

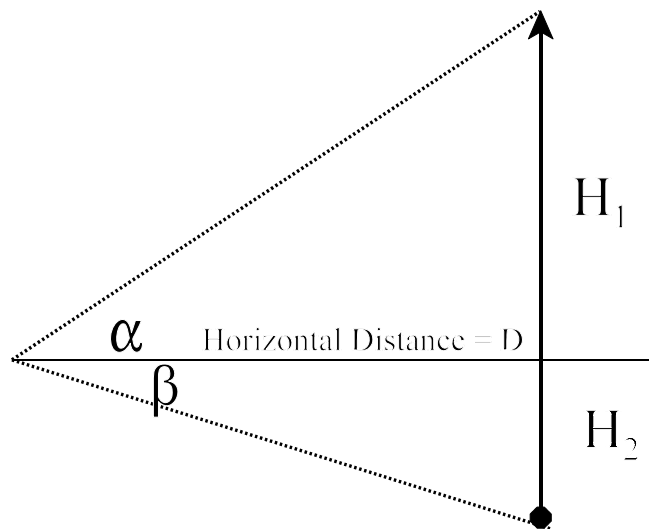
FO-2213 Forest Measurement  
Topic 7: **Measuring Heights of Standing Trees**

**Total height** = height (or stem length) from ground line to top of terminal bud.

**Merchantable height** = stem length (or height) from assumed stump height to an arbitrary, fixed upper-stem diameter (ib or ob)

**Height Measurement Principle:** tangent function of right triangle;  $\tan \alpha = \text{oppos}/\text{adjac}$

**Warning:** Do not exceed a  $45^\circ$  angle; i.e.  $D \geq H_1$ , since  $\tan(45^\circ) = 1$



$$\tan \alpha = H_1 / D \text{ thus } H_1 = D * \tan \alpha \text{ (height above horizontal)}$$

$$\tan \beta = H_2 / D \text{ thus } H_2 = D * \tan \beta \text{ (height below horizontal)}$$

$$\text{Height} = H_1 + H_2$$

**Clinometer and Abney Level**

Index distance scales: 66 ft = topographic scale, or  
100 ft = percent scale

Height equation: 
$$\text{height} = \left[ \frac{\text{horizontal distance (ft)}}{\text{index distance (ft)}} \right] (\text{Reading@top} - \text{Reading@bottom})$$

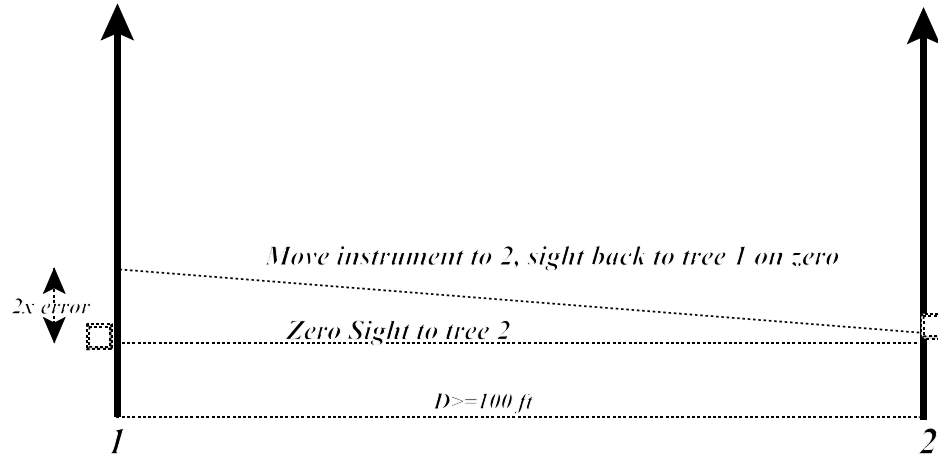
**Field Procedures:**

1. Measure the distance D with tape or DME.
2. Select the scale to use; % or topo
3. Take the reading@top point
4. Take the reading@bottom point; note if the sign is - or +
5. Compute the height with the height equation.

## Checking Accuracy of Clinometers

### The Peg Method:

1. Place the instrument on a knife blade or nail (stuck in the side of tree 1) and sight a distance of 100+ ft to tree 2 with the angle set to zero.
2. Have your partner mark the sighting location on the side of tree 2 with a knife blade or nail.
3. Move to tree 2, leaving your original knife/nail in place on tree 1, and place your instrument on top of the sighted knife/nail position and sight back to tree 1.
4. Have your partner mark the new sighting location on tree 1.
5. The distance between the two knives/nails on tree 1 represents double (2X) the vertical error.
6. Measure this 2X distance with sign (i.e. + or -) and record the actual 1X error as a percent of the distance; i.e. **error = (1X error/distance) x 100%**
7. The error is  $\pm X\%$ . Thus, if the error is -4%, then a corrected height would be 1.04 x height. A positive error of 4% would translate to 0.96 x height corrected reading.  
**Clinometer correction = (1 - %error as decimal) x height**



### Height example: (percent scale)

Distance = 137 ft; Reading to top = + 46 ; Reading to bottom = -5; Clinometer error = -2.5%  
 Height = {1.025} \* (137/100) [46 - (-5)] = 71.6 ft

### Height example: (topo scale)

Distance = 137 ft; Reading to top = + 46 ; Reading to bottom = +5; Clinometer error = +2.5%  
 Height = {0.975} \* (137/66) [46 - (+5)] = 83.0 ft