CV0121 UNIT 2

Chapter-1: Basics of Surveying

Dept. of Civil Engineering
Institute of Tech. & Engg.

Subject: BASICS OF CIVIL ENGINEERING

Subject Code: CV0121

Topics to be covered(Teaching hours: 04)

- Definition of Surveying
- Aims of Surveying
- Applications of Surveying
- Fundamental Principles of Surveying
- Primary Divisions Of Surveying
- Classification of Surveying
- Plans and Maps
- Scales
- Units of Measurement

Introduction

- Surveying is the art of and science of determining the relative positions of various points or stations on the surface of the earth by measuring the horizontal and vertical distances, angles, and taking the details of these points and by preparing a map or plan to any suitable scale.


BOUNDARY LAYOUT SURVEY AT VIDYASAGAR INDUSTRIAL PARK, KHARAGPUR,

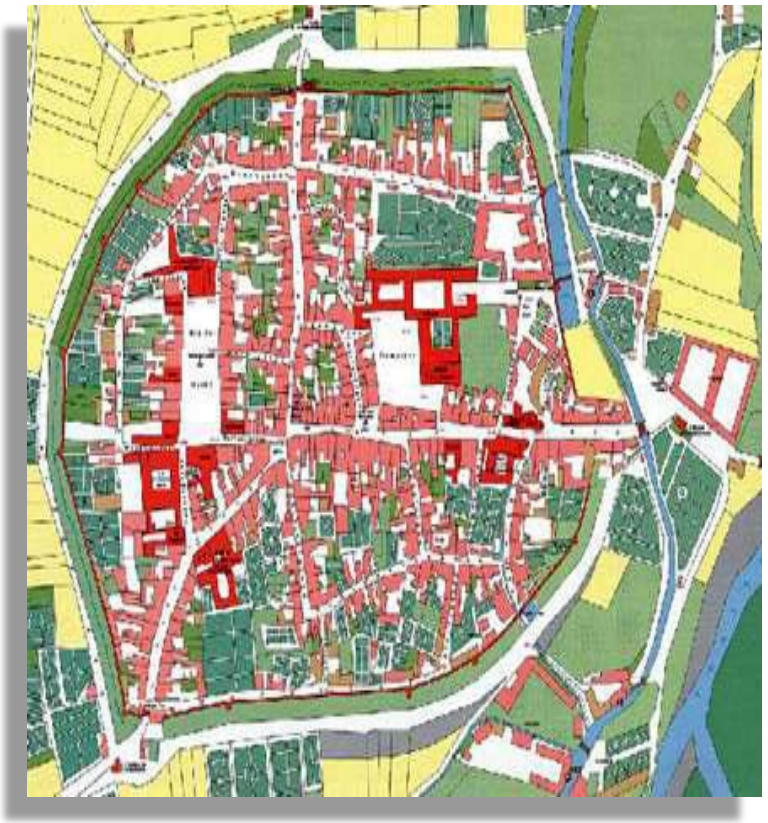
Aims of Surveying

- The object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth.
- The map or plan is drawn to some suitable scale. It also shows boundaries of districts, states, and countries too.
- It also includes details of different engineering features such as buildings, roads, railways, dams, canals etc.

Applications of Surveying

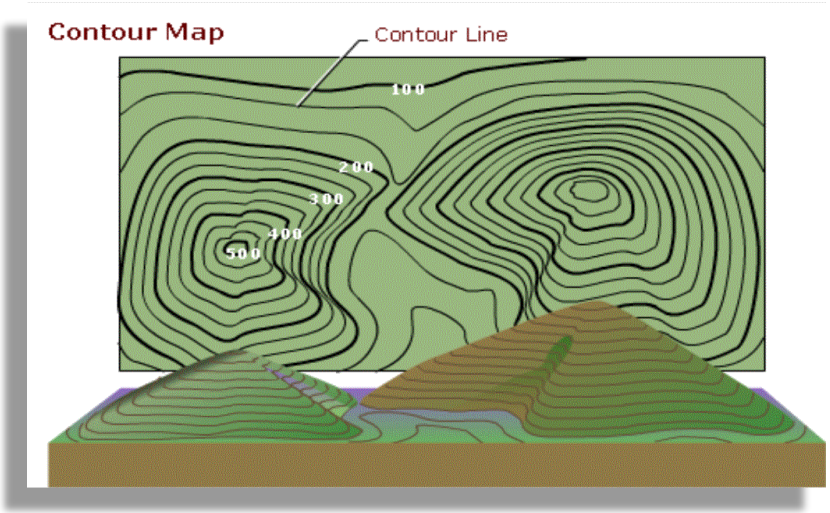
- The surveying may be used for following purposes:
  - To prepare a topographical map which shows hills, valleys, rivers, forests, villages, towns etc.
  - To prepare a cadastral map which shows the boundaries of fields, plots, houses and other properties..
  - To prepare an engineering map which shows the position of engineering works such as buildings, roads, railways, dams, canals.
  - To prepare a contour map to know the topography of the area to find out the best possible site for roads, railways, bridges, reservoirs, canals, etc.
  - Surveying is also used to prepare military map, geological map, archaeological map etc.
  - For setting out work and transferring details from the map on the ground.

Topographic Map

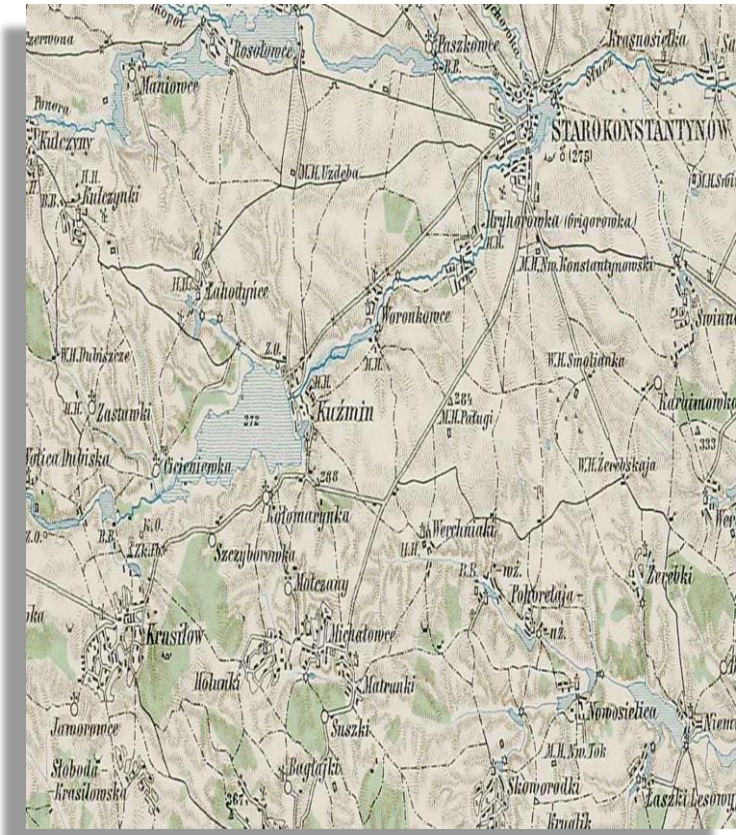


Cadastral Map

Engineering Map



Contour Map



SIZE SYMBOLS

- • Squad
- •• Section
- ••• Platoon
- I Company or Battery
- II Battalion of Squadron
- III Regiment or Air Group
- X Brigade
- XX Division or Wing

UNIT SYMBOLS

- Basic Unit
- ∞ Air
- LVT Amphibian Tractor
- Antiaircraft
- • DB Defense Battalion
- E Engineer
- • Field Artillery
- Infantry
- Para Parachute
- Prcht
- P Pioneer
- Rdr Raider
- Tank

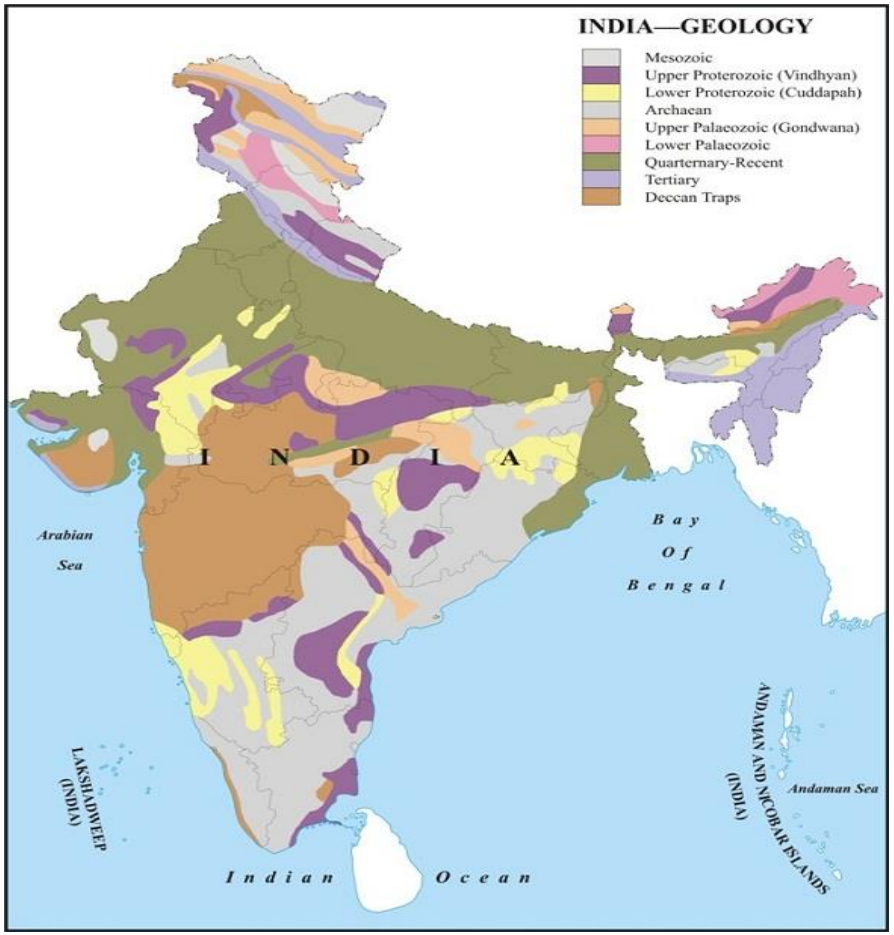
MISC. SYMBOLS

- Command Post
- Observation Post
- Boundary (battalion)
- Aid Station (battalion)

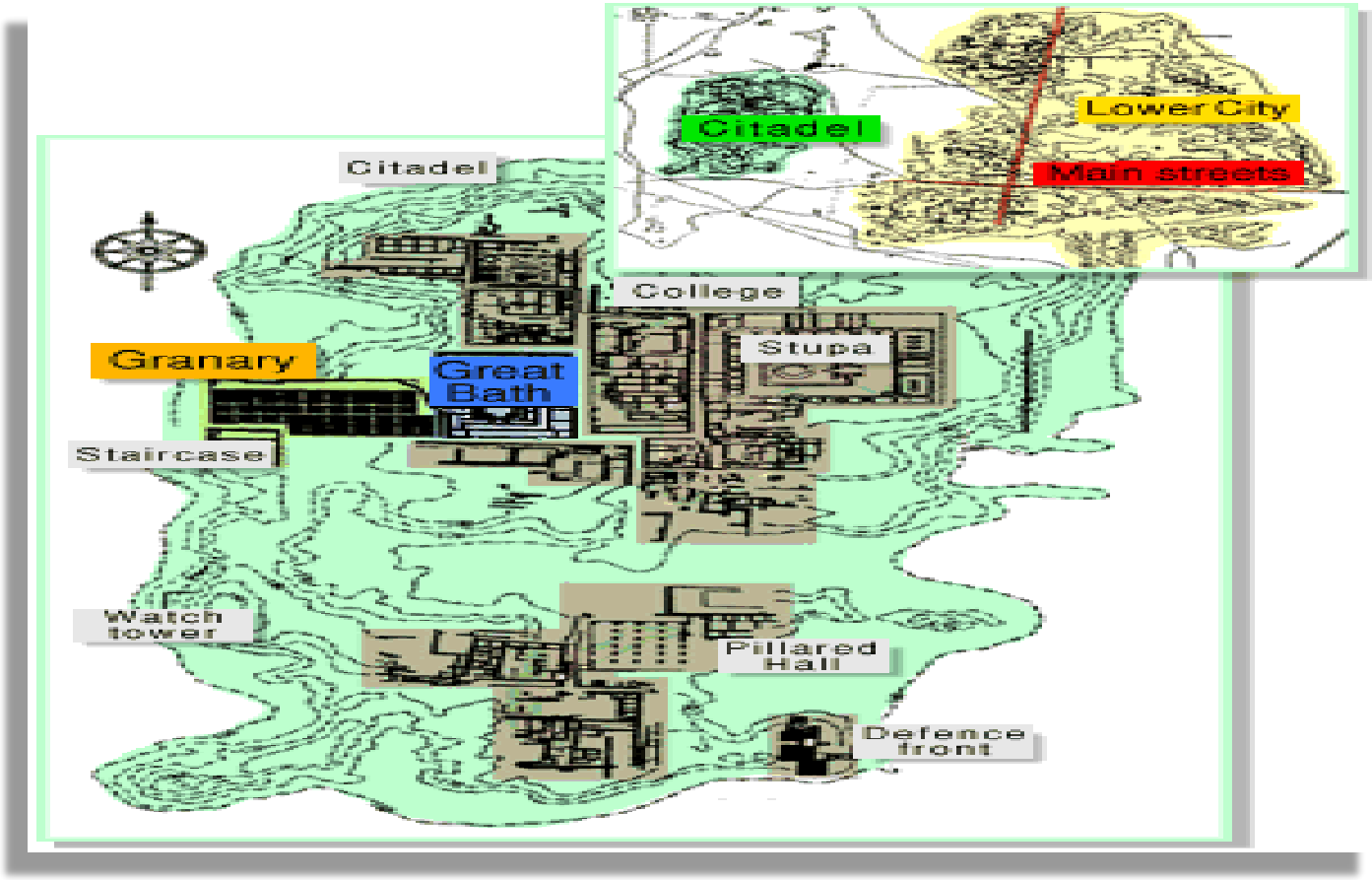
EXAMPLES

- 1L •• • 1DB — 1st Sec, L Btry, 1st Def Bn
- B I 5 — Co B, 5th Mar Regt
- II 1Rdr — 1st Rdr Bn
- III • 11 — 11th Mar Regt
- II 2 7 — OP, 2d Bn, 7th Mar Regt
- XX 1 — CP, 1st Mar Div

Millitary Map



Geological Map



Archaeological Map

Fundamental Principles of Surveying

- Two basic principles of surveying are:
  - Always work from whole to the part and
  - To locate a new station by at least two measurements (linear or angular) from fixed reference points.

Primary Divisions of Surveying

- We know that the shape of the earth is spheroidal. Thus the surface is obviously curved. Surveying is primarily divided into two types considering the curvature of the earth's surface.
  - Plane Surveying
  - Geodetic Surveying

Plain Surveying

- The plain surveying is that type of surveying in which earth surface is considered as a plane and the curvature of the earth is ignored.
- In such surveying a line joining any two stations is considered to be straight.
- The triangle formed by any three points is considered as a plane triangle, and the angles of the triangle are considered as plain angles.
- Surveying is carried out for a small area of less than 250 km^2 . It is carried out by local or state agencies like R & B department, Irrigation department, Railway department.

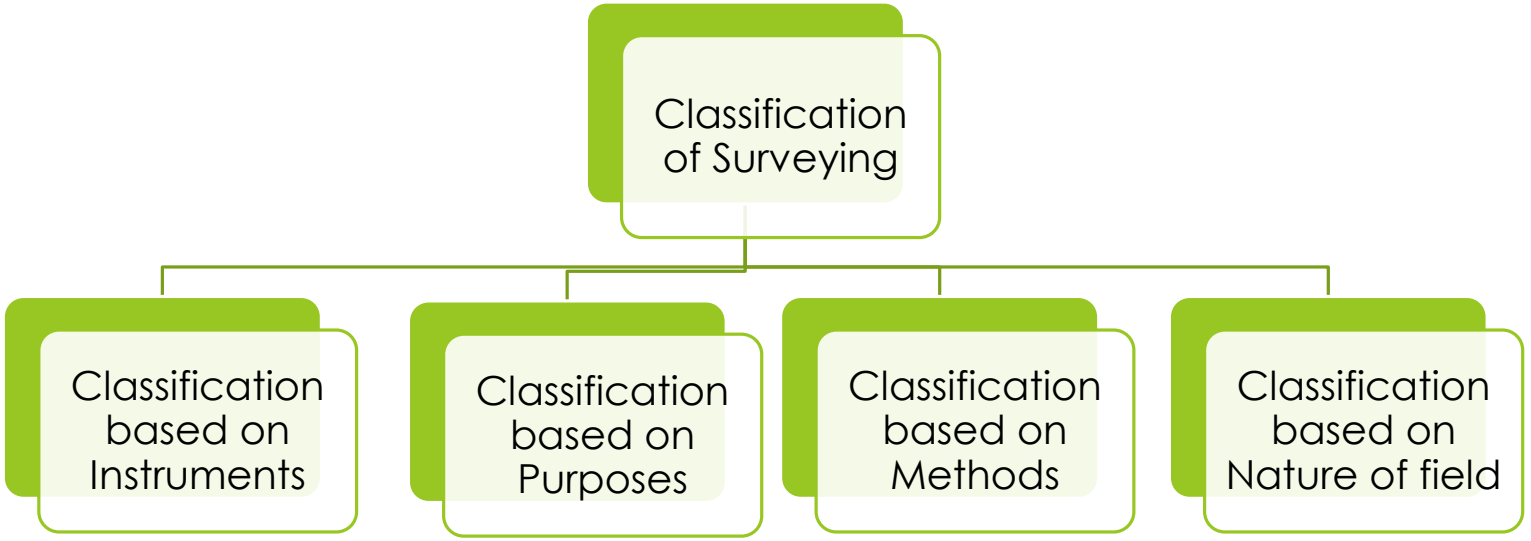
Geodetic Surveying

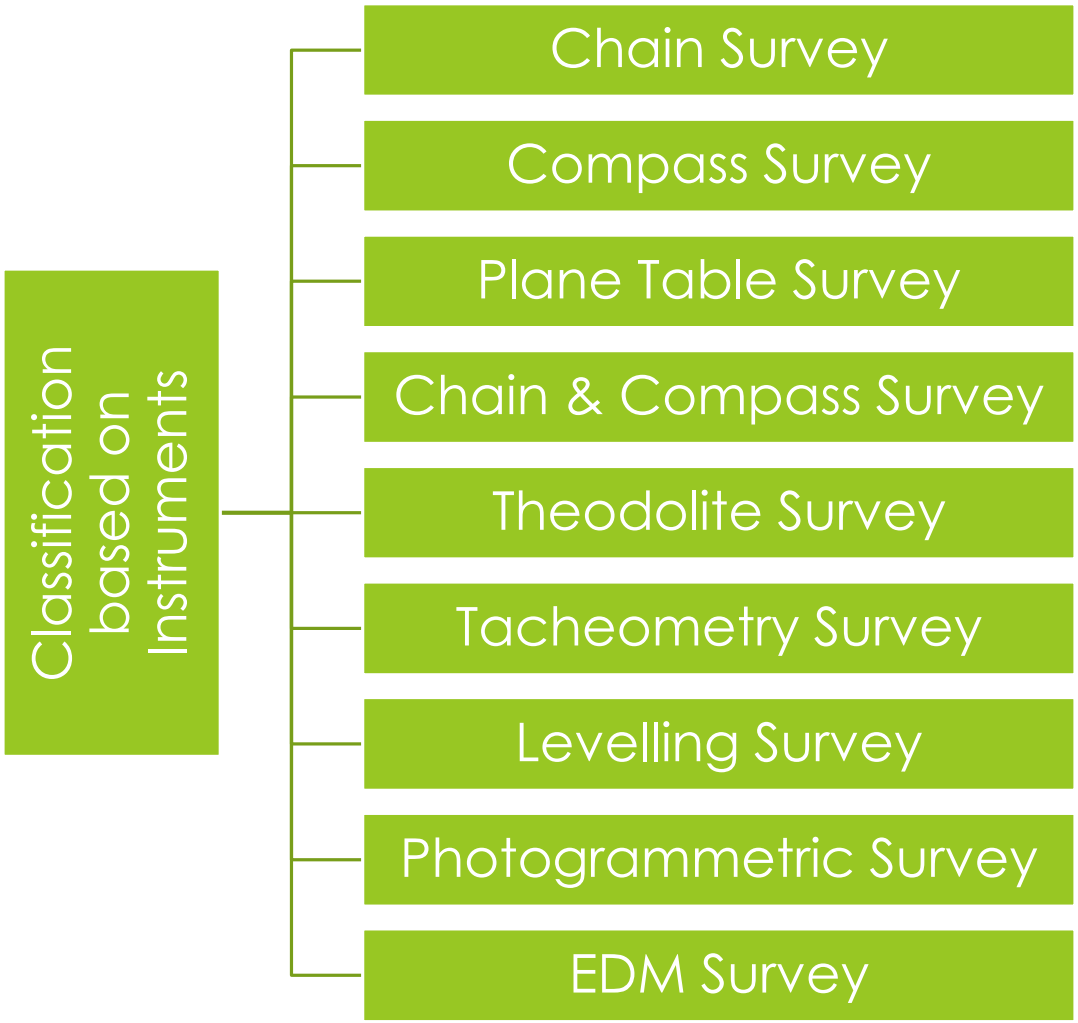
- The geodetic Surveying is that type of surveying in which the curvature of the earth is taken into account.
- It is generally extended over larger areas.
- The line joining any two stations is considered as curved line.
- The triangle formed by any three points is considered to be spherical and the angles of the triangle are considered to be spherical angles.
- Geodetic surveying is conducted by the survey of India Department and is carried out for a larger area exceeding 250 km^2

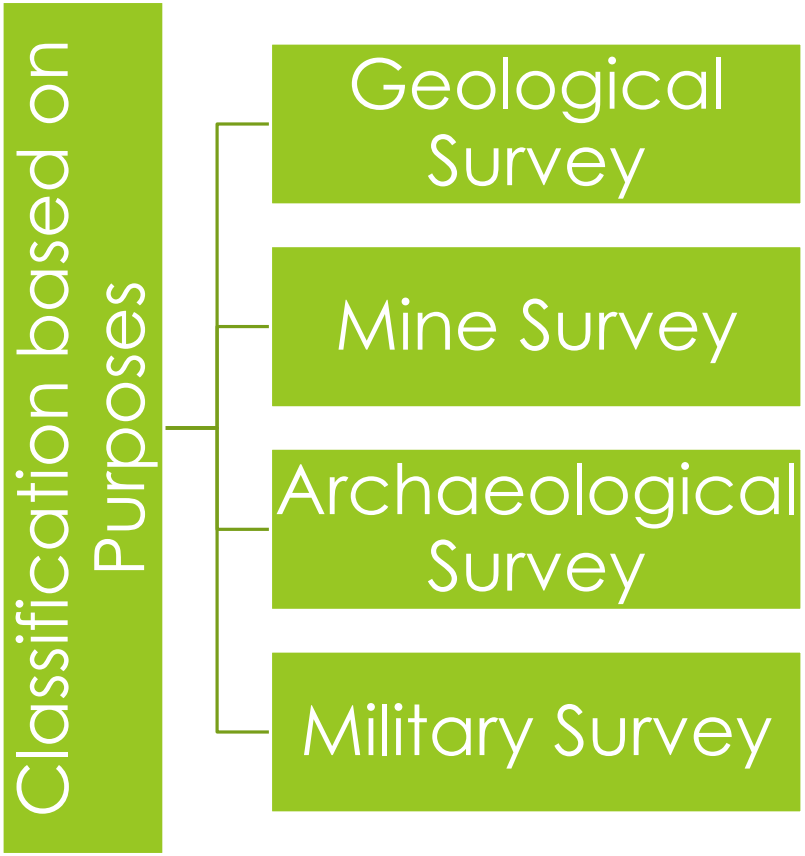
No.	Plain Surveying	Geodetic Surveying
1	The earth surface is considered as plain Surface.	The earth surface is considered as Curved Surface.
2.	The Curvature of the earth is ignored.	The curvature of earth is taken into account.
3	Line joining any two stations is considered to be straight	The line joining any two stations is considered as spherical.
4.	The triangle formed by any three points is considered as plain.	The Triangle formed by any three points is considered as spherical.
5.	The angles of triangle are considered as plain angles.	The angles of the triangle are considered as spherical angles.
6.	Carried out for a small area < 250 km^2.	Carried out for a large area > 250 km^2.

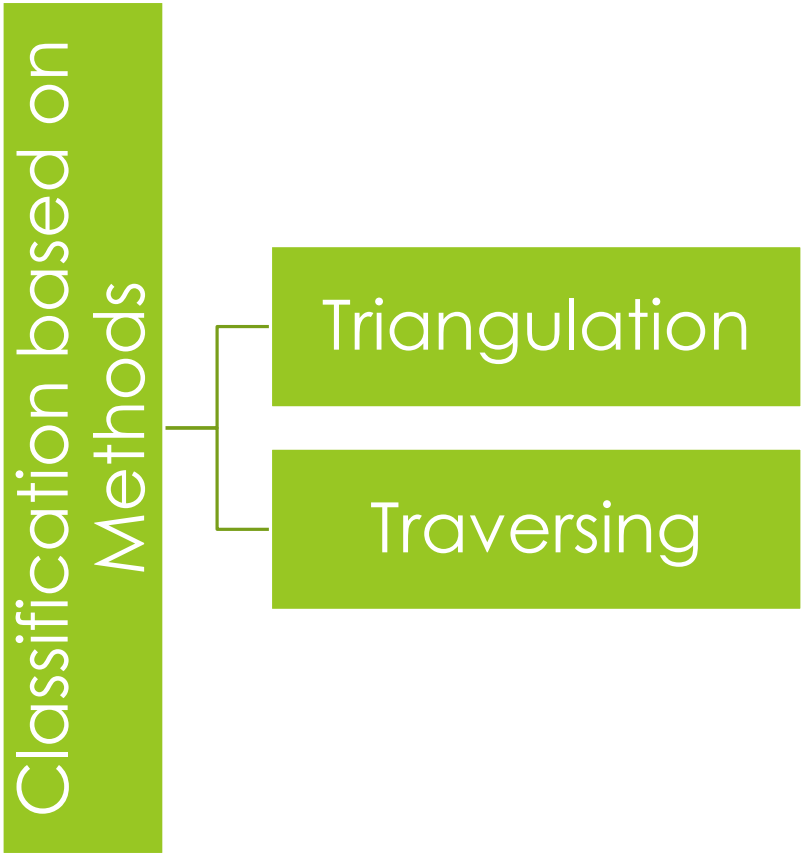
Classification of Surveying

- Survey can be classified into various categories:



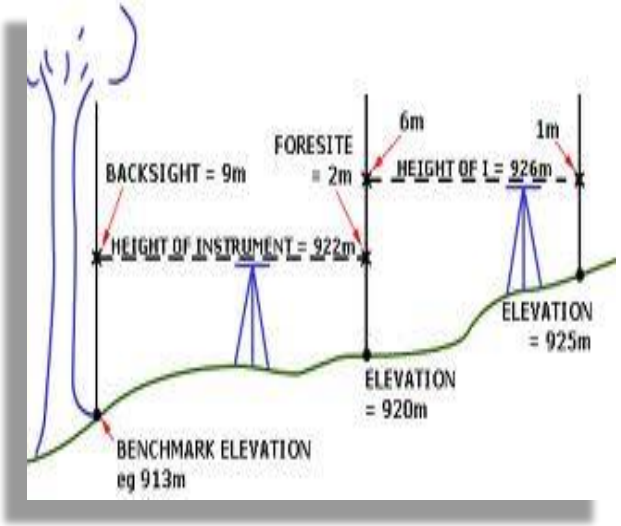

Classification based on Instruments
Chain Survey
Compass Survey
Plane Table Survey
Chain & Compass Survey
Theodolite Survey
Tacheometry Survey
Levelling Survey
Photogrammetric Survey
EDM Survey


Classification based on Purposes
Geological Survey
Mine Survey
Archaeological Survey
Military Survey

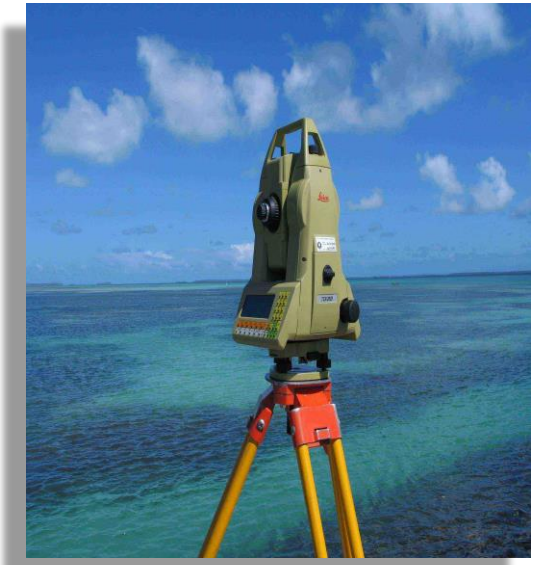

Classification based on Methods
Triangulation
Traversing


Classification based on Nature of field
Land Survey
Hydrographic Survey
Astronomic Survey
Aerial Survey


REPRODUCTION-SURVEY CHAIN


6m
1m
FORESITE
= 2m
BACKSIGHT = 9m
HEIGHT OF I = 926m
HEIGHT OF INSTRUMENT = 922m
ELEVATION
= 925m
ELEVATION
= 920m
BENCHMARK ELEVATION
eg 913m


Targeting Sight
Objective Lens
Horizontal Clamp Knob
Horizontal Tangent Screw
Display Window
Operating Keys
Leveling Screws
Instrument Center Mark
Optical Plummet
Tripod Base Plate



Plans & Maps

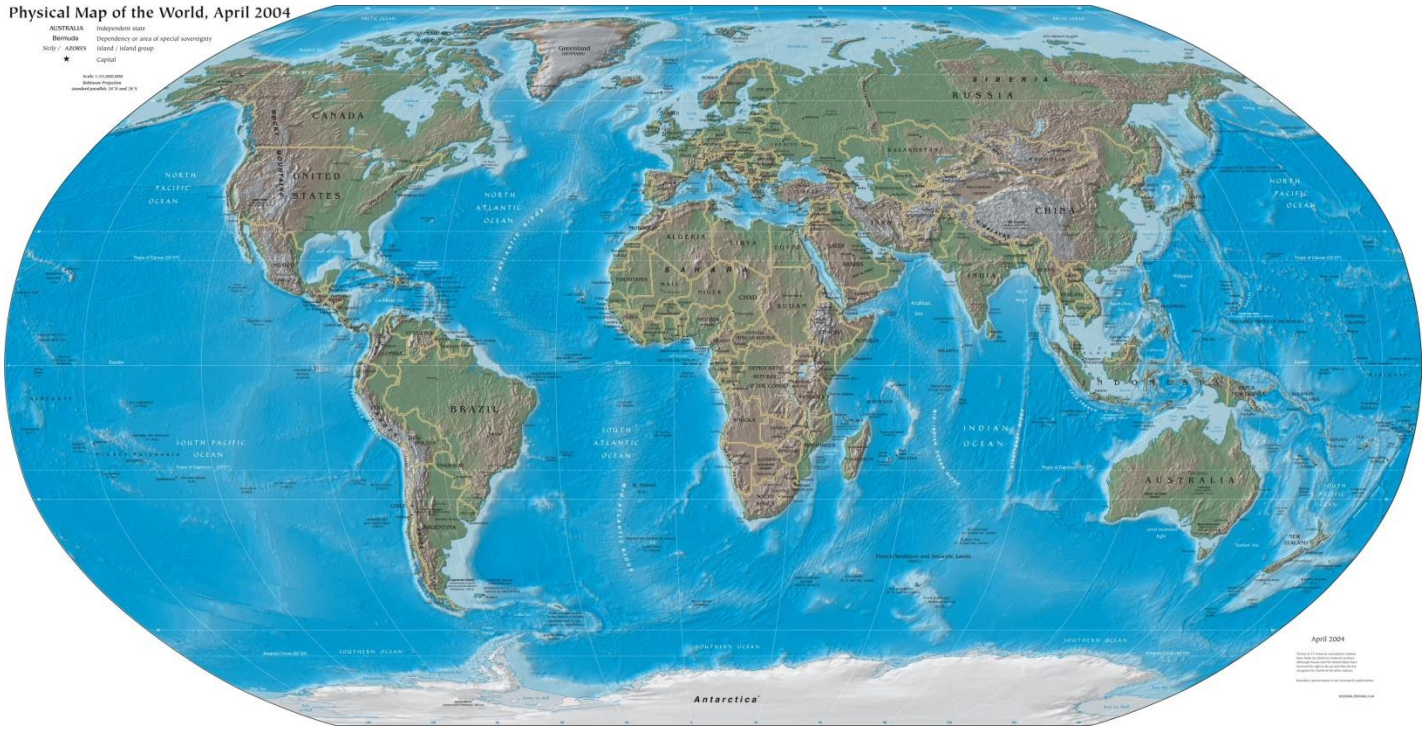
- **Plan**
  - A plan is the graphical representation to some scale, of the features on, near or below the surface of the earth as projected on a horizontal plane.
  - The horizontal plane is represented by plane of drawing sheets on which the plan is drawn to some scale.

Master Plan


RESIDENTIAL ENTRY & EXIT
OFFICE BUILDING
RESIDENTIAL BUILDING
OFFICE ENTRY & EXIT
DROP OFF
PARK & OPEN SPACE
19.2M WIDE ROAD
8.0M WIDE DRIVEWAY


BALCONY
10'6"x4'0"
3200x1219
RWP
BEDROOM 2
10'10½"x10'4½"
3314x3162
KITCHEN
8'0"x6'7½"
2438x2019
UTILITY
4'0"x6'3"
1219x1905
DINING
11'7½"x7'9"
3543x2362
TOILET
6'9"x4'6"
2057x1371
TOILET
7'6"x4'6"
2286x1371
LOFT ABOVE
LIVING
10'6"x14'0"
3200x4267
M.BEDROOM
12'0"x14'0"
3657x4267
ENT.

- **Map**
  - If the scale of the graphical projection on a horizontal plane is small, the plan is called a map. Thus graphical representation is called a plan if the scale is large while it is called a map if the scale is small.
  - On plan, generally only horizontal distances and directions or angles are shown. On topographical map, however the vertical distances (elevations) are also represented by contour lines.


Physical Map of the World, April 2004
AUSTRALIA Independent state
Bermuda Dependency or area of special sovereignty
Corvo / AZORES Island / island group
Capital
CANADA
UNITED STATES
RUSSIA
CHINA
BRAZIL
AUSTRALIA
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
SOUTHERN OCEAN
Antarctica
April 2004


INDIA
N
AFGHANISTAN
PAKISTAN
CHINA
NEPAL
BHUTAN
BANGLADESH
MYANMAR
SRI LANKA
INDIAN OCEAN
Arabian Sea
Bay of Bengal
JAMMU & KASHMIR
Srinagar
Jammu
HIMACHAL PRADESH
Amritsar
Jalandhar
Shimla
Ludhiana
Chandigarh
PUNJAB
Patiala
UTTARAKHAND
Hardwar
Ganganagar
Karnal
Sirsa
Muzaffarnagar
HARYANA
Sonipat
Meerut
Moradabad
NEW DELHI
Ghaziabad
Faridabad
Bareilly
Bikaner
Gurgaon
Aligarh
Shahjahanpur
Sikar
Alwar
Mathura
Bahraich
Farrukhabad
Bharatpur
Agra
RAJASTHAN
Jaipur
Etawah
Lucknow
Gorakhpur
Ajmer
Kanpur
Rae Bareli
Jodhpur
Gwalior
Darbhanga
Chapra
Pumia
Pali
Mau
UTTAR PRADESH
Patna
Raiganj
Bhilwara
Jhansi
Allahabad
Varanasi
Jagraj Bazar
Kota
Mirzapur
BIHAR
Bhagalpur
Udaipur
Satna
Rewa
Gaya
Baharampur
Murwara
JHARKHAND
Dhanbad
Asansol
Durgapur
Ranchi
Gandhinagar
Ratlam
Ujjain
Bhopal
Jabalpur
Jamshedpur
WEST BENGAL
Barddhaman
GUJARAT
Ahmedabad
Dewas
Kolkata
Jamnagar
Indore
MADHYA PRADESH
Kharagpur
Rajkot
Vadodara
Sagar
Korba
Haldia
Bilaspur
Raurkela
Bhavnagar
Khandwa
ODISHA
Junagadh
Burhanpur
Jalgaon
Nagpur
Raipur
Surat
Dhule
Bhilai
Cuttack
Daman & Diu
Amravati
Akola
Malegaon
Bhubaneswar
DADRA & NAGAR HAVELI
MAHARASHTRA
Chandrapur
CHHATTISGARH
Jalna
Brahmapur
Mumbai
Ahmednagar
Nanded
Nizamabad
Karimnagar
Vizianagaram
Pune
Latur
Bidar
Warangal
Visakhapatnam
Solapur
Hyderabad
Rajahmundry
Kakinada
Kolhapur
Sangli
Kalaburagi
TELANGANA
Vijayawada
Eluru
Vijayapura
Guntur
Machilipatnam
Raichur
Belagavi
Kurnool
Panaji
GOA
Hospete
Bellary
ANDHRA PRADESH
Anantapur
Nellore
KARNATAKA
Shivamogga
Tirupati
Tumkuru
Chennai
Mangaluru
Bengaluru
Vellore
Mysuru
Puducherry
Puducherry
Salem
Kozhikode
TAMIL NADU
Tiruchirappalli
Thanjavur
Thrissur
Dindigul
Kochi
Madurai
KERALA
Alappuzha
Kollam
Tirunelveli
Nagercoil
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
Port Blair
SIKKIM
Gangtok
Siliguri
ARUNACHAL PRADESH
Itanagar
ASSAM
Guwahati
NAGALAND
Kohima
Shillong
MEGHALAYA
Imphal
MANIPUR
Agartala
Aizwl
TRIPURA
MIZORAM
International Boundary
State Boundary
Rivers
Country Capital
Major Cities
Map not to Scale
Copyright © 2014 www.mapsofindia.com
(Updated on 10th December 2014)

Scales

- It is basic requirement for the preparation of plan or map.
- Scale is used to represent large distances on paper.
- The ratio by which the actual length of the object is reduced or increased in the drawing is known as the 'Scale'.
- For example, if 1 cm on a map represents a distance of 10 metres on the ground, the scale of the map is said to be 1 cm = 10 m.

Representative Fraction

- The ratio of the distance on the drawing to the corresponding actual length of the object on the ground is known as the representative fractions. i.e..
- R.F= $\frac{\text{Distance of the Object on Drawing}}{\text{Corresponding Actual distance of object on Ground}}$
- Both the distances are in same unit

- For example,
- If a scale is1 cm = 10 m
- R.F. = $\frac{1}{10 \times 100} = \frac{1}{1000}$ or 1: 1000


THANK YOU

Chapter-2: Linear Measurements

Dept. of Civil Engineering
Institute of Tech. & Engg.

Subject: BASICS OF CIVIL ENGG.

Subject Code: CV0121

Topics to be covered(Teaching hours: 05)

- Methods of linear measurement
  - Approximate methods
- Instruments used in Chain surveying
- Principles of Chain Surveying
- Terms related with chain surveying
- Selection of survey stations
- Operations in Chain Surveying
  - Chaining
  - Ranging
  - Offsetting
- Errors in Chaining
- Corrections
- Conventional symbols

Introduction

- The determination of the distance between two points on the surface of the earth is one of the basic operation of surveying.
- Measurement of horizontal distances or measuring linear measurement is required in chain surveying, traverse surveying and other types of surveying.

Methods

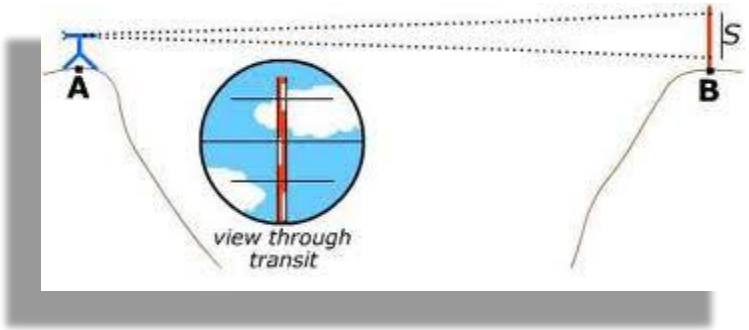
- There are 3 methods of making linear measurements.
  - 1- Direct Method.
  - 2- Optical Method.
  - 3- E.D.M Method.

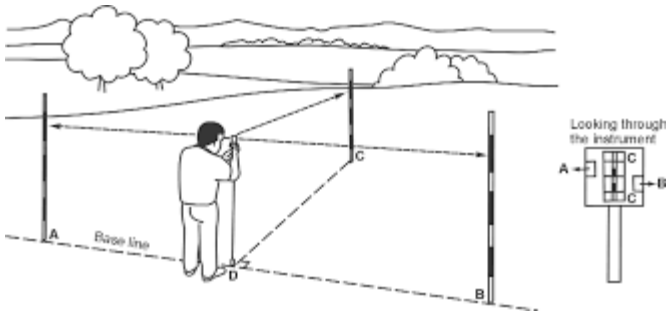
Direct Method

- In the direct method, the distance is actually measured during field work using a chain or a tape. This is the most commonly used method for linear measurements.

Optical Method

- In the optical methods, principles of optics are used.
- The distance is not actually measured in field but it is computed indirectly.
- The instrument used for making observations is called tacheometer.





E.D.M Method

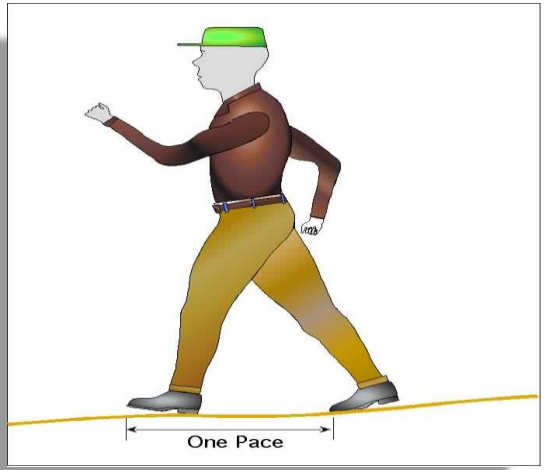
- Electronic Distance Measuring (E.D.M) instruments have been developed quite recently.
- These are practically replacing the measurement of distances using chains or tapes.
- There is a large variety of such instruments and depending upon the precision required the instruments should be used.

Approximate Methods

- Pacing.
- Passometer.
- Pedometer.
- Odometer.
- Speedometer.
- Measuring Wheel.

Pacing

- The distance between two points can be approximately be determined by counting the number of paces and multiplying it with average length of the pace.



Passometer

- It is a small instrument which counts the number of paces

Pedometer

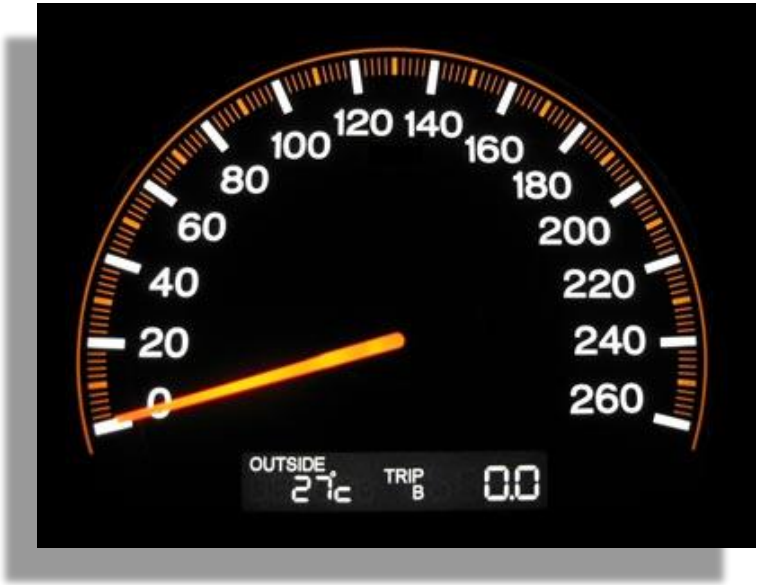
- This instrument directly gives the distance by multiplying the number of paces with the average pace length of the person carrying the instrument.

Odometer

- An odometer is a simple device which can be attached to the wheel of a bicycle or any such vehicle.
- The odometer registers the number of revolution made by the wheel. The distance covered is equal to the product of the number of revolutions and the perimeter of the wheel

Speedometer

- This is used in automobiles for measuring distances.



Measuring Wheel

- It is a wheel fitted with a fork and handle. The wheel is graduated and shows a distance per revolution. There is a dial which records the number of revolution. Thus the distance can be computed.


BOLE
JW 316
METER COUNTER

Instruments used in Chain Surveying

1) Chains
2) Tapes
3) Arrows
4) Ranging Rods and Offset Rod
5) Pegs
6) Plumb- bob

Chains

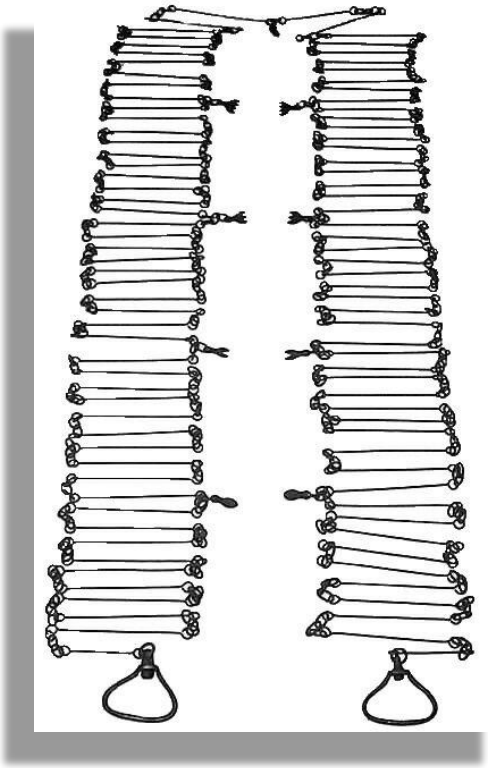
- Various types of chains used in surveying are
  - Metric chain
  - Gunter's chain or Surveyor's chain
  - Engineer's chain
  - Revenue chain
  - Steel band or Band chain

Metric Chain

- Chain consists of galvanized mild steel wire of 4 mm diameter known as link.
- The ends of the links are bent into loop and connected together by means of three oval rings which provide the flexibility to the chain and make it less liable to kinking.

Gunter's Chain

- A 66 feet long chain consists of 100 links each of 0.66 ft it is known as Gunter's Chain
- Here, 10 sq chain are equal to 1 acre,
- 10 chains= 1 furlong and 8 furlongs = 1 mile
- This chain is suitable for taking length in miles and areas in acres.



1 chain = 66 ft. / 100 links

4 poles (or rods) = 16.5 ft. + 16.5 ft. + 16.5 ft. + 16.5 ft.

10 chains = 1 furlong

10 square chains = 1 acre

80 chains = 5,280 feet = 1 mile

Engineer's Chain

- A 100 ft chain of 100 links each of 1 foot is known as Engineer's chain.
- Brass tags are fastened at every 10 links.
- This chain is used to measure length in feet and area in square yards.

Revenue Chain

- Revenue chain is 33 ft long chain consisting of 16 links. This chain is used for distance measurements in feet & inches for small areas.

Steel Band or Band Chain

- Steel bands are preferred than chains because they are more accurate, but the disadvantages is that they get broken easily and are difficult to repair in the field.
- They are numbered at every metre and divided by brass studs at every 20 cm.

Tapes

- Tapes are used for more accurate measurement. The tapes are classified based on the materials of which they are made of such as:
  - Cloth or linen tape.
  - Fibre tape.
  - Metallic tape.
  - Steel tape.
  - Invar tape.

Cloth or linen tape

- Linen tapes are closely woven linen and varnished to resist moisture.
- They are generally 10 m, 20 m, 25 m and 30 m long in length and 12 to 15 mm wide. They are generally used for offset measurements. These tapes are light and flexible.

Fibre tape

- These tapes are similar to linen and plastic coated tapes but these are made of glass fibre.
- The tapes are quite flexible, strong and non-conductive.
- These tapes do not stretch or shrink due to changes in temperature or moisture.

Metallic tape

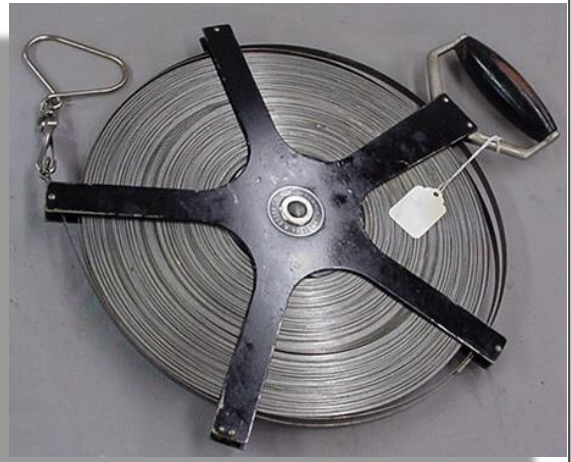
- A linen tape reinforced with brass or copper wires to prevent stretching or twisting of fibres is called a metallic tape.
- As the wires are interwoven and tape is varnished these wires are visible to naked eyes. This is supplied in a lather case with a winding device.

Steel tape

- The steel tape is made of steel ribbon of width varying from 6 to 16 mm.
- The commonly available length are 10 m, 15 m, 20 m, 30 m and 50 m.
- Steel tapes are used for accurate measurement of distances.

Invar tape

- Invar tape are made of alloy of nickel 36 % and steel 64 % having very low co-efficient of thermal expansion.
- It is not affected by change of temperature therefore, it is used when high degree of precesion is required.



Arrows

- Arrows are made of tempered steel wire of diameter 4mm.
- One end of the arrow is bent into a ring of diameter 50mm and the other end is pointed.
- Its overall length is 400mm.
- An arrow is inserted into the ground after every chain measured on the ground.

Ranging Rods and Offset Rod

- Ranging rods are 2 to 3 m in length.
- Used for ranging some intermediate points on the survey line.
- Painted with alternate bands of black and white or red and white colours.
- With length of each equalising 20 cm.

Ranging rods

Pegs

- Made of timber or steel.
- Used to mark the position of stations.
- Pegs are in length of 15 cm.

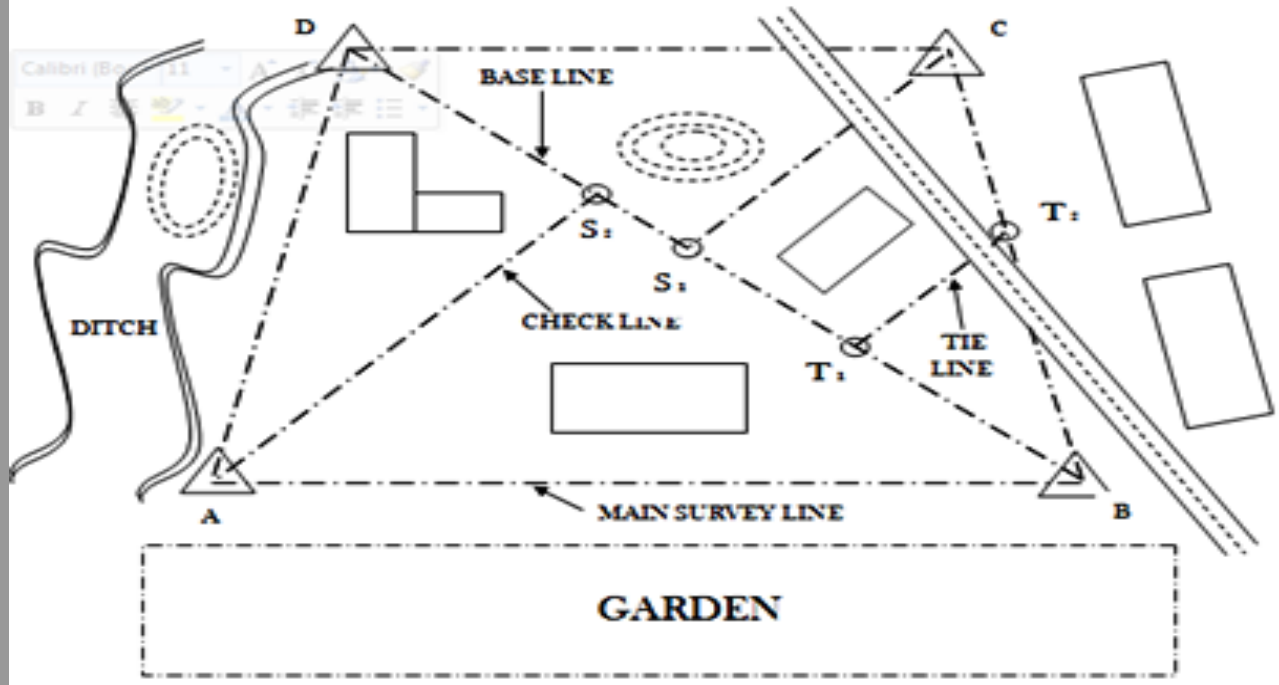
Plumb-Bob

- Used to transfer points on ground.
- Used for fixing instrument exactly over the stations.

Principle of Chain Surveying

- The principle of chain surveying is to divide the area into a number of triangles of suitable sides.
- In this area is divided into a number of triangles with the suitable sides.
- The plan of the area can be easily drawn.
- As a triangle is the only simple plane geometrical figure.

Terms related with Chain Surveying



Survey Stations

- Main Stations
- Subsidary Stations
- Tie Stations

Main Stations

- Main Station Stations along the boundary of an area as controlling points are known as 'Main Stations'.
- The lines joining the main station are called ' Main Survey Lines'.
- The main survey lines should cover the whole area to be surveyed. The main stations are denoted by Δ.

Subsidiary Stations

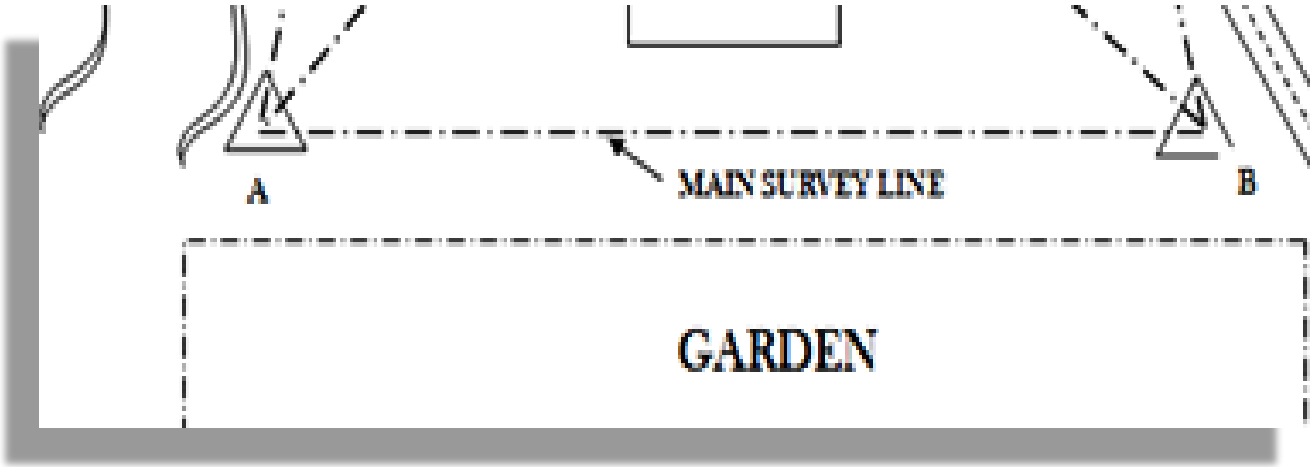
- Stations which are on the main survey lines or any other survey lines are known as ‘ Subsidiary Stations’
- These stations are taken to run subsidiary lines for dividing the area into triangles, for checking the accuracy of triangles and for locating interior details.
- These are denoted by ⊙

Tie Stations

- These stations are also subsidiary stations taken on the main survey lines.
- Lines joining the stations are known as ‘ Tie lines’ Tie lines are taken to locate interior details.
- These are also denoted by ⊙

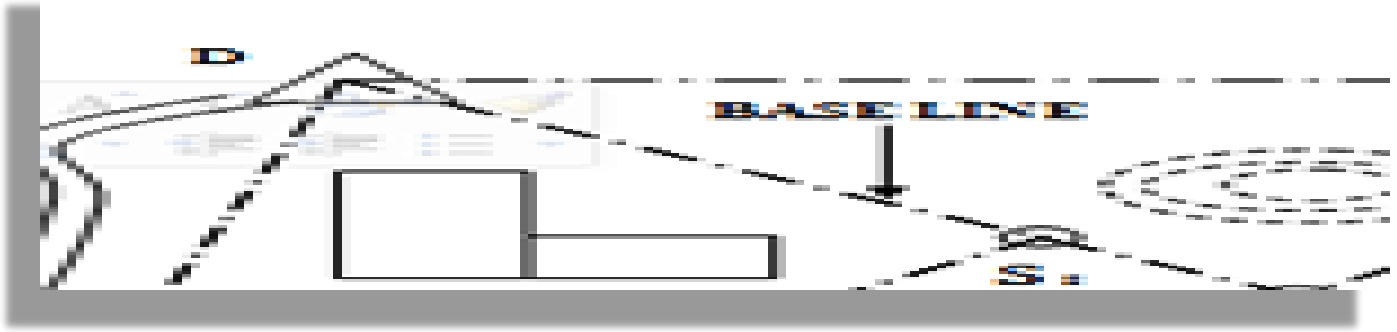
Main Survey Line

- The line joining the main stations are called main survey lines or chain lines.



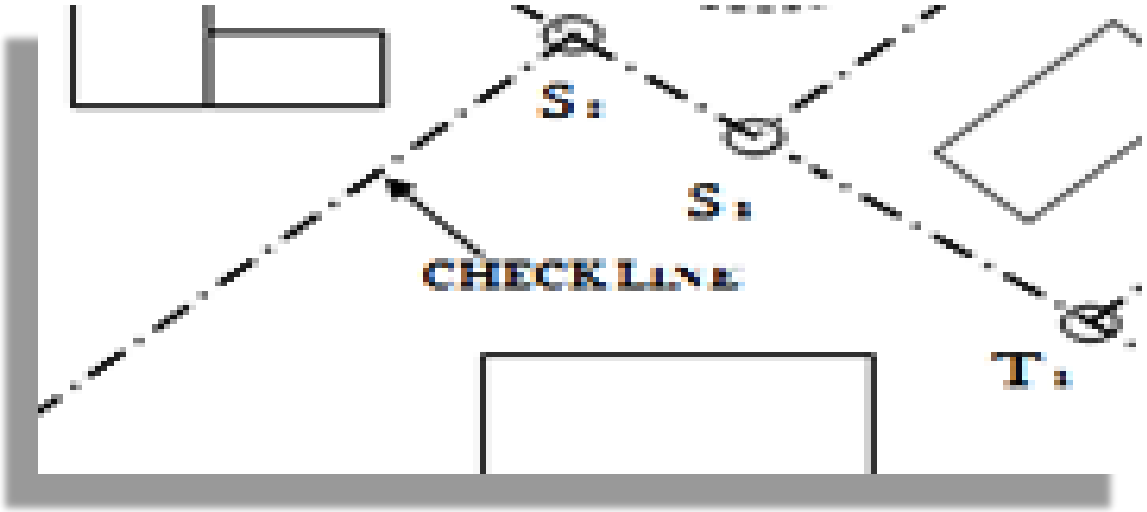
Base line

- The line on which the framework of the survey is built is known as ‘ Base line’.
- The longest of the main survey lines is considered as the base line.
- This lines should be taken through fairly level ground, and should be measured very carefully and accurately.



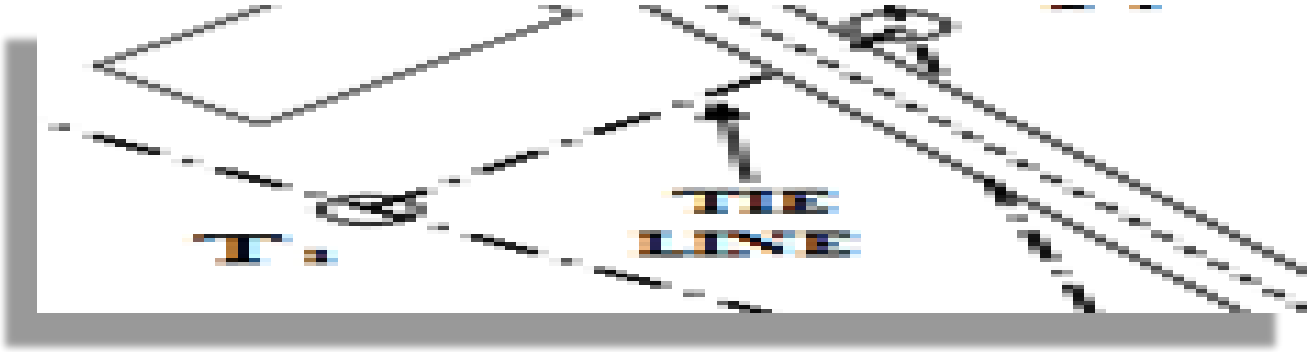
Check Line

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



Tie Line

- A line joining tie stations is termed as a tie line. It is run to take the interior details which are far away from the main lines and also to avoids long offsets. It can also serve as check line



Selection of Survey Stations

- Survey lines should be minimum as far as possible and should be taken on fairly level ground.
- Should be inter-visible.
- Should form well conditioned triangles.
- Should be located that tie lines, check lines, baseline etc. can be formed.
- Should be selected within the boundary of the area to be surveyed.

Operations in Chain Surveying

- Chaining
- Ranging
- Offsetting

Chaining

- Chaining can further subdivided into two methods:
  - Chaining on level ground.
  - Chaining on sloping ground.

Chaining on Level Ground

- Chaining on level ground

It involves following operations

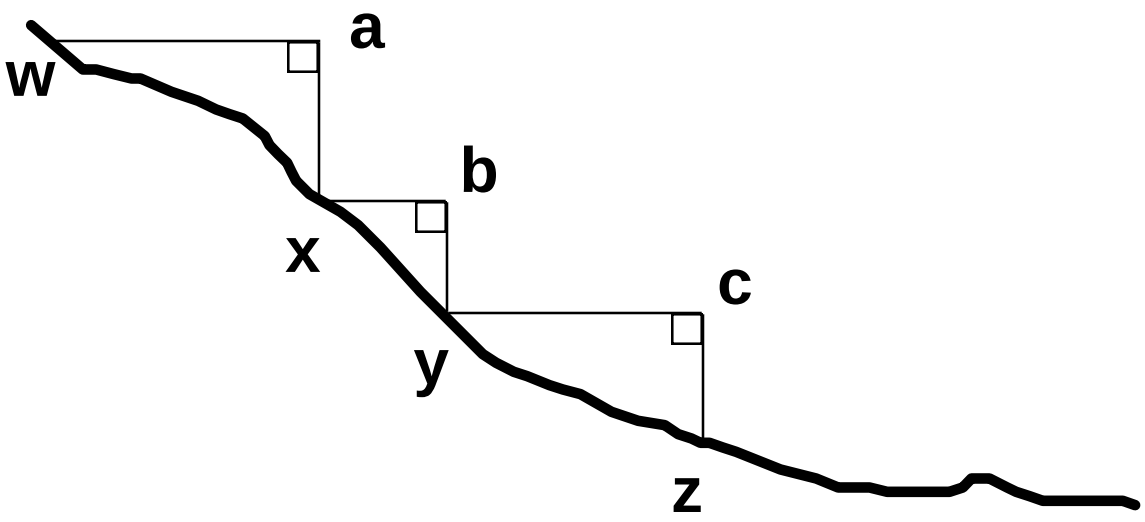
1) Fixing the stations.
2) Unfolding the chain.
3) Ranging.
4) Measuring the distance.
5) Folding the chain.

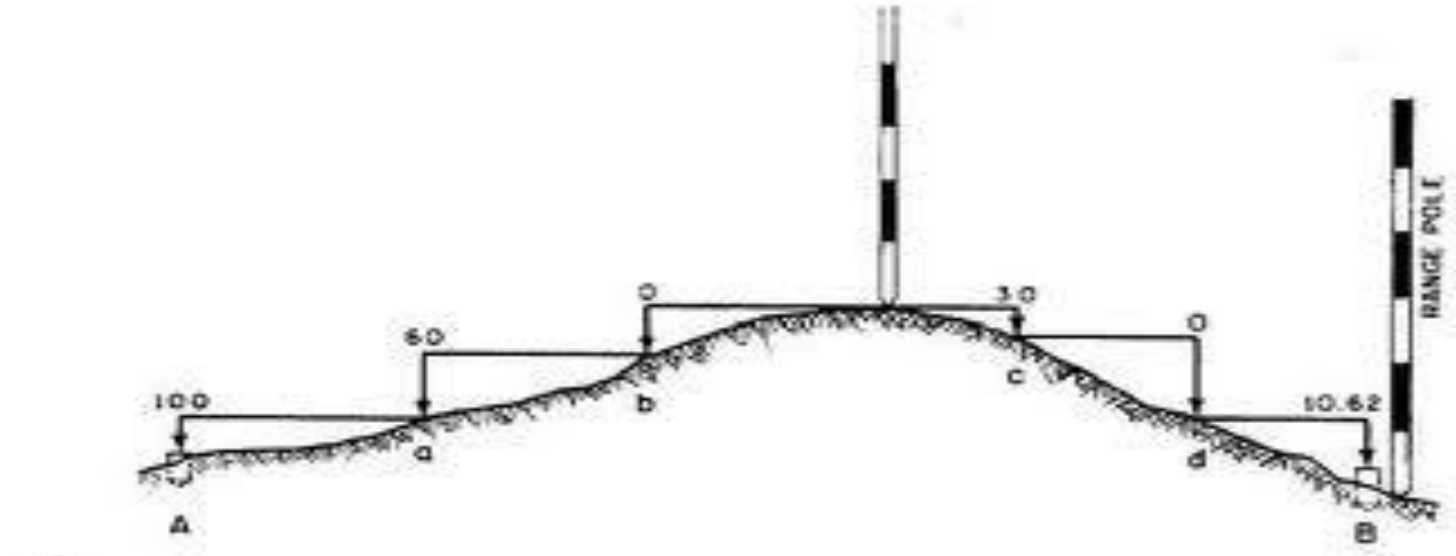
Chaining on Sloping Ground

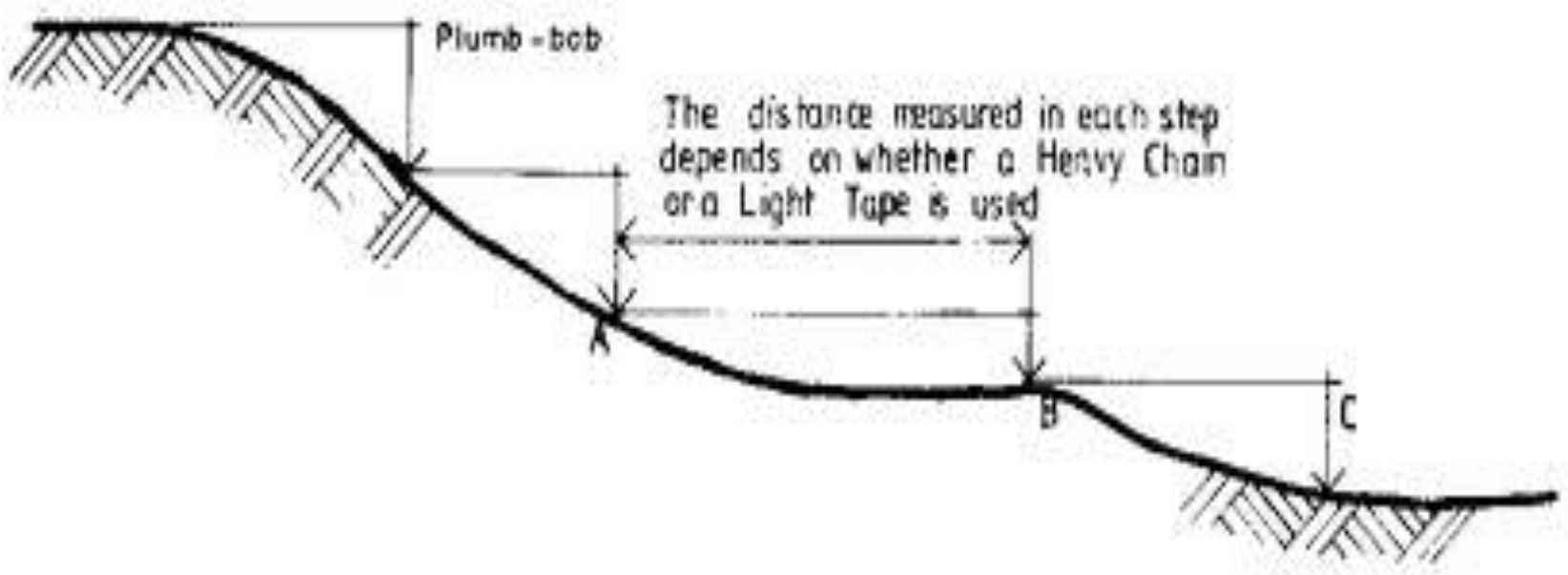
There are 2 methods:

- Direct Method:
  - Also called as stepping.
  - In this method, the distance is measured in small horizontal stretches say a_1, a_2 …a_n with suitable length of chain or tape.
  - Finally the total horizontal distances are added to get the required distances .
- Indirect Method:
  - It involves calculation from directly measured lengths.
  - There are three methods designed for indirect calculations.

Chain surveying ("stepping")







Chaining on sloping ground

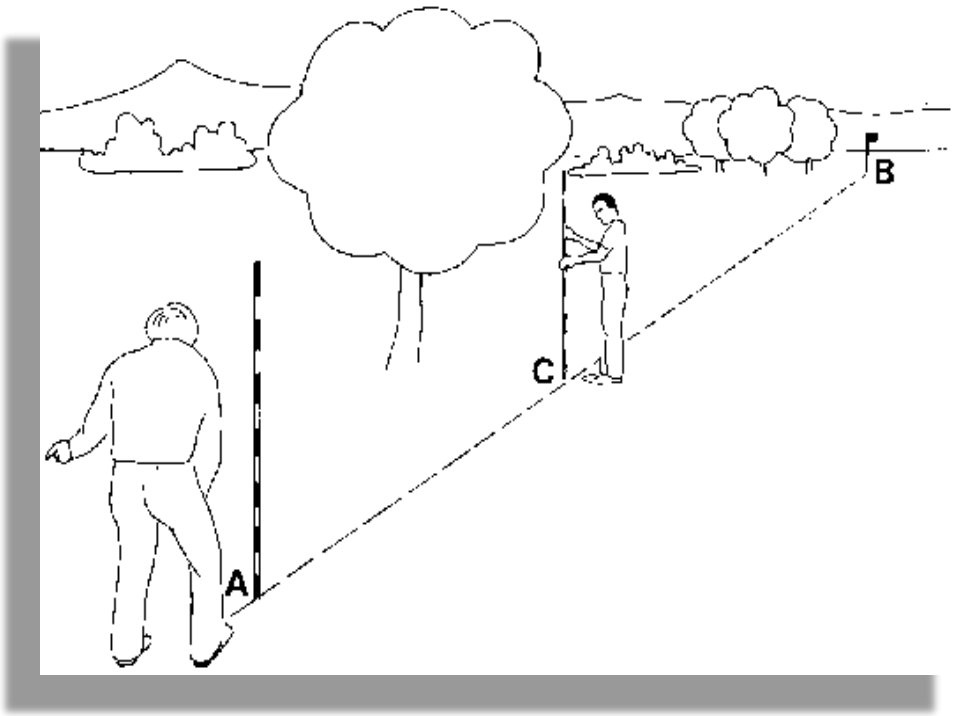
Ranging

- When the length of line exceeds the length of chain , to proceed in straight line intermediate points are required to be established between two stations.
- The process of establishing intermediate points on a straight line between two end points is known as ranging.
- There are 2 methods:
  - Direct ranging
  - Indirect ranging or Reciprocal ranging.

Direct Ranging

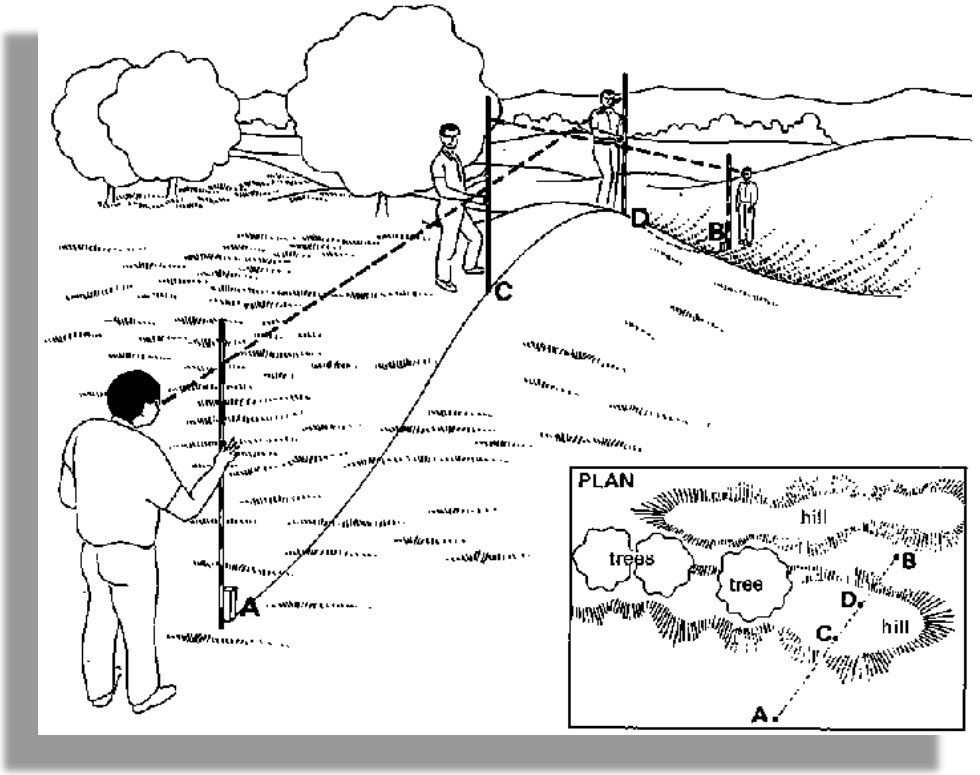
- When intermediate ranging rods are fixed on a straight line by direct observation from end stations, the process is known as direct ranging.

- Direct ranging also can be done with a line ranger it consist of 2 right isosceles triangular prisms. Placed one above other.



Indirect or Reciprocal Ranging

- When the end stations are not intervisible due to there being high ground between them, intermediate ranging rods are fixed on the line in an indirect way.
- The method is known as indirect ranging or reciprocal ranging.



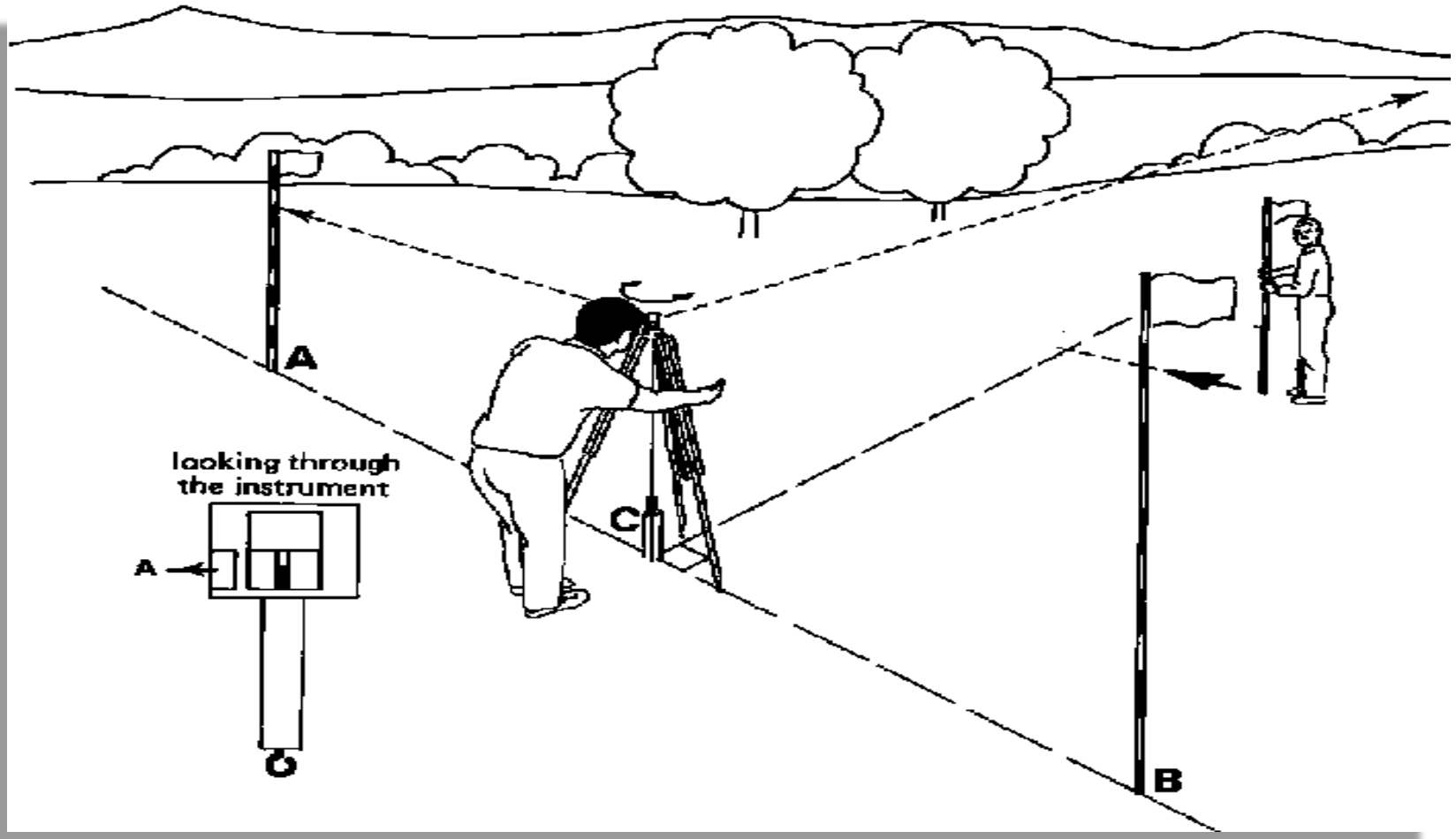
Offsetting

- The method of taking perpendicular distances from chain line to the objects which are to be plotted is known as offsetting.
- Lateral measurements to chain lines for locating ground features are known as offsets.

- There are 2 types of offsets:
  - Perpendicular offsets:

    The offsets which are taken perpendicular to the chain are termed as above.
  - Oblique offsets:

    Oblique distance is always greater than perpendicular distance. All the offsets which are not taken at right angle to chain line are known as above.


A
looking through
the instrument
A
C
B

Instruments for laying Offsets

- Optical square.
- Indian optical square.
- Open cross staff.
- Prism square.

Optical Square

Indian Optical Square

Open Cross Staff

Errors in Chaining

- There are 2 types
  - Cumulative errors : The errors, which occur in the same direction and tend to accumulate are called cumulative errors.
  - Compensating errors :The errors, which occur in either direction and tend to compensate are called compensating errors.

Sources of Errors in Chaining

- Instrumental Errors
- Natural errors
- Personal errors

Errors due to Incorrect Chain

- If chain is too long ,Measured distance will be less. Correction: positive
- If chain is too small Measured distance will be more. Correction: negative

Examples on Errors in Chaning

- A 20 m chain was found to be 8 cm long at the end of day's work after measuring 4000 m . If the chain was correct before commencement of work, find correct length of line.

- A 20 m chain was found to be 10 cm too long after chaining a distance of 1500 m . It was found to be 18 cm too long at the end of one day's work after chaining the total distance of 3900 m . Find the true distance if chain was correct before commencement of work.

Tape corrections

- Corrections for absolute length
- Corrections for temperature
- Corrections for pull
- Corrections for sag
- Corrections for slope

Conventional Symbols

Chain line

Triangulation station

Traverse station

Building

Shed with open side

Shed with closed side

Temple, mosque and church

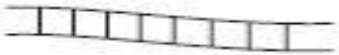
Path

Unfenced road

Fenced road

Railway line: Single

Railway line: Double



Road bridge

Level crossing

Road over railway

Road under railway

Boundaries without pillars

Boundaries with pillars

Township or taluka boundaries

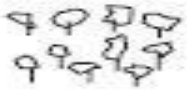
River

Pond

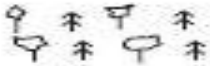
Electric line

Tree

Orchard

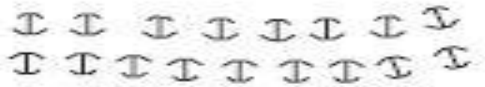


Woods

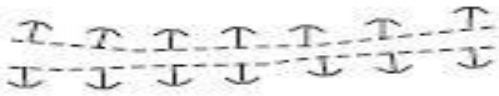


Grass

Cutting



Embankment



North line


THANK YOU

Chapter-3: Angular Measurements

Dept. of Civil Engineering
Institute of Tech. & Engg.

Subject: BASICS OF CIVIL ENGG.

Subject Code: CV0121

Topics to be covered (Teaching hours: 05)

- Instruments used for angular measurement
- Traversing
- Principles of Compass Surveying
- Types of compass : Overview
- Types of bearings
- Measurement of bearings

Introduction

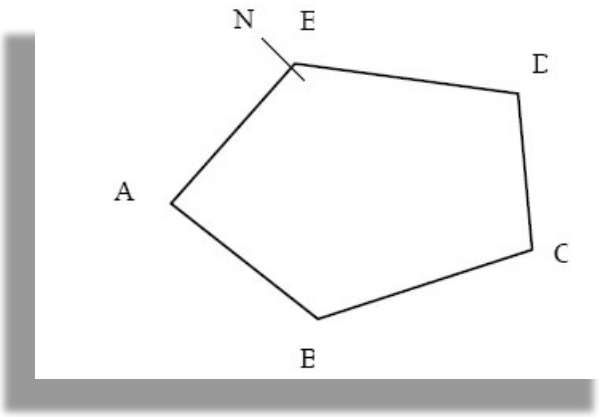
- Points on the ground or on a map are related to each other through a horizontal distance and a horizontal angle (or direction).
- Horizontal angular measurements are made between survey lines to determine angle between the lines.
- A horizontal angle is the difference between two measured directions.

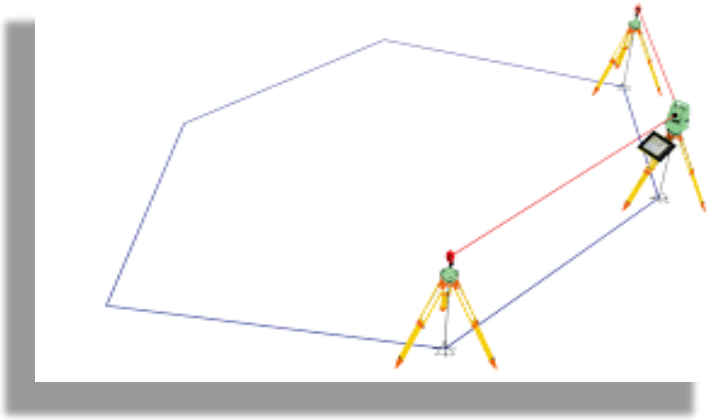
Instruments used for Angular Measurement

- When area is large, undulating and crowded with many details, triangulaion is not possible.
- Thus it becomes essential to use some sort of instrument which enables us to measure horizontal angles or directions.
- The instruments used for this purpose are:
  - Compass
  - Box-Sextant
  - Theodolite
  - Total station

Traversing

- Traversing is generally adopted when the area is large and undulating or where triangulation is not possible.
- In traversing, the frame work consists of number of connected lines.





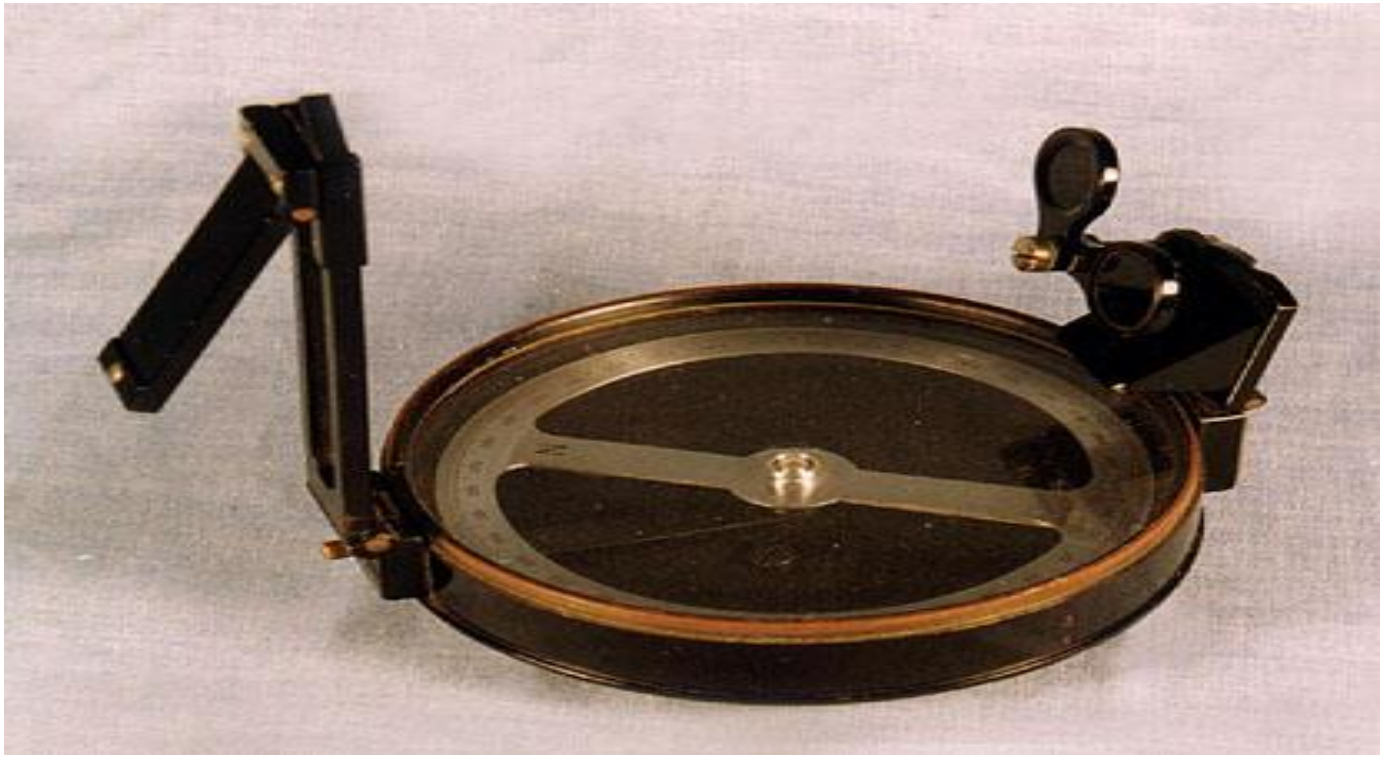
Principle of Compass Surveying

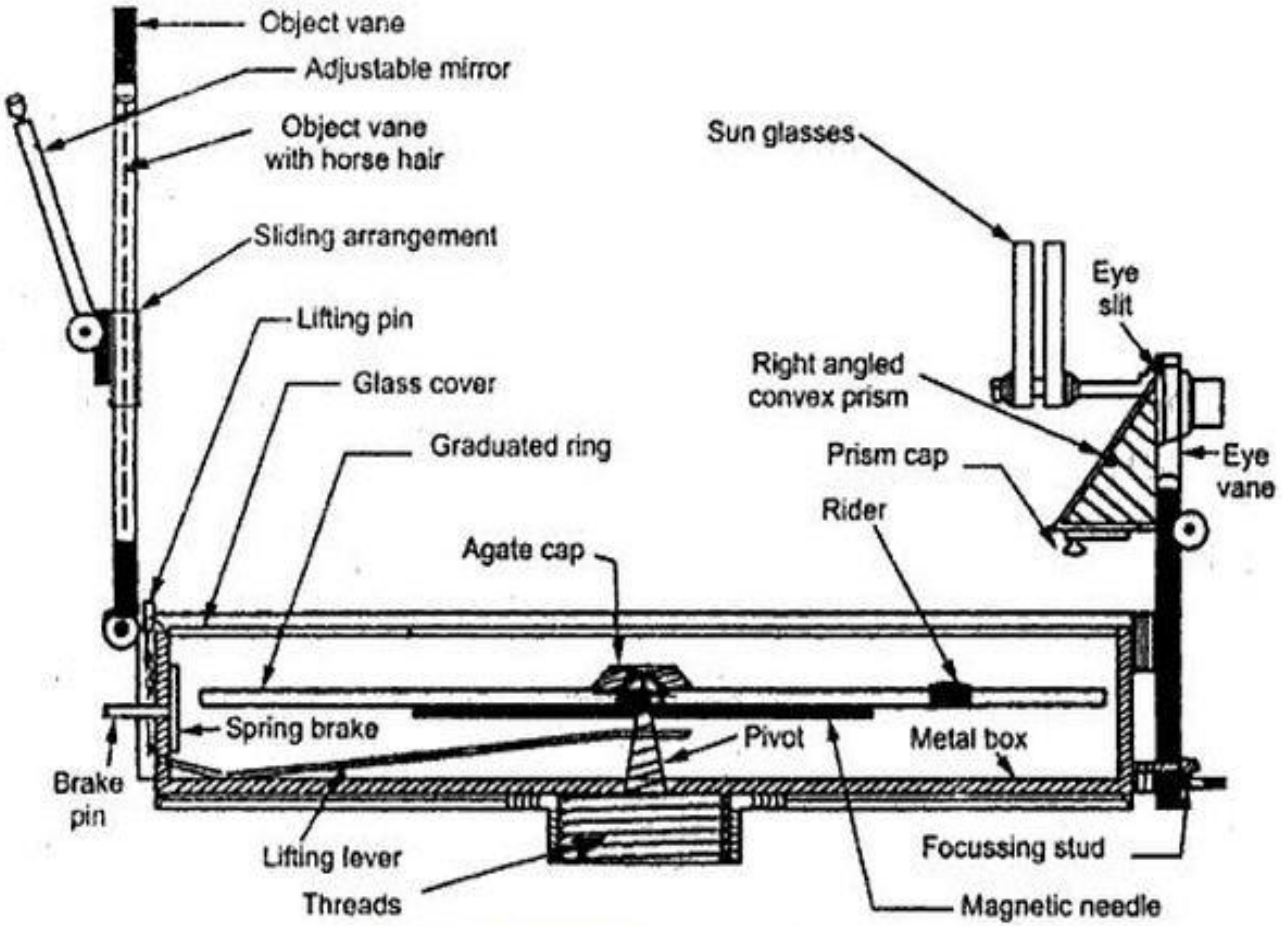
- The Principle of compass surveying is traversing; which involves a series of connected lines.
- The magnetic bearings of the lines are measured by prismatic compass and the distances are measured by chain.
- Recommended when area is large, undulating and crowded with many details.
- Not recommended where local attraction is suspected.

Types of Compass

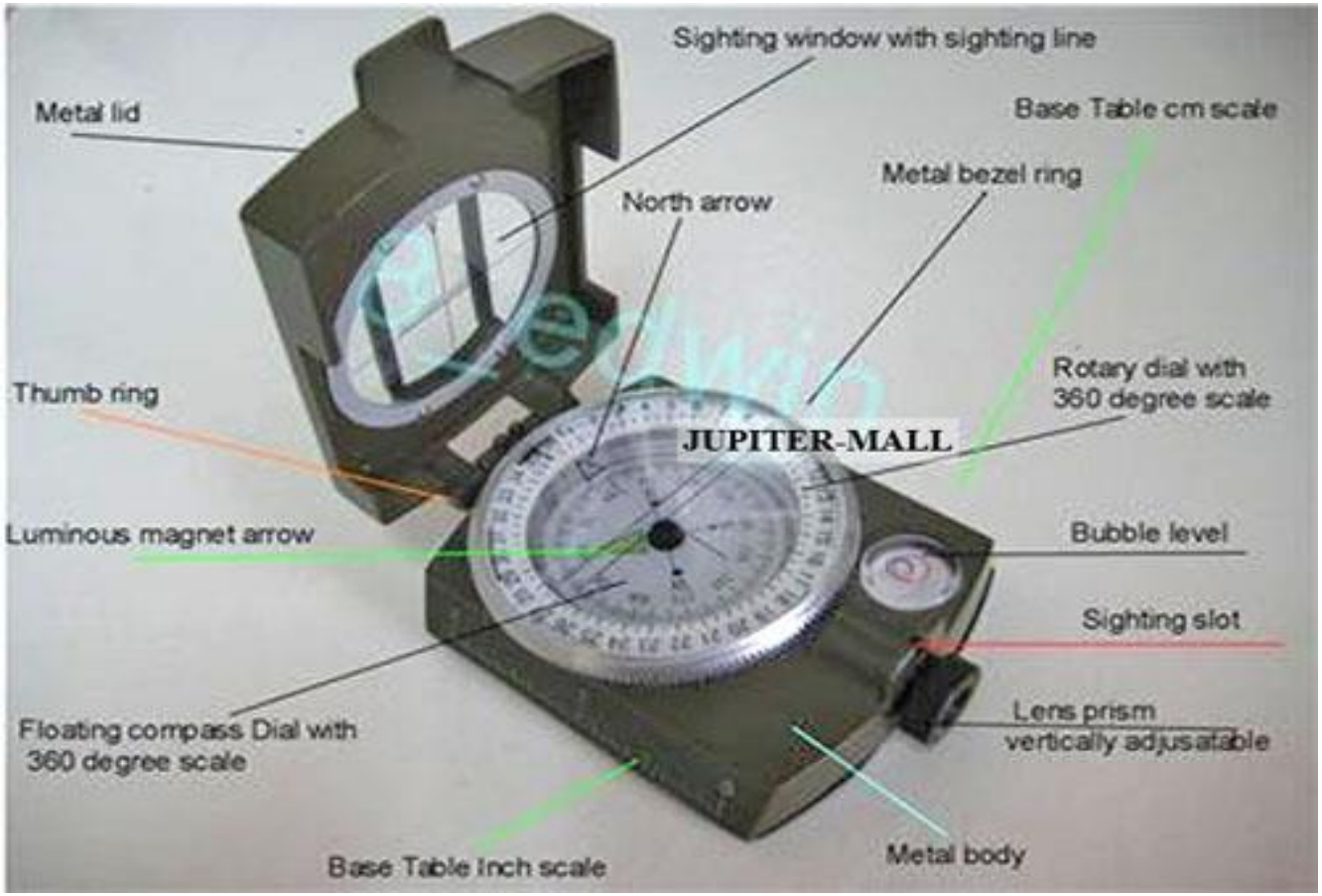
- A compass is a small instrument essentially consisting of magnetic needle, a graduated needle, and a line of sight.
- The compass cannot measure angle between two lines but directly measure angle of a line with reference to magnetic meridian .
- There are two types of compass:
  - Prismatic compass
  - Surveyor's compass

Prismatic compass



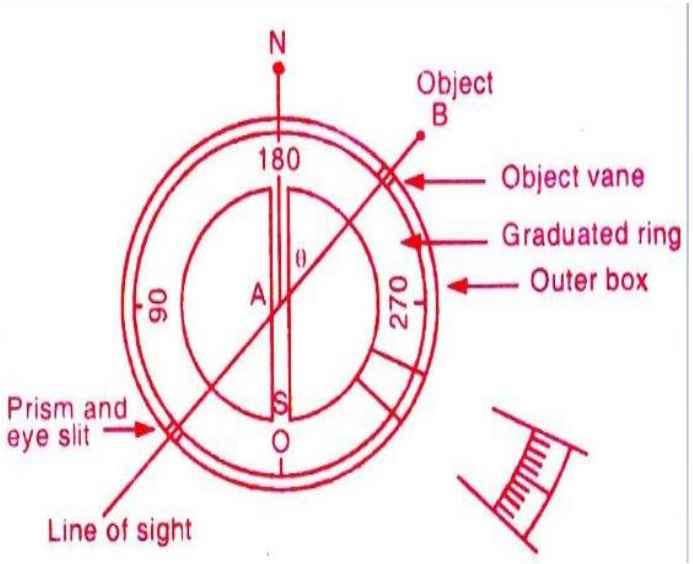


Prismatic compass in sectional front view


Sighting window with sighting line
Metal lid
Base Table cm scale
Metal bezel ring
North arrow
Thumb ring
Rotary dial with
360 degree scale
JUPITER-MALL
Luminous magnet arrow
Bubble level
Sighting slot
Floating compass Dial with
360 degree scale
Lens prism
vertically adjusatable
Base Table Inch scale
Metal body

- Temporary adjustments of a prismatic compass are :
  - Centering : Centering is the operation in which compass is kept exactly over the station from where the bearing is to be determined. The centering is checked by dropping a small pebble from the underside of the compass.
  - Levelling : Levelling of the compass is done with the aim to freely swing the graduated circular ring of the prismatic compass. The ball and socket arrangement on the tripod will help to achieve a proper level of the compass.
  - Focusing : The prism is moved up or down in its slide till the graduations on the aluminum ring are seen clear, sharp and perfect focus.

- Observing Bearing of Line:
  - Consider a line AB of which the magnetic bearing is to be taken.
  - By fixing the ranging rod at station B we get the magnetic bearing of needle wrt north pole.
  - The enlarged portion gives actual pattern of graduations marked on ring.



Surveyor's Compass

- It is similar to a prismatic compass except that it has a only plain eye slit instead of eye slit with prism and eye hole.
- This compass is having pointed needle in place of broad form needle as in case of prismatic compass.
- Working of Surveyor`s Compass:
  - Centering
  - Leveling
  - Observing the bearing of a line : In this compass, the reading is taken from the top of glass and under the tip of north end of the magnetic needle directly. No prism is provided here.

Difference between Prismatic Compass and Surveyor

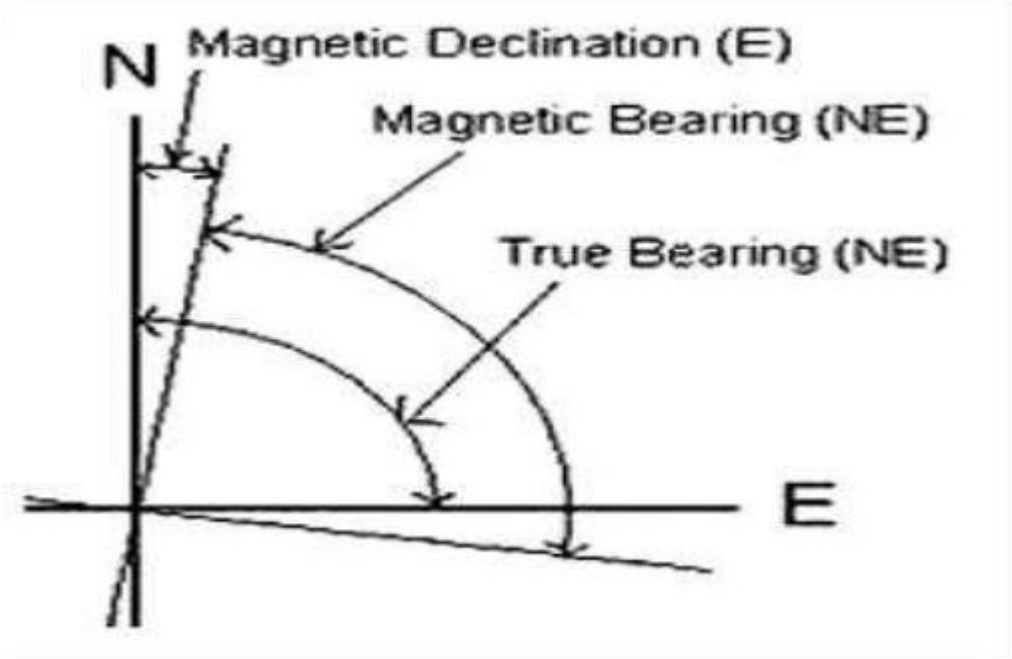
Sr. No.	*Prismatic Compass*	*Surveyors Compass*
1.	Graduation circle is fixed to broad type needle. Hence, it will not rotate with the line of sight.	Graduation circle is fixed to the box. Hence, it rotates with the line of sight.
2.	There is a prism at viewing end.	At viewing end there is no prism. There is only a slit.
3.	Sighting and reading can be done simultaneously.	Sighting and viewing cannot be done simultaneously.
4.	The magnetic needle do not act as an index.	Magnetic needle acts as index while reading.
5.	The graduations are in whole circle bearing.	The graduations are in quadrantal system.
6.	Graduations are marked inverted since its reflection is read through prism.	Graduations are marked directly. They are not inverted.
7.	The reading is taken through a prism.	The reading is taken by directly viewing from top glass.
8.	Tripod may or may not be used. It can be held on a stretched hand also.	Tripod is essential for using it.

Types of Meridian

- Bearing of a line is always measured clockwise wrt to some reference line or direction. This fixed reference line is known as meridian. There three types of meridian:
  - Magnetic meridian: The direction shown by a freely suspended needle which is magnetized and balanced properly without any influence by other factors is known as magnetic meridian.
  - True meridian: True meridian is the line which passes through the true north and south.
  - Arbitrary meridian: In case of small works or in places where true meridian or magnetic meridian cannot be determined, then any direction of a prominent object is taken as a reference direction called as arbitrary meridian.

Types of Bearings

- The bearing of a line is the horizontal angle which it makes with a reference line(meridian).
- There are four type of bearings they are as follows:
  - True Bearing: The true bearing of a line is the horizontal angle between the true meridian and the survey line. The true bearing is measured from the true north in the clockwise direction.
  - Magnetic Bearing: the magnetic bearing of a line is the horizontal angle which the line makes with the magnetic north.
  - Grid Bearing: The grid bearing of a line is the horizontal angle which the line makes with the grid meridian.
  - Arbitrary Bearing: The arbitrary baring of a line is the horizontal angle which the line makes with the arbitrary meridian.

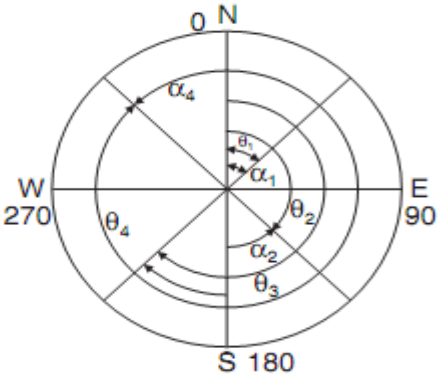

N
Magnetic Declination (E)
Magnetic Bearing (NE)
True Bearing (NE)
E

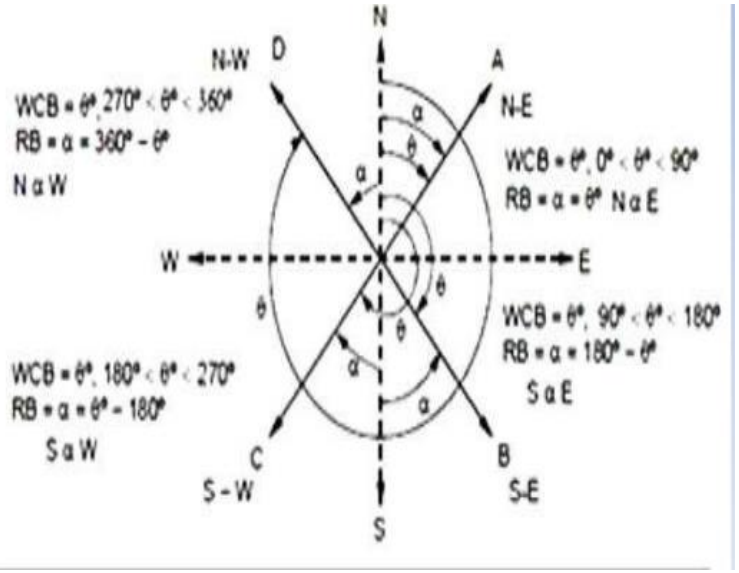
Measurement of Bearings

- Can be measured in following systems:
  - Whole Circle Bearing System(WCB).
  - Quadrantal Bearing System(QB)

Whole circle bearing system(W.C.B.)

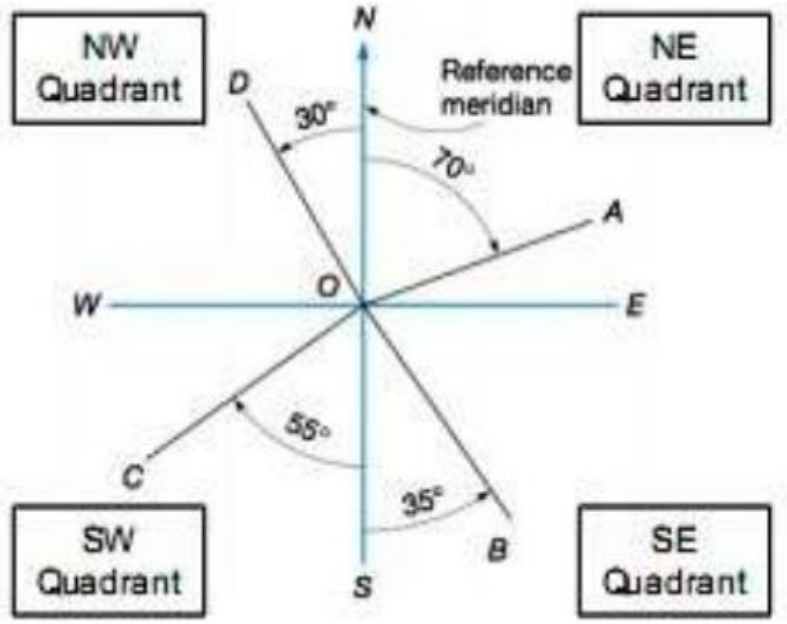
- The bearing of a line measured with respect to magnetic meridian in clockwise direction is called magnetic bearing and its value varies between 0° to 360°.
- The quadrant start from north an progress in a clockwise direction as the first quadrant is 0° to 90° in clockwise direction , 2nd 90° to 180° , 3rd 180° to 270°, and up to 360° is 4th one.





Quadrantal bearing system(Q.B.)

- In this system, the bearing of survey lines are measured wrt to north line or south line which ever is the nearest to the given survey line and either in clockwise direction or in anti clockwise direction.



Reduced Bearing

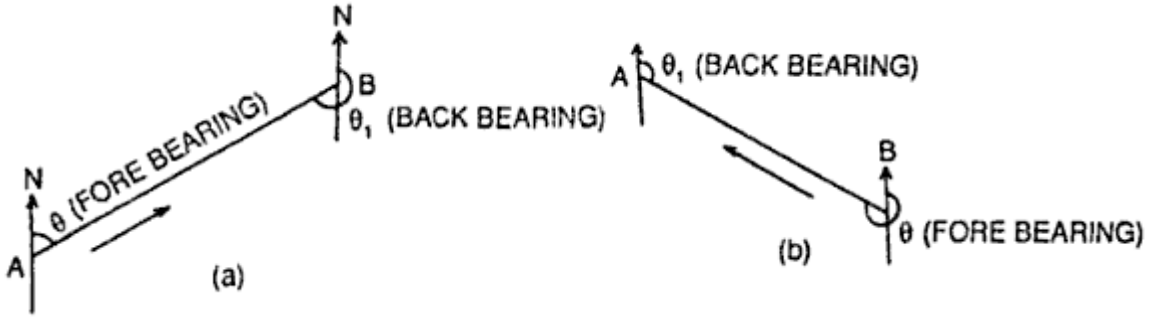
- When the whole circle bearing is converted into Quadrantal bearing , it is termed as "REDUCED BEARING".
- Thus , the reduced bearing is similar to the Quadrantal bearing.
- Its values lies between 0^o to 90^o, but the quadrant should be mentioned for proper designation.

- The following table should be remembered for conversion of WCB to RB.

W.C.B OF ANY LINE	QUADRANT IN WHICH IT LIES	RULES FOR CONVERSION	QUADRANT
0° TO 90°	I	RB=WCB	N-E
90° TO 180°	II	RB=180°-WCB	S-E
180° TO 270°	III	RB =WCB-180°	S-W
270° TO 360°	IV	RB=360° - WCB	N-W

Fore bearing and Back bearing

- The bearing of a line measured in the forward direction of the survey lines is called the 'fore bearing'(F.B.) of that line.
- The bearing of a line measured in direction backward to the direction of the progress of survey is called the 'back bearing'(B.B.) of the line.



- Points to remember:
  - In WCB the difference between FB and BB should be exactly 180°
  - BB=FB+/-180°
  - Use the +ve sign when FB<180°
  - Use the –ve sign when FB> 180


THANK YOU