

**KANSAS DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION TO THE
STANDARD SPECIFICATIONS, EDITION 2015**

Delete SECTION 802 and replace with the following:

SECTION 802

CONTRACTOR CONSTRUCTION STAKING

802.1 DESCRIPTION

Provide land surveying and construction surveying services and set right-of-way survey monuments according to the Contract Documents, KDOT's Construction Manual-Part III and consistent with standard surveying practices.

For the purposes of this specification, work being performed by the Professional Surveyor shall conform to the Kansas Statutes and Kansas State Board of Technical Profession's Regulations.

Work may be performed by the Professional Surveyor's authorized agents and employees as allowed by the Kansas Statutes and Kansas State Board of Technical Profession's Regulations.

BID ITEMS

Contractor Construction Staking
Right-of-Way Survey Monument
Benchmark Monument (Concrete Cylinder)
Monument Box
Sign (Environmental Mitigation)

UNITS

Lump Sum
Each
Each
Each
Each

802.2 MATERIALS

a. General. Provide the necessary materials to complete the specified surveying services. Provide materials and equipment that comply with the current requirements of the Kansas Statutes, Kansas State Board of Technical Profession's Regulations and the Contract Documents.

b. Benchmark Discs. Provide standard manufacture 2-inch diameter, domed, brass or bronze survey monuments to be set in concrete.

Refer to **subsection 802.3c.(7)** for individual stamping requirements.

c. Concrete. Use commercial grade concrete that complies with **SECTIONS 401** and **402**. Volumetric proportioning and hand mixing of concrete is permitted for concrete footings where small quantities are required.

d. Miscellaneous Materials. Provide the following miscellaneous materials:

- Commercially available steel posts that comply with the physical requirements for steel delineator posts, **DIVISION 1600**;
- 3-inch x 8-inch x 16-gage metal sign blanks;
- Commercially available galvanized 2-inch x 5/16-inch bolts, with 2 flat washers, 1 lock washer and 1 nut per bolt;
- Commercially available 5/8-inch x 30-inch reinforcing steel bars (non-coated); and
- Other miscellaneous materials for R/W Survey Monuments detailed in the Contract Documents.

e. Monument Box. Provide a monument box of the brand and type shown in the Contract Documents.

f. Acceptance of Materials. The Engineer will accept materials for the specified surveying services, right-of-way survey monuments, miscellaneous materials and monument boxes based on compliance with dimensional and other specified requirements and visual inspection for condition.

g. Environmental Mitigation Area Signs. Other miscellaneous materials for the Environmental Mitigation area signs, detailed in the Contract Documents.

- Aluminum sign blanks, **DIVISION 1600**;
- Galvanized U-Posts, 2 lb./ft, **SECTION 1622**;
- Commercially available galvanized 2-inch x 5/16-inch bolts, with 2 flat washers, 1 lock washer and 1 nut per bolt; and
- Other miscellaneous materials for Environmental Mitigation Area Signs detailed in the Contract Documents.

802.3 CONSTRUCTION REQUIREMENTS

a. General.

(1) With the Engineer's approval, the Contractor's surveying operations may begin after the contract is signed, but prior to issuing the Notice to Proceed.

(2) Surveying Personnel. Before performing any surveying operations on the project, inform the Engineer of the Contractor's personnel responsible for land surveying, construction surveying and staking. Provide a Professional Surveyor, trained and experienced in construction staking and licensed by the Kansas State Board of Technical Professions according to Kansas Statutes to perform the required land surveys, the setting of all section corners, right-of-way survey monuments and reference point monuments set on the right-of-way lines.

(3) Provide surveying equipment that complies with the following tolerances:

- **Slope Staking:** Horizontal and Vertical tolerance of ± 0.10 feet (per KDOT Construction Manual - Cross Sections 3.06.02). Use a GPS system, a Total Station, or a Level & Transit.
- **Finish Staking:** (grade hubs, blue tops, string lines, etc.) and Structures: Horizontal tolerance = ± 0.05 feet; Vertical tolerance = ± 0.01 feet (per KDOT Construction Manual, subsection 3.09 - Finishing Stakes, Part III). For Horizontal, use a GPS system or a Total Station. For Vertical, use a Level or Total Station. Do not use GPS for Vertical.
- **Critical Bridge Member Staking:** Horizontal tolerance = ± 0.02 feet; Vertical tolerance = ± 0.01 feet (Vertical as per Construction Manual, subsection 3.09 - Finishing Stakes, Part III). For Horizontal, use a GPS system or a Total Station. For Vertical, use a Level. See **subsection 802.3c.(2)** for Critical Bridge Member Staking.
- **Right of Way Survey Monuments:** For relative precision of all R/W Survey Monuments, comply with the precision expressed in the Kansas Minimum Standards for Boundary Surveys from the project coordinate data. Use a GPS system or Total Station.
- **Project Control Points:** The relative precision of any project control point ± 0.05 feet from the project coordinate data. Use a GPS system or Total Station.
- **Field Notes:** For all land surveying and construction staking, record 2 measurements for verification in the field notes for all PLSS corners and all project control points.
- **GPS equipment:** Take 2 GPS measurements at a minimum interval of 2 hours with the base station at 1 or 2 project control points. Include in the field survey notebooks a copy of the site calibration. The site calibration includes an area extending a minimum of 200 feet beyond the beginning and ending of the project and the construction limits furthest offset to the left and right of the project centerline. Take a minimum of 4 calibration points or as directed by the Engineer. Use the sum of the average residual of the site calibration and the delta of the point being staked.
- **Total Stations:** To verify the tolerances, record total station measurements from 2 project control points (set-up or backsight) to the point being established. Use the average of the 2 resulting coordinate values for the point being staked for the specified tolerances.
- **Levels:** Record in the field notes a turn through each project benchmark as they are encountered during staking activities (per KDOT Construction Manual, subsection - 3.23.05 – Elevations, Part III).
- **Control Stakes:** Do not perform vertical control using GPS.

(4) Before proceeding with the field surveys, provide the Engineer with a written report of any errors or apparent discrepancies found in previous surveys or the Contract Documents. The Engineer will provide the corrections or necessary interpretations.

Correct any deficient engineering layout or construction work that is the result of inaccuracies in the Contractor's surveys or staking operations, or the failure to report inaccuracies found in the work previously done by KDOT, at no additional cost to KDOT.

(5) The Engineer will perform final checks, measurements and surveys involving the determination of any pay quantities. The Engineer may check the accuracy and control of the Contractor's construction staking at any time throughout the duration of the project.

b. Land Surveying.

(1) Before any construction activity starts in the immediate area of an endangered Public Land Survey System (PLSS) corner, recover all endangered section corners and accessories of the PLSS on the project. Endangered PLSS corners are those as defined by Kansas Statutes and/or shown in the Contract Documents as lying within the range from the project centerline to distance 100 feet outside the construction limits, throughout the length of the project. Establish a minimum of 4 reference ties for each endangered PLSS corner. Each reference tie shall be a direct measurement to a precise (hard defined) point. Specify slope or horizontal measurement.

Complete a Land Survey Reference Report marked as a "Notice of Endangerment Activity" for each endangered PLSS corner. File the reports with the appropriate governmental custodian responsible for maintaining those records, as required by Kansas Statutes. Provide the Engineer with copies of the completed reports.

(2) Before any construction activity starts in the immediate area, clearly establish the right-of-way as shown in the Contract Documents. If the R/W Survey Monuments are set initially, determine each monument's position with the project coordinates, project stationing and offset.

(3) Before acceptance of the project, recover and verify, or reset all of the PLSS corners previously reported as endangered PLSS corners. Verify the top of all PLSS corners monuments are $\frac{1}{4}$ to $\frac{1}{2}$ inch below the finish grade on concrete pavement and 4 to 6 inches below the finish grade on asphalt pavement. Establish a minimum of 4 reference ties for each of the PLSS corners. Each reference tie shall be a direct measurement to a precise (hard defined) point. Specify slope or horizontal measurement.

Complete a Land Survey Reference Report marked as a Notice of Completion of Endangerment Activity and Report of Restoration for each restored PLSS corner previously reported as endangered. File the reports with the appropriate governmental custodian responsible for maintaining those records, as required by Kansas Statutes. Provide the Engineer with copies of the completed reports. The Engineer will submit this report to the corresponding District surveyor.

(4) Before acceptance of the project, set supplemental/additional offset control points for each corner of the PLSS on the project that is located in the pavement.

Install one offset control point within public right-of-way along a PLSS line radiating from the corner if said line was determined by the preliminary survey of the project and the offset control point can be placed in an unpaved location, or install 2 offset control points in 2 adjacent quadrants at optimal unpaved locations

The offset control points shall be a brass or bronze capped rebar (minimum of 30 inches long and $\frac{5}{8}$ inch in diameter). Stamp the cap with the Project Number and the stamping "PLSS - O/S".

The preferred locations are:

- An even foot from the PLSS corner;
- Bury control point 4 – 6 inches deep;
- At top of back slope in cut sections;
- Approximately 12 feet off shoulders in fill sections;
- At optimal location to fit conditions.
- Do not place within 7 feet to right-of-way, to avoid utilities.

Include the offset control points on the as-built plans as an additional reference tie to the PLSS corner. Include the project coordinates and station/offset tied to project stationing.

(5) Before the acceptance of the project, set all of the R/W Survey Monuments shown in the Contract Documents. If the R/W Survey Monuments were set initially, visually inspect each R/W Survey Monument to determine if it was either disturbed or destroyed. Reset all of the R/W Survey Monuments that are determined as disturbed or destroyed, at no cost to KDOT. Determine each reset monument's position with both the project coordinates and the project station/offset. Provide the Engineer with a written report of all right-of-way survey monuments set. The Engineer will submit this report to the corresponding District surveyor.

c. Construction Surveying and Staking.

(1) General.

- Check alignment and reference or re-reference all necessary control points.
- Establish or re-establish project centerline.
- Run a level circuit to check or re-establish plan benchmarks; set other benchmarks as needed.
- Take original cross-sections that are not incorporated in the plans.
- Stake or re-stake right-of-way where needed (to be done by a Professional Surveyor).
- Perform all construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, grading, paving, drainage and all other appurtenances required for the completion of the work.
- Construction of ditches and other planned excavation and embankment designated in the Contract Documents may be performed by Global Positioning System (GPS) controlled grading equipment, according to the Contract Documents and this specification. GPS controlled grading equipment does not eliminate the need for finish staking or blue top staking according to the Contract Documents. Once a week, provide the Engineer with documentation (on a preapproved form) verifying machine calibration to monitor, verify, adjust and compensate for the wearing surface of the cutting edge of the machine being utilized.

(a) GPS Equipment. Use GPS controlled grading equipment capable of meeting the end results specified in the Contract Documents. The Engineer may require alternative (non-GPS) verification of shot locations. This could be by witnessing the Contractor take shots with GPS Rover, etc.

(b) Electronic Design Files/GPS Model. When available, KDOT will provide Electronic Design Files for the project. Convert the files provided by KDOT into the format required by the Contractor's system and equipment. Conform to the typical sections. Notify KDOT Design and the Field Office administering the contract, in writing, of any errors, omissions, ambiguities, or perceived inadequacies found in the Electronic Design Files provided by KDOT.

Make no claim on the contract under **SECTION 104**, for additional money, additional time or both because the KDOT produced plans differ from drawings generated from the Electronic Design Files, even if the Contractor did not manipulate the Electronic Design Files before generating the GPS Model. Accept sole responsibility for the adequacy and accuracy of all Contractor-generated, subcontractor-generated, or supplier-generated documents or GPS Models used on the project. Assume the risk of errors and omissions resulting from software conversions, Electronic Design File manipulation or other Electronic Design File creation used by the Contractor, subcontractors, suppliers or any combination thereof.

The GPS Model the Contractor generates from the Electronic Design Files may differ from the Contract Documents. The Contractor assumes the risk of such discrepancies.

KDOT printed plans controls over the related Electronic Design File(s) which controls over the Contractor's GPS Model.

(c) GPS 3D Model. Before beginning any GPS controlled machine grading, provide the KDOT Field Office and KDOT Design with an electronic copy of the GPS 3D Model created for that use. In addition to the GPS machine control, provide centerline stakes, slope stakes and grade stakes from the beginning thru the end of the project, at 500-foot intervals on straight runs, and at 250-foot intervals on curves, transitions, intersections, interchanges and break points. The Engineer may require closer staking intervals for other locations, such as transition areas. GPS controlled machine grading does not eliminate the need for finish staking or blue top staking.

The Engineer may review the Contractor's GPS machine control grading results, surveying calculations, records, field procedures and actual staking at any time. If the Engineer determines the work is not meeting the required horizontal and vertical tolerances, see Unacceptable Work, **SECTION 105**.

Contractor delays or errors due to operating the GPS machine control system will not result in any adjustment under **SECTION 104**, for additional money, additional time or both.

(2) Bridge. Prior to construction, set project control points and Critical Bridge Element control points for the horizontal and vertical location of the Critical Bridge Element features by a Professional Surveyor. Critical Bridge Elements include, but are not limited to the features listed in **TABLE 802-1**.

Prior to construction, provide an independent survey performed by a different Professional Surveyor to check the accuracy of the original survey of project control points and locations of the Critical Bridge Element features.

Report any differences or discrepancies to the Project Engineer.

Resolve any differences or discrepancies, prior to construction of the Critical Bridge Elements.

After the Critical Bridge Elements have been constructed, provide a survey by a Professional Surveyor to verify the locations and elevations of the Critical Bridge Elements.

All surveys shall be within the tolerances for that bridge element allowed in the Contract Documents. Report any discrepancies in excess of the tolerances to the Project Engineer.

TABLE 802-1: CRITICAL BRIDGE ELEMENTS	
Critical Element	Critical Component(s)
Spread Footing	Location & Elevation of CL
Pile Cap Footing	Location & Elevation of CL
Drilled Shaft	Location & Elevation of Center
Drilled Shaft Cap	Location & Elevation of CL
Column	Location & Elevation of Center
Pile Bent with Web Wall	Location & Elevation of CL
Abutment Beam/Bearing Seat	Location & Elevation of CL
Pier Beam/Bearing Seat	Location & Elevation of CL
Bearing Devices	Location & Elevation of CL, Temp. Offset
Bearing Stiffener	Location & Elevation of CL, Temperature Offset
Girder/Beam	Location of CL
Anchor Bolts/Preformed Holes	Location of CL
Expansion Device	Gap (Corrected for Temp) and Alignment
Fillets (Tenth Points)	Elevation
Surface of Forms (Slab Bridge Tenth Points)	Elevation
Post-tensioning Duct	Location & Elevation
Bolted Field Splice	Elevation

(3) Documentation. Provide and maintain a current copy of all field survey notebooks at the project site at all times. Produce the original field survey notebooks for inspection upon request by the Engineer. Include a detailed list of any abbreviations, codes, formatting or other nomenclature contained in the notebooks to facilitate clarity of the notes. Provide either one or a combination of both of the following types of notes, as directed by the Engineer:

- Provide standard, bound field notebooks where the handwritten field notes are indexed and kept in a clear, orderly and neat manner consistent with standard surveying practices and according to KDOT's procedures.
- Provide a legible ASCII file for electronic field notes where the "theoretical (calculated) point" can be checked against the "established point" set in the field. This method allows for a check of the inverse distance and direction for error tolerance. This procedure should be utilized for points with elevations. Before any construction staking begins, the procedures for all electronic field notes must be approved by the Engineer.

(4) Offset Horizontal Control (HC) Points. On projects 1 mile or longer, a Professional Surveyor shall set offset HC points. For projects up to 4 miles long, set 4 evenly spaced offset HC points. For projects over 4 miles, add an offset HC point for each additional mile or part thereof.

The preferred locations are:

- As directed by the Engineer;
- On hill tops;
- At top of back slope in cut sections;
- Approximately 12 feet off shoulders in fill sections;
- At optimal location to fit conditions.
- Do not place within 7 feet to right-of-way, to avoid utilities.

The offset HC points shall be a brass or bronze capped rebar (minimum of 30 inches long and $\frac{5}{8}$ inch in diameter) placed in a concrete footing (6-inch diameter, minimum 4-foot depth into the ground) cast in place. Recess the cap approximately $\frac{1}{4}$ inch below the concrete. Stamp the cap with the Project Number and an ID of sequential numbers starting with one and running with project stationing [i.e.: KA-1234 HC1].

Provide the Engineer with a written report of all project offset HC points, listing the offset HC point number, project coordinates, and station/offset, and its physical location. The Engineer will submit this report to the corresponding District surveyor.

(5) Monuments. Upon completion of the surfacing, a Professional Surveyor shall recover and verify or reset all of the field survey monuments (such as P.I.'s, P.O.T.'s, P.C.'s, P.T.'s, P.O.S.T.'s,) on the project centerlines or baselines, as shown in the Contract Documents. Verify that the top of the field survey monuments are set a maximum of ½ inch below the finish grade on concrete pavement, or a maximum of 6 inches below the finish grade on asphalt pavement. Verify the accuracy of the locations of all field survey monuments versus those of the project centerlines or baselines shown in the Contract Documents. Establish a minimum of 4 reference ties for each of the field survey monuments on the project centerlines or baselines.

(6) Reports. Provide a written report to the Engineer indicating the descriptions of all field survey monuments and their 4 reference ties, regardless if the information in the Contract Documents was revised or not. Include in the report "station calls" for each of the field survey monuments (such as P.I.'s, P.O.T.'s, P.C.'s, P.T.'s, P.O.S.T.'s) on the project centerlines or baselines shown in the Contract Documents. The Engineer will submit this report to the corresponding District surveyor.

(7) Benchmarks. Recover and verify all of the project benchmarks shown in the Contract Documents. Establish permanent replacement benchmarks for all project benchmarks that were destroyed during the construction using one of these methods:

- A benchmark disc "set in place" on new concrete structure.
- A benchmark disc "drilled and grouted" on existing concrete structure.
- A benchmark disc set in the top of a concrete footing (6-inch diameter x 4-foot depth into the ground, minimum) cast in place.
- As directed by the Engineer.

Stamp the benchmark caps with the "Project Number" and the permanent replacement benchmark number as a letter designation following the benchmark it is replacing (i.e.: destroyed BM #21 is replaced by BM #21A). Without exception verify that the maximum spacing between benchmarks is a maximum of 30 feet in vertical difference, 500 feet in horizontal distance in urban areas or 1500 feet in horizontal distance in rural areas.

Provide the Engineer with a written report of all post project benchmarks, listing the benchmark number, elevation, project stationing and offset, and a complete description of the monument type and its physical location. Include in the report, all of the remaining benchmarks shown in the Contract Documents, the permanent replacement benchmarks and the remaining additional "construction benchmarks" used for the staking of the project. Do not include in the report any "temporary benchmarks" used for the construction staking of the project that are classified as "temporary" or "degradable" in nature. The Engineer will submit this report to the corresponding District surveyor.

d. Right-of-Way Survey Monuments. A Professional Surveyor shall set all right-of-way survey monuments on and along the KDOT right-of-way lines at these locations:

- All P.I. locations along normal/tangent sections.
- All P.C. and P.T. locations along curved sections.
- At an offset where a physical obstruction impedes the exact location.

Set all Reference Point monuments on and along KDOT right-of-way at these locations:

- At inter-visible points a maximum of 1320 feet apart where the right-of-way is straight, or on a continuous horizontal curve of constant radius.
- At the crest of a sharp hill or the shoulders of a large/rounded hill.
- At the treeline/brushline/cropline on both sides of a creek or river.
- As directed by the Engineer.

Set all right-of-way survey monuments according to the Contract Documents.

Fasten the R/W sign to the witness post in this sequence: bolt, flat washer, sign, post, flat washer, lock washer and nut.

When conditions warrant, the Engineer may adjust the specified depth. The depth shall be 15 inches in cultivated areas, 4 inches in pasture areas, drilled and grouted in rock, or a depth directed by the Engineer. When it is impossible to set a right-of-way survey monument at the exact point because of an obstruction, set the right-of-way survey monument along the right-of-way line, or the extended right-of-way line, on both sides of the obstruction. Use

1-foot increments for the offset distance from the exact point to the set monument. Field stamp the aluminum cap “O/S” either below or to the right of the “R/W” stamping.

e. Concrete Footings. When required, construct footings of commercial grade concrete according to the Contract Documents.

Extend the top of the footing slightly above the ground line and steel trowel to a smooth finish with a slope to drain away from the post.

f. Monument Box. When required, install the monument box and survey marker by a Professional Surveyor as shown in the Contract Documents.

If the monument box is installed in concrete pavement, use the same mix as used in the pavement.

g. As-Built Construction Plans and Survey Notebooks. Upon completion of the project, provide the Engineer with a set of electronic as-built construction plans in a pdf file format with the following information:

- As-built survey information shall be red in color on the plans;
- The monument descriptions and the 4 reference ties for all restored PLSS corners;
- The monument descriptions and the 4 reference ties for all field survey monuments on the project centerline or baseline;
- The monument descriptions and the 4 reference ties for all Offset Horizontal Control (HC) Points on the project; include the project coordinates and station/offset tied to project stationing.
- The project stationing and offset of the final position of every right-of-way survey monument and project alignment reference point that was set;
- The permanent replacement benchmarks and remaining construction benchmarks with benchmark number, project station/offset, elevation, and description;
- Stamped on the Signature and Seal sheet by a Professional Surveyor.

Deliver the original field survey notebooks and as-built construction plans to the Engineer upon completion of the project. See **TABLE 802-2**.

h. Sign (Environmental Mitigation). Install environmental mitigation area signs (including posts) as shown in the Contract Documents.

802.4 MEASUREMENT AND PAYMENT

The Engineer will measure each right-of-way survey monument, benchmark monument (concrete cylinder), monument box and environmental mitigation area signs (including posts) as a unit. Contractor construction staking will be measured by the lump sum.

The Engineer will make partial payments according to **TABLE 802-2**. The Engineer may adjust the **TABLE 802-2**, based on Contractor’s progress and project complexity.

TABLE 802-2: CONSTRUCTION STAKING PAYMENT SCHEDULE*	
Percent of Original Contract Amount Completed	Percent of Bid Item Paid
Work Started	25%
5%	40%
25%	60%
50%	80%
70%	95%
All field books, As-Built construction plans (subsection 802.3g.) and records have been submitted to the Engineer.	100%

*Until all appropriate information is received, and the bid item is 100% paid, the work is considered incomplete and subject to **SECTION 108**.

The Percent of Original Contract Amount Completed = the amount earned by the Contractor divided by the total dollar value of the original contract (all bid items).

Payment for "Contractor Construction Staking", "Right-of-Way Survey Monument", "Benchmark Monument (Concrete Cylinder)", "Monument Box" and "Sign (Environmental Mitigation)" at the contract unit prices is full compensation for the specified work.

03-30-18 C&M
Nov-18 Letting