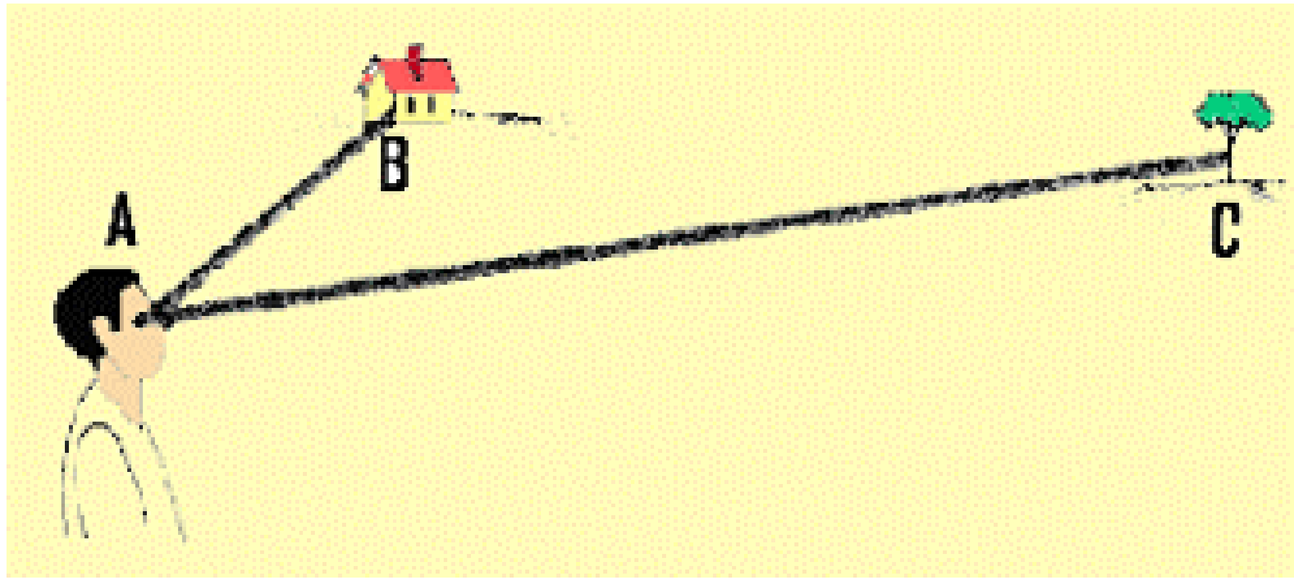
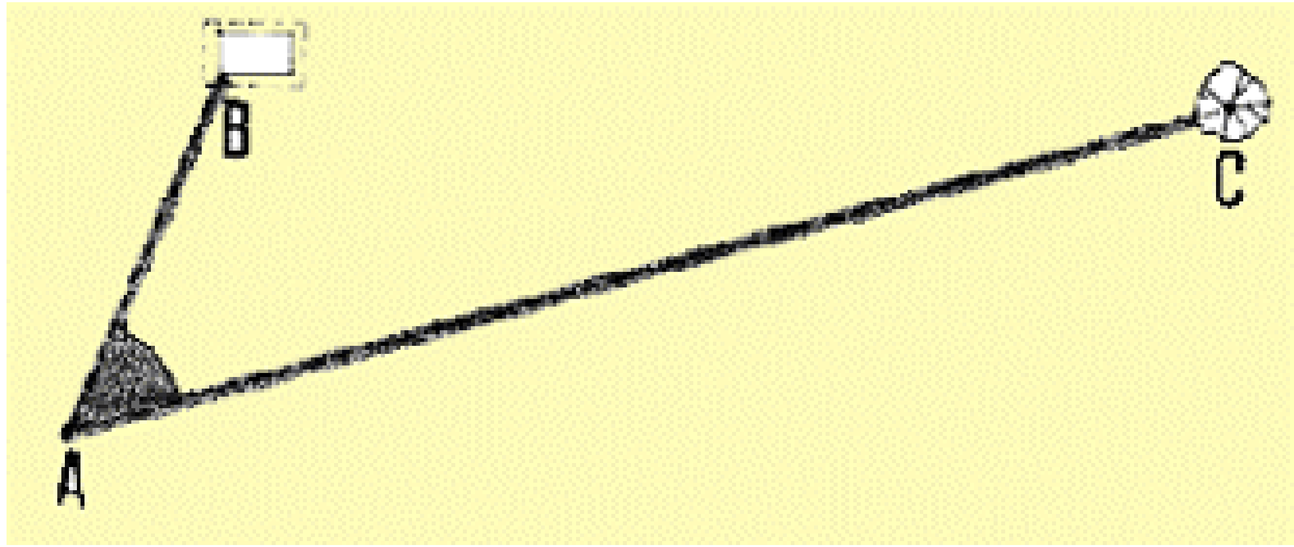

Angles
Measurement

Angles Measurement

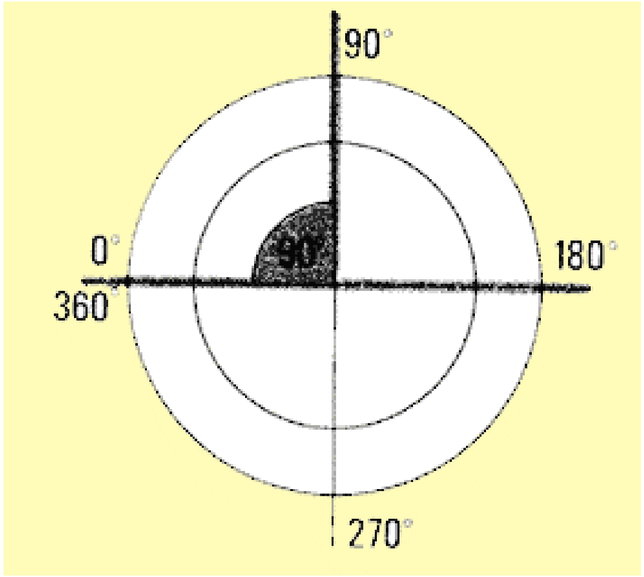




In topography, the angle made by two ground lines is measured horizontally, and is called a horizontal angle. You may replace these ground lines by two lines of sight AB and AC. These lines of sight are directed from your eyes, which form the summit A of the angle BAC, towards permanent landmarks such as a rock, a tree, a termite mound, a telephone pole or the corner of a building.

Angles Measurement

Horizontal angles are usually expressed in degrees. A full circle is divided into 360 degrees, abbreviated as 360°. Note from the figure these two particular values:

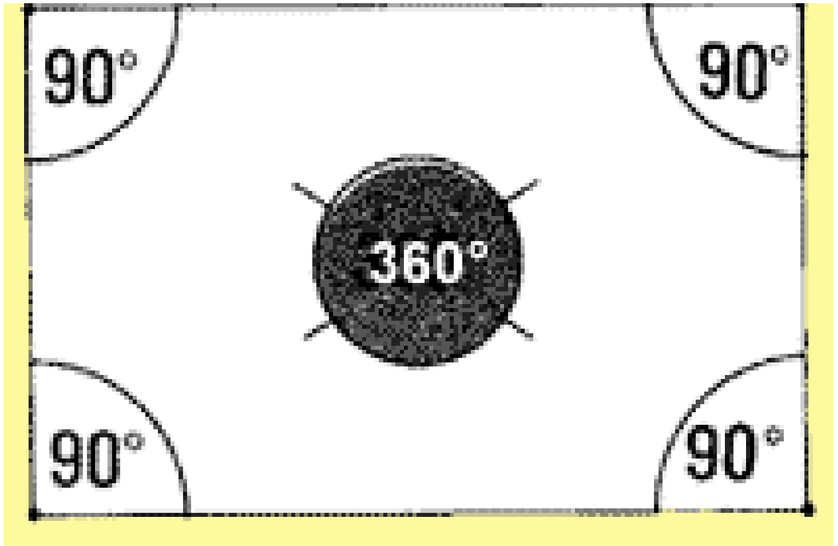


Each degree is divided into smaller units:

1 degree = 60 minutes (60');

1 minute = 60 seconds (60").

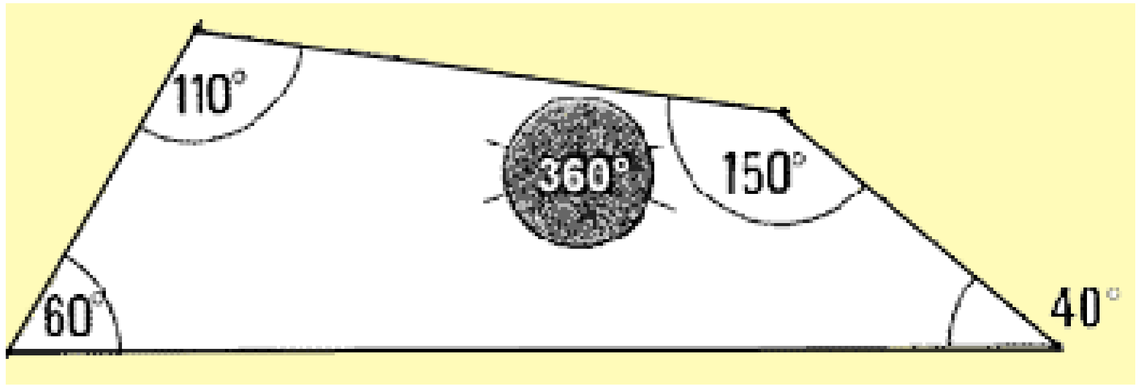
These smaller units, however, can only be measured with high-precision instruments.



A rectangular or a square shape has four straight sides and four interior 90° angles. The sum of these four interior angles is equal to 360°.

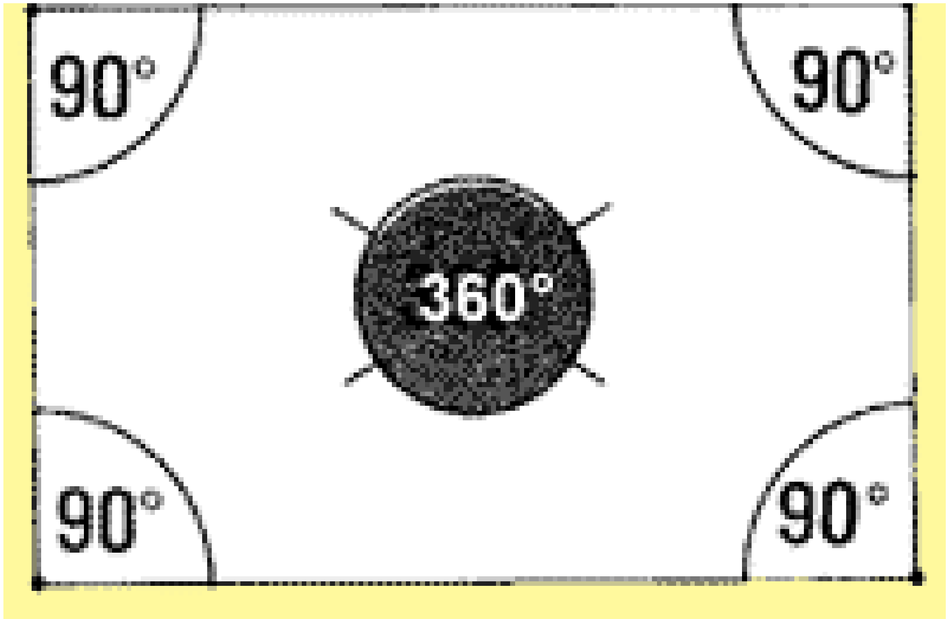
Angles Measurement

The sum of the four interior angles of any four-sided shape is also equal to 360°, even if they are not right angles.



It will be useful for you to remember the general rule that the sum of the interior angles of any polygon (a shape with several sides) is equal to 180° times the number of sides, (N), minus 2, or:

Sum angles = (N - 2) x 180°

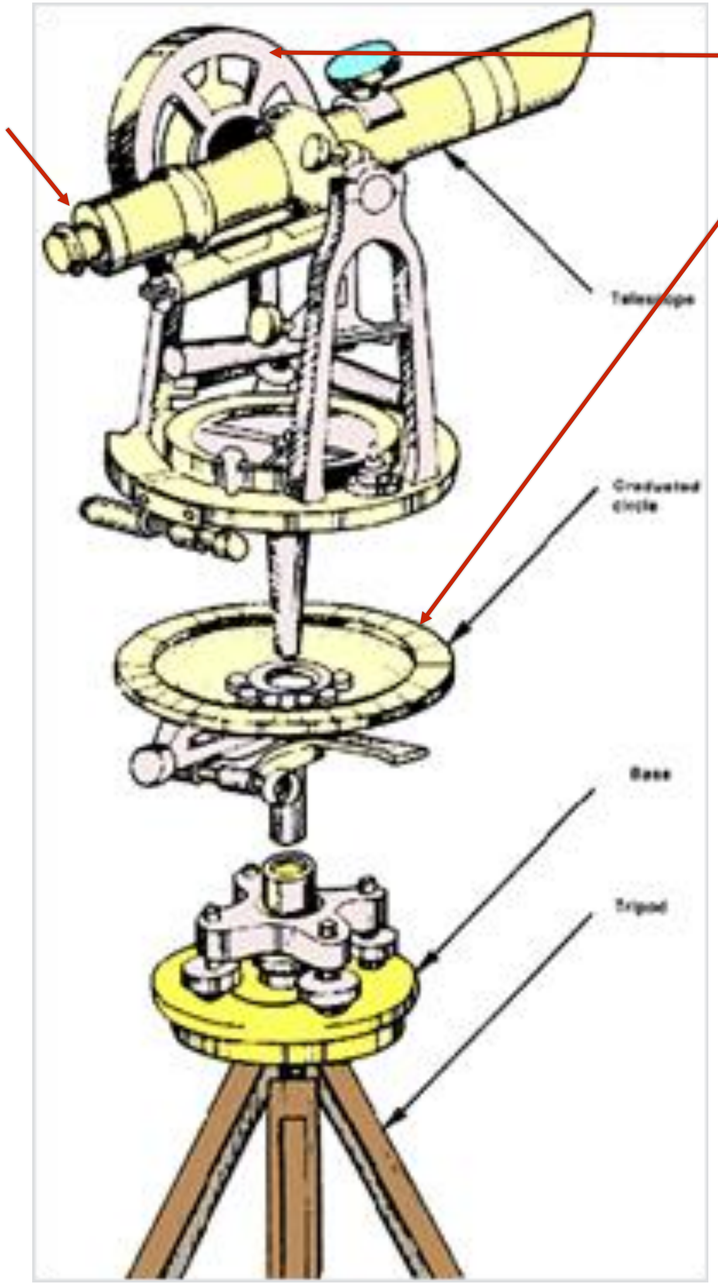


Example:
If a piece of land has five sides. The sum of its interior angles equals (5-2) x 180° = 540°.

Types of Theodolites

Transit:

It featured a telescope that could "flop over" ("transit the scope") to allow easy back-sighting and doubling of angles for error reduction.

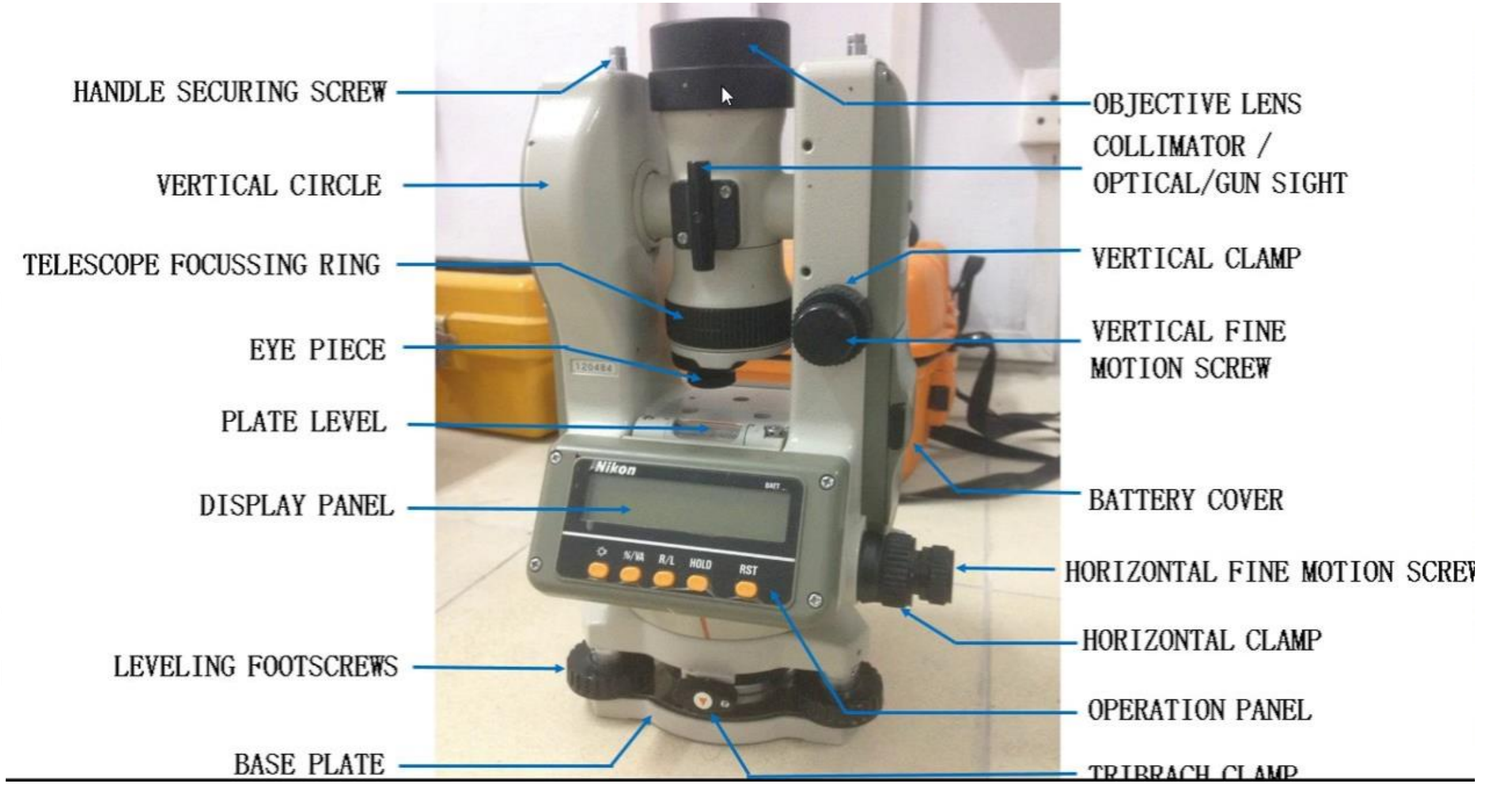


Types of Theodolites

Optical and digital (electronic) theodolites:

A theodolite is an instrument for measuring both horizontal and vertical angles. It is a key tool in surveying and engineering work, particularly on inaccessible ground.

A modern theodolite consists of a movable telescope mounted within two perpendicular axes—the horizontal or trunnion axis, and the vertical axis.

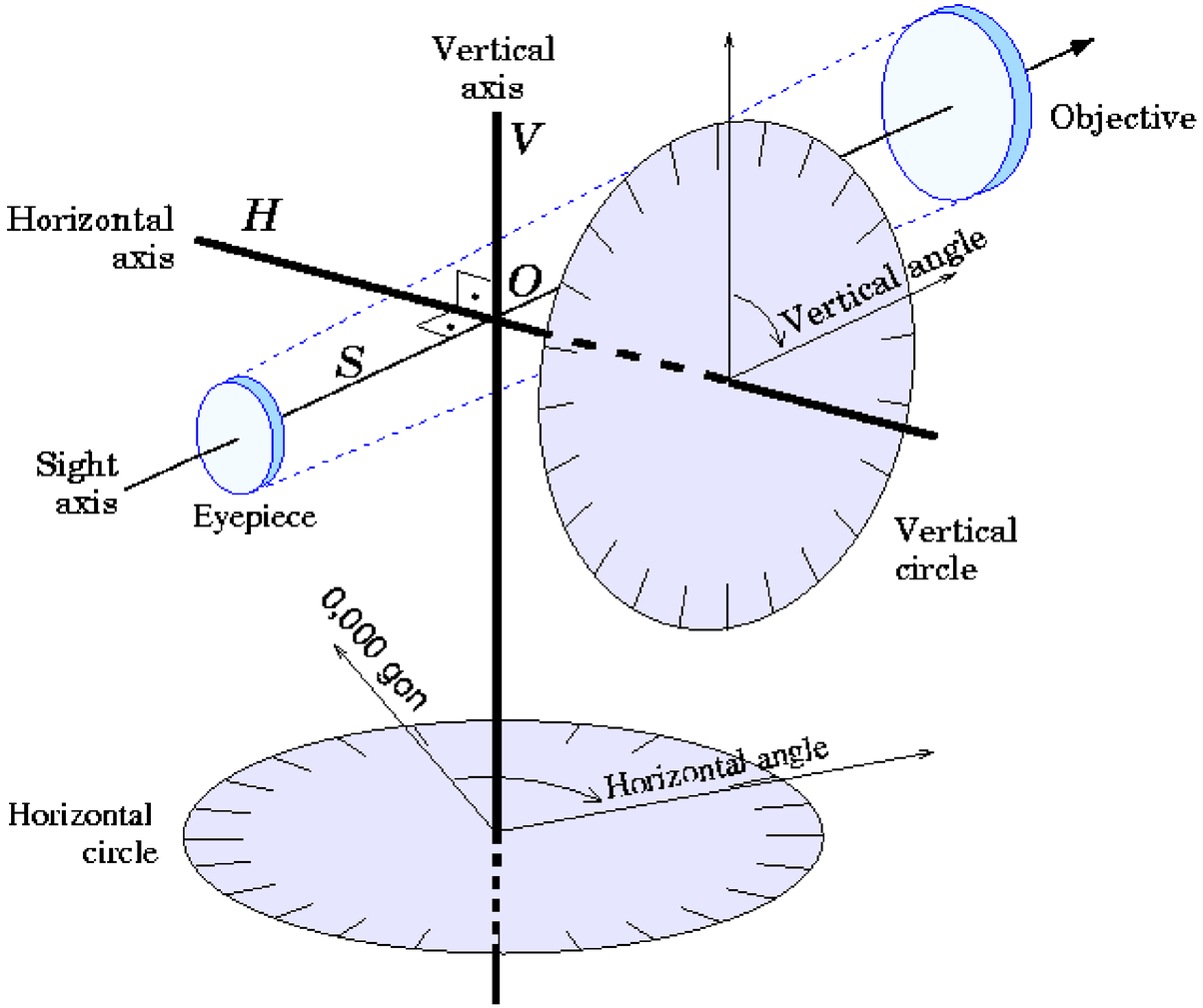


The Axes and Circles of a Theodolite

Both axes of a theodolite are equipped with graduated circles that can be read out through magnifying lenses.

The vertical circle (which 'transits' about the horizontal axis) should read 90° or 100 grad when the sight axis is horizontal, or 270° (300 grad) when the instrument is in its second position, that is, "turned over" or "plunged".

Half of the difference between the two positions is called the "index error".

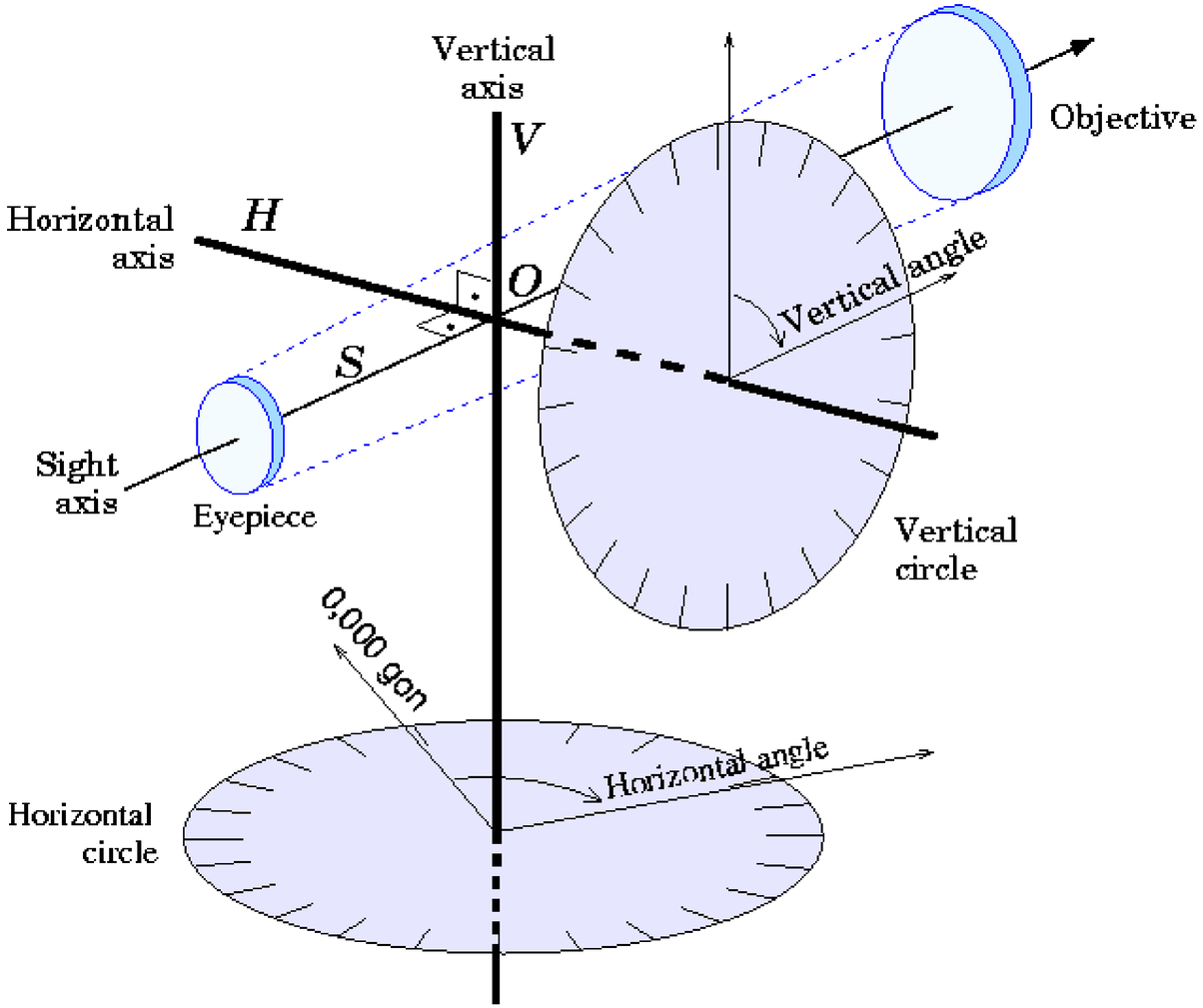


The Axes and Circles of a Theodolite

The horizontal and vertical axes of a theodolite must be perpendicular to each other.

The condition where they deviate from perpendicularity and the amount by which they do is referred to as "horizontal axis error".

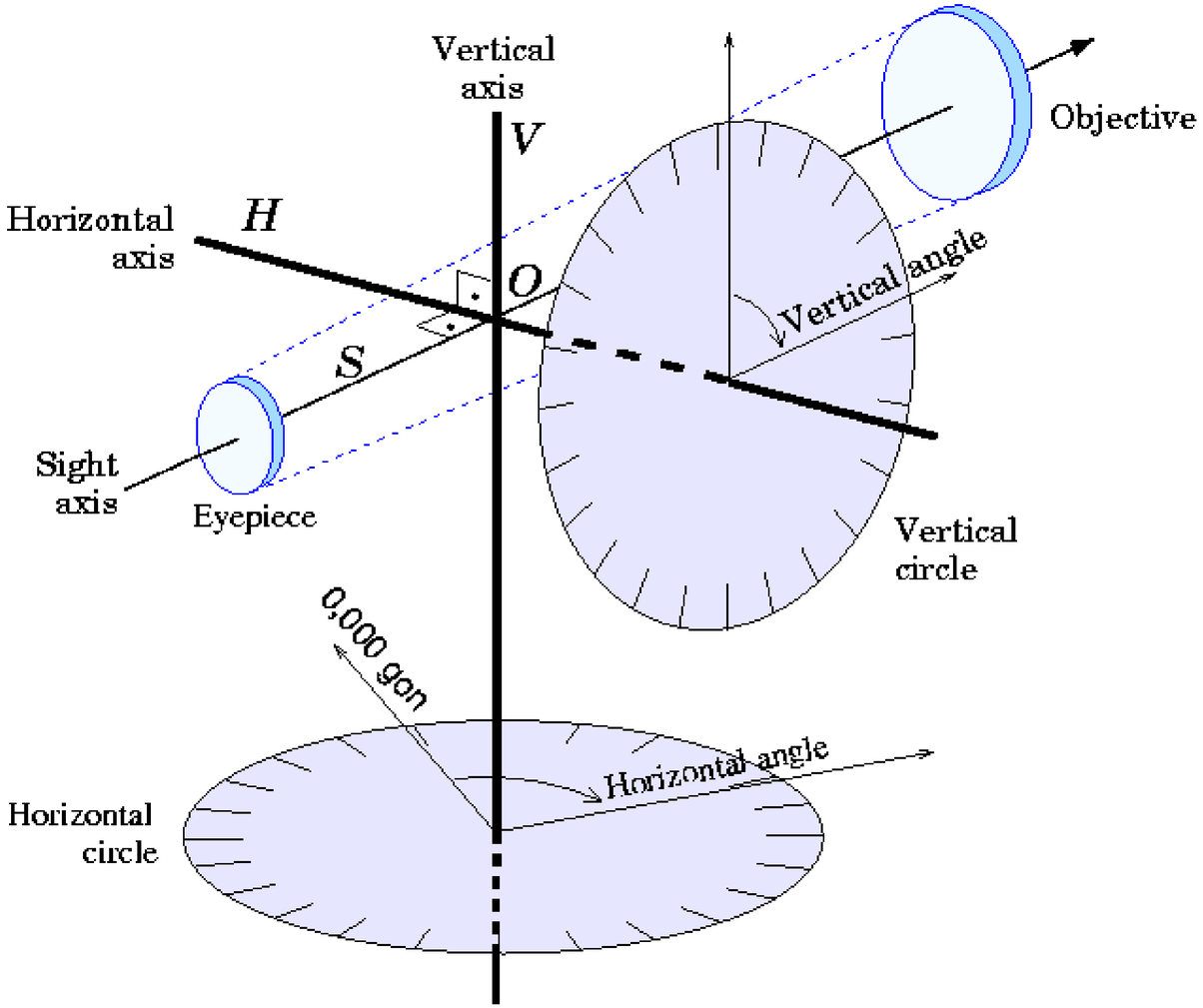
The optical axis of the telescope, called the "sight axis" and defined by the optical centre of the objective and the centre of the crosshairs in its focal plane, must similarly be perpendicular to the horizontal axis. Any deviation from perpendicularity is the "collimation error".



The Axes and Circles of a Theodolite

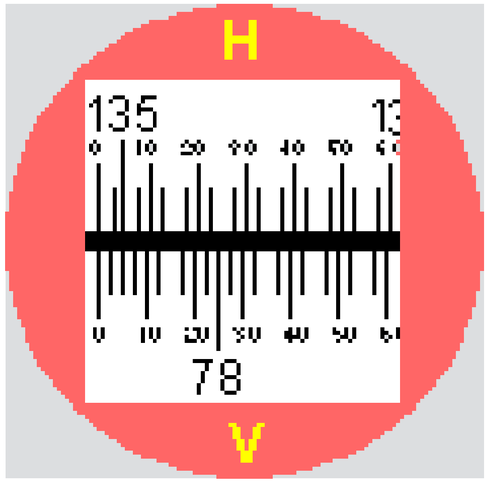
Horizontal axis error, collimation error, and index error are regularly determined by calibration and are removed by mechanical adjustment at the factory in case they grow large.

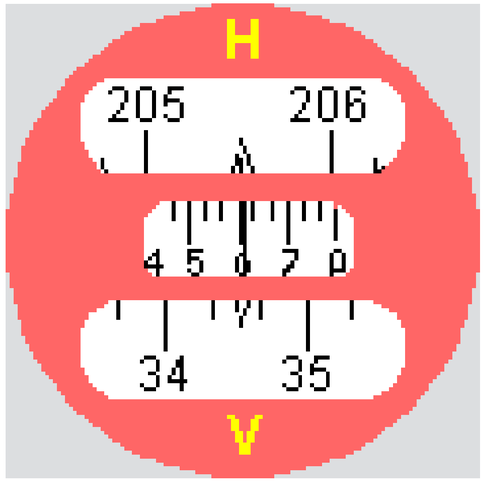
Their existence is taken into account in the choice of measurement procedure in order to eliminate their effect on the measurement results.

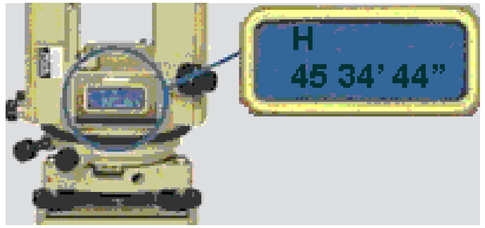


Theodolite Reading Systems

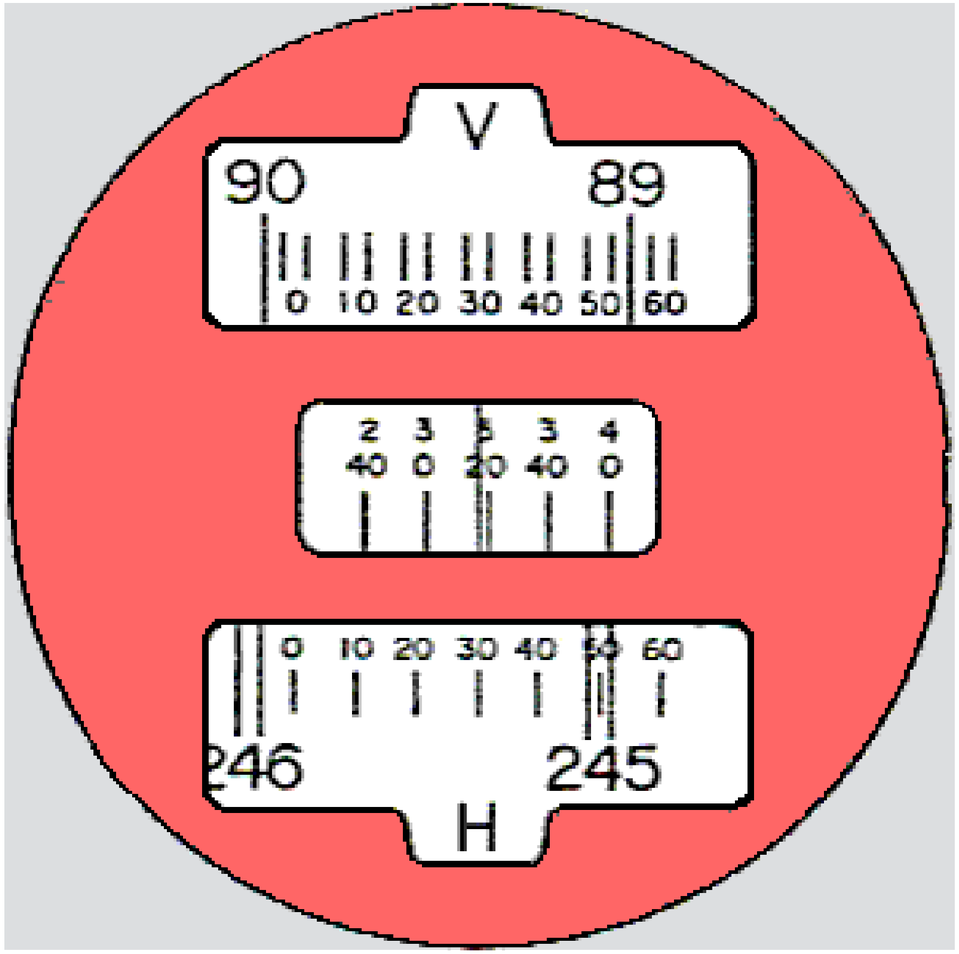
1. Direct reading: scale can read degrees & minutes
2. Micro reading: scale can read degrees, minutes & seconds
3. Digital reading: (electronically) reads degrees, minutes & seconds







Theodolite Reading Systems



Two set of parallel lines are seen in the H window. If the observed reading in the H-window is 245° sitting between 50' and 60' divisions you need to turn the micrometre knob until the parallel 245° lines are bisected by the 50' line as shown in figure. Then the window above the H window will shows in the top row the minute and below the seconds.

The final reading as shown in the figure is 245° 53' 18". (The seconds reading is scaled and not precise.)
The vertical circle (V-window) is read in a similar manner.

Theodolite Reading Systems

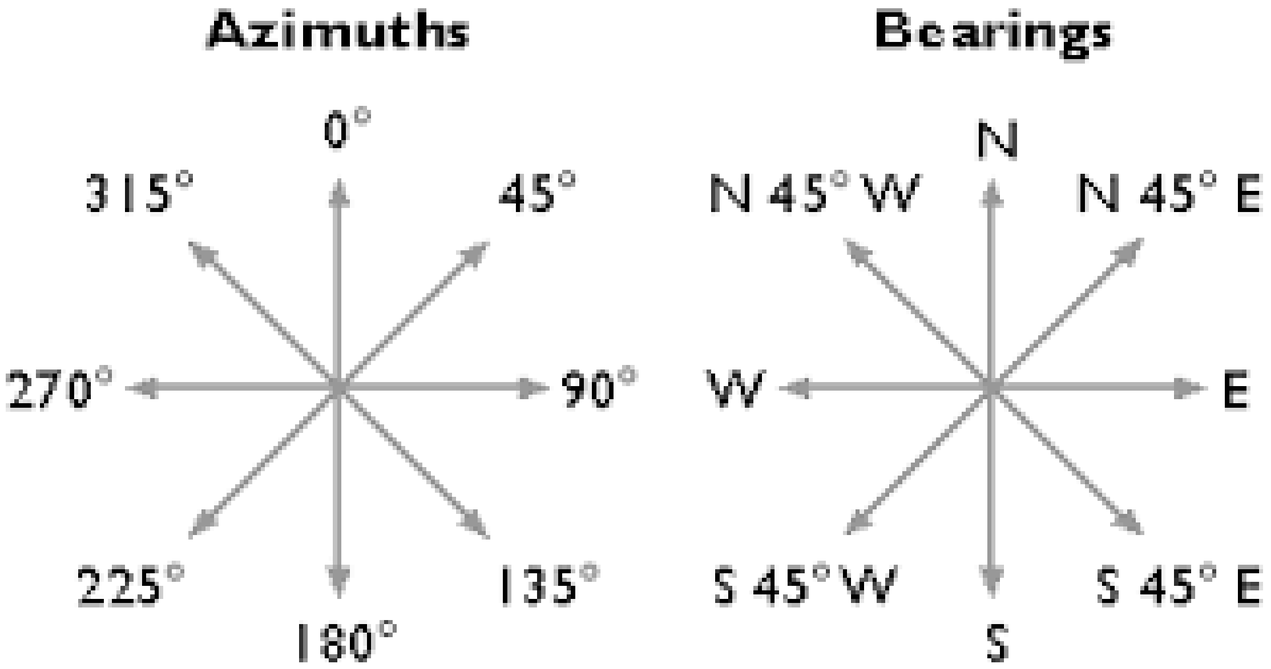
HORIZONTAL CIRCLE READING			
MAIN SCALE	182°	30′	
MICROMETER		2′	54″
TOTAL	182°	32′	54″

VERTICAL CIRCLE READING			
MAIN SCALE	36°	40′	
MICROMETER		5′	23″
TOTAL	36°	45′	23″

Azimuth and Bearing

In land navigation, a bearing is ordinarily determined in a clockwise direction starting from a reference direction of 0° and increasing to 359.9 degrees. Measured in this way, a bearing is referred to as an azimuth.

If the reference direction is north (either true north, magnetic north, or grid north), the bearing is termed an absolute bearing.



Types of bearings

Types of bearings include: true (geographic) bearings, magnetic bearings, grid bearings, compass bearings and relative bearings.

Whole Circle Bearing (WCB) is like Azimuth, measured from north in the clockwise direction to the line (from 0° to 360°).

Quadratic Bearing (QB) is either measured from north (in first and forth quadrants of the circle) or from south (in the second and third quadrants).

For example, the green line in the figure has:
Azimuth or WCB = 103°
Quadratic Bearing (QB) = S 77° E