

SECTION 01 71 23

CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall govern the performance of construction staking to establish vertical and horizontal positioning for all components of the project including all labor, materials, submittals, tools and equipment necessary to perform all construction layout, control and reference staking for satisfactory completion of the project.

This specification is applicable to city projects as well as development projects.

Specific instructions on the construction plans will govern or override this specification.

1.2 SURVEY REFERENCE POINTS

- A. Known basic horizontal and vertical control points for the Project are indicated.
- B. Locate and protect survey control points prior to starting site work, and preserve all permanent reference points during construction such as property pins and land monuments.. Additional reference points may be set by the contractor as needed.
- C. Notify ENGINEER in writing within 24-hours of any survey work changes or clarifications required for Project. Secure written authorization prior to making any changes or relocations.
- D. Report in writing when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- E. Replace construction stakes damaged or destroyed by CONTRACTOR at no additional cost to OWNER.

1.3 MEASUREMENT AND PAYMENT

Measurement and payment for this item shall be based on a lump sum for construction staking completed in accordance with these specifications and shall include all labor, materials, testing, submittals, tools and equipment necessary to complete the work as specified. Partial payments will be made for this item based on the percentage completed of the overall work, as determined by the Engineer.

---OR---

All costs associated with surveying shall be subsidiary to the various bid items.

1.4 SUBMITTALS

- A. Prior to contract closeout or acceptance of the infrastructure, submit the following:
 - 1. Documentation to verify accuracy of survey work, this includes GPS work plan.
 - 2. When required by Laws and Regulations or the Contract Documents submit a certificate signed by a Registered Public Land Surveyor (RPLS) certifying that elevations and locations of improvements conform with the Contract Documents.

3. As-built survey, prepared by a Registered Public Land Surveyor (RPLS), of the project components specified in the Contract Documents such as spillway elevations, sanitary sewer manhole flowlines and rims, gate valve depths and lids, storm sewer junction boxes and inlet flowlines and gutter elevations at intersections of all public streets. Submit the survey in both sealed PDF and CAD format so that the information can be utilized by the City in its Geographic Information System.
4. Any submittal required on the construction plans.

PART 2 - PRODUCTS

Furnish all surveying equipment, stakes, flags, pins, lath, whiskers, hubs and other materials necessary to perform this work, subject to the engineer's approval. Hubs shall be 1-1/2 inch x 1-1/2 inch x 16 inch oak and witness stakes shall be 1 inch x 1 inch x 36 inch oak or other hardwood.

Maintain neat, orderly, and complete survey notes, drawings and computations used in establishing the lines and grades. Make the survey notes and computations available to the engineer within 24 hours, upon request, as the work progresses. This requirement applies to the use of GPS or laser equipment as well as conventional surveying tools.

Check horizontal and vertical information including but not limited to alignments, locations, elevations, and dimensions, that either the plans show or the engineer provides, for compatibility with existing field conditions. Conduct similar compatibility checks and accuracy checks of horizontal and vertical positions established in the field.

Furnish, set, reference and maintain all stakes and markings necessary to establish the alignment, location, benchmarks, elevations, and continuous profile grades for all work associated with the project.

PART 3 - EXECUTION

3.1 PROJECT SURVEY REQUIREMENTS

- A. Any work done by CONTRACTOR is at CONTRACTOR's own risk.
- B. The contractor may substitute global positioning system (GPS) machine guidance for conventional staking on all or part of the work. The engineer may require the contractor to revert to conventional staking methods for all or part of the work at any point during construction if, in the engineer's opinion, the GPS machine guidance is producing unacceptable results. Establish additional benchmarks and control points as necessary to support the method of operation, or as the engineer directs. Do not use global positioning methods alone to establish critical elevations or horizontal positions.
 1. No stakes are required for work completed using GPS machine guidance.
 2. Coordinate with the engineer throughout the course of construction to ensure that work performed using GPS machine guidance conforms to the contract tolerances and that the methods employed conform to the contractor's GPS work plan and accepted industry standards. Address any GPS machine guidance issues with the engineer immediately.
 3. Submit a comprehensive written GPS work plan for review at least 5 business days before the preconstruction conference. This work plan should discuss how GPS machine guidance technology will be integrated into other technologies employed on the project. Include but do not limit the contents to the following:

- i. Designate which portions of the contract will be done using GPS machine guidance and which portions will be done using conventional subgrade staking.
 - ii. Describe the manufacturer, model and software version of the GPS equipment.
 - iii. Provide information on the qualifications of contractor staff, include formal training and field experience. Designate a single staff person as the primary contact for GPS technology issues.
 - iv. Describe how project control is to be established, include a list and map showing control points enveloping the project site.
 - v. Describe calibration procedures. Include a map of control points used for calibration and control points used to check the site calibration. Describe the calibration and checking frequency and how that information will be documented. Daily calibration checks should be performed.
 - vi. Describe the contractor's quality control procedures. Describe procedures for checking, mechanical calibration, and maintenance of equipment. Include the frequency and type of checks performed including sensor calibrations.
 - vii. Develop and maintain the initial design surface DTM for areas of the project employing GPS machine guidance. Confirm that the design surface DTM agrees with contract plans. Provide such DTM to engineer.
 - viii. Revise the design surface DTM as required to support construction operations and to reflect plan revisions.
- C. Project As-builts shall be sealed by a Registered Public Land Surveyor licensed by the State of Texas.
- D. Hubs with tacks shall be used for all control points, centerline or baseline offsets and structure stakeout and shall be accompanied by witness stakes marked with the pertinent information. For supplemental stakeout only, witness stakes alone may be used. For laser grade control and the verification of the laser elevation a hub with witness shall be provided.
- E. The Contractor shall submit certified cut sheets to the City Engineer within twenty (24) hours of performing staking. All stakes shall be set on an offset that will be clear of the excavation of the intended facility. All cut sheets shall identify benchmarks used, benchmark elevations, actual hub elevations, proposed elevations and cuts or fills for all entries. The Contractor and Project Representative for the City shall have cut sheets in hand prior to construction. If the Contractor is using GPS and laser guided equipment the cut sheet requirement can be omitted if approved by the engineer. The contractor will verify elevations and make all machine settings available to the engineer upon request. Laser levels should be used for utility installations whenever possible.
- F. Minimum conventional staking requirements are as follows:
- 1. Rough Grading or Subgrade – Provide stakes at all property corners or topographic feature changes as necessary.
 - 2. Sanitary Sewer Lines
 - i. Line and grade stakes shall be set every 25' for the first 100' out of the downstream manhole, and every 100' thereafter to the next manhole. Stakes shall be set on centerline stationing.
 - ii. A line reference stake shall be set for each manhole location.
 - iii. Wye locations, stationing from the downstream manhole, shall be staked and the stationing shown on the cut sheets.

- iv. Proposed elevations of service inverts at 15' past the right-of-way line or end of service shall be staked and shown on the cut sheets.
 - v. Proposed structure top elevation and upstream and downstream invert elevations shall be shown on the cut sheets (manhole castings shall be set 0.05' below finished street grade).
3. Water Mains
- i. Line and grade stakes shall be set every 100' on centerline stationing.
 - ii. Fitting locations shall be staked and the stationing shown on the cut sheets.
 - iii. Line and grade stakes shall be set for all hydrants (normally, the top of the operating nut shall be set 18"-24" above the top of curb). A line reference stake shall be set for each hydrant location.
 - iv. Proposed elevations of the tops of curb boxes shall be staked and shown on the cut sheets. Line reference stakes shall be set for curb box locations.
4. Storm Sewer
- i. Line and grade stakes shall be set every 25' for the first 100' out of the downstream manhole, and every 100' thereafter to the next manhole or catch basin.
 - ii. An offset hub and line reference stake to back of curb shall be set for all catch basins and catch basin manholes.
 - iii. Catch basin top, invert elevations, manhole top elevation and upstream & downstream invert elevations shall be shown on the cut sheets.
 - iv. Line and grade shall be set every 25' from the downstream structure for all storm sewer
 - v. Wye locations, cleanouts stationed from downstream structure shall be staked.
 - vi. An offset hub and line reference stake to end of storm sewer service stub.
5. Streets
- i. Set stakes to roadway centerline and edge of pavement at 50' intervals, all grade breaks, and at ¼ points on vertical curves for roadway subgrade.
 - ii. When centerline stakes are set for grading subgrade, cut sheets shall be provided (unless blue tops are set).
 - iii. Set stakes at finish rock grade at 50' intervals on center of the roadway. For roadways with a raised median island, stakes are required for the roadway on each side of the median.
 - iv. Line and grade stakes shall be set every 25' and for all begin, mid and end rad points at all street intersections.
 - v. Set stakes at 25' intervals, at BC and EC for all curvilinear alignment and at midpoint of curb returns.
 - vi. Cut sheets shall be provided for all curb and gutter construction.
6. Retaining/Sound Walls
- i. Set stakes at 50' intervals on centerline stationing. At all top and bottom of steps in the footing and wall.

END OF SECTION