

1300.02 CONSTRUCTION STAKES

A. General - Construction Staking

1. Construction surveying represents a large proportion of the construction engineering cost and, therefore, requires study to eliminate all needless refinements. The goal to be reached is a satisfactory project constructed according to the approved plans with a minimum of cost. Centerlines, right-of-way monuments and benchmarks should be established within recognized limits. Other stakes should be established to standards commensurate with their use.
 - Rt or Lt is relative to stationing – align yourself looking up to next higher station number to determine left or right.
 - The Department usually stakes the ROW as needed for the relocation and location of utilities before the contract is awarded. Utility companies need references to determine how to move their property before the project begins.
 - Utilities may damage stakes—communicate the Departments desire to maintain stakes and require utilities to relocate damaged stakes where possible.
 - The project manager needs to communicate with the contractor to determine where the contractor plans to start work. With good communication, the Project Manager should be able to accommodate the contractor's need for stakes within time requirements specified in the contract.
 - Today the centerline is generally defined by coordinates however, it is still significant in the majority of the construction staking.
 - The survey crew should set the construction stakes as far ahead of the contractor as practicable. The Project Manager must have the area staked sufficiently in advance to avoid construction delays.
 - The stakes provide the contractor the construction lines and grades and also serve as an inspection guide.
 - Stakes must be accurate.
 - Keep communication with the contractor open so if a change is necessary, staking will not delay the project.
 - The contractor shall be responsible for the protection and integrity of the stakes after placement. The contractor shall take the necessary measures to achieve this.

- All preliminary survey results go to Ken Hartwig, Geodetic Survey Section. Ken checks the data then passes the data onto both Kurt Svoboda, Right-of-Way, and to the Roadway designer responsible for the project.
 - ROW surveys are generally done as part of the Preliminary survey. However, Gene Thomsen does many of the ROW surveys.
 - Hydraulic surveys are also part of the Preliminary survey and the data is provided to Don Jisa,
- The Geodetic Survey Section does Photogrammetric surveys. The Photogrammetry Section plots/maps the survey data.
- GPS Pairs are permanent monuments.
 - On each project the Geodetic Survey Section will provide a GPS pair at the beginning, end and every 2-3 miles along the project.
 - Usually the monuments are offset 500-1,000' left and right of the centerline.
- The GPS establishes the state coordinate system.
 - HARN was created in 1995 with the help of a National Geodetic Survey, which established a grid of accurate points across Nebraska based on GPS sightings.
 - Contact the Bridge or Roadway Design Division if you need the coordinates of any point.
- Geodetic surveys are expensive.
 - Preliminary surveys are estimated at 200 hours per mile in rural areas \pm correction factors.
 - Preliminary surveys are estimated at 800 hours per mile in urban areas \pm correction factors.
 - If a contract survey is estimated above in-house time allocations, try to find a way to do the work in-house.

B. Minimum Survey Requirements

Each project is unique and has different survey requirements. Table 1300.2 describes the common stakes. Table 1300.3 explains the minimum stakes necessary and their appropriate location in normal conditions for the item listed. Table 1300.4 shows the minimum placement intervals for stakes. Finally Table 1300.5 shows how to stake structures (Bridges & culverts).

Table 1300.2 STAKE DESCRIPTION*	
STAKE	DESCRIPTION
Hub (Right of Way)	1" x 2" x 18" (oak)
Hub (Blue Tops)	2" x 2" x 9" (oak) or 1" x 2" x 18"
Hub (Paving Hubs)	2" x 2" x 9" (oak)
Guard Stakes for Marking/Describing Hubs	1/2 " x 2" X18"
Information Stakes For Use in Right of Way, Structures	1" x 2" x 18" (pine)
Slope Stakes	1/2" x 2" x 18" (pine)
Lath (marks hub/guard sites)	1/2" x 2" x 48"
Pink Ribbon	Delineates lath or other objects for visual locating.
Wire Flags – Pink	Marks Bluetops, Paving Hubs, ROW, Structure Stakes, etc.
Rebar	5/8" x 36" Used in establishing control points, ROW breaks.
Aluminum Caps	Placed on rebar to accurately establish a given survey point and stamp point information.

*Ground conditions may require other sizes and or types of stakes, than those indicated.

STAKE DEFINITIONS

Table 1300.3

	DESCRIPTION	PURPOSE
HUB LINE	1" x 2" x 18" oak/pine hub stake set usually at 100' intervals or at plan cross section locations between ROW breaks on the ROW boundary. The hub is protected with a 1" x 2" x 18" guard stake with station/offset information, and a ½" x 2" x 48" pine lath.	Establishes the boundary of the Department property, shows the offset location of the centerline and shows stationing. Also may be used to define rough grading. May also be used to mark temporary and permanent easements.
ROW	½" x 2" x 18" hub or 5/8" or ¾" x 36" rebar rods set at points in the Hub Line where the ROW changes directions (Deflections). Set on PC's, PT's of curves, in Hub Line where tangent sections are over 1,000 feet in length and on hills so ROW may be viewed.	Establishes the boundary breaks of the Department property. Right of Way markers are normally installed on these points by the contractor. (Confirm control points before staking ROW.) Or at ROW hub (See example at Subsection 1300.02 C.)
SLOPE STAKES	½" x 2" x 18" pine stake with lath (optional) and guard stake (optional) with information describing the limits of rough grading. Set on the extreme outside points of the designed cross section where the grading work and natural ground intersect. Usually set at 100-foot intervals and where changes in slopes, roadway width, sharp curves or ditch dimension change. Slope stakes are protected by a wire flag or lath for visibility.	Defines rough grading requirements – cut/fill, slope, offset from centerline, toe of backslope distance, hinge point/shoulder distance and ditch dimensions. A cut or fill to centerline may be written on the back of the stake.
BLUE TOPS (A Subgrade Lath is sometimes used instead of a Blue Top in cases of extreme subgrade overfill or deficiency with the PM's approval)	2" x 2" x 9" or 1" x 2" x 18" oak/pine Hub stake depending on soil conditions with plain, blue or white colored top. Set the stake at finished subgrade elevation and place another stake (short lath) or wire flag near it for protection. Sometimes colored fiber tail ("chaser") is placed atop the stake to aid grader. Generally the Department will not color the top of the hub or place a fiber tail chaser – that is the responsibility of the contractor.	Used to establish the final subgrade elevations and final grading slopes. These stakes are set centerline; edge of mainline roadway (¼ points), & edge of shoulder transversely across the roadway. (Additional stakes are needed on multilane highways.) Bluetops are usually set at 100' intervals longitudinally. Additional blue tops may be set at 50' intervals in cases such as vertical curves, sharp horizontal curves, or slope transition areas. Set Blue tops at the exact finish grade elevation—the contractor must make any adjustment.
PAVING HUBS	2" x 2" x 9" oak/pine hub with a tack set at a contractor specified offset distance from the pavement centerline/edge of pavement. A ½" x 2" x 18" pine stake is driven beside the paving hub which explains offset, grade (cut/fill) and station of the paving hub. Usually set at 50' intervals on both sides of the mainline. In cases of sharp vertical curves, horizontal curves over 1 degree, or transition areas, hubs are set at 25-foot longitudinal increments.	Used to set the string line to guide the trimming and pavement-finishing machines. Grade (cut/fill) is indicated on the stake. Need to determine with the contractor whether the offset is level from the edge of pavement or is the projected slope.
DRAINAGE, PIPE, CULVERT, BRIDGE, WALL, DRIVEWAY, CURB, SIDEWALK AND OTHER STRUCTURE STAKES.	1" x 2" x 18" oak/pine Hub set at a specified offset from the structure being staked. A (1" x 2" x 18") pine guard stake which explains offset, grade (cut/fill) and station of the paving hub and a ½" x 2" x 48" lath stake is driven beside the hub for visibility and protection. On long pipe runs usually for storm sewers, offset stakes are set at 50' intervals.	Shows the location of structures in terms of project stationing and offset distances.
SHIM SHOTS	Points on a girder. At locations directed by the Bridge Division. Use a paint mark to mark location.)	Used to determine the final grade of the bridge deck. (Make sure all the Bridge Division knows where on the girder the points were taken.) The actual shim amount is shown with a black marker on steel girders and with paint on concrete girders.
STATIONING LATHS	½" x 2" x 48" pine stake (lath). Usually only needed on asphalt overlay projects.	Defines the project stationing. Usually placed before the subgrade is set to help define/establish pavement quantities. Offset near edge of shoulder.
PAVEMENT STAMP	Imprinted station number on pavement. (3" brass number stamps imprints in plastic concrete). Place stamp every 100-foot or 20-meters. Normally place on the right side, progressing up stationing so the stamp can be read from the shoulder. Avoid rumble strip location.	Defines the project stationing.
ALIGNMENT POINTS OR CONTROL POINTS	May be ¾" or ½" x 36" rebar for permanent points; a 60d spike for a less permanent point; or frequently a 1" x 2" x 18" oak/pine hub with a tack. ½" x 2" x 48" pine stake (lath) is used to protect the hub.	Defines the centerline alignment. Such as the beginning or ending of a curve, or the point of deflection of two tangent segments. Control points may also be offset from the centerline at various locations and are tied to the highway with coordinates.

MINIMUM SURVEY REQUIREMENTS

Table 1300.4

MAJOR CONSTRUCTION						
TYPE OF STAKE	LOCATIONS	LEVEL GRADE (feet)	HORIZ. CURVES >2 degree ($r \leq 2865'$) (feet)	HOR. CURVES <2 degree ($r \geq 2865'$) (feet)	SHARP VERT. CURVES (feet)	OTHER REQUIREMENTS
Hub Line	Hub, guard and Lath set between ROW Breaks on the ROW boundary	HL(100')	HL(100')	HL(100')	HL(100')	Hubs may be "graded" to centerline for use by the grading contractor.
ROW	Hubs or Rebar rods, guard and lath set at points in the hub line where the ROW changes direction (deflects).					Set a stake at each break point; on level ground every 1000-feet; at Control points; and at the top of hills to provide Line of Sight and at other locations described in Subsection 1300.02. .
Slope Stakes	Slope stake and wire flag or lath to be set at the extreme outside points of the designed cross section where the grading work and the natural ground intersect.	SS(100')	SS(100')	SS(100')	SS(100')	Changes in roadway width, slopes, ditch dimensions or sharp curves may require additional slope stakes.
Blue Tops	White or blue topped hubs with wire flag or colored fiber tail (chaser) set to final grade elevations across subgrade template. Bluetops may be replaced by subgrade lath if approved by the Project Manager. Only a short lath with cut/fill marked on them is placed on subgrade template.	BT(100')	BT(50')	BT(100')	BT(50')	Blue Tops establish the final grading limits. These stakes are set at centerline; ¼ points; & subgrade/foreslope intersection (edge of shoulder). (Additional stakes may be necessary on multilane roads.)
Paving Hubs	Hubs with guard stakes are set at specified offset distance from edge of pavement.	PH(50')	PH(25')	PH(50')	PH(25')	Offset needed for their equipment. Graded to top of proposed pavement surface. (Level or projected grades as required by the contractor.)
Radius Points and Other Control Points	Locate and verify control points and benchmarks from preliminary survey.	As necessary	As necessary	As necessary	As necessary	Add construction benchmarks and roadway alignment as necessary.

PH=Paving Hubs

HL=Hub Line

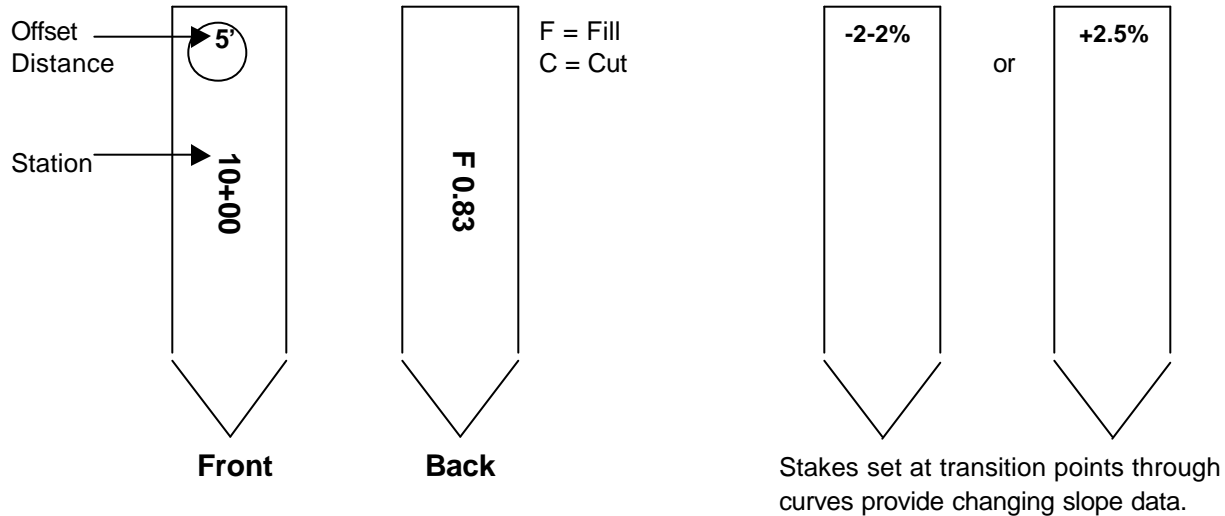
BT=Blue Tops-Final Grading

SS=Slope Stakes

SURVEY REQUIREMENTS Table 1300.5		
STRUCTURES (BRIDGES AND CULVERTS)		
	STAKES LOCATION	
ABUTMENT CENTERLINE	BS (8 each)	Normally two stakes are placed on each side of the bridge at specified distances from centerline of the bridge at each abutment.
WING ENDS	BS (8 each)	Two stakes are placed at specified distances from the end of the wing. These stakes are on the same azimuth as the wing.
PILE LOCATIONS AND ELEVATIONS		Contractor measures from existing stakes to pile locations. Elevations should be verified by the inspector.
PIER CENTERLINE	BS (4 each/pier)	Two stakes are placed on each side of the pier at specified distances from the center of the bridge pier.
GRADE BEAM CENTERLINE	BS (8 each)	Two stakes are placed on each side of the grade beam at specified distances from the center of the bridge.
SHIM SHOTS ON EACH GIRDER	SSR – As Directed By The Bridge Division.	Used to determine the final grade of the bridge deck. (Make sure all the Bridge Division knows where on the girder the points were taken.) The actual shim amount is shown with a black marker on steel girders and with paint on concrete girders.
PIPE CULVERTS	CS (2 each) @ each end of pipe offset as required.	Hub, guard and lath should be placed at a specified offset from the end of the floor on centerline of the pipe, at each end. Any broken back or horizontal break should also be referenced on the end stakes or staked separately.
BOX CULVERTS	CS (2 each) @ each end of pipe offset as required	Hub, guard and lath should be placed at a specified offset from the end of the floor on centerline of the box, at each end. Some contractors may require parapet stakes and wing stakes (mostly on skewed boxes). These should be set at a specified distance to the centerline of the box or end of wing, on the parapet line or wing line. Any broken back or horizontal break should also be referenced on the end stakes or staked separately.
CS=culvert stakes require a hub, guard and lath. BS=bridge stakes may require a hub with nail, information guard and lathe. SSR=shim shot reading		

C. Survey Stake Minimum Requirement Examples—Suggested Format

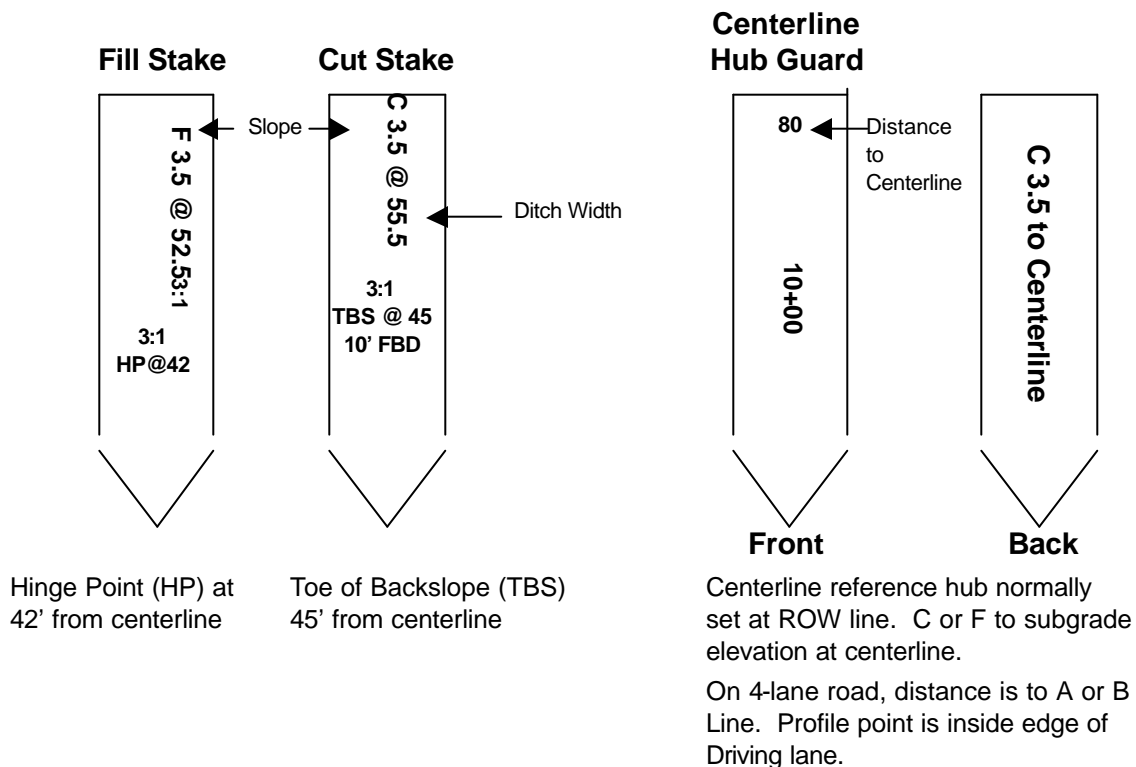
PAVING STAKES



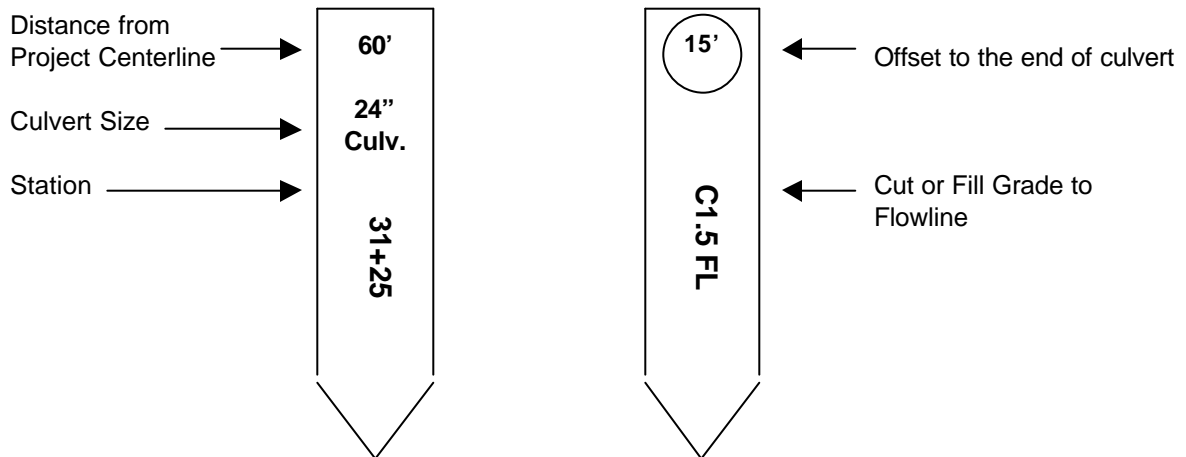
Fill (cut) is to the top of the pavement at outside edge.

Pavement grades may be computed flat from edge of pavement to paving hub, or on projected slope of pavement out to paving hub. Coordinate with contractor for method preferred.

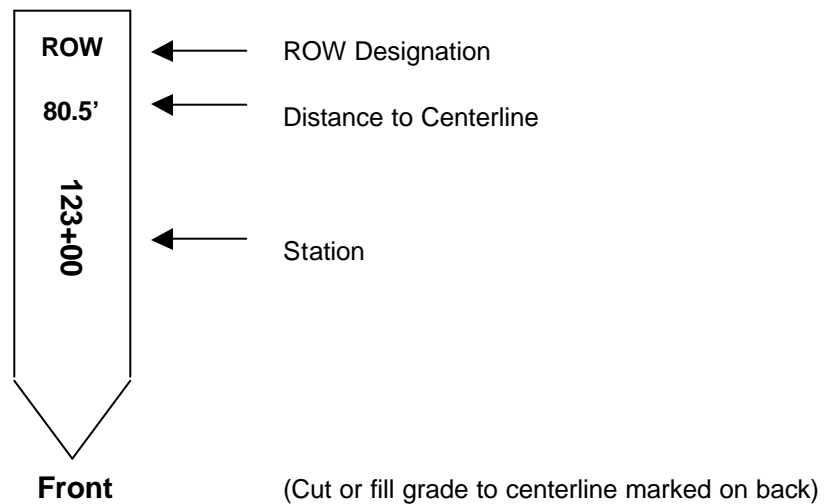
SLOPE STAKES



CULVERT STAKES



ROW STAKES



Hub Flags: Green-Yellow flag for easements.
Orange flag for ROW.