

Surveying, the first step of starting a new civil engineering project, is a very important branch of civil engineering. To understand the techniques of surveying a student must carefully study the basics of it. To start learning surveying one must start with the definition of surveying and its importance.

What is Surveying?

Surveying is the technique of determining the relative position of different features on, above or beneath the surface of the earth by means of direct or indirect measurements and finally representing them on a sheet of paper known as plan or map.

According to the American Congress on Surveying and Mapping (ACSM),

Surveying is the science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the Earth, and to depict them in a usable form, or to establish the position of points or details.

Surveying also includes the technique of establishing points by predetermined angular and linear measurements. From the plans, sections, and maps prepared by surveying, the area and volume of a particular plot of land can be calculated. A map represents the horizontal projection of the area surveyed and not the actual area. But the vertical distance can be represented more correctly by drawing sections.

During a survey, surveyors use various tools to do their job successfully and accurately, such as total stations, GPS receivers, prisms, 3D scanners, radio communicators, digital levels, [dumpy level](#) and surveying software etc.

Importance of Surveying

The knowledge of surveying is advantageous in many phases of engineering. Surveying is of vital importance in any engineering project. Some of the basic importance of Surveying is discussed below.

- The first necessity in surveying is to prepare a plan and a section of an area to be covered by the project. From these prepared maps and sections the best possible alignment, amount of earthwork and other necessary details depending upon the nature of the project can be calculated.
- The planning and design of all [Civil Engineering](#) projects such as railways, highways, tunneling, [irrigation](#), dams, reservoirs, waterworks, sewerage works, airfields, ports, massive buildings, etc. are based upon surveying measurements.
- During execution of the project of any magnitude is constructed along the lines and points established by surveying.
- The measurement of land and the fixation of its boundaries cannot be done without surveying.

- The economic feasibility of the engineering feasibility of a project cannot be properly ascertained without undertaking a survey work.
- The execution of [hydrographic](#) and oceanographic charting and mapping requires.
- Surveying is used to prepare a [topographic map](#) of a land surface of the earth.

Types of Surveying

Surveying can mainly be classified into 2 groups-

- **Plane Surveying**
- **Geodetic or Trigonometrical Surveying**

Plane Surveying

Plane surveying deals with small areas on the surface of the earth assuming the surface of the land to be plane. So curvature of the earth is neglected. Plane surveying can further be subdivided in the following ways:

Chain Surveying

- Area to be surveyed is divided into a number of triangles
- The length of the sides are measured and the interior details recorded
- Whole are then plotted on a drawing sheet to a suitable scale to produce the map

Traverse Surveying

- The plot of the plan is enclosed by a series of straight lines making angles with each other.
- The length of the lines and angles are measured and plotted with details on a drawing paper to a suitable scale to produce the map

Plane Table Surveying

- The observations and plotting are done simultaneously
- An art paper or sheet is fixed on a calibrated plane table
- The field observations are taken and recorded side by side on the paper and eventually the map is prepared.

Ordinary Leveling

- The elevations of different points on the earth surface are determined.
- Provides all the elevation data needed for construction activities

Geodetic Surveying

Geodetic surveying deals with vast areas, so curvature has to be considered. Geodetic surveying can be subdivided in the following ways:

Triangulation

- A network of well-defined triangles is formed on the plot of land to be surveyed.
- One of the lines is considered as the baseline, all other lines and angles are then measured accordingly.

Reciprocal Leveling

- Used in leveling across streams, gullies, and other obstructions to eliminate instrumental errors
- Level readings are taken from two setups at two different points
- The difference in levels between two sites with obstructions is determined through this survey

Tacheometry or Stadia Surveying

- A telescopic sight instrument is used to measure distances
- It incorporates a theodolite controlled by an operator and a level staff held by another surveyor at a distance.
- Both vertical and horizontal distances are computed through stadia (the two horizontal markings on a theodolite) readings

Astronomical Surveying

- The meridian, azimuth, latitude, longitude, etc. of the plot to be surveyed is determined with the help of celestial bodies.

Photographic surveying

- Maps are prepared from photographs taken from suitable camera stations; the stations can be even airplanes.
- The output is a map, a drawing or a 3D model of some real-world scene or object.