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CHAPTER TWENTY-THREE

ELECTRONIC DATA COLLECTION SURVEY

23-1.0 GENERAL

An electronic data collector may be used to collect field survey information for a highway-improvement project. There is hardware and software available to collect and interpret this information. However, it is not within the scope of this Chapter to provide procedures and guidelines for every situation, as the Department accepts only MOSS format surveys.

Implementing electronic data collection does not alter the amount or type of survey information required for a highway-improvement project. All the information that is required for a conventional survey is still necessary and is provided in a conventional survey book.

The correct location of each topographical feature is plotted by computer. Coordinates or station and offset values need not be shown on the plot unless the survey is submitted as a final product and the design is to be completed by others. However, all topographic features must be identified.

Property-corner markers, easements, existing right-of-way lines, fences, or other evidence of ownership, and section and subdivision lines and corners and similar information which are ordinarily shown within the limits of the survey must be plotted and identified with coordinates or station and offset values shown on the plot.

All plotting should be conducted using the conventional line types and symbols as determined by the Department.

A road plan provides all major topographical features that affect the ground surface and that influence the interpolation or generation of contours and cross sections. This includes such features as follows:

1. building;
2. road;
3. top of bank;
4. toe of slope;
5. ditch flow line;
6. edge of water;
7. edges of stream;
8. lake;

9. quarry;
10. wall; and
11. other item that represents abrupt changes in slope or surface elevations.

Each spot elevation should be depicted on the plot together with the elevation of each shot.

A section or other corner tie requires a separate plot that includes all traverse and closure data together with the following:

1. error of uncertainty;
2. description; and
3. evidence and references for each corner.

A bench circuit for elevation control should be shown in the conventional format and should include a description and location (i.e., station and offset) for each benchmark.

A conventional section plat and conventional notice of survey is required. See Chapter Twenty-two for preliminary research requirements.

23-2.0 GUIDELINES AND PROCEDURES

23-2.01 Field Book

An electronic-data-collection field book is a skeletal field book that includes supplemental data for the survey. Information pertaining to topography and the ground model is included in the data collector. The following provides information relevant to the electronic field book.

1. The field-book format is letter-size paper.

2. Set up the field book in the following sequence.

    a. flyleaf page;
    b. Index page;
    c. General Information;
    d. Stream Data (if applicable);
    e. present-structure tie-in (if applicable);
    f. public utilities;
    g. alignment line “A,”;
    h. bench tie-in circuit;
    I. bench level notes;
    j. level notes;

k. level notes for present structure (if applicable);
l. high-water levels;
m. testimony of local residents (if applicable);
n. section-corner references;
o. aerial cross references (if applicable);
p. miscellaneous envelope (see Chapter Twenty-six for contents); and
q. check guides (see Figure 23-2A, Guide for Checking Survey Book). An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/).

23-2.02 Alignment Baseline and Data

Information pertaining to establishing the alignment baseline and collecting alignment data is provided in Section 22-5.0. See Figure 23-2B, Alignment Sketch.

23-2.03 Bench Level

The guidelines and procedures relative to running a bench level and collecting bench-level data are discussed in Section 22-5.0.

23-2.04 Data-Collector Preparation

The procedure to aid in the preparation of the electronic data collector is as follows:

1. select the instrument;

2. select the job settings;

3. configure the reading for collecting data in raw-data SDVA format (i.e., slope distance vertical angle);

4. select the input type to accommodate metric units of measure; and

5. input data tolerances.

23-2.05 Keyboard Input

The keyboard input that is required includes the following:

1. designation number;

2. project number;

3. old or new structure number, as applicable;

4. name of survey firm;

5. names of survey-party personnel;

6. project description and location;

7. coordinates for all centerline and adjusted control points;

8. centerline station, line letters, and monument type;

9. start date of survey;

10. end dater of survey; and

11. additional survey or pickup survey notes, including dates or other description information. Indicate whether the information is additional survey or pickup survey data.

23-2.06 Setting Temporary Control or Fly Stations

1. Station Location. Set each temporary control station beyond the roadway in a visible location.

2. Survey Control. Set each temporary control station from the survey control.

3. Third-Generation Control. A third-generation temporary control station is not permitted. If an additional temporary control station is necessary, return to the survey-control line and backsight a control-line point. The additional temporary control station can then be set.

23-2.07 INDOT String-Label Conventions

For a copy of the current list of INDOT string labels, contact the Production Management Division's Survey Team.

23-2.08 Topography Plot

The key information that should be shown on a topography plot is described below.

23-2.08(01) Building

Identify each building type that extends within the limits of the survey including the following:

1. accurate location;
2. dimensions; and
3. a brief description (e.g., frame, brick, concrete).

Round and record all dimensions to the nearest 30 mm. The extent of coverage from the baseline varies, and the amount of coverage is determined either from the Engineer's Report or the Survey Team. See Figure 23-2C, Topography Plot Example, for an example of showing a building on a topographic plot.

23-2.08(02) Fence

Identify each fence with at least two points on each tangent of the fence including fence corners. Figure 23-2C provides an example.

23-2.08(03) Tree or Forest

If a wooded tract is encountered, show its limits, and approximate the number and prevailing kinds and sizes of the trees within the survey limits right and left of the baseline. Apart from a forest, show each individual tree of appreciable value, particularly a tree or shrub located on a lawn, etc., and that are within the proposed right-of-way limits. Show each fruit tree. See the examples in Figure 23-2C.

23-2.08(04) Field

The limits of a pasture, truck patch, garden, berry patch, lawn, or park that are within the survey limits should be recorded on the topography plot. Figure 23-2C provides an example.

23-2.08(05) Utilities

Each utility should be identified on the topography plot including the following:

1. electric line;
2. telephone line;
3. cable-television line;
4. water line;
5. gas line;
6. oil line;
7. sewer line (e.g., sanitary, storm);
8. manhole;
9. fire hydrant;
10. transmission-line tower;
11. power line; or
12. underground oil- or gas-transmission line.

A power-transmission line must be tied to the baseline by locating either the centerline of each high-tension tower or all four legs. Both right and left distances from the center of the closest tower must be recorded. The easement width must be obtained from the utility company and placed in the survey envelope. Power, telephone, or telegraph poles are observed to the center of the pole. Identification numbers which appear on the poles should be shown on the topography plot. Utility companies prefer that underground utility lines be located and marked by their employees. Further discussion regarding utilities is provided in Section 22-2.0. Utilities should then be located by the survey party and recorded in the topography notes as illustrated in Figure 23-2C, Topography Plot Example.

23-2.08(06) Roadway or Path

Each public road, private road, or field entrance should be located on the topography plot together with a complete description (e.g., type, purpose or use, width, type of surface, condition). The need to survey an S-line is determined by the Survey Team prior to the party's assignment to a project. The length and coverage limits required for an S-line is predetermined by the Survey Team. The topography plot also should include the location and description of each sidewalk, curb, gutter, retaining wall, or other similar item. Figure 23-2C illustrates examples of locating the items discussed herein.

23-2.08(07) Railroad

Where railroad switch or mainline tracks are encountered, locate the centerline of track and the gauge side of each rail to the nearest 5 mm. Locate each switch or frog point within the survey limits both right and left of the baseline. Surveying a separate line (e.g., "RR-1-A") both right and left of the baseline and along the centerline of the tracks is warranted. Such survey line runs from left to right across the baseline using station 5+000.000 at the equation point on the baseline. However, if railroad plans are available, it is permissible to survey a railroad line on the railroad stationing. An accurate distance must be obtained that relates to an identifiable feature along the railroad (e.g., milepost, bridge). Railroad plans may be available from the county surveyor's office if unavailable from the Production Management Division's Utilities Team.

23-2.08(08) Natural Drainage Feature

Each natural drainage feature should be identified on the topography plot. Identify the limits, direction of flow, extreme- and ordinary-high-water elevation, and other relevant information for features as follows:

1. quarry;
2. gravel pit;
3. stream;
4. lake;
5. pond;
6. marsh;
7. spring;
8. sinkhole; and
9. dry run.

A drainage area of 40 ha or less should be determined in the field and recorded in the survey notes. The high-water elevations are recorded in the level notes. An example of providing natural drainage features is illustrated in Figure 23-2C, Topography Plot Example.

23-2.08(09) Geographical Feature

Depict rock, shale outcrop, peat bog, or muck area on the topography plot by identifying the area limits. Rock or muck soundings are taken where required, and recorded in the level book. Each ditch, tile drain, catch basin, or curb inlet must be depicted together with information describing its location, size, direction of flow, type, and depth below surface. Figure 23-2C provides examples of locating the items discussed herein.

23-2.08(10) Structure

The topography plot should identify each bridge, culvert, or small structure. Report in the survey notes, together with corresponding sketches, sufficient details regarding each structure's condition and future usefulness. A structure that is 6096 mm or longer is considered a bridge. Figure 23-2C illustrates an example of the appropriate method to identify a structure.

23-2.08(11) Sign

Each sign that is within the survey limits (e.g., traffic, public, private) should be shown on the topography plot. Sign dimensions should be determined and recorded to the nearest 30 mm. The sign message should also be identified.

23-2.08(12) Mailbox

The topography plot should show each mailbox within the limits of the survey. The size and type of post support and the number of boxes should also be indicated.

23-2.08(13) Guardrail

Where guardrail is shown on the topography plot, record the X, Y, and Z values of the top of the beam rail where it meets the blockout or post. Both horizontal and vertical breaks should be shot. See Figure 23-2D, Guardrail Survey Point.

23-2.08(14) Property Line

An important objective of a project survey is to collect sufficient data to adequately describe the right-of-way requirements of the project. However, performing a full retracement of each property affected is not an objective of the survey. As such, the following statement should be recorded on the General Information page.

> *The purpose of this survey is to collect data for the design of a highway improvement, and to provide a basis for describing right-of-way required for the project. It is not a property retracement survey. All apparent property lines or corners, or subdivision or section corners, are based on physical evidence or testimony. For example, a fence between two houses can be identified as an apparent property line.*

The survey party should gather all information pertaining to evidence, physical or otherwise, of property lines including the following:

1. fence;
2. iron pipe;
3. rebar;
4. stake;
5. hedge row;
6. tree line;
7. field divide; and
8. testimony.

Where located, record these items in the survey book as, for example, *apparent property line*, or *apparent corner* (i.e., *App. PL* or *App. Cor.*). Locating markers should be conducted with a high degree of accuracy. Where a property line exists without evidence or testimony, a statement should be recorded in the topography plat indicating, *no evidence of property line* (i.e., *NEPL*). The locations of property lines should not be computed so they can be plotted for the survey. Record only the physical evidence or testimony. A property-owner's name should be recorded on each side of a property line. If evidence or testimony is unavailable, property deeds may be used to determine the general limits of ownership.

Where a subdivision is involved, it is necessary to locate the subdivision corners within the project limits. At least one additional corner beyond the project limits is required to indicate direction. If subdivision corners are unavailable, the individual lot corners should be identified. The number of corners required is based on a prudent search and should represent a consensus of surveys conducted in the area.

Identical procedures should be followed to locate property-corner markers of metes-and-bounds descriptions. An accurate location of each property-corner marker is required for the same reasons as previously indicated. A reasonable and prudent search should be made for existing markers within the project limits. If the last deed of record is examined, the monument corners referenced in the instrument should be located and, if not found, should be indicated. Not all property-corner monuments need be located. However, property-corner monuments should be located for each property line which intersects the centerline or is within the survey limits. However, the purpose of the survey is not to retrace the entire description in the field.

Copies of subdivision plats and metes-and-bounds descriptions should be transmitted to the Survey Team along with the completed survey books.

23-2.08(15) Right-of-Way Line

Physical evidence of a right-of-way line should be identified on the topography plot including the following:

1. fence;
2. property-corner marker;
3. pole;
4. edge of field; and
5. right-of-way markers.

Physical evidence of property and right-of-way limits should be recorded in the data collector. For a right-of-way marker, locate and record the center of the back edge of the marker. All other monuments are to be located at the center of the monument.

23-2.09 Procedures for MOSS User

The following are the procedures that should be considered by a MOSS user.

1. 201's (straight);

2. 202's (curve);

3. 203's (parallel line);

4. circles;

5. rectangles;

6. offset for an object that cannot be seen due to obstruction is as follows.

    a. An angle offset is made by observing the horizontal angle with one reading and the vertical angle and distance with another. The two are then combined into one observation record.

    b. A single-distance offset is made by observing a prism located at a known distance from the target point. The direction from the prism to the target is normal to or along the line of sight from the instrument to the prism. The instrument measures the angle and distance to the prism. The offset distance and the offset direction are input into the data collector.

7. taping;

8. closing;

9. repeat shot;

10. discontinuities;

11. A P-note is a note that is related to a single point and should immediately follow the observation (e.g., P 1234 0.15 CMP outlet); and

12. An S-note is a note that relates to a single string and can be placed after the first or last shot in that string or in between (e.g., S UT01 200-pair cable owned by Ameritech).

23-2.10 Checking Shots

At least once every half hour, the horizontal circle reading on the backsight should be checked. If a discrepancy of only a few seconds is found, the circle may be reset, and data collection may continue. If a greater discrepancy is found, the source of error should be located and corrected. At least once during each setup, a check shot should be taken. If the same setup is used during the morning and afternoon, a check shot should be taken during each session. A check shot should be conducted on a known point such as centerline control point. This reconciles the horizontal angle, the vertical angle, and the distance between the control points.

23-2.11 Data-Processing Checks

The items that should be checked during data processing are as follows:

1. string crossings;
2. triangles;
3. contours;
4. corrupt discontinuities;
5. format of notes;
6. validity of codes; and
7. single-point strings.

23-2.12 Survey Transmittal

Chapter Twenty-six discusses the procedures for transmitting a survey to the Department.

SURVEY BOOK CHECKLIST Survey Book No. _____

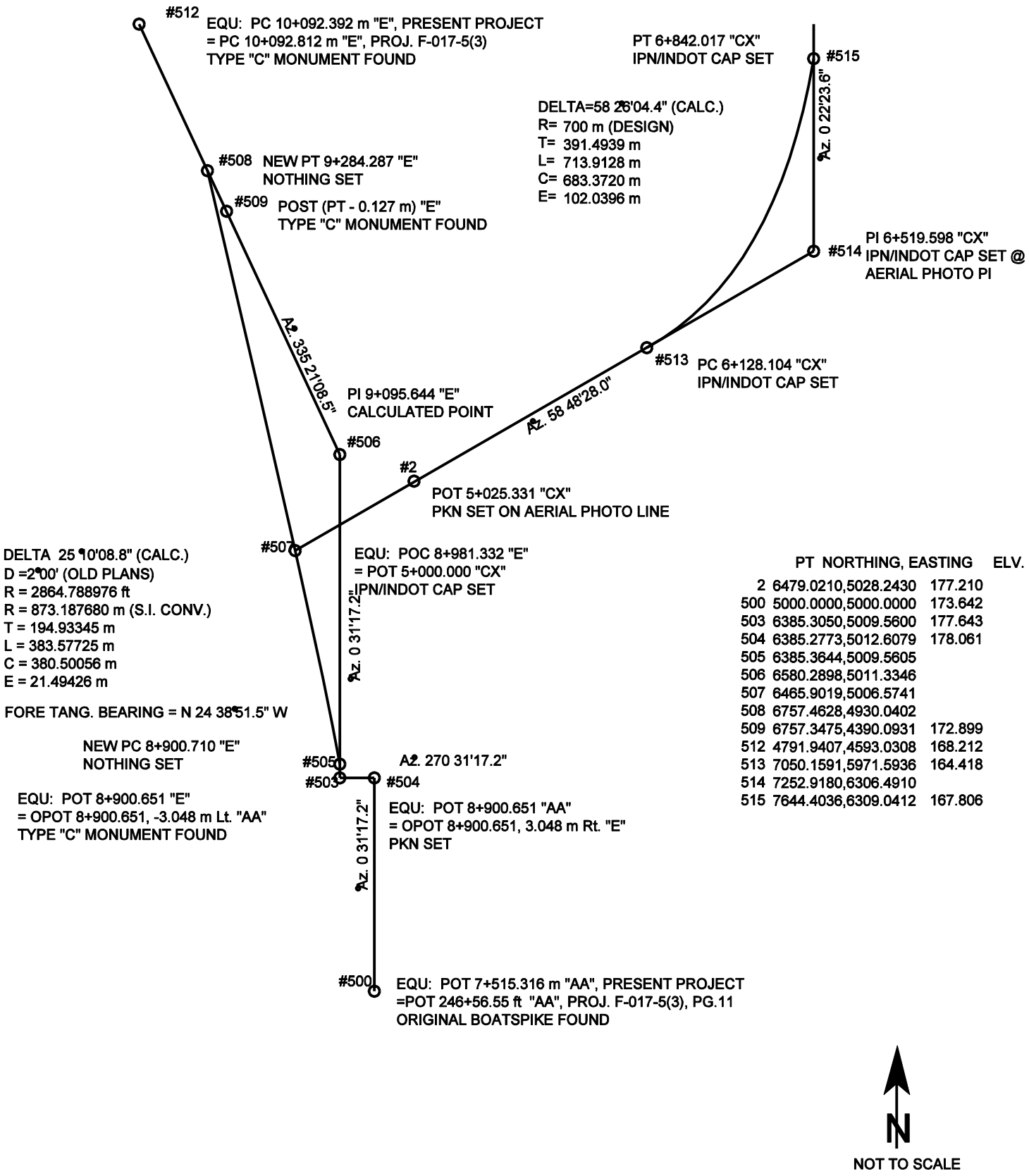
Click on the box next to each item that applies to this book, so that an X appears in the box.

Items with an X in the box next to them apply to this book.

1. ☐ Check Guide inserted in back of book.
2. ☐ Book Number on front flyleaf.
3. ☐ Return address on front flyleaf.
4. ☐ Front flyleaf notation [Book No., Project No., Des. No., Route No., Terminal Points of Project, County, brief description of each line, and Instrument data.]
5. ☐ Title page and Index complete.
6. ☐ Pages numbered.
7. ☐ Section Plats complete, with State and County routes, Streams, RRs, Towns, Villages, Cornerstones, Property Owners, Survey Centerlines; Sec. No., Township and Range; Civil Township.]
8. ☐ Project Number and Line letters at tops of pages.
9. ☐ Continuation notes within book, or book-to-book cross reference.
10. ☐ Start and end of each line shown with equations and cross references to other surveys.
11. ☐ Control Points labeled and coordinates shown.
12. ☐ Alignment data shown and checked.
13. ☐ References shown and checked.
14. ☐ Bearings calculated, checked, and sources fully described.
15. ☐ Daily notations; Date, Party, Weather Conditions of each day's work.
16. ☐ Centerline points correctly placed; Curves red-lined in topography.
17. ☐ Details of topography, buildings, etc., near line likely to be damaged by construction
18. ☐ Distance to near graves in cemeteries.
19. ☐ Section, Quarter Section, and Property corners located.
20. ☐ Public Utilities, Gas and Water mains, Telephone and Power lines, and Cable Television ownership noted.
21. ☐ Underground Utilities Reference Number noted on public utilities page.
22. ☐ Underground Oil and Gas transmission lines shown; Easements and address of owner noted.
23. ☐ Names of Cities and Towns.
24. ☐ State and County routes; types of surfaces noted.
25. ☐ Details of existing structures near line.
26. ☐ Structures up- and downstream.
27. ☐ Drainage areas and recommendations.
28. ☐ High-water elevation and date, and source and date of information.
29. ☐ Section Corners referenced and shown in the book and on the section corner reference cards.
30. ☐ Source of level datum.
31. ☐ Bench mark descriptions complete.
32. ☐ Legal flowline elevations of county ditches.
33. ☐ Elevations of low wire of overhead transmission lines.
34. ☐ Level equations with other surveys shown, and explained.
35. ☐ Enough topography coverage to satisfy study report.
36. ☐ Shots on near structures, and sketches showing structures.
37. ☐ Centerline points correctly placed.
38. ☐ Book is clean.

Checked By: _____

Click When Done Clear Data



PT	NORTHING, EASTING	ELV.
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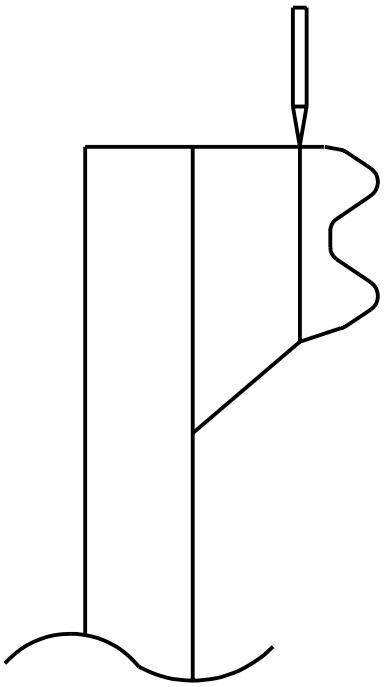
500	5000.0000,5000.0000	173.642
503	6385.3050,5009.5600	177.643
504	6385.2773,5012.6079	178.061
505	6385.3644,5009.5605	
506	6580.2898,5011.3346	
507	6465.9019,5006.5741	
508	6757.4628,4930.0402	
509	6757.3475,4390.0931	172.899
512	4791.9407,4593.0308	168.212
513	7050.1591,5971.5936	164.418
514	7252.9180,6306.4910	
515	7644.4036,6309.0412	167.806

ALIGNMENT SKETCH

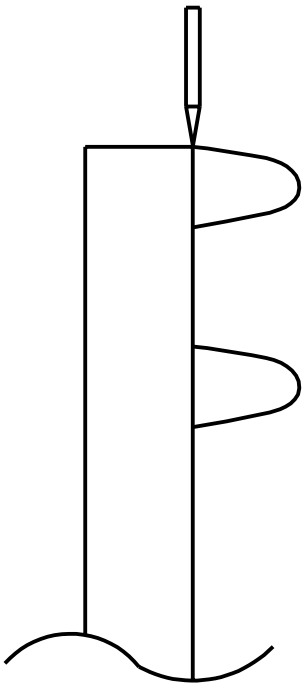
Figure 23-2B

Figure 23-2C, Topography Plot Example, is not yet available but will be supplied to users and owners of Part III of the new Indiana Design Manual when it is developed.

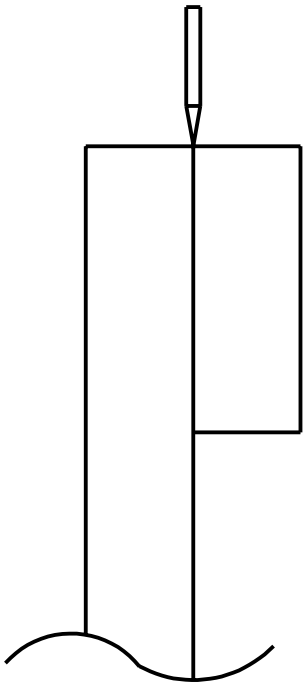
Topography Plot Example
Figure 23-2C



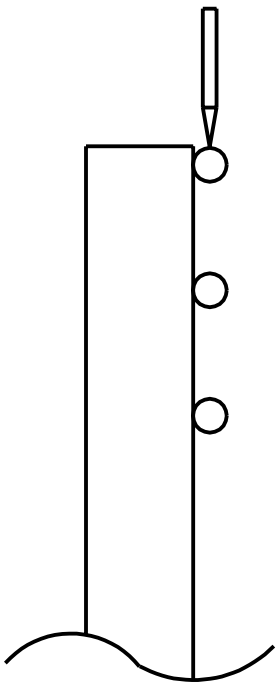
STEEL BEAM



ALUMINUM



WOOD



CABLE

GUARDRAIL SURVEY POINTS

Figure 23-2D