SLOPE STAKES, CURB AND GUTTER STAKES

SETTING SLOPE STAKES

Before earthwork construction is started, the extremities of a cut or fill must be located at numerous places for the benefit of machine operators engaged in the earthwork. The toe of the fill and the top of the cut are shown in Figure 1.

With the centerline as a reference, the edge (toe) of a fill must be established on the natural ground. This point is known as the toe of slope. Likewise, the top edge of a cut must be established on the natural ground. Because the natural ground may slope from left to right or from right to left, the distance from the centerline to the left toe of slope of a fill is usually different from the distance from the centerline to the right toe of slope at any particular station. The same is true of the top of a cut. This fact, plus the fact that the height of fill or depth of cut varies along the centerline, makes toe and top lines irregular.

The toe of a fill or the top of a cut is found by a measure and try method. The horizontal distance from centerline to toe or top is determined by horizontal tape measurements combined with vertical distance measurements derived by use of level and rod.

Dimensions of the top of a fill or bottom of a cut, and the slope of the sides of the fill or cut must be known. These are used in the measure and try method.
The side slopes of a fill and the back slopes of a cut are expressed as a ratio of horizontal to vertical distance. Thus, a 4:1 slope means a rise or fall of 1 foot for each 4 feet of horizontal distance. A slope of 2:1 is illustrated in Figure 2.

With the centerline finish elevation, width of top of fill or bottom of cut, and side slopes all known, the intersection of the side slopes and the natural ground is located at each station or intermediate point.

When the intersection is found, it is marked by a slope stake. The stake is driven so that it slopes away from the fill or cut, and is marked with its horizontal distance (left or right) from the centerline, and the vertical distance from the ground at the stake to the finish elevation. A stake marked "C 3.2-48.2" means that the stake is 48.2 feet from the centerline, and the ground at the stake is 3.2 feet above the finish elevation. The station number is shown on the side of the stake facing the ground. Stake orientation is shown in Figure 3.

Figure 3

GRADE ROD

In setting slope stakes, as in setting finish elevation for pavement, sewer lines, etc., the grade rod is used to determine the difference in elevation between the H.I. and the finish elevation. To determine the cut at a particular point, the rod is read on the ground, and the ground rod is subtracted from the grade rod at that point. To determine the fill at a particular point, the grade rod is subtracted from the ground rod if the H.I. is above the finish elevation (Figure 4). The grade rod is added to the ground rod of the H.I. is below the finish elevation (Figure 5).

Figure 4
SETTING SLOPE STAKES AT CUT SECTIONS

An explanation of setting slope stakes without the benefit of a demonstration in the field is difficult. In the following example, a scale drawing is used at a cut section at which the H.I., and finish elevation are known and plotted on the drawing. The width of the ditch bottom and the side slopes (also referred to as back slopes) are also known. In this example, the level and rod are replaced.

EXAMPLE

Figure 6 shows the ground cross-section at a section at a station at which slope stakes are to be set for fill. H.I has been established at 479.24. The finished elevation is 470.45. The width of ditch bottom (12 feet), and sides slopes (2:1) have been obtained from construction plans. Centerline of ditch has also been established at this station. In this example, two unsuccessful tries to locate the
stakes are shown in the space below the cross-section for each side of the centerline. Known information is tabulated.

Finish elevation of ditch bottom = 470.45  
Bottom width = 12 feet  
Side slopes = 2:1  
H.I. = 479.24

**SOLUTION**

**Step 1:** Compute grade rod (G.R.):
G.R. = H.I. - finish elevation  
= 479.24 - 470.46 = 8.78

**Step 2:** Read the rod on the ground (use scale) at the centerline. A rod reading on the ground is known as a ground rod. This centerline ground rod will enable us to find the cut (vertical distance from ground to finish elevation) at the centerline and the horizontal distance from the centerline to the slope stake (on each side) if the ground were level. This distance will be used as a guide to find the actual distance to the slope stake where the ground is not level. Ground rod = 4.1

Cut at centerline = G.R. - ground rod  
= 8.78 - 4.1 = 4.7

**Step 3:** Find cut and horizontal distance from centerline to slope stake on the left side.

a. The horizontal distance from centerline to left stake is equal to one-half the width of the ditch bottom plus the horizontal distance from the left edge of ditch bottom to stake.

b. The slope is 2:1. Therefore, the side slope will rise (from ditch bottom) one foot vertically for each two feet horizontally. For level ground, the vertical rise is the cut at the centerline, which has been found to be 4.7. Therefore, the horizontal distance for level ground is

\[2 \times 4.7 = 9.4\]

The distance from the centerline is

\[6 + 2 \times 4.7 = 15.4\]

c. The ground is not level. The slope is down from left to right, and the left slope stake will be at a greater distance from the centerline than the right slope stake.
d. Use the horizontal distance computed for level ground (15.4) as a guide. Make a first try beyond it because of the slope of the ground.

e. Try a distance of 19.0 feet (chosen arbitrarily) from the centerline and read the rod on the ground at this point. (Use scale for rod). The Ground Rod is 2.7. Then,

\[ \text{cut} = 8.78 - 2.7 \]
\[ = 6.1 \]
\[ \text{distance from centerline} = 6 + 2 \times 6.1 \]
\[ = 18.2 \]

This is not the correct location because the measured distance (19.0) does not agree with the computed distance (18.2).

f. For the next try, move toward the centerline because 19.0 was too far. Try 17.0 where the Ground Rod is 3.2. Then

\[ \text{cut} = 8.78 - 3.2 \]
\[ = 5.6 \]
\[ \text{distance from centerline} = 6 + 2 \times 5.6 \]
\[ = 17.2 \]

g. Try 17.2, where the Ground Rod is 3.2 again.

\[ \text{distance from centerline} = 6 + 2 \times 5.6 = 17.2 \]

We have found the correct location for the slope stake, so we mark if C 5.6 @ 17.2 on one side and the station number on the other. We drive the stake with the station number down and sloping away from the cut.

**Step 4:** Find cut and horizontal distance on the right side.

The slope stake on the right is set in the same manner. In arbitrarily selecting a horizontal distance for the first try, we select a distance less than the 15.4 computed for level ground because the slope is down from left to right.
The correct cut and distance for the right slope stake is shown on the stake marking in Figure 7.