

Surveying



* Surveying :-

Surveying is the art of the science of determining the relative position of the various point or station on below, above the surface of the earth by measuring the distance, direction elevation, by the means of direct measurement.

* Objective of Surveying *

- (i) To Prepare maps and plans
- (ii) To So the relative position of the object on the surface of the earth.
- (iii) To establish the boundaries of the land.
- (iv) to select a suitable site on engineering Project.

* Principle of the Surveying *

- (i) Working from whole to part.
- (ii) Locate a point by at list two measurement.

1) Working from whole to part :

- 1) In surveying major area, a system of control point are identify and they are located with high precision.



* Average triangulation error less than 12 inch.

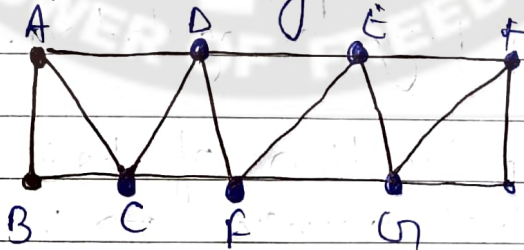
layout of Triangulation.

* The element of the various triangulation sense is known as the layout of triangulation.

* Types of layout :-

- ① Simple triangles in chain
- ② Braced quadrilateral in chain
- ③ Central triangle or polygon.
- ④ Simple triangle in chain.

• used when control point are provided in a narrow strip of terrain such as valley between two ridges.



$$\text{Sine rule} \div \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

* Rapid and economical due to its simplicity of sighting.



(vi) Underground Surveying

- * An underground surveying involves mapping and measuring underground features such as tunnel, utility pipelines and mineral deposits.
- * It is used in Mining Construction and civil engineering to understand subsurface condition and ensure safe and efficient project execution.

(vii) Aerial Surveying (Aircraft, camera, Drone)

- * An Aerial Survey is the process of capturing images or data of the earth surface from an aircraft or drone.

(D) Classification of Based on purpose of Surveying.

- (i) Engineering Survey.
- (ii) Defence Survey.
- (iii) Geological survey.
- (iv) Geographical Survey.
- (v) Mine Survey.
- (vi) Archaeological survey.
- (vii) Route survey.
- (viii) Reconnaissance Survey.
- (ix) Preliminary Survey.



- (vi) Under Ground Survey.
- (vii) Aerial Survey.

(D) Based on Purpose of Surveying

- (i) Engineering Surveying.
- (ii) defence Surveying
- (iii) Geological Surveying
- (iv) Geographical Surveying.
- (v) Mine Surveying.
- (vi) Archeological Surveying
- (vii) Root Surveying
- (viii) Reconnaissance Surveying
- (ix) Preliminary Surveying
- (x) Control Surveying
- (xi) Location Surveying.
- (xii) Astronomical

(E) Based on Method of Surveying:

- (i) Triangulation
- (ii) Traverses $\left\{ \begin{array}{l} \text{open} \\ \text{closed} \end{array} \right.$

(A) Based on accuracy desire

- (i) Plane Surveying: Type of Surveying in which earth surface is considered as a plane and the curvature of earth is ignored.



* Classification of triangulation

* The triangulation survey is classified into three type.

(i) Primary triangulation survey is classified into three type.

(ii) Primary triangulation or first order triangulation.

(iii) Secondary triangulation or second order triangulation.

(iv) Tertiary triangulation or third order triangulation.

* (i) Primary triangulation

* Highest great of triangulation system

* To determine shape or size of the earth surface.

* Station are generally selected 16km to 150km apart.

⇒ Specification

(i) length of base line 5km to 12km

(ii) length of side 16km to 150km

(iii) Average triangulation error less than 1 inch.



⇒ Suitable for area with moderate terrain and obstacles.

(iii) Leveling :-

It is a surveying method used to determine the height or elevation of point on the surface relating to reference point, typically create a level surface or measure the difference in height between point.

⇒ Purpose used in construction road design, drainage system etc, accurate height of measurement.

(4) Plane table surveying

It is a method of surveying where field measurement and map plotting are done on a drawing board (Plane table) setup at the every survey site. It provide a quick and direct way of creating a map on site field work and plotting are done together.

- Plumb bob
- Drawing sheet
- Ruler
- Drawing board
- Pencil/eraser
- Reduced level (RL)
- U-fork
- MSL (Mean Sea level)
- Alidade
- Chain/stap



(iii) EDM (Electronic Distance Measurement.)

* EDM Surveying is a method used to measure distance electronically using a specialized Instrument.

(c) Classification of Based on place of Surveying

- (i) Land Survey
- (ii) Topographical Survey.
- (iii) Cadastral Survey.
- (iv) City Survey.
- (v) Hydrographical survey.
- (vi) Underground Survey.
- (vii) Aerial Survey.

(i) Land Surveying (Earth Surface)

* It is the process of measuring and mapping the boundaries features and topography of a specific portion or part of land.

* It involves determining relative position of point on the earth surface for legal construction and development purpose.

(ii) Topographical Surveying :-

* It is a type of land survey that measure and maps the natural and manmade features of a land area, including elevation.



⇒ In such surveying line joining any two station is considered to be straight.

(ii) Geodetic Surveying :-

Type of surveying in which curvature of earth is taken into consideration

⇒ In such surveying the line joining any two station considered in a curve line

Plane	Geodetic
① Earth surface is considered Plane surface	① Earth surface is considered Curve surface.
② Curvature of earth is ignored	② Curvature of earth is taken into consideration
③ The line joining any two station considered as straight line.	③ The line joining any two station considered as curve line.
④ The angle of triangle is considered to be plane	④ The angle of triangle is considered to be spherical.
⑤ Carried out for small area $< 250 \text{ km}^2$	⑤ Carried out for large area $> 250 \text{ km}^2$



Unit of Measurement

There are many types of unit of measurement such as are cgs system, FPS system and mks system but SI unit is standard one.

Length Conversion of unit ÷

Unit	Conversion.
1 foot	0.3048
1 fathom	1.8288
1 furlong	201.168
1 inch	0.0254
1 light year	9.461×10^{15}
1 mile	1809.344
1 nautical mile	1852
1 yard	0.9144

Area unit conversion ÷

Unit	Conversion
1 acre	4046.85
1 arc	100
1 hectare	10 ⁴
1 ft ²	0.0929
1 inch ²	6.456×10^{-4}



- (B) Based on the instrument used
- (C) Based on Place of Survey.
- (D) Based on the purpose of Survey.
- (E) Based on Method of Survey

(A) Based on accuracy desire :-

- (i) Plane Surveying
- (ii) Geodatic Surveying.

(B) Based on the instrument used :-

- (i) Chain Surveying
- (ii) Compass Surveying
- (iii) Leveling surveying
- (iv) Plane table Surveying
- (v) Tacheometry.
- (vi) Photogrammetry.
- (vii) EDM (Electronic distance measurement)

(C) Based on Place of Survey :-

- (i) Land Survey.
- (ii) Topographic Survey.
- (iii) Cadstral survey.
- (iv) City Survey.
- (v) Hydrographical survey

* It provide a rough overview of the area without much precision.

(IX) Preliminary survey

* This is a more detailed investigation conducted after the reconnaissance survey to collect precise data necessary for project design and planning.

* It involves accurate measurement and assessments such as topography, boundaries and environmental condition and is used for creating design or feasibility study.

(X) Astronomical survey :-

* It is a systematic observation and mapping of celestial object and phenomena across the sky.

* It involves the collection of data from stars, planets, galaxies and other astronomical bodies using telescope and various observational instruments.

(E) Based on method of surveying

(i) Triangulation → open traverse

(v) Theodolite \rightarrow

A theodolite is a surveying instrument used to measure horizontal and vertical angles.

- It is commonly used for tasks like triangulation, leveling and alignment in construction and engineering projects.

(vi) Tacheometry

It is a surveying method used to quickly measure distance and elevation using tacheometry.

* Process:

It measures horizontal distance and vertical angle based on the reading from the instrument and staff.

- It is used in hill terrain where taping is difficult to use.

(vii) Photogrammetry

- * It is a method of surveying and mapping that uses photographs typically taken from aircraft or drones to measure and analyze the physical characteristics of an area.

- ii) Then Secondary control point are located using less precise method,
- iii) The detail of localized area are measure and
- iv) This is called the working from whole to part.
- v) This principle surveying helps in localising the errors.
- vi) If the surveying carried out by adding localised area errors accumulated and may become unacceptible when.

② Locate a point by at least two measurement

- i) Control point are selected in the area and the distance between them measured accurately. The line joining these two point is plotted to scale on the drawing sheet.
- ii) Now the begin point (New station) can be plotted by making.
- iii) The new station are located by linear or angular measurement are both.

- * Precisely measured line is called base line
- * Computed two lines are used as a base line for interconnected triangles.
- * vertices of individual triangle are known as triangulation station.
- * Standing this process network of triangle can be computed over the entire area.
- * As a check the length of one side of last triangle is also measured and compared with the computed one.
- * Subsidiary bases are measured suitable interval to minimize accumulation of error in length.

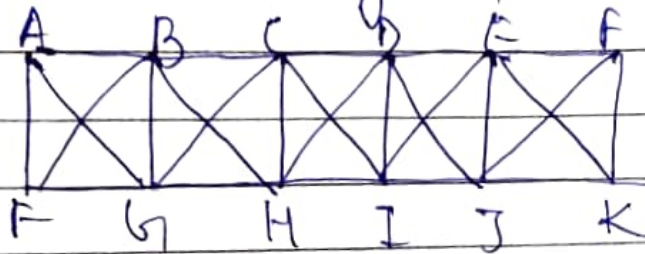
* Purpose of triangulation

- (i) To establish the accurate the control point for plane and geodetic survey of large area.
- (ii) To establish the accurate the control point for photogrammetry survey.
- (iii) Accurate location of engineering work.

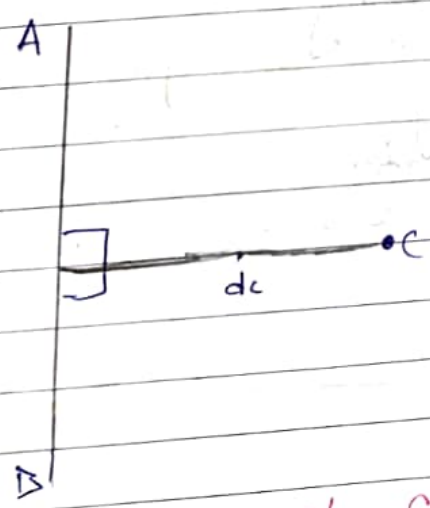
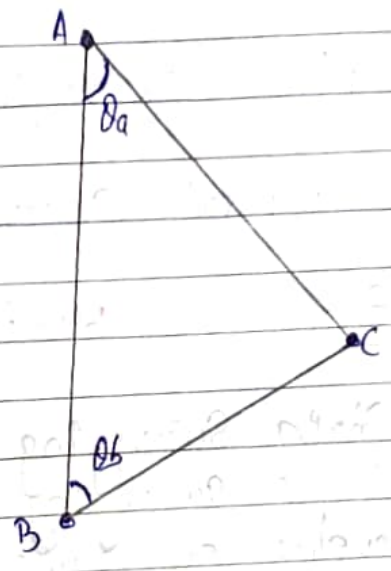
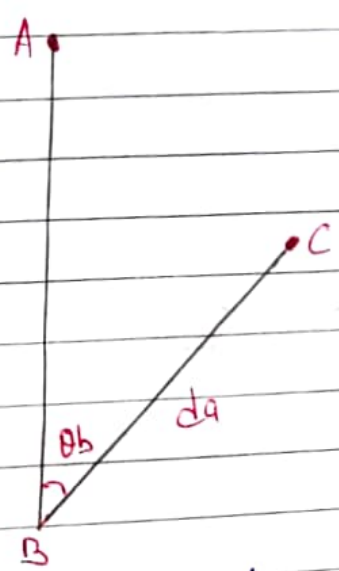
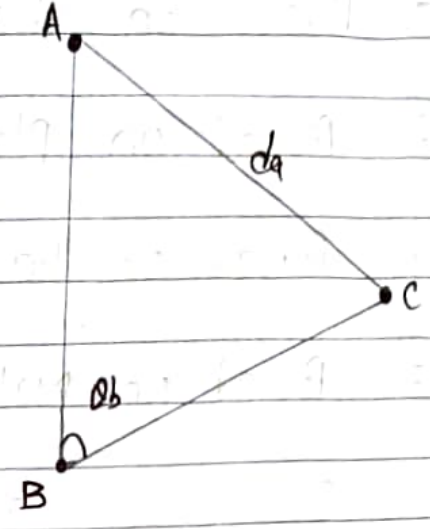
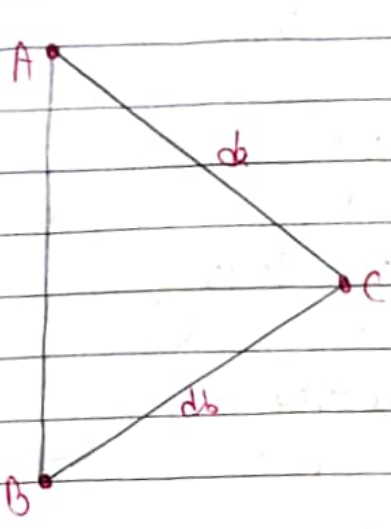
* Not provide any check on the accuracy of observation. As there is only one route through which distance can be computed.

(2) Braced quadrilateral in chain

• consist of figure containing four corner station and observed diagonal.



• Braced quadrilateral system is treated to best arrangement of triangle as it provides a means of computing of length of the side using difference side and angle.



* Classification of Surveying

(A) Based on accuracy desire.

Changes and Control lines. (Physical features)

(iii) Cadastral Surveying. (Boundary)

* A cadastral survey is the process of determining and documenting the boundaries, dimensions and ownership of land. It creates detailed map and records used for legal properties descriptions, land registration and property assestion.

(iv) City survey. (~~Waters Bodies~~) (Ea-Street Building Sewerline Drainage line)

* A city survey involves mapping and documenting the interior structure, boundaries and features of an urban area. It includes details of road, area, building, utilities and other facilities adding in urban planning development and management of public resources.

(v) Hydrographical Surveying. (~~Waters Bodies~~)

* It is the process of measuring and mapping under water features including the depth, shape and physical condition of water bodies. suggest river, lake and ocean.

* It is used for navigation / marine construction resource explanation and environment monitoring.

(ii) Secondary triangulation

- * To connect two primary triangulation to provide control point closer together than those of primary triangulation.
- * for the densification of horizontal control point

* Specification

- (i) length of the base line 2km to 5km
- (ii) length of side 10km to 25km
- (iii) Average triangulation error less than 3 inch.

(iii) Tertiary Triangulation.

- * To provide control point between station of primary and secondary triangulation.
- * for the densification of horizontal control point for topographic survey on various scale.

* Specification

- * Length of base line 100m to 500m
- * Length of side line 2km to 10km

(v) Mine Survey (Mines Related Survey)

* It involves the measurement and mapping of underground and surface mining areas to ensure safe and efficient extraction of minerals.

(vi) Archeological Survey (Ancient Construction)

* It is a method used to locate, identify and record information about past human activities.

(vii) Route Surveying (Road, Railway, Gas pipeline)

* It is a type of survey conducted to plan and design transportation or utility routes such as roads, railways, pipelines etc.

(viii) Reconnaissance Survey

* It is a broad initial exploration conducted to gather general information about an area.

* It is a broad initial exploration conducted

* Its goal is to identify key features, obstacles and opportunity for further study.

Volume unit Conversion

unit	Conversion factor from m^3
• 1 barrel	0.15899
• 1 yard ³	0.765
• 1 us gallon	3.785×10^{-3}
• 1 uk gallon	4.546×10^{-3}
• 1 lit	1×10^{-3}

Pressure unit

Conversion :

unit	Conversion factor for N/m^2
• 1 atm	1.01325×10^5
• 1 bar	1×10^5
• 1 mm of Hg (Mercury)	133.3
• 1 pound per sq-foot	47.88
• 1 pound per sq-inch	6894.75
• 1 torr	133.32

(i) Triangulation

* In surveying it is a method used to find the exact location of a point by creation of triangle.

* The entire area is divided into a network of triangles.

* Well Condition triangle :-

(i) angle should not be less than 30°

(ii) angle should not be greater than 120°

$$30^\circ < \theta < 120^\circ$$

* Principle of Triangulation.

(i) Entire area to be surveyed is converted into form work of triangle.

(ii) If all three angle and length of one side are measured precisely the length of other two side can be computed.

$$\text{Sine Rule} = \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$



(x) Astronomical survey.

(i) Engineering survey

* An engineering survey is a detailed examination and measurement of a site together with data required for the design, planning and construction of engineering projects.

(ii) Defence surveying

* A defence survey is the collection and analysis of geographical, infrastructural and environmental data to support military operations and strategic defence planning.

(iii) Geological survey : (Earth crust) mineral.

* A geological survey is the systematic study and mapping of the earth subsurface and surface features.

(iv) Geographical Survey (Earth surface) (Mineral, Oil)

* A geographical survey is the process of mapping and analysing the physical features of the earth's surface.

* It involves collecting data on land forms, terrain, water bodies, vegetation and human made structure.