

## **SECTION 01 71 23**

### **FIELD ENGINEERING**

#### **PART 1 – GENERAL**

##### **1.1 DESCRIPTION**

- A. CONTRACTOR shall provide field engineering services and professional services of the types indicated for the Project, including:
1. Furnishing civil, structural, and other professional engineering services specified or required to execute CONTRACTOR's construction methods.
  2. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
  3. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
  4. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
  5. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
  6. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
  7. Providing such facilities and assistance necessary for ENGINEER to check lines and grade points placed by CONTRACTOR. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by ENGINEER.
  8. CONTRACTOR may choose to provide a Project Engineer and have Field Engineering provided by subcontractors with approval of the OWNER. If CONTRACTOR chooses this option then CONTRACTOR will prepare and submit a Field Engineering Plan describing the roles and responsibilities of the CONTRACTOR'S Project Engineer and the Subcontractors Field Engineers.

##### **1.2 CONTRACTOR'S FIELD ENGINEER**

- A. Employ and retain at the Site a field engineer or a project engineer and field engineers with experience and capability of performing all field engineering tasks required of CONTRACTOR, including:
1. Preparing and maintaining daily reports of activity on the Work. Submit reports to ENGINEER including the following information, at minimum:
    - a. Number of employees at the Site.

- b. Number employees at the Site for each Subcontractor.
  - c. Breakdown of employees by trades.
  - d. Major equipment and materials installed as part of the Work.
  - e. Major construction equipment utilized.
  - f. Location of areas in which construction was performed.
  - g. Materials and equipment received.
  - h. Work performed, including field quality control measures and testing.
  - i. Weather conditions.
  - j. Safety.
  - k. Delays encountered, amount of delay incurred, and the reasons for the delay.
  - l. Instructions received from ENGINEER or OWNER.
2. Submit two copies of CONTRACTOR's daily reports at ENGINEER'S field office by 9:00 a.m. the next working day after the day covered in the associated report. Daily report shall be signed by responsible member of CONTRACTOR's staff, such as CONTRACTOR's project manager or superintendent, or foreman designated by CONTRACTOR as having authority to sign daily reports.
  3. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with the Contract Documents.
  4. Maintain field office files and drawings, record documents, and coordinate field engineering services with Subcontractors and Suppliers as appropriate. Prepare layout and coordination drawings for construction operations.
  5. Check and coordinate the Work for conflicts and interferences, and immediately advise ENGINEER and Resident Project Representative, if any, of all discrepancies of which CONTRACTOR is aware.
  6. Cooperate as required with ENGINEER and Resident Project Representative, if any, in observing the Work and performing field inspections.
  7. Review and coordinate the Work with Shop Drawings and CONTRACTOR's other submittals.

### 1.3 CONTRACTOR'S SURVEYOR

- A. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor shall be a professional land surveyor registered and licensed in the jurisdiction where the Project is located, or a professional engineer registered and licensed as a professional engineer in the jurisdiction where the Project is located and authorized under Laws and Regulations to practice surveying. Surveyor's tasks include, but are not necessarily limited to, the following:
  1. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.
  2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements.
  3. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.

4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities encountered.
5. Complying with requirements of the Contract Documents relative to surveying and related work.

#### 1.4 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Field Engineering:
  - a. Submit daily reports as indicated in this Section.
  - b. When requested by ENGINEER, submit documentation verifying accuracy of field engineering.
2. Surveying:
  - a. Complete plan for conducting survey work, submitted ten days prior to beginning survey Work.
  - b. Example of proposed survey field books to be maintained by CONTRACTOR's surveyor. Example shall have sufficient information and detail, including example calculations and notes, to demonstrate that field books will be organized and maintained in a professional manner, complying with the Contract Documents.
  - c. Submit original field books within two days after completing survey Work.
  - d. Submit certified survey in accordance with this Section.
3. Certificates: When requested by ENGINEER, submit certificate signed by professional engineer or professional surveyor, as applicable, certifying that elevations and locations of the Work comply with the Contract Documents. Explain all deviations, if any.
4. Qualifications Statements:
  - a. Field Engineer: Name and address. When requested by ENGINEER, submit qualifications.
  - b. Surveyor: Name and address of firm, and resumes of each professional land surveyor and crew chief conducting the survey Work. Submit at least ten days prior to beginning survey Work. During the Project, submit resume for each new registered land surveyor and crew chief employed by or retained by CONTRACTOR at least ten days prior to starting on the survey Work.

#### 1.5 RECORDS

- A. Maintain at the Site a complete and accurate log of control and survey Work as it progresses.
1. Survey data shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the locality where the Site is located. Original field notes, computations, and other surveying data shall be recorded by CONTRACTOR's surveyor in CONTRACTOR-furnished hard-bound field books, and shall be signed and sealed by CONTRACTOR's surveyor. Completeness and accuracy of survey

Work, and completeness and accuracy of survey records, including field books, shall be responsibility of CONTRACTOR. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.

2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by ENGINEER.
- B. Upon completion of foundation walls and major Site improvements, prepare a certified survey, signed and sealed by professional surveyor, showing dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities encountered during the Work.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.1 SURVEYING

A. Reference Points:

1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, regarding reference points.
2. OWNER's established reference points damaged or destroyed by CONTRACTOR will be re-established by OWNER at CONTRACTOR's expense.
3. From OWNER-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.

B. Surveys to Determine Quantities for Payment:

1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for ENGINEER to determine final quantities of Work in place.
2. Notify ENGINEER at least 24 hours before performing survey services for determining quantities. Unless waived in writing by ENGINEER, perform quantity surveys in presence of ENGINEER.

C. Construction Surveying: Comply with the following:

1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.
2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
3. Structure: Stake out structures, including elevations, and check prior to and during construction.
4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
5. Road: Stake out roadway elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
6. Cross-sections: Provide original, intermediate, and final staking as required, for site work other locations as necessary for quantity surveys.
7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden laths with flagging at 100-foot maximum intervals.
8. Record Staking: Provide permanent stake at each blind flange and each utility cap that is provided for future connections. Stakes for record staking shall be material acceptable to ENGINEER.

D. Accuracy:

1. Establish CONTRACTOR's temporary survey references points for CONTRACTOR's use to at least second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at least third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

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