LECTURE 1

Introduction:

- Surveying is defined as "taking a general view of, by observation and measurement determining the boundaries, size, position, quantity, condition, value etc. of land, estates, building, farms mines etc. and finally presenting the survey data in a suitable form". This covers the work of the valuation surveyor, the quantity surveyor, the building surveyor, the mining surveyor and so forth, as well as the land surveyor.

- 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.

The process of surveying is therefore in three stages namely:

(i) Taking a general view

This part of the definition is important as it indicates the need to obtain an overall picture of what is required before any type of survey work is undertaken. In land surveying, this is achieved during the reconnaissance study.

(ii) Observation and Measurement

This part of the definition denotes the next stage of any survey, which in land surveying constitutes the measurement to determine the relative position and sizes of natural and artificial features on the land.

(iii) Presentation of Data:

The data collected in any survey must be presented in a form which allows the information to be clearly interpreted and understood by others. This presentation may take the form of written report, bills of quantities, datasheets, drawings and in land surveying maps and plan showing the features on the land.

Types of Surveying

On the basis of whether the curvature of the earth is taken into account or not,surveying can be divided into two main categories:

Plane surveying: is the type of surveying where the mean surface of the earth is considered as a plane. All angles are considered to be plane angles. For small areas less than 250 km^2 plane surveying can safely be used. For most engineering projects such as canal, railway, highway, building, pipeline, etc constructions, this type of surveying is used. It is worth noting that the difference between an arc distance of 18.5 km and the subtended chord lying in the earth's surface is 7mm. Also the sum of the angles of a plane triangle and the sum of the angles in a spherical triangle differ by 1 second for a triangle on the earth's surface having an area of 196 km^2.

Geodetic surveying: is that branch of surveying, which takes into account the true shape of the earth (spheroid).

Classification of surveying

Introduction

For easy understanding of surveying and the various components of the subject, we need a deep understanding of the various ways of classifying it.

Objective

To enable the students have understanding of the various ways of classifying surveying

Classification Of Surveying

Surveying is classified based on various criteria including the instruments used, purpose,

the area surveyed and the method used.

Classification on the Basis of Instruments Used.

Based on the instrument used; surveys can be classified into;

i) Chain tape surveys

ii) Compass surveys

iii) Plane table surveys

iv) Theodelite surveys

Classification based on the surface and the area surveyed

i) 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,

etc.

(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 harbours 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.

LECTURE 2

CLASSIFICATION ON THE BASIS OF PURPOSE

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 Defence Survey is carried out to map places of military and strategic importance

iv) Archeological 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 over an irregularly shaped area with minimum space left.

ii. 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.

1. Closed Traverse :

When a series of connected lines forms a closed circuit, i.e. when the finishing point coincides with the starting point of a survey, it is called as a 'closed traverse', here ABCDEA represents a closed traverse. (Fig 2.1 (a))

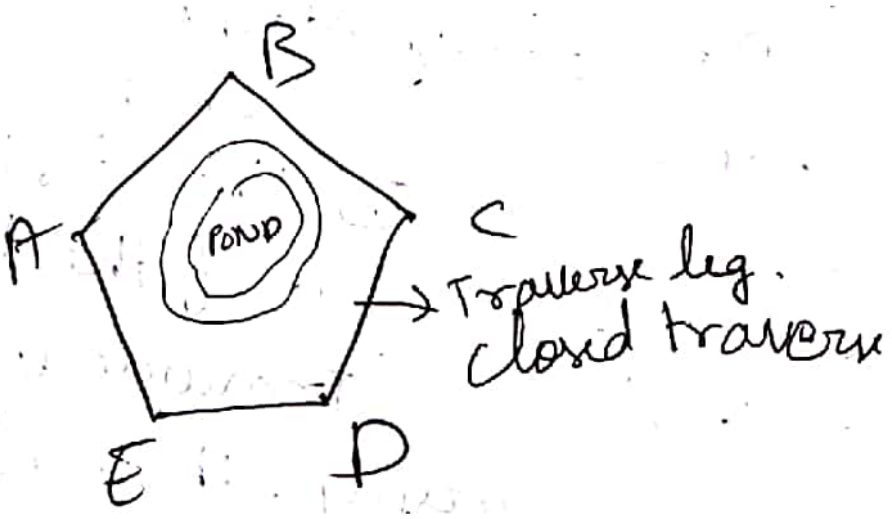


Fig 2.1 (a) Closed traverse is suitable for the survey of boundaries of ponds, forests etc.

2. Open Traverse :

When a sequence of connected lines extends along a general direction and does not return to the starting point, it is known as 'open traverse' or (unclosed traverse). Here ABCDE represents an open traverse. Fig 2.2 (b)

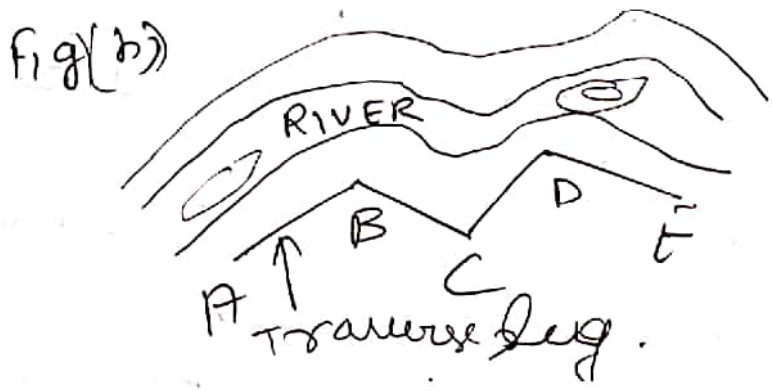


Fig 2.2 (b) Open traverse is suitable for the survey of roads, rivers etc.

LECTURE 3

CLASSIFICATION OF SURVEYORS

Surveying is made up of various specializations known as sectors or classes as shown below:

1. **General Practice Surveyors:**

   - Surveyors under this class are mostly concerned with valuation and investment. Valuation surveyors deal with property markets, land and property values, valuation procedures and property law. Investment surveyors help investors to get the best possible return form property.

   - They handle a selection of properties for purchase or sale by pension funds, insurance companies, charities and other major investors. They also specialize in housing policy advice, housing development and management.

2. **Planning and Development Surveyors**

   - They are concerned with preparing planning applications and negotiating with local authorities planners to obtain planning permission.

3. **Building Surveyors**

   - Their work involves advising on the construction, maintenance, repair of all types of residential and commercial property.

   - The analysis of building defects is an important part of a building surveyors discipline.

4. **The Quantity Surveyors**

   - They evaluate project cost and advice on alternative proposals. They also

ensure that each element of a project agrees with the cost plan allowance and that the overall project remains within budget.

5. **Rural Practice Surveyors:**

- Surveyors in rural practice advice land owners, farmers and others with interests in the country side.
- They are responsible for the management of country estates and farms, the planning and execution of development schemes for agriculture, forestation, recreation, sales of properties and live stock.

6. **Mineral Surveyors**

- They plan the development and future of mineral workings. They work with local authorities and the land owners on planning applications and appeals, mining laws and working rights, mining subsidence and damage, the environmental effects of land and deep underground mines.

7. **Land surveyors:**

- They measure land and its physical features accurately and record them in the form of a map or plan for the purpose of planning new building and by local authorities in managing roads, housing estates, and other facilities.

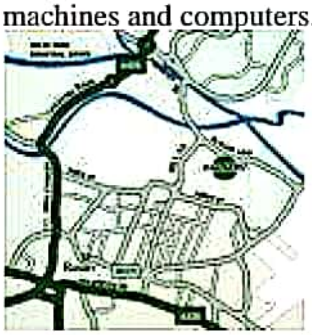
- They also undertake the positioning and monitoring for construction works.

LECTURE 4

BRANCHES OF SURVEYING

1. Aerial Surveying

- Aerial surveys are undertaken by using photographs taken with special cameras mounted in an aircraft viewed in pairs. The photographs produce three-dimensional images of ground features from which maps or numerical data can be produced usually with the aid of stereo plotting machines and computers.



2. Hydrographic Surveying (Hydro-Survey)

- Hydro survey is undertaken to gather information in the marine environment such as mapping out the coast lines and sea bed in order to produce navigational charts.

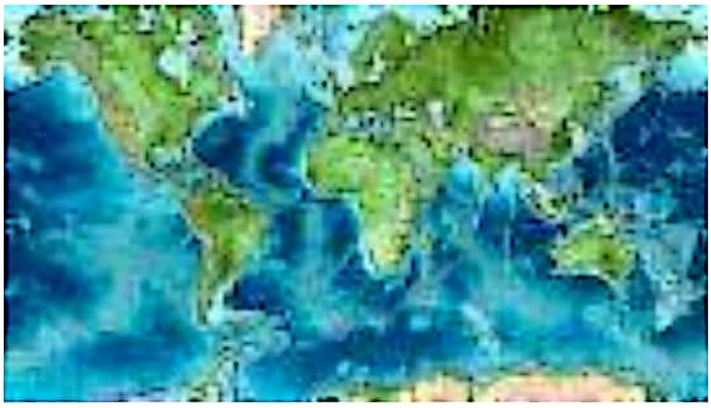
- It is also used for off shore oil exploration and production, design, construction and maintenance of harbours, inland water routes, river and sea defence, pollution control and ocean studies.

3. Geodetic Survey:

- In geodetic survey, large areas of the earth surface are involved usually on national basis where survey stations are precisely located large distances apart. Account is taken of the curvature of the earth, hence it involves advanced

mathematical theory and precise measurements are required to be made.

- Geodetic survey stations can be used to map out entire continent, measure the size and shape of the earth or in carrying out scientific studies such as determination of the Earth's magnetic field and direction of continental drifts.



4. Plane Surveying

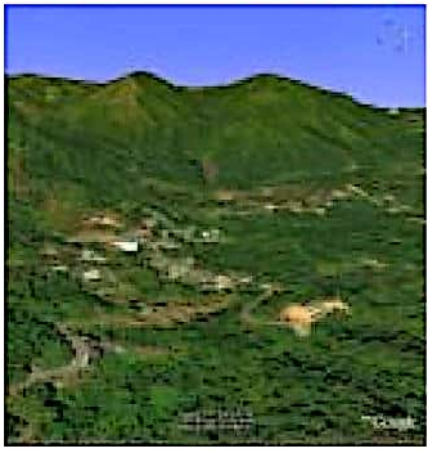
- In plane surveying relatively small areas are involved and the area under consideration is taken to be a horizontal plane. It is divided into three branches.
    - Cadastral surveying
    - Topographical surveying
    - Engineering surveying

5. Cadastral surveying

- These are surveys undertaken to define and record the boundary of properties, legislative area and even countries.
- It may be almost entirely topographical where features define boundaries with the topographical details appearing on ordinance survey maps.
- In the other hand, markers define boundaries, corner or line points and little account may be taken of the topographical features.

6. Topographical Survey

- These are surveys where the physical features on the earth are measured and maps/plans prepared to show their relative positions both horizontally and vertically.



- The relative positions and shape of natural and man –made features over an area are established usually for the purpose of producing a map of the area of for establishing geographical information system.

8. Engineering Survey

- These are surveys undertaken to provide special information for construction of Civil Engineering and building projects.

- The survey supply details for a particular engineering schemes and could include setting out of the work on the ground and dimensional control on such schemes.

LECTURE 6

BASIC PRINCIPLES IN SURVEYING

PRINCIPLE OF WORKING FROM WHOLE TO PART

- It is a fundamental rule to always work from the whole to the part. This implies a precise control surveying as the first consideration followed by subsidiary detail surveying.
- This surveying principle involves laying down an overall system of stations whose positions are fixed to a fairly high degree of accuracy as control, and then the survey of details between the control points may be added on the frame by less elaborate methods.

- Once the overall size has been determined, the smaller areas can be surveyed in the knowledge that they must (and will if care is taken) put into the confines of the main overall frame.

- Errors which may inevitably arise are then contained within the framework of the control points and can be adjusted to it.

Surveying is based on simple fundamental principles which should be taken into

consideration to enable one get good results.

(a) Working from the whole to the part is achieved by covering the area to be surveyed with a number of spaced out control point called primary control points called primary control points whose pointing have been determined with a high level of precision using sophisticated equipments. Based on these points as theoretic, a number of large triangles are drawn. Secondary control points are then established to fill the gaps with lesser precision than the primary control points. At a more detailed and less precise level, tertiary control points at closer intervals are finally established to fill in the smaller gaps. The main purpose of surveying from the whole to the part is to localize the errors as working the other way round would magnify the errors and introduce distortions in the survey. In partial terms, this principle involve covering the area to be surveyed with large triangles. These are further divided into smaller triangles and the process continues until the area has been sufficiently covered with small triangles to a level that allows detailed surveys to be made in a local level. Error is in the whole operation as the vertices of the large triangles are fixed using higher precision instruments.

(b) Using measurements from two control parts to fix other points. Given two points whose length and bearings have been accurately determined, a line can be drawn to join them hence surveying has control reference points. The locations of various other points and the lines joining them can be fixed by measurements made from these two points and the lines joining them. For an example, if A and B are the control points, the following operations can be performed to fix other points.

i) Using points A and B as the centers, ascribe arcs and fix (where they intersect).

ii) Draw a perpendicular from D along AB to a point C.

iii) To locate C, measure distance AB and use your protractor to equally measure angle ABC.

iv) To locate C the interior angles of triangle ABC can be measured. The lengths of the sides AC and BC can be calculated by solving the triangle.

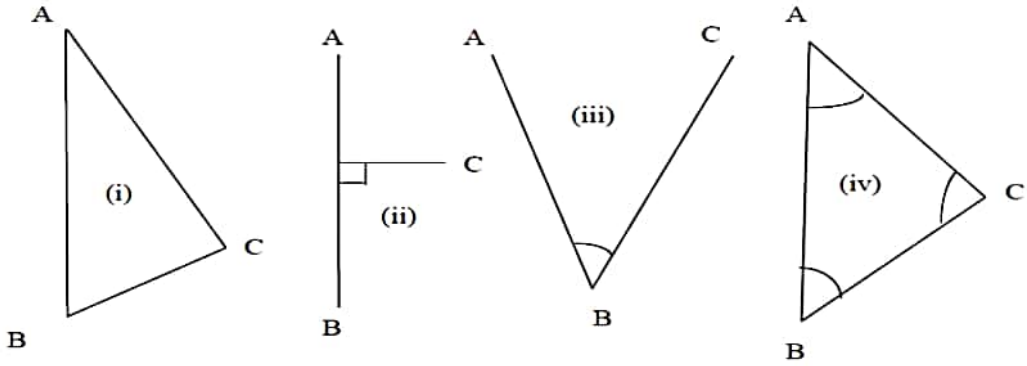


Fig. 6.1: Fixing the third points using two points

The process of surveying:

The survey process passes through 3 main phases – the reconnaissance, field work and measurements, and, the office work.

(a) Reconnaissance survey

This is a pre-field work and measurement phase. It requires taking an overall inspection of the area to be surveyed to obtain a general picture before commencement of any serious survey. Walking through the site enables one to understand the terrain and helps in determining the survey method to be adopted, and the scale to be used. The initial information obtained in this stage helps in the successful planning and execution of the survey.

(b) Field work and measurement:

This is the actual measurements in the field and the recordings in the field notebook. To get the best results in the field, the surveyor must be acquainted with the functions of the equipments and take good care of them.

(c) Office work: This is the post field work stage in which data collected and recordings in the field notebooks are decoded and used to prepare the charts, planes and maps for presentation to the clients and the target audience.

LECTURE 7

IMPORTANCE OF SCIENTIFIC HONESTY

- Honesty is essential in booking notes in the field and when plotting and computations in the office. There is nothing to be gained from cooking the survey or altering dimensions so that points will tie-in on the drawing. It is utterly unprofessional to betray such trust at each stage of the survey.
- This applies to the assistants equally as it does to the surveyor in charge. Assistants must also listen carefully to all instructions and carry them out to the later without questions.

CHECK ON MEASUREMENTS

- The second principle is that; all survey work must be checked in such a way that an error will be apparent before the survey is completed.
- Concentration and care are necessary in order to ensure that all necessary measures are taken to the required standard of accuracy and that nothing is omitted. Hence they must be maintained in the field at all times.

- Surveyor on site should be checking the correctness of his own work and that of others which is based on his information.
- Check should be constantly arranged on all measurements wherever possible. Check measurements should be conducted to supplement errors on field. Pegs can be moved, sight rails altered etc.

- Survey records and computations such as field notes, level books, field books, setting out record books etc must be kept clean and complete with clear notes and diagrams so that the survey data can be clearly understood by others. Untidy and anonymous figures in the field books should be avoided.

- Like field work, computations should be carefully planned and carried out in a systemic manner and all field data should be properly prepared before calculations start. Where possible, standardized tables and forms should be used to simplify calculations. If the result of a computation has not been checked, it is considered unreliable and for this reason, frequent checks should be applied to every calculation procedure.

- As a check, the distances between stations are measured as they are plotted, to see that there is correspondence with the measured horizontal distance. Failure to match indicates an error in plotting or during the survey.

- If checks are not done on observations, expensive mistake may occur. It is always preferable to take a few more dimensions on site to ensure that the survey will resolve itself at the plotting stage.

ACCURACY AND PRECISION

These terms are used frequently in engineering surveying both by manufacturers when quoting specifications for their equipments and on site by surveyors to describe results obtained from field work.

- Accuracy allows a certain amount of tolerance (either plus or minus) in a measurement, while;

- Precision demands exact measurement. Since there is no such things as an absolutely exact measurement, a set of observations that are closely grouped together having small deviations from the sample mean will have a small standard error and are said to be precise.

ECONOMY OF ACCURACY AND ITS INFLUENCE ON CHOICE OF EQUIPMENTS

- Survey work is usually described as being to a certain standard of accuracy which in turn is suited to the work in hand. Bearing in mind the purpose for which the survey is being made, it is better to achieve a high degree of accuracy than to aim for precision (exactness) which if it were to be altered would depend not only on the instrument used but also on the care taken by the operator to ensure that his work was free from mistake.

- Always remember that, the greater the effort and time needed both in the field and in the office, the more expensive survey will be for the client. The standard accuracy attained in the field must be in keeping with the size of the ultimate drawings.

- The equipment selected should be appropriate to the test in hand. An important factor when selecting equipment is that the various instruments should produce roughly the same order of precision. A steel chain best at an accuracy of 1/500 to 1/1000 would be of little use for work requiring an accuracy of 1/1000. Similarly, the theodolite reading to one second would be pointless where a reading to one minute is sufficient.

- Having selected the equipment necessary, the work should be thoroughly checked and if found wanting should be adjusted, repaired or replaced or have allowance calculated for its deficiencies. This task will be less tedious if field equipment is regularly maintained.

Horizontal Distance Measurement

One of the basic measurements in surveying is the determination of the distance between two points on the earth's surface for use in fixing position, set out and in scaling. Usually spatial distance is measured. In plane surveying, the distances measured are reduced to their equivalent horizontal distance either by the procedures used to make the

measurement or by applying numerical corrections for the slope distance (spatial distance). The method to be employed in measuring distance depends on the required accuracy of the measurement, and this in turn depends on purpose for which the measurement is intended.

Pacing: – where approximate results are satisfactory, distance can be obtained by pacing (the number of paces can be counted by tally or pedometer registry attached to one leg). Average pace length has to be known by pacing a known distance several times and taking the average. It is used in reconnaissance surveys& in small scale mapping

Odometer of a vehicle: - based on diameter of tires (no of revolutions X wheel diameter); this method gives a fairly reliable result provided a check is done periodically on a known length. During each measurement a constant tyre pressure has to be maintained.

Tachometry: -distance can be can be measured indirectly by optical surveying instruments like theodolite. The method is quite rapid and sufficiently accurate for many types of surveying operations .

Taping (chaining): - this method involves direct measurement of distances with a tape or chain. Steel tapes are most commonly used .It is available in lengths varying from 15m to 100m. Formerly on surveys of ordinary precision, lengths of lines were measured with chains.

Electronic Distance Measurement (EDM): - are indirect distance measuring instruments that work using the invariant velocity of light or electromagnetic waves in vacuum. They have high degree of accuracy and are effectively used for long distances for modern surveying operations.