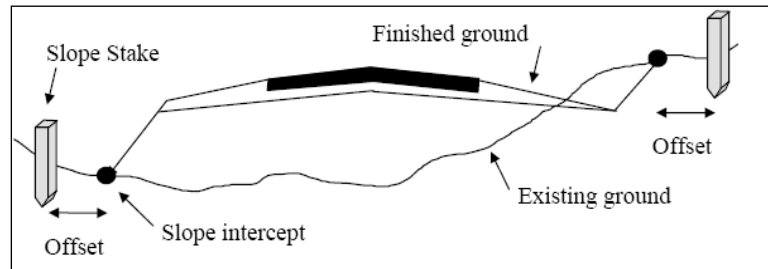


## SECTION 762 Slope Staking

Slope stakes mark the outer limits of grading on a construction project. Slope stakes mark, using a standard offset, the point where the proposed back slope of a cut or fill intercept with the existing ground. This intercept with existing ground is known as the slope intercept. Slope stakes must be set and maintained on each side of the road at each cross-section location shown in the plan. Slope stakes mark the outer limits of the grading and are set to indicate the point where the back slope or the fill slope intersects the natural ground or are offset from that point.

FIGURE 762-1 Slope Stakes



Slope stakes are the control points from which the contractor takes horizontal and vertical measurements for use in constructing the rough grade of the earth. Contractors using GPS machine guidance generally do not use slope stakes to construct the grade and ditches. However, the slope stakes provide important reference for the engineer and subcontractors, so they should continue to be provided at all cross-section locations.

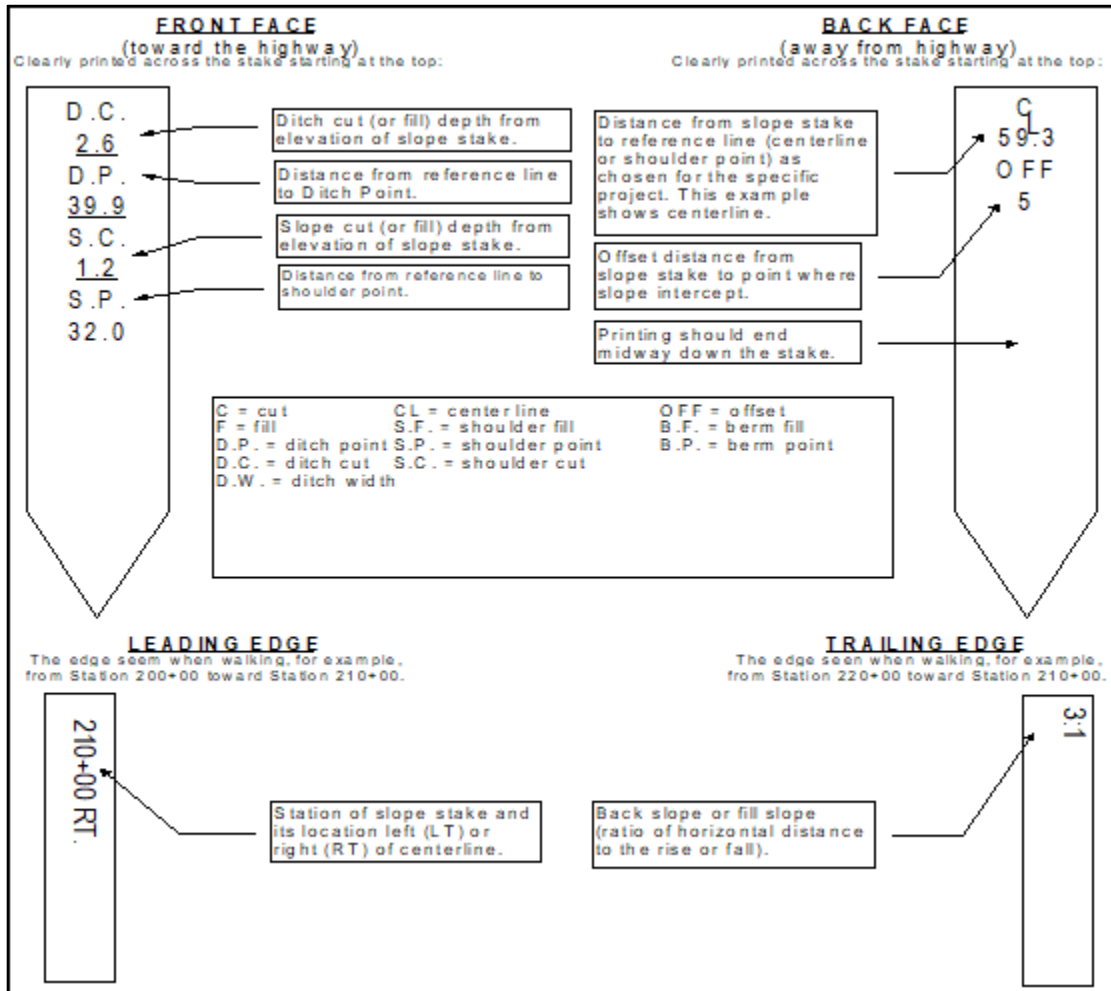
Stakes show the cut or fill from the ground elevation at the stake to the elevation of the finished subgrade at the road centerline or at the shoulder or other predefined point. A "cut" marking on the stake designates the vertical distance the ground at the stake is above the finished subgrade. Elevations are generally marked to the nearest tenth of a foot. A "fill" marking designates the vertical distance the ground at the stake is below the finished subgrade. Either the shoulder subgrade or the centerline subgrade may be referenced in setting the stakes. Whichever is chosen must be used consistently throughout the project and the grading contractor and engineer must be informed accordingly.

**TABLE 762-1 Slope Staking Process**

Slope Staking Process	
1.	Locate information in the approved plan. <ul style="list-style-type: none"> <li>- Plan and profile sheets</li> <li>- Typical sections</li> <li>- Cross section details</li> </ul>
2.	Prepare slope stake field book. Include items shown in the general section of this manual and: Refer to <a href="#">CMM 160</a> of this manual for general field note information. <ul style="list-style-type: none"> <li>- Station of stake</li> <li>- Slope intercept elevation from cross sections</li> <li>- Offset distance slope stake to actual slope intercept</li> <li>- Offset slope stake to centerline from cross sections</li> <li>- Benchmarks</li> <li>- Other pertinent information should be included in the field notes</li> </ul>
3.	Re-establish centerline, if necessary, from control points.
4.	Verify benchmarks used for staking before use. Document these checks in the field book.
5.	Establish slope intercept location in field from slope stake field book. Record actual elevation of ground at this point in slope stake field book.
6.	Compare ground elevations at slope intercept and slope stake to plan elevations recorded in the slope stake field book. The project may warrant additional existing ground elevation, obtained from plan cross-section sheets, to verify project plan (existing section) to actual field conditions. Always discuss with the project engineer and grading contractor any additional elevation verification they may foresee to the specific project. Elevation must be within 0.4 foot of the plan elevation to be considered acceptable. If acceptable: continue to step 7 If not acceptable: The true slope point needs to be located. <ul style="list-style-type: none"> <li>- Do not set out a slope stake.</li> <li>- Set a stake or mark on the reference line at the bad station.</li> <li>- This station may need to be re-cross sectioned again.</li> <li>- The staking contractor needs to inform the engineer of the questionable sections in order to determine appropriate action to be taken. The engineer should consider going back to the designer to determine if a greater problem exists, and to help with corrective action. The engineer determines who will perform the re-cross section work. Any re-cross section work can be performed by the department, the staking contractor, or by a consultant under a surveying master contract with the department, using WisDOT digital data standards. If the work is performed by the staking contractor it should be considered as extra work.</li> <li>- The engineer will plot the correct original ground line to determine the true slope intercept location.</li> </ul> If a plot is off for a significant number of stations, a recheck of the benchmarks and their adjustment may be necessary to preserve integrity of the plan. Any benchmark and grade adjustment must be brought to the attention of the engineer and documented in the field notes.
7.	Set out slope stake at the project offset distance beyond the intercept location.
8.	Establish elevation on the ground at the offset stake.
9.	Record elevation of ground at this point in field notes.
10.	Mark stakes Stake may include: <ul style="list-style-type: none"> <li>- Station of stake</li> <li>- Elevation on ground at slope stake</li> <li>- Slope stake distance to centerline</li> <li>- Offset distance to actual slope intercept</li> <li>- Cut or fill to predefined location (ditch cut, etc.)</li> <li>- Rate of slope</li> <li>- Ditch cut and shoulder width may also be included when appropriate</li> <li>- Other pertinent data</li> </ul>
11.	Keep neat and accurate field notes and give to engineer when not in use. <ul style="list-style-type: none"> <li>- Include all elevations, distances and calculations used to determine cuts and fills in the field book.</li> </ul>

To ensure against disturbance during the construction operations, the stake is offset or set back a short distance from the actual point where the constructed slope intercepts existing ground, usually 5 feet. It is desirable that all slope stakes for a given project be offset the same distance. The cut or fill is computed from the elevation of the ground at the offset stake. The surveyor should establish the offset distance and stake marking in consultation with the grading contractor and the engineer.

**FIGURE 762-2 Example of Marking Stakes and Lath for Slope Staking**

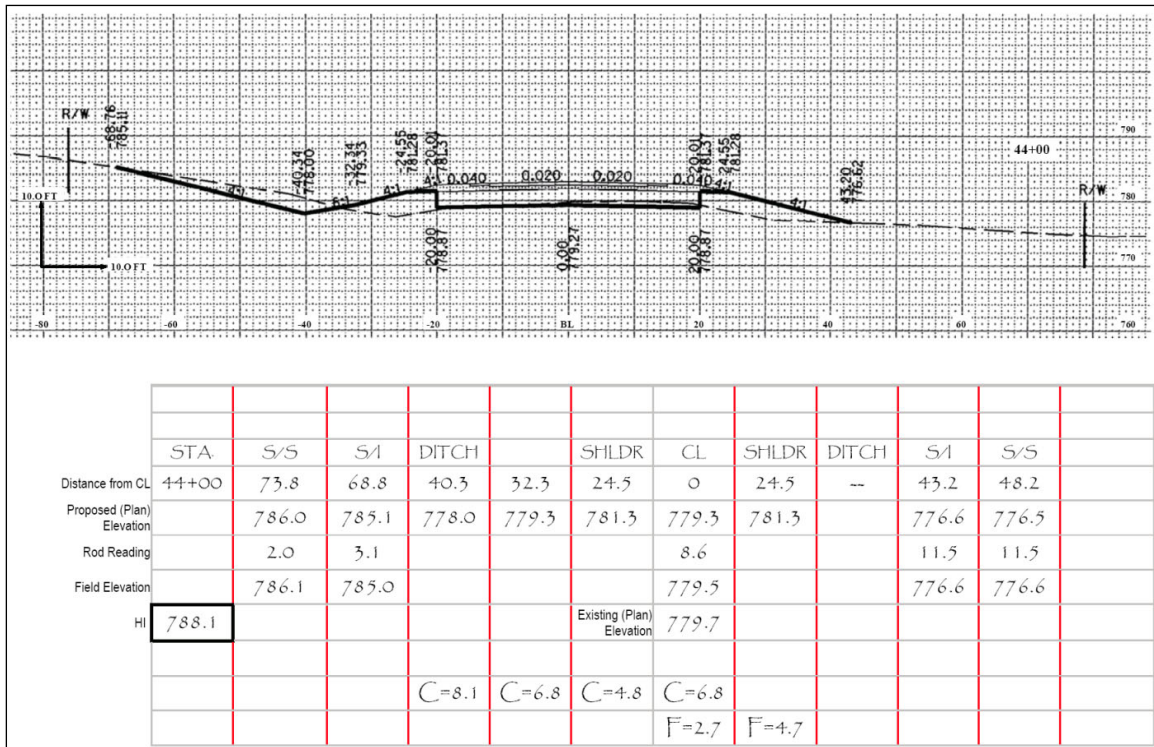


In certain situations, a standard offset or baseline may be the format the grading contractor wants. These stakes provide cuts and fills but are a uniform distance from the reference line. They are more commonly used in urban projects.

**762.1 Slope Staking Notes**

Staking notes, referred to as a "slope stake field book", should be prepared by the staking contractor before the time the staking crew sets the slope stakes. Notes may be in the form of digital file for data collectors, computer printout, or set up in a field book. The surveyor should discuss the desired format with the engineer and the grading contractor before setting stakes.

**FIGURE 762-3 Example Slope Staking Field Notes**



The slope stake book should contain plan and field elevations, slopes, and distances. The slope intercept distance from the centerline must be determined. There are two methods to find this distance.

1. The first is to use the approved plan cross sections. The distance from the centerline and the elevation of the slope intercept can be "picked" off the cross sections.
2. The second is to have a computer program generate the report including all points needed. This report should be cross-referenced to the approved plan.

The engineer may be able to provide a digital file or computer printout for the staking contractor's use. The slope stake book must be made available to the engineer and grading contractor for the duration of the project.

### 762.1.1 Requirements

Slope staking for each phase of construction must be 100% complete and acceptable to the engineer and grading contractor before earthwork for the particular phase is started. If slope staking is not completed, construction must be stopped until the staking is complete. This will ensure the earthwork quantities will be calculated and any required earthwork changes are made in a timely manner.

After stakes have been set, it is useful to sight along the slope stakes to check for major breaks in staking. Unless the terrain has sharp breaks in elevation, transitions between stakes should be smooth and in harmony with the rise and fall of the land. Stakes which do not follow this pattern should be checked to the corresponding plan cross-section for an elevation or offset error.

The staking contractor should contact the grading contractor for the preferred offset distance from actual slope intercept to slope stake and grade line to be referenced (ditch line, centerline etc.) before beginning to stake. This offset and grade references should be consistent throughout the project. Also discuss what information should be included on stakes.

The staking contractor should check with the engineer for changes to the approved plans before doing any staking or grade computations.

### 762.1.2 Slope Stake Report

The slope stake report is used by the surveyor to help set the slope stakes. It is used to verify existing field conditions and compare plan to field elevations. The report is also a useful tool to help calculate yardage quantities for contractor payment.

**FIGURE 762-4 Caice Slope Stake Report**

CAiCE Slope Stake Report						
Alignment Used for Station and Offset: SICL1						
STATION	OFFSET	PLAN ELEV	FIELD ELEV	C/F	POINT TYPE	SLOPE
=====	=====	=====	=====	===	=====	=====
44+00.00	-73.76	786.00			SS	
	-68.76	785.11			SI	
	-40.34	778		C	DPLT	1: 4
	-32.34	779.33				1: 6
	-24.55	781.28			SHLD	1: 4
	-20.01	781.37				0.02 ft/ft
	-20	778.87				VERTICAL
	-12	779.03				0.02 ft/ft
	0	779.27				0.02 ft/ft
	12	779.03				-0.02 ft/ft
	20	778.87				-0.02 ft/ft
	20.01	781.37				VERTICAL
	24.55	781.28				-0.02 ft/ft
	43.2	776.62				1: 4
	48.2	776.50		F	SS	

Note: Slope Stake (S/S), Slope Intercept (SI), and Center Line (CL) elevations need to be within 0.40 foot when comparing plan to field elevations. If the elevation at the slope intercept is off by more than 0.40 foot, notify the engineer. Contractor may also want % of slopes, subgrade elevations, etc. Discuss with the contractor and agree on content before making slope stake book.