

ATTACHMENT “B”

STANISLAUS COUNTY
CONSTRUCTION SURVEYS

<u>Section</u>		<u>Page</u>
1	General	1
2	Policy	1
	2.1 Responsibilities	2
	2.2 Surveys.....	2
	2.3 Resident Engineer (RE)	4
	2.4 Structure Representative	4
	2.5 Contractor	5
	2.6 Project Engineer.....	5
3	Request for Construction Staking	6
4	Request for Construction Staking Form SC-3013	7
	4.1 Contractor	7
	4.2 Resident Engineer	7
	4.3 Surveys.....	8
5	Restaking	8
6	Alternatives to Normal Staking	10
7.	Automated Machine Guidance (AMG)	10
	7.1 Supplemental Project Control	10
	7.2 Suggested Best Practices for Surveys Include	11
8.	Office Preparation & Preconstruction Conference	11
	8.1 Office Preparation.....	11
	8.2 Preconstruction Conference	12
9.	Stake Tolerances & Field Notes	13
	9.1 Tolerances	13
	9.2 Field Notes	13
10.	Stake Types and Markings	13
11.	Typical Construction Stakes	14
	11.1 Clearing Stakes	14
	11.2 Rough Grade Stakes.....	14
	11.3 Final Grade Stakes	15
	11.4 Staged Construction	15
	11.5 Drainage Stakes	15
	11.6 Curb Stakes	16
	11.7 Major Structure Stakes – Ground	17
	11.8 Major Structure Stakes – Superstructure	17
	11.9 Miscellaneous	18

DEFINITIONS AND TERMS

Contractor	Any person or persons, firm, partnership, corporation or a combination thereof who have entered into a contract with any person, corporation, company, special district, the County of Stanislaus as a party or parties of the second part, or his or their legal representatives, for the construction of any capital improvement within the County of Stanislaus.
Department	Department of Public Works, Stanislaus County or authorized representative
Project Engineer	An authorized representative of the Resident Engineer.
Resident Engineer (RE)	Engineer responsible for the contract administration.
Structure Representative	The Resident Engineer's representative responsible for the satisfactory completion of structures on an improvement project.
Surveys	The Resident Engineer's representative authorized to perform the construction surveys as described in this manual.

1. GENERAL

The Department is responsible for providing construction surveys to establish “control stakes”, also known as “grade stakes” for basic line and grade for project construction unless the contract specifies otherwise. From these control stakes the Contractor sets, when needed, supplemental “working stakes.” The control stakes are also used by the Resident Engineer (RE) or the Structure Representative to check the work for contract compliance.

These survey provisions provide policy, procedures and general information regarding Department-furnished construction stakes—the types of stakes furnished, and their density, placement, and markings. These procedures are subject to requirements in Contract specifications, Contract Change Orders (CCOs), or other provisions approved by the RE.

2. POLICY

The Department’s basic policy regarding Department-furnished construction stakes, as defined by this document is to provide the necessary control stakes to establish the lines and grades required for the completion of the work.

Working stakes used by the Contractor in actually performing the work are the Contractor’s responsibility and are to be set by the Contractor’s forces based on Department-furnished control stakes. Methods used to establish working stakes are at the Contractor’s option. These methods may include any means capable of maintaining the necessary tolerances as required by this manual and/or by the RE. Except for any contractual restrictions, the Contractor has the right to employ reasonable means and methods to execute the work on a project, including the use of Automated Machine Guidance (AMG) equipment.

The density of control stakes, as defined by this manual, will not be increased. When conditions and tolerances for the type of work involved permit, fewer construction stakes will be set, as determined by the RE.

Examples are:

1. Only one set of control stakes describing the final grade may be set to complete a roadway involving minor grading;
2. One set of stakes may be used for both final grade stakes and for curb stakes;
3. Existing pavement may be used to control contiguous widening work, instead of final grade stakes;
4. Control stakes may be set at larger intervals when Automated Machine Guidance (AMG) is used.

Nothing contained in this manual is to be construed to limit the surveyors’ basic responsibilities related to land surveying work as contained in the Professional Land Surveyor’s Act.

2.1 Responsibilities

The responsibilities described in this section pertain to construction surveys. To be fully successful, all parties must act in concert. Each must cooperate to ensure a good working relationship.

Business and Professions Code section 8726(e) provides that a land surveyor has legal authority to:

“By the use of the principles of land surveying determines the position for any monument or reference point which marks a property line, boundary, or corner, or sets, resets, or replaces any monument or reference point.”

All reference points necessary to allow the setting of control stakes will be set by Surveys. All monuments that mark a property line, boundary line, or corner must be set, replaced, or referenced under the responsible charge of a licensed land surveyor per section 8771 (b) of the Land Surveyor’s Act.

Construction stakes must be set under the responsible charge of a licensed land surveyor or civil engineer. Stakes set that are referenced to California Coordinate System (CSS) coordinates must be set under the responsible charge a person authorized to practice land surveying in the State of California.

2.2 Surveys

Construction staking is the responsibility of Surveys. The construction surveys will be performed in cooperation with the Resident Engineer and the Structure Representative.

The following are the responsibilities of Surveys:

1. Reviews site conditions for survey party safety.
2. Ensures conformity with this Manual.
3. Provides horizontal and vertical project control monuments and a project control diagram.
4. Performs construction staking in numeric order as shown on the “Request for Construction Staking” form unless otherwise directed by the RE.
5. Performs construction staking prior to contract award, as determined necessary by the Project Engineer and/or Resident Engineer.
6. Begins staking within 2 working days of receipt of a completed Request for Construction Staking form from the Resident Engineer.
7. Not perform any construction staking without a request signed by the Resident Engineer.
8. Determine that the area is prepared for staking and notify the Resident Engineer if it is not.
9. Set the construction stakes in the order and location requested, noting any changes on the field notes.

10. Complete form (SC-3013), indicating the date(s) that the staking started and was completed, and listing the total surveys crew hours needed to complete any stakes or reset stakes.
11. Sign, date and return completed form with a copy of the field notes for all worked performed to the RE within 2 working days of date staking was completed.
12. Surveyor shall not act upon any staking request that may involve restaking unless a reset is marked by the Contractor or approved by the RE.
13. Surveyor shall notify the RE immediately of any discrepancy with regards to whether a staking request involves restaking.
14. Attends the pre-construction meeting with the Resident Engineer, Contractor and Structure Representative to discuss project control, amount of construction stakes, and any AMG details before construction starts.
15. Performs all Department-furnished construction staking that requires the use of a survey party.
16. Determines the methods and procedures to accomplish the Department-furnished construction staking.
17. Checks data furnished by the Project Engineer for completeness and discrepancies.
18. Checks the conformity of planned lines and grades with existing conditions at pavement “conforms”, curb and gutter joints, inlets and outlets of drainage facilities, etc.; advises the Resident Engineer of any problems; makes minor adjustments to lines and grades under the direction of the Resident Engineer.
19. Advises the Resident Engineer of any discovered design issues regarding lines and grades, and records the issues in daily survey party reports.
20. Keeps the Resident Engineer informed of pertinent construction staking issues; accepts construction staking requests only from the Resident Engineer; and keeps adequate records of Department-furnished construction staking efforts (work accomplished, dates, time and resources required, survey data and restaking).
21. Preserves, references, or replaces all survey monuments according to Section 8771 of the Business and Professions Code.
22. Verifies that all staking is clearly written and readily visible.
23. Communicates with the Structure Representative on the availability of safety-related protection equipment for work on superstructures.
24. When the Contractor is using AMG for construction, Surveys will:
 - a. Verify survey control and provide the RE with coordinates and elevation for the local control calibration points to ensure datum consistency.
 - b. Review the written calibration report provided by the Contractor using Global Navigation Satellite Systems (GNSS) technology. If the report is rejected, Surveys will confer with the RE and Contractor as soon as practical to resolve any problems.
 - c. Set additional control to assist the RE staff in checking and inspection of project.

2.3 Resident Engineer (RE)

The Resident Engineer (RE) is responsible for the satisfactory administration and completion of the project, including the coordination of construction surveys in cooperation with Surveys and the Structure Representative.

The following are the responsibilities of the RE:

1. At the preconstruction meeting or other times, explains to the Contractor with the assistance of Surveys (i) the Department-furnished construction staking procedures as detailed in this manual; (ii) the procedures and contract requirements for requesting Department-furnished construction staking; (iii) the contract requirements regarding preservation of Department-furnished stakes, and (iv) staking furnished when AMG is used.
2. Coordinates priorities and schedules for all requests for Department-furnished construction stakes.
3. Verifies that the Contractor's request for Department-furnished construction stakes are acceptable.
4. Works with the Project Engineer and Surveys to deliver needed electronic design files to the Contractor for use with AMG.
5. Checks the final construction lines and grades against Department-furnished stakes to verify that the work was performed at the proper line and grade.
6. Determines when restaking costs are to be assessed to the Contractor and coordinates with Surveys.
7. Resolves design issues regarding lines and grades; and checks/approves line and grade adjustments made by Surveys.
8. Settles disputes regarding staking priorities and schedules.

2.4 Structure Representative

The Structure Representative is responsible for the satisfactory completion of structures on an improvement project. The Structure Representative will also ensure that Surveys is apprised of all Structures-specific project safety issues and that Surveys be apprised in a timely manner of situations that would affect construction survey operations for a structure.

The following are the responsibility of the Structure Representative:

1. Confers with Surveys regarding the need for Surveys support for the structures on a project and coordinates the assignment of resources for the requested support from Surveys.
2. Coordinates with Surveys regarding any special job-specific safety training that may be required to perform a construction survey for a structure (i.e. fall protection, confined spaces, water safety, railroad safety training).
3. Establishes with Surveys a communications protocol to be used for the life of the project when requesting Surveys support.
4. Verifies that the Contractor's requests for Department-furnished construction stakes for structures are acceptable.

5. Interprets and translates all requests for construction stakes for a structure to stations and offsets that are referenced to a horizontal alignment shown on the contract plans.
6. Recommends to the RE when the Contractor is to be assessed re-staking costs associated with structures.
7. Establishes the priorities and schedules for requests for construction staking for structures with the RE and Surveys.

2.5 Contractor

The following are the responsibilities of the Contractor:

1. Discusses scheduling of staking needs for Contractor operations and time estimates of staking operations with the RE and Surveys at the pre-construction conference and throughout the project.
2. Makes only one (1) staking request per form and numbers the forms in numerical order, i.e. 1, 2, 3, etc. (Note: Construction staking will be performed in numeric order unless otherwise directed by the RE.)
3. Requests Department-furnished construction stakes a minimum of three (3) full working days in advance of starting an operation that will use the stakes. Include estimated time to perform staking operations in addition to three (3) full working days notice when determining the start of specific construction operations.
4. Submits a suitable Construction Survey Request (Form SC-3013) for Department-furnished construction stakes, ensuring that the requested staking area is ready for stakes and that the stakes will begin to be used within 5 days of staking.
5. Coordinates construction operations so that areas to receive stakes are relatively clear of construction equipment activity, in order that stakes can be set in a safe and expeditious manner.
6. Submits all requests for Department-furnished construction stakes to the RE for approval.
7. Preserves Department-furnished construction stakes, including those requested by the RE.
8. Sets working stakes (i.e., “Bluetops”) as required to complete the work.
9. Reports suspect staking or design issues immediately to the RE.
10. If using AMG, develops the needed electronic files and provides copies to the RE. If any design issues are discovered while creating the files, the RE will be notified promptly so a resolution can be determined.
11. If using AMG, utilizes and constrains to the provided local survey control points.

2.6 Project Engineer

The project Engineer will provide all files requested by Surveys as needed. The following information is a partial list of the typical delivery in the Survey file:

1. Final contract plans and annotated roadway cross-sections.
2. Control diagram and coordinate list for the control used to design the project.
3. All roadway alignments including main lines, ramps, branch connections, frontage roads, and detours.
4. Roadway slope stake listings (one or two stations per page), for all roadway and detour alignments.
5. Drainage cross-sections, alignments with station/offset and coordinates for angle points, end points, curve data, and structure locations with station/offset and coordinates to the centerline point at the flow line.
6. All profiles including roadway, curb and gutter, ditch, and channel.
7. All lay-out lines including ditches, channels, retaining walls, sound walls and benches, with station/offset and coordinates for angle points, end points and curve data.
8. Taper, transition curve, super elevation diagrams, and flare locations, including sufficient data to precisely define beginning and ending locations and elevations, radius points, offsets, and parabolic curve base line distances.
9. Data for structures including abutment and wing wall lay-out lines, abutment fills, and pier alignments.

Note: All design data will be delivered to Surveys in both digital and hard copy Format.

3. REQUESTS FOR CONSTRUCTION STAKING

The Contractor is required to provide a written request for Department-furnished construction stakes to the Resident Engineer (RE). To facilitate the Contractor's written request and to ensure that all necessary information is included in the request, the RE will furnish the Contractor with a supply of Form SC-3013, "Request for Construction Staking," for this use. Requests for stakes will only be accepted by Surveys from the RE.

Prior to contract award, requests for construction surveys originate from the Project Engineer or RE. After contract award, most requests will be initiated by the Contractor. Exceptions include control surveys, monument staking, surveys for design information, and surveys to determine pay quantities.

When the Contractor requires construction stakes, the Contractor will notify the RE of his requirements, in writing, on form SC-3013, three (3) full working days in advance of starting operations that require the stakes. Surveys begins staking within two (2) full working days of receipt of a completed Request for Construction Staking form from the RE. Some requests for stakes will require more time to complete, thus requiring the Contractor to allow for staking time in addition to the three (3) full working days in advance of operations that will use the stakes. The Contractor, RE, and Surveys will discuss staking time estimates.

If the area or facility is not prepared satisfactorily for the stakes, as determined by the RE, the staking request will be voided by the RE and the Contractor must submit a

new Request for Construction Staking form when the area or facility has been properly prepared. If a survey party has been mobilized to an area that is not ready for stakes, the RE may charge the Contractor with restaking charges for the survey party's time.

After receiving form SC-3013 from the RE, Surveys schedules the work. To facilitate scheduling, requests will include calendar dates to indicate when the stakes are needed and all requests should be specific as to area and types of stakes to be set. If a request includes more stakes than the advance notice gives time to prepare for, it should be returned to the RE for a discussion on scheduling with the Contractor.

4. REQUEST FOR CONSTRUCTION STAKING FORM SC-3013

All staking requests must be submitted on Form SC-3013.

4.1 Contractor

The Contractor will fill out the following sections of the form:

1. Project information (if not pre-printed).
2. Type of Staking: slope stakes, curb stakes, drainage, etc.
3. Stakes are either Original or Reset.
4. Location: alignment, beginning and ending stations, drainage structures, etc.
5. Date: The Contractor will indicate the date that the site will be ready for stakes, and when the Contractor intends to begin work using the stakes.
6. In the Comments section, Contractor will indicate requested offsets for the reference points, and any other relevant instructions.
7. Contractor's signature and date of request.

4.2 Resident Engineer

The RE will review the form as follows:

1. Verify that the request date and date that the stakes will be used allow enough days for Surveys to complete the work.
2. Verify that stakes listed as "Original" are not "Reset".
3. Checks that the designated areas are ready for work.
4. In consultation with Surveys, determines that the staking request allows time for Surveys to complete the work in the time requested. If there is a scheduling issue, the RE will hold a meeting with the Contractor and Surveys to resolve the issue.
5. If the RE determines that the Request is not complete due to the failure to complete (1) through (3) above, the RE will return the request to the Contractor.
6. When the RE determines that the request is acceptable, the RE will sign and date the form and forward it to Surveys.
7. If the request is for restaking, the RE will review the time actually charged by Surveys, calculate the costs, determine if the restaking costs are to be charged to the Contractor, and sign the determination.

4.3 Surveys

Surveys will review the form as follows:

1. Verify that the request date and date that the stakes will be used allow for the minimum two (2) full working days for Surveys to complete the work.
2. Verify that stakes listed as “Original” are not “Reset”.
3. Checks that the designated areas are ready for work.
4. In consultation with RE, determines that the staking request allows time for Surveys to complete the work in the time requested. If there is a scheduling issue, the RE will hold a meeting with the Contractor and Surveys to resolve the issue.

Surveys will fill out the following sections of the form:

1. Date: Surveys will indicate the date staking began and the date staking was completed.
2. Indicate whether or not the staking is a reset.
3. Indicate the name and equipment number of each person and equipment respectively that was onsite working. (Note: equipment refers to vehicles or construction equipment used, not survey instruments.)
4. Description of labor and equipment, i.e. Labor Classification for personal.
5. Hours spent onsite working for each person and equipment.
6. Was time spent on reset, yes or no.
7. Date personnel and equipment were onsite working.
8. Sign and date and return completed form with a copy of the field notes for all worked performed to the RE within 2 working days of date staking was completed.

5. RESTAKING

The Contractor shall preserve stakes and marks placed by the Department. If the stakes or marks are destroyed, the Department replaces them at the Department’s earliest convenience and deducts the cost from the Contractor.

Surveys will keep an accurate record of time required to complete restaking and report to the Resident Engineer and the Structure Representative any restaking that is done on form SC-3013. The RE is responsible for determining if charges for restaking will be made.

6. ALTERNATIVES TO NORMAL STAKING

As determined by the Resident Engineer in cooperation with Surveys, additional Department-furnished construction stakes will be provided for areas of staged construction, as necessary, to provide control for the lines and grades.

Department-furnished construction stakes will be provided for facilities not covered by this document to control lines and grades, as determined necessary by the RE and the Structure Representative in cooperation with Surveys.

In cooperation with the RE, the Structure Representative, and the Contractor, alternate Department-furnished construction stakes (stake density, placement, and markings) will be considered to facilitate the Contractor's construction methods.

For reconstruction and rehabilitation work, other Department-furnished construction stakes might be requested when the stakes described by this document are impractical, as determined by the RE in cooperation with Surveys. For example, reference marks with a stationing identification might be painted on existing pavement and a hardcopy listing provided to the Contractor of elevations, distances, or cuts/fills as appropriate.

7. AUTOMATED MACHINE GUIDANCE (AMG)

Automated Machine Guidance (AMG) technology uses positioning devices, alone or in combination, such as the Global Navigation Satellite System (GNSS), Total Stations, and/or rotating laser levels to determine the real time X, Y, and Z position of construction equipment and compare that position against a 3D Digital Design Model (DDM) stored in an onboard computer. A computer display shows the operator or grade checker several perspectives and delta values of their position compared to the design surface. This technology has the potential to increase the Contractor's efficiency, increase the Contractor's productivity, reduce the number of survey stakes required, and reduce construction working days.

7.1 Supplemental Project Control

AMG may require a higher density of control monuments than needed for conventional methods. Setting additional monuments for machine guidance is part of construction staking. The Contractor must utilize and constrain to the provided project survey control points for the Digital Terrain Model (DTM), DDM, and construction equipment locations to match.

GNSS satellite signals can be subject to interference from canyons, buildings, trees or even fencing. Additional monuments will be set when needed for adequate site coverage. Not all locations are suitable for AMG techniques, and it is the Contractor's responsibility to determine if the site conditions are practical for AMG.

Surveys involvement in projects using AMG technology can vary from project to project, but in general may include the following:

1. Report any issues to the Project Engineer and the RE.
2. Assist the Project Engineer with data format conversion as expertise permits.
3. Recover, verify, and evaluate project survey control used to develop the existing ground surface for consistency and create a site calibration prior to construction.
4. Perform terrain checks to identify any changes from earlier mapping.
5. Establish supplemental project control as needed for AMG operations.
6. Meet with the RE and the Contractor to discuss control, calibration, and staking.
7. Provide the Contractor with the latest control points. Provide the RE and Contractor with coordinates and elevation for the local survey control calibration points to ensure project consistency.
8. Review the Contractor's calibration report and compare with the Department's calibration.
9. Assist the RE with inspection of line and grade in areas without conventional staking. Surveys may assist the RE with project inspection using survey equipment, the project model, and survey control if so resourced and requested.
10. Surveys will set additional control to assist the RE staff in checking and inspection of project.
11. Deliver the files necessary to the RE in order for the RE to evaluate work completed by AMG methods.
12. Act as an advisor to the RE as requested on GNSS and AMG issues.

7.2 Suggested Best practices for Surveys include:

Set conventional slope stakes at all "conform" stations, beginning and end of curves, and begin and end of transitions to aid with inspections. Set stakes as requested by the RE for inspection purposes.

Set other construction stakes as necessary. The use of AMG will not eliminate the need for the staking of structures, drainage, utilities, etc.

8. OFFICE PREPARATION & PRECONSTRUCTION CONFERENCE

8.1 Office Preparation

Surveys is responsible for confirming that data obtained from the Project Engineer is both complete and suitable. Missing data, conflicts and uncertainties must be reported to the Project Engineer and/or the Resident Engineer as appropriate. Surveys should not revise design data without the approval of the Project Engineer and/or the RE.

Surveys should develop a strong partnership with the Project Engineer to ensure that all information needed by Surveys is provided in a ready-to-use format. Duplication of efforts by the Project Engineer and Surveys must be avoided.

Whenever practical, the Surveys office prepares the information for staking, called the staking package. The staking package should include all information required to efficiently stake the project. Generally, a construction survey effort should not begin without a completed staking package produced in an office environment where efficient, appropriate data processing capability is available. Use of survey party time to prepare the package should be minimized.

8.2 Preconstruction Conference

Resident Engineer/Surveys: Surveys will have a preconstruction meeting with the RE. Any Party Chief(s) permanently assigned to a project should attend this meeting. This meeting will occur soon after the RE is assigned. The purpose of this meeting is to establish a working relationship between the RE and Surveys and to review the anticipated survey work, including tentative schedules and project-specific safety issues. Anticipated survey requests prior to contract award should also be discussed.

Resident Engineer/Contractor: Surveys will attend the pre-construction meeting between the RE and the Contractor. The RE will provide the Contractor with a copy of this Manual and explain that, along with the Standard Specifications, it represents the Department's procedures concerning Department-furnished construction stakes. Surveys should be ready to describe the types, density, placement and marking of stakes. The RE will explain the construction staking request process, including the Contractor's responsibilities of coordinating construction operations so that areas to receive stakes are relatively clear of construction equipment activity, in order that stakes can be set in a safe and expeditious manner. Calibration and control issues must be discussed on AMG projects. The need for preserving stakes and the restaking process should also be discussed.

Structure Representative/Surveys: Surveys will have a preconstruction meeting with the RE and the Structure Representative on projects that have structures. This meeting should occur soon after the Structure Representative is assigned. The purpose of this meeting is to establish a working relationship between the Structure Representative and Surveys and to review the anticipated survey work, including tentative schedules. Anticipated survey requests prior to contract award should also be discussed. This meeting may occur in conjunction with the Preconstruction Conference between the RE and Surveys.

9. STAKE TOLERANCES & FIELD NOTES

9.1 Tolerances

Tolerances stated for each type of control stake in this chapter indicates the acceptable deviation of the position of each reference point from its computed position relative to the given alignment and grade. When the stake is positioned within its tolerances, it is deemed “good.” Staked positions are generally checked using electronic stakeout reports and, if within tolerances, the staked position is accepted. For precise measurements such as structures, reference points may also have an accuracy relative to each other.

Horizontal Control

The head of a nominal 1”x1” wooden ginnie is 0.06’ square. A point set to a tolerance of 0.03’ will fall on the head of the ginnie, and is considered within tolerance. The same is true for most metal spikes. If larger ground stakes are used, tacks or punch marks will be set to achieve the required tolerance for a given reference point. All rough grade stakes shall be set within 1.0’ foot of calculated positions. All other stakes shall be set to the 0.03’ tolerance as described above.

Vertical Control

All rough grade elevations shall be marked to the nearest 0.10’ (tenth) of a foot. All other grade stakes shall be set within 0.02’ foot vertically of calculated position.

9.2 Field Notes

Construction survey field notes in the form of electronic stakeout reports, stakeout listings with actual staked positions noted, or other suitable forms, will be filed with the Resident Engineer upon completion of the survey. The RE will provide copies to the Contractor upon request.

10. STAKE TYPES AND MARKINGS

The stake marking shall be an agreed upon format from the RE, General Contractor and Surveys.

Distances and cuts/fills are measured from the reference point for the stake to the point (feature) being staked (referenced, located). For most staking, the reference point for measurements is the ground stake. The elevation markings are for the top of the reference point. Examples of ground stakes are (a) small wooden hub (ginnie) in front of the marker/reference stake, (b) a wooden hub and tack in front of the marker/reference stake, (c) a spike driven in front of the marker stake, (d) a concrete nail in AC pavement (e) a scribed “X” on PCC pavement, or (f) the marker stake itself, depending on the precision required and field conditions (typically for fencing and clearing limits).

48” lath with flagging are used only when extra visibility is needed, typically when stakes are in tall vegetation, or as guard stakes to protect survey control monuments and marker stakes.

11. TYPICAL CONSTRUCTION STAKES

This manual outlines the typical types, density, and placement of construction stakes. Alternate locations (positions) for the stakes may be used if required by the construction conditions, as determined by Surveys.

11.1 Clearing Stakes

Clearing Stakes are set to show the limits of clearing and grubbing. Clearing Stakes are only set when the limits are not defined by the contract. Clearing stakes are set for: Clearing-only contracts, contracts requiring clearing to be completed for new aerial photography/ remote sensing before grading, and where necessary as determined by the RE in cooperation with Surveys to protect and preserve desirable natural features.

Stake Set:

Lath at clearing limit, no reference point.

Spacing:

Space longitudinally as necessary to provide intervisibility, but not less than 100 feet.

Markings:

Mark “CLEAR LIMIT” on the lath facing the centerline.

Setting Tolerance:

Stakes should be set within 1.0 foot of planned clearing limit. Consider using a greater accuracy in park lands, areas where the entire right-of-way is to be cleared like orchards or urban areas, and where there is possibility of damage to highway facilities or utilities.

Checking:

Check stakes visually and by reviewing the electronic stakeout reports and/or survey notes.

11.2 Rough Grade Stakes

Rough grade stakes are set to aid rough finishing of the grading plane. They are set when requested by the RE when cuts or fills are greater than 30 feet. Intermediate slope stakes will serve as rough grade stakes if within 30 feet (cut/ fill) of the grading plane. The RE should discuss the need for rough grade stakes with the Contractor using AMG prior to construction.

Stakes Set:

Reference point with a marker stake on only one line per roadbed, such as the centerline of construction.

Spacing:

Space longitudinally every 50 to 100 feet, as determined by Surveys with the concurrence of the RE, depending on the construction conditions, alignment and grade.

Markings:

Stakes should be marked “RGS” for rough grade stake and identify the line and station and off-set, if any, on which they are set, and give the cut/fill to finished grade for the point the stake references.

Setting Tolerance:

Stakes should be set within 1.0 foot for stationing, 0.1 foot for horizontal offset, and 0.1 foot vertically of calculated position.

Checking:

Check stakes visually and by reviewing the electronic stakeout reports and/or survey notes.

11.3 Final Grade Stakes

Final grade stakes are set when the rough finishing of the grading plane is completed. Final grade stakes are set only once for each grading plane. This one set of final grade stakes controls all elements of the structural section (the grading plane, subbase, base, and pavement). In some cases, one set of stakes may be used for several purposes, such as slopes, final grades and curbs.

11.4 Staged Construction

The RE, in cooperation with Surveys determines stakes needed for staged construction. A common form of staged construction is widening of existing pavement. Generally, the longitudinal spacing for this type of staged construction is the same as conventional construction, but the types of stakes and markings used will depend on conditions found on specific projects.

11.5 Drainage Stakes

Stake Set:

Reference point and marker and line stakes for the following points in drainage facilities:

- Ends of facilities
- Grade breaks

- Alignment breaks
- Junctions
- Inlets and similar facilities
- Skewed cut-off lines, when necessary as determined by the RE in cooperation with Surveys.

Note: The plumbing of risers and other similar facilities is the Contractor's responsibility; no reference stakes are set for plumbing.

11.6 Curb Stakes

On some cases, one set of stakes may be used for several purposes, such as slopes, final grades and curbs.

Stake Set:

Reference point and marker stake at a constant horizontal offset distance from the flow line.

Spacing:

Space longitudinally every 50 feet and at beginning and end of curb and beginning and end of horizontal and vertical curves. When grade is less than 0.3 percent or radius of curvature is less than 1000 feet space every 25 feet. A lesser spacing may be used for flares, tapers or curb returns when necessary, as determined by the RE.

Curb returns are typically staked based on the length of curve at gutter line. Curb returns having a length of curve less than 10' are staked at only the BCR and ECR.

Curb returns having a 10' to 20' length of curve are typically staked at the BCR, ECR, and $1/2 \Delta$. Curb returns having a length of curve greater than 20' are typically staked at the BCR, ECR, and $1/4 \Delta$ intervals.

Curb ramps are constructed by the Contractor from the dimensions in the Construction Details and Standard Plans. Additional stakes may be set if requested by the RE. When practicable, a radius point may be staked to facilitate construction for curb returns having a radius of 25' or less. No other line stakes are set.

Markings:

Reference stakes show the horizontal offset distance, cuts/fills to the curb flow line, and for non-standard curbs, cuts/fills (from the flow line) to the top-front-edge of the lip.

11.7 Major Structure Stakes – Ground

The extent of construction stakes for major structures such as bridges varies, depending on the type and complexity of the structure and its construction. In most cases GPS equipment will not be used by Surveyor or the Contractor to set major structure stakes. Staking of footings (bents, abutments, wingwalls, etc.) is normally provided by Surveys. Surveys, in cooperation with the RE and the Structure Representative, will determine the actual staking provided.

No stakes are set by Surveys for the following:

- The locations of individual piles,
- Individual pile cutoff elevations
- Falsework

Stakes Set:

For footings (Bents, Abutments, and Wingwalls), two reference points, each with a marker stake that provides elevation, distance and line references for the controlling lines. A third reference stake, for “line only,” is set when required by the construction conditions, as determined by the Surveys personnel in cooperation with the Structure Representative. Generally, for footings, bents, and abutments, a set of reference stakes is established on each side of the structure.

Markings:

Reference stakes for major structures provide references for only the controlling lines for the structure and reference elevations.

The identification of the major structure component being staked (abutment, wing-wall, pier, etc.)

Generally, for major structures, a set of stakes will consist of two reference stakes, each providing line, distance, and elevation. Where appropriate, a third “line only” stake also will be set.

11.8 Major Structure Stakes - Superstructure

The extent of control stakes for superstructures is a combination of stakes provided by Surveys and the Structure Representative. The types, density, and placement of control stakes are dependent on the complexity of the superstructure. Surveys, in cooperation with the RE and the Structure Representative, will determine the actual staking provided.

This section describes the typical superstructure staking provided by Surveys. The Structure Representative may provide additional Department-furnished control stakes for the superstructure.

Stakes Set:

Temporary bench marks on the tops of columns marked "TBM".

One set of control stakes at a constant offset to the alignment set on the soffit forms. The Structure Representative will determine the offset.

Spacing:

Space longitudinally every 25 feet.

Markings:

Stakes should be marked "STR" for structure stake and identify the alignment station and offset.

Setting Tolerances:

Stakes will be set to within 0.02 feet horizontally or 0.02 feet vertically.

Note: The control stakes on the soffit will not have vertical information.

Checking:

Check stakes visually and by reviewing the electronic stakeout reports and/or survey notes.

11.9 Miscellaneous Stakes

Contour Grading:

Construction stakes for contour grading vary with the design and terrain. Surveys, in cooperation with the RE, will determine what stakes are provided. Generally, stakes are set at a longitudinal spacing of 50 feet. A "grid" pattern of stakes might be used for areas of relatively shallow fills or cuts. Stakes should be marked in the same manner as rough grade stakes.

Utilities:

Utility work generally is controlled by adjacent construction staking or adjacent facilities, and no stakes are set. If separate stakes are necessary, as determined by the RE in cooperation with Surveys, stakes will be provided in the same manner shown for similar roadway work.

Stakes set for water and sewer lines at a longitudinal spacing of 50 feet; a 25 foot spacing will be used when the grade is less than 0.3 percent or when the radius of curvature is less than 1000 feet.

Sidewalks:

Stakes are set only as determined necessary by the RE for sidewalks that meander or change grade independently as compared to controlling elements such as adjacent curbs or nearby building foundations.

Signs:

When necessary, as determined by the RE, stakes are provided to locate signs.

Channels, Dikes, and Ditches:

Major channels and dikes are controlled by slope stake references. For ditches, reference stakes are provided for line and grade breaks, when necessary, as determined by the RE.

Subsurface Drains:

Stakes are set only as determined necessary by the RE. Set stakes for subsurface drains in the same manner as for drainage pipes. Stabilization trenches and permeable blankets are controlled by slope stakes or contour grading stakes.

Overside Drains:

For straight discharge overside drains, stakes (references) are provided only for longitudinal location. Alignment and grade breaks will only be staked at the direction of the RE.

Markers:

Markers are located by stakes (or references), as determined necessary by the RE.

Railings and Barriers:

Where railings and barriers are controlled by adjacent construction staking or adjacent facilities, no stakes are provided, except stakes that establish the beginning and end of each railing or barrier. All staking is to the base of the barrier only.

Where construction staking is necessary, as determined by the RE, stakes (references) are generally provided for alignment and grade at a spacing of 50 feet along the facility. 25 foot spacing will be used: (a) when the radius of curvature is less than 1000 feet; (b) in areas of superelevation transition; and (c) within 100 feet of “conforms” or bridges. A lesser spacing will be used for flares, when necessary, as determined by Surveys.

Hot Mix Asphalt Dikes:

Stakes are provided only at the beginning and end of HMA dikes.