CHAPTER 11 ELEMENTARY SURVEYING

After studying this chapter, students will be able to:

- define surveying;
- describe the various branches of surveying;
- list and highlight the importance of surveying;
- describe the types of surveying;
- describe chain surveying the instruments used and the procedure for executing it;
- describe compass traversing and the procedure involved;
- describe the procedure for avoiding obstacles during surveying on the field;
- describe the procedure for producing map from surveying readings.

11.1 Definition

Surveying may be defined as the art, science and process of making measurements of relative positions of points or locations above or beneath the Earth's surface. It also involves the plotting of these measurements into chart, plans or maps depending on the objective of the measurement. Usually, the aim of surveying is to determine the size, slope, figure, boundaries and positions of places on the Earth's surface.

In recent times, surveying has developed such that it has come to be regarded as a discipline and profession. In response to this experience, several people have pursued courses in the area of surveyors and have been licensed to perform and practice the profession as full-time surveyors.

11.2 Branches of Surveying

There are basically two branches or fields of surveying and they are:

(a) Geodetic surveying

(b) Engineering surveying

Geodetic Surveying

This is the branch of surveying that is concerned with the measurement of the Earth's curved surface. This is necessary because the curvature or sphericity of the Earth's surface to a large extent will determine the accuracy or otherwise of measurements taken on the Earth's surface. If the Earth were flat, there will be no distortion and measurements will be easy to be taken. However, due to the Earth's curved surface, there is the need for special ways of taking the measurements so that the distortions will not lead to errors and discrepancy. Hence this branch of surveying devises better ways of taking accurate measurements with due reference to the Earth's curvature and its effects.

Engineering Surveying

This is the branch of surveying that involves the taking of measurements of places for the purpose of executing special projects such as road construction, building, dams, town planning etc. The main thrust of this branch is based on the fact that projects are better executed, planned and managed if accurate and reliable measurements are taken. Hence, this type of surveying is undertaken with every sense of precision and carefulness. It is also multi-disciplinary in nature as it involves the cooperation and direct involvement of other professional such as planners, architects, engineers, environmentalists etc. in addition to the surveyor. With this, it is possible to execute measurements that are detailed, precise, accurate and effective. Such measurements can be easily interpreted and

can be directly verified in case of conflict and controversy as to the relevance or otherwise of the exercise.

11.3 Importance of Surveying

Surveying either as an activity, profession or a discipline is important in some many ways, some of which are:

It provides detailed and accurate information about objects and features on the earth's surface with respect to their important attributes such as size, shape and position.

It provides vital information that can be used as vital instruments for the ownership of properties such as land, buildings etc.

It is required as a condition for the registration of land and property registration

It provides vital information that is later used in the production of maps particularly topographic maps and cadastral maps.

It provides information that serves as data base for use in some important human activities such as physical planning, construction works, agriculture, provision of public utilities etc.

It provides vital information used in the demarcation of local and international boundaries and territories.

11.4 Types or Classes of Surveys

Surveying is a broad discipline and activity. It consists of five major types, namely:

(a) Land survey involves measurement of distances, direction and objects directly on the ground. It consists of topographic Surveys, cadastral survey and city surveys.

(b) Marine, Hydrographic or Water survey: This involves the measurement of water bodies, their depth, volume etc.

(c) Aerial or Space survey: This involves the measurement of objects and features on the Earth's surface as done or viewed from the mid-atmosphere, outer space or above the earth's surface. The information gathered from these surveys are used in producing aerial photographs, satellite imageries, topographic maps etc.

(d) Engineering surveys are activities that has to do with the measurements of areas for the purpose of determining the quantities and the collection of data for the execution of projects such as road construction, bridges, railways etc

(e) Military surveys are done for the purpose of determining both offensive and defensive points of strategic importance or places that serves as point of attack during wars.

1.5 Methods of Surveying – Triangulation and Traversing

There are several ways by which surveying is carried. However, there are mainly two methods of executing survey and they include:

(a) Triangulation

(b) Traversing

Triangulation

This is the process of measuring objects, usually land parcels by dividing them into a network of equilateral triangles. It involves the measurement of one and three angles of a chain network. In this method, the system or network consists of a chain network. In this me method, the

system or network consists of a number of inter-connected triangle in which the length of only one line called the base line known and the angles of the triangles are measured precisely.

When the values of the three angles and the length of the sides of the triangle instead of the angles. The length of the sides of the triangle are often determined using electronic distance measuring devices such as the tellurometer. For precision and accuracy, trilateration is usually combined with triangulation. Triangulation as a survey method is appropriate for large position or expanse of land.

Traversing

This is a surveying method in which a series of connected straight lines whose length and directions are measured with the aid of a tape or chain and a compass. In a traverse, each end point are referred to as STATION or HUBS while the straight lines between the two consecutive stations are called TRAVERSE LEGS.

Traversing is divided into two types, namely:

(a) Chain traversing

(b) Compass traversing

Chain Traversing

This method involves only the measurement of length and distances. Where there is obstruction such as forest, ponds, rock outcrops, offsets are drawn around the objects. Chain traversing involves measuring and reading straight line distances on the ground with instruments. The measurements made are then recorded in a field book from where plottings can be made later in the office.

Chain traversing is done in a team that consists of the leader, the front men, the back men and the recorders all of which work together to ensure that measurements are well taken and are properly recorded in the field note.

Procedure in the Conduct of Chain Traversing

a. The area to be surveyed must be chosen and should be that which can be well managed and accessible. It must be chosen after a reconnaissance survey or familiarization visit has been paid to the area.

b. The plan of the campaign must be well spell-out especially the activities to be carried out, the materials needed and the route to be taken during the exercise.

c. The base lines must also be determined by choosing straight lines that are well noted such as near a fence or any straight feature.

d. The chain lines must be numbered or lettered for easy identification.

e. The exercise begins with the leader (that is, the surveyor) who sets off by carrying the ranging pole or a set of ten arrows and also dragging the chain or tape (as the case may be).

f. The follower (that is, the assistant to the surveyor) directs the leader into the line with a remote ranging pole when the chain or tape has been fully suspended.

g. The chain is drawn and an arrow pushed vertically into the ground touching the outside of the handle of the chain in the leaders hand while the other handle is made to touch the other ranging pole.

h. Recording begins when the booker (the person with the field book) enters the first length (i.e. the full length of a chain in tape) to indicate that a complete chain has been measured, care has to be

taken to ensure that entries are correctly made and that there is no ambiguity.

i. The process is then repeated continuously until the entire area is covered and at each point the follower collects the arrow en-route till the entire exercise is completed.

j. At the end of each line, check should be made such that the number of arrows collected tallies exactly with the number of chains entered by the leader and the booker.

k. Where there are obstructions, offsets should be taken with the use of an offset staff. Offsets should be as short as possible and avoid excessive number of offsets.

l. Start the field entries of each line at the bottom of a new page in the field book.

m. Where the chain line crosses a feature such as fence, path or stream, it should be shown in the double line of a field book by a broken oblique line.

n. Determine a suitable scale for the survey plan by use of intersecting arcs.

o. Insert an arrow to indicate the north point or the magnetic north if it is obtained by a compass.

p. Insert the date the survey was conducted.

q. Draw out the plan as early as possible.

Steps in Taking a Chain Traverse (Survey)

1. Make a reconnaissance survey to the area by taking a walk to the area and noting how the place look like and important features there.

2. Take note of the general layout of the area.

3. Take a detailed note of the position of the features and the shape of the area.
4. Decide the procedure to be used particularly the framework and the stations. Mark the stations by driving down the pegs.
5. Make a sketch of the layout on the last page of the field book in addition to the date and the name of the survey team.
6. Note the longest line of the survey. It is usually taken as the base line and is thus measured first.

The Survey Instruments Used in Chain Traversing

There are several types of instruments used for carrying out surveying activities depending on the type of survey. For a simple survey work which involves purely the measurements of length and distances, the following instruments are often used:

1. Ranging pole
2. Measuring tape
3. Chain
4. Station pegs
5. Optical square
6. Arrows or pins
7. Watkin's clinometers
8. Offset staff
9. Steel band
10. Field book

1. **Ranging pole:** This is a long pole or bar made of wood or metal. It is of varying lengths e.g. 1.8m, 2.4m or 3.0m. It is otherwise called a picket. It is a pole of sub-circular section and is divided into red,

white and black colours. It is used to measure the height of objects are aligned to the line and for marking positions in the field. For proper identification pickets may be tied with flags of red or white fabrics when visibility is impaired by distance or the physical background. Pickets have a pointed show and is driven to the ground for stability and to mark stations.

2. **Measuring tape:** This is usually made of linen or finc steel sheet. It is usually marked on one side with metric units and the other side in the imperial units. The tape is of various types and lengths and it is wound in a small case from where it is pulled for use. It is used to take measurements especially lengths. Tapes are indispensable to the surveyor as they aid most measurements. They are not stable materials because they can easily absorb moisture and hence the length can vary with respect to time. It is expands if it is hot and contracts when it is cold.
3. **Chaining pin or arrows:** These are metal objects in form of a pin with a circular top. Their length is about 40mm with a diameter of 3-4mm. They are used in marking positions on the ground, that is, to mark the end of one tape length. They can also be used to check the result of chaining especially as it relates to the verification of measurements made on the field. For every identification, a piece of red ribbon may be tied at the top.
4. **Station pegs:** These are similar to chaining pin or arrows. A typical size is 40mm x 40mm x 0.4m long. They are used in marking points of intersection of chain lines and are marked by nails set in the tops of rak legs driven into the ground by a mallet. Steep pegs may be used for hard surfaces.
5. **Optical square or cross staff:** It consists of four metal arms turned up at the ends and cut with vertical sighting slits at right angles. The

head is attached to an iron-shod staff which is planted at the point if it is desired to set out right angles. The two slits are sighted along the survey line and the right angle is set out in a picket through the other pair of silts.

6. **Chain:** These are long metal strings or wires that are used to measure length or distances on the field. They are made up of tempered steel wire are consists of links which measure 200mm from centre to centre of each middle connecting ring. Brass handles are tilted at each end and the total length over the handles. In recent times, falling markets made of plastic and brass are attached at every whole metre position and are of a different colour.

There are three types of chains:

(i) **Gunter's chain:** This is exactly 66ft long and it is divided into 100 links, each of point 6.6ft or 2 inches. The chain was invented by a renowned mathematician Edmund Gunter.

(ii) **The metric chain:** This is 20m long and it is divided into 100 links each of 200mm long.

(iii) **The engineer's chain:** This is the chain widely used by civil engineers on the field. It is 100ft long and is divided into 100 links with each link 1 foot long.

Before the coming of the measuring tape, the chain has been in use. The major advantage of the chain is that it is not easily broken. However, with constant usage, the length may increase due to som factors such as expansion of chain owing to wear on the metal to metal surfaces, bending of the links and the effect of temperature changes. Where this occurs, it may lead to errors. Secondly, the weight is another disadvantage especially where it has to be suspended in order to make readings.

7. **Watkin's Clinometer:** It consists of a counter-weighted scale that is freely suspended so that it is always horizontal. The scale is divided from 0^0 in both elevation and depression. It is used for measuring the angles of ground slopes.
8. **Offset staff:** This is a graduated rod of about 3m high. A hook may be filled at the top for the purpose of pulling a chain through a hedge. It has a telescopic link which is 0.3m (30cm) in length. This instrument is used for taking offset measurements.
9. **Steel band:** This is made up of a steel ribbon. Its length may be 30m, 40m, 100m. It is marked with 5mm graduation and the millimeter figure is repeated every 10cm. It is used for measuring distances and can only be used under certain conditions of temperature and mode of support. It is open to weather changes. When it is cold it absorbs moisture and thereby contracts and if is too hot it stretches or expands, both of which can lead to error in measurement.
10. **The field note book:** This is a book where measurements taken on field are entered. It has stiff covers which is 150mm by 100mm wide. It contains plain leaves of good quality paper. It is opened lengthwise and secured with an elastic band. Usually two red lines about 15mm apart, are ruled centrally down the middle of the page and it represents the survey line and the notes are recorded up the page.

    When using the book, entries are made at the back and continue towards the front. In essence, measurements are recorded in a forward manner in the same direction as the team walks.

    The recording in such a way that it starts by inserting the date and place of survey, together with the name of those making it. This

later followed by a diagrammatic sketch of the chain lines, the stations being lettered and the number of the line being measured in addition to the direction in which it is measured.

In entering information inside the field note, the following must be well noted:

(i) Features such as rock outcrops, hedges, rivers etc. are sketch in the book.

(ii) The distances of the features from the main chain line are inserted beside the dimension on the line from which the offset was taken.

(iii) No features are drawn across the pair of red lines as it is being used for entering the dimensions only.

(iv) Where there are intersections of survey lines being measured, their directions are indicated.

Fig. 11.1: Surveying Instruments

11.6 Compass Traversing

As mentioned earlier on, traversing is a method whereby survey liens are laid, more or less in conformity with the configuration of the area or the object being surveyed. It is an extension of the method of fixing a point by distance and bearing. Already, the principles and procedures of chain traversing have been discussed.

A compass traverse is a series of adjoining lines, the bearing and length of which must be measured. Unlike chain traversing where only length and distances are measured, the bearings of the survey lines are taken in addition to their linear measurements. In executing a compass traversing, equipment such as theodolite, prismatic compass etc are needed in addition to the survey instruments used for chain traversing. The ideal is the theodolite. However, theodolites are expensive and many schools may not afford it. Hence, prismatic compasses can be procured as an alternative. Equipment required for compass traversing consist of a compass, a field note book, a rotrator, a perambulator (a measuring wheel0. To carry out a compass traverse, two to four people are needed.

Procedure in Compass Traversing

The following procedure and steps are recommended in carrying out compass traversing.

1. Embark on a reconnaissance survey or a familiarization visit to the areas being surveyed which involves:
   (a) Identification of the area for which the compass traverse is meant.
   (b) Decide on the layout of the route 'legs' to be followed. In doing this, ensure that the individual legs are as long as the area to be surveyed to have one leg for each side. Here, it is

better to use legs of equal length especially where the boundaries are not marked. As such, make sure that the two ends of a leg are intervisible from one another. For effectiveness, avoid the use of very short legs and make sure that there are few or no obstructions along the length of a leg.

2. For every identification, mark the stations with numbers or letters e.g. P, Q, R, S etc.
3. Take angular measurements to the next station from a previous one e.g. A to B, B to C, C to D, and D to A especially for enclosures.
4. Begin the linear measurement form one station to the next, that is, from A to B, B to C, etc till all the stations are covered.
5. As linear measurements are being taken, take all the bearings and offsets from important objects e.g. real boundary, gates, buildings, trees, rivers, hills, rock outcrops etc.
6. Ensure that all the measurements, offsets and bearings are properly entered into the field notebook.
7. Choose a suitable scale and with that plot all the measurements and observations, especially where memory of the activities carried out on the field are still fresh.

11.7 Types of Traverses

A traverse can be classified as CLOSED and OPEN traverses.

(a) Closed Traverse

A traverse is regarded as closed when a complete run or circuit is made around the object being measured, that is, when measurements returns to the starting point thereby forming a closed polygon or when measurements begins and end at points where positions on plan are known. This makes it easier to cross check and balance up the measurement taken. Closed traversing is an

appropriate method that can be used for locating or demarcating boundaries or territories of objects such as woods (forest), lakes, ponds and also for the survey of relatively big or large portion of land, in most survey works, a close traverse is often preferred.

(b) Open Traverse

1. This is obtained when a traverse or a system of measurements does not form a closed figure or polygon. In this case it will consists of a series of lines extending in the same general direction without returning to the starting point.
2. At the same time, it does not begin and stop at points whose positions on the plan are known.
3. Open traverses are most suitable for the survey of linear objects or features with narrow strips such as roads, the valley or banks of a river, a railway, pipeline transmission lines etc.

Plotting of a Compass Traverse

1. In plotting a compass traverse it is presumed that there is a table consisting of measurements taken with respect to the distance and direction of stations already established on the field.
2. With this table, adopt the following steps listed below:
   i. With the aid of a pencil and ruler draw a line up the sheet of plotting paper to represent the reference direction, that is the magnetic north.
   ii. Choose a convenient scale to represent the various length contained in the table
   iii. With the references direction, the starting point is denoted A from which further plotting and measurement on the paper can proceed.

iv. Based on the chosen scale, proceed to establish other prints (station) by measuring their respective distance on paper and plotting their bearing using a good protractor. In plotting their bearings using a good protractor. In plotting directions ensure that the zero line of the protractor coincides with the reference direction. Continue this process until all the points are plotted using the same procedure.

Error of Closure

1. Often times when measurements are taken in respect of a compass traverse, there are situations when the traverse legs do not close or meet at the starting point that is the traverse does not end up where it began.
2. Hence an error of closure has occurred. This error has to be corrected or adjusted if a closed traverse is to be obtained.
3. To correct an error of closure, this demands that the observed error is distributed around the traverse shifting each station proportionately to the total distance right from the beginning of the traverse in a direction to the closing error. This is known as method of least distortion.
4. Error of closure occurs due to:
   (i) Discrepancies in measurements and taking of bearings
   (ii) Attraction of the compass due to the magnetic effect of the Earth
   (iii) Use of faulty equipments
   (iv) Making wrong recordings or bookings

Adjustment or Correction of Error of Closure

Error of closure can be corrected through the following steps:

1. Cross – checking of bearings and other measurements by taking backward or forward bearings.
2. Checking to see whether there is the presence of magnetic metals that are capable of causing unreliable compass readings.
3. Checking the accuracy and reliability of instruments even in the field.
4. Correction of plotting using the field book recordings.

The closure error can further be adjusted by taking the following measures:

Graphically, it can be resolved through the Bowditch's method which involves the following:

1. Produce a length equal to the perimeter of the traverse.
2. Mark the stations or points along line drawn at proportional lengths.
3. At the end of the lines drawn, draw a perpendicular equal to the error of closure.
4. Complete the triangle by an hypotenuse.
5. At each station on the line, draw perpendiculars to meet the hypotenuse of the triangle.

For the second method, take the following steps:

1. On the base map, draw lines from each of the station or hubs parallel to and in the direction of the error of disclosure.
2. Using appropriate lengths from the diagrams described above, mark the proportional lengths of the perpendicular in the first diagram.
3. Join the points marked along the parallels. These lines are the adjusted traverses

Advantages of Chain Traversing

1. It is easy to undertake since it involves only the measurement of distances.
2. Its readings can easily be taken and recorded as it does not involve any form of computation especially where metric system is used.
3. Readings can easily be entered into the field note as the technique for doing so is not cumbersome or complex to understand.
4. It uses simple instruments.
5. It can only be used in areas without abstractions or obstacles.
6. Detailed measurement of small area can be measured.

Disadvantages of Chain Traversing

1. The instruments are bulky and may constitute physical strain if it has to be carried over long distances.
2. It is possible to sustain injuries during the process of carrying out the exercise especially in the handling of the instrument and in crossing thick vegetation
3. Obstacles such as lakes, ponds, dense vegetation constitute problem in executing this types of surveying.
4. Influence of weather elements such as temperature, rainfall etc often times makes the instruments to contract or expand thereby resulting in unreliable measurements and discrepancies.
5. It cannot be used for surveying large areas of land e.g. estates.
6. It is unsuitable for built-up, endorsed or bush covered areas.

Advantages of Compass Traversing

1. It is easy to undertake as readings can be directly read off from the compass.
2. It can be used to run several traverse lines without having regard to preceding lines thereby help in saving time and avoid undue repetition of tasks.

3. The instruments especially the compass is light, portable and easy to carry out regardless of the nature of the terrain.
4. Due to the portability of the compass, taking of bearings becomes an easy exercise to undertake.
5. Owing from the above, the easiness in taking bearings eliminates the need for check lines and by so doing makes the survey faster to complete.
6. The occurrence of obstacles is never a problem so long as it does not impede the line of sight.
7. It allows for independent determination of bearings so that any error incurred in the determination of bearings can be confined only to that particular leg and not carried over to other legs.
8. It is perhaps the best method suited for exploratory activities especially reconnaissance surveys and can be well carried out in obstacles such as jungle or dense forests where attractions on surveying instruments are appreciably reduced.
9. It is accurate and can easily be verified.

Disadvantages

1. It cannot be used to run great distances or length without the aid of a telescope.
2. The degree of accuracy can be largely affected by poor readings and environmental attractions on the compass.
3. The needle of the compass most times may not be reliable due to magnetic effects which is capable of bringing in discrepancies.
4. For an effective use of the compass a through grasp and knowledge of angles and bearings is needed.
5. The instruments are expensive to procure and maintain.

11.8 Obstruction in Traversing and How to Overcome Them

In the course of undertaking traversing, it is possible to encounter obstacles. Obstacles are generally barriers that are capable of affecting the running of survey lines. This problem is much common in chain traversing and it is capable of:

(a) impeding the chaining or measurement of survey lines that is, inability to run the chain over the obstacle; and

(b) preventing the alignment of the survey line.

Obstacles in chain surveying can be grouped into two, namely:

(i) Detached or Isolated obstacles; and

(ii) Continuous obstacles

Detached or isolated obstacles are features that can impeded chaining and they include features such as isolated hills, ponds, lakes and low plantations, woods and buildings.

Continuous obstacles are those barriers that impede chaining and the measurement and alignment of chains or tapes. Examples include rivers, canals, high boundary walls and blocks of buildings.

To overcome these obstacles during chaining, the following methods can be adopted:

1. taking of right-angled offsets;
2. using the Pythagoras theorem in determining side to measure;
3. using the principle of similar triangles.

The use of the principles of plane-geometry especially the setting of perpendicular or right-angled offsets and similar triangles is considered effective for the purpose. For detached or isolated obstacles, perpendicular offsets are effective while similar triangles can be overcome by using similar triangles. All these methods belong to the realm of plane geometry.

11.9 Production of Maps from Survey Measurements

It is possible to produce simple or sketch maps from information obtained from simple surveys taken on the field. To do this, the following steps should be taken:

1. Study and get familiar with the land surveys or any data being used for making the map.
2. Select the details to be mapped as not all details may be needed so as not to overcrowd the map. The rule here is to omit the irrelevant ones and retain the relevant ones, without overcrowding them.
3. Choose a suitable scale for the map. In doing this, bear in mind that the area to be mapped and the fact that it is not possible to show all the details as they appear on the field.
4. If there is a base map, use it on a grid of squares.
5. On the grid, insert the selected features using appropriate map symbols.
6. Make sure that the symbols used are simple, small distinct, consistent and adequate.
7. Let the letters used on the map be legible and consistent particularly in terms of size, style, alignment, arrangement and spacing. Note that the appearance of the map to a large extent depends on the lettering and other symbols used on the map.
8. Provide relevant marginal information in the form of the key, map title and scale. The information should be at the border of the map.
9. Go through the map again to ensure that all the details are properly shown on the map.

Summary

Survey is an activity, discipline and a profession.

Surveying involves the taking of measurements of points on the Earth's surface and fixing of position of area surveyed.

In recent years, surveying has grown to be a profession and a discipline.

There are basically two branches or fields of surveying – geodetic surveying and engineering surveying.

There are several types of surveying – land survey, cadastral survey, aerial survey, military survey, marine or hydrographic survey, topographic survey.

Surveying is done with the aid of instruments such as chains, tapes, arrows, ranging pole, prismatic compass, plane table, theodolite etc.

Methods used in surveying include triangulation and traversing.

There are two types of traversing: chain traversing and compass traversing.

Obstacles in forms of features such as hills, rivers, canals, buildings, plantation etc. can affect the measurements of lines and distances.

Maps can be produced in form of simple sketches from survey readings.

Revision Questions

1. Surveys which are carried out to provide a national grid of control for the preparation of accurate maps of large areas are known as
   A. plane surveys
   B. geodetic surveys
   C. geographical surveys

D. topographic surveys

2. Hydrographic surveys deals with the measurements of
   A. large water bodies
   B. heavenly bodies
   C. canal system
   D. forests
3. In chain surveying, the field work is limited to:
   A. linear measurements only
   B. angular measurements only
   C. linear and angular measurements
   D. pilot surveys
4. Which of the following instruments is not used in chain traversing?
   A. Ranging pole
   B. Prismatic compass
   C. Gunter's chain
   D. Tape
5. Error of closure can be corrected by all but one of the following.
   A. Geographical method
   B. Optical means
   C. Making of measurements
   D. Re-orientation of prismatic compass
6. The field note contains
   A. imaginary measurements
   B. account of conversation among survey teams
   C. detailed field measurements
   D. in-door measurements
7. Which of the following is the major instrument used in a compass traverse?
   A. Plane table

B. Ranging pole
C. Leveling staff
D. Prismatic compass

8. Chain traversing is best suited for one of the following.
A. A river
B. A road
C. A forest reserve
D. An estate

9. The person recording measurements taken on a field is called
A. foreman
B. back man
C. book man
D. leader

10. Compass traversing is best considered for its
A. accuracy
B. precision
C. complex
D. complex nature

Essay

1(a.) Define surveying.
(b.) Describe four branches of surveying.
2(a.) Give two features of chain surveying.
(b.) Describe five survey instruments and their uses.
3(a.) State four points that should be considered when entering measurement details in a field book.
(b.) Describe three limitations of chain surveying.
4(a.) Define compass traversing.
(b.) Describe three methods used in compass traversing.

5(a.) State three sources of error in compass traversing.

(b.) Describe three ways of correcting such errors.