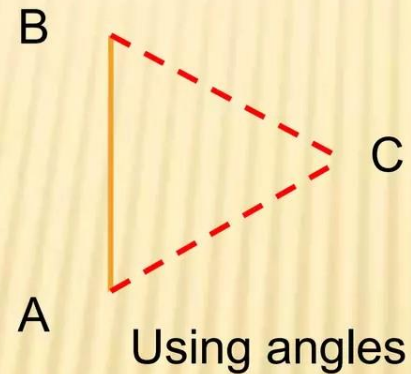
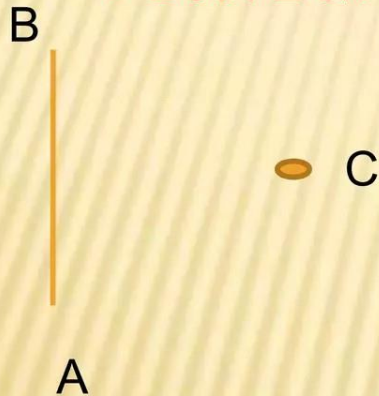
- To know the relative positions and shapes of topography
- To establish the boundary line of property
- To find the areas of boundary
- To calculate the volumes of earth work
- To select the suitable site for engineering works

WORKS OF SURVEYOR

- Field work
- Office work
- Care and adjustments of instruments

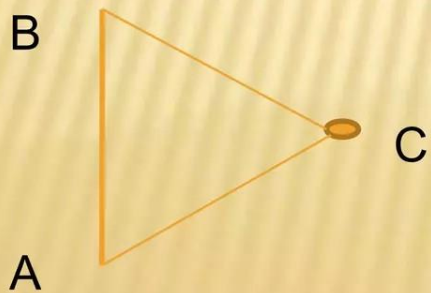
PRINCIPLES OF SURVEYING

- Location of a new point
- Working from whole to part
- Location of a new point:
 - Linear measurements
 - Angular measurements
 - Both L & A



Other conditions:

1. Perpendicular straight line
2. One angle and linear



Working from whole to part:

1. Huge area
2. Triangles or traverse



odometer



Speedometer



pedometer



Measuring wheel



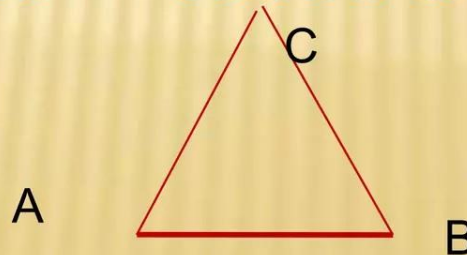
passometer

1.2 CHAIN SURVEYING

Definition:

- It is the simplest form of land surveying.
- Chain surveying is a method of surveying in which the area divided into network of triangles and the lengths of sides of triangles are measured with a chain or tape without use of an angle measuring instruments.
- Chaining – the process of measuring the distance with a chain or tape
- Chain triangulation
- **WELL CONDITIONED TRIANGLE:**

A triangle whose angles are greater than 30° and less than 120° called a well conditioned triangle.



PURPOSES:

- ❖ To obtain necessary data for the boundaries of the land
- ❖ To find the area of the land
- ❖ To collect necessary data for preparing plan
- ❖ Re-establish the boundaries of an area
- ❖ Divide the land into number of units – sizes (plots)
- ❖ Limitations: not suitable for large and crowd areas

CHAIN SURVEYING

OPERATIONS INVOLVED IN CHAIN SURVEYING

- Ranging
- Chaining
- Offsetting

INSTRUMENTS USED FOR CHAIN SURVEYING

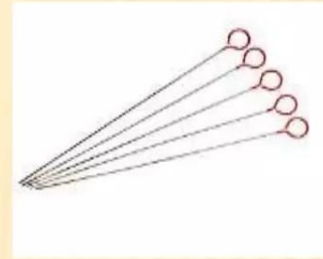
- Chain
- Tape
- Arrows
- Pegs
- Ranging rods
- Offset rods
- Plum bob
- Cross staff
- Hammer



CHAIN



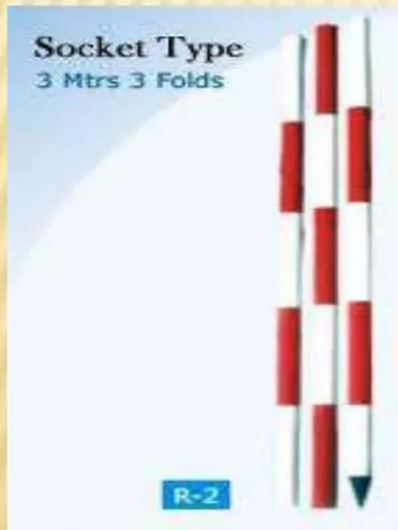
TAPE



ARROWS



PEGS



RANGING ROD



PLUMB

CHAIN

- Metric chain / non metric chain
- Links 100 / 150 links
- Galvanized iron / steel wires 4 mm to 6mm diameter
- Links connected with rings

TYPES OF CHAIN

- **Metric chain**
- **Non-metric chain**
 - Engineers chain – 100 feet / 100 link
 - Günter's / surveyors chain – 66 feet
 - Revenue chain – cadastral survey - 33 feet
 - Steel band

Construction of a 20m chain / 30m chain

- 20 m chain – 100 links
- Each links 0.2m length / 200 mm
- Tallies 1m /5m / 15m
- Unfolding a chain
- Folding a chain
- Reading a chain

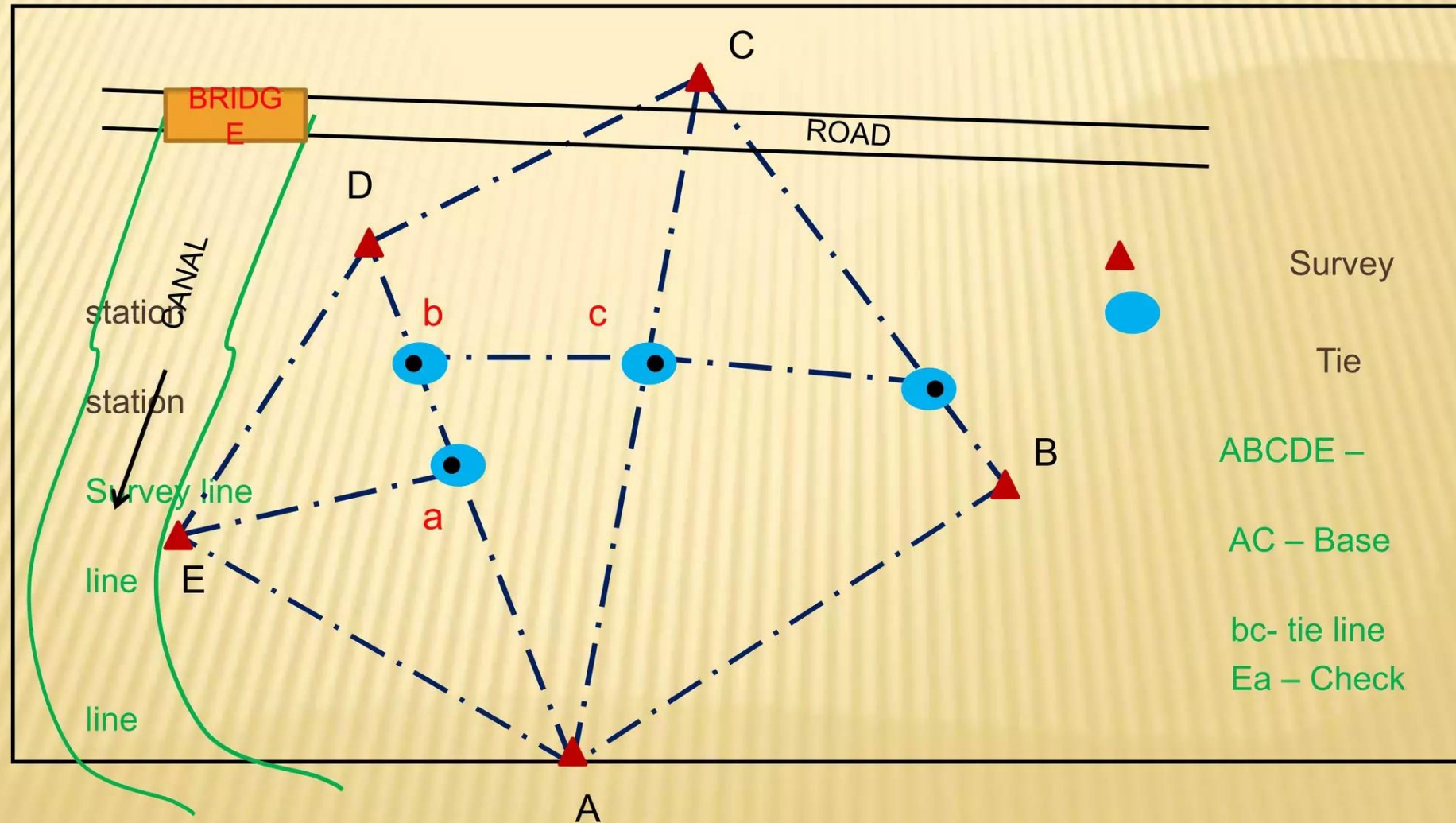
TAPES

- Made from different material
- Types of tapes
 - Linen tape or cloth
 - Metallic (five or six wires woven along linen thread) – 2,5,10,20,30
 - Steel tape
 - Synthetic tape / Glass fibre
 - Invar tape

TERMS USED IN CHAIN SURVEYING

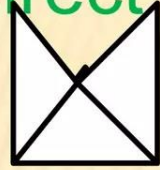
- **Survey station** (Prominent point on a chain line at either end)
(Sym:Δ)
- **Tie station / subsidiary station** (Stations selected any where on the chain line to run tie line, check line etc) (sym;)
- **Survey line : line joining the main survey stations** (dash dot)
- **Base line** : longest main survey line – run through middle line
- **Check line** : a line run to check accuracy
- **Tie line** : a line joining the tie or subsidiary stations

CONTD..

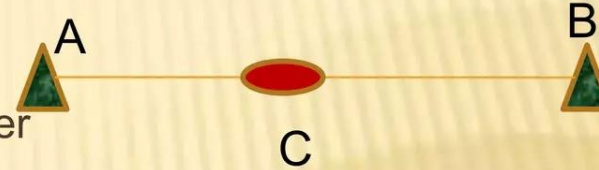


Ranging : Locating intermediate points in between the terminals

➤ Direct ranging

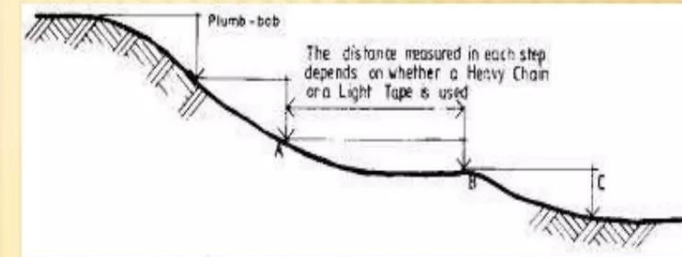


- Eye judgment
- Ranging by line ranger

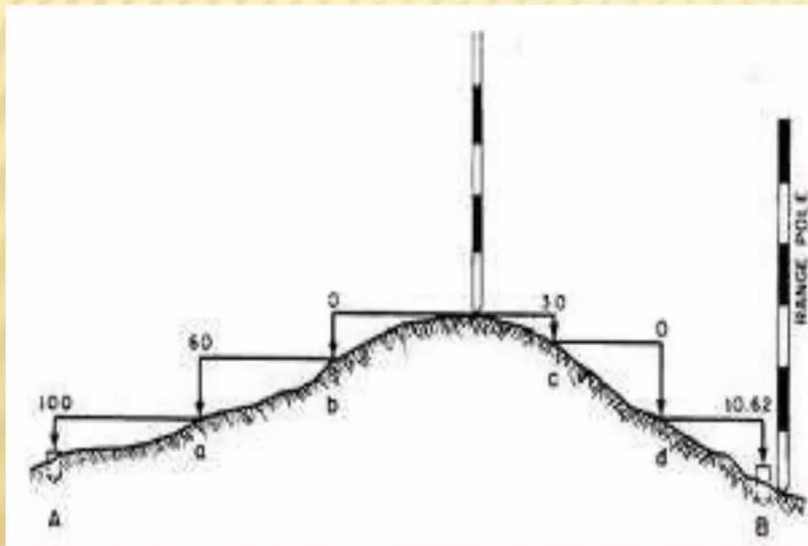


➤ In direct ranging

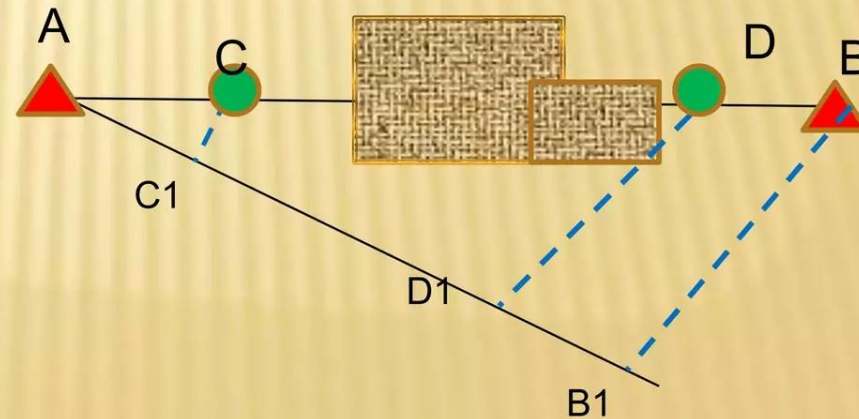
- Hills / valley



➤ Reciprocal ranging



➤ Random line ranging



➤ Chaining

- Flat ground

- Slopping ground

 - Direct method

 - Stepping method

 - Indirect method

 - Angle measurement

 - Application of hypotenuse allowance

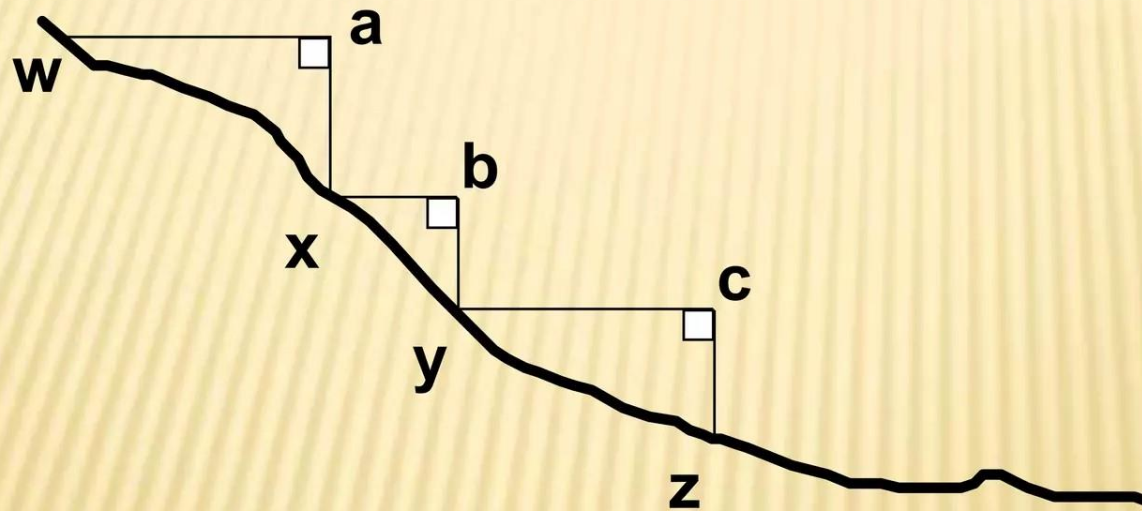
 - Measuring different elevation

CHAINING ON LEVEL GROUND

- Chaining on level ground
- It involves following operations
 - ✓ Fixing the stations.
 - ✓ Unfolding the chain.
 - ✓ Ranging.
 - ✓ Measuring the distance.
 - ✓ Folding the chain.



CHAIN SURVEYING (“STEPPING”)



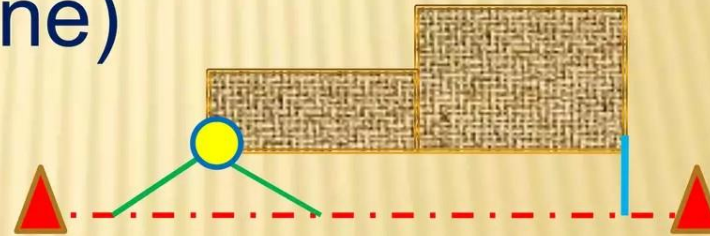
Offset :

Define: The lateral measurements taken to the left or right of a survey line to locate the details such as buildings, boundaries, fences and road.

Types:

- **Oblique offset** (offset taken at an angle other than 90° to a survey line)

- Length and angle
 - Length
 - Angle



- **Perpendicular offset**

- By eye
- By swinging tape
- By instrument (cross staff)

INSTRUMENTS USED FOR OFFSET

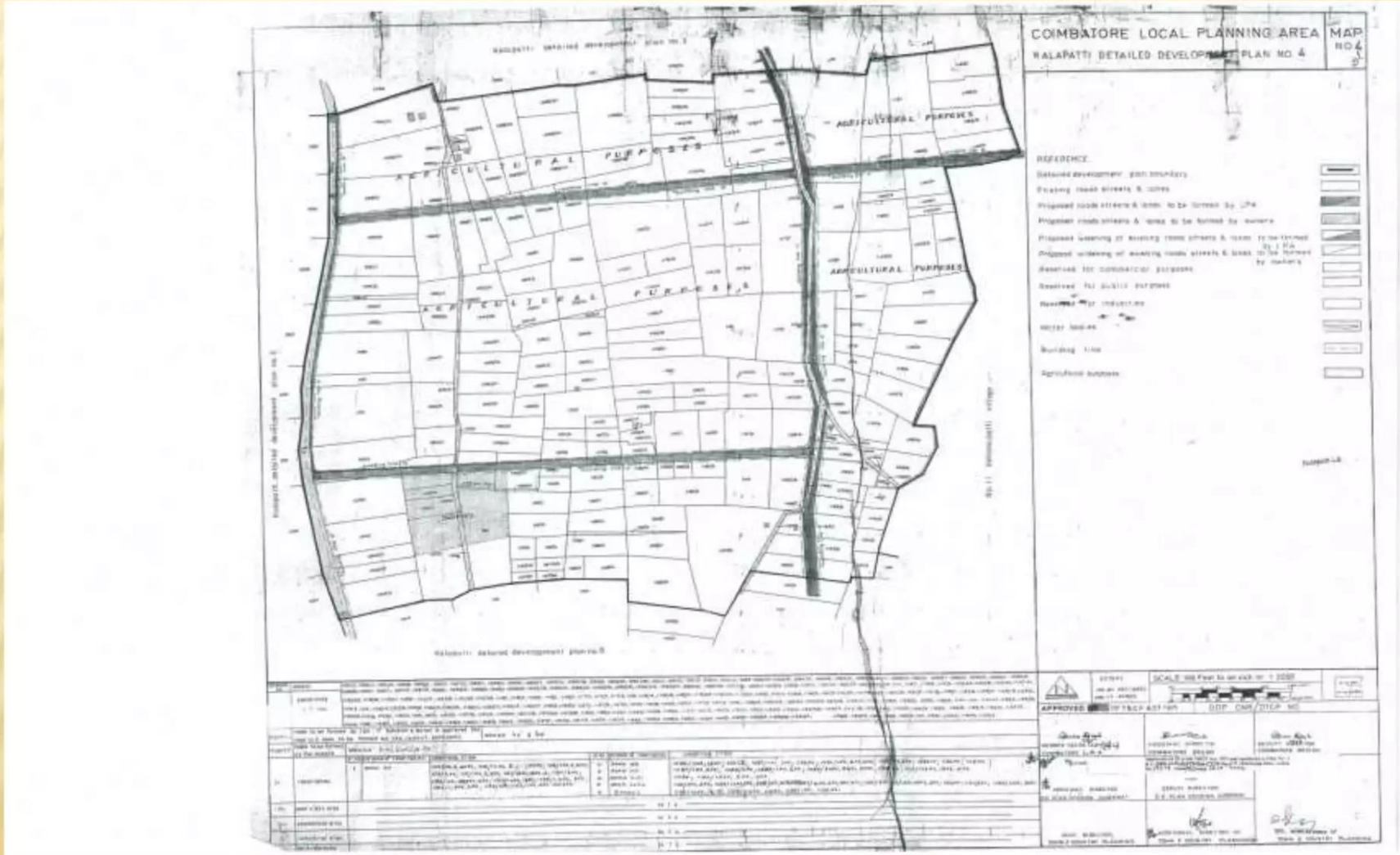
➤ Types of cross staff

- **open cross staff** (wooden block 150mm square, round or octagonal, 38mm deep, height – 1.2m to 1.5m)
- **French cross staff** (octagonal brass tube , 100mm wide and 150mm deep, with vertical slits) use 45° angle multiples
- **Adjustable cross staff** (two brass cylinders of same dia placed one over the another, lower degree and minutes)
- **Optical square**: optical square contained circular box 50mm dia and 12.5mm length with metal box – use to perpendicular offset

Field works

- Field work
- Field book
- Conventional signs
- Chain triangulation

FIELD MAP



TYPES OF CROSS STAFF

Open cross staff



French Cross Staff



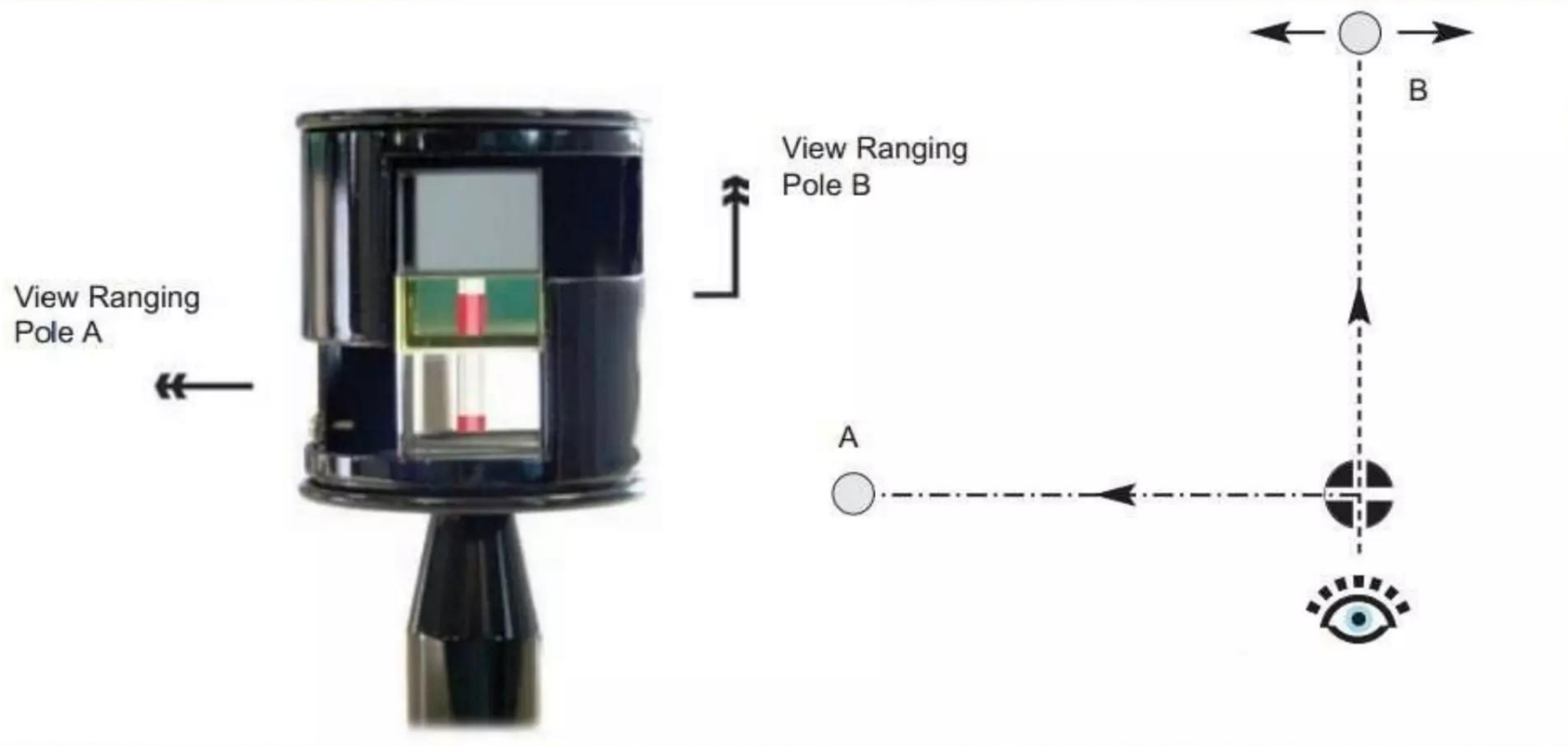
45° and 90°



Adjustable Cross Staff



OPTICAL SQUARE

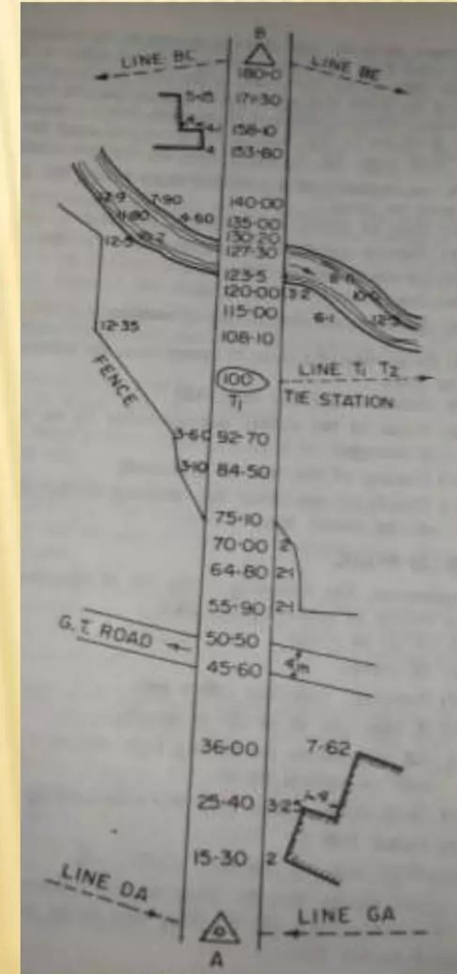


FIELD BOOK

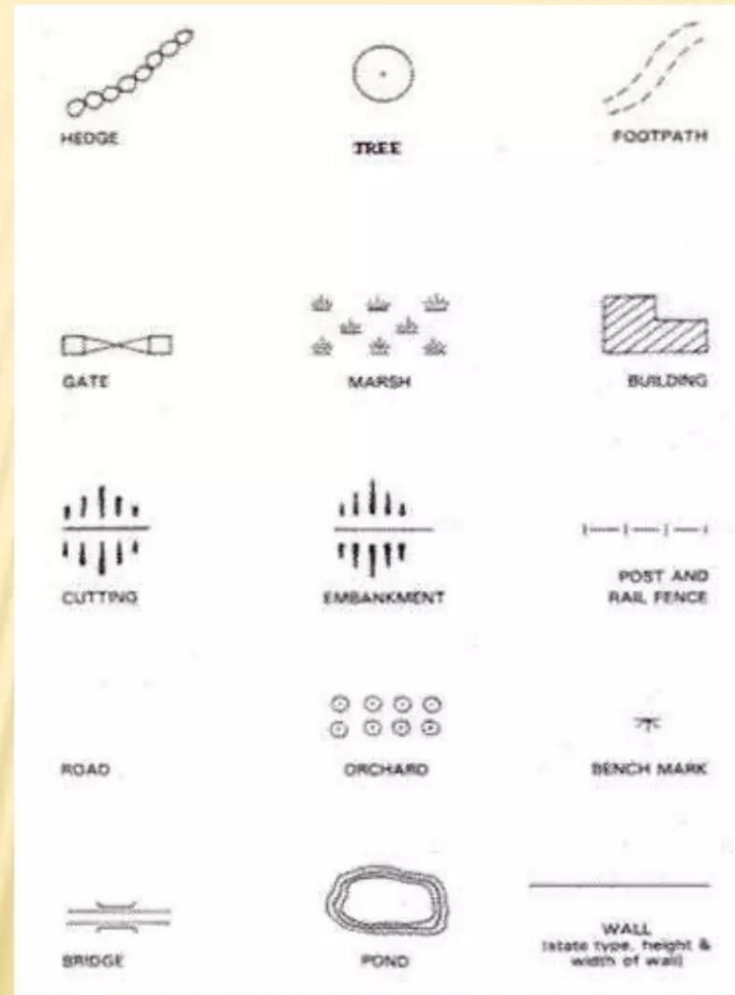
STATION	GROUND DIST	ANGLE	VERT DIST	ELEV	NOTES & REMARKS
A	HI-0			1000	① SOURCE #1 (ARBITRARY ELEV=1000m)
B	8	-22°	-3	997	
C	7	-35°	-4	993	② SITE OF COLLECTION TANK 1.5m OF GZ FOR GULLY
D	15	-5°	-1	992	
E	27	-26°	-8	984	Gravel & Sandy Soil
F	45	-27°	-9	975	
G	65	+7°	+3	978	
H	90	+12°	+6	984	
I	120	-2°	0	984	③ SITE FOR RESERVOIR
J	132	-5°	-2	982	
K	155	-7°	-3	979	④ INTERCEPTS FOOTPATH
L	206	-7°	-3	976	
M	14	-3°	-1	975	⑤ TAP #1 (SCHOOL)
N	220	0°	0	975	
O	30	0°	0	975	
P	250				
Q	21	-6°	+2		

All distances & elevations in meters

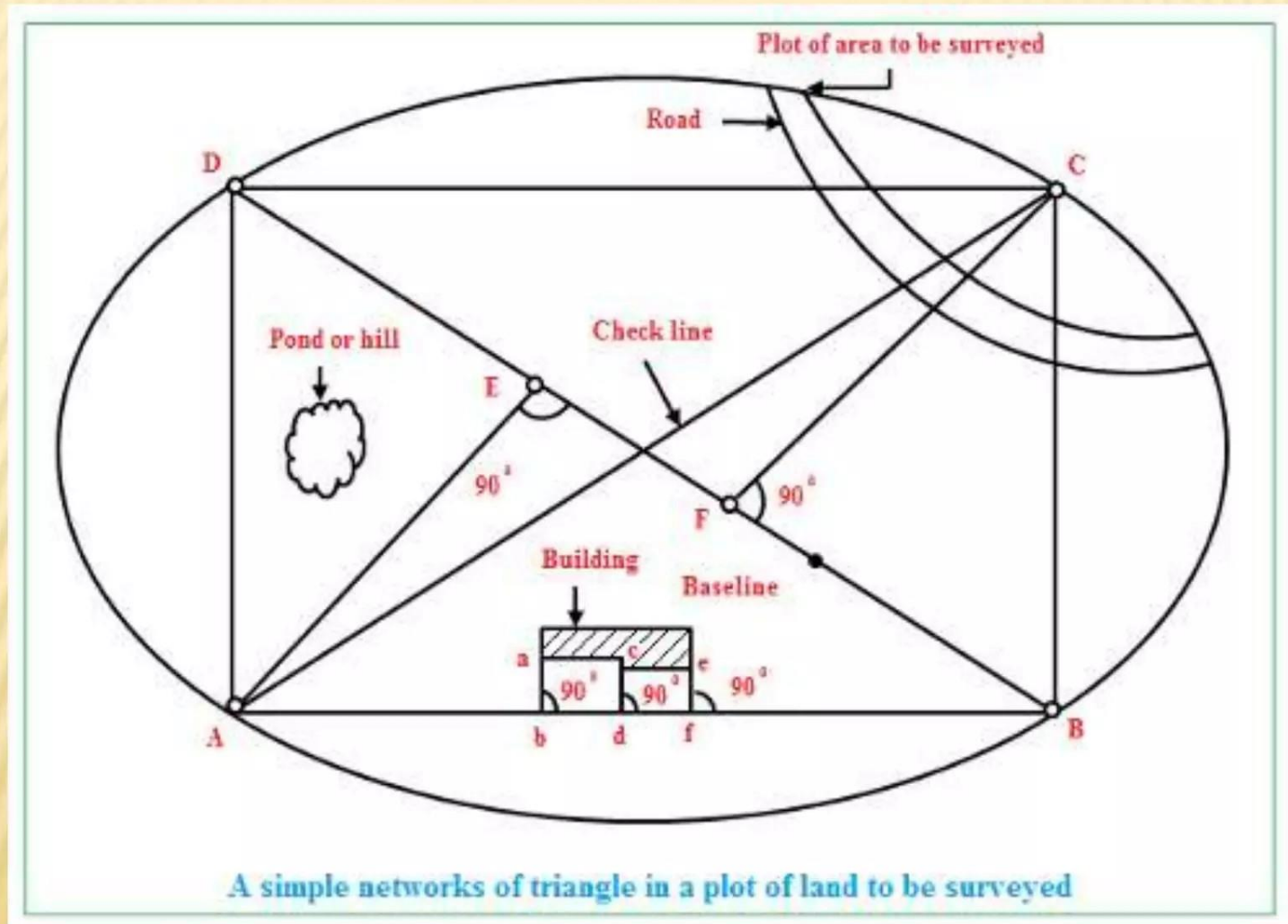
MAINLINE (PROCEEDING DOWNSTREAM FROM SOURCE)



CONVENTIONAL SIGN



CHAIN TRIANGULATION



ERRORS IN A CHAIN

SOURCES

- Instrumental error (due to imperfect or faulty adjustments of instruments used for measurements) – removal of rings or links
- Personal errors (due do want of perfection in observation)
- Natural errors - temperature, rain , atmospheres

TYPES

- Mistakes
- Cumulative errors / systematic errors (same direction and which finally tend to accumulate) (+/-)
 - Positive errors: chain length shorter, slope or sag are not considered, measurement taken wrong)
 - Negative errors: rings open, applied pull, temperature, elongation of links
- Compensating errors (errors which may occur in both directions ie both + / - and tend to compensate.
 - Incorrect holding of the chain

Fractional parts of the chain is not uniform throughout

MISTAKES:

- ✓ Displacement of arrows
- ✓ Miscounting number of chains
- ✓ Misreading
- ✓ Erroneous recording (number, calling, booking)
- ✓ Failure to observe the position of the zero point of the tape
- ✓ Adding or omitting a full chain or tape
- ✓ Reading from the wrong end of chain

OBSTACLES IN CHAIN SURVEYING

- ❖ Obstacles prevent direct measurement of distance between the points.
- ❖ Hence it is called as indirect measurement.
- ❖ **TYPES OF OBSTACLES**
 - ❖ Obstacles to vision or ranging
 - ❖ Obstacles to chaining
 - ❖ Obstacles to both ranging and chaining

OBSTACLES TO VISION OR RANGING

- ❑ This obstacles obstruct ranging, but can be chained in the line.
- ❑ Raising ground, intervening hill and wooded forest.
 - ❑ Case 1: Ends of the line are visible
 - ❑ Case 2: Ends of the line are not visible from midpoint

INTERVENING HILLS



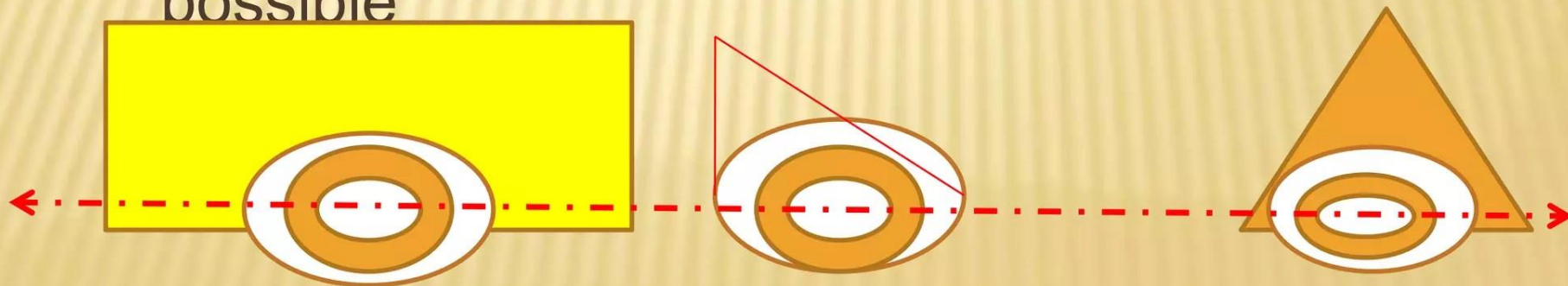
RAISING GROUND



WOODED FOREST

OBSTACLES TO CHAINING

- ❑ This obstacles obstruct direct chaining – but execute ranging work
- ❑ Pond, lake, river or hedge.
 - ❑ Case 1: chaining around obstacles are possible – pond (equal perpendicular, Hypotense,)
 - ❑ Case 2: chaining around obstacles are not possible



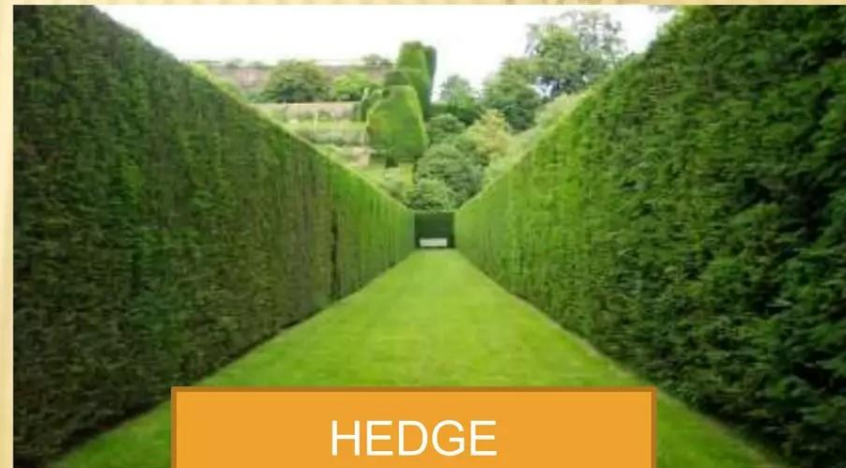
POND



LAKE



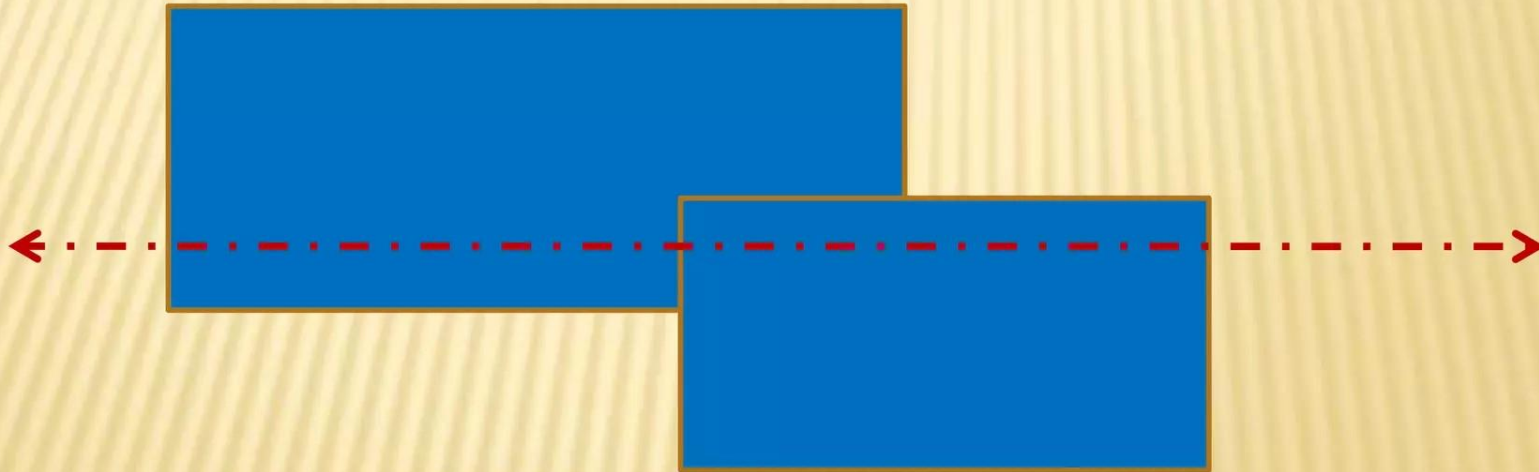
RIVER



HEDGE

OBSTACLES TO BOTH CHAINING AND RANGING

- ❑ This obstacles obstruct ranging and chaining
- ❑ Tall buildings



TALL BUILDINGS



Common errors

- Erroneous length of chain
 - Bad ranging of chain length
 - Careless holding of chain
 - Bad stretching
 - Non- horizontally
 - Sagging
 - Change in temperature
 - Change in pull
-
- **Testing a chain**
 - **Chain corrections (-)negative error (measured length short ; use positive correction)**
 - **(+) positive error (measured length greater ; use negative correction)**

CHAIN CORRECTION : standardization and slope

Expression for correction factor

Actual Length (l_1) = (Incorrect length of chain / designated length) x Measured length

TAPE CORRECTIONS

- ✓ Correction for standardization
- ✓ Correction for slope
- ✓ Correction for temperature
- ✓ Correction for pull
- ✓ Correction for sag

THANK YOU