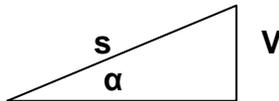


Finding Vertical and Horizontal Elevation Differences between Points

There are two common methods of surveying to determine slope distance. The traditional method involves stadia, where the difference in rod readings at the upper and lower stadia hairs are converted to a slope distance. The newer method uses a total-station instrument and prism pole to determine the slope distance electronically.

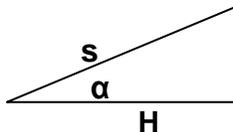
The two methods of acquiring the slope distance require different methods of determining the vertical and horizontal distances between the instrument and the point of interest. The total-station and prism pole give a true slope distance. However, the stadia method requires an extra correction factor due to an inclined line of sight reading on a vertical rod.

When hand calculating the vertical distance between points, this difference needs to be taken into consideration. Because the total station gives a true slope distance, the vertical difference is simply $V = s * \sin \alpha$ (see figure below).



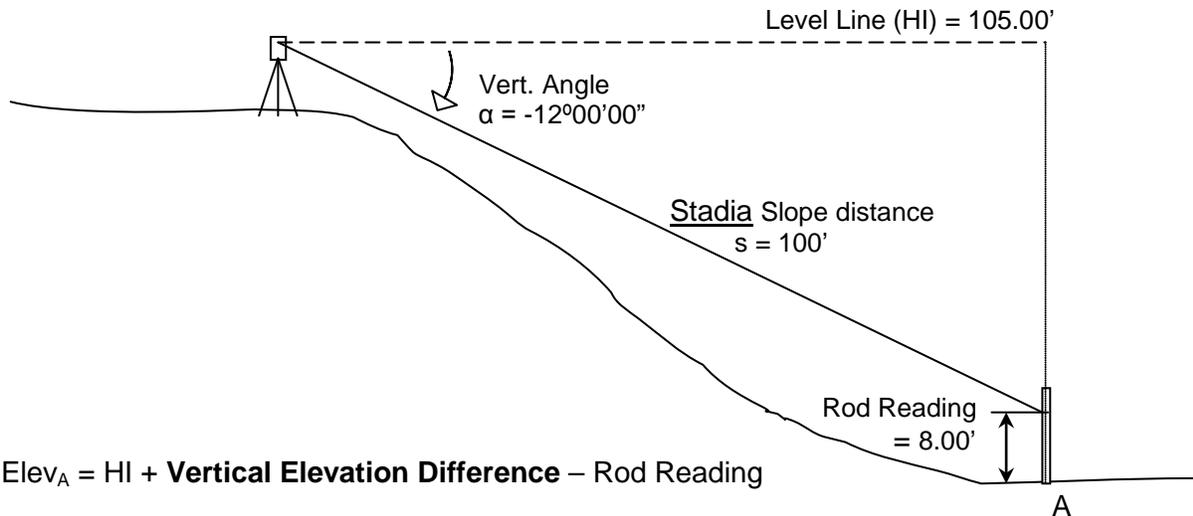
However, with the stadia reading a correction for the angle between the line of sight and the rod needs to be included: $V = s * (\sin 2\alpha) / 2$ (figure not shown).

When calculating the horizontal distance between points, this difference also needs to be taken into consideration. Because the total station gives a true slope distance, the horizontal difference is simply $H = s * \cos \alpha$ (see figure below).



However, with the stadia reading a correction for the angle between the line of sight and the rod needs to be included: $H = s * \cos \alpha * \cos \alpha = s * \cos^2 \alpha$ (figure not shown)

This difference between total station measurements and stadia readings is also accounted for in survey note reduction programs such as SSRP and AutoCAD. These programs usually ask whether slope distances are from stadia or prisms. The program then applies the correct formulas. It is important that this variable is correct in the reduction program you are using.

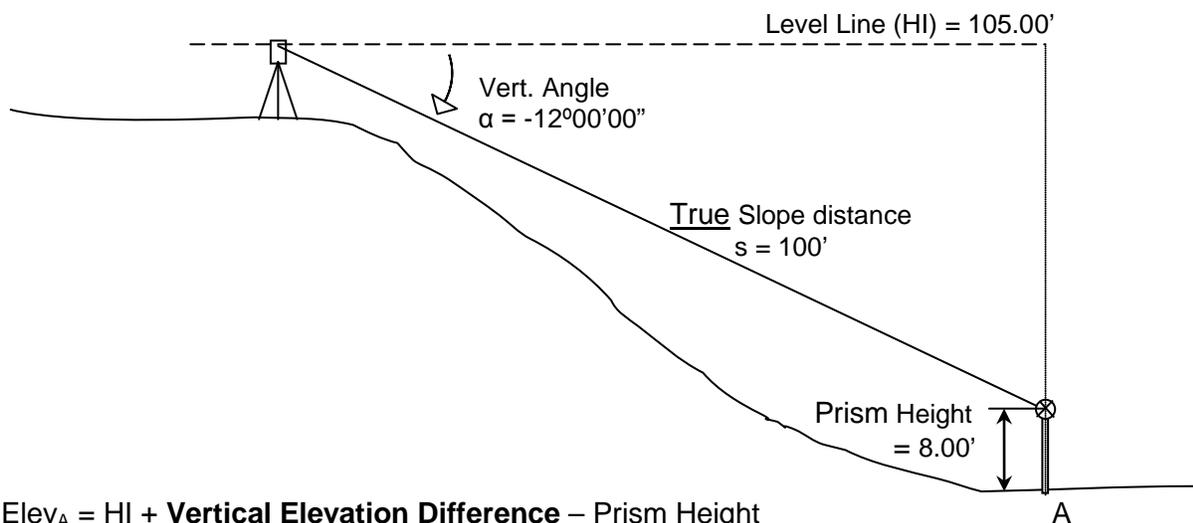
Find Unknown Ground Elevation from Known HI1. Distance Reading Taken Using Stadia

$$\text{Elev}_A = \text{HI} + \text{Vertical Elevation Difference} - \text{Rod Reading}$$

$$\text{Elev}_A = \text{HI} + \{s * (\sin 2\alpha) / 2\} - \text{Rod Reading}$$

$$\text{Elev}_A = 105.00 + \{100 * (\sin 2(-12)) / 2\} - 8.00$$

$$\text{Elev}_A = 105.00 + (-20.34) - 8.00 = \underline{76.66}$$

2. Distance Reading Taken with EDM and Prism

$$\text{Elev}_A = \text{HI} + \text{Vertical Elevation Difference} - \text{Prism Height}$$

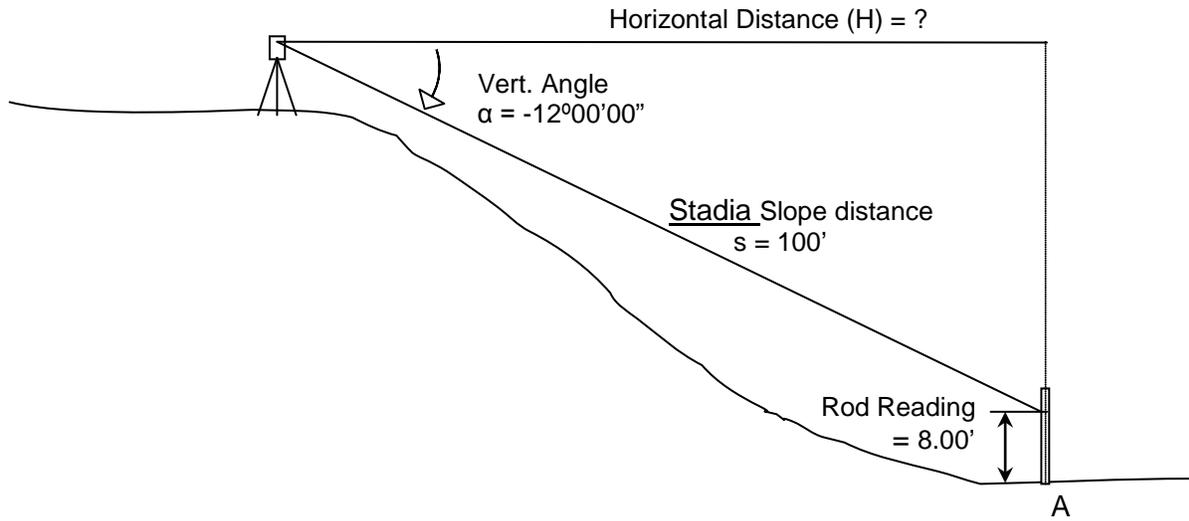
$$\text{Elev}_A = \text{HI} + (s * \sin \alpha) - \text{Prism Height}$$

$$\text{Elev}_A = 105.00 + \{100 * (\sin (-12))\} - 8.00$$

$$\text{Elev}_A = 105.00 + (-20.79) - 8.00 = \underline{76.21}$$

Find True Horizontal Distance from Slope Distance

1. Distance Reading Taken Using Stadia

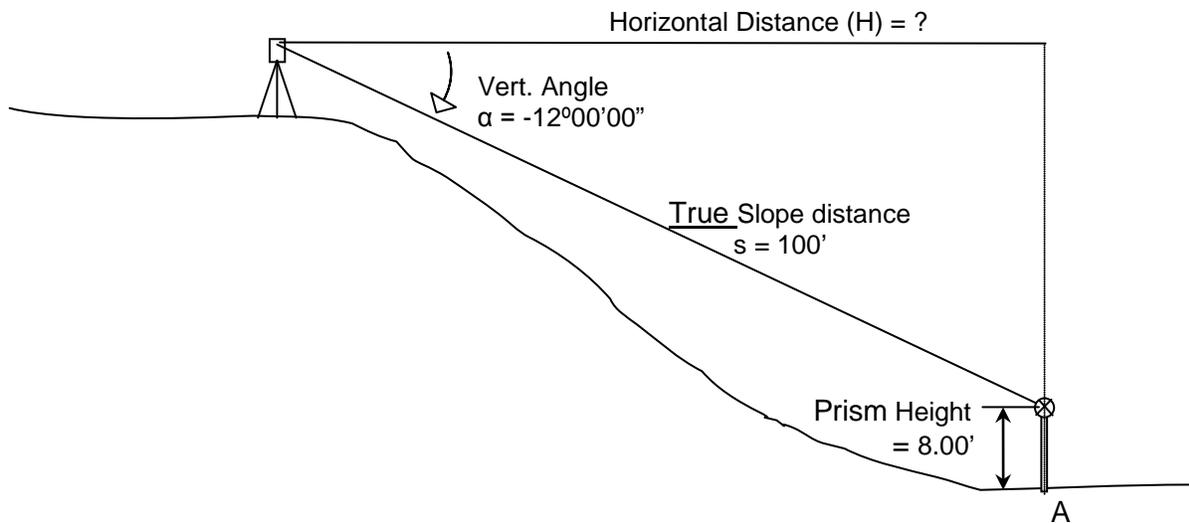


$$H = s * \cos^2 \alpha$$

$$H = 100 * \cos (-12) * \cos (-12)$$

$$H = 100 * 0.9781 * 0.9781 = \underline{95.7}$$

2. Distance Reading Taken with EDM and Prism



$$H = s * \cos \alpha$$

$$H = 100 * \cos (-12)$$

$$H = 100 * 0.978 = \underline{97.8}$$