Technical Note 22.
Computing Per cent Slope

1.0 Background

Slope is an important factor to consider in soil investigations. Slope controls the movement of surface water as well as subsurface profile water. Slope also affects soil fertility, air and temperature, and vegetation. These variables are usually distributed along a length parallel to the slope in the form of *gradients*. In particular, per cent slope affects the magnitude and direction of soil erosion. Slope is one of the key factors used to compute soil loss in the Universal Soil Loss Equation (LS factor) and is an important design parameter for erosion control structures. Because mineral salts are dissolved in the soil water, fertility gradients often form on slopes with the movement of nutrients to the slope toe and away from the summit and upper slope sides. *Slope aspect* is an important determinant of soil and air temperature. South facing slopes often have elevated air and soil temperatures compared to north facing slopes; this affects soil moisture status as well as vegetation type.

Slope can be measured accurately using an engineer's transit. However, instrument set-up and movement is time consuming, and the instrument is bulky and expensive. Slope can also be measured using an inexpensive optical instrument called an Abney level or clinometer. Although not as accurate as a transit, clinometers are easy to use and are small enough to carry in the pocket. The following figures illustrate the basic principles.

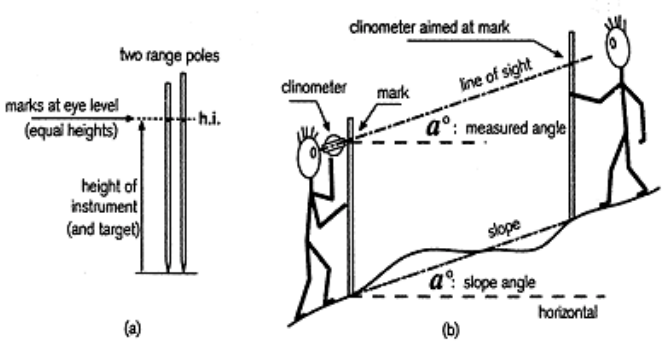
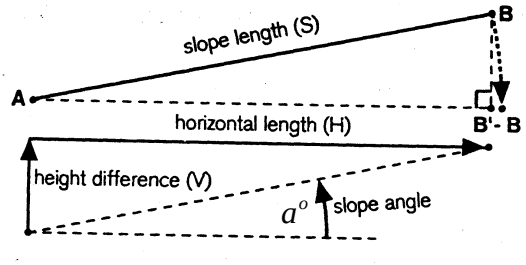


Figure 1. Determination of a slope angle with a clinometer. (a) Two range poles of rods with equal high marks are used for marking a line sight parallel to the slope. (b) The measured angle of this line of sight is equal to the slope angle. Source*: Loedeman, J.H. 2000*.



The clinometer is used to measure a^o, the slope angle indicated above. The slope length **S** is measured using a tape. Surveyor's tapes that are graduated in 10ths are best for this purpose. Knowing the slope angle and slope length allows one to compute **H** horizontal length using the formula:

$$H = S \cos a^o$$

The vertical rise **V** is computed using the Pythagorean relation $c^2=a^2 + b^2$ for a right triangle. This relation can be restated using different symbols as:

$$S^2 = V^2 + H^2 \quad \text{or solving for V as } V^2 = S^2 - H^2$$

Once the vertical rise **V** has been determined, per cent slope is given as **V**/**H** x 100.

Further Reading

Loedeman, J.H. (2000). Simple construction surveying for rural development applications. 2nd ed. Agrodeok series No. 6. Agromisa, Wageningen, The Netherlands.

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