TOTAL STATION

The most commonly used surveying instrument today is the total station . A total station is a combination of an electronic theodolite, an electronic distance measuring device (EDM) and a microprocessor with memory unit.

The electronic digital theodolite first introduced in the late 1960s by Carl Zeiss Inc., helped to set the stage for modern field data collection and processing. When the electronic theodolite was used with a built –in electronic distance –measuring unit, the birth of new concept in fully automated surveying started.

The original name for an instrument of this type was electronic tacheometer, but Hewlett-Packard introduced the name total station over 30-years ago and the name immediately caught on with the profession.

With this devices, one can determine angles and distances may be used to calculated the actual positions(X, Y, and Z or nothing, easting and elevation) of surveying points in absolute terms.

The electronic transit provides a digital read-out of those angles instead of a scale, which is more accurate and less prone to errors arising from interpolating between marks on the scale or from recording error. The read-out is also continuous, and hence, angles can be checked at any time.

The EDM instrument transmits an infrared beam, which is reflected back to the unit with the help of a prism (for total internal reflection), and the EDM uses timing measurements to calculated the distance travelled by the beam. With few exceptions, the EDM instrument requires that the target be highly reflective, and a reflecting prism is normally used as the target.

Most of the total stations include data recorders. The raw data (angles and distances) and the co-ordinates of points sighted are recorded along with some additional information (usually codes to aid in relating the co-ordinates to the points surveyed). The data thus recorded can be directly downloaded to a computer at a later time. The use of a data recorder further reduces the recordings errors and eliminates the need for a person to record the data in the field.

At the present, total station is widely used in many survey sites. Sometimes it is not fully used since the users are unaware of its full operational capability. Total indirect leveling. It can maintain considerable accuracy and is hence used for many public works such as construction of roads, airports and harbours.

Advantages of Total Station:

a) Quick setting of the instruments on the tripod using laser plummet.

b) On-board area computing programme to computer the area of the field.

c) Greater accuracy in area computation because of the possibility of taking arcs in area computation.

d) Graphical view of plots and land for quick visualization.

Advantages of Total Station:

e) Coding to do automated mapping. As soon as the field jobs are finished, the map of the area with dimensions is ready after transfer.

f) Enormous plotting and area computation at any user required scale.

g) Integration of database(exporting map to GIS packages)

h) Automation of old maps.

i) Full GIS creation (using Map info software)

j) Local language support.

CONCEPT & APPLICATION OF TOTAL STATION

THE TOTAL STATION is an instrument which consists of the following:

1. Distance measuring instrument (EDM).
2. An angle measuring instrument (Theodolite).
3. A simple microprocessor.

Other Components:

4. Data Collector (built in or separate)
5. Data Storage (internal or external memory card)
6. Battery (internal and/or external)
7. Prisms.

PRINCIPLE: Given the co-ordinate of the instrument position and bearing of a backward station (ordinate) the co-ordinates of any other point can be computed. Total station can be used:

1. When two points are given.
2. When only one co-ordinate is given. in which case the coordinate of the back station is determined by any suitable method.
3. When no co-ordinates were given in which case arbitrary system of coordinates is used.

FUNCTIONS PERFORMED BY TOTAL STATIONS:-

Total Stations, with their micro processors, can perform a variety of functions and computations, depending on how they are programmed. The capabilities vary with different instruments, but some standard computations include:

1. Averaging multiple angle and distance measurements.
2. Correcting electronically measured distances from prism constant, atmospheric pressure, and temperature.
3. Making curvature and refraction corrections to elevations determine by trigonometric leveling.
4. Reducing slope distances to their horizontal and vertical components.

FUNCTIONS PERFORMED BY TOTAL STATIONS:-

5. Calculating point elevations from the vertical distance components (supplemented with keyboard input of instrument and reflector heights).
6. Computing coordinates of survey points from horizontal angle and horizontal distance components.
7. Computes inverses, polar, resections.

OPERATION OF TOTAL STATION: -

Because the Total Station contains delicate electronic components they are not as rugged as ordinary Theodolites. They must be packed and transported carefully, handled gently and carefully removed from their cases.

The setting of Total Station over the station mark is similar to an ordinary Theodolite. This includes:

1. Centering
2. Levelling
3. Removal of parallax

APPLICATIONS OF A TOTAL STATION:

There are many other facilities available, the total station can be used for the following purposes.

1. Control Survey (Traverse).
2. Detail survey i.e., data collection.
3. Height measurement (Remove elevation measurement- REM).
4. Remote distance measurement (RDM) or Missing line measurement (MLM).
5. Fixing of missing pillars (or) Setting out (or) Stake out.
6. Resection.
7. Area calculations, etc.

ACCURACY OF A TOTAL STATION:

Accuracy depending upon the instrument and varies from instrument to instrument.

1. The angular accuracy varies from 1” to 20”
2. Distance accuracy depends upon two factors.
    a) Instrumental error which ranges from +/-10mm to +/-2mm.
    b) Error due to the length of measurement. It can be from +/-10mm to +/-2mm per kilometer.

ACCURACY OF A TOTAL STATION:

Instrument	Angular accuracy	Distance Accuracy			Remarks
		Max distance with 1 prism 2.5-2.7km	2 prisms 5-7 km	3 prisms 10-12 km	Triple the number of prisms double the distance
NIKON	One second	+/-2mm/km or 2ppm			Triple the number of prisms double the distance
LEICA	One second				
SOKKIA	One second				

The sources of error in transit work are :

(1) Instrumental,

(2) Personal, and

(3) Natural.

1. INSTRUMENTAL ERRORS:

i) Error due to imperfect adjustment of plate levels

ii) Error due to line of collimation not being perpendicular to the horizontal axis

iii) Error due to horizontal axis not being perpendicular to the vertical axis

iv) Error due to non-parallelism of the axis of telescope level and line of collimation

v) Error due to imperfect adjustment of the vertical circle vernier

vi) Error due to eccentricity of inner and outer axes

vii) Error due to imperfect graduations

viii) Error due to eccentricity of verniers

2. PERSONAL ERRORS

(a) Errors in manipulation. They include :

(i) Inaccurate centring

(ii) Inaccurate levelling

(iii) Slip

(iv) Manipulating wrong tangent screw

b) Errors in sighting and reading. They include :

(i) Inaccurate bisection of points observed

(ii) Parallax

(iii) Mistakes in setting the vernier, taking the reading and wrong booking of the readings.

3. NATURAL ERRORS

Sources of natural errors are :

(i) Unequal atmospheric refraction due to high temperature.

(ii) Unequal expansion of parts of telescope and circles due to temperature changes.

(iii) Unequal settlement of tripod.

(iv) Wind producing vibrations.

Temporary adjustments:

Temporary adjustment or station adjustments are those, which are made at every instrument setting and preparatory to taking observation with the instrument. The temporary adjustments are: -

(a) Setting over the station.

(b) Levelling up.

1. <u>The operation of setting up includes:</u>

(i) Centering of the instrument over the station mark by plum bob or Optical Plummet.

(ii) Approximate leveling with the help of tripod legs, by moving the leg radially, the plum bob or optical Plummet is shifted in the direction of the leg while by moving the leg side-wise considerable change in the inclination is affected without disturbing the plum bob. The second movement is, therefore, effective in the approximate leveling of the instrument. The approximate leveling is done by eye judgment.

2. **<u>Leveling up</u>:** After having centred and approximately leveled the instrument, accurate leveling is done with the help of foot screws and with reference to plate levels. The purpose of leveling is to make the vertical axis truly vertical.

(i) Turn the upper plate until the axis of the plate level is roughly parallel to a line joining any two of the leveling screws.

(ii) Hold these two leveling screws between the thumb and first finger of each hand and turn them uniformly so that the thumb move either towards each other or away from each other until the bubble is control. It should be noted that the bubble will move in the direction of movement of the left thumb.

(iii) Turn the upper plate through 90°, i.e. until the axis of the level passes over the position of the third leveling screw.

(iv) Turn this leveling screw until the bubble is central.

(v) Return the upper plate through 90° to its original position and repeat step (ii) till the bubble is central.

(vi) Turn back again through 90º and repeat step (iv).

(vii) Now rotate the instrument through 180º. The bubble should remain in the centre of its run, provided it is in correct adjustment.