Surveying III

Electronic or digital theodolite

. Most accurate instrument designed for the measurement of horizontal and vertical angles upto 10" or 20"

. Also known as universal instrument It consists of a moveable telescope mounted so as it can rotate around horizontal and vertical axies and provide angular readouts (used in night)

Components of electronic theodolite

Telescope.

. The primary optical components of the theodolite consists of eye piece and objective lens.

Levelling bubbles

There are typically two levelling bubbles help to ensure that the theodolite is correctly levelled before taking measurements.

Display panel

Provides a digital readout of the measured angles, distance and other relevant informations It may also include a key board or button

for entering datas and making adjustments.

Data storage and communication.

often have built in memory for storing measurement data. They may also include data tranfer and communication with external device like data collectors or computers.

Battery compartment.

It is typically powered by rechargeable or disposable batteries.

Compass

Some theodolite include a magnetic compass for determining the azimuth or true north direction

EDM (Electronic Distance Measurement)

many modern electronic theodolite come equipped with an EDM unit. which uses electromagnetic waves (infra red or laser) to measure distance accurately.

Tribrach and base plate : Is a mounting device that attaches the theodolite to the tripod or other support. The base plate that connects to the tribrach.

Sighting mechanism : It consists of cross hairs or recticles inside the telescope

Adjustment screw : Used to make fine adjustment to the horizontal and vertical circles. levelling bubbles and other components to ensure accuracy and alignment.

Carrying handle : A carrying handle or handhold is often provided for easy transport

<u>working of digital theodolite</u>

→ The theodolite is made to stand vertically above the survey point with the help of plumb bob or optical plummet.

→ Temporary adjustments are done with the help of internal spirit levels, plumb bob, etc its leg etc

→ After levelling, through the telescope aim the cross hairs at the point to be measured.

→ The horizontal and vertical angles are read from LCD screen.

Uses.

- Mapping application
- Construction industry
- Aligning tunnel
- Mining work
- Measuring magnetic bearing
- Determining the difference in elevation

Temporary adjustments :

- Setting up & centering
- levelling
- focusing the eye piece & objective

Maintenance of EDM instruments

- Do not submerge instrument in water or any other chemicals
- Do not drop the instrument
- Make sure theodolite is locked in its case while transporting.
- When raining use cover over the instrument.
- Do not look directly into the sunlight through the telescope or the instrument.
- Never hold the instrument by the telescope.
- Always clean the instrument after using

- When storing make sure that the telescope on the instrument is in the vertical position.
- Using a wooden tripod can protect the instrument from vibrations better than an aluminium tripod.

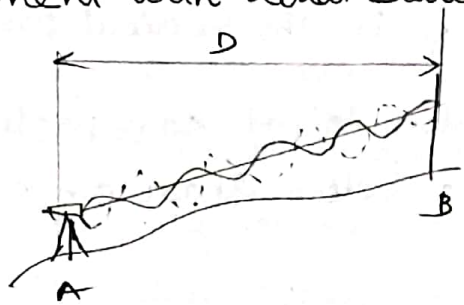
Total station

→ was introduced in 1971
→ Combination of EDM and electronic theodolite.
→ Also integrated with microprocessor, electronic data collector and storage system.
→ Total station can be used to measure
Horizontal angles
Vertical angles
Sloping distance and coordinates

Advantages of total station

1. Field works is carried out very fast.
2. Accuracy of measurement is high
3. Manual errors involved in reading and recording are eliminated.
4. Computers can be employed for map making and plotting contours and cross sections.
5. Contours intervals and scales can be changed in no time.
6. can be used at day and night

Measurement with total station



- Total station measures the distance between the ~~instrum~~ instrument and target.
- Slope distance gets converted to horizontal and vertical distance.

Distance measurements.

- EDM is a major part of total station.
- Its range varies from 2.8 km to 4.2 km.
- The accuracy 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 the instrument to the object.

ANGLE MEASUREMENTS

→ The electronic theodolite part of total station is used for measuring vertical and horizontal angle.

→ For measurement of horizontal angles any convenient direction may be taken as reference direction

→ For vertical angle measurement vertical upward direction is taken as reference direction.

→ The accuracy of angle measurement varies from 2 to 6 seconds.

EDM.

→ Measurements of distance is with a modulated microwave of infrared carrier signal.

→ Generated by a small emitter within the instrument optical path and reflected by a prism reflector.

→ Returning signals is read and interpreted by the onboard computer in the total station.

{ Generation of waves, propogation, reflection and reception }

→ Distance is determined by emitting and receiving multiple frequencies

→ Determine the number of wavelengths to the target for each frequency

→ Distance displayed in the screen.

$$D = n\lambda + \Delta\lambda$$

n = number of complete wavelength.

λ = wave length

$\Delta\lambda$ = fractional wavelength.

Distance range = 100 km.

Accuracy 1 in 100000

Types of EDM

- Geodimeter
- Tellurometer
- Distomat.

Parts of ~~theodolite~~ Total station

Electronic theodolite
EDM
Data collector.
Microprocessor (recording, reading & fundamental calculations of measurements)
Display unit
Software
Prism
Optical plummet.
Electronic note book and different menus.
(Data storage)

Least count of total station

Angle 1 second

Distance 1mm.

Capacity of total station

2000 – 4000 points data

Disadvantages:

1. Easily broken
2. Can't measure spherical co-ordinates
3. Instrument is costly
4. Skilled persons are required

Operations of total station:

→ Instrument is mounted on tripod, levelled by levelling screws.
→ within a small range instrument is capable of adjusting itself to the levelling position.
→ It is possible to set required units (FPS or SI)
→ When target is sighted horizontal and vertical angles sloping distances are measured by pressing appropriated keys. (measured directly).
→ Processor. Computes various informations about the point and displays on the screen

→ This information is also stored in electronic note book

→ At the end of the day the point data downloaded to the computer can be used for further processing.

→ There are softwares like auto civil and autoplotter clubbed with auto.CAD which can be used for plotting contours at any specified interval and for plotting contours at any specified interval and for plotting cross section along any specified line.

Errors in total station

(1). Tilting axis error :- Tilting axis is not perpendicular to vertical axis (eliminated by two face measurement)

(2) Horizontal collimation error / line of sight error. Line of sight not perpendicular to vertical axis. eliminated by observing on two faces.

(3) Vertical collimation error :- angles from 0° to 180° in the vertical circle doesnot coincide with the vertical axis of the instrument (eliminated by two face measurements)

(4) Compensation index error : error due to improper setting centering and levelling (elimination - instrument is fitted with a compensator, it will measure the residual tilts of the instrument and will apply corrections to the horizontal and vertical angles for these

(6) Zero error : constant errors in all linear measurements.

(6) Slip error : error induced when instrument is not firmly held on tripod head.

Applications of total station

> contours and detailed mapping
> Remote object elevation.
> Setting out and construction work
> mining
> Archeological investigations.

Principle of total station:

The basic principle of the total station is that the distance between any two points can be known once the velocity and the time taken by the light to travel are known. 'Distance = Velocity × time'

Devices used to transfer data.

USB flash device or USB sticks.

DMA → Direct memory access is a method to transfer data between the device and computer memory.

Prism mode in total station.

The total station sends out invisible infrared waves that reflected by the prism, which is typically attached to a pole.

By measuring the prism's position and knowing the precise angle and distance to that prism the total station calculate the prisms location and coordinates

non prism mode in total station

It enables to use in place where is difficult to place prism directly such as heavy trafic or difficult to go in