

# 3

## SURVEYING

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### 3.1 INTRODUCTION

The art of measuring the distances and angles on ground in such a way that it becomes reproducible on a map which is drawn to scale later on, is called surveying.

Surveying is a science as well as an art, by which studies are made of the objects present on the ground and below the ground at different points. Although the earth is spherical but during survey of small areas, we consider it flat. If large areas are to be surveyed, it is considered spherical, while making maps of the different countries. In that case it is called Geodetic survey.

### 3.2 OBJECTIVES

After reading this lesson you will be able to:

- define surveying;
  - describe the aims of surveying;
  - explain the utility of the apparatus used in surveying and their proper use;
  - prepare the maps of the land pieces and calculate the area of the land;
  - establish the relative position of every point on the land and their levels;
  - explain layout the building plan on the land;
  - calculate the area of land.
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### **3.3 WHAT IS SURVEYING**

Knowing about the relative position of various objects, determination of distances between them, measurement of angles, measurement of height, determination of boundaries and relative heights of various points come under the purview of surveying.

It is very essential to mark the various points on the land, boundary lines of the proposed construction sites and levels (heights) of the various locations before starting the construction of building, bridge, embankment, railway line etc.

After performing the measurements of the shape, size and location of objects on ground, the details are plotted on paper (drawing sheet). After the completion of drawing which may be one or more than one, describing the details, the construction process is started. After determining the details of the soil strata below ground and bearing capacity of soil which is called Geotechnical survey, the depth of earth work is decided by the engineer. All these things are inter-related and forms the part of the total survey work.

At first sight the job of survey looks very simple but it actually requires special knowledge about it and the understanding of the job. The students who have studied or who have the knowledge of Mathematics and Physics can acquire the knowledge about survey in a nice manner. The pace of development which is going on in India and through out the world has increased the importance of survey, related works.

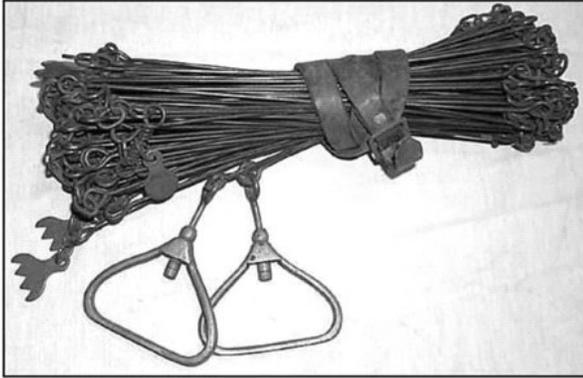
#### **Measurement of Length**

Appropriate measuring tape (Fiber, steel, etc.) or chain (Fig. 3.1) is used. The metallic end of the tape is also taken into account while measuring the length. The distances are written on the tape in m, cm, etc.

### **3.4 TYPES OF SURVEYING**

The types of surveying which are extensively being conducted are many e.g. Contour survey, Land survey, city survey, topographical survey, route survey, Mines survey, engineering survey, satellite survey, geological survey, Construction survey etc. However we, will discuss only construction related surveys here.

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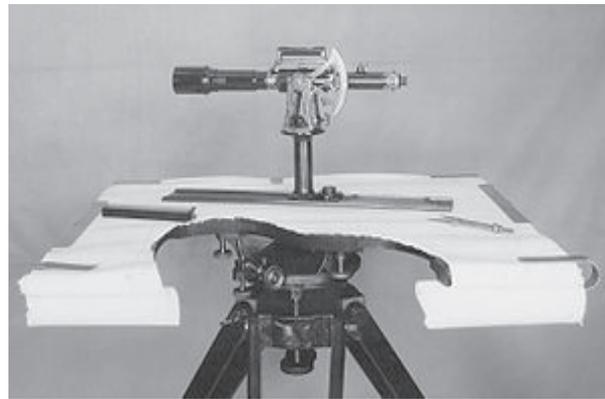
**Fig. 3.1**

### 3.4.1 Classification of Survey

- a) **Compass Survey:** In this survey either trough compass (Fig. 3.2) or prismatic compass (Fig. 3.3) are used. The angles are measured as internal angles using those apparatuses and the lengths between various points are measured by using measuring tapes.

**Fig. 3.2:** Trough Compass**Fig. 3.3:** Prismatic Compass**Fig. 3.4:** Prismatic compass

- b) **Levelling:** Relative heights of different points situated on the ground is measured by this apparatus. This helps to know as to by how much amount a point is either higher or lower with respect to each other and standard bench mark.
- c) **Plane Table Survey:** This type of survey is conducted by using a drawing board mounted on a Tripod stand, Control over the point situated on the ground which is called station. An alidade is used to draw line parallel to the line between the two existing stations A and B. The alidade has a slit on the observation side and a thread (vertical) on the object side. Only one side of the alidade is used (usually right hand side). The lines are drawn to the selected scale on the drawing paper pasted on the drawing board of the plane Table. This type of survey is called Plane Table Survey (Refer Fig. 3.5)



**Fig. 3.5**

### **3.5 ANGLES**

If a circle is drawn using drawing compass, its total angle is  $360^\circ$  (degree). Every degree is divided into 60 minutes and then every minute is divided into 60 seconds e.g.

1 degree = 60 minute

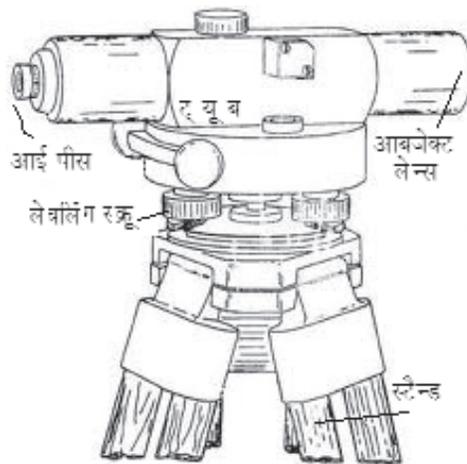
1 minute = 60 seconds

### **3.6 LEVELLING**

Leveling (survey) is conducted either by a conventional apparatus called “Dumpy

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level” or by a modern apparatus called “Total station” (Automatic modern levelling apparatus). In both the machines a telescope is horizontally mounted on a tripod stand. This telescope is free to move in 360° rotation in the horizontal plan. The viewing glass near the eye is called eye piece, and the viewing glass facing the object is called object piece. The line (imaginary) which joins the centres of the eye piece and object lens, is called the line of collimation.



**Fig. 3.6: Dumpy level**



**Fig. 3.7: Modern Automatic levelling M/c**

In the Dumpy level the line of collimation is made horizontal by using the bubble of the spirit level which comes into middle when the horizontality is achieved. This is done by using leveling screens. In automatic leveling machine a rough horizontality is achieved by using spirit level and finally fine tuning is done in an automatic manner. After achieving, the horizontality of line of collimation The instrument is turned by 360°. The imaginary plane formed by the rotation of

line of collimation by  $360^\circ$  is called the plane of collimation. All the readings of level are taken at this plane of collimation by rotating the equipment horizontally.

In automatic machine (total station) it is possible to record the distance and height electronically without actually measuring the distances on the ground.

(Ref Fig 3.6 for Dumpy level and Fig 3.7 for modern automatic leveling machine)

### **3.6.1 Words used in leveling survey works**

1. Station: It is a point on the ground where the leveling staff is kept (erect position) for measuring the height of line of collimation.
2. Leveling staff: It is a collapsible 4" (five inch wide) wooden staff on which m, cm & mm are marked.
3. Height of instrument: The height of line of collimation with respect to reference bench mark is called height of instrument.
4. Back sight: When the leveling staff is kept erect at a point on the ground whose level is already known by previous measurement whether done much earlier or during the present survey after changing the instrument station, is called the Back sight reading.
5. Fore sight: It is the last reading taken on the leveling staff during level survey.
6. Intermediate sights (reading): Reading taken on the leveling staff on any point on the ground which is in between back site reading and fore sight reading.

## **3.7 FIELD BOOK (LEVEL SURVEY)**

There are two methods by which the levels of different points situated on ground is calculated after completing the field work. These are :

1. Height of Instrument method
  2. Rise and fall method
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Table 3.1: Height of Instrument Method

Station (1)	B.S. (Back Sight) (2)	I.S. (Intermediate Sight) (3)	F.S. (Fore Sight) (4)	H.I. (Height of Instrument Method) (5)	R.L. Reduced Level (6)	Remarks (7)
A	1.310	2.10		101.310	100.00 99.210	BM
B	1.420		2.245	100.485	99.065 98.865	TP
C		1.620	2.150		98.335	
Sum	2.730	3.720	4.395			

According to the above table three stations viz., A, B and C have been chosen. The R.L. at station A which is called Bench Mark (B.M.) is known/assumed to be equal to 100.00. The instrument has been shifted to 'B' and back sight at 'A' is taken an intermediate site is also taken and these after Final reading at station 'C' which is called fore sight is also taken. All the readings are shown in Table 3.1.

For checking the work following formula is used:

(Sum of all Back Sight – sum of all Fore Sight) = First reading – last reading

$$(2.730 - 4.395) = (98.335 - 100)$$

$$\text{Or } 1.665 = - 1.665$$

It means that our calculation is correct.

### 3.8 WHAT HAVE YOU LEARNT

- Main information related to surveying.
- Classification of surveying
- Apparatus/Equipment used in surveying

- Importance of measurement of angle and levels.
- Words used in survey works.

### **3.9 TERMINAL QUESTIONS**

1. Define surveying and give its classifications.
  2. Give the different classifications of surveying based on the type of equipment used.
  3. What is leveling?
  4. Prepare a chart for finding the levels of different points situated on a piece of land.
  5. Define the following words:
    - a) Intermediate Readings
    - b) Back sight
  6. What is Plane Table Survey and how it is conducted? Describe in brief.
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