



A TOTAL STATION

Devashish S. Gulhane¹, Asmita R. Dhole², Shweta V. Gawande³, Shantanu A. Deshmukh⁴

¹Student, Civil, Government Polytechnic Yavatmal, Maharashtra, India, devagulhne124@gmail.com

²Student, Civil, Government Polytechnic Yavatmal, Maharashtra, India, ashmitadhole2000@gmail.com

³Student, Civil, Government Polytechnic Yavatmal, Maharashtra, India, shwtgwnd@gmail.com

⁴Student, Civil, Government Polytechnic Yavatmal, Maharashtra, India, shantanudeshmukh1770@gmail.com

Abstract

Accuracies of real-time kinematic global positioning (RTK-GPS) system, total station and automatic level were investigated. Total station is an instrument that can be qualified as the equipment. Whose accuracy parameter can be tested with the measuring and calculation procedure. Beginning in about 1980, an EDM component, which also had been improved to enable automatic distance measurement, was combined with an electronic theodolite to create a single instrument called as the total station. Total station instrument is used to measure sloping distance of object to the instrument, horizontal angles and vertical angles. It is also integrated with micro-processor electronic data connector and storage system. In this instrument, one example is deformation surveys in mines. Continuous monitoring necessitates sheltering or housing the instrument to protect it against harsh weather conditions that are characteristic of mining environments. Test and analysis were performed at the University of Witwatersrand by setting up a total station permanently in a shelter with removable window glass of different properties. The data collected was subjected to the atmospheric correction formulae proposed by the instrument manufacturer.

Index Term : *cantering, levelling*

1. Introduction:-

A total station is an optical instrument used in modern surveying and archaeology as well as by police, crime scene investigation, private accident reconstructionist and insurance companies to take measurements of scenes. A total station is a modern surveying instrument that integrates an electronic theodolite with an electronic distance meter, which can read slope distance from the instrument to a particular point of land and on-board computer to collect data and perform advanced coordinate-based calculation. Total station instruments combine three basic components: an EDM instrument and electronic digital theodolite and a computer microprocessor into one integral unit. In a total station instrument, the theodolite uses a movable telescope to measure angles in both the horizontal and vertical planes. Traditionally, they are manual instruments that come in two types: transit, which rotates in a full circle in the vertical plane, and non-transit, rotating in half circle. They digitally observe and record horizontal direction, vertical direction, and slope distance, which are adjusted and transformed to local X, Y, and Z coordinates using an internal or external microprocessor. Various geodetic correction and elevation factors can be input and applied. The total station saves the observation or these data may be downloaded to an external data storage.

In total station instruments, angles can be electronically encoded to one arc second. The electronic angle measurement system minimizes some of the horizontal and vertical angle errors that normally occur in conventional instruments. The modern version of survey total stations are called robotic total stations, which can record measurements from a long distance, viz. remote control. This eliminates the need for an assistant staff member as the operator holds the reflector and controls the total station from the observed point.

2. Total Station Instrument:-

The total station was invented in 1980, and it was introduced in 1971 and for the first time distance and angle measurements could be recorded by one instrument. The total station is a transit instrument integrated with an EDM, electronic distance meter component, which also had been improved to enable automatic read-out, was combined with an electronic theodolite to create a single instrument called a total station. The function of the distance and angle measuring components was controlled by an interface computer with the help of modern station instruments. We can measure the slope distance from the instrument to a particular point of land, automatically display the results, and also store the data in the computer memory. Total station is a surveying and

building construction equipment combination of electro magnetic distance measuring instrument and electronic theodolite in conjunction with electronic distance meter (EDM). It also integrated with micro processor, electronic data collector and storage system. The micro processor unit enables for competition of data collected the further calculate the horizontal distance, coordinates of point and reduce level of point. Data collected from total station can be downloaded into computer, laptops, for further processing of information



Fig.1

Fig.2

There is a new advancement in the surveying industry with the addition of the robotic total station, which can record measurements from a long distance via remote control. This eliminates the need for an assistant staff member as the operator holds the reflector and controls the total station from the observe point. He robotic total station also has a microprocessor install which can record measurements in a memory chip and perform any necessary computations and calculations surveyor.

3. Components Of Total Station:-

3.1 Electronic theodolite:

A electronic theodolite is an electronic/optical instrument used for surveying. A theodolite used as a movable telescope to measures angle in both the horizontal and vertical planes. The electronic theodolite is a instrument that comes in two types - Transit, which rotates in a total station instrument used electronic transit theodolites in conjunction with a distance meter to read any slope distance they are hence two essential surveying instrument in one and when used with other technology such as mapping.



Fig.3

3.2 EDM (Electronic distance measurement):-IT is a component of total station which measure the distance

from the instrument to it's target. It is heated inside the telescope of total station. It is help to measuring the distance electronically between two points through electro- magnetic waves it is used to measured the distance rely on propagation, reflection and reception of waves. Now a days use of EDM in civil engineering. Is a widespread that it would be difficult to imagine contemporary site surveying without it. In recent year the rapid development of EDM equipment has enable the surveyor and engineer to measure distance much more easily and to a higher precision than is possible using tapping or optical methods. The EDM sends out an lesser or infrared beam which is reflected back to the unit, and the unit uses velocity measurements to calculate the the distance travelled by the beam.

3.3 MICRO-PROCESSOR: -it is a component of total station which saves the lot of work surveyor. It typically performs the following functions:-

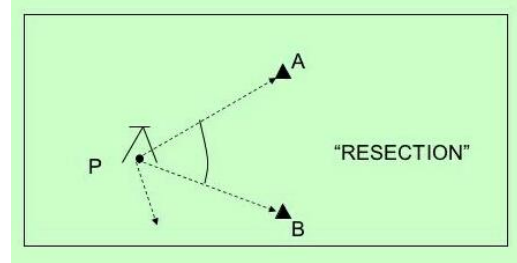


Fig.4

- Average multiple angle measurements .
- Average multiple distance measurements.
- Computes horizontal and vertical distance
- Provides corrections for temperature, pressure and humidity.
- Computes inverse, polars , resections.
- Computes X,Y and Z co-ordinates.

The final piece of the piezle is the electronic display. Basically it's function is to provide a visual of what is happening in total station. Depending on the button press it helps the user navigate to the various menu items. It also enables input of instrument and reflector heights as well as to the store data. It displays horizontal distance, vertical distance, horizontal angles and vertical angle differs in elevation of to observed points and all the three co-ordinates of the observe points(XYZ).

3.4 Leveling the unit:-

Leveling the total station must be accomplished to sufficient accuracy otherwise the instrument will not report result. The electronic level works similar to the bubble level that is found on a typical survey tribrach. You want to have the small leveling circle contained within the cross-hairs of the target circle on the display screen.

The small black foot screw of the tribrach can be used to adjust the level of the unit and move the small leveling circle in to the desired position. The tilt values will also

gets smaller as you get closer to having the unit levelled. When you have the instrument levelled then pressed the F1 function key to continue and this will return you to the main menu.



Fig.5



Fig.6

4. Features of Total Station:-

An electronic theodolite of total station is used to measure angles. Total station can record angles with a resolution between 1 and 20". The highly accurate and reliable angle - measurement system consists of a static line – coded glass circle, which is read by a linear CCD array. A special algorithm determine the exact position of the code lines on the array and determines the precise measurement instantly All the components of the electronic theodolite described in the previous lectures are found total stations.

The axis configuration is identical and comprises the vertical axis, the tilting axis and line of sight (or collimation). The other components include the tribatch with levelling footscrews, the keyboard with display and the telescope which is mounted on the standards and which rotates around the tilting axis.

Levelling is carried out in the same way as for a theodolite by adjusting to centralise a plate level or electronic bubble. The telescope can be transited and used in the face left (or face I) and face right (or face II) positions. Horizontal rotation of the total station about the vertical axis is controlled by a horizontal clamp and tangent screw and rotation of the telescope about the tilting axis

4.1 Angular measurements:-

The axis configuration is identical and comprises the vertical axis and line of sight(or collimation),the highly

accurate and reliable angle measurements system consists of static line –coded glass circle, which is read by a linear CCD array. Most total station instrument measure angles by means of electro-optical scanning of extremely precise digital bar-codes etched on rotating glass cylinders or disc within the instrument. An electronic theodolite of total station is used to measure angles. Total station can record angles with a resolution between 1 and 20". The highly accurate and reliable angle - measurement system consists of a static line – coded glass circle, which is read by a linear CCD array. A special algorithm determine the exact position of the code lines on the other components include the tribatch with levelling foot screws, the keyboard with display and the telescope which is mounted on the standards and which rotates around the tilting axis.

Levelling is carried out in the same way as for a theodolite by adjusting to centralise a plate level or electronic bubble. The telescope can be transited and used in the face left (or face I) and face right (or face II) positions. Horizontal rotation of the total station about the vertical axis is controlled by a horizontal clamp and tangent screw and rotation of the telescope about the tilting axis

4.2 Distance measurement:-

The electromagnetic distance measuring device, measures the distance from the instrument to its target. Electronic distance measuring (EDM) instrument is a major part of total station.the EDM sends out an infrared beam which is reflected back to the unit, and the unit uses time measurement 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 horizontal distance. Its range varies from 2.8 km to 4.2 km. The accuracy of measurement varies from 5 mm to 10 mm per km measurement. They are used with automatic target recognizer. The distance measured is always sloping distance from instrument to the object.

4.3 Data Processing:-

This instrument is provided with an inbuilt microprocessor. The microprocessor averages multiple observations. With the help of slope distance and vertical and horizontal angles measured, when height of axis of instrument and targets are supplied, the microprocessor computes the horizontal distance and X, Y, Z coordinates. The processor is capable of applying temperature and pressure corrections to the measurements, if atmospheric temperature and pressures are supplied . total When data is downloaded from a total station onto a computer, application software can be used to compute results and generate a map of the surveyed area. Some models include internal electronic data storage to record distance, horizontal angle, and

vertical angle measured, while other models are equipped to write these measurements to an external data collector, such as a hand-held computer.

When data is downloaded from a total station onto a computer, application software can be used to compute results and generate a map of the surveyed area. The newest generation of total stations can also show the map on the touch-screen of the instrument immediately after measuring the points.

5. Coordinate measurement:-

The coordinates of an unknown point relative to a known coordinate can be determined using the total station as long as a direct line of sight can be established between the two points. Angles and distances are measured from the total station to points under survey, and the coordinates (X, Y, and Z or easting, northing and elevation) of surveyed points relative to the total station position are calculated using trigonometry and triangulation. To determine an absolute location a Total Station requires line of sight observations and can be set up over a known point or with line of sight to 2 or more points with known location, called Resection (Free Stationing).

For this reason, some total stations also have a Global Navigation Satellite System receiver and do not require a direct line of sight to determine coordinates. However, GNSS measurements may require longer occupation periods and offer relatively poor accuracy in the vertical axis.

6. Advantages of total station:-

It gives more accurate measurements and daily survey information can also be quickly downloaded in to CAD which eliminates data manipulation time required using conventional survey techniques.

It is used for measuring horizontal and vertical angles as well as sloping distances with the help of pressing appropriate keys they are recorded along with point number. It also measure simultaneous calculation of project co-ordinates.

The instrument is capable of adjusting itself to the level position and it gives relatively quick collection of information.

Multiple survey can be performed at one set-up location. It shows the graphical view of land and plots.

7. Disadvantages of total station:-

Vertical elevation accuracy not as accurate as using conventional survey level and rod technique.

Working with total station is not so easy, as more skilled surveyors are required to conduct a total station survey the people who handle the instrument is should have a perfect knowledge of that instrument.

To check the survey work thoroughly it would be necessary to come back to the office and prepare the drawings by using the right software.

Horizontal co-ordinates are calculated on a rectangular grid system. However, the real world should be based on a spheroid and rectangular Co-ordinates must be transformed to geographic co-ordinates if projects are large scale.

The instrument is costlier than other conventional surveying instruments.

8. Precaution to be taken while using a total station :-

Before using the total station, there are some precautions, such as per, construction inspection, equipment loading and unloading, handling and cleaning, generally do the following

1-use both hands to hold the total station handle.

2-set up the tripod as stable as possible.

3-Do not move or carry a tripod with the total station fixed on it, except for cantering.

4-Store the battery pack with the battery discharged.

5-Do not over tighten any of clamp screws.

6-Take maximum care when the tribrach is removed from the total station instruments.

9 .Conclusion:

Total station instruments gives accurate measurements. This instrument gives more clearance and angles, distance, parameter, area etc. Are easily got of the building. In this instrument total station records the data on its built data recorder. According to this data generates map within a friction of time it is easy to work if we compared to other instrument. The total station is highly precision. It is combination of theodolite, electronic distance meter (EDM) ,software running on an external computer etc. Hence , this instrument is advanced technology which is a total station for surveying work. Also time consuming will be less and total station instrument made survey work easy. Maintenance of total station instrument is more. This instrument contain sensitive electronic Assembles which have been well protect against dust and moisture.foe example, traverse through UNCW where the scale factor is changing and the observations are affected by curvature and refraction . The correction should be turned on and a line scale factor should be applied hence, total station instrument is the solution of surveying.

Reference:-

[1] Charles D. Ghilwani , Paul R. Walf - 2008-shipet view.

[2] Dr. S. C. Rangawala, April 2010, surveying 3rd.

[3] George Cole, PE, PLS - 2014.

[4] Dr. H. S. Vishwanath, March 2011, surveying 3rd.

[5] Introduction and simple guide to using the total station., written by Ted Mackinnon and Jonathan Murphy.