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CHAPTER TWENTY-TWO

GENERAL SURVEY PROCEDURES

The intent of Part III of the *Manual* is to follow the rules and procedures concerning route surveys as defined in 865 IAC. In the event that INDOT rules and procedures are determined to be less stringent than those presented in 865 IAC, then the 865 IAC will govern.

22-1.0 PRELIMINARY ENGINEERING STUDY REPORT

The preliminary engineering study report provides a project number, a designation number (e.g., Des No. 90 10075) and, if for a bridge project, a new structure number. The report may be for one of various types of projects such as follows:

1. bridge replacement;
2. bridge rehabilitation and repair;
3. small structure replacement;
4. intersection improvement;
5. road rehabilitation and repair;
6. added travel lanes; or
7. a new centerline route.

The engineering study report also establishes the project's survey limits and incorporates any incidental construction and right-of-way (i.e., temporary or otherwise) that is required.

Once the preliminary engineering study report is received by Location Survey, a survey then may be initiated. A major objective of the survey, is to establish a baseline that covers the survey limits documented in the engineering study report. If right-of-way is required, section corners must be located during the survey project.

22-2.0 PRELIMINARY RESEARCH

22-2.01 Research Requirements

The list of items to be researched by the Design Division's Location Survey Engineer, his or her assistants, or a consultant and furnished to the Field Survey Party prior to initiating the survey is as follows:

1. USGS quadrangle maps which encompass the project, ensuring that adjoining maps are obtained where drainage basins extend beyond the primary maps' edge;
2. bench mark locations, elevations and base datum (NGS 1988 NAVD required if within 8 mi of the project);
3. existing road and intersection survey books;
4. existing road plans;
5. bridge survey books of existing structures;
6. layout and general plans of existing structures;
7. railroad plans within the limits of the project;
8. preliminary engineering study report of the proposed project;
9. painted cross references;
10. available section corner references;
11. project designation (i.e., DES) number;
12. project number including the parenthesized character;
13. structure number, if for a bridge project; and
14. line designation letters.

These items should be packaged so that any item which was researched but not found is readily identified by the party chief.

22-2.02 Sources of Information

There are several sources that should be contacted during the research phase of the survey (e.g., public offices, private surveyors, utility companies). The information obtained from these sources will be of great value during the development of the survey. Key sources of information are discussed in the sections that follow.

22-2.02(01) County Surveyor's Office

One of the primary sources to contact is the County Surveyor's Office. Contact this office for any section corner references that may be required. The County Surveyor, by virtue of its position, is on the County Drainage Board and will have relevant information concerning legal drains within its county. Information that is required for legal drains include the following:

1. cause number,
2. flow line profile,
3. side slopes,
4. bottom width,
5. last year dredged,
6. official drainage area and how it was determined, and
7. information pertinent to tying stationing and level equations to the survey baseline.

22-2.02(02) County Auditor's Office

One of the duties of the County Auditor's Office is to maintain property plat maps. Contact this Office to obtain updated records of property owners who may be affected by the planned project survey. A notice of survey will need to be sent to each of the affected property owners. This information will also be required to prepare section plats and topography notes. The preparation of notice of survey and section plats is discussed in Section 22-3.0 and Section 22-4.0, respectively.

22-2.02(03) County Recorder's Office

The County Recorder's Office maintains all final subdivisions plats, property surveys, Title 865 surveys, deeds and easement records. Without exception, if a survey baseline is in the vicinity of a subdivision or platted town, a copy of the official plat and its description must be obtained. These plats are necessary to locate relevant property lines and section corners. Deeds for all affected property owners within the survey area also must be obtained and packaged with the completed survey.

22-2.02(04) Private Surveyors

Another good source of information is the records kept by surveyors in the private sector. Private surveyors are typically very familiar with the section corners, property deeds and any peculiarities particular to their locale.

22-2.02(05) Utility Companies

A critical part of the survey is the accurate location of the underground utilities that will be affected by the project. This requires that each local utility company be notified before the project survey is initiated. To facilitate this task, the utility companies in Indiana have established the two toll-free telephone numbers as follows:

1. 800-382-5544 for calls originating within Indiana, and
2. 800-428-5200 for calls originating outside Indiana.

Do not attempt to contact individual utility companies unless they are not listed by “Underground Indiana.” Most utility companies will not respond to a utility location request unless placed through these numbers, and it is best to give as much advance notice as practical. When the call is placed, the caller should be prepared to give the person contacted the information as follows:

1. county name,
2. township,
3. section,
4. address (or location),
5. type of work,
6. extent of work,
7. name of caller,
8. title of caller,
9. telephone number,
10. best time to call,
11. start date,
12. start time,
13. contractor,
14. surveyor or engineer’s number, and
15. contracting engineer’s or surveyor’s address.

During the conversation, the person contacted will inform the caller of the companies that will be notified. This information should be compiled for placement in the field book. The person contacted will also issue a reference number that should be retained in case future discussions are needed or a problem arises (e.g., schedule conflicts, utility company fails to locate lines). The person contacted will ensure that all relevant utility companies are notified of the planned project survey. Each notified company then will schedule its own field crew to locate underground utility lines and appurtenances. Afterwards, the locations of all affected utilities should be incorporated into the field survey book.

22-2.02(06) Indiana Department of Transportation

Because the survey will most likely involve existing State-maintained routes, the plans and the field books for any and all affected highways must be obtained. These can be found in the Design Division's Records Unit. The telephone number is 317-232-5344. Department bench mark information can be obtained from the Design Division's Location Survey Unit. It is most desirable that the names of the bench marks already be determined by field reconnaissance before calling in for the elevations. The telephone number is 317-232-5127.

22-2.02(07) National Geodetic Survey

The desired control, both vertical and horizontal, is obtained from NGS. It is most important that any control that is used be noted for the datum (e.g., NGVD29, NAVD88, NAD83 (1986). However, the latest datum should be used with little exception. The telephone number is 301-713-3242, the fax number is 301-713-4172, and the web site is <http://www.ngs.noaa.gov>.

22-3.0 NOTICE OF SURVEY

22-3.01 Indiana Code Requirements

To comply with Indiana Code IC 8-23-7-26 through 8-23-7-28, it is necessary to mail survey notices to all affected property owners. Quoted below is Indiana Code 8-23-7-26 through 8-23-7-28 as added by Public Law 18-1990, SEC. 216.

1. *Sec. 26. An authorized employee or representative of the department engaged in a survey or investigation authorized by the commissioner or the commissioner's designee may enter upon, over, or under any land or property within Indiana to conduct the survey or investigation by manual or mechanical means, which include the following: (1) Inspecting, (2) Measuring, (3) Leveling, (4) Boring, (5) Trenching, (6) Sample-taking, (7) Archeological digging, (8) Investigating soil and foundation, (9) Transporting equipment, (10) Any other work necessary to carry out the survey or investigation.*
2. *Sec. 27. Before an authorized employee or representative of the department enters upon, over, or under any land or water under section 26 of this chapter, the occupant of the land or water shall be notified in writing by first class United States mail of the entry not later than five (5) days before the date of entry. The employee or representative of the department shall present written identification or authorization to the occupant of the land or water before entering the land or water.*

3. Sec. 28. *If during an entry under section 26 of this chapter damage occurs to the land or water as a result of the entry or work performed during the entry, the department shall compensate the aggrieved party. If the aggrieved party is not satisfied with the compensation determined by the department, the amount of damages shall be assessed by the county agricultural extension educator of the county in which the land or water is located and two (2) disinterested residents of the county, one (1) appointed by the aggrieved party and one (1) appointed by the department. A written report of the assessment of damages shall be mailed to the aggrieved party and the department by first class United States mail. If either the department or the aggrieved party is not satisfied with the assessment of damages, either or both may file a petition, not later than fifteen (15) days after receiving the report, in the circuit or superior court of the county in which the land or water is located.*

22-3.02 Preparation of Survey Notices

The following presents the instructions for completing a notice of survey as illustrated in Figure 22-3A. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/.

1. Item (1). The name of the person or persons whose name(s) appear on the tax records in the Office of the Assessor or Auditor of the county where the project is located. This information should be written near the top-left side of the sheet.
2. Item (2). Telephone number is 317-232-5310 and should be located near the top-right side of the sheet. If a consultant is performing the survey, its telephone number should be located here instead of the above mentioned number. Also, include a fax number as indicated.
3. Item (3). Item (3) is the date of mailing.
4. Item (4). RE: Survey _____. This information must contain the Project No. and a brief project description written in layman's terms. This description is very important as the Project Number alone means nothing to the recipient.
5. Item (5). The notice should close with "Sincerely yours," and incorporate, for example, the following:

John Q. Boss

Location Survey Engineer
or Consultant Project Manager

6. Item (6). Item (6) is the designation (i.e., DES) number for the survey project.

The front page of both the white and yellow copies of the form are identical and should be completed with the same information (i.e., a carbon copy). The white copy must be sent by first-class mail to the property owner. The yellow copy is retained for the interviewer.

Prior to entering private property, the occupant first must be interviewed. The back of the form's yellow copy is used to document the interview. The following presents the instructions for completing the survey interview report as illustrated in Figure 22-3B. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/

1. Item (1). In the blank for Des, enter the designation number of the project.
2. Item (2). In the blank for Project Number, enter the number of the project.
3. Item (3). For Item (3), enter the name of the county where the project is located.
4. Item (4). For Item (4), enter the name of the highway where the project is located.
5. Item (5). Item (5) requires a brief description of the location of the survey project.
6. Item (6). In the space for "Name of person interviewed", the name and relationship (e.g., owner, renter) of the person being interviewed should be entered. This name may be different from the owner as it may be a renter, lessee or other occupant.
7. Item (7). Item (7) should reflect the date the interview took place.
8. Item (8). For Item (8), enter the name of the interviewer on the survey party.
9. Item (9). Has occupant received "Notice of Survey" letter? Check yes or no for Item (9).
10. Item (10). Item (10) should be used to correct the name and address if necessary.
11. Item (11). For Item (11), list anything relevant to property access and the interviewee (i.e., attitude, special requests, instructions to close gates, beware of dog, future identification).

The yellow copies of the survey notices are retained until the completion of the survey and then filed in the Records Section of the Department.

22-3.03 Public Relations

Location Survey Unit personnel and project consultants are in an excellent position to promote good public relations for future contacts by representatives of the State of Indiana. These individuals are among the first representatives to contact people that will be affected by the planned highway improvements. A first impression is a lasting one, and its importance cannot be over-emphasized. To achieve this goal, the survey party should perform a service to the Department by being courteous, presenting a good appearance, conducting themselves properly and by properly identifying themselves to the people that they contact during the performance of their duties.

Survey notices and interview reports, as described in the preceding sections, are just the first step in this process for good public relations. The important point is to be sensitive to the needs of each property owner. For example, an overgrown fence row may be viewed by some farmers as a nuisance and be quite happy to have the survey crew cutting brush as needed for surveying operations. Other people might view the same fence row as prime wildlife habitat, or it might contain their favorite persimmon tree or berry patch. The survey crew will need to work differently with each property owner or occupant in such circumstances.

While we have the right to enter on private property to conduct a survey, we do not own or control the property. The survey crew should take all reasonable care to minimize adverse impacts. The crew should not leave behind any trash or debris. Lath and flagging should also be removed, unless the owner agrees they can remain in place. For farm animals, plastic flagging or sheeting may pose a health hazard if eaten, and the owner or occupant might prefer that it not be used at all. Likewise, due consideration must be given to lath and stakes that extend above ground which might interfere with farm operations or cause damage to farm equipment such as combines if left in place. Sometimes, even just walking around the site may be a problem if at a time of year when farm crops are especially susceptible to damage.

Survey control points that must be left in place to facilitate subsequent phases of project development pose other special concerns. In farm fields which are plowed, these points need to be buried 1.0 ft to 1.5 ft below ground line to avoid being disturbed by plowing and also to eliminate any possibility of damage to the plow or other farm equipment. Where possible, it may be desired to locate such points in fence rows or edge of fields where they are less likely to be disturbed or cause a problem.

Buried survey points may also be needed for those occasional projects where vandals or unhappy property owners remove or disturb the control monuments overnight while the survey is still in progress. While a considerable nuisance for the survey crew, such actions generally cannot be stopped since we do not own the property. One trick that may help in extreme cases is to install a somewhat visible nearby “decoy” point that vandals can pull, while the real survey control point is carefully buried to be as inconspicuous as possible.

On rare occasions, property owners or occupants may refuse to allow the survey crew onto the property, or may become belligerent or threatening. In those cases, the crew should withdraw to a

neutral area and contact their office for further instructions. For consultants, their office should contact the Location Survey Unit at 317-232-5340 for further instruction. Depending on the situation, a phone call or letter from the Location Survey Unit or the Legal Division may resolve the problem. In some cases a law enforcement officer may be needed to help preserve the peace, and sometimes a court order may be needed to enforce INDOT's right to enter upon private property to complete a survey. No survey crew should argue with property owners or occupants, should not force their way onto a property, and should not take any action that might endanger their safety.

Property owners and occupants, nearby residents, and occasionally the media can all be expected to be curious about the effect of the project on their property and the area in general. Questions from media should be directed to the Office of Communications at 317-232-5533. Property owners deserve some explanation when we enter on their property. However, most inquiries are best addressed by explaining the general nature of the project (intersection improvement, bridge replacement, road reconstruction, etc.). It is also generally best to explain that the survey crew is there only to gather information necessary for proper design of the project. The survey crew is usually unfamiliar with details of the project except for the scope of the needed survey, and questions about specific design features or impact on specific properties generally must be referred back to their office (or INDOT) and often cannot be answered until later in the project.

Survey crews should make every attempt to be good neighbors and maintain good public relations with landowners and occupants and the public in general. It is quite normal that these people may have some anxiety or concerns about the project and its potential impact on their property and that they may not want us there at all. A little understanding and concern for individual needs and concerns will go a long way in making the survey process easier for both the crew and the public.

22-4.0 SECTION PLATS

22-4.01 Section Plat Requirements

Preprinted section plat paper is obtained from the Location Survey Unit. These sheets are furnished to the field survey parties for use in preparing section plats. Items to be completed on this form are as follows:

1. Project Number. This is the number that has been assigned to the particular project.
2. Transit Book Number. For bridge projects, this is typically Number 1, as very seldom will a bridge survey be long enough to require multiple books. For road projects, multiple books are numbered consecutively.
3. Line Letters. This information pertains to the line letters that are assigned to the project.

4. County. Enter the county or counties where the project is located.
5. Township. This pertains to the civil township(s) where the project is located.
6. Section. Enter the congressional section(s) where the project is located.
7. Township. Enter the congressional township(s) where the project is located.
8. Range. This should be the congressional range(s) where the project is located.
9. Designation Number. Enter the designation number (i.e., Des) for the project.
10. North Arrow. The north arrow is preprinted on the form.
11. Scale. Enter the scale used to develop the plat. A scale of 1:12 000 is used to facilitate the use of USGS quadrangle maps at double scale.
12. Date. This refers to the date of plat preparation.
13. Survey. Survey pertains to the person who prepared the plan and the survey party member(s).

22-4.02 Preparation of Section Plats

The following presents the information relevant to the preparation of a Section plat.

1. Property Information. The plat should present all the property contained within the quarter section(s) where the project is located. All contiguous properties which lie within adjoining quarter sections should also be noted. The Land Acquisition Division requires this information to assess property damages. The property owner names also should be noted and may be obtained either at the County Auditor's Office or at the Township Assessor's Office. A routine check of the Transfer Books is necessary so that the current owner is identified on the plat.
2. Development Identification. Towns, subdivisions or additions should be identified by shaded areas. Copies of the official plat that is obtained from the County Recorder's Office must be submitted with the field book.
3. Survey Baseline. The survey baseline must be presented on the plat, and beginning and ending points must be noted.

4. Color Schemes. The color scheme should be as follows:
 - a. blue for streams,
 - b. yellow for State-maintained routes,
 - c. red for survey baselines, and
 - d. green for county roads.

This achieves a neat and consistent appearance on the original section plat. It should be noted, however, that color does not typically appear on copies of documents.

5. Section Monuments. Section and quarter section monuments should be noted on the plat.
6. Road Names. All road names should be identified on the section plat.

Copies of the completed section plat should be made and placed in an envelope in the back of the field book. The original section plat is retained in the Design Division's Records Unit. [Figure 22-4A](#) presents an example of a completed section plat sheet.

If counties update plat records electronically, their plat books will be located on a computer. A copy then would need to be purchased and manually updated as counties typically would not update the older plat books. Owners will have a code number associated with their property holdings. Items on the older plats should still appear on the electronic plat (e.g., scale).

22-5.0 SURVEY OPERATIONS

22-5.01 Establishing Alignment Baselines

One of the first operations of the survey is to establish the baseline. Extreme care should be taken in establishing the baseline as the new baseline is used for the following:

1. determine the present right-of-way in relation to the baseline,
2. determine additional right-of-way requirements, and
3. stake the new right-of-way.

In establishing the baseline, permanent points should first be located from the original survey. Frequently, iron pins will be in their original position if not disturbed by construction. This approach is best for establishing both alignment and stationing. However, other means may be necessary to establish the baseline. For example, in cases involving a concrete road, split the pavement in two locations at either side of a PI, and project the tangents to their point of intersection. The stationing then can be equated at the PI. In cases where a concrete road has been resurfaced with asphalt, a pick or jackhammer should be used to locate the pavement edge. In cases

where a road without as-built plans is involved (e.g., a county road takeover), the baseline can be established by splitting the pavement using the longest possible sights available or by establishing an offset baseline that identifies pavement edges at 60 -ft intervals.

After the centerline tangents are recreated and intersected to form the PIs, then the delta is determined by the results of the centerline traverse or by coordinate geometry calculation with verification on the calculations. Since these measurements are most likely being done by more accurate equipment than when the original survey was done, then obviously the delta for the curve and the stationing are going to vary considerably. Just as it is not desired to have a station equation at every monument found, so it would not be good to force the recent more precise delta to conform to the old even minute deltas of the original survey. Horizontal curve calculations require two elements of the curve in order to define the curve geometrically. Apart from the delta, the desired second element for curve calculation is the plan radius or the degree of curve converted to feet and then to meters. If monuments are found at the PCs or PTs, they should be used for tangent line determination only because of the discrepancy in the stationing as previously mentioned. Therefore, the two desired elements for curve determination are the new measured delta and the radius as obtained from the old survey plans.

22-5.02 Alignment Data

Once the alignment has been established, a closed traverse should be run through the PIs and back on a separate line to the beginning of the traverse. Measured distances should be recorded and a minimum of two pair of angles (i.e., one direct, one reverse) should be turned at each traverse point. In addition, the Horizon should be closed at the end of the traverse. The misclosure should be calculated, and the traverse should close with a precision of at least 1 in 20 000. The raw field data should be recorded in the field book.

After checking the misclosure, a full adjustment should be performed on the traverse and the adjusted data recorded in the field book for the alignment data. All curve information then should be calculated and the PCs and PTs set from existing monuments at the PIs.

The alignment data is the listing of the permanent points in the field and curve data. Each individual point is to be listed as close to its appropriate position as possible. The listing should reflect the type of point (e.g., PC, PT), its correct stationing (e.g., 107+80.26) and type of monument set. The PI station should present the following:

1. delta angle,
2. radius of curve,
3. tangent length,
4. length of curve,
5. external distance, and

6. bearing of the fore tangent of the curve.

Points in the survey baseline should not exceed an interval of 1000 ft and should be of a material and size that conforms with Indiana Code 865 IAC 1-12-24 on route survey monumentation.

All permanent points must be referenced. The references must be shown in the Topography Notes next to the point listing. The most common reference is a roofing nail that is driven through a bottle cap into a tree. However, any point on a distinct object may be used as long as the reference is fully described (e.g., northeast corner of headwall, bolt on light standard). However, be careful of the directional description.

In this age of pull-tab cans, it is sometimes difficult to locate bottle caps. Folded pieces of flagging also may be used for references. As the tree matures, the flagging will remain visible long after the tree has grown over the nail. At least three references should be used and positioned to swing arcs from the references so that they will have a distinct crossing over the point. If a slope distance is used, it should be noted on the reference.

22-5.03 Obtaining Bearings

The starting bearing must be shown and the source fully described. Methods of obtaining a bearing are as follows:

1. celestial observation, either polar observation or sun shot;
2. using global positioning equipment to fix a bearing;
3. running a bearing traverse from a USC&GS triangulation station; or
4. using a bearing off of existing road or bridge plans.

22-5.04 Running Bench Levels

Only the amount of line covered by the Transit Book should be in the corresponding Level Book. Ordinarily, bench mark elevations begin on Page 2 of the Level Book for road surveys.

Bench levels should always originate at a bench mark that is on a sea level datum. The permitted types of bench marks typically used in Indiana are as follows:

1. National Geodetic Survey (NGS), formerly U.S. Coast & Geodetic Survey (USC&GS),
2. U.S. Geological Survey (USGS),

3. Indiana Flood Control & Water Resources (IFC&WR under the Indiana Department of Natural resources), and
4. Indiana Department of Transportation (INDOT).

If available, NGS with NAVD 1988 datum is required within a 3.0 mi radius of the project. In any case, the monument should be described in detail including the fully spelled out name of the agency, the datum used, the elevation, and a rubbing of the disc. The NGS bench mark elevations that are in the vicinity of the work area are available from NGS at the location listed in Section 22-2.02.

In cases where the starting bench is distant from the start of the project, then a circuit must be run from that bench mark to the first bench mark set for the project and back to the original bench mark to complete the circuit. All bench circuits should be run to third order accuracy and specification. The allowable error in the circuit is computed by the formula as follows:

$$\text{Allowable Error} = \pm 0.05 \text{ ft} / K \quad \text{where: } K = \text{length of circuit, mi}$$

This provides the survey crew a starting elevation to use as the bench mark elevation for the baseline bench marks following the double run bench mark circuit as shown in [Figure 22-5A](#).

In running bench levels, do not make sights more than 300 ft long. Keep the back sight and foresight as equidistant as practical with a 30-ft maximum difference per setup and a 30-ft cumulative maximum per circuit (see Third Order Leveling Specifications, NGS). One should mark the selected point before giving a sight. Frequently, if more than one sight is needed, the exact point is lost between sights. The rodperson should always use a solid turning point and keep the bottom of the rod shoe free from mud, ice, etc. The same standards and allowable error in the circuit apply for the benches along the baseline. The habit of doing the things that ensure good level closures is easily acquired and with proper attention can be maintained. Habitually poor closures are very time consuming. Never set or check benches as side shots on a bench. Always make a complete turn on every bench mark with a different instrument set-up for a foresight and back sight. Once the circuit has been closed, then the bench marks for the project are set. Starting at the bench mark, set in the circuit at the start of the project, the bench marks for the project should be set not more than 1000 ft apart. In hilly country they should be set even closer as the number of turns determine the frequency rather than the distance. No bench marks should be greater than four turns apart. They should be far enough from the baseline so that the bench marks will not be disturbed during construction. The bench marks should be set in permanent objects that are not likely to be disturbed during the construction of the project. The most common object used is a 6-in spike in a tree. The boat spike should be placed as low in the tree as practical so that, if the tree is cut down, the bench will remain undisturbed in the stump. Other bench marks can be chiseled crosses or squares in the concrete base of signs, etc. The description of the bench marks written in the right-hand page should describe the bench mark followed by its location as a plus and distance out from the baseline. A minimum of

three bench marks should be set for all survey projects, with one at each end of the project and outside of the construction limits.

With the new technology of electronic levels, conventional field book notes may not be utilized due to recordation in an electronic data collector. However, if the software used for processing the data allows for the printout of a level book format report, it would be highly desirable to include this with the adjusted elevations in the skeleton survey field book.

When starting a baseline for a new survey, the usual practice is to number the bench mark at the start of the survey as TBM #1, the next bench mark as TBM #2, etc. Bench marks retain the number given to them on the earliest field survey. Thus, if survey line "A" is completed and it later becomes necessary to run baseline "B" \pm 1 mi from line "A." Bench mark 1 "A" retains its original number and elevation. If line "B" bench levels tie into any other line "A" benches, these also carry their original numbers 1st TBM 1 "A," 2nd TBM 1 "B," 3rd TBM 2 "B," 4th TBM 5 "A," etc.

Level equations, with their respective basis of datum, are to be shown in bench levels as illustrated in the example in [Figure 22-5A](#). All bench marks are tied to the survey baseline by station and offset. Benches can be tied using conventional surveying techniques or electronic data collector. Also, show party, date and weather conditions at the time bench levels are run.

After the bench marks have been run and the backsights and foresights have been totaled, then the rule that the difference between the totals of the foresights and the backsights is equal to the difference in elevation between the start and end of the bench circuit applies. This is done at the end of each bench circuit and is a check on the mathematics of the circuit. All level circuits should be adjusted according to standard techniques.

22-5.05 Locating Section Corners

All section and $\frac{1}{4}$ section corners in the area should be located and tied in to the survey baseline so that an accurate Location Control Route Survey Plat can be made. If the last deed of record is examined, the monument corners referenced by the instrument should be located; and if not found, it should be noted. The Land Acquisition Division uses the information which appears in the Location Control Route Survey Plat to compute right-of-way takings and to write descriptions of such takings.

If a reference point cited from a last deed of record or records cannot be found, it is suggested that the County Surveyor's Office be notified of a candidate location which needs to be re-established by that office.

In cases where section corners are visible from the survey line, a distance and a minimum of two pair of angles should be measured to the section corner. These measurements should be recorded in the field book or electronic data collector.

In cases where a section corner is not visible from the survey baseline, a closed traverse shall be run from the survey line to the section corner with the measured distance recorded and two pair of angles turned at each traverse point. In addition, the Horizon will be closed at the end of the traverse. The traverse misclosure should be calculated and the traverse should close with a precision of at least 1 in 20,000. The raw data of the completed traverse should be recorded in the field book or electronic data collector.

Other pertinent information about the monument found at a section corner also should be recorded in the field book. This could be items such as follows:

1. type of monument,
2. size of monument,
3. mass of monument,
4. distance above or below the ground,
5. any other existing monuments near the subject monument,
6. reasons for using the monument,
7. testimony, and
8. any other relevant information.

The above list is by no means a complete list of items but should provide sufficient guidance to the type of information that is to be recorded in the field book. The references are to be drawn in the book and provided on reference cards as shown on [Figure 26-1C](#).

There exists a notion that the County Surveyor is the only one who can reset a quarter section or section corner monument. Whether this is true is open for debate. The following sections of the Indiana Code should clarify this issue:

1. Indiana Code 36-2-12-13, Sec. 13. *A person may, for excavation, mineral extraction, or other purposes related to the person's business, temporarily remove a monument marking a corner. The person must notify in writing the county surveyor at least thirty (30) days before removing the monument. The person must replace the monument within a reasonable time at the person's expense under the supervision of the county surveyor or, if the county surveyor is not registered under IC 25-31, the registered person who is selected under section 11 of this chapter. The surveyor shall file a copy of the notice in the corner record book.*

Only a county surveyor or a designee may change the location of any monument. A person who wishes to have the location of a monument changed must make a request to the surveyor in writing and furnish written approval of all landowners whose property is affected by the proposed change. The surveyor may approve, reject, or modify the request and shall file a copy of the notice and the landowners' consents in the corner record book.

2. Indiana Code 8-23-9-24. *If in the construction or maintenance of a state highway it is necessary to remove or bury a monument marking or evidencing an established corner, the department shall cause to be set in the pavement or right-of-way at the place where the monument was located a monument capable of activating a metal detection device. The top of the monument must be level with the pavement or the grade of the right-of-way. The department shall cause a memorandum of the monument to be filed in the county surveyor's office of the county.*

To perpetuate the locations of the corners before, during and after construction, the following definitions apply.

1. Established Corner. A corner that the county surveyor has provided references, which was found as referenced and described, and which the county surveyor has recognized as being true and correct.
2. Re-established Corner. A corner that has been reestablished by the field survey party and accepted by the county surveyor as being true and correct.
3. Apparent Corner. A corner location that has been reestablished by the field survey party and has not yet been approved or accepted by the county surveyor.

All three types of corners should be documented in the field survey notes, referenced, and the type noted. For only Items 2 and 3 listed above, a pin or rebar should be set on those corners and the type of monument should be noted. The references should be given to the county surveyor as well as an explanation of the procedure used so that he can add them to his reference book.

22-6.0 FIELD BOOK FORMAT

22-6.01 Front Fly Leaf

There should be an identifying note on the Fly Leaf. The note should include the project number, a designation number, a structure number (if bridge survey) and a brief description of the project.

The description of bridge projects as found in the improvement program are taken directly from the bridge inventory book. If there are disagreements between the improvement program and the bridge inventory book, then the wording of the improvement program should be used because many people use the improvement program to work with. To further clarify the previous statement, the following example applies.

The improvement program states SR 2, bridge over Wolf Creek, 6.60 mi south of US 30. The bridge inventory book shows Wolf Creek on SR 2 to be 6.60 mi south of US 30 and also 6.85 mi north of US 231.

Note that the description in this example is expressed to the hundredths of a mile.

The description to be used on the Fly Leaf should read as follows:

Structure No. 2-64-1170 over Wolf Creek, 6.60 mi south of US 30.

If the other description, “*Structure No. 2-64-1170 over Wolf Creek, 6.85 mi north of US 231,*” was used, then all subsequent correspondence might raise a doubt as to whether that bridge or some other was being discussed. A check of the bridge inventory book would be needed for clarification.

In the case of road projects, the description shown in the improvement program should be followed as closely as possible.

For example:

US 6, from the west junction with SR 3 to 0.40 mi east of Kendallville.

See [Figure 22-6A](#) for an example of a Front Fly Leaf.

22-6.02 Index Sheet

The index sheet is typically page 1 of the Road and Bridge Surveys Transit Book. The list of the information that should appear on the index sheet is as follows.

1. Transit Book Number. The transit book number should be centered on the top line of the left-hand sheet.
2. Project Number. The project number should be to the right margin on the second line.
3. Route Number. The route number should be to the left margin on the second line.
4. County Name. The county name(s) should be centered on the third line.
5. Structure Number. The new structure number of the proposed bridge should be centered on the fourth line.

6. Designation Number. The designation number for the project should be centered on the fifth line.
7. Line Description. The line description should be listed in order of appearance on the actual survey in progressing headline. The lines should state, for example: S-16-G - a side road survey @ Co. Rd. 500S from Station 50+21.78 to Station 62+62.63.
8. Instrument Data. Instrument data should be shown, including the instrument manufacturer, model and serial number for total station, or transit and EDM, along with horizontal circle least count and the manufacturer's specified accuracy for the EDM.
9. Registered Seal. The book must be sealed by a registered Indiana land surveyor. The land surveyor who stamps the book should place his seal on the lower left hand sheet of page 1 under the line description. He should sign his initials and the date adjacent to his stamp.
10. Top Line. The top line of the right hand sheet of page 1 should indicate "Indiana Department of Transportation" and "Location Survey Unit" or the consultant's name.
11. Roster. The roster of the survey party should be shown under the party number.
12. Index. The index for the various items of the transit book follows the roster for the party numbers.
13. Dates. The last line on the sheet shows the date the book was started and the date the book was finished.

The only difference between the road and bridge survey index sheets is the indexed items. Ordinarily, the level book and transit book for bridge surveys are one in the same, and there will only be one index. This also applies to small intersection improvements or spot improvement surveys. See [Figure 22-6B](#) for an example.

22-6.03 General Information Sheet

This sheet is normally page 2 in a bridge survey and is not included in a road project. However, on road projects it is useful to have this sheet to describe how the baseline was set up and certain specifics about the project.

This sheet is used to point out specifics of the project which are difficult to show graphically, but the designer needs to keep in order to arrive at a logical design.

Sometimes there is more than one name for a stream. The Bridge Inventory Book might have one name; the quad map for the area may have another; and the County Records may show a third. If the stream is a legal ditch, the name of the first person to sign the petition is used as the name of the ditch. Those cases where there is more than one name, the name which appears on the Bridge Inventory Book should be used, with the other names shown in brackets, so that everyone working on the project will be aware that the stream has more than one name. The following is the information typically found on the general information sheet as illustrated in [Figure 22-6C](#):

1. Alignment and Stationing. A full explanation of the method of establishing the alignment is necessary. In those cases where the old plans are available, they should be used to establish the baseline of the survey. If the old line is re-established, then the existing right-of-way is much easier to determine by the Land Acquisition Division. If the baseline is established at random with no regard to the existing right-of-way, then the existing right-of-way is very difficult to re-establish. The baseline should be tied to the old plans by equations in at least two places. In that case, the existing right-of-way can be determined mathematically.
2. Level Datum. A full explanation of the level datum used is needed. Many times the old bridges were built on project or assumed datum. As it is required to survey INDOT projects on sea level datum (see Section 22-5.04), there should be a statement in the general information concerning the level datum used, and any level equations must be shown between the survey for the present structure and the survey for the proposed bridge.
3. Present Structure. There should be a short description of the present structure in the general information. This description should state type of structure, number of spans, lengths of spans and roadway width of structure.
4. Miscellaneous Information. This is the location to make comments about informal things such as conversations with local people about the location of section corners, unusual circumstances encountered on the project (e.g., such as not being able to re-establish the baseline without difficulty), etc. Sometimes things which are neither Level Notes nor Topography Notes are invaluable to the designer in his work.
5. Survey Purpose. A statement as to the purpose of the survey (e.g., widening, replacement, repair) should be inserted in the field book. A typical statement is, “*The purpose of this survey is to provide data for the repair and widening of the present structure.*”
6. Other References. There should be reference to any old books, plans or miscellaneous information so that the designer is aware that more information is available.

22-6.04 Stream Data Information

Stream data information appears on page 4 of the bridge field book and is not included in a road field book. [Figure 22-6D](#) illustrates an example of stream data. The information needed is similar to drainage data for small to medium sized areas. The information can be given in narrative form and also should include discussions of items such as follows:

1. how fast the water level rises and falls,
2. the condition of the channel,
3. siltation,
4. brush,
5. amount and size of drift, and
6. ice flow.

22-6.05 Present Structure Information

The present structure information normally appears on page 5 of the bridge field book and is not included in a road field book.

In cases where the bridge is to be replaced, whether on its present location or on a slightly different location, the regular plus and distance, as shown in the Topography Notes, is sufficient to show the existing bridge. If the old bridge was State built and plans are available, then the old plans can be used to determine the quantities for removal of the old structure. A simple statement that the bridge was built according to plan is sufficient.

In cases where the bridge is to be repaired and/or widened, it is necessary to get detailed information on the existing structure so that the new work will match the existing structure when completed. A plan view of the structure needs to be drawn, with the plus and distance out recorded on the drawing to the nearest 0.02 ft. See [Figure 22-6E](#) for an example.

Also, a side view should be drawn so that the elevation can be recorded. The elevations ordinarily needed are as follows:

1. top of opening,
2. profile along the main baseline under the bridge, showing enough ordinates to adequately figure the effective opening;
3. low water elevation;
4. ordinary high water elevation;
5. extreme high water elevation;

6. bridge seat elevations;
7. top of curb (if any); and
8. top of hand rail.

Additional levels on the present structure will be discussed later in this chapter. See [Figure 22-6F](#) for an example.

22-6.06 Utility Ownership Information

The complete name and address of each utility and the reference number should be listed on Page 2 of the road field book and page 6 of a bridge field book. If more than one company for a single utility is encountered on a particular project, then all names and addresses should be listed. The limits of each utility company should be noted by stationing and/or left and right, as the case might be.

The names of the utilities shown refer to the area served by those utilities and only imply the company involved. In cases where there are no utilities in the field, then “NONE” should be written by the name of the utility. See [Figure 22-6G](#) for an example.

22-7.0 FIELD POINT REFERENCE

This section presents information that will assist the surveyor in maintaining uniformity and minimizing ambiguity in reference drawings. Examples are illustrated in [Figure 22-7A](#) and [Figure 22-7B](#).

22-7.01 Field Book Entries

Make field book entries reasonably neat but be expedient in entering information. If a question arises about spelling, wording, coordinates, etc., ask and resolve the question before entering the information. Avoid erasing field book entries. If an entry cannot be crossed out (e.g., ~~erossed~~), then redo the field book page. Entering the information correctly the first time is desirable over having to redo pages in a hurried job.

22-7.02 Orientation

In some locations (e.g., new areas, areas accessed via winding roads), it is relatively easy to become disoriented. To minimize mistakes resulting from becoming disoriented, always use a compass for all reference ties. In addition, have an assistant check all information. Use the following guidelines for orientation:

1. Reference any survey or base line point to the ahead line.
2. Reference any section corner, or other point not referenced to the survey line, to North.
3. Always label the arrow appropriately (e.g., line name, NORTH) and check the compass reading to verify the direction of the line.
4. When drawing the reference, ensure that it is properly labeled. If the southwest corner of a post is used, draw the line to the southwest corner of said post.
5. If the point is an equation point of two lines, orient to the current line of the survey. Show the relationship of the other line by drawing a solid line at the appropriate angle and label both lines. In the equation note, list the station of the current alignment first and the intersecting line second. In a reference note, list the S-line page number for the corresponding equation reference in the book.
6. Use a compass and give an azimuth, from North, to the nearest one degree to each reference point from the point being referenced. Also, show the azimuth of each line drawn (e.g., angled roads, fences, walls).

22-7.03 Drawing Details

Frequently, when a point is revisited after a considerable length of time, some, if not most, of the references will be missing. Therefore, document sufficient detail to increase the likelihood that something will exist in the field that would assure finding the point. Write the Point Number and the Designation Number in the lower left corner of the section corner card. All points will have coordinates placed in the book after traverse adjustments are made. As before, have an assistant check the information gathered. Use the following guidelines to make the drawing.

1. Make all notations and drawings on field book paper. If the drawing absolutely has to be redone for clarification, place the original in the back of the book until the final check. Keep the original reference drawing in the field book.
2. Use a straight edge, protractor, and template for drawing circles, rectangles, trees, etc., and make the drawings as graphically accurate as practical. However, for clarity, an angle or distance may have to be exaggerated graphically to avoid clutter.

3. Measure all distances horizontally. Choose tie points such that the measurement will be as level as practical.
4. Draw and specify any fence lines, tree lines, edge of pavement (including road name or number), edge of field, etc.
5. For the PI, draw the deflection of the line in the appropriate direction and specify the delta angle.
6. If a corner post is used, specify the direction of the fence lines and label which side or corner of the post that the reference nail was set.
7. When a reference is set and measured to, state what was used on all drawings (e.g., N&C for nail and bottle cap).
8. If a reference is set and described with a particular height, then, for consistency, describe all such references within the project in the same fashion. Measure and document to the nearest 0.1 ft.
9. Ensure that everything written is legible, especially the distances.
10. Write the distances with the line, not across it. Illegible numbers result when written over the line.
11. Write distances measured in feet to two decimal places. Always specify the unit of measurement (e.g., 97.00'). Specify the last digit(s) even if they are zero.
12. For tree sizes, specify the diameter to the nearest inch.
13. For decimal measurements of less than one foot, specify a zero at the beginning of the documented number (e.g., 0.1 ft post). Otherwise, if the decimal point becomes illegible, the distance will be read as 1 ft.
6. Always take reference measurements using a feet-and-decimals tape. If the original measurements absolutely must be taken in feet and inches, specify the distance in the units used to measure with, then convert and specify the distance in the desired units in parenthesis (e.g., 7'-2³/₄" (7.23')).
7. If references are all in a straight line, then draw it as such (e.g., three fence posts).
8. When referencing to repetitious objects (e.g., fence posts, railroad ties), specify the object by the number away from the control point (e.g., 3rd tie, 5th post).

9. The desired number of references is four. Specify three references only if there is not a reasonable fourth tie available. If there are less than three ties available, then state N.O.R.A. (i.e., No Other Reference Available) or N.R.A. (i.e., No Reference Available).
10. When referencing section corners, indicate the following:
 1. how the found monument fits any original County Surveyor ties;
 2. the physical condition of the monument;
 3. the relationship to the surface of the ground; and
 4. the uncertainty of the found monument.

22-8.0 CONVENTIONAL SURVEYS

The old Indiana survey manual should be referenced for conventional survey operations. It has been Department experience that few, if any, surveys are conducted using this method. All INDOT survey crews, open-end surveying firms and most consulting firms are using electronic surveying techniques. If the standard-book method of surveying is desired, the old survey manual should provide sufficient guidance. Please note, however, that the final survey must be submitted in an electronic format as outlined in Chapter Twenty-six. In addition, the information presented in the *Design Manual* supersedes that presented in the old survey manual.

22-8.01 Nomenclature

Members of survey parties are expected to use consistent nomenclature in survey work and notebooks. [Figure 22-8A](#) presents a sample illustration of nomenclature use and [Figure 22-8B](#) defines the nomenclature terms.

22-8.02 Conventional and Topographic Lines and Symbols

[Figure 22-8C](#) presents the conventional and topographic lines and symbols that should be used.

22-8.03 Abbreviations for Note Keepers

The abbreviations shown in [Figure 22-8D](#) are mostly well established by long time common usage and should be used in note keeping in preference to spelling the words out to save time and space. The abbreviations shown in [Figure 22-8E](#) are not so well established but may be used at the option of the individual taking the notes where necessary or convenient to save time and space, provided the

manner of usage is such as to make the abbreviation clear. For example, the abbreviation "Loc." for locust would be in connection with the usual symbol for a tree and diameter in inches would usually be given, as, "15-in. Loc." "Rec.," recommend, would be used in recommending that certain things be done or used in the design and construction, as, for instance, "49 + 56, Rec. 15-in. pipe" meaning that it is recommended that a 15-in. pipe be placed at station 49 + 56 under the road to be constructed.