



**Al-Mustaqbal University College
Department of Building &
Construction Technology
Engineering**



Theodolites , Principle of Construction

Applied Surveying

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THEODOLITE

- **What is Theodolite?**
 - Use of Theodolite
 - Theodolite Terminology مصطلح

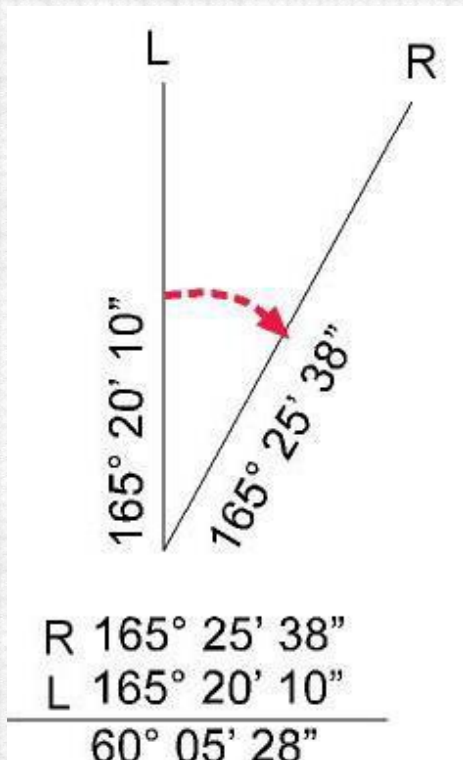
THEODOLITE

- **(Types of Theodolites According to Construction)**
 - Optical-Mechanical Theodolites بصري
 - Electronic Theodolites

- **Types of Theodolites According to Accuracy**
 - Construction Theodolite '1
 - Tacheometry "1
 - Precise Theodolite "0.2

What is Theodolite?

A surveying instrument and precision instrument for measuring angles in the horizontal and vertical planes.

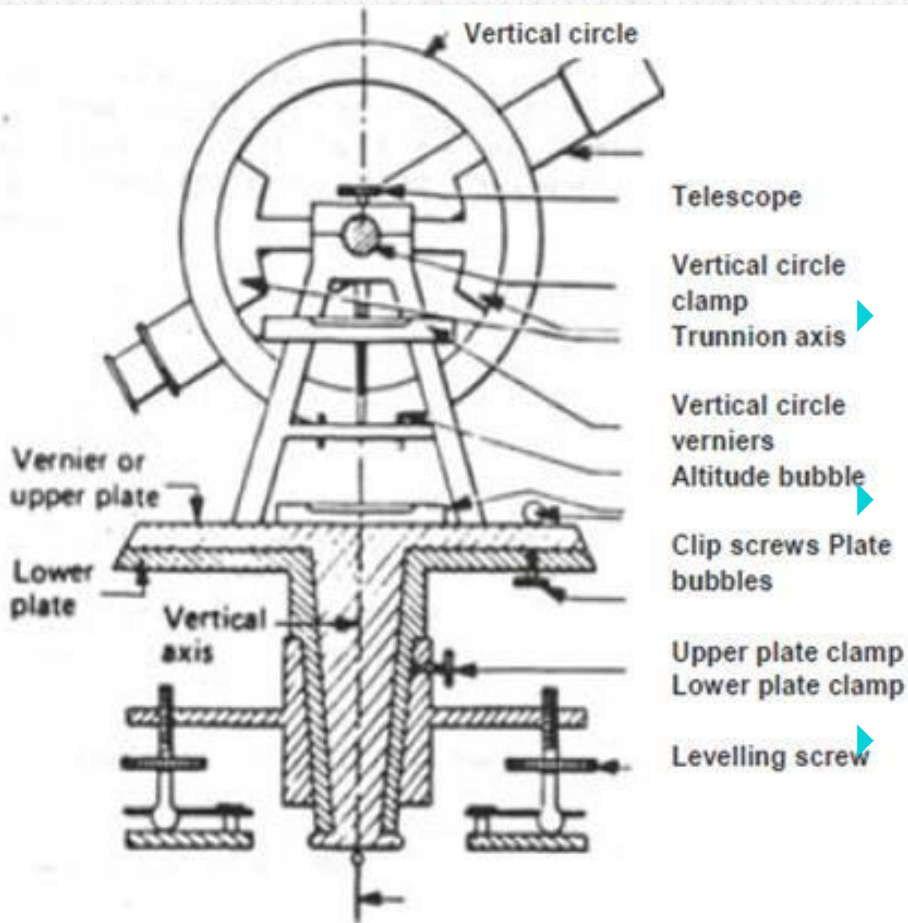


Uses of Theodolite

Use of theodolite;

- ▶ Mapping applications and in the construction industry...
- ▶ Measurement of Horizontal and vertical angle
- ▶ Measurement of magnetic bearing of lines
- ▶ Locating points on line
- ▶ Prolonging survey lines
- ▶ Determining difference in elevation
- ▶ Setting out curves
- ▶ Aligning tunnels
- ▶ Mining works etc.

Main Components



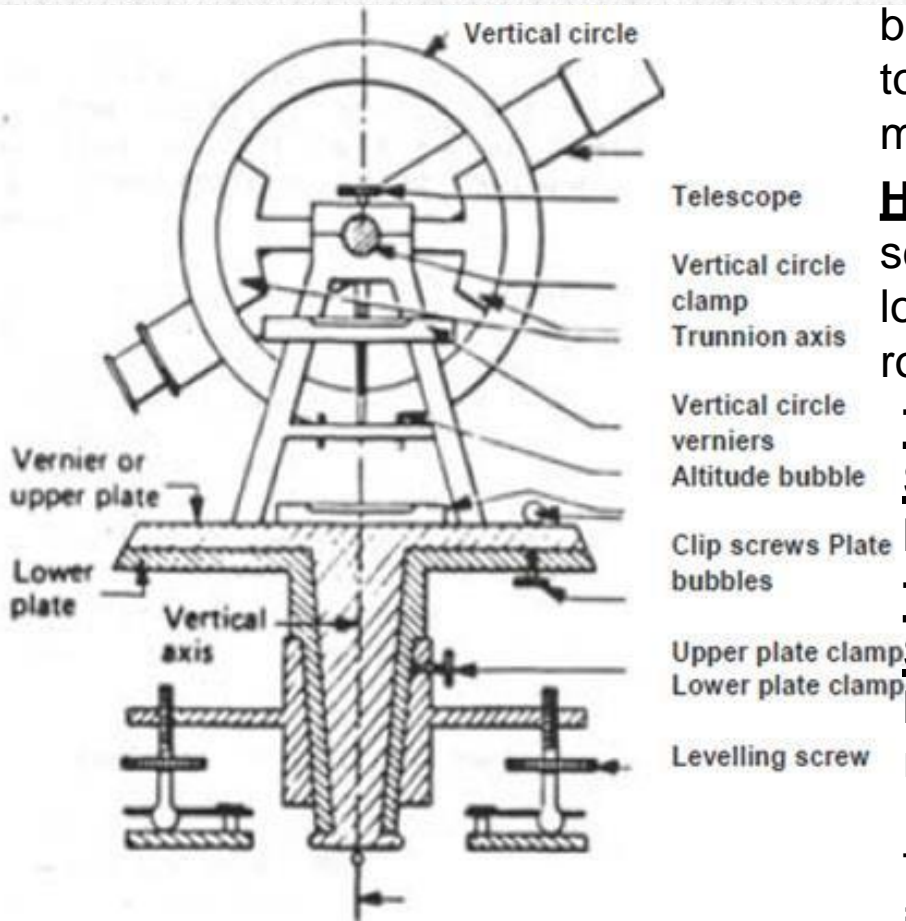
- ▶ **Upper Plate:** It is the base on which the standards and vertical circle are placed. For the instrument to be in correct adjustment it is necessary that the upper plate must be perpendicular to the alidade axis and parallel to the trunnion axis.

▶ **Telescope:** It has the same features as in a level graticule with eyepiece and internal focussing for the telescope itself.

▶ **Vertical Scale (Circle):** It is a full 400g scale. It is used to measure the angle between the line of sight (collimation axis) of the telescope and the vertical axis.

▶ **Vertical Clamp and Tangent Screw :** This allow free transiting of the telescope. When clamped, the telescope can be slowly transited using vertical tangent screw.

Main Components



The Lower Plate: It is the base of the whole instrument. It houses the foot screws and the bearing for the vertical axis. It is rigidly attached to the tripod mounting assembly and does not move.

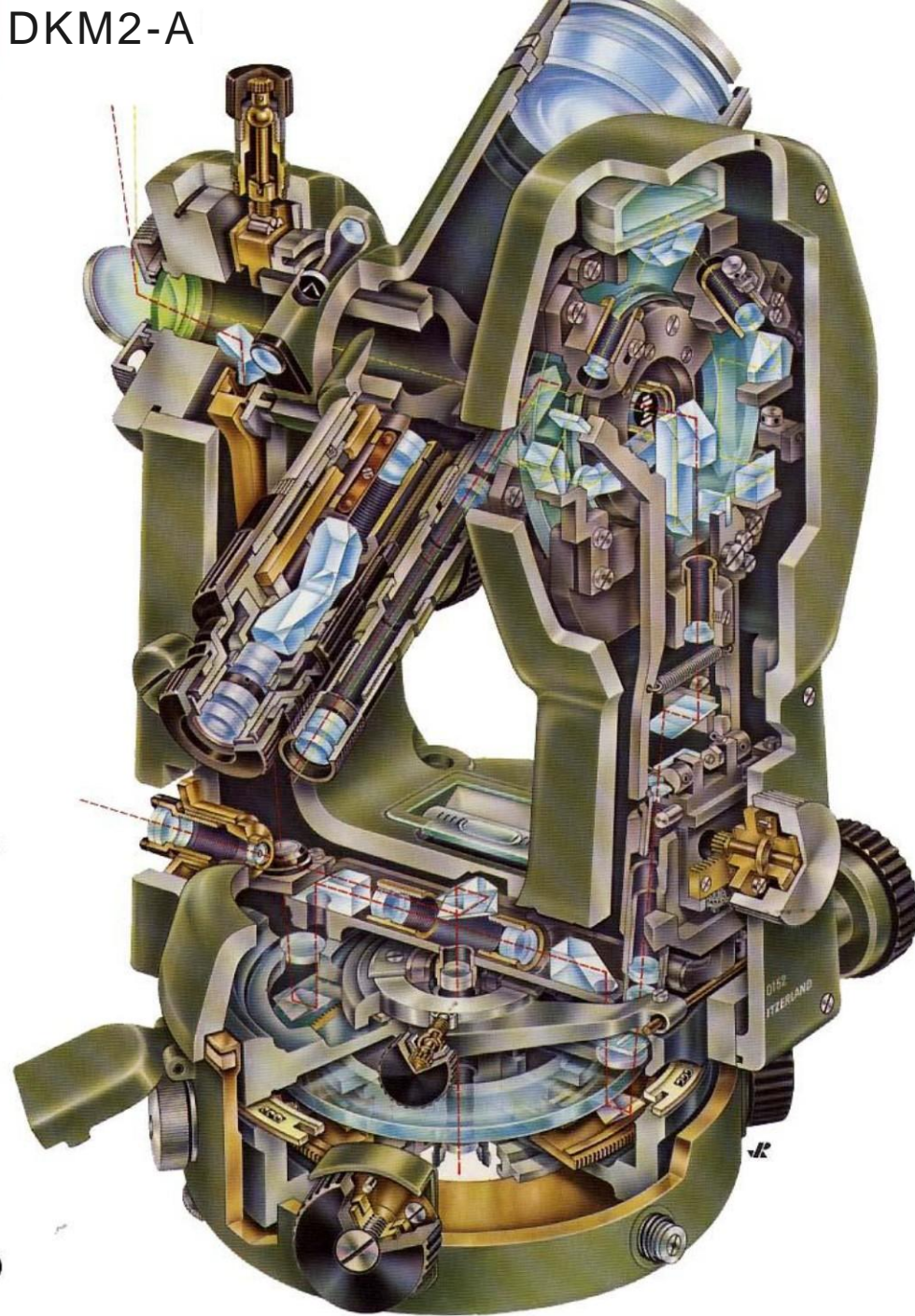
Horizontal Scale (Circle): It is a full 400g scale. It is often placed between the upper and lower plates. It is capable of full independent rotation about the trunnion axis.

The Upper Horizontal Clamp and Tangent Screw: used during a sequence or “round” of horizontal angle measurements.

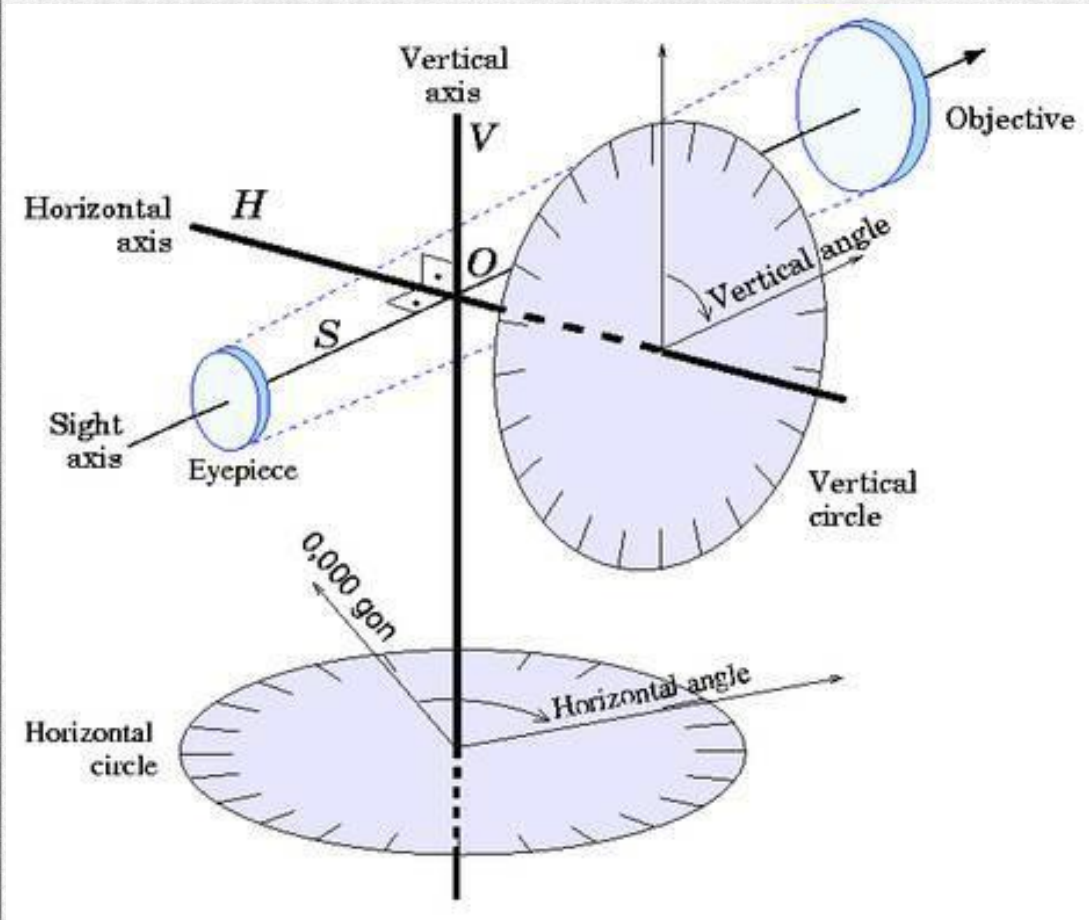
The Lower Horizontal Clamp and Tangent Screw: These must only be used at the start of horizontal angle measurements to set the first reading to zero.

Circle Reading and Optical Micrometer: The vertical and horizontal circles require illumination in order to read them. This is usually provided by small circular mirrors

DKM2-A



Axes of Theodolite



V - Vertical axis

S – Sight axis, collimation axis

H – horizontal axis
(telescope rotary axis)

L – level axis
(the alidade axis)

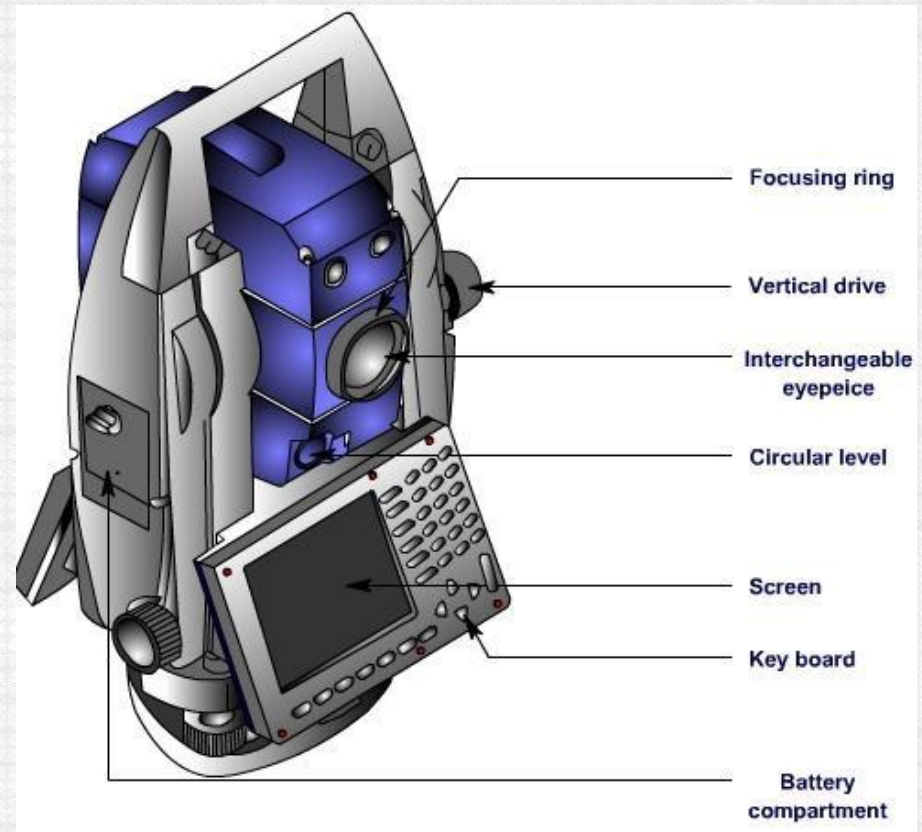
Digital Theodolite



- Provides the value of observation directly in viewing panel.
- The precision of this type of instrument varies in the order of 1" to 10".

Digital Theodolite

- All the parameters required to be observed during surveying can be obtained.
- The value of observation gets displayed in a viewing panel.
- The precision of this type of instrument varies in the order of 0.1" to 10".



Digital Theodolite

- ▶ The important features of total station are:
 - **Key-board**: Control all the functions are controlled by operating key board.
 - **Digital panel**: Displays the values of distance, angle, height and the co-ordinates of the observed point, where the reflector (target) is kept.
 - **Remote height object**: The heights of some inaccessible objects such as towers can be read directly. The micro-processor provided in the instrument applies the correction for earth's curvature and mean refraction, automatically.
 - **Traversing program**: The co-ordinates of the reflector and the angle or bearing on the reflector can be stored and can be recalled for next set up of instrument.
 - **Setting out for distance, direction and height** : Whenever a particular direction and horizontal distance is to be entered for the purpose of locating the point on the ground using a target, then the instrument displays the angle through which the theodolite has to be turned and the distance by which the reflector should move.

Comparision of theodolite and Total Station

Theodolite and Total Station are land-surveying instruments used to deduce information about the plot under consideration for construction buildings, bridges, roads, highways, dams, etc

A Theodolite specializes in angle measurements (horizontal and vertical) to the precision of degree

Total station on the other hand, is a multipurpose surveying instrument based on electronic distance measurement (EDM). They can measure distance, angles, and elevations with a high level of precision

Theodolites can only measure angles, have a minimum range of about less than a kilometer and are less precise when compared to Total station, also less expensive than total station

Total station on the other hand can measure different data rather than just angles. They have a minimum range of about 1 km and are very precise. They are hence obviously expensive when compared to theodolites

Modern Surveying Instruments

There are four basic types of this surveying equipment :



Robotic Total Station



Construction
Total Station



Imaging
Total Station



Optical Total Station

Sources of Error in Theodolite

1. Instrument Errors

- a) Non-adjustment of plate bubble
- b) Line of collimation not being perpendicular to horizontal axis .
- c) Horizontal axis not being perpendicular to vertical axis.
- d) Eccentricity of Inner and Outer axes
- e) Graduation not being Uniform.

2. Personal Errors

3. Natural Errors

References

1. Volland, C., I.U.M Centre the Villeurbanne, 2017.
2. Dennison, K, Thedolite presentation, 2016.s
3. Mitchell, M., Jolley, J., Survey Methods Overview, 2010.