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Department of Civil Engineering

IV SEMESTER

(ADVANCED SURVEYING 16CV42)

CLASS NOTES ON

UNIT - II

"TOTAL STATION"

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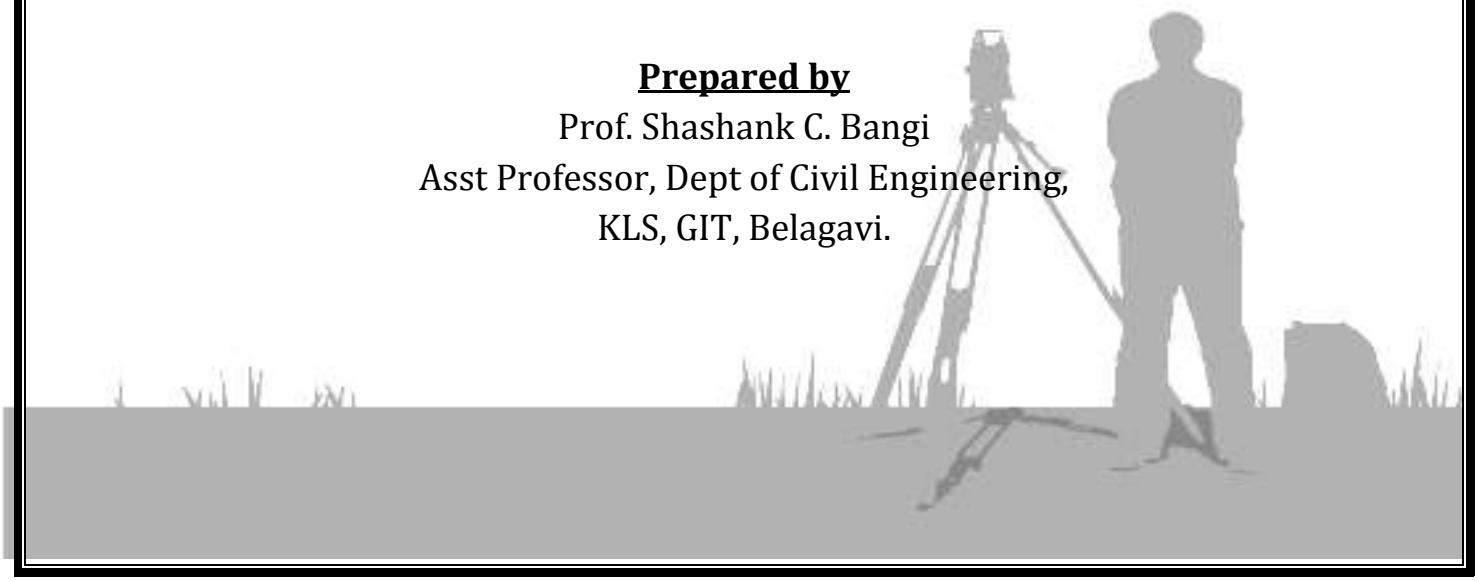


Introduction to Total Station

Definition:

The Total Station is an electronic digital instrument consisting of the following :-

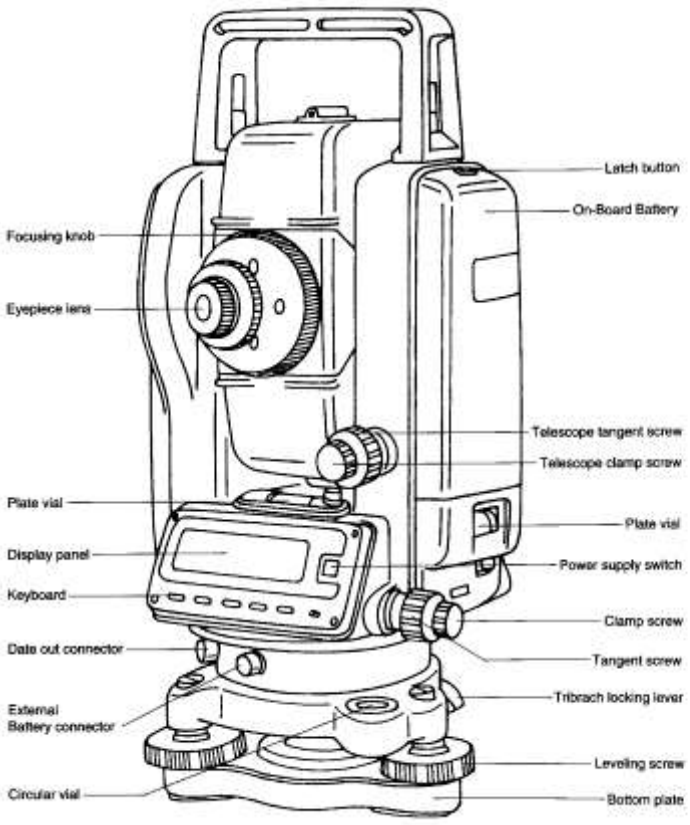
a) Distance measuring device (EDM).

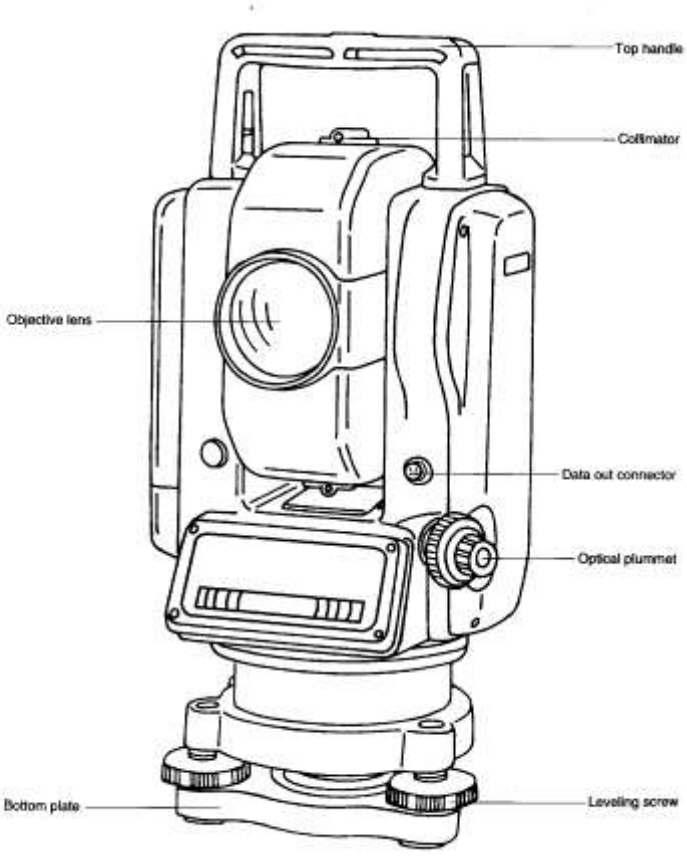
b) Angle measuring device (Theodolite).

c) An inbuilt micro processor device with suitable software loaded in it.

d) The instrument has also a Memory Card to store the field data.

Parts of Total station:





WORKING PRINCIPLE OF TOTAL STATION:-

With known co-ordinate of the instrument position and a known bearing of back station or North direction, the co-ordinates of any other point can be computed from Total Station observation.

To start with Total Station, the essential requirements are:-

a) When two points are known.

b) When only one point is known, the bearing of back station is also known.

c) When no co-ordinates were given in which case arbitrary system of coordinates is used.

- These devices, also called electronic Tachometers, can automatically measure horizontal and vertical angles as well as slope distances from a single set up. From these data they can instantaneously compute horizontal and vertical distance components, elevations, and coordinates, and display the results on LCD. They can also store the data, either on board or in external data collectors. If the coordinates of the occupied station and a reference azimuth are input to the system, the coordinates of the sighted point are immediately obtained. This information can be directly stored in an automatic data collector, thereby eliminating manual recording. These instruments are of tremendous value in all types of surveying. Total Stations offer many advantages for almost all types of surveying. They are used for topographic, Hydrographic, cadastral, project and construction surveys.
- The EDM instrument component installed in a Total Station is relatively small but still has distance ranges adequate for most work. Lengths about 2.5 km can be measured with a single prism, and about 5 to 7 km with two prisms and 10-12 km with three prisms.

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:

- Averaging multiple angle and distance measurements.
- Correcting electronically measured distances from prism constant, atmospheric pressure, and temperature.
- Making curvature and refraction corrections to elevations determine by trigonometric levelling.
- Reducing slope distances to their horizontal and vertical components.
- Calculating point elevations from the vertical distance components (supplemented with keyboard input of instrument and reflector heights).
- Computing coordinates of survey points from horizontal angle and horizontal distance.

In Short:

- **Averages** multiple **angle** measurements.
- **Averages** multiple **distance** measurements.
- Computes **horizontal** and **vertical distances.**
- **Corrections** for temp, pressure and humidity.
- **Computes** inverses, polars, resections.
- **Computes** X, Y and Z **coordinates.**

OPERATION OF TOTAL STATION:

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

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

1. Centering
2. Leveling
3. Removal of parallax

1. Centering:

Setting up the total station over a ground point

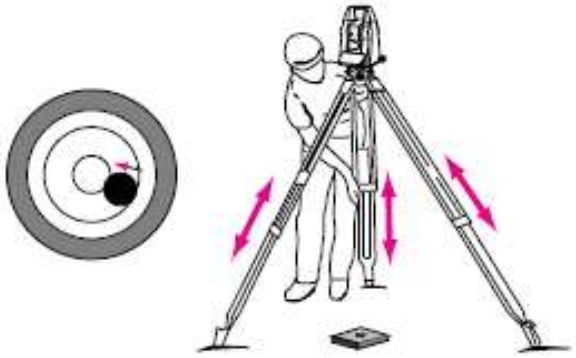
1. Place the tripod approximately over the ground/station point.

2. Inspect the tripod from various sides and correct its position so that the tripod plate is roughly horizontal and above the ground point.

3. Push the tripod legs firmly into the ground and use the central fixing screw to secure the instrument on the tripod.

4. Switch on the laser plummet (or, for older instruments, look through the optical plummet) and turn the foot screws so that the laser dot or the optical plummet is centered on the ground point.

5. Centre the bull's-eye bubble by adjusting the lengths of the tripod legs.



6. After accurately leveling up the instrument, release the central fixing screw so that you can displace it on the tripod plate until the laser dot is centered precisely over the ground point.

7. Tighten the central fixing screw again.

2. Leveling

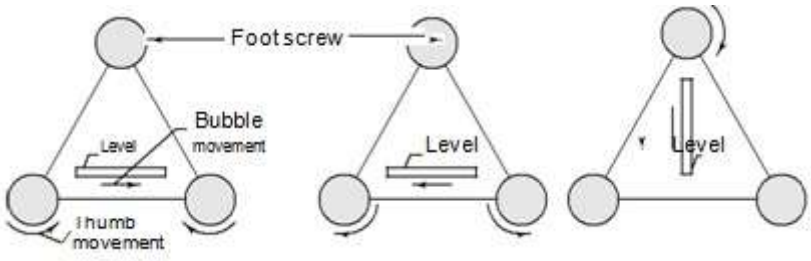
Levelling-up the instrument

a. After setting up the instrument, level it up approximately with the bull's-eye bubble.

b. Bring the bubble tube parallel to line joining any two foot screw and Turn two of the foot screws together either towards inwards or outwards until bubble come at center of its run.

c. Rotate the instrument by 90° and use the third foot screw to centre the bubble

d. To check, rotate the instrument 90°. Afterwards, the bubble should remain at the centre.



3. Elimination of Parallax

To obtain the clear reading, the image formed by the objective lens should fall in the plane of diaphragm and the focus of eye-piece should also be at the plane of diaphragm. This is being carried out by removing parallax by proper focusing of objective and eye-piece. Thus, focusing operation involves two steps:

Focusing of eye-piece:

For focusing of the eye piece, point the telescope to the sky or hold a piece of white paper in front of telescope. Move the eye-piece in and out until a distinct sharp black image of the cross-hairs is seen. This confirms proper focusing.

Focusing of object glass:

It is done for each independent observation to bring the image of the object in the plane of cross hairs. It includes following steps of operation: First, direct the telescope towards the object for observation. Next, turn the focusing screw until the image of the object appears clear and sharp as the observer looks through properly focused eye-piece. If focusing has been done properly, there will be no parallax i.e., there will be no apparent movement of the image relative to the cross hairs if the observer moves his eye from one side to the other or from top to bottom.

File Manager:

A file manager or file browser is a computer program that provides a user interface to manage files and folders. The most common operations performed on files or groups of files include creating, opening (e.g. viewing, playing, editing or printing), renaming, moving or copying, deleting and searching for files, as well as modifying file attributes, properties and file permissions.

Components and Functions of file manager

- **Job Creating:** Job creating function is used to create new file in total station so that all data obtained from measuring can save to current measurement file.
- **Selecting:** This function is used to select a particular file to work on it.
- **Storing:** This function is used to store measured data (in N, E, Z format) in selected file so that later data can be transfer to computer and processed according to the requirement of project.
- **View and editing:** This function is used to view and edit measurement data in selected file. This function is very helpful to correct the mistakes done by the operator and to view real time measured data.
- **Deletion:** This function is used to delete measured data stored in particular file and also this function can be used to delete entire file.

Applications of 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).
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

1. Control Survey (Traverse).

- In traverse a number of connected survey lines form a framework of survey.
- The direction and length of survey lines are measured with the help of an angular measuring device (Theodolite) and distance measuring device (Tape, chain, EDM, GPS etc.).

Application of Traverse

- Providing control points for large scale surveys.
- Boundary surveys
- Fixing route of a river, road, canal accurately.
- Project surveys.
- Alignment surveys and many more.
- True North i.e. Meridian line
- Grid North line
- Magnetic North line
- Any arbitrary reference line.

2. Detail Survey

Given two points whose coordinates are known, a total station can be used to get the coordinates of various other points based upon those two co-ordinates. Care should be taken that the new points survey are carefully coded. The Map of the area can be obtained after downloading and processing.

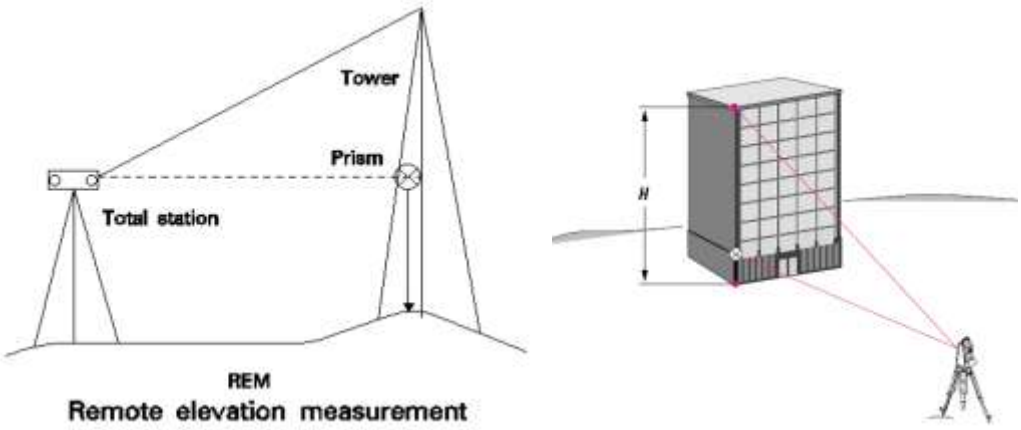
3. Remote Elevation Measurement (REM)

The process of finding the height of objects without actually going to the top of the object is known as Remote Elevation Measuring (REM) i.e., a total station placed remotely (faraway) from the object is used to measure the heights.

Method: The prism is kept at the base of the object sight the telescope to the prism, and measure the slope distance 'd', now tilt the telescope up-to the tip of the object. The height of the object is displayed, from the bottom of the prism depending upon the instrument.

This feature measures the elevation of a point where a prism cannot be placed directly. The measurement is extended along the plumb line while the elevation is continuously displayed.

There are two modes for REM measurement: with TH and without TH. You can select with TH mode when you need the altitude from ground to target , otherwise without TH when you need the altitude from any reference point to target .

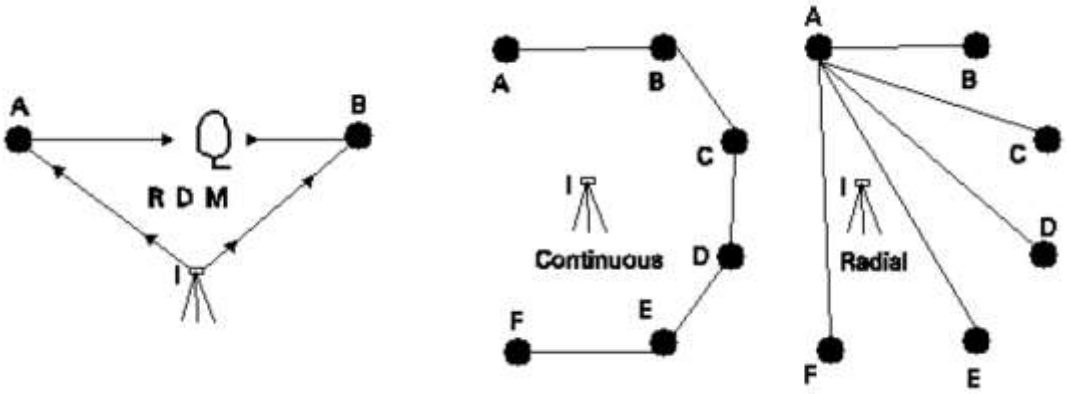


4. Remote Distance Measurement (RDM) or Missing Line Measurement (MLM):

The process of finding the distance between two points A & B (which are not inter-visible from each other) from another point 'I' (instrument position) is known as RDM.

This method is very useful for finding distances between two points which has an obstruction between them. It is of two types:

- Continuous
- Radial



Distances can be obtained either in the **continuous mode** i.e., AB, BC,CD, DE,EF etc., or in the **radial mode** i.e., AB,AC,AD,AE,AF etc., however, the field procedure is same for both only the selection of operation varies. This is required when there are obstructions in between survey line.

5. Fixing of Missing Pillars (or) Setting Out (or) Stake Out:

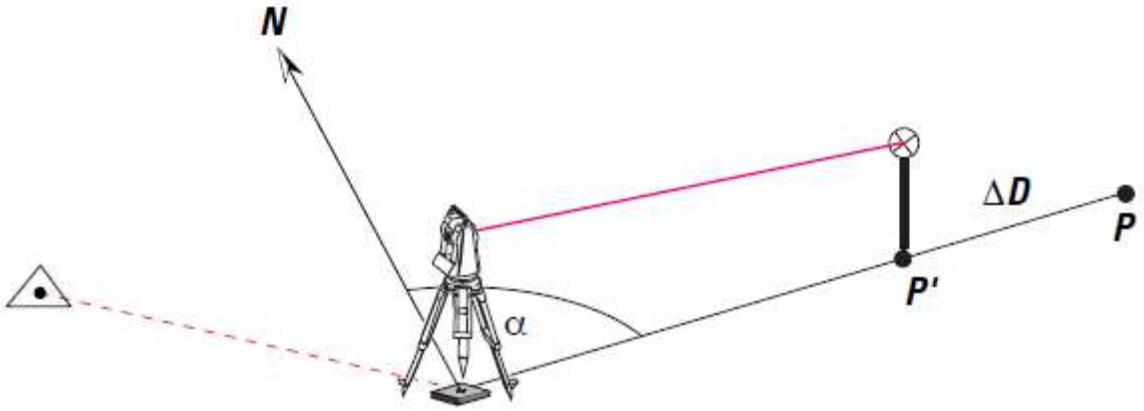
The process of fixing missing pillars on the ground using its theoretical coordinates is known as STAKE OUT. Here two other known coordinates are required.

- Process of finding the positions of known coordinates points e.g. missing boundary pillars.

Procedure:

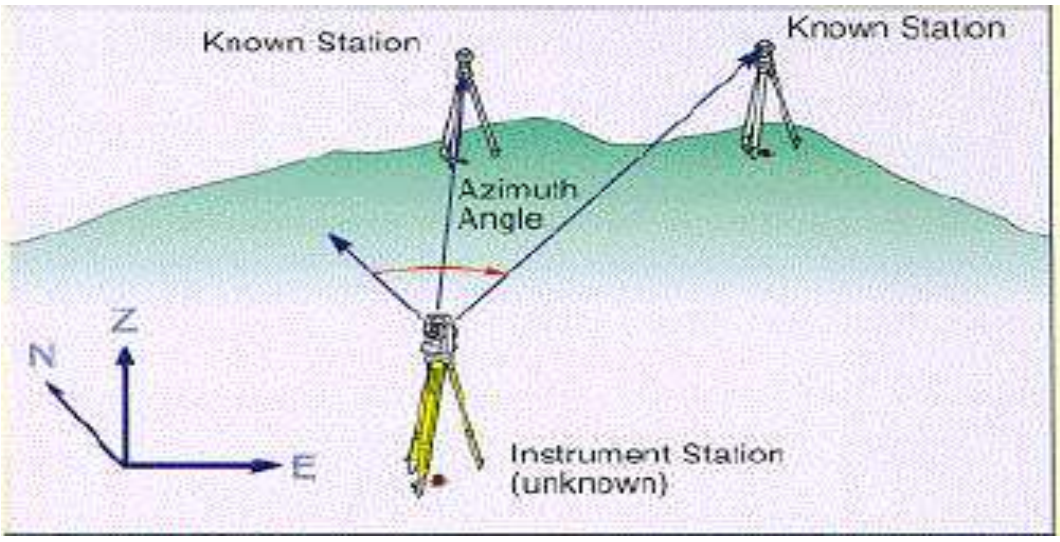
1. Set up the instrument at a known point and position
2. Enter manually the coordinates of the point to be staked out. The program automatically calculates direction and distance (the two parameters needed for staking out).
3. Turn the total station until the horizontal circle reads zero.
4. Position the reflector at this point (point P').
5. Measure the distance; the difference in the distance ΔD to the point P will be displayed automatically.

Alternatively, the coordinates of the points to be staked out can be transferred beforehand, back in the office, from the computer to the total station. Under these circumstances, in order to stake out, only the point number then needs to be entered.



6. Resection:

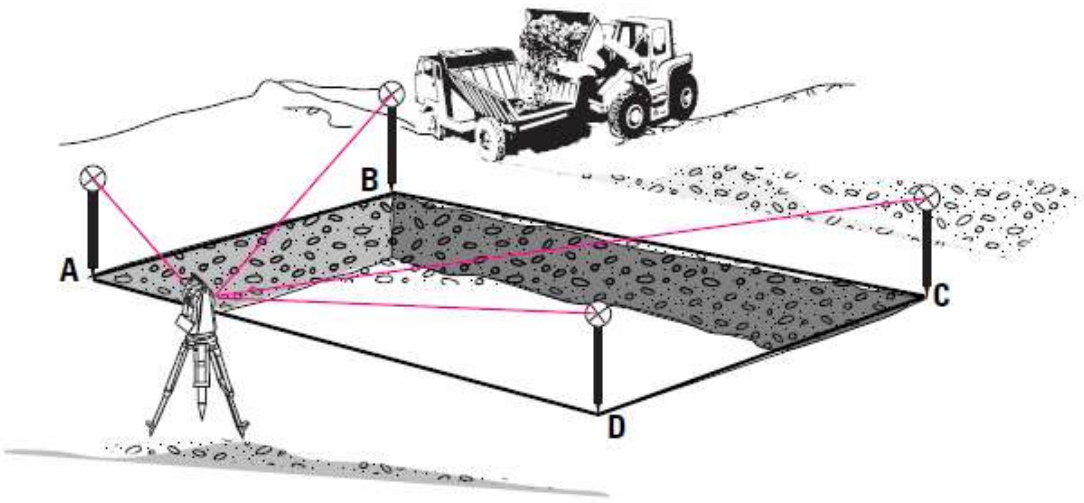
The process of finding the coordinate of the instrument position making use of other control points (points whose coordinates are known) is known as RESECTION.



7. Area measurement

Area can be computed of any figure just by giving the coordinates of the corners of the figure

1. Set up the total station in the terrain so that it is within view of the entire area to be surveyed. It is not necessary to position the horizontal circle.
2. Determine the boundary points of the area sequentially in the clockwise direction. You must always measure a distance.
3. Afterwards, the area is calculated automatically at the touch of a button and is displayed.



Data Collection and Transfer:

Measurements can be stored "on board" with all the total stations. The two options that are available are

- Data can be stored directly in the memory of the microcomputer, and later downloaded to an external storage device via a USB connection.
- The second option is the removable memory card. When one card is full, it can be removed and another card can be quickly installed.

USES OF TOTAL STATION

The uses of Total Station are as follows:

- Mine Survey
- Cadastral Survey
- Engineering Survey
- Large Scale Survey
- Road / Rail / Canal Survey
- Large scale surveys and mapping for planners
- Updating mapping
- Topographic survey
- Hydrographic survey
- Project construction survey

Advantages of Using Total Stations

The following are some of the **major advantages of using total station** over the conventional surveying instruments:

1. Field work is carried out very fast.
2. Accuracy of measurement is high.
3. Manual errors involved in reading and recording are eliminated.
4. Calculation of coordinates is very fast and accurate. Even corrections for temperature and pressure are automatically made.
5. Computers can be employed for map making and plotting contour and cross-sections. Contour intervals and scales can be changed in no time.

Question bank for total station:

1. What are the functions of file manager in Total station? Explain in detail.
2. What are the functions performed by total station?
3. Explain the working principle of total station.
4. What are the temporary adjustments of Total station? Explain in detail
5. What is Total station? And what are the applications of total station? Explain in detail.
6. What is Remote Elevation Method (REM)? Explain the procedure of REM with neat sketch.
7. What is Missing Line Measurement (MLM)? Explain the procedure of MLM with neat sketch.
8. What is Stake out? Explain the procedure of stake out with neat sketch.
9. List out the uses of Total station
10. Mention the major advantages of using total station over the conventional surveying instruments

Question bank for Transition curve and vertical curve:

1. What is transition curve? Why and where these curves are provided? List the functions of transition curve.
2. List the functions and requirements of transition curve
3. How would you determine the length of transition curve
4. What are the different types of transition curve? Explain each in detail with neat sketch.
5. What are vertical curves and where are they used?
6. Why vertical curves provided on highways? List the different types of vertical curves with neat sketches.
7. Explain the method of calculation of length of vertical curve.