1109 SLOPE STAKES

1109-1 General

Slope stakes may be placed prior to the Contractor clearing the ground in cases of open, grassy prairie, or cultivated land, where a minimum of clearing is required; otherwise, a clearing line should be established and the roadway prism should be cleared prior to setting of slope stakes, or as specified in the special provisions. Exhibit 1109-1-1 demonstrates commonly found slope staking placement codes.

1109-2 Roadway Cross Sections

Cross sections are taken and slope stakes are set for two primary purposes.

1. The sections recorded in a field book serve as a quantity pay document for work performed by the Contractor.

2. The slope stakes outline the cut or fill limits and the slopes to be built for the Contractor.

Cross sectioning and slope staking are usually performed at the same time. Usual practice is to cross section and stake at all full and 50 foot (15 meter) stations and at all breaks in topography within the roadway section that will effect the calculation of the volumes of excavations and embankments. In desert or reasonable flat terrain, slope stakes, and cross sections may be spaced at 100 foot (30 meter) intervals. (See Exhibit 1109-2-1 for cross section computations).

Slope stakes need not always be set at every cross section, however, all the information needed for calculating quantities must be indicated in the notebook.

Measurements shall be from the centerline and shall be noted in the field book for computations. (See Exhibit 1109-2-2, Roadway Cross Section Book.) In setting slope stakes, the rod is read to the nearest 0.1 feet (3 centimeters) and horizontal distances measured with a metallic tape (if required) at right angles to the survey centerline also recorded to the nearest 0.01 feet (3 millimeters). In heavy work on steep hillsides, special care shall be taken in reading the rod and in setting slope stakes at right angles to the centerline and also in properly measuring the horizontal distances from the survey centerline to the point where rod readings are taken and where slope stakes are set.

The use of hand levels and the Rhode's Arc should generally be limited to determining elevations of inaccessible locations because elevations taken by this method are not as accurate as elevations read with the engineer's level. In rough terrain, parallel profile levels outside of the slope stake lines may be used to check hand level work. It is recommended that electronic instruments are used for this application to increase accuracy.

1109-3 Cross Sections in Cuts

The centerline stake will be marked with the station facing the beginning of the project. The opposite side of the centerline stake shall be marked with the vertical cut which is the vertical distance from the original ground at this point to the construction grade. This cut will be the difference between the centerline profile elevation and the plans subgrade elevation. All significant breaks in the ground surface and all breaks in the construction grade template are to be recorded in the cross section field notes. A slope stake shall be set where the cut slope intersects the existing ground surface. (This is known as the "catch point".) The slope stake will be marked on the back side with the appropriate stationing. The inside of the slope stake will bear

the letter "C" (indicating that a cut is to be made, the amount of cut to be made at that particular point, the horizontal distance from the centerline to the slope stake, and the slope ratio).

During the excavation operation, the life of a slope stake is short due to equipment operation. Therefore, a reference to each slope stake in a cut section should be set as follows:

- A guinea shall be driven flush with the ground, outside the slope rounding area, and preferably at an even horizontal distance from the slope stake; a 10 foot (3 meter) offset is usually adequate; if not, additional increments of 10 feet (3 meters) is suggested.
- A guard stake shall be driven behind the guinea. (A guinea is a small stake driven flush with the ground surface.) The back side of the guard stake shall show the station of the section. The front side shall show the cut at the slope stake and the horizontal distance from the slope stake to the reference.

Slope rounding shall be staked to conform to the roadway standards when slope rounding is required. (See Exhibits 1109-3-1 and 1109-3-2)

1109-4 Cross Sections in Fills

Rod readings and horizontal distances should be recorded at all significant breaks in the ground line in fills and in cut sections. In most cases, it is not necessary to offset the fill slope stake except where the fill will catch on a traveled roadway. In this event, a guinea should be driven flush with the ground at the point where the toe of the fill intersects with the natural ground (catch point). The slope stake shall be placed back of the guinea and out of the traveled way at right angles to the centerline. The marking shall show the stationing of the section on the back of the stake; the front face shall show the letter "F," to indicate fill, with the amount of the fill from the guinea to the grade, the horizontal distance from centerline to the guinea and the ratio of the fill slope to be constructed.

A slope stake marked 0.0 should be driven at the shoulder grade point on entering a cut from a fill or vice versa.

The standard size slope stake is 1 in. X 2 in. X 14 in. (2.5 cm X 5 cm X 35 cm).

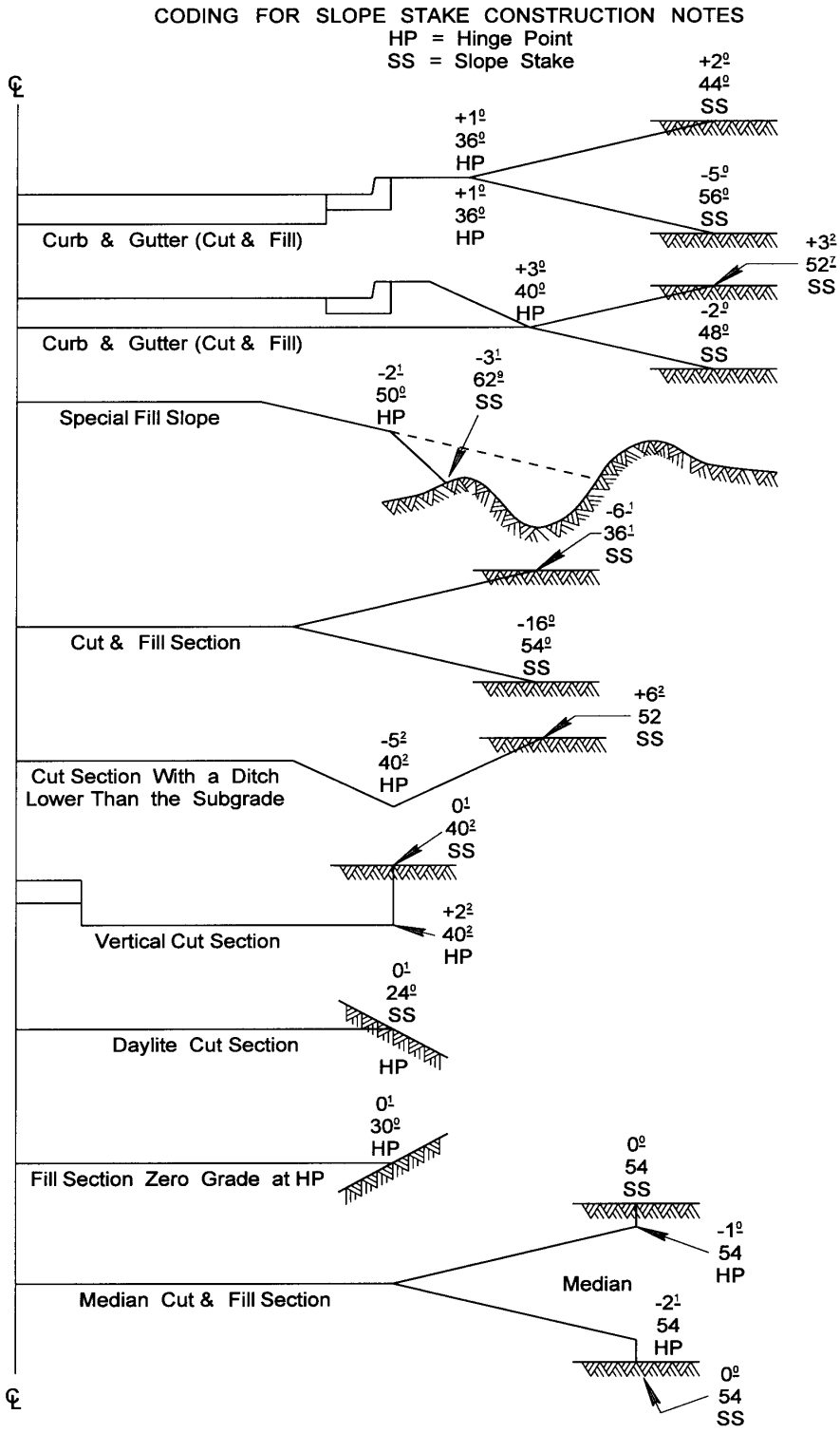
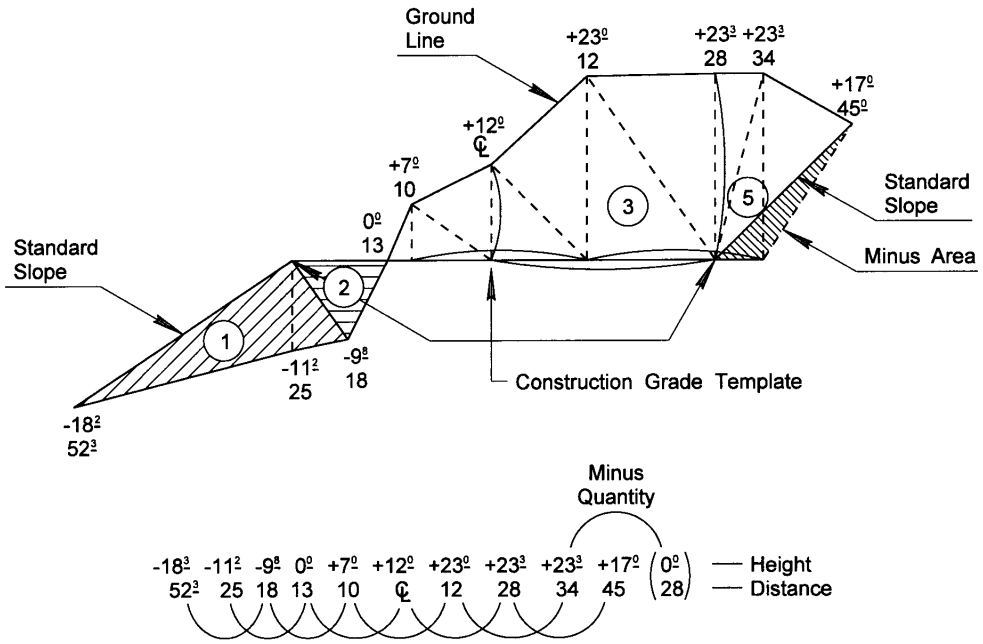


Exhibit 1109-1-1. Slope Staking Coding & Placement



EMBANKMENT

34.3 x 11.7 + 12.0 x 9.8 = 518.91 (Double Area)

(1) (2)

EXCAVATON

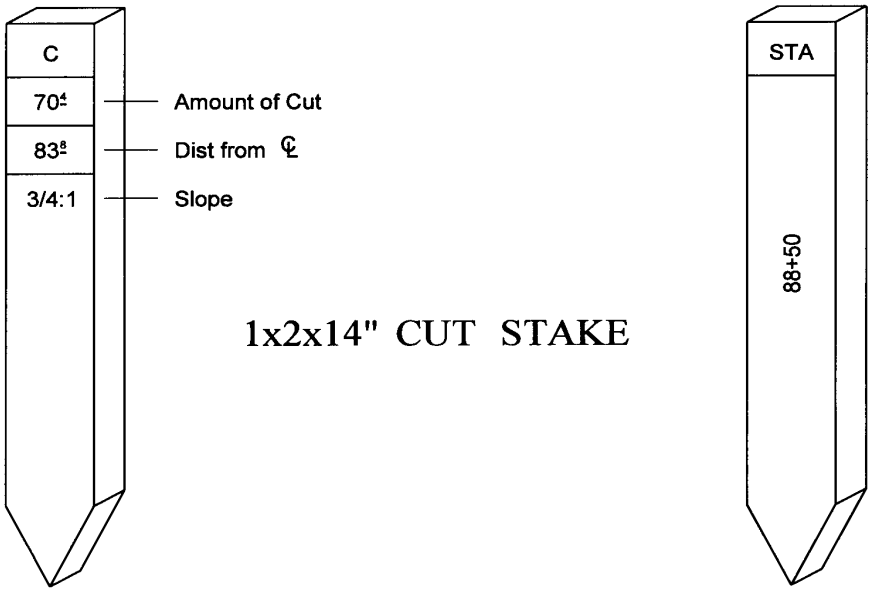
13.0 x 7.0 + 22.0 x 12.0 + 28.0 x 23.0 + 22.0 x 23.3 + 17.0 x 23.3 - 6.0 x 17.0 = 1805.70 (Double Area)

4 (3) (5)

Exhibit 1109-2-1. Cross Section Computations

Station											GR	EL
88+50	$+88^{0}$ 106^{0} RS	($+70^{4}$ 83^{8} SS 3/4:1)	$+32^{8}$ 31^{0} HP	$+31^{3}$ 23^{5}	$+19^{6}$	$+5^{1}$ 29^{5}	$+2^{6}$ 37^{0} HP	($+2^{0}$ 38^{5} SS 3/4:1)	$+5^{4}$ 53^{0} RS	4199 04	3967.48	87.08
										4002 15		
89+00	$+79^{4}$ 101^{8} RS	($+68^{2}$ 82^{2} SS 3/4:1)	$+41^{1}$ 31^{0} HP	$+23^{9}$ 23^{5}	$+19^{7}$	$+6^{3}$ 29^{5}	$+1^{8}$ 37^{0} HP	($+1^{0}$ 37^{8} SS 3/4:1)	$+6^{0}$ 49^{0} RS	4445 61	3969.34	89.04
										4295 92		

Exhibit 1109-2-2. Roadway Cross Section Book



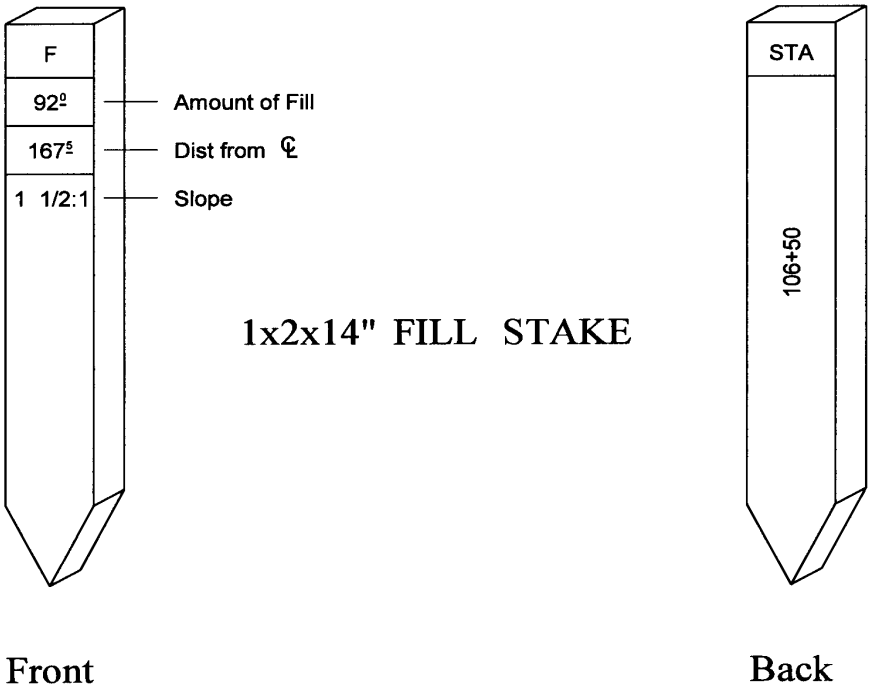
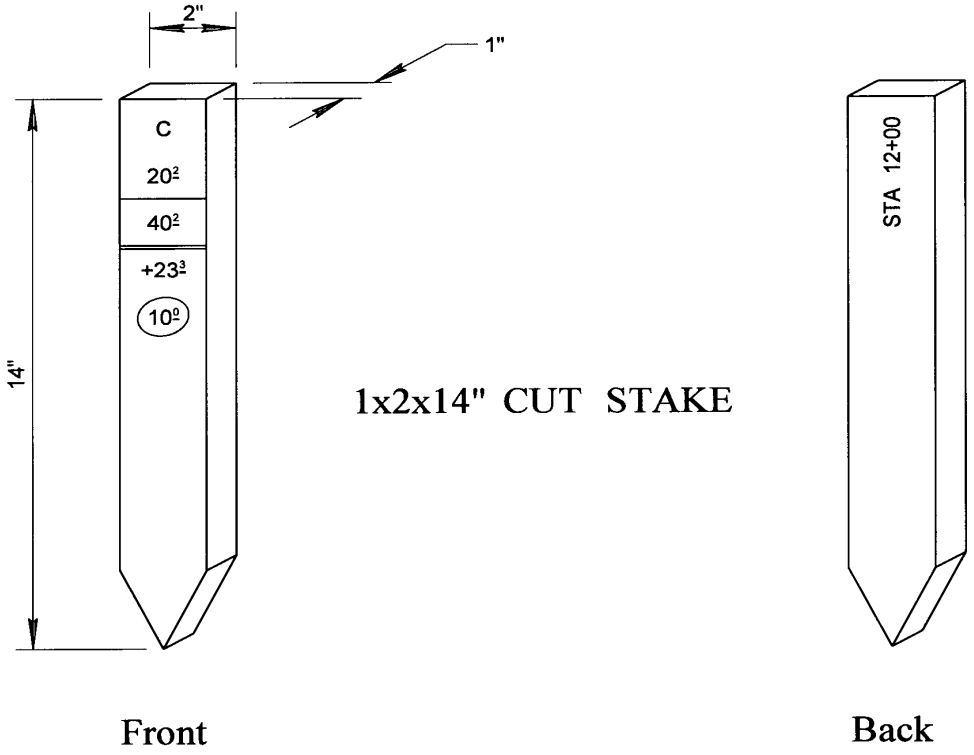


Exhibit 1109-3-1. Marking of Slope Stakes



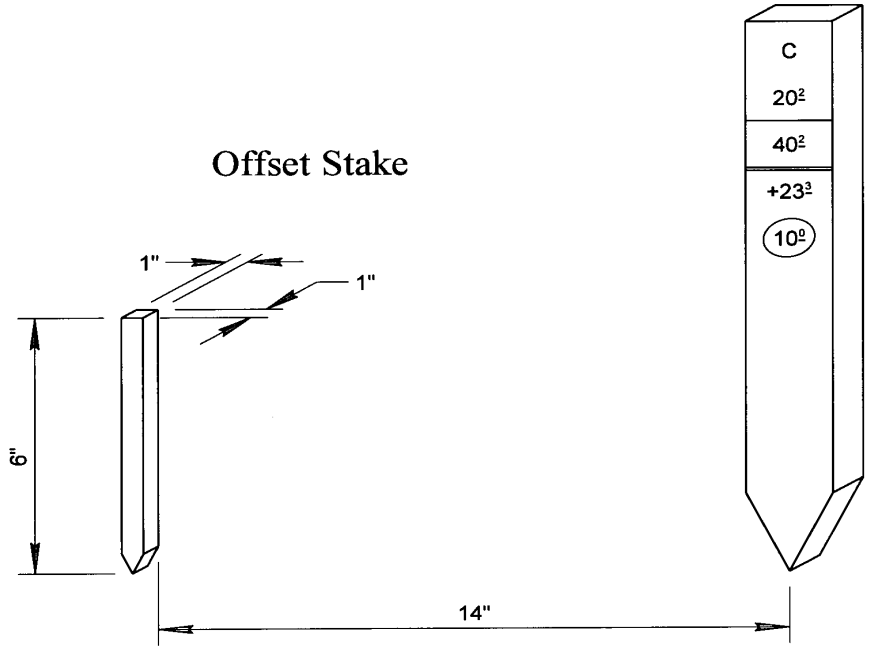


Exhibit 1109-3-2. Slope Stake Offset Alternate