Estimating Obstruction Height

The fuel for a wind generator is moving air, and its energy content increases cubically as wind speed increases. So for good performance, it's vital to get wind generators up into the powerful, nonturbulent winds.

To be effective, wind generators need to be sited well above nearby obstructions. One common rule in the small wind industry is to make sure that the lowest blade tip is *at least* 30 feet above everything within a 500-foot radius.

To decide on tower height, you must know the height of nearby obstructions, be they hills, trees, or buildings. There are several methods to determine these heights.

Climbing & Measuring Method

Perhaps the most obvious method of determining the height of an obstruction is to measure it directly. This is often not possible or practical, but when it is, why not do it? Climb to the roof of the building or up the tallest tree, carrying a long tape measure. With an assistant on the ground, you can get a very accurate measurement.

In the case of a tree, you can climb with the tail of the tape attached to your harness. You won't be able to climb to the very top, but you'll be able to estimate the distance above you when you reach as high as you can go. Remember to do the research to understand what the *mature* tree height will be, since this will be important to your tower height as trees grow over the years.

While you are at that measured high spot—be it building, tree or hill—you can use a site level to gauge other nearby obstructions. Once you have a baseline measurement from your high location, you'll be able to make a reasonable guess of the height of other tall things nearby. Some perspective from an on-the-ground helper may help: "…if you're at 80 feet, that tree over there must be about 95 feet tall…"

Inclinometer

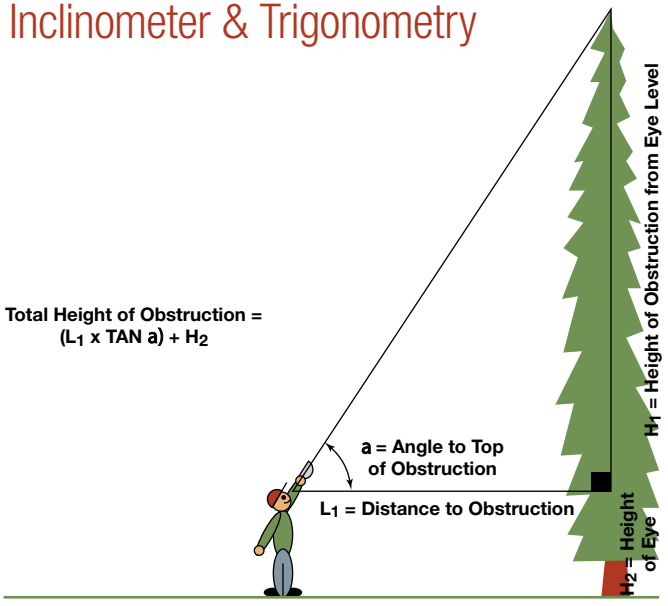
An inclinometer is a device that measures angles of inclination and costs $100 to $300. You sight through it at an object, and the tool tells you what angle from level your sight line is. A low-budget alternative is to use an inexpensive angle gauge attached to a yardstick, which you can sight up.

With the angle formed by the ground and this sight line, a bit of measurement and math can tell you an obstruction's height:

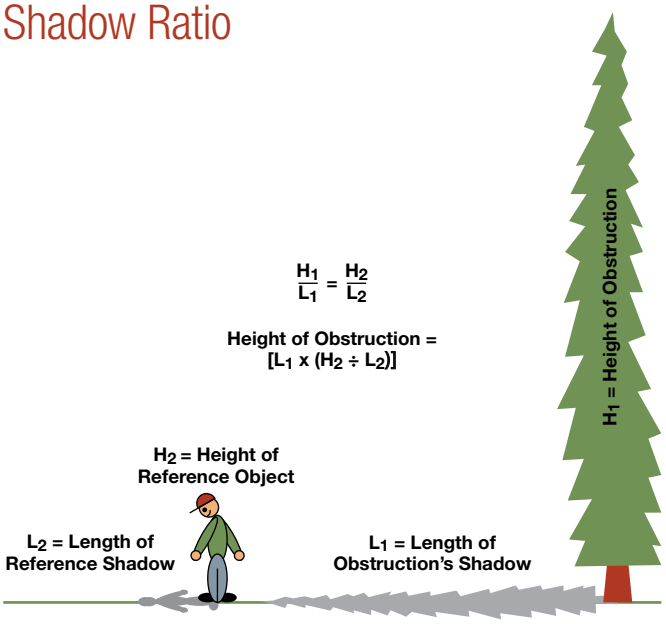
- Measure the level distance from your inclinometer reading spot to the obstruction.
- Find the tangent of the angle—scientific calculators have this function, and some inclinometers will give you a read-out in the tangent of the angle.

Obstruction height = height of your eye above the ground + (distance to obstruction × tangent of angle)

Inclinometer & Trigonometry



Shadow Ratio



Shadow Method

A simple method that doesn't require any complex or expensive gear is useful when the obstruction casts a clearly measurable shadow. First measure that shadow length at a specific time of day. At the same time of day, measure the shadow of an object of known height. Then do the math to calculate the height of your obstruction.

For example, if a 6-foot-tall fence post casts a 10-foot-long shadow, you know the ratio between the post height and its shadow length. If the obstruction in question casts a 100-foot-long shadow, you can use the ratio to calculate that the obstruction is 60 feet tall.

Stick Methods

You can use a stick held vertically in front of you at arm's length. Hold the stick with your thumb and a finger near the bottom, and adjust the stick so that when you sight with one eye, your thumb marks the base of the obstruction and the top end of the obstruction is at the top end of the stick.

Measure the stick height (using a yardstick helps) and the length of your arm (the distance between the stick and your eye), and you can calculate the obstruction height with this formula:

Obstruction height = distance to the obstruction × stick height ÷ arm's length

Another method is to use the stick just as in the previous method. After you've sized up the tree with it, simply tip the stick sideways and put one end so it appears to be at the base of the tree. Note where sighting across the other end of the stick shows up on the ground parallel to the tree, and have a second person measure from the base of the tree to that location. This works best with level ground.

45-Degree Method

Basic geometry tells you that a right triangle (90° angle at one corner) with two equal-length sides will have 45° angles at its other two corners. A simple application of this can quickly get you the height of an obstruction. The 90° part of the triangle will be the tree, relative to the ground. Stand back from the obstruction and point at it, holding your arm at a 45° angle. You can use a tri-square with level, an angle gauge or a smartphone app to gauge the correct angle.

Move back until your angled arm is pointing at the top of the obstruction, and you will be about the same distance from the obstruction as its height. If you want to get exact, run your 45° angle down from your eye to the ground behind you, and then measure from that point to the base of the obstruction.

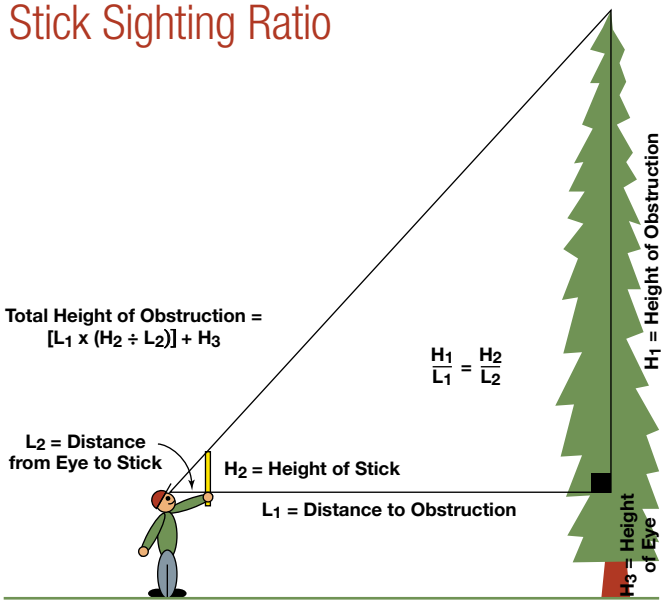
Smartphone users might want to tap into high-tech applications like Smart Measure for Androids and DAH-Measure for iPhones. These apps use the smartphones' cameras and level sensors for input and then calculate height for you.

Interpreting & Rounding

Any of these methods will give you an idea of the height of the obstructions within range of your proposed wind generator. How exact the measurement is will depend on which method you use and how carefully you apply it. But precision is not necessary, since you should round up generously anyway. The two most important words in the 30/500 rule —site wind generators at least 30 feet above anything within 500 feet—are "at least." Higher will always be better.

—Ian Woofenden

Stick Sighting Ratio



45° Angle Sighting