

Surveying

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Lectures
Spring
Semester

Lecture 1:

Introduction to Surveying:

Definition

Surveying is the art of determining the relative position of different object on the surface of the earth by measuring the horizontal distance between them, and preparing a map to any suitable scale. Thus, in this discipline the measurements are taken only in the horizontal plane.

Another school of thought define surveying “as the act of making measurement of the relative position of natural and manmade features on earth’s surface and the presentation of this information either graphically or numerically.

Surveying

The practice of measuring angles and distances on the ground so that they can be accurately plotted on a map

Objectives of Surveying

- The data obtained by surveying are used to prepare the plan or map showing the ground features.
- **When the area surveyed is small and the scale to which its result plotted is large, then it is known as Plan**
- **When the area surveyed is large and the scale to which its result plotted is small, then it is called as a Map**
- Setting out of any engineering work like buildings, roads, railway tracks, bridges and dams involves surveying

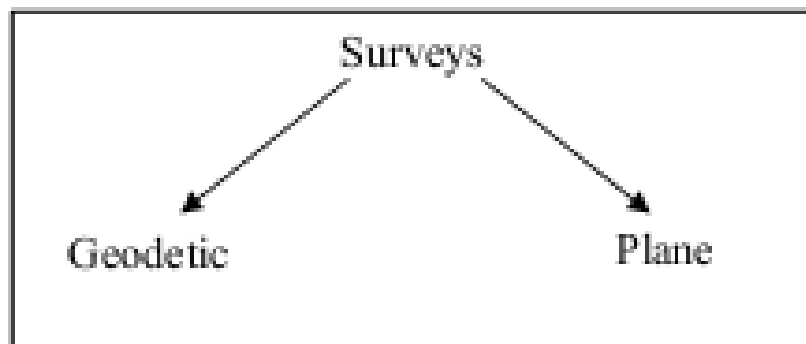
Uses of Surveying

- 1- To prepare a topographical map which shows the hills, valleys, rivers, villages towns, forest, landscaping, etc. of a country.
- 2- To prepare a cadastral map showing the boundaries of fields, houses and other properties.
- 3- To prepare an engineering map which shows the details of engineering works such as roads, railways, reservoirs, irrigation canals, etc.
- 4- To prepare a contour map to determine the capacity of a reservoir and to find the best possible routes for roads, railways, etc.

- 5- To prepare a military map showing the road and railway communications with different parts of a country. Such a map also shows the different strategic points important for the defense of a country.
- 6- To prepare a geological map showing areas including underground resources.
- 7- To prepare an archaeological map including places where ancient relics exist.

MAIN DIVISIONS OF SURVEYING

Geodetic and Plane Surveys



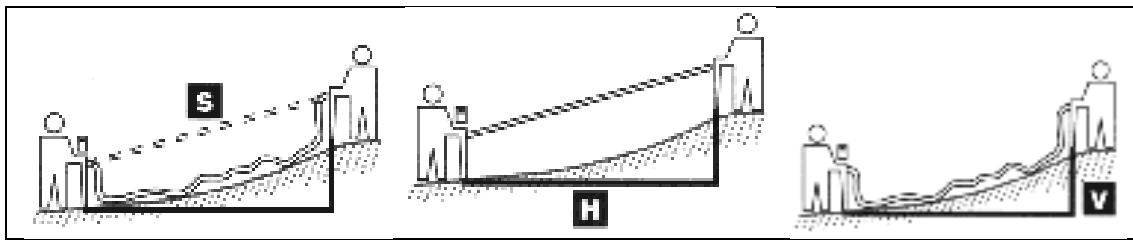
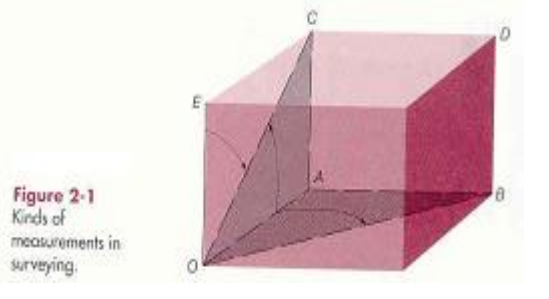
- Field measurements for geodetic surveys are usually performed to a higher order of **accuracy** than those of plane surveys.
- Geodetic surveying, the **curved surface** of the earth is considered by performing the computations on an ellipsoid.
- It is now becoming common to do geodetic computations in **three-dimensional**, earth-centered Cartesian coordinate systems.
- Geodetic methods: to determine relative positions of widely spaced **monuments** and to compute lengths and directions of the long lines between them.

1- Plane surveying: The surveys in which the curvature of earth is not taken into consideration are known as plane surveys. These surveys extend or small areas less 250km².

2- Geodetic surveying: The surveys in which the curvature of earth is taken into consideration are known as geodetic surveys. These surveys extend or large areas more 250km².

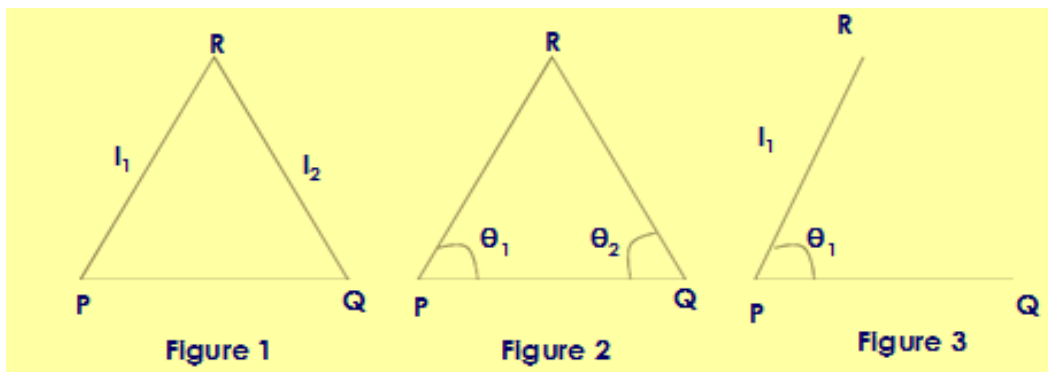
Five kinds of measurement are:

- 1- Horizontal angles
- 2- Horizontal distances
- 3- Vertical (or zenith) angles
- 4- Vertical distances
- 5- Slope distances



Major principles of measuring:

- (a) Measurement of two distances.
- (b) Measurement of two angles
- (c) Measurement one angle and one distance



International Federation of Surveyors made following definition for surveying:

- 1) Determination of the size and shape of the earth and measurement of all data needed to define the size, position, shape, and contour of any part of the earth.
- 2) Positioning of objects in space, and positioning and monitoring of physical features, structures, and engineering works on, above, or below the surface of the earth.

- 3) Determination of the positions of boundaries of public or private land, including national and international boundaries, and registration of those lands with appropriate authorities.
- 4) Design, establishment, and administration of land and geographic information systems, and the collection, storage, analysis and management of data within those systems.
- 5) Study of the natural and social environment, measurement of land and marine resources, and the use of the data in planning of development in urban, rural, and regional areas.

Surveying required

1- To plan, construct and maintain highways, railroads, rapid-transit systems, buildings, bridges, missile ranges, launching sites, tracking stations, tunnels, canals, irrigation, ditches, dams, drainage works, urban land subdivisions, water supply and sewage systems, pipelines and mine shafts.

2- Laying out industrial assembly lines and jigs.

3- Guiding the fabrication of large equipment such as airplanes and ships.

Surveying is used in the following sciences

1- Agronomy	7- Geophysics
2- Archeology	8- Landscape architecture
3- Astronomy	9- Meteorology
4- Forestry	10- Paleontology
5- Geography	11- Seismology
6- Geology	12- Military and civil engineering

Specialized types of surveys

1. Control surveys	6. As-built surveys
2. Topographic surveys	7. Mine surveys
3. Land, boundary and cadastral surveys	8. Solar surveys
4. Hydrographic surveys	9. Optical tooling
5. Route surveys	

Principles of Surveying

The fundamental principles upon which the surveying is being carried out are

Working from whole to part;

After deciding the position of any point, its reference must be kept from at least two permanent objects or stations whose positions have already been well defined.

The purpose of working from whole to part is

1. To localize the errors , and
2. To control the accumulation of errors

Classifications of Surveying

Based on nature of field (Classification based on the surface and the area surveyed)

1) Land survey

Land surveys are done for objects on the surface of the earth. It can be subdivided into:

(a) Topographic survey: This is for depicting the (hills, valleys, mountains, rivers, etc.) and manmade features (roads, houses, settlements...) on the surface of the earth.

(b) Cadastral survey is used to determining property boundaries including those of fields, houses, plots of land, etc.

(c) Engineering survey is used to acquire the required data for the planning, design and Execution of engineering projects like roads, bridges, canals, dams, railways, buildings,

(d) City surveys: The surveys involving the construction and development of towns including roads, drainage, water supply, sewage street network, etc, are generally referred to as city survey.

(2) Marine or Hydrographic Survey:

Those are surveys of large water bodies for navigation, tidal monitoring, the construction of harbors etc.

(3) Astronomical Survey:

Astronomical survey uses the observations of the heavenly bodies (sun, moon, stars etc.) to fix the absolute locations of places on the surface of the earth.

Classification on the Basis of Purpose (Based on Objects)

I) Engineering Survey

II) Control Survey Control survey uses geodetic methods to establish widely spaced vertical and horizontal control points.

III) Geological Survey

Geological survey is used to determine the structure and arrangement of rock strata. Generally, it enables to know the composition of the earth.

IV) Military or Defense Survey

is carried out to map places of military and strategic importance

V) Archeological Surveying

survey is carried out to discover and map ancient/relies of antiquity.

Classification Based on Instrument Used

i. Chain/Tape Survey:

This is the simple method of taking the linear measurement using a chain or tape with no angular measurements made.

ii. Compass Survey:

Here horizontal angular measurements are made using magnetic compass with the linear measurements made using the chain or tape.

iii. Plane Table Survey:

This is a quick survey carried out in the field with the measurements and drawings made at the same time using a plane table.

iv. Leveling

This is the measurement and mapping of the relative heights of points on the earth's surface showing them in maps, plane and charts as vertical sections or with conventional symbols.

vi. Theodolite Survey:

Theodolite survey takes vertical and horizontal angles in order to establish controls

Classification Based on the Method Used

1. Triangulation Survey

In order to make the survey, manageable, the area to be surveyed is first covered with series of triangles. Lines are first run round the perimeter of the plot, then the details fixed in relation to the established lines. This process is called triangulation. The triangle is preferred as it is the only shape that can completely cover an irregularly shaped area with minimum space left.

2. Traverse survey:

If the bearing and distance of a place of a known point is known: it is possible to establish the position of that point on the ground. From this point, the bearing and distances of other surrounding points may be established. In the process, positions of points linked with lines linking them emerge. The traversing is the process of establishing these lines, is called traversing, while the connecting lines joining two

points on the ground. Joining two while bearing and distance is known as traverse. A traverse station is each of the points of the traverse, while the traverse leg is the straight line between consecutive stations. Traverses may either be open or closed.

Check Line:

Units of Measurements

Magnitudes of measurements must be given in terms of specific units.

Units in surveying

- Length
- Area
- Volume
- Angle

International System of Units (SI)

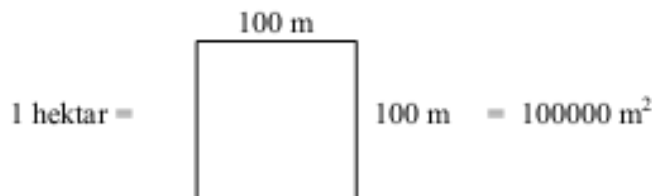
a degree = 1 / 360 of a circle

1° = 60 minutes

1 minute = 1' = 60 seconds

Division of seconds are tenths, hundredths, thousandths

⊕ 360° = 400 grads



Rounding off numbers

78, 374 → 78, 37

78, 3749 → 78, 37

78, 375 → 78, 38

78,376 → 78, 38

78, 3749 → 78, 375 → 78, 38 (?) wrong !!

78, 37 49 → 78, 37

Correct

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46, 7418
 1, 03
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422, 7718
422, 8
    
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Incorrect

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46, 7
 1, 0
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422, 7
422, 7
    
    
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