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CONSTRUCTION SURVEY**PART 1 - GENERAL****1.01 SECTION INCLUDES**

Construction survey includes qualified personnel, equipment, and supplies required for, but not limited to, the following:

- A. Project Control
- B. Grading
- C. Bridges, Structural Walls, and Reinforced Box Culverts
- D. Pipe Culverts
- E. Sanitary and Storm Sewers
- F. Water Mains
- G. Paving
- H. Replacement of Disturbed Monuments
- I. Additional Items Included in the Contract Documents

1.02 DESCRIPTION OF WORK

Construction survey and staking necessary for construction of the project as shown in the contract documents.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Qualifications:** Upon request, submit a resume identifying survey personnel and their respective qualifications to the Engineer for review.
- B. Documentation:** Format the survey work documentation in a manner acceptable to the Engineer. Ensure documentation is sufficient to prove means and methods used to transfer design intent to construction stakes. Check tie-ins with existing roadways, structures, and utilities prior to staking; notify the Engineer if discrepancies are found.
 - 1. Benchmarks:** Submit descriptions and elevations of new permanent benchmarks. Establish benchmarks on existing durable fixtures not subject to frost action or disturbance.
 - 2. Replacement of Disturbed Monuments:** Upon completion of construction, submit the following to the Engineer.
 - a. Description of new monuments using existing features for reference.
 - b. Horizontal position of new monument by state plane or local coordinate system.
 - c. Elevation of new monuments including level run documentation for new benchmarks.
 - d. Recorded section corner certificates and property pin replacement if applicable.
 - 3. Staking Records:** Upon request, submit all field books, computer-aided design and drafting (CADD) files, digital log files, etc.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS**A. Qualifications:**

1. Perform construction survey directly by or under responsible charge of a Professional Engineer or Professional Land Surveyor licensed in the State of Iowa.
2. Set new monuments or reset disturbed monuments under the responsible charge of a Professional Land Surveyor licensed in the state of Iowa.

B. Obtain Engineer's approval when interpolating grades or using cross-sections to obtain alignments and elevations.**C. The Jurisdiction will provide benchmarks, right-of-way corners, and primary control points from the original survey in the contract documents. Roadway alignment data will be provided as required for construction.****1.08 MEASUREMENT AND PAYMENT****A. Construction Survey:** If the contract documents specify that the Contractor is responsible for construction survey, measurement and payment will be as follows.

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for construction survey.
3. **Includes:** Lump sum price includes, but is not limited to, the costs of resetting project control points, re-staking, and any additional staking requested beyond the requirements of this section.

PART 2 - PRODUCTS**2.01 HUBS**

Provide hardwood, metal, or plastic stakes of sufficient size and length to prevent stake movement due to adjacent construction activity.

2.02 LATH

Provide wood lath that is approximately 3/8 inch thick by 1 1/2 inches wide by 48 inches long.

PART 3 - EXECUTION**3.01 EQUIPMENT**

- A. Utilize survey equipment with a level of accuracy appropriate for the type of work being staked.
- B. Do not use GPS equipment for staking the vertical elements of paving hubs, bridges, structural walls, or reinforced box culverts.

3.02 PROJECT CONTROL

Provide all horizontal and vertical control data to the Jurisdiction at the completion of each phase of the construction survey work activity.

- A. Primary Monuments:** Primary survey monuments are established by the Jurisdiction prior to project construction.
 - 1. Replace primary monuments disturbed by construction.
 - 2. Reference a minimum of three ties to durable objects (trees, fence posts, station marks, etc.) in the description of the new monument.
- B. Secondary Monuments:** Secondary control points are established by the Contractor or Contractor's Surveyor during construction to facilitate staking or instrument calibration.
 - 1. Place in locations likely to survive construction.
 - 2. Reference to the primary monuments with a resulting error radius not to exceed 0.10 feet.
 - 3. Replace any points disturbed during construction. Points do not need to be replaced after construction.
- C. Benchmarks:** Utilize the benchmarks shown in the contract documents to establish all other vertical control on the project site.
 - 1. Establish new permanent vertical control benchmarks on new structures (bridges, reinforced box culverts), fire hydrants, or power poles located in the project limits.
 - 2. Identify permanent benchmarks.
 - 3. Transfer elevations from construction plan benchmarks to new permanent benchmarks using a digital level or a three-wire leveling method.
 - 4. Record descriptions and elevations of new permanent benchmarks.
- D. Property Limits:** If specified, mark all construction easements, permanent easements, and rights-of-way with flagged lath at 100 feet intervals on tangents; at the PC and PT of curves; at 25 feet intervals on curves; and at all angle points.

3.03 CONSTRUCTION STAKING

For each construction operation specified in the contract documents, provide stakes as follows. If approved by the Engineer, staking frequency may be modified as long as the level of accuracy appropriate for the type of work is achieved.

A. Grading:

1. Conventional Grading:

- a. Set slope stakes left and right (nails or wood hubs) at 100 foot intervals, or less if needed, for all embankment or roadway excavation. Mark slope stakes with wooden lath depicting station, offset, and elevation reference (cut or fill) to all pertinent breaks in the slope.
- b. In lieu of slope stakes, set a 100 foot grid with lath over project limits for mass grading with cut or fill marked for finished grade elevation. Finished grade refers to the finished surface of construction (top of paving for paved areas, top of black dirt for unpaved areas).
- c. For paved areas, in addition to the 100 foot grid, set lath at appropriate offsets around the perimeter at 50 foot intervals, high and low points, and points of inflection. Mark lath with cut or fill to finished grade (top of paving).
- d. For building pads, set lath at appropriate offsets for building corners or gridlines. Provide a semi-permanent benchmark, consisting of a 2 foot wooden hub or rebar, set to the same elevation as the proposed finished floor elevation.
- e. Set finished grade stakes (blue tops) at 100 foot intervals at both edges of paving and along centerline for roadways, and in a 100 foot grid in parking areas. Mark blue tops with a stake chaser or similar method.

2. GPS Machine-Controlled Grading:

- a. Establish GPS control points consisting of a minimum of 5 semi-permanent points located around the perimeter of the site. Points may be established horizontally using GPS, but transfer elevations of said points from an original benchmark located in the construction documents using a total station or level.
- b. Provide grade check stakes at an approximate spacing of 300 feet on roadways.
- c. Provide approximately 20 grade control check stakes for building pad and parking areas.

B. Bridges, Structural Walls, and Reinforced Concrete Box Culverts:

1. Provide appropriate offsets for centerline of abutments, piers, back of parapets, face of walls, etc.
2. Provide stakes consisting of a tacked wooden hub with a lath. Clearly mark offset distance and referenced line identification: centerline roadway, abutment, pier, etc.
3. Clearly mark height of cut or fill to a pre-determined elevation reference: flowline, top of wall, top of footing, etc. For structural walls, provide elevation reference to either top of wall or top of footing. Do not reference off of bottom of wall.
4. Set a minimum of two semi-permanent benchmarks, consisting of a 2 foot wooden hub or rebar, for each structure. Transfer elevation to benchmarks from construction plan benchmarks using a total station or level.

3.03 CONSTRUCTION STAKING (Continued)

5. Perform an independent check of all the above stakes. Independent check can be performed by an independent survey crew or by arbitrary verification of the location of the stakes as placed in the field.
 - a. For an arbitrary verification, survey stakes and control points in an arbitrary coordinate system and then rotate digitally into the design file to verify accuracy with the contract documents.
 - b. Notify Contractor of any discrepancies within 24 hours of placing the stakes for each structure.

C. Pipe Culverts:

1. Place stakes for offsets to ends of pipe, labeled with offset distance, and cut or fill to proposed flowline of the new culvert.
2. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.
3. For culverts over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

D. Sanitary and Storm Sewers:

1. Place stakes for all manholes, intakes, cleanouts, and other structures associated with new sewer.
2. Provide offset stake for each structure set at 10 to 15 feet. Offset may be increased for deep sewers.
3. For back of curb intakes, set two offset stakes along the curb alignment to properly align the new grate. Stakes may also be offset perpendicular to the curb alignment as required to avoid conflicts with the proposed storm sewer.
4. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.
5. For pipe sections over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

E. Water Mains:

1. Place stakes for proposed water main on line (no offset) at 100 foot intervals. Label stakes as centerline of water main with elevation reference to the top of the proposed pipe to ensure sufficient depth is achieved.
2. Place stakes for all hydrants, valves, bends, tees, and other appurtenances with appropriate offsets. Label stakes with offset distance and elevation reference to proposed finished grade adjacent to the hydrant, valve, bend, tee, or other appurtenance.
3. Place stakes at all crossings of storm sewers and sanitary sewers. Label stakes with top of pipe elevations at the crossing for water mains and sewer mains to ensure proper depth and vertical separation.

3.03 CONSTRUCTION STAKING (Continued)**F. Paving:**

1. Set paving hubs at appropriate offsets around perimeter of paved areas. Place hubs at grade breaks (high and low points), points of horizontal deflection (bends), and 25 foot intervals in between. Label stakes with offset distance and elevation reference to the top of paving.
2. For paving areas wider than 60 feet, set paving hubs at appropriate offsets on 25 foot intervals along interior bays or drive lanes. Label stakes with offset distance and elevation reference to the top of paving.
3. Place stakes for curb drop locations for sidewalk ramps and driveways. Set hubs on both sides of the drop curb at the bottom of the drop to ensure the appropriate width of curb opening is achieved. Label stakes with offset distance and elevation reference to top of paving.
4. Place stakes for sidewalks and trails on one side only at appropriate offsets. Place stakes at 50 foot intervals in straight and level sections and 25 foot intervals for horizontal or vertical curves. Label stakes with offset distance and elevation reference to the top of paving.

3.04 DISTURBED MONUMENTS

Replace land corners, property corners, permanent reference markers, and benchmarks specified in the contract documents, or if disturbed during construction.

END OF SECTION

