

# Surveying-I

CE-205 (T)

## Introduction

Department of civil engineering  
UET Peshawar

Lecturer  
Engr. Muhammad Rizwan

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# Surveying

- The process of determining **by measurement**, the relative positions of points above, on, or beneath the earth surface, in order to produce map or plan (which shows feature of the surface) in horizontal or vertical plane.
- The Term surveying refers to those measurements or operation, which deal in production of map or plan in **horizontal plane**.

Or

- **Surveying** is the science of measuring and representing natural and artificial features on the ground in a limited area, regarding the earth as flat.

# Leveling

- The art of determining **the relative heights or elevation** of different points on the surface of earth.
- Determining position of points in vertical plane.
- Surveying and leveling are considered as distinct operations, however in broad sense, the term surveying includes leveling.



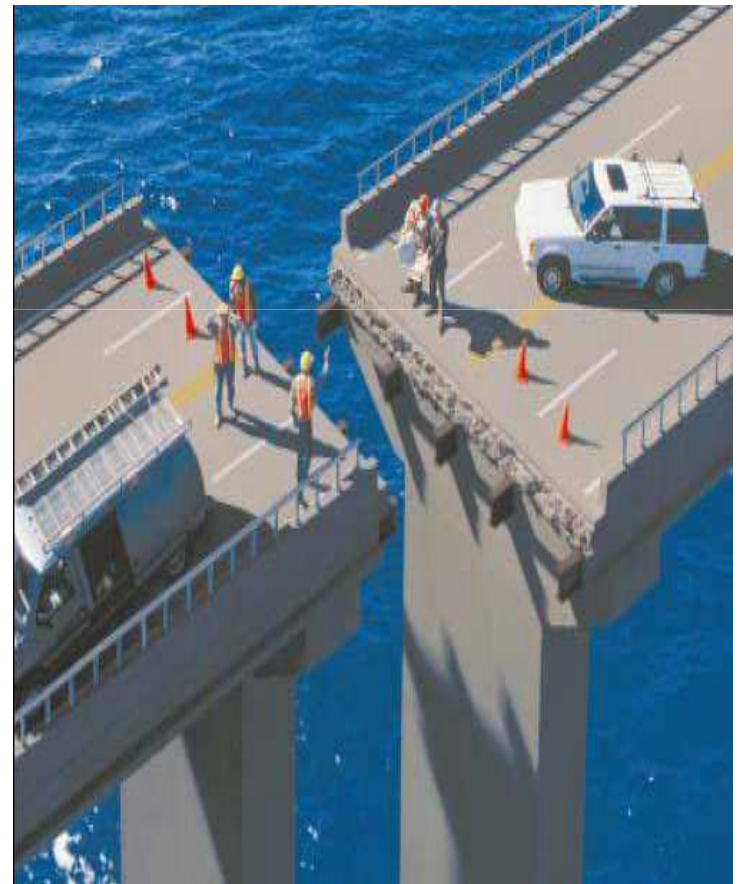
# Object OF Survey

- The Primary objective of survey is the preparation of **plan and map of an area**.
- The result of survey in the form of data when plotted and drawn on paper, we get a plan/map.
- If the scale is large it is called Plan.  
E.g Plan of a Building  
let 1:100
- If the scale is small, it is called Map.  
E.g Map of Pakistan  
let 1:25,000



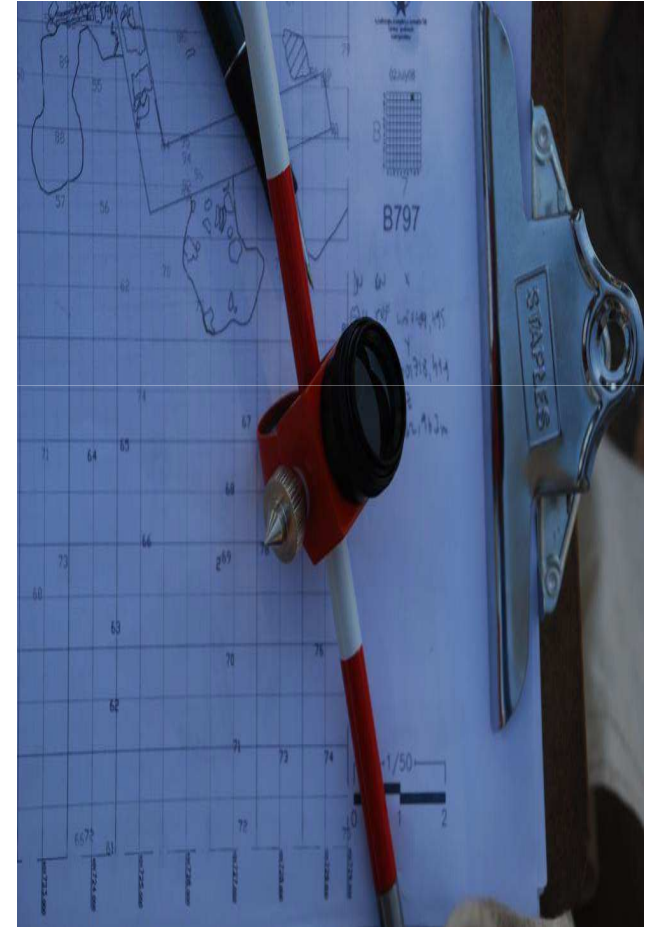
# Why should we study surveying?

- You may be required to perform simple surveying operations (particularly if you're employed in construction company and Local Gov.), or you will need to discuss your needs with surveyors.
- **Every Engineer needs surveying skills**



# Parts of Surveyor's work

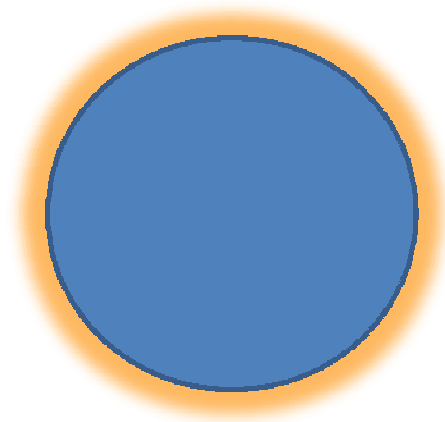
- Decision making (selecting techniques and equipments, etc.)
- Fieldwork (data acquisition)
- Data processing (calculations to give locations, areas, volumes, etc.)
- Mapping (maps, plans, charts)
- Reporting (conclusion of the task)



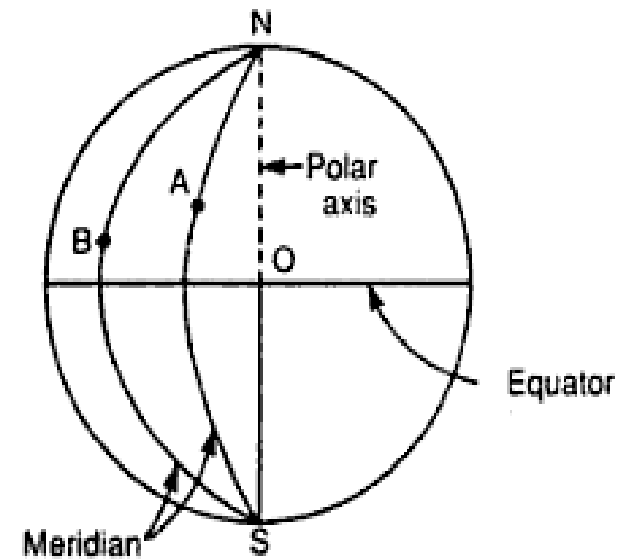


# Shape of Earth

- The earth is Approximately Spheroid.



Sphere



# Primary Division of Survey

**1. Geodetic Surveying**

**2. Plane surveying**

## 1. Geodetic or Trigonometrical Surveying:

- **When the radius of curvature of earth is taken in to account.**
- Large area and large distances are covered.
- Object of geodetic survey is to determine precise positions on the surface of earth.
- Refined Instruments and Methods are used.
- Conducted by Government agencies.

# Primary Division of Survey

## 2. Plane Surveying:

- **When radius of curvature of the earth is not taken into account.**
- Small area and small distances are covered
- Degree of accuracy is comparatively low.
- American survey put 250 km<sup>2</sup> for treating survey as Plane, but controlling factor should be degree of precision rather than extent of area.

# Classification of Survey

## 1. Based upon Nature of field

- Land Survey
- Marine Survey
- Astronomical Survey

## 2. Based upon Object of Survey

- Geological Survey    different strata in the earth crust.
- Mine Survey            mineral wealth such as coal, gold.
- Military Survey        points of strategic importance.

## 3. Based upon Method Employed

- Triangulation
- Traversing

## 4. Based upon Instrument Used

Chain , Theodolite, Compass, Plane Table, Photographic and Aerial Surveys

# cont..

- Land Survey can be further divided into:

## 1. Topographical Survey :

- Determine natural features of a country such as hills, valleys, lakes woods etc. and also arterial features such as roads, buildings, canals, towns etc.

## 2. Cadastral Survey :

- Details such bundies of houses, town, fields and other properties pathways are determined.
  - City Survey
  - Engineering Survey

- Engineering Survey can be further divided into:

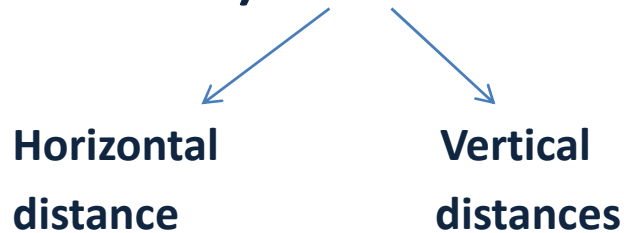
Reconnaissance	-the feasibility and rough cost of the scheme
Preliminary Survey	-for collecting more precise data.
Location Survey	- for setting out the work on the ground.

# Measurements & Instrumentation

## What is measured?

- Two kinds of measurements used in plane surveying.

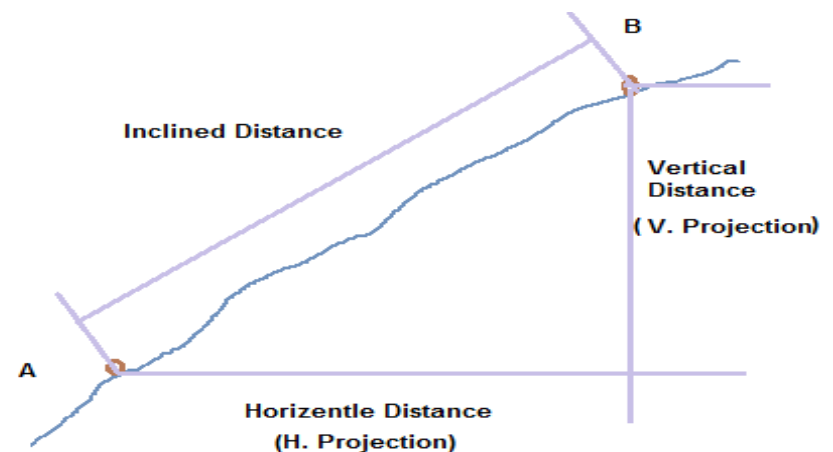
### 1) Linear



### 2) Angular



- In Surveying all measurements are horizontal, can be inclined, reduce to horizontal and vertical components in plotting.
- Distance between 2 points on a plan or map is always horizontal distance irrespective of their elevation, (distance between their projection on horizontal plane).



- **Horizontal distance**
  - Distance between two points in horizontal plane
- **Vertical Distance**
  - Distance between two points in vertical plane
- **Horizontal angle**
  - A horizontal angle is the angle formed in a horizontal plane by two intersecting horizontal lines.
- **Vertical angle**
  - A Vertical angle is formed by two intersecting lines in a vertical plane, one of these lines horizontal.

# Measurements & Instrumentation

## What is measured?

- Distances
  - To calculate areas, volumes, etc.
  - To draw plans, maps, etc.
- Angles
  - Both horizontal and vertical
- Heights
  - Levels or elevations.



# How are these measured and which instrument should I use?

- **Distances (horizontal)**

- Chaining, Taping (steel tape), tacheometry (theodolite), electronic (EDM, GPS)

- **Angles**

- tacheometry (theodolite, total station),

- **Heights**

- leveling (level, theodolite, total station)

# Instruments For Measuring Distances

- Two main methods for measuring distances. (Linear Measurements)

## A. Direct Method

- By chain or Tape or other Instruments directly

## B. Indirect method

- Distance is obtain by calculation  
eg: Triangulation

# Direct Measurement

Several methods/ Instruments are available

1. Pacing
2. Passometer
3. Pedometer
4. Odometer
5. Speedometer
6. Perambulator
7. Judging distance
8. Time Measurement

Assignment. ( Part a )  
Page 34 (Part 1)

## **9. Chaining**

# Chaining

- **Most Common method is the method of measuring distance with a Chain or Tape, Called Chaining.**
- For Ordinary work (less Precision) Chain is Used.
- For Great Accuracy Steel Tape is used.
  
- Chaining                      with Chain.
- Taping                         with Tape.

# Chain

- Chain is composed of 100-150 pieces of galvanized mild steel called LINKS.
- Links are Connected to each other through oval ring for flexibility.
- End Provided with Brass handle to drag chain, Outside of handle is ZERO.
- Length Measured from outside of one handle To outside of other handle.
- Metallic tags are attached to specified distances.



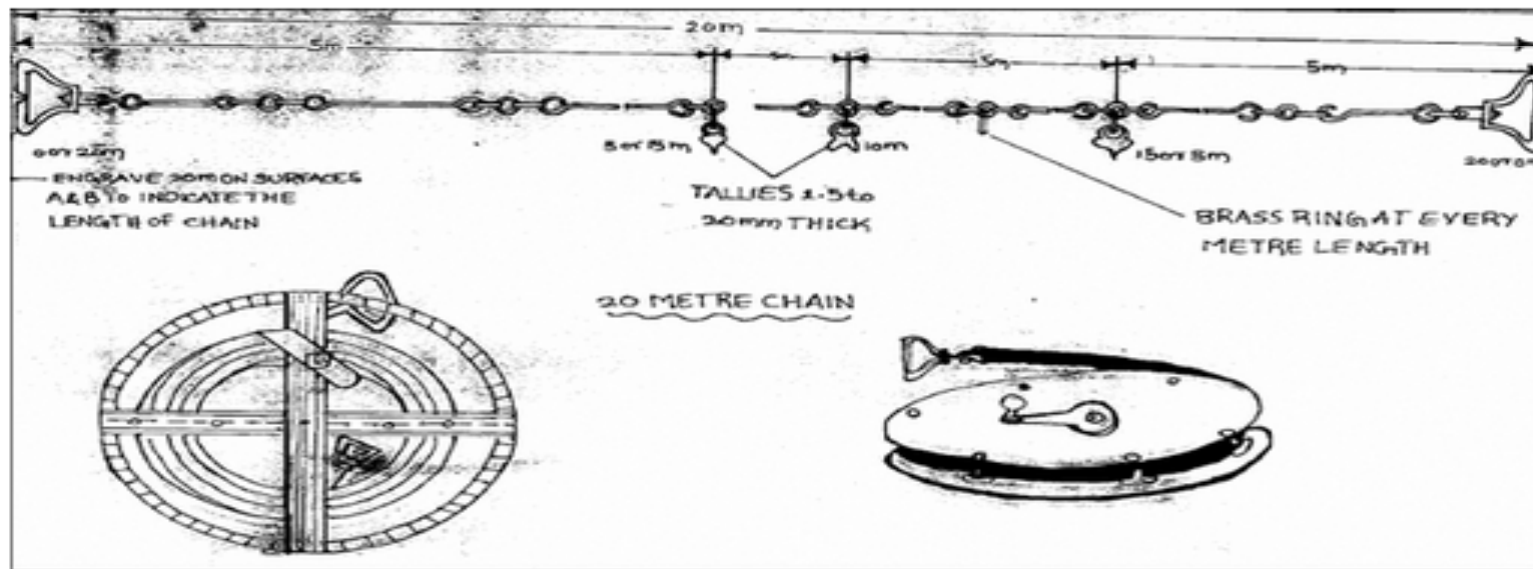
# Different Types of Chain

- Following are the various types of chain in common use:
- - 1) Metric chains
  - 2) Steel band or Band chain
  - 3) Gunter`s chain or surveyors chain
  - 4) Engineers chain
  - 5) Revenue chain

Assignment ( Part b)

# Metric chain:

- Metric chains are made in lengths 20m and 30m. Tallies are fixed at every five-meter length and brass rings are provided at every meter length except where tallies are attached



# Different Types of Chain

## Gunter's Chain

- Length= 66' (22 yards), No of links= 100, Each link= .66'
- Used for measuring distances in miles or furlongs(220 yards), acres(Area).

## Engineer's Chain

- Length=100', No of links=100, Each link = 1'
- Used in all Engineering Surveys.

## Revenue Chain

- Length=33', No of links= 16
- Commonly used for measuring fields in cadastral Survey.



# Tapes

- Tapes are made of different materials
- **1) Cloth or linen tape**
  - Used for subsidiary measurements
  - Very light, easy to handle
  - May effect by moisture
- **2) Metric steel tape**
  - Made of steel
  - Outer end is provided with a ring for holding
- **3) Invar tape**
  - Used for high precision work
  - Made of alloy steel
- **4) Synthetic tape**
  - Made of glass fiber with PVC coating
  - These are used for short measurements

# Principle of Surveying

- **Two Fundamental Principles**

- 1. To work from the Whole to the Part, not from the part to the Whole.**

e.g. set out the main frame first, and add details onto the frame.

Object of this system is to prevent accumulation of errors and to control and localized minor errors.

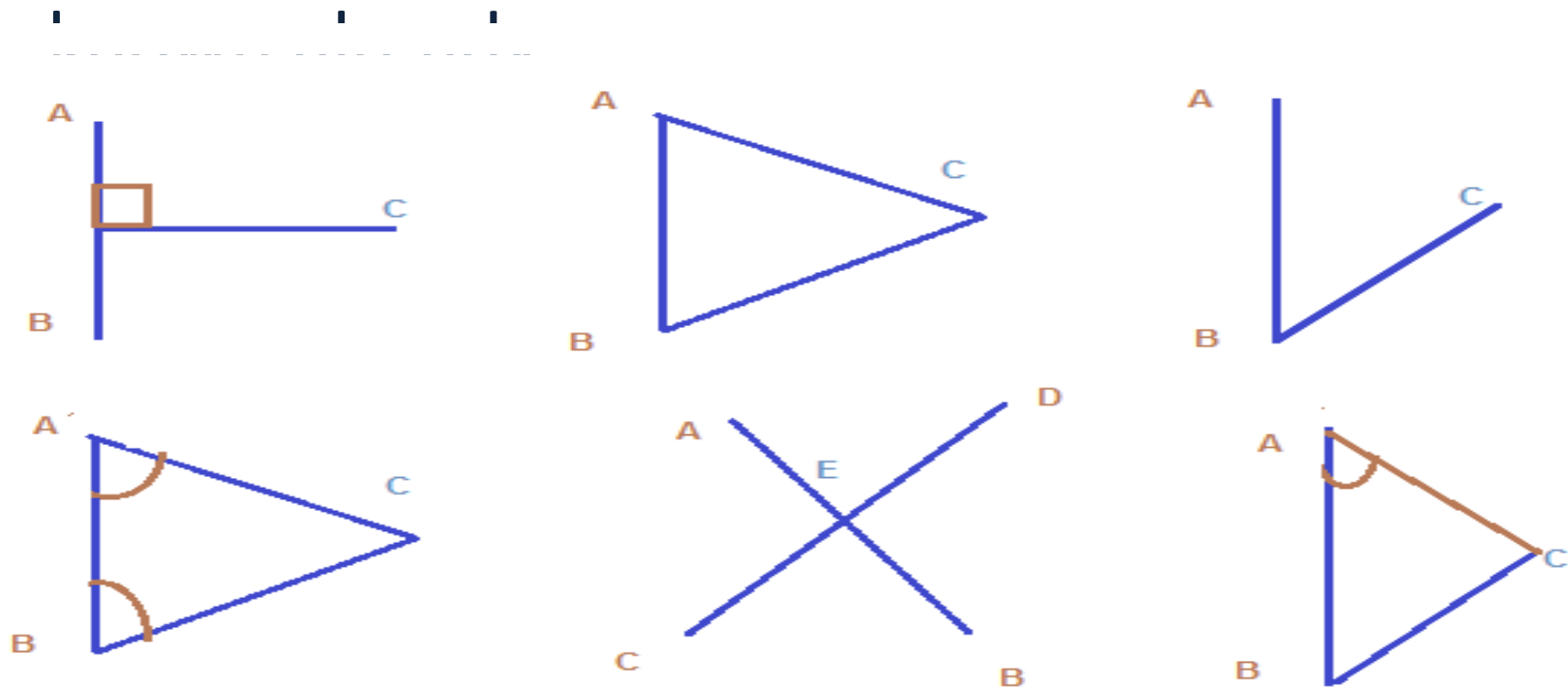
- 2. To Fix Position of New point (Station) by at least two independent processes.**

New Station can be fixed from points already fixed

By 1) Linear measurement 2) Angular measurement 3) or Both

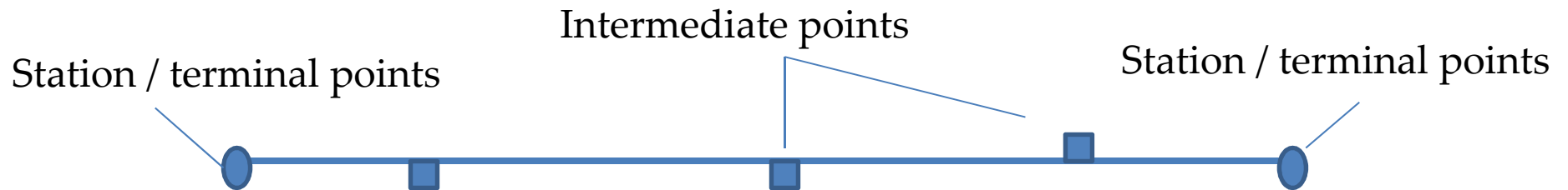
# Methods of locating Points (New Station)

- In Surveying relative position of points are located by measurement from at least two points of reference, whose positions must be



# Ranging Out Survey Line

- Ranging is process of establishing Intermediate points on straight line between the terminal points or stations.



## Different kinds of Ranging

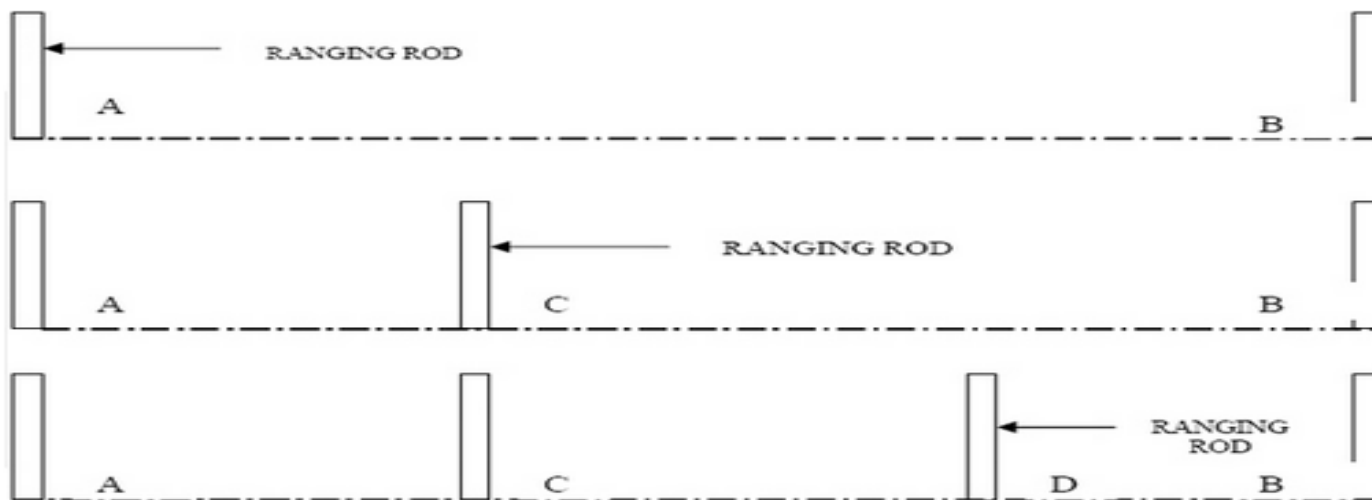
- Two kinds

### 1. Direct Ranging

### 2. Indirect Ranging

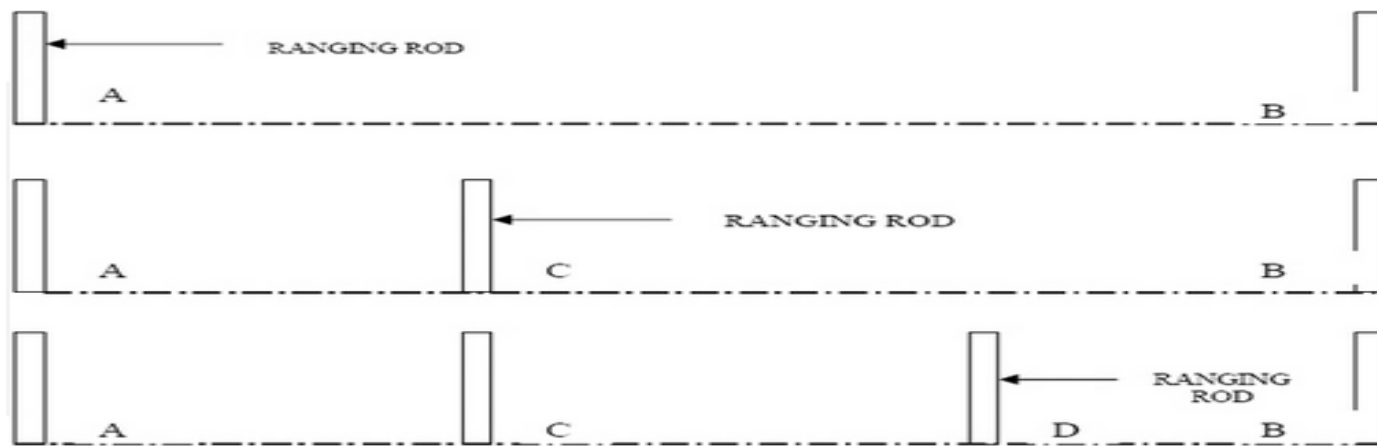
# 1. Direct Ranging

- **It is used while ranging on a plane ground, when two points are intervisible.**
- **PROCEDURE:**
  - » Fix the ranging rods at the two given stations.
  - » The follower stands behind station A and directs the leader, with ranging rod to come in line with AB by signals of ranging.
  - » When the ranging rod comes in the line of AB the follower directs the leader to fix the ranging rod in position.
  - » Let the intermediate point be C which should be less than 100 feet.



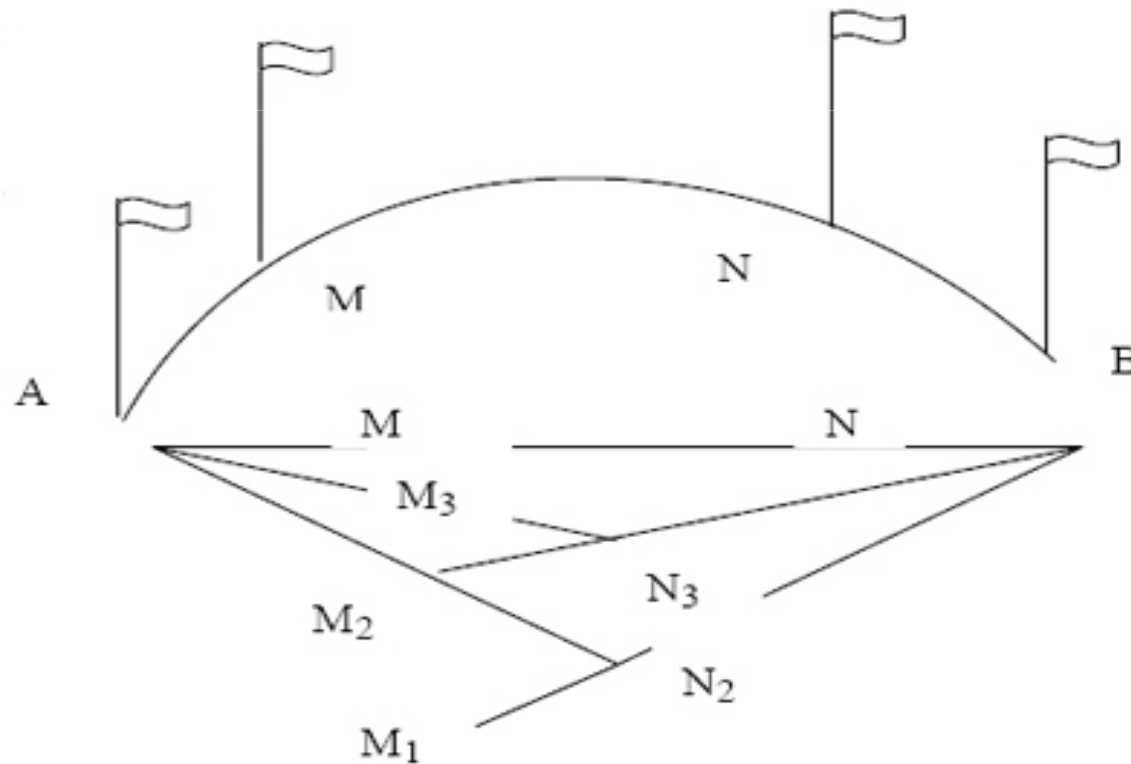
- Now the leader taken another ranging rod and stands between A and B about 2/3 distance from A
  - » The follower directs the leader to come in line of AB by using signals of ranging.
  - » As and when the point is located in the line of AB the follower instructs to fix the ranging rod in position.
  - » Let the other intermediate position be D which is less than 100 feet from B
  - » Now A, B, C and D are in one line.
- Now the leader and follower measure the distance by measuring along A, C, D, B.
- 

RESULT: The distance between AB = \_\_\_\_\_ feet



## 2. In Direct Ranging

- This type of ranging is carried out when two sides are not intervisible.







# Errors in Length due to incorrect Chain

- The most common errors are that the chain may be too long or too short.
- It will be corrected by using the formula

**The length of a line =  $L'/L$  \* (Measured Distance)**

Where  $L'$  = Incorrect Length of chain  
 $L$  = Correct length of chain

- If chain is too long then the measured length will be smaller than the actual, so the error is negative and the correction is positive.
- If chain is too short then the measured length will be too long that is longer than the actual, so the error is positive and the correction is negative.

## Example

- The length of a line measured with the help of 20m chain was found to be 634.4m. It was found afterwards that the chain was 0.05 m too long.
- Find the true length of the chain.

- **Solution:**

True length of line =  $L'/L \times$  (measured length)

$$L' = (20 + 0.05) = 20.05 \text{ m}$$

$$L = 20 \text{ m}$$

$$\text{Measured length} = 634.4 \text{ m}$$

$$\begin{aligned} \text{True length} &= (20.05/20) \times (634.4) \\ &= 635.99 \text{ m} \end{aligned}$$

# **Example 2 and Example 3**

Assignment ( Part c)

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# References

- Surveying & Leveling (part 1) by T P Kanetkar & S V Kulkarni