1.4 COMPASS SURVEY - BASIC PRINCIPLES

The direction of the survey lines is measured with the help of an instrument known as compass. The direction of survey lines may be defined in two ways: (i) relative to each other, (ii) relative to some reference direction. In the first case, the directions are expressed in terms of angles between two consecutive lines, measured with a theodolite. In the second case, these are expressed in terms of bearings, measured with a compass.

Definitions

Meridian

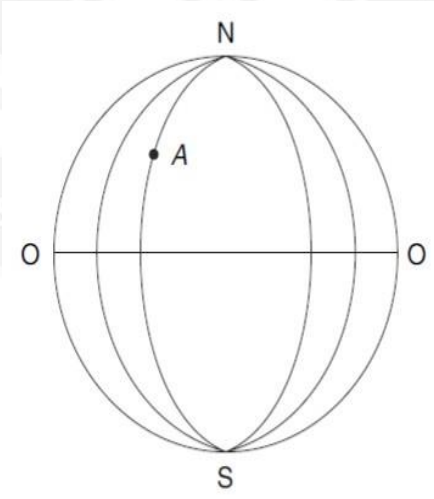
It is the fixed direction in which the bearings of survey lines are expressed.

Bearings.

It is the horizontal angle between the reference meridian and the survey line measured in clockwise or anticlockwise direction. The bearing is described either from north or south and the angle described is either east or west. The bearing of a line is obtained with the aid of whole circle bearing, quadrantal bearing (reduced bearing) and grid bearing (in geodetic survey).

True Meridian:

The true meridian passing through a point on the earth's surface is the line in which a plane passing through the given point (say A) and the geographic (true) north and south poles, intersects the surface of the earth. It represents the true north-south direction at the place.



The True Meridian

True Baring:

The horizontal angle measured clockwise between the true meridian and the line is called true bearing of the line.

Grid meridian

Grid meridian is the reference meridian for a country on a national survey map. The vertical grid lines on a national survey map indicate the direction of grid north. For survey of a country, the true meridian of a central place is regarded as the reference meridian. All the other meridians in the country are assumed to be parallel to the grid meridian.

Grid bearing:

The horizontal angle which a line makes with the grid (central) meridian is called grid bearing.

Magnetic meridian

It is the direction indicated by a freely suspended and balanced magnetic needle unaffected by local attractive forces. The location of the magnetic poles is constantly changing; hence the direction of magnetic meridian also changes. However, the magnetic meridian is employed as a line of reference on rough surveys.

Magnetic bearings:

The horizontal angle which a line makes with the magnetic meridian is called magnetic bearing. It varies with time.

Arbitrary meridian:

It is any convenient direction, usually from a survey station to some well-defined permanent object. The first line of survey at times is also taken as arbitrary meridian.

Arbitrary bearing: The horizontal angle measured with respect to the arbitrary meridian is called arbitrary bearing.

Azimuth:

When survey is done for a large area, i.e., when curvature of earth is accounted for (in geodesy), bearing of lines are sometimes reckoned as azimuth. The azimuth is called geographic if it is reckoned from the geographic meridian, and magnetic, if reckoned from the magnetic meridian in the same manner as that for bearings.

TYPES OF COMPASSES

Surveying compass may be classified as trough compass, tubular compass, prismatic compass and surveyor compass.

Trough compass

It consists of a long magnetic needle in a narrow rectangular box. The needle of trough compass consists of a long, narrow, magnetised bar of steel, pointed at both ends with the usual agate bearing at

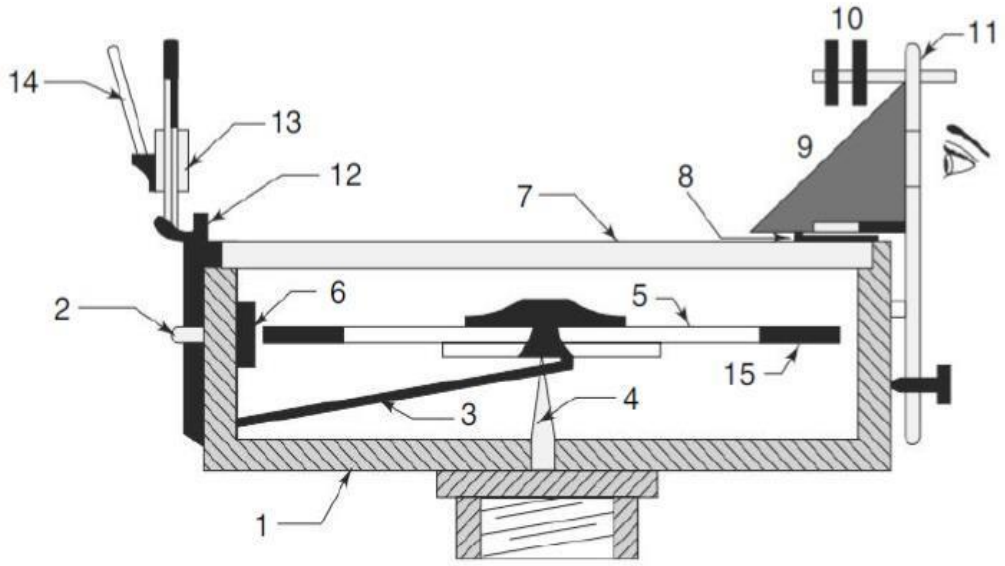
the centre. At each end of the box is a block of metal, on which is engraved a zero line and a very short graduated arc extending about 5° on either side of the zero mark. When it is used in conjunction with a plane table, the

sides of the box are used as a ruler to plot the north direction. When fitted on a theodolite (generally attached by screws to the side of one of the standards), it is used to align the telescope in the meridian.

Tubular compass

A tubular compass is an improved version of a trough compass. In a tubular compass, the magnetic needle is contained in a tube, at one end of which an eye piece and a diaphragm carrying a glass plate with vertical rulings is fitted. This is nearly in the same plane as one end of the needle. The reticule being suitably illuminated by a reflector, the observer on looking through the eye piece, sees the end of the needle without any parallax.

Prismatic Compass



1. Box
2. Braking pin
3. Lifting lever
4. Pivot
5. Needle
6. Spring
7. Glass cover
8. Prism cap
9. Prism
10. Sun glass
11. Eye vane
12. Lifting pin
13. Object vane
14. Mirror
15. Graduated ring

Prismatic Compass

1. It consists of a circular box about 100 mm in diameter.

2. There is a broad magnetic needle balanced on a hard steel pointed pivot (Fig.).

3. An aluminium ring, graduated to degrees and half degrees is attached to the needle. A prism is provided on the observer's side to read the bearing. The ring is graduated from the south end of the needle. The observations run clockwise round to 360° with zero placed at south as shown in Fig. This is

done to facilitate direct reading of the bearings. The figures on the graduated ring are engraved inverted as they are viewed through the prism.

4. When the needle is balanced on the pivot, it orients itself in the magnetic meridian and the north and south ends of the ring face the N–S direction.

5. The object vane carries a vertical hair of fine silk thread attached to a suitable frame.

6. The sight vane consists of a vertical slit cut into the upper assembly of the prism. The two vanes are hinged at the box in diagonally opposite directions.

7. The object vane is sometimes provided with a hinged mirror which can be raised upwards or lowered downwards and can also be slided, if required, to sight the objects too high or too low. Figure 3.4 explains the use of the mirror.

8. Sunglasses are provided on the prism to sight luminous objects. The inverted figures in the graduated ring below the prism can be read erect after being reflected from the hypotenuse side of the prism, when the observer looks horizontally into the prism.

10. The two perpendicular faces of the prism are made convex, so that it also acts as a magnifier.

11. When not in use, the object vane may be folded on the glass lid. It presses against a lever which lifts the needle off the pivot, thus preventing undue wear of the pivot point.

12. Breaking pin, provided at the base of the object vane is used to dampen the oscillations of the needle to facilitate the reading.

13. A prismatic compass reads the whole circle bearing of the lines of objects directly.

SURVEYOR COMPASS

Surveyor compass acquires its name from its extensive use by surveyors. But the prismatic compass has now replaced it as it is light, compact, and handy. It is similar in construction to the prismatic compass except for a few differences as follows:

1. The graduated ring is attached to the circular box and not to the magnetic needle (Fig. 3.5).

2. The edge bar type magnetic needle floats freely over the pivot and is not attached to the ring. When the magnetic needle is lowered to its pivot, it will come to rest pointing north.

3. The eye vane consists of metal vane with a fine sight hole.

4. As the compass box is turned, the letters N, E, S, and W turn with it, but the needle continues to point towards the north and gives a reading which is dependent on the position of the graduated circle.

5. The 0° is placed at both north and south directions and 90° is marked at east and west directions.

6. The east and west markings are interchanged from their normal position as shown in Fig. to read the bearings in the proper quadrant. Suppose the compass is rotated to point N30°30 E. In reading the

bearing, the north end of the needle will be found between the letters N and E or 30°30 from N towards E. If W had been on the left in place of E, as one naturally expects it to be, the north end of the needle would fall between N and W, which might lead to the mistake calling the bearing to be NW instead of NE.