Section 2526. Construction Survey

2526.01 DESCRIPTION.
Perform survey for construction projects.

2526.02 MATERIALS.
None.

2526.03 SURVEY.

A. Furnish all survey necessary for construction of the project before work begins in the area. Do not apply the provisions of Article 1105.06 to this work, except to preserve the original stakes set by the Engineer. If, in the opinion of the Engineer, the Contractor has destroyed or disturbed any of the original survey stakes or benchmarks, the cost of replacing will be charged to the Contractor. Bring design errors discovered to the Engineer's attention for review prior to staking. Construction survey includes qualified personnel, equipment, and supplies required for, but not limited to, the following items:

1. Project Control.

a. Primary Control Monuments.
A primary control monument is a survey point the Contracting Authority establishes prior to project commencement. These are shown in the contract documents. The point will be established by placing a monument in the ground.

b. Secondary Control Monuments.
A secondary control monument is a survey point the Contractor establishes on grading or other projects specified in the plans, and preserves on all other projects.

1) The Engineer will provide monuments, similar to those the Department uses for Global Positioning System (GPS) control.

2) Place secondary permanent horizontal control monuments, under the Engineer’s direction, at locations likely to survive project construction and at intervals not to exceed 2640 feet (0.8 km). Place the monuments in the ground along the project corridor. Place at higher elevations along the corridor to provide a view of the immediate project topography and to provide for visible clear line of sight to the nearest secondary permanent control monument in either direction. Primary project monuments may be substituted if appropriate.

3) Plant secondary control monuments 1 to 4 inches (25 mm to 100 mm) below existing ground. Drive a metal fence post within 1 foot (0.3 m) to mark their location.

4) Carefully determine project coordinates relative to the nearest primary project control monument using project coordinate values the Engineer has provided. Ensure the resulting error radius of the secondary monument does not exceed 0.10 feet (30 mm) ±2 ppm relative to the primary control. Provide the Engineer with all the field data of the survey. The data may be either unedited printed or electronic formatted field data, or both. Provide the Engineer with an ASCII comma delineated

file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature).

5) Perform an independent traverse check between the secondary control monuments by observing distance and angular measurements or by use of GPS. Provide the Engineer with all the field data for the traverse check. The data may be either unedited printed or electronic file, or both. Provide the Engineer with a diagram indicating horizontal ground distances to nearest 0.01 foot (3 mm) and angles to at least the nearest 10 seconds between each secondary control monument. Ensure inverses between the coordinate pairs as determined in the previous paragraph do not exceed 0.10 feet (30 mm) of the direct measurements.

6) Replace secondary control monuments disturbed during construction activities using procedures outlined above, at no additional cost to the Contracting Authority.

c. Durable Physical Objects.

1) Using measurements to the nearest 0.10 foot (30 mm), reference each control monument to a minimum of three durable physical objects located 20 to 100 feet (6 m to 30 m) away from the monument. Durable physical objects could include trees, poles, fence posts, station marks in new roadway pavement, or metal fence posts.

2) Provide the Engineer with either a printed or electronic reference image (for example JPEG, TIFF, etc), or both, including each reference and project coordinate.

d. Benchmarks.

1) Establish permanent vertical control benchmarks at all bridges and reinforced concrete box culverts within the project. Use an Iowa DOT brass plug on bridge barrier rail or headwall of reinforced concrete box culvert to indicate the benchmark. If the Engineer approves, a sawn “X” on bridge barrier rail or headwall of reinforced concrete box culvert may be used.

2) Transfer all benchmark elevations from construction plan benchmarks to the permanent benchmarks using the three-wire method or by trigonometric leveling. Use temporary benchmarks of reasonable stability to preserve the plan benchmarks.

3) Provide the Engineer with all field benchmark elevation data. The data may be either unedited printed or electronic formatted, or both. Provide the Engineer with the project x and y coordinates of all benchmarks along with an ASCII comma delineated file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature).

4) Ensure benchmark level loops do not exceed an error of 0.05 feet (15 mm) times the square root of the loop’s length in miles (kilometers). Distribute the error equally along the loop on all intermediate traverse/benchmark points.

2. Grading.

a. Survey right-of-way line between permanent right-of-way corners at 100 foot (20 m) intervals, or less if needed, including borrows,

temporary easements, and right of entry. Mark these points by placement of a metal pin or wood hub, flat, and lath at the same location as the slope stakes. Clearly mark the flat with the station number, distance from centerline, and elevation (cut or fill) to subgrade.

b. Set slope stakes at 100 foot (20 m) intervals, or less if needed, for all embankment and excavation work including roadway, channel changes, and borrow areas. Interpolations may be necessary to match the cross-sections. Set the stakes at the toe of the foreslope or the top of the backslope, or both. Mark slope stakes with a flat and lath. Clearly mark the flat with the station location, distance, slope, and cut/fill information.

c. Set grade check stakes at 100 foot (20 m) intervals for bottoms of subgrade treatments. Set the stakes on centerline for two-lane roads and in the median for four-lane roads. Mark grade check stakes with a lath. Clearly mark the lath with the station location and cut or fill information.

d. Set finish grade stakes (blue tops) at 100 foot (20 m) intervals, or less if needed. Set the blue tops at each shoulder line and at each point where there is a change in cross slope. Mark blue tops with a wood hub and a stake chaser or similar type tassel.

e. Take original and final elevations of all borrows. Provide original and final graphical cross sections at 100 foot (20 m) intervals, or less if needed, suitable for use by the Engineer to calculate excavation quantities.

f. Set bridge berm slope stakes to establish all transitions, including the face of the berm. Set finish grade stakes (blue tops) on all roadway shoulder lines and roadway centerlines to project down the face of the bridge berm at the top, face of berm bench, and toe.

g. When Class 12 excavation is an item, take cross section elevations at 100 foot (20 m) intervals, or less if needed, and plot cross sections for use by the Engineer to calculate the excavation quantities.

h. Use a lath to locate, on each side of roadway at the right-of-way line, agricultural drain tile shown in the contract documents. Clearly mark lath to show station location, distance from centerline, tile size and type, and flowline elevation.

3. Bridges.

a. Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark flat with the pier/abutment station location, design number, and offset distance from centerline of the approach roadway.

b. Establish a minimum of three temporary benchmarks.

c. Mark location of test pile with a wood hub.

d. Perform an independent check of the above stakes.

e. Submit elevations of all completed substructure beam seats to the Engineer for review prior to installation of bearings and superstructure elements.

f. Take elevations of beams as erected. Provide the elevations to the Engineer for computation of finish elevations for deck construction.

Locations for determining beam elevations are to be according to the plans.

g. Provide the Engineer with a copy of the staking diagram prior to commencing work.

4. Reinforced Concrete Box Culverts.

a. Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, design number, cut/fill elevation, and offset distance from the centerline of the culvert and back of parapet.

b. Perform an independent check of the above stakes.

c. Provide the Engineer with a copy of the staking diagram prior to commencing work.

d. Report to the Engineer questionable flow lines and alignments that do not match existing drainage.

5. Pipe Culverts.

a. Mark locations and elevations with metal pin or a wood hub, flat, and lath. Clearly mark the flat with the station location, cut/fill elevation, and offset distance to both ends or centerline of pipe.

b. Report to the Engineer questionable flow lines and alignments that do not match existing drainage.

6. Sanitary and Storm Sewers.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, pipe number, cut/fill elevation, and offset distance to centerline of pipe.

7. Water Mains.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, pipe number, cut/fill elevation, and offset distance to centerline of pipe.

8. Intakes and Utility Accesses.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, intake or utility access number, cut/fill elevation (including bottom of well and form grade), and offset distance to the Station Location.

9. Pavements (PCC & HMA).

a. Mark locations and elevations with metal pin or tack in a wood hub (only tack one side), flat, and lath. Mark elevations on both sides of the pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark the flat with the station location, cut/fill information, and offset distance to the edge of pavement. Include pavement cross slope information in superelevated curves.

b. Take elevations of pavement centerline and both edges at bridges and existing pavement at 10 foot (3 m) intervals for 100 feet (30 m). Submit final elevations to the Engineer for approval.

c. When a new profile grade is not included in the contract documents:

1) Obtain elevations of the existing shoulders and/or pavement as stated in Article 2526.03, A, 9.
2) Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed in the contract documents. This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. Submit this proposed grade line to the Engineer for approval.

10. HMA Overlays

a. Reference and preserve existing control points located at each Point of Intersection (P.I.).
b. Obtain the Engineer's approval for the method used to reference points.
c. Reset Control Points after the work is complete.

11. PCC Overlays

a. Mark locations and elevations with metal pin or tack in a wood hub (only tack one side), flat, and lath. Mark elevations on both sides of pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark flat with the station location, cut/fill information, and offset distance to edge of pavement. Include pavement cross slope information in superelevated curves.
b. Take elevations of pavement centerline and both edges at bridges and existing pavement at 10 foot (3 m) intervals for 100 feet (30 m). Submit final elevations to the Engineer for approval.
c. When a new profile grade is not included in the contract documents:
1) Obtain elevations of existing pavement at centerline and both pavement edges for bonded overlays and projects including mainline stress relief course and/or pavement scarification.
2) Obtain elevations of existing pavement at centerline, quarter points, and both pavement edges for unbonded overlays and whitetopping projects when a stress relief course and/or pavement scarification are not included.
3) Obtain elevations at 100 foot (30 m) intervals on straight and level sections and at 50 foot (10 m) intervals on horizontal and vertical curves.
4) Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed in the contract documents. This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. This proposed grade line shall be submitted to the Engineer for approval.
d. Reference and preserve existing control points located at each Point of Intersection (P.I.).
e. Obtain Engineer's approval for method used to reference points.
f. Reset Control Points after work is complete.

12. Structural Walls.

a. Survey requirements for structural walls includes the following work types:

1) Mechanically Stabilized Earth (MSE) Walls.
2) Cast in Place (CIP) Retaining Walls.
3) Soil Nail Walls.
4) Tie Back Walls.
5) Noise Walls.
6) Modular Block Retaining Walls.
7) Segmental Retaining Walls.

b. Mark locations and elevations with a metal pin or a wood hub, flat, and lath. Clearly mark the flat with the station location, cut/fill elevation, and offset distance to face of wall.

B. Submit the method used to preserve project control to the Engineer for approval. Format the survey work documentation in a manner acceptable to the Engineer. Ensure survey work is completed by a Professional Engineer licensed in the State of Iowa in responsible charge or a Professional Land Surveyor licensed in the State of Iowa in responsible charge, according to the provisions of Chapter 542 B, Code of Iowa. Submit a resume to the Engineer identifying the field survey personnel and their capabilities to perform the intended requirements.

C. Obtain the Engineer's approval for the method of determining alignments and elevations and the method of preserving control points. This approval does not act to relieve the Contractor of the responsibility for the correctness of the survey work. Do not use plan cross-sections for vertical or horizontal control.

D. The Engineer will provide bench mark elevations, right-of-way corners, and reference control points on the original survey as shown in the contract documents. A GeoPak alignment will be provided if available.

E. Check tie-ins with existing roadways for correctness of alignment prior to construction staking.

F. When survey work is done under traffic, detail sheets in the contract documents will establish the required signing.

G. Establish benchmarks in the adjacent area before installing settlement plates in accordance with Article 2526.03, A, 1, d.

1. Obtain Engineer's approval for method of determining alignments and elevations and the method of preserving control points. This approval does not relieve Contractor of the responsibility for correctness of survey work.

2. Do not use plan cross-sections for vertical or horizontal control. The Engineer will locate and determine elevations of settlement plates.

H. Replace land corners and permanent reference markers unless stated otherwise in the contract documents.

I. All survey work documentation becomes the property of the Contracting Authority. The work of this specification will be considered finished when the documentation is furnished to and accepted by the Engineer.

J. For the purpose of subcontracting, this item will be considered a specialty item.

2526.04 METHOD OF MEASUREMENT.

None. Lump sum item.

2526.05 BASIS OF PAYMENT.

1. Payment for Construction Survey will be paid for at the lump sum contract price.

2. Payment is full compensation for the survey work required for the project as let, including any interpolations that may be necessary between cross-section and field staking.

3. Payment for revisions after the letting will be paid for according to Article 1109.03, B.