

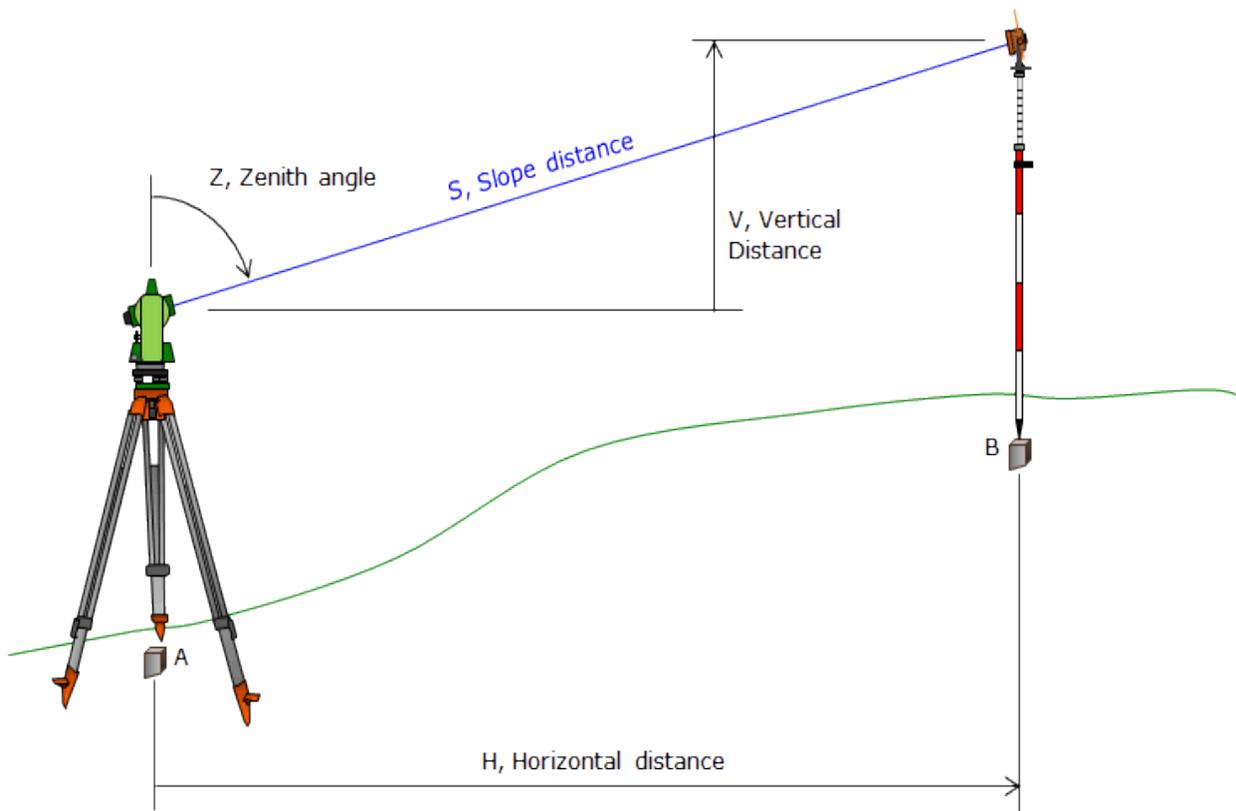
## **HEIGHT DETERMINATION** (S.Ndlovu June 2015)

### **(LEVELLING)**

- ▶ Vertical surveying (leveling) is the process of determining elevations above a chosen datum, Mean Sea Level. In geodetic surveys, geodetic positions (y,x) are referred to an ellipsoid, and the elevations of those positions are referred to the geoid.
- ▶ Precise geodetic leveling is used to establish a basic network of vertical control points. The mean sea level surface used as reference (vertical datum) is determined by averaging the hourly water heights for a specified period of time at specified tide gauges.
- ▶ The purpose of leveling was in most cases to establish a series of national or municipal benchmarks along certain routes. National benchmarks are found along most national roads, while municipal benchmarks are found in most large cities and towns situated along the road networks.
- ▶ There are three leveling techniques. Barometric, Trigonometric and Differential leveling.
- ▶ **BAROMETRIC LEVELING**
  - In barometric leveling, differences in height are determined by measuring the differences in atmospheric pressure at various elevations. Air pressure is measured by mercurial or aneroid barometer, or a boiling point thermometer.
  - Although the accuracy of this method is not as great as either of the other two, it obtains relative heights very rapidly at points which are fairly far apart. Its uses include reconnaissance surveys and exploratory surveys where more accurate measurements will be made later or where a high degree of accuracy is not required.

► **TRIGONOMETRIC LEVELING**

- Trigonometric leveling is so named because it uses a total station instrument's slope distance and zenith angle to mathematically determine a point's elevation using trigonometric formulae.
- Using appropriate procedures, such as adjustment for curvature of the earth and the refraction of light, accuracies similar to differential leveling can be achieved. Because trigonometric leveling is not limited to a horizontal line of sight, it is more flexible and provides faster elevation data collection.



- Trigonometric leveling embraces all types of heights determination by the use of vertical angles, distances and trigonometric functions. We find out the vertical distance between points by taking the vertical angular observations and the known distances. The known distances are either assumed to be horizontal or the geodetic length at the mean sea level.

### ► **SPIRIT (OPTICAL) LEVELING**

- This is the most important type of leveling and with the most accurate results. Instrument used for this method vary from simple handheld levels to highly accurate and precise levels, but with all having a sole purpose of measuring height differences between two points that are situated close together.
- This method employs most commonly the spirit level, an instrument consisting of a telescope with crosshair and a tube level like that is used by carpenters, rigidly connected. When the bubble in the tube level is centered, the telescope's line of sight is supposed to be horizontal.
- The accuracies obtained depend on the corrections applied to eliminate errors such as collimation error, and also placing the instrument equidistant from the two points to be measured to eliminate curvature and refraction errors.
- One cannot stress enough the importance and role of the human error. The observer needs to take precaution when leveling to eliminate any errors from arising.