5.1 TOTAL STATION

A total station, also known as electronic tacheometer, is an optical instrument. It is a combination of an electronic theodolite for measuring horizontal and vertical angles, an electromagnetic distance measurement (EDM) device for measurement of slope distances and on-board software to convert the raw observed data to three dimensional coordinates. A total station may determine the actual positions (X, Y, and Z or northing, easting and elevation) of surveyed points, or the position of the instrument from known points, in absolute terms.

The various features of a TCA version total station are shown in Fig. 1. The total station system offers more functionality and greater flexibility for a wider variety of survey applications. The large display is positioned under the telescope to give the user access to much more information at a glance. The keyboard, with its function keys, is easily understood and permits convenient input. Removable data storage, the large battery capacity and on-board application programs ensure that every available facility is contained in one unit. Some of the total station systems also offer the external connection of external data loggers, computers or batteries.

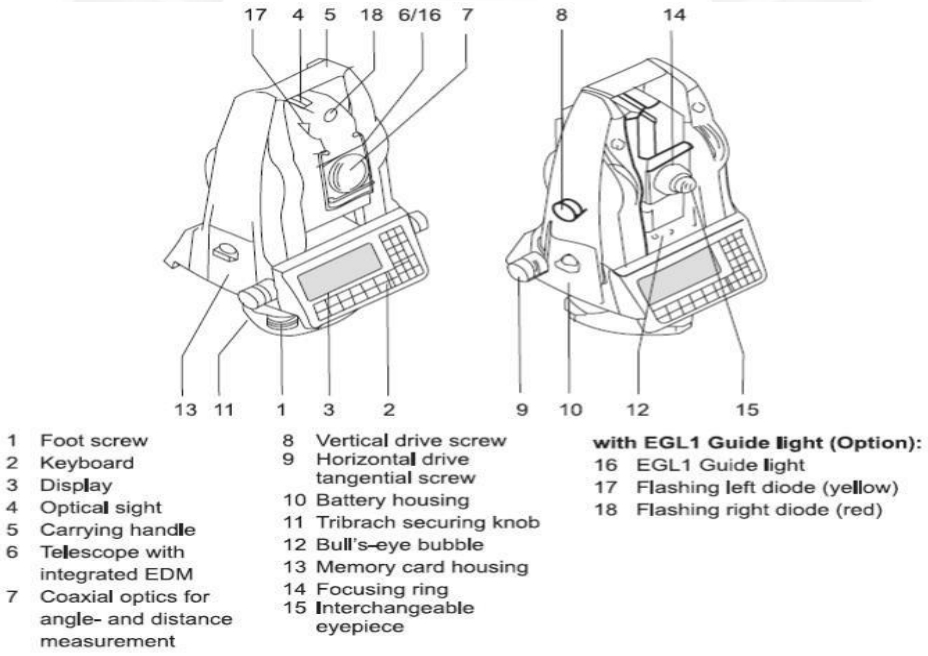

Fig: 1 Features of total station

Distance Measurement

The electromagnetic distance measuring device, measures the distance from the instrument to its target. The EDM sends out an infrared beam which is reflected back to the unit, and the unit uses time measurements to calculate the distance travelled by the beam. Generally, a total station measures a slope distance, and the microprocessor uses the vertical angle recorded by the theodolite along the line of sight to calculate the horizontal distance. In addition, the height distance between the trunnion axis and the prism centre is also calculated and displayed.

All the total stations use coaxial optics in which the EDM transmitter and receiver are combined with the theodolite telescope.

Three modes are usually available for distance measurement:

1. ***Standard Mode:*** It has a resolution of 1 mm and a measurement time of 1 to 2 s.
2. ***Precise or time mode:*** It has a resolution of 1 but a measurement time of3 to 4 s. This is more accurate than the standard mode, since the instrument refines the arithmetic mean value by making repeated measurements.
3. ***Tracking or Fast Mode:*** The distance measurement is repeated automatically at intervals of less than

1. Normally, this mode has a resolution of 10 mm. The range of a total station is typically 1 to 3 km to a single prism assuming good visibility. The precision of a typical total station is 5 mm. The distance readings are automatically corrected for atmospheric effects such as pressure and temperature.

In general, three distance measurement functionalities are available with the total station system, the first being the distance measurement with a reflector (IR-Mode), secondly the distance measurement without a reflector (RL-Mode) and the third being the distance measurement - long range.

ACCESSORIES

1. **Track light or Lumi Guide:** It is a visible light which enables a pole-mounted prism to be set directly on the line of sight. The device flashes three colour lights. If the prism is to the left of the line of sight, a green light flash. If the prism is to the

right, a red light is seen. And if the prism is on line, a white light flashes, the frequency of which doubles when it strikes the prism, confirming that the prism is in the correct position.

2. **Getronics Unicom:** It is a communication system which allows speech to be transmitted from the instrument to the prism. This consists of a small microphone on the control panel which is activated by pressing a key and a receiver with small loudspeaker mounted on the prism pole.
3. **Retroreflector:** A special form of reflector known as corner cube prism, which is pole mounted, is used as a target. These are constructed from glass cubes or blocks, and they return a beam along a path exactly parallel to the incident path over a range of angles of incidence of about 20° to the normal of the front face of the prism. As a result, the alignment is not critical and is quickly set when making observations. Associated with all reflecting prisms is a prism constant. This is the distance between the effective centre of the prism and the plumbing and pivot point of the prism. The effective centre of a prism is normally well behind the physical centre or vertex. A typical prism constant value is - 30 or - 40 mm.

SETTING-UP AND ORIENTING A TOTAL STATION

The process of setting up total station consists of centring it over the station, levelling and orientation. Since the two processes, centring and levelling, influence each other, the process is of trial and error. The step-by-step procedure for setting up is as follows.

Centring

The tripod is placed over the station and its three legs are spread. It is ensured that tripod is at suitable height so that the surveyor can work conveniently when the total station is tightened over its top. One of its legs is placed firmly in the ground and the other two legs are moved radially in or out so as to bring approximately centre of the total station over the station mark. With the laser beam emitted by the total station ensure the centring has been achieved. The laser plummet is located in the standing

axis of the instrument (Fig. 5). If not, slide the instrument over the tripod by loosening it, by the use of tightening screw provided with the tripod plate to achieve exact centring.

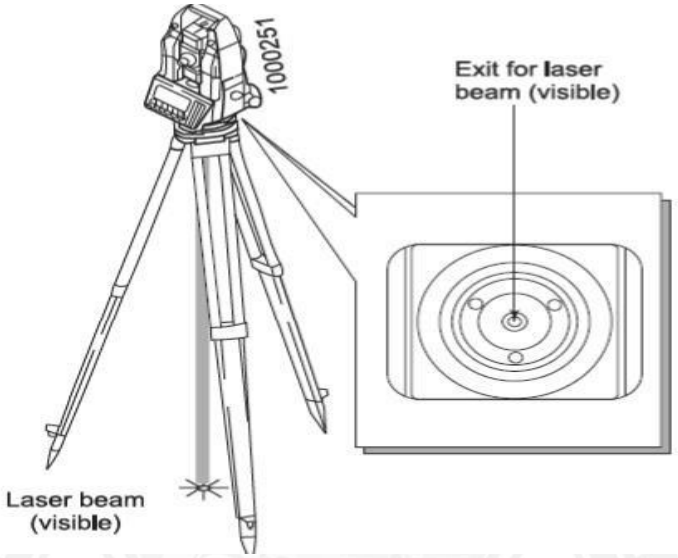

Fig: 5 Centring with laser plummet

LEVELLING-UP

Approximate Levelling-Up

The total station has to be set approximately over the ground reference point using the optical or laser plummet primarily and then it has to be ensured that the tripod legs are firmly placed into the ground. The total station plate has then to be levelled using the tripod legs as shown in Fig. 6. Now, any one of the three legs is moved circumferentially, keeping the other two legs fixed, to bring the bull's eye bubble (Fig. 6) central which is provided over the tribrach. In this process, the centring will get disturbed. A number of trialsmay be required to achieve levelling.

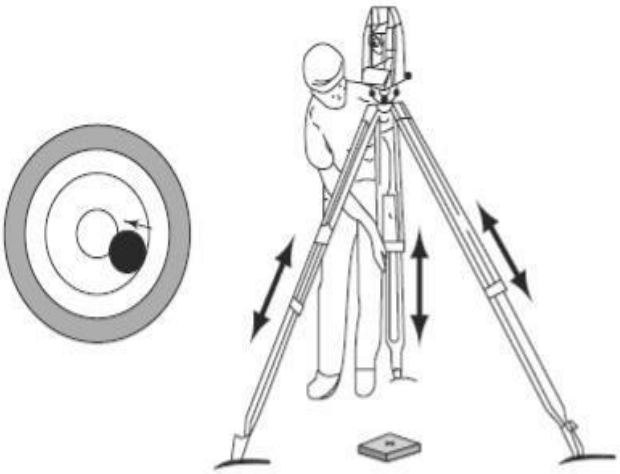

Fig:6 Approximate Levelling up pf a total station

Precision levelling-up

Once the total station is approximately levelled and placed over the station point on the tripod, the system is fine-tuned through the levelling using the electronic bubble with the help of the foot-screws. The steps are portrayed in Fig.7.

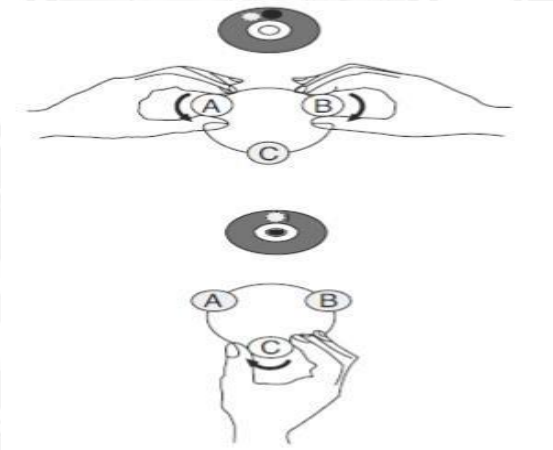

Fig: 7 Precision levelling-up

Orientation

After the instrument has been switched on, the instrument model and software model are briefly displayed. The horizontal circle can be oriented and application programs started. For this first, the coordinates of the station point are set, and the point number of station point is entered. The coordinates of the station is entered directly or is imported from data file of the memory card. The station data consists of point number,

easting, northing, station height and instrument height. Orientation implies fixing line of sight in a particular known direction w.r.t. which measurement of angles or bearings are done.

For traversing by measurement of angles the reference point is back sighted, and the Hz direction is set to 0° 00 00, or a known value is entered. The total station is ready for making the measurements of angles. The total station can also be oriented in north direction with an attachment consisting of a magnetic needle. This facility is available in some of the makes of total station.