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| Site Surveying & Set Out 2  |  |  |  |  |  | | --- | --- | --- | --- | --- | | [Theodolite checks](#1) | [How to read micro scales](#2) | [Vertical angles and heights](#3) | [Height calculations](#4) | [Using an optical square](#5) |  Using the Theodolite In Surveying 2 we use a theodolite to determine (read) both horizontal and vertical angles to an accuracy of 20" and mark out the buildings on College ground using theodolite and tape (Module requirements)  A theodolite is an instrument for measuring both horizontal and vertical angles. It consists of a telescope mounted movably within two perpendicular axes, the horizontal and vertical axis.  All students have to use the **Sokkia** instrument. as that is the only one in our department. Using the same instrument students can learn from each other how to read scales and use all the feature of the theodolite.  The left instrument in the opposit figure shows a Wild Theodolite and the right instrument shows a Sokkia Theodolite Checking a theodolite A theodolite can measure angles in both the horizontal and vertical planes. How accurately this can be will depend partly on the quality of the instrument, and partly on the competence of the student.  A theodolite may not be in perfect adjustment and the lines and planes should be checked. To minimise error as much as possible, an angle is measured a number of times with instrument: ►***face left*** (vertical circle on the left of the telescope) and ►***face right*** (vertical circle on the right of the telescope). Reading an angle face right and face left will eliminate the errors due to the non adjustment of the line of collimation and the trunnion axis.  We won't do any adjustment and assume the instrument is calibrated.  Both axes of a theodolite are equipped with graduated circles that can be read out through microscopes. The vertical circle (the one associated with the horizontal axis!) should read 90° when the sight axis is horizontal.  A theodolite, like the Level is mounted on a tripod by means of a forced centering plate or tribrach, containing three thumbscrews for rapid levelling. Before use, a theodolite must be placed precisely and vertically over the point to be measured.  [back to top](#top) Reading scales Theodolites have different reading scales. A theodolite can read, depending on the accuracy,  **a)** degrees, **b)** degrees and minmutes or **c)** degrees, minutes and seconds.   |  |  |  | | --- | --- | --- | | **a)** scale can read degrees & minutes | **b)** scale can read degrees, minutes & seconds | **c)** digital reading (electronically)  reads degrees, minutes & seconds |   Modern theodolites read the horizontal and vertical circles electronically and display readings digitally as in **c)** above. How to read the micro-scales on the Sokkia Theodolite The opposite figure shows a typical view through the microscope eye piece. The microscope eyepiece is located adjacent (right) to the telescope eye piece. Two set of parallel lines (0° and 360°} 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 mircometer knob until the parallel 245° lines are biseced 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.  [back to top](#top)  **Using the Vertical Angles and the distances to determine the height.** The measured vertical angle combined with the distance to any object can be used to determine the height of an object. Most modern theodolites will automatically set the reference direction for the vertical circle once the theodolite is leveled. Zero degrees for the vertical circle is usually set at the zenith (vertically above the theodolite) and the telescpoe reading is 90° when it is horizontal. The vertical angle is then the angle from the zenith down to the line of observation. Points on equal elevation (horizontal plane) to the theodolite will therefore be at 90 degrees. Basically the precision for our vertical angle measurement will determine the accuracy of measured positions.  **Procedures to measure vertical and horizontal angles**  Aim at the first specified corner of the building and **zero** the horizontal circle reading. Readings for horizontal angles should be either in a clock wise or anti clock wise direction. Do not change directions and close the cirle at 360°. Then read the vertical angles (angle of elevation & angle of depression) to determine the height of the corner of the building. Make sure the sighting points are verticle above each other. After that sight the next specified corner and read the horizontal angle, and note the reading of the vertical angles.The horizontal distance between all specified building corners must be exactly measured. (Note the distance to angle A is different to angle A.) Continue reading horizontal and vertical angles as well as distance measures until the specified corners of all buildings are completed.  [back to top](#top) Height calculations We use the *tan-function* to calculate the height. As shown in the figure above the height is determined by measuring two angles (angle of elevation & angle of depression). To calculate the Height A multiply the horizontal distance on for your first height reading by the tan of the related angle.  Height A = horizontal distance x tan 90°- A°  Height B = horizontal distance x tan B°- 90°  Now add both distances together. Add this measurent to the known reduced level (RL) at the bottom to obtain the new height level (RL gutter or fascia) at the top.  Make up a template for recording angles and measurements.  The reading precision of the instrument and the accuracy of your angle reading and horizontal measured distance will determine the correct height distance. Using an double prism optical square Surveyor's use the instrument for laying out right angles and placing points on line. It is a very simple geodetic instrument. The prism has two mirrors for measure right angles Figure) 1 or in-line parallel to an object using range poles (Figure 2)  **Figure 1**  **Figure 2**  [Standard operation procedure](https://triginstruments.co.nz/brochures/Optical%20Square.pdf)  [back to top](#top) The total station All surveyors used nowadays a total station, thats consists of atheodolite with a built-in distance meter. It can measure angles and distances at the same time. Today’s electronic total stations all have an opto-electronic distance meter (EDM) and electronic angle scanning ability. |