

DETERMINING SLOPE

3



OBJECTIVES

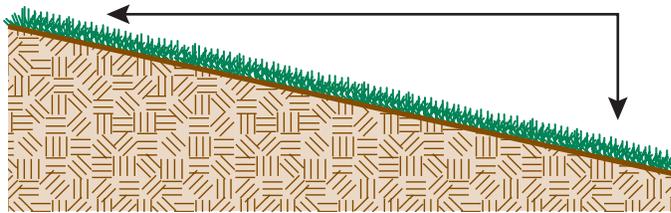
The purpose of this chapter is to:

- Measure slope.
- Calculate percent slope.
- Understand the different locations that slope may be measured from.

Slope



What is slope?



Slope is the change in elevation, measured in consistent units, from one point to another.



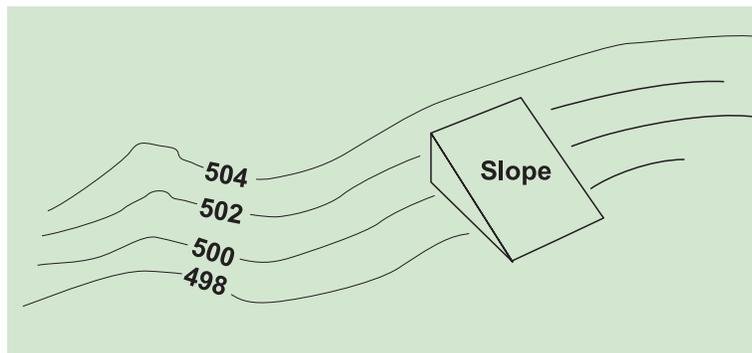
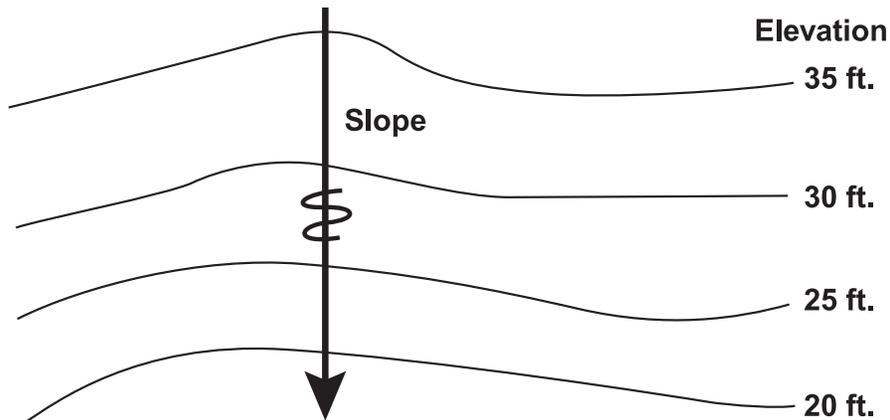
Why would slope be a factor in evaluating a site for an onlot sewage disposal system?

How To Measure Slope

Slope must be measured perpendicular to the contours of the land. Contours are lines of equal elevation.



NOTES



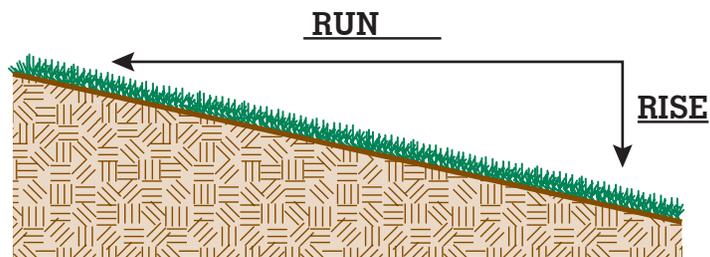
There are two ways to measure slope:

- 1) By taking field measurements and dividing the vertical distance by the horizontal distance ($\text{rise} \div \text{run}$), and then multiplying by 100 for percent slope.
- 2) By measuring the angle with an instrument.

1) VERTICAL AND HORIZONTAL DISTANCES

Slope can be calculated by using the rise over run method of dividing the vertical distance by the horizontal distance. Multiply the answer you get by 100 to get percent slope.

vertical distance \div horizontal distance = slope



NOTES

SAMPLE PROBLEM

Solve for the percent slope. Round to the nearest whole percent.

Vertical distance is 6 feet 8 inches and horizontal distance is 38 feet. Percent slope = _____



NOTES



EXERCISE 3-1

Solve for the percent slope. Round to the nearest whole percent.

1) Vertical distance is 5 feet and horizontal distance is 57 feet. Percent slope = _____

2) Vertical distance is 3 feet 5 inches and horizontal distance is 56 feet. Percent slope = _____

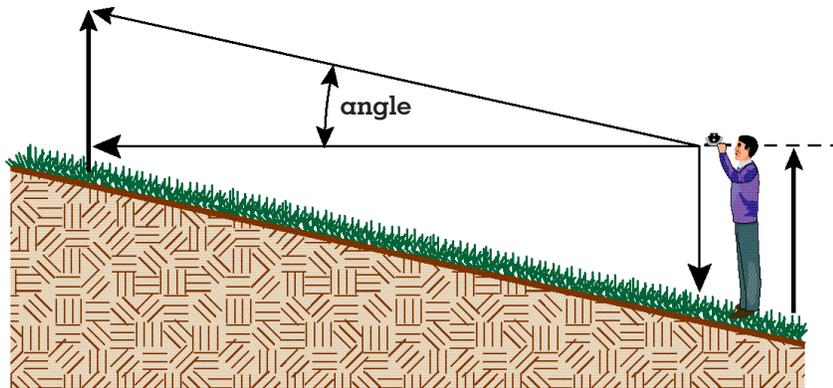
3) Vertical distance is 5 feet 4 inches and horizontal distance is 48 feet 7 inches. Percent slope = _____

2) MEASURING THE ANGLE

Slope can also be determined by measuring the angle. With this method, horizontal and vertical distances are not needed. An instrument is used instead.



NOTES



Instruments to Determine Slope

LOCK LEVEL

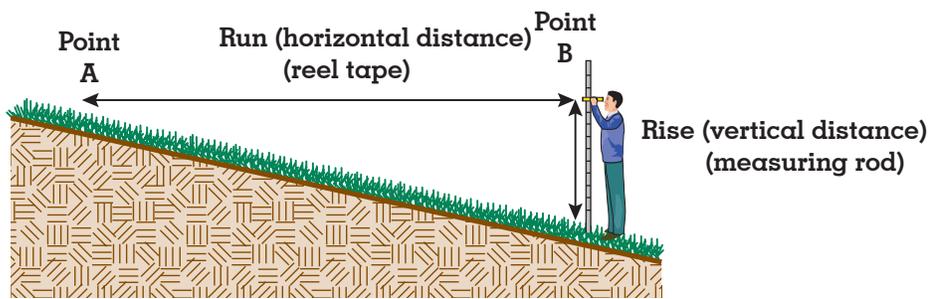


TOOLS:

- 1) Reel tape measure of 100 feet or greater
- 2) Measuring rod or pocket tape measure
- 3) Screwdriver, chaining pin, or large spike



NOTES



PROCEDURE:

Measure the Run

- 1) Push the screwdriver, chaining pin, or large spike into the ground through the hook on the zero end of the reel tape measure at point A.
- 2) Measure the distance between points A and B; this will give you the run (horizontal distance). This distance should be the approximate width of the absorption area for an in-ground system or the distance from toe of berm to toe of berm for an elevated system.
- 3) To accurately measure the run, the reel tape must be pulled level as shown in the drawing above.

Measure the Rise

- 4) Standing at point B, line up the leveling bubble on the cross hair in the lock level. Slide the lock level up or down the measuring rod until the cross hair is lined up on point A.
- 5) Once this position is achieved, read the number on the measuring rod. This is the rise (vertical distance).

Calculate the Percent Slope

- 6) Calculate the percent slope by dividing the vertical distance by the horizontal distance and multiply by 100 for percent slope.

$$\frac{\text{Rise}}{\text{Run}} \times 100 = \text{percent slope}$$



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ABNEY LEVEL

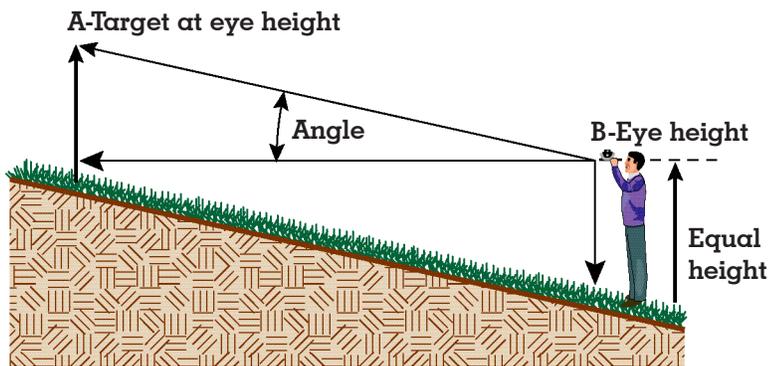
The angle is measured directly with an Abney level.



NOTES



TOOL: A target at the same vertical distance above grade as your eye height. For example, a measuring rod or tape around an object such as a tree or stake.



PROCEDURE:

- 1) Set up your target at point A.
- 2) Measure the distance between points A and B; this will give you the run (horizontal distance). This distance should be the approximate width of the absorption area for an in-ground system or the distance from toe of berm to toe of berm for an elevated system.
- 3) Standing at B, look through the eyepiece of the Abney level and sight the target at point A. Slope may be measured up or down hill with an Abney level.
- 4) Line up the cross hair on the target, and turn the thumb screw on the Abney level until the bubble lines up with the cross hair.
- 5) Read the percent slope directly off the dial indicator.

CLINOMETER

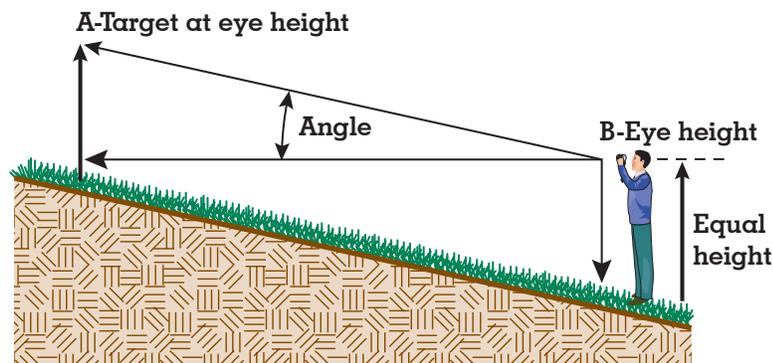
The Clinometer, like the Abney level, works on the same principle of measuring the angle directly.



NOTES



TOOL: A target at the same vertical distance above grade as your eye height. For example, a measuring rod or tape around an object such as a tree or stake.



PROCEDURE:

- 1) Set up your target at point A.
- 2) Measure the distance between points A and B; this will give you the run (horizontal distance). This distance should be the approximate width of the absorption area for an in-ground system or the distance from toe of berm to toe of berm for an elevated system.
- 3) Standing at the other end of slope (B), look through the eyepiece of the Clinometer with one eye, and look at the target with the other eye. Both eyes must be open for the Clinometer to work. Sight (either upslope or downslope) at the target at point A.
- 4) While looking into the eyepiece, line up the cross hair with the target and read the percent slope directly from the scale in the clinometer.

LASER LEVEL/BUILDER'S LEVEL/TRANSIT

The laser level measures the exact elevation change. The vertical and horizontal distances are used to calculate slope.



Warning: Never look directly into the laser light as doing so could cause permanent eye damage or blindness.

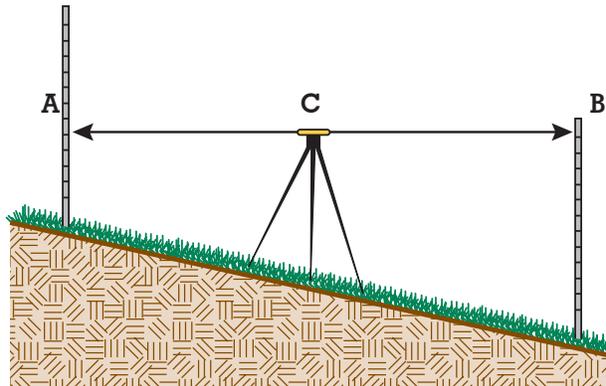


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TOOLS:

- 1) Measuring rod with target
(purchase as part of package with laser)
- 2) Reel tape measure of 100 feet or greater



PROCEDURE:

- 1) Set up the laser level at a location close to the proposed absorption area, where you have unobstructed sight to points A and B.
- 2) Pull the tape measure level, as you would with the lock level, to measure the run (horizontal distance) between A and B. This distance between A and B would be the width of the absorption area.
- 3) Walk to the highest vertical point of the absorption area (A). Hold the rod exactly vertical, or plumb, at A, and move the sighting target up or down on the rod until the laser beam strikes the target at A, creating an audible sound. Record the elevation measured.
- 4) Walk to the lowest part of the absorption area (B). Hold the rod exactly vertical, or plumb, at B, and move the sighting target up or down on the rod until the laser beam strikes the target at B, creating an audible sound. Record the elevation measured.
- 5) Subtract the elevation measured at A from the elevation measured at B. The difference between these two elevations is the rise (vertical distance).
- 6) To calculate percent slope, divide the rise (vertical distance) by the run (horizontal distance) and multiply by 100.



NOTES

Example: At the top of the slope (A), you read 6 feet on the measuring rod. At the bottom of the slope (B), you read 12 feet on the measuring rod. Your horizontal distance is 75 feet.



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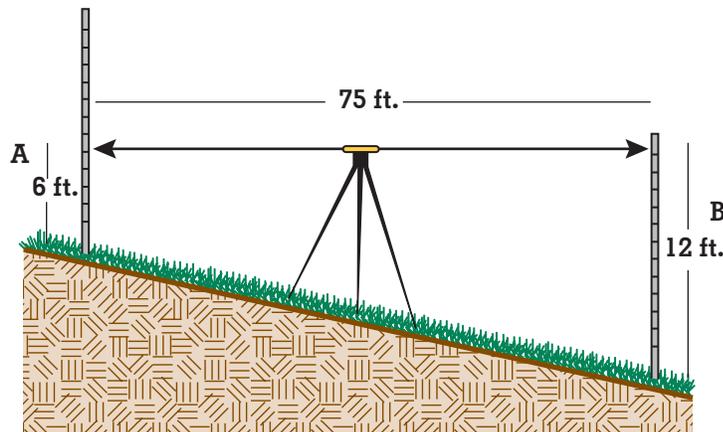
Greatest vertical reference – smallest vertical reference = vertical distance

Vertical distance \div horizontal distance = slope

Slope \times 100 = percent slope



What is the percent slope?



CALIBRATE THE SLOPE-MEASURING INSTRUMENT

- Periodically check your slope-measuring instrument to ensure that it is measuring slope accurately.
- Check the manufacturer's instructions on how to calibrate the instrument.
- Set up a known slope somewhere, such as your home or office, to frequently check the accuracy of your instrument.



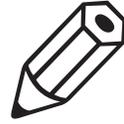
NOTES

Locations To Measure Slope From

KEY TERMS

The _____ is part of the onlot sewage disposal system. It is the aggregate-filled area where the effluent seeps into the soil.

In a sand mound, the _____ of the _____ is the edge of the soil material that is placed around the sand. The berm holds the material in place.



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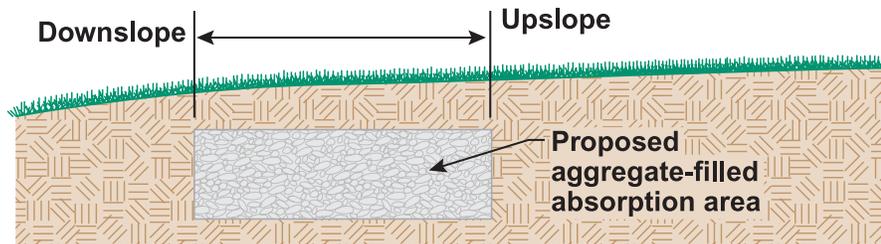
1) IN-GROUND SYSTEM

For an in-ground system, slope is measured from the extremity of aggregate on the upslope side to the extremity of aggregate on the downslope side.



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PROPOSED IN-GROUND SYSTEM



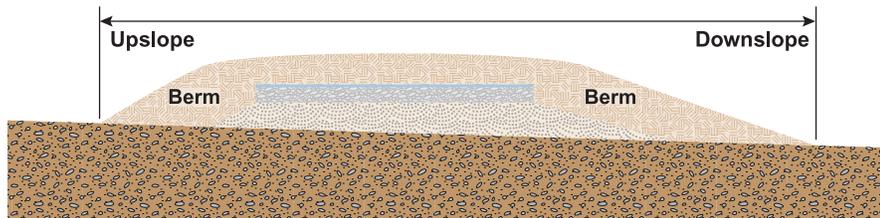
2) ELEVATED SYSTEM

For an elevated system, slope is measured from extremity of the berm on the upslope side to extremity of the berm on the downslope side. The steeper the slope, usually the larger the berm.

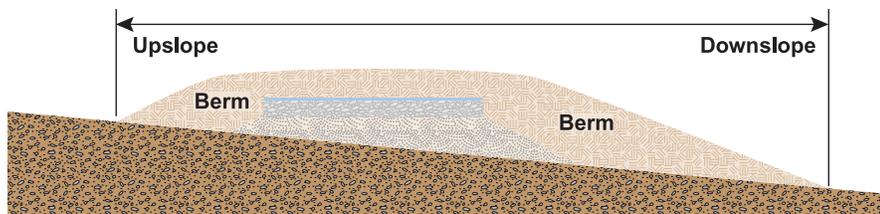


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PROPOSED ELEVATED SYSTEM - Gradual Slope



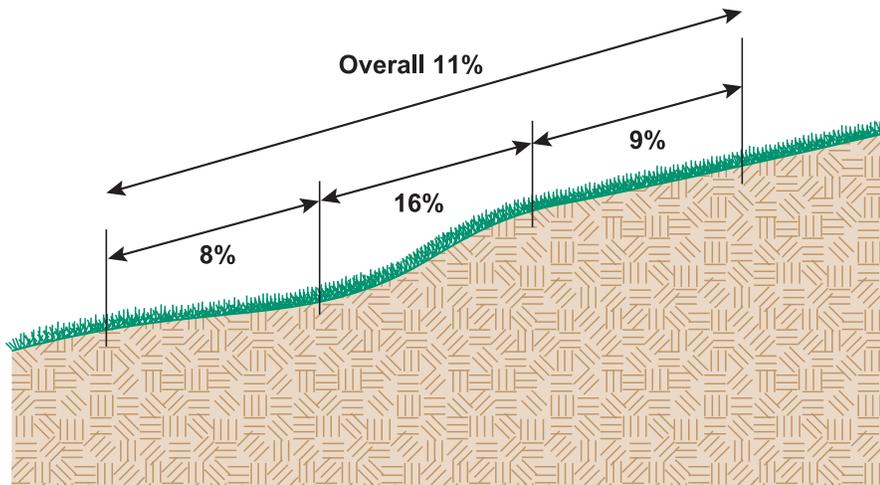
PROPOSED ELEVATED SYSTEM - Steep Slope



3) MEASURE THE STEEPEST SLOPE

If the slope varies, differs, or changes over a large portion of the area being measured, then the steepest, or maximum, slope must be used.

In the diagram below, 16 percent is the slope used because it is the steepest, or maximum, slope in the area being considered.



NOTES

Maximum Slope

25 percent is the maximum slope for a site to be approved for an onlot sewage disposal system. When the slope is close, accuracy is very important. Make sure the slope is correctly measured during these situations.

For more information, you can consult page I-A-2 of the slope section of the field manual that lists specific slope requirements for conventional systems.



KEY POINTS

- Slope is one of the first things measured when determining if a site is suitable.
- SEOs must make sure they are measuring slope from the correct location.
- Percent slope is used to help determine what type of disposal area could be placed on the site.



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